

TRAINER MANUAL

Practical Exercise Module A\_PE\_1\_Placing and mounting of a split AC system

Level 0

<p><b>Objectives:</b></p>	<p>Participants gain knowledge and skills in:</p> <ol style="list-style-type: none"> <li>1. Placing and mounting of a split AC system, indoor unit (IDU) and outdoor unit (ODU)</li> <li>2. Observation and application of measures for occupational health and safety and accident prevention regulations.</li> <li>3. Observation and application of environmental protection and rational use of material resources and energy.</li> <li>4. Planning and controlling structured work processes, controlling and evaluating work results.             <ol style="list-style-type: none"> <li>4.1 Preparing workstation with consideration of the work task</li> <li>4.2 Planning and defining work steps and procedures</li> <li>4.3 Arrange work tasks for teamwork</li> <li>4.4 Arrange for division of work</li> <li>4.5 Read and interpret written technical information related to the work task</li> <li>4.6 Work based on technical drawings and required dimensional accuracy</li> <li>4.7 Apply verbal and written practices of communication</li> <li>4.8 Select and use appropriate equipment &amp; tools.</li> <li>4.9 Demonstrate knowledge and skills for installation of the split air-conditioning system (work tasks exclude handling of refrigerant and start-up of the condensing unit and evaporator).</li> <li>4.10 Demonstrate knowledge and skills for installation of copper piping together with insulation, electrical cable, condensate drain and weather protection.</li> <li>4.11 Cleaning of installation site, write a report about the installation conditions and prepare the system for handing over for final commissioning.</li> </ol> </li> <li>5. Maintenance and servicing of tools &amp; equipment             <ol style="list-style-type: none"> <li>5.1 Cleaning, maintaining and preserving tools &amp; equipment</li> </ol> </li> </ol>
<p><b>Duration:</b></p>	<p>225 minutes</p>
<p><b>Material:</b></p>	<p>Whiteboard/Blackboard or handout of exercise description</p> <ol style="list-style-type: none"> <li>a. A_PE1_HO_Work description</li> <li>b. A_HO_Last minute risk assessment</li> <li>c. A_HO_Inst Manu Split AC EXAMPLE</li> <li>d. A_HO_Installation protocol Split AC</li> <li>e. A_HO_Table of copper tubes</li> <li>f. A_HO_MSDS_N2</li> <li>g. A_HO_MSDS R32</li> <li>h. A_HO_Safe Isolation Flowchart</li> </ol>
<p><b>Tools &amp; equipment:</b></p>	<ol style="list-style-type: none"> <li>i. 8 x Split AC systems</li> <li>j. 8 x Installation rack or wall brackets for the ODU installation (as applicable)</li> <li>k. 8 x Tube bending tools</li> <li>l. 8 x Electrician screwdriver set (Insulated 1000</li> <li>m. 8 x Electrician pliers set</li> <li>n. 8 x Wire stripper</li> <li>o. 8 x Spirit level</li> <li>p. 8 x Hacksaw and/or hole saw (as applicable)</li> <li>q. 8 x Masonry drill bits (as applicable)</li> </ol>

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	<ul style="list-style-type: none"> <li>r. 8 x marker pens (permanent)</li> <li>s. 8 x steel measuring tapes</li> <li>t. 8 x 8 Screws, fasteners, plugs (for fixation and securing IDU &amp; ODU)</li> <li>u. 8 x Core bits for drilling</li> <li>v. 8 x Hammer</li> <li>w. 8 x Drilling machine</li> <li>x. 8 x Tube bender</li> <li>y. 8 x Adjustable wrench</li> <li>z. 8 x Torque wrench</li> <li>aa. 8 x Piping set (AC manufacturer supply) including insulated refrigerant transfer pipes with industrial flares, condensate drain tube, electrical cabling, wall sleeves, putty and weather protection tape</li> <li>bb. 8 x 2 Flare adapter for refrigerant transfer pipes (as applicable)</li> <li>cc. Clamps or saddles to fix and protect tubing and cabling</li> </ul>
<p><b>Workshop arrangements</b></p>	<p>Workshop is arranged for up to sixteen (16) participants. Provision of eight (8) work benches, eight (8) complete sets of tools.</p> <p>Sufficient workshop space</p>



Figure 1: OEM piping set (example)



Figure 3: Drain hose extension



Figure 1: Training rig "Split air-conditioner" mounted on rack (example)

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TIME	CONTENT	OBJECTIVES	TRAINING MATERIAL	DESCRIPTION OF TRAINING SESSION AND TRAINER NOTES
30'	1. Participants briefing 2. General safety briefing	<b>Participants:</b> <ul style="list-style-type: none"> <li>• Understand the given work-task</li> <li>• Understand the function and configuration of a split air- conditioning system</li> <li>• Are familiar with the required safety arrangements</li> <li>• Are familiar with the local conditions</li> </ul>	<ul style="list-style-type: none"> <li>• A_PE1_HO_Work description</li> <li>• A_HO_Last minute risk assessment</li> <li>• A_HO_Inst Manu Split AC EXAMPLE</li> <li>• A_HO_Installation protocol Split AC</li> <li>• A_HO_Table of copper tubes</li> <li>• A_HO_MSDS_N2</li> <li>• A_HO_MSDS R32</li> <li>• A_HO_Safe Isolation Flowchart</li> </ul>	<u>Plenary</u> <ul style="list-style-type: none"> <li>• Trainer explains work task and executes safety briefing</li> <li>• Trainees build up team</li> <li>• Trainees arrange for division of works</li> <li>• Trainees obtain permit of work</li> </ul>

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<p>100'</p>	<p><b>Preparation of worksite, fit IDU &amp; ODU to wall/stand as per work description</b>            Filling of check-list while executing work-steps:</p> <ul style="list-style-type: none"> <li>• Obtain permit of work, execute risk assessment</li> <li>• Prepare installation sketch</li> <li>• Undertake worksite preparation, tools, equipment and PPE check (having risk assessment in mind)</li> <li>• Safeguard the workshop area and inform involved parties</li> <li>• Unpack split AC equipment IDU &amp; ODU and verify condition (completeness, damages, potential leakages, etc.)</li> <li>• Use AC manufactures' supplied installation materials</li> <li>• Fit indoor unit bracket to wall/stand</li> </ul> <p>Drill hole through wall/stand to accommodate copper tubes, drain tube and electrical cables (as applicable) using a core bit with power drill</p> <ul style="list-style-type: none"> <li>• Mount indoor unit on bracket, feeding tubes and electrical cable through core bit hole</li> </ul>	<p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Obtain knowledge of how to execute a risk assessment at installation site</li> <li>• Learn how to get familiar with using PPE</li> <li>• Obtain knowledge and skills on how to use and prepare tools for execution of the work task</li> <li>• Learn how to unpack split AC equipment IDU &amp; ODU and verify its delivery conditions (completeness, damages, potential leakages, etc.)</li> <li>• Obtain knowledge of how to carry out a check for leakage of the system using an indirect method</li> <li>• Learn how to mark a wall for drilling</li> <li>• Learn how to drill holes for fixing screws and plug them</li> <li>• Learn how to secure indoor unit bracket to wall/stand</li> </ul>	<p>Tools and equipment as specified above</p>	<p>Trainer observes work routine and gives instructions to participants if they have questions. Trainer evaluates work according to outlined criteria with the help of an assessment sheet (will be provided at a later date).</p> <p><u>Group work of 2 participants at one workstation:</u></p> <ul style="list-style-type: none"> <li>• All authorisation was obtained</li> <li>• Installation sketch is presented and acceptable</li> <li>• Installation requirements are verified in line with site conditions and the provided components</li> <li>• Work area is safeguarded</li> <li>• Appropriate PPE is selected in line with the job requirements</li> <li>• Split AC equipment is unpacked, equipment conditions are verified</li> <li>• All necessary tools are in safe conditions and well arranged</li> <li>• Work instructions technical plans/drawings are interpreted as per job requirements</li> <li>• Indoor unit bracket is fitted consistent with the approved designs and specifications</li> <li>• Indoor unit is fitted correctly in a neat and tidy fashion</li> <li>• Outdoor unit brackets are fitted consistent with the approved designs and specifications</li> <li>• Outdoor unit is fitted correctly in a neat and tidy fashion</li> <li>• Workplace arrangements are structured and in clean conditions.</li> <li>• Environmental protection and rational use of material resources and energy was maintained.</li> </ul>
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	<ul style="list-style-type: none"><li>• Mark wall/stand for bracket fixings (as applicable)</li><li>• Drill wall/stand for fixings</li><li>• Fit outdoor unit brackets to wall/stand</li><li>• Mount outdoor unit on brackets and secure in position</li></ul>	<ul style="list-style-type: none"><li>• Learn how to secure outdoor unit brackets to wall/stand</li><li>• Learn how to use core bits to make hole for tubes etc.</li><li>• Obtain knowledge and skills to practically execute indoor unit installation.</li><li>• Obtain knowledge and skills to practically execute outdoor unit installation.</li><li>• Learn how to secure outdoor unit to brackets</li></ul>		
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TIME	CONTENT	OBJECTIVES	TRAINING MATERIAL	DESCRIPTION OF TRAINING SESSION AND TRAINER NOTES
45'	<p><b>Connect indoor unit to outdoor unit with copper tubes as per work description</b></p> <ul style="list-style-type: none"> <li>• Obtain OEM copper tubes supplied with the unit (pre-flared)</li> <li>• Secure one end of each copper tube to indoor unit copper tube flare fittings</li> <li>• Tighten flare nut loosely using 2 spanners to flare fitting on indoor unit (discharge tube first)</li> <li>• Repeat above for larger tube</li> <li>• Bend each copper tube in turn to ensure flare nut on opposite end of tube aligns with fitting on outdoor unit</li> <li>• Repeat above for the suction tube</li> <li>• Tighten all flarings with accurate torques by the use of a spanner and a torque wrench</li> <li>• Introduce holding charge with OFDN (condensing unit ODU is isolated)</li> <li>• Carry out a check for leakage of the system using one of the</li> </ul>	<p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Obtain knowledge and skills to connect indoor unit to outdoor unit with copper tubes.</li> <li>• Know about national applicable standards</li> <li>• Learn how to use OEM provided piping set with industrial manufactured flares</li> <li>• Obtain knowledge and skills how to use tube bending machines</li> <li>• Obtain knowledge and skills how to use (open-end) spanners and a torque wrench and how to select the correct torques for the different flare size</li> <li>• Obtain knowledge and skills how to use pressurise the system with OFDN (holding charge) for tubing and evaporator (ODU is isolated)</li> </ul>	Tools and equipment as specified above	<p>Trainer observes work routine and gives instructions to participants if they have questions. Trainer evaluates work according to outlined criteria with the help of an assessment sheet.</p> <p><u>Group work of 2 participants at one workstation:</u></p> <ul style="list-style-type: none"> <li>• Appropriate PPE is selected in line with the job requirements</li> <li>• All necessary tools are in safe conditions and well arranged</li> <li>• Work instructions technical plans/drawings are interpreted as per job requirements</li> <li>• Installation requirements are verified in line with site conditions and the provided components</li> <li>• Indoor unit and outdoor unit are connected with copper tubes consistent with applicable standards and OEM specifications (man-made flares shall not be accepted)</li> <li>• Tubing and IDU is pressurised with OFDN (holding charge), bubble test is executed</li> <li>• Values and findings of the direct leakage check are recorded</li> <li>• Workplace arrangements are structured and in clean conditions.</li> <li>• Environmental protection and rational use of material resources and energy was maintained.</li> </ul>

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	direct methods which does not entail breaking into the refrigerant circuit of the ODU (e.g. bubble test)	<ul style="list-style-type: none"> <li>• Obtain knowledge and skills how to use execute bubble test</li> <li>• Note down values and findings of the direct leakage check</li> </ul>		
20'	<p><b>Connect indoor unit to outdoor unit with cable. Split system is prepared to be connected to the appropriate power supply</b></p> <ul style="list-style-type: none"> <li>• Obtain wiring diagram (from indoor / outdoor units)</li> <li>• Terminate cable ends as appropriate</li> <li>• Fit cable to correct terminals on indoor unit</li> <li>• Fit cable to correct terminals on outdoor unit</li> <li>• Prepare the system to be connected to a suitable power supply (no work on electrical equipment under voltage)</li> <li>• Check power supply</li> </ul>	<p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Learn how to read simple wiring diagrams</li> <li>• Learn how to select correct cable</li> <li>• Learn how to terminate cable</li> <li>• Learn how to secure cable</li> <li>• Obtain knowledge and skills to electrically connect indoor unit to outdoor unit.</li> <li>• Learn how to prepare the system to be connected to a suitable power supply (no work on electrical equipment under voltage)</li> </ul>	Tools and equipment as specified above	<p>Trainer observes work routine and gives instructions to participants if they have questions. Trainer evaluates work according to outlined criteria with the help of an assessment sheet.</p> <p><u>Group work of 2 participants at one workstation:</u></p> <ul style="list-style-type: none"> <li>• Appropriate PPE is selected in line with the job requirements</li> <li>• Workplace arrangements are structured and in clean conditions.</li> <li>• All necessary tools are in safe conditions and well arranged</li> <li>• Work instructions technical plans/drawings are interpreted as per job requirements</li> <li>• Installation requirements are verified in line with site conditions and the provided components</li> <li>• Indoor unit and outdoor unit are electrically interconnected consistent with the approved designs and OEM specifications</li> <li>• System is prepared to be connected to a suitable power supply (no work on electrical equipment under voltage)</li> </ul>

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				<ul style="list-style-type: none"> <li>Environmental protection and rational use of material resources and energy was maintained.</li> </ul>
20'	<p><b>Connect indoor unit condensate drain hose, routed together with the refrigerant transfer tubes, to a suitable drainage point at the ODU</b></p> <p>Filling of checklist while executing work-steps:</p> <ul style="list-style-type: none"> <li>Obtain suitable flexible condensate drain hose (OEM supply)</li> <li>Route the drain hose together with the refrigerant transfer tubes and electrical cable</li> <li>Check flow of the drain hose (by water injection into the IDU condensate tray)</li> <li>Check drain hose connections for leakage</li> <li>Secure drain hose and cables at indoor unit, outdoor unit and along pipe run</li> <li>Arrange refrigerant tubing with insulation, cables and drain hose to a bundle and wrap the weather protection tape around</li> </ul>	<p>Participants:</p> <ul style="list-style-type: none"> <li>Learn how to get familiar with using PPE</li> <li>Learn how to direct condensate drains</li> <li>Obtain knowledge and skills to connect indoor unit condensate drain to suitable drainage point.</li> <li>Obtain knowledge and skills to route and arrange refrigerant tubes, cables and condensate drain hose to form a pipe bundle</li> <li>Learn how to protect the pipe bundle with weather protection</li> </ul>	Tools and equipment as specified above	<p>Trainer observes work routine and gives instructions to participants if they have questions. Trainer evaluates work according to outlined criteria with the help of an assessment sheet.</p> <p><u>Group work of 2 participants at one workstation:</u></p> <ul style="list-style-type: none"> <li>Indoor unit condensate drain is connected consistent with the approved designs and OEM specifications</li> <li>Condensate flows consistent with the approved designs and OEM specifications</li> </ul>

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	<ul style="list-style-type: none"> <li>Arrange for adequate fixation of the pipes and cable bundle</li> </ul>			
10'	<p><b>Final preparation of the system for handing over for commissioning.</b></p> <p>Filling of checklist while executing work-steps:</p> <ul style="list-style-type: none"> <li>Check the system if placing and mounting is completed</li> <li>Write a handing over report about the condition of the main components and installed supply circuits and (if applicable) identifies any problems that could damage the system and eventually lead to refrigerant leakage or release, should no action be taken.</li> <li>Provide evidence for direct leak detection and holding charge provision with OFDN</li> <li>Cleaning, maintaining and preserving tools, installed equipment and workplace</li> </ul>	<p>Participants:</p> <ul style="list-style-type: none"> <li>Learn how to do a final check of the placed and mounted system</li> <li>Learn how to write hand over reports</li> <li>Learn how to maintain and preserve tools and installed equipment</li> <li>Learn how to do a final cleaning of the workplace</li> </ul>	<p>Tools and equipment as specified above</p>	<p>Trainer observes work routine and gives instructions to participants if they have questions. Trainer evaluates work according to outlined criteria with the help of an assessment sheet.</p> <p><u>Group work of 2 participants at one workstation:</u></p> <ul style="list-style-type: none"> <li>All equipment is installed as projected</li> <li>All reports are provided</li> <li>Tools and working equipment are cleaned and appropriately stored</li> <li>Workplace is presented in clean and well-arranged condition</li> <li>Environmental protection and rational use of material resources and energy was maintained.</li> </ul>
				<p><u>Competency must be assessed through:</u></p> <ul style="list-style-type: none"> <li>Direct observation</li> <li>Demonstration</li> <li>Questions related to required knowledge</li> </ul>

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				<ul style="list-style-type: none"> <li>• Competency may be assessed in the work place or in a simulated work place setting</li> </ul> <p><u>Assessment requires evidence in form of:</u></p> <ul style="list-style-type: none"> <li>• Conducted the relevant risk assessment</li> <li>• Ensured continuous OHS measures</li> <li>• Installation sketch is prepared and presented</li> <li>• Conducted survey of site for placement and installation of IDU &amp; ODU</li> <li>• Conducted survey of site for installation of the copper tubes and other system utilities</li> <li>• Split AC system is fitted consistent with the approved designs and specifications</li> <li>• Considered environmental protection and rational use of material resources and energy.</li> <li>• Reporting of OFDN pressure testing and holding charge (IDU and refrigerant tubing)</li> <li>• Reporting of split system installation and hand-over report preparation</li> <li>• Ensured continuously organised and clean workplace condition</li> </ul>
<b>225 min</b>	Total time			