In recent years, one of the greatest revolutions in the field of stamping car structural parts has occurred due to hot forming technology.

This has been called press hardening, hot forming, hot stamping, etc. and in any event refers to a technology centred on transforming the metallographic characteristics of steel sheeting (22MnB5) while simultaneously forming the sheeting. For this process, metal sheeting is first heated to temperatures around 900ºC to obtain its complete austenite transformation and is then transferred to a forming station (press + die) where the part is simultaneously cooled with the die closed.

Although the technique has been known for around 20 years, the biggest challenge was its financially viable implementation in mass production industrial facilities to manufacture components in the medium range car sector and not solely for exclusive models with small batches.

There are three stages limiting the production capacity of a hot stamping line. Firstly, the destacking installation, responsible for feeding the sheet metal into the furnace, secondly, the plate heat system (furnace) and thirdly, the forming cell comprising the press itself, the die and the loading and unloading system.

Forming cell

Analyzing the forming cell forms part of the sphere of the die technology to achieve quick uniform cooling of the part so as to reduce cell idle times to a minimum and consequently the current cycle times.

Not many years ago, the standard equipment had a cooling time of over 15 seconds. Nowadays, due to the development of specific steels for this application which have a high conductivity of up to 66 W/mK (Rovalma HTCS 150) without serious negative effects on the mechanical characteristics of the steel, a closed-die time of 6 seconds, and also more often one of 5 seconds, can be achieved.

Likewise the speeds required for hydraulic presses are in a higher range than usual for this press type. Linear speeds of up to 900 mm/s are necessary to obtain complete competitive cycles.

In the following lines we will set out in greater detail how to tackle part transfer, both for loading the hot blank onto the press and for unloading the formed part.
Relative furnace-press position

Starting from the generic configuration of the cell around the press, the first point to analyze in each step is the relative position of the furnace centring table and the press itself.

Depending on the different factors, the press may be configured in alignment with the furnace itself or at 90º in relation to the furnace centring table, in a perpendicular position. 1

Several factors influence the decision regarding the most convenient position and each case should be analyzed separately. The aim is to reduce the time required to transfer the part into the die, resulting in lower cycle times while also preventing heat loss of the metal sheeting outside the furnace so that this loss does not invalidate the controlled hardening process to be performed once the die is closed.

So the influencing factors are: part dimensions, number of parts to be processed simultaneously, the practicality of the rejects box being in line with the press and the part transfer system (as we shall see later on).

Transfer using Robots

The first transfer type for loading and unloading the press used commercial robots.

This has the advantage of using widely tested equipment which works even in adverse conditions (e.g. forging). Furthermore, both engineering and maintenance teams are familiar with the characteristics so during the installation design phase, both the use and the maintenance can easily be industrialized.

Finally, flexibility of movement makes them extraordinarily versatile and capable of dealing with very different configurations in the relative position between pick-up and positioning points. 2

All these advantages made this part transfer system the most widely used in first generation installations and it is still used today, even though the search for greater cadences requires the implementation of more complex robotic systems (e.g. doubles) or other totally different transfer systems.

Loading-unloading using feeder: speed

Although robots had all the aforementioned advantages, other specific equipment may be used for certain configurations to optimize the cycle times.

As the result of an optimum configuration of press-furnace it is possible to reduce the movement to a main linear transfer movement between both elements and a secondary up-down movement for pick-up. 3

This configuration enables the use of Feeder type systems where independent drives perform the Cartesian movements.

The Fagor LR3120 Feeder also has the advantage of having a telescopic arm on its main movement, where not only are the speeds of the main action amplified but the
collision issues are also minimized as it manages to make clamp holder gripper reach the end positions at both ends of the travel.

High speeds are achieved with these feeder systems:

- **Forward (X-Axis) X = 0 to 3,500 mm.**
  - Acceleration $A_x = 12 \text{ m/s}^2$
  - Speed $V_x = 7 \text{ m/s}$

- **Up (Z-Axis) Z = 0 to 600 mm.**
  - Acceleration $A_z = 10 \text{ m/s}^2$
  - Speed $V_z = 3 \text{ m/s}$

In addition, the main axes can be equipped with other, either linear or rotary, axes which may be interesting not only for positioning the parts during production but also for gripper change operations or defective part rejection.

**Transfer modes: time optimization**

The systems described so far are based on the use of mechanical gripping systems which efficiently clamp the part on all sides.

Commercial elements (with particularities inherent in the environment temperatures) traditionally used in robotic systems can be employed.

This type of part fixing requires delaying the start of the unloading gripper entry into the die until the press is completely open. Likewise the press cannot begin its downward travel until the loading gripper has exited the sweep area of the upper die.

This kind of situation is also known in cold stamping and was traditionally optimized using part feeder transfer systems.

The transfer systems are characterized by anchoring the part solely at the ends, making part handling delicate and which in the case of hot stamping is accentuated when handling sheet plates at 900°C.

However, one can achieve:

- Small die openings.

- **Overlapping:**
  - System introduction during cooling period.
  - Part lifting with press opening.
  - Die closing with system exit.

As a whole this may mean production increases of up to 25% for the same part.

Contrary to classic cold stamping transfer systems with two lateral bars along both sides of the die, Hotteknik integrates the transfer systems of four separate units with divided bars facilitating independent control of loading and unloading which particularly optimizes the overlapping between both operations and the press itself.

These units, based on Fagor LR360 and CNC6S models, in conjunction with high speed hydraulic presses provide the best possible cadences.
PRESS + FEEDER Synchronization

Although the features of the components are vital for the final results, special attention must be paid to synchronization of relative movements when talking about cadence.

If we seek to optimize the entire transfer system in conjunction with the hydraulic press, the press must have a control system in closed cycle enabling us to guarantee its position at all times. Otherwise, we will be forced to increase the safety margins of the relative movements in detriment to the efficiency of the entire unit. Controls like Simotion by Siemens allow this kind of functions.

A line control guaranteeing optimum electronic synchronization for Load Feeder-Press-Unload Feeder using communication.

HOTTEKNIK integrates the press (Onapres), the automation (Fagor) and the hot stamping dies (Batz) all into the same technical equipment unit. This capacity to conceive the line as a single unit at all levels means optimum features can be guaranteed in terms of both installation cadence and reliability.