# Magnetic field nulling or degaussing? It depends...

*What's best for stopping magnetic arc blow on your job? Dr Steve Foulds reports.*

Magnetic arc blow causes welding job delays, poor weld quality, frustration and unexpected costs – particularly irritating when everything is in place yet the project is completely stalled because of magnetism.

Why can't you just degauss the whole pipe? This question is often voiced but it is simply not a sensible option. Pipes are large and the coils required to demagnetise them are similarly large and must be passed over the pipe. The process is difficult, expensive, power hungry and slow. Worst of all, a demagnetised pipe may have become magnetised again by the time it reaches the pipeline destination.

Two solutions are commercially available and commonly used. The first is generation of a magnetic field that exactly cancels the field in the weld preparation due to the inherent magnetism in the pipe – commonly referred to as field nulling. The second is removal of the magnetism from the material around the weld preparation – referred to as joint degaussing when carried out at fit up or pipe end degaussing if carried out before fit up.

## Field nulling

Magnetism in pipes appears in two distinct ways. One, referred to as longitudinal magnetism, results in a magnetic field across the weld preparation that is of similar magnitude and sign around the circumference. In contrast, zone magnetism results in a magnetic field that changes magnitude and sign around the pipe circumference.

Diverse's Zeromag ZM100A provides field nulling with two modes: manual and automatic. Manual nulling is an excellent solution for all cases of longitudinal magnetism. There are no restrictions on the number of weld positions and no field probe needs to be deployed during welding. For cases of zoned magnetism, manual nulling is not preferred due to the need to continually stop the welder to check the field and readjust the nulling field.

Automatic nulling works well for all types of magnetism but is particularly useful with zoned magnetism. In this mode the field is actively nulled at the weld position as the welder progresses. The drawback with active nulling and zoned magnetism is that only one weld position can be effectively nulled, in this case a second welder is not able to weld the other side of the pipe. Fig. 1 shows how the field generated by coils concentrates in the pipe walls and the weld preparation region between the pipes.

## Degaussing

Although degaussing complete pipes is not practical, degaussing the area of the joint at fit up or pipe-ends before fit-up is possible in some cases.

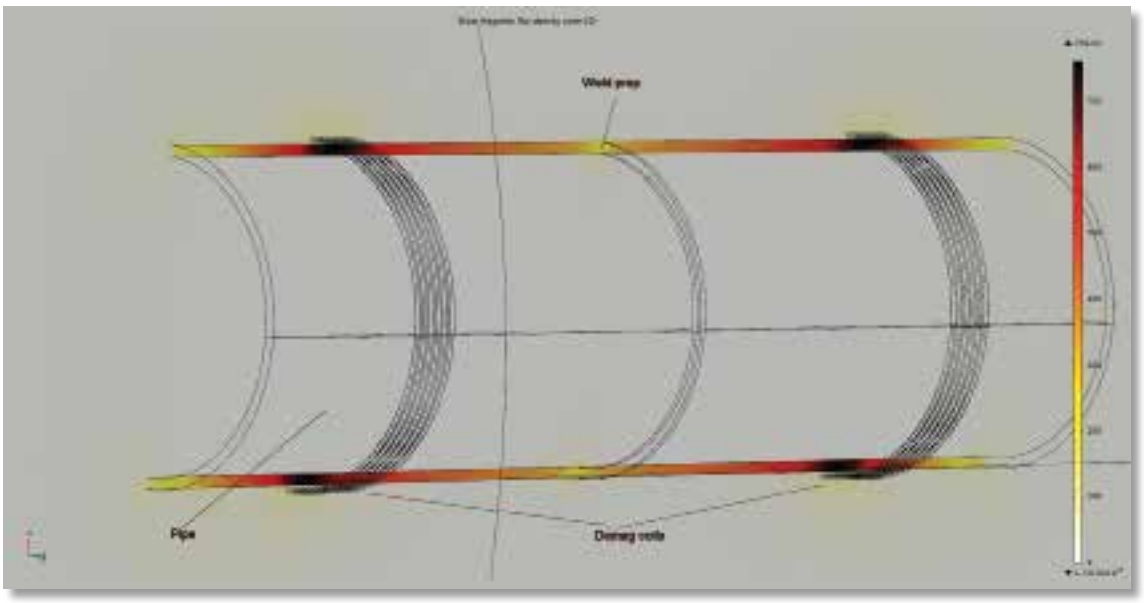


**Fig. 1. Magnetic field in pipes.**

Degaussing is a preferred choice as there are no issues with the type of magnetism or restriction on the number of weld positions. There are two drawbacks: the magnetism remains in the rest of the pipe and will return to the region to be welded over time; and whether it will be successful is not known in advance.

Classic degaussing removes the magnetic field by exciting it to a very high positive value then progressively decreasing the magnitude of the field to zero while alternating its sign – a process called down cycling (Fig. 2). The success of this technique depends on two crucial factors: the maximum field supplied; and the rate of the down cycle.

Is the field applied large enough? To successfully degauss the applied field must be large enough to magnetically saturate the steel (i.e. reach the region of the BH graph in Fig. 2 where the slope is flattening).

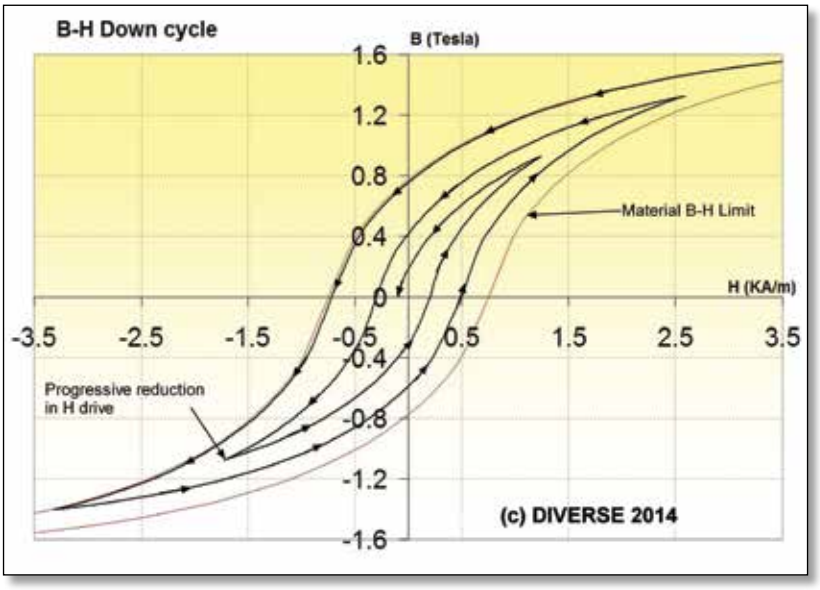


**Fig. 2. BH curve showing classic degauss down cycling.**

If the maximum field does not saturate the steel then, following the degauss cycle, the pipe will be left in a magnetised state. A number of factors affect the field that can be applied, including the number of turns applied to the pipe and the geometry, and the maximum degaussing current.

Pipe size is a factor that is defined for a particular job and this determines the maximum number of turns that can be applied. Fig. 3 shows how the degaussing field drops as the pipe size increases (for a fixed current of 100A and 100m length of demag cable). For large pipe sizes the degauss field is unlikely to saturate the material and in this case degaussing will not be successful.

For a given conductor diameter, degausser power is important because it determines the maximum degaussing field (ampere turns) that can be achieved.

The maximum degauss field for a specific scenario can be calculated, however, whether this is sufficient for effective degaussing depends on the material.

Different grades of steel have varying saturation fields and their BH curves are often not readily available. For different materials with similar geometry, one may be successfully degaussed whereas for another field nulling is required.

Is the downcycle frequency slow enough? Down cycle frequency determines how far the magnetic field penetrates into the pipe wall. Many industrial degaussers operate at 50Hz, but the field at this frequency only penetrates a few mm (again this is material dependent). At frequency of 1Hz penetration rises to at least 10-20mm. So for thick walled pipe degaussers that can operate at lower frequencies are required, such as the ZM150 degausser operated with Zeromag.

Selecting the best route to tackle magnetism depends on the details of the job. Field nulling will work for all jobs but can place restrictions on the number of welders that can work simultaneously. Whether manual or automatic nulling is used will be governed by the type of magnetism present.

Joint and pipe end degaussing solutions do not place any restrictions on the job but whether they work for a particular job depends on a number of factors. So to answer the question originally posed, it depends! ●

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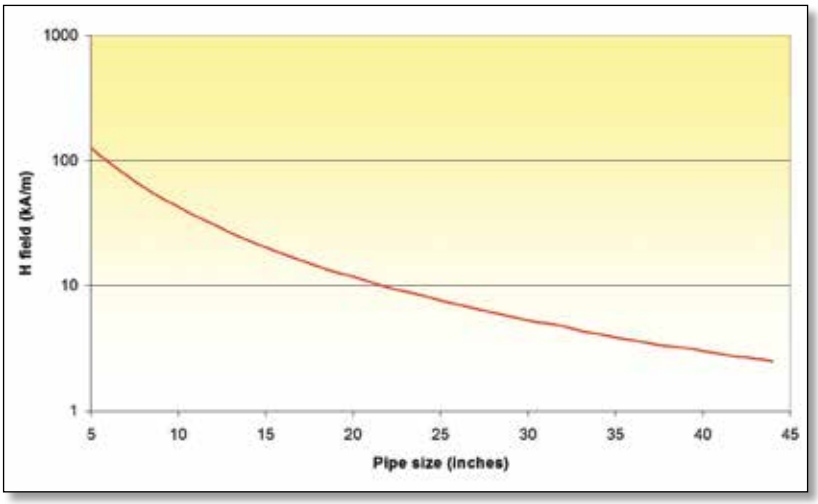


**Fig. 3. Nominal degauss field for 100A through 100m demag cable wound over 15cm.**

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