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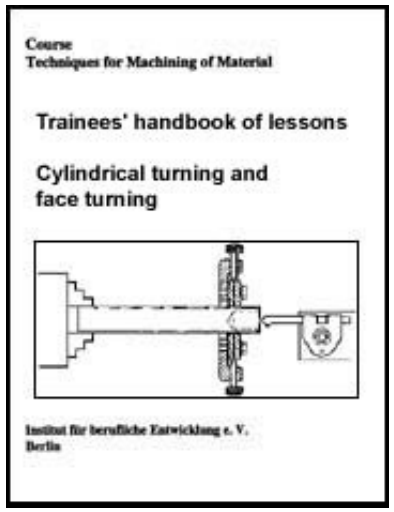

Cylindrical Turning and Face Turning - Course: Techniques for machining of material. Trainees' handbook of lessons (Institut fr Berufliche Entwicklung, 19 p.)

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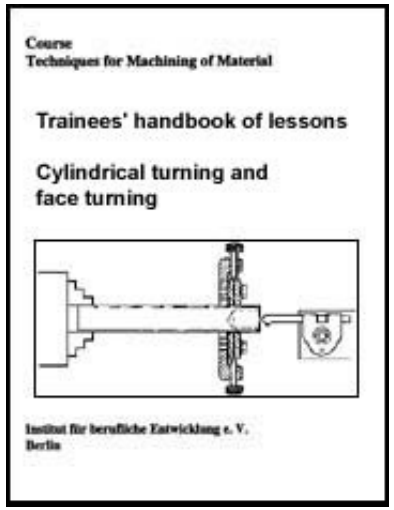

(introduction...)

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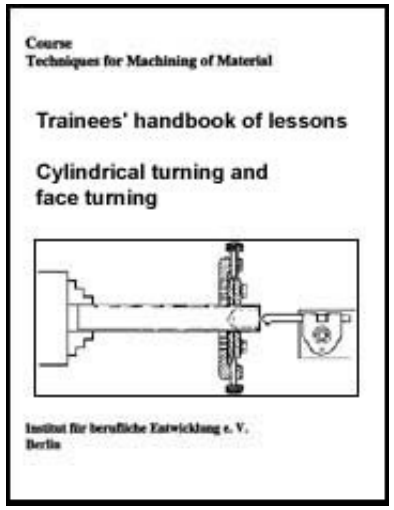

Cylindrical Turning and Face Turning - Course: Techniques for machining of material. Trainees' handbook of lessons (Institut fr Berufliche Entwicklung, 19 p.)

1. Objectives and purpose of cylindrical turning and facing

Turning as metal-cutting operation with primarily single-edged tool which is constantly in action, is used to produce rotationally symmetrical parts. Turning is basically characterized by the cutting movement and feed movement.

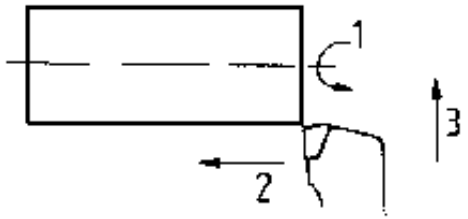

Figure 1 Main movements of turning operations

1 cutting movement
2 longitudinal feed movement
3 cross feed movement

The techniques of cylindrical turning and facing as forms of metal cutting serve

- to cut the shape of the part
- to produce the required/necessary accuracy to size
- to ensure the required surface finish.

Cylindrical turning (plain turning) means machining of the external or internal surface of the part by means of the turning tool in longitudinal direction to the axis of rotation.

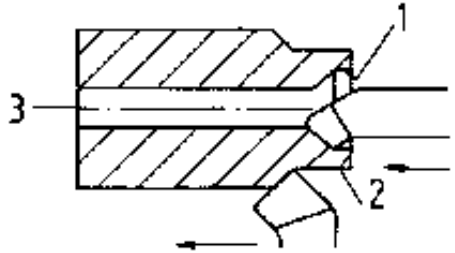

Figure 2 Cylindrical turning

1 internal surface
2 external surface
3 axis of rotation

Facing (surfacing, transverse turning) means machining of the part in transverse direction to its axis of rotation on its end or base face.

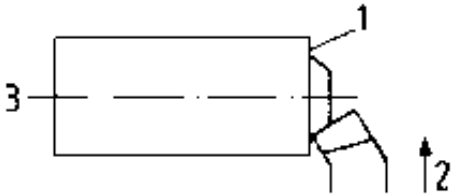

Figure 3 Facing

1 end face
2 feed movement
3 axis of rotation

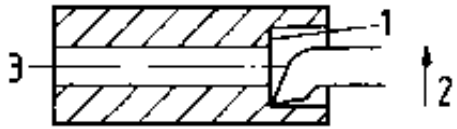

Figure 4 Facing

1 base face,
2 feed movement,
3 axis of rotation

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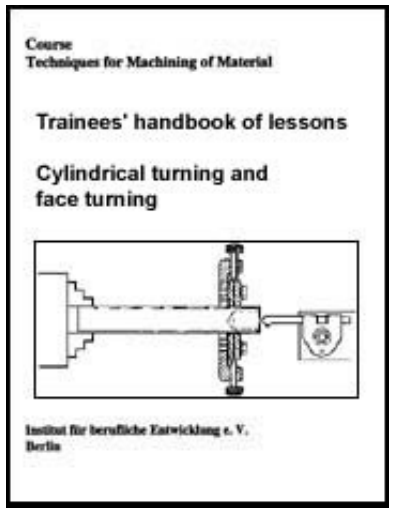

2. Design and types of turning tools

What is the basic design of the turning tool?

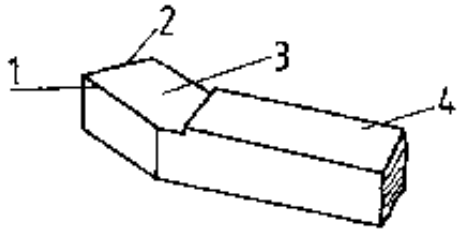

Figure 5 Design of the turning tool

1. _____
2. _____
3. _____
4. _____

The following turning tools are used for cylindrical turning and facing :

- right-offset side-cutting tool
- right-bent roughing tool
- internal side-cutting tool (boring tool)
- internal roughing tool

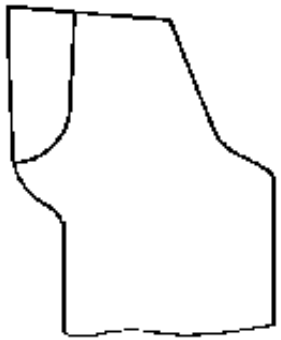

Figure 6 Right-offset side-cutting tool

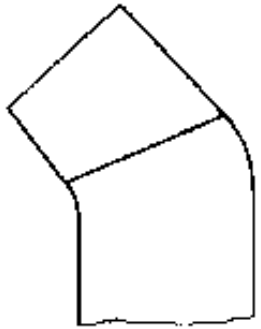

Figure 7 Right-bent roughing tool

Figure 8 Internal side-cutting tool (boring tool)

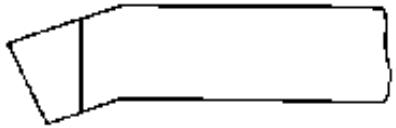

Figure 9 Internal roughing tool

When looking at the turning tool from the front, the position of the side-cutting edge tells us whether it is a right-hand or left-hand cutting tool.

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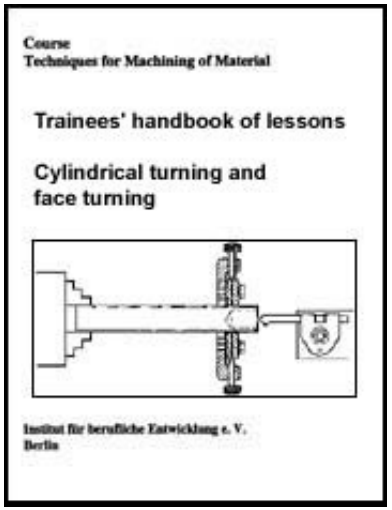

(Institut fr Berufliche Entwicklung, 19 p.)

3. Preparation of cylindrical turning and facing

Before starting with cylindrical turning and facing, all tools and auxiliary means necessary for the work are to be duly and properly placed at disposal observing the following rules:

- Check the tools for serviceability.
Use serviceable tools only.
- Tools to be used must not be placed one above another.
- Store tools in clean condition.

- Store measuring and testing tools on adequate supports only.

- Select the necessary auxiliary means according to the work order and place them at disposal on adequate supports.

Setting up of the lathe (turning machine) basically involves the following steps:

Clamping/chucking of the parts

- Use three-jaw chucks for chucking of short rotationally symmetrical parts.

- Use stepped chuck jaws which can be turned out for premachined parts. Such jaws ensure safe chucking. The surface of the part will not be damaged.

- Use length blocks to suit the relevant lengths of the parts to be machined. The length blocks are to be placed one after another, between the end stop and longitudinal slide, corresponding with the length of the part to be machined.

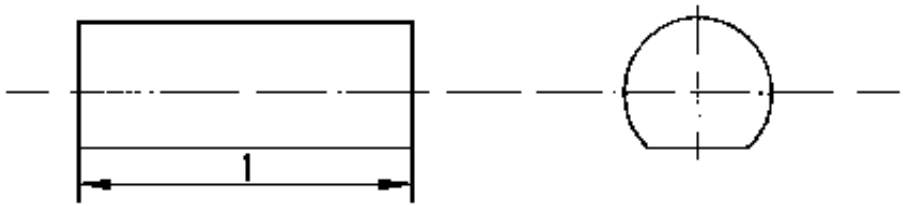

Figure 10 Length block

1 machining and length-block length

- For long parts use the follow or stationary steady rest.

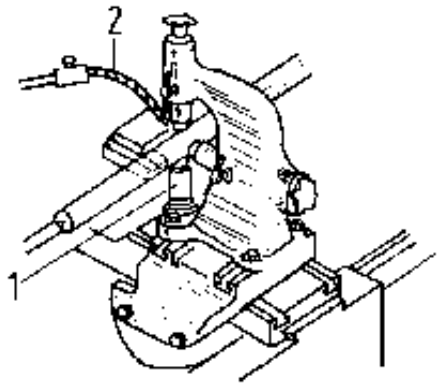

Figure 11 Follow rest

1 pressure jaws
2 application of coolant/lubricant

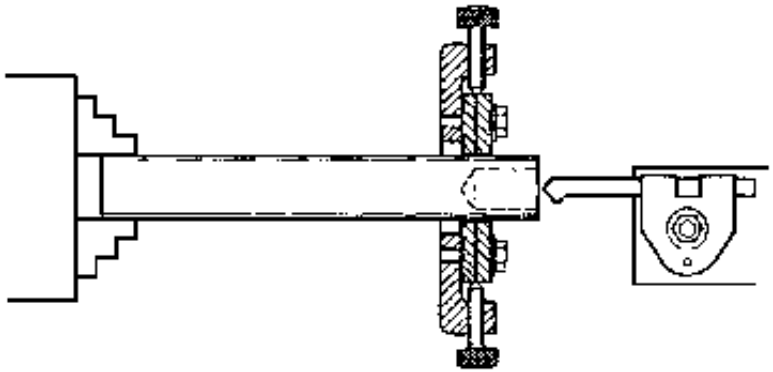

Figure 12 Use of the stationary steady rest

- For parts to be machined in one setting use the driving centre.

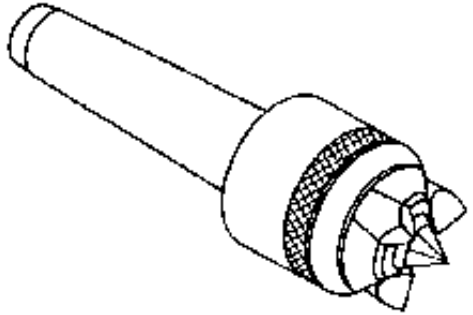

Figure 13 Driving centre

Clamping of the tools

When clamping the turning tool make sure it is in centre position.

Setting of the cutting values

The values to be set depend on the kind of turning operation and on the setting possibilities of the lathe. The cutting speed (V) depends on the material of the tool and is given in the list below:

WS (tool steel)	- V = 6 - 25 m/min
SS (high-speed steel)	- V = 25 - 50 m/min
HSS (super high-speed steel)	- V = 50 - 80 m/min
HS (carbide)	- V = 80 - 120 m/min.

What rotational speed (n) will be necessary for machining a part of 50 mm diameter using a carbide tipped tool?

(V, the cutting speed, is to be determined on your knowledge or to be taken from

the above list)

1. **for the cylindrical turning technique**
2. **for the facing technique.**

Formula: $n = \frac{V \times 1000}{\pi \times d}$

given:

required:

Calculation for cylindrical turning

n = _____ (r.p.m.)

n = _____

Calculation for facing

n = _____ (r.p.m.) Attention d/2 !

n = _____

- Provide lubricant and coolant to prolong the tool life and ensure proper chip removal.

- Let the tool take the first cut on the circumferential surface or end face of the rotating part.

- Return the tool slide to initial position.

- Feed setting, graduated dial to be set to "0". If in setting to final size, by the crank-handle of the tool slide, the respective scale value was exceeded by mistake, turn the crank--handle in the opposite direction by approximately one revolution (because of the lost motion of the spindle) and re-set.

- Switch on the feed motion - do not forget length setting. The power feed is selected according to the desired surface roughness (Rz) and chip pattern (short-chipping).

- Switch off the feed motion.

- Return the tool slide to initial position. When the final size is achieved, avoid damage to the surface by lifting the turning tool clear off the surface machined.

- Dimensional and visual inspection

What is the purpose of chucking in stepped chuck jaws which can be turned out?

_____

_____

_____

What is to be done if in setting to final size by the crank-handle of the tool slide the respective scale value was exceeded by mistake?

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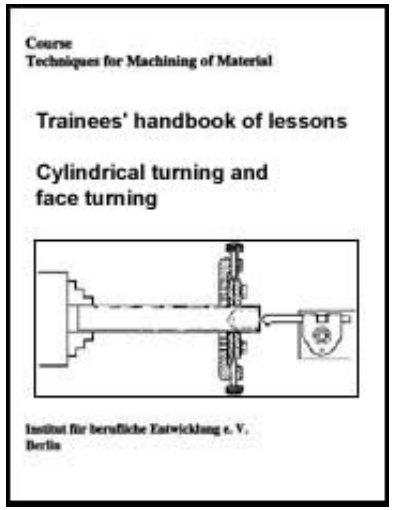

4. Main movements for cylindrical turning and facing

Feed movement

For cylindrical turning the power to the longitudinal feed is transmitted by the feed shaft of the lathe. The turning tools primarily used are the side-cutting tool and roughing tool.

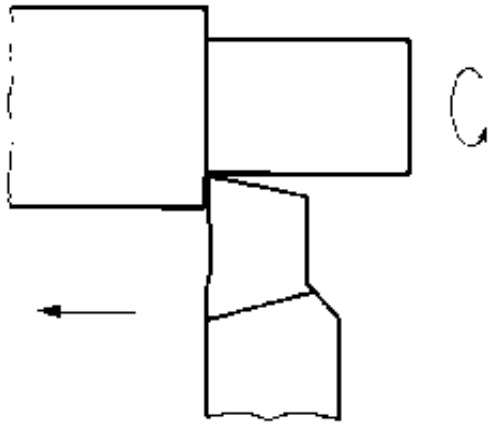

Figure 14 Cylindrical turning with the side-cutting tool

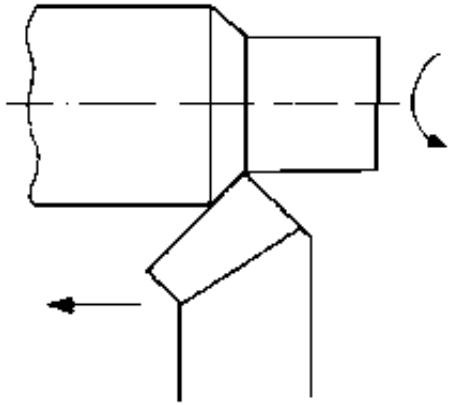

Figure 15 Cylindrical turning with the roughing tool

Because of the rotation, the amount of feed measured for the given scale graduation changes the diameter of the part by double that amount.

For 0.1 mm feed setting in transverse direction (feed setting- at the cross slide),

the diameter is changed by 0.2 mm.

For the facing operation the power is also transmitted via the feed shaft of the lathe. The roughing tool is primarily used as cutting tool For economical reasons, cylindrical turning and facing can be combined. The time-consuming re-clamping/changing of the turning tool can thus be eliminated.

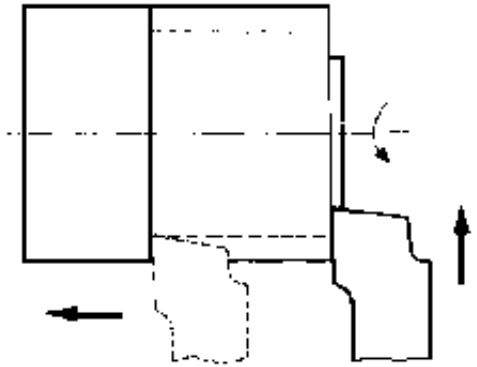

Figure 16 Combination of cylindrical turning and facing

The facing operation may be performed from the outside inwards or vice versa. In order to avoid convex (curved) surface shapes of the end faces, the tool slide is to be locked in longitudinal direction prior to cutting.

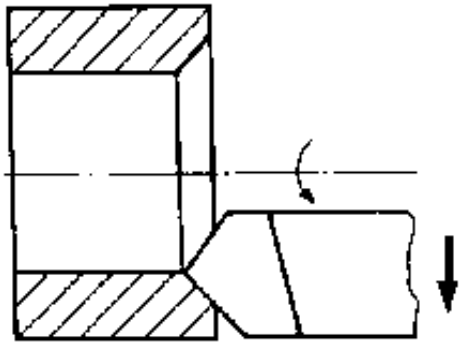

Figure 17 Facing from the inside outwards

The cutting movement is effected by the rotation of the part around its axis of rotation

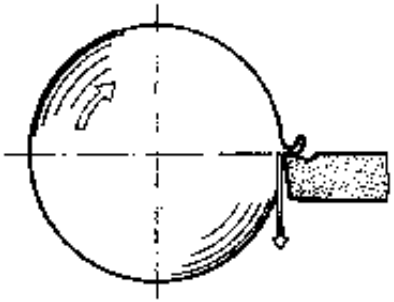

Figure 18 Cutting movement when turning

What are the main steps in setting up the lathe for cylindrical turning and facing?

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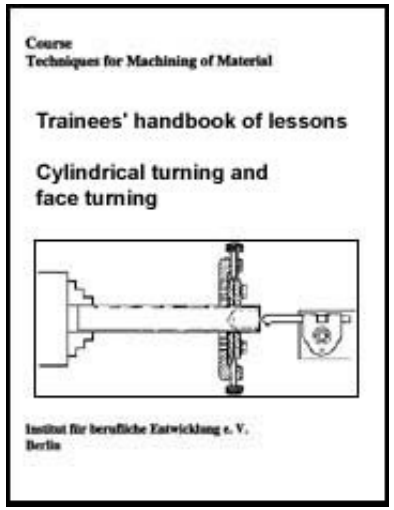

5. Cylindrical turning and facing of simple cylindrical parts

Simple cylindrical parts can be machined with the part held in a chuck without counter-support or between centres. The cutting is done on the circumferential surface or end face of the part.

- The part may be clamped in a three-jaw chuck but also between centres. In case of short locating faces (chuck), firm chucking is essential

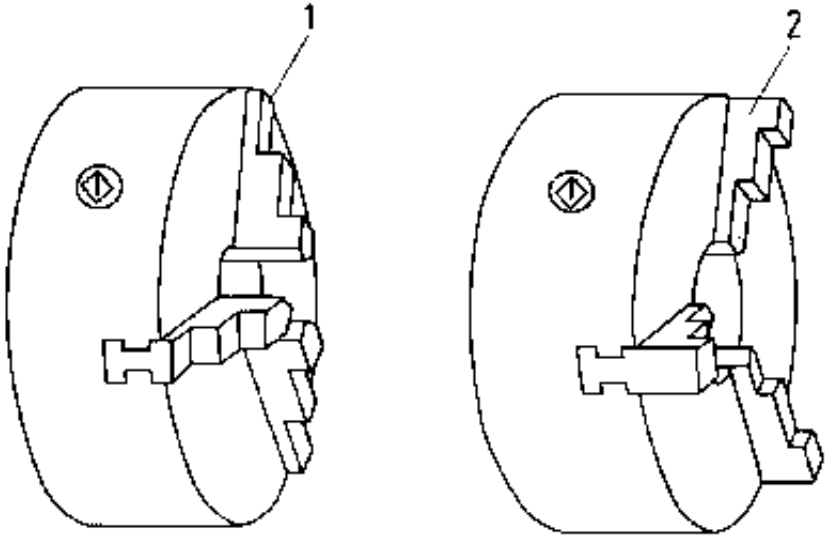

Figure 19 Three-jaw chuck

1 turning jaws
2 boring jaws

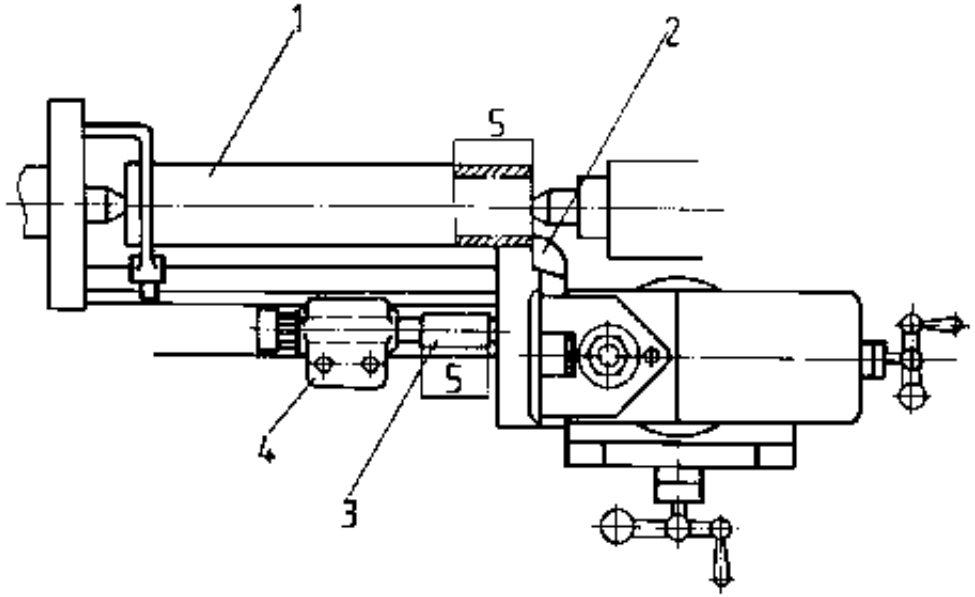

Figure 20 Turning between centres using length blocks

1 parts to be machined,
2 tool,
3 length block,
4 end stop,
5 machining length and length-block length

- The cutting process may be a combined operation (cylindrical turning and facing) using one cutting tool only (right-hand side-cutting tool) or an individual operation using the side-cutting tool or roughing tool.

The central position of the turning tool in line with the axis of rotation is to be ensured.

- Undue radial and axial run-out (concentricity check as per Fig. 21) can be compensated by turning out the chuck jaws.

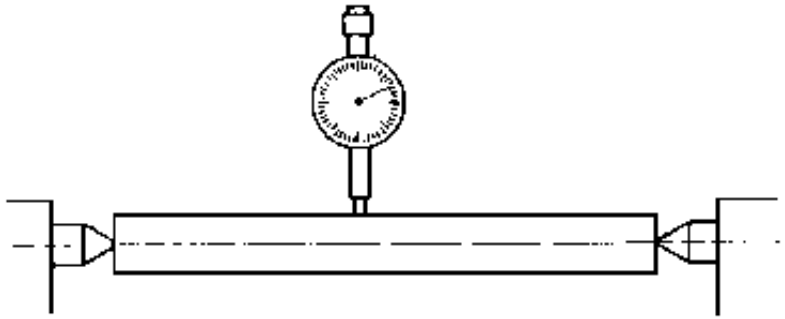

Figure 21 Concentricity check with dial gauge

- For hollow parts with hard incrustation it is recommended to move the turning tool from the inside outwards when facing (see Fig. 17).

To prevent accidents, the bed stop is to be set prior to machining so as to avoid

any possible collision between the cutting tool and rotating chuck jaws (see Fig. 20).

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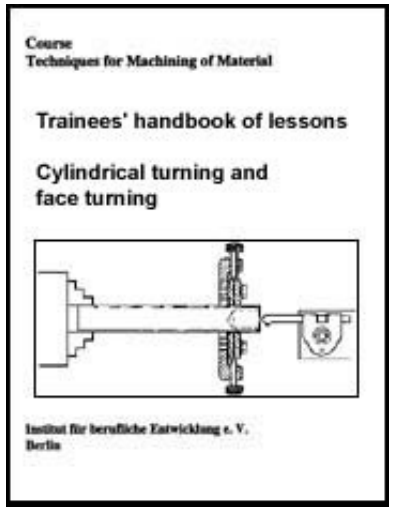

6. Cylindrical turning and facing of shouldered cylindrical parts

Turning of shouldered cylindrical parts means turning of parts having one or more shoulders (diameters). This is also often called turning with trip stop control (or turning multiple diameters). The part is held in a chuck or between centres with or without counter-support. The cutting is done on the circumferential surface or end face of the part.

- In cylindrical turning the internal surface (using the internal turning tool, also called boring tool) or external surface of the part is machined (see Fig. 2).

- In batch production it is absolutely necessary to use the bed stop and length blocks.

- As counter-supports the tailstock with centre (Fig. 22) and steady rest are used.

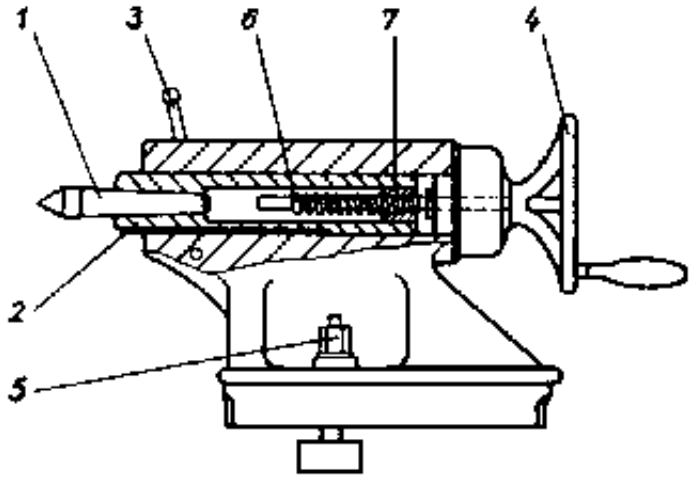

Figure 22 Tailstock. sectional view

1 tailstock centre,
2 sleeve,

3 handle for lock nut,
4 hand-wheel,
5 look nut,
6 spindle,
7 spindle nut

- When turning longer parts using the tailstock or steady rest as counter-support, the cylindricity of the part must always be checked. Misalignment of the steady rest or centre offset of the tailstock may result in eccentricity. In that case the tailstock is to be aligned as per Fig. 23.

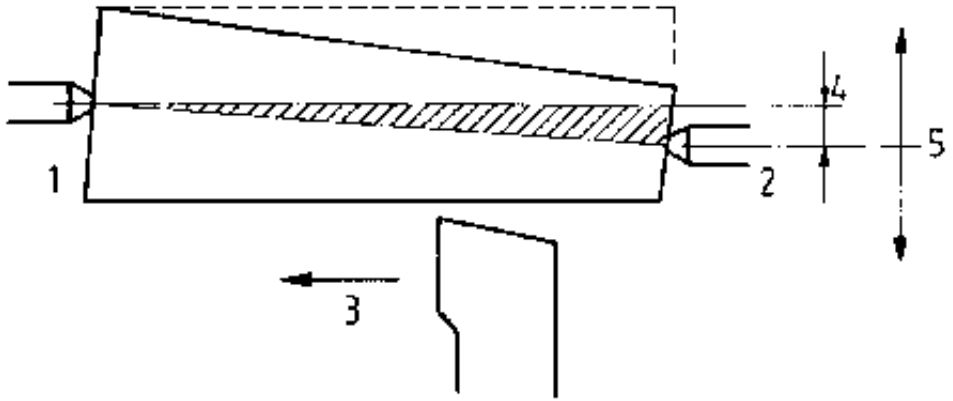

Figure 23 Aligning the tailstock

1 work spindle end,
2 tailstock end,
3 feed direction of the turning tool,
4 tailstock alignment in mm,
5 correction facilities

- Constant lubrication to the tailstock guideways is a must.

- When facing any shoulders (shoulder faces) the cutting tool is to be moved in opposite direction to the feed direction. This avoids faulty faces.

- Firm chucking of the part is of utmost importance

Existing safety facilities must not be made ineffective.

What are the reasons for eccentricity when machining parts with counter-supports?

_____

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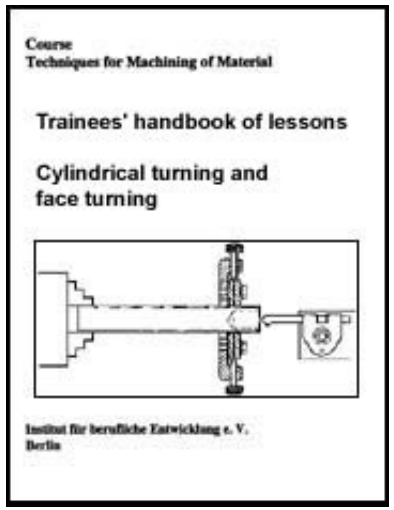

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7. Cylindrical turning and facing of long cylindrical parts

Long cylindrical parts can be machined with the part held in a chuck, between centres, but also sometimes using collets. The use of counter-supports is always necessary.

The cutting is done on the circumferential surface or end face of the part.

- You should always select the safest way of chucking/clamping for the relevant part The more chucking/clamping face you have, the more safe is the machining process.

- The tailstock with live centre and the stationary or follow steady rest are used as counter-support. Longer parts necessitate the combined use of tailstock and steady rest or of several steady rests.

- The use of the steady rest prevents deflection of long shafts and the production of chatter marks as well.

- For parts mounted overhung, the steady rest (without using the tailstock as

counter-support) permits facing and boring operations to be performed, if it is used to support and guide the freely rotating end of the part (see Fig. 12).

- The contact faces of the steady jaws must be round and even. Sufficient lubrication during the machining process is necessary.

- For non-round or uneven contact faces the use of a scroll chuck (Fig. 24) is recommended.

- Areas of the part succeptible to deflection should be sup-ported by stationary steady rests mounted on the lathe bed. The length to be turned is then subdivided.

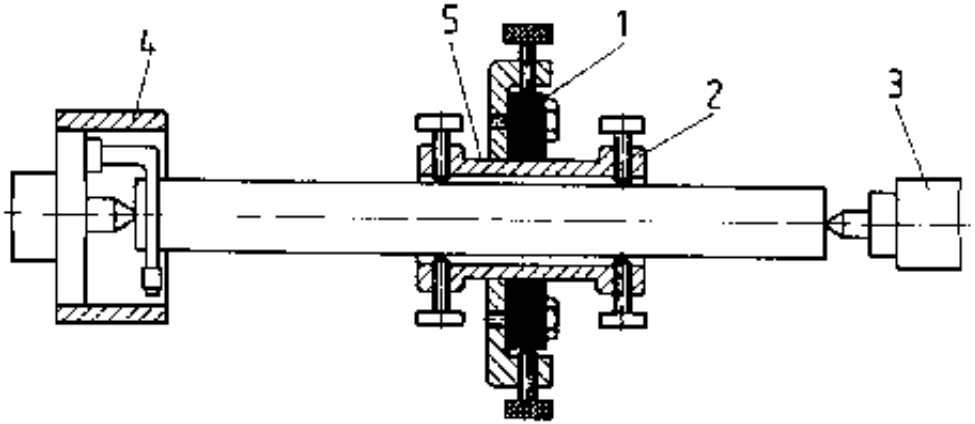

Figure 24 Scroll chuck

1 tailstock jaws,
2 scroll chuck,
3 tailstock,
4 work gripping in driver,
5 bearing surface

- Follow rests are mounted on the tool slide and perform the same feed movement as the turning tool. In this connection attention is to be paid to the facts that

- **the steady rest top jaws must always be softer than the material of the part to be machined,**
- **the steady rest must be precisely aligned,**
- **the pressure of the top jaws on the surface of the part must not be too high (heat expansion),**
- **the top jaw contact faces must suit the diameter of the part,**

- If any part shows heavy deflection, it must be straightened before machining.

- When machining long parts, the turning tool should be mounted slightly above centre to avoid hooking.

- The cylindricity is to be checked and, if necessary, corrected.

- A negative rake angle (tool face and side relief of the cutting tool) is useful for machining parts with a high length-diameter ratio.

What is the basic difference in the use of a stationary and follow rest?

_____

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What basic rules are to be observed when using a steady rest?

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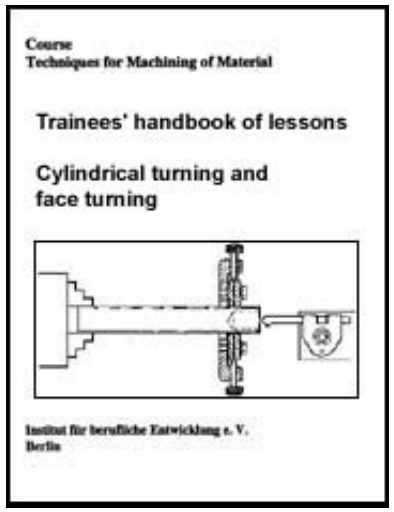

8. Cylindrical turning and facing of hollow cylindrical parts

Hollow cylindrical parts can be machined with the part held in a chuck or between centres. The use of counter-supports (steady rest) depends on the length of the part, the diameter to be machined and the weight of the part. It is always to be considered an additional support. The cutting is done on the external or internal surface and end face of the part.

- When chucking thin-walled parts, the chucking pressure must be selected so as to avoid any deformation of the part. For this purpose, clamping bushes as per Fig. 25 may be used.

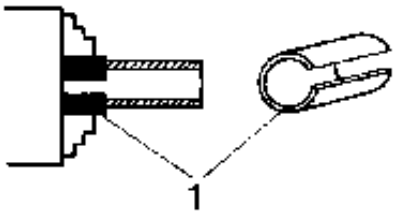

Figure 25 Clamping in clamping bushes

1 clamping bush

- If a tailstock is used as counter-support with a centre smaller than the bore of the part, thrust pads as per Fig. 26 are to be used.

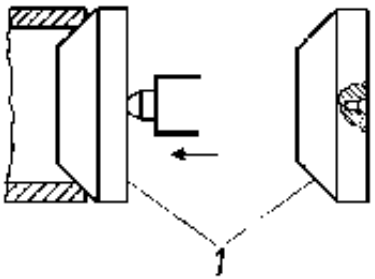

Figure 26 Counter-supporting by means of thrust pads

1 thrust pad

- Hollow parts warm up more quickly than solid material during machining. This fact is to be considered when choosing the cutting values and in dimensional inspection.

What kinds of counter-supports do you know?

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_____

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