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Evaluating Plate Processor Design

Characteristics

Capabilities

Advantages

Limitations

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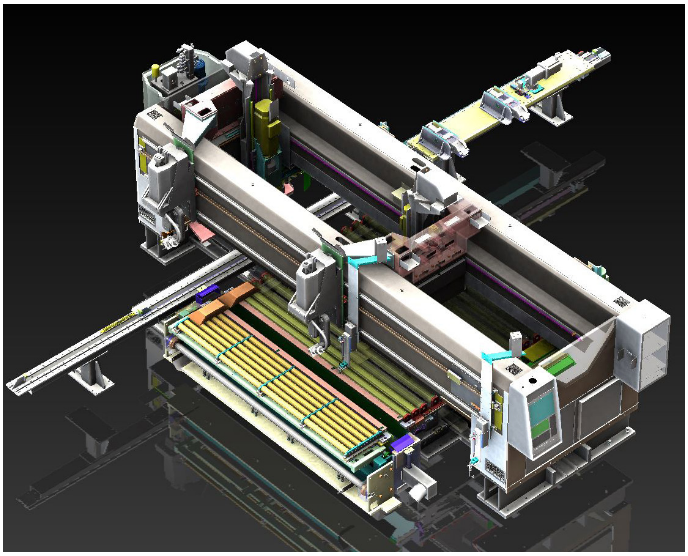
The creative nature of machine tool manufacturers has, over time, attacked the fabrication of plate components or parts with different approaches and characteristics.



Typically, the CNC systems that have been developed have focused on the concept of consolidating diverse processes into one system. This practice has the advantage of eliminating the need to route plate components to different work centers.

This eliminates or reduces:

- Material handling steps
- Number of operators required
- Plant space
- Total labor consumed
- Process time from start to stop

The fabrication of parts or components by CNC plate processors typically incorporates most of the following capabilities:

- Punching
- Drilling
- Plasma cutting
- Oxy-fuel cutting
- Thermal beveling for weld prep
- Milling
- Tapping
- Countersinking
- Scribing for layout
- Counter boring
- Part marking

As the machine tool industry has designed CNC systems for the fabrication of plate components, the diverse types that have been engineered to accomplish these tasks can be defined as follows:

- **Pull through style systems**
- **Gantry style systems**

Pull Through Style Systems

Pull Through Style Systems without Sub-Axis Capability

Plate processors of this style move the stock plate in the length axis and the tool (punch, drill or both) in the width axis.
When holes are generated by drilling or punching in the stock plate, it must be positioned in the length axis and the tool in the width axis to achieve the required coordinates for each hole.

Once in position the plate must be clamped prior to punching or drilling then unclamped upon completion of the hole before positioning to the next set of coordinates prior to clamping the material again.

If thermal cutting is incorporated in the system, the torches are moved in the width axis in conjunction with the movement of the plate in the length axis. The numerous material clamp and unclamp cycles associated with punching and drilling of each hole is not required for thermal cutting.

As the plate is positioned in the length axis the smaller finished parts can be located over a drop table to automatically remove the part from the plate skeleton.

When completing a part that exceeds the size of the drop table (generally about 600 mm x the plate width of the system), the process must be stopped so the part can be manually removed from the plate skeleton before the plate processor can continue its automatic operation.
When considering operations generated by the drill spindle, this design is considered a “point-to-point” system.
Once both the plate and the spindle has achieved the programmed coordinate position the spindle is activated for drilling, tapping countersinking, etc.

Point-to-point systems are not efficient for the generation of operations that would require the plate and the spindle to be positioned in coordination with each other like in the case of milling for example.

The mill tolerance and abnormalities of rolled plates causes changes of the position of the top surface during positioning. This changing position of the plate’s surface, in conjunction with the inability to effectively clamp the plate during positioning near the point of operation, makes milling operations unadvisable.
This does not apply to scribing, however, as the tool is spring-loaded so it can float as the height of the plate’s top surface changes and maintain a constant depth of penetration.

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Pull Through Style Systems with Sub-Axis Capability

Pull through systems of this type have all the advantages of those without sub-axis positioning but also have many significant additional advantages.

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These systems have the ability to move the spindle in the length and width axis simultaneously as they have none of the limitations of the point-to-point systems described above.

The additional advantages can be summarized as follows:

- It is no longer necessary to clamp and unclamp the stock plate as part of the drilling cycle for each hole in a pattern.
- A greater productivity is achieved resulting from quicker “chip-to-chip” times as it is more efficient to position a spindle in milliseconds versus having to release material clamps, position a plate that weighs several tons and then re-clamp the material.
- The efficiency of typical milling and scribing operations are maximized, as the plate remains stationary and rigidly clamped during these operations.
- These systems can be furnished with two totally independent spindles each with their own sub-axis. Two different patterns with differing length axis coordinates can be generating drilling, milling and scribing operations simultaneously.
- Typical increase in spindle productivity of up to 100% is achieved.

Gantry Style Systems

Gantry Style Systems without Sub-Axis Capability

This style of plate processors starts with a gantry that travels the full length of the stock plate. Incorporated in the gantry is the drill spindle and the full complement of plasma and oxy-fuel torches. In this design the stock plate remains stationary as the gantry travels in the length axis and the tools (spindles and torches) traverse within the gantry to cover the width of the plate.

When holes are generated by drilling, the gantry and the tools within the gantry must be positioned to achieve the required coordinates for each hole. Once in position the plate must be clamped prior to drilling then unclamped upon completion of the hole before positioning the gantry and spindle to the next set of coordinates.

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If thermal cutting is incorporated in the system, the torches are moved in the width axis in conjunction with the movement of the gantry in the length axis.

The numerous material clamp and unclamp cycles associated with drilling of each hole are not required during thermal cutting.

Since the stock plate is stationary the finished parts, both large and small, can be removed from the plate skeleton while another stock plate is engaged in the fabrication processes.

When considering operations generated by the drill spindle, this design is considered a “point-to-point” system.
Once both the gantry and the spindle have achieved the programmed coordinate position, the spindle is activated for drilling, tapping, countersinking, etc.

Point-to-point systems are not efficient for the generation of milling operations that require the plate and the spindle to be positioned in coordination with each other. In pull through plate processors, the mill tolerance and abnormalities of rolled plates cause changes to the position of the top surface of the plate during positioning.

This changing position of the plate’s surface, in conjunction with the inability to effectively clamp the plate during positioning near the point of operation, makes milling operations unadvisable when you consider the reduction of tool life and diminished milling rates required to minimize vibration.

Gantry Style Systems with Sub-Axis Capability

Gantry style systems of this type have all the advantages of those gantry style systems without sub-axis positioning, but they also have many significant additional advantages.
These systems have the ability to move the spindle not just in the width axis but also in the length axis.
This sub-axis positioning enables both the plate and the gantry to remain rigidly clamped while the spindle or spindles generate the full range of machining functions.

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The additional advantages can be summarized as follows:

- It is no longer necessary to clamp and unclamp the stock plate and the gantry to the rails as part of the drilling cycle for each hole, for example.
- As the length axis coordinate changes for a process zone within the part, it is no longer necessary to reposition the gantry each time.
- A greater productivity is achieved resulting from quicker "chip-to-chip" times as it is more efficient to position a spindle in milliseconds versus having to release material clamps, position the complete gantry and then re-clamp the material.
- The efficiency of typical milling and scribing operations are achieved, as the plate and gantry remain stationary during these operations and the plate remains rigidly clamped during these processes.
- These systems can be furnished with two totally independent spindles each with their own sub-axis. Two different patterns with differing length axis coordinates can generate drilling, milling and scribing operations simultaneously.
- Typical increase in spindle productivity of up to 100% is achieved.

The fact that plate processors have been designed and offered to the market in four distinctively different styles reinforces that the proper CNC system selection is typically driven by the characteristics of the application.

A detailed review of the family of parts to be fabricated and productivity analysis is necessary to determine and select the optimum plate processor.

Plate Processor Capability Chart

	Pull Through Style Systems without Sub-Axis Capability	Pull Through Style Systems with Sub-Axis Capability	Gantry Style Systems without Sub-Axis Capability	Gantry Style Systems without Sub-Axis Capability
				
Drilling	√	√	√	√
Punching	√	X	X	X
Entry and exit footprint	√	√	X	X
Hard stamp marking	√	√	X	X
Plasma torches	1 (2)	1 (2)	1 (2)	1 (2)
Plasma bevel	X	√	√	√
Oxy-fuel torches	1 (2)	1 (2)	1 (4)	1 (3)
Drill spindles	1 (2)	1 (2)	1	1 (2)
Auto small part unloading	√	√	X	X
Ability to unload large parts during CNC operations	X	X	√	√
Offset simultaneus operations	X	√	X	√
Clamp/unclamp cycle for each operation	√	X	√	X
Productive milling	X	√	X	√