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DEMAGNATIZATION
of
DOWNHOLE TOOLS

For most Drilling Personnel, the inspection of Downhole Tools holds a mystique. The inspector arrives in the field with a Black Light, and perhaps a small coil, sprays on a fluorescent liquid and by the grace of god finds some cracks in the last engaged thread. In today's world there is much more science than *Smoke and Mirrors* in the Magnetic Particle Inspection (MPI) of Threaded Connections. This article will shed some light on the subject.

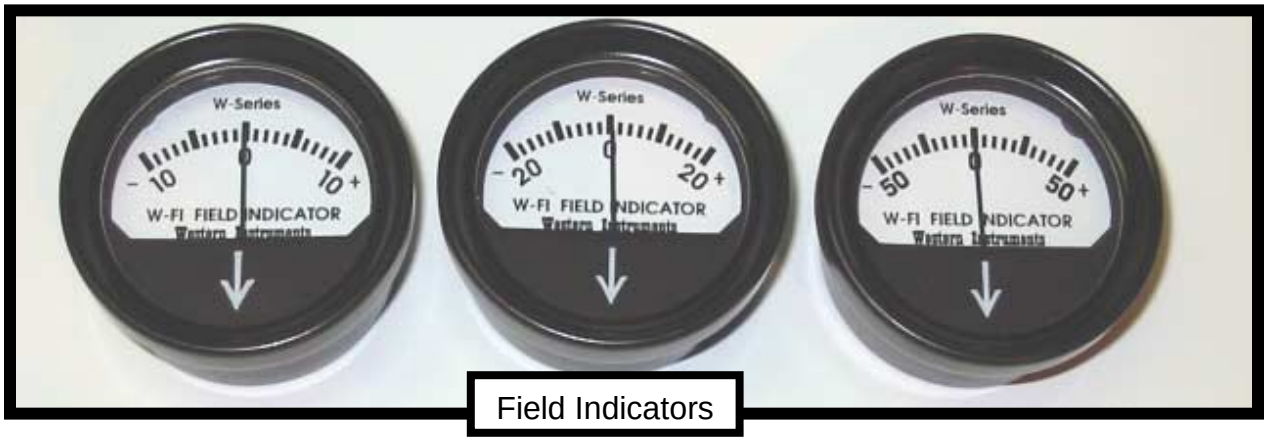
To start with we know that putting tools on a drill stem and tripping them downhole will induce a strong magnetic field in both the Drill Stem and any Bottom Hole Assembly. However in most cases this is far too strong a Magnetic Field to perform a proper Fluorescent MPI on the Threads (Pin and Box Ends). Rather than the fine Magnetic Particles (5 to 20 Microns) flowing over the surface and migrating to cracks, the particles simply adhere to the surface. Unless the inspector realizes this and knows how to read the indications, they may simply be going through the motions of an inspection. Luckily the type of Magnetic Field set up in the BHA Downhole, is longitudinal and optimal for detecting cracks in threads.

Now the driller has some concern about a tool, and wants the threads inspected or the Monitoring While Drilling (MWD) Technician is concerned about the Strong Magnetic Field Interfering with his downhole equipment. What can be done? The tool needs to be demagnetized for two reasons; firstly so the inspector can induce a controlled Magnetic Field for a proper inspection; and secondly to ensure there isn't a Magnetic Field to reek havoc on the MWD sensors. Any Magnetic Field, in any BHA, can interfere with the MWD sensors, so it must be Demagnetized either when being tripped, while being rebuilt, or when it arrives on the lease.

Measuring a Field

Magnetic Field Indicators come in two forms, Electronic and Mechanical. Electronic Field Indicators measure a far larger range of fields, typically 0 to 200 Gauss (or greater) in 0.01 Gauss increments, than is required for Magnetic Particle Inspection. Pocket Magnetometers measure a limited range of fields, typically 10-0-10 (+/-10), 20-0-20 (+/-20), & 50-0-50 (+/-50). A 10-0-10 would be used during Demag to ensure the

residual field is less than 3 Gauss, while a 50-0-50 would be used to check a part for field intensity and direction. A 20-0-20 allows the cheap inspector to use only one Field Indicator.



Field Indicators

Demagnetizing

In order to Demagnetize a BHA, a Reversing DC Magnetizing Coil is required; portable AC Coils do not produce a strong enough Field to affect any BHA. This Magnetizing Coil needs to be able to induce a field almost as strong as the one that has been setup in the tool while downhole. Secondly, the Coil must be able to induce either a Positive or Negative Field (Reversing Polarity), and finally an Intensity Control to reduce the amount of Field produced by the coil (Variable Amperage). With these three features, a *Reversing DC Demag* procedure can be performed. Typically these powerful DC Coils weigh in at over 40 Pounds, while the 'Toys' (AC Coils) are much smaller and weigh less than 15 pounds.

DC End Area Demag Coil

General Purpose AC Coil

Performing Reversing DC Demagnetization is not a matter of 'waving' a coil over the tool joint. The field must be measured, for intensity and polarity (+/-). The DC Coil is typically placed in the middle of the assembly, and the operator starts to progressively reduce and reverse the output of the coil, until the field is reduced to zero. When the middle of the assembly is Demagnetized the operator starts to work his way to each end, alternating from one side of the center to the other. Obviously a short tool can be demagnetized quite quickly, but a longer tool takes more time. Fully assembled tools,

such as Jars and Mud Motors can be demagnetized when they are fully assembled, but can take hours to 'chase' the field out.

For years, in both the Aircraft and Downhole Inspection Business, Demagnetization has been considered more art than science. No matter the industry however, the operator always has a Field Indicator in his hand to measure the field after each step of the way. If he isn't using one, he doesn't know what he's doing!

Magnetizing

When magnetizing a Threaded Connection, the 'rule of thumb' is a surface field of 18 to 24 Gauss. Anything Stronger will cause the Particles to adhere to the surface, while anything less will not provide enough field strength to hold the particles to the area of a crack. Reference Specifications, such as API and ASTM, have formula to calculate the necessary field to perform Magnetic Particle Inspection, however if the inspector is using a field indicator, he can be assured he has the correct Field Strength.

Here again, the type of Coil used (AC or DC) by the inspector does matter. AC Coils only induce a surface field, and are not strong enough to set-up a field in a Box End. Some will insist that on a *Box End* below 3 ½" OD, an AC coil can be used, however AC will only detect 'surface' defects. In many cases, 'Metal Smear' may be covering the crack, so a DC Coil is normally used so 'Sub-Surface' Indications can be detected. Finally, a Field Indicator should be used to test the Field Strength.

The picture on the right shows a DC End Area Coil, placed over an assembly for Demagnetizing a "tool", both of which are supported by a fixture. We know this illustrates demagnetization because the effective area of the field produced by a coil, only extends out approximately 1 ½ diameters from the center of the coil.

Inspection

Some refer to Florescent Magnetic Particle Inspection as "Black Light" inspection, and they are correct in that a Long Wave Ultraviolet Lamp (Black Light) is used. These relatively standard Lamps produce a tremendous intensity of Long Wave UV Light, and appear only to glow, however the Fluorescent Particles are coated with a UV absorbing material which glow when exposed to the correct wavelength of light. Outdoors or in a Shop, the light produced is overwhelmed by Visible or White Light, so the operator must shield this ambient light while inspecting the workpiece. Inspectors often use a Tarp or Cape, to cover themselves and the workpiece, to block out visible light, while well-equipped shops will have inspection areas (booths) curtained off with mounted UV Light Fixtures.

Long Wave UV Light is regularly measured for intensity, no matter if the light source is fixed or portable, the light intensity can be measured with a Radiometer (Black Light Meter). Reference Specifications call for UV Light Fixtures to be checked "Upon Change of Location" or at the start and end of a shift. Furthermore, radiometers must have a regular calibration frequency of 4, 6, or 12 months, depending on the reference

specification. The long term affects from any type of UV Light, especially from High Intensity lamps, is harmful to the eyes so proper UV absorbing eye protection must be used

Conclusion

If, prior to or after inspection, the magnetic field in the workpiece is to strong, the assembly must be demagnetized. Like any type of work, we have the right tool for the job, and Fluorescent Magnetic Particle Inspection of Down Hole Assemblies is no different. The job requires the correct type of Coil (Reversing and Decaying DC field), UV Lamp, and the correct measuring tools (Gauss Meter and Radiometer).