



# RESTORE 1030™ Testing Protocol

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Test protocols will vary depending on the type of equipment being evaluated. The length of time required to do the testing, however, remains consistent no matter what the equipment is that is being tested.

## **1. Unit(s) & Space Selection:**

Test only A/C unit(s) that operate(s) in a *dedicated area*. Conditioned air space in a building that is shared with other A/C units must all be treated and tested at the same time. Failure to treat all the units in a shared space will not give accurate test results because of the shared untreated air that is circulating. Since the treated and tested unit will be picking up the supply air from untreated units, the true effects of RESTORE 1030 will not be captured by the data loggers. ALL units that share common air space MUST be treated and tested simultaneously to get a true result.

- Select units that are at least 5 years of age OR preferably older. 8 years or older is the best option. There is no maximum age limit. Older units, according to ASHRAE, will have more oil fouling, therefore, RESTORE 1030 will produce higher energy saving results.
- Units that are 5-8 years old can expect to see a 7-15% improvement, while 8-30 years can expect a 15-30% improvement.
- Make sure the unit is in a sound operating condition and within its specifications. Check the pressure and refrigerant levels before installing RESTORE 1030.

## **2. Establish Baseline Data (before RESTORE 1030):**

All testing protocols begin with a “**baseline**” that will “before installation conditions” of the unit begin tested. The baseline data should capture **consecutive ten (10) to fourteen (14) days of 24 hour periods**. This length of time will ensure we capture data to depict day changes that are found in weather and building space usage. Using this timeframe allows for normalizing these changes in weather and operation and become statistically relevant.

**Minimum data recording parameters you will need to log for an A/C system:**

**All Units:**

- **Ambient Temperature and Humidity** at or near the condenser. ***This reading must not be in direct sunlight!*** (Remember the load put on any system is dependent on ambient temperature and humidity, as well as heat load in the conditioned area. This is the only way to make accurate comparisons. We will use comparisons, when the temperature and time of day are as close to identical as possible, in order to eliminate as many variables as possible and give us a true picture of the results.)
- **Voltage**
- **Amp draw** may be taken at the compressor or power bus depending on whether you want just compressor or whole unit amperage. One meter is recommended for each compressor that operates in the test unit. If the unit runs on 3 phases, you will need to measure all 3 phases. *Measuring just the total current load may give inaccurate readings of compressor run times due to air handling unit operation.*
- If you are not recording humidity you can use temperature probes instead.
- **NOTE:** All of these data points should be measured in **1-minute intervals** so the data can be combined on a same time basis. Time intervals that are set longer than 1 minute will result in less accurate distorted operation of the unit temperatures and compressor runtimes. Larger equipment such as chillers are not as susceptible since these units will basically run continuously. Smaller DX systems that cycle on-off frequently will cause these distortions.

**DX units only:**

- **Supply air (SA) temperature and humidity**
- **Return air (RA) temperature and humidity**
- **Coolant entry and exit temperature** if there is a liquid cooled condenser
- **(Optional):** You can expand your data collection to cover individual components in DX units to show energy consumption of the blower motors, condenser fans. To do so, simply add more amp draw clamps/meters for each additional component.

• **Chiller Units only:**

- **Inlet coolant temperature**
- **Outlet coolant temperature**
- **Condenser inlet and outlet temperatures** (if liquid cooled)
- **Coolant flow rate in gallons per minute**

Capturing this basic information will allow statistically relevant basis comparisons of efficiency in a before installation, “baseline” and after installation, “results”, comparison. This information will allow you to calculate the chiller output in BTU’s and energy used in Kwh, which will give you a measure of work done and energy consumed (BTU/Kwh).

***Important: Check the data out of the loggers BEFORE injecting RESTORE 1030 to verify that the baseline data was collected properly! Once the unit is treated with RESTORE 1030, there is no possibility of collecting baseline data again.***

### **3. Unit Treatment/RESTORE 1030 Injection:**

<https://www.youtube.com/watch?v=7DZwKpf2BF0>

Once the baseline data has been collected and the unit operation has been verified, RESTORE 1030 can be added to the unit. First, turn on the unit so that the compressor(s) are operating.

- ***SHAKE THE RESTORE 1030 BOTTLE FOR 30 SECONDS PRIOR to INJECTION.*** This will allow the PTFE to mix back into suspension before injection into the unit(s). PTFE will settle out of suspension after 45 minutes. PTFE does not react with any refrigerants or the surfactant ingredients in RESTORE 1030, so re-agitation is required for proper mixing of RESTORE 1030 every 45 minutes during treatment of multiple units.
- Inject the RESTORE 1030 into the low pressure port of the refrigerant line. Add approximately 1.6 US fluid Ounces (oz) of RESTORE 1030 per ton (3.5kw) of rated operation. We recommend using a hand injector for accurate measurement and be sure the injector fits properly into the 50 oz. RESTORE 1030 bottle. We have found The Max-flow™ #77940 from Yellow Jacket to be very accurate and not very



expensive. <http://yellowjacket.com/?s=77940> The stroke shaft can be marked in ½ and ¾ intervals for extremely accurate dosage delivery. Each stroke is 2.6 US fluid ounces (oz).

- Allow the unit to operate for approximately 30 minutes to allow the RESTORE 1030 to begin treating the unit. The unit can then be put back in normal operation mode.

#### **4. Treatment Period:**

Once the unit(s) have been treated with RESTORE 1030, allow the unit(s) to operate to accumulate 40-50 hours of compressor operating time.

**Note:** This is COMPRESSOR run time, meaning the compressor is ON for 40-50 hours. Depending on the weather, this could take days or even weeks! It depends completely upon the cycling on and off of the unit!

The 40-50 hours of compressor time is needed for the RESTORE 1030 to emulsify the oil fouling back into liquid suspension and allow the PTFE to mechanically bond permanently to the metal surfaces inside the unit(s). Data collected during this treatment period will show the progress of the RESTORE 1030 treating the unit, but will not show the complete energy savings effects when compared to the baseline data.

#### **5. Final Data Collection:**

In order to assure you have the most accurate data for analysis, it is best to collect data from a **consecutive 10 to 14 day period of 24 hours** each day at 1 minute intervals. This closely matches times and number of days of the baseline period.

#### **6. Data Analysis:**

We collect Cooling Degree Days (CDD) and Heating Degree Days (HDD) data from a nearby weather station for use in comparison of day-to-day weather. We match degree days as closely as possible from both the baseline data and post RESTORE 1030 data. A comparison of total amps consumed and minutes of compressor usage will show the energy savings from reduced electricity consumption and compressor cycles. We can assume that, in addition to energy savings, we will achieve less wear and tear on the equipment due to the fact that the compressor will run less.

## Step by Step Data Logging

(Hobo Data Loggers and Software)

### **Recommended Equipment**

Selection of data loggers is based on the amount of data to be collected, parameters to be tested, and the frequency of downloads requiring direct access to the loggers to obtain the data. Choose a company that is familiar with the loggers they sell so they can provide assistance if needed.

We recommend the Green-Volt, LLC series of HOBO data loggers. These devices give very accurate readings and can obtain information in **1 minute intervals** for extremely accurate usage. The units have enough memory for 8 days of data collection. *The data collected will require that the data be downloaded every 7 days.* There is equipment for remote access that will eliminate the need for direct connection to the units, but the cost for the remote unit is much higher. The battery that is contained in the unit will last for approximately 12 months before needing to be recharged. Products and software can be found at: [www.greenvoltusa.com](http://www.greenvoltusa.com)



**U12-13 logger**



**Amp Clamp**



**Temp Sensor**

This logger will record temperature and relative humidity and has two ports available on the right side to accommodate amp clamps or temperature probes. These loggers are not waterproof so they must be installed in a dry place and avoid direct sunlight to avoid improper ambient temperature and relative humidity readings.

## **Hobo Software Installation**

1. Look at the manual for familiarization that comes with the data logger. It is very complete and will answer your questions.
2. Run HoboWare Setup.
3. After you have run the basic setup install Hoboware Pro Updater 3.7.8
4. The installation requires the latest version of Java. If you do not have it on your computer, the setup program will ask you if you want to update from the internet. Select update and follow the instructions.
5. Install Hoboware Pro Updater 3.7.8. At the end it may ask you for a key or if you want a 30 day trial. Select the trial. The license you will receive when you pay for the key will be multi computer so 1 license will be enough. No need to buy a key.

Note: You will need a USB cord with the small (mini) connector to interface with the Hobo Logger. If you have a digital camera you may already have one to download pictures to your computer. If not they are readily available.

## **Data Logger Use**

First and most importantly READ and UNDERSTAND the instructions for data logger use. This will help prevent incomplete data gathering and having to start the comparison again in another location. Once you understand how the loggers work you can begin to gather data.

The following are essential for gathering comparative information with data loggers.

Once you have captured this information you can compute and compare the following:

- Amp draw
- Compressor run time in minutes
- Compressor run time as a percentage of total time
- SA & RA temperature and humidity
- Delta T

## Configuring and Launching the HOBO logger

1. Start the HOBO software
2. Plug the miniplug into the logger and USB port on your computer
3. Go to HOBO Pro and select Device and Launch
4. You will see a screen that has selections on it. Fill in the descriptions and select by checking the box for items you want recorded.
5. If you are using the miniports make sure the first attached device is in the top port. It is very important the description and device match. Position 3 is the top port.
6. Once the logger is configured then select the status icon to see that the values are recording correctly. **VERIFY that the time is set to 1 minute intervals!** The data will need to be downloaded once every 7 days to avoid overwriting data. The memory of the unit only lasts 8 days.
7. The screen will also show you the time available to record depending on how many ports are used

8. You have 3 options to launch the logger they are launch now, launch at some future time and launch with the button

## Downloading Logger Data

1. Start the HOB0 software
2. Plug the miniplug into the logger and the USB port into your computer.
3. Go to Device and select Readout
4. The software will then ask you whether to connect to a specific serial number logger.  
Answer yes
5. If the logger is running it will ask you whether to stop the logger before reading out.  
Answer "Stop" This will clear the memory after readout and before you relaunch. That assures you have full memory capacity.
6. The software will readout the logger and ask you where to save the information. Make that selection and click "save"
7. The Plot Setup screen will come up next. If you collected temperatures and RH then check Dew Point as well and click "plot" You will now see a graphical representation of your information
8. Select Export Table Data from the File menu and follow the instructions to export the data to an Excel spreadsheet

## Restarting the Logger

1. Go to Device then Launch and you will see a setup screen
2. Go to the description box and add an A to the description. This will make sure there is no difficulty in determining the before and after
3. Under Launch options make sure you have selected "Launch Now" and click "Launch"

## Checking Status

1. Make sure your logger is launched and recording by selecting Device and then Status
2. Check the memory used ( should say zero) and the current status should say "launched, logging"

3. You can also observe the current readings on what you have chosen to log
4. If everything is Ok then click “OK” and unplug the miniplug from the logger. If not then follow the Restarting instructions

Most other questions can be answered by the included software manual or the U12-13 user’s guide.