Rural Electrification Administration
Telephone Engineering & Construction Manual

Section 821
Issue No. 2
Addendum No. 2
May 1962

Reprinted May 1978

MULTIPAIR DISTRIBUTION WIRE PROTECTION

(ELECTRICAL PROTECTION OF FIGURE 8 ONE-PAIR AND FIGURE 8 MULTIPAIR DISTRIBUTION WIRE)

Purpose: The purpose of this addendum is to provide information on the electrical protection requirements for Figure 8 one-pair and multipair distribution wires. REA TE & CM-821, "Multipair Distribution Wire Protection," dated July 1959 and Addendum No. 1 dated April 1961, remain in effect for PE-15 distribution wire. The new material is as follows:

GENERAL LIGHTNING CONSIDERATIONS

1.01 This addendum applies to Figure 8 multipair distribution wire covered by REA Specification PE-28, and Figure 8 one-pair distribution wire covered by REA Specification PE-27.

Throughout this Addendum, Figure 8 multipair distribution wire is referred to as "Fig. 8 MPDW." Figure 8 one-pair distribution wire is referred to as "Fig. 8 one-pair DW." Where the same information applies to both types of wire the term "Fig. 8 DW" is used.

1.02 The actual surge dielectric strength of Fig. 8 DW is not yet available. From known data however the surge dielectric strength of Fig. 8 MPDW is conservatively estimated to be 20 kv between conductors and greater than 95 kv from conductors to the support wire. The surge dielectric strength of Fig. 8 one-pair DW is conservatively estimated to be 25 kv between conductors and greater than 60 kv from conductors to the support wire.

1.03 These dielectric strengths are adequate to prevent damage from lightning surges except for direct strokes and those arising from connections to stations that are severly exposed such as fire towers, radio stations, etc. There is no economically feasible way to protect aerial facilities against direct strokes and therefore no attempt is made to do so. The dielectric strength of Fig. 8 types of DW between conductors and the support wire is so great that the provision of air gap arresters from conductors to support wire is not essential from protection considerations.

Because of differences in potential between conductors which can arise during the passage of surges, washer gaps are desirable in some situations to limit these potentials as described herein. The provision of a metallic path from washer gap terminal blocks to ground is not necessary except for unusually severe surges. Because the dielectric strength from the outside of the jacket to the support wire is substantially less than the dielectric strength from conductors to support wire, ready access enclosures can be mounted by clamping over the support wire insulation. Unusually severe surges would then cause breakdown between the clamps and the support wire before dielectric failure between the conductors and the support wire would occur.

2. GENERAL POWER CONTACT CONSIDERATIONS

2.01 With outside plant wire and cable of all types, the most effective measures in the prevention of power contacts lie in the provision of sound construction, proper clearances, and avoidance of nonstandard conditions. Because Fig. 8 DW will be twisted around its support wire during construction, power conductors can make physical contact with either the jacket over the support wire or the jacket over the conductors. For design purposes the 60-cycle dielectric strength of the Fig. 8 MPDW is conservatively estimated to be 30 kv from conductors to the outside and 20 kv from the support wire to the outside. The Fig. 8 one-pair DW is estimated to have a 60 cycle dielectric strength of 19 kv from conductors to the outside and 12 kv from the support wire to the outside.

2.02 In the event of a physical power contact to Fig. 8 MPDW or Fig. 8 one-pair DW, no electrical contact would occur unless and until dielectric failure of the jacket over the support wire or failure of the jacket and insulation over the conductors occurred. The heat of the arc resulting from dielectric breakdown would melt the jacket and insulation from the wire at the point of contact thereby establishing a direct or arcing contact to the support wire. Coordinated protection can therefore be obtained by effectively grounding the support wire as described in paragraph 5.01. The probability of a contact to the conductors which would not involve the support wire is so small that the application of power contact protectors between conductors and the support wire, of either Fig. 8 MPDW or Fig. 8 one-pair DW cannot be justified.

Station protection in conjunction with #24-gauge copper leads or a #20-gauge 30% conductivity copper-steel bridle wire (hereinafter referred to as #20-gauge bridle wire) fuse link between the Fig. 8 DW and the drop wire will provide adequate protection to telephone users and to subscribers' premises.

2.03 The National Electrical Safety Code (NESC) has not recognized Fig. 8 DW as being immune to power contacts so all applicable provisions of the NESC for "communication conductors" should generally be met. However, because this type of facility was not contemplated when the NESC was written, some latitude of engineering judgment within the intent of the NESC requirements is permissible. In this connection REA considers joint use, crossings, and conflicts (if they cannot be avoided) of Fig. 8 DW with Grade C power line construction permissible without specific measures to obtain coordinated protection other than grounding the support wire. If local authorities question this interpretation, Grade B construction of the power line should be provided.

3. GENERAL LOW FREQUENCY ELECTRIC INDUCTION CONSIDERATIONS

3.01 Voltages are induced electrically in Fig. 8 DW from exposures to 60 cps power systems in the same manner as in open wire circuits. The magnitude of the induced voltage however is much lower in the case of Fig. 8 DW than in the case of open wire because there is much greater capacitance between the conductors and the grounded support wire of Fig. 8 DW than there is between open wire conductors and ground. Drainage units are <u>not</u> required.

4. SPECIFIC LIGHTNING PROTECTION MEASURES APPLICABLE TO FIGURE 8 DW

4.01 <u>Junctions of Fig. 8 DW with Aerial Plastic Insulated Cable</u>

Although there is an appreciable difference in the conductor-to-support wire surge dielectric strength of Fig. 8 DW, and the conductor-to-shield dielectric strength of aerial plastic insulated (PIC) cable, both facilities have a sufficiently high dielectric strength to withstand most surges and it is unlikely that either facility would be damaged by surges fed from the other. Fig. 8 DW may therefore be spliced directly to PIC cable conductors without washer gaps or other lightning protection measures.

4.02 <u>Junction of Fig. 8 DW with Paper Insulated Cable</u> - Lightning protection of paper insulated cable (by means of 700 volts rms. carbon blocks) at junctions with Fig. 8 DW is required in accordance with REA TE & CM-815, "Cable Circuit Protection.

4.03 Junctions of Fig. 8 DW with Open Wire - Because of the large differences in potential that can exist between conductors of an open wire pair, and because of the considerably greater dielectric strength between conductors of open wire as compared to Fig. 8 DW, lightning protection in the form of washer gaps should be provided at such junctions.

4.04 Junctions of Fig. 8 DW with Other Fig. 8 DW - No protection is required.

4.05 Junctions of Fig. 8 DW with Old Type MPDW (REA Specification PE-15) - Splicing and terminating considerations are of more importance than lightning protection because the probability of lightning damage to either of these facilities is small. Because it is not practicable to splice these conductors directly together, the conductors of PE-15 MPDW and the Fig. 8 DW should be terminated on binding posts of terminal blocks. Washer gap terminal blocks without leads mounted in ready access enclosures are recommended for this purpose.

4.06 Junctions of Fig. 8 DW with Old Type One-Pair DW - (REA Specification PE-17) - The probability of lightning damage to either of these facilities is small; therefore, splicing and terminating considerations are controlling. Because it is not practical to terminate PE-17 conductors on binding posts, bridle wire must be run from the PE-17 wire to the Fig. 8 DW. The bridle wire should be connected to binding posts on a washer gap terminal block without leads mounted in a ready access enclosure on Fig. 8 MPDW, or to a wire-mounted terminal on the Fig. 8 one-pair DW.

4.07 Junctions of Fig. 8 DW with Drop Wires - Lightning protection is not essential. However, terminal blocks to which #24-gauge leads or #20-gauge bridle wire conductors are connected are normally required for termination and station protection reasons (see paragraph 5.03). Washer gap terminal blocks are recommended for Fig. 8 MPDW. There is no suitable one-pair washer gap terminal available for Fig. 8 one-pair DW.

4.08 Junctions of Fig. 8 DW with Buried Cable - There is no specific requirement for lightning protection at junctions of Fig. 8 DW with buried cable. However, terminal blocks to which 24-gauge leads are connected are usually required at such junctions in connection with the protection of stations along the buried cable. Washer gap terminal blocks are recommended for this purpose.

4.09 Junctions of Fig. 8 DW with Buried Wire - No lightning protection is needed for the Fig. 8 DW, but a one-pair washer gap terminal block is required for termination and protection of the buried wire.

5. POWER CONTACT PROTECTION MEASURES APPLIED TO FIG. 8 DW

5.01 As stated in paragraph 2.02, no specific power contact protection is required for Fig. 8 DW except effective grounding of the support wire. Grounds should be placed at the beginning and at the end of nonshielded joint use sections with power circuits exceeding 2900 volts to ground, and in addition at one-half mile intervals. The grounds should be made by connecting to an MGN, or to other low impedance grounds if an MGN is not available. The support wire should also be grounded at or near crossings and conflicts.

5.02 Grounding of the support wire as described in paragraph 5.01 is not required, (1) where Fig. 8 DW is installed below aerial cable or other wire facilities and is therefore shielded from contacts, or (2) for exposures of less than 2900 volts to ground.

5.03 Some of the measures required by the National Electrical Code (NEC) to protect stations against the effects of power contacts are included in the wire plant and are discussed in the following paragraphs. Where large power fault currents are likely such as near junctions with open wire, #20-gauge bridle wire of adequate length is specified to limit the current through service drops and station protectors. Where large power fault currents are not likely, such as at intermediate drop locations along Fig. 8 MPDW leads, shorter #24-gauge copper leads connected to washer gap terminal blocks meet code requirements economically and are considered adequate. It is not practicable to provide a #24-gauge copper fuse link between Fig. 8 one-pair DW and drop wire within a one-pair support wire-mounted distribution wire terminal. Therefore, #20-gauge bridle wire must be run from the distribution wire terminal to a drop wire terminal at each point where a drop wire connects to Fig. 8 one-pair DW.

5.04 Part of the justification for omitting power contact protectors from Fig. 8 DW is the provision of suitable fuse links to isolate service drops, and the use of relatively high current-carrying capacity fuseless station protectors. Color coded #24-gauge leads connected to terminal blocks are also adequate to maintain the unexposed status of buried plant if used at junctions between Fig. 8 DW and buried plant to connect between the two facilities. Splicing connectors now available make practicable bridge tap splicing of Fig. 8 DW conductors to #24-gauge leads connected to terminal blocks.

5.05 Junctions of Fig. 8 DW with Buried Cable or Buried Wire

5.051 At junctions with buried cable or buried wire, where Fig. 8 DW is an extension of or a tap off the buried facility, the buried facility should be terminated directly on binding posts of terminal blocks mounted in a buried plant terminal housing. It is desirable to use washer gap terminal blocks for this purpose as indicated in paragraph 4.08. The Fig. 8 DW conductors requiring termination should be spliced to #24-gauge copper leads at least 8" long. The other ends of the #24-gauge leads should be terminated on the appropriate binding posts of the terminal block. This arrangement provides a fuse link between the Fig. 8 DW and the buried plant as required by REA TE & CM-816, "Electrical Protection of Buried Plant."

5.052 Where the buried cable or wire is a tap off Fig. 8 DW, it may be more economical to provide a washer gap terminal block mounted in a ready-access enclosure mounted on the Fig. 8 DW, in lieu of in a buried plant terminal housing. The connection and splicing details including the #24-gauge fuse links would be the same as described in paragraph 5.051.

5.06 Junctions of Fig. 8 DW with Open Wire - At junctions with open wire, connections to Fig. 8 DW should be made with #14-gauge bridle wire to minimize the probability of the connection being burned open by lightning. Open wire type power contact protectors should be furnished on the open wire in accordance with REA TE & CM-820, "Open Wire Circuit Protection" if it is exposed to power contacts. Power contact protectors are not included as part of Fig. 8 DW protection. The #14-gauge bridle wire and the Fig. 8 DW should be terminated on the binding posts of terminal blocks in ready-access enclosures. If service drops are installed on the open wire junction pole and are connected to pairs extended by open wire, #20-gauge bridle wire should be used to provide a fuse link between the terminal block and a drop wire terminal.

6. BONDING OF SUPPORT WIRES OF FIG 8 DW

6.01 The support wires of Fig. 8 DW should be made electrically continuous throughout their lengths.

6.02 At junctions with aerial or buried cable, buried wire, and other wire supported distribution wires, the support wire of Fig. 8 DW should be bonded to cable support strands, cable or wire shields, and/or support wires as applicable.

6.03 Where Fig. 8 DW is carried on the same pole as strand supported cable, it is not necessary to bond the support wire of the Fig. 8 DW to the cable strand because insulation on the DW would prevent a lineman from simultaneously making contact with the cable strand and the support wire.

7. GUYS

Where Fig. 8 DW is placed on existing joint use power poles beneath existing telephone plant such as cable or open wire which shield it from contact, the guying requirements of REA TE & CM-650, "Guys and Anchors on Wire and Cable Lines" regarding grounded guys versus strain insulators in guys apply. Where Fig. 8 DW is <u>not</u> shielded by other telephone plant and is exposed to power voltages in either joint use or at crossings, strain insulators are required <u>unless</u> the support wire is grounded to a grounded cable strand or shield or to an MGN within one-fourth mile of the guy location.