



Worldwide repairs carried out with PolymerMetall®

*MM-metal SS-steelceramic
MM-metal SS-“product group“*

(Photographs incl. descriptions of each repair can be found
on our website www.polymermetal.com, „Worldwide repairs“, REP-number)

REP-# Description

- 001 Repair of 14 bearing bushes of the gear box, which is destined to the bucket wheel drive of an excavator for the field of open-cast mining. The worn bearing bushes with a diameter of 280 to 580 mm and a width of 130 to 150 mm were reconstructed with MM-metal SS-steelceramic and Hardener yellow. The standstill time of the excavator was considerable reduced to 72 hours.
- 003 The packing surface of an aluminium mould used for the production of foamed plastic car seats was repaired by applying MM-metal SS-steelceramic. The thermal loading is 150 °C, the pressure 10 kg/m².
- 004 5 cracks in the casing of the water pump D-6300/80 at a land reclamation station was repaired with MM-metal SS-steelceramic and Hardener yellow.
- 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.
- 009 Repair of a worn bearing seat on the drive of a bulldozer with MM-metal SS-steelceramic and Hardener yellow.
- 010 Sealing of cracked leaky welding seams at crankcase of a ship diesel with MM-metal SS-steelceramic and Hardener yellow.
- 011 Machining of MM-metal SS-steelceramic with diamond tools, e.g. Syndite PKD (trademark of „De Beers Diamond Division“). Data for machining: cutting speed $v_c = 60 - 125$ m/min • cutting depth $a_p = 0,5 - 1$ mm • feed $f = 0,1 - 0,2$ mm/U
- 014 Corrosion damages at a brake drum caused by brake dust were repaired by using MM-metal SS-steelceramic and Hardener yellow.
- 016 Repair of cracked Diesel injection pumps using MM-metal SS-steelceramic and Hardener yellow.
- 017 Repair of a cracked valve casing by 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.
- 020 Repair of a paper roll with a diameter appr. 600 mm, length appr. 3400 mm and weight 8000 kg. Cause of damage: undersize of up to 1 mm at one journal bearing of 270 mm diameter. The repair has been carried out with MM-metal SS-steelceramic and Hardener yellow. After curing the roll has been machined with diamond tools.
- 021 Cracked welding seams in a silo tank were repaired by using MM-metal SS-steelceramic and Hardener yellow.
- 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.
- 023 Repairing of a car engine Mercedes Benz near the crankshaft by using MM-metal SS-steelceramic and Hardener yellow. For reinforcement a 1 mm steel plate with the outline of the hole was patched into the engine.



- 025 Repair of four cracks on the cylinder block of a big engine called "Super MAZ" were repaired with MM-metal SS-steelceramic and Hardener yellow. One of the cracks passed the oil channel and was therefore sealed with MM-metal oL-steelceramic and Hardener red.
- 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.
- 028 Repair of a CV-plant's double cross spray head for the manufacture of rubber-insulated cable with MM-metal SS-steelceramic and Hardener yellow.
- 029 Repair of a grinding machine in a cement company. The damage, a worn out bearing housing, was repaired with MM-metal SS-steelceramic and Hardener yellow. Herewith the previous repair method "resurfacing by welding" was replaced.
- 030 Repair of a turbine casing using MM-metal SS-steelceramic and Hardener yellow. Operating conditions: pressure 4 bar, temperature 150 °C.
- 031 A cylinder head of a car engine having corroded under water channels was repaired by applying MM-metal SS-steelceramic and Yellow hardener.
- 032 Repairing of cylinder blocks and working faces of a 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 scavenging air receiver. For this type of repair the engine manufacturer recommends to use exclusively MM-metal SS-steelceramic with Hardener green.
- 033 The seat of a ball bearing of a shaft, which serves for lining up, showed an abrasion of 0,2 mm. First the seat of the ball was turned off by 0,5 mm, then the repair site was cleaned with MM-Degreaser Z. Afterwards MM-metal SS-steel with Hardener yellow was applied. Finally the original shaft diameter was reached again by machining. Now the shaft was operational again without any problems.
- 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.
- 036 The contact surfaces of a supercharger have been rebuilt with MM-metal SS-steelceramic and Hardener yellow.
- 037 A cracked gearbox casing was repaired using MM-metal SS-steelceramic, Hardener yellow and MM-Fabric tape (metal).
- 040 During the maintenance on a fuel/oil storage tank several leakages were noticed. After sandblasting the leakages were sealed by using the Direct MM-Bonding method with MM-metal oL-steelceramic and Hardener red. Furthermore parts affected by pitting were coated by applying MM-metal SS-steel, pasty. 24 hours were needed for the repair works with PolymerMetals, curing time included. The usual repair procedure including emptying of the tanks, cleaning of steel walls and welding would have taken 6 days.
- 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.
- 055 Repair of a worn-shaft-bearing for the adjustment of rolls at a 1200 ingot-blooms-rolling stand in a steel rolling mill with MM-metal SS-steelceramic. By the use of a PolymerMetal instead of a different repair method the down time was shortened from 75 to 19 hours. This is equivalent to appr. 7 working shifts. The use of the PolymerMetal MM-metal SS-steel 382, which has been developed in the meantime, would be recommended today, which offers even better compressive strength values for such types of repair. To this repair there is available an experience report upon request.



- 062 The repair of a crack on the drying drum of a cotton spinning machine was carried out with MM-metal SS-steelceramic and Hardener yellow. Data: steam pressure 3 bar, steam temperature 180 - 240 °C.
- 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.
- 092 Sealing of 3 hydrogen pipings by using MM-metal SS-steelceramic. Hydrogen was escaping at 350 psi. A metal sleeve with a pressure compensating valve was prepared. MM-metal SS-steelceramic was applied to the sleeve and the pipings. While the valve was open the sleeve was assembled, therefore the hydrogen could easily escape through the opened valve. After totally curing of MM-metal SS-steelceramic the valve was closed and the installation was ready to operate. If the pipings had been exchanged the whole installation would have had to be stopped.
- 099 A leakage in a 154 KV P.O.F. insulation pipe was sealed using MM-metal oL-steelceramic and Hardener red working with the direct-MM-bonding method. In addition corrosion damages of the piping were removed by applying MM-metal SS-steel, liquid and Hardener yellow, liquid. Oil pressure 200 psi, diameter of the piping 300 mm, oil quality polybdenum.
- 111 Repair of a water pump. Damage: a crack of approx. 15 cm length. Data of the pump: year of construction 1969, power: 1500 m³/h, material: GGG-40.3, working pressures 20-40 bar. The pump has been repaired with MM-metal SS-steelceramic, Hardener yellow and MM-Fabric tape (carbon). Several attempts to carry out the repair by conventional welding before failed.
- 118 Repair of the plunger of a metal bar extrusion press using MM-metal SS-steelceramic. The damage was caused by fatigue fracture. Length of the plunger 3800 mm, diameter 952 mm, weight 13 to., material: white cast iron, surface hardness 420 HB, hydraulic pressure 350 bar, operating pressure 2000 to. Procurement of a new plunger would have cost 81.000 EUR at a delivery time of appr. 9 months.
- 119 Repair of the anti-wear blinding, carried out in a steel mill using MM-metal SS-steelceramic and Hardener yellow.
- 122 Repair of a turbo charger using MM-metal SS-steelceramic. Today MultiMetall recommends the newer product VP 10-500.
- 124 Repairing a corroded and worn out pillow block bedding of a steel sheet rolling line using MM-metal SS-steelceramic. The precise pillow block seat was obtained with the help of a metal plate.
- 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.
- 127 Repair of a car's cooling water circulating pump with MM-metal SS-steel, liquid and Hardener yellow, liquid.
- 128 A carburettor has been repaired using MM-metal SS-steelceramic with Hardener yellow.
- 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.
- 134 34 damaged back-up rolls bearing houses of a steel work's hot strip mill were modified. The above drawing shows a bearing shell which was damaged by turning of the outer bearing bore. Conventional repairs of these damages would have been executed by welding on, heat-treating and turning to original size. Cheaper and less time intensive is an innovative repair with MM-metal steelceramic and Hardener yellow.
- 34 damaged back-up rolls bearing houses of a steel work's hot strip mill were modified. The above drawing shows guiding plates as a fixture to the bearing house. To achieve a constant distance to the bearing at



unchanged plate thickness, the surface damaged by erosion and mechanical load was restored by MM-metal steelceramic and Hardener yellow.

- 140 In a steel plant the repair of a broken gearbox with a weight of 40 t would have taken up 10 days by using the conventional way of welding. By using the repair technology of MultiMetall combined with the PolymerMetal MM-metal SS-steel and MM-Release agent a repair time of just 27 hours was necessary. Stresses of 120 MPa occur at the gearbox.
- 141 A damaged injection mould for manufacturing plastic cups at a refuse dressing plant was repaired with MM-metal SS-steel.
- 145 A reeling machine was worn out due to abrasion. After roughening the surface to be treated, it was coated with the PolymerMetal MM-metal SS-steel and therefore put into working order again.
- 147 In a mining plant the cost and time intensive new acquisition of a replacement shaft for a damaged shaft of a vibrating screen was prevented by the repair with MM-metal SS-steel.
- 149 Due to abrasion a worn out metal ring of a dredging pump had to be replaced. With the help of MM-metal SS-steel the new metal ring was fixed. PolymerMetals present a high shearing strength; MM-metal SS-steel offers a value 30 MPa.
- 150 A broken pump casing was repaired with the help of the PolymerMetal MM-metal SS-steelceramic.
- 151 Into an old cracked valve with a broken flange, a pipe with a suitable diameter was inserted and fixed by using the PolymerMetal MM-metal SS-steel. Then this connection was secured by several screws.
- 152 Onto a damaged area of an axle end MM-metal SS-steel, later MM-metal SS-steel 382 was applied to receive a higher surface quality. After curing, the work piece was machined down with a lathe to the desired diameter.
- 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.
- 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.
- 170 The pump capacity of a diesel pump decreased due to a leakage. There was a small leak probably resulting from an untight soldered seam or a crack in the copper pipe at a difficult accessible repair place at a measuring plug. A soldering/welding linked the measuring steel plug (diameter approx. 25 mm) with a 3/4-inch copper pipe. By using MM-metal SS-steelceramic and Hardener yellow the damage was repaired and later the customer (a water treatment company) put the pump into operation again with the usual working pressure of 16 bar.
- 173 A piping made of carbon steel in a refinery had a severe leakage with benzol streaming out with high pressure (10 bar). With the help of an auxiliary construction, MM-metal oL-steelceramic and MM-metal SS-steel the leak was sealed. Here besides the common application method (trowelling) also the injection method was used. Further detailed information can be found here www.metalexistence.com/benzenepipe

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Worldwide repairs carried out with PolymerMetal®

MM-metal SS-steel 382

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

REP-# Description

- 055 Repair of a worn-shaft-bearing for the adjustment of rolls at a 1200 ingot-blooms-rolling stand in a steel rolling mill with MM-metal SS-steelceramic. By the use of a PolymerMetal instead of a different repair method the down time was shortened from 75 to 19 hours. This is equivalent to appr. 7 working shifts. The use of the in the meantime developed PolymerMetal MM-metal SS-steel 382 would be recommended today, which offers even better compressive strength values for such types of repair.
- 139 After many years of working, the worn-out rock shaft of a crushing plant for recycling demolition material was repaired with MM-metal SS-steel 382 in September 2002. First the driving fly wheel was carefully dismantled to receive access to the shaft. After the surface preparation of the up to 1 mm worn-out shaft area, MM-metal SS-steel 382 was applied and then machined down to the desired diameter. A replacement due to the necessary dismantling of the damaged shaft, the purchase and the assembly of a new shaft, would have involved considerable additional costs and time. An examination 4,5 years later (March 2007) has come to the result, that the repaired work piece is still in function without any complaints.
- 152 Onto a damaged area of an axle end MM-metal SS-steel, later MM-metal SS-steel 382 was applied to receive a higher surface quality. After curing, the work piece was machined down with a lathe to the desired diameter.
- 175 The slewing bearing (Ø 4371 mm) of a bucket-wheel excavator showed some deviations outside of the tolerance range at some spots in the area between upper structure and chassis. For the solution of this repair problem the high-strength repair material MM-metal SS-steel 382 was chosen. The very thin fluid product type is extreme flowable and pourable. Further information about this application can be found here: www.metalexistence.com/slewingbearing

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Worldwide repairs carried out with PolymerMetall®

MM-metal oL-steelceramic

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REP-#	Description
008	A leakage on a transformer (240.000 kVA) was repaired with MM-metal oL-steelceramic and Hardener red without cutting of the station. After this a second layer with MM-metal oL-steelceramic and Hardener yellow was applied.
018	Oil leakages of large transformers using MM-metal oL-steelceramic, Hardener red and Hardener yellow have been sealed.
024	Sealing of a leakage in a fuel tank using MM-metal oL-steelceramic with Hardener red referring the direct-MM-bonding.
025	Repair of four cracks on the cylinder block of a big engine called „Super MAZ“ were repaired with MM-metal SS-steelceramic and Hardener yellow. One of the cracks passed the oil channel and was therefore sealed with MM-metal oL-steelceramic and Hardener red.
038	During the first run of a diesel locomotive's engine a shrinkage cavity in the casting was found above the engine block near the central lubrication. Oil was leaking from this cavity. The repair was carried out with MM-metal oL-steelceramic and Hardener yellow. After several test runs the repaired engine has been installed into a new diesel locomotive.
039	Oil flew trough a crack at the cable terminal funnel of a block transformer. The repair was carried out by the method of direct-MM-bonding with MM-metal oL-steelceramic, Hardener red and Hardener yellow.
040	During the maintenance on a fuel/oil storage tank several leakages were noticed. After sandblasting the leakages were sealed by using the Direct MM-Bonding method with MM-metal oL-steelceramic and Hardener red. Furthermore parts affected by pitting were coated by applying MM-metal SS-steel, pasty. 24 hours were needed for the repair works with PolymerMetals, curing time included. The usual repair procedure including emptying of the tanks, cleaning of steel walls and welding would have taken 6 days.
041	Sealing of a large transformer in a power station. The leakage was sealed with MM-metal oL-steelceramic and Hardener red using the direct-MM-bonding method. Then a layer of MM-metal oL-steelceramic and Hardener yellow was applied to the first layer.
042	The surface of a transformer between copper plates and fibreglass coating showed several oil leakages. The repair has been affected using the direct-MM-bonding method with MM-metal oL-steelceramic combined with Hardener red and Hardener yellow afterwards.
043	In a transformer station plant oil leakages at welding seams of a conservator were repaired with the direct-MM-bonding method by using MM-metal oL-steelceramic, Hardener red and Hardener yellow.
044	At the on-load tap changer of a large transformer oil was penetrating through cracks between the top and the on-load tap-changing equipment. The direct-MM-bonding method was used to solve this repair problem. It was carried out with MM-metal oL-steelceramic and Hardener red and afterwards Hardener yellow.
045	In order to avoid oil leakages at current transformers, the bolts were inserted with MM-metal oL-steelceramic and Hardener yellow.
047	Coating of welding seams on a large transformer with MM-metal oL-steelceramic and Hardener yellow.079 Durable repair of a hydraulic piping using MM-metal oL-steelceramic and MM-Fabric tape (steel). Pressure load 180 bar.



- 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.
- 099 A leakage in a 154 KV P.O.F. insulation pipe was sealed using MM-metal oL-steelceramic and Hardener red working with the direct-MM-bonding method. In addition corrosion damages of the piping were removed by applying MM-metal SS-steel, liquid and Hardener yellow, liquid. Oil pressure 200 psi, diameter of the piping 300 mm, oil quality polybdenum.
- 109 Repair of a hair crack at a main engine block of a bulldozer (make Komatsu). The hair crack was appr. 20 inches long. A first attempt to repair by electro welding failed. Then the engine block was successfully restored by using the direct-MM-bonding method with MM-metal oL-steelceramic.
- 110 Sealing of leakages on large transformers using MM-metal oL-steelceramic and Hardener red.
- 114 Leakages between porcelain insulators and steel discs were sealed with MM-metal oL-steelceramic and Hardener yellow.
- 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.
- 116 Repairing of oil pipes using MM-metal oL-steelceramic. The origin of the damage was leaky welding seams.
- 137 Due to steady climate influence (salty air and rainfall) several strong corroded areas and a leakage of a natural gas carrying pipe system on an oil platform have been repaired with MM-metal oL-steelceramic. To avoid any extra costs the repair was carried out without switching off the system and so the repair has been done at a pressure of 10 bar. Gas streamed out of a leakage of a 10 inch, therefore a provisional valve was built, through which the gas was able to stream out until the final closure of the leakage. A construction consisting of a plate and a nut was made, which was then fixed on the leaky place of the pipe by using MM-metal oL-steelceramic. After the PolymerMetal was cured this valve was closed by using a screw. Finally a coating of MM-metal oL-steelceramic was applied over the complete provisional construction for safety reasons.
- 154 Oil exuded through micro cracks caused by vibration in a defective welded seam. The leak of oil has amplified after unsuccessful attempt to execute repair by usual welding. Then it was decided to carry out a repair by using the "direct-MM-bonding"- technology with the help of MM-metal oL-steelceramic and hardener red followed by a second layer of MM-metal oL-steelceramic with hardener yellow.
- 155 Repair of a vertical crack in a welding in length of ~ 80 mm by using the repair technology "direct-MM-bonding" with the help of MM-metal oL-steelceramic and the hardeners red and yellow.
- 156 The welding at 19 places of transformers had micro cracks and blowholes, where oil exuded. First the paint has been removed with an electro drill equipped with an abrasive tool and the metal has been cleaned at the defective areas. Then MM-metal oL-steelceramic with Hardener red and afterwards Hardener yellow was applied. After checking the tightness of the repaired areas the corresponding areas have been painted over again.
- 157 Elimination of a leak of oil in a welding using the PolymerMetal MM-metal oL-steelceramic with Hardener red and Hardener yellow.
- 158 Several worn areas of a steel plant's leaky power transformer have been sealed with MM-metal oL-steelceramic and Hardener yellow.
- 159 A damaged power transformer located in a steel plant has been repaired by using MM-metal oL-steelceramic and Hardener yellow.
- 173 A piping made of carbon steel in a refinery had a severe leakage with benzol streaming out with high pressure (10 bar). With the help of an auxiliary construction, MM-metal oL-steelceramic and MM-metal SS-steel the leak was sealed. Here besides the common application method (trowelling) also the injection method was used. Further detailed information can be found here www.metalexistence.com/benzenepipe



- 174 Alternatively to extensive conventional repair procedures (e.g. welding works) at floating roof tanks an expensive drain of the liquid stored in the tank can if applicable be abstained from by using a repair method with PolymerMetall®. MM-metal oL-steelceramic can be applied on problematic surfaces (contamination due to oil, fuel et cetera). The additional purpose of the flexible material MM-Elastomer is effective against tensions. Here are further information available for the application at floating roof tanks: www.metalexistence.com/f-roof
- 176 For a long time MultiMetall's repair technology is used successfully in the energy sector for the elimination of various types of damages. Because of the advantages of the polymer metallic materials against conventional welding procedures particularly MM-metal oL-steelceramic is well-established for the repair of leaky transformers at notable transformer producers, operators and service companies. For metal specific problems and plenty damage variants in the energy sector MultiMetall offers a customised solution on a polymer-metallic basis. Further information about this field of application can be found here: www.metalexistence.com/transformer

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Worldwide repairs carried out with PolymerMetal[®]

MM-metal UW

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

REP-#	Description
015	Sealing of a steam pipe under pressure using MM-metal UW while the plant was still operating with a pressure of 87 psi at a temperature of 160 °C.
046	Sealing of a cooling water pipe made of steel without switching off the plant. Cause of the damage was material fatigue. The repair was carried out with MM-metal UW with Hardener UW3 and MM-Fabric tape (glass fibre).
050	Sealing of an overrun container on board of a ship with MM-metal UW and Hardener UW3 respectively Hardener UW9.
051	Repair of a water piping which was under pressure by using MM-metal UW and Hardener UW3. The sealing has been carried out while water was still escaping.
052	Sealing of a warm water pipe in a heat station with MM-metal UW and Hardener UW9 together with MM-Fabric tape.
053	Leakage removal at a hydraulic pressure header tank with MM-metal UW and Hardener UW3.
054	A leakage in a cooling pipe was sealed without reducing the water pressure. The repair was carried out with MM-metal UW and Hardener UW9.
056	Sealing of a steam pipe under pressure by using MM-metal UW and Hardener UW3. Reason for the repair were cracks of welding seams caused by vibration at a working pressure of 2 bar and a temperature of 90 °C.
058	Repair of an installation pipe with MM-metal UW and Hardener UW3. The leakages have been caused by corrosion due to water and sand.
059	Sealing of a cooling water pipe in the high-hazard area of a high-pressure water installation without interrupting operation. The leakage was a 5 cm long crack at a water pressure of 2,5 bar. The sealing was carried out with MM-metal UW and Hardener UW3 without pressure reduction. Materials used were a pre-shaped metal sheeting and MM-Fabric tape (glass fibre).
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.
074	Repair of an oil / gas tank under arctic temperature. The repair was carried out with MM-metal UW and Hardener UW3 in Russia.
078	Repair of a water piping system which was under pressure using MM-metal UW and Hardener UW3.
087	Durable repair of a leakage in a piping system under water by using MM-metal UW and Hardener UW9.
107	A leaky welding seam of a sea water pump was sealed using MM-metal UW and Hardener UW9.
120	Sealing of a cracked pump casing at reduced water outlet using MM-metal UW and Hardener UW3.



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

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Ceramium®

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REP-#	Description
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.
007	Repair of heat exchangers using Ceramium and Hardener CE.
012	Elimination of damages at two vessel's propeller caused by cavitation with Ceramium and Hardener CE.
013	Deep grooves at the surface were filled out with Ceramium and Hardener CE.
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.
035	The upper part of an impeller of a pump for filling up the ready cement in sacks was exposed to very strong wear and tear. In the meantime it was tried to restore by build-up welding. The final repair has been carried out with Ceramium and Hardener CE.
048	Repair of an automatic glass machine at a channel for broken glass and water. The coating procedure was affected in two steps - first application with Ceramium, pasty, followed by a second application with Ceramium, liquid. The previous reconstruction procedure was build-up welding.
057	Repair of a corroded gas pipe due to throat gas from blast furnace carried out with Ceramium and Hardener CE.
063	Reconstruction of the sealing surface of the cover at a turbine. The repair was carried out with Ceramium, liquid and Hardener CE at an electric generating station.
064	A crack at an enamel coated chemical plant for the production of solvents was filled with Ceramium and Hardener CE.
065	Ceramium with hardener CE was used to repair cracks and damages caused by erosion between cast segments at a gas washer (Venturi) of a blast furnace cleaning facility. Due to this the life of the component was doubled.
066	Repair of two turbine rotors. Damages were present at all areas of the blades where the water leaves the blades. First large holes have been welded. Then the erosive areas have been filled up with Ceramium, pasty. Finally a supplementary layer of VP 10-017 has been applied as protection against cavitation.
067	Cavitation damages on a flange were repaired by using Ceramium pasty and Hardener CE.
068	Because of bad maintenance during the resting period the covers of 3 auxiliary capacitors, each 6 m2 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 was applied.
070	Repair of a bucket wheel excavator for the field of open-cast mining by applying Ceramium liquid. The main drive shaft of the bucket wheel rim, which was damaged due to abrasion, was reconstructed at a length of 400 mm with a diameter of 360 mm. The diameter has been reduced to 350 mm before the



rebuilding.

- 071 Repair of the bottom part of a coal mill. The repair has been carried out both with Ceramium pasty and Ceramium liquid.
- 072 Coating of the inner respectively outer diameter of a penstock pipe with diameter appr. 1,5 m , length appr. 900 m. Damages were caused by erosion and abrasion due to water and sand. The coating was affected with Ceramium pasty with Hardener CE.
- 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.
- 083 Repair of heat exchangers using Ceramium and Hardener CE.
- 089 Repair of the soot blower compressor at a heat station by coating the additional cooler with Ceramium. The coating was affected in two steps: a first application of Ceramium pasty type, afterwards a second application with Ceramium liquid type.
- 090 A cover with Ceramium was reconstructed. The coating was affected in two working procedures: First a surface reconstruction with Ceramium, pasty and Hardener CE. Second an application with Ceramium, liquid with Hardener CE.
- 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.
- 094 Blocking valves have been reconstructed by using Ceramium. Responsible was serious wear and tear on the steel alloy caused by the clay loam.
- 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.
- 097 Maintenance of a shaft of a paint coating machine at a paper mill in the zone of the stuffing box packing with Ceramium pasty and Hardener CE. The formerly common company repair solution by metal spraying was not considered because the machine would have been too long out of order.
- 104 An additional water-centrifugal pump being damaged by erosion and cavitation was rebuilt using Ceramium. Housing and flanged socket were coated inside with VP 10-017.
- 105 Coating of a turbine impeller due to cavitation damages. Here the materials Ceramium and Hardener CE were used.
- 108 Repair of worn piston rods caused by the exhausts of a blast furnace. The piston rods were brought to nominal diameter again using Ceramium. After the repair has been completed the piston rods are in operation again over 3 years.
- 112 Corrosion and abrasion damages on high pressure fan casings in a paper-mill have been removed using Ceramium pasty and Hardener CE.
- 113 Repair of gas drilling surge valves. Abrasion due to escaping gas (2800 psi) and carrying contaminations such as e.g. sand. The repair has been carried out using Ceramium. A later inspection did not reveal any damages.



- 117 A damaged shaft of a conveyer worm was rebuilt using Ceramium. An inspection after 6 months did not reveal any damages on the conveyer worm.
- 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.
- 132 In a granulation plant several pumps (2 granulation pumps, 2 condense pumps, 2 cooling circuit pumps, 1 submerged pump) material loss caused by wear. All pump casings and running wheels consist of hard cast. Pumping medium is circuit water with a slag sand content of appr. 10 mg/l at a average corn size of 0,3 mm. The water temperature is 90 °C (194 °F) at the cooling circuit pumps and 40 °C (104 °F) at the condense pumps. The pumps have been repaired with a coating of Ceramium.
- 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.
- 143 Several valves of a line system on an oil platform were damaged. The problem was abrasion caused by the transportation of sand and sea water. The damages were repaired with the help of Ceramium, pasty.
- 144 A turbine paddle was worn out caused by a water-sand-mixture. The pasty variant of the PolymerMetal Ceramium was used to rebuild the worn-out areas.
- 146 At a steelwork, heavy erosion caused damage of a blast furnace. Several areas of the conveyer cone were severely damaged due to the continuous loading with coke. Some plates were welded on the cone and then coated with Ceramium as well as some other damaged parts and the machine was put into operation successfully again.
- 148 Several holes and damaged spots respectively in the roof of a big tank at an oil refinery were first coated with Ceramium. Then a layer of MM-Elastomer was applied to compensate any bigger tensions.
- 166 The turbine in an important hydroelectric power plant in South America was repaired with Ceramium. A turbine shovel was damaged by effect of cavitation and erosion. In the turbine wheel there is a pressure of up to 12 bar and 700.000 litres water per second is moved. After 10 months of continuous operation a revision was carried out and merely low erosion and cavitation damages could be determined in the Ceramium coating which were not of further importance. 95% of the Ceramium coating was in good order.
- 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.

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Worldwide repairs carried out with PolymerMetall®

Ceramium® CH

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

REP-# Description

- 172 A refinery's gas washer for cleaning sour natural gas suffered from hard exposures and had massive corrosion damages in several areas. There appear high temperatures (140 °C), pressure (3 bar) and a line of chemicals (Amines MDEA, H₂S, CO₂, O₂, various acids, ...). With MultiMetall's coating material Ceramium® CH / Hardener CH1 excellent results were achieved. Further details can be found here www.metalexistence.com/gaswasher

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Worldwide repairs carried out with PolymerMetall®

VP 10-017

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

REP-# Description

- 066 Repair of two turbine rotors. Damages were present at all areas of the blades where the water leaves the blades. First large holes have been welded. Then the erosive areas have been filled up with Ceramium, pasty. Finally a supplementary layer of VP 10-017 has been applied as protection against cavitation.
- 086 Various purposes of VP 10-017, a tough and elastic polymer-ceramic, which can be applied e.g. on covers, models, pump housings, mountings, pipe works, machines and plants. VP 10-017 offers a durable, elastical, high impact and wear resistant corrosive protection. VP 10-017 can be applied with brush or spatulas in one go to an application thickness of 300 µm even on vertical surfaces.
- 091 Coatings with VP 10-017 for air coolers, tanks and other big surfaces. VP 10-017-coatings as surface protection and protection against corrosion do offer a very smooth, flexible and wear resistant surface. VP 10-017 is temperature resistant up to 100 °C and offers a very high chemical resistance.
- 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.
- 104 An additional water-centrifugal pump being damaged by erosion and cavitation was rebuilt using Ceramium. Housing and flanged socket were coated inside with VP 10-017.
- 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.
- 142 Several defective covers of a heat exchange system were repaired with VP 10-017.

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Worldwide repairs carried out with PolymerMetall®

VP 10-500

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

REP-# Description

- 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.
- 171 In fractionating columns or cracking facilities in the chemical or petrochemical industry, there are operating temperatures of 200 - 300 °C and pressures of 0,3 - 2 bar. During the extraction of heavy fuel, side products like anthracene, creosote, naphthalene, disinfectant, etc. are generated, which will cause chemical corrosion of the inner walls in the long run. After various investigations it was decided to apply the hot-curing PolymerMetall® VP 10-500 as a protective coating on the inner walls of a new plant. VP 10-500 possesses a very good temperature and also a good chemical resistance against various chemicals originated by the oil. Untreated inner walls made of stainless steel (steel grade SA240-316L) are corroded already after 6 months. In contrast the functionality of the VP 10-500 coating is still given without any objections even after 8 years.

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Worldwide repairs carried out with PolymerMetal®

Molymetall®

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

REP-#	Description
076	A seized oil pump was repaired by using Molymetall.
080	Repairing a damaged bearing bush using Molymetall.
085	Axial and radial grooves on drilling upright machines and bed ways were filled with Molymetall and machined down to size.
106	A chrome plated hydraulic piston showed strong surface flaking. As there were thinnest layers and antifricition properties required, the repair was affected with Molymetall.
121	The bearing seat of a brake shield was reconstructed to its original size with Molymetall. First 2 mm were turned down and then Molymetall was applied. After total curing (appr. 12 h) the size of the original diameter of the seat was reached by turning down again.
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 ² 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.
138	The worn-out shaft of a gear motor for moving an ore conveyer belt was repaired with PolymerMetal. For this the polymer material Molymetall was applied to the damaged shaft on the spot and after partial curing reduced to the desired dimension by grinding by hand with abrasive paper. The solution of the problem by using a PolymerMetal had the big advantage that through this a dismantling of the facility or shaft was not necessary. Due to this modern type of repair, the customer was able to save around 67 hours of machine shut-down.
165	The slideways and bedways of 10 elder threading machines for the processing of drilling rods for the natural gas and oil industry have been rebuilt with Molymetall by injection/moulding. The application thickness was partly up to 7 mm. Because of the high wear resistance, the very low coefficient of friction and the self-lubricating properties of Molymetall the customer is very satisfied after several previous failed repairs with competitive products. The machines are in service again successfully for several years.

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Worldwide repairs carried out with PolymerMetal®

Sealium®

(Photographs incl. description of each repair can be found
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REP-# Description

077 Sealing of micropores in fittings using Sealium by immersion or brush method.

081 Leakages (micro pores) in a cylinder head were closed with Sealium.

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Worldwide repairs carried out with PolymerMetal®

MM-metal S-“product group“

(Photographs incl. description of each repair can be found
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REP-# Description

082 Casting defects on compressor housings were repaired using MM-metal S-steel.

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Worldwide repairs carried out with PolymerMetall®

MM-Elastomer

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

REP-#	Description
002	Sealing of an oil leak between the cover and diverter switch of a transformer with MM-Elastomer 95. First the oil in the transformer was drained and the surface thoroughly cleaned with MM-Degreaser Z. Finally MM-Elastomer 95 was applied using a brush.
101	A conveying belt of a compost filling plant showed a 120 mm x 130 mm long triangle fracture at the corner. After cleaning and degreasing with MM-Degreaser Z an application of MM-Elastomer 95 with Hardener EL95 was done. Afterwards the conveying belt was put into action again with a tensile stress of 5 bar.
148	Several holes and damaged spots respectively in the roof of a big tank at an oil refinery were first coated with Ceramium. Then a layer of MM-Elastomer was applied to compensate any bigger tensions.
174	Alternatively to extensive conventional repair procedures (e.g. welding works) at floating roof tanks an expensive drain of the liquid stored in the tank can if applicable be abstained from by using a repair method with PolymerMetall®. MM-metal oL-steelceramic can be applied on problematic surfaces (contamination due to oil, fuel et cetera). The additional purpose of the flexible material MM-Elastomer is effective against tensions. Here are further information available for the application at floating roof tanks: www.metalexistence.com/f-roof

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