TRADE : REFRIGERATION MECHANIC (COMMERCIAL)

MODULE	CODE	OBJECTIVES	CRITERIA
INDUCTION	ID1	Recall applicable sections of the Manpower Training (Act No 56, 1981), with special reference to discipline and legal responsibilities.	Pass a questionnaire with at least 80%.
	ID2	Recall terms and conditions of apprenticeship as Gazetted 26 July 1991.	Pass a questionnaire with at least 80%.
	ID3	Recall applicable grievance procedures.	Pass a questionnaire with at least 80%.
	ID4	Recall applicable disciplinary procedures.	Pass a questionnaire with at least 80%.
	ID5	Recall company rules and procedures.	Pass a questionnaire with at least 80%.
	ID6	Recall quality assurance procedures.	Correct according to company standards and procedures with a minimum of five (5) questions and 100% pass.
SAFETY	SF1	Recall relevant regulations of the following Act; (where applicable) – **Occupational Health and Safety Act (Act No 85, 1993)** – Minerals Act and Regulations (Act No 50, 1991).	Pass a questionnaire with at least 80%.
	SF2	Attend a standard industrial safety course accredited by the industry.	Obtain a recognised certificate.
	SF3	Recall safety in welding and gas cutting.	All safety aspects correct according to accredited procedures.
	SF4	Attend a first aid course.	Obtain a recognised certificate - 1st level.

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	SF5	Identify relevant colour markings and symbolic safety signs.	Correct use of SABS 0140 and SABS 1186 publications.
HAND TOOLS	HT1	Identify measuring, checking, forming, cutting, marking and fastening tools and tooling aids.	Correctly identified all the tools and state their physical characteristics.
	HT2	Use measuring, checking, forming, cutting, marking and fastening tools and tooling aids.	(a) Measuring and marking tools - 1,0mm accumulative dimensional tolerance and 2° on angular tolerance. (b) Checking tools - 0,5mm dimensional tolerance. (c) Forming, cutting and marking tools - correct application. (d) All safety aspects adhered to.
	HT3	Maintain measuring, checking, forming, cutting, marking and fastening tools and tooling aids.	Tools in a safe and functional working condition.
	HT4	Use hand tools applicable to the trade.	1. All safety aspects adhered to. 2. No tools or equipment is damaged. 3. All tools and equipment are clean after use.
WORKSHOP TOOLS	WT1	Use fixed and portable drilling machines.	1. Correct speeds and feeds to be used. 2. Holes to be within 0,5mm of centre. 3. Correct cutting compounds to be used.
	WT2	Use fixed and portable grinding machines including replacing, setting, truing and ringing of wheels.	All prescribed safety standards applied.
	WT3	Use a portable jig-saw.	1. All safety aspects are adhered to. 2. No equipment is damaged 3. All tools and equipment are clean after use.
	WT39	Use power tools.	1. All safety aspects adhered to. 2. No damage to components and equipment.

MODULE	CODE	OBJECTIVES	CRITERIA
	WT20	Use hand operated presses.	1. All safety aspects adhered to. 2. No damage to components.
	WT22	Dress a grinding wheel.	Wheel must be concentric.
MATERIALS	MA1	Recall terms, definitions and use of materials pertaining to the trade with special reference to plates, tubes, pipes and hollow sections.	Minimum of 15 questions with at least 80% pass.
	MA2	Recall the physical properties and characteristics of metals.	Minimum of 15 questions with at least 80% pass.
	MA3	Identify ferrous and non-ferrous metals.	Each type of material correctly identified.
	MA5	Identify metal defects visually.	100% correct.
	MA16	Recall the use and application of valves and fittings applicable to the trade.	Minimum of 15 questions with at least 80% pass.
	MA17	Recall the different materials associated with various refrigerants.	Minimum of 10 questions with at least 80% pass.
DRAWINGS AND SKETCHES	DS1	Recall terms and definitions pertaining to engineering drawings.	A test of minimum 15 questions to be set with 100% pass mark against SABS 044 Part 1 and SABS 0111.
	DS2	Interpret relevant symbols, abbreviations and tolerances.	A test of minimum 20 questions to be set with a 100% pass mark against SABS 044, Part 2 and SABS 0111.
	DS36	Compile material lists from drawings.	All items, descriptions and specifications to be noted correctly.

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	DSE1	Recall symbols and abbreviations used on electrical circuits for schematic and wiring diagrams, connection schedules, layouts and single-line drawings.	A test of minimum 25 questions to be set with an 80% pass mark in accordance to a recognised code of practice.
	DSE2	Recall symbols and abbreviations as used on engineering drawings.	A test of a minimum 25 questions to be set with an 80% pass mark against SABS 044, Part 2.
	DSE4	Interpret electrical drawings.	Explanation of drawings to be 100% functionally correct.
	DSE5	Interpret engineering drawings.	Correct according to an acceptable code of practice.
	DSE8	Make free hand sketches of existing circuits and installations including mechanical components.	Sketches to be legible and identifiable.
MARKING OFF	MO1	Mark off a drill angle-gauge.	1. All angles to be within $\pm$ 30 minutes. 2. All dimensions to be within $\pm$ 0,25mm.
	MT9	Mark off projects for manufacturing using all standards marking-off techniques and tools.	1. No double lines. 2. Punch hole centres 100% correct. 3. All dimensions to be within 0,25mm. 4. According to specific drawings.
HAND SKILLS	HS1	Fabricate a drill angle-gauge from mild steel.	1. All dimension to be within $\pm$ 0,25mm. 2. All angles to be within 30 minutes. 3. Surface texture N7.
	HS2	Sharpen chisels.	Cutting angle is correct and no mushroom on the chisel head.
	HS3	Sharpen drills.	Angle according to tables and application.
	HS4	Dress screwdrivers.	1. All safety aspects adhered to. 2. Screwdrivers to be functionally correct.

MODULE	CODE	OBJECTIVES	CRITERIA
	HS5	Sharpen punches.	1. All safety aspects adhered to. 2. Correct included angles according to application.
	HS7	Sharpen marking-off tools.	Marking edge to make single scribing lines.
	HS8	Manufacture a project using the following techniques and material: filing, sawing, drilling, tapping, reaming. Material: mild steel.	1. All sizes within 0,05mm. 2. All surfaces flat and square. 3. Surface texture down to N9 according to comparison scale.
ARC WELDING	AO1	Identify and set up AC and/or DC welding machines, equipment including starting up and shutting down procedures.	1. Correct according to manufactures Handbook. 2. All safety aspects adhered to.
	AO2	Differentiate between arc welding consumables.	Correct to manufacturers' specifications.
	AO3	Prepare material for arc welding.	1. Correct according to company welding procedures and practises with regard to weld joint preparation, voltage, amperages and welding consumable. 2. All safety aspects adhered to.
	AO4	Tack and arc weld workpieces incidental to the trade using manual arc welding techniques.	1. Correct according to company quality control procedures. 2. All safety aspects adhered to.
GAS WELDING AND BRAZING	GW10	Identify and set up oxygen-fuel gas equipment including light up, adjustment of gas pressures and shut down procedures.	1. Correct according to manufacturers handbook. 2. All safety aspects adhered to. 3. Selection to correct size nozzles in relationship to material thickness correct according to manufacturers specifications.
	GW11	Differentiate between brazing and gas welding consumable.	Correct according to manufacturers' specifications.

MODULE	CODE	OBJECTIVES	CRITERIA
	GW12	Prepare material for brazing and gas welding.	1. Correct to company brazing and gas welding procedures with regard to joint preparation including brazing and gas welding consumable. 2. All safety aspects adhered to.
	GW13	Braze and gas weld work pieces incidental to the trade.	1. Correct according to company quality control procedures. 2. All safety aspects adhered to.
GAS CUTTING AND HEATING	GC1	Identify and assemble gas cutting and heating equipment, including light up and shut down procedures.	Correct method and procedure according to safety standards.
	GC2	Select nozzles and gas pressures for cutting and heating different materials of various thicknesses.	100% correct according to manufacturers charts.
	GC3	Hand cut and heat materials incidental to the trade.	Company quality standards on finish and with maximum 2mm deviation from line.
BASIC LIFTING TECHNIQUES	BG2	Recall overhead crane signals.	100% correct according to recognised code of practice.
	BG3	Demonstrate overhead crane hand signals.	100% correct according to recognised code of practice.
	BG4	Use the following equipment: – chain block : 2 ton max – coffing block : 2 ton max – shackles : 2 ton max – chain slings : 2,5 ton max – wire rope slings : 20mm diameter	1. Working load not to exceed equipment safe loading capacity. 2. Correct method of slinging. 3. No kinks in wire rope slings and chain slings. 4. No damage to equipment.

MODULE	CODE	OBJECTIVES	CRITERIA
ELECTRICAL TESTING INSTRUMENTS	ET5	Identify and use the following instruments for safety and fault finding as used for electrical systems up to 1200 volts: voltage tester, multimeter, insulation tester, earth leakage tester, phase rotation tester.	1. Correct test instruments selected for the application. 2. evaluation of test readings. 3. All safety rules to be applied.
CABLES	CA1	Make off and join multi and single core, stranded PVC armoured cable up to 16mm² 4 core, 1200 volt.	1. Glands, ferrules and lugs used to be correct according to manufacturers' specifications. 2. Joint to be electrically and mechanically sound and according to manufacturers' specifications.
	CA2	Identify ratings of cables by current, voltage and temperature.	Correct according to SABS 0142.
	CA4	Terminate PVC cables (up to 1200 volt) for entry into cable end box using mechanical and compression methods.	Correct according to SABS 0142.
INSTALLATION OF MACHINERY	IM3	Install and level a compressor, motor and machine parts on a fabricated base.	1. All safety aspects adhered to. 2. No damage to equipment. 3. Level within 0,05 mm per 1000 mm. 4. Correct position of wedges and packings.
	IM4	Install a commercial refrigeration systems of maximum capacity of 10 kW refrigeration at 0° C including pipe work.	100% correct according to drawing specifications.
AC MACHINES	AC5	Connect the following AC machines: – single phase induction motors – 3 phase squirrel cage induction motors	1. Rotation 100% correct. 2. Correct according to SABS 0142. 3. All connections electrically and mechanically sound.
	AC6	Test the following AC machines: . single phase induction motors . 3 phase squirrel cage induction motors	1. Correct according to SABS 0142 test procedures. 2. All connections electrically and mechanically sound.

MODULE	CODE	OBJECTIVES	CRITERIA
	AC7	Fault find the following AC machines: – single phase induction motors – 3 phase squirrel cage induction motors	All faults recorded and required according to SABS 0142 and manufacturers specifications.
FAULT FINDING	FA3	Fault find on the following: control panels and motor control gear.	1. All safety aspects are adhered to 2. Correct test instrument is used. 3. Specification as per drawing is adhered to. 4. All assemblies are correct. 5. All faults are corrected.
	FA4	Fault find refrigeration equipment with the aid of a fault finding guide.	1. All safety aspects are adhered to. 2. Correct test instrument is used. 3. Specification as per drawing is adhered to. 4. All assemblies are correct. 5. All faults are corrected.
	FA5	Fault find air conditioning equipment with the aid of instruments	1. All safety aspects are adhered to. 2. Correct test instruments used. 3. All assemblies correct. 4. All faults corrected.
	FA6	Adjust H.P.L.P. control on commercial equipment.	1. All safety aspects adhered to. 2. Correct L.P. pressure maintain proper temperature and defrost. 3. Correct procedure gauges used. 4. Correct H.P. to protect system.
	FA7	Pump down system.	1. All safety aspects adhered to. 2. Gauges fitted H.P. + L.P. 3. Pump down to positive pressure. 4. Decant receiver if necessary.
	FA8	Fault find electric defrost hot gas. Defrost on low temperature equipment.	1. All safety aspects adhered to. 2. Correct test instruments. 3. Correct procedure. 4. Correct size or in solenoid valve.

MODULE	CODE	OBJECTIVES	CRITERIA
BEARINGS	BE7	Identify the following ball bearings - deep groove, angular, contact, self-alignment and thrust.	100% correct.
	BE8	Identify the following types of roller bearings - spherical, thrust, taper and cylindrical.	100% correct.
	BE9	Fit a ball bearing to a shaft using a hand operated press, sleeve, oil bath and induction heater.	1. No damage to components and equipment. 2. Fits according to ISO R286 standard. 3. Correct bearing load application. 4. No shock loads applied to bearing. 5. Maximum heating temperature 110° celsius. 6. Correct speed application.
	BE10	Remove a ball bearing from a shaft using a bearing puller or hand operated press.	No damage to components.
DRIVES	DR12	Identify belt drives.	100% correct.
	DR2	Identify A, B and C class V-belts.	100% correct.
	DR3	Install and align a single belt drive.	1. Tension set according to 1mm per 100mm span length per kilogram force. 2. Aligned within 0,05mm.
	DR4	Install and align match set belt drives.	1. Tension set according to 1mm per 100mm span length per kilogram force. 2. Aligned within 0,05mm.
	DR7	Maintain belt drives.	1. Groove according to standard V-belt gauge. 2. No scorch marks on belts. 3. No axial movement of pulleys.
ASSEMBLIES	AS3	Identify the following types of fits on shafts and hole basis - clearance, transition, interference.	All tolerances within ISO standard hole basis system.

MODULE	CODE	OBJECTIVES	CRITERIA
	AS7	Fit and dismantle a taper lock bush.	1. No damage to components. 2. Only extractor screws to be used.
	AS8	Fit seals to components.	1. No damage to components. 2. Sealing direction 100% correct.
	AS9	Recall the principles, operation and reason for installation of oil separators.	1. Refrigerant flow correct. 2. Oil change in separator. 3. Shut off valve in oil return line.
	AS10	Recall principles of operation and uses of reversing valve.	1. Pipes connected correctly. 2. No heat to body of valve. 3. Solenoid coil nut tight. 4. No loose connections.
	AS11	Recall principles, operations and uses of back pressure regulating valve.	1. Correct position. 2. Correct setting.
	AS12	Recall principles of operation and use of oil pressure switch.	1. Correct setting. 2. Correct type. 3. Manual reset.
REFRIGERATION	RF2	Recall basic refrigeration systems and identify the major components and state their uses.	Correct according to SABS 0147 code of practice.
	RF6	Evacuate refrigeration systems.	Correct according to company and manufacturers' specifications and procedures.
	RF7	Charge refrigeration systems including self-contained system with dial a charge.	Correct according to company and manufacturers' specifications.
	RF9	Recall the different types of refrigerants.	Minimum of 10 questions with at least 80% pass.
	RF10	Recall the various terms used in the refrigeration industry.	Correct according to SABS 0147.

MODULE	CODE	OBJECTIVES	CRITERIA
	RF11	Identify the following types of expansion devices and controls- capillary tubes, automatic expansion valves (with internal and external equaliser), distributors, thermostats, pressure switches, oil pressure safety controls and pressure relief devices.	Minimum of 10 questions with at least 80% pass.
	RF12	Recall the principles of operation of the following types of expansion devices and controls- capillary tubes, automatic expansion valves (with internal and external equaliser), distributors, thermostats, pressure switches, oil pressure safety controls and pressure relief devices.	100% correct.
	RF14	Carry out a pressure test on equipment/plant.	100% correct.
	RF15	Commission refrigeration equipment/plant.	System operates 100% correct according to manufacturers and drawing specifications.
	RF16	Clean contaminated systems.	1. Correct procedures. 2. No F11 to be used. 3. 5 questions 100% pass. 4. Acid test on oil.
	RF17	Recall all the effects of moisture in a system.	1. 100% correct. 2. Minimum 10 questions 100% pass.
	RF18	Recall all effects of air in a system.	1. 100% correct. 2. Minimum 5 questions 100% pass.
	RF19	Diagnose faults due to partial and complete blockage in a system.	1. Bubbles in sight glass. 2. Drier sweating. 3. Short cycling. 4. Clear sight glass.

MODULE	CODE	OBJECTIVES	CRITERIA
CONDENSERS AND COOLING TOWERS	CT1	Identify the following types of condensers and cooling towers - air, water, evaporative, forced and induced draft cooling towers and industrial water coolers.	100% correct.
	CT2	Recall the principles of operation of condensers and cooling towers - air-cooled, water cooled, evaporative, forced and induced draft cooling towers and industrial water coolers.	Minimum of 10 questions with 80% pass.
	CT3	Maintain the following condensers and cooling towers - air-cooled, water cooled, evaporative, forced and induced draft cooling towers and industrial water coolers.	Correct according to maintenance procedures.
EVAPORATORS	EV1	Identify the following types of evaporators - plate, bare and finned pipe, shell and tube.	100% correct.
	EV2	Recall the operation of the following types of evaporators -plate, bare and finned pipe, shell and tube.	Minimum of 10 questions with 80% pass.
	EV3	Maintain the following types of evaporators - plate, bare and finned pipe, shell and tube.	Correct according to maintenance procedures.
ACCESSORIES	ACS1	Identify the following accessories - liquid receiver, accumulator, muffler, filter drier, sight glass, service valves, oil separator, crankcase heater, vibration isolator, shut-off valve, solenoid valve, heat exchanger and a schraeder valve.	100% correct.

MODULE	CODE	OBJECTIVES	CRITERIA
	ACS2	Recall the operation of the following accessories- liquid receiver, accumulator, muffler, fitter drier, sight glass, service valves, oil separator, crankcase heater, vibration isolator, shut-off valve, solenoid valve, heat exchanger and a schraeder valve.	Minimum of 10 questions with 80% pass.
	ACS3	Maintain the following accessories- liquid receiver, accumulator, muffler, fitter drier, sight glass, service valves, oil separator, crankcase heater, vibration isolator, shut-off valve, solenoid valve, heat exchanger and a schraeder valve.	Correct according to maintenance procedures.
FANS	FN4	Identify the following fans- propeller, axial flow and centrifugal.	Identified 100% correct.
	FN5	Recall the operation of following fans- propeller, axial flow and centrifugal.	100% correct.
	FN6	Service the following fans- propeller, axial flow and centrifugal.	Correct according to maintenance procedures.
COMPRESSORS	COM7	Identify the following compressors- – reciprocating – screw – open – hermetic – semi-hermetic	100% correct.
	COM8	Recall the operation of the following compressors- – reciprocating – screw – open – hermetic – semi-hermetic	Minimum of 10 questions with 80% pass.

MODULE	CODE	OBJECTIVES	CRITERIA
	COM9	Maintain the following compressors- – reciprocating – screw – open – hermetic – semi-hermetic	Correct according to maintenance procedure.
LUBRICATION	LU1	Identify the following types of lubrication systems: force-feed, splash-feed and gravity-feed.	100% correct.
	LU2	Recall the requirements for refrigeration oils.	1. Correct handling procedures. 2. No contamination. 3. Correct viscosity of oil for compressor according to manufacturer.
	LU3	Diagnose faults in a force feed system.	1. No dirt contamination in system. 2. All blockages detected. 3. All outlets to deliver set amount of grease. 4. All in-line filters clean.
INSULATION (LAGGING)	INS1	Recall the necessity for insulation.	100% correct.
REFRIGERATION SYSTEMS	RSY1	Identify different refrigeration systems.	100% correct according to SABS 0147 code of practice.
CODE OF PRACTICE	COD1	Recall the applicable regulations of the SABS 0147 code of practice.	Minimum of 10 question with 80% pass.
THEORETICAL TRAINING		A four subject pass is needed to obtain the N course. Mathematics and the relevant trade theory subject is compulsory. A further two relevant subjects must be chosen by the employer, college and apprentice in order to obtain the four subjects required for the course.	

TRADE : REFRIGERATION MECHANIC (COMMERCIAL)

MODULE	CODE	OBJECTIVES	CRITERIA
	TT1	Mathematics N1 Refrigerator Trade Theory N1 Plus two relevant subjects N1	Obtain a four subject certificate.
	TT2	Mathematics N2 Refrigerator Trade Theory N2 Refrigeration Technology N2 Plus one relevant subject N2 "Should the apprentice have a qualification higher than that prescribed in the schedule, it must be ensured that the subjects are relevant to the trade in question, before a trade test date will be allocated."	Obtain a four subject certificate.
ON THE JOB EXPERIENCE AND INDEPENDENT WORK	EX1	On the job experience and independent work should cover at least 80% of all modules to ensure as wide as possible field of experience and must take place under supervisory control.	All work done to be recorded with respect to performance levels.

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