

**RESEARCH | TECHNOLOGY | EDUCATION**

**IN FOCUS**

**Joining of Plastics in DVS**

# The technical-scientific cooperative work in DVS

DVS is a technical-scientific association that is fully committed to joining technology, with nearly 120 years of experience under its belt. In other words: at DVS, everything revolves around joining, cutting and coating of metallic and non-metallic materials and material composites. The objective of all DVS activities is to comprehensively promote joining technology. This is done in many different ways.

DVS initiates and accompanies research activities, grasps the current state of the art, develops it continuously and makes sure that the DVS training and continuing education offerings, too, reflect the respectively latest state of knowledge from technology and research. This narrow network made up of research, technology and education is the core element of the technical-scientific cooperative work in DVS.

True to the principle „one becomes three“ technical discussions, research questions, or work results are communicated across the various departments, which is why they also mutually positively influence one another. With this interdisciplinary approach, DVS guarantees that its varied work results will always be based on the latest findings and are mutually compatible with each other.

An impressive example of this successful working philosophy is being documented by DVS set of rules, consisting of DVS Technical Bulletins and DVS Technical Codes. For the training and continuing education, DVS set of rules sets high training

standards and comparable qualifications. In the technical areas, joining, cutting and coating methods, however, also aspects of testing and quality assurance, industrial safety and environmental protection as well as the added upstream and downstream process stages are being currently described. The foundations for the highest standards and uniform procedures are specified by DVS set of rules.

With the series of booklets titled “In Focus”, we would like to demonstrate to you with the help of specific examples which practically oriented results the technical-scientific teamwork produces in DVS and would like to invite you to get involved in the varied activities in DVS. Every booklet is dedicated to a central topic of interest and shows how the close connection between research, technology and education in DVS not only benefits the respective industry but the entire industrial location of Germany. DVS offers competitive solutions for joining technology – the work results are published among other things by DVS Media GmbH in trade journals, reference books and other publications and are therefore made accessible to the professional circles.

Dipl.-Ing. Jens Jerzembeck  
Head of Research and Technology

Photo: Fotolia



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Title photo: "Infrared weld of PP-H", Georg Fischer, Piping Systems

# Joining of Plastics

Plastics have become an indispensable part of modern life. In many industries, therefore, the joining of plastics play an important role: Whether in the electrical industry or in the automotive industry, household goods, medical equipment, in pipeline engineering, in apparatus engineering or in tank construction - in application areas like these, the joining of plastics or plastics and metals is an essential part of production. This makes it even more important for companies in such industries to know the current status of joining technology in terms of cost-efficiency and productivity, to work with practical solutions and to be able to rely on the expertise of qualified employees. The technical-scientific cooperative work within DVS offers the right instruments for all these components.

Joining of Plastics is an umbrella field made up of several different areas. This is on the one hand the welding of plastics with its priority application areas of pipeline, tank, appliances and plant engineering and series welding. Another major branch in the Joining of Plastics is the adhesive bonding of plastics and metals, something that is especially often used in lightweight construction and in microelectronics, consisting of precision engineering, electrical engineering and communication technology. In addition, plastic adhesive bonding allows the joining of different materials, whether same alloyed or of different types. The latest technologies for joining of plastics include laser welding of plastics composites or high temperature resistant thermoplastics, mechanical joining techniques for thin-walled components as well as the function expansion of screw threaded connections. In line with the systematic breakdown into welding of plastics on the one hand and adhesive bonding of plastics and metals, on the other hand, there are also various professional qualification possibilities that arise and which DVS has on offer. The range of further education offerings includes the following selections: Training as plastics welder and Specialist for Plastic Welding, European Adhesive Bonder, European Adhesive Specialist and European Adhesive Engineer.

All qualification offers consider - concerning the contents - the state of the art and are continuously updated, for one of the priority duties of the technical-scientific teamwork within DVS is not only to understand, know and apply the state of the art but

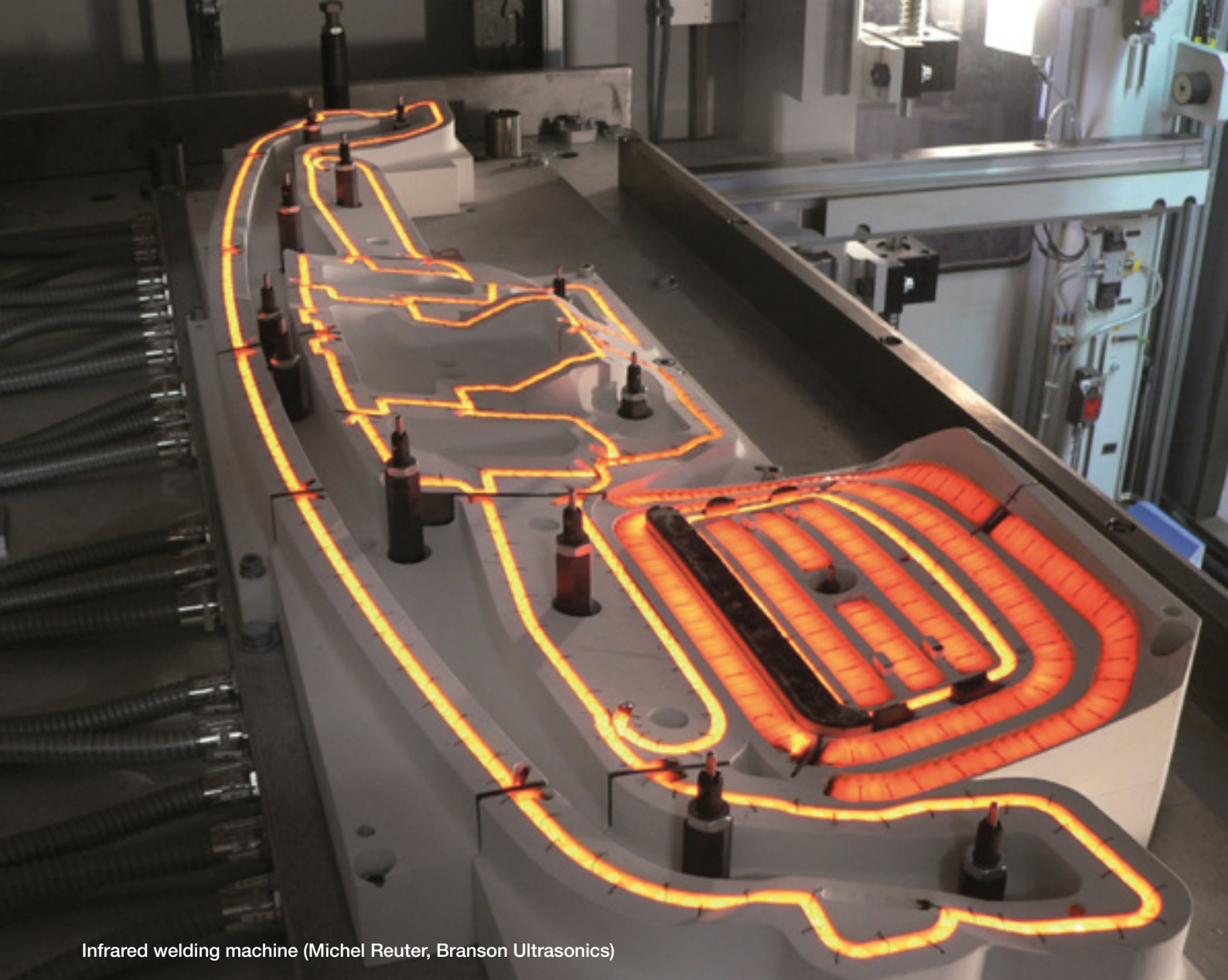
**Dipl.- Ing. Thomas Frank,**  
Frank GmbH (Mörfelden-Walldorf)  
Chairman of Working Group  
“Joining of Plastics” (AG W4) at the DVS

also to continue to develop it further. The following trends in the field of plastics joining are recognisable:

- applications of plastics joining in microsystems
- technology, e.g. the welding of components with integrated, highly sensitive electronic components.
- low-particle welding of components with stringent cleanliness requirements, as is being demanded in medical technology and in the automobile industry.
- decrease in the cycle times during joining without any quality losses by means of intelligent process development. Here, for example, the following should be mentioned: forced cooling using compressed air in the case of heated tool welding.
- The development of new technologies for the joining of materials and their combinations which are well-known, as well as of those that have not yet been tried out or have been classified as unsuitable, for example, welding of plastics with high proportions of fillers or with wood-fibre reinforcement or the vibration welding of wood and wooden materials.
- modification and further development of test procedures, especially of accelerated test procedures, in order to determine the long-time properties of the welds.
- The joining of fibre composite materials such as FRP / CFRP and hybrid components (Metals / plastic)

We would like to provide you with comprehensive information on the following pages about the structures and the approach of the technical-scientific teamwork as well as the work results resulting from it in the areas of “Joining of Plastics”.

**Dr.- Ing. Marco Wacker,**  
Oechsler AG (Ansbach)  
Chairman of Expert Committee “Joining of Plastics” (FA 11)  
in the Research Association of the DVS



Infrared welding machine (Michel Reuter, Branson Ultrasonics)

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The DVS set of rules on “Joining of Plastics” offers extensive application-related information about procedure, quality assurance, testing, design etc. and, in addition, also defines the special requirements placed on skilled workers in the field of plastics joining.

Through interdisciplinary collaboration between the research association of DVS, the Technical Committee and the Education Committee, a globally established and recognized DVS policy set has been created, which constitutes a self-contained system.

The DVS policy set is also available in English.

DVS-members have free access under: [www.dvs-regelwerk.de](http://www.dvs-regelwerk.de)

# Research at DVS

## The Research Association on Welding and Allied Processes e. V. of DVS

At the core of the Research Association on Welding and Allied Processes e. V. of DVS, there are the expert committees (FA). They are respectively assigned to a given department and as a result have a clearly defined thematic orientation. The functions of the expert committees are defined clearly: They are the interfaces assimilating the knowledge from enterprise, industry, trade and workmanship from the research centres, from the research association itself and from DVS. Each of them contribute their own individual specialist knowledge to the work of the expert

committees, something that means that practically oriented re-research projects and results can be guaranteed from the outset. This is because it is the task of the expert committees to derive research requirements within their respective specialist department and to communicate the results of the respective research. Therefore, the expert committees of the research association of DVS are also involved in all phases of a given research project. They initiate and plan the projects, guide and control their implementation and finally evaluate the results.



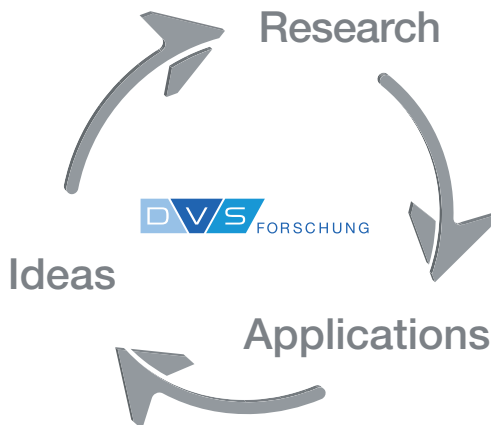
Expert Committees of the Research Association of DVS

Bielomatik

## Cooperative industrial research

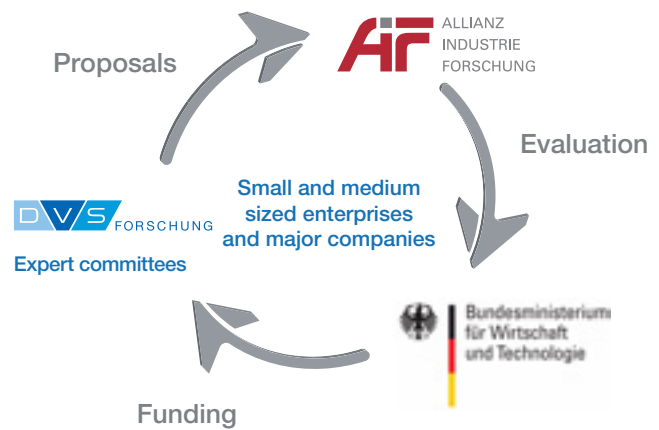
The core activity of the Research Association is the Cooperative Industrial Research (IGF), which orients itself above all on the interests of small to medium-sized enterprises from the joining technology industry which frequently lack the means for own research activities. Via the IGF, these it is possible to intercept these disadvantages that exist for structural reasons and to convert them into real competitive advantages because IGF combines the aspects of minimised economic risk with major research potential.

Core competence of the IGF is the close integration of theory and practice: Requirements that are formulated directly from operational practice form the basis for the research activities. In view of joining-related research, these requirements are announced within the individual expert committees of the research association. In the second step, the research priorities will be derived from this and these will be subsequently investigated by different research institutes in the form of research projects. Owing to the permanent communication with the expert committees and the active cooperation of enterprises going along with it during all the various phases, the aspect of a practically oriented research project always remains guaranteed. In addition, the cooperation of enterprises with the IGF gives rise to a swift knowledge transfer and hence also a parallelism of research and results exploitation. This is because the enterprises can investigate the initial results from the research directly for their practical usefulness and report their findings from this back to the research centres.



Research from practice for practical use:  
The principle of the cooperative industrial research

The funding of the research projects takes place via the AiF – Federation of Industrial Research Associations „Otto von Guericke“ e. V. from funds provided by the Federal Ministry of Economic Affairs and Technology (BMWi).



Partners and implementation of the Cooperative Industrial Research

In this context, too, the expert committees of the research association assume important functions for they are the ones to decide which research projects are important for the joining industry and, hence, should be recommended for implementation. These research requirements are finally evaluated by a professional appraiser process of the AiF and, in the event of a positive decision, are recommended to the BMWi for implementation.

Given the complex processes within joining-based cooperative research, the interface functions of the expert committees within the research association manifest in a variety of ways. The way in which these expert committees perform their tasks, however, can be summarized under one umbrella heading: „Research from practice for practical use“.

**i** For more information and updates on the work of the Research Association on Welding and Allied Processes e. V. of DVS, please see: [www.dvs-forschung.de](http://www.dvs-forschung.de)

## Expert Committee 11 “Joining of Plastics”

An open communication between enterprises and research institutes identifies the approach in the Expert Committee “Joining of Plastics” as a dedicated pool of ideas for research and application. There is also a very intense exchange of knowledge between the Expert Committee 11 and the topically related Working Group W 4 “Joining of Plastics” in the Technical Committee of DVS. At international level, there is also a tight contact with Committee XVI “Joining of Polymers and Plastics” of the International Institute of Welding (IIW). Through intensive collaboration, synergetic effects are created for research and technical advancement, for every aspect of the subject of “Joining of Plastics”.

The research in Expert Committee 11 includes not only the welding but also the adhesive bonding and mechanical joining of plastics. The focus is primarily on the new demands of the market and the requirements derived thereof – both from series welding as well as the processing of semi-finished products- with regard to engineering, materials, process, quality and testing aspects.

All research activities that are initiated in the Expert Committee “Joining of Plastics” are aimed at a more intense understanding of the Joining of Plastics and at developing solutions with which those joining processes for plastics can be efficiently implemented in practice. Currently, the following research fields and key topics are central issue in the Expert Committee 11 “Joining of Plastics”:

- consideration of the joints from the viewpoint of
- materials engineering with regard to the manufacturing process of the joining members (e.g. injection moulding-induced warping of the components to be joined).

PVC welding apparatus



Photo: Fotolia



- research into new developments in machine technology.
- simulation of joining processes and moulding properties.
- optimisation of well-known joining processes such as vibration welding, ultrasonic welding and heated tool welding as well as the development of new process variants and combinations.
- selective investigation of, as yet, non-established joining processes with regard to more intense understanding of the relationship between the process, the structure and the properties. This is to ensure that even small and medium-sized businesses can apply plastics joining processes at high quality within their workplace practices.
- The exploration of possibilities into the transfer of established technologies to materials which have either not yet been investigated - as in the case of composite fibre materials (FRP / CFRP) – or have been classified as unsuitable in terms of joining technology until now – such as thermoset materials. Something else that is also being explored is what new technological processes can be developed for these materials.

500 µm wide laser transmission welding of two PA66-adherends

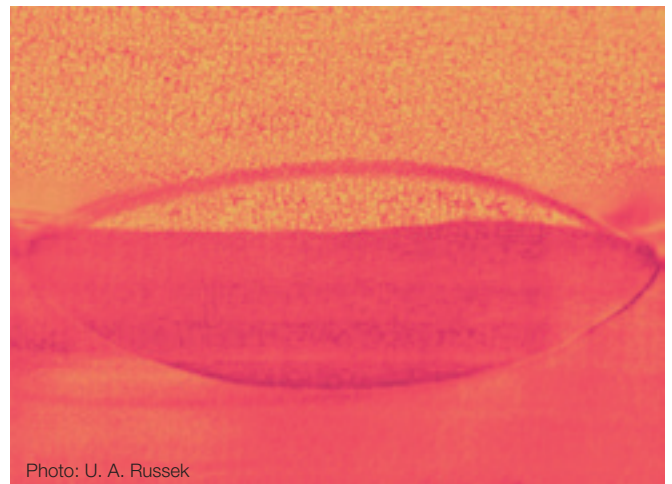


Photo: U. A. Russek



- optimisation of materials with or without functional additives (electrically, magnetically, thermally conductive) for processing with established or new joining processes.
- miniaturisation as a new application field for joining of plastics.
- development of suitable evaluation and test procedures – not only for joining processes but also for finished parts, in order to be able to determine relevant quality characteristics.
- opening-up of new application fields for the industrial joining of thermoplastics with the objective of obtaining suitable supplements or alternatives to existing joining processes.

Beside the intensive cooperation with the respective working

groups in the Technical Committee, the Expert Committee “Joining of Plastics” supports various measures for the transfer of its research results. This takes place for example during the annual plenary session of Working Group W4 as well as through presentations in industrial companies, at research institutes or also at public events for ongoing training and technology transfer.

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Further information about the Expert Committee 11 is available at: [www.dvs-forschung.de/fa11](http://www.dvs-forschung.de/fa11)

## How applied research works – an example

### Research Topic:

“Saving cycle time without loss in quality during heated tool welding and vibration welding through forced cooling by means of compressed air”

### Research Centre:

Polymer engineering, University Paderborn,  
Department of polymer- and rubber processing

**Runtime:** 01.04.2009 - 31.07.2011

**IGF-No.:** 16.035 / **DVS-No.:** 11.022

### Starting situation:

Heated tool welding (HT-welding) is one of the most commonly used methods in plastic joining technology. HT-welding, in comparison to other methods of joining technology, is particularly identified by long cycle times, something that causes high unit cost. Decisive for these long cycle times is the cooling, in particular. Hence, the optimisation of the cooling periods constitutes a possible starting for the shortening of the cycle times.

Besides HT-welding, vibration welding was also examined under this point of view. Though its cycle times are shorter than those of HT-welding, however, they are still above those of ultrasonic welding.

### Objectives:

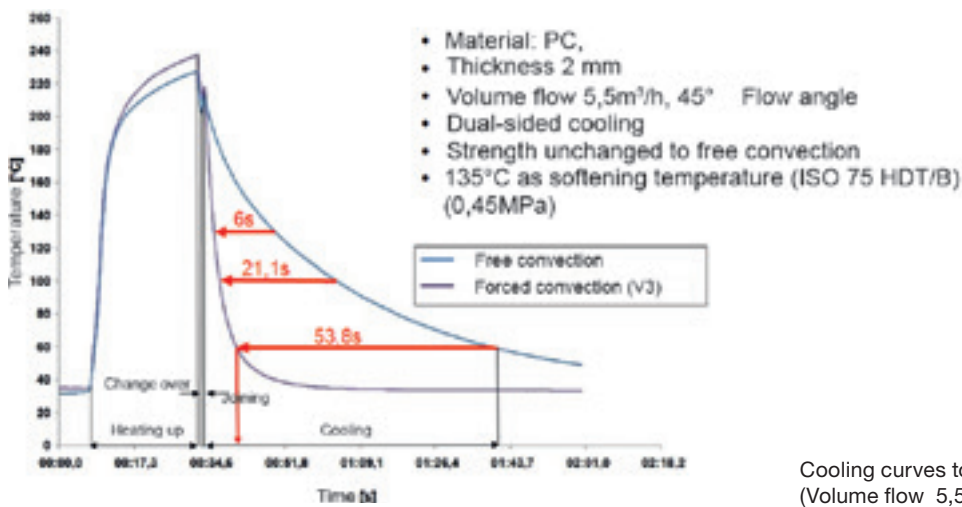
The objectives of the research project are the systematic analysis and optimisation of the cooling phase of the heated tool welding process through forced cooling by means of compressed air with concurrent guarantee of the weld seam quality. The results are information, technical codes and recommendations for production of components of satisfactory quality within the shortest possible cooling times.

According to the described objectives, the research results can be broken down as follows:

- Cooling period optimisation by varying the different compressed air parameters: The correlations between compressed air parameters and cooling effect are worked out through a systematic analysis of the cooling phase of the HT-process, taking into account predefined cooling conditions.
- Analysis of the joint seam quality (correlation between cooling condition and joint seam quality).

### Outcomes:

The results are that the user will have all of the following available: information, technical codes and recommendations for production of components of satisfactory quality within the shortest possible cooling times. This contributes to an essential improvement of the economic efficiency of heated tool welding.



Cooling curves to free and forced convection (Volume flow 5,5 m<sup>3</sup>/h)

### References from the industry

**Dipl.-Ing. Stefan Gövert, 3 Pi Consulting & Management GmbH, Project management:**

“These studies were able to sufficiently demonstrate that saving cycle time without loss in quality is possible through forced cooling by means of compressed air. If one looks at the huge number of products where heated tool welding is being used, the economic efficiency achieved by forced cooling by means of compressed air becomes evident, as does the cycle time savings associated with it.”

**Dr.-Ing. Tobias Beiß, bielomatik Leuze GmbH & Co. KG, Head of Innovation Management Plastics:**

“The implementation of the findings from the project is just starting at bielomatik. A cold-air nozzle was obtained and it is planned to conduct first experimental examinations on some customer products under cooling curves of free and forced con-

vection (air flow 5.5 m<sup>3</sup> / h) within the scope of prototype weldings or pre-acceptance. In addition, there is currently a call for a bachelor thesis that is supposed to deal with possible nozzle shapes for industrial weld geometries.”

**Dr.-Ing. Odo Karger, Hella KGaA Hueck & Co., Head of Process Development Joining Technology:**

“The findings from the research project have indicated an interesting expansion of the familiar field of heated tool welding. A reduction of the cooling period and hence of the cycle time can be achieved without any quality loss by using active convective cooling. This is absolutely a promising option for many users.”



You will find an overview of other ongoing or already concluded research projects at [www.dvs-forschung.de/forschungsergebnisse](http://www.dvs-forschung.de/forschungsergebnisse)

## DVS-Research Seminar “Technologies for Joining of Plastics in Lightweight Construction and Renewable Energies”

In every expert committee, the action fields of the research activities are predefined thematically. In order to formulate current research trends or to determine important questions to be investigated, research seminars are an important instrument of the work of DVS. Within the scope of these seminars, the experts from science and industry get together in order to establish essential guidelines of their future work, for example through a research agenda.

The DVS research seminar “Technologies for Joining of Plastics in Lightweight Construction and Renewable Energies” was carried out to compile a research agenda “Joining of Plastics” that is supposed to guide the research association of DVS in its future strategic orientation in these areas. A previously commissioned study on the joining of plastics, where more than 150 decision makers from economy and science been involved, served as a basis for their discussions.

With the DVS research agenda “Joining of Plastics”, a position paper going beyond competition limits and individual fields of interests was developed by means of which the challenges for a sustainable plastics joining technology in the 21st century are shown in an impressive manner by industrial users from different fields.

Megatrends like a more deliberate use of resources and the search for new energy sources already today steadily advance the development of new applications and markets in the areas “lightweight construction and renewable energies”. On the material side, for the purposes of specific mixing construction concepts (“material on local demand”), the result of this is already an increased use of efficient fibre composites, and the targeted use of modified functional types. On this occasion, polymers keep assuming an increasingly ever more prominent role. On

the process side, this can only be insufficiently represented in a production that is limited to primary shaping and/or re-forming operations, which is why joining has established itself as an integral building block in the value added chain for plastics moulded parts. Nor did it develop into a “Commodity” over the last decades but, rather, it was (and still is) characterized by a steadily increasing “technologisation” in order to address the complex requirement profiles of new applications with intelligent joining concepts.

The greatest industrial research need is considered to be in the field of welding and adhesive bonding of composite materials, wherein the focus is on the joining of hybrid material combinations. Moreover, every fifth questioned enterprise explicitly wished for more research activities on the subjects “Calculation” and “Simulation”. In view of the properties of bonded components, the focus for future research - according to the study - should be on the subjects of “Corrosion Protection” and “Ageing” as well as “Stress caused by temperature changes”. Open issues and concomitant research needs were also identified by the representatives from science and industry in the area of the “definition of process parameters” for “quality assurance” as well as in the search for possibilities how to reduce the “process times” overall.

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The research agenda “Joining of Plastics” was published along with the study as DVS Reports Volume 294 and is available for download at [www.dvs-forschung.de/aktuell](http://www.dvs-forschung.de/aktuell)

Photo: DVS



# Technology at DVS

## Technical Committee

In view of currently more than 250 different joining processes, whose numbers continue to increase, the technical-scientific cooperative work of DVS can and must be done systematically. Guarantor for this is the Technical Committee (AFT) with its more than 200 subject-oriented working bodies. The AFT unites more than 2,000 specialists from the economic and scientific fields,

from authorities and from other areas, that are work together to capture the state of the art and continuously advance it.

The fact that DVS, with this bundled up specialist knowledge, is also recognized in international circles as a sovereign and competent partner in all questions relating to joining technology is obvious. Through its involvement in the International Institute of Welding (IIW) and the EWF - European Federation for Welding Joining and Cutting, DVS decisively supports the international joining technology network in its activities.

### International partners of DVS:

DIN	German Institute for Standardization
CEN	European Standards Committee
ISO	International Standards Organisation
IIW	International Institute of Welding
DIBt	German Institute for Structural Engineering
VdTÜV	Federation of the Technical Inspection Associations
DVGW	German Association of the Gas and Water Industry
AGFW	Association for District Heating
AWS	American Welding Association
NIL	Dutch Welding Association
EFW	European Federation for Welding, Joining and Cutting

The work results in the AFT are published as DVS Technical Bulletins and DVS Technical Codes. Besides, a close collaboration with other rule-making national and international institutions like the German Institute for Standardization, the CEN or others (see table) further ensures that the contents of DVS Technical Bulletins and DVS Technical Codes are sensibly coordinated with the rules and regulations of the other institutions.

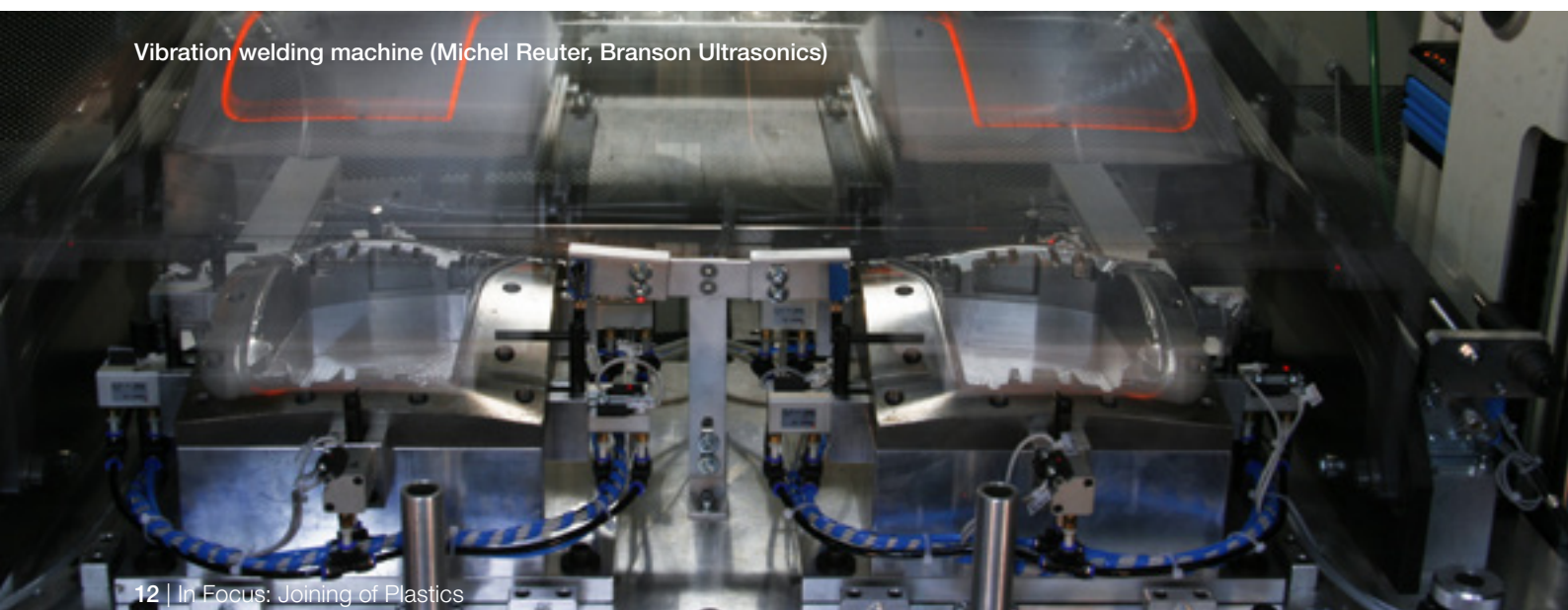
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DVS members benefit from free access to the German-version set of rules of DVS at

[www.dvs-regelwerk.de](http://www.dvs-regelwerk.de).

All DVS Technical Bulletins and DVS Technical Codes of the association are retrievable there in electronic form.

Vibration welding machine (Michel Reuter, Branson Ultrasonics)



## Structure of the Technical Committee

### Main Division W

Basic materials, filler materials and auxiliary materials

<b>AG W 1</b> Technical gases	<b>AG W 2 **</b> Welding of cast materials	<b>AG W 3 **</b> Joining of metal, ceramic and glass	<b>AG W 4</b> Joining of plastics	<b>AG W 5 *</b> Welding consumables	<b>AG W 6 *</b> Welding of aluminium and other light metals
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### Main Division V

Processes and equipment

<b>AG V 1 *</b> Gas welding	<b>AG V 2 *</b> Arc welding	<b>AG V 3 *</b> Resistance welding	<b>AG V 4</b> Underwater engineering	<b>AG V 5 *</b> (Thermal) cutting	
<b>AG V 6.1 *</b> Brazing	<b>AG V 7 *</b> Thermal spraying and thermal sprayed layers	<b>AG V 8</b> Adhesive bonding	<b>AG V 9.1</b> Electron beam welding	<b>AG V 10 **</b> Mechanical joining	<b>AG V 11 *</b> Friction welding
<b>AG V 6.2 *</b> Soldering			<b>AG V 9.2</b> Laser beam welding and allied processes		

### Main Division Q

Quality management, design, calculation, health and safety

<b>AG Q 1</b> Design and calculation	<b>AG Q 2*</b> Quality management for welding	<b>AG Q 4*</b> Testing of welds	<b>AG Q 5*</b> Demands on welding personnel	<b>AG Q 6</b> Health and safety and environmental protection
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### Main Division I

Information

<b>AG I 1</b> Information and communication technology	<b>AG I 2*</b> Application oriented welding simulation	<b>AG I 3</b> History of welding technology	<b>AG I 4 *</b> Illustration, terms and definitions
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### Main Division A

Applications

<b>AG A 1</b> Welding in turbo machine building	<b>AG A 2</b> Joining in electronics and precision engineering	<b>AG A 5</b> Welding in construction settings	<b>AG A 6</b> Welding in shipbuild and marine engineering
<b>AG A 7</b> Welding in railway vehicle manufacturing		<b>AG A 8</b> Joining in vehicle manufacturing	<b>AG A 9 *</b> Welding in aviation and aerospace engineering

### Specialist Societies

Specialist Society for "Brazing/Soldering"	Specialist Society SEMFIRA/EMF ***
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AG: Working Group, \* Joint Working Group with NAS (Standardisation Committee Welding and Allied Processes)

\*\* Joint Working Group with other Societies, \*\*\*SEMFIRA = Safety in ElectroMagnetic Fields, EMF = ElectroMagnetic Fields.

### The Working Group AG W 4 “Joining of Plastics”

The Working Group W 4 “Joining of Plastics” in the Technical Committee deals with the welding, adhesive bonding and mechanical joining of plastics. In detail, this field covers the following topics:

- welding, adhesive bonding and mechanical joining processes
- testing and calculation of joining seams and structures
- application of the joining processes in practice
- training and examination of the specialist personnel

With regard to the extensive field of “Joining of Plastics” as part of the technical-scientific cooperative work, the Working Group W 4 is divided into different sub groups:

- AG W 4.1a Heated Tool Welding of Boards and Pipes
- AG W 4.1b Hot Gas Welding
- AG W 4.1c Rotational Friction Welding
- AG W 4.1d Ultrasonic Welding
- AG W 4.1e High-Frequency Welding
- AG W 4.1f Vibration Welding
- AG W 4.2 Adhesive Bonding of Plastics
- AG W 4.3a Structural Design - Pipeline Construction
- AG W 4.3b Structural Design –Apparatus Engineering
- AG W 4.4 Measurement and Testing
- AG W 4.6 Training and Examination
- AG W 4.7 Plastic Films and Webs
- AG W 4.8 HS Series (Mass) Welding
- AG W 4.11 Mechanical Joining of Plastics
- AG W 4.12 Laser Welding of Plastics
- AG W 4.13 Infrared welding

The coordinators of the individual sub-groups meet regularly to share knowledge and experience. At these meetings, the activities are coordinated with each other, new topics are defined and DVS Technical Codes are released for publication. Additionally, the plenary meeting of all the members of the Working Group W 4 takes place once per year.

The set of rules compiled by DVS is used worldwide and very successfully so. Hence, the DVS Technical Codes on joining of plastics are also available in English.

In addition to the DVS Technical Codes, standards also play a role in the set of rules in the field of joining technology. In the field of joining of plastics, too, there are standards whose development is actively supported by DVS experts from the Working Group AG W 4 in the Technical Committee.

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The respective annual report provides a summary overview about the annual work results of the entire Working Group that can be download on the website of the Working Group: [www.dvs-aft.de/AfT/W/W4](http://www.dvs-aft.de/AfT/W/W4)

## The practical relevance of DVS set of rules – an example

Requirements for a good joining connection are always an appropriate training of the staff in the respective joining processes for only then will the required quality of the joining connection be achieved. In the case of polyethylene connections the Technical Code DVS 2207-1 has a decisive influence on weld seam quality. In this, the methods are described for heated tool butt welding (HS) see image 1, heated tool socket fusion welding (HD) and electrofusion welding. With its comprehensive practical information, the Technical Code DVS 2207-1 is also a very good basis for training and advanced training. Its already wide acceptance among professional circles is magnified by the fact that it is additionally available in an English translation version.

In addition to the main Technical Code, there were also two supplementary sheets published:

- Supplement 1 deals with welding of thermoplastic synthetic materials - electrofusion welding of pipes from PE-X with conduit parts from PE-HD.
- Supplement 2 applies to heated tool butt welding of large diameter pipes from PE100 according to DIN 8074/75 with wall thicknesses > 30 mm. Supplement 2 has been newly released and - together with part 1 - deals with the special requirements for welding of large diameter pipes from PE100.

Image 2 shows an example from the sector of water supply. By means of electrofusion welding, here in form a saddle weld, connections with existing PE100 pressure pipelines are very simply created, for example to ensure the supply to back streets in a residential area

Fig. 1: Principle behind heated tool butt welding using the example pipe

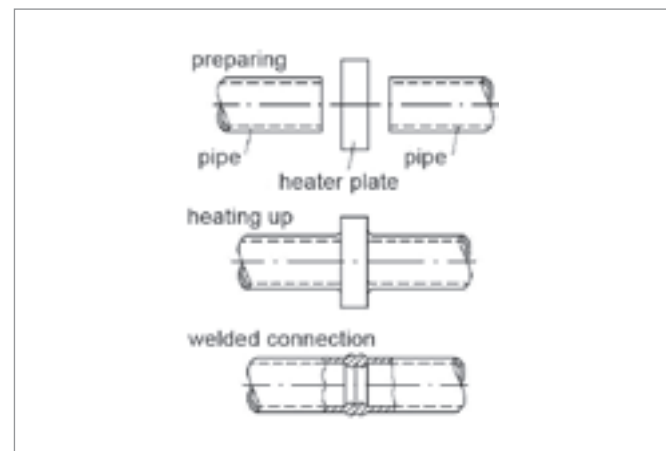


Fig. 2: Practical example of a saddle weld by means of electrofusion welding.



Photograph: Georg Fischer, Piping Systems

# Education at DVS

## Education Committee

The Education Committee (AfB) initiates measures to adapt the education and certification offering of DVS to present developments and to prepare for future requirements. At the same time, the AfB acts as a guidance committee for the Personnel Certification Body DVS-PersZert and its activities. In this respect, the AfB assumes the role of a Strategy Committee. In this, it is being supported by the Working Group Training and Examination (AG SP).

The Working Group Training and Examination assumes - in the "Education and Certification" area - the task of creating uniform training and testing material as part of the qualification of joining experts and managers. Thereby, national, but also current European and International requirements of the EWF – European Federation for Welding, Joining Cutting or the International Institute for Welding (IIW) are implemented in the training and testing standards.

Because the AG SP equally considers the interests of industry and trade in its work, the needs of industry are directly reflected in the compiled DVS-Guidelines. The area of responsibility of the AG SP encompasses the development of the specific syllabuses and curriculums for joining-related education and training, in addition, however, also all other areas that are associated with the field of Training and Examination. The fact that these training and testing standards are ultimately truly complied with all over the country, and are actually also being implemented, is something that is ensured by the Personnel Certification Body of DVS, DVS-PersZert.

Specialised groundwork in the training and examination area, with everything to do with the joining of plastics, is done by the Expert Committee 4.3 "Joining of Plastics". The Expert Committee deals with the development of DVS-Guidelines for qualification and examination in the field Joining of Plastics.

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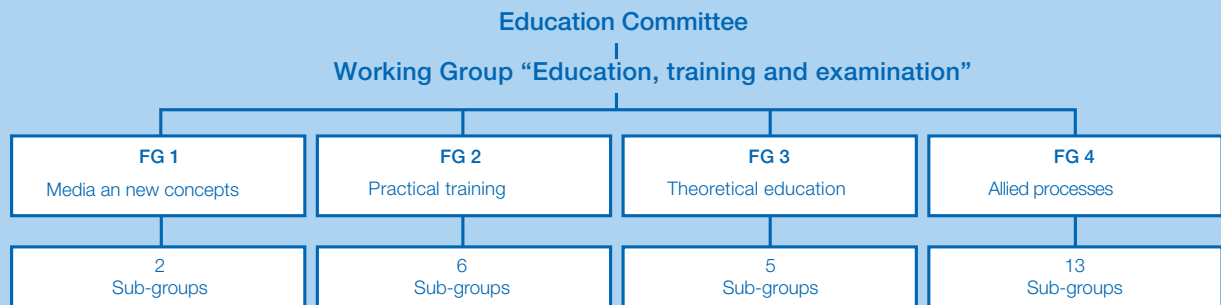
The latest training and further education offers can be found at: [www.bildungskatalog.de](http://www.bildungskatalog.de)

Photo: Fotolia





## Structure of the Education Committee



FG: Expert Group

## Training and career paths in the field of Joining of Plastics

### Plastics welder

The core task of plastics welders is to process so-called semi-finished products, i.e. precast raw material forms like metal sheets, bars, pipes and coils, with the help of special plastic welding techniques. This results in appliances, pipelines, tanks, fittings and other plastic products.

On account of their area of responsibility, plastics welders work primarily in the plastic and in the rubber processing industry, for example with manufacturers of building supplies, boards, sheets or packaging materials made of plastic. In addition, they can also be employed in the plastic pipeline construction industry, with manufacturers of plastic casings, switches or engine housings.

To be able to perform an activity as a plastics welder, training in the plastics and in the rubber technology is usually necessary. Depending on the respective field of application and the requirements, different welder examinations are assumed to have been successfully passed, in addition.

### DVS-Training and advanced training offers for plastics welders

For plastics welders, DVS provides educational paths for hot gas welding, heated tool welding as well as hot gas extrusion welding. The final, standardized exams are based on common understandings with the Association of Technical Safety Standards Inspectorates (VdTÜV). The training to become a specialist for plastics welding allows to assume a supervisory function in later professional life for qualified welding work in this

area. The relevant examination is also carried out according to DVS-Guidelines.

### European Adhesive Bonder

The continuing education offer to become a European Adhesive Bonder is aimed primarily at employees from the assembly or manufacturing industries. European Adhesive Bonders expertly carry out adhesive bonding tasks according to specifications. In addition, they have specialized knowledge of the adhesive bonding technology field and, hence, also know the specific features of these manufacturing methods in comparison to other joining technologies. This reduces the faulty production scrap in an operation as well as the effort required for the post-processing of the adhesive bonds.

### European Adhesive Specialist

In particular in industrial manufacturing is where the European Adhesive Specialists plan the joining of different materials like metal, plastics, glass and ceramics and carry out the adhesive bonding process.

Accordingly, European Adhesive Specialists work mainly with manufacturers of optical and photographic devices or watches or are employed in enterprises that, for example, make electric instrumentation and control devices. Other fields of activity for European Adhesive Specialists will become apparent in establishments dealing with mechanical engineering, the plastics and Indian rubber processing industry and vehicle construction.

In order to work as an European Adhesive Specialist, training and/or advanced training or continuing education is usually necessary in the areas of metalworking, plastics, rubber or chemistry. Work experience or a continuing education in the area of Adhesive Bonding is of advantage.

### European Adhesive Engineer

The continuing education offer to become an European Adhesive Engineer is interesting above all for supervisory staff from the areas of construction, research and development, production planning, quality assurance, applications engineering and sales. The training to become an European Adhesive Engineer unites extensive knowledge from the fields of chemistry, physics and the engineering sciences, so that the participants, once they have passed their exams, can independently supervise all adhesive bonding processes - starting with product development and the selection of suitable adhesives up to the adhesive-friendly construction. Knowledge on production planning, quality assurance and costing is also conveyed in these courses.

### DVS-Training and advanced training offers by DVS for adhesive bonding specialist staff

For specialist staff in Adhesive Bonding, there are three different qualification stages to choose from amongst the training and continuing education offer of DVS. European Adhesive Bonders expertly carry out adhesive bonding tasks. The training and advanced training is recognized throughout Europe and is not subject to any separate approval requirements. European Adhesive Specialists are qualified supervisory staff that supervise the work

of the European Adhesive Bonders during manufacturing and assembly.

Their training, too, is done in accordance with standards that are recognized throughout Europe. „European Adhesive Engineers“ are qualified for all aspects of adhesive bonding, also in a technical and commercial regard. Course requirements are a passed final examination in engineering or natural sciences at a tertiary education institute. The continuing education to become an European Adhesive Engineer is also valid throughout Europe after passing the examination.

A comprehensive set of rules by DVS considers the special requirements for professional staff in the area of Joining of Plastics. Owing to the interdisciplinary cooperation between the Technical Committee, the Education Committee and the AG SP, a globally established and recognized DVS policy set has been created, which constitutes a self-contained system. These documents compiled by DVS are globally recognized and are also available in English.

**i**

DVS-training and advanced training offers on the Joining of Plastics and adhesive bonding are offered in the following DVS educational facilities or DVS-approved educational facilities:

[www.dvs-aft.de/AfT/W/W4/Files/Pruefstellenliste.pdf](http://www.dvs-aft.de/AfT/W/W4/Files/Pruefstellenliste.pdf)

### Excerpt DVS Guidelines of the Expert Committee 4.3 on the training and examination in the field of Joining of Plastics

<b>2212-1</b>	(2006-05)	Qualification testing of plastics welders - Qualification Test Groups I and II
<b>2213</b>	(2010-12)	Specialist for welding of plastics
<b>2221</b>	(2010-12)	Testing of synthetic adhesives - pipe connections made from PVC-U, PVC-C and ABS with dissolving adhesives
<b>2280</b>	(2010-12)	DVS- Basic training course on the processing of semi-finished products made of thermoplastic materials

# Trade media and teaching materials for joining of plastics

## DVS Media GmbH

When it comes to publications and press relating to all aspects of the subject of joining, cutting and coating, DVS Media GmbH is the right place to go. The programme of the publishing house includes German and foreign language trade journals, specialist books, teaching media, technical bulletins and guidelines, videos and software. The products of DVS Media GmbH reflect all fields of activity of the DVS Association and all findings that have been worked out there.

Numerous professional media of DVS Media GmbH devote themselves to the work results that have originated in the areas of research, technology and education in connection with the Joining of Plastics: This includes Specialist books and trade journals, as well as training materials and set of rules, available individually or collected as a paperback.



### How to get DVS Technical Bulletins and DVS Technical Codes

DVS members have free access to all DVS Technical Codes and DVS Technical Bulletins at [www.dvs-regelwerk.de](http://www.dvs-regelwerk.de). Non-DVS members can order the DVS set of rules under [www.dvs-media.info](http://www.dvs-media.info)

Photo: istockphoto



## Publications on joining plastics



### The trade journal "Joining Plastics – Fügen von Kunststoffen"

The trade journal "Joining Plastics – Fügen von Kunststoffen" is published quarterly at DVS Media GmbH as a bilingual title (German / English): It is dedicated in detail to all the issues, topics, products and services for the joining of plastics and plastic products.

Application-oriented specialist articles indicate the newest developments and the state of the art for series welding and for the joining of plastics in pipeline and tank construction and apparatus engineering. Furthermore, the reader learns everything important from the sections entitled companies, quality management and standardisation, research and development as well as safety at work and environmental protection.

ISSN: 1864-3450



### Paperback DVS Technical Bulletins and Technical Codes "Joining of Plastics" - new edition in 2012

The current 15<sup>th</sup> Edition of the paperback DVS Technical Bulletins and DVS Technical Codes "Joining of Plastics" offers on more than 1,000 pages - a collection of all DVS Technical Bulletins and DVS Technical Codes and draft Technical Codes on joining in pipeline and tank construction and apparatus engineering and on series production, in German. The DVS set of rules documented in this book represent the generally accepted codes of practice for the joining of plastics and are mandatory for all work on the subject.

**This book is also available in electronic form as a USB stick.**

15<sup>th</sup> Edition 2014 (available from January 2014)

1092 pages, Hardcover

ISBN: 978-3-87155-233-5



### Paperback "Technical Codes on Plastic Joining Technologies"

The English counterpart to the DVS Paperback "Kunststofffügen" was published in December 2012 as a new edition. It contains the complete collection of all DVS Technical Bulletins and DVS Technical Codes in English, which deal with joining of plastics in pipeline and tank construction and apparatus engineering as well as in series production.

**This book is also available in electronic form as a USB stick.**

3<sup>rd</sup> Edition 2013

925 pages, Hardcover

ISBN: 978-3-87155-226-7



### Professional car body repair of motor vehicles according to Guideline DVS 1110-3

This teaching document accompanies the theoretical lessons of the course “Professional car body repair of motor vehicles according to DVS 1110-3 Plastics Repair”. The course content is divided into chapters according to focus, among others Fundamentals of Plastics, plastics used in automotive engineering, manufacturing and application of plastics, repair techniques.

Participant document, A4 bound booklet, 60 pages  
Item no.10905



### Course document “Preparing for the plastics welder qualification test according to DVS 2212-1 and DVS 2212-3”

This course document is intended for the training of participants in order to prepare them for the plastics welder qualification test in accordance with Guideline DVS 2212-1 and DVS 2212-3. This publication supports the theoretical lessons and includes the full curriculum, which is necessary for understanding the practical work.

**An English version of this teaching document is available.**

Participant document German, A4 bound booklet, 114 pages  
Item no. 10730

Participant document English, A4 bound booklet, 114 pages  
Item no.10731



### Course document “Plastics Laminating and adhesive bonding” in accordance with Guideline DVS 2290

In the preparatory course for the examination according to Guideline DVS 2290 “Qualification testing of plastics laminators and adhesive bonders”, the publication focuses on the processing of fibre reinforced plastics that are applied, for example, in apparatus and pipeline construction, in boatbuilding as well as in rotor blade construction. Key topics are:

- Basics of plastic materials
- reactive resins
- reinforcing agents
- fillers, paints, release agents
- manual laminating procedures
- mechanical processes

Participant document, A4 bound booklet, 104 pages  
Item no. 10732

# Your contact persons in the area of “Joining of Plastics”

## Your contact person for Research | Technology | Education



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### DVS – German Welding Society

Aachener Str. 172, D-40223 Düsseldorf  
[www.dvs-ev.de](http://www.dvs-ev.de)

### Technical Committee

[www.dvs-aft.de](http://www.dvs-aft.de)

### AG W 4 “Joining of Plastics”

[www.dvs-aft.de/AfT/W/W4](http://www.dvs-aft.de/AfT/W/W4)

#### Chairman:

Dipl.-Ing. Thomas Frank, Frank GmbH

#### Vice-Chairman:

Dipl.-Ing. Leo Wolters, IKV Aachen



### DVS PersZert

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[www.dvs-afb.de](http://www.dvs-afb.de)

### Education Committee

[www.dvs-afb.de](http://www.dvs-afb.de)

### FG 4.3 “Joining of Plastics”

#### Chairman:

Dipl.-Ing. Leo Wolters, IKV Aachen

#### Vize-Chairman:

Dr.-Ing. Georg Crolla, BASF SE



### Research Association on Welding and Allied Processes e. V. of DVS

Aachener Str. 172, D-40223 Düsseldorf  
[www.dvs-forschung.de](http://www.dvs-forschung.de)

### Expert Committee 11 “Joining of Plastics”

[www.dvs-forschung.de/fa11](http://www.dvs-forschung.de/fa11)

#### Chairman:

Dr.-Ing. Marco Wacker, Oechsler AG

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## Your contact person for publications on joining of plastics



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DVS maintains a tight network made up of **research, technology** and **education** as a core element of the technical-scientific cooperative work

## Joining of Plastics is your subject?

DVS is at your service.  
Your participation in our committees is worthwhile!

- Because you will learn about important changes in the rules and regulations work first.
- Because you will actively participate in shaping technology fields.
- Because you can experience first-hand technical knowledge transfer.
- Because you can identify trends early on.
- Because you can benefit from important national and international contacts.

Become a part of our network of over **3,000 companies** and **16,000 professionals** who are associated with the joining technology.

**Please contact us!**

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