

Shaping of Surfaces Standing at an Angle to Each Other and Stepped Surfaces – Course: Techniques for Machining of Material. Instruction Examples for Practical Vocational Training

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Shaping of Surfaces Standing at an Angle to Each Other and Stepped Surfaces – Course: Techniques for Machining of Material. Instruction Examples for Practical Vocational Training

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Introduction

This material contains 4 instruction examples which serve the purpose of consolidating the knowledge, abilities and skills in the technique of shaping surfaces standing at an angle to each other and stepped surfaces.

The necessary working materials, tools, measuring and testing means and auxiliary equipment are indicated to make work easier. The previous knowledge necessary is mentioned as a recommendation. This previous knowledge is necessary for carrying out the technique of shaping surfaces standing at an angle to each other and stepped surfaces in good quality. It should be repeated before starting work.

As far as the choice of material is concerned, the steel is characterized by the value of the tensile strength in the unit of “Megapascal” (MPa). The choice of the material of the work-piece has no decisive influence on the technological sequence of operations.

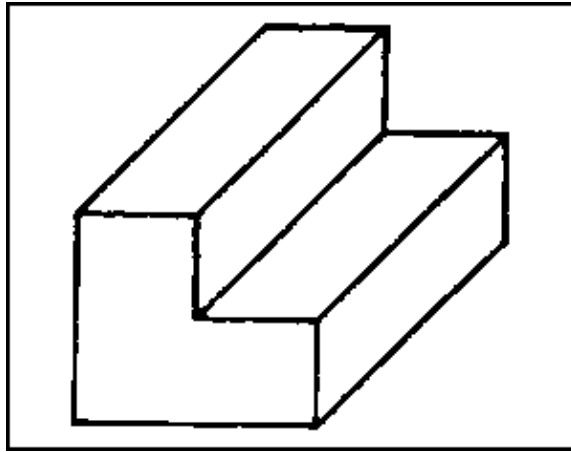
The order of steps given under the sequence of operations must be followed, if good quality is to be achieved.

Premachining of the workpieces (milling, planing, shaping) is a prerequisite for the sequence of operations given in the instruction examples.

The technological sequence of operations is preceded by necessary explanations on the working drawings.

Instruction example 3.1.: Stop

This instruction example deals with the manufacture of prismatic workpieces with stepped surfaces standing at right angles to each other by means of shaping.



Material

St 60 (St = steel, 600 MPa tensile strength)

Dimensions

120 x 60 x 30 (premachined)

Tools

Left-hand shoulder tool (SHSS)

Measuring and testing means

Vernier caliper, depth gauge

Auxiliaries

Vice with clamps and clamping bolts, parallel strips, rubber hammer, chip brush, chuck key, alignment means

Required previous knowledge

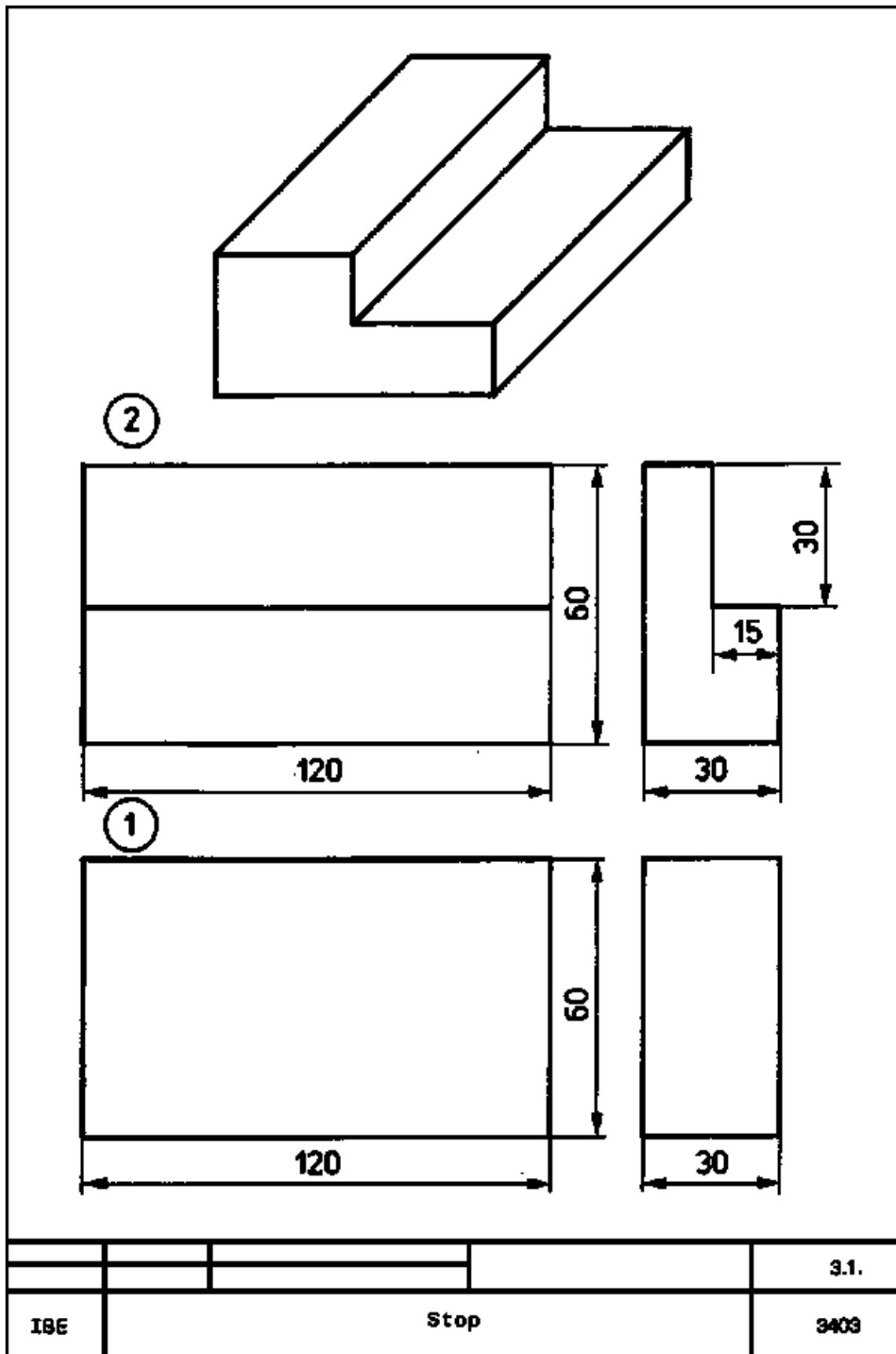
Reading of drawings, measuring and testing, setting and operation of shaping machines

Explanations to the working drawing

- (1) Premachined state of workpiece
- (2) Final state of workpiece

Sequence of operations	Remarks
1. Measure rough dimensions.	In case of undersize, reject workpiece.
2. Clamp the workpiece.	Kind of clamping: Vice chucking, place parallels in position, chuck for size 60, upset the workpiece with the rubber hammer on the parallels, make sure that bearing surfaces are clean.
3. Clamp tool.	Clamp the tool short, pay attention to cutting height.
4. Set cutting values.	$n = \frac{vm \cdot 1000}{2 \cdot L} \text{ (per min.)}$
5. Start cut.	Position shaper tool over workpiece, switch on machine and start a cut in the workpiece.
6. Infeed.	With the shaper tool moved out, feed according to scale (a = 3 mm), note spindle play.
7. Shape size 30 x 10.	Finish surface with 4 cuts, premachine size 30 to 29 (formation of steps).
	Adjust shaper tool to size 30, switch off feed, face by hand to size 30 x 10.

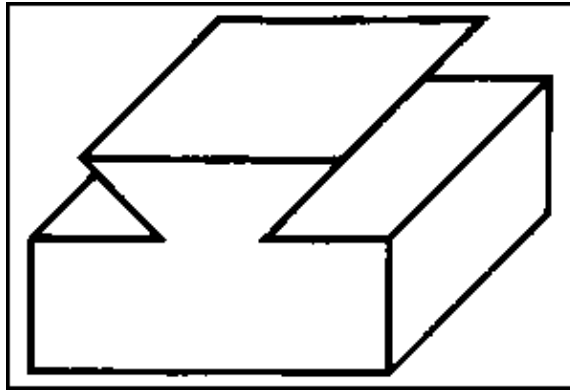
8. Face size 30.	
9. Switch off machine.	Bring tool into initial position.
10. Make dimensional inspection and visual check.	Make visual examination of surface, pay attention to surface roughness.
11. Dechuck workpiece,	Clean locating and supporting surfaces of vice.



Stop

Instruction example 3.2.: Prismatic bearing surface

This instruction example deals with the manufacture of prismatic workpieces with surfaces meeting under an acute angle by means of shaping.



Material

GGL – 25 (GG – grey cast iron, L – laminar, tensile strength 250 MPa)

Dimensions

80 x 70 x 40 (premachined)

Tools

Left–hand and right–hand roughing tool, left–hand and right–hand pointed shoulder tool

Measuring and testing means

Vernier caliper, depth gauge, protractor

Auxiliaries

Stop and clamping nuts, alignment means, chuck key, shim

Required previous knowledge

Reading of drawings, measuring and testing, setting and operation of shaping machines

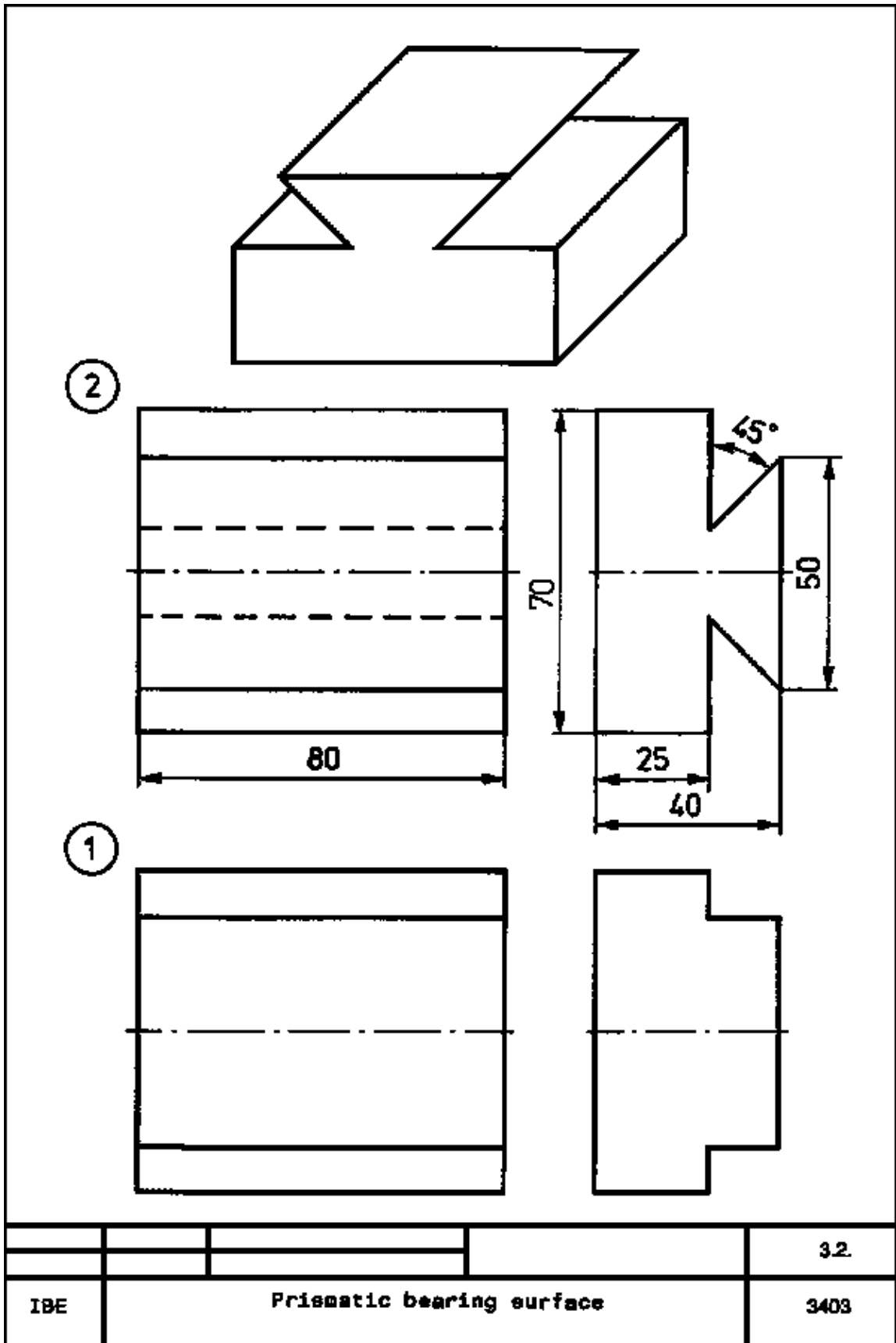
Explanations to the working drawing

(1) Premachined state of workpiece

(2) Final state of workpiece

Sequence of operations	Remarks
1. Measure rough dimensions.	In case of undersize, reject workpiece.
2. Clamp the workpiece.	Kind of clamping: Setting up on the machine table by clamping; clamp for size 70 (use shim on clamping side), make sure that bearing surfaces are clean, in case of vice chucking align the workpiece analogously to instruction example 1.
3. Clamp tool.	Turn tool holder by 45°, swivel tool block away from workpiece, clamp tool short (consider the height of the clamping nut bearing), keep secondary cutting edge of tool free (grind, if necessary).
4. Set cutting values.	For facing (feed direction is vertical) reduce recommended values for machining by approx. 50%.
5. Start cut and feed.	$a = 2 - 3 \text{ mm}$
6. Shape (rough) size 15 x 45°	Rough right guide surface, consider allowance of approx. 0.5 mm. Feed direction is at first from the top downwards, then horizontally from the outside inwards. Feed by hand, work corners remaining according to the tool shape, check angle in tool midposition and end position.
7. Clamp tool.	Grind tool on both sides. Acute angle smaller than required workpiece angle.
	Remove corners left from roughing, shape allowance to final size, check angle.

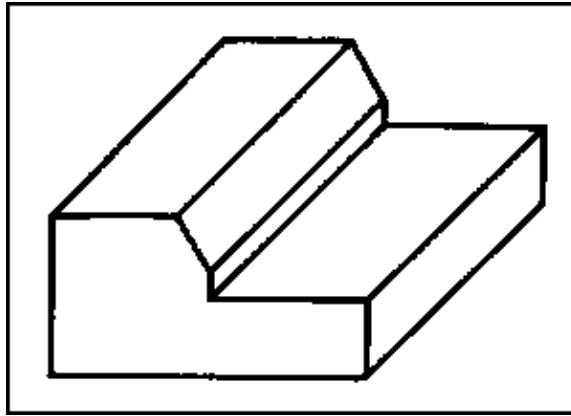
8. Shape (finish) size 15 x 45°	
9. Make dimensional inspection and visual check.	Make dimensional inspection, pay attention to surface roughness. Switch off machine and secure it.
10. Clamp tool.	Proceed according to working step 3, swivel tool holder from 0–position into the direction opposite to that of working step 3.
11. Set cutting values.	according to working step 4
12. Start cut and feed.	according to working step 5
13. Shape (rough) size 15 x 45°.	according to working step 6
14. Clamp tool.	Grind tool on both sides.
15. Shape (finish) size 15 x 45°	according to working step 8
16. Make dimensional inspection and visual check.	
17. Unclamp workpiece.	



Prismatic bearing surface

Instruction example 3.3.: Saddle piece

This instruction example deals with the manufacture of prismatic workpieces with stepped and angular surfaces by shaping.



Material

C 60 (allayed steel, carbon content 0.6%)

Dimensions:

90 x 30 x 60 (premachined)

Tools

Left-hand shoulder tool, broad-nose tool (SHSS)

Measuring and testing means

Vernier caliper, depth gauge, protractor

Auxiliaries

Vice, parallels, rubber hammer, chuck key

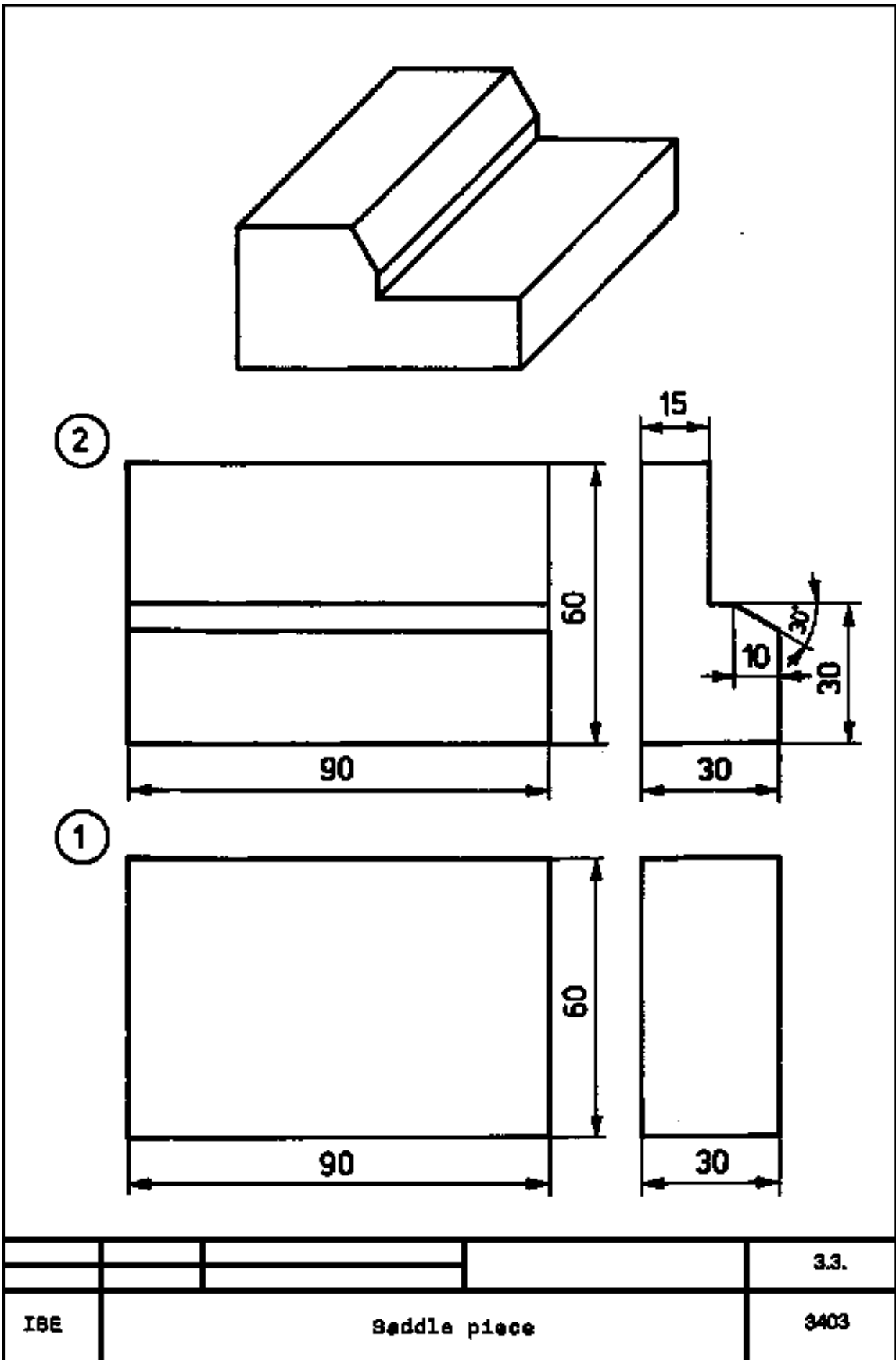
Required previous knowledge

Reading of drawings, measuring and testing, setting and operation of shaping machines

Explanations to the working drawing

- (1) Premachined state of workpiece
- (2) Final state of workpiece

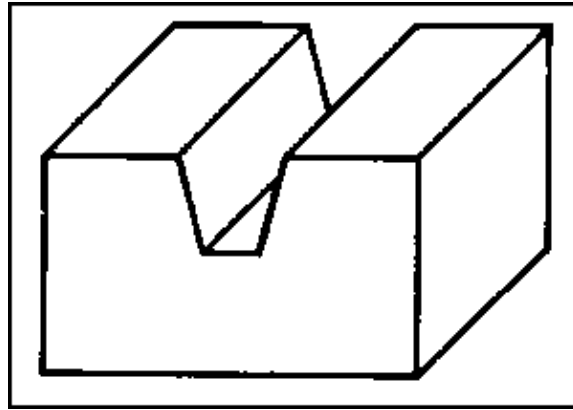
Sequence of operations	Remarks
1. Measure rough dimensions.	In case of undersize, reject workpiece.
2. Clamp the workpiece.	Kind of clamping: Vice chucking: align workpiece, if necessary; upset it, chuck for size 60.
3. Clamp tool.	Clamp tool short, consider cutting height.
4. Shape size 30 x 15.	Face-shaping $a = 3$ mm with an allowance of 0.5 mm to size 60, feed mechanically, feed end face to size 15 by hand, remove admeasure.
5. Clamp tool.	Turn tool holder by 30° , pay attention to tool cutting edge (right angle to shank is necessary).
6. Shape size 10 x 30° .	Shape by means of face-milling, feed by hand, reduce recommended values for machining by approx. 50%, prechecking of angles is necessary.
7. Make dimensional inspection and visual check.	Pay attention to surface roughness.
8. Dechuck workpiece.	



Saddle piece

Instruction example 3.4.: Shaped part

This instruction example deals with the manufacture of prismatic workpieces with stepped and profiled surfaces by shaping.



Material

St 38 (St – steel, 38 – 380 MPa tensile strength)

Dimensions

60 x 60 x 35 (premachined)

Tools

Parting-off tool (SHSS), forming tool (SHSS)

Measuring and testing means

Vernier caliper, depth gauge, profile gauge

Auxiliaries

Vice, parallels, alignment means, chuck key

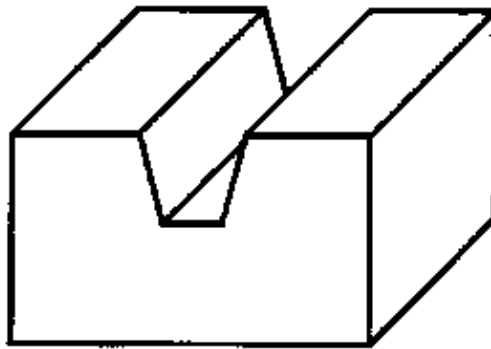
Required previous knowledge

Reading of drawings, measuring and testing, setting and operation of shaping machines

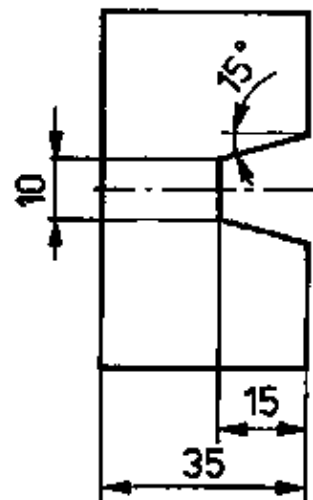
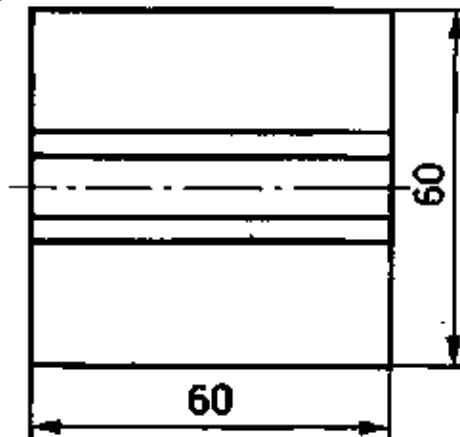
Explanations to the working drawing

- (1) Premachined state of workpiece
- (2) Final state of workpiece

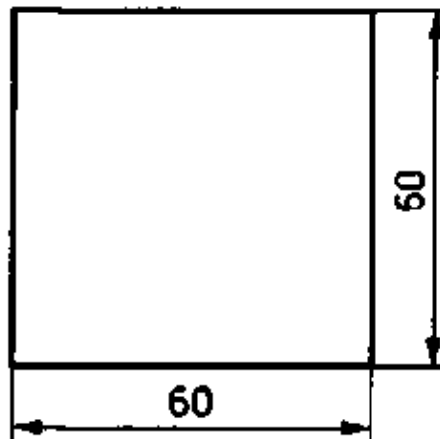
<u>Sequence of operations</u>	<u>Remarks</u>
1. Measure rough dimensions.	In case of undersize, reject workpiece.
2. Clamp the workpiece.	Kind of clamping: Vice chucking, upset workpiece, align.
3. Clamp tool.	Clamp tool short.
4. Preliminary parting-off size 10 x 15	$v = 10 \text{ m/min.}; 0.5 \text{ mm}$ Pay attention to dimensional allowance (tool width 9.5 mm).
5. Clamp tool.	Clamp tool short, pay attention to surfaces below cutting edge.
6. Shape size 10 x 15	$v = 8 \text{ m/min.}; a =$ according to the cutting depth between 0.5 – 0.05 mm (pay attention to increasing cutting force)
7. Make dimensional inspection and visual check.	Check the surface, pay attention to surface roughness, make visual split test over the whole length of the workpiece with the profile gauge.
8. Dechuck workpiece.	Clean locating and supporting surfaces.



②



①



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Shaped part

