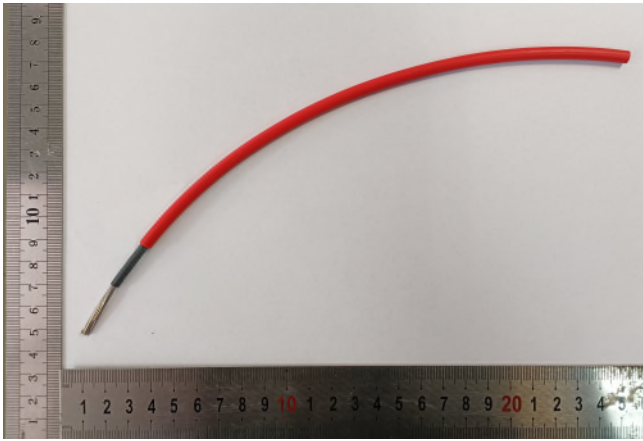


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Kunden-Referenz-Nr.: <i>Client reference no.:</i>	2599200	Auftragsdatum: <i>Order date:</i>	2024-07-23	
Auftraggeber: <i>Client:</i>	Jinan Mashiji Intelligent environmental protection technology Co., Ltd No. 77 Keyuan Street, Economic Development Zone, Shanghe County, Jinan City, 251600 Shandong P.R. China			
Prüfgegenstand: <i>Test item:</i>	Cables for Photovoltaic Systems			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	H1Z2Z2-K 1X2,5...10mm ²			
Auftrags-Inhalt: <i>Order content:</i>	TÜV mark approval			
Prüfgrundlage: <i>Test specification:</i>	EN 50618:2014 Kabel und Leitungen - Leitungen für Photovoltaik Systeme <i>Electric cables for photovoltaic systems</i>			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2024-07-01			
Prüfmuster-Nr.: <i>Test sample no.:</i>	P01534800-01 P01534800-02			
Prüfzeitraum: <i>Testing period:</i>	2024-07-01 - 2024-08-20			
Ort der Prüfung: <i>Place of testing:</i>	See other below for details			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (China) Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>			genehmigt von: <i>authorized by:</i>	
Datum: <i>Date:</i>	2024-08-29	Jiaxin Peng/PE Kun Zhao/Trainee	Ausstellungsdatum: <i>Issue date:</i>	2024-08-29 Vivian Ren/Report Authorizer
Stellung / Position:	Sachverständige(r)/Expert		Stellung / Position:	Sachverständige(r)/Expert
Sonstiges / <i>Other:</i>	1. Place of testing: National Special Cables Products Quality Supervision and Inspection Center (Hebei) No.103, XinXing Road, NingJin 055550, Hebei, China 2. Attachment 1. Used MTE.			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

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Anmerkungen
Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. <i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i>
2	Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben. Informationen zur Verifizierung der Authentizität unserer Dokumente erhalten Sie auf folgender Webseite: go.tuv.com/digital-signature <i>As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged. For information on verifying the authenticity of our documents, please visit the following website: go.tuv.com/digital-signature</i>
3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. <i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i>

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Produktbeschreibung
Product description

Characteristics of cable					
Code designation	H1Z2Z2-K				
Trademark	Jinan Mashiji Intelligent environmental protection technology Co., Ltd				
Rated Voltage AC	U ₀ /U AC: 1/1 kV				
Rated voltage DC	1,5 kV DC (conductor-conductor and conductor-earth) Max permitted voltage DC 1,8 kV				
Cross section:	[mm ²]	4(red)	6(black)		
Outer dimension:	[mm]	5,7	6,3		
Meas. wall thickness insulation:	[mm]	0,8	0,7		
Specified value of thickness insulation:	[mm]	0,7	0,7		
Meas. wall thickness sheath:	[mm]	0,9	1,0		
Specified value of thickness sheath:	[mm]	0,8	0,8		
Min. wall thickness compl. Insulation:	[mm]	0,53	0,53		
Standard	EN 50618:2014				
Lower ambient temperature	-40 °C				
Upper ambient temperature	+90 °C				
Max temperature at conductor	+ 120°C @ 20.000 h				
Material separation layer between conductor and insulation	—				
Material insulation	Halogen free cross-linked polyolefin FPV120-1				
Material separation layer between insulation and sheath	—				
Material sheath	Halogen free cross-linked polyolefin FPV120-2				
Extrusion type	CO- Extrusion				

Remarks:

All tests according to EN 50618:2014 in this report were performed to the complete cable H1Z2Z2-K 1X4mm² (black insulation and red sheath), H1Z2Z2-K 1X6mm² (black insulation and black sheath) which were provided by the client with 200m each type.

Please refer to test report 50272706 001 for thermal endurance test.

This test report contains 21 pages and an attachment 1 with 7 pages for testing equipment list.

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Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Evaluation</i>	
5.1	CONDUCTOR			
5.1.1	Material			
	Number of cores:	1	P	☒
			F	☐
			N/A	☐
			N/T	☐
	Single wires are of copper and tinned:	tinned copper wires	P	☒
			F	☐
			N/A	☐
			N/T	☐
	Compliance with class 5 acc. to IEC 60228 <i>SEE TABLE 5.1.5</i>	class 5 conductor	P	☒
			F	☐
			N/A	☐
			N/T	☐
	There are no visible gaps in the continuous layer, when examined with normal or corrected vision.	no visible gap	P	☒
			F	☐
			N/A	☐
			N/T	☐
5.1.2	CONSTRUCTION			
	The class of the conductor must be class 5 in accordance to EN 60228		P	☒
			F	☐
			N/A	☐
			N/T	☐
	The maximum diameter of the wires in the conductor are be in accordance to EN 60228		P	☒
			F	☐
			N/A	☐
			N/T	☐
5.1.3	SEPERATOR BETWEEN CONDUCTOR AND INSULATION			
	Separation layer of halogen free material between insulation and conductor		P	☐
			F	☐
			N/A	☒
			N/T	☐
5.1.4	CHECK OF CONSTRUCTION			
	The construction must be checked in accordance of the requirements of 5.1.1, 5.1.2 and 5.1.3 including the requirements of EN 60228 for class 5 conductor	checked		
5.1.5	ELECTRICAL RESISTANCE			

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Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation
	The resistor of each conductor at 20°C must be in accordance with the requirements of EN 60228 for class 5 conductor		P ☒ F ☐ N/A ☐ N/T ☐
	Compliance must be checked by the test of clause 5 of EN 50395		P ☒ F ☐ N/A ☐ N/T ☐
5.2	INSULATION		
5.2.1	MATERIAL		
	The insulation must be crosslinked and fulfil the requirements of table B.1 in Annex B	Halogen free crosslinked polyolefin in black	P ☒ F ☐ N/A ☐ N/T ☐
5.2.2	APPLICATION TO THE CONDUCTOR		
	Insulation extruded, smooth and consistently applied and possible to remove without damage to the insulation itself, to the conductor or to the tin coating.		P ☒ F ☐ N/A ☐ N/T ☐
	Compliance must be checked by inspection and by manual test		P ☒ F ☐ N/A ☐ N/T ☐
5.2.3	THICKNESS		
	For each piece of insulation, the average of the measured values, rounded to 0,1 mm have be not less than the specified value for each size of table 1		P ☒ F ☐ N/A ☐ N/T ☐
	The smallest value must not fall below 90% of the specified value by more than 0,1 mm. Compliance must be checked using by test of clause 4.1 of EN 50396		P ☒ F ☐ N/A ☐ N/T ☐
5.3	SHEATH		
	The sheath must be crosslinked and fulfil the requirements of table B.1 in Annex B	Halogen free crosslinked polyolefin in black or red	P ☒ F ☐ N/A ☐ N/T ☐

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Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation	
5.3.2	APPLICATION			
	The sheath must be applied homogeneously by extrusion and halogen free material. The application of the sheath must give the finished cable a practically circular shape		P ☒ F ☐ N/A ☐ N/T ☐	
	Separation layer of halogen free material between insulation and sheath		P ☐ F ☐ N/A ☒ N/T ☐	
5.3.3	THICKNESS			
	For each piece of insulation, the average of the measured values, rounded to 0,1 mm must be less than the specified value for each size of table 1		P ☒ F ☐ N/A ☐ N/T ☐	
	The smallest value must not fall below 85% of the specified value by more than 0,1 mm. Compliance must be checked using by test of clause 4.1 of EN 50396		P ☒ F ☐ N/A ☐ N/T ☐	
5.3.4	COLOUR			
	The colour of the sheath must be black, unless otherwise agreed between manufacturer and customer. The colour must be throughout for whole sheath.	black,red	P ☒ F ☐ N/A ☐ N/T ☐	
6	MARKING			
6.1	GENERAL			
	The marking at the sheath must be by printing, embossing or indenting.	by printing	P ☒ F ☐ N/A ☐ N/T ☐	
6.2	INDICATION OF ORIGIN			
	Cables are marked with			
	a) manufacturer's name or Trademark or identification number	Jinan Mashiji Intelligent environmental protection technology Co., Ltd	P ☒ F ☐ N/A ☐ N/T ☐	

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Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation	
6.3	b) Code designation	H1Z2Z2-K	P	☒
			F	☐
			N/A	☐
			N/T	☐
6.4	c) Nominal cross-sectional area of conductor	2,5...10mm ²	P	☒
			F	☐
			N/A	☐
			N/T	☐
6.5	CONTINUITY OF MARKING			
	Spacing between the end of marking and the begin of the following identical marking does not exceed 550mm	<=550mm	P	☒
			F	☐
			N/A	☐
			N/T	☐
6.6	The name CENELEC, in full or abbreviated, does not be marked on, or in, the cables		P	☒
			F	☐
			N/A	☐
			N/T	☐
6.7.1	Marking is still legible after test of cl. 5.1 of EN 50396		P	☒
			F	☐
			N/A	☐
			N/T	☐
6.7.2	All markings are legible.		P	☒
			F	☐
			N/A	☐
			N/T	☐
Table 2	TEST FOR CABLES TO EN 50618			
1	ELECTRICAL TEST			
1.1.1	Conductor resistance		P	☒
			F	☐
			N/A	☐
	SEE CLAUSE 5.1.5 AND TABLE 5.1.5		N/T	☐
1.2	No breakdown at high voltage test with			
	- AC 6,5kV, or		P	☒
			F	☐
			N/A	☐
			N/T	☐
	- DC 15kV		P	☐
			F	☐
			N/A	☐
			N/T	☒

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1.4	Insulation resistance		
1.4.1.2	- during test in water at 20°C Min. as stated in table 1 of this standard: see table 8.1 [MOhm*km]		P ☒ F ☐ N/A ☐ N/T ☐
1.4.2	- during test in water at 90°C Min. as stated in table 1 of this standard: see table 8.1 [MOhm*km]		P ☒ F ☐ N/A ☐ N/T ☐
1.5.1	During long term resistance of insulation to D.C. a stable progress has been identified, no breakdown of the test voltage: [V d.c.]	no breakdown	P ☒ F ☐ N/A ☐ N/T ☐
1.5.2	After long term resistance test no damage or cracks of the insulation have been visible.	no damage and visible cracks	P ☒ F ☐ N/A ☐ N/T ☐
1.6.2	Surface resistance of sheath min 10 GOhm: [Ohm]	1X4mm ² (red):4,1X10 ¹¹ 1X6mm ² (black):1,6X10 ¹¹	P ☒ F ☐ N/A ☐ N/T ☐
2	CONSTRUCTIONAL AND DIMENSIONAL TEST		
2.1	Conductor		P ☒ F ☐ N/A ☐ N/T ☐
2.1.1	Maximum diameter of the conductor in accordance to EN 60228 clause 6.1 SEE table 5.1.5		P ☒ F ☐ N/A ☐ N/T ☐
2.1.2	Checking continuity of tin to clause 5.1.1 No visible gaps occurred	no visible gaps	P ☒ F ☐ N/A ☐ N/T ☐
2.2	Wall thickness of insulation Not less than stated in clause 5.2.3 of this standard SEE TABLE 5.2.3		P ☒ F ☐ N/A ☐ N/T ☐
2.3	Wall thickness of sheath Not less than stated in clause 5.3.3 of this standard SEE TABLE 5.3.3		P ☒ F ☐ N/A ☐ N/T ☐
	Measurement of overall dimensions Not less than stated in table 1 of this standard SEE TABLE 5.3.4		P ☒ F ☐ N/A ☐ N/T ☐

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	Mean value SEE TABLE 7.3.3		P	☒
			F	☐
			N/A	☐
			N/T	☐
2.4	Ovality max. 15% Not less than stated in clause 7.3.3 of this standard SEE TABLE 7.3.3		P	☒
			F	☐
			N/A	☐
			N/T	☐
2.5 2.5.1	Sheath colour Visual examination as stated in clause 7.3.1 of this standard	black,red	P	☒
			F	☐
			N/A	☐
			N/T	☐
2.6 2.6.1	Sheath marking Visual examination and measurement as stated in clause 7.3.2 of this standard		P	☒
			F	☐
			N/A	☐
			N/T	☐
3	Insulation material as stated in table B.1 of this standard		P	☒
			F	☐
			N/A	☐
			N/T	☐
4	Sheath material as stated in table B.1 of this standard		P	☒
			F	☐
			N/A	☐
			N/T	☐
5	COMPATIBILITY TEST ACCORDING TO EN 60811-401			
5.1	Test conditions: Duration of test 168 h Temperature 135 ± 2 °C			
5.2	Result in accordance to Table B.1 Lfd. No.: 1.7 of this standard SEE RESULT OF TABLE B1 No. 1.7		P	☒
			F	☐
			N/A	☐
			N/T	☐
6	COLD IMPACT TEST ACCORDING TO EN 60811-506			
6.1	Test conditions as stated in annex C of this standard -40°C			
6.2	After the test no cracks are visible	no cracks	P	☒
			F	☐
			N/A	☐
			N/T	☐
7	COLD BENDING TEST ACCORDING TO EN 60811-504 (Cable diameter ≤ 12,5 mm)			

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7.1	Test conditions: Conditioning duration 16 h: Temperature $-40 \pm 2^{\circ}\text{C}$: Diameter of mandrel: [mm]		
7.2	After the test no cracks are visible	no cracks	P ☒ F ☐ N/A ☐ N/T ☐
8	COLD ELONGATION TEST ACCORDING TO EN 60811-505 (Cable diameter > 12,5 mm)		
8.1	Test conditions: Conditioning duration 16 h Temperature $-40 \pm 2^{\circ}\text{C}$		
	Elongation at break min 30%: [%]		P ☐ F ☐ N/A ☒ N/T ☐
9	OZONE RESISTANCE ON COMPLETE CABLE		
9.1	Method A: Temperature $25 \pm 2^{\circ}\text{C}$ Duration 24 h Ozone concentration (by volume) $(250-300) \cdot 10^{-4} \%$		P ☒ F ☐ N/A ☐ N/T ☐
9.2	Method B: Temperature $40 \pm 2^{\circ}\text{C}$ Relative humidity $55 \pm 5 \%$ Duration 72 h Ozone concentration (by volume) $(150-250) \cdot 10^{-6} \%$		P ☐ F ☐ N/A ☒ N/T ☐
9.3	After the test no cracks are visible	no cracks	P ☒ F ☐ N/A ☐ N/T ☐
10	WEATHERING / UV RESISTANCE TEST (see annex E)		
10.1	Temperature during drying $65 \pm 3^{\circ}\text{C}$ Relative humidity 65 % Power at wavelength betw. 300 to 400 nm $60 \pm 2 \text{ W/m}^2$ Duration spraying/ drying 18 / 102 Min Duration 720 h After test conditioning the exposed five specimens at ambient temperature for 16h		P ☒ F ☐ N/A ☐ N/T ☐

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10.2	Variation of tensile strength $\geq 70\%$ Variation of elongation at break $\geq 70\%$ <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
11	DYNAMIC PENETRATION TEST (annex D) <i>see table 7.4</i>		P ☒ F ☐ N/A ☐ N/T ☐
12	DAMP HEAT TEST		
12.1	Temperature 90 °C Duration 1000 h Relative humidity min. 85 % Reconditioning period 16 to 24 h		
12.2	Variation of tensile strength max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
	Variation of elongation at break max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
13	SHRINKAGE		
13.1	Length of cable before test [mm] Length of cable after test: [mm]	1X4mm ² (red):300/298 1X6mm ² (black):300/297	
13.2	Shrinkage after test max 2%: [%]	1X4mm ² (red):1 1X6mm ² (black):1	P ☒ F ☐ N/A ☐ N/T ☐
14	TEST UNDER FIRE CONDITIONS		
14.1	Length of sample 600 $\pm$ 25 mm Temperature during conditioning 23 $\pm$ 5 °C Relative humidity during conditioning 50 $\pm$ 20 % Duration of conditioning 16 h Overall diameter of test sample: [mm] Duration of flame application, depending on the diameter of the test sample 60 s		
	Distance from the lower edge of the top support to the upper onset of charring > 50 mm: [mm]	373 for 1X4mm ² (red) 395 for 1X6mm ² (black)	P ☒ F ☐ N/A ☐ N/T ☐

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Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation
	Charring does not extend downwards to a point greater than 540 mm from the lower edge of the top support: [mm]	490 for 1X4mm ² (red) 493 for 1X6mm ² (black)	P ☒ F ☐ N/A ☐ N/T ☐
15	SMOKE EMISSION OF COMPLETE CABLE ACCORDING TO EN 61034-2		
15.1	Test result light transmittance, min 60%: [%]	81 for 1X4mm ² (red) 84 for 1X6mm ² (black)	P ☒ F ☐ N/A ☐ N/T ☐
16	ASSESSMENT OF HALOGEN ACCORDING TO 50525-1 ANNEX B		
16.1	Determination of halogen		P ☒ F ☐ N/A ☐ N/T ☐
	Chloride, fluoride and bromide have been determined during test acc. to annex C (If yes, continue with phase 1)		P ☒ F ☐ N/A ☐ N/T ☐
	Phase 1		
	ph-value min. 4,3: [ph]	insulation: 5,8(red), 5,8(black) sheath: 5,7(red), 5,9(black)	P ☒ F ☐ N/A ☐ N/T ☐
	If ph-value min. 4,3 conductivity must be measured: [μS/mm]	insulation: 1(red), 1(black) sheath: 1(red), 1(black)	P ☒ F ☐ N/A ☐ N/T ☐
	If conductivity is > 2,5 μS/mm but < 10 μS/mm continue with phase 2, if conductivity is max. 2,5 μS/mm material is acceptable without phase 2		P ☒ F ☐ N/A ☐ N/T ☐
	Phase 2		
	Chlorine- and bromine content max. 0,5% (continue with phase 3): [%]	< 0,5 for insulation < 0,5 for sheath	P ☒ F ☐ N/A ☐ N/T ☐
	Phase 3		

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Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Evaluation</i>	
	Flouride content max. 0,5%: [%]	0,03 for insulation 0,03 for sheath	P ☒ F ☐ N/A ☐ N/T ☐	
Table B.1	REQUIREMENTS FOR INSULATION AND SHEATHING MATERIALS			
1	MECHANICAL CHARACTERISTICS			
1.1	Mechanical properties before ageing			
1.1.1	Determined median values for tensile strengt			
	- for insulation min. 8,0N/mm ² <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐	
	- for sheath min. 8,0N/mm ² <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐	
1.1.2	Determined median values for elongation at break			
	- for insulation min. 125% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐	
	- for sheath min 125% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐	
1.2	MECHANICAL PROPERTIES AFTER AGEING IN OVEN (150°C/168H)			
1.2.1	Test temperature: 150 ± 2°C Test duration: 168h			
1.2.2	Determined median values for tensile strength			
	- for insulation variation max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐	

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	- for sheath variation max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
1.2.3	Determined median values for elongation at break		
1.2.3	- for insulation variation max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
	- for sheath variation max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
1.3	HOT SET TEST IN OVEN ACCORDING TO EN 60811-507 (250°C / 15 MIN / 20N/cm2)		
1.3.2	Elongation under load max. 100%: [%]	Insulation: 15(red), 15(black) sheath: 20(red), 20(black)	P ☒ F ☐ N/A ☐ N/T ☐
	Permanent elongation after cooling max. 25%: [%]	Insulation: 0(red), 0(black) sheath: 0(red), 0(black)	P ☒ F ☐ N/A ☐ N/T ☐
1.4	THERMAL ENDURANCE TEST ACCORDING TO EN 60216 PARTS 1 AND 2		
	The determined Arrhenius curve resulting from the test results of test according to IEC 60216-2 shows a thermal endurance of min. 20.000h at a temperature of 120°C. <i>SEE ENCLOSURED ARRHENIUS-CALCULATION SHEET</i>	Refer to test report 50272706 001 for thermal endurance test.	P ☒ F ☐ N/A ☐ N/T ☐
1.5	COLD ELONGATION TEST ACCORDING TO EN 60811-505		
1.5.1	Test conditions see EN 60811-505		
1.5.2	Elongation of break min. 30%: [%]		P ☐ F ☐ N/A ☒ N/T ☐
1.6	SHEATH RESISTANCE AGAINST ACID AND ALKALINE SOLUTION ACCORDING TO EN 60811-404		

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1.6.1	Acid: N-Oxal-acid Alkaline solution: N-sodium hydroxide solution Temperature 23 C° Duration 168 h		
1.6.2	max. Variation of tensile strength $\pm 30\%$ <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
1.6.3	Min. Elongation at break $> 100\%$ <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
1.7	COMPATIBILITY TEST ACCORDING TO EN 60811-401		
1.7.1	Test conditions: Temperature 135 $\pm$ 2°C Duration of treatment 168 h		
1.7.2	Variation of tensile strength insulation max. $\pm 30\%$ Variation of tensile strength sheath max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐
1.7.3	Variation of elongation at break insulation max. $\pm 30\%$ Variation of elongation at break sheath max. - 30% <i>SEE TABLE B.1</i>		P ☒ F ☐ N/A ☐ N/T ☐

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Clause	Anforderungen - Prüfungen / <i>Requirements - Tests</i>	<i>Measuring results - Remarks</i>	<i>Evaluation</i>

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ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

H1Z2Z2-K 1X4mm²

Table B.1 MECHANICAL CHARACTERISTICS

Samples of insulation	☐ test plate	☒ sleeve probe	Black				
Samples of sheath	☒ test plate	☐ sleeve probe	Red				
INSULATION							
	Values of tensile strength [N/mm²]:					Median [N/mm²]	Variation [%]
Before ageing	-	-	-	-	-	13,4	-
After ageing in oven	-	-	-	-	-	14,4	+7
After damp heat test	-	-	-	-	-	-	-
After test of mutual influence	-	-	-	-	-	14,1	+5
	Values of elongation at break [%]:					Median [%]	Variation [%]
Before ageing	205	210	210	220	210	210	-
After ageing in oven	215	220	220	230	220	220	+5
After damp heat test	-	-	-	-	-	-	-
After test of mutual influence	215	210	220	220	225	220	+5
During cold elongation test	-	-	-	-	-	-	-
SHEATH							
	Values of tensile strength [N/mm²]:					Median [N/mm²]	Variation [%]
Before ageing	16,8	17,0	17,5	16,9	17,9	17,0	-
After ageing in oven	16,9	16,6	16,7	16,0	17,2	16,7	-2
After damp heat test	16,5	15,9	17,0	16,2	16,7	16,5	-3
After storing in acid	16,5	17,0	16,2	16,1	16,2	16,2	-5
After storing in alkaline	17,6	15,9	16,7	17,9	17,3	17,3	+2
After storing UV Weathering	14,5	14,9	15,3	14,5	14,8	14,8	87
After test of mutual influence	16,9	16,5	17,4	16,6	17,3	16,8	-1
	Values of elongation at break [%]:					Median [%]	Variation [%]
Before ageing	200	180	190	200	200	200	-
After ageing in oven	190	180	190	200	190	190	-5
After damp heat test	190	180	190	190	180	190	-5
After storing in acid	200	190	190	180	190	190	-
After storing in alkaline	180	190	180	180	190	180	-
After storing UV Weathering	170	180	170	170	180	170	85
After test of mutual influence	200	210	190	190	180	190	-5
During cold elongation test	-	-	-	-	-	-	-

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ZUSATZ-DOKUMENTATION
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H1Z2Z2-K 1X6mm²

Table B.1 MECHANICAL CHARACTERISTICS

Samples of insulation ☐ test plate ☒ sleeve probe

Black

Samples of sheath ☒ test plate ☐ sleeve probe

Black

INSULATION

	Values of tensile strength [N/mm ²]:					Median [N/mm ²]	Variation [%]
Before ageing	-	-	-	-	-	13,2	-
After ageing in oven	-	-	-	-	-	13,9	+5
After damp heat test	-	-	-	-	-	-	-
After test of mutual influence	-	-	-	-	-	13,8	+5
	Values of elongation at break [%]:					Median [%]	Variation [%]
Before ageing	160	160	165	175	180	165	-
After ageing in oven	200	210	185	195	205	200	+21
After damp heat test	-	-	-	-	-	-	-
After test of mutual influence	200	185	195	170	185	188	+14
During cold elongation test	-	-	-	-	-	-	-

SHEATH

	Values of tensile strength [N/mm ²]:					Median [N/mm ²]	Variation [%]
Before ageing	11,8	11,9	12,2	12,0	11,2	11,9	-
After ageing in oven	10,5	11,0	10,8	11,1	10,6	10,8	-9
After damp heat test	9,5	9,8	9,2	10,1	10,3	9,8	-18
After storing in acid	9,8	11,3	10,7	10,0	10,6	10,6	-11
After storing in alkaline	9,9	9,6	10,5	10,9	10,8	10,5	-12
After storing UV Weathering	9,7	9,9	9,5	10,0	9,3	9,7	82
After test of mutual influence	10,5	11,2	10,8	10,4	11,4	10,8	-9
	Values of elongation at break [%]:					Median [%]	Variation [%]
Before ageing	170	180	160	190	180	180	-
After ageing in oven	160	185	170	175	160	170	-6
After damp heat test	165	170	155	160	170	165	-8
After storing in acid	165	175	160	180	175	175	-
After storing in alkaline	160	155	165	170	165	165	-
After storing UV Weathering	155	145	150	160	150	150	83
After test of mutual influence	175	165	160	180	160	170	-6
During cold elongation test	-	-	-	-	-	-	-

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Table 5.1.5 COMPLIANCE OF CONDUCTOR WITH CLASS 5 OF IEC 60228

	Diameter of single wires		Resistance of conductor	
	Max. [mm]	Measured [mm]	Max. [Ω /km]	Measured [Ω/km]
H1Z2Z2-K 1X4mm ² (red)	0,31	0,27	5,09	5,08
H1Z2Z2-K 1X6mm ² (black)	0,31	0,25	3,39	3,39

Table 8.1 INSULATION RESISTANCE VALUE

Cross section	Insulation resistance at 20°C		Insulation resistance at 90°C	
mm ²	Min. MΩ•km	Measured MΩ•km	Min. MΩ•km	Measured MΩ•km
1X4mm ² (red)	580	1100	0,58	6,00
1X6mm ² (black)	500	1840	0,50	13,85

Table 5.2.3 WALL THICKNESS OF INSULATION

Values of measured wall thickness not less than stated in clause 5.2.3 of this standard (smallest value shall be highlighted) [mm]							Average value [mm]	Minimum thickness of insulation [mm]	Smallest measured value not less than $t_m \geq 0,9t_s - 0,1 \text{ mm}$
1X4mm ² (red)	0,526	0,754	0,750	0,904	0,798	0,780	0,8	0,53	0,53
1X6mm ² (black)	0,532	0,744	0,644	0,604	0,759	0,774	0,7	0,53	0,53

Table 5.3.3 WALL THICKNESS OF SHEATH

Values of measured wall thickness not less than stated in clause 5.3.3 of this standard (smallest value shall be highlighted) [mm]							Average value [mm]	Minimum thickness of sheath [mm]	Smallest measured value not less than $t_m \geq 0,85t_s - 0,1 \text{ mm}$
1X4mm ² (red)	0,743	0,840	0,952	0,960	0,962	0,800	0,9	0,74	0,58
1X6mm ² (black)	0,832	0,859	0,917	1,005	1,165	0,975	1,0	0,83	0,58

Table 7.3.3 MEAN VALUES AND OVALITY OF CABLE

Values of measured ovality not less than stated in clause 7.3.3 of this standard

	Sample 1		Sample 2		Sample 3		Average value [mm]	Manufacturer spec. [mm]	Ovality [%]
	Value 1 [mm]	Value 2 [mm]	Value 1 [mm]	Value 2 [mm]	Value 1 [mm]	Value 2 [mm]			
1X4mm ² (red)	5,664	5,838	5,685	5,829	5,665	5,808	5,7	6,6	3
1X6mm ² (black)	6,582	6,019	6,590	5,974	6,521	6,027	6,3	7,4	8

ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

Table 7.4 Dynamic penetration test (Annex D)

Nominal cross-sectional area of conductor: [mm ²]	4(red)	6(black)
Rated diameter of conductor according to table 2 of IEC 60719 (D _N): [mm]	2,50	3,0
Minimum value of force (150 * √D _N): [N]	237	260
Determined mean value of force: [N]	300	430

1.4 Thermal endurance properties

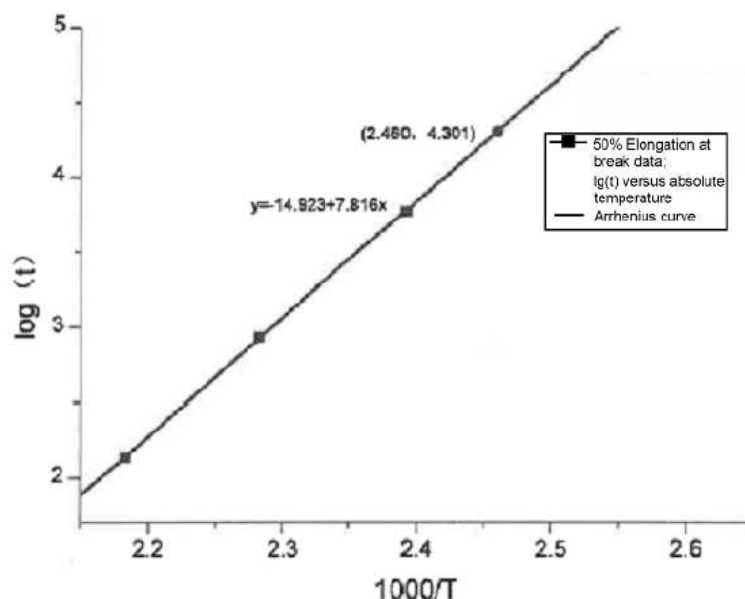
Testing method according to EN 60216-2

Test conditions

Temperature Index : 120
Selected exposure temperatures : 185°C, 165°C, 145°C
Elongation at break : 50 %

Test sample	Time to end-point at exposure temperature 185°C hour	Specified time (min.) h	Time to end-point at exposure temperature 165°C hour	Time to end-point at exposure temperature 145°C hour	Obtained absolute temperature K	Absolute temperature (min.) K	
insulation	136	100	851	5856	407	393	P
sheath	136	100	844	6062	407	393	P

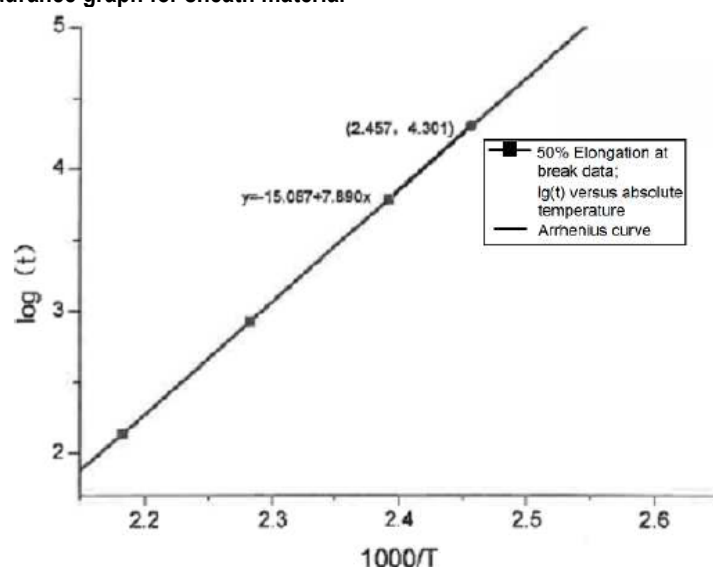
Thermal endurance graph for insulation material



(Remark: The value of t is equal to 20,000 h at $\lg(t)=4,30$)

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Thermal endurance graph for sheath material



(Remark: The value of t is equal to 20,000 h at $\lg(t)=4,30$)

End of test report

List of test equipment used-EN 50618

(GL202402302、GL202402303)

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
	Measurement of thickness of insulation	MCDMS Automatic Measuring System of Wire and Cable Structural Parameters (16-1334)	1~130mm	2024.02.01	2025.01.31
	Measurement of thickness of sheath	MCDMS Automatic Measuring System of Wire and Cable Structural Parameters (16-1334)	1~130mm	2024.02.01	2025.01.31
	Measurement of thickness of overall dimensions	MCDMS Automatic Measuring System of Wire and Cable Structural Parameters (16-1334)	1~130mm	2024.02.01	2025.01.31
	Hot set test	RYS-III Hot Set Tester (03-2216)	RT+10~300℃	2024.01.05	2025.01.04
	Hot set test	Electronic Balance (17-0132-7)	0~220g	2023.11.10	2024.11.09
	Hot set test	Electronic Balance (17-0131-7)	0~220g	2023.11.10	2024.11.09
	Hot set test	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Hot set test	Vernier caliper (D03-0055)	0~150mm	2023.10.07	2024.10.06
	Hot set test	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Hot set test	Stopwatch (03-2375)	-	2023.09.26	2024.09.25
	Shrinkage test at complete cable	RYS-III Hot Set Tester (03-2217)	RT+10~300℃	2024.01.05	2025.01.04
	Shrinkage test at complete cable	Steel ruler (D03-0043)	0~300mm	2023.10.07	2024.10.06
	Shrinkage test at complete cable	Steel ruler (D03-0041)	0~300mm	2023.10.07	2024.10.06
	Dynamic penetration test	Dynamic penetration Tester (03-2393)	0~1000N	2024.02.07	2025.02.06
	Dynamic penetration test	Steel ruler (D03-0043)	0~300mm	2023.10.07	2024.10.06



	Dynamic penetration test	Steel tape measure (03-2109)	0~5m	2024.07.10	2025.01.09
	Cold Impact test at -40℃	DWCJ Impact Testing Machine (03-2211)	100g~1500g	2024.02.07	2025.02.06
	Cold Impact test at -40℃	Low Temperature Test Chamber (03-2138)	-70℃~100℃	2024.01.05	2025.01.04
	Cold Impact test at -40℃	Vernier caliper (D03-0055)	0~150mm	2023.10.07	2024.10.06
	Cold Impact test at -40℃	DWCJ Impact Testing Machine (03-2210)	100g~1500g	2024.02.07	2025.02.06
	Cold Impact test at -40℃	Low Temperature Test Chamber (03-2222)	-70℃~100℃	2024.01.05	2025.01.04
	Cold Impact test at -40℃	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Cold bending test at -40℃	DWJR Low temperature automatic winding instrument (03-2209)	0~12.5mm	2024.02.07	2025.02.06
	Cold bending test at -40℃	Low temperature test chamber (03-2220)	-40℃~150℃	2024.01.05	2025.01.04
	Cold bending test at -40℃	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Cold bending test at -40℃	DZJY Low temperature automatic winding instrument (03-2097)	0~12.5mm	2024.02.07	2025.02.06
	Cold bending test at -40℃	Low temperature test chamber (03-2137)	-40℃~150℃	2024.01.05	2025.01.04
	Cold bending test at -40℃	Vernier caliper (D03-0055)	0~150mm	2023.10.07	2024.10.06
	Resistance of conductors	PC36C DC Resistance Tester (03-2185)	0,01μΩ-199,99Ω	2023.10.10	2024.10.09
	Resistance of conductors	Conductor resistance Clamp (03-2301-1)	0~1000mm	2023.09.26	2024.09.25
	Resistance of conductors	Digital thermohygrograph (D03-0048)	-40℃~85℃ 0%~100%RH	2023.10.07	2024.10.06
	Voltage test on completed cable with AC or DC	JTGN-10kVA/25kV AC Voltage Test System (03-2123)	0~25kV	2024.02.09	2025.02.08
	Voltage test on completed cable with AC or DC	SY-3 Constant Temperature Water Bath Apparatus (03-2213)	RT+5℃ ~99.9℃	2024.01.05	2025.01.04

	Voltage test on completed cable with AC or DC	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Voltage test on completed cable with AC or DC	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Surface resistance of sheath	Damp heat Chamber (03-2076)	0℃~150℃ 25~98%RH	2024.01.05	2025.01.04
	Surface resistance of sheath	ZC-90G Insulated Resistance Tester (03-2190)	100~2×10 ¹⁷ Ω	2023.10.08	2024.10.07
	Surface resistance of sheath	Vernier caliper (D03-0056)	0~150mm	2023.10.07	2024.10.06
	Surface resistance of sheath	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Surface resistance of sheath	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Long term resistance of insulation to D.C.	YN 42024 Constant Temperature Water Bath Apparatus (16-1261)	RT~98℃	2024.01.05	2025.01.04
	Long term resistance of insulation to D.C	Voltage Test System (22-0043)	0~10kV	2023.10.30	2024.10.29
	Long term resistance of insulation to D.C	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Long term resistance of insulation to D.C	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Insulation resistance	ZC-90G Insulated Resistance Tester (03-2190)	100~2×10 ¹⁷ Ω	2023.10.08	2024.10.07
	Insulation resistance	SY-3 Constant Temperature Water Bath Apparatus (03-2213)	RT+5℃ ~99.9℃	2024.01.05	2025.01.04
	Insulation resistance	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Insulation resistance	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Test for vertical flame propagation at complete cable	JS/DR-III Single Cables Vertical Flammability Tester (03-2384)	-	2024.01.05	2025.01.04

	Test for vertical flame propagation at complete cable	Vernier caliper (D17-0184)	0~150mm	2024.01.19	2025.01.18
	Test for vertical flame propagation at complete cable	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Test for vertical flame propagation at complete cable	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Ozone resistance test at complete cable	Ozone Ageing Testing Chamber (20-0060)	0-1000PPHM	2024.06.11	2025.06.10
	Ozone resistance test at complete cable	Tape measure (D03-0018)	0~10m	2024.07.10	2025.01.09
	Ozone resistance test at complete cable	Tape measure (D03-0017)	0~10m	2024.07.10	2025.01.09
	Ozone resistance test at complete cable	Vernier caliper (D03-0056)	0~150mm	2023.10.07	2024.10.06
	Assessment of halogen	Acid Gas Emission Tester (03-2169)	Ambient temperature ~950℃	2024.01.05	2025.01.04
	Assessment of halogen	pH (03-2169-3)	0.00-14.00	2023.10.19	2024.10.18
	Assessment of halogen	Conductivity Tester (03-2169-4)	0.00 μ S/cm~100.0 mS/cm	2023.10.19	2024.10.18
	Assessment of halogen	Electronic Balance (03-2225)	0~210g	2023.11.10	2024.11.09
	Assessment of halogen	Fluorine Content Tester (03-2180)	0.001~9999 ppm	2023.10.19	2024.10.18
	Smoke density	Smoke density tester (03-2183)	0~100%	2024.01.31	2025.01.30
	Smoke density	MCDMS Automatic Measuring System of Wire and Cable Structural Parameters (16-1334)	1~130mm	2024.02.01	2025.01.31
	Mechanical properties before ageing	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06

	Mechanical properties before ageing	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Mechanical properties before ageing	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Mechanical properties before ageing	Vernier caliper (D17-0185)	0~150mm	2024.01.19	2025.01.18
	Mechanical properties before ageing	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Mechanical properties after ageing	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06
	Mechanical properties after ageing	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Mechanical properties after ageing	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Mechanical properties after ageing	Vernier caliper (D17-0185)	0~150mm	2024.01.19	2025.01.18
	Mechanical properties after ageing	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Mechanical properties after ageing	LHX- II Air Oven (03-2149)	Ambient temperature ~300℃	2024.01.05	2025.01.04
	Mechanical properties after ageing	LHX- II Air Oven (03-2148)	Ambient temperature ~300℃	2024.01.05	2025.01.04
	Test of mutual influence	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06
	Test of mutual influence	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Test of mutual influence	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Test of mutual influence	Vernier caliper (D17-0185)	0~150mm	2024.01.19	2025.01.18
	Test of mutual influence	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Test of mutual influence	RL100 Air Oven (03-2170)	Ambient temperature ~300℃	2024.01.05	2025.01.04

	Test of mutual influence	RL100 Air Oven (03-2176)	Ambient temperature ~300℃	2024.01.05	2025.01.04
	Damp heat test	Damp heat Chamber (03-2250)	-40℃~150℃ 25~98%RH	2024.01.05	2025.01.04
	Damp heat test	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06
	Damp heat test	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Damp heat test	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Damp heat test	Vernier caliper (D17-0185)	0~150mm	2024.01.19	2025.01.18
	Damp heat test	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Resistance against acid and alkaline solution	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Resistance against acid and alkaline solution	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06
	Resistance against acid and alkaline solution	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Resistance against acid and alkaline solution	Vernier caliper (D17-0185)	0~150mm	2024.01.19	2025.01.18
	Resistance against acid and alkaline solution	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Weathering/UV-resistance	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Weathering/UV-resistance	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06

	Weathering/UV-resistance	SN-900B Xenon Weather-Ometer (03-2219)	RT~100℃	2024.07.23	2025.07.24
	Weathering/UV-resistance	Dial gauge (D23-0036)	0~10mm	2024.08.13	2025.08.12
	Weathering/UV-resistance	Vernier caliper (D19-0045)	0~150mm	2024.01.19	2025.01.18
	Thermal endurance properties	EK50011 Air Oven (21-0119)	Ambient temperature ~300℃	2024.01.05	2025.01.04
	Thermal endurance properties	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2241)	0~500N	2024.02.07	2025.02.06
	Thermal endurance properties	CMT6502 Microcomputer Control Electronic Universal Testing Machine (03-2242)	0~500N	2024.02.07	2025.02.06
	Marking	Steel tape measure (03-2109)	0~5m	2024.07.10	2025.01.09
	Marking	Tape measure (D22-0010)	0~10m	2024.03.04	2024.09.03

