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Applications
Engineering Note

Micro cable Blowing Guide

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As duct real estate becomes more congested, smaller cables with higher optical fiber counts are needed. Cable manufacturers are answering the call with high-fiber-count micro cables. Fiber capacity in these cables extends over the 432 fiber count mark with diameters less than 11 mm. These small cables are great in applications requiring high fiber density, flexibility for future network upgrades, and are designed specifically for use in microducts. These cables are engineered to be installed by cable blowing methods, so they have much lower tensile ratings than a typical outside plant cable. These cables should be installed into high fill ratio environments (~50-80%) which optimize achievable blowing distances. Blowing cables has several advantages. Longer installed lengths, higher installation speeds, and increased flexibility are only a few. This AE Note outlines considerations before beginning a micro cable installation.

Safety Information

Safety is the most essential part of successful installations. Blowing cables requires the use of very high air pressures. Proper monitoring of the air equipment is important to ensure there are no explosions or failures of coupling. Breaks in hoses can cause uncontrolled movements of the hose and could result in serious injury.

Safety glasses should be worn at all times when the air pressure is being supplied, and hearing protection should be worn while the air compressor and other equipment are running. Please refer to your company's safety policies for the proper job site safety procedures.

Blowing Equipment

Machines

For blowing machines to function properly, many different parts and pieces are used to match cable and duct combinations. The purpose of the seals, cable guides, and drive wheels/tracks is to make sure optimum conditions are achieved, and the machines are used to their maximum potential. Not using the correct pieces will result in shorter installation distances and reduced install speeds.

Cable guides in the machines are sized for a range of cables. Cable guides perform two functions. Guides are machined to accept a particular size cable, but also sized for specific cable seals. The cable seals prevent air from leaking around the cable and out of the machine. The guides prevent the cable from kinking or buckling in the machine and allow the machine to operate at the maximum available push force. A guide that is too small for the

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cable could result in pinching of the cable and increased resistance. A guide that is too big will not give sufficient support and could result in permanent damage/failure of the installed cable.

Drive wheels and tracks are also sized for specific ranges of cables. These pieces will have machined or molded grooves that maximize surface area contact with the cable. If the drive wheel or track is too small, the cable will ride the edges of the drive system and can become damaged. If the drive system is too big, the whole surface of the cable is not being used and can decrease blowing distance and push force. The correct sized drive fits around the cable, distributing the load on the cable evenly. For the drive system to function properly, compressive forces are applied to the cable allowing the drive system to clamp against the cable. If the wrong size is used, the load is not distributed throughout the jacket and can cause fiber breaks due to over compressing the cable.

Duct sizes are an important component when considering what machine to use or duct size to use. Blowing machines are designed to accept a specific range of duct diameters. The outer diameter of the duct has custom sized inserts for blowing machines. These inserts are there for two reasons. The first is to strain-relieve the duct to keep the duct securely attached to the machine. The second is to allow for proper sealing of the duct to minimize or eliminate air leaking out of the duct. Most inserts have a machined groove to accept the appropriate cable seal for the cable that is being installed.

Air Compressors

The air supply should be efficient enough for the duct diameter and total connected footage of duct. Blowing equipment manufacturers have a recommended air compressor rating for the duct and cable being used. Some blowing equipment is also pneumatically driven, which will increase the air supply that is required. An ideal air compressor for micro cable installations would be rated at 220 psi at 32 CFM. Acceptable results can be seen with air compressors with lower ratings. Consult the equipment manufacturer for recommendations on the correct size air compressor before beginning installing cables.

Dryers/Air Coolers

Air compressors are an integral part of blowing cables but could also be the direct cause of major issues if the correct equipment is not used in conjunction with the compressor. Air compressors build significant condensation during their operation. Condensation will also form inside of the supply hoses due to temperature differences in the air and the hose. Dryers should be used to make the air as dry as possible before entering into the machine and the duct. Compressor lines should be as short as possible. If the line is excessively long from the dryer to the blowing machine, condensation could build back in the line, and reverse the work the dryer has already done.

An air cooler should be used when the ambient air temperature exceeds 68 °F. If the air compressor being used has a cooler, an external cooler may not be needed. The purpose of the cooler is to keep the air as cool as possible relative to the ambient. Hot air entering the machine and the duct can result in softening of the cable jacket and duct walls. This, in turn, will increase the coefficient of friction between the cable and the duct. Increasing the coefficient of friction will decrease installation speeds and result in shorter installed lengths. As temperature builds in the duct, the duct will become softer and weaker and the risk of a duct blowout greatly increases. Air coolers are often times driven by the air compressor, so be sure the size of the compressor can accommodate the added load from the cooler.

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Payoff System

A payoff system needs to be utilized while deploying micro cables using any blowing equipment. The cable should never be fed across the side of the reel. This will cause twisting to occur and could cause damage to the cable. The cable should be assisted coming off the reel during installation. This will require workers to spin the reel while the cable is being installed. Keeping slack in the cable by spinning the reel allows the machines to only push the cable in, and not have to overcome the rolling resistance of the payoff, which could decrease push force. A basic reel stand or reel trailer can be used for a payoff system.

Duct

Microducts are ducts with inner diameters that range in size from 3.5 mm to 16 mm. Microducts are commonly installed in larger existing ducts to save on installation time and cost. Microducts can come in many different configurations. They can either be smooth-walled, or ribbed.

Duct couplers are an important part of the duct installation. When blowing or jetting in cables, the system must be airtight to allow for the air to do its job. If the duct is leaking air, the cable will not experience the full effect of the air inside of the duct, and the total installed distance can be greatly affected. Push-Lock style couplers are the most commonly used for joining microducts together. They create an airtight connection and allow a smooth transition from duct to duct. Pressure inside of the duct can exceed 125 psi, therefore, the couplers need to be able to withstand the maximum pressure produced by the air compressor being used.

Microducts can be installed inside of existing duct or can also be direct buried in the ground. The same installation practice used for pulling regular outside plant cables into duct also applies for blowing. Bends and undulations in the duct path will affect the overall distance that can be achieved. If a new system is being installed, care should be taken to minimize bends and elevation changes. This will maximize the blowing distance. Studies have shown that bend radii and elevation changes in duct directly affect the blowing distances of micro cables.

Typical outside plant duct installations limit pulls through no more than 180° of combined bend. This can be many different combinations, for example, two 90° bends or three 60° bends. When blowing cables, this rule does not apply. There is no set limit on how many 90° bends you can blow a cable through, but cable weight and flexibility will now be the limiting factor. The two together affect how many bends the cable will be able to navigate.

Blowing Equipment Setup

Machine Setting

Machine settings can vary with different manufacturers and environmental conditions. Cable diameter and flexibility could also affect the machine settings. Duct pressure, cable speed and push force are the settings that will be of concern during installation. In general, the machine starts pushing the cable with no air being fed into the duct system. The cable is pushed in this manner until the speed of the cable begins to decrease (~300 feet). Once this point is reached, air can be added gradually to the duct. The air drags across the cable surface and reduces friction along the duct wall resulting in increased cable speed without

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increasing the push force required. Air will be added incrementally over the entire installation in this manner. Consult the equipment manufacturer for the appropriate installation recommendations.

Crash Testing

Micro cables are often times very flexible and have thin outer jackets. Care should be taken to make sure the blowing machine does not damage the cable during installation. If the cable is forced to stop in the duct by an obstruction or air, but the machine is still pushing, buckling of the cable or jacket abrasion can occur. To prevent this, a crash test is performed. A crash test can be done simply by connecting a short piece of duct to the machine with a cap on the end. Install the cable into the machine, and without pressurizing the duct, use the machine to push the cable into this short piece. When the cable crashes into the capped end of the duct, it may buckle or the wheels slip on the jacket. If this happens, adjust the machine accordingly and test again. When the machine is adjusted properly, the cable will contact the end cap and all pushing forces will stop. Upon completion of this process, you can feel confident that the blowing machine will not damage the cable during installation.

Duct Proofing/Lubrication

Duct proofing and lubrication are a very important part of blowing cables, which if overlooked, could result in serious consequences during the installation. Duct proofing shows the condition of the duct system. This is especially important if another crew installed the duct system. Foam spreaders are commonly used for duct proofing. These are sized specifically for certain duct sizes. The spreaders are blown through the duct using air pressure. If the spreader comes out of the duct system torn, or doesn't come out at all, this can be a sign that there are obstructions in the duct path. This is also a good way to make sure the duct is dry. Blowing several spreaders through the duct may be required to get the duct as dry as possible. The time at which it takes the spreader to reach the other end can verify that the duct is not flattened anywhere along the path. If the foam spreader never comes out, or the time it takes is longer than expected, there may be issues with the condition of the duct.

Lubrication is also an important aspect of this type of installation. Petroleum-based lubricants should never be used. Silicon-based lubricants are recommended, and lubricants that are designed for micro cable installations are also recommended. Too little or too much lubricant can be just as bad as none. The correct amount is outlined from the manufacturer of the lubricant and is generally measured in ounces per 1000 ft. of duct. Excessive lubrication can pool in low-lying areas of duct, causing problems during the installation. If more lubrication is desired, cable lubricators can be used to pre-lube the cable before entering the duct. Lubricant may not be needed if the duct is already pre-lubed.

Lubricant is inserted directly into the duct, followed by a foam spreader. The spreader should be blown through the duct to evenly distribute the lubricant throughout the duct system. Duct manufacturers offer duct that comes pre-lubed with silicon-lined inner walls. These ducts may not require additional lubrication before installing the cable. It is best to contact the manufacturer of the duct to ensure the proper lubrication procedures are being followed.

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Required Personnel

Installing cables does not require many people to complete an installation. One person will always be dedicated to running the blowing equipment, and another to pay off the cable from the reel to make sure no additional force is felt by the blowing machine. A person may be needed to monitor the cable as it exits the ground. This person would be responsible for spotting the cable and communicating back to the operator that the cable has made it to its destination, and also managing the cable slack as it comes out of the ground. Managing the slack will be very important to the survival of the cable.

Environmental Conditions

Environmental conditions should be taken into account before blowing or jetting begins. The first and foremost is temperature. As previously stated, air coolers may have to be used if the temperature is too high. Blowing machines have specified operating temperature ranges. If the ambient temperature is outside of the specified range, other solutions may have to be used for the install. Temperature also can affect the cable. Cables will also have an installation temperature range. If the cable is below the installation temperature, damage to the cable can occur.

Water is an enemy of cable blowing. Rainy weather can introduce unwanted water into the duct system. As before, water increases the coefficient of friction between the cable jacket and the duct, leading to undesirable blowing results. A wet cable could also affect the machines ability to grip and push the cable properly.

Cleanliness of Cable

During cable blowing, cables need to be as clean as possible. Care should be taken to make sure the cable is not touching the ground before going into the equipment. Dirt could not only cause damage to the blowing equipment, but also reduce the traction of the drive wheels. Reduced traction results in reduced push forces and reduced blowing distances. Tarps or ground cloths are recommended when slacking cable on the ground to minimize the dirt introduced into the duct system.

Planning

When planning to install cable by jetting or blowing, it is important to have a good estimation of how far you will be able to install without stopping. Many micro cables do not have sufficient pull tensions to be pulled out of the duct and blown back in if the cable becomes stuck in the duct. There is a high risk of damaging fibers if the cable is pulled. Because of this, intermediate access points may have to be installed if the distances of the entire run are greater than the estimated blowing distance. This way, you can be confident that you will not get the cable stuck inside the duct.

With intermediate access points, you may be required to figure-8 a large amount of cable on the ground. Machines are available that can be used in conjunction with blowing equipment to slack the cable as it comes from the ground. This will help keep the cable clean and not in contact with the ground.

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Summary

The desire to maximize conduit space is being satisfied by the introduction of micro cables into the telecommunications industry. Micro cables allow high fill ratios that have historically not been achievable by conventional installation techniques such as pulling. At first glance, installation of these cables can be intimidating. Understanding and using the right equipment and knowing the subtle installation differences outlined in this AE Note can lead to repeatable successful installations.

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