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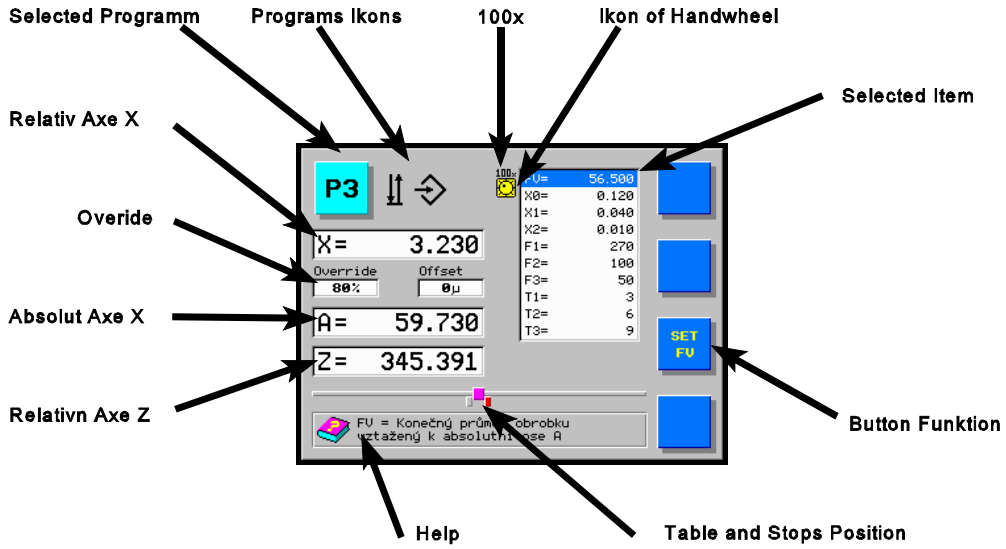
Intro

These instructions give a survey of all modes and operating procedures of the control system **K51-C** with color display. The individual steps are described from the starting operation to the final operation.

If these operating instructions give a reference to a machine panel-mounted switch a description of the control of this switch can be found in the machine operating instructions.

These operating instructions are applicable to any design variant of the machine. The operating facilities of the individual systems are modified to meet the customer's requirements when he is ordering the system. Therefore, some selectable facilities given in the operating instructions need not be applicable to the particular machine, but most of them can be additionally ordered. These items have been marked in the operating instructions.



For applications where technological values should be entered as numerical values, cycles with parametric programming are available. In this case, the individual grinding parameters (diameter, infeed rate, points of deceleration and sparking-out) are selected consecutively in the menu and the parameter values are set by rotating the handwheel.

1. Description of the control system

The control system is designed for drive control of the grinding machines.

For applications where technological values should be entered as numerical values, cycles with parametric programming are available. In this case, the individual grinding parameters (diameter, infeed rate, points of deceleration and sparking-out) are selected consecutively in the menu and the parameter values are set by rotating the handwheel.

For concave/convex grinding, only the diameter of curvature of the workpiece surface should be programmed.

The control system is user-friendly, making it possible for the operator to make full use of his practical experience without the necessity of learning how to program the machine.

1.1 Grinding modes

a) Manual grinding

In manual grinding, infeed control of the wheelhead is effected directly by the handwheel with the possibility of multiplication 10x, or by the rapid-traverse keys on the machine control panel.

b) Longitudinal grinding with automatic grinding addition at reversal points - Cycle **A**

In this grinding mode, the operator presets the amount of grinding addition at the reversal points, employing the handwheel. Then, the control system ensures that this grinding allowance is reapplied till a zero is indicated on the display.

) Plunge-cut grinding at programmable speed - Cycle **P**

In this control mode, plunge-cut grinding can be made at a preprogrammed speed.

f) Wheel dressing

Apart from automatic feed to the diamond position (X-axis), the control system permits wheel dressing to be effected at an increment preset by the handwheel, increment compensation being provided. In the automatic grinding sequence, intermediate dressing can be performed with return to the point of interrupt.

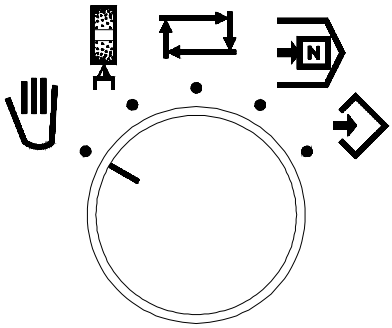
g) Concave/convex grinding

Longitudinal grinding of the concave/convex cylinders with the specified diameter of the envelope can be accomplished.

h) Grinding with preprogrammed parameters

In this mode, grinding can be carried out in an automatic grinding cycle with preprogrammed parameters. This cycle is suitable for grinding workpieces requiring the defined technological conditions of the grinding process to be repeatedly satisfied.

1.2 Main switch



Basic design

MAIN SWITCH	MEANING
	Manual grinding
	Programming.
	Selection of the program number and functions.
	Automatic control mode.
	Wheel dressing mode.

1.3 Keys

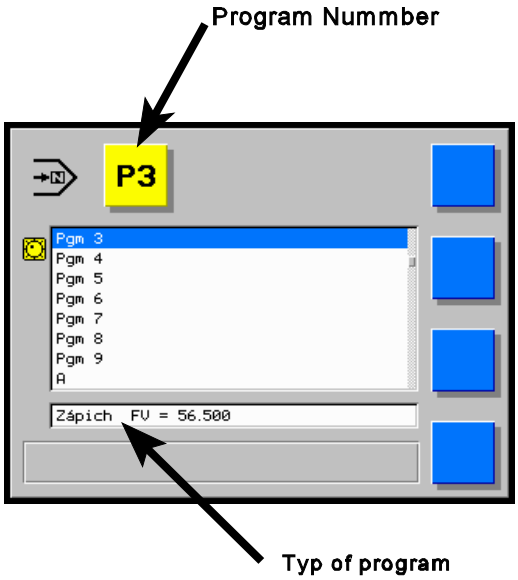
Function of each push-button is by help description designed.

1.4 WSP position

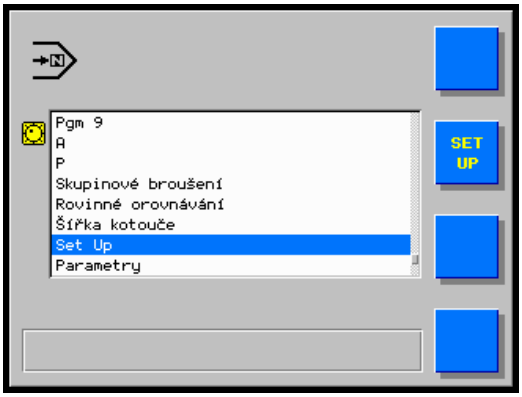
MODE	MEANING
	The WSP position is relative X-axis position 0.000.
	The WSP position is a work addition (X0).
	The WSP position is the diamond X-axis position.

1.5 Selection of the program number and functions

When the switch on the control system panel is in position  the program number or the selected function lights in the lower right corner of the display. The number of the desired program or the function can be selected by means of the handwheel.



Here You can select next possibilities:



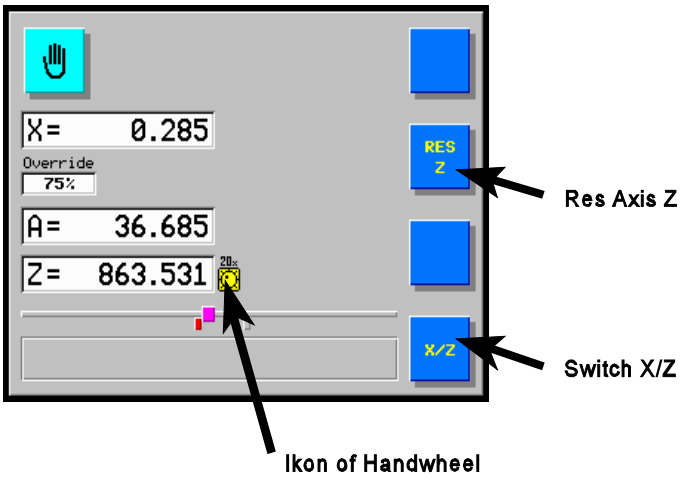
Data switching can be made by the **SET** key being repeatedly operated.
When no program has been programmed the message No Program # and the selected program number are displayed.

2. Manual grinding

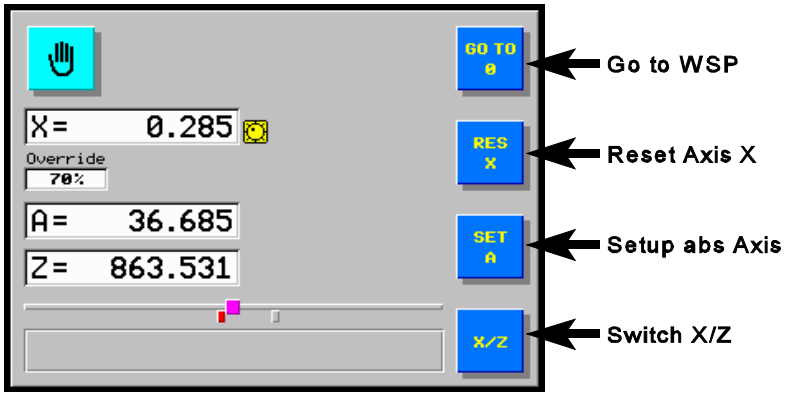
2.1 Manual plunge-cut grinding

The manual control mode is the basic method used for infeed control of the grinding machine. It can be used e.g. for readjustment of the wheelhead to the position for wheel change, adjustment of the wheelhead to the workpiece grinding allowance position, approach of the wheelhead to the diamond position for dresser adjustment, and manual plunge-cut and longitudinal grinding. Entry into the manual control mode is ensured by moving the switch on the system control panel to position . Infeed control is provided by the handwheel, it being possible to follow the wheelhead position on the display.

The infeed rate controlled by the handwheel can be increased by means of key 10x. The original rate (1x) can be restored by operating the key again or by changing the position of rapid feed. To indicate the increased feed rate, a lighted display of marker 10x is provided. To adjust numerical values for the value of absolute coordinate and some parameters when entering values for parametric and concave-convex grinding, rate 100x can be selected by key 10x. In this case, the increased feed rate is shown on the display by marker 100x.



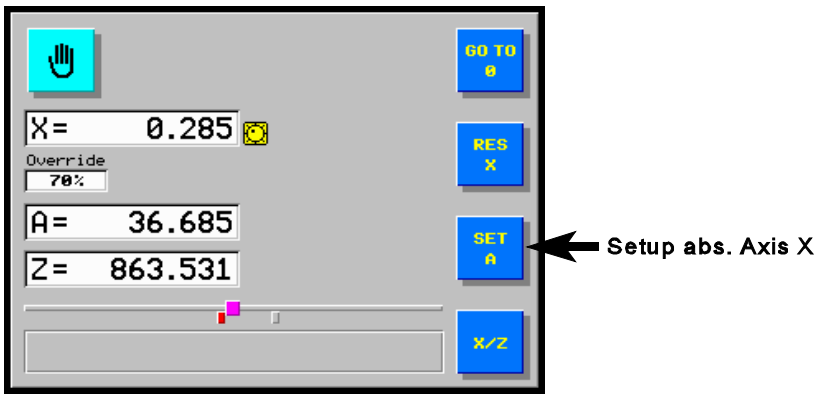
For adjustment of the wheelhead over a larger distance, the rapid feed keys fitted on the machine panel can be used. For forward movement, the wheelhead should be in the front position of rapid feed. On operation of the key, the wheelhead starts moving at a low speed first and then gradually increase its speed after a while.



When the WSP key is depressed for 3 seconds the wheelhead is brought into position "0.000". In manual grinding, this function can be used to bring the wheelhead into the same point or back into the original position after dressing.

2.2 Absolute measurement

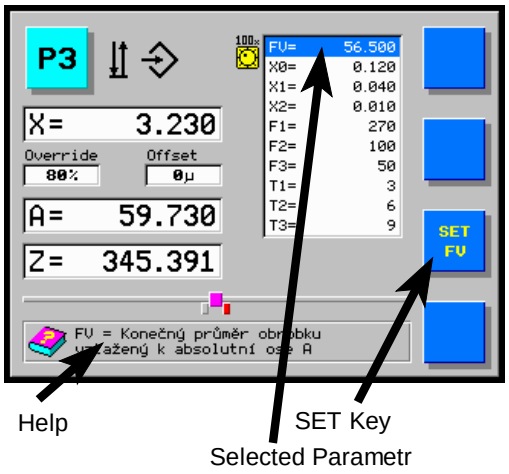
The absolute position of the **X**-axis is shown in the lower line of the display and designated **A=** . Adjustment of the value on the display is carried out during installation, on wheel change or when the displayed value differs from the actual one. After the workpiece has been ground retraction should be made at high speed, the workpiece should be measured and, with the **SET** push-button depressed, the measured value should be put down on the display by means of the handwheel.

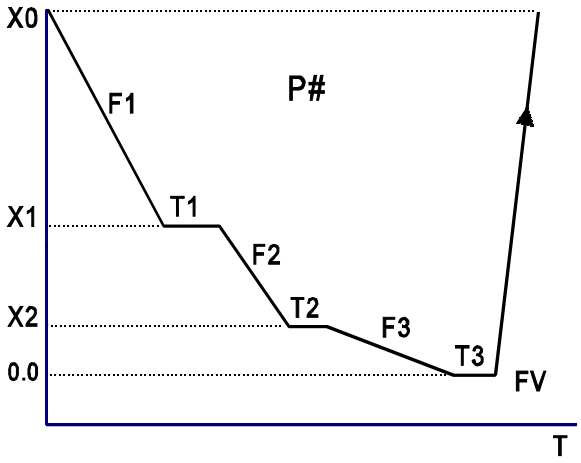


Rate 100x can be selected by means of key **10x**. In this case, the increased feed rate is shown on the display by marker 100x. Adjustment of the absolute **X**-axis position entails no change in the wheelhead position (only the display is changed).

All positions of the programs remain unchanged, but the final diameter FV in the parametric cycles is related to the absolute **X**-axis whose position, when varies, causes even the final position (zero) of all of these cycles to change. This can be turned to use for simultaneous compensation of all cycles.

2.3 Parameters for the plunge-cut grinding cycle P# without size gauge

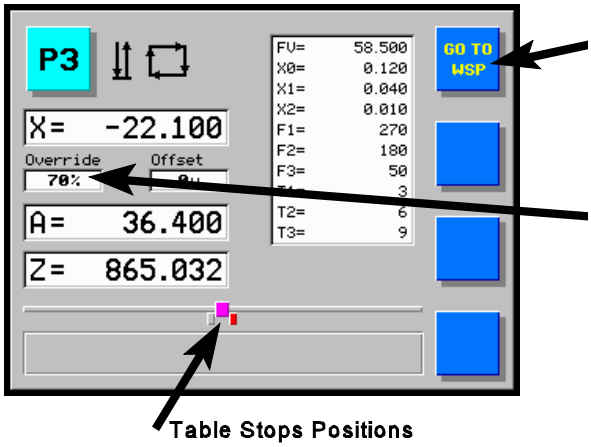




No.	Main switch	Action	Display	Note
1			P#	The required cycle No. is selected by means of the handwheel
2		+ **SET**	G	With size gauge = YES; without size gauge = **NO**
			FV	Workpiece diameter, related to the absolute X-axis 〈 1÷ 700 〉 mm
			X0	Amount of grinding allowance + safety〈 0.01÷ 10 〉 mm
			X1	End of rough grinding speed 〈 0.01÷ X0 〉 mm
			X2	End of grinding speed 〈 0÷ X1 〉 mm
			X3	End of finish grinding speed 〈 0÷ X2 〉 mm
			F1	Rough grinding speed 〈 20÷ 9000 〉 µm/min
			F2	Grinding speed 〈 5÷ 5000 〉 µm/min
			F3	Finish grinding speed */ 〈 5÷ 3000 〉 µm/min
			T1	Sparking-out in the X1-axis 〈 0÷ 120 〉 sec
			T2	Sparking-out in the X2-axis 〈 0÷ 120 〉 sec
			T3	Sparking-out at the zero point */ 〈 0÷ 120 〉 sec

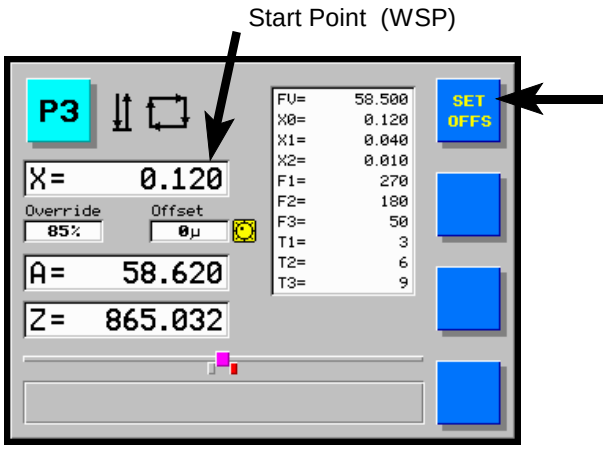
With the **SET** push-button operated, the parameter value can be adjusted by turning the handwheel. (For this purpose, the **SET** push-button should be held depressed).

After all parameters have been programmed the handwheel should be rotated backwards (to the left) so that they can be checked by the system. When an error is detected an ERROR message is displayed, the incorrect parameter being set on the display for correction. The data should be corrected and the handwheel should be rotated again to the left (backwards). When no error has been found in the programmed parameters the main switch can be rotated to position ⟲. In case that any data has not been programmed at all or has been programmed incorrectly, the program is not released, the message NO PROGRAM being displayed.



In this case, the **GO TO WSP** key should be operated so that the wheelhead is brought back into the outgoing position. The automatic cycle of the machine can be started by means of the main lever.

By operating the potentiometer, OVERRIDE can be set in per cent of the programmed speed. When "0" has been set infeed is stopped.



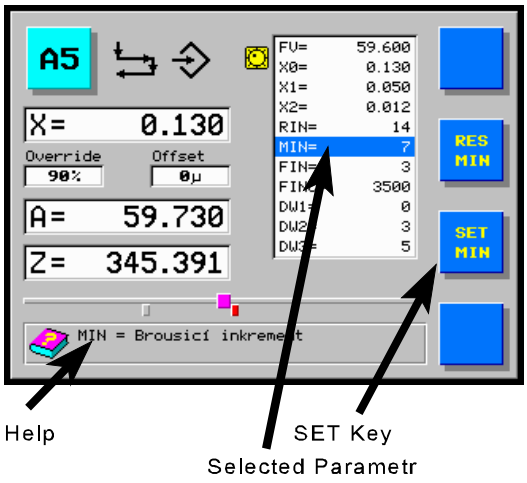
Prior to starting the automatic cycle, final diameter compensation (OFFSET) can be effected by means of the handwheel while the **SET** push-button is held depressed. The maximum value is ± 0.127 mm.

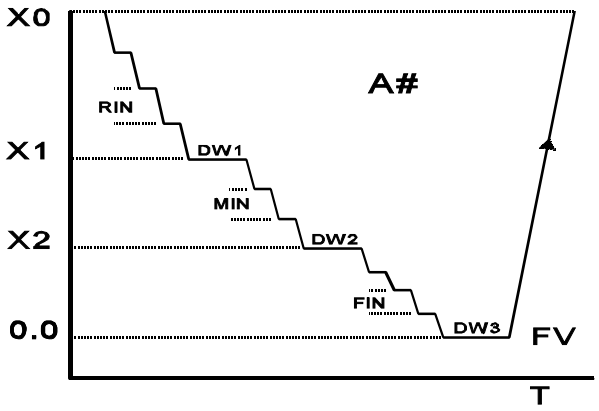
When setting positive OFFSET, a lower value than the amount of grinding allowance should be entered.

When programming a new value of final diameter (FV=), OFFSET is automatically cleared.

*/ Request G (with size gauge/without size gauge) and values X3 and T3 are available in a special design variant only and need not be contained at all events.

2.4 Parameters for the longitudinal grinding cycle A#



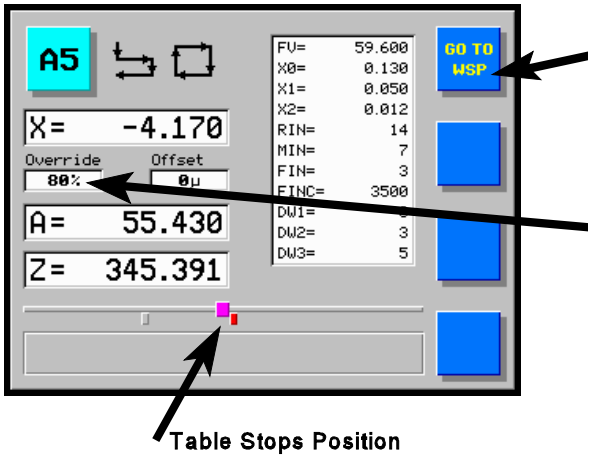


No.	Main switch	Action	Display	Note
1			A#	The required cycle No. is selected by means of the handwheel
2		+ **INS**	G	With size gauge = YES; without size gauge = **NO**
			FV	Workpiece diameter, related to the absolute X-axis 〈 1÷ 700 〉 mm
			X0	Amount of grinding allowance + safety〈 0.01÷ 10 〉 mm
			X1	End of rough grinding increment 〈 0÷ X0 〉 mm
			X2	End of grinding increment 〈 0÷ X1 〉 mm
			RIN	Rough grinding increment 〈 0.002÷ 15 〉 mm
			MIN	Grinding increment 〈 0.002÷ 10 〉 mm
			FIN	Finish grinding increment 〈 0.001÷ 8 〉 mm
			Finc	Rate of increment 〈 60÷ 60000 〉 µm/min
			DW1	Number of sparking-out strokes in the X1 〈 0 ÷ 120 〉
			DW2	Number of sparking-out strokes in the X2 〈 0 ÷ 120 〉

			DW3	Number of sparking-out strokes at the zero point 〈 0 ÷ 120 〉

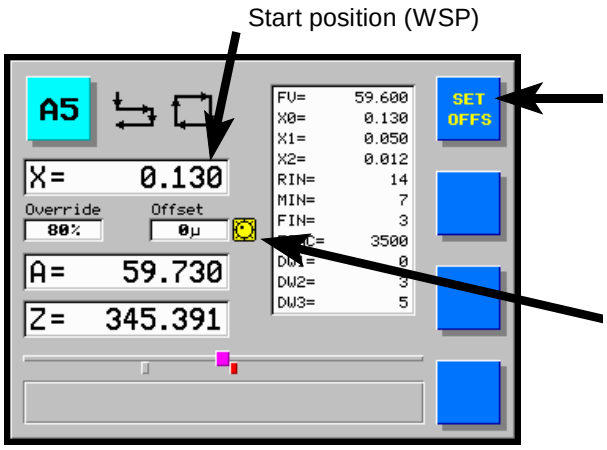
With the **SET** push-button operated, the parameter value can be adjusted by means of the handwheel. (For this purpose, the **SET** push-button should be held depressed.

After the parameters have been programmed they are checked by the system. When an error is detected an ERROR message is displayed, the incorrect parameter being set on the display for correction.



After all parameters have been programmed the **GO TO WSP** key should be operated so that the wheelhead is brought back into the outgoing position. The automatic cycle of the machine can be started by means of the main lever.

By operating the potentiometer, OVERRIDE can be set in per cent of the programmed speed. When "0" has been set infeed is stopped.



Prior to initiation of the automatic cycle, final diameter compensation (OFFSET) can be accomplished by means of the handwheel while the **WSP** push-button is being held depressed. The maximum value is ± 0.127.

Handwheel Ikon.

When setting positive OFFSET, a lower value than the amount of grinding allowance

should be entered.

When programming a new value of final diameter (FV=), OFFSET is automatically cleared.

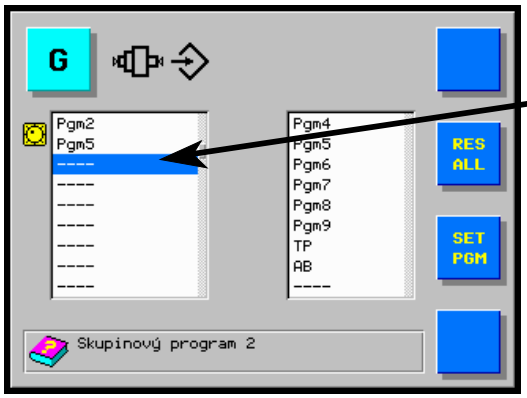
For X1, X2, X3 = 0, the table moves without incrementing for each breakpoint (3x). For grinding with a single increment without sparking-out, it is preferable to program the breakpoints in multiples of the increment.

2.5 Automatic group cycle

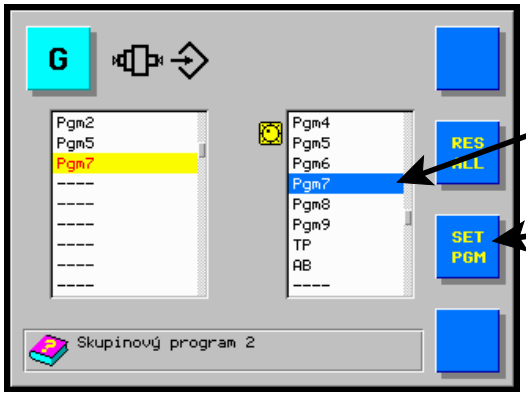
In the system incorporating this facility, a number of parametric cycles can be arranged to form a group so that several diameters can be ground in a single automatic group cycle. Between the individual cycles, the so-called by-pass can be interposed, which is a diameter to which the grinding wheel, while moving from diameter to diameter, is set.

All parametric cycles included in the group should be preprogrammed, including table stops. This applies even to the plunge-cut grinding cycles where the left and the right stops are identical. Each programmed cycle can be tested beforehand in order to finely adjust all its parameters.

1/ Programming of the group cycle should be selected by the handwheel.



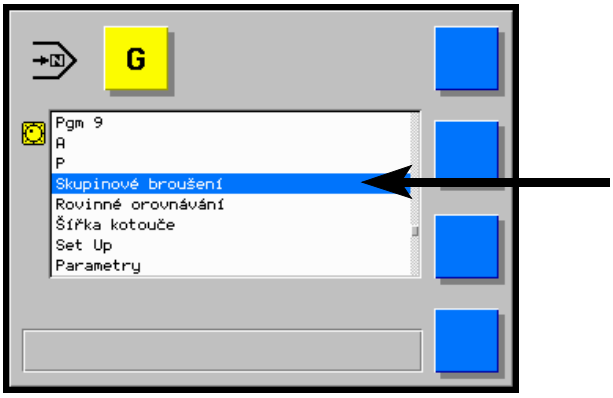
2/ The programmed cycle can be selected by rotating the handwheel. On the display, the selected position of the cycle is accentuated through the position or size of the displayed marker.

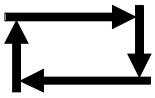


3/ With the **SET** key operated, the required number of the parametric cycle or by-pass can be set.

(For this purpose, the SET push-button should be held depressed).

Proceed as described in Points 2 and 3 till all necessary cycles and by-pass are programmed.





3. Automatic control mode

3.1 Automatic cycle RESET

No.	MAIN SWITCH	ACTION	NOTE
1.			The automatic cycle can be interrupted at any point by deflecting the main lever backward. In this case, wheelhead infeed is adjusted to the starting WSP position, the wheelhead is moved backward at high speed and the workhead, table travel and cooling are stopped.

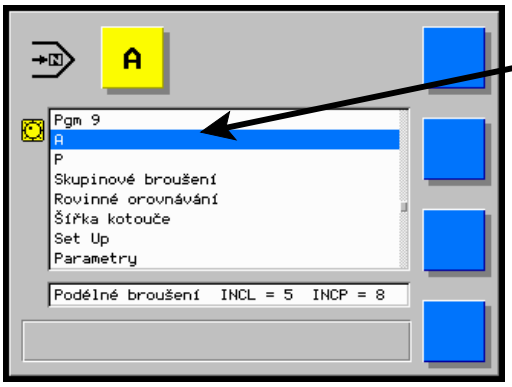
3.2 Automatic cycle interrupt

No.	MAIN SWITCH	ACTION	NOTE
1.			When the "Grinding Enable" switch is rotated to the position "0" the automatic cycle is suspended as long as the switch remains in this position. The resumption of the automatic cycle is conditioned by bringing the switch back into position "1". The table is not arrested.

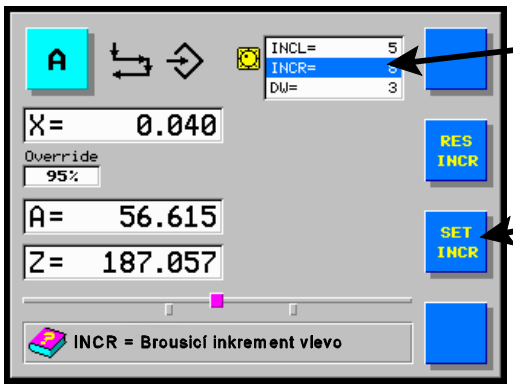
4. Longitudinal grinding with automatic addition at reversal points - Cycle A

Preparation:

By deflecting the main lever forward (in), the wheelhead is moved forward at high speed. The workpiece is slightly ground by means of the handwheel. By deflecting the main lever backward, the wheelhead is moved backward at high speed. The amount of grinding addition is measured.



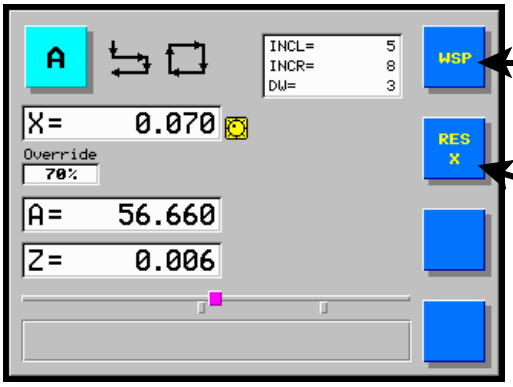
Change-over to the control mode **A** is made by means of the handwheel.



In the position of the main switch select parameters.

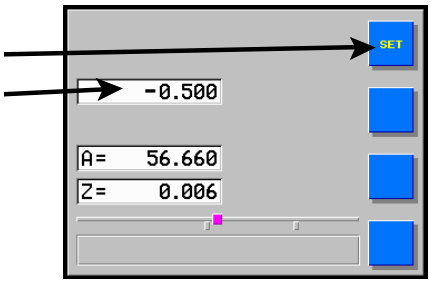
With the **SET** key operated, the required parameter of the cycle can be set.

Switch to position . You have 2 possibilities:



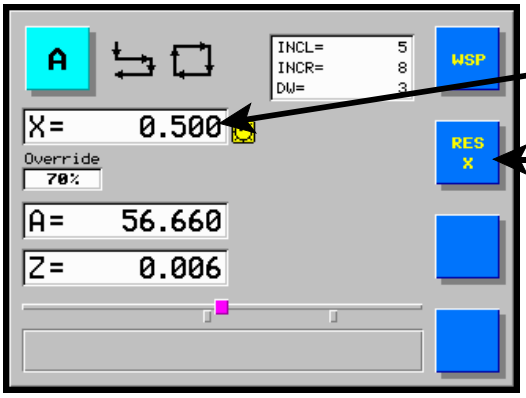
1/ With the **WSP** push-button depressed wheelhead is brought back into the outgoing WSP position (old value).

2/ The display is cleared by the RES push-button



With the **SET** push-button depressed, the taken-down amount of grinding allowance is adjusted on the display by

rotating the handwheel to the right (into the cut).



On release of the WSP push-button, the amount of grinding allowance (positive value) is displayed.

When an error occurs the display can be cleared by the RES push-button and a new value can be adjusted.

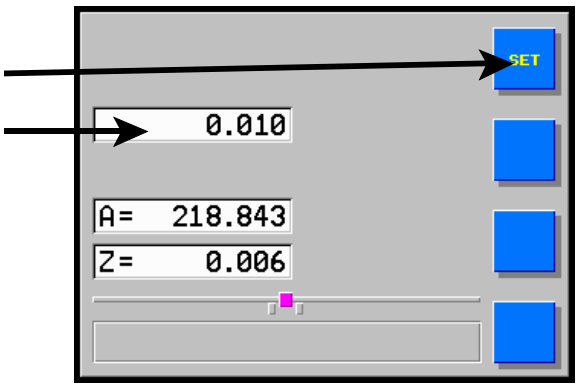
By deflecting the main lever forward, the wheelhead is moved forward at high speed. The table can be started by means of the table feed starting switch.

Both at the left and right reversal points, the amount of automatic grinding allowance (which may be different at either reversal point, or even negative in one direction) is set by means of the handwheel.

In a table position between the reversal points, the grinding addition can be canceled simultaneously at both reversal points by the handwheel being moved a step backwards. During further rotation of the handwheel, the wheelhead can be withdrawn from the workpiece by an arbitrary amount. For subsequent grinding, increments should be set anew at the two reversal points. In a table position between the reversal points, the wheelhead is moved into the cut by rotating the handwheel forward. The forward movement is limited by a displayed zero.

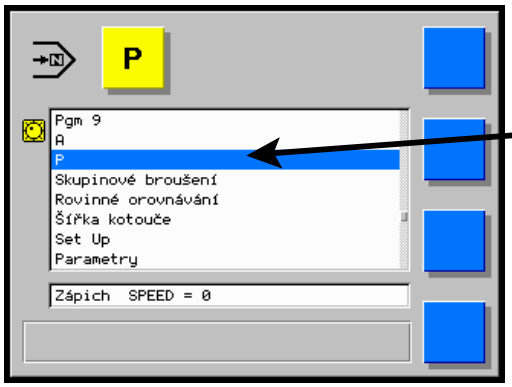
The amount of grinding allowance can be changed by rotating the handwheel in the corresponding direction. At start-up, this new position of grinding allowance is stored. On completion of the automatic cycle, the wheelhead is automatically brought back into this new position.

With the **SET** push-button depressed, a correction of the final workpiece diameter can be made by means of the handwheel.

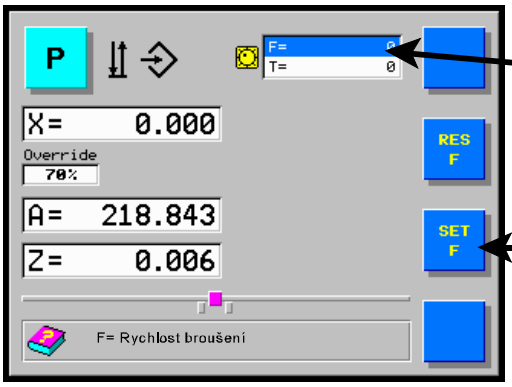


5. Plunge-cut grinding at programmable speed - Cycle P

In this control mode, plunge-cut grinding can be carried out at a preprogrammed speed. During grinding, the infeed rate can be changed within a range of 0 to 150% (OVERRIDE) by means of the potentiometer.



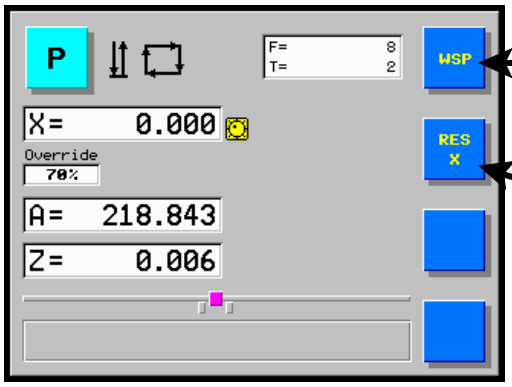
Change-over to the control mode **P** is made by means of the handwheel.



In the position  of the main switch select parameters.

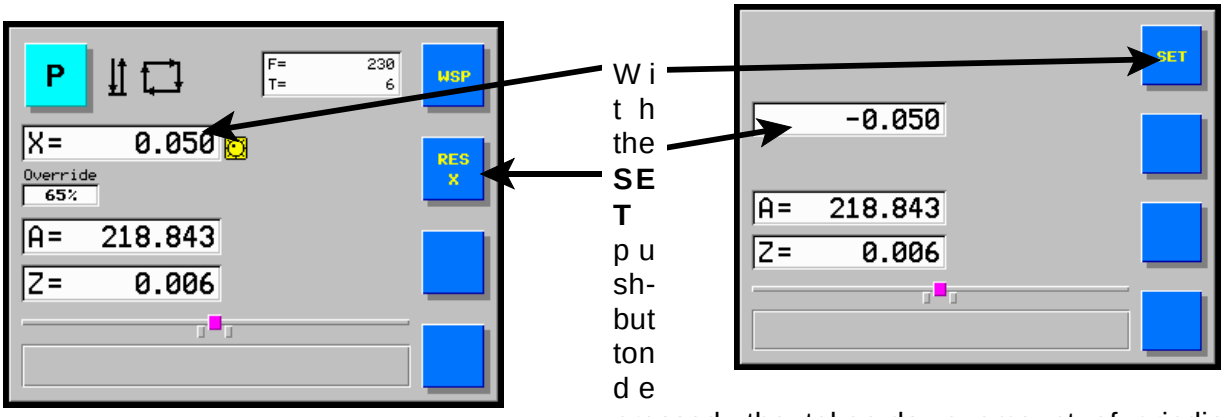
With the **SET** push-button depressed, the required infeed rate related to the workpiece diameter can be adjusted on the display in steps of 20% within the infeed range of 6 to 1500 µm/min, related to the workpiece diameter. This speed is adjusted in steps of 20%.

Switch to position  . You have 2 possibilities:



1/ With the **WSP** push-button depressed wheel-head is brought back into the outgoing WSP position (old value).

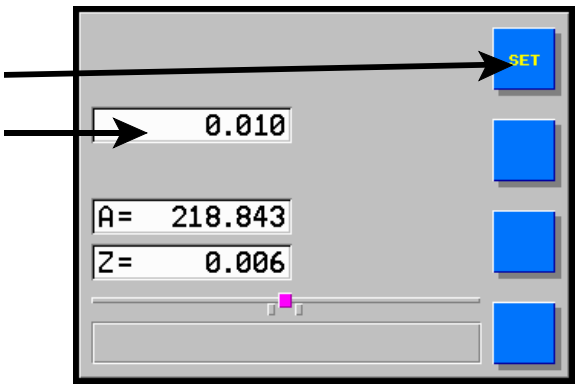
2/ The display is cleared by the RES push-button



With the **SET** push-button depressed, the taken-down amount of grinding allowance is adjusted on the display by rotating the handwheel to the right (into the cut).

On release of the WSP push-button, the amount of grinding allowance (positive value) is displayed.

When an error occurs the display can be cleared by the RES push-button and a new value can be adjusted



Moving the main lever forward initiates the automatic cycle in which the workpiece is ground up to the "zero" at a preset speed, sparking-out taking place within 5 sec (or a time preset by parameter T_p). Then, the automatic cycle is terminated by automatic resetting of the wheelhead to grinding allowance and infeed withdrawal at high speed.

The amount of grinding allowance can be changed by rotating the handwheel in the corresponding direction. At start-up, this new position of grinding allowance is stored. On completion of the automatic cycle, the wheelhead is automatically brought back into this new position.

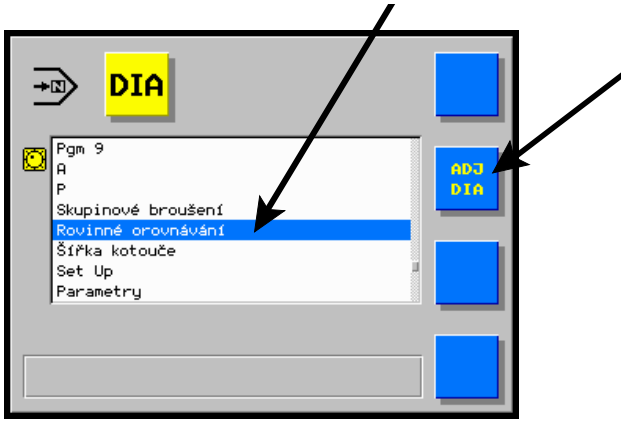
With the **SET** push-button depressed, a correction of the final workpiece diameter can be made by means of the handwheel.

6. Wheel dressing

6.1 Wheel dresser gauging

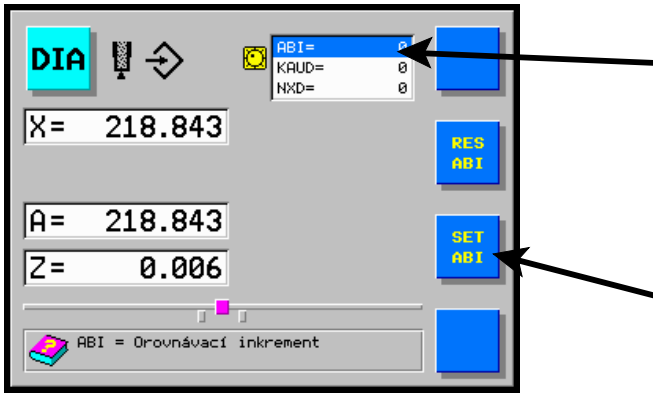
The wheel is brought into contact with the diamond through wheelhead infeed and is dressed, employing the handwheel. If radius wheel dressing is also used, the grinding wheel is positioned with its center opposite the diamond.

Diamond position setting on the display Adj Dia is selected by operating the handwheel.



The display is cleared by depressing and holding the RES push-button for 9 sec. and a new diamond position is set. As a result, the diamond position adjustment is terminated.

Setup of diamond position is finished. The dressing stops of the table are set at ±60 mm away from the actual position of the table. Their position can be readjusted by bringing the table into a new position and operating the corresponding key for setting the stop. If the diamond is on the left-hand side of the grinding wheel operate the left key. If the diamond is on the right-hand side of the grinding wheel the right key should be operated.



In the position of the main switch select parameters.

With the **SET** key operated, the required para-meter of the cycle can be set.

The number of the program or cycle is selected by means of the handwheel. (When this point has been cut out the message INCORRECT PROCEDURE appears on the display since it has not been determined for which cycle dressing is to be made.)

Whenever change-over from any position of the switch to the dressing position is made the relative distance of the grinding wheel from the diamond is displayed. The operation of the WSP push-button causes the wheelhead to be moved to position "0.000" in which it is automatically arrested. The movement is controlled in such a way that clearance in the infeed mechanism is always taken up. This means that, during infeed from the front position to the diamond position, automatic overtravel of the diamond takes place, followed by return to position "0.000". The wheelhead can be readjusted forward by the amount of a dressing increment to carry out dressing.

It should be noted that there is a difference in use of the **RES** push-button between the dressing

mode and the Adj Dia operation for the diamond. On operation of the **RES** push-button even after the Adj Dia operation, the display is cleared and, after wheel dressing, the diamond position is set at this point. The difference consists in that, after the Adj Dia operation, the absolute position of the programmed diameters remains unchanged while their relative position is converted with respect to the diamond position. On operation of the **RES** key, the relative position of programmed diameters with respect to the diamond position remains unchanged while their absolute position is converted. As already stated, the **RES** push-button is thus used for wheel wear compensation after wheel dressing while the AdJ diA operation is used for adjusting a new diamond position after the diamond has been replaced.

6.2 Straight wheel dressing

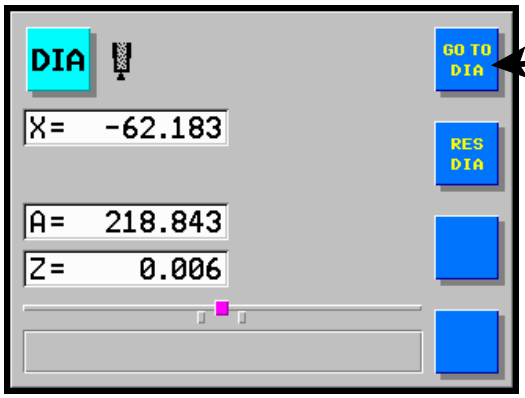
You have 3 possibilities for dressing.

❶ Manual wheel dressing with compensation dressing
❷ Asynchrony automatic dressing cycle initials by push-button on the operator panel
❸ Synchron automatic dressing cycle in automatic group cycle

Preparation: Wheel dresser gauging, adjustment of dressing stops

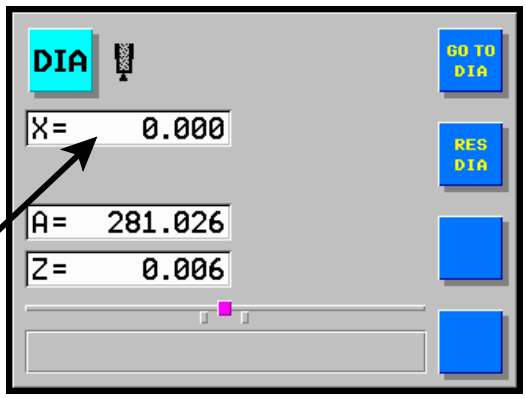
6.3 Manual wheel dressing with compensation dressing

By deflecting the main lever to the left, the table is moved so that the grinding wheel is brought into a position opposite the diamond.



Dressing is always started by means of the **GO TO DIA** key.

On operation of the WSP key, wheelhead infeed is set at the starting dressing position. When wheelhead infeed has been already set at this position starting of the dressing operation is enabled.



The automatic table feed at a preselected dressing speed is started by means of a panel-mounted key.

At the points of reversal, the grinding wheel is moved by the amount of dressing increment (negative value) towards the diamond by means of the handwheel.

At the end of wheel dressing, the **RES DIA** push-button is depressed to clear the display, automatic wheel wear compensation after wheel dressing being provided.

For wheel dressing, changes in the wheel diameter due to wheel wear prior to dressing and

material removal of the diamond should be taken into account. Therefore, special attention should be devoted to check return of the wheel to the workpiece. After dressing, the wheel seems to be larger than before dressing. It is therefore advisable to interrupt the grinding process before it is completed (prior to “zero”), to check the workpiece size and to correct the absolute axis.

6.4 Wheel dressing during the working cycle

No.	MAIN SWITCH	ACTION	DISPLAY	NOTE
1.			x=0.123	The working cycle is suspended by the main switch being rotated to the said position and the wheelhead is moved backward at high speed.
2.				The table is moved to a position between the dressing stops by deflecting the main lever.
3.		WSP	x=0.000 *	Wheelhead infeed is set to the diamond position, an asterisk being displayed to indicate that a wheel dressing operation takes place during the working cycle.
The dressing cycle is then resumed, as described in the Chapter "Wheel Dressing".				
4.			x=0.000 *	By deflecting the main level the table is brought into a position between the working stops.
5.		WSP	x=2.000 *	By operating the WSP key and deflecting the main lever forward, the wheelhead is placed back in the position in which the working cycle started.
6.			x=0.123	By the second deflection of the main lever forward (acceleration), wheelhead infeed is set to the position in which the wheel dressing operation started. After the original position is reached, the asterisk on the left side of the display, which indicates that the intermediate wheel dressing operation is in progress, darkens. Considering the new conditions established after wheel dressing (the workpiece has not been sprung and the grinding wheel has not been worn out), attention should be devoted to the return of the wheelhead to the original grinding point. The number of intermediate wheel dressing operations is not limited.

NOTICE:

To prevent a collision between the grinding wheel and the workpiece, the operations described in Points 4 and 5 supra should be made in the given or opposite order, depending on the workpiece diameter and absolute diamond position.

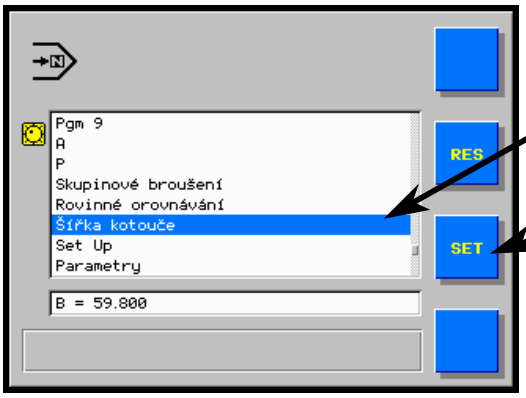
If the absolute diamond position > the workpiece diameter, the order of operations 2 - 3 and 4 -

5 should be observed.

If the absolute diamond position < the workpiece diameter, the opposite order of operations 3 - 2 and 5 - 4 should be applied.

7. Progressive plunge-cut grinding

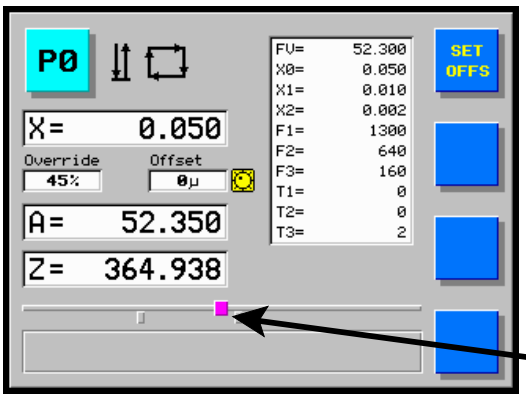
In this control mode, plunge-cut grinding can be carried out, according to program P0 or P. In this case, a plunge grind having been completed, the wheelhead is brought back to the WSP position and the table is automatically moved by the amount of programmed wheel width. Thereafter, a new plunge grind is carried out. When the system incorporates facilities for progressive concave/convex grinding any concave-convex cylinder can ground progressively, employing program # 0 only.



The symbol for wheel width adjustment (the amount of table feed) is set on the display by means of the handwheel.

With the **SET** push-button operated, the wheel width, i.e. the reduced amount of table feed (depending on the set table speed), is set on the display by means of the handwheel.
The preprogrammed plunge-cut grinding cycle P0 or P is selected by the handwheel.

The table is moved to the first plunge grind position by deflecting the main lever. By deflecting the main lever sidewards, the direction of table movement in progressive plunge-cut grinding is determined. Table feed is started by a switch on the machine control panel.
The working cycle is started by deflecting the main lever forward.



After the control system has completed the plunge grind the wheelhead is returned to the WSP position and the table is moved automatically by the amount of programmed wheel width. Thereafter, a new plunge grind is carried out.

While the table is moved to a new position the wheelhead is not withdrawn at high speed, table marker flash.

This cycle is repeated till the table, while traveling, strikes against the stop where the last plunge grind is effected, the control system being automatically switched over to the control mode **A**. (In this case, the "zero" in the mode **A** coincides with the "zero" of the preceding plunge grind). Then, longitudinal grinding in the control mode **A** can be carried out.

8. Error messages

The control system checks some states and positions and issues an error message whenever it detects some discrepancies.

DISPLAY	FAILURE	REMEDY
no WSP	The wheelhead is not in the starting position for initiation of the automatic grinding process or on compensation for wheel dressing.	Operate the WSP key or deflect the hand lever backward.
*no Pr*ogram	For the required diameter number, no program has been created.	Change over to the control mode and grind the first workpiece.Check all parameters of cycles.
no Hdr	No supply voltage of the input circuits, hydraulic equipment not actuated.	Activate the hydraulic equipment.
Error 0	Monitoring of the stepping motor movement disabled.	Remove the jumper on the left side in the middle of the printed circuit board.
Error1 flickering DISPLAY	During the time of high-speed adjustment, a power supply failure, a failure of the output stage or motor locking occurred. Coupling of the motor to the control system has been lost. After switching off/on the power supply a flickering display appear.	After removal of the failure, display flickering can be eliminated by performing machine SET-UP, readjusting the diamond position Adj Dia and operating the RES key in . If the display starts flickering after switching on the standby battery should be replaced.
Error2	The feed motor has run against the limit switch at the end of the ball screw.	Retraction from this position can be made by means of the handwheel.
Error3	The feed motor has run against the limit switch at the end of the ball screw.	
Error4	Checksum error in EPROM	Replace EPROM.
Error5	Range of the axes has been exceeded.	Machine SET UP should be effected.
Error6	External function failure detected by diagnostics.	Switch off/on the system.
Error7	Checksum error in RAM	Replace RAM.
Error8	Parity error detected by diagnostics.	Switch off/on the system. If the failure recurs a repair is necessary.
Error9	Checksum error in SMC EPROM detected by diagnostics. 9a Configuration error in Xilinx	Replace SMC EPROM. Switch off/on the system. If the failure recurs a repair is necessary.
Error10..16.	Designed for machine failure messages.	See Operating instructions of the machine.
Error20	Error in communication with the I/O board.	Check the connecting optical cable.
Error21	Failure of potentiometer.	Check the condition of potentiometer.
Error22	End position of the table.	Retraction from this position can by made by the handwheel only.
Error23	End position of the table.	
Error25	X-axis servo switched off with failure.	Switch of/on the machine. If the failure recurs a repair is necessary.
Error26	Z-axis servo switched off with failure.	
Error27	Error in servo initialization.	
Error28	Error in setting of stops.	Proceed, according to the Operating instructions of the machine.
Error34	Failure of the X-axis encoder.	Check the condition and connection of the encoder.
Error28	Failure of the Z-axis encoder.	
Error36	Control deviation X exceeded.	Switch off/on the machine. If the failure recurs a repair is necessary. Check that no mechanical braking of the axis takes place.
Error37	Control deviation Z exceeded.	
Error38	X-axis servo failure.	Switch off/on the machine. If the failure recurs a repair is necessary. Check that a green LED lights on the servo driver.

Error39	Z-axis servo failure.	
Error40	X-axis servo failure.	
Error41	Z-axis servo failure.	
Error42	Checksum error 1/2 EPROM.	Check all parameters in EPROM and program.
Error43	Checksum error 2/2 EPROM.	
Error45	The entered value for by-pass is small.	Program, according to the instructions.
Error45	The position of stops has been lost.	Set the stops, according to the instructions.

* Machine SET UP is effected in the machine control mode u by the RES push-button being depressed for 10 sec. The messages ERROR 10 to 16 are designed for machine failure indication, see Operating instructions of the machine.

8.1 Disposal of the machine

When the machine is being disposed off the control system should be passed over to a competent firm for ecological disposal and recycling of electronic devices. The control system contains rare metals and a lithium battery.