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| Work Instruction | PRESCRIPTIONS FOR THE MANUFACTURE AND THE INSPECTION OF WELDED STEEL ASSEMBLIES | IR/QM/02 Rev 2 |
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1 Object and field of application

The present specification defines prescriptions relating to the manufacture (new construction, reinforcement and repair) and the inspection of mechanical welded steel assemblies.

It applies to constructions in the machine engineering industry such as: machine housings, equipments for blast furnace, etc.

Equipments covered by specific standards or regulations such as pressure vessels or lifting devices, etc. are excluded.

The standards requested in this instruction are ISO standards (International) or sometimes EN standards (European) which are applicable to different markets. For other markets as China, Brazil, the United States, Taiwan, etc... other standards are applicable. A table at the end of the document gives all needed equivalences between standards from market to market.

2 Supplier

The supplier (as defined in the International Standard ISO 9000) is reliable for the mechanical welded construction, according to the present specification of Paul Wurth, to the prescriptions of the code and the standards listed, as well as for eventual particular requirements stated in the order.

In order to assure an efficient production of the mechanical welded constructions and to detect potential problem sources, the supplier is required to implement appropriate quality management procedures.

Contractual welding requirements:

The International Standard ISO 3834 (for welding quality requirements parts 2 and 3) shall be applied to demonstrate the capability of the supplier to fabricate steel structures according to the quality requirements mentioned in contractual documents of Paul Wurth.

The supplier confirms his ability to satisfy all the contractual requirements relating to the welding by returning the duly completed and signed form (annexed) back to Paul Wurth before starting the welding process.

Paul Wurth reserves the right to assess and approve the welding quality management system of the supplier or to have it assessed by an approved body or by a third party. In any case, Paul Wurth reserves the right to assess and approve the welding quality system presented according to other codes and standards, which are different from those indicated in this specification (e.g.: ASME, AWS, etc...).

3 Subcontracting

The supplier can subcontract part of his supplies with the prior consent of Paul Wurth. It is up to the supplier to make sure that the conditions placed in the

order documents of Paul Wurth as well as the corresponding documents are supplied to the subcontractor(s).

4 Welding

4.1 Welding specifications

Prior to manufacturing, the supplier draws up documentation, which he will submit to Paul Wurth at first request, with the following content:

- the description of the welding procedure specifications applied for each assembly type or assembly family (group),
- the copy of the qualification reports of the welding procedure specifications each assembly type,
- the list of the qualified welders / operators or a copy of the qualification certificates,
- possibly, at the request of Paul Wurth, a description of the sequence of the different manufacturing stages, which can have an incidence on the welding process (heat treatments, non-destructive tests, etc.),
- the welding coordination during the work process.
- the welding map

4.2 Description of welding procedure specifications (WPS)

The welding shall be realized according to the descriptions of the welding procedure specifications as stated in the International Standard ISO 15609-1 or in applicable Quality Inspection Plan (QIP).

The supplier shall make sure that applicable welding procedure specifications are correctly used in the production process.

If necessary, the welding procedure specifications shall be completed by work instructions. They shall be available at the welders working place.

At request of Paul Wurth and before the beginning of the welding processes, the welding procedure specifications shall be approved (see point 4.1).

4.3 Qualification of welding processes (PQR)

The welding processes (or a combination of them) covered by the European Standard EN 1011 can be used. Other welding processes will be used only after Paul Wurth agreement.

The welding procedure specifications must be qualified according to the International Standard ISO 15614-1 or to applicable QIP, before initiating the welding process (see point 4.1).

A qualified welding procedure specification is applicable to the realization of all the welded joints carried out by the supplier, insofar as the characteristics of such joints and their carrying-out are within the limits of the range of validity.



The qualifications of welding procedure specifications are registered in a report (see the International Standard ISO 15614-1) and are put at the disposal of Paul Wurth to allow the check of their validity.

In any case, Paul Wurth reserves the right to choose between the acceptance of qualification presented according to other codes and standards or the necessity of proceeding to new qualifications.

4.4 Qualification of welders / operators

The qualification of the welders and operators allows verifying their aptitude to carry out predefined welded assemblies according to the required quality criteria.

- The welders shall be qualified according to the European Standard EN 287-1.
- The operators shall be qualified according to the European Standard EN 1418.

The qualifications form the subject of a certificate with the precise indication of the domain of the qualification obtained and shall be put at the disposal of Paul Wurth on request (see point 4.1) to allow the check of their validity. In any case, Paul Wurth reserves the right to choose between, the acceptance of qualifications according to codes and standards, which are different from those indicated above or the necessity to proceed to new qualifications.

4.5 Welding coordination

The supplier shall have qualified and experienced coordination personnel to make sure that the execution and the control of the welding process is carried out in good conditions.

The welding coordinators shall have adequate technical know-how according to the International Standard ISO 14731 (see point 4.1).

In any case, Paul Wurth reserves the right to accept persons having sufficient know-how to carry out the supervision of the welding operations in order to make sure that such operations are carried out according to the contractual requirements.

The coordinator's qualification certificate shall be presented to Paul Wurth on request.

4.6 Welding products

For the realization of the objects of the contract, welding products such as metallic welding consumables (electrodes, wire, etc.), solid or gaseous consumables, shall be of the same type as those used during the qualification of the welding procedure specification.

The products with the same denomination in a standard or the same commercial designation are acceptable.

The welding consumables shall be suitably stored and handled.

They shall be preheated before using, if not otherwise specified, in accordance with the supplier's instructions.



If required in the project specifications of Paul Wurth, the acceptance certificates of the welding consumables shall be submitted. Unless otherwise stipulated in the project specifications of Paul Wurth, the document «test report» according to the European Standard EN 10204 - 2.2 is accepted.

5 Materials

5.1 Use of materials

The technical documents of the contract (drawings, bills of materials, technical specification, project specifications) prescribe the nature and the grade of the materials to use for the manufacturing of the ordered objects.

The supplier shall make sure that the used materials correspond to those prescribed.

Under no circumstances the grade and quality of the prescribed materials shall be modified without the prior consent of Paul Wurth.

Generally the plate thicknesses indicated in Paul Wurth S.A. bills of materials pertain to finished dimensions of plates requiring machining after welding. The supplier is held to determine plates thicknesses according to the related technical drawings and the fabrication facilities used for this purpose.

5.2 Supply

The components to be used for the realization of the objects of the purchase order shall be supplied following a written order by the supplier.

Any components order must stipulate, besides the dimensional characteristics, the following indications:

- the standard, the grading, the quality or the grade,
- the type of acceptance expected, the nature of the inspection and the type of acceptance document required,
- the particular requirements of possible regulations,
- the state of heat treatment on delivery if the standard foresees several heat treatment modalities,
- the non-destructive tests,
- the additional tests possibly required by the specifications of Paul Wurth,
- the required surface quality,
- dimensional tolerances.

Paul Wurth reserves the right to ask the supplier, for any purposes, for a copy of the written order of the components.



5.3 Inspection documents (acceptance certificates according to the European Standard EN 10204)

The final acceptance of the components shall only take place if the inspection and testing results comply with the requirements of the order / specifications and after the reception of the required acceptance documents.

In any case, the components shall come with perfectly legible, reproducible acceptance documents in their totality and written in the language stipulated in the contract.

Unless otherwise stated in the specifications or prescribed by the construction code, acceptance documents in conformity with paragraph 4.1 of the European Standard EN 10204 as "Inspection certificate type 3.1" are required.

However, in agreement with Paul Wurth, "certificates of compliance with the order" type 2.1 or "test reports" type 2.2 according to the European Standard EN 10204 are acceptable for parts like fasteners, stiffeners, supports, etc.

5.4 Identification of materials

The materials shall be identifiable at each stage of the manufacturing process from the supply to the acceptance of the final product.

The supplier shall be able to prove, during the manufacturing process, the nature and origin of the used materials, by ensuring that their identification is retraceable and preserved. If necessary, he shall carry out the necessary identification reports himself.

6 Preparation of the parts before welding

6.1 Cutting and chamfering

The metal sheet, the pipes and other components can be shaped before or after the forming and welding operations, provided that the following conditions are fulfilled:

- the cutting and chamfering by machining is permitted for all the materials,
- cutting can require preheating according to the steel grade and thickness,
- shearing is allowed by taking in account the steel grade and thickness,
- if the zone hard drawn by shearing is not totally melted during the welding process, the manufacturer shall make sure that material characteristics are not affected,
- important irregularities, creeks, cracks, calamine patches and different superficial non-conformities that might affect the weld quality should be systematically eliminated,
- if the cutting and the chamfering of the components reveal inclusions or termination doublings, the measures for an eventual possible repair are to be taken in agreement with Paul Wurth.

6.2 Forming

The forming of parts can be carried out by cold or hot processes, either by rolling or by a press or by any other proven process, provided that the properties of the material are not affected beyond tolerated limits.

The method used shall allow complying with the required tolerances.

Hammering must not be used for cold forming operations.

As regards hot-shaping, the recommendations of the steel supplier must be complied with.

Forming and bending at temperatures from 250 °C to 380 °C are not allowed.

The supplier shall make sure that the implemented forming process does not affect in an irreversible way the metal properties or its surface quality.

If necessary, he shall proceed to the post forming heat treatments required by the codes or standards.

After the forming process and possible heat treatments the components shall be inspected as to their dimensions. The shaped faces shall be free from cracks, creeks, notches, scratches or other stress-implying non-conformities.

Paul Wurth reserves the right to ask the manufacturer to provide a description of the forming process as well as a qualification to make sure that the required mechanical characteristics are not affected.

6.3 Assemblies

6.3.1 Common dispositions applicable to all assemblies

- The assemblies shall allow the carrying out of each weld in good conditions of accessibility.
- All the necessary dispositions shall be taken to reduce to the minimum the stress due to calorific effects or shrinkage.
- The accumulation of welds as well as dispositions leading to the concentration of high stress shall be avoided.

The European Standard EN 1011 "Recommendations for metallic materials welding" do apply, particularly:

- part 1: General guidelines for arc welding,
- part 2: Arc welding of ferritic steel,
- part 3: Arc welding of stainless steel.

6.3.2 Assembly types

The assembly type is determined by the number, the dimensions and the orientations relating to the parts to be assembled.

Examples are given in a schematic way in the International Standard ISO 17659 with the terms and corresponding explanations.

Unless otherwise stated in the order documents of Paul Wurth, the choice of assemblies' best suited to satisfy the requirements in the specifications of Paul Wurth or the prescribed construction code is up to the supplier.

For that purpose it is recommended to consider the European Standard EN 1708 "Basic weld joint details in steel".

6.4 Edges to be welded

The surfaces of the edges to be welded and the adjacent surfaces of a weld shall be free from grease, rust, non-adherent calamine, humidity and paint.

However, the use of steel sheets coated with a pre-point primer (Primer) without prior elimination is accepted provided that such coating has no harmful impact on the welding progress.

For steel structures, the quality of the flame (thermal) cutting shall be in accordance with the International Standard ISO 9013 range 4.

The edges to be welded shall be held in position, either by mechanical devices or by weld points (see point 6.6) or by a combination of both.

The maintaining of position of the edges to be welded shall allow the compliance with the prescribed alignment tolerances during the whole welding process (ex. the European Standard EN 1011).

The gap allowed for the preparation of the edges to be welded and the adjustments shall comply with the values of the welding procedure specifications.

Paul Wurth reserves the right to verify correct positioning.

Note:

The International Standard ISO 9692-1 gives recommendations concerning details of the preparation of the edges to be welded.

6.5 Preheating

It may be necessary to preheat the components before any welding and tack welding process in order to avoid the risk of cracking in the heat affected zone.

The preheating temperature depends on the steel grade, the thickness of the element to be welded, the type of joint and the energy supply.

The preheating temperature shall be maintained constant during the whole duration of the welding process.

The maintaining of the preheating temperature shall be continuously monitored by means of adequate measuring instruments or temperature indicating pens.

The WPS of the manufacturer shall specify the preheating temperatures and, if necessary, of the temperatures between the extensions of two weld seams.

Note:

The recommendations concerning preheating are exposed in the parts of the European Standard EN 1011.

As for the measurement of the preheating, interpass and preheat maintaining temperature, see the guidelines of the International Standard ISO 13916.



6.6 Tack welding

The carrying out of tack welding processes is subject to the same welding conditions as those foreseen for the first welding seam of the concerned joint, including if necessary, the preheating.

It is possible to incorporate a tack weld into a definitive weld on condition:

- that its shape is adapted,
- that it is carried out by a qualified welder and according to the description of the welding procedure specifications.

The surfaces of the tack welds shall be cleaned carefully before the final welding.

The tack welds presenting cracks or other non-conformities shall be eliminated.

Note:

The recommendations of the different parts of the European Standard EN 1011, where applicable, shall be followed.

6.7 Temporary fixing devices

The attachments of temporary elements for the supporting, sustaining or alignment of the parts by welding shall be carried out while taking the appropriate precautions, corresponding to the grade of the implemented steel.

The removal of Temporary fixing devices shall be done by means, which do not affect the characteristics of the material of the concerned element.

After the removal / cutting, the affected zone is submitted to a grinding process followed by an inspection. A magnetic particle inspection (MT) or a Liquid Penetrant test (PT) may be needed!

Such cutting or grinding shall not reduce the thickness of the wall of the component below the minimum value indicated on the drawing.

Elimination by hammering is not allowed.

Note:

The recommendations of the different parts of the European Standard EN 1011, where applicable, shall be followed.

7 Execution of the welding

Before starting any welding process Paul Wurth shall have:

- checked and accepted the welding specifications, if required in the contract, (program, instructions and descriptions of the welding procedure specifications) as stipulated in the points 4.1 and 4.2,
- approved the welding processes and the welders as stipulated in the points 4.3 and 4.4.

All the welding operations shall be supervised permanently by the manufacturer, in this particular case by his welding coordinator as defined in point 4.5.



The welding operations shall be carried out under protection against rain, snow and wind and shall be interrupted when the temperature of the elements to be welded is below or equal to 0°C. For temperature below 0°C a specific agreement shall be given by Paul Wurth!

The consumables shall be in the hygrometric state, which is convenient for their use; they are stoved and maintained according to the prescriptions of the manufacturer (see point 4.6).

Striking of the arc off the edges to be welded shall be avoided and in case of unintentional striking, the affected surface shall be slightly grinded and inspected.

The projection of weld drops shall be avoided. In case of projections they shall be eliminated.

Each weld seam shall be free of slag, cleaned and surface irregularities shall be eliminated before the carrying out of the following seam in order to grant the good quality of the metal brought in.

The end craters of the welds shall be eliminated by grinding or by prolonging the seams on suitable lengthening pieces. If this is impossible, the end weld point shall be in the least affected zone of the weld.

If the welding process requires full penetration, the back-hand welding of a welded joint shall be preceded by a thermal or mechanical gouging or by a grinding process.

In agreement with Paul Wurth, welds with full penetration carried out on one single side can be realized with a back-up bar. Requirements concerning this use shall appear in the description of the welding procedure specifications.

Note:

The recommendations for metallic material welding provided by the different parts of the European Standard EN 1011 should be followed as well.

8 Identification of the welds

The supplier has to take all the necessary steps to allow identification of the welder / operator who carried out the welds, either by:

- identifying the weld locally by apposing the symbol corresponding to the welder / operator,
- by replacing the identification of the welds by resuming the corresponding parameters in the manufacturing documents (drawings, weld lists ...).

9 Post weld correction of distortions

If the precautions, taken before the welding process (order of the execution, preheating, etc), did not allow to avoid or to compensate for the effects of shrinkage, such local deviations or distortions can be corrected so as to obtain an end product in conformity with the contractual documents.

The adjustments / the straightening shall be carried out according to a welding procedure specification agreed by the contracting parties.



- Adjustment / straightening by local heating is allowed as long as the temperature does not exceed 600°C, if such process does not modify unfavourably the characteristics of the metal and if the final state of delivery of the component is not altered.
 - Cold hammering to eliminate overlapping or other distortions is not permitted.
 - Accelerated cooling by water or similar is not permitted.
- All the deviations, adjustments and straightening shall be documented.

10 Post weld heat treatment

If the welded parts shall undergo a post weld heat treatment, the supplier shall define, specify and document:

- the heat treatment method to apply,
- the temperature mounting and descending speed,
- the maintenance temperature and duration of maintaining.

The supplier has to take into account the recommendations of the manufacturer of the material concerning the grade(s) of the steel used in the process.

The duration and temperatures of the complete cycle of the post welding heat treatment shall be registered during the whole process.

The heat treatment diagram shall be put at the disposal of Paul Wurth (see final documentation of the supplier).

11 Machining

Any eventual final machining of the concerned parts shall only be carried out after the welding and the heat treatment. The machining of flanges should always be carried out after the welding on the connection tube, unless welding neck flanges are being used.

The dimensions and tolerances are specified on the drawings or specification of Paul Wurth. The surface roughness shall be according to the drawings (see also the International Standard ISO 1302).

12 Inspections and testing

12.1 Organization of inspections

- During the fabrication of the parts, the inspections and examinations shall be carried out at duly defined manufacturing stages by the supplier in order to ensure the conformity of the manufactured parts with the contract documents.
- For that purpose, the supplier shall send Paul Wurth the manufacturing schedules, which take in account the different inspection and testing operations.

12.2 Conditions of carrying out inspections

- In order to avoid systematic non-conformities, inspections shall be undertaken as from the beginning of the manufacturing process.
- Any weld that becomes inaccessible due to ulterior operations shall be inspected prior to the execution of such operations. Paul Wurth shall be informed before the consecutive operations to these inspections can be continued.
- No weld seam may be painted before having been inspected and approved.
- The works or parts of works submitted to inspection shall allow an examination under good conditions and cannot be dispatched without the prior consent of the responsible person at Paul Wurth.
- Non-annotated welds (Shop slices) shall be 100% checked: VT and UT. The Shop slices shall be shown on the fabrication drawings.

12.3 Qualification of inspection agents

- The qualification level of the inspection agents shall correspond to the operations they shall carry out.
- In the case of non-destructive inspections, they shall be qualified according to the stipulations defined in the European Standard EN 473.

12.4 Range of inspections

12.4.1 Range of non-destructive inspections

The range of non-destructive inspections is either:

- specified by the standard or the construction code,
- mentioned in the execution drawings,
- indicated in the specifications / requirements of Paul Wurth.

12.4.2 Visual inspection of the welds

This kind of examination is a minimal inspection requirement to which all the welds are submitted.

The visual inspection comprises:

- the verification of the existence and the location of all the welds,
- the inspection of the weld surfaces and shapes,
- the measuring of the weld dimensions and positions,
- the detection of superficial non-conformities,
- the detection of involuntary arc striking and projected drops.



12.4.3 Non-destructive inspections (dye penetration test, magnetic particle inspection, radiography, ultrasonic inspection)

The inspection ranges are expressed in percentages of the total lengths of each type of the welds to be inspected (ex.: 10, 20 or 50%).

The percentages are specified in the contract documents.

As regards welds with important lengths, these ranges shall be divided in inspection zones distributed along each weld.

Inspections by sampling shall be evenly spread out over the totality of each assembly type presenting the same process qualification.

The supplier shall establish a document which allows identifying all welds or zones of weld tested.

- Non Destructive inspections shall be only done at least 24 hours after welding completion!

12.5 Technical conditions of inspections

12.5.1 Visual examination

The welded assemblies undergo a visual examination according to the International Standard **ISO 17637**.

12.5.2 Dye penetration test

The dye penetration shall be carried out according to the dispositions of the European Standard EN 571-1.

12.5.3 Magnetic particle inspection

The magnetic particle inspection shall be carried out according to the dispositions of the International Standard **ISO 17638**.

12.5.4 Ultrasonic inspection

The ultrasonic inspection shall be carried out according to the dispositions of the International Standard **ISO 17640**. As regards the characterization of the indications, refer to the International Standard **ISO 23279**.

12.5.5 Inspection by radiography

The inspection by radiography shall be carried out according to the dispositions of the European Standard EN 1435.

12.5.6 Note

The non-destructive inspection methods specified in the above paragraphs shall be applied in accordance with written inspection procedures. Such procedures shall be put at the disposal of Paul Wurth on request.

12.6 Acceptance criteria

The acceptance criteria relating to the inspection techniques shall comply with the standards indicated below and, when available, with the specifications indicated in the drawings or with other contractual documents.

The different non-conformities discovered in the inspected welds are defined in the International Standard ISO 6520-1.

12.6.1 Visual examination

The acceptance criteria of the revealed non-conformities are specified in the International Standard ISO 5817.

12.6.2 Dye penetration test

The acceptance criteria of the non-conformities are specified in the International Standard **ISO 23277**.

12.6.3 Magnetic particle inspection

The acceptance criteria of the non-conformities are specified in the International Standard **ISO 23278**.

12.6.4 Ultrasonic inspection

The acceptance criteria of the non-conformities are specified in the International Standard **ISO 11666**.

12.6.5 Inspection by radiography

The acceptance criteria are specified in the European Standard EN 12517.

12.7 Extension of inspections

If the inspection leads to the detection of "non-conformity" with regard to the acceptance criteria, the inspections are extended (in the case of a partial inspection by sampling (5, 10, and 20%)).

As regards inspection extensions, refer to annexure **C** of the International Standard **ISO 17635**.



12.8 Inspection reports

Each non-destructive inspection carried out forms the subject of an inspection report established by the supplier.

This document shall at least contain the following information:

- the references to contract documents (order, drawings),
- the location of the welds,
- the date of inspection,
- the name of the inspector,
- the operating conditions of the inspections (procedures, inspection instructions),
- the inspection results,
- the interpretations and conclusions of the inspector.

13 Repairs

13.1 Repairs of geometric and appearance non-conformities

- Excessive or irregular bulbs, which do not present the prescribed shape, shall be corrected by grinding.
- Non-conformities such as undercuts, grooves or lack of penetration may be corrected by grinding and surfacing. The surfacing is to be carried out according to the welding conditions stipulated by the supplier in his welding procedure specifications.
- After the repair, the weld seams shall undergo a new inspection.

13.2 Correction of internal non-conformities

Internal non-conformities revealed during a non-destructive inspection shall be eliminated and the corresponding weld zones shall be repaired.

The corrections shall be carried out according to a qualified welding procedure specification.

After the repair works, the weld seams are inspected again.

13.3 Obligations of the supplier

Paul Wurth shall be informed about the corrections carried out.

In case of important corrections, which might alter the final behaviour of the assembly, the supplier shall obtain the consent of Paul Wurth before proceeding to such corrections. In case of repair, the supplier shall make sure that the regular execution of the corrections are carried out carefully and shall mention them in his dimensional inspection report.

14 Dimensional control

14.1 Final dimensional inspection

A final dimensional inspection shall be carried out by the inspection department of the supplier.

If the contract / order requires the presence of Paul Wurth and of the final customer during such inspections, the supplier has to address, with advance notice as stipulated in the contract, a written notification to Paul Wurth.

14.2 Manufacturing tolerances

The manufacturing tolerances apply to the dimensions defined in the drawings / specifications approved by Paul Wurth.

The admissible deviations are defined:

- by Paul Wurth (in Paul Wurth drawings or Paul Wurth specifications) for the values, whose precision is imposed by the fitting or connection requirements,
- by the International Standard ISO 13920 "Welding - General tolerances for welded constructions - Dimensions for lengths and angles, Shape and position" (Tolerance classes CG),
- or by the specified construction code.

14.3 Control documents

The real measured dimensions shall be reported:

- on an overall drawing or detail drawing,
- in a dimensional inspection report,
- respectively on the inspection sheet of Paul Wurth attached to the contract.

14.4 Out of tolerance values

If, after the completion of the welding works, the welding dimensional inspection reveals out of tolerance values, the concerned parts shall be treated as non-conformities of the supplier and shall either:

- undergo repair work in the workshop,
- possibly be scrapped,
- be submitted to a derogation request for a possible acceptance without any repairing.

A derogation to the contractual requirements may in certain cases be accepted, provided that the usability is not being affected.

However, a derogation presumes the prior consent of Paul Wurth and the final customer.

The dimensional inspection report and the drawing(s) shall be included in the supplier's file.



14.5 Calibration

The measuring devices used to check the conformity of an element according to final documentation with the stipulated requirements shall be periodically calibrated and can only be used during the validity period of their calibration.

15 Test assembly in the workshop

Except otherwise stated in writing by Paul Wurth, the supplier has to proceed to a test assembly in the workshop (trial erection) of the different parts of an equipment.

The test assembly shall be carried out in such a way that not a single part is shipped without having been preassembled.

This operation consists in assembling the parts as foreseen in the workshop drawings, in fitting them with the adequate bolts and in adjusting them in such a manner that the joint edges to be welded on the assembly site do present the prescribed shapes and dimensions.

The test assembly and the disassembly shall be possible without causing deformations of the parts or holes.

The identification of the parts before their disassembly is compulsory.

On request, the supplier works out a test assembly program and submits it for approval to Paul Wurth.

If asked, the supplier has to take photographs of the test assembly of the parts and hand them to Paul Wurth.

16 Anti-corrosion work

Anti-corrosion work carried out in the workshop can only be executed after the inspection and the final acceptance of the components.

Such work shall be carried out according to the specification of Paul Wurth. (FOR 518, FOR 519)

Before applying any coating, the supplier shall ensure that the surface quality of the parts allows the coating in conformity with the specification.

The supplier shall make sure that the prescriptions of the manufacturer of the coating product are respected, namely:

- the preparation of the product,
- the application method,
- the drying time between the layers,
- the climatic conditions.

The verification of the coating thickness shall be carried out with a calibrated measuring device.

The measured values shall be registered in a report (FOR 520) to be handed to Paul Wurth.

17 Other tests

Tests such as:

- pressure tests (hydraulic pressure tests or pneumatic pressure tests),
- tracer gas leakage test,
- functional testing of the parts,

may be required by Paul Wurth according to the modalities defined in the documents.

18 Requirement of documentation

The documents, which constitute the complete final documentation, shall be established in the language mentioned in the order or particular specification of Paul Wurth.

Unless otherwise required in the order document of Paul Wurth, the final documentation shall comprise all the documents that illustrate the different stages of supply, realization and inspection of the parts, namely:

- the quality plan respectively the inspection plan,
- the materials certificates,
- the welding products (consumables) certificates
- the welding procedure specification,
- the descriptions of the welding processes,
- the qualification of welding processes,
- the qualification of welders / operators,
- the qualification of inspection agents,
- the list and the diagram of heat treatments,
- the non-destructive inspection reports,
- the dimensional inspection report or the «as-built» drawings,
- the certificates of eventual pressure tests,
- the reports of repair works,
- the list of non-conformities,
- the certificate of conformity with the code / standard / order and particular specification of Paul Wurth, drawn up and signed by the supplier,
- the anti-corrosion coating inspection certificate,
- the functional test reports,
- the welding map: location of welds (in the drawings) with relevant WPS.

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19 Table of equivalences of standards

| Item | § in IRQM02 | Brief Description of standards | Standards for Europe Market | Equivalent standards for Chinese Market | Equivalent standards for American Markets (US, Brazil) | Equivalent standards for Taiwanese Market | Equivalent standards for other Markets | Equivalent standards for other Markets |
|------|-------------|--|-----------------------------|---|--|---|--|--|
| 1 | 2 | Quality Management System | ISO 9000 | ISO 9000 | ISO 9000 | ISO 9000 | | |
| 2 | 2 | Quality requirement for fusion welding of metallic material: Part 1~4 | ISO 3834 | GBT 12467.3 | AWS D1.1 | AWS D1.1 | | |
| 3 | 4.2 | Specification and Qualification of welding procedures: Welding Procedure Specification (WPS) (General rules) | ISO 15609 (ISO15607) | GBT 19867 (GBT 19866) | AWS D1.1 § 4 Part B | AWS D1.1 or ASME SEC IX | | |
| 4 | 4.3 | Specification and Qualification of welding procedures: Welding procedure Record | ISO 15614-1 | GBT 19869.1 | AWS D1.1 § 4 Part B | AWS D1.1 or ASME SEC IX | | |
| 5 | 4.4 | Qualification test of welders: Welding (Steels) | EN 287-1 | GBT 15169 | AWS D1.1 § 4 Part C | AWS D1.1 or ASME SEC IX | | |
| 6 | 4.4 | Approval testing of Welding Operators | EN 1418 | GBT 19805 | AWS D1.1 § 4 Part C | AWS D1.1 | | |
| 7 | 4.5 | Welding coordination: tasks and responsibilities | ISO 14731 | GBT 19419 | AWS B5.9 | | | |
| 8 | 4.6 | Types of Inspection documents: declaration of compliance with tests results of non-specific inspection | EN 10204-2.2 | EN 10204-2.2 | ASTM | ASTM or JIS x xxxx | | |
| 9 | 5.3 | Types of Inspection documents: declaration of compliance with tests results of specific inspection | EN 10204-3.1 / 3.2 | EN 10204-3.1 / 3.2 | ASTM | ASTM or JIS x xxxx | | |

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| Item | § in IRQM02 | Brief Description of standards | Standards for Europe Market | Equivalent standards for Chinese Market | Equivalent standards for American Markets (US, Brazil) | Equivalent standards for Taiwanese Market | Equivalent standards for other Markets | Equivalent standards for other Markets |
|------|-------------|---|-----------------------------|---|--|---|--|--|
| 10 | 5.3 | Types of Inspection documents: declaration of compliance without tests result | EN 10204-2.1 | EN 10204-2.1 | ASTM | ASTM or JIS x xxxx | | |
| 11 | 6.3.1 | Recommendations for welding of metallic materials | EN 1011 | GBT 12467 | AWS D1.1 | AWS D1.1 | | |
| 12 | 6.3.2 | Multilingual Terms of welded joints with illustrations (EN, FR and GE) | ISO 17659 | GBT 3375 | AWS A3.0 | | | |
| 13 | 6.3.2 | Basic weld joint details in steel: Pressurized components | EN 1708-1 | GBT 985, GB 986, GB 150 | | | | |
| 14 | 6.4 | Recommendations for joint preparation | ISO 9692-1 WPS | GBT985 WPS | AWS D1.1 ISO5817 Quality Level C WPS | AWS D 1.1 WPS | | |
| 15 | 6.5 | Guidance on the Measurement of preheat temperature, interpass temperature and preheat maintenance temperature | ISO 13916 | GBT18591 | AWS D 1.1 | AWS D 1.1 | | |
| 16 | 11 | Geometrical Product Specification (GPS): indication of surface texture in technical product documentation | ISO 1302 | GBT131 | ISO 1302 | ISO 1302 | | |
| 17 | 12.3 | Qualification of Non Destructive Testing personnel: general principles | EN 473 Level 2 | GBT 9445-2008 | ASNT-TC-1A or (only for Brazil) ABENDE NA 001 | ASNT-TC-1A or (locally) SNTCT xx | | |
| 18 | 12.5.1 | NDT: Visual inspection of welds | ISO 17637 | GBT20967-2007 GBT 19418-2003 | AWS D 1.1 § 6 Part D | ASME SEC V | | |
| 19 | 12.5.2 | NDT: Penetrant Testing of welds | EN 571-1 | GBT18851, JBT4730.5 | AWS D 1.1 § 6 Part D | ASME SEC V | | |

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| Item | § in IRQM02 | Brief Description of standards | Standards for Europe Market | Equivalent standards for Chinese Market | Equivalent standards for American Markets (US, Brazil) | Equivalent standards for Taiwanese Market | Equivalent standards for other Markets | Equivalent standards for other Markets |
|------|-------------|---|-----------------------------|--|--|---|--|--|
| 20 | 12.5.3 | NDT: Magnet particle Testing of welds | ISO 17638 | GBT15822, JBT4730.4 | AWS D 1.1 § 6 Part D | ASME SEC V | | |
| 21 | 12.5.4 | NDT: Ultrasonic Testing of welded joints | ISO17640 | GB11345, JBT4730.3 | AWS D 1.1 § 6 Part F | ASME SEC V | | |
| 22 | 12.5.5 | NDT: Radiographic Testing of welded joints | EN 1435 | GBT 3323, JBT4730.2 | AWS D 1.1 § 6 Part E | ASME SEC V | | |
| 23 | 12.6 | Welding and allied processes: classification of geometric imperfections in metallic materials | ISO 6520-1 | GBT6417-1 | ISO 6520-1 | ISO 6520-1 | | |
| 24 | 12.6.1 | Welding: Quality level for imperfections | ISO 5817 Quality Level C | GBT 19418 Quality Level C | ISO 5817 Quality Level C and AWS D 1.1 § 6 Part C | ISO 5817 Quality Level C | | |
| 25 | 12.6.2 | NDT: Penetrant Testing Acceptance Levels | ISO 23277 Accept. Level 1 | JBT 6062, Accept. Level 2 JBT4730.5 | AWS D 1.1 § 6 Part C | ASME SEC VIII | | |
| 26 | 12.6.3 | NDT: Magnet particle Testing Acceptance Levels | ISO 23278 Accept. Level 1 | JBT6061 Accept. Level 2 JBT4730.4 | AWS D 1.1 § 6 Part C | ASME SEC VIII | | |
| 27 | 12.6.4 | NDT: Ultrasonic Testing Acceptance Levels | ISO 11666 Accept. Level 3 | GB 11345 Class B Accept. Level 2 JBT4730.3 Accept. Level 2 | AWS D 1.1 § 6 Part C | ASME SEC VIII | | |
| 28 | 12.6.5 | NDT: Radiographic Testing Acceptance Levels | EN 12517 Accept. Level 2 | GBT 3323 Accept. Level 2 JB4730.2 | AWS D 1.1 § 6 Part C | ASME SEC VIII | | |
| 29 | 12.7 | Non-Destructive Testing of welds - General rules for metallic materials | ISO 17635 | GBT12469, JBT4730 | AWS D 1.1 | AWS D1.1 or ASME SEC V | | |

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| Item | § in IRQM02 | Brief Description of standards | Standards for Europe Market | Equivalent standards for Chinese Market | Equivalent standards for American Markets (US, Brazil) | Equivalent standards for Taiwanese Market | Equivalent standards for other Markets | Equivalent standards for other Markets |
|------|-------------|---|------------------------------|---|--|---|--|--|
| 30 | 14.2 | Welding: General tolerances for welded constructions | ISO 13920 B/F | GBT 19804 B/F | AWS D 1.1 or ISO13920 B/F | AWS D 1.1 or ISO13920 B/F | | |
| 31 | 16 | PW forms for coating (Painting Spec, Standard and Control Sheet | FOR 518, FOR 519 and FOR 520 | GBT 19355 | ISO8501 & ASTM D 1000 or NBR 11003 | FOR 518, FOR 519 and FOR520 | | |

GB/T 12467 Means partially comparable (**not equivalent**) standard: to be defined project by project No equivalent standard