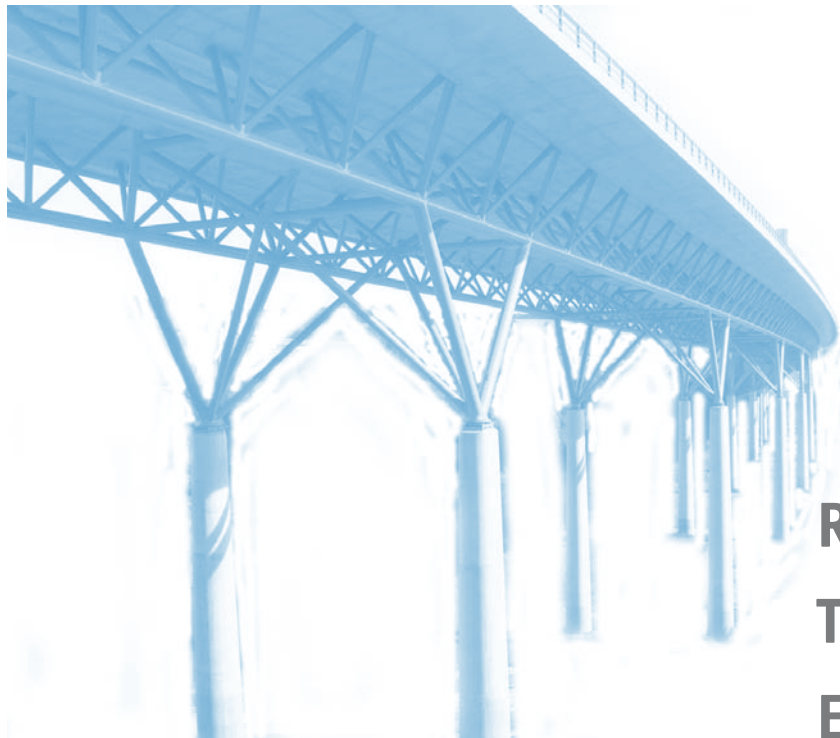


# DVS

## Competitive solutions for joining technology

DVS-up to date: “Welding in Construction  
Settings”



Research...  
Technology...  
Education...

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## Competitive Solutions in Joining Technology

### Welding in Construction

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

Technical Committee 1

“Metallurgies and Materials Engineering”

[www.dvs-ev.de/fv/fa01](http://www.dvs-ev.de/fv/fa01)

Technical Committee 3 “Arc Welding”

[www.dvs-ev.de/fv/fa03](http://www.dvs-ev.de/fv/fa03)

Technical Committee 9 “Engineering (calculation) and Design”

[www.dvs-ev.de/fv/fa09](http://www.dvs-ev.de/fv/fa09)

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##### Technology Committee

Working group AG A5 “Welding in Construction”

[www.dvs-aft.de/AFT/A/A5](http://www.dvs-aft.de/AFT/A/A5)

Coordination committee of approved authorities for metal structures in building inspection

[www.eignungsnachweis.de](http://www.eignungsnachweis.de)

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Expert panel 2.2 “Welder”

Expert panel 3.1 “Welding Supervisors”

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

##### DVS®-Courses

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

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

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### Image Sources

Universität Stuttgart,

Institut für Konstruktion und Entwurf,

Stuttgart

Ingenieurbüro Grassl, Berlin

Plauen Stahl Technologie GmbH

### „Welding in Construction“

With the foundation of the European Community and the resulting creation of a European home market, a comprehensive process was put into operation regarding the adjustment of legal and administration requirements for the EC member states. With the issue of the Construction Products Directive (CPD) and its implementation through the building products act in German, construction became another area to adapt originally German stipulations to the European market.

The working group AG A5 „welding in construction“ is involved in the creation and harmonisation of standards and specification of relevance to building authorities. Jointly with the construction committee of the DIN and the coordination committee “Metal construction” of the DVS, a standard adjustment is currently underway, from the “tried and tested” execution standards DIN 18800-7 “Steel Structures” and DIN V 4113-3 “Aluminium constructions under predominantly

static loading” to the European standard DIN EN 1090-1 “Execution of steel structures and aluminium structures - Part 1: Conformity proof procedure for structural components”.

The AG A5 bundles the interests of those involved in construction: Builders, planners (architects and expert engineers), manufacturers, user, building inspectors and building permit authorities. The aim here is to prepare manufacturers, for increasing their competitiveness, for future changes on the metal construction market when it comes to new or amended measuring and execution regulations. Notified authorities need to be created, for assistance with the implementation of the required conformity evaluation measures as part of the CE certification of construction products, so that the providers can then immediately hit the market with their Europe-conformed products.



Dietzenbach, March 2009

**Dipl.-Ing. Peter Ordu**

Dietzenbach

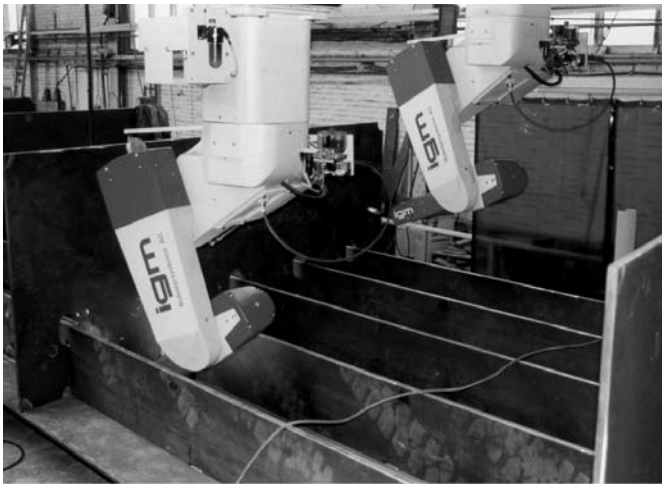
Chairman AG A5 “Welding in construction”

## Overview

### „Construction – an important Industry in Germany“

Construction is an important industry in Germany and, moreover, it is a highly “joining-happy” field. For this reason, construction is one of the special focal areas of the DVS.

The building permit authorities deal with this by calling for special constructor qualifications in this legally controlled area. Such qualifications are compulsory for the design of



*Fully automated fillet seam welding in PB position*



*Ultra sound inspection of weld seams*

Welding technology is the joining procedure of preference for construction, e.g. in steel and metal design, especially when processing thick-walled metal components. Welding technology is counted among the so-called “specialist processes”. For instance, process results cannot be clearly verified in the aftermath through inspection, something that requires special quality control measures during operation.

structural steelwork after DIN 18800-7 (in future: DIN EN 1090fw) and aluminium structures after DIN V 4113-3. Reinforced steel welding works are also legally controlled and also require constructor qualifications after DIN 4099 (in future: DIN EN ISO 17660).



*Pipe geometry of the road bridge at Sankt Kilian*



*Truss weld seam preparation*

### Firms with Constructor Certification

The DVS holds a list of firms with constructor certification, accessible at [www.eignungsnachweis.de](http://www.eignungsnachweis.de)

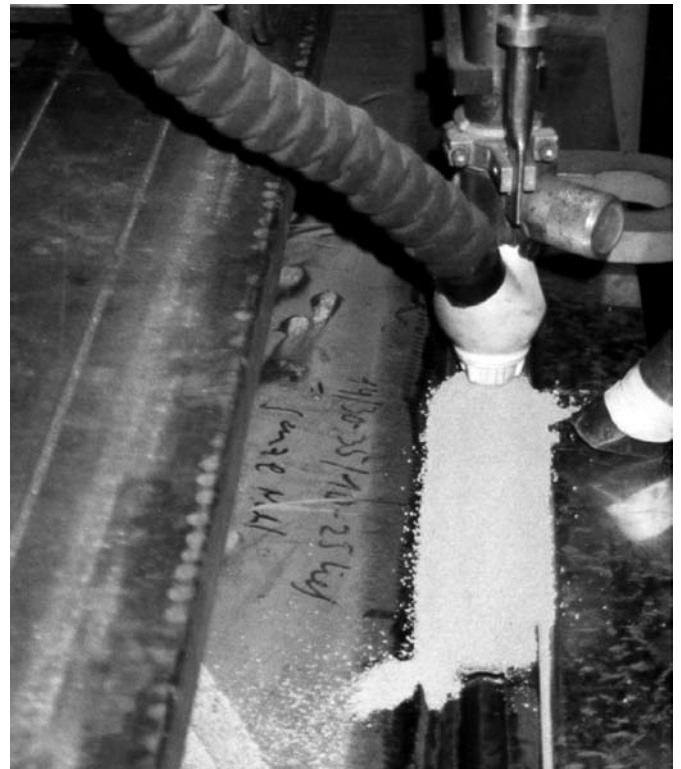
the addition of several thousand small and medium size enterprises and only serve to emphasise the significance of the construction industry for the German economy. ◀



*Undercarriage for a road bridge in composite design  
(Tray cross-section)*

The list contains over 8500 firms, both national and abroad. Hence, the data bank provides a comprehensive overview of construction manufacturers and may be used by them for marketing purposes also.

Once firms of the A category, after DIN 18800-7, will be included - which do not require a constructor qualification according to building permit stipulations – this will result in



*SAW welding in flat position*



*Thick-walled steel component with cross joint*

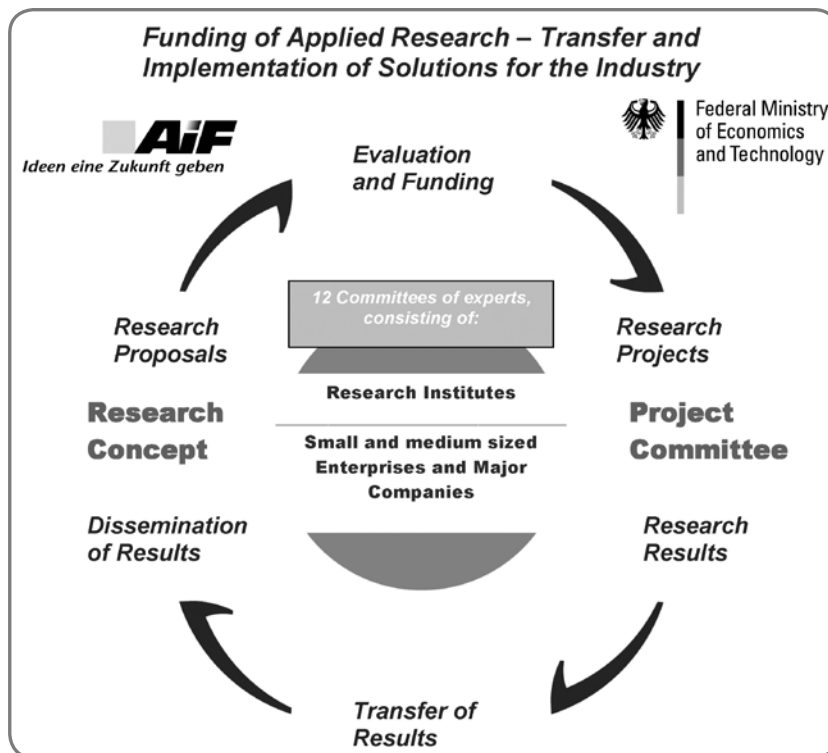


*Boiler frame structure for a power station block*

## The Research Association on Welding and Allied Processes of DVS

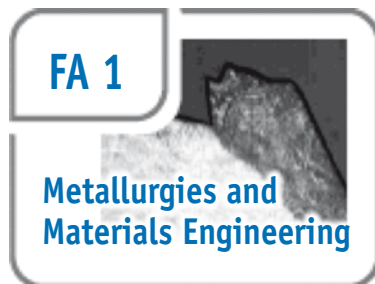
The core activity of the Research Association on Welding and Allied Processes of DVS is the cooperative industrial research (IGF) in which companies, corporate bodies and research institutes from the various fields of joining technology actively take part. The Research Association is divided into 13 expert committees (FAs) with specific subject-related main focal points. The companies agree upon the need for cooperative research and define main focal points for pioneering research which the research institutes involved convert into concrete research projects without delay. The cooperative

industrial research achieves optimum closeness to the application and permits the direct utilisation and implementation of the results. The collaboration of industry means that know-how is transferred at an early stage and that the research work and the utilisation of the results are parallelised. IGF research projects may be promoted from funds of the Federal Ministry of Economic Affairs and Technology (BMWi) via the "Otto von Guericke" Federation of Industrial Research Associations (AiF). ◀



Further information at: [www.dvs-ev.de/fv](http://www.dvs-ev.de/fv)

## Expert Committee 1 „Metallurgies and Materials Engineering“



**Chairman:**

Dipl.-Ing. F. Palm, EADS, München

**Vice-Chairman:**

Dr.-Ing. H. Heuser,  
Böhler Schweißtechnik, Hamm

**Secretary:**

M. Kubanek

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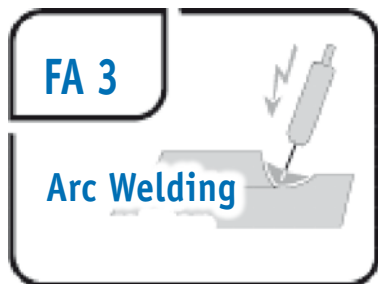
**Website:** [www.dvs-ev.de/fv/FA01](http://www.dvs-ev.de/fv/FA01)

Under investigation are localised materials changes, to basis materials, additive and auxiliary materials, resulting from joining, coating and cutting. These can have a significant impact on process results. This includes interpretation of thermal, metallurgical and mechanical influences, immediately prior, during and after execution of the process. The aim is to arrive at definite conclusions about the materials influenced during the welding technological production process and, hence, their effect on the products.

**Fields of Research:**

- Deeper recognition of metallurgical behaviour and technological characteristics of materials during welding engineering joining-decoupling-and coating procedures
- Questions about the joinability of newly developed or modified materials
- Novel additive materials matched to requirements
- Modifications and amendments to joining procedures from a metallurgical and materials engineering point of view
- Impact of thermal, mechanical or thermo-mechanical measures before, during and after welding and/or coating
- Questions about handling special short-term metallurgical procedures, long-term materials changes during use, mechanical material behaviour questions and other effects during welding (e. g. residual stress)
- Evaluation and use of prediction instruments on the basis of „Finite Element Methods“ (FEM - Modelling) for prediction of certain effects and influences on weld result
- Use of statistic experimental methods

### Expert Committee 3 „Arc welding“

**Chairman:**

Dr.-Ing. Wolfgang Scheller  
Salzgitter Mannesmann Forschung  
GmbH, Duisburg

**Vice-Chairman:**

Dr.-Ing. Sven-Frithjof Goecke  
EWM HIGHTEC WELDING GmbH,  
Mündersbach

**Secretary:**

Dipl.-Ing. Wolfgang Queren-Lieth  
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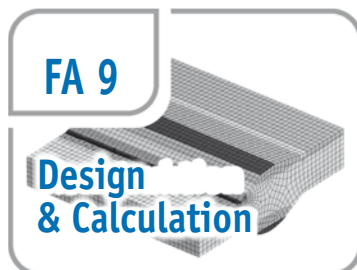
**Website:** [www.dvs-ev.de/fv/FA03](http://www.dvs-ev.de/fv/FA03)

The general goal behind the research works is the further advancement of efficiency and profitability of arc welding processes for joining in industrial settings. These research undertakings are to take into account such aspects as boundary and environment conditions like pre-treatment and follow-up treatment, tolerance levels, warpage, emissions, impurities and typical practice quality criteria. Economical considerations and estimations are part of the research scope.

**Fields of Research:**

- Arc joining processes for performance-oriented materials and combination materials
- Development of process varieties and hybrid processes that are matched to the joining task
- Instrument- and installation engineering, sensor technology, quality control
- Modelling, simulation, visualisation and calculation of arc processes

## Expert Committee 9 “Design and Calculation”



### Chairman:

Dr.-Ing. M. Kaßner  
Alstom LHB GmbH, Salzgitter

### Vice-Chairman:

Dr.-Ing. G. Zhang  
Volkswagen AG, Wolfsburg

### Secretary:

Marcus Kubanek  
Phone: 0211 - 1591-120 | Fax: -200  
Email: marcus.kubanek@dvs-hg.de

**Website:** [www.dvs-ev.de/fv/fa09](http://www.dvs-ev.de/fv/fa09)

The safe and efficient use of joined components and the products manufactured with them requires optimum constructive design and sufficient strength. To guarantee this, there is a need for design rules for construction on one hand and, on the other, interpretation criteria for the dimensioning and/or strength reliability of joined components. Stress and influencing during operation are to be sufficiently considered in this. With the research undertakings that were initiated and are now being supervised, fundamentals and possibilities to this end are to be further developed. This also includes suggestions for policies and foundations for future software developments.

### The following research areas are within the scope:

- The constructive development of joined components, meaning creation of or expansion on construction approaches and also determining and/or deducing of design fundamentals and rules
- Interpretation of joined components, meaning designing calculation procedures for stress loads and also the advancement of concepts for proving yield strength
- Simulation of joining processes for determining mechanical effects, including process-caused deformations, residual stress and its effect on load levels and mechanical characteristics and/or material parameters of the joining zone for strength level interpretation.

## Research Projects (Selection)

### Current Research Projects

#### Investigation into the avoidance of hydrogen embrittlement during arc stud welding of steel materials

DVS-Nr.: 01.061 / IGF-Nr.: 15.564 N  
Start: 01.03.2008 - End: 28.02.2010

#### Institutes involved:

Dipl.-Eng. F. Zech  
SLV Munich, Section of the GSI mbH

#### Development of a weld head guiding system for automated MSG welding of steel and aluminium alloys

DVS-Nr.: 03.076 / IGF-Nr.: 15.296 N  
Start: 01.08.2007 - End: 31.07.2009

#### Institutes involved:

Prof. Dr.-Eng. K. Dilger  
Braunschweig University of Applied Sciences, Institute of Welding-and Joining Technology

Prof. Dr.-Eng. U. Reisgen  
RWTH Aachen,  
Institute of Welding-and Joining Technology

# Research

## Current Research Projects

### **Life cycle evaluation of weld joints with material-mechanical and static models while taking into special consideration the aspect of residual stress**

DVS-Nr.: 09.049 / IGF-Nr.: 15.913 N

**Start:** 01.12.2008 - **End:** 30.11.2010

#### **Institutes involved:**

Prof. Dr.-Ing. H. Hanselka  
Darmstadt University of Applied Sciences, Institute of System Reliability and Machine Acoustics

Prof. Dr. rer nat. P. Gumbsch  
Fraunhofer Institute for Materials Mechanics IWM

## Completed Research Projects

### **Investigation into minimising crack susceptibility during SAW welding of high-strength fine-grained steels of StE 890 and StE 960 quality**

DVS-Nr.: 01.014 / IGF-Nr.: 11.376 N

#### **Institutes involved:**

Prof. Dr.-Eng. U. Reisgen  
RWTH Aachen, Institute of Welding-and Joining Technology

### **Investigations into welding of cold-formed areas of fine-grained steels with yield strengths of at least 355 N/mm<sup>2</sup>**

DVS-Nr.: 01.034 / IGF-Nr.: 12.674 N

#### **Institutes involved:**

Prof. Dr.-Eng. K. Dilger  
Braunschweig University of Applied Sciences, Institute of Welding-and Joining Technology

### **Crack reduction when welding Al alloys of medium and high strength**

DVS-Nr.: 01.047 / IGF-Nr.: 13.983 B

#### **Institutes involved:**

Prof. Dr.-Eng. I. Martinek  
Otto-von-Guericke University at Magdeburg, Faculty of Mechanical Engineering, Institute of Joining-and Beam Technology

### **Improvement of efficiency when welding high alloy materials**

DVS-Nr.: 01.236 / IGF-Nr.: 40.000 D

#### **Institutes involved:**

Prof. Dr.-Eng. I. Martinek  
Otto-von-Guericke University at Magdeburg, Faculty of Mechanical Engineering, Institute of Joining-and Beam Technology

### **Software for heat control during welding of fine-grained steels for avoidance of hydrogen-influenced, delayed cold crack formation**

DVS-Nr.: 01.241 / IGF-Nr.: 33.200 D

#### **Institutes involved:**

Dipl.-Phys J. Hoffmann  
SLV Mecklenburg-Vorpommern GmbH

### **Expansion of the cooling time $t_{8/5}$ concept after SEW 088 to welding of non-alloy and low-alloy steels of different wall thickness**

DVS-Nr.: 01.253 / IGF-Nr.: 93.180 N

#### **Institutes involved:**

Dr.-Eng. S. Keitel  
SLV Duisburg, Section of the GSI mbH

### **Investigation of distribution ratio of harmful and harmless hydrogen in high-strength deposits of multi-layer welding seams and determination of most favourable heat treatment for avoidance of cold cracking**

DVS-Nr.: 01.256 / IGF-Nr.: 96.290 N

#### **Institutes involved:**

Prof. Dr.-Eng. U. Reisgen  
RWTH Aachen,  
Institute of Welding-and Joining Technology

## Technical Committee (Aft) of DVS

The technical-scientific cooperative work of DVS is predominantly determined by the activities of its Technical Committee (Aft) with its working bodies oriented to specific subjects. Specialists from the economic and scientific fields, from authorities and from other areas collaborate in them. The Technical Committee promotes the active exchange of experience amongst experts, describes the state of the art by elaborating and contributing to the preparation of a set

of technical rules (DVS technical bulletins, technical codes, guidelines and standards) and is actively involved in the technical development of welding and the allied processes such as brazing/soldering, thermal spraying, adhesive bonding, mechanical joining and plastics joining. Joint committees with the Standards Committee for Welding Technology of DIN also exist for this purpose. ◀

**Further information at: [www.dvs-aft.de](http://www.dvs-aft.de)**

### Working Group A 5 “Welding in Construction”

#### Chairman:

Dipl.-Ing. P. Ordu  
Dietzenbach

#### Vice-Chairman:

Prof. Dr.-Ing. G. Kuscher  
SLV Hannover NL der GSI mbH

#### Secretary:

Dipl.-Ing. M. Lehmann  
Phone: 0211 / 1591-203 Fax: -200  
Email: [martin.lehmann@dvs-hg.de](mailto:martin.lehmann@dvs-hg.de)

**Website:** [www.dvs-aft.de/Aft/A/A5](http://www.dvs-aft.de/Aft/A/A5)

The DVS working group titled “Welding in Construction” entails more than 35 experts from the areas of industry, trade, research and technology and from approved authorities, associations and official bodies. The working group is involved with the relevant standards together with the standards committee “construction” at the DIN – Deutsches Institut für Normung (German Institute for Standardisation). The WG A5 is also closely connected to the “coordination committee of approved authorities for metal structures in building supervision” and thus helps in specifying the rules for constructor certification. Further, information material is made available in form of DVS bulletins and guidelines, making it easier for constructors to apply the directives in practice. ◀

## Essential work results (selection)

### DVS Bulletins and Guidelines

**DVS 1702** Procedure qualification for structural engineering  
Published: Re-issue in preparation

**DVS 1704** Requirements and procedures for obtaining constructor’s qualification for welding of steel structures after DIN 18800-7  
Published: Mai 2004

**DVS 1705** Usable steel and cast materials for welded metal structures  
Published: September 2007

**DVS 1707** Requirements and procedures for obtaining constructor’s qualification for welding of aluminium constructions under predominantly static loading after DIN V 4113-3  
Published: January 2007

**DVS 1708** Requirements and procedures for obtaining constructor’s qualification for welding of reinforced steel after DIN EN ISO 17660-1 or after DIN EN ISO 17660-2  
Published: December 2008

**DVS 1709** Overhaul and reinforcement of orthotropic roadway slabs  
Published: May 2008 ◀

## Standards

### **DIN 18800-7**

Steel Buildings– Part 7: Execution and Constructor Qualification

### **DIN V 4113-3**

Aluminium constructions under predominantly static loading- Part 3: Execution and qualification of constructors

### **DIN 4099**

Welding of reinforced steel

### **DIN EN ISO 17660**

Welding - Welding of reinforced steel – Part 1: Load-bearing welded joints

### **DIN EN 1090ff**

Execution of steel structures and aluminium structures

### **DIN EN 287-1**

Qualification test for welders – Fusion welding - Part 1: Steels

### **DIN EN ISO 9606-2**

Qualification test for welders - Fusion welding - Part 2: Aluminium and aluminium alloys

### **DIN EN 1418**

Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials

### **DIN EN ISO 14731**

Welding coordination – Tasks and responsibilities

### **DIN EN ISO 3834**

Quality requirements for fusion welding of metallic materials

### **DIN EN ISO 15609**

Specification and qualification of welding procedures for metallic materials

### **DIN EN ISO 15610**

Specification and qualification of welding procedures for metallic materials -Qualification based on tested welding consumables

### **DIN EN ISO 15611**

Specification and qualification of welding procedures for metallic materials - Qualification based on previous welding experience

### **DIN EN ISO 15612**

Specification and qualification of welding procedures for metallic materials - Qualification by adoption of a standard welding procedure

### **DIN EN ISO 15613**

Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test

### **DIN EN ISO 15614**

Specification and qualification of welding procedures for metallic materials - Welding procedure test

### **DIN EN 473**

Non-destructive testing - Qualification and certification of NDT personnel - General principles

### Specialist Books (In German only)

#### Specialist Book Series Welding Techniques Volume 94

C. Ahrens, R. Zwätz

Schweißen im bauaufsichtlichen Bereich - Erläuterungen mit Berechnungsbeispielen

#### Specialist Book Series Welding Techniques Volume 67

F.W. Strassburg und H. Wehner

Schweißen nichtrostender Stähle

#### Specialist Book Series Welding Techniques Volume 12

H.G. Hofmann, J.W. Mortell, P. Sahmel, H.J. Veit

Grundlagen der Gestaltung geschweißter Stahlkonstruktionen

#### Specialist Book Series Welding Techniques Volume 149

T. Behnisch, H.J. Bossenmayer, J. Neudel, R. Neuhoff,

J. Schuster

Geschweißte Stahlkonstruktionen Bemessung, Konstruktion und Herstellung

The specified publications can be purchased via DVS Media GmbH:

DVS Media GmbH · Aachener Straße 172 · D-40223 Düsseldorf · Tel.: 0211 / 1591-162 · [media@dvs-hg.de](mailto:media@dvs-hg.de) · [www.dvs-media.info](http://www.dvs-media.info)

### DVS information brochures

As a new service, DVS is offering its members and all the interested people bundled technical information about various subject areas in joining technology with the portfolio of services from DVS. The information brochures prepared in two languages (German/English) include not only detailed explanations about the respective main focal points including a description of the development potential but also valuable explanations about the activities and available work results of DVS in the fields of research, technology and education.

The brochures which have been published until now are available to you for downloading.

[www.dvs-ev.de/dvs-aktuell-ftb](http://www.dvs-ev.de/dvs-aktuell-ftb)

Printed copies can be requested by e-mail ([aft@dvs-hg.de](mailto:aft@dvs-hg.de)).

## Education

### Education Committee (AfB)

#### Personnel qualification in DVS

The Education Committee (AfB) of DVS elaborates and structures the range of training and further education offered by DVS in the fields of joining, cutting and coating. It follows tendencies and trends as well as concrete developments in the education sector and evaluates their effects on society in general and on the areas of joining, cutting and coating in particular. AfB is oriented to the latest state of the art

and to the needs of the German economy. Due to the close network of DVS, the structures of the society are used optimally, the latest findings are exchanged across bodies and there is feedback about the current needs. DVS thus offers the expert world of joining technology, members and interested people a comprehensive range of competitive solutions for joining technology. ◀

**Further information at: [www.dvs-afb.de](http://www.dvs-afb.de)**

## Practice-Oriented Training



For the relevant „legally controlled areas“, the use of certified welders is compulsory. The training and certification process for welders consists of a theoretical and a practical part to ensure sufficient practical skills for the respective welding procedure. Qualification requirements and course profiles have been internationally adjusted and can be found in the guideline titled DVS®/EWF/IIW 1111 “International

Welder (IW) General notes, requirements, topical overview“. The expert panels of the working group “Training and Certification“ (AGSP) of the DVS convey these qualification requirements through teaching materials.

#### Expert Panel 1.1 “Media“:

##### Chairman:

Dipl.-Ing. T. Ross  
HWK Südwestfalen, Arnsberg

##### Secretary:

Dipl.-Ing. S. Leising  
Phone: 0211 / 1591-277 Fax: -200  
Email: [susanne.leising@dvs-hg.de](mailto:susanne.leising@dvs-hg.de)

#### Expert Panel 2.2 “Welder“:

##### Chairman:

Dipl.-Ing. A. Börnert  
SLV Halle GmbH

##### Secretary:

Dipl.-Ing. Christoph Esser  
Phone: 0211 / 1591-178 Fax: -200  
Email: [christoph.esser@dvs-hg.de](mailto:christoph.esser@dvs-hg.de) ◀

### DVS®-Courses

Market globalisation calls for training concepts that are adjusted both internationally and Europe-wide. Increasingly, national regulations are being replaced by European and international ones. In order to contribute to the harmonisation process, the DVS became involved early on in several international institutions of relevance to joining technology: EWF – European, Federation for Welding, Joining and Cutting and the IIW – International Institute of Welding.

Well-trained expert staff can guarantee product quality of a given construction via correct selection of materials and processes. National and international standards are directives stipulate tasks and responsibilities for welders and welding supervisors as well as requirements for their credentials.

#### DVS®-Courses

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

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



### Theoretical Training

Through using qualified supervisory staff (e. g. in welding technology after DIN EN ISO 14731), the manufacturer of welded products can significantly improve product quality. The supervisory staff is responsible for the coordination of the executing personnel. Supervisory staff in welding technology can be classified into the following groups, depending on the complexity and type of manufacture, whereby the EWF and IIW have designed recommendations for minimum requirements for welding supervisors.

#### **Welding Supervisor: Quality Guarantee in Welding Technology**

From design to manufacture, welding supervisors with in-depth welding knowledge are required in order to handle the wide scope of tasks associated with the construction or manufacture of bridges, pressure vessels, boilers, high structures in steel, water-rail-and road vehicles, aerospace applications, as well as for mechanical engineering or plant and pipe line construction. Depending on requirements, legal stipulation distinguish between three different qualification levels according to steel construction (DIN 18800-7 now DIN EN 1090ff), aluminium construction (DIN V 4113-3 now DIN EN 1090ff), railways vehicle construction (DIN EN 15085) etc.

#### **Welding supervision with in-depth expert knowledge: International Welding Engineer (IWE)**

Unlimited authority and responsibility

#### **Welding supervision with specific technical knowledge: International Welding Technician (IWT)**

Authority and responsibility for select or restricted areas

#### **Welding supervision with basic technical knowledge International Welding Expert (IWS)**

Authority and responsibility restricted to simple design

The educational measures of the DVS are implemented in courses after DVS®, DVS®/EWF or DVS/EWF/IIW/ guidelines – in DVS authorized educational institutions.

#### **Expert Panel 3.1 “Welding Supervisors”**

##### **Chairman:**

Dipl.-Eng. Ch. Ahrens

SLV Duisburg, NL der GSI mbH

##### **Secretary:**

Dipl.-Eng. M. Metzger

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