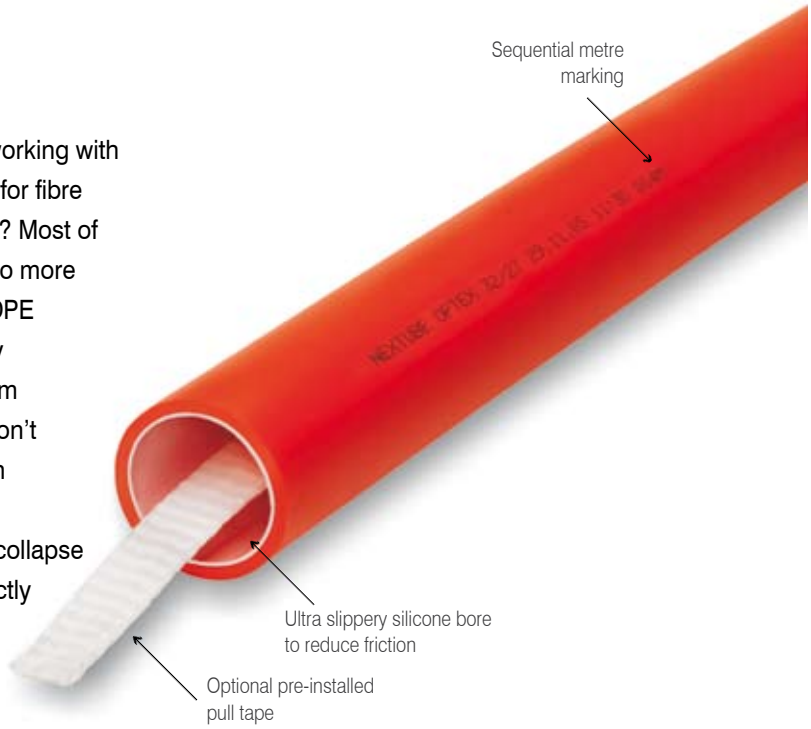
SABS ISO 9001

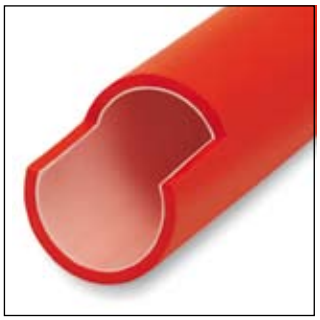
Optex®

Permanently pre-lubricated HDPE duct for fibre optic cables

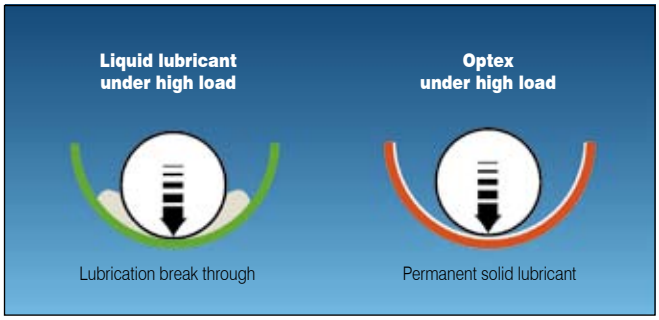
Are you tired of working with low quality ducts for fibre optic (FO) cables? Most of these ducts are no more than coloured HDPE water pipes. They spring off the drum like a pig's tail, won't haul into the main duct, burst when blowing fibre, or collapse when buried directly in the ground.

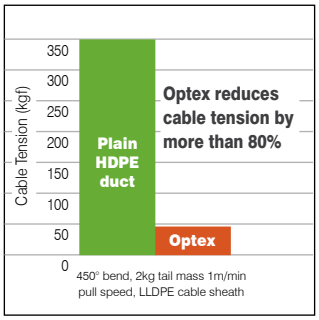
Help has arrived. Introducing **Optex**, a revolutionary, purpose designed, FO cable duct system manufactured in South Africa to the highest quality standards. **Optex** duct is manufactured from virgin HDPE and has an ultra slippery silicone co-extruded bore. This dramatically reduces the friction between the cable and the duct. This means lower pulling tensions, less cable damage, longer pulls, and quicker installation. **Optex** is suitable for direct burial or use as a sub duct.





Optex – the answer to fibre optic duct problems





Quality

Nextube, the manufacturer of **Optex**, adheres to the highest quality standards. Nextube has been awarded SABS ISO9001 certification, and also holds the coveted Telkom SA Quetel Gold quality certification.

Friction

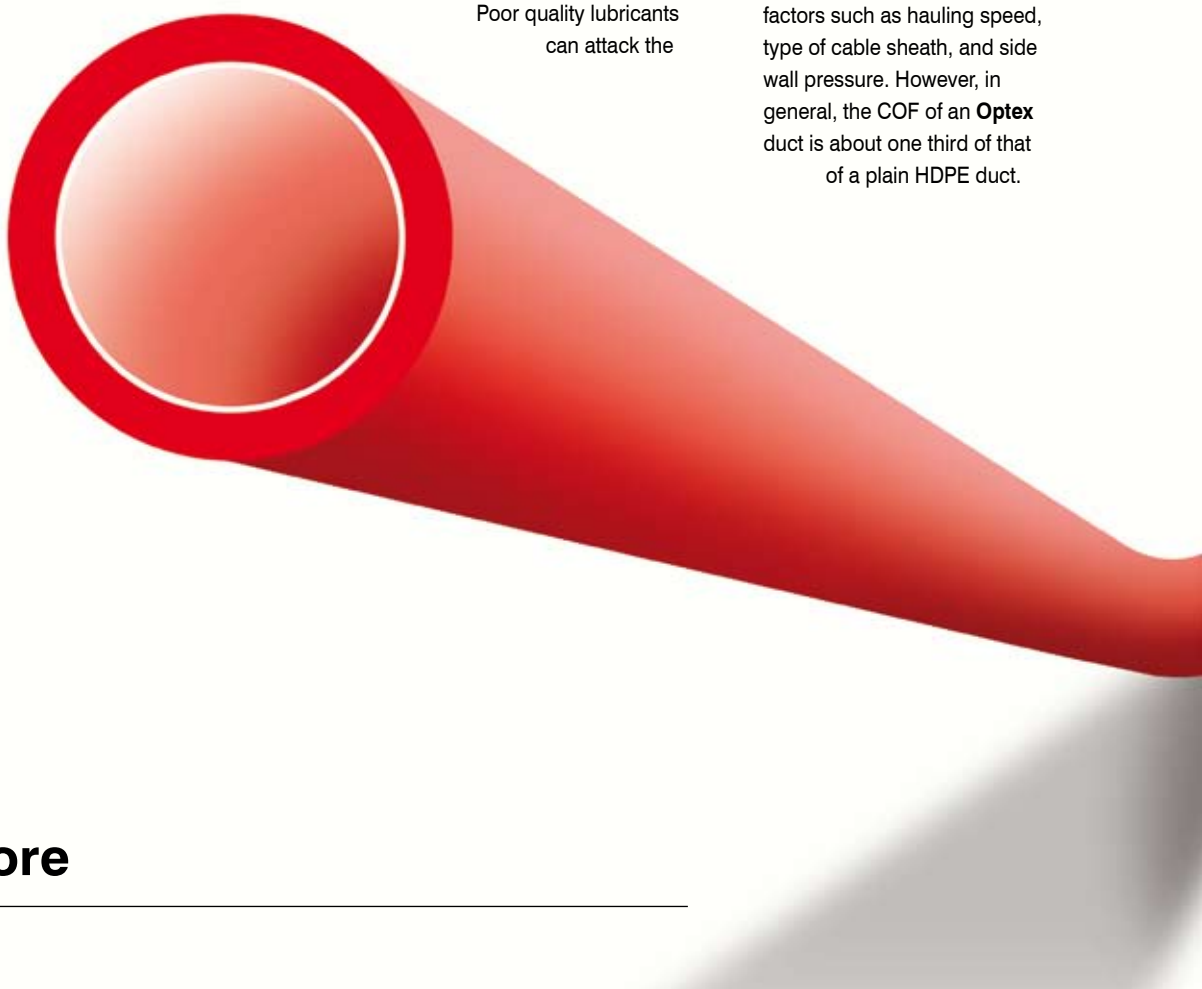
The most important factor to consider when installing cable into a duct is the coefficient of friction (COF) between the sheath of the cable and the inside bore of the duct. The lower the COF, the lower the hauling tension required on the cable. The lower the hauling tension, the less chance of damage to the cable, the quicker the installation, and the longer the pulling or blowing distance. Cable manufacturers will tell you that excessive tension during hauling is the single biggest cause of cable failure.

Many Engineers believe that friction is not important when cable is blown into duct, since it floats on a bed of air and does not touch the duct. However this is not true. Even with blow-in techniques there are multiple points of contact between the cable and duct, and friction reduction is just as important.

So how do you reduce the COF? In the past the most common method has been the use of liquid lubricants. These are very messy, attracting dust and dirt. They are difficult to apply uniformly around the inner bore of the duct. Poor quality lubricants can attack the cable sheath or duct causing stress cracking that ultimately leads to the failure of the cable or duct. Liquid lubricants also dry out over time, and in some cases even cause the cable to stick to the duct.

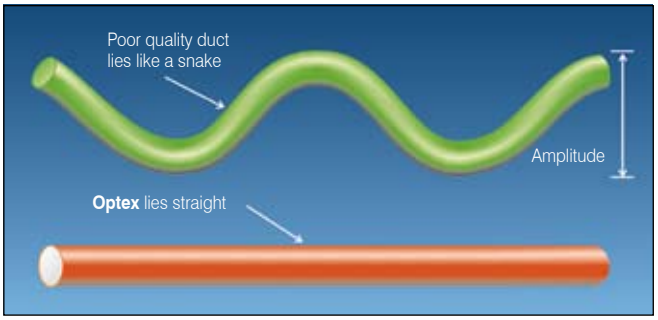
Some ducts have internal longitudinal ribs that are supposed to reduce the COF. Our laboratory results show that these ribs can actually increase the COF when compared to plain HDPE ducts.

Optex duct has a solid co-extruded super slippery bore in which silicone molecules are evenly and permanently bonded to the inner duct wall. They do not dry out or get displaced by the pressure between the duct and cable. The COF between a duct and cable depends on many factors such as hauling speed, type of cable sheath, and side wall pressure. However, in general, the COF of an **Optex** duct is about one third of that of a plain HDPE duct.



Optex – super slippery silicone bore

Table showing effect of bends on cable tension			
		Cable tension (kgf)	
Number of wraps	**Bend (°)**	**Optex duct** COF 0.12	**Plain HDPE duct** COF 0.38
1	360°	21	109
2	720°	45	1 185
3	1 080°	96	12 905
4	1 440°	204	140 500



The relationship between the COF and cable tension is not linear, it is exponential. A small reduction in COF can result in a very large reduction in cable tension. See graph on opposite page. This is because all practical duct installations have some amount of bend in them; they are never perfectly straight. The following experiment shows how bends affect cable tension. A cable is pulled into a duct that is still on a drum.

Each time the cable is wrapped around the drum it has gone through 360° of duct bend. Results of a test with a one metre diameter drum and 10 kilograms of back tension on a FO cable are shown in the table above. Notice how after only 2 wraps (720°) the cable tension in a plain HDPE duct is 1185kg, which is way over the maximum permissible tensile load of the cable.

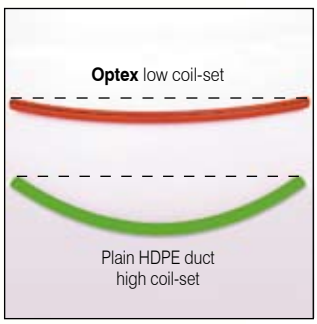
How is COF measured?
Not by sliding your finger on the inner bore of the duct, this can be very misleading! The industry standard is the Bellcore friction test. The test varies in its detail but basically consists of wrapping a length of test duct around a mandrel, inserting a cable with a tail weight, and measuring the force to pull the cable through the duct. See the picture of typical test apparatus below.

Coil-set
When poor quality HDPE duct is unreeled or uncoiled it retains the curvature of the drum or coil. It does not lie flat, it spirals. This is known as coil-set and it is a measure of how much *reel* memory a duct has.

Coil-set creates two problems. Firstly, the spiralling makes it extremely difficult for the sub duct to be hauled into the main duct. Secondly, once the sub duct is installed in the main duct, or directly buried in the ground, it does not lie straight but lies in a snake-like configuration. At each curve the cable touches the duct. The friction between the cable and duct at these points of contact adds cumulatively over the entire length of the pull, and **dramatically** increases cable tension.

The table below shows the effect of coil-set on cable tensions. The higher the coil-set the greater the amplitude. As the amplitude of the snake increases, so the pulling tension increases exponentially.

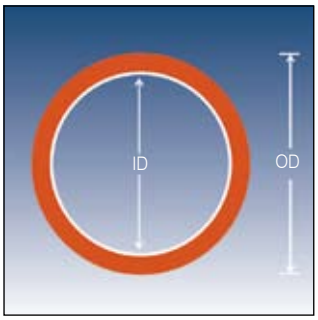
Duct that is coiled before it has had time to cool sufficiently from the extrusion process exhibits high coil-set. The **Optex** manufacturing process is designed to reduce coil-set to the absolute minimum, so it lies as straight as possible when unreeled.



Coil-Set Amplitude (mm)	Cable Tension (kgf)
0	25
13	61
25	102
50	478
150	13 500

Increasing coil-set

This assumes an 800m pull, a cable mass of 1kg per metre, a friction coefficient of 0.15, no incoming tension, and a wave period of 9 metres.



Jointing

Optex duct is joined by means of standard compression couplings. The duct should be cut with pipe shears or a rotary pipe cutter, and the inside bore reamed to ensure that there are no rough edges on which the cable can snag.

Working life

Duct that is manufactured with recycled or poor quality polymer is susceptible to stress cracking from environmental chemical attack. The cracks start micro-scopically but eventually lead to the complete failure of the duct. **Optex** is only manufactured from the highest quality virgin polymer and has an operational life in excess of 50 years.

UV stability

Optex is UV stabilised and can be stored outdoors for a maximum of one year.

Specifications

There are no SABS, EN or IEC specifications for fibre optic ducting. **Optex** is manufactured in accordance with major interna-tional Teleco specifications. A detailed **Optex** specification is available on request.

Sizes

Optex is available in 3 standard outside diameters and 2 wall thicknesses depending on whether the application is direct burial or sub duct.

As a rule of thumb the cable diameter should not exceed half the inside diameter of the duct.

Sub duct OD/ID (mm)	Direct burial duct OD/ID (mm)	Recomm. max. cable diameter (mm)
32/27	32/26	13
40/35	40/33	16
–	50/42	21
Other diameters and wall thicknesses are available on request		

Bending radius

The minimum recommended bending radius is 10 times the outside diameter of duct.

Pull tape

It is possible to pre-install a polyester pull tape into the duct. This tape has a breaking strain of 800kg and is used to pull in the FO cable. Alternatively a more economical pilot rope can be installed with a 100 kg breaking strain.

Packaging

Optex can be supplied either on steel reels or in coils. The standard reel dimensions are 2.25m flange diameter, 1.1m overall width, and 90mm spindle hole diameter. Other reel sizes or coil lengths are available on request.

Duct diameter (mm)	Drum length (m)	Coil length (m)
32	3 000	500
40	2 000	500
50	1 000	500
Other lengths are available on request		

Removal of cables

Re-cabling is common in the refurbishment of telecommunica-tion systems. The old cable has to be removed and the new one installed. This sounds simple in theory but often the old cable is adhered to the duct by silt, mud, or old dried liquid lubricants. It requires enormous force to remove the bonded cable resulting in the cable breaking and the duct having to be abandoned. The silicone lubricant used in the bore of **Optex** will not dry out over time as its lubricant is molecularly bonded to the HDPE duct wall. This allows for the easy removal of old cables many years after they were installed.

Marking

Optex is marked with contrasting lettering at metre intervals showing date of manufacture, duct dimensions, sequential metre marking, and any other information required by the customer. This marking allows the user to see how much duct has been installed and how much remains on the drum.

Colours

Optex can be supplied in any colour to suit the customer's requirements. The addition of four coloured longitudinal stripes for identification purposes is optional.

Installation

Optex should be laid in accor-dance with SANS 1200 LB, but the soil particle size for bedding and padding material must be less than 12mm. Care must be taken to lay the duct as straight as possible.

Pressure rating

The direct buried ducts have a pressure rating of 10 bar and the sub-ducts a rating of 6 bar.

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