KILLICKS STANDARD GROUT PUMP:
The KILLICKS Standard Grout Pump is a simple but efficient low cost equipment ideally suited for grouting cable ducts in small and medium sized pre stressed concrete members. It is a hand operated stirrup pump of the diaphragm type in which grout is drawn up the suction pipe past a simple non return ball valve, and on the pressure stroke is driven forward into the feed hose through a similar non-return valve. Site trials of grouting of ducts in normal beams have shown that the KILLICKS Standard Grout Pump can supply 130 liters of neat cement grout per hour of pumping time, which means it is a pump having a fairly large capacity. The maximum working pressure is 3 Kg/cm² (40 psi).

GROUTING PRACTICE:
The purpose of grouting post tensioned tendons in pre stressed concrete members is to provide permanent protection to the post tensioning steel and to develop bond between the pre stressing steel and the surrounding concrete. This also applies to grouting of soil and rock anchors. However, in the case of soil and rock anchors, since the hardened grout sustains the full pre stressing force, more detailed consideration has to be given to grout strength and injection procedures.

GROUT MIX:
The grout is a mixture of cement and water with or without admixtures. The recommended grout mix is 1 bag (50 kg) of Portland cement to 22 liters of water, which works out to a water cement ratio of 0.44. Under normal conditions, this mix gives a cube strength of around 200 kg/cm² at 7 days or 300 kg/cm² at 28 days.

SAND SHOULD NOT BE ADDED TO THE GROUT MIX.
We do not recommend use of sand in the grouting of pre stressed concrete works as experience has shown that presence of sand in the grout causes too many difficulties and, offers no advantage. KILLICKS grout pumps are therefore designed for use with pure cement grout without sand. Portland cement used. For making grout should conform to IS 269 and should be fresh and should not contain any lumps or show any signs of hydration.

The water used should be potable, clean and free of injurious quantities of substances known to be harmful to Portland cement or to the pre stressing steel. Known harmful substances are chlorides, fluorides, and sulphates.

KILLICKS HIGH PRESSURE GROUT PUMP:
The KILLICKS high pressure grout pump is designed for use in medium and large sized pre stressed concrete works. It is a hand-operated diaphragm unit and weighs only 9 kg. It is easily handled and particularly suited for working on scaffolding or where operating space is restricted. The pump produces a pressure of 10 kg/cm² (140 psi) and delivers 600 liters of neat cement grout per hour of pumping. The pump is so designed that all working parts are readily accessible for easy maintenance.

ADMIXTURES: Research has confirmed that for basically horizontal tendons in rigid ducts, satisfactory quality of grout may be achieved without use of any admixtures. However, admixtures, if used should impart the properties of low water content, good flowing ability and minimum bleed. Its formula should contain no chemicals in quantities that may have harmful effect on the pre stressing steel or cement. Admixtures containing chlorides (as CI in excess of 0.5 percent by weight of admixture) fluorides, sulphates and nitrates should not be used. If desired aluminium powder of the proper fineness and quality which is well dispersed can be used to obtain a 5 to 10 percent unrestrained expansion of the grout. All admixtures should be used in accordance with the instructions of the manufacturer.

DUCTS
All ducts should have grout opening at both ends. Grout vents at high, and low points of draped cables are normally not necessary for tendons up 120 m Length. However, low point drain vents should be provided in works located in freezing climates for draining rain water etc. For tendons made up of a number of wires, bars or strands the cross sectional area of the duct should be at least twice larger than the nominal diameter of the wire, bar or strand.

PREPARATION FOR GROUTING
Flushing of metal ducts may not be necessary in most cases. Historically, flushing has used to clear the ducts of foreign materials and to wet the surfaces for better groutability.

In recent years grouting experience has indicated that flushing is not necessary and may in fact be undesirable in the case of large and long tendons due to the difficulty of fully removing the water from the duct. Ducts with concrete walls may be flushed with water to ensure that the concrete is wetted. Well before commencement of
the actual grouting operation, all anchorage recesses (at both ends of the cable being grouted) should be mortared up with the appropriate type of grout connector threaded in place. Allow the mortar to set.

**MIXING OF GROUT AND GROUTING:**
Grout can be manually mixed in drum or with a mechanical grout mixer (Agitator). Correct Amount of water should first be poured into the mixer/drum followed by correct quantity of Portland cement. SAND SHOULD NOT BE ADDED. Mixing should be of such duration as to obtain a uniform thoroughly blended grout (without excessive temperature increase in the case of mechanical mixing). The grout should be kept continuously agitated until it is pumped. Normally mechanical mixtures require 1 1/2 to 3 minutes to satisfactorily mix the grout and manual mixing takes about 3 to 5 minutes. For grouting with KILLICKS Standard Grout Pump the pump should be placed over a bucket containing the mixed grout. When using KILLICKS High Pressure Grout pump its sieved suction funnel should be placed inside the grout. In either case, the suction inlet of the grout pump should be kept low inside grout. Start pumping to check the operating of the pump so that grout starts to flow freely through the pump. Continue pumping with steady even strokes and keep the grout pump bucket topped up with grout and keep the grout gently agitated whilst pumping. Do Not allow the level of Grout in the bucket to fall below the Suction inlet of the pump. Once pumping has commenced it should be continued without ceasing until the duct concerned is full. When a member contains several ducts these should be grouted in order from the lowest to the highest. Always complete the full grouting of a member in one continuous series of operations. If a member is made-up of precast segments which are assembled together and post tensioned, grouting should be done after complete pre stressing of the entire beam whenever this possible. Do not grout if there is any danger of freezing weather occurring before the grout is set. If the pump tends to block keep the suction inlet sieve of pump manually cleaned whilst grouting. If this does not help, dismount the pump and pump clean water through it. On reconnecting, regard the duct as un grouted and pump enough additional grout through to fill the duct and provide 25% excess. This will ensure that no air pocket is left by the disconnection.

When the duct is completely full of grout allow sufficient quantity of grout to over flow from the other end to ensure no air pockets are left. Once thick grout starts flowing from the other end of the duct, plug the vent hole and continue pumping till the pump become hard to operate. Close the pressure retaining grout cock on the pumping side and unscrew the coupling. The pressure retaining grout cock can be unscrewed only after the initial-set of the grout which will be about 2 ½ to 3 hours after grouting. The grout cock should be thoroughly cleaned immediately after it is unscrewed to remove all grout from the inside.

**PRECAUTIONS:**
1. Do not use and sand in the grout mix.
2. Sieve all cement before use.
3. Keep dirt out of the ducts by plugging the open ends, with paper.
4. It is not necessary to flush ducts with water or to blow them with compressed air before grouting. The can cause difficulty by blowing forward dirt which can accumulate against a spacer and cause a blockage.
5. It is necessary to grease all grout connectors, pressure retaining cocks and coupling etc. both internally and externally before use to prevent the grout from blocking them.
6. Above all, do not forget to flush the grout pump with clean water immediately after the grouting operation. Otherwise, you will be grouting the grout pump itself!