POLE LINES

INSPECTION OF POLES

CONTENTS PAGE

1. GENERAL

1.01 This section covers the inspection of all types of poles in service.

1.02 This section is reissued to update references and to emphasize vital practices and procedures.

1.03 In connection with pole inspection work, any hazardous conditions resulting from faulty or nonstandard construction shall be noted.

1.04 In addition to inspection of the poles, nonstandard clearances (particularly where power facilities are involved), need of replacement of guys, anchors, crossarms, etc, need of straightening poles, necessity of pruning the adjacient trees, or any other work which may require attention shall be reported.

1.05 When a joint use pole line is to be inspected, the arrangements for the inspection shall be discussed with the power company or other company concerned before the work is undertaken.

1.06 For the purposes of this section, guy and reinforcing stubs and pole braces are considered as poles.

1.07 The minimum circumferences of poles at critical sections are outlined in Section 621-215-011.

2. TOOLS

2.01 The tools required for pole line inspection are as follows:

(a) Hammer or hand ax for sounding the poles to detect internal decay and for driving increment borer hole plugs. The hand ax is useful for cutting brush and roots ***but shall never be used for chopping away sound wood*** in an attempt to explore the internal condition of a pole.

(b) Shovel for excavating around the groundline.

(c) Increment borer for determining the internal condition of the poles.

(d) B pole prod for examining pole surface below groundline, determining extent of top rot, etc.

(e) Climbers, body belt, and safety strap for use when determining extent of defects in upper part of pole.

(f) Pole tape for measuring circumferences.

(g) Six-inch steel scale for measuring thickness of shell, and width and depth of decay pockets.

(h) Digging bar for breaking hard or frozen soil.

(i) Increment borer extension (optional) for boring poles set in pavement.

(j) B ratchet brace (optional) for turning increment borer extension.

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(k) Heartwood black locust plugs for plugging increment borer holes. Ordering information is as follows: Plug, wooden (length) inches. Plugs are available in 2-, 3-, 4-, or 6-inch lengths.

(l) Appropriate safety equipment.

A wrecking bar or similar tool shall not be used under any circumstances.

3. USE OF INCREMENT BORER

3.01 The increment borer, illustrated in Fig. 1, is a tool used for determining the condition of the interior of poles. It consists of a handle, a bit, and an extractor. The bit and the extractor nest in the handle when not in use. The bit is hollow and cuts out a cylindrical core of wood. The core, which is drawn out with the extractor, will show the depth of sound wood and the extent of any decay.

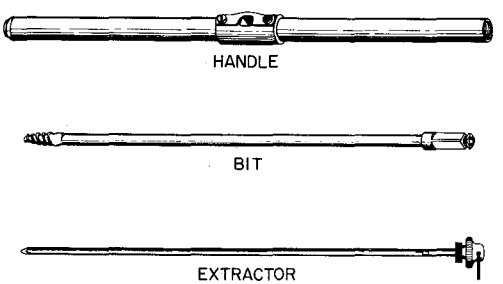


Fig. 1—Increment Borer

3.02 The increment borer is used as follows:

(a) Prevent damage to the cutting edge of the borer by removing dirt and grit from the surface of the pole at the point selected for boring.

(b) Remove the bit and the extractor from the hollow handle.

(c) Place the square shank of the borer bit in the square hole of the handle and lock it in place.

(d) To start the borer, press the cutting edge of the bit firmly against the pole surface at the same time turning the handle. Do not jab it into the pole. When the threads have caught in the wood, turn the bit in without further pressure. If the pole surface is hard, the borer will start easier in a gaff mark. Never start the borer in a crack or split as the core will wedge in the bit and will be difficult to remove.

(e) When the bit has reached the center of the pole or the desired depth, insert the extractor along the top of the core with the concave side down, taking care not to distort the core.

(f) When the extractor has been fully inserted, back the bit up one-half turn to break off the core. This also rotates the extractor so that it is positioned along the bottom of the core.

(g) Pull the extractor and core out slowly and gently.

(h) Do not remove the core from the extractor until the examination of the core is completed. The examination and measurements can be made with greater facility if the core is left in the extractor.

(i) Unscrew the bit and if pole is not to be condemned, plug the hole with a wooden plug.

(j) It is desirable, especially in the thinner sapwood poles where decay may be present in untreated heartwood, to sterilize the increment borer holes before plugging them. This will prevent infection which may be carried from a decaying pole to sound poles by the borer. The sterilization may be done with B wood preservative applied with a pressure oil can.

(k) The prod, if properly used, should not penetrate sound wood. Therefore, it need not be sterilized after use on a decaying pole.

(l) Make the boring horizontally, ie, at right angles to the pole surface. In poles set in pavement, and the pavement is not to be broken, make a boring at the groundline slanted downward at a 45 degree angle.

Caution: If the bit becomes clogged so that the core cannot be pulled out with the extractor, do not try to clear it by inserting extractor in cutting end. In some cases the jammed core may be forced out by boring a sound pole. It may be necessary, however, working from the rear end of the bit, to push the jammed core out with a stiff wire or to drill it out with a long twist drill using a tap wrench as a handle.

3.03 The use of an increment borer extension, illustrated in Fig. 2, will faciliate making borings below groundline and in poles set in pavement. The lower end of the extension is designed to accommodate the bit and the upper end to fit a standard ratchet brace. Some workmen prefer the combination for all boring as it is easier to start the borer and to turn it in with the brace than with the borer handle.

4. METHOD OF INSPECTION

4.01 Inspection of poles is done in three steps:

(1) Visual inspection of the above ground section of pole.

(2) Sounding and boring to determine the internal condition of the pole.

(3) Below groundline inspection.

Visual Inspection

4.02 Examine the surface of the pole from top to groundline for visible defects and external evidence of internal defects. When necessary, climb to the level of any damaged or suspicious looking area (unless it is in the power space on a joint use pole) that is out of reach from the groundline for further examination or testing. Use the sounding tool (hammer or hand ax), the increment borer, or the pole prod as described later.

4.03 The most common visible defects or external indications of internal defects are:

(a) Split tops or through cracks in the tops. These are not generally serious enough to justify condemnation of a pole unless they are located in a plane so that attachments are loosened.

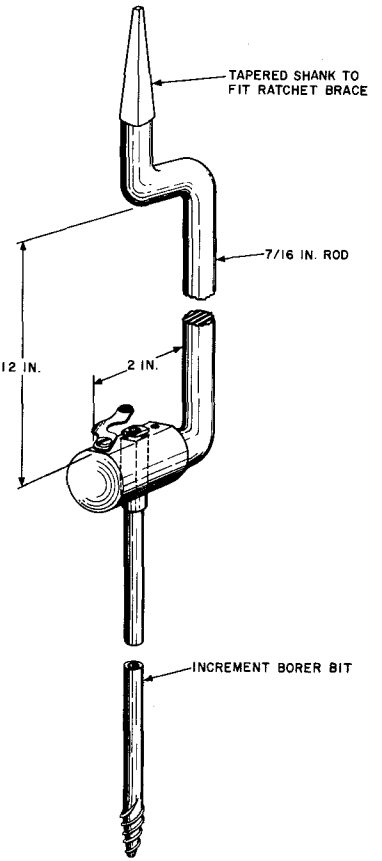


Fig. 2—Increment Borer Extension

(b) Lightning damage. This is cause for condemnation only if the upper part of the pole has been badly shattered or split.

(c) Unusual cracking, shrinkage, or discoloration at the top of a pole. These may be indicative of top rot and the top should be checked with the pole prod. The downward extent of the decay may be determined with the pole prod or by increment borings taken at intervals until sound wood is reached. (Do not make these tests in the power space on a pole.) Unless the decay affects attachments, the pole should not be condemned.

(d) Unusual cracking or splits in the side surface, such as a number of small cracks in a localized area, sometimes accompanied by shrinkage of the pole surface, wet spots, or shrinkage along seasoning cracks. Such areas should be tested by sounding with a hammer or hand ax supplemented by increment borings. If decay is present, deductions shall be made for it as described in Part 5.

(e) Woodpecker holes. These shall be checked with the prod for depth, extent of hollowing out of the pole, and possible association with decay and insect damage. If decay or insect damage is suspected, an increment boring shall be taken below the center of the hole for confirmation. Unless they are associated with decay or insect damage, or the pole has been hollowed out for nesting, or they are large enough or sufficiently numerous in a short section to reduce the cross-sectional area materially, woodpecker holes are not cause for condemnation. They should be regarded as having the same effect on strength as an exposed decay pocket or hollow heart as discussed in 5.06. Enlargement of bolt holes or widening of seasoning checks should be ignored.

(f) Cracks or crossbreaks. These are actual breaks across the fibers of the wood and are a safety hazard. They are generally the result of an impact load imposed during handling or by a motor vehicle after erection. They may be caused by whipping of the wires or strand as the result of an automobile hitting a pole several spans away. Any poles so cracked should be condemned.

Cracks and crossbreaks are often associated with knots. They shall not be confused with the lifting the fibers around knots due to uneven shrinkage caused by the exposure of end grain.

(g) Insect damage. Sawdust or dross in cracks aboveground or on the ground at the base of a pole are indicative of the presence of carpenter ants, bees, or aerial termites. Mud-filled cracks near the base of the pole are indicative of subterranean termite activity. The extent of damage shall be determined by sounding and by increment borings. Deductions for insect damage shall be made as discussed in 5.05.

(h) Rotten knots. The extent of damage shall be determined by prodding and an increment boring shall be taken below the knot to determine if internal decay (heart rot) is present. If the decay is confined to the knots, it is not cause for condemnation as knots are considered as holes in calculating strength. If heart rot is present, deductions shall be made as discussed in 5.01.

(i) Mechanical damage. This type of damage is caused by road or farm machinery, automotive vehicles, etc. It is not cause for condemnation unless the residual effective circumference has been reduced below that required to support the load on the pole.

(j) Shell or sap rot on cedar poles. This type of decay is prevalent in the sapwood of untreated or butt treated western red cedar poles. It starts in the inner sapwood and develops under a thin layer of outer sapwood which is too dry to decay. In the advanced stages the sapwood may slough off, exposing sound heartwood. The sapwood of cedar averages 1/2 to 3/4 inch in thickness. Since there is usually an excessive amount of wood in the upper part of the pole, loss of the sapwood is not considered cause for replacement.

Sounding and Boring

4.04 If the pole is not condemned for defects found during the visual inspection, sound each pole for indications of internal decay, using a hammer or back of a hand ax. Strike the pole lightly but sharply, at closely spaced intervals both vertically and circumferentially, from the groundline to the maximum convenient height within arm's reach. A decaying pole sounds dull or hollow and, in some cases, the wood gives under the impact of the blow. A pole free from decay sounds clear and solid. Other conditions, such as a wet surface due to recent rains, a wet interior near the groundline due to high soil moisture, shakes in the pole near the surface, wide cracks, heavy concentrated loads (large cables, loading coils, or transformers) or guards over riser cables may change the sound of a solid pole. Care must be taken not to mistake the altered sound due to these or other causes for the sound associated with internal decay. Take an increment borer core in all cases where sounding indicates the pole is not solid or when there is any doubt about the internal condition of the pole.

4.05 When internal decay is found, determine its extent and the thickness of sound shell by additional sounding and boring. Figure 3 shows typical examples of decay and the locations of borings to determine extent and shell thickness. Shell thickness is measured on the increment borer core using the 6-inch steel scale. Allowances for internal decay, discussed in 5.02, shall be based on the minimum shell thickness.

4.06 Poles in which the internal decay extends more than halfway around the pole, but which have a continuous shell of sound wood, shall be considered as having hollow heart, regardless of the presence of a core of solid heartwood.

4.07 Poles in which internal decay extends less than one half of the circumference shall be considered as having a decay pocket.

Below Groundline Inspection

4.08 If the aboveground section of the pole is free from defects or the defects are not sufficient to require replacement of the pole, examine the belowground section.

4.09 Excavate around the base of the pole. The depth of excavation required to reach the location of greatest decay depends on the height of the water table and the type of soil. Where the water table is high, maximum decay is usually at or just below groundline. Where the water table is low, it may be some distance below groundline. In hard packed clay soils it will be close to groundline and in well-drained sandy or gravelly soils it may be some distance below groundline. The depth of excavation must be based on local conditions and experience. As a general

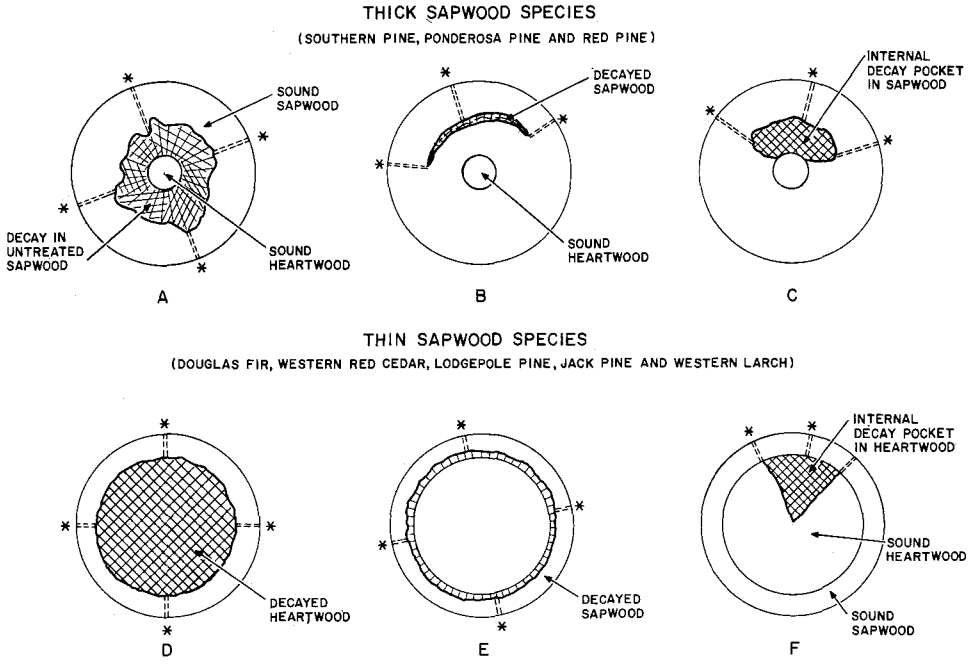


Fig. 3—Types of Internal Decay

rule 8 to 10 inches is sufficient depth, but in some localities maximum decay occurs 2 feet or more below groundline.

4.10 Examine the exposed below groundline section with the pole prod for the presence of external decay. When using the pole prod, place the point against the pole surface and push. Do not jab it into the pole and turn it so as to remove a slab of treated wood. This is very important when inspecting poles of the shallow sapwood species. Removal of the thin treated sapwood will expose untreated heartwood to attack by decay organisms.

4.11 External decay may be around the circumference of a pole, progressing from the surface toward the center of the pole. It may be along cracks, giving the pole a fluted appearance, or it may occur as exposed pockets. Typical examples of external decay are shown in Fig. 4. Allowances for external decay are discussed in 5.04.

4.12 Sound the exposed below groundline section, supplemented by increment borings, for the presence of hollow heart or enclosed decay pockets. Internal decay below groundline is most common in the thin sapwood types. Unless it is near the surface, the decay is often difficult to detect by sounding. Bore all poles of the thin sapwood type below groundline.

4.13 When the inspection is completed, replace the earth, packing it firmly around the butt of the pole. If the earth replaced is insufficient to fill the hole and to make a small mound around the pole to compensate for settling, obtain additional earth and use it for this purpose. Stones removed during the excavation for inspection should be replaced against the pole surface when backfilling.

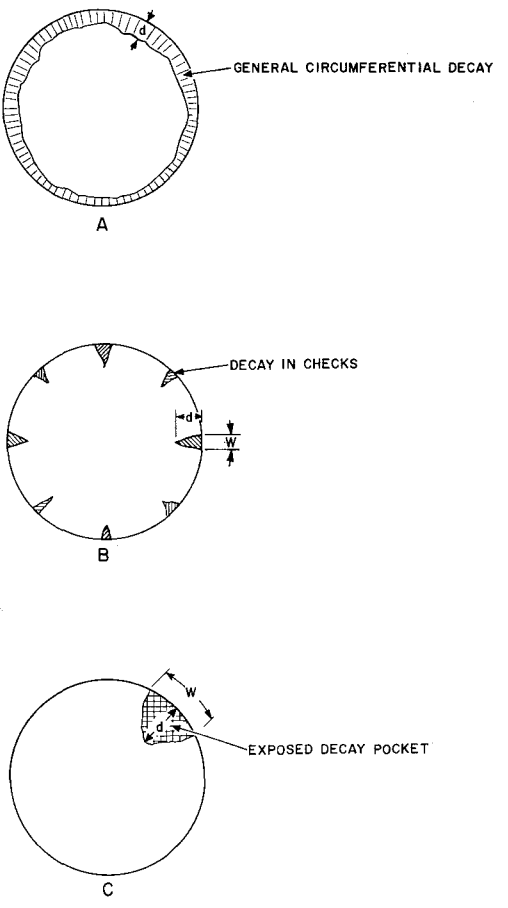


Fig. 4—Types of External Decay

5. DEDUCTIONS FOR DEFECTS

Hollow Heart

5.01 Measurements of poles having hollow hearts may be corrected by deducting the amounts listed in Table A. For example, a hollow pole having an outer circumference (after any external rot has been removed) of 30 inches, and a minimum thickness of shell of 2-1/2 inches, is equivalent in strength to a solid pole measuring 1 inch less. The pole shall then be compared with the dimensions listed in the tables of minimum circumferences at the critical section or the pole inspection rule as if it were a solid pole measuring 29 inches at the critical section.

▶*Note:* Section 621-215-011 covers the B pole inspection rule.◀

Enclosed Pockets

5.02 For poles having enclosed pockets on one side or near the groundline, the measurements shall be corrected by deducting the amounts listed in Table B. In this table, depth refers to the maximum depth of radial dimension of the pocket.

TABLE A

POLES WITH HOLLOW HEARTS[1]

MEASURED CIRCUMFERENCE OF SOUND WOOD OF HOLLOW POLE IN INCHES	MINIMUM THICKNESS OF SHELL IN INCHES[2]						
	2.0	2.5	3.0	3.5	4.0	4.5	5.0
20	1	—	—	—	—	—	—
21	1	—	—	—	—	—	—
22	1	1	—	—	—	—	—
23	1	1	—	—	—	—	—
24	1	1	—	—	—	—	—
25	1	1	—	—	—	—	—
26	1	1	—	—	—	—	—
27	1	1	1	—	—	—	—
28	1	1	1	—	—	—	—
29	1	1	1	—	—	—	—
30	2	1	1	1	—	—	—
31	2	1	1	1	—	—	—
32	2	1	1	1	—	—	—
33	2	1	1	1	—	—	—
34	2	1	1	1	1	—	—
35	3	2	1	1	1	—	—
36	3	2	1	1	1	—	—
37	3	2	1	1	1	—	—
38	3	2	1	1	1	1	—
39	3	2	1	1	1	1	—
40	4	2	2	1	1	1	—
41	4	3	2	1	1	1	—
42	4	3	2	1	1	1	1
43	4	3	2	1	1	1	1
44	5	3	2	1	1	1	1
45	5	3	2	2	1	1	1
46	5	4	2	2	1	1	1
47	6	4	3	2	1	1	1
48	6	4	3	2	1	1	1
49	6	4	3	2	1	1	1
50	6	4	3	2	2	1	1
51	7	5	3	2	2	1	1
52	7	5	4	2	2	1	1
53	7	5	4	3	2	1	1
54	8	6	4	3	2	1	1
55	8	6	4	3	2	2	1
56	8	6	4	3	2	2	1
57	9	6	5	3	2	2	1
58	9	6	5	3	2	2	1
59	9	7	5	4	3	2	1
60	10	7	5	4	3	2	1

Note 1: Deductions to be made from measured circumferences in inches to obtain circumferences of equivalent solid poles.

Note 2: Poles with hollow heart which have a minimum shell thickness of less than 2 inches should be replaced.

It lists, for example, that a pole having a 30-inch measured circumference, a minimum shell thickness of 2 inches, and a pocket 5 inches deep is equivalent in strength to a solid pole circumference of 1 inch less, or 29 inches.

Exposed Pockets

5.03 Measurements of poles having exposed pockets of varying shapes and dimensions, near the groundline, shall be corrected by deducting the amounts listed in Table C, where width refers to the horizontal width at the outside of the pole, and depth is the average distance obtained by measuring at right angles from a straightedge (such as the prod carried for other purposes) placed across the pocket. This table lists, eg, that a pole having a measured circumference of 30 inches and an exposed pocket 4 inches wide and 3 inches deep will be equivalent in strength to a solid pole circumference of 5 inches less than 30, or 25 inches.

External Decay (Section 621-220-011)

5.04 Measurements of poles having external decay around the circumference shall be corrected by:

(a) Measuring the average depth of decay and deducting six times the depth from the circumference of the pole measured just above the decay.

(b) Scraping away the decay and measuring the residual circumference. This is not recommended unless the pole is to be given a supplementary groundline treatment.

Insect Damage (Section 621-220-011)

5.05 Poles that are infested with ants or termites can be expected to deteriorate more rapidly than poles not infested, and extra allowance, based on local experience, shall be made for the more rapid rate of deterioration.

Note: The small red or black ants commonly found in checks in poles do not affect the strength of the wood.

Woodpecker Damage (Section 621-220-011)

5.06 Woodpecker damage may consist of holes that go straight into the pole that are made

TABLE B

POLES WITH ENCLOSED POCKETS[1]

MEASURED CIRCUMFERENCE OF SOUND WOOD IN INCHES	THICKNESS OF SHELL ON THIN SIDE IN INCHES	MAXIMUM DEPTH OF POCKET IN INCHES		
		3.0	4.0	5.0
22—30	1.0	2	2	3
22—30	2.0	—	1	1
22—30	3.0	—	—	—
31—38	1.0	2	3	3
31—38	2.0	1	1	2
31—38	3.0	1	1	1
39—50	1.0	2	3	4
39—50	2.0	1	2	2
39—50	3.0	1	1	1

Note: Deductions to be made from measured circumferences in inches to obtain circumferences of equivalent solid poles.

TABLE C

POLES WITH EXPOSED POCKETS[1]

DEPTH OF POCKET IN INCHES	WIDTH OF POCKET IN INCHES							
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
1.0	1	1	2	2	3	3	4	5
2.0	1	2	3	4	5	6	7	8
3.0	1	2	4	5	6	8	9	11
4.0	2	3	4	5	7	9	10	13
5.0	2	3	4	6	7	9	11	—

Note: Deductions to be made from measured circumferences in inches to obtain circumferences of equivalent solid poles.

in search of food, or the pole may be hollowed out for nesting purposes. Unless the pole has been hollowed out for nesting, consider the hole as an exposed decay pocket and make appropriate circumferential deductions. If the pole has been hollowed out for nesting, consider the entrance hole as an exposed decay pocket and hollowed out portion as hollow heart and make appropriate circumferential deductions. No deductions are made for woodpecker damage above the top attachment on a pole.

5.07 Woodpecker damage is not necessarily indicative of other deterioration in a pole. Woodpeckers have been known to attack freshly set, new poles before transfer of attachments had been made. In some cases, however, woodpecker damage may be associated with decay or insect attack (usually carpenter ants). The presence of decay or insect damage may be determined by sounding and/or boring above and below the woodpecker holes.

Guyed Poles

5.08 Storm side guyed poles, guyed corner poles and poles of H-fixtures, may be permitted to deteriorate 10 percent under the replacement circumferences listed in the tables of minimum circumferences at the critical section or the pole inspection rule due to the greater stability of these poles.

Short Rural Poles

5.09 In connection with the inspection of short poles in rural lines it may be desirable to omit the detailed inspections and measurements of the section of maximum decay, and apply instead the push pike test. The push pike test, which is outlined in the instructions covering Rural Lines

(Section 620-131-010), consists of applying at the center of the wire load a certain push at an angle of 45 degrees and noting the effect on the pole.

6. REQUIRED CIRCUMFERENCES

6.01 Required minimum circumferences (Section 621-215-011) vary with the bending moment imposed on the pole under storm loading conditions, the class of line and the fiber stress of the pole timber. Determination of whether a pole meets the minimum circumference requirement is based on the actual circumference of sound wood at the critical section or the equivalent circumference of sound wood at the critical section after deductions for defects as described in this section have been made. Required minimum circumferences may be determined by means of either the tables of minimum circumferences at the critical section or by the pole inspection rule as described in Section 621-215-011.

6.02 The critical section is considered as the section of a pole most likely to fail because of deterioration by decay or insect damage. In most areas maximum decay will occur at the groundline or at less than one foot below groundline. In such cases, the groundline is considered the critical section. In some areas, because of the character of the soil or moisture conditions, maximum decay may occur one foot or more below groundline. In such cases the critical section is considered at the point of maximum decay.

6.03 If the maximum deterioration occurs at a point above groundline, the critical section is considered as the groundline and required circumferences are determined as follows:

(a) If the section of maximum deterioration is below a point one-fourth the distance from groundline to the top of a pole, the required circumference is that determined from the tables of minimum circumferences at the critical section or the pole inspection rule.

(b) If the section of maximum deterioration is between the quarter point referred to in (a) and the midpoint of a pole, the required circumference is 10 percent less than that determined from the tables of minimum circumferences at the critical section or the pole inspection rule, but not less than 14 inches, except for poles in Class R lines. For example, if the required circumference at the critical section is 30 inches, the circumference required at the higher point is 30 inches minus 3 inches, or 27 inches.

(c) If the section of maximum deterioration is between the midpoint and the top of a pole, the required circumference is 20 percent less than that determined from the tables of minimum circumferences at the critical section or the pole inspection rule, but not less than 14 inches, except for poles in Class R lines. For example, if the required circumference at the critical section is 30 inches, the circumference required at the higher point is 30 inches minus 6 inches, or 24 inches.

7. RECOMMENDATIONS

7.01 When the circumference at the critical section is less than the minimum as determined from the tables of minimum circumferences at the critical section or the pole inspection rule, or when a pole has been badly weakened by burning, cracking, splintering, or other mechanical damage, replacement shall be recommended. Also, replacement shall be recommended for those poles which due to deterioration have a circumference at the critical section above the required minimum, but will further deteriorate so their circumference will be below the minimum by the time of the next inspection.

7.02 Poles shall be reported immediately that have deteriorated sufficiently because of decay or insect infestation, or have sufficiently weakened by mechanical damage to be obviously dangerous and could be broken off while climbing or working aloft, or constitute a hazard to the public or employees.

7.03 Replacement of defective poles that are not dangerous shall be made as soon as practical on a regular replacement schedule. The proper class and spacing to be recommended for new poles, considering any additional attachments that will be required within an economical period, shall be determined by plant engineering.

7.04 Rearrangements of sections of pole line shall be recommended where the inspection indicates the necessity for the replacement of a number of poles and where a change in the location of these and possible adjoining poles will improve

or shorten the route. It may be advisable to recommend joint use for consideration where it is not already in effect.

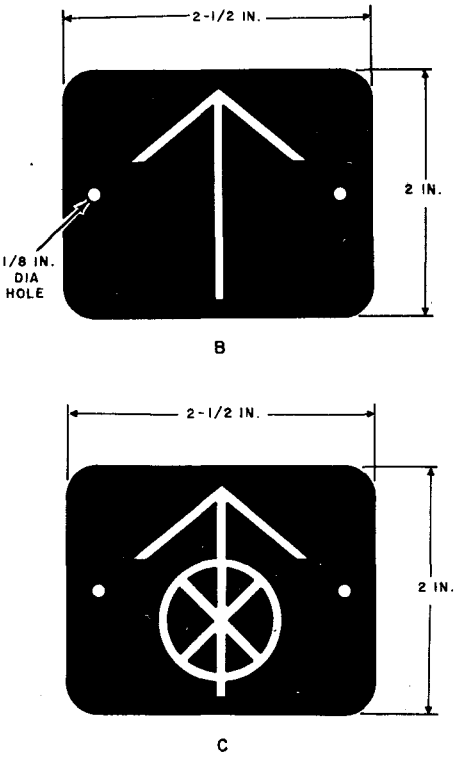
8. MARKING DEFECTIVE POLES

8.01 All poles which are recommended for replacement shall be plainly marked to indicate they are defective. The method for marking poles shall be uniform throughout the Bell System. Two aluminum tags, designated as B and C pole tags have been standardized for this purpose (Fig. 5).

8.02 The B pole tag has a white arrow on a red background. It is intended for marking defective poles that do not require immediate replacement, ie, poles that are not yet considered dangerous as described in 7.02. It is a warning to employees that the pole is defective and is not to be climbed or worked on without following the recommendations of Section 620-131-010.

8.03 The C pole tag is similar to the B pole tag except that an "X" inscribed in a circle is imposed on the arrow shaft. This tag is intended for marking poles that are dangerous and require immediate replacement. It is a warning to employees that the pole is dangerous and is not to be climbed or worked on before being temporarily supported as described in Section 620-131-010.

8.04 Place one tag on the road side of the pole just below the pole number or at approximately 6 feet above groundline if the pole is not numbered. Place another tag at approximately the same height on the field side of the pole. If the pole is defective in the groundline section, place the tags so the arrows point downward. If the pole is defective in the upper portion, place the tags so the arrows point upward. If the pole is defective in both the groundline section and in the upper portion place a double set of tags, one set with the arrows pointing downward and the other set with the arrows pointing upward. Attach the tags with pole tag nails.



B AND C POLE TAGS

Fig. 5—B and C Pole Tags