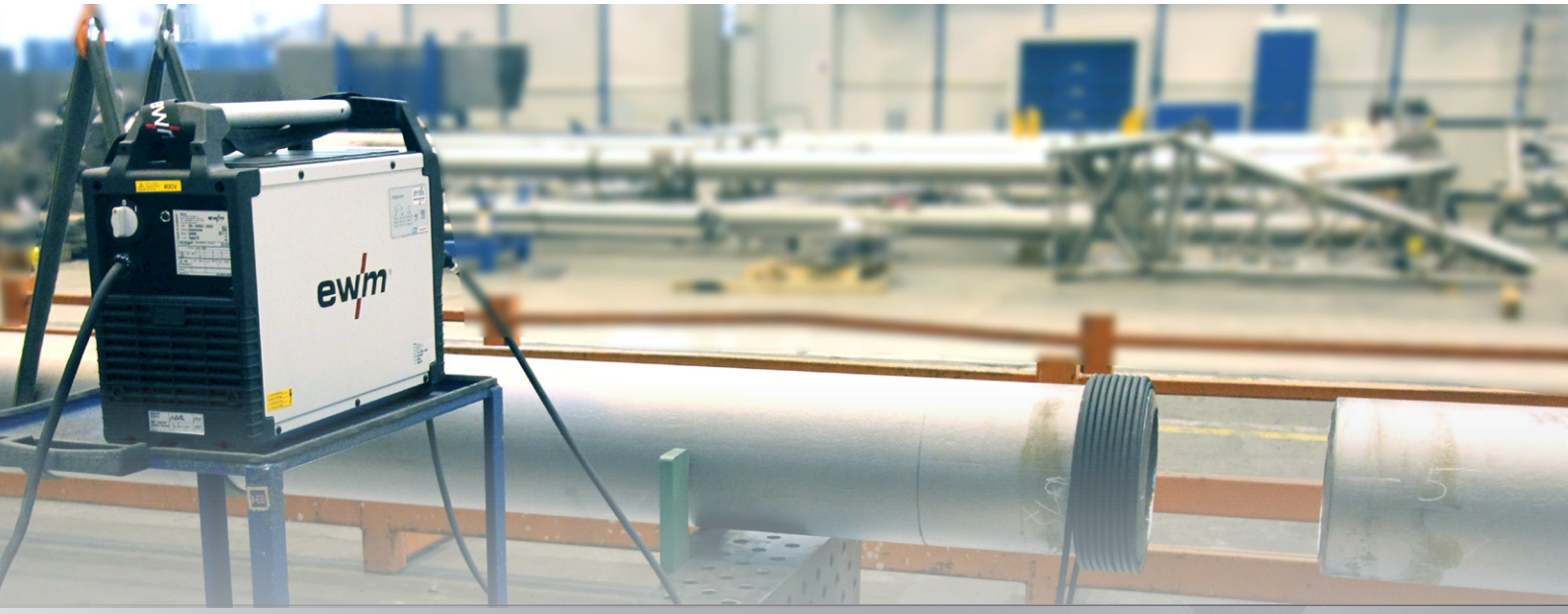
Degauss 600 / Pico 350 cel puls pws dgs

Degaussing of pipes and metal sheets



- Degaussing of magnetic components
- Safe welding process with no magnetic deflection of the arc
- Automatic degaussing process

Degauss 600

Pico 350 cel puls pws dgs

3 Years 5 Years transformer and rectifier
ewm-warranty*
24 hours / 7 days
*For details visit www.ewm-group.com

/// simply more

Degaussing prior to welding

Degaussing

Degauss 600

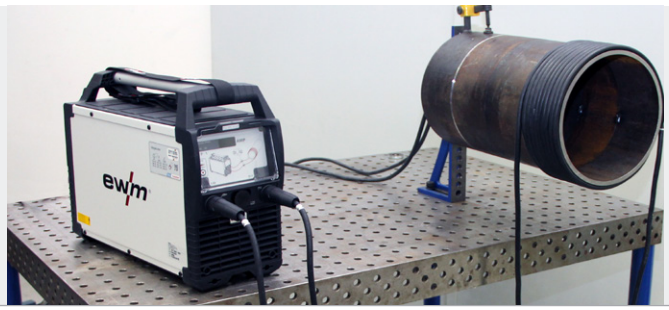
Magnetism is not desired where steel is welded. Undesired residual magnetism in steel parts results in an unstable and deflected arc. The effect may be so great that welding is impossible.

When using the Degauss 600, you can degauss your materials and workpieces. Following the easy installation of the components at the workpiece, the continuous degaussing process will automatically be completed within the shortest possible time.

The effect of the degaussing will show immediately in the subsequent welding process. Your welding results speak for themselves: The arc is stable and no longer deflected, there are no unnecessary arc striking spots, sidewalls are fused without lack of fusion, perfect results without rework or scrap are achieved.

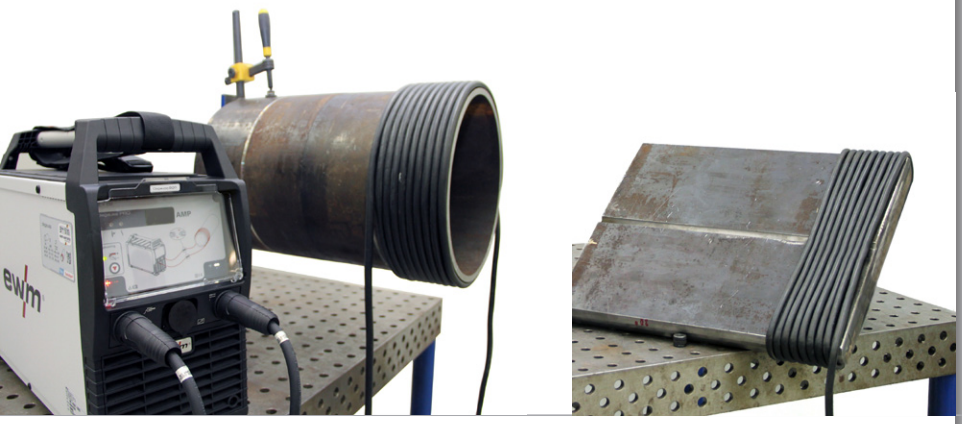
Your benefits

- Degaussing of magnetic materials and workpieces
- Single button operation – automatic degaussing
- Stable welding process without magnetic deflection – perfect welding result without finishing work



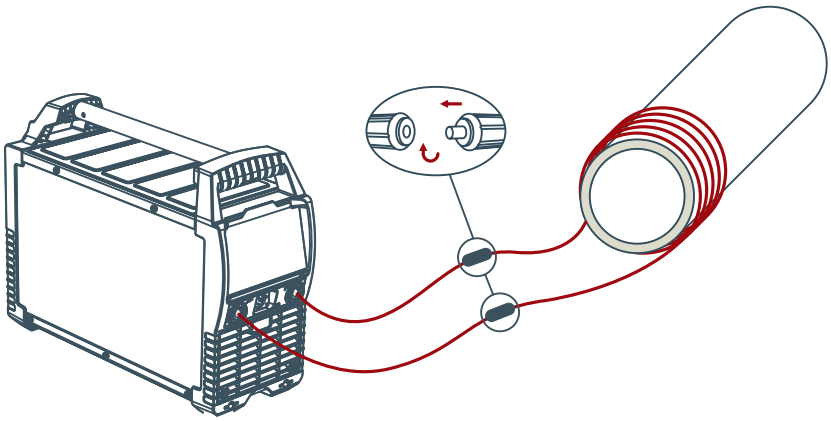
Your benefits

Degaussing of pipes and metal sheets



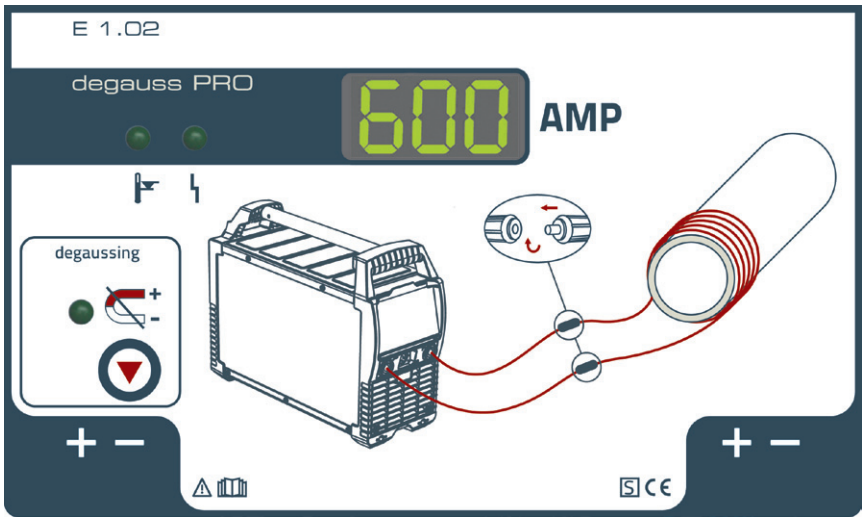
User's advantages

- No deflection of the arc by residual magnetism in the workpiece
- Avoidance of lack of fusion due to insufficient sidewall fusion
- Minimisation of finishing work
- Cost-efficient and high-quality results
- Degaussing of pipes and metal sheets



Very straightforward handling

- The set includes all components required for degaussing
- Quick connection at the pipe by means of three load cables
- Single button operation
- Automatic degaussing process
- Use at -25 °C to +40 °C with mains voltage tolerances of +/-20%
- Portable and robust



Degauss 600

- Compact degaussing power source suitable for use at the construction site
- Single button operation
- Automatic degaussing process

Degaussing and welding with only one machine

- Degaussing
- MMA
- MAG CC-CV
- TIG (Liftarc)

Pico 350 cel puls pws dgs

Resistant against cold, heat, rain or dirt, enormously rugged for the toughest usage and, thanks to low weight, ideal for changing deployment locations!

100% safe for vertical-down welding of CEL electrodes

MAG welding with Pico drive 4L wire feed unit

Degaussing of pipes and metal sheets

Especially durable

/ Production-standard control panel protective cover

Degaussing

/ Automatic degaussing function to eliminate residual magnetism in pipes and sheets

Polarity-reversing device

/ Integrated as standard equipment (PWS version)

Best protection

/ Protection against the ingress of foreign objects

/ Insertable protective dust filter (optional)

Highly practical

/ Rugged carrying handle with shoulder strap

/ Production-standard mains cable bracket

IP 34s protection

/ All-round protection against splash water

For tough jobs

/ Secure penetration depth when placed in accumulated water

/ Especially solidly-designed base

Pico 350 cel puls pws dgs

Mains voltage:	3 x 400 V (-25 % - +20 %)
Mains fuses:	3 x 16 A
Open circuit voltage:	95 V
Setting range:	10 A - 350 A
Duty cycle 40 °C:	350 A / 35 %
	280 A / 60 %
	230 A / 100 %
cos φ:	0,99
Efficiency:	88%

Pico 350 cel puls pws dgs
with E 1.03 control unit (MMA Pro PWS)
Selectable polarity

+

or

Pico drive 4L or Pico drive 200 C
Versatile usage thanks to MAG CC-CV for MAG welding and self-shielding for flux cored wire

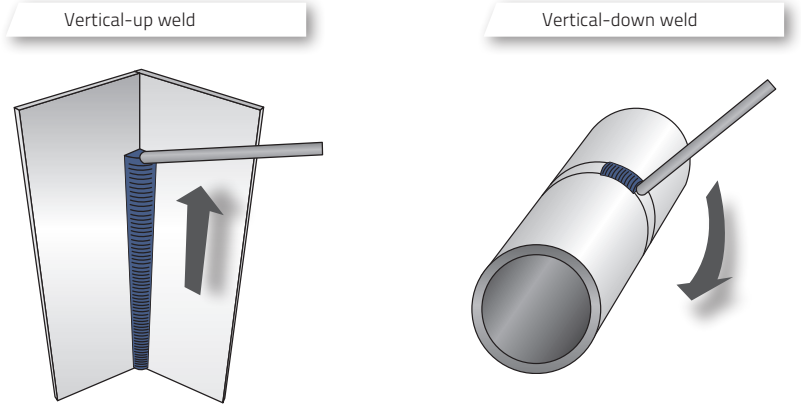
Your benefits

Built for the most extreme demands

- Inspected protection against splash water (IP 34s)
- Ruggedly-designed base enables placement in dirty and wet environments
- No ingress of accumulated water
- Durability because of replaceable filters
- 3-year guarantee, without any performance restrictions, also for 3-shift, 24-hour/7-day operations
- 5-year guarantee for transformer and rectifier

Maximum functionality – easiest operation

- Polarity can be reversed by pressing a button
- Energy efficient due to standby mode
- Automatic degaussing process
- Easiest operation, also for novices, thanks to self-explanatory, clearly-arranged user interface



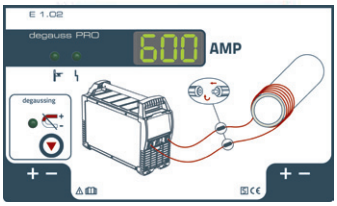
Very easy vertical-up and vertical-down welds

- 100% reliable vertical down welding
- Perfect electrode vertical-up welding through PF pulse function
- Pulsing (MMA pulsing)
- Automated pulsing

For all climatic zones

- Temperature range of operating machines: -25 °C to +40 °C
- Temperature range for transport and storage: -30 °C to +70 °C100 %
- High mains voltage tolerances (-25% to +20%)
- 100% generator compatibility

Degauss 600



- Degaussing of pipes and metal sheets
- Single button operation – automatic degaussing
- Dependable degaussing for better welding results through stable welding process without magnetic deflection, minimisation of finishing work
- Portable and robust
- Quick connection at the pipe by means of three load cables
- Use at -25 °C to +40 °C with mains voltage tolerances of +/- 20%
  - **Advantages of degaussing:**
  - No deflection of the arc by residual magnetism in the workpiece
  - Prevention of lack of fusion due to insufficient sidewall fusion
  - Minimisation of finishing work
  - Cost-efficient and high-quality results

Mains voltage (tolerances)	3 x 400 V (-25 % - +20 %)
Mains fuses (slow-blow)	3 x 16 A
Degaussing current	600 A
cos φ	0.99
Efficiency	90 %
External dimensions, compl.	600 x 205 x 415
Weight	25 kg

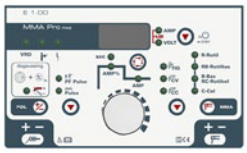
Type	Designation	Item no.
Set Degauss 600	Set: Degauss 600 degaussing machine, two 5-metre 35 mm² load cables, one 20-metre 35 mm² load cable	091-002065-00502

Magnetic field meter FIM1-4 set

- Magnetic field meter for measuring magnetic permanent and alternating fields
- Three possible measuring ranges: 20 mT, 200 mT and 2000 mT
- Hand-held unit for operation with mains, battery or power-pack
- LCD digital display
- Measuring accuracy: better than ±2% of measured value ±1 digit using internal calibration voltage, better than ±1% of measured value ±1 digit via calibrated comparison magnet
- Resolution: 0.01 mT
- Output: ±199.9 mV analog output corresponding to 1,999 digits, connection for analog display, X-Y plotter and A-D converter
- Operating time: approx. 100 hours with dry-cell battery, approx. 50 hours with power-pack charge (power pack not included)

Type	Designation	Item no.
FIM1-4 Set	Set: magnetic field meter, hall probe/axial	092-002937-00000

Pico 350 cel puls pws dgs



- MMA inverter welding machine, pole reversing switch, degaussing
- GMAW welding with Pico drive 4L or Pico drive 200C wire feeder
- Suitable for flux cored wire welding
- CC/CV characteristic
- Degaussing function: Automatic degaussing of pipes and metal sheets
- Stick electrode/MMA for all electrode types
- stick electrode/MMA cellulose electrodes: 100% safe for vertical-down welding
- MMA/MMA pulse welding:
  - Particularly suitable for root welding
  - Very suitable for difficult electrodes
  - Outstanding gap bridging with no sagging of the root side
  - Less distortion due to controlled heat input
  - Less finishing work due to less spatter
  - Fine-flaked weld surface similar to a TIG look for final passes
- Welding polarity can be reversed by pressing a button (pole reversing switch)
- Perfect vertical-up welding through PF pulse function
- Portable, shoulder strap
- Adjustable hot start current and hot start time
- Adjustable Arcforce
- Antistick function
- TIG lift arc welding
- Robust design suitable for construction site use
- Impact-resistant casing
- Inspected protection against splash water (IP-34s)
- Electricity savings thanks to highly efficient performance and standby function
- 5 m mains supply lead
- Mains connection 3 x 400 V/16 A

Mains voltage (tolerances)	3 x 400 V (-25 % - +20 %)
Mains fuses (slow-blow)	3 x 16 A
Open circuit voltage	95 V
Setting range for welding current	10 A - 350 A
Duty cycle 40 °C	350 A / 35 %
	280 A / 60 %
	230 A / 100 %
cos φ	0.99
Efficiency	88 %
Dimensions LxWxH in mm	600 x 205 x 415
Weight	23.5 kg

Type	Designation	Item no.
Pico 350 cel puls pws dgs	MMA inverter welding machine, pole reversing switch, degaussing	090-002127-00502
WK50 mm² 4m/K	Welding lead	092-000003-00000
EH 50qmm 4m	Electrode cable	092-000004-00000
OW CEE 32A	Factory-fit option, mains plug including fitting	092-008215-00000

Degaussing of ferromagnetic materials

Andreas Burt, Martin Hartke
EWM AG, Mündersbach

When arc welding ferromagnetic materials, magnetism is not desired because it causes the process to become very unstable and leads to insufficient welding results. Magnetism may even make arc welding impossible. This short paper deals in detail with the mechanism of magnetism in connection with welding processes and solutions for degaussing workpieces are examined to enable high-quality, reproducible and economic results.

1 Magnetic fields

Magnetism and magnetic phenomena have been known for a long time. While in ancient times magnetism was observable only in magnetic iron ore, we see it in many natural phenomena and technical applications today. For example, when looking at the earth's magnetic field and its effects on a compass [1] [2]. In terms of physics, the strength of a magnetic field can be defined by the magnetic field intensity H [A/m] and the magnetic flux density B [T] (magnetic induction). If we look at the entire bundle of all existing field lines and relate them to the respective area, the result is the magnetic flux density. The flux density B is the higher, the higher the field intensity H is [3].

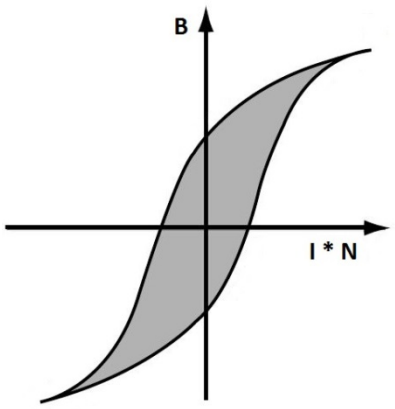


Fig. 1: *Hysteresis loop [3]*

If N turns of a copper cable are wound around an iron specimen and a current I flows through the cable, the iron specimen can be magnetised. In this way, the field intensity H is also easy to understand, as it is the product of the number of turns N and the current I (Fig. 1).

In the example of a completely demagnetised iron specimen without external magnetic fields or magnetomotive forces, the flux density is B=0, and, likewise, the field intensity is H=0. The continuous rise of the field intensity H causes an increase of the flux density B until the iron's saturation limit is reached. When the field intensity is reduced again, the flux density declines not along the rise curve but along a curve branch which is located above the rise curve. When H becomes zero, a residual flux density remains due to this fact [4]. This "residual magnetism" is the reason why the arc cannot burn stably during welding, the arc weaves and is deflected, droplets are not evenly detaching, sidewall fusion is improper and the welding result is insufficient altogether.

2 Ferromagnetic materials

Ferromagnetic means that a material is magnetic without the influence of an external field. The reason for this can be looked at in different ways. While, at the atomic level, electron shells interact via orbital and spin angular momenta to create a parallel alignment of the atomic magnetic moments (and hence cause magnetisation), the physicist Pierre-Ernest Weiss in 1907 came up with the idea of interpreting the phenomenon as due to the existence of magnetic areas [3]. Each Weiss domain has all magnetic moments within it pointing in the same direction and has a neighbour of identical size within which they point in the opposite direction. This can be illustrated in experiments using an ultra-fine magnetite suspension on a polished workpiece surface, where the ultra-fine magnetite particles deposit at the borders of the Weiss domains and make them visible. Basically, primarily the alloying elements iron, nickel and cobalt exhibit ferromagnetic properties.

Magnetic fields in semi-finished products made of ferromagnetic materials neutralise each other in the semi-finished product after production and cooling because the Weiss domains are in equilibrium. When producing sheet and pipe cuttings from a continuously cast semi-finished product, the Weiss domains are separated from each other and no longer are in equilibrium. For example, disequilibrium states which influence the arc during welding may occur at joint sidewalls to be welded. Another possibility of influencing the arc is mentioned in [5]. There, it is assumed that magnetically hard spots, caused by a lack of homogeneity and impurities in the material, create permanent magnetic properties which need to be degaussed prior to welding (Fig. 3). Other sources [6] point out that magnetic crack testing carried out in particular at the beginning and ends of pipes using direct current may cause magnetism in the pipe sections.

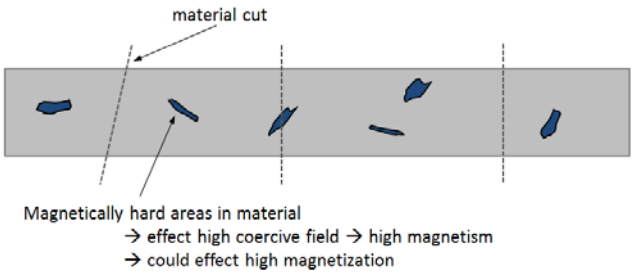


Fig. 3: *Magnetically hard areas in the material [5]*

3 Consequence of magnetism during welding

During welding, a high-temperature plasma causing the materials to be welded to heat extremely and melt is created between a cathode and an anode due to the ionised gas and freely moving charge carriers. The plasma column is infinitely mobile and behaves like an electrical conductor towards electrical and magnetic fields, which is why it is sensitive to electrical and magnetic interference. If a critical magnetic flux density B exists in the material to be welded, the plasma column is attracted or repelled, depending on polarity. The arc is then deflected, irrespective of the welding torch position, and behaves unstably. The consequences may be insufficient sidewall fusion during weld preparation and hence lack of fusion in the welding result. Droplet detachment is negatively affected, the arc weaves and moves on the workpiece. The energy cannot be applied where it is needed. From the user's point of view, all this leads to insufficient welding results and much finishing work, up to scrapping of the workpiece, and hence to serious qualitative and economic loss.

4 Degaussing of ferromagnetic materials

The above preliminary considerations make it clear that ferromagnetic materials can be degaussed by flooding them with alternating current. In the example of the pipe, a copper cable needs to be wound around the pipe (N turns). A current I, which after a certain time changes its direction of flow and also its amplitude towards a lower value, is sent through the windings around the pipe. The amplitude of the current is reduced each time it passes through the cable. Due to this process, the magnetic field intensity B, and hence also the residual magnetism in the material, are reduced to near zero, as shown in Fig. 4

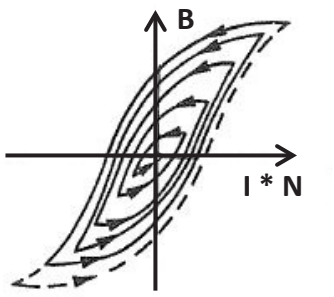


Fig. 4: *Degaussing process [3]*

4 Application-specific solution – Pico 350 cel puls pws dgs

As a manual metal arc welding machine, the *EWM Pico 350 cel puls pws dgs* power source (Fig. 5) is actually designed for extreme situations, especially in pipeline construction. 100% reliable vertical down welding with up to 6 mm thick cellulose electrodes anywhere in the world characterise the machine. Operating temperatures between -25 °C and +40 °C and mains voltage tolerances of up to 25% are no obstacles to operation. In addition, the power source includes a function to carry out a continuous degaussing process. For the user, this means: no instability of the arc, low-spatter and high-quality welding results, no finishing work and hence cost-efficient working without compromises.

Fig. 5: EWM Pico 350 cel puls pws dgs

In addition to the power source with degaussing function, EWM offers the *degauss 600* as a power source exclusively for degaussing (Fig. 6). Both machines are delivered with all aids required for degaussing.

Fig. 6: EWM degauss 600

5 Degaussing of a creep-resistant pipe made of alloy P91 (X10CrMoVNb9-1)

At the start of the experiment, a gaussmeter was used to determine the magnetic flux densities B in a pipe with a diameter of 400 mm and a wall thickness of 38 mm. In a subsequent weld test it was found that the arc is strongly deflected especially in the upper area of the sidewalls of the weld preparation because there the magnetic field is positive on one side and negative on the opposite side.

To degauss the pipe, grounding cables were attached to the pipe halves (Fig. 7). The grounding cable was wound in the form of a single-layer coil with ten turns per pipe half. The degaussing process was then performed using the *EWM Pico 350 cel puls pws dgs*. Starting at 350 A, the degaussing process is carried out automatically as described at section 4. Due to the even degaussing with changing current flow direction and decreasing amplitude, the Weiss domains can be turned and aligned continuously, so that the pipe is degaussed and can be welded without disturbance.

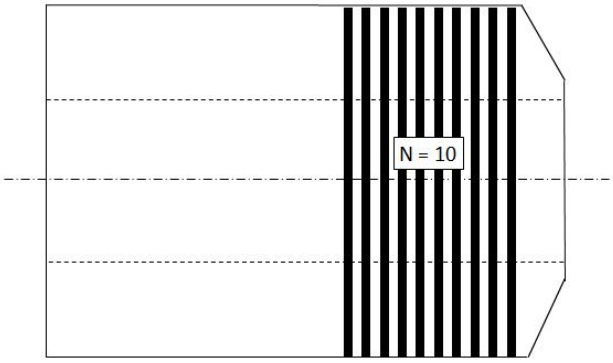


Fig. 7: *Coil winding at one pipe half*

After degaussing, the magnetic flux densities resulting at the defined markings were measured again and recorded. Another weld test was made to assess the effect of the degaussing on the arc.

The *EWM Pico 350 cel puls pws dgs* reliably degaussed the previously magnetised pipeline tube P91 The comparison between magnetised and demagnetised pipe is shown in Fig. 8

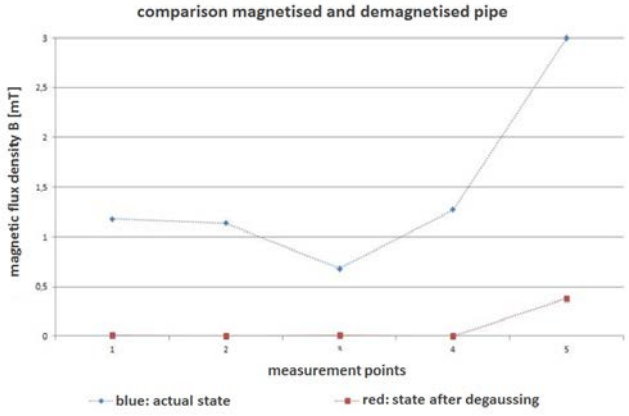


Fig. 8: *Comparison magnetised and demagnetised pipe*

6 Recommendations regarding degaussing

The *EWM Pico 350 cel puls pws dgs* and the *degauss 600* feature a stored sequence program which the user can run to degauss metal sheets and pipes. The current change increments are selected based on trials and permanently stored in the process control unit, so that errors in practical application with respect to the actual degaussing process are ruled out.

However, special attention should be given to the number of windings applied around the workpiece to be degaussed. As a rule, residual magnetism decreases with increasing number of turns following successful degaussing and, as a consequence, the welding result is improved. The tests described were carried out with ten turns per side and yielded very good results regarding the welding behaviour or no detectable deflection of the arc. Examinations with just five turns showed a value of the magnetic flux density B after degaussing which was about three times high-

er. The lower number of turns had a negative effect especially at the fusion faces.
Therefore, the number of turns should be chosen in such a way that any possible residual magnetism is not expected to affect the welding process but the degaussing work can still be carried out economically.

7 List of references

[1] Online source: http://www.weltderphysik.de/gebiete/stoffe/magnete/was-ist-magnetismus/, retrieved on 13-08-2014

[2] Online source: http://de.wikipedia.org/wiki/Magnet, retrieved on 11-08-2014

[3] Ilschner, B., Singer, R.F.: *Werkstoffwissenschaften und Fertigungstechnik – Eigenschaften, Vorgänge, Technologien.* 5th edition, Springer Verlag Berlin, Heidelberg, 2010, p. 292

[4] Haug, A.: *Grundzüge der Elektrotechnik zur Schaltungsberechnung*. 2nd edition, Hanser Verlag München Wien, 1985, pp. 274–281

[5] Online source: http://umformtechnikmagazin.de/umformtechnik-fachartikel/ungeliebte-eigenschaften_ 12916_de, retrieved on 06-08-2014

[6] Online source: http://www.ndt.net/article/dgzfp03/papers/p10/p10.htm, retrieved on 06-08-2014

Degaussing
Information sheet and user instructions

Why do we degauss and what is our aim?

Magnetism causes deflection and instability in arcs, which lead to spatter, irregular droplet detachment and irregular sidewall fusion. This produces an unsatisfactory welding result, which requires finishing work.

The aim is to degauss noticeably magnetised components in sections to be welded using an affordable, mobile degausser before starting the actual welding process.

How does the degaussing process work and what is included in the set?

The set consists of a load cable 20 m long and two connecting pieces, 5 m long each. The long load cable is wound around the component. When the degausser is switched on, the coil generates an opposing field, which is increasingly reduced, thus demagnetising the component. A characteristic is stored for degaussing.

How are the load cables attached to the component?

→ Basically, the load cables are placed close to one another around the component.
→ The load cables are positioned in the joining section and wound around the actual joint as far as possible.

→ In the case of long and strongly magnetised components, the turns are placed at a gap equal to two fingers (3–5 cm) from one another to widen the area on which the degaussing process has an impact.

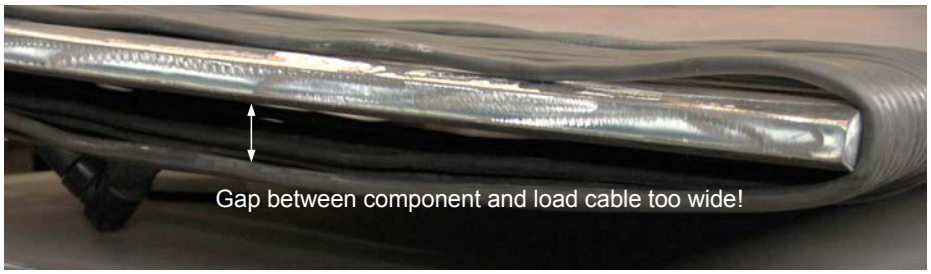
What are the crucial factors for degaussing?

1. Number of turns around the component
   → The more turns that can be placed around the component, the better.
   It is recommended to use a high number of turns during initial attempts since this is likely to produce the best result. During following attempts, reduce the number of turns to minimise the expense for the customer.

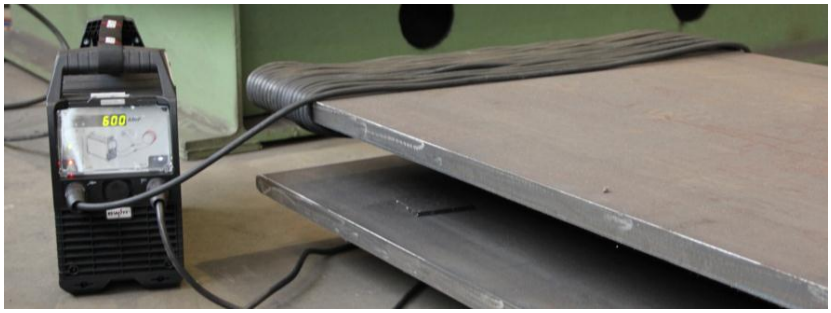
2. High initial current
   → Low magnetism & narrow wall thickness → Use Pico 350 cel puls pws dgs
   → Strong magnetism, large wall thickness and long components → Degauss 600

Can plates also be degaussed?

→ Yes. However, it is more difficult to wind the load cables around plates than pipes, for example. You must ensure that the load cables are close together over the whole section.



Examples of degaussing



Limit or empirical values which cause an arc to deflect?

→ TIG from about 0.5–1 mT
→ GMAW from about 3–4 mT

Degaussing
Information sheet and user instructions

Does EWM offer a measuring instrument?

→ Yes, there is a magnetic field meter FIM1-4 Set (item no.: 092-002937-00000)

What different machine variants are there for degaussing?

→ Degauss 600 as a degaussing machine with no welding function (item no. 091-002065-00502)
→ Pico 350 cel puls pws dgs with welding function (item no.: 090-002127-00502)
and cable set (item no.: 092-002921-00000)

How long does the degaussing process take?

→ Degauss 600: about 75 sec.
→ Pico 350 cel puls pws dgs: about 45 sec.

The process runs automatically based on a stored characteristic after switching on.

Is it worth repeating the degaussing process several times one after another?

→ As a basic rule, one degaussing process is sufficient. A second run will only bring a slight improvement to the degaussing result. Refrain from repeating more than twice.

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