

Report No.: TN21-1690E

Sample No.: CN21-1315

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Contract No.: ISTCW21-0523

## Test Report

Consigner Hennan Huadong Cable Co., Ltd.  
North side of the west section of Yunxiang Road, Industrial cluster area, Jiaozuo City, Henan Province

Sample Name 0.6/1kV Copper conductor XLPE insulation steel wire armour PVC outer sheath flame retardant power cable

Type and Size ZC-YJV32 0.6/1kV 4×120

Kind of test Type Test

Sample Received Date March 25, 2021

Test Duration March 27, 2021 – April 26, 2021

Test Conclusion The sample has been carried out to the series of tests in accordance with IEC 60502-1:2004+A1:2009. The results indicate that the sample complies with the requirements of IEC 60502-1:2004+A1:2009.

Authorized by  
Shanghai Intelligent Service and Technology Co., Ltd.

李骥 Li Ji



Issue date 2021-04-27

Testing Engineer: 袁常俊 Yuan Changjun

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## 1 Sample Description

Manufacturer	Hennan Huadong Cable Co., Ltd. North side of the west section of Yunxiang Road, Industrial cluster area, Jiaozuo City, Henan Province
Type and Size	ZC-YJV32 0.6/1kV 4×120
Quantity	35m
Marking	Hennan Huadong Cable Co., Ltd. 0.6/1kV 4×120mm <sup>2</sup> CU/XLPE/PVC/ SWA/FR-PVC Flame retardant Power Cable meters
Color	Black
Source	Sent by the consigner
Status	Normal appearance

## 2 Testing and Verdict Standards

### 2.1 Testing Standards

IEC 60502-1:2004+A1:2009 Power cables with extruded insulation and their accessories for rated voltages from 1 kV ( $U_m = 1,2$  kV) up to 30 kV ( $U_m = 36$  kV) – Part 1: Cables for rated voltages of 1kV ( $U_m = 1,2$  kV) and 3 kV ( $U_m = 3,6$  kV)

### 2.2 Verdict Standards

Same to Testing Standards

## 3 Other Information

### 3.1 Description of the testing party

- The sample's name, type and size, manufacturer information are provided by the consigner;
- This report is the English version of test report of TN21-1690. If there is any inconsistency or conflict between the English and Chinese versions, the Chinese version shall prevail for all purposes.

### 3.2 Test location

The flame spread test on bunched cables (Category C) items were conducted at No.458 Haixiang Road, Fengxian District, Shanghai.

### 3.3 Symbol Definition

Requirement:	/ = no requirement in standards * = no requirement for positive deviation
Verdict:	P = complying with requirement / Pass F = not complying with requirement / Fail N = not required

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#### 4 Electrical type tests

##### 4.1 Measurement of the electrical resistance of conductor

The measurement of the electrical resistance of conductor test was carried out in accordance with 15.1a) of IEC 60502-1:2004+A1:2009.

The test method was 15.2 of IEC 60502-1:2004+A1:2009.

Test parameters

Environment temperature 20 °C

Duration of time 24 h

Test Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
Conductor resistance at 20°C	Ω/km	≤0.153	0.151	0.151	0.151	P

##### 4.2 Insulation resistance measurement at maximum conductor temperature

The insulation resistance measurement at maximum conductor temperature test was carried out in accordance with 17b) of IEC 60502-1:2004+A1:2009.

The test method was 17.2 of IEC 60502-1:2004+A1:2009.

Test parameters

Environment temperature 20 °C

Immersion time 2 h

The length of sample 10 m

Test Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
Insulation resistance constant at 90°C	MΩ·km	≥3.67	5120	4620	4430	P

##### 4.3 Voltage test for 4 h

The voltage test for 4 h was carried out in accordance with 17c) of IEC 60502-1:2004+A1:2009.

The test method was 17.3 of IEC 60502-1:2004+A1:2009.

Test parameters:

Environment temperature 20 °C

Immersion time 2 h

The length of sample 10 m

Test connection		Voltage applied, 50Hz		Duration (h)		
Voltage applied to	Earth connected to	...×U <sub>0</sub>	(kV)	Red	Yellow	Green
Conductor	Water	4	2.4	4	4	4



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Test Item	Requirement	Test Result	Verdict
Voltage test for 4h	No breakdown of the insulation shall occur	No breakdown of the insulation	P

## 5 Non-electrical tests

### 5.1 Check of cable construction

The check of cable construction test was carried out in accordance with 5-13 and 18.1-18.2 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60228:2004, IEC 60811-201:2012+A1:2017, IEC 60811-202:2012+A1:2017, IEC 60811-203:2012, and IEC 60502-1:2004+A1:2009.

Test Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
<b>Conductor</b>						
- class		Class 1, class 2, or class 5 in IEC 60228	Class 2 in IEC 60228			P
- material		Copper	Copper	Copper	Copper	P
- type		/	Stranded circular compacted			N
- No. of wires		≥18	24	24	24	P
<b>Insulation</b>						
Nominal thickness: 1.2	mm					
- average thickness	mm	≥1.2	1.5	1.4	1.4	P
- minimum thickness	mm	≥0.98	1.41	1.31	1.32	P
<b>Extruded inner covering</b>						
Nominal thickness: 1.3	mm					
- average thickness	mm	/		2.1		N
- minimum thickness	mm	≥0.84		1.87		P
<b>Metallic armour</b>						
- type		Round wire		Round wire		P
- material		Steel		Galvanized steel		P
- no. of wires	mm	/		53		N
Nominal diameter: 2.5	mm					
- average diameter	mm	≥2.38		2.50		P
<b>Oversheath</b>						
Nominal thickness: 2.7	mm					
- average thickness	mm	/		3.0		N
- minimum thickness	mm	≥1.96		2.82		P
<b>Complete cable</b>						
- colour		/		Black		N
- average diameter	mm	/		54.9		N

## 5.2 Tests for determining the mechanical properties of insulation before and after ageing

The tests for determining the mechanical properties of insulation before and after ageing was carried out in accordance with 18.3 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-501:2012+A1:2018.

The ageing treatments was carried out in accordance with IEC 60811-401:2012+A1:2017.

Test parameters

Ageing temperature	135	°C
Duration	168	h
Test temperature	23	°C
Separation rate	250	mm/min

Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
<b>Without ageing</b>						
- tensile strength	N/mm <sup>2</sup>	≥12.5	22.0	22.8	22.5	P
- elongation-at-break	%	≥200	570	560	560	P
<b>After ageing without conductor</b>						
- tensile strength	N/mm <sup>2</sup>	/	25.3	25.4	25.3	N
- variation with samples without ageing	%	≤±25	+15	+11	+12	P
- elongation-at-break	%	/	600	600	600	N
- variation with samples without ageing	%	≤±25	+5	+7	+7	P

## 5.3 Tests for determining the mechanical properties of non-metallic sheaths before and after ageing

The tests for determining the mechanical properties of non-metal sheaths before and after ageing was carried out in accordance with 18.4 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-501:2012+A1:2018.

The ageing treatments was carried out in accordance with IEC 60811-401:2012+A1:2017.

Test parameters

Ageing temperature	100	°C
Duration	168	h
Test temperature	23	°C
Separation rate	250	mm/min

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Item	Unit	Requirement	Test Result	Verdict
<b>Without ageing</b>				
- tensile strength	N/mm <sup>2</sup>	≥12.5	18.1	P
- elongation-at-break	%	≥150	310	P
<b>After ageing without conductor</b>				
- tensile strength	N/mm <sup>2</sup>	≥12.5	18.7	P
- variation with samples without ageing	%	≤±25	+3	P
- elongation-at-break	%	≥150	320	P
- variation with samples without ageing	%	≤±25	+3	P

#### 5.4 Additional ageing test on pieces of completed cables

The additional ageing test on pieces of completed cables was carried out in accordance with 18.5 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-501:2012+A1:2018.

The ageing treatments was carried out in accordance with IEC 60811-401:2012+A1:2017.

Test parameters

Ageing temperature	100	°C
Duration	168	h
Test temperature	23	°C
Separation rate	250	mm/min

Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
<b>Insulation</b>						
- tensile strength	N/mm <sup>2</sup>	/	22.9	22.6	22.8	N
- variation with samples without ageing	%	≤±25	+4	-1	+1	P
- elongation-at-break	%	/	550	560	570	N
- variation with samples without ageing	%	≤±25	-4	0	+2	P
<b>Oversheath</b>						
- tensile strength	N/mm <sup>2</sup>	/		18.7		N
- variation with samples without ageing	%	≤±25		+3		P
- elongation-at-break	%	/		320		N
- variation with samples without ageing	%	≤±25		+3		P



### 5.5 Loss of mass test on PVC sheaths of type ST<sub>2</sub>

The loss of mass test on PVC sheaths of type ST<sub>2</sub> was carried out in accordance with 18.6 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-409:2012.

Test parameters

Ageing temperature	100	°C
Duration	168	h
Test temperature	23	°C

Item	Unit	Requirement	Test Result	Verdict
Loss of mass	mg/cm <sup>2</sup>	≤1.5	0.76	P

### 5.6 Pressure test at high temperature on PVC sheaths of type ST<sub>2</sub>

The pressure test at high temperature on PVC sheaths of type ST<sub>2</sub> was carried out in accordance with 18.7 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-508:2012+A1:2017.

Test parameters

Temperature	90	°C
Duration	6	h
The compressing force	12.5	N

Item	Unit	Requirement	Test Result	Verdict
Depth of indentation	%	≤50	17	P

### 5.7 Test on PVC sheaths of type ST<sub>2</sub> at low temperatures

The test on PVC sheaths of type ST<sub>2</sub> at low temperatures was carried out in accordance with 18.8 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-505:2012 and IEC 60811-506:2012.

#### 5.7.1 Cold elongation test

Test parameters

Temperature	-15	°C
Duration	4	h

Item	Unit	Requirement	Test Result	Verdict
Elongation	%	≥20	73	P

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### 5.7.2 Cold impact test

Test parameters

Temperature	-15 °C
Duration	16 h
Weight	1250 g

Item	Requirement	Test Result	Verdict
Check on inner and outer surfaces of insulation and sheath	No crack	No crack	P

### 5.8 Test for resistance of PVC sheaths of type ST<sub>2</sub> to cracking (heat shock test)

The test for resistance of PVC sheaths of type ST<sub>2</sub> to cracking (heat shock test) was carried out in accordance with 18.9 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-509:2012+A1:2017.

Test parameters

Temperature	150 °C
Duration	1 h

Item	Requirement	Test Result	Verdict
Heat shock test	No crack	No crack	P

### 5.9 Hot set test for XLPE insulations

The hot set test for XLPE insulations was carried out in accordance with 18.11 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-507:2012.

Test parameters

Temperature	200 °C
Time under load	15 min
Mechanical stress	20 N/cm <sup>2</sup>

Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
Elongation under load	%	≤175	48	50	43	P
Permanent elongation after cooling	%	≤15	0	0	0	P



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### 5.10 Water absorption test on insulation

The water absorption test on insulation was carried out in accordance with 18.13 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60811-402:2012.

Test parameters

Temperature 85 °C

Duration 336 h

Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
Increase of mass	mg/cm <sup>2</sup>	≤1	0.06	0.07	0.07	P

### 5.11 Flame spread test on single cables

The flame spread test on single cables was carried out in accordance with 18.14.1 of IEC 60502-1:2004+A1:2009.

The test method was IEC 60332-1-2:2015.

Test parameters

Pretreatment temperature 23 °C

Pretreatment relative humidity 50 %

Pretreatment time 24 h

Flame application time 240 s

Test Item	Unit	Requirement	Test Result	Verdict
The distance between the lower edge of the top support and the onset of charring	mm	>50	422	P
The distance from the lower edge of the top support to the lower onset of charring	mm	≤540	517	P

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### 5.12 Flame spread test on bunched cables (Category C)

The flame spread test on bunched cables (Category C) was carried out in accordance with 18.14.2 of IEC 60502-1: 2004+A1:2009.

The test method was IEC 60332-3-24:2018.

Test parameters

Number of test pieces	2
Total volume of non-metallic	1.5 L/m
Positioning of test pieces	Touched
Number of layers	1
Flame application time	20 min
Number of burners	1

Item	Unit	Requirement	Test Result	Verdict
Maximum extent of the charred portion above the bottom edge of the burner	m	≤2.5	0.83	P
Time to extinction of all burning or glowing	h	/	0.03	N

### 5.13 Shrinkage test for XLPE insulation

The shrinkage test for XLPE insulation was carried out in accordance with 18.16 of IEC 60502-1: 2004+A1:2009.

The test method was IEC 60811-502:2012.

Test parameters

Distance between marks	200 mm
Temperature	130 °C
Duration	1 h

Item	Unit	Requirement	Test Result			Verdict
			Red	Yellow	Green	
Shrinkage	%	≤4	3	2	2	P

- The End -