Welding by electromagnetic pulse technology (EMPT) can join dissimilar or similar materials in 25µs without generating heat and without mechanical contact. Long and short welds are possible with up to 3 m length.

The Working Principle:
PSTproducts has expanded the possibilities of conventional electromagnetic pulse technology (EMPT) from welding closed section tubes to welding of dissimilar sheet metals. One of the two sheets to be joined, the so-called flyer, is accelerated by a pulsed electromagnetic field at velocities of above 200 m/s. This is accomplished within a distance of 0.3-2mm. When the driven sheet impacts its stationary counterpart, the oxide layers covering the metal surface are cracked and chipped in the area of impact. The air entrapped between both sheets is compressed by the displacement of the flyer with the resulting jet expelling the oxide flakes out of the joining area. This results in metallically pure and thus highly reactive surfaces being compressed by extreme contact normal pressure. Both factors facilitate the creation of a metallurgical weld between both contact partners.

Benefits:
This welding process does not heat up the metals by thermal energy, so providing the possibility to weld metals with completely different melting points. Moreover, there is no heat affected zone. This facilitates the creation of welded joints between aluminum and advanced high strength steels without any danger of reducing the materials yield strength.

More information is available on: www.english.pstproducts.com
Does Size Matter?
The Modular Design of the PSxx BlueWave Systems

The modular design of PSTproducts’ EMPT machine systems allows a step-by-step upgrade of the pulse generator. Therefore new developments and future products can be manufactured according to the actual demand. In addition to the modular adjustments, the EMPT machine systems of the BlueWave series can be divided in so-called banks by switching on and off the capacitors, to set various currents or discharging energies at defined discharging frequencies. This additional option demonstrates the versatility of the BlueWave machine systems, either in high-volume production of different batches or for research and development.

Additional information is available on:
http://www.english.pstproducts.com/data_sheet.htm

Quality Control with Every Pulse
Parameter Monitoring and Integration of PSxx BlueWave EMPT Machine Systems in Line

Independent of the industry sector and application, the EMPT BlueWave pulse generators are equipped with a process control unit, which consists of an integrated PLC and parameter monitoring system. The operator can collect data about the discharging parameters current, energy and frequency, as well as compare the pre-set and actual values according to the requirement of the cycle time, and can define warning signals, if there are unforeseen discrepancies.

All data can be stored with the integrated memory devices of the control unit or can be archived by LAN on the existing server of the company, where they can be evaluated if wanted or required. The control unit can be optionally equipped with remote maintenance software, to enable remote access maintenance tasks or software upgrades by PSTproducts or by other sites of the customer.

www.english.pstproducts.com/data_sheet

Excerpt from the PSxx-16/25 BlueWave Data Sheet

<table>
<thead>
<tr>
<th>PS8-16 TO PS 16-16/25</th>
<th>PS32-16 TO PS48-16/25</th>
<th>PS64-16 TO PS160-16/25</th>
<th>MULTIPLE JOINING COIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated conveyor belt installation of a PS48-16 BlueWave system. Specified for 2,000,000 parts per year in 3 shift operation</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Current carrying conductors are affected by a force, when placed in a magnetic field. This force is called the Lorentz force. Moreover, current carrying conductors will generate a surrounding magnetic field. Hence, two parallel wires will experience an attractive force, in case of equal current conduction direction. Otherwise, the conductors are forced apart, if the currents run in opposite directions. The same phenomenon occurs, if a metallic tube is placed in a coil, through which an alternating current runs (AC). The coil current induces a counter-rotating eddy current in the tube according to Lenz’s law. In conjunction with the coil’s magnetic field the induced eddy current causes a repulsive force in radial direction.

When the current’s polarity is altered, a counter-rotating eddy current is induced once again within the tube. Thus, there are no changes in direction of the resulting magnetic forces.

Because of the component’s inertia, the forming operation is phase delayed with respect to the time-current function. Some time elapses while the sinusoidal current increases, until the first displacement of the cross section towards a smaller diameter takes place.

Simultaneously stresses inside the specimen increase rapidly, until their amplitude is sufficient to overcome the yield strength of the work piece as well as its inertia. Successively, the diameter reduction rate is rapidly increased, causing an end of the forming process prior to the zero point of the first half wave of the electrical current. An alternating current in the range of 100kA can be supplied by a pulse generator and is essential for the generation of the high-flux magnetic field.

The pulse generator is assembled of a bank of capacitors, switches and associated charging and control devices. The first step to start a forming operation is to charge the capacitors for 3-8 seconds. Afterwards, a high-current switch, which initially separates coil and capacitors, is closed.

Now, the current oscillates at high frequency between capacitor and coil. This set-up is capable of generating altering currents in the range of some 100kA.

Due to the capacitor charging time, the pulse generator can be operated through a conventional 380V / 32A socket. The electricity for a PS60 system (60kJ) costs only approximately 0.0025 € per pulse, i.e. a ¼ Cent.
Is Finite Element Analysis a Development Tool which Play an Important Part also for Customer related EMPT Product Adaptations?

The answer is: Yes!
Numerical simulation is used by PSTproducts intensively for the modeling of the EMPT process, the coil and all components of the pulse generator.

Finite element analysis (FEA) provides optimization of all the components of the pulse generator in terms of electrical quantities.

The current density distributions can be displayed and adjusted for the specific needs of each work piece. The exact knowledge of the location and amplitude of the maximum mechanical loads allows an extension of the coil life time. The necessary material parameters are available at PSTproducts.

A validation of the numerical work by subsequent experimental investigations is common practice at PSTproducts.

Forming trials are conducted for establishing and specifying the process parameters and durability test are done to predict the life expectancy of all coil concepts and pulse generators.

The customers obtain thus the knowledge about an industrially applicable process and equipment suitable for their needs.

More information is available at:

www.english.pstproducts.com/services
EMPT and the Electrical Mobility
Higher Compression Rates for Improved Electrical Efficiency

The topic of electric vehicles is not a future issue, but very important right now. Apart from the automotive industry, the energy sector has identified a leading market with enormous potential.

Looking at this issue technically, the wiring plays an important role in the provision of high electrical efficiency.

All industry sectors depend on a reliable cables and low-loss energy transmission, whether they focus on mechanical engineering, road transport, logistics or process engineering.

The contact resistance between plugs and cables is a critical factor here, because the electrical conductivity is much higher if the normal contact force is high which acts on the contact area.

The EMPT provides a very high compaction rate, and therefore a very strong compression of the strands. This results in maximum contact forces between the individual conductors of the wire.

The possible EMPT compression levels go far beyond the mechanical crimping approach.

Multiple Layers Welded in One Pulse
Welding of thin foils by EMPT

To establish the competitive, automated mass production of high-volume lithium-ion cells, suitable production technologies and processes as well as the necessary machinery and equipment technology have to be developed.

Appropriate pulse generators of the PSxx BlueWave Series allow now the joining of metallic foil stacks. The determining factor is to establish a reliable weld area between all individual foil layers, so that a low electrical contact resistance and sufficient mechanical strength is guaranteed.

It is also possible with the help of EMPT to manufacture thin-walled transition joints between copper foils and aluminium bus bars. These connections are required, among other things, for the packaging of individual cells.
Time to Market
EMPT Attracts Development Programs

Time to market is in today’s globalized and interconnected world, one of the most important aspects in the placement of innovative products and services. Special programs are being conducted to bring sophisticated technological approaches quickly to the market and into production.

PSTproducts has conducted several collaborative projects funded by the Free State of Bavaria and the Federal Republic of Germany under the ZIM-Scheme, i.e. the Central SME Innovation Program of the Federal Ministry of Economics and Technology (BMWi).

Topics are in electrical engineering, packaging and process engineering as well as automotive lightweight structures. Some have been successfully and effectively implemented by PSTproducts, others are still under development and demonstrate the strong interest of the public authorities for the future-oriented actions of PSTproducts in the field of EMPT.

World-Wide Sales Network
Close to the Customer

Maintaining regular contact with the customers by qualified and experienced staff during every phase of the interaction is a professional strength of PSTproducts and is a valuable service of the company.

In the initial years of manufacturing EMPT systems the priority was put on the European market with the focus on Germany.

However, during the last two years the company started proactively – and also supported by the world-wide interest in EMPT – to develop new European markets in Sweden, Austria and Switzerland as well as overseas markets in USA, Canada, India, China, South Korea, Japan and Taiwan. Discussions with potential sales partners in Italy and Brazil are currently underway.

Therefore, PSTproducts can provide qualified consultants and service engineers locally for existing and potential customers.

More information is available at:

www.english.pstproducts.com/locations
PSTproducts goes to India

As part of the extension of the sales activities and based on the large number of enquiries for EMPT from India, a collaboration with Proteck Machinery Pvt. Ltd. was successfully launched in November 2009.

Proteck Machinery Pvt. Ltd. is a machine manufacturer and sales company that was established in 1985 with several sites in major industrial cities in India. Customers from the automotive industry and metal fabricators make increasing use of the EMPT for current and new production concepts.

The former President of India, Prof. Dr. Abdul Kalam, honored PSTproducts for the active contributions during the first EMF conference at the well known Anna University in Chennai and thanked for the technical presentations and the live demonstration of a PS60 EMPT machine system during the well attended event.

Experts from India and all parts of the world reported about their impressions and experience with the electromagnetic pulse technology.

More information about sales offices is available at:

www.english.pstproducts.com/locations

Innovation-Champion TOP 30

NoAE Innovations-Wettbewerb 2010

Innovation-Champion 2010

Thirty Innovation Champions were selected and honored during the annual prize giving ceremony of the Network of Automotive Excellence (NoAE) from 420 international applications in 5 clusters. PSTproducts impressed the prestigious and carefully selected jury panel with representatives of the automotive industry by innovative EMPT-sheet welding of similar and dissimilar types of metals.

The production method has been industrialized in September 2010, and now it provides high-strength, heat-free welded joints. Therefore it achieves no thermal distortions even between materials with very different melting points.

In addition to the similar metallic materials, combinations of aluminum to steel, aluminum to copper, steel to copper and steel to magnesium are feasible. In the latest automotive summit in Würzburg in November 2010, the directors and founders of PSTproducts GmbH Dr. Pablo A. Pasquale and Mr Wolfgang O. Schütz received the formal recognition as Innovation Champion 2010.

Automobil Gipfel Würzburg 2010

PST inside

Apprentices at PSTproducts

Creativity and innovation have to be developed at an early stage of the carrier. Since September 2008 PSTproducts is one of many training providers for apprentices in Germany. The first apprentice passed her exam in spring 2011 as an Industrial Merchant.

Three additional apprentices joined the team in September 2010 for being trained as Industrial Mechanics or Industrial Merchants.

Internships, Studies, Diploma and Master Theses

PSTproducts offers for young technicians and academics interesting and unusual themes. Several students of the University of Applied Sciences Aschaffenburg and the University of Darmstadt have already demonstrated their skills and enthusiasm while solving technical challenges and tasks within the core research program of PSTproducts.

Recertification 2010

PSTproducts received in October 2010 for the second time its company certificate according to DIN ISO 9001:2008 with an excellent result.
Events and Trade Fairs

Conferences
SheMet, 18. - 20. April 2011, 14th international Conference on Sheet Metal, Leuven Belgium

Exhibitions
During the fair there will be daily demonstrations of EMPT sheet welding with a PS20-25 BlueWave machine and a demonstration of many typical industrial applications