

DVS MAGAZIN

TITLE SUBJECT:

WELDING TRAINING SYSTEMS – A “REVOLUTION” IN THE TRAINING IN JOINING TECHNOLOGY?



Offprint

Dear Readers,

It is a fundamental element of all DVS training and further education concepts to always take the latest expert knowledge into consideration as far as their contents are concerned. Because only if the newest findings are also passed on to the (prospective) specialists can the optimum standard for joining technology for which DVS stands with its work be guaranteed in practice.

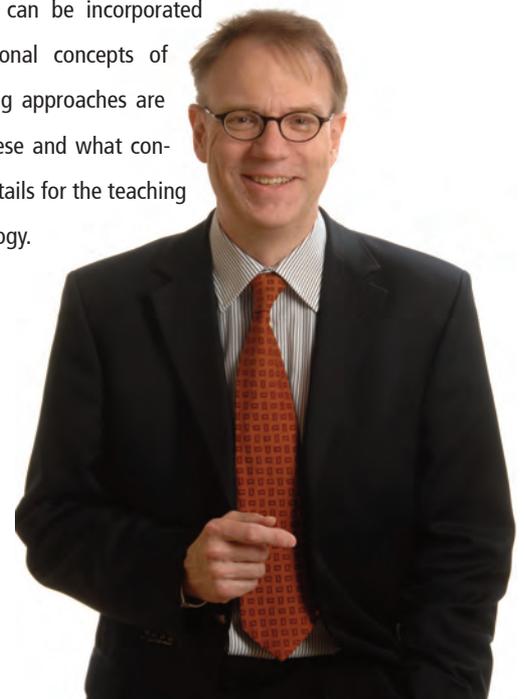
However, it is decisive not only to take account of innovations in joining technology but also to take up other developments in the educational field of DVS. In the age of the information and knowledge society, electronic media have become a permanent fixture in our society in the meantime. They leave their mark on our imparting of knowledge, they create new forms of teaching and learning contents and, therefore, they must not be ignored in the educational field of DVS either. "Virtual Welding Training Systems" (VWTS) are the catch phrase which stands for a new, future-oriented component in the training and further education in joining technology.

Today, there is a whole host of different systems which all entail an enormous potential for utilisation

in the practical welder training. The "Welding Training Systems" working group which has been newly created in DVS has set itself the task of sounding out the utilisation possibilities of the Virtual Welding Training Systems. Its primary objective is to develop concrete proposals for these with regard to how the training in welding technology can be put into effect in the future including Welding Training Systems.

The main subjects in this offprint are what must be borne in mind in this respect, what chances these systems are opening up and what limits still exist at the moment. Read up on how these Virtual Welding Training Systems can be incorporated into the educational concepts of DVS, what training approaches are resulting from these and what consequences this entails for the teaching in joining technology.

Yours faithfully,
Klaus Middeldorf





Photograph: DVS

Welding Training Systems – A “revolution” in the training in joining technology?

Welding Training Systems are a very present subject in joining technology. In addition to the different developments of the systems, the most interesting question is what role the Welding Training Systems can and should play in the qualification of specialist welding personnel in the future. Will Welding Training Systems modernise the training in welding technology to a decisive extent?

■ An idea is going around the world

In the past 15 years, different Welding Training Systems have been developed all over the world and discussions have been initiated as to whether and to what extent the so-called Virtual Welding Training Systems (VWTS) can be integrated into the training.

It is being discussed just as intensively whether the VWTS are even ringing in the end of the classical welder training. Amongst other bodies, the “Welding Training Systems” working group in DVS which was founded in September 2011 is dealing with questions like these. In this working group, GSI mbH is also intensively involved in the expert discussion about everything to do with the VWTS as well as in their refinement.

The premiere event on the subject took place in 2010, i.e. the first international GSI specialist conference entitled “WELDING TRAINER 2010 – The Future of Education”. In its Welding Training Systems Laboratory, GSI – Bildungszentren Rhein-Ruhr develops and tries out a modular training concept in order to be able to integrate the VWTS into the welding training. GSI mbH will present the initial results on the occasion of the second international conference entitled WELDING TRAINER 2012 at SLV Duisburg on September 26 and 27, 2012.

Two fundamental facts are already definite at present: On the one hand, the VWTS will be refined technically as a result of experience and rising computer capacities. On the other hand,

the Welding Training Systems nevertheless cannot succeed in portraying all the aspects of the real welding process. “Anybody who has already carried out welding themselves once knows: Only in the real process can you gather all the experience which you need as a welder. Only there do you develop a feeling for how the weld pool behaves in various welding positions and with different materials,” explains Wolfgang Hildebrand-Peters. The director of the GSI – Bildungszentren Rhein-Ruhr in Oberhausen has been dealing with the subject of Welding Training Systems for years and is the Chairman of the DVS working group at the same time.

What technology should it be?

In principle, the VWTS can be divided into two

variants: One variant works with a genuine arc and the other places its faith in computer-animated representations. Moreover, the available systems offer further distinguishing features. In this respect, each system follows its own concept. A few systems have mobile modules and others are intended exclusively for stationary utilisation. Depending on the system, different welding processes and various welding positions are portrayed. Accordingly, the individual profile of requirements of the training establishment and the training objective are decisive for the selection of a VWTS.

Renowned manufacturers are SLV Halle, Fronius International, Lincoln Electric, EWM Hightech Welding and 123 Certification Inc. Most systems work with computer animation. No protective equipment is required. Due to the very low risk potential, it can, however, also be utilised in training rooms and university lecture halls.

"The GSI SLV - Welding Trainer from SLV Halle is the only system which works with a genuine arc," explains Wolfgang Hildebrand-Peters. "The heat development and brightness of the

"Only in the real process can you gather all the experience which you need as a welder."

arc, the necessary protective equipment and the resulting sound effects create conditions which are close to reality and make the GSI SLV system unique," Hildebrand-Peters states further.

However, irrespective of all the technical differences, all the systems pursue the objective of portraying exercise sequences as close to practice as possible. Thus, even beginners can gather initial experience on the subject of welding. Moreover, VWTS help to understand the complex sequences of the welding process in a better way because the systems divide the entire working sequence into single parameters which can each be trained, such as the angles to be complied with, the torch manipulation in exact positions or the constant distance away from the workpiece.



VWTS – Virtual Welding Training Systems – help beginners to understand the complex sequences of the welding process in a better way. Majorly young people are keen on the virtual opportunities.

The advantages of the VWTS (Virtual Welding Training Systems)

"But the absolutely greatest advantage of the VWTS," according to Wolfgang Hildebrand-Peters, "is doubtlessly the chance for permanent correction by the system during the ongoing exercise. Furthermore, the trainer has the possibility of seeing the exercise sequence and the trainee at the same time. Thus, the trainer can provide assistance directly." This results in a totally new teaching and learning situation. Because the trainee is already corrected and assessed during the virtual welding process whereas, in the classical training, the quality of the welding bead of the trainee is, as a rule, only evaluated after the real welding process. Due to the direct feedback of the VWTS, a greater understanding of the sequences is permitted at the start of the training in welding technology. By practising the individual para-

An overview of various systems:

GSI SLV - Welding Trainer from SLV Halle

The device works with a real low-power arc. The elaborated work specimens are thus suitable for a large number of exercises. The system records essential process parameters during the welding operation and provides the user with information about execution mistakes during the exercise using acoustic and optical signals. Moreover, all the training results are archived in the system. Because the parameter setting is variable and theoretical training compo-



Photograph: SLV Halle GmbH

nents can be integrated into the start menu, the GSI SLV - Welding Trainer can also be used for the training of already advanced participants. Due to the compact design with integrated anti-glare protection, the GSI SLV - Welding Trainer can be put to variable and mobile uses.

VRTEX 360, Lincoln Electric Deutschland

The VRTEX 360 consists of a welding machine, a welding torch, a workpiece holder, a welder's helmet and several workpieces. With the system, it is possible to train the manual electric arc, MIG, MAG and flux-cored wire welding processes in different positions and with various weld and joint types (T joint, flat position and groove weld).

The virtual welding operations are accompanied by corresponding sound effects and the visualisation of a true-to-reality weld pool which the pupil can model himself. The VRTEX 360 is equipped with a fact-based score system which serves to make the individual learning status recognisable at any time. On the VRTEX 360, it is also possible to work in pairs. In this respect, the welding exercises of one participant are followed by the other on the screen. Due to a playback function, the virtual process sequences can be viewed and evaluated even at a later point in time.

One main attraction relates to the virtual environments which can be selec-

meters, the learners are guided to the manual skill required for a welding process step by step. In spite of this, the VWTS are not all-rounders and limits are set on them too. The experts agree that the systems cannot replace the training in the booth altogether.

“The absolutely greatest advantage of the VWTS is the chance for permanent correction by the system.”

It is a fact: Virtual Welding Training Systems save time, material and energy. Nevertheless, this must not be the main argument in favour of using the systems in the training, in the unanimous opinion of the “Welding Training Systems” working group in DVS. The utilisation of Welding Training Systems is permitting initial research studies which relate to the physical burdens on the welder and were conducted by GSI in cooperation with the German Sports University in Cologne. The objectives are the ergonomic arrangement of welder workplaces and posture recommendations for the welders. The posture can be trained with the systems because the operation is not carried out in the seclusion of the welding booth.

The utilisation of VWTS is paying off at universities as well since the systems make it possible to integrate teaching units close to practice into

the courses of study. Another interesting utilisation possibility for the VWTS is for personnel recruitment. Specialists in welding technology are being sought despairingly – at the interview, a test run on the VWTS could already show where the strengths and weaknesses of the job applicant lie.

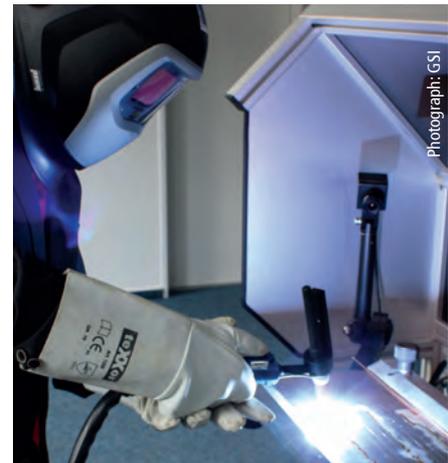
In turn, training establishments or training companies appreciate completely different properties of the VWTS because, with Welding Training Systems, fundamental sequences can already be learned and the required manual skills efficiently trained in the initial period of the welder training. The provision of theoretical learning contents in the systems is another convincing constituent of the technology.

Last but not least, Virtual Welding Training Systems are ideal means of arousing the enthusiasm of novices for welding technology, of improving the image of welding technology and of awakening positive associations to this occupational field. Also for children and young people in the “electronic media” generation, the VWTS are an exciting instrument with the character of a computer game. “In the most favourable

case, this playful component awakens the interest not only in technology but also in taking up a career in welding technology after leaving school,” explains Dr. Klaus Middeldorf, General Manager of DVS. Therefore, it is no wonder that VWTS frequently become an absolute crowd-puller at educational fairs, events like the “Technology Day” or comparable occasions.

New teaching forms become possible

With Welding Training Systems, learners have the possibilities of consolidating knowledge and organising the learning speed according to their level of knowledge. Thus, these are the best pre-



Photograph: GSI



Photograph: Lincoln Electric Deutschland

ted. They simulate situations in the welder's booth or on the building site. This results in additional learning effects.

Virtual Welding, Fronius International GmbH

With the Welding Training System from Fronius it is possible to train the execution of butt welds and fillet welds in different positions. The PB, PF and PD welding positions can be chosen in the case of the fillet welds and the PA, PF and PE welding positions for single V welds.

Haptic workpieces supplement the virtual reality with exact positions

One particular highlight is the so-called “ghost” function because this virtual trainer permits a nominal-actual comparison: The welding speed, the distance away from the workpiece and the tilt angle of the welding torch can be programmed in advance by the trainer as a “ghost”. A traffic-light system subsequently indicates the quality of the completed exercise to the user. A preset “ghost” with parameters established by experts can also be selected. Using a playback function, mistakes can be analysed independently and the correct postures trained. All the results are recorded by the system and permit not only basic documentation but also the representation of the training results as a ranking.

Virtual Welding Trainer from EWM HIGHTECH WELDING

The PA, PB, PC, PF and PG welding positions can be trained with this Welding Training System. In this respect, the single welding parameters can optionally be set freely or according to the international guidelines. A genuine torch ensures a particularly real welding experience. Because EWM HIGHTECH WELDING primarily concentrates on the training of the abilities relating to motor functions, neither the arc nor the results are portrayed in real form but the sequences relating to motor functions are.



Photograph: DVS



Photograph: DVS

requisites for making effective preparations for the practical training parts. Moreover, the systems promote the social interaction with other participants and, of course, with the trainer too. In turn, he can impart expert knowledge much more directly since the virtual welding does not take place in a welding booth.

In any case, instructors and qualification testers play an absolutely decisive role in relation to the integration of the VWTS into the DVS training concepts, as Wolfgang Hildebrand-Peters explains: "In the future, not only the welder training but also the training concepts for the trainers themselves will have to take account of the fact that the VWTS are becoming ever more present. Because only in this way is it guaranteed that the devices will become precisely the ideal supplement to teaching which we are striving for."

Training, discussing and integrating

At the same time, the presentation of all the Welding Training Systems available until now at the fair in 2009 also raised the worldwide specialist discussions on the subject to a new level. It quickly became clear that the increasing popularity of the Welding Training Systems will ensure changes in the training and further education in welding technology. How the VWTS can be integrated into the educational concept of DVS is therefore one of the most important tasks with which the DVS working group is concerned. After all, the welder training of DVS according to the DVS/IIW 1111 guideline is the only one with international recognition until now. "Of course, we would not like to lose this exclusivity characteristic under

any circumstances," according to Dr. Middeldorf, "but, at the same time, it is an important matter for us to anchor VWTS as a permanent fixture in the training." Since it may be assumed that the VWTS are equally sensible in the practical and specialist theoretical training, the training paths to become international welders, welding instructors, welding technologists, welding specialists and welding engineers will therefore change correspondingly.

The International Institute of Welding (IIW) is proposing that the authorised national bodies (i.e. DVS in this country) should recognise the fundamental suitability of the Virtual Welding Training Systems in an initial step. When this has happened, the corresponding courses could be implemented in the authorised educational establishments. The latest international guidelines for welder training (IAB 089 guideline) and for supervisory welding personnel (IAB 252 guideline) provide orientational help: In the case of the four-stage training to become an international welder, the VWTS would account for a proportion of up to 20 percent in Modules 1 to 4. For the training of supervisory welding personnel, virtual contents would make up a proportion of max. 50 percent. "Both are a clear indication that the Virtual Welding Training Systems are not planned as a substitute for real welding processes," Dr. Middeldorf explains and adds: "One prerequisite for the sensible utilisation of VWTS is always the linking with the real process!" Now, it is the task of the DVS working group to develop solutions for how these IIW stipulations can be integrated into the welder training in concrete terms. There are already initial successes, as Hildebrand-Peters, the Chairman of the working group, explains: "In the

autumn, we will present a concept which will highlight in a concrete way how the systems can be integrated into the training of welding instructors." However, looking to the future, it will still be decisively significant to regularly exchange opinions about the experience with the VWTS and to include educational establishments and companies while doing so.

"The VWTS offer ideal prerequisites for supplementing the training in a sensible and effective way," explains Hildebrand-Peters. However, it would be appropriate to adapt the educational contents gradually in view of the expected technical refinement of the systems. In principle, the utilisation of VWTS would be conceivable in supracompany apprentice instruction (SAI) as well. Now, DVS, the chambers of handicrafts and the various trade associations must also clarify to what extent this can be put into effect.

Conclusion: Virtual Welding Training Systems are an ideal supplement in the training in welding technology and create new possibilities of imparting the rising level of required knowledge. However, the VWTS cannot and should not replace the important practical experience with the real welding process. Therefore, no revolution is imminent in the training in joining technology but very probably a future-oriented, discernible reform. (UT)

All the manufacturers of Welding Training Systems offer favourable starting possibilities of using the devices. The contact is Wolfgang Hildebrand-Peters, GSI – Bildungszentren Rhein-Ruhr, tel.: +49.(0)208.85927 11, hildebrand@gsi-slv.de



Nomination of the GSI SLV - Welding Trainer from SLV Halle for the Occupational Health and Safety Prize 2011



Photograph: GSI - Gesellschaft für Schweißtechnik International mbH

■ SLV Halle GmbH put itself forward as a candidate for the German Occupational Health and Safety Prize 2011 with its GSI SLV - Welding Trainer and, out of over 200 applicants, was nominated for the final selection by the German Ministry of Employment and Social Affairs together with ten other companies. Professor Dr. Ing. Steffen Keitel, the Managing Director of GSI mbH, explains ...

... the background to putting itself forward as a candidate ...

We already had the first reason to be happy in 2010 when we won the Occupational Health and Safety Prize of the Federal State of Saxony-Anhalt with the GSI SLV - Welding Trainer. At that time, our attention was then immediately drawn to the candidature for the Occupational Health and Safety Prize – of course, we seized the chance. Firstly, we are glad that we are making a decisive contribution to the refinement of occupational health and safety measures with our GSI SLV - Welding Trainer. On the other hand, such prizes and nominations naturally offer an ideal opportunity to promote the image of welding technology and to make it well-known to a wider public.

... the motivation behind developing a GSI SLV - Welding Trainer ...

In its work, GSI basically focuses on developing new methods of welder training. And even a long time ago, it was already planned to develop a training method for prospective welders which can be compared, for

example, with the preparations of competitive sportsmen: "Dry exercises" and movement sequences are trained first of all and only then is it a matter of the "real thing". Our GSI SLV - Welding Trainer is designed according to this principle but it was only ten or fifteen years ago that computer technology had also advanced so far that the idea could be turned into reality. What is characteristic of our GSI SLV - Welding Trainer is the fact that it works with a genuine arc and, to top it all, a genuine torch is used as well. These are the best prerequisites for discharging the prospective welders into the welders' booths after these training units. The objective of GSI and its branches is to train better welders in a shorter time – the GSI SLV - Welding Trainer is an extremely efficient resource in doing this.

...the role of Virtual Welding Trainer Systems in the training ...

Welding Training Systems are becoming ever more popular. This development does not surprise me because the systems offer the possibility of intensive training. The trainer can correct any posture mistakes or wrong movement sequences without any time delay. In turn, that ensures better training and shorter training times. The fact that the Welding Training Systems also save material, costs and energy in addition and, to top it all, are helpful instruments with regard to the development of occupational health and safety concepts is, of course, one advantage which we greatly welcome.

(UT)

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If it is a matter of joining technology, DVS is the right address. Because, with more than 19,000 members, the society represents a network of experts which has an answer to all the questions relating to everything to do with the joining, cutting and coating of metallic and non-metallic materials.

The work of DVS covers all the facets of joining technology. These include the training and qualification testing of specialists and the certification of companies, the technical-scientific work with regard to technologies and processes, research activities, conferences and congresses for the exchange of experience as well as the elaboration of

DVS guidelines, technical codes and technical bulletins for recognised standards.

DVS has worldwide activities and is acknowledged as a competent partner for joining technology throughout the world. In order to ensure that the interests and concerns of every individual member are not ignored in this respect, 81 district branches and 14 state branches all over Germany are dedicated to the technical-scientific cooperative work in situ.

Therefore, DVS also stands for THE JOINING SPECIALISTS.

Your contact to DVS:

The DVS headquarters

Mail: info@dvs-hg.de
Internet: www.die-verbindungs-spezialisten.de

Members service

Mail: mitglieder@dvs-hg.de
Internet: www.die-verbindungs-spezialisten.de

The Research Association on Welding and Allied Processes of DVS

Mail: forschung@dvs-hg.de
Internet: www.dvs-forschung.de

DVS-PersZert, the personnel certification agency

Mail: perszert@dvs-hg.de
Internet: www.dvs-perszert.de

DVS ZERT e. V., the certification agency for products and management systems

Mail: zert@dvs-hg.de
Internet: www.dvs-zert.de

Conferences and events in DVS

Mail: tagungen@dvs-hg.de
Internet: www.die-verbindungs-spezialisten.de

Public relations and communication

Mail: uta.tschakert@dvs-hg.de
Internet: www.die-verbindungs-spezialisten.de

DVS Media GmbH, the specialist publishing house of DVS

Mail: verlag@dvs-hg.de
Internet: www.dvs-media.info

GSI – Gesellschaft für Schweißtechnik International mbH

Mail: sekretariat@gsi-slv.de
Internet: www.gsi-slv.de

DVS-TV, the Internet television station of the sector

Mail: info@dvs-tv.de
Internet: www.dvs-tv.de

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