

## When Space is an Issue

Complete engine overhaul and line boring to support vessel conversion to livestock carrier

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## COO's message

## The Changing Face of Goltens

A few years back, at about the time the world's merchant fleet was beginning to feel the consequences of the global financial crisis, Goltens was executing a conscious strategic plan to diversify its business around the world. One of our goals in this plan was to offer our portfolio of services into non-marine markets in a more focused and strategic way. Prior to this, Goltens had largely focused on expanding its geographic footprint, the effect of which was largely to cater to a merchant clientele.

While Goltens has always serviced markets other than the merchant marine sector, never before did we make the conscious decision to focus on the development of both our core services and their application into markets that have not historically been significant to Goltens. The results of this plan are increasingly evident and are becoming more significant for us as a company:

**SERVICE DEVELOPMENT**

Fundamental to this diversification initiative is a focus on the core services and products we offer. From a service perspective, Goltens' core has always been Diesel Engine Service and In-Situ Machining with the majority of that machining related to restoring diesel engines. We identified an opportunity to further develop our diesel engine competence and to significantly expand the range and dimension of our machining services. From this came the development of diesel diagnostic services, expanded governor and turbocharger services, crankshaft annealing, large scale flange facing, line boring, tapered boring, metal stitching and large scale surface milling, to name a few. In addition, Goltens continues to make significant investments in helping our customers navigate pending environmental regulations with the establishment of Goltens Green Technologies, which brought 3-D laser scanning, detailed engineering design and turnkey piping installation capability to Goltens service facilities around the world.

**MARKET DIVERSITY**

In addition to investing in the development of an expanded and more specialized service portfolio, Goltens is successfully offering these specialized services in a broader range of market segments with positive responses from many customers. Building on regional success in the Goltens Group, we began a focused effort to increase penetration into parallel markets where our services are also in demand. We have continued to make significant progress in penetrating the stationary diesel markets and even branched more deeply into offshore oil and gas, offshore merchant, hydro power, natural gas engines, ship building and the stationary gas turbine and steam markets. Penetration into these new and parallel markets continues to be achieved through targeted acquisition and investments in new capital equipment all executed in combination with a more customer

specific sales approach and an expanded view on our global agent relationships.

*"...never before did we make the conscious decision to focus on the development of both our core services and their application into markets that have not historically been significant to Goltens."*

**GEOGRAPHIC SELECTION**

With over 25 service and sales facilities in 15 countries, geographic reach and market coverage has traditionally been a strong suit and focus for Goltens. This global footprint provides Goltens the ability to service our customers where and when they need us in an efficient and responsive way. This efficiency and responsiveness is what our customers have relied on Goltens for for almost 75 years and separates Goltens from everyone else in the industry.

Since 2008, Goltens has successfully expanded our service capability with new service stations in Vietnam, India, Saudi Arabia, Indonesia and Philippines. Additionally, our \$15 million investment in a state-of-the-art repair facility in Dubai's Maritime City has reinforced our prominent position in the UAE and Middle East markets.

However, growing is not always about expanding and in certain situations it involves contraction and/or a reallocation of assets and resources. In recent years, Goltens has twice made the difficult decision to exit mature markets in favor of investing in other broader markets. This thinking is evident by our recent decision to leave New York after 74 years servicing that market in favor of a longer-term investment in our new service facility in Houston, Texas, that will service a range of market segments in the US Gulf region.

In this issue of InService, we want to draw special attention to the significant progress Goltens is making in expanding our service capability, geographic reach and our focus on delivering the best possible result to a growing and increasingly diverse customer base around the world. As Goltens changes in many ways to increase our relevance to our customers and their needs, we will always remain focused on the core elements that help us minimize downtime for our customers – Presence, Precision and Response. |||

Roy S. Strand  
Chief Operating Officer  
Goltens Worldwide

# Annealing With Class

## Germanischer Lloyd, Lloyd's Register and Indian Register of Shipping

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In the 18 months after obtaining GL approval, Goltens undertook over 50 additional crankshaft annealing projects around the world saving badly damaged crankshafts from being condemned and salvaging crankshafts with the

least amount of material removed from the shaft.

As further testament to the viability and increasing acceptance of this repair process, Goltens has further received global process approval from Lloyd's Register in late 2013 and from the Indian Register of Shipping in 2014.

Goltens continues to aggressively market this repair procedure throughout the world and across industry lines to increase the awareness of this invaluable alternative to costly crankshaft replacements among operational managers, technical surveyors, insurance underwriters and others. This, coupled with the numerous class approvals, has resulted in a dramatic upswing in crankshaft annealing work around the world, saving customers millions of dollars in avoided replacement costs and unnecessary operational downtime. |||



**IRCLASS**

Indian Register of Shipping

**DNV·GL**

\* Reference GL certificate # 12-26348 HH

# Annealing In Action: Working With the Manufacturer to Save a Crankshaft

After a United States Navy replenishment oiler experienced a crankpin casualty on one of its Pielstick 10PC4.2V main engines while operating in Japan, the engine maker contacted Goltens to discuss possible in-situ repairs to the crankpin.

The maker reported that one of the crankpins had surface damage and higher than acceptable hardness levels. Goltens proposed the application of its class-approved annealing process in combination with its single-point cutting tools to repair the crankshaft and save it with the least amount of shaft diameter loss.

After reviewing the proposed process with Goltens, the engine manufacturer directed Goltens to deploy its in-situ machining and annealing technicians and equipment to Japan to complete the on-site inspection and perform the repairs.

**MAJOR TIME AND COST SAVINGS**

The application of Goltens' annealing process and in-situ machining avoided a costly and time-consuming shaft removal and replacement. Goltens' In-Situ machinists completed the repairs to within the maker's specifications with the smallest amount of shaft loss possible.

The job was completed without interruption and allowed the engine to be restored to service with limited additional downtime. |||

## A Sampling of Engines Successfully Annealed by Goltens Globally

- BERGEN B35:40V12
- BERGEN B35:40V12AG\*
- BERGEN B35:40V16AG\*
- BERGEN BR M8
- BERGEN C25:33L8P
- BERGEN C25:33L9P
- BERGEN KVG16
- BERGEN KVG18
- BERGEN KVG18-G3
- BERGEN KVGS18-G4
- BERGEN KVGS18-G4.2
- COLT PIELSTICK 10PC 4.2V
- DEUTZ 12M640\*
- DEUTZ 5BV 8M698
- DEUTZ 6SVM 640
- GMT 420.12
- IHI PIELSTICK 12V PC2
- MAK 16 CM 32\*
- MAK 453
- MAK 551
- MAK 6M20
- MAK 6M453
- MAK 6M552C
- MAK 8M19
- MAK 8M20\*
- MAK 8M25
- MAK 8M32\*
- MAK 8M552
- MAK 8M601
- MAN B&W 10V52/55A
- MAN B&W 12V28/32
- MAN B&W 12V52/55
- MAN B&W 16U28LH-4
- MAN B&W 16V40/54
- MAN B&W 18V40/45
- MAN B&W 18V40/54A
- MAN B&W 5L28/32\*
- MAN B&W 6L28/32\*
- MAN B&W 6L28/33
- MAN B&W 6L48/60
- MAN B&W 7L28/32H
- MAN B&W 7L40/45\*
- MAN B&W 8L23/30
- MAN B&W 8L27/38
- MAN B&W 8L32/40
- MAN B&W 9L28/32H
- MAN B&W 9L32/40
- MAN B&W 9L40/54
- MAN B&W V9V40/54
- MIRRLEES BLACKSTONE 16KV Major MK II\*
- MIRRLEES BLACKSTONE ESL 6MA
- MIRRLEES BLACKSTONE K6 Major MK3
- MIRRLEES BLACKSTONE K8 Major
- MITSUBISHI 14V40/45A
- MITSUBISHI KU30B\*
- MITSUBISHI MHI 16 KU
- MITSUBISHI V9V 40/54
- NIIGATA 16V 32 CLX
- NIIGATA 32 CX
- PIELSTICK 14VPC 4\*
- PIELSTICK PC2
- RUSTON 6RKCM-H\*
- SEMT PIELSTICK V12 PC2
- SKL VDS 26/20
- SULZER 12ZV40/48\*
- SULZER 14ZAV40S
- SULZER 16ZAV40s\*
- SULZER 18ZAV40S
- SULZER 6AL25/30\*
- SULZER 8S20
- SULZER 8ZAL40
- SULZER 8ZAL40s
- SULZER AL 25/30
- SULZER ZA 40
- SWD / WARTSILA 6 TM 410
- SWD / WARTSILA 8L280\*
- SWD / WARTSILA 8TM620
- SWD / WARTSILA TM 410
- WARTSILA 12ZAV40S
- WARTSILA 18V26
- WARTSILA 18V32
- WARTSILA 18V38
- WARTSILA 18V46\*
- WARTSILA 18V46B
- WARTSILA 18VW32B
- WARTSILA 6L32
- WARTSILA 6L46C
- WARTSILA 9V32
- WARTSILA 9V32

\* Denotes that engine type has been annealed by Goltens numerous times

### ANNEALING AND MACHINING WORK PERFORMED

- Inspected the crankshaft, performing run-out, Magnaflux and hardness checks on the shaft
- Pre-annealing machining to -1.30mm to diameter 463.70mm to clear the crankpin of surface cracks
- Annealing of crankpin journal #5 with resulting hardness <300HB
- Final machining to -2.00mm undersize
- Machine polished the crankpin to a surface roughness of 0.4Ra
- Completed post-machining run-out and crack tests



USNS Rappahannock (T-AO 204) - US Government photo



Annealing equipment installed and insulated on the damaged pin after machining to remove all surface cracks.

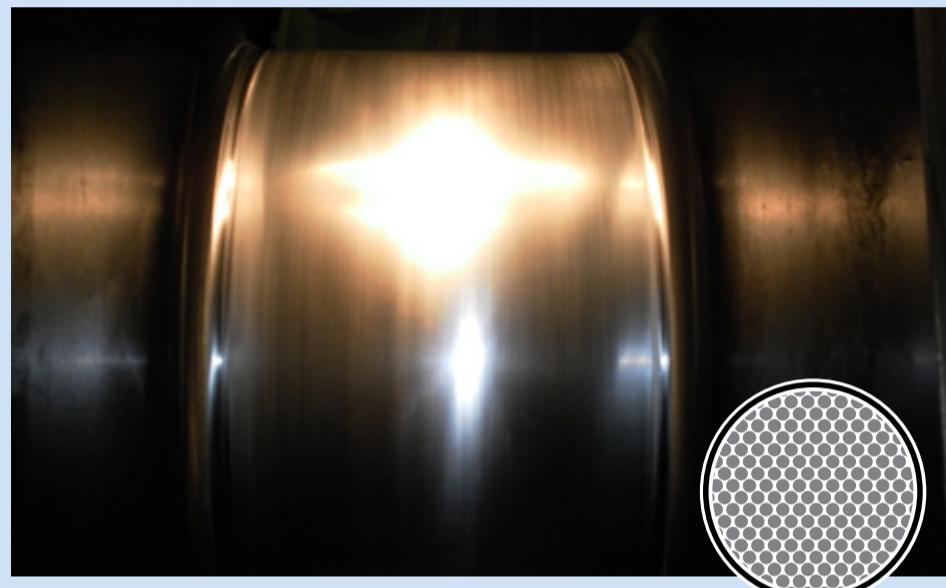


Checking journal hardness before annealing after machining 0.40mm from the damaged surface on the Rappahannock's PIELSTICK 10PC4.2V main engine.

# What is Annealing?

## FACTORY TEMPERED STATE

Unhardened crankshafts generally have a hardness in the range of 250-350HB (Hardness Brinell).

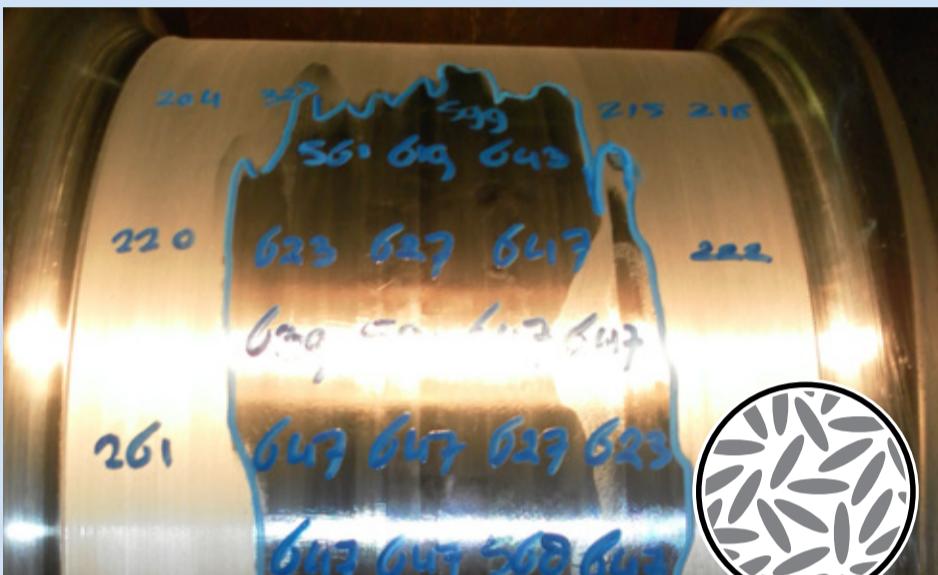


### Metal Characteristics

Homogenous grain structure with a hardness that provides desired strength, rigidity, resistance to wear, corrosion and impact.

## CRANKSHAFT CASUALTIES

During a bearing failure, a crankshaft absorbs an incredible amount of heat. Emergency stopping of the engine introduces an uncontrolled cooling or quenching that often results in areas of excessive hardness in the range of 600 to 700+HB



### Metal Characteristics

Uneven grain structure with significant and visible differences in hardness create areas that are highly susceptible to cracking and potential shearing under force. Oftentimes, this hardness goes deep into the metal and without annealing would result in the condemnation of the crankshaft.

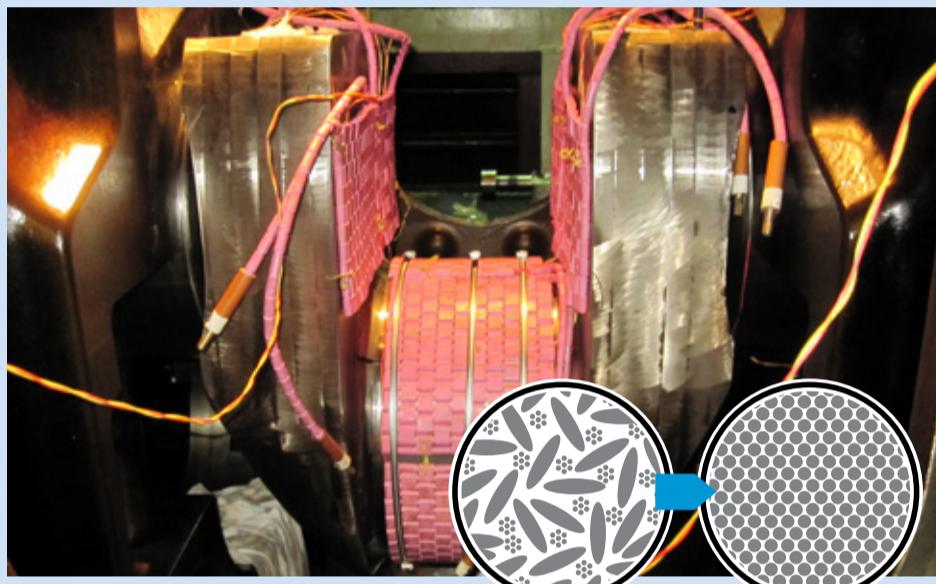
Sampling  
Of Crankshaft  
Annealing Jobs  
Completed By  
Goltens Since  
Receiving  
GL Class  
Approval  
In 2012



**Annealing is a heat treatment process commonly used to remove the stress and hardness within a metal and to increase its ductility. Hardness is a measure of how resistant solid matter is to permanent shape change under application of force, and ductility is a material's ability to deform under stress.**

## ANNEALING THE SHAFT

Heat is applied to the shaft in a tightly controlled manner above its critical temperature but well below the austenite range where the crankshaft could be permanently damaged. This temperature is held for a time period related to shaft diameter and extent of damage before being cooled in an equally controlled manner.



### Metal Characteristics

During annealing, once the metal reaches the critical temperature, the molecules are allowed to recrystallize (realign) to a state consistent with its original ductility and hardness when it was delivered from the factory. Hardness levels are reduced to within acceptable parameters and within maker tolerances.

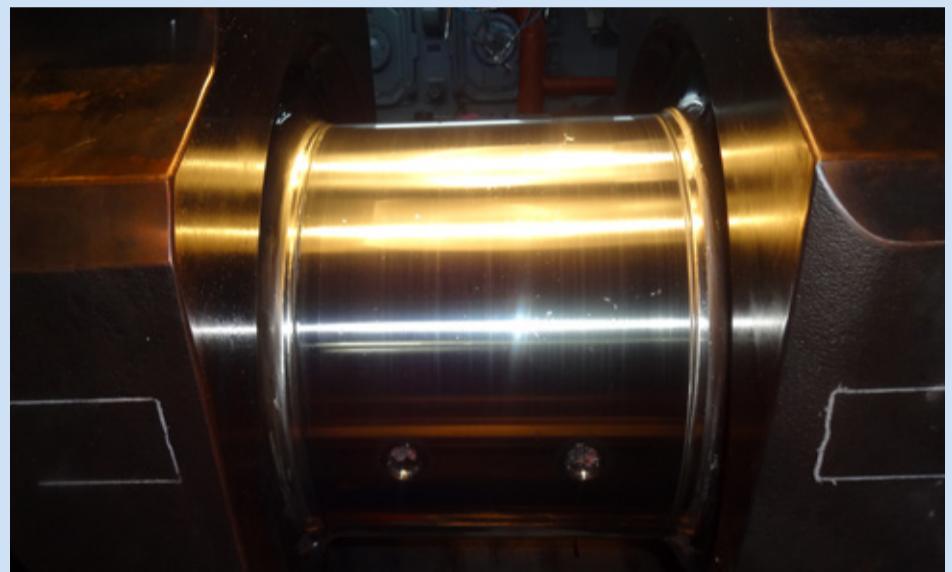
On a molecular level, when a metal such as steel cools down rapidly, the crystalline grains in the metal transform into a lenticular shape. This causes the metal to become harder but also more brittle in the process. Heating the metal to an appropriate temperature causes a homogenous growth of new crystals. The more heat is applied to the metal, the more its ductility increases and its hardness decreases.

During annealing, the steel is heated above its critical temperature and held at this temperature for a period of time before controlled cooling. The controlled cooling process allows the crystals to diffuse into a more flexible, cubic-shaped state.

### SO HOW DOES THIS APPLY TO CRANKSHAFTS?

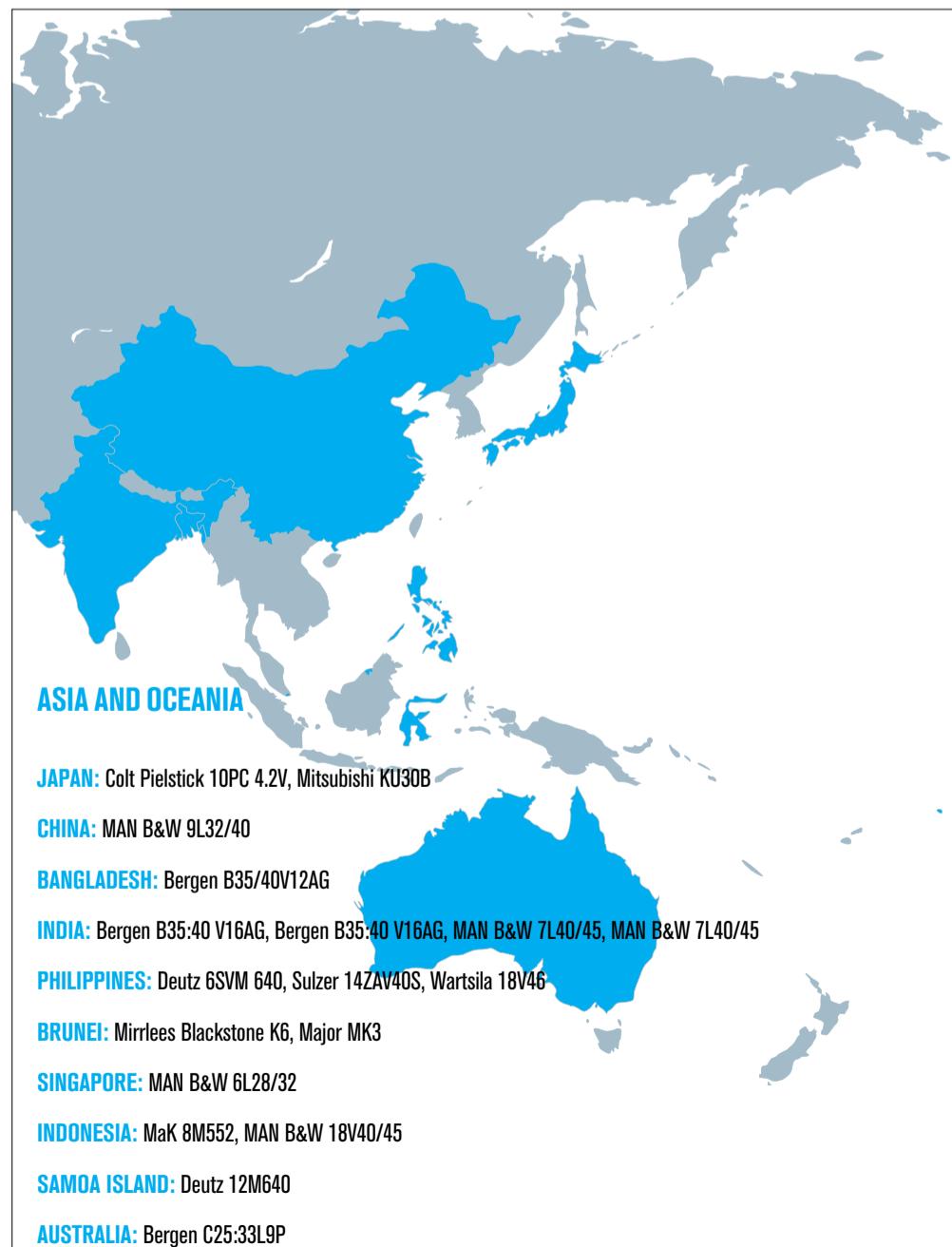
## POST ANNEALING

Once the shaft is cooled, the surface of the journal is rough with scale from oxidation of the metal during the annealing process. The shaft must then be machined to finish diameter and machine polished to the required finish.



### Metal Characteristics

The journal now has an acceptable hardness across the entire surface of the pin and the surface has been polished to a finish generally of  $0.03R_a$  or better.



# Powering it Up

## Goltens' In-Situ Machining — it's not Just Diesel Engines

**Goltens is world renowned for its cutting-edge crankshaft machining and annealing capabilities, and its technicians travel the globe every day to restore damaged diesel engines in the marine and stationary power markets.**

Many would be surprised, however, to learn that Goltens is called upon to perform in-situ machining on many other types of engines and generators all over the world, as well as many large scale machining applications for non-power applications in shipyards, oil and gas, manufacturing and other industrial applications.

Goltens' wide range of specialized tooling deployed regionally, its ability to manufacture highly specialized tooling and the ability to respond quickly makes it a clear choice for complex machining requirements. These high-demand services include journal machining, laser alignment, flange facing, large scale boring and taper boring, surface milling, reaming and drilling and other precision machining services.

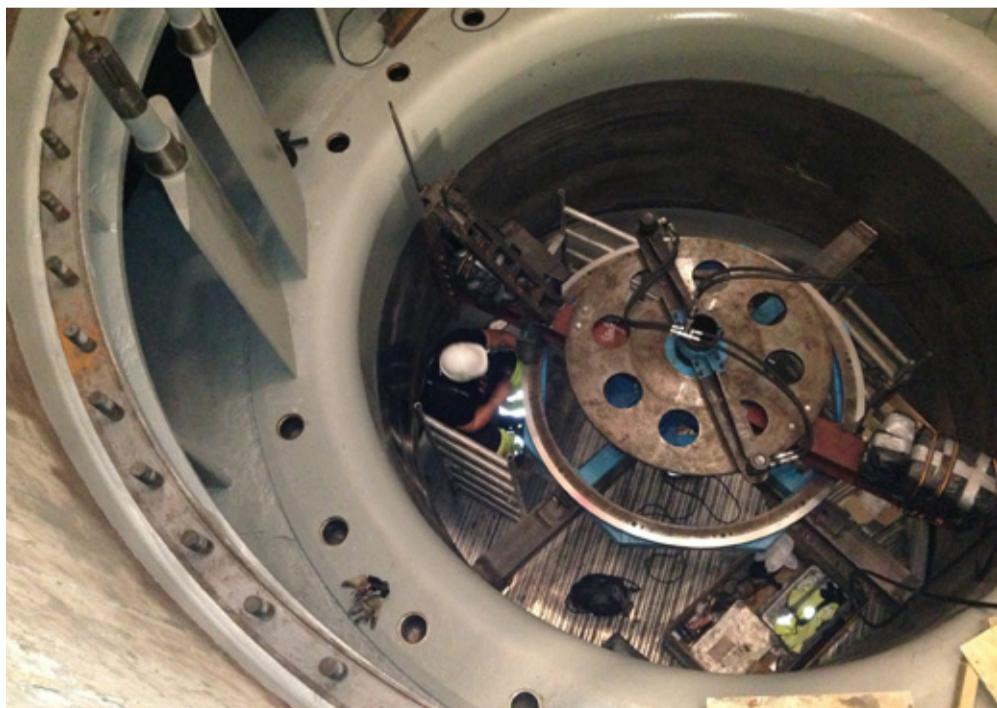
Below are a few examples of jobs completed by Goltens in the recent months on non-diesel power plant applications. |||



Goltens In-Situ machinists machining a 610mm diameter shaft on a newly installed Hitachi TC4F steam turbine journal that was damaged during operational testing at the Maasvlakte Electrabel Powerplant in the port of Rotterdam. Working closely with the manufacturer's technical representatives, Goltens removed 1.20mm from the shaft diameter and finished the journal surface to 0.12Ra.



Saudi Electric Company (SEC) contacted Goltens Red Sea (Saudi) about damage to the shaft on a Fiat TG 20 B-7/8 Gas Turbine at their Narjan Power Plant. As the damage on the compressor bearing journal was more significant, Goltens' In-Situ machinists needed to perform fine grinding and honing on the journal to remove the heavy scoring. Goltens removed the scoring taking only 0.25mm from the shaft diameter. As the damage to the exhaust side was less severe, Goltens was able to remove the lighter scoring with only honing and machine polishing.



Andritz Hydro was contracted to produce a new impeller for a Kaplan hydro turbine at a plant in Hunsfoss in Southern Norway to increase the efficiency of the power plant. In order to accommodate the new impeller, Goltens was asked to machine an 800mm wide flat area and another 300mm wide oval surface on the 3.5m diameter turbine outlet. The challenging job was complicated by limitations on how Goltens' machinery could be mounted on the turbine housing. Three of Goltens In-Situ machinists completed the job in a period of 25 days, removing an average of 3.5mm from the radius.



Goltens Saudi was engaged to perform in-place machining on six 1.2 meter diameter flanges on the gas lines connecting the SGT6-5000 gas turbines and reaming of the 114 turbine coupling bolt holes on six SST6-4000 steam turbines to bring the connections to required tolerances prior to connection at Qurayyah Power Independent Power Plant (QIPP). After completion, QIPP will be the largest combined cycle, gas-fired power plant in the world. The plant, located in the Eastern Province of Saudi Arabia, will generate ~4,000MW of power to feed the rapidly increasing power demands in the Kingdom.

# Metal Stitching Solutions Minimize Cost and Downtime

**When cracks appear or major pieces break free from a cast piece, metal stitching is often the only reasonable method to repair the damage and salvage what is otherwise likely a condemned component or major piece of equipment.**

Traditional welding is not effective and in many cases can result in more damage to the welded piece. Recognizing the need for alternatives to replacement, Goltens stations around the world maintain an expertise in metal stitching repairs.

The following two stories detail just how Goltens solves these major problems for customers, minimizes downtime and saves them significant sums in the avoidance of unnecessary equipment replacement.

## FIVE-DAY TURNAROUND ON YANMAR METAL STITCHING, CRANKSHAFT GRINDING AND LINE BORING

A bulk carrier's Yanmar 6N18-UN auxiliary engine suffered a broken connecting rod, resulting in serious damage to the engine block and crankshaft.

Being authorized by Yanmar and experienced in this type of repair, Goltens provided a class-approved repair procedure to repair the block by metal stitching as well as complete the rest of the required repairs on the engine during the vessel's dry docking in China. Goltens mobilized two teams to repair the engine block and complete the crankshaft grinding working on a two-shift basis in order to meet the vessel's schedule.

### JOB SCOPE

The engine work consisted of complete cleaning and inspection of the engine block, repair of the badly damaged crankcase door by metal stitching, laser alignment checks and line boring of main bearing pockets, straightening of the crankshaft and bench grinding on all crankpin journals along with supply of seven sets of undersize bearings and polishing of all main journals.

### RESULTS

Goltens technicians completed the full scope of the job in just five days to keep up with customer's sailing schedule. Class approved the repair and the owners were satisfied with the timely performance of Goltens' service team.



Badly damaged Yanmar 6N18-UN crankcase door resulting from a connecting rod failure.



Pre-finish machining metal stitch repair.  
Full repair completed in only five days by Goltens Shanghai.



Dye penetrant crack check on the completed repair.

## METAL STITCHING REPAIR SALVAGES BADLY DAMAGED MAK 12M282 ENGINE BLOCK FOR OFFSHORE OPERATOR

When a highly specialized offshore vessel in the U.S. Gulf suffered a catastrophic failure on one of its MaK 12M282 generators, the call went to Goltens. One of the generator's connecting rods had broken away from the crankshaft and tore through the block of the engine.

Goltens had been supporting this customer for years in the repair and maintenance of these engines and, after inspection, was able to propose a repair to salvage the badly damaged block by metal stitching. Goltens also proposed to rebuild the entire engine in its workshop and install it onboard the offshore vessel when completed.

The repair was made easier by the fact that Goltens had access to a condemned block of the same model that it could cannibalize for replacement pieces to stitch into place.

### REPAIR SCOPE

The repairs on the damaged generator included the full inspection of the damaged block, removal of damaged portions of the block, cutting and fitting replacement pieces from condemned block to stitch into place, metal stitching replacement pieces into place, finish machining and stress relieving of seam surfaces and finally crack testing of the repairs.

### METAL STITCHING RESULTS

Goltens' metal stitching repair avoided the costly purchase of a replacement block and enabled the owner to repair the engine in a much more cost effective manner. The repair was reviewed and accepted by class and the engine was ready to be rebuilt and put back into service on the vessel.



Damage resulting from a connecting rod failure on the vessel's MaK 12M282 engine.



Machinist fitting replacement piece into place prior to metal stitching.



Goltens' machinist stitching replacement piece into place prior to installation of locks to complete the repair.

# Larger Scale Custom Built Tooling Put to Work

## Goltens Asia Leads the Way

**Goltens expands its capabilities in response to high demand for larger scale machining applications.**

As part of an aggressive push to expand its in-situ machining capabilities, Goltens has actively pursued larger scale and increasingly complex opportunities around the world. The payoffs of Goltens' investments in larger scale in-situ machining tools are best dem-

onstrated by the companies in Asia where Goltens has been consistently engaged in newbuild and repair yards across the region.

Recent jobs in Vietnam, Singapore and other Asian yards are perhaps the best examples of Goltens' comprehensive capability. Over the past months, Goltens has been busy almost non-stop supporting newbuild, conversion and repair activities in shipyards around the region.

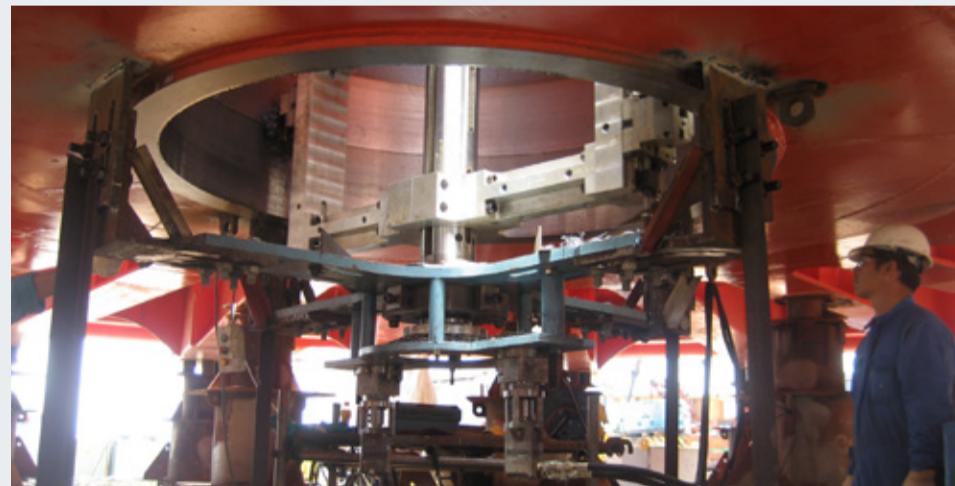
### LARGE SCALE BORING AND TAPERED BORING

Goltens has long been a player in line boring applications, but strong demand from our customers for larger scale precision boring and tapered boring applications has driven the development of a larger range of customized tooling. In response to a request for larger diameter and tapered boring from Triyards shipyard in Vung Tau, Vietnam, for newbuild vessel *Leewek Constellation*, Goltens Singapore designed and built a

custom expandable boring tool, the G2000. The G2000 can handle larger diameters (up to 3 meters), tight tolerances and requirements for tapered boring. After successful completion of the Leewek Constellation job, Goltens received a follow-on order from Triyards to machine the inside diameter on a newbuild outer turret column on the *Bellinda FSO* project with an inside diameter of 2.9 meters.



Goltens' G2000 boring machine during construction in Goltens Singapore workshop.



Goltens G2000 boring machine at work on the Leewek Constellation's 2.1 meter diameter 400-ton deck reel hub bearing housings in Triyards shipyard in Vietnam.

### LARGE SCALE X-Y-Z MILLING

Large scale and precise X-Y-Z milling is also a common requirement presented to Goltens and one where traditional smaller scale milling machines don't meet the requirements or tolerances required by Goltens or its customers. In response to this, Goltens designed and manufactured the G3000i X-Y-Z milling machine which is capable of handling 4m x 3m applications with a tolerance of 0.1mm to 0.15mm.

Goltens G3000i X-Y-Z milling machine at work machining an OSX-2 module on a new build FPSO in Singapore. The scope of works included X-Y-Z milling of the foundation sole plates with a requirement to control flatness within +/- 0.5mm across the surface. The work involved machining and laser alignment checks on 3 foundation plates ranging in sizes 4000mm L x 1980mm W and 1990mm L x 1300mm W.

### LARGE SCALE FLANGE FACING

Medium and large diameter flange facing is another common requirement presented to Goltens from shipyards all around the world. Common requirements include crane pedestals, Azipod mount flanges, turrets and other

large surfaces. Goltens has acquired and custom manufactured flange facing machines of various sizes to meet the needs of these customers.



Goltens 6000i flange facing machine mounted on the 4.7m diameter flanges for the vessel's two 6MW Stern Thrusters. Machining was complicated by the inverted mounting of the machinery and the tight flatness tolerances of 0.15mm across the surface.



Flange facing of the underside of a turret head on an FPSO conversion project in Keppel Shipyard in Singapore (OD 5.99m/ID 5.58m)



## OUTSIDE DIAMETER MACHINING

Machining journals and other cylindrical surfaces to fine tolerances has always been a core competency of Goltens, but the scale of recent customer challenges has driven Goltens to expand its portfolio of outside diameter machining tooling.

To handle the machining of a large inconel turret inner column in a yard in Vietnam, Goltens' toolmakers modified their existing 6-meter diameter flange facer to fit the requirements. The piece to be machined

had an outside diameter or just under 3 meters and the surface was 3 meters below the location where the machine could be mounted. Goltens removed the spider mount from the base of the flange facer, mounted it to specially positioned vertical beams fitted with rollers to facilitate the cutting. The machine was also custom fit with a belt sanding device for post machining polishing to required finish and can be modified handle diameters of up to 5.5 meters. |||

Goltens 6m diameter flange facer modified to handle the outside diameter machining on and inconel turret column on a newbuild vessel in Vietnam. Shop trials of the modified machinery underway in Goltens' workshop prior to shipment to Vietnam.



# Precision, Speed and Maker Authorization

## Mitsubishi 6UEC52LA Main Engine Guide Rail Casualty Restored in Only 10 Days

**A 7,934 DWT refrigerated cargo vessel experienced a sudden main engine casualty after an oil mist detection alarm sounded during engine start up.**

The ship manager requested Goltens, Mitsubishi's authorized service partner, to immediately dispatch their In-Situ Machining supervisor and technical manager to check the main engine guide shoe condition. Goltens' inspection revealed severe and deep scoring all along the length of the guide shoe support rails on three

cylinders as well as serious damage to the guide bearings.

### A COORDINATED APPROACH TO REPAIR

Goltens provided a comprehensive solution involving resources from the Diesel, Machine Shop and In-Situ Machining teams as it included the full scope of repair. The affected cylinders needed to be disassembled, the guide rails machined and the guide shoes reabbotted prior to rebuilding of the engine.

All of this had to be done in an extremely compressed schedule to minimize downtime in the shipyard in China.

Goltens' In-Situ specialists modified their existing X-Y-Z milling machinery to fit within the engine crankcase and immediately transported it to the vessel where Goltens' diesel specialists had dismantled the damaged cylinders.

### PRECISION AND SPEED

Goltens' In-Situ specialists removed between 1.5 and 2.5mm from the badly damaged rails in

cylinders #1 and #2 and machine polished the rails in cylinder #3. Once complete, the reconditioned guide shoes were transported to the vessel, installed and the engine was rebuilt for successful commissioning and sea trials.

Goltens' Diesel, Reabbetting and In-Situ Machining service teams completed the entire job within 10 days, inclusive of workshop preparation and mobilization work. The job was completed a full week earlier than committed to the owner, thus significantly reducing the downtime and expense for the owner. |||



Goltens' In-situ Machining technician monitoring the progress of the guide rail machining on damaged Mitsubishi 6UEC52LA. Note deep vertical scoring on rails.



Machining near completion on one of the damaged guide rails. Deep scoring has been removed.

# Goltens Green Technologies Hits its Stride

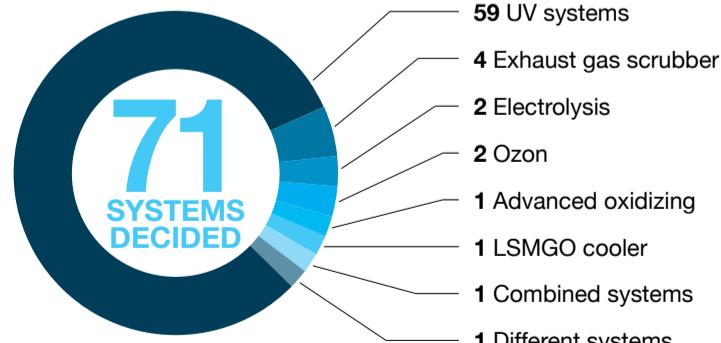
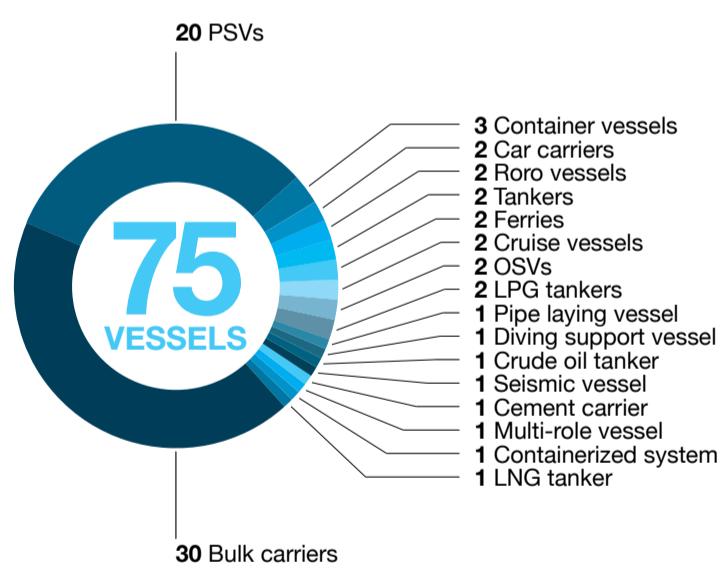
**2013 was a breakout year for Goltens Green Technologies during which Goltens completed its 65th job related to ballast water treatment retrofits.**

Goltens took on 3-D scanning, detailed engineering and design and installation/implementation jobs for a wide range of systems that included Optimarin Ballast System, Hyde Guardian, NKO3 Blue Ballast, Alfa Laval Pure Ballast, Severn Trent de Nora Balpure, Headway Oceanguard, Tech-cross ECS, RWO CleanBallast and BIO UV BioSea. These jobs were performed on a variety of vessels including offshore supply and support, oil tankers, LNG and LPG tankers and numerous other merchant container and bulk carrier vessels.

With the ratification of the IMO Ballast Water Management Convention appearing more likely than ever and the United States implementing their own regulations ahead of IMO ratification, more and more shipowners have begun to take appropriate steps to prepare for and, in many cases, install ballast water systems on their vessels.

To support this, Goltens Green Technologies has purchased additional 3-D laser scanners, hired extra design resources and brought on more seasoned project leaders at major stations around the world. Goltens now has experienced teams in every region and is capable of handling projects of any size that comes its way.

Additionally, Golten has established business and technical steering committees for the Green Technologies business area to ensure that a consistent approach is taken with each customer and that lessons learned are shared and used to improve the overall scan, design and implementation processes. |||



Type of vessel	Type and Size of system (m³/hr)	3D Laser Scanning & System Modeling	Detailed Engineering Design	Installation Supervision	System Installation
Cement carrier	UV system, 334				
Bulk carrier	Combined system, 2000				Shipyard
Bulk carrier	Different systems, 1200				
PSV	UV system, 334				Shipyard
PSV	UV system, 167				
PSV	UV system, 334				Shipyard
PSV	UV system, 334				
PSV	UV system, 334				
Container vessel	UV system, 1000			Shipyard	Shipyard
Bulk carrier	Electrolysis, 5000				
PSV	UV systems, 2 x 167				
PSV	UV systems, 1 x 167				
Bulk carrier	UV system, 2000				Shipyard
PSV	UV system, 167				On order
PSV	UV system, 167				
PSV	UV system, 167				
PSV	UV system, 334				
PSV	UV system, 334			On order	On order
PSV	UV system, 334			TBD	TBD
Bulk carrier	UV system, 2000				Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
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Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Bulk carrier	UV system, 2000			On Order	Shipyard
Car carrier	UV system, 150				
Bulk carrier	Advanced Oxidizing, 5000				
Roro vessel /ferry	UV system, 500				
Roro vessel /ferry	UV system, 500				
PSV	UV system, 2 x 150				
PSV	UV system, 2 x 150				
PSV	UV system, 334			On Order	On Order
Pipe laying vessel	UV system, 500				
Bulk carrier	Electrolysis, 5000				
Tanker	Ozon, 2000				
Tanker	Ozon, 2000			On Order	Shipyard
OSV	UV system, 150			On Order	On Order
OSV	UV system, 150			On Order	On Order
Ferry *	Exhaust gas scrubber				
Ferry *	Exhaust gas scrubber				
PSV	UV system, 150				
Multi-role Vessel	UV system, 250		TBD	TBD	TBD
Diving support vessel	Undecided, 150		TBD	TBD	TBD
LPG tanker	UV system, 250			TBD	TBD
Conteinerized system	UV system, 2000				
Container Vessel	UV system, 200				
Crude oil tanker	TBD, 3000		TBD	TBD	TBD
LPG tanker	UV system, 250			TBD	TBD
Container vessel	UV system, 1000		TBD	TBD	TBD
LNG tanker	TBD, 800		TBD	TBD	TBD
Car carrier	UV system				
Seismic vessel	TBD, 150				
PSV	UV system, 150		On Order	On Order	On order
PSV	UV system, 150	On Order	On Order	On Order	On order
PSV	UV system, 150	On Order	On Order	On Order	On order
Cruise vessel *	Exhaust gas scrubber		TBD	TBD	TBD
Cruise vessel *	Exhaust gas scrubber		TBD	TBD	TBD
Bulk carrier *	LSMGO cooler				

\* Denotes non-ballast water green project

# Goltens Green Technologies – Independence and Breadth of Experience

**Goltens Green Technologies was founded on a principle of providing independent advice and execution support to help shipowners around the world navigate the complex challenges presented by environmental regulations such as the ones being put into place regarding ballast water treatment.**

This independent approach has resulted in Goltens garnering a wide range of experience in these complex retrofits on a wide array of vessel types with a broad cross section of ballast water management systems well in advance of the actual ratification of the IMO Ballast Water Management Convention.

Goltens Green's focus has always been on helping shipowners meet the requirements of this non-payback regulation in the most time



and cost efficient way possible with the absolute minimum of downtime for the vessel.

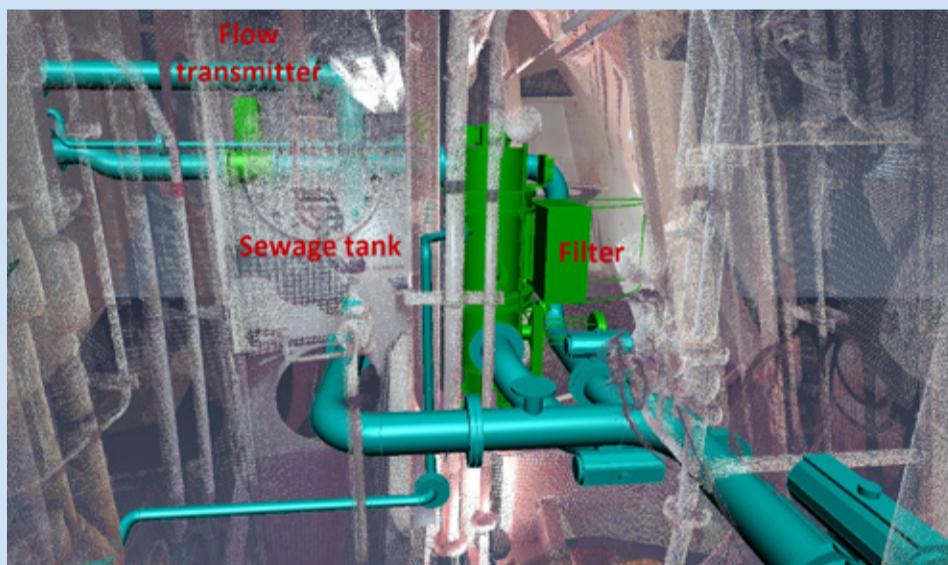
This has resulted in projects that range from basic 3-D laser scans of engine spaces for feasibility studies all the way to complete cradle to grave turnkey installations of the selected system.

Below are three recent examples of retrofit projects executed by Goltens Green resources around the world covering three different systems and three different vessel types. All of these retrofits followed the standard Goltens Green ballast water management system retrofit process and all had predictably excellent results. III

## ALFA LAVAL PURE BALLAST 250 M<sup>3</sup>/H FOR LPG TANKER CHELSEA

Komaya Shipping Co. engaged Goltens Green to help them prepare to execute a ballast water treatment system retrofit on one of their LPG tankers, Chelsea. Goltens carried out 3-D laser scanning in Curacao while the vessel was in dry dock and then delivered a detailed engineering package for the installation of an Alfa Laval Pure Ballast system on the vessel.

Goltens delivered detailed pipe isometrics and foundation drawings, as well as a full installation manual for the system. This vessel is one of six that will be retrofitted from 2014 onward. The actual installation will most likely take place during normal operation of the vessel and the detailed and extremely precise drawings will allow for prefabrication of all piping and foundations so the installation time will be minimized with limited to no rework anticipated.



Proposed Alfa Laval Pure Ballast Filter location overlaid on 3D scan output.

### PROJECT FACTS: CHELSEA

**Vessel type:** LPG tanker  
**Ballast flow rate:** 250 m<sup>3</sup>/h  
**Total ballast water capacity:** 3050 m<sup>3</sup>  
**Ballast treatment system:** Alfa Laval Pure Ballast 250 m<sup>3</sup>/h



## HYDE GUARDIAN HG200L BALLAST WATER TREATMENT RETROFIT FOR CONTAINER SHIP – SEABOARD ATLANTIC

Seaboard Marine, a major container operator in Miami, contacted Goltens Green Technologies' specialists in Miami to undertake and manage the end-to-end retrofit of a Hyde Guardian HG200L ballast water treatment system on board one of its 30 vessels, the Seaboard Atlantic.

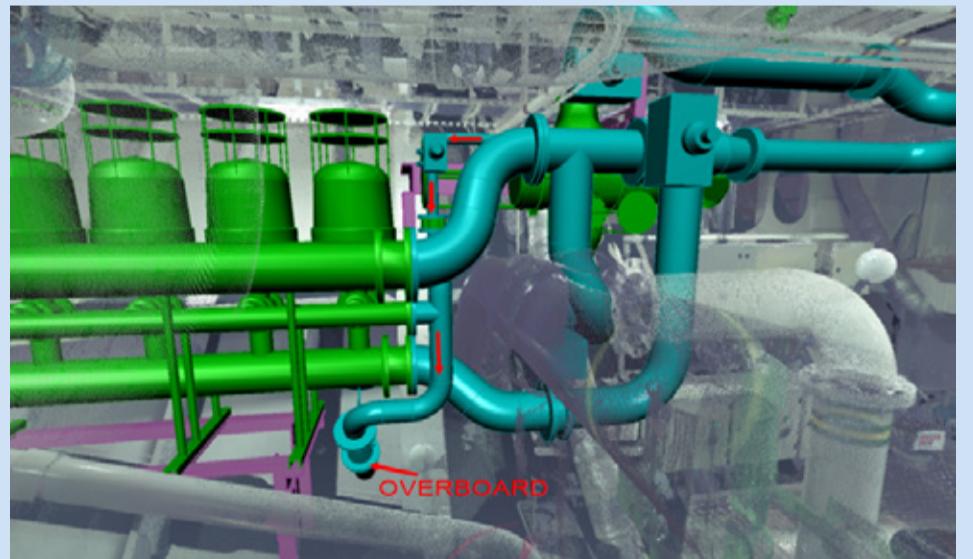
The retrofit installation would take place during dry dock in the Bahamas at the end of 2013, so all scanning, design and prefabrication had to be completed in advance. The project was started in July of 2013 with 3-D scanning of the vessel while in port in Miami and was quickly followed by completion of the detailed engineering package. Once reviewed, Goltens prefabricated all required piping and installation materials and delivered the complete installation kit to the shipyard in the Bahamas.



Goltens' technician preparing the Hyde Guardian filters for rigging into place in the engineering spaces.

### PROJECT FACTS: HYDE BWT RETROFIT

**Vessel type:** Container ship  
**Ballast flow rate:** 200 m<sup>3</sup>/h  
**Total ballast water capacity:** 11,007 m<sup>3</sup>  
**Ballast treatment system:** Hyde Guardian HG200L



Overlay of the Hyde Guardian system on 3-D scan output showing location and connections to existing systems.

## TURNKEY OPTIMARIN BALLAST WATER TREATMENT RETROFIT FOR SEISMIC VESSEL – PGS APOLLO

Goltens undertook a turnkey Optimarin ballast water treatment system retrofit project on the PGS Apollo for Petroleum Geo-Services (PGS), a company with 14 offshore seismic vessels.

As these ships are only in port for very short periods, getting all the information required for the later installation while the vessel was alongside was crucial. The potential loca-

tions in the engineroom were fully scanned in Namibia in November 2012.

Goltens completed the detailed engineering package and prefabricated all required piping and components to install the system during a future maintenance stop. The mechanical installation was completed by Goltens in October 2013, during a busy three-day port call alongside in IJmuiden, the Netherlands.

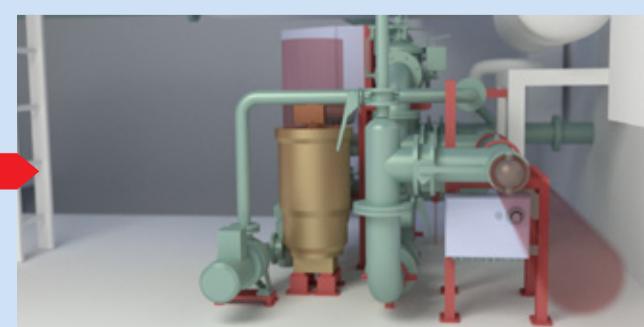
The three-day installation proved once again the value of Goltens' precise approach to scanning, design and fabrication in limiting the downtime of vessels undergoing retrofit. It would not have been possible to install the treatment system in such a short time without the precision afforded by the 3-D scans and precision pipe manufacturing.

### PROJECT FACTS: PGS APOLLO

**Vessel type:** Seismic Vessel  
**Ballast flow rate:** 150 m<sup>3</sup>/h  
**Ballast treatment system:** Optimarin 167 m<sup>3</sup>/h with Filtrex filter



BWT System overlay on 3-D Scan results.



Rendering of the BWT System 3-D Model.



Installed Optimarin BWT system.

# Branching Out

## Goltens Green Technologies Pushes Beyond Ballast Water Treatment

**The looming deadlines and pending approvals for a wide variety of environmental regulations are making compliance and retrofit a key concern of most shipowners around the globe.**

In a proactive response to this, Goltens has expanded its competency beyond the ballast water space and is making further investments to be positioned to help our customers navigate this complex and costly compliance process.

Compliance with IMO ECA regulations pertaining to sulfur emissions is looming large for owners, and unlike the regulations affecting ballast water treatment, these regulations are in full effect with additional deadlines approaching. For the existing fleet, this means retrofit and the consideration of a range of possible compliance solutions. Goltens Green Technologies (GGT) is now involved in a much broader range of solutions but using the same proven process to limit cost and operational impact.

### EXHAUST GAS SCRUBBERS

Goltens has been engaged to scan machinery spaces for a very large passenger vessel op-

erator undertaking a fleet wide exhaust scrubber installation challenge as well as conducting numerous scans for a ferry operator also installing scrubbers. These scans are being used to optimize the preparation, prefabrication and installation process so the off-hire period and dry-docking time can be reduced to a minimum. The end result, as seen in ballast water treatment system retrofits, is predictable and reduced project execution costs and more reliable project management.

### LSGO FUEL CONVERSION: LNG MAIN BOILERS

IMO and SECA environmental legislation compliance is imminent for ECA LNG vessels in 2015 and for IMO regulations in 2020. In response to this, Goltens has established a new division within GGT to focus on helping LNG operators comply through the retrofit of their main boilers. This alternative compliance solution is proving to be a much more cost effective solution when compared to alternative abatement solutions.

The majority of the global LNG fleet are steam propulsion vessels with 2 x HP & HT dual firing main boilers (running off LNG boil

off gas and HFO). Goltens is offering a turnkey solution to convert the vessel's main boilers to tri-fuel by adding LSGO into the equation. This involves burner and boiler control system modification in collaboration with key OEM's and design and installation of a parallel LSGO fuel supply system. More significantly, Goltens' turnkey solution provides operators with fuel selection flexibility and increased global trading opportunities, allowing operators to more freely participate in the spot market.

Following the same process of scan, design and retrofit applied in the ballast water treatment arena, Goltens packages solutions that allow for turnkey, class-approved retrofits that minimize downtime and cost while meeting compliance regulations.

### LSGO COOLER INSTALLATIONS

As an alternative solution to scrubber installations, some operators are pursuing the installation of coolers into their fuel systems. Earlier engineering plants were not designed to operate on low sulfur marine fuels which have a much lower viscosity than traditional fuel sources. By introducing fuel oil coolers into the system, operators are able to increase the viscosity and burn the lower sulfur content fuels. Similar to ballast water treatment, Goltens is assisting owners to identify locations and create effective design solutions and offering turnkey solutions for the installation of these systems. As a result, there is as little invasion and interruption in the vessel's operation as possible.

### BEYOND COMPLIANCE – FULL VESSEL AND MACHINERY SPACE SCANS AND PIPING RENEWALS

Not all scanning and design work is related to compliance. Goltens has now been contracted to complete full vessel scans of large yachts and of full engine rooms on other offshore and merchant vessels so that they have "as-built" documentation of the equipment layouts and machinery for future use. Leveraging this, Goltens has also created detailed isometric drawings for a vessel renewing its piping systems during a yard period. Due to the compressed schedule of the yard period and the very high daily hire rate for the vessel, the owner chose to have Goltens scan the systems, complete the drawings of the piping and to prefabricate the piping for installation in as little time as possible.

Goltens has found that for vessels with a lot of wear and tear on their piping systems, like dredgers, having a predesigned set of drawings "in the box" can be very beneficial. A pipe that is nearly worn out can be ordered by telephone – all details with regard to exact size and material specification are known in the Goltens' database and can be pulled out at any time for prefabrication at the location of choice. As soon as the vessel arrives in that port the pipe can be ready for installation by a Goltens riding squad or by the shipowner's local installation partner. |||

# Basic Approach in Action – a Customer's Perspective

**Dutch shipowner Anthony Veder is preparing for the ballast water treatment system installation with the "basic approach" – shipboard survey combined with the 3-D laser scanning and modeling. Repair and maintenance manager René van Dierendonck explains the reasons behind company's strategy.**

**What prompted Anthony Veder to start planning for a ballast water treatment system installation before the ratification of the Ballast Water Management Convention?**

For a large number of vessels in our fleet (mainly our LNG/LPG/LEG carriers of up to 7,500 cubic meters), the size of BWT systems available today is an immense problem in regard to the pipe routing and the space in the engine room. Goltens' 3-D laser scanning and shipboard survey and modeling provides the ultimate approach for us to find out which system – or systems – can be shortlisted. Following that, we will be able to make a decision about which system

(or systems) would be the best solution for our fleet. In addition, the 3-D scan will be available later on for the detailed engineering stage.

### Why did Anthony Veder choose to opt for the preliminary design option?

Like many shipowners, we are not confident that the presently available BWT systems will get the USCG type approval. Choosing an available, suitable and IMO approved system right now could, in the worst case scenario, possibly imply that the investment was worthless – in case the USCG approval does not get through. However, the regulations are not going away. Our choice is to start planning smartly in order to be prepared at the time when things get clearer.

**What have you learned from this experience?** We started with organizing the 3-D laser scanning and modeling and the shipboard survey with Goltens onboard one of our most problematic vessels with respect to available space. The result was that although the space was

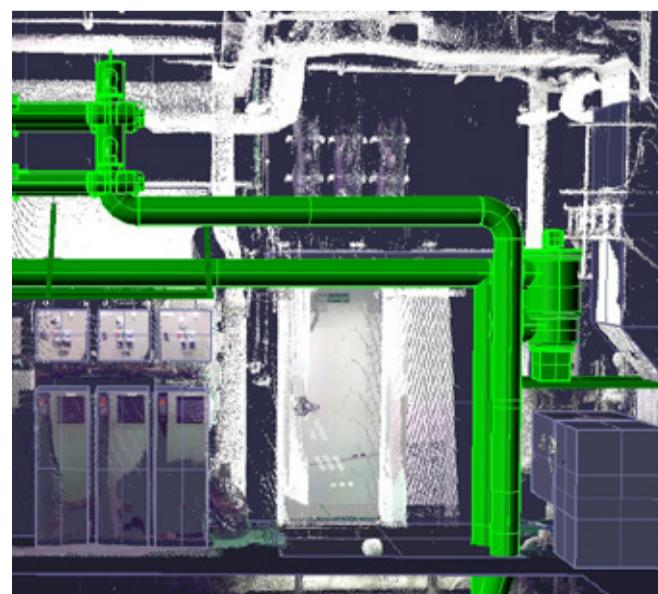
very tight, it would still be possible to install an available BWT system on board this vessel. We are quite sure that we would not have reached this outcome without having carried out the 3-D scanning and system modeling. This gives us confidence for the rest of the fleet. We will continue with the 3-D scans and the shipboard surveys during the months to come.

### What would you recommend to other shipowners when it comes to planning and executing a BWT system installation?

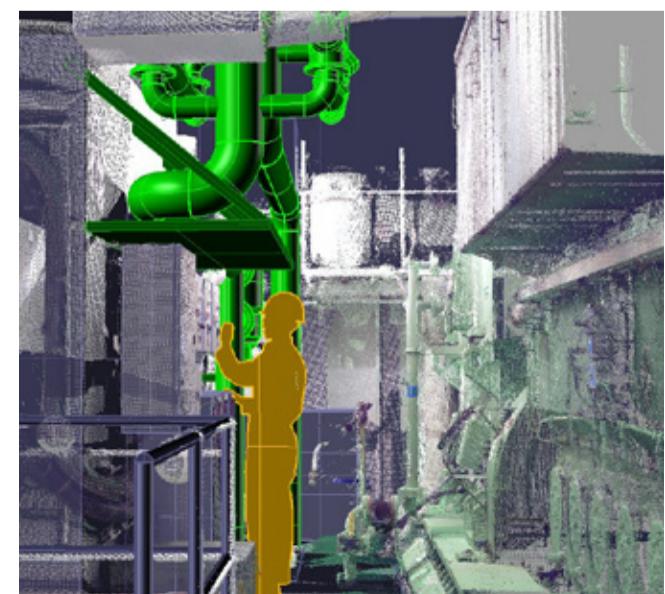
I would say, be prepared. There is a lot that can be done in preparation for the BWT system installation without having to make a final decision about which system is finally going to be installed. |||



3-D scan and BWTS survey was carried out on board Coral Methane in 2013.



Side view of the system on the tween deck.



BIO UV400m<sup>3</sup>/h system, looking forward.

# Demonstrating BWT Compliance

## Bactest Signs Global Distribution Agreement for its Speedy Breedy Portable Contamination Testing Product

**Ballast water treatment system (BWTS) installation is one thing – meeting the gross non-compliance (GNC) standard is another.**

Goltens has long been helping shipowners navigate the challenging task of BWTS retrofits to meet the existing U.S. regulations and pending IMO Ballast Water Management Convention ratification, but assisting owners in demonstrating that these systems function properly and meet the GNC standards was an unanswered question.

While researching available technologies, Goltens Green Technologies met with UK-based company Bactest, and a lightweight, portable, cost effective solution for shipowners became clear. Bactest is the inventor and manufacturer of Speedy Breedy, the world's most sensitive, versatile and portable contamination test. Speedy Breedy is the only instrument on the market that can be used on ships or in port to test for compliance with the IMO standard for the three bacteria set out in the standard: *Vibrio cholerae*, *E. coli* and *enterococcus*.

Both companies recognized that the combination of Goltens Green Technologies' market share in the BWTS retrofit market and Goltens' global footprint in 15 countries, coupled with

Bactest's Speedy Breedy product, presented great opportunities. As a result, the companies signed an exclusive global agreement in May 2014 for the distribution of the Speedy Breedy product for the ballast water market targeting shipowners, BWTS manufacturers, port state authorities and enforcement.

"We are absolutely delighted to be working with Goltens Green Technologies," said Bactest CEO Annie Brooking. "They have an impressive track record of retrofitting BWTS and indeed lead the market in this field. Bactest will benefit hugely from their global sales infrastructure and marketing strength."

Maarten Jeronimus, Vice President of Goltens Europe and Managing Director for Goltens Green Technologies in The Netherlands added, "We have been looking for a product like Speedy Breedy for some time to complement our BWTS business. Speedy Breedy is quite unique. With more than 22 stations in the Goltens network worldwide, this agreement has a global reach. We will be strongly promoting Speedy Breedy to both our customers and colleagues in the maritime industry." |||



# Waiting Smartly

## How Forward-Thinking Owners are Efficiently Preparing Now for Ballast Water Convention Ratification

### WITH THE LACK OF LEGISLATION, WHY NOT WAIT?

Where is the compelling force for owners to spend money and to take action? Why would shipowners install a ballast water treatment system right now?

The US Coast Guard has already issued their final rule on ballast water treatment, so a large number of vessels are already due for retrofitting as we speak. However, there are no official USCG type approved treatment systems yet. The first ones are expected before the end of 2014, but right now, none exist. Additionally, applications for extensions are generally being granted for one or two years, further reducing the urgency.

Beyond the readily granted extensions, the financial advantages of postponement are also clear. Delayed investment in non-payback technologies has an immediate and positive effect on the OPEX of the vessel for the time being. In addition, no one knows what new technologies may come to market in the next few years, and making a decision now locks the owner in.

### WHY ISN'T EVERYONE WAITING THEN?

The clear answer to this is that there are also clear and significant risks to doing nothing. Prices are almost certain to rise as demand potentially outstrips availability. This is especially true for the systems deemed to be better than their competition. This may leave owners who waited with fewer choices once

the clock starts ticking. Additionally, demand on qualified design and installation partners will almost certainly exceed supply, and even proper planning will become a challenge.

Instead of just waiting, why not choose to wait smartly? Many forward-thinking owners are preparing now for what appears to be inevitable. These owners are not laying back doing nothing, but taking various steps to prepare without necessarily completing full installation of the systems. They recognize that relatively low-cost preparations will position them in front of the queue that will inevitably form as soon as the convention is final. They are reducing the risks involved in waiting and saving money and time at the same time.

### HOW ARE THEY DOING THAT?

Preparations are not a one-size-fits-all model. Goltens is assisting owners with a variety of different approaches, ranging from basic to advanced.

#### The Basic Approach

A basic approach consists of a shipboard survey, combined with 3-D laser scanning. The available space is measured in detail and a survey of available power, common ballasting practices and preference of type of treatment system are completed. After this Goltens prepares a basic design for one or two chosen treatment systems where the main components are modeled in the scanned image showing the owner how and where the system

could be fitted. These scans are an investment that has greater utility because they can be used at a later point in time for detailed engineering. This is also the stage where a more extensive comparison between systems can be made, based on available space, power consumptions or ease of installation without the financial burden of purchase.

#### The Medium Approach

In this approach, a final system choice is made so that Goltens can prepare the detailed drawings for all pipes and foundations that are needed. The result is an engineering package that can be used for production or to compare quotations from different shipyards or installation companies. The deliverable is, in fact, an installation guide that can be used by any experienced company to install the system. Additionally, as part of the basic or medium approach, certain preparations can be made during routine dry docking that may alleviate the need for a special docking to install the system. With the design in hand, preparations like new overboard hull connections, installation of additional breakers in the main switchboard or preparing the automation system can be completed ahead of system installation.

#### The Advanced Approach

The advanced approach takes the preparations one step further but still avoids the immediate purchase of the system. Goltens or

another qualified installation partner uses the detailed engineering to prefabricate all pipes and foundations and installs them onboard. Instead of fitting the actual equipment, dummies are installed so that the final system components can be replaced later. A bit of extra installation work is involved as part of the work needs to be redone, but the advantage is that the cost for the actual treatment system can be postponed.

### ECONOMIES OF SCALE – FLEET AGREEMENTS

To reduce the risk of price increase of the treatment system or non-availability of the installation partner of choice, many owners are finding it wise to negotiate fleet agreements. Especially for owners of larger fleets, retrofitting will be an onerously large project, so finding the right system manufacturer and installation partner and negotiating for volume driven pricing becomes especially important. Working with an experienced and reliable partner will prevent headaches and ensure good quality.

Goltens has secured a number of fleet agreements that stretch over five or six years, ensuring these customers that their fleet of vessels are well planned in a relaxed schedule and will be retrofitted in time. As work can be planned over a longer period, sharper prices are possible to further save the owner money. |||

# When Space is an Issue

## Complete engine overhaul and line boring to support vessel conversion to livestock carrier

### THE CHALLENGE

A 17-year-old vessel was undergoing conversion to a livestock carrier in Batam, Indonesia, and the vessel's owners concluded that the vessel's MAN B&W 12V32/40 main engine was not in working condition. Goltens' detailed inspection revealed the engine was in very poor condition and would require full overhaul. Inspection indicated the crankshaft journals should be polished, and laser checks of the bore alignment showed the engine would need to be line bored as well. Given the extremely tight space

in the engine room, the challenge was to find the most efficient solution for the full repair.

### THE SOLUTION

Given the restricted space for line boring and the magnitude of the required repairs, Goltens determined the best approach would be to remove the engine block from the engine room and complete the required in-situ line boring in the yard's workshop. Goltens' diesel experts disassembled the engine and rigged the block and the crankshaft shoreside for the repair. Si-

multaneous with this, Goltens arranged for the supply of the liners, bearings and other spare parts required for the engine overhaul.

Prior to line boring, Goltens specialists completed straightness checks on the foundation and dye penetrant checks on the main bearing pockets to make sure there was no additional damage. Once satisfied on the magnitude of the damage, Goltens proceeded to line bore the engine, polish the crankshaft and blue fit the crankshaft counterweights. Goltens then installed the crankshaft and main bearings and

rigged the block back into the engineroom for reassembly with the supplied spares.

### THE RESULT

Once the engine was fully overhauled and reassembled, it was flushed, timing checked, laser aligned and chocked before operational testing and full sea trials. During sea trials, the engine was successfully tested on both MDO and HFO with 75 percent load at 14 to 16 knots with all engine parameters within the acceptable range. |||



MAN B&W 12V32/40 engine block being rigged into place for the installation of the crankshaft after engine lineboring.



Vessel undergoing conversion to livestock carrier in Indonesian shipyard.



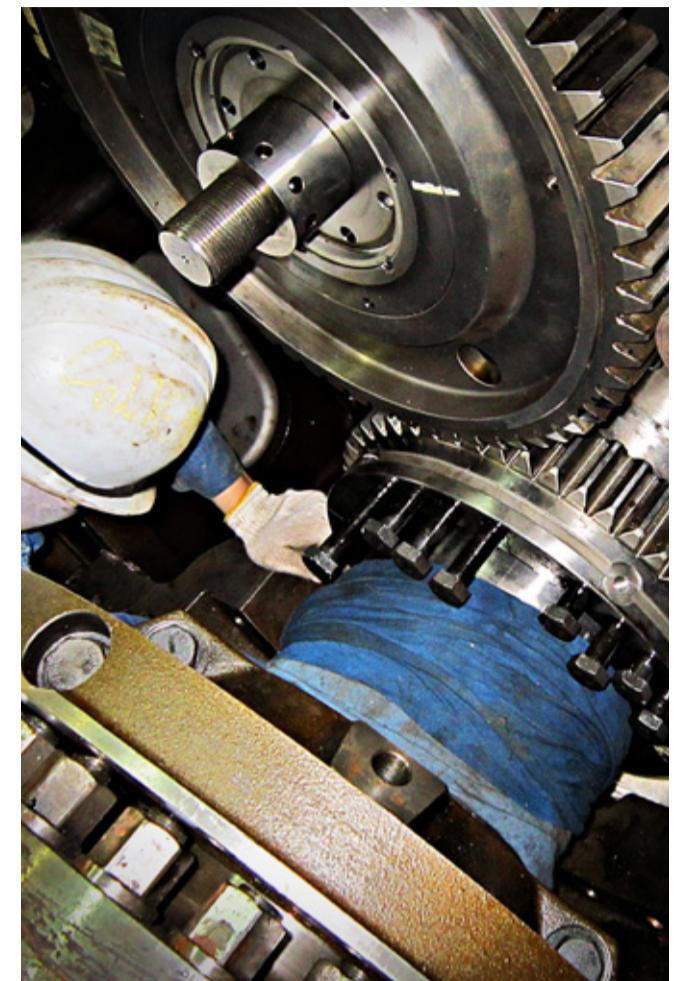
Rigging of the damaged MAN B&W 12V32/40 from the vessel for repairs.



Installation of main bearings on the engine prior to rigging back on board.



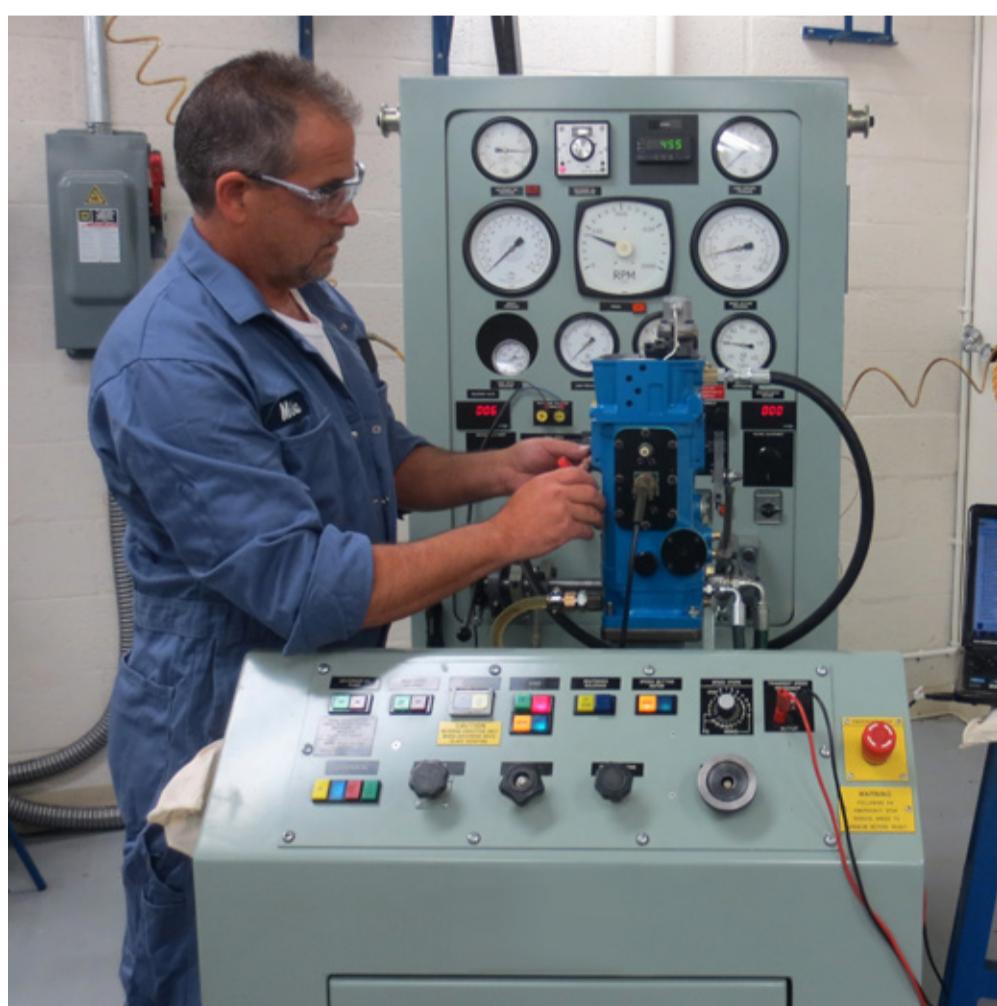
Lowering the repaired MAN B&W 12V32/40 engine into position in the engine room.



Goltens technicians adjusting timing on the overhauled engine.

# Keeping Governors Under Control

**Goltens Expanding Network of Authorized AISFs Supporting Critical Engine Components**



One of Goltens' governor specialists testing an overhauled governor on the test bench.

**Should diesel engine governors and speed controls fail or require specialized services, various markets around the world can depend on Goltens for a full range of maintenance and repair services.**

Goltens stations around the globe have been servicing speed controls for marine and stationary power applications for decades, but the recent expansion of Authorized Independent Service Facility (AISF) authorization in Miami and Surabaya for Heinzmann/Regulateurs Europa and Woodward respectively, makes Goltens' global network that much stronger in this highly specialized and competitive service area.

## A COMPREHENSIVE SOLUTION TO GOVERNOR-RELATED PROBLEMS

A faulty governor can be destructive, not just to the engine but to the business. Without the ability to control an engine's speed, the engine can easily overspeed and destroy itself. The unplanned loss of a single diesel engine has immediate consequences on operations, whether inside a ship, power station, offshore production facility or a factory. These markets need fast, reliable solutions for emergent problems.

This is the reason Goltens is constantly seeking to expand the breadth and geographic coverage of its specialized governor related services. Goltens is committed to developing and maintaining a full range of capabilities to overhaul, repair and test a comprehensive range of governors and actuators across the globe, including the retrofitting of mechanical to electronic governors.

Various Goltens locations have been appointed as AISFs for leading governor manufacturers inclusive of Woodward, Heinzmann/Regulateurs Europa and Diesel Kiki, who recognize Goltens' ability to service their products. These facilities are fully equipped with specialized tools, test benches, and spare parts to offer a full set of services across a broad range of makes and models of speed controls.

## Goltens' Authorized Independent Service Facilities

- MIAMI
- SAUDI ARABIA
- UNITED ARAB EMIRATES
- BAHRAIN
- INDONESIA (Jakarta and Surabaya)
- PHILIPPINES
- VIETNAM

## A UNIQUE COMBINATION – A COMPETITIVE DIFFERENCE

What sets Goltens apart from many AISFs around the world is its breadth and depth of diesel expertise and its focus on fast response and field-work. In addition to the fact that Goltens' governor specialists are all exceptionally qualified with factory training and years of experience, Goltens operational understanding of how the governor functions on a diesel engine and the ability to respond quickly to emergent troubleshooting and repairs in the field are the key differentiators for many customers.

Goltens routinely responds to requests for emergent support to restore a troubled engine to service and minimize downtime. To support this, Goltens maintains a large stock of spare parts and a variety of new and reconditioned governors that can be deployed on a moment's notice with a qualified technician to restore the outage.

## TRUSTED BY MANY

Every year, these Goltens AISFs overhaul, repair, upgrade or retrofit well over a thousand governors for marine, industrial, and oil and gas customers. All overhauls undergo strict quality control procedures, starting with disassembly through cleaning, parts renewal, testing and calibration to original specifications. These practices ensure that once replaced, the governor functions like new, ensuring reliable uptime and maximal output of both power and profit. |||

# Root Cause Analysis Leads to Comprehensive Repair and the Salvage of an Engine Block

## Crankshaft replacement and In-Situ Machining restore Sulzer Z40/48 in the Philippines

After a big end bearing failure on one of its Sulzer Z40/48 diesel generators, Tarlac Power Corporation in the Philippines requested Goltens Singapore to do an inspection of the damage and propose a repair solution for the 18-year-old engine.

### DAMAGE ASSESSMENT AND ROOT CAUSE ANALYSIS ARE KEY

As important as restoring an engine to service is diagnosing the root cause of the casualty so it does not reoccur. This required a detailed inspection of the crankshaft and engine components. Goltens found that the crankshaft was damaged beyond repair and that it would need to be replaced. The damaged crankshaft was skidded out from the engine for further inspection and the main bearing showed signs that the crankshaft was not sitting in the center and that the alignment of the engine was not within maker's specifications.

Digging further, laser and flatness checks were performed on the foundation skids, lower engine mating surface to foundation skid and main bearing pockets. The skids were found to be too stiff and had developed cracks. Additionally, the skids, mating surfaces and main bearing pockets were all found to be distorted. Although the crankshaft was a total loss, Goltens determined that by line boring the engine and performing in-place machining on the mating surfaces, the engine block could be saved.

### THE REPAIR SOLUTION

As the plant was under high operational demand, time was critical and Goltens immediately mobilized tools and technicians. Given the state of the engine, Goltens needed to perform a variety of steel and In-Situ Machining repairs to the engine prior to replacement of the crankshaft and the rebuild of the engine. The scope of the machining and steel repairs consisted of:

- Repair cracks on the foundation side by gouging, welding and stress relieving.
- X-Y-Z in-situ milling of foundation skid and underside of engine block to achieve flatness.
- Laser alignment/flatness checks on the foundation skid top face and engine block underside surface.
- Brush electroplating on the main bearing saddle sides to restore side dimension to original size.
- Milling of horizontal face of the main bearing saddle.
- Blue fitting of the main bearing saddle to the engine block.
- Line boring of the main bearing pockets and post-boring calibration and alignment check by laser.

After the in-place machining works were completed and the replacement crankshaft inspected, Goltens technicians installed the new crankshaft and rebuilt the engine, laser aligned the generator and completed full commissioning and load testing up to 100% load. ■■■

**"We are very pleased with Goltens' performance on this job. Their team's deep technical knowledge and thorough inspection identified the root cause of the failure and resulted in a comprehensive repair of our generator engine which saved us from replacing the engine block. Goltens' technical execution was excellent and their ability to handle all aspects of the work themselves allowed us to deal with a single contractor for the entire job."**

**Engr. Gilbert Mar J. Soliman**  
Plant Manager, Tarlac Power Corporation



Goltens technicians rigging replacement Sulzer Z40/48 crankshaft into position at Tarlac Power.



Goltens In-Situ machinists milling the underside mating surface of the Sulzer Z40/48 engine block to remove distortions.

# Two Engine Overhaul in 18 Days for Star Cement Plant in Ras al-Khaimah

## CRITICALLY DEPENDENT ON ITS OWN POWER GENERATION

Star Cement operates a Clinker plant in the emirate of Ras al-Khaimah in the UAE powered by three MAN B&W 9L58/64 engines, the largest four-stroke engine designed by MAN. These large four-stroke engines are used in both stationary power and marine diesel electric propulsion applications and are in fact the same type of engines in operation on the Queen Elizabeth II. As Star Cement is not connected to the power grid, the plant relies on the power supplied by these engines for its operations, so reliable operation and minimal plant downtime is an absolute must for them.

Goltens has been supporting the maintenance on these engines for Star for the past five years. In preparation for a planned maintenance outage on two of these engines, Goltens Dubai carried out a full performance test and used this evaluation as the basis for the recommended overhaul work scope.

## LARGE WORK SCOPE SHORT TIMEFRAME

As the power supplied by these engines is the lifeblood of the plant, minimizing downtime was critical and needed to be completed without fail during the maintenance window. The scope of the overhaul was significant and the time available was not. The overhaul included:

- Reconditioning of all cylinder heads
- Reconditioning of all pistons including crown renewal as required
- Inspection of selected big end housings and bearings
- Opening, inspection and calibration of selected main bearings
- Deglazing and calibration of all cylinder liners

- Cleaning, inspection and calibration of the engines' turbochargers
- Inspection and cleaning of scavenging air coolers

## THE RESULTS – WORK COMPLETION IN 18 DAYS

After engine reassembly, the engines were operationally tested and run up according to Goltens' and the maker's procedures resulting in only minor adjustments and securing of leaks. The engines were both load tested to 9.0MW (90 percent of full load for the alternators) and kept at load until a full heat balance was achieved and Star was satisfied with the results. |||

"Our whole business depends on the reliable operation of the 3 x 12.16 MW MAN engines at our power plant. Goltens is regularly engaged with us for the scheduled maintenance works as well as to attend any unforeseen breakdowns. Goltens' service is excellent and they have contributed a lot to the sustainable operation of our power plant. Their team of technicians is highly qualified and committed, and we trust their services all the time. In addition to routine maintenance, they undertake periodic health checkups on our engines, and we have found that all their suggestions are very useful to optimize our engine performance. Above all, they are available to us 24-7 to attend any of our service requirements."

**TVS. Chidambaram**  
Chief Operating Officer, Star Cement



Star Cement Clinker plant in Ras al-Khaimah, which operates three MAN B&W 9L58/64 engines.



Goltens' Diesel Technicians fastening the lifting yoke to remove a cylinder head from one of the MAN B&W engines.



Goltens Diesel Technicians finalize work on one of the MAN B&W 9L58/64 engines at Star Cement.

## Better Service Through Stronger Relationships

When specialized services are required or the customer is beyond their reach, engine makers and manufacturers around the world trust Goltens for support.

In today's highly competitive and increasingly global market, the world's leading engine makers are expected to offer after sales services to support owners and keep these machines in excellent working condition wherever they may be. Diesel engines are used for critical operations in diverse markets, including merchant and offshore marine, oil and gas, stationary power and other industries, and unexpected diesel engine downtime can result in multimillion dollar losses. The presence of quick, reliable, and global support is often a dealmaker or breaker in a diesel engine investment decision.

## A GLOBAL CHALLENGE – A CLEAR CHOICE

Diesel engines are in operation across the globe, oftentimes beyond the reach of many manufacturers' support services. When engine makers are unable to provide the required level of support or wish to augment it with a strong service partner, many choose Goltens. Among the different service providers, Goltens' widely recognized brand as an engine specialist with a global capability supported by roughly 1,300 employees in over 25 locations in 15 countries makes it the clear choice. Over the past seven decades, Goltens has built a reputation anchored on its global reach, quick response to emergencies and precision work – always focused on minimizing downtime for the customer.

Because of these capabilities, many engine makers and manufacturers have authorized

Goltens to service their diesel engines — recognizing and validating the quality of the company's services. With Goltens' help, partner manufacturers can offer fast support services in almost every corner of the world, maximizing the investments of their clients while drastically reducing losses.

## GOLTENS' PARTNERS

Though these diverse engine makers compete with each other, they respect and trust Goltens' ability to improve their brand through its quality, global services. Some of the most recognized names have partnered with Goltens stations worldwide in global relationships as well as regional or local partnerships.

These manufacturer relationships ensure that Goltens has ready access to all necessary tools, technical details and technical training

to offer repair and maintenance services for a wide variety of diesel engines. Despite these close relationships, Goltens remains an independent service provider that places its customers first. Goltens always offers the most optimal solution to its customers' problems, taking into account the engine makers' recommendations, but acting according to its expertise and its customers' interests. |||

## Engine Manufacturers With Service Relationships With Goltens

- Akasaka Diesels Limited
- Anqing Daihatsu
- Diesel United
- Doosan
- General Electric
- H. Cegielski Service Ltd.
- HHI
- Mitsubishi-UEC
- STX Engines
- STX Heavy Industrial
- Yanmar
- Zhenjiang CME



**CSSC** 安庆中船柴油机有限公司  
Anqing CSSC Diesel Engine Co., Ltd.



**HYUNDAI** HEAVY INDUSTRIES CO., LTD.

**H-Serv**



# From the Ashes

Past performance with insurance underwriter Lavaretus lands Goltens Dubai a massive fire repair job on Saudi Arabian desalination barge.

**While operating in Yanbu, Saudi Arabia, a major fire ripped through the 3,500 ton desalination barge Bowarege 2, owned by International Barges Company (IBC). Bowarege 2 is one of only two full-time, commercially operational and self-contained desalination plants in the world and provides a viable solution for addressing temporary and chronic water shortages in Saudi Arabia on the Red Sea**

The fire totally destroyed the barge's accommodation block and three of its nine Genset containers, as well as caused extensive peripheral damage, taking the plant out of service. Goltens was awarded the contract by IBC after initial discussions with Scandinavian underwriters, Lavaretus. Goltens has a trusted and respected reputation within Lavaretus following a number of successful major repair projects involving both parties in recent years. Goltens

was awarded this particular project amid stiff competition from Mediterranean and Middle East shipyards. This past experience and Goltens Dubai's full docking capabilities and comprehensive range of services gave Lavaretus the confidence to support the award of the entire job to a single, trusted service provider, avoiding the complexities of managing multiple vendors to get the barge restored.

The scope of work included demolition,

safe handling and removal of the existing burnt-out accommodation block, complete redesign, construction, outfit, and installation of a new four-deck accommodation block, supply of six new Genset containers with Cummins engines, installation of a further 12 new Cummins engines various structural repairs, new electrical installation including MCC and PLC panels, full system commissioning, and a full five-year docking scope.

The project was completed over a tightly scheduled five-month period alongside Goltens' facility in Dubai Maritime City. Once completed, the barge's systems were fully commissioned and tested enabling the owner to return the desalination plant to operation in the Red Sea. |||



Bowarege 2 arrives in DMC end December 2013 with its Accommodation Block completely destroyed as well as serious damage to several containerized Gensets



Work starts immediately to carefully remove the remnants of the burnt-out Accommodation Block, an exercise that took 3 weeks to safely complete before refurbishment work could progress.



One of 6 MCC Panels in the MCC Room as part of a major electrical installation that also included PLC Cabinets, a SCADA System, and 32,000 metres of cable.



Docking scope is complete along with total refurbishment of the structure housing the desalination equipment.

"The project phases were, from day one, dealt with by Goltens in a sound, professional manner. Goltens provided reliable services and technological expertise to service a diverse range of challenges throughout the entire project.

Their dedicated facilities and infrastructure were critical to the project's success. Goltens was chosen for the project based not only on financial considerations, but based upon our experience with them as a company which delivers quality and has a skilled workforce equipped to handle and find solutions. Lavaretus Underwriting and Risk Engineering appreciate Goltens involvement through what was, once again, a mutual task between Underwriters and Goltens to serve a client."

**Michael Skipper**  
Chief Technical Officer, Lavaretus Underwriting



One of Goltens' specialist engineers working on one of the 18 Cummins Gensets.



The completely refurbished vessel, sporting its brand new Accommodation Block, departs DMC en route its permanent location in Yanbu, KSA.

"Thanks to excellent cooperation with Barge Owner, IBC, along with Lavaretus Underwriters, we managed to squeeze a huge amount of work into the 22 week programme. The Goltens Engineering, Afloat, Docking, Diesel, HVAC, and Electrical & Automation Departments, all worked on parallel programmes along with our subcontract partners to bring about a successful and timely conclusion to the project with all parties delighted with the standard of workmanship and commitment."

**Tom Boyle**  
Vice President Goltens UAE

# One Year On!

## Goltens in Dubai Maritime City

When Goltens Dubai left Al Jadaf Shipyard for its new purpose built, state-of-the-art facility in Dubai Maritime City (DMC) in May 2014, the company was optimistic that the efficiencies brought about by the new facility as well as the proximity to the docking facilities in DMC would pay off.

Slightly more than a year later, Goltens is starting to see the fruits of that large investment and is continuing to invest in the facility as well as equipment and machinery to keep the forward momentum that has been built. All technical departments, i.e., Reconditioning, Electrical & Automation, Diesel, In-Situ Machining, Fuel, Turbocharger, Governor, Mechanical, Steelwork, and Docking were fully settled into the new facility during the second quarter of 2013 and saw increased demand during the second half of the year.

### CONTINUED INVESTMENT

As expected, the prime location relative to the docking facilities enables Goltens to achieve much greater efficiencies but more investment to support the demand was required. Goltens Dubai completed a record number of 28 dockings during 2013 despite the considerable disruption associated with relocating several hundred pieces of equipment and around 400 staff members.

Since the move, the company has continued to invest in equipment, resources, and new services and is seeing improvements in efficiencies from the new location and these investments. Around \$1 million was invested in additional equipment to support increased docking activity, namely cherry-pickers, generators, hydro-blasting equipment and scaffolding materials, thus limiting the requirement for subcontractors, increasing the department's flexibility and control, and allowing more competitive pricing.

Additional project management resources were also recruited to cope with the increased demand, which has been clearly maintained with 18 further dockings completed in the first half of 2014. Goltens Dubai made a strategic decision to increase the Docking department's activity to 35-40 dockings per year to maximize utilization of their new facility in DMC. The increase in dockings is also providing substantial spin-off for Goltens' specialist services in Dubai such as electrical, mechanical, machining, diesel, turbo-charger, and governor.

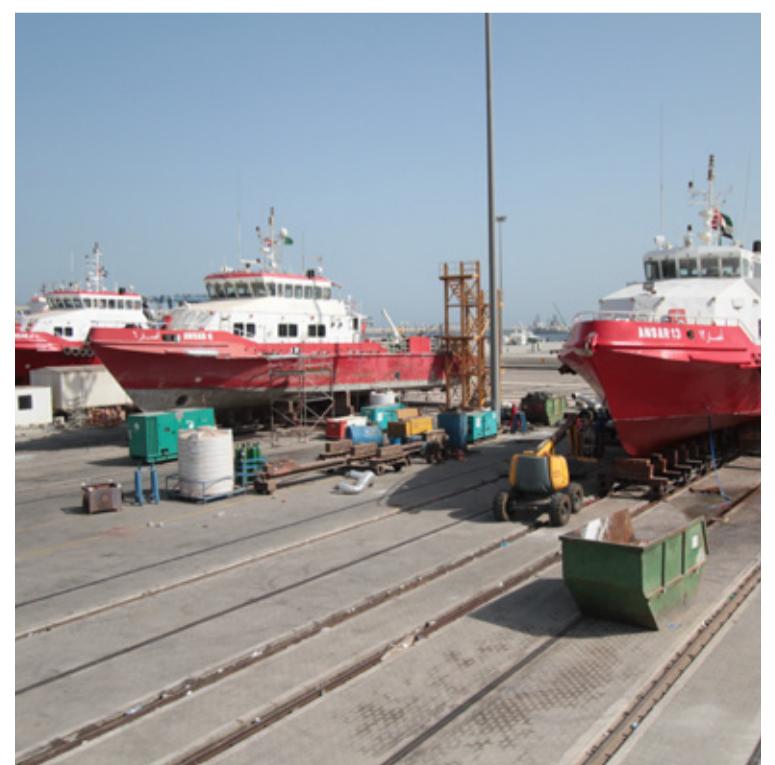
### INCREASED RANGE OF SERVICES

In addition to further investment in core activities, Goltens Dubai has also added new services to its already considerable portfolio. The company's new Green Technologies division offers turnkey packages for retrofits relating to ballast water treatment systems and low sulfur gas oil conver-

sions for main boilers. Both of these new services include machinery space scanning and 3-D modeling, spatial integration of equipment, detailed design and class approval, procurement of equipment, manufacture of steelwork and pipework, system installation, project management and commissioning. In addition to this, Goltens Dubai now also offers air conditioning installation and repair services from its new Heating, Ventilation and Air Conditioning department. |||



Goltens new facility in Dubai Maritime City includes 10,000 square meters of workshops, 1,500 square meters of offices, 10,000 square meters of open yard and a prime location abutting DMC's docking yard.



Three Red Sea Marine Services offshore vessels, ANSAR 4, ANSAR 6 and ANSAR 13, all undergoing parallel dry dockings in Dubai Maritime City in 2013.

# The End of One Era and the Start of Another

## Goltens New York and Goltens Houston

**Goltens Worldwide announced earlier this year that it would close its operations in Brooklyn, New York, after more than 70 years of service. As Goltens New York was the founding location for the Goltens Group in 1940, the decision was not an easy one, yet the company believes it is in its best interests long term.**

"The closure of Goltens New York represents a strategic business decision to focus our attention on other geographic markets," said Roy

Strand, Goltens Worldwide Chief Operating Officer. "We carefully considered the long-term growth prospects of the New York market against other investments we wish to make as a company, and while we have long had a special feeling for our New York location, there were simply more appealing investment options in the United States and abroad."

Coincident with the decision to close the New York location is the company's announcement that it was opening a new service facility in Houston in 2014. "Goltens has always sought to be directly present in locations

where our customers need us the most and where we can be successful in the long term," said Strand. "As such, we expect to continue to expand Goltens Miami and have established a new workshop in Houston, Texas in the middle of 2014. The investment in the workshop in Houston is viewed as critical to our ability to service the large volume of merchant traffic, as well as the offshore merchant and oil and gas customers that frequent the Gulf and Gulf Area ports and represents the achievement of a long-term goal of being directly present in the Gulf of Mexico."

Goltens is confident that these two U.S. locations will be well positioned to provide specialized Diesel and In-Situ Machining services to its customers in a proactive and responsive manner. |||



Goltens New York – established in Brooklyn, NY in 1940.



Goltens Houston, established in 2014, located in close proximity to the Port of Houston with ready access to the other Houston area ports.

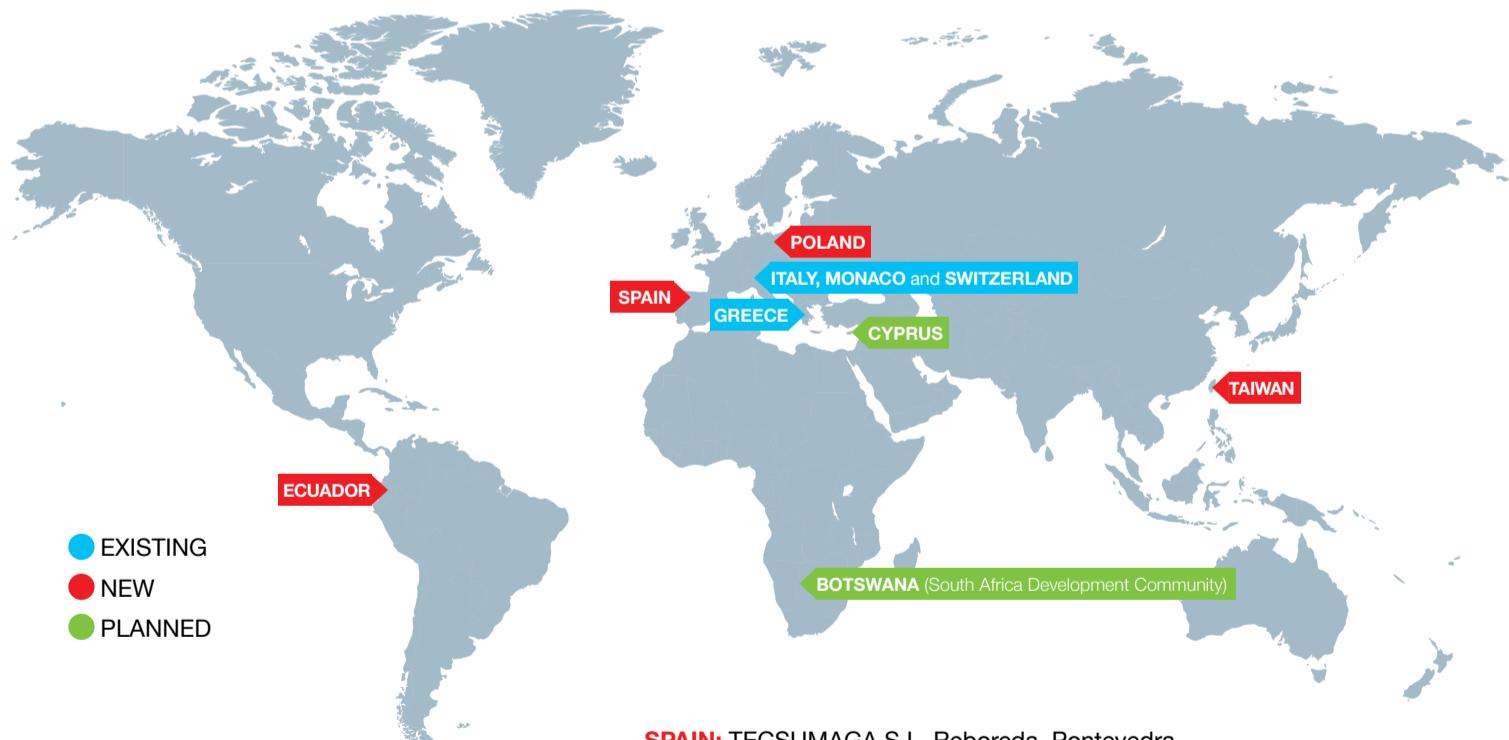
## Goltens Expands Footprint With new Agents

**2013 and 2014 have been marked by an expansion of Goltens' agent network worldwide.**

Goltens' strategy for more consistent and direct customer contact has led to the appointment of additional agents to cover markets where a local touch or specific knowledge of a market is required to provide adequate support for the customers. Goltens has always had an active direct sales model, yet certain markets require a closer form of contact due to language barriers, geographic hurdles or local customs.

Recognizing this, in 2013 and 2014, Goltens has appointed new group-wide sales agents in Poland, Spain, Ecuador and Taiwan, thus expanding its existing network of agents covering Italy, Switzerland and Monaco and more recently Greece, which was converted from a Goltens sales office to an agency at the beginning of 2014. Goltens has further plans to appoint agents to cover other key marine and industrial markets around the world in the coming months, including agents in Botswana/South Africa and Cyprus.

### GOLTENS' WORLDWIDE AGENT NETWORK



**SPAIN:** TECSUMAGA S.L. Reboreda, Pontevedra

**POLAND:** INTER PARTNER, Warsaw

**ECUADOR:** MR. AXEL R. REICH, Guayaquil

**GREECE:** G. POULAKIS MARINE SERVICES, Athens

**ITALY/MONACO/SWITZERLAND:** ITALPRORAMAR SERVICE, Genova, Italy

**TAIWAN:** POLYVERIX TAIWAN CO, LTD, Taipei