Lifeline® RC90 Fire Resistive Cable Installation Guide

Recommended Practices
Technical Information Sheet TIS#401CA

prysmian

lifeline®

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USING THIS MANUAL

The information contained herein is intended for evaluation and use by technically skilled and appropriately trained persons. Although the information is believed to be accurate as of the date of printing, Prysmian makes no representations or warranties, expressed or implied, with respect to the accuracy or completeness of this document, nor does Prysmian assume any obligation to update or correct the same in the future. You should always consult a trained professional for the most current industry practices and procedures unique to your application.
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SPL-FPT-0025-0624

INTRODUCTION

This guide provides suggestions for various methods, equipment and tools that have been found practical based on field experience during the installation of Prysmian's fire resistive Lifeline® RC90 and Lifeline® RC90 LSZH Cable systems in fire-rated applications. The intent of this guide, along with applicable federal, state, and municipal regulations, is to provide guidance for an optimized installation of fire resistive cabling systems. For suggested grips, supports and fasteners, lubricants and pulling eyes, please contact the manufacturers regarding the suitability of their products in the specific applications. It is recognized that each and every installation is different and there will be situations where customized techniques will be required that may be different from those found within this document. For specific installation guidance on your application please contact Prysmian Cables and Systems (US) Inc. at (859) 572-8000.

Lifeline RC90 Application

Lifeline RC90 CSA C22.2 No. 123 Metal sheathed cables are certified and classified to the demanding requirements of ULC-S139, *Tests for Fire Resistive Cables*, and are CSA listed Type RC90. Lifeline® RC90 Cables meet industry code requirements of the National Building Code of Canada Articles 3.2.6 and 3.2.7.10, NFPA 70, NFPA 72, NFPA 101, NFPA 130, and NFPA 502 for fire resistance according to ULC-S139 standard when installed per applicable codes, including federal, state, local and municipal rules, laws and regulations, as well as Electrical Circuit Integrity Systems Certified for Canada - 51 or 51A (FHIT7.51 or FHIT7.51A). Note that Authorities Having Jurisdiction (AHJ) should be consulted for approval prior to cable purchase and installation.

Lifeline RC90 Power Cables do not have to be installed in a separate raceway and provide a cost-effective solution for many applications such as emergency tunnel lighting and fire pumps. Conductors within RC90 Cable are continuously supported and are not subject to requirements of CEC 12-120(4)(c) Supporting of Conductors. CEC 32-300(b) - *Fire Pumps Insulated Conductors* and CEC 46-000 - *Emergency Power Supply, unit equipment, exit signs and life safety systems.* Unlike Mineral Insulated (MI) cables, Lifeline RC90 can be produced in long continuous lengths, eliminating the need for labor-intensive splices which require special and expensive tooling, resulting in an easier and quicker installation process. Prysmian offers tailored technical support to provide the best, most cost effective and code compliant solution to your specific application. For sales and technical support, please contact your Prysmian sales representative to learn more about our full range of fire resistive, ULC-S139 approved options including cable-in-conduit solutions.

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PRODUCT HANDLING

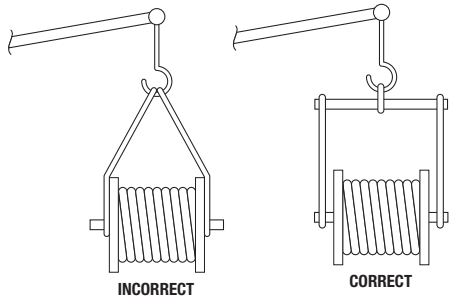
Lifeline® RC90 cables are durable high-quality products relatively unaffected by ambient conditions. The instructions of this section should be followed to prevent damage during storage or installation.

Handling Reels

Upon receiving, and before acceptance of a shipment, all reels should be visually inspected for evidence of damage during shipment. Damage such as broken or interlocked flanges, damaged wrapping or lagging, reels broken loose from their ties or blocking, etc. Any signs of such damage should immediately be reported to the carrier. If the protective wrapping or lagging is removed to inspect for possible damage during shipment, it should be replaced prior to placing the reel into long term storage.

When moving cable reels, care should be taken to ensure material handling equipment does not contact cable surfaces or protective covering on reel. Under no circumstances should cable reels be dropped from any height, or be allowed to roll uncontrolled.

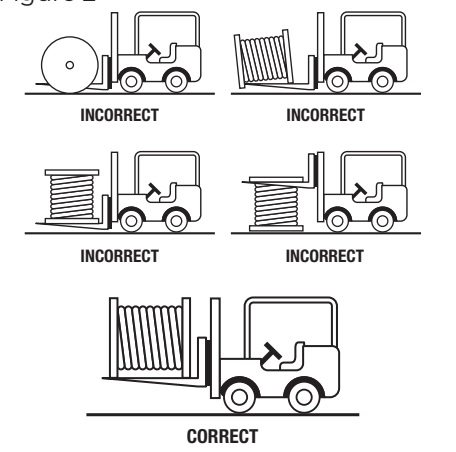
Figure 1



1. For cranes, booms or other overhead lifting equipment, a heavy steel arbor or suitable heavy rod or pipe should be inserted through the reel hubs so that the cable reel can be lifted by slings utilizing a spreader bar or a lifting yoke. This method will reduce risk of damage or injury caused by sling pressure against a reel flange, tipping of the reel, slipping of the sling, and other unbalanced situations. (Figure 1).

2. When lifting reels by fork truck, reels should only be lifted from sides, and only with blades of the fork truck under and cradling both flanges. This method will ensure that the lift pressure is equally distributed on both flanges and not on the cable itself (Figure 2).

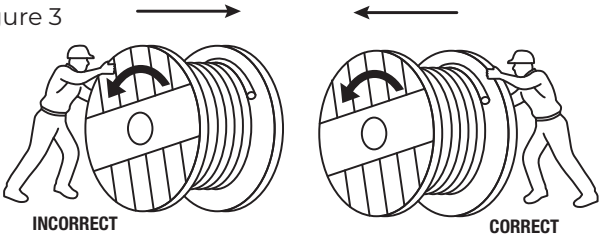
Figure 2



3. Rolling reels containing cable should be kept to a minimum; if rolling is necessary, reels should always be rolled in the direction opposite to which the cable is wrapped onto reel as shown in Figure 3. This procedure will prevent loosening of cable on reel which may result in problems during installation.

4. The path over which the cable reels are to be rolled must be clear of any debris, which might damage the cable if the reels were to roll over it. Cable reels unloaded down ramps should be rolled in a controlled manner. Ramps must be of a gradual descent, spaced parallel and wide enough to ensure contact with both reel flanges throughout unloading.

Figure 3



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PRODUCT HANDLING (cont)

Storage Conditions

Reels should be stored in an area reserved for this purpose. The location must be accessible to forklifts and trucks, but removed from areas of constant traffic. If available space prohibits separation, suitable barriers should be erected to prevent damage from moving equipment. Reels must be stored in an area where they cannot be damaged by falling objects, chemical spills including oil and grease, open flames or welding operations, and excessive heat.

It is also advisable to secure the designated area to prevent theft or vandalism.

Whenever possible, reels should be stored indoors to provide maximum protection. However, a controlled environment is not required. If the cable must be stored outside, the reels should be placed on a hard, well-drained surface that will prevent the reel flanges sinking into it and allowing the weight of cable and reel to rest on the cable surface. It is recommended, but not required, that non-jacketed cable intended for storage longer than six months have overhead protection or be covered with a suitable material such as canvas or opaque polyethylene to avoid prolonged exposure to weather.

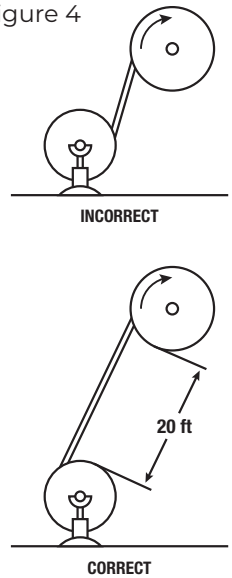
If a portion of the cable is used, the open end of cable remaining on reel should immediately be re-sealed in manner equivalent to the factory seal to prevent entrance of moisture. After re-sealing, the cut end should be secured to reel flange to prevent damage during reel movement.

Reels should always be stored with their flanges vertical. They must not be stored on their sides or stacked one on top of another. Care should be taken to prevent reels rolling into one another where flange of one reel hits the surface of cable on another reel. Reel flanges should be chocked to prevent movement.

Removing Cable from Reels

Considerable care must be exercised in uncoiling or unreeling Lifeline RC90 cables since their performance is substantially influenced by the way in which they are handled. Reverse bending or twisting can cause internal damage or kinking of the armor which can adversely affect the life of the cable. Reels should be placed on jacks or stands with a bar through the arbor holes. This will allow the reel to be turned easily, and the cable to be payed-off. Cables can be payed-out from the bottom or the top of the reel, but if they are to be removed from a shipping reel to be installed on another reel, they should be payed-out in such a manner as to follow the natural cast in the cable. Reverse bending should be avoided (Figure 4).

Figure 4



If possible, the distance between pay-off reel and take-up reel should be at least 20 feet to allow the cable to straighten before it is taken up on the application reel. The cable should be evenly distributed across the whole width of the take-up reel. The take-up reel must be clean and solid. It should not be overfilled. Cable in coils should be handled in a similar manner. This can be achieved by supporting the coil in a vertical plane and rotating it by hand as the cable is carefully uncoiled (Figure 5). The cable should never be pulled over the flange of a reel, or pulled off the side of a coil, since this will introduce a twist in the cable (Figure 6).

Figure 5

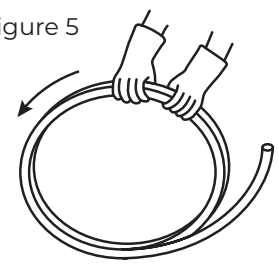
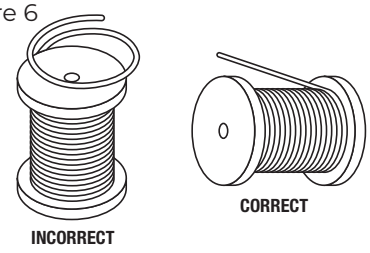


Figure 6



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PRE-INSTALLATION

This section provides information needed to prepare for cable installation. The recommendations should be followed to ensure Lifeline RC90 Cable is successfully installed.

Pulling Calculations

During installation, cables will be subjected to stresses due to bend radius, sidewall pressure, and pulling tension. These stresses are endured during installation and are reduced after installation. The primary cause of these forces are cable weight and friction between cable and contact surfaces.

Factors that need to be considered before installation work is carried out are:

- Cable weight
- Maximum allowable pulling tension
- Estimated pulling tension
- Estimated sidewall pressure
- Back tension
- Cable tray fill, if applicable
- Minimum bending radius

Maximum Allowable Pulling Tension

The maximum allowable pulling tension on cable is the lowest tension value from one of the following three tension limits:

A) Conductor Tensile Strength

Maximum pulling tension due to conductor tensile strength is provided in **Tables 4 and 5** for each of the Lifeline RC90 products. This calculation assumes cable connection method transfers all forces to cable conductors. Tension values in **Tables 4 and 5** are for single cable pulls calculated using the following formula:

Tc = K x F x kcmilT

Tc = Maximum allowable tension based on conductor tensile strength (pounds)
K = Factor based on material strength with a safety margin; 8 for annealed copper
F = Factor to account for possible unequal tension distribution; 1 for a single multi-conductor cable, 0.8 for more than one multi-conductor cables, and 0.6 for multiple cables win unequal conductor sizes.
kcmilT = The sum of the circular mil area of all conductors in thousand circular mils (kcmil)

B) Sidewall Pressure

Maximum pulling tension due to sidewall pressure is only applicable when pulling cables around a bend. Radial force is exerted on armor, inner binder jacket, and insulation as cable is pressed against inner arc of bend. Sidewall pressure is expressed in pounds per foot of radius. The maximum recommended values for Lifeline RC90 Cables are 400 lbs/ft with 10 times cable diameter pulling radius and 300 lbs/ft with 7 times cable diameter training radius. See maximum tension values in **Table 1**. Note that sheave inner diameter is equal to 2 times cable bending radius; make sure sheave radius is not less than minimum bending radius of the cable.

Tp = SWP x R

Tp = Maximum allowable tension which will not exceed the sidewall pressure limit in pounds
SWP = Sidewall pressure limit in pounds per foot
R = Radius of bend in feet

C) Method of Connection to the Cable

Method of connection to cable can also be a limiting factor for maximum allowable pulling tension. When pulling using a pulling eye or bolt, a maximum tension limit is typically 10,000 lbs. However, this is dependent on the method of application and bolt/eye limit. A basket weave grip is typically limited to 2000 lbs. Review grip manufacturer's recommendations for connection method being used.

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PRE-INSTALLATION (cont)

Table 1: Side Wall Pressure

Sheave Inner Diameter	Maximum Tension Based on SWP Limit (lbs)	
(In)	SWP = 400 lbs/ft	SWP = 300 lbs/ft
10	167	125
12	200	150
15	250	188
18	300	225
20	333	250
25	417	313
28	467	350
30	500	375
35	583	438
40	667	500
42	700	525
45	750	563
48	800	600
50	833	625
55	917	688
60	1000	750
65	1083	813

Estimated Pulling Tension

As a precaution before cable pulling has begun, an estimated pulling tension calculation should be carried out. These estimated values can determine if the maximum allowable pulling tension is being exceeded during the operation.

The estimated pulling tension of one cable in a straight section of raceway may be calculated from the following formula:

T = L x W x K

T = Estimated pulling tension in pounds
L = Length of installation in feet
W = Weight of cable in pounds per foot
K = Coefficient of friction*

* Values used for coefficient of friction can vary from 0.1 to 0.8 depending upon many factors. A value of 0.5 is generally used in calculations. Tray installations over well lubricated sheaves may use a value of 0.1.

Estimated pulling tension of a cable for an inclined section may be calculated using the following formula, where prior tension is the tension at beginning of incline and multiplying factor (M) is tabulated below:

T = L x W x M + (prior tension)

Note: short downward bends may be neglected.

L = Length of installation in feet
W = Weight of cable in pounds per foot
M = Multiplying Factor - tabulated in **Table 2** for Coefficient of friction (K)

To calculate the tension around a bend, the following formula should be used:

$T = T_1 \times F$

T = Tension coming out of the bend in pounds
T_1 = Accumulated tension going into the bend in pounds
F = Friction factor for various values of coefficient of friction (K) and bends as shown in **Table 3**

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PRE-INSTALLATION (cont)

Table 2: Multiplying Factor (M)

Angle from Horizontal in Degrees						
K	15	30	45	60	75	90
0.1	0.36	0.59	0.78	0.92	0.99	1.00
0.2	0.45	0.67	0.85	0.97	1.02	1.00
0.3	0.55	0.76	0.92	1.02	1.04	1.00
0.4	0.65	0.85	0.99	1.07	1.07	1.00
0.5	0.74	0.93	1.06	1.12	1.10	1.00

Table 3: Friction Factor (F)

Angle of Bend in Degrees						
K	15	30	45	60	75	90
0.1	1.03	1.05	1.08	1.11	1.14	1.17
0.2	1.03	1.11	1.17	1.23	1.30	1.37
0.3	1.08	1.17	1.27	1.37	1.48	1.60
0.4	1.11	1.23	1.37	1.52	1.69	1.87
0.5	1.14	1.30	1.48	1.69	1.92	2.19

Estimated Sidewall Pressure

The sidewall pressure acting upon a single cable at a bend may be estimated from the following equation:

P = T/R

P = Sidewall pressure on the cable in pounds per foot
T = Estimated tension out of the bend in pounds
R = Radius of the bend in feet

Back Tension

Back tension is force required to pull cable off reel drum. This is normally assumed to be zero since cable is fed off reel. Light braking may be applied to control unreeling to avoid feeding at an excessive rate. Braking should be applied only to prevent reel over-run when pull is slowed, stopped, or declining installations where cable weight is enough to overcome cable-duct friction.

Cable Tray Fill

Cable trays should not be loaded beyond their maximum capacity. Follow Canadian Electrical Code and local code requirements as required. For ampacity derating, consult the Canadian Electrical Code and applicable ICEA standards.

Minimum Bending Radius

The minimum bending radius for Lifeline RC90 cable is defined in two conditions:

1. The minimum pulling radius is used when cable under tension and being pulled around a bends during installation is 10 times the cable diameter.
2. The minimum training radius, used when cable is not under tension, and when cable is in final installation position is 7 times the cable diameter.

While the Canadian Electrical Code 12-712(3) requires RC90 to be bent no less than 9X OD of sheath, Lifeline RC90 can be safely bent to 7X the Overall Diameter. During installation and handling, the bend radius should be kept as large as possible using a sheave equal to or greater than cable minimum bending radius.

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Table 4: Lifeline RC90 Cables without Jacket

Part Number	Conductor Size	Conductor Circular Mil Area	Number of Conductors	Nom. Core Diameter	Nom. Armor Diameter	Cable Weight	Minimum Bending Radius-Training	Minimum Bending Radius-Pulling	Maximum Allowable Pulling Tension
	AWG or MCM	(kcmil)	(No.)	(in.)	(in.)	(lbs/mft)	(in.)	(in.)	(lbs)
LMC03014C	14	4.11	3	0.55	0.85	444	5.95	8.50	99
LMC05014C	14	4.11	5	0.66	0.96	561	6.72	9.60	164
LMC02012C	12	6.53	2	0.56	0.85	468	5.95	8.50	104
LMC03012C	12	6.53	3	0.59	0.90	506	6.30	9.00	157
LMC04012C	12	6.53	4	0.64	0.96	570	6.72	9.60	209
LMC05012C	12	6.53	5	0.70	0.96	607	6.72	9.60	261
LMC02010C	10	10.4	2	0.61	0.85	510	5.95	8.50	166
LMC03010C	10	10.4	3	0.64	0.96	580	6.72	9.60	249
LMC04010C	10	10.4	4	0.70	0.96	636	6.72	9.60	332
LMC05010C	10	10.4	5	0.77	1.08	742	7.56	10.80	415
LMC07010C	10	10.4	7	0.85	1.27	916	8.89	12.70	582
LMC02008C	8	16.5	2	0.70	0.96	648	6.72	9.60	264
LMC03008C	8	16.5	3	0.75	1.08	722	7.56	10.80	396
LMC04008C	8	16.5	4	0.82	1.20	852	8.40	12.00	528
LMC05008C	8	16.5	5	0.90	1.27	980	8.89	12.70	660
LMC02006C	6	26.2	2	0.78	1.08	748	7.56	10.80	420
LMC03006C	6	26.2	3	0.83	1.20	882	8.40	12.00	630
LMC04006C	6	26.2	4	0.91	1.27	1036	8.89	12.70	840
LMC05006C	6	26.2	5	1.00	1.35	1190	9.45	13.50	1050
LMC03004C	4	41.7	3	0.95	1.35	1147	9.45	13.50	1002
LMC04004C	4	41.7	4	1.04	1.35	1324	9.45	13.50	1336
LMC05004C	4	41.7	5	1.15	1.57	1718	10.99	15.70	1670
LMC03003C	3	52.6	3	1.00	1.35	1297	9.45	13.50	1263
LMC04003C	3	52.6	4	1.11	1.40	1544	9.80	14.00	1684
LMC03002C	2	66.4	3	1.07	1.40	1445	9.80	14.00	1593
LMC04002C	2	66.4	4	1.18	1.57	1888	10.99	15.70	2124
LMC03001C	1	83.7	3	1.24	1.77	2008	12.39	17.70	2009
LMC04001C	1	83.7	4	1.37	1.77	2355	12.39	17.70	2678
LMC011/0C	1/0	106	1	0.65	0.90	745	6.30	9.00	845
LMC031/0C	1/0	106	3	1.33	1.77	2236	12.39	17.70	2534
LMC041/0C	1/0	106	4	1.47	1.83	2700	12.81	18.30	3379
LMC012/0C	2/0	133	1	0.69	0.96	864	6.72	9.60	1065
LMC032/0C	2/0	133	3	1.41	1.83	2622	12.81	18.30	3194
LMC042/0C	2/0	133	4	1.56	1.98	3176	13.86	19.80	4259
LMC013/0C	3/0	168	1	0.74	1.08	1021	7.56	10.80	1342
LMC033/0C	3/0	168	3	1.52	1.98	3030	13.86	19.80	4027
LMC043/0C	3/0	168	4	1.69	2.15	3763	15.05	21.50	5370
LMC014/0C	4/0	212	1	0.80	1.20	1214	8.40	12.00	1693
LMC034/0C	4/0	212	3	1.64	2.15	3625	15.05	21.50	5078
LMC044/0C	4/0	212	4	1.82	2.27	4480	15.89	22.70	6771
LMC01250C	250	250	1	0.87	1.27	1390	8.89	12.70	2000
LMC03250C	250	250	3	1.81	2.27	4195	15.89	22.70	6000
LMC04250C	250	250	4	2.00	2.48	5272	17.36	24.80	8000
LMC01300C	300	300	1	0.93	1.27	1558	8.89	12.70	2400
LMC01350C	350	350	1	0.98	1.35	1734	9.45	13.50	2800
LMC03350C	350	350	3	2.04	2.48	5360	17.36	24.80	8400
LMC04350C	350	350	4	2.26	2.73	6733	19.11	27.30	11200**
LMC01400C	400	400	1	1.03	1.40	1943	9.80	14.00	3200
LMC03400C	400	400	3	2.13	2.73	6091	19.11	27.30	9600
LMC04400C	400	400	4	2.37	2.79	7607	19.53	27.90	12800**
LMC01500C	500	500	1	1.11	1.57	2435	10.99	15.70	4000
LMC03500C	500	500	3	2.31	2.79	7183	19.53	27.90	12000**
LMC04500C	500	500	4	2.57	3.08	9120	21.56	30.80	16000**
LMC01600C	600	600	1	1.22	1.77	2887	12.39	17.70	4800
LMC03600C	600	600	3	2.54	3.08	8516	21.56	30.80	14400**
LMC04600C	600	600	4	2.83	3.35	10834	23.45	33.50	19200**
LMC01750C	750	750	1	1.32	1.77	3378	12.39	17.70	6000

*Maximum Allowable Pulling Tension calculated using F=1 for single cable.
** Do not exceed pulling attachment limit.
The above dimensions are approximate and subject to normal manufacturing tolerances. Information subject to change

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Table 5: Lifeline RC90 Cables with LSZH Jacket

Part Number	Conductor Size	Conductor Circular Mil Area	Number of Conductors	Nom. Core Diameter	Nom. Armor Diameter	Nom. Jacket Diameter	Cable Weight	Minimum Bending Radius-Training	Minimum Bending Radius-Pulling	Maximum Allowable Pulling Tension
	AWG or MCM	(kcmil)	(No.)	(in.)	(in.)		(lbs/mft)	(in.)	(in.)	(lbs)
LMCJ03014C	14	4.11	3	0.55	0.85	0.95	541	6.65	9.50	99
LMCJ05014C	14	4.11	5	0.66	0.96	1.06	664	7.42	10.60	164
LMCJ02012C	12	6.53	2	0.56	0.85	0.95	563	6.65	9.50	104
LMCJ03012C	12	6.53	3	0.59	0.90	1.00	607	7.00	10.00	157
LMCJ04012C	12	6.53	4	0.64	0.96	1.06	677	7.42	10.60	209
LMCJ05012C	12	6.53	5	0.70	0.96	1.06	720	7.42	10.60	261
LMCJ02010C	10	10.4	2	0.61	0.85	0.95	605	6.65	9.50	166
LMCJ03010C	10	10.4	3	0.64	0.96	1.06	686	7.42	10.60	249
LMCJ04010C	10	10.4	4	0.70	0.96	1.06	743	7.42	10.60	332
LMCJ05010C	10	10.4	5	0.77	1.08	1.18	862	8.26	11.80	415
LMCJ07010C	10	10.4	7	0.85	1.27	1.37	1055	9.59	13.70	582
LMCJ02008C	8	16.5	2	0.70	0.96	1.06	755	7.42	10.60	264
LMCJ03008C	8	16.5	3	0.75	1.08	1.18	840	8.26	11.80	396
LMCJ04008C	8	16.5	4	0.82	1.20	1.30	982	9.10	13.00	528
LMCJ05008C	8	16.5	5	0.90	1.27	1.37	1105	9.59	13.70	660
LMCJ02006C	6	26.2	2	0.78	1.08	1.18	901	8.26	11.80	420
LMCJ03006C	6	26.2	3	0.83	1.20	1.30	1013	9.10	13.00	630
LMCJ04006C	6	26.2	4	0.91	1.27	1.37	1175	9.59	13.70	840
LMCJ05006C	6	26.2	5	1.00	1.35	1.45	1352	10.15	14.50	1050
LMCJ03004C	4	41.7	3	0.95	1.35	1.45	1301	10.15	14.50	1002
LMCJ04004C	4	41.7	4	1.04	1.35	1.45	1478	10.15	14.50	1336
LMCJ05004C	4	41.7	5	1.15	1.57	1.69	1889	11.83	16.90	1670
LMCJ03003C	3	52.6	3	1.00	1.35	1.45	1445	10.15	14.50	1263
LMCJ04003C	3	52.6	4	1.11	1.40	1.50	1694	10.50	15.00	1684
LMCJ03002C	2	66.4	3	1.07	1.40	1.50	1598	10.50	15.00	1593
LMCJ04002C	2	66.4	4	1.18	1.57	1.69	2093	11.83	16.90	2124
LMCJ03001C	1	83.7	3	1.24	1.77	1.89	2248	13.23	18.90	2009
LMCJ04001C	1	83.7	4	1.37	1.77	1.89	2596	13.23	18.90	2678
LMCJ011/0C	1/0	106	1	0.65	0.90	1.00	841	7.00	10.00	845
LMCJ031/0C	1/0	106	3	1.33	1.77	1.89	2468	13.23	18.90	2534
LMCJ041/0C	1/0	106	4	1.47	1.83	1.95	2949	13.65	19.50	3379
LMCJ012/0C	2/0	133	1	0.69	0.96	1.06	967	7.42	10.60	1065
LMCJ032/0C	2/0	133	3	1.41	1.83	1.95	2862	13.65	19.50	3194
LMCJ042/0C	2/0	133	4	1.56	1.98	2.10	3429	14.70	21.00	4259
LMCJ013/0C	3/0	168	1	0.74	1.08	1.18	1134	8.26	11.80	1342
LMCJ033/0C	3/0	168	3	1.52	1.98	2.10	3285	14.70	21.00	4027
LMCJ043/0C	3/0	168	4	1.69	2.15	2.27	4034	15.89	22.70	5370
LMCJ014/0C	4/0	212	1	0.80	1.20	1.30	1339	9.10	13.00	1693
LMCJ034/0C	4/0	212	3	1.64	2.15	2.27	3913	15.89	22.70	5078
LMCJ044/0C	4/0	212	4	1.82	2.27	2.42	4774	16.94	24.20	6771
LMCJ01250C	250	250	1	0.87	1.27	1.37	1522	9.59	13.70	2000
LMCJ03250C	250	250	3	1.81	2.27	2.42	4490	16.94	24.20	6000
LMCJ04250C	250	250	4	2.00	2.48	2.63	5676	18.41	26.30	8000
LMCJ01300C	300	300	1	0.93	1.27	1.37	1690	9.59	13.70	2400
LMCJ01350C	350	350	1	0.98	1.35	1.45	1876	10.15	14.50	2800
LMCJ03350C	350	350	3	2.04	2.48	2.63	5764	18.41	26.30	8400
LMCJ04350C	350	350	4	2.26	2.73	2.88	7169	20.16	28.80	11200**
LMCJ01400C	400	400	1	1.03	1.40	1.50	2089	10.50	15.00	3200
LMCJ03400C	400	400	3	2.13	2.73	2.88	6538	20.16	28.80	9600
LMCJ04400C	400	400	4	2.37	2.79	2.94	8071	20.58	29.40	12800**
LMCJ01500C	500	500	1	1.11	1.57	1.69	2630	11.83	16.90	4000
LMCJ03500C	500	500	3	2.31	2.79	2.94	7647	20.58	29.40	12000**
LMCJ04500C	500	500	4	2.57	3.08	3.25	9695	22.75	32.50	16000**
LMCJ01600C	600	600	1	1.22	1.77	1.89	3099	13.23	18.90	4800
LMCJ03600C	600	600	3	2.54	3.08	3.25	9091	22.75	32.50	14400**
LMCJ04600C	600	600	4	2.83	3.35	3.52	11462	24.64	35.20	19200**
LMCJ01750C	750	750	1	1.32	1.77	1.89	3593	13.23	18.90	6000

*Maximum Allowable Pulling Tension calculated using F=1 for single cable.
** Do not exceed pulling attachment limit.
The above dimensions are approximate and subject to normal manufacturing tolerances. Information subject to change

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PRE-INSTALLATION (cont)

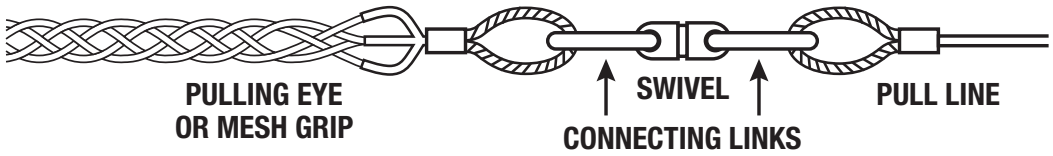
Installation Equipment
The following recommendations should be followed whenever cables are to be pulled into conduits, ducts, or cable trays. This will increase the likelihood of a successful pull; however, these recommendations cannot cover every situation which might be encountered.

Basket Weave Pulling Grips
This is a device consisting of a woven metal mesh with loops at one end for attachment to the pulling line that grip tighter as pulling tension increases - such as Kellems® grips. They are generally used with light to medium weight copper cables on relatively short pulls. When pulling armored cables, these grips should be used in conjunction with pulling eye to prevent armor pullback.

Pulling Eye
Pulling eyes are connected directly to the conductors. Commercially available eyes are generally applied by crimping to conductor which necessitates matching eye and crimping dies with each range of wire size to be pulled. One type of eye, the wedge-type, is reusable except for inexpensive disposable wedge. Medium to heavy cables and/or long pulling lengths will require use of pulling eyes.

Forming the Conductor into a Loop
This method may be used for all types of pulls. However, care must be taken to ensure loop will withstand the tension required to pull cable. To avoid rotational torsion when pulling, a swivel should be used with the pulling device **(Figure 7)**.

Figure 7



Cables Guides
To avoid abrasion and damage of the cable jacket or armor when guiding the cable from the reel to installation, all guides should be smooth-surfaced, free-turning sheaves, or rollers. If guide tubes or chutes must be used, they should have smooth, burr-free surfaces, well flared entrances, largest possible bend radii, and be securely anchored. Cable tension through guides should be kept to minimum by mounting cable reel on sturdy jacks, leveling reel shaft, and lubricating reel arbor holes and shaft with grease. The following points should be carefully observed when pulling cable:

1. Cable support rollers should be spaced close enough so cable sag with tension applied will not result in dragging on tray. Cable rollers or sheaves should be flanged or contoured so cable will not ride off edge of roller, or be pinched into a sheave contour diameter that is smaller than that of the cable.
2. Where rollers/sheaves are used to guide cable through bends, it is essential to use a sufficient number to support and guide cable in a smooth curve of desired radius from tangent point to tangent point; otherwise cable will be “kinked” around the radius of each roller.

In direct-burial installations cable may be paid off reel and laid into trench as reel is moved along length of trench. In such cases cable is simply laid on bed of screened soil or sand. Where cable must be pulled through a trench, the preferred method is to support cable on temporary rollers so cable does not drag over the soil or sand bed. If rollers are not available, sacks filled with fine sand or other fine powdery material may be used to support the cable and keep it from dragging on trench bed during pulling.

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PRE-INSTALLATION (cont)

Installation Temperature
Low temperatures create varying degrees of handling and pulling difficulties depending on cable construction and installation conditions. Installation at low temperatures require special consideration of cold-induced stiffness of cable when choosing radii and number of bends, and estimated pulling tension. Most cables can be safely handled at temperatures greater than -10°C (14°F). It is not recommended to install the Lifeline RC90 LSZH Jacketed Cable in temperatures below -10°C. The Lifeline RC90 Cable without jacket should not be installed in temperatures below -50°C (-58°F). During cold weather installations, cable should be pulled more slowly. The cable should not be impacted, dropped, kinked, or bent sharply.

Environmental Effects on Installation
Cable should not be installed close to heat sources that may reduce cable life. When installing cable in areas where ambient temperature is greater than 30°C, the ampacity rating is reduced. Refer to Canadian Electrical Code 4-004(7)(b)(i) and Table 5A correction factors for installations at ambient temperatures other than 30°C. When installing in corrosive environments, Lifeline RC90 with a LSZH jacket cable should be used. When transitioning between two structurally separated supports, cable slack should be provided to avoid disfigurement due to mechanical strain. Terminating materials must be compatible with cable and terminations must be made in a clean environment.

Electrical Compatibility Considerations

1. Metallic sheath must be properly grounded.
2. Cables should be arranged in such manner that induced currents will not cause the heating of the surrounding metal.

Health, Safety and Environmental (HSE)
Personal protection devices should be used following OSHA and other applicable regulations to avoid personal injury.

All tools should be checked before use to ensure proper functioning and safety. Tools must be suitable for the application and sized accordingly.

Waste disposal during and after installing the cable system must be in accordance with applicable waste management, recycling, environmental protection, and hazardous materials regulations.

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INSTALLATION

General

Lifeline RC90 can be installed and supported in accordance with CEC 12-706(2) and applicable federal, state, and municipal regulations similar to non-fire-resistive Metal Sheathed cable, including direct buried. For code compliant fire resistive installations Lifeline RC90 Cable must be installed according to ULC Electrical Circuit Integrity System FHIT7.51 and FHIT7.51A where the following requirements must be observed:

1. Securing and Supporting Spacing – Code compliant two-hour fire resistive installation in both horizontal and vertical orientations requires cable be secured and supported at intervals not exceeding four feet (48 inches), at each side of cable bends, and within one foot (12 inches) of cable connector terminations. Noted exception: support spacing described above is in lieu of support spacing allowed in the Canadian Electric Code and is required for compliant two-hour fire resistive installation.
2. Supports and Fasteners – Cables shall be secured to supports using steel two-piece single-bolt pipe clamps. Supports shall be steel components or other fire rated components (described in FHIT7.51 or FHIT7.51A) proven to meet the required fire resistance ratings. No substitute components are allowed.
3. Lifeline RC90 LSZH jacketed products are permitted for direct burial installations and embedding in concrete.
4. Lifeline RC90 and RC90 LSZH are not permitted for use where subject to physical damage.

Cable Support

In non-fire rated installation areas, Lifeline RC90 can be supported and secured by staples, cable ties, straps, hangers, or similar fittings or other approved means designed and installed so as not to damage the cable. In non-fire rated installations, the Lifeline RC90 can be secured at intervals not exceeding 6 ft. For fire rated areas, see limits described in FHIT7 System No. 51 or No. 51A. To comply with FHIT7.51 or FHIT7.51A, runs of Lifeline RC90 need to be supported using a 2-piece clamp at intervals not exceeding 4 ft.

When transitioning from a straight run to a bend supports are required at start and end of bend as shown in **Figure 8**.

Cables shall be secured within 12 inches of boxes, cabinets, fittings or other cable terminations.

If necessary straighten by hand, do not use tools such as a hammer or screwdriver, since this may damage armor or outer jacket.

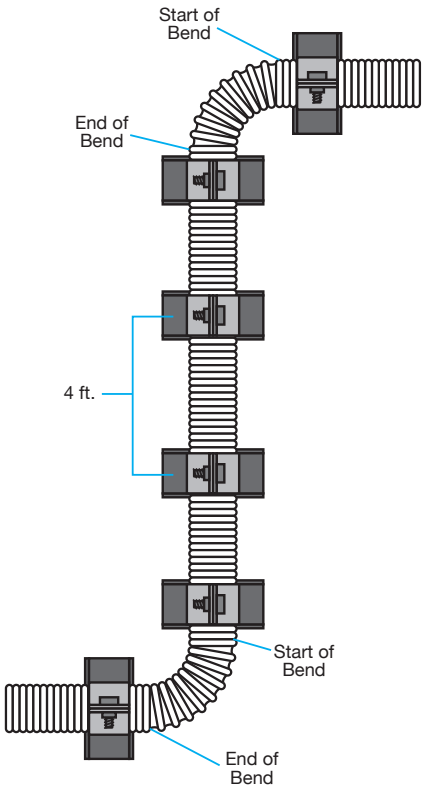
Make sure the minimum bend radius is observed, reference **Tables 4 and 5** (pp. 17 & 18) for minimum bending radii for Lifeline RC90 Cables. Do not try to make entire bend in one movement as kinking of cable armor is possible. Bend in small increments. Shape into final position gradually.

When bending multiple cables at same location shape inner cable first and form other cables out from first inner cable.

Cables should not be under tension after installation. Slack is desirable

in the region of the terminations. In open installations cable must be adequately supported to prevent undue strain on cable and termination.

Figure 8



Cable Spacing

When multiple multi-conductor cables are installed, spacing should be sufficient to address ampacity requirements (generally one cable diameter apart at minimum) or reduced in ampacity rating in accordance with CEC.

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INSTALLATION (cont)

Induced Currents in Metal Enclosures or Metal Raceways
Where conductors carrying alternating current are installed in ferrous metal enclosures or ferrous metal raceways, conductor shall be arranged to avoid inductive heating of surrounding ferrous metal. To accomplish this, all phase conductors and, where used, the grounded conductor and all equipment grounding conductors shall be grouped together.

Pulling
Set up to pull the total length of the run if possible. Position sheaves and pulling ropes so cable will move freely during the pulling operation. Attach pulling line to cable by suitable means. Cable armor should be fastened to pulling line and/or the conductors to prevent separate movement of the conductors and armor. Use supplementary pulling lines with luffing grips as applicable. Cable should be pulled straight off the reel. Use light back pressure on reel to avoid reverse bending or overrunning as cable leaves the reel. Maintain a steady speed during pulling operation of up to 20-25 feet per minute and slower as needed for steady pull. Avoid stops and starts as much as possible. Adjust the pulling speed as needed to eliminate surging. When pulling around a bend, use as large a radius as possible and keep curves long and smooth. For difficult pulls involving several bends or changes in elevation, a jacketed cable is recommended for additional mechanical protection.

Lubricants
When cables are pulled in contact with a stationary surface, friction at these points cause an increase in the tension required to install the cable. LSZH lubrication is recommended for these areas such as Polywater® LZ Universal Cable Pulling Lube. When cables are laid in trays, pulled over rollers and sheaves, or directly buried, lubrication is not required.

Electrical Circuit Integrity System
Electrical Circuit Integrity Systems consist of specific components evaluated for circuit integrity as a system through fire exposure and hose stream impact testing, described in ULC S139. Specifications for the protective system and its assembly are important for the systems fire rating and apply to the system; not individual components. See system specifications described in the *Electrical Circuit Integrity System (FHIT7) No. 51 or No. 51A*.

Authorities having jurisdiction should be consulted in all cases as to the specific requirements covering the installation and use of these classified systems. The Lifeline RC90 and RC90 LSZH Cable is rated for 600 volts (conductor to conductor) when used as a 1-hour or 2-hour fire resistive cable.

Open Runs/Installation of Cable in Free Air
Code compliant fire resistive installations supports and hardware shall be in accordance with Electrical Circuit Integrity System FHIT7. 51 or FHIT7. 51A requirements. For non-fire-resistive installations support spacing may be per the Canadian Electrical Code.

Cable Trays
Cable trays shall be suitable in strength and rigidity to support all contained wiring. Each run of cable tray needs to be completed before the installation of cables. Supports shall be used at the entrance to raceways or other enclosures from cable tray systems. Tray supports should be 48 inches on center maximum. Tray supports and tray should be suitable for possible fire conditions. In other than horizontal runs, the cables shall be fastened securely to transverse members of the cable trays. Multiconductor cables can be installed in random configuration. For ampacity considerations, it is suggested that cables be installed in a single layer and spaced a minimum of one cable diameter apart. Cable Trays shall be exposed and accessible as permitted by the Canadian Electrical Code. Sufficient space shall be provided and maintained about cable trays to permit adequate access for installing and maintaining the cables. Cable trays should be suitably grounded.

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INSTALLATION (cont)

Installation in Cable Trays

The entire path that cable will follow during pulling should be checked to make sure that cable will ride free and clear all obstructions, sharp edges or projections which might cause it to jam or be damaged. In making this check, allowance must be made for the position cable will assume when under tension and allowed to go slack. It is recommended that personnel be positioned at corners and periodically along the route of cable tray to assist in hand feeding.

In straight runs a sufficient number of rollers should be used to stop the cable dragging on the tray. Sharp bends should be avoided by using sheaves assembled so that the effective cable bend radius conforms to the contour of the tray bend. Cable tray manufacturers may recommend the number, type, and location of the sheaves and rollers as well as instructions for their application.

Cables should be properly spaced for ampacity concerns.

Cables should be segregated by voltage level (such as medium voltage and low voltage cables) and separated by function (e.g. power and instrument cables should be installed in separate trays).

During installation, temporary tray edging should be used to protect cable. If cable is installed and rests on the side rail, a permanent tray edging should be installed. Material used for tray edging should be fire retardant, have a large surface area, be compatible with the installation, and have a suitable temperature rating.

Cables installed in trays having an expansion gap or fitting (to accommodate differential movement) should be placed in tray in such a manner that a slack section of cable is present. The expansion gap allows for free movement of the trays without damage to the cable. The cables should not be tied down within five feet of each side of the gap.

In Concrete

Lifeline RC90 LSZH Jacketed products may be installed in concrete or earth. Minimum burial depth should be in accordance with CEC 12-012 Underground Installations and Table 53.

Cable Splices

A two-hour and one-hour ULC Classified fire resistive splices are available for Lifeline RC90 and Lifeline RC90 LSZH Cable. Installation of the splice and components selected must be in accordance with *Technical Information Sheet (TIS) # 403CA – Installation Instructions for Lifeline RC90: Cable Splice Using Lifeline Ceramifiable Tape* for the 2-hour listed splice according to Electrical Circuit Integrity System (FHIT7) No. 51 and *Technical Information Sheet (TIS) # 402CA – Installation Instructions for Lifeline RC90 Cable Splice Using Ceramic Standoffs* for the 1-hour listed splice according to Electrical Circuit Integrity System (FHIT) No. 51A.

Other Installations

For guidance regarding other installation contact the Lifeline team at Prysmian Cables & Systems (US) Inc. (859) 572-8000.

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POST-INSTALLATION

This section provides general information on activities such as cable terminating, splicing, and testing.

General

A sufficient length of cable should be removed from the pulling end to ensure adequate length of undamaged cable is available for termination. Cable(s) should be identified with nonconductive tags on both ends of installation. Cable slack should be provided at transition points between non-connecting support structures such as trays or raceways, and equipment. A sufficient length of cable core should be pulled into equipment, panels and boxes to permit efficient arrangement of conductors and compliance with the following:

- Cable should be trained into final installation position without violating the minimum bending radius.
- Minimum required separation distance is maintained.

Terminating Lifeline RC90 at Electrical Switch Gear/Equipment

A junction box is optional on either end of the fire rated cable in the fire rated room as follows:

1. Once cable enters the fire rated room, a minimum of 12 inches, terminate Lifeline RC90 Cable into appropriate size junction box in accordance with CEC. Use any listed RC90 connector suitable for a corrugated copper sheath, a listed lock nut and insulating bushing to terminate the cable to the box. Connector should be suitably grounded. Equipment grounding conductors should be carried through and maintained as required. Utilize a grounding hub as required.
2. Using the appropriate raceway for the specified area, connect the junction box to the equipment.
3. Install appropriate wiring between the junction box and the equipment.
4. Splice Lifeline RC90 to the wire using an approved method. Note a transition splice may be required based on ampacity considerations.
5. Seal the end of the raceway in the junction box to keep gases from migrating down into the equipment in the case of a fire. This may be done using a pliable compound.

Note 1: All wiring methods and installation procedures shall comply with CEC and local amendments.

Note 2: CEC 4-006 Temperature limitations should be considered regarding the temperature limit of the wiring to the equipment. The Lifeline RC90 cable may be sized at 90°C.

Cable Terminating

General procedures for terminating are provided below. Be advised that Prysmian in not responsible for the effectiveness of a termination or splice because it has no control over the fabrication of these items. The environment should be clean and dry. Tools should be in good working order and used for the intended purpose. Terminating materials must be high quality and be compatible with the cable. As shown in the following section, remove the outer jacket (if present) and armor from the end of the cable a sufficient distance to allow separation of the conductors, provide the necessary length to connect to the equipment being used, and provide the necessary termination creepage distance. Any underlying tapes and fillers should then be removed.

- In removing this material, care should be taken not to damage any underlying layer, particularly the cable insulation.
- Install the connector per manufacturer's instructions. Connections to enclosures should be with connectors approved for use with copper metal clad cable in the environment that it is installed.
- Generally, a seal should not be applied around the connector. Contact the Prysmian Engineering Department for further information.

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POST-INSTALLATION (cont)

Cable Terminating (cont)

- Strip the insulation from each conductor for a distance equal to the depth of the terminal lug plus 1/4 inch. Care should be taken to avoid cutting, nicking, or scoring of the conductor strands.
- Apply compression terminal lugs or connectors per manufacturer instructions. When using a compression connector, a calibrated, properly sized compression tool should be used.
- Insulate the applied terminal lug with a shrinkable insulating sleeve or tape. The sleeve or tape should be of sufficient length after application to cover the connector barrel and at least 2 inches of the conductor insulation.
- Properly terminate and ground the armor of the cable if that function is not provided by the connector.
- Utilize an insulating bushing to protect the conductors in enclosures, boxes, etc.
- Use proper hardware and tightening torque to connect the terminal lugs.

Jacket Removal

1. Measure length of jacket to be removed from end of cable and mark the position. With a sharp knife score around jacket **(Figure 9a)**.
2. Starting at end of cable, make a cut all the way through jacket to armor for about 1 inch of length. Then continue to score at approximately half the thickness of jacket to mark made in Step 1 **(Figure 9b)**.
3. Using pliers, peel back jacket, starting at end of cable. Move along the longitudinal score mark made in Step 2 until reaching the score mark made in Step 1 **(Figure 10)**.


Figure 9a


Figure 9b


Figure 10

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POST-INSTALLATION (cont)

Armor Removal

1. Mark where armor is to be cut. Use a tubing cutter capable of cutting copper. Adjust cutting wheel to meet crest of corrugation. Roll backwards and forwards in ever increasing arcs while tightening the cutter knob. Once a 360° track has been made rotate cutter 360° while tightening knob until armor is cut through **(Figure 11)**.
2. Rotate the armor back and forth slightly to check if armor has been cut through completely. If required, flex cable to assist in separating armor **(Figure 12)**.
3. Keep rotating the armor back and forth while removing the armor. Be careful not to tangle the filler cord. When present, remove tape and filler cord **(Figure 13)**.


Figure 11


Figure 12


Figure 13

Inner Binder Jacket Removal

1. Mark where the jacket is to be cut. Using a knife, cut through binder jacket at very end of cable. Cut through about 1 inch in length. The length of free conductor should be given per CEC and local amendments. To avoid damaging insulation cut only half the jacket thickness **(Figure 14)**.
2. Pull apart the cut binder jacket and peel back to expose the conductors. Carefully begin cutting binder jacket down length of the cable while pulling binder jacket away from conductors. Be careful not to cut insulation **(Figure 15)**.
3. At the end of longitudinal cut, cut binder jacket circumferentially. Pull away the binder jacket. Inspect the insulation for any damage **(Figure 16)**.


Figure 14


Figure 15


Figure 16

Cable Test

After installation and prior to energizing, insulated cable should be tested in accordance with local required procedures.

For Installation Videos go to na.prysmian.com/lifeline

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