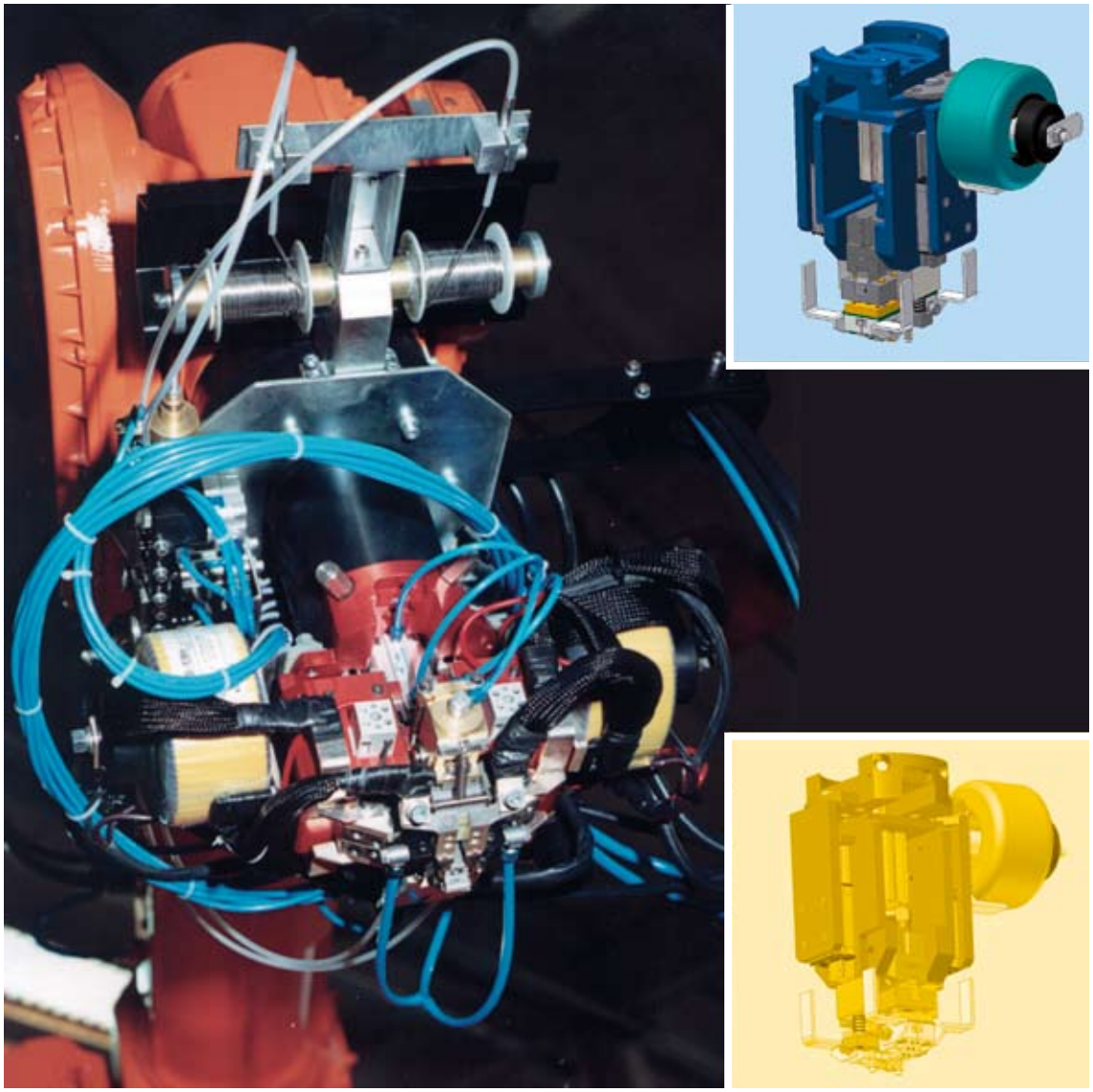
SOLUTIONS FOR THE AUTOMOTIVE GLASS INDUSTRY

The Backlight Soldering



STAR
Engineered Robotics Solutions

GENERAL DESCRIPTION

The soldering of terminal tabs onto heated backlights is a technological application constrained by a number of critical and tricky parameters, though requiring flexibility to be adapted to both the wide range of glasses and terminals to handle, and to the various plant configurations of the different production lines. Particularly where high performance rates are expected, the top reliability and utilisation coefficient are to be matched.
Further to the non-negligible but typical differences in size and shape among the automotive glass models, more and more issues are to be taken into account:

- *Number, position and shape of tabs to solder*
- *Chemical and physical aspects of the printed layer (depending on the heater grid characteristics and also on the manufacturing process)*
- *Technical specification both from the End-user or superimposed by the same manufacturer (pull-off resistance, aesthetics for the joint, capabilities, limited downtimes, etc.)*
- *Operating modalities of the production process (layout limitations, output rate, number of shifts, frequence and duration of changeovers to plan, etc.)*

STAR SYSTEM

In full awareness of the wide variety of the product requisites and of the economic and technical constraints of the process in its whole, STAR offers a soldering technology intrinsically effective and controlled which is the right answer to the quality needs through customised solutions for each specific Customer.
Ranging from the simplest operator assisted application to the most powerful fully automatic system, the technological

soldering operation from STAR grants the highest quality standard currently available on the market.
Three major items constitute the soldering technology of STAR: the electronic control system to drive the process, the special soldering head and the feeding module for the terminal tabs to solder.
The other devices that make up a productive unit, specifically the handlers for tools and backlights, are designed to set up the best suitable configuration with respect to the individual Customer plant requirements.

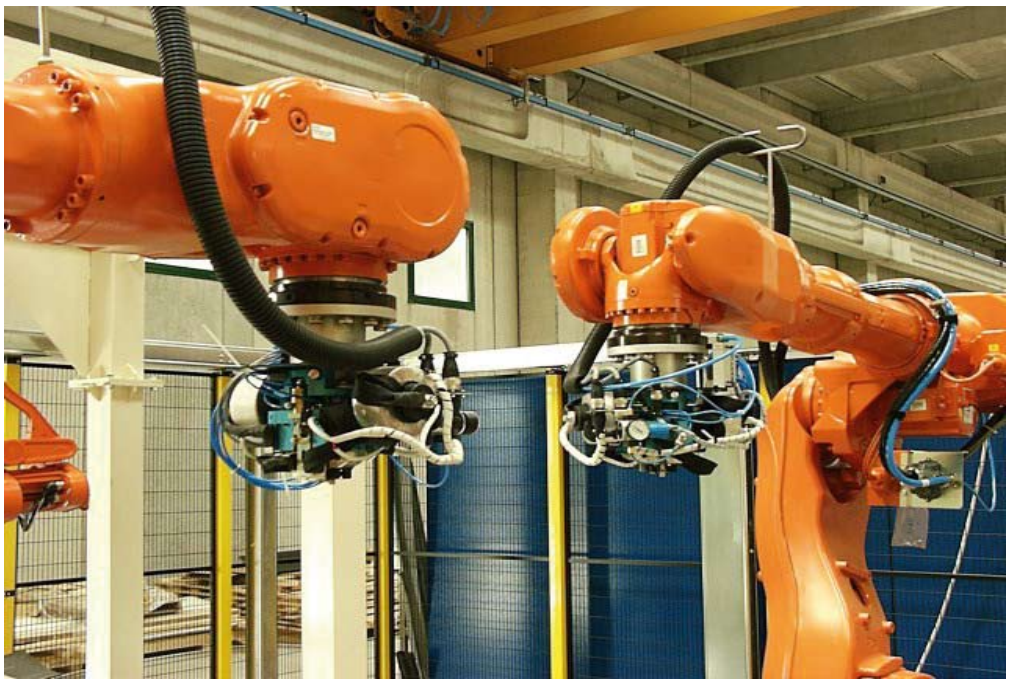
The Control System

The electronic control system is designed to fully manage one or more soldering heads and one or more tabs feeding systems; it incorporates a complete "operator interface" for the handling of the process through the technological parameters, and also the

system interface with the outer devices, handling and services, included in the productive unit.
The technological parameters, despite representing the core of a sophisticated process, are turned to plain and easy instruments, very straight and interpretable through the "visible" effects of the available adjustment.

The Soldering Head

The soldering head realises the special STAR technology, based on the heat generation through the electrical power transmitted to the tab to solder by a number of electrodes .
An accurate supply and distribution of the heat to the different elements involved, is available through multiple sequenced phases. The soldering is made by heating up the terminal tab directly (and the solder), and is sequenced to minimise the interaction with the printed layer of the backlight.
A dedicated software, elaborating real-time measures coming up from the process, is able to control via feedback loop, the right quantity of energy transmitted to the single clip in order to obtain a constant soldering quality during the production and the highest level of capability. Furthermore is possible to control separately the energy transmitted to the single "foot" of the clip (left and right) with a perfect balancing of the soldering quality.
The mechanical structure of the head, modular in its major components, allows setting up the right configuration for widest range of terminal tabs "families": solid copper, flexible sleeved or unsleeved, flat, bent up, etc.
In particular the mechanism to pick up the tab is specialised for a single terminal tabs "family".
The soldering head itself is designed for quick swapping on the productive unit , so allowing easy changeover and maintenance operations, thank to quick pneumatic and electric connector plugs and to the reference dowells it's equipped with for fitting.



The Feeding Module

The feeding module for the terminal tabs to solder is the mechanical system which allows presenting one after the other the terminal tabs in a pre determined position, firm and secure, for the next pick up and handling by the soldering head.

Various tabs feeders are available, different from each other, both in terms of feeding technique (vibration based, carrier equipped, pick-and-place structured, ..) and in terms of tabs loading modality (magazine, bowl, individual slide, ..). According to the the size and shape of the terminal tabs to handle, the proper feeder can be chosen for the best effective and reliable operation.

One tab feeding system is configured for one kind of tabs, and is suitable for parts which have some peculiar characteristics, dimensions and tolerances, constant and granted. The STAR technological soldering system, thanks to its stable control of the process parameters, gives the best premise for a consistent production at the highest quality levels.

The achieved results by the units in operation by the major glass companies in the world, for example in terms of pull-off resistance and aesthetic quality, are such as to match the most stringent acceptance specification from car makers, users of this product.

SET - UPS

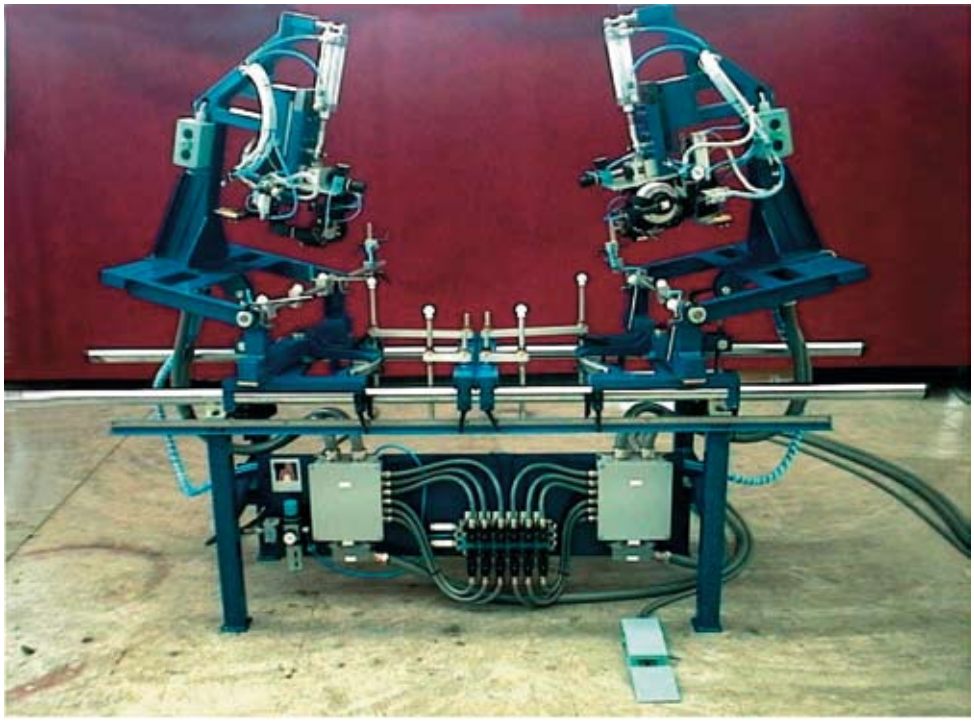
The Semi-automatic Machine

The elementary solution for a soldering station is made of the semi-automatic soldering machine TAI-SM.

This incorporates a supporting bench for the backlight, one or two soldering heads, and one control driving unit.

Its structure is such as to grant the automatic performance of the technological operation, while an operator is charged of manually loading/unloading the backlight, squaring it and of the feeding of the terminal tabs into the soldering heads.

The automatic cycle is started by the operator through a pedal switch.



This semi-automatic machine is suitable for the processing of limited number of glasses per day; backlights are to be the classic type with one terminal tab per side.

Production capacity, strictly related to the actual duration of manual operation, can vary between 30 to 60 backlights per hour, excluding of course other possible ancillary operations (such as busbar abrasion, grid checking, ...) which could be eventually made by the operator in the same station.

Optional Features

Energy controlled process - For the soldering phase the available parameters for each clip base side are used as follows: once the optimal energy to give is determined and the relevant value downloaded, the soldering level can be chosen from lowest to highest in order to select the best soldering modality; during the soldering cycle, the system will keep supplying power at the selected voltage level for so long as required to deliver the targeted energy. The system will stop as soon as the targeted energy is matched.

Twin control circuit - One of the two soldering circuits is dedicated both to the preheating phase through the clip grippers and to the soldering of one side of the clip base, through one pair of electrode tips; the second soldering circuit is for the soldering of the other side of the clip base, through the other pair of electrode tips.
The two soldering circuits have independent adjustable parameters, so that the two sides of the clip, left and right, can be soldered under different settings.
The mentioned possibility, together with the two individual energy control systems, allows real-time monitoring of the heat balance between the two sides of the clip base.

Soldering wire feeding - Each soldering head can comprise one base structure, one positioning group and one feeding unit for solder wire. The head is a complete subassembly, conceived as an interchangeable module for the STAR soldering systems.

Automatic pull test - Either for product sorting and SPC, the mechanical resistance of a soldering tab is metered. Shear/pull stress or strip-off test is applied.

Electrical check - Bus bar buffing, grid amperage, overvoltage test and lines continuity check are performed at once in a line-compatible time. Specifically for complex heated backlights.

In line automatic labeling of process parameter - Product data are stamped on each glass, right after a performance test, for certification or sorting purposes.

The Robotized Cell

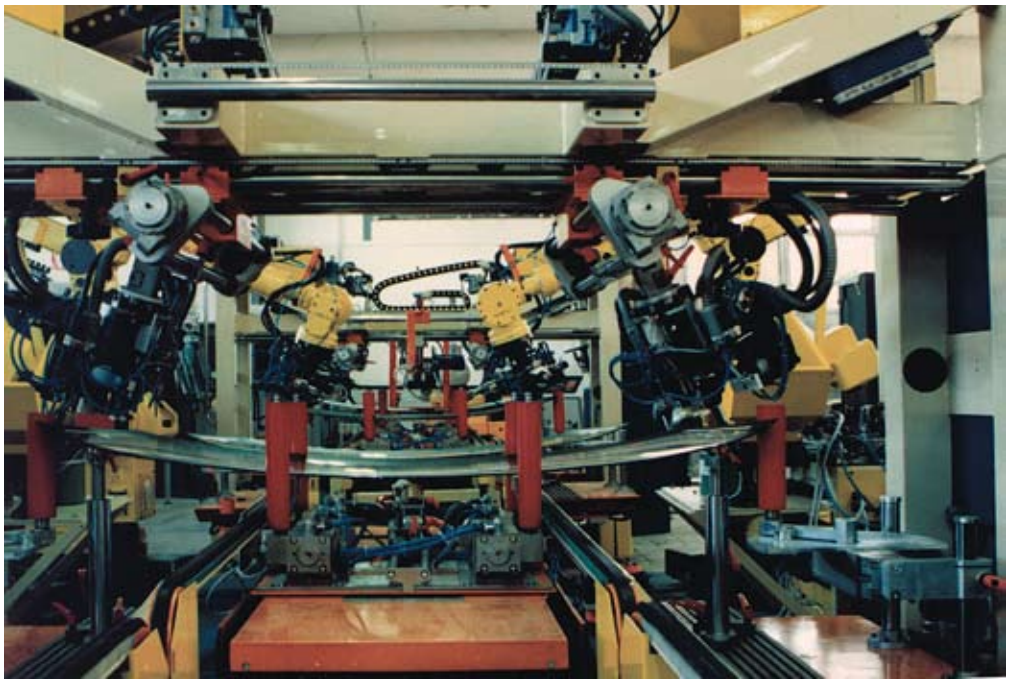
One even more automated solution is the type TAI-RDS which employs industrial robots equipped with the soldering head. Example of such type of layout is shown in the reported pictures; as far as the backlight streaming flow is concerned, these are similar to the ones described above.

Another alternative solution is where the robots are hanging upside-down from a gantry frame across the transport line of the glasses: this is to make the best possible use of the available robot envelope. Robots can be of a smaller size with reference to those for installation on the floor right beside the line.
Major advantage is the reduced floor space needed for the system and the easy fencing of the cell.
The great flexibility of the RDS solutions, based on the industrial robot that carries the soldering tool, consists of the chance to perform in the same station more than on soldering operation on the same backlight and possibly with different terminal tabs picked up from their respective feeders, contemporarily present within the robot reach.

It is then possible to :

- Step gradually into automation, initially realising one single soldering unit (which will solder the two terminal tabs one after the other) and deserve the possibility to install one second station only when the real need would arise to improve twice as much the output rate.
- Process backlights with more than two terminal ends: since such king of products quite often represents a little percentage of the total volume, the output rate reduction can be seen as the right compromise between cost of installation and cost of production.
- Minimise the stoppage due to changeover for different types of terminal tabs to use; in many cases the whole change, part program swap, addressing and line management, can be automatically performed by the line control system through a pre-recorded software sequence.

Finally, this type of line keeps the characteristics of high productivity of the systems based on the automatic machines, also enhancing the flexibility, particularly with respect to the changeover operations.



The soldering working islands

One conceptually different from those above, is that of the soldering work islands, where the backlight to solder is handled by an industrial robot and is carried along through processing work stations. In such case, one or more robots, equipped with proper end-of-arm tool, pick up glasses to solder from a squaring station and bring before one or more soldering machines type TAI-SWS.

Each soldering machine can solder one type of terminal tab per run, and it is also possible to make more soldering, one after the other, on the same backlight.

In the case of the working island where two handling robots and two soldering machine TAI-SWS are included, two modes of operation are available:

Sequence in parallel: the robots alternatively pick the backlight up from the squaring conveyor and take before the respective soldering machine to perform the two (or more) soldering required. Such modality is possible when the two (or more) terminal tabs to solder are of the same type.

Sequence in series: the first robot picks the glass up from the squaring conveyor and brings to the first soldering machine, where the first (or the firsts) soldering is performed; then it drops the glass off onto an exchange bench which keeps the squaring.

The second robot will pick the glass up from such exchange bench and bring to the second soldering station where the second(s) soldering is performed. The terminal tabs soldered by the two machines can be different from each other (e.g. one right-handed and one left-handed; one short for + and one long for ground connection to the car body).

This type of solution offers some advantages, especially when further handling is conveniently required prior or after the soldering operation; i.e. depalletizing, loading onto inspection conveyors, decking, etc

The soldering development system

The testing procedures can be conveniently carried out off line by means of a full scale operative bench in order to monitor the characteristics of new backlights to be introduced into a process incorporating the automatic soldering of the terminal tabs, or even to provide for small sampling of new products.

This one is the TAI-SSS unit, equipped with the three main equipment sets: soldering head, terminal tabs feeder, busbar abrasion head and control system. It can exactly reproduce the same working conditions, from the technological point of view, of the completely automatic line processing systems.

Moreover, the control system is the “open” type, meaning that both the range of adjustment and the display of operating parameters is particularly extended and detailed. The specific tooling for the bench is absolutely interchangeable with that of production, so the soldering heads, the feeders and the abrasion head can be taken from the automatic line and viceversa. This is of help also for maintenance purposes.

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