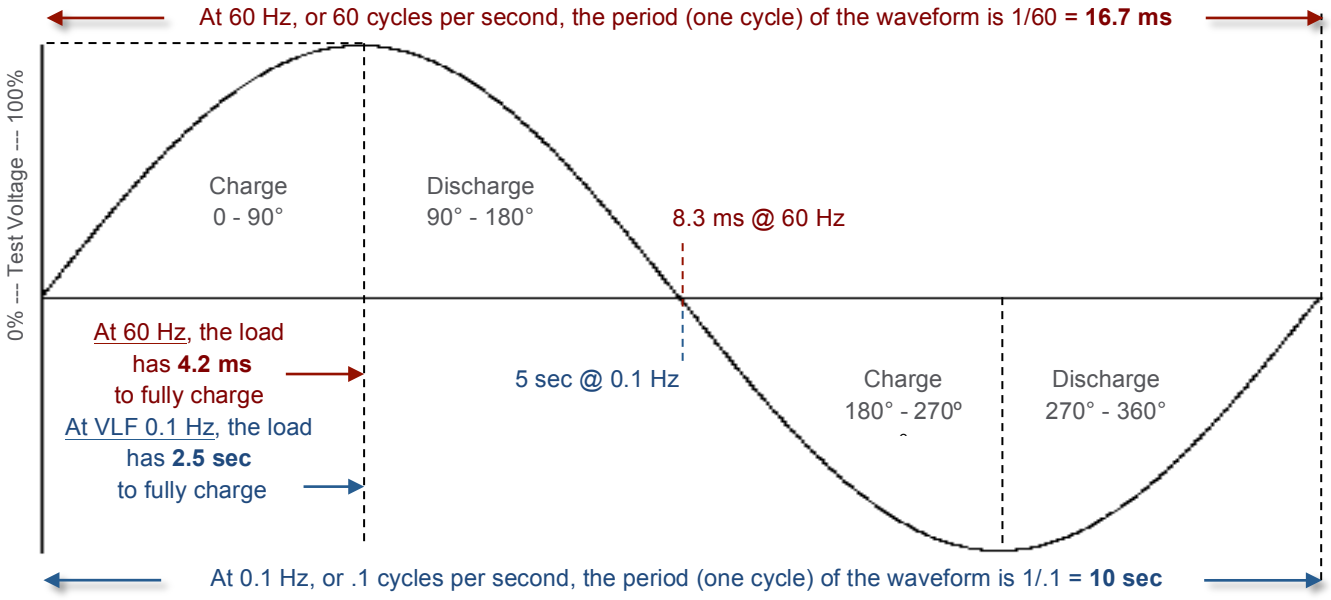
MOTOR & GENERATOR TESTING WITH AC VOLTAGE

Selecting the kVA Required from the Test Set

When testing motor coils with high voltage AC, far more mA of charging current is needed from the hipot than when DC testing. When AC testing, it is necessary to determine the power and/or current rating of the test set needed to charge the load to the desired test voltage. Different from DC testing, where a small 5 mA hipot is sufficient since we can take many minutes to bring the coil up to full voltage, far more current is needed when AC testing since the windings must be charged in just a quarter cycle, or in only 4.2 milliseconds at 60 Hz. AC hipot testing, depending on the capacitance of the load, often requires AC power supplies that must be rated 10, 20, 100 kVA+ in size, compared to a small DC tester. **To select an AC test set, the user must determine the kVA rating needed:** how much current does the winding draw from the test set at the test voltage?

When AC testing at 60 Hz, where each full cycle of the waveform, or the 360° period, is 16.7 ms, **the capacitance of the windings must be fully charged to the test voltage in just 4.2 ms** – at the peak of the waveform. Every half cycle (8.3 ms @ 60 Hz) the motor charges and discharges. When DC testing, where the applied voltage is always in one polarity (negative), the voltage can be slowly raised over minutes until the coil is fully charged at the test voltage, thus requiring a far lower power test set than when AC testing: minutes with DC instead of milliseconds (ms) with AC to charge the capacitance of the coil.



Very Low Frequency (VLF) AC Testing is an alternative to using power frequency test sets to test larger motors & generators, per the IEEE 433-2009 standard. A VLF AC test set is a high voltage AC hipot only its output frequency is 0.1 Hz or lower rather than 50/60 Hz. The lower the frequency of an AC voltage applied to a high capacitance load the lower the current and kVA needed. At 0.1 Hz it takes 600x less power than at 60 Hz to test the same coil. A 100 lb. VLF model can perform the same test as a multi-ton 60 Hz hipot costing many times more and far larger and heavier and requiring a very high input power. High Voltage, Inc. offers many VLF products. Refer to the HVI website for more information or send us an email. VLF technology is used worldwide for testing medium and high voltage cables.

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Must know the kVA/current rating required

The capacitance of the windings tested will determine the kVA needed. If you are testing the entire coil, it can be very high. If testing only one stator winding, it will be lower. You must know the highest capacitance load that will be tested to size a test set powerful enough to handle all of your testing needs. There are a few ways to determine the power needed from the test set:

- Do you know or can you measure the capacitance of your load and then calculate the AC current needed? To calculate the AC current needed to test a capacitive load, use the following equation:

  Amps = $2\pi fCV$ f = frequency in Hz C = load capacitance in Farads V = test voltage in Volts

- What AC hipot has been used before that works? What is the current rating of that test set?
- Are there old test reports that show the AC charging current at the test voltage, or at any voltage?
- If you have a small AC hipot, even if with a lower voltage output, use it to apply a few kV and measure the current. The charging current of the load will be fairly linear with increasing voltage. If it draws 20 mAac at 5 kVac, it will be draw approximately 200 mAac at 50 kVac.

Below is an example of DC, VLF, and six AC hipots. The DC model can test any size coil while the AC models are limited by their output current's ability to test the capacitance of the load. A 10 kVA AC hipot may be needed where a .5 kVA DC hipot could be used if DC was permitted. Some standards require AC voltage to perform a proper over-voltage withstand test. Larger coils are tested per **IEEE 433-2009 with Very Low Frequency AC** to perform Withstand, Tan Delta/Power Factor, and Partial Discharge tests.

DC Hipot/Megohmmeters

Models from 20 kVdc – 600 kVdc
Hipot, Leakage Current, IR Test

PTS-37.5 0-37.5 kVdc @ 10 mAdc

60 Hz AC Hipots:

The mA current draw at the test voltage, which depends on the coil's capacitance rating, must be known to size the test set.

Parallel Resonance Test Set not shown.

PFT-301CM
0-30 kVac @ 1 kVA

PFT-103CM
0-10 kVac @ 3 kVA

PFT-1003CM
0-100 kVac @ 3 kVA

VLF Sinusoidal Hipots

VLF-34E & VLF-65E
Test large uF loads
0 - 34kVac & 0-65 kVac
.5 - 10 uF load @ 0.1 Hz

Tan Delta

TD-65E

HPA-30020FC3
0-300 kVac @ 20 kVA

HPA-1010FC3
0-10 kVac @ 10 kVA

HPA-6010PC3
0-60 kVac @ 10 kVA
Corona free < 10pc

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