A Primer on Cable Pressurization Maintenance

Due to operating company downsizing, and the resulting re-distribution of personnel, there is a definite need these days for some basic information on cable pressurization. While this information may seem obvious to an experienced pressure technician, there are many people—at various levels of the telco organization—who are unfamiliar with pressurization. This primer is intended for anyone who would like to gain an understanding of the importance, benefits, design characteristics, and basic components of a cable pressurization system. It also describes some of the key management functions required for a successful air pressure operation. To help familiarize you with the terminology used, a brief glossary is provided at the back of this primer.

Why Are Telephone Cables Pressurized?

Types of Cable Insulation

The biggest threat to telephone wires (conductor pairs) is moisture. Many of the copper cables use paper or pulp as insulation between the individual conductor pairs. This type of cable offers excellent insulation characteristics as long as it is maintained dry. *Pulp insulation* has been around for a long time, and for many years it had essentially no competition. In more recent years *plastic insulated conductor (PIC)* cable has encroached upon its popularity and has taken over the number-one spot.

Unfortunately, the integrity of the protective cable sheath (which is made of lead or polyethylene) is compromised when cracks develop. The cracks in the sheath or associated splice cases allow water to enter and *electrolysis* to occur, which results in faulted pairs within the cable.

All of us are familiar with moisture damage when the morning paper is left in the rain. The characteristics of the paper change completely with the water damage. This is the same thing that happens inside the cable sheath when water permeates it. The first indication of moisture in a cable is noise on the line, followed by complete cable failure.

Water and Cable Pressure

In underground pulp insulated cable, a special problem develops due to water pressure being applied to the outside of the protective sheath. And, since the cable is usually underground (often located several feet deep), a real disaster can occur when utility holes fill with storm water.

As water rises above a cable, there is approximately 0.43 Pounds per Square Inch (PSI) of pressure applied for each foot of water level above the cable. So, for example, if a cable is 7 feet below the surface and the utility hole fills with water, there will be 7 x 0.43 (or 3 PSI) of water pressure bearing down on the cable. If there is a crack in the cable or splice case, water will permeate and cause conductor damage **unless** there is positive pressure within the cable that exceeds and counters the 3 PSI of external force caused by the water.

Minimum Air Pressure Standards

This is the basic premise of cable pressurization: Keep the pressure within the cable in excess of the pressure that could be applied by standing water. To help achieve this objective, telephone companies establish *minimum air pressure standards* for cables in different environments. For example, an *underground cable* (one that goes through conduit and utility holes underneath the street) might have a minimum air pressure standard of 5 PSI, enough to protect the cable from approximately 10 feet of water. A direct *buried cable* requires less air pressure protection (usually 3 PSI) because it is placed only a foot or so below the surface. *Aerial cables* typically require only 2 PSI because they are at less risk from water damage.

Where Does the Air Pressure Come From?

Source Pressure

The cable, although filled with individual conductors and associated insulation, is much like a long garden hose carrying air pressure instead of water. The pressure comes from a mechanical *air compressor* and dryer, located somewhere near the telephone company cable *vault*. The compressor supplies the air at approximately 10 PSI, while the dryer removes the residual moisture. Essentially, this means that air with very low humidity is forced into the cables.

How Is the Air Pressure Distributed?

Imagine once again that the cable route is like a garden hose. This hose is made up of different sections that are many thousands of feet long. Depending upon its age and a number of other variables, there will typically be leaks at various points along the cable. Like a hose, the pressure in the cable diminishes as the length increases. The pressure must be re-established in the system along the route, or the cable will be unprotected at substantial distances from the central office. Obviously, finding and fixing all of the leaks in the cable will help considerably. But, with technicians constantly working on cables (opening *splices*, etc.) and with electrolysis being a constant threat, air pressure must also be raised.

Benefits of Air Pipe

One popular way of raising air pressure in the system is by using *air pipe* that follows the cable route and introduces pressure at various fixed points (Figure 1). Because the air pipe does not include conductors (which restrict the passage of air), it is a far more efficient method of transporting air to the needed areas. The air pipe is connected to a manifold which distributes air to the cables in the utility hole.

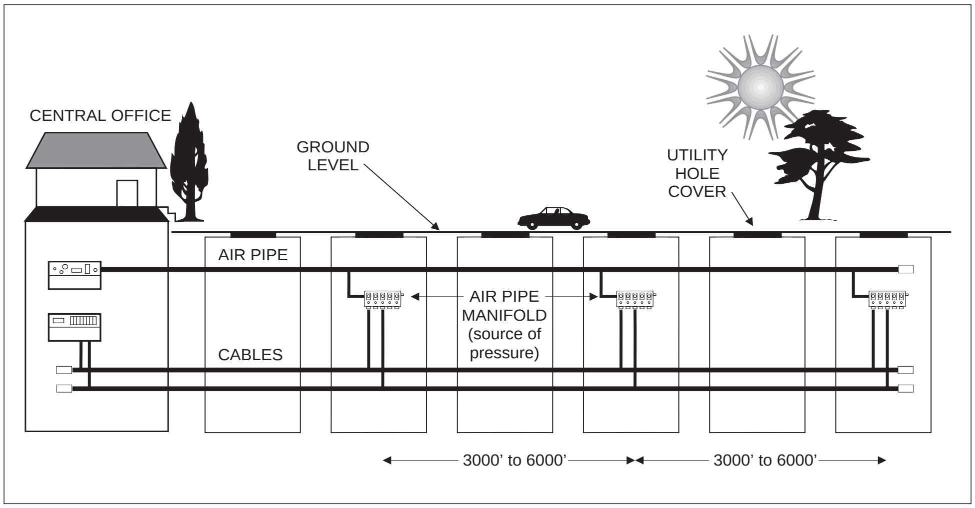


Figure 1—Air Pipe System

Air Pipe Endpoint Pressure Standard

To make sure that adequate delivery pressure is supplied to the cables in the field, most telephone companies set a minimum *pipe endpoint pressure* standard of 7.5 PSI. If the pipe pressure falls below this standard, cable protection is jeopardized. For example, it's impossible to maintain 5 PSI in an underground cable when the delivery pressure from the air pipe is only 4 PSI. For this reason air pipe delivery pressure must be carefully monitored. Think of it as a main artery in the system. If pressure in the air pipe is low, the whole system is low.

Should Maintenance Be Performed on a Routine Basis?

It is commonly thought that, once a cable leak has been found and fixed, the cable will be safe from moisture. After a repair, there is a natural tendency to conclude that "everything is okay" and that maintenance can be ignored until more leaks are found on the cable. This couldn't be further from the truth.

Maintaining a reliable cable plant is something like maintaining a large building. Deterioration of the building must be taken seriously—especially the roof—which should be frequently repaired to ensure extended use. Several parts of the country exdamage. There’s no problem for buildings (and cables) when it doesn’t rain, but after extended periods of neglect, they both require constant attention to fend off the water problems when the storms come. Maintenance is best performed when the weather’s dry.

Proactive Cable Maintenance

Today, this type of routine maintenance is often called *proactive maintenance*. Many telephone companies are shifting towards a proactive approach to the outside plant in order to prevent subscriber calls, Public Utilities Commission (PUC) complaints, and even catastrophic failure. It’s preventive medicine for the outside plant. Rather than treating the outcome of poor health (big leaks and low delivery pressure), a good diet and exercise program (changing out old cable/devices and performing maintenance on the problematic routes first) will keep future problems from occurring.

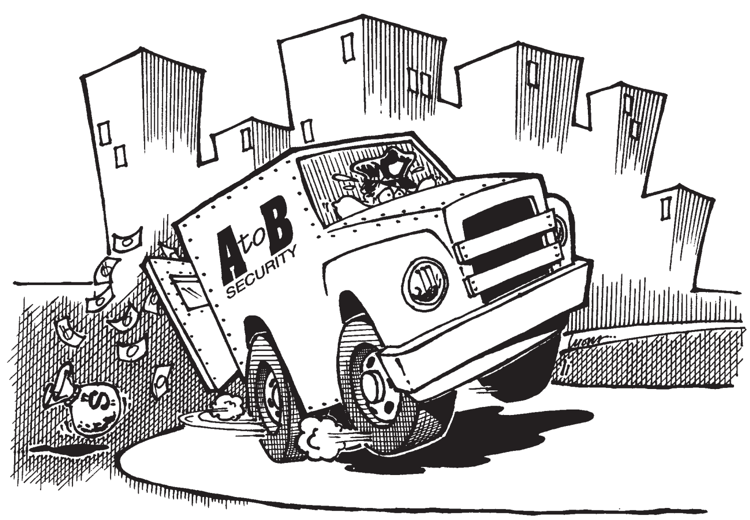
Are Cable Leaks Hard to Find?

Air Flow Analysis

When looking for leaks, an entire cable cannot be held under water (like a tire tube) to look for bubbles at the point of damage. You have to devise another method. Pressure readings will tell you that a cable is losing air, but they don’t tell you where. Because there is an inherent amount of air flow in pressurized cables, the best scheme is to follow the air flow to the leak. By setting up check points and using devices to measure the air flow, the leak can be quickly located without a foot-by-foot examination of the cable.

To use another analogy, let’s say we’re transporting money between two points (Checkpoints A and B). We would want to count the amount leaving Checkpoint A and confirm that it arrived at Checkpoint B. If the two amounts were not the same, this would indicate that we had a problem somewhere along the way between Checkpoint A and B.

By counting the amount of air flow at two designated checkpoints on a cable route, we can quickly determine if there is a leak between them. If everything arrives at Checkpoint B, we’re home free because there is no leak in that particular section.



How Is Air Flow Measured?

Flow Measurement Standards

By far, the most accurate way to measure air flow is to count individual molecules. To make this measurement more manageable, the molecules are measured by the box full. The box size is a standard cubic foot (12" x 12" x 12"), measured at sea level (a point of standard atmospheric pressure). The amount of standard cubic feet consumed is measured either per hour or per day. This measurement lets you measure high consumption rates (air dryer output) or relatively low consumption (air flow into a cable) in a meaningful way, using *Standard Cubic Feet per Day (SCFD)* or *Standard Cubic Feet per Hour (SCFH)*. These measurements help in monitoring for system leaks and in cable maintenance.

Allowable Air Consumption

Because of maintenance activity, cable splices, and the use of pneumatic fittings along the cable route, all cables tend to leak to some extent. For this reason, an allowable air flow rate, called *Optimum Air Usage (OAU)* has been established. OAU is the calculated air consumption rate that an air pressure system should use under normal operating conditions. It is based on a consumption rate of 1.25 SCFH per *sheath mile* of cable.

Like the minimum air pressure standards, OAU is important in dispatching maintenance technicians. A flow increase at an air source is **not** valuable information unless you also know the OAU, or what the air source should be flowing. OAU is also important in the design of an air pressure system and for evaluating system quality.

What About Air Pressure?

Pressure Measurement Standards

As mentioned previously, most of the air distributed into a cable system is provided by a mechanical air compressor/dryer. This central office equipment compresses or squeezes air molecules together within a given area to create greater air pressure. It’s kind of like a garbage compactor in some ways, but with a more useful end result. The amount of compression is measured in *Pounds per Square Inch* or *PSI*. For years, PSI readings were the only measurements being used in air pressure maintenance. They’re still very important, but nowadays people have come to rely on both pressure and air flow measurements.

And What’s Pneumatic Resistance?

Blockage of Air Within a Cable

Another important concept in cable maintenance is *pneumatic resistance*. This is the amount of resistance that air flow meets as it moves along inside the cable sheath between conductors. What determines the amount of pneumatic resistance in a particular section of cable are its length, the gauge of the conductors, the type of insulation (PIC or pulp), and the number of pairs in the cable.

Pneumatic resistance must be taken into account when using pressure and flow measurements when leak locating along a route. Together these three components comprise the important information needed to perform many of the successful leak locating formulas being used today.

What Is the Best Design for Protecting Cables?

In some ways, cable pressure systems are similar to municipal water systems. They have main feeder routes and lateral sections of cable which branch off and serve customers along the way. If you're in an outlying residential area, far from the pumping station, your water pressure is not going to be as great as the pressure on the main feeder route. The water pipe serving your house is going to be much smaller than the water main leaving the main station.

Lower Pressure at the End of a Route

Pressurized air is not supplied to the cables in an air pressure system by different size pipes. Still, the pressure at the end of a cable route is always going to be less than at the delivery source due to cable leaks and the pneumatic resistance of the cable. When a leak occurs in a cable, it can result in a section of cable being totally unprotected, depending upon the size of the leak and whether or not there is additional air being supplied to the cable.

Design Types

There are three basic engineering designs for protecting cables: a *static system*, a *single feed system* and a *dual feed system*. Static systems were used before there was a good method of supplying a continuous source of air to a cable (before air compressors/dryers). They're like bicycle tires—they hold pressure for a while, but eventually they will go flat.

Single feed systems pump air into the cables from one direction (one air source, such as a central office air dryer). They provide adequate cable protection as long as there are no serious leaks in the system. If you have a big leak, one that drops the cable pressure to 0 PSI, the entire section of cable beyond the leak (on the side opposite the air source) will have no air protection at all (Figure 2).

Dual feed systems prevent this from happening. They introduce air into the system at different points along the cable route. As described previously, the most efficient way to do this is with an air pipe. In a dual feed system, pressurized air converges on a leak from opposite directions, supplying positive pressure protection to the sections of cable between the leak and the two air sources (Figure 3).

What Makes Up an Air Pressure System?

System Components

We've already mentioned some of the key system components: air compressors, air pipe and air pipe manifolds. In the central office, where air is introduced into the system, there are a number of other important system components. *Distribution* or *meter panels* (referred to by either name) are rack-mountable equipment panels that regulate pressure from the air compressor and distribute it to the cables in the vault. *Pipe alarm panels* provide the same function for air pipe leaving the central office. Both panels are equipped with flow raters for physically checking outgoing flow rates.

Cable Protection Jeopardized by Zero Leak

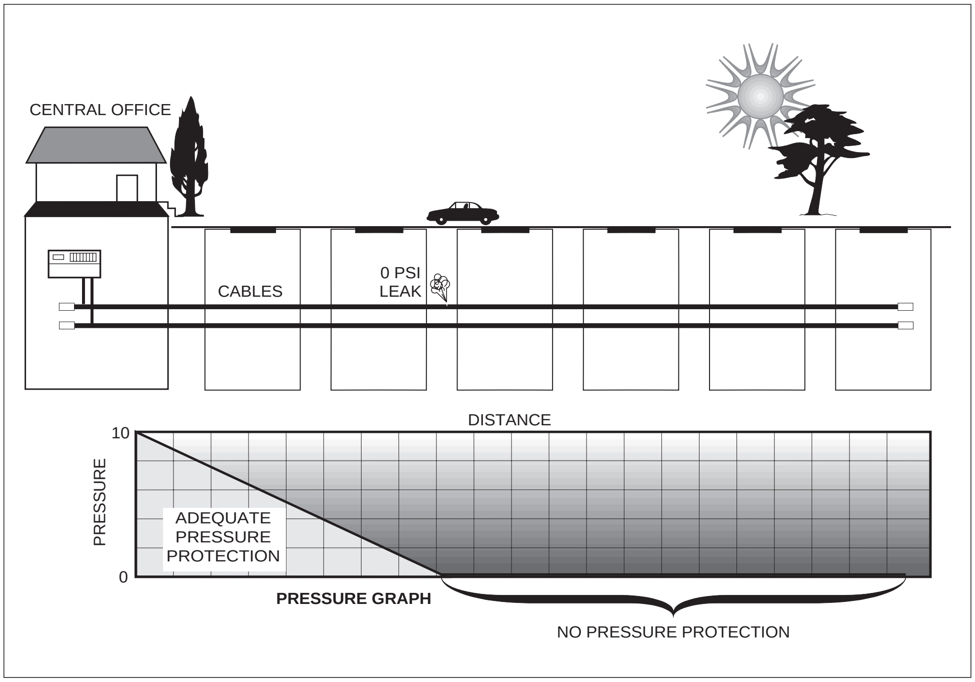


Figure 2—Single Feed System

Improved Cable Protection Even With Leaks

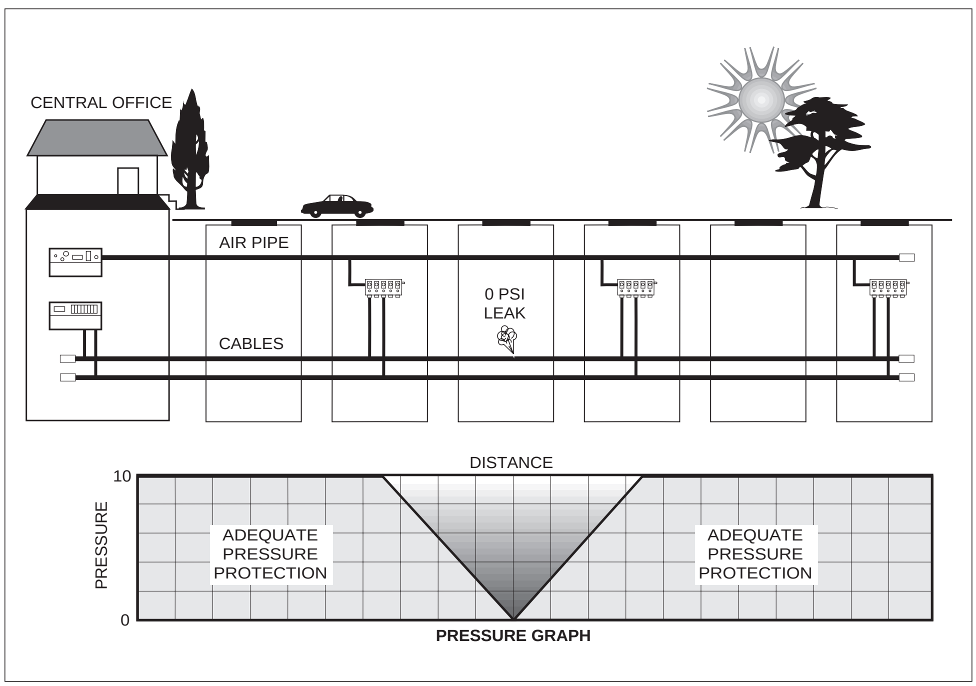


Figure 3—Dual Feed System

Central Office Monitoring Devices

In well-designed systems, the central office panels are also equipped with pressure and flow monitoring devices. These sensors, called *transducers*, monitor delivery pressure and flow rates at the point of installation, but they cannot perform this function by themselves. They must be wired to a central office monitor so that continual device readings can be taken throughout the day and night.

Field Monitoring Devices

In the field, *pressure transducers* are typically installed at the ends of cables and at designated points along the cable route. The placement of these devices is critical in the leak locating process. *Flow transducers* are also installed wherever air is introduced in to the system. The most obvious field location is at an air pipe manifold. Some systems use remote air dyers in the field to provide a boost in cable pressure. These air sources are also monitored for pressure and for flow.

What's the Current Status of Air Pressure Management?

Over the years there have been a number of changes in the management of air pressure systems. In order to be successful today, air pressure managers need to know the quality of the cable pressurization system and what it costs to maintain that particular level of quality. With this information they can make intelligent decisions regarding where to dispatch technicians and, just as importantly, where not to dispatch them.

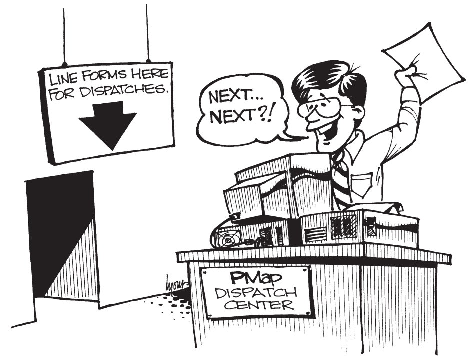
Cost Analysis Controls

Keeping track of the *labor hours* spent on cable maintenance per sheath mile of cable is a key cost analysis control. It may take some effort initially to obtain sheath mileage data, but once this information is known maintenance tasks can be evaluated to determine labor hour efficiency. When this information is compared with a rating of the quality of the system, effective management decisions can be made.

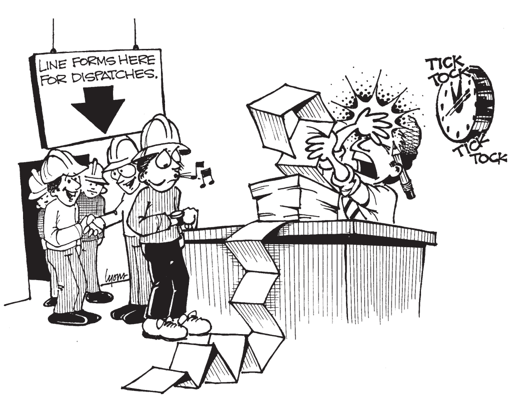
How is Monitoring Being Improved?

New instrumentation and computer programs, such as the *PressureMAP*™ Management Analysis Program, have simplified cable maintenance and given management much greater control over dispatching and labor hours. This software program obtains monitoring device data from office monitors, analyzes it, and provides valuable management and maintenance reports.

Management Analysis Software



One of PressureMAP's most valuable tools is its "high five" report. In the past managers would have to manually pour over pages and pages of monitoring system printouts each morning in order to determine where to dispatch technicians. PressureMAP eliminates this function by carefully analyzing pressure and flow conditions and prioritizing the five most important leak locating tasks in each office. This capability frees up manage-



ment time and eliminates the stress and confusion of "on-the-spot" dispatching.

***S**ystem Quality Rating*

PressureMAP also provides an early warning alarm system wherein damaged cable problems can be detected before conductors get wet. Alarms are received from office monitors, evaluated to determine if they need immediate response, automatically verified if determined to be of alarm status, and distributed to assigned centers or personnel for immediate response. This type of reactive capability is a vast improvement from the monitoring systems of old, where an alarm status represented a drop below or a step above a programmed device threshold.

PressureMAP's *System Quality Index (SQI)* uses pressure readings and air flow rates per sheath mile of cable to provide an accurate measurement of the status of a system—both by office and by route. The standard SQI rating is between 80 and 85. Indexes above the optimum represent excessive maintenance ("goldplating"). Low indexes are the result of one or more factors: too few labor hours being spent in an office/route, inadequate/inaccurate engineering, poor dispatching, and/or a lack of proper leak locating skills.

But what's even more important for today's telephone operations is the software's proactive capabilities. Not only does PressureMAP identify system-threatening conditions and dispatch technicians accordingly, it also offers the tools to systematically improve the cable pressurization system. This proactive function helps eliminate expensive after-hour alarm response time and makes it possible to schedule key maintenance activities. To use an earlier analogy, this is the difference between making needed repairs to your roof at your convenience, or having to do the work in the pouring rain.

Summary

The reasons behind cable pressurization are basically easy to understand. The main goal of pressurization is to protect the cables from water damage—keep cable pressures above the minimum standards established for the various cable environments. When cable pressure is low, it's typically the result of two things: low delivery pressure or actual cable leaks.

Monitoring devices in the central office and field help make it possible to identify both types of problems and determine the cause of low cable pressure. In the case of cable leaks, air flow analysis makes it possible to prioritize which leaks are doing the most damage to the system. With a knowledge of Optimum Air Usage, you can easily distinguish between a good flow and a bad flow. And once you know this, air flow leak locating techniques can be used to help locate the large, system damaging leaks.

Air pressure design is an important factor in the success of an air pressure operation. Certain designs, such as dual feed, offer better cable protection than others. An air pipe system is one of the best means for providing dual feed protection to cables, but it is not cost effective for every type of air pressure operation. For this reason, there are alternative dual feed design systems available which provide many of the same protection and monitoring capabilities of the more expensive systems.

Improvements in air pressure monitoring have made it easier to analyze system conditions and perform important management and maintenance functions. These software programs offer greater tools and controls for today's cable pressurization managers and maintenance technicians. They emphasize a proactive approach to cable maintenance while, at the same time, providing superior alarming and dispatching capabilities.

Cable pressurization is an important part of today's telephone operations. The technology being used in this field has evolved rapidly in the past decade, and improvements are continually being made. For more information on basic cable pressurization, system design components, proactive maintenance and alarming, please contact System Studies Incorporated.

Pressurization Glossary

The following terms are provided to assist in the understanding of key pressurization terms as they are used today by various engineering, maintenance and construction personnel. It is essential in the development and upkeep of a cable pressurization system that all participating departments be familiar with these terms.

Actual Air Usage (AAU) AAU is a measurement of the total air consumption that an individual air source (such as an air pipe manifold) is using at a given time. AAU can be compared with Optimum Air Usage (OAU).

Aerial An elevated or overhead cable, or transducer that is associated with an elevated cable.

Air Dryer See Central Office Compressor.

Air Flow Calculation A formula used to determine how much air is passing through a section of cable at a given point in time.

Air Pipe Plastic CA 3131 pipe used to distribute pressurized air from the central office compressors to the air pipe manifolds in the field. Typical air pipe is a ½ inch in diameter, and has an aluminum lining to prevent vaporization.

Air Pipe Manifold A cable pressurization hardware device located in the field. Pneumatically connected to an air pipe, a single air pipe manifold distributes air to as many as five individual cables.

Air Pipe Purification The systematic identification of all air consumption on an air pipe, section by pipe section.

Air Pressure Index See System Quality Index.

Air Pressure Record See Pressure Record.

Air Source Any of a number of types of equipment designed to introduce pressurized air into a cable pressurization system. This equipment includes central office compressors or air dryers, air pipe manifolds, and remote air dryers.

Alarm The notification by an air pressure monitor or monitoring software of an undesirable condition existing within the pressurized cable network that requires correction.

Auxiliary Air Source A supplementary (other than central office) source of pressurized air, such as a remote dryer or nitrogen cylinder.

B-Meter Panel See Distribution Panel.

Back Projection A formula used in single feed cable sections to determine the distance (in feet) to leak from an air source (or bypass valve).

Buffering A supplemental and temporary source of air supplied to a cable system in order to maintain pressure in a cable during splicing activity.

Buried A cable, transducer, or other pressurization device that is direct-buried, with no protective conduit.

Butterfly Map A field verification aid used to systematically list the contents and position of all pressurization items in a utility hole. The butterfly map provides the means of organizing and recording air pipe and cable duct assignments, air pipe manifolds, transducers, splice cases, load coils, pressurization hardware, etc.

Bypass Valve An arrangement of tubing designed to circumvent a pneumatic plug in a cable. The bypass has a shutoff valve so that air flow around the plug can be controlled.

Cable Paired and insulated conductors (fiber optics, quads, videos or coaxials) formed into a compact core and covered with a protective sheath.

Cable Network All pressurized cable within a specified geographical area.

Cable Pressurization Automatic Monitoring System (CPAMS) Microprocessor-based equipment designed to remotely monitor a pressurized cable network. It is a user-programmable monitor that interfaces with standard teletype printers or computer terminals to provide pressure and flow information upon request or at predetermined intervals.

Cable Route A defined cable path out of a central office used to organize and group telephone cables. Cables are generally associated with an air pipe and grouped by route according to the direction in which they are headed.

Central Office (CO) The starting point, or "hub" of a cable pressurization system—the inside plant.

Central Office Compressor A mechanical device that compresses ambient air molecules, extracts the moisture from the air, and pumps the dry air into the cable network via the central office panels.

Central Office Manifold A collecting tube which combines either the low or high side air outputs of two air dryers into a single air source. The air is then directed to the pipe alarm panels.

Central Office Sector The circular area surrounding the central office that contains all the cables fed by distribution panels. The boundary of the CO sector is located at a point approximately half-way to the first air source in a dual feed system, or approximately 3,000 feet out from the office in a single feed office.

Check Valve A valve that allows air to flow in one direction only. The check valve is commonly installed in-line on tubing connecting the manifold to the air pipe.

Conductor Insulation Material surrounding a wire conductor that protects it from electrical interference. the two types of insulation are paper (pulp) or PIC.

Contactor A remote pressure sensor used to signal a drop in air pressure to a preset level. The contactor is a simple on/off device with a resistive output of 540 kilohms in the normal condition and 270 kilohms in the alarm condition.

Dedicated Pair A pair of wires exclusively assigned to report data from a transducer to an office CPAMS.

Delivery Pressure A pressure measurement at a point where air enters the pressurized cable network.

Device See Monitoring Device.

Device Type A device designation based on the device's position and function within the pressurization system.

Distribution Panel A central office panel used in an air pipe system. Usually considered the first manifold on the cable run, the distribution panel is often referred to as the meter or B-meter panel.

Dual Feed System A cable pressurization system that provides pressurized air to both ends of a pneumatic section.

Electrolysis Damage to cable pairs caused by the interaction of moisture and electrical current.

End Point The pneumatic end of an air pipe or cable.

Flow Range A flow transducer's factory-calibrated flow measuring parameters. Typical flow ranges are 0–10 SCFH, 0–19 SCFH, 0–50 SCFH, and 0–100 SCFH.

Flow Rate The amount of air flow in a pressurized cable system over a period of time. This flow is commonly measured in Standard Cubic Feet per Hour (SCFH) or in Standard Cubic Feet per Day (SCFD).

Flow Transducer An electronic device which measures the rate of air flow at its point of installation and transmits this information back to a CPAMS. Flow transducers are commonly installed at pipe alarm panels, air pipe manifolds, and at remote dryers. Two basic types of flow transducers are in use: mechanical, resistive devices, and 4–20 milliamperes, solid-state devices.

Frame Interconnect Block The apparatus in the central office where individual transducer circuits are wired. The connection from the frame interconnect block to an automatic monitoring system is completed by use of 25 pair cables.

Hardware The physical components of a cable pressurization system, and/or specific computer equipment. Cable pressurization hardware may be classified as field hardware or central office hardware.

Interlacing The pneumatic connection of one cable to another, originally designed to increase pair capability. However, an unfortunate leak-masking side effect results when pressurized cables are interlaced—air pressures equalize. All interlacing should be plugged.

Junction A point within a cable network where two or more pressurized cables meet (not a point where one cable is extended with another of the same gauge, size, and distribution).

Labor Efficiency Indicator (LEI) A rating system used to gauge the efficiency of cable pressurization maintenance efforts. The LEI is a comparison of an office's System Quality Index (SQI) and the number of labor hours that have been expended to maintain the office at the SQI level.

Labor Hours The number of hours used to maintain the air pressure systems (excluding hours for system installation).

Lateral A single fed pneumatic cable section that branches out from a main feeder cable.

Manifold See Air Pipe Manifold.

Meter Panel See Distribution Panel.

Minimum Air Pressure Standards The minimum amount of internal pressure needed to protect a cable. Generally, the minimum pressure for underground cable is 5 PSI, 3 PSI for buried cable, and 2 PSI for aerial cable.

Modem An acronym for MOdulator/DEModulator, a modem is a device that converts digital data into audio tones suitable for transmission over regular telephone lines.

Monitor See Cable Pressurization Automatic Monitoring System.

Monitoring Device A remote electronic sensing device that monitors pressure, flow, or other conditions. Monitoring device data is accessed by a CPAMS.

Optimum Air Usage (OAU) A standard air flow rate per sheath mile of cable. The OAU indicates what consumption should be under ideal conditions. OAU can be computed for any air source.

Office Index See System Quality Index.

Open An open circuit. When monitoring pressure and flow transducers and contactors, any measurement exceeding 6.5 megohms in resistance is considered an open circuit. A trunk/toll cable loop resistance reading greater than 8190 ohms is an open.

Pipe Panel A regulating and monitoring device located in a central office. The pipe panel regulates air pressure from the central office dryer(s) and monitors air flow to an air pipe.

Pipe Purification Procedure This procedure verifies the location of all air consumers along an air pipe run. It also helps to identify all pneumatic sections on an air pipe run in order to ensure complete monitoring. See Air Pipe Purification.

Plastic Insulated Cable (PIC) Cable containing conductors that are insulated with a coating of either polyethylene or polypropylene.

Pneumatic Plug See Pressure Plug.

Pneumatic Resistance The characteristic restriction of air flow through a cable. The resistance is a function of the gauge of the conductor, the insulation surrounding the conductors, and the number of conductors.

Pneumatic Section The basic unit of cable pressurization. A section of cable whose pneumatic boundaries are defined by air sources or pneumatic plugs. The introduction of a new air source at any point in an existing pneumatic section (other than one of the end points) creates at least one additional pneumatic section.

Pressure The force exerted by compressed air against its enclosure—the interior wall of a cable, air pipe or air dryer. Pressure is commonly measured in Pounds per Square Inch (PSI).

PressureMAP Monitoring software used for cable pressurization alarming and analysis.

Pressure Plug An intentional blockage of air flow through a cable. The plug creates a pneumatic dam within the cable sheath.

Pressure Record A finished stickmap or cable map that graphically displays the arrangements of the various parts of a cable pressurization system. It includes detail boxes containing air pipe, cable, and monitoring device information. Depending upon the specific design, there can be several types of pressure records for each office.

Pressure Transducer A device used to remotely measure air pressure in the pressurized cable network. The transducer has an electrical output that varies with changes in pressure. Generally, the pressure transducer is calibrated in Pounds per Square Inch Gauge (PSIG). Two basic types of pressure transducers are in use: mechanical, resistive devices, and 4–20 milliamperes, solid-state devices.

Pressurization System A pressurized cable network contained within a specific geographical area, made up of the following three essential components:

- **Hardware** Used to introduce air and maintain air pressure, system hardware includes air dryers, air pipe manifolds, central office panels, and pneumatic plugs.
- **Monitoring Equipment** Used to sense changes in air activity, this equipment includes CPAMS, transducers, and contactors.
- **Tools** Instruments and procedures used to maintain pressure within a cable network.

Proactive Maintenance Performing maintenance on a routine basis in order to prevent serious air pressure problems from occurring in the future.

Pulp Cable Paper insulated cable. Each conductor is wrapped in paper insulation to inhibit electrical interference. Pulp cable has a relatively high pneumatic resistance.

Remote Air Dryer A compressor located outside the central office. The remote air dryer is designed to pump dry air into a cable pressurization system. It is generally used when air feed out of the central office is impractical.

Remote Air Source A source of air supply to a pressurization system outside the central office. These sources supplement pressure feed from the central office. Remote air dryers and nitrogen cylinders are examples of remote air sources.

Riser Pole The pole or other point at which a cable emerges from the underground into an aerial environment.

Routining A systematic, proactive approach to leak locating in a pressure route or zone. When a cable route is routined, all air leaks are identified and repaired section by cable section.

Splice Location along cable where pairs have been joined together or altered in some manner.

Splice Case Protective case on cable allowing access to telephone conductor pairs.

Standard Cubic Foot per Hour (SCFH) A common measure of air flow rate based on the standard cubic foot—a “box” of air measuring 1 foot on each side. The measurement indicates the rate of air (of number of standard cubic foot boxes) flowing past a given point in a pressurization system in 1 hour.

Standard Cubic Foot per Day (SCFD) A measurement of the rate of air flowing past a given point in a pressurization system in one day.

Sheath A casing made of polyethylene or lead that surrounds and protects a cable from the elements.

Sheath Mile A unit of cable measurement equal to 5,280 feet used to calculate Optimum Air Usage.

Single Feed System A cable pressurization system in which air is supplied to a cable, or cables, from only one source.

Sphere of Influence The section of cable or cables most directly affected by an air source delivery pressure. In a dual feed system, the area of pressurization encompassing all pressurized cables extending in both directions and ending at a point on the cable midway between manifolds.

Stickmap The initial engineering drawing of a complete cable route showing the number of air pipes, utility hole locations, number of cables in a utility hole, air pipe manifolds, transducers, and other pressurization equipment. It is a working drawing intended to be updated as information is compiled.

Subscriber Pair A pair of wires assigned for subscriber service on which monitoring device equipment is sometimes installed.

System Quality Index (SQI) A measurement of the quality of cable protection in a given route, office, or district. The System Quality Index (SQI) is a formula based on average cable pressures and air flow per sheath mile of cable. The output of the SQI is a relative number where 90 is standard.

Underground A cable or transducer that is located in conduit or ducts. It is not buried directly in the ground.

Vault Underground compartment where cables leaving the central office are housed.

Zero Leak Projection A formula that limits the area of search when a section of cable is being investigated for a leak. The calculation is used to determine the farthest point on a cable that a leak could be from an air source or measurement location.

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