

Customer Story

Quality improved – competitiveness increased

ewm forceArc[®] – successful change of technology in steel construction

IN A NUTSHELL

Advantages at a Glance

- / **ewm forceArc[®]** – exceptionally powerful and stable arc allows technological transformation.
- / **Great savings potential** – less preparatory and rework as well as reduced wage, material, gas and power costs.
- / **Compelling results** – no lack of fusion but deep penetration and excellent root and sidewall fusion instead.
- / **Trouble-free joining** over distances of up to 800 mm even with sheet thicknesses of up to 80 mm.
- / **Welding without a backing run** – no gouging necessary.

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Behind the modest facade of an SMB with 190 employees, Plauen Stahl Technologie GmbH with a production site in Plauen in Vogtland is one of Germany's leading structural steelwork companies. Every year, around 20,000 tons of structural steelwork leave the production halls. Cutting-edge production processes for sawing and drilling of profiles, for flame cutting, drilling and chamfering of sheet metal and for performing crucial joints with state-of-the-art welding technology allow structures to be manufactured to the highest technical standards, even for architecturally extravagant projects. For these projects, safety and quality are the top priorities.

Efforts to achieve safety and quality, combined with the desire for greater cost-effectiveness, led to the company investing in forceArc®, currently the most innovative gas-shielded metal-arc welding (GMAW) process, two years ago. The latest results for production at Plauen turn the physics of welding technology on its head.



/ Head of process planning and welding engineer, Dipl.-Ing. Jörg Neudel: "With forceArc®, we wanted to make the MAG joining process even safer. In the interim, we demonstrated this for some applications with single and double bevel groove seams, and thereby achieved a massive improvement in quality"

Mündersbach, 22 January 2010. When asked about the core business of Plauen Stahl, the head of process planning and responsible welding engineer (EWE) at the company headquarters in Plauen, Dipl.-Ing. Jörg Neudel, initially sums up succinctly: "Our domain is structural steel engineering, specialising in heavy structural steelwork." Then he adds: "We usually handle high-volume projects where the weight of individual components starts at around 50 tons."

The Vogtland engineer describes the projects and industries as follows: "In bridge construction, we are an international premier league player producing steel structures for rail- and tramway bridges and large-scale projects such as the gigantic Millau Viaduct in France, higher than the Eiffel Tower and

longer than the Champs-Élysées, for which Plauen Stahl Technologie supplied individual bridge components. We are a world leader in boiler-supporting steelwork for power plants. Our experience in this field dates back to the 1970s." The company also specialises in crane bridges with spans of 50 to 100 metres and the structural steelwork of lock gates. The dimensions of these segments are impressive, with spans of 40 to 70 metres and heights of up to 20 metres. For a special gate in the Danube, a lock segment was constructed with a height of 35 metres.

Step by step towards the dominant joining method

Well-thought-out material flow in the Plauen production halls forms the basis for effective and economical production. In the first stage, profiles and metal sheets are sent from the warehouse to the hall for beam treatment and NC-controlled cutting. Afterwards they go to one of two halls with production stations for partial segments and assemblies, and from there they are sent for finishing with final colour conservation.

The halls for partial segment production and finishing bustle with activity. The work pattern here is mainly determined by welding work – in 2- or 3-shift operation depending on the order situation. The welding personnel have access to the latest system and power-source technology for their work. For joining, they use the submerged arc welding process with single-wire and two-wire technology – mechanised at several portals. Added to this are a number of "tractors" for submerged arc welding.

A number of conventional metal active gas (MAG) power sources are available for the

GMAW welding tasks. The welding filler material varies between solid and cored wires, depending on the joining task. The shielding gas from the closed circular pipelines in the halls is the same for all GMAW devices: M21, a mixture of 82 percent argon and 18 percent carbon dioxide – slightly modified for the high quality requirements.

Two years ago, MAG welding at Plauen Stahl entered a new era. The company ordered 14 highly dynamic inverter power sources, type Phoenix 521 puls forceArc®, from the German market-leading manufacturer EWM AG, Mündersbach. These devices are ideal for the forceArc® joining method that is becoming ever more dominant in the structural steelwork industry.



/ Plauen Stahl Technologie GmbH, Plauen, Germany. Every year, around 20,000 tons of structural steelwork leave the production halls. For these steelwork structures, safety and quality are the top priorities.

Minor effect has major significance

The decision to acquire ewm technology was not a difficult one. As an experienced and circumspect welding expert, Jörg Neudel always has his finger on the pulse of the industry: "We are an almost flawless

welding company with extremely high quality standards. This means we are producing more and more butt welds which we always, in 100 percent of cases, subject to a non-destructive test – with ultrasound or radiography. With forceArc®, we wanted to make the MAG joining process even safer. In the interim, we demonstrated this for some applications with single and double bevel groove seams, and thereby achieved a massive improvement in quality. The failure rate compared with conventional spray or pulse arcs is significantly lower. An effect that at first seemed to be of minor importance became almost the main reason for using forceArc® – the targeted use of this technology in the root area and for intermediate layers saves us time, a lot of time,” he explains. “In the past, the seam root generally had to be removed by air arc gouging before the backing run could be welded on the other side of the metal sheet. The seam geometry was configured accordingly with a two thirds to one third ratio: one third with a large seam opening angle for the side being gouged, two thirds for the side that is filled at the start. With the opening angle that is now symmetrical for the forceArc® process, we save seam volume and handle angle distortion much better”.

A totally clean – and highly rated – process. MAG joining is now considerably more defined in Plauen. To enable this, the groove preparation and the preproduction have been restructured. This starts with the metalworkers taking a more disciplined approach to the assembly work. They need to pay special attention to maintaining the exact air gap between the components. This requires them to identify more strongly with their own work, but does not take up more time. Looking at the welding process alone, forceArc® reduces non-productive time considerably – cleaning and gouging work is minimised, allowing the welder to do what he joined his profession for: weld without his rhythm being interrupted. Although Neudel does not state the precise percentage of the savings, he sees the improved flow throughout the whole production chain as an excellent result.

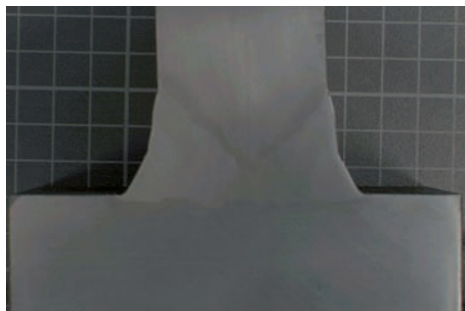
The welders therefore rate the forceArc® process extremely highly. They feel the same way about the Phoenix power source too, without reservation. As well as the innovation, this is also perfect for the pulse and spray arc MAG variants commonly used up till now. Neudel sums up as follows: “The machine runs completely cleanly in the spray arc area for vertical-up seams with 5-6m/min of wire feed and 200 amps of welding current; the same applies to the pulse arc with 20m/min of wire feed at 400 amps.”



/ 30 years' experience of structural steel engineering – a specialist area for Plauen Stahl Technologie is the production of supporting steelwork for boilers, air pre-heaters and hoppers for coal-fired power plants

/ The introduction of the powerful and directionally stable forceArc® has marked a technological transformation in the production process. Now Plauen Stahl also joins 800 millimetre-long seams with forceArc® – with sheet thicknesses up to as much as 80 millimetres





/ The perfect weld seam: "The powerful forceArc® is extremely easy to control. It also ensures excellent fusion penetration in the sidewall. We have not as yet been able to spot a single fusion error between the welding layers.



/ If pores occur at all, they are generally to be found on the fringe areas of the parent metal. The parent metal with its non-metallic impurities, rather than the welding process, is largely responsible for this. It can only be prevented by better quality rolled metal sheets with fewer impurities.



/ Turns the physics of welding on its head: the inspection inside the welded structure reveals fillet welds that correspond to evaluation group B in accordance with ISO 5817, with a defined hollow fillet and corresponding overlap – and at 3 millimetres, the throat thickness also complies with the value required by the standard. It is therefore now possible to weld certain seams from one side only. The backing run is created "automatically".

From structural to high-strength steel

The welders are very well prepared for their tasks. They are all qualified to join materials in Group 1 (up to structural steel S 355). A defined group of persons also specialises in joining work on fine-grain structural steels and chrome/nickel steels. At the Vogtland plant, fine-grain structural steels up to S 960 are also processed. S 355 ML steel is used in bridge construction because of its resistance to low temperatures, as well as the high-strength fine-grained structural steel S 460. Hydraulic engineering (lock gates) involves joining duplex and chrome/nickel steels, mostly using black and white connections.

SSO opens new doors: convincing trial run

Neudel sees the commitment of the ewm dealer, Peter Schüler, as a further factor that was integral to the new process gaining a foothold at all at Plauen. The dynamic owner of Schweiß- und Schneidtechnik Oelsnitz, SSO, worked together with Plauen Stahl to define the configurations and settings of the machine and the process, and to determine the characteristic curves. He provides an outstanding level of service. SSO supplied Plauen with a Phoenix power source to try out for three months – the quality of the machine and the process proved convincing. For Jörg Neudel, the particular technical and economic benefits of the machine/process combination lie in the details: "The crucial factor for us is that we always achieve root reinforcement with forceArc®, which is not the case with standard MAG welding. This actually defined reinforcement can in certain cases eliminate the need for complete gouging of the backing run. We have learnt to work with precision for this." Neudel sees the introduction of the powerful and directionally stable forceArc® as a technological transformation of his

production process: "In the past, we generally used submerged arc welding for sections over 500 millimetres. Now we also join up to 800 millimetre sections with forceArc® – with sheet thicknesses up to as much as 80 millimetres where for example 100 welding layers have to be laid. Unlike with submerged arc welding, the MAG variant requires less setup time and is extremely easy to control. It also ensures excellent fusion penetration in the sidewall. We have not as yet been able to spot a single case of lack of inter-run fusion between the welding layers. If lack of fusion/pores occur, these are generally to be found on the fringe areas of the parent metal. Even with the most careful work, pores continued to occur in these places sporadically." Welding engineer Jörg Neudel is convinced that the parent metal with its non-metallic impurities is largely responsible for this. There is a need for better quality rolled metal sheets with fewer impurities.

A strikingly simple solution

Industry experts are only slowly becoming aware of what actually constitutes the enormous potential of forceArc®. A love of experimentation and an open approach to new possibilities for technological applications have already led to discoveries and results at the Plauen plant that completely redefine the physics of welding. The root reinforcement of a single bevel seam creates a finished fillet weld with the required throat thickness on the reverse that fulfils all quality requirements.

Jörg Neudel explains this, not without a hint of pride: "After a series of preliminary tests, we used a single bevel seam on the box section of a crane bridge; forceArc® was used to lay the 30-metre long seams. The inspection inside the box revealed that we are achieving fillet welds that correspond to evaluation group B in accordance with ISO 5817, with a defined hollow fillet and

corresponding overlap – and at 3 millimetres, the throat thickness also complies with the value required by the standard." He goes on to explain, "The reason for this is that we maintain a defined air gap from end to end. We are aware of what this result means for the future of welding technology." What he means is that it is now possible to weld certain seams from one side only. The backing run is created "automatically" – no joining – no welding.

Groundbreaking engineering

Jörg Neudel is also happy to talk about small details – work techniques, materials, welding workflow – from experience he has gathered over 26 months of using forceArc®: "Our welders have to work with full concentration. They are not allowed to produce any slag inclusions in the weld metal. Backhand welding is therefore an advantage. We pre-heat at the start of the seam and have developed techniques to ensure there are no end-craters. This applies equally to double-sided fillet welds and full connection."

The welding process in Plauen is fully oriented to the safety and quality of the components. Neudel sees no limits for forceArc® as far as joinable steel materials are concerned, whether working with creep-resistant steels for power plant engineering or chrome/nickel steels.

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