TRADE INFORMATION

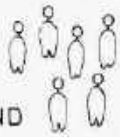
FOR APPRENTICE TRAINING

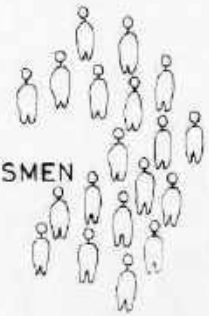
ELECTRICIAN GENERAL

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

MODERN INDUSTRY NEEDS:

FEW ENGINEERS 

MORE TECHNICIANS AND SUPERVISORS 

MANY SKILLED CRAFTSMEN AND OPERATORS 

FOREWORD

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

PRICE - Rs. 6/-
Printed at Aalamgeer Press

C O N T E N T S :

A TRADE DEFINITION

SCOPE OF ACTIVITY

A. TRADE DEFINITION - SCOPE OF ACTIVITIES

E L E C T R I C I A N G E N E R A L *

An Electrician General installs, maintains and repairs electrical wiring systems and related equipment in residences, industrial and commercial establishments and other buildings.

He carries out repairs of wiring faults and other minor defects in domestic appliances and industrial apparatus.

Details:

/ He examines drawings and other specifications,

/ positions and fixes distribution boards, fuse boxes, switches and light and power points,

/ cuts, bends and installs conduit wiring and installs sheathed cable wiring,

/ connects wiring to sources of electrical supply,

/ replaces or repairs defective wiring and related equipment,

/ fits, adjusts and repairs electrical motors and related apparatus,

/ tests for defects and makes necessary adjustments.

* 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

ELECTRICIAN GENERAL

Proper Working

1. Working to general workshop rules and regulations
   a) care and maintenance of tools and equipment;
   b) correct handling of tools and appliances;
   c) proper storing of tools and appliances;
   d) keeping workshop neat and clean.
2. Listing correct sequence of operations for the job.
3. Listing tools required for job.
4. Working to safety regulations.
5. Working to WAPDA and general rules and regulations.
6. Elementary first aid including artificial respiration in case of shocks.
7. Working to sketches, drawings and blue prints.

Bench Work (Fitting and Sheet Metal)

8. Measuring
9. Marking
10. Filing
11. Sawing
12. Drilling
13. Chipping
14. Stamping
15. Thread cutting
16. Bending and forming
17. Cold riveting
18. Tool grinding
19. Making of clamps
20. Soldering, tinning, brazing and sweating.

Carpentry

21. Handling of carpenter's hand tools.
22. Preparation of switch boards, round blocks etc.
23. Making batten joints.
24. Making casing and capping joints.

Installation of Wiring Systems

25. Use of common hand tools used in electrical engineering.
26. Handling of various types of wires and cables used in electrical installations.

27. Making all types of joints.

28. Installation of all types of lighting circuits.

29. Preparing of layouts for wiring circuits including all specifications.

30. Installing and connecting various types of lighting fittings including fluorescent lamps.

31. Provision of fuse boards and bell indicators.

Repair and Maintenance of Wiring Systems

32. Preparing of different types of testing boards.

33. Fault finding, use of test lamps and danger boards.

34. Systematic detection of faulty circuits.

35. Precautions prior to repairing faulty circuits.

36. Carrying out electrical and mechanical repairs of electrical appliances viz:
switches, plugs, cut-outs, regulators etc.

37. General maintenance of wiring systems and ceiling and pedestal fans.

38. General and routine inspection of all electrical wirings.

39. Form of report to electrical inspector in case of an electrical accident.

Electrical Measurements

40. Use, care and maintenance of
    a) Voltmeter
    b) Ammeter
    c) Power meter
    d) Energy meter
    e) Power factor meter
    f) Avometer
    g) Earth tester
    h) Megger testing set
    i) Tong tester
    j) Battery testing set

Distribution of Power

41. Operating HT switch gear equipment.

42. Installation and operation of LT main switch board control.

43. Installation of capacitor system.

44. Installation and maintenance of overhead distribution incl.:
    a) Distribution and subdistribution of power and lighting
    b) Lines between OH-lines and buildings
    c) Earthing of OH-line system
    d) Jointing of OH-wires and cables
    e) Routine check and testing
    f) Precautionary measures prior to working on OH-lines.

45. Installation of underground cables.

46. Preparation of power and lighting schemes for workshops and residential compounds.

47. Action to be taken at time of a power failure.

Connection and Use of Machinery and Appliances

48. Handling secondary cells and batteries: Charging with charging board, maintenance and repair.
49. Installation of step up and step down transformers.
50. Connecting transformers in parallels.
51. Installation and maintenance of rectifiers.
52. Connection of various kinds of DC and AC motors, single phase and three phase.
53. Installation of all kinds of accessories: Starters, regulators, switch gears, control units etc.
54. General layout of machines on their foundations.
55. Testing installed machines and appliances.

Maintenance and Repair of Machinery and Appliances

56. General routine check and maintenance of all electrical machinery and appliances.
57. Finding of faults.
58. Dismantling, repair, reassembling and setting of motors and auxiliary equipment.
59. Replacement of worn out parts.
60. Rewinding of burnt out armatures of motor fans and other small motors.
61. Other repairs of armature coils and field coils.
62. Skimming of commutators.
63. Overhauling all machinery.

(b) THEORETICAL KNOWLEDGE

1. TRADE THEORY

Handtools and their operation
Simple machine tools
Basic quantities of electrical engineering
Electrical circuits
Magnetism
Alternating current
Three-phase current
Protective methods
Measuring methods
Cells and batteries
Electrical machines
Transformers
Rectifiers
Power generation and distribution
Lighting systems
Rules and regulations

2. RELATED MATHEMATICS

in addition to the topics of Trade Theory:

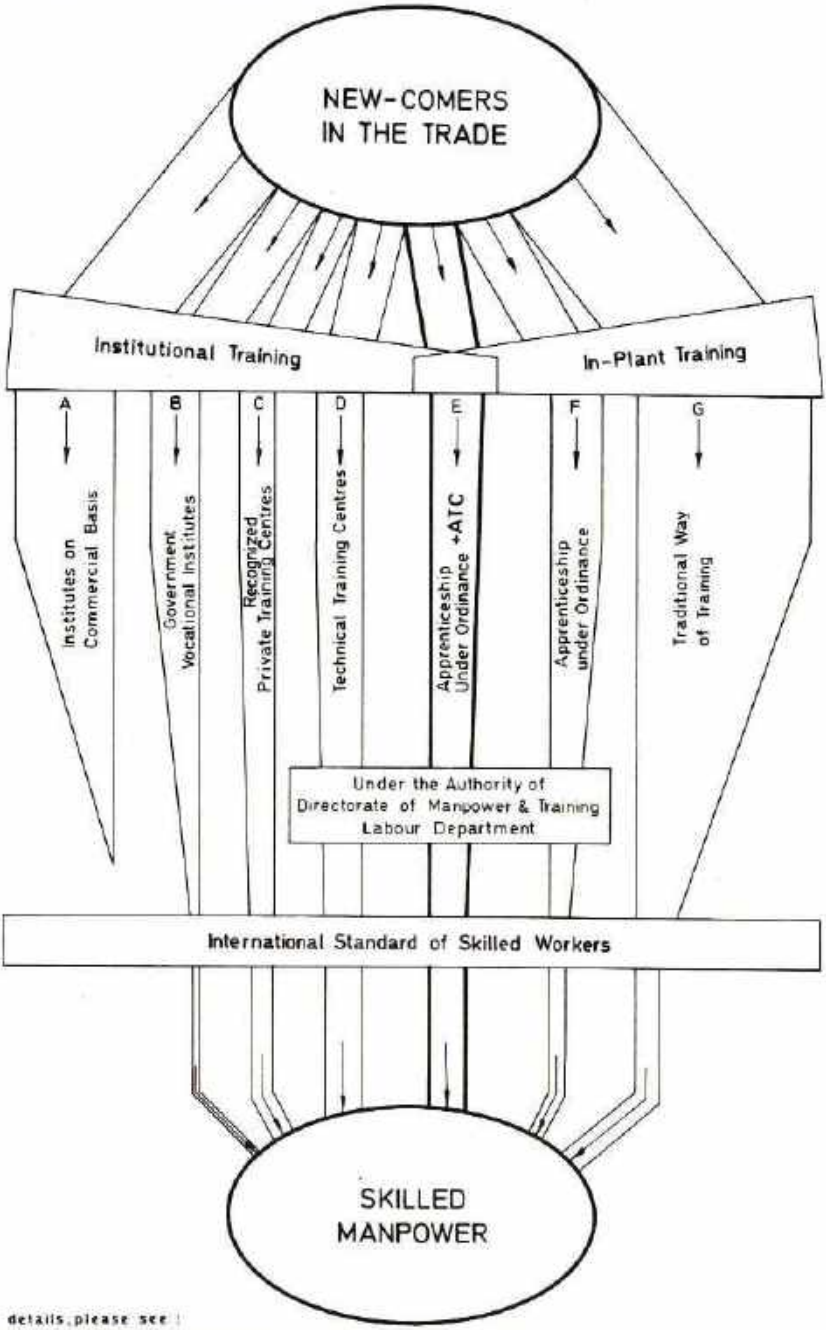
Numbers, fractions, decimal system, percentages
Transposition of equations
Trigonometrical ratios
Pythagorean proposition
Selection of service lines and fuses
Voltage drop on lines

3. TECHNICAL DRAWING

in addition to the topics of Trade Theory:

Representation of prismatic and cylindrical workpieces
Dimensioning
Heating appliances
Residential wiring systems
Contactor and relay connections
Transformer and motor winding diagrams
Transmission systems

B. (c) WAYS TO BECOME A SKILLED CRAFTSMAN



For details, please see :

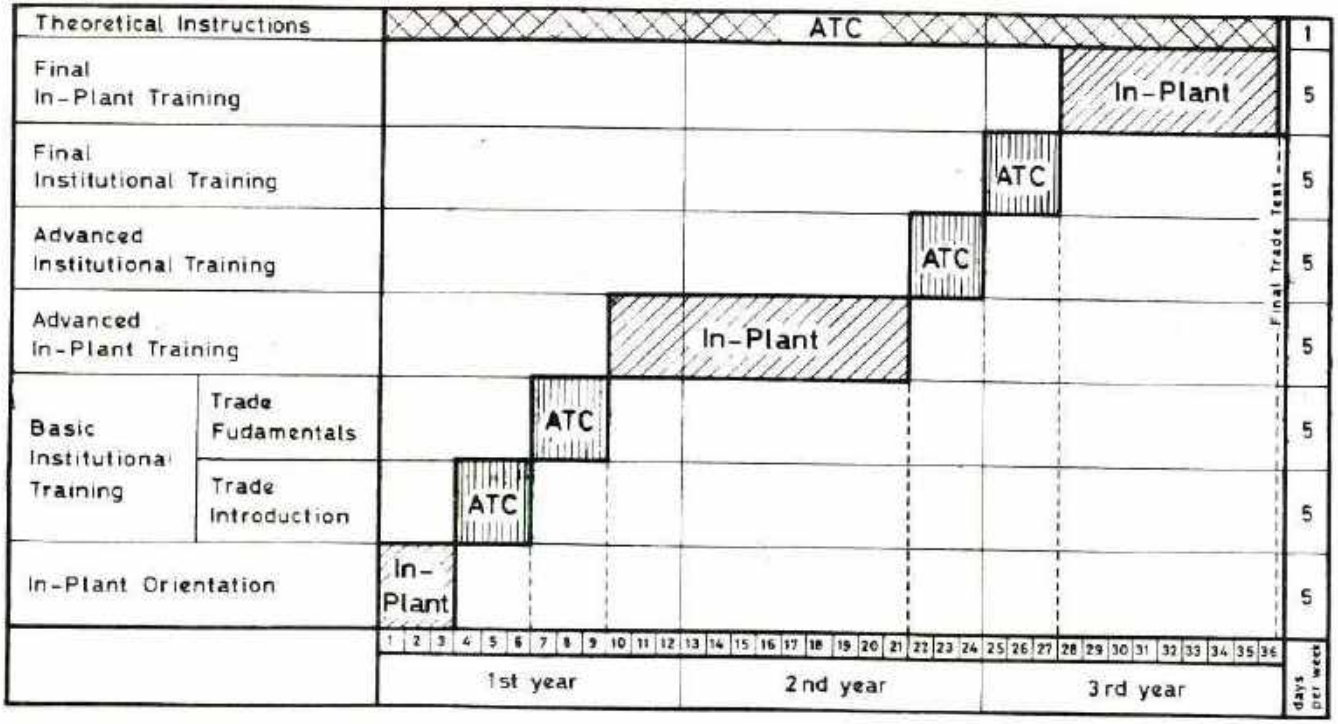
SURVEY OF VOCATIONAL EDUCATION FOR BOYS IN PAKISTAN, compiled by PUNJAB BOARD OF TECHN EDUCATION, LAHORE 74

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



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 apprentices of the Electrician General trade have to be trained during these 12 months are:

- Fitting or Basic Shop: (2 months)	Practicing basic fitting operations, working with power drill and power hacksaw, handling of ordinary and precision measuring instruments.
- Electrical Workshop: (2 months)	Handling of wires and cables and commonly used accessories, preparation of joints for batten and casing & capping wiring.
- Repair Workshop: (2 months)	Repair and preparation of electrical components, practicing soldering and brazing.
- Installation Site: (6 months)	Installation of simple circuits, fault finding.

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 Electrician General 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:

- Electrical Workshop: (2 months)	Installation and repair of motor controls.
- Installation Site: (3 months)	Installation of all kinds of lighting and power circuits, working on switch gears and protection devices.
- Repair Shop: (4 months)	Servicing and repair of electric machines and appliances, practicing of electrical measurements.

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 ELECTRICIAN GENERAL

1. BASIC TRAINING

1.0.1	Basic Fitting	(10 weeks)
1.0.2	Mechanical Measuring I	(2 weeks)
1.5.3	Benchwork	(2 weeks)
1.5.4	Electrical Installation I	(8 weeks)
1.5.5	Woodworks	(2 weeks)

The courses Basic Fitting and Measuring I are common for all metal and electrical trades. The remaining three courses were prepared to impart training in fundamentals of the Electrician General trade.
The Basic Training in general is designed to provide a background of knowledge and skills to prepare the apprentices for the following phase of In-Plant Training in the undertakings.

2. ADVANCED TRAINING

2.5.1	Electrical Measuring	(1 week)
2.5.2	Electrical Installation II	(10 weeks)
2.5.3	Electrical Control Circuits I	(1 week)

In the Advanced Training the main emphasis is put on making trainees familiar with the different wiring systems. The Electrical Measuring and Control Circuits are carried out in small groups of 3 to 4 apprentices. Therefore only few workplaces for measuring and control circuits are needed, but these are used in rotation, so that they are permanently occupied.

3. FINAL TRAINING

3.5.1	Electrical Control Circuits II	(2 weeks)
3.5.2	Electrical Installation III	(6 weeks)
3.5.3	Servicing Electrical Machines	(2 weeks)
3.5.4	Repair of Windings	(2 weeks)

The apprentices are split up into groups working in different sections of the Final Training. In a rotary system the groups are shifted to the other sections, so that finally all jobs are done by each apprentice. But in any case the 'Control Circuits II' course must be passed before the 'Electrical Installation III' course. The duration may vary according to the individual needs of the apprentices or their undertakings. In the courses 'Servicing Electrical Machines' and 'Repair of Windings' machinery or appliances of the training centre may be serviced or repaired. But in case no such work is to be done at the moment, a standard course is offered.

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 INTRODUCTION COURSE (months 4-6)

1.1.1 General introduction to workshop rules and regulations

1.1.2 Proper working

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

1.1.3 Measuring and checking

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

1.1.4 Marking

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

1.1.5 Punching and stamping

-centre-punching
-stamping with letters and figures.

1.1.6 Sawing (by hand and machine)

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

1.1.7 Chipping

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

1.1.8 Filing

-flat and square filing to an accuracy of $\pm$ 0.1 mm,
-filing radii and slots.

1.1.9 Drilling - Counterboring - Reaming

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

1.1.10 Riveting

-preparation of the job,
-cold riveting.

1.1.11 Thread Cutting

-making internal and external threads by hand.

1.1.12 Tool grinding

-sharpening chisels, scribers, punches,
-regrinding drills.

1.2 TRADE FUNDAMENTAL COURSE (months 7-9)

1.2.1 Soldering

-making sheet metal joints,
-making wire joints.

1.2.2 Handling of wires and cables

-selecting wires and cables,
-cutting to proper length,
-stripping,
-bending,
-making eyes,
-fastening,
-bundling and insulating with tape.

1.2.3 Filing

-filing plastics to an accuracy of $\pm$ 0.1 mm.

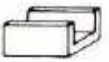
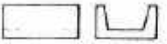
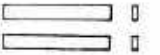
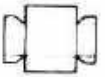
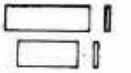
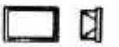
1.2.4 Fixing of components

-terminal plates,
-clamps,
-sockets and plugs,
-switches,
-lamp holders,
-distribution boxes.

1.2.5 Connecting up circuits according to drawings

1.2.6 Carpentry

-making batten joints,
-making casing and capping joints.

FILING EXERCISE I  Flat filing 1 → 4	MARKING EXERCISE  Flat filing, marking & centre punching 2 → 5	STRETCHING EXERCISE  Filing, marking & hammering 3
FILING EXERCISE II  Flat-and square filing 1 → 4 → 28	SAWING EXERCISE  Sawing, Square filing 2 → 5 → 10	FOR INSIDE CALIPER  Special filing operations. 6 → 15
FOR SHEET-METAL BOX  Marking, shearing, filing. 7 → 15	FOR DRILLING EXERCISE  Smooth-filing acc. to given dimensions. 8 → 13	FOR RIVETING EXERCISE  Filing 9 → 14
CHIPPING EXERCISE  Cross and flat chiselling. 5 → 10 → 12	CHIPPING EXERCISE  Groove chiselling Chisel regrinding 10 → 12	DRILLING EXERCISE  Marking, drilling, drill regrinding 8 → 13 → 18
RIVETING EXERCISE  Marking, drilling, riveting 9 → 14	INSIDE CALIPER  Filing acc. to marking lines, assembling. 6 → 15	SHEET-METAL BOX  Sheet-metal bending and folding 7 → 16
DRILLING EXERCISE  Counter-boring, reaming, thread cutting 13 → 18	THREAD BOLT  External thread cutting, form filing 19	

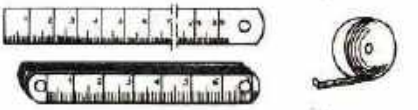
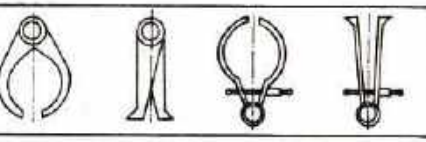
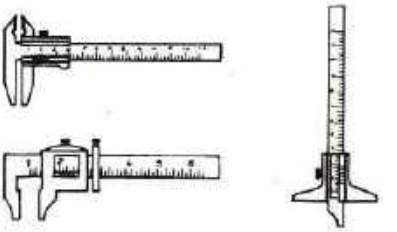
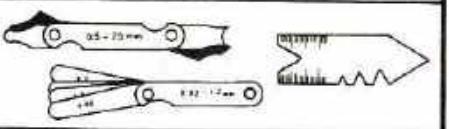
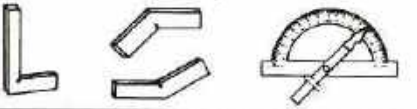
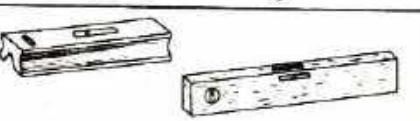
BASIC TRAINING	LAYOUT	No. 1 0 1 BASIC FITTING

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK GERMAN TECHNICAL TRAINING PROGRAMME

GENERAL ELECTRICIAN

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.

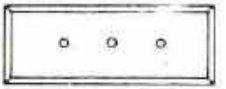
NAME OF MEASRG.TOOL	DRG. NO.	ACCURACY	SKETCHES OF MEASURING TOOLS
STEEL RULE	1.11 1.12	0.5mm or 1/32 inch	
FOLDING RULE	1.11	1 mm or 1/16 inch	
ROLLING TAPE	1.13	1 to 5 mm	
OUTSIDE CALIPER	1.21 1.22 1.23		
INSIDE CALIPER	1.21 1.24		
OUTSIDE VERNIER CALIPER	1.31 1.33 1.34 1.35	0.1 mm 0.05 mm 1/128 inch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

BASIC TRAINING	LAY OUT	No. 1.0.2 MEASURING I

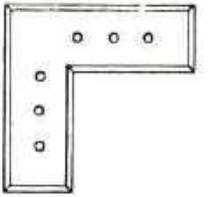
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

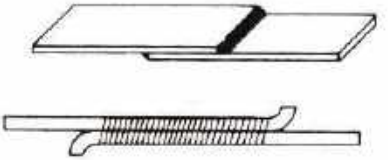
METAL AND ELECTRICIAN TRADES



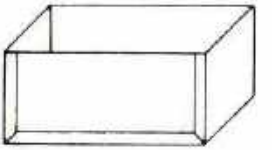
TERMINAL PLATE I 01



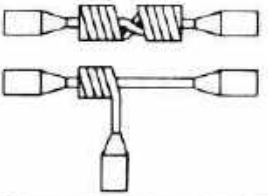
TERMINAL PLATE II 02



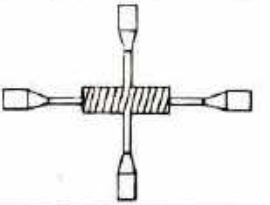
SOLDERING I 03



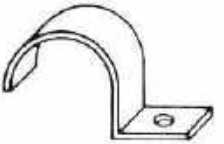
SHEETMETAL BOX 04



SOLDERING II 05

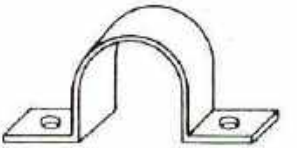


SOLDERING III 06



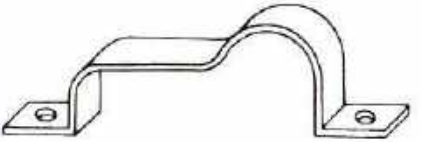
FOUR CLAMPS

CLAMP I 07



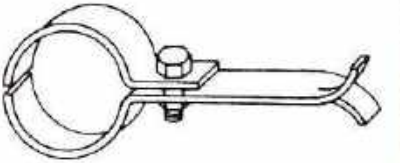
THREE CLAMPS

CLAMP II 08



TWO CLAMPS

CLAMP III 09



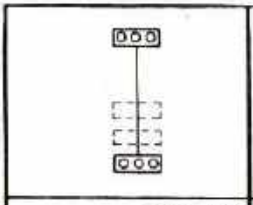
CLAMP IV 10

BASIC TRAINING	LAYOUT	No. 1.5.3 BENCH WORK

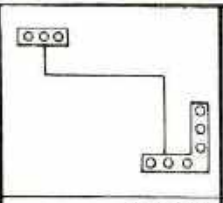
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

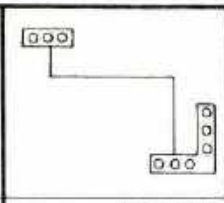
GENERAL ELECTRICIAN



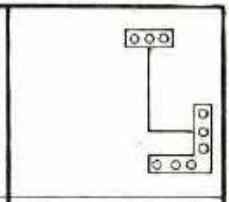
WIRE 01



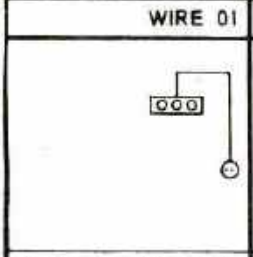
WIRE 02



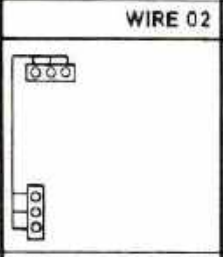
CABLE 03



03 WIRE 04



03-04 → CABLE 05



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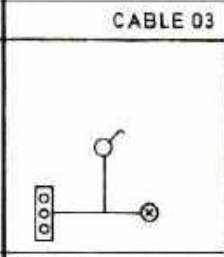

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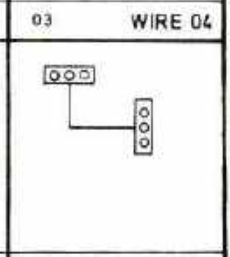
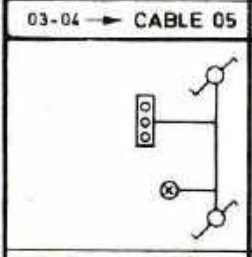


06-07 → CABLE 08



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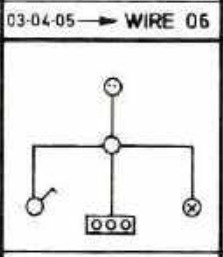
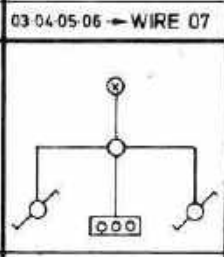
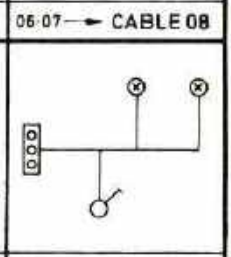


CABLE 10



CABLE 11



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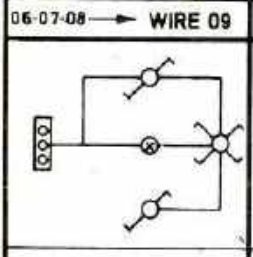
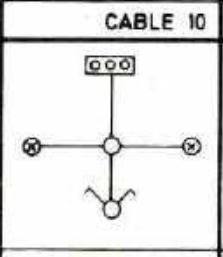
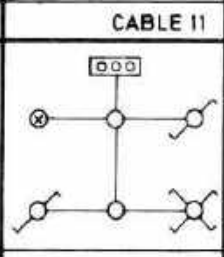


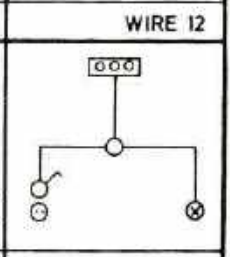
WIRE 13



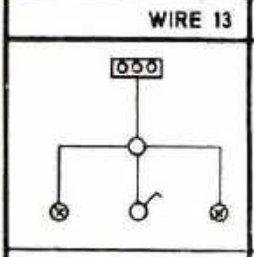
CABLE 14



CABLE 15



CABLE 16



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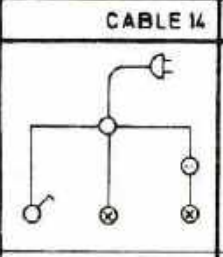

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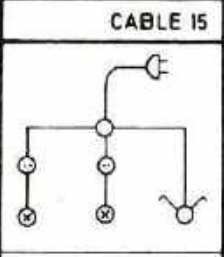

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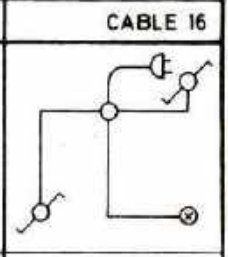


CABLE 20

BASIC TRAINING	LAYOUT	No. 1.5.4
		INSTALLATION I

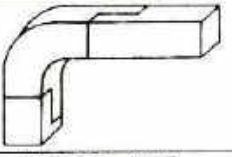
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

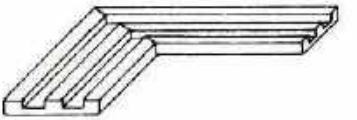
GENERAL ELECTRICIAN

1 STRAIGHT BATTEN JOINT

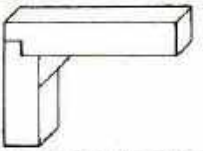
8 STRAIGHT CASING AND CAPPING JOINT



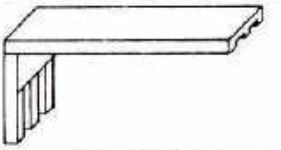
2 L-BATTEN JOINT



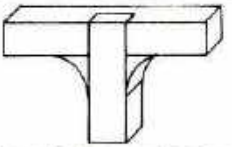
9 L-CASING AND CAPPING JOINT



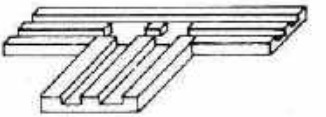
3 CEILING BATTEN JOINT



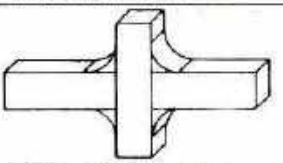
10 CEILING CASING AND CAPPING JOINT



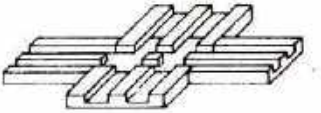
4 T-BATTEN JOINT



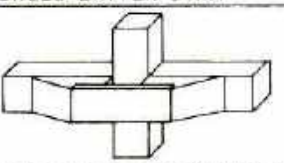
11 T-CASING AND CAPPING JOINT



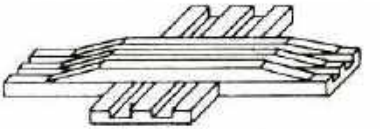
5 CROSS BATTEN JOINT



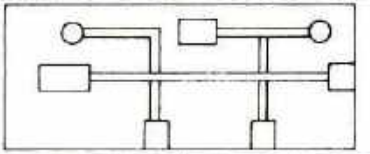
12 CROSS CASING AND CAPPING JOINT



6 BRIDGE BATTEN JOINT



13 BRIDGE CASING AND CAPPING JOINT



7 VARIOUS BATTEN JOINTS

14 VARIOUS CASING AND CAPING JOINTS

BASIC TRAINING	LAYOUT	No. 1.5.5 WOOD WORK

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

GENERAL ELECTRICIAN

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 Completion of wiring and current-path diagrams

-working according to given lay-out diagrams.

2.2 Implementation of lighting circuits

in casing and capping, batten wiring, pipe wiring, cable wiring:

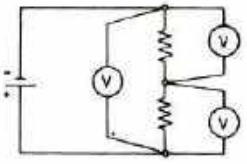
-one-way switch circuit,
-two-way switch circuit,
-multi-circuit-switch circuit,
-impulse-switch circuit,
-trembler-bell circuit,
-time-switch circuit,
-indicator bell circuit.

2.3 Implementation of control circuits

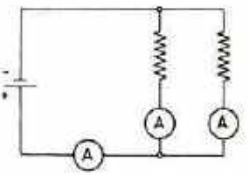
-on - and off-circuit,
-electro-thermic overcurrent protection,
-interlocking by switches and contactors,
-sequence-control circuit.

2.4 Measuring exercises

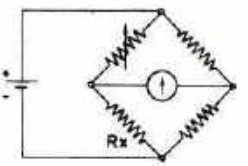
-meter reading,
-measuring E, I, R, P, W, cosine φ



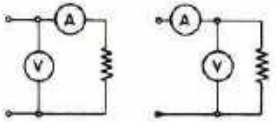
Voltage Measurement 1



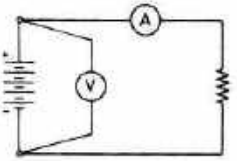
Current Measurement 2



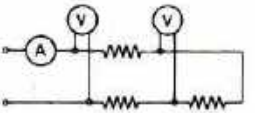
Resistance Measurement 3



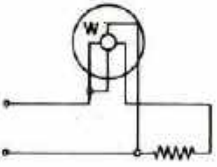
Resistance Measurement 4



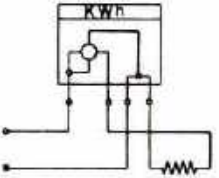
Terminal Voltage 5



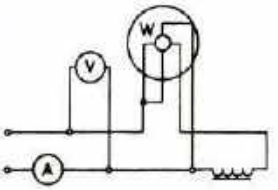
Voltage Drop 6



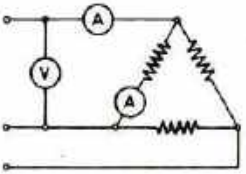
Power Measurement AC & DC 7



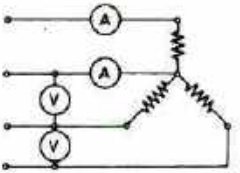
Energy Measurement 1~3~ 8



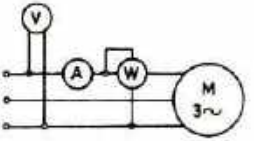
Power Factor Measuremenet 9



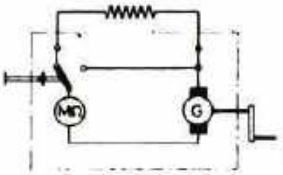
Delta Connection 10



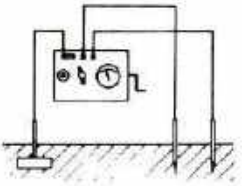
Star Connection 11



Power Factor 12



Insulation Resistance 13



Ground Measurement 14

TEST

15

ADVANCED TRAINING

LAYOUT

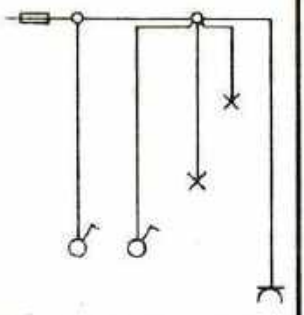
No. 2.5.1

MEASURING COURSE

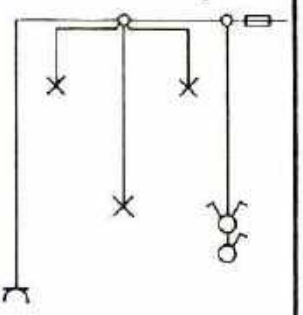
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

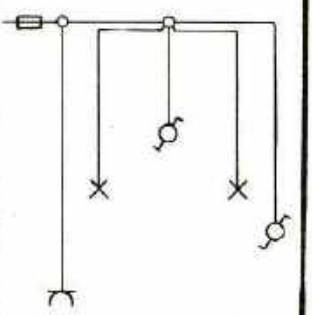
ELECTRICIAN GENERAL



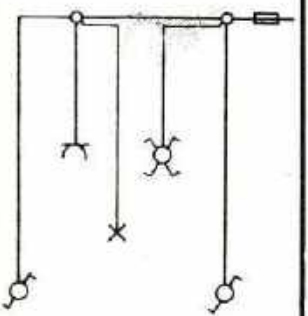
01 KITCHEN INSTALLATION



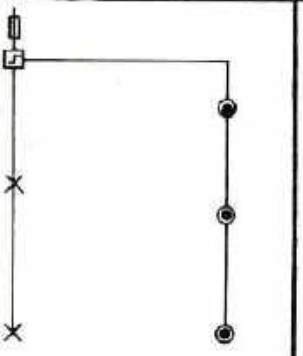
02 DRAWING ROOM INSTALLATION



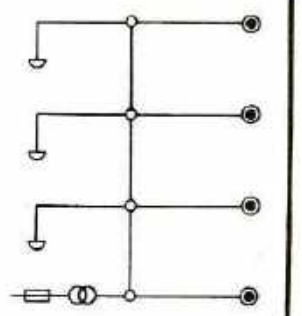
03 SLEEPING ROOM INSTALLATION



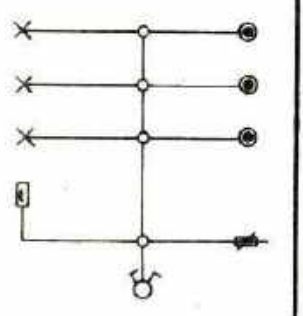
04 HALL INSTALLATION



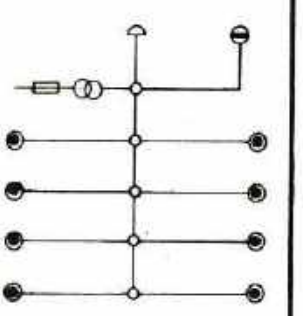
05 IMPULSE SWITCH CIRCUIT



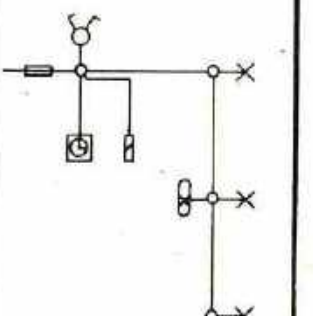
06 TREMBLER BELL CIRCUIT



07 TIME SWITCH CIRCUIT



08 INDICATOR BELL CIRCUIT



09 TIMING SWITCH CIRCUIT

ADVANCED TRAINING

LAY OUT

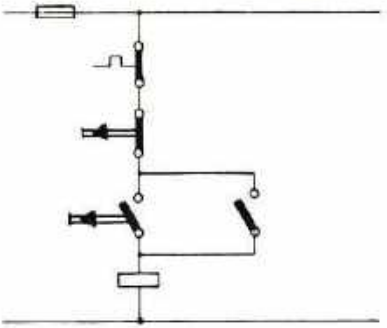
No. 2.5.2

INSTALLATION II

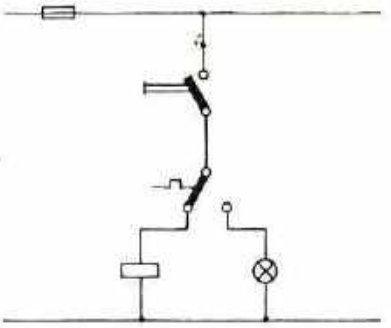
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

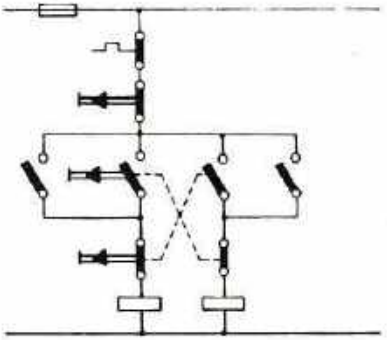
GENERAL ELECTRICIAN



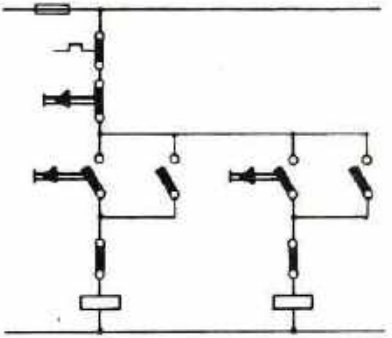
01 ON AND OFF CIRCUIT



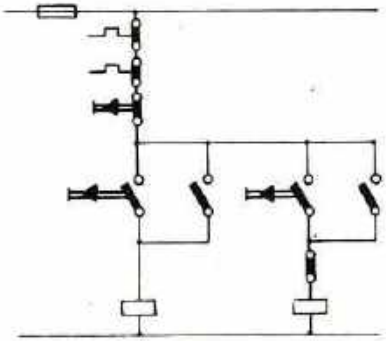
02 OVER CURRENT PROTECTION



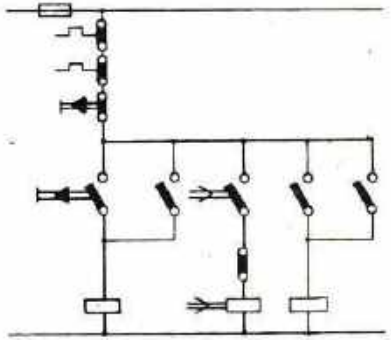
03 INTERLOCKING BY SWITCHES



04 INTERLOCKING BY CONTACTORS



05 SEQUENCE CONTROL HAND DRIVEN



06 SEQUENCE CONTROL TIME RELAY DRIVEN

ADVANCED TRAINING	LAY OUT	No. 2.5.3 CONTROL CIRCUITS

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

GENERAL ELECTRICIAN

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 Industrial Installation

-electrical machine connections including control and power circuits,
-starting circuits of AC and DC-motors,
-reverse-circuits of single-phase, three-phase and DC-motors,
-speed control of DC-motors.

3.2 Finding the characteristics of

-single-phase transformers,
-AC-motors,
-DC-motors and generators.

3.3 Servicing electrical machines

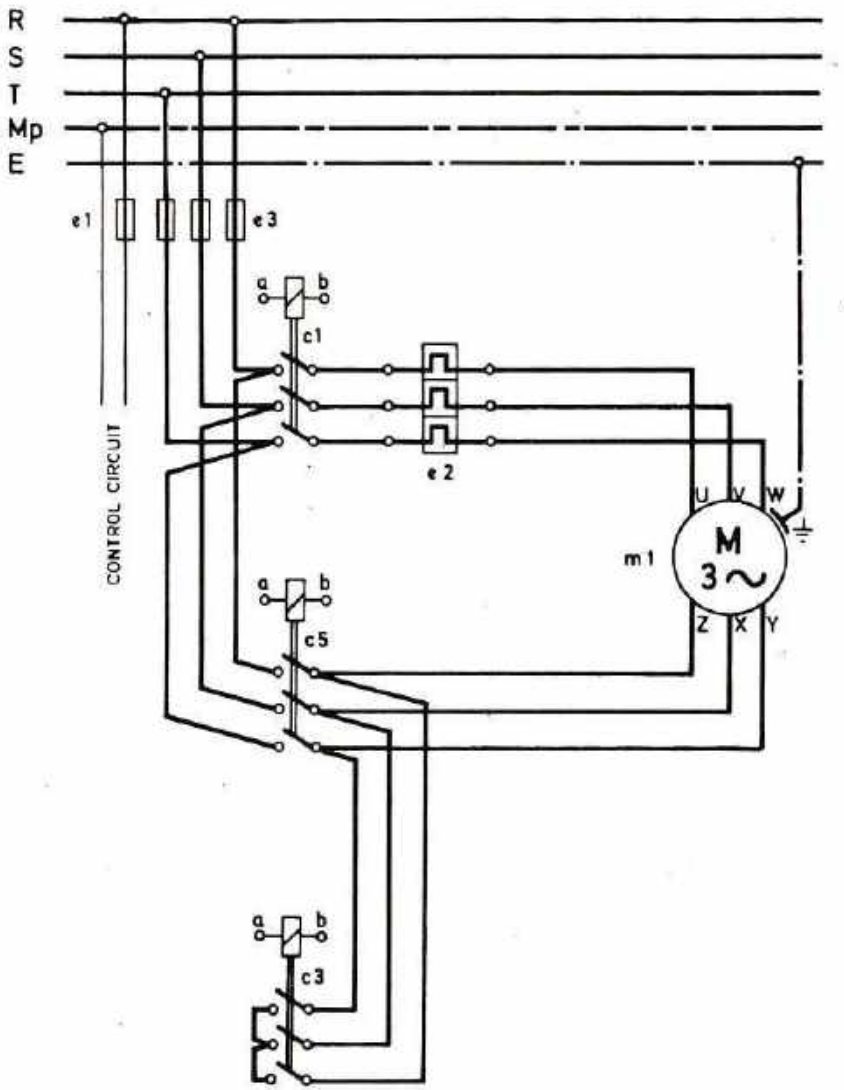
-dismantling and reassembling,
-replacement of carbon brushes,
-overhauling of commutators,
-replacement and greasing of bearings,
-testing electrical and mechanical functioning.

3.4 Repair of windings

-specifying,
-use of micrometers and SWG,
-dismantling of coils,
-preparation of insulation materials,
-making winding forms,
-rewinding and reassembling,
-varnishing and drying,
-bandage work,
-testing the insulation and functioning.

Example out of course ELECTRICAL INSTALLATION III

(INDUSTRIAL INSTALLATIONS)



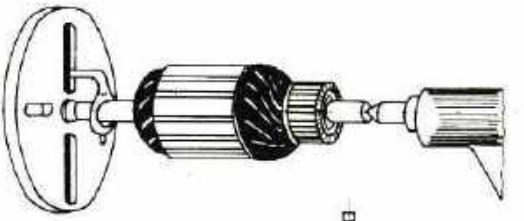
FINAL TRAINING	AUTOMATIC CONTACTOR STAR–DELTA	No. 3.5.2
		ELC. INSTALLATION III

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

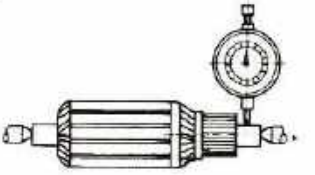
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN GENERAL

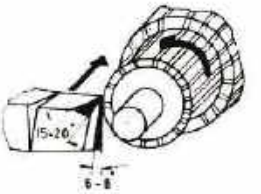
1) MOUNT ROTOR BETWEEN CENTRES



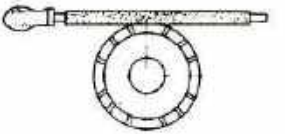
2) CHECK TRUENESS WITH DIAL INDICATOR



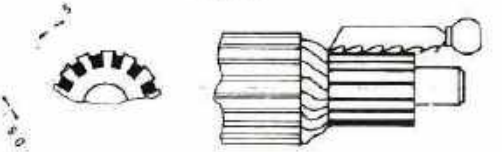
3) CAREFULLY TURN LIGHT CUT



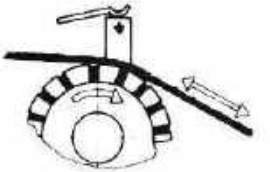
4) SMOOTH WITH EMERY-SHEET



5) REMOVE INSULATION BETWEEN SEGMENTS WITH HACKSAW BLADE

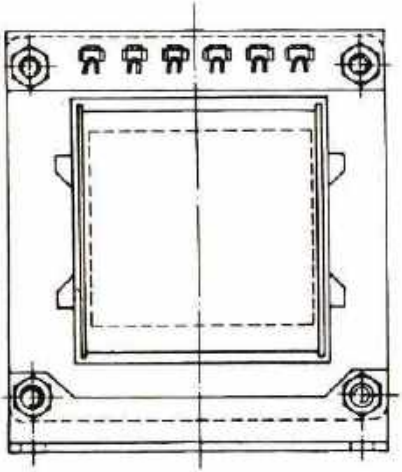


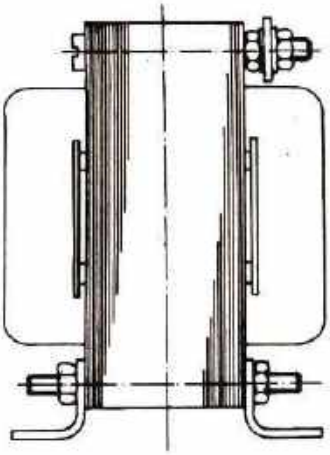
6) DRAW EMERYSHEET BETWEEN BRUSH AND COMMUTATOR

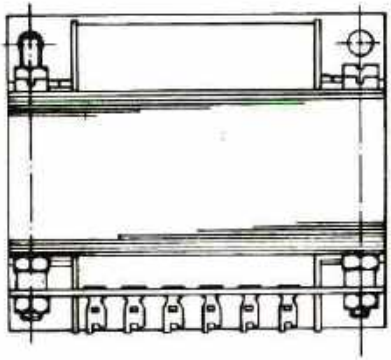


Example out of the course REPAIR OF WINDING

(STANDARD PROGRAMME)







FINAL TRAINING	TRANSFORMER	No. 3.5.4 REPAIR OF WINDING

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

GENERAL ELECTRICIAN

SYLLABUS FOR APPRENTICE TRAINING

GENERAL ELECTRICIAN TRADE

Months 1-3
4-6
(Semester 1)

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		
3	Measuring I	Resolution of forces	Non-ferrous metals	Fractions (common fractions)	Views of prismatic workpieces I
4	Marking		Plastics		
5	Chipping-cutting		Wood-leather-rubber	Decimal system of measurement	
6	Grinding I	Hardness	Grinding materials	Decimal fractions Conversion of inch into metric system	Prismatic workpieces II Dimensioning
7	Machine tools introduction to: -drilling machines -power hacksaw -lathe machines -shaping machines	Motions	Lubricants - coolants	Percentages	Cylindrical workpieces

	Trade Theory	Related Mathematics	Technical Drawing
8	Basic Quantities -Bohr's atomic system -electric charges -possibilities to produce electrical pressure -electric current -hazards of the electric current -electrical resistance	Transposition of Equations -equation: scales in balance -transposition of formulae Basic Quantities -solving techn. problems by calculation -current and current density -resistance of a wire	Electrical Circuits I -symbols -current path diagram -installation and wiring diagram -single-pole switch circuit -multicircuit-switch circuit -two-way switch circuit -intermediate switch circuit -voltmeter and ammeter connection -combination of various circuits
9	Electrical Circuits I -Ohm's Law -measurement of current and voltage -working with multi-purpose instruments -series connection	Electrical Circuits I -Ohm's Law -measurement of electrical quantities -series connection	

SYLLABUS FOR APPRENTICE TRAINING

GENERAL ELECTRICIAN TRADE

Months 7-12 (Semester 2)

Unit No.	Trade Theory	Related Mathematics	Technical Drawing
10	**Electrical Circuits II** -parallel connection -Kirchhoff's laws in a network -voltage drop -internal resistance of voltage sources	**Electrical Circuits II** -parallel connection -network connections -voltage drop -internal resistance of voltage sources	**Electrical Circuits II** current path, wiring diagram and installation layout: -kitchen installation -livingroom installation -staircase installation -sleeping-room/hall inst. -time-switch installation -installation layout for a building
11	**Electrical Power and Energy** -electrical power -electrical energy -efficiency	**Electrical Power and Energy** -electrical power -electrical energy -efficiency	
12	**Heating Effect of the Current** -basic theory of heat -heating appliances -fuse effect	**Thermal Effect of the Current** -calculation of the produced heat -selection of fuses and wires	**Heating Appliances** -heater wiring diagram -electric range -electric water heater
13	**Magnetism** -permanent magnetism -electromagnetism -iron in the magnetic field -current-carrying conductor in the magnetic field -current-carrying coil (motor principle) -induction voltage (generator principle) -self-induction -inductance -Lenz's law -eddy currents	**Trigonometrical Ratios** -triangles -sine of an angle -cosine of an angle **Magnetism** -magnetomotive force -magnetic field strength -magn. flux and flux density -conductor-moving forces -induction voltage -inductivity	**Magnetism** magn. lines of forces of: -permanent magnets -current-carrying conductor -current-carrying coil -magnetizing diagrams **Contactors and Relays** -symbols -on-off circuit -interlocking -sequence control -bell circuit -diagrams incl. inductances

SYLLABUS FOR APPRENTICES TRAINING GENERAL ELECTRICIAN TRADE			Months 13-18 (Semester 3)
Unit No.	Trade Theory	Related Mathematics	Technical Drawing
14	Alternating Current I (coils) -origin of AC -basic quantities of AC -ohmic resistance in AC -coil in AC -combination of resistance and coil -principle of transformer	Alternating Current I -induction voltage in AC -basic quantities of AC -frequency of the induced volt. -instantaneous values -effective values -reactance -power of reactance -series conn.of resr. and coil -power of AC resistances -transformer ratios	Alternating Current I -line diagrams -vector diagrams -diagrams for I and E -diagrams for P, ohmic load -diagrams with induct. load -diagrams with ohmic and inductive load -shapes of transformer cores -simple transformer circuit
15	Alternating Current II (capacitors) -capacitors -capacitor in DC -construction of capacitors -capacitor in AC -combination of resistance and capacitance -compensation of reactive power -RCL circuit	Alternating Current II -determinating values of a capacitor -charging time -connection of capacitors -capacitive resistance -power of a capacitor -series conn. of resr. and capr. -compensation of reactive power	Alternating Current II -electric field -RC unit -types of capcitors -diagrms of I and E, (capacitive load) -diagram of reactive power -motor starting capacitor -series circuit (RCL)

SYLLABUS FOR APPRENTICE TRAINING GENERAL ELECTRICIAN TRADE			Months 19-24 (Semester 4)
Unit No.	Trade Theory	Related Mathematics	Technical Drawing
16	Three-Phase Current -generation of three-phase current -star connection -delta connection	Three-Phase Current -interlocking of current and voltage -three-phase power	Three-Phase Current -three-phase line diagram -distribution system -star-delta connection
17	Protective Methods -general introduction -protection with and without Protective wire -motor protective switches	Selection of Conductors and Fuses -standardization of conductors -selection of fuses -earthing and loop resistance -testing the loop resistance	Protective Methods -layout diagram with particulars of cables and fuses -protective appliances -earthing in three-phase system -fault current protection -motor protective switch
18	Measuring Methods -moving iron instrument -moving coil instrument -electro-dynamic instrument -construction of meters -symbols and classifications -determination and measurement of resistance -measuring three-phase power -energy meters	Measuring Methods -extension of current and voltage range -measuring low and high resistances -errors of measurement -Wheatstone bridge -calculating power from measurements -determining power factor	Measuring Methods -internal connection of multimeter and ohmmeter -ammeter and voltmeter to determine resistance -symbols on meters -measuring power and power factor -energy meter
19	Cells and Batteries -electrolysis -galvanic cell -storage battery	Cells and Batteries -deposition of substances due to electrolysis -terminal voltage -connection of cells -capacity and efficiency of batteries	Cells and Batteries -connection of cells -measuring device for batteries -charging and discharging

SYLLABUS FOR APPRENTICE TRAINING GENERAL ELECTRICIAN TRADE			Months 25-30 (Semester 5)
Unit No.	Trade Theory	Related Mathematics	Technical Drawing
20	Transformers -fundamentals -construction and types -instrument transformers -three-phase transformers -vector groups	Transformers -voltage and current ratios -open-circuit and short-circuit voltage -ratio of instrument transfrs. -ratios for three-phase transfrs. -efficiency	Transformers -connection diagrams of: single-phase transformer tapped transformer instrument transformer set three-phase transformer -vector diagrams
21	Synchronous Generators -construction -functioning -excitation -synchronization	Synchronous Generators -number of revolutions -induced voltage -layout of winding	Synchronous Generators -rotary magnetic field of: one pole pair two pole pair -alternator with synchronizing equipment
22	Induction Motors -working principle -slip-ring motors -squirrel-cage motors -Dahlander connection -starting methods -single-phase motors	Induction Motors -number of revolutions, slip -power consumption -power factor and compensation -capacitor layout -layout of winding -pole pairs and number of slots	Induction Motors -starting connections -reverse connection -Dahlander connection -single-phase motor with: auxiliary winding starting capacitor
23	DC-Generators -principle of producing DC -types of excitation -shunt generator -compound generator	DC-Generators -terminal voltage and EMF -internal resistance & voltage drop -power and efficiency -generator characteristics	DC-Generators -terminal boards -seperately excited generator -shunt generator -compound generator

SYLLABUS FOR APPRENTICE TRAINING GENERAL ELECTRICIAN TRADE			Months 31-36 (Semester 6)
Unit No.	Trade Theory	Related Mathematics	Technical Drawing
24	DC-Motors -principle of DC-motors -shunt- and series motors -compound motors -armature reaction & interpoles	DC-Motors -rated and starting current -starting resistance -efficiency -motor characteristics	DC-Motors -shunt motor -series motor -compound motor -motor with interpoles
25	Single-Phase Commutator Motors -series motor -repulsion motor	Operating Values of Motors -number of revolutions -current, power, torque	Winding Diagrams -layout of armature winding -layout of stator winding
26	Rectifiers -valve rectifier -semi-conducting materials -semi-conducting rectifiers	Rectifiers -characteristic diagram -number of discs and disc area -voltage values	Rectifiers -half-wave rectifier -full-wave rectifier
27	Power Generation & Distribution -power plants -transformer stations	Voltage Drop and Selection of Proper Service Lines -for DC -for AC, single- & three-phase	Sketches of Transmission Systems -network (grid) system -transformer station
28	Lighting Systems -bulbs -fluorescent tubes -mercury lamps -high-voltage-discharge-lamps	Lighting Systems -lumination values -luminous efficiency -lighting requirements in houses, shops, factories	Lighting Systems -connection diagrams of fluorescent lamps -connection for high-voltage-discharge-lamp -layout diagrams of factory lighting systems
29	Regulations -for building installation -for transmission systems	Review	
30	Review		Review

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