Technical Construction File

on behalf of

YUEQING SOCOME IMPORT AND EXPORT CO.,LTD

Cable Lug or Accessories

M/N: DTL

Prepared For:	YUEQING SOCOME IMPORT AND EXPORT CO.,LTD
	No.126, Suao East Road, Liushi Town, Yueqing City, Wenzhou,
	Zhejiang Province, China.

TCF No.:	TLZJ19010316617
Date of Edit:	January 03, 2019 to January 22, 2019
Date of Issue:	January 22, 2019

EN 61238-1:2003 Compression and mechanical connectors for power cables for rated voltages up to 36 kV(Um=42kV) – Part 1:Test methods and requirements EN 13600:2013 Copper and copper alloys. Seamless copper tubes for electrical purposes.	
Report Reference No. ....:	TLZJ19010316617
Reviewed by (name + signature)................:	Jacky Zhang
Approved by (name + signature)…………..:	David Yang
Date of issue..:	January 22, 2019
The Third Party...:	Shanghai Global Testing Services Co., Ltd.
Address: ....:	Floor 2nd, Building D-1, No. 128, Shenfu Road, Minhang District, Shanghai, China.
Applicant's name.....................................:	YUEQING SOCOME IMPORT AND EXPORT CO.,LTD
Address: ....:	No.126, Suao East Road, Liushi Town, Yueqing City, Wenzhou, Zhejiang Province, China.
Manufacturer's name.............................:	ZHEJIANG BAOLIN ELECTRIC CO.,LTD
Address: ....:	No.126, Suao East Road, Liushi Town, Yueqing City, Wenzhou, Zhejiang Province, China.
Factory's name..............................:	Same as manufacturer
Address: ....:	
TCF specification:	
Standard..:	EN61238-1:2003 & EN13600:2013
Test procedure..:	CE
Procedure deviation...................................:	No
Non-standard TCF method.........................:	No
TCF Form No...............................:	EN61238-1 A& EN13600 (modified by GTS)
TCF Form(s) Originator..................:	N/A
Master TCF...:	2007-09
TCF item description................................:	Cable Lug or Accessories
Trade Mark...:	N/A
Model/Type reference................................:	CAU、DTL-1、DTL-2、DTL、BL、MCCB、DLT、TAL、TDC、SBL、SBLC、DTC、DTCL、BLT、BLB、BLA、MCL、MC、ACL、SCM、SCE、SCA、SCB、DIN、CL、JGA、JGB、JGK、JGY、CLB、CAL、AUS、GTY、L、LA、T、M、CLK、JG、TM、TPE、DTG、DTG-2、CAL-PB、AD、AU、DL、DT、DLA、GTL、PBL、RST、MDC、BCRL、DSL、GL、GLB、GLC、CASR、GT-G、GLI、ALK、GTD、ETC、FTS、CAPG、APG、PGA、PGS、PGM、PGL、PGC、JBTL、JBT、JBL、T/J、WCJB、WCJC、CCT

Summary of TCF:
Model DTL was selected to conduct tests and it was found to be compliance with the Test standards of EN 61238-1:2003 Compression and mechanical connectors for power cables for rated voltages up to 36kV(u_m=42kV)-part1: Test methods and requirements

Possible TCF case verdicts:

-TCF case does not apply to the TCF object……......…..:	N/A
-TCF object does meet the requirement..........................:	P (Pass)
-TCF object does not meet the requirement…………….:	F (Fail)
TCF……..………………………………………….………..:	
Date of receipt of TCF item……………………….....……..:	January 03, 2019
Date(s) of performance of TCF……………....…………....:	January 03, 2019 to January 22, 2019

General remarks:
The TCF results presented in this file relate only to the object.
This TCF shall not be reproduced, except in full, without the written approval of the Issuing party.
"(See Enclosure #)" refers to additional information appended to the file.
"(See appended table)" refers to a table appended to the file.
Throughout this file a comma (point) is used as the decimal separator.

This TCF includes the following:

Annex I: Photo Documentation, **3** page (s)

General product information:

1, Cable Lug or Accessories, models CAU、DTL-1、DTL-2、DTL、BL、MCCB、DLT、TAL、TDC、SBL、SBLC、DTC、DTCL、BLT、BLB、BLA、MCL、MC、ACL、SCM、SCE、SCA、SCB、DIN、CL、JGA、JGB、JGK、JGY、CLB、CAL、AUS、GTY、L、LA、T、M、CLK、JG、TM、TPE、DTG、DTG-2、CAL-PB、AD、AU、DL、DT、DLA、GTL、PBL、RST、MDC、BCRL、DSL、GL、GLB、GLC、CASR、GT-G、GLI、ALK、GTD、ETC、FTS、CAPG、APG、PGA、PGS、PGM、PGL、PGC、JBTL、JBT、JBL、T/J、WCJB、WCJC、CCT.

2, they are compression and mechanical connectors for power cables for rated voltages up to 36 kV (Um = 42 kV).

3, Used in telecommunication equipment and in electronic appliance. The terminals have different dimensions.

4, The terminals have the similar construction.

5, The manufacturer states that the terminals are manufactured with the same material and processing techniques, as well as the operating principles.

6, The difference between all of the models is dimension.

EN 61238-1			
Clause	**Requirement**	**Result-Remark**	**Verdict**
1	**Scope and object**		—
	This part of IEC 61238 applies to compression and mechanical connectors for power cables for rated voltages up to 30 kV (um=36 kV), e.g. buried cables or cables installed in buildings, having	The voltage of cooper tube terminal/cable lugs <=30kV	P
	a) conductors complying with IEC 60228 and IEC60228A with cross-sectional areas 10 mm^2 and greater for copper and 16 mm^2 and greater for aluminium,	It meets the requirements of IEC60228 and 60228A Cross-sectional areas is 6 mm^2 -10mm^2	P
	b) a maximum continuous conductor temperature not exceeding 90 °C.	Not exceeding 90°C	P
	This standard is not applicable to connectors for overhead conductors, which are designed for special mechanical requirements, or to separable connectors with a sliding contact or multi-core connectors (i.e .ring connectors).	The insulated butt connectors neither for overhead conductors nor for a sliding contact or multi-core.	P
	Although it is not possible to define precisely the service conditions for all applications, two broad classes of connectors have been identified.		—
	Class A These are connectors intended for electricity distribution or industrial networks in which they can be subjected to short-circuits of relatively high intensity and duration.		P
	As a consequence, Class A connectors are suitable for the majority of applications.		P
	Class B These are connectors for networks in which overloads or short-circuits are rapidly cleared by the installed protective devices, e.g. fast-acting fuses		N/A
	Depending on the application the connectors are subjected to the following tests:		-
	Class A: heat cycle and short-circuit tests;	Heat cycle and short-circuit test	P
	Class B: heat cycle tests only		N/A
5	**General**		-
5.1	**Conductor**		-
	The following information shall be recorded in the test report:		-
	-conductor material;	Aluminum or Copper, Surface: Tin plated	P
	-nominal cross-sectional area, dimensions and shape. It is recommended that the actual cross-sectional area should also be given;	Model DTL-10 5.3 mm^2 Model DTL-120 15 mm^2 Model DTL-16 6.3 mm^2 Model DTL-150 16.5 mm^2	P

		Model DTL-25 7.3 mm^2 Model DTL-35 8.5 mm^2 Model DTL-50 9.8 mm^2 Model DTL-70 11.5 mm^2 Model DTL-95 13.5 mm^2 Model DTL-185 18.5 mm^2 Model DTL-240 21 mm^2 Model DTL-300 24 mm^2 Model DTL-400 27 mm^2 Model DTL-500 29 mm^2	
	-type of conductor, i.e. solid or stranded. In the case of stranded conductors, details of conductor constructions shall be shall be given when known, or can	Stranded conductor	
	Be determined by inspection, e. g:		
	-compacted		P
	-non-compacted;		N/A
	-flexible (Class 5 and 6, according to IEC 60228);		P
	-number and arrangement of strands;	(Class 2 conductors according EN60228)	P
	-type of plating , if applicable ;	Tin plated	P
	-type of impregnation water blocking, etc., if applicable		N/A
	-approximate indication of hardness, e.g. annealed, half-hard, hard	annealed	P
	-in the case of insulation-piercing connectors, material and thickness of insulation		N/A
5.2	**Connectors and tooling**		
	The following information shall be recorded in the test report:		-
	-the assembly technique that is to be used;	compression and connection technology	P
	-tooling, dies and necessary setting	Crimp tool; hydraulic compression head, wire strippers	P
	-bolts, nuts, washers, torque, etc;	Nuts; bolts; torque; washers; Rubber	P
	-preparation of contact surfaces, if applicable;		P
	-type, reference number and any other identification of the connector,	Identified every connector with only number	P
	-in the case of insulation piercing connectors, type of insulation and installation temperature.		N/A
5.3	**Range of approval**		-
	In general, tests made on one type of connector/ conductor combination apply of connector/conductor combination apply to that arrangement only.		P
	However, to limit the number of tests the following is permitted:		-

	-a connector which can be used on stranded round conductors or on stranded sector shaped conductors which have been rounded, is approved for both type if satisfactory results are obtained on a compacted round conductor;		P
	-a connector which covers a range of cross-sectional areas shall be approved, if satisfactory results are obtained on the smallest and the largest cross-sectional area(see Note 2 below);	The copper tube terminal cross-sectional areas is between 6mm^2-16mm^2. Models SC6-6 and SC16-8 are selected for approving.	P
	-if a connector is a through connector for two conductors of different cross-sectional areas, shapes, or materials, and if the technique and the connector barrels used have already been tested separately for each cross-sectional area, no additional test is necessary.		P
	If not, and if it is required for bimetallic through connectors, additional tests shall be made using the conductor having the highest temperature of the two conductor having the highest temperature of the two conductors, as reference conductor,		N/A
	-if a manufacturer can clearly demonstrate that common and relevant connector design criteria were used for a family of connectors, conformity to this standard is achieved by successfully testing the largest, the smallest and two intermediate connector sizes;		P
	-in the case of range-taking connectors, the maximum and minimum conductor cross-sectional area for the selected connectors shall be tested;	The copper tube terminal cross-sectional areas are between 6mm^2-16mm^2. Models DTL-1 is selected for approving.	P
	-satisfactory test results on insulation piercing connectors tested on PVC insulation at lower temperatures for heat cycles and for short-circuits shall give approval of such connectors for PVC insulation only;		N/A
	-satisfactory test results of a connector on dry conductor shall give approval for its use on a conductor of the same type from an impregnated paper insulated cable;		P
	-for connectors where one or both sides are designed for a range of cross-sectional areas, and a common clamping or crimping arrangement serves for the connection of the different cross-sectional areas, then mechanical tests on conductors with the largest and		P

	smallest cross-sectional areas shall be carried out according to Clause7.		
6	**Electrical tests**		—
6.1	**Installation**		—
	All conductors of the same cross-sectional area in the test loop shall be taken from the same continuous core.		P
	For each series of tests, six connectors shall be fitted in accordance with the manufacturer’s instructions, on a bare conductor or on a conductor that has had the insulation removed before assembly, to form a test loop together with the corresponding reference conductor.		P
	For stranded conductors, potential between the strands at measuring points can cause errors in measuring electrical resistance.		
	Equalizers (see Annex A) shall be used to overcome this	Equalizers is used in this test	P
	problem and to ensure uniform current distribution in the reference conductor and between connectors at the equalizer points.		P
	In the case of insulation piercing connectors, the insulation shall be retained on the conductor under the connector and for a distance of at least 100mm outside the connector.		P
	Reference conductor(s) with the insulation retained shall also be included in the test loop.		P
	If the connector is to be tested according to Class B, there is no need for bare reference conductors. The test loop shall be installed in a location where the air is calm.		N/A
	The ambient temperature of the test location shall be between 15°C and 30°C .	Ambient temperature: 23°C	P
	For assembly of the IPC, the temperature shall be (23+/-3) °C.		N/A
	In the case of solid conductors, the potential measuring points shall be as close as possible to the connector in order to reduce la and lb close to zero.		N/A
	The test loop may be of any shape provided that it is arranged in such a way that there is no adverse affect from the floor, walls and ceiling.		P
	To permit the short-circuit tests (Class A connectors only) to be made easily, the loop can be made dismantle able.		P
	In this case, the technology of the sectioning connections shall be such that they do not influence the measurements, particularly from the point of view of temperature.		P
	Retightening of bolts or screws of the connectors under		P

	test is not permitted.		
6.1.1	**Through connectors and terminal lugs**		
	The test loop is shown in Figure 1, which indicates the dimensions that shall be used.		P
	Where terminal lugs are to be tested, the palms shall be bolted to linkin bars in accordance with the manufacturer's instructions.		P
	These linking bars shall, at the point of connection, be of the same dimensions and thickness as the palm, and also of the same material.		P
	It may be necessary to adjust the thermal characteristics of the linking bar outside the point of connection, to achieve the temperatures specified in 6.3.		P
	As an alternative to linking bars, test can be made on terminal lugs with palm connected direct to palm. In case of disagreement, the method with linking bars shall be used.		P
	If however it is requested that the terminal lug test includes an evaluation of the performance of the bolted palm when connected to a plant terminal, then linking bar ends, or an intermediate piece, shall be used of a material, size and surface coating agreed between the parties.		P
6.1.2	**Branch connectors**		
	When the branch connector is intended for a branch cross-sectional area equal to the main, or a cross-sectional area immediately above or below the main, it is treated as a through connector between the main and the branch, and the test method for through connectors is applicable.		N/A
	In other cases, the test loop shall be as shown in Figure 2.		N/A
	Where a type of connector makes it necessary for the main conductor to be cut, that part of the connector which acts as a through connector, shall also be tested as for through connectors.		N/A
6.2	**Measurementa**		
6.2.1	**Electrical resistance measurements**		
	Measurements of electrical resistance shall be made at stages throughout the test as specified in 6.3.		P
	These measurements of resistance shall be made under steady temperature conditions of both the test loop and test location.	The measurements of resistance are made under steady temperature conditions of both the test loop and test	P

		location.	
	The ambient temperature shall be between 15°C and 30°C	23°C	P
	The recommended method is to pass a direct current of up to 10 % of the heat cycling current, through the connectors and the reference conductor, without increasing the temperature and to measure the potential diffrence between specific potential points		P
	The ratio of potential difference and direct current is the resistance between those points.		P
	For branch conductors assembled in accordance with Figure 2, the whole of the connector whose potential difference is being measured.		N/A
	Switches or disconnect points may be provided for this purpose.		P
	Thermorlectric voltages may affect the accuracy of low resistance measurements of the order of 10).		P
	If this is suspected, two resistance measurements shall be taken with the direct measuring current recersed between readings.		P
	The mean of the two readings is then the actual resistance of the sample.		P
	The potential points shall be as indicated in Figure 3, and Annex B, and the various lengths shown shall also be measured to enable the actual connector shall be recorded and reference conductor shall be recorded when resistance measurements are made.		P
	For direct comparison, the resistance values shall be corrected to 20 ℃. Information on the recommended method is also given in Annex B.		P
	Temperature measurements at these locations shall be made during he heat cycling test.		P
6.2.2	**Temperature measurements**		
	The temperature measurements shall be made at stages throughout the test, as specified in 6.3.		P
	Temperatures of both connectors and reference conductors shall be measured at the points indicated in Figure 3.		P
	Temperature readings shall have an accuracy within +/-2K.		P
6.3	**Heat cycle test**		
	The heat cycling test shall be made with alternating current.		P

6.3.1	**First heat cycle**		
	The object of the first heat cycle is to determine the reference conductor temperature to be used for subsequent cycles and also to identify the median connector.		P
a)	**Non-IPC through connectors and terminal lugs** Current is circulated in the test loop, bringing the reference conductor to 120℃ at equilibrium.		P
	Equilibrium is defined as the moment when the reference conductor and the connectors do not vary in temperature by more than +/-2K for 15min.		P
	If the temperature of the median connector (see3.11) is equal to or greater than 100 ℃, the reference conductor temperature for subsequent heat cycles shall be deemed to be 120 ℃.		P
	If not, then the current shall be increased until the median connector temperature reaches 100 ℃ at equilibrium, subject to the reference conductor temperature not exceeding 140 ℃.		P
	If the temperature of the median connector does not reach 100 ℃, even with a reference conductor temperature of 140 ℃, the test shall be continued at that temperature.		P
	The measured reference conductor temperature R shall then be used for subsequent heat cycles (120 °C ≤R ≤140 °C). The current IN at equilibrium temperature shall be recorded in the test report.		P
b)	**Non-IPC branch connectors**		
	Where it is necessary to use the circuit shown in Figure 2, bringing the main reference conductor and the three branch reference conductors to 120 ℃ at equilibrinm.		N/A
	To achieve this, the currents in the three branches shall be adjusted by current injection or impedance control. If the median connector temperature(see 3.11) is then equal to or greater than 100°C, the reference conductor temperature for subsequent heat cycles shall be deemed to be 120 ℃.		N/A
	If not, then the current shall be increased in the loop until the median connector temperature reaches 100 ℃ at equilibrium, provided the reference conductors do not exceed 140 ℃.		N/A
	It may be necessary at this stage, and also at intervals throughout the test, to adjust the current		N/A

	in an individual branch so as to ensure that each branch reference temperature is the same as the main reference temperature.		
	The measured reference conductor temperature R on the main and branch conductors, shall then be used for subsequent heat cycles (120 °C≤R ≤140 °C).		N/A
	The current(s) /N at equilibrium temperature in the main and branch conductors shall be recorded in the test report.		N/A
c)	**IPC**		
	For tests of IPCs, the same test loop an in Figure 1 OR 2 shall be used except that the insulated reference conductor(s) is (are) added in the circuit.		N/A
	During cycling, the temperature on the median connector shall be modified to be 10 K higher than the maximum conductor temperature in normal operation for which type of connectors are intended.		N/A
	However, the circulated current shall be limited so that the temperature of the insulated reference conductor at equilibrium is not more than 10 K to 15 K above the maximum conductor temperature in normal operation.		N/A
	In the case of branch connectors, it may be necessary at intervals throughout the test, to adjust the current in an individual branch so as to ensure that each branch reference temperature is the same as the main reference temperature.		N/A
	The current(s) /N at equilibrium temperature in the main and possible branch conductors shall be recorded in the test report.		N/A
	NOTE 2 If a connector is used in an application where considerably higher temperatures are reached than the maximum conductor temperature in normal operation, additional tests at higher temperature of the test loop may be made, after agreement between manufacturer and user.		N/A
	The additional increase in temperature of the test loop should be achieved by the application of thermal insulation.		N/A
6.3.2	**Second heat cycle**		
	The object of this second heat cycle is to determine the heat cycle duration and temperature profile which will be used on the test loop for all		P

	subsequent heat cycles.		
	Current is circulated in the loop until the main reference conductor temperature reaches the value R determined in 6.3.1, with a tolerance of 0.6K and the median connector temperature is stable within a band of 2K pver a 10 min period.		P
	An elevated current may be used to reduce the heating period.		P
	The duration of this elevated current is given in Table 1.		P
	The current shall thereafter be decreased or regulated to a mean value of the current close to /N to ensure stable conditions during the median-connector control period.		P
	It may be necessary to use more than one cycle to determine the second heat cycle.		P
	The reference conductor temperature shall be the control parameter, in order to keep the temperature profile during the heat cycle test.		P
	In this way, the fluctuation of the ambient temperature will not affect the temperature profile of the reference conductor.		P
	The reference temperature time (t1) heating profile, see Figure 4, determined in this way shall be recorded and used for all subsequent cycles.		P
	After the period t1, follows a period t2 of cooling to bring the temperature of all connectors and the reference conductor to a value ≤35 ℃.		P
	It may be necessary in subsequent heat cycles to adjust t2 to ensure that the temperature conditions are reached.		P
	If accelerated cooling is used,it shall act on the whole of the loop, and use air within ambient temperature limits.		P
	The total period t1+t2 constitutes a heat cycle (see Figure 4).		P
6.3.3	**Subsequent heat cycles**		
	A total of 1 000 heat cycles (as defined in 6.3.2) shall be made.		P
	After the cooling period of the cycles indicated below, the resistance and temperature of each connector and each reference conductor shall be recorded as indicated in 6.2.		P
	The maximum temperature of each connector during the cycle just prior to or following the		P

	resistance measurements shall also be recorded.		
	Measurements shall be made at the following cycles:		P
	Class A 0 (before the first heat cycle, see 6.3.1) 200, before short-circuit 200, after short-circuit 250 Then every 75 cycles (in total 14 measurements)		P
	Class B 0 (before the first heat cycle, see 6.3.1) 250 then every 75 cycles (in total 12 measurements)		N
	A tolerance of ± 10 cycles may be used.		P
6.3.4	**Short-circuit tests (for Class A connectors only)**		
	Six short-circuits are applied after the 200th heat cycle.		P
	The short-circuit current level shall be such that it raises the bare reference conductors from a temperature of ≤35°C to a temperature between 250°C and 270°C.		P
	However, for IPC connectors the short-circuit current shall be limited so that the temperature of the insulated reference conductor does not exceed the maximum permissible temperature of the insulation.		N/A
	The maximum temperature, time and approximate current, or the actual current and time, used for the short-circuit test, shall be recorded and stated in the test report.		P
	The duration of the short-circuit current shall be ｜(1＋0,5/-0,1 s with a maximum current of 25kA.		P
	If the required short-circuit current exceeds this value a longer duration ≤5 s with a current between 25kA and 45kA shall be used.		P
	After each short-circuit, the test loop shall be cooled to a temperature ≤35°C.		P
	Since the short-circuit test is intended to reproduce the thermal effects is high currents only, the recommended method is to use a Concentric return conductor in order to reduce the electro-dynamic forces.		P

	The test arrangements shall be recorded.		P
	Where tests are required to reproduce, e.g. forces that occur on terminal lugs bolted to a terminal plant, then the mechanical arrangement of the test loop should be agreed between the parties concerned.		P
6.4	**Assessment of results**		-
	An individual connector resistance factor k enables a common method of connector assessment to be made over the ranfe of conductor cross-sectional areas applicable to this standard.		P
	The parameters listed below are calculated (see Annex E).		P
	a) The connector resistance factor k shall be calculated according to Clause E.2, for each of the six connectors at all the measurement internals listed in 6.3.3.		P
	b)The initial scatter, between the six initial values of k, measured at heat cycle 0, shall be calculated according to Clause E.3.		P
	c)The mean scatter, between the six values of k, averaged over the last 11 measurement intervals, shall be calculated according to Clause E.4.		P
	d)The change in resistance factor D for each of the six connectors shall be calculated according to Clause E.5. D is the change in the value of k taken over the last 11 measurement intervals, calculated as a fraction of the mean value of k in this interval.		P
	e)The resistance factor ratio, shall be calculated according to Clause E.6.		P
	f)The maximum temperature max on each connector shall be recorded according to Clause E.7.		P
6.5	**Requirements**		
	The six connector out of the six does not satisfy one or more of the requirements, a re-test may be carried out.		P
	In this event, all six new connectors shall satisfy the requirements.		P
	If more than one connector out of the six do not satisfy one or more of the requirements, no retest is permitted and the type of connector shall be deemed as not conforming to this standard.		P

Table 2-Electrical test requirments

Parameter	Designation	Text reference	Maximum value
Initial scatter	δ	E.3	0.30
Mean scatter	β	E.4	0.30
Change in resistance factor	D	E.5	0.15
Resistance factor ratio	λ	E.6	2.0
Maximum temperature	υmax	E.7	υref
NOTE Values given in this table are based on experience.			

7	**Mechanical tests**		-
	The purpose of these tests is to ensure an acceptable mechanical strength for the connections to the conductors of power cables.		P
	NOTE The pull-out force does not give any reliable indication of the electrical quality of the connector.		P
7.1	**Method**		-
	The test shall be made on three additional connectors identical to those used for the electrical test.		-
	The connectors are fitted as for the electrical test of 6.1.		P
	The conductor lengths, between connectors or between connector and tensile test machine jaws, shall be ≥500mm.	500mm	P
	The rate of application of the load shall not exceed 10N per square millimetre of cross-sectional area and per second up to the value in Table 3, which is then maintained for 1min.	≤10N /s.mm^2	P
	If the connector is tested electrically for conductors with a different cross-sectional area, the different connectors shall be tested individually, in accordance with Table 3.	See table 7.2	P

7.2	Table: Tensile force for mechanical tests	P

Model	Conductor, cross-sectional areas, A	Material of conductor	Applied tensile force (N)	slipping occurred	Verdict
DTL-10	5.3	Copper&Aluminum	360	☐Yes ☒ No	P
DTL-16	6.3	Copper&Aluminum	360	☐Yes ☒ No	P
DTL-25	7.3	Copper&Aluminum	600N	☐Yes ☒ No	P
DTL-35	8.5	Copper&Aluminum	600N	☐Yes ☒ No	P
DTL-50	9.8	Copper&Aluminum	600N	☐Yes ☒ No	P
DTL-70	11.5	Copper&Aluminum	600N	☐Yes ☒ No	P

DTL-95	13.5	Copper&Aluminum	600N	☐Yes ☒ No	P
DTL-120	15	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-150	16.5	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-185	18.5	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-240	21	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-300	24	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-400	27	Copper&Aluminum	960N	☐Yes ☒ No	P
DTL-500	29	Copper&Aluminum	960N	☐Yes ☒ No	P

Test condition:
Material of conductor: Copper&Aluminum
The conductor lengths, between connector and tensile test machine jaws: 500 mm
The rate of application of the load: <=10N/mm^2.s
Duration of load: 60s

Table 3-Tensile force for mechanical tests

Conductor material	Tensile force N
Aluminium	40×Aa;maximum20000
Copper	60×Aa;maximum20000
a) A=nominal cross-sectional area (mm^2)	

7.2	**Requirements**		
	No slipping shall occur during the last minute of the test.		P
8	**Test report**		
	The test report shall include the following information:		—
	-connector class (see Clause 1);	Class A	P
	-conductor used (see 5.1);	Tin plated	P
	-connector and tooling (see 5.2);		P
	-installation (for example see 6.1.1);		P
	-current at equilibrium temperature (see 6.3.1);		P
	-for Class A, the short-circuit parameters (see 6.3.4);		P
	-electrical test results;		P
	-mechanical test results		P

EN 13600			
Clause	**Requirement**	**Result-Remark**	**Verdict**
1	**Scope**		—
	This European Standard specifies the composition, property requirements including electrical properties, and tolerances on dimensions and form for seamless drawn copper tubes for electrical purposes		P
2	**Normative references**		—
3	**Terms and definitions**		—
4	**Designations**		—
4.1	**material**		—
4.1.1	**General**		—
	The material is designated either by symbol or by number		P
4.1.2	**Symbol**		—
	The material symbol designation is based on the designation system given in ISO 1190-1.		P
4.1.3	**Number**		—
	The material number designation is in accordance with the system given in EN 1412.		P
4.2	**Material condition**		—
	For the purposes of this standard, the following designations, which are in accordance with the system given in EN 1173, apply for the material condition: D Material condition for the product as cold worked without specified mechanical properties; H... Material condition designated by the minimum value of hardness requirement for the product with mandatory hardness requirements; R... Material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile strength, 0,2 % proof strength and elongation requirements. Products in the H... condition may be specified to Vickers or Brinell hardness. The material condition designation H... is the same for both hardness test methods. Exact conversion between the material conditions designated H... and R... is not possible.		P
4.3	**Product**		—
	The product designation is no substitute for the full content of the standard. The product designation for products to this standard shall consist of: a) denomination (tube);	Tube—EN 13600— Cu-ETP	**P**

	b) number of this European Standard (EN 13600); c) material designation, either symbol or number (see Table 1 and Table 2); d) material condition designation (see Table 3); e) cross-sectional shape (the following designations shall be used, as appropriate: RND for round, SQR for square, RCT for rectangular); f) nominal dimensions: b) number of this European Standard (EN 13600); c) material designation, either symbol or number (see Table 1 and Table 2); d) material condition designation (see Table 3); e) cross-sectional shape (the following designations shall be used, as appropriate: RND for round, SQR for square, RCT for rectangular); f) nominal dimensions:		
5	**Ordering information**		—
	In order to facilitate the enquiry, order and confirmation of order procedures between the purchaser and the supplier, the purchaser shall state on his enquiry and order		P
6	**Requirements**		—
6.1	**Composition**		—
	The composition shall conform to the requirements for the appropriate material given in Table 1 and Table 2.		P
6.2	**Mechanical properties**		—
	The mechanical properties shall conform to the appropriate requirements given in Table 3. The tests shall be carried out in accordance with either 8.2 (tensile test) or 8.3 (hardness test).		P
6.3	**Electrical properties**		—
	The electrical properties shall conform to the appropriate requirements given in Table 4. The test shall be carried out in accordance with 8.4.		P
6.4	**Freedom from hydrogen embrittlement**		—
	Tubes in copper grades Cu-OF (CW008A), CuAg0,10P (CW016A), CuAg0,10(OF) (CW019A), Cu-PHC (CW020A) and Cu-HCP (CW021A) shall show no evidence of cracking, when tested and visually examined in accordance with 8.5.		P
6.5	**Dimensions and tolerances**		—
6.5.1	**Outside dimensions**		—
	The dimensional tolerances are applied on the outside dimensions and wall thickness, if not otherwise agreed between the purchaser and the supplier.		P

	For round tubes, the diameter shall conform to the tolerances given in Table 5. For square and rectangular tubes, the outside dimensions shall conform to the tolerances given in Table 6.		
6.5.2	**Corner radii**		—
	The corner radii of square and rectangular tubes shall conform to the requirements given in Table 7.		P
6.5.3	**Wall thickness**		—
	The wall thickness of round, square and rectangular tubes, measured at any one point, shall conform to the tolerances given in Table 8.		P
6.5.4	**Length**		—
6.5.4.1	**General**		—
	Tubes shall be supplied either in manufactured lengths or fixed lengths, with ends either sawn or sheared. If deburring of the cut ends of the tubes is required, it shall be agreed between the purchaser and the supplier.		P
6.5.4.2	**Manufactured lengths**		—
	Manufactured lengths (ML) shall be supplied in the nominal lengths. The tolerances are by agreement between the purchaser and the supplier.		P
6.5.4.3	**Fixed lengths**		—
	Tubes supplied as fixed lengths (FL) shall conform to the tolerances given in Table 9.		P
6.5.5	**Form tolerances**		—
6.5.5.1	**General**		—
	The form tolerances given in 6.5.5.2 and 6.5.5.3 apply to: a) outside dimensions equal to or greater than 10 mm; b) all material conditions except H035 and R200.		P
6.5.5.2	**Twist**		—
	Square and rectangular tubes shall conform to the tolerances given in Table 10. The twist v shall be measured as indicated in Figure 1.		P
6.5.5.3	**Straightness**		—
	Tubes shall conform to the tolerances given in Table 11.		P
6.6	**Mass tolerances**		—
	The mass of a consignment shall conform to the following mass tolerances: —straight lengths: ± 10 %; — level wound coils: ± 20 %.		P
6.7	**Surface condition**		—
	The products shall be clean and free from injurious defects, which shall be specified by agreement between		P

	the purchaser and the supplier at the time of enquiry and order. A superficial film of residual lubricant is normally present on cold drawn products and is permissible unless otherwise specified.		
7	**Sampling**		—
7.1	General		—
	When required, an inspection lot shall be sampled in accordance with 7.2 and 7.3.		N/A
7.2	Analysis		N/A
7.3	Mechanical and electrical tests		N/A
8	**Test methods**		N/A
9	**Declaration of conformity and inspection documentation**		N/A
10	**Marking, packaging, labelling**		N/A
	Unless otherwise specified by the purchaser and agreed by the supplier, the marking, packaging and labelling shall be left to the discretion of the supplier.		N/A

Table 1— Composition of Cu-OFE and Cu-PHCE

Material designation		Composition % (mass fraction)																	
Symbol	Number	Element	Cu	Ag	As	Bi	Cd	Fe	Mn	Ni	O	P	Pb	S	Sb	Se	Sn	Te	Zn
Cu-OFE	CW009A	min.	99,99	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		max.	—	0,002 5	0,000 5	0,000 20	0,000 1	0,001 0	0,000 5	0,001 0	—[a]	0,000 3	0,000 5	0,001 5	0,000 4	0,000 20	0,000 2	0,000 20	0,000 1
Cu-PHCE	CW022A	min.	99,99	—	—	—	—	—	—	—	—	0,001	—	—	—	—	—	—	—
		max.	—	0,002 5	0,000 5	0,000 20	0,000 1	0,001 0	0,000 5	0,001 0	—[a]	0,006	0,000 5	0,001 5	0,000 4	0,000 20	0,000 2	0,000 20	0,000 1

[a] The oxygen content shall be such that the material conforms to the hydrogen embrittlement requirements of EN 1976

Table 2— Composition of copper grades, other than those made from Cu-OFE (CW009A) and Cu-PHCE (CW022A)

Material designation		Composition in % (mass fraction)								
		Element	Cu	Ag	Bi	O	P	Pb	other elements (see NOTE)	
Symbol	Number								total	excluding
Cu-ETP	CW004A	min.	99,90[a]	—	—	—	—	—	—	Ag, O
		max.	—	—	0,000 5	0,040[b]	—	0,005	0,03	
Cu-FRHC	CW005A	min.	99,90[a]	—	—	—	—	—	—	Ag, O
		max.	—	—	—	0,040[b]	—	—	0,06[d]	
Cu-OF	CW008A	min.	99,95[a]	—	—	—	—	—	—	Ag
		max.	—	—	0,000 5	—[c]	—	0,005	0,03	
CuAg0,10	CW013A	min.	Rem.	0,08	—	–	—	—	—	Ag, O
		max.	—	0,12	0,000 5	0,040	—	—	0,03	
CuAg0,10P	CW016A	min.	Rem.	0,08	—	—	0,001	—	—	Ag, P
		max.	—	0,12	0,000 5	—[c]	0,007	—	0,03	
CuAg0,10(OF)	CW019A	min.	Rem.	0,08	—	—	—	—	—	Ag, O
		max.	—	0,12	0,000 5	—[c]	—	—	0,006 5	
Cu-PHC	CW020A	min.	99,95[a]	—	—	—	0,001	—	—	Ag, P
		max.	—	—	0,000 5	—[c]	0,006	0,005	0,03	
Cu-HCP	CW021A	min.	99,95[a]	—	—	—	0,002	—	—	Ag, P
		max.	—	—	0,000 5	—[c]	0,007	0,005	0,03	

NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.

[a] Including silver, up to a maximum of 0,015 %.

[b] Oxygen content up to 0,060 % is permitted, subject to agreement between the purchaser and the supplier.

[c] The oxygen content shall be such that the material conforms to the hydrogen embrittlement requirements of EN 1976.

[d] Higher total impurities content is permitted, subject to agreement between the purchaser and the supplier.

Table 4— Electrical properties (at 20 °C)

Designations				Volume resistivity $\frac{\Omega \times mm^2}{m}$	Mass resistivity[a] $\frac{\Omega \times g}{m^2}$	Conductivity	
Material		Material condition				MS/m	% IACS[b]
Symbol	Number			max.	max.	min.	min.
Cu-OFE Cu-PHCE	CW009A CW022A	annealed		0,017 07	0,151 7	58,6	101,0
				0,017 24	0,153 3	58,0	100,0
Cu-OFE Cu-PHCE	CW009A CW022A	other than annealed		to be agreed between the purchaser and the supplier			
Cu-ETP Cu-FRHC Cu-OF CuAg0,10 CuAg0,10(OF) Cu-PHC	CW004A CW005A CW008A CW013A CW019A CW020A	D		0,017 86	0,158 8	56,0	96,6
		H035	R200	0,017 24	0,153 3	58,0	100,0
		H065	R250	0,017 54	0,155 9	57,0	98,3
		H090	R290	0,017 86	0,158 8	56,0	96,6
		H100	R360				
CuAg0,10P Cu-HCP	CW016A CW021A	D		0,018 18	0,161 6	55,0	94,8
		H035	R200	0,017 54	0,155 9	57,0	98,3
		H065	R250	0,017 86	0,158 8	56,0	96,6
		H090	R290	0,018 18	0,161 6	55,0	94,8
		H100	R360				

NOTE 1 The % IACS values are calculated as percentages of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission. Copper having a volume resistivity of 0,017 24 µΩ × m at 20 °C, is defined as corresponding to a conductivity of 100 %.

NOTE 2 1 MS/m is equivalent to 1 m/(Ω × mm^2).

[a] Calculated with a density of copper 8,89 g/cm^3.

[b] IACS: International Annealed Copper Standard.

Table 5— Tolerance on outside diameter of round tubes

Nominal outside diameter		Tolerances		Maximum deviation from circular form[a, d] for level wound coils
over	up to and including	applicable to mean diameter	applicable to any diameter including deviation from circular form[a, b, c] for straight lengths	
mm	mm	mm	mm	%
3[e]	10	± 0,05	± 0,08	± 5
10	20	± 0,06	± 0,10	± 8
20	30	± 0,08	± 0,15	± 12
30	50	± 0,10	± 0,20	—
50	80	± 0,15	± 0,30	—
80	120	± 0,20	± 0,40	—
120	150	± 0,30	± 0,60	—
150	300	± 0,60	± 1,20	—
300	450	± 1,0	± 2,0	—

[a] The tolerances in this column are not applicable to tubes with a ratio of outside diameter to wall thickness (*OD*/*t*) > 30.

[b] The tolerances in this column are not applicable to tubes in the annealed material condition (H035/R200), see Table 3.

[c] When the diameter is measured at a distance from the ends of the tube of up to 100 mm or the equivalent of one nominal outside diameter (whichever is the smaller), unless otherwise agreed, the tolerance may be increased by a factor of 3.

[d] Referring to nominal *OD*.

[e] Including 3.

Table 6— Tolerance on across-flats dimensions of square and rectangular tubes

Values in millimetres

Nominal across-flats dimensions		Tolerances[a, b]
over	up to and including	
5[c]	15	± 0,10
15	30	± 0,15
30	50	± 0,20
50	80	± 0,25
80	120	± 0,30
120	150	± 0,35

[a] The tolerances in this column are not applicable to tubes in the annealed material condition (H035/R200), see Table 3.

[b] If tolerances all plus or all minus are required, double the values given.

[c] Including 5.

Table 7— Corner radii of square and rectangular tubes

Values in millimetres

Nominal wall thickness		Maximum radii	
over	up to and including	external corners	internal corners
0,5[a]	1,5	1,8	0,8
1,5	3	2,2	0,8
3	6	3,5	0,8
6	10	6,0	0,8

[a] Including 0,5.

Table 8— Tolerances on wall thickness

Values in millimetres

Nominal outside diameter or major across-flats dimension[a]		Tolerances on wall thickness[b, c] in % for wall thicknesses				
over	up to and including	from 0,3 up to and including 1	over 1 up to and including 3	over 3 up to and including 6	over 6 up to and including 10	over 10
3[d]	15	± 13	± 12	± 10	—	—
15	30	± 13	± 12	± 10	± 10	—
30	50	± 13	± 12	± 12	± 10	± 10
50	100	—	± 12	± 12	± 10	± 10
100	250	—	± 13	± 13	± 12	± 11
250	450	—	—	± 15	± 14	± 13

[a] In the case of rectangular tube, the major across-flats dimension determines the thickness tolerance applicable to all wall thicknesses.

[b] The wall thickness tolerance is defined as the maximum deviation of the wall thickness at any point in percentage of the nominal wall thickness.

[c] If tolerances all plus or all minus are required, double the values given.

[d] Including 3.

Table 9— Tolerances on fixed lengths for tubes in straight lengths

Values in millimetres

Nominal outside diameter		Tolerances on fixed lengths			
over	up to and including	up to and including 250	over 250 up to and including 1 000	over 1 000 up to and including 4 000	over 4 000
3[a]	30	+1 0	+3 0	+5 0	by agreement
30	100	+3 0	+5 0	+10 0	
100	450	+5 0	+8 0	+15 0	

[a] Including 3.

Table 10— Maximum twist of square and rectangular tubes

Nominal across-flats dimensions mm		Maximum permitted twist v mm	
over	up to and including	in any 1 m length	in total length L (in m)[b]
10[a]	18	1,0	$1,0 \times L$
18	30	1,5	$1,5 \times L$
30	50	2,0	$2,0 \times L$
50	80	3,0	$3,0 \times L$
80	120	4,5	$4,5 \times L$
120	150	6,0	$6,0 \times L$

[a] Including 10.

[b] Up to 4 m. Over 4 m, the maximum twist is subjected to agreement.

Table 11— Straightness

Values in millimetres

OD/t [a]		Maximum depth of arc	
over	up to and including	in any length of 1 m	in any length of 0,4 m
—	5	2	0,8
5	10	3	1,2
10	20	4	1,6
20	40	5	2,0
40	—	6	2,5

[a] OD/t: Ratio of outside diameter or major across-flats dimensions to wall thickness t.

Table 12— Sampling rate

Values in millimetres

Mass per unit length kg/m	Mass of inspection lot for one test sample kg up to and including
up to and including 0,25	1 000
over 0,25 up to and including 5	1 500
over 5	2 500

NOTE Larger inspection lots require sampling in proportion, up to a maximum of five test samples.

List of Testing Equipment

Decription	Manufacturer	Type	S/N	Specification	Calibration date	Calibration due date
Tensile force tester	Zonsky Intruments Co., Ltd.	ZY6010	10122262	0-10,000N	2018.10.25	2019.10.24
Insulation resistance tester	Guangzhou Cezhibao Electrical Instruments Co., Ltd.	GY2681	1017248	200Gς Accuracy: ≤±5%	2018.10.25	2019.10.24
Lower Insistance Tester	Changzhou Tonghui Electrical	TH2513	10172749	+/-1%; +/-1μΩ	2018.10.25	2019.10.24
Muli-meter	Uyigao	VA9205N	VA0899615	+/-1%	2018.10.25	2019.10.24
LCR digital electrical bridge	Changzhou Huifa Technology Co., Ltd.	HF2810B	7011	+/-0,3μΩ	2018.10.25	2019.10.24
Voltage, Current, Power Meter	Hangzhou Fuda Testing Technology Insitue	FD2796	FD20967	Voltage: +/-0,53% +/-5μV	2018.10.25	2019.10.24
Hybrid Recorder	YOKOGAWA	DR130	JT-1	Temperature: +/-1K	2018.03.24	2019.03.23
D.C Electronic load	Chroma	63143864/ DL-2	6314	Temperature: +/-1K	2018.12.12	2019.12.11
DC potentionmeter	Hangzhou Weibo Electronic Instrument Co., Ltd.	6271A	WB1054368	Measurement Range: 0-24V Accuracy:0.1%	2018.12.12	2019.12.11
Current meter	Hangzhou Weibo Electronic Instrument Co., Ltd.	3350	WB3455689	0-300A, Accuracy: 0,1%	2018.12.12	2019.12.11
Humidity meter	Hangzhou Weibo Electronic Instrument Co., Ltd.	403	WB5761379	<=1,5% RH(Relavive Humidity)	2018.12.12	2019.12.11

- End of Test Report -

Photo documentation

Type of equipment, model: Cable Lug or Accessories, CAU、DTL-1、DTL-2、DTL、BL、MCCB、DLT、TAL、TDC、SBL、SBLC、DTC、DTCL、BLT、BLB、BLA、MCL、MC、ACL、SCM、SCE、SCA、SCB、DIN、CL、JGA、JGB、JGK、JGY、CLB、CAL、AUS、GTY、L、LA、T、M、CLK、JG、TM、TPE、DTG、DTG-2、CAL-PB、AD、AU、DL、DT、DLA、GTL、PBL、RST、MDC、BCRL、DSL、GL、GLB、GLC、CASR、GT-G、GLI、ALK、GTD、ETC、FTS、CAPG、APG、PGA、PGS、PGM、PGL、PGC、JBTL、JBT、JBL、T/J、WCJB、WCJC、CCT

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

Details of:

View:

[X] general

[ ] front

[ ] rear

[ ] right

[ ] left

[ ] top

[ ] bottom

-End of Photo Documentation -