

## MM-Info „Ship“

Info folder with branch specific information of chosen PolymerMetals  
for customers from the shipping sector



**MultiMetall**  
the MetalExistenceCompany®

PolymerMetall® • MultiMetall® • Ceramium® • Molymetall® • Sealium® • XETEX®

MultiMetall is the manufacturer of PolymerMetall®.

For more than 40 years MultiMetall invests in polymer-metallic material technologies for the maintenance of metals and alloys.

In the fight with these special tasks our polymer-metallic materials are professionally equipped.

Tough hard, wear resistant and long-lived – even under more difficult conditions.

Successful on oily or under water lying repair areas.

Good to exceptionally good is the assessment as per certificate 301954. (Lloyds Register of Shipping)

Superiority due to mechanical physical data, which counteracts the constant load.

The continuous compressive strength under load can be more than 160 MPa.

A force of 245 MPa is necessary to reach the upper limit. (test report Fraunhofer Institut Germany)

Difficult to damage when attacked by chemicals e.g. acids, alkaline solutions, solvents, salts, gases etc.

PolymerMetall® has a high potential of research and development.

The equipment that lets metals live longer.

## MultiMetall

the MetalExistenceCompany®



PolymerMetall® for the repair of metallic devices

[www.polymermetal.com](http://www.polymermetal.com)

MultiMetall

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# PolymerMetall®

## Introduction

MultiMetall Germany invests for more than 40 years in polymer-metallic material technologies for the maintenance of metals and alloys. In plants and constructions often functional particularly important components are exposed to stresses like break, tear, corrosion, cavitation, chemical or thermal demands. Components treated with PolymerMetals can be preventatively protected against above mentioned stresses. Furthermore MultiMetall's cold repair technology facilitates a gentle material treatment and a durable repair of damaged parts.

Wherever technical security is concerned, PolymerMetals offer the required quality. Certificates from classification societies, test results from research laboratories as well as positive evaluations from customers worldwide verify that fact. Even at problematic surfaces, on oil, grease, fuel or under water, PolymerMetals are used. This technology is called „direct-MM-bonding“.

## PolymerMetals - Excellent properties

Engineers and technicians need to have a clear picture of the quality of the products available on the market to be able to choose the best product. Therefore we decided to list excellent properties of different MultiMetall-products in the following overview. Please make your own comparison and let the figures speak for themselves.

Compressive strength (DIN ISO 604):	211 MPa
Compressive strength after post-curing (DIN ISO 604):	245 MPa
Flexural strength (DIN 53452):	110 MPa
Hardness (DIN 50351):	55 Brinell
Modulus of elasticity at 20 °C (DIN EN ISO 6721-5):	15.600 MPa (2.262.000 psi)
Modulus of torsion at 20 °C (DIN EN ISO 6721-2):	5.900 MPa (855.500 psi)
Corrosion:	none
Electrochemical corrosion (DIN 50900):	none
Resist against internal pressure:	300 bar
Totally cured at temperatures up to:	minus 30 °C
Total curing time:	3 min
Repairs in high temperature range at metal temperatures up to:	300 °C
at water cooled metal surfaces up to:	550 °C
Repairs of all metals and alloys	
Application of oily, greasy or fuel contaminated metal surfaces	
Application under water or on wet metal surfaces	
Surface protection against erosion, abrasion, cavitation & corrosion	
Chemical resistance very high against acids, lyes & solvents	
Storage over 5 years without any loss of quality possible	

## Acceptance by classification societies

American Bureau of Shipping • China Classification Society • Det Norske Veritas • Germanischer Lloyd • Lloyd's Register of Shipping • Nippon Kaiji Kyokai • Russian Type Approval

## Availability

Technical data sheets are generally available in German or English language. PolymerMetals are only produced in Germany and delivered worldwide within short time by MultiMetall. In addition to that our products are internationally available from many MultiMetall-partners. Ask for further products from MultiMetall.

## Repair of components with PolymerMetals

air sleeves • axles • bearing housings • bearing seating • boiler • bridge bearings • compensators • compressors • condensers / capacitors • conveyor belts • cooling tubes • cyclone • cylinder barrels • cylinder sleeves • engine blocks • engines • exhaust pipelines • exhaust pipes • exhaust turbines • gaskets • gearbox housings • guide rails • heat exchangers • housings for gas inlet and outlet • hulls • hydraulic cylinders • hydraulic oil pipes • hydraulic pistons • impellers • kort nozzles • oil coolers • oil pipelines / oil feed pipes • oil tanks • petrol pipelines / petrol feed pipes • petrol tanks • plain bearings • plungers • propellers • pumps • rudder bearings • seals • shaft plates • shafts • slab frames • spline shafts • steam pipelines / steam feed pipes • tappet guides • transformers • turbine housings • turbochargers • V-grooves / keyways • valve housings • valves • vibration dampers • water coolers • water pipes • water tanks

## Trademarks

MultiMetall®  
PolymerMetal® • Ceramium®  
Molymetall® • Sealium® • XETEX®

## Reference list (Extract of German customers)

ABB AG • AG der Dillinger Hüttenwerke • AIDA Cruises • Alstom Power Service GmbH • Atlas Copco Energas GmbH • Blohm + Voss Industrietechnik GmbH • Bombardier Transportation GmbH • BVG Berliner Verkehrsbetriebe • Carl Büttner Ship Management • Continental AG Automotive Systems • Daimler AG • DB AG • Deutsche BP AG • Deutz AG • E.ON AG • ENSO Energie Sachsen Ost AG • Erdgas Südsachsen GmbH • Europipe GmbH • Evonik Power Saar GmbH • German Tanker Shipping GmbH & Co. Ship Owners & Tanker Operators • HeidelbergCement AG • Henschel Industrietechnik GmbH • HKM Hüttenwerke Krupp Mannesmann GmbH • Holborn Europa Raffinerie GmbH • IVECO Motors FPT Deutschland • K + S KALI GmbH • KKW Krümmel • KKW Brokdorf • KS Aluminium-Technologie GmbH • KSB AG • LEW Lechwerke AG • LH Luitpoldhütte AG • MAN Diesel SE • Metalock Industrie Service GmbH • MTU Friedrichshafen GmbH • N-ERGIE AG • Norddeutsche Reedereien H. Schuldt GmbH & Co KG • PCK Raffinerie GmbH • Peiner Umformtechnik GmbH • Pirelli Kabel & Systeme GmbH & Co.KG • Porsche AG • Ruhrpumpen GmbH • RWE AG • Saarstahl AG • Salzgitter AG • Shell Deutschland Oil GmbH • Siemens AG Power Generation • Stadtwerke München • Stadtwerke Trier • ThyssenKrupp Industrieservice GmbH • ThyssenKrupp Marine Systems Blohm & Voss Repair GmbH • ThyssenKrupp Steel Europe AG • Vattenfall Europe AG • ZF Friedrichshafen AG

# MultiMetall

the MetalExistenceCompany®



## Overview product range

### MM-metal SS-steelceramic

MM-metal SS-steelceramic is the PolymerMetal with the widest range of application for repairs and maintenance of all metals and alloys. MM-metal SS-steelceramic offers a very high quality at mechanical repairs of damaged components (e.g. caused by crack, corrosion, abrasion, impact or chemical stress).

Machinability: SiC-grinding plates, Diamond tools

### MM-metal SQ

Characteristic for this PolymerMetal are the easy processing and extreme short curing time. The variable mixing ratio offers application consistencies from pasty to liquid. MM-metal SQ can be used at ambient temperatures up to minus 30 °C.

Machinability: standard tools

### MM-metal SS-steel 382

MM-metal SS-steel 382 is a PolymerMetal and construction material. The high performance material MM-metal SS-steel 382 delivers the best technical data under mechanical and physical stress.

Machinability: standard tools

### MM-metal SS

PolymerMetals of the SS-basis possess very high quality standards for the reconstitution of metallic components. These PolymerMetals are available with the alloy materials steel, aluminium, copper and bronze.

Machinability: standard tools

### MM-metal oL-steelceramic

MM-metal oL-steelceramic is a PolymerMetal tested and certified for the repair of oily, greasy or fuel contaminated metals and alloys in case of stress due to cracks, corrosion, abrasion, impact or chemicals. MM-metal oL-steelceramic can also be used to seal oil, grease or fuel pouring from leaks at systems under pressure.

Machinability: SiC-grinding plates, Diamond tools

### MM-metal UW

MM-metal UW is a PolymerMetal with extreme short curing time. It is certified for repairs under water or on wet metal surfaces. Possible application areas of MM-metal UW are the repair of under water components or the sealing of leaks. MM-metal UW can also be used to seal water pouring from leaks at systems under pressure.

Machinability: SiC-grinding plates, Diamond tools

### Ceramium®

Ceramium offers maximum wear resistance against continuous material loss on metallic surfaces. With tough hard layers, Ceramium protects against erosion, abrasion, cavitation or corrosion in case of dry or wet or chemical stress.

Machinability: SiC-grinding plates, Diamond tools

### Ceramium® CH

Ceramium CH is a wear resistant Polymer-Ceramic with excellent resistance against chemicals. These include inorganic (mineral) and organic (carboxylic) acids - also in concentrated form – as well as halogenated and aromatic hydrocarbons, ester, ketone, alcohols, bases and oxidising salt solutions.

Machinability: SiC-grinding plates, Diamond tools

### XETEX® BD

XETEX BD is a cold-setting two-component construction adhesive on basis of epoxy resin / ceramic, which has been developed for high-strength bonding. The application is the joining of materials (e.g. metals, ceramics and plastics) with very high strength at high mechanical, static and dynamic loads.

### VP 10-017

VP 10-017 is a tough elastic PolymerCeramic with high impact and cavitation resistance. This extremely smooth surface protection provides a good resistance against chemicals and has a high mechanical-physical load capacity.

### VP 10-500

VP 10-500 is a PolymerMetal for repair and maintenance of metals in the high temperature range. It is a hot-hardening material which does have a clearly higher temperature resistance than cold-hardening polymer materials. A high chemical resistance especially against sulphuric acid is given.

Machinability: SiC-grinding plates, Diamond tools

### Molymetall®

Molymetall is a PolymerMetal with a very low coefficient of friction and self-lubricating properties. The emergency running properties against solid dry friction such as sliding wear and stick-slip are excellent. After curing, Molymetall can be processed to a finished measure up to the  $\mu$ -area.

Machinability: standard tools

### Sealium®

Mostly Sealium is used as sealant and sealing of metallic casting materials. Furthermore alloys and thermal coated components can be treated with Sealium. As a one-component material with extremely high capillary activity, Sealium penetrates micro-porosities or hairline cracks and reacts in the structure of the metallic material.

### MM-metal S

PolymerMetals of the S-basis are used for removing bubbles in cast parts, for quick repairs and for visual improvements. MM-metal is available with high metal filling particular for the cast materials steel, iron, aluminium, copper and bronze.

Machinability: standard tools

### MM-Elastomer

MM-Elastomer is a material with rubber-like characteristics. Using MM-Elastomer elastic connections can be created or components repaired which are e.g. subject to abrasion. The range of MM-Elastomer goes from Shore A hardness 40 to 95.

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XETEX® • the MetalExistenceCompany®  
are registered trademarks of MultiMetall

# Technical Report PolymerMetal®

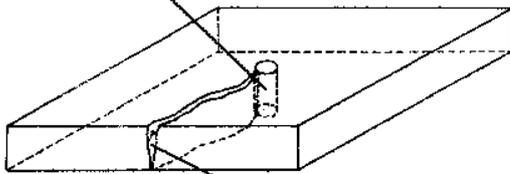
## TEC-# 016

Sample applications

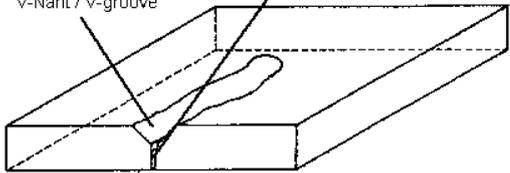
### Used products

PolymerMetals

Rissende ausgebohrt / crack end drilled out



V-Naht / V-groove



Riss / Crack

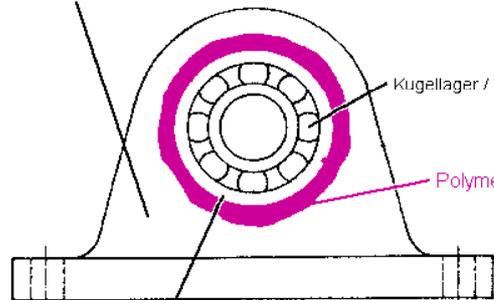
appliziertes PolymerMetal /  
applied PolymerMetal



Reparaturstelle nach Bearbeitung /  
Repair site after machining



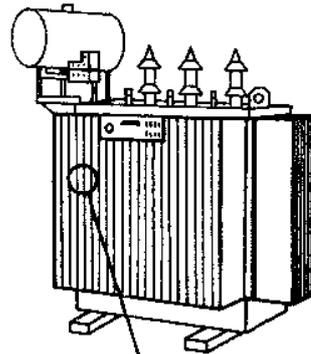
Lagerblock / pillow block



Kugellager / Ball bearing

PolymerMetal

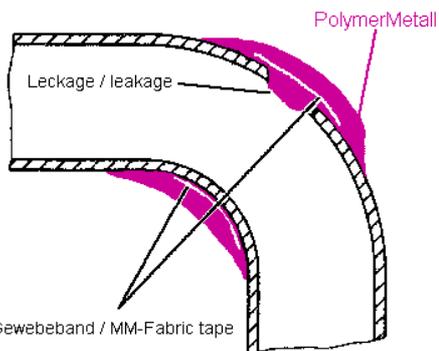
MM-Trennmittel / MM-Release agent



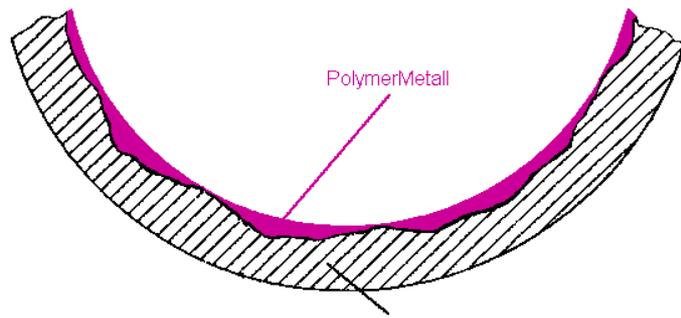
PolymerMetal



Leckage mit Flüssigkeitsaustritt /  
leakage with liquid pouring out



MM-Gewebeband / MM-Fabric tape



verschlissenes Pumpengehäuse / worn pump casing

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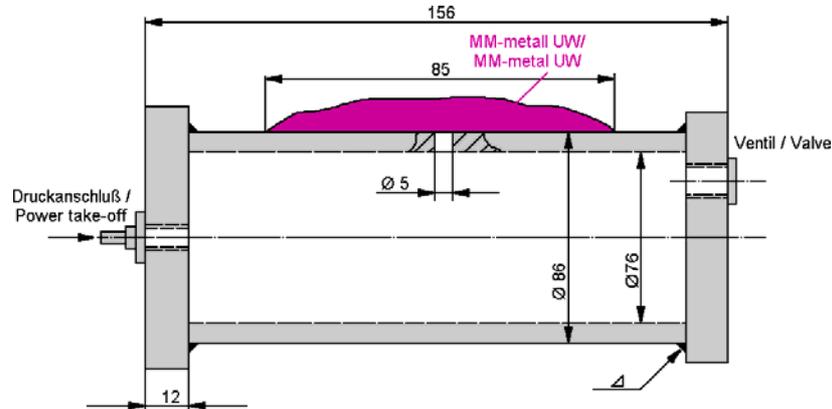
## Technical Report PolymerMetal®

### TEC-# 012

Pressure tightness test of MM-metal UW

### Used products

MM-metal UW



### Testing method:

The pressure tightness has been tested at repaired leakages at MAN-testing bodies with MM-metal UW. This test has been carried out according to the test reports of Lloyd's Register of Shipping.

### Results:

The following data are from a repair under water with MM-metal UW and Hardener UW9:

<u>Pressure</u>	<u>Data</u>
50 bar	pressure tight
100 bar	pressure tight
120 bar	after 10 min small leakage

The following data were achieved at a repair on a wet metal surface with a first layer of MM-metal UW with Hardener UW3 and a final coating with MM-metal UW and Hardener UW9:

<u>Pressure</u>	<u>Data</u>
100 bar	pressure tight
150 bar	pressure tight
200 bar	after 15 min small leakage

### Conclusion:

MM-metal UW can be used in many cases, where an application under water or on wet surfaces is required. The total curing time at 20 °C is between 10 - 60 minutes and a processing is possible up to an ambient temperature of 0 °C. Because of the a.m. technical data MM-metal UW can be used e.g. to seal leakages at water pipings, which need to resist strong pressure.

## MultiMetall

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The product information and instructions provided in this leaflet were prepared to the best of our knowledge and serve information purposes only. We recommend that appropriate tests are carried out prior to application in order to ensure that the products and methods fulfil the purpose desired by the user. In this procedure, the given data may serve as a basis. Application and processing of the products lie outside our possible control and are therefore the sole responsibility of the user.



## Technical Report PolymerMetal®

### TEC-# 007

The corrosion-chemical behaviour of PolymerMetals in combination with casting material (contact corrosion)

### Used products

MM-metal SS-steelceramic / MM-metal SQ / MM-metal SS-steel 382 / MM-metal SS-steel / MM-metal oL-steelceramic / MM-metal UW / Ceramium® / MM-metal S-steel

### Introduction

PolymerMetals are used for repairs of metallic constructions which were damaged by physical loads like tear, impact, erosion, abrasion, corrosion and cavitation or by chemical load.

Questions of customers concerning the contact corrosion of our PolymerMetals lead us to do tests.

The following report shows how the test has been carried out and what results have been obtained. Tests have been made with seven different PolymerMetals in artificial sea water (laboratory test) as well as in aggressive marshy soil. The PolymerMetals used were potentially equivalent or potentially superior to the base material (cast iron).

### Place of repair

Moorland in the North of Germany and laboratory

### Preparation of test samples

56 plates measuring 150 x 95 x 25 mm and 95 x 47 mm have been cut off cast iron. The surface of 23 plates has been treated mechanically. 2-3 bore holes of different diameters were installed in order to create different proportions between cast iron and PolymerMetals.

### General information

An ordinary salt spray test proved insufficient. As the tested PolymerMetals are non-electrical conductive products it was decided not to measure the current density potential curves. The contact resistance in the Meg-Ohm-sphere was too high.

### Test in moorland

Marshy soil is to be said very aggressive (DVGW rating no. -15 up to -19)

Reasons are:

- very low soil resistance (appr. 950-1200 Ohm x cm)
- very high salt content (chloride 800 - 1250 mg/kg / sulphate 4300 - 19000 mg/kg)
- very high moisture contents (appr. 55 - 85%)
- anaerobic conditions, proved by hydrogen-sulphide

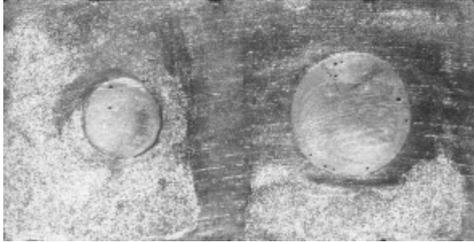
The cast iron plates and PolymerMetals, machined and non-machined, were stored in a considerable depth of marshy soil for more than one year.

### Test in artificial see water (laboratory test)

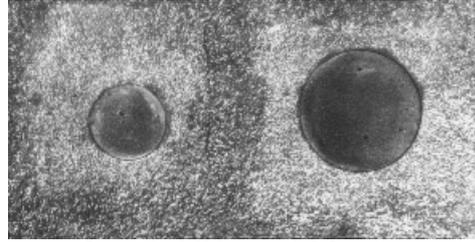
The cast iron plates and PolymerMetals - machined and non-machined - were stored in a laboratory in considerable depth of artificial sea water (DIN 50 900) for more than one year.

## Samples

The following photographs show the different PolymerMetals applied to cast iron which have been partly machined after full curing. After they have been stored for 12 months in aggressive moorland or artificial sea water the samples have been examined. The following four photographs concern machined samples which have been exposed to artificial sea water:



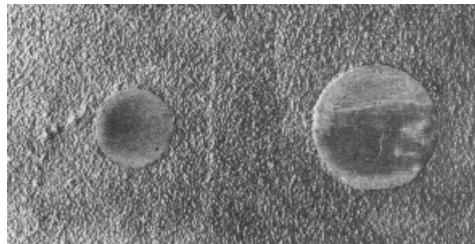
Sample MM-metal SS-steelceramic



Sample MM-metal SS-steel



Sample MM-metal oL-steelceramic



Sample MM-metal UW

## Result

The results of both tests were nearly the same. Due to the strong reaction caused by the aggressive soil or by the sea water the cast iron plates were coated with ferric hydroxide. While the surface of the cast iron plates were differently affected, the PolymerMetals still remained unchanged after storage of more than 12 months. They were only covered with rust deposit. Even peak-to-valley heights from previous treatments could clearly be recognised. There was no contact corrosion, not even at the transitional point of the PolymerMetal and the cast iron. It was proved that PolymerMetals are not electrically conductive and cannot constitute any local element with cast iron.

## Tested PolymerMetals

MM-metal SS-steelceramic  
MM-metal SS-steel 382  
MM-metal SS-steel  
MM-metal SQ  
MM-metal oL-steelceramic  
MM-metal UW  
Ceranium®  
MM-metal S-steel

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## Technical Report PolymerMetal®

### TEC-# 006

Microscope photographs, direct-MM-bonding, bonding on contaminated surfaces, pressure tight tests

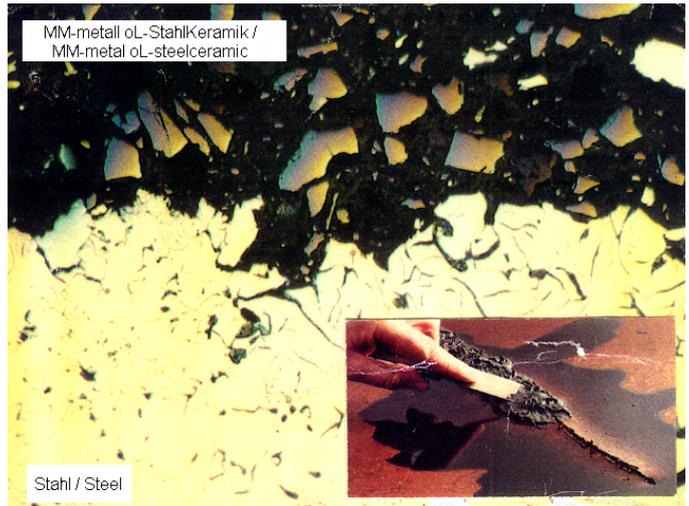
### Used products

MM-metal oL-steelceramic

### Description

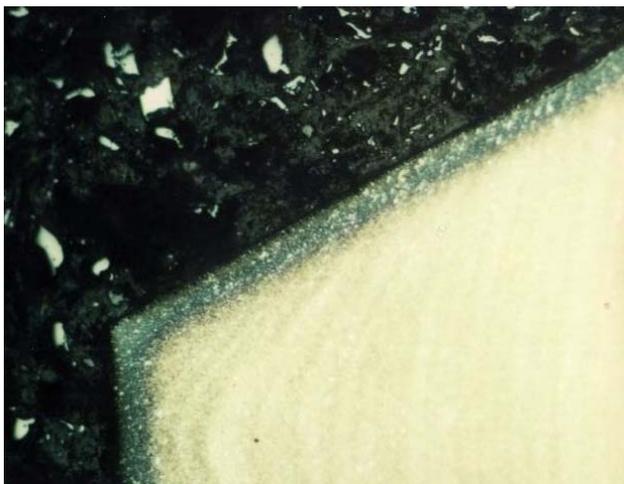
MM-metal oL-steelceramic is a PolymerMetal tested and certified for the repair of oily, greasy or fuel contaminated metals and alloys in case of stress due to cracks, corrosion, abrasion, impact or chemicals. The degree of soiling does not in any way affect the bonding with the structure of the soiled metal surface. High technical data and also the chemical resistance and bonding with the structure on a dirty metallic surface are remarkable features of MM-metal oL-steelceramic.

This technology is approved by Lloyd's Register of Shipping.



### Microscope photographs / direct-MM-bonding

The following pictures show microscopic photographs of the fully cured PolymerMetal MM-metal oL-steelceramic magnified by a factor of 100 and 500. Here the bonding between MM-metal oL-steelceramic and metallic surfaces (steel or casting), which have been contaminated by various applied oils before, has been analyzed.



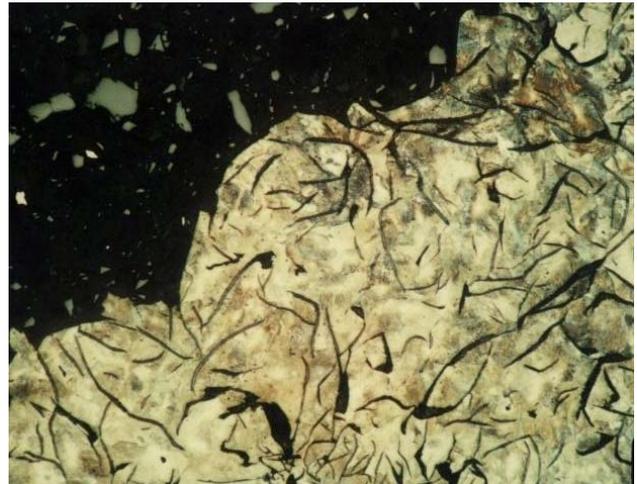
on industry gear oil / steel  
(Magnification 100)



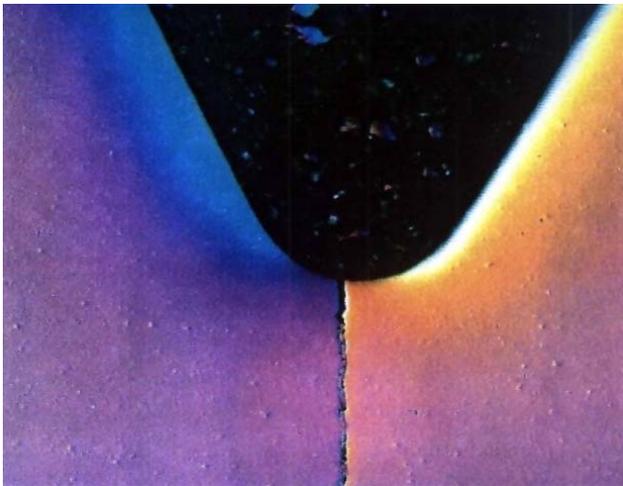
on petroleum / casting  
(Magnification 100)



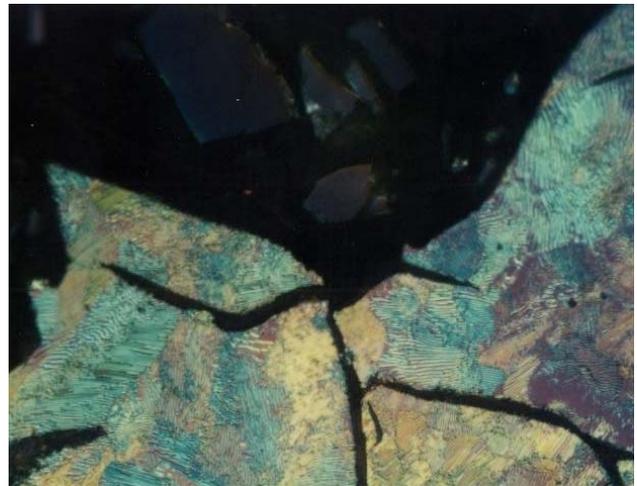
on diesel / steel  
(Magnification 100)



on compression oil KSL 68 / casting  
(Magnification 100)



on hydraulic oil T 29-50 / steel  
(Magnification 100)

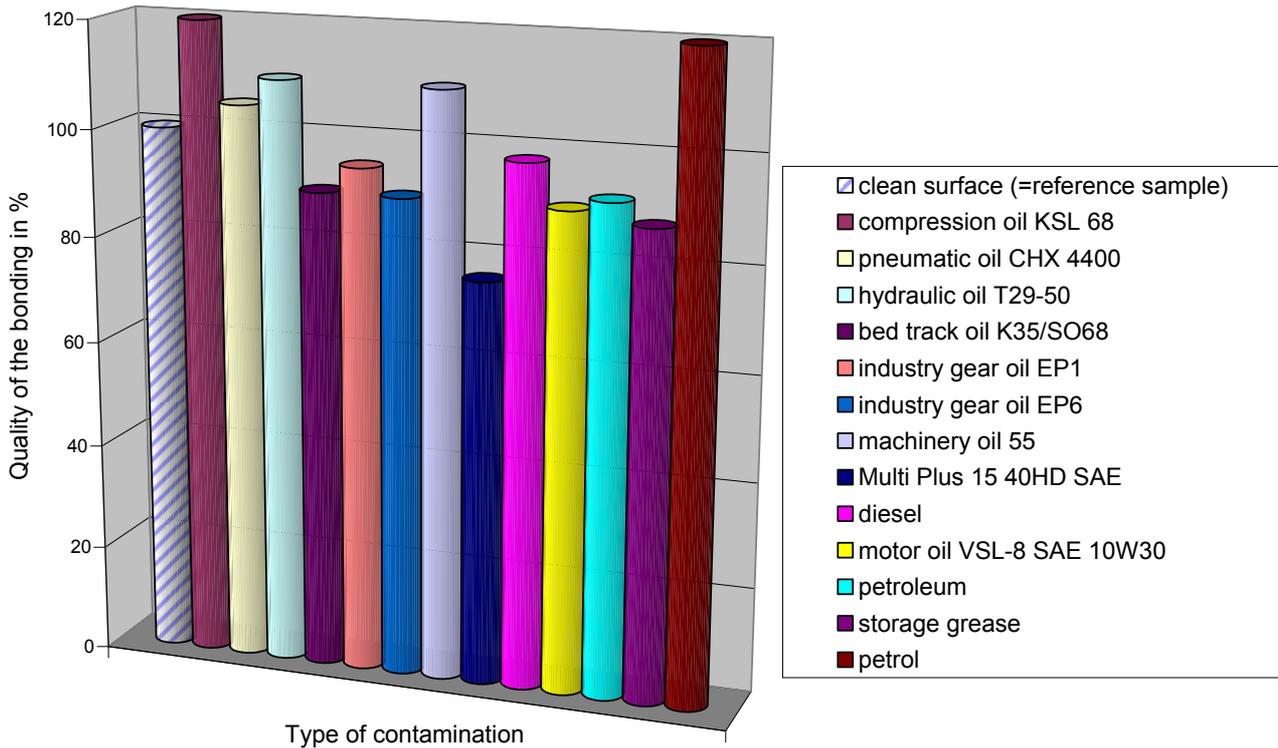


on gear oil / machine oil 55  
(Magnification 500)

MM-metal oL-steelceramic penetrates and absorbs oil, grease and fuel. The direct-MM-bonding technology secures the direct and high solid bonding on contaminated surfaces.

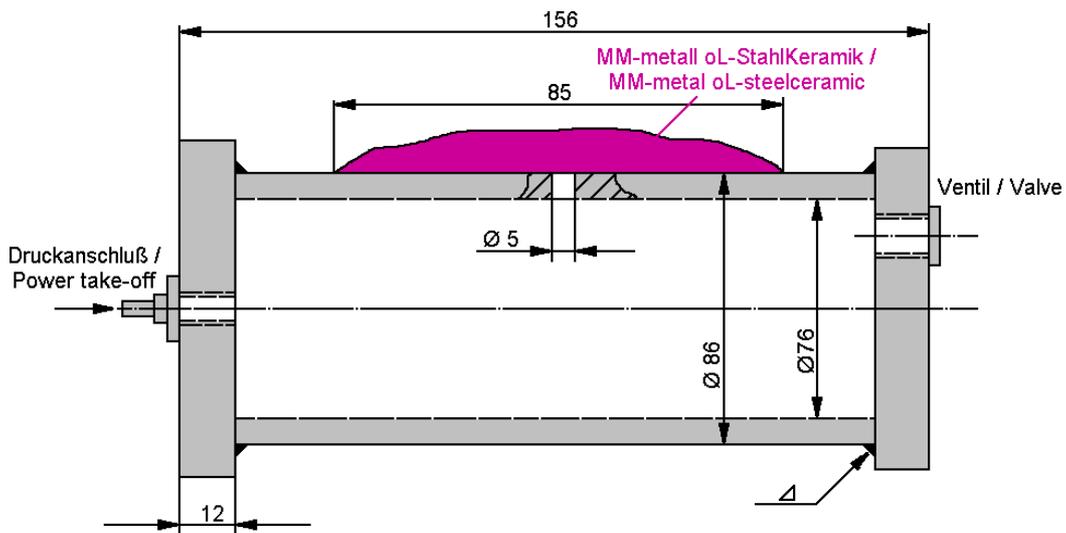
### Bonding on oily surfaces

Tests have been carried out to evaluate the quality of the bonding on different surfaces. At the reference test MM-metal oL-steelceramic and Hardener yellow have been applied to a cleaned (that means oil free) and roughened metal surface. The reference value of 100% stands for the quality of the various determined technical data during bending, shearing & hydraulic tests after total curing time. Other values have been determined by applying MM-metal oL-steelceramic on different contaminated metal surfaces. The test results demonstrate that sometimes better technical values were reached after application on oily metal surfaces than on clean metal surfaces.



### Testing of pressure tightness

To be able to evaluate the quality of the application of MM-metal oL-steelceramic on oily surfaces, tests have been carried out at company M.A.N. under supervision of the classification society Lloyds Register of Shipping. Here special test pipes made off steel have been created according to the following drawing. Around a leakage of a size of diameter 5 mm the metallic shiny surface (Rz 65  $\mu\text{m}$ ) of the test cylinder was contaminated with oil. Then the cold-curing MM-metal oL-steelceramic with Hardener yellow was applied around the leakage with a layer thickness of up to max. 8 mm. After full curing of the PolymerMetal the test cylinder has been filled with a liquid and pressure was built up. Then the system was checked against pressure tightness.



Pressure	Temperature of test cylinder	Auxiliaries	Result
100 bar	20 °C	-	pressure tight
150 bar	20 °C	-	pressure tight
200 bar	20 °C	-	after 8 hours small leakage

In the course of the time the research and development division of MultiMetall was successful to continue optimising the material MM-metal oL-steelceramic and new tests with same conditions have been carried out at MultiMetall. The following results were achieved:

Pressure	Temperature of test cylinder	Auxiliaries	Result
200 bar	20 °C	-	pressure tight
300 bar	20 °C	-	pressure tight
350 bar	20 °C	-	after 2 hours small leakage
150 bar	75 °C	pipe clip	pressure tight
400 bar	75 °C	pipe clip	pressure tight

The pipe clip was fixed around the test cylinder in the area of the leakage. Reinforcing elements as e.g. fibres or mats consisting of glass or carbon have not been used. These would have increased the physical strength essentially.

The tests have been carried out at M.A.N. (test report No. 1731/82) under supervision of Lloyds Register of Shipping (certificate No. 301954) in 1982, the test at MultiMetall in 1995.

Extract of the certificate: „The test results of MM-metal oL-steelceramic may be classed as ranging from good to exceptionally good. All test results were in support of the maker’s claim that MM-metal oL-steelceramic will bond on oily surfaces with a high degree of reliability.”

**Practical example**

At Weatherford pressure tests have been carried out with MM-metal oL-steelceramic. The test piece was pressure tight up to a tested pressure load of 4.000 psi (~ 275 bar).

Here are some photographs incl. test records:





Weatherford CDL 9405R1c)

Program : 1.58  
 Date : 900025  
 Part No. : 0  
 Serial No. : 0  
 Assembly : 0

Acquiring Date 21.01.2006  
 Acquiring Time 11:00:03

**Admin Data**

Company ACOTS  
 Order no. KLAUS  
 Operator

**Pipe Data**

Pipe Type 31/2" PIPE  
 Manufacturer  
 Pipe Diameter  
 Weight  
 Grade  
 Lubricant  
 Comment

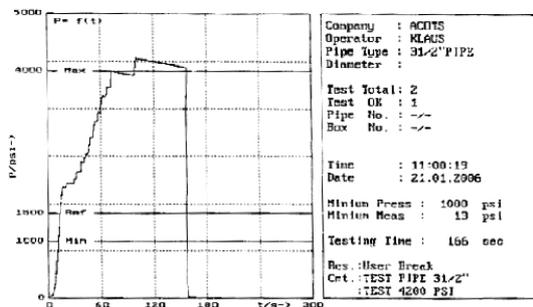
**Pressure Values**

Pressure Range 5000 psi  
 Max. Pressure 4000 psi  
 Min. Pressure 1000 psi  
 Ref. Pressure 1500 psi

**Sensor Data**

Sensor Type  
 Sensitivity (mV/V) 2.000

Weatherford CDL 9405R1c) Ver. 1.30 Date 900025



Further information can be provided upon request.

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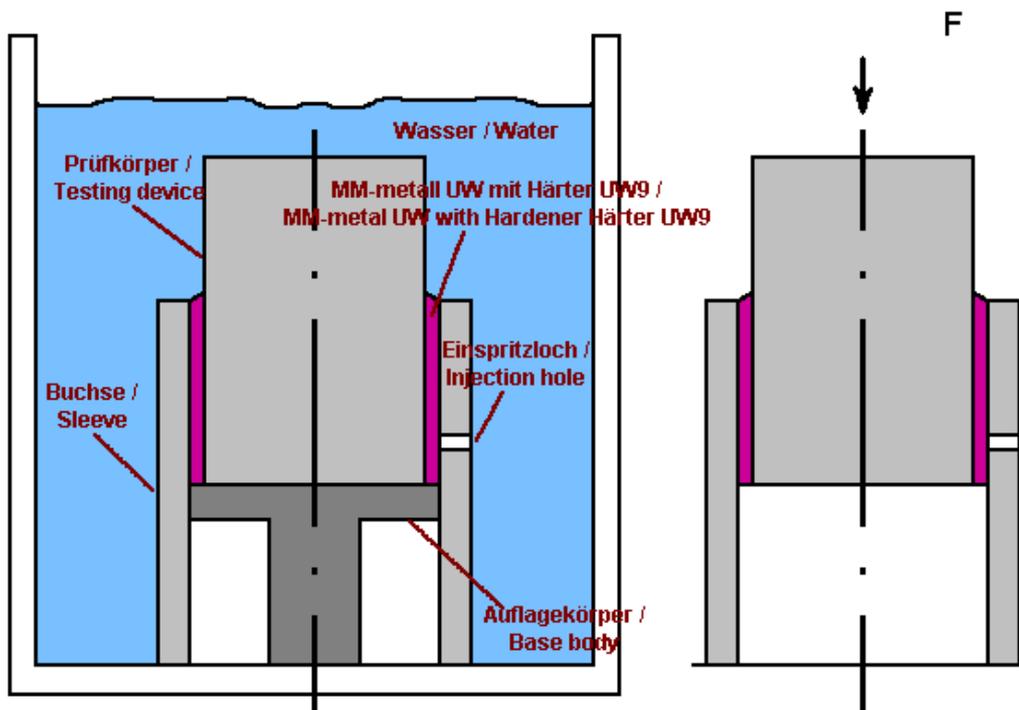
## Technical Report PolymerMetal®

### TEC-# 005

Test of the compression-shear-strength of MM-metal UW with Hardener UW9 after injection under water

### Used products

MM-metal UW with Hardener UW9



### Description

Normally MM-metal UW gets a pasty application consistency after mixing with Hardener. When a different mixing ratio (2 volumen parts MM-metal UW with 1,5 volumen parts Hardener UW) is chosen, you receive a liquid application consistency, so that the PolymerMetal can also be injected.

During the test the PolymerMetal was injected under water at a very low water temperature of 3 °C. From the changed mixing ratio and the low temperature results a pot life of appr. 65 min.

The test of the compression-shear-strength result in the following values

#### Time of measuring

6 h after injection  
18 h after injection  
48 h after injection

#### Compression-shear-strength

5,21 MPa  
7,80 MPa  
8,34 MPa

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### TEC-# 028

Surface preparation before the coating of hydraulic rams

### Used products

Molymetall®

### Introduction

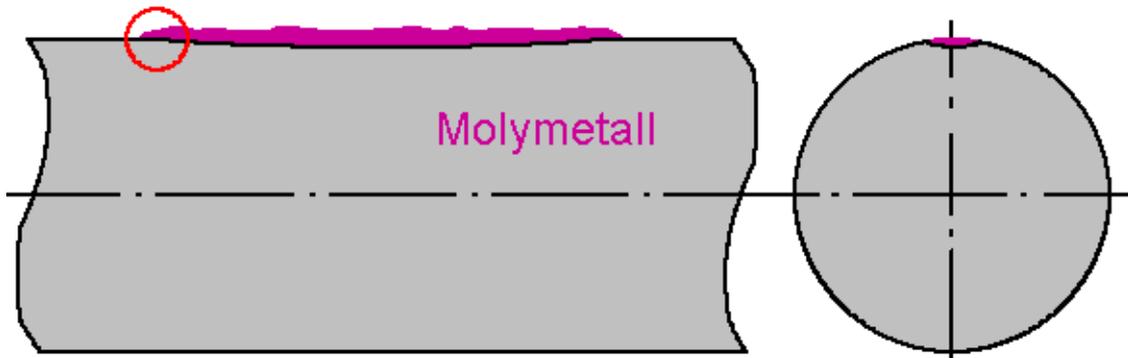
Molymetall® is a PolymerMetal with a very low coefficient of friction and self-lubricating properties. The emergency running properties against solid dry friction such as sliding wear and stick-slip are excellent. After full curing, Molymetall can be processed to a finished measure up to the  $\mu$ -area. Possible applications are e.g. hydraulic pistons, pillar guides, slide bearings, slide ways, tappet guides.

### Description

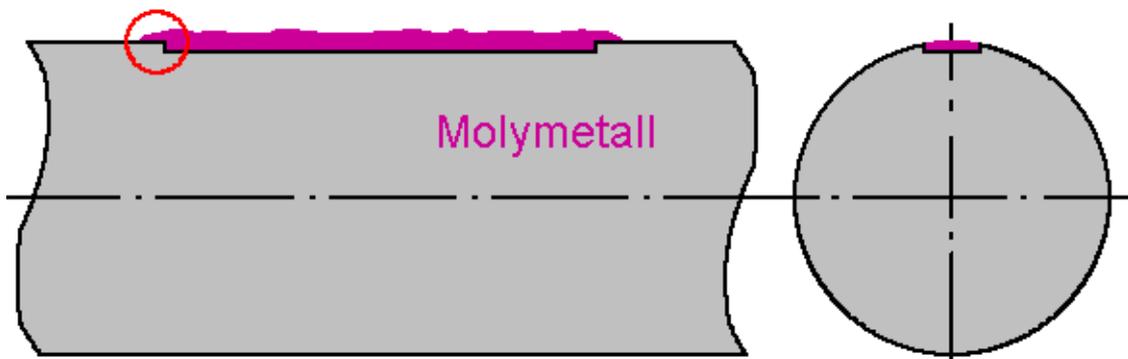
Especially when Molymetall® is used for the repair of hydraulic rams, it is important that the surface of the work piece is thoroughly prepared before coating. Therefore

**make the surface metallically clean and carryable &  
rough up the surface mechanically by sandblasting, cutting, grinding etc.**

Wrong:



Right:



Especially during the creation of a metallically clean and carryable surface, it is very important that any pittings and cracks on the work piece surface, which were caused by wear won't be let run out, but machined instead. That means that before the application of Molymetall® covering the complete area, any cracks should be grinded down by appr. 1 mm. This way the bonding of Molymetall® on the surface is secured.



**clean again by sweeping, blowing or sucking off  
thoroughly degrease with MM-Degreaser Z**

It is important that only suitable degreasers like e.g. MM-Degreaser Z, acetone or ethyl acetate are used. Benzine, alcohol, varnish and paint thinner or other unknown substances are not suitable. Remains of oil diffused in the work piece can be removed by heating up the damaged area by using a Bunsen burner or a gas flame. Through this the adhesion of Molymetall® on the surface won't be affected by remainders of oil.

**MM-Release agent**

Apply a thin layer of MM-Release agent on the surfaces, where a compound should not be formed with the PolymerMetal and polish after a short drying period

**Hints for the application of Molymetall®**

During the application of the PolymerMetal we recommend striking out a thin layer of the mixed PolymerMetal on a clean (metal) plate or any similar suitable substrate before starting to coat the work piece. Through this small air bubbles arisen in the still soft PolymerMetal during mixing of the components can be avoided or removed. Molymetall® should be applied to up to appr. 0,5 mm above the wanted nominal layer thickness, because normally a machining of the initially or fully cured Molymetall® is desired or necessary later to achieve a very smooth and regular surface of the damaged area. In every case it is important that first some Molymetall® is applied over the nominal diameter because if sufficient material has not been applied, a surface preparation must be done again. We recommend applying more material because Molymetall® can be machined quite easily. The machining can be done by e.g. using first coarse and later fine sand paper.

Following some examples of hydraulic rams, which have been repaired with Molymetall®:



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## Possible use of PolymerMetals on ships

The experience shows, that a lot of repair problems on board of a ship can be solved with the help of products from MultiMetall. Following you will find various possibilities where to use our PolymerMetals:

Location	Specific type of damage / repair	Suggested MM-Product
Hull	Steel plate pitting	MM-metal SS-steelceramic
	Underwater hull crack	MM-metal UW
	Water getting into the oil tank due to a hull crack	MM-metal UW on exterior hull and MM-metal oL-steelceramic inside of oil-tank
Propeller	Cavitation on the blades	Ceramium
	Worn out propeller shaft	Ceramium
Rudder	Blade steel plate pitting	Ceramium
	Worn out pintle bush	Ceramium
	Worn out stock key-way	MM-metal SS-steel 382
Mooring Gear	Worn out winch shaft in the area of stuffing-box or oil-seal	Ceramium
	Corroded windlass / winch casing	MM-metal SS-steelceramic
	Corroded fairlead bearing surface	Molymetall
Main Deck	Top deck pitting	MM-metal SS-steelceramic
	Corroded air-vent heads	Ceramium
	Leaking hydraulic / oil pipes	MM-metal oL-steelceramic
	Leaking sea-water pipes	MM-metal UW
	Corroded conduit pipes / manifold	MM-metal SS-steelceramic
	Corroded IGS / air pipes	MM-metal SS-steelceramic
	Corroded oil pipes	MM-metal SS-steelceramic
	Corroded hatch packing channels	MM-metal SS-steelceramic
	Corroded gangway winch bearing housing	MM-metal SS-steelceramic
	Corroded steam pipes / valves	MM-metal SS-steelceramic
	Hatch cover hydraulic rams	Molymetall
Fire protection, Emergency equipment	Corroded fire-hose cabinets	Ceramium with Fibre-glass mats
	Damaged life-boat hull, steel or fibreglass	MM-metal SS-steelceramic
Tanks	Corroded ballast / oil tank striking plates	MM-metal SS-steelceramic
	Corroded distributing pipes under ballast / oil tank	MM-metal SS-steelceramic
	Corroded ballast / oil tank bottom or side plates	MM-metal SS-steelceramic
	Corroded oil / tank heating coils	MM-metal SS-steelceramic
	Valve bodies and flaps	Ceramium
Engine room	Pump casings / impellers / shafts / key-ways / bearing housings	Ceramium
	Heat-exchanger tube plates and covers	Ceramium
	Pipe / valve repairs	MM-metal SS-steelceramic
	Cracked / corroded main engine cylinder jacket	MM-metal SS-steelceramic
	Turbocharger gas inlet / outlet casings	VP 10-500
	Corroded inert gas fan casing	MM-metal SS-steelceramic
	IGS scrubber casing and pipes	MM-metal SS-steelceramic
Electrical	Damaged cable insulation	MM-Elastomer
	Damaged motor shaft and bearing housing	Ceramium
Cranes	Corrosion on boom and fittings	Ceramium
	Shafts and bearing housings	Ceramium

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## *Worldwide repairs carried out with PolymerMetall® in the ship industry*

(Photographs incl. description of each repair can be found  
on our website [www.polymermetal.com](http://www.polymermetal.com), „Worldwide repairs“, REP-number)

REP-#	Description
005	Repair of a marine engine with MM-metal SS-steelceramic and Hardener yellow. Damage: cracked packing surface between cooling water space and cylinder liner.
006	Repair of several bilge pumps and fire pumps (type Loew VZLG 65/1/2, power 60 m3/h) with Ceramium pasty and Ceramium liquid. An inspection 3 years after the repair did not show any faults or objections at the repaired object.
010	Sealing of cracked leaky welding seams at crankcase of a ship diesel with MM-metal SS-steelceramic and Hardener yellow.
012	Elimination of damages at two vessel's propeller caused by cavitation with Ceramium and Hardener CE.
016	Repair of cracked Diesel injection pumps using MM-metal SS-steelceramic and Hardener yellow.
019	A worn out bearing bush of a floating dredger was rebuilt using MM-metal SS-steelceramic and Hardener yellow. Besides MM-metal SS-steel liquid type with Hardener yellow liquid was injected into a gap of 4 mm between bearing bush and boom.
022	Repair of a frost damage at a centrifugal pump. MM-metal SS-steelceramic together with Hardener yellow and MM-Fabric-tape (steel) has been used.
026	The packing surface of an adjustable propeller was repaired by using MM-metal SS-steelceramic.
027	Repair of two tail bearings of a propeller shaft by using MM-metal SS-steelceramic, Hardener yellow and Hardener green. A ring with exact interior diameter has been bolted to both sides of the bearing. This ring has been centralized to the ideal shaft axis. Then MM-metal SS-steelceramic has been applied and been stretched parallel to the axis.
032	Repairing of cylinder blocks and working faces of big marine diesel engine with MM-metal SS-steelceramic. The repair was necessary due to damages caused by big abrasion between cylinder block and working face particularly in the region of the scaving air receiver. For this type of repair the engine manufacturer recommends to use exclusively MM-metal SS-steelceramic with Hardener green.
034	Repair of a three-way valve housing for sea water. Material: grey cast iron. Damage: considerable wash-outs as well as a gaping hole in the valve housing. The repair was carried out with MM-metal SS-steelceramic and Hardener yellow and Ceramium, liquid with Hardener CE.
049	Through leakages at the sealing surface of a cylinder liner's engine block cooling water flew out. The reconstruction work was affected with MM-metal SS-steel and Hardener yellow at eight cylinder block threads. After the application procedure the seats were machined to nominal diameter 308 mm. The main engine was an engine Daihatsu type 8 DSM 26, power 1252 kW, 720 U/min.
050	Sealing of an overrun container on board of a ship with MM-metal UW and Hardener UW3 respectively Hardener UW9.
060	A tanker (size 15.000 GRT) loaded with petrol, touched ground. Damage was an extensive leakage with a size of 200 mm x 700 mm. The repair was carried out under water using MM-metal UW with Hardener UW9 and a metal plate.
061	A leakage at the stern of a barge was sealed under water using MM-metal UW with Hardener UW9. The repair was completed within 30 minutes time.



- 068 Because of bad maintenance during the resting period the covers of 3 auxiliary capacitors, each 6 m<sup>2</sup> were affected by erosion of up to 3 cm depth. The volume for filling was obtained by applying 200 kg Ceramium and Hardener CE.
- 069 Repair of 160 cylinder liners using Ceramium, pasty and Hardener CE. Afterwards a layer of Ceramium, liquid and Hardener CE were applied.
- 073 Repair of a Kort nozzle using Ceramium with Hardener CE.
- 075 Elimination of cavitation damages at a bronze propeller and a steel propeller with Ceramium and Hardener CE.
- 084 Repair of a turbo charger on board of a ship: during a voyage problems occurred at a turbo charger. The turbine inlet casing was removed and after cleaning a wasted area of appr. 600 mm x 130 mm on the lower part of the casing was revealed. Due to the technical possibilities on board the repair was carried out with MM-metal SS-steelceramic and a steel plate as reinforcement. At an exhaust temperature of appr. 400 °C in this repair area today MultiMetall's VP 10-500 would have been the better choice.
- 093 Repair of a ship propeller shaft made of bronze in the zone of the stuffing box packing with Ceramium pasty and Hardener CE. The original shaft diameter of 630 mm was machined down to 615 mm over a length of 60 cm. After the application of Ceramium the diameter was 632 mm. Finally the applied Ceramium was turned down to the requested diameter. For the complete repair 39 units of Ceramium / Hardener CE were used for applying 4 layers. Additionally 3 layers of glass fibre fabric tape were processed.
- 095 Repair of an undersized bronze propeller shaft: diameter appr. 380 mm, length appr. 6000 mm due to friction in the stuffing box. Material used: Ceramium with Hardener CE. After curing the propeller shaft was machined.
- 096 Repair of a propeller shaft near the stuffing box packing by using Ceramium pasty with Hardener CE.
- 098 Coating of a Kort nozzle using VP 10-017 as protection against cavitation and corrosion.
- 100 Corrosion protective coating of ship hatches with VP 10-017.
- 102 Repair of a ship's turbocharger with VP 10-500. Scourings, cracks and apertures from the gas entrance to the cooling water side were repaired with VP 10-500. For the reinforcement two layers of MM-Fabric tape (glass fibre) were used.
- 103 With VP 10-500 a non-sealant vent plug in a cylinder head at an exhaust port was repaired. VP 10-500 was applied in a thickness of appr. 3 mm. Afterwards the plug seals remained gas-proof in spite of high operating temperatures of 300 °C.
- 107 A leaky welding seam of a sea water pump was sealed using MM-metal UW and Hardener UW9.
- 115 Repair of a leaking simplex compact packing. The repair was difficult due to oil pouring out of the repair site. Therefore it was decided to use the direct-MM-bonding method by applying the PolymerMetal directly on the greasy surface. Here MM-metal oL-steelceramic with Hardener red was chosen.
- 122 Repair of a turbo charger using MM-metal SS-steelceramic. Today MultiMetall recommends the newer product VP 10-500.
- 125 Repair of two-stroke engine cylinder liners Sulzer RND 76N ship's diesel engine with MM-metal SS-steel and Hardener yellow. The outer diameter is 900 mm and the inner diameter is 760 mm.
- 126 Repair of a pump housing. Damage: erosion and corrosion had reduced the wall thickness to a minimum. The resulting damage was a hole in the housing. For deep wash-outs Ceramium, pasty with MM-Fabric mats (steel) were used. For the purpose of wear-and-tear resistance the pump was coated with Ceramium, liquid.



- 129 Durable protection against wear and corrosion on welded constructions e.g. receivers and covers can be achieved by using Ceramium together with an application of VP 10-017 afterwards.
- 130 A cracked housing of a hydraulic pump in a steering gear made off aluminium was repaired using MM-metal SS-steelceramic with Hardener yellow. Afterwards the whole housing was coated with VP 10-017 in order to seal the pores in the casting.
- 131 Due to ageing and sea water corrosion, the hard chrome coating in the top section of some hydraulic rams of several vessel deck hatch covers was peeled off. To avoid re-chroming, the hydraulic rams were repaired with Molymetall. First the corroded areas were machined down. Then Molymetall was applied and after curing machined down to size. The 270 kg heavy hydraulic cylinders with a diameter of 125 mm work with a pressure of 280 kg/cm<sup>2</sup> and a stroke of 635 mm. Tests, carried out 5 years after the repair, show that the hydraulic rams are still in good condition and fully functional.
- 133 The seat of a vessel's pintle bushing has been restored. At first under water the pintle bushing was fixed at a temperature of 2-3 °C. Then MM-metal UW with Hardener UW9 was injected through several threaded ports drilled into the bushing flange. Here an appr. 1,4 mm clearance between pintle bushing and gudgeon casting filled. The repair was carried out by a Canadian diving company. Because of the quick total curing time of the PolymerMetal in spite of the low temperature the vessel was ready for action again within short time.
- 136 A worn pump casing was coated with Ceramium liquid. Depending on the application consistency, Ceramium can be applied with a brush, a spatula or any other suitable tool or by pouring or injecting. Before coating, the surface must be roughened e.g. by sand blasting and then cleaned with MM-Degreaser Z or Acetone.
- 153 Several cracks in cylinder no. 1 in the main engine block of a ship diesel engine, which probably occurred due to aging and vibration, have been closed with MM-metal SS-steelceramic and Hardener yellow. The cylinder jacket had long vertical cracks of 215 mm and 125 mm length and two further cracks of 135 mm each in the upper area. Even 7 years after the repair has been carried out, the repaired ship engine is in operation without complaints. The extreme difficult repair has been completed by our Netherlands partner company („EMHA technisch bureau b.v.“) and company Metalock in a port in Thailand.
- 167 In November 2009 five at about 100 year-old locks were adapted to the operational and traffic-technical demands for the next years as a result of basic repair measures respectively steel hydraulics constructions improvements along the Dortmund-Ems canal. The concerned lock gates (lifting gates) are circumferentially furnished with trapezoid-shaped elastic lips. After having been moved up and bordering to the corresponding counter surfaces (gate seats) the lifting gate should close tightly. In the course of the time these gate seats showed pittings and they were no longer sufficient planar. Therefore the pasty version of the PolymerCeramic Ceramium was chosen to balance these areas. Per gate a seat area of about 20 running metres of 7 cm width with an average coating thickness up to 7 mm Ceramium was calculated. Because of the low ambient (10 °C) and work piece temperature at that season and the weather dependence the repair and curing conditions were difficult. Nevertheless after the repair the responsible water and shipping authority could release the locks respectively the canal again for the shipping according to plan.
- 168 The cylinder liner of a tanker's diesel engine was damaged. The sealing surface to the cylinder head was drilled into by mistake. The material loss at the damaged area was equalized again by applying MM-metal SS-steel (pasty) with Hardener yellow (pasty). After curing this repair area received a surface-grinding. This way the repaired engine was put into operation very fast again. Due to the use of this PolymerMetal from MultiMetall the expensive supply of a new cylinder liner was not necessary which would have been resulted in a more than 25-times higher repair cost.
- 169 In an approximately 8 m long pipe section of a fuel pipe situated in sea water (location Middle East) of a well known energy provider, a considerable wall thickness recession was detected by ultrasonic tests caused by corrosion and erosion. Prior to the decision of repairing the 16 inch (outer diameter) big piping, a pre-test was carried out. Here MM-metal UW was used together with fabric tapes made of glass fibre. The above photographs show the corresponding test application of a slightly slimmer pipe. After the good test results the actual pipe (16 inch outer diameter, original wall thickness ~ 13 mm, wall thickness recession at thinnest spot to approx. 5 mm; in addition to that deep pittings; water temperature during application approx. 14 – 18 °C; operation pressure in pipe approx. 5,5 up to max. 10 bar) was also repaired



later. In the end 100 units of MM-metal UW / Hardener UW were used for this operation. Here the pipe was prepared/machined (roughened) in the worn area. Then, under water, a first (base) coat was applied. Afterwards the fabric tapes were prepared – that means they were coated from both sides with the mixed MM-metal UW – and then wrapped around the pipe onto the still not cured base coating. For a good repair success it was important that the pot life was kept, that means the time which is available for processing the material.

- 177 By way of trial some damaged spots at steel pilings were repaired with MM-metal UW. These areas showed perforation corrosion, so the surfaces were first cleaned and roughened. Then the PolymerMetal® was applied. At the same time steel sheets (wall thickness 10 mm) were prepared with MM-metal UW on the underside and attached to the damaged areas previously coated with this substance. Then further material was applied along the edges respectively in the border areas. Approximately one year later a visual test of the repair place was done. All fixed steel sheets are still in position, but partly they showed rust grains. Dissolutions are not to be recognised. On the contrary, after cleaning the areas treated with MM-metal UW look almost as new.

## MultiMetal

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*Worldwide repairs carried out with PolymerMetal®*

**REP-# 005**



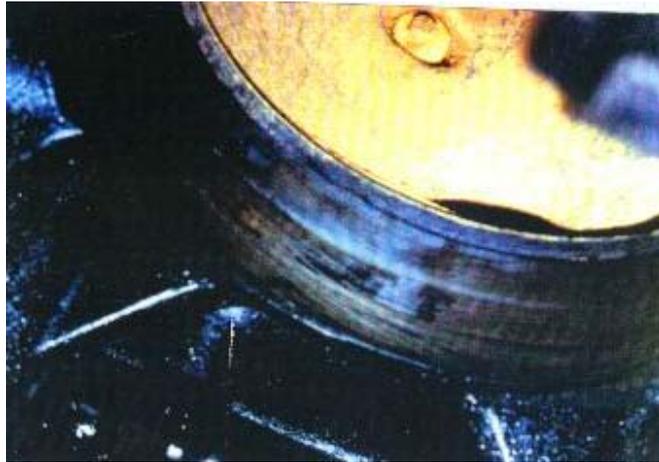
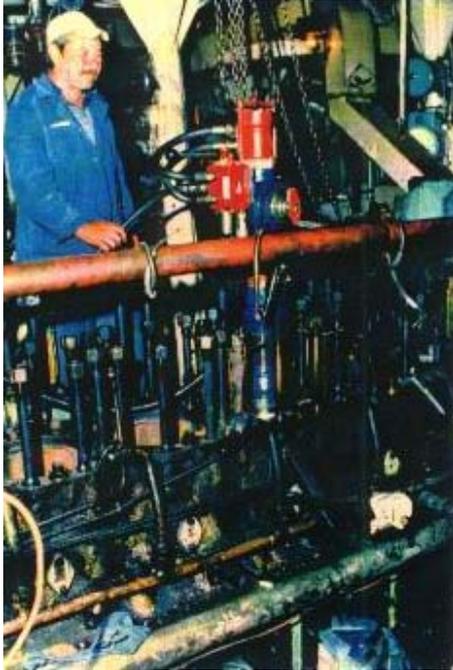
Repair of a marine engine with MM-metal SS-steelceramic and Hardener yellow. Damage: cracked packing surface between cooling water space and cylinder liner.

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**REP-# 049**



Through leakages at the sealing surface of a cylinder liner's engine block cooling water flew out. The reconstruction work was affected with MM-metal SS-steel and Hardener yellow at eight cylinder block threads. After the application procedure the seats were machined to nominal diameter 308 mm. The main engine was an engine Daihatsu type 8 DSM 26, power 1252 kW, 720 U/min.

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**REP-# 061**



A leakage at the stern of a barge was sealed under water using MM-metal UW with Hardener UW9. The repair was completed within 30 minutes time.

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**REP-# 084**



Repair of a turbo charger on board of a ship: during a voyage problems occurred at a turbo charger. The turbine inlet casing was removed and after cleaning a wasted area of appr. 600 mm x 130 mm on the lower part of the casing was revealed. Due to the technical possibilities on board the repair was carried out with MM-metal SS-steelceramic and a steel plate as reinforcement. At an exhaust temperature of appr. 400 °C in this repair area today MultiMetall's VP 10-500 would have been the better choice.

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**REP-# 088**



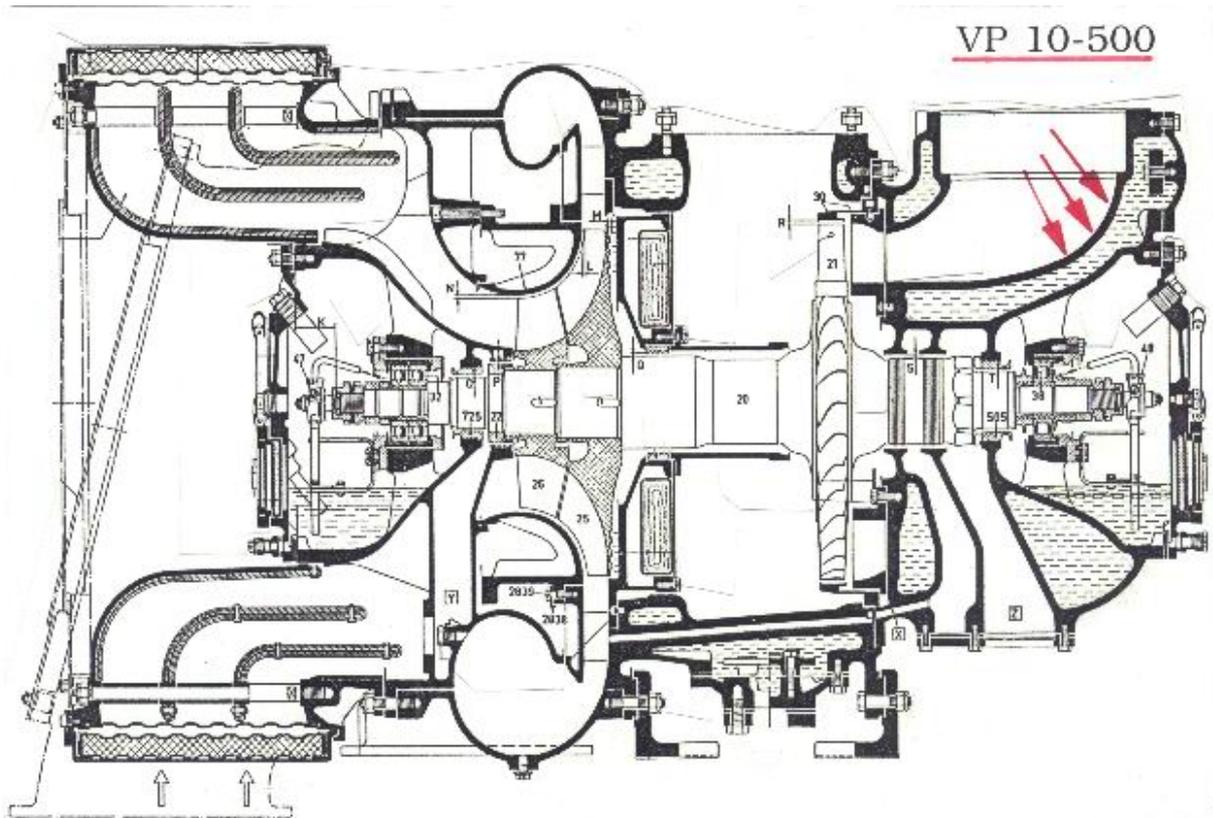
A machine casing was repaired by using MM-metal oL-steelceramic and Hardener red and afterwards Hardener yellow. The application has been done using the direct-MM-bonding technology.

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REP-# 102



Repair of a ship's turbocharger with VP 10-500. Scourings, cracks and apertures from the gas entrance to the cooling water side were repaired with VP 10-500. For the reinforcement two layers of MM-Fabric tape (glass fibre) were used.

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**REP-# 115**



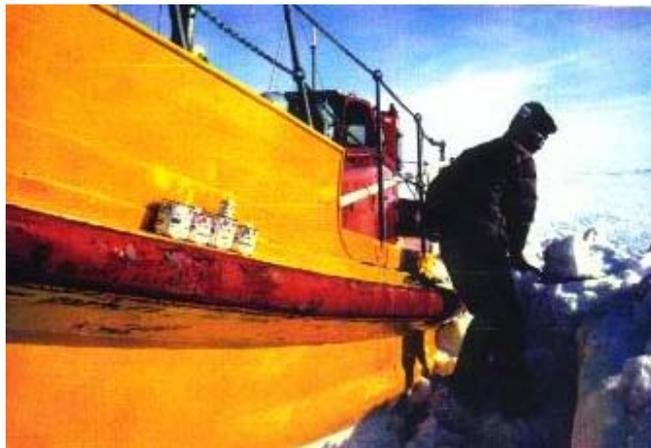
Repair of a leaking simplex compact packing. The repair was difficult due to oil pouring out of the repair site. Therefore it was decided to use the direct-MM-bonding method by applying the PolymerMetall directly on the greasy surface. Here MM-metal oL-steelceramic with Hardener red was chosen.

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REP-# 123



Repairs with MM-metal UW and Hardener UW3 are possible under arctic conditions at temperatures even down to minus 20 °C.

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REP-# 125



Repair of two-stroke engine cylinder liners Sulzer RND 76N ship's diesel engine with MM-metal SS-steel and Hardener yellow. The outer diameter is 900 mm and the inner diameter is 760 mm.

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REP-# 131

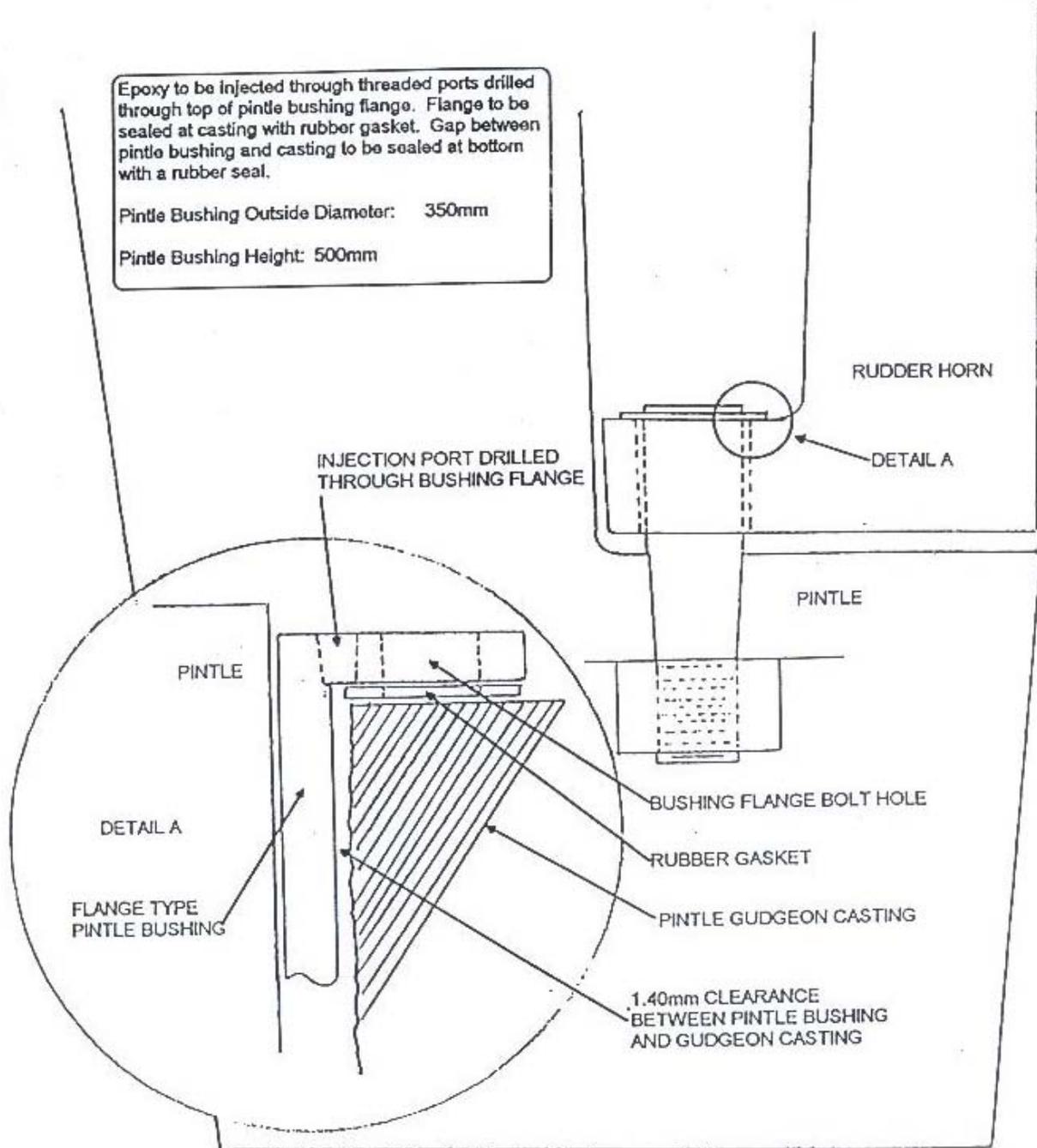


Due to ageing and sea water corrosion, the hard chrome coating in the top section of some hydraulic rams of several vessel deck hatch covers was peeled off. To avoid re-chroming, the hydraulic rams were repaired with Molymetall. First the corroded areas were machined down. Then Molymetall was applied and after curing machined down to size. The 270 kg heavy hydraulic cylinders with a diameter of 125 mm work with a pressure of 280 kg/cm<sup>2</sup> and a stroke of 635 mm. Tests, carried out 5 years after the repair, show that the hydraulic rams are still in good condition and fully functional.

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REP-# 133



The seat of a vessel's pintle bushing has been restored. At first under water the pintle bushing was fixed at a temperature of 2-3 °C. Then MM-metal UW with Hardener UW9 was injected through several threaded ports drilled into the bushing flange. Here an appr. 1,4 mm clearance between pintle bushing and gudgeon casting filled. The repair was carried out by a Canadian diving company. Because of the quick total curing time of the PolymerMetal in spite of the low temperature the vessel was ready for action again within short time.

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## Worldwide repairs carried out with PolymerMetal®

REP-# 136



A worn pump casing was coated with Ceramium liquid. Depending on the application consistency, Ceramium can be applied with a brush, a spatula or any other suitable tool or by pouring or injecting. Before coating, the surface must be roughened e.g. by sand blasting and then cleaned with MM-Degreaser Z or Acetone.

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# Produktübersicht / Product Overview

Prod-#	Produkt (Deutsch / German)	Product (Englisch / English)	Einheit/Unit	Notizen/Notes
	<b>MM-metall SS-StahlKeramik</b>	<b>MM-metal SS-steelceramic</b>		
200	MM-metall SS-StahlKeramik, pst.	MM-metal SS-steelceramic, pst.	1000 g	
249	Härter gelb, pst.	Hardener yellow, pst.	50 g	
248	Härter rot, pst.	Hardener red, pst.	100 g	
	<b>MM-metall SQ</b>	<b>MM-metal SQ</b>		
300	MM-metall SQ, pul.	MM-metal SQ, pow.	1000 g	
301	Härter SQ2, fl.	Hardener SQ2, liq.	220 g	
302	Härter SQ8, fl.	Hardener SQ8, liq.	220 g	
	<b>MM-metall SS-Stahl 382</b>	<b>MM-metal SS-steel 382</b>		
217	MM-metall SS-Stahl 382, pst.	MM-metal SS-steel 382, pst.	1000 g	
249	Härter gelb, pst.	Hardener yellow, pst.	50 g	
218	MM-metall SS-Stahl 382, fl.	MM-metal SS-steel 382, liq.	1000 g	
250	Härter gelb, fl.	Hardener yellow, liq.	50 g	
	<b>MM-metall SS, pastöse Konsistenz</b>	<b>MM-metal SS, pasty consistency</b>		
201	MM-metall SS-Stahl, pst.	MM-metal SS-steel, pst.	1000 g	
205	MM-metall SS-Aluminium, pst.	MM-metal SS-aluminium, pst.	600 g	
209	MM-metall SS-Kupfer, pst.	MM-metal SS-copper, pst.	1000 g	
211	MM-metall SS-Bronze, pst.	MM-metal SS-bronze, pst.	1000 g	
249	Härter gelb, pst.	Hardener yellow, pst.	50 g	
	<b>MM-metall SS, flüssige Konsistenz</b>	<b>MM-metal SS, liquid consistency</b>		
202	MM-metall SS-Stahl, fl.	MM-metal SS-steel, liq.	1000 g	
206	MM-metall SS-Aluminium, fl.	MM-metal SS-aluminium, liq.	600 g	
210	MM-metall SS-Kupfer, fl.	MM-metal SS-copper, liq.	1000 g	
212	MM-metall SS-Bronze, fl.	MM-metal SS-bronze, liq.	1000 g	
250	Härter gelb, fl.	Hardener yellow, liq.	50 g	
	<b>MM-metall oL-StahlKeramik</b>	<b>MM-metal oL-steelceramic</b>		
2460	MM-metall oL-StahlKeramik, pst.	MM-metal oL-steelceramic, pst.	1000 g	
249	Härter gelb, pst.	Hardener yellow, pst.	50 g	
248	Härter rot, pst.	Hardener red, pst.	100 g	
246	MM-metall oL-StahlKeramik, pst.	MM-metal oL-steelceramic, pst.	500 g	
253	Härter gelb, pst.	Hardener yellow, pst.	25 g	
248	Härter rot, pst.	Hardener red, pst.	100 g	
	<b>MM-metall UW</b>	<b>MM-metal UW</b>		
1160	MM-metall UW, pul.	MM-metal UW, pow.	1000 g	
1170	Härter UW3, fl.	Hardener UW3, liq.	250 g	
1180	Härter UW9, fl.	Hardener UW9, liq.	250 g	
116	MM-metall UW, pul.	MM-metal UW, pow.	500 g	
117	Härter UW3, fl.	Hardener UW3, liq.	125 g	
118	Härter UW9, fl.	Hardener UW9, liq.	125 g	
	<b>Ceramium®</b>	<b>Ceramium®</b>		
601	Ceramium, pst.	Ceramium, pst.	695 g	
611	Härter CE, pst.	Hardener CE, pst.	55 g	
602	Ceramium, fl.	Ceramium, liq.	695 g	
607	Härter CE, fl.	Hardener CE, liq.	55 g	
	<b>Ceramium® CH</b>	<b>Ceramium® CH</b>		
622	Ceramium CH, pst.	Ceramium CH, pst.	1000 g	
623	Härter CH1, pst.	Hardener CH1, pst.	75 g	
624	Härter CH1, fl.	Hardener CH1, liq.	65 g	
625	Härter CH2, pst.	Hardener CH2, pst.	80 g	
626	Härter CH2, fl.	Hardener CH2, liq.	70 g	
	<b>XETEX® BD</b>	<b>XETEX® BD</b>		
455	XETEX BD, pst.	XETEX BD, pst.	750 g	
456	Härter BD, fl.	Hardener BD, liq.	50 g	

# Produktübersicht / Product Overview

Prod-#	Produkt (Deutsch / German)	Product (Englisch / English)	Einheit/Unit	Notizen/Notes
	<b>VP 10-017</b>	<b>VP 10-017</b>		
705	VP 10-017, fl.	VP 10-017, liq.	800 g	
706	Härter VP 10-017 rot, fl.	Hardener VP 10-017 red, liq.	400 g	
707	Härter VP 10-017 grau, fl.	Hardener VP 10-017 grey, liq.	400 g	
	<b>VP 10-500</b>	<b>VP 10-500</b>		
701	VP 10-500, pst.	VP 10-500, pst.	650 g	
711	Härter VP 10-500, pst.	Hardener VP 10-500, pst.	650 g	
702	VP 10-500, str.	VP 10-500, br.	650 g	
712	Härter VP 10-500, str.	Hardener VP 10-500, br.	650 g	
	<b>Molymetall®</b>	<b>Molymetall®</b>		
401	Molymetall, pst.	Molymetall, pst.	800 g	
403	Härter Molymetall, pst.	Hardener Molymetall, pst.	30 g	
404	Härter Molymetall, fl.	Hardener Molymetall, liq.	30 g	
	<b>Sealium®</b>	<b>Sealium®</b>		
551	Sealium, fl.	Sealium, liq.	2000 ml	
	<b>MM-metall S</b>	<b>MM-metal S</b>		
101	MM-metall S-Stahl, pul.	MM-metal S-steel, pow.	1000 g	
102	MM-metall S-Eisen, pul.	MM-metal S-iron, pow.	1000 g	
105	MM-metall S-Aluminium, pul.	MM-metal S-aluminium, pow.	650 g	
108	MM-metall S-Kupfer, pul.	MM-metal S-copper, pow.	1650 g	
109	MM-metall S-Bronze, pul.	MM-metal S-bronze, pow.	1650 g	
147	Härter S8, fl.	Hardener S8, liq.	250 g	
148	Härter S15, fl.	Hardener S15, liq.	250 g	
	<b>MM-Elastomer</b>	<b>MM-Elastomer</b>		
951	MM-Elastomer 95, pst.	MM-Elastomer 95, pst.	370 g	
952	MM-Elastomer 95, fl.	MM-Elastomer 95, liq.	370 g	
953	MM-Elastomer 95, str.	MM-Elastomer 95, br.	370 g	
962	Härter EL95, fl.	Hardener EL95, liq.	110 g	
956	MM-Elastomer 85, fl.	MM-Elastomer 85, liq.	370 g	
964	Härter EL85, fl.	Hardener EL85, liq.	110 g	
958	MM-Elastomer 65, fl.	MM-Elastomer 65, liq.	370 g	
966	Härter EL65, fl.	Hardener EL65, liq.	74 g	
960	MM-Elastomer 40, fl.	MM-Elastomer 40, liq.	370 g	
968	Härter EL40, fl.	Hardener EL40, liq.	89 g	
	<b>MM-Sets</b>	<b>MM-Sets</b>		
802	MM-Basic Set	MM-Basic Set	Stück / pc	
803	MM-Set SS	MM-Set SS	Stück / pc	
804	MM-Set oL	MM-Set oL	Stück / pc	
805	MM-Set UW	MM-Set UW	Stück / pc	
806	MM-Set VP 10-500	MM-Set VP 10-500	Stück / pc	
	<b>Zubehör</b>	<b>Accessories</b>		
10	MM-Lösung Z, fl.	MM-Degreaser Z, liq.	1000 ml	
11	MM-Lösung Z, fl.	MM-Degreaser Z, liq.	250 ml	
14	MM-Trennmittel, fl.	MM-Release agent, liq.	100 ml	
33	Mischplatte (Kunststoff)	Mixing plate (synthetic material)	20 x 12 cm	
16	Mischstab (rostfreier Stahl)	Mixing stick (stainless steel)	Stück / pc	
15	Mischbecher (Kunststoff)	Mixing cup (synthetic material)	Stück / pc	
25	Messlöffel rot	Measuring spoon red	Satz / set	
26	Messlöffel gelb	Measuring spoon yellow	Satz / set	
29	Messlöffel VP 10-500	Measuring spoon VP 10-500	Satz / set	
18	Gewebeband (rostfreier Stahl)	Fabric tape (stainless steel)	100 x 10 cm	
20	Gewebeband (Glasfaser)	Fabric tape (glass fibre)	1000 x 5 cm	
22	Gewebematte (Glasfaser)	Fabric mat (glass fibre)	30 x 40 cm	
23	Applikationsroller	Application roller	Stück / pc	
34	Temperaturindikator (Einweg)	Temperature indicator (one-way)	15 Stück / pc	

## Hinweise / Notes:

Konsistenz/consistency: pst./pst.=pastös/pasty; fl./liq.=flüssig/liquid; pul./pow.=pulvrig/powdery; str./br.=streichbar/brushable

EXW = Lieferung ab Lager Deutschland excl. Verpackung / delivery ex works stock Germany excl. packing

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In order to find out which PolymerMetall® could be used to solve your repair problem we would like to ask you to fill in and send back this form. Additional sketches, drawings, photographs etc. could be helpful. We thank you for your effort!

**Description of the device**

Machine/Plant/Construction: .....

Damaged device (Name): .....

Function: .....

Material of the device: .....

Relevant dimensions (e.g. length, width, height, diameter, wall thickness...):  
of the device: .....

of the damaged area: .....

Damage description (e.g. crack, wear, leakage,... – in detail please):  
.....  
.....  
.....

Reason and cause of damage (Why?... Whereby?... – in detail please):  
.....  
.....

Constructive weakening (structural/mechanical strength) of the device due to damage  
 No |  Yes

Notes/Other: .....

**Influences on the repair area at operating conditions**

Thermal stress  
min ..... °C | max ..... °C | Durable Ø ..... °C

Mechanical stress  
 No |  Yes ..... MPa |  Yes .....

Pressure load by fluids  
 No |  Yes ..... bar |  Yes.....

Chemical stress  
 No |  Yes Chemical(s) (if so with concentration data)                      Chemical temperature  
..... °C  
..... °C  
..... °C

Tribological stress

<input type="checkbox"/> No   <input type="checkbox"/> Yes		Sliding wear (Adhesion)	<input type="checkbox"/> Yes		Impact particle wear (Abrasion)
<input type="checkbox"/> Yes		Sliding abrasion (Abrasion)	<input type="checkbox"/> Yes		Drop erosion wear (Surface fatigue)
<input type="checkbox"/> Yes		Particle erosion – fluids (Erosion, Abrasion)	<input type="checkbox"/> Yes		Cavitation wear (Surface fatigue)

