



# **RELIABILITY OF OVERHEAD DISTRIBUTION CIRCUITS**

Hendrix has long maintained that Spacer Cable significantly improves the reliability of electrical distribution circuits. However, comparative data has been difficult to obtain due to differences in local environments, distribution systems, circuit age and usage. This paper reviews the information from one utility that has over thirty years experience with the combination of bare wire, tree wire and spacer cable. Spacer cable averaged 75% fewer outages than bare wire systems during the three year period from 1995-1997.

<b>Construction Type</b>	<b>Outages per 100 Circuit Miles Per Year</b>
Bare Wire	50.3
Tree Wire	21.7
Spacer Cable	12.5

## **BACKGROUND**

Bare wire is the most common construction on the distribution system. The second most common construction is tree wire--85 mil single layer on older constructions and 2 layer 175 mil covering since about 1990. Over 500 circuit miles of Spacer Cable exists which represents the smallest portion of the installed capacity.

Comprehensive information on the local environments where the different construction types are used is not available. However, the company's policy is to use spacer cable where special circumstances exist--heavily wooded, trimming limitations, right of way problems, underbuilds, and circuits where reliability is critical.

We could not determine the average age of the three types of circuits. However, bare wire has been used throughout the company's history. Tree wire has been used extensively in recent years and probably has the lowest average age of installed capacity. Spacer cable has been used since its inception in the mid-1950's and was most heavily used in the 1960's.

Outages are classified into 3 categories: 1) less than 5 minutes in duration, 2) storm related outages, and 3) non-storm outages greater than 5 minutes in duration. Information by construction type is only available for non-storm related outages greater than 5 minutes in duration. Outages less than 5 minutes are the most common type of outage on many distribution systems. Both tree wire and spacer cable will provide significant reductions in these types of outages since the heavy covering on the conductors greatly inhibits animals, branches and other foreign objects from causing electrical faults.

Storm related outages were extracted from the data in order to make year-to-year comparisons more meaningful. Storms accounted for about 20% of all the outages. However, they accounted for 42% of the customer interruptions (SAIFI) and 77% of the outage minutes (SAIDI). Spacer Cable is designed to prevent storm related outages. Experience at other utilities suggests that spacer cable's greatest benefit will be preventing outages under storm conditions.

## **CAUSE OF OUTAGE**

<b>Cause of Outage</b>	<b>Bare Wire</b>	<b>Tree Wire</b>	<b>% Red</b>	<b>Spacer Cable</b>	<b>% Red</b>
Tree Related	17.6	6.6	62	1.8	90
Animals	12.1	5.9	51	2.9	76
Lightning	3.4	1.9	44	1.0	71
Unknown	5.9	2.6	56	1.0	83
All Other	11.3	4.6	59	5.9	48
<b>TOTAL</b>	<b>50.3</b>	<b>21.7</b>	<b>57</b>	<b>12.5</b>	<b>75</b>

As expected, Spacer Cable significantly reduces outages related to trees. The data also shows that spacer cable minimizes the effects of virtually every cause of outages on overhead distribution systems.

Tree related outages are common on bare wire systems since branches can come into direct contact with the conductors and cause a fault. Tree wire reduces outages by over 60%. This occurs since the conductor covering interrupts the flow of fault current in the event of a contact. Spacer Cable reduces outages by 90%. In addition to the benefits provided by the covered conductor, spacer cable is less susceptible to outages caused by large branches or trees. It is designed so branches will strike the high strength messenger that protects the compact configuration of conductors hanging below it. This is critical during high winds or when ice and snow accumulate on the limbs.

Animal caused outages are also reduced because of the covering on the conductors. The “extra” benefit from spacer cable is difficult to determine from the available data. One possibility is that the tree wire is stripped at the dead-ends exposing contact areas. Conversely, the recommended method for installing spacer cable avoids compromising the covering by using covered grips. Other possible explanations are that the tree wire may include stripped coverings at the insulators, and the older 85 mil single layer constructions may be breaking down under stresses.

The reduction of lightning related outages on tree wire is probably due more to application than the nature of the tree wire system. For example, tree wire is generally located in wooded areas where the trees may partially shield the conductors from lightning strikes. Also, extensive installation of tree wire in recent years may mean that these circuits are simply better protected than the rest of the system. Spacer cable outages are almost 50% less than tree wire and 70% less than bare wire. This occurs since spacer cable is protected by an adequately grounded messenger that functions as a shield wire for the system.

## **CONCLUSIONS**

Hendrix Spacer Cable is designed to minimize the impact of the root causes of outages on overhead distribution systems. Multiple layer covered conductors, compact design, high mechanical strength, lightning shield wire, and all compatible components form the core of this system. The data presented in this paper suggest that use of spacer cable can provide dramatic reductions in outages thereby improving the reliability of service to utility customers.

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