

# **U-3ARC TRAINING WEBINAR N°36**



## **DIAGNOSIS OF COMMON ISSUES IN SPLIT AC**

**TRAINER:**

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# ***DIAGNOSIS OF COMMON ISSUES IN SPLIT AC***



## **Training objectives**

- ❖ Introduction
- ❖ Recap of major split AC components
- ❖ Basic electrical flow of a split AC
- ❖ Basic tools and equipment used in diagnosis of split AC
- ❖ Root cause analysis
- ❖ Common split AC faults and their remedies
- ❖ Pressure reference chart of common refrigerants
- ❖ Diagnosing common split AC components



# Introduction

- ❑ A split AC consists of several important components each playing a key role in the operation process.
- ❑ The unit is majorly divided into an indoor unit and outdoor unit.
- ❑ The two parts are interconnected by use of copper pipes which transport refrigerant within the system..

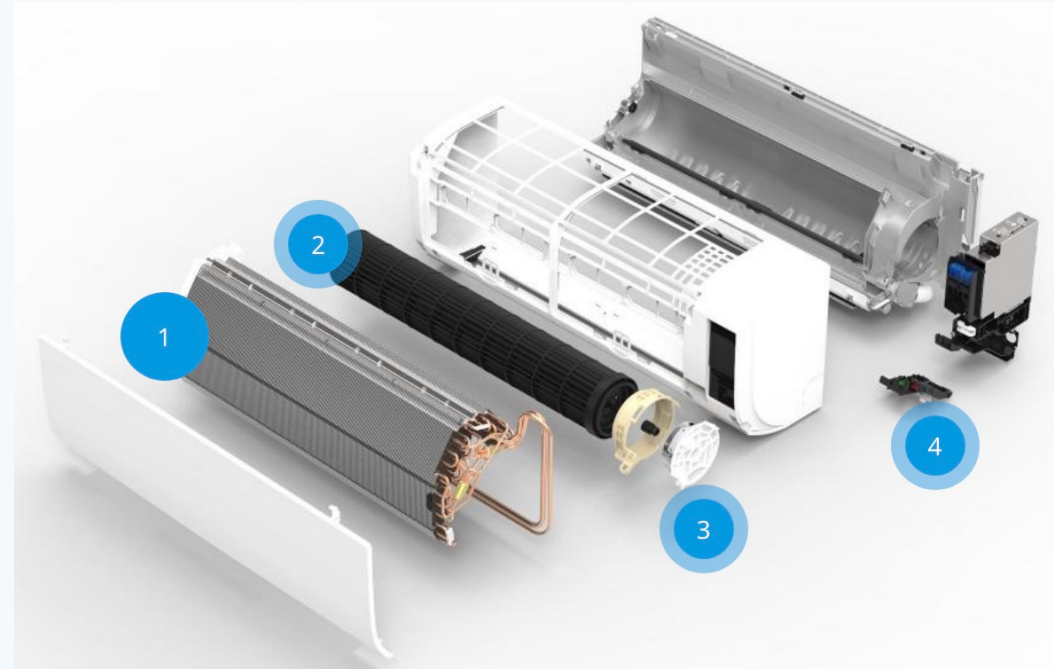




# Introduction cont'd

## Indoor unit

The indoor unit is typically mounted inside the room. It contains the evaporator, fan blower and the control circuit.

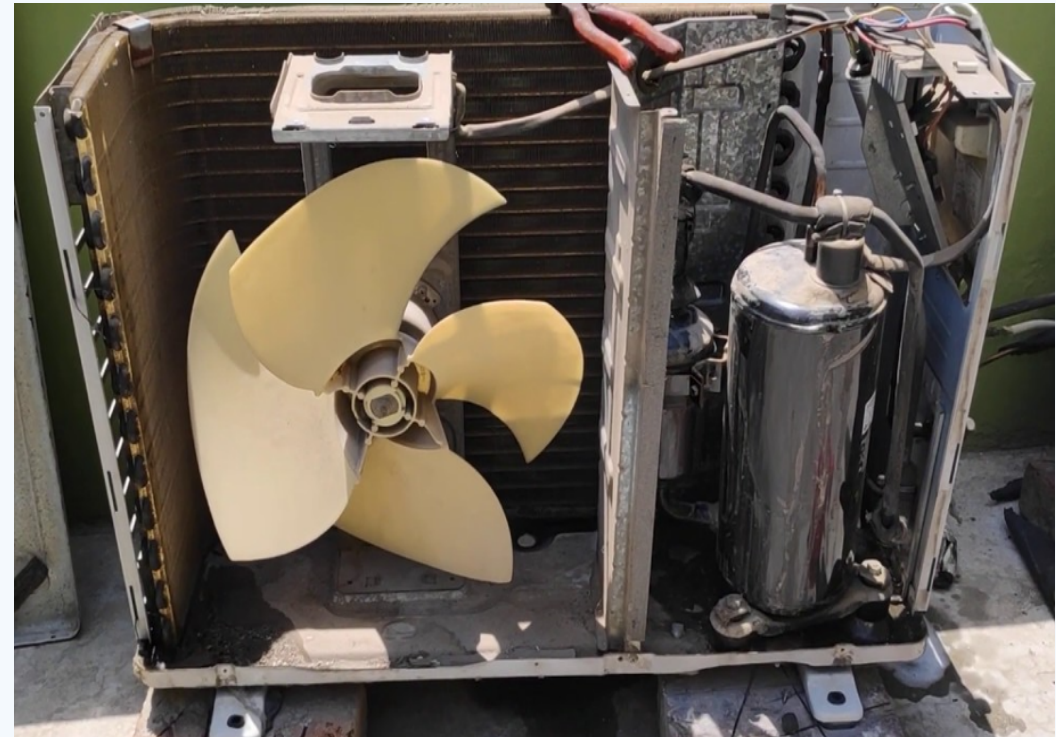




# Introduction cont'd

## Outdoor unit

- ❑ The outdoor unit is the component of split AC which is installed outside the building.
- ❑ It comprises of the compressor, condenser, expansion valve and the fan motor.





# Recap of major split AC components cont'd



## compressor

- ❑ The compressor plays a pivotal role by compressing the refrigerant gas and converting it into a liquid state.
- ❑ This liquid refrigerant then moves on to the next stage in the cooling process.



# Recap of major split AC components cont'd



## condenser

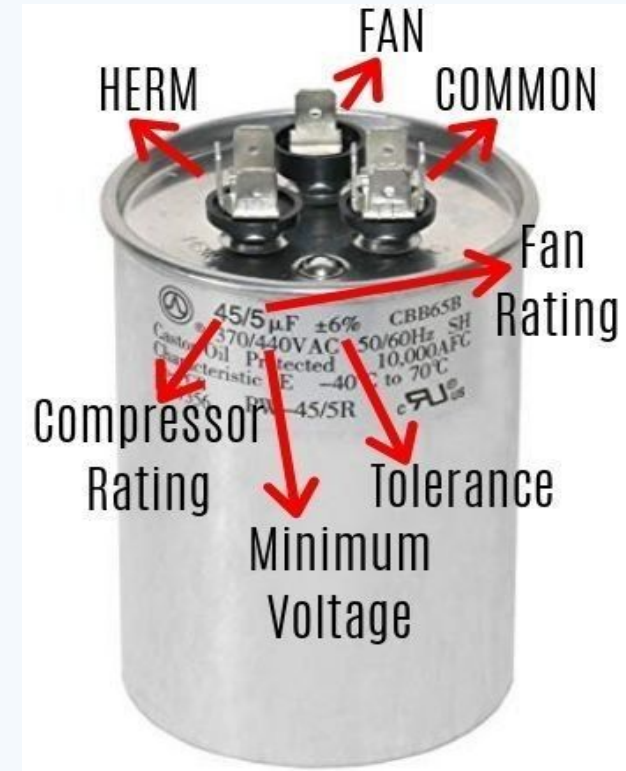
- ❑ This is a network of tubes filled with refrigerant that facilitates the heat exchange process.
- ❑ The refrigerant releases the absorbed heat to the outside air as it flows through the coils.



# Recap of major split AC components cont'd

## Capacitor

- ❑ A capacitor is crucial for stabilizing the system during startup.
- ❑ It is also responsible for operating various circuits and facilitating power switching within the unit.



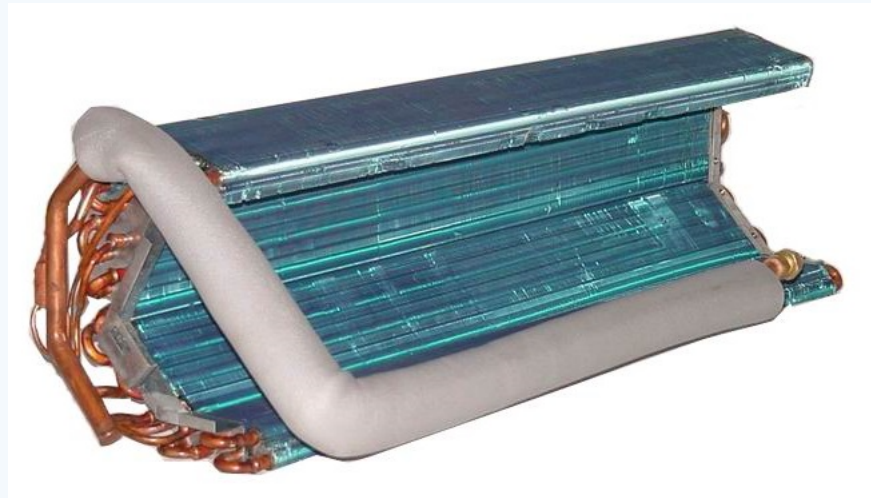




# Recap of major split AC components cont'd

## evaporator

The evaporator primary function is to cool the indoor air by absorbing heat from the environment and transferring it into the refrigerant, an essential step in the cooling process.





# Recap of major split AC components cont'd



## Expansion valve

The expansion valve is a pressure control device that regulates the flow of refrigerant, ensuring it maintains the appropriate pressure drop as it moves through the system.



# Recap of major split AC components cont'd

**Fan motor (Outdoor)** The motor fan is responsible for moving hot air from the condenser to the surrounding environment.

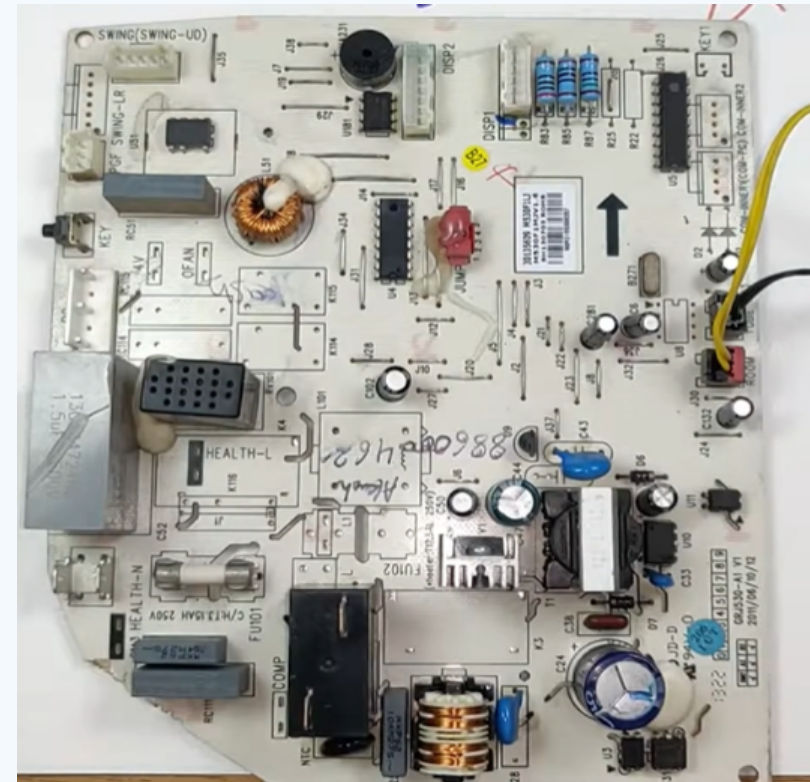




# Recap of major split AC components cont'd

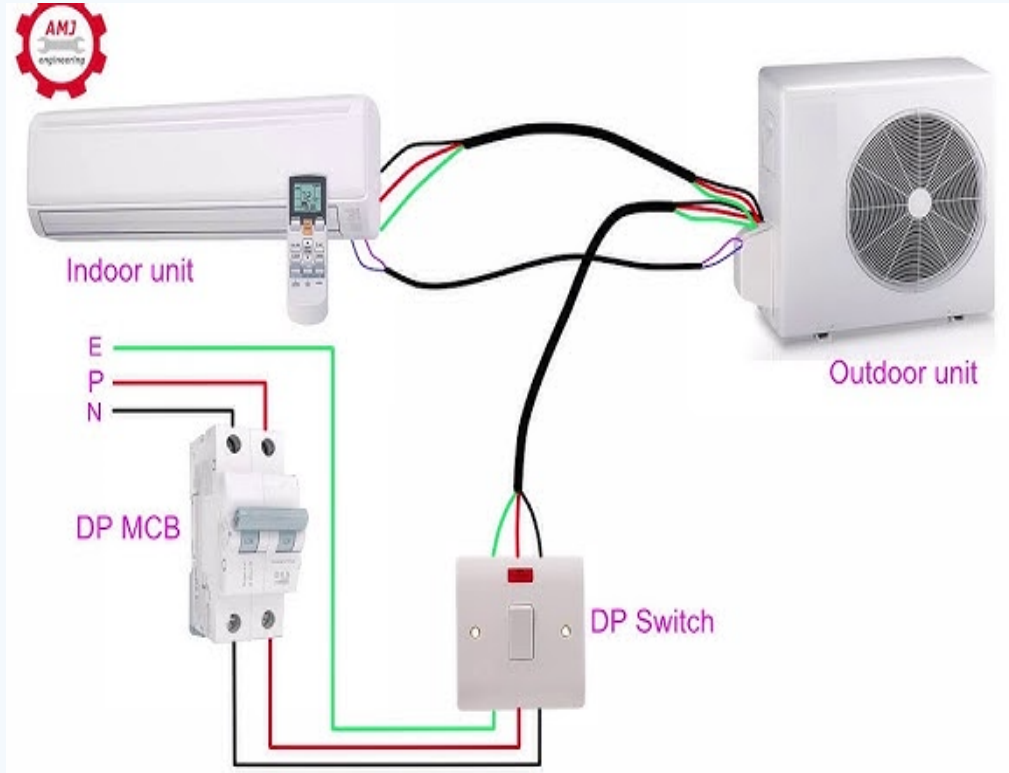
## Power circuit board (PCB)

This manages the power supply and controls various switching functions such as compressor, fan motors, fan speeds





# Basic electrical flow of a split AC



- ❑ The AC unit is connected to the main electrical supply typically through a dedicated circuit breaker.
- ❑ From the MCB, power passes through the double pole (DP) switch, then through the power protector (AVS), then up to the unit.
- ❑ When the room temperature raises above the set point, the thermostat sends a signal to the control board to start the cooling process, thus activating the compressor (outdoor unit).

# Basic tools used in diagnosis and fixing of split AC



- Manifold pressure gauge
- Multi-meter and clamp meter
- Set of screw drivers
- Temperature gun
- Phase tester
- Flaring and swaging tool
- Insulation tape
- Map gas and torch
- Spanners
- Allen keys
- Multi purpose pliers
- Vacuum pump





# Root cause analysis in split AC

## Root cause analysis (RCA);

This is a systematic approach used to identify the underlying causes of faults in split AC. Some key steps are as below;

1. Data collection. Capture data on system performance parameters including pressure, electrical measurements, temperature and any error code if possible.
2. Fault detection. Identify symptoms of such faults such as unusual noise, reduced cooling efficiency, or increased energy consumption. This step normally involves data comparison of current data with expected or previous data. Meaning make it an habit to capture and record relevant performance parameters while operating or maintaining a split AC unit. This data can be captured in the job card or maintenance report



## RCA cont'd

**3. Fault isolation.** Use diagnostic tools and techniques to isolate the specific component leading to the fault. This can include electrical measurements to obtain current and voltage, plus temperature and pressure analysis.

**4. Root cause identification.** Once the fault component has been isolated, investigate further to determine the root cause. This might involve visual inspection, testing individual components, and historical data analysis to ascertain patterns or recurring issues.

**5. Corrective action.** After identifying the fault, implement corrective action to fix the issue. This could involve cleaning, leakage fix, repair, or replacing fault component.

**6. Verification and monitoring.** After the repair, endeavor to verify that the issue has been resolved by monitoring the system performance over time.





# Diagnosis of common split ac faults

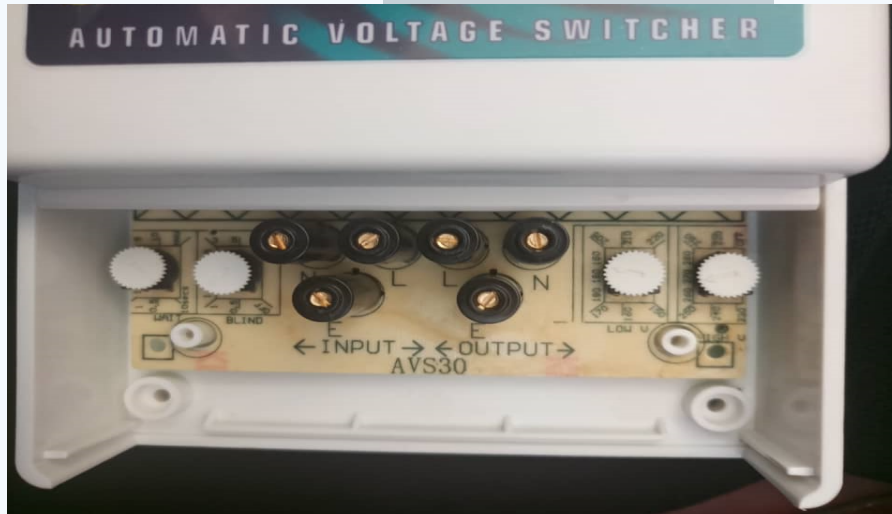
## 1. Split AC doesn't come on.

- When the split AC doesn't start ( doesn't respond to the remote controller /thermostat), two things to be checked. Either;
- the unit doesn't receive power supply or
- it has developed a fault with its electrical control circuit.
- For a, checkout the power supply network from the MCB-DP SWITCH-AVS. Any of the above components in the network can be at fault, so checkout and isolate one by one.
- For b, the electrical control circuit has to be checked. There could be a fault with the fuse or the power circuit board (PCB).





# Power flow network



- ❑ **Circuit breaker (MCB).** This is an essential electrical component designed to protect circuits from overcurrent and short circuits by automatically switching off electrical circuits during abnormal conditions such as overloads or faults, ensuring safety and preventing damage.
- ❑ A double pole (DP) switch can disconnect both live and neutral wires ensuring that the AC unit is completely isolated from the power supply when turned off. This is crucial during maintenance safety
- ❑ An AVS ensures that the AC unit only operates within the safe set voltage limits preventing damage to sensitive components like circuit boards and compressors.



# Diagnosis cont'd

## 2. Split AC not cooling

if the split unit AC isn't cooling as fast as it used to earlier despite keeping it turned on for hours, then it must have developed some fault. This scenario contributes to over 80% of the most common faults with split AC units.

### a. Wrong remote or thermostat settings

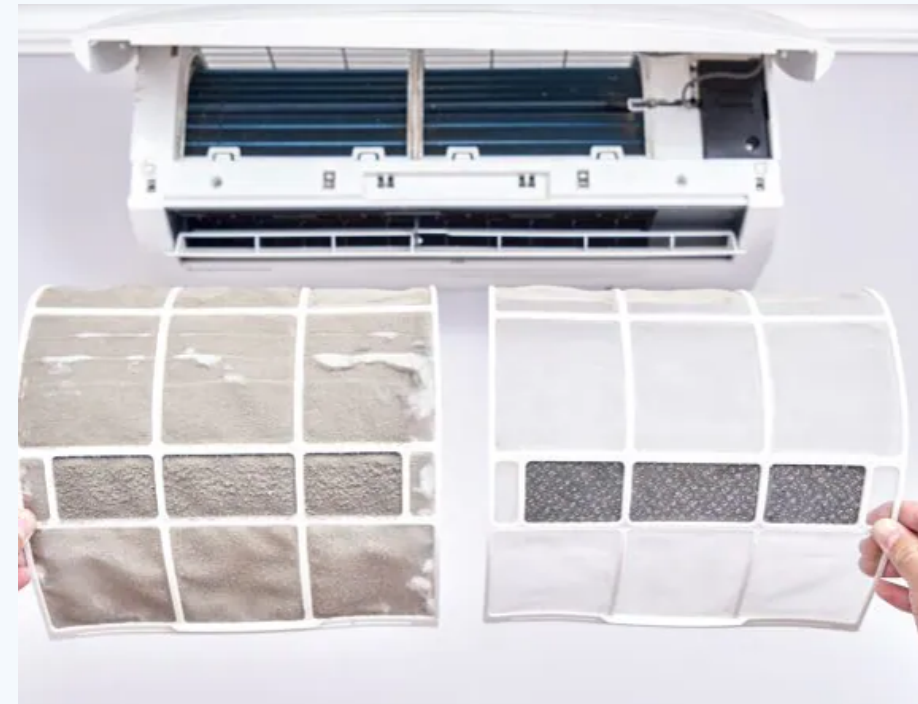
An issue with the remote settings can lead to insufficient or no cooling. This relates to settings of "cooling mode", "fan speed", "temperature set point" etc. endeavor to checkout remote settings before anything else can be done. End-user training on remote settings and end-user compliance can solve this fault.



# Diagnosis cont'd

## b. Clogged air filters

- ❑ Air filters are made to protect the air conditioner from dust, debris, and other tiny particles.
- ❑ In event the air filters are not cleaned regularly (at least once every three months if used frequently), they can get clogged and affect the AC's cooling performance.
- ❑ In addition, having clogged filters also means the air conditioner has to work harder (and thus, consume more power) to cool the same room.
- ❑ Ultimately, this results in higher electricity bills and reduced cooling efficiency.





# Diagnosis cont'd

## c. Ice formation on the evaporator coils

- ❑ Another possible reason for the split AC not cooling could be ice formation on the evaporator coils.
- ❑ Ice can form on the air conditioner's evaporator coils if you do not maintain the unit routinely.
- ❑ This can lead to a build-up of dirt, dust, and fungi on the air filter as well as around other parts of the air conditioning unit.
- ❑ In addition to above, ice formation on the evaporator can as well be caused by over running of the unit, refrigerant leakage leading to reduced refrigerant pressures, and a fault with indoor unit blower/ motor.
- ❑ Meaning after de-icing, endeavor to test run the unit and obtain performance parameters. If any fault is detected then take action.





# Diagnosis cont'd

## d. Dirty or blocked condenser

- ❑ The split AC's cooling efficiency can also be affected if the outdoor unit condenser is dirty or gets blocked by debris.
- ❑ This can affect effective heat exchange. Pressure washing the condenser should easily get it cleaned.





# Diagnosis cont'd

## e. A fault component in the outdoor unit.

- ❑ A faulty component in the outdoor unit can as well affect the cooling effect of the system.
- ❑ Components include compressor, capacitor, fan motor, blocked or clogged capillary tube, fault electronic expansion valve (EEV).





# Diagnosis cont'd

## **f. Broken communication with indoor unit.**

Communication cable transmits signal between indoor unit and outdoor unit. So if this cable is broken then signal can not be received. In some systems, when the communication cable is broken, the unit will display an error code.

This can be fixed through inspecting the cable for visible damage or disconnections, testing continuity using a multi-meter, then replacing the cable if deemed necessary.

## **g. Frequent on/off cycling.**

This can be due to a dirty condenser or evaporator coils, an issue with the thermostat settings, or an issue with the sensors. Checkout and eliminate.



# Diagnosis cont'd

## 3. Split AC leaking water

Here are some of the causes and remedies to water leakage.

- ❑ **Clogged drain line.** Over time dust and debris can accumulate in the drain pan causing water to buildup and leak. Cleaning the pan often and flushing the drain pipe can solve this.
- ❑ **Dirty air filters.** When air filters are dirty, they restrict air flow leading to ice buildup on the evaporator coil. When ice melts it can overflow the drain pan.





## Diagnosis cont'd

- ❑ **Low refrigerant levels.** Low refrigerant pressures can cause the evaporator coil to freeze, and then it thaws consequently leading to leakage.
- ❑ **Improper installation.** If the unit is not installed rightly, it can affect the drainage system leading to water leakage.
- ❑ **Faulty condensate pump.** If the condensate drain pump is malfunctioning, it can cause a leak.



# Diagnosis cont'd

## 4. Noisy operation.

Loose or damaged fan blades, or failing motor or compressor can cause unusual noises. Inspecting the cause of the noise of the noise is crucial in fixing this.

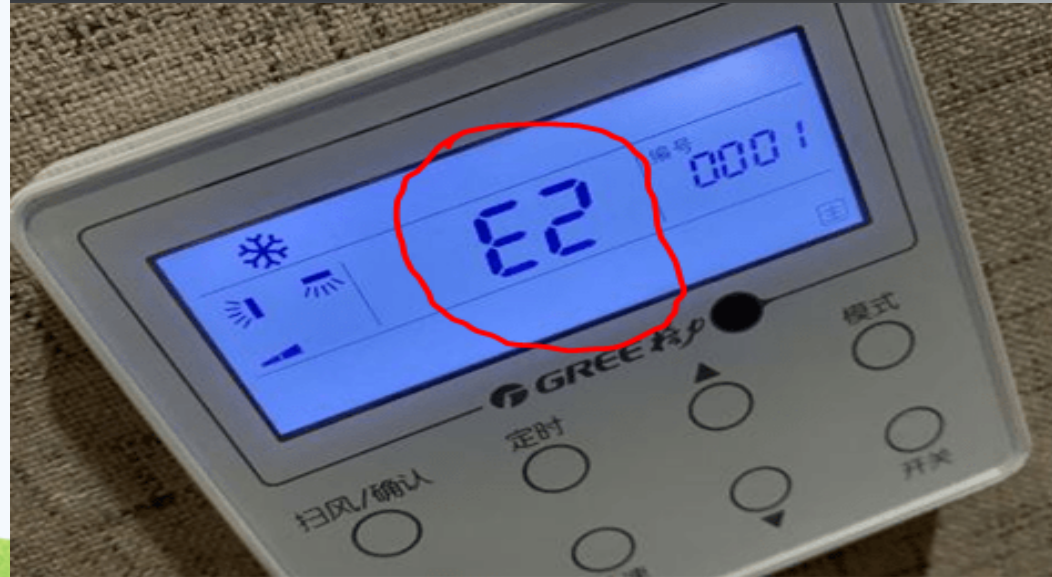
## 5. Unpleasant odors.

Mold or dirt can cause bad smells. Cleaning the unit thoroughly and ensuring proper drainage can eliminate possible odors

# Diagnosis cont'd

## 6. Split AC displaying a malfunction (error) code.

- ❑ On many instances, a split AC unit will display an error code on the indoor unit display or on the thermostat display.
- ❑ This will make the unit to either fail to cool or fail to operate at all. Always endeavor to checkout the particular error code being displayed for that particular brand of split AC unit.
- ❑ The error code displayed will provide an hint on the cause of the fault hence simplifying the troubleshooting process.



# Pressure reference chart of common refrigerants



Ref name	Standing press (psi)	Standing press (bar)	Operating suction pres (psi)	Operating suction press (bar)	Disc press (psi)	Disc press (bar)	Boiling pt temp (c)
R-22	150-155	10.5-10.7	60-70	4.1-4.8	250-300	17.2-20.7	-40.8
R-134a	80-95	5.5-6.5	12-15	0.8-1.0	150	10.3	-26.2
R-600a	40-50	2.7-3.4	Below 0-1	0	150	10.3	-11.7
R-32	240-245	16.5-16.8	110-115	7.6-7.9	175-375	12.0-25.9	-52.0
R-290	125-130	8.6-8.9	65-70	4.5-4.8	275-300	19.0-20.7	-42.1
R-407C	180-185	12.4-12.8	75-80	5.2-5.5	275-300	19.0-20.7	-45.0
R-404a	180-185	12.4-12.8	80-90	5.5-6.2	275-300	19.0-20.7	-46.2
R-410a	225-230	15.5-15.9	120-130	8.3-8.9	450-500	31.0-34.5	-51.4
R-417	140	9.7	65	4.5	261	18.0	-39.0



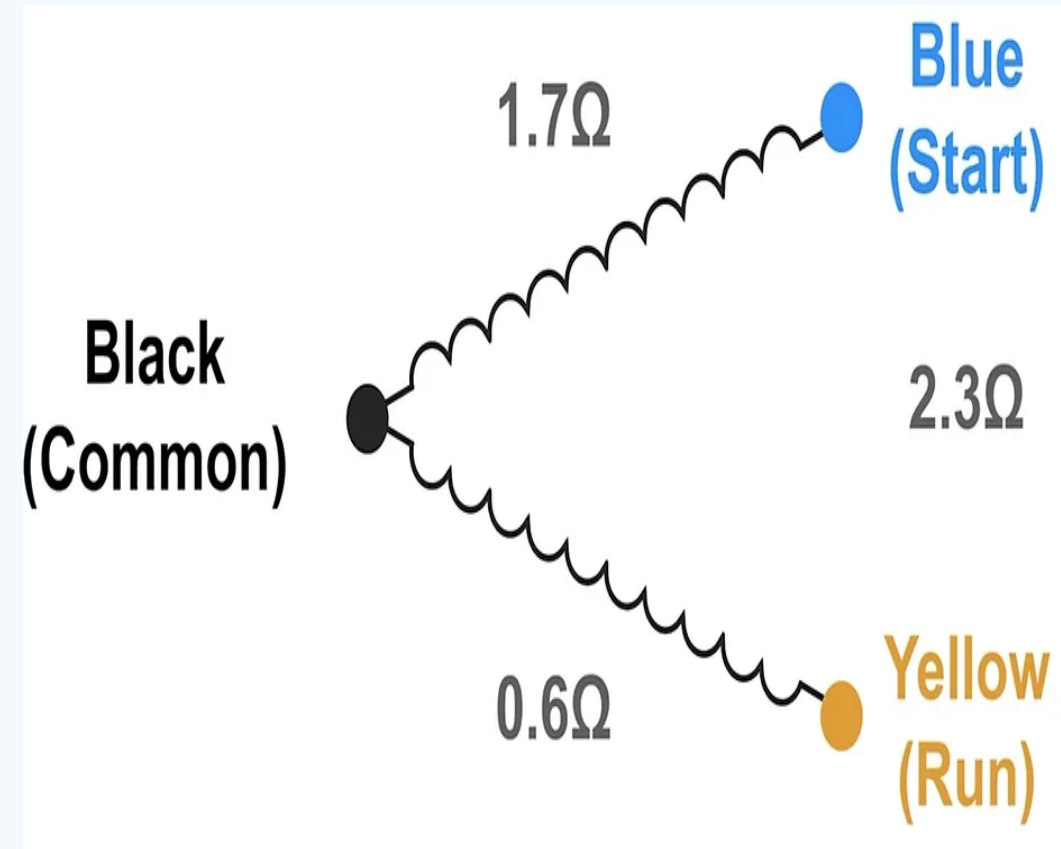
# Diagnosing common split AC components

## 1. Compressor

Common symptoms include;

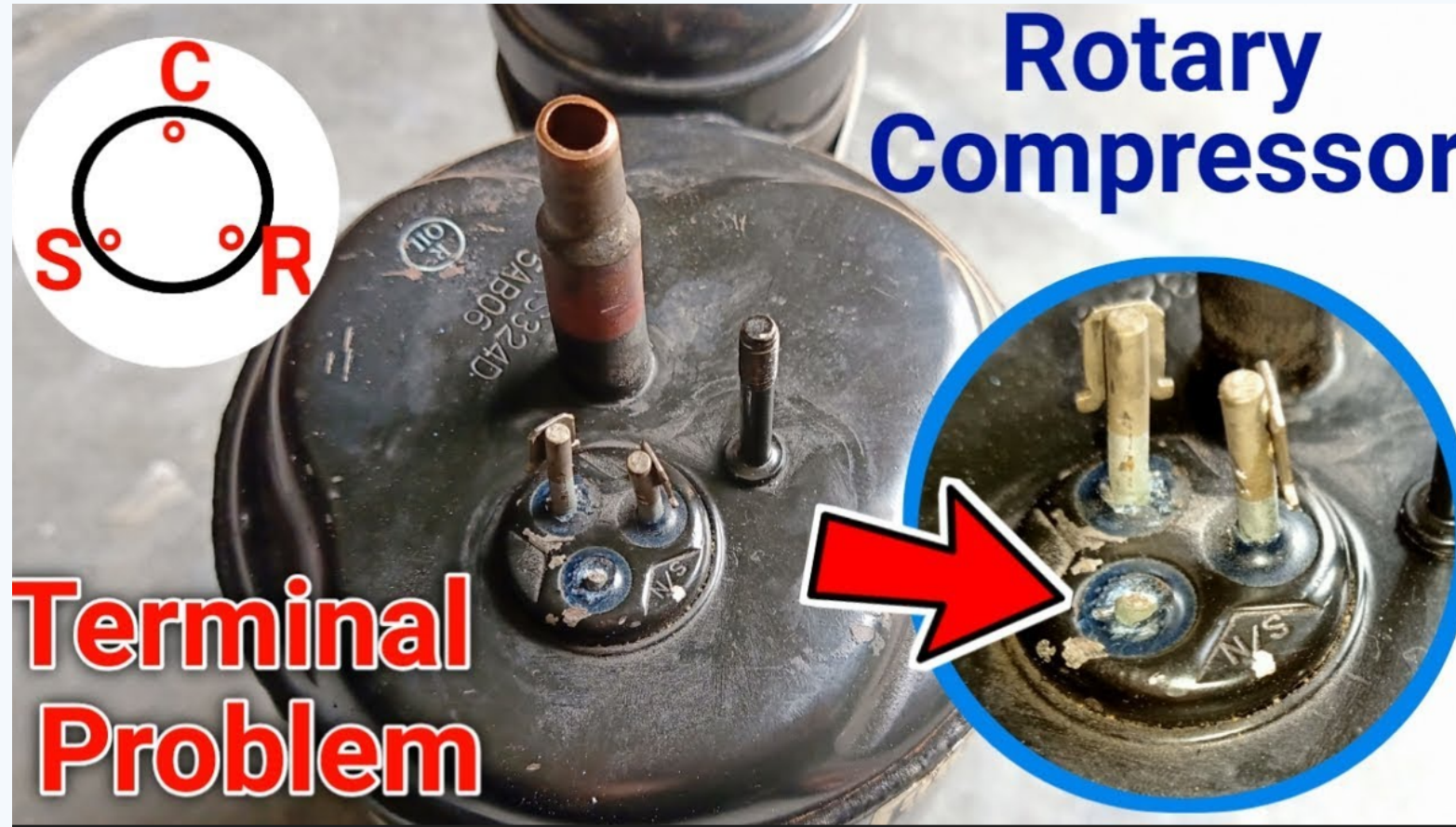
- No cooling
- Tripped circuit breaker
- Unusual noise
- Compressor heating up

The compressor has three windings, common ©, start (s), and run (R)





# Compressor faults



# Compressor winding measurement



- ❑ Set the multi-meter to ohms and then measure two windings at a time. The resistance between S to R should be the sum between C to S and C to R should be measurable.
- ❑ C to R will give the smallest resistance. If any of the readings shows infinite resistance (OL) it indicates an open winding. If any reading shows zero resistance, it indicates a shorted winding.
- ❑ Endeavor to as well check for continuity between each terminal and the compressor casing (body). If there's continuity it indicates a grounded winding.



# Component diagnosis cont'd



## 2. Capacitor

Common symptoms of a bad capacitor

- Humming of compressor /motor
- Frequent cycling
- Higher energy bills

Before diagnosis, use an insulated screwdriver to short the terminals and discharge any stored charge. This is crucial for safety.



# Capacitor diagnosis cont'd

- ❑ Inspect the capacitor. Look for visible signs of damage such as bulging, oil leakage, or corrosion as these are clear indicators of a faulty capacitor.
- ❑ Then proceed to test the capacitor with a multi-meter to the capacitance setting. The reading should match the capacitor's rated capacitance usually printed on the it.





# Component diagnosis cont'd

## Fan motor

Ensure power to the AC unit is off to avoid electrical shock.

### Common symptoms of a faulty fan motor;

- Fan won't start,
- fan runs slowly,
- intermittent fan operation
- noisy operation.



# Fan motor diagnosis cont'd

## Steps to diagnosis;

- Inspect the fan motor by looking out for visible signs of damage such as rust, corrosion, or debris obstructing the fan blades.
- Check electrical connections by looking out for loose connections, and burnt areas.
- Listen to the motor for unusual sound
- Check the fan capacitor. If capacitor is faulty, the fan motor may not start or may run intermittently.
- Measure voltage and compare the readings with the specifications in the user manual to ensure its receiving the right voltage.
- Checkout for heating up. If the motor is overheating, it may shut down intermittently. This could be due to lack of lubrication or a failing mot