REDUCING SERVICE CALLS ON DROPS

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ABSTRACT

This paper discusses the high percentage of drop-related service calls to all service calls. It cites some of the causes of drop-related service calls and suggests possible solutions to those particular problems. Much of the data was obtained from responses to a survey conducted throughout operating divisions at ATC and Paragon.

This paper also describes both the field testing and the laboratory testing of drops which are taking place at ATC. (While the testing is still in the early stages, results are given where available.) It is clear that either the current methods and/or the materials we are utilizing in installations must be revised if we are to reduce service calls and improve customer service.

INTRODUCTION

Most system technical personnel agree that a large proportion of the service calls they receive are due to various problems with subscriber drops and therefore affect a single customer only. Over time the potential exists for an operator to run a service call to each and every subscriber in each and every system. Identifying the reasons for these service calls and finding long term solutions will have a significant and positive financial impact on system operations.

DEFINING THE PROBLEM

We asked our system engineers what percentage of their service calls are related to problems in the drop portion of the plant. Responses ranged from 5% to 90% with the average falling in the 45-50% range. This would imply that resolving drop problems over the long term could reduce the number of service calls by about half.

In an average system* having 50% penetration, 47% of the total plant will be drop wire. It should be no surprise, therefore, that 45-50% of the service calls are drop-related. As penetration numbers improve in the quest for added revenues, more than half of the plant will be drop wire and, at the current service call rate, more than half of the service calls will be drop-related. Any progress which can be made now in reducing truck rolls on drop-related service calls will increase the operating savings as subscriber penetration numbers increase.

Our immediate goal is to study causes and develop solutions for those problems which occur along the drop between the tap and the ground block. We believe that 30-40% of the problems which inspire drop-related service calls occur in this portion of the drop.

CAUSES

Results from a survey of ATC and Paragon operating divisions indicate that approximately one-third (1/3) of the drop-related service calls are caused by problems at the F-connector. These problems typically fall into one of the following four categories:

1) those improperly installed
2) those which have corroded
3) those which have loosened over time
4) those which have manufacturing defects.

We know also that service calls are generated when drops are taken down by storms or other accidental means, or when buried drops are cut, and that drop replacements due to such damage account for 4% of service calls. Another 2% of drop cables are replaced when the service technician is able to confirm that the problem is indeed in the drop but cannot determine that a specific component is causing the problem.

The causes of the remaining 64% of the drop-related service calls have not specifically been identified. It is probably fair to say that they are due to problems within the home stemming from faulty electronic equipment (the subscriber's or the operator's) or the subscriber's inability to properly use the equipment. While this paper does not cover these particular problems, preliminary results from our field test indicate that most of the service calls which have been run in the test area resulted from consumer education issues.

* An average system is defined for this paper as having 100 homes per mile, an average drop length of 125 feet and a trunk to feeder ratio of 1:3.

TESTING

In order to adequately determine what are the real causes of service problems within the subscriber drop it is necessary to study the methods and tools employed in doing an installation as well as to test the drop materials which are currently available on the market. The test parameters being used for both the field and the laboratory testing of methods and materials were established by ATC's Engineering and Technology Department.

Procedures - Field Testing

The first field test is taking place on a northern coastal island where the environmental conditions are severe and where the test area is well-defined and isolated. Additional test areas in other systems will be identified which will also be relatively small and self-contained for control purposes.

The current test area contains approximately 500 passings and 180 subscribers. (The penetration will increase as we move into the summer months.) The island can be accessed only by boat and has been assigned to one service technician. It was selected because of the harsh environment as well as the ability to control the quality of the installations and follow up on service calls. Having only one system technician directly involved with running service calls also provides a more controlled environment.

All drop wires installed were messengered RG-6 cables with 67% braid coverage. In this particular case, only the cable from one manufacturer was used, but we installed both a regular drop cable and a waterproof drop cable, marking system design maps for later reference and identification.

Two connectors, from different vendors, were used. One was a standard type F-connector and the other was a waterproof type F-connector. Again, system maps were marked to identify locations for each material for later reference and identification.

Drops were installed by a drop contractor in accordance with the manufacturers' specifications, using otherwise standard installation practices. All samples were installed using "boots and grease" on the tap end. Control samples were sealed with RTV sealant on the ground block end with the remaining samples having "boots and grease" at the ground block end. No additional protection was provided for the waterproof connectors. The drops within the test area were post-inspected by system and corporate engineering personnel to verify that proper installation procedures were used.

Each possible scenario was given a code which was to be used on the system design maps to track the various installations. Trouble calls were to be recorded, drop-related or not.

Additional information was to be kept for the drop-related trouble calls, such as:

1) location of the failure
2) symptom as seen by the customer
3) symptom reported by the service technician
4) code type of the drop in question
5) corrective action taken
6) any failed components were to be replaced with the same equipment and procedures as the original install

In addition to the controlled test described above, several systems are experimenting with materials which are newly on the market or which have been used sparingly in the past by ATC or Paragon systems. The system engineers are reporting results as they have them or when they are queried, providing other test beds, albeit without the same controlled environment.

Results - Field Testing

Upon inspection of the initial installations, which took place in September and October of 1987, several were found to have been crimped with pliers instead of the proper hexagonal crimping tool. About 20 connectors have been replaced because of this problem. Not all of the incorrectly installed connectors were replaced before causing a service call, however. Two of these caused problems with off-air pick-up and were corrected by replacing the F-connectors using the proper tool.

To date, there have been no problems resulting in service calls due to the cable itself and no drops have been damaged. Peeling the messenger back on one of the cables, as one does at the tap and at the P-hook, also peeled the cable's poly jacket back exposing the braid. (This happened only on occasion.) All other drop-related service calls (about six) were due to consumer education issues.

Below are some comments received from systems which have experimented with waterproof, extended life drop cable. Comments are:

. fittings were easily installed
. water and salt migration seemed to be slowed when left to the beach environment
. foam dielectric adhered to the center conductor and had to be scraped off
. the messenger sometimes pulled out of the poly covering while stripping it back, exposing bare steel
. stripping the messenger back sometimes left ragged edges on the drop cable
. no noticeable difference compared to non-waterproofed drop cable over a period of a few months
. the key seems to be waterproofing of fittings

Procedures - Laboratory

The laboratory testing will determine how well various drop cables, connectors and protection methods perform. Samples will be placed in a salt spray chamber for a period of 15 days in a spray solution containing salt water and acetic acid (copper-accelerated acetic acid-salt spray testing). The acid is used to speed the aging process, such that one day's exposure in the chamber is equivalent to one year of exposure in a harsh, coastal environment. The samples will be examined for environmental effects at 3, 7, 11 and 15 days, which will represent 3, 7, 11 and 15 years respectively.

The test will contain six (6) connectors from five (5) vendors and six (6) cables from three (3) vendors. All cables will be RG-6 size with 67% braid. All six connectors will be installed on all six cables, (requiring thirty-six (36) samples) in accordance with the manufacturers' installation procedures. Each individual sample will be tagged for identification.

Thirty -six cable samples approximately 24" in length, are attached to a bracket. One end of the cable has an installed F-connector, the other end is capped. The brackets allow the samples to be suspended in the chamber and to be easily removed for inspection purposes. There are a total of five brackets, one for each of the four time periods, and a control sample, bringing the grand total of cable samples to one hundred eighty (180).

Each cable sample will have a knife cut around the perimeter of the cable, cutting the outer jacket, but not cutting the inner braid. All connectors will have "boots and grease" applied except those which are built to be moisture resistant.

After the first three days, the first set of samples will have the outer sheath removed in quarter inch increments on either side of the original cut in order to note the migration of water and/or salt along the cable. The open end will also be cut back in quarter inch increments to determine the depth of water migration.

The boots will be removed to note the effects of the salt spray environment on the connectors. One connector will be removed also, noting the amount of torque required for removal.

Contact resistance will be measured at two locations on the samples. First, from the connector (the back of the ferrule) to the F-81 at the bracket and second from the knife cut (16"-18" along the sample) also to the back of the ferrule on the connector.

The same procedure will be repeated for each of the four (4) periods.

In addition, a pull-out or tensile strength test will be done to determine the minimum strength required to pull the connector away from the cable. Pull-out is defined as slippage of at least one-eighth inch.

Results - Laboratory Testing

To date, there has been some collection of raw data, but the tests are incomplete and therefore the data have not yet been analyzed. The results of the initial pull-out test and the measurement of water migration from the first week in the chamber are available and are shared below.

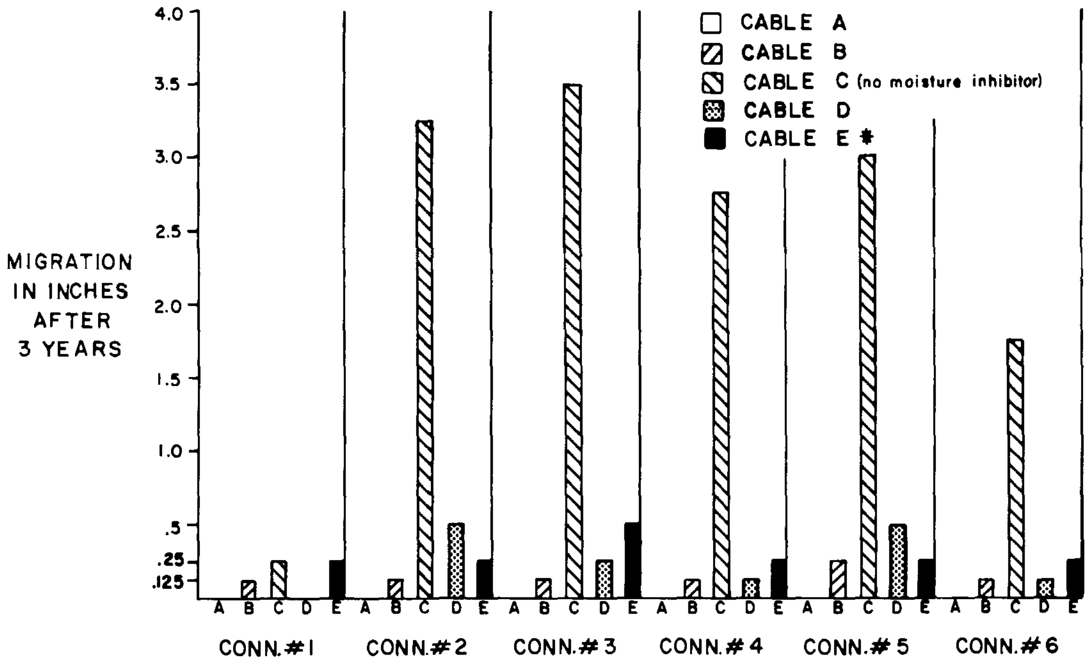
The pull-out testing was done on all 180 samples prior to putting them in the chamber. Of the 180 connectors, there were eighteen (18) which pulled out at tensile strengths below the minimum at which the manufacturers said they should. Of the eighteen (18) failures, twelve (12) could be attributed directly to the connectors and the remaining six (6) to the cables.

There has been insufficient analysis as to why the connectors did not grip well at all times in this test (a 3.3% failure rate of the all brands and types of connectors). No one connector was at fault significantly more than others, although all of the connectors seemed to fail more often on one manufacturer's cables.

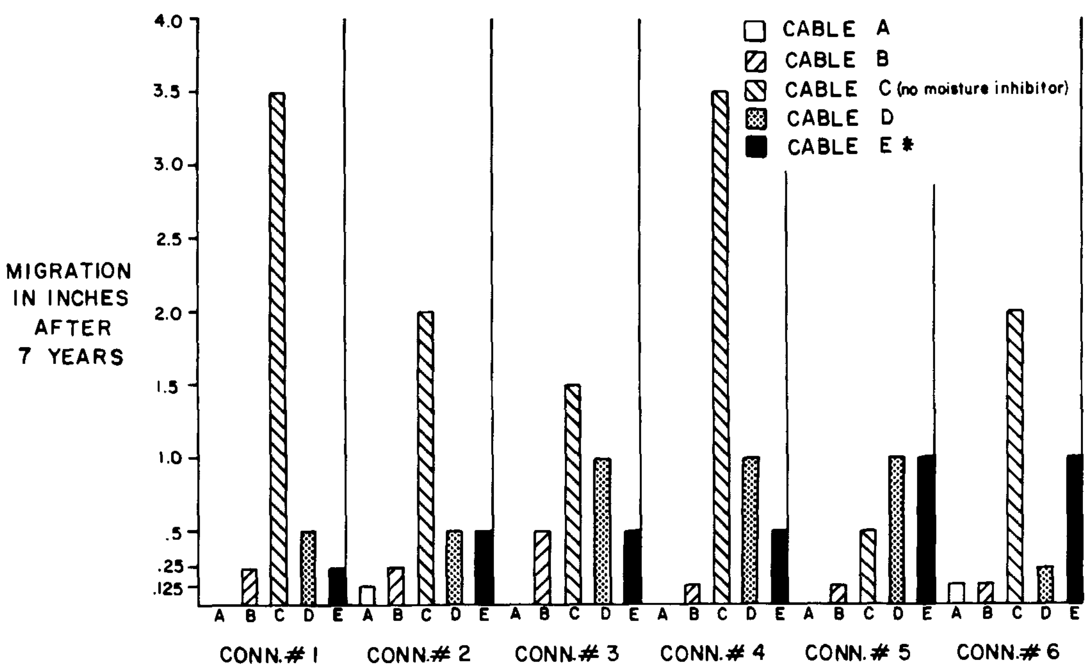
It appears that the cables (all manufacturers) caused the connectors to pull out because they are irregular (i.e. braiding material is sometimes bunched and the poly jacket does not have a constant thickness).

One week in the chamber has been completed as of this writing, an equivalent of seven years due to the age acceleration process. The results of testing contact resistance, removal torque and connector pull-out will not be reported until the completion of a full 15 days in the chamber, as they are not deemed relevant at this point. Water migration was measured at the end of both the 3 and the 7 year periods and is shown below on bar charts.

The graphs show that cable C, which is the only cable without a moisture inhibiting compound, consistently shows the greatest amount of water migration, while cable A has the least amount (usually none at all). Cables D and E allowed significantly more water migration over a seven year period than over the three year period.



* The 6[th] cable was added on day 7



* The 6[th] cable was added on day 7

CONCLUSIONS

While testing is far from being completed and therefore there has been no analysis, preliminary results would indicate that the use of drop cables with moisture inhibiting compounds may be of some benefit in reducing water migration. Since water in the cable affects the signal quality, it could perhaps be inferred that the use of drop cables with a moisture inhibiting compound will also reduce service calls.

Insuring that all installers use the proper methods of installing connectors along with the use of the correct tools should also help, although we found that some connectors will pull out even if they are installed with great care in a laboratory setting.*

It is apparent that some loose connector problems are caused by irregular cable diameters, and not because the connectors or installation methods are faulty, although a 3.3% failure rate on connectors with respect to holding or gripping capacity perhaps needs to be improved upon.

SUMMARY

Nearly thirty-six per-cent of drop-related service calls could be eliminated by accomplishing the following:

1) manufacturing cables such that all dimensions are accurately retained throughout the cable length
2) making F-connectors such that they
   a) resist corrosion
   b) prevent moisture from entering the cable
   c) are more easily installed with a minimum of installer training
   d) retain shielding integrity
3) burying drops 6-8" below grade
4) having all installers and service technicians carry the proper connectors for all types of drop cable within the system, and trained to recognize them and use them properly
5) using drop cables which have effective moisture inhibiting compounds
6) developing a special tool for peeling back the messenger so that the remaining cable surface is smooth and will not channel water into the connector.

The remaining sixty-four per-cent of the drop-related service calls are due to problems within the subscribers' homes. Many of these calls could be resolved with better consumer education programs, and could be effected by CSR's rather than rolling a truck. The telephone companies solved this problem by making telephone wiring universal and by allowing homeowners to own the internal system components, thereby being able to charge a customer for a service call which requires in-home repairs or adjustments. While our product is not yet universal in scope, if we as an industry could include installation procedures and workmanship and material specifications in the Uniform Building Code all new housing starts could be prewired. A by-product of this effort would be hardware which could be installed easily by the homeowner (perhaps similar to the wall-plate approach used by the telcos), plus all products sold at local outlets would have to meet the industry's standards of quality. The cable operator could then recover the cost of service calls caused by problems within the home.

In the absence of conclusive evidence, the best approach we can take today is to thoroughly train our employees and contractors in the proper use and application of the connectors and cables currently being used. Proper use of the correct wrench or crimping tool is key. This training in itself is not sufficient to insure quality workmanship. A second effort in the form of an effective quality assurance follow-up program for in-house and contractor installers is also necessary. Both of these must be an on-going effort, but training and motivating employees is key. When we do have test results which clearly direct us to use specific materials and equipment, we can then firmly move in what we will know is the right direction.

* In no cases in the course of this study was there a situation whereby the installer had to choose a connector to fit an older or different size drop cable. In the real world, this can be an issue, and installers must be able to recognize the different cables and the connectors that fit them, and they must have an adequate supply of all necessary components in their vehicles.

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