Eskom	Standard	Technology

Title: **INSTALLATION OF HVAC EQUIPMENT – WINDOW / CONSOLE / SPLIT UNITS**

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Content

1. Introduction

This standard is compiled to assist staff in performing installation activities on HVAC & R plant in an identical way and consistent manner.

2. Supporting Clauses

2.1 Scope

To formalize the required tests to be done, as well as methods, precautions and check sheets to be adhered to when installing window / console / split units.

2.1.1 **Purpose**

The purpose of this document is to capture general guidelines and rules to be adhered to when performing work activities on mentioned HVAC & R plant.

2.1.2 **Applicability**

This standard is applicable where PTM (including contractors in PTM service or under PTM supervision) is rendering a service to a client with regards to installation of HVAC equipment – window / console / split units.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 **Normative**

[1] ISO 9001 Quality Management Systems

[2] TOPAC-002, Installation of HVAC equipment

2.2.2 **Informative**

[1] None

2.2.3 **General**

Definition	Description
Check	Examination, recording, deduction or calculation and proposal for corrective action if necessary.
Components	The individual parts which each piece of equipment exists out of.
Condition	The state in which equipment and components have to perform to optimum.
Equipment	All the structures as well as electrical and mechanical machinery required to obtain the expected level of performance applicable.
Mechanisms	Clusters or groups of components or even one component to perform a specific action or task at a given time.
Installation	A large piece of equipment installed for controlling the humidity, ventilation, and temperature in a building, typically to maintain a cool atmosphere in warm conditions.

2.3 Abbreviations

Abbreviation	Description
HIRA	Hazard identification and risk assessment
OHS Act	Occupational Health and Safety Act
ORHVS	Operating Regulations for High Voltage Systems
PPE	Personal Protective Equipment

3. Document Content

3.1 Safety

It is the responsibility of each person to ensure that the correct plant is isolated according to a specific regulation (ORHVS or Plant Safety) a permit has been issued, all staff has signed the workers register, a proper job brief has been done and that the days HIRA were completed. Adhere to the OHS Act.

No	Possible risks, hazards and danger	Compulsory required precautionary measures
1	Physical electrical contact during testing.	a) All equipment used must adhere to OHS Act. b) Use all test equipment according to prescribed procedures and manuals. c) Unauthorised access prohibited (Only PTM staff, barricading tape, lock gates, etc.) d) Ensure that plant is properly earthed and that the earthing arrangement meets the requirement of the isolations and at the point where work has to be performed. On the LV supply there is no earth facility and isolation is still required.

2	Safe Handling of Refrigerants	a) Ensure that safe handling of refrigerants certificate is valid and MSDS for the refrigerant are reviewed. b) Wear safety goggles and gloves at all times when handling refrigerants or servicing a refrigeration system. c) Wear the proper respiratory protection while working with refrigerants. Check the MSDS for the proper level of protection required. d) Proper ventilation or respiratory protection is required for any work on equipment in an enclosed area where a leak is suspected. e) Always ventilate or test the atmosphere of an enclosed area before beginning work. Many refrigerants which may be undetectable by human senses are heavier than air and will replace the oxygen in an enclosed area causing loss of consciousness. f) Inhaling refrigerants can cause sudden death. Intentional inhalation of refrigerants to produce intoxication can cause the heart to cease functioning properly and may be fatal. g) Refrigerant cylinders should never be filled over 80% of their capacity (liquid expansion may cause the cylinder to burst). h) Inspect refrigerant cylinders regularly. Do not use the cylinders if they show signs of rust, distortion, denting, or corrosion. Store cylinders secured and upright in an area where they will not be knocked over or damaged.
3	Packaging Material	a) Safely dispose of the packing materials. b) Packing materials, such as nail and other metal or wooden parts may cause stabs or other injuries. Tear apart and throw away plastic packaging bags appropriately.
4	High elevated position. Work that needs to be performed at an elevated level.	a) Compulsory use of safety belt / harness is required when the possibility exists that a person can fall from an elevated position. b) Complete Q-411 and send to SHEQ office
5	Slippery surfaces, oil spillages, leaks, etc.	a) All slippery surfaces to be kept clean before commencing with work. b) Avoid spillages.
6	Use of scaffolding.	a) Safe for use sign displayed. b) Access ladder fitted. c) No openings in/on platform. d) Kick plates fitted. e) Handrails fitted.
7	Personnel injury.	e) Wear PPE.
8	Unsafe working conditions.	f) Report any unsafe act / condition.

3.2 Indoor Unit Installation

3.2.1 Installing the mounting plate

(1) The mounting plate should be installed on a wall which can support the weight of the indoor unit.

(2) Temporarily secure the mounting plate to the wall, make sure that the plate is completely level, and mark the boring point on the wall.

(3) Secure the mounting plate to the wall with screws.

3.2.2 Drilling a hole through the wall for inter connecting piping and cables

(1) Drill a feed through hole of 3-1/8 inch (80mm) in the wall so it has a down slope towards the outside.

(2) Insert a wall pipe into hole.

(3) Insert a wall cover into wall pipe.

(4) After completing refrigerant piping, wiring, and drain piping, close pipe hole gap with putty.

3.2.3 Refrigerant Tubing

3.2.3.1 Use of the Flaring Method

Many of the conventional split system air conditioners employ the flaring method to connect refrigerant tubes which run between indoor and outdoor units. In this method the copper tubes are flared at each end and connected with flare nuts.

3.2.3.2 Flaring Procedure with a Flare Tool

(1) Cut the copper tube to the required length with a tube cutter. It is recommended to cut approx. 12” to 20” (30 to 50cm) longer than the tubing length you estimate.

(2) Remove burrs at the end of the copper tube with a tube reamer or file. This process is important and should be done carefully to make a good flare.

(3) When reaming, hold the tube end download and be sure that no copper scraps fall into tube.

(4) Remove the flare nut from the unit and be sure to mount it on the copper tube

(5) Make a flare at the end of the copper tube with a flare tool.

(6) A good flare should have the following characteristics:

- Inside surface is glossy and smooth
- Edge is smooth
- Tapered sides are of uniform length

3.2.3.3 Caution before Connecting Tubes Tightly

(1) Apply a sealing cap or water- proof tape to prevent dust or water from getting into the tubes before they are used.

(2) Apply refrigerant lubricant to the matching surfaces of the flare and union before connecting them together this is effective for reducing gas leaks.

(3) For proper connection, align the union tube and flare tube straight with each other, and screw - in the flare nut lightly at first to obtain a smooth match.

3.2.3.4 Caution before Connecting Tubes Tightly

(1) Tightly connect the indoor side refrigerant tubing extended from the wall with the outdoor side tubing. To fasten the flare nuts, apply torque as specified in table below:

Tube Diameter	Nut Size	Tightening Torque
¼"(6.35 mm)	21/32" (17mm)	Apprx.120-160 lbs. in (140-180kgf cm)
3/8" (9.52 mm)	7/8" (22mm)	Approx.300-360lbs in (340-420kgf cm)
½"(12.70 mm)	1-1/32" (26mm)	Approx. 430-480 lbs. in (490-550kgf cm)
5/8"(15.8 mm)	1-5/32" (29mm)	Approx. 590-710 lbs. in (680-820kgf cm

(Table 1)

3.2.3.5 Insulation of Refrigerant Tubing

(1) To prevent heat loss and wet floors due to dripping of condensation, both tubes must be well insulated with proper insulation material. The thickness of the insulation should be a minimum 5/6" (8 mm).

(2) After the tube has been insulated, never try to bend it into a narrow curve as this may cause the tube to break or crack.

(3) After finishing insulation and taping over the tubing, use sealing putty to seal off the whole in the wall to prevent rain and draft from entering.

3.2.3.6 Insulation of Refrigerant Tubing

(1) Air and moisture remaining in the refrigerant system have undesirable effects as indicated below and therefore needs to be purged completely:

- Pressure in the system rises.
- Operating current rises.
- Cooling (or heating) efficiency drops.
- Moisture in the air my freeze and block capillary tubing.
- Water may lead to corrosion of parts in the refrigerant system.

3.2.3.7 Pressurize the piping with Nitrogen gas, and test for leaks

(1) Check that each tube (both narrow and wide tubes) between the indoor and outdoor unit have been properly connected and all wiring for the test run has been completed. Note that both narrow and wide tube service valve on the outdoor unit are kept closed at this stage.

(2) Using an adjustable wrench or box wrench, remove the valve caps from the service valve on both narrow and wide tubes.

(3) Connect the low-pressure side of the manifold (blue line) to the suction valve (wide pipe) of the system.

(4) Connect the service line of the manifold (the middle valve on the manifold) to the nitrogen gas cylinder.

(5) With both valves on the manifold closed, open the nitrogen gas cylinder valve.

(6) Using the pressure regulating valve connected to the nitrogen cylinder, adjust the pressure to the desired testing pressure +-600-800kpa.

(7) Open the low-pressure side valve on the manifold to pressurize the piping.

(8) Once the low pressure gauge on the manifold reads the same pressure as the one on the nitrogen regulator, close the low pressure valve on the manifold and take note of the reading.

(9) Use water and soup solution test for leaks on all piping connections (flair connections, or sweat-on joints).

(10) Bubbles will indicate a leak. If any leak is observed, close the nitrogen cylinder valve and discharge the nitrogen gas from system, and repair a leaking joint. (after repairing a leak repeat step 5-9 to ensure that the system is leak proof).

(11) Release the nitrogen from the system and prepare the system for evacuation.

(12) Connect a vacuum pump and a manifold valve (with pressure gauges) to the service port on the wide tube service valve.

(13) The service port on the wide tube service valve uses a Schrader core valve to access the refrigerant system. The valve core is similar to those used in automobile tires. Therefore, be sure to use a vacuum hose connector which has a push pin inside.

(14) Be sure to use a manifold valve for air purging if it is not available, use a stop valve (field supply for this purpose. The “HI” knob of the manifold valve must always be kept closed.

(15) With the “Lo” knob of the manifold valve open, run the vacuum pump. The operation time for the vacuum pump varies with tubing length and capacity of the pump. The following table shows the amount of time required for evacuation.

Required time for evacuation when 100 liter/h vacuum pump is used	
10 If tubing length is less than 33.ft (10m)	If tubing length is more than 33 ft. (10m)
10 min. or more	**15 min. or more**

(Table 2)

(16) With the vacuum pump still running, close the “lo” knob of the manifold valve. Then stop the vacuum pump.
(17) Be sure to completely insert the hex wrench before attempting to turn the valve.
(18) With the hex wrench, turn the wide tube service valve stem counter – clockwise to fully open the valve.
(19) Turn the narrow tube service valve stem counter- clockwise to fully open the valve.

(20) Loosen the vacuum hose connected to the wide tube service port slightly to release the pressure. Then, remove the hose.

(21) Fasten the valve cap on the wide tube service port securely with an adjustable wrench or box wrench. Next, mount the valve cap on the service valve and tighten it to 170 lbs. in (200 kgf cm) with a torque wrench. This process is very important to prevent gas from leaking from the system.

(22) Tests run the Air-Conditioning unit.

(23) While the air conditioner is running , apply liquid soap and check for any gas leak around the service valves or caps

(24) If there is no leakage, stop the air conditioner.

(25) Wipe off the soap on the tubing.

3.3 Outdoor Unit Installation

(1) Choose a place as cool as possible that is well ventilated.

(2) Install in a location where at least two sides are unobstructed, so that the flow of air at the intake port or exhaust port is not blocked, and so that sufficient space is ensured for maintenance to be carried out without trouble. In general the top also must be unobstructed.

(3) Provide a solid above ground level to reduce humidity and protect the unit against possible water damage and decreased service life.

(4) Install cushion rubber under unit's feet to reduce vibration and noise.

(5) Use lug bolts or equal to bolt down unit, reducing vibration and noise.

3.4 Remote Controller Installation Position

3.4.1 The remote controller can be operated from either a non-fixed position or a wall-mounted position. To ensure that the air conditioner operates correctly, do not install the remote controller in the following places:

- In direct sunlight.
- Behind a curtain or other place where it is covered.
- More than 8 m away from the air conditioner.
- In the path of the air conditioner's airstream.
- Where it may become extremely hot or cold.
- Where it may be subject to electrical or magnetic interference.
- Where there is an obstacle between the remote controller and the air conditioner

3.4.2 Mounting on a Wall Before mounting the remote controller, press the ON/OFF operation button at the mounting location to make sure that the air conditioner operates from that location. The indoor unit should make a beeping sound to indicate that it has received the signal.

3.5 Pump Down

3.5.1 Pump down means collecting all refrigerant gas in the system back into the outdoor unit without losing any of the gas. Pump down is used when the unit is to be moved or before servicing the refrigerant circuit. The pump down procedure is as follow:

(1) Carry out pump down with the unit in cooling mode.

(2) Connect the Low side charging hose of the manifold valve to the service port on the wide tube service valve.

(3) Using a hex wrench, turn the narrow tube service valve clockwise all the way to close the service valve and confirm that the wide tube service valve is fully open.

(4) Press the operation button and start cooling operation.

(5) When the low pressure gauge reading falls to 14.2 to 7.1 psi (1 to 0.5 kg/cm2), fully close the wide tube valve stem. Then quickly stop the unit.

(6) Disconnect all gauges and hoses, and replace the valve caps as they were before

4. General Precaution on Wiring

(1) Before wiring, confirm the rated voltage of the unit as shown on its nameplate, then carry out the wiring closely following the wiring diagram

(2) Provide a power outlet to be used exclusively for each unit, with a power supply disconnected and circuit breaker for overcurrent protection provided in the exclusive line

(3) To prevent possible hazards due to insulation failure, the unit must be grounded.

(4) Each wiring connection must be done tightly and in accordance with the wiring system diagram. Wrong wiring may cause the unit to malfunction or become damaged.

(5) Do not allow wiring to touch the refrigerant tubing, compressor or any moving parts of the fan.

(6) Unauthorized changes in the internal wiring can be very dangerous. The manufacturer will accept no responsibility for any damage or malfunction that occurs as a result of such unauthorized changes.

5. Installation Records

1. Maintenance records should be completed in accordance with the approved check sheet – TOPAC-002/1.
2. Check sheet TOPAC-002/1 must be completed in full, with accurate and relevant information in neat legible hand writing.
3. The latest revision of the check sheet is saved on Hyper-wave and may be printed in order to keep records of maintenance and breakdown work completed.
4. The serial numbers of evaporator and condenser units are compulsory. Location and model numbers are equally important for record purposes.
5. All installation records to be kept for a period of three years from date of installation.
6. Document or records older than three years must be archived appropriately. It should be noted that all results obtained from any test done should be recorded. If the check sheet used does not make provision for additional measurement recorded it should be added.

6. Training Providers

Where possible, course should be provided internally at Eskom Academy of Learning (EAL). In the event, that this is not possible, external training providers that are appointed according to Eskom's procedures and standards could be used.

7. Authorisation

This document has been seen and accepted by:

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8. Revisions

Date	Rev	Compiler	Remarks
18 January 2018	0.1	R Niranjan	Document revised and transferred to Eskom format.
12 May 2024	0.2	R Niranjan	Document reviewed.

9. Development team

The development team consisted of:

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