



Copper tube system

Quality assurance
RAL-GZ 641

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In any case of doubt, the German language shall prevail!

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**Quality assurance
RAL-GZ 641**

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This quality assurance has been compiled in compliance with the Gütezeichen (quality mark) principles underlying an approval procedure conducted by RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V. with the collaboration of the affected professional and trade groups. This issue replaces the quality assurances RAL-GZ 641/1, issued October 2014; RAL-RG 641/2, issued October 2002; RAL-RG 641/3, issued January 2000; and RAL-RG 641/4, issued April 2001.

Bonn, September 2018

**RAL DEUTSCHES INSTITUT
FÜR GÜTESICHERUNG
UND KENNZEICHNUNG E.V.**

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General quality and test specifications for copper tube systems

RAL-GZ 641

(In any case of doubt, the German language shall prevail!!)

1 Scope

These general quality assurance and test specifications define the general principles applying to the content and scope of monitoring measures for copper tube systems. Special quality assurance and test specifications define detailed performance requirements for the affected separate areas. These areas are:

- copper tubes, RAL-GZ 641/1,
- press fittings made of copper tube, RAL-GZ 641/2,
- soldering fittings made of copper tubes, RAL-GZ 641/3,
- hard solders and hard soldering fluxes, RAL-GZ 641/4,
and
- soft solders, soft soldering fluxes, and soft soldering pastes, RAL-GZ 641/5

1.1 General

These general quality assurance and test specifications apply only in conjunction with the assigned special quality assurance and test specifications.

1.2 Terminology

Copper tubes as defined under the quality assurance and test specifications are seamless semifinished products (installation tubes) of copper of circular cross section and unbroken circumference with an unvarying wall thickness over their whole length. They are used in gas and drinking water installations and heating systems, including radiant panel installations. Depending on their use, they may present a tinplated inner surface or be fitted with a nonremovable plastic jacket.

Press fittings made of copper tubes as defined under the quality assurance and test specifications are fittings made of copper tubes that are tool pressed in position to form a permanent connection with copper tubes. The tightness of this connection is safeguarded with elastomer sealing elements, e.g. O rings. Press fittings may take the form of elbows, reducing adapters, T pieces, sleeves, caps, or plugs.

Soldering Fittings made of copper tube as defined under the quality assurance and test specifications are fittings made of copper tubes that are hard or soft soldered to form a connection with copper tubes. The uniform spread of solder is obtained through its capillary effects between the tube and fitting ends. Solder fittings may take the form of elbows, T pieces, sleeves, reducing adapters, or reducing sleeves.

Hard solders and hard soldering fluxes as defined under the quality assurance and test specifications are metallic materials (metals or metal alloys) in the form of wires, rods, or bars for the hard soldered connection of copper

tubes / solder fittings. Hard soldering is a method for fusing materials whose working temperatures exceed 450° C. Hard soldering fluxes are added to solder to enhance its wetting properties on workpieces.

Soft solders, soft soldering fluxes, and soft soldering pastes as defined under the quality assurance and test specifications are metallic materials (metals or metal alloys) in the form of wires, rods, bars, or pastes for the soft soldered connection of copper tubes / solder fittings. Soft soldering is a method for fusing materials whose working temperatures are less than 450° C. Soft soldering fluxes are added to solder to enhance its wetting properties on workpieces.

1.3 Hygiene requirements

Materials coming into contact with drinking water must not present any health issues. They must not detract from the quality defined in the German drinking water ordinance TrinkwV. Organic materials must fulfil the guidelines published by the German Federal Environment Agency (UBA) for the assessment of materials in contact with drinking water. Metal bodies and coatings must comply with the requirements under DIN 50930-6 and be on the list of products approved by the UBA for drinking water hygiene.

1.4 Other applicable regulations

There must be adherence to all other applicable regulations, laws, and directives in the latest wording of the sections covered by the scope of the general and special quality assurance and test specifications: See the affected special quality assurance and test specifications.

2 Quality assurance and test specifications

The quality assurance and test specifications are presented in the affected special quality assurance and test specifications.

3 Monitoring

3.1 General

Monitoring is divided into:

- initial testing procedure,
- constant self-regulation,
- neutral independent monitoring
- repeat testing.

3.2 Initial testing Procedure

Products must pass the initial testing procedure before they can be awarded and may bear the quality assurance association's Gütezeichen (quality mark). This initial testing procedure verifies whether the applicant's products fulfil without exception all of the requirements defined in the general and special quality assurance and test specifications. The applicant is obliged to submit to the quality assurance association all of the documents needed for the introduction and implementation and to provide products enabling the external tester commissioned by the quality assurance association to examine the applicant's quality level. This initial testing procedure is arranged by the quality assurance association's committee, which commissions a testing body to conduct the tests (see Annex A to these general quality assurance and test specifications).

This initial testing procedure serves in addition to determine whether the products exhibits the properties needed to fulfil properly the general and the assigned special quality assurance and test specifications. Initial testing procedure obliges the applicant to submit when prompted for inspection by the external tester all records available to date, e.g. documents on participation in specialised training courses, verification of implemented constant self-regulation measures, etc.

The external tester compiles a test report on this initial testing procedure. The applicant and the quality assurance association's committee each receive a copy of the test report sent to them.

3.3 Constant Self-Regulation

Adherence to the affected special quality assurance and test specifications requires that the Gütezeichen (quality mark) bearer must implement continuous, and at all times reproducible constant self-regulation of all quality assured products.

The Gütezeichen (quality mark) bearer must maintain meticulous records (documentation) of this constant self-regulation. These documents must be archived in a suitable form for five years and submitted to the neutral independent monitoring body.

3.4 Neutral Independent Monitoring

Neutral independent monitoring serves to determine whether the Gütezeichen (quality mark) bearer continues to fulfil the quality assurance and test specifications and the requirements defined for the proper performance of these tests. An external inspector commissioned by the quality assurance association's committee (see Annex A) must perform neutral independent monitoring based on the general and special quality assurance and test specifications regularly at the Gütezeichen (quality mark) bearer's facilities. This does not require prior announcement. In this respect, the Gütezeichen (quality mark) bearer is obliged to provide the external tester from the quality assurance association regularly with quality assured products from ongoing production. The commissioned external tester must

verify his legitimacy on site in the form of an order issued in writing by the quality assurance association's committee. This obligation to verify legitimacy may not cause delays to the testing procedure.

During neutral independent monitoring, the tester must inspect how constant self-regulation is handled and examine the findings for completeness and conclusiveness.

Furthermore, the Gütezeichen (quality mark) bearer must verify without prior prompting that the latest wording of all other applicable regulations, directives, and standards listed under Section 1.4 and in Annex B have been provided as the basis of this work.

3.5 Repeat testing

If, during neutral independent monitoring, the commissioned external tester ascertains that the Gütezeichen (quality mark) bearer's Quality fails to comply with one or more of the general or special quality assurance and test specifications, he must inform immediately the quality assurance association of this, irrespectively of the issuing of a test report.

Thereupon, the quality assurance association's board, after consulting with the quality committee, may order a repeat testing whose date, content, and scope are set down by the quality committee.

If the repeat testing also fails, the quality assurance association's board, after consulting with the quality committee, may implement further measures as defined under Section 5 of the implementation requirements issued by Gütegemeinschaft Kupferrohr e.V.

3.6 Test costs

The costs of each performed monitoring or testing must be borne by the applicant or Gütezeichen (quality mark) bearer.

3.7 Test and monitoring reports

A test report must be compiled for each and every testing or monitoring performed by the commissioned external tester. The applicant or Gütezeichen (quality mark) bearer and the quality assurance association's office receive a copy of this test report sent to them.

4 Labelling

Services that have been provided in compliance with the general and the assigned special quality assurance and test specifications and that have led to the award of the quality assurance association's Gütezeichen (quality mark) may be labelled with the Gütezeichen (quality mark) as depicted in the following:



This Gütezeichen (quality mark) must be supplemented with the product related information as set down in the special quality assurance and test specifications.

The Gütezeichen (quality mark) may be awarded and borne exclusively in compliance with the implementation regulations issued by Gütegemeinschaft Kupferrohr e.V.

5 Changes

All changes, including text edits, to the general and special quality assurance and test specifications require prior approval issued in writing by RAL before they become effective. These come into force when the quality assurance association's board notifies the Gütezeichen (quality mark) bearer after an appropriate transition period following prior consent of the general meeting.

Annex A

Testing bodies

The tests are performed by the following testing bodies appointed by DVGW CERT GmbH:

MPA – Hannover
Materialprüfanstalt für das Bauwesen und Produktionstechnik
An der Universität 2
D-30823 Garbsen
Tel.: +49 (0) 511 762-43 62
Fax: +49 (0) 511 762-30 02
Email: office.garbsen@mpa-hannover.de

TÜV Rheinland LGA Bautechnik GmbH
Tillystraße 2
D-90431 Nürnberg
Tel. +49 (0) 911 81771-280
Fax +49 (0) 911 81771-282
Email: bautechnik@de.tuv.com

Materialprüfungsamt Nordrhein-Westfalen
Marsbruchstraße 186
D-44287 Dortmund
Tel. +49 (0) 231 4502-450
Fax +49 (0) 231 4502-545
Email: info@mpanrw.de

The latest list of approved testing bodies can be consulted on the Gütegemeinschaft Kupferrohr e.V. website at <https://guete-kupferrohr.de/downloads.html>.

Annex B

The latest versions of other applicable standards and bodies of regulations cited in the general and special quality assurance and test specifications

Only the latest issues of the listed standards and other bodies of regulations shall be applied. Revisions are subject to a transition period of one year following their date of issue, after which the latest version must be applied. The following applies in the sections covered by the scope of the quality assurance and test specifications:

Standard/regulations	Content	Reference
DIN 2459	Inseparable elastomer sealed connectors made of metal for metallic pipes for use in drinking water system installation – General requirements and test methods	GZ641-2
DIN 4102	Fire behaviour of building materials and building components – Part 1: Building materials; concepts, requirements and tests	GZ641-1
DIN 50930-6	Corrosion of metals – Corrosion of metallic materials under corrosion load by water inside of tubes, tanks and apparatus – Part 6: Evaluation process and requirements regarding the hygienic suitability in contact with drinking water	General
DIN CEN/TS 13388	Copper and copper alloys-- Compendium of compositions and products	GZ641-2/3
DIN CEN/TS 156560	Copper and copper alloys – Determination of phosphorus content – Spectrophotometric method	GZ641-1
DIN EN 10204	Metallic products – Types of inspection documents	GZ641-1/3
DIN EN 10244	Steel wire and wire products – Non-ferrous metallic coatings on steel wire	GZ641-1
DIN EN 1045	Brazing – Fluxes for brazing – Classification and technical delivery conditions	GZ641-4
DIN EN 1057	Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating application	GZ641-1
DIN EN 1254-1	Copper and copper alloys – Plumbing fittings – Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes	GZ641-3
DIN EN 13349	Copper and copper alloys – Pre-insulated copper tubes with solid covering	GZ641-1
DIN EN 13501-1	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests	GZ641-1
DIN EN 1412	Copper and copper alloys – European numbering system	GZ641-1/2
DIN EN 16117-2	Copper and copper alloys – Determination of copper content – Part 2: Electrolytic determination of copper in materials with copper content higher than 99.80%	GZ641-1
DIN EN 1652	Copper and copper alloys – Plate, sheet, strip and circles for general purposes	GZ641-4/5
DIN EN 1971	Copper and copper alloys – Eddy current test for measuring defects on seamless round copper and copper alloy tubes	GZ641-1
DIN EN 1976	Copper and copper alloys – Cast unwrought copper products	GZ641-3
DIN EN 2626	Copper – Hydrogen embrittlement test	GZ641-3
DIN EN 681	Elastomeric seals – Material requirements for tube joint seals used in water and drainage applications	GZ641-2
DIN EN 723	Copper and copper alloys – Combustion method for determination of the carbon content on the inner surface of copper tubes or fittings	GZ641-2/3
DIN EN 806-4	Specifications for installations inside buildings conveying water for human consumption – Part 4: Installation	GZ641-4/5
DIN EN ISO 11885	Water quality – Determination of selected elements by inductively coupled plasma optical emission spectrometry	GZ641-4/5
DIN EN ISO 17672	Brazing – Filler metals	GZ641-4
DIN EN ISO 2578	Plastics – Determination of time-temperature limits after prolonged exposure to heat	GZ641-1
DIN EN ISO 3166-1	Codes for the representation of names of countries and their subdivisions – Part 1: Country codes	GZ641-1
DIN EN ISO 8491	Metallic materials – Tube (in full section) – Bend test	GZ641-1
DIN EN ISO 8493	Metallic materials – Tube – Drift-expanding test	GZ641-1
DIN EN ISO 9001	Quality management systems – Requirements	All

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Quality assurance and test specifications

Standard/regulations	Content	Reference
DIN EN ISO 9080	Plastics piping and ducting systems – Determination of the long-term hydrostatic strength of thermoplastics materials in tube form by extrapolation	GZ641-1
DIN EN ISO 9453	Soft solder alloys – Chemical compositions and forms	GZ641-5
DIN EN ISO 9454-1	Soft soldering fluxes – Classification and requirements – Part 1: Classification, labelling and packaging	GZ641-5
DIN ISO 2859-1	Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection	GZ641-3
EN 1254	Copper and copper alloys – Plumbing fittings – Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes	GZ641-2
EN 549	Rubber materials for seals and diaphragms for gas appliances and gas equipment	GZ641-2
ISO 4741	Copper and copper alloys; Determination of phosphorus content; Molybdovanadate spectrometric method	GZ641-1
DVGW – GW 7	Technical testing specification – Filler metals and fluxes for soldering copper tubes in gas and drinking water installations; Requirements and tests	GZ641-4/5
DVGW – GW 8	Technical testing specification – Plumbing fittings of copper for capillary soldering in gas and drinking water installations; Requirements and tests	GZ641-3
DVGW – GW 392	Technical testing specification – Seamless tubes of copper for gas and drinking water installations and seamless internally tinplated tubes of copper for drinking water installations; Requirements and tests	GZ641-1
DVGW – G 5614	Technical rule – Inseparable tube connections for metallic gas lines; compression connectors	GZ641-2
DKI material test sheet 781	Eddy current test of round condenser and heat exchanger tubes of copper and copper alloys	GZ641-1

The quality assurance association does not itself examine adherence to the above normative and legal regulations; instead, adherence (conformity) must be verified in suitable form to the quality assurance association during initial testing procedure and neutral independent monitoring.

Special quality and test specifications for copper tubes

RAL-GZ 641/1

(In any case of doubt, the German language shall prevail!)

1-1 Scope

The Gütezeichen (quality mark) "System Kupferrohr" (copper tube systems) can be awarded for the following copper tubes:

1-1.1 Special

These special quality assurance and test specifications apply only in conjunction with the general quality assurance and test specifications.

Group A (for all applications without restriction)

Seamless installation tubes of copper as defined under DIN EN 1057 in the states R220, R250, and R290 in the dimensions listed in Tables 1b, 1c, and 1d of DVGW worksheet GW 392:

in straight lengths R290	in straight lengths R250	in coils R220
12 x 0.8 mm	12 x 0.8 mm	12 x 0.8 mm
12 x 1.0 mm	12 x 1.0 mm	12 x 1.0 mm
15 x 1.0 mm	15 x 1.0 mm	15 x 1.0 mm
18 x 1.0 mm	18 x 1.0 mm	18 x 1.0 mm
22 x 1.0 mm	22 x 1.0 mm	22 x 1.0 mm
28 x 1.0 mm	28 x 1.0 mm	
28 x 1.5 mm	28 x 1.5 mm	
35 x 1.2 mm		
35 x 1.5 mm		
42 x 1.2 mm		
42 x 1.5 mm		
54 x 1.5 mm		
54 x 2.0 mm		
64 x 2.0 mm		
76.1 x 2.0 mm		
88.9 x 2.0 mm		
108 x 2.5 mm		
133 x 3.0 mm		
159 x 3.0 mm		
219 x 3.0 mm		
267 x 3.0 mm		

Group B (not for gas or drinking water)

Seamless installation tubes of copper as defined under DIN EN 1057 in the states R220, R250, and R290 of the following dimensions:

in straight lengths R290	in coils R220
6 x 0.8 mm	6 x 0.8 mm
6 x 1.0 mm	6 x 1.0 mm
8 x 0.8 mm	8 x 0.8 mm
8 x 1.0 mm	8 x 1.0 mm

in straight lengths R290	in coils R220
10 x 0.8 mm	10 x 0.6 mm
10 x 1.0 mm	10 x 0.8 mm
12 x 0.7 mm	10 x 1.0 mm
12 x 0.8 mm	12 x 0.6 mm
15 x 0.8 mm	12 x 0.7 mm
18 x 0.8 mm	14 x 0.8 mm
22 x 0.9 mm	15 x 0.7 mm
22 x 1.5 mm	18 x 0.8 mm
28 x 1.0 mm	
35 x 1.0 mm	
42 x 1.0 mm	
54 x 1.2 mm	

Group C (not for gas or drinking water)

Seamless tubes of copper as defined under DIN EN 1057 in the states R220 and R290 with plastic jacket for heating installations of the following dimensions:

in straight lengths R290	in coils R220
12 x 0.7 mm	10 x 0.6 mm
15 x 0.8 mm	10 x 0.7 mm
18 x 0.8 mm	12 x 0.6 mm
22 x 0.9 mm	12 x 0.7 mm
28 x 1.0 mm	14 x 0.8 mm
	15 x 0.7 mm
	15 x 0.8 mm
	18 x 0.8 mm

Group D (for drinking water and gas)

Seamless installation tubes of copper as defined under DIN EN 1057 in the states R220 and R290 with tinned inner surface in the dimensions listed in Table 1e on DVGW worksheet GW 392:

in straight lengths R290	in coils R220
12 x 0.7 mm	
12 x 1.0 mm	12 x 1.0 mm
15 x 0.7 mm	
15 x 1.0 mm	15 x 1.0 mm
18 x 0.8 mm	
18 x 1.0 mm	18 x 1.0 mm
22 x 1.0 mm	22 x 1.0 mm
28 x 1.5 mm	
35 x 1.0 mm	
35 x 1.2 mm	

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Quality assurance and test specifications

in straight lengths R290	in coils R220
42 x 1.2 mm	
54 x 1.2 mm	
54 x 1.5 mm	
76.1 x 2.0 mm	
88.9 x 2.0 mm	
108 x 2.5 mm	

Group E (not for gas)

Seamless installation tubes of copper in the state R220 with non-removable plastic jacket of following dimensions:

in coils R220
14 x 2.0 mm
16 x 2.0 mm
18 x 2.0 mm
20 x 2.0 mm
26 x 3.0 mm

1-2 Quality assurance specifications

1-2.1 Material

The tubes of all groups consist of Cu-DHP, material number CW024A, as defined under DIN EN 1412 with the material composition:

Cu + Ag: min 99.90%

0.015% < P < 0.040.

The hygiene requirements for materials under Section 1.3 of the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") must be fulfilled.

1-2.2 Tensile strength and elongation at break

Group A, B, C, and D tubes must exhibit the values for tensile strength and elongation at break defined under DIN EN 1057.

1-2.3 Dimensions and tolerances

Bare and jacketed Group A, B, C, and D tubes must fall within the dimensions and tolerances defined under DIN EN 1057. Group C tubes jacketed as defined under DIN EN 13349 must also fall within the dimensions and tolerances under this standard.

The maximum deviations the listed standards apply to the outer diameter include ovality of tubes in straight lengths. Tubes in coils may be calibrated prior to testing.

In addition, the precalibration ovality of Group A, B, C, and D tubes in coils may not exceed the following values:

Outer diameter	Maximum ± deviations
6 mm	0.20 mm
8 mm	0.25 mm
10 mm	0.30 mm
12 mm	0.35 mm
14 mm	0.40 mm
15 mm	0.45 mm
16 mm	0.50 mm
18 mm	0.55 mm
22 mm	0.65 mm

The wall thickness e may not be less than e_{min} or greater than e_{max} .

Brand new Group E tubes must comply with the following definitions in Table 1:

Table 1 - Tube dimensions and limit deviations for Group R220 tubes

Nominal size	Medium tube			Composite tube		
	Inner diameter	Limit deviation Inner diameter ¹⁾ Applicable to mean value	Wall thickness	Limit size Wall thickness ²⁾ %	Outer diameter	Limit deviation Applicable to mean value
14 x 2.0 mm	10 mm	± 0.1 mm	0.30 mm	± 10	14.0 mm	± 0.15 mm
16 x 2.0 mm	12 mm	± 0.1 mm	0.35 mm	± 10	16.0 mm	± 0.15 mm
18 x 2.0 mm	14 mm	± 0.1 mm		± 10	18.0 mm	± 0.15 mm
20 x 2.0 mm	16 mm	± 0.1 mm	0.50 mm	± 10	20.0 mm	± 0.15 mm
26 x 3.0 mm	20 mm	± 0.1 mm		± 10	26.0 mm	± 0.15 mm

¹⁾ Limit sizes apply to the mean diameter. The tubes should always be tested in the calibrated state.

²⁾ Including eccentricity

1-2.4 Surface

The inner and outer surfaces of tubes must be smooth, clean, and free of any die scratches that may compromise their use. When in doubt, please consult e.g. the quality committee or Deutsches Kupfer-Institut e.V. in Düsseldorf.

1-2.5 Quantitative and qualitative definitions of carbon residue on the inner surface

Brand new tubes of Groups A–E must comply with the quantitative and qualitative definitions in Table 2 (specifications based on Annex 1):

Table 2 – Definitions for carbon residues

RAL RG 641/1	Coils R220		Straight lengths R250
	Groups A and E	Groups B and C	Groups A
IC contamination (mg C/dm ²)	≤ 0.10 all dimensions	≤ 0.20 OD ≥ 10 mm	≤ 0.10 all dimensions
HNO ₃ test	all dimensions	OD ≥ 10 mm	all dimensions

RAL RG 641/1	Straight lengths R290
	Groups A, B, and C
IC contamination (mg C/dm ²)	≤ 0.20 10 ≤ OD ≤ 54 mm
IC contamination (mg C/dm ²)	≤ 1.0 OD > 54 mm
HNO ₃ test	10 ≤ OD ≤ 54 mm

These tests must be conducted on samples that have been taken directly from production or the original packaging.

Group D tubes must not be tested for carbon residues.

1-2.6 Bending properties

Brand new Group A, B, C, and D tubes in the states R250 and R290 must pass the bending properties test (conducted as set down in Annex 2).

Brand new Group E tubes must pass the bending properties test in Annex 3.

1-2.7 Drift expanding properties

Brand new Group A, B, C, and D tubes in the states R220 and R250 must pass the drift expanding properties test (conducted as set down in Annex 2). Group E tubes must not be tested for their drift expanding properties.

1-2.8 Tightness

The tubes of all groups must have been tested for tightness.

1-2.9 Plastic jackets on Group C and E tubes

Group C and E tubes must be certified by an accredited body (e.g. FMPA, Stuttgart or MPA, Nordrhein-Westfalen) to proof the fire properties corresponding to Class B2 (DIN 4102) or Class E (DIN EN 13501 Part 1).

1-2.10 Thermal stability of plastic jacket material on Group E tubes

The thermal stability of the plastic jacket material must be verified in compliance with DIN EN ISO 2578 or DIN EN ISO 9080.

Verified must be their suitability for a service life of fifty years at a constant service temperature of 70 °C.

1-2.11 Inner tinplating on Group D tubes

The inner surface of Group D tubes must exhibit continuous, homogeneous tinplating. Chemical tinplating on these tubes must be no less than 1 µm thick, and hot dipped tinplating no less than 4 µm.

The tinplating must correspond to Sn + Cu ≥ 99.90%.

The bath concentration for chemically tinplated tubes must be less than 0.1% at precipitable elements other than tin and copper. The purity of the hot dipping tin must be no less than 99.90%.

Brand new tubes must pass the migration test (conducted as set down in Annex 5).

1-2.12 Delivery form

For outer diameters up to 28 mm, Gütezeichen (quality mark) tubes in straight lengths are delivered in the state R250 (half hard) in fixed lengths of 5000 mm with a maximum deviation of +50 mm. For outer diameters up to 133 mm, Gütezeichen (quality mark) tubes in straight lengths are delivered in the state R290 (hard) in fixed lengths of 5000 mm with a maximum deviation of +50 mm; for outer diameters greater than 159 mm, in fixed lengths of 4000 mm or 5000 mm with a maximum deviation of +50 mm. The delivered tubes may not be shorter than the fixed length.

Gütezeichen (quality mark) Group A, B, C, and D tubes in coils are delivered in the state R220 (soft) in fixed lengths of 25 m and 50 m with a maximum deviation of +500 mm. The delivered tubes may not be shorter than the fixed length.

Gütezeichen (quality mark) Group E tubes are delivered in fixed lengths of 25 m, 50 m, 100 m, or a multiple of 100 m. Fixed lengths of 25 m, 50 m, or 100 m may be delivered with a maximum deviation of +500 mm. Under no circumstances may the delivered tubes be shorter than these lengths.

1-2.13 Packaging

The tubes must comply with the packaging directive issued by Gütegemeinschaft Kupferrohr e.V. (see Annex 6).

Quality assurance and test specifications

1-2.14 Storage

The companies must maintain an adequate stock as verification for the continuous production of quality tubes.

Group A, B, C, and D tubes

Adequate verification stipulates that stocks contain at least 3 t of all those dimensions that must be tested in every case under Section 1-5.8, and also 3 t of all other dimensions and tolerances that must be tested.

If more than seven dimensions and tolerances must be tested, stocks of at least 25 t are adequate, but these must contain all of the dimensions set down under Section 1-5.8.

Group E tubes

Adequate verification stipulates that the stocked fixed lengths must be at least 3000 m for every measurement.

1-2.15 Quality assurance system

The companies must implement an ISO 9001 quality management system and proceed accordingly.

1-2.16 Changes to regulations

Only the latest issues of the listed DIN standards, EN standards, and other bodies of regulations may be applied. Following changes to standards and pertinent specifications, the quality committee may be requested to determine a suitable transition period.

1-3 Test specifications

1-3.1 Approval

Declaration of the applicant

The applicant must declare to the quality committee:

- the dimensions and tolerances – with exact specifications of outer diameters and wall thicknesses – and the material states in his application for the Gütezeichen (quality mark),
- that its production plant is able to produce the affected products in the quality demanded for the Gütezeichen (quality mark) in its application,
- that the quality assurance specifications will be fulfilled in future as well,
- that the applicant has the human, production, and testing resources for an adequate inspection of the products, and
- that the applicant is prepared to build up and maintain stocks of the specified quantities.

1-3.2 Incoming inspection by the Quality committee

In the event of justified or justifiable doubts pertaining to these specifications, the quality committee may inspect the production plant, also by sending delegates.

1-3.3 Initial testing procedure

The quality committee arranges testing (see Section 1-5) on an appropriate number of dimensions for each group in the application for the Gütezeichen (quality mark). The results of these tests must be set down in writing and included in the quality committee's files.

1-3.4 Inspection of the quality assurance system

Together with the order to conduct initial testing procedure, the quality committee also empowers the managing director to order the inspection of the quality management system in accordance with DIN EN ISO 9001.

If a company can submit certification of its quality management system by an accredited certification body, the quality committee recognises this approval. There is then no repeat test by the quality committee or its delegates.

1-4 Constant self-regulation

1-4.1 Requirements

Every mark bearer must implement constant self-regulation regularly on its products labelled with the Gütezeichen (quality mark). These control procedures are to ensure adequate testing of ongoing production for its adherence to the quality conditions. The quality committee defines the type and scope of these control measures from case to case.

If the quality committee sees no reason to set down special definitions, then:

For the minimum number (Z) of

- tests on sizes and limit deviations,
- tests on inner and outer surfaces according to the requirements under Section 1-2.4,
- tests of total carbon on all sizes excluding 15 x 1 mm and 18 x 1 mm in the states R220 and R250,
- tests on tensile strength and elongation at break,
- tests on bending properties (only tubes in the states R250 and R290); the bending properties of Group E tubes in the state R220 are tested once a year or after a change to the formulation of the plastic jacket,
- tests on drift expanding properties (only Group A, B, C, and D tubes in the states R220 and R250),
- tests on migration properties (only Group D tubes),

the following formula applies to the production inspections that must be conducted each month:

$$Z = 0.05 \times \sqrt{n}$$

n = tube length in metres for each dimension produced per month of sizes up to and including 54 x 2 mm.

For sizes bigger than 54 x 2 mm, the formula is:

$$Z = 0.02 \times \sqrt{n}.$$

For tests on the inner surfaces of tubes dimension 15 x 1 mm and 18 x 1 mm in the states R220 and R250, the formula is

$$Z = 0.1 \times \sqrt{n}.$$

A quarter of the total carbon tests on the dimension 15 x 1 mm and 18 x 1 mm in the states R220 and R250 must be conducted according to the quantitative method; three quarters of the required tests following the carbon film test in brand new copper tubes (see Annex 1).

For all other Group A, B, C, and D tubes in the states R220 and R250, half of the required tests are conducted according to the quantitative method, half after the carbon film test. For Group E tubes, the total number of required tests are conducted according to the quantitative method and following the carbon film test. For their constant self-regulation of total carbon on the inner surfaces of tubes, the manufacturers may apply other or modified methods, e.g. semiquantitative testing (visual comparisons, drop tests, etc.). In cases of doubt, however, the manufacturers must verify that their methods achieve the same precision and conclusiveness. On the other hand, the methods set down in Annex 1 must be applied for monitoring tests and in cases of dispute.

For R290 tubes in straight lengths, the quantitative determination of potential carbon proves adequate on all samples when the production conditions safeguard the absence of carbon films.

The tightness test must be conducted on every produced tube.

The material composition (Annex 4) must be tested on every cast lot intended for tube production. Production facilities that do not cast their own copper must test the material composition of every delivery. This test may take the form of the supplier's final acceptance certificate as set down under DIN EN 10204, Section 3.1. When purchased externally, billets or cast bars must be subjected at least twice a year to a check analysis by a laboratory independent of the supplier.

Tubes with jackets complying with the DIN EN 13349 requirements must be tested accordingly at the described intervals.

The jackets of Group E tubes must comply with DIN EN ISO 2578 or DIN EN ISO 9080 (long term behaviour) and DIN EN ISO 13501 Part 1 Class E (fire behaviour). The consistent composition of the materials must be verified in the form of manufacturer certificates (final acceptance certificate 3.1 according to DIN EN 10204) issued by the granulate supplier.

The purity of the tinplating on Group D tubes (Annex 5) must be tested at least once a year and after every change to the tinplating material (e.g. modified formulation of the tinplating solution, new supplier, etc.). The tinplating thickness must be tested at least once per production order.

The purity of the tube tinplating baths must be verified by the manufacturer and confirmed in the form of certificates. The purity of the hot dipping tin used for the tubes must be verified by the supplier in the form of a works test certificate.

1-4.2 Records

The Gütezeichen (quality mark) bearer must document in full all of the inspection methods it applies. These records must be archived for at least five years and rendered acces-

sible on demand to the quality committee and its commissioned testing bodies.

1-4.3 Internal audits

Each and every Gütezeichen (quality mark) bearer must supplement the tests on its products with the quality assurance measures defined in its quality management system.

1-5 Neutral independent monitoring

1-5.1 Sampling schedule

The ongoing monitoring tests are initiated by the quality committee. The quality committee draws up the sampling schedule for the tests at the production plants based on each of the Gütezeichen (quality mark) bearer's supplies of copper tubes, divided into tubes in coils and tubes in straight lengths, for the year prior to the testing as set down under Section 1-5.2. Afterwards, the quality committee empowers the managing director to award the testing orders. The managing director of the quality committee is responsible for examining the full implementation of the measures provided herein.

The following must be tested at least once in the course of each year in all groups:

- Every dimension whose annual delivery exceeds 10 t of quality assured Group A, B, C, and D tubes and 3 t of quality assured Group E tubes. Every measurement in the application must be tested at least once within three years.
- All dimensions on Group E tubes must be tested. The tests on the wall thicknesses and residual carbon of Group E tubes require reference samples, with all of the test dimensions, of these tubes in the unjacketed state.

If not all dimensions have been subjected to ongoing testing, suitable measures must be arranged for additional sampling and testing, e.g. at dealer warehouses.

New Gütezeichen (quality mark) bearers that have not supplied copper tubes with Gütezeichen (quality mark) in the previous year receive the test scope set down by the quality committee following consultation.

1-5.2 Sampling

The sampling schedule differentiates between basic quantity and additional quantity.

The annual monitoring tests require three samples: the first from dealers early in the year, the second from dealers later in the year, and the third and last from the plant. Whenever possible, there must be two different dealer warehouses selected. If there is only one dealer warehouse in Germany, the two samples are taken at two different times.

If there is no dealer warehouse, the two samples must be taken from the plant at two different times in the year.

In special cases, the quality committee may authorise deviations from this regulation.

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When taken from dealers, the samples must originate from original packaging, if these are packaged as such by the supplying manufacturer.

On the inspector's instructions, the test samples prescribed for the basic and additional quantities are taken at random from stocks or production.

The reference samples defined under Section 1-5.1 must be used for the wall thickness and residual carbon tests on Group E tubes.

1-5.2.1 Basic quantity

The basic quantity comprises one sample of every dimension to be tested on the Gütezeichen (quality mark) tubes.

A sample (tube sample, test specimen) consists of a tube end about 1 m in length.

As a rule, the samples taken permit dimensions of more than one quantity.

The basic quantity of samples are subjected to the following tests:

- Tests on sizes and limit deviations (outer diameter, wall thickness, length; sample lengths are measured on their delivery forms),
- Tests on the consistency of outer and inner surfaces (see also Section 1-5.3).

Carbon tests (see Annex 1) on R290 tubes in straight lengths must be conducted on at least three samples, even if the total number of samples should be less.

Carbon tests (see Annex 1) on R250 tubes in straight lengths must be conducted on at least three samples, even if the total number of samples should be less. In every case, the dimensions 12 x 1 mm, 15 x 1 mm, and 18 x 1 mm must be tested. If monitoring tests are conducted on more than one date within one year, the measured carbon values must be spread over all of these dates.

- Tests on tensile strength and elongation at break.
- Tests on chemical composition.
The material composition tests (see Annex 3) must be conducted on a sample from all samples.
- Examination of the labelling.
- Tests on bending properties, if prescribed (see Annexes 2 and 3).
- Tests on drift expanding properties, if prescribed (see Annex 2).
- Tests of tinplating thickness on 50% of samples (see Annex 5).
- Tests of migration properties on 100% of samples (see Annex 5).

1-5.2.2 Additional quantity

A further sample of each dimension is taken from every 250 t of annual Group A, B, C, and D tube production and from every 80 t of Group E tube production.

This additional quantity of samples are subjected to the following tests:

- Tests on sizes and limit deviations (outer diameter,

wall thickness, length; sample lengths are measured on their delivery forms).

- Tests on the consistency of outer and inner surfaces (see also Section 5.3).
- Tests on tensile strength and elongation at break.
- Examination of the labelling.

1-5.3 Quantitative and qualitative definitions of carbon residue on the inner surface

The DIN EN 1057 tests on the inner surfaces of all samples (basic and additional quantities) also include the quantitative carbon contamination method (see Annex 1) after the carbon film tests (see Annex 1).

If one or more of the dimensions tested exceed the maximum total carbon value, tests continue on a second, full set of samples, equalling four times the quantity, with the test dimensions. If the maximum values are exceeded here as well, the monitoring tests have not been passed.

If the first set of samples are found to exceed the total carbon by over 100%, the monitoring tests are considered to have failed and must be aborted. In this event, the quality committee schedules repeat testing. The same applies when the second set of samples is also found to exceed the maximum values. In every event, the manufacturer is obliged to sort out immediately the affected charge/bundle since the last passed internal testing. The result must be recorded in the test report.

1-5.4 Stores

The inspector inspects the tubes' packaging and storage to verify their proper state in compliance with the regulations.

If the corresponding stocks are absent at the production plants, the Gütezeichen (quality mark) bearers must verify stocks to the prescribed amounts in dealer warehouses that permit inspections by testing institutes named in Annex A to the general quality assurance and test specifications.

If any of the dimensions are not stocked as above, they are not tested and hence may be declared to have failed their monitoring tests.

1-5.5 Manufacturer's records

The manufacturer's ongoing records are checked for their completeness with respect to the requirements under Section 4.

1-5.6 Compliance between testing equipment and testing methods

The testing institute and the manufacturer examine the compliance between the testing equipment and the testing methods. (The tester may compare the testing equipment and, if necessary, the testing methods if the equipment has not been calibrated. He is obliged to do so at the request of the tested production facilities.)

1-5.7 Assistance from the tested production plants

The tested production plants must assist the testers by providing free of charge subsidiary workers and equipment needed to conduct the tests. The testers may use the testing machinery available at the production plants.

1-5.8 Monitoring tests on incomplete stocks

If the monitoring tests are to be passed at all, the following dimensions must be tested without fail on Group A tubes in straight lengths and in coils complying with DIN EN 1057 (nominal or obligatory samples):

in straight lengths R290	in straight lengths R250	in coils R220
12 x 1.0 mm	12 x 1.0 mm	12 x 1.0 mm
15 x 1.0 mm	15 x 1.0 mm	15 x 1.0 mm
18 x 1.0 mm	18 x 1.0 mm	18 x 1.0 mm
22 x 1.0 mm		

One or more of the above dimensions need not be tested only if the application submitted by the Gütezeichen (quality mark) bearer does not include these dimensions.

In the case of other dimensions, tests may be conducted on alternative samples until the total number defined for the tested samples has been reached. This regulation, however, may be applied only to one third at the most of all dimensions for which the Gütezeichen (quality mark) has been awarded. Each and every dimensions for which the Gütezeichen (quality mark) has been awarded must have been tested at least once within three years.

Group C DIN EN 1057 tubes in the Gütezeichen (quality mark) application must be subjected to at least two dimensions tests. These tests may include Group C samples with other dimensions until the required number of samples has been reached. This regulation, however, may be applied only to one third at the most of the dimensions. Each and every dimensions must have been tested at least once within three years.

The following dimensions must be tested on Group D tubes:

in straight lengths R290	in coils R220
12 x 1.0 mm	15 x 1.0 mm
15 x 1.0 mm	
18 x 1.0 mm	

The following dimensions must be tested on Group E tubes:

in coils R220
14 x 2.0 mm
16 x 2.0 mm
20 x 2.0 mm

Group D and E tubes may not be exchanged with tubes from other groups.

1-5.9 Repeat tests on the quality assurance system

Together with the order to conduct ongoing monitoring tests as defined under Section 1-5.1, the quality committee

also empowers the managing director to order the regular ongoing testing of the quality management system's effectiveness. If a company can submit certification of regular repeat tests on its quality management system by an accredited certifying company, the quality committee recognises this repeat testing.

1-6 Testing in special cases

1-6.1 Restriction to individual specifications – general

When the implementation requirements for the Gütezeichen (quality mark) statute include tests owing to special incidents, the quality assurance association may restrict these tests to individual specifications. These must, however, extend to all submitted complaints and prove adequate for defining binding specifications.

1-6.2 Restriction to individual specifications – repeat testing

Section 1-6.1 also applies to repeat testing when tests have given rise to complaints.

1-7 Conducting the tests

The tests are conducted by the testing bodies named in the general quality assurance and test specifications for copper tubes.

The required values must be determined in accordance with standards or other technical rules, if such exist.

1-7.1 Tests on sizes and limit deviations

Testing commences with the sampling.

Immediately after sampling, compliance of the outer diameter is tested. The outer diameter is tested outside of the embossing. If these tests ascertain noncompliances on samples of differing dimensions, the tests are considered to have failed and are aborted.

If a measurement test returns poor values for one or more samples, this measurement test is repeated on four times the number of samples. If these subsequent dimensions again identify substandard tubes, the tests on sizes and limit deviations have failed. If the subsequent dimensions return the defined values, the tests are considered passed, but the test report must refer explicitly to the nonconformities ascertained previously. In every case, the manufacturer is obliged to test immediately the compliance of this measurement on the remaining stocks and sort out noncompliances.

The tester decides whether the total number of samples from each group (A, B, C, D, and E) are to be tested at the commissioned material testing institute or in the tested plant's laboratories with the tester present.

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1-7.2 Testing of total carbon

The inner surface is tested for total carbon with the method described in Annex 1.

1-7.3 Testing of bending properties

The bending properties are tested with the method described in Annexes 2 and 3.

1-7.4 Testing of drift expanding properties

The drift expanding properties are tested with the method described in Annex 2.

1-7.5 Testing of tinplating thickness

The tinplating thickness is tested with the method described in Annex 5.

1-7.6 Testing of migration properties

The migration properties are tested with the method described in Annex 5.

1-7.7 Testing of tightness

The manufacturer selects the test method

1-7.7.1 Eddy current method (DIN EN 1971) in accordance to DK1 material test sheet no. 781, but with the difference that the device configuration is examined after every change to a measurement, after every ascertained malfunction, but at least twice a shift. Adjustments must be documented. In order to ensure the effectiveness of the eddy current test a section (1 mm wide and 5 mm long) will be sawn into the tube immediately after it has exited the die with an angle of 90° to the drawing direction. A tube damaged in this manner must be ejected to the "bad" side. OR

1-7.7.2 Internal pressure test at 4 bar air in water as defined in DIN EN 1057 OR

1-7.7.3 Internal pressure test with water as defined in DIN EN 1057.

1-7.8 Examinations of labelling, surface, and packaging

The labelling, surface, and packaging in all groups must be examined visually.

1-7.9 Sampling in dealer warehouses

If samples can be taken in dealer warehouses only, the tester or a delegate of the quality assurance association must in every case conduct a monitoring inspection in addition at the plant.

1-8 Test results

1-8.1 Test report

The inspector must compile a report with the test results and submit this to the quality committee. The tested Gütezeichen (quality mark) bearer receives a duplicate.

1-8.2 Determination by the Quality committee

The quality committee determines the results from the report.

1-8.3 Test report

If the test report does not show any findings, the quality committee issues in writing a certificate of this and sends a copy to the tested Gütezeichen (quality mark) bearer. If necessary for the quality assurance, the quality committee additionally refers the Gütezeichen (quality mark) bearer specifically to certain conclusions derived from the test report.

1-8.4 Repeat testing

If the testing ascertains that the tested production plant does not fulfil the quality conditions, the quality committee informs the production plant of the conclusions reached, at the same time ordering a repeat testing. This must be conducted as soon as possible.

The further procedure is regulated in the implementation requirements for awarding and bearing the Gütezeichen (quality mark).

1-9 Labelling

Gütegemeinschaft Kupferrohr e.V. is the agency for the Gütezeichen (quality mark) applying to copper tube systems ("System Kupferrohr").

Copper tubes complying with the requirements in these quality assurance and test specifications may be labelled with the Gütezeichen (quality mark) issued by Gütegemeinschaft Kupferrohr e.V.

An additional box outside of the Gütezeichen (quality mark) (underneath or on the right) then contains the product code "RAL-GZ641/1". The layout must be agreed in binding form with Gütegemeinschaft Kupferrohr e.V.



Copper tubes complying with the quality assurance and test specifications are labelled in the following (simplified) form:



Group A, B, and D tubes must also be labelled in accordance with the specifications under DIN EN 1057. Group A, D, and E tubes must be labelled with the DVGW test mark and their register number, if authorisation has been awarded to bear this. Group A, B, and D tubes bear in addition to the Gütezeichen (quality mark) the country of manufacture either as a two letter code defined under DIN EN ISO 3166-1 or in German, e.g.

- Deutschland (Germany),
- Frankreich (France),
- Belgien (Belgium), Großbritannien (Great Britain), etc.

Group C tubes must be labelled as follows:

- manufacturer's label,
- outer diameter,
- wall thickness,
- simplified Gütezeichen (quality mark),
- "EN 1057",
- country of manufacture (as Group A, B, D tubes),
- date of manufacture (as in DIN EN 1057).

The jackets of Group C tubes must bear the following symbols:

- "Heizungsrohr" (heating tube),
- outer diameter of the copper tube,
- simplified Gütezeichen (quality mark),
- reference to fire properties (see Section 1-2.9),
- labelling as defined under DIN EN 13349 (geometry, manufacturer), if the requirements under DIN EN 13349 are fulfilled.

The jackets of Group E tubes must bear the following symbols:

- manufacturer's label,
- outer diameter,
- wall thickness,
- simplified Gütezeichen (quality mark),
- country of manufacture (as Group A, B, D tubes),
- date of manufacturer or traceability code,
- reference to fire properties (see Section 1-2.9).

Group E tubes must be labelled with the DVGW test mark and their register number, if authorisation has been awarded to bear this.

The labelling on the tubes must be consecutive and take the form of permanent, highly legible embossing or ink-

jet printing. Inkjet labelling on Group A, B, C, and D tubes must be supplemented with embossed labelling containing at least the manufacturer's name, the standard, and the year of manufacturer together with the quarter or month.

1-10 Changes

All changes to these special quality assurance and test specifications are subject to Section 5 of the general quality assurance and test specifications for copper tube systems.

1 Carbon film test on brand new copper tubes

1.1 Preparing samples

A section about 200 mm long is cut out of the centre of the test tube, and its outer surface cleaned with a trichloroethylene or acetone wipe.

One end of the tube section is sealed tightly with a plug or plastic cap of acid resistant material. This end is immersed to a depth of about 100 mm in concentrated nitric acid that removes any external contamination. Afterwards it is rinsed with deionised water and dried. Cleaning may take the form of mechanical removal, e.g. filing or turning with grease free tools.

The sample removed from this cleaned section is 25 mm long and halved along its longitudinal axis, e.g. with a small circular saw. The sample is degreased by being immersed in (analysis grade) acetone. On tubes larger than 22 x 1 mm, suitable tools must be used to part off a comparable area. The further procedure is then analogous.

1.2 Implementation

With its inner surface facing up, the sample is placed in a flat bottomed porcelain dish (ignition dish) about 45 mm in diameter, and 25% nitric acid at room temperature added until it just covers all of the sample.

The pickling effects dissolve any contamination on the inner surface. Carbon film residues then float to the surface. The process can be observed under a binocular microscope at 10x magnification. The time needed (about 5 min) depends on the degree of surface contamination. The process may be considered ended when the acid turns a clear blue. The sample is removed with tweezers, and any adhering particles rinsed off with deionised water in the dish.

1.3 Assessment

The quantity and type of the particles floating on the surface of the liquid are assessed with the naked eye under good lighting conditions. The evaluation is based on the following:

passed: nothing detectable, or at best negligible residue that may not be filmlike (particles)

not passed: clear filmlike residue

Clearly visible films may be of carbon or oxide. Carbon and oxide films can be differentiated when the porcelain dish is heated slightly and the acid boils for about 5 min. Any oxide filming is then dissolved.

Afterwards, the test must be repeated.

The test has been passed when only negligible particles remain.

The binocular microscope is used for the qualitative decision as to whether the observed residues are filmlike.

2 Combustion method for the quantitative determination of carbon content on a tube's inner surface (DIN EN 723)

2.1 Basis

The outer surface of the copper tube is cleaned of carbon containing residue and then oxidised in an oxygen flow at 800–900 °C. The carbon dioxide formed from the internal residue is measured by a photometer via infrared absorption.

The method described here is useful only on brand new tubes.

2.2 Implementation

A tube section 300 mm in length is parted off with a grease free saw or tube cutter, deburred, and its outer surface pickled clean over about three quarters of its length. This involves sealing tightly one end of the tube with a silicone plug and immersing it in a 50% nitric acid solution (analysis grade). Afterwards, it is rinsed in deionised water and immersed in boiling deionised water for 30–60 s.

Remark 1: Deionised water absorbs CO₂ from the air, so change this daily or after about 40 samples, whichever is the earlier.

Remark 2: Before using the deionised water, boil it for about 5 minutes so that it is completely degassed.

Remark 3: Change the nitric acid weekly or after about 40 samples, whichever is the earlier.

Use a grease free saw to cut out of the cleaned tube section a sample about 50 mm long with an internal area of 20–25 cm². The sample must be sized to within ±0.1 mm. The sample is placed in the tube furnace heated to 800 °C through which carbon free (> 99.99%) oxygen flows. During a reaction time of about 3 min, the surface of the copper tube oxidises, and carbon and carbon compounds burn to form carbon dioxide. Carried by the oxygen, this is supplied to the infrared measuring cell. The result is given in mg/dm² C.

Remark 4: If the sample is longer than the furnace's combustion zone, cut the sample in 2 pieces and measure both halves at the same time.

Remark 5: Combustion times less than 3 minutes may be chosen when it is ensured that all of the carbon is measured during the measuring time.

2.3 Reference value

The reference value must be defined as follows:

A tube section prepared for combustion and equalling the length, dimensions, and production of the analysis sample is degreased completely by being immersed and shaken in cold (analysis grade) trichloroethane and afterwards dried. Cleaned in this manner of die grease residue, the tube section is analysed as described under 2.2. The reference value yielded in mg/dm² C is deducted from the result returned by the analysed sample.

2.4 Calibration

The analyser must be calibrated at the start of each test and at least once a day during continuous operation. The carbon dioxide used for this must have a minimum purity of 99.99%. See the device manufacturer's instructions. Alternatively, the device may be calibrated with material of known carbon content determined empirically (e.g. D-Mannitol or powder with known carbon concentration) at an analysis temperature of 800 °C for an analysis period of 3 min. All other device parameters must be configured according to the device manufacturer's recommendations for this analysis mode.

2.5 Remarks

Conventional tube furnaces may be used in the described manner to analyse copper tubes with diameters up to 28 mm. Tubes of larger diameters are cut into suitable strips after external cleaning, or the prepared sections pressed together until they fit in the furnace. The tools used for this work must be free of grease. The specified drawing grease residue in mg/dm² C does not indicate that it contains less than 100% carbon.

Annex 2 to the special quality assurance and test specifications RAL-GZ 641/1

1 Testing the bending properties of Group A, B, and D tubes

Cold bending properties must be tested on R290 tubes in straight lengths due to DIN EN ISO 8491, whose diameters do not exceed 18 mm and on R250 tubes in straight lengths whose diameters do not exceed 28 mm.

Used for this test is a conventional bending device whose manufacturer has approved it for bending the test tubes and whose attachments are designed for the bending radii listed in the following table.

There may be no cracking and no pleating visible to the naked eye.

Bending radii for R250 and R290 tubes in straight lengths:

Material state		Outer diameter in mm	Inner radius in mm	Neutral axis radius in mm
R250	R290			
x	x	12	39	45
x	x	15	48	55
x	x	18	61	70
x		22	66	77 *
x		28	100	114 *

* not for R290 (hard) tubes

2 Testing of drift expanding properties

The drift expanding test must be conducted as set down in DIN EN ISO 8493. A conical 45° drift must be used to expand the outer diameter of the tube end by min 30%.

There must not be any cracking and no fracturing visible to the naked eye.

Annex 3 to the special quality assurance and test specifications RAL-GZ 641/1

1 Testing the bending properties of Group E tubes

Requirement:

The copper tube can be bent with suitable bending tools. There may be no cracking and no pleating visible to the naked eye. After bending through 90°, the sample must allow back bending through 20°.

Testing:

The samples must be cooled to 0 ± 1 °C, either in water and ice for thirty minutes or in air for two hours.

The test must be conducted within one minute after the sample has been removed from its cooling environment.

The tubes must be examined for kinking, pleating, and cracking.

2 Dimensions and their bending radii for Group E tubes

Outer tube diameter Nominal size mm	Min bending radius Neutral axis radius mm	Inner radius mm
14	50	43
16	55	47
18	72	63
20	80	70
26	88	75

1 Analysis of copper content

1.1 Copper content is analysed with the following method:

1 g of chips are dissolved in 20 ml of nitric acid, HNO_3 , $\rho = 1.4 \text{ g/ml}$ (analysis grade). The nitrogen oxides are boiled out. The solution is then cooled and diluted with distilled water to a volume of 100 ml. After a spatula tip of (analysis grade) potassium chlorate (KClO_3) has been added, a current of 3 A is sent through the agitated electrolyte for one hour. After 30 minutes of electrolysis, about 1 g of (analysis grade) urea $\text{CO}(\text{NH}_2)_2$ is added. The cathode is washed with deionised water and ethanol $\text{C}_2\text{H}_5\text{OH}$ (both analysis grade) and dried at $105 \text{ }^\circ\text{C}$. It is then weighed.

1.2 As an alternative to the method under Section 1.1, emission spectroscopy may be used for ongoing monitoring to determine all of the expected contaminants. The copper content is then calculated from

$100\% - \text{total contaminants in \%}$. Silver must be interpreted as copper.

1.3 In cases of doubt, an umpire assay may be performed as set down under "Analyse der Metalle", first supplemental volume to Volume I "Schiedsanalysen" and Volume II "Betriebsanalysen", or ISO 1553 DIN EN 16117-2.

2 Determination of phosphor content in copper

2.1 Basis

In a solution of nitric acid, ammonium vanadate, and an excess of ammonium heptamolybdate, phosphoric acid forms a yellow, soluble complex that can be measured with a photometer.

2.2 Applications

0.005–0.15%wt of phosphor.

Additions causing clouding or discoloration are eliminated after comparison with a reference sample.

3 Reagents

All analytical reagent grade, 100% deionised water.

3.1 Nitric acid 2+3 (mix 200 ml HNO_3 , $d = 1.4 \text{ g/ml}$ with 300 ml H_2O).

3.2 Potassium permanganate solution: Add water to 10 g KMnO_4 to a volume of one litre.

3.3 Ammonium vanadate solution: Dissolve 1 g NH_4VO_3 in warm water, cool, add 8 ml nitric acid ($d = 1.4 \text{ g/ml}$), add water to a volume of one litre.

3.4 Ammonium heptamolybdate solution: Dissolve 100 g $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4 \text{ H}_2\text{O}$ in about 600 ml water at $50 \text{ }^\circ\text{C}$, cool, and add (if necessary filtered) water to a volume of one litre.

3.5 Phosphor standard solution: 1 mg P/ml

Dissolve 2.1969 g monopotassium phosphate (KH_2PO_4 dried at $105 \text{ }^\circ\text{C}$) in water, add 100 ml nitric acid 1+5 (mix 20 ml HNO_3 , $d = 1.4 \text{ g/ml}$ with 100 ml H_2O), add water to a volume of 500 ml.

3.6 Hydrogen peroxide solution, approx 3%

Mix 10 ml H_2O_2 , 30%, with 100 ml water.

4 Equipment

Spectrophotometer

Measuring wavelength: 418 nm

Cell with coating thickness: 20 mm

5 Calibration curve

5.1 Weighed-in quantity of 1 g each of phosphor free copper.

5.2 Add phosphor standard solution in increasing quantities, according to the phosphor content. Further processing as specified under Section 6.1.

6 Implementation

P content (%wt)	Weighed-in quantity
0.005 to approx 0.05	1 g analysand
0.05 to 0.15	0.5 g analysand + 0.5 g P free copper

6.1 Dissolve sample and reference sample chips in separate 150 ml glass beakers with 10 ml nitric acid 2+3 in a warm environment (next to the hotplate).

6.2 Boil until nitrogen oxides have degassed.

6.3 Oxidise with 2 ml potassium permanganate solution – bring to the boil.

6.4 Add 1 ml of freshly prepared 3% hydrogen peroxide solution to break down excess potassium permanganate. Afterwards, add 5 ml ammonium vanadate solution.

6.5 Boil carefully until the solution turns a clear blue (H₂O₂ excess has been broken down).

6.6 Cover and cool sample and reference sample with water in separate 50 ml graduated flasks.

6.7 Add water to the reference sample to the mark, and mix. Add 5 ml ammonium heptamolybdate solution to the sample, cool as well, add water to the mark, and mix.

6.8 After waiting ten minutes, photometer with the specified wavelength against the reference solution.

7 Calculations

The phosphor concentration included in the measured absorbance can be taken from the calibration curve (note weighed-in quantity).

8 Remark

The acid losses in the form of solution- and oxidation-induced degassing must be kept as low and as uniform as possible.

Alternatively, the phosphorus content measured with emission spectroscopy under Section 1 may be used.

In cases of doubt, an umpire assay may be performed as set down under "Analyse der Metalle", first supplemental volume to Volume I "Schiedsanalysen" and Volume II "Betriebsanalysen", or ISO 4741 DIN CEN/TS 15656.

1 Tinplating thickness tests on Group D tubes

The tinplating thickness test may be based on either

- the stripping method as defined under DIN EN 10244 or
- measurements on metallographically prepared microsections. This involves measuring the tinplating's minimum thickness over the whole tube circumference in the microsection plane under 1000x magnification, or
- suitable nondestructive testing methods.

2 Testing the migration properties of Group D tubes

2.1 Basis

The inner surface of internally tinplated copper tubes is exposed to the action of an ammonium persulfate solution. If there is migratory copper as a result of either pores or copper diffusion areas within the tinplating, there is oxidation, forming the blue copper tetraammine complex.

The concentration is measured with atomic absorption spectrometry. Alternatively, colorimetry, photometry, or atomic emission spectroscopy methods may be applied.

2.2 Preparing samples

A section approx 300 mm in length is cut out of the centre of the test tube. There must be no swarf adhering to the tube's inner surface. The cut edges of the tube section are deburred carefully.

Remove chips inside the tube with a powerful water jet, and drain the tubes a little.

Condition the PE sample receptacle with hydrochloric acid (1 + 10) for at least 12 hours.

2.3 Chemicals

2.3.1 Ammonium persulfate, $(\text{NH}_4)_2\text{S}_2\text{O}_8$, analysis grade

2.3.2 Ammonia solution, w $(\text{NH}_4\text{OH}) = 25\%$, $\rho = 0.91 \text{ kg/l}$, analysis grade

2.3.3 Nitric acid w $(\text{HCl}) = 37\%$, analysis grade

2.4 Equipment

2.4.1 Miscellaneous plugs of inert material, e.g. silicone

2.4.2 PE sample receptacle, flared neck, with screw cap

2.4.3 Atomic absorption spectrometer (AAS), hollow Cu cathode lamp

2.5 Test solution

Dissolve 10 g ammonium persulfate in deionised water, add 20 ml ammonia solution, and add deionised water to a volume of 1 l.

2.6 Procedure

Seal tightly one end of the tube with an inert plug, and position vertically. Fill with a defined quantity of test solution to about 20 mm below the top edge. Cover the top end of the tube with a watch glass or small glass beaker. Now transfer the test solution to a conditioned PE receptacle, and acidify with nitric acid w $(\text{HCl}) = 37\%$ for AAS measurements.

The test solution remains in the tube for 60 minutes at room temperature (max 35 °C).

2.7 Calculations

The assessment value $b(\text{Cu})$ is calculated from the copper concentration measured in the test solution with consideration to the volume to surface ratio of the tested copper tube as follows:

$$b(\text{Cu}) = c(\text{Cu}) \times \frac{V}{O}$$

with $b(\text{Cu})$: assessment value in $\mu\text{g}/\text{mm}^2$

$c(\text{Cu})$: copper concentration in the test solution in mg/ml

V/O : volume to surface ratio of the copper tube in mm

2.8 Assessment

The assessment value b is a measure of the tinplating's quality calculated from the copper migration. If $b < 1$, the Sn coating is okay.

3 Testing the purity of tinplating on Group D tubes

The tinplating purity can be verified by electron spectroscopy for chemical analysis (ESCA), energy-dispersive X-ray spectroscopy (EDX), or an adequate, acknowledged testing method.

Packaging copper tubes with the RAL Gütezeichen (quality mark)

The manufacturer is responsible for proper packaging, storage within the manufacturer’s sphere of influence, and loading for transport to the customer.

Packaging is subject to the following specifications:

1 Tubes in coils

1.1 Group A, B, C, and D tubes in coils are delivered in fixed lengths of 25 m and 50 m in compliance with Section 2.12 of the quality conditions. Group E tubes are delivered in fixed lengths of 25 m, 50 m, 100 m, or a multiple of 100 m. Group A, B, C, and D tubes in coils must be wrapped in crêpe paper or plastic film.

The choice of packaging material must take into consideration the stacking stability of coils in all groups and the maintained cleanliness of the packages. Ecofriendly packaging material must be the preferred choice owing to its recyclability and disposability.

1.2 The crêpe paper or plastic film used for wrapping must overlap.

1.3 Only packages of the named lengths are permitted.

1.4 The packaging materials may not contain any substances or exhibit any properties that may prove detrimental to the packaged goods during prolonged storage. The responsibility lies with the Gütezeichen (quality mark) bearer, which must verify adherence to these requirements in cases of doubt. The quality monitoring and approval procedures do not include this testing.

1.5 The outside of the packaging must bear an adhesive strip or tape bearing the company logo, the Gütezeichen (quality mark), and the measurements of bare conduits and “DIN EN 1057” for Group A, B, C, and D tubes.

1.6 If suitable storage facilities are available at the manufacturer’s or its shipping locations that protect tubes against sustained damage from contamination, these tubes may be delivered in other packaging types and shipping modes.

2 Tubes in straight lengths

2.1 R250 tubes in straight lengths are delivered in fixed lengths of 5000 mm as set down under Section 1-2.12 of the quality conditions. For outer diameters up to 133 mm, R290 tubes in straight lengths are delivered in fixed lengths of 5000 mm as set down under Section 1-2.12 of the quality conditions; for outer diameters greater than 159 mm, in fixed lengths of 4000 mm or 5000 mm. If suitable storage facilities are available at the manufacturer’s or its shipping locations that protect tubes against sustained damage from contamination, these tubes may be delivered in bundles without further packaging. Each bundle must be wrapped at least three times with adhesive tapes.

2.2 The preferred quantity contained in each bundle should be selected from the following table:

Tube length m	Outer diameter mm
200	6
200	8
100	10
100	12
50, 100	15
50	18
50	22
25	28
25	35
15, 25	42
15	54

2.3 The printed adhesive tapes must bear the company logo, the Gütezeichen (quality mark), and “DIN EN 1057” and indicate the material state.

Measurements and details on the contained tube length must be affixed in suitable form to each bundle. They may be printed on the adhesive tapes in addition to the required details.

2.4 Packaging the bundles in crêpe paper or plastic film is permitted, but must comply with the conditions under Section 1.

2.5 Jacketed copper tubes in straight lengths may be delivered in cartons or bundles wrapped in crêpe paper or plastic film. Section 2.1 applies accordingly.

The cartons must be provided with a clearly visible adhesive label that bears the company designation, the Gütezeichen (quality mark), the dimensions of the tube, “EN 13349”, and the material state.

Bundles wrapped in crêpe paper are subject to the corresponding specifications under Section 1.

Special quality and test specifications for press fittings made of copper tubes

RAL-GZ 641/2

(In any case of doubt, the German language shall prevail!)

2-1 Scope

These quality assurance and test specifications apply to press fittings (inseparable connectors) made of copper tubes. They also extend to their elastomer sealing elements.

The range of applications for copper tubes are defined in the special quality assurance and test specifications for copper tubes – GZ 641/1 – Section 1-1.

Quality assurance may be applied to those press fittings only whose dimensions are compatible with quality assured copper tubes for drinking water and gas installations (Groups A and D) defined under the special quality assurance and test specifications for copper tubes (RAL-GZ641/1). Annex 1 lists the press fittings covered under these quality assurance and test specifications.

2-1.1 Special

These special quality assurance and test specifications apply only in conjunction with the general quality assurance and test specifications.

2-2 Normative requirements

Fittings intended for use in drinking water installations must comply with the latest applicable wording of DIN 2459, although some of the requirements hereunder are stricter than those in this standard. Seals of elastomer must fulfil the requirements in accordance with DIN EN 681 (Table 3).

The hygiene requirements for materials under Section 1.3 of the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") must be fulfilled.

Fittings intended for use in gas installations must comply with DVGW worksheet G5614.

2-3 Materials

2-3.1 Materials – Fittings / primary material

The fittings must be manufactured from semifinished products with characteristics and properties corresponding to

- a) deoxidised copper as defined due to DIN CEN/TS 13388, Table 1.4 [Cu-DHP, material number CW024A as defined under DIN EN 1412]

or

- b) oxygen free copper as defined under DIN CEN/TS 13388, Table 1.3 [Cu-OF, material number CW008A as defined under DIN EN 1412]

The manufacturer must draw up terms of technical delivery conditions for the primary materials used in the manufacture of its fittings.

2-3.2 Materials – Elastomers

The respective requirements that elastomer seals must fulfil for fittings intended for use in drinking water installations are based on DIN 681-1 in conjunction with DIN 2459, Section 5.1.2. These requirements must be fulfilled for all of the characteristics listed in Table 7 of DIN 2459. The requirements pertaining in each case are listed in Annex 2.

The requirements that elastomer seals must fulfil for fittings intended for use in gas installations are based on EN 549.

2-4 Test specifications – Approval, incoming inspection, and initial testing procedure

2-4.1 Declaration of the applicant

The applicant must declare to the quality committee:

- the dimensions and fitting types he is applying for the Gütezeichen (quality mark),
- that its production plant is able to produce the affected products in the quality demanded for the Gütezeichen (quality mark) in its application,
- that the quality assurance specifications will be fulfilled in future as well,
- that the applicant has the human, production, and testing resources for an adequate inspection of the products.

2-4.2 Incoming inspection by the Quality committee

In the event of justified or justifiable doubts pertaining to these specifications, the quality committee may inspect the production plant, also by sending delegates.

2-4.3 Initial testing procedure

The quality committee thereupon arranges the testing defined under Section 2-5. The findings of these tests must be set down in writing and included in the quality committee's files.

2-4.4 Tests on the quality management system

Together with the order to conduct initial testing procedure, the quality committee also empowers the managing direc-

Quality assurance and test specifications

tor to order the verifying of the quality management system in accordance to the standard series ISO 9001.

If a company can submit certification of its quality management system by an acknowledged certifying company, the quality committee recognises this certification. There is then no repeat test by the quality committee or its delegates.

2-5 Test methods

2-5.1 Primary material for fittings

The tubes must be subjected to an receiving inspection for their compliance with the internal terms of technical delivery conditions.

The primary materials used for production of fittings must either be documented by internal analysis sheets, or their compliance with the ordering party's regulations is submitted by acceptance certificates 3.1 due to DIN EN 10204 issued by the tube supplier.

The monitoring test reports issued by an accredited testing institute and the contained results of analysis must be verified.

2-5.1.1 Structural dimensions and wall thicknesses

The structural dimensions and wall thicknesses must be in compliance with those given in the technical drawings submitted by the manufacturer. The findings based on these documents must be submitted in the form of suitable test reports, e.g. type examinations.

2-5.1.2 Surface of the fittings

2-5.1.3 Visual examination of the surface

The fittings must present a smooth inner and outer surface, i.e. they must be free of burr and inhomogeneities. These characteristics are examined visually.

2-5.1.4 Contamination with lubricant residue (inner surface)

Testing for total carbon content on inner surfaces (prior to sealant fitting) as defined under EN 723 must not exceed values of 1.0 mg/dm².

2-5.1.5 Contamination with carbon film

Carbon film testing must be conducted only when the limits given in 2-5.1.4 are exceeded.

2-5.2 Elastomers

Press fittings for drinking water installations must fulfil the requirements given in Annex 2 or EN 2459 (Table 7). A valid certificate issued by the supplier must be submitted and verified.

Press fittings intended for use in gas installations must fulfil the requirements in accordance to EN 549, Class B2A3 (or higher). A valid certificate issued by the supplier must be submitted and verified.

2-5.3 Connections

The test report (see type examination Table 6) issued by an accredited certifying body must be submitted and examined.

2-5.4 Measuring equipment

All testing and measuring equipment must be monitored in accordance with the specifications under ISO 9000 f.

2-5.5 Labelling

The labelling must be examined for its compliance with the manufacturer's specifications and the sales documentation.

2-6 Production control by the manufacturer (constant self-regulation)

Each manufacturer must conduct constant self-regulation at regular intervals.

Only material with a release note may be used for production.

Production may not start until a flawless production has been verified by testing pilot samples.

Accruing scrap, either from startup stage as well as from ongoing production, must be collected in marked reject receptacles and may not be mixed up with "good" parts.

Meticulous records must be maintained of the implemented constant self-regulation measures.

All records must be archived for five years and handed over to the tester on request during external testing.

The records must contain all important details (primary material, fitting type, dimensions, test characteristics and results, implemented action, date, tester's name).

The test intervals selected for each of the production measuring sites must be such that in the event of a noncompliance the partial lot since the last passed testing can be sorted out and again subjected to a 100% testing.

2-6.1 Tests and test scope

The tests must be conducted as described in the test methods given in Section 2-5.

2-6.1.1 Fittings

These are tested as given in Section 2-5.1.

2-6.1.2 Elastomers

These are tested as given in Section 2-5.2 in conjunction with Annex 2.

2-6.1.3 Connections

These are tested as given in Section 2-5.3.

2-7 Neutral independent monitoring

2-7.1 Objectives

Neutral independent monitoring is intended to analyse the manufacturer's organization and records for the purpose of verifying the effectiveness of the manufacturer's constant self-regulation of fittings production.

These tests are arranged by the quality committee.

2-7.2 Sequence

The testing body examines the records or production processes to verify the effectiveness of constant self-regulation.

2-7.3 Scope

2-7.3.1 Fittings – Tests for all requirements in accordance to Section 2-5.1

All relevant documents, test reports, and certificates are examined for their completeness and applicability.

2-7.3.2 Elastomers – Tests for all requirements in accordance to Section 2-5.2

All relevant documents, test reports, and certificates are examined for their completeness and applicability.

2-7.3.3 Connections– Tests for all requirements in accordance to Section 2-5.3

All relevant documents, test reports, and certificates are examined for their completeness and applicability.

2-7.4 Consequences of failed monitoring tests

If a press fitting fails to fulfil the requirements given in these special quality assurance and test specifications, the quality committee sets down suitable action.

2-7.5 Testing in special cases

If the implementing rules requirements include tests owing to special incidents, the quality assurance association may restrict these tests to individual specifications.

These must, however, include to all submitted complaints and prove adequate for defining binding ascertainments.

2-8 Test results

2-8.1 Test report

The inspector must compile a test report with the test results and submit this to the quality committee. The tested Gütezeichen (quality mark) bearer receives a duplicate.

2-8.2 Determination by the Quality committee

The quality committee determines the results from the re-

port.

2-8.3 Test report

If the testing did not give rise to a complaint, the quality committee issues in writing a certificate of this and sends a copy to the tested Gütezeichen (quality mark) bearer. If necessary for the quality assurance, the quality committee additionally refers the Gütezeichen (quality mark) bearer specifically to certain conclusions derived from the test report.

2-8.4 Repeat testing

If the testing ascertains that the tested production plant does not fulfil the quality conditions, the quality committee informs the production plant of the conclusions reached, at the same time ordering a repeat testing. This must be conducted as soon as possible. The further procedure is regulated in the implementation requirements for awarding and bearing the Gütezeichen (quality mark).

2-9 Labelling

Fittings must be labelled indelibly and legibly with the manufacturer's logo or name and the connecting diameters, but at least with the manufacturer's name.

For safety reasons, press fittings intended for use in gas installations must be provided in addition on both sides with a yellow mark and the manufacturer's specified PN (maximum operating pressure) and GT (RHT test pressure), e.g. PN5GT5 = 5 bar max operating pressure and RHT test conducted and passed under 5 bar.

Gütegemeinschaft Kupferrohr e.V. is the agency for the Gütezeichen (quality mark) "System Kupferrohr" (copper tube system).

Press fittings of copper tubes complying with these quality assurance and test specifications may bear on their packaging the Gütezeichen (quality mark) issued by Gütegemeinschaft Kupferrohr e.V.

An additional box outside of the Gütezeichen (quality mark) (underneath or on the right) then contains the product code "Press fittings RAL-GZ 641/2". The layout must be agreed in binding form with Gütegemeinschaft Kupferrohr e.V.



Press fittings RAL-GZ 641/2

Fittings complying with the quality assurance and test spec-

Quality assurance and test specifications

ifications are labelled in the following (simplified) form:



Products bearing a quality test mark must be marked clearly as such in the manufacturer's catalogues and sales material.

2-10 Changes

All changes to these special quality assurance and test specifications are subject to Section 5 of the general quality assurance and test specifications for copper tube systems.

Only the latest issues of the listed DIN standards, EN standards, and other bodies of regulations may be applied. Changes to the standards and pertinent specifications are subject to a transition period of one year following their date of issue, after which the latest version must be applied.

Annex 1 to the special quality assurance and test specifications RAL-GZ 641/2

Scope: Types and diameters

The Gütezeichen (quality mark) "System Kupferrohr" (copper tube system) can be awarded for the following press fitting types:

- elbows (including full crossovers, reducer elbows, and spigot elbows),
- reducers / reducing sleeves,
- T pieces,
- caps/plugs,
- sleeves / sliding sleeves.

The diameters and wall thicknesses must agree with the specifications for quality assured copper tubes as defined under Section 1-1 of the special quality and test specifications for copper tubes RAL-GZ 641/1. Accordingly, fittings are possible for the following pipe sizes:

6 x 0.8	22 x 1.5
6 x 1.0	28 x 1.0
8 x 0.8	28 x 1.5
8 x 1.0	35 x 1.0
10 x 0.6	35 x 1.2
10 x 0.7	35 x 1.5
10 x 0.8	42 x 1.0
10 x 1.0	42 x 1.2
12 x 0.6	42 x 1.5
12 x 0.7	54 x 1.2
12 x 0.8	54 x 1.5
12 x 1.0	54 x 2.0
14 x 0.8	64 x 2.0
15 x 0.7	76.1 x 2.0
15 x 0.8	88.9 x 2.0
15 x 1.0	108 x 2.5
18 x 0.8	133 x 3.0
18 x 1.0	159 x 3.0
22 x 0.9	219 x 3.0
22 x 1.0	267 x 3.0

Special requirements for seals of elastomers

A. General requirements

Seals of elastomers must be verified to fulfil the hygiene requirements in accordance to the elastomer guidelines issued by the German Federal Environment Agency (UBA). They must also fulfil both the technical requirements due to DIN EN 681-1:2006-11, Table 3 (type WB/WE) and the following additional requirements.

1. Volume changes / swelling

Volume changes / swelling must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.8; also butyl rubber (IIR) may not exceed the 15% limit.

2. Tear propagation resistance

The tear propagation resistance, including IIR, must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.10.

3. Cold compression set

The cold compression set must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.5.3.

4. Long term behaviour

In dependence on DIN EN 681-1:2006-11, 4.2.11, all elastomers must fulfil the following requirements for the compression set in water at 110 °C:

- a) after a test duration of 3000 h: compression set \leq 30%;
- a) after a test duration of 10,000 h: compression set \leq 40%.

5. Hardness

The hardness must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.3

6. Tensile strength and elongation at break

The tensile strength and elongation at break must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.4

7. Compression set in air

The compression set in air must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.5

8. Accelerated ageing in air

The accelerated ageing in air must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.6

9. Compressive stress relaxation

The compressive stress relaxation must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.7

10. Ozone resistance

The ozone resistance must fulfil the requirements due to DIN EN 681-1:2006-11, 4.2.9

B. Use in gas installations

Elastomer seals for press fittings intended for use in gas installations must fulfil in addition the following requirements for long term behaviour:

- The minimum class requirements in accordance to EN 549 must be fulfilled (class B2H3 EN 549)

Special quality and test specification for soldering fittings made of copper tubes

RAL-GZ 641/3

(In any case of doubt, the German language shall prevail!)

3-1 Scope

These quality assurance and test specifications apply to soldering fittings made of copper tubes for capillary soldering. The connecting diameters are defined on the DVGW worksheet GW 8. Annex 1 lists the fittings covered under the quality assurance and test specifications.

3-1.1 Special

These special quality assurance and test specifications apply only in conjunction with the general quality assurance and test specifications.

3-2 Requirements

The basis is provided by DIN EN 1254-1, although some of the requirements hereunder are stricter than those in this standard.

3-2.1 Primary material

The fittings must be manufactured from semifinished products with characteristics and properties corresponding to

- deoxidised copper as defined under DIN CEN/TS 13388, Table 1.4 [Cu-DHP, material number CW024A as defined due to DIN EN 1412]

or

- oxygen free copper as defined under DIN CEN/TS 13388, Table 1.3 [Cu-OF, material number CW008A as defined due to DIN EN 1412]

The manufacturer must draw up terms of technical delivery conditions for the primary material used in the manufacture of its fittings.

The hygienic requirements for materials in accordance to Section 1.3 of the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") must be fulfilled.

3-2.2 Connecting diameters and their limit deviations

The permitted limit deviations listed in Table 2 of DIN EN 1254-1 must be observed. This then safeguards the capillary distribution of the solder, serving to centre the fitting's external soldering end or the tube end in the internal soldering end.

3-2.3 Soldering lengths and their limit deviations

An internal soldering end (Figure 1) is that end of a fitting

for capillary soldering that is inserted over the external soldering end of a tube or fitting.

An external soldering end (Figure 2) is that end of a tube or fitting for capillary soldering that is inserted into the internal soldering end of a fitting for capillary soldering.

The minimum soldering lengths are listed in Table 3 of DIN EN 1254-1.

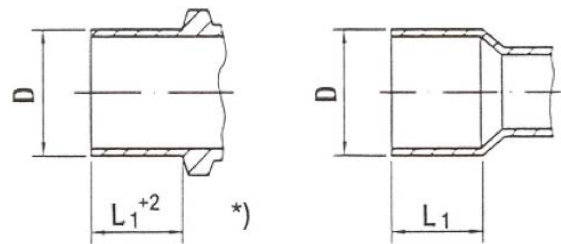


Figure 1 - Internal soldering end

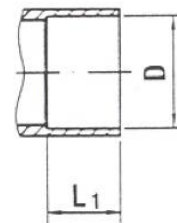


Figure 2 - External soldering end

D = diameter of external soldering end
L1 = soldering length

*) If the diameter of the external soldering end is smaller than the rest of the fitting's body, the external soldering length must be 2 mm longer than the internal soldering length.

3-2.4 Structural dimensions of selected forms

The structural dimensions (here the so called Z dimensions) must comply with the documentation (technical catalogues) issued by the manufacturer.

3-2.5 Tube stop

The fitting's internal soldering end must present an effective tube stop that limits the maximum length reached by an inserted external soldering end or tube with the minimum permissible outer diameter.

The tube stop may take the form of a shoulder, bead, or punched depression.

Sockets must present an angle $\leq 45^\circ$ (Figure 3).

Quality assurance and test specifications

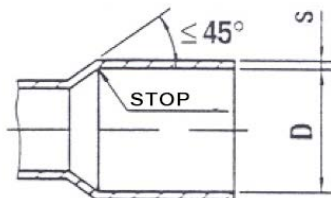


Figure 3 – Socket

D = diameter of internal soldering end
S = minimum wall thickness

3-2.6 Minimum wall thickness

The minimum wall thickness must correspond to the values listed in Table 5 (column 2) given in Section 4.3.4 of DIN EN 1254-1.

3-2.7 Deflections

90° deflections of copper tube must take the form of elbows with a minimum radius $R = 1.2 D$ (neutral axis). The internal and external soldering ends must not be shaped until after the elbow has fully formed.

3-2.8 Structural component

For the manufacture of new fixtures or equipment for the production or modification of the primary material, the parts produced with these must be subjected to component testing as set down under Section 3-4.8.

This component testing must be repeated:

- after every change to tools affecting the component's geometry,
- after every dimensional change of the corresponding primary material.

3-2.9 Surface

3-2.9.1 Visual requirements for the surface

The fittings must be free of defects, e.g. pleating, production induced deformation, cracking; finished free of burr and clean; free of machining and lubricating agents; and metallurgically blank. Brand new fittings must be free of stains.

3-2.9.2 Inner surface

The inner surfaces of fittings must fulfil the requirements due to Section 3-2.9.1.

3-2.9.2.1 Contamination with lubricant residue

Carbon and lubricant residue (measured as carbon) $\leq 0.5 \text{ mg/dm}^2$.

3-2.9.2.2 Contamination with carbon film

Carbon film after HNO_3 testing: No filmlike residue; at most single, nonfilmlike black particles.

3-2.10 Measuring equipment

A complete list must be submitted of all testing and measuring equipment used in the production facilities. This list must contain the limit values and the time of verification.

Worn or defective testing and measuring equipment must be sorted out and may no longer be used.

3-3 Test specifications – Approval (incoming inspection and initial testing procedure)

3-3.1 Declaration of the applicant

The applicant must declare to the quality committee:

- the dimensions and fitting types he is applying for the Gütezeichen (quality mark),
- that its production plant is able to produce the affected products in the quality demanded for the Gütezeichen (quality mark) in its application,
- that the quality assurance specifications will be fulfilled in future as well,
- that the applicant has the human, production, and testing resources for an adequate inspection of the products.

3-3.2 Incoming inspection by the Quality committee

In the event of justified or justifiable doubts pertaining to these specifications, the quality committee may inspect the production plant, also by sending delegates.

3-3.3 Initial testing procedure

The quality committee thereupon arranges the testing defined under Section 3-6. The findings of these tests must be set down in writing and included in the quality committee's files.

3-3.4 Tests on the quality management system

Together with the order to conduct initial testing procedure, the quality committee also empowers the managing director to order the verifying of the quality management system in accordance to the standard series ISO 9001.

If a company can submit certification of its quality management system by an acknowledged certifying company, the quality committee recognises this certification. There is then no repeat test by the quality committee or its delegates.

3-4 Test methods

3-4.1 Primary Material

The tubes must be subjected to a receiving inspection for their compliance with the internal terms of technical delivery conditions.

The primary material used in the production of fittings

must either be documented by internal analysis, or their compliance with the ordering party's regulations is submitted by in acceptance certificates 3.1 due to DIN EN 10204 issued by the tube supplier.

In the latter case, a laboratory independent of the tube supplier must be commissioned to conduct a check analysis at least once a year on the used primary materials (see Annex 4 to the special quality assurance and test specifications for copper tubes). Primary material for Cu-OF fittings must be tested in addition for their hydrogen resistance as set down due to DIN EN 1976 and DIN EN ISO 2626. The results must be submitted to the ordering party.

3-4.2 Connecting diameters and their limit deviations

These characteristics must be tested with GO / NO GO gauges complying with Tables 7 and 8 due to DIN EN 1254-1.

The fittings are true to gauge when the GO gauge ends fit inside or over them, but the NO GO ends do not.

Some ovality is permitted if the GO gauge end can be inserted under appropriate manual force and the arithmetic mean of the diameters lies within the limit deviations.

3-4.3 Soldering lengths and their limit deviations

These characteristics must be tested with suitable measuring equipment (GO / NO GO gauges).

3-4.4 Structural dimensions

These characteristics must be tested with suitable measuring equipment.

3-4.5 Tube stop

These characteristics must be tested with suitable measuring equipment.

3-4.6 Minimum wall thickness

This characteristic must be tested with suitable measuring equipment.

3-4.7 Deflections

These characteristics must be tested with suitable measuring equipment.

3-4.8 Structural component

Testing must proceed as follows.

After hard soldering and annealing at 800 °C (one minute for diameters up to 28 mm, two minutes for larger diameters), a fitting must withstand an internal hydraulic gauge pressure of 80 bar without leaking. This testing may cause deformations for which no limit values have been defined.

The connecting tubes used for this strength testing must

present adequate wall thickness so that they do not fail before the fitting.

3-4.9 Surface

3-4.9.1 Visual examination of the surface

These characteristics are examined visually.

3-4.9.2 Inner surface

3-4.9.2.1 Contamination with lubricant residue

The carbon content must be determined with the method described under DIN EN 723.

3-4.9.2.2 Contamination with carbon film

The method applied to detect and assess a carbon film must comply with the specifications as described in DIN EN 1254-1, Annex A.

3-4.10 Measuring equipment

All testing and measuring equipment must be calibrated at suitable intervals, and the results documented.

3-4.11 Labelling

The labelling and the sales documentation must be verified.

3-5 Production control by the manufacturer (constant self-regulation)

Each manufacturer must conduct constant self-regulation at regular intervals.

Only material with a release note may be used for production.

Production may not start until a flawless production has been verified by testing pilot samples.

Accruing scrap, either from startup stage as well as from ongoing production, must be collected in marked reject receptacles and shall not be mixed up with "good" parts.

Meticulous records must be maintained of the implemented constant self-regulation measures.

All records must be archived for five years and handed over to the inspector on request during external testing.

The records must contain all important details (primary material, fitting type, dimensions, test characteristics and results, implemented action, date, inspector's name).

The test intervals selected for each of the production measuring sites must be such that in the event of a non-compliance the partial lot since the last passed testing can be sorted out and again subjected to a 100% testing.

Quality assurance and test specifications

3-5.1 Tests and test scope

The tests must be conducted as described in the test methods given in Section 3-4.

3-5.1.1 Primary material

These are tested as set down given in Section 3-4.1.

3-5.1.2 Connecting diameters

The fittings are tested lot by lot according to statistical quality control criteria. The sampling scheme is for normal assessments corresponding to testing level I (see DIN ISO 2859, Part 1).

- Testing degree: AQL = 2.5

3-5.1.3 Soldering length, tube stop, surface (visual)

- Testing degree: AQL 6.5; else as under Section 3-5.1.2.

3-5.1.4 Minimum wall thickness and labelling

These characteristics are tested lot by lot on at least three fittings.

3-5.1.5 Structural component

The component test as defined under Section 3-4.8 is conducted on at least three fittings.

3-5.1.6 Inner surface

Samples are taken between final cleaning and packaging.

3-5.1.6.1 Contamination with lubricant residue

The tests must be conducted at least four times spread evenly over each month.

The tests may also be conducted by external testing bodies.

3-5.1.6.2 Contamination with carbon film

The HNO₃ test is conducted on a total of five fittings spread evenly over each week.

This must ensure that every fitting is tested at least once a year.

3-6 Neutral independent monitoring

3-6.1 Objectives

Neutral independent monitoring is intended to analyse the manufacturer's organization and records for the purpose of testing the manufacturer's constant self-regulation of fittings production.

The testing body conducts the initial tests and then spot tests at least once a year on fittings from the manufacturer's ongoing production or on finished fittings from the stock in accordance with the specifications under this section.

These tests are arranged by the quality committee.

3-6.2 Sequence

The inspector checks the manufacturer's constant self-regulation on the basis of the organization and its corresponding records as given in Section 3-5.

The random samples are taken at the production plant.

The fittings needed for these tests are taken from the stores or production, as instructed by the inspector.

If the various fitting types required for the tests cannot be taken from production or stores, reference samples may be taken for at most one third of the required samples. If fewer than two thirds of the required fittings can be taken at the production plant, the manufacturer must verify the existence of dealer stocks from which the inspector chooses to take the remaining fittings. The test report must note whether the samples were taken from reference samples or dealer stocks.

The manufacturer must point out to the inspector whether the samples contain Cu-OF fittings and, if necessary, present a list of these. The material is tested (only the copper content analysed) in the testing body's laboratory.

All other characteristic values are tested at the production plant. The inner surfaces are tested (for lubricant residue) in the testing body's laboratory or, if chosen by the inspector, in the manufacturer's laboratory witnessed by the inspector.

3-6.3 Scope

3-6.3.1 Testing for all requirements in accordance with Section 2 – excluding the internal surface

20 different fittings are taken at random from the test types covered by the application (see Section 1).

3-6.3.2 Testing the inner surface

The twenty fittings taken for the basic quantity are the same as those under 3-6.3.1.

In addition, double this number is taken for the reference quantity, whenever possible from another lot.

The twenty fittings in the basic quantity are tested with quantitative methods for carbon (see Section 3-4.9.2.1). If fittings do not present the stipulated minimum surface area of 0.1 dm², it may be necessary to analyse a correspondingly larger number. This must be considered for both the basic and reference quantities.

The twenty fittings in the basic quantity are likewise subjected to the HNO₃ test (see Section 3-4.9.2.2).

3-6.4 Consequences of failed monitoring tests

3-6.4.1 Consequences from Section 3-6.3.1

(Requirements, excluding those for internal surfaces)

If a fitting fails the test, the test is conducted immediately on two identical fittings, whenever possible taken from another lot.

If one of these fittings fails the test, the test for this fitting

has not been passed. In this case, the manufacturer must test the lots stored since the last test that was passed internally.

The inspector verifies the documentation of this while next monitoring testing.

A fitting that has not passed the test is noted on the test report.

The same applies to any second and third fitting.

If fewer than four fittings fail the test, these must be included additionally in the test scope at the next monitoring testing. If one of these fittings again fails the test on the same characteristic, the manufacturer's right to bear the Gütezeichen (quality mark) will be withdrawn for all fittings.

If four fittings fail the test, testing is aborted. Repeat testing must be conducted. This again involves taking twenty different fittings, which must include the same fitting types that failed the first testing.

If four fittings again fail this repeat testing, the whole testing is deemed not passed.

3-6.4.2 Consequences from Section 3-6.3.2 (Testing the inner surface)

If a fitting fails the test, the test is conducted on two identical fittings from the available reference quantity. Otherwise, the procedure is that described under Section 3-6.4.1.

3-7 Testing in special cases

3-7.1 Restriction to individual specifications – general

If the implementing rules include tests owing to special incidents, the quality committee may restrict these tests to individual specifications.

These must, however, include all submitted complaints and prove adequate for defining binding ascertainment.

3-7.2 Restriction to individual specifications – repeat testing

The same also applies analogously to repeat testing when tests have given rise to complaints.

3-8 Test results

3-8.1 Test report

The inspector must compile a test report with the test results and submit this to the quality committee. The tested Gütezeichen (quality mark) bearer receives a duplicate.

3-8.2 Determination by the Quality committee

The quality committee determines the results from the report.

3-8.3 Test certificate

If the testing did not give rise to a complaint, the quality committee issues in writing a certificate of this and sends a copy to the tested Gütezeichen (quality mark) bearer. If necessary for the quality assurance, the quality committee additionally refers the Gütezeichen (quality mark) bearer specifically to certain conclusions derived from the test report.

3-8.4 Repeat testing

If the testing ascertains that the tested production plant does not fulfil the quality conditions, the quality committee informs the production plant of the conclusions reached, at the same time ordering a repeat testing. This must be conducted as soon as possible. The further procedure is regulated in the implementation requirements for awarding and bearing the Gütezeichen (quality mark).

3-9 Labelling

Fittings must be labelled indelibly and legibly with the manufacturer's logo or name and the connecting diameters, but at least with the manufacturer's name.

Gütegemeinschaft Kupferrohr e.V. is the agency for the Gütezeichen (quality mark) applying to copper tubes ("Kupferrohr").

Fittings of copper tubes for capillary soldering complying with these quality assurance and test specifications may bear on their packaging the Gütezeichen (quality mark) issued by Gütegemeinschaft Kupferrohr e.V.

An additional box outside of the Gütezeichen (quality mark) (underneath or on the right) then contains the product code "Fittings for capillary soldering RAL-GZ 641/3". The layout must be agreed in binding form with Gütegemeinschaft Kupferrohr e.V.



Soldering Fittings RAL-GZ 431/3

Fittings complying with the quality assurance and test specifications are labelled in the following (simplified) form:



Quality assurance and test specifications

Products bearing a quality test mark must be marked clearly as such in the manufacturer's catalogues and sales material.

3-10 Changes

All changes to these special quality assurance and test specifications are subject to Section 5 of the general quality assurance and test specifications for copper tubes.

Only the latest issues of the listed DIN standards, EN standards, and other bodies of regulations may be applied. Changes to the standards and pertinent specifications are subject to a transition period of one year following their date of issue, after which the latest version must be applied.

Annex 1 to the special quality assurance and test specifications RAL-GZ 641/3

Scope

90°- Elbow i-o 5001A	12	T piece 5130	12	T piece 5130	35	Reducing sleeve 5240	15 x 12
	15		12 x 15 x 12		35 x 12 x 35		
	18				35 x 15 x 22		18 x 12
	22		15		35 x 15 x 28		18 x 15
	28		15 x 12 x 12		35 x 15 x 35		
	35		15 x 12 x 15		35 x 18 x 35		22 x 12
	42		15 x 15 x 12		35 x 22 x 22		22 x 15
	54		15 x 18 x 12		35 x 22 x 28		22 x 18
			15 x 18 x 15		35 x 22 x 35		
			15 x 22 x 12		35 x 28 x 22		28 x 12
90°- Elbow i-i 5002A	15		15 x 22 x 15	35 x 28 x 28		28 x 15	
	18			35 x 28 x 35		28 x 18	
	22	18		35 x 35 x 22		28 x 22	
	28	18 x 12 x 12		35 x 35 x 28			
	35	18 x 12 x 15		35 x 42 x 35		35 x 18	
	42	18 x 12 x 18				35 x 22	
	54	18 x 15 x 12				35 x 28	
		18 x 15 x 15		42			
		18 x 15 x 18		42 x 15 x 35			42 x 22
		18 x 18 x 12		42 x 15 x 42			42 x 28
45°- Elbow i-o 5040	18		18 x 18 x 15	42 x 18 x 42		42 x 35	
	22		18 x 22 x 15	42 x 22 x 22			
	28		18 x 22 x 18	42 x 22 x 35			
	35		18 x 28 x 18	42 x 22 x 42		54 x 22	
	42			42 x 28 x 28		54 x 28	
	54			42 x 28 x 35		54 x 35	
		22		42 x 28 x 42		54 x 42	
		22 x 12 x 12		42 x 28 x 42			
		22 x 12 x 15		42 x 35 x 28			
		22 x 12 x 18		42 x 35 x 35			
45°- Elbow i-i 5041	15		22 x 15 x 12	42 x 35 x 42	Reducing adapter 5243	15 x 12	
	18		22 x 15 x 15	42 x 35 x 42		18 x 12	
	22		22 x 12 x 22	42 x 42 x 28		18 x 15	
	28		22 x 15 x 15	42 x 42 x 35			
	35		22 x 15 x 18				
	42		22 x 15 x 22	54		22 x 12	
	54		22 x 18 x 15	54 x 22 x 54		22 x 15	
			22 x 18 x 18	54 x 28 x 54		22 x 18	
			22 x 18 x 22	54 x 35 x 54			
			22 x 22 x 12	54 x 42 x 42			
180°- Crossover 5085	15		22 x 22 x 15	54 x 42 x 54		28 x 12	
	18		22 x 22 x 18	54 x 42 x 54		28 x 15	
	22		22 x 28 x 15	54 x 54 x 42		28 x 18	
			22 x 28 x 18			28 x 22	
			22 x 28 x 22				
135°- Crossover 5086	15		28			35 x 12	
	18		28 x 12 x 22			35 x 15	
	22		28 x 12 x 28			35 x 18	
			28 x 15 x 12			35 x 22	
			28 x 15 x 15			35 x 28	
			28 x 15 x 22				
			28 x 15 x 28			42 x 15	
			28 x 18 x 15			42 x 18	
			28 x 18 x 18			42 x 22	
			28 x 18 x 22			42 x 28	
			28 x 18 x 28			42 x 35	
			28 x 22 x 12				
			28 x 22 x 15			54 x 28	
			28 x 22 x 18			54 x 35	
			28 x 22 x 22			54 x 42	
			28 x 22 x 28				
			28 x 28 x 15				
			28 x 28 x 18				
			28 x 28 x 22				
			28 x 35 x 22				
			28 x 35 x 28				
					Sleeves 5270	12	
						15	
						18	
						22	
						28	
						35	
					42		
					54		

Special quality and test specifications for hard solders and hard soldering fluxes

RAL-GZ 641/4

(In any case of doubt, the German language shall prevail!)

4-1 Scope

Hard solders due to DIN EN ISO 17672 and fluxes due to DIN EN 1045 for the hard soldering of copper tube connections.

4-1.1 Special

These special quality assurance and test specifications apply only in conjunction with the general quality assurance and test specifications.

4-2 Quality assurance specifications

4-2.1 Hard solders

4-2.1.1 Packaging

The hard solders must be packaged as given in Annex 1 to these special quality assurance and test specifications and given in DIN EN ISO 17672.

4-2.1.2 Delivery mode

Gütezeichen (quality mark) hard solders are generally ordered as rods by weight. They are delivered as rods with a fixed length of 500 mm and a maximum deviation of ± 5 mm.

4-2.1.3 Delivery forms and dimensions

The delivery forms and dimensions must comply with the requirements given in DIN EN ISO 17672.

4-2.1.4 Surface quality

The surface consistency must comply with the requirements given in DIN EN ISO 17672.

4-2.1.5 Alloy composition

The composition of the hard solders must correspond to the alloys CuP 179, CuP 279, Ag 244, Ag 145, or Ag 134 due to DIN EN ISO 17672. This is determined by means of ICP optical emission spectrometry due to DIN EN ISO 11885. In individual cases, a different testing method (e.g. gravimetry, electrogravimetry, photometry) may be applied following consultation with the quality committee.

4-2.2 Hard soldering fluxes

4-2.2.1 Packaging

The hard soldering fluxes must be packaged as set down under Annex 1 to these special quality assurance and test specifications and under DIN EN 1045.

4-2.2.2 Delivery mode

Gütezeichen (quality mark) hard soldering fluxes are generally delivered as paste by weight.

4-2.2.3 Delivery forms

The delivery forms must comply with the requirements given in DIN EN 1045.

4-2.2.4 Composition

The composition of the hard soldering fluxes must correspond to the type descriptions and characteristics FH 10 as given in DIN EN 1045. The flux may not contain more than 30% by weight of fluoride concentrate. This is determined as given in Annex 2.

4-2.2.5 Testing of effectiveness

The flux must ensure an adequate wetting and spread of the melted solder on the metal (Annex 3).

4-2.2.6 Hygienic requirements

After processing, the fluxes must be removable by rinsing due to DIN EN 806-4, Section 6.2. This requirement is deemed fulfilled when at least 95% of the flux has been removed following treatment in accordance with Annex 4.

The hygienic requirements for materials under Section 1.3 of the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") must be fulfilled.

4-2.2.7 Quality assurance systems

The companies must implement an ISO 9001 quality management system and proceed accordingly.

4-2.3 Changes to regulations

Only the latest issues of the listed DIN standards, EN standards, and other bodies of regulations may be applied. Changes to the standards and pertinent specifications are subject to a transition period of one year following their date of issue, after which the latest version must be applied.

4-3 Initial testing procedure

4-3.1 The applicant must declare to the quality committee that its production plant is able to produce the products he has applied for in the quality demanded for the Gütezeichen (quality mark) in its application, that the quality assurance specifications will be fulfilled in future as well, and that the applicant has the resources for an adequate

Quality assurance and test specifications

inspection of the products. In the event of justified or justifiable doubts pertaining to these specifications, the quality committee may inspect the production plant, also by sending delegates.

4-3.2 The quality committee thereupon arranges the testing defined under Section 4-5 for those products in the application for the Gütezeichen (quality mark). The results of these tests must be set down in writing and included in the quality committee's files. The applicant receives a duplicate.

4-3.3 Together with the order for approval testing, the quality committee also empowers the managing director to order the testing of the quality management system for compliance with DIN EN ISO 9001.

If a company can submit certification of its quality management system by an accredited certification body, the quality committee recognises this approval. There is then no repeat test by the quality committee or its delegates.

4-4 Constant self-regulation

4-4.1 Every mark bearer must implement inhouse quality control regularly on his products labelled with the Gütezeichen (quality mark). These control procedures are to ensure adequate testing of ongoing production for its adherence to the quality conditions. From case to case, the quality committee defines the type and scope of these control with consideration to the given production equipment and the arrangement for control taken by the affected Gütezeichen (quality mark) bearer.

Hard solders

Adequate regular testing requires a quantitative analysis of the main constituents at least once on every melted lot.

Hard solders with a high silver content must be tested at random for cadmium (Cd) and lead (Pb) contamination. The cadmium content may not exceed 0.01%wt, the lead content 0.025%wt. Hard solders containing phosphorus must be tested at random for cadmium and zinc contamination. The cadmium content may not exceed 0.01%wt, the lead content 0.025%wt. The zinc content may not exceed 0.05%wt.

Hard soldering fluxes

Adequate regular testing requires a function test on every formulation (see Annex 3). The composition must be tested after every change of raw material in a lot.

4-4.2 The Gütezeichen (quality mark) bearer must set down in writing the test methods it applies and the test results they return. These records must be archived for at least five years and rendered accessible on demand to the quality committee and its commissioned testing bodies.

4-5 Neutral independent monitoring

4-5.1 The ongoing monitoring tests are initiated by the quality committee. The quality committee empowers the managing director to award the testing orders. The managing director of the quality assurance association is responsible for verifying the full implementation of the procedures

provided herein. The ongoing monitoring tests, which must be conducted at least every two years, include all solder types and fluxes. If not all of these inspections have been performed, suitable actions must be arranged for additional sampling and testing.

4-5.2 As a rule, samples are taken at the production plant. When, in special cases, taken from dealers or buyers, the samples must originate from original packaging, if these are packaged as such by the supplying manufacturer.

4-5.3 The samples needed for these tests are taken from the stores or production, as specified by the quality committee or instructed by the inspector.

4-5.3.1 Five soldering rods are then taken at random, and their dimensions and surface quality tested. If possible, the soldering rods should be taken from at least two lots, after their packaging and labelling has been verified. One soldering rod is analysed in the laboratory of the Gütezeichen (quality mark) bearer, the others by the commissioned testing institute. The results of all analyses are also compared with the values returned by constant self-regulation (see Section 4-4.1) and must be within the tolerances usual for these analyses. The composition of the solders must be within the tolerance range for alloying elements due to DIN EN ISO 17672.

4-5.3.2 Three flux packages are then taken at random, and their packaging and labelling verified. If possible, the fluxes should be taken from at least two lots. The tests for effectiveness and compliance with the hygienic requirements are conducted on all taken samples, either witnessed by the inspector on the Gütezeichen (quality mark) bearer's premises or by the commissioned testing institute. The composition is tested on one sample.

4-5.4 The tested production plants must assist the inspector by providing free of charge subsidiary workers and equipment needed to conduct the tests.

4-5.5 Procedure in the event of noncompliance in the first set of samples

If the testing reveals that one of the samples taken fails to fulfil the requirements in accordance with Section 4.2, a further three samples must be taken and tested. If a sample from this second taking then fails the test, the test is considered to have failed.

4-6 Tests in special cases

4-6.1 Restriction to individual specifications – general

If the implementing rules include tests owing to special incidents, the quality committee may restrict these tests to individual specifications. These must, however, include all submitted complaints and prove adequate for defining binding ascertainties.

4-6.2 Restriction to individual specifications – repeat testing

The same also applies analogously to repeat testing when

tests have given rise to complaints.

4-7 Test results

4-7.1 Test report

The inspector must compile a report with the test results and submit this to the quality committee. The tested Gütezeichen (quality mark) bearer receives a duplicate.

4-7.2 Determination by the Quality committee

The quality committee determines the results from the report.

4-7.3 Test certificate

If the testing did not give rise to a complaint, the quality committee issues in writing a certificate of this and sends a copy to the tested Gütezeichen (quality mark) bearer. If necessary for the quality assurance, the quality committee additionally refers the Gütezeichen (quality mark) bearer specifically to certain conclusions derived from the test report.

4-7.4 Repeat testing

If the testing ascertains that the tested production plant does not fulfil the quality conditions, the quality committee informs the production plant of the conclusions reached, at the same time ordering a repeat testing. This must take place within ninety days of the testing giving rise to the complaints.

If this repeat testing again fails, neutral independent monitoring is considered to have failed completely.

The further procedure is regulated in the implementation requirements for awarding and bearing the Gütezeichen (quality mark) for copper tubes.

4-8 Labelling with the Gütezeichen (quality mark)

Gütegemeinschaft Kupferrohr e.V. is the agency for the Gütezeichen (quality mark) applying to copper tube systems ("System Kupferrohr").

Hard solders must be labelled in compliance with the specifications under DIN EN ISO 17672. Hard soldering fluxes must be labelled in compliance with the definitions under DIN EN 1045 and on DVGW worksheet GW 7.

Hard solders and hard soldering fluxes complying with these quality assurance and test specifications may bear on their packaging the Gütezeichen (quality mark) issued by Gütegemeinschaft Kupferrohr e.V.

An additional box outside of the Gütezeichen (quality mark) (underneath or on the right) then contains the product code "Hard solders and hard soldering fluxes RAL-GZ 641/4". The layout must be agreed in binding form with Gütegemeinschaft Kupferrohr e.V.



Hard solders and hard soldering fluxes RAL-GZ 641/4

Here too, labelling includes the manufacturer's logo and address, the hard solder's abbreviated code according to DIN EN ISO 17672 and the flux's according to DIN EN 1045, the quantity in the form of the net weight, and the pertinent labels defined in the German hazardous substances ordinance GefStoffV.

4-9 Changes

All changes to these special quality assurance and test specifications are subject to Section 5 of the general quality assurance and test specifications for copper tube systems.

Packaging of hard solders and hard soldering fluxes with RAL Gütezeichen (quality mark)

Corresponding to subclauses 4-2.1.1 and 4-2.2.1 "Packaging" of the quality conditions for hard solders and hard soldering fluxes, hard solders and hard soldering fluxes with the RAL Gütezeichen (quality mark) must be delivered in appropriate standard packaging.

Taking these aspects into account, the quality committee sees as appropriate standard packaging:

1. Packaging

- 1.1** Hard solders in quantities more than 1 kg must be packaged in cartons, quantities of 1 kg or less in cartons or sleeves.
- 1.2** Hard soldering fluxes must be packaged in sheet metal or plastic with detachable sealing closure.

2. Packaging material

The packaging materials may not contain any substances or exhibit any properties that may prove detrimental to the packaged goods during prolonged storage. The responsibility lies with the Gütezeichen (quality mark) bearer, which must verify adherence to these requirements in cases of doubt. The quality monitoring and approval procedures do not include this testing.

3. Labelling on packaging

Packaging must be labelled as follows:

- 1. DIN EN or DIN EN ISO codes,
- 2. brand name, if any,
- 3. company name and address,
- 4. net weight,
- 5. Gütezeichen (quality mark),
- 6. labelling according to GefStoffV (German hazardous substances regulation),
- 7. lot number or production date.

Annex 2 to the special quality assurance and test specifications RAL-GZ 641/4

Determination of fluoride content

Basis: Water soluble fluorides form complex salts that decolorise the zirconium-alizarin indicator.

Reagents: Zirconium chloride solution
Indicator solution
HCl m/2

Equipment: 25 ml burette with 1/10 ml gradations
300 ml Erlenmeyer flask

Preparing the zirconium chloride solution:

8.056 g of zirconyl chloride ($ZrOCl_2 \cdot 8H_2O$) is dissolved in a 1000 ml graduated flask with 20 ml of concentrated nitric acid and water, and water added to the mark.

Preparing the indicator solution:

0.500 g of 3-Alizarinsulfonic acid disodium salt dissolved in 100 ml of water. Borax cryst sodium fluoride

Formulating the zirconium chloride solution:

50 ml NaF solution (1.000 g NaF in 1000 ml H_2O = 452 mg F, 1 ml = 0.452 mg F) + 100 mg $Na_2B_4O_7 \cdot 10H_2O$ (= 11.34 mg B) take five drops of alizarin solution and water added to a volume of 150 ml. Then HCl is added drop by drop until the colour turns yellow m/2, and zirconium chloride solution added until orange/yellow (onion colour). The consumption is e.g. 12.3 ml. Since the prepared 50 ml NaF solution contains $50 \times 0.452 \text{ mg} = 22.6 \text{ mg F}$ and the theoretical F equivalent of the consumed 12.3 ml zirconium equals $1.9 \times 12.3 = 23.37 \text{ mg}$, the following formula returns a correction factor of 0.9670

a) found quantity F = 23.37 mg

a) prepared quantity F = 22.60 mg

$$23.37 : 22.60 = 1 : x ; x = 0.9670$$

The correction factor must be recalculated prior to each test series.

Implementation:

A weighed-in quantity of the pasty material equalling 0.100–0.150 is placed in a 300 ml Erlenmeyer flask and dissolved further in 40 ml H_2O ; 7 drops of alizarin solution are added, and water added to a volume of 150 ml. Then HCl is added drop by drop until the colour turns yellow m/2, and then zirconium chloride solution added until orange/yellow (onion colour). The found quantity F in mg (consumed zirconium chloride solution in ml multiplied by 1.9) must be converted with the calculated correction factor.

Sources of error:

Nonmatching colour nuances between the reference sample (zirconium chloride) and the sample solution lead to erroneous fluoride results.

Calculations:

Consumption (ml) \times 1.9 \times correction factor : 10 = % F

Weighed-in quantity:

e.g. $9.3 \text{ ml} \times 1.9 \times 0.9670 : 10 = 15.4\% \text{ F}$

0.1107

Flux function test

A 10 mm length of Ag 145 soldering wire (DIN EN ISO 17672) 1.5 mm in diameter is placed on a plane Cu-DHP (CW024A) sheet section (DIN EN 1652) of 80 mm x 35 mm x 1 mm. To the length of the soldering wire is applied 0.2 g of thoroughly mixed flux paste directly before the test. The sample body is heated to 800 °C on a metal block (40 mm x 40 mm x 120 mm) in a muffle furnace. A thermocouple measures the furnace temperature and the temperature of the metal block. Once the temperatures of the furnace and metal block reach 800 ± 5 °C, the sample body is placed flat on the metal block. After 90 seconds of heating, it is taken out of the furnace and assessed visually. The solder must have wetted and spread over the copper sheet.

Annex 4 to the special quality assurance and test specifications RAL-GZ 641/4**Testing the rinsability of hard soldering fluxes**

A 10 mm length of Ag 244 soldering wire (DIN EN ISO 17672) 1.5 mm in diameter and 0.6 g of flux paste is placed on each of three plane CuZn37 (CW508L) sheets (DIN EN 1652) of 40 mm x 40 mm x 1 mm. The sample body is heated to 750 °C on a metal block (40 mm x 40 mm x 120 mm) in a muffle furnace. A thermocouple measures the furnace temperature and the temperature of the metal block. Once the temperatures of the furnace and metal block reach 750 ± 5 °C, the sample body is placed flat on the metal block. After 45 seconds of heating, it is taken out of the furnace. Each sheet is then rinsed in succession for three minutes. The 5 l/min flow of cold water (≤ 25 °C) should impinge on the sheet in unpressurised free fall from a height of 50 cm. At the same time, the sheet must be manipulated so that its whole surface is rinsed uniformly with water. Afterwards, the three sheets are dried at a temperature of 50 °C or in a desiccator at room temperature until a constant weight is reached.

Special quality and test specifications for soft solders, soft soldering fluxes, and soft soldering pastes

RAL-GZ 641/5

(In any case of doubt, the German language shall prevail!!)

5-1 Scope

These quality assurance and test specifications apply to

- soft solders due to DIN EN ISO 9453,
- soft soldering fluxes due to DIN EN ISO 9454, and
- soft soldering pastes (mixtures of soft soldering flux and soft solder powder) due to DIN EN ISO 9453 and DIN EN ISO 9454-1.

5-1.1 Special

These special quality assurance and test specifications apply only in conjunction with the general quality assurance and test specifications.

5-2 Quality assurance specifications

5-2.1 Soft solders

5-2.1.1 Packaging

Gütezeichen (quality mark) soft solders must comply with the packaging guidelines in Annex 1 and the requirements due to DIN EN ISO 9453.

5-2.1.2 Delivery mode

Gütezeichen (quality mark) soft solders are delivered as wire by weight.

5-2.1.3 Delivery forms and dimensions

The delivery forms must comply with DIN EN ISO 9453.

5-2.1.4 Surface quality

The surface consistency must fulfil the requirements due to DIN EN ISO 9453.

5-2.1.5 Composition

The composition of the soft solders must correspond to the alloy 702 [S-Sn97Ag3] or the alloy 402 [S-Sn97Cu3] due to DIN EN ISO 9453. This is determined by means of ICP optical emission spectrometry due to DIN EN ISO 11885. In individual cases, a different testing method (e.g. gravimetry, electrogravimetry) may be applied following consultation with the quality committee.

5-2.2 Soft soldering fluxes

5-2.2.1 Packaging

Gütezeichen (quality mark) soft soldering fluxes must com-

ply with the packaging guidelines in Annex 1 and the requirements due to DIN EN ISO 9454-1.

5-2.2.2 Delivery mode

Gütezeichen (quality mark) soft soldering fluxes are delivered as paste or liquid by weight.

5-2.2.3 Delivery forms

The delivery forms must comply with DIN EN ISO 9454-1.

5-2.2.4 Composition

The composition of the soft soldering fluxes must correspond to the type description as given in DIN EN ISO 9454-1 and the type characteristics 3.1.1, 3.1.2, or 2.1.2.

The flux shall not contain more than 12% by weight of chloride or 27% by weight of bromide concentrate. Types 3.1.1 and 3.1.2 must contain at least 80% of the verified halides in the form of Zn or another heavy metal salt. The halide content is determined by Vollhard titration. The zinc content is determined by complexometric titration.

5-2.2.5 Effectiveness

The flux must ensure an adequate wetting and spread of the melted solder on the metal.

5-2.2.6 Hygienic requirements

After processing, the fluxes must be removable by rinsing due to DIN EN 806-4, Section 6.2. This requirement is deemed fulfilled when at least 95% of the flux has been removed following treatment in accordance with Annex 2.

The hygienic requirements for materials in accordance with Section 1.3 of the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") must be fulfilled.

5-2.3 Soft soldering pastes

5-2.3.1 Packaging

Gütezeichen (quality mark) soft soldering pastes must comply with the packaging guidelines in Annex 1 and the requirements due to DIN EN ISO 9453 and DIN EN ISO 9454-1.

5-2.3.2 Delivery mode

Gütezeichen (quality mark) soft soldering pastes are delivered as paste by weight.

5-2.3.3 Delivery forms

The delivery forms must comply with DIN EN ISO 9453 and

Quality assurance and test specifications

DIN EN ISO 9454-1.

5-2.3.4 Composition

The composition of the soft soldering fluxes must correspond to the type description 3.1.1, 3.1.2, or 2.1.2 as given in DIN EN ISO 9454-1.

The halide concentration shall not exceed 9% by weight of chloride or 20% by weight of bromide, based on the mixture. Types 3.1.1 and 3.1.2 must contain at least 80% of the verified halides in the form of zinc or another heavy metal salt. The halide content is determined by Vollhard titration. The zinc content is determined by complexometric titration.

The composition of the soft solder powders must correspond to the soft solder alloy 702 (S-Sn97Ag3) or alloy 402 (S-Sn97Cu3) as given in DIN EN ISO 9453. This is determined by means of ICP optical emission spectrometry due to DIN EN ISO 11885. In individual cases, a different testing method (e.g. gravimetry, electrogravimetry) may be applied following consultation with the quality committee.

The soft solder powder content must be no less than 60%.

5-2.3.5 Effectiveness

The containing flux must ensure an adequate wetting and spread of the melted solder on the metal.

5-2.3.6 Hygienic requirements

After processing, the fluxes must be removable by rinsing due to DIN EN 806-4, Section 6.2. This requirement is deemed fulfilled when at least 95% of the soft soldering paste's flux content has been removed following treatment in accordance to Annex 2.

5-2.3.7 Quality management systems

The companies must implement an ISO 9001 quality management system and proceed accordingly.

5-2.4 Changes to regulations

Only the latest issues of the listed standards and other bodies of regulations may be applied. Changes to the standards and pertinent specifications are subject to a transition period of one year following their date of issue, after which the latest version must be applied.

5-3 Initial testing procedure

5-3.1 The applicant must declare to the quality committee that its production plant is able to produce the products he has applied for in the quality demanded for the Gütezeichen (quality mark) in its application, that the quality assurance conditions will be fulfilled in future as well, and that the applicant has the resources for an adequate inspection of the products. In the event of justified or justifiable doubts pertaining to these specifications, the quality committee may inspect the production plant, also by sending delegates.

5-3.2 The quality committee thereupon arranges the testing defined under Section 5-5 for those products in the

application for the Gütezeichen (quality mark). The results of these tests must be set down in writing and included in the quality committee's files. The applicant receives a duplicate.

5-3.3 Together with the order for approval testing, the quality committee also empowers the managing director to order the testing of the quality management system for compliance with DIN EN ISO 9001.

If a company can submit certification of its quality management system by an accredited certification body, the quality committee recognises this approval. There is then no repeat test by the quality committee or its delegates.

5-4 Constant self-regulation

5-4.1 Every mark bearer must implement inhouse quality control regularly on its products labelled with the Gütezeichen (quality mark). These control procedures are to ensure adequate testing of ongoing production for its adherence to the quality conditions.

5-4.2 Soft solders

Adequate ongoing testing requires on each melted lot an analysis of the main constituents silver (Ag) in the alloy 702 (S-Sn97Ag3) or copper (Cu) in the alloy 402 (S-Sn97Cu3) (see Annex 1).

5-4.3 Soft soldering fluxes

Adequate ongoing testing requires a determination of the halide and zinc content and a test for effectiveness after every batch change of raw materials.

5-4.4 Soft soldering pastes

Adequate ongoing testing requires a determination of the halide, zinc, and soft solder powder content, an analysis of the main constituent (see Section 5-4.2) in the soft solder powder, and a test for effectiveness.

5-4.5 The Gütezeichen (quality mark) bearer must set down in writing the test methods it applies and the test results they return. These records must be archived for at least two years and submitted on demand to the quality committee and tester it has commissioned for neutral independent monitoring.

5-5 Neutral independent monitoring

5-5.1 The ongoing monitoring tests are initiated by the quality committee. The quality committee empowers the managing director to award the testing orders. The managing director of the quality assurance association is responsible for verifying the full implementation of the procedures provided herein. The ongoing monitoring tests, which must be conducted at least every two years, include all solders, fluxes, and soft soldering pastes. If not all of these inspections have been performed, suitable actions must be arranged for additional sampling and testing.

5-5.2 Samples are taken at the production plant gener-

ally. When, in special cases, taken from dealers or buyers, the samples must originate from original packaging, if these are packaged as such by the supplying manufacturer.

5-5.3 On the inspector's instructions, the test samples are taken at random at the production plant.

5-5.4 Soft solders

Five reels are then taken at random, and their dimensions and surface quality tested. If possible, the reels should be taken from at least two lots, after their packaging and labelling has been verified. One reel is analysed in the laboratory of the Gütezeichen (quality mark) bearer, the other two by the commissioned testing institute. The results of all analyses are also compared with the values returned by constant self-regulation (see Section 5-4.1) and must be within the tolerances usual for these analyses. The composition of the solders must be within the tolerance range for alloying elements due to DIN EN ISO 9453.

5-5.5 Soft soldering fluxes

Three flux packages are then taken at random, and their packaging and labelling verified. If possible, the fluxes should be taken from at least two lots. The tests for effectiveness and compliance with the hygienic requirements are conducted on all taken samples, either witnessed by the inspector on the Gütezeichen (quality mark) bearer's premises or by the commissioned testing institute. The composition is tested on one sample.

5-5.6 Soft soldering pastes

Three soft soldering paste packages are then taken at random, and their packaging and labelling verified. If possible, the fluxes should be taken from at least two lots. The tests for effectiveness and compliance with the hygienic requirements are conducted on all taken samples, either witnessed by the inspector on the Gütezeichen (quality mark) bearer's premises or by the commissioned testing institute. The composition is tested on one sample.

5-5.7 When samples are taken at the production plant, this must assist the inspector by providing free of charge subsidiary workers and equipment needed to conduct the tests.

5-5.8 Procedure in the event of noncompliance in the first set of samples

If the testing reveals that one of the samples taken fails to fulfil the requirements in accordance with Section 5.2, a further three samples must be taken and tested. If a sample from this second taking then fails the test, the test is considered to have failed.

5-6 Tests in special cases

5-6.1 Restriction to individual specifications – general

If the implementing rules include tests owing to special incidents, the quality committee may restrict these tests to individual specifications. These must, however, include

all submitted complaints and prove adequate for defining binding ascertainment.

5-6.2 Restriction to individual specifications – repeat testing

The same also applies analogously to repeat testing when tests have given rise to complaints.

5-7 Test results

5-7.1 Test report

The inspector must compile a test report with the test results and submit this to the quality committee. The tested Gütezeichen (quality mark) bearer receives a duplicate.

5-7.2 Determination by the Quality committee

The quality committee determines the results from the report.

5-7.3 Test certificate

If the testing did not give rise to complaints, the quality committee issues in writing a certificate of this and sends a copy to the tested Gütezeichen (quality mark) bearer.

If necessary for the quality assurance, the quality committee additionally refers the Gütezeichen (quality mark) bearer specifically to certain conclusions derived from the test report.

5-7.4 Repeat testing

If the testing ascertains that the tested production plant does not fulfil the quality conditions, the quality committee informs the production plant of the conclusions reached, at the same time ordering a repeat testing. This must take place at the earliest possible date, but no later than four weeks after the testing that gave rise to the complaints.

If this repeat testing again fails, neutral independent monitoring is considered to have failed completely.

The further procedure is regulated in the implementation requirements for awarding and bearing the Gütezeichen (quality mark).

5-8 Labelling with the Gütezeichen (quality mark)

Gütegemeinschaft Kupferrohr e.V. is the agency for the Gütezeichen (quality mark) applying to copper tube systems ("System Kupferrohr").

Soft solders, sold soldering fluxes, and soft soldering pastes must be labelled in compliance with the definitions under DIN EN ISO 9453 and DIN EN ISO 9454-1 and on DVGW worksheet GW 7.

Soft solders, sold soldering fluxes, and soft soldering pastes

Quality assurance and test specifications

complying with these quality assurance and test specifications may bear on their packaging the Gütezeichen (quality mark) issued by Gütegemeinschaft Kupferrohr e.V.

An additional box outside of the Gütezeichen (quality mark) (underneath or on the right) then contains the product code "Soft solders, sold soldering fluxes, and soft soldering pastes RAL-GZ 641/5". The layout must be agreed in binding form with Gütegemeinschaft Kupferrohr e.V.



Soft solders, soft soldering fluxes, and soft soldering pastes RAL-GZ 641/5

Here too, labelling includes the DIN EN abbreviated code, the manufacturer's logo, the net weight, the metal content in percent (for soft soldering pastes), the lot number, and the pertinent labels defined in the German hazardous substances ordinance GefStoffV.

5-9 Changes

All changes to these special quality assurance and test specifications are subject to Section 5 of the general quality assurance and test specifications for copper tube systems.

Annex 1 to the special quality assurance and test specifications RAL-GZ 641/5

Packaging of soft solders, soft soldering fluxes, and soft soldering pastes with RAL Gütezeichen (quality mark)

Corresponding to subclauses 5-2.1.1, 5-2.2.1, and 5-2.3.1 "Packaging" of the quality conditions for soft solders, soft soldering fluxes, and soft soldering pastes, soft fluxes and soft soldering pastes with the RAL Gütezeichen (quality mark) must be delivered in appropriate standard packaging.

1. Packaging

- 1.1 Soft solders in quantities of 100–1000 g on plastic, wood, or sheet metal reels; in quantities less than 100 g on cardboard or plastic wrapping cards. Delivered as wire rods in cardboard packaging.
- 1.2 Soft soldering fluxes must be packaged in plastic with detachable sealing closure.
- 1.3 Soft soldering pastes must be packaged in plastic with detachable sealing closure.

2. Packaging material

The packaging materials shall not contain any substances or exhibit any properties that may prove detrimental to the packaged goods during prolonged storage. The responsibility lies with the Gütezeichen (quality mark) bearer, which must verify adherence to these requirements in cases of doubt. The quality monitoring and approval procedures do not include this testing.

3. Labelling on packaging

Packaging must be labelled as follows:

1. DIN EN abbreviated code,
2. brand name, if any,
3. company name and address,
4. net weight (as defined under the German prepackaging ordinance FertigPackV of 18 December 1981, German Federal Law Gazette BGBl, year 1981; Part 1, pp 1585 ff),
5. metal content in %wt (for soft soldering pastes),
6. lot number,
7. Gütezeichen (quality mark),

Here, the company logo may not be appreciably larger than the Gütezeichen (quality mark).

Testing the rinsability of soft soldering fluxes

A spatula tip of the lot to be tested is applied in a thin layer covering completely about 1 cm² to the surface of a plane R280 CuZn37 sheet (DIN EN 1652) measuring 40 mm x 40 mm x 1 mm, and a section of soldering wire 402 (S-Sn97Cu3) about 10 mm long and 2.0 mm in diameter placed on top.

Then the sheet is heated as uniformly as possible with a burner. The flux should flow and spread at the same time as the solder flows and wets the substrate.

Implementation requirements for awarding and bearing the Gütezeichen (quality mark) for copper tube systems

(In any case of doubt, the German language shall prevail!)

1 Quality basis

The quality basis for the Gütezeichen (quality mark) for copper tube systems ("System Kupferrohr") consists of the

- general quality assurance and test specifications and the
- special quality assurance and test specifications for copper tubes and the
- special quality assurance and test specifications for press fittings and the
- special quality assurance and test specifications for soldering fittings and the
- special quality assurance and test specifications for hard solders and hard soldering fluxes and the
- special quality assurance and test specifications for soft solders, soft soldering fluxes, and soft soldering pastes

They are supplemented and updated in line with the state of the art.

The terminology of the products comprising the quality assurance can be taken from Section 1.2 of the general quality assurance and test specifications for copper tube systems.

2 Awarding of the Gütezeichen (quality mark)

2.1 The Quality association awards to manufacturers of

- copper tubes,
- press fittings,
- soldering fittings,
- hard solders and hard soldering fluxes,
- soft solders, soft soldering fluxes, and soft soldering pastes,
- and other ancillary materials for the installation (provided that quality assurance and test specifications have been defined for these products),

on application, the right to bear the Gütezeichen (quality mark) for copper tube systems ("System Kupferrohr") with the product based additions outside of the Gütezeichen (quality mark).

2.2 The application must be submitted in writing to the office of the Quality association. The application must include a legally binding commitment undersigned by the applicant (see sample 1 under these specifications).

2.3 The application and the actual prerequisites for the award of the Gütezeichen (quality mark) are examined by the quality committee in accordance with the verified under the general and special quality assurance and test

specifications. Specifically, it must ascertain whether the products covered in the application for the right to bear the Gütezeichen (quality mark) fulfil the quality conditions.

2.3.1 These ascertainments must be based on tests on sample products taken from the applicant's production facilities and stores. This testing must include an inspection of the applicant's production facilities, which must focus specifically on the existing production and storage equipment and the quality monitoring precautions.

2.3.2 The quality committee may itself conduct the testing. It may also commission sworn-in experts, state approved testing bodies, or other acknowledged, neutral institutes that must be obliged to maintain secrecy before third parties. The quality committee must select this option when this appears appropriate for reasons of secrecy with respect to production methods and competition.

2.3.3 The costs of this testing must be borne by the applicant.

2.4 When the findings verify that the applicant's products fulfil the quality conditions, the quality committee suggests to the board that it awards the right to bear the Gütezeichen (quality mark).

This award takes the form of a special award certificate based on sample 2 in these specifications.

2.5 If the testing finds that the applicant's products do not fulfil the quality conditions, the quality committee shelves the application. It must inform the applicant thereof, specifying the reasons. It may then schedule a date for repeat testing.

3 Use of the Gütezeichen (quality mark)

3.1 Gütezeichen (quality mark) bearers may use the Gütezeichen (quality mark) with the product based additions for those products only that comply with the pertinent special quality assurance and test specifications, and only for the life of the award. Gütezeichen (quality mark) bearers are not obliged to manufacture and market exclusively Gütezeichen (quality mark) products. In these cases, there must be no marketing reference to the awarded Gütezeichen (quality mark), both in compliance with the anticartel laws and for preserving the significance of the Gütezeichen (quality mark).

3.2 The Quality association alone has the right to commission production of Gütezeichen (quality mark) labelling (metal embossing, embossing stamps, printing block, lead seals, sealing labels, rubber stamps, etc.) – also by way of the Gütezeichen (quality mark) bearer, to issue or appoint agents to issue this to the Gütezeichen (quality mark) bearer, and to define its uses in greater detail.

3.3 The board may determine the scope within which the Gütezeichen (quality mark) may be used for advertising on printed matter, business paper, envelopes, packaging, etc.

Implementation requirements

It has the right to issue special conditions for joint advertising as a measure to uphold the anticartel laws and prevent abuse of the Gütezeichen (quality mark).

3.4 The quality committee may specify that the Gütezeichen (quality mark) is applied in different forms to different products.

3.5 The authorisation to bear the Gütezeichen (quality mark) is not transferable to third parties.

3.6 Exceptions are the quality assurance for press fittings and soldering fittings and the quality assurance for solders, fluxes, and soldering pastes. On application, a manufacturer bearing a Gütezeichen (quality mark) is awarded the right to bear the Gütezeichen (quality mark), in accordance with the regulations applying thereto, for other products it has not manufactured itself (for completing a range) when the following prerequisites have been fulfilled:

3.6.1 It purchases the affected press fittings and/or soldering fittings or the affected solder and/or flux and/or the affected soldering paste exclusively from production plants that have been awarded the right to bear the Gütezeichen (quality mark) for these products.

3.6.2 The production plant places in the ordering company's packaging and applies the ordering company's labelling to the affected press fittings and/or soldering fittings or the affected solder and/or flux and/or the affected soldering paste. The production plant conducts inspections identical to those for its own products and is accountable to the Quality association or its agents.

3.6.3 The labelling is applied in the production plant in compliance with the Quality association's regulations.

3.6.4 The production plant and the ordering company have declared their agreement in writing to this regulation and informed the Quality association's managing director thereof.

3.6.5 The ordering company accepts the inspection of its stores by the Quality association or its agents and declares its agreement to the quality committee's initiation of monitoring tests on press fittings as defined under Section 2-6 of the special quality assurance and test specifications, on soldering fittings as defined under Section 3-6 of the special quality assurance and test specifications, on hard solders and hard soldering fluxes under Section 4-5 of the special quality assurance and test specifications, and on soft solders, soft soldering fluxes, and soft soldering pastes under Section 5-5 of the special quality assurance and test specifications, including those in the ordering company's stocks.

4 Monitoring of the bearing of a Gütezeichen (quality mark)

4.1 For the purpose of safeguarding the quality properties, the Quality association monitors the Gütezeichen (quality mark) bearers for their adherence to the general and the assigned special quality conditions for the products labelled with the Gütezeichen (quality mark).

The Gütezeichen (quality mark) bearer must report to the quality committee when production of the Gütezeichen (quality mark) product is to be suspended, not only tempo-

rarily, and resumed only after a prolonged period.

4.2 Each Gütezeichen (quality mark) bearer must take precautions safeguarding the constant compliance of their Gütezeichen (quality mark) products with the quality conditions. It must implement ongoing quality control. Records must be kept regularly of this and other tests. The quality committee or its agents may view these records at any time.

4.3 The Gütezeichen (quality mark) user submits to monitoring tests by the Quality association in accordance with its quality conditions. The Quality association safeguards constant, adequate monitoring in the form of quality testing contracts with the neutral institutes commissioned for this purpose. These tests are subject to Sections 2.3.1 and 2.3.2 accordingly. It submits to authorities and RAL verification of ongoing monitoring.

The commissioned inspectors may at any time request or take samples in the Gütezeichen (quality mark) bearer's facilities, also from dealers or buyers.

Requested samples must be handed over immediately.

4.4 The tests take place at each Gütezeichen (quality mark) bearer's location in accordance with the corresponding special quality assurance and test specifications. The quality committee provides the details on frequency and type. If justified, the quality committee may also initiate, after giving reasons, special tests and inspections of Gütezeichen (quality mark) bearers' production installations. These inspections are performed above all at Gütezeichen (quality mark) bearers that have not manufactured for longer than one year any products awarded the right to bear the Gütezeichen (quality mark) and before they resume production of these products. In such cases, the quality committee always commissions repeat testing and inspection.

4.5 The costs of ongoing monitoring tests must be borne by the tested Gütezeichen (quality mark) bearer. If a monitoring test gives rise to complaints, the costs of these tests also must be borne by the affected manufacturer.

4.6 A certificate must be issued for each of the test findings, and one copy each sent to the Quality association and the Gütezeichen (quality mark) bearer.

4.7 If monitoring tests find that products labelled with the Gütezeichen (quality mark) do not comply with the quality conditions, the quality committee instructs at short notice one or more repeat tests. The Gütezeichen (quality mark) bearer also may demand repeat testing.

In every case, the costs of the repeated testing are borne by the Gütezeichen (quality mark) bearer.

4.8 Tests may also be initiated on application of buyers and other persons and companies when the quality committee is convinced of their justified interest, provided that the applicant is obliged to advance the test costs. If these tests do not indicate a cause for complaints, the applicant must definitively bear the test costs. If the test was ordered by the Quality commission directly, the costs must be born by the Quality association. If the tests give rise to complaints, the affected Gütezeichen (quality mark) bearer must bear in all cases the test costs.

5 Penalties for violations

5.1 The board may decide to take the following measures against Gütezeichen (quality mark) bearers that violate the obligations they have accepted:

5.1.1 warning,

5.1.2 imposed penalty of up to €10,000.00,

5.1.3 temporary or permanent withdrawal of the right to bear the Gütezeichen (quality mark).

5.2 Gütezeichen (quality mark) bearers violating the specifications under the above Sections 3 or 4 must be warned.

5.3 In the case of serious violations, the board may impose for each violation a penalty up to the amount named under subclause 5.1.2. This penalty must be paid within fourteen days following receipt of the decision by the Quality association.

5.4 Warnings and penalties may also be issued together.

5.5 The board must withdraw the authorisation to bear a Gütezeichen (quality mark) if an ongoing monitoring test and at least one repeat test under Section 4 reveal that the affected Gütezeichen (quality mark) bearer is unable to fulfil the quality conditions for its products.

Withdrawal is preceded by a warning and a deadline for fulfilling the quality conditions.

5.6 Authorisation to bear a Gütezeichen (quality mark) may be withdrawn if a Gütezeichen (quality mark) bearer despite warning

5.6.1 hinders or delays monitoring tests,

5.6.2 violates repeatedly and sustainedly in any other manner regulations under these specifications or the quality conditions,

5.6.3 does not defray to the Quality association the test costs it must bear under Section 4.5,

5.6.4 does not manufacture or market for at least one year products awarded the Gütezeichen (quality mark) and does not resume this production and marketing by a suitable deadline set by the board.

5.7 In urgent cases, the board chair of the Quality commission may provisionally withdraw the Gütezeichen (quality mark) with immediate effect. The board must uphold or reverse this provisional measure within fourteen days.

5.8 All decisions under Section 5.1 of this regulation must be issued in writing and sent by registered post to the affected Gütezeichen (quality mark) bearer.

6 Usage fees

6.1 The use of the Gütezeichen (quality mark) for copper tube systems ("System Kupferrohr") requires the payment of an annual fee that is the same for all Gütezeichen (quality mark) bearers of a product group. The amount of this usage fee is set down in a scale of subscriptions and fees agreed upon by the general meeting of Gütegemeinschaft Kupferrohr e.V. The latest wording of this scale of subscriptions and fees must be provided to each Gütezeichen (quality mark) bearer and applicant.

6.2 The use of the Gütezeichen (quality mark) and the obligation to defray the usage fee may be terminated no later than three months before the end of the year. Otherwise, it is extended by one year.

7 Loss of the right to bear a Gütezeichen (quality mark)

7.1 In addition to withdrawal under Section 5 of these specifications, a Gütezeichen (quality mark) bearer loses its right to bear the Gütezeichen (quality mark) on

7.1.1 insolvency proceedings or winding up,

7.1.2 gross violation of the association's interests,

7.1.3 default of payment of the usage fee under Section 6 after the second warning.

7.2 The loss of the right to bear a Gütezeichen (quality mark) is determined by the board, and the Gütezeichen (quality mark) bearer informed thereof in writing. Gütezeichen (quality mark) bearers that have lost in this manner the right to bear the Gütezeichen (quality mark) are obliged to return to the Quality association the award certificate and all labelling materials for the Gütezeichen (quality mark). There is no claim to recompense.

8 Complaint

8.1 Within four weeks following receipt of decisions under Sections 5 and 6 of these specifications, Gütezeichen (quality mark) bearers may submit a complaint to the quality committee.

8.2 If the quality committee does not provide a remedy for the complaint, the complainant may, within four weeks following receipt of the rejection, apply to an arbitration tribunal as defined under Section 12 of the Quality association's statute. The above regulation under Section 12 of the statute applies accordingly:

8.2.1 An arbitration tribunal must rule on all disputes arising from the statute together with the Gütezeichen (quality mark) statute and implementation requirements or from the association's activities.

8.2.2 The arbitration tribunal consists of an umpire and two arbitrators. Each party to the dispute appoints an arbitrator who together appoint the umpire, who must be a fully qualified lawyer. If the arbitrators cannot agree on the person of the umpire, this must be appointed by the president of the higher state court OLG in Düsseldorf.

8.2.3 The party applying to the arbitration tribunal must submit to the opposing party in writing the name of its arbitrator and the claim under dispute and request the opposing party to appoint its arbitrator within two weeks. If this period expires without result, the affected party must submit an application to the president of the OLG Düsseldorf to appoint a second arbitrator.

8.2.4 If, after the appointment of the second arbitrator, they cannot decide on an umpire, each of the parties to the dispute has the right to request the president of the OLG

Implementation requirements

Düsseldorf to appoint the umpire.

8.2.5 The arbitration tribunal rules on the dispute and on the payment of the costs. Its procedure should apply the German code of civil procedure ZPO analogously.

8.2.6 Recourse to ordinary law courts may be claimed only against the ruling of the arbitration tribunal.

9 Rewards

9.1 Gütezeichen (quality mark) bearers that have lost the right to bear a Gütezeichen (quality mark) may be reawarded this on repeat application no earlier than six months afterwards.

9.2 The procedure is determined in accordance with Section 2 of these specifications, but the board may set down additional conditions.

10 Changes to the implementation requirements and samples

10.1 These implementation requirements and samples (declaration of acceptance, award certificate) are acknowledged by RAL. All changes, including edited text, require prior consent issued in writing by RAL before they can become effective.

10.2 Changes to the implementation requirements and samples must grant Gütezeichen (quality mark) bearers a suitable transition period after which the new regulations must be adopted. The general meeting determines the time of coming into force.

Declaration of acceptance

(under Section 2.2 of the implementation requirements issued by Gütegemeinschaft Kupferrohr e.V.)

1. The signatory / undersigned company applies hereby to Gütegemeinschaft Kupferrohr e.V. for
 - acceptance as a member^{*)}
 - the award of the right to bear the Gütezeichen (quality mark) for copper tube systems ("System Kupferrohr")^{*)} with the product based addition under Section 2 of this declaration of acceptance for the following products

2. It is hereby confirmed that
 - the statute of Gütegemeinschaft Kupferrohr e.V.
 - the Gütezeichen (quality mark) statute of Gütegemeinschaft Kupferrohr e.V.
 - the implementation requirements for awarding and bearing the Gütezeichen (quality mark) for copper tube systems ("System Kupferrohr")
 - the general quality assurance and test specifications for copper tube systems ("System Kupferrohr") in conjunction with the
 - special quality assurance and test specifications for copper tubes
 - special quality assurance and test specifications for press fittings made of copper tubes
 - special quality assurance and test specifications for soldering fittings made of copper tubes
 - special quality assurance and test specifications for hard solders and hard soldering fluxes
 - special quality assurance and test specifications for soft solders, soft soldering fluxes, and soft soldering pastes

have been noted and acknowledged as binding.

Name/company of the applicant
(legally binding signature of the applicant)

^{*)} Please delete where applicable

Award certificate

(under Section 2.4 of the implementing requirements for the award and use of quality marks issued by
Gütegemeinschaft Kupferrohr e.V.)

Following the inspection conducted by its quality committee at the company,
Gütegemeinschaft Kupferrohr e.V. awards hereby

the Gütezeichen (quality mark) for copper tube systems acknowledged
by RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V., Bonn, and protected as
a collective trademark through registration at the German patent and trademark office DPMA

Gütezeichen "System Kupferrohr"

in conjunction with the product based addition in accordance with the following
Gütezeichen (quality mark) visualisation



RAL-GZ 641/_____

for the products listed in the following

Bearing the Gütezeichen (quality mark) requires adherence to the obligations accepted
by the manufacturer and to the quality conditions for the aforesaid product.

_____ Düsseldorf,

_____ Gütegemeinschaft Kupferrohr e.V.
- The Board -



HISTORY

The Reichsausschuss für Lieferbedingungen (RAL) – Committee of the German Reich for Terms and Conditions of Sale – was founded in 1925 as a combined initiative of the German private sector and the German government of that time. The joint aim was the standardization and clear definition of precise technical terms of delivery. For this purpose, fixed quality standards and their control were needed – the system of quality assurance was born. Its implementation required the creation of an independent and neutral institution as a self-governing body of all parties active in the market. That was the moment of birth for RAL and ever since that time it has been the competent authority for the creation of quality labels.

RAL TODAY

RAL acts as an independent service provider in its fields of activity. It is recognized as a non-profit organization and organized in the legal form of a registered association. Its organs are Executive Committee, Board of Trustees, General Assembly of Members and the management.

RAL's independent and neutral position finds expression in the fact that the principles of its activities are established by the Board of Trustees which is composed of representatives from the leading organizations representing industry, consumers, agriculture, the federal ministries and other federal bodies. They have a permanent seat and vote on that body. In addition to them, the General Assembly of Members elects four quality assurance associations on the Board of Trustees as representatives of the RAL members.

RAL'S AREAS OF COMPETENCE

- RAL creates Quality Marks
- RAL is responsible for registrations, agreements and RAL certificates

RAL DEUTSCHES INSTITUT FÜR GÜTESICHERUNG UND KENNZEICHNUNG E.V.
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