NDT Supply.com, Inc.
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Degauss 600 / Pico 350 cel puls pws dgs

Degaussing of pipes and metal sheets

- Degaussing of magnetic components before and during welding
- Reliable welding process with no magnetic deflection of the arc

Degauss 600

Pico 350 cel puls pws dgs

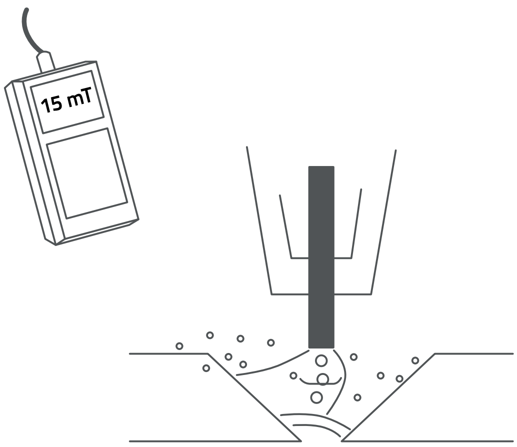
Save money, improve quality

Arc deflection caused by magnetism is a thing of the past.

Magnetism is undesirable wherever steel is being welded. Residual magnetism in a component results in an unstable and deflected arc. The effect may be so great that welding is impossible.

Without degaussing

Workpiece is magnetised » Heavy arc deflection

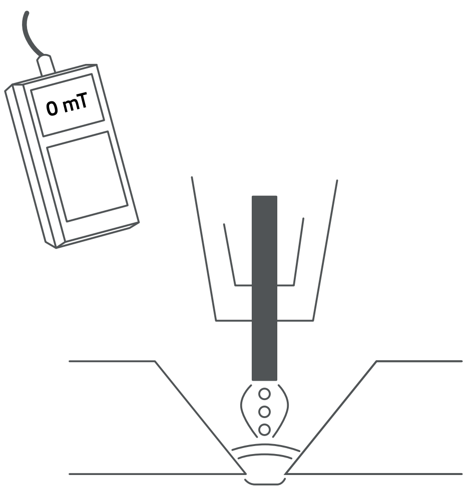


With degaussing

Workpiece was degaussed with the Degauss 600 or Pico 350 cel puls pws dgs
» No arc deflection

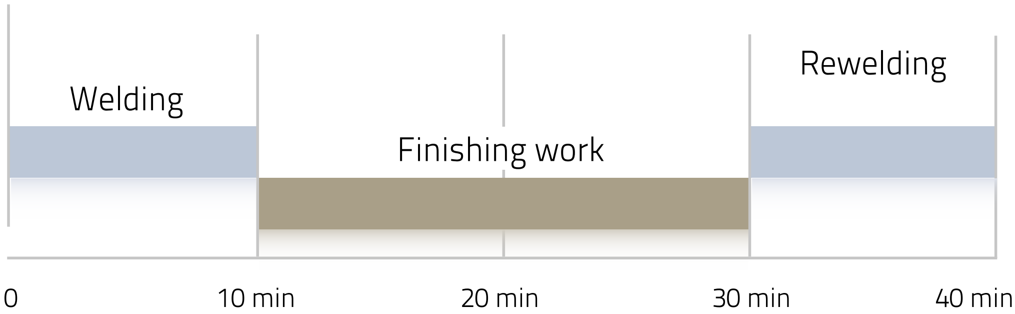
Degauss 600
Degaussing machine

Pico 350 cel puls pws dgs
MMA Welding machine with degaussing function



» Inadequate welding results mean considerable finishing work, loss of time and high additional expenses

40 min of work – without degaussing



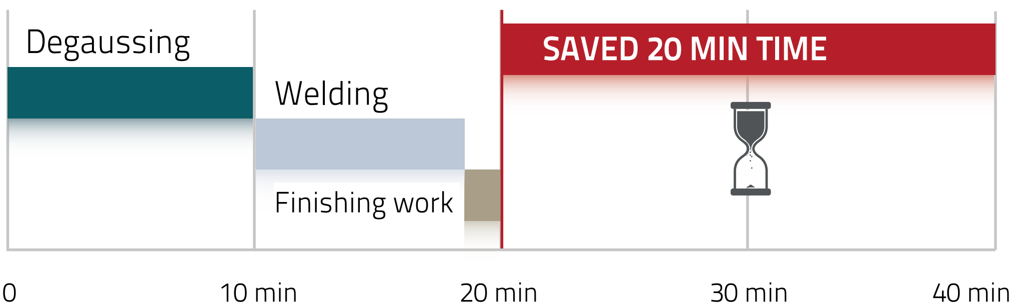
Example: 200-mm-diameter pipe with a wall thickness of 20 mm and a length of 10 m

Magnetism in the workpiece causes:

/ Instability of the arc
/ Uneven droplet detachment
/ Heavy spatter formation
/ Uneven sidewall fusion

» Reduce expenses, conserve resources and increase quality through high-quality welding results, minimising of finishing work and reducing material and gas consumption

20 min of work – with degaussing



Example: 200-mm-diameter pipe with a wall thickness of 20 mm and a length of 10 m

Outstanding welding results:

/ Stable arc
/ Even droplet detachment
/ Spatter-free
/ Good sidewall fusion

Save money, improve quality

Arc deflection caused by magnetism is a thing of the past.

Magnetism caused by the mechanical separation of components, filing in preparation for welding or due to grinding processes occurs particularly frequently. For high-quality welding results, we recommend degaussing after mechanical processing and before the actual welding process (Application 1). Application is very easy thanks to automatic running of the degaussing program.
With very long, thick-walled and hard-to-reach components which are heavily magnetised, the magnetic field may return after degaussing. This will lead to arc deflection during welding. In this case, we recommend the "activgauss" function. Here, an opposing magnetic field is generated during the welding process (Application 2).

Application 1

Degaussing prior to welding

"Degaussing prior to welding" is especially suitable for pipes and metal sheets with a length of up to about 10 metres and a prevailing magnetic field strength of up to 20 mT.

1. Degaussing as a work preparation step

2. Welding process

Fields of application

- Ferromagnetic materials and components
- Up to 10 m component lengths
- Up to 20 mT field strength

Very straightforward handling

- Single button operation – automatic degaussing
- Quick connection to the component thanks to the practical load cable set

activgauss – Generation of an opposing magnetic field during the welding process

With very long and thick-walled components, Application 2, "Magnetising during welding" is used (for example in crane construction and with kilometre-long pipe construction).

Degaussing **during** the welding process

Fields of application

- For very heavily magnetised, **long** and thick-walled ferromagnetic components
- > 10 m component length
- > 20 mT field strength

Very straightforward handling

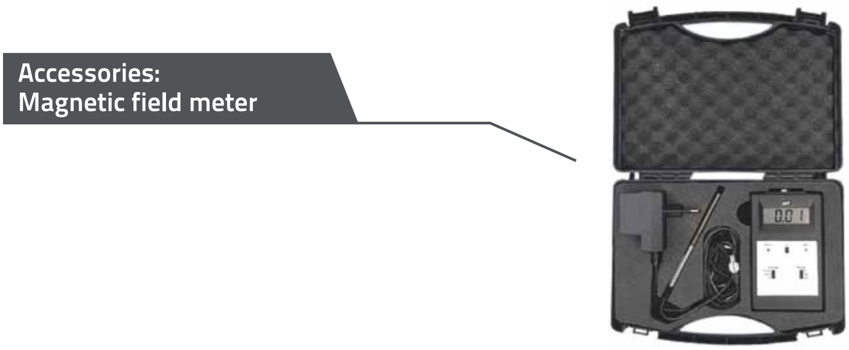
- Practical remote control for
  - Setting the current for generating an adequately large opposing field
  - Controlling degaussing (current on/off and polarity changes)
- Quick connection to the workpiece thanks to the practical load cable set

Degaussing of pipes and metal sheets

Degaussing

Degauss 600

The Degauss 600 machine is suitable both for degaussing before the welding process and during the welding process.

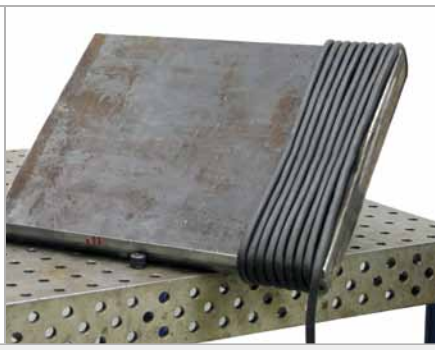


How this benefits you – Degausser

/ Compact and suitable for construction sites
/ Portable and robust
/ High mains voltage tolerances +/- 20%
/ 100% generator-compatible

Technical data

Mains voltage:	3 x 400 V/16 A
Temperature range:	-25 °C to +40 °C
Dimensions (L x W x H):	600 x 205 x 415 mm
Weight:	25 kg



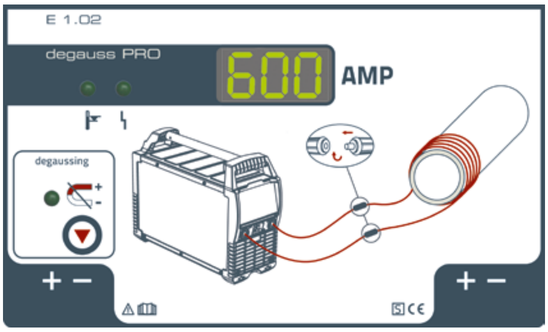
Your benefits

Degauss 600 set

Very straightforward handling

- The set includes all components required for degaussing
- Quick connection to the pipe using three load cables with welding sockets and plugs

Machine control E 1.02



Controls degaussing prior to welding (Application 1)

- Single button operation
- Automatic degaussing

Remote control RT DGS1

Controls degaussing during welding – activgauss (Application 2)

- Remote control RT DGS1 activates the activgauss function
- Continuously adjustable current for generation of the required opposing magnetic field
- Polarity reversing switch, start/stop function
- Operation directly at the welding site

Magnetic field meter

For measuring magnetic direct and alternating fields

- Hand-held unit for operation with mains, battery or power-pack
- Three measuring ranges: 20 mT, 200 mT and 2,000 mT
- LCD digital display
- Resolution: 0.01 mT

Degaussing and welding with a single machine

- Degaussing
- MMA welding
- MAG CC-CV
- TIG (lift arc)

Pico 350 cel puls pws dgs

Resistant to cold, heat, rain and dirt, extremely rugged for the toughest usage and, thanks to its light weight, ideal for changing deployment locations !

100% safe for vertical-down welding of CEL electrodes

MAG welding with Pico drive 4L or Pico drive 200C wire feeder

Degaussing of pipes and metal sheets prior to welding

Especially durable

- Control panel protective cover as standard

Degaussing

- Automatic degaussing function for the removal of residual magnetism in pipes and metal sheets

Polarity-reversing device

- Integrated as standard equipment (PWS version)

Optimum protection

- Protection against the ingress of foreign objects
- Insertable protective dust filter (optional)

Highly practical

- Rugged carrying handle with shoulder strap
- Mains cable bracket as standard

IP34s protection

- All-round protection against splash water

For tough jobs

- Ruggedly-designed base enables placement in dirty and wet environments

Pico 350 cel puls pws dgs

Mains voltage:	3 x 400 V (-25% to +20%)
Mains fuse:	3 x 16 A
Open circuit voltage:	95 V
Welding current:	10–350 A
Duty cycle:	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
(MMA Pro PWS)
Selectable polarity

Pico drive 4L or Pico drive 200C
Versatile in use thanks to MAG CC-CV for MAG welding and for self-shielded flux cored wires

Pico 350 cel puls pws dgs
with cable set
For degaussing prior to welding

Your benefits

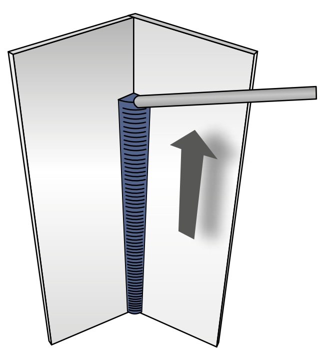
Built for the most extreme demands

- Inspected protection against splash water (IP34s)
- Ruggedly-designed base enables placement in dirty and wet environments
- Durability thanks to replaceable filters

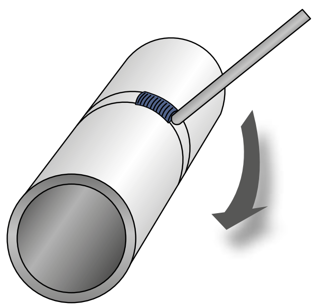
Maximum functionality – easiest operation

- Polarity can be reversed by pressing a button (POL)
- Energy efficient thanks to standby mode
- Automatic degaussing process
- Easiest operation, even for novices, thanks to self-explanatory, well-laid-out operating panel

Vertical-up weld **PF**



Vertical-down weld **PG**



Very easy vertical-up and vertical-down welds

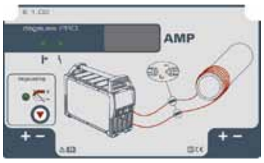
- 100% reliable vertical down welding
- Perfect electrode vertical-up welding thanks to PF pulse function
- Pulsing (MMA pulsing)
- Automated pulsing

For use in all climate zones around the world

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

Degauss 600

E1.02



- Degaussing of pipes and metal sheets
- 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	23,5 kg

Type	Designation	Item no.
Set Degauss 600	Set: Degauss 600 degaussing machine, two 5-metre, 35 mm^2 load cables, one 20-metre, 35 mm^2 load cable, RT DGS1 remote control and 5-m connection cable	091-002065-00502
OW CEE 16A	Factory-fit option, mains plug including fitting	092-008214-00000

RT DGS1

- Remote control with a polarity reversing switch and start/stop function for Degauss 600
- Remote control activates additional function – generation of an opposing magnetic field during the welding process
- Infinitely adjustable current (0% to 100%) to produce the required opposing magnetic field directly at the welding site

Type	Designation	Item no.
RT DGS1	Degauss remote control	090-008806-00000
RA5 19POL 5m	Connection cable e.g for remote control	092-001470-00005

FIM1-4 Set

- Magnetic field meter for measuring magnetic direct 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: ±2% of measured value ±1 digit using internal calibration voltage, better than ±1% of measured value ±1 digit using calibrated comparison magnet
- Resolution: 0.01 mT
- Output: ±199.9 mV analogue output corresponding to 1,999 digits, connection for analogue display, X-Y plotter and A-D converter
- Operating time: about 100 hours with dry-cell battery, about 50 hours with power-pack charge (power pack not included)

External dimensions, compl. in mm	145 x 80 x 38
Weight	0.8 kg

Type	Designation	Item no.
FIM1-4 Set	Set: magnetic field meter, including Hall effect sensor	092-002937-00000

Pico 350 cel puls pws dgs

E1.00

- MMA inverter welding machine, polarity 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 prior to welding
- 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 (polarity 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)
- Energy-saving thanks to high efficiency 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	25 kg

Type	Designation	Item no.
Pico 350 cel puls pws dgs	MMA inverter welding machine, polarity reversing switch, degaussing	090-002127-00502
Set LC 35 mm²	Set: Two 5-metre load cables (35 mm²) and one 20-metre load cable (35 mm²) for degaussing	092-002921-00000
WK50 mm² 4m/K	Welding lead	092-000003-00000
EH 50qmm 4m	Electrode holder with cable	092-000004-00000
OW CEE 16A	Factory-fit option, mains plug including fitting	092-008214-00000

1 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.

2 Degauss 600: Degaussing prior to welding

The aim is to degauss noticeably magnetised components in <u>sections to be welded</u> 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 20-m long load cable and two connecting pieces of 5 m each. The long load cable is wound around the component. When the degausser is switched on, the coil generates an alternating magnetic field, which is increasingly reduced, thus degaussing the component. A characteristic is then stored for degaussing.

How are the load cables attached to the component?

→ The load cables are always to be laid around the component directly next to one another
→ The load cables are positioned in the joining section and wound as far as possible to the joint

→ In the case of long and heavily magnetised components, it is possible to place the turns with a two finger-wide spacing (3 to 5 cm) in between them so as to enlarge the area affected by the degaussing process.

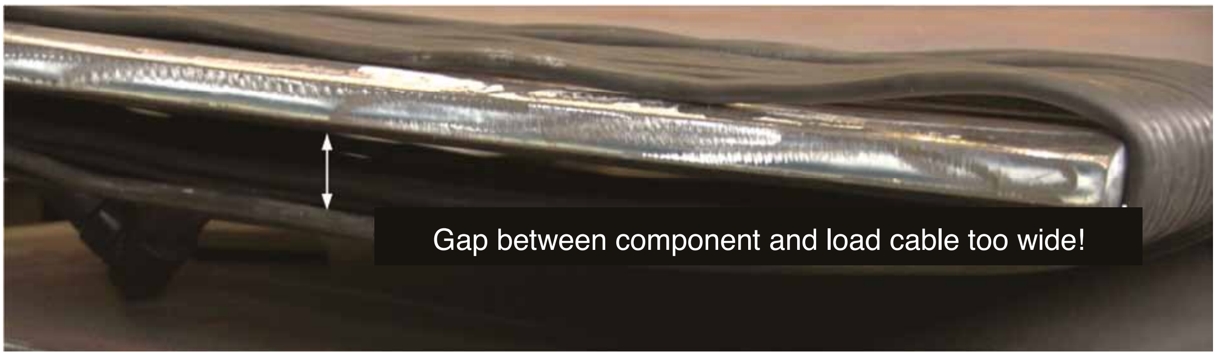
What are the crucial factors for degaussing?

1. Number of turns around the component
   → The more turns that can be placed around the component, the better.
   We recommend using a high number of turns during initial attempts since this is likely to produce the best result. In subsequent attempts, reduce the number of turns to minimise the expense to the customer.

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

Can metal sheets also be degaussed?

→ Yes. However, it is more difficult to wind the load cables around metal sheets than pipes, for example. You must ensure that the load cables are close together across the entire area.



Examples of degaussing

Limit or empirical values which cause an arc to deflect

Recommended values for TIG welding

Field strength	Result
< 0,5 mT	****
0,5 – 1 mT	***
1 – 2 mT	**
2 – 5 mT	*
> 5 mT	-

Recommended values for MIG/MAG welding

Field strength	Result
< 3 mT	****
3 – 4 mT	***
4 – 6 mT	**
6 – 8 mT	*
> 8 mT	-

Does EWM offer a measuring device?

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

What different machine variants are there for degaussing prior to welding?

→ Degauss 600 set (item no. 091-002065-00502) – degaussing machine only
→ 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 60 s
→ Pico 350 cel puls pws dgs:	about 45 s

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

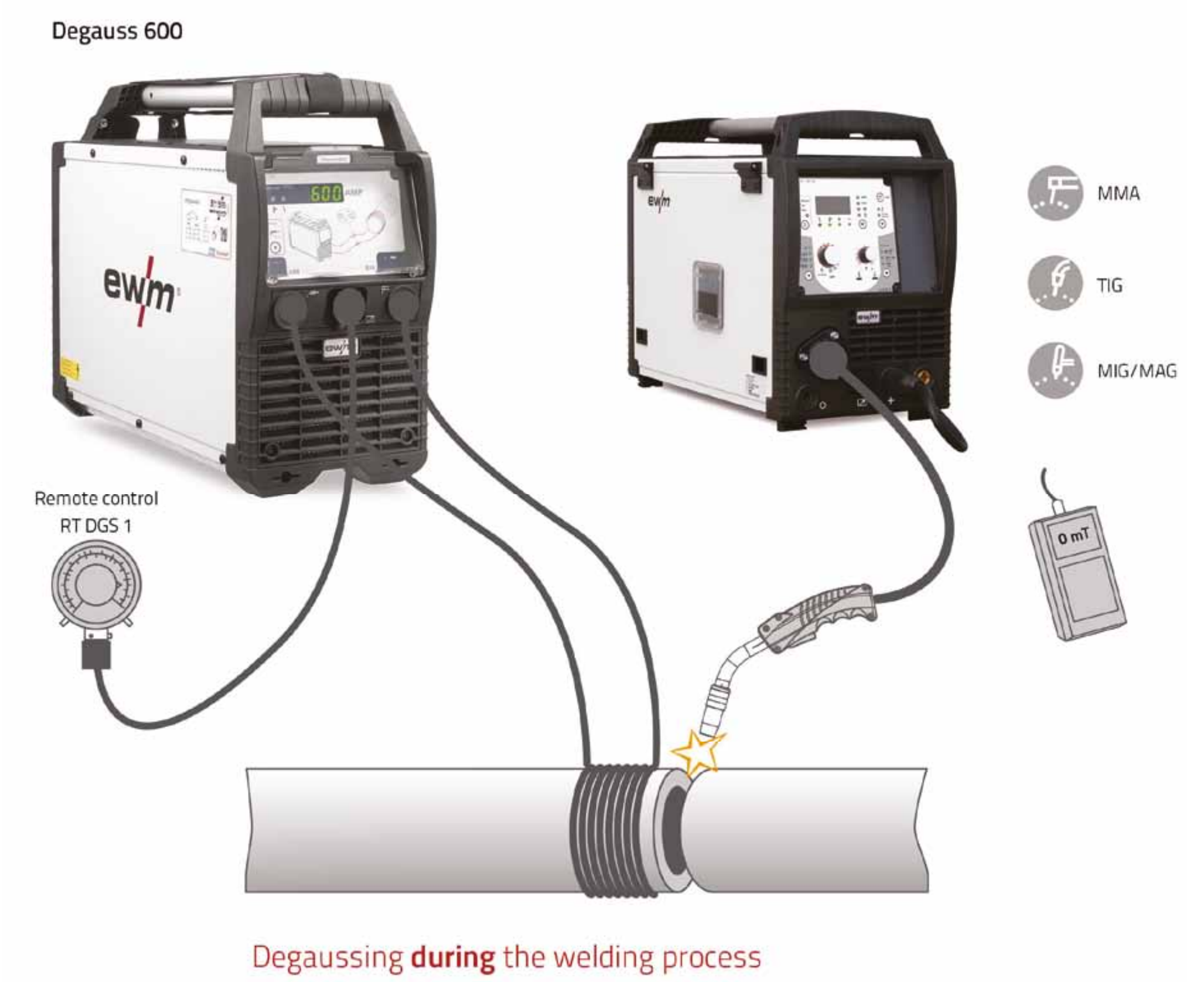
Is it worth repeating the degaussing process several times one after another?

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

3 Degauss 600: Degaussing during the welding process - activgauss -

Degaussing with the Degauss 600 prior to the welding process as a work preparation step (generation of an alternating magnetic field) is always to be preferred, as a degaussing program runs automatically. In the case of very long and very heavily magnetised components, however, the magnetic field may return after degaussing and cause the arc to deflect during welding. This is solved with the activgauss function in the Degauss 600.

Using this function, a direct current (10 to 250 A) is used to generate an opposing magnetic field which is active during the welding process and which counteracts the existing magnetism in the component. This enables welding without arc deflection and spatter formation and with clean sidewall fusion.

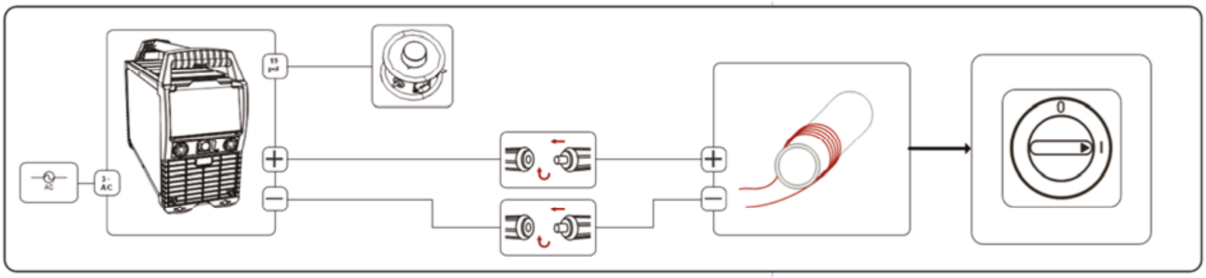


What is required on the Degauss 600 for the extra activgauss function?

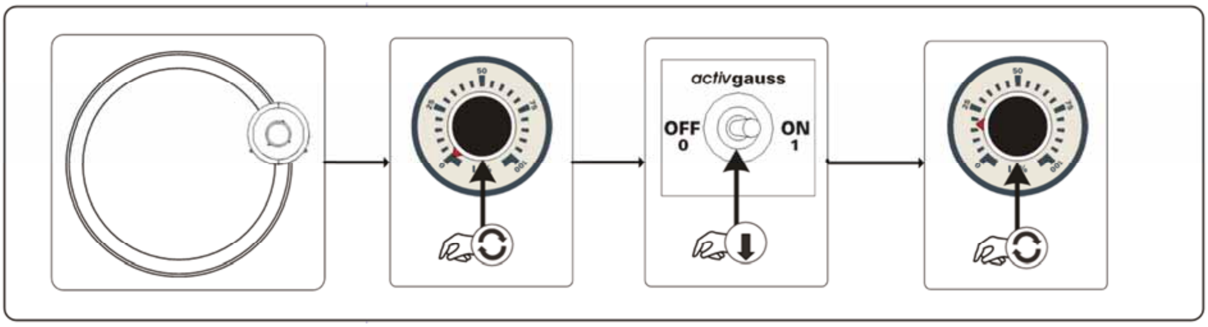
- Remote control RT DGS1 (special remote control which activates the extra activgauss function), included in the Degauss 600 set
- Connection cable RA5 19POL (item no.: 092-001470-00005), included in the Degauss 600 set
- We recommend a magnetic field meter (item no.: 092-002937-00000) for measurement of the existing and self-setting magnetic field

How activgauss works:

1. Make at least five turns around the component directly next to one another in the area in which welding will take place, with a spacing of about 10 cm to the joint
2. Connect load cable to Degauss 600
3. Connect remote control RT DGS1 to 19-pole connection of the Degauss 600, and switch on machine
   → Remote control will activate the extra activgauss function

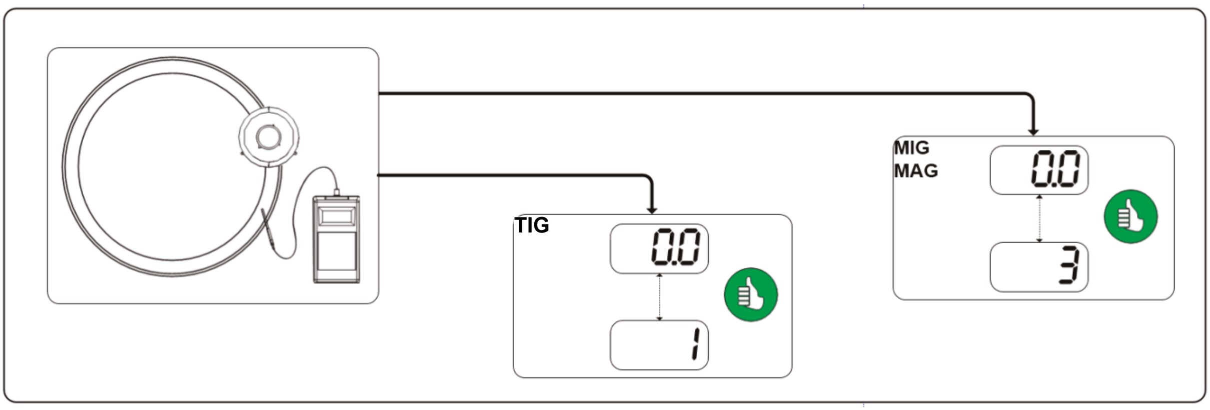


4. Position magnetic field meter at the fusion face in the root area
5. Set remote control RT DGS1 to 0% I_H%, and switch on the remote control's switch
6. Slowly increase current with rotary knob, thus generating a magnetic field at the component



7. When increasing the current, pay attention to the measurement value on the magnetic field meter:

Case 1:Measurement value on the magnetic field meter decreases → Correct
→ Increase current until the measurement value is near 0

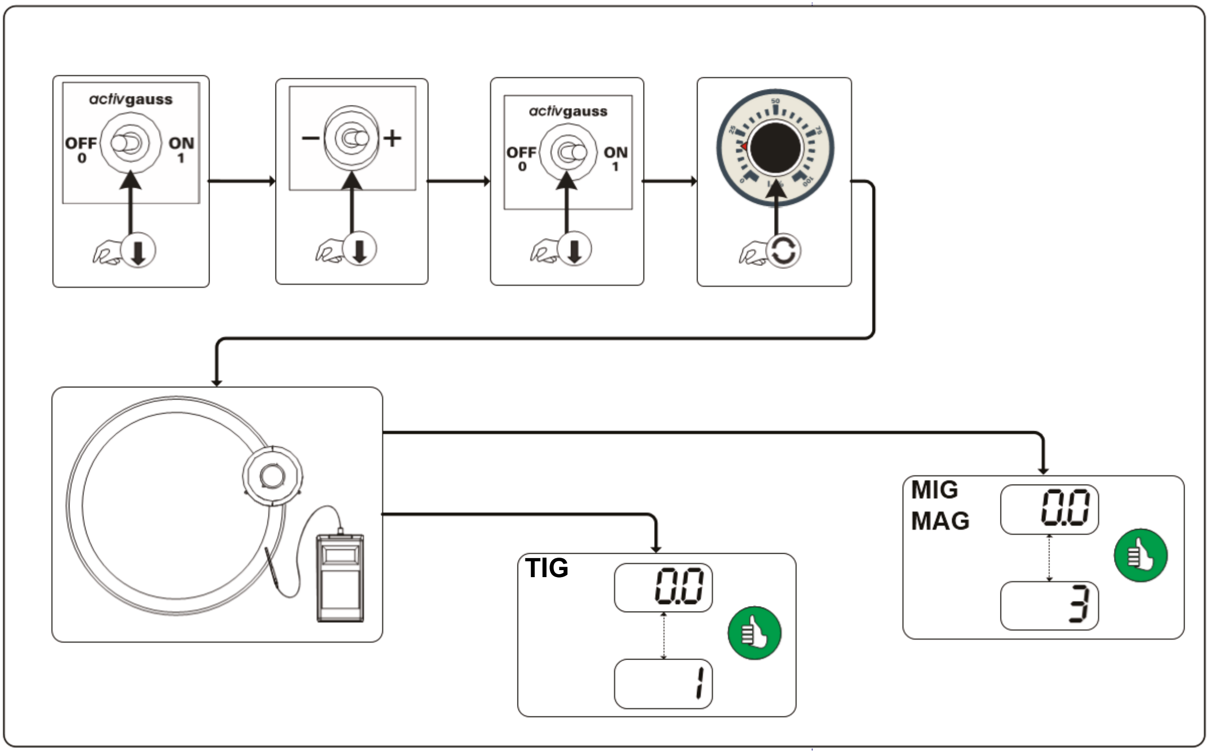


Case 2:Measurement value on the magnetic field meter increases → Incorrect

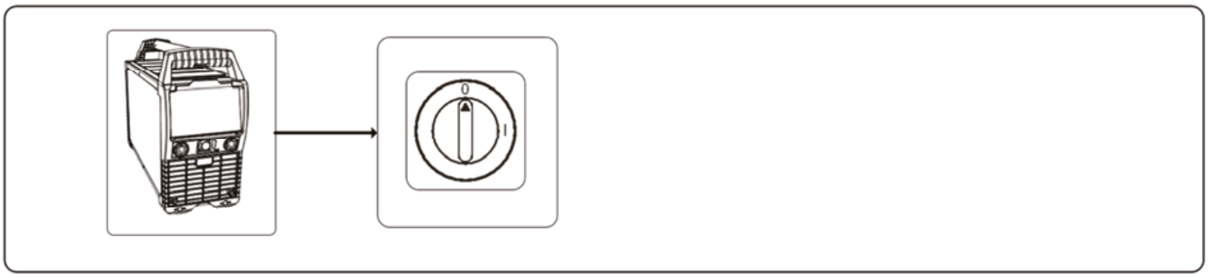
→ Switch off direct current at the remote control using the switch

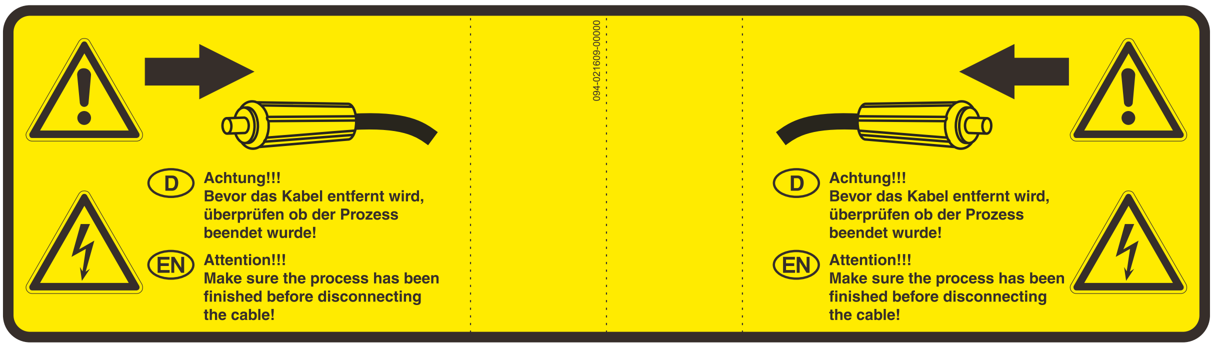
→ Change polarity on the remote control using the switch

→ Increase current until the measurement value is near 0



8. Root welding without magnetic influences
9. First switch off current at remote control, then remove load cable from Degauss 600





Scientific paper

Degaussing of components for reliable welding in day-to-day work

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Summary
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. In the following, a more detailed account of 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 Introduction

Qualitative and reliable welding connections are of increasingly greater importance. In particular with regard to high tensile materials and safety-related components requiring time-consuming seam and welding preparation and precise welding sequences, the stated goal is more difficult than ever to achieve. Adding component magnetism to this quickly makes flawless welding results a challenge for every welder to attain. Magnetism in a component causes the arc to deflect, meaning that it can no longer burn stably and that clean sidewall fusion can no longer be ensured. With GMAW processes, it also leads to uneven droplet detachment, which can manifest as spatter on the component or interrupt the arc in case of strong magnetism. Inadequate welding results and time-consuming finishing work are the result, and this can be costly.
Using the fundamentals of magnetism, ferromagnetic materials and the consequences of magnetism while welding as a starting point, two degaussing options are presented here. In addition to theoretical considerations, day-to-day use and application tips are a primary focus which enable reliable welding in every area of application.

2 Basic principles
2.1 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, such as 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 strength 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 higher the field strength H [3], the higher the flux density B.

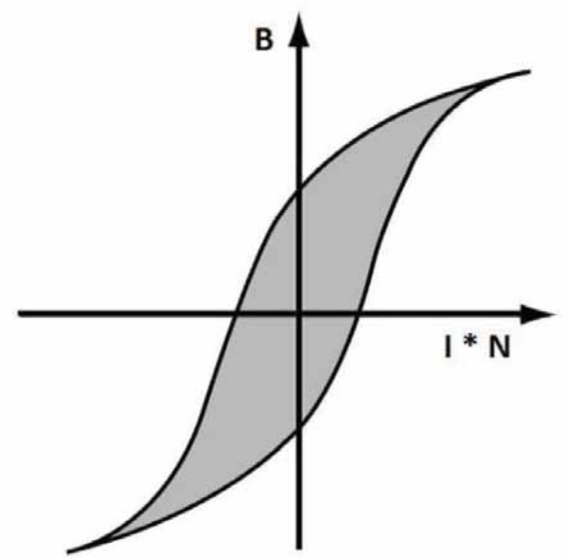

Fig. 1 Hysteresis loop [3]

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 strength 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 degaussed iron specimen without external magnetic fields or magnetomotive forces, the flux density is B = 0, and, likewise, the field strength is H = 0. The continuous rise of the field strength H causes an increase of the flux density B until the iron's saturation limit is reached. If the field strength is reduced again, the flux density declines, not along the rise curve, but rather along a curve branch which is located above the rise curve. When H becomes zero, a residual flux density remains for this reason [4]. This "residual magnetism" is the reason why the arc cannot burn stably during welding, the arc weaves and is deflected, drops do not evenly detach, sidewall fusion is improper and the welding result is insufficient altogether [7].

2.2 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 thus cause magnetisation), physicist Pierre-Ernest Weiss came up with the idea of interpreting the phenomenon as being due to the existence of magnetic areas [3] in 1907. Each Weiss domain has all magnetic moments within it aligned in the same direction and has a neighbour of identical size which points 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, making them visible. Primarily the alloying elements of iron, nickel and cobalt always 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, as the Weiss domains are in equilibrium. When producing metal sheet and pipe cuttings from a continuously cast semi-finished product, the Weiss domains are separated from each other and are no longer in equilibrium. For example, imbalances which influence the arc during welding may occur at joint sidewalls to be welded. Another potential arc influence is mentioned in [5]. There, the assumption is made 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. 2).

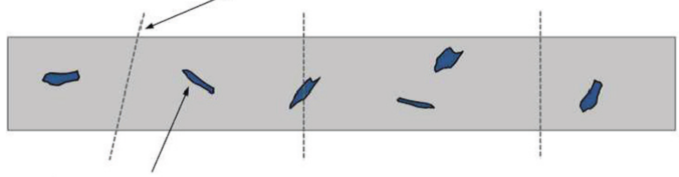

Fig. 2 Magnetically hard areas in the material [5]

Other sources [6] point out that magnetic crack testing carried out especially at the beginning and ends of pipes using direct current may cause magnetism in the pipe sections.

3 Effect of magnetism during arc welding

During welding, high-temperature plasma which causes the materials to be welded to be heated excessively and melt is created between a cathode and an anode by 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 the polarity. The arc is then deflected, irrespective of the welding torch position, and behaves unstably. This deflection can be illustrated through high-speed recording of the TIG arc:

Fig. 3 Comparison of a magnetically deflected TIG arc (left) and a stable TIG arc without the effect of magnetism (right) in a single-V butt weld

The consequences of arc deflection (Fig. 3) may be insufficient sidewall fusion during weld preparation and hence a lack of fusion in the welding result. In the GMAW process, droplet detachment is negatively affected and the arc is deflected onto the workpiece in an uncontrolled way, resulting in weld spatter and the inability to ensure sufficient shielding gas coverage (Fig. 4).

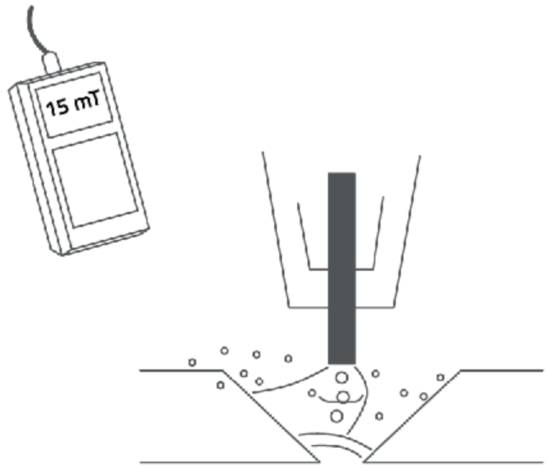

Fig. 4 Schematic representation: Instability in the GMAW arc and spatter formation due to magnetism

As a result of arc deflection, energy cannot be applied where it is needed. From the user's point of view, all this leads to insufficient welding results, a great amount of finishing work and even to scrapping of the workpiece in some cases, and hence to serious losses in quality and economy. Prevailing magnetism affects arc processes to a different degree. The TIG process arc is most susceptible to magnetism, where magnetic flux densities even as low as 0.5 to 1 mT can deflect the arc. In this range, the welder can overcome deflection through weaving and higher currents. At levels of 3 to 5 mT, arc deflection already results in the fusion faces not being adequately melted. Additionally, shielding gas coverage is not guaranteed as welding consumables are being fed in. This results in the formation of pores in the weld pool, which in turn requires reworking or scrapping. Thanks to its continually regulated arc length, the GMAW process remains stable to a large degree with magnetic flux densities of up to 3 to 5 mT.
Starting at about 8 mT, however, it becomes nearly impossible to control this process as well. The result is spatter formation and, with strong magnetic fields, arc interruption, reignition and thus defects in the weld seam.

4 Degaussing ferromagnetic materials in practical applications

The above preliminary considerations make it clear that ferromagnetic materials can be compensated for or degaussed by flooding them with current and thus generating an opposing magnetic field or a decreasing alternating field. Two possible variations are available to users in day-to-day work for this purpose:

Preventing arc deflection

- Degaussing prior to the welding process as a work preparation step
- Generation of an opposing magnetic field during the welding process

Fig. 5 Process variations for preventing arc deflection

In the following, the process variations shown in Fig. 5 will be presented with regard to potential applications and method of functioning and will be highlighted with application tips from day-to-day use.

4.1 Degaussing as a step in work preparation

Magnetism caused by the mechanical separation of components, filing in preparation for welding or due to grinding processes occurs particularly frequently. The first sign of magnetism is the appearance of filings arranged in the shape of a Christmas tree on a component (Fig. 6). This is an indication to the welder of the risk of arc deflection during the welding process. For high-quality welding results, degaussing is recommended after mechanical processing and before the actual welding process (comp. Fig. 7).

Fig. 6 Filings arranged in a Christmas tree pattern are an indication of magnetism

A pipe with prevailing magnetism which would not permit flawless welding is shown in the schematic representation. In the example of the pipe, a copper cable needs to be wound around the pipe (N turns). The copper cable coiling is done in an area relevant to the welding process, i.e. near the weld seam to be created. A current I, which after a certain time changes its direction of flow and also its amplitude to 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. As a result of this process, the magnetic field strength B and thus also the residual magnetism in the material, are reduced to near zero.

Fig. 7 Degaussing prior to welding

Thanks to the current sequence stored in the power source, the user is able to degauss components before the welding process without specialised knowledge. As a basic principle, however, the greater the number of turns around the component, the more the residual magnetism is reduced. It is not possible to make a blanket statement regarding exactly how many turns should be made, as it depends on the existing magnetism, the material thickness and the component length. Approximately 10 to 20 turns have proven promising for most applications, however. The "degaussing prior to welding" method is especially suitable for pipes and metal sheets with a length of up to about 10 metres and a prevailing magnetic field strength of up to 20 mT. In the case of larger or hard-to-reach components, variation II (generating an opposing magnetic field) is suitable for countering the active magnetic field during the welding process.

4.2 Generation of an opposing magnetic field during the welding process

Magnetised components can be degaussed as described in the previous section, or the magnetism can be reduced to minimal residual field strengths before the actual welding process. In pipe construction where kilometre-long pipelines are laid or frequent replacement and repair scenarios occur, this degaussing variation is only suitable under certain conditions. Due to the length of the pipes, their magnetism can only be reduced for brief periods. The displaced magnetic field often returns once the degaussing program has come to an end. This can occur after a few seconds or last a few minutes. To achieve a directionally stable arc and ultimately high-quality welding results with magnetised pipelines, however, an opposing magnetic field must be generated to counter the existing magnetic field during the actual welding process.
As shown schematically in Fig. 8, the pipes are positioned to one another. The existing magnetic field strength is measured with a measuring device in the fusion face. Next, the copper cables are positioned around one pipe at a distance of 10 to 20 cm from the joint. The number of turns is to be determined based on the prevailing magnetic field. The greater the number of turns applied, the lower the subsequent current setting for generating the opposing magnetic field, where 10 turns are adequate for most applications. Applying direct current to the copper cable generates a magnetic field which then counteracts the prevailing magnetic field in the pipe. Continuously increasing the current (establishing an opposing magnetic field) reduces the magnetic field in the fusion face. If the magnetic field increases in size when the opposing field is applied, reverse the polarity.

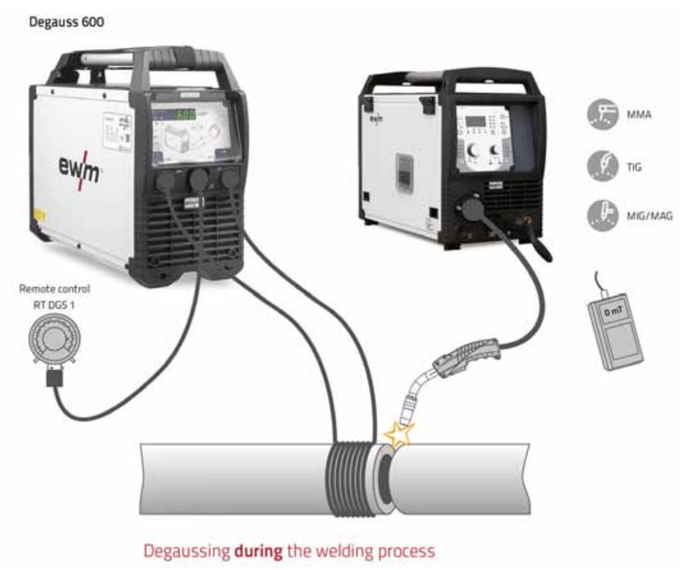

Fig. 8 Schematic representation: Generation of an opposing magnetic field during the welding process

When a magnetic field near zero is achieved, root welding is carried out with the degaussing power source switched on. Thanks to compensation of the magnetic field, the welding process is not subject to arc deflection. When the root pass is made, a short circuit is created in the pipeline (the existing air gap is filled with weld metal) such that the magnetism also no longer prevails in this area or is only minimally prevalent. For the subsequent filler and cover passes, no opposing field is required, or only a minimal one in the case of thick walls. As previously described, the magnetic field is a product of the number of turns around the component and the current. In Fig. 9, you can see that the generated opposing magnetic field increases almost linearly as the current increases.

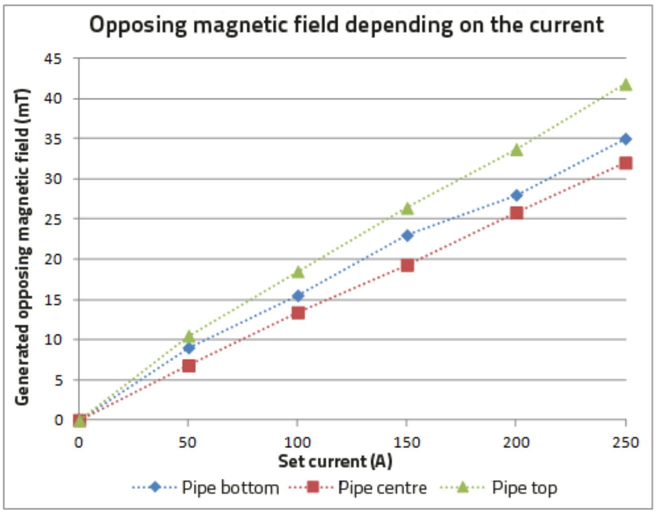

Fig. 9 Measurement values for generating an opposing magnetic field based on the current with N = 10

For this test, a pipe with an outer diameter of 250 mm and a wall thickness of 32 mm was wound with 10 turns of copper cable. Charging with 250 A forms an opposing magnetic field of up to 42 mT. This measurement value lies in the upper range of the pipe and can be achieved for thin-walled pipes with an overall cross-section of up to 15 mm. At the lower measuring point, with a wall thickness of 32 mm, it was still 35 mT. This shows that the generated magnetic field decreases as the wall thickness increases. This effect is first noticeable with wall thicknesses greater than 20 mm, however. Increasing the number of turns from 10 to 15 can generate opposing fields of up to 60 mT with 250 A of current, confirming the linear up-slope. In practice, nearly every application can be controlled and a reliable arc welding process ensured using the opposing fields achieved.

5 Application-technical solutions from EWM – Pico 350 cel puls pws dgs / Degauss 600

As a manual metal arc welding machine, the EWM Pico 350 cel puls pws dgs power source (Fig. 10) 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 for carrying out a continuous degaussing process (variation 1) (initial current: 350 A). Besides the power source with a degaussing prior to welding function, EWM offers the Degauss 600 as a power source exclusively for degaussing (Fig. 11). Two options for degaussing are available to the user here: degaussing before welding as a work preparation step and the generation of an opposing magnetic field during the welding process. With the Degauss 600, the user is able to counter magnetism in nearly every field of application. The Degauss 600 is supplied with all the required auxiliary materials, such as:

- 1 x 20 m load cable
- 2 x 5 m load cables
- Remote control for setting the opposing magnetic field with polarity reversing switches
- 5 m remote control connection cable

The direct current function (10 to 250 A) for generating the opposing magnetic field in the Degauss 600 is activated using the remote control. We also recommend using a measuring device to determine the existing magnetic field.

Fig. 10 Pico 350 cel puls pws dgs

Fig. 11 Degauss 600

5 Summary

Arc deflection caused by magnetism is a known problem in joining technology. Due to its sporadic occurrence, it is necessary to provide welders with fast and reliable methods in day-to-day work. EWM makes this possible with the Degauss 600. Degaussing prior to welding as a work preparation step and generating opposing magnetic fields during the actual welding process stabilise the arc and thus ensure reliable welding processes without time-consuming finishing work in many different areas of application. The Pico 350 cel puls pws dgs enables degaussing prior to the actual welding process.

6 Literature

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