

Operations with Routing Machines – Course: Mechanical woodworking techniques. Instruction examples for practical vocational training

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Operations with Routing Machines – Course: Mechanical woodworking techniques. Instruction examples for practical vocational training

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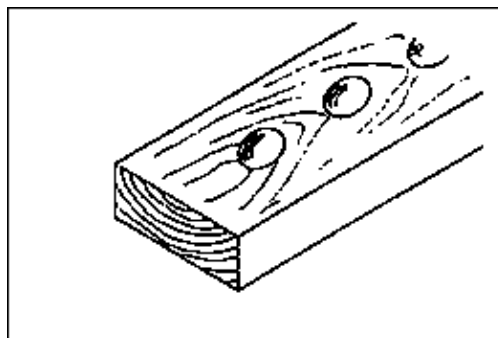
Preliminary Remarks

This material features four selected instruction examples for practising operations with routing machines. The trainees acquire skills in handling the machine, the machine tools and the necessary aids under varying operating conditions.

The necessary materials, machines and tools, measuring and testing means and auxiliary accessories have been cited to facilitate preparation and realization of exercises. Furthermore, required preliminary knowledge is given for preparing and undertaking the instruction examples. The exercises can be undertaken independently using workshop drawings and adopting the necessary work sequences. It is necessary to adhere to the sequence of instruction examples for these gradually become more complicated.

Instruction Example 05.1.: Bores

The routing machine can undertake sound quality and accurate bores in wood. The borehole diameter can be steplessly aligned through the eccentric arrangement of the tool in the tool bearer. This instruction example concentrates on the setting up of the machine.



Material

Soft wood, 25 mm thick, 130 mm wide, minimum length 420 mm, levelled and milled to thickness, narrow faces rectangularly planed

Tools and chucking means

Cylindrical routing machine, $d_1 = 16$ mm, eccentric chuck size 5, locking wrench for chuck screw and differential nut

Measuring and testing means

Folding rule, vernier caliper, workpiece with tenons to check the bore (For example: Rod with clothing hangers from "Work with Wood Turning machines" Instruction Example 04.3.)

Auxiliary accessories

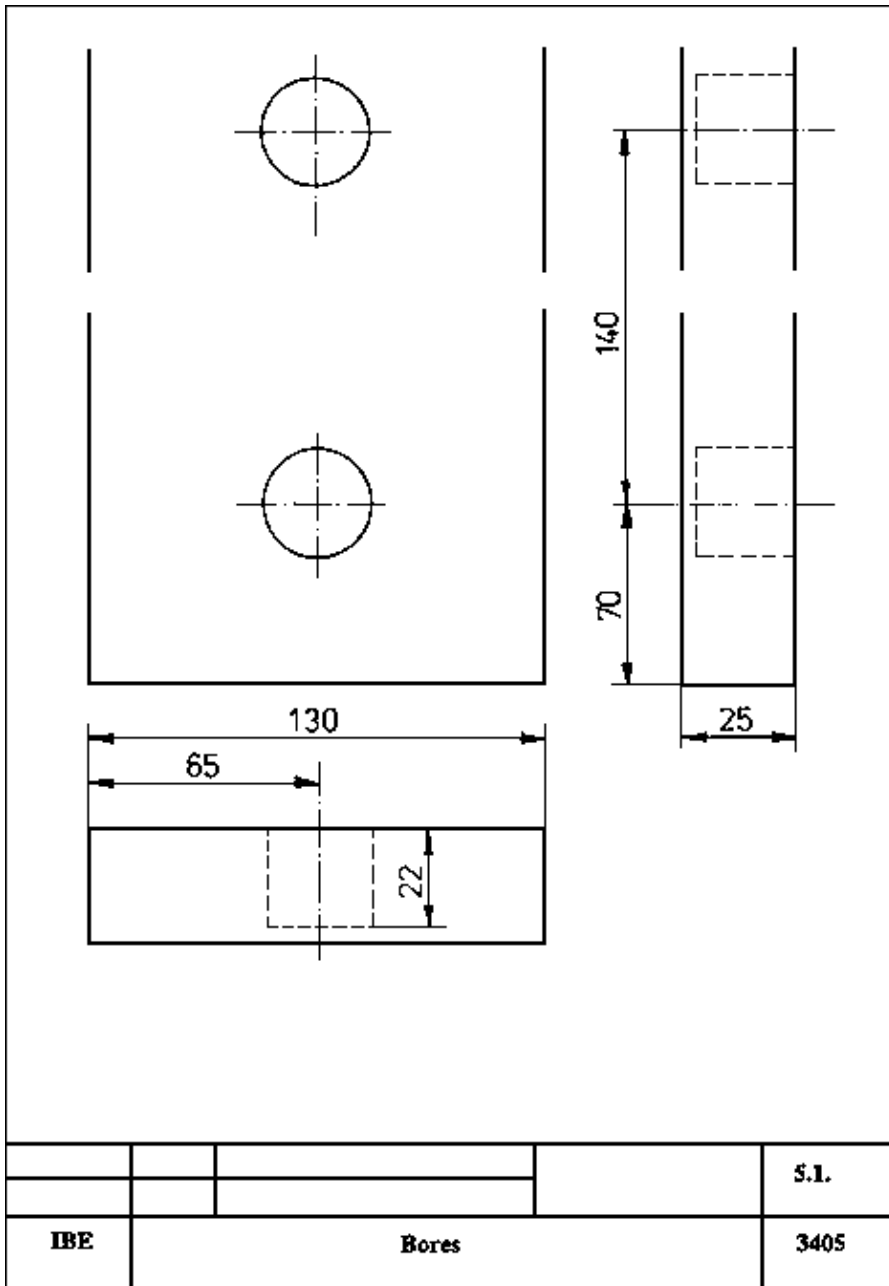
Balancing roll, faceplate, screwdriver, stop strip 25 mm thick, screw clamps or screws for attaching the stop strip, try square and pencil

Necessary preliminary knowledge

- assembly and function of a routing machine
- mode of operation of routing in conjunction with the chuck
- labour safety provisions for operating routing machines
- read drawings, marking, measuring and checking

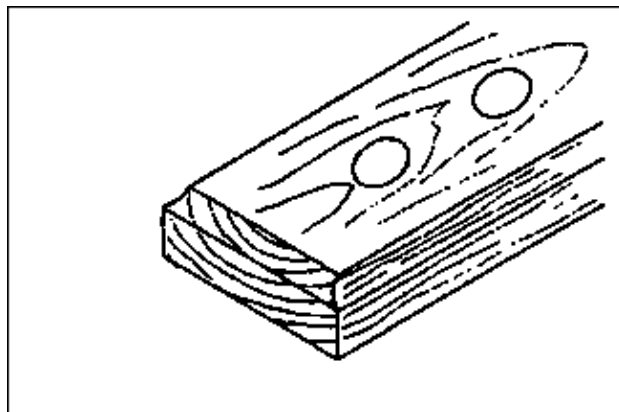
Sequence of operations	Comments
1. Position work materials in readiness, check machine and tools for proper working condition	Check completeness of work materials, sharpness of tools and cleanliness of the machine
2. Position the tool in the chuck, turn the tool to the envisaged plan angle and tighten by means of adjusting screws	Determine the plan angle according to survey I in the work material "Using the shaping machine"
3. Balance the chuck by means of the balancing roll	Repeat until any unbalance has been eliminated
4. Position the chuck in the machine and tighten with differential nut	Before arrest the spindle with the retainer pin. After the differential nut has been chucked, release the arrest!
5. Set the machine rotational speed of $n = 12,000 \text{ min}^{-1}$	Remove the coverplate from the top part of the machine and insert the medium-sized V-belt pulley with V-belt, tension the V-belt again and seal the gear opening with the coverplate
6. Set the machine for bore operations – reset the circulatory lever – loosen the compensating mass	Turn out the hand wheel (on the right of the lower machines part) by left turning to the stop. After lowering the milling spindle must glide back independently to the initial position!
7. Set the bore depth Workpiece thickness = 35 mm – bore depth = 22 mm = distance of workpiece to table top surface 3 mm – fine setting with stop screw and spiral spacer	– turn the spiral spacer to medium pitch – the tool must not be positioned on the machine table as the spindle is lowered! – locator pin must not extend beyond the table surface!
8. Attach the stop strip to the machine table. Distance from middle locator pin to bearing surface = 65 mm	– position the strip laterally to the visual line – mounting to the machine table can ensue either by means of machine screws and the tapped holes in the table surface or with two clamps
9. Pencil mark the stop strip	The borehole centre is pencil marked (locator pin middle) with the help of a try square
10. Swivel in the guard basket and tighten	The guard basket must not touch the positioned workpiece and must also enclose the tool in the upper

	spindle position
11. Check machine for proper operating condition	<ul style="list-style-type: none"> – all removable machine parts and the stop must be securely chucked – check the unimpeded running of the spindle – do not leave any loose objects on the machine table
12. Switch on the machine, first the main switch, then the machine switch	
13. Drill a hole in the test piece	<ul style="list-style-type: none"> – position the workpiece according to pencil mark and hold firmly with both hands to the stop. <p>Keep hands away from the bore area!</p> <ul style="list-style-type: none"> – depress the foot lever slowly to the stop and return to rest position.
14. Switch off the machine	– switch off the machine switch
15. Size and quality control. Given undersize, enlarge the plan angle of the workpiece in the chuck, given oversize, diminish the plan angle	<ul style="list-style-type: none"> – check bore size with a vernier caliper or test tenon. <p>Given size deviations turn off the main switch and alter the tool plan angle.</p> <ul style="list-style-type: none"> – after correction to tool or step, repeat the working process from work sequence 10
16. Once the size consistency of the test bores has been attained, the bores can be undertaken on the marked workpiece	
17. Switch off the machine, first machine switch then main switch	
18. Quality control	
<ul style="list-style-type: none"> – cleanliness of the borehole top edge – top surface quality of the borehole wall 	



Instruction Example 05.2.: Quarter Chamfer

Chamfers are milled as profiles on flat elements. The chamfer is mainly for the optical arrangement of furniture and narrow surfaces. In this instruction example the trainees practise such profiles using the routing machine.



Material

soft wood, 25 mm thick, 130 mm wide, minimum length 420 mm, planed and milled to thickness, narrow surfaces rectangularly levelled.

(The bored workpiece in the first instruction example can be used for further processing.)

Tools and chucking means

16 mm chamfer routing machine, chuck for concentric tool chucking

Measuring and testing means

Folding rule

Auxiliary accessories

Stop strip, about 15 mm thick, approx. 750 mm long clamps or machine screws to fix the stop strip

Necessary preliminary knowledge

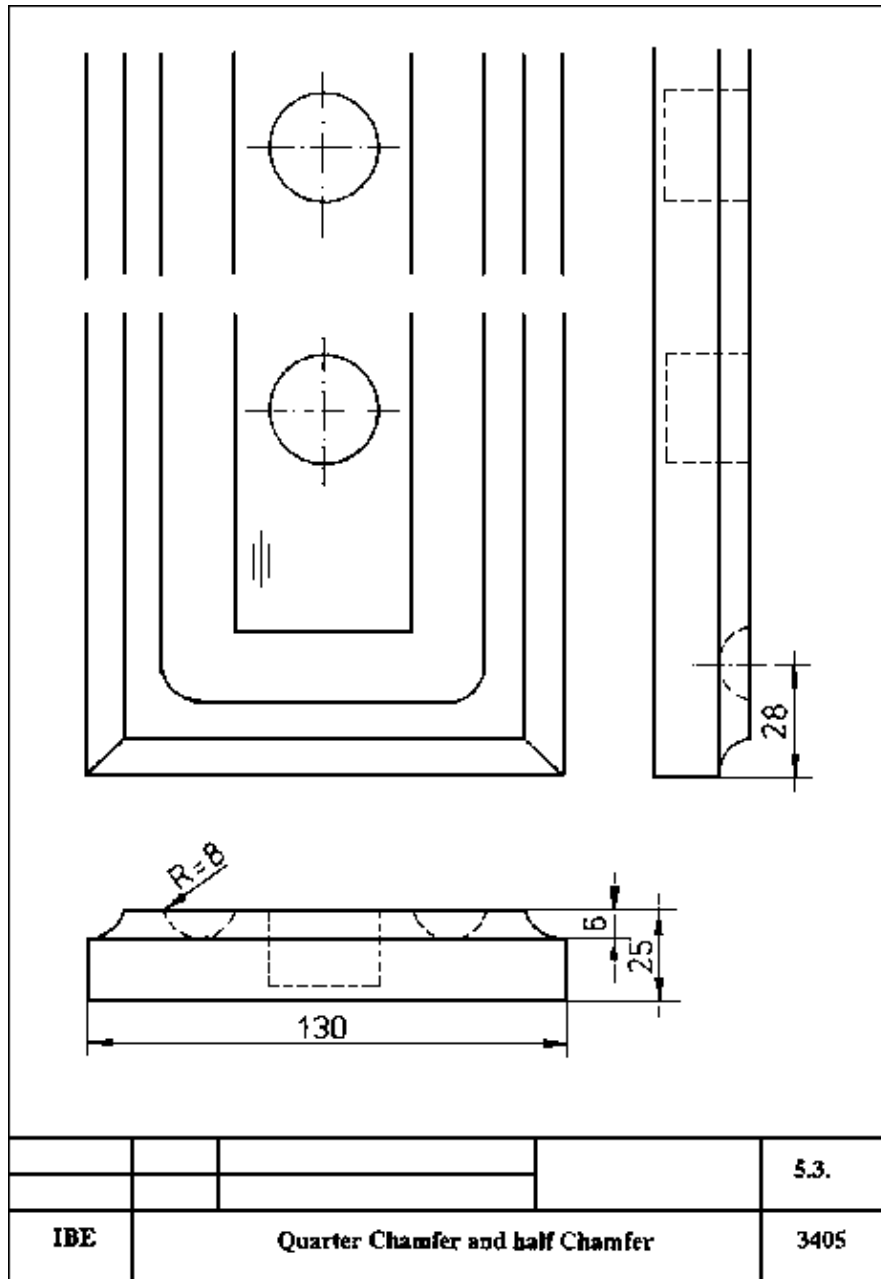
- assembly and function of the routing machine
- mode of operation of milling tools
- knowledge and skills in chucking tools and setting up machines
- labour safety requirements for routing machine operations
- reading a drawing, measuring and checking

Sequence of operations	Comments
1. Position work materials in readiness, check machine and tools for proper working condition	Check completeness of work materials, sharpness of tools and cleanliness of machine
2. Set machine to routing operations – swivel the circulatory lever to the front hinged pins – firmly chuck the compensating mass	Tighten the hand wheel (right on the lower machine part) through right turn to the stop
3. Set the machine rotational speed of $n = 12,000 \text{ min}^{-1}$	If required, change the belt pulley set, ensure proper belt tension
4. Position the chuck in the machine spindle and tighten with the differential nut	Arrest the spindle beforehand. Release the arrest after differential nut has been firmly chucked
5. Chuck tool in the clamp	
6. Attach the stop strip to the machine table by means of machine screws or clamps	Arrange the stop strip laterally to the visual line. The support surface of the stop strip must be exactly above the axis of the locator pin. It should not extend beyond the table surface.
7. Set the milling depth – rough setting by height adjustment of the machine table – fine setting by turning the spiral spacer and by setting the stop screw – return spindle to rest position	Bring the spiral spacer to middle position. Drop the spindle, the workpiece must not touch the stop strip Position the workpiece onto the machine table and place one tool cutter to a workpiece edge. Set according to drawing dimensions – all movable machine parts and the stop must be firmly chucked

	<ul style="list-style-type: none"> – check the unimpeded running of the spindle – ensure that no loose objects are on the machine table
8. Check machine for proper functioning and adherence to labour safety stipulations	
9. Position guard basket and chuck securely	In its highest workpiece position the guard basket must enclose the tool
10. Switch on the machine	<ul style="list-style-type: none"> – switch on main switch – switch on machine switch
11. Depress the foot lever carefully, loosen the holding pin and slowly depress the spindle by lifting the foot	
12. Mill a short chamfer on the test piece	
13. Switch off the machine	Spindle remains in depressed operating position
14. Size control	Given size deviation, a machine setting correction is undertaken
15. Switch on the machine and mill workpiece chamfers	<p>The first chamfer is milled at the grain end of the workpiece. Turn the workpiece 90° so that, during processing, the tool first of all engages the milled grain edge.</p> <p>Process the workpiece further in the work sequence</p>
16. Switch off the machine and return the spindle to rest position	
17. Quality control	Top surface quality in the chamfer and edges quality is corroborated

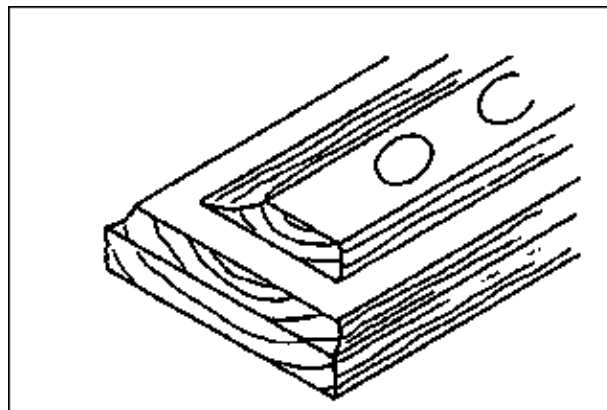
Possible additions:

- chamfer further workpieces
- the workpiece completed in this work instruction is processed further in the Instruction Example 05.3.



Instruction Example 05.3.: Quarter Chamfer and Half Chamfer

A copying device on the routing machine is required for this exercise. This facility makes possible both a straight and curved processing of the workpieces.



Material

Workpiece from the Instructions Example 05.2.

Tools and chucking means

16 mm chamfer routing machine (double-edged), chuck for concentric tool chucking

Measuring and testing means

Folding rule

Auxiliary accessories

Copying device

Necessary preliminary knowledge

- assembly and function of the machine
- mode of operation of the milling tools
- knowledge and expertise in tool chucking, balance the chuck and set up the machine
- labour safety requirements for operating routing machines
- read a drawing, measuring and testing

Necessary preliminary work

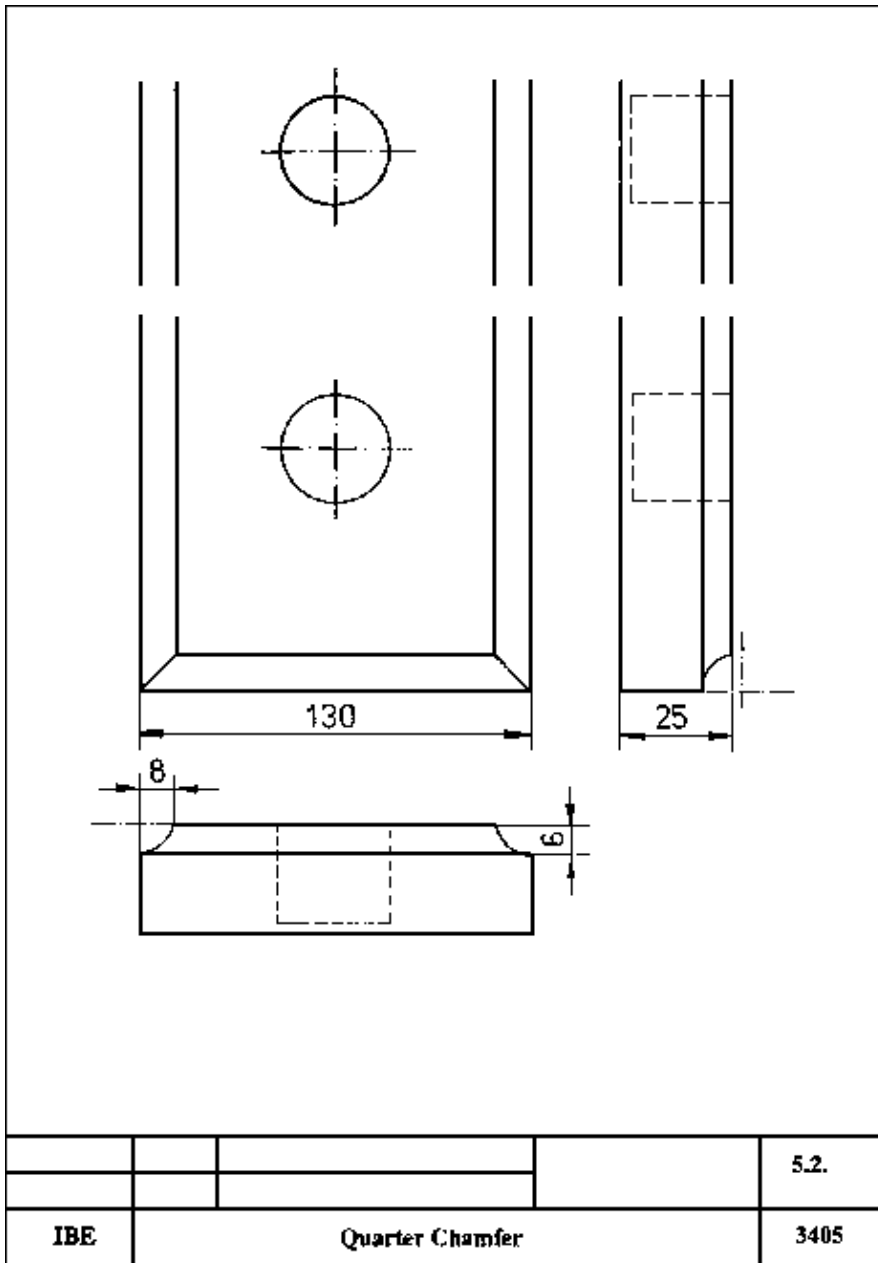
Prior to operations a copying device must be prepared as model facility for the workpiece. The copying device is described in the Trainees' Handbook of Lessons "Operations with routing machines". Prepare a test workpiece of commensurate dimensions for undertaking machine setting operations.

Sequence of operations	Comments
1. Position work materials in readiness and check machine for proper working condition	Check completeness of work materials, sharpness of tools and cleanliness of the machine
2. Set the machine to routing operations	
3. Set the machine rotational speed of $n = 12000 \text{ min}^{-1}$	
4. Position chuck in the machine and clamp	
5. Clamp tool in chuck	
6. Set the locator pin to first stage	
7. Place the copying device onto the machine table and attach the test piece of the device	Locator pin must engage the locator slot
8. Set milling depth – rough setting – fine setting	Lower the machine spindle and set the machine height so that the tool just touches the workpiece top surface Lower the tool spindle by 6 mm by turning the spiral spacer or stop pin. Beforehand, remove workpiece from copying facility.
9. Attach guard basket	
10. Tighten the test piece in the device and check the proper functioning of the machine	Ensure, above all, the unimpeded passage of the locator pin in the locator slot of the copying facility!

11. Switch on the machine	As milling operations commence the locator pin should be in the top right-hand corner of the locator slot
12. Lower the spindle and mill the chamfer in the test piece. Return the spindle to rest position	
13. Switch off the machine Size and quality controls	If required correct the machine setting
14. Chuck the prepared workpiece and mill the rotating chamfer in the workpiece	Commence as for work sequence 11.
15. Return the spindle to rest position and switch off machine	Switch off the machine and main switches
16. Unchuck the workpiece, quality control	Slightly twisted grains at the chamfer edges are typical for this milling technology and do not denote inferior quality. The chamfers must be straight with no unevenness

Possible additions:

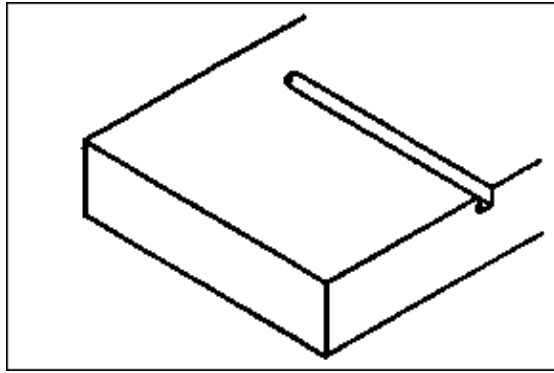
Further workpieces with the same dimensions can be processed.



Instruction Example 05.4.: Slot

Slots are frequently milled into the outer elements of furniture for insert shelves and partition walls. These slots are not generally throughgoing and their widths must be aligned exactly to the reference size of the element to be incorporated.

The present instruction example aims at consolidating and controlling the knowledge and skills acquired in previous instruction examples.



Material

Soft wood, 25 mm thick 130 mm wide, some 200 mm long, levelled and milled to thickness, narrow surfaces rectangularly levelled

Tools and chucking means

Cylindrical routing machine 4.5 mm or 5 mm in diameter, chuck for eccentric chucking, chuck size 1.5

Measuring and testing means

Folding rule

Auxiliary accessories

- a piece of playwood 6 mm thick as test piece for the fit
- stop strip of approx. 100 x 50 x 20 mm
- clamp

Necessary preliminary knowledge

All knowledge acquired in conjunction with operations for Instruction Examples 04.1. to 04.3.

Sequence of operations	Comments
1. Position work materials in readiness and check machine for proper working condition. Determine the workpiece reference faces	Check the completeness of work materials, tool sharpness and cleanliness of the machine
2. Set the machine to routing operations	
3. Set the machine rotational speed to $n = 18000 \text{ mm}^{-1}$	Change the belt pulley pair
4. Remove the chuck from the machine	
5. Chuck the tool into the chuck (chuck size 1.5)	Determine the plan angle according to survey I of the Trainees' Handbook. (The measure $d_2 = 6 \text{ mm}$ does not feature in the table. Heed the control questions in section 2.3.!)
6. Balance the chuck. Insert the chuck into the machine spindle and clamp tightly with the differential nut	Ensure cleanliness! After tight chucking, release the arrest!
7. Set the table height	
8. Set spindle stroke	
9. Fix the guide rule to the machine table	Arrange the guide rule in lateral position behind the locator pin

10. Set the guide rule to 47 mm from mid–locator pin to stop face	
11. Screw–clamp the stop strip to guide rule	Secure the stop at a distance of 109 mm from mid–locator pin to the left
12. Attach guard basket	
13. Check machine for functionality and labour safety parameters	
14. Position workpiece	Place workpiece to the left on the stop
15. Switch on the machine	
16. Press the workpiece to the stop and to the guide rule thereby lowering the spindle	
17. Milling a slot	Move the workpiece to the right on the guide rule
18. Raise the spindle	
19. Switch off the machine	
20. Control all size and correct plan angle in the event of size deviations	The slot width is checked with the 6 mm test piece. The test piece must slide easily into the groove
21. Quality control	Check the straightness of the slot and edge quality

Possible addition:

Further slots can be milled at the other workpiece end. Milling is also possible on the workpiece rear side. More slots can be milled together at desired distances. In that case the setting of the slip gauge between locator pin middle and stop face must be changed.

