



The digital gauges used by today's HVACR service professionals are a far cry from what was employed by many in the industry even 10 years ago. But knowing the nuances of these instruments is critical to maximizing their performance.

BY CARTER STANFIELD, CM

When the first digital gauges were introduced to the HVACR marketplace, only the air-conditioning techno-geeks and tool hounds had them. However, as technology has continued to improve and the cost of digital equipment has been reduced, the use of digital gauges and other testing equipment has grown exponentially. Today, many companies that traditionally only made gauge-manifold sets now have a digital offering—at least four companies that are well-known for manufacturing traditional analog gauges now have digital gauges available to the HVACR service professional. Even companies that traditionally have focused solely on electronic test equipment, not gauge manifolds, now are offering digital gauge-manifold sets.

However, with all of this technology also comes the need for instruction and understanding on how to utilize it. A tool is only as good as the individual who holds it in their hand. Knowing the differences between some of the digital gauges and testing equipment out there—and how to employ them correctly on the job—is critical to both properly installing or servicing equipment and maximizing the efficiency of the gauges/analyzers.

Making an analysis

Many digital gauges and related equipment are billed as digital system analyzers because they do more than read pressure. These products also show the saturation temperature for

most common refrigerants and have a place to plug in a thermocouple temperature probe for reading line temperatures. These gauges can calculate superheat and subcooling because they have both pieces of necessary information: the refrigerant saturation temperature and the actual refrigerant temperature. Some analyzers are available with two temperature probes. Using the appropriate high and low pressures, along with their respective temperatures, will allow for simultaneous display of both superheat and subcooling in real time. One digital-gauge set will even calculate a target superheat for a fixed restriction system based on the indoor wet-bulb and outdoor ambient temperatures. There are several digital analyzers that also will read vacuum in microns, doubling as a deep vacuum gauge.

The prices of digital-gauge sets are coming down, and some in the industry expect digital-gauge sets will be in the same price range as good-quality analog Bourdon-tube gauge sets within five years. As was noted earlier, this drop in prices and the increased offerings with these sets have more and more technicians thinking about digital gauges—many of whom would not have considered them just a few years ago.

Accurate assessments

The strongest argument for digital gauges is accuracy. Accuracy is becoming increasingly important as system operating efficiency becomes more critical in daily operation. Tools



« Digital gauges are often called digital system analyzers because they allow technicians to calculate superheat and subcooling—and sometimes numerous other functions—via their ability to accurately read actual refrigerant temperature and the refrigerant's saturation temperature.

that can make precise, accurate measurements are necessary if technicians are going to ensure equipment is performing to the manufacturer's specifications.

Many Bourdon-tube refrigeration gauges are class B, 3-2-3 gauges. This means that they can be 3% off at the bottom and top of their range, and 2% off in the middle of their range. While 3% may not sound like much, that works out to 10.5 psig on a compound gauge with a range of 350 psig. On an R-22 medium-temperature refrigeration system, a difference of 10 psig suction pressure can be the difference between working and not working.

The best Bourdon-tube refrigeration gauges available are class 1A; they have a full-scale accuracy of 1%. For a compound gauge with a maximum usable reading of 350 psig, that is 3.5 psig of error. Conversely, the typical accuracy for digital gauges is 0.5% of full scale—1.75 psig of error on a gauge that reads up to 350 psig. However, digital gauges range in accuracy from 0.35% full scale to 1% of full scale. The accuracy of a digital gauge can vary with temperature. A temperature-compensated digital gauge will have an accuracy that remains stable through a wider operating temperature range.

But percentage of full-scale accuracy is only part of the story. Display resolution is just as important. Most digital

gauges have a resolution of 0.1 psi. They can display pressures through their entire range in increments of 0.1 psi. The best 3-1/8-in. analog gauges designed for use with R-410A equipment use increments of 5 psi, while smaller R-410A gauges have increments of 10 psi. Even if the analog and digital gauges have exactly the same accuracy, the analog gauges cannot show the difference between two readings that vary by just a few psi—but digital gauges can show differences of 0.1 psi.

However, with that improvement in accuracy also comes the need for proper care of the equipment. Because digital devices rely on electronics and sensors to provide accurate readings, service professionals must make a point to regularly calibrate their gauges. Refer to the manufacturer's instructions for how to service and maintain gauges, including how often gauges should be recalibrated.

Features and functionality

Today's digital system analyzers offer a wide range of features—which not surprisingly often correspond to the accompanying price tag of the instrument. For example, one manufacturer offers digital manifold sets that range from around \$300–\$1,800, depending on the features selected.

It is important to consider what features are really important

» Digital gauges offer improved accuracy and allow technicians to make today's HVACR systems even more efficient. Always check the gauges and equipment being used to ensure that the equipment will work with the pressures and oils associated with the refrigerants utilized by the system.

versus those that might simply be “nice to have.” If a feature can save time or make the technician more productive, it is worth paying for. On the other hand, having features that never will be used may just add unjustifiable cost to the end user.

One increasingly popular feature is the addition of a micron vacuum gauge to the manifold. This has the advantage of convenience and reduces hose connections. It also can save the cost of a separate vacuum gauge. One thing to consider is whether it is necessary to have the vacuum gauge in the manifold—especially since there can be quite a difference in reading at “unit” versus at the manifold itself. A vacuum reading at the unit will be more accurate because it is reading the vacuum of the unit, not the vacuum that the vacuum pump produces. For sets with a built-in vacuum sensor, make sure it can be isolated from the rest of the manifold to protect the vacuum sensor.

Another very interesting feature is data logging. Some digital analyzers can capture pressure and temperature data, and download it to a computer. This is a valuable tool if the technician is looking to benchmark a system over time, or perhaps is seeking evidence of a problem so that they can present it to the building owner when suggesting an equipment change or upgrade. However, if this is an unlikely scenario based on applications and typical workload, the tech may not want to pay for it.

Making a choice

It is of critical importance when choosing a digital-gauge set that the HVACR professional check the specifications of the gauges. In particular, look to see what type of full-scale accuracy the gauge offers and at what temperature. Also remember to seek out a set that is temperature compensated.

Remember too that when looking at digital-gauge manifold sets, the purchase is that of a manifold, not just a set of gauges. Sets that are paired with better manifolds cost more, as is the case with analog-gauge sets. There are digital-gauge sets packaged with two-valve, 1/4-in. bore manifolds. Think about the purchase, and ask if the technological investment being made should be tied to a manifold that the technician would never consider using if it were independent of the digital gauges.

There are companies that sell digital analyzers without the manifold. This allows the technician to put the analyzer of choice on the manifold. But while this can be the most satisfying, it usually is the most expensive way to go. However, this higher cost also means that techs get exactly what they want. Most of the sets billed as system analyzers have the ability to read temperature. Some use standard type-K thermocouple probes, while others use temperature probes with proprietary ends. These work fine, but they limit use to just temperature clamps and probes from that one company. Again, the tech has to weigh this against



having the option to use a standard type-K thermocouple temperature probe from any manufacturer—and what the cost of having that flexibility will be.

Caveats and reminders

There are some very inexpensive digital-gauge manifolds advertised online that are intended specifically for automobiles and/or R-134a. They will not work on systems that use other types of refrigerant—especially R-410A. Today's service professional really should not consider investing in a high-tech tool that will not work with R-410A. Its widespread use and adoption by the industry at large means that HVACR contractors and technicians will find themselves working with it more and more in the future.

Some gauges use sensors that are protected from the refrigerant and oil, while others have the sensors exposed to the system refrigerant. A dose of acidic refrigerant could take out those sensors, so it is important to find out exactly what is covered by the manufacturer's warranty (better units have at least a two-year warranty).

And as was noted at the beginning of this feature, remember that owning a digital system analyzer does not make a service contractor or technician any smarter. While these digital devices can make a job easier to complete, it requires a skilled operator who understands the fundamentals of heat transfer to maximize their use. A digital system analyzer is a precision tool and, like any tool, a skilled craftsman is needed to achieve great results. ☺

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