

**Corrugated Hard Polyethylene Pipe (FP)
for Labor and Cost Savings
in Underground Cable Installation**



EFLEX



BANGKOK TELECOM CO., LTD.

MADE IN THAILAND

Realize Major Saving in Labor Costs in Underground Laying Use Only EFLEX for Conduits!

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As cities become more crowded in the wake of industrial development, there is a growing demand for cables for power transmission and distribution to be laid in the ground. Until recently troughs, asbestos pipes, Hume pipes, cast iron pipes, and PVC pipes were the most popular choices for underground cable systems.

But all of these share the disadvantages of being inflexible, short in unit length (thus requiring many joints) too heavy, and troublesome in install. In addition, shortages of labor can also raise costs and delay installation of these pipes.

EFLEX-"corrugated hard polyethylene ducts" (F.P.) developed by FURUKAWA ELECTRIC.

Spirally corrugated, **EFLEX** has several times as much flattening strength as ordinary uncorrugated plastic pipes and is remarkably flexible and easy to handle.

Easy to bend, strong and economical, **EFLEX** replaces conventional pipes and has already been used extensively in many underground cable installations to favorable reviews. **EFLEX** won an award of the U.S. Wire Association in 1968 and was also awarded the 11th Ichimura Prize in Japan. It was produced in Thailand by Bangkok Telecom Co.,Ltd.

EFLEX is Suitable for a Wide Variety of Construction Sites — Roads, Parks, Schools, Factories, New Dwelling Projects, etc.





EFLEX Offers a Range of Merits Not Shared by Conventional Conduits Such as Steel and PVC Pipes

1 Easy to Bend

Because of its corrugations, **EFLEX** can be bent freely and can be easily laid around obstacles.



2 Available in Continuous Lengths

EFLEX is available in continuous lengths to overcome problems of installation and save labor required in coupling conventional cable conduits. This saves costs and time needed for installation work.



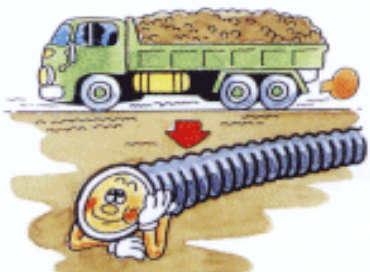
3 Light-weight

Made of polyethylene, **EFLEX** is much lighter and easier to carry and lay than the troughs, Hume pipes and other conventional cable conduits.



4 Mechanically Strong

Corrugations give **EFLEX** high flattening strength. **EFLEX** does not collapse in the ground.

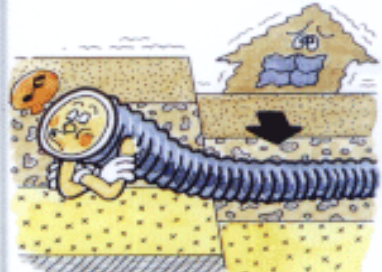


5 Highly Corrosion and Weather Resistant.



6 Safe

Flexible and resistant to pressure, **EFLEX** is safe against earthquakes, and ground subsidence, etc.



7 Allows Easy Cable Pull-in

EFLEX'S low coefficient of friction and internal pulling wire make it easy to pull cables in. Thus **EFLEX** permits longer distances between handholes.



8 Highly Reliable

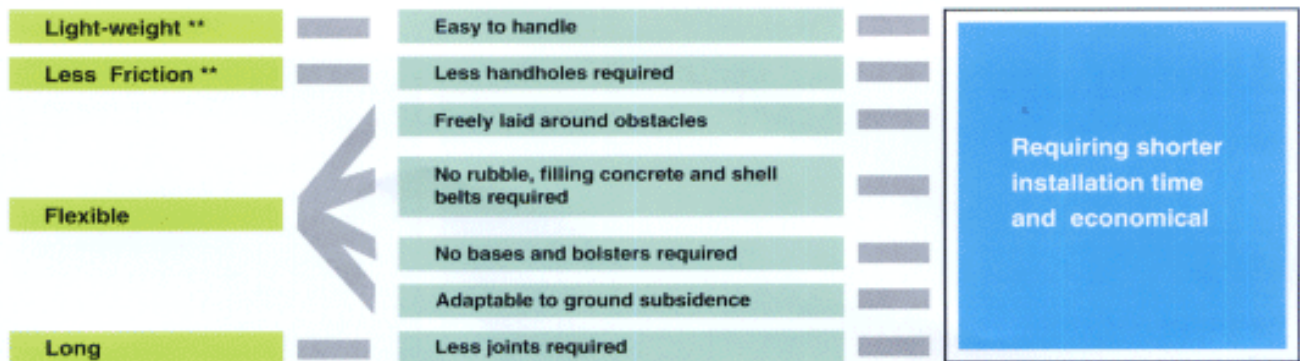


9 Economical

Considering all of these features, **EFLEX** is far more economical than other cable conduits. It can be laid more efficiently in a shorter length of time and demands fewer handholes.



EFLEX - the New Cable Conduit, Well Designed to Reduce Installation Time and Costs



The above features of EFLEX can be summarized as: "it requires only simple installation and is all round more economical."

* Weight per unit length (per1000-m)

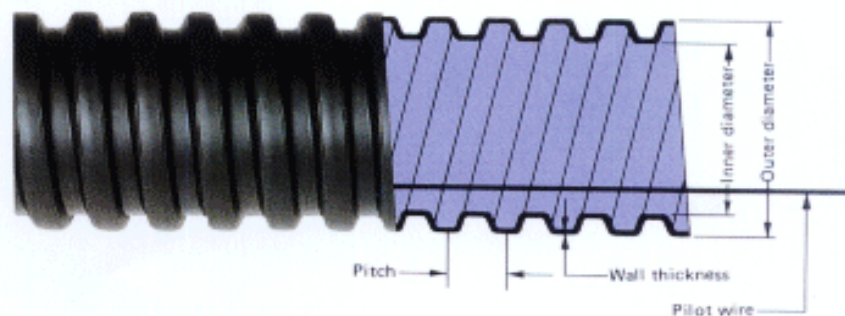
EFLEX	1.1 kg
Trough	42.0 kg
Lined steel pipe	13.1 kg
Hume pipe	26.5 kg
Hard vinyl pipe	3.4 kg

** Coefficient of friction

EFLEX	0.3
Lined steel pipe	0.5
Hume pipe	0.7
Hard vinyl pipe	0.4

EFLEX Is Available in Many Sizes Ranging from 30 Ø to 150 Ø — Ready to Be Delivered upon Request

The standard dimensions of EFLEX are as shown in the table below. A pilot wire is provided inside EFLEX in the course of its production. It is connected with the cable pilot wire to pull the cable in to the pipe. EFLEX is, as a rule, shipped from the factory, wound in a coil. A pilot wire has an allowable tensile strength of 50 kg.



• Table of Standard Dimensions

SIZE mm	Outer Diameter about mm	Inner Diameter about mm	Wall Thickness about mm	Pitch about mm	Weight for reference kg/m	Standard length per coil m	Standard OD and height of coil m
30 Ø	40	30	1.4	10	0.23	300	1.4 x 0.55
50 Ø	64	50	1.4	17	0.36	200	1.5 X 0.7
80 Ø	102	80	1.9	25	0.8	100	1.7 X 0.7
100 Ø	130	100	2.0	33	1.1	100	1.9 X 0.8
125 Ø	160	125	2.2	39	1.6	100	2.05 X 1.0
150 Ø	188	150	2.5	44	2.3	50	1.7 X 1.25

- When purchasing EFLEX, it is recommended that its nominal diameter be more than 1.5 times as large as the outer diameter of the cable to be accommodated.
- Dimensions other than the above standards are acceptable, but requests for longer dimensions cannot always be met due to transportation considerations.

Remark: EFLEX SIZE Ø 200MM.(ID)WILL BE SUPPLIED ORIGINAL TYPE. FOR ANY FURTHER INFORMATION SUCH AS PRODUCT STRUCTURE, SPECIFICATION, WITNESS TEST, KINDLY DO NOT HESITATE TO CONTACT US : TEL : 0-2653-2550 EXT : 329, 330, 331

EFLEX Offers Excellent Properties — Exceptional Strength, corrosion Resistance, Durability and Resistance to Chemicals

*Material Properties (for reference)

Description		Remarks
Density	0.95 g/cm ³	Standard JIS K - 6760
Vicat softening point	120 °c	JIS K - 6870
Brittle temperature	<-70 °c	JIS K - 6723
Thermal expansivity	1.3 x10 ⁻⁴ deg ⁻¹	ASTM D - 696
Yield tensile strength	2.4 kg/mm ²	JIS K - 6761
Yield elongation	10%	JIS K - 6761
Breaking Tensile strength	2.7 kg/mm ²	JIS K - 6761
Breaking elongation	800%	JIS K - 6761
Torsional resistance	150 kg/cm	ASTM D - A1004
Hardness	66	JIS K - 7072
Oil resistant tensile strength residual rate	>95%	JIS K - 6723 (JIS oil, class2)
Oil resistant elongation residual rate	>95%	JIS K - 6723 70 °c x 4H
Heat aging tensile strength residual rate	>95%	JIS K - 6723 90 °c x 96H
Heat aging elongation residual rate	>85%	JIS K - 6723
Environmental cracking resistance	>200hr	modified ASTM D1693-60

Chemical resistance			
Chemicals	Temperature		
	25 °c	50 °c	75 °c
30% hydrochloric acid	⊙	⊙	⊙
20% sulphuric acid	⊙	⊙	⊙
10% nitric acid	⊙	⊙	⊙
20% acetic acid	⊙	⊙	⊙
20% caustic soda	⊙	⊙	⊙
10% ammonia water	⊙	⊙	⊙
JIS,Class 2 insulation oil	⊙	⊙	⊙
Sea water	⊙	⊙	⊙
50% formalin	⊙	⊙	/
Benzene	⊙	○	/
Gasoline	⊙	○	/
Ethanol	⊙	⊙	/

⊙ ... not affected
○ ... slightly affected
/ ... no test

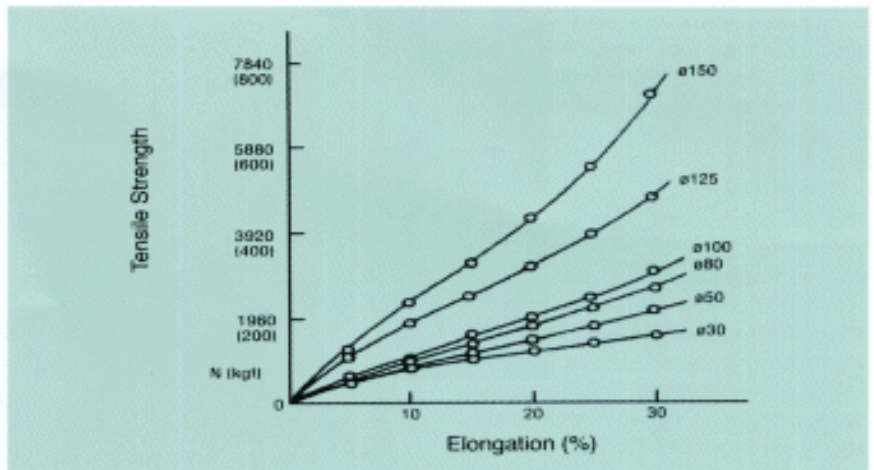


The Japanese Industrial Standard JIS C3653 for "Installation Methods of Power Cables Buried in the Ground" was set in 1987. EFLEX meets the standard for specified performance of corrugated rigid polyethylene pipes.

● **Product Characteristics**

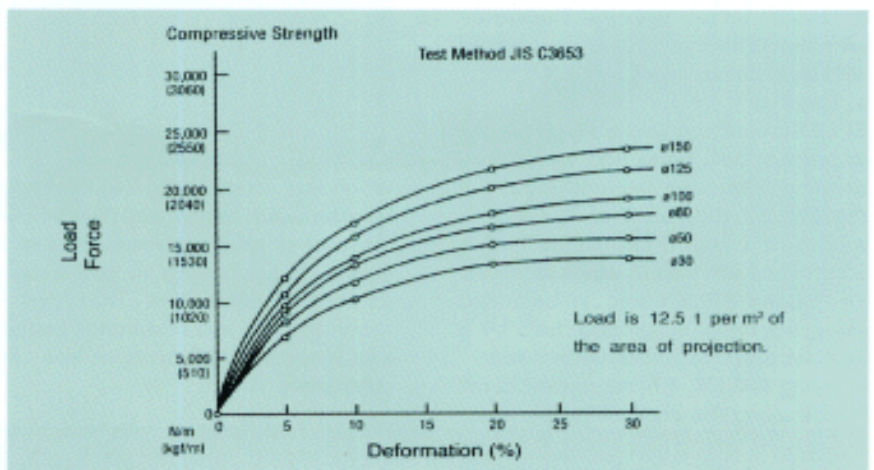
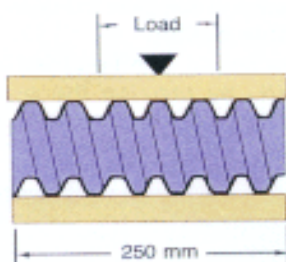
Tensile Strength

When **EFLEX**, both ends of which have been specially processed with terminals, is stretched axially, it displays tensile strengths for different sizes as shown in the top Figure. When released from an approximately 40% elongation, **EFLEX** returns to its original state without retaining any permanent strain. In addition, its joints demonstrate the same strength as its main body.



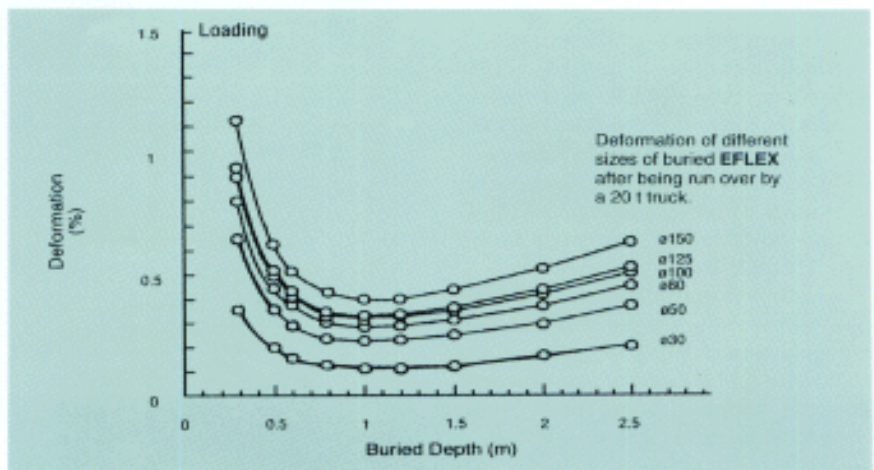
Flat-compression Characteristics

When compressed between two parallel plates as shown in the sketch below, **EFLEX** displays the relationship between load and elongation according to size as shown in the middle Figure.



Load-withstanding Strength

For this, **EFLEX** was buried 1.2 m under the ground and was run over by a truck. The flattening deformation was measured with a strain gauge and showed that **EFLEX** was scarcely affected, demonstrating sufficient strength.



EFLEX, Long and Easy to Bend, Facilitates Installation and Saves Installation Time for Cable Conduits

EFLEX, if used as a cable duct, should be laid in accordance with all items prescribed in the Electrical Equipment Technique standard and all other applicable laws and regulations. At the construction site, therefore, EFLEX should be laid in accordance with the standardized laying procedures described below.

• Trenching

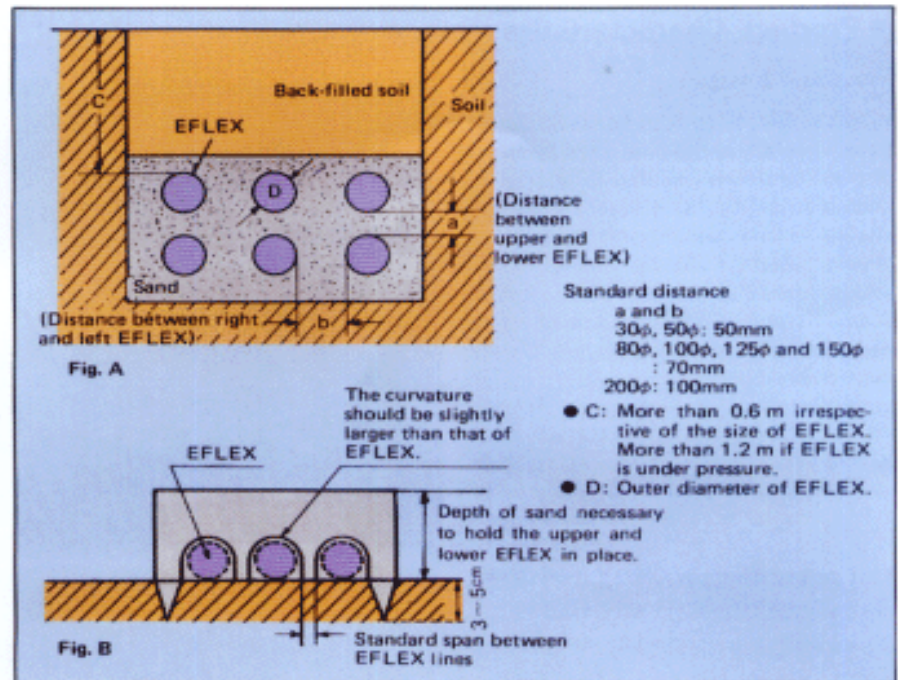
The trenching width is determined by the number of EFLEX laid. However, the width should be determined according to considerations of economy and safety associated with the laying operation-it is necessary to follow all safety procedures so that landslides do not occur at the minimum width. The lower-most EFLEX should not be laid directly on rocks and pebbles. It is recommended that the excavated area should be leveled and then covered with sand before laying EFLEX.

• Laying

EFLEX should be laid carefully so as to prevent soil, sand and water from entering it through the end mouth. If the EFLEX delivered to the site is wound in a coil, it should be laid in accordance with the following procedure. The coiled EFLEX should be rolled along the trenched ground, held by 3 or 4 laborers to avoid deformation. In laying EFLEX, it is necessary to roll its coil along the crute, if pulled along without rolling, EFLEX will twist as every turn of the coil is stretched straight.

• Arrangement straightening sand filling

When 2 or more EFLEX are to be laid in parallel, the respective EFLEX should be arranged with the specified distance as shown in Fig. A. To this end, a simple gauge shown in Fig. B should be prepared to straighten the laid EFLEX every 3 or 4 meters. The straightened EFLEX should then be held in place with sand or the equivalent, and the gauge should be removed. EFLEX should not be laid on pipe saddles which have been used for conventional Hume pipes.



• Passing test rod

When laid completely, EFLEX should be checked for straightening and internal void. Test rods should be selected according to the size of EFLEX. Passing of test rod is recommended in provisional burying and when EFLEX systems are laid completely.

• Filling

After conduits are checked for void by passing a test rod through them, fill in the trench to complete the laying.

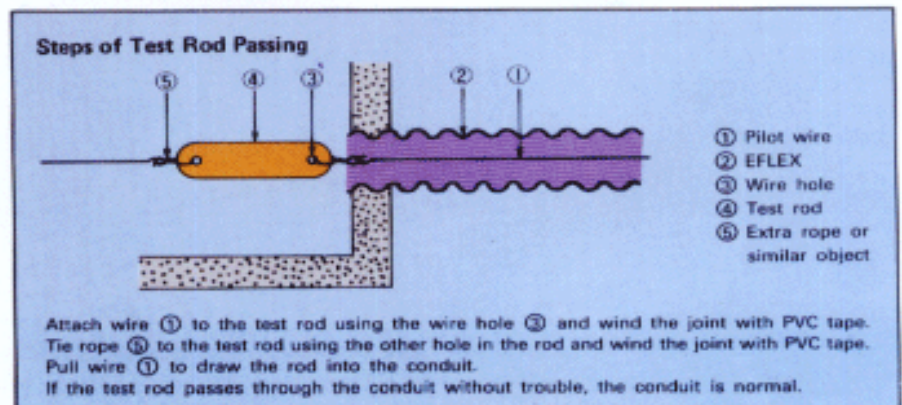
• Cable pulling - in

Cables should then be pulled into the EFLEX by utilizing the pilot wire previously accommodated in the EFLEX.

Size of Test Rod (for reference)

unit : mm

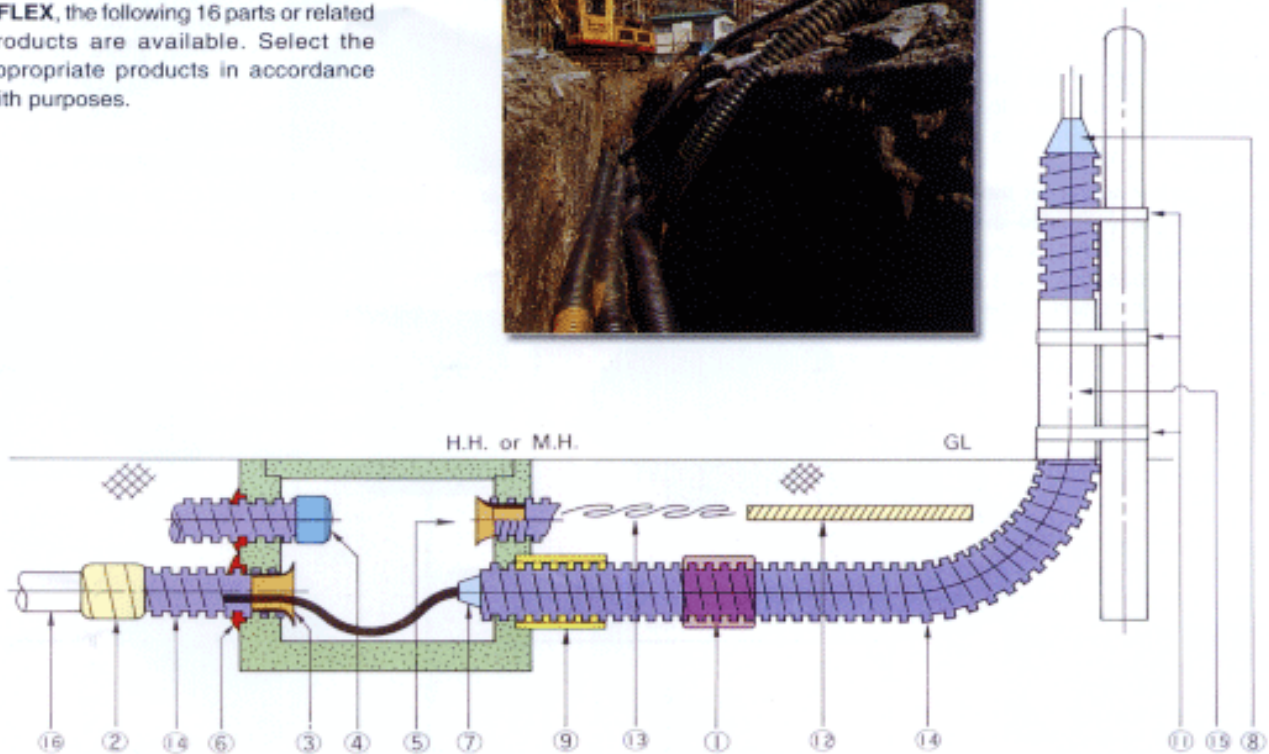
Size (mm)	30φ	50φ	80φ	100φ	125φ	150φ
Outer test rod diameter	20	40	60	80	105	130
Test rod length (for 2m R)	400		600			



Parts and Related Products of EFLEX — Ensure Safer, More Reliable Cable Conduits

Cable Conduit Model

A model for a manhole and outdoor rising terminal is shown below. For EFLEX, the following 16 parts or related products are available. Select the appropriate products in accordance with purposes.



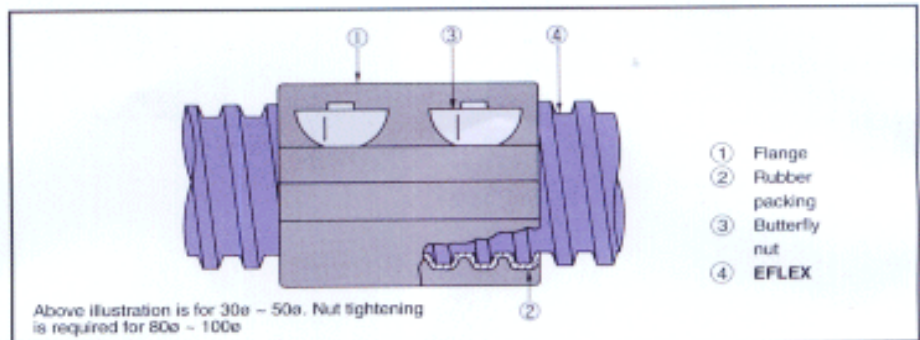
	Parts and Related products	Purpose	Type
1.	Straight joining materials	For joining EFLEX units together	For EFLEX sizes
2.	Joining materials for EFLEX to other pipe	For joining EFLEX units to other pipes	Various in accordance with mated pipes
3.	Bellmouth	For finishing manhole walls	For EFLEX sizes
4.	Waterproof cap	For closing the openings of spare conduits	For EFLEX sizes
5.	Bellmouth with cover	To prevent sand from entering spare conduits	For EFLEX sizes
6.	Waterproof wall sealing compound	For sealing manhole walls against water	Two-agent type
7.	Waterproof materials for EFLEX in manhole (Sand Preventive)	For waterproof treatment of manhole walls	For EFLEX sizes each for single and for multiple cables
8.	Outdoor end treatment (Sand Preventive)	For waterproof treatment of rising terminals	For EFLEX size each for single and for multiple cables
9.	Buffer materials	For reinforcing the outside of manholes	For EFLEX sizes
10.	Clamp	For security of terminal boxes.	For EFLEX sizes
11.	Universal band (commercially available)	For security of electrical poles	For 50 mmØ or less and for 80 mmØ or up
12.	EFLITE	For preventing damage during trenching	20 mm thick, 300 mm wide and 1700 mm long
13.	Sign tape	For warning against damage during trenching	0.15 mm thick, 150 mm wide and 50 m long
14.	EFLEX		
15.	Rising end protector (commercially available)		
16.	Other pipe		

Joining and Finishing of EFLEX Ends are Made Easy with the Straight Joining Technique and by Using Waterproof EFLEX Materials within a Manhole

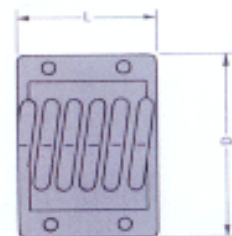
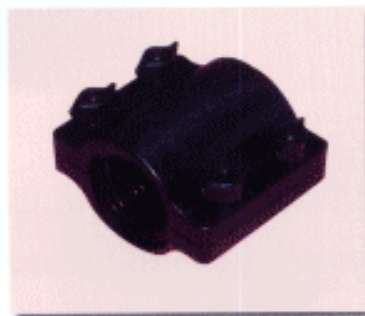
- **Straight Joining Part (for joining the EFLEX system together)**

- **Straight joining procedure (high joining type) for 30ø - 100ø**

Wipe water and dirt off the surface of the EFLEX joining portions with a cloth and connect the pilot wires inside the EFLEX to each other. Fit EFLEX systems together and cover them with two split flanges (note the direction for covering the flanges and align eyemark directions with each other). Attach butterfly nuts and tighten them manually.



- ① Flange
- ② Rubber packing
- ③ Butterfly nut
- ④ EFLEX

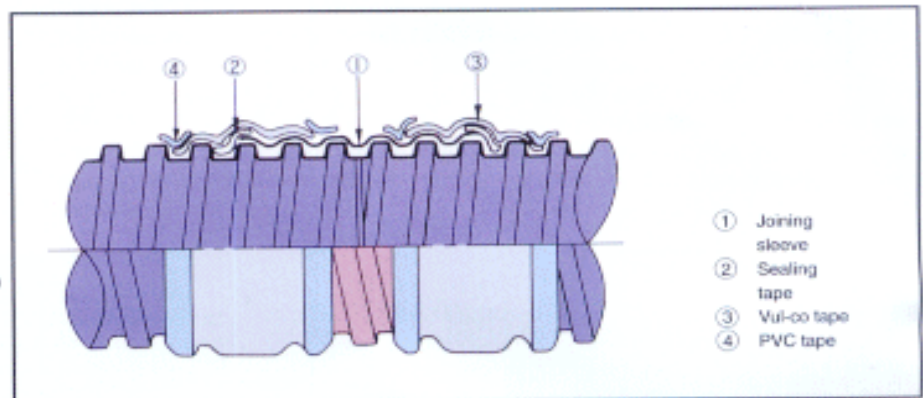


Size (mm)	Flange width D (mm)	Total length L (mm)
30ø	87	60
50ø	118	100
80ø	167	150
100ø	192	190

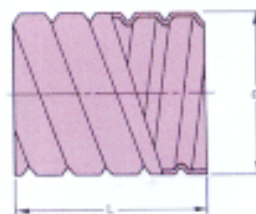
Import form Japan

- **Straight joining procedure (taping type) for 30ø - 150ø**

Screw the sleeve (1) into one of the ends of EFLEX to be joined and connect pilot wires. Align the two EFLEX ends and join EFLEX together by turning the sleeves in opposite directions. Wrap the sealing tape (2) around both ends of the sleeve and cover the sealed parts with Vul-co tape (3). Secure the tape edges with PVC tape (4).



- ① Joining sleeve
- ② Sealing tape
- ③ Vul-co tape
- ④ PVC tape



Size (mm)	Outer dia D (mm)	Length L (mm)
30ø	47.0	102.0
50ø	72.0	169.0
80ø	111.0	245.0
100ø	142.0	327.0
125ø	175.0	392.0
150ø	205.0	436.0

- **Bellmouth**

After EFLEX has been fixed to the manhole, the bellmouth should be attached to the end part of EFLEX to enhance appearances and prevent cable from being scratched or damaged when being pulled in. The bellmouth can be screwed easily into the EFLEX.

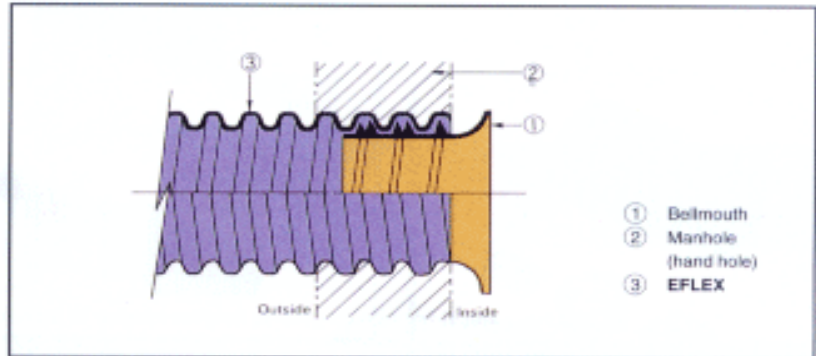
- **When ordering the bellmouth:**

Identify the part as follows "Bellmouth EFLEX for mm (Standardized stock part)

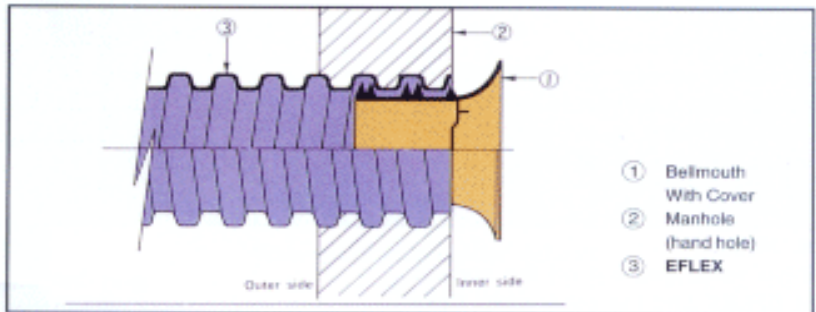
- **Bellmouth with cover**

For preventing sand from entering spare conduits

A cover is attached to the bellmouth to prevent sand and dust from entering conduits. The cover should be removed when the bellmouth is in use.

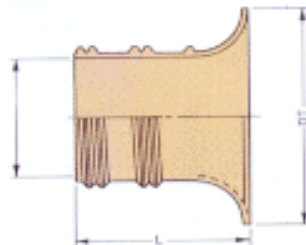


- ① Bellmouth
- ② Manhole (hand hole)
- ③ EFLEX



- ① Bellmouth With Cover
- ② Manhole (hand hole)
- ③ EFLEX

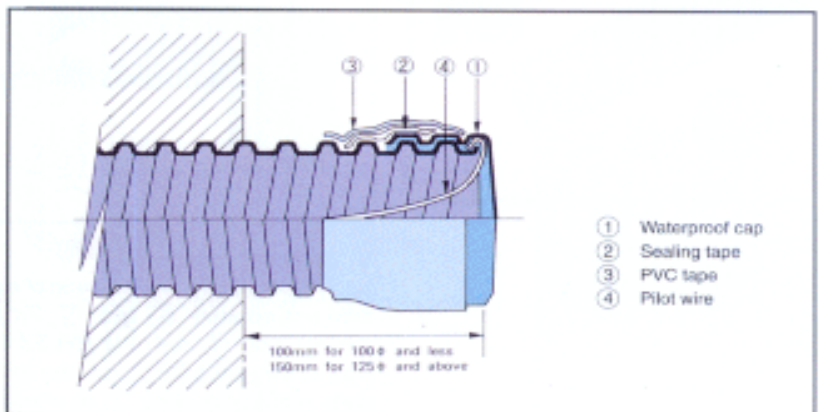
Material: High density polythylene



Size (mm)	Outer dia DT(mm)	Inner dia d(mm)	length L (mm)
30 ø	50	25.5	40
50 ø	78	44.5	60
80 ø	115	74.0	85
100 ø	144	93.0	105
125 ø	176	116.0	130
150 ø	205	140.5	150

- **Waterproof cap for EFLEX End**

Screw the water cap onto the outside of EFLEX (the amount of EFLEX protruding from a wall should match the amount of a taping). Wrap sealing tape around the boundary line of EFLEX and secure its end with PVC tape.



- ① Waterproof cap
- ② Sealing tape
- ③ PVC tape
- ④ Pilot wire

- **Kinds: 6 types**

FFC-30, 50, 80, 100, 125, 150

- **Composition**

Waterproof cap, sealing tape and PVC tape

● **Joining EFLEX to Other Pipes**

Adaptor



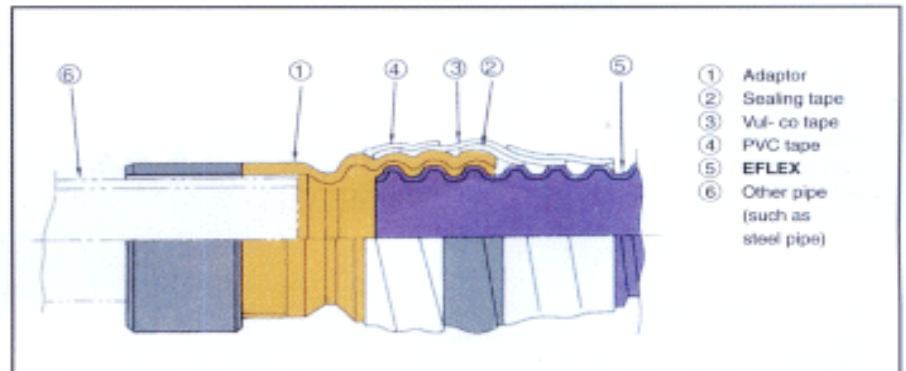
Import From Japan

■ **Joining procedure**

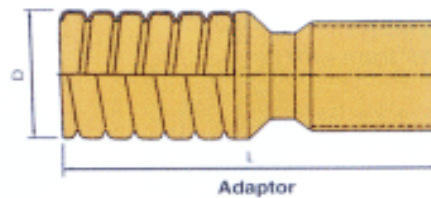
Screw the adaptor ① into EFLEX and push another pipe into the adaptor until it fits into EFLEX. Cover the portion with waterproof tape, as for straight joining. (②, ③ and ④)

■ **Notice**

Wipe water and dirt off the surface of EFLEX and the other pipe. (take particular care with screw portions.)



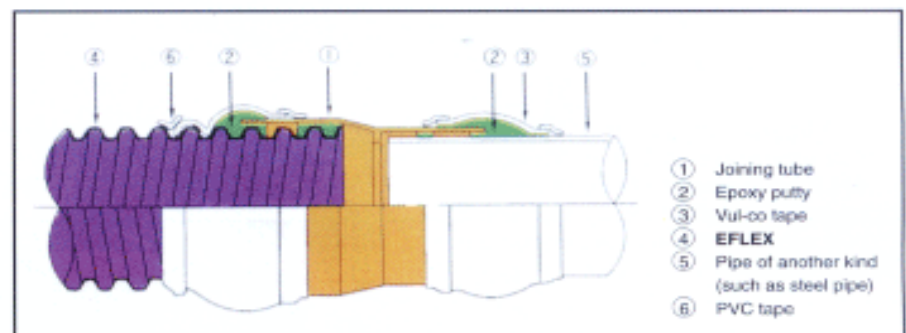
- ① Adaptor
- ② Sealing tape
- ③ Vul-co tape
- ④ PVC tape
- ⑤ EFLEX
- ⑥ Other pipe (such as steel pipe)



Adaptor

Size (mm)	ADAPTOR	
	D (mm)	L (mm)
30 φ	47.0	101.0
50 φ	72.0	155.0
80 φ	111.0	240.0
100 φ	142.0	282.0
125 φ	175.0	314.0
150 φ	205.0	336.0

A type joining part



- ① Joining tube
- ② Epoxy putty
- ③ Vul-co tape
- ④ EFLEX
- ⑤ Pipe of another kind (such as steel pipe)
- ⑥ PVC tape

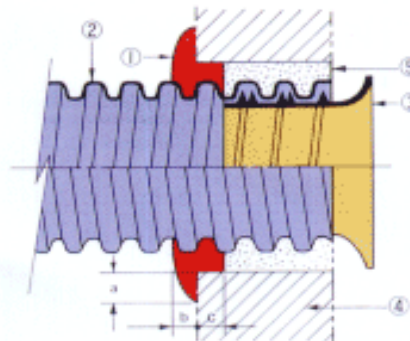
■ **Joining procedure**

Apply Epoxy putty over one end of each different conduit ④ and ⑤. Fit the joining tube ① over the EFLEX and pipe to be joined, and pad the joined parts with Epoxy putty ② as shown in the above figure. Cover the padded parts with Vul-co tape ③ and secure the Vul-co tape edges with PVC tape ⑥.

■ **Please place orders for type A parts as early as possible since they are designed according to the size of the EFLEX and the other pipe.**

Waterproof Wall Sealing Compound

If **EFLEX** is laid in a location with a high underground water level, a waterproof wall sealing is necessary for **EFLEX** systems set in manholes. The waterproof wall sealing compound (Epoxy putty) is composed of a base (black) and a hardener (white). Mix the sealing compound well and apply it into cavities between the wall and the **EFLEX**. Be sure to wear rubber gloves when handling the compound.



- ① Waterproof wall sealing compound (Epoxy putty)
- ② **EFLEX**
- ③ Bellmouth
- ④ Manhole (Hand hole)
- ⑤ Mortar

Size (mm)	a(mm)	b(mm)	c(mm)
30φ - 100φ	20	10	20
Above 125φ	20	10	30

When ordering

Please specify "waterproof wall sealing compound"

A package consists of a can containing 1.5 kg of the compound and a can containing 1.5 kg of curing agent (total of 3 kg). The compound and agent are also available as a 0.5 kg = 0.25 kg+0.25 kg set. (However, the sale unit is 1 kg)

Amount of waterproof wall sealing compound (Epoxy putty)

EFLEX		Dia of hole on wall	Amount of Epoxy putty
Size (mm)	Outer dia. (mm)	Approx. mm	kg
30 φ	40	80	0.5
50 φ	65	110	0.5
80 φ	105	160	1.0
100 φ	130	180	1.5
125 φ	160	210	2.0
150 φ	190	260	4.0

Waterproof Material for EFLEX Used in Manholes and Outdoors



Waterproof material should be applied to **EFLEX** attached to a manhole into which water may penetrate and to **EFLEX** used outdoors.

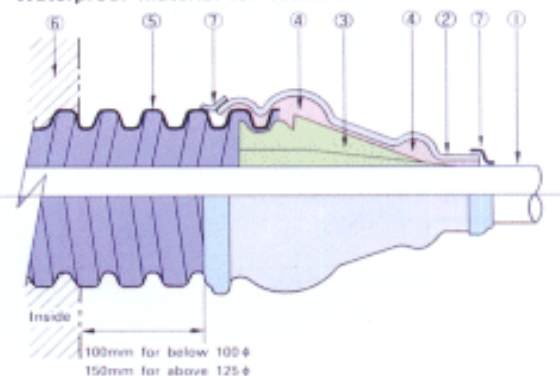
Application procedure

Insert sand preventive (3) into an end of **EFLEX** and cover with waterproof compound (4) or sealing tape. Wrap Vul-co tape around it and secure its end with PVC tape. The end of the sand preventive should be cut beforehand so that its length matches the outer diameter of the cable. When **EFLEX** is attached to a manhole part, the amount that protrudes should match the amount required for taping before it is attached to the manhole

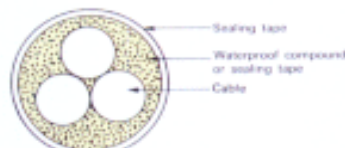
When ordering

Please specify your order for water proof material as follows: □ mm **EFLEX**. Also, please specify whether your order for waterproof material is for multiplex cables: when the cable is triplex or when multiplex cables are collectively pulled through **EFLEX**.

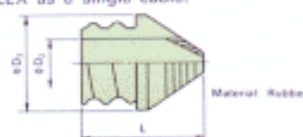
Waterproof material for conduit



Example of when multiplex cables are pulled through EFLEX



When triplex cables or multiplex cables are pulled through **EFLEX**, they should be rounded to resemble a single cable and should also be pulled through **EFLEX** as a single cable.



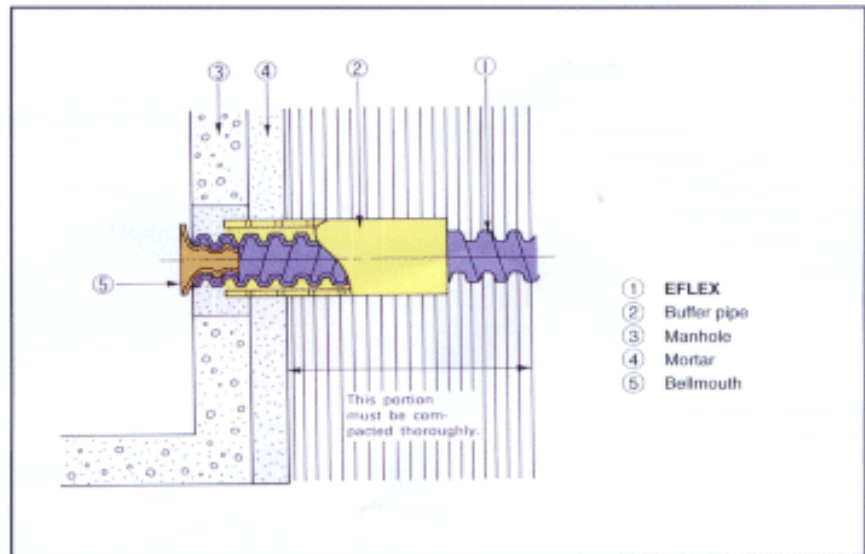
Size (mm)	D ₁ (mm)	D ₂ (mm)	L(mm)
30 φ	25	43	56
50 φ	40	68	82
80 φ	69	105	118
100 φ	90	135	162
125 φ	111	163	175
150 φ	132	198	212

● **Buffer Pipe**

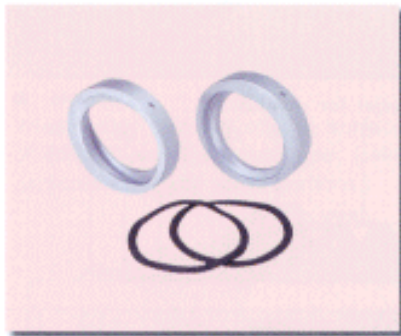
For installation at locations which are subject to heavy ground subsidence, buffer pipes as shown in the Figure opposite are recommended for manhole fitting.

■ **When ordering**

Please specify your order for buffer pipes as follows: mm ø EFLEX.



● **EFLEX Clamp**



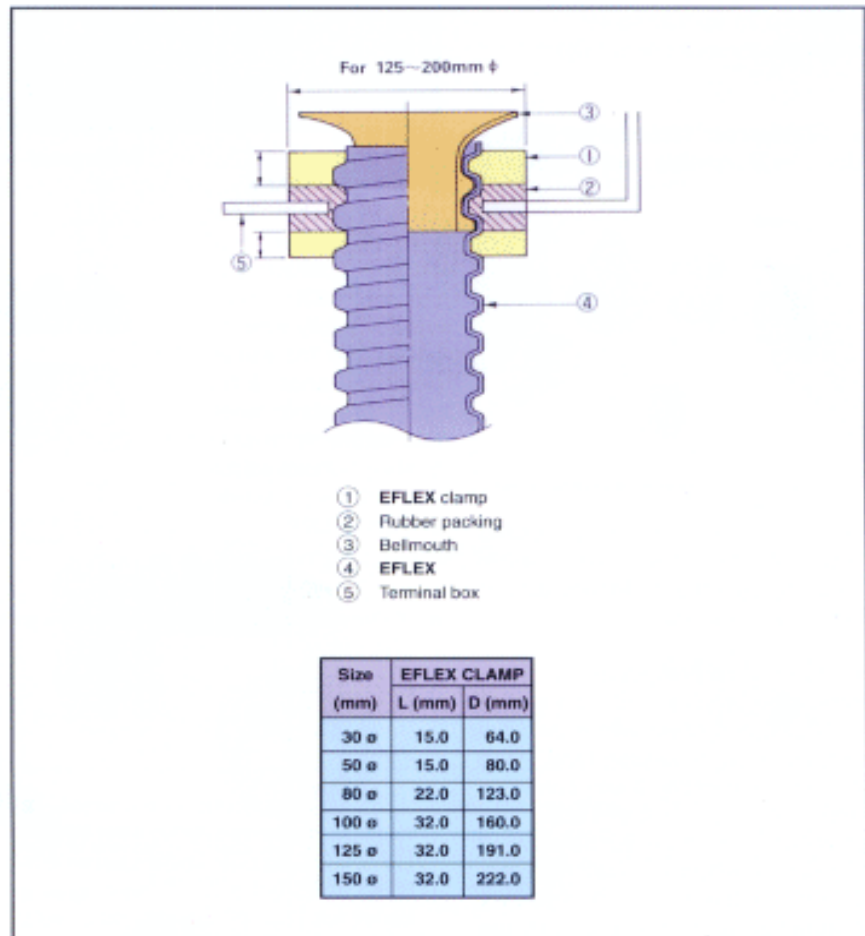
If EFLEX units are fitted to a terminal box, use EFLEX clamps as shown in the Figure.

A hole such as that indicated in the Table below should be opened on the EFLEX fitting plane of the terminal box to match the diameter of EFLEX used.

Size (mm)	Hole dia. of wall (mm)
30 ø	Approx 50
50 ø	Approx 75
80 ø	Approx 110
100 ø	Approx 140
125 ø	Approx 170
150 ø	Approx 200

■ **When ordering**

Please specify your order for clamps as follow: EFLEX mmø



EFLEX-FR

EFLEX - FR CORRUGATED HARD POLYETHYLENE PIPE WITH FLAME RETARDANT



EFLEX - FR will be needed as a cable protecting conduit in exposed area of factories, building and power stations where nonflammability is demanded and optimum for work sites.

HIGH LEVEL OF NONFLAMMABILITY

1. NONFLAMMABILITY

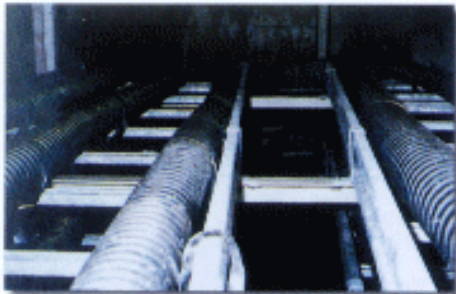
Meet the nonflammability test stipulated in IEEE STANDARD 383.

2. OUTSTANDING STRENGTH

Endowed with excellent flattening compression strength same as EFLEX.

3. WORK ABILITY

Laying EFLEX - FR can be done in a minimum space and serves for the upgrading of working efficiency short time and labour saving



FACTORIES



MANHOLE



POWER STATION



CABLE TUNNEL