

**WÄRTSILÄ** **Engine services**

On-site crankpin machining and heat treatments  
by Wärtsilä Italia Services





ABLE TO OPERATE, WHEREVER YOU ARE

## Crankpin Machining and Heat Treatments on-site by Wärtsilä Italia Services: the run never stops

Continuously looking at the development of products and services which support customers' needs of efficient operations and highly productive installations, Wärtsilä Italia Services is now able to take its Workshop directly into your facilities, wherever you are and anytime you need, providing cost effective solutions for the reconditioning of strategic engine parts, such as crankshaft or engine block.

The on-site crankpin machining and the on-site

heat treatment illustrated in this brochure can be performed directly on-site by qualified Wärtsilä personnel, ensuring the same high quality results obtained at Wärtsilä Workshops. The on-site treatment solutions represent a valid alternative to critical parts replacement, both for owners or operators of a new or an old engine, either the engine is used for ship propulsion or for electrical power generation.





## ON-SITE CRANKPIN MACHINING

When a failure occurs, in certain cases the damage is limited to surface seizure, without additional development of high temperatures on the material surface, which might cause further modifications in the material structure.

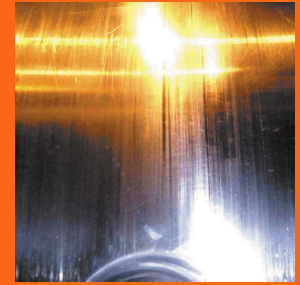
under-sizing is considerable, restrictions may be imposed on the power or engine speed to be developed, based on calculations and torsional vibration measurement on the repaired crankshaft.



Cracks



Hammering damage



Scratches



In such cases, when seizure, impressions, scoring and cracks on the crankpin are still within certain limits, they can be removed through machining or grinding of the pin, thus reducing its diameter in accordance with the instructions of engine manufacturer and Classification Societies.

In certain extreme cases, when the resulting

Side grooves are remachined as well, according to the pin undersize.

Thanks to the own developed technology, Wärtsilä is able to guarantee the highest quality standards, usually obtained in the workshops.

Crankpins for both 4 and 2-stroke engines can be machined by the innovative Wärtsilä tool.



## OVERHEATING AND METALLURGIC HARDENING

In case of heavy breakdowns, the surfaces of the crankshaft can be subjected to overheating (over 850°C) followed by rapid cooling, with inevitable modification of the microstructure of the material. The overheating is coming from the heat developed by friction between the rotating elements, which afterwards also cause the sudden stop of the engine and the consequent rapid cooling down to the ambient temperature of the previously heated surface.

Heating and cooling the surface as described above is equivalent to the metallurgic heat treatment of hardening, which has the final result of increasing the hardness of the material. The pin that has suffered the overheating and the consequent failure results with increased and irregular hardness, with peaks that can reach 650 HB (degrees of Brinell hardness), values well in excess to those required by design specification and

manufacturing process and which therefore make the safe re-use of the shaft impossible. Also Classification Societies do not accept residual post-failure values of hardness higher than those laid down by the engine builder, usually between 350 and 450 HB.

In certain cases the hardened layer can be of a thickness high enough that no machining procedure permits it to be removed. In such situations and according to the normal practice, there would be no possibility of repairing and putting back into service the crankshaft, and the only alternative would be that of replacing the crankshaft with a new one.

Crankshaft replacement is a very expensive operation in itself, it involves, above all, a long time out of service for the engine due to the considerable work of disassembly and reassembly and sometimes can be not immediate, due to availability of spare crankshaft.



## ON-SITE HEAT TREATMENTS: THE PROCESS

For the nature of the treatment and the importance of the engine part involved in an eventual failure, the operation of crankshaft in-place heat treatment is very sensible and has to be considered a specialist undertaking, which needs to be assigned only to the very few companies in the world today capable of guaranteeing the success of the entire operation.

Making this process a part of the daily working routine, with very high customer satisfaction, Wärtsilä Italia Services is the knowledge centre within Wärtsilä, capable of performing crankshaft in-place heat treatment for all types of engines, utilizing own original technology, professional personnel and special tools.

Before starting the on-site heat treatment, exact material composition of the crankshaft is investigated, in order to define the original hardening and tempering heat treatment parameters and establish related relieving treatment process, such as maximum temperature to which the pin is to be heated, speed of heating, time for which the pin needs to be held at the full temperature and final speed of cooling down to ambient conditions.

The engine crankshaft is subjected to different inspections and measurements, starting from alignment and deflection data. The same data are then verified and monitored during the heat treatment process; the scope is to avoid deformation and / or misalignment of the shaft and, if the case, try to recover the original values thanks by relieving the accumulated and latent stresses.

Depending on the engine type, size and the type of application, dismantling of engine

components is carried out to leave the shaft free from eventual mechanical constraints, weights, loads which that might inhibit its natural dilation and contraction.

After this, the pin to be treated is carefully prepared: heating resistances, temperature sensors and thermal insulation are installed, cables, electrical and electronic connections to power supply and control board are positioned separately from the engine.

## ON-SITE HEAT TREATMENTS

Wärtsilä Italia Services is able to perform in place heat treatment, which allows the surface hardness to be brought back to the original design values, therefore allowing the full functional recovery of the crankshaft after heavy breakdowns. The process consists in subjecting the steel of the hardened crankshaft to a treatment of localized stress relieving, carried out in a programmed and controlled way. It is applied only on the pins that have been subjected to overheating and consequent hardening.

Specially designed equipment and highly specialized personnel are used to perform the relieving surface treatment, which is carefully monitored, recorded and documented thus allowing subsequent certification by Classification Societies. In place heat treatment can also be the preliminary treatment to any mechanical machining of the damaged pin, with the scope of restoring the normal and homogeneous hardness of the steel surface.

- 1 Measurement of crankpin surface hardness.
- 2 A damaged pin ready for heat treatment. Crankshaft flexions are measured on the other cranks and kept continuously under control.



1



2

# TECHNICAL PROCEDURES

Heat treating a crank pin to reduce hardness also reduces the amount of re-machining and makes the machining work easier.

The heat treatment is to be made carefully in a well-controlled manner and below the original tempering temperature of the shaft, so that there is no influence on the basic mechanical properties of the shaft.

Following the treatment the hardness is typically reduced by 200HB ± depending on the original status of the pin. However, not more than the initial hardness of the shaft material.

### Equipment needed

The heating equipment consists of a heat treatment transformer, which transforms the voltage and controls the heating process. Triple cables and splitter cables are used to connect the tailor-made heating elements to the transformer.

Temperature recorder and thermocouple wires are used for controlling the material temperature of the pin, which is to be heated. Thermocouples are jointed to the pin with special stainless-steel band.

Heat insulation mats are used to cover the pin to be heated.

### Control of heating

The whole heating process should be monitored and the following parameters are to be continuously recorded:

- Heating temperature (°C)
- Heating rate (°C/h)
- Treatment temperature (°C)
- Holding time (h)
- Cooling down rate (°C/h)

### General

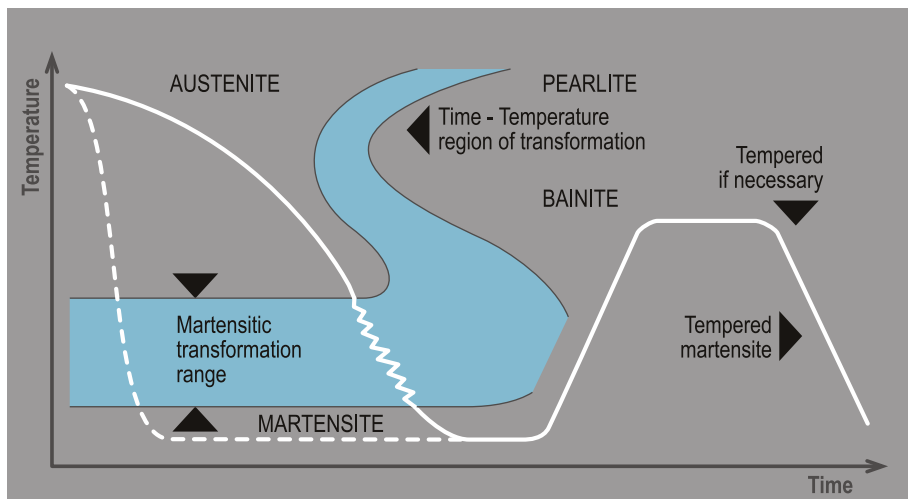
The total process time is depending on the quality of the material, type of shaft and dimensions of the crank pin and its hardness.

The process takes typically 36 to 48 hours.

It is crucial that the treatment process is not interrupted.

The hardness of the base material is not be changed when performing the process described above, because the heat treatment applied doesn't induce microstructure modification, being the heating temperature lower than the value of the original treatment. Crankshaft with original hardened surface cannot be heat treated.

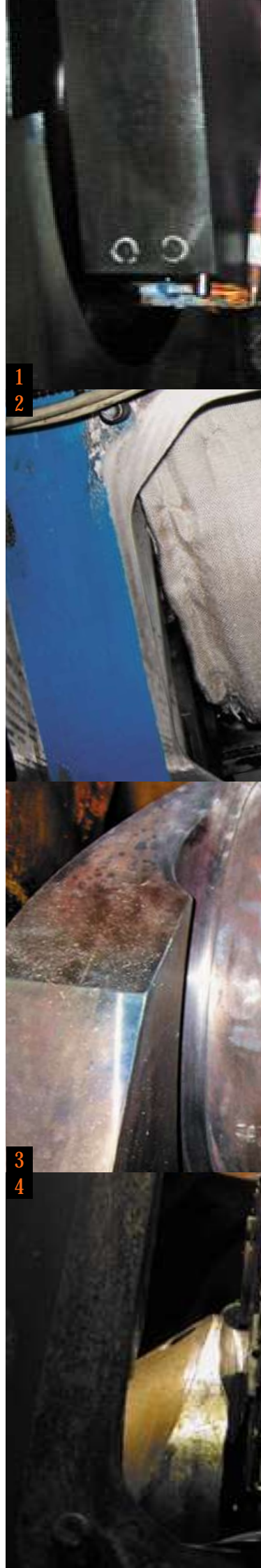
Results can vary from -100 to -200 HB after heat treatment, depending on the original treatment and hardness value of the pin.

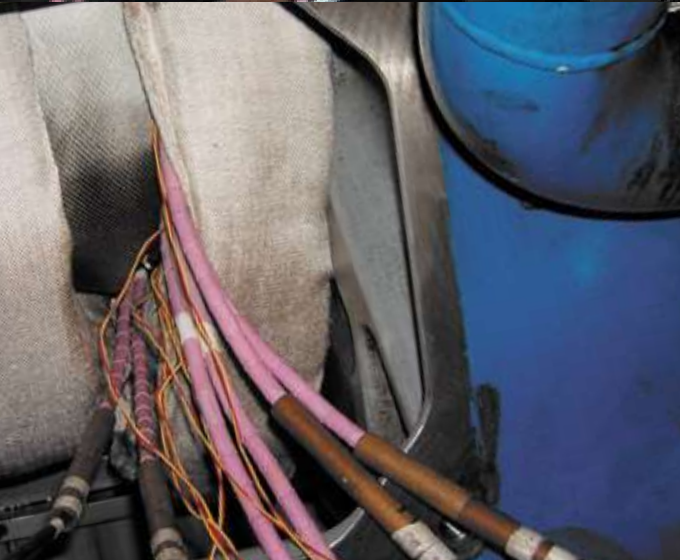


The Time-Temperature Transformation curves correspond to the start and finish of transformations which extend into the range of temperatures where austenite may transform to pearlite / bainite / martensite. The different microstructures are obtained with different cooling rates from the austenite. In case of hardened pin, tempering heat treatment is performed in order to reset the local irregular and high values of superficial hardness (up to 650 HB) down to the design values.

- 1 Positioning of heating elements on the crankpin
- 2 Insulation covers to reduce heat losses

- 3 Crankpin aspect after heat treatment
- 4 Machining to final dimension and roughness





## APPLICATIONS

### On-site Crankpin Machining

Application Field: damaged crankpin (seizure, impressions, scoring, cracks)

Engine types: all engine types, 2 and 4-stroke

Material type: all

### On-site Heat Treatments

Application Field: Overheated surface with high hardness; preliminary treatment for damaged crankpin machining.

Engine types: all engine types, 2 and 4-stroke

Material quality: quench-hardening steels

## WÄRTSILÄ ITALIA SERVICES: YOUR TOTAL SERVICE PROVIDER

Wärtsilä Italia Services is continuously developing its portfolio of service solutions. With the on-site crankpin machining and the on-site heat treatment solutions Wärtsilä Italia Services is bringing its competence and expertise to your site, ensuring the same high quality results obtained at Wärtsilä Workshops.

The new on-site solutions reflect our commitment to be the Total Service Provider, always focused on reliability, flexibility and cost-effectiveness, constantly striving for the most updated technology to foster our customers' business.



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