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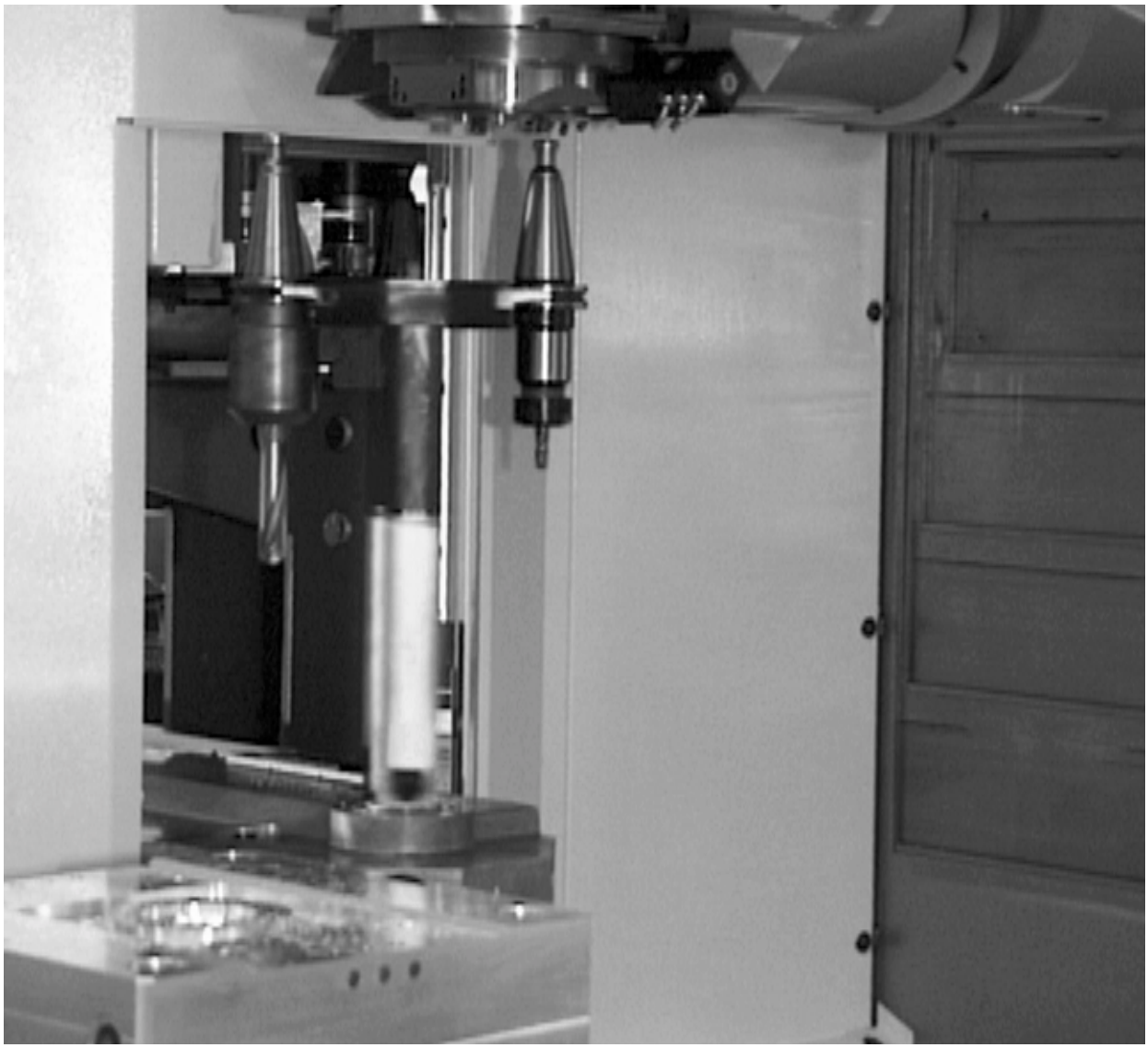
The Automatic Tool Changer of DMU 60 / 80 P with Mill Plus Control



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The A.T.C. of DMU 80 P with Mill Plus-Control

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The Tool Changer of DMU 80 P

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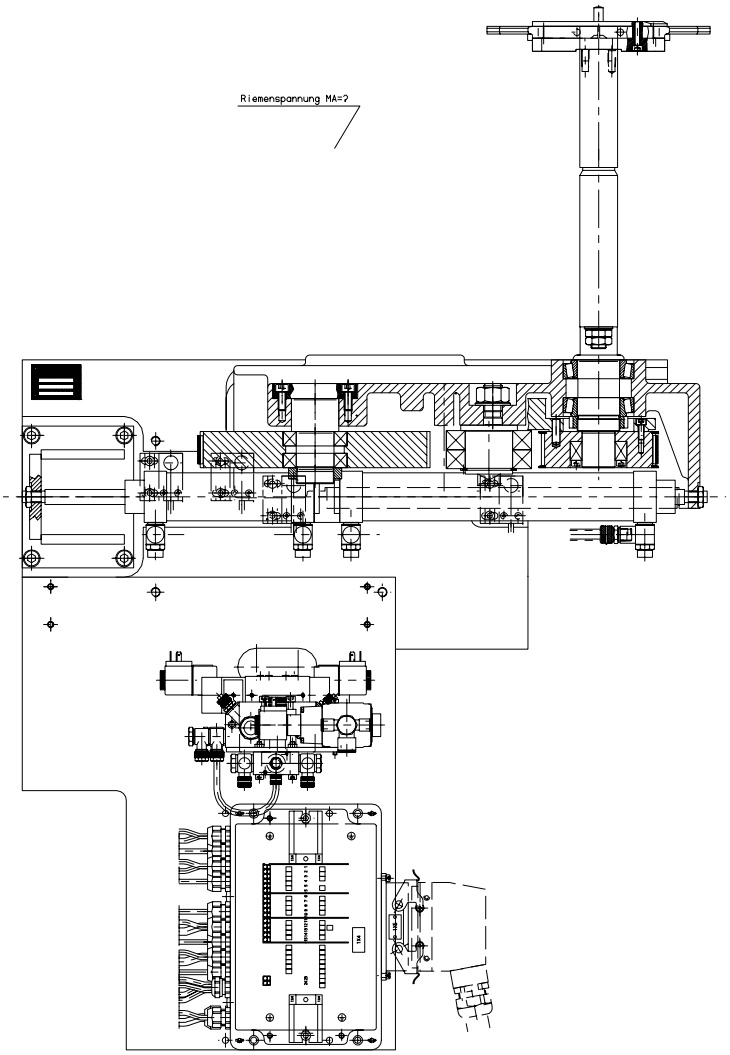
- 81.241391 Tool Gripper
- 81.242129.01 - 03 Tool Changer with 60 Tools
- 81.242128.01 - 02 Tool Magazine for 60 Tool
- 81.242124 Chain Link



Introduction:

The individual movements necessary for a Tool Changing are regulated by means of Pneumatic Cylinders. One of the Grippers is executed as a “Fetcher” and the other one as a “Collector” .
The **(Gripper 1) Collector** is only capable to take the Tool out of the working Spindle and deposit it in the Tool Magazine.
The **Fetcher (Gripper 2)** takes the Tool from the Tool Magazine and brings it to the Working Spindle .

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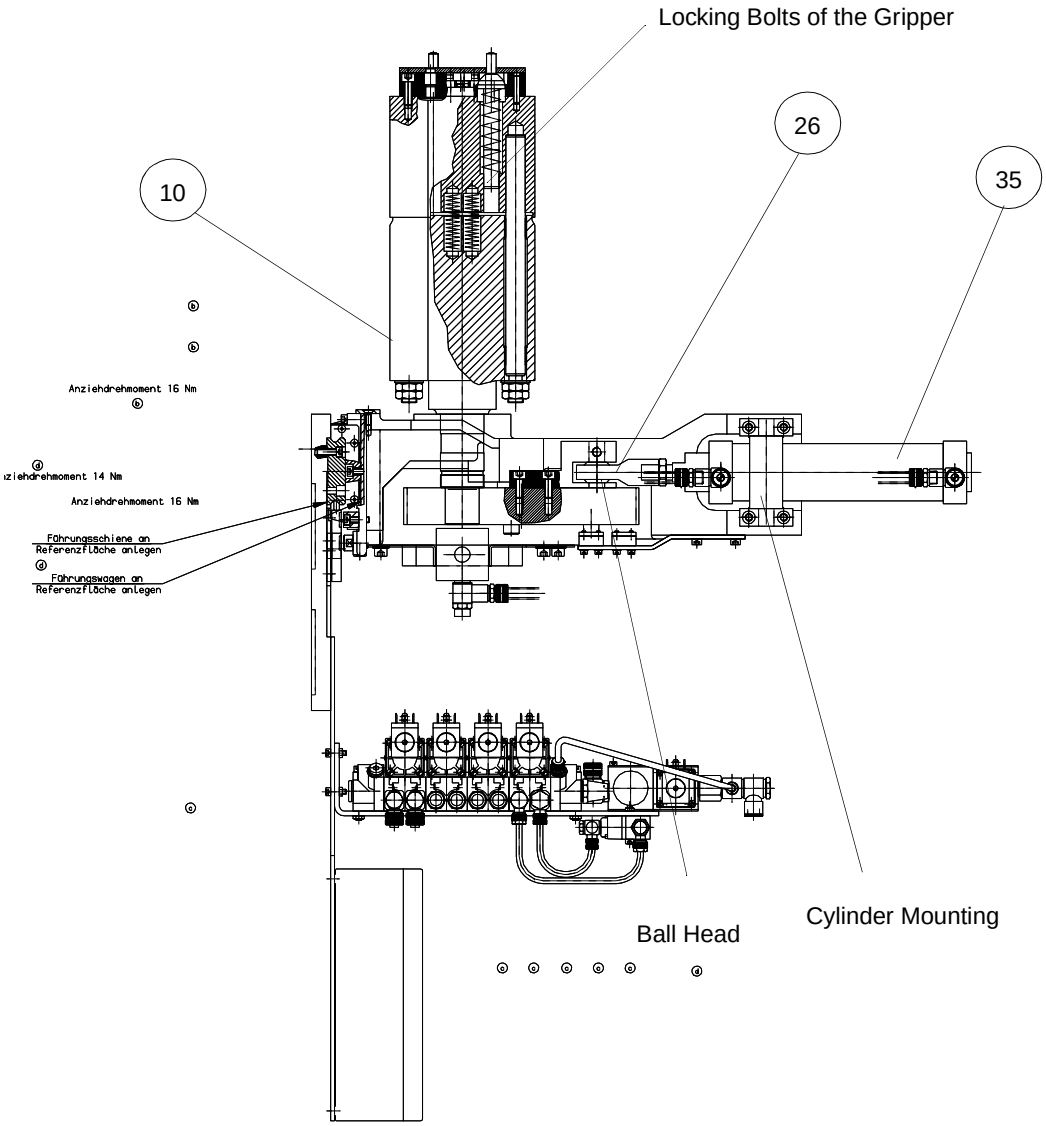
Adjustments to be done during **Module Assembly** of Tool Changer

Adjustment of Limiting Positions for rotation of Tool Grippers 1 und 2

Function: The Toothed Disc ,Pos. 26 will be rotated by the double acting Pneumatic Cylinder ,Pos. 35 . With a Toothed Belt ,this rotation is transmitted to another Toothed Disc, Pos. 13. This second Disc is connected to the Gripper , Pos. 10 .

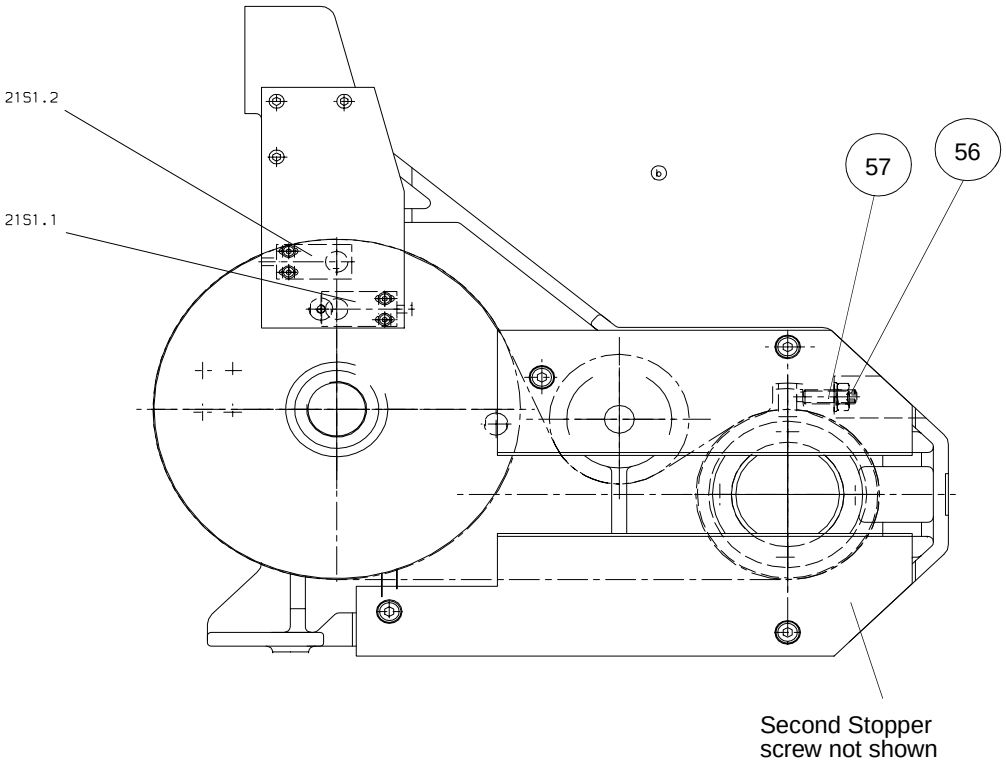


Preliminary Adjustments of Rotation

During the preliminary adjustments, the stroke of the Pneumatic Cylinder is set in such a way, that the Limiting Position of 180 Degrees is exceeded roughly 5 mm in both directions .
This setting can be done by loosening the Cylinder Mounting or by adjusting the Ball Head of the Piston Rod .

Accurate adjustment of Grippers' final Position

The final position for gripper rotation will be set exactly on both sides, by adjustment of Set Screws ,Pos. 56, which are provided twice to act as movement limits (STOPPERS) for each direction.



Necessary Instruments for setting l

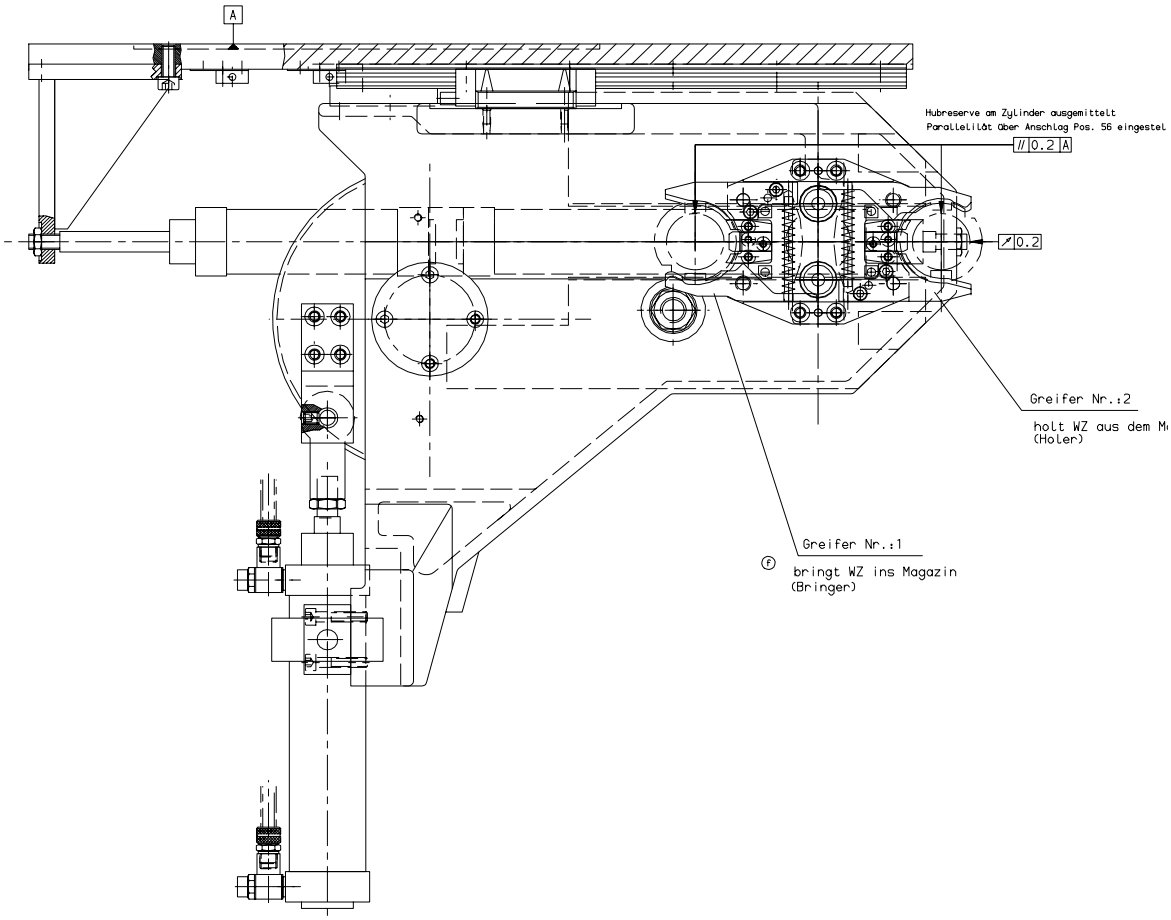
To carry out adjustments, two cutting tools of equal diameter clamped in tool holders and a Dial Indicator with 1/100 mm count along with suitable magnet base holder will be necessary.

Each of the tool Grippers are to be mounted individually with a cutting tool.For indroducing the tool in a Gripper , it is necessary to first push down the locking bolt of the gripper body(refer drawing Page 4).The magnet base of Dial Indicator has to be fixed firmly on tool Magazine with a Screw Clamp (Aluminium Surface).
The tool gripper No.2 (Fetcher) must stand facing the tool Magazine pressing against the Stopper .The Dial Indicator is now set against the Tool and the highest point is searched by moving the Tool Changer to and fro.The Indicator is to be set to Zero at the highest point.
The Tool Changer is now moved so that the highest point of the second tool is touched by the Indicator . If the Indicator shows a deviation from previous tool at this stage then correcting steps are necessary .

Steps of Correction:

The Stopper position can be set accurately by adjusting the position of Set

Screws using an Allen Key 6 mm ,and a Tubular Socket Wrench 17mm. The measurements and subsequent adjustments are to be repeated till the Indicator does not show a diviation higher than 0.2 mm.



Adjustment of Stop position for the second Gripper (Collector)

The same method of adjustment is used for setting Gripper 1 ,as has been used for the Gripper 2. The Gripper 1 (Collector) will be turned towards the tool magazine and the Dial Indicator set against the tool and zeroed at the highest point.The measurement will be carried out as described earlier and the deviations observed .

Correction

The position setting of the Stopper is to be done by adjusting the second Set screw in the same way as before (Refer drawing, Page 5).

Height Adjustment of Tool Changer corresponding to Tool Magazine

Note :

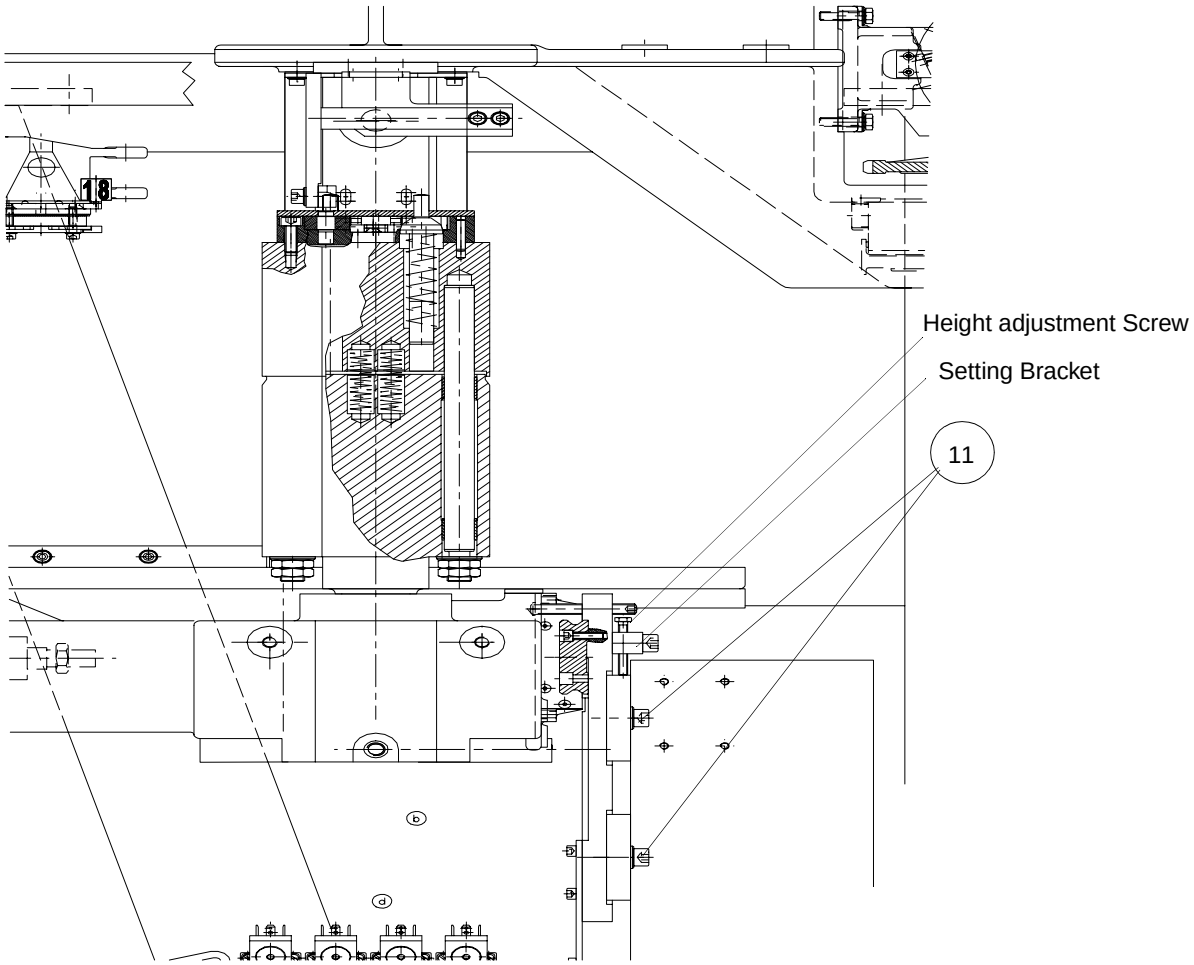
For this Adjustment,the tallest Chain Link (H)and the lowest Tool Gripper must be used.
The gap between the bottom plate of Tool Pocket (Tool Resting Surface) and the lower surface of the Tool Gripper must be 4 mm + 5/100 mm .This measurement is conducted without a tool.

Method of measurement :

The tallest Chain Link,which is marked “ H “,will be brought to the Tool Hand Over Position. The lower Tool Gripper, marked “ T “ is now turned to face the Tool Magazine. Finally push the Tool Gripper towards Tool Pocket so far inside, that the Gripper Jaws are located directly above the Tool Resting Surface of Pocket. The Gap is now to be checked using Slip Gauge.

Correction:

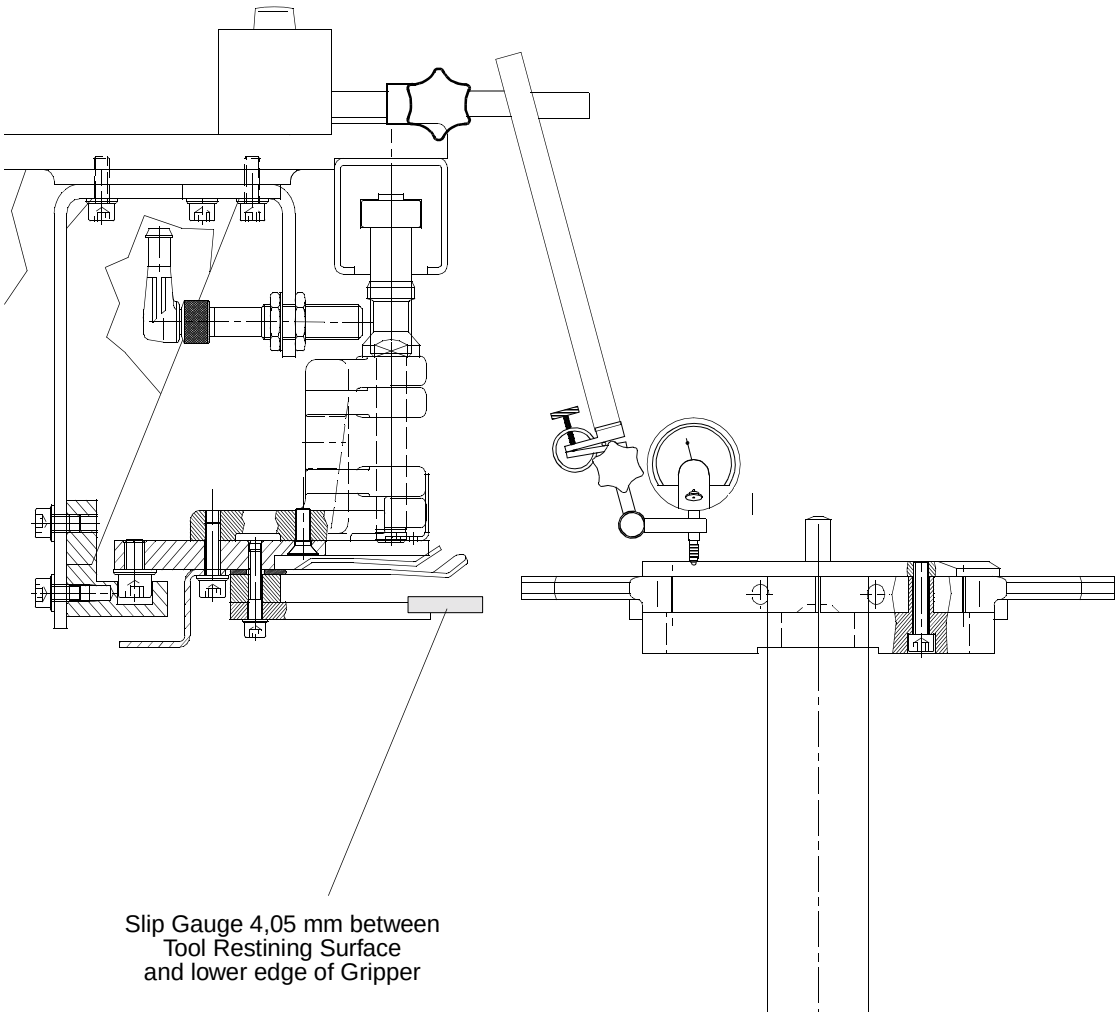
Assemble Adjustment Bracket for height adjustment,at the Tool Changer.
If any adjustment of height is necessary, then the four holding bolts (Pos.11)of the Tool Changer are to be lighty unscrewed first.Because the Tool changer is top heavy ,it has a tendency to tilt slightly, inspite of the adjustment Bracket.
Due to this reason,the parrallel positioning of the Tool Changers must also be checked additionally during the height adjustment (see drawing next page).



Method of Adjustment :

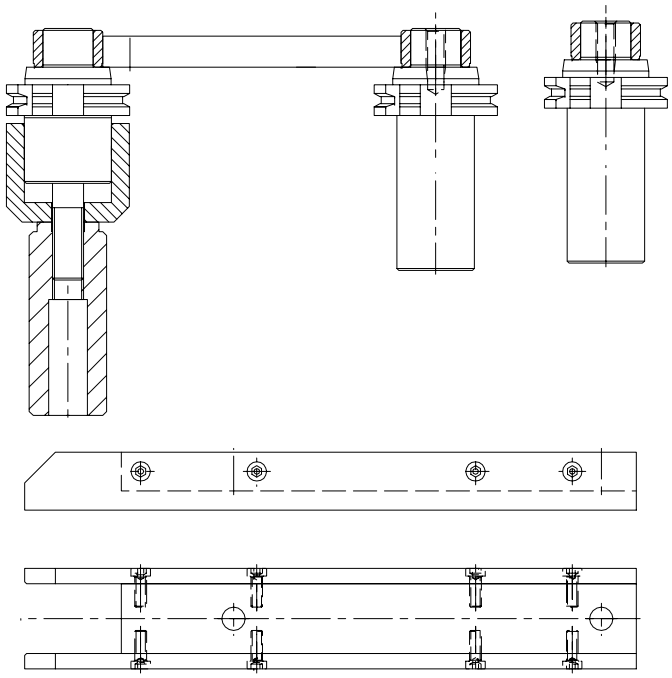
Position magnet base of Dial Gauge holder on Tool Magazine and fix it with a Screw clamp. The Gauge is set agaist the top plate of Tool Gripper and zeroed. The height of the Tool Changer is adjusted by turning the Height Adjustment Screw.The Gap between the Tool Resting Surface in Magazine and the Gripper Jaw is checked again with Slip Gaugee.The process will be repeated ,till both the conditions of parallelity and gap distance are satisfied. The holding bolts are to be tightened only after that. A final checking of the adustment is again necessary after tightening the bolts.

Tolerance: Height to Chain pocket + 0,05 mm max



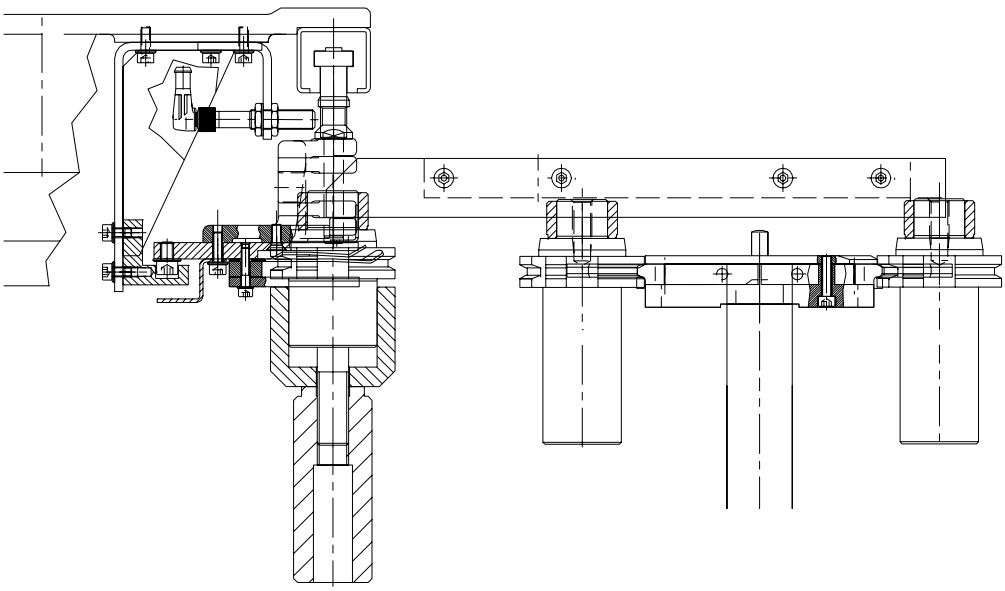
Lateral adjustment of Hand Over Position to Tool Gripper

Special Tools No. 61.112646, 61.112657 and 61.112658 are necessary for this operation.

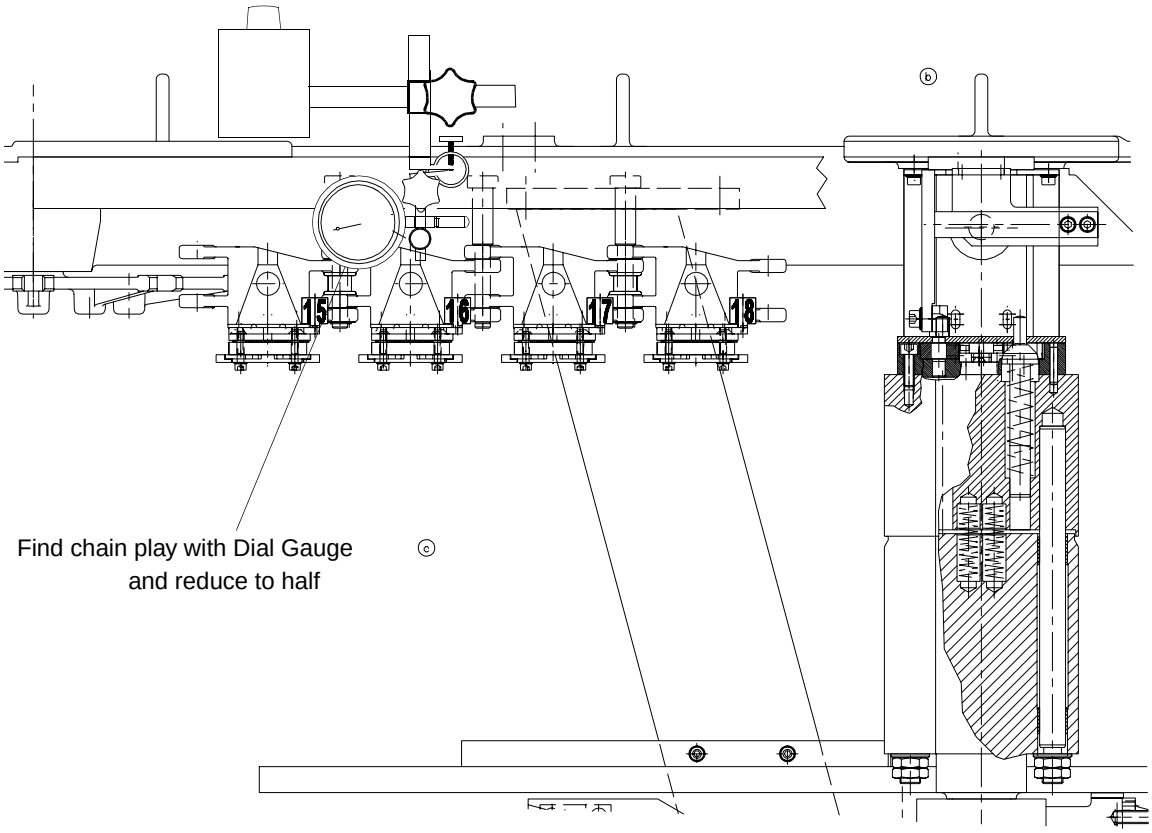


Method of Adjustment :

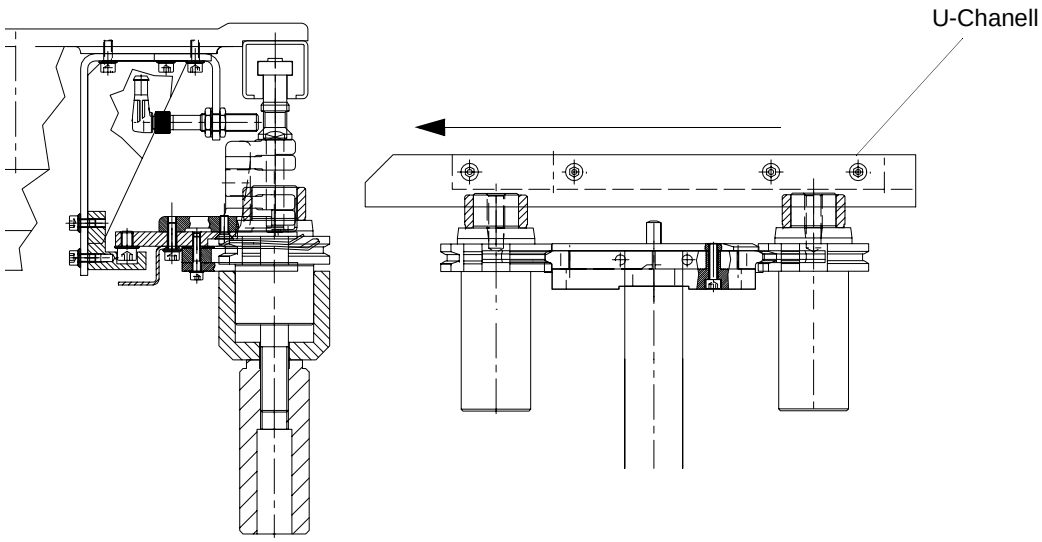
The shortest Chain Link (“K“) should be brought to the Hand Over Position. The tool with spring sleeve is to be mounted in this pocket .Both the Grippers are to be loaded with setting tools.



The Back Lash of Magazine Chain is measured with a Dial Gauge. This is to be set agaist one of the Guide Bolts of Chain Link and the existing play is reduced to half of the initial value.



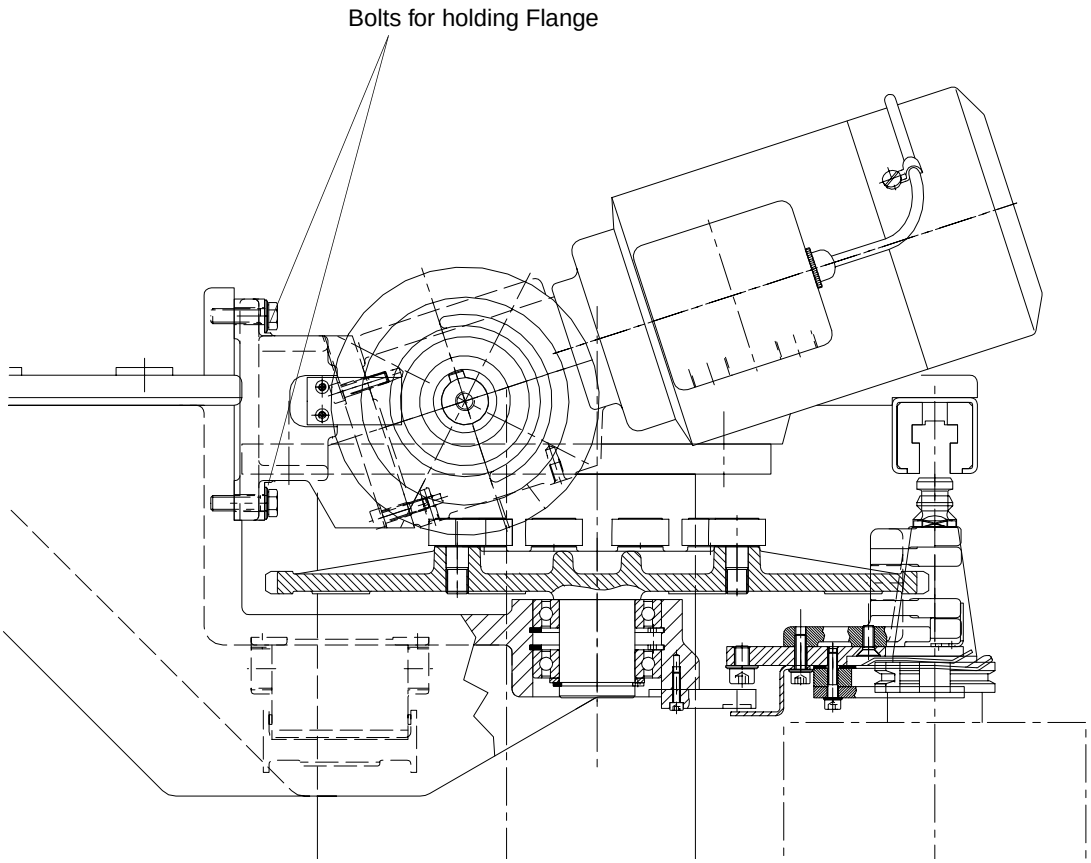
The three tools create a three point support . Using the U-Chanel ,which is placed over both the tools in the Grippers,and then moved towards the tool at hand over position,a lateral offset can be clearly checked.



Possibilities of Adjustments at Tool Magazine with 30 or 60 Pockets :

The fixing bolts at Flange for Chain Drive are loosened and the Motor is displaced sideways. The chain play is measured and reduced to half the value. Check again with U-Chanel and readjust the postion of Chain Drive.Re-

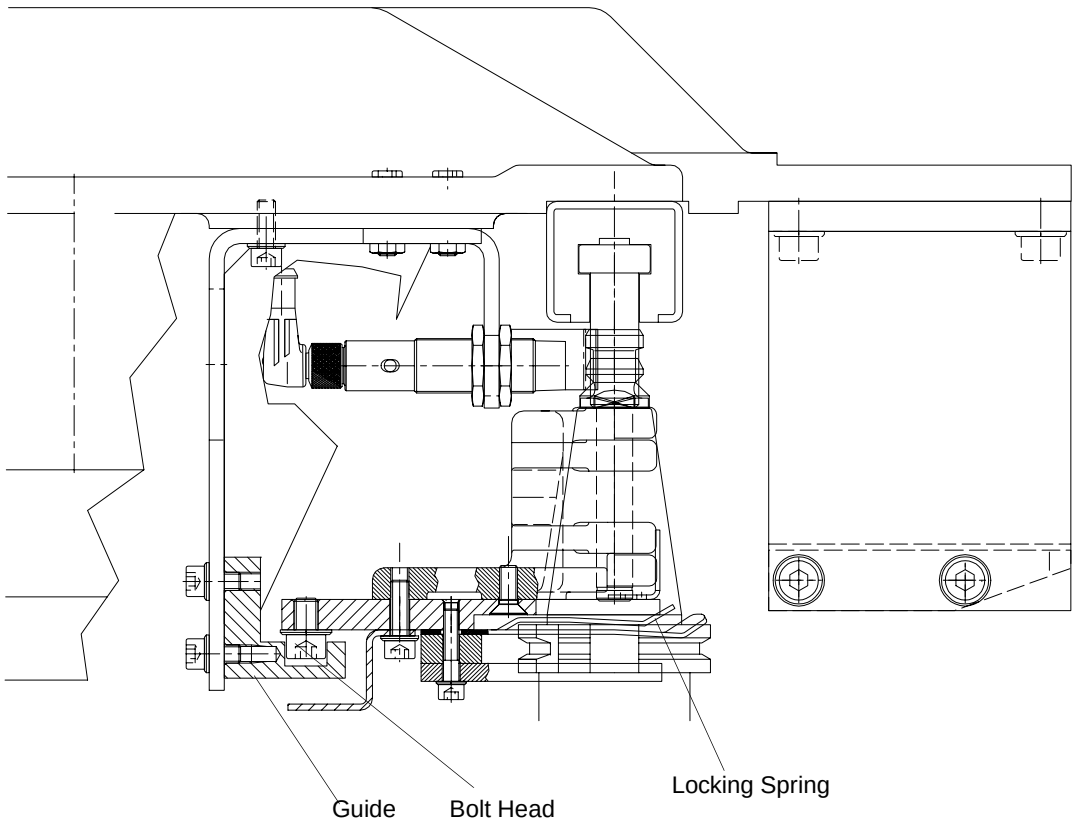
peat the procedure so long, till the Tool Pocket is in line with the Tool Gripper. Tighten the Flange Bolts of Chain Drive ,loosened earlier.



Final Position of Tool Changer related to Tool Magazine

Function :

A Chain Link (Bolt Head)of the Tool Magazine must receive a firm support in the chain guide during the inward movement of Tool Changer in the Magazine. Equally,the Bolt Head of a Chain Link must be capable of free movement in its Guide during positioning motions of Chain.Therefore to ensure a secured grip of the Locking Springs during the tool deposit in pocket,the stroke is set **at 5/10 mm behind the actual Tool Hand Over Point.**



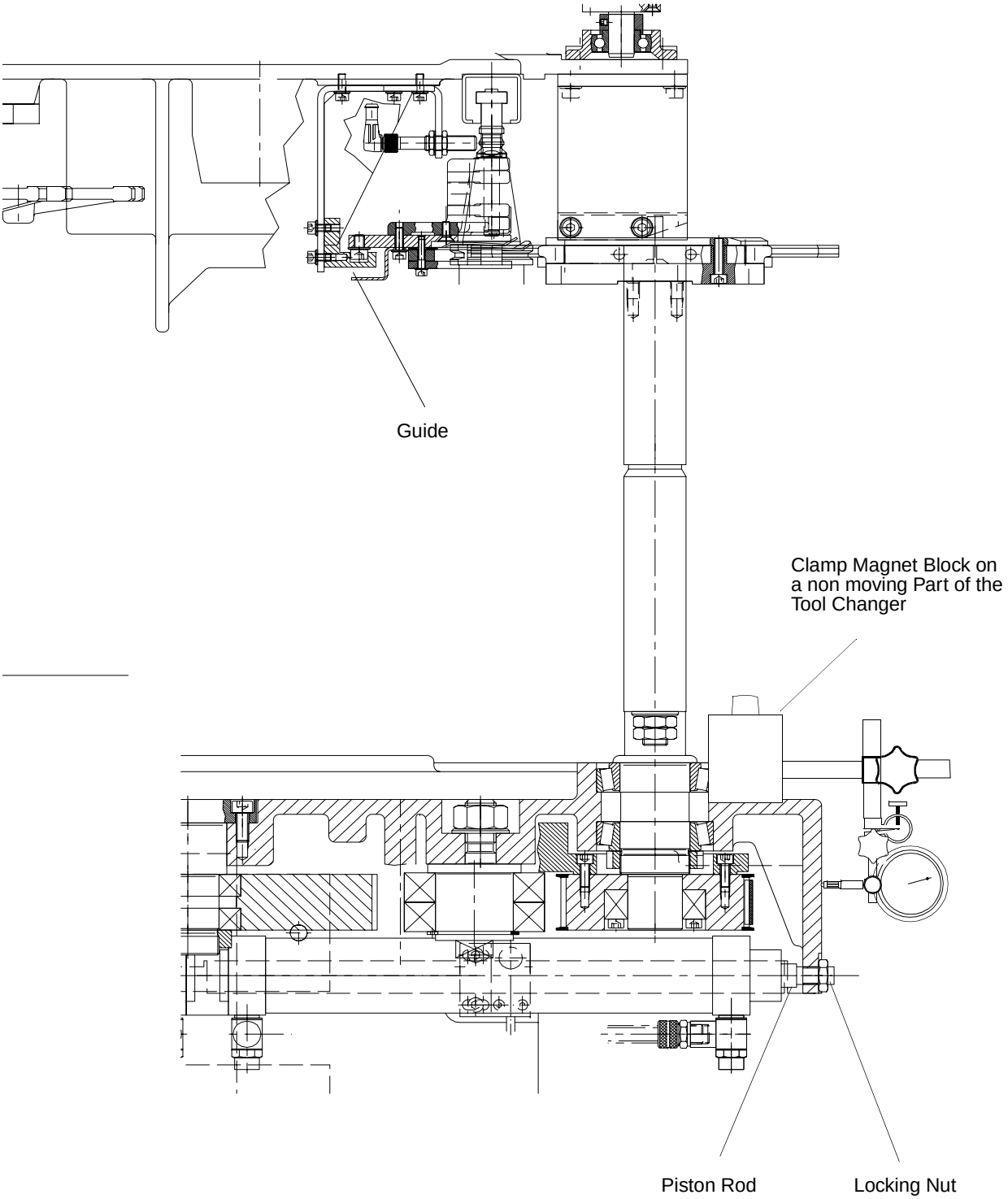
The setting is to be performed with the **shortest Chain Link** and the **shortest Tool Gripper**. A **Tool** is **introduced in the Tool Gripper** initially.With the-Stroke adjustment of Pneumatic Cylinder the Tool Changer is to be set for the **Final Position at Tool Magazine** .

Adjustments :

For final adjustment of stroke, bring the tool changer to **End position at Magazine** with **Valve opened** for pneum. cylinder.Unscrew the locking nut at piston rod .A magnet block is now mounted **on ATC Carriage** . The **Dial Gauge** is pressed **against** the Aluminium housing of Tool Changer **and zeroed .**
If the **Piston Rod** of the Pneumatic Cylinder **"under Pressure "**,is now rotated to push the Tool Changer towards the Magazine,the movement can be observed at the dial indicator (see Fig. next page).In case **no movement is recorded at the Dial any more ,** it is an indication that the Bolt Head is pressed against the Guide of Chain Links. This codition is to be rechecked using a Filler Gauge.
The dial gauge has to be removed now ,the ATC brought to the Basic Position and the **Tool removed.** Move Tool Changer once again to the Final Position

in the Magazine. Mount the Dial gauge again and set to zero against Aluminium housing. Rotate the Piston rod further to gain 5/10 mm additional stroke of ATC against the chain guide. Tighten locking nut and remove the dial gauge .

Final Position of Tool Changer to Magazine



Adjustments of Tool Changer during asssembly on DMU 80P Machine

Introduction

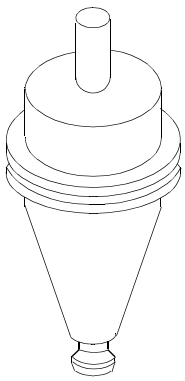
The Tool Changer is assembled as a Functional Module initially .This approach limits the ammount of adjustment work during final machine assembly, as listed below.

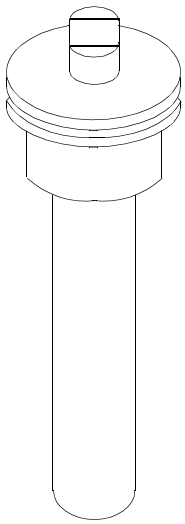
They are: - Determining Tool Changing Position for X-Axis (N 3145) and the Z-Axis (N 3345)
- The position of Tool Magazine in Y-Direction for a tool change.
- M19-Position of Spindle (see Page 41)

Note: A maximum deviation of 1/10 mm only from the exact position is permissible .

Relevant Machine Constants

N 1100	C 3	Machine type 3 = DMU 80P
N 1111	C 3	Tool Changer 3 = DMU 80P
N 1049	C 0 nach C 1	Axis release despite existing Error display for Tool Changing system.
N 3114	C .. nach C 0	Reference Point Offset of X-Axis
N 3314	C .. nach C 0	Reference Point Offset of Z-Axis



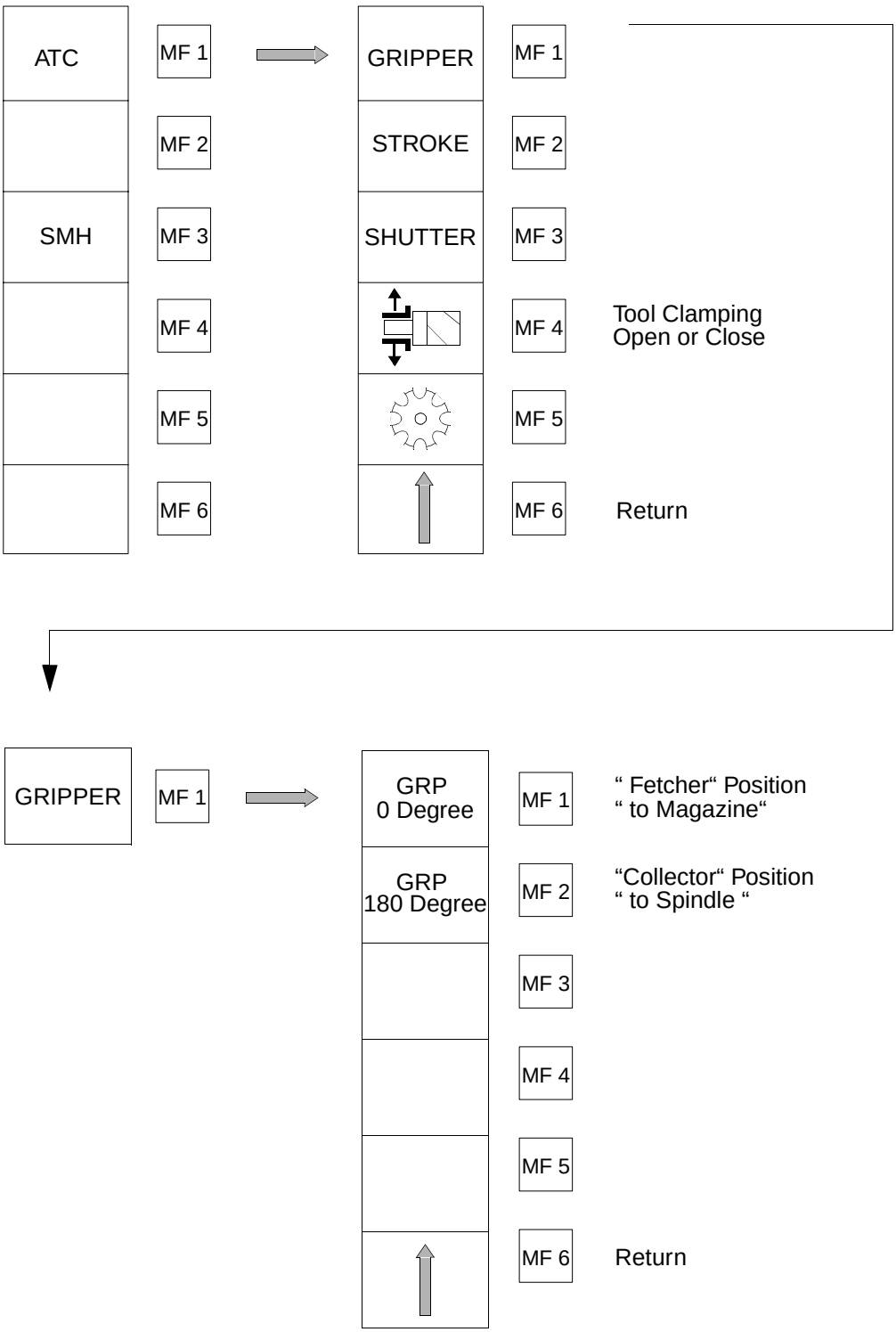


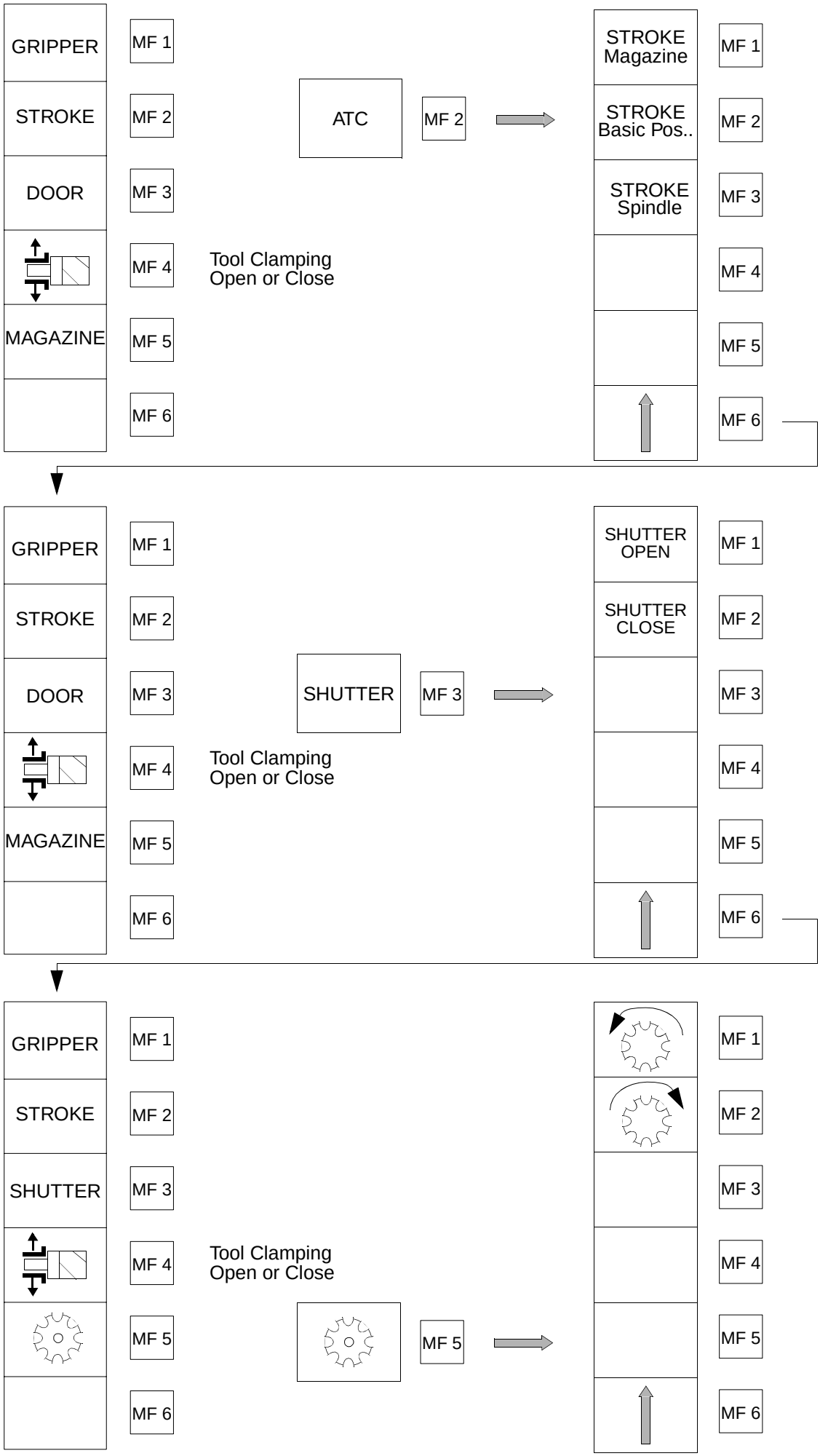
Determining Tool Changing Position for the X-Axis (Longitudinal Axis N 3145)

Sequence of operations for mode Diagnosis

Set switch “19s2”in electrical cabinet to position “1“in mode “ Manual “.After that, the softkeys MF1 - MF6 changed to different interpretation.

- Change switch position of 19 S 2 to “ Diagnis“ in electrical cabinet

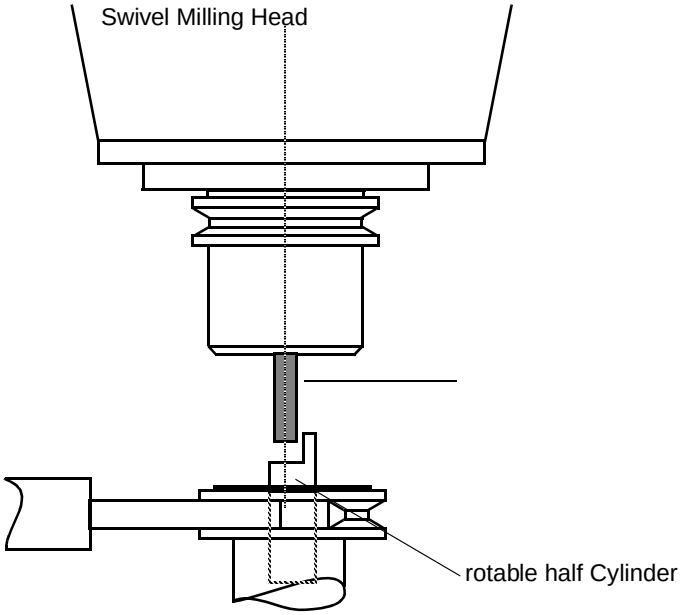



GRIPPER
STROKE
DOOR
MAGAZINE
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6
ATC
MF 2
Tool Clamping
Open or Close
STROKE
Magazine
STROKE
Basic Pos..
STROKE
Spindle
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6
GRIPPER
STROKE
DOOR
MAGAZINE
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6
SHUTTER
MF 3
Tool Clamping
Open or Close
SHUTTER
OPEN
SHUTTER
CLOSE
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6
GRIPPER
STROKE
SHUTTER
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6
Tool Clamping
Open or Close
MF 5
MF 1
MF 2
MF 3
MF 4
MF 5
MF 6

Determining Tool Chanhing Position for the X-Axis (Longitudinal Axis N 3145)

A direct reading of the position values ispossible by setting the Machine Constants **N 3114 and N 3314** to value zero.

Determining Tool Changing Position of X-Axis (N3145)



With the SMH in the vertical operating position ,introduce the tool holder with cylindrical dowel(Special Tool 63.019599)in the milling spindle. The machine axes should be positioned to the center of their travel first for safety,before the tool changer is moved at all in the machine working area.The tool changer can then be moved to the following Final Positions using the Service Functions.

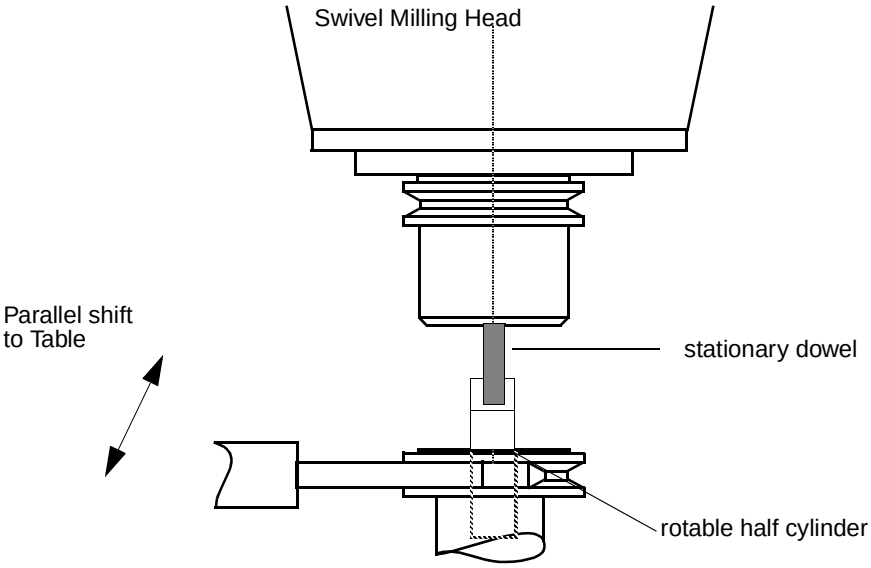
- Open Shutter of tool changer
- Position Gripper 2 to Spindle (Rotation possile only in the Basic Position and under the spindle)
- Move tool changer to spindle
- Press down the tool locking device of gripper and introduce the complimentary tool(Special Tool 61.112660).

The X and Y Axis are to be positioned now in such a way,that both the tools are nearly co-axial. The deviation in the X-direction can be observed by tool lifting and by rotating the half cyinder.The correct tool changing position can be now be determined by zeroing the deviation with incremental axis jogging.Once the correct position is reached the position value can be noted display of X to be used later as **Input Value of N 3145**.

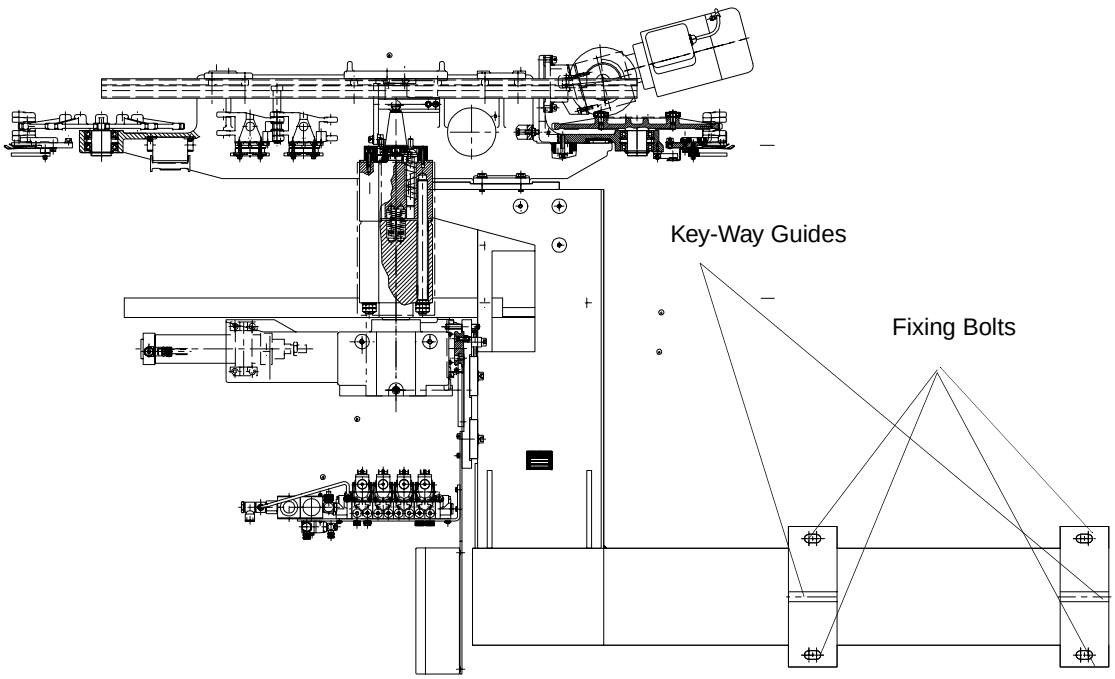
Position Adjustment of Tool Changer in Y-Axis (Cross Axis)

The position of the Tool Changer in the Y-Axis is not governed by the axis motion. Which means : In case a position adjustment is required , we have to shift the complete Tool Changer Module parallel to the Y-Axis (Table)..

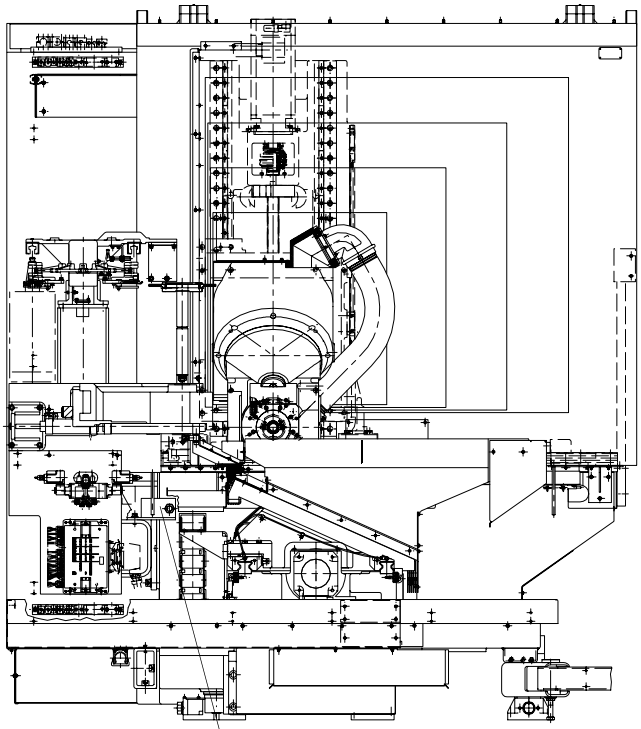
Determining Tool Changing Postion of Y-Axis

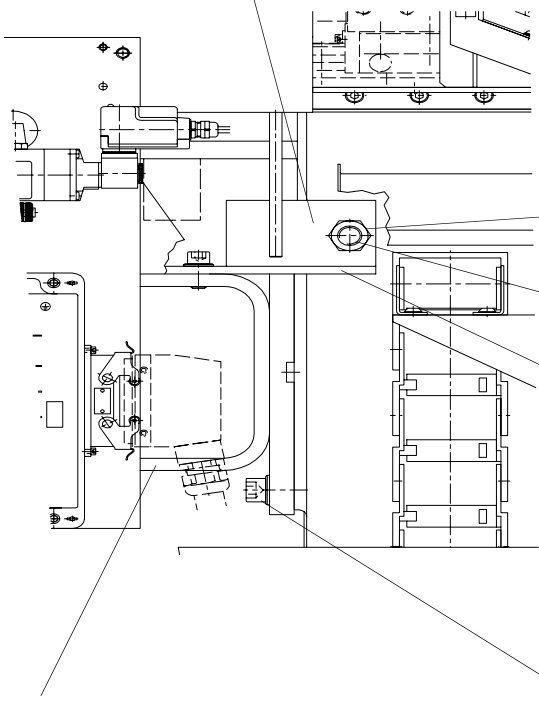


The Tool Changer Module is screwed on to the machine bed as a complete unit



and is provided with two Accurate key- ways for guidance during Y-Axis shift(parallel to Table).The position shift of the complete module can be carried out with a screw rod, provided.





Locking Nut

Adjustment Screw

Angle

Carrier of ATC-Module

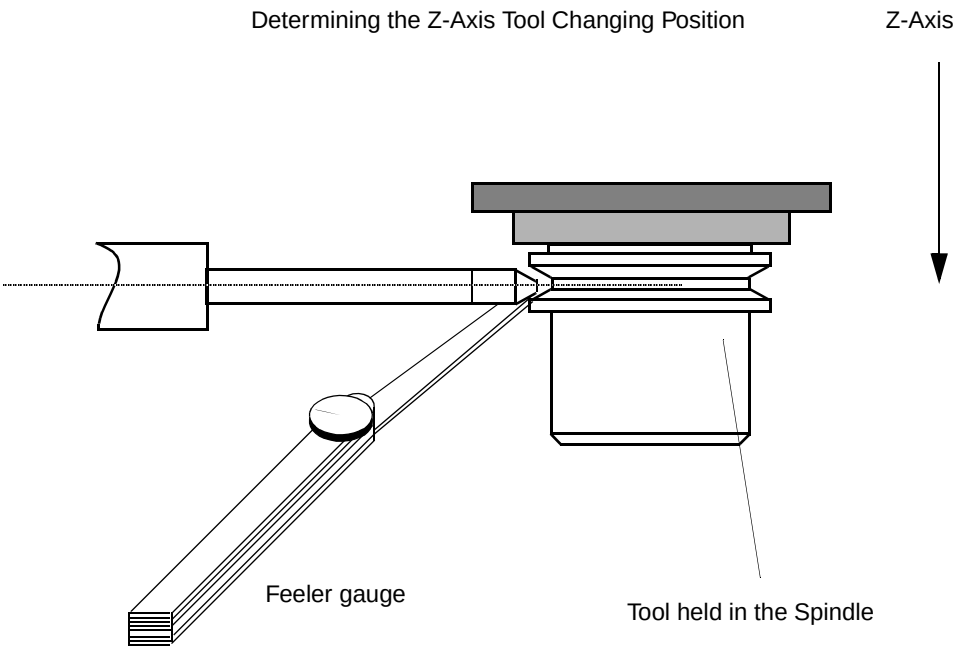
4 x Fixing Bolts
for ATC-Module

The ATC-Module has a tendency to tilt, when the 4 fixing bolts are unscrewed and theby cause tightness in the key-ways for any shifting.To prevent this, first support the module with Wood underneath at top of the Floor Plate. In case a crane is available , it can also provide support by a slight lifting of the ATC-Module. By rotating the Adjustment Nut of Screw Rod,the complete ATC- module is to be set concentric to spindle, in the Y-axis. After tightening the fixing bolts , it is necessary to repeat the position check for the X and the Y-axis.Eventually, a final adjustment of the axes are to be carried out for accuracy.

Determining the Tool Changing Position for the Z-Axis (Vertical Axis N 3345)

Procedure:

The special setting tool ,which is in now the tool gripper, is to be removed. With the tool changer in Basic Position, move the Z-axis to a position where the tool gripper is exactly in the middle of V-groove at tool holder collar (tool in spindle).For safety reasons ,it is advisable to disconnect the valve control before and move the tool changer by hand .



Finding Position :

As a first step, push the tool changer towards the tool in spindle to a distance that the gripper jaws come very close to the tool holder collar.The gap can now be measured with the feeler gauge.The Z-axis is now to be adjusted by incremental step jogging,till the gripper is concentric with the V-groove.The position value is to be recorded from the Actual Position display to be used as **Input value for N 3345** .

Now push back the tool changer system to the Basic Position.Enter in the machine constants memory the determined input values and revive the other machise constant values, which were changed initially for the adjustments.Finally the tool changer system has to be checked for functionality.

Finding and Checking the Draw Back Position of Z-Axis (N 3346)

The draw back position of Z-Axis (N 3346- Tool disengaged from Spindle Cone) is to be calculated as shown below:

Example: **N 3346** = N 3345 (Determined Position - 115 000

Relevant Machine Constants for the Tool Changer

Machine Constants	Significance	Input value
N 1023	Max.value of X-axis ,permissible for Head Swivelling.If this position value is exceeded,the PLC-Position 3 (N 3147) wii be moved to.	
N 1043	Tool Change sequence from Horizontal 0 = Swivel back head parallel to next command positioning 1 = Swivel back head at tool change position	
N 1100	Type of Machine 0 = None 1 = DMU80T 2 = DMU50V 3 = DMU80P 9 = MH 1200/1600S	3
N 1111	Type of A.T.C. 0 = None 1 = DMU80T 2 = DMU50V 3 = DMU80P 9 = MH 1200/1600S	3
N 1112	Special A.T.C. Functions 0 = None not used currently	0
N 1113	Type of Tool breakage Monitor 0 = None 1 = Data format - BCD , 8-Bit Interface 2 = Same as 1, but with tool exit 3 = Data format - Binary, 4-Bit Interface 4 = Same as 3, but with tool exit 11.. 14 correspondent to settings 1.. 4 .A further processing of the NC-Programm is however suspended,till the measurement is complete (danger of Collision at breakage).	
N 1137	Pausing time during the tool removal or diposit in Magazine, prior to commencing motion in the other direction. This step ensures a correct mechanical handling of a tool during the process . 0...255 [50 ms]	3= (150ms)
N 3145	1. Axis : PLC-Position 1 - Changing position A.T.C. DMU 80P	

N 3146	1st. Axis : PLC-Position 2 - Swivelling position SMH DMU80P (near Cabine door, in case position exceeds Monitoring Limit N 1023)	
N 3147	1st. Axis : PLC-Position 3 - Swivelling position SMH DMU80P (near ATC-Shutter, in case position exceeds Monitoring Limit N1024)	
N 3245	2nd. Axis : PLC-Position 1 - Safety position ATC DMU80P - Safety position SMH DMU80P	
N 3345	3rd. Axis : PLC-Position 1 - Tool change position ATC DMU80P	
N 3346	3rd. Axis : PLC-Position 2 Draw back position ATC DMU80P N 3346 = N 3345 - 115 000	
N 3347	3rd. Axis : PLC-Position 3 - Safety position ATC DMU80P - Safety position ATC DMU80P	

Necessary Maschine Positions

To execute an automatic tool changing, it is required to move the machine axes to specific positions . The machine axes which are not involved in the process, are moved to positions of safety to prevent a likely collision with the tool changer or with a tool involved.

Description of Machine Positions:

Changing position: Axis positions for executing the function.Accurate positioning is mandatory , due to interrelation with ATC mechanisism.

Draw back position: Axis position for executing the function. No connection to tool changer mechanism.

Safety position: Not required for executing a funktion.It serves the purpose of avoiding a collision.

Following positions will be used :

Constants	Axis	Name	Significance
N 3145	X (Horiz. longitudinal)	Machine position 1	Changing position ATC.
N 3146	X (Horizontal -dto-)	Machine position 2	Swivell Position near ATC Shutter
N 3147	X (Horizontal -dto-)	Machine position 3	Swill Position near Cabine Door
N 3245	Y (Horizontal cross)	Machine position 1	Safety position ATC / SMH
N 3346	Z (Verticall)	Machine position 1	Changing position ATC
N 3347	Z (Vertical)	Machine position 2	Draw back position ATC
N 3348	Z (Vertical)	Machine position 3	Safety position ATC / SMH

Name of In-and Output points :

Input points (Basic Position gray underlaid)

I 202	Tool-Mag. Tool Identify Hand-over Position
I 206	ATC without Fault (Motor safety switch)
I 207	ATC release
I 210	Tool gripper 2: Position Milling spindle
I 211	Tool gripper 2: Position Tool-Mag.
I 212	ATC Pneumatic cylinder 1: Position Tool-Mag.
I 213	ATC Pneumatic cylinder 1: Basic Position
I 214	ATC Pneumatic cylinder 2: Basic Position
I 215	ATC Pneumatic cylinder 2: Position Milling spindle
I 216	ATC Shutter opened
I 217	ATC Shutter closed
I 223	Tool-clamping opened
I 224	Tool-clamping closed

Output points (Output points for reaching basic position are gray underlaid)

O 113	Tool-clamping open
O 117	Blow air for tool cone
O 205	Tool gripper 2: Direction Milling spindle
O 206	Tool gripper 2: Direction Tool magazine
O 207	ATC pneumatic cylinder 1: Position Tool-Mag.
O 208	ATC pneumatic cylinder 1: Basic position
O 209	ATC pneumatic cylinder 2: Position Milling spindle
O 210	ATC pneumatic cylinder 2: Basic position
O 211	ATC Shutter open
O 212	ATC Shutter close
O 213	ATC Valve refilling unit

Switches, Switch gaps and Switch reliability

Description	Switch	Switch gap	Reliability
Reference signal tool magazine	22S2	2± 1	
Counting signal tool magazine	22S1	2± 1	
Tool recognition hand-over pocket	22S3	8+ 0,5	
Tool grpper 2 position milling spindle	21S1.1	2± 1	1+1
Tool gripper 2 position magazine, basic pos..	21S1.2	2± 1	1+1
Pneumatic cylinder 1 position magazine	21S2.1	2± 1	0.3+0,2
Pneumatic cylinder 1 basic position	21S2.2	2± 1	1+1
Pneumatic cylinder 2 position milling spindle	21S3.1	2± 1	0,5+1
Pneumatic cylinder 2 basic position	21S3.2	2± 1	1+1
ATC shutter up (open)	21S4.1	2± 1	2± 1
ATC shutter down	21S4.2	2± 1	2± 1

Instructions for adjustments of switch ” 22S3 “, Tool Recognition at hand over pocket

General:

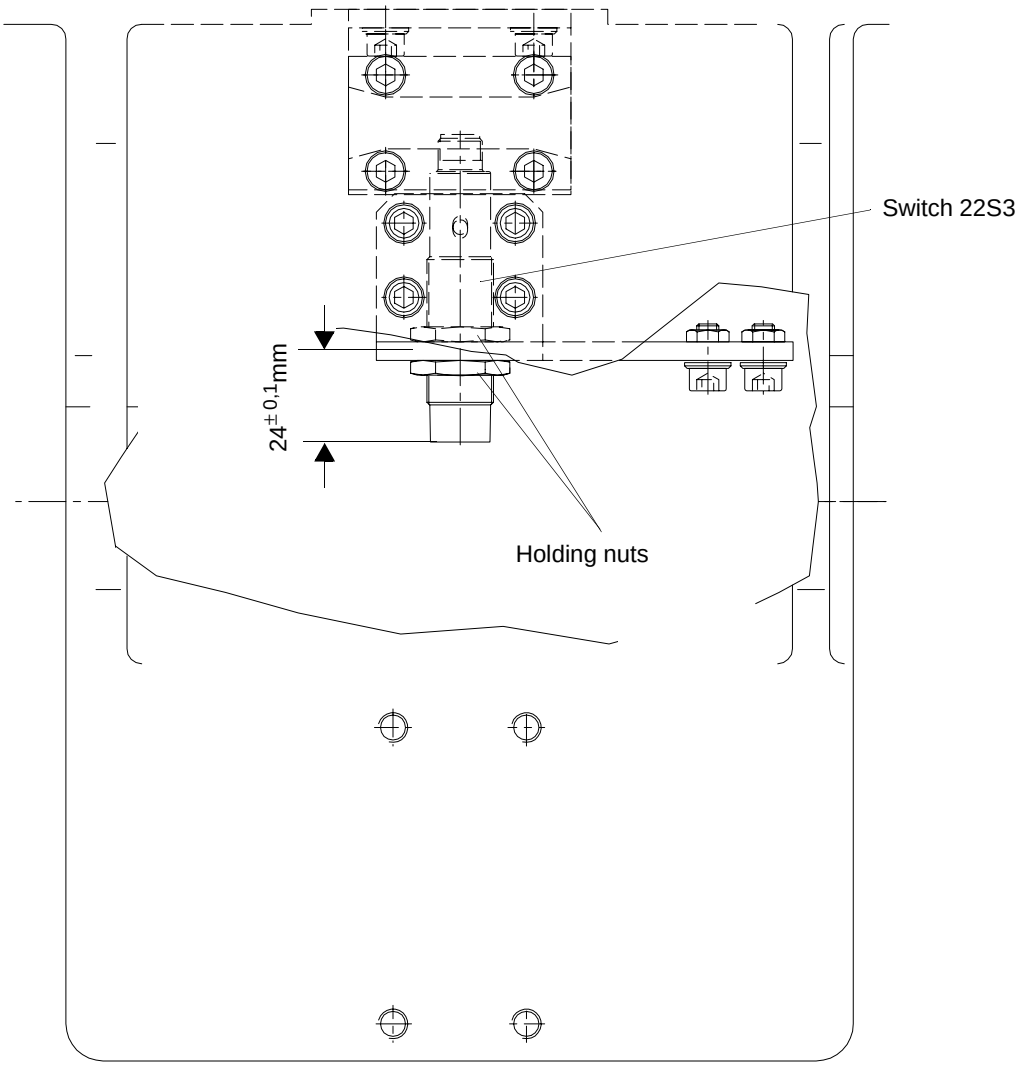
The basic function for recognising tools at hand over pocket with switch “22S3“ has been enlarged with the followinge suppliments:

-As soon as a tool is collected from the magazine,the switch will be monitored for the “Zero-Signal“ - which indicates that the tool is in the gripper.

- During tool depositing in the magazine,it will be first of all checked, whether the tool pocket is empty or not. Further, it will be checked also,if the tool has really been deposited in the pocket susequently. The switch signal must be at “1“ now.In case the process sequence is faulty,because the tool gripper has again taken back the tool, the tool changer will move a second time to the magazine.An error display takes place only after the second failure.

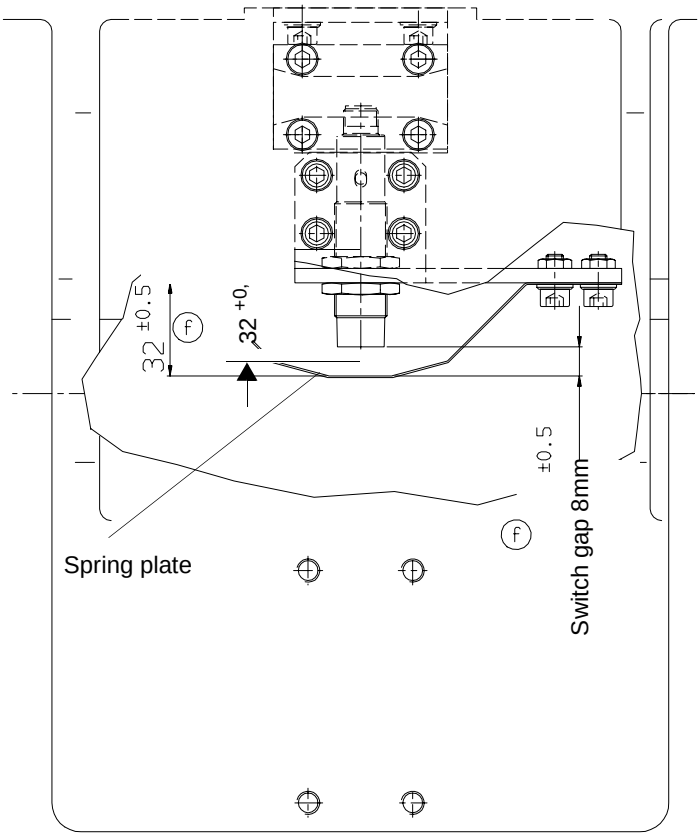
Adjustment

To begin with,the spring plate ,which is mounted in front of the swith is to be removed.The switch is now to be set for a gap of 24 mm,measured betwwen holding angle and the switching surface.This setting can be carried out only after loosening the holding nuts of the switch..



The spring plate is now to be assembled back after setting. Care must be

taken to ensure that the switching surface is completely covered.
The gap between the spring plate and the switching surface can be only 8±0,5 mm now.



A right adjustment of the gap may need a slight bending of the spring plate. In case the specified gap is maintained lower,the switch will be activated by the spring plate ,even in absence of a tool.

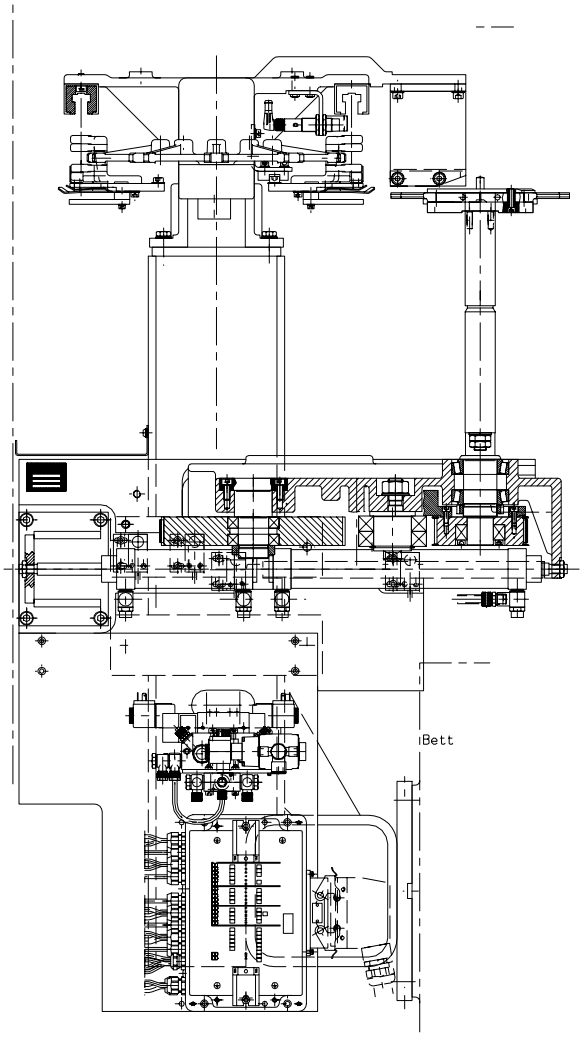
Checking :
The switch should not respond, in case there is no tool in the tool pocket at hand over position.The switch response should be available if the tool pocket carries a tool and the tool mamazine is moved for a forward and backward crossing of the hand over point.

Warning :
For tool holders with draw bolts, ISO-Type A, the spring plate must be pushed up(use slots for holding bolts)for clearance.Without this setting, the draw bolt will foul against the plate and cause error .Additionally ,care must be taken to avoid any contact between the spring plate and the greeen guideways for draw bolts.

Status display of in - and output point:

- Push key “I“ (Information).
- The I/O status is available over the key MF 4
- Push the key for display of I/O listing .

Basic position of the Tool changer



Switch and input points (Basic position is underlaid in grey)

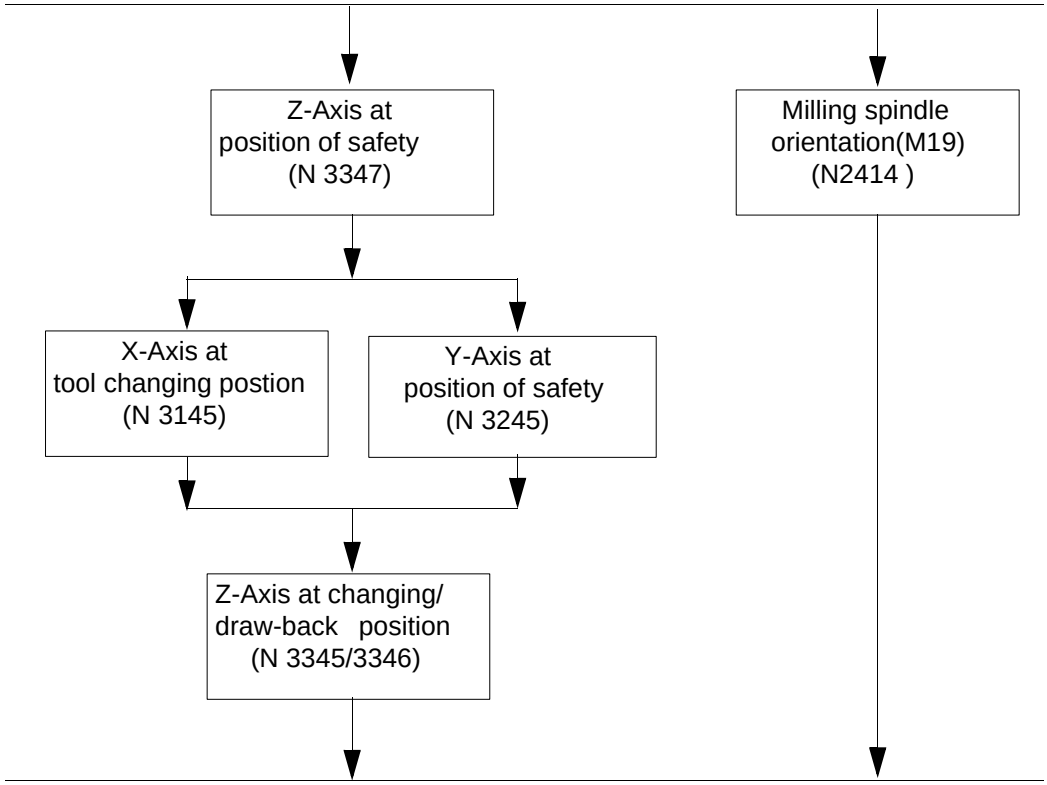
21S1.2	I 211	Tool gripper 2: Position Tool magazine
21S2.2	I 213	ATC Pneumatic cylinder 1: Basic position
21S3.2	I 214	ATC Pneumatic cylinder 2: Basic position
21S4.2	I 217	ATC Shutter closed
5S2	I 224	Tool clamping closed

Attention: In the basic position ,the piston rod of pneumatic cylinder for tool gripper is moved out .

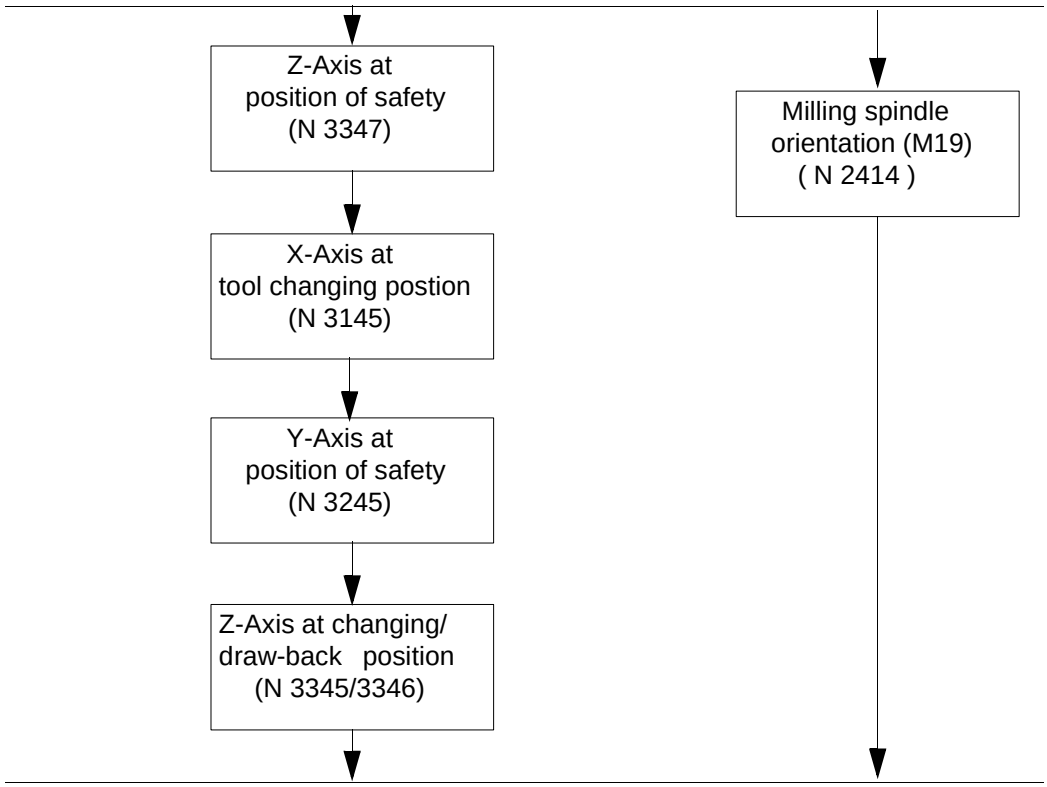
Sequence of movements during tool changing

The flow chart explains the functional sequence for the tool changer, movement of axes, spindle orientation, swivelling of milling head etc.

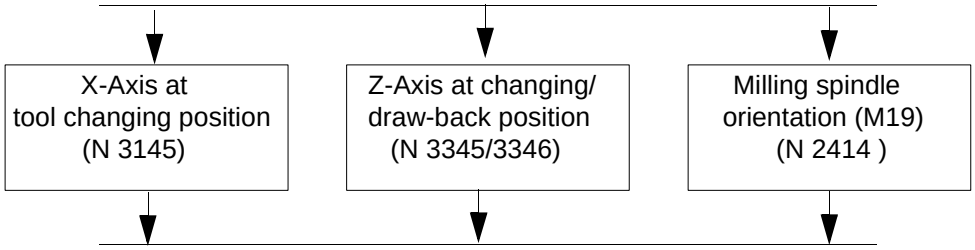
Tool changing vertical with ATC (M6 ; No 5th axis or 5th axis < 30 degrees)



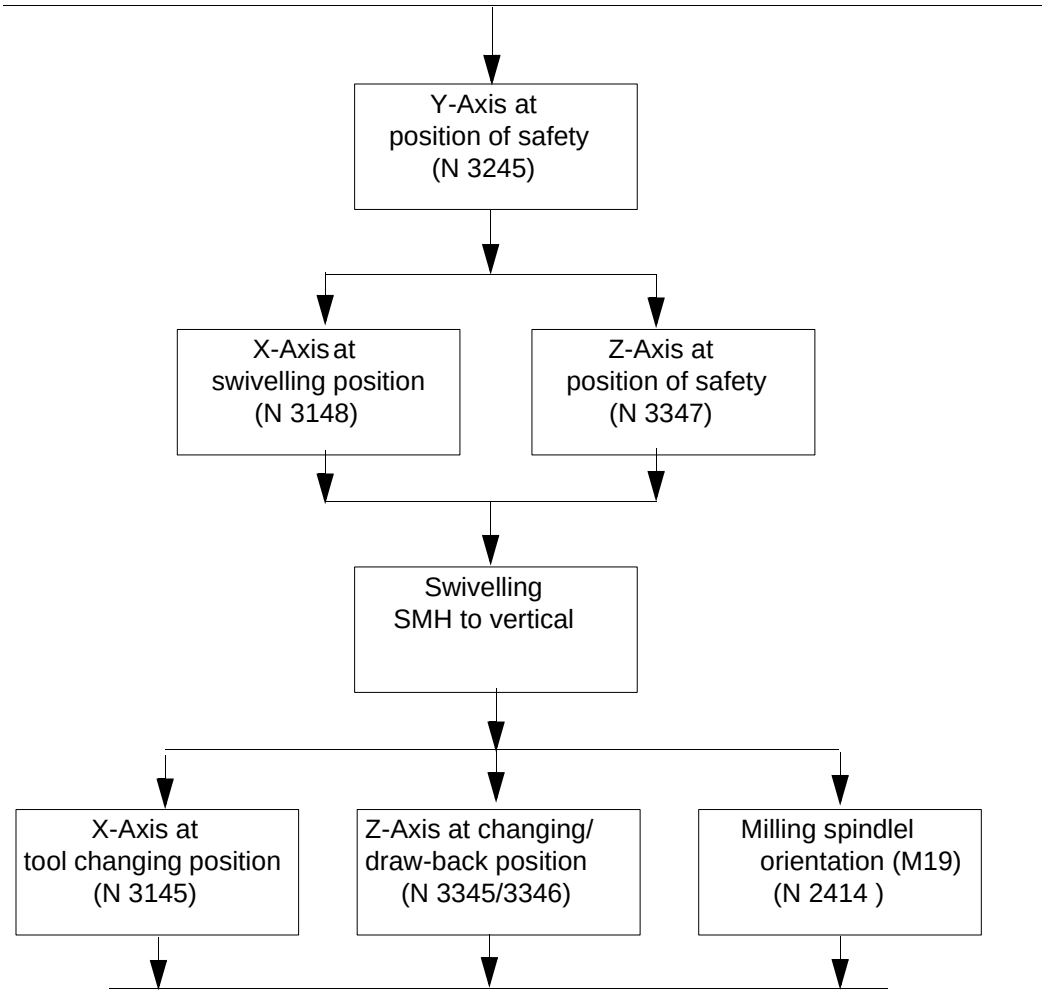
Tool changing vertical with ATC (M6, 5. Axis > 30 Degrees)



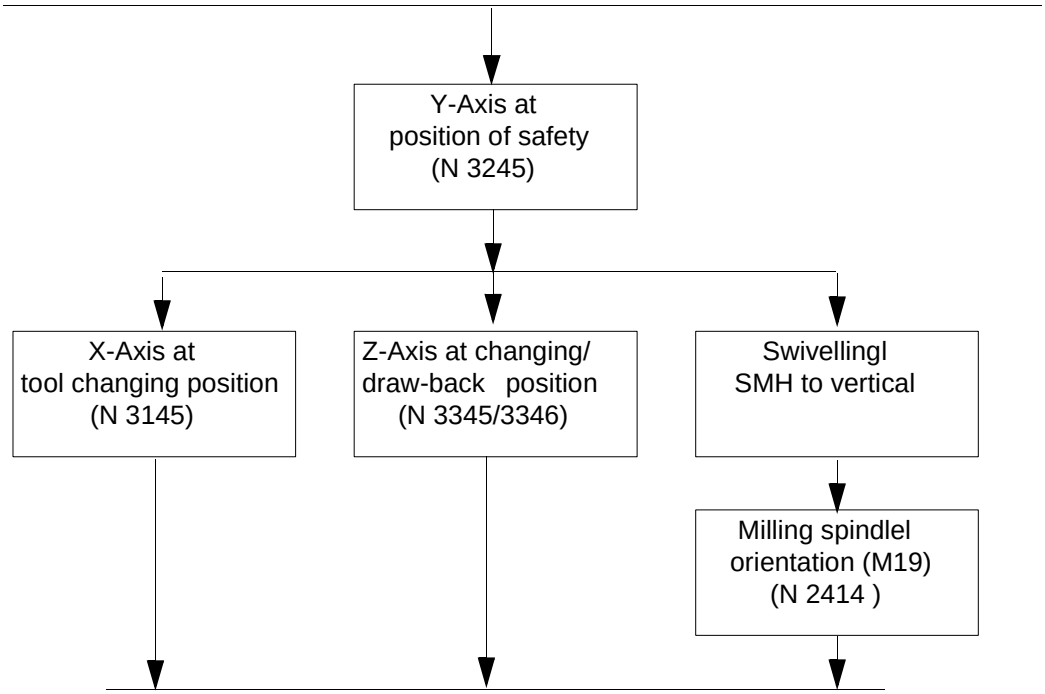
Tool changing vertical with ATC (M46)



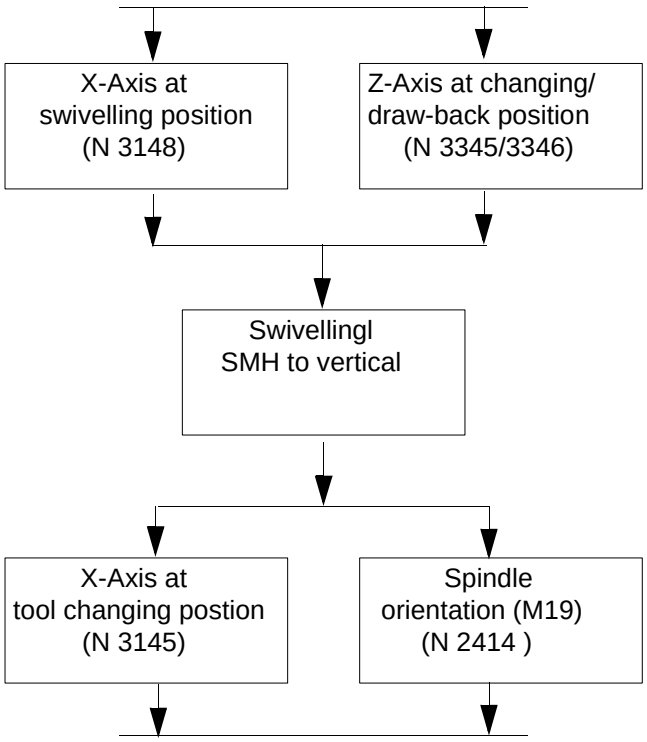
Tool changingl horizontal with ATC (M6, 5. Axis)



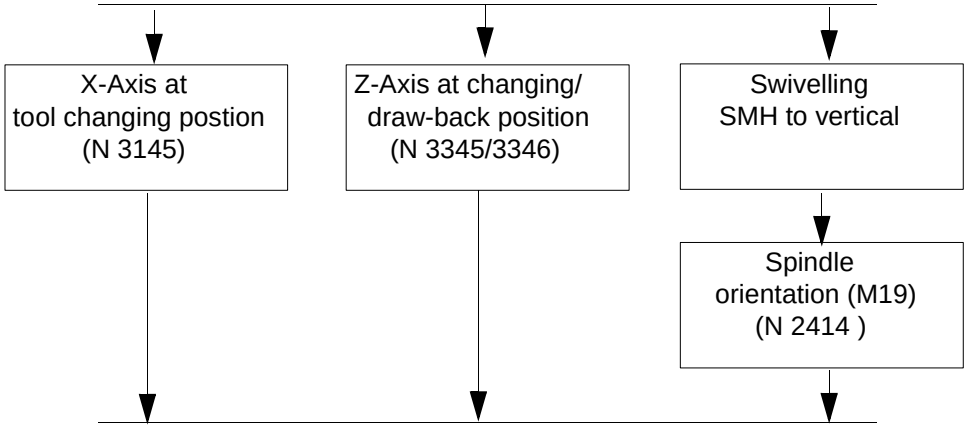
Tool changingl horizontal with ATC (M6, No 5th. Axis)



Tool changing horizontal with ATC (M 46)



Tool changingl horizontal with ATC (M 46, No 5th. Axis)

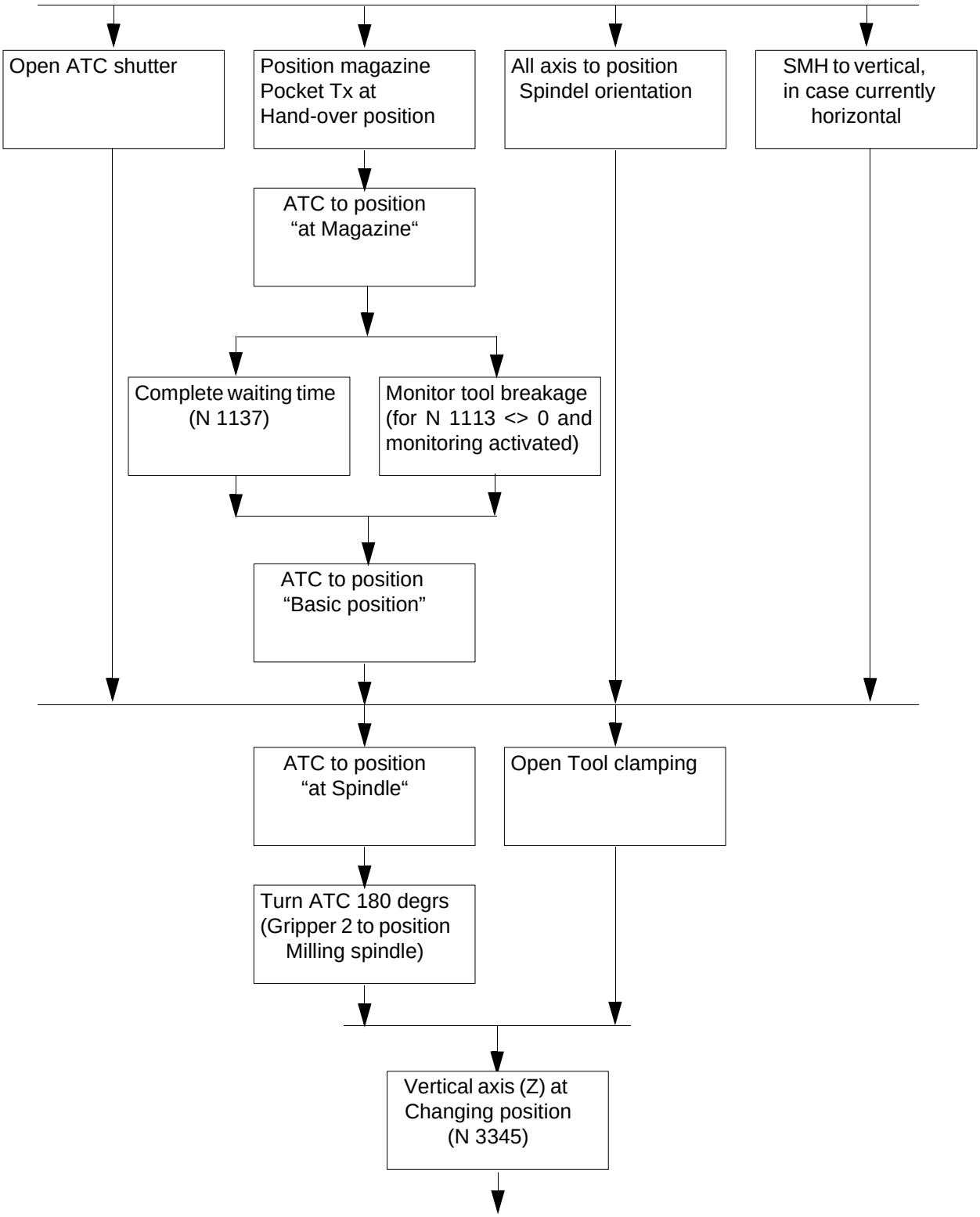


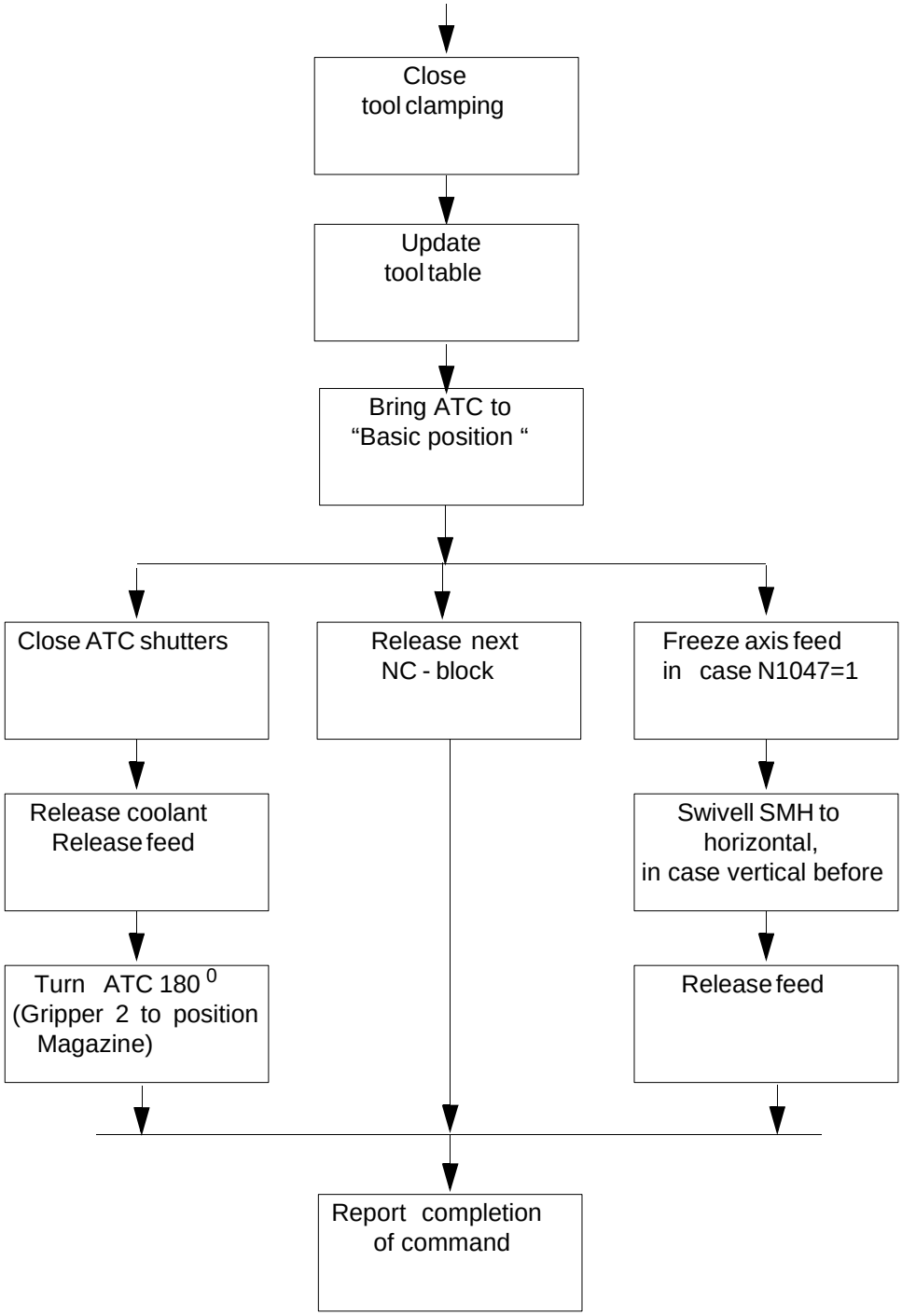
Flow chart for a Tool to be in Spindle (command Tx M6)

Status: The milling spindle is either empty or is carrying a tool, which was previously introduced manually (M 66 Change).

Precodition: A tool change with the ATC has been programmed with command M6 or M46 .

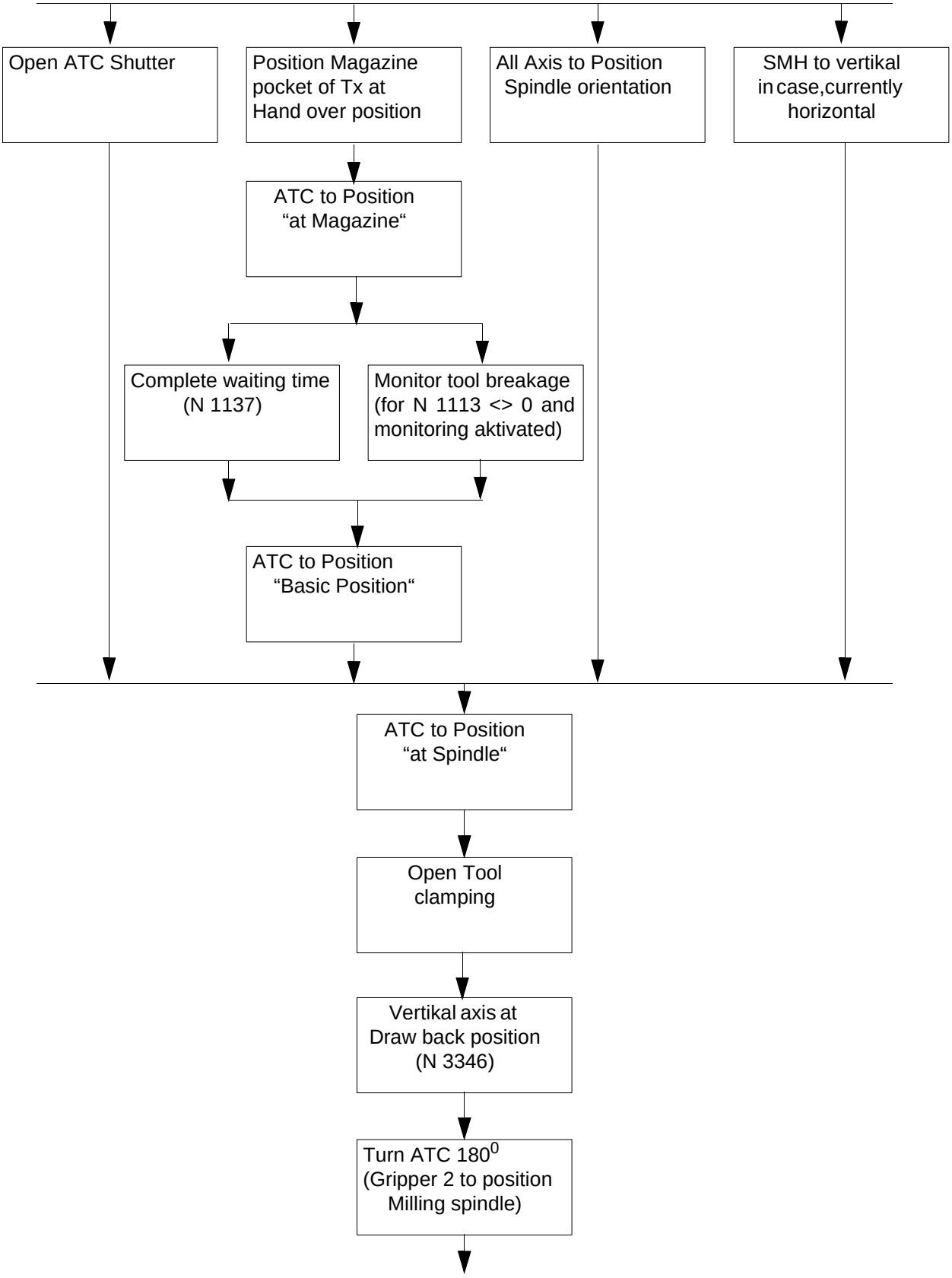
Activities: In case a tool was previously manually introduced in the spindle,it has to be removed first , also manually. A change of tool from magazine with the ATC ,follows next .

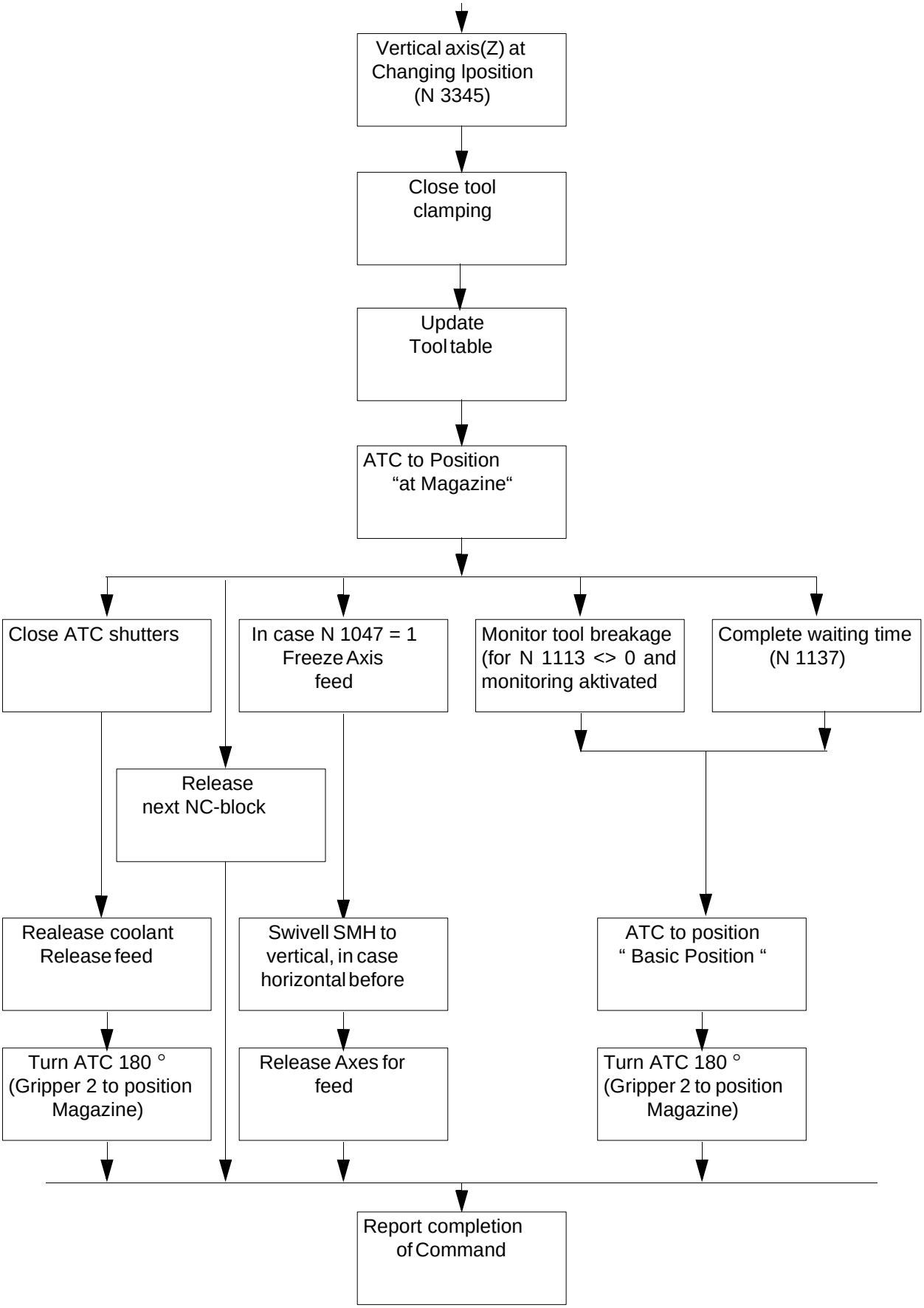



Close
tool clamping
Update
tool table
Bring ATC to
“Basic position “
Close ATC shutters
Release next
NC - block
Freeze axis feed
in case N1047=1
Release coolant
Release feed
Swivell SMH to
horizontal,
in case vertical before
Turn ATC 180 0
(Gripper 2 to position
Magazine)
Release feed
Report completion
of command

Flow chart for an Automatic Tool Change (command Tx M6)

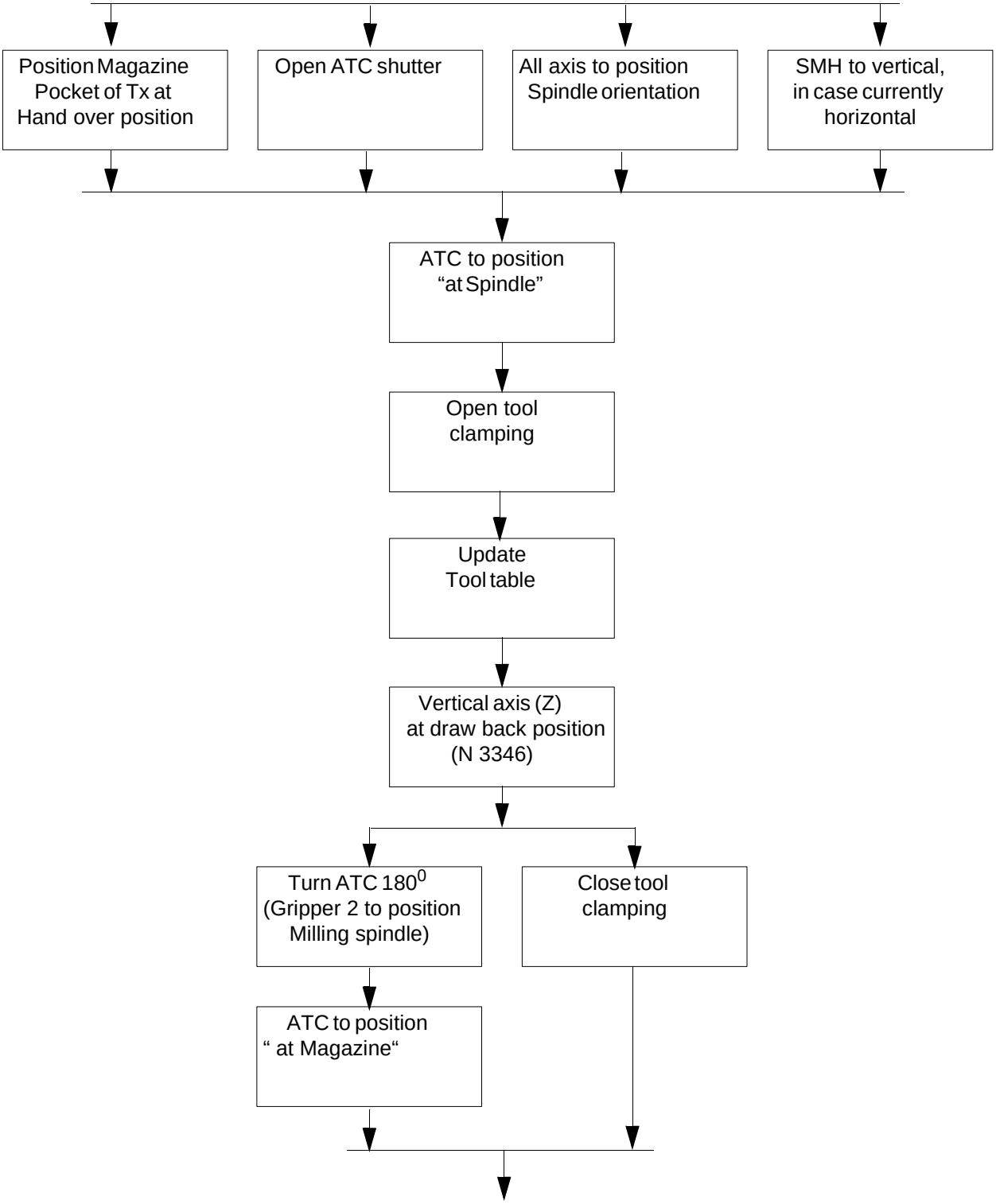
Status: The spindle presently carries a tool from the magazine.
Precondition: Another tool from the magazine has been called up with command M6 or with M46 .
Activities: Execution of a full tool change (exchange of tools in a single sequence).

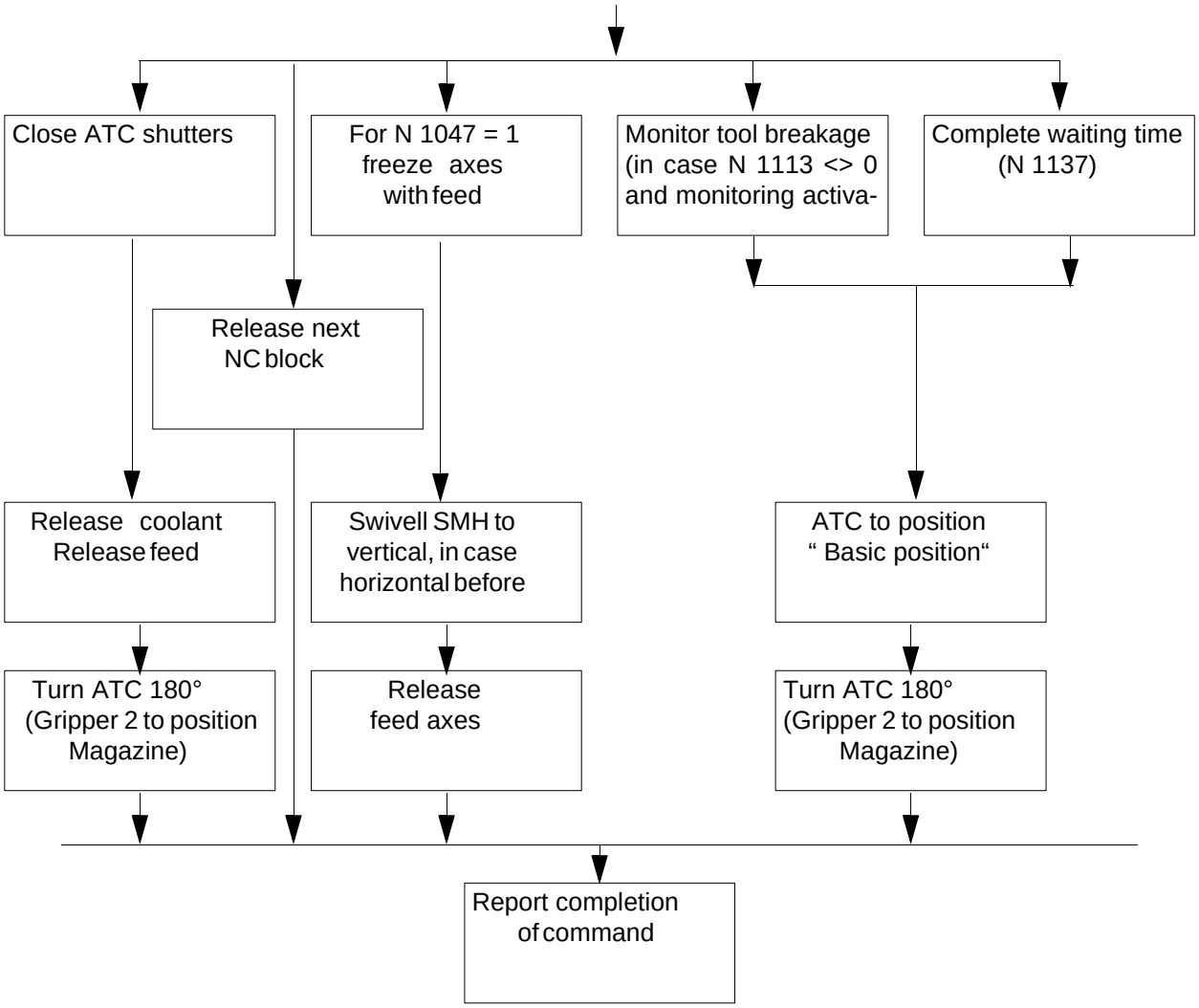



Vertical axis(Z) at Changing lposition (N 3345)
Close tool clamping
Update Tool table
ATC to Position “at Magazine“
Close ATC shutters
In case N 1047 = 1 Freeze Axis feed
Monitor tool breakage (for N 1113 <> 0 and monitoring aktivated
Complete waiting time (N 1137)
Release next NC-block
Realease coolant Release feed
Swivell SMH to vertical, in case horizontal before
ATC to position “ Basic Position “
Turn ATC 180 ° (Gripper 2 to position Magazine)
Release Axes for feed
Turn ATC 180 ° (Gripper 2 to position Magazine)
Report completion of Command

Flow chart for a tool exchange (T0 M6)

Status : A tool from the magazine is now in the spindle.
Precondition: The tool in spindle is to be removed first with T0 M6 or for an external tool with Tx M66 for a tool change.
Activities: Execution of tool retrieval, thereafter new tool in spindle wuth ATC or manually as the case demmands .




Close ATC shutters
For N 1047 = 1 freeze axes with feed
Monitor tool breakage (in case N 1113 <> 0 and monitoring activa-
Complete waiting time (N 1137)
Release next NC block
Release coolant Release feed
Swivell SMH to vertical, in case horizontal before
ATC to position " Basic position"
Turn ATC 180° (Gripper 2 to position Magazine)
Release feed axes
Turn ATC 180° (Gripper 2 to position Magazine)
Report completion of command

Procedures for interruptions during an Automatic Tool Changing

Nature of Interruption

1)The sudden interruption was created by pressing one of the keys - “Feed Stop“ or “Feed/Spindle Stop“.

Consequences:
- All movements come to a halt.
- The achieved target positions are held by control.
- Movenents, which could not come to a completion, are stopped by closing down the corresponding valves.

How to continue work

- The Machine starts functioning by pressing the “Start”-key. All interrupped motions are released.During this process, an additional pressure-reduction valve is opened for each individual movement, simultanously with the motion release execution. This measure creates a gradual preassure reduction in the empty Pneumatic Cylinders. (Othewise, hard mechanical movement,for lack of cushioning force.)

2) Emergency Stop

The interruption is created by emergency stop

- One of the “Emergency Stop “ switches was pressed.

Consequences:
- All movements are stopped.
- All output points are switched off.
- The Hydraulic System is swiched off .

How to continue work

- Switch on the Hydraulic System
- The axis positions, arrived at stop, will be controlled again.
- The machine starts functioning by pressing the “Start” -key.
- All interrupted motions are released. Additional pressure-reduction valves are opened for each individual movement,simultaneously with the motion release execution , to achieve a gradual preassure reduction in the empty Pneumatic Cylinders.

Abbruch

Auslöser eines Abbruchs

- Betätigen von Softkey „Block abbrechen“, „Satz abbrechen“, „Programm abbrechen“, „CNC Rücksetzen“ oder „Netz Aus“.

Consequences:

- All movements are stopped.
- The execution is aborted.All demmands cease to exist.
- A corresponding error message is displayed in case, the ATC is not at the Basic Position.

How to continue work:

- Manual retraction of the ATC either by actuating the Pneumatic Valves or

by using the “Diagnosis”-mode(switch 19S2 in E-cabinet).
- Automatic retraction using resetting function “M 77“
- The Tool Memory must be checked again ,if the ATC was at the Basic Position.

Resetting function and Diagnosis mode

When the execution is aborted,the ATC normally stands in the working area with a tool in the gripper,or even half way during the removal from the spindle. PLC- monitoring will react thereby in the following way:
- The command values for the axes and the spindle are frozen.No further movement will be possible.
- A movement for the tool magazine is blocked.
- The input of all M-Functions, except “M 77“ is blocked.

To terminate this situation for continuing work, two possible methods are available.

- Automatic resetting by using function M 77
- Manual resetting ,using mode “Diagnosis“ and the MF-Softkeys to cover all individual functions as required.

Notes for resetting function “M 77“

During the execution of the resetting function “M 77“ ,the activities discontinued earlier will be nenewed at the breaking point .This is necessary due to the basic function design of the two grippers as ”Fetcher“ and “Collector“-whereby a tool cannot be any more deposited in the “Collector”-gripper.The control system takes care in the process automatically to update the tool memory.

The function **M77 cannot be used after a power shut-down**.This is due to the fact, that the Reference Points cannot be approached, on account of the ATC being parked in the working area. In such a case, the ATC must be initially moved out to the Basic Position manually -using the mode “Diagnosis”. **Check Tool Memory for tallying with the prevailing Machine status .**

Stages of ATC-Movement executed manually in mode “Diagnosis”

When the repostioning of ATC to its Basic Position is no longer possible with the function “M77”, it can be brought back only by using the MF-Softkeys in mode “Diagnosis”.For this , set switch 19S2 in E-cabinet to position “1“.This will provide new interpretetion of MF-Softkeys (see Page 16 - 17).

The use of the Diagnosis function is permitted only for a trained person as the system does not check for machine safety.THe use must finally ensure that the Tool Memory corresponds to actual machine status.

Following points are valid during use of the “Diagnosis” -mode:

- A movement will continue only so long,as the MF-Softkey is pressed.
  The motion stops immediately with the release of pressure .
- When the final position is reached, it is maintained by servo-control.
- During the Start of each motion,pressure reduction valves are activated for a gradual preassure build up in Pneumatic Cylinders(Cushioning).

-Informations about Tools,in case any in the grippers at this stage ,are deleted .
- Command M77 cannot be executed in mode “Diagnosis“.

Setting M 19 at Mill Plus Control

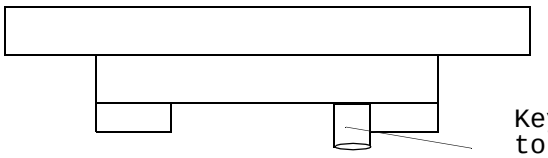
Machine constants to be changed and their function:

N 1036	C 0 to C 1	Mode M 19 (0=off, 1=on)
N 2590	C 2 to C 3	Mode M 19 (0=off, 1=Mech., 2=NC, 3=Init)
N 1004	C 0	Offset value Vertical (Enter 1/10 Degree)
N 2414	C ..to C 0	Offset value Horizontal

- If the machine axes are positioned at random in the working area,move them all to respective reference points.
- Enter command “M 19 ”in operating mode “ MDI“ and execute.The spindle will rotate and the refence point of ROD will be crossed over.

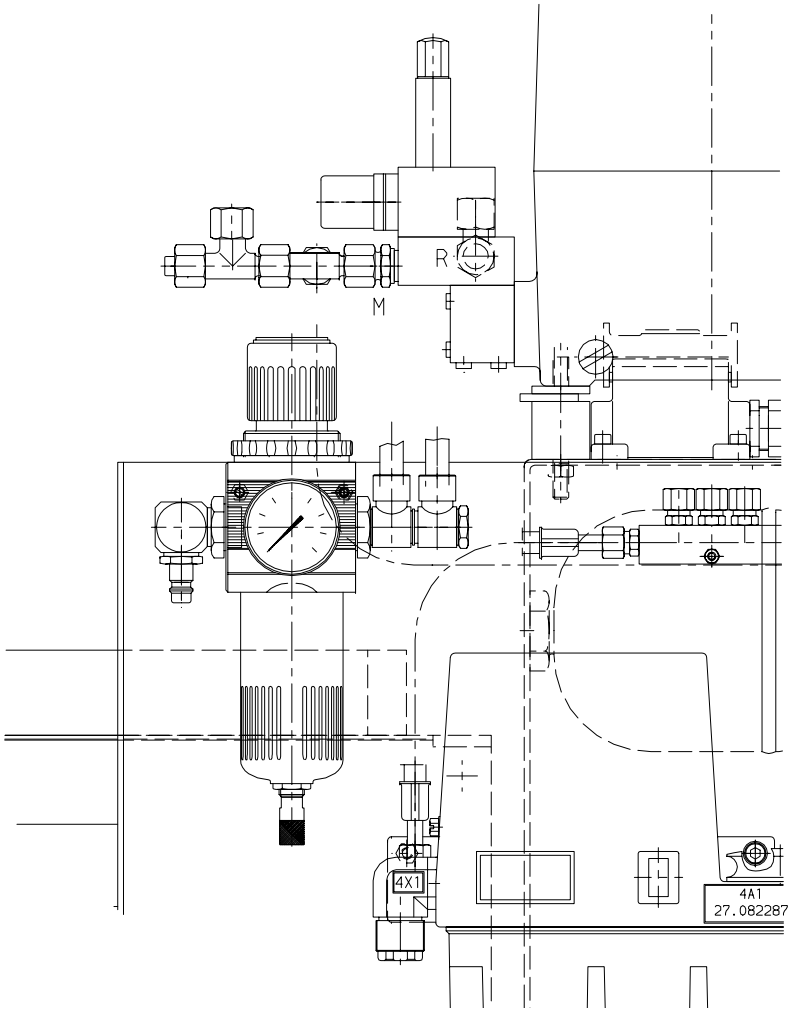
-  Press MF -Softkey for opening Cabine door
(the position control circuit for Spindle is opened)

- Open cabine door and turn spindle to correct point(M19- Position)



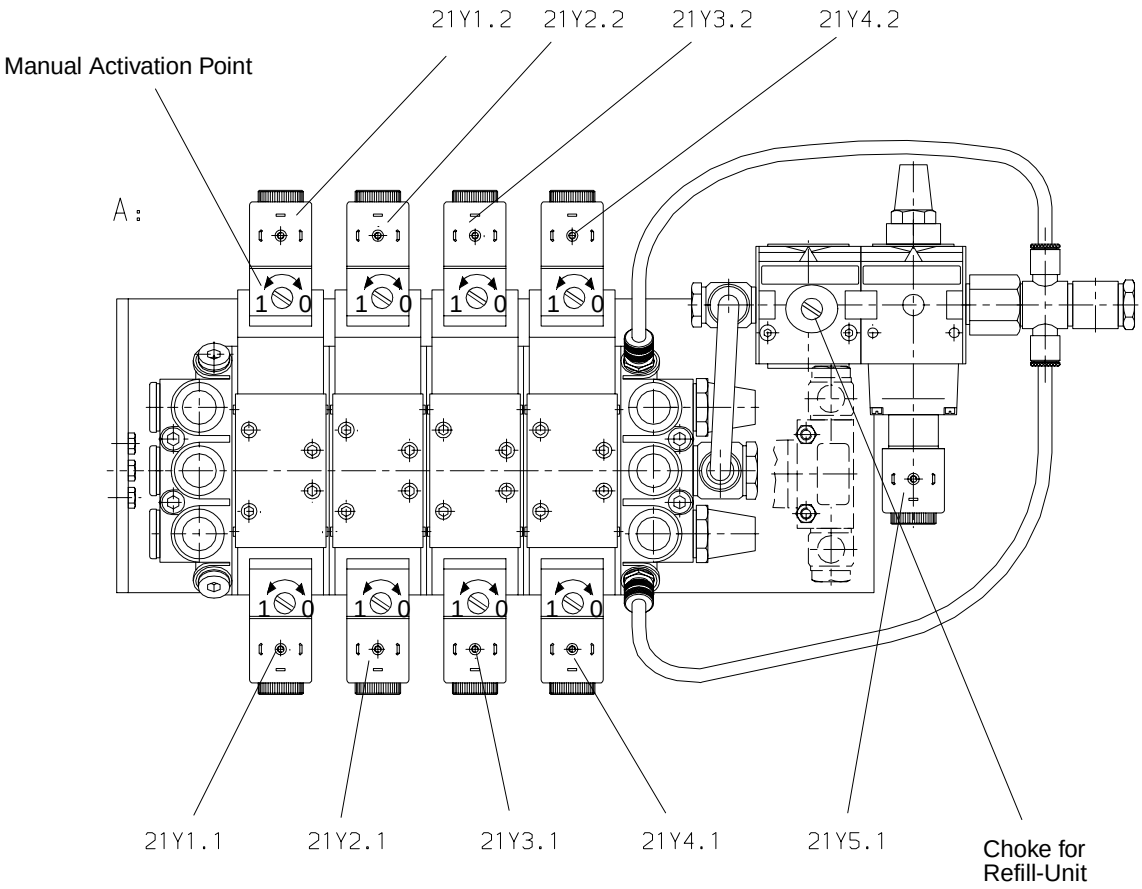
- The accuracy of the Position is to be checked with a dial gauge of 1/100 mm count and zeroing at the spindle keys .
- Read value of “ Actual S “ from display (for example: 272.989).Note down this value to be entered finally **as Input value for Maschine Constant No.“N 2414“ .**
- Reinstate the original Machine Constant value ,changed earlier, together with the now determined value of N2414 in the constants memory.

Cofirmatory Check: Move all axes once again to their reference points.Execute command “M 19” . Check the spindle keys for parralelity to X-axis with dial gauge.



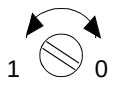
The working preassure is set for 5 bar at the preassure regulating unit.

Description of indidual valves



Valve	Function
21Y1.1	Tool Gripper 2 ,in direction Milling Spindle
21Y1.2	Tool Gripper 2 ,in direction Tool Magazine - Basic Position
21Y2.1	Pneumatic Cylinder 1, for position Tool Magazine
21Y2.2	Pneumatic Cylinder 1, for Basic Position
21Y3.1	Pneumatic Cylinder 2, for position Milling Spindle
21Y3.2	Pneumatic Cylinder 2, for Basic Position
21Y4.1	Open ATC shutter
21Y4.2	Close ATC shutter - Basic Position

Manual Operation of Valves



The valves can be operated manually in two ways,using a screw driver.A valve can be switched “ On “ either by a clockwise turn of screw head or by pressing the the head down for jogging.

Basic Adjustment of the Pneumatic System (Chokes and Dampers)

The precondition for an adjustment remains , that the dampers and the chokes are in closed condition.The following list shows the preliminary adjustments of the individual movements.

Grundeinstellung Pneumatik Ⓕ

Ausgangsstellung: Dämpfung und Drossel geschlossen.

Bezeichnung	Drosel	Endlagendämpfung
WZ-Greifer 2 Richtung Fräs(„pindel (Vorne)	4,5	1,0
WZ-Greifer 2 Richtung WZ-Magazin (Hinten)	5,0	1,2
Pneumatik Zylinder 1 Stellung WZ-Magazin	2,0	2,75
Pneumatik Zylinder 1 Grundstellung	3,75	2,0
Pneumatik Zylinder 2 Stellung Fraesspindel	4,75	1,5
Pneumatik Zylinder 2 Grundstellung	3,75	1,75

Drossel der Befülleinheit 5 Umdrehungen geöffnet Umdrehungen geöffnet

Final Adjustments

The final and an exact adjustment of the units can be done only by a close obversation of the way of movement for the ATC , or alternatively by checking the “Chip to Chip Time “(6,5 Sec.).

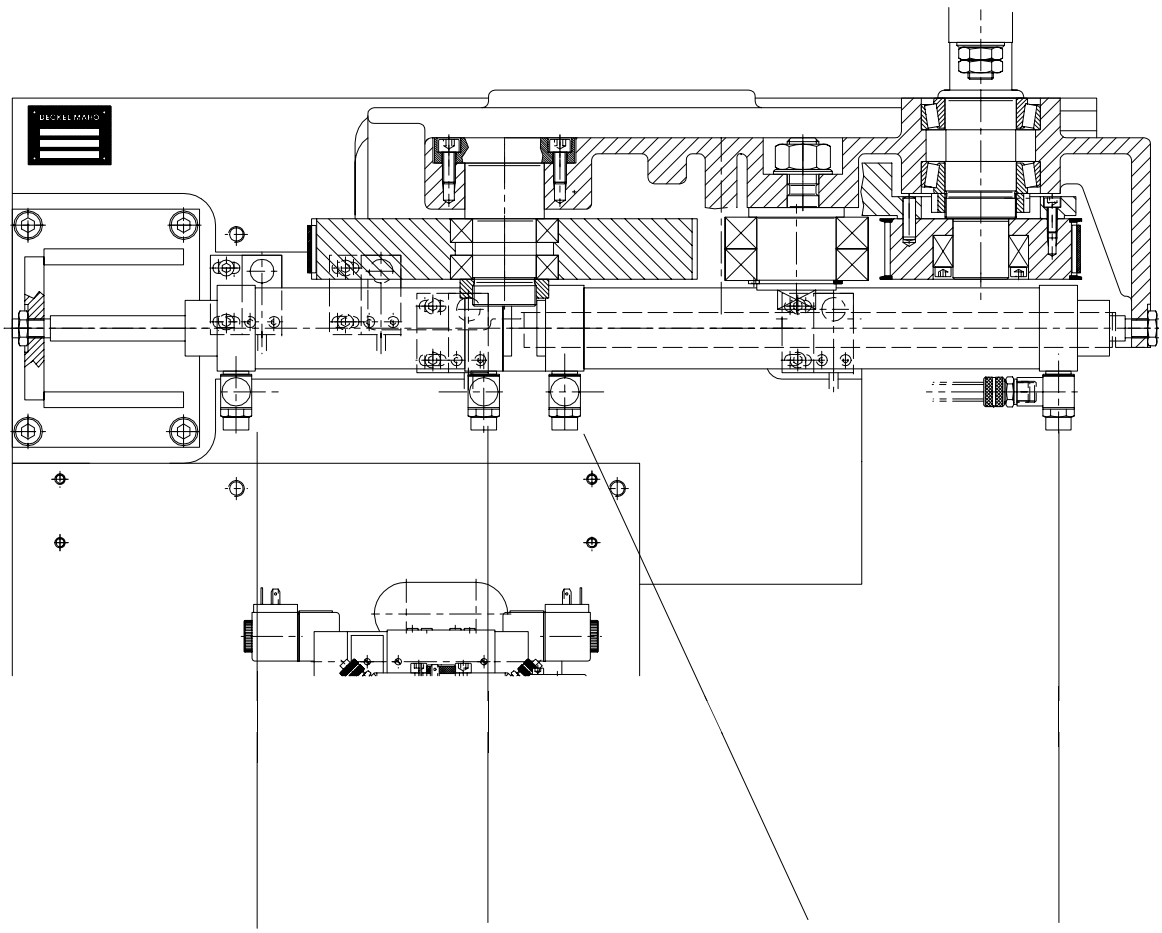
Function and Adjustment of the Refill -Unit

During an “Emmergency Stop “ condition ,the pneumatic valves are no longer controlled, which allows Air to escape from cylinders. During a Restart of machine, without a Refill-Unit ,the cylinders will face on one side of piston no pressure and on the other side a preassure of 5 bar.This will cause a very sudden and a hard movement(mechanischal shock) of the ATC.
The chokes integrated in the Refill-Unit, permit during switching on of air flow,the air to expand .This resuslts in a gradual build up of preassure in the pneumatic cylinders,which are now being controlled.After a certain period when the cylinder arrives its end of stroke position, a cushioning counter preassure is avalable.The chokes are at this stage bye-passed. The operating preassure is effective only at this stage.

Setting

The Choke of the Refill-Unit will be initially fully closed and thereafter opened 5 turns.From **Series 1233 (85841 - 85859) onward,** the Choke will be fully opened first, and then closed 3 turns.

Location of Chokes and Dämpers at the individual Pneumatic Cylinders



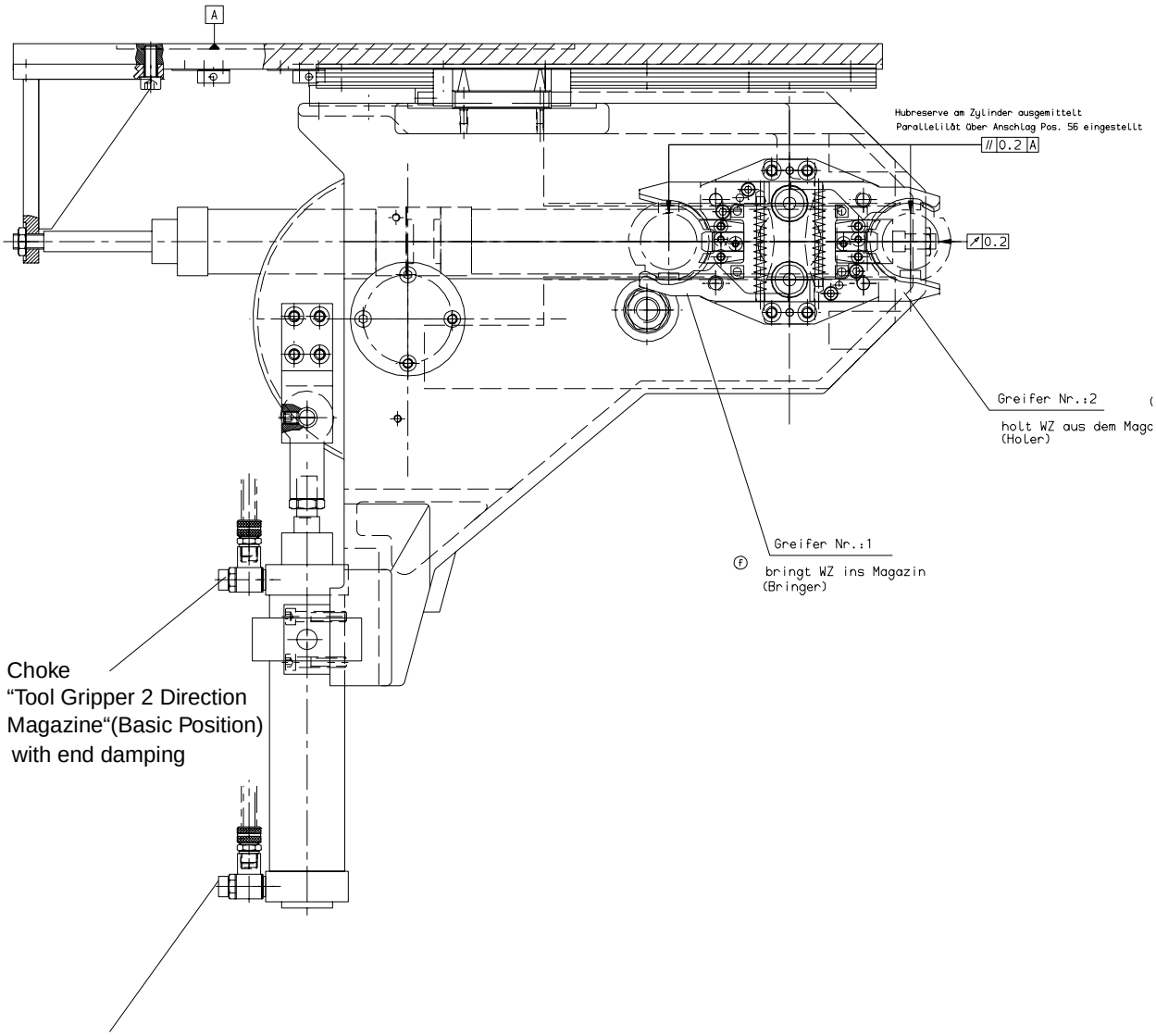
Choke Cylinder 1 “Basic Position“

Choke Cylinder 1 “Position Magazine“

Choke Cylinder 2 “Basic Position“

Choke Cylinder 2 “Position Spindle“

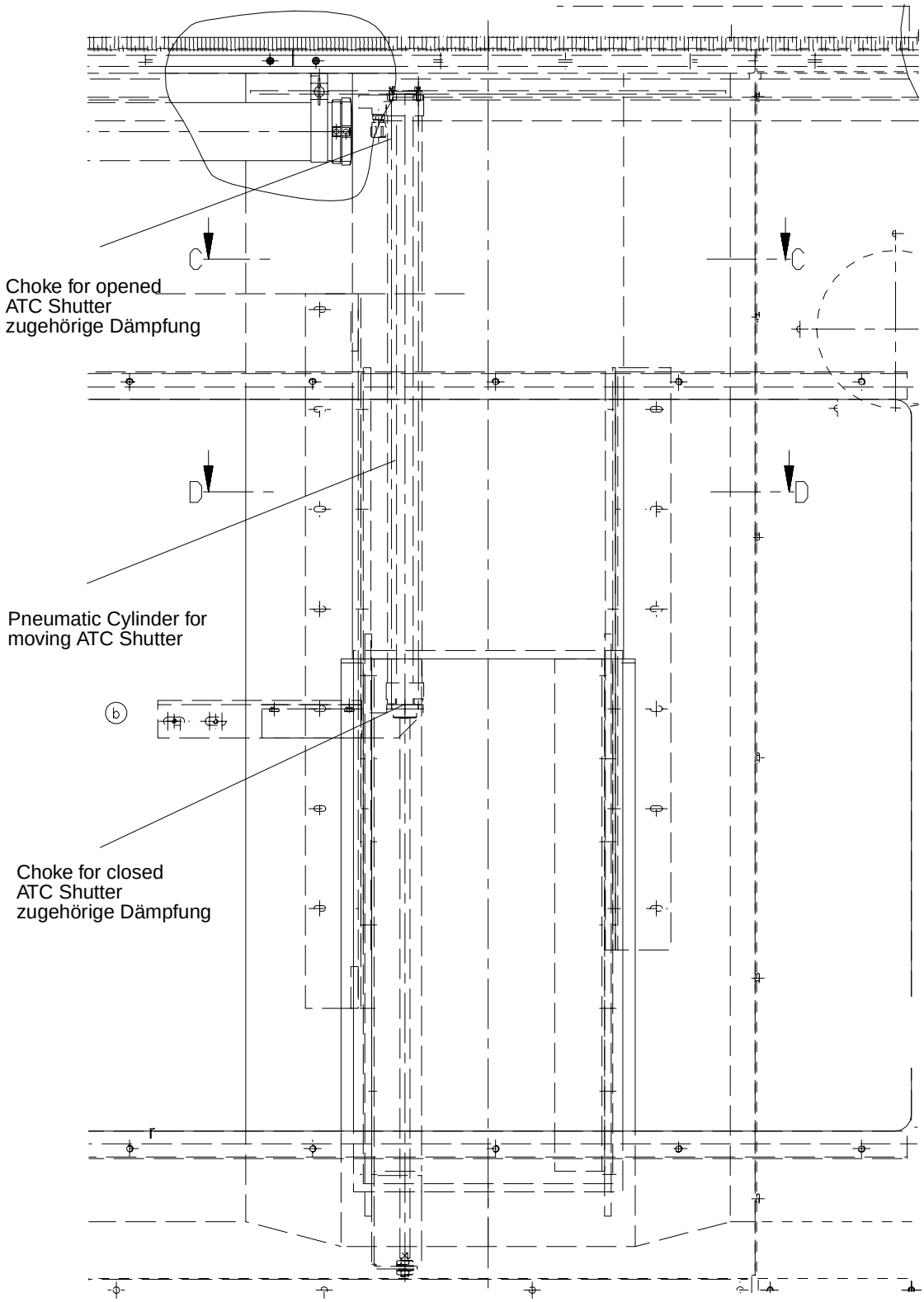
Beachte: The adjustment screws (hex. socket head)for Dampers are located behind the connecting points for air.



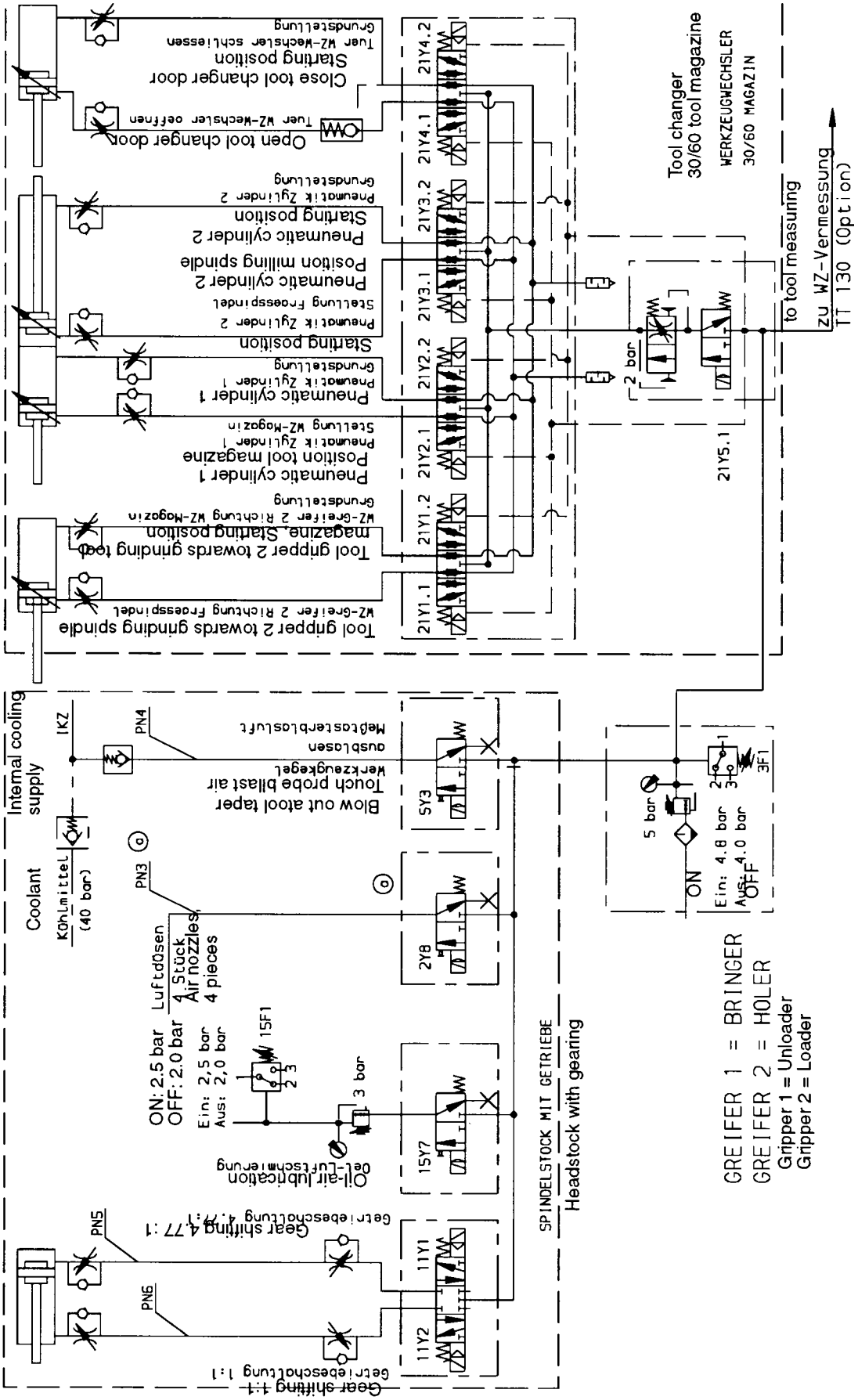
Choke
“Tool Gripper 2 Direction
Magazine“(Basic Position)
with end damping

Choke
“Tool Gripper 2 Direction
Spindle“
with end damping

Location of Pneumatic Cylinders for ATC Shutter



Pneumatic Circuit Diagramm (Spindel Head with Gear Box)



Pneumatic Circuit Diagramm (Integral Motor - Spindle)