ASSEMBLY AND INSTALLATION OF CABLE RACK, CONDUIT, AND AUXILIARY FRAMING GENERAL EQUIPMENT REQUIREMENTS POWER SYSTEMS

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LIST OF ILLUSTRATIONS

1. GENERAL

1.01 This section covers the general requirements for the assembly and installation of cable rack, conduit, and auxiliary framing.

1.02 The requirements covered in this section shall be followed except as modified by applicable specifications and drawings.

2. CABLE RACK

2.01 In general, install cable rack in accordance with the general equipment requirements for cable rack. Leads on cable racks are shown in Fig. 1 and 2.

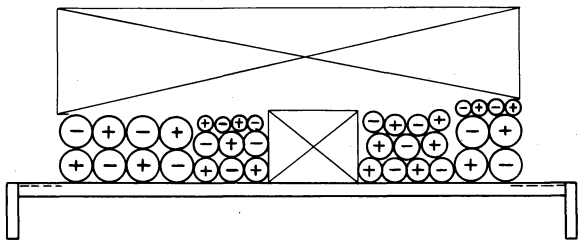


Fig. 1—Power and Switchboard Cable on Cable Rack—Typical Section

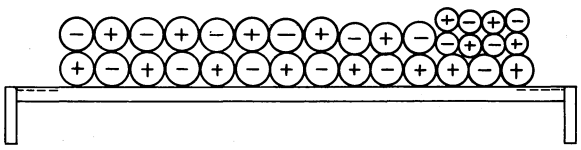


Fig. 2—Pairing of Talking Conductors on Cable Rack—Typical Section

2.02 In general, cable rack is supported in power plants by resting on frameworks or on auxiliary framing, but isolated runs over areas

without framework or auxiliary framing may be supported directly from the ceiling.

3. CONDUIT

3.01 Where specified by applicable specifications or drawings, rigid, flexible, or electrical metallic tubing conduit shall be installed in accordance with the following.

3.02 Rigid conduit and associated fittings shall be KS-5351. Electrical metallic tubing and flexible conduit shall be approved UL products and may be used when permitted by controlling electrical codes and in environments (ie, nonearthquake) where the superior properties of rigid conduit are not required.

3.03 A comparison of rigid conduit and electrical metallic tubing shows that rigid conduit has greater structural strength; requires less frequent support for most sizes; has better grounding capability; and does not necessitate the use of threadless fittings only.

3.04 Figures for supporting conduit apply only to KS-5351 rigid conduit. Electrical metallic tubing shall be installed in compliance with the applicable requirements of the National Electrical Code and local codes.

Caution: Grounding limitations covered in the National Electrical Code 250-91(b) 1975 shall be observed when using electrical metallic tubing.

3.05 Flexible steel conduit may be used in place of pull boxes or at bends in rigid conduit; also for terminating rigid conduit at vibrating apparatus.

3.06 Support conduits as in Fig. 3, 4, and 5 except for small conduit installations where single-hole pipe clamps, 2-hole pipe straps, or hangers will generally prove satisfactory. Conduits may also be supported by fastening to the wall with single-hole pipe clamps. A spacing of 6 feet, maximum, between supports shall be used to agree with aisle lighting. To install the wire type conduit support clips use the R-4287 tool.

3.07 A few conduits may be supported underneath a cable rack by means of J-bolts and iron bars, or if a single conduit only is involved, along the side of the rack stringers, using J-bolts or U-bolts, and short iron bars. If no rack is available, a single conduit may be supported by a pipe hanger, one type of which is illustrated in Fig. 6. Fig. 7 shows two conduits supported on 5/8 inch, 11 threaded rod and short lengths of bar or channel. If one of the conduits thus supported is larger than the other, it should be located close to the supporting rod, and in any case the bars or channels should not extend more than 12 inches from the supporting rod.

3.08 Support conduits at power boards with metal details or U-bolts fastened to the framework.

Conduit Bends

3.09 Conduit from fitting to fitting or outlet to outlet shall contain no more than four quarter bends or the equivalent. If more are required, insert pull boxes. (See 3.16.)

3.10 Make bends of rigid or flexible conduit so that the conduit will not be injured or the internal diameter appreciably reduced. The radius of the curve of the inner edge of any field bend shall be not less than 6 times the nominal internal diameter where rubber-covered cables are used, and not less than ten times the nominal internal diameter where lead-covered cables are used.

Conduit Terminations

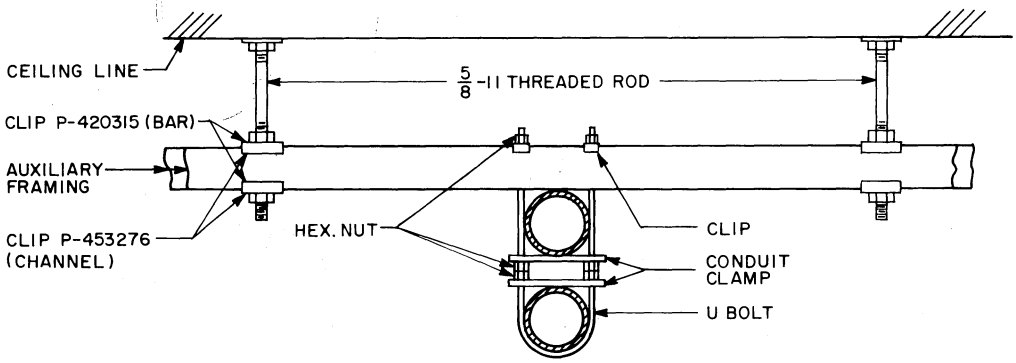
3.11 Terminate conduits as follows.

(a) Ream or otherwise smooth the ends of cut conduit to remove rough edges.

(b) Where threaded conduit terminates in untapped holes in cabinets, boxes, etc, use locknut on outside and metal bushing or bushing of insulating material with a locknut on the inside of box.

(c) With threadless fittings used on the conduit use the shoulder of the fitting or a locknut on the outside and a nut on the inside.

The above are intended to provide tight metallic joints between conduit and box to insure a low resistance to fault currents so overload protection will be operated. Additional provisions apply in certain cases as follows.



SIZE OF CONDUIT	U BOLT	CONDUIT CLAMP	CLIP FOR 3/8 BAR	CLIP FOR 1/2 BAR	CLIP FOR CHANNEL	HEX. NUT
1/2	P-160046	P-160056	P-420317	P-160067	P-374681	P-401452
3/4	P-160047	P-160057				
1	P-160048	P-160058				
1 1/4	P-160049	P-160059				
1 1/2	P-160050	P-160060				
2	P-160051	P-160061	P-420306	P-160068	P-453278	P-125614
2 1/2	P-160052	P-160062				
3	P-160053	P-160063				
3 1/2	P-160054	P-160064				
4	P-160055	P-160065				

Fig. 3—Conduit Support for Two Tiers of KS-5351 Conduit

3.12 Where ungrounded conductors No. 4 or larger or where conductors are subject to vibration, carrying commercial power service, enter a cabinet or a raceway, a substantial bushing providing a smoothly rounded insulating surface must be provided to guard against possible damage to the wire insulation which might result in grounding. This insulation under conditions such as those covered in 3.11 may be as follows.

Condition (a): A substantial insulating insert held firmly in place.

Condition (b): If the bushing is of the metal type not providing insulation, add an insulating insert held firmly in place.

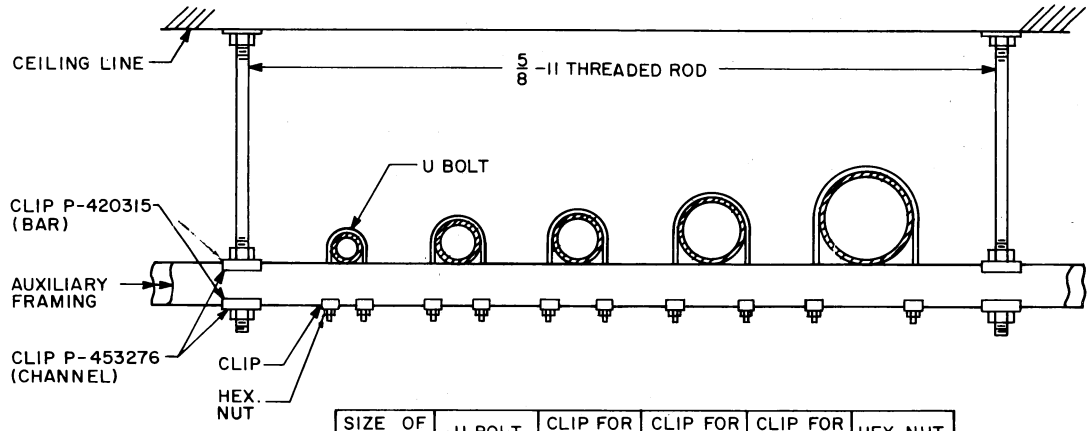
Condition (c): Add an insulating bushing or an insulating insert held firmly in place. Insulating bushings may be of metal with molded-in insulating material at rim, or may be made entirely of insulating material. If a metal bushing clamps tightly against the inside wall of the cabinet or box, the inside locknut normally used under condition (c) may be omitted.

3.13 At power boards, switchboards, and similar protected locations, use an insulating bushing on the end of the conduit.

3.14 At power boards the height of the conduit fitting should be:

At top of board—bottom of fitting even with top of board.

At bottom of board—top of fitting 4 inches above floor.



SIZE OF CONDUIT	U BOLT	CLIP FOR 3/8 BAR	CLIP FOR 1/2 BAR	CLIP FOR CHANNEL	HEX NUT
1/2	P-160036	SEE FIG 5	P-160066	SEE FIG. 5	P-94442
3/4	P-160037				
1	P-160038				
1 1/4	P-160039	P-420317		P-374681	
1 1/2	P-160040				
2	P-160041	P-420306	P-160067	P-453278	P-401452
2 1/2	P-160042				
3	P-160043				
3 1/2	P-160044				
4	P-160045				

Fig. 4—Conduit Support for One Tier of KS-5351 Conduit

Sealing Ends of Sleeves and Conduits Not Terminating in Cabinets or Fittings

3.15 The ends of sleeves or conduits carrying power wire alone or with switchboard-type cable, which terminate upward or horizontally, shall be sealed by packing first with oakum and then sealing with RM-641575 compound. For sleeves or conduits all openings of which are in the same room or enclosure, no ends need be packed and sealed unless they turn upward or are located in open-type battery rooms where all openings are packed and sealed. See Section 800-614-153 on sheathing for cable openings.

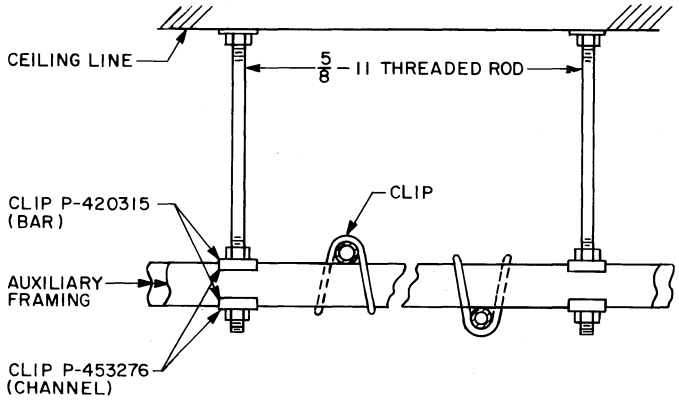
Use of Flexible conduit as a Pull Box

3.16 In straight runs of rigid conduit or at bends, where some form of pull box is required, flexible conduit approximately the length of a standard elbow if at bends (1 foot 6 inches if in a straight run) may be used between the two sections of rigid conduit. If there are four or more medium-size conduits or a conduit larger than 3 inches in a run, a pull box usually is preferable. Flexible sections may be used in an offset in rigid conduit where it rises or drops from one level to another.

Routing of Conduits

3.17 Do not route conduits through foundation piers, columns, beams, stairways, elevator shafts, or any other building structure. Avoid boiler rooms or hot locations. Route conduits through cable vaults only when exceptional conditions make it necessary, and then only with the telephone company's approval.

3.18 Conduits shall not be extended over batteries at such a height as to interfere with maintenance of the batteries.



SIZE OF CONDUIT	CLIP FOR 2 INCH CHANNEL	CLIP FOR 1 1/2 INCH RECTANGULAR BAR
1/2	840035133	840035109
3/4	840035141	840035117
1	840035158	840035125

Fig. 5—Conduit Support Using the Wire Type Conduit Supporting Clip

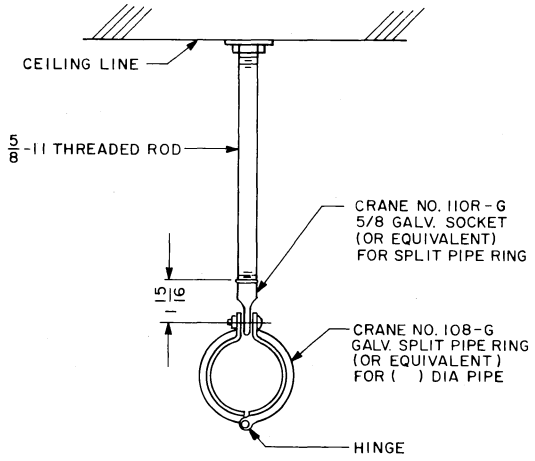


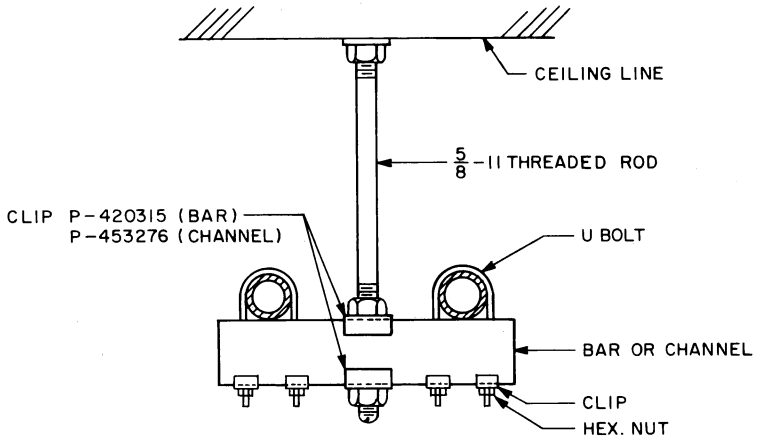
Fig. 6—Conduit Support for Single KS-5351 Conduit Where Auxiliary Framing is Not Used

3.19 All exposed runs of conduit shall be run parallel with or at right angles to the walls of the building as far as possible.

3.20 All concealed runs of conduit shall, in general, be as short as possible, irrespective of crosses and bends in the run. No part of the conduit or coupling concealed in a cement floor shall come closer than 1-1/2 inches to the finished floor except where it emerges.

Location of Conduit With Respect to Other Pipes

3.21 Minimum clearances shall be as follows.



SIZE OF CONDUIT	U BOLT	CLIP FOR 3/8 BAR	CLIP FOR CHANNEL	HEX. NUT
1 1/4	P-160039	P-420317	P-374681	P-94442
1 1/2	P-160040			
2	P-160041	P-420306	P-453278	P-401452
2 1/2	P-160042			
3	P-160043			
3 1/2	P-160044			
4	P-160045			

Fig. 7—Conduit Support for Two KS-5351 Conduits Where Auxiliary Framing is Not Used

(a) At least 1 inch from the water-cooled sections of engine exhaust pipes.

(b) Insulated exhaust pipes or silencers, conduit at right angles: 1 inch when conduit is under or at side, 3 inches if conduit crosses above.

(c) Insulated exhaust pipes or silencers, conduit parallel: 1 inch when conduit is under or at side, 12 inches if conduit runs above.

(d) Uninsulated exhaust pipes or silencers, conduit at right angles: 12 inches when conduit is under or at side, 3 feet 0 inch when conduit crosses above except that the 3 feet 0 inch may be reduced to 12 inches if conduit or exhaust is insulated at the point of crossing for a distance of at least 12 inches beyond the uninsulated pipe or conduit.

(e) Uninsulated exhaust pipes or silencers, conduit parallel: 12 inches when conduit is under or at side, 3 feet 0 inch when conduit runs above.

(f) ***Steam Pipes:*** 1 inch from covered pipes, 6 inches from uncovered pipes.

4. AUXILIARY FRAMING

4.01 Install the auxiliary framing in accordance with the general equipment requirements for auxiliary framing. In power plants, bracing to the ceiling is usually not required except over floor-mounted batteries.

4.02 Keep the area above equipment as free as possible of bars and hangers, consistent with support requirements. Use only one level of framing if possible, except at generator bays.

Support the framing from frameworks and stands whenever possible.

4.03 If it is necessary to suport to the ceiling in areas without frames or stands (as for cable rack carrying discharge conductors and for bus bars at the tanks in open-cell battery rooms), install 5/8-inch, 11 Star Loxin expansion bolts or equivalent in ceilings of concrete construction if inserts are not available, and run rods directly to them. Use beam clamps in ceilings of tile arch and cinder fill construction, with framing in accordance with the general equipment requirements for auxiliary framing.

4.04 Steel auxiliary framing and support details are used for closed-cell installations and outside of the battery room in open-cell installations.

Permissible Load

4.05 The following values are supplementary to the general engineering requirements for auxiliary framing and cable racks. Permissible loads are as follows:

	LOAD POUNDS
5/8-inch, 11 threaded rod	1200
Ceiling insert (Kneas socket or equivalent)	1200
Acme Beam Clamp	800
5/8-inch Star Loxin Shield or equivalent (in rock concrete)	500
3/8-inch Lag screws in wood (2 inches or more)	300
Framing (One pair, 2- by 3/8-inch steel bars, or one pair, 2- by 9/16-inch by 3/16-inch channels)	
Span between supports	
Up to 2 feet 0 inch	2000
2 feet 0 inch to 3 feet 0 inch	1500
3 feet 0 inch to 5 feet 0 inch	1000
5 feet 0 inch to 7 feet 0 inch	700
7 feet 0 inch to 10 feet 0 inch	500

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