

TRADE INFORMATION

FOR APPRENTICE TRAINING

T U R N E R
LATHE SETTER OPERATOR

TTP-13



TTP-13

DEVELOPMENT CELL
FOR SKILLED LABOUR TRAINING
DIRECTORATE OF MANPOWER & TRAINING
GOVERNMENT OF THE PUNJAB
LAHORE

Price: Rs. 5.

MODERN INDUSTRY NEEDS:

FEW ENGINEERS 

MORE TECHNICIANS AND SUPERVISORS 

MANY SKILLED CRAFTSMEN AND OPERATORS 

F O R E W O R D

With a view to standardize Skilled Labour Training operated under the aegis of the Directorate of Manpower and Training, Punjab, Lahore, a Development Cell has been set up at this Directorate under the Pak-German Technical Assistance Programme.

One of the activities of the Development Cell is to prepare "Trade Information Manuals" showing trade definitions, lists of skills and operations and the detailed systematic training programme for Skilled Labour Training in accordance with international standards and local requirements. For this purpose different undertakings in the Punjab were approached to find their requirements and opinions about the present Training Programme.

The Development Cell has prepared the "Trade Information Manual" in consultation with the undertakings and the Apprenticeship Wing of this Directorate. This manual gives the revised systematic training programme for apprentices to meet the minimum requirements for the training of Skilled Craftsmen. This manual shall help the employers and trainees to know precisely the functions and training of a tradesman in a particular trade.

A standardized trade test shall be conducted at the end of the programme to ensure that the minimum required skills and knowledge have been achieved.

The instructional material for carrying out the training programme of a trade, such as detailed course outlines and syllabi, job and lesson sheets and trade books, prepared by the Development Cell are available upon request from the office of the:

Deputy Director (Trade Testing)
Development Cell for Skilled Labour Training
25, Amin Park, P.O. Ferozepur Road
L a h o r e - 16.

Lastly we are thankful to all concerned, who have helped us in preparing this "Trade Information Manual".

Suggestions for further improvement of the programme are welcomed.

Lahore

December 10, 1975

MUHAMMED ASLAM VIRK

Director Manpower & Training
Punjab, Lahore

C O N T E N T S :

A. TRADE DEFINITION

B. TRAINING CONTENTS

- (a) List of Skills and Operations
- (b) Theoretical Knowledge
- (c) Ways to Become a Skilled Craftsman

C. PROGRAMME OF TRAINING FOR APPRENTICES

- (a) Break-Up of the Training Programme
- (b) Course Outlines for Pract. Training
- (c) Course Outlines for Theor. Instruction

D. TRADE TESTING

A TRADE DEFINITION
 SCOPE OF ACTIVITY

A. TRADE DEFINITION - SCOPE OF ACTIVITY

T U R N E R
(Lathe Setter-Operator) *

A Turner sets up and operates a power-driven metalworking lathe.

Details:

- / He examines drawings and specifications of part to be made;
- / fastens metal and tools in position on lathe using chucks, jigs and other fixtures as required;
- / adjusts guides and stops;
- / sets rotations speed of metal and starts machine;
- / manipulates hand wheels, or sets and starts automatic controls, to guide cutting tool into or along metal;
- / controls flow of lubricant on edges of tools;
- / checks progress of cutting with measuring instruments and makes necessary adjustments to machine setting.

In view of the particular needs of trade and industry in Pakistan the scope of activity of a Turner has to be somewhat wider than defined in the ILO Standard Classification cited above.

Certain skills and operations therefore had to be added in the following list.

* According to INTERNATIONAL STANDARD CLASSIFICATIONS OF OCCUPATIONS, Revised Edition, ILO, Geneva 1968 adopted by the Government of West Pakistan, Directorate of Labour Welfare, Lahore 1969

B TRAINING CONTENTS

- (a) SKILLS AND OPERATIONS
- (b) THEORETICAL KNOWLEDGE
- (c) WAYS TO BECOME A SKILLED CRAFTSMAN

B. (a) SKILLS AND OPERATIONS

T U R N E R
(Lathe Setter-Operator)

Proper Working

1. Knowledge of workshop rules and regulations such as:-
 - a) working to safety regulations;
 - b) care and maintenance of tools and equipment;
 - c) storing of tools and equipment;
 - d) keeping work place neat and clean.
2. Working to workshop drawings and sketches.
3. Listing the correct sequence of operations for the job.
4. Listing of the tools required for each job.

Bench Work (Fitting and Sheet Metal)

5. Measuring with:-
 - a) steel rule;
 - b) vernier caliper (outside, inside);
 - c) micrometer (outside, inside and with extension bars).
6. Transfer of measurements with calipers (outside, inside).
7. Checking of workpieces with:-
 - a) gauges (height and depth, radii, limit gauges);
 - b) try square, back square;
 - c) protractors (single, universal);
 - d) dial test indicators.
8. Marking and scribing:-
 - a) coating for marking;
 - b) scribing parallel lines, circles, angular lines;
 - c) marking from reference faces;
 - d) finding centres of round bars.
9. Chipping and cutting (by hand):-
 - a) chiselling (straight to size, chipping slots and grooves);
 - b) sawing (flats, pipes, bars);
 - c) filing (flat & square, to an accuracy of ± 0.1 mm);
 - d) thread cutting with taps, dies and stocks.
10. Punching and stamping (centre punching, stamping with letters and figures).
11. Drilling - countersinking - counterboring - reaming:-
 - a) drilling with power drilling machines (bench drilling machine, column drilling machine, heavy duty drilling machine);
 - b) drilling holes in solid material, sheet metal, pipes, bars;
 - c) drilling holes in different types of material, such as steel, copper, aluminium, cast iron;
 - d) countersinking;
 - e) counterboring;
 - f) reaming (parallel and tapered holes);

- g) regrinding twist drills to required angles;
 - h) using proper coolants and cutting compound.
12. Cold bending of flat steel and sheet metal.
 13. Cold riveting.

Operating the Centre Lathe

14. Starting, manipulating, controlling and stopping the lathe, adjusting levers and controls.
15. Oiling and cleaning the lathe.
16. Selecting of and working with appropriate tools.
17. Selecting cutting speeds and feeds (using machine table) and setting the lathe accordingly.

Turning (Chuck work)

18. Setting the lathe, mounting the chuck.
19. Truing up.
20. Centering.
21. External turning:-
 - a) facing;
 - b) longitudinal turning;
 - c) step turning;
 - d) recessing;
 - e) chamfering.
22. Drilling - Boring - Counterboring - Reaming.
23. Knurling.
24. Taper turning (internal, external).
25. Thread cutting:-
 - a) internal, external, with taps & dies;
 - b) internal, external, with lathe tools;
 - c) cutting Vee-thread and acme thread;
 - d) cutting right & left hand thread;
 - e) cutting different standard threads;
 - f) cutting multi start threads.
26. Form turning (straight, convex, concave).
27. Use of independant chuck:-
 - a) chucking raw shape jobs;
 - b) excentric turning, drilling, boring, recessing.
28. Use of collet chuck.
29. Turning of steel, cast iron, non-ferrous metals and plastics.
30. Turning to an accuracy of ± 0.01 mm.

Turning (between centres)

31. Setting the machine.
32. External turning:-
 - a) longitudinal turning;
 - b) step turning;
 - c) recessing and chamfering;
 - d) form turning;
 - e) thread cutting.

33. Holding the workpiece on a mandrel.
34. Taper turning, by:-
 - a) tail stock set-over;
 - b) swivelling rest (compound rest) set over;
 - c) taper attachment.

Face and Angle Plate Work

35. Setting and truing irregular shaped jobs.
36. External turning:-
 - a) facing;
 - b) longitudinal turning;
 - c) step turning;
 - d) recessing;
 - e) chamfering.
37. Drilling - Boring - Counterboring - Reaming.
38. Taper turning (internal, external).
39. Thread cutting (internal, external).

Turning long workpieces

40. Use of steady rest.
41. Use of follower rest.

Allied Trade Training to the extent normally required for a Turner in the undertaking

42. Grinding:-
 - a) wheel mounting, changing, dressing;
 - b) off-hand grinding of bench tools, twist drills, turning & shaping tools;
 - c) use of grinding attachment to the lathe.
43. Shaping:-
 - a) setting the shaping machine, proper clamping of the job;
 - b) square and parallel shaping;
 - c) longitudinal and vertical step shaping;
 - d) form shaping (radii).
44. Blacksmithing:-
 - a) forging and hardening work as required to maintain bench and lathe tools.

B. (b)

THEORETICAL KNOWLEDGE

1. TRADE THEORY

a) Technology

Handtools and their operation
Measuring
Operating techniques
Fastening methods
Fits and tolerances
Machine elements
Mechanical power transmission
Machining operations with machine tools

b) Related Science

Power, force and pressure
Mechanical properties of materials
Temperature and heat
Condition of aggregation
Inclined plane
Lever
Oxidation of metals
Strength of materials

c) Materials

Introduction to various materials
Production of iron and steel
Standardization
Testing materials
Heat treatments
Material of cutting tools
Lubricants

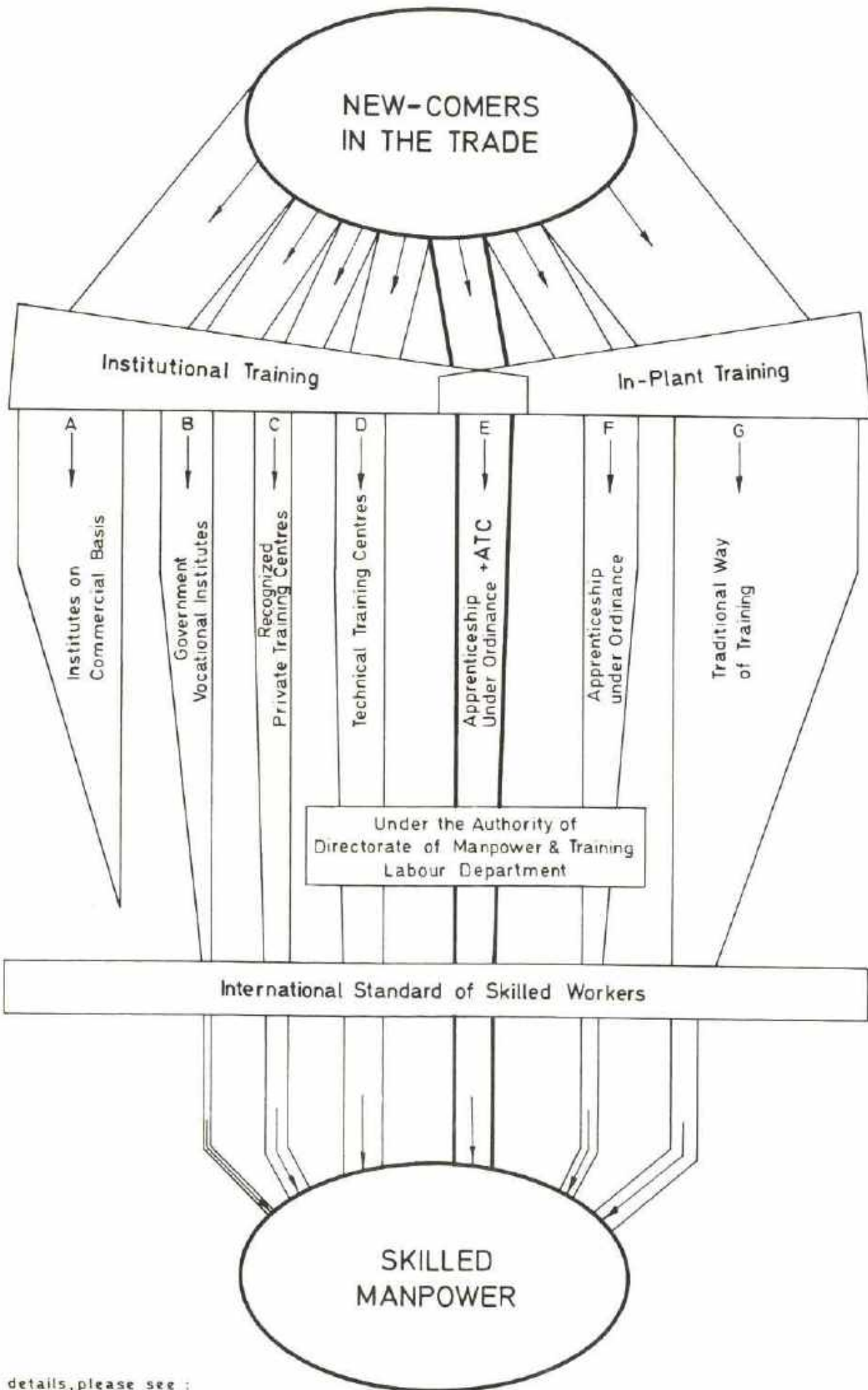
2. TECHNICAL MATHEMATICS

Numbers, fractions, percentages
Angles, length, area, volume, weight
Pythagorean proposition
Trigonometric ratios
Strength, time, motion, work, power
Mechanical power transmission
Turning, drilling, milling, chaping calculations

3. TECHNICAL DRAWING

Representation of prismatic, cylindrical,
pyramidal and conical workpieces
Representation of symbols for surface, fits
and tolerances, welding joints, threads
Dimensioning, reference edges and faces
Sections
Key and pin joints
Assembled workpieces
Gears

B. (c) WAYS TO BECOME A SKILLED CRAFTSMAN



For details, please see :

SURVEY OF VOCATIONAL EDUCATION FOR BOYS IN PAKISTAN, compiled by
PUNJAB BOARD OF TECHN. EDUCATION, LAHORE 74

C. PROGRAMME OF TRAINING FOR APPRENTICES

- (a) BREAK-UP OF THE TRAINING PROGRAMME
- (b) COURSE OUTLINES FOR PRACTICAL TRAINING
- (c) COURSE OUTLINES FOR THEORETICAL INSTRUCTIONS

Theoretical Instructions		ATC																																				1
Final In-Plant Training		In-Plant																																				5
Final Institutional Training		ATC																																				5
Advanced Institutional Training		ATC																								Final Trade Test						5						
Advanced In-Plant Training		In-Plant																																				5
Basic Institutional Training	Trade Fundamentals	ATC																																				5
	Trade Introduction	ATC																														5						
In-Plant Orientation		In-Plant																																				5
		1st year												2nd year												3rd year												days per week
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

APPRENTICE TRAINING PROGRAMME

C. (a) BREAKUP OF THE TRAINING PROGRAMME
FOR A T C AND IN - PLANT TRAINING

The diagram on page gives a survey of the training programme designed for APPRENTICE TRAINING CENTRES or APPRENTICE TRAINING WINGS of TTCs. It can also be applied to training centres within industrial enterprises.

The total apprenticeship of three years is split into periods of institutional and in-plant training as follows:

1. Practical Training

1.1 In-Plant Orientation (3 months)

The apprentices spend the first three months in their respective companies to get a general orientation of their trades.

1.2 Trade Introduction (3 months)

Apprentices of all metal and electrical trades are trained together in the training centre and follow the same course outlines, concerned mainly with benchwork.

1.3 Trade Fundamentals (3 months)

After completion of the Introduction Course the practical training is carried out in trade groups, so that the apprentices may get an understanding of their particular trade. The course is very intensive in order to impart the fundamental skills. However, for lack of time it provides no opportunity for further practice in the training centre.

1.4 Advanced In-Plant Training (12 months)

The apprentices undergo an on-the-job training (in-plant training) in their various undertakings. This period of training must be properly planned too; but its detailed organization depends upon the actual facilities of the individual industries. The Development Cell for Skilled Labour Training, Directorate of Manpower and Training, Lahore, may be approached for any advice and assistance in this matter.

This period of training ought to be mainly concerned with the skills and operations covered already in the institutional Basic Training and listed in para C. (b). These skills and operations have to be practiced in the various situations as they arise during the production process.

The main workshops or sections where the apprentices of the Turner trade have to be trained during these 12 months are:

- Fitting or Basic Shop: Practice of basic fitting operations, handling of ordinary and precision measuring instruments. (3 months)

- Machine Shop: Practice of operations on shaping- and drilling machine, power hacksaw, emphasis on turning operations on lathe machine, tool grinding and sharpening. (9 months)

1.5 Advanced Institutional Training (3 months)

This course connects to the Basic Institutional Training but it is assumed that the apprentices have practiced those skills and operations during their in-plant training. At this stage in another intensive course the apprentices are introduced to the main skills and operations of the trade. All trades are trained in separate groups.

1.6 Final Institutional Training (3 months)

For the last three months of institutional training there are courses provided for some special fields of the trade. By the end of this course all main skills and operations of the Turner trade have been implemented, but further practice is required in the In-Plant Training.

1.7 Final In-Plant Training (9 months)

In the next phase of in-plant training, the on-the-job training is continued at a higher level. The contents of this part of training are the skills and operations covered by the Advanced and Final Institutional Training and listed in para C.(b) By the end of this period, the apprentices should have been trained in all main skills and operations under workshop conditions.

The main workshops or sections where the apprentices have to be trained during these nine months are:

- Machine Shop: Emphasis on turning operations on lathe machine, practice on shaping machine, tool grinding and sharpening. (8 months)

- Measuring Section: Measuring and checking with precision measuring instruments and gauges for quality control. (1 month)

2. Theoretical Instructions

During the whole three years' apprenticeship (periods of institutional as well as in-plant training) the apprentices undergo a theoretical training at the training centre one day per week.

(Under particular circumstances block release could also be considered for imparting the theory lectures during the period of in-plant training.)

The subjects are:

- Trade Theory (including: Technology, Materials and Related Science)
- Technical Mathematics
- Technical Drawing

The theoretical instructions run parallel to the practical training as far as possible and only those topics are taught which are necessary for a better understanding of the practical work. That is why Science is integrated into Trade Theory and Technical Mathematics deal only with solution of technical problems at the level of the individual trade. The syllabi are shown in para C. (c) .

3. Breakup in Percentages

The overall percentages of the training are:

- | | |
|--------------------------------------|------|
| - practical institutional training | 28 % |
| - practical in-plant training | 55 % |
| - theoretical institutional training | 17 % |

C. (b) COURSE OUTLINES FOR PRACTICAL TRAINING

FOR TURNER

1. BASIC TRAINING

1.0.1	Basic Fitting	(16 weeks)
1.0.2	Measuring I	(2 weeks)
1.0.3	Shaping I	(2 weeks)
1.0.4	Turning I	(2 weeks)
1.0.5	Tool Grinding	(2 weeks)

The Basic Fitting and Measuring I courses are common for all metal and electrical trades. The remaining three courses were prepared to impart training in the fundamentals of the Turner trade.

The Basic Training in general is designed to provide a background of knowledge and skills to prepare the apprentices for the first phase of In-Plant Training in the undertakings.

2. ADVANCED TRAINING

2.0.1	Measuring II	(2 weeks)
2.1.2	Turning II/T	(8 weeks)
2.1.3	Shaping II/T	(2 weeks)

After the Measuring II course, which is common for all metal trades, there follow the Turning and Shaping courses, which are specially designed to develop advanced skills required for the Turner trade. The jobs are selected in a way to provide systematic training. After turning some of these jobs can be used to serve the training needs of other trades (e.g. machinist and fitter). There the jobs will be completed and finally assembled into useful units (e.g. bench vice).

3. FINAL TRAINING

3.1.1	Turning III/T	(10 weeks)
3.1.2	Shaping III/T	(2 weeks)

The Final Training is organized like the Advanced Training but at a higher level. The individual jobs as well as the complete units resulting from them are more complicated. Two examples of such projects are given in para C. (c). They show how apprentices of different trades are trained to work together for the completion of a product. This scheme provides systematic training on the one hand and on the other results in the production of serviceable units. The given examples can easily be replaced by other projects, if the training facilities require such a change. This can be done only if all skills and operations compiled for this Final Training are properly covered. The Development Cell for Skilled Labour Training, Lahore may be approached for any advice and assistance in this matter.

1. BASIC TRAINING

(months 4-9)

The following list shows the SKILLS and OPERATIONS being learned in the Basic Training of the ATC-programme:

1.1 General introduction to workshop rules and regulations

1.2 Proper working

- care and maintenance of tools and equipment,
- working to drawings and sketches,
- working according to proper sequences of operations.

1.3 Measuring - Checking

- with steel rule,
- with vernier caliper,
- with spring calipers, divider,
- with protractor combination set,
- with try square and back square,
- with gauges.

1.4 Marking

- coating for marking,
- scribing parallel lines, circles, radii, angles,
- finding centres,
- marking from reference faces and lines.

1.5 Punching and stamping

- centre-punching,
- stamping with letters and figures.

1.6 Sawing (by hand and machine)

- fixing sawblades, adjusting and clamping the job,
- cutting flats, pipes, bars,
- using coolants.

1.7 Chipping

- cross and flat chiselling,
- chiselling grooves,
- regrinding of chisels.

1.8 Filing

- flat and square filing to an accuracy of ± 0.1 mm,
- filing radii and slots.

1.9 Drilling - Counterboring - Reaming

- holding tools in different ways, setting the machine,
- drilling holes, blind holes, pilot holes,
- counterboring, reaming.

1.10 Riveting

- preparation of the job,
- cold riveting.

1.11 Thread cutting

- making internal and external thread by hand.

1.12 Turning

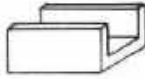




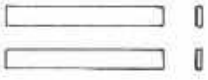
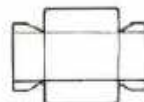
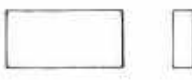
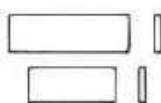

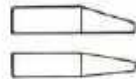

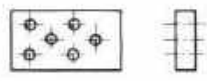
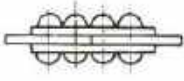


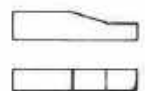
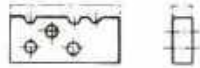


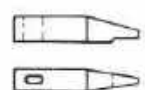
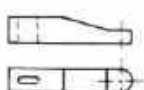
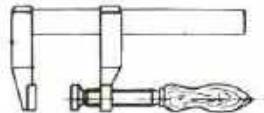
- chucking (three-jaw-chucks), step turning,
- facing, chamfer turning,
- centering,
- longitudinal turning (between centres),
- drilling,
- thread cutting (using taps and dies),
- taper turning (external),
- knurling.

1.13 Shaping

- proper clamping of the job, setting the machine,
- square and parallel shaping,
- longitudinal and vertical step shaping,
- form shaping (radii).

1.14 Tool grinding

- offhand grinding of benchtools, drills, turning and shaping tools.

<p>FILING EXERCISE I</p>  <p>Flat filing</p> <p>1 → 4</p>	<p>MARKING EXERCISE</p>  <p>Flat filing, marking & centre punching.</p> <p>2 → 5</p>	<p>STRETCHING EXERCISE</p>  <p>Filing, marking & hammering.</p> <p>3</p>	<p>FILING EXERCISE II</p>  <p>Flat & square filing</p> <p>1 → 4 → 26</p>
<p>SAWING EXERCISE</p>  <p>Sawing, square filing.</p> <p>2 → 5 → 10</p>	<p>FOR INSIDE CALIPER</p>  <p>Special filing operations.</p> <p>6 → 15</p>	<p>FOR SHEET-METAL BOX</p>  <p>Marking, shearing, filing</p> <p>7 → 16</p>	<p>FOR DRILLING EXERCISE</p>  <p>Smooth-filing acc. to given dimensions</p> <p>8 → 13</p>
<p>RIVETING EXERCISE</p>  <p>Filing.</p> <p>9 → 14</p>	<p>CHIPPING EXERCISE</p>  <p>Cross & flat chiselling.</p> <p>5 → 10 → 12</p>	<p>FIXED JAW</p>  <p>Marking, chiselling, radius filing.</p> <p>11 → 21</p>	<p>CHIPPING EXERCISE</p>  <p>Groove chiselling, chisel regrinding.</p> <p>10 → 12</p>
<p>DRILLING EXERCISE</p>  <p>Marking, drilling, drill regrinding.</p> <p>8 → 13 → 18</p>	<p>RIVETING EXERCISE</p>  <p>Marking, drilling, riveting.</p> <p>9 → 14</p>	<p>INSIDE CALIPER</p>  <p>Filing acc. to marking lines, assembling.</p> <p>6 → 15</p>	<p>SHEET-METAL BOX</p>  <p>Sheet-metal bending & folding.</p> <p>7 → 16</p>
<p>MOVEABLE JAW</p>  <p>Filing.</p> <p>17 → 22</p>	<p>DRILLING EXERCISE</p>  <p>Counter-boring reaming, internal thread cutting.</p> <p>13 → 18</p>	<p>SPINDLE</p>  <p>External thread cutting, form filing.</p> <p>19 → 23</p>	<p>SLIDING BAR</p>  <p>Radius, filing, stamping, notch filing.</p> <p>20 → 23</p>
<p>FIXED JAW</p>  <p>Slot filing.</p> <p>11 → 21 → 23</p>	<p>MOVEABLE JAW</p>  <p>Assembling.</p> <p>17 → 22 → 23</p>	<p>SCREW CLAMP</p>  <p>Assembling.</p> <p>19, 20 → 23 → 22, 21</p>	
BASIC TRAINING	LAYOUT		No 1 0.1
			BASIC FITTING

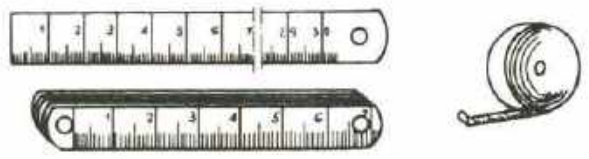
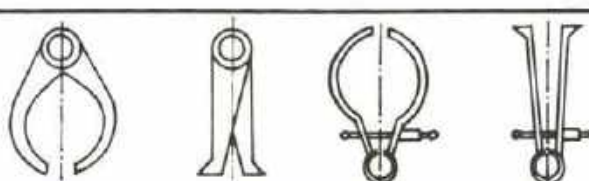
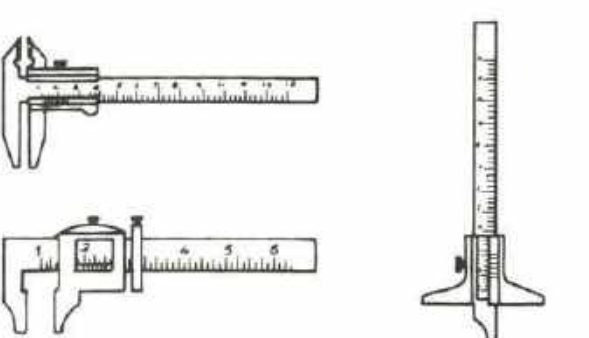
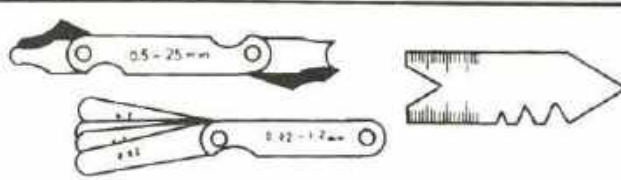
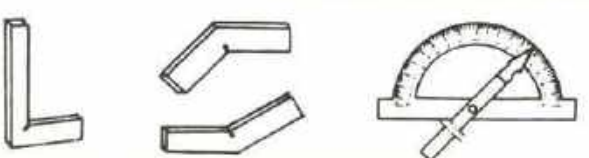
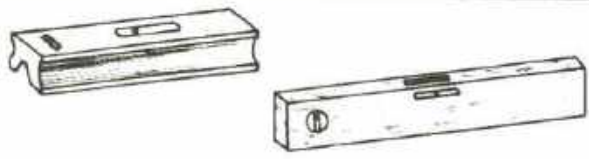


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

TURNER /
MACHINIST

THE MEASURING COURSE COMPRISES HANDLING OF MEASURING AND CHECKING TOOLS WHICH CAN BE USED FOR ALL TECHNICAL TRADES. THE ACCURACY OF THESE TOOLS IS NOT MORE THAN 0.05mm AND 0.001 inch, FOR THE PROTRACTOR IT IS 1/2 degree. BESIDES MEASURING TOOLS, THE HANDLING OF CHECKING TOOLS AS WELL AS GAUGES AND BEVELS IS EXPLAINED, TOO.

NAME OF MEASRG.TOOL	DRG. NO.	ACCURACY	SKETCHES OF MEASURING TOOLS
STEEL RULE	1.11 1.12	0.5mm or 1/32 inch	
FOLDING RULE	1.11	1 mm or 1/16 inch	
ROLLING TAPE	1.13	1 to 5 mm	
OUTSIDE CALIPER	1.21 1.22 1.23		
INSIDE CALIPER	1.21 1.24		
OUTSIDE VERNIER CALIPER	1.31 1.33 1.34 1.35	0.1 mm	
INSIDE VERNIER CALIPER	1.36 1.37	0.05 mm 1/128 inch	
DEPTH VERNIER CALIPER	1.38 1.39	0.001 inch	
GAUGES	1.41 1.42		
SQUARES (CHECKING TOOL)	1.52		
BEVEL PROTRACTOR (MEASURING TOOL)	1.53	0.5 degree	
LEVEL	1.61 1.62 1.63	min 0.01mm/m	

BASIC TRAINING

LAY OUT

No. 1.0.2

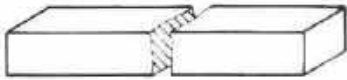
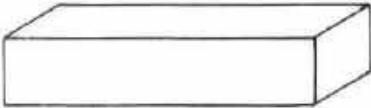
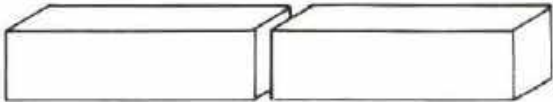
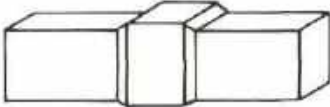
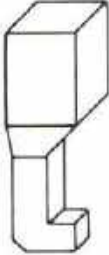
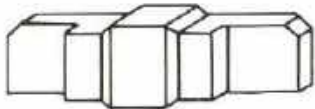

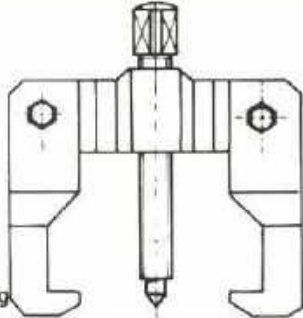
MEASURING I



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

METAL AND
ELECTRICIAN
TRADES

<p style="text-align: center;">SQUARE BAR</p>  <p>Clamping, Longitudinal (horizontal) Shaping.</p> <p style="text-align: center;">1 → 1, 0, 4</p>	<p style="text-align: center;">PULLER BRIDGE</p>  <p>Clamping, Toolhead setting, Horizontal-and Vertical Shaping.</p> <p style="text-align: center;">2 → 4</p>
<p style="text-align: center;">PULLER ARMS</p>  <p>Clamping, Horizontal-and Vertical Shaping, Hacksaw-cutting.</p> <p style="text-align: center;">3 → 5</p>	<p style="text-align: center;">PULLER BRIDGE</p>  <p>Marking, Clamping, Tool-setting, Horizontal Shaping.</p> <p style="text-align: center;">2 → 4 → 6</p>
<p style="text-align: center;">PULLER ARM</p>  <p>Marking, Clamping, Tool-setting.</p> <p style="text-align: center;">3 → 5 → 7</p> <p style="text-align: right;">Horizontal-and Vertical Groove-shaping.</p>	<p style="text-align: center;">PULLER BRIDGE</p>  <p>Marking, Clamping, Toolhead-setting Horizontal-and Vertical Shaping.</p> <p style="text-align: center;">4 → 6 → 8</p>
<p style="text-align: center;">PULLER ARM</p>  <p>Marking, Clamping, Toolhead setting.</p> <p style="text-align: center;">5 → 7 → 8</p> <p style="text-align: right;">Horizontal-and Vertical shaping.</p>	<p style="text-align: center;">PULLER</p>  <p>Marking, Thread cutting</p> <p style="text-align: right;">Drilling, Assembling.</p> <p style="text-align: center;">5 7 → 8 ← TEST</p>

THE ABOVE SHOWN EXERCISES SHOULD BE COMPLETED WITHIN 2 WEEKS. FOR PART NO. 4 OF THE PULLER (TEST PIECE) ADDITIONAL TIME WOULD BE GIVEN. BESIDES THESE EXERCISES THE TRAINEES HAVE TO REGRIND THEIR REQUIRED CUTTING TOOLS. AFTER EACH REGRINDING THE INSTRUCTOR CONCERNED HAS TO CHECK THE TOOL THOROUGHLY.

THE MATERIAL OF EXERCISE NO 1 WILL BE USED AS GRINDING EXERCISE IN THE TOOL GRINDING COURSE.

RAW MATERIAL REQUIRED FOR THE ABOVE SHOWN EXERCISES:

1 PIECE EACH OF $3/4 \times 3/4 \times 182$ mm, $1 1/4 \times 1 1/4 \times 115$ mm, $1 1/2 \times 1 1/4 \times 205$ mm.

BASIC TRAINING

LAYOUT

No. 1.0.3

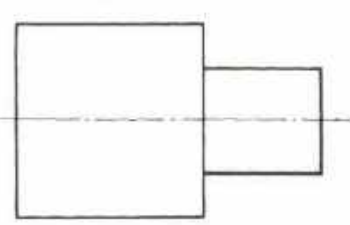

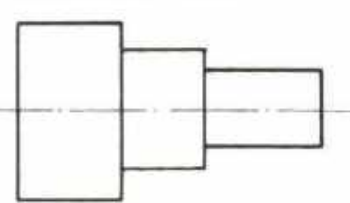
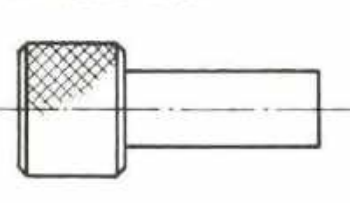
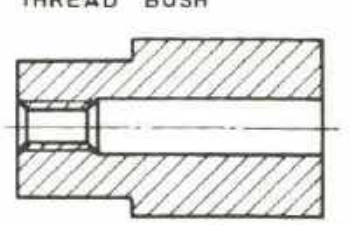
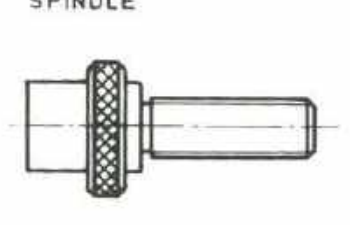
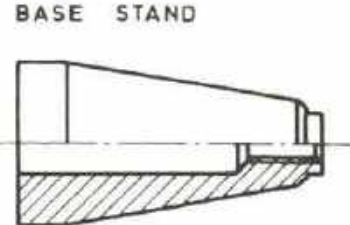

SHAPING I



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

TURNER /
MACHINIST

<p style="text-align: center;">STEPPED BAR</p>  <p style="text-align: center;">Chuckling, Facing, Longitudinal Turning</p> <p style="text-align: center;">1 → 5</p>	<p style="text-align: center;">ROUND BAR</p>  <p style="text-align: center;">Chuckling, Facing, Centering, Longitudinal Turning, Chamfer Turning</p> <p style="text-align: center;">2 → 3</p>
<p style="text-align: center;">CENTERED BOLT</p>  <p style="text-align: center;">Chuckling, Facing, Centering, Holding between Centres, Longitudinal Turning</p> <p style="text-align: center;">2 → 3 → 4</p>	<p style="text-align: center;">KNURLED BOLT</p>  <p style="text-align: center;">Knurling</p> <p style="text-align: center;">3 → 4 → 6</p>
<p style="text-align: center;">THREAD BUSH</p>  <p style="text-align: center;">Chuckling, Facing, Centering, Drilling, Thread Cutting, Longitudinal Turning</p> <p style="text-align: center;">1 → 5 → 7</p>	<p style="text-align: center;">SPINDLE</p>  <p style="text-align: center;">Thread cutting</p> <p style="text-align: center;">4 → 6 → 8</p>
<p style="text-align: center;">BASE STAND</p>  <p style="text-align: center;">Chuckling, Taper Turning</p> <p style="text-align: center;">5 → 7 → 8</p>	<p style="text-align: center;">SCREW JACK</p>  <p style="text-align: right;">Marking, Filing, Assembling</p> <p style="text-align: center;">6 → 8 → 7</p>

THE ABOVE SHOWN EXERCISES SHOULD BE COMPLETED WITHIN 2 WEEKS. BESIDES THESE EXERCISES THE TRAINEES HAVE TO REGRIND THEIR REQUIRED CUTTING TOOLS. AFTER EACH REGRINDING THE INSTRUCTOR CONCERNED HAS TO CHECK THE TOOL THOROUGHLY.

RAW MATERIALS REQUIRED FOR THE ABOVE SHOWN EXERCISES:
 1 PIECE ϕ $2\frac{1}{2}$ " x 85 mm LENGTH, 1 PIECE ϕ $2\frac{1}{2}$ " x 90 mm LENGTH.

BASIC TRAINING

LAYOUT

No. 1.0.4

TURNING I



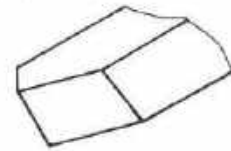
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ALL METAL
TRADES

HINTS FOR
OFFHAND GRINDING

RIGHT HAND ROUGHING
TOOL

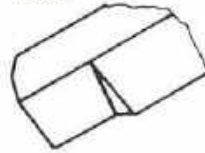


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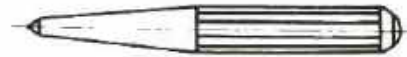
1.0.3/01 →

2

RIGHT HAND SIDE TOOL



CENTRE PUNCH



1.0.3/01 →

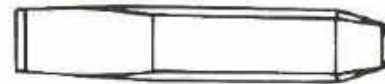
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4

SCRIBER



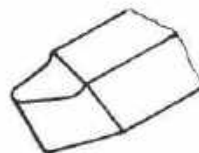
FLAT CHISEL



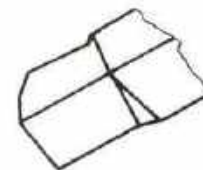
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6

ROUND NOSE
SMOOTHING TOOL



RIGHT HAND
SIDE TOOL



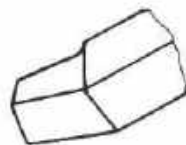
1.0.3/01 →

7

1.0.3/01 →

8

RIGHT HAND
ROUGHING TOOL



TWIST DRILL



1.0.3/01 →

9

10

THE ABOVE SHOWN EXERCISES SHOULD BE COMPLETED WITHIN 2 WEEKS.
AFTER COMPLETION OF THIS OFFHAND GRINDING COURSE, THE TRAINEES SHOULD
BE ABLE TO SHARPEN THESE TOOLS IN A CORRECT MANNER AND WITHOUT
ANY ASSISTANCE.
THE REQUIRED MATERIAL FOR THE TOOL BITS IS TO BE TAKEN FROM SHAPING
EX 1.0.3/01. FOR THE OTHER EXERCISES WORN-OUT OR BLUNT TOOLS CAN BE USED.

BASIC TRAINING

LAYOUT

No. 1.0.5

TOOL GRINDING



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

TURNER/
MACHINIST

2. ADVANCED TRAINING

(months 22-24)

The following list shows the SKILLS and OPERATIONS being learned in the Advanced Training of the ATC-programme:

2.1 Turning (chuck work)

- truing up,
- centering,
- facing,
- longitudinal turning,
- step turning,
- parting off,
- drilling, boring, counterboring,
- taper turning (outside, inside),
- thread cutting (inside, outside) with lathe tools,
- turning to ISO-fits, checking with gauges,
- turning to an accuracy of ± 0.01 mm,
- form turning (radii, balls),
- knurling,
- use of independent chuck,
- use of collet chuck,
- turning of cast iron and brass.

2.2 Turning (between centres)

- longitudinal turning,
- step turning,
- recessing, chamfering,
- form turning (grooves),
- thread cutting (with lathe tools, acme thread),
- holding the workpiece on a mandrel,
- taper turning by using swivelling rest.

2.3 Turning (face and angle plate work)

- setting and truing irregular shaped jobs,
- facing,
- drilling, boring.

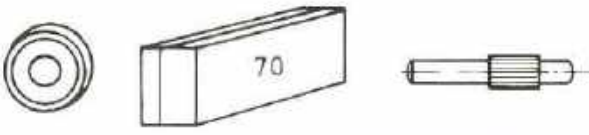


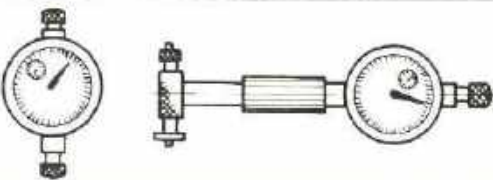
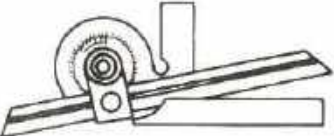
2.4 Shaping

- square and parallel shaping,
- longitudinal and vertical shaping,
- shaping grooves,
- shaping cast iron.

2.5 Measuring - Checking

- measuring to an accuracy of 0.01 mm,
- use of limit gauges, plug gauges,
- use of thread plug and ring gauges,
- use of taper gauges,
- use of gauges for grinding and setting thread tools.

PART II OF THE MEASURING COURSE COMPRISES HANDLING OF FINE MEASURING AND CHECKING TOOLS WITH AN ACCURACY OF 1/100 TO 1/1000 MM AS WELL AS THE UNIVERSAL BEVEL PROTRACTOR. TABLES SHOWING I.S.A. FITS AND TOLERANCES ARE ADDED.

NAME OF MEASRG. TOOL	DRG. No.	ACCURACY	SKETCHES OF MEASURING TOOLS
GAUGE BLOCK	2.21 2.22	1/1000 mm	
CONTROL GAUGE BAR OF RING	2.23	1/1000 mm	
LIMIT AND CALIPER SNAP GAUGE	2.31 2.32	1/1000 mm	
LIMIT PLUG GAUGE	2.33 2.34	1/1000 mm	
THREAD LIMIT GAUGE	2.35	1/1000 mm	
OUTSIDE MICROMETER	2.41 2.42	1/100 mm 1/1000 inch	
INSIDE MICROMETER	2.43 2.44	1/100 mm 1/1000 inch	
THREAD MICROMETER	2.45	1/100 mm	
DIAL INDICATOR	2.51 2.52 2.53	1/100 mm and 1/1000 mm	
INSIDE DIAL INDICATOR	2.54	1/100 mm and 1/1000 mm	
UNIVERSAL BEVEL PROTRACTOR	2.61 2.62 2.63	1/12 degree or 5 minutes	

CARE WITH PRECISION MEASURING TOOLS:

Needless to say that precision measuring tools should be handled with the greatest care. Good tools are made of hardened steel and will stand a lifetime of use without breakage, but the accuracy of even the finest tool can be quickly impaired by careless or abusive treatment. In working with precision measuring tools, be careful to avoid accidental scratches or nicks that will obscure graduations or distort surfaces. Rust is the enemy of all finely finished surfaces. Tools should be wiped clean of finger prints after using and kept in separate boxes or cases. A light dressing of oil applied with a soft, lint-free cloth will protect fine measuring tools in storage.

ADVANCED
TRAINING

LAY OUT

No. 20.1

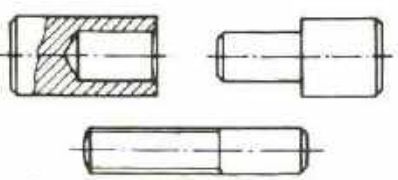

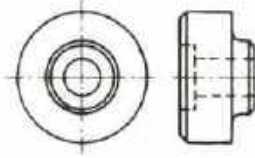
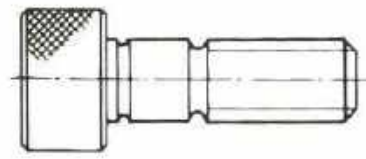
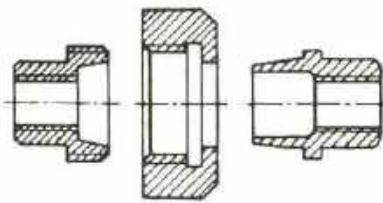
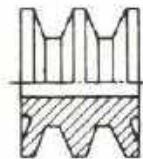
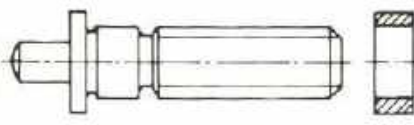
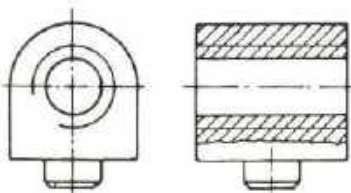
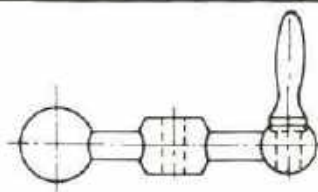
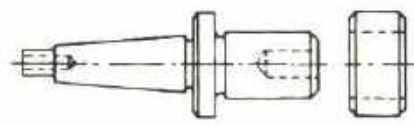
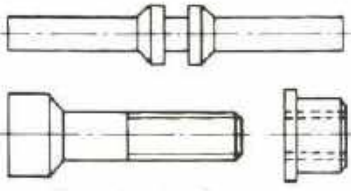
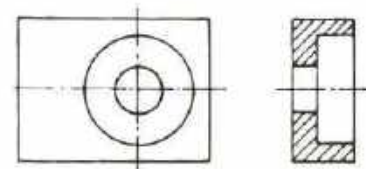
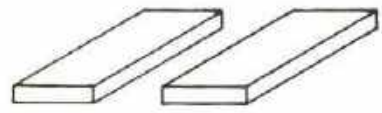
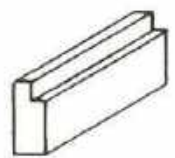
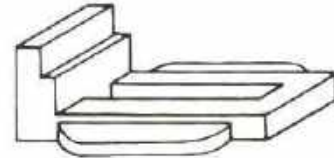
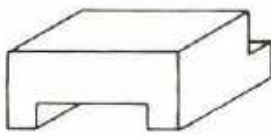

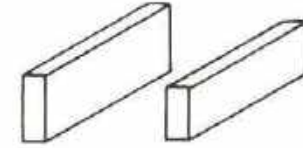

MEASURING II



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ALL METAL
TRADES

TURNING 2.1.2/0.1-12		
 <p>Facing, Thread-cutting, Drilling,</p> <p>1</p>	 <p>Turning between Centres</p> <p>2</p>	 <p>Mandrel Work, Boring</p> <p>3 → 2.2.4/11</p>
 <p>Knurling, Threading,</p> <p>4</p>	 <p>Taper Turning, Boring, Threading,</p> <p>5</p>	 <p>Form-Turning</p> <p>6 → 2.3.5/4</p>
 <p>Turning to high Accuracy Cutting of ACME-Thread</p> <p>7 → 3.3.4/</p>	 <p>Work with Independent Chuck</p> <p>8 → 3.3.4/</p>	 <p>Form Turning</p> <p>9</p>
 <p>Taper - Turning</p> <p>10</p>	 <p>Thread - Turning</p> <p>11 → 2.2.4/6</p>	 <p>Face-Plate Work</p> <p>12</p>
SHAPING 2.1.3/0.1-06		
 <p>Parallel and Square Shaping</p> <p>1 → 3.3.4/</p>	 <p>Step Shaping</p> <p>2 → 3.3.4/</p>	 <p>Shaping Cast Iron</p> <p>3 → 3.3.4/</p>
 <p>Parallel and Square Shaping</p> <p>4 → 2.2.4/9</p>	 <p>Form - Shaping</p> <p>5 → 2.2.4/2</p>	 <p>Parallel and Square Shaping</p> <p>6</p>
ADVANCED TRAINING	LAYOUT	No. 2.1.2 No. 2.1.3
 <p>DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING</p> <p>PAK-GERMAN TECHNICAL TRAINING PROGRAMME</p>		TURNER

3. FINAL TRAINING

(months 25-27)

The following list shows the SKILLS and OPERATIONS being learned in the Final Training of the ATC-programme:

3.1 Turning (chuck work)

- further training in all type of chuck work as started with in the basic & advanced trade training,
- thread cutting (left hand thread, multi start thread),
- excentric turning,
- setting of stops,
- turning of carbon steel, cast iron and plastics,
- use of tool post grinding attachment,
- use of steady rest and follower rest.

3.2 Turning (between centres)

- further training in all type of work as started with in the basic & advanced trade training,
- form turning (using hand tools),
- excentric turning (crankshaft),
- taper turning (swivelling the tailstock and using taper attachment).

3.3 Turning (face and angle plate work)

- further training in different type of work as started with in the basic & advanced trade training,
- counterbalancing of irregular shaped jobs.

3.4 Shaping

- further training of different types of shaping work as started with in the basic & advanced trade training,
- shaping of racks,
- shaping of internal keyways,
- shaping of dovetails.

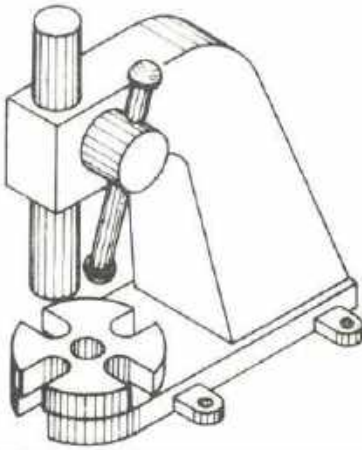
3.5 Measuring - Checking

- further improvement in all types of measuring-checking techniques to an accuracy of 0.01 mm.

APPRENTICES TRAINING PROGRAMME
FINAL TRAINING
TRAINING PROJECT

To be executed in TEAMWORK by:

Machinist
Turner
Millwright-Fitter
Tool & Die Maker
Welder (if available in the
training centre)

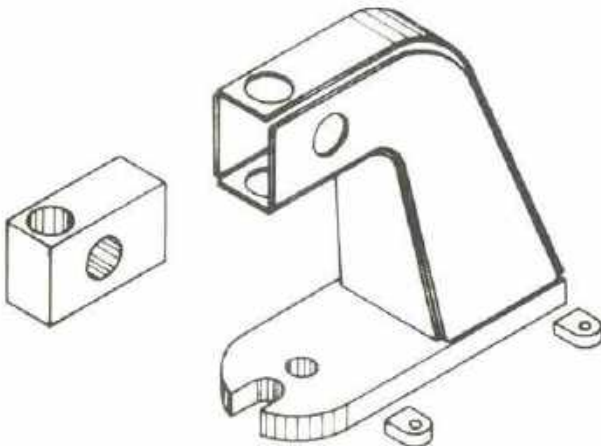


Training Objectives:

Millwright-Fitter: Marking
Cutting

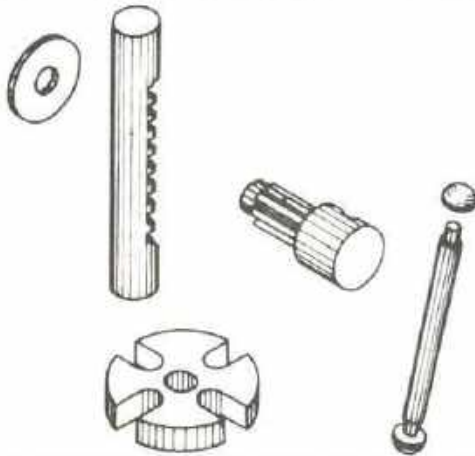
Machinist: Shaping
Milling
Drilling
Boring
Reaming

Welder: Corner-welds
Fillet-welds



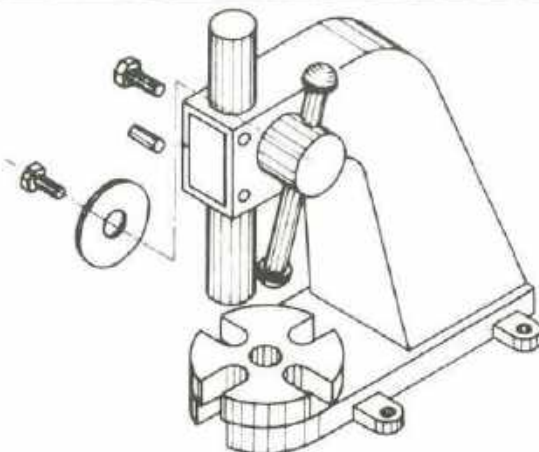
Turner: Facing
Longitudinal
turning
Step turning
Drilling
Threading

Machinist: Milling



Millwright-Fitter /
Tool & Die Maker:

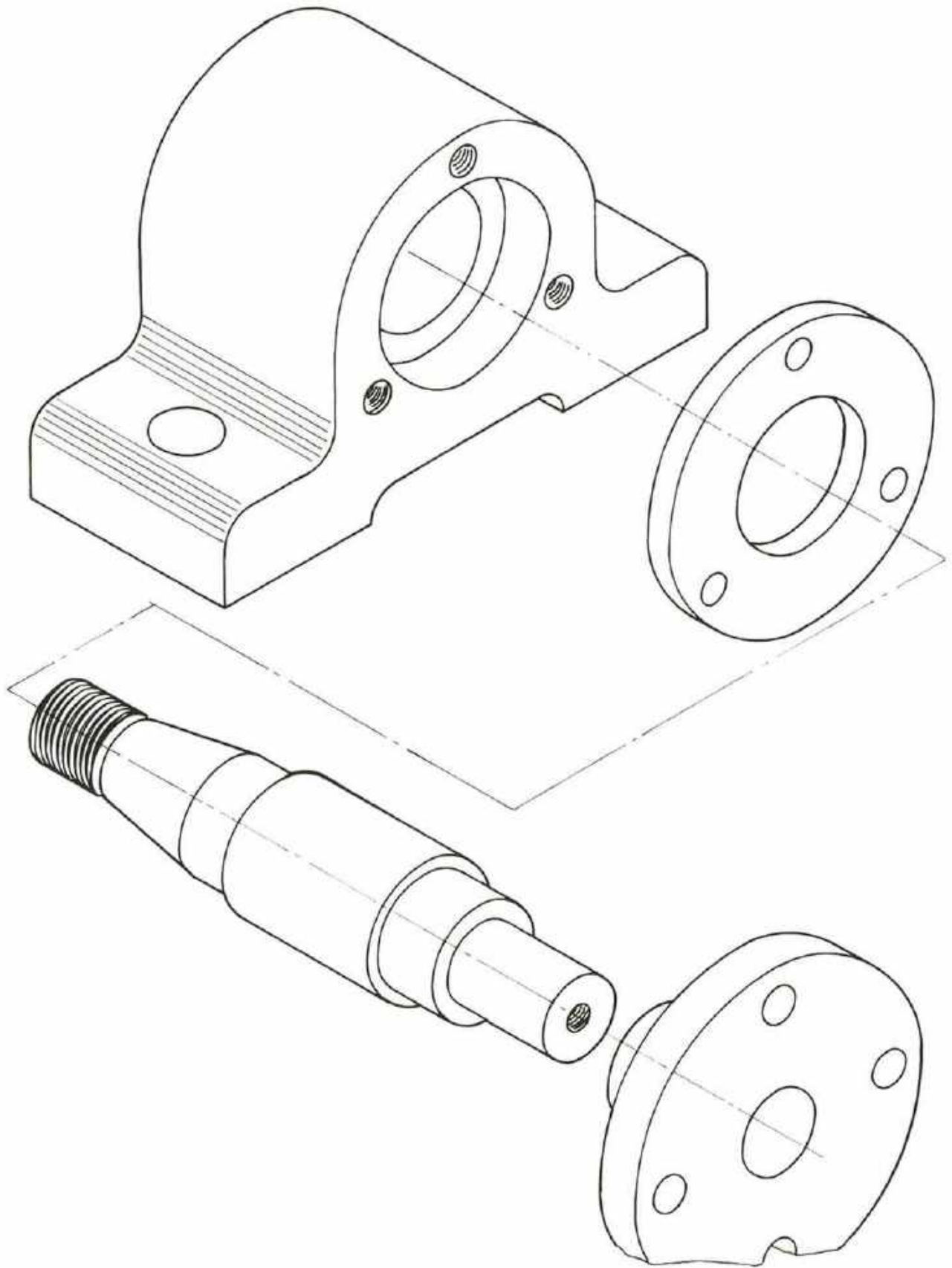
Drilling
Threading
Reaming
Assembling
Checking



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

METAL
TRADES



FINAL TRAINING

PLUMBER BLOCK

No. 3.1.1

TURNING III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

TURNER

C. (c) COURSE OUTLINES FOR THEORY INSTRUCTIONS
(related theoretical knowledge)

SYLLABUS FOR APPRENTICE TRAINING						Months 1-3 4-6 (Semester 1)
ALL METAL TRADES						
Unit No.	Technology	Rel. Science	Materials	Techn. Mathematics	Techn. Drawing	
1	Trade introduction	Power	General introduction of materials	Whole numbers	Introduction to Techn. Drawing	
2	Handtools in the workshop	Force	Ferrous metals	Fractions (common fractions)	Views of prismatic workpieces I	
3	Measuring I	Resolution of forces	Non-ferrous metals	Decimal system of measurement	Prismatic workpieces II Dimensioning	
4	Marking		Plastics	Percentages		Cylindrical workpieces
5	Chipping-cutting		Wood-leather-rubber			
6	Grinding I	Hardness	Grinding materials	Decimal fractions		
7	Machine tools introduction to: -drilling machines -power hacksaw -lathe machines -shaping machines	Motions	Lubricants - coolants	Conversion of inch into metric system		
8	Operat. Techniques I -chiselling -sawing -scraping -filing -drilling -countersinking -counterboring -reaming	Temperature - heat	Production of Iron and Steel -raw materials -blast furnace -steel making -high grade steel -carbon steel -alloy steel -grey cast iron	Angles (formation and units) Tolerances Surface Area I-II (rectilinear and angular)	Surface symbols Tolerances Reference edges Reference faces	
9	Measuring II -caliper/vernier -micrometer	Thermal expansion of metals	Standardization of iron & steel	Use of tables	Drawing from models	

**SYLLABUS FOR APPRENTICE TRAINING
ALL METAL TRADES**

Months 7-12
(Semester 2)

Unit No.	Technology/Related Science	Materials	Techn. Mathematics	Techn. Drawing
10	<u>Measuring III</u> -measurement of angles -gauges		Pythagorean proposition Evolving of roots	Representation of pyramidal and conical workpieces
11	<u>Operating Techniques II (noncutting operations)</u> -forging -bending-straightening -shearing <u>Science: Conditions of Aggregation</u>	<u>Special Characteristics of Steel</u> -extensibility/malleability -structure -tensile/shearing strength	<u>Surface Area III</u> -perimeter -circumference -composed figures	<u>Sections I</u> -full sections (one view) -full sections (two views)
12	Casting	Castability of metals	Transposition of equations	<u>Representations of thread</u> -external -internal -screw joints
13	Threads, Screws, Bolts, Nuts <u>Science: Inclined plane</u>			
14	<u>Fastening Methods I (temporary)</u> -screw joints -locking devices -threaded pipe joints <u>Science: Levers</u>		<u>Volumes</u> -simple solids -composed solids <u>Weight</u> -on the basis of: -volume -length -area	<u>Sections II</u> -half sections -offset sections -parts not sectioned
15	<u>Fastening Methods II-IV</u> -welding (gas, arc) -soldering/brazing -riveting <u>Science: Pressure/Units of Pressure</u> Oxidation of Metals	<u>Gases</u> -oxygen/acetylene -storing & handling Solders/Brazers	Wastage and Estimation	<u>Welded Joints</u> -symbols -welded workpieces Drawing from models

SYLLABUS FOR APPRENTICE TRAINING

ALL METAL TRADES

Months 13-18
(semester 3)

Unit No.	Technology/Related Science	Materials	Techn. Mathematics	Techn. Drawing
18	ISO - Fits and Tolerances	Standardization of Steel II (ISO)	Calculation of Fits	Rectangular cuts on prisms with triangular and hexagonal base
19	<u>Pastening Methods V</u> -keys and key joints -pins and pin joints <u>Science:</u> Tensile strength Shearing strength	<u>Testing Material</u> -testing tensile strength -testing hardness	Trigonometrical Ratios Inclination-Tapering	Representation of Fits Rectangular cuts on pyramids Representation of key and pin joints
20 21	<u>Machine Elements</u> -axles -shafts -couplings-clutches -bearings	Heat Treatment of Steel (hardening) Standardization of Non-ferrous Metals Heat Treatment of Steel (annealing)	<u>Elements of Mechanics</u> -strength -time and motion -work and power	Rectangular cuts on cylinders Assembled Workpieces
22	<u>Mechanical Power Transmissions</u> -belt drive -gears -gear transmissions -chain transmissions	Belt Materials	<u>Mechanical Power Transmission</u> -frictional drive -gears and gear drive	Representation of Gears

SYLLABUS FOR APPRENTICE TRAINING

Months 19-24
(semester 4)

ALL METAL TRADES

Unit No.	Technology	Materials	Techn. Mathematics	Techn. Drawing
23	<p>Machining Operations with Machine Tools I</p> <p>Turning Operations</p> <ul style="list-style-type: none"> -turning processes, tools, lathes -cutting speed, cooling <p>Typical Lathe Work</p>	<p>Materials for Turning Tools</p> <ul style="list-style-type: none"> -general properties -classification -HSS-tools -cemented carbides 	<p>Cutting Speeds</p> <p>Turning Calculations</p> <ul style="list-style-type: none"> -speed, feed, rate of tool travel -machining time -taper calculations 	<p>Angular Cuts on prisms and pyramids</p> <p>Lathed Workpieces</p>
24	<p>Machining Operations II</p> <p>Drilling Operations</p> <ul style="list-style-type: none"> -types of holes -types of machines/tools -speed, feed, cooling <p>Typical Drilling Work</p>	<p>Types and Shapes of Chips</p> <ul style="list-style-type: none"> -chip cross section -types of chips -shapes of chips 	<p>Drilling Calculations</p> <ul style="list-style-type: none"> -cutting speed -spindle speed -machining time, total time 	<p>Drilled Workpieces</p>
25	<p>Machining Operations III</p> <p>Milling Operations</p> <ul style="list-style-type: none"> -type of work to be done -types of machines/tools -clamping workpieces <p>Typical Milling Work</p>	<p>Lubrication</p>	<p>Milling Calculations</p> <ul style="list-style-type: none"> -spindle speed -use of tables 	<p>Milled Workpieces</p>
26	<p>Indexing</p> <ul style="list-style-type: none"> -rapid indexing -dividing head 		<p>Indexing Calculations</p> <ul style="list-style-type: none"> -worm drive -direct/indirect ind. 	<p>Drawing from Models</p>
27	<p>Machining Operations IV</p> <p>Grinding Operations</p>	<p>Handling of grinding wheels</p>	<p>Project calculations incl. estimation, machining time, %age wastage and material cost</p>	<p>Reading Drawings</p>

In the third year of training the apprentices will be applying and widening the knowledge and skills learnt during the first two years.

Instead of dealing with a single new topic (e.g. fits and tolerances) a project, i.e. a comprehensive process or a complete technical device is to be discussed now.

Such a project may include the problem of fits and tolerances. The problem to be discussed now, however, is not what basically a fit is, but what type of fit is used here, how it can be manufactured, measured and checked.

Under these aspects a breakup of the daily instructions in Trade Theory, Technical Mathematics and Technical Drawing seems no longer useful. Instead, a comprehensive type of instruction will include all subjects and topics pertaining to the project.

Generally the topics to be discussed are as follows:-

For projects where mainly manufacturing problems are to be discussed.

1. Purpose of the project (technical and economical considerations).
2. Representation-Design-Application.
3. Materials and tools.
4. Manufacturing problems.
5. Sequence of operations.
6. Measuring and checking.
7. Related calculations.

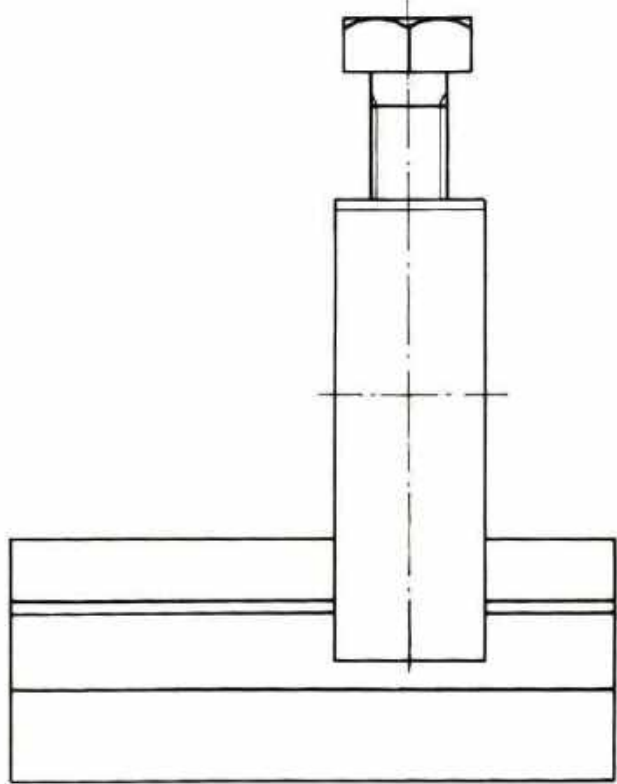
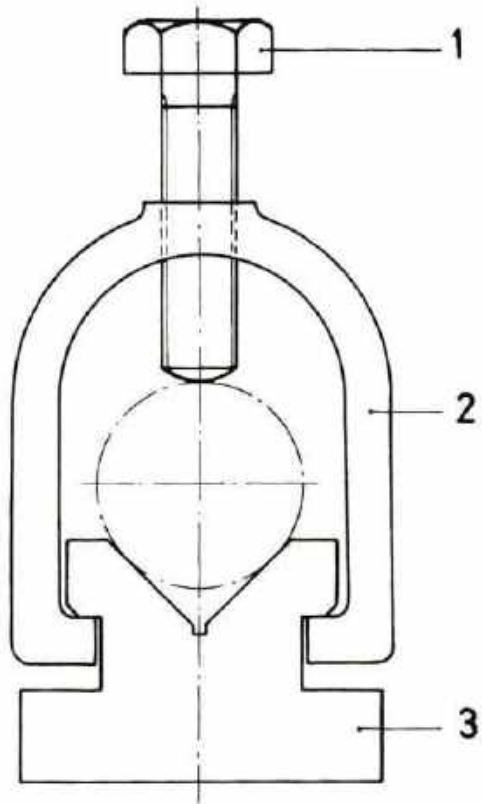
For projects where mainly problems of assembly and design are to be discussed.

1. Purpose of the project (technical and economical considerations).
2. Function of the project.
3. Representation in the drawing-assembling-dismantling.
4. Materials and manufacturing problems.
5. Related calculations.
6. Range of application-provision for special purposes-other possible designs.

The complete didactical breakup of the different projects proposed will be followed as given in the manual. ⁺

The breakup of two projects, however, is included here as a sample.

⁺ Manual: PROJECTS - Workbook for Applied Theory



3rd Year

CLAMPING PRISM

PROJECT No.1

TRADE THEORY



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ALL METAL
TRADES

Project No. 1 - Two lesson days -

CLAMPING PRISM

1. Purpose of a clamping prism

- 1.1 To achieve a precisely horizontal (vertical) position of workpieces in general
- 1.2 To achieve a fixed position of cylindrical workpieces

2. Function of a clamping prism

- 2.1 V-block and its advantages for clamping cylindrical workpieces
- 2.2 Fixing the workpiece with the help of bow and screw bolt

3. Representation - assembling - dismantling

- 3.1 Preparation of a free-hand sketch in cavalier projection (part no. 3) and free-hand workshop drawings (parts no. 2 and 3)
- 3.2 Standard thread and fine thread: identification and application

4. Materials and manufacturing problems

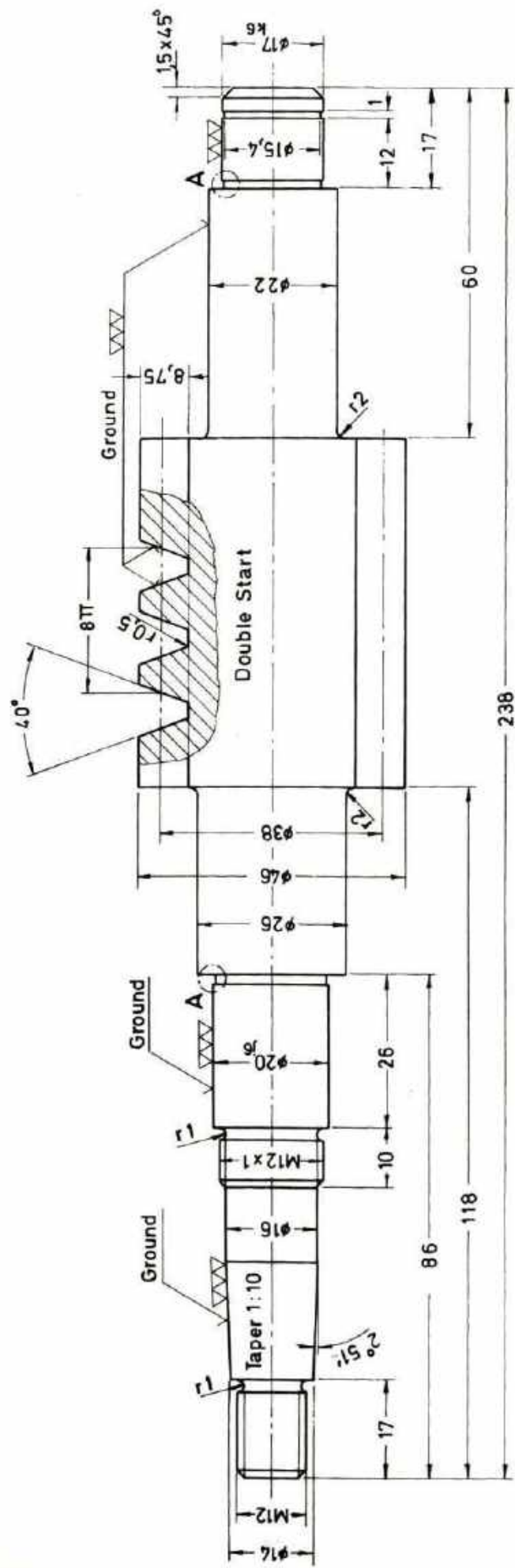
- 4.1 Interpretation of the codes used in the title block
- 4.2 V-block: practicable methods of production
- 4.3 Surface hardening
- 4.4 Clamping bow: practicable methods of production taking the number of required pieces into consideration

5. Related calculations

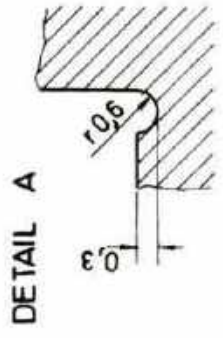
- 5.1 Neutral fibre
- 5.2 Stretched length (of the bow)
- 5.3 Wastage, percentage

6. Range of application - special purposes - other designs

- 6.1 Drilling holes through the centre
- 6.2 Mass production
- 6.3 Avoiding damage to the surface of the job when tightening the screw bolt (part no. 1)



41 Cr 4V (VW)



DETAIL A

3rd. year	DOUBLE START WORM SHAFT	PROJECT No. 10 TRADE THEORY
 DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		TURNER

DOUBLE START WORM - SHAFT1. Purpose of a Worm

- 1.1 Technical needs to be suited by a worm gear drive: great reduction of speed; transmission of high forces; transmission of motion with intersecting shafts.
- 1.2 Achieving different transmission ratios with worm gear drives: changing pitch; changing lead; changing number of teeth of the worm wheel.
- 1.3 Acme thread applied as motion thread: forces at an inclined plane; selflocking effect of a worm; friction, efficiency.
- 1.4 Purposes of different portions of the worm shaft.

2. Representation, Design, Application

- 2.1 Dimensions and terms of a worm.
- 2.2 Representation of worm and worm wheel with standard symbols.
- 2.3 Difference between Thread and Worm when dimensioning pitch (P) and lead (L).
- 2.4 Examples of application of worm gear drives.

3. Materials and Tools

- 3.1 Standard symbols and properties of materials used for worms.
- 3.2 Lathe tools for cutting worm threads; concave grinding, angles of the cutting edge.
- 3.3 Milling and grinding worms.

4. Manufacturing Problems

- 4.1 Thickness of chips in relation to the lead of a worm.
- 4.2 Methods of producing a multi start worm.

5. Sequence of Operations

- 5.1 Manufacturing the double start worm-shaft.
- 5.2 Economical considerations for the production of a great number of pieces.

6. Measuring and Checking

- 6.1 Measuring outside dia, root dia and dimensions with given off-sizes.
- 6.2 Checking the pitch.
- 6.3 Checking the profile of worm.

7. Related Calculations

- 7.1 Module
- 7.2 Change gears
- 7.3 Number of teeth of worm wheels

TRADE TESTING

As it becomes necessary in the present stage of industrialization to standardize all trade definitions and training methods, it is also necessary to standardize the trade testing. Therefore the Development Cell for Skilled Labour Training will also be carrying out this task to meet the following requirements:

1. Working out rules and procedures for promotion and final trade tests
2. Preparing papers for practical and theoretical tests
3. Conducting tests
4. Making assessment of practical work and theoretical papers
5. Issuing certificates
6. Recommending necessary alterations in curricula based on the assessment of examinations

