EmPowr® CL™ UL Type MV-105*

Eco-nomical, Eco-efficient, Eco-friendly

EmPowr® CL™ – the next generation in renewable energy collection systems. It's the only medium-voltage cable that costs less now and pays more later.

- Reduced upfront cost
- Better long-term efficiency
- Environmentally friendly
- Greater return on investment

Our Non-Stop Commitment

When specifying cables that effectively and efficiently operate under complex conditions, your options have changed. There's now something better. Prysmian's team of experts has once again applied extensive R&D experience to re-engineer our medium-voltage cable, improving the performance of collection systems and making renewable energy more **eco-nomical, eco-efficient and eco-friendly** than ever before.

EmPowr® CL™ – Eco-nomical
Through an innovative redesign of the cable's concentric neutrals, Prysmian has succeeded in reducing the amount of high-cost copper to cut initial material costs.

EmPowr® CL™ – Eco-efficient
This exciting breakthrough features the latest in Cross-linked Polyethylene (XLPE) cable jacketing coupled with reduced concentric neutrals, providing better efficiency over the life of the cable through cooler operation, lower line loss and greater resistance to deformation.

* See Page 4

EmPowr® CL™ – Eco-friendly
Prysmian's EmPowr® medium-voltage cables are already the greenest choice for wind farm construction. EmPowr offers high dielectric strength with the lowest dielectric loss characteristics of any medium-voltage cable type. With its built-in cost benefits and long-term efficiencies, CL™ is the total green solution — allowing you to go green and save green for an overall better return on investment.

- Reduced Copper in Concentric Neutrals
- Cooler Operation
- Enhanced Thermomechanical Properties
- Optimal Efficiency with Lower Line Loss
- Environmentally Friendly with Lead-Free Compounds
- Returnable Reels and Carbon Credit Value

Prysmian, a Fortune 500 company, is one of the world's leading manufacturers of cabling solutions for traditional and renewable energy markets and the largest medium-voltage cable supplier in North America. Our uncompromising commitment to quality and product innovation is continually demonstrated in our investment in cable technology that **maximizes energy capture and customer return on investment.**



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Through extensive industry-recognized testing, this next-generation cable has proven its ability to meet the needs of today's wind farm collection systems while maintaining the reliability and performance of Prysmian's existing EmPowr 35 kV TRXLPE insulated cable. Look at the test data on every purchase of medium-voltage cable to ensure that you're getting the performance you expect.

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U.S. Specification for TRXLPE Medium-Voltage Underground Distribution Cable with XLPE Jacket



1.0 SCOPE

This specification covers single conductor tree-retardant cross-linked polyethylene insulated, concentric neutral cables rated from 5 kV to 46 kV. The cable shall be suitable for both single- and three-phase primary underground distribution (UD) for installation in underground ducts, conduit and direct burial in wet or dry locations. It shall also be suitable for on-grade and aerial installations. The cable shall be rated 90°C for normal operation, 130°C for emergency overload, and 250°C for short-circuit conditions in accordance with the latest revision of ANSI/ICEA S-94-649, AEIC CS8 and UL 1072 as applicable.

2.0 GENERAL

Cable shall meet or exceed the latest requirements of the following industry specifications and standards. The order of precedent is as follows: 1) Customer Specification,
2) AEIC CS8, 3) ANSI/ICEA S-94-649, 4) UL 1072. Where a particular product requirement or characteristic is specified in more than one document, the most stringent requirement will apply. Wherever reference is made to an industry specification or standard, it shall be understood to be the latest edition of that document.

3.0 QUALITY ASSURANCE

The cable shall be produced with the conductor shield, insulation and insulation shield applied in the same extrusion operation. All three extruded layers shall be applied in a common extruder head. A dry-cure process shall be used. Compound pellets used for strand shield, insulation and insulation shield shall be received and unloaded using an ultra-clean bulk handling system and/or an ultra-clean box handling system. The bulk handling system shall be a closed system. The material transfer/storage system shall use filtered air. The box handling system shall incorporate a dedicated material transfer system with filtered air involving at least the following: a Class 10,000 clean room per FED-STD-209E to hold the bag of compound as it is unloaded into the transfer system or a Class 10,000 clean compartment per FED-STD-209E surrounding the transfer point.

4.0 CONDUCTORS

The central conductor shall be either solid or stranded. If stranded, it shall be filled with a material compatible with the conductor and the conductor shield to prevent the longitudinal penetration of water into the conductor. Solid aluminum shall meet the requirements of ANSI/ICEA S-94-649 Part 2. Stranded aluminum conductor shall be Class B, compressed per ANSI/ICEA S-94-649 Part 2. Conductor temper shall be H-16 to H-19 (3/4 to hard drawn) for stranded conductors and H-14 to H-16 (1/2 to 3/4 hard) for solid conductors.

5.0 CONDUCTOR SHIELD

The conductor shield shall be an extruded thermosetting semi-conductive material complying with the applicable requirements of AEIC CS8 and ANSI/ICEA S-94-649 Part 3. The extruded shield shall be easily removable from the conductor and shall be firmly bonded to the overlying insulation.

6.0 INSULATION

The insulation shall be a tree-retardant cross-linked polyethylene and shall comply with AEIC CS8 and ANSI/ICEA S-94-649 Part 4. The thickness shall be as required by ANSI/ICEA S-94-649 Table 4-4. An insulation pellet inspection system capable of examining 100% of the insulation pellets and rejecting contaminants shall be used. The manufacturer shall state the method used to examine and reject contaminated pellets.

7.0 INSULATION SHIELDING

The insulation shield shall be a thermosetting semi-conductive material complying with the applicable requirements of ANSI/ICEA S-94-649 Part 5.

8.0 CONCENTRIC NEUTRAL

The concentric neutral conductor shall consist of bare annealed copper wires per ANSI/ICEA S-94-649 Part 6, applied helically and essentially equally spaced over the outer semi-conducting shield, with a lay length of not less than six nor more than ten times the diameter over the concentric neutral conductor. The neutral indents in the insulation shield shall be within the requirements of ANSI/ICEA S-94-649 Part 5.2. The cable shall contain water-blocking components for the concentric neutral, and the completed cable longitudinal water penetration resistance shall comply with the requirements of ANSI/ICEA S-94-649 Part 6 and ANSI/ICEA T-34-664.

9.0 OVERALL OUTER JACKET

The outer jacket is an extruded-to-fill black non-conducting cross-linked polyethylene jacket, meeting the physical requirements of Table 1 when tested by the methods specified in ANSI/ICEA S-94-649. The jacket shall be free-stripping and not interfere with an intimate contact between the neutral wires and the underlying extruded insulation shield. The jacket shall contain a print legend marking, sequential length marking and three longitudinal extruded red stripes.

Table 1: Physical Properties of Extruded-to-Fill XLPE Jacket

PHYSICAL REQUIREMENTS	VALUES
Unaged Tensile Strength, Min. (psi)	1500
Aged* Tensile Strength, Min. Ret. (%)	70
Unaged Elongated, Min. (%)	150
Aged* Elongated, Min. Ret. (%)	70
Heat Distortion 1 hr at 131°C, Max. (%)	30

*Aged for 168 hrs at 121°C.

10.0 TESTS

All tests required by the referenced specifications shall be performed and passed prior to shipment, and a certified copy of the results of the tests shall be sent to the customer, if so requested. The manufacturer shall either submit with the quotation, or have on file with the customer, certified support data for the qualification tests required by ANSI/ICEA S-94-649 Part 10 as applicable.

11.0 EXCEPTIONS

All exceptions to these specifications are to be clearly stated in the bid proposal and will require the review and approval of the customer.

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COMPRESSED CONDUCTOR CLASS B STRAND			INS. DIAMETER (1)		NOM. JACKET THKN.(1)	LLDPE JACKET								EMPOWR® CL™									
			IN (mm)		IN (mm)	NEUTRAL CONFIGURATION				NOM. JACKET O.D.	AMPACITY (2)		APPROX. SHIELD FAULT CAPACITY (4)	NEUTRAL CONFIGURATION			NOM. JACKET O.D.	AMPACITY (2)		APPROX. TOTAL WT.	TYPICAL LENGTH (5)	COND. SIZE
AL (AWG or kc-mil)	NOM. COND. DIA. IN (mm)	APPROX. AL WT. LBS/KFT (kg/km)	MIN. INS. O.D.	MAX. INS. O.D.	LLDPE JACKET	NEUT. SIZE	NO. OF WIRES	WIRE SIZE (AWG)	APPROX. CU WT. (1) LBS/KFT (kg/km)	INCHES (mm)	DIRECT BURIED FLAT (3)	DIRECT BURIED TRE-FOIL	CURRENT @ 6 CYCLES (AMPS)	NO. OF WIRES	WIRE SIZE (AWG)	APPROX. CU WT. (1) LBS/KFT (kg/km)	INCHES (mm)	DIRECT BURIED FLAT (3)	DIRECT BURIED TRE-FOIL	LBS/KFT (kg/km)	FT (m)	AL (AWG or kcmil)
1/0	0.362 (9.19)	99 (147)	1.045 (26.54)	1.145 (29.08)	0.055 (1.40)	Full	16	14	214 (318)	1.404 (35.66)	245	230	13700	19	16	159 (237)	1.377 (34.99)	245	230	831 (1236)	8000 (2450)	1/0
						2/3	17	16	143 (213)	1.378 (35.00)	245	230	9400	13	16	109 (162)	1.377 (34.99)	245	230	786 (1169)		
						1/2	13	16	109 (162)	1.378 (35.00)	250	230	7000	10	16	84 (125)	1.377 (34.99)	250	230	763 (1135)		
						1/3	9	16	76 (113)	1.378 (35.00)	250	230	5000	7	16	59 (87)	1.377 (34.99)	250	230	740 (1101)		
3/0	0.456 (11.58)	158 (235)	1.140 (28.96)	1.240 (31.50)	0.055 (1.40)	Full	16	12	339 (504)	1.532 (38.91)	310	300	21800	18	14	240 (357)	1.498 (38.05)	315	300	1053 (1567)	7000 (2150)	3/0
						2/3	17	14	227 (338)	1.498 (38.05)	315	300	14700	20	16	168 (250)	1.471 (37.37)	315	300	964 (1434)		
						1/2	20	16	168 (250)	1.472 (37.39)	315	300	10900	15	16	126 (187)	1.471 (37.37)	320	300	927 (1379)		
						1/3	14	16	118 (176)	1.472 (37.39)	320	300	7800	10	16	84 (125)	1.471 (37.37)	320	300	889 (1323)		
4/0	0.512 (13.00)	199 (296)	1.195 (30.35)	1.295 (32.89)	0.055 (1.40)	Full	20	12	423 (630)	1.588 (40.34)	350	340	26800	23	14	307 (457)	1.554 (39.47)	350	340	1196 (1780)	7000 (2150)	4/0
						2/3	21	14	280 (417)	1.554 (39.47)	355	340	17600	16	14	214 (318)	1.554 (39.47)	355	340	1112 (1655)		
						1/2	16	14	214 (318)	1.554 (39.47)	355	340	13700	19	16	159 (237)	1.528 (38.81)	360	340	1038 (1544)		
						1/3	17	16	143 (213)	1.528 (38.81)	360	340	9300	13	16	109 (162)	1.528 (38.81)	365	340	993 (1477)		
350	0.661 (16.79)	329 (490)	1.355 (34.42)	1.455 (36.96)	0.080 (2.03)	2/3	22	12	466 (693)	1.797 (45.64)	440	445	29500	26	14	347 (516)	1.763 (44.78)	445	445	1542 (2294)	5000 (1500)	350
						1/2	26	14	347 (516)	1.763 (44.78)	445	445	23000	19	14	254 (378)	1.763 (44.78)	455	445	1458 (2169)		
						1/3	18	14	240 (358)	1.763 (44.78)	455	450	15100	20	16	168 (250)	1.737 (44.12)	465	450	1353 (2013)		
						1/6	14	16	118 (176)	1.737 (44.12)	475	450	7800	10	16	84 (125)	1.737 (44.12)	475	450	1278 (1902)		
500	0.789 (20.04)	468 (697)	1.480 (37.59)	1.580 (40.13)	0.080 (2.03)	2/3	20	10	673 (1002)	1.967 (49.96)	505	535	43500	23	12	487 (725)	1.925 (48.90)	510	540	1952 (2904)	5000 (1500)	500
						1/2	24	12	508 (757)	1.925 (48.90)	510	540	32700	17	12	360 (536)	1.925 (48.90)	520	540	1838 (2735)		
						1/3	25	14	334 (497)	1.891 (48.03)	525	545	21800	18	14	240 (357)	1.891 (48.03)	540	545	1690 (2515)		
						1/6	20	16	168 (250)	1.865 (47.37)	555	545	11300	15	16	126 (188)	1.865 (47.37)	570	550	1557 (2317)		
750	0.968 (24.59)	703 (1047)	1.670 (42.42)	1.770 (44.96)	0.080 (2.03)	1/2	22	10	741 (1102)	2.184 (55.47)	585	655	49600	26	12	551 (820)	2.142 (54.41)	590	660	2461 (3662)	5000 (1500)	750
						1/3	24	12	508 (757)	2.142 (54.41)	595	665	32700	17	12	360 (536)	2.142 (54.41)	615	670	2290 (3407)		
						1/6	19	14	254 (378)	2.108 (53.54)	645	675	16100	22	16	185 (275)	2.082 (52.88)	670	680	2053 (3055)		
1000	1.117 (28.37)	937 (1394)	1.815 (46.10)	1.920 (48.77)	0.080 (2.03)	1/2	24	9	1018 (1515)	2.358 (59.89)	650	740	64400	22	10	741 (1102)	2.333 (59.26)	650	760	3690 (5490)	4000 (1200)	1000
						1/3	20	10	673 (1002)	2.333 (59.26)	645	755	42600	23	12	487 (725)	2.291 (58.19)	660	765	2774 (4127)		
						1/6	25	14	334 (497)	2.257 (57.32)	695	775	21800	18	14	241 (359)	2.257 (57.33)	725	785	2504 (3726)		
1250	1.251 (31.78)	1172 (1744)	1.960 (49.78)	2.065 (52.45)	0.080 (2.03)	1/3	25	10	842 (1253)	2.481 (63.02)	690	825	53200	18	10	606 (902)	2.481 (63.02)	700	845	3328 (4952)	3500 (1050)	1250
						1/6	20	12	424 (631)	2.439 (61.95)	730	855	27300	23	14	307 (457)	2.405 (61.09)	765	870	2943 (4379)		
						1/12	25	16	210 (313)	2.405 (61.09)	815	880	13700	18	16	151 (225)	2.379 (60.43)	850	885	2764 (4113)		
1500	1.370 (34.80)	1406 (2093)	2.100 (53.34)	2.205 (56.01)	0.080 (2.03)	1/3	24	9	1018 (1515)	2.625 (66.68)	730	875	64500	22	10	741 (1103)	2.600 (66.86)	725	900	3690 (5490)	3000 (900)	1500
						1/6	24	12	509 (757)	2.558 (64.97)	750	920	32700	17	12	360 (536)	2.558 (64.97)	785	935	3281 (4882)		
						1/12	19	14	254 (378)	2.524 (64.11)	845	950	16100	22	16	185 (275)	2.498 (63.45)	895	960	3028 (4505)		

(1) Extruded layer thicknesses and insulation and insulation shield diameters are in accordance with ANSI/ICEA S-94-649 for concentric neutral cables rated 5-46 kV and also meet the requirements of the latest revisions of AEIC CS8. Dimensions and weights not designated as minimum or maximum are nominal values and are subject to manufacturing tolerances.

(2) Ampacity based on earth thermal resistivity of 90°C-cm/watt, 90°C conductor temperature, 20°C earth ambient temperature, 75% load factor and 36" depth of burial. Values are based on one three-phase circuit, one conductor per phase, with neutral wires bonded at each end.

(3) Cables buried in flat adjacent configuration with 7.5" spacing between conductors.

(4) Approximate Shield Fault Capacity is the average, rounded value of the two neutral designs. EmPowr® CL™ neutral configurations are designed to provide equivalent shield fault capacity of the corresponding neutrals, based on LLDPE jackets with 90˚C normal operation.

(5) Based on capacity of 96" non-returnable wood reels.

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Industry-Leading Reliability and Performance

EmPowr® CL™ UL Type MV-105*— Your Best Choice

Utilities have historically used Linear Low Density Polyethylene (LLDPE) thermoplastic jackets for the beneficial balance of cost and physical protection they provide. The future of utility power cable jacketing is thermoset XLPE jackets that provide a lower-total-cost solution.

Advantages of this new generation of cable construction include:

Approximately 25% reduction in copper in the concentric neutrals:
Using the ICEA P-45-482-2007 calculations to determine the shield cross-sectional area required for a given fault current, LLDPE jackets are limited to a maximum transient temperature of 200°C; XLPE jackets allow 350°C. The higher temperature allowance provides a greater amount of fault current capability for a given cross-sectional area, reducing the required copper in the neutrals. A smaller circulating current provides a reduced operating temperature, resulting in higher cable ampacities.

Further savings can be realized through the EPRI Short2 Program. Prysmian's engineering team will gladly assist you in optimizing your cable design.

Reduced shield losses equate to lower line loss:
With reduced copper concentric neutrals, the shield resistance will increase, with lower losses due to circulating currents. This effect is most easily seen in the larger kcmil sizes but is applicable to all conductor sizes.

Equivalent physical properties to existing LLDPE jacketed construction:
Test data has shown that EmPowr® CL™ maintains the physical properties, jacket stripping, coefficient of friction and installation characteristics of traditional EmPowr® LLDPE jacket constructions.

Enhanced thermomechanical performance provides excellent resistance to deformation:
To simulate three-conductor installed performance, Prysmian conducted AEIC/ICEA thermomechanical testing on traditional EmPowr® LLDPE jacketed cables and EmPowr® CL™ XLPE jacketed cables.

Photos and results of the testing are shown below:

EmPowr® LLDPE jacketed cables:
The results of the testing showed that the LLDPE failed 3 x 1/C Cable/Conduit 140°C testing. It clearly melted and fused together, causing exposed concentric neutrals at some locations.





EmPowr® CL™ XLPE jacketed cables:
These cables passed 3 x 1/C Cable/Conduit 140°C testing with no problem areas.



Comparative Study: EmPowr® Versus EmPowr® CL™

PRODUCT DESIGN	DESCRIPTION - 1000 kcmil Aluminum, TRXLPE, 1/3 CN, 35 kV			
	EMPOWR® LLDPE JACKET		EMPOWR® CLTM XLPE JACKET	
Concentric Neutrals	No. of Wires: 20	10 AWG	No. of Wires: 23	12 AWG
Concentric Neutrals - CU WT.	673 lbs/kft (1002 kg/km)		487 lbs/kft (725 kg/km)	
Shield Fault Capacity – Currents @ 6 Cycles (AMPS)	42645 A		42695 A	
Ampacity [1] Direct Buried @ 90°C – Flat	645 A		660 A	
Cost of Shield Losses [2]	$82,700		$75,300	
Calculated Savings [3]			$976,800	

(1) Based on cables with 90°C normal operation.
(2) Based on 3 conductor, flat, 7.5" spacing, 36" burial depth, 20°C ambient, 75% load factor, soil Rho 0.9°C-m/W.
(3) Based on 3 conductor, flat, 7.5" spacing, 645 A, avg. energy cost $0.06/kWh, 1 circuit mile, 1-year time frame.
(4) Based on 3 conductor, flat, 7.5" spacing, 645 A, avg. energy cost $0.06/kWh, 20 circuit miles, 20-year life of a wind farm, 1/3 production time.

*UL Type MV-105 EmPowr® CL™ is rated MV-105 in accordance with the UL 1072 standard. It should be noted that utilizing a 105°C normal operating conductor temperature will increase cable ampacity rating but will reduce the shield fault capability slightly. If the user plans on operating these cables at 105°C conductor temperature for normal operation and 140°C for emergency overload, please contact Prysmian for the applicable cable ampacity and shield fault capability ratings. Another important consideration is that the migration of soil moisture away from the cable is more likely at the higher operating conductor temperature and can result in an increase in soil thermal resistivity, resulting in an increase in conductor and soil temperature.

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