How to Test an HVAC Capacitor

This standard operating procedure explains how to test an HVAC capacitor safely and accurately. It covers the role capacitors play in single-phase motors, how to identify capacitor types and ratings, and the step-by-step process for discharging and testing both single and dual run capacitors with a multimeter. Following this procedure helps you confirm whether a capacitor is functioning correctly or needs replacement, reducing the risk of motor failure and electrical hazards.

Purpose

Capacitors are essential components in many single-phase motors, including furnace blowers, air conditioner fans, compressors, and pumps. This SOP provides a reliable method to test these capacitors so you can confirm their condition before returning equipment to service.

Scope

This procedure applies to single run capacitors and dual run capacitors found in common HVAC equipment. It includes safe discharge procedures, capacitance testing, and continuity testing for shorts to ground.

Required equipment and PPE

- Multimeter with capacitance (µF) and ohms (Ω) settings
- Screwdriver with an insulated handle (or a resistor) for discharging capacitors
- Replacement capacitor matching the correct capacitance and voltage rating, if needed

Understanding capacitor function

A capacitor stores electrical energy. As an electrical charge builds and releases between the dielectric plates, the voltage lags behind the charging current. This lag creates a magnetic phase shift in the start winding, which provides the torque needed to turn the rotor.

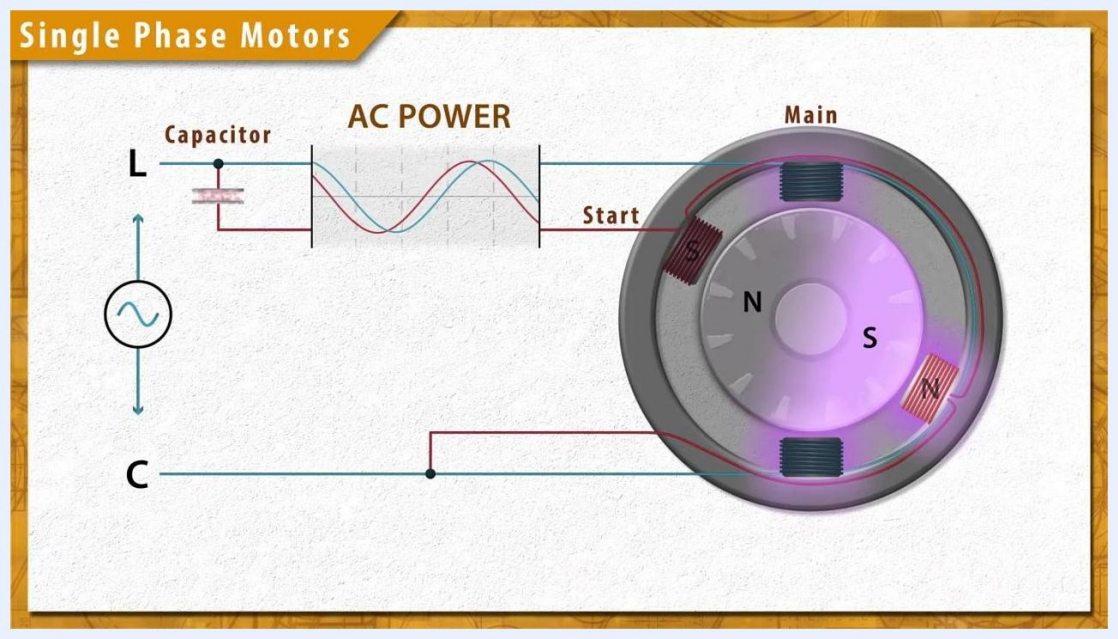
Diagram showing the wiring and operation of a single-phase motor, including the capacitor, AC power, start and main windings, and the resulting magnetic field in the rotor

Recognizing symptoms of capacitor failure

Watch for the following signs that a capacitor may have failed:

- The motor does not start or starts slowly
- The capacitor shows visible bulging or leaking

- Some failures are internal and produce no visible external signs



Close-up of a failed capacitor showing bulging and leaking as signs of failure

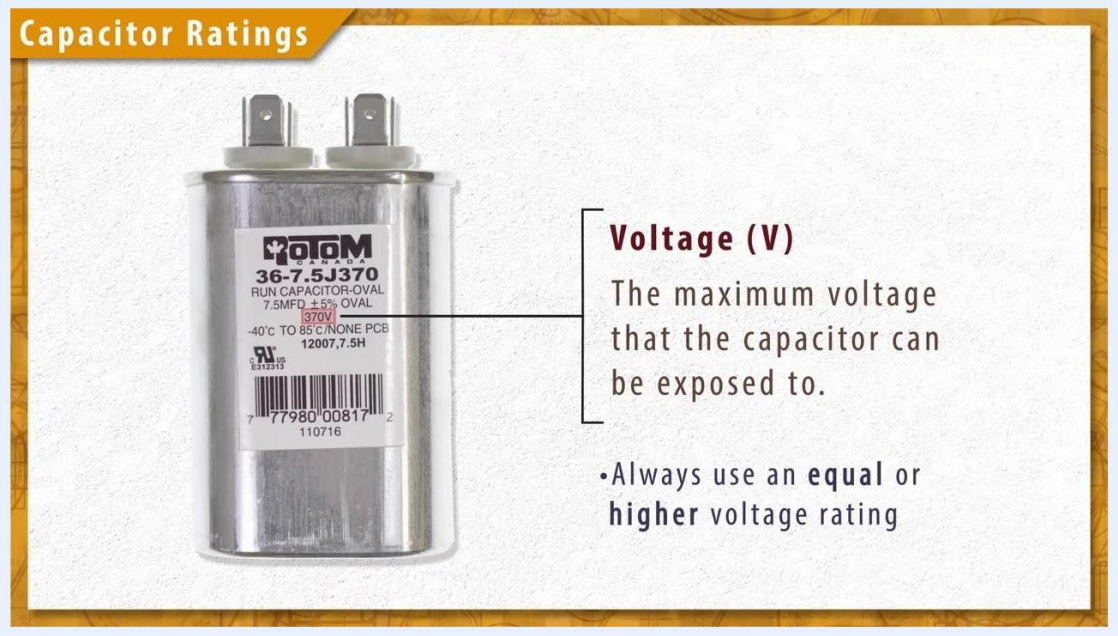
Always ensure the capacitor is safely discharged before testing. Use a multimeter to test the capacitance, as described later in this procedure.

Capacitor ratings and selection

Every capacitor has two main ratings printed on its label:

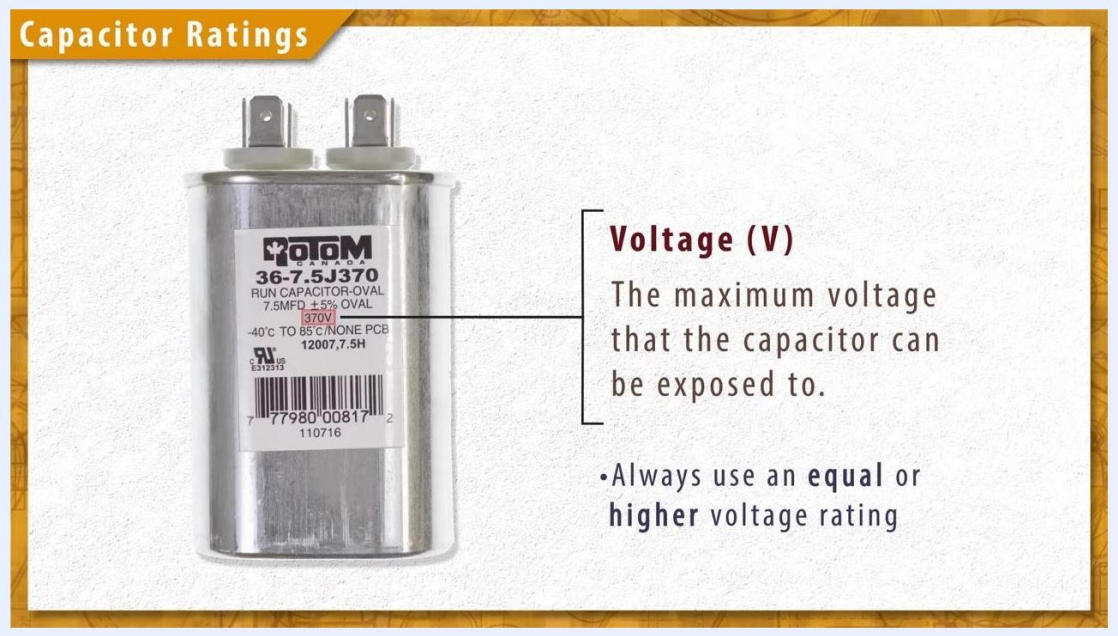
- Capacitance (expressed in microfarads, MFD or µF): indicates how much energy the capacitor can store

- Voltage rating (V): indicates the maximum voltage the capacitor can be exposed to



Capacitor label showing capacitance and voltage ratings

When selecting a replacement capacitor, always use one with an equal or higher voltage rating than the original. Never install a capacitor with a lower voltage rating, as this can cause capacitor failure.



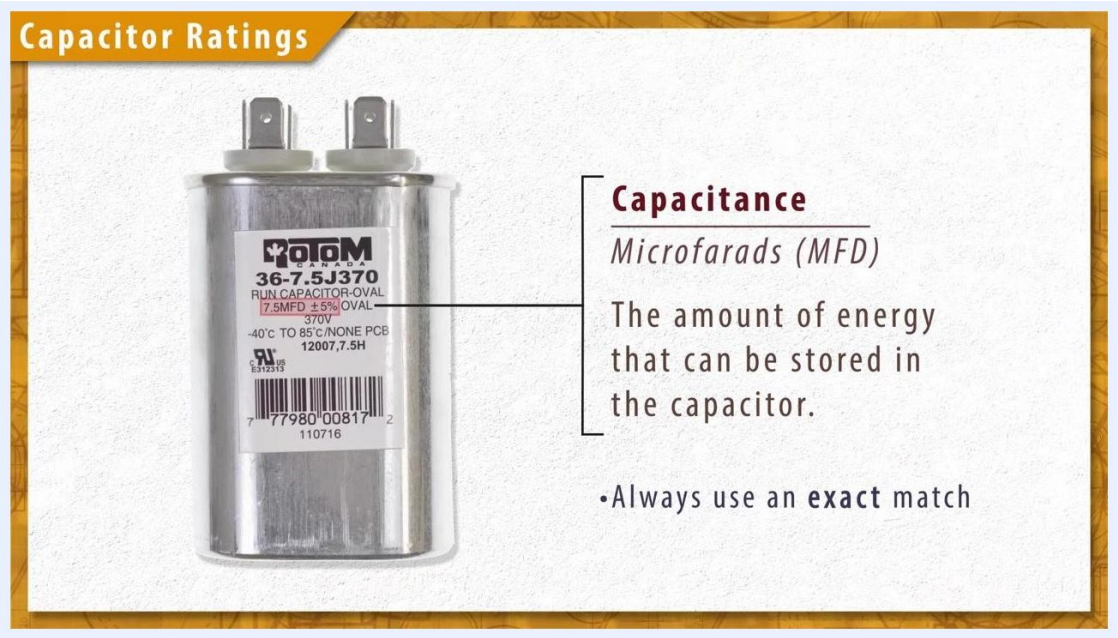
Highlighted capacitor label with text explaining voltage rating and the importance of matching or exceeding the original rating

The capacitance value determines the energy storage capability of the capacitor, which is critical for correct motor operation.

Identifying capacitor types

Start capacitors

Start capacitors have high capacitance, typically ranging from 40 to 300 microfarads (MFD). They are used only briefly during the startup sequence in capacitor start motors.



Start capacitor labeled 189–227 MFD, indicating high capacitance for use in capacitor start motors

Run capacitors

Run capacitors have lower capacitance, generally between 5 and 80 microfarads (MFD). They remain permanently wired into the circuit and are used in permanent split capacitor (PSC) motors.

Run capacitor labeled 7.5 MFD ±5%, indicating low capacitance for use in PSC motors

Dual run capacitors

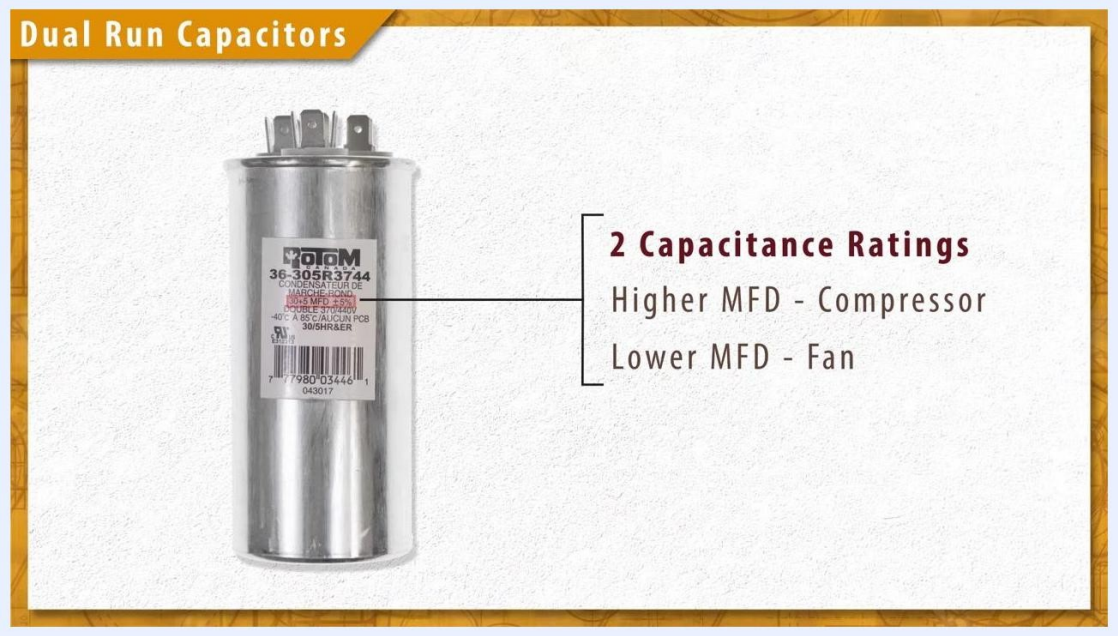
Dual run capacitors support two electric motors, such as the compressor and blower fan in an air conditioning unit. They have three terminals labeled Common (C), Fan, and Herm (hermetically sealed compressor), along with two microfarad ratings — a higher rating for the compressor and a lower rating for the fan.

Top view of a dual run capacitor showing three terminals labeled Common (C), Fan, and Herm

Dual run capacitor label showing two capacitance ratings: a higher MFD value for the compressor and a lower MFD value for the fan

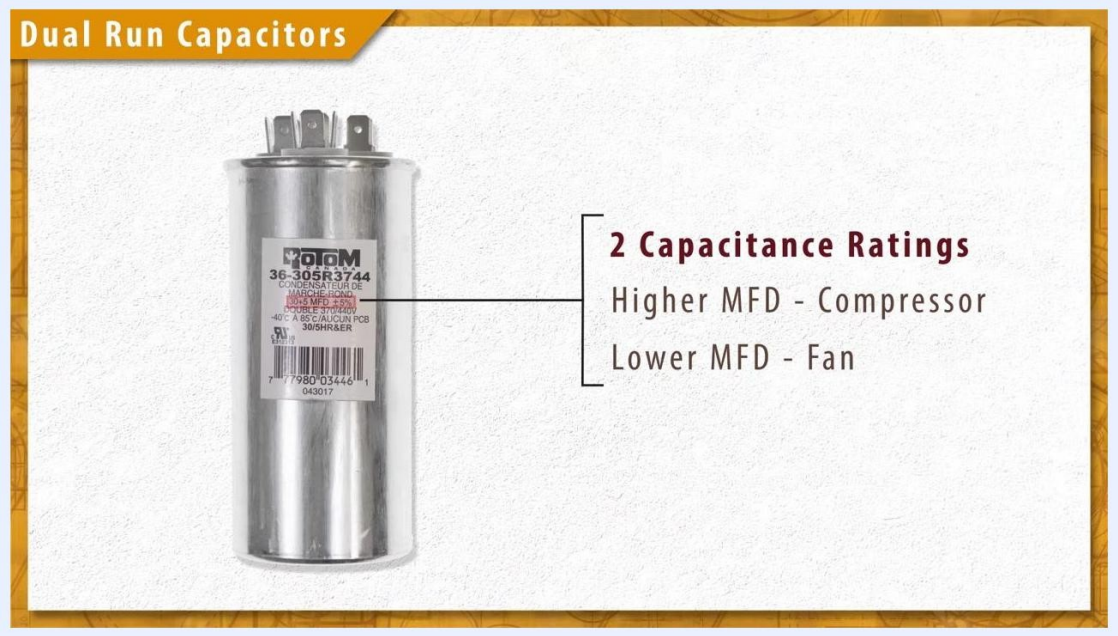
Safety precautions before handling capacitors

Before accessing any capacitor, disconnect the power and gas supply to the equipment.



Hand turning off a gas valve, with a safety warning banner

Capacitors can retain a charge even after the power is switched off. Always assume a capacitor is charged, since contact with a charged capacitor carries a risk of serious electrical shock.



Capacitor still connected to wiring inside equipment, with a safety warning banner

Discharging a capacitor safely

Before testing, you must discharge any stored electrical energy in the capacitor. Place a resistor or a screwdriver with an insulated handle across the terminals to short out and discharge the capacitor.

Run capacitor placed on a wooden work surface, ready to be discharged, with a safety warning banner

To discharge a single run capacitor, touch both terminals at the same time with a screwdriver that has an insulated handle. This shorts the terminals and safely discharges the capacitor.

Hand using an insulated screwdriver to short the terminals of a run capacitor, with a safety warning banner

For a dual run capacitor, discharge both sides by touching the screwdriver across the Perm (permanent) and Common terminals. This discharges both capacitors contained within the dual run unit. Always observe safety precautions to avoid electrical shock.

Hand using an insulated screwdriver to short terminals on a dual run capacitor, with a safety warning banner

Testing a single run capacitor with a multimeter

Set your multimeter to the capacitance (µF) testing function. Confirm the capacitor is fully discharged before proceeding.

Touch one probe to each terminal of the capacitor and observe the reading on the multimeter display.

Red Milwaukee multimeter set to capacitance mode, with probes ready to test a run capacitor on a wooden surface

The multimeter should display a value close to the capacitor's rated capacitance, for example 7.5 MFD on a run capacitor rated at that value. If the reading falls within ±5% of the rated value, the capacitor is good.

Multimeter showing 7.5 µF while testing a run capacitor labeled 7.5 MFD

If the multimeter shows 0.0 µF or a value far from the rated capacitance, the capacitor has failed and should be replaced.

Multimeter showing 0.0 µF while testing a run capacitor labeled 7.5 MFD

Testing a dual run capacitor with a multimeter

Test each section of the dual run capacitor separately:

- Test from Herm (compressor) to Common and note the reading. It should match the higher MFD rating, for example 35 MFD.
- Test from Fan to Common and note the reading. It should match the lower MFD rating, for example 5 MFD.

Both readings should be close to their respective rated values.

Multimeter showing 35.2 µF while testing between the Herm and Common terminals on a dual run capacitor labeled 35 + 5 MFD

Multimeter showing 4.9 µF while testing between the Fan and Common terminals on a dual run capacitor labeled 35 + 5 MFD

Checking for a short to ground

Set the multimeter to the ohms (Ω) setting. Touch one probe to each terminal and the other probe to the metal housing of the capacitor. The multimeter should display "OL" (open loop), indicating no continuity.

Multimeter showing OL while testing for continuity between a capacitor terminal and the metal housing

If any resistance is detected during this test, the capacitor is shorted to ground and must be replaced.

Verification

Confirm that all capacitance readings fall within tolerance of the rated values and that no shorts to ground were detected. If both conditions are met, the capacitor is safe to use.

Multimeter showing a 28 µF reading with both probes in use during testing

If any reading is significantly outside the rated tolerance, or if a short to ground is present, replace the capacitor before returning the equipment to service.

Getting additional help

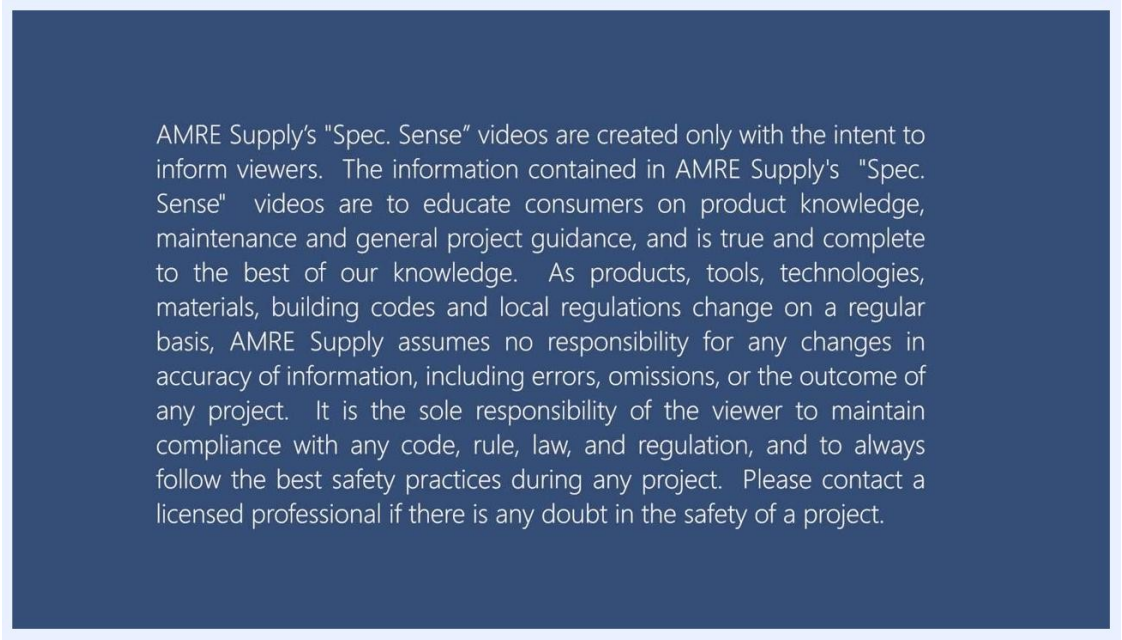
If you require further assistance or have questions about testing or replacing motor capacitors, call or visit an AMRE Supply location. Knowledgeable staff can provide expert advice and support.

Safety and responsibility disclaimer

This procedure is intended to inform and educate on product knowledge, maintenance, and general project guidance. The information provided is accurate to the best of available knowledge; however, materials, codes, and regulations may change, and errors or omissions are possible.

- You are responsible for complying with all applicable codes, rules, laws, and regulations.
- Always follow best safety practices during any project.

- Contact a licensed professional if you have any doubts about the safety of your project.

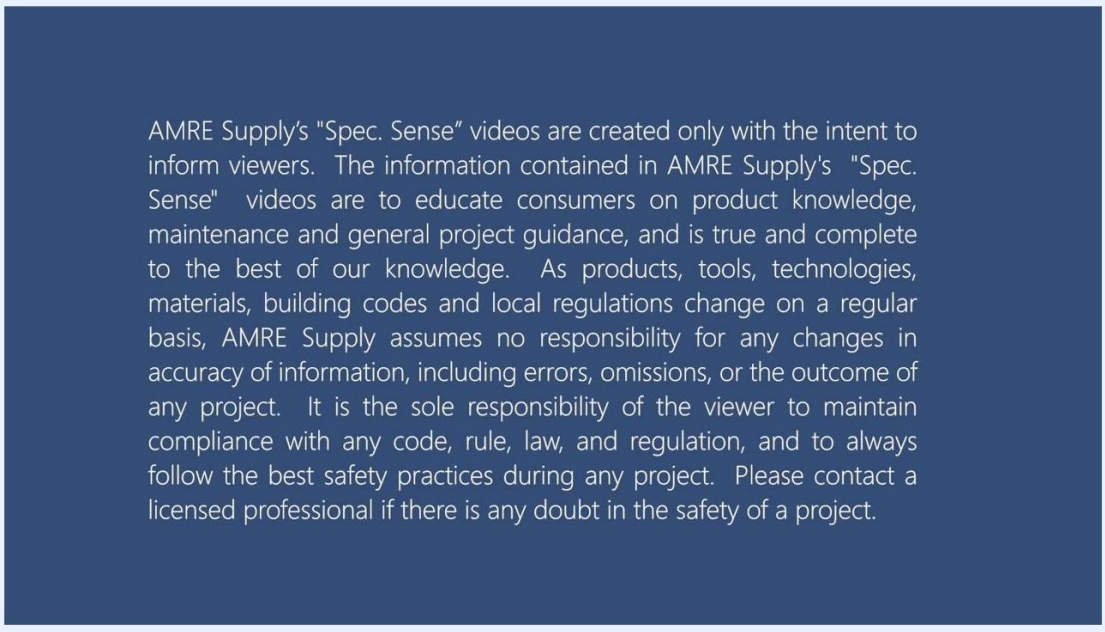


Disclaimer text outlining the intent, limitations, and safety responsibilities associated with this procedure

What's next

Once you have confirmed the capacitor's condition, either return the tested capacitor to service or install a replacement matching the correct capacitance and voltage rating. Always disconnect power and discharge capacitors before performing any further electrical work.

Presenter standing in a studio with shelves, plants, and lighting, gesturing towards the camera



Presenter standing in a studio with shelves, plants, lighting, and demonstration equipment, gesturing towards the camera while offering further assistance