



## 2 Your Machine Configuration

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### 2.1 Base Machine

The Base Machine consist of :

#### MF420070 HEC 800 X5 Sinumerik 840 D

- 2 Pallets with fixing threads
- Trunnion table with direct drives
- Pallet changer with indexable load-unload station
- Work spindle with gear box
- Tool chain magazine
- Interface for a hand-held panel with an electronic handwheel
- Coolant tank with back-flush filter
- Internal Coolant supply through spindle center
- External coolant supply through nozzles at the spindle
- Flushing pistol
- Scraper-chain chip conveyor
- Complete machine enclosure
- Part counter
- Remote diagnostic
- PC coupling via Ethernet interface
- Tool specific spindle speed monitoring
- Display for operating hours at the operator panel
- Dialog language switchable between German or English
- Documentation in German in form of linked files in PDF format

**When options are ordered, they will replace the corresponding items of the standard delivery envelope.**

**The option measuring probe in combination with the option hand-held control panel, electronic handwheel is required or at least the option measuring probe interface in combination with the option hand-held control panel, electronic handwheel.**

**Coolant temperature equalization and temperature compensation are options to be recommended to ensure a stability of the machine accuracy under varying environmental conditions and measuring in JOG.**

IPS - Measures for an energy efficient application of the machining center

- Energy recovery system for motors during the braking operation
- Stand-by mode with the deactivation of the
  - o Control voltage
  - o Coolant pumps
  - o Hydraulic pumps
  - o Compressed air supply
- Accumulator charging for the hydraulic system
- Reduction of the energy consumption for the support movements due to a hydraulic counter balance
- Energy efficient lamps
- Conformance usage of energy efficient motors classes IE2 / IE3
- Highly efficient direct drives for motor spindles, NC-rotary tables and trunnion tables (HEC 400 – HEC 800)

Description of the Control Sinumerik 840D sl with HMI operate

Hardware components

- NCU720 with 10 Mbyte remanent user memory for programs and data
- NCU with integrated PLC
- IPC with WINDOWS operation system
- SINAMICS S120 drive components
- Operating point with:

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- o OP015A with TCU incl. 15" TFT color display
- o Qwerty-keyboard with short-stroke buttons
- o Feed rate and rapid traverse override (0 ... 120/100 %) on a common rotary switch
- o Spindle override (50 ... 120 %)
- o USB interface
- o Electronic key-system Co. PILZ as access verification and selection system for authorisation to select the mode of safe operator
- Ethernet-interface 100 Mbit/s (RJ45-Connector)
- 1 USB-Stick

#### Siemens specific CNC functionalities

- NC program management (program names with alphanumeric characters)
- Main program call from main or under program
- Oriented spindle stop
- Thread tapping with and without compensation chuck
- Dimensions in the NC program switchable between mm and inch
- Input and display resolution 0.0001 mm/degree
- Geometry axes online switchable in the NC program
- Synchronized actions and rapid help function display
- Program input and program editing simultaneously to the machining
- Standard mill and drill cycles with graphic support and access protection
- Programming languages (DIN 66025 and high-level programming language extension)
- Dynamic pre-control (speed pre-control, programmable with FFWON for dynamic increase of accuracy)
- Quadrant error compensation / friction compensation
- Block search with and without computation
- Manual data input (MDI)
- Setup functions (JOG) for all axes and the work spindle via operator panel or hand-held control panel, electronic handwheel.
- 40 work piece coordination systems. Additively applicable
- Work piece coordination systems programmable (FRAMES)
- Options for 3+2 axis machining (No 5-axis simultaneous machining):
  - o Cycle 800
  - o Multi-axis interpolation
  - o Measurement of machine kinematic
  - o Residual material detection
  - o 3D-Simulation of the finished part
  - o Simultaneous recording
  - o IPS - Collision Avoidance

#### Manufacturer specific CNC functionalities

- Pallet management  
This function enables the creating of pallets in the machine control via a comfortable input mask. Names, status values and pallet correction values can be assigned to each pallet.
- Pallet sequence mode 1  
In addition to the pallet management, a NC program can be assigned to each of the two pallets. This assignment will be executed in a loop, if the pallet sequence mode is activated. The work piece loading and unloading will be acknowledged at the load / unload station by the machining enable. Further inputs at the operator panel during the activated pallet sequence mode are not required.  
Additional functions:
  - o Alternatively automatic or manual start of the NC program
  - o Changing the processing order of the pallets
  - o Changing the processing order of the NC programs per pallet
- Tool management (Siemens with manufacturer HMI)  
This is optimally adapted to the design characteristics of the tool magazines and contains all basic functionalities for operating the tool magazine. This includes typical basic functions such as the creation of tools, the modification of tool data and the loading and unloading into the magazine. In addition, further filter and search functions, tool wear monitoring (lifetime, number of work pieces) and spare tool management are provided.



The functions of the tool management can be expanded by means of options.

Storage capacity:

- o Number of storable tools in response of the size from the magazine and the NC memory (max. 600)
- o Total number of tool corrections (tool cutting edge) in response of the size from the magazine and the NC memory (max. 1500)

- Tool cabinet

By the help of Tool cabinet, the tool data can be stored when the tools will be unloaded.

Thus, the tool data can be retrieved and a new input of the tool data for a tool can be avoided.

- Secure and defined shut down

- IPS - Permanently active diagnostic system with extended error and status information

- o Number and head line of the message
- o Effect of the message on the machine
- o Details on the message such as the position of the effected module
- o Description of the remedy

- Displays for viewing and entering:

- o Tool data, process data, data regarding chip conveyor running time regime
- o Data to manipulate the operation by the operator
- o Operating hours counter
- o Service function for tool and pallet changer

- IPS - Remote diagnostic

Via network and internet connection and Software "TeamViewer" pre-installed on the machine's IPC.

**BUS systems**

- central in control cabinet: Profibus DP for I/O peripherals and ProfiNet for the machine control panel
- decentral in machine: ASi
- for data exchange with peripherals: see interface description

**Standard accessories**

1 piece documentation in the form of linked files in PDF format consisting of:

- Introduction
- Machine design and technical data
- Operation
- Programming
- Maintenance
- Transportation, installation and commissioning
- Spare parts (without manufacturer's data)
- Purchased assemblies
- Diagrams (circuit diagrams, hydraulic plans and pneumatic plans, no PLC data)

Diagrams on DIN A4 size paper (circuit diagrams, hydraulic plans and pneumatic plans, no PLC data) in the control cabinet

**2.2 Options**

**TI410442 Package MT-X5 - Multi-Tasking with trunnion table**

With the components:


**NC-rotary table with 500 rpm**

- |  |              |             |
|--|--------------|-------------|
| - Table speed for positioning operation                                |              | 60 rpm      |
| - Table speed for turning operation                                    |              | 500 rpm     |
| - Operation with 100 % duty cycle with a rotational speed of > 200 rpm |              | max. 30 min |
| - Max. pallet load up to a rotational speed of 60 rpm                  |              | 1,200 kg    |
| - Max. pallet load with a rotational speed above 60 rpm                |              | 1,000 kg    |
| - Tangential torque  |              | 8,000 Nm    |
| - Tilting torque   |              | 13,000 Nm   |
| - Drive capacity   | (100 % duty) | 52 kW       |
| - Drive torque   | (100 % duty) | 1,680 Nm    |

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Pallets with reduced imbalance 800x800 mm instead of the two pallets 800x800 mm from the basic machine

The machine is equipped with an automatic out-of-balance detection.

Work pieces and clamping fixtures have to be clamped in such a way that the gravity center is in the turning axis. A Displacement of the gravity center causes an imbalance. This leads to an excursion of the Z-slide and therefore dimensional and form deviations during the turning operation.

Horizontal-spindle with holder for turning tool and with clamped Hirth rings inclusive spindle extension of 100 mm with tool holder HSK-T100

- Tool length max. 700 mm

**Attention**

- Turning is permitted only with A'-axis clamped
- Pivoting of the A'-axis is only permitted in case of positioning operation of the B'-axis
- Not in conjunction with the option of a hydraulic clamping system
- Only in conjunction with a spindle with a 2-stage high-precision gearing

**SP410035 2 round pallets with 1000 mm (39.4") diameter instead of pallets 800x800 mm**

**KS1050774 Additional pallet 800x1000 mm with surace after Starrag drawing Nr.164757**

**HS410325 Spindle speed range 7500 rpm**

- Spindle speed range 20 ... 7500 rpm
- with 2-stage high-precision gearing
- Motor capacity (25 % duty) 83 kW (111 hp)
- Motor capacity (100 % duty) 44 kW (59 hp)
- Spindle torque (25 % duty) 1500 Nm (1,106 ft-lbs)
- Spindle torque (100 % duty) 1500 Nm (1,106 ft-lbs)

(Only available with horizontal work spindle)

**WM410410 Basic tower magazine with 180 tool pockets**

In 2 towers

Tool dimensions

- Diameter, max. (empty adjacent pockets) 340 mm (13.4")
- Diameter, max. (full adjacent pockets) 110 mm (4.3")
- Tool length, max. 450 mm (17.7")
- Total weight of all tools per tower 900 kg (1,984 lbs)
- Imbalance of tool weight per tower, max. 150 kg (331 lbs)

Enclosure with integrated sub-operating point with OP15AT incl. 15" color display and tool service place

Manual loading point for standard tools (doors equipped with windows)

Lighting of the tool towers

**WM910450 Extension for basic tower magazine by 90 tool pockets**

2.0 Piece

- One additional tool tower
- Lighting of the tool tower

(Maximum 3 times selectable)

**WM910290 15 tool pockets for tools longer than 450 mm in the basic tower magazine**

- 15 tool pockets for over long tools in tower 2
- Omission of further 15 tool pockets in tower 2
- Maximum tool length according to the technical data of the basic machine or the designation of the spindle option


(Maximum 3 times selectable)

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**WM410660 Balluff tool identification system BIS-M at the basic tower magazine**

To avoid incorrect input and to reduce load-unload time.

**Function with the option load and unload rack**

Tools can be inserted in the load and unload rack. The tool robot of the magazine recognizes the inserted tools, takes them one after the other and reads the tool data via a reading and writing head mounted on the tool robot. Subsequently, the tools will be automatically loaded in the magazine. During the unloading of tools, the remaining lifetime will be updated.

The external reading and writing head is used only for control functions or the loading / unloading of tools with special contours.

Attention:

- Data format with maximum 7 cutting edges per tool according to manufacturer standard
- Data carrier according to ISO 15693
- For SK tool holders applies: the data carrier is inserted into the gripper groove

**KM410325 Coolant system fleece compact filter**

Coolant supply through the spindle center by 7 steps up to 50 bar (725 psi) adjustable via M-command, 1750 l (462 gal) tank capacity, free-standing

**KS1044714 Increasing cooling pressure to 100bar**

Coolant supply through the spindle center (only include with option KM410324 or KM410425),  
Coolant supply through the spindle center by 7 steps, adjustable via M-command

**KM410040 Process cooling through the spindle center with air instead of coolant**

Process cooling is switchable between air and coolant via M-command.

Information: After 2 hours process cooling with air it is necessary to switch in the coolant mode to lubricate the rotary union.

**KM410334 Coolant temperature equalization and temperature compensation**

with the components:

- Temperature stabilization for the coolant system
- Sag compensation for positioning accuracy improvement
- Automatic correction of thermal caused axial shiftings to stabilize the spindle position by temperature changes at the machine
- Temperature data recorder with a ring memory. The memory has a capacity of 250 hours. The data recorder capture measured temperatures. The temperature profiles can be visualized at the operator panel. (Only for machines with Siemens control)

Information:

The process safety for this option is given only with the options Warm up program and measuring probe.

**KM410320 Linked chain chip conveyor**

(In lieu of scraper-chain chip conveyor)

**ZF410340 Interface for emission extracting system for machining area**

**ZF712345 Electric Visiport**

rotating disk window built into the access door to the machining area at the main operator position

**ZF710425 Drip pan drawing**

The drip pan drawing contains all necessary information to manufacture a drip pan.

**ZF410402 Axis travel Y-axis increase 1100 to 1300 mm (43.3" to 51.2")**

For horizontal spindle head,

Increased chip-to-chip times,

The maximum height of work piece will not change.

**ZF410461 Energy efficiency PLUS coolant supply**

Modification of the coolant unit with unregulated high pressure pump to a frequency-controlled high pressure pump

**ZF410403 Increased Z'-axis travel from 1300 mm to 2050 mm (51.1" to 80.7")**

- Working range
  - Spindle face to pallet center distance 250 up to 2300 mm (9.84" up to 90.5)
- Feed rate, infinitely variable machining feed 1 ... 45000 mm/min (0.04 ... 1,771 ipm)
- Rapid traverse rate 45 m/min (1,771 ipm)
- Increased chip-to-chip time + 2 sec

**KU420046 Renishaw radio measuring probe RMP60M**

and control prepared for use of probe, consists of:

- Probe with transmitter module, 50 mm styli and tool holder
- Receiving module
- Measuring cycles
- Tool length of the measuring probe:
  - o HSK-A100 426,75 mm
  - o SK-50 form AD 402,00 mm

2 additional Renishaw radio measuring probes can be implemented by the customer.

**KU620050 Tool breakage detector**

During primary processing time in the tool chain or tower magazine via pneumatic cylinder with an integrated measuring system.

Technical Data:

Checkable type of tools:	boring tools	
Tool dimensions	Tool diameter, min.	3 mm
	Tool length	35 mm up to maximum tool length
Measurable deviation of length, min.	2 mm	

**KU420530 IPS - Work spindle diagnostic**

An acceleration sensor at the work spindle in conjunction with an analyzer enables the monitoring and diagnostic of the work spindle. The following data of the work spindle will be monitored:

- Unbalance of the work spindle
- Conditions of the bearings
- Oscillating acceleration during machining
- Impact / shock

The data will be stored on the analyzer and can be downloaded and visualized with analyzer software.

**OS450587 IPS - Work spindle load monitoring**

The capacity of the work spindle drive is tool-specifically monitored in the PLC. The monitoring becomes active after ramping up the work spindle.

The following 3 steps are the reaction to an exceeded work spindle load:

1. Limitation of the feed rate override to 100 %
2. Limitation of the feed rate override to 75 % and blocking of the tool (Factory settings, Percentage can be adjusted)
3. Stop of the running NC program

By reducing the feed rate, a reduced spindle load is expected, so that the machining can be completed with the possibly dull tool or with increased oversize.

During the turning operation, the NC-rotary table is being monitored instead of the work spindle. If a constant cutting speed is programmed, this function is limited due to speed changes of the respective work spindle.

In addition, the HMI of machines with Siemens control will be supplemented by the following information:

- Feed force of the linear axes
- Load of the work spindle

  
**KU820060 Signal lamp, 4 colors**

Machine status display:

- Red - machine not operating
- Green - machine operating in automatic mode
- Yellow - tools in magazine blocked or reserved
- Blue - work piece machining completed

**ZF410387 Shaping (spiral)**

incl. tangential control option Application:

Production of surfaces similar to turning surfaces  
(e.g. pump flanges)

**KU420070 Calibration set for trunnion table**

Hard- and Software package to determine the axe compensation values of the trunnion table.

The requirements are an empty pellet to mount the calibration set, a certified plug gauge and a special measuring probe prescribed by the manufacturer.

Within the limits by the calibration software the determined compensation values are automatically taken in the machine data.

A necessary training is not included. The training can be selected in under the Point Training.

**KU820081 Calibration set for measuring probe**

Hard- and Software package to calibrate the measuring probe.

Within the limits by the calibration software the determined compensation values are automatically accepted by the machine data.

For the period of probe calibration, the calibration set has to be mounted at the side of trunnion table.

(Not in conjunction with the option, Renishaw measuring probe TS27R for tool setting inside the work space)

**OS450643 Milling of cylindrical paths**

(incl. option cylinder area transformation)

Application: Machining of cylindrical paths with a rotary and a linear axis at a constant rotary table diameter

**OS450640 Package for 5-axis simultaneous machining**

Consist of:

- Machining package 5-axis (TRAORI)
- Advanced Surface
- Spline interpolation incl. compressor function
- 3D-Tool radius offset
- Peripheral surface transformation

(For the machines HEC 500 – 800 X5 with trunnion table applies:

- Max. speed of B'-axis 15 rpm
- Max. speed of A'-axis 5 rpm)

**OS450646 Extension of the CNC user memory by 2 Mbyte**

Attention:

- Up to 6 extensions possible for NCU720 / NCU730
- Up to 3 extensions possible for NCU710

**OS450583 Measuring in JOG**

Through the measurement at the JOG mode the set up time can be reduced and the operator convenience increased. With this feature the measuring probe can be calibrated and measure the outline of a work piece (edge, corner, bore, cone, pivot, rectangle) so that afterwards with the determination and the setting of a correction factor the work piece can be positioned and aligned.

**OS450588 Warm-up program**

A specific time for automatically starting the machine up and running an NC program can be defined for all seven days of the week. This aids in reaching the desired operating temperature prior to starting production.

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**OS450989 Load and unload rack in basic tower magazine for all tools**

Tool loading and unloading of tools by the operator occurs at one rack of tower 1.

Re-sorting of tools in the magazine is carried out automatically by the transporter. This function occurs parallel to the machining process.

10 of 15 tool pockets are reserved for this function. Hence they can not be used to store tools. The remaining 5 tool pockets are separated by a sheet metal and can be used as regular tool pocket.

The handling of overlong tools is realized on condition that the total number of tool pockets is reduced by further 15 tool pockets.

**OS450560 Hand-held control panel with Electronic handwheel**

**SZ480545 1 set of leveling hardware, plugged**

Incl. mortar cartridges and threaded rods

**KS000001 Special customer requests**

If special options ordered along with the machine, technical data could possibly change too.

**DS100041 Language Czech**

for dialog, documentation, signs

Exceptions:

- Spare part drawings German
- Sub assembly documentations English
- Machine control documentation Czech

Spare and wear parts can be identified by means of the part number on the spare parts drawings. The description of the spare and wear parts can be read in Czech in the spare and wear part list.

**KS1044715 Modification of the roof area to reduce dripping water when entering working area**

**KS1044722 Hydraulic clamping unit 3-lines, 90 bar, programmable, at the load-unload station and in the work area in connection with the option Multi-Tasking with trunnion table**

For hydraulic clamping fixtures with 3 hydraulic connections and pneumatic alignment control; connections located centrally around the pallet center

- 1 hydraulic line for clamping with a clamping pressure of 90 (+/-10) bar
- 1 hydraulic line for the release sequence with a pressure of 90 (+/-10) bar
- 1 hydraulic line to check the hydraulic pressure in the clamping fixture
- 1 pneumatic alignment control on the load-unload station
- 1 pneumatic alignment control in the work area for permanent control of the mechanical fixture

Notice:

- The maximum height of work pieces and clamping fixtures will be reduced 100 mm from 1000 mm to 900 mm, maximal 130 mm because of the raised pallet-surface to the hall floor
- The hydraulic clamping will be supplemented by a pilot-operated check valve
- This pilot-operated check valves prevent the risk of an uncontrollable pressure decrease
- Because of their position the following modules / interfaces are not secured by this actions:
  - Tubing / Piping from the valve to the rotary feed-through in the NC rotary-table
  - Coupling elements and media transfer between NC rotary-table and machine pallets
  - Coupling elements and media transfer between machine pallets and clamping fixtures

Responsibilities of the clamping fixture supplier:

- The delivery limit of the Starrag GmbH is machine-pallet top edge
- The clamping fixture will be mounted on the machine-pallet for hydraulic clamping with the above mentioned functions
- Only if all requirements are fulfilled (control-pressure and alignment control) rotary operation is possible
- Equally, the same applies to the workpiece clamping
- The customer / clamping fixture supplier is responsible

In the event of an order, further versions are carried out with a specific description 'Turning with hydraulic clamping'