

PW Group Instruction

**PWGIN5201R00 - Manufacture, inspection & testing of welded steel assemblies**

**CONTENTS**

<b>1</b>	<b>PURPOSE</b>	<b>3</b>
<b>2</b>	<b>SCOPE/APPLICATION</b>	<b>3</b>
<b>3</b>	<b>SUPPLIER</b>	<b>3</b>
<b>4</b>	<b>SUBCONTRACTING</b>	<b>3</b>
<b>5</b>	<b>WELDING</b>	<b>4</b>
5.1	Welding documentation	4
5.2	Welding procedure specifications (WPS)	4
5.3	Qualification of welding procedures (WPQR)	4
5.4	Welders/welding operators	5
5.5	Welding coordination personnel	5
5.6	Welding consumables	5
<b>6</b>	<b>MATERIALS</b>	<b>6</b>
6.1	General	6
6.2	Inspection documents	6
6.3	Material identification and traceability	6
<b>7</b>	<b>PREPARATION OF THE PARTS BEFORE WELDING</b>	<b>6</b>
7.1	Cutting and chamfering/beveling	6
7.2	Forming	7
<b>8</b>	<b>PREPARATION AND EXECUTION OF WELDING</b>	<b>8</b>
8.1	General	8
8.2	Joint preparation	8
8.3	Preheating	8
8.4	Tack welding	8
8.5	Temporary fixing devices	9

Owner: <b>FU Supplier Quality</b>	Date: <b>02.06.2017</b>	Checked by: (IAN) 	Approved by: (MSG) 
-----------------------------------	-------------------------	---	--

## PW Group Instruction

### PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies

<b>9</b>	<b>EXECUTION OF THE WELDING</b>	<b>9</b>
<b>10</b>	<b>IDENTIFICATION OF THE WELDS</b>	<b>10</b>
<b>11</b>	<b>POST WELD CORRECTION OF DISTORTIONS</b>	<b>10</b>
<b>12</b>	<b>POST WELD HEAT TREATMENT</b>	<b>11</b>
<b>13</b>	<b>MACHINING</b>	<b>12</b>
<b>14</b>	<b>INSPECTIONS AND TESTING</b>	<b>13</b>
14.1	General	13
14.2	Welding inspection	13
14.2.1	Qualification of non-destructive testing (NDT) personnel	13
14.2.2	Scope of welding inspection/testing	13
14.2.3	Extent of supplementary testing	15
14.2.4	Test reports	15
14.2.5	Control of Non-conforming welds	15
14.3	Dimensional control	15
14.3.1	Manufacturing tolerances	15
14.3.2	Dimensional inspections	15
14.3.3	Control documents	15
<b>15</b>	<b>CORROSION PROTECTION</b>	<b>16</b>
<b>16</b>	<b>DOCUMENTATION REQUIREMENTS</b>	<b>16</b>

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

#### **1 PURPOSE**

This instruction defines the minimum requirements for the manufacture (new construction, refurbishment, or repair), inspection and testing of welded steel assemblies provided to Paul Wurth.

#### **2 SCOPE/APPLICATION**

This is applicable to all suppliers of welded steel assemblies provided to Paul Wurth, including (but not limited to) machine housings, casings for mechanical equipment, gear boxes, valve actuating units, receiving hoppers, pressure equalizing valves, dismantling devices, bleeder valves, drives, bellow arrangements, slow down boxes, distributors, INBA drums, etc.

Exclusions to this instruction are equipment covered by specific standards or regulations such as pressure vessels or piping (e.g. EN 13480, EN 13445, AD 2000, CODAP, GOST R52630, or ASME code), steel structure (e.g. EN1090) etc.

In case the supplier wants to use standards not listed in this instruction, he has to get prior approval by Paul Wurth.

#### **3 SUPPLIER**

The supplier (and their sub-contractors) shall provide and maintain a quality system that will ensure all products delivered conform to the drawings, specifications, and requirements specified in the purchase agreement.

The supplier (and their sub-contractors) shall provide and maintain a quality system that conforms to ISO 9001 (as a minimum) as documented by a third party register.

The supplier (and their sub-contractors) shall be certified according to EN ISO 3834 part 3 (minimum) or EN 1090 part 2, EXC 2 (minimum). In the case a supplier (and/or sub-contractor) is not certified accordingly, an additional evaluation by Paul Wurth is required, which can include e.g. a detailed qualification audit.

Paul Wurth reserves the right to assess and approve the welding quality management system of the supplier (and their sub-contractors), or to have it assessed by an approved notified body or third party.

Where applicable, Paul Wurth reserves the right to assess the welding quality management system according to other codes and standards, which are different from those indicated in this specification (e.g. ASME, AWS D1.1, GB/T Chinese standards, etc.)

#### **4 SUBCONTRACTING**

The supplier can subcontract part of his supplies only after the approval of Paul Wurth. If the supplier intends to use sub-contracted services or activities (e.g. welding, inspection, non-destructive testing, heat treatment), information necessary to meet the applicable requirements of Paul Wurth shall be provided by the supplier to the sub-contractor. The supplier shall remain responsible for the quality of the whole product.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

The supplier shall ensure that each of its subcontractors has a quality/welding management system compliant with this document.

## **5 WELDING**

### **5.1 WELDING DOCUMENTATION**

Prior to the start of manufacturing, the supplier shall provide to Paul Wurth the following welding related documentation for review;

- the list of the qualified welders/welding operators and a copy of their qualification certificates,
- the list of welding coordination personnel and a copy of their qualification certificates,
- the welding plan in accordance with EN 1090 part 2, clause 7.2,
- the welding procedure specifications (WPS) covering each weld joint within the ranges and tolerances stipulated in the relevant standard and according to the supplier's experience,
- the welding procedure qualification record (WPQR) covering each weld joint within the range of variables listed in the relevant standard.

### **5.2 WELDING PROCEDURE SPECIFICATIONS (WPS)**

All welding shall be executed according to the welding procedure specifications (WPS) as stated in EN ISO 15609-1.

The welding processes (or a combination of them) as covered in EN 1011 part 1 can be used. Other welding processes can be used only after agreement from Paul Wurth.

The supplier shall ensure that the applicable welding procedure specifications are correctly used throughout the production process, and are available at the welders working place.

If required, the welding procedure specifications shall be completed by work instructions, which shall also be available at the welders working place.

The supplier shall submit all welding procedure specifications (WPS) to Paul Wurth for review prior to the start of manufacturing (see 5.1)

### **5.3 QUALIFICATION OF WELDING PROCEDURES (WPQR)**

The welding procedure specifications (WPS) to be used in production shall be qualified by an appropriate WPQR. This shall be achieved by performing welding procedure approval tests in accordance with EN ISO 15614-1 and approved by a reputable international third party/notified body (e.g. GL, SLV, DNV, TÜV, SGS, etc.), before initiating the welding works (see 5.1).

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

For non-critical welds, welding procedure approval tests can be in accordance with EN ISO 15613, only after agreement by Paul Wurth.

A WPS can only be used within the ranges as stipulated in the standard. (e.g. WPS qualified with a post weld heat treatment can only be used to weld parts which will undergo a post weld heat treatment, and vice versa).

When a supplier possesses a WPS which has been qualified by another standard, Paul Wurth reserves the right to deem it acceptable for use or not.

A WPQR according to EN ISO 15614-1 & 15613 shall be used regularly in the production; maximum amount of time without use is 3 years.

#### **5.4 WELDERS/WELDING OPERATORS**

Welders and welding operators shall be qualified according to EN ISO 9606-1 and EN ISO 14732. This shall apply to shop and site welders, and shall include welders/operators welding temporary attachments and tack welds.

In the case a welder/welding operator's performance is deemed not acceptable, Paul Wurth reserves the right to forbid this person from continuing to perform welding works for Paul Wurth equipment, until such time the supplier can prove further specific training of that particular welder/operator has been implemented and deemed effective.

The supplier shall submit the details of all welder/welding operators' qualifications to Paul Wurth for review prior to the start of manufacturing (see. 5.1)

#### **5.5 WELDING COORDINATION PERSONNEL**

The supplier shall have at his disposal appropriate welding coordination personnel. Such persons having responsibility for quality activities shall have sufficient authority to enable any necessary action to be taken. The tasks and responsibilities of such persons shall be clearly defined in accordance with EN ISO 14731. At least one qualified and experienced welding coordinator and one deputy welding coordinator shall be nominated. All personnel shall hold an IWE, IWT, or IWS diploma in accordance with the recommendations of EN ISO 14731.

Welding coordinator shall be permanently employed by the supplier.

The supplier shall submit the details of the welding coordination personnel to Paul Wurth for review prior to the start of manufacturing (see. 5.1). Paul Wurth reserves the right to evaluate and deem the supplier's welding coordination personnel suitable.

#### **5.6 WELDING CONSUMABLES**

The supplier shall produce and implement procedures for storage, handling, identification, and use/re-use of welding consumables to avoid moisture pick up, oxidation, damage, etc.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

These procedures shall be in accordance with the requirements of EN ISO 3834-3 (minimum), and according to the recommendations of the consumable manufacturer. Unless otherwise stipulated in the purchase agreement, a test report "type 2.2" in accordance with EN 10204, shall be provided.

#### **6 MATERIALS**

##### **6.1 GENERAL**

The supplier shall make sure that the used materials correspond to the technical documents of the contract (e.g. drawings, bills of materials, technical specification, project specifications), and those prescribed in accordance with the technical delivery conditions of the applicable standard, as well as possible additional requirements specified by Paul Wurth (e.g. EN 10160, EN 10164, etc.).

All used materials shall be new, with rust grades A or B in accordance with ISO 8501-1 only.

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

##### **6.2 INSPECTION DOCUMENTS**

Unless otherwise stipulated in the purchase agreement, the following inspection documents in accordance with EN 10204 shall be provided;

- Inspection certificate "Type 3.1", for steel grades  $Re > 235$  MPa.
- Inspection report "Type 2.2", for steel grades  $Re \leq 235$  MPa.

In case of "Type 3.1" the supplier shall provide certificates for each batch/heat with indication of chemical analysis, mechanical properties, internal soundness (UT results), and heat treatment as per Paul Wurth specification/drawing and as per delivery standard.

All provided inspection documents shall be in good condition and legible and written in the language stipulated in the purchase agreement.

##### **6.3 MATERIAL IDENTIFICATION AND TRACEABILITY**

The supplier shall have and maintain an identification system for materials used in fabrication, so all materials in the completed work can be traced to its origin.

#### **7 PREPARATION OF THE PARTS BEFORE WELDING**

##### **7.1 CUTTING AND CHAMFERING/BEVELING**

Cutting shall be carried out in such a way that the requirements for geometrical tolerances, maximum hardness and smoothness of free edges as specified in the purchase agreement are fulfilled.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

If coated materials are to be cut, the method of cutting shall be selected to minimise the damage on the coating.

Burrs that could cause injury or prevent the proper alignment or bedding of section or sheeting shall be removed.

The surface to be welded shall be thoroughly cleaned of oxide, scale, oil grease or other foreign substance and shall be free of defects such as inclusions, cracks and laminations to avoid any detrimental effect on weld quality. If the cutting and the chamfering of the components reveal inclusions or laminations, the measures for an eventual possible repair are to be taken in agreement with Paul Wurth.

- Cutting and chamfering by machining is permitted for all materials.
- Thermal cutting is permitted, however precautions shall be taken to ensure that the edges are not adversely influenced by hardening. If not stipulated in the purchase agreement, the quality of cut surfaces shall be in accordance with EN ISO 9013-44.
- Shearing and nibbling is permissible, taking into account the steel grade and thickness. The free edge surfaces shall be checked and smoothed as necessary in order to remove significant defects. 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.

#### **7.2 FORMING**

Steel may be bent, pressed, rolled, or forged to the required shape either by the hot or by the cold forming processes, provided the properties are not reduced below those specified for the worked material.

Requirement and recommendations for hot, cold forming and flame straightening of steels shall be as given in the relevant product standards and/or by the steel manufacturer.

Shaped components that exhibit cracking or lamellar tearing, or damage to surface coating, shall be treated as non-conforming products.

Flame straightening can be used to correct distortion if required. This shall be undertaken by local application of heat, ensuring that the maximum steel temperature and the cooling procedure are controlled. The supplier shall develop a suitable procedure and present to Paul Wurth upon request. Max temperature for flame straightening is typically executed in the range 650-680 °C. It is forbidden to perform flame straightening on all thermomechanically rolled steels (e.g. M-grades according to EN 10025-4)

Cold forming produced either by roll forming, pressing or folding shall conform to the requirements for cold formability given in the relevant product standard or by the steel manufacturer. Hammering shall not be used. If a stress relief treatment is carried out after cold forming, the supplier shall follow the guidelines specified in the codes/standards or recommendation of the steel supplier.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

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.

## **8 PREPARATION AND EXECUTION OF WELDING**

### **8.1 GENERAL**

Components to be welded shall be brought into alignment and held in position by tack welds or external devices and maintained during initial welding.

Assembly shall be carried out such that the fit-up of joints and the final dimensions of the components are all within the specified tolerances. Suitable allowances shall be made for distortion and shrinkage. All joints to be welded shall be readily accessible and easily visible to the welder.

Generally the requirements of EN 1011 "Recommendations for metallic materials welding" shall be followed;

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

### **8.2 JOINT PREPARATION**

Joint preparation shall be appropriate for the welding process and shall comply with the type of preparation used in the related welding procedure test. Tolerances for joints preparations and fit-up shall be given in the WPS. Joint preparation shall be in accordance with EN ISO 9692-1, EN ISO 9692-2 and EN 1708-1.

All surfaces to be welded shall be dry and free from material that would adversely affect the quality of the welds or impede the process of welding (rust, organic material, galvanising, etc...)

Prefabrication primers (shop primers) shall not be left on the fusion faces.

### **8.3 PREHEATING**

Preheating shall be carried out in accordance with EN 1011-2, and confirmed as acceptable by WPS, and applied during welding, including tack welding and the welding of temporary attachments.

Preheating temperature shall be controlled in accordance with EN ISO 13916.

### **8.4 TACK WELDING**

Tack welds shall be made using a qualified welding procedure. The minimum length of the tack shall be the lesser of four times the thickness of the thicker part or 30 mm, unless a shorter length can be demonstrated as satisfactory by test.



## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

All tack welds not incorporated into the final welds shall be removed. Tack welds that are to be incorporated into the final weld shall have a suitable shape and be carried out by qualified welders. Tack welds shall be free from deposition faults and shall be cleaned thoroughly before final welding. Cracked tack welds shall be removed.

If necessary, tack welds shall be applied to retain the components in their alignment during welding. The lengths of the individual tack welds and their frequency should be specified in the relevant welding procedure specification (WPS) or in other documents, if required. The tack welds shall be carried out in a balanced sequence in order to reduce the risk of distortion and to maintain good fit-up.

Where applicable, the recommendations as stipulated in the different parts of EN 1011 shall be followed.

#### **8.5 TEMPORARY FIXING DEVICES**

Where the assembly requires the use of temporary welded attachments (e.g. for supporting or alignment purposes, transmission of forces, etc.) these shall be configured in such a way that they can be easily removed without damaging the structure.

The material of attachments, welding consumables, and the welding procedures used shall be compatible with the parent metal.

The removal of temporary fixing devices shall be carried out in such a way to ensure the characteristics of the parent metal are not affected. Chipping and hammering are not permitted.

The surface of the parent metal shall be carefully ground after the removal of these welded-on parts, ensuring the parent metal's wall thickness has not been reduced below the minimum value indicated on the drawing. Surface inspection (i.e. magnetic particle 'MT' or penetrant testing 'PT') shall be carried out to demonstrate that the material is free from unacceptable imperfections.

#### **Note:**

The recommendations as stipulated in EN 1011 parts 1 to 3, where applicable, shall be followed.

### **9 EXECUTION OF THE WELDING**

All the welding operations shall be supervised permanently by the manufacturer, in this particular case by his welding coordinator as defined in point 5.5.

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. In this case a specific agreement shall be given by Paul Wurth.

The consumables shall be stored and maintained according to the recommendations of the consumables supplier (see point 5.6)

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

Precautions shall be taken to avoid stray arcing, and if stray arc do occur the surface of the steel shall be lightly ground and checked. Visual checking should be supplemented by penetrant or magnetic particle testing.

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. When possible, suitable run-on/run-off pieces shall always to be used.

If the design requires full penetration, both side welding shall always be executed wherever possible, and shall be preceded by back gouging (e.g. a thermal, mechanical, or grinding process). When using a copper covered carbon electrode, subsequent grinding is required.

If not otherwise stipulated, all welds shall be executed as all-around welds.

All weld spatter shall be removed.

Visible imperfections such as cracks, cavities and other not permitted imperfections shall be removed from each run before deposition of further runs.

All slag shall be removed from the surface of each run before each subsequent run is added and from the surface of the finished weld. Particular attention shall be paid to the junctions between the weld and the parent metal.

#### **Note:**

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

### **10 IDENTIFICATION OF THE WELDS**

The supplier shall maintain an accurate record of which welder or welding operator has carried out each weld.

This may be by marking each weld with a welder identification mark or alternatively by means of records which assure traceability of the welder to his work throughout the construction of the assembly. Hard stamping shall be avoided.

### **11 POST WELD CORRECTION OF DISTORTIONS**

Parts which have been distorted beyond the specified tolerances by welding may be corrected only by a specified method. The method for correcting the distortion should not be deleterious to the component.

Flame straightening shall be carried out according to a written procedure by the supplier, which shall also be in line with the recommendations of the steel manufacturer (see 7.2)

Peening of welds may be used only if specified.

## PW Group Instruction

### PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies

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.

#### 12 POST WELD HEAT TREATMENT

Unless otherwise specified, post-weld heat treatment (PWHT) shall be carried out in accordance with the following;

PWHT applies to the material sub-group 1.1 and 1.2 (delivery conditions +N (Normalised) and +AR (As Rolled) only) according to ISO / TR 15608, like e.g.:

<b>S235JR</b>	<b>1.0038</b>
<b>S355J2+N</b>	<b>1.0577+N</b>
<b>P235TR2</b>	<b>1.0255</b>
<b>P355N</b>	<b>1.0562</b>
<b>P275NH</b>	<b>1.0487</b>
<b>P265GH</b>	<b>1.0425</b>
<b>P355NH</b>	<b>1.0565</b>
<b>P355GH</b>	<b>1.0473</b>

The requirements of EN ISO 17663 shall be followed by the supplier, where applicable:

**Stress relief temperature:** 550 - 600 °C.

The rate for heating or cooling of the vessel / equipment shall not exceed, if not otherwise specified by the steel manufacturer, the following:

##### 1. Rate of heating

- $e_n \leq 25$  mm      220 °C per hour
- $25 < e_n \leq 100$  mm     $(5500/e_n)$  °C per hour
- $e_n > 100$  mm      55°C per hour

##### 2. Holding time at stress relief temperature

- $e_n \leq 35$  mm      30 min
- $35 < e_n \leq 90$  mm     $e_n - 5$  min
- $e_n > 90$  mm       $40 + 0.5 \times e_n$  min

##### 3. Rate of cooling

- $e_n \leq 25$  mm      220 °C per hour
- $25 < e_n \leq 100$  mm     $(5500/e_n)$  °C per hour

## PW Group Instruction

### PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies

- $e_n > 100$  mm      55°C per hour
- From 150 °C cool down to ambient temperature by opening the furnace door

#### **$e_n$ : definition:**

Where the vessel/equipment contains welded joints connecting parts which differ in thickness, the thickness  $e_n$  to be used in applying the requirements for post weld heat treatment shall be:

- The thinner of the two parts butt-welded together
- The thickness of the shell in connection to flanges or similar connections
- The weld throat thickness (fillet welds) of the shell to nozzle weld in nozzle attachment welds

The subcontractor shall guarantee the general and geometric tolerances of the parts.

For each treatment the subcontractor shall produce an inspection certificate type 3.1 according to EN 10204, with the following information to be provided;

- Name of the subcontractor
- Paul Wurth project reference number
- Paul Wurth order number
- Designation of the parts with drawing and item number
- Type of heat treatment
- Identification of the furnace (in case the subcontractor has more than one furnace)
- Heating/cooling rate, holding time, temperatures.
- Related time-temperature-diagram
- Date and signature

#### **Note:**

Stress relief by vibration (vibratory stress relief, VSR) shall be used as an alternative method to thermal stress relief only after the approval of Paul Wurth.

### **13 MACHINING**

In general final machining shall only be executed after post weld heat treatment or vibratory stress relief (VSR).

The machining of flanges shall always be carried out after the flange has been welded to the connection tube, unless weld neck flanges are being used.

Machining dimensions and tolerances are specified on the drawings, control sheets or specifications of Paul Wurth.

All machined surfaces shall be protected against corrosion using the appropriate coating for the intended shipping method/duration (e.g. Tectyl® protective coatings)

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

#### **14 INSPECTIONS AND TESTING**

##### **14.1 GENERAL**

In general welds seams and dimensions have to be in accordance with the design. Supplementary specific requirements for dimensional control, weld quality levels are provided by Paul Wurth within the technical specification/drawings, etc.

All inspection and testing shall be undertaken to a predetermined plan with documented procedures.

All measurement and test equipment used for inspections shall be calibrated according to the Quality Management System of the supplier and/or the recommendations of the manufacturer of the equipment, and shall only be used during the corresponding validity period.

Welds not indicated in the drawings (shop splices) shall be 100% checked: VT, UT/RT (see 14.2.2, weld stamp below). The shop splices shall be shown on the supplier's fabrication drawings (as built).

All dimensions/welds to be inspected shall be in a condition that allows proper interpretation of the required quality/tolerances.

In case of major non-conformances or deviations discovered, the supplier shall inform Paul Wurth in order to define and establish a suitable corrective/follow up action.

##### **14.2 WELDING INSPECTION**

###### **14.2.1 QUALIFICATION OF NON-DESTRUCTIVE TESTING (NDT) PERSONNEL**

Non-Destructive Testing (NDT), with the exception of visual inspection (VT), shall be performed by personnel qualified and certified according to EN ISO 9712, Level 2 for MT, PT, UT, and RT. Personnel responsible for visual testing (VT) shall be qualified but need not be certified.

###### **14.2.2 SCOPE OF WELDING INSPECTION/TESTING**

If not otherwise indicated in the drawings, the technical specification, quality control plan (QCP), etc., the non-destructive testing (NDT) shall be performed according to the weld stamp below.

The final non-destructive testing shall always be executed after a post weld heat treatment (PWHT).

Further guidance regarding non-destructive testing is given in EN ISO 17635.

PW Group Instruction

PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies

Non-destructive testing of welding	Standards	Acceptance standards	Scope of testing	
Visual Examination (VT)	EN ISO 17637	EN ISO 5817 Quality level C	100 %	
Magnetic Particle inspection (MT)	EN ISO 17638	EN ISO 23278 Acceptance level 2x	B, A, C, D, F, G	100 % * 20 % *
Penetrant Testing (PT)	EN ISO 3452-1	EN ISO 23277 Acceptance level 2x	B, A, C, D, F, G	100 % * 20 % *
Radiographic Testing (RT)	EN ISO 17636-1 class B	EN ISO 10675 - 1 Acceptance level 2	F G	20 % 100 %
Ultrasonic Testing (UT)	EN ISO 17640 testing level B	EN ISO 11666 Acceptance level 3	C D	20 % 100 %

- A: Standard fillet welds; k-welds; butt welds \* Magnetic particle inspection can be replaced by Penetrant Testing and or vice versa
- B: Lifting eyes Penetrant Testing and or vice versa
- C: Full penetration welds and butt welds (K welds) (thickness  $t \geq 10\text{mm}$ )
- D: Full penetration welds not mentioned or indicated in the drawing (thickness  $t \geq 10\text{mm}$ )
- F: Full penetration welds (thickness  $t < 10\text{mm}$ )
- G: Full penetration welds not mentioned or indicated in the drawing (thickness  $t < 10\text{mm}$ )

- 1) Welds marked with (#) must be included in the test scope.
- 2) In case of defect detection at initial sample inspection (e.g. 20%), the extent of testing has to be increased in gradual manner, if necessary up to 100%.
- 3) In case of doubt, radiographic examination must be supplemented by ultra-sonic examination and inversely.
- 4) At the beginning of fabrication, the extent of testing must be increased in order to verify, if the welding parameters/process etc. are correct.
- 5) In case of partial surface crack examinations (e.g. 20%) the zones to be checked must also be chosen, where visual examinations give some doubt, furthermore weld crossings and end of welds must be checked.
- 6) All NDT must only be performed at least 24 hours after welding completion.

TECHNICAL REQUIREMENTS

Please consult the technical specifications and quality control plan (QCP) of the project.  
In case of different requirements the stricter ones have to be applied.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

#### **14.2.3 EXTENT OF SUPPLEMENTARY TESTING**

If the weld testing reveals non-acceptable imperfections/indications, which are out of the acceptable level stipulated in the purchase agreement, the testing shall be extended according to the applicable weld stamp on the drawing or as above.

#### **14.2.4 TEST REPORTS**

All non-destructive testing shall be performed in accordance with written procedures as required by the standard for the individual testing method or as specified, and by qualified and certified personnel.

In support of all NDT activities, written test reports shall be prepared in accordance with the standards referred to in EN ISO 17635.

#### **14.2.5 CONTROL OF NON-CONFORMING WELDS**

All welds which do not conform to the design specification shall be corrected. The supplier shall carry out an investigation in order to find the reason for the non-conforming results.

All repairs by welding shall be carried out in accordance with qualified welding procedures. Any major weld repairs performed after post weld heat treatment shall require the stress relief process to be repeated.

Corrected welds shall be checked and shall meet the requirements of the original welds, and recorded in the NDT report.

### **14.3 DIMENSIONAL CONTROL**

#### **14.3.1 MANUFACTURING TOLERANCES**

If not otherwise specified, e.g. in the drawings, technical specifications, quality control plan (QCP), control sheets (e.g. IQS), EN ISO 13920, class BF shall be applied.

#### **14.3.2 DIMENSIONAL INSPECTIONS**

Dimensional inspections shall be carried out by the quality department of the supplier.

If the purchase agreement requires the presence of Paul Wurth and/or the final customer during such inspections, the supplier has to notify Paul Wurth in due time of the inspection date (e.g. normally 2 weeks in advance within Europe). For contracts outside of Europe, sufficient notice periods shall be agreed with Paul Wurth before start of manufacturing.

#### **14.3.3 CONTROL DOCUMENTS**

The actual measured dimensions shall be reported;

- on the control sheet provided by Paul Wurth attached to the purchase agreement,
- in a dimensional inspection report issued by the supplier,
- indicated on an assembly or detail drawing.

## PW Group Instruction

### **PWGINS201R00 - Manufacture, inspection & testing of welded steel assemblies**

#### **15 CORROSION PROTECTION**

All surface preparation and corrosion protection work carried out in the workshop shall only be executed after inspection and final acceptance of the components.

All corrosion protection works shall be executed according to the paint manufacturer's recommendations, Paul Wurth's technical specification, drawings, purchase order.

All tests, including the dry film thickness (DFT) for all layers/coats shall be recorded in a report.

In general the requirements of EN ISO 12944, parts 1-7 shall be followed.

#### **16 DOCUMENTATION REQUIREMENTS**

If not otherwise indicated, the quality documentation has to be provided by the supplier as specified in the applicable documentation requirements and/or related quality control plan (QCP).