CONDUIT - GENERAL

POWER ROOM AND FRAME AND AISLE LIGHTING

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2. GENERAL

2.1 Scope

2.11 This section covers the installation of KS-5351 Conduit, lighting fixtures, supports and fittings for frame and aisle lighting. It also applies to miscellaneous conduit runs, such as for ac service, for shielding plate leads or for leads when the number of conductors is too small to warrant the use of a cable rack. As indicated in the Table of Contents, specific operations such as cutting, bending, etc., are covered in other sections of the 9 series.

2.12 The term conduit system as used in this section is intended to include elbow outlet boxes, appliance outlets, junction boxes, wire ways of fluorescent lighting fixtures and other fittings. It does not include diesel or gasoline engine exhaust lines, air lines or short lengths of metal conduit used as sleeves.

2.2 Sleeves

2.21 Sleeves are used to retain and protect wires passing through walls or floors. Conduit nipples, short lengths of conduit, smooth iron pipe free from burrs, or nonmetallic duct may be specified.

2.3 Job Information

2.31 Job information covering conduit should insure that the completed product conforms to the National Electrical Code. However, in special cases reference to the code may be advisable. It is therefore recommended that each installer be familiar with the code requirements and that a copy be available on the job. Special requirements of a Local Code which are more exacting than the National Code must be followed. Requirements of this type will be covered in the job information or specifically mentioned by the telephone company's representative at the time of installation.

2.32 Check on the allowable number and size of wires to be run in each conduit and check that fittings, boxes, bends, etc., will not prohibit the conductors from meeting the minimum bending radius requirement of the largest power wire it will contain (Section 6B). This applies particularly to "L" fittings in 2-inch sizes and larger.

2.33 All fluorescent lamps shall be furnished by the Telephone Company. The Installer should notify the Telephone Company representative at least two weeks in advance, as to the quantity and size (wattage) of the fluorescent lamps required for the job.

2.4 Description

2.41 KS-5351 Conduit is provided in ten foot lengths and threaded on each end. Each length is equipped with one threaded coupling. This is either a commercial grade zinc coated rigid conduit which will approximately match in color KS-5482-01 power wire and the gray auxiliary framing, or an aluminum conduit. There are three authorized galvanized types (zinc coated). The electrogalvanized type is medium light blue gray in color; hot dipped galvanized - silver gray color; and the sherardized (zinc dust process) is darker due to a final lacquer application and is of a greenish gray color. The electrogalvanized type is the best color match. The galvanized steel and the aluminum conduit may be used together indiscriminately.

2.42 Sections of flexible metal conduit (such as Greenfield) may be used to aid termination of rigid conduits at pull boxes. Use it in place of rigid elbows as an aid for pulling in power wire on long runs, and/or when the amount of work appears excessive in off-setting large conduits or where vibration is evident at rotating apparatus such as motor generator sets and engine alternators. It may also be used where it is necessary to allow equipment to be moved slightly for maintenance purposes without disconnecting.

2.5 D.S. Inspection

2.51 As soon as practicable after receipt, inspect KS-5351 rigid conduit to determine that it has been approved by the Underwriters' Laboratories and that it has a galvanized finish. U.L. approval is usually found in the form of a decalcomania placed near one end of the conduit or elbow and need not be removed.

2.52 Conduit other than KS-5351 may be furnished in black, green, etc. This should only be used after determining that the KS-5351 conduit cannot be obtained.

3. INSTALLING EQUIPMENT

3.1 Tools

3.11 The tools required for operations covered in the Section 9 series are in Kit No. 3 (General Power), Kit No. 5 (Frame & Aisle Lighting) and the following:

Code	Description
R-2863 R-3032	Bender, Conduit, Hydraulic Drill, Electric 1/2" (Required when R-2541 Hole Saws are provided in Kit No. 3)
R-2557 or R-3030	Saw, Hack, Power, Portable (See Note 1)
R-2506	Vise, Pipe, Portable

NOTE 1: Specify the type of current (ac or dc), the voltage, and the frequency (ac only) to insure the receipt of a saw equipped with the proper motor.

3.2 Supplies

3.21 For sealing conduit ends or touching up marred conduit the following is required.

Code	Description
RM-641575	Compound Sealing
KS-8662	Enamel, Gray
RM-585920	Oakum, Rope

3.3 Test Sets

Code	Description
ITE-4442	Volt-Ohmmeter

4. LAYOUT

4.1 Follow the conduit plans when furnished and whenever possible.

4.2 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 or battery rooms with open cell batteries, only when exceptional conditions make it necessary and then with the telepone company's approval.

4.3 Do not run conduits over open cell batteries except when specifically required by the office layout. Conduits shall not be extended over enclosed type batteries at such a height as to interfere with maintenance of the batteries.

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

4.5 All concealed runs of conduit shall in general, be as short as possible, irrespective of crosses and bends in the run.

4.6 Conduit of as small a size as consistent with requirements for number of wires to be pulled in, is generally used. Check Table A before installing conduit extensions not covered by any layout, to determine correct size for allowable leads in the run. Special conditions apply for mixed sizes of wires and sizes of wire through short conduit runs used mainly for mechanical protection. When conduit layouts are not provided, questions relating to these special conditions should be referred to the equipment engineers or to the telephone company engineers in the case of a telephone company engineered job.

TABLE A DIMENSIONS OF CONDUIT AND ALLOWABLE NUMBER OF KS-5482-01 POWER WIRES IN ONE CONDUIT (PAR. 4.6)

CONDUIT SIZE	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"
OUTSIDE DIA.	27/32"	1 1/16"	1 21/64"	1 43/64"	1 29/32"	2 3/8"	2 7/8"	3 1/2"	4"
INSIDE DIA.	5/8"	13/16"	1 3/64"	1 3/8"	1 39/64"	2 1/16"	2 15/32"	3 1/16"	3 35/64"
WIRE SIZE									
14	4	6	10	18	25	41			
12	3	5	8	15	21	34			
10	1	4	7	13	17	29			
8	1	3	4	7	10	17	25		
6	1	1	3	4	6	10	15		
4	1	1	1	3	5	8	12		
2		1	1	3	3	6	9	14	
1		1	1	1	3	4	7	10	
0			1	1	2	4	6	9	12
00			1	1	1	3	5	8	11
000			1	1	1	3	4	7	9
0000				1	1	2	3	6	8
300000				1	1	1	3	4	5
400000					1	1	1	3	4
500000					1	1	1	3	4
600000						1	1	1	3
700000						1	1	1	3
800000						1	1	1	2

(RP-11024)

5. CLEARANCES

5.1 Minimum conduit clearances shall be as follows:

5.11 Insulated exhaust pipe or silencers - conduit at right angles: 1" when conduit runs at centerline or below exhaust pipe or silencer or 3" if above. Measurement is from the outside of insulation.

5.12 Insulated exhaust pipe or silencers - conduit parallel: 1" when conduit runs at centerline or below exhaust pipe or silencer, or 12" if above. Measurement is from the outside of insulation.

5.13 Uninsulated exhaust pipe or silencers - conduit at right angles: 12" when conduit runs at centerline or below exhaust pipe or silencer, or 36" if above.★

5.14 Uninsulated exhaust pipe or silencers - conduit parallel: 12" when conduit runs at centerline or below exhaust pipe or silencer, or 36" if above.

5.15 Steam Pipes: Conduit must be 1" from covered pipes, and 6" from uncovered pipes.

★ 36" may be reduced to 12" if conduit or exhaust is insulated at the point of crossing for a distance of at least 12" beyond the uninsulated pipe or conduit. An alternate means of insulating the crossing is to provide a piece of transite at least 1/8" thick between the runs, the transite extending 12 inches either side of the midpoint of the crossing in all directions.

6. ASSEMBLY AND SUPPORT

6.01 Install and support conduit as shown on the job drawings when furnished.

6.02 In case of interference, contact the equipment engineer with a suggested rearrangement and mark drawings as required.

6.03 Assemble on the floor or at the bench as much material as practicable before placing it in its permanent position. This includes conduit risers, appliance outlet runs, etc. To avoid excessive handling and changing of tools perform like operations on a number of assemblies before proceeding with the next operation.

6.04 To get maximum use from each 10 ft. length of conduit, study the measurements and make the cuts so as to obtain a minimum of discarded ends.

6.05 It will not be necessary to cut the threaded ends off as the hub in each threadless fitting will grip a threaded end as well as a nonthreaded end.

6.06 Utilize the threaded couplings shipped with the conduit for splicing threaded ends whenever this is practicable.

6.07 It is not necessary to scrape off any coating which may be on the conduit to insure an electrical connection to a threadless fitting as each hub is made with concentric rings which force themselves in the conduit metal as the nut is tightened. All conduit connections should be tight so as to assure a good ground.

6.08 In order to have permanent lighting on crossbar installations as soon as possible and to facilitate the installation of conduit where the ladder tracks are installed before the erection of the frames, place all frame aisle conduits at the time the ladder tracks are installed, as both the track and conduit supports are secured partly by the same bolt assembly.

6.09 Securely fasten all exposed conduit at intervals of 6' 0" maximum.

6.10 All conduit and fittings shall be securely assembled and fastened in place before the wiring operations are performed.

6.11 After completing the conduit system and before pulling in the wires, inspect for and correct within the system any burrs, sharp edges, or other obstructions that may damage the wire insulation.

6.12 On completed conduit systems, all unused openings on boxes, fittings, fixtures, conduit ends, etc., shall be closed with appropriate plugs, caps, snap-in blanks, or knockout plugs. All pull boxes shall be closed with proper covers. In addition any conduit system used solely for support, but which provides an access to enclosed wiring, must be similarly closed.

7. FRAME AND AISLE LIGHTING DRAWING USAGE

7.1 Frame and aisle lighting drawings furnished to the installer are of two types:

(a) Job Drawings prepared specifically for each job and showing the arrangement and the equipment to be installed on that job.

(b) Standard drawings used on all jobs showing in detail the groups of equipment which are combined in various ways to make up any kind of installation. These drawings may be in the form of stocklist drawings with an associated assembly drawing or as a combined stocklist and assembly drawing.

7.2 Use of Job Drawings: The job "Frame and Aisle Lighting Drawing" will show where conduit and groups of fittings, fixtures and supporting details are to be used on a particular job.

7.21 At the edge of the main figure on this drawing short lengths of low type superstructure bars will be shown. With the aid of a ruler and a colored pencil it is suggested the installer lightly extend a single line from each set of superstructure bars through the cross (support) points on the conduit runs. This overlay will distinguish support points from fixtures, etc.

7.22 The job layout will consist of a Figure 1 (main figure) showing the frame and aisle lighting arrangement on a floor plan basis. In addition a sketch usually referred to as Sketch A, will show a detailed arrangement defining the details of the commonest job. Designations in Sketch A apply to equipment in the job layout when undesignated. Designations in the job layout show deviations from sketch A.

7.23 The equipment groups are shown by cross lines on the conduit run similar to the following: —+———— 2F +—— 20S Each cross being identified by a symbol consisting of a number and a letter. These symbols such as 15F, 48R, etc., are used to identify a particular fixture, a method of support, a conduit arrangement, etc.

7.231 When an "X" symbol is used, such as 1X, 2X, 3X, etc., this refers to information not found on standard drawings. The "X" portion of the symbol indicates information located thereon and the number portion indicates the figure.

7.232 The "letter" portion of the symbol corresponds to a standard stocklist drawing as indicated in the notes. The "number" portion of the symbol is the group number of equipment shown on this standard stocklist drawing.

7.24 This standard stocklist ED drawing contains an Information Table, and from the group numbers listed, circuit drawing information and associated assembly figures can be determined. Also included is a Stocklist for determining the parts necessary for the detailed assembly of each group and for checking materials shipped. The assembly figures show the parts comprising one or more groups and how they are to be installed.

7.25 Should the Job drawing make reference to a standard H drawing, it will show on Table A, the applicable ED drawing for assembly information. The H drawing will also contain a stocklist as an aid in determining the parts necessary for the assembly of each group and as a check for material shipped.

8. KS-15857 FLUORESCENT LIGHTING FIXTURES

8.01 This lighting unit shown in Figure 1 is a standard fixture provided as an alternate to the KS-15673 Track Integrated Fixture and used in most locations where the track intergrated fixture cannot be used. Note the absence of starters made possible by the design of the Trigger Start Ballast in the 20 watt lamp size and the Rapid Start Ballast in the 40 watt lamp size. The fixture, identified by KS number and List number or Drawing ED-81343-15 and Group number, is essentially the same fixture as the previous "Day Brite Cat. TR-___" series.

8.02 The principle feature of this fixture is its rapid adaptability for use as a single fixture as shown in Figure 2 or connected physically end to end for use as a continuous channel assembly as shown in Figure 3.

8.03 Locate the individual fixtures according to the job drawings. Assemble and securely tighten all fastening devices. Install lamps. Make sure the F40T12/W/RS Rapid Start Lamps are actually furnished for the 40 watt lamp size Rapid Start Fixture.

8.04 Attach the plug on the fixture cord to the associated receptacle in the conduit run. Test all lamps for correct circuit association and see that all control switches operate satisfactorily.

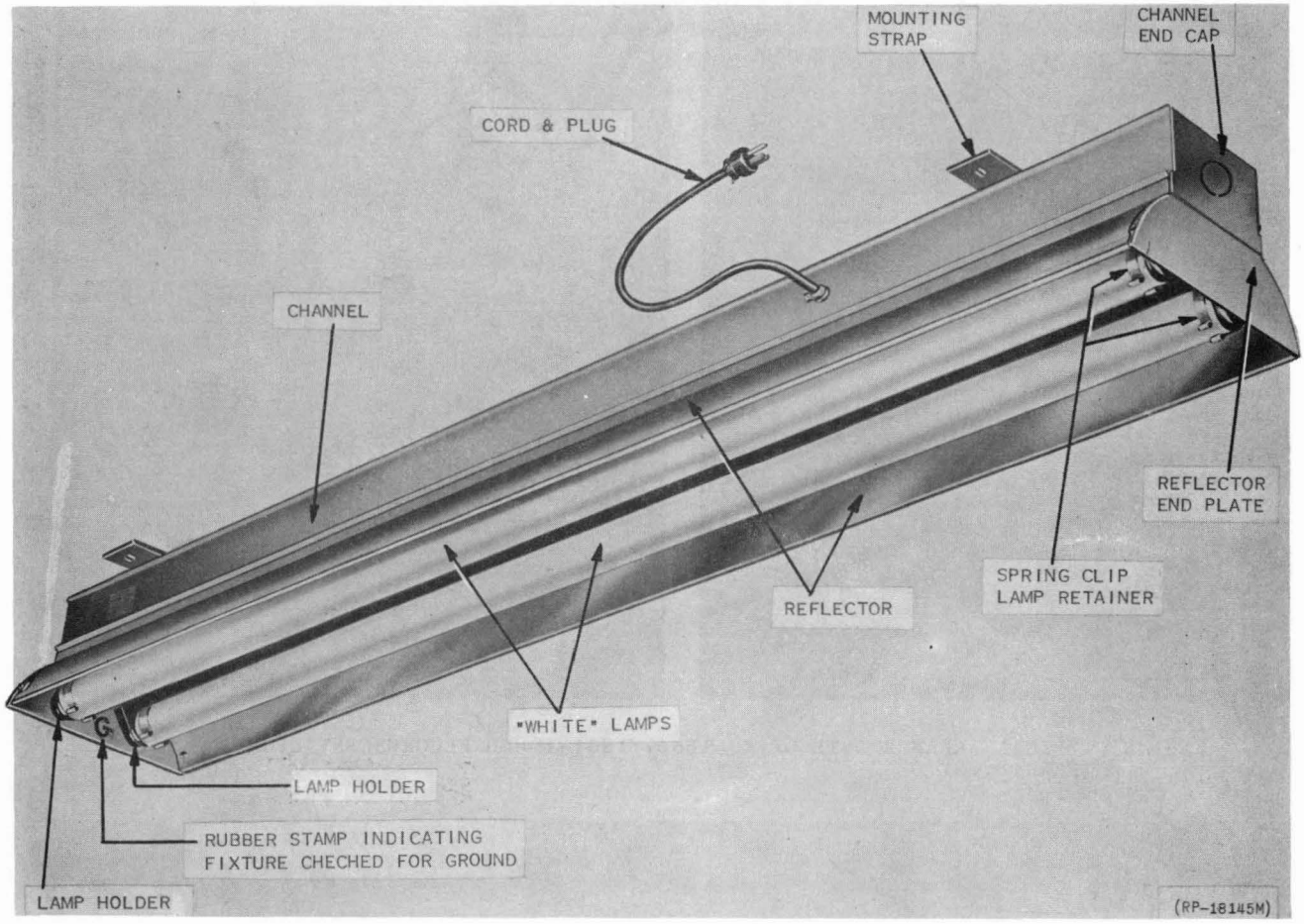

FIG. 1 KS-15857 INDIVIDUAL TWO LAMP FLUORESCENT LIGHTING UNIT (PARS. 8.01, 10.6)

8.05 If the fixture is supplied with power by any means other than conductors within a metallic sheath, it is necessary to check the fixture for ground as covered in Paragraph 10. On subsequent job orders, when cabling and other work operations are required above the fixtures and this access is blocked, remove plug-in type fixtures as necessary and mask out the "G" temporarily until the fixture is reinstalled and rechecked for ground. After the work operations are complete, reinstall the fixtures and restore the plug and cord connection. The fixtures that have been removed and reinstalled must be checked for an adequate ground whether or not they were previously checked and stamped with a "G". Follow Paragraphs 10.3 through 10.6.

8.06 To facilitate installation of <u>continuous channel assemblies</u>, consider the following procedure: (See Figure 4)

8.07 Determine the overall limit of the continuous lighting arrangement for the particular lineup. Select the auxiliary framing bars nearest each end of the proposed layout to which the lighting channels may be attached. Mark the vertical side of each of the selected framing bars near the lower edge with a pencil to indicate the proposed center of the channel run. Mark the center of two P-374919 support clamps, and install them on the end framing bars with the center of the clamps situated to coincide with the center marks on the framing bars, and the set screw side of both clamps on the same side of the center line. Securely fasten the clamps in place.

8.08 Use an R-1384 chalk line drawn up tightly between the two clamps and on the under side of the framing bars. Adjust the line to the edge of each clamp on the side away from the set screw. It may be necessary to insert a wooden spacer between the chalk line and one or both of the end framing bars to give clearance between the chalk line and any intermediate bars which may be lower or out of horizontal alignment.

8.09 Securely fasten in place, where required, all intermediate clamps with the identical point of each clamp even with the chalk line.

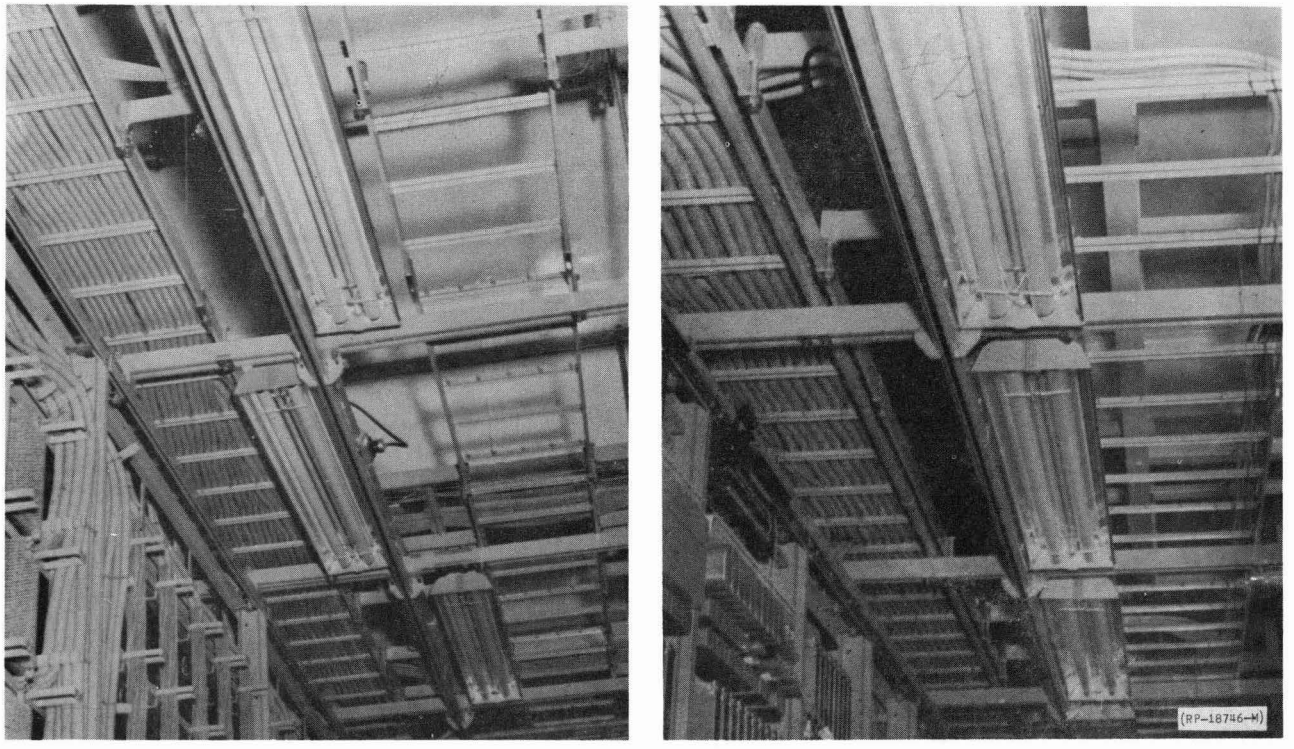

FIG. 2 TYPICAL ARRANGEMENTS OF KS-15857 INDIVIDUAL FLUORESCENT LIGHTING FIXTURES (PAR. 8.02)

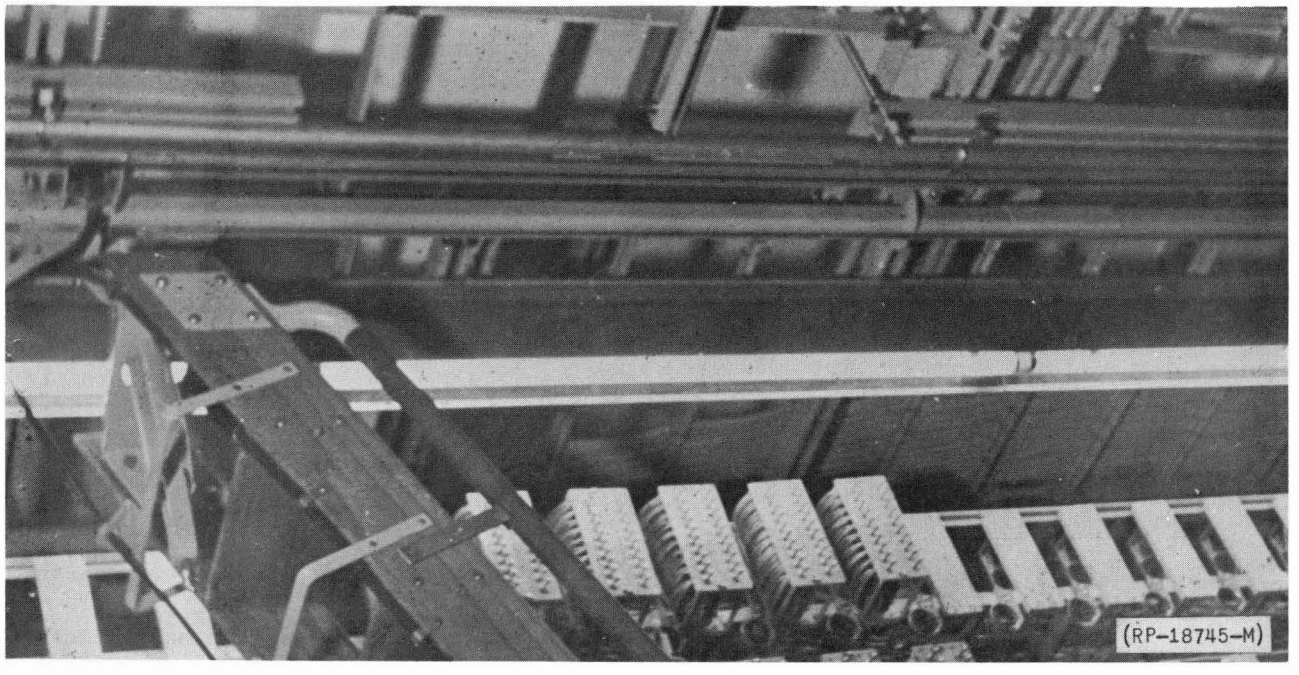

FIG. 3 TYPICAL VIEW OF KS-15857 CONTINUOUS LIGHTING ASSEMBLY AT DISTRIBUTING FRAME (PAR. 8.02)

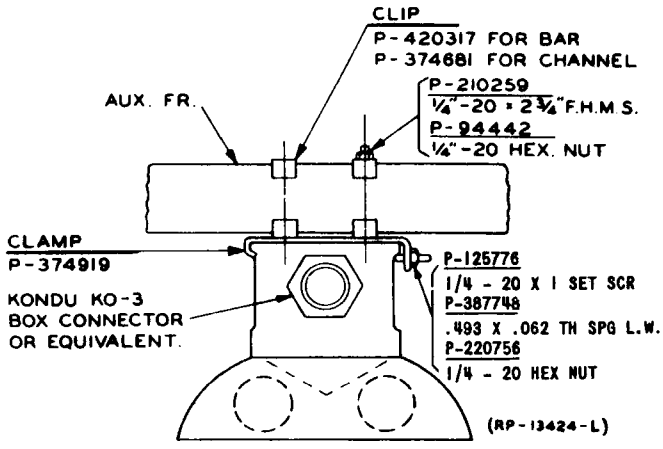

FIG. 4 METHOD OF SUPPORTING CONTINUOUS LIGHTING CHANNEL FROM AUXILIARY FRAMING (Par. 8.06)

8.10 Back off all P-125776 set screws until the leading end of the screw is even with the inside face of the clamp so as not to interfere when placing the channel in the clamp.

8.11 Install all channels in close approximation to the final position. Set up lightly, all set screws, to hold channels in place but still allow some movement.

8.12 Install and secure the channel coupling at the center of the layout and work toward each end until all couplings are tightened in place.

8.13 If the distance between the chalk line (horizontal line) and the lower edge of any intermediate framing bar, measures more than 1/4", a metal spacer should be placed between the bottom clips on the framing bars and the clamp (P-374919). The spacer should be long enough to completely cover both bottom clips, and be provided with clearance holes for the screws.

8.14 After all channels are in position and completely wired, the channel covers and reflectors should be installed in a manner which permits accurate joining and aligning throughout the run. To assure this alignment it is recommended that all reflectors and their coupling screws be set up finger tight, the parts aligned, and then finally tightened.

8.15 Install lamps. Make sure the F40T12/W/RS Rapid Start Lamps are actually furnished for the 40 watt lamp size Rapid Start Fixture.

8.16 Test all lamps for correct circuit association and see that all control switches operate satisfactorily.

9. KS-15673 TRACK INTEGRATED FLUORESCENT LIGHTING FIXTURES

9.01 Planning: On Number 1, Tandem and Number 4 Crossbar jobs where apparatus aisles are thirty inches wide, access to over frame cable racks from the aisle at fixture locations is completely blocked. If the fixtures are left out during the cabling operations, approximately six inches is available between the cable rack stringer and the ladder track and this will provide a measure of access to these racks from the apparatus aisles.

9.02 On new jobs, consideration should be given to installing these fixtures after completion of cabling.

9.03 Assembly: A small section of 1 inch conduit is supplied with each List 1 and 3 (80 watt) fixture. The threadless conduit connector at one end of the fixture is equipped with a bushing which stops the conduit at the end cap.

9.04 The conduit connector at the other end of the fixture has a modified bushing without a stop permitting the excess length of the 1 inch conduit to enter or telescope into the channel. This allows the fixtures to be connected end-to-end and adjusted between pairs of framing bars on standard centers of from 5 to 6 feet. Attach the telescoping 1 inch conduit to the threadless connector which stops the conduit at the end cap and tighten securely.

9.05 Mounting First Fixture: Locate the first fixture over the ladder track at the beginning of the lineup and center it between the framing bars with the conduit extension facing the direction of lineup growth. Secure the conduit extension to the top of the framing bars with the conduit clamp and the ladder track support bracket screw. The "U" shaped bracket should straddle the ladder track preparatory to its final adjustment.

9.06 Mounting Subsequent Fixtures: Place the next fixture in center position between the framing bars and slide the connector without the stop over the conduit of the fixture previously installed. Hand tighten the connector. Repeat this process for the lineup. (See Figures 5.)

9.07 Adjustment of Supports: After a lineup of fixtures are assembled, level each fixture and adjust the "U" shaped adjustable bracket downward through an arc to rest on the ladder track. Tighten all holding bolts of the adjustable bracket and set up securely all lock nuts on the connections at the adjustable end of the fixtures after the adjustments are made.

9.08 Reflectors and Lamps: Complete the wiring according to the job circuits. Place and dress interior wiring along the V channels on either side of the fixture, and install the spring retaining clips. Inspect to insure all wiring is retained loosely by the clips and not caught between the end of the clip and the fixture. Close the hinged cover, and fasten with the self retaining machine screws. Place the reflectors which are provided with slots over the two captive screws in the channel side members. Tighten these screws securely to hold the reflectors firmly against the channel. Install the lamps. Make sure the F40T12/W/RS Rapid Start Lamps are actually furnished for the 40 watt lamp size Rapid Start Fixture.

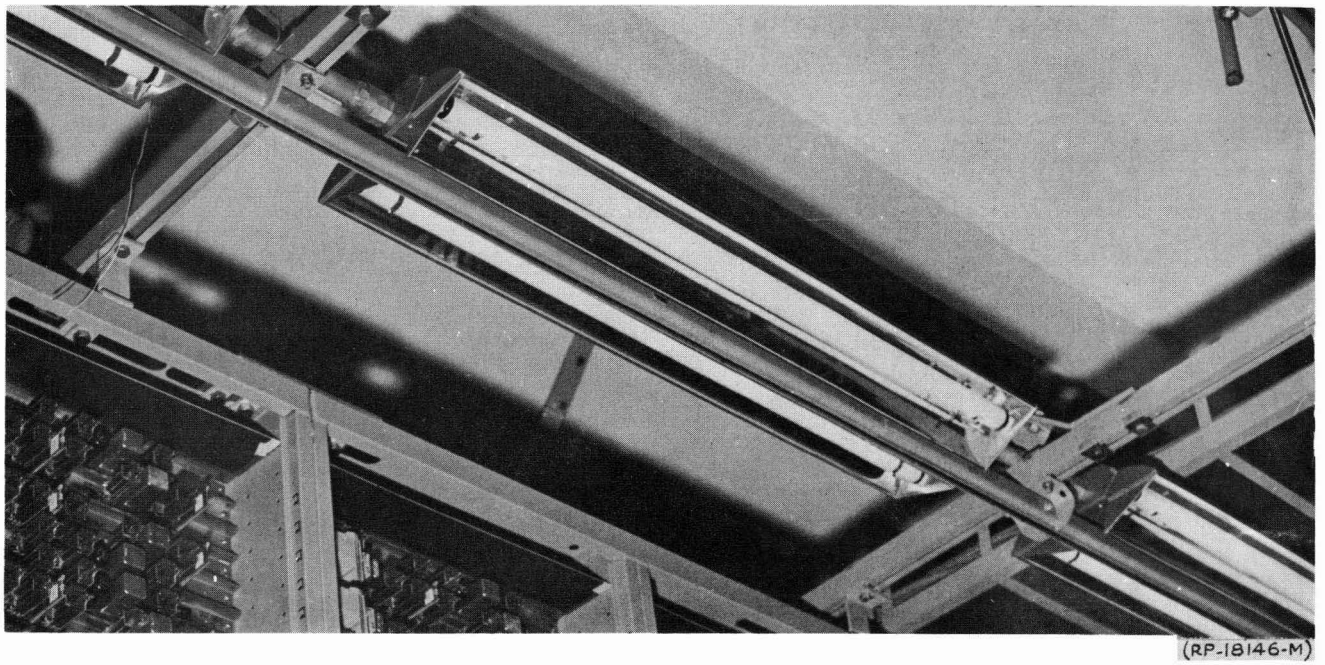

FIG. 5 TYPICAL KS-15673 TRACK INTEGRATED FIXTURE ARRANGEMENT (PAR. 9.06)

9.09 Test: Test all lamps for correct circuit association and see that all control switches operate satisfactorily.

9.10 Modified with Flexible Cords:

Track integrated fixtures may be provided with three conductor cords and arranged to plug into a separate conduit run. This arrangement is used where access to work on cable racks, etc., above the fixture level is blocked with the fixture in place, but accessible with the fixture removed. The conduits between units which normally carry the branch circuits are then only used for fixture support.

9.11 Plug-in type fixtures shall be checked for ground as coverd in Paragraph 11. On subsequent job orders, when cabling and other work operations are required above the fixtures and this access is blocked, remove plug-in type fixtures as necessary and temporarily support the remaining fixtures as required with 1" lengths of conduit. Mask out the "G" temporarily until the fixture is reinstalled and rechecked for ground. After the work operations are complete, reinstall the fixtures and restore the plug and cord connection. The fixtures that have been removed and reinstalled must be checked for an adequate ground whether or not they were previously checked and stamped with a "G". Follow Paragraph 11.

10. KS-15912 POWER AND ENGINE ROOM FLUORESCENT LIGHTING FIXTURES

10.1 This recently introduced lighting fixture is shown in Figure 6. The fixture and conduit arrangement, and the method of support is shown on Standard Drawings furnished to the job.

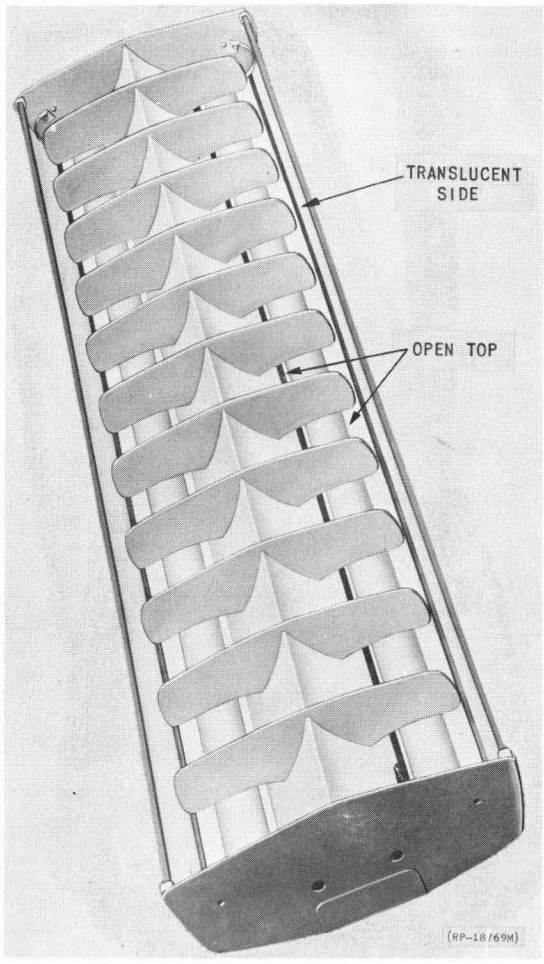

FIG. 6 KS-15912 POWER AND ENGINE ROOM FLUORESCENT FIXTURE

11. GROUNDING - CONDUIT AND LIGHTING FIXTURES

11.1 Conduit: Conduit grounding is covered in Section 4 of this handbook.

11.2 Fixtures are considered grounded when connected through by flexible or rigid metal conduit from the ac lighting cabinet.

11.3 Installed Plug-in Fixtures - Two Conductor. Fluorescent fixtures wired with flexible cords frequently depend on the supporting iron work for their ground. This fixture ground may be derived through several painted junctions of iron work thereby affecting the assurance of an adequate ground.

11.4 When installed, each two conductor flexible cord connected fluorescent fixture, rigidly fastened either directly or indirectly to supporting iron work, shall be tested for presence of ground.

11.5 Disconnect power from the fixture to be checked. Use the "Ohms X 1" scale of the ITE-4442 Volt-Ohmmeter and determine that the resistance between the reflector and the conduit or fitting normally furnishing power to the fixture, is not greater than 5 ohms.

11.51 For those fixtures whose resistance is greater than 5 ohms it will be necessary to measure with the ohmmeter, the resistance of each succeeding iron work connection, to find the one or ones at fault.

11.52 The high resistance fault usually caused by dirt or paint may sometimes be eliminated by repeated loosening and retightening clamping assemblies.

11.53 When this is unsatisfactory, disassembly will be necessary. Remove paint from contact areas by scraping or with abrasive paper and then reassemble securely. After fault is cleared, refinish exposed bare metal to match surroundings.

11.6 Installed Plug-In Fixtures - Three Conductor: Flourescent fixtures wired with 3 conductor flexible cords are grounded through the green ground wire located in the flexible cord. To test the fixture for ground, remove the power from the fixture by means of the light switch at the end of the aisle. (Do not disconnect the flexible cord from the conduit fixture, as this will remove the ground).

11.61 Using the "Ohm X1" scale of the ITE-4442 Volt Ohmmeter, determine the resistance between the reflector and the metal body of the outlet box which is furnishing power to the fixture. Resistance should not exceed 1 ohm.

11.62 If test fails, check for loose ground connection at the fixture, or for faulty plug or cord.

11.7 After obtaining a satisfactory check, indicate this on each fixture. Stamp a 3/8 inch "G" on the inside of one of the reflector end caps. Locate the "G" below the lamps, so that it may be seen from the floor. See Figure 1.

11.8 Existing Untested Plug-in Fixtures: When necessary to work in close proximity to untested flexible cord connected fluorescent fixtures previously installed, these shall be checked for ground as outlined above. This same test is specified by Handbook 0 Section 13D.

11.9 Nonstandard Fixtures: When it is necessary to work in close proximity to nonstandard fixtures (usually installed by outside contractors) that are supplied with power by any means other than conductors within a metallic sheath (example chain supported or rubber cord connected fixtures), it is necessary to ascertain the absence of a potential on the fixture body. With an ac voltmeter connected from the ac service conduit or an equally reliable ground to the fixture body, determine that the fixture is free of ac service voltage. Any voltage detected should be reported to the operating company for any necessary correction required.

12. UNDERWRITER'S INSPECTION

12.1 The Western Electric Company shall ascertain from the telephone company whether inspection by the city or Underwriters is desired of the emergency alternator set and of the wiring and equipment connected directly to the commercial power service; if so, after completion of the power work such inspection shall be requested by the telephone company or at their direction, by the installer. Any certificates of approval received by the installer shall be turned over to the telephone company. This does not include wiring, machines, batteries, etc., to which the telephone circuits are connected since they are classed as signaling equipment under the code and do not require approval.

→ Arrowed lines indicate new or changed information.

[Vertical line at side of paragraphs indicates requirements.

Manager, Product Engineering

Reason for Reissue:
To indicate that fluorescent lamps will be furnished by Telephone Company. (Paragraph 2.33)