

DIGIVAC: Application Note

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Designing innovative vacuum gauges and controllers for over 30 years

APPLICATION NOTE: TRANSFORMER OIL PURIFICATION WITH THE BULLSEYE PRECISION GAUGE

ABSTRACT: TRANSFORMER OIL PURIFICATION IS OFTEN COMPOSED OF FILTERING AND APPLYING A VACUUM TO THE TRANSFORMER OIL, TYPICALLY IN SOME KIND OF RIG THAT MAXIMIZES SURFACE AREA. THE VACUUM ENABLES THE WATER AND OTHER GAS CONTAMINANTS TO BE PURGED FROM THE OIL, IMPROVING ITS EFFECTIVENESS AS A DIELECTRIC AND MINIMIZING THE RISK OF TRANSFORMER DETERIORATION CAUSED BY IMPURITIES. FOR VACUUM RATED TRANSFORMERS, A DIGIVAC BULLSEYE PRECISION GAUGE CAN BE USED FOR THE BASIC TRANSFORMER DRYOUT SERVICE.

INTRODUCTION: A DIGIVAC BULLSEYE PRECISION GAUGE CAN BE USED FOR THE BASIC TRANSFORMER DRYOUT SERVICE. THE NEED FOR TRANSFORMER OIL PURIFICATION: WATER MAY WORK INTO THE TRANSFORMER OIL OVER TIME WHICH WOULD REDUCE THE OIL'S DIELECTRIC (INSULATION) PROPERTIES. MOISTURE, ESPECIALLY IN THE PRESENCE OF OXYGEN, IS EXTREMELY HAZARDOUS TO TRANSFORMER INSULATION.

AT 2.5% MOISTURE BY DRY WEIGHT (M/DW) OR 30% OIL SATURATION, THE TRANSFORMER SHOULD HAVE A DRYOUT IF THE TRANSFORMER TANK IS RATED FOR VACUUM.

THERE ARE 5000-7000 POUNDS OF PAPER INSULATION IN A TYPICAL LARGE POWER TRANSFORMER IN A SUBSTATION. AT 2.5% M/DW AND ABOVE, PAPER INSULATION DEGRADES MUCH FASTER THAN NORMAL. AS PAPER DEGRADES, MORE WATER AND OXYGEN IS

PRODUCED FROM THE DECAY PRODUCTS, AND THE TRANSFORMER BECOMES EVEN WETTER AND DECAYS EVEN FASTER. WHEN A TRANSFORMER GETS ABOVE 4% M/DW, IT IS IN DANGER OF FLASHOVER (ARCS/SPARKS) IF THE TEMPERATURE RISES TO 90° C.

EACH TIME THE MOISTURE IS DOUBLED IN A TRANSFORMER, THE LIFE OF THE INSULATION IS CUT BY ONE-HALF.

FOR VACUUM RATED TRANSFORMERS, A DIGIVAC BULLSEYE PRECISION GAUGE CAN BE USED FOR TRANSFORMER DRYOUT SERVICE. OFTEN, THIS IS DONE BY APPLYING A VACUUM TO A TRANSFORMER AFTER THE DIELECTRIC OIL HAS BEEN REMOVED. A RULE OF THUMB IS THAT WHEN THE TRANSFORMER GETS BELOW 100 MICRONS, THE WATER HAS BEEN SUFFICIENTLY REMOVED. THIS PROCESS MAY TAKE DAYS.



UNDERSTANDING THE PRODUCT DESIGN: THE BULLSEYE PRECISION GAUGE IS DESIGNED TO MEET THE DEMANDS OF FIELD USE WITH A 70-HOUR BATTERY LIFE, RUGGED, RUBBER BOOT, A MAGNET FOR HANDS-FREE USE AS WELL AS AN INTEGRATED STAND. IT OPERATES ON THE PRINCIPLE OF INDIRECT PRESSURE MEASUREMENT, WHERE IT SENSES THE COOLING OF THE SURROUNDING GASES. THE LESS GAS (THE LOWER THE PRESSURE), THE HOTTER THE THERMOCOUPLE GETS AND VICE VERSA. THIS TEMPERATURE IS CORRELATED TO A PRESSURE FOR AIR, NITROGEN, AND OTHER SIMILAR GASES.

FLEXIBILITY OF

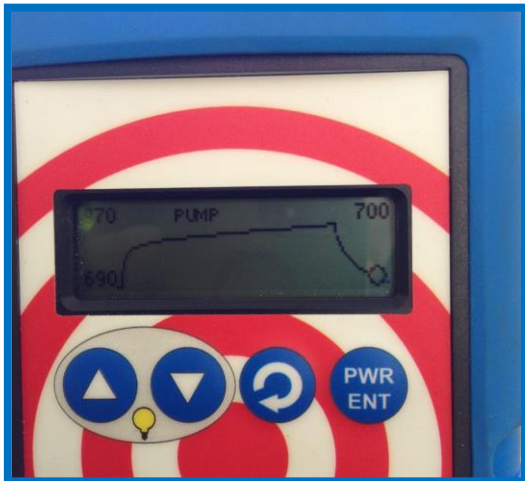
APPLICATION: BESIDES THE BASIC VACUUM READING, THE BULLSEYE PRECISION GAUGE GIVES PUMP DOWN STATISTICS AND A GRAPH TO LET YOU KNOW THE RATE OF THE PUMPDOWN, WHICH IS ESPECIALLY USEFUL TO DIAGNOSE A POTENTIAL LEAK OR PROBLEM WITH THE TREND.



A TRANSFORMER SERVICE MIGHT INVOLVE A DROP TEST WHERE YOU WOULD PUMP THE TRANSFORMER DOWN FROM ATMOSPHERIC PRESSURE TO ABOUT 1 TORR, AND OBSERVE THE LEAK RATE.

A 150 MICRON LEAK RATE MAY BE OK, BUT A 1 TORR LEAK IN 20 MINUTES MAY NOT BE.

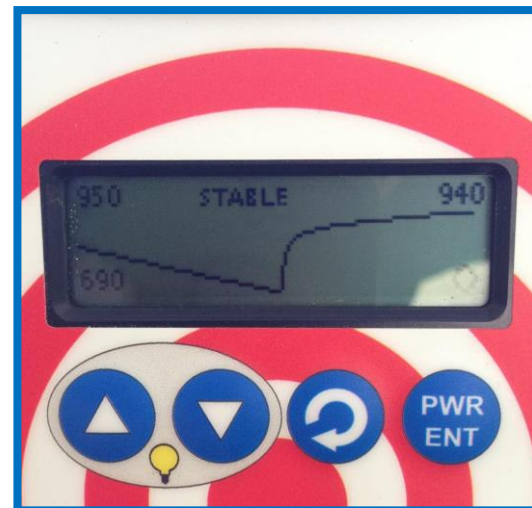
THE GRAPHICAL TRENDING FEATURE OF OUR GAUGE ENABLES A TECHNICIAN TO SEE THE VACUUM RISE OR FALL OVER TIME, AND EASILY INTERPRETS THAT WITH VACUUM ANALYTICS.



THE GAUGE'S BLUETOOTH

FEATURE ENABLES A TECHNICIAN TO SEE WHAT THE READING IS AND LOG DATA, REGARDLESS OF WHERE THE SENSOR AND DISPLAY ARE PLACED.

FOR PERMANENT INSTALLATIONS, A DIGIVAC MODEL 215V IS IDEAL FOR MEASURING VACUUM IN AN OIL PURIFICATION RIG.



PERFORMANCE OF THE PRODUCT:

THE BULLSEYE PRECISION GAUGE IS DESIGNED TO BE RUGGED, ACCURATE, AND REPEATABLE FOR YEARS OF CONSISTENT RELIABLE SERVICE. IT CAN OPERATE IN EXTREME WEATHER CONDITIONS (-14°F TO 120°F). IT INCORPORATES THERMOCOUPLE PASSIVE SENSOR TECHNOLOGY, WHICH HAS PROVEN RELIABILITY IN FIELD OPERATIONS. IT HAS THE ABILITY TO BE CALIBRATED IN THE FIELD, AND THE SENSOR CAN BE CLEANED OR REPLACED. EACH BULLSEYE PRECISION GAUGE IS MANUFACTURED IN THE USA, AND IS CALIBRATED UNDER REAL VACUUM USING A NIST STANDARD.

CONCLUSION:

DigiVac Thermocouple Gauges are designed to meet the demands of field use, where: ruggedness, repeatability, and accuracy are required to get the job done. The Bullseye Precision Gauge is ideal for the transformer oil purification application, due to its unique vacuum analytics and optional Bluetooth connectivity for remote monitoring, logging, and trending of data.