

FIBERGLASS CONDUIT SYSTEM FOR

# UNDERWATER

applications



**FRE**  
COMPOSITES®

F I R S T I N T H E F I E L D



FRE Composites' plants produce North America's highest quality fiberglass conduit products, ready for shipment worldwide. These plants house up-to-date automated filament winding equipment, and contains plenty of warehousing capacity, both indoors and outdoors.

**FRE**  
COMPOSITES®

F I R S T I N T H E F I E L D

®

# OUR VISION

At FRE Composites, we have the experience, having manufactured our first fiberglass products as far back as 1958. Today, the company has skilled and experienced workforces operating two (2) plants and exporting product to numerous countries worldwide.

Currently, FRE Composites is focused exclusively on the design, engineering and production of composite filament-wound fiberglass conduit products and accessories. However, in addition to core products serving electric, telecom, water and wastewater utilities, and transportation industries, FRE Composites has engineered and produced highly specialized products for use in space exploration made from carbon fibers and other exotic materials, such as rocket launch tubes and the main structure of the CANADARM robotic arm, which is used by NASA's Space Shuttle to manipulate payloads in space. The CANADARM was also used to assist in the construction of the International Space Station, and in 2005, a CANADARM system attached to the International Space Station successfully assisted in the first in-orbit repair of the Space Shuttle Discovery.

Our 100,000 sq.ft. plant in Canada and our 50,000 sq. ft. plant in the United States have the capacity to accommodate high production requirements while maintaining substantial flexibility to foster to our growing customer base needs. Although we are the only source of FRE® trademarked conduit, it's no secret that we are not the only suppliers of fiberglass conduit in North America. Considering that you have choices, why should you do business with us ?

EXPERIENCE  
COMPETENCE  
COMMITMENT

## Quality

Our products are engineered to exacting standards, and are produced to consistent quality standards to provide superior life expectancy. Design performance and quality control always have been, and always will be, our number one priority.

## Experience

Our long experience has taught us how to design and to build our products right: First in the Field®.

## Production capacity

FRE Composites operates the largest production facility to produce fiberglass conduit in North America, which enables us to produce large volumes of product within tight delivery deadlines while being flexible to service ongoing requirements of numerous projects. We value distribution.

## Distribution

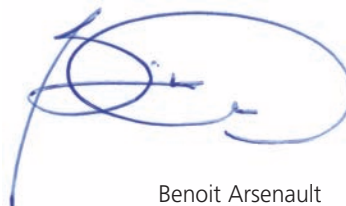
FRE Composites has always joined forces with distribution to promote its product lines. FRE® fiberglass conduit products are available in all popular sizes from stocking distributors from coast to coast in both Canada and the United States.

## Service

We are organized to provide courteous and professional customer service in Chinese, English, French, Italian, Russian and Spanish. To better serve clients beyond continental North America, we are in the process of adding service capabilities in several additional languages.

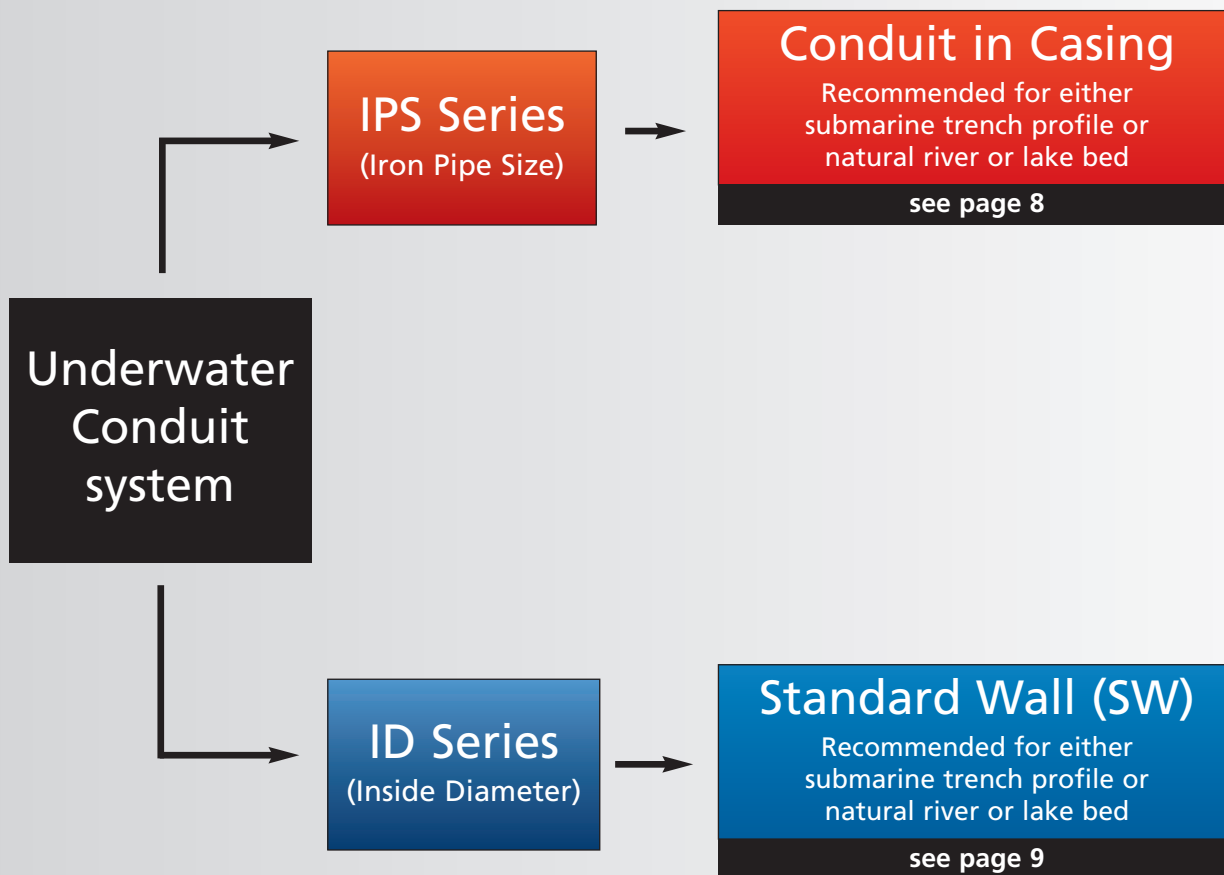
We are eager to serve you professionally and courteously, supplying you with high quality conduit systems in accordance with your requirements.

**No job is too small or too big.**



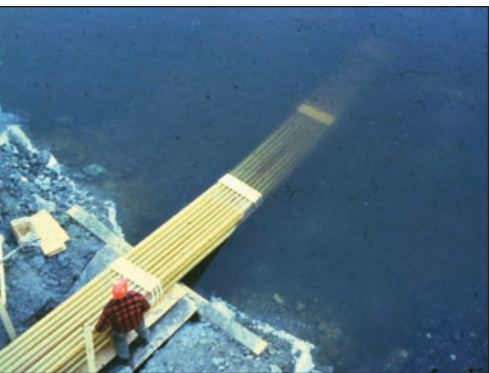
Benoit Arsenault  
President

# Underwater FRE® Conduit System



Upon special request, FRE Composites products can be designed to meet specific requirements.

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## LIMITATION OF LIABILITY

Due to the varied nature of electrical system designs, field conditions and installation techniques and practices under which Underwater FRE® Conduit may be used, no guaranty or promise can be made regarding its performance in individual applications, since these factors are beyond the control of FRE Composites (2005) Inc. ("FRE Inc."). Therefore FRE Inc. or any of its affiliates and associates, accepts no responsibility for the performance of installed Underwater FRE® Conduit systems.

At the written request of the engineer, architect, designer or contractor responsible for the design, installation practices or supervision, FRE Inc. may provide assistance or on-site advice based on past experience but only as a guide for successful installation. However said engineer, architect, designer and contractor shall remain solely responsible for ensuring the design, installation practices and supervision are adequate for the intended application. FRE Inc. shall not be liable in any way towards anyone by reason of such assistance or on-site advice.

In all cases, FRE Inc.'s only liability will be the replacement of conduit or fittings shown to be defective in workmanship or materials prior to installation. Under no circumstances shall FRE Inc. be liable for any claims, damages, losses (including a loss of opportunity, business or profit) or costs whether based on the fault or negligence (whether gross or not) of FRE Inc., on contractual, legal or statutory warranties, strict liability or otherwise except as expressly provided herein.

Underwater FRE® Conduit is primarily designed for use in underwater environments. Should prolonged exposure be desired, please contact us for details on special protection techniques.

FRE Inc. has prepared this data as a guide only. Although FRE Inc. believes the information contained herein is accurate and reliable, this information shall not be construed as representation, warranty or guarantee, whether express or implied. FRE Inc. reserves the right to update products and/or data as necessary without notice.

# Why should you consider using Underwater **FRE®** conduit?

Underwater FRE® conduit offers many advantages over expensive aerial and submarine ducts, as listed below:

## **EASE OF ASSEMBLY:**

Underwater FRE® fiberglass conduit is easy to install, partly resulting from its light weight, which facilitates handling. Fitting sections together using the push-fit spigot and bell design further facilitates assembly. Underwater FRE® conduit is joined through the application of splice kit.

## **SAFE & SHORT PULL TIME:**

With the use of BullNose Pulling eyes Underwater FRE® conduit secure joint couplings permit continuous lengths of Underwater FRE® conduit to be pulled at one time, eliminating expensive and time consuming coffer dams. In fact, Hydro-Quebec – one of the world's largest hydro power utilities is absolutely convinced about the outstanding performance of Underwater FRE® conduit. In severe winter conditions, they pulled assembled FRE® in an 8 conduit bank, underwater 1 024 ft or 312m in just 45 minutes.

## **ENVIRONMENTALLY-FRIENDLY:**

Made in inert thermosetted resin, Underwater FRE® conduit crossings don't detract from the natural beauty of marine areas. While protecting your cables and unlike expensive aerial systems, Underwater FRE® isn't damaged by freezing, rain, ice and wind.

## **CORROSION RESISTANT:**

Underwater FRE® conduit is not affected by the effects of water, salt water or most other chemicals. Contact the factory for further information, if specific information is required.

## **FLEXIBLE AND IMPACT RESISTANT:**

The flexibility of Underwater FRE® conduit allows it to conform to trench floors and can accommodate irregular trench on natural lake or river bed profiles.

## **LOW COEFFICIENT OF FRICTION:**

The coefficient of friction of Underwater FRE® conduit is lower than that of steel. This means that electrical cables are easier to pull through, resulting in labour savings and less stress on cables.

## **CABLE FUSION:**

Fiberglass is an excellent insulator. Unlike fiberglass conduit, steel conduit will weld with cable may fuse or melt under electrical fault conditions.

## **NO BURN-THROUGH:**

Underwater FRE® fiberglass conduit offers strong resistance to being cavitated or pierced as a result of rope pull.

**a complete system**

# Why should you specify Underwater **FRE**® conduit made by FRE Composites?

There are a number of reasons why Underwater FRE® conduit offers the industry the most for its money. Underwater FRE® conduit system is not just a translucent epoxy conduit, but rather it is a specially formulated resin system which offers high mechanical strength and enough flexibility for ease of installation on irregular trench or lake/river bed profiles. Our **experience** and **quality record** speak for themselves. We live and breathe quality: quality is the number one priority to which everything else is subordinate. After nearly fifty years in the business, we know how to do things right, and we know how to ensure that we keep doing them right.

Our **total production capacity** is the largest in the industry enabling us to produce large volumes of product within tight delivery deadlines, and product is available from **stocking distributors** throughout Canada, the United States and elsewhere around the world.

TO ENSURE THAT YOUR PROJECT WILL BENEFIT FROM THE HIGHEST QUALITY CONDUIT PRODUCTS, **SPECIFY UNDERWATER FRE® CONDUIT:**

#### KEY SPECIFICATION POINTS:

- Shall be manufactured from E or E-CR glass and specially formulated epoxy resin (no fillers).
- Shall have a glass content of 68%, plus or minus 3%.
- Shall be able to demonstrate several successful past installations as reference.
- Union made.
- Multiple locations to better serve your needs.

**For more information, please contact us  
1 888 849-9909**



**low cost**



**your right choice**

# IPS STANDARD WALL (SW) CONDUIT IN CASING SYSTEM

IPS  
SW

## IPS STANDARD WALL (SW) IN CASING

When dredging or trenching is not a viable option and your project requires added mechanical duct bank protection, FRE Composites offers a custom design Underwater **FRE**® conduit in casing system to conform to irregular trench floors or natural lake or river bed. Such system can either be assembled in factory or at the job site. Your right choice for best value.



**Civil Engineering & Infrastructure**  
**Genis Civil Infrastructure**  
**FRE COMPOSITES INC**  
 Canada - 75, rue Wales - Saint-André d'Argenteuil - Québec - J0V 1X0

**Product description**  
 Description du produit  
 A pipe made of composite materials that is used for transporting electricity for the water pumping station for the city of Las Vegas. The first project is high-voltage electric cables that were installed under water. All necessary: the first section of a large pipe that contained cables were used for the storage, winding, and adhesive bonding technologies were used for installation. FRE Composites is a family manufacturing the professional system which was designed in Las Vegas to be assembled on-site. Also designed which was designed in Las Vegas to be assembled on-site. Also designed which was designed in Las Vegas to be assembled on-site.

**Launching / marketing date**  
 Date de lancement / commercialisation  
 The project started in the middle of 1999 and was commercialized in the middle of 2001.  
 Le projet a démarré en 1999 et a été mis en service en 2001.

**Markets**  
 Marchés  
 The project was a one-time operation, but the concept is equally applicable to any situation where electrical or optical cables must be installed under water. A large pipe operation unique, with its concept developed to replace a steel pipe which was damaged in the water for the cable/cables/energy in trench.

**Additional information**  
 Démarches complémentaires  
 The low weight and unique manufacturing possibilities of the composite solution are significant advantages compared to traditional steel solutions. It is specifically designed for the protection of the cables in the trench. The lightness of the structure and the possibility of prefabrication in one step. The project was a one-time operation, but the concept is equally applicable to any situation where electrical or optical cables must be installed under water. The main objective was to replace a steel pipe which was damaged in the water for the cable/cables/energy in trench.

**Company description**  
 Description de la société  
 FRE Composites is a Canadian company that specializes in filament winding. FRE Composites est une société canadienne spécialisée en enroulement filamentaire.

**Advantages of composites**  
 Avantages des composites  
 The low weight and unique manufacturing possibilities of the composite solution are significant advantages compared to traditional steel solutions. It is specifically designed for the protection of the cables in the trench. The lightness of the structure and the possibility of prefabrication in one step. The project was a one-time operation, but the concept is equally applicable to any situation where electrical or optical cables must be installed under water. The main objective was to replace a steel pipe which was damaged in the water for the cable/cables/energy in trench.

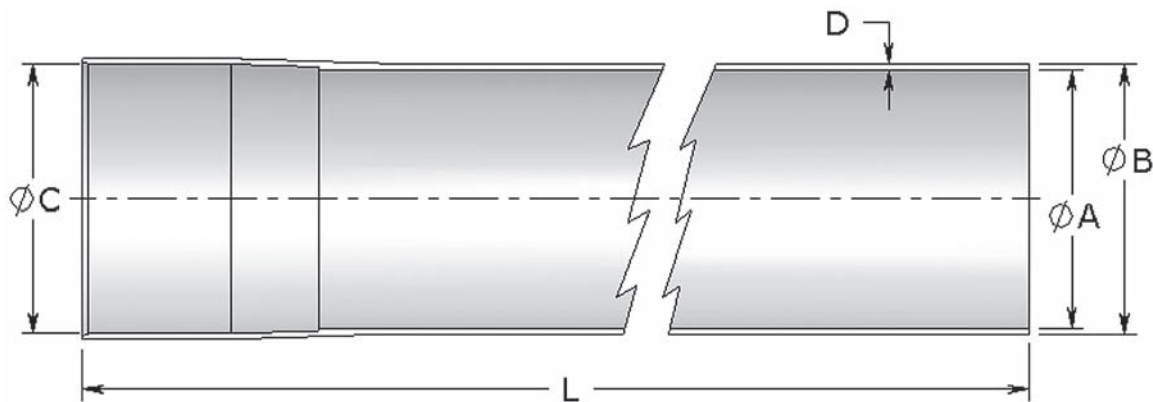
**Other nominees**  
 Autre nommé  
 ANS BRITISH BY COMPOSITES France  
 From Composite, a new global look of environmental friendly professional solutions, making it clear that the best way to do it is to use the best materials. The project was a one-time operation, but the concept is equally applicable to any situation where electrical or optical cables must be installed under water. The main objective was to replace a steel pipe which was damaged in the water for the cable/cables/energy in trench.





# ID STANDARD WALL (SW) CONDUIT SYSTEM

## ID STANDARD WALL (SW) CONDUIT



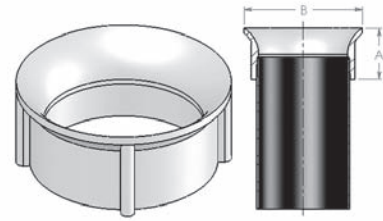
Size	Symbol	No.	inches				millimeters				L meters	
			ØA	ØB	ØC	D	ØA	ØB	ØC	D		
3½	91	60-3500	3.500	3.640	3.670	0.070	236.25	88.9	92.5	93.2	1.8	6
4	103	60-4000	4.000	4.140	4.170	0.070	236.25	101.6	105.2	105.9	1.8	6
4½	116	60-4500	4.500	4.690	4.730	0.095	236.25	114.3	119.1	120.1	2.4	6
5	129	60-5000	5.000	5.190	5.230	0.095	236.25	127.0	131.8	132.8	2.4	6
6	155	60-6000	6.000	6.190	6.230	0.095	236.25	152.4	157.2	158.2	2.4	6

- All our Underwater FRE® products are offered with a push-fit assembly requiring splice.
- Standard length is 19.68 ft. (6m), but can also be available in 39 ft. section (12m), if required.
- Spigot end tapered for ease of installation

# STANDARD WALL (SW) ACCESSORIES

## ID SW RADIUS BELL END

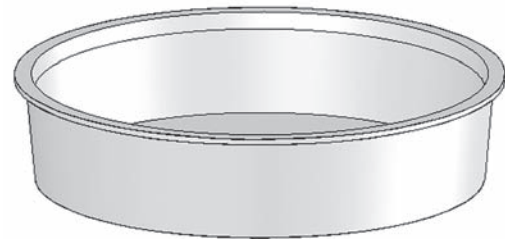
Size		Symbol No.	ØA	ØB	ØA	ØB
in	mm		inches		millimeters	
3½	91	<b>40-3518</b>	1.7	4.5	43.2	114.3
4	103	<b>40-4018</b>	2.2	5.0	55.9	127.0
4½	116	<b>40-4518</b>	2.2	5.5	55.9	139.7
5	129	<b>40-5018</b>	2.2	6.0	55.9	152.4
6	155	<b>40-6018</b>	2.4	7.0	61.0	177.8



# GENERAL ACCESSORIES

## ID THERMOPLASTIC CAPPLUG

Size		Symbol No.	Depth	
in	mm		in	mm
3½	91	<b>40-3528</b>	1.0	25.4
4	103	<b>40-4028</b>	1.3	33.0
4½	116	<b>40-4528</b>	1.0	25.4
5	129	<b>40-5028</b>	1.0	25.4
6	155	<b>40-6028</b>	1.5	38.1



## SPLICE KIT

Size      Symbol No.

All        40-0174



## JOINT CALCULATION TABLE (PER KIT)

ID BASED				
Size in	Size <i>mm</i>	Joints made per kit	Pull-Out Strength	
			lbs	<i>kg</i>
3½	91	11	3 500	1 587
4	103	10	4 000	1 814
4½	116	8	4 500	2 041
5	129	7	5 000	2 268
6	155	6	6 000	2 722

# PRODUCT TEST DATA

## Underwater FRE® fiberglass conduit

MATERIAL	TEST RESULTS	TEST PROTOCOL
Resin Glass	Epoxy (no fillers) Fiberglass (E or E-CR Glass)	CSA.C.22.1.2420
PHYSICAL PROPERTIES	TEST RESULTS	TEST PROTOCOL
Glass Content	68% ± 3%	API 15LR
Specific Gravity	1.94 g/cm <sup>3</sup>	ASTM D792
Barcol Hardness	46 ± 2	ASTM D2583
U.V. Resistance	> 3 500 Hrs (Xenon Arc)	CSA C22.2 No. 2515
Water Absorption	< 1%	ASTM D570
MECHANICAL DATA	TEST RESULTS	TEST PROTOCOL
Tensile Strength (axial)	≥ 7 000 Psi (48 Mpa)	ASTM D638
Elasticity Modulus (4")(103 mm)	1.3 E6 Psi (8 963 Mpa)	ASTM D638
Adhesive Joint Pull-Out Load	1 500 lbs (680 kg)	ASTM D638
SURFACE FINISH	TEST RESULTS	TEST PROTOCOL
Exterior (average)	<2 000 microinches (50.8 micrometers)	
Interior (average)	<125 microinches (3.2 micrometers)	
Color	Translucent (standard)	
THERMAL PROPERTIES	TEST RESULTS	TEST PROTOCOL
Coefficient of Thermal Expansion	1.37 E5 in./in./°F (2.47 E5 m./m./°C)	ASTM D696
Thermal Conductivity	2 Btu.in/ft <sup>2</sup> .h. °F (0.288W/ m.K)	ASTM D335
Thermal Resistivity	0.5°F. ft <sup>2</sup> .h/Btu.in (3.47 mK/W)	ASTM D335
Flammability	Satisfactory	
Heat Deflection Temperature (HDT)	312°F (156°C)	ASTM D648
ELECTRICAL DATA	TEST RESULTS	TEST PROTOCOL
Dielectric Strength	500 volts/mil (19.68 kV/mm)	ASTM D149
Dielectric Breakdown Voltage	29.7 kV	ASTM D149
Dissipation Factor	0.5%	ASTM D150
COEFFICIENT OF FRICTION	TEST RESULTS	TEST PROTOCOL
Cross Linked Polyethylene Cable	0.233 ± .02	CSA B196.1
PVC Jacketed Cable	0.385 ± .06	CSA B196.1
Concentric Neutral Cable	0.160 ± .03	CSA B196.1
Teck (Armored) Cable	0.161 ± .03	CSA B196.1

## REPRESENTATIVE PERFORMANCE SPECS

Size in	mm	Wall in	mm	Weight		Axial Strength (ASTM D2412)		Axial Load at Failure		Safe pulling load at 3 500 Psi Stress Level		Allowable Peak Load during Duct Pull	
				lbs/ft.	Kg/m	Psi		lbs	Kg	lbs	kg	lbs	kg
<b>ID STANDARD WALL (SW)</b>													
3½	91	.070	1.8	.64	.95	7 000		5 200	2 359	2 600	1 179	2 600	1 179
4	102	.070	1.8	.73	1.09	7 000		5 900	2 676	3 000	1 361	2 950	1 338
4½	116	.095	2.4	1.10	1.64	7 000		9 700	4 400	4 900	2 223	4 850	2 200
5	129	.095	2.4	1.21	1.80	7 000		10 800	4 899	5 400	2 449	5 400	2 449
6	155	.095	2.4	1.49	2.22	7 000		12 900	5 851	6 500	2 948	6 450	2 925

Size in	mm	Compressive Modulus (E) (Psi x 10 <sup>6</sup> )	Load @ 5% Deflection Psi	Stress Level @ 5% Deflection Psi	Load at Failure		Duct Stiffness	Stiffness Factor	Impact Resistance		Min. Bending Radius	
					lbs	kg			lbs ft.	kg m	ft.	m
<b>ID STANDARD WALL (SW)</b>												
3½	91	2.71	150	9 800	2 000	907	77	65	90	12.4	57	17.4
4	103	2.23	95	7 100	1 400	635	43	53	95	13.1	65	19.8
4½	116	2.30	235	9 300	3 300	1 497	94	169	160	22.1	73	22.3
5	129	2.34	195	8 600	2 700	1 225	70	173	170	23.5	81	24.7
6	155	2.90	170	8 900	2 100	953	51	215	380	52.6	97	29.6

## FLEXURAL DATA

Flexural Modulus:	1.3E6 Psi	8 963 Mpa
Allowable working stress at 0,2% strain:	2 400 Psi	16,55 Mpa
Long term flexural modulus at 0,2% strain:	0.84E6 Psi	5 792 Mpa
Long term allowable design stress:	1 680 Psi	11,58 Mpa

## CHEMICAL RESISTANCE

	after 45 days	after 90 days		after 45 days	after 90 days
Sodium chloride, 10% aq. sin.	E	E	Nitric acid, 10% aq. sin.	E	E
Diesel fuel	E	E	Sodium carbonate, 10% aq. sin.	E	E
Unleaded gasoline	E	E	Benzene	NR	NR
Jet fuel	E	E	Toluene	E	E
Hydrochloric acid, 10% aq. sin.	E	E	Xylene	E	E
Sulfuric acid, 10% aq. sin.	E	E	Acetone	NR	NR

E: excellent chemical resistance

NR: not recommended for long term contact.

Note : Chemical resistance tests reported here were conducted according to UL-651 section 38. Samples were immersed in the specified chemical reagent for 45 and 90 days, respectively. Weight gains or weight losses at the end of the immersion period were recorded. Mechanical integrity was determined by the parallel plate crush (ASTM D2412) test. Loads were measured at 5% deflection and at failure at the end of the immersion period and compared to the reference values of control specimens not exposed to any chemical attack. Weight gains or losses above 2% and drops in crushing resistance (load at 5% deflection or load at failure) above 15% were considered as evidence of insufficient chemical resistance.

## WIRE FILL

Maximum allowable percentage wire fill from 2008 National Electrical Code (NEC) and 2012 Canadian Electrical Code (CEC).

## ID SIZES

IMPERIAL					
Trade size ID	Inside Diameter (in)	Total Area 100% (in <sup>2</sup> )	NUMBER OF CONDUCTORS & Percent of cross section of conduit for conductors		
			1 53% fill (in <sup>2</sup> )	2 31% fill (in <sup>2</sup> )	Over 2 40% fill (in <sup>2</sup> )
3½	3.500	9.621	5.099	2.983	3.848
4	4.000	12.566	6.660	3.896	5.027
4½	4.500	15.904	8.429	4.930	6.362
5	5.000	19.635	10.407	6.087	7.854
6	6.000	28.274	14.985	8.765	11.310

METRIC					
Trade size ID	Inside Diameter (mm)	Total Area 100% (mm <sup>2</sup> )	NUMBER OF CONDUCTORS & Percent of cross section of conduit for conductors		
			1 53% fill (mm <sup>2</sup> )	2 31% fill (mm <sup>2</sup> )	Over 2 40% fill (mm <sup>2</sup> )
89	91	6 207	3 290	1 924	2 483
102	103	8 107	4 297	2 513	3 243
114	116	10 261	5 438	3 181	4 104
127	129	12 668	6 714	3 927	5 067
152	155	18 242	9 668	5 655	7 297

## STANDARD CONDUIT PACKAGING

### ID STANDARD WALL (SW)

Size		Length		Weight per Stick		Weight per Crate		Sticks per Crate	Footage per Crate		Crate per Truck	Footage per Truck		Weight per Truck		Width per Crate		Height per Crate	
in	mm	ft	meter	lb	kg	lb	kg		ft	meter		ft	meter	lb	kg	in	mm	in	mm
3½	91	39.0	11.9	24.96	11.32	1 847	838	74	2 886	880	8	23 088	7039	14 776	5 483	45	1 143	24	610
4	103	39.0	11.9	28.47	12.91	1 623	736	57	2 223	678	8	17 784	5422	12 984	5 889	45	1 143	24	610
4½	116	39.0	11.9	42.90	19.46	1 845	837	43	1 677	511	8	13 416	4090	14 760	6 695	45	1 143	24	610
5	129	39.0	11.9	47.19	21.41	1 793	813	38	1 482	452	8	11 856	3615	14 344	6 506	45	1 143	24	610
6	155	39.0	11.9	58.11	26.36	1 511	685	26	1 014	309	8	8 112	2473	12 088	5 483	45	1 143	24	610

## GLOSSARY

### Underwater FRE® Conduit

Underwater FRE® conduit manufactured by FRE Composites. Underwater FRE® is a trademark in Canada, United States and elsewhere in the world, and is a recognized name worldwide since 1970's for superior quality advanced composite products.

#### IPS (Iron Pipe Size)

Dimensional standard widely utilized in North America for both metallic (such as RMC, EMT, IMC) and Rigid Non metallic (RTRC, PVC and HDPE) electrical conduit. This trade size has established its Outside Diameter as the constant value.

#### ID (Inside Diameter)

Dimensional standard widely utilized in North America for electrical and telecommunication raceways. This trade size has established its Inside Diameter as the constant value.

#### Standard Wall (SW) conduit for Below Ground (BG) typical Direct Burial (DB) or Encased Burial (EB) installations or for typical Above Ground (AG) exposed applications

Conduit built with a standard nominal wall thickness that varies based on the conduit diameter.

#### RTRC (Reinforced Thermosetting Resin Conduit)

An industry acronym for conduits that are manufactured using a mineral reinforcement such as fiberglass in a fully cured thermoset resin.

#### Specification Grade

IPS or ID conduit system products manufactured to FRE Composites' own specification.

#### Conduit

Straight section available in 9.84 ft (3 m) or 19.68 ft (6 m) length, and in standard diameters from ¾" to 8" (21 to 203 mm).e gasket with a triple indentation.

### Key Technical Descriptions

#### Glass content

Weight percent of glass fiber present in the conduit, as % of total weight.

#### Span distance

Distance between conduit supports which varies based on the selected cable weight and conduit trade size.

#### Deflection

Deformation of conduit due to the weight of the cable installed inside it. Deflection is a function of the diameter and weight of the cables, and of the distance between conduit supports. Measured in inches.

#### Coefficient of thermal expansion

Ratio representing the change in linear dimension of a section of conduit resulting from changes in temperature ( $\Delta T^\circ$ ).

#### Coefficient of friction

Ratio of the force tending to maintain contact between two surfaces and the force which opposes the sliding of the surfaces one along the other.



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