Installation Engineering Handbook 18
Western Electric Company, Incorporated
Kearny Works

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CONDUIT

CONNECTING, TERMINATING, SEALING AND PAINTING

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1. SCOPE

1.1 This section covers the requirements and methods to be followed when connecting flexible and rigid conduit to sheet metal boxes, wireways, cabinets, fittings, etc., and when splicing sections together. Also contained herein are methods for terminating conduit not connected to a wiring enclosure. Instructions are given for those instances when it is necessary to seal conduit ends and to paint conduit.

2. CAUTIONS

2.1 Sealing compounds, if heated to a sufficiently high temperature, will release a combustible gas. Sealing compounds used in this section must not be heated beyond the putty stage. Application of too much heat must be avoided.

2.2 To prevent dirt from entering conduits (especially those terminating upwards) before they are permanently sealed, plug the ends with oakum rope, wood, metal or a fiber disc, the disc being held in place with a bushing or conduit fitting.

3. GENERAL

3.1 Make up all fittings and connections securely so as to establish and maintain a low resistance ground continuity path. Refer to Section 4 in this handbook for grounding requirements.

3.2 Approved conduit fittings provided are so designed that when they are securely tightened ground continuity is established even when protective coatings are employed on the KS-5351 conduit.

3.3 The conduit system shall be completed before pulling wires in. All openings in boxes, fittings, fixtures, conduits, cabinets, etc., shall be closed.

4. INSTALLING EQUIPMENT

4.1 The required tools and supplies are shown in Section 9A.

5. COUPLINGS

5.1 The threaded coupling provided with each length of rigid conduit should be used for connecting sections and full lengths when threaded ends are available. When either conduit end does not have threads use an "H" or "WEH" coupling.

5.2 To connect flexible metallic conduit to rigid conduit arrange to terminate the rigid conduit with a threaded end to which the flexible metallic conduit connector may be attached by means of a threaded coupling.

5.3 To splice sections of flexible conduit use Flexible Steel Conduit Connectors and straight threaded couplings such as provided with rigid conduit. See Figure 1 for a list of flexible conduit connectors.

6. FITTINGS

6.1 Frequently used conduit fittings are shown in Figure 2. Conduit fittings provide a convenient means for routing conduit by reducing the number of bends and offsets required. Conduit fittings also provide access in the run for pulling leads, connecting leads and locating fixtures and receptacles.

6.2 Catalogue numbers of Kondu fittings usually indicate size by a number representing quarter-inches, for example; Catalogue T2 is a "T" fitting with 1/2" conduit openings and an L8 is an "L" fitting with openings for 2" conduit.

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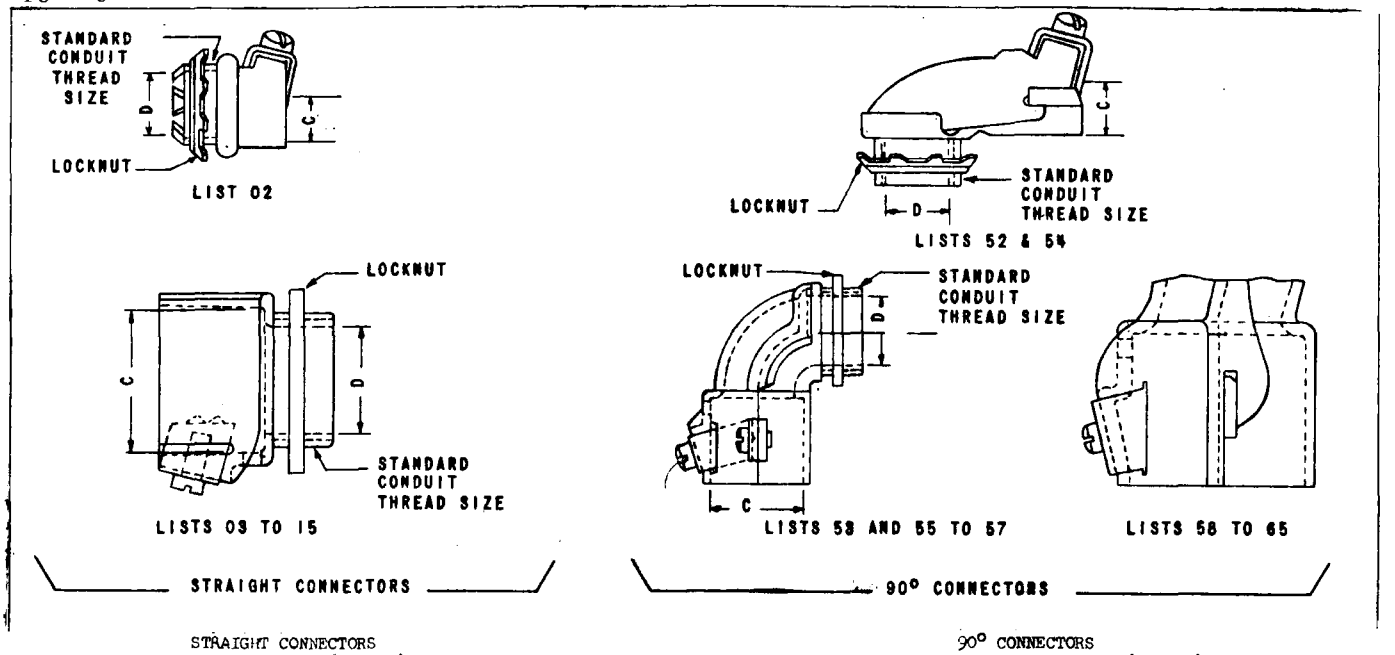

STRAIGHT CONNECTORS
DIMENSIONS IN INCHES (APPROX)

LIST NO.	CONDT SIZE	C INCHES MIN.	C INCHES MAX.	D	FLEX CONDT SIZE
31	1/2	.390	.656	11/32x17/32	5/16, 3/8
32	1/2	.625	.766	19/32	-
33	1/2	.750	.937	19/32	1/2
34	3/4	.812	1.000	25/32	-
35	3/4	.906	1.093	25/32	3/4
36	1	1.046	1.218	1	-
37	1	1.250	1.468	1	1
38	1-1/4	1.250	1.406	1-5/16	1
39	1-1/4	1.562	1.750	1-5/16	1-1/4
*40	1-1/2	1.625	2.062	1-17/32	1-1/2
*41	2	1.850	2.406	1-31/32	2
*42	2	2.000	2.406	1-31/32	2
*44	2-1/2	2.350	2.968	2-11/32	2-1/2
45	3	3.312	3.562	2-31/32	3

90° CONNECTORS
DIMENSIONS IN INCHES (APPROX)

LIST NO.	CONDT SIZE	C INCHES MIN.	C INCHES MAX.	D	FLEX. CONDT SIZE
81	1/2	.375	.625	19/32	5/16, 3/8
82	1/2	.625	.781	19/32	-
83	1/2	.750	.937	19/32	1/2
84	3/4	.812	1.000	25/32	-
85	3/4	.906	1.093	25/32	3/4
86	1	1.040	1.218	1	-
87	1	1.250	1.468	1	1
88	1-1/4	1.250	1.406	1-5/16	1
89	1-1/4	1.562	1.750	1-5/16	1-1/4
*90	1-1/2	1.625	2.000	1-17/32	1-1/2
*91	2	1.850	2.437	1-31/32	2
*92	2	2.000	2.437	1-31/32	2
*93	2-1/2	2.225	2.937	2-11/32	2-1/2
*94	2-1/2	2.350	2.937	2-11/32	2-1/2
95	3	3.312	3.562	2-31/32	3

THESE FITTINGS ARE EQUIPPED WITH FILLERS TO ASSIST IN GRIPPING THE ARMOR. DISCARD FILLERS AS NECESSARY WITH FLEXIBLE CONDUIT. LIST 93 HAS TWO FILLERS.

FIG. 1 KS-5497-01 FLEXIBLE STEEL CONDUIT CONNECTORS (PARS. 5.3, 8.3)

6.3 Special wrenches are provided for tightening threadless "Kondu" outlet boxes. These are R-2538 (1/2" and 3/4"), R-2200 (1" and 1-1/4"), and R-3389 (2" and larger).

6.4 As an aid in holding threadless outlet boxes while tightening, use a short length of conduit temporarily as a handle and as shown in Figure 3. Another method of holding the smaller boxes is with the R-1543 adjustable wrench fitted to the side containing the hub being tightened.

6.5 "Kondu" boxes may be installed between two rigidly supported lengths of conduit as when adding a "C" or "T" fitting in an existing conduit run. After removing the wiring and the section of conduit, install the new outlet box as shown in Figure 4.

6.6 Normally "Kondu" threadless outlet boxes are installed without disassembly. When building a conduit system, place the box on the end of the existing conduit, position, and tighten securely. Continue with the next length of conduit securing it to the existing box and providing support as necessary.

7. HOLES IN BOXES AND CABINETS

7.1 Knockouts

7.11 Knockouts are provided on certain switch boxes and cabinets to permit attachment of conduit or armored cable to them.

7.12 Concentric type knockouts are provided to accommodate one of several different conduit sizes.

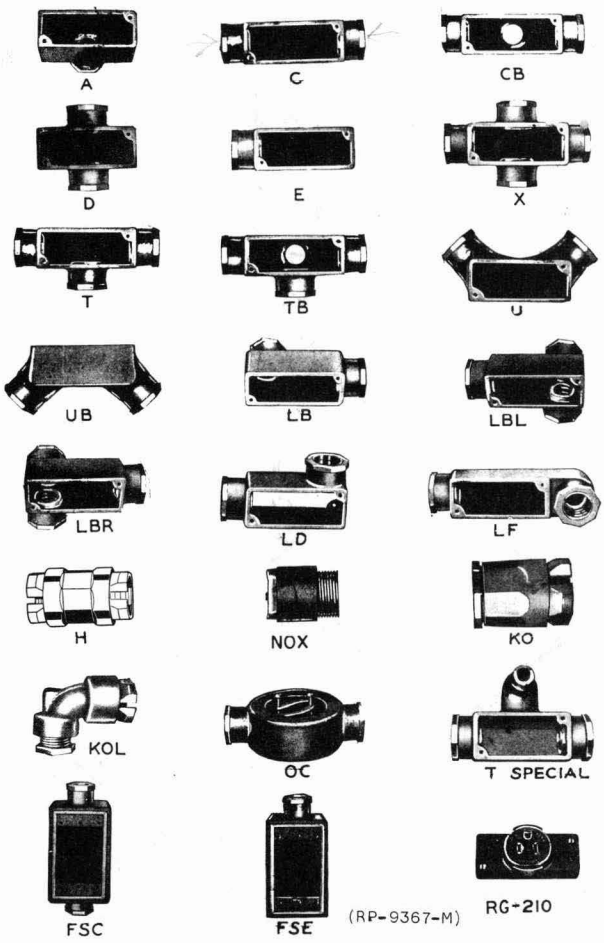

FIG. 2 VARIOUS TYPES OF THREADLESS "KONDU" OUTLET BOXES AND FITTINGS (PAR. 6.1, 8.2)

7.13 To remove concentric type knockouts place the point of a chisel approximately as indicated in Figure 5 and tap with a hammer displacing the metal. Grasp with a pair of pliers twist out one size at a time starting with the smallest size first. For example, if a 1-1/2" conduit is to be used, remove 1/2" center first.

7.2 Punched Holes

7.21 Where knockouts are not provided and it is necessary to cut holes in metal boxes or cabinets, use the R-3241 hydraulic conduit punch set for conduit up to 3". For 3 1/2", 4" and 5" conduit use the R-4284 Supplementary punches.

7.22 When using the R-3241 or R-4284 conduit punch set, a pilot hole 7/16" must be drilled and then the punch for 1/2", 3/4" or 1" conduit is used as is or to enlarge this hole. The R-4284 punch is equipped with a 1 1/8" Drive Screw. See Figure 6 and 7.

CAUTION: The threads of the die should be fully engaged during all cuts.

FIG. 3 TIGHTENING "KONDU" BOXES (PAR. 6.3, 6.4)

7.23 Operate the pump slowly to avoid breaking the 3/8" stud. Allow time for the punch to finish movement after each stroke. Support the ram and die as it cuts through the metal to prevent it from falling.

7.24 Once the hole is enlarged the dies up to the size for 5" conduit may be used to complete the hole. If the slug sticks in the die a sharp blow driving it into the die past the cutting edge will loosen it.

CAUTION: Do not operate the punch dry. Occasionally oil punch 3/8" and 1 1/8" screw and ball bearing.

7.25 If a punch requires sharpening, return it to the functional Service Center. Do not attempt to sharpen punches in the field.

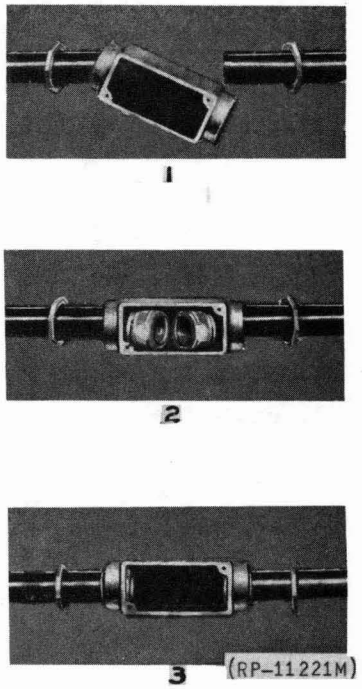

FIG. 4 ASSEMBLING THREADLESS "KONDU" OUTLET BOX IN AN EXISTING RUN (PAR. 6.5)

7.3 Small Drilled Hole Method

7.31 The series of small holes method may be used where no hydraulic conduit punch set is available. The holes can be laid out as shown in Figure 8. Where the hole itself will not be visible, that is, being covered with washers or bushings after a conduit or fitting is connected to it, it is not always necessary to finish off the irregular edges caused by the small drill.

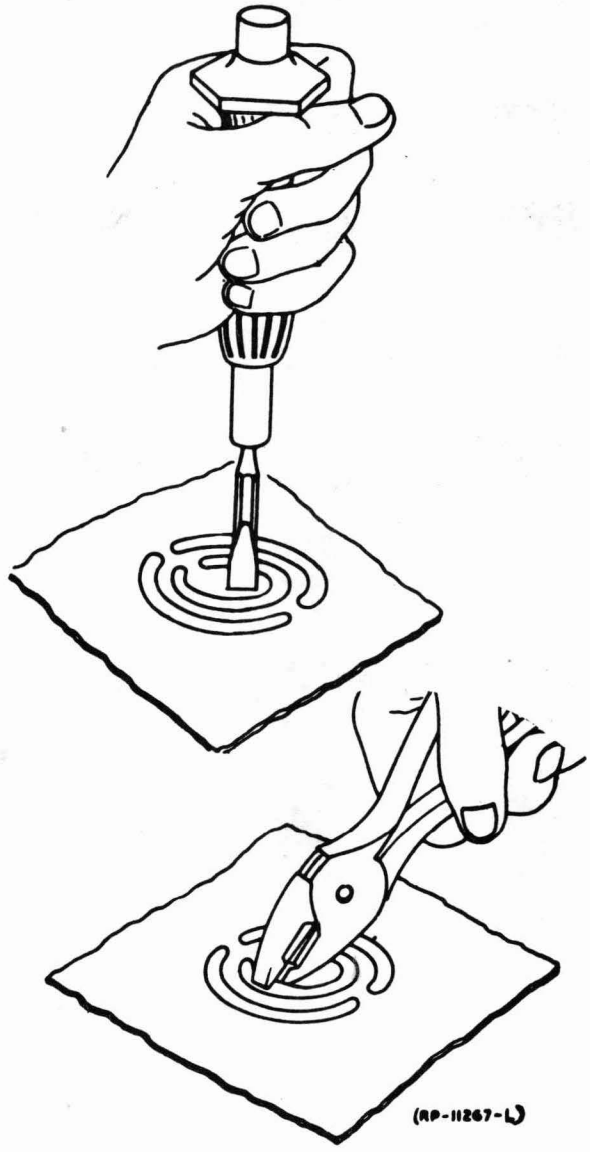

FIG. 5 REMOVING CONCENTRIC KNOCKOUT (PAR. 7.13)

7.4 Panels on Power Service Cabinets

7.41 Frequently the top front panels of ac power service switchboards are split. One panel is to be used to terminate load conduits, etc., and the other is left blank so as to provide access for subsequent wire running and terminating operations. Typical of this is the arrangement shown on drawing ED-81414-01.

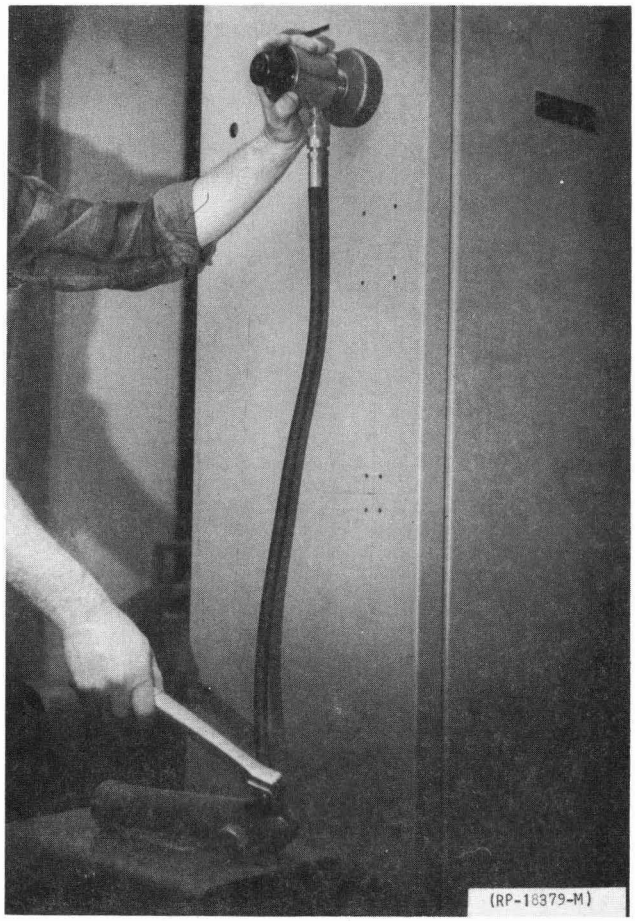

FIG. 6 USING HYDRAULIC CONDUIT PUNCH R-3241 OR R-4284 (PAR. 7.22)

8. TERMINATING AT BOXES AND CABINETS

8.1 Threaded Conduit may be fastened with a locknut on the outside, and on the inside either a locknut and bushing or only a bushing if it is a wholly metallic type or an insulated metallic type. See Paragraph 8.4 for additional requirements where conduit system is used for ac power service.

8.2 Threadless Conduit as well as threaded ends may be secured with "Kondu" boxes or fittings "NOX," "KO," and "KOL." The "NOX" as shown in Figure 2 is externally threaded and requires a metal bushing or a locknut and bushing. The "KO" and "KOL" are internally threaded and are secured with self contained chase nipples except as required in Paragraph 8.4 where power service conduits require it be held with a short threaded nipple, a locknut, and an insulated type bushing.

8.3 Flexible Conduit is secured with Flexible Steel Conduit Connectors as shown and listed in Figure 1. These are fastened to the box or cabinet with a metal locknut and bushing or where room does not permit a metal bushing only.

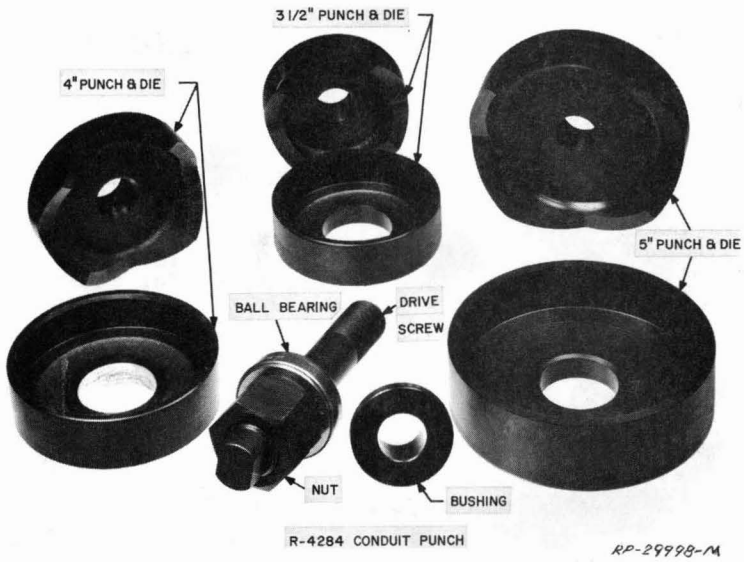

FIG. 7 R-4284 CONDUIT PUNCH (PAR. 7.22)

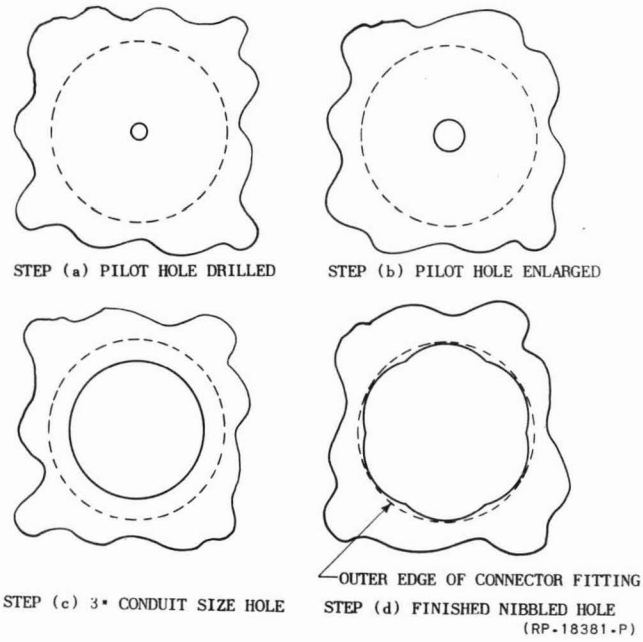

FIG. 8 LARGE HOLE MADE BY SERIES OF SMALL HOLES (PAR. 7.31)

8.4 Where power service conductors No. 4 or larger enter cabinets, raceways, etc., provide insulation to guard against possible damage to the wire and its insulation. This may be either an insulating bushing, or if the bushing is entirely of metal not providing insulation, add an insulating insert held firmly in place.

9. TERMINATING IN THE OPEN

9.1 Conduits carrying signaling leads which terminate in the open (not connected to a box or cabinet) at power boards, switchboards, cable racks, etc., shall be equipped with a bushing. Commonly used types of bushings are either screwed on threaded conduit or are equipped with set-screws for unthreaded conduit.

9.2 Conduits carrying commercial and emergency ac power service conductors are equipped with insulating bushing type fittings when terminated in the open. As specified, leads may be brought collectively through a bushing with a common opening or through individually bushed holes. This arrangement may infrequently be found at the rear of power boards, switchboards, engine alternators, etc., all of which are in a protected location in that they are inaccessible to unauthorized personnel.

9.3 At power boards the height of the terminating conduit fitting should be:

9.31 At top of board - bottom of fitting even with top of board.

9.32 At bottom of board - top of fitting 4" minimum above floor.

10. SEALING - CONDUIT AND SLEEVE

10.1 The top end of sleeves through floors shall be sealed with oakum rope and sealing compound.

10.2 The open ends of conduit terminating in the open and carrying power wire with or without switchboard type cable shall be sealed as follows:

10.21 When both conduit ends are within one room other than in a battery room containing open type cells, no sealing is required.

10.22 Any end, including any holes in fittings, within a battery room containing open type cells shall be sealed with oakum rope and sealing compound.

10.23 Where wire or cable is run in conduit having openings in rooms with different atmospheric conditions, circulation of air and excessive condensation of moisture may result. Examples of rooms having different atmospheric conditions are engine rooms, blower rooms, and furnace rooms. The conduit ends in these rooms shall be sealed with oakum rope and sealing compound.

10.24 Through walls or partitions between rooms normally closed to each other, each end terminating upward or horizontally shall be sealed with oakum rope and sealing compound.

10.3 The depth of the oakum should be a minimum of 1" placed to allow the compound to enter the pipe approximately 1/8" beyond the face of the bushing.

10.4 Use RM-585920 oakum rope and RM-641575 sealing compound and observe the caution in Paragraph 2.1. Pack the oakum rope in around the conductors with a blunt tool to form a stop for the sealing compound. Work in small amounts of the sealing compound at a time. The compound can be softened by the warmth of the hand or by holding it immersed in heated water which is not too warm for the hand. At the same time, similarly warm an R-1060 putty knife or the equivalent. When each is thoroughly warmed, force the compound in against the oakum rope and finish smooth to the face of the fitting.

10.5 For information on sealing conduit with switchboard cable only, see Section 2A of Handbook 8.

11. PAINTING

11.1 KS-5351 conduit will approximately match in color and will harmonize with the gray finish of the surrounding equipment. It may be medium light blue gray (electrogalvanized), silver gray (hot dipped) or a greenish gray (sherardized).

11.2 Touch up standard KS-5351 conduit in exposed places, where marked in transit or marked with tools during installation with KS-8662 gray enamel finish. KS-5351 conduit need not be entirely refinished unless specifically authorized by the telephone company.

11.3 Underwriter's marks or labels need not be removed unless requested by the telephone company. If requested, the label should be painted over with KS-8662 gray enamel after first peeling off any loose ends. Do not remove the label by scraping.

11.4 Where it becomes necessary to furnish other than KS-5351 conduit, and the color is comparable to the KS-5351 colors, it need not be painted.

11.5 Black or other conduit in exposed locations not harmonizing in color with the surrounding gray equipment or finishes shall be given the gray KS-8662 finish. In the case of black asphaltum finished conduit, a coat of shellac should be applied before the first coat of paint.

11.6 If the first coat of gray paint should not result in a satisfactory appearance, apply a second coat. Where two coats of paint are applied, allow the first or primer coat to thoroughly dry before applying the second coat.

11.7 Where conduits are mounted on locally made battens or blocks these shall be finished to match the surrounding equipment.

→ Arrowed lines indicate new or changed information.

[Vertical lines at sides of paragraphs indicate requirements.

Manager, Product Engineering

Reason for Reissue:
(1) To revise Figure 1 to show list numbers in agreement with latest KS-5497-01 specification.
(2) To remove obsolete information.
(3) To include reference to the R-4284 punch. Paragraphs 7.21 through 7.25 and Figure 8.
(4) To bring BSP references up to date and make minor changes throughout section.