The More Things Change ...

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"One thing hasn't changed over the years — skilled technicians are needed to operate and interpret the data from the test sets being used."

Sometimes the "good old days" may not have been as good as we like to remember. For example, old faithful – no, not Ned who hasn't missed a day in 30 years, but that MEGGER Series 1 test set (See Figure 4). Oh, it did the job and probably still could do the job, but would you really want to muscle that up a ladder or carry down into a subbasement?

Without a doubt the old equipment did the task and looked impressive doing it. In fact, many of these units, some that might be considered museum pieces, are actually still functioning. And although that old equipment is much larger, heavier, and cumbersome, it has an almost classical look – heavy wooden cases, iron handles and hinges, numerous gauges, meters, wing nut connectors and switches – all indicating that these were serious test sets.

Of course, it was the transistor that dramatically changed the equipment used in the electrical testing industry, as it did so in many others, from communication and medicine to entertainment and navigation.

Today's test equipment for the most part performs the same tests and delivers the same valuable data as yesteryear's test meters. The difference today is that the data comes in a more concise format, in less time, through equipment with smaller footprints and less density. In addition, the data received is much more refined.

A major advancement has been the equipment's ability to automatically "slice and dice," then present the data. But the data still needs to be accurately interpreted, and a course of action must be planned based on these interpretations. This can only be done by a skilled, experienced test technician. So, in many ways, although the equipment has simplified the test procedure, the skill level needed to operate and even understand them is more complicated. Examples of just a few of the technology and equipment changes follow, including relay testing, circuit breaker operation analysis, and insulation resistance reading.

Relay Testing Then – The equipment used in relay testing has changed drastically in the past 25 years. Vintage test sets used reactors and capacitors for phase shifting and rotating geared clocks for timing. Some of these were homemade, one-of-a-kind test sets that had more knobs and dials than an airplane cockpit.

Figure 1 — The equipment used in relay testing has evolved drastically in the past 25 years to keep up with the changing relay itself.

These test sets were ingeniously designed and configured to minimize space and weight, but still could only marginally test some of the more complex relays, such as power, transformer differential, and distance relays.

Due to the numerous knobs, dials, and current taps that had to be configured or set on these test units, repeatability of the tests could sometimes be compromised when using different test sets or if different technicians performed follow-up tests.

Although the relay test sets have changed, they have not changed as much as the relays themselves. Old relays were constructed much like the old test sets using reactors and capacitors, jeweled bearings, and springs. This limited the accuracy of the relays and also made the relay more susceptible to drift over time from its original settings. And, the relay components were likely to change due to temperature, age, and contamination.

Relay Testing Now - The main factor which necessitated the need for new relay test sets was the evolution of the relay itself. The new microprocessor-based relays were much more accurate than the test sets used to test them. New relays provided advanced features that could not be properly tested using existing equipment.

In the mid 1980s, modern test sets began to employ multiple microprocessor-controlled platforms which are computer driven and have since evolved into systems with as few as two or three moving parts. A laptop computer is often needed to operate the test set with the myriad knobs and dials replaced by software programs which can continually be updated. These programs make the test set more versatile, allowing it to keep up with the constantly changing relay models and features.

The new test sets allow for extremely accurate testing of even the most complex relay systems and protection schemes. Many of the test sets allow for test plans or programs to be written for a particular relay with certain settings. This allows for repeatability from one test interval to another even if different technicians are performing the tests with different test sets, ensuring consistent and precise test results.

Figure 2 — This circuit breaker operation analyzer was applicable to all breakers of the time period except for those having rotary motion of the contacts.

Circuit Breaker Operation Analyzer Then - The circuit breaker operation analyzer circa 1955 (see Figure 2) was applicable to all breakers of the time period except for those having rotary motion of the contacts, which required an adapter. Manufactured by the Cincinnati Clock and Instrument Company (Bellevue, Kentucky) – the same company that brought us the synchronized clocks kids still stare at in classrooms each school day at around 2:45 p.m. – this device literally made time distance measuring an art, with its painstakingly configured graphs.

The transducer consisted of two main components, a vertical drum carrying a ruled chart, driven by a synchronous motor through suitable gear reductions and a marking mechanism with pulleys and wires and a mechanical pencil, which was operated by the breaker's lift rod. The rotary motion of the drum gave the time in hertz as the abscissa on the chart while the ordinate of the chart represents the travel time of the circuit breaker.

Many may recall having to manually prepare the glue strip on the graph paper or in other words, lick it like a long envelope. This was, of course, before the peel and stick breakthrough of the 1970s.

However, if the breaker was of the lift rod type and was not preequipped by the manufacturer to accommodate this instrument, one had to first drill a 3/8 inch hole in the top of the circuit breaker housing (if the lift rod was inaccessible). This is usually the case with oil circuit breakers – and yes I said "is," for even today this technique is often used. The lift rod can then be drilled and tapped for 10-32 threaded connecting rod – while not interfering with the linkages – and the 3/8 inch hole and the 10-32 inch threaded hole must be aligned. By "means of brackets made to suit local conditions" the analyzer may then be set in position and clamped in position with "C" clamps.

Finally, by using rulers, triangles, and pencils and employing a few simple trigometric formulas and a little basic geometry, a technician could easily and accurately calculate the speed. The tech then went back to the breaker, made the necessary adjustments and calibrations, and then started the whole process again. Simple enough unless, of course, the drum spun in the wrong direction and the graph paper ripped apart. Then Step Two quickly became "Insert Choice Words Here."

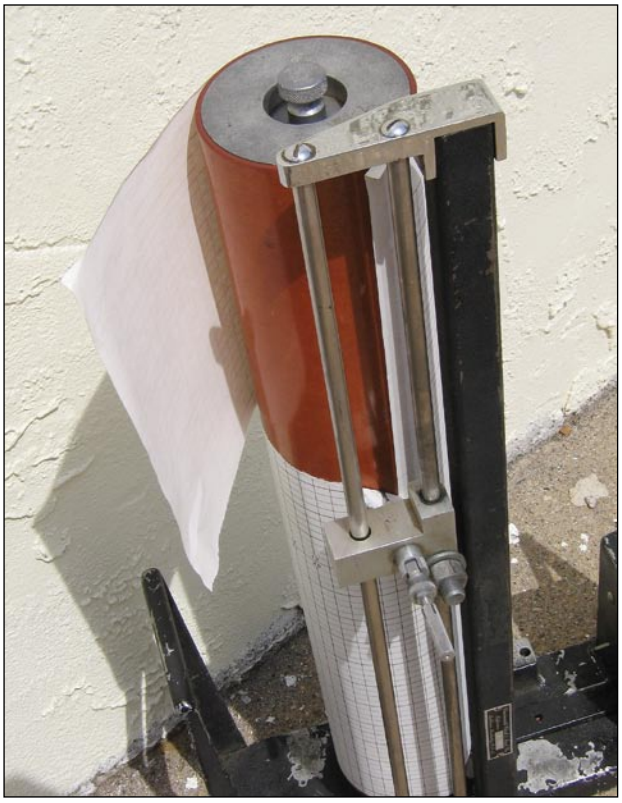

Figure 2a — A reversed spinning drum usually ended in a ripped graph and an unhappy tech.

Circuit Breaker Operation Analyzer Now – Today a technician still installs a transducer but attaches leads, pushes a button, and all the data is quickly downloaded into a database. The breaker's mechanical and electrical speeds are precisely calculated as well as acceleration, velocity, and pole separation. If you feel the need, some units still let you load a roll of thermal graph paper to record the data for old time's sake.

But not everything new is necessarily different. Today you still need to mount the transducer, albeit a much lighter, leaner instrument, on a level, stable surface and tie it to the lift rod in order to get an accurate measurement. This still may require drilling and tapping of the rod.

Figure 3 — Today a technician may attach leads and push a button; but not everything new is necessarily different.

Insulation Testing Then - You can't discuss insulation testing without mentioning the name MEGGER. Manufacturing insulation testers from 1 kV to 10 kV is where the firm started. According to the company Web site, the brand dates back to 1889, when the first portable insulation tester was introduced with the MEGGER name on it. (The trademark was first registered in May 1903 and is still strongly guarded by the company.)

Figure 4 — The Megger Series 1 insulation test kit was a sturdy, reliable instrument.

Weighing in at 44 pounds, about 80 pounds in its case, the MEGGER Series 1 insulation test set was a pioneering piece of test equipment. Technical advancements of the time ranged from a simple bubble level ensuring the set and particularly the meter movement remained level to an automatic discharge switch which was installed due to the danger of the test specimen capacitance being left in a charged condition at the completion of the tests. The switch was fitted in the instrument which shorted the test terminals through a resistance when the mains were switched off. It was then advised to leave the terminals connected for at least 30 seconds after switching off.

Insulation Testing Now - Today's technicians have a choice of several insulation resistance test sets from companies like Megger, Phenix Technologies, Amprobe, Vanguard Instruments and AEMC Instruments. Ranging from 2.5 pounds to 20 pounds, today's test sets are truly portable. With combination analog/ digital displays housed in ruggedized, industrial-grade plastic, usually being both line supply or battery operated. Modern test units deliver automatic results from insulation resistance tests to polarization index (PI) and from step voltage (SV) to dielectric discharge (DD), that can be recorded or downloaded with the push of a button. Information displayed includes resistance, voltage, leakage current, capacitance, battery status, and time constant, and all can be stored in the unit's own memory with a time and date stamp.

Hey, Remember This?

Anyone remember using this? What is it? A 1940's Tazer? A space-age tuning fork?

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Figure 5: — Today's insulation resistance test sets are truly portable and offer a variety of result outputs.

... The More Things Stay the Same

Although the look, weight or even capability of test equipment has changed over the years, two crucial factors have not — the first being that periodic and regularly scheduled testing and maintenance is the only way to ensure reliable and safe operation of electrical and electrical distribution equipment.

The second factor is that skilled personnel who complete years of training and are required to maintain a level of expertise are needed to calibrate, configure, and professionally install the test equipment. These technicians then safely conduct the tests and interpret the results in order to make recommendations for corrective actions. Without the experience and ingenuity of the technician, even today's test equipment is as useful as a museum display.

Charlie Simpson is the Technical Writer for Croydon, PA-based Burlington Electrical Testing Co. (BET, www.betest.com), a NETA Accredited Company. BET is an independent testing and maintenance firm that serves the industrial, commercial, construction, institutional, and utility industries, including testing, engineering, and repair of all manufacturers' power distribution gear and equipment.