

Principles and development of quality assurance in welding of rail structures

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Foreword

The present document should serve to make everybody obliged to apply the series of standards EN 15085 (e.g. national safety authority, manufacturer certification bodies and rail vehicle industry) conscious of uniformly applying the standard EN 15085. In doing so, handling throughout Europe as unique as possible is to be demonstrated on the basis of the proven national experience obtained.

1 History

From the beginning of transportation by rail, quality assurance in welding in the field of railways in Germany has been performed by Deutsche Reichsbahn (DR), Deutsche Bundesbahn (DB) up to Deutsche Bahn AG (DB AG) of today. The importance of welding stems from the structure of the product and the stringent demands resulting from the high transportation loads and speeds.

Besides welding on rail vehicles, quality assurance also includes the railway bridges, the welding of superstructures as well as the repair welding in these fields. The experience in the application obtained from this is related to a wide range of materials, stringent structural demands as well as a comprehensive range of processes. Welding of railways and the quality assurance connected with it has therefore been a point of orientation for other sectors of industry too.

Knowledge in welding achieved by individual experience, operational development and research has been laid down in a comprehensive national guideline which was based on work groups and standardisation boards who today put their knowledge into European guidelines nationwide. These guidelines have been supplemented by national regulations and technical bulletins of DVS - Deutscher Verband für Schweißen und verwandte Verfahren (German Welding Society) with the help of which the user can obtain support with the interpretation of them. This is even more important since, besides the technical interpretation, the interpretation in relation to different languages must be considered too.

Table 1: Previous regulations for the assurance of the quality of welds in rail vehicle construction and repair

Set of regulations	Remark
DV 952	Regulations of the DR state railways and, after 1945, DB
DS 952, later: DS 951 01 and DS 952 02	Regulations of the DB state railways and, as from 1994, of DB AG
DIN 6700	National liberalised system
EN 15085	European liberalised system

2 History of quality assurance „Welding in rail vehicle construction“

a.) *Legal rules on quality assurance*

A distinction is principally made between two systems of quality assurance when using technical products manufactured by welding. In railway traffic, there is a *legally regulated field*, the same as we have in building, plant engineering and aviation. It has been regulated by the legislator which requirements have to be fulfilled in order to use welding processes according to the state of the art in such a way that neither the public nor individuals are subject to risks. In the execution of them, the legislator uses competent bodies such as the German Railway Authority, the German Institute for Building Technology or the General Federal Aviation Administration who themselves define obligatory procedures on the basis of a state of the art assured by the regulations.

Legally regulated systems describe minimum requirements of quality assurance which each welding shop has to prove to a certification body recognised by the federal authorities.

On the other hand, welding on passenger vehicles, for example, is not *legally regulated*, is exclusively certified on the basis of manufacturer demands and is embedded in the system of product liability. These standards, however, are based on national and international standards as a recognised state of the art. For verifying the quality requirements, the manufacturer of a product makes use of internal and external certification processes.

Independent of the fact whether the system is legally regulated or not, the manufacturer or operator of a welded product is interested in assuring during the production that the requirements determined by the designer are securely fulfilled.

b.) *Principles of quality assurance with Deutsche Bundesbahn*

Together with the basic social conditions, the demands on organisation and quality assurance have changed too such as those on the DB-owned and DR-owned institutes dealing with the quality of the production of welded products.

Due to its status as a state-owned company, DB directly applied the state requirements on safety on railways, organised the establishment of regulations expressing the state of the art and certified welding shops entrusted with welding on rail vehicles.

This position was changed in 1994 with the political decision to liberalise the market in railway traffic in Germany and the privatisation of DB connected with it.

c.) *Principles of quality assurance after the privatisation of Deutsche Bundesbahn*

The liberalisation of railway traffic has caused operators other than DB AG to use the federally owned railways. The system of quality assurance and thus the requirements on welding had to be oriented in such a way that the same rules are applicable to all operators of rail vehicles.

One of the tasks of the newly created railway authority (EBA) was to organise the liberalisation process. The German Railway Authority is authorised by the General Law on Railways (AEG) as well as the Railway Building and Working Rules (EBO).

For welding engineering, this has meant the introduction of the national standard DIN 6700 as acknowledged rules of technology and the nomination of certification bodies by the German Railway Authority. The certification bodies perform the inspection and monitoring of the weld shops and the performance of welding in the production and repair of rail vehicles for their compliance with DIN 6700-2. With the successful fulfilment of the qualification process, this will lead to issuing a certificate on welding according to DIN 6700-2. Based on a cost-efficient administration, the German Railway Authority itself has limited its own capacities to the expert competence of verifying

the certification bodies as well as decision competence in matters of interpretation of regulations.

The evaluation of the quality of the welding work executed resides with the bodies contracted which can be both, the operator itself or a certification body.

d.) Coordination board (KoA) „Railway Vehicles“

In particular for the interpretation of regulations as well as for the implementation of the same standards when issuing certificates on welding, the coordination board „Railway Vehicles“ was founded on February 29, 1996 on the initiative of EBA with DVS - Deutscher Verband für Schweißen und verwandte Verfahren. Its basis for action has been described and maintained in the rules of procedure which came into force on January 30, 1997 and were extended on November 18, 1997.

The following essential tasks are performed by the coordination board today:

1. Consulting of the German Railway Authority concerning the application of the regulations. To this end, KoA continuously develops coordination board regulations where the qualification process and the interpretation of the regulations are definitely laid down in coordination with the German Railway Authority.
2. Organisation of the exchange of experience (Erfa) of the certification bodies – The aim is that about 60 certifiers of the certification bodies in Germany conduct the interpretation of the regulations according to the same level.
3. Organisation of training for the certifiers, in particular when new regulations have come up.
4. Establishment and definition of the requirements on an internet register – All certificates issued are incorporated into the internet register. Thus, the certification bodies are enabled to investigate cross-information. It also serves the welding shops to represent their own performance within the scope of validity and to make them easy to find by customers. The internet register also includes additional information about the German Railway Authority, the coordination board and, since the end of 2007, the welding consumables certified by DB AG.
5. Safeguarding of requirements on certification by the bodies in compliance with the German Railway Authority.
6. Intermediary function in the case of different interpretation of regulations between the certification body and the welding shop as well as between the certification bodies themselves.
7. Safeguarding of a sufficient number of available certification bodies in order to take into account the ideas of liberalisation.

In cooperation with the coordination board, the certification bodies are obliged to fulfil the requirements of the German Railway Authority. A special challenge to the coordination board has been the introduction and establishment of DIN 6700.

e.) Composition and working method of the coordination board

In order to assure the execution of the comprehensive tasks, the coordination board is composed of representatives of the railway industry (manufacturers and operators), the German Railway Authority and the certification bodies (now: manufacturer certification bodies). The different aims of interest assure a balanced, high-quality system of self-checking while the German Railway Authority focuses on the assurance of public safety in railway traffic.

Besides matters of public safety, the manufacturers of rail vehicles as well as the operators must consider matters of economic efficiency too. Hence, the motto is valid: „As good as necessary“. On

the one hand, the certification bodies are in between them and, on the other hand, they compete corresponding to the rules of a liberalised market. The contradictions inevitably arising are compensated for by a high measure of transparency within the system. In this respect, a decisive contribution is made not only by the work of the coordination board but also by the internet register.

f.) The series of standards DIN 6700

DIN 6700 with its six parts satisfied the national requirements when it was introduced and was a suitable scope of the liberalisation of the market conditions in railway traffic in the field of welding. It was introduced in 1997 after having been considerably prepared by the national rail vehicle industry, thus replacing the regulations of DB AG valid up to then. Particularly DIN 6700-2 describes the requirements on welding shops for being issued a certificate for welding.

In order to facilitate the user applying the standard, a guideline of the coordination board was published first and the technical code DVS 1619 later.

The complex correlations of the six parts of the standard to each other, the technical code DVS 1619 and the additional rules of interpretation of the coordination board were completed by training for the acknowledged auditors of the certification bodies and for the welding coordinators of the welding shops. Besides the standard, the necessary relation to practice could be represented by current case studies.

After approx. 10 years of working with the series of standards DIN 6700, it can be stated that this constitutes the use of a set of regulations which corresponds to the quality requirements of rail vehicle construction and will assure them for a long time. Based on this and the worldwide activities of the German manufacturers of rail vehicles, the standards are used both on a national level and by more than a third of the foreign users listed in the register. Even in China, rail vehicles are manufactured applying the series of standards DIN 6700.

g.) Requirements on the certification bodies approved according to DIN 6700-2

Within the scope of a self-obligation agreed with the German Railway Authority, demands on the certification bodies have been defined by the coordination board. Like the welding shops, the certification bodies too must continuously prove their competence. The demands are related to preconditions concerning

1. personnel,
2. technology and
3. organisation.

These demands are permanently checked by the German Railway Authority, however after 5 years at the latest. New auditors must prove their skilled competence by an expert discussion with the German Railway Authority. This expert discussion comprises the knowledge concerning not only DIN 6700 (now EN 15085) but also the applicable regulations.

The certification of the certification bodies is always continuously checked by the German Railway Authority. Deficiencies in certification and supervision will be determined and remedial measures will be taken. If general obligations result from this, they will be made accessible to all certification bodies via the organisation for the exchange of experience (Erfa). Participation in this organisation is obligatory for the head of the certification body.

h.) Exchange of experience for certification bodies in the system DIN 6700

A central element of interpretation of the regulations of the same quality is the annual exchange of experience of the certification bodies approved by the German Railway Authority. The exchange of experience raises current questions and tries to find common, binding procedures of the certification bodies within the scope of the existing regulations. It is prepared by the coordination

board.

Since the foundation of the coordination board, the exchange of experience has been annually conducted on a regular basis. It has often been connected with visits to the plant for practical relevance. Particularly with the introduction of the standards DIN 6700 as well as now EN 15085, the exchange of experience was connected with the training of all acknowledged auditors, now called certifiers.

i.) Internet register

An up-to-date register which is available at all times has been needed in order to be able to fulfil the requirements of DIN 6700a. Due to the limited technical possibilities, this register was first made available as a hardcopy and, later, as a computer-based database by the central office appointed by the German Railway Authority.

With the internet register DIN 6700 published on January 1, 2003 for the first time, a tool has been created where the current scopes of validity, the periods of validity and the responsible welding coordinators are found, thus offering a high measure of transparency in the work of the certification bodies.

On the one hand, it was possible to impose the documentation of special requirements such as the application of external, responsible welding coordinators. On the other hand, the expert competence of the certification bodies is checked, via the data entered in the register, by both, the certified body and the competitors.

In order to keep the costs resulting from the operation of an internet register low for everybody participating, the data available to everybody have, in agreement with the German Railway Authority, been used for investigations of welding shops. Since a partly comprehensive supply of welded components is necessary not only in rail vehicle construction but also in repair, the respective conditions of supply can be checked by the welding workshops, thus reducing the expenditure on looking for qualified sub-suppliers. Welding shops can also enter further information for advertising for themselves.

It can be rated as positive that all certification bodies acknowledged by the German Railway Authority have participated in the internet register, thus enabling a complete overview.

3 Quality assurance for welding in rail vehicle construction throughout Europe

a.) EN 15085 – Railway applications – Welding of rail vehicles and components

This European standard originated in 1997 and was elaborated in CEN TC 256/WG 31 with the considerable contribution of Germany. The five parts of EN 15085 were published in January 2008 and introduced by the Germany Railway Authority with a transitional period until the end of 2010. Certification of the welding shops according to EN 15085-2 is binding as from April 1, 2008 with the series of standards EN 15085 superseding DIN 6700.

It must, however, be stated that the introduction of the standard alone does not guarantee the fulfilment of the quality requirements in the European scope of validity. Acceptance of the standard is therefore decisively determined by the fact how far it can be developed to be a reliable indicator when evaluating welding shops in rail vehicle construction. In the interest of public safety, this reliability must be ensured for both, the national safety authorities in Germany (the German Railway Authority in Germany) and the rail vehicle constructors placing orders throughout Europe and wishing to evaluate their sub-suppliers.

If this approach is not successful, the application of the standard will become additional expenditure

without additional value. For the manufacturers of the system, there would be the alternative of determining defined manufacturer certification bodies when placing orders based on bilateral contracts. The original idea of liberalising the market of rail vehicle construction would suffer from this and wide acceptance of the standard too.

b.) Consequences when nationally introducing the series of standards EN 15085

There is a special situation for Germany compared to other European states. On a national basis, the series of standards DIN 6700 will be replaced by the series of standards EN 15085. Transitional periods and regulations must be created. On the other hand, a proven system for the application of the standard can be relied on. This is particularly valid for the function of the German Railway Authority as a national safety authority.

The coordination board and the organisation of the exchange of experience have been able to focus on this situation. Thus, the new preconditions in the manufacturer certification bodies (former: certification bodies) were present when the new standard was introduced.

Since, as an important tool of quality assurance, the internet register was to be kept on an international basis as early as applying it to DIN 6700, its replacement by EN 15085 was predominantly a question of adaptation to new scopes of validity. The required multilingualism is already ensured by the alternative choice of English. A French version too will be available.

c.) Introduction of EN 15085 on a European and international basis

On a European scale, it must be stated that a set of regulations with a complexity similar to that of the series of standards DIN 6700 was rarely used on a national basis. The liberalisation of the railway traffic has been on a relatively high level in Germany.

Therefore, the type of quality assurance via manufacturer certification bodies has been new to European welding shops with no relations to suppliers in Germany. It is still not known which national safety authorities will have the same function as the German Railway Authority. Only the responsibility of the respective ministries of transport and economic affairs can be supposed to exist. However, these do not have the necessary knowledge in the field of welding.

d.) Requirements on the manufacturers of rail vehicles

For the manufacturers and repair shops of rail vehicles, the certification of their welding shops by external manufacturer certification boards means additional costs at first and in the short term. These costs are only justified in those cases where the following advantages are obtained:

- Avoidance of unfair competition on a European scale
- Establishment of their own quality strategy
- Reduction of their own requirements in quality assurance
- Improvement of the processes concerning sub-suppliers

In order to fulfil these requirements, the certification system of EN 15085-2 must predominantly assure a sustainable and reliable statement on quality. This reliability is obtained only if all manufacturer certification bodies acknowledged in Europe permanently work on the same defined quality level.

e.) Contradiction between European standardisation and execution on a national level

EN 15085-2 has served to create generally binding rules for the qualification of welding shops for the welding of rail vehicles and components thereof in Europe. It can, however, be expected that the responsibility of the national safety agencies will be perceived differently, also due to different expert knowledge which may have a negative impact on the quality of the work of the manufacturer

certification bodies and the acceptance of a manufacturer certification.

In the end, the series of standards EN 15085 will completely take effect when it is capable of fulfilling the required safety demands and of giving the welding shops support in performing measures for quality assurance. This can only be achieved by the same quality of the work of the manufacturer qualification bodies.

f.) Function of EN ISO 3834 in relation to EN 15085

The series of standards EN ISO 3834 describes the general quality requirements in welding. It is the basic standard also referred to in EN 15085-2. If a manufacturer has a certification according to EN ISO 3834-2 to -3, it can refer to it during the certification according to EN 15085-2.

EN 15085-2 specifies the requirements of the series of standards EN ISO 3834, in particular concerning the staff of the manufacturing shops. Furthermore, certification according to EN 15085-2 is based on the requirements of the entire series of standards (among others, the determination of the weld performance class / certification class, structural design and ndt). Therefore, the equivalence of the certification requirements according to EN 15085-2 and EN ISO 3834-2 to -3 is not ensured. Thus, a certificate according to EN ISO 3834 cannot replace the certification according to EN 15085-2 alone.

4 Proposals for a harmonised, European work method of the manufacturer certification boards according to EN 15085-2

Continuing the previous national regulations, a European system of harmonised co-operation between the manufacturer certification boards should rest on a voluntary basis. The following elements of the system on quality assurance for the manufacturer certification bodies are proposed:

a.) European coordination board for certification according to EN 15085-2

A European coordination council (European Coordination Council for Application and Interpretation of EN 15085 - ECC) should be founded in order to enter into contact with the national safety authorities and national manufacturer certification bodies. The ECC should be composed of representatives from:

1. the national safety authorities,
2. the welding shops in rail vehicle construction and
3. the manufacturer certification bodies.

The objective should be membership of at least one group of interest of all European states aiming at an active execution of the series of standards EN 15085. The aim of the work of ECC should be to assure the certification of welding shops on a scale indispensably having the same level. Each participating manufacturer certification body should be obliged to do that.

b.) European exchange of experience of the manufacturer certification bodies

All manufacturer certification bodies obliged to co-operating with ECC and the rules organised by it should be actively involved in the annual exchange of experience having the aim of harmonising the manufacturer certification bodies.

c.) Code of honour of the manufacturer certification bodies

The manufacturer certification bodies should plead for a code of honour which should be established by ECC and should define the quality requirements and procedures in application and interpretation of the series of standards EN 15085 to each other.

d.) European internet register for the establishment of EN 15085-2

All manufacturer certification bodies support the work of a European internet register where the certificates are laid down in the system of EN 15085-2. They will be granted the respective access to it.

e.) International conference on the execution of the series of standards EN 15085

The previous national central office for the keeping of a register of the certified shops is preparing an international conference to be conducted in April 2010 for the first time. The main emphasis of the conference will be the exchange of experience when applying the series of standards EN 15085 as well as structural and technological aspects in the manufacture and repair of rail vehicles.

To be able to apply this quality assurance system, the German coordination council is offering its national and international experience. The respective resolutions have been made and institutes interested in it have been addressed too. A first meeting of the German coordination board with the participation of international guests was held on December 3, 2008.

5 Summary and prospects

Time is running and more and more countries all over Europe are introducing EN 15085 as the national standard! For the time being, more than 65 % of the existing certificates in the internet register have been under the rules of EN 15085. By 2010, there will be no more certificates according to the old standard DIN 6700.

Since 2008, all national German authorised bodies have been accredited by the German safety authority EBA according to EN 15085. The same procedure is taking place in other countries like France, the Czech Republic, Switzerland, Italy and so on. But somehow the situation is uncertain depending on the differences in the single nations.

For this reason, we are inviting all interested parties of national safety authorities, certification bodies as well as manufacturers and suppliers of welded railway vehicles and components to join the network for the harmonised application of EN 15085.

Please send us an e-mail to the contact addresses below if you are interested in the harmonised application of EN 15085 and if you are willing to join the existing internet register. The internet register is a particularly important tool for the national safety authorities to check the rules of EN 15085 as well as it is for the manufacturers of railway vehicles in search of suppliers. For the certification bodies, it is a question of acceptance by the customers to be a constituent of the internet register.

The next steps are defined. There will be a European Meeting for national safety authorities as well as certification bodies on November 25, 2009, hosted by DVS. Please contact the German Coordination Committee for participation. We are going to invite all renowned institutions.

On April 28 - 29, 2010, there will be the first International Conference "Join-Trans" for all persons and parties interested in welding and construction of railway vehicles, held at SLV Halle. One main topic will be the discussion about the experience gained from the introduction of EN 15085 so far.

Please join us to improve the quality of welded railway vehicles!

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