

**Manual Reaming – Course: Technique for Manual Working of Materials. Instruction Examples for Practical Vocational Training**



# Table of Contents

<b><u>Manual Reaming – Course: Technique for Manual Working of Materials. Instruction Examples for Practical Vocational Training</u></b> .....	<b>1</b>
<u>Introduction</u> .....	1
<u>Instruction example 8.1. Training workpiece with straight fitting holes</u> .....	1
<u>Instruction example 8.2. Screw lock</u> .....	4
<u>Instruction example 8.3. Training workpiece with tapered fitting holes</u> .....	7
<u>Instruction example 8.4. Training workpiece for reaming rivet hole</u> .....	10
<u>Instruction example 8.5. Joint</u> .....	13



# Manual Reaming – Course: Technique for Manual Working of Materials. Instruction Examples for Practical Vocational Training

Institut für berufliche Entwicklung e.V.  
Berlin

Original title:  
Lehrbeispiele für die berufspraktische Ausbildung  
"Reiben von Hand"

Author. B. Zierenberg

First edition © IBE

Institut für berufliche Entwicklung e.V.  
Parkstraße 23  
13187 Berlin

Order No.: 90–33–3108/2

## Introduction

The present material includes 5 selected instruction examples where the main methods of manual reaming can be practised. This serves to practise straight and tapered fitting holes, press-type fits and clearance fits in plain pin joints, taper pin joints and reaming of offset holes for riveted joints.

The instruction examples are mainly confined to the manufacturing of fitting holes, because these techniques of manual working can be mastered only by much training.

Only the lock of the screw represents a part which can be used as a component for a C clamp. As a complex work the joint combines all previously practised techniques of reaming.

In order to facilitate the preparation and implementation of the work, the necessary materials, working tools, testing and measuring tools as well as accessories are specified for each training example. Moreover, previous knowledge is named that is necessary to perform the exercises.

Besides the enclosed working drawing, the sequence of operations is explained in a convenient variant.

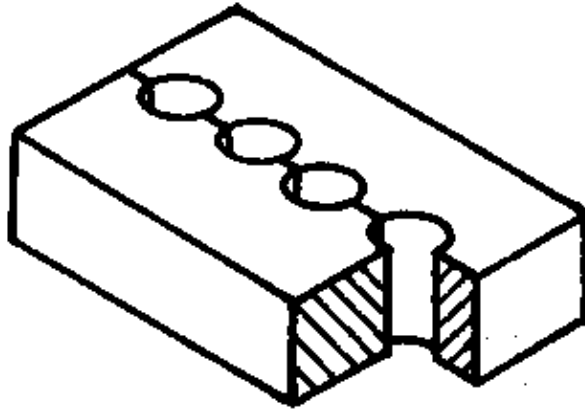
Explanation on the indication of the material:

The steel indication is done according to the value of the tensile strength in the unit "Megapascal" (MPa).

## Instruction example 8.1. Training workpiece with straight fitting holes

To practise the making of straight fitting holes

Material



2 x square steel (380 MPa)

thickness: about 24 mm

length: 90 mm

#### Working tools

Steel scribe or marking gauge, centre punch, locksmith's hammer, drills (normal type)  $\varnothing$  4.8 mm;  $\varnothing$  7,8 mm;  $\varnothing$  9,8 mm, countersink 90°, straight manual reamer  $\varnothing$  5K7;  $\varnothing$  8H8;  $\varnothing$  10E8, adjustable reamer  $\varnothing$  10–12 mm

#### Measuring and testing tools

Steel rule, vernier caliper, external micrometer, internal micrometer, limit plug gauge  $\varnothing$  5K7;  $\varnothing$  8H8;  $\varnothing$  10E8

#### Accessories

2 C clamps, machine vice, vice, tap wrench, soluble oil, cutting oil.

#### Necessary previous knowledge

Reading of drawings, scribing, prick-punching, measuring, testing, sawing, filing, drilling, countersinking/counterboring

### **Sequence of operations**

### **Comments**

1. Arrange the working place.  
Prepare the working material

– Check for completeness

2. Check the initial length of the material; if necessary, saw to 90 mm and remove the burr

3. Clamp together the parts with the clamps, scribe and punch the central line being visible by the edges of the parts

– Conditions:  
The space between the finished upper edges of the holes shall be 11 mm each!

4. Fix the clamped parts in a machine vice and prepare the drilling machine

5. Drilling

- 5.1. For hole Ø 5K7  
make a through hole Ø 4.8 mm – n = 2,240 r.p.m.
- 5.2. For hole Ø 8H8  
make a through hole Ø 7.8 mm – n = 1,400 r.p.m.
- 5.3. For hole Ø 10E8  
make a through hole Ø 9.8 mm – n = 1,120 r.p.m.
- 5.4. For hole Ø 10,61 mm  
make a through hole Ø 9.8 mm – n = 1,120 r.p.m.

## 6. Countersinking/counterboring

- 6.1. Countersink/counterbore hole Ø 4,8 mm to 5.2 mm – n = 350 r.p.m.
- 6.2. Countersink/counterbore hole Ø 7,8 mm to 8.2 mm – Countersink/counterbore all holes on both sides
- 6.3. Countersink/counterbore holes Ø 9,8 mm to 10.2 mm

- 7. Fasten the workpiece in a vice. – Do not unfasten the clamps

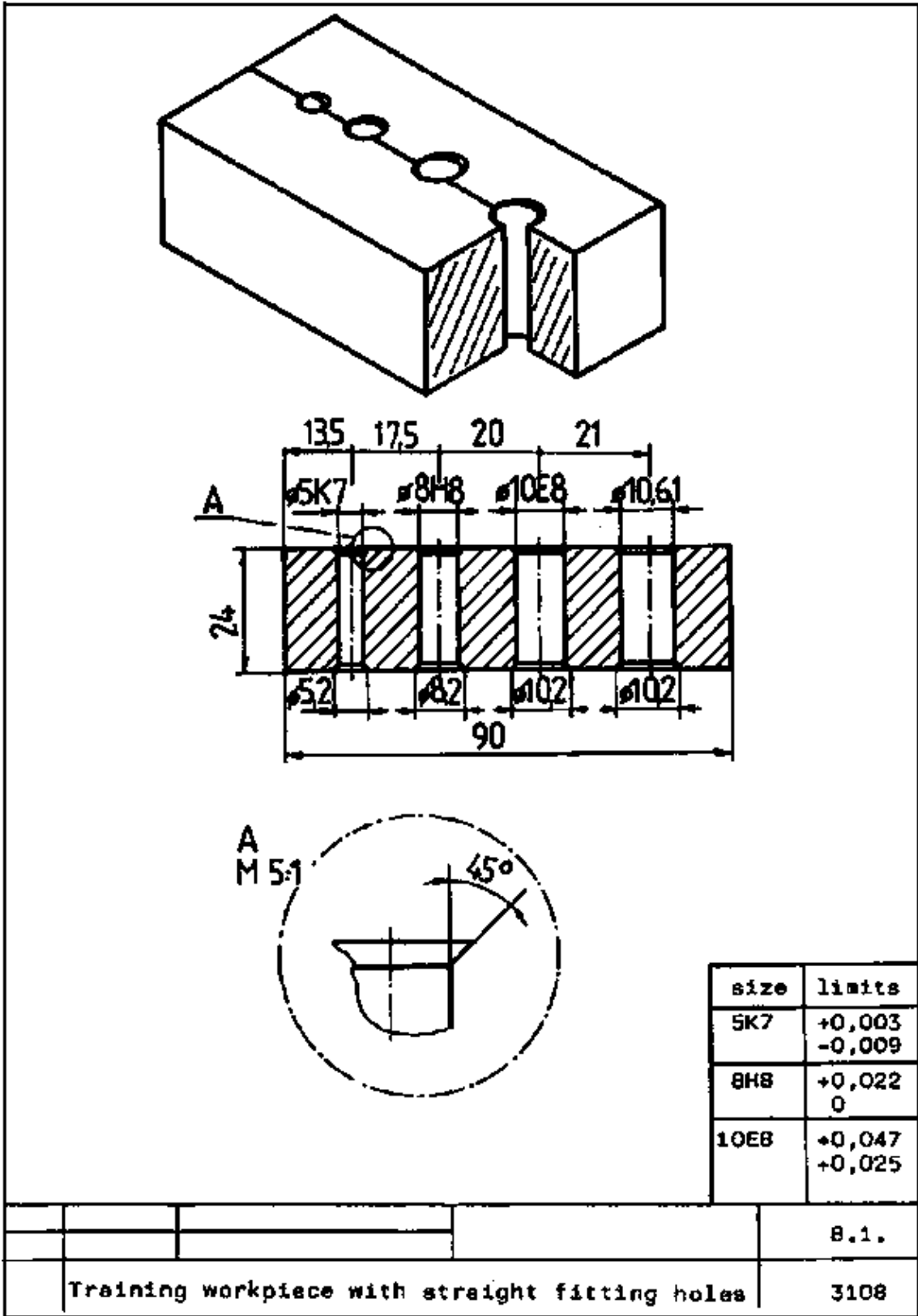
## 8. Reaming the holes

- 8.1. Ream hole Ø 4,8 mm with a manual reamer Ø 5K7 – Clamp the reamer tightly in the tap wrench
- 8.2. Ream hole Ø 7.8 mm with a manual reamer Ø 8H8 – Turn constantly in clockwise direction
- 8.3. Ream is hole Ø 9.8 mm with a manual reamer Ø 10E8 – Add cutting oil
- 8.4. Ream 2nd hole Ø 9.8 mm with an adjustable reamer (set the reamer with the external micrometer to the specified diameter) – Remove chips from time to time

## 9. Clean the holes

10. Check the accuracy of fit of the holes with the appropriate limit plug gauges and the internal micrometer

11. Unfasten the parts and check surface of the holes for finish quality

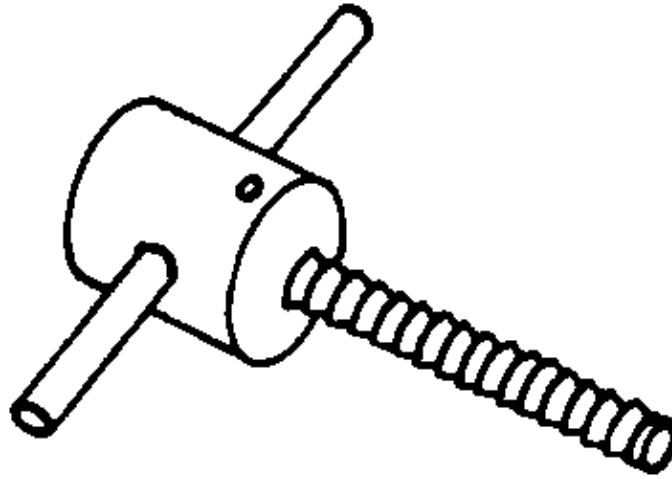


**Instruction example 8.2. Screw lock**

To practise reaming of straight fitting holes for the press-type fit of plain pins.

Material





round bar steel (420 MPa)

diameter: 15 mm

length: 20 mm

screw bolt: (600 MPa) nominal diameter: M 10

length: 106 mm (or both parts from training example 9.5)

plain pin  $\varnothing$  6m6

length: 60 mm

plain pin  $\varnothing$  3m6

length: 15 mm

#### Working tools

Marking gauge, centre punch, locksmith's hammer, drills  $\varnothing$  2,8 mm;  $\varnothing$  5.8 mm, countersink  $90^\circ$ , manual reamer  $\varnothing$  3K7 and  $\varnothing$  6K7.

#### Measuring and testing tools

Vernier caliper, limit plug gauge  $\varnothing$  3K7 and  $\varnothing$  6K7.

#### Accessories

Machine vice with vee jaws, light metal plug, tap wrench, soluble oil, cutting oil.

#### Necessary previous knowledge

Reading of drawings, scribing, prick-punching, measuring, testing, drilling, countersinking/counterboring

### **Sequence of operations**

### **Comments**

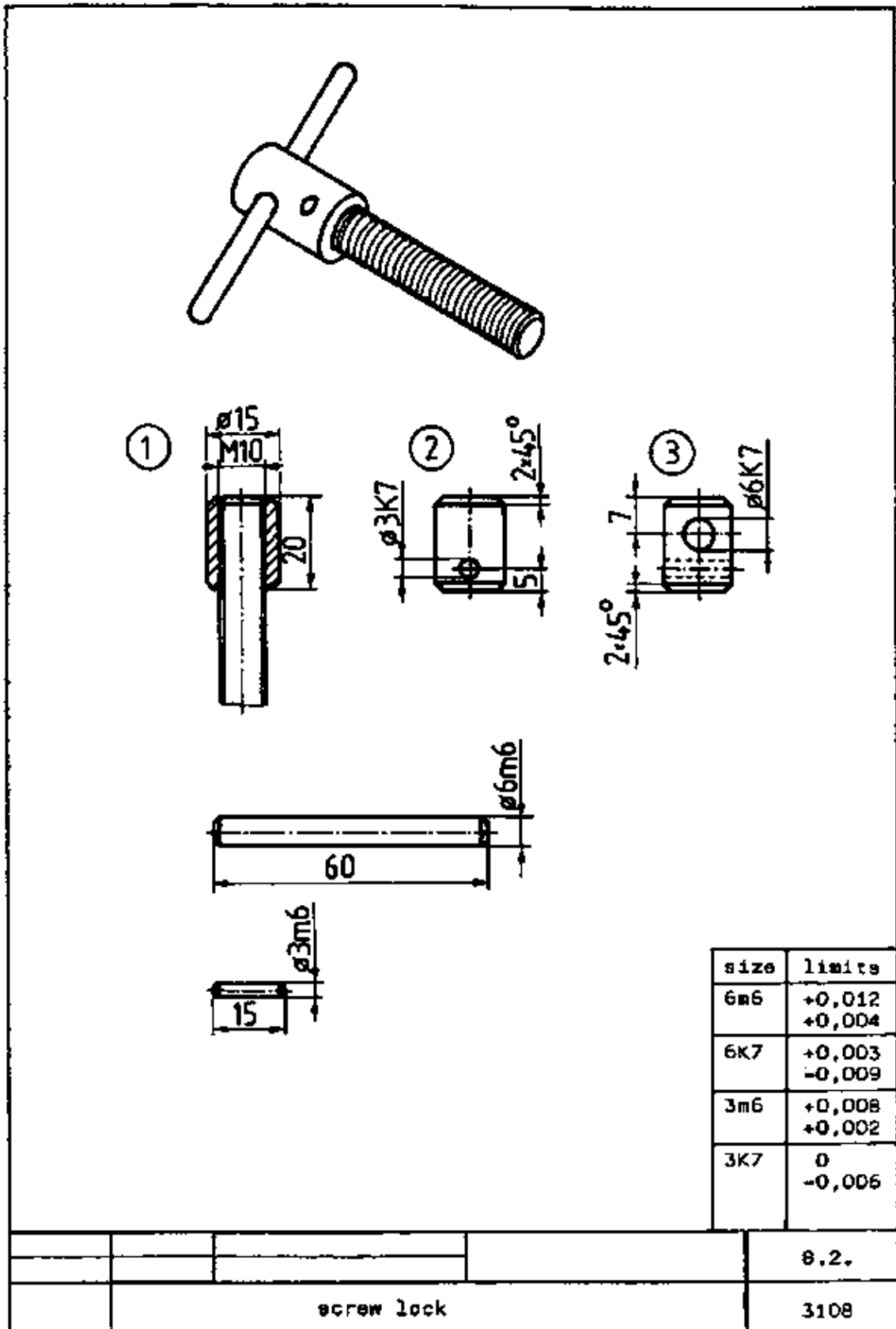
- |  |                          |
|--|--------------------------|
| 1. Arrange the working place. Prepare the working material.                      | – Check for completeness |
| 2. Screw in the bolt into the round bar material with internal thread            | – Stage (1)              |
| 3. Fasten in the machine vice, scribe and prick-punch the hole $\varnothing$ 3K7 |                          |

4. Drill the hole  $\varnothing$  2.8 mm, countersink at both ends to  $\varnothing$  3.2 mm; ream with manual reamer  $\varnothing$  3K7 and check. – Stage (2)  
n = 1,800 r.p.m.  
Apply cutting oil
5. Insert the plain pin  $\varnothing$  3m6 x 15 and check for press fit. – drive in with the light metal plug and a hammer
6. Fasten in the machine vice, scribe and prick–punch the hole  $\varnothing$  6K7 (turned by 90° to the previous hole) – Stage (3)
7. Drill the hole  $\varnothing$  5.8 mm countersink at both ends to  $\varnothing$  6.2 mm; ream with a manual reamer  $\varnothing$  6K7 and check. – n = 900 r.p.m.
8. Insert the plain pin  $\varnothing$  6m6 x 60 and check for press fit.

Remark

- Together with the training examples 2.5. (C clamp bow)  
2.6. (rotary head for threaded spindle)  
and 9.5. (screw bushings and screw bolts for a C clamp)

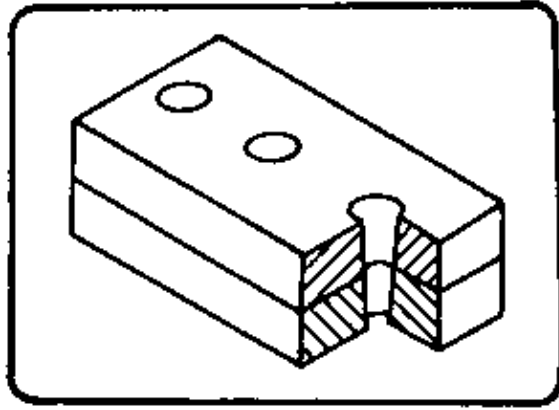
this lock, as a component of a screw, forms a complete C clamp for workshop use.



### Instruction example 8.3. Training workpiece with tapered fitting holes

To practise the making of tapered fitting holes for taper pins 1:50.

Material



2x square steel (380 MPa)

thickness: 26 mm

length: 68 mm

taper pins  $\varnothing 6 \times 50$

$\varnothing 8 \times 50$

$\varnothing 10 \times 50$

#### Working tools

Marking gauge, centre punch, locksmith's hammer, aluminium hammer, drills (normal type)  $\varnothing 6$  mm,  $\varnothing 8$  mm,  $\varnothing 10$  mm, taper reamer (1: 50)  $\varnothing 6$  mm,  $\varnothing 8$  mm,  $\varnothing 10$  mm, countersink  $90^\circ$ .

#### Measuring and testing tools

vernier caliper

#### Accessories

2 C clamps, machine vice, light metal plugs  $\varnothing 6$ ,  $\varnothing 8$ ,  $\varnothing 10$ , tap wrench, soluble oil, cutting oil.

#### Necessary previous knowledge

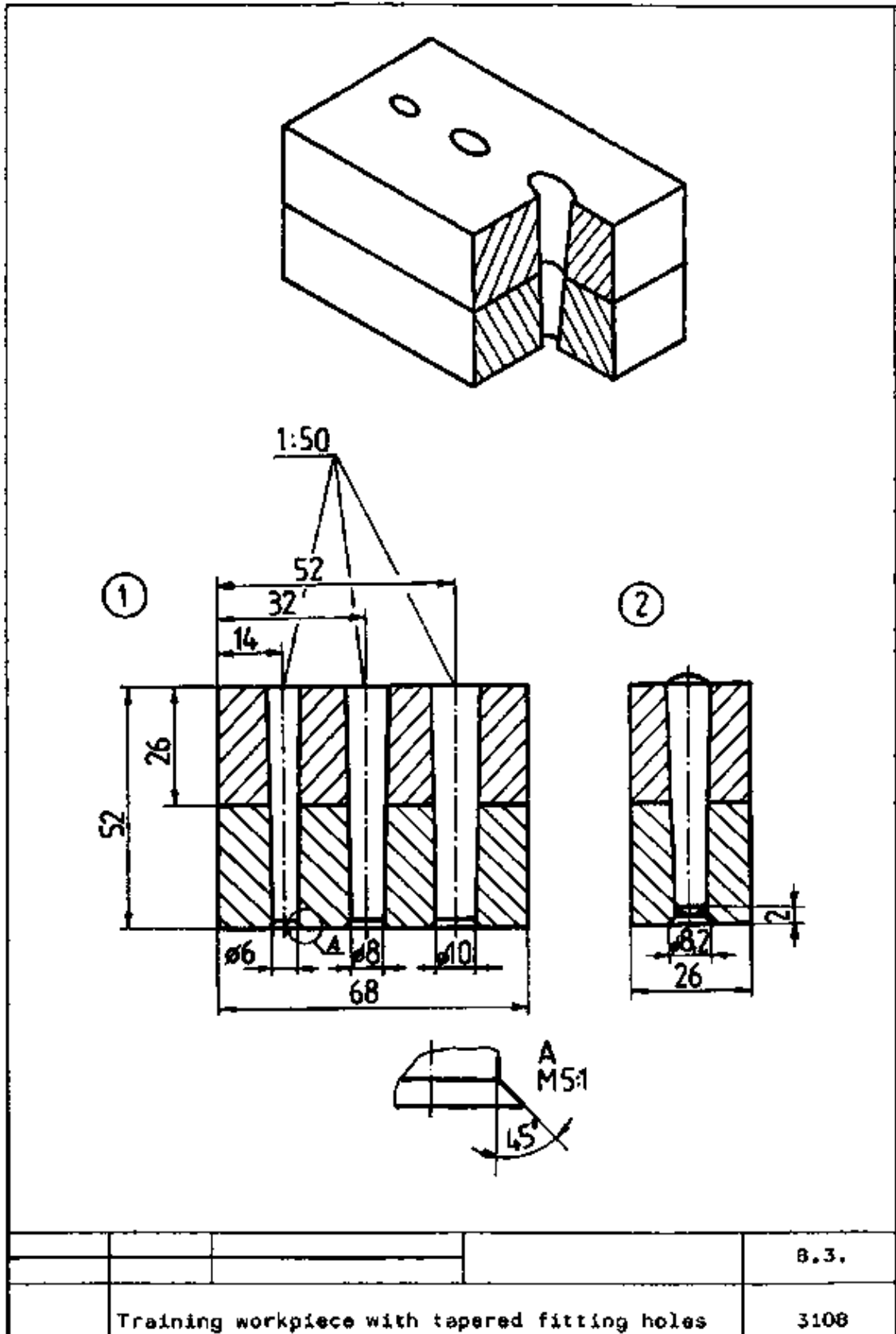
Reading of drawings, scribing, prick-punching, measuring, testing, sawing, filing, drilling, countersinking/counterboring

### **Sequence of operations**

### **Comments**

1. Arrange the working place. Prepare the working material. Check for completeness
2. Check the initial dimensions of the parts, if necessary, rework, remove the burr.
3. Clamp together the working parts with C clamps, scribe and punch as to given size.
4. Fasten the clamped parts in a machine vice and set up the drilling machine.

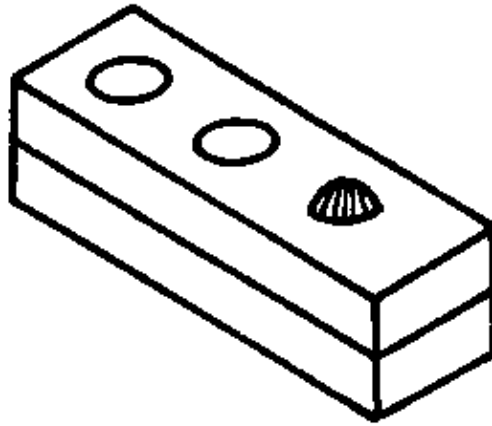
5. Drilling the holes:  
 Ø 6 mm  
 Ø 8 mm and  
 Ø 10 mm
- n = 1,400 r.p.m.  
 – n = 1,400 r.p.m.  
 – n = 1,120 r.p.m.
6. Countersinking: both ends to a countersinking diameter of Ø 6.2 mm, Ø 8,2 mm and Ø 10.2 mm, each. – n = 350 r.p.m.
7. Fasten the working parts in a vice. Do not unfasten the clamps.
8. Reaming the holes Ø 6: – stage (1)
- Turn the 6 mm dia. taper reamer through until little before leaving the hole. Turn in clockwise direction.  
 – Add cutting oil.  
 – Pull out with a clockwise rotation,
- Pull out the taper reamer, clean the hole.
- Push the taper pin with the thumb tightly into the hole.
- The taper pin should now protrude above by the pre-fitting size. – pre-fitting size:  
 Ø 6 = 4 – 5 mm  
 Ø 8 = 6 mm  
 Ø 10 = 8 mm
- If the pin protrudes too much it should be knocked out and reamed again. – Use a light metal plug for driving out.
- If the pin fits right, fix it with 2–3 blows of the aluminium hammer. – stage (2)
9. Check if it fits tight. – Both parts should not twist after removing the C clamps.
10. Remove the taper pin with a light metal plug. – Hammer against it from below.
11. Repeat the operations 8–10 for the holes Ø 8 and Ø 10.
12. Check for tight fit and alignment of the head with the upper edge of the hole after each operation.



### Instruction example 8.4. Training workpiece for reaming rivet hole

To practise reaming of offset holes.

Material



2x steel sheets (380 MPa)

thickness: 5 mm

width: 20 mm

length: 80 mm

button-head notched nail  $\varnothing 4 \times 10$  2 button-head rivets  $\varnothing 6$  mm

#### Working tools

Marking gauge, centre punch, locksmith's hammer, drills (normal type)  $\varnothing 4.0$  mm and  $\varnothing 6.4$  mm, rivet hole reamer  $\varnothing 5$  mm.

#### Measuring and testing tools

vernier caliper

#### Accessories

2 C clamps, machine vice, soluble oil, tap wrench, cutting oil.

#### Necessary previous knowledge

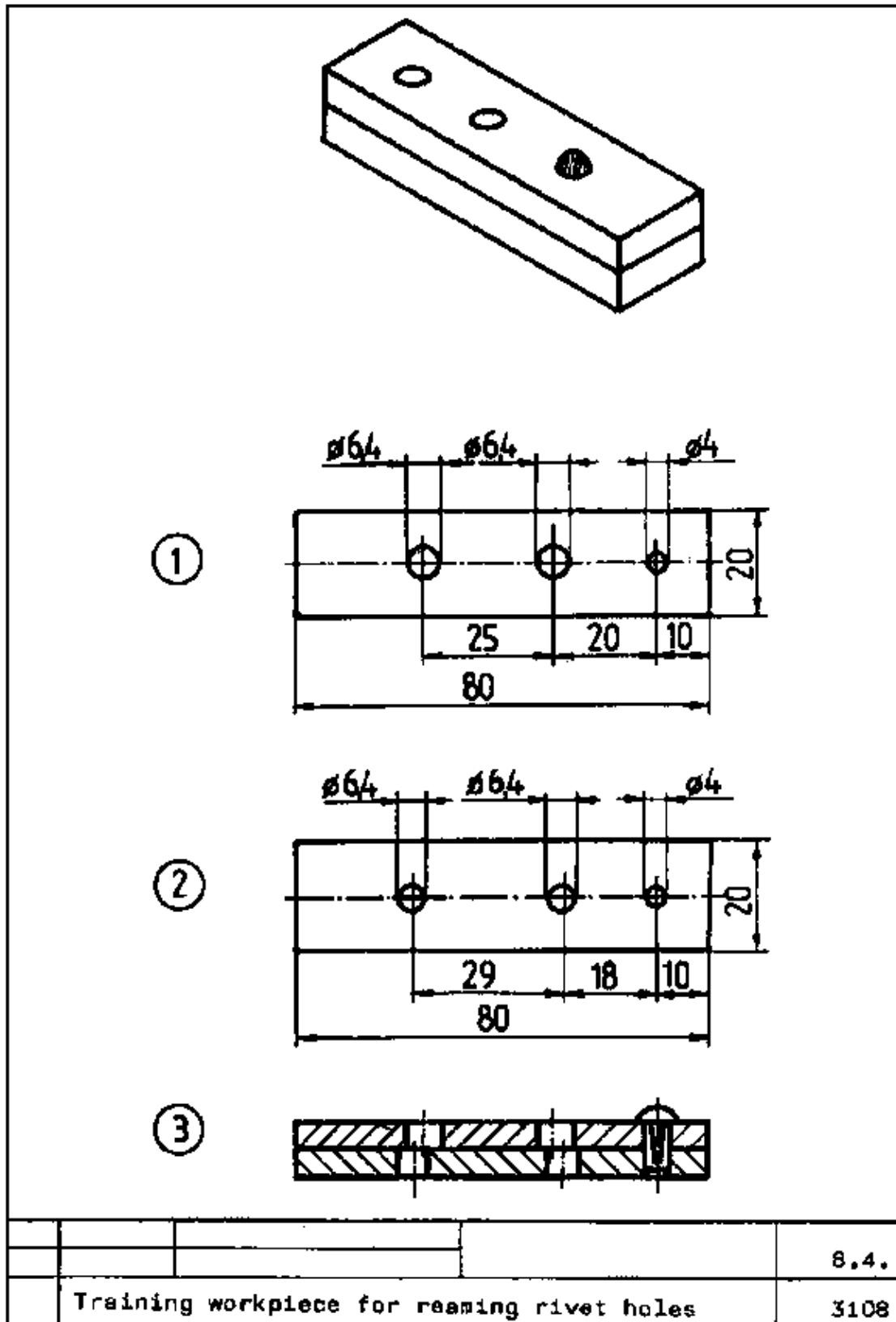
Reading of drawings, scribing, prick-punching, measuring, drilling, testing.

<b><u>Sequence of operations</u></b>	<b><u>Comments</u></b>
1. Arrange the working place. Prepare the working material.	– Check for completeness
2. Scribe, punch and drill the parts separately according to the drawing.	– stage (1) – stage (2)
3. Clamp together the parts with C clamps, place the notched nail into the appropriate hole.	– stage (3)
4. Fasten the clamped sheets in a vice, ream the offset holes with the rivet hole reamer until the rivet can be easily placed into them.	

5. Check the holes.

– with vernier caliper  
rough size:  $\varnothing 6.1$

Completion: Rivet the sheets together.

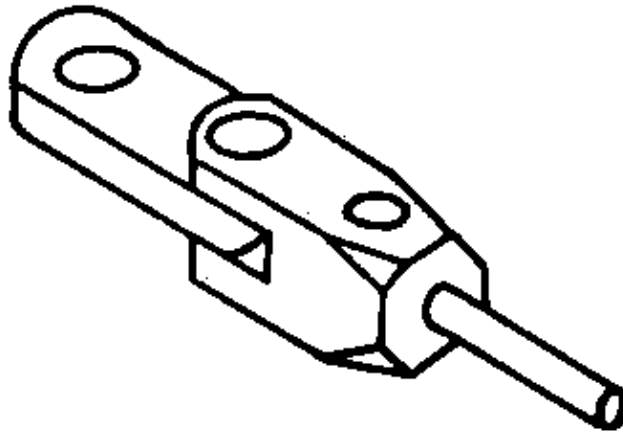




## Instruction example 8.5. Joint

To practise making of cylindrical and tapered pin connection as combined press-type fits and clearance fits.

### Material



flat steel (380 MPa)

thickness: 10 mm

width: 20 mm

length: 70 mm

square steel (380 MPa)

thickness: 20 mm

width: 20 mm

length: 70 mm

round bar steel (380 MPa)

diameter: 10 mm

length: optional

plain pin  $\text{Ø} 10\text{m}6$

length: 20 mm

taper pin  $\text{Ø} 3 \times 18$  (1:50)

### Working tools

Hand hacksaw, bastard files and smooth files 200 mm (flat and square), steel scribe, centre punch, locksmith's hammer, aluminium hammer, drills  $\text{Ø} 3$  mm and 9.8 mm, hand hacksaw  $\text{Ø} 10\text{K}7$  and  $\text{Ø} 10\text{E}8$ , taper reamer  $\text{Ø} 3$  mm (1:50).

### Measuring and testing tools

Vernier caliper, limit plug gauge  $\text{Ø} 10\text{K}7$  and  $\text{Ø} 10\text{E}8$ .

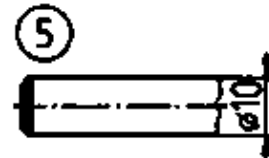
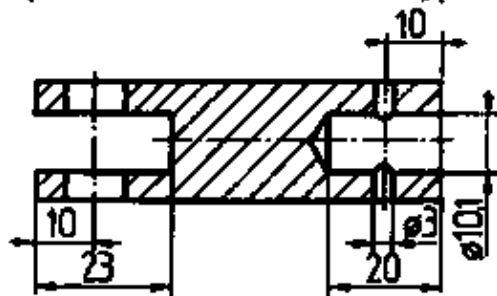
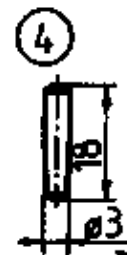
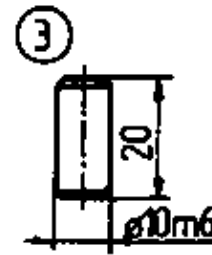
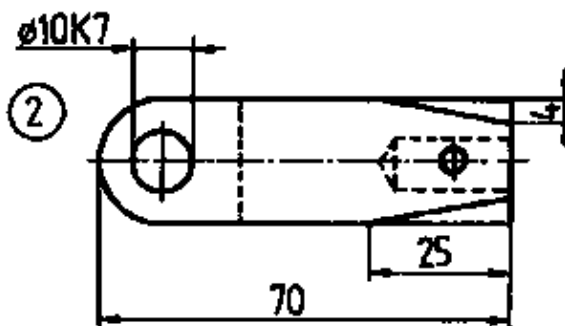
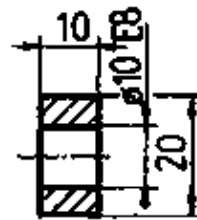
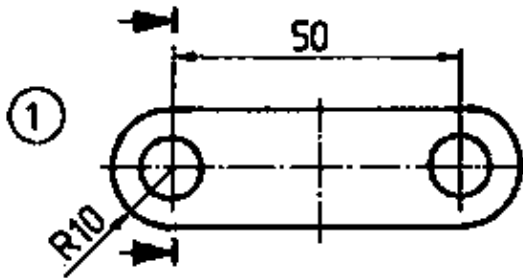
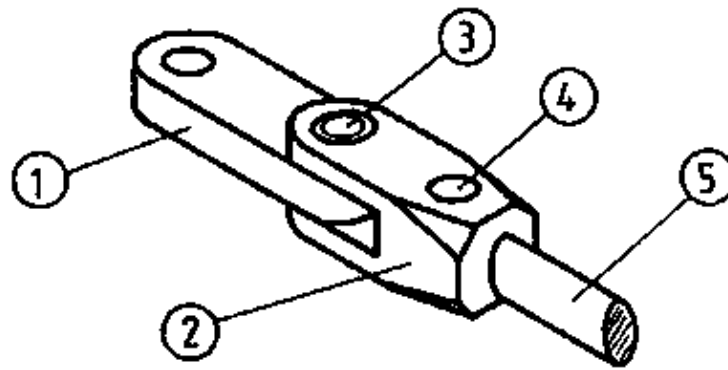
### Accessories

Machine vice, vice, tap wrench, soluble oil, cutting oil.

### Necessary previous knowledge

Reading of drawings, scribing, prick-punching, measuring, testing, sawing, filing, drilling, countersinking/counterboring.

<b><u>Sequence of operations</u></b>	<b><u>Comments</u></b>
1. Arrange the working place. Prepare the working material.	– Check for completeness
2. Prepare the external outlines of parts (1) and (2) according to the drawing, smooth the surface throughout.	– Saw, file, drill
3. Provide part (1) with fitting holes $\varnothing 10E8$ .	
4. Provide part (2) on the slotted side with a fitting hole $\varnothing 10K7$ .	
5. Check the holes.	
6. Connect part (1) and (2) by a plain pin (3).	– Clearance fit in part (1) – Press-type fit in part (2) – Part (1) must be slewable
7. Scribe hole $\varnothing 3$ mm on part (2), Place the round bar steel (5) $\varnothing 10$ mm into the hole $\varnothing 10,1$ mm, drill together and ream conically.	
8. Insert taper pin (4) and check for tight fit.	
9. Final control.	– Function of the pin joints



		size	limits
		10E8	+0,047 +0,025
10m6	+0,015 +0,006	10K7	+0,005 -0,010

				8.5.
			Joint	3108

