

# Industrial Power Cables: Conductors in Shining Armour

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## ABOUT MYSELF



Wissam Geahchan  
Applications Engineer

# Agenda

- 1 | Introduction → What is an industrial cable?
- 2 | Types of industrial power cables
  - a. Single Conductors → T90 Nylon/TWN75, RW90/RWU90, TEW
  - b. Armoured Power → AC90, TECK90, ACWU90, RA90, VFD, MV
  - c. Specialty → ACIC, CIC, Tray Cables
- 3 | Types of armour → CWC vs AIA / armour vs shield
- 4 | The armouring process → with real pictures
- 5 | Installation considerations
- 6 | Take-aways
- 7 | Q & A

## O. NEXANS CANADA

Proud to be a **Canadian** Cable Manufacturer since **1911**



**Montreal Rod Mill**  
(since 1931)



**Weyburn, Saskatchewan**  
(since 1956)



**Fergus, Ontario**  
(since 1965)

Vertically Integrated

**750+ Products** in residential, commercial, industrial, utility, renewable energy & copper/rod

Purpose: **Electrify the Future**

# 1. INTRODUCTION

Industrial power cables are used in industrial sites such as pulp and paper mills, chemical processing facilities, other factory environments.

In Canada, installations that fall under the CE Code require industrial power cables designed, manufactured and tested to CSA.

Unique installation conditions, which are encountered often in these types of settings, may require certain optional markings and features.

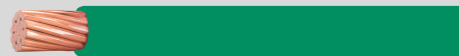


## 2. WIRE & CABLE

### Single Conductors



RW90 and RWU90  
Thermoset-insulated wire  
rated 90C



T90 Nylon / TWN75  
Thermoplastic-insulated wire  
with a nylon covering rated  
90C dry and 75C wet



TEW  
Thermoplastic insulated  
wire with extruded nylon  
jacket rated 105C

### Armoured Power



AC90 / AC90 ISO-BX  
Armoured cable with 2, 3 or 4  
XLPE-insulated Cu conductors  
+ bare Cu ground



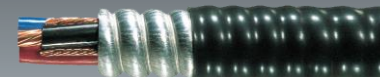
ACW90  
Armoured and jacketed cable  
with 2, 3 or 4 XLPE-insulated  
Al conductors + bare Al Grd



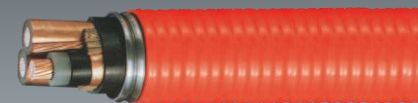
TECK90  
Armoured and jacketed  
(inner/outer) cable with multiple  
XLPE-insulated Cu conductors +  
bare Cu ground



CORFLEX® RA90  
Armoured and jacketed cable  
with 1 XLPE-insulated Cu  
conductor.



DriveRx® VFD cable  
Armoured and jacketed cable  
with 3 XLPE-insulated Cu  
conductors + 3 bare Cu Grds

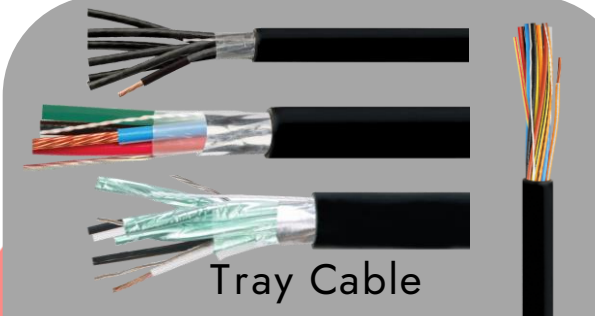


MV Armoured (5 - 15 kV)  
Armoured and jacketed  
(inner/outer) cable with 3  
shielded TR-XLPE insulated Cu  
conductors + bare Cu ground

### Specialty



CIC / ACIC  
Single or multiple individually  
shielded pairs or triads, overall  
cable shield with PVC jacket.  
Optional armour and outer  
jacket.



Tray Cable  
Cables listed as type TC with  
PVC/Nylon- or XLPE-insulated  
shielded or unshielded copper  
conductors with an overall  
jacket.

## 2. WIRE & CABLE

### APPLICATIONS for Single Conductors



RW90 and  
RWU90

- For open wiring and raceways (except cable trays\*) in dry or wet locations
- Approved for use with ceiling fixtures
- Branch circuits in conduit and service entrance
- RWU90 only: For direct earth burial (with appropriate protection)

\*RW90 can be installed in cable trays in accordance with CE Code Rule 12-2202 5)



T90 Nylon /  
TWN75

- For open wiring and raceways (except cable trays) in dry or wet locations
- Approved for use with ceiling fixtures
- Branch circuits in conduit



TEW

- For internal wiring of electrical equipment and lighting fixtures
- Transformer leads



#### DID YOU KNOW?



Nexans  
Canada does  
make a range  
of products  
for the US  
market.



Reach out to  
us to learn  
more!

## 2. WIRE & CABLE

### Single Conductors

CRITERIA	RW90 	T90 / TWN75 	TEW 
Standard	CSA C22.2 No. 38	CSA C22.2 No. 75	CSA C22.2 No. 127
Voltage	600 V	600 V	600V
O.D.	Smaller than T90 in > 6 AWG	Smaller than RW90 in 14 AWG – 6 AWG	Similar to RW90
Size range	Cu: 14 AWG – 1000 kcmil Al: 6 AWG – 1000 kcmil	Cu: 14 AWG – 500 kcmil	TEW: 24-4/0 AWG TWEN: 18-16 AWG High strand count
Insulation	XLPE (thermoset)	PVC / Nylon (thermoplastic)	PVC / Nylon (thermoplastic)
Cond Temp.	90C Dry/Wet	90C Dry 75C Wet	105C Dry 60C Oil
Cold Temp.	-40C	-10C	No rating
Flame rating	Optional FT1, Optional FT4	FT1	FT1
Sun Res	Black, 6 AWG and larger	Not Sun Res	Not Sun Res

#### DID YOU KNOW?

INSTAGLIDE® reduced friction construction\* reduces the pulling force required to pull thru ducts

We sometimes refer to RW90 and T90 as “conduit wire” since in buildings, they typically must be installed in conduit.





## 2. WIRE & CABLE

### APPLICATIONS for Armoured Power



AC90 / AC90  
ISO-BX



- For open and concealed wiring in dry locations only
- Office furniture, ceiling fixtures, branch circuits, and tight areas
- **AC90 ISO-BX** → for installations where an isolated ground is required such as computers and sensitive electronics. Also, in patient care areas of healthcare facilities



ACWU90

- For exposed and concealed wiring in dry or wet locations and exposed to weather and sunlight. ALL hazardous locations.
- For use in cable trays
- Service entrance, direct earth burial, above/below ground, and branch circuits

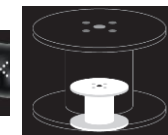


TECK90

- Designed for the harshest of installations. ALL hazardous locations. Both dry or wet locations and exposed to weather and sunlight
- For use in cable trays
- Service entrance, direct earth burial, above/below ground, and branch circuits

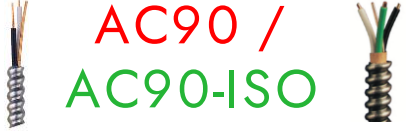


**DID YOU  
KNOW?**

Nexans' **TECK 300m** boasts innovative packaging and sequential meter markings (300 m → 0 m) for easier handling/distribution and to easily identify remaining cable length on the reel!



## 2. WIRE & CABLE

### Armoured Power

CRITERIA	 AC90 / AC90-ISO	 ACWU90	 TECK90
CSA standard	C22.2 No. 51	C22.2 No. 51	C22.2 No. 131
Voltage    Cond. Temp.	600 V / 90C	600 V / 90C	0.6 – 5 kV / 90C
Conductors	2/3/4 Cu (+ bare Cu Grd)	2/3/4 Al (+ bare Al Grd)	1 – 50 Cu (+ bare Cu Grd)
Sizes* <small>*size range may vary depending on # and type of conductors</small>	14 AWG – 1000 kcmil / 12 AWG	6 AWG – 500 kcmil	14 AWG – 750 kcmil
Insulation	XLPE	XLPE	XLPE
Shield Type	N/A	N/A	N/A
Inner Jacket	No	No	PVC
Armour Type	Alum. Interlocked Armour (AIA)	AIA	AIA
Outer Jacket	N/A	PVC	PVC
Flame rating	FT4	FT4	FT4
Hazardous Locations	No	Yes	Yes
Cold Temp. Rating	-40C	-40C	-40C
Sun Res	No	Yes	Yes
Special Ratings	FT4-ST1 HAL-FREE AG14	Optional FT4-ST1 HAL-FREE AG14	Optional FT4-ST1 HAL-FREE AG14

#### DID YOU KNOW?



Nexans uses **100%** “low-carbon” aluminum for our conductors that significantly reduces the cable’s carbon footprint.

Watch our last sustainability webinar for more info!

## 2. WIRE & CABLE

### APPLICATIONS for Armoured Power



**CORFLEX®  
RA90**

or CORFLEX® MC-HL (UL-listed)

- ALL hazardous locations. Both dry or wet locations and exposed to weather and sunlight
- For use in cable trays
- Service entrance, direct earth burial, above and below ground



**DriveRx®  
VFD cable**

- For connecting a VFD and motor. **Excellent shielding.**
- ALL hazardous locations. Both dry or wet locations and exposed to weather and sunlight
- For use in cable trays
- Service entrance, direct earth burial, above and below ground



**MV Armoured  
(5 - 15 kV)**

- ALL hazardous locations. Both dry or wet locations and exposed to weather and sunlight
- For use in cable trays
- Service entrance, direct earth burial, above and below ground

### DID YOU KNOW?




Nexans has manufactured **CORFLEX®** cables for the Canadian market since the 1950s and the US market since the '70s.



Many decades of field-proven acceptance and reliability!

## 2. WIRE & CABLE

### Armoured Power

CRITERIA	CORFLEX® RA90 	DriveRx® VFD cable 	MV 
CSA standard	C22.2 No. 123	C22.2 No. 123	C68.10
Voltage    Cond. Temp.	600 V / 90C	1 kV / 90C	5 – 15 kV / 105C
Conductors	1 Cu or Al (No Grd) CORLFEX® MC-HL: 3-cond	3 Cu (+ 3 Bare Cu Grds)	3 Cu (+1 Bare Cu Grd)
Sizes* <small>*size range may vary depending on # and type of conductors</small>	1 AWG – 1000 kcmil	12 AWG – 500 kcmil	1 AWG – 500 kcmil
Insulation	XLPE	XLPE	TR-XLPE
Shield Type	N/A	3 symmetric ground wires	Cu Tape
Inner Jacket	No	No	PVC
Armour Type	Continuously Welded & Corrugated	CWC	AIA
Outer Jacket	PVC	PVC	PVC
Flame rating	FT4	FT4	FT1, FT4
HL	Yes	Yes	Yes
Cold Temp. Rating	-40C	-40C	-40C
Sun Res	Yes	Yes	Yes
Special Ratings	Optional FT4-ST1 HAL-FREE AG14	Optional FT4-ST1 HAL-FREE AG14	AG14

#### DID YOU KNOW?

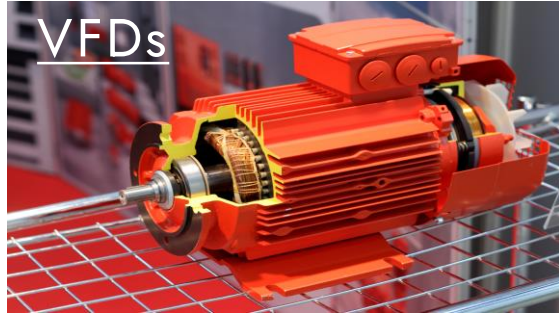
Nexans offers a **LIMITED-SMOKE HALOGEN-FREE** version of our jacketed armoured products.

A valuable feature for products in enclosed public spaces.

Reach to us to learn more!

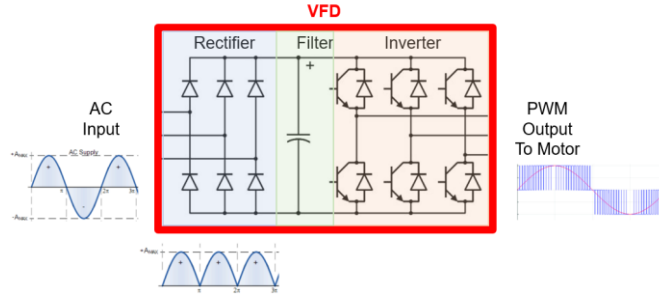
## 2. WIRE & CABLE

### Armoured Power - DriveRx VFD cable



#### Advantages

- ✓ Increased productivity
- ✓ Smooth start and stop
- ✓ Energy savings
- ✓ High quality output
- ✓ Lower maintenance cost



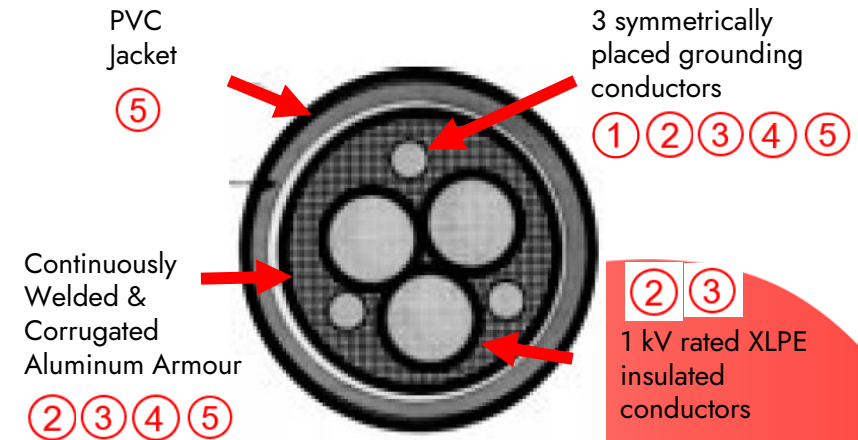
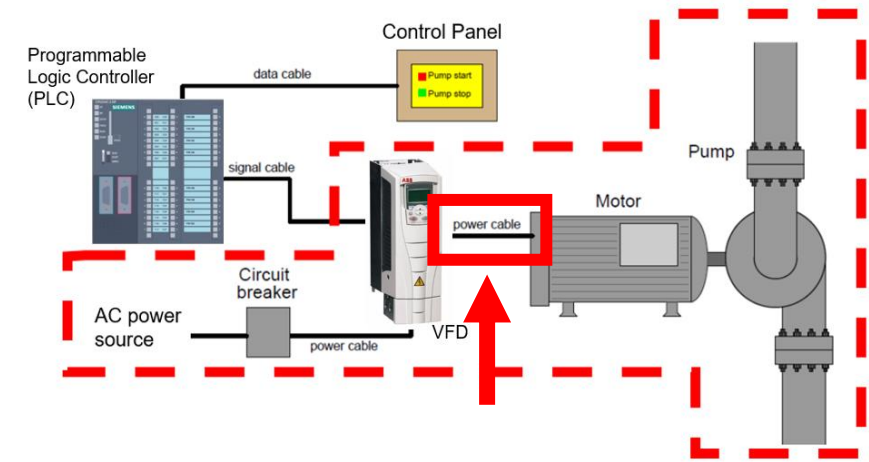
#### Complications

- Electromagnetic Interference (EMI)
- Repetitive high voltage spikes
- Corona discharge
- Reflected wave and standing waves
- Possibility of motor bearing failures
- Limited motor cable length



#### 5 benefits of Nexans DriveRx VFD Cable

1. Minimizes net injected ground current into drive system ground bus
2. Minimizes common-mode currents (and bearing currents)
3. Minimizes motor frame standing voltage (and electrical shock hazard)
4. Best possible cable shielding (minimizes cross-talk)
5. Best possible ground path in cable

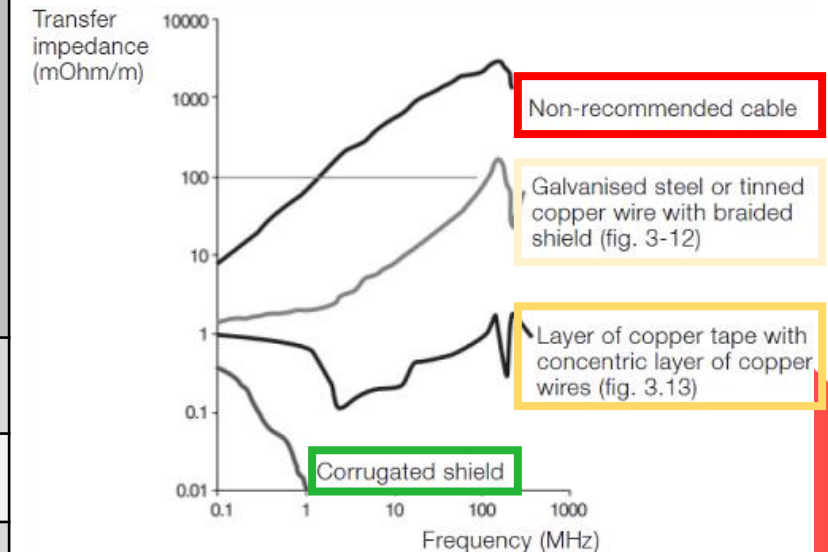


These 5 performance concerns were investigated and addressed in an IEEE paper titled "Evaluation of Motor Power Cables for PWM AC Drives". The DriveRx<sup>®</sup> VFD cable design was #1 out of 8 cable constructions studied for use between a VFD and the motor.

## 2. WIRE & CABLE

### Armoured Power - DriveRx VFD cable

Characteristic	Aluminum sheath, with XLPE conductors	Copper tape, with XLPE conductors	Braided shield, with XLPE conductors	Any wire or cable w/ XLPE conductors
High Frequency Bonding	✓	✓		
Flexibility		✓	✓	
Self-Supporting	✓			
Mechanical Protection	✓			
Suitable as a VFD Cable	✓	✓	✓	✗



Source: "Technical guide No. 3 EMC compliant installation and configuration for a power drive system", ABB, 2012

## 2. WIRE & CABLE

### APPLICATIONS For Specialty Cables



CIC / ACIC  
(Control and Instrumentation Cables)

- Used for signaling, monitoring, and control of low power electrical systems and processes such as temperature, pressure, speed, flow and weight.
- Suitable for direct burial, use in conduit
- Suitable for use in both dry or wet locations and exposed to weather and sunlight
- ACIC suitable for use in cable trays (CIC as well, but with the optional TC rating)






Tray Cable

- Cable tray installations requiring a TC rating
- Suitable for dry or wet locations in cable trays, raceways and open air.
- Suitable for exposure to weather and weather
- Suitable for direct earth burial

## 2. WIRE & CABLE

### Specialty



CRITERIA			
CSA standard	C22.2 No. 239	C22.2 No. 239	C22.2 No. 230
Voltage    Cond. Temp.	600V    90C	300V, 600V    105C Dry / 90C Wet	600V    90C
Conductors	Cu: 2 – 50 (No Grd)	Cu: 2 – 50 (No Grd)	Cu: 2 - 50
Sizes* <small>*size range may vary depending on # and type of conductors</small>	14 – 4/0 AWG	20-14 AWG (300V) & 18-4/0 AWG (600V)	14 AWG – 2000 kcmil
Insulation	XLPE	XLPE	XLPE
Shield Type	Cu Tape shield	Optional helical Cu or Al tape over assembly or over pairs or triads	Optional – Helical Al tape + tinned copper drain
Inner Jacket	No	PVC	No
Armour Type	No	AIA	No
Outer Jacket	PVC	PVC	PVC
Flame rating	FT1, FT4	FT1, FT4	FT4
HL	No	Yes	No
Cold Temp. Rating	-40C	-40C	-40C
Sun Res	Yes	Yes	Yes
Special Ratings	Optional TC	Optional TC	TC



### 3. ARMOUR TYPES

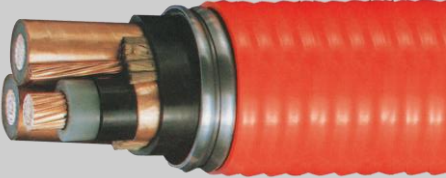



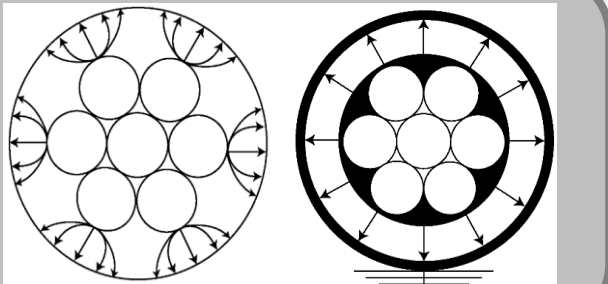
Armour provides mechanical protection; a shield provides electrical protection

#### ARMOUR

Aluminum Interlocked Armour (AIA)	Continuously Welded and Corrugated Armour (CWC)
	
A formed tape wrapped over the cable	Welded and corrugated tube over the cable
Typically aluminum, but can be galvanized steel	Typically aluminum
Cannot be used as a bonding conductor	Can be used as a bonding conductor
More flexible than a continuous sheath	Corrugated for flexibility
Can be broken open if bent too sharply	Can be damaged if bent excessively
Will allow moisture to penetrate to core	Will not allow moisture to penetrate to core
Typically supplied with an outer covering	Typically supplied with an outer covering
Used on AC90, ISO-BX, ACWU90, ACIC, TECK90, and MV Shielded Power cables	Used on CORFLEX® RA90 and VFD cables

### 3. ARMOUR TYPES

#### SHIELD

<p>Helical Cu Tape</p> 	<p>LACT</p> 	<p>Concentric Neutral (8 AWG – 16 AWG)</p> 	<p>Wire Shield (22 AWG – 18 AWG)</p> 
<p>Used on industrial cables</p>	<p>Used on large single conductor sized utility and industrial cables</p>	<p>Used by utilities on underground distribution cables</p>	<p>Same applications as Cu tape (but very uncommon)</p>
<p>Good electrostatic shielding</p>	<p>Good electrostatic shield</p>	<p>1/3 or 33% conductance used on 3 phase systems</p>	<p>Similar short circuit &amp; ampacity derating as copper tape</p>
<p>May be applied with gaps or overlapped</p>	<p>Provides a moisture barrier when longitudinal overlap is sealed</p>	<p>Full or 100% conductance used on single phase system</p>	<p>Not manufactured by Nexans</p>
<p>- Low short circuit capacity - If both ends are grounded, conductor current derating is small</p>	<p>"Medium" short circuit levels (between helical tape and CN)</p>	<p>- Higher short circuit levels - Conductor current derating can be high if grounded both ends</p>	



## 4. ARMOURING PROCESS

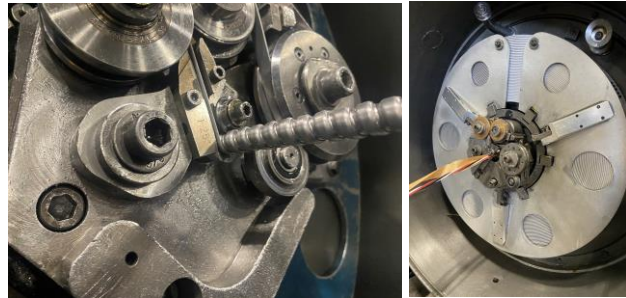
Armouring requires finding the perfect balance between machine speed, tape positioning, armour tightness, and operator know-how.

The armouring machines that produce Nexans' industrial armoured power cable products are an engineering feat.

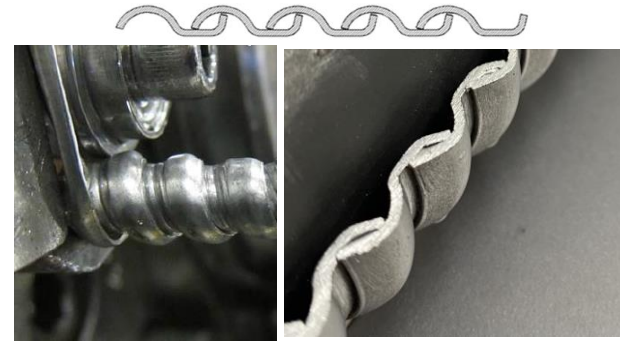
### AIA process



1. Aluminum strip is inserted into the machine in large rolls



2. The coil is mounted perpendicular to the conductors with the conductors passing through the centre of the coil



3. Strip is helically wrapped and formed around the conductors and interlocked on itself.

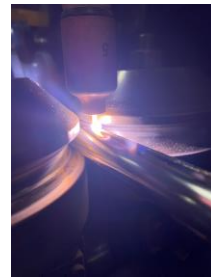


4. Finished product

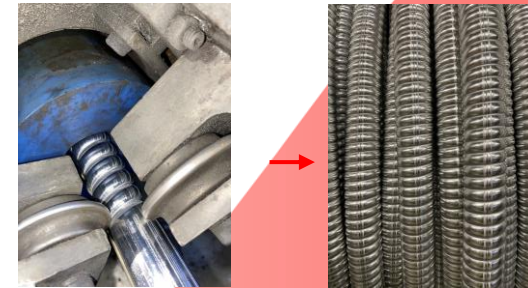
### CWC process



1. Aluminum strip is inserted into the machine in large rolls



2. Strip is fed parallel to the conductors and is formed around the conductors as a smooth tube and tig welded



3. The smooth aluminum tube passes through a corrugator to improve the flexibility and strength of the conductor.

## 5. INSTALLATION CONSIDERATIONS

- ✓ Installation of industrial power and control cables require careful planning and execution.
- ✓ Factors that need to be accounted for include minimum bend radius, maximum pulling tensions, maximum sidewall bearing pressures, and low temperatures.
- ✓ Nexans recommends that, wherever possible, cables be pulled by means of the conductors, aided with a basket-type grip over the inner jacket, armour, and outer jacket. This ensures the cable components are pulled as a unit.
- ✓ For installation of cable in trays, rollers are highly recommended.
- ✓ The minimum bend radius for the cable must also be accounted for during installation so as to not cause damage to the cable components.
- ✓ Improper installation of armoured product may result in one of the following three pictures.

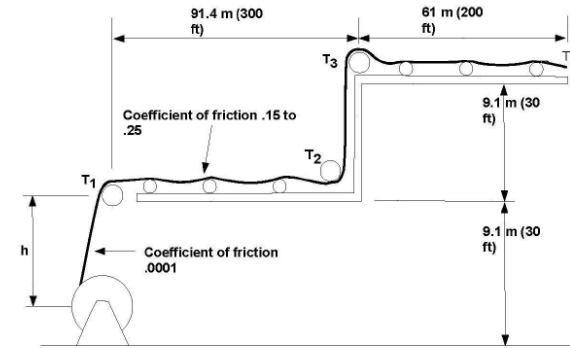
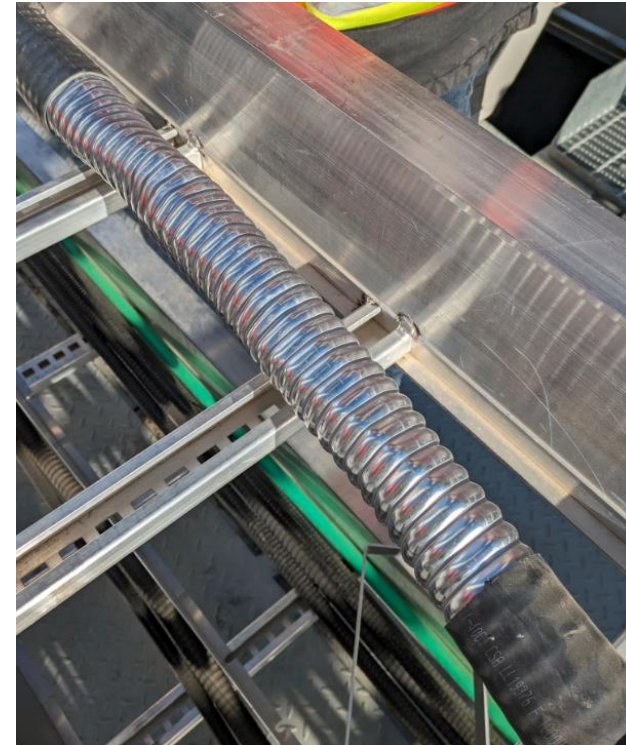


Figure 4—Example of cable tray with cable supported by rollers during pull



## 5. INSTALLATION CONSIDERATIONS

Low temperature installations

Installations in low temperatures also require careful planning and appropriate precautions must be taken.

Cables must meet certain design and testing criteria for cold bend and cold impact (typically @ -25C or -40C)

These tests are conducted under carefully controlled laboratory conditions

These cables may be handled and installed at temperatures lower than -10°C, but appropriate care must be taken, which includes:

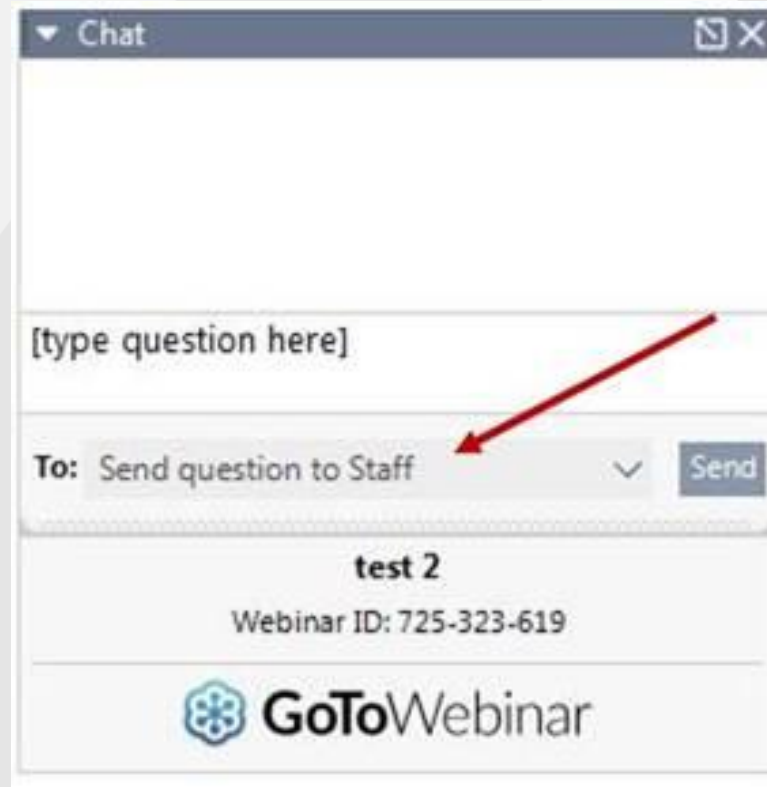
- a. expose the cable to a temperature of at least 15°C for 24h immediately prior to installation
- b. minimize flexing of the conductor;
- c. when flexing the conductor, bend the conductor slowly; and
- d. work with an increased minimum bend radius.



## 6. KEY TAKE-AWAYS

- ✓ Nexans offers a wide range of robust industrial power and control cable products.
- ✓ INSTAGLIDE® reduced friction constructions for select sizes of single conductor RW90 and T90 for ease of installation.
- ✓ TECK 300 m offer provides easier handling and identification of remaining cable length.
- ✓ Nexans CORFLEX® RA90 and CORFLEX® MC-HL products have over half a century of field-proven acceptance and reliability in North America.
- ✓ A long history with manufacturing and installations in the North American market.
- ✓ Nexans DriveRx® VFD cable's superior construction offers several benefits.

# Q&A



# Contact us

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[nexans.ca](http://nexans.ca)