INSTALLATION AND COMMISSIONING A MONO SPLIT AC





Learning outcomes

 Know the procedure and requirements of installation of SAC according to RACHP standards

21/06/2024

- Know the procedure and basic requirements of commissioning
- ✓Know how to keep a safe working environment
- ✓ Refrigerant circuit flushing with OFDN
- ✓After installation report

Take necessary precautions when working on a system that contains flammable refrigerants. Do a risk assessment to identify necessary precautions

The system should not be mounted at the following sites because of the existing danger of outer influences for a risk of malfunction or failure:

- 1. Places with strong heat sources, combustible gases, vapours or volatiles
- 2. Places evoking high frequency waves, e.g. by radio equipment, medical or welding equipment
- 3. Places with an unusually high salt content in the air
- 4. Places with oil containing air
- 5. Places next to hot sources or geysers because of sulphite gases could be dissolved in the air
- 6. Any other places with specific but comparable conditions to those mentioned above. In case of any doubts refer to the manufacturer or to an authorised service center.

21/06/2024

1.2. General considerations before carrying out work are:

- Ensure to be completely familiar with the equipment and all its details: the installation and/or service manual from the manufacturer should be at hand.
- Ensure all safety material data sheets are at hand to evaluate the potential risk of hazardous substances in use
- Ensure to be familiar with the equipment's purpose and operation
- All electrical operating equipment must be grounded (except battery powered)
- > Electrostatic Discharge (ESD) control must be in place
- Ensure that all refrigerant handling and mechanical handling equipment is available
- Ensure all necessary personal protective equipment is ⁴ available and being used correctly





1.3.RACHP most relevant Safety Standards

Field	Europe	International
Classification (Refs)	-NA- (based on ISO)	ISO817
S States and States	EN378	ISO5149
Refrigerant charge limits and	Euro EN603 <mark>35-2-40</mark>	IEC60335-2-40
safet <mark>y requirements</mark>	EN <mark>60335-2-89</mark>	IEC60335-2-89
100	EN60335-2-24	IEC60335-2-24
Training/qualification	EN ISO 22712:2023-4	ISO 22712:2023-4
Operation of electrical installations	EN50110-2014 (VDE105)	Vasa-
Brazing competencies certification		ISO13585-2012
Qualification of tightness		ISO14903-2017
Pressure equipment for RACHP	EN14276-2017	21/06/2024

1.4. Steps of Installation and commissioning a mono Split



1	Obtain permit of work, execute risk assessment(if needed)	9	Execute installation of all components (IDU, CU, pipes, insulation,) as per OEM installation
2	Undertake worksite preparation, tools, equipment and PPE check (having risk assessment in mind)	10	manual Install IDU & ODU according to provided space of the installation rack and the OEM installation
3	Safeguard the work area and inform involved parties		manual (original equipment manufacturer)
4	Unpack the split AC unit and check IDU and ODU for damages.	11	Execute refrigerant circuit commissioning (pressure testing, evacuation, charging with refrigerant leak test) according to installation
5	Execute leak check at pre-charged ODU		manual
6	Preparation drawing (hand-sketch) indicating important refrigerating system requirements (if	12	Check the system during operation, documenting work results through target and actual values comparison
7			Clean the installation site
	Check compliance of the refrigerating system with	14	Advise the client on how to use the system
8	provided documentation (HO) ⁶ Installation and commissioning split AC Check electrical safety		Cleaning, maintaining and preserving tools and equipment ^{21/06/2024}

2.Installation



7



2.1. Split Air conditionner





The system components are delivered in a preinstalled condition. With delivery, the two main components (indoor- and outdoor-unit) are pressurized and contain the complete refrigerant charge amount of the functional AC system. For installation, besides mounting the indoor and the outdoor unit, it is only necessary to make the connection between the two units



Type of	Security	ODP	GWP
réfrigérant	class		
R22	A1	0.055	1800
R410A	A1	0	2890
407C	A1	0	2090
R32	A2L	0	675
R290	A3	0	3



2.2. Tools and Equipment for Installation

The minimum set of tools and equipment required for installation of air-conditioners are



:1. A screw driver set 2. Phillips head screw driver 3. Knife or wire stripper 4. Steel tape measure 5. Spirit level 6. Hacksaw 7. Core bits for drilling 8. Hammer 9. Drilling machine 10. Tube cutter

10

11. Tube flaring tool 12. Tube bender 13. Torque wrench 14. Adjustable wrench 15. Reamer (for deburring) 16. Refrigeration (thermal) insulation tape 17. Insulated staples for connecting electrical wires 18. Putty

19. Clamps or saddles to protect the refrigerant tubes 20. Thermometer 21. Multi-meter or clamp tester or tong testser. 22. Guage manifold 23. Thermometer 24. Tong tester 25. Clamp meter 26. Brazing equipment 27. Vaccum pump 28, electronic scale 29, recovery equipment

Installation and commissioning split AC

2024

2.3. The installation site – out door unit

- Choose the installation location in a way that noise from the system or outgoing air from the system neither jeopardises nor bothers neighbours, animals or vegetation.
- Make sure to choose an installation location which has free airflow (sufficient air volume) and is dry. Avoid direct sunlight or locations which are subject to strong winds.
- Make sure that walls can stand the weight of the unit and can handle the associated vibration.
- Consider the dimensions diagram during installation in order to achieve good accessibility for maintenance and services and to reduce the risk for material assets.
- Mount the unit out of the reach of children.
- Make sure that walkways are not blocked and that there are no negative influences to the skyline.
- In case of any doubts refer to the responsible authority in the country where the installation Air done.
- In some countries special laws and restrictions for the mounting of split air conditioning units may apply





2.4. The installation site – indoor unit

- 1. Make sure that condensate can flow out easily.
- 2. Keep in mind that the pre-installed pipe-set is exactly 5 m and no modifications are permitted (to shorten or to lengthen the refrigerant tubes) and that connections to the outdoor unit are easy to be set up.
- 3. Easy access to the indoor unit must be ensured for maintenance and servicing purposes such as a change of the filters.
- 4. The indoor unit should be mounted out of the reach of children.
- 5. Make sure that the installation position of the indoor unit can handle the weight of the unit and the associated vibration. At best no additional noise pollution should be generated.
- 6. Keep the unit away from heat sources, flammable and explosive materials.
- 7. The air inlet and outlet vent should not be obstructed, make sure that the air can be blown throughout the entire room.
- 8. There shall be no electric appliance, power switch or socket under the indoor unit.
- 9. There should be a minimum distance of about 1 m from TV-sets or any other electric appliances

2.5. Installation of accessories

The Mounting Plate

Install the mounting plate where the indoor unit will be placed.

Place the mounting plate horizontally, ensuring there is still a slight tilt in order to make sure that condensate will run out unimpeded from the indoor unit.



13

Installation of connection pipes and cables



Make sure that the condensate pipe is always mounted with a natural descent to the outside, 5% descent is recommended.



Copper Tubing Operations

Most tubing used in refrigeration and air-conditioning (RAC) is made of copper. All tubing in RAC is carefully processed to be sure that it is clean and dry inside. The ends must be kept sealed until it is sed

Straightening

The straightening has to be done from the head to the tail of the tube. Before cutting the tube, marking it is important

Cuttig

Cutting of copper tubes has to be done precisely. The cutting of the tube should be done using a appropriated tube cutter, **Reaming**

While reaming, the face of the tube and the reamer should be facing each other without any deviation.

Bending

Bending of the tube helps to avoid doing many joints on the tube during the servicing of air-conditioners.

Swaging

The swaging operation helps to join two tubes of the same diameter. For









2.6. Installation of electrical control units



- Inherently safe systems are delivered with integrated electrical control units. No further actions have to be taken.
- For other units, it is possible to install a pre-made electrical control unit as offered by many commercial suppliers of RACHP equipment or to design it.
- In both cases it is important that all electrical devices must not be potential sources of ignition.
- When RACHP systems are connected to the public electricity grid, it is important to conform to the requirements of the local energy provider as well as national regulations. State-of-the-art, building regulations and standards have to be followed.

21/06/2024

3. Commissioning

Commissioning brings an installation from static completion to full working order. Careful commissioning can reduce the risk of faults at a later stage. The bigger the system, the higher the requirements on comprehensive commissioning procedures.



16



Before the AC split system commissioning any installation work on the indoor and on the outdoor unit must be finished completely.

For the first time activation make sure that the following working steps listed below are complete:

- 1. The outdoor unit is mounted securely and tightly screwed in order to prevent vibrations during operation. The fixing ground is stable enough in order to carry the weight of the unit.
- 2. The wall penetrations are filled and tightened with moisture-resistant insulation and sealed professionally.
- 3. The earthing wire has been checked.
- 4. The water drain hose (condensate) is mounted correctly.
- 5. The surrounding area nearby the indoor and the outdoor unit is free such that neither the air intake nor the air outlet is obstructed

21/06/2024

17 Installation and commissioning split AC

3.2. Strength (pressure) and leakage testing

Once the assembly of the refrigeration circuit is completed, it is necessary to test the strenph and check leaks on the fittings, brazes, gaskets and all

 Note: If manifolds are used for the pressure test procedure it is essential that these manifold sets do not have a sight glass! Sight glasses may rupture during pressure testing, causing serious injury to involved persons around!



Strength (pressure) and leakage testing

- Testing of the strength and tightness of the system using pressure is normally required after piping (with brazing and fraring)
- Once the **assembly** of the refrigeration circuit is completed, it is necessary to test the strength and leakage lon the fittings, brazes, gaskets and all elements that are likely to leak,

In summary:

19

- Ensure all personnel are at a safe distance from any refrigerant containing parts
- Charge the system with an inert gas typically OFDN
 Gradually pressurise the system to 1.1 × allowable working
- Gradually pressurise the system to 1.1 × allowable working pressure of the system, as prescribed on the system data plate
- Hold the pressure for several minutes and then gradually depressurise the system
- Check all parts of the system for deformation or leakage, by applying soapy wayer

21/06/2024









Examples of suitable test pressures (EN378)

Refrigerant	LP-Site PS in bar sing tempero	LP-Site Test Pressure PS x 1.1 ture 55°C / max. c	HP-Site PS in bar ambient temp	HP-Site Test Pressure PS x 1.1 erature 32°C)	
R-22	11.5	12.7	20.8	22.9	
R-290	10.3	11.3	18.1	19.9	
R-717 11.4		12.5	22.1	24.3	
R134a	7.2	7.9	13.9	15.3	
R-407C	13.2	14.5	23.8	26.2	
R-404A	A 14 15.4 2		24.8	27.3	
R-410A	18.9	20.8	33.3	36.6	
R-32 Installation	and commissioning split	^{AC} 21.3	34.2	21/06/2024 37.6	

•



3.3. Pressure Regulator





3.4. Evacuation : Deep Vacuum

- Before charging with refrigerant, the refrigerant circuit must be evacuated in order to remove:
 - non-condensable gases (air, N₂ or residual refrigerants),
 Humidity
- Always maintain the vacuum pump in good working performance. Regularly check the pumps oil if contaminated. Replace oil if advisable (when milky or contaminated).
- With start-up of deep-evacuation procedure operate the pumas gas ballast valve!

22





21/06/2024



© ITE Tools

Circuit—Evacuation and Charging



'Vacuum pump interconnection with refrigerant circuit



	Valve		Refrigerant Hose
Α	Manifold >Low Pressure Gauge	Е	Connection Hose valve A > L, Outdoor Unit
В	Manifold > Vacuum Pump	F	Connection Hose valve B > Vacuum Pump
С	Manifold > Refrigerant Cylinder	G	Connection Hose valve C > R-290 Cylinder
D	Manifold (Vacuum Gauge)	I	Connection Hose valve D > Vacuum Gauge
н	Outdoor Unit Liquid Side (High)		
L	Outdoor Unit Gas Side (Low)		

21/06/2024

Deep-vacuum measuring device

- Deep vacuum should be measured with an appropriate electronic vacuum gauge.
- Only electronic micron gauges can confirm and accurately determine a deep vacuum in a refrigerant circuit without leaks and NCGs.
- An analogue manifold gauge only indicates that a vacuum at -1 bar (-30 inch Hg) is being produced.
- In the figure, the range of 25,000 microns is marked. This example shows that it is impossible to identify a sufficient vacuum of 500 microns with these pressure gauges.



25,000 Micron

Installation and commissioning split AC

24

© SUPCO

21/

	Evaporation	Evaporation	mbar	Microns	PSI	Torr	Inch Mercury	%
Boquired proceure repos	H₂O °F	H₂O °C					(Hg) gauge	Vacul
Required pressure range	212	100,0	1013,070	759.968,00	14,69800	759,968	0,00	0
for evacuation	205	96,1	713,150	535.000,00	10,34690	535 <i>,</i> 000	8,86	29 <i>,</i> 59
	194	90,0	700,530	525.526,00	10,16200	525 <i>,</i> 530	9,23	30,63
	176	80,0	473,340	355.092,00	6,86600	355,100	15,94	53,13
	158	70,0	311,500	233.680,00	4,51900	233,680	20,72	69,15
	140	60,0	199,090	149.352,00	2,88000	149,350	24,04	80,29
ITE-54V	122	50,0	123,240	92.456,00	1,78800	92,460	26,28	87,8
DIGITAL VACUUM GAUGE	104	40,0	73 <i>,</i> 470	55.118,00	1,06600	55,120	27,75	92,72
	86	30,0	42,320	31.750,00	0,61400	31,750	28,67	95 <i>,</i> 81
	80	26,7	33,860	25.400,00	0,49100	25,400	28,92	96 <i>,</i> 65
	76	24,4	30,470	22.860,00	0,44200	22,860	29,02	96 <i>,</i> 98
AS ITE	72	22,2	27,090	20.320,00	0,39300	20,320	29,09	97 <i>,</i> 32
	69	20,6	23,700	17.780,00	0,34400	17,780	29,12	97,65
	64	17,8	20,550	15.420,00	0,29500	15,420	29,31	97,96
	59	15,0	16,930	12.700,00	0,24600	12,700	29,42	98,32
© SUPCO	53	11,7	13,540	10.160,00	0,19600	10,160	29,55	98 <i>,</i> 65
	45	7,2	10,150	7.620,00	0,14700	7,620	29,62	98,99
2 8	32	0,0	6,090	4.572,00	0,08800	4,570	29,82	99,4
300 17 700	21	-6,1	3,390	2.540,00	0,04900	2,540	29,84	99 <i>,</i> 66
	6	-14,4	1,690	1.270,00	0,02450	1,270	29,86	99 <i>,</i> 83
	1,4	-17,0	1,330	1.000,00	0,01934	1,000	29,88	99,87
	-4	-20,0	0,990	750,00	0,01450	0,750	29,89	99,9
	-9,4	-23,0	0,670	500,00	0,00967	0,500	29,90	99,93
	-24	-31,1	0,340	254,00	0,00490	0,254	29,905	99,97
	-35	-37,2	0,170	127,00	0,00245	0,127	29,910	99 <i>,</i> 98
	-40	-40,0	0,133	100,00	0,00193	0,100	29,916	99,986
	-60	-51,1	0,034	25,40	0,00049	0,025	29,917	99,996
	-70	-56,7	0,017	12,70	0,00024	0,013	29,918	99,998
25 Installation and co	-90	-67,8	0,003	^{2,50} 21/06/2	0,00005	0,002	29,919	99,999
© ITE			0,000	0,00	0,00000	0,000	29,920	100

3.5.Charging the system with refrigerant



- Charging of refrigerant may be carried out in a number of possible ways, • as with any other refrigerant:
- Volumetric charging by graduated cylinder*
- Mass charging by (electronic) balance
 Charging to sight glass (if applicable)
- > Charging according to system performance and current drawn
- Typically, a balance should have an accuracy of at least ±3% full-scale and a resolution of 2 gram, especially when working on critically-charged systems.

* Volumetric charging by graduated cylinder is not recommended for HC refrigerants because these devices are equipped with an electrical heater and this can be considered as a source of ignition.



Charging the system with refrigerant

- When connecting hoses between the refrigeration system, manifold gauges and refrigerant cylinder, ensure that the connections are secure and there are no potential sources of ignition nearby
- Evacuate (or purge) the hoses and manifold prior to charging to avoid contamination of the refrigerant
- Hoses or lines should be as short as possible to minimize the amount of refrigerant contained in them
- Ensure that the refrigeration system is earthed prior to charging the system with refrigerant, to avoid the potential for static build-up
- Extreme care must be taken not to overfill the refrigeration system
- Upon completion of charging, a further leak check must be carried out prior to leaving the site
- Swich on the system and check the operational parameters
- Label the system when charging is complete (if not already)
- The mass of refrigerant charged into the system and the operational parameters should be noted in a log-book,





Additional Refrigerant Charge

Connective Pipe Length (m)	Air Purging Method	Additional Refrigerant				
< Standard pipe length	Vacuum Pump	N	N/A			
> Standard pipe length	Vacuum Pump	Liquid Side: Ø 6.35 (Ø 0.25") R32: (Pipe length – standard length) x 12g/m (Pipe length – standard length) x 0.13oZ/ft R290: (Pipe length – standard length) x 10g/m (Pipe length – standard length) x 0.10oZ/ft R410A:	Liquid Side: Ø 9.52 (Ø 0.375") R32: (Pipe length – standard length) x 24g/m (Pipe length – standard length) x 0.26oZ/ft R290: (Pipe length – standard length) x 18g/m (Pipe length – standard length) x 0.19oZ/ft R410A:			
		(Pipe length – standard length) x 15g/m (Pipe length – standard length) x 0.16oZ/ft R22: (Pipe length – standard length) x 20g/m (Pipe length – standard length) x 0.21oZ/ft	(Pipe length – standard length) x 30g/m (Pipe length – standard length) x 0.32oZ/ft R22: (Pipe length – standard length) x 40g/m (Pipe length – standard length) x 0.42oZ/ft			

For R290 refrigerant unit, the total amount of refrigerant to be charged is no more than: 387g(<=9000Btu/h), 447g(>9000Btu/h and <=12000Btu/h), 547g(>12000Btu/h and <=18000Btu/h), 632g(>18000Btu/h and <=24000Btu/h).

4. Installation Report



The technician must fill the installation report as per the format given here below. The technician must learn all the procedures for proper installation of air-conditioners and further acquire the best skills for installation. The report is a proof of good work done and for reference Installation Company's Name:

Address:	
Tel No:	
Technician's Name:	
Customer's Name:	
Address:	
Tel No:	
Installation / Appliance Data:	
Model No: Sr. No:	
Date of Installation / Repairs: Time:	
Refrigerant's Name/Type: Refrigerant Qty in g:	
Suction Pressure / Discharge Pressure:	
Air Temp Entering Condenser/ Air Temp Leaving	
Condenser:	
Air Temp Entering Evaporator: Air Temp Leaving	
Evaporator:	
Total Length of Copper Tubing: Elevation of	
Installation: at a later date	
21/06/2024	11/11/11/11/11/11

29

Other Executions for System Commissioning

Note: Use only Correct and Reliable Tools / Equipment for System Commissioning

I			
	1	Functional AC System Check Including Performance Test	
ĺ		Check the AC System for Refrigerant Leakage	
ĺ		Check that Electric Connection are Tight	
		Check that Condensate Drain is Tight and Down-grade	
ĺ		Check Insulation of Refrigerant Transfer Tubes and Quick-coupler	
		Check Free Run of Condenser and Evaporator Fans	
		Check System Operation (Indoor / Outdoor) on Abnormal Operational	
		Noise	
ĺ		Clean System Components Including Air Filter (if Indicated)	
		Check Display of the Remote Controller	
ĺ		Execute Briefing of	
	00		
	- 30	Installation and commissioning split AC 21/06/2024	
-			

Company Signature and Date:

Customer Signature and Date:

