

Bending – Course: Technique of Working Sheet Metals, Pipes and Sections. Instruction Examples for Practical Vocational Training

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Bending – Course: Technique of Working Sheet Metals, Pipes and Sections. Instruction Examples for Practical Vocational Training

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Preliminary Remarks

This material contains 6 selected instruction examples, by means of which bending of sheet metals and sections with various tools and appliances can be practised. The following techniques are applied for making the practising pieces:

- Folding of sheet metals and round sections
- Turning over of sheet metals
- Flanging and seaming of sheet metals
- Rounding of sheet metals, round sections and pipes
- Rolling of sheet metals

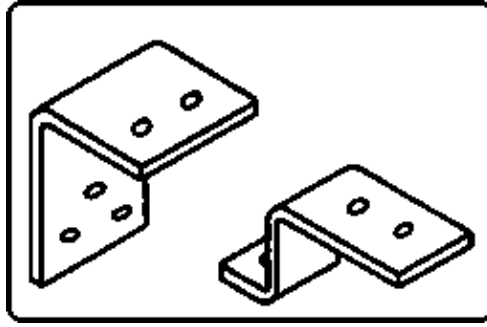
While "mounting angles" and "double pipe knee" exclusively are exercise pieces, the "half-round bracket", the "interlocking sleeve" and "beaker" may be used in the workshop in practice.

To facilitate preparation and execution of work, the materials, tools, measuring and testing instruments as well as auxiliary means necessary for each instruction example are specified. Moreover, the previous knowledge needed to perform the exercises is mentioned.

Based on working drawings and the appurtenant sequence of operations, the exercises can be done independently.

Instruction Example 14.1.: Mounting Angle

Practise the folding of thin sheet metals on the vise with and without hammers.



Material

Sheet steel (380 MPa) 1
 thickness: 1 mm
 width: 60 mm
 length: 165 mm

Sheet steel (380 MPa) 2
 thickness: 2 mm
 width: 20 mm
 length: 155 mm

Tools

Steel scribe, centre punch, smooth file 200 mm (flat), light metal hammer, machinist's hammer

Measuring and testing means

Vernier caliper, steel rule, steel square

Auxiliary means

Surface plate, vise, bending plate, intermediate plate 40 × 40

Previous knowledge required

Manual material working: Measuring, testing, scribing, punching, filing, shearing

Sequence of operations	Comments
1. Prepare the working place and make available working material.	Check completeness.
2. Check initial sizes of sheets. If need be, cut to size, deburr and straighten.	
3. Scribe bending edges of sheet (1) and sheet (2).	Scribe on internal sides.
4. Clamp sheet (1) in vise and bend with your ball of the thumb and, if need be, use bending plate.	Strike bending edge with light metal hammer.
5. Clamp sheet (2) in vise and fold first bending edge with light metal hammer.	Strike hammer directly against bending edge. Strike against the fixed vise jaw.

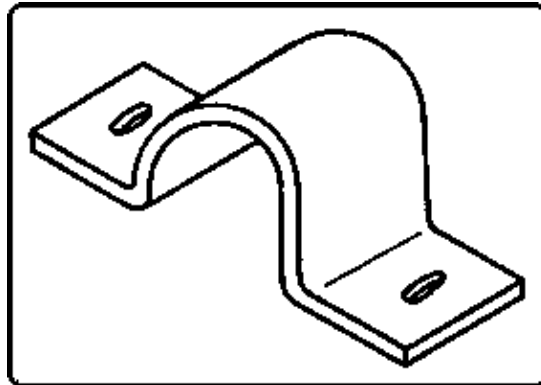
6. Reclamp sheet (2) with intermediate plate in vise and fold second bending edge.	If need be, strike bending edges with hammer face of machinist's hammer.
7. Check bending edges.	- Accuracy to size - Angularity - Shape
8. Drill the workpiece.	Ask the instructor as for drilling sizes.

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Mounting angle

Instruction Example 14.2.: Half-round Bracket

Practise the folding and rounding of sheet metal on the vise with hammer and bending mandrel.



Material

Sheet steel (380 MPa)
 thickness: 2 mm
 width: 20 mm
 length: 90 mm, approx.

Tools

Steel scribe, centre punch, smooth file 200 mm (flat), machinist's hammer

Measuring and testing means

Steel rule, vernier caliper

Auxiliary means

Surface plate, straightening plate, vise, bending mandrel 0 20 mm

Previous knowledge required

Manual material working: Measuring, testing, scribing, punching, filing, shearing

Sequence of operations	Comments
1. Prepare the working place and make available the material.	Check completeness.
2. Check initial size and, if need be, rework, deburr and straighten.	
3. Calculate stretched length (x), cut sheet to this length, deburr and straighten.	Subdivide total length into 5 partial lengths.
4. Scribe centre $\left(\frac{x}{2}\right)$ on one side of sheet and scribe tang lengths on the other external side (20 mm).	Stage (1)
5. Fold clamped tangs.	Stage (2)
6. Place sheet on open vise and put bending mandrel on sheet centre (see scribed line) and strike with hammer.	Stage (3)
	Vise opening:

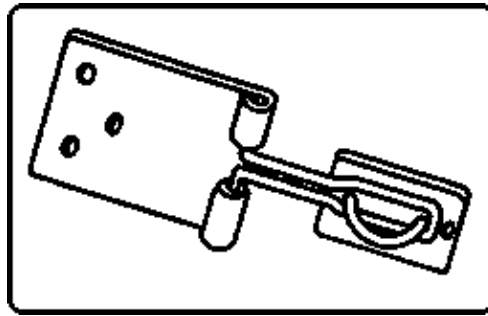
	Diameter of bending mandrel plus two times the sheet thickness.
7. Strike tangs planely in final position and straighten on straightening plate.	Stage 4
8. Check bending.	– Evenness on surface plate – Angularity
	– Accuracy to size
	– Shape
9. Drill workpiece.	

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IBE	Half-round bracket		3114

Half-round bracket

Instruction Example 14.3.: Hasp

Practise the folding and rounding of round section in the vise as well as rolling of sheet metal with the rolling device.



Material

Sheet steel (380 MPa) 1

thickness: 2 mm

width: 53 mm

length: 80 mm

Sheet steel (380 MPa) 2

thickness: 2 mm

width: 32 mm

length: 67 mm

Round section (380 MPa) 3

diameter 5 mm

length: 280 mm

Round section (380 MPa) 4

diameter 5 mm

length: 80 mm

Tools

Steel scribe, centre punch, smooth file 200 mm (flat), drill ϕ 5 mm, countersink 75°, machinist's hammer, hand-type hack saw

Measuring and testing means

Steel rule, vernier caliper, steel square

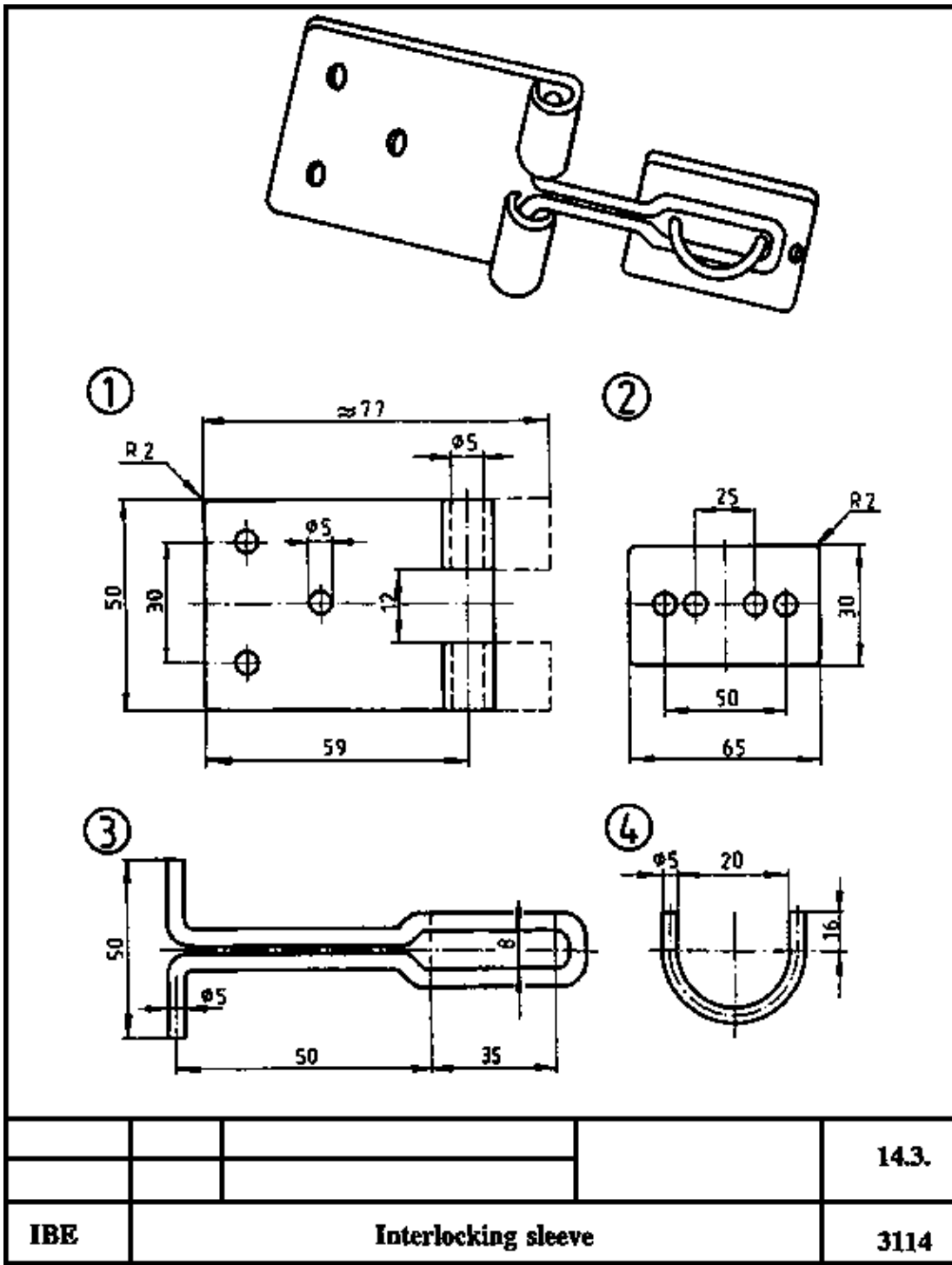
Auxiliary means

Rolling device with bore ϕ 10 mm, vise, bending mandrel ϕ 20 mm, bending mandrel 8 mm (flat)

Previous knowledge required

Manual material working: Checking, measuring, scribing, punching, sawing, filing, drilling, counterboring, rivetting.

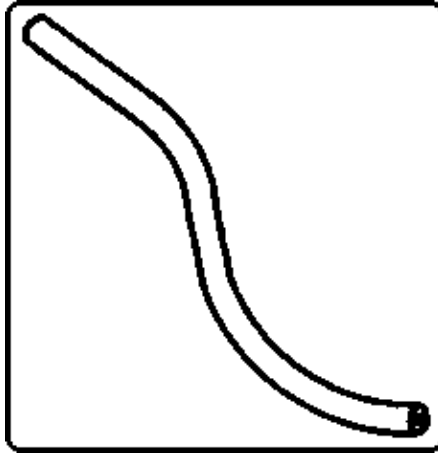
Sequence of operations	Comments
1. Prepare the working place and make available the working material.	Check completeness.
2. Prepare hinge sheet (1) and trim tab (2) as to specified size, counterbore trim tab back for rivetting.	Shearing, deburring, drilling, counterboring.
3. Roll hinge sheet on rolling device, then bend upwards hinge side by 5 mm.	Tightly clamp rolling device, pre-bend sheet and then roll it.
4. Round and fold joint piece 3 as to specified size and subsequently saw it to size.	Apply bending mandrel 8 mm.
5. Round staple (4) as to specified size and subsequently saw it to size.	Apply bending mandrel 0 20 mm.
6. Put joint piece (3) in hinge sheet (1) and press hinge side together.	Joint piece must be moved easily.
7. Insert staple into staple plate (2) and rivet from the back.	
8. Check bendings	– Function
	– Accuracy to size
	– Shape



Interlocking sleeve

Instruction Example 14.4.: Double Pipe Knee

Practise the rounding of a pipe with the pipe bending device and hammer.



Material

Steel pipe (380 MPa)
 diameter 25 mm
 length: about 1000 mm

Tools

Pipe bending device, smooth file 200 mm (flat and round), hand-type hacksaw, welding torch, machinist's hammer

Measuring and testing means

Steel rule, template R 400 and R 89, steel square

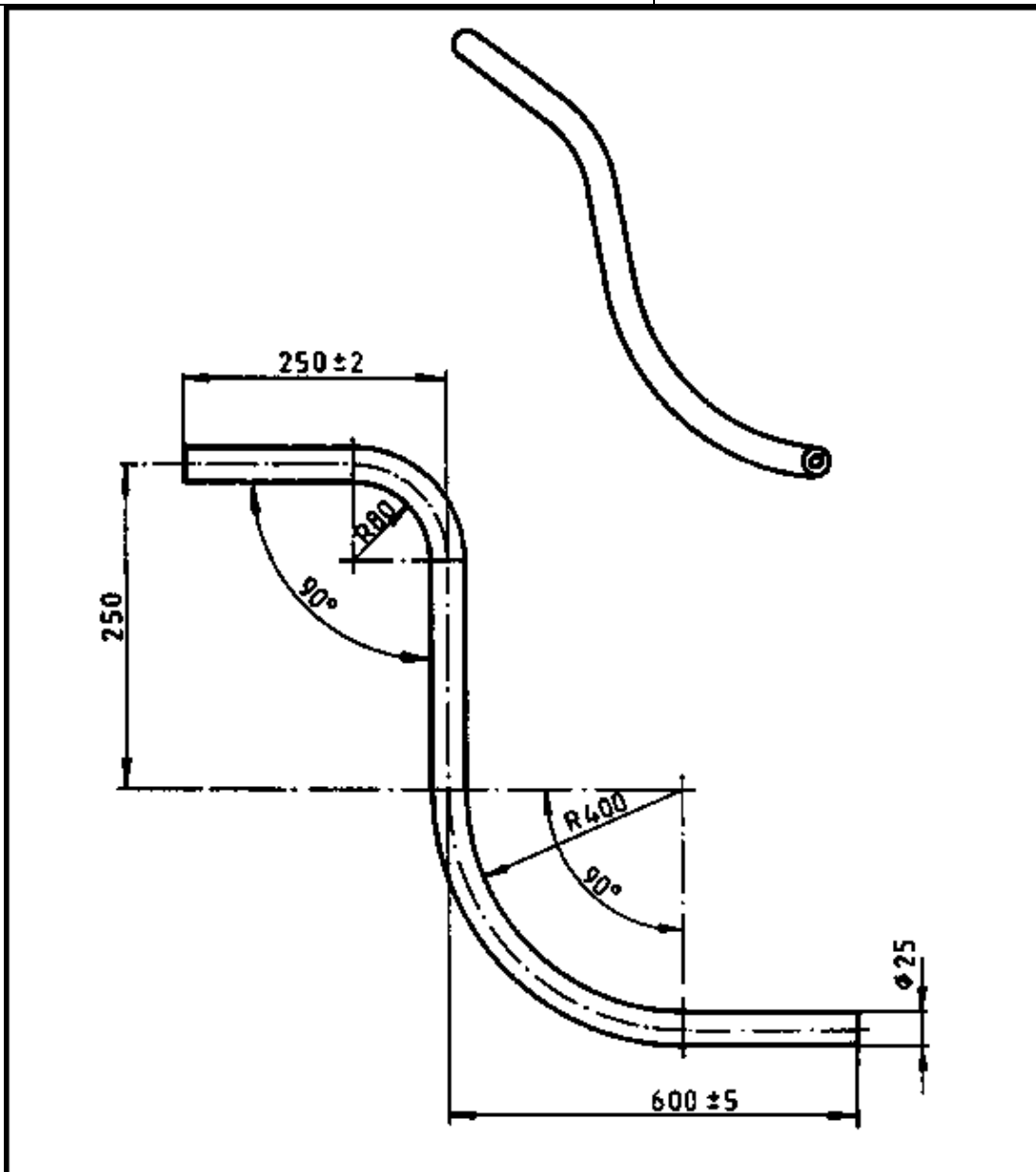
Auxiliary means

Vise, fine-grained sand, wooden stopper

Previous knowledge required

Manual material working: Measuring, testing, scribing, sawing, filing.

Sequence of operations	Comments
1. Prepare the working place and make available the working material.	Check completeness.
2. Calculate stretched length.	Subdivide total length into 5 partial lengths.
3. Saw pipe to length and deburr it.	
4. Fill pipe with sand and close it with wooden stopper.	Only use dry and fine-grained sand.
	After filling, compress the sand by knocking.
5. Bend radius of 400 without heating in the bending device.	
6. Bend radius of 80 on the vise with the hammer by uniform heating.	Before bending, scribe length to be heated.
7. Check bendings.	- Accuracy to size
	- Angularity

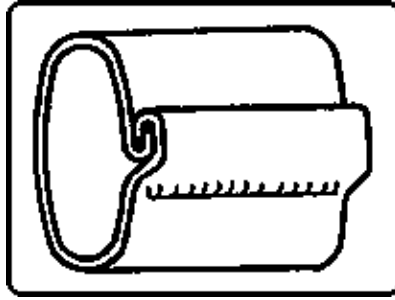


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IBE	Double pipe knee			3114

Double pipe knee

Instruction Example 14.5.: Beaker Jacket

Practise the folding, turning over and rounding of sheet metal and fabricating a jacket seam joint.



Material

Sheet steel (380 MPa)
 thickness: 1 mm
 width: 102 mm
 length: 210 mm

Tools

Steel scriber, smooth file 200 mm (flat), light metal hammer, machinist's hammer, folding bench

Measuring and testing means

Steel rule

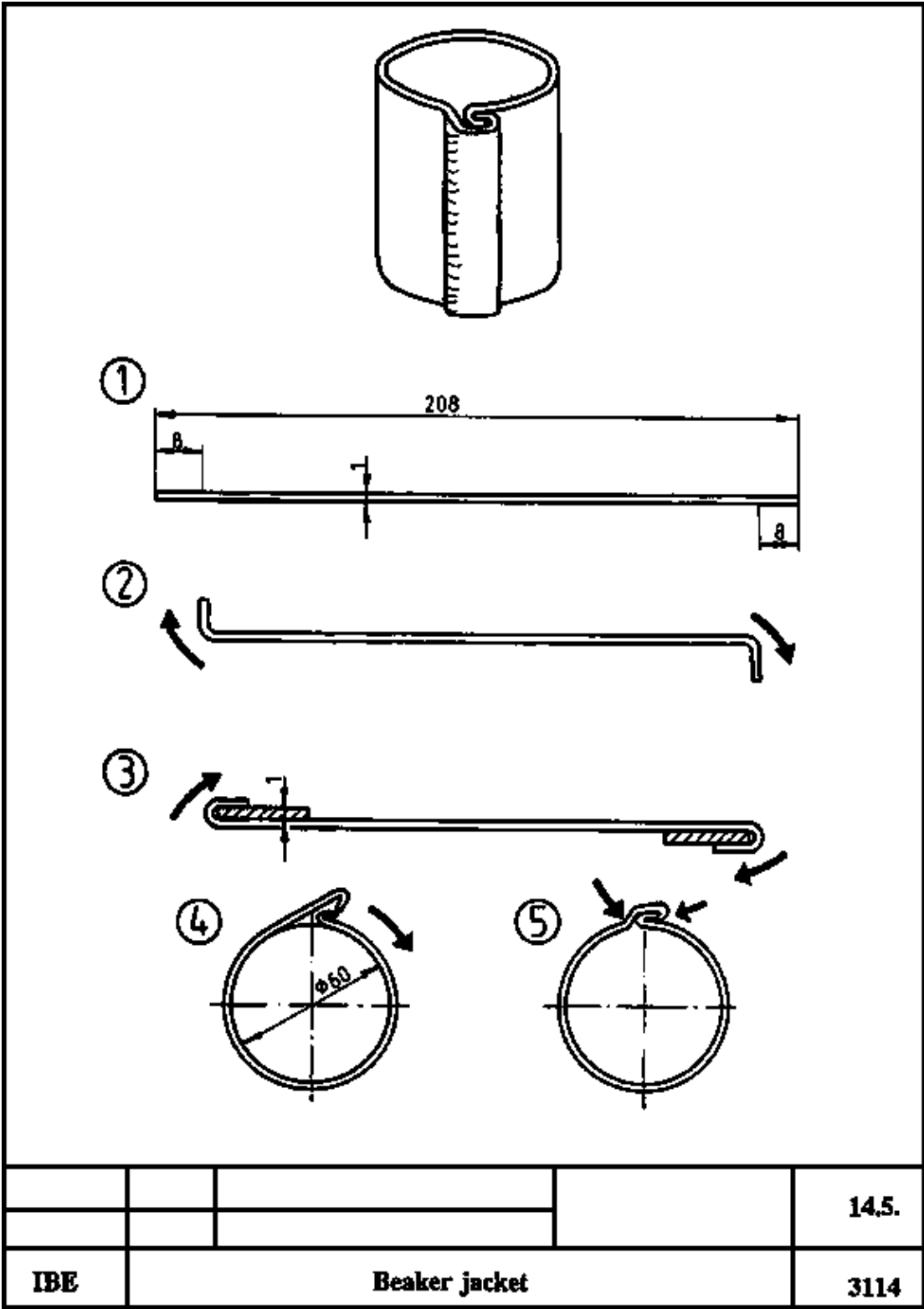
Auxiliary means

Vise, intermediate plate 1 mm, bending mandrel ϕ 60 mm

Previous knowledge required

Manual material working: Measuring, testing, scribing, hammering, filing

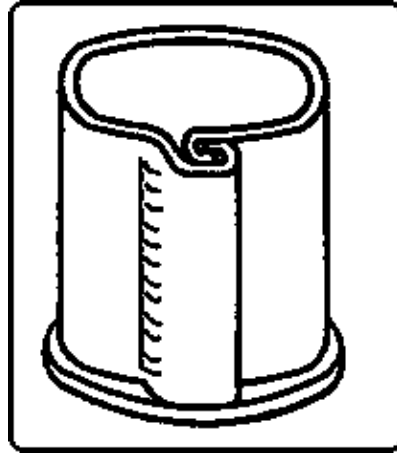
Sequence of operations	Comments
1. Prepare the working place and make available the working material.	Check completeness.
2. Check initial size, deburr and straighten.	Re-work, if need be.
3. Scribe seam width and fold seam on folding bench.	Stages (1) and (2)
4. Turn over the seam with intermediate plate inserted.	Stage (3)
	Insert intermediate plate of 1 mm
5. Gradually round sheet on vise around the bending mandrel.	Stage (4)
	Insert bending mandrel of ϕ 60 mm
6. Hook in the seam without bending mandrel.	Stage (5)
Press the seam together and upset it on the bending mandrel.	Press together with hammer face.
	Upset with hammer pane.
7. Check rounding and jacket seam.	



Beaker jacket

Instruction Example 14.6.: Beaker

Practise the flanging of sheet metal and fabricating a bottom seam joint



Material

Beaker jacket as to Instruction Example 2.5.

Sheet steel (380 MPa)
 thickness: 1 mm
 diameter 80 mm

Tools

Steel scriber, smooth file 200 mm (flat), machinist's hammer, hand-type hacksaw

Measuring and testing means

Steel rule

Auxiliary means

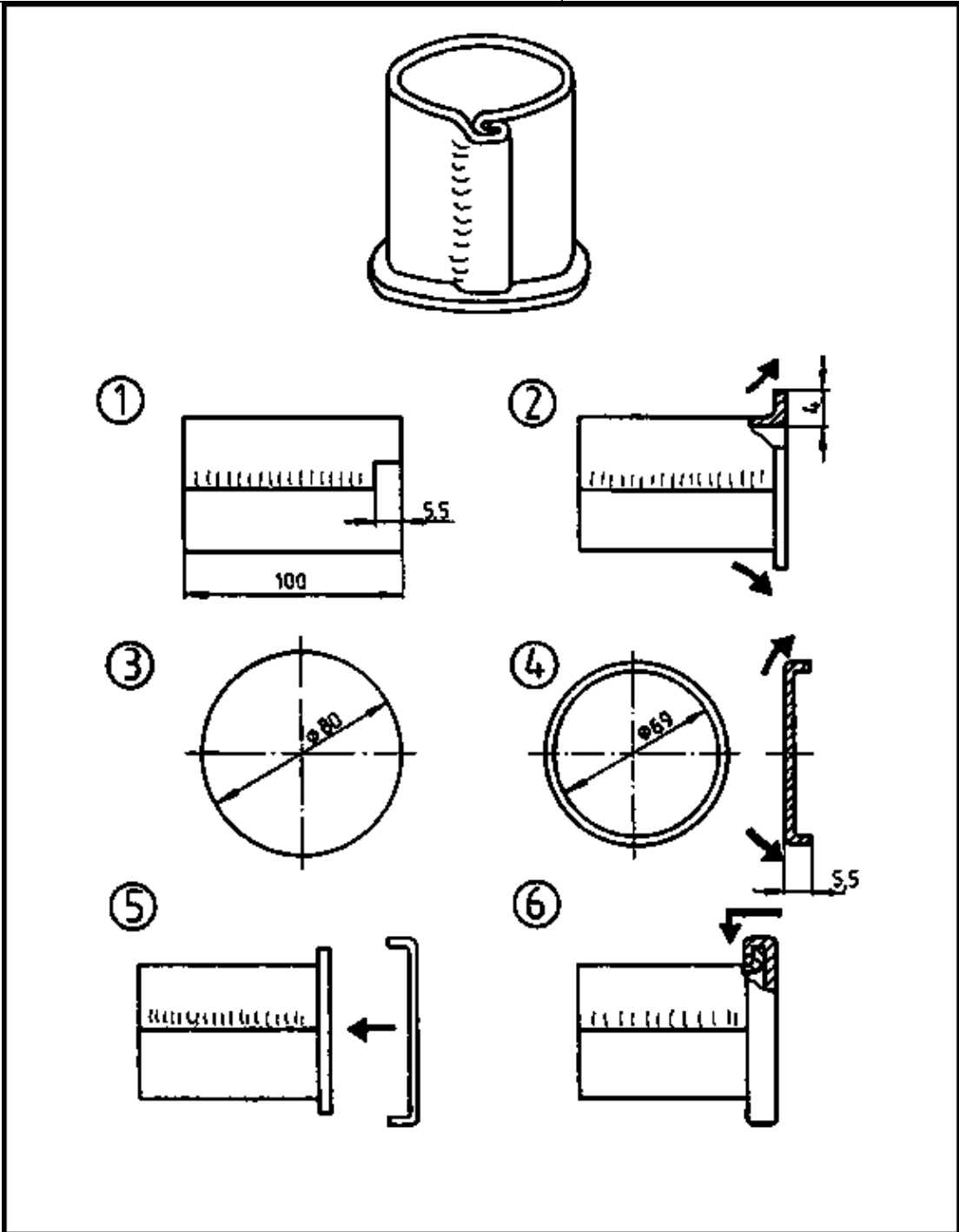
Vise, cylindric striking support ϕ 69 mm, ferrule

Previous knowledge required

Manual material working: Measuring, testing, scribing, hammering, sawing, filing

Sequence of operations	Comments
1. Prepare the working place and make available the working material.	Check completeness.
2. Clamp beaker jacket of Instruction Example 2.5. and shorten seam on one side.	Stage (1)
3. Fabricate outside flanging.	Stage (2)
	Start and finish flanging on anvil.
4. Check diameter 80 mm of bottom sheet	Stage (3)
	Rework, if need be.
5. Scribe bottom sheet for flanging, tightly clamp on cylindric striking support and flange edge.	Stage 4
	Insert ferrule and striking support ϕ 69 mm.
6. Put bottom sheet on beaker (flanged side).	Stage 5

7. Joint bottom sheet and beaker by bottom seam.	Stage 6
	First, fold short bottom sheet piece, then clamp it under the jacket seam and finish folding.
8. Check bottom seam.	Shape.



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Beaker