INDUCTION FOR CARS
OVERVIEW OF APPLIED AUTOMOTIVE APPLICATIONS

MOTOR	**VALVES** **CRANKSHAFT** **CAMSHAFT** **FLYWHEEL AND STARTING RING GEAR**
DRIVE	**CLUTCH** **AXLE SHAFTS** **GEAR BOX ELEMENTS** **WHEEL BOLTS**
BRAKES	**BRAKE FLUID CONVEYANCE PIPES**
EXHAUST SYSTEM	**SILENCER PIPE**
FEED SYSTEM	**FUEL CONVEYANCE PIPES**
ACCESSORIES	**ELECTRIC SERVOMOTORS**
BODY	**RESIN CURING** **THREADED INSERTS OF STRIPPING** **RIVETS**
HYDRAULIC SERVO CONTROLS	**FLUID CONVEYANCE PIPES**
SUSPENSIONS	**SHOCK-ABSORBERS**

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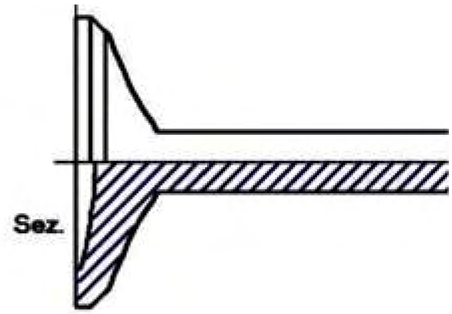
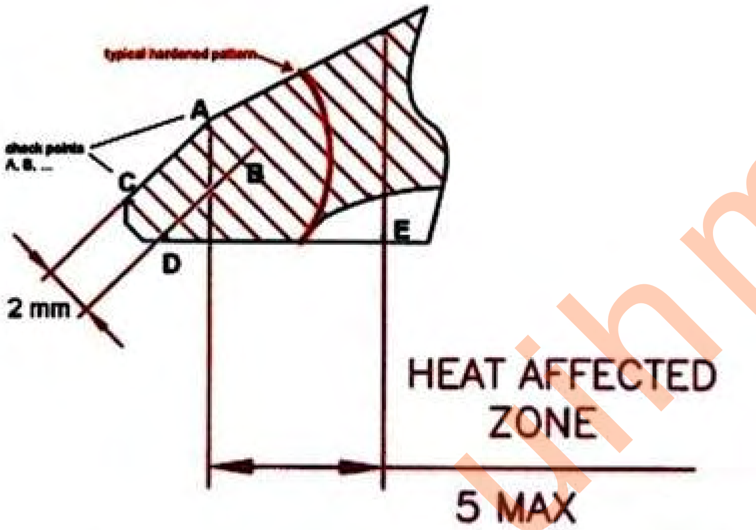
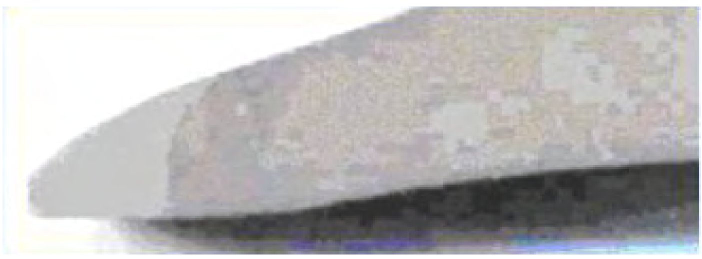


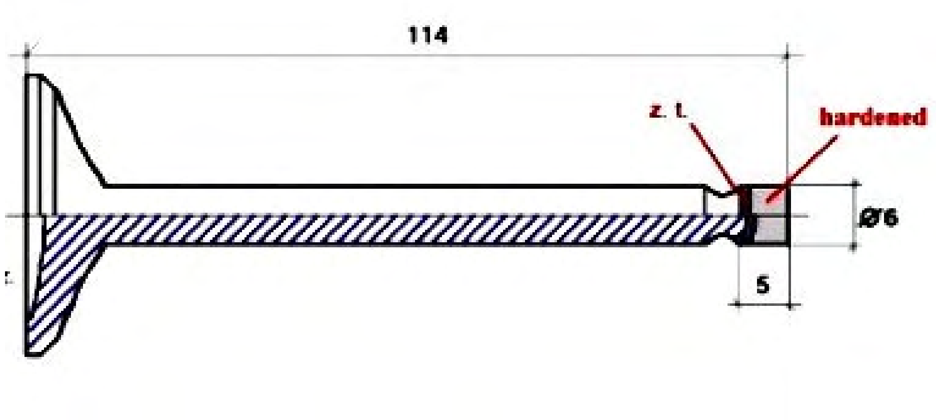
TREATMENT PARAMETERS
Head diameter: maximum 36 mm
Valve length: 80÷130 mm
Hardening depth: from 4.5 to 7 mm
Typical hardness: 52÷55 HRC
Typical production: 1,100÷1,200 pieces/hour



The installation dedicated to hardening of the valve seats can be equipped with a special coil to permit stress relief of the valve seats covered with Stellite.



Special versions of the valve seat hardening installation can attain production rates of 1,300 valves per hour with head diameter ranging from 32 and 36 mm, if provided with high power solid state generators.



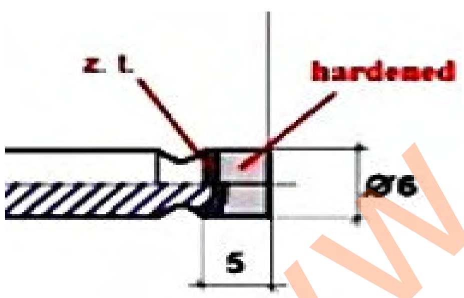
TREATMENT PARAMETERS

Head diameter: up to 60 mm for lorry valves

Valve length: maximum 200 mm

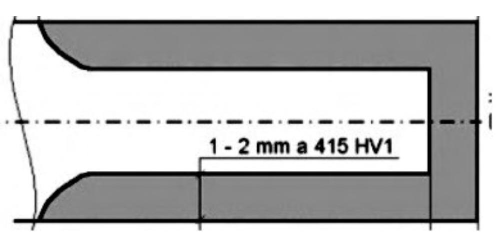
Hardened zone length: from 3.5 mm to 13 mm according to the model

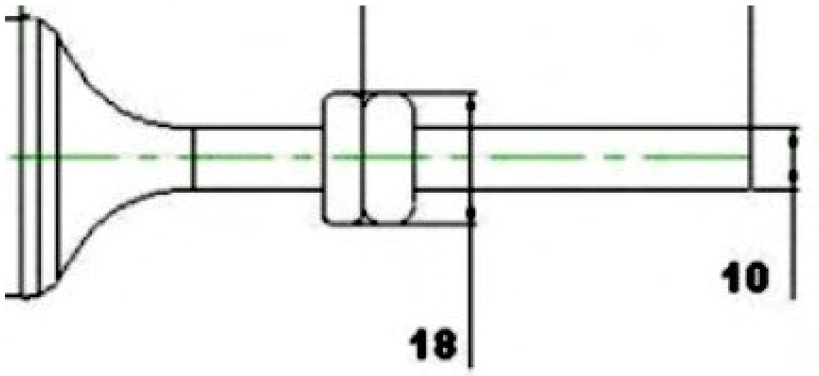
Typical hardness: 52 HRC for the “short” hardening - 50÷60 HRC for the “long” hardening



Typical production: 1,700 pieces/hour for “short” hardening - 1,200 for “long” hardening
Some "custom-made" machines make it possible to carry out both "core" hardening of the valve stem and "profile" hardening.

In this special case, typical production is 700 pieces/hour.





TREATMENT PARAMETERS

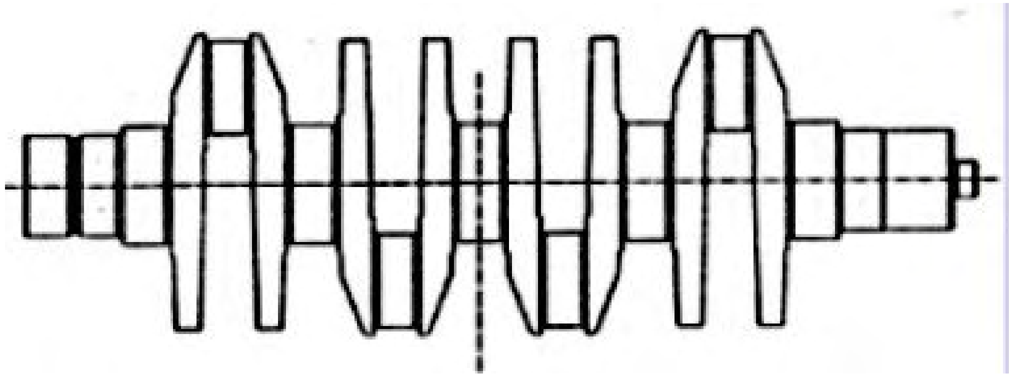
Head diameter: up to 60 mm for lorry valves

Valve length: maximum 200 mm

Typical hardness of the area affected by friction welding: 500÷650 HV1

Typical hardness after heat treatment: 370÷390 HV1

Using the latest solid state generators it is possible to have production rates greater than 1,000 valves per hour. The temperature control system is able to inspect the product one-hundred per cent and it allows the automatic rejection of the valve that, for whatever reason, could not reach a temperature in accordance with technology.



TECHNOLOGY DESCRIPTION

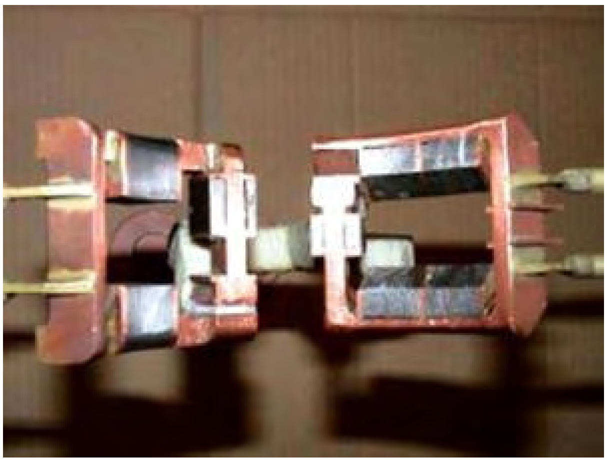
Surface hardening treatment of connecting rod pins and main journals of crankshafts.

TREATMENT TARGET

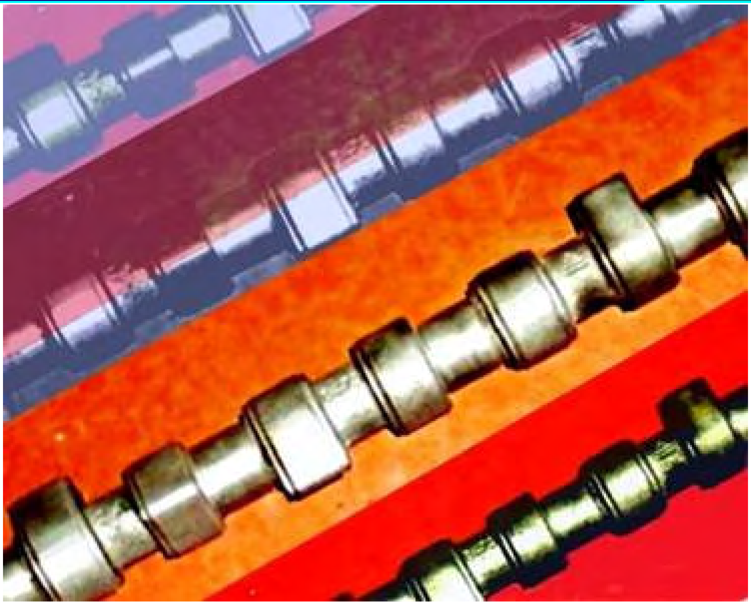
To improve the mechanical characteristics of torsion resistance and flexural rigidity of crankshafts by hardening the side pin connectors and consequent elimination of rolling operations.

SPECIAL FIXTURES

Heating is made possible by special coils provided with flux concentrators that direct the energy supplied by the solid state medium frequency generators in an extremely precise and localized way on the concerned zone of the crankshaft.



MOTOR CAMSHAFTS



TECHNOLOGY DESCRIPTION

Surface hardening treatment of camshafts.

TREATMENT TARGET

To improve the mechanical characteristics of torsion resistance and flexural rigidity of camshafts by hardening the side pin connectors and consequent elimination of rolling operations. Generally a surface hardness of 50÷56 HRC is required, obtained after stress relief in hot air furnaces. For camshafts coming from ductile cast iron fusion, an annealing operation is useful after forming to improve internal distribution of graphitic spheroids; and to avoid anomalous areas of ferrite deposit.

TECHNOLOGY DESCRIPTION

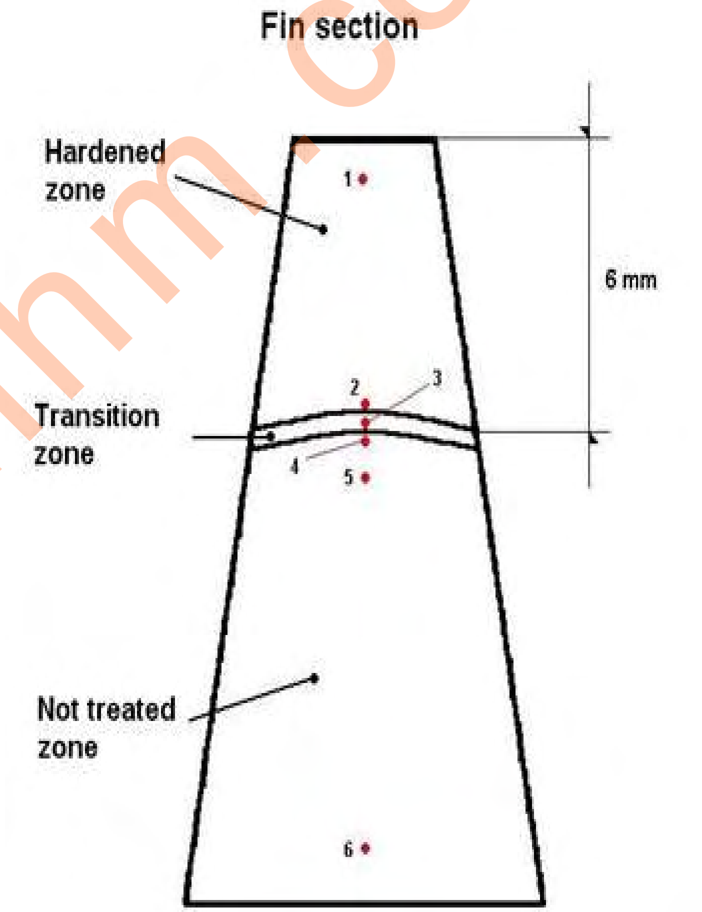
Surface treatment of the ring gear and subsequent hot-shrinkage on the motor flywheel.

Thanks to use of the modern Termotek series, the ring gears coming from feed magazine are heated and hardened very rapidly, so that geometrical deformation of the ring gear is avoided.

The cooling phase is stopped when the starting ring gear still has sufficient temperature to provoke the expansion needed to fit it on the flywheel. The ensemble is then definitively cooled.

TECHNOLOGY DESCRIPTION

Surface treatment in the central zone of the clutch pusher disk spring.



THE SYSTEM

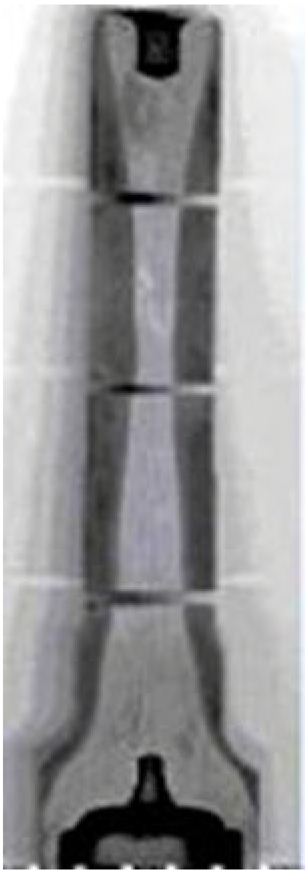
The production volumes require the use of highly automated systems that allow reduced production times and total control of the non-destructive process.

THE HEAT GENERATOR

It is necessary to use heating units with rather high power (output power rating of 75 kW) to obtain largely localized heating of the pusher disk with subsequent transition zone in the hardened zone and not highly limited to the total advantage of the mechanical properties.

TREATMENT AND TEMPERING AFTER HARDENING

Stress relief after hardening is normally carried out in a traditional furnace.



TECHNOLOGY DESCRIPTION

Surface hardening followed by self-tempering of axle shafts for drive transmissions.

TREATMENT PARAMETERS

Effective hardening depth: 3.5÷5 mm

Total hardening depth: 4.5÷6 mm

Surface hardness after hardening: 505÷2 HRC

Cycle time: 18 sec

HEATING AND HARDENING

Because of the considerable production volumes, it is necessary to use "single shot" shaped inductors capable of heating the entire hardening profile simultaneously. I.G.B.T. solid state generator power is suitable (150÷200 kW). Hardening shower and cooling liquid management are of greatest importance.

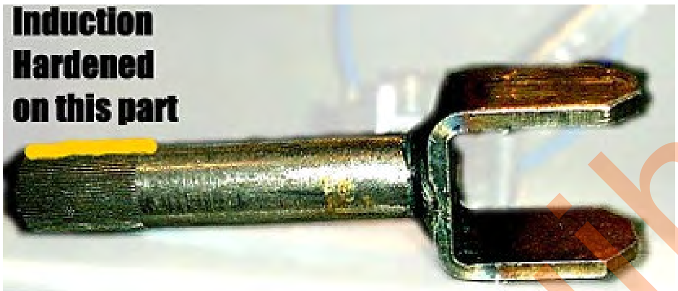
TECHNOLOGY DESCRIPTION

Surface hardening of gear parts such as levers, shifting forks, etc.



DIFFERENT TYPES OF INSTALLATIONS

Based on the type of gear box details and production required, a different installation method must be used. The suitable installation ranges over a rotary table with two heating generators and load interlocked by robot with cycle times lower than 5 seconds, to transfer installations or semi-automatic installation for small production (spare parts market).



THE IMPORTANCE OF THE HEATING GENERATOR

It is often necessary to heat using inductors with small dimensions and very irregular shapes: it is essential to have generators that can supply considerable powers, also at high frequencies, with absolute repetitiousness of the performance.

It is extremely advisable to use M.O.S.F.E.T. technology when high frequency up to 300 kHz is needed.

"Skin effect" heating is a precious instrument to control the hardening profile that, for most of these product types, is absolutely critical.

If medium frequency heating is required, modern solid state I.G.B.T. generators are preferred that have a larger range of frequencies than those with thyristors, being by this time obsolete.

The "trend" locking bolts for wheels is becoming increasingly widespread. These are bolts with coined heads that are then hardened, so that it is possible to screw or unscrew them with merely the key provided in their kit.

TECHNOLOGY DESCRIPTION

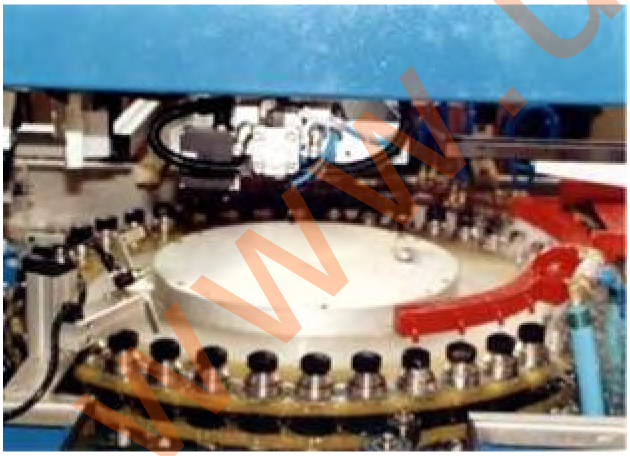
Surface hardening of the heads of locking bolts for wheels

TREATMENT PARAMETERS

Effective hardening depth: 2.5÷3 mm

Hardness after hardening: 52÷54 HRC

Hourly production: 1,800 pieces



ANCILLARY APPLICATION

Although for different purposes, hardening is suitable for bolt heads that clamp the tracks of earth-moving machines.

TREATMENT PARAMETERS

Effective hardening depth: 6÷8 mm

Hardness after hardening: 48÷52 HRC

Hourly production: 800 pieces of M 20 diameter

TECHNOLOGY DESCRIPTION

Double wall on-line brazing used for transport of the braking circuit liquid.

ON-LINE PROCESS ADVANTAGES

Since this particular tube has been invented, with considerably higher resistance characteristics compared to classic single wall tubes, furnace brazing technology with controlled atmosphere has always been used. The cold-profiled brake-fluid conveyance pipe was cut down to variable lengths but not more than 40 metres. It was then passed with others in a furnace where, once a temperature of 1,200°C was attained, it was brazed. The revolutionary technology developed by Termomacchine permits the pipe to be brazed directly on the production line at a speed of about 110 meters per minute for 4.76 mm diameter, and not much less for the 6.35 mm diameter.

REDUCED PRODUCTION COSTS

It appears evident that the production costs are drastically lowered and the waste due to the necessity to cut down a tube length for the furnace passage is reduced. The number of personnel employed for production is reduced substantially.

INCREASE IN QUALITY

A modern brazing line by Termomacchine can offer valid opportunities for production quality control thanks to continuous monitoring of the process temperature, to the production atmosphere composition, and to many other technological parameters. A concrete increase in safety is given by a tangible reduction of the circulating gas volume in comparison to traditional furnaces.

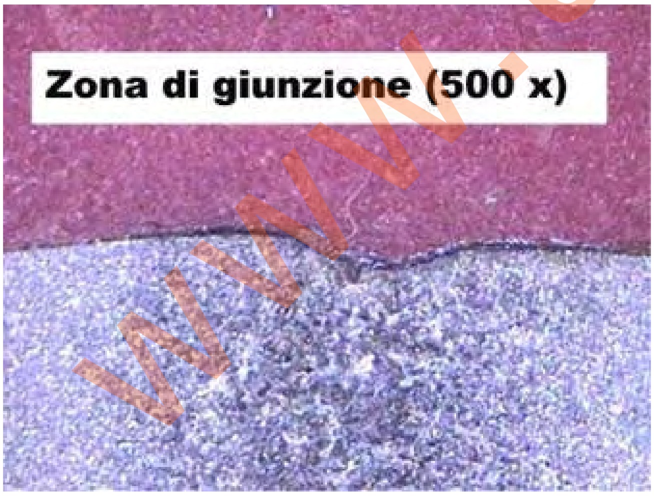
TECHNOLOGY DESCRIPTION

Longitudinal welding of tubes drawn from strip destined for manufacturing of exhaust silencers.

The longitudinal welding of silencer pipes by induction heating is a low cost technology that makes very high production speeds possible both on carbon steel and on stainless steel.

QUALITY AND RELIABILITY

Termomacchine's high frequency thermionic and solid state generators are time-proven in products that are capable of offering high performance and remarkable energy savings with extremely low maintenance needs.



ANCILLARY TECHNOLOGIES

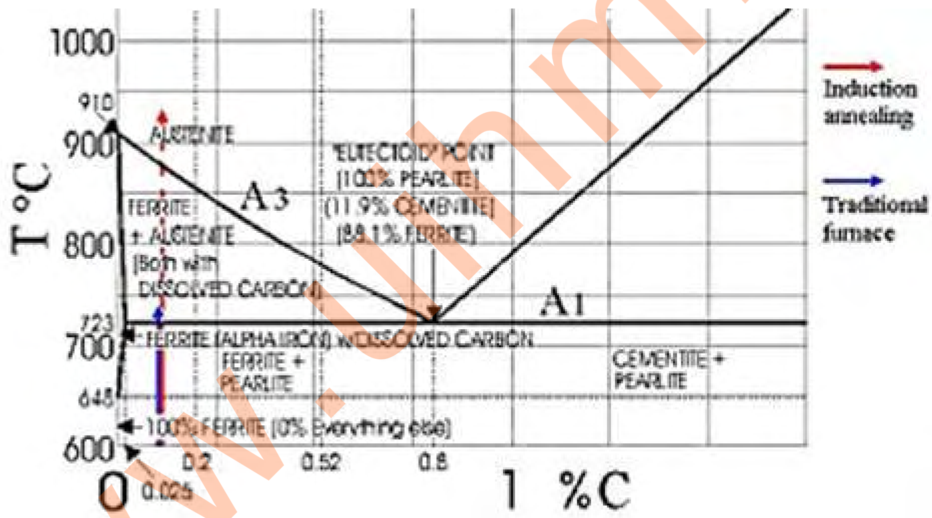
Induction heating is usually used for a series of applications is the tube used in the automotive market. It ranges from brazing of pipe fittings, to hot tube deformation, through to welding of flanges or heat treatment after welding of specially stressed parts that need a "stress relief" process.

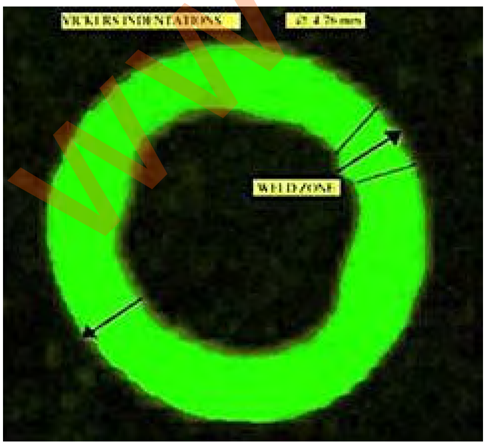
TECHNOLOGY DESCRIPTION

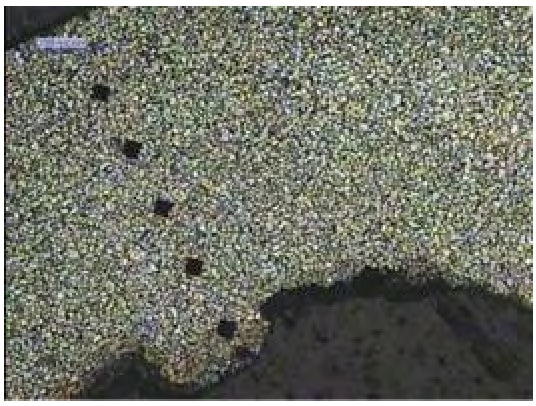
Single wall on-line tube annealing treatment used for the transport of fuel to allow the subsequent shaping.

ON-LINE PROCESS ADVANTAGES

In the traditional production process of tubes for fuel conveyance (diameters between 8 x 0.7 to 12 x 1.0 mm), the tubes had to be wound in coils to undergo the heat treatment in bell "furnaces"; afterwards, they had to be straightened and cut to size. Today heat treatment is made on-line at very high speeds: over 100 meters per minute for a tube with diameter 8 x 0.7 is the norm; for smaller diameters, which are used for refrigeration, it exceeds 200 meters per minute (diameter 4.76 x 0.7 mm).







TECHNOLOGY DESCRIPTION

Replacement of the traditional insulation paper or half bearing in the 12 VDC electric servomotors used in the automotive sector with another obtained from epoxy resin polymerisation applied with spray-coating process.

ADVANTAGES OF THE SPRAY-COATING PROCESS IN ELECTRIC SERVOMOTOR TREATMENT

First of all production speed: for smaller rotors (diameter 17 x pack height 10 mm) a production rate of 1,200 pieces hour is obtained with a completely automatic system, unthinkable for the traditional systems that apply the insulation strip inside the slot.

Production costs obviously decrease because the reduced resin thickness (0.3 mm) is sufficient to ensure very good insulation.

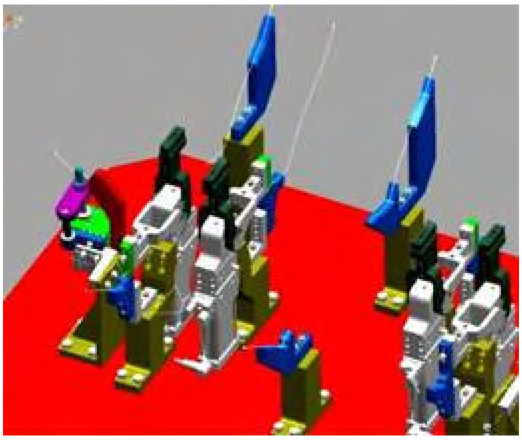
Lower insulation thickness implies larger free space inside the slot: making it consequently easier to wind.

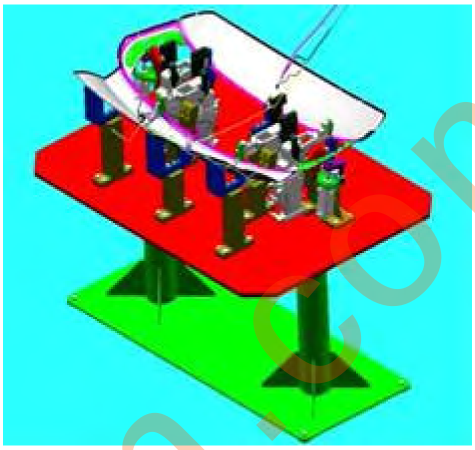
BODY **RESIN CURING**

TECHNOLOGY DESCRIPTION

Resin precuring applied to body parts before they enter the furnace where polymerization will take place.

The part (for example hatchback) is positioned on the holding fixture and blocked.





At this point, the resin is spread on the piece perimeter.

The solid state generator equipped with an inductor that follows the piece shape heats up the perimeter at about 130°C causing the resin to harden.

Although the complete polymerization is attained in the furnace, the resin is almost solidified and the piece can move without any problems.

EFFICIENT CONTROL OF THE RESIN CURING MACHINE

The system is provided with a process temperature control unit. Temperature is analyzed by 10 thermocouples for statistical certification of process parameters.

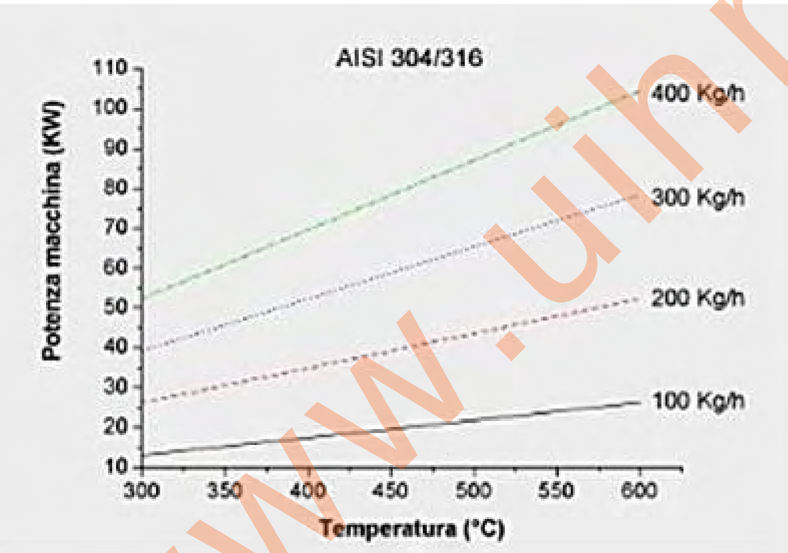
BODY	THREADED INSERTS OF STRIPPING RIVETS

TECHNOLOGY DESCRIPTION

Heating of stainless steel wires on a multiheader to allow heading of threaded inserts for anchor of body components for cars and/or for vehicles

ADVANTAGES OFFERED BY THE INNOVATION

Cold heading of stainless steel is particularly critical when complex forms are to be obtained such as threaded body inserts. Preheating the wire (400÷500°C), just before it is headed, can offer many advantages; not least is a large increase in the duration of punches and matrices. Termomacchine has been the first manufacturer of induction systems to insert the heating inductor directly on the press "en bloc" immediately before the cut bush; the wire does not lose heat before it arrives at deformation as deformation takes place if the wire is heated prior to entering in the press.



TECHNOLOGY DESCRIPTION

Brazing of fittings and flanges for pipes for fluid transport to hydraulic servo systems.

INDUCTION BRAZING ADVANTAGES

Induction heating is rapid, eco-friendly and it can be parameterized.
The old concept of flame brazing summons up an unhealthy smoky working environment where the sole guarantee for lot treatment uniformity was operator's professionalism.
Termomacchine's induction brazing machines for fluid conveyance pipes are real machine centres, with control of parameters and possibility of process certification.

ZERO REJECTS

The target is no longer utopia.
Constancy of power supply, the possibility of distributing in automatic deoxidizer and alloy and opportunity of controlling quantity and process temperature have a great influence on the reduction of component rejects and production cost of the component.

TECHNOLOGY DESCRIPTION

Stem surface hardening for shock absorbers.

TECHNOLOGY PARAMETERS

Stem diameter: from 11 to 26 mm

Stem length: from 130 to 650 mm

Treatment depth: 0.8 ÷1.5 mm

Feed speed: 100 mm/sec

“PASSAGE” TECHNOLOGY

The high production rates that are necessary nowadays are only feasible with horizontal hardening equipment when the piece being turned is pushed through the hardening inductor and then immediately cooled.

Since just a very short shock absorber stem length is heated, there are no distortions; below the hardening system is straightening occurs without the need for a straightening station.

ANCILLARY TECHNOLOGIES

Thanks to induction heating, it is possible to deform the tube with which the fluid or gas magazine that cushions shock absorber stem movement is manufactured; no more welding and micro waste of time.

Induction is a precious vehicle for "dehydrogenization" technology that is applied to some types of particularly stressed stems.