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Quality Requirements Specification (QRS)
General Quality Requirements
in Siemens Industry Sector

Cast Iron Parts

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- hereinafter referred to as "**Siemens**"

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SIEMENS AG Industry Sector

QRS: Cast Iron Parts

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Contents

1. Definitions and Documents	4
1.1. Definitions and abbreviations.....	4
1.1.1. Siemens.....	4
1.1.2. Cast part	4
1.1.3. Supplier	4
1.1.4. Subcontractors	4
1.2. Documents referred to	4
1.2.1. General standards	4
1.2.2. Material standards	4
1.2.3. Surfaces and Dimension	4
1.2.4. Testing.....	5
2. General Considerations	5
2.1. Scope / applicability	5
2.2. Ruling in the event of inconsistencies	5
2.3. Placing of casting orders with subcontractor	6
2.4. Special Release	6
3. Technical Requirements	7
3.1. Appearance of Castings.....	7
3.2. Dimensional requirements and machining allowances	7
3.3. Material Properties	7
3.4. Surface hardness	7
3.5. Heat treatment	8
3.6. Testing	8
3.7. Identification Marking	8
4. First Sample Qualification	8
5. Environmental Requirements	9
5.1. Aspects of procurement and manufacturing	9
5.2. Special requirements on the Products.....	9
6. Packaging	10
7. Storage Conditions	10
8. Appendices	10
9. Read and Accepted	11

1. Definitions and Documents

1.1. Definitions and abbreviations

1.1.1. Siemens

As well as **Siemens** in the sense of this specification is the Siemens AG Industry Sector with all locations and subsidiary companies, all foreign companies of the Siemens AG with products of the Industry sector as well suppliers of Siemens which cast parts buy to use in their products and for supply of these products to Siemens.

1.1.2. Cast part

Products are all by Siemens ordered products which are manufactured as raw parts by means of pouring of cast iron melt into sand mould.

1.1.3. Supplier

Supplier, unless noted otherwise, refers to the corporation, company, partnership, sole proprietorship or individual with whom Siemens places a Purchase Order.

1.1.4. Subcontractors

Subcontractor is a supplier whose customer is a Siemens supplier and who receives orders from this customer over the whole production process or individual process steps of the products for Siemens.

1.2. Documents referred to

The listed norms are to be applicable in the version which is valid at the moment of ordering.

1.2.1. General standards

DIN EN 1559-1	Founding- Technical conditions of delivery - Part 1 General
DIN EN 1559-3	Founding- Technical conditions of delivery - Part 2 Additional requirements for iron castings
DIN EN 1560	Founding- Designation system for cast iron - Material symbols and material numbers;

1.2.2. Material standards

DIN EN 1561	Founding- Grey cast irons;
DIN EN 1563	Founding- Spheroidal graphite cast iron;

1.2.3. Surfaces and Dimension

EN ISO 12944-4	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation
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ISO 8062	Castings - System of dimensional tolerances and machining allowances
DIN EN 12890	Founding - Patterns, pattern equipment and core boxes for the production of sand moulds and sand cores

1.2.4. Testing

EN 10002-1	Metallic materials - Tensile testing - Part 1: Method of testing at ambient temperature
EN 10045-1	Charpy impact test on metallic materials - Part 1: test method
EN ISO 6506	Metallic materials - Brinell hardness test - Part 2: Verification and calibration of testing machines
DIN EN 473	Non destructive testing - Qualification and certification of NDT personnel- General principles
EN ISO 945	Designation of microstructure of cast irons - Part 1: Graphite classification by visual analysis
DIN EN 1369-1	Founding - Magnetic particle inspection
DIN EN 1370	Founding - Surface roughness inspection by visual tactile comparators
DIN EN 1371-1	Founding - Liquid penetrant inspection - Part 1: Sand, gravity die and low pressure die castings
DIN EN 12680-1	Founding - Ultrasonic examination - Part 1: Steel castings for general purposes
DIN EN 12680-3	Founding - Ultrasonic examination - Part 3: Spheroidal graphite cast iron castings
DIN EN 12681	Founding - Radiographic examination
DIN EN 10204	Metallic products - Types of inspection documents

2. General Considerations

2.1. Scope / applicability

The Quality Requirements Specification (QRS) for Cast Iron Parts applies for all parts supplied to Siemens AG Industry Sector which fall within the area of commodity. These requirements have to be regarded as minimum requirements which, if necessary, have to be amended by product or process specific agreements. Parts are all individual parts, semi-finished parts and assemblies, supplied by one supplier. Prototypes and samples are exempted if they are ordered for material tests and tests of properties of products which are not intended for serial production.

2.2. Ruling in the event of inconsistencies

In the event of a conflict between QRS and other documents, the order of precedence from highest to lowest is as below:

1. The product specification (drawing, parts list, product review)
2. Other details / stipulations / specifications which provide specifications to supplement the drawings (e.g. factory specification)
3. Appendices and vendor addenda contained in a GQA which has been agreed
4. Quality requirements (QRS) specific to the material area

5. General standards and stipulations itemized in standard part GQAs / ZVEI QAAs.

The use of geometrical data files requires a written agreement about the status of the drawings in relation to the data files (draft angles; cast on sign; tolerances and so on).

Always those Siemens material specific regulations, standards and documents are valid, which have been agreed on and signed by Siemens and supplier at last.

2.3. Placing of casting orders with subcontractor

All used subcontractors for at least the process steps:

- core making
- mould making and pouring
- cleaning and fettling
- heat treatment
- priming and machining
- testing

of the supplier have to be announced to Siemens and require the written release by Siemens. The supplier has to install an approval process for subcontractors and makes sure to provide all relevant information to the subcontractor. On demand documents of qualification and further information have to be supplied to the orderer. Siemens reserves the right to conduct an audit of subcontractors or to conduct first-sample inspection by Siemens or by a company assigned by Siemens for this inspection.

This release by Siemens, the accomplished First Sample Qualification and/or auditing of the subcontractor by Siemens does not relieve the supplier of its exclusive responsibility for the products supplied by it to Siemens.

2.4. Special Release

If the supplier intends to deliver products not corresponding to product specifications, a previous written special release by Siemens shall be necessary.

For this if necessary location-specific defaults and forms must be used.

A special release refers only to a temporary absence of specific quality characteristics of the respective products which are described in detail in the respective special release. This description shall contain at least:

- the exact features of the restricted quality characteristics
- the quantity time period of the validity
- the nature of the identification.

This special release shall not release the supplier from complying with the other quality characteristics and requirements in the product specifications not expressly excluded in the respective special release.

3. Technical Requirements

Technical requirements listed below are minimum technical requirements which can be amended by further specifications and by product-specific requirements.

3.1. Appearance of Castings

Neatly cast, fettled and blasted (Sa 2 ½ acc. to DIN ISO 12944 T4).

Casting surface (acc. to DIN EN 1370) should achieve following minimum requirements compared to Scrata - Comparator for assessing surface quality.

- Surface roughness: A3
- Surface inclusions: B1
- Gas porosity: C2
- Surface finish – mechanical dressing: H1

Other surface defects (e.g. scale layer, sand grains, over primed blasting materials and similar) are not allowed. Cementation, filling and finishing (repair) welding is allowed only after transmitting a written analysis of defect to Siemens, and receiving of a written approval from Siemens.

Priming has to be done according to the product specification or according to the order.

3.2. Dimensional requirements and machining allowances

Dimensional requirements and machining allowances have to be completed according to DIN ISO 8062. In case of no other tolerance grade is specified, tolerance grade CT11 is agreed.

3.3. Material Properties

For properties of Products DIN-EN 1561 (GJL) or DIN-EN 1563 (GJS) are valid.

For GJL (DIN-EN 1561) test bars acc. DIN-EN 1561 are to be prepared.

Design and type of cast samples for GJS (DIN-EN 1563) have to be derived from the material grade named in the order/drawing.

Cast samples must be poured from each melt and/or melt treatment and must be heat treated in case heat treatment of casting is required.

In case test pieces should to be machined from the casting, then their form, location (position) in the casting and nominal value of properties are to be agreed with Siemens and written in the Inspection certificate.

Low residual stress of Products shall be ensured. This can be reached by cooling down below 450°C before shake out. Should this not be achieved stress relief annealing shall be conducted.

3.4. Surface hardness

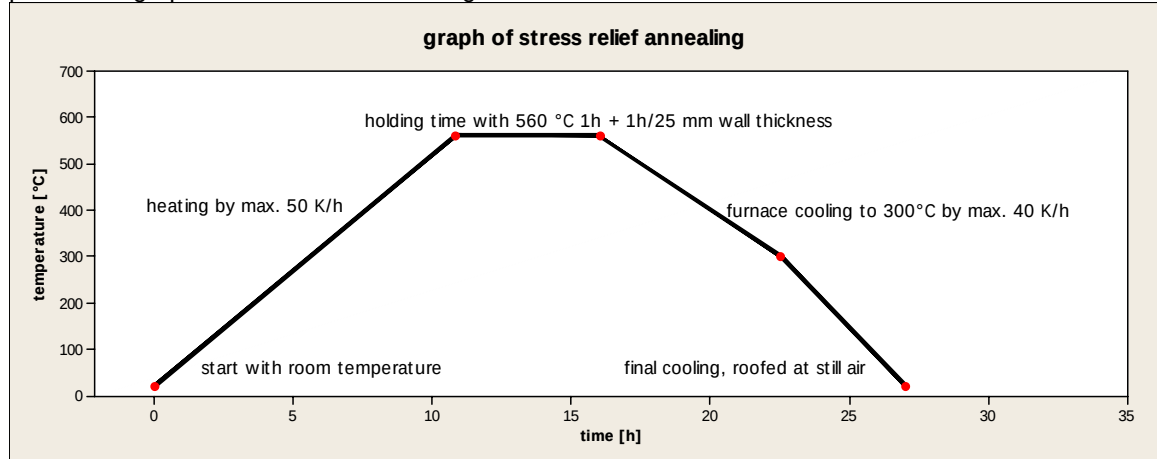
Hardness testing of Products shall be conducted according to ISO 6506-1 according Brinell method. For test at the casting additional mobile test devices are approved which use at least busting a steel ball in casting surface and evaluation by measuring

the diameter of print. (e.g. shear force hardness tester, Poldi-hammer, Kingston-hardness tester)

3.5. Heat treatment

Heat treatment shall be conducted according to the product specific requirements or if a low residual stress condition could not be ensured after casting (see 3.3). Then stress relief annealing shall be conducted with following graph:

picture 1 – graph of stress relief annealing



3.6. Testing

All material properties according to DIN EN 1561 and DIN EN1563 must be examined and the results must be documented according to the respective DIN standards.

3.7. Identification Marking

For identification purposes all the parts shall be marked on their surface with the information: pattern number; pouring date/charge number; supplier logo and if applicable the cavity number. Identification marks shall be done on non-machined surfaces of casting with character size adapted to the manufacturing method and casting size.

4. First Sample Qualification

First samples are Products which are manufactured under serial production conditions using serial production tools and manufacturing facilities.

First samples are necessary:

- When a new Product is ordered for the first time,
- After each modification of Product by SIEMENS,
- After pattern new make or pattern change,
- Due to supply stop or supply/product interruption for more than three years

- Due to the change of manufacturing method, relocation of production or due to use of newer or relocated machinery or process devices,
- Due to the use of alternative materials (e.g. primer),

The measure examination has to take place for all drawing dimensions incl. radii and angles. For more cavities with copied patterns (made by cast resin or CNC-manufactured) need to measure only one cavity complete and for all other only process depending dimensions and main dimensions.

If samples are necessary, the supplier has to announce this independently at the latest with the receipt of the next order at Siemens and to agree quantity; required tests and schedule.

Potentially Siemens will abdicate a first sample qualification by Siemens and will transfer the examination of the changes to the supplier by an internal sample qualification by the supplier.

For sampling relevant changes have to be accomplished during series production, then this is to be agreed upon before the change with Siemens

5. Environmental Requirements

The products shall comply with all valid regulation in the European Union (among others ROHS guideline 2002-95 EG).

The following chapter refers to the guidance to the environmentally friendly product design of Siemens AG.

5.1. Aspects of procurement and manufacturing

- Reduce the production waist through corresponding product design.
- Consider environmental aspects while selecting and procuring semi-finished parts, components and OEM-Products.
- Respect bans, restrictions and prevention lists during the selection of materials and components.
- Avoid dangerous materials in the manufacturing of goods.
- Minimize energy consumption in the manufacturing.
- Obtain information about environmentally relevant aspects of procured semi-finished parts, components and OEM-Products.
- Minimize amount of packaging (weight, volume)
- Optimize environmental compatibility of packaging concerning material selection and logistics.
- Minimize waste such as old sand, sewage and thinners.

5.2. Special requirements on the Products

- Supplier guarantees that the delivered products are free of radioactive/nuclear contamination. The supplier can ensure it by requesting a certificate/conformation at his sub-suppliers (primarily his raw material

suppliers and scrap dealers) about the absence of radioactive/nuclear contamination of all delivered metallic materials

- Materials used in surface treatment, priming and conservation shall comply to the regulations of the European Union and must be approved in writing by Siemens.

6. Packaging

Packaging requirements shall be agreed upon Siemens depending on product requirements. All packaging materials, such as wood, plastic foils, and plastics shall correspond to the valid regulations of European Union (e.g. IPPC for wood) for import and recycling.

7. Storage Conditions

Depending on transportation and storage times, suitable packaging and rust-proofing means shall be defined together with Siemens. The materials to be used shall be fixed in writing. Additional rust-proofing with oils, greases, etc, is not allowed.

8. Appendices

no attachments

9. Read and Accepted

The QRS has been noted and accepted in writing.

Place, Date _____

Company

Signature(s)

Name(s)

Title/Function