FUNDAMENTALS OF EQUIPMENT ENGINEERING

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Western Electric Company
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Personnel Service Branch *Training Department*

Western Electric Company, Inc.
Hawthorne Works
Personnel Service Branch
Training Department

Telephone Systems Training
Course: Equipment Engineering Practices

FUNDAMENTALS OF EQUIPMENT ENGINEERING

These lessons are issued to describe in general the fundamental routines and practices employed by the Equipment Engineer. Information contained herein is to be used for training purposes only.

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Bell System Publications

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Lesson No. 1

PLANNING THE CENTRAL OFFICE

This lesson is issued to describe the general features of planning a central office. Information contained herein is to be used for training purposes only.

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SECTION 1. INTRODUCTION

An order for telephone central office equipment arriving at Hawthorne or Kearny is the result of very exhaustive studies extending usually over a period of several years. The Telephone Company, in carrying out its purpose of providing satisfactory telephone service economically in all areas under its control, must by necessity be entirely familiar with all of the conditions that may affect this service. Such familiarity can be obtained only by careful investigation and analysis of these conditions. By means of a proper summary of the results of such studies, a clear and concise picture of not only the present status but also of the expected future status of each exchange area is continuously maintained. As time passes and the periods for action as noted on the summaries for each area are arrived at, orders for additions to existing central offices or for new central offices, as the case may demand, are originated and sent to Hawthorne, or Kearny for fulfilment.

The Telephone Company's studies are carried on by highly specialized groups as follows:

1. The Commercial Engineer forecasts the prospective demand for telephone service in each area and also the revenues which may be expected if this demand is met.

2. The Plant Extension or Fundamental Plans Engineer, using the Commercial Engineer's forecasts, prepares construction programs for considerable periods in advance so that the telephone plant will meet the increasing demands for service in the most economical way.

3. The Traffic Engineer, using the forecast of stations and lines made by the Commercial Engineer together with the program set forth by the Plant Extension Engineer and the Traffic Department's data on usage both as to number and distribution of subscribers' calls, develops the specific recommendations for units of central office equipment, inter-office trunking and toll circuit requirements.

4. The Equipment Engineer, using the Traffic Department's recommendations, plans the detailed layout of the office, issues specifications and drawings for the purchase of the equipment and prepares an estimate of equipment costs for the management's approval.

5. The Building Engineer, working in cooperation with the Equipment Engineer, is responsible for the proper design of the building, purchase of land, contracting and inspection of construction.

6. The Outside Plant Engineer, using the Commercial and Plant Extension Engineers' data, is responsible for the subscribers' distribution system consisting of conduit, pole lines, feeder cable, distributing cable, house cable, etc., and the trunk cable system together with any loading if required.

The functions of each of the above engineering groups are discussed in detail in the following sections.

SECTION 2. COMMERCIAL ENGINEERING

A business forecast may be defined as an estimation of reasonable future possibilities based upon the facts that are knowable today, upon the principles evolved from yesterday's experiences and upon the assumption that in a varying degree these principles will be valid in the future as they have been in the past. Accordingly, the Commercial Engineer's job is to ascertain the present status and distribution of the telephone business in the particular exchange area and then to estimate its probable growth up to certain future periods.

A prime factor affecting the telephone business is the change in population. Some idea of the future trend may be indicated by plotting a curve of the census figures of the area for the last several decades and extending the curve into the future up to the period for which the study is made. This period is taken as 15, 18 or 20 years hence and is known as the ultimate period. The average life of a telephone office building and its associated equipment is from 25 to 35 years. However, it has been found that a reasonably accurate commercial forecast can be made for a period of only 15 to 20 years hence, and therefore studies of this nature are limited to that period. The population curve, as a basis for making forecasts, is too general. It is therefore necessary to make a more detailed study which is known as the Commercial Survey.

The Commercial Survey consists of a detailed canvas of the buildings in a telephone area taken block by block to determine the amount and distribution of the population, the character of the present population, the trend of the future population, the amount, distribution, character and trend of business, and the resultant amount of present and future telephone business in terms of the number of telephones and the type of service such as single party, 2 or 4 party, flat rate, message rate or coin box. The first step in the survey consists of dividing the city into market areas, that is into areas in which there is a good market for telephones, those in which there is a poor market, etc. These areas usually take the form of downtown business areas, industrial and warehouse areas, combined residential and neighborhood business areas, restricted residential areas and outlying areas. The next step is to divide each area into house count sections. Each house count section or working section, as it is sometimes called, is selected as that area in which theoretically the ultimate telephones will be connected to a single distributing cable in the outside plant equipment. A section may consist of one city block, several blocks, a partial block or more extensive areas in the outlying regions.

Card Records of existing subscriber showing the name, address, telephone number and type of service are posted on Field Survey Sheets arranged according to house count sections. Field men then canvas each section noting the class and amount of business, the type of residences, that is whether apartments, flats or houses and the estimated rental paid on each. The rental value is important because it is found that there is a direct ratio between the rental and the percentage of telephones in use and also in the class of service. For instance a high rental area will have a very high percentage of telephones and of the more desired single party service, whereas a moderate rental area will have a lower percentage of telephones with service of the 2 party and 4 party lines predominating. Data collected is summarized to show the present telephone market conditions.

As the survey progresses, an important feature includes the prospects for future development of the business. As noted above, expected changes in the population of the area for the next 15 to 20 years must be carefully determined. Business men are interviewed to determine what the general business conditions are expected to be. Opinions of the owners of undeveloped property are obtained in regard to the proposed erection of new

homes and industrial buildings. City government officials, real estate and development company officials and members of the board of trade, chamber of commerce and other civic organizations often have important data concerning the expected growth of the area. Possible expansion of existing industries or the establishment of new industries must be considered.

Summarizing the above information, the Commercial Engineer is required to determine the density of population and its geographical distribution in the exchange area. The topography of the land such as rivers, hills, railroad lines, transportation facilities, etc., have an important bearing on the distribution. Finally after a consideration of the present average size of families and the future trend in size, the population figures are broken down into the anticipated number of families in each house count section. A ratio between the number of telephones and the number of families in each section is set up depending upon the classes of people expected to locate in each. The application of this ratio together with an estimate of the neighborhood and downtown business then results in the ultimate telephone requirements for each block or house count section. The figures thus obtained are posted on large maps according to house count sections and market areas. The maps are made available to other organizations in the Telephone Company for further analysis.

SECTION 3. PLANT EXTENSION OR FUNDAMENTAL PLANS ENGINEERING

The effect of adding one individual subscriber's line within a given exchange area is to use up one unit of station apparatus, one cable pair within the subscribers' outside plant, one set of frame terminals, an answering jack and a multiple jack if in a manual office or a line terminal in the line finder and terminal in the connector or final mult if in a dial office, and such other elements within the office for interconnecting, also power plant and trunk plant as are required. As new telephone subscribers are obtained and the amount of available plant with which to give service is decreased, it becomes necessary to add new units of plant in order to insure that telephone service will be available for any additional subscriber. Eventually, the capacity of the existing central office is reached and there is involved the problem either of increasing the capacity by erecting an addition to the present building and extending the associated present plant or of establishing a new central office area and erecting an entire new plant to serve this new area. If a new central office area is to be established the question then arises as to whether it shall be treated as a single area to be served by one central office building or shall be further divided into several areas each of which will have its own building. Additions are also required in order to replace worn out plant, obsolete plant, inadequate plant and plant which has been damaged by fire, flood, etc., so that it cannot be reused.

From the above it may be seen that major additions to an exchange area may usually be handled in a number of different ways. In planning for future construction it becomes the job of the Plant Extension or Fundamental Plans Engineer to determine what plan shall be followed in order to obtain the greatest overall economy so that the business may be conducted with a reasonable profit on the investment. This analysis results in what is known as the Exchange Fundamental Plan and is based upon the map of the exchange area resulting from the Commercial Survey as made by the Commercial Engineer.

The Exchange Fundamental Plan is a broad picture of an exchange area as it will probably appear 15 to 20 years hence. The plan shows the number of central office districts in the exchange area, their ultimate office locations and boundaries, and if any change from the present arrangement is to take place, the plan will illustrate the steps necessary to arrive at this proposed arrangement. The Exchange Fundamental Plan for any area is made up of the following steps or divisions:

1. Fundamental Districting Comparison
2. Program Study
3. Loop and Trunk Study
4. General Conduit Plan

The Fundamental District Comparison consists of setting up a number of tentative theoretical central office arrangements for the ultimate date and then comparing the annual cost of each with the cost of the plan most nearly approximating the present arrangement. These trial arrangements vary in number from two or three for smaller cities to as many as 15 or 20 for a subdivision of a large city. They usually include: A plan with one office for the exchange area, located at its ultimate wire center; a two office plan; a three or four office plan; and so on.

It can be seen that in a large city the single office plan would require an enormous building located at its operating center. Cables would connect all subscribers in the city to the one building, resulting in a very high average length of subscribers' lines. In order to make it possible for subscribers located farthest from the operating center to talk, it would be necessary to provide wires of very large comparative diameters or other expensive means to eliminate undue transmission losses. The opposite extreme would be an arrangement consisting of little operating centers located in each block or house count section, resulting in very short subscriber's lines. However, the inter-connections between the many operating centers would result in a very complex and expensive trunk plant. Also, the cost of the many buildings, equipment, power and operating and maintenance labor would be excessive. Somewhere between the two extremes is a plan in which the subscribers' loops would balance with the amount of inter-office trunking to bring about the most economical arrangement. This analysis is known as the Loop and Trunk Study.

The procedure starts with locating a wire center in each district of each plan to be compared. The wire center for a given district may be defined as that point at which it is most economical to locate a central office from a subscribers' and trunk plant standpoint. For comparative cost studies it is necessary to place all factors on a common basis. Therefore, inasmuch as the subscribers close to the wire center will be served by 26 gauge wire and those at greater distances will be served by 24, 22, and 19 gauges respectively as the distances increase, it is necessary to equate the number of subscriber lines in each house count section into larger numbers of equivalent 26 gauge lines. Inter-office trunks and toll lines are also equated to 26 gauge lines and considered as subscribers' lines. These equated lines are used to determine the wire center.

It is logical to assume that the wire center will be located at a point close to the center of telephone development, and it usually will be found in or near a business district. A tentative location is chosen and two base lines are drawn at right angles to each other through the point in question. The equated number of subscribers' lines to the right and left of one base line are totaled, and, if approximately equal, the wire center will fall on this base line. If, however, there are more lines on one side of the base line than on the other, the base line is moved to the right or left as required until a balance is obtained. Similarly, the point on this base line, above and below which the line totals are substantially equal, is the wire center.

After the wire centers for all of the districts in each proposed arrangement have been located, the annual costs of subscriber mileage are calculated for each plan. At this point in the comparison it is frequently possible to eliminate some of the plans because they would be obviously uneconomical. The surviving arrangements are then studied in more detail by comparing the annual costs of the variable items in each plan, which include; land, building, central office equipment and labor, inter-office trunk plant, etc.

A summary of the annual costs will indicate the comparative merits of each plan, from which the most economical plan is selected.

As stated above, the various plans considered under the Fundamental District Comparison are entirely theoretical without regard for the existing plant in the exchange area. If the final plan selected by this study is similar to the existing plant, then no further comparison is required. If, however, some different plan appears to be most economical, a practical and more detailed analysis, known as the Program Study, is required.

The object of the Program Study is to determine whether or not the arrangement appearing to be ultimately the most desirable would still be economical when compared, on a practical basis, to an extension of the present existing arrangement. This study starts with the existing plant and so adjusts the practical program under each plan throughout a suitable period, as to meet the expected service requirements and work toward the respective ultimate arrangements under comparison. The mechanics of a study of this nature become quite involved and include consideration of all variable annual costs, losses on plant to be removed, salvages, rearrangement costs and other expenses. If, after all the facts have been compiled, the results of the study show that it would be economical to change the present arrangement, a program setting forth the requirements of this proposed plan is prepared and sent to the departments concerned.

A feature of the construction program for an exchange area involves what is known as the General Conduit Plan. This plan is made up in order to show the extent and location of all main underground conduit necessary to accommodate the expected growth of cables by the ultimate date. The ultimate conduit routes are laid out to utilize the existing conduit to the best advantage and to indicate the most direct feed to the central offices for all subscriber cables, as well as to route the inter-office trunks over their most economical paths.

SECTION 4. TRAFFIC ENGINEERING

After the most economical Fundamental Plan from a theoretical and practical standpoint is decided upon for the particular exchange area, the Traffic Engineer proceeds to ascertain the specific amounts of Central Office equipment that will be required not only for the ultimate period but also for the immediate future or initial period and in some cases for an intervening or intermediate period. In fact, much of this work will have been accomplished during the development of the Fundamental Plan studies, inasmuch as the functions of the various Engineering Departments in the Telephone Company are more or less inter-coordinated. For instance, during the final cost analysis of the various proposed plans by the Plant Extension Engineering Department, it was necessary to convert the results of the Commercial Survey into terms of Central Office equipment, buildings, maintenance and operating labor, outside plant, etc., so that these could be individually priced and included in the estimates. However, for the sake of clarity, the functions of the various departments herein are being considered in a progressive order rather than as normally performed.

In connection with making the traffic estimates, the initial period is the period for which the equipment is engineered and installed. Allowance is made for expected growth from the date of the cutover to the end of the initial period. In manual installations this is taken, under normal conditions, as three years. With dial equipment, however, the annual carrying charge for idle equipment is somewhat larger than with manual equipment due to the greater investment cost per line. Generally, the dial installations are engineered on the basis of a two year initial period. The ultimate period covers the period after cutover for which traffic estimates should be furnished for estimating building requirements, such as floor plan

layouts, size and cabling arrangements of frames, racks and switchboards, and size of power plant. As noted previously, the ultimate period is usually assumed to be 15 or 20 years after the cutover.

The Traffic Engineer's fundamental information consists of the line and station estimates obtained from the Commercial Survey, the data on usage composed of the subscribers' busy hour calling rate and holding time estimates as prepared by the Traffic Department and finally the A. T. & T. Company's standard tables of coefficients and loads.

The calling rate is an estimate of the number of originating calls per station in the office busy hour. The rate is sometimes expressed in calls per line and may be interchanged by applying the ratio between stations and lines as determined by the Commercial Survey. The calling rate is determined from routined peg count data for the various months of the preceding years. The average of the three highest months in each year is taken as the representative rate for that year. Data for as many as ten years past should be used if available so that both the high and the low years in the business cycle may be detected and allowances made in selecting the future rate. The aim in selecting this rate is to secure a figure which will result in the provision of sufficient equipment to care for sustained volumes of traffic in the busier seasons of the normal years. A rate too high will result in additional investment for which there would be no appreciable justification and a rate too low would result in frequently recurring overloads causing unfavorable subscribers' reactions.

The holding time is the average length of time in seconds that any particular trunk or equipment is held by the subscriber. This includes the time to build up the call plus the conversation time plus the time to restore the equipment to normal. The holding time estimates are usually based on observations made at the office to be replaced or relieved or at another office of similar characteristics. The observations are made through service observing equipment, holding time recorders, or peg counts.

The total number of stations of various classes shown in the commercial estimate when multiplied by the calling rate per station will give the total originating busy hour traffic in terms of the actual number of busy hour calls, irrespective of the average length or duration of each call. Inasmuch as the duration of each call or holding time varies for different classes of calls and districts in the exchange area, it is necessary to equate all calls to a common basis with respect to holding time. This common basis has been selected as 100 seconds. All standard traffic tables of loads, coefficients, etc. have been made up on this basis. Therefore, in making traffic studies, it is necessary to determine not the total number of calls for any particular class but the equivalent total number of 100 second calls. The actual number of calls multiplied by the holding time and divided by 100 will give the total number of busy hour 100 second calls. When using the number of stations as a basis, the number of busy hour 100 second calls is equal to the number of stations multiplied by the calling rate multiplied by the holding time and divided by 100.

Formulae for the above calculations are:

$$\text{Stations} \times \text{C.R.} = \text{Number of Busy Hour Calls}$$

$$\frac{\text{No. of B.H. Calls} \times \text{H.T.}}{100} = \text{Number of Busy Hour 100" Calls}$$

$$\frac{\text{Stations} \times \text{C.R.} \times \text{H.T.}}{100} = \text{Number of Busy Hour 100" Calls}$$

The originating busy traffic is further subdivided into group busy hour traffic by classes of service. This is accomplished by applying a ratio between busy hour peg count calls for each class and for the office as a whole, to the office busy hour 100 second calls. The traffic data resulting from this procedure will show the number of busy hour 100 second calls for each of the Flat Rate, 1 Party Message Rate, 2 Party Message Rate, Coin Box, etc., classes of originating service.

Similarly, other traffic estimates are set up which will result in the number of busy hour 100 second calls for the following:

(a) Distribution of originating traffic into local calls, outgoing calls, calls to manual supervised boards, etc.

(b) Incoming traffic from other local offices, tandem, toll, etc.

(c) Terminating traffic on subscribers' lines.

(d) D.S. "A" Board traffic in dial systems.

(e) Operating Room Desks such as Chief Operator, Information, Service Observing, etc.

Further steps in the traffic procedure are concerned in the conversion of the data in terms of busy hour 100 second calls into units of central office equipment through the application of the standard tables of loads and coefficients. This procedure can be shown more clearly by several examples of the traffic study on a Step-by-Step Dial System office.

An explanation of the standard tables of loads and coefficients at this time will make their application more understandable. The table of loads shows the number of trunks (or units of equipment) that are required for various quantities of busy hour 100 second calls. The table was developed mathematically by the following formula:

$$\frac{\text{No. of B.H. Calls} \times \text{H.T.} \times \text{Efficiency Factor}}{3600} = \text{No. of Trunks}$$

The number of actual busy hour calls multiplied by holding time per call gives the total time in seconds that central office equipment is in use. Since there are 3600 seconds in the hour, the total time divided by 3600 will give the number of trunks or units required provided that they are used without rest, that is provided that as each call would end, a succeeding call would immediately seize the equipment. Such a procedure would be infinitely remote, and, accordingly, the results must be modified by the efficiency factor, which allows for the periods of inactivity between calls. The efficiency factor was determined by probability and experience studies and of course varies for the several types of equipment used. This variation is shown in the several examples below. The tables of coefficients are used in connection with manually operated equipment such as D.S. "A" Board positions, Desk positions, etc., and represent the relative importance of various kinds of calls in terms of the operators' attention required for building up the calls, supervision and restoring to normal.

The following are casual examples from a Step-by-Step Dial System Office Traffic Estimate:

(a) Line Finder Equipment

Fundamental Data	Initial
Flat rate lines working	4610.
Busy hour calls per line	1.44
Holding time in seconds	107.

Line Finder Groups

Common practice is to reserve 2% of the lines in a 200 point line finder group for readjustment of the load after cutover. This amounts to 4 lines per group, which, together with the 2 test lines always assigned, leaves a balance of 194 working line per line group assigned initially.

Total Number of Line Groups = $\frac{4610 \text{ Lines}}{194}$ = 23 Groups of 194 Lines each and 1 Group of 148 Lines.

Line Finders per Group

This requires the use of the load tables which are in terms of 100" calls. Therefore, B.H. calls per line must be converted into 100" calls as follows:

$$\frac{\text{B.H. Calls x H.T.}}{100} = \frac{1.44 \times 107.}{100} = 1.54 \text{ B.H. 100" Calls}$$

The next step is:

194 lines per group x 1.54 B.H. 100" calls per line = 299 100" calls per group in the busy hour.
From the "Summary of Trunk Tables Recommended" and "Trunk Capacity Tables" partially shown below, the 299 100" calls from Table "B" would require slightly over 16 trunks (or line finders) per group. Thus the 23 flat rate groups would require 16 line finders each. The remaining group of 148 lines x 1.54 B.H. 100" calls per line = 228 100" calls.
From Table "B" it is found that this group will require 14 line finders.
Total flat rate line finders = (23 x 16) + (1 x 14) = 382.

(b) 1st Selector Equipment and Grouping

The number of flat rate 1st selectors should equal the number of flat rate line finders since these are directly connected. Therefore, there should be 382 flat rate 1st selectors initially. For an example of selector grouping development, the second level is taken. The fundamental data shows 1395 busy hour 100" calls from this level.

$\frac{1395}{382}$ = 3.65 100" calls per selector in the busy hour.

Assuming that trunks from this level will terminate on local 2nd selectors, Table "B" of the "Selector Multiple Arrangement" chart, partially shown below, indicates a graded multiple arrangement of 13 trunks on 60 selectors as being most efficient.

$\frac{382}{60}$ = 6 groups of 60 and 1 group of 22.

For the remaining 22 selectors:

22 Selectors x 3.65 100" calls = 80 100" calls.

From Table "B" of the Trunk Capacity Tables, 80 calls will require 7 trunks. A summary of Level 2 therefore is as follows:

First Selector Multiple Arrangement - Initial Period							
Flat Rate (F)			Sel. 382		Banks 390		
Lev.	To	100" Calls	Sub. Grps.	Sels. Per Sub. Grp.	Trunks Per Sub. Grp.	Trunks Total	Terminate
2	Chestnut	F-1395	6	60	13	78	
			1	22	7	7	
				382		85	2nd Selector

From the above it is noted that the outgoing traffic from Level 2 of the Flat Rate 1st Selectors requires a total of 85 Local 2nd Selectors. Similarly, the requirements for all of the various types of equipment in the Dial office are determined. These quantities are summarized on standard forms and are forwarded to the Telephone Company.'s Equipment Engineering Department for further action.

* Summary of Trunk Tables Recommended			
Items of Equipment	Tables of Trunk Capacity		
	A	B	C
Line Finders - First Selectors		x	
Operators First Selectors		x	
Local 2nd Sels. - 5 digit		x	
Local 2nd Sels. - 4 digit			x
Out Trunk Switches	x		

* Trunk Capacity Tables			
Trunks	Cap. - Equiv. 100" Calls		
	Table A	Table B	Table C
1	.036	.360	.720
2	1.62	5.36	7.92
3	6.88	15.7	20.5
4	15.4	29.6	36.7
5	26.6	46.1	55.8
6	40.0	64.4	76.0
7	54.7	83.9	96.8
8	70.9	105	119
9	88.2	126	142
10	107	149	166
11	126	176	191
12	145	195	216
13	166	220	241
14	187	244	267
15	208	269	293
16	231	294	320
17	253	320	347
18	276	346	374
19	299	373	401
20	323	399	429
100	2589	2816	2900

* Equivalent 100" Calls per Selector with Corresponding Multiple Arrangement				
Equivalent 100" Calls per Selector			Multiple Arrangement	
Table A	Table B	Table C	Selectors	Trunks
.55	.75	.84	200	10
.73	1.01	1.12	150	10
1.10	1.53	1.71	100	10
1.24	1.72	1.92	100	11
1.41	1.91	2.14	100	12
1.39	1.92	2.16	80	10
1.57	2.16	2.42	80	11
1.78	2.40	2.70	80	12
1.88	2.58	2.89	80	13
1.88	2.60	2.93	60	10
2.14	2.93	3.28	60	11
2.34	3.23	3.60	60	12
2.64	3.59	4.00	60	13
2.87	3.90	4.34	60	14
2.93	4.06	4.52	40	10
4.06	5.56	6.12	40	13
5.39	7.18	7.90	40	16
6.90	9.02	9.85	40	19
6.79	9.08	10.02	20	10
10.54	13.43	14.51	20	13
14.94	19.03	20.60	20	16
20.74	26.08	28.24	20	19

Note * The above tables not complete.
For complete tables see A. T. & T. Company's Traffic Circular No. 341.

SECTION 5. EQUIPMENT ENGINEERING

An outstanding feature in connection with the planning of the central office concerns the time intervals involved for the various steps and the establishment of schedules so that the steps may be properly co-ordinated. There are effectively two stages in the development of the plans for central office equipment. The first stage might be termed advance planning and includes the determination of the ultimate requirements based on the results of the Commercial Survey, Traffic and Plant Departments estimates and the fundamental plan and cost comparison studies. The second stage is concerned with the plan for the initial installation. It is this, the second stage of central office planning, for which the Equipment Engineering Division is largely responsible.

The need for a specific project is first reflected in the Provisional Estimate and Two-Year Forecast, which, as compared with the Commercial Survey, is the short term view of equipment requirements. The Provisional Estimate and Two-Year Forecast is the presentation of the estimate of growth in stations and plant and the expected financial results from their use. It serves as the means of budgetary control of expenditures and gives the approximate date that equipment should be provided to meet service requirements. The "Provisional Estimate" is the prediction for the first year of the three year period, and the "Forecast" is for the remaining two years. The following major groups cover the information furnished in the estimate and forecast.

1. Station and Line Growth, and Station Movements
2. Calling Rates and Toll Usage
3. Construction Program and Estimated Expenditure for Additions to Plant
4. Revenues, Expenses and Earnings
5. Financial Requirements

Due to changing conditions, the budget is reviewed periodically, usually twice a year. From these reviews, the Provisional Estimate and Two Year Forecast is made up at the end of each year and is forwarded to the A. T. & T. Co. When the Provisional Estimate is accepted, it becomes the budget for the year. Thus there is a sequence of forecasts. The current and next two years are twice reviewed between issuance of the Provisional Estimate. As the Provisional Estimate year goes into "actual results", a year from the forecast becomes the Provisional Estimate, and the Two Year Forecast adds a new year from the future.

To insure an orderly procedure for the provision of new central offices and additions to existing offices, the Equipment Engineering Division maintains a "Switchboard Schedule" which lists future jobs together with a brief description of each and the associated scheduled due dates for the various steps as follows:-

1. Traffic Recommendations Due
2. Order due W. E. Co.
3. Shipping Date
4. Installation Completion Date
5. Desired Service Date
6. Required Service Date

At the time a specific project is placed on the switchboard schedule, advance notice is given to the Western Electric Company that plans are under way which will necessitate the provision of equipment. This notice is called the Prospective Questionnaire and is issued approximately fourteen months prior to the date on which shipment is required. The questionnaire serves two purposes:

1. To give the Western Electric Company sufficient details regarding the nature of the work to be done, so that the time required for engineering, manufacturing and installing may be determined, from which the Telephone Company is advised as to the required dates for the issuance of the confirmation questionnaire and requisition.

2. To provide means for the Western Electric Company to adjust its engineering, manufacturing and installation man load.

The Confirmation Questionnaire is similar in form to the Prospective Questionnaire and is forwarded 9 weeks before the order is placed. It is an assurance to the Western Electric Company that the Telephone Company will proceed with the project and gives somewhat more detail regarding the equipment. The Requisition is the actual order and gives authority to the Western Electric Company to proceed with the work.

Using the Traffic Department's recommendations as indicated on the Traffic Order, the Equipment Engineer prepares the Telephone Company's Specifications and Drawings for the manufacture and installation of the initial equipment. The Specifications give the type and amount of equipment required, its arrangement and data for calculating the size of power plant. The drawings cover floor study plans, traffic schematics, equipment of bays, front equipments of boards and racks, architect's building plans, etc. After the completion of the specifications and prior to the time that they are forwarded to the Western Electric Company it is necessary to obtain executive approval for the required expenditure of money for the project.

In order to obtain this approval a Specific Estimate is prepared. This consists of an Authorization Sheet which describes the project for which the expenditure is to be made, the reasons for doing it, the reasons for doing it at this time and in this way, and the estimated cost. It also includes an estimate of the cost of any plant which may be removed.

After the project is approved by the management the Specifications and Drawings are forwarded to the Western Electric Company, together with the Requisition which authorizes the Western Electric Company to engineer, furnish and install the equipment. On some minor jobs the Telephone Company will complete all of the detailed engineering, in which case the requisition will authorize manufacture and installation only. Likewise, cases of install only orders, or engineer and furnish only orders occur. These, of course, are treated accordingly upon receipt by the Western Electric Company.

The work of the Equipment Engineer is not finished, however, with the issuance of the specifications, for the engineer must be prepared to answer any questions which may arise during the period from the issuance of the specifications to the completion of the installation. Furthermore, the Equipment Engineer is required to make a check of the Western Electric Company's specifications covering the detailed engineering of the job. This check is made immediately upon completion of the specifications to determine whether the equipment as proposed meets the requirements outlined in the Telephone Company's specifications.

About the time that the manufacture of the equipment is completed and prior to the installation of it, the Western Electric submits a contract covering the cost of the work. The contract shows separately the cost of the equipment, engineering and installing. The Equipment Engineering Division analyzes the contract to compare the costs with the Telephone Company's estimate and then accepts the contract if favorable.

During installation, the progress of the work is followed carefully by the Equipment Engineer in order to insure that the required standards as to installation and performance are complied with. After the mechanical part of installing has been completed, the work of testing and adjusting begins, at which time the Telephone Company places its tester with those of the Western Electric Company, so that the Telephone Company will be assured of the satisfactory performance of the equipment.

After the projects is completed and is accepted by the Telephone Company, the Equipment Engineer prepares a Completion Report showing the actual expenditures together with an explanation of any difference between the actual and estimated costs.

SECTION 6. BUILDING ENGINEERING

Telephone buildings provide space not only for central office equipment but also for general offices, motor equipment and storage. The course to be followed in establishing a central office depends on various factors such as value of the telephone equipment, type of equipment, growth, etc. Generally, the procedure for various cases is as follows:

1. Dial Equipment or #1 Manual Equipment, due to the large investment involved, to its capacity for future growth, to the extent to which the public is served from these offices and to special building requirements, are housed in company owned fire-proof buildings in order to safeguard the investment and to insure continuous service as much as possible.

2. #9 or #11 Manual Equipments are provided in either company owned or rented buildings, usually of common construction.

3. Magneto offices are usually provided in rented quarters as the space requirement is small and in most cases it is more economical to rent than to erect a building and maintain it for this type of equipment.

In the case of a new building project, the Building Engineer obtains a copy of the Equipment Engineer's preliminary and theoretical floor plan, which is used as a guide for the purchase of land. A large enough parcel of property is secured to care for the requirements of the new proposed office for an indefinitely long period of time. The site should be at or near the wire center, should have good transportation facilities and should have zoning conditions which would permit the erection of a satisfactory building with respect to the height, area over lot, etc. Corner lots are more desirable, if excessive costs are not involved, in order that better light and air conditions will be obtainable and so that the building may be displayed to better advantage. The policy of the System is to provide well designed and ornate buildings that will reflect creditably to the Telephone Company and to the neighborhood in which they are located.

Buildings are planned to provide space initially for an eight year period, or longer, as there is an economy in providing for more than an immediate requirement and carrying it partially vacant rather than increasing the number of building operations. Plans for future additions may include vertical growth through the construction of additional floors or horizontal growth over the lot area. Standard equipment layouts of the A. T. & T. Company are followed if possible. However, in some cases, due to lot dimensions, building restrictions, etc., the standard plan cannot be followed in its entirety and necessary adjustments are made with the aid of the Equipment Engineer to fit the individual case. After the preliminary plans have been prepared, they are submitted to the various departments involved and to the A. T. & T. Company for approval, following which, authorization is secured from the management to proceed with the erection of the building.

After the proposed project is approved, an architectural firm is employed to prepare architect's plans and specifications. The ultimate number of stories and the loads which the floors will be required to carry are important factors governing the design. Usually buildings not to exceed five or six floors in the ultimate are of reinforced concrete construction. Higher buildings are of steel and concrete or steel and tile construction. A foundation of spread footings is provided for buildings up to six or eight stories where soil of good bearing capacity is encountered. Pile footings are provided where the bearing capacity is inadequate. For larger buildings, caisson foundations are used. Normally a period of six weeks to three months is required to prepare architect's plans and specifications.

After completion, the plans and specifications are checked by the Building Engineer and then submitted to contractors for bid. Contracts are drawn up with the successful bidder, after which the project is submitted to the Board of Directors for approval. During construction, the contractor is required to furnish progress charts in order to insure completion as scheduled. The period of construction varies from four months to a year or more. Strict inspection is maintained by the Building Engineer and architect during this period. When the building is completed and turned over to the Telephone Company, the Plant Department assumes the responsibility for its operation and maintenance.

SECTION 7. OUTSIDE PLANT ENGINEERING

The engineering of the Outside Plant progresses along lines which are quite similar to those followed by the Equipment Engineer. For instance, the Plant Engineer, using the Commercial Survey, the fundamental plan and the Traffic recommendations, issues specifications and drawings for the construction and maintenance of pole lines, underground conduit, underground and aerial cable (subscribers, trunk and toll), house cable, block plant and aerial wire. In order to obtain the management's approval for the expenditure of money for outside plant construction, a Specific Estimate is issued where the estimated expenditure exceeds $2,500. The Authorization Sheet of the estimate gives an explanation of why the work is necessary at all, why it should be done at this time, and why it should be done in the manner proposed.

Where the estimated expenditure involved is below the minimum set for a specific estimate, the work is carried out under formally authorized Job Orders and is summarized under a Quarterly Routine Estimate which is prepared for each quarterly period of the year.

Outside plant is engineered to meet certain standards based on performance, cost, durability and appearance. Standard Specifications are issued by the A. T. & T. Co. in the form of Bell System Practices, and provide detailed instruction for the use of the plant forces in installing and maintaining the various parts of the telephone plant. Occasionally, problems are encountered in the engineering and construction of the outside plant which cannot be solved by the application of existing practices and standards. When such a situation arises the Outside Plant Engineer is responsible for a practical method of solving the problem.

The standardization of materials, tools and motor equipment required in the construction and maintenance of the outside plant is an additional function of the Outside Plant Engineer. Since the investment in outside plant is very large, a continuous effort is being made toward economical improvements in materials used, in tools and labor saving devices and in their safety requirements. The provision of safety devices for sharp tools, such as drawing knives and chisels, the requirements for body and safety belts, the care of belts, the requirements for linemen's pliers, linemen's climbers, pole derricks, hole diggers, pumps, etc., are typical examples of the latter functions.

Western Electric Company, Inc.
Hawthorne Works
Personnel Service Branch
Training Department

Telephone Systems Training
Course: Equipment Branch Practices

Lesson No. 2

HOW HAWTHORNE HANDLES AN EQUIPMENT ORDER

This lesson is issued to describe the general features of how Hawthorne handles an equipment order. Information contained herein is to be used for training purposes only.

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General Telephone Sales Instructions

SECTION 1. ORDER ENTERING AND SCHEDULING

In planning Central Offices, the Telephone Company, through its Commercial Surveys, Fundamental Plans, Traffic Estimates, and Equipment, Building and Outside Plant Engineering, is required to forecast the requirements and to establish definite schedules for construction of new buildings and new equipment or additions to existing buildings and existing equipment. This procedure is necessary in order that the future demands for subscribers' lines may be fulfilled not only without delay as the occasion arises but also in a manner that will prove economical in the financial management of the business. In accordance with the established schedules, the various Telephone Companies in the System enter orders on the Western Electric Company for Central Office Equipment.

The orders enter the Western Electric Company through its Distributing or Branch Houses, which are located in principal key cities for the convenience of the various Telephone Companies. The orders then are forwarded to the Kearny Merchandise Department if for Manual or Toll equipment or to the Hawthorne Merchandise Department if for Dial equipment. It may be readily seen then, that without some method of control and co-ordination of orders on a broad basis for the entire system, a considerable and indefinite fluctuation of business in the Western Electric Company would result. Thus, it becomes essential for the Western Electric Company to forecast requirements and to schedule orders, so as to:

1. Provide the Telephone Companies with satisfactory schedules
2. Avoid rapid fluctuations of Engineering, Manufacturing and Installation loads.
3. Provide stocks of material, parts and apparatus.
4. Assure that established schedules will be kept in the maximum number of cases.

Forecasting and scheduling in the Western Electric Company require definite preliminary planning and advance notification from the various Telephone Companies in the System. For a specific project, the major items which compose the routines of establishing schedules and entering the order are as follows:

1. Prospective Questionnaire
2. Prospective Schedule
3. Confirmation Questionnaire
4. Confirmation Schedule
5. Telephone Company's Specifications, Drawings and Requisition
6. Switchboard Order (originated by Distributing House and forwarded to Western Electric Company's Merchandise Dept.)
7. Engineering Loading
8. Shop Loading
9. Installation Loading
10. Firm Schedule

The Telephone Company's schedules are set up on the basis of the required completion date for each project, that is, the date on which the equipment is to be ready for subscribers' use. By applying the installing interval as furnished by the local Installation Planner, the shipping date can be determined by figuring backwards from the required completion date. The "Due date" for the Prospective Questionnaire is then determined. This date is set at 14 months prior to the shipping date.

The Telephone Company issues the Prospective Questionnaire and forwards 4 copies to the Distributing House. One copy is retained and the remaining 3 are sent to the Installation Planning Supervisor who adds the Installation interval on the form. Two copies are forwarded to Hawthorne Merchandise, one of which is sent to the Shop Scheduling Department.

The Prospective Questionnaire contains the following information:

(a) The schedule Item Number, which is used to identify the project until the actual order number is assigned
(b) City and Office name
(c) Address of building
(d) Distributing House
(e) Whether the job is associated with a new building or is an addition in an existing one
(f) Completion date required
(g) Shipment date desired. (Filled in by Western Electric Company)
(h) Date order can be furnished by the Telephone Company
(i) Date building will be ready
(j) Whether there are any coordinated projects. (Such as Toll Switchboard)
(k) Major items of equipment
(l) List of any unusual equipment or installation features

The Prospective Schedule is issued by Merchandise Department within 2 weeks of receipt of prospective questionnaire and includes the information listed below. Copies of this paper are sent to the Distributing House (who forwards a copy to the Telephone Company), the Installation Planner, the Dial Program Engineer at New York, and to the Shop Scheduling Department.

(a) Confirmation Questionnaire Due Date
(b) Order Due Date
(c) Summary of Equipment (Major items)
(d) Shipping Date
(e) In Transit Interval (Weeks)
(f) Installation Start Date
(g) Installing Interval (Weeks)
(h) Completion Date
(i) Completion Required Date

An explanation of how these various dates are determined is as follows. The Questionnaire gives the Completion Required Date and the installing interval. From this is determined the Installation Start Date. The In Transit Interval is a standard interval which varies according to the distance from the factory. When subtracted from the Start Date, the In Transit Interval will give the Shipping Date. By applying the standard Engineering and Manufacturing interval for the job, the Order Due Date is determined. The due date for the Confirmation Questionnaire is scheduled for 9 weeks prior to the Order Due Date.

The Shop Scheduling Department originates a Job Master Card from the analysis of the Prospective Questionnaire. This record card shows the shipping date and a break down of all load items and is used as the basis for program planning and load charts and for various periodical reports such as the Quarterly and Annual Production Estimate, the Switchboard Activities Report, etc.

The Confirmation Questionnaire is issued 9 weeks prior to the order due date and is a definite promise that the Telephone Company's order for central office equipment as planned will be forthcoming. The job master card is revised if necessary. The Confirmation Schedule is originated and routed in a manner similar to that used for the Prospective Schedule. These two schedules are made up from the same form, but for purposes of distinction, the Prospective Schedule is duplicated on pink sheets and the Confirmation Schedule on green sheets. The Firm Schedule, as discussed later, is issued on yellow sheets.

When the Order Due Date arrives the Telephone Company forwards the Requisition, which is its form of the order, together with 6 to 12 copies of its Specifications and Drawings and 2 copies of the Architect's

Plans to the Distributing House. The Western Electric Company's order number is then assigned to the job. Blocks of order numbers are allotted to the Distributing Houses by the Merchandise Department. Switchboard orders are assigned in the five digit series from 10,000 to 89,999 for the Western Electric Company and from 90,000 to 99,999 for the Northern Electric Company, Graybar Electric, Electrical Research Products, Inc., etc. Six digit order numbers are assigned for apparatus orders. Upon receipt of the Telephone Company's Requisition, the Distributing House issues the "Purchase Order for Switchboard Equipment" (with order number assigned) and forwards it, together with the Telephone Company's specifications and drawings, to the Merchandise Department.

The Merchandise Planning Department receives the Distributing House order, edits the order in regard to proper form, wording, etc., and forwards the order to the Editing and Order Entering Department where it is again re-issued as a "Switchboard Equipment Order". The set-up for this order includes the Order Sheets, Service Record Sheet and Firm Schedule Sheet. The Order Sheet and Firm Schedule Sheet are forwarded to the Scheduling Department together with the Specifications and Drawings. At this point the job Master Card, which was originated when the Prospective Questionnaire was received, is checked against the specifications and drawings and is revised if required.

The order sheet, specifications and drawings finally reach the Equipment Engineering Departments. Shortly after receipt of the order, the Equipment Engineer (Analyzer) arranges space for the job on the Engineering Load Charts and issues the Engineering and Manufacturing Schedule. In this connection it should be emphasized that any subsequent Telephone Company engineering changes that may affect the Engineering and Manufacturing Schedule should be reported immediately by means of a supplemental schedule. The various specifications to be written for the job are listed on the Engineering and Manufacturing Schedule, together with the associated longhand specification due dates and tracing due dates. By adding the interval for transcription, the Clerical Department determines and adds the dates on which the completed specifications are to be delivered to all departments.

After the engineering and transcription dates are added, the Engineering and Manufacturing Schedule is delivered to the Scheduling Department, where the shop load is finally adjusted and the shop order due dates and the manufacturing completions dates are added. The Engineering and Manufacturing Schedule is typed at this time, duplicated, and routed to the interested departments. In the final adjustment of the shop load during a period of increasing business, cases arise where a job or several jobs may appear on the load chart for completion on a date considerably beyond the required or desired completion date. These jobs are properly marked on the charts and notification of the delay is given to the interested organizations. Many times, a delay in manufacturing may be absorbed in the installing interval without affecting the final completion date of the job. However, if the delay is not acceptable, a protest is made. The Scheduling Department may attempt to revise the loading so that the protested job may be moved forward in the schedule. This of course will require that other jobs be moved backwards. If such revision results in further non-acceptance of schedule on the changed jobs, then the matter is placed before the Switchboard Program Supervisor in New York who obtains an order of precedence from the A.T. & T. Co. for the affected jobs or obtains an authorization from the Sales Department for an increased rate of manufacture. On the other hand, in some cases a job may be advanced in order to level out unused space on the load chart, in which case proper notification is given to the Distributing House and Telephone Company. Large jobs, due to the volume of equipment required, may cause difficulty in the process of loading. Accordingly, the standard engineering and manufacturing interval for this type of job provides an additional two to four weeks margin over the normal interval so that the Prospective and Confirmation Schedules originally set up will have made proper allowances for load adjustment.

During the time that the engineering and manufacturing analysis is being made, the Installation Planner analyzes the job, determines the firm installing interval and notifies the Scheduling Department accordingly. Sometimes unusual installation man load conditions are encountered which require modifications in the normal loading of the job in the shop in order to meet these conditions. Also it is endeavored to schedule the shop so as to provide an even installation load in each territory.

After the manufacturing completion date is determined and the firm installing interval is received from the Planner, the remaining firm dates such as the Release Date, Ship Date, Installation Start and Completion Dates are determined and are posted on the Firm Schedule Sheet of the Merchandise Order setup. Normally the Firm Schedule should be completed and released by the Scheduling Department within five weeks after the receipt of the order. This interval is exceeded only when the time required for engineering and manufacturing is unknown due to the development of new circuits or new equipment. In the latter case the Distributing House is notified of such delay together with a promise as to when the firm schedule will be available. The Firm Schedule is duplicated and distributed to interested organizations by the shop order department.

SECTION 2. ENGINEERING

During the process of scheduling, as outlined in the above section, the Order Sheet and the Telephone Company's specifications and drawings were delivered by the Scheduling Department to the Equipment Engineering Department. Upon its receipt, the order is routed through the Engineering Service Department where a Job Drawing Base Number is assigned to the office. All job drawings issued thereafter are identified by the base number together with a dash number suffix which indicates the nature of the drawing and the type of equipment represented. The Order Sheet together with all copies of the Telephone Company's specifications and drawings are forwarded to the Clerical Department where Job Index Cards are originated. These cards are placed according to town and office in the Central Office Index File for future engineering reference. After being indexed, the order and specifications and drawings are delivered to the Equipment Engineer who forwards surplus sets of the specifications and drawings to the Engineering File, where copies may be withdrawn by the Line Engineers as required during the period of detailed engineering.

The Equipment Engineer makes a detailed analysis of the job requirements and originates the Job Keysheet and the Engineering and Manufacturing Schedule. The Job Keysheet is a list of all of the circuits, which are in the form of Bell Telephone Laboratories' or Telephone Company schematic drawings, together with inter-connection information to show how the various schematics required are related to each other. The Job Keysheet is made from the Laboratories' Standard Keysheet. Features of the job which are not covered by the Standard Keysheet are considered as special and are referred by the Equipment Engineer to the Laboratories for recommendation. Such features may require the use of new circuits to be developed by the Laboratories or of obsolete circuits where special operating conditions are to be met. If any information required for determining what to furnish on the job is lacking in the customer's specification, the Equipment Engineer obtains the required data through correspondence with the Telephone Company. Eventually, all of the circuits used in the office are posted on the Job Keysheet.

There is one exception to the above description of the preparation of the job keysheet. On the crossbar system where the entire series of T- drawings have the same base number as the Laboratory SD- drawing, the wiring list is considered as sufficient for an SD- job record by some Telephone Companies and a job keysheet is not prepared. In this case the Equipment Engineer records his information regarding schematic drawings to be used in a copy of Telephone Company specification or other folder for the engineers' use. This copy is filed in the job folder for ready reference.

The Equipment Engineer is required to definitely determine not only what is to be furnished on the job but also what specifications are to be originated and what is to be covered by each. There are approximately 60 kinds of specifications that may be written for a Panel or Crossbar Dial Office and 40 kinds for a Step-by-Step Dial Office. Each specification covers a particular type of framework or equipment and is identified by a numerical dash number which follows the order number. All types of specifications are not required for every job, depending, of course, upon the nature of the particular order. The specifications to be written are indicated on the Engineering and Manufacturing Schedule. The dates on which these specifications and associated job drawings are to be completed are also indicated, as explained in Section 1.

A Traffic Schematic is usually originated by the Equipment Engineer. This gives a picture of the traffic between various types of equipment in the office and terminations on the distributing frames.

A Job Folder is originated by the Equipment Engineer and is maintained throughout the period of engineering, manufacturing and installing. In this folder are placed the master copy of the Telephone Company's specification on which the job analysis was made, copies of all correspondence, memoranda, schedules, information to and from other specifications, cabling information and completed transcribed specifications. Its purpose is to aid in eliminating the loss or misplacement of information papers and to serve as a ready reference relative to job questions which arise from time to time. (Copies of all official job correspondence are filed in the Engineering file.)

After the job is analyzed, the specifications, as indicated on the Engineering and Manufacturing Schedule, are assigned by the Equipment Engineer or Verification Equipment Engineer (checker) to the various line engineers in a manner that will allow each engineer sufficient time in which to properly perform the required functions. Engineering is normally divided into three classes, namely Switchboard, Power and Cabling. Job Drafting also is identified by these classes. The detailed steps involved in each class or for various types of specifications in any one class vary considerably according to the equipment in question. However, a description of the major steps required for engineering a typical specification will give a general idea of the line engineer's function.

The first duty of the line engineer, after he has been assigned to a particular specification, is to gather together the various items of information and data with which he will be concerned and then to proceed to analyze these papers in order to determine how the required equipment is to be provided. A copy of the Telephone Company's specification and drawings are obtained from the Equipment Engineer or the Engineering File. These are studied and compared with the master copy contained in the job folder. Particular attention is given to those portions affecting the specification to be written and to the Equipment Engineer's markings covering the schematic drawings and standard equipment specifications required. From the above data and from the Longhand Specification Form, which is obtained from the Standards Engineering Division, requisitions are originated for blue prints of all required drawings. In case the order is for an addition to an existing office, blue print requisitions are also issued for the required job drawings of the existing office as indicated by the Central Office Index File or by the Job Index Drawing if one had been prepared for the office on a previous order. Correspondence, memoranda and information from other specifications contained in the Job Folder are carefully read and noted.

After the engineer's detailed analysis of his assigned portion of the job is well under way, it is essential that a forward view be taken of the engineering, manufacturing and installation effort required. The future progress of the engineering work is visualized to determine whether any interruptions or delays will be encountered due to lack of or faulty engineer-

ing information. This visualization of the engineering work should disclose any points which may need to be referred to the Telephone Company or other organizations for their approval, and which would otherwise delay the progress of the engineering. After all of the necessary working papers and forms are on hand and all questionable points which can be foreseen, are taken up with the Telephone Company or other interested organizations, the engineer is in a position to proceed with the preparation of the specification and associated drafting information.

It is more or less customary for the engineer to follow a definite sequence in performing the general engineering operations. The extent of the various operations will depend on whether standard equipment may be specified or whether the job must be built up on a detailed basis. The following is the sequence of the general engineering operations.

1. Selection of lists from standard equipment specification drawings
2. Preparation of the wiring list
3. Preparation of the equipment and terminal assembly drawings and other forms when required
4. Ordering of all apparatus, framework, equipment, local cables and local power cables
5. Writing shop and installer's notes
6. Listing all drawings used
7. Listing engineering and installer's reference papers
8. Preparation of cabling information
9. Ordering of wire when required
10. Issuing information to other specifications
11. Issuing drawing orders or change supplements

The Wiring List is a job drawing prepared in standard form of all circuits used for the manufacture and installation of the specific equipment. It includes the title, the circuit, schematic, schematic figures and options on Crossbar and Step-by-Step jobs, circuit figure numbers, optional wiring and apparatus, quantities of circuits wired and equipped, circuit numbers wired and equipped and maintenance notes. It is usually arranged in two sections - one to cover equipment which is directly associated with a local cable and which may be wired by the shop or the installer, and one for equipment and cabling which are placed in position by the installer and are not associated with local cables. Wiring lists of standard equipment as indicated on the standard equipment specifications are repeated in the job wiring list and equipped as required.

The wiring list is primarily a record of the equipment installed. It is used by the shop for the design and manufacture of job local cables and for assembly, wiring and testing of units not covered by standard specifications. The installer is vitally interested in it as a record of work to be done. After installation is completed, the wiring list is used for maintenance purposes by the Telephone Company and as an engineering record when additions to the office are to be made.

Job Equipment Drawings are made up in cases where standard equipment drawings are not used or where the standard equipment drawings do not fully cover the equipment arrangement. For some types of equipment, the wiring list and equipment drawing are combined into one drawing. Other drawings such as terminal assemblies, cabling schematics, cross connection charts, etc., are made up when required.

The Longhand Specification Form is used in connection with the various remaining engineering operations. These forms are made up for each common type of specification and are made as complete as possible for an average job. It is then necessary for the engineer to enter quantities, group or list numbers, notes, etc., to cross out information not required and to add any special editing not already shown. After completion, the

longhand specification and associated papers are held by the engineer until called for by the Verification Engineer (checker). All drawings used in engineering the job should be arranged in sequential order and delivered to the verification engineer with the longhand specification.

After the job is checked, the unused pages are removed and the remaining pages are numbered by the verification engineer. The specification is delivered to the department clerk for record puposes on or before the longhand specification due date. After being recorded, it is forwarded to the Engineering Service Department for application of returned goods material and thence to the Clerical Department for issue checking. The longhand specification is then returned to the engineer for approval of the raised issue numbers of the drawings as required. Any change in the editing or drafting information due to new issues of the drawings should be made at this time. When issue checking is completed, the Clerical Department picks up the specification for delivery to the Shop Order Department.

The Equipment Drafting Section prepares the new or changed job drawings from the engineer's information in accordance with the established schedules. The tracings are checked by the engineer and are delivered to the vault so that blue prints may be made as required for the shop and installer.

Combination Orders are those covering engineering and equipment to be furnished by both Hawthorne and Kearny. Many new Step-by-Step offices have dial equipment in one portion of the building and Toll equipment in another portion of the building. In such cases, Hawthorne usually "controls" the job; each Plant, however, does its own engineering and manufacturing. When a combination order is received the Equipment Engineer coordinates the job with the Kearny engineering department. A letter to Kearny is originated which covers the "division of responsibility" of the two engineering organizations, supplemented later with a Coordination Chart drawing showing the number, circuits, and terminating points of equipment furnished by Hawthorne which connects to equipment furnished by Kearny. Common drawings such as floor and cabling plans, are originated and controlled by the Plant having the major items of equipment thereon.

SECTION 3. MANUFACTURING

Before taking up shop ordering and manufacturing procedures, two classes of material commonly referred to throughout the Plant as "Non-X" and "X" should be clearly understood. Class Non-X material is that which is shipped to the Installer either as an assembled unit (wired equipment or framework) or as a loose item (piece part, framework detail, item of apparatus, etc.) and which is listed in job specifications for shipment. Class X material, on the other hand, is the component apparatus and material used by the shop to produce the wired and assembled units ordered in job specifications.

The longhand specification, after being issue-checked, is delivered to the Shop Order Department for the first editing operation. In this connection, an item of equipment may be shipped to the Installer either as a single completely assembled unit as described by the engineer or as a number of partial assemblies and individual parts. The first, or Class Non-X, editing operation concerns itself, therefore, with this latter class of item and consits of itemizing and indicating in the longhand specification the shops and stores that are to deliver the various component parts in the form in which they are shipped. With the exception of general use parts (nuts, screws, bolts, washers, etc.) required by the Installer and which are compiled for the entire job and summarized in the -94 specification, these parts are listed immediately following the item with which they are associated and are each assigned a sub-item number for identification purposes. The main item is then marked with a significant letter to in-

dicate that shipment is made in a different form. Common items of equipment are edited in accordance with Standard NX Folders. If a folder is not available for a specific item, the editing must be done in longhand by the Shop Order Editor. The longhand specification, the selected Standard NX Folders and the longhand editing are delivered to the Shop Order Typing Section for typing of the stencils. Direct Shipment orders for purchase of outside supplier material to be shipped direct to the job are typed at this time also. The stencils are then mimeographed and the copies bound into complete specifications for delivery to the Telephone Company, Installer, and interested local shop and clerical organizations. The wiring departments shown in the source column to ship wired equipments receive complete specifications; other shops and stores receive only the portion of the specification listing the items of apparatus and material they are to furnish. Through this process of Shop Order Department editing, the complete specification becomes not only an engineering record for the manufacture and installation of equipment but also a shipping record of all component parts.

Following issuance and distribution of completed specifications, the Shop Order Department performs the second, or Class X, editing operation on Crossbar, Panel, and Common Systems equipment. The Class X ordering of apparatus and material for Step-by-Step system's mechanical and non-mechanical equipment is done in the Step-by-Step Wiring Department.

There are at present three different methods of performing the Class X ordering operations. Crossbar and Step-by-Step mechanical equipments are ordered in much the same manner; that is, like items of apparatus and material for a given week's output in these wiring shops are combined and ordered in bulk from the various product shops. On Crossbar, tabulating machines are employed to compile the ordering data, while on Step-by-Step, ordering information is summarized by strictly manual effort. Panel, Common Systems, and Step-by-Step non-mechanical units are also ordered by manual effort, but the method of preparing and furnishing the information to the shops differs from Crossbar and Step-by-Step ordering practices, in that separate material ordering lists are originated and furnished the shops for each wired and assembled item of equipment ordered in job specifications.

In general, and considering each of the three methods separately, they are set up along the following lines:

Crossbar Systems Equipments

The Shop Order Department originates tabulated sheets listing all items of apparatus and material shown in the stock list of equipment drawings and "J" specifications. For each item listed, a tabulated card is originated showing the description of the item and the supplying product shop unit or store. The cards are grouped in sets and filed under the respective equipment drawing or "J" specification number for which they were originated.

Upon receipt of job specifications from the Central Office Equipment Scheduling and Shop Loading Department showing dates the assembled frames and units listed are scheduled to ship, shop load analysis sheets are originated for each item. The job order number, specification item number, and scheduled shipping date are shown on the analysis sheets and then filed according to the schedule dates. The sheets are selected for compiling and tabulating sufficiently in advance of the shipping date (in accordance with established normal manufacturing intervals) to allow the product shops, after receipt of authorizations, to manufacture the component parts in time for the Wiring Department to select the material, and assemble and wire the equipment ordered.

At the time the load analysis sheets for a given week's business are selected for tabulating, the Shop Order Department requests, for each item of wired equipment listed in the job specification, a set of selecting and mounting information lists from Central Office Standards Engineering and Coordinating Department. The lists specify the quantity and apparatus to be mounted on mounting plates and panels for a quantity of one wired frame or unit as specified in the corresponding "J" specification or drawing stock list. One week prior to the date material for given jobs is scheduled for selection, copies of these lists are prepared on a job requirement basis by the Shop Order Department and furnished to the Wiring Shop's storeroom selectors and assemblers. The lists furnished show the job order number, item number, scheduled shop delivery date and other pertinent data essential to the selection and assembly of the equipment in accordance with job specification requirements.

During the interim the Central Office Engineering Standards and Coordinating Department is preparing the aforementioned selecting and mounting lists, the Shop Order Department compiles a list of all wired and assembled frame and unit items for "J" specifications and other drawings for the same jobs. The sets of tabulating cards previously originated for the corresponding "J" specification and other drawing items are then selected and by a process of machine operations, all like items of apparatus and material required for the jobs scheduled are combined. The cards and/or lists are forwarded to the interested product shops as authorizations to manufacture and deliver to the Wiring and Assembly Departments, on the schedule date shown, the items of apparatus and material ordered.

Step-by-Step Mechanical Equipments

Ordering practices for these equipments are quite similar to those followed on Crossbar, except that the compiling and ordering of apparatus and material requirements is performed at present on a manual basis. Another exception is that selectors and assemblers work from stock lists of drawings instead of from selecting and mounting information lists to perform their operations.

Step-by-Step Non-Mechanical Equipments

These equipments are ordered in the Step-by-Step Wiring Department in the same manner as Panel and Common Systems equipments are ordered in the Shop Order Department. They are described in the following paragraphs.

Panel and Common Systems Equipments

The ordering of apparatus and material requirements for these equipments is performed by manual effort. Standard ordering folders (instead of tabulated sets of cards) are originated for equipment stock list drawings and "J" specifications. The folders are complete ordering standards covering all items of apparatus and material required to assemble and wire units for "J" specifications and other equipment drawings.

In the Class X editing of a job specification, standard folders are applied by indicating to the right of the item the identifying folder number. The folders are then prepared by inserting longhand "riders" showing variable quantities and mounting plate positions (based on the job specification requirements) in lieu of the fixed quantities and positions shown. The folders are attached to the specification and forwarded to the typing section for hectograph transcription of stock list authorizations. Where standard folders are not available, items of equipment ordered are laid out in longhand and then typed.

The material stock list authorizations list all Class X items of apparatus and material required by the Wiring Department specified to wire and assemble the equipment. The various stores and product shops furnishing the items of material are also shown to the left of each item listed.

After the stock lists are typed they are forwarded to the Central Office Equipment Scheduling and Shop Loading Department for the application in hectograph ink of product shop delivery schedule dates, also the Wiring and Assembly Departments selecting, and final shipping schedule dates.

When the manufacturing is completed and the assemblies have been passed by the Final Inspection Departments, the material is delivered to the Merchandise Department for packing and shipping.

It is the function of the Central Office Equipment Scheduling and Shop Loading Department to load wired and assembled equipments, and schedule the Class X apparatus and material for these equipments, so as to maintain balanced loads and an even flow of production in all shop departments.

With the exception of the wiring departments, our product shops are to a large degree set up to function as self-contained units. They purchase and maintain the required stocks of raw material and parts; perform their own detailed shop ordering operations; scheduling, tracing of raw material, etc.

SECTION 4. SHIPPING

Several weeks prior to the scheduled shipping date, the delivery of the hundreds of items required for the job will be started by the shop. This period varies, and depends upon the arrangement of the shop load and the facility with which any of the particular items are manufactured. Accordingly, it becomes the duty of the Merchandise Department to provide warehouse space, where the material can be accumulated and stored until released for shipment.

Upon receipt of the material, the Clerical Section of the Merchandise Shipping Department marks the Delivery Tickets to indicate whether the job is a Holding Job or a Shipping Job. The Packing Section of the Warehouse Department then proceeds to pack the material for shipment. The packed cases are properly marked with order number, destination, description of contents and weight. A box number is assigned to each case and is also marked on the shipping summary for the particular items. If the job is a holding job, the amount of warehouse space required is estimated and assigned. After being packed, the cases marked "Hold" are delivered by truck or travelling crane to the assigned area. If the job is a shipping job, the packed cases are delivered immediately to the shipping platform.

About a week prior to the scheduled shipping date, the Installation Field Service Department issues a Shipping Release for the job. If the job is to be installed in a new building or in a new addition to an existing building, it is necessary for the Field Service Department to ascertain whether the building is completed and ready for occupancy before the release is issued. When the Release is received, the Merchandise Shipping Department issues typed Loading Sheets on which are identified the various packed cases and their locations in the warehouse. On the day of shipment the cases are selected, loaded and shipped to the job.

SECTION 5. INSTALLING

In the case of a job involving a new building, the completion date of the building and the installation start date usually are the same. This permits the installer to move into the building with his force of men and to prepare the building for the work of installation. Protection material for walls, columns, floors, hallways, stairs, entrances, etc., is set up. Space is assigned for storage of material to be received, and the floor plan arrangement of the initial equipment is laid out. Trucking and hoisting of material is usually done by the Telephone Company. The installer checks the receipt of material by box and item number with the shipping summaries in each specification and reports back to Hawthorne in regard to shortages or defective material. Engineering questions are raised by Job Information Memoranda, (JIM's). Installer's Requisitions are issued for apparent shortages. Near the end of the installation period, excess material is returned to Hawthorne by means of Returned Goods Memoranda. At this time final marked prints of the office equipment, wiring list, cabling and floor plan drawings are sent to Hawthorne for correction of records due to installer's changes made on the job.

After completion, the office equipment is tested and turned over to the customer for acceptance.

SECTION 6. BILLING

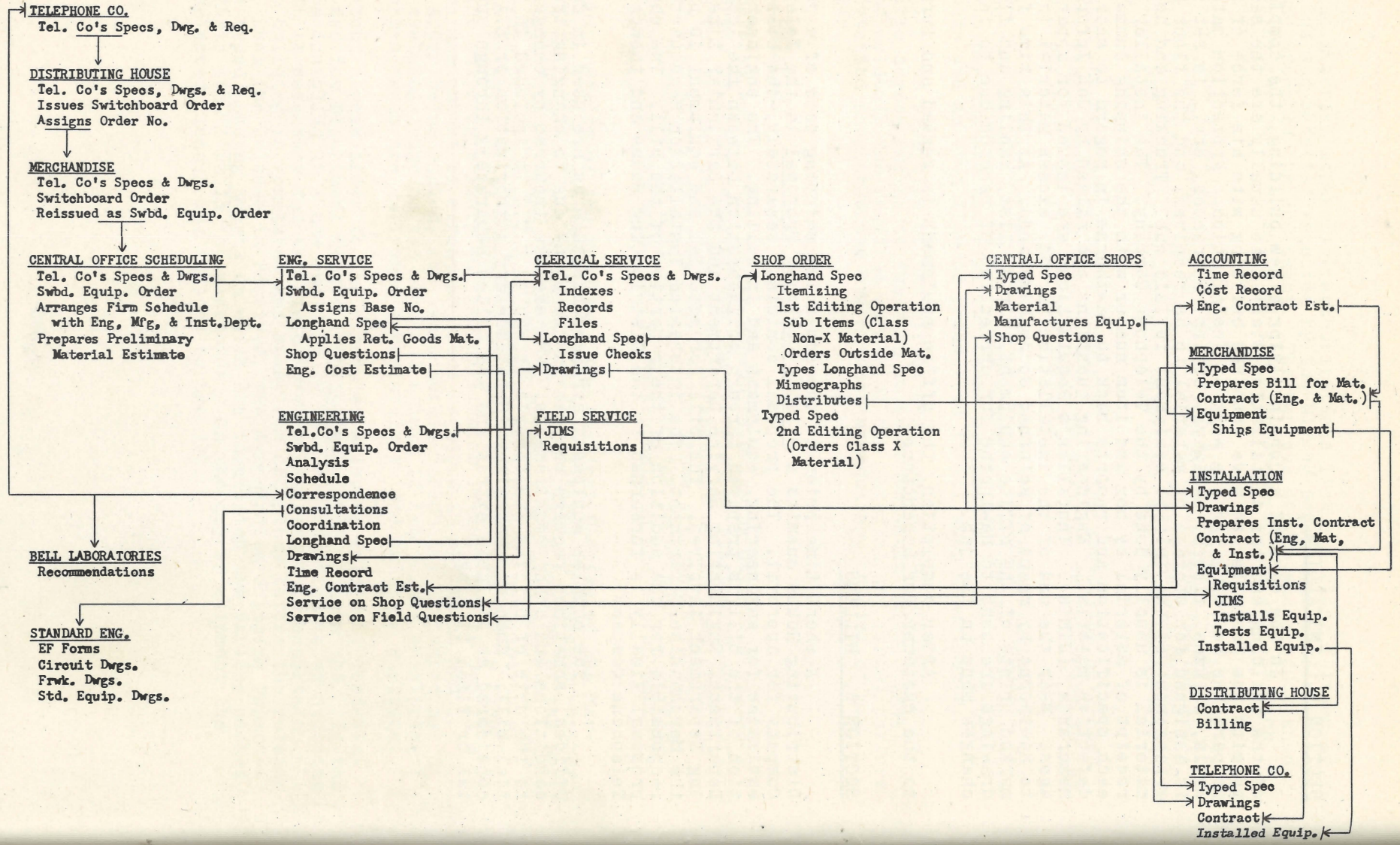
A short time prior to the scheduled shipping date of a job, the Distributing House submits a Billing Contract Proposal to the Telephone Company for approval. The proposal contains, separately, the billing estimates for engineering, equipment and installing. The engineering portion of the bill is prepared through collaboration between the Accounting Department, Engineering Service Department and the particular Line Engineering Department involved. The bill for material and equipment is prepared by the Merchandise Department. The interested Installation Headquarters are responsible for the addition of their portion of the bill. The complete proposal finally is forwarded to the Distributing House and thence to the Telephone Company.

The complex equipment arrangements such as are used in Central Offices, sometimes require changes in the plans due to changing traffic conditions and other requirements. The expense incurred by changes prior to the date of billing (Customer's change or C.C.) is included in the initial bill. Changes thereafter (Supplementary authorization or S.A.) are considered as billable extras and are billed separately through supplemental or final billing.

SWITCHBOARD ORDER

ORIGINATION AND ROUTING OF SWBD. ORDER AND FUNCTIONS OF THE ORGANIZATIONS

THESE ORDERS COVER NEW OFFICES OR ADDITIONS TO EXISTING OFFICES
AND REQUIRE THE PREPARATION OF JOB SPECS AND NEW DRAWINGS OR
CHANGES ON EXISTING DRAWINGS



Western Electric Company, Inc.
Hawthorne Works
Personnel Service Branch
Training Department

Course: Telephone Systems Training
Equipment Branch Practices

Lesson No. 3

ANALYSIS OF A JOB EQUIPMENT SPECIFICATION

This lesson is issued to describe the general features of a job equipment specification. Information contained herein is to be used for training purposes only and is not intended to prescribe methods or to replace or supplement existing instructions available in the Equipment Engineering Departments.

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BIBLIOGRAPHY

Bell System Publications
Equipment Engineering Handbook

SECTION 1. GENERAL DESCRIPTION AND NUMBERING

Western Electric Company job equipment specifications are prepared to cover manufacturing and installing information for equipment for a particular telephone central office in accordance with the requirements set forth by the Telephone Company. The Equipment Engineering Departments are responsible for the preparation of the job specifications and the associated job drawings from which the central office equipment can be manufactured and installed. Much of the information contained in the job specifications is specified in terms of standard drawings, such as specification drawings, equipment drawings and circuit drawings. These standard drawings are prepared and maintained by the Central Office Standards Engineering and Drafting Departments from information and drawings originated at the Bell Telephone Laboratories. Thus, in brief, it may be stated that the Laboratories determine the standard arrangements for use throughout the System, the Standards Engineering and Drafting Departments convert this information into standard drawings adapted for the shop's use and the installer's use, and the Equipment Engineering Departments apply the various standard drawings to meet the specific job requirements as outlined in the Telephone Company's order, specification and drawings. Occasionally, portions of the Telephone Company's requirements cannot be fulfilled through the application of the standard arrangements, in which case the Laboratories develop and recommend the use of special arrangements as required.

Job equipment specifications are prepared on all orders which are engineered by the Equipment Departments with the exception of certain miscellaneous and small orders where editing information can be shown on the order sheet. The orders for Step-by-Step, Panel and Crossbar Dial Equipments are engineered at Hawthorne and those for Local Manual, Toll, Repeater and Associated Equipments are engineered at Kearny. The equipment on an order is grouped in different job specifications according to the various kinds of sections, frames and other equipment required. This grouping of equipment must take into account the time required for manufacturing so that those items requiring the longer periods will be ordered early enough to permit satisfactory deliveries to the installer. The shop wired equipment ordinarily requires a longer manufacturing interval than frames and racks, switchboard cable (which is selected from stock and in some cases formed and soldered) and miscellaneous material such as wire and conduit. Consequently the specifications for the shop wired equipment are written as early in the engineering period as possible.

Job equipment specifications are identified by the Specification Number which is made up of the job order number and a three digit suffix. The order number is assigned to the job at the Branch House at the time that the Telephone Company's order, specification and drawings are received there. The three digit suffix number is assigned in accordance with a numbering plan established for all job specifications. The first digit of the suffix indicates the type of system, that is whether the Manual or one of the several Dial systems, and also usually whether the specification covers new or additional equipment or miscellaneous equipment. The last two digits are determined by the type of equipment ordered. The letter H or K immediately precedes the three digit suffix and indicates whether the specification was written at Hawthorne or Kearny.

Examples of some of the commonly used specification dash numbers are as follows:

System								Description
Manual		Panel		Crossbar		Step-by-Step		
New or Add. Eqpt.	Misc. Eqpt.	New or Add. Eqpt.	Misc. Eqpt.	New or Add. Eqpt.	Misc. Eqpt.	New or Add. Eqpt.	Misc. Eqpt.	
-101		-401		-501		-701		Cabling
-111	-211	-411	-311	-511	-611	-711	-811	D.S."A" Swbd.
-113	-213	-413	-313	-513	-613	-713	-813	Trunk Swbd.
-138	-238	-438	-338	-538	-638	-738	-838	S.O. Desk or Swbd.
-147	-247	-447	-347	-547	-647	-747	-847	Test Sets
-150	-250	-450	-350	-550	-650	-750	-850	Loc.Test Desk
-165		-465		-565		-765		Power Plant
-168		-468		-568		-768		MDF, IDF, etc. Frwk.
-170		-470		-570		-770		MDF, IDF, etc. Eqpt.
-192		-492		-592		-792		Installing

A complete list of specification numbers is given in the Equipment Engineering Handbook, Section 31.

Specification numbers in the Misc. Eqpt. columns are assigned to cover miscellaneous additions or modifications to existing wired equipment where the shop is not required to furnish new frames, bays, sections or wired units.

In some instances considerable quantities of equipment are required to be engineered and manufactured in advance of the regular set-up of the job. A method sometimes used for such instances consists of the origination of an "Advance Manufacture Specification," which is assigned the specification dash 300, 600, 800 number depending on the system or type of equipment ordered. Later when the regular specifications are written, a note is included in each one affected to indicate the particular associated items in the advance specification.

Specifications which order equipment to be manufactured by the Automatic Electric Company are assigned in the 900 series, such as 928 spec. However, non-wired Automatic Electric Company equipment can be ordered in the 700 series specifications with a note to obtain the equipment from the A. E. Co. The Merchandise Department the orders this equipment from the Automatic Electric Company.

SECTION 2. SPECIFICATION CONTENTS

In accordance with the present established routines, job equipment specifications are typed in two parts, namely, Section "A" and Section "B". The information contained in each section varies considerably between different types of specifications due to the many kinds of equipment involved. The description of a typical "assembly and equipment" specification will include the major divisions of information.

Section "A" may include the following:

(a) Title of specification
(b) General statement of equipment covered
(c) List of engineering reference papers
(d) List of drawings, including installers equipment, specification drawings, framework assembly and equipment drawings, circuit and schematic drawings and in some cases Telephone Company's drawings
(e) List of installer's reference papers
(f) Wiring list
(g) General notes and installer's notes

Section "A" generally is transcribed as originated by the engineer. Section "B" however, which covers the "Framework and Summary of Apparatus" may undergo considerable change after being written by the engineer and previous to transcription. This is due to the process of the Shop Order Department's editing, which adds the list of partial assemblies, apparatus, or piece parts, to any item which is shipped as other than a completely assembled unit. Thus, Section "B" becomes not only the engineer's list of material required but also a "Shipping Summary" of the individual parts in the form in which they are shipped to the job. The following paragraphs describe the various classes of information as outlined above.

Title. The first page of the job specification contains the order number and specification number, date of transcription, number of pages in Section "A", engineer's, checker's and shop order editor's name or initials, type of equipment, type of telephone system, the Telephone Company, the Telephone Company's area or division if required, the office name, building name and town and state.

General. Under this heading is given a brief description of the scope of the specification. The description includes a list of the major items of equipment to provide a general overall picture of the manufacturing and installation effort required. In the case of the installing specification (-492, -792, etc.) a list of all job specifications written for the particular order, together with a condensed statement of equipment or modifications covered by each, is shown under "Supplementary Specifications." This information is particularly valuable to the installation planner and to the installer in quickly determining the amount of work involved. Other organizations such as scheduling, cost estimating, etc., find this list helpful when a quick check of the equipment is required.

Engineering Reference Papers. Specifications and drawings are listed under this heading for reference purposes in connection with work to be performed within the Equipment Departments. The Telephone Company's specification and the Western Electric Company's floor plan drawing showing the location of the associated equipment are usually always listed. In some cases where a miscellaneous specification is being written and the equipment concerned is not covered by a wiring list drawing, the job specifications of the previous additions or original installation are also shown. In the installing specification, the floor plan drawing is listed under "Drawings" rather than under "Engineering Reference Papers."

Installers Reference Papers. Drawings needed by the installer only but on which succeeding issues will not be required, are listed under this heading. These drawings usually show existing arrangements where the framework, apparatus or wiring is to be modified in the field to agree with other drawings. Suffix "N" drawings showing present equipment are listed under this heading.

Drawings. Drawings required for engineering and installation of the particular equipment are listed in the job specification. Drawings are not listed for manufacturing purposes since the shop obtains their drawing numbers from the shop orders and not from the job specification. Inasmuch as all drawings are subject to changes for various reasons from time to time, the particular status of each drawing is identified by an issue number. Thus the original issue of a drawing is issue number 1 and succeeding issues become numbers 2, 3, etc. Therefore, it is essential, with a very few exceptions, that the issue number of each drawing required for the job be posted in the specification. This will insure that all interested organizations will work with the same information and that the drawings will agree with the latest data and information available at the time engineering is completed. In this respect, the Clerical Service Department posts the job order and specification number in the Drawing Issue Files for each specification drawing and circuit drawing specified. This information becomes valuable in connection with C.N's or "Change Notices" authorized by the Bell Telephone Laboratories, when changes are to be made on all jobs already installed or in the process of manufacture. Thus, through the use of the Issue Files, it becomes an easy matter to determine the jobs that are affected by any particular Change Notice. The proposed plan of posting job wiring list drawings instead of job order numbers will further facilitate this procedure.

Drawings listed in the job specification may not be required by all organizations. Various characters therefore, are posted in front of such drawings by the engineer or issue files as required. Among other signs, the equality sign "=" indicates that the drawing is not required by the installer. The plus sign "+" shows that the drawing is not required by the Telephone Company. The percentage sign "%" denotes that the specified issue of the drawing had been previously furnished to the Telephone Company's area file.

The drawing list is usually divided into four groups; namely, Installers Equipment, Specification Drawings, Framework Assembly and Equipment Drawings and Circuits. Under the first group are listed drawings required only by the installer on which he must receive later issues such as cable connecting drawings and switchboard power cable drawings. Under the second group are listed the "J" Specification drawings and "C" Specifications from which equipment in the job specification is ordered. In the third group, the various job and standard framework, assembly, and equipment drawings required in the manufacture and installation are listed. Job circuits, job wiring lists and all standard circuits and associated schematic drawings involved in the wiring or cabling of the equipment are shown under the fourth group of drawings. Routines are set up whereby Circuit Descriptions if available are furnished for all schematics except in cases where the schematic is marked by the engineer with an asterisk "*" as noted.

Drawings under the various headings are usually listed in numerical order. Such an arrangement is ordinarily provided for in the longhand specification form used by the engineer and is of considerable convenience in checking drawings during the process of engineering, manufacturing and installation.

Certain equipment drawings covering cross connections and location charts, are required by the wire chief for maintenance purposes after the central office is cut over for service. Inasmuch as the wire chief receives drawings listed under circuits and schematics only, it is necessary for the engineer to list such additional equipment drawings under this heading rather than with the framework assembly and equipment drawings. It is the function of the -99 specification (that is the -199, -499, -599, or -799) to order the drawings required by the wire chief. This specification is prepared by the Clerical Service Department from a summary of all job specifications originated for the order.

In some instances it is necessary for the installer to use Telephone Company's drawings. These are listed under a separate heading. A note is included to instruct the installer to obtain the listed drawings from the Telephone Company at the time of installation.

Mounted terminal assembly drawings in the Step-by-Step System and mounted or unmounted designation charts in the Panel System are required for maintenance purposes in connection with certain specifications. Also, specifications ordering double row fuse panels on which the fuses are assigned on a job basis, require the preparation of Fuse Record Sheets. The mounted and unmounted drawings and charts and the record sheets and the associated binders are ordered in the affected specifications under suitable headings placed immediately following the drawing list. The editing for these papers thereafter is included in the -99 specification where the material is furnished along with the wire chief's other information.

Wiring List. Wiring lists covering the wiring of equipment for the office are normally placed on drawings. These wiring list drawings are listed under "Circuits" in the job specification and are used as required by the shop and installer. When the equipment ordered is covered by the standard specification drawings, the shop works from the standard drawing instead of the wiring list drawing.

When additions are made to existing equipment involving new complete shop wired equipments, the wiring list drawing is changed as required. In addition to this, a wiring list is placed in the specification, listing briefly the frames or units added, with specification drawing number and job circuit numbering, so that the installer can identify the equipment on the wiring list drawing, from which he will install the equipment. On additions, however, where existing wiring is changed or where wiring is added to existing equipment, a complete detailed wiring list is placed in the specification for the installer's benefit, in addition to making the necessary changes on the wiring list drawing.

The specification wiring list may consist of several sections all under the general heading "Wiring List". The various sections are used as required to cover particular kinds of wiring or changes to be made as follows:

(a) "Wired equipment to be placed by the installer" is used to cover briefly the addition of complete shop wired equipments as outlined in previous paragraph.

(b) "Local cables to be placed by the installer" covers additional wiring which is made up into a local cable by the shop to be placed in position by the installer.

(c) "Wiring and apparatus to be placed by the installer" covers all changes such as modifications of existing wiring, added wiring to existing equipment, etc., as outlined in Equipment Engineers Handbook, Section 43.

(d) "Equipment to be removed" is used to cover the removal of complete equipments such as frames or units.

General Notes. General notes in the job specification are primarily for the particular instruction to the shop where additional information is required beyond that available on the specified drawings. These notes may affect the installer also in cases where both the shop and installer are involved. The notes are numbered beginning with 51. Numbers below 51 are reserved for use on job drawings, and are called "Maintenance" notes, and cover information required by the maintenance force of the Telephone Company. They provide information for the installer also.

General Notes for the Installer. These notes convey special instructions to the installer regarding requirements not covered elsewhere. The installer's notes are identified by letters beginning with "A". These notes include special job information used by the engineer and which may be useful to the installer.

Summary of Apparatus. Under this heading first appear the Summary Notes which explain the meaning of the various symbols used in connection with the ordering of the items of framework, equipment and apparatus. Some of the common symbols are S, A, R, and T, which indicate respectively: items to be shipped, items to be shipped in advance, items to be reused by the installer from present equipment, and items to be furnished by the Telephone Company. Additional symbols are shown and explained in the Equipment Engineering Handbook, Section 43, paragraph 17. During the process of Shop Order editing further symbols and notes are added.

The Summary of Apparatus contains the framework items, major units of wired equipment covered by List Numbers in J-Specification drawings or Group Numbers in ED-equipment drawings; also individual pieces of apparatus, local cables and local power cables. Normally, the various items are listed under the Summary of Apparatus in alphabetical order for uniformity and for the convenience of the interested organizations. Major units to be equipped are followed by the term "Equipped With" and then by the list of material to be mounted thereon by the shop. Similar items are combined together so as to reduce the total number of items. Items to be shipped to the job and mounted by the installer, however, are designated "S" and are segregated from those items to be mounted by the shop.

SECTION 3. SPECIFICATION APPENDICES

Appendices are written to job equipment specifications whenever it is necessary to add, remove or change any of the information or material ordered. They are prepared in as abbreviated a form as possible and still convey complete information for making the changes required. The title of the particular appendix is the same as the original specification except that the appendix number is added to the specification number. These are assigned numerically by the Clerical Service Department at the time of issue checking. The title also includes the class of the appendix and the reason for the change. Appendices are classified in accordance with the following:

Class A - Due to changes made by the Telephone Company or Distributing House

Class B - Due to errors in the Equipment Engineering Departments

Class D - Due to requests from departments within the Manufacturing Department, not to correct engineering errors, but to facilitate manufacturing or to permit use of stock or standard equipment

Class EA - Due to the result of Bell Laboratories' development work which is billable to the customer. In general, these appendices are issued by the "C.N." Engineer

Class EE - Due to the result of Bell Laboratories' development work which is non-billable. These appendices also are generally issued by the "C.N." Engineer

Class M. - Due to information not available at the time specification was written. (Anticipated by an "incomplete" note in the spec.)

Appendices are sometimes originated after the job is shipped, in which case complete manufacturing information is shown. The changes required are usually expressed in terms of straight additions rather than changes on existing items. Also complete drawing information and shipping

instructions are shown. "Requisition appendices" are those so designated, which are written after a job is shipped and on which "Requisition" or special service is required on the part of the Field Service Department.

In some cases an excessive number of appendices on a particular specification are required resulting in considerable difficulty in verifying the ultimate list of material. To remedy such a condition, a dash "A" specification sometimes is issued, for instance -411-A. This is a rewritten copy of the original specification incorporating all the appendix changes up to that time. The original specification is then considered as being replaced and is so indicated by means of an appendix. Additional changes thereafter are made by appendices to the dash "A" specification and not to the original specification.

Western Electric Company, Inc.
Hawthorne Works
Personnel Service Branch
Training Department

Telephone Systems Training
Course: Equipment Branch Practices

Lesson No. 4

TOOLS AND INFORMATION USED BY EQUIPMENT ENGINEERS IN WRITING JOB SPECIFICATIONS

This lesson is issued to describe the general features of the tools and information used by the equipment engineer in writing job specifications. The material contained herein is to be used for training purposes only.

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BIBLIOGRAPHY

Bell System Publications
Equipment Engineering Handbook
Dial Equipment Engineering Guide

SECTION 1. GENERAL

Due to the complexity of the various telephone systems used throughout the Bell System and the many organizations involved in the engineering, manufacture, inspection, installation and maintenance of the associated equipment, the sources of information relating to any particular phase of the work are many and varied. To the Western Electric Company's Equipment Engineer, who is responsible for the preparation of the job specifications and job drawings for the manufacture and installation of equipment for a particular central office, much of the accumulated information is of great value and quite indispensable. Naturally, this information is highly intensified, being the result of the compounded experiences of thousands of employees who have had their share in bringing the system to the state of refinement that is in effect today.

It may be assumed that the art will continue to develop in the future as it has in the past, and with it there will evolve new and additional sources of information for the use of every one concerned. It is logical, therefore, that some system of identification and cataloging be applied in order that the desired information at any particular moment may be found without difficulty or delay.

The source of the standard information used by the Equipment Engineer may be traced either directly or indirectly to the Systems Development Department of the Bell Telephone Laboratories. This department maintains a Master Index or centralized reference which lists the key papers in the various series of numbers used for identifying engineering information. The Master Index is assigned the specification number X-64200 and is available in the standard specification file in each Equipment Engineering Department.

The standard engineering information is prepared partly in bulletin or specification form and partly in the form of drawings, and consists of Specifications, Bell System Practices (B.S.P.), Drawings, Keysheets and Data Sheets. The key papers or indices mentioned above afford a means of identifying information on any specific subject either by number or by title. These key papers are prepared in the following forms: (See X-64200)

(a) Checking Lists (AA 128.101 Master Checking List)
(b) Classified Lists
(c) Master Keysheet (SD 90250-01)
(d) Drawing Lists (AA 128.100 series)

Checking Lists are numerical indices and Classified Lists are topical indices. Keysheets are circuit lists and are arranged to indicate the direction of traffic and inter-connection of circuits handling telephone service. The Master Keysheet lists the individual keysheets applying to various systems or subdivisions thereof. Keysheets are prepared in letter size bulletin form for convenience in handling. Drawing Lists are indices of Bell System circuit and equipment drawings recommended for distribution and use. The circuits are in the SD - five digit - 01 series and the equipments are in the ED - five digit - 01 series. These indices afford a means of locating drawings without reference to other papers.

SECTION 2. STANDARD SPECIFICATIONS AND BELL SYSTEM PRACTICES

Standard specifications are issued to provide standard working information for the engineering, installation, inspection and maintenance forces of the Bell System. These specifications have been assigned in the J-, X-, KS- and in some cases the C- series. Recently, however, a new scheme of identification under the title of "Bell System Practices" has been adopted. The existing standard specifications are being replaced by or are in some cases merely being assigned a Bell System Practices number (abbreviated B.S.P.).

Bell System Practices are identified by a letter representing the functional requirement such as engineering, installation, maintenance, etc., followed by a three digit division or series number representing a particular class of the main function, and thence a decimal point and a three digit section number representing the specific subject. An example of this numbering is B.S.P. Section AA221.008.

Technical information prepared by the Systems Development Department is assigned in the A, B, D and AA series of B.S.P.'s. The A series of practices is devoted to Central Office Maintenance and is intended to replace the former X-70000 series of specifications covering requirements and adjusting procedures, installation and maintenance, and description and operation of apparatus. The B series of practices covers PBX Installation and Maintenance. The D series is assigned to Recovery and Repair. The AA series is for Equipment Engineering information and will be described more in detail inasmuch as it is of primary interest to the Equipment Engineer.

The AA100 Division of B.S.P.'s covers general information and is subdivided as follows:

AA101 Scope and Arrangement
AA102 Plan for Issuing Practices
AA126 Alphabetical Indices
AA127 Numerical Indices
AA128 Checking Lists

The AA200 and AA300 Divisions are known as Equipment Design Requirements and have been assigned to classify the "J" series of Engineering Requirements specifications. This change consists essentially of adding B.S.P. section numbers to the "J" specifications for the purpose of filing these specifications in their proper place in the B.S.P. file. The method of equipment codification, i.e., the assignment of a "J" code and list to the equipment (as explained in the following Section 3) will not be changed by the assignment of a B.S.P. Section number. Each "J" specification will carry both the "J" Specification number as heretofore and the new B.S.P. number.

The combined B.S.P. sections and "J" Specifications covering equipment design requirements are issued primarily for the Manufacturing and Installation Departments. In general, these specifications tie in all of the separate requirements and other information necessary for the manufacture, assembly, testing, and installation of the unit or system as a whole. This includes all supplementary information, associated drawings, an explanation of the nature of the system or unit and its application in the telephone plant. Individual specifications are prepared for the various equipments which form units or links in the traffic scheme within the plant. Examples are line finders, senders, test desks, alarm frames, etc.

The "J" series of numbering has been set up in order to obtain an easy means of association between the manufacturing and engineering requirements. With this series the same base number is used all through the manufacturing processes so that the identifying numbers are the same whether engineering requirements, manufacturing, pricing or billing information is referred to. "J" Specifications were originally assigned numbers in the X-61000 series for the dial systems and in the X-63000 series for the manual and toll systems. The majority of these "X" specifications have since been replaced by "J" Specifications. Others, whose status does not warrant changing, will remain in the "X" series.

The following list shows the association between the first or identifying digit of the "J" specification number and the B.S.P. number in the AA200 and AA300 series together with the type of equipment covered.

"J" Specification (1st digit)	B.S.P. Section	Equipment
J 1	AA210	Local Manual
J 2	AA220	Panel
J 2XX50	AA240	Crossbar
J 3	AA230	Step-by-Step
J 5	AA350	P.B.X.
J 6	AA260	Toll
J 7	AA280	Telegraph
-	AA320	Station
J 8	AA360	Power
J 9	AA380	Common

The AA600 Division of B.S.P.'s are known as General Equipment Requirements and have been assigned to replace the former X-65000 series of General Engineering Requirement specifications. . These are classified as follows:

AA600 General
AA610 General Installation and Manufacturing Requirements
AA630) Performance Requirements
AA640)
AA650(Inspection Requirements
AA660(

Specifications in the KS-5000 series are issued to cover engineering requirements which must be met by outside suppliers in connection with equipment which they furnish to the Western Electric Company. These specifications are used by the Merchandise and Manufacturing Departments for ordering, analyzing and editing purposes and by the Inspection Department for checking purposes.

"C" Specifications were used extensively for standard equipments previous to the advent of the codification plan as covered by the present "J" Specifications. With a few exceptions, where the status of the equipment does not warrant a change, the old series of "C" Specifications have been entirely replaced by the new series of "J" Specifications or by standard equipment drawings in the ED-series. Numbering consists of the three digit dash number of the specification in which the equipment is usually ordered and a two digit suffix 01 to 99. Example: C-474-14.

"D" Specifications cover special apparatus which is designed to care for conditions which cannot be covered by existing standard apparatus. Whenever the engineer specifies "D" Specification apparatus in a job equipment specification, he should check the "D" Specification to determine whether an apparatus code number had been assigned. In the latter case, the code number would be specified in place of the "D" Specification number. In some cases the engineer may request a new "D" Specification for job conditions not properly filled by existing apparatus.

Some of the key papers, listed in the Master Index, for standard specifications of particular interest to the equipment engineer are as follows:

Checking Lists

AA128.002 - Equipment Design Requirements (J Specifications)
AA128.006 - General Equipment Requirements (X-65000 Specifications)

Classified Lists

J-39206 - Step-by-Step Office Engineering Requirements
X-61400 - Panel Office (Bat. on C.O. Relay) Engineering Requirements

SECTION 3. STANDARD DRAWINGS AND KEYSHEETS

Standard drawings used by the Equipment engineer are orginated by the Systems Development Department of the Bell Telephone Laboratories and by the Standards Engineering and Drafting Departments of the Western Electric Company. Under the present routines, the standard drawings issued by the latter departments normally are based on information received from the Laboratories in the form of specifications and drawings. This relation between the two organizations is described in detail in the following paragraphs.

Equipment Codes. The Laboratories assign equipment codes to those items of equipment which are used repeatedly on different orders. The codes and the associated information are prepared in order to avoid the expense of duplicating the manufacturing information for identical equipment on each individual order and to avoid variations in design which would occur if engineering was performed in detail on each order. Units of equipment are coded by the Laboratories in terms of "J" specifications and associated code letters and list numbers. The "J" specification covers certain portions or types of central office equipment and the individual codes cover the various subdivisions, smaller units and parts. In case of changes or improvements in design, the code number assigned for a particular unit of equipment remains the same as long as the new equipment can be used interchangeably with that which the code number originally covered. If the design undergoes radical changes or if an entirely new design is developed so that it is not interchangeable with the old, the Laboratories assign a new code number. The "J" specifications are issued by the Laboratories in bulletin form.

"J" Specification Drawings. From the Laboratories' specifications, the Western Electric Company prepares "J" specification drawings for manufacturing and installation purposes. These drawings have the same specification and code numbers as are assigned by the Laboratories but in addition have a dash number which indicates the serial number of the drawing. This number is added since it is sometimes necessary to replace the drawings and yet retain the same "J" specification number. This is done when changes in design are made by the Laboratories and the code number remains the same. It is desirable in such cases to retain a record of the equipment as it was furnished on jobs in accordance with the original design. A second manufacturing drawing, therefore, is made for the changed design to be used on subsequent orders. Separate specification drawings are prepared for each code number bearing a different code letter. For instance, the code assigned by the Laboratories to a particular type of equipment may be the "J" specification number plus the code letters A list 1, B list 1 and B list 2. The corresponding manufacturing drawings on the original design would consist of two drawings numbered as follows: The "J" specification A-1 ordering list 1 and the "J" specification B-1 ordering lists 1 and 2. Subsequent new designs would be numbered A-2, B-2, A-3, B-3, etc. Certain equipment features which are optional or quantities which are variable to meet the Telephone Company's requirements on specific jobs, cannot be included in the fixed code. Therefore, lettered lists (which are not regarded as codes) are shown on the manufacturing drawings for such items.

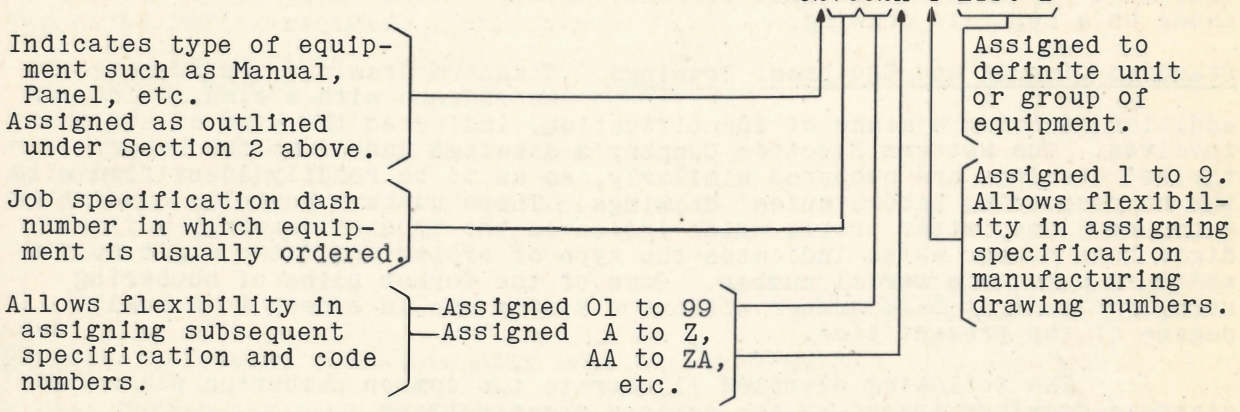
An example of the scheme of numbering employed in the Equipment Coding Plan is as follows:

Bell Telephone Laboratories' Number

J27602A List 1

Western Electric Company's Number

J27602A-4 List 1



Features of a "J" specification drawing are the title and number, framework and apparatus list, drawing table, wiring list, information for manufacturing purposes, information not for manufacturing purposes, "Table A" and equipment and numbering sketches.

The title gives a brief description of the equipment and the number serves to identify the drawing.

The framework and apparatus list orders the framework, local cable and all of the apparatus for circuits that are to be equipped. It usually consists of several lists which provide for a selection of circuit features to meet the various traffic requirements of the telephone companies. Symbols are used in the apparatus list to call attention to particular manufacturing and shipping requirements as explained in notes under information for manufacturing purposes. In some cases a list is divided into parts 1 and 2. The part 1 portion orders all equipment that remains unchanged when equipment of other lists is also furnished. Part 2 covers that portion which may be changed by supplementary lists. This division is made for the convenience in placing orders on the shop.

All general drawings other than circuits are listed for manufacturing and installing purposes in the drawing table. These drawings usually cover framework, equipment and partial assemblies. Drawings in this table required by the installer are listed in the job equipment specification.

The wiring list specifies all circuits that are to be wired in the local cable and indicates the circuits which are equipped in all cases and those which are to be equipped to meet the needs of the Telephone Company. This latter type is specified as "wired only" on the "J" specification but is shown equipped as required on the job wiring list and in the job specification. In order that the job wiring list will completely cover all wiring as it is installed on the job, the "J" specification wiring lists used are duplicated on the job wiring list drawing.

The notes under information for manufacturing purposes convey instructions to the shop and installer.

Information not for manufacturing purposes covers engineering notes and information for ordering the equipment to suit the job conditions. These notes usually refer to "Table A," which covers the features, equipment and circuit figures associated with each numbered and lettered list contained on the drawing.

Equipment and numbering sketches show the arrangement of the equipment, functional designations and numbering information. Some designations are shown for wiring information only while others are to be stamped on the equipment. The location of the local cable with respect to the equipment is shown in cases where it can be covered without making the equipment sketch too difficult to read. Otherwise the local cable plan is shown on a separate drawing.

Standard Circuit and Equipment Drawings. Standard drawings are numbered in accordance with a plan, which, in addition to being a means of identification, indicates the kind of equipment involved. The Western Electric Company's drawings made from the Laboratories' drawings are numbered similarly, so as to be readily identified with the corresponding Laboratories' drawings. These numbers normally consist of a two or a one letter prefix which indicates the type of drawing, a five digit base number which indicates the type of system and a two digit suffix which is used as a serial number. Some of the former plans of numbering using a six digit base number without a suffix are in effect to a small degree at the present time.

The following examples illustrate the common numbering plans for standard drawings issued by the various organizations.

Bell Telephone Laboratories' Number

Schematic Drawings	SD - 21225-01
Circuit Descriptions	CD - 21225-01
Equipment Drawings	ED - 20300-01
Equipment Explanations	EE - 20300-01

Prefix-Indicates type of drawing

Serial Suffix 01 to 09

Base Number-Indicates type of equipment Assigned as follows:

		Plant Affected
Manual	10000 to 19999	Kearny
Panel	20000 to 24999	Hawthorne
Crossbar	25000 to 29999	Hawthorne
Step-by-Step	30000 to 39999	Hawthorne
Toll	(60000 to 64999	Kearny
	(67000 to 68999	Kearny
PBX	65000 to 66999	Haw. & Kearny
Station	69000 to 69999	Haw. & Kearny
Teleg.	70000 to 79999	Kearny
Power	80000 to 89999	Haw. & Kearny
Common	90000 to 99999	Haw. & Kearny

Western Electric Company's Number

Wiring diagrams (circuit drawings)	T-21225-12
Wiring records	WRT-21225-12
Soldering records	SRT-21225-12

Prefix-Indicates type of drawing

Bell Laboratories' Base Number - Same as corresponding SD-drg. no.

Two digit suffix-11 to 29 assigned at Hawthorne, 30 to 99 assigned at Kearny, except 20000 and 30000 series in which Hawthorne assigns 11 to 99

Western Electric Company's Number

Equipment, Framework & Cable Plan Dwgs. — ED-20300-52

Bell Laboratories' Prefix & Base Number

Two digit suffix-assigned as follows:

Suffix	Fully Piece Parted	Groups on corresponding Bell Lab. Dwg.
10 to 29	No	No
30 to 49	No	Yes
50 to 69	Yes	No
70 to 89	Yes	Yes

Western Electric Company's Dwgs. not made from Labs. Dwgs.

Equipment, Framework & Cable Plan Dwgs. — H-574-135

* Base Number-Assigned as follows:

Manual	H-200 to 299
Panel	H-500 to 590
Crossbar	H-591 to 599
Step-by-Step	H-900 to 999

Serial Number
001 to 099 for information dwgs.
100 to 999 for Manufacturing Dwgs.

* Note: See Equipment Engineering Handbook Section 31, Paragraph 4.23 for detailed assignments.

Older Numbering Plans

Bell Labs. Six digit Schematics
Method of Operation Sheets
Corresponding W. E. Co. Dwgs.

ES-240252
CD-or BT-240252
T-514602

Assigned in following series:

Std. Local Cables Running List	T-493000
Misc. Panel Circuits	T-514000
Misc. Panel Frwk. & Eqpt.	T-516000
Misc. SxS Frwk. & Eqpt.	T-530000
Misc. SxS Circuits	T-616000
Kearny Loc. Cables, Frwk. Eqpt. & Circuits	T-620000 to T-634999
Misc. Crossbar Circuits	T-520000

Miscellaneous Drawings

Standard Local Cable Design Dwgs. — LC-476-001

Prefix-Indicates type of drawing

Serial suffix 001 to 999

Indicates type of equipment

Manual	2
Panel	4
Crossbar	5
Step-by-Step	7
Common	9

Job specification dash number in which equipment is usually ordered except in the Manual equipments

Piece Part Drawings P-423261

Assigned as follows:
Hawthorne 420000 to 449999
Kearny 409000 to 419999

Equipment "A" Dwgs. A-110105

ED-Drawing Equipment Codes. Certain items of equipment, such as cable turning sections, main distributing frames, and wired units involving only one circuit drawing, are coded with an ED-assembly drawing number rather than with a "J" specification code. The group number on the ED-assembly drawing is considered as a part of the code and must agree in every case with the group number assigned by the Laboratories on the corresponding ED-dash 01 drawing. In the case of wired units the Bell Laboratories' SD-dash 01 circuit drawing and ED-dash 01 equipment drawing will have the same base number. The Western Electric Company's equipment and circuit information in such cases is often placed on the one drawing, that is, the ED-drawing. An example of this procedure is the Step-by-Step Selector Switch circuit and equipment as follows:

	Laboratories Dwgs.	Corresponding W.E.Co. Dwg.
Circuit	SD-30200-01	
Equipment	ED-30200-02	Ckt. & Eqpt. ED-30200-33

ED-Drawings and EE-Equipment Explanations. Laboratories' ED-drawings covering framework assemblies, framework details, equipment arrangements, wiring plans and cabling plans may be used directly in many cases by the equipment engineer, shop, outside supplier and the installer. Generally, however, the Western Electric Company prepares corresponding ED-drawings for the shop and installer, especially where framework assemblies are covered. These drawings are numbered as outlined in the examples shown above.

The essential parts of a Framework Assembly drawing as prepared by the Western Electric Company, are the views, showing the manner in which all parts should be assembled, and the stocklist, which orders the material and details necessary to the assembly. The framework covered may be either metal or wood or a combination of both. The assembly views are limited in number to those actually required to show manufacturing and installing information which cannot be given in notes. In some cases individual parts are shown in complete detail in the assembly views. More often, however, separate sketches are used to show the design of details. These sketches may be shown on the assembly drawing or on supplementary detail or piece-part drawings. Where dimensions of certain parts vary for each group, a lettered dimension is shown in the assembly view and a table of the variable dimensions is placed on the drawing.

The stocklist consists of one or more groups which order the material for a complete framework assembly or a portion thereof. Several groups may be required for different arrangements of equipment. Supplementary framework features may be ordered in additional groups. The group column signifies the quantities of each of the various parts. Other columns indicate the Piece or Detail number, the description, material and the detail drawing number. When piece parts are used no material or detail drawing number is specified as this information is covered on the associated piece-part drawing.

Associated with each Laboratories' ED-drawing there is prepared an equipment explanation or EE sheet which explains the reasons for issuing or re-issuing an equipment drawing. The EE sheet bears the same base number as the associated ED-drawing.

SD-Schematic Drawings and CD-Circuit Descriptions. The circuits as represented by the SD-series of drawings are drawn by the Laboratories in schematic form. The conventions of apparatus and connections show only the electrical characteristics in order that the operation of the circuit can be traced easily. Shown on the schematic drawing, is a circuit requirement table giving the electrical values for adjusting apparatus. Functional designations are assigned to the apparatus and are used for identifying the various pieces in the associated drawings and papers. The apparatus code number is not sufficient for this purpose, as several pieces with the same code number may be used in one circuit.

Along with the schematics the Laboratories issue circuit description or CD sheets which outline the functions of the circuit, give a detail description of its operation and describe the changes made in the circuit or apparatus when new issues are originated. The CD sheet bears the same base number as the associated schematic drawing. The schematics and their circuit descriptions, in addition to being used for adjusting the apparatus and testing the operation of the circuits, are also used as a basis for making the circuit wiring diagrams by the Western Electric Company.

Where the information to be shown on a schematic drawing will not fit on one drawing, the drawing may be prepared in two or more sheets. In such cases, a third digit (or sheet number) is added to the suffix, as -011, -012, etc. These sheets are not distributed separately and are considered collectively as a single drawing. Thus for engineering record purposes the two digit suffix is always shown regardless of the number of sheets.

Circuit Wiring Diagrams. Circuit wiring diagrams commonly called circuit drawings, are prepared by the Western Electric Company from Laboratories' schematic drawings. The circuits usually are assigned in the T-series of numbers using the base number of the schematic plus a two digit suffix as illustrated in the above examples on numbering. Circuits show the apparatus conventions, the relative locations of all terminals, and the size, color and pairing of leads. They are used to facilitate the manufacture of local cables and the soldering of apparatus. Several drawings may be required to show the complete circuit covered by one schematic.

The circuit is arranged in one or more complete divisions, each of which is assigned a numbered figure. The main figure is designated "Figure 1" in all cases. Lettered figures include optional or variable wiring and apparatus which is supplementary to a numbered figure. A descriptive title is shown with the figure number such as "Relay Equipment," "Key Equipment," etc. Optional apparatus and optional wiring within a main figure are usually identified by the latter letters of the alphabet, such as "X" apparatus, "Y" wiring, etc. The association of all wiring diagram figures and options with schematic (SD-) figures and options are shown in a table.

Notes covering instructions and explanation of symbols used on the drawing are placed under the heading, "Information for Manufacturing Purposes." Other notes under the heading, "Information Not for Manufacturing Purposes," are for the convenience of the engineer and explain the application of the various figures, optional wiring and other information of an engineering nature.

When a series of wiring diagrams consist of three or more drawings, the engineering notes and instructions for the entire series are frequently placed on a separate drawing numbered in the same series with dash number -09. The engineer obtains all of his circuit information from one drawing, eliminating the necessity of looking over several wiring diagrams.

An apparatus, cable and wire list is commonly shown at the left of the drawing title and is designated "Apparatus Information - Not for Manufacturing Purposes." This list is for the convenience of the engineer in ordering the apparatus. He does not specify the list but uses it as a guide or check at the time of writing the summary of apparatus portion of his specification. However, some circuits lend themselves to placing an apparatus stocklist on the drawing which the engineer can specify thereby relieving him of the work of ordering all of the apparatus in detail in the specification he is preparing. These lists may be specified either in the standard specifications and drawings or in the job specification. A separate group is shown for each figure on the drawing.

The terminations of the individual leads in the local wiring or local cable, the local power cable and the connecting switchboard cables may be shown as connecting rack terminal punchings. These punchings are classified as "switchboard or frame punchings" which are represented on the circuit drawing by small circles 3/32" in diameter or as "miscellaneous punchings" which are represented by larger circles 5/32" in diameter. The punchings are identified by letters or numbers. The designations of switchboard or frame punchings are shown not only on the circuit and on the associated equipment drawing, but are stamped also on the equipment itself. Miscellaneous punchings are assigned in a group on the terminal strip, on which the terminals are numbered from 1 up. The terminal strip is stamped "Misc" and the miscellaneous punchings on the circuit drawing are numbered accordingly. This arrangement, however, is suitable only where there is no duplication of punching numbers in the group of circuits used. If the numbers do conflict then the lettered designations are used, the terminal strip is designated "Power" and a power punching list is furnished. The power punching list shows the lettered designations which appear on the circuit drawings and the corresponding punching numbers which are assigned on the equipment drawing.

Miscellaneous Drawings. A brief description of various miscellaneous drawings is given in Section 8 of this lesson under the title of "Glossary of Commonly Used Terms."

Ratings of Drawings and Specifications. Drawings and specifications prepared by the Laboratories for central office equipment are rated in accordance with a standard list of terms to indicate the extent to which any particular information may be applied on specific jobs. The various rating terms, their definitions and their restrictions are as follows:

Standard (Provisional Standard or A. T. & T. Co. Standard). Papers bearing this rating conform with standard practices and may be applied on central office equipment without authorization from the Laboratories.

Provisional. Papers bearing this rating are in the process of standardization and generally conform with existing standard practices. They are not to be applied on central office equipments unless approval is received from the Laboratories for each job application or unless they are listed on the standard keysheet.

Standard for A. & M. Only. Papers bearing this rating are associated with equipment which has been rated for "Additions and Maintenance Only" such as Panel Sender Selector Type Offices, Panel Ground Cut Off Relay Offices, Step-by-Step Line Switch Offices, #12 Local Test Desk,

No. 1 Toll Board, etc. The abbreviation, "Std.," indicates that the information is the latest available for such equipment. "A & M Only" drawings associated with "A & M Only" types of equipment should be considered as the standard drawings for this type of equipment unless the drawings are marked "Replaced."

A & M Only. Papers bearing this rating cover central office equipment which may not be the latest available. Drawings rated "A & M Only" should be used for equipping circuits previously wired per that drawing or for providing additional circuits which require both wiring and equipment.

Special. Papers bearing this rating cover certain special features on engineering requirements designed for a particular job or office, where standardization of the arrangement shown is not planned. Each job application of papers so rated requires a specific authorization from the Laboratories.

Preliminary. Papers rated "Preliminary" cover features that are in the early stages of development. They are generally used on trial installations and should not be used unless specifically authorized by the Laboratories.

Mfr. Disc. At the time that the rating of papers is changed to "M.D." or "Manufacture Discontinued," the tools for the construction and assembly of the associated equipment are usually destroyed. It is necessary to obtain recommendations from the Laboratories when a request for the new application of an "M.D." drawing arises. However, an "M.D." drawing may be used for equipping circuits previously wired per that drawing. The replacing drawings are used for providing any additional circuits which require both wiring and equipment.

A. & M. for Mfr. Disc. This rating is used when a new drawing is made from a Laboratories' Mfr. Disc. drawing for the purpose of modifying existing equipment.

Non-Associate. Papers rated in this manner are exclusively designed for a non-associate job or Telephone Company. Specific authorization is required for each job application of papers so rated except on additions where they have been previously used.

Information. Papers with this rating are issued exclusively for standard engineering information and are not usually specified for manufacturing or installation purposes.

With the exception of job equipment and wiring list drawings, all Western Electric Company's manufacturing drawings issued by the Equipment Departments are rated. The rating usually agrees with that shown on the corresponding Laboratories, A. T. & T. or Telephone Company drawing from which the manufacturing drawing was made. Occasionally, only a portion of a drawing is affected by a change in rating, in which case the drawing maintains its original rating but the affected part is covered by notes or other designations.

Information which is marked "Replaced" is no longer in good standing and should not be used under any circumstances. "Superseded" information may be used for replacements and additions to existing equipment with the approval of the Laboratories.

Classification of Changes on Laboratories Information. Equipment and circuit changes made by the Laboratories on existing information are classified to indicate their importance in regard to the extent to which the change shall be applied. These classifications are as follows:

Class "A". A class "A" change is one that is due to an electrically or mechanically inoperative condition or to a maintenance or traffic condition of major importance as a consequence of which the circuit or equipment will not operate satisfactorily, even temporarily. This change must be made before cutover and on every job where the circuit or equipment has been used. In general, there should be no cases where this class of change affects a job already cutover.

Class "AR." A class "AR" change is one that is due to an electrically or mechanically inoperative condition of minor importance or to an impractical maintenance, traffic or other non-commercial condition in any circuit or equipment. A class "AR" change will be made in every office where the drawing or specification has been used, but the change may be made after cutover if the turnover would otherwise be delayed.

Class "B." A class "B" change is one that is due to an important improvement in the design of the circuits, apparatus or equipment or some associated maintenance or traffic condition which, in general, is desirable on all jobs where it can be applied without delaying completion.

Class "D." A class "D" change is one that is due to an improvement in design or maintenance of circuits, apparatus or equipment, a change for record, or to care for routine conditions such as the replacement of worn tracings. This change will not affect work already done and will be made as soon as it appears to be desirable from an overall systems standpoint.

Classification of Changes on Western Electric Company Drawings (See Eng. H.B. Section 19). Changes on Western Electric Company drawings are made by means of Drawing Supplements and are classified as follows:

Class "A." This class covers changes to be made at once in all equipment in stock or in process of manufacture or installation.

Class "B." This is a change limited to affect equipment in process of manufacture or installation as specified on the supplement.

Class "B" Future. Changes to be applied immediately on new work are made by this class of change.

Class "C." Class "C" changes are used for test sets and tools where the change is to be made as soon as possible without incurring expense due to delays in delivery, or junking or conversion of equipment, parts or material.

Class "D." This is a change to affect new orders or for record only.

Class "E." This is used to change engineering information only.

Class "AD." This is a combination Class "A" and "D" change.

Keysheets. The Master Keysheet, SD-90250-01 lists the A. T. & T. Company's standard, provisional standard, standard and A & M only keysheets of the various systems of telephone and telegraph equipment. Keysheets rated "provisional" or "special" are not listed on the master keysheet.

Drawing Lists. All Laboratories' drawings available for distribution are numerically and topically listed in sections in the AA128.100 series of B.S.P.'s. Section AA128.101 is a master checking list, listing checking lists for drawings by systems or types of equipment.

Western Electric Company drawings are listed in the various files covered by later sections in this lesson.

SECTION 4. EQUIPMENT DEPARTMENT FORMS

Forms commonly used in the Equipment Engineering Departments in connection with the writing of job specifications consist of Specification Forms, Wiring List and Equipment Drawing Forms and Stationery Forms.

Specification Forms. These forms are originated and maintained by the Central Office Standards Engineering and Drafting Departments and are used by the line engineers and draftsmen in writing job specifications. The forms contain the general heading usually found in a specification, a list of the manufacturing "J" specifications, equipment and circuit drawings for the particular type of frame, desk or switchboard and a list of framework, apparatus and wired equipment commonly ordered. Supplementary sheets cover cabling information, information to other specifications and a requisition for the blueprints usually required in engineering the equipment covered by that particular specification.

For identification purposes the forms are numbered with the specification dash number, with or without a lettered suffix and with a prefix, "HEF." In case a specification form is common to more than one system, the first digit of the specification number is omitted. This digit, of course, is added by the line engineer to complete the specification number when the job order number is added. The prefix, "HEF," indicates "Hawthorne Engineering Form." The suffix identifies the particular form in cases where more than one form is available for the specification, due to variations in the type of equipment. The Equipment Engineering Handbook, Section 25, Supplement "B" lists the numbers of the various available forms and their associated titles.

Wiring List and Equipment Drawing Forms. The Central Office Standards Engineering and Drafting Departments and the Equipment Engineering Coordinating Department prepare and maintain forms for the guidance of the line engineer and draftsman in originating job wiring lists and job equipment drawings. These forms are identified usually by an H-drawing number which is listed in the engineering form for the associated equipment.

Stationery Forms. Numerous standard stationery forms for conducting the business of job engineering and job drafting are in common usage. The forms are identified in the EF- or ID- series of numbers and are listed in alphabetical order in Section 25 of the Equipment Engineering Handbook. The majority of these forms are available in the departmental stationery files although some of the less frequently used types may be held in the Engineering Files or in the Central Office Standards Engineering Departments.

SECTION 5. REFERENCE BOOKS

In addition to the volumes of "J" Specifications, "X" Specifications and "KS" Specifications which are available in each Engineering Department and in the Engineering Files, a number of other sources of information in the form of reference books are of use to the equipment engineer and draftsman.

Equipment Engineering Handbook. This handbook covers Equipment Department routines and other information commonly used in the process of engineering and drafting central office equipment. The information is arranged in sections according to the subject matter treated. Sections are numbered from 1 up for general information, 101 and up for specification information and from 201 up for drawing information. The general information sections are arranged in alphabetical order according to their respective titles. A Section "0" appearing in the front

of the Handbook is used to introduce new routines. After a routine becomes established it is condensed in form and transferred from Section 0 to its regular place in the Handbook. Handbook Section 3 is devoted to apparatus commonly used in all telephone systems, and is distributed to each engineer by the Clerical Service organization. The complete Handbook is distributed to all Equipment Engineers. An alphabetical index in the back of the Handbook provides a means for locating specific information.

Power Data Book. The Power Data Book is a compilation of power data sheets prepared by the Laboratories for the use of power engineers and draftsmen. The data sheets provide information for ordering and mounting power apparatus furnished by outside suppliers. The electrical characteristics and other engineering information is often included in the data sheets. These books are furnished and maintained by the Clerical Service organization.

Floor Plan Data Book. This data book is on file in each Engineering Department and is made up of sheets prepared by the Laboratories. The data sheets give standard frame sizes, floor conventions, standard aisle clearances, typical arrangements, etc. for all types of frames, switchboards, desks, relay racks, fuse boards, distributing frames, power apparatus, etc. These books are furnished and maintained by the Clerical Service organization.

Price Book. This book shows prices of telephone apparatus to Associated Companies and is often useful in deciding the economies of alternatives in engineering jobs involving re-arrangements. A copy of the price book is available in the Engineering Service Department.

Installers' Handbooks. The Installers' Handbooks are prepared by the General Installation Engineer's organization and cover installing practices on Central Office Equipment. A file of Installers' Handbooks is maintained in the Central Office Standards Engineering Departments.

Circuit Drafting Convention Book. The Circuit Drafting Convention Book covers conventions of various pieces of apparatus; the colors of leads and the assignment of standard colors to certain types of wiring, such as battery, ground and ringing; and typical arrangement, wiring, cabling and designation of various pieces of apparatus. This book is issued and kept up to date by the Standards Engineering and Drafting Departments.

Raw Material Handbook. This handbook lists raw material and the store-room carrying this material. It is issued by the Engineer of Manufacture organization and a copy is available in the Standards Engineering and Drafting Departments.

SECTION 6. FILES

Various files, consisting of direct information, indices and cross references are maintained for the engineer's and draftsman's uses in the line Engineering Departments, Central Office Standards Engineering Departments and Installation Service Clerical Department. Inasmuch as the value of any file may be measured by the extent to which the file is used, it should become the purpose of each engineer and draftsman to become thoroughly familiar with each of these files. A knowledge of the type of information provided will result in their more frequent use and a definite savings in time required to answer any current problems.

Apparatus Card Catalogue (Line Engineering & Standards Files) This catalogue consists of a file of apparatus cards which are published by the Bell Telephone Laboratories and which show the codes of telephone apparatus, general electrical and mechanical characteristics, mounting information, ordering information and rating of apparatus. The cards are filed alphabetically by types of apparatus and numerically within each type. Several of these files are maintained in condensed form in convenient locations throughout the engineering and drafting departments. A complete or master file is maintained in the Standards Engineering Departments. The apparatus codes regularly used are shown on white cards and are rated as follows:

A. T. & T. Co. Std.	Approved apparatus usually carried in stock.
A. T. & T. Co. Spl.	Approved under special conditions and may or may not be carried in stock depending on the demand.
W. E. Co. Stock	Not approved but will furnish.
A. & M.	For additions and maintenance. Usually not used on new equipment but may be furnished on existing equipments.
Mfg. Disc.	Manufacturing discontinued. A replacing code is usually shown.

The master file contains several other colors of cards in addition to the white cards normally contained in the regular files. Yellow cards cover associate or non-associate apparatus codes which are not yet standardized and which are not to be used unless the card is stamped, "O.K. to Use." Pink cards cover non-associate apparatus and are rated as "Distributor Standard" or "Distributor A. & M. Only." Green cards are issued by the Merchandise Department to indicate the status of the apparatus. If new codes are assigned or if present apparatus is changed in design, the green card will show the dates when tool made samples will be ready, when the apparatus will be ready for regular manufacture and when the apparatus may be shipped on equipment orders and on customers' orders. If the apparatus rating is changed to A. & M. or M.D., the green card will show the reason for the change and the replacing information.

Issue Files (Clerical File). A numerical record of all standard and job drawings is maintained in this file. Information which the engineer and draftsman may obtain either by telephone or by counter service, consists of the latest issue number of drawings, classification of supplement on previous issues, initials and department number of person who originated the supplement, list of jobs on which drawing has been used, whether tracing is "in" or "not in" the vault, and the date tracing was sent to the vault.

In this file is also maintained a record, by job order number, of specifications and appendices originated and dates of delivery to the shop. The record is divided into live orders which are filed in the "Black Books" and into final billed orders.

A. T. & T. Topical & Numerical File (Clerical File). This is a topical and numerical loose leaf file of all types of equipment and lists the A. T. & T. Company papers consisting of specifications, bulletins, letters and circulars relating to each type. The file is divided into two main sections, namely, Plant Engineering and Plant Operation. The types of papers shown are identified as G.E.C. (General Engineering Circular), P.E.C. (Plant Engineering Circular), P.E.L. (Plant Engineering Letter), P.E.M. (Plant Engineering Memorandum), P.O.C. (Plant Operation Circular), P.O.L. (Plant Operation Letter), T.C. (Traffic Circular), T.L. (Traffic Letter),

C.B. (Commercial Bulletin), C.C. (Commercial Circular), C.L. (Commercial Letter), General Letters, Specifications and Bulletins. A partial topical list of the above is kept in the Engineering Coordinating Department.

Numerical Card File of Laboratories Specifications (Line Engineering File). This card file identifies the title of the various laboratories specifications in the following series: KS-Specs., B.S.P.'s, J-Specs., Engineering Requirement X-Specs., and Equipment Requirement X-Specs.

Numerical Card File of Equipment Drawings (Line Engineering File). This is a card file of Laboratories equipment ED- and ES- drawings (shown on blue cards) and the associated Western Electric Company ED-, H-, J-, and T-drawings (shown on white cards) for Dial System equipments. Another portion of this card file shows the Hawthorne "H" and J-Specification drawings arranged in numerical order.

ES- & SD-Dial Circuits - Numerical Loose Leaf File (Line Engineering File). This loose leaf file is arranged numerically in accordance with the Laboratories schematic drawing numbers which are placed on blue sheets. Following each ES- or SD-drawing record are placed buff colored sheets showing the Western Electric Company T-drawing circuits made therefrom. Salmon colored sheets cover temporary records for T-drawings to show that manufacturing drawings are being made. At one time the Step-by-Step drawing records were colored Goldenrod and Gray for the SD- and T-drawings respectively. Some of these latter colors are still in file. The information shown on the drawing records includes the title, rating, schematic drawing and reference drawing if any.

Dial T-Drawing Circuits - Numerical Loose Leaf File (Line Engineering File). Old five digit and six digit T-drawing circuits and a few A- and H-drawing circuits are arranged numerically in this file. The information shown for each drawing is similar to that described above. (Not kept up to date)

Telephone Company Circuits - Loose Leaf File (Line Engineering File). This file contains a list of A. T. & T. Company and Associated Bell System Telephone Company circuits used in equipment engineering or in installation. The file is arranged by Telephone Companies and numerically within each Company's list. (Not kept up to date)

A. E. Co. Circuits - Numerical Loose Leaf File (Line Engineering File). A numerical list of Automatic Electric Company circuit drawings and associated circuit titles is contained in this file. (Not kept up to date)

Master File on N.D.D.'s (Line Engineering File). New Development Descriptions are issued to describe new types of equipment. In addition to a general description, the N.D.D. includes a list of new drawings and dates available, a list of replaced drawings and associated ratings, list of unapproved apparatus, outside suppliers' apparatus and first job application. The N.D.D.'s are kept for a period of 15 years after publication and are arranged in five volumes, namely, Panel Equipment, Step-by-Step Equipment, Crossbar Equipment, P.B.X., Power and Common Equipment, and Kearny Equipment.

Job Card Files (Line Engineering File). This file contains an index of job information arranged by town and office. The index cards include the Telephone Company job specification numbers, Telephone Company job drawing numbers, Western Electric Company order and specification numbers, Western Electric Company job drawing numbers and the drawing numbers of the Architect's Plans.

Telephone Company Specifications and Drawings - Numerical Card Files (Line Engineering File). The cards in this file are arranged alphabetically according to the Telephone Company and numerically for each Company.

Numerical Base Number - Card File (Line Engineering File). Job drawing base numbers are arranged numerically in this file. The cards identify the town and office for which the base number had been assigned.

Schematic Drawing, Circuit Description, Equipment Drawing and Equipment Explanation Files (Line Engineering File). This file located adjacent to the Job Card Files contains copies of the Laboratories SD- and ED- drawings and the associated CD- and EE- sheets for Dial System and Common Equipments. The file is maintained for the engineer's and draftsman's immediate reference and accordingly the drawings are not to be removed unless re-ordered at the time of removal.

Six digit ES- circuit prints and six digit ES- equipment prints are included in this file also.

Specification Files (Clerical File). This file contains a copy of Telephone Company job specifications; Telephone Company general and job drawings; Western Electric Company job specifications, including 9600 orders; standard specifications in the J-, X-, KS-, and C- Specification series and D specifications. After a particular order is final billed, Panel and Crossbar Systems job specifications are maintained in file by order and specification number and Step-by-Step System job specifications are placed in final billed volumes as outlined in the Equipment Engineering Handbook Section 39, Part 1.

Job Correspondence Files (Clerical File). Copies of all incoming and outgoing letters and telegrams written in connection with a particular office are filed according to town and office, order number and date. Correspondence with the Telephone Company and with the Laboratories is filed in a "General" folder. That with the installer in regard to job questions is filed in a "J.I.M." folder. Correspondence relating to several offices in the same city is filed in a "City Folder" such as, "New York City - General." General correspondence with a Telephone Company is filed in a "Telephone Company Folder" such as, "New York Telephone Company - General."

General Correspondence Files (Clerical File). Folders containing correspondence with the Laboratories on general engineering items are maintained. The questions discussed are usually handled by the Standards Engineering and Drafting Departments. These folders are identified by a File Number as outlined in the Equipment Engineering Handbook Section 39, Part 2.

A. T. & T. Company Paper File (Clerical File). Within this file are contained copies of the A. T. & T. Company bulletins, letters, circulars, etc. These papers are identified by code letter and serial number such as P.E.L., P.E.M., G.E.C., etc., as outlined above under "A. T. & T. Co. Topical File."

Terminal Assignment Lists (Clerical File). These are power punching lists of local power cable distributing power terminal strips (D.P.T.S.)

Power Calculation File (Clerical File). Power plant calculations, as prepared by the power engineer and upon which the sizes and capacities of various component parts of the power plant are based, are kept in file according to the town and office of the particular job.

Specification Form Files (Standards Engineering File). "HEF" forms to be used by engineers for writing various specifications.

Tracing Form Files (Line Drafting File). A supply of tracing forms used by the draftsman in preparing job circuits, floor plans and equipment drawings are contained herein.

Stationery Files (Engineering Service File). Stationery forms and supplies required by the engineer and drafstman are contained herein.

File of Job Correspondence with the Bell Telephone Laboratories (Engineering Coordinating File). This is a file maintained by the Engineering Coordination organization and consists of job recommendations in the form of letters and telegrams from the Laboratories covering special job conditions. These files may be consulted by the line engineers encountering special conditions which may possibly have arisen on other jobs and the information may be used as a basis for proceeding, although usually specific recommendations for the particular condition and job are obtained from the Laboratories. The correspondence is filed on a topical basis. A folder of A. E. Co. circuit conversion information is also available for reference.

The services of a Power General Analyzer, Step-by-Step General Analyzer, Panel General Analyzer and Cable General Analyzer are available for consultations on these files or on any job question which may arise.

SECTION 7. JOB INFORMATION

Tools and information used by the equipment engineer and draftsman as outlined in the above sections were those of a general nature and were adapable to every job. The specific information for the particular job, however, is furnished in the Telephone Company's job specification, associated drawings and correspondence, and in the detailed job analysis.

Telephone Company Specification and Drawings. The Telephone Company's job specification is prepared by the Telephone Company's Equipment Engineering Department for each central office order and covers in a general manner the equipment required. The quantity of each type of frame, the quantity of circuits (where the number is optional), circuit features required (where the circuits list optional features) and the list of associated drawings are included in these specifications. The specifications are prepared from traffic data received from the Telephone Company's Traffic Department and follow the general form of a questionnaire. This questionnaire is prepared by the Bell Telephone Laboratories and shows the form in which the information is to be given to the Western Electric Company so that detailed engineering may proceed in an orderly manner.

Telephone Company floor plans, and in some cases equipment drawings, show the desired arrangement of equipment and form an important part of the job information used by the Western Electric Company's equipment engineer and draftsman. Architect's plans, where a new building or an addition to an existing building is involved, form a very vital part of the information also. Such information as column sizes, wall thicknesses, ceiling heights, cable hole locations, interference of building piping and equipment, etc., is obtained from the Architect's plans, from which exact equipment locations may be determined. Appendices to the Telephone Company's specification and letters of correspondence frequently make additions or changes in the original plans, and therefore form an important link in the completion of the job. Thus the Telephone Company's information together with Laboratories J- and X-specifications, and the engineering notes on circuit T-drawings, J-drawings and HEF-forms, supply the Western Electric Company engineer with sufficient information for determining the job equipment requirements.

Job Keysheet. The Western Electric Company's equipment engineer prepares the job keysheet when required to show the Laboratories SD-schematic drawings required to meet the traffic requirements for the job. An interconnection plan for the various schematics is also shown. From this keysheet the line engineer may determine the corresponding Western Electric Company circuit wiring diagrams required for his portion of job. If a job keysheet is not made or has not been completed at the time of detailed engineering, the analyzer's marked copy of the Telephone Company's specification and the standard keysheet may be referred to.

Job Traffic Schematic. In some cases the Telephone Company's job traffic schematic is used directly by the line engineer without the preparation of a corresponding Western Electric Company traffic schematic. In either case the traffic schematic shows the routing of traffic through the various frames and becomes useful for determining the cabling in the office.

Job Floor Plans. The Western Electric Company floor plans for the particular office are prepared from the Telephone Company's study plans and Architect's plans. The floor plans show the frame, switchboard, desk, relay rack, fuse board, power plant, and distributing frame locations, size, and numbering, together with motor (Panel System), aisle pilot, distributing terminal strip and fuse holder locations. These become useful especially in regard to the direction of growth for various lineups of equipments.

Job Layout Sketch. This is sometimes prepared by the engineering analyzer to show the specifications to be written for a particular job, the time they are due to the checker and typist, and the engineers assigned to each. Also, listed on this sketch are the numbers of the Telephone Company's specification, the job base number, job analysis drawings (keysheet, floor plans and traffic schematic), and sometimes a recommended similar job for reference purposes. The job shipping date may also appear on this layout.

Job Folder. This folder is made up by the Department Clerk or analyzer at the start of the job and contains copies of incoming and outgoing correspondence, cabling information, information to other specifications and other information and papers peculiar to the particular job.

Western Electric Company Job Specifications and Job Drawings. Specifications and drawings issued toward the latter part of the engineering interval often require that the engineer and draftsman make use of those issued in the earlier stages. In some cases where required job drawings have not been completed, reference is made to the engineer's original marked drawings, or information is obtained directly from the engineer involved.

SECTION 8. GLOSSARY OF COMMONLY USED TERMS ASSOCIATED WITH EQUIPMENT SPECIFICATIONS AND DRAWINGS

APPENDIX - Supplementary information to a job, standard or Telephone Company's specification which changes the original information.

A & M - A rating for drawings to be used for "Additions and Maintenance Only."

BLUE LINE PRINT - A white print with blue lines made from a vandyke.

BLUEPRINT - A blue print with white lines made from a tracing.

B. T. SHEETS - A common name for method of operation sheets.

BULK CABLE - Lengths of switchboard cable which are shipped from the factory unformed.

CARD CATALOGUE - Cards furnishing a description of coded apparatus. Issued by the Bell Telephone Laboratories.

C. C. - Abbreviation for "Customer's Change" before contract.

C. D. - Abbreviation for "Circuit Description."

CHANGE IN SCHEDULE - A paper originated by the Equipment Department changing the dates when job drawings and specifications are due the Manufacturing Department.

CHANGE NOTICE - A paper issued by the Equipment Department to the installation field for the purpose of coordinating all information required for making changes which affect several jobs in the process of installation.

CIRCUIT CONVENTION BOOK - A book containing information as follows for the preparation of wiring diagrams: (a) conventions of various pieces of apparatus, (b) the colors of leads and the assignment of standard colors to certain types of wiring such as battery, ground and ringing.

CIRCUIT DESCRIPTION - A paper issued by the Bell Telephone Laboratories describing the operation of a particular circuit and which also provides a record of the circuit changes.

CIRCUIT REQUIREMENT TABLE - That part of a Bell Telephone Laboratories circuit drawing which contains the current flow adjustments required for the maintenance of a circuit.

CLASS NON-X MATERIAL - That which is shipped to the Installer either as an assembled unit (wired equipment) or as a loose item (piece part, item of apparatus, etc.)

CLASS X MATERIAL - The component apparatus and material used by the shop to produce the wired and assembled units ordered in job specifications.

COMPLAINT - Questions raised by the Manufacturing Department regarding difficulties encountered in manufacturing equipment in accordance with the switchboard specifications and drawings.

C. N. - An abbreviation for equipment change notice.

CUSTOMER'S CHANGE - A term used when referring to a change which the Telephone Company requests in one of its job orders.

DRAWINGS - LETTER PREFIX USED IN DESIGNATING GENERAL GROUPS OF DRAWINGS

"A" DRAWING - A series of drawings covering standard switchboard equipment. Replaced by the "ED" series for new drawings.

"ED" DRAWING - A series of standard drawings covering all types of switchboard framework and equipment.

"ES" DRAWING - An older series of Bell Telephone Laboratories' drawings covering circuits, framework and equipment. Replaced by SD-circuit schematic drawings and ED-framework and equipment drawings on new developments.

"H" DRAWING - A series of standard drawings covering all types of switchboard framework and equipment and modification drawings. Replaced by the "ED" series for drawings made from Bell Telephone Laboratories' drawings.

"ITD" DRAWING - Drawings covering manufacturing information for installer's test sets.

"J" DRAWING - Specifications for standard units of equipment prepared in drawing form.

"LC" DRAWING - Standard or job local cable design drawings.

"M" DRAWING - Drawings covering standard moldings used on switchboards and desks. This drawing series is obsolete. Being replaced by "P" drawings.

"P" DRAWING - Drawings for switchboard piece parts. They may show either a single piece or several pieces assembled and carried in stock as one part.

"SD" DRAWING - Bell Telephone Laboratories' circuit drawings, called "schematics".

"SRT" DRAWING - Drawings covering information for connecting and soldering apparatus shown on manufacturing circuit drawings.

"T" DRAWING - A series covering all circuit drawings, job drawings and old standard framework drawings. New standard framework drawings are issued in the "ED" series.

"WRT" DRAWING - Drawings covering a list of wires with their terminating points, grouped by size and color. They are used in the making of local cables. Use same base number as associated circuit wiring diagram.

"WRED" DRAWING - Similar to a "WRT" drawing except for circuit wiring diagrams made on an "ED" combined wiring and equipment drawing basis.

TYPES OF DRAWINGS

ASSEMBLY DRAWING - A drawing covering the design of framework units and includes a stocklist of all parts required for assembly. (ED Series)

CIRCUIT SCHEMATIC - A circuit drawing prepared in one of its simplest forms to facilitate tracing its operation. (SD Series)

DETAIL DRAWING - Drawings showing manufacturing information for individual parts of a framework assembly.

JOB DRAWING - Drawings showing equipment arrangements for a specific central office. (T Series)

LOCAL CABLE DESIGN DRAWING - Same as "LC" drawing.

PIECE PART DRAWING - Drawings showing manufacturing information for individual parts of an equipment assembly where the part is used in sufficient quantities to justify stocking, as well as the preparation of permanent tools. (P Series)

SPECIFICATION DRAWING - Same as "J" drawing.

WIRING DIAGRAM DRAWING - A circuit drawing which shows the colors, size, and terminating points of leads and shows the associated apparatus in such conventional form as to facilitate soldering and wiring. (T Series) (Occasionally in the ED Series).

WIRING LIST DRAWING - A job drawing listing the circuits specified for a particular central office. (T Series)

WIRING RECORD DRAWING - Same as "WRT" drawing.

DRAWING ORDER - A paper issued by the engineer to convey information to the draftsman relative to the preparation of a drawing.

E.F. or H.E.F. FORM - Common term for specification form. Formerly identified as I.D. or H.I.D. form.

EQUIPMENT ENGINEERING HANDBOOK - A book covering routines, methods and practices used by the equipment engineers and draftsmen in performing equipment engineering work.

FACTORY CABLE - Formed switchboard cable which is soldered to jacks, lamps, keys, etc., in the shop.

FLOOR PLAN DATA SHEETS - Information issued by the Bell Telephone Laboratories showing standard dimensions used in locating equipment on floor plans.

FORMED CABLE - Switchboard cable which is stripped, butted, formed and sewed in the shop.

FUSE BOARD RECORD SHEETS - Papers showing the fuse assignments on double row fuse panels.

GENERAL ENGINEERING CIRCULAR - A numbered series of papers abbreviated "GEC" formerly issued by the A. T. & T. Company on engineering matters. Replaced by "Plant Engineering Circulars" and "Plant Engineering Letters."

HOLD, RELEASE OR CANCELLATION - An authorization issued by the Equipment Department to hold, release or cancel engineering or shop work on switchboard orders.

INTERVAL CHARTS - Charts covering standard engineering, manufacturing and shipping intervals for equipment specified on switchboard orders.

ISSUE FILE - A file containing a record of the latest issue of all drawings, method of operation sheets, and circuit descriptions with a record of the jobs on which the drawings are used.

J. I. M. - An abbreviation for "Job Information Memorandum."

JOB INFORMATION MEMORANDUM - A paper issued by the installer requesting additional information required on the installation of the job.

LOCAL CABLE - A cable which is made by hand and used for interconnecting apparatus within a unit of equipment.

LOCAL POWER CABLE - A hand made cable for interconnecting apparatus in a single lineup of frame, desks or switchboards. (Being replaced by switchboard cable.)

METHOD OF OPERATION SHEETS - These papers describe the operation of circuits. Now obsolete, replaced by "Circuit Descriptions."

MFR. DISC. - A rating for drawings not to be used.

NEW DEVELOPMENT DESCRIPTION - A paper issued by the standards engineers as an advance notice to the Merchandise and Manufacturing Departments that it will be necessary to manufacture a new type of equipment. This paper describes the type of equipment, shows the probable annual demand, its effect on present equipment, and a list of the associated drawings and specifications.

N.D.D. - Abbreviation for "New Development Description."

PERIODIC CHANGES - This is a term used to identify a system which requires that changes on certain types of equipment be made periodically, usually once a year.

PLANT ENGINEERING CIRCULAR - A numbered series of papers, abbreviated "PEC" issued to the operating companies by the A. T. & T. Company, covering engineering matters of major importance.

PLANT ENGINEERING LETTER - A numbered series of papers abbreviated "PEL" issued to operating companies by the A. T. & T. Company, covering engineering matters of minor importance or of a less permanent nature.

POWER DATA SHEETS - Engineering data on power apparatus and supplies furnished by outside manufacturers issued by the Bell Telephone Laboratories.

POWER PUNCHING LIST - An assignment list for associating numbered punchings on a power terminal strip with those leads on a circuit drawing which are shown terminating at power punchings and which have designations which cannot be stamped on the terminal strip so as to be legible for maintenance purposes.

QUESTIONNAIRE - Forms issued by the Bell Telephone Laboratories for the guidance of the Telephone Companies in writing Telephone Company specifications. These forms indicate the information required by the Equipment Departments in order to engineer the equipment and provide uniformity in the information received from various Telephone Companies.

REQUISITION - A form used for ordering material on an emergency basis for use in connection with equipment in the hands of the installer.

RETURNED GOODS MEMORANDUM - A form issued by the installer on which he lists excess material returned to the factory.

REMARK SHEET - A paper which lists the wiring record and local cable design drawings required in making a local cable. Identified by the prefix "RS" followed by the job order number, specification number and shop order dash number assigned to the local cable.

REPRODUCED TRACING - A reproduction of a tracing made on tracing cloth by photographic processes and is suitable for use as a duplicate of the original.

S.A. - An abbreviation for "Supplemental Authorization" or customer's change after contract.

SCHEDULE - A paper issued by the Equipment Department showing the dates when job specifications and drawings are due the Manufacturing Department.

SCHEMATIC - See "Circuit Schematic."

SPECIFICATIONS

D-SPECIFICATION - Specification issued for the purpose of furnishing manufacturing information on special apparatus which is designed to care for conditions which cannot be met by existing standard apparatus.

ITE SPECIFICATIONS - Specifications covering the manufacture of installer's test sets.

JOB SPECIFICATION - Specifications covering manufacturing and installing information for a specific central office.

KS SPECIFICATION - Specifications issued by the Bell Telephone Laboratories covering engineering requirements manufactured by outside suppliers.

STANDARD EQUIPMENT SPECIFICATION - Specifications covering information for the manufacture of standard units of equipment commonly known as J-specifications.

X SPECIFICATIONS - Issued by the Bell Telephone Laboratories to cover specific or general engineering requirements.

SUMMARY OF APPARATUS - This is that part of a job specification which lists the apparatus and equipment.

SUPPLEMENT - Papers issued by the equipment engineer which cover information to the Drafting Department for making changes on drawings. Supplements designated class "A" or "B" authorize the shop and field to make changes on equipment in process of manufacture or installation.

SWITCHBOARD CABLE - A number of insulated wires made up into a cable by machine and covered with a braided textile covering.

TEMPORARY INFORMATION MEMORANDUM - A paper issued as an authorization for a limited time permitting the shop or installer to deviate from standard requirements in the manufacturing or installing of equipment.

T.I.M. - An abbreviation for "Temporary Information Memorandum."

TRAFFIC CIRCULAR - A numbered series of papers, abbreviated "TC," issued to the operating companies by the A. T. & T. Company, covering traffic matters of major importance.

TRAFFIC LETTER - A numbered series of papers issued to the operating companies by the A. T. & T. Company, covering traffic matters of minor importance or of less permanent nature.

VANDYKE - A transparent negative print of a tracing from which blue line prints are made.

Western Electric Company, Inc.
Hawthorne Works
Personnel Service Branch
Training Department

Telephone Systems Training
Course: Equipment Branch Practices

Lesson No. 5

PROCEDURES FOR WRITING JOB SPECIFICATIONS

This lesson is issued to describe the general features of writing a job specification. Several items are duplications of what has been covered before, but are repeated in an effort to make this lesson a unit in itself.

Information contained herein is to be used for training purposes only, and is not intended to prescribe methods or to replace or supplement existing instructions in the Equipment Engineering Department.

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BIBLIOGRAPHY

Bell System Publications
Equipment Engineering Guide (Manual)
Equipment Engineering Handbook

PREFACE

Accuracy, thoroughness, efficiency, and the personal satisfaction of doing a good job are the essential factors in establishing a high standard of engineering performance. With the increase in complexity of equipment engineering, it has become apparent that a definite system of engineering procedure is necessary to assist in realizing the desired performance. To meet this need, the plan covered herein has been prepared.

Even when a definite system of procedure is conscientiously applied, the general engineering responsibilities are such as to require logical and consistent thought throughout the process of the work. To be of maximum assistance the application of this plan must be habitual, thus permitting full consideration of the real engineering problems.

The following description of engineering procedures is only general in nature. Practical everyday engineering activities deal with individualized and unique situations which are never exactly duplicable and of which, accordingly, no complete description is possible.

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SECTION 1. JOB ANALYSIS

1. Analysis of the Job by the Equipment Engineer (Analyzer)

The action in the equipment department starts with the receipt of the job by the equipment engineer , who, based on the study of the Telephone Company's specification, associated drawings, and any supplemental information which he may have received, determines what is to be furnished on the job and prepares the following information:

a - Originates a keysheet when required showing the Bell Laboratories' circuits (SD's) required to meet the traffic requirements of the job, and the interconnection of the circuits.

b - Lays out a traffic schematic which shows a functional layout and interconnection of the various frames which make up the traffic channels and the main associated equipment.

c - Together with the cabling and power engineer directs the preparation of the floor plans.

d - Starts a Job Folder for the purpose of eliminating the loss or misplacement of information papers received with the telephone company's specification and to establish a definite place for the engineer's copy of all future correspondence, memoranda, and information to and from other organizations. In its preparation, all papers should be arranged in an orderly manner to facilitate reference to any desired information and the folder designated to distinguish it from those folders that have been prepared on other active orders. Original copies of all correspondence received with the job should not be filed in this job folder but should be routed to all other organizations affected and then filed in the regular correspondence folder. (Clerical file.)

Provision should be made in the job folder for recording, from time to time, those items on which action cannot be completed on schedule, the reason why they can't be taken care of, and the probable completion date.

e - Issues the engineering and manufacturing schedule.

f - Issues recommendations covering the provision of any special features. In case the equipment engineer is not in a position to provide this information, he will refer the question to the Bell Laboratories.

g - In case information required in determining what to furnish on the job is lacking in the customer's specification, the equipment engineer obtains this information from the Telephone Company.

h - Determines whether all the necessary connecting circuits have been specified in the telephone company's specification and whether the operating features are satisfactory.

j - Guides and coordinates the different phases of the job. At the time the job is planned, consideration should be given to its possible relationship to other jobs. In case the job is part of a project, the job completion date should be checked against the overall completion date of the entire project, and the type of equipment being furnished should be studied to insure its conformance to the type of equipment being furnished on the other jobs in the project.

k - On a combination job, consideration must be given to the interchange of engineering information between plants, the overall completion date, the necessary connections including tie cables between offices, the general cabling scheme, the power requirements, and to the possibility of interference of frame and rack equipment locations.

l - With regard to other jobs which may be in process for the same office, a check should be made for interference of equipment locations and other possible installation difficulties that may be encountered due to modifications or relocations.

2. Preliminary Survey by the Engineer

In starting the engineering of any job, a general understanding of the character and the scope of the work involved should be obtained. This is secured by carefully reading through the entire telephone company's specification, all correspondence, and the equipment engineer's recommendations and by studying the traffic schematic, keysheet, floor plans, schedule sheets and all other papers pertaining to the job, to determine what is to be furnished what is the function of the equipment, how the equipment will fulfill the general traffic features, the arrangement of the present and additional equipment, and how it will be installed.

During this preliminary survey, all essential information papers that should accompany the customers' specification are determined and the necessary steps taken to procure those that have not been received.

In case new or unfamiliar equipment is ordered, reference should be made to the general engineering circulars and new development descriptions (NDD) covering this particular type of equipment.

3. Office Records and Working Papers

After becoming acquainted with the general requirements of the job, the necessary office records, such as previous specifications and equipment drawings, are ordered. The working papers consisting of specifications, drawings and editing forms should be obtained as completely as possible at this time, although it may be necessary to order additional papers in the course of the analysis and planning of the job.

4. Detailed Engineering Analysis

In addition to the study made by the equipment engineer for the purpose of determining what to furnish, it is necessary for the engineer to analyze the details of the job to determine how to properly provide the required equipment. This detailed analysis of the job, by the engineer, is a fundamental pre-requisite to efficient engineering.

In this analysis, the customer's specification is studied to determine the items of equipment that are to be furnished, and their relationship to the present office equipment and to others portions of the order. Consideration should be given at this time to any framework requirements that affect equipment capacities. Some conception of the traffic features of a circuit will greatly aid in its application. This information may be secured from the Bell Laboratory schematic and the associated circuit description. It is also advisable to study the Bell Laboratory Information Specification covering the equipment involved.

Information concerning the application of standard circuits or equipment should be obtained from the equipment engineer, whereas, it is a function of the practice engineer to furnish the general interpretation of standard circuits and equipment arrangements as provided for on the standard equipment drawings.

It is desirable that a detailed analysis of one circuit be made and followed through to the completion of the specifications and drawing information covering that phase of the work before making the detailed analysis on another circuit.

5. Planning

Having determined what equipment is required and how it will be provided, it is essentail that a forward view be taken of the engineering, manufacturing and installation effort required on the job. The future progress of the engineering work is visualized to determine whether any interruptions or delays will be encountered due to lack of or faulty engineering information. This visualization of the engineering work should disclose any points which may need to be referred to the telephone company or other organizations for their approval, and which would otherwise delay the progress of the engineering. The planning of the manufacturing and installation work involves the fitting together of the various items of equipment, as well as determining whether the job as a whole is so arranged that all phases of it may progress in an orderly and efficient manner.

Any questions concerning the engineering of a job or questions of procedure may be freely discussed with the verification engineer who is the engineer's immediate supervisor and, as checker, must approve the completed longhand specifications before their release.

6. Summary

As all other engineering operations are based on the Job Analysis, it is essential that this function be performed thoroughly and accurately to secure a clear understanding of the job, a knowledge of what equipment is required, and a plan for providing it. The necessary working papers and forms should be on hand and all questionable points, which can be foreseen, should be taken up with the telephone company in order to avoid any delay when preparation of the job specification is begun.

SECTION 2. JOB PREPARATION

1. Sequence of General Engineering Operations

To insure accuracy and completeness in the preparation of the job specifications and drawings, a definite sequence in performing the general engineering operations is essential. The extent of the various operations will depend on whether standard equipment may be specified, or whether the job must be built up on a detailed basis.

The following is the sequence of the general engineering operations:

a - Selection of lists from standard specification drawings)
b - Preparation of the wiring list)
c - Location of circuit apparatus) applied successively for each wiring list item.
d - Ordering of circuit apparatus)
e - Preparation of cabling information)
f - Editing of miscellaneous information)
g - Locating and ordering of framework and non-circuit apparatus
h - Listing of drawings
j - Completion of longhand specification

The above sequence is applicable in most cases; however, when standard specification drawings are not used, the sequence should start with Item b.

2. Job Progress Indicator

In order to maintain a definite sequence, it is essential that a means of indicating the progress and completeness of each of the engineering operations directly associated with each item in the job wiring list be used. Each experienced engineer has his own method of proceeding with spec. writing, but in general, all these methods cover the same items. However, until an engineer has adopted an efficient method of his own for writing a spec., the following method is suggested. In the suggested method the completion of each operation for a particular item is indicated by placing a character opposite this item in the wiring list.

The characters used are as follows:

✓ - Indicates that the circuit meets the job requirements
L - Indicates that the circuit apparatus has been located
O - Indicates that the circuit apparatus has been ordered
C - Indicates that the cabling information has been written
M - Indicates that the miscellaneous information has been edited
/ - Indicates that the circuit drawing has been listed.

When a circuit is found which meets the job requirements, the wiring list is prepared and the item designated by a check mark. Then the other operations are applied successively to this item and the completion of each operation indicated by placing the associated character, that is, L for locating, O for ordering, etc., on the check mark.

The completion of all operations for a particular wiring list item is indicated by ✓LOCM, which is termed the Job Progress Indicator.

In case no action is required for a particular operation, the associated character is shown in the regular manner, indicating that the necessary consideration has been given.

3. Status of Items in Telephone Company Specification

As an assurance that all portions of the telephone company's specification have been considered and the necessary action taken, and as a means of indicating the authorization for any deviations, the following plan is suggested.

The completion of the action required in connection with each paragraph, item, note, or section of the telephone company's specification is indicated by the placing of a check mark before that individual portion in the telephone company's specification.

Notations of changes in the telephone company's specification are made opposite the particular portions affected, indicating the letter, appendix, or other authority for the change.

Explanatory notes covering engineering procedure which require the telephone company's approval are made on the back of the page opposite the questionable portions in the telephone company's specification. In general, items of this kind and also confirmations of verbal information, should be referred to the telephone company, at the time the engineering of the job specifications affected is completed. By the time the last specification has been completed, all questionable items should have been referred.

4. Selection of J Drawing Lists

On job specifications for equipment covered by J specifications, after the proper J specifications are determined, they should be analyzed by the engineer to determine what lists are required for the job. The drawing can be used as a work sheet for this purpose, checking the required

list, indicating quantity and other pertinent information and crossing out the lists not required. The information can then be transferred to the wiring list drawing and specification HEF form.

Do not duplicate wiring lists of standard equipment specifications in the job specification wiring list. The installer will complete all outside of section wiring shown on the figures covered by J spec lists. However, outside of section wiring shown on separate figures or on wiring diagrams not listed on the J drawing, but required in connection with it shall be ordered in the job specification wiring list on additions to existing jobs.

5. Preparation of the Job Wiring List

It is of utmost importance that the wiring list be prepared thoroughly and accurately, in order to minimize the necessity of alterations in it at a later stage in the preparation of the specification. The wiring list for any one circuit should be completely prepared before proceeding with any other engineering operations applying to this equipment. The following procedure is essential in connection with each of the various circuits to be used in the preparation of the wiring list.

a. Selection of the Circuits

When unit equipment on a J-drawing is used, the required circuits are obtained from the J-drawing as explained in paragraph 4.

For a job or portion of a job that must be built up on a detailed basis, the selection of the circuits is made from the schematic recommendations on the job keysheet or from the equipment engineer's marked copy of the Telephone Company's specification. A careful reading of the titles of the corresponding T-drawings will aid in determining the particular circuit which will fulfill the specific job needs. (Engineering SD File). The ED card file (Line Engineering File) lists the J-drawings, if any, which are made from the Bell Laboratories' ED-drawings. The proper HEF specification form lists the standard drawings to be used.

b. Analysis of "Notes not for Manufacturing Purposes"

Having selected the circuit to be used, it is important that a careful analysis be made of all notes on the circuit drawing. Those notes that have a bearing on the application of the circuit to the job should be designated by placing a check mark opposite them. Notes that do not apply to the job should be indicated by a cross mark.

c. Selection of Figures and Optional Wiring

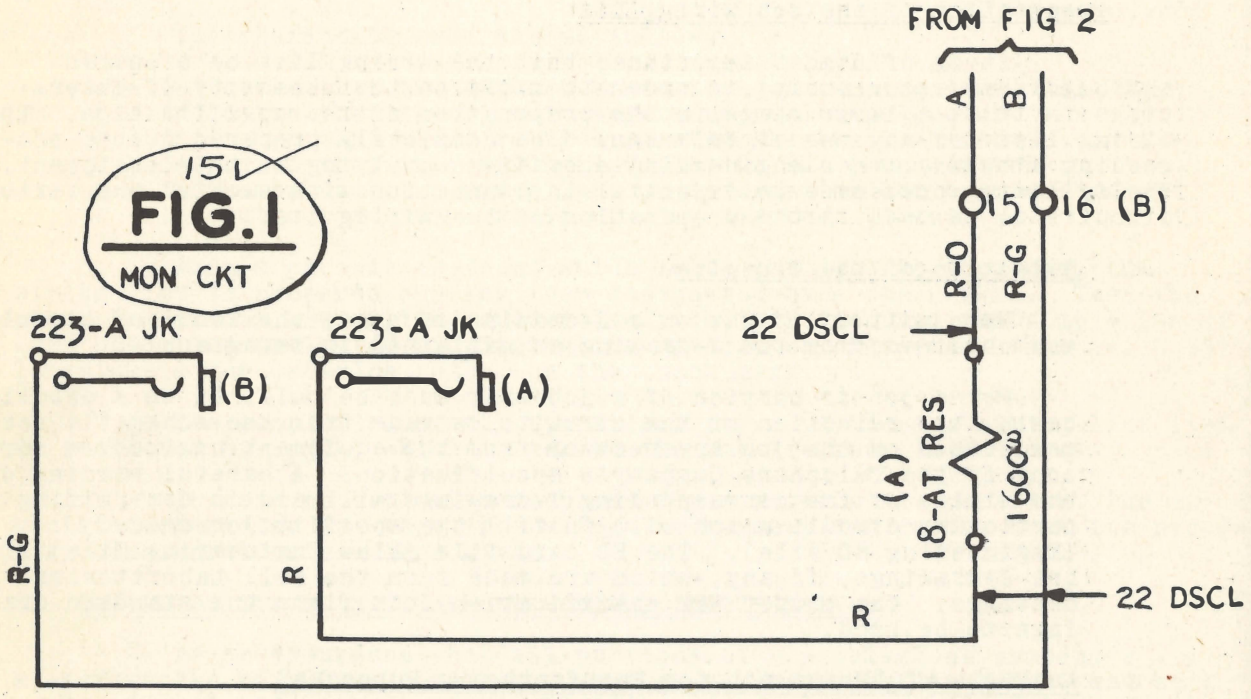
The choice of optional figures and wiring is made in the analysis of notes and from a study of the arrangement of the circuit drawing. In cases of several optional features, a study of the Bell Laboratory schematic is advisable in order to select the proper optional wiring. When specification drawings are used, the lists selected will determine many of the figures and options to be used. As the figures and optional wiring are selected, a circle is drawn around the numbers of the figures and optional wiring designations that should be specified. A circuit drawing when marked with these circles provides a systematic basis for writing the job wiring list.

When a circuit figure is being specified for a certain position, bay or unit, and other figures on the same circuit drawing are being specified for other positions, bays or units, the number of the position, bay or unit with which each figure is associated is written in

the circle drawn around the number of the figure. These positions, bay or unit numbers will prevent confusion where figures are required in several different locations.

When a figure number or optional wiring designation has been entered in the wiring list, a check mark is made opposite the position, bay or unit number which has been written in the circle drawn around the figure number.

Example:



d. Checking Connecting Leads

The connection of a lead, or group of leads to another figure on the same circuit drawing, or to another drawing, should be established. A check mark is used where connection is required and a cross mark where connection is not required.

In those cases where the connection to another circuit drawing is required and the connecting circuit drawing number is not shown, it should be written across the ends of the leads to identify the connecting drawing. In cases where connecting circuit drawing numbers are shown across the ends of the leads, those that are not applicable to the particular wiring list should be crossed out.

Uncolored leads may or may not be connected, depending on whether or not the connecting circuit is used. Colored leads, however, must always be taken care of.

On specs. where many circuit drawings are to be considered, it is advisable, as the circuit drawings are being used, to keep a record of the connecting leads and associated circuit drawing numbers and to check off the connecting leads as the remaining circuit drawings are applied. In this way all the loose ends are taken care of.

e. Wiring List Editing

When the proper arrangement of a circuit has been determined as covered in the preceding sections, the circuit should be edited in the wiring list. The wiring list is prepared in the form of a drawing, and, in the case of additions where existing wiring is modified, etc., it is also shown as a list in the specifications as outlined in Lesson 3, Section 2. (See Eng. Handbook for further information.)

Standard wiring list drawing forms for definite types of equipment are used to assist in the preparation of wiring lists on drawings and to maintain uniformity.

When incorporating the wiring list in the specification for additions and modifications, the progressive order of editing each item is as follows:

1) - Description of the work to be done
2) - Quantity of circuits to be equipped
3) - Name of circuit
4) - Circuit drawing number, figures and optional wiring
5) - Numbering of circuits being equipped where more than one circuit is wired for
6) - Quantity and numbering of the circuits wired for, where more circuits are wired for than are equipped
7) - Location as to where the circuit is to be installed

An example of the specification form of editing follows:

Add: 2-- Special service cords T-21435-12 Fig. 1, A, C & F ("X" & "E" wiring) ckts. 7 & 8 wire for 6 ckts 7 to 12 (Pos. 3 & 4 only)

Do not duplicate wiring lists of standard equipment specifications in the job specification.

f. Shop and Installer's Notes

The preparation of the job wiring list also involves the use of notes that will completely explain and clearly outline to the shop or the installer a condition for which necessary information is not completely shown on the circuit and equipment drawings.

Notes duplicating information that is fully included in the wiring list or associated information should be avoided. Notes necessary in providing a permanent record of special conditions and those which involve information for the maintenance of the equipment after it has been installed are placed on the wiring list drawing.

g. Table of SD Figures and Options Equipped

On Crossbar and Step-by-Step jobs, it is also necessary to show on the wiring list drawing the schematic figures and options equipped. The wiring list forms are arranged for this information to be shown either in columns in the regular wiring diagram (T drawing) table or in a separate table. The first method required that the associated SD figure and option be shown for each T drawing figure and option listed on the drawing, which in many cases will result in a duplication of the SD figures and options. The second method provides a separate table in which to list SD figures and options used on each frame or unit of equipment. All wiring diagrams have tables showing the SD figures and options associated with each T drawing figure and option and the engineer must transcribe this information to the wiring list drawing for each new drawing or change on an existing wiring

WIRING LIST OF DISTRICT JUNCTOR FRAMES
SUMMARY OF CLASS AND WIRING OF JUNCTOR UNITS

LINE	UNIT CLASS DESIG	NAME OF CIRCUIT	CIRCUIT DRAWING NOS SCHEMATIC	CIRCUIT DRAWING NOS WIRING DIAGRAM	FIGS	CONDITIONAL WIRING FURN	CONDITIONAL WIRING CONN	CONDITIONAL WIRING APP	QUANTITY OF CKTS PER UNIT	CIRCUIT NUMBERS LOWER GROUP EQUIPPED	CIRCUIT NUMBERS LOWER GROUP WO	CIRCUIT NUMBERS UPPER GROUP EQUIPPED	CIRCUIT NUMBERS UPPER GROUP WO	NOTE	EQPT DWG REF NOS	REMARKS
1	A	DIST JCTR MR1	SD-25020-01	T-25020-11	1,B,C			V,XORT	20	0 TO 9		0 TO 9		6		
2			SEE TABLE A		2				1							
3																
4																
5	B	MR2			1,A,C			A,V,XORT	20	0 TO 9		0 TO 9		3		
6					2				1							
7																
8																
9	CS	COIN SINGLE	SD-25210-01	T-25210-11	1			Y,XCOW	20	0 TO 9		0 TO 9		3		
10			SEE TABLE A		2				1							
11																
12																
13	D	"A" BD KP	SD-25021-01	T-25021-11	1,3	B	B		20	0 TO 9		0 TO 9				
14			SEE TABLE A													
15																
16																
17																
18																
19																
20																
21	U	FUSE ALM	SD-25204-01	T-25204-12	5	A	A		1							WRG ONLY
22	V	SEE TABLE A			2				(1)							
23		TBS & PC LP			3				1							WRG ONLY
24	W				3				(1)							
25		FUSE ALM			2				1							WRG ONLY
26	X	FUSE ALM TBS & PC LP			2,3				(1)							
27		TALK BAT SUP MISC WRG		T-620101	2			1 PER DIST								
28	Y	MISC CKT DIST JCTR FR		T-25204-12	1		REM	REM	JCTR FR					1,2		※ APP & WIRING FRS 0 TO 3,9-11 ONLY
29																WRG IN DIST LK LOCC A
30									COL	J	K	L	M			

MISCELLANEOUS EQUIPMENT

									QUANTITY OF CKTS	CIRCUIT NUMBERING EQUIPPED	CIRCUIT NUMBERING WIRED ONLY		
33	INT CHK ALM TIMING INT	SD-25268-01	T-25268-11	1,B			N	1				3,4	DJ FR 0 TO 8
34		SEE TABLE A		1,B				6					DJ FR 3 TO 19
35	TST REL			2				40					DJ FR 0 TO 19 (2 PER FR) J23058R-1
36	ALM LP			3				20					DJ FR 0 TO 19
37													
38													
39													
40													
41													
42													
43													
44													
45													
46													
47													
48													
49													
50													
COLUMN		A	B	C	D	E	F	G	H	N	P	Q	R

S

T

GENERAL NOTES

1. NOTES NUMBERED ABOVE 50 OR LETTERED NOTES WILL BE FOUND IN THE JOB SPEC
2. IN "QUAN OF CKTS" COLUMN NUMERALS NOT IN ( ) INDICATE CKTS WHICH ARE TO BE EQPD AND NUMERALS IN ( ) INDICATE TOTAL OF THE EQPD AND UNEQPD CKTS
3. NUMERICAL SUFFIX TO UNIT CLASS DESIGNATION INDICATES PARTIALLY EQPD UNIT.
4. FOR LOCATION OF D.P.T.S. & S.D.P.T.S. SEE T-1565-5840.
5. WHEN IT IS NECESSARY TO REPLACE THE 204-C OR TYPE "C" P.C.B. FOR MAINTENANCE REASONS, REPLACE IT WITH THE 206-91 TYPE LOOP THE TWO LEADS AT THE POSITION OF THE "T" COIL AND SEW THESE LEADS BACK INTO THE FORM. REMOVE THE "T" RETARD COIL FROM THE M7G PLATE
6. FOR 8 UNITS WIRED PER CLA SHOD CABLE TO HOLDER & D.U.CTS. IS IN POSITION ADJ. TO F LOOP SHOD CA CONNECTING TO BOTTOM UNIT. O VERT. T.S. FROM DIST JCTR INT. CHK E.C.T. SHALL CONNECT TO UNIT 1 VERT. T.S.

1924IH572	6-25-40
LINE & COL	1924IH572 CLA 1
0,4?,8	CKT. MRI FIG. 18.2 & CKT. MR2 FIG. 2.M, 2 REMARKED RSRD
2,8	"A" REMOVED
57-58 K 57-58 L 58-47 W 62-63 W	CKT. & EQPT. READ V,8 & I CKT. & EQPT. READ V,C,M,CM INDICATES PARTIALLY EQPD UNIT. CKT. & EQPT. READ V,8 & I 1924IH572 8-16-40 CL. A
5?&62-8 78 F. 4,8M	UNIT 4 UNDER CKT X REMOVED 1924IH572 12-1-40 CL A 3
11&12-A,C,D 57&58-N 63&64-Q TO X,W 57&58-K 55 TO 58	READ, COIN, MULTI; T-25210-11 & 1 RESP. CKT & EQPT. READ D,8,D. CKT & EQPT. READ X, 8 & D CKT & EQPT. READ X, CM & CM CKT & EQPT. READ X, CM & CM CKT & EQPT. READ V, A & Z CKT & EQPT. READ V, C & C,S EQPT. DESIG. C READS AN/A4SSA-8 OFF. OFFICE REMOVED FROM TITLE 1924IH572 2-19-41 CL. A 4
	CHANGE CANCELLED. 1924IH572 5-20-41 CL A 5
61,8? 27-CD	ADDED READ ED-25349-10; "B" RESP
33-G 51,52	READ M "U" ADDED 1924-IH572 6-9-41 CL-A 6
1,5,9 36 1-52,9	X OR Y ADDED X CM W ADDED J ADDED 2021 F ADDED 8,8 & 11 REM. T.S. TO 8 & 11 REM. 10-31-?9 7
101 TO 104 111,112	ADDED K-20 12-30-46 CL D 8
58,60	FOR 2 CKT & EQPT READS M-K & IF RESP NOT M, MAKE & ADDED CKT & EQPT READS M-M & D CL D 9
	K-20 4-26-45 CL D 10

DISTRICT JUNCTOR FRAMES

DISTRICT JUNCTOR FRAME EQUIPMENT

LINE	FRAME UNIT	FRAME TGR	0 CKT	0 EQPT	1 CKT	1 EQPT	2 CKT	2 EQPT	3 CKT	3 EQPT	4 CKT	4 EQPT	5 CKT	5 EQPT	6 CKT	6 EQPT	7 CKT	7 EQPT	8 CKT	8 EQPT	9 CKT	9 EQPT	10 CKT	10 EQPT	11 CKT	11 EQPT	12 CKT	12 EQPT	13 CKT	13 EQPT	14 CKT	14 EQPT	15 CKT	15 EQPT	16 CKT	16 EQPT	17 CKT	17 EQPT	18 CKT	18 EQPT	19 CKT	19 EQPT
51	4	9	D,U	D	D,U	D	D,U	D	D,U	D	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	D,U	D	D,U	D	D,U	D	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B	X,B,U	B
52		8																																									
53	3	7	X,B	B	X,B	B	X,B	B	X,B	B	X,CS	C	X,CS	C	X,CS	C	X,CS	C	X,CS	C	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B	X,B	B
54		6																																									
55	2	5	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C	W,CS	C
56		4																																									
57	1	3	V,A	A	V,A	A	V,A	A	V,CS	C	V,A	A	V,A	A	V,A	A	V,A	A	V,A	A	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C	V,CS	C
58		2																																									
59	0	1	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	ARE UNITS 4		W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A	W,A	A
60		0																																									
61	MISC		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
COLUMN			A		B		C		D		E		F		G		H		J		K		L		M		N		E		4		R		S		T		U		V		W	

CLASS DESIGNATION

STANDARD FRAMEWORK & EQUIPMENT RECORD

LINE	CLDES	DWG NO	LIST OR GRP	DESCRIPTION	FR NO
81	A	J27551B-3	1,3	DIST JCTR UNIT (MR1)	DJ O TO 19
82	B	J27551D-3	1,2	(MR2)	DJ O TO 19
83	C	J27551E-3	1,2	(COIN)	DJ O TO 19
84	D	J27551F-3	1,2	(ABDKP)	DJ O TO 3,9-11
85	Y	M-592-355	1,2,3	FILTER, JK 2 FUSE PAN MOD	DJ-DTO 19
86		ED-25346-10	1,2	TALK BAT SUP MISC WRG	DJ O TO 19
87		ED-91393-30		TALK BAT SUP FILTER UNIT	DJ O TO 19
88		J23058R-1	1,2,3,4	INT CHK UNIT	
89		ED-25051-11	1	DIST JCTR FR ASSEM	DJ O TO 19
90					
91					
92					
93					
94					
COL	A	B	C	D	E

JOB EQUIPMENT DRAWING REFERENCE TABLE

LINE	REF NO	DWG. NO.	TITLE
71	1	T-1565-156	DJ & FR EQPT
72	2	T-1565-140, -141	HMDF
73	3	T-1565-513	FUSE BAY
74		T-1565-02	FLOOR PLAN
75	4	T-1565-175	REL RK
76			
77			
78			
79			
80			
COL	A	B	C

TABLE A — CIRCUIT, SCHEMATIC FIGURES & OPTIONS (BRG'S & APP) USED

DISTRICT JUNCTOR CKTS
SEE DIST JCTR FR EQPT FOR LOC OF UNITS

LINE	UNIT CLASS DESIG	NOTE = RES & COND PER FIGS 5 OR 6 ARE LOC ON ADJACENT SUBS SDR LK FR SCHEMATIC	FIGURES	OPTIONS	REMARKS
101	A	SD-25020-01	1,2,3, 5, B, D	C, E, G, J, ST OR W, V, Y	* SEE NOTE 5
102	B	SD-25020-01	1,2,3, 5,A, D	C, E, G, J, ST OR W, V, Y	
103	CS	SD-25210-01	1,2,3, 5, B,C, E	C, E, G, J, X OR W, Y	
104	D	SD-25021-01	1	A	
105					
106					
107					
108					
109					
110					
COLUMN	A	B	C	D	

MISC FR CKTS

NOTE = INT CHK CKT PER SD-25268-01 IS LOC ON MISC REL RK

LINE	FRAME NOS	SCHEMATIC	FIGURES	OPTIONS
111	0 TO 19	SD-25204-01	2,5, 5,6, 8, 11,12,13	Y
112	0 TO 19	SD-25268-01	1,2,3,5,	Q, S, U, V, W, X, Z
113				
114				
115				
116				
COLUMN	A	B	C	D E

ENGINEERING NOTES

51.

T-1565-5720
WIRING LIST & EQUIPMENT
DISTRICT JUNCTOR FRAMES 0 TO 19
2ND FLOOR
ILLINOIS BELL TEL. CO
BRIARGATE
HOLLYCOURT
SHELDRAKE
ROGERS PARK OFFICES (ROGERS PARK BLDG) CHICAGO, ILL.

TC

T-1565-5720
OR

WESTERN ELECTRIC COMPANY, INC.

T-1565-5720

80

list drawing. Since this information is used extensively by the Telephone Office maintenance force and the Telephone Company Engineering force, it is very important that it be accurate and complete.

h. Indication of Completion

When a circuit item in the job wiring list has been completely determined and edited, a check mark is placed opposite the item on the wiring list. This check mark provides the basis for the Job Progress Indicator.

6. Locating Circuit Apparatus

a. Establishment of Apparatus Location

Upon completion of an item in the wiring list, the location of all apparatus shown on the circuit figures for the particular wiring list item is made in the following manner:- When unit equipment per J-drawing is used, all of the inside of section apparatus is located on the J-drawing equipment sketches. However, the job engineer must provide for fuse board and terminal strip locations and in the case of J-drawing units, arrange for the unit location on a job equipment drawing by wiring information to the 30, 69 and 70 specifications. When apparatus not on a standard specification drawing is ordered, there is usually a standard equipment layout on a standard equipment drawing which can be used for the job equipment layout. Occasionally, however, it is necessary to provide location and equipment layouts on a job basis for each piece of apparatus and a job equipment drawing or sketch must be originated. Information outlined in the following paragraph should be shown on the job equipment drawings.

In establishing the location, the electrical and maintenance limitations of the apparatus and the physical requirements of both the apparatus and the mounting framework must be considered in determining a suitable arrangement. Accurate designations on the equipment drawing is important. When locating equipment it is essential that the functional designations be the same as is shown on the apparatus on the circuit drawing. Code numbers should agree with the code on the circuit drawing.

Fuses on central fuse boards, terminal strips on distributing frames, and equipment on relay racks are located by the engineer writing the 30, 69 and 70 specifications. The Job Engineer must give the necessary information to these specifications. Sheets are provided in the HEF form for this purpose. The following information should be provided.

1) Code of apparatus (except terminal strips - number of punchings per circuit given in information to 70 spec.)
2) Functional designation as shown on circuit drawing
3) The circuit name or abbreviation which should be the same at all terminations of the circuit as that used on the job wiring list drawing
4) The circuit drawing number (fuse board, relay rack and distributing frames only)
5) Cable symbol (specification number) (fuse board, relay rack and distributing frame only) the symbol would logically be added during the preparation of the cabling information, but in practice, in order to save time, it is usually added when the equipment is located
6) Circuit numbering, both wired and equipped
7) Code of mounting plate, etc., if required

When relay rack units are used, the only information required is the name, number (T and J-drawings), circuit numbering, and number and size of mounting plates.

b. Information to Fuse Board (69 Spec.)

The information to the fuse board (69 spec.) should state the name and location of the fuse board on which fuse equipment is being added. When the cabling information is made up this particular fuse board should be specified as a terminating end.

If the fuse board engineer for any reason finds that it is impractical to furnish this type of fusing on the specified board, he will notify the originating engineer of this change to enable him to change the cabling information accordingly.

c. Information to Relay Rack and Distributing Frames

Miscellaneous information for other specs. varies for Panel and Step-by-Step and it also varies somewhat in the different departments.

In Panel, the information to the relay rack (70 spec.) should also give the name of the relay rack cabled to in the cabling information.

The relay rack information should be in such complete form that all the 70 spec. engineer needs to do is to find a bay to place it in. He will mark this bay number on the information and hand it to the draftsmen who will draw the relay rack equipment drawing.

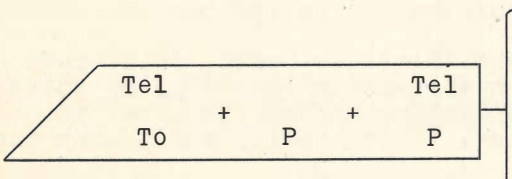
In general, the relay rack information in Step-by-Step, made up by the 730, 748, and 750 spec., is placed on relay rack bay sketches, with each engineer locating his own equipment. All relay rack sketches from other specifications are turned over to the 730 spec. engineer who writes the drawing order or change supplement.

The information to the MDF, IDF, and TDF (70 spec.) must give the side of frame cables to (horizontal or vertical) and the frame number when more than one frame is used on the job, such as, HIDF 101 or HIDF 301. Here again the 70 spec. engineer finds a location for the equipment, marks it on the information which he then hands to the draftsmen to show on the equipment drawing.

In writing information to the 30, 69 and 70 spec., consideration must be given to the form which the information should take. Separate sheets should be used for each fuse board bay, relay rack lineup, and each side of each distributing frame. This cooperation with the 69 and 70 spec. engineers aids them in their work, simplifies their filing system and reduces the possibilities of error.

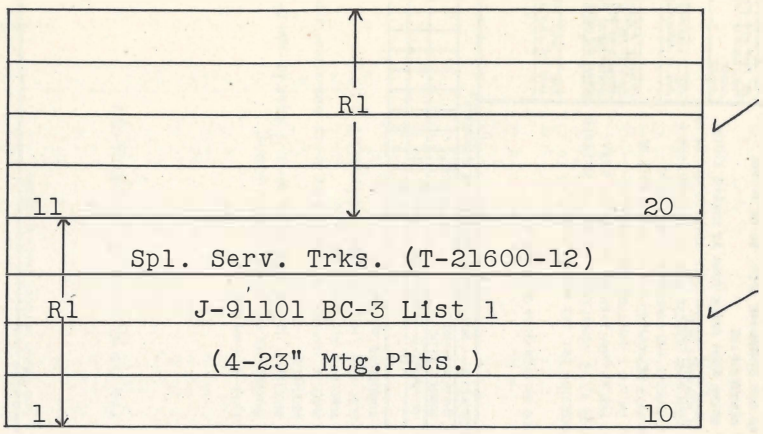
At the time of establishing the location of the individual pieces of apparatus on the equipment drawing or sketch, the location should be designated by a check mark.

Examples of Indicating Location of Apparatus

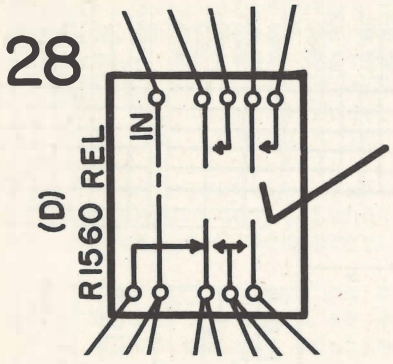


✓	606-S Mtg. Plt. with	Pos
	B Rel	1-8
	19 Type Res	9
	139 A Cond	10
✓	178 A Rel	12
✓	137 A Cond	14
✓	85 Ret. Coil	16
	Undrilled	All Others

REAR EQUIPMENT SKETCH



INFORMATION FOR
"A" POS. RELAY RACK 101



On establishing the location of the apparatus on an equipment drawing, the code of the apparatus should be compared with that on the circuit drawing and a check mark placed on the apparatus convention on the circuit drawing.

This check mark indicates that the apparatus location has been provided for and the code of the apparatus verified.

Apparatus, such as cordweights, lamps, vacuum tubes, etc., which is not located on any equipment drawing should be ordered directly from the circuit drawing. The ordering of this apparatus should be indicated by placing a check mark at the code designation in the apparatus list or circuit figure.

When locating apparatus shown on the circuit, consideration must also be given to locating and designating non-circuit apparatus, such as apparatus blanks, key spaces, jack spaces, mounting plates, etc.

d. Provisions for Future Equipment

Location of apparatus for which wiring only is provided is made in the same manner as for apparatus that is provided, with the exception that the apparatus location should include the designation "WO."

Where required, space for ultimate equipment is arranged for and designated "future" at all locations. In general, the same ultimates should be planned for at all terminations of any one circuit.

e. Indication of Completion

Having located and designated all apparatus associated with a particular wiring list item, the completion of this operation is indicated by the addition of the character L in the job progress indicator, thus L

FIG-1

INCOMING ALARM EQUIP (SD-90642-01 FIG 1)

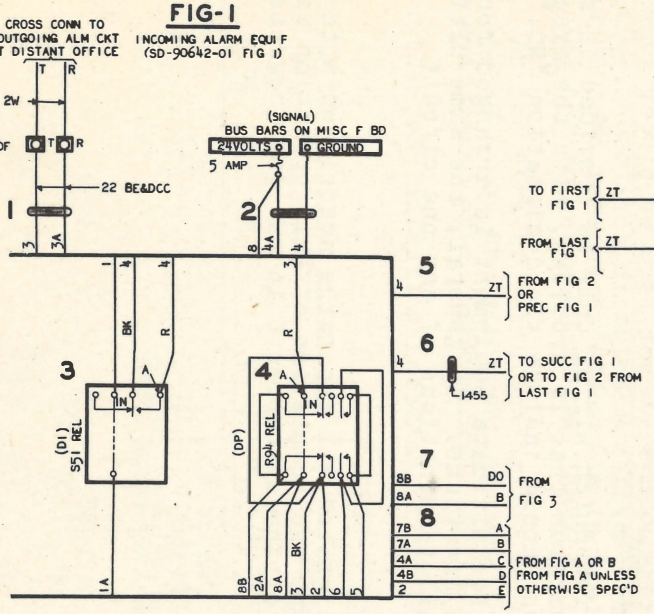


FIG-2

AUDIBLE ALARM EQUIPMENT (SD-90642-01 FIG 2)

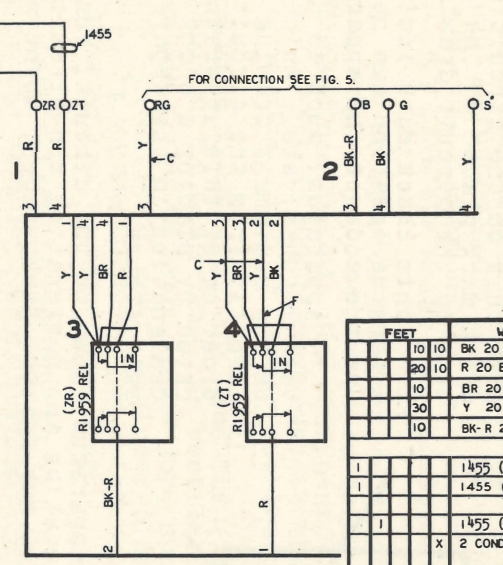


FIG-3

INCOMING ALARM LAMP

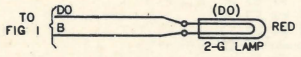


FIG-4

AUDIBLE ALM SUBSET (SD-90642-01 FIG 2)

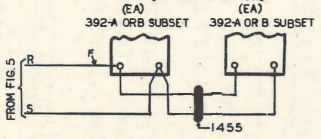


FIG. A

(MFR DISC)

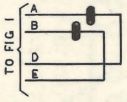


FIG. B

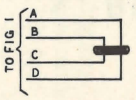
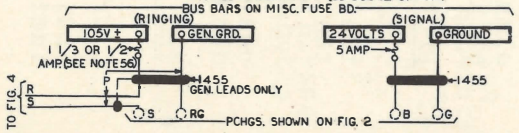


FIG-5

AUDIBLE ALM F. P. EQPT. (SD-90642-01 FIG. 2)



INFORMATION - FOR MANUFACTURING PURPOSES

CONVENTIONS

-------STD. STRAPPING FURNISHED WITH APP

DENOTES CABLE

1. WIRES NOT OTHERWISE SPEC. TO BE 20 BBE
2. "P" DENOTES PAIR
3. "F" BRING FROM CABLE FORM AT SEPARATE STITCH
4. "C" WIRING TO BE SEPARATE CABLE SEWED TO OUTSIDE OF REGULAR CABLE
5. "B" TERM PCHG NEAREST BASE OF TERMINAL STRIP
6. "2W" DENOTES TWO CONDUCTOR JUMPER WIRE
7. TERMINALS DESIGNATED "A" ON (DP) & (DI) RELAYS IN FIG 1 SHALL BE EQUIPPED WITH - NO. 8 RED KS-7851 VARNISH SATURATED SLEEVING, SO AS TO COMPLETELY COVER THE SOLDERED CONNECTION AND THE RELAY TERMINAL.
8. METHOD OF OPERATION CD-90642-01

ISSUE: 1

FIGS. 4 & 5 WERE PART OF FIG. 2. NOTE 9 WAS REMOVED & READ "FIGS. 1 & 2 ARE INSTALLER WIRED. NOTE 37 READ "BOOK" FOR FIG 2 SHALL BE CHECKED PER ED-90882-10 G-1. IN NOTE 75 "FOR FIG. 3" WAS NOT SHOWN. "FIG. 2 USED IN LOCAL CA. P-426268 ADDED. 11-1-33 CLASS "A"

2

FIG. A WAS PART OF FIG. 1. FIG. B ADDED. NOTE 51 CHANGED

3

IN NOTE 7 "KS-7851 VARNISH SATURATED SLEEVING" READ "IMPREGNATED VARNISHED TUBING (KNITCHELL BRAND CO, NEW YORK)."

FIG. B WAS REMOVED FROM NOTE 53 AND ADDED IN NOTE 51

4

INFORMATION - NOT FOR MANUFACTURING PURPOSES

51. THIS DRAWING AGREES WITH ISSUE 1 3
SD-90642-01 (PROV-STD) ISSUE 1 3

52. SCHEMATIC SD-90642-01
53. SPECIFY 1 FIG. 1 FOR EACH DISTANT OFFICE
54. SPECIFY 1 FIG 2, 4 & 5 PER OFFICE.
55. SPECIFY 1 FIG 38B FOR EACH DISTANT OFFICE WHEN VISUAL SIGNAL IS REQUIRED
56. SPECIFY A 1/2 AMP FUSE WHEN RINGING IS SUPPLIED FROM 84-D OR 84-F INTERRUPTER OR 1/2 AMP RINGING MACHINE
57. FIG. 2 IS IN J98303C-1

75. LAMP CABINET ASSEMBLY ED-90470-70 FOR FIG. 3

101. FIG 2 USED IN LOCAL CABLE P-426268

FIG B	FIG A	FIG 5	FIG 4	FIG 3	FIG 2	FIG 1	FEET	WIRE (PER 10 OKTS)
							10 10	BK 20 BBE
							20 10	R 20 BBE
							10	BR 20 BBE
							30	Y 20 BBE
							10	BK-R 20 BBE
								CABLE
						1		1455 (REL HOUSING TO MISC F BD)
						1		1455 (REL HOUSING TO F BD) (PEN LEADS)
						1		1455 (SUB SET TO SUB SET)
							X	2 CONDUC IN MISC 20 BBE CABLE (F BD TO REL RK)
							X	2 CONDUC IN 22 BE & DCC CA (REL RK TO HMDF)
						2	1	CONDUC IN 20 BBE CABLE (LAMP CAB TO REL RK)
						1		CONDUC IN 20 BBE CABLE (LAMP CAB TO FUSE BOARD)
							X	NO. 8 RED VARNISH SAT. SLEEVING KS-7851
							1	S51 REL
							1	R-94 REL
							X	2 PT ON HMDF TERM. STRIP.
					1			2-G LAMP
				2				392-A OR B SUBSET
			1				1	5 AMP (AS REQ)
			1					1/2 OR 1 1/3 AMP FUSE (SEE NOTE 56)
								APPARATUS INFORMATION - NOT FOR MANUFACTURING PURPOSES

T-90642-11

COMMON SYSTEMS
EMERGENCY ALARM CIRCUIT
INCOMING FROM DISTANT OFFICE
FOR USE IN SINGLE OR MULTI-ZONE OFFICE WHEN
INCOMING CIRCUIT IS NOT TO BE CONNECTED TO ZONE SIGNALING CIRCUIT

EM. ALM.

STANDARD

APPROVED: 5-18-33

DRAWN BY

CHECKED BY

WESTERN ELECTRIC COMPANY, INC.

T-90642-11

T-90642-11

7. Ordering Equipment

a. Ordering from Specification Drawings

When specification drawings are used, the equipment is ordered in the job specification summary of apparatus by referring to the various lists selected for the particular job. The quantity required, J spec number, description of apparatus and list numbers are recorded as indicated in the following examples:

1 J27501 List 1 Dist Sel Fr (Fr 101) eqpd with
60 List 2 (Sel Ckt 1 to 60)

HEF specification forms have skeleton summaries of apparatus in which it is only necessary to fill in quantities of lists and frame or circuit numbers as required.

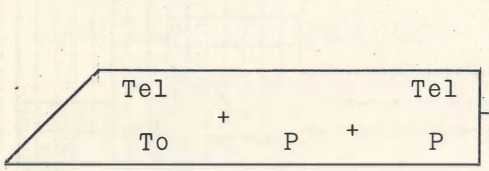
b. Ordering from Equipment Drawings (When Specification Drawings are not Used)

After all apparatus shown on the circuit drawing has been located, the apparatus for this circuit should be ordered in the apparatus summary in the spec. form directly from the equipment drawing or sketch. The apparatus associated with each circuit on the wiring list drawing should be ordered immediately after the equipment has been located. In case apparatus for several circuits is located on one mounting, such as on a miscellaneous mounting plate or rear equipment, it is advisable to order all this apparatus at the time the apparatus for the last circuit is located on the sketch.

It is essential that the card catalog be consulted on the status of any apparatus (standard, A & M, obsolete, replaced, etc.) whenever any unfamiliar equipment is being ordered.

After entering the order in the summary for an individual item of apparatus, the code as entered in the summary should be compared with that shown on the equipment drawing and a cross line placed on the check mark at the apparatus on the equipment drawing.

Examples of Indicating Ordering of Apparatus



	606-S Mtg. Plt. with	Pos
	B Rel	1-8
	19 Type Res	9
	139 A Cond	10
✓	178 A Rel	12
✓	137 A Cond	14
✓	85 Ret Coil	16
	Undrilled	All Others

REAR EQUIPMENT SKETCH

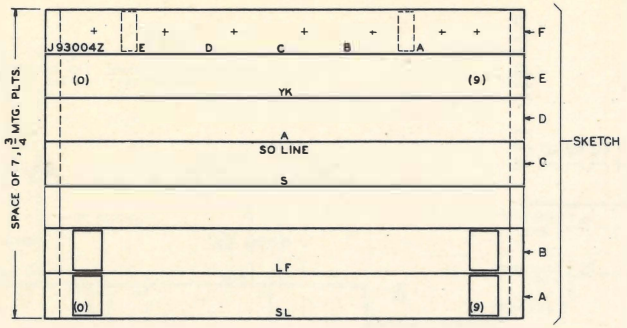


FIG. 1

ENGINEERING NOTES:-

51. DWG MADE FROM ED-30532-01 ISS.3 FIG 3 & BSPAA382.006 (MOD) ISSUE 2
52. MODIFICATION OF BSPAA382.006 ISS 2 CONSISTS OF OMITTING PROVISION FOR AM WIRING.

MANUFACTURING NOTES:-

1. DESIGNATIONS IN ( ) SHALL BE STAMPED IN ACCORDANCE WITH JOB INFORMATION
2. EQUIP CIRCUITS PER TABLE "A" IN ACCORDANCE WITH THE LISTS SPECIFIED
3. MOUNT RELS IN POS AS SHOWN BELOW

NO OF LISTS 2 OR 3	1	2	3	4	5	6	7	8	9	10
MT REL IN POS	1	1,2	1TO3	1TO4	1TO5	1TO6	1TO7	1TO8	1TO9	1TO10

NDD93004-2A ISSUE 1
NOTE 51 ED-30532-01 WAS ISS 2 4-14-37 CL. O
2

TABLE A

RATING	LIST	EQUIPMENT	CKTS	FIGURES EQPD
	1	ASSEM LOC CA'S & COMMON EQPT FOR 10 CKT UNIT		T-31347-12 FIG 1,E WIRING ONLY
	2	APP FOR 1 CKT FOR OBS ON SUB LINES SOME OF WHICH ARE MR LINES	1	T-31347-12 FIG 1,A
	3	APP FOR 1 CKT FOR OBS ON SUB LINES IN OFFICES WHERE THERE ARE NO MR LINES	1	T-31347-12 FIG 1,B

3	2	1	CODE	DESCRIPTION	NOTE	LINE
		1	600-AT	MTG PLT EQPD WITH SK F		23
		5	28-B	BRKT(ITEM 1)ON REAR WITH		
		5	203-A	TERM STRIPS IN POS 2,4,6,8&10		20
				UNDRILLED ALL OTHER POS		
		1	737-B	MTG PLT EQPD WITH SK E		
1	1		E1470	REL POS 1 TO 10	3	
		1	737-B	MTG PLT EQPD WITH SK D		15
1	1		E503	REL POS 1 TO 10	3	
		1	737-B	MTG PLT EQPD WITH SK C		
	1		R1124	REL POS 1 TO 10	3	
1			R1225		3	10
		1	600-A	MTG PLT EQPD WITH SK B		
1	1		B358	REL POS 1 TO 10	3	
		1	600-A	MTG PLT EQPD WITH SK A		5
	1		B135	REL POS 1 TO 10	3	
		1	LC-738-000	G-1 LOCAL CABLE		
		1	ED-90782-50	G-7 UNIT ASSEM		1

LIST

J930042-1 ISSUE 1 -SHEETS SHEET 1

LINE	NAME	SCHEMATIC	ISS	DESCRIPTION	DWG. NO.	ISS.	FIG.	OPT. WIRING	WIRED	NOTES	REMARKS
	CIRCUITS										
1	OBSERVING LINE CKT	SD-31347-01	5		T-31347-12	1	1,E		10		
2											
3											
4											
5											
6											

WIRING PROVIDED IN THE LOCAL CABLE

NAME	NUMBER	ISS	NAME	NUMBER	ISS
CABLING PLAN	ED-90757-05	3			
UNIT UPRIGHTS	ED-90782-50	-			

LIST OF ASSOCIATED DRAWINGS

J930042-1

STEP BY STEP SYSTEM
CENTRALIZED DIAL SERVICE OBSERVING EQUIPMENT
SPECIFICATION FOR
FRAMEWORK ASSEMBLY AND EQUIPMENT FOR
OBSERVING LINE UNIT
FOR USE WITH SUBS LINES AND LOCAL SELECTORS
IN LINE FINDER OFFICES
ARRANGED FOR 19" RELAY RACK

STANDARD

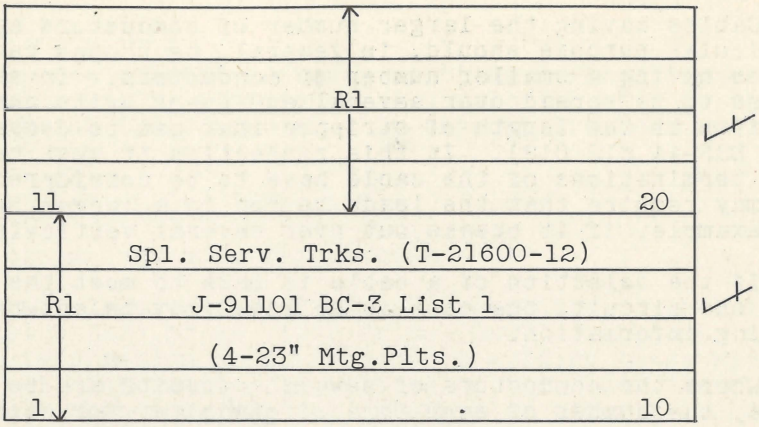
APPROVED 1-8-37 DRAWN BY CHECKED BY

WESTERN ELECTRIC COMPANY INC.

J93004Z-1

0

J93004Z-1



INFORMATION FOR
"A" POS RELAY RACK 101

b. Designation in Summary

Wherever it is possible to do so, shop wired material in the summary is designated with the position, bay, section or unit with which it is associated. On the other hand non-shop wired material in the summary is designated by the circuit drawing number with which it is used. (See Eng. Hand Book)

To identify the quantity associated with each circuit drawing, a list is made of the individual quantities required for each circuit, as follows:

Example:

- 139-A Cond

2 - T-21230-41
1 - T-21125-10
20 - T-90530-12

c. Indication of Completion

On ordering all apparatus associated with a particular wiring list item, the completion of this operation is indicated by the addition of the character O in the job progress indicator, thus \1.0

8. Preparation of Cabling Information

a. Selection of Cable Code

In case the code of cable is shown on the circuit drawing, this code should be used unless the number of circuits ultimately required differs greatly from those for which the cable is designed.

Where the code of cable is not shown on the circuit drawing, it is necessary to select a suitable cable fulfilling the following requirements:

(a) Number of conductors
(b) Gauge of conductors
(c) Number of pairs

Cables having the larger number of conductors applicable to the particular purpose should, in general, be chosen rather than several cables having a smaller number of conductors. In selecting large cables to be spread over several equipment units consideration should be given to the length of stripper that can be conveniently handled. (See BSP-AA 612.018). In this connection it must be remembered that both terminations of the cable have to be considered, since the other end may require that the leads be run in a larger number of cables, for example, if it breaks out over several verticals of MDF.

If the selection of a cable is made to meet the requirements of only one circuit, the code as selected may be entered directly in the cabling information.

Where the conductors of several circuits are to be run in a common cable, the number of each type of conductor for each circuit should be recorded and when the total conductor requirements are thus obtained, the proper cable may be selected. It must, however, be understood that circuits are run in a common cable only when they have the same terminations.

b. Method of Editing Cabling Information

The descriptive information for each item includes the name of circuit, circuit drawing and figure numbers.

The terminating points of each run of cable should be definite, that is, fuse board and relay rack frame numbers, and distributing frame number and side of frame should be given. When bay numbers of relay rack or fuse board etc., are known, they also should be given.

The equipment location on the originating and terminating equipment such as terminal strip designations, switch numbers, fuse row numbers, bay and shelf numbers shall also be indicated. The circuit numbers included in each cable shall be shown. The standard cabling information sheets provide columns for these various items of information required.

The code of all strip mounted jacks, lamp sockets, keys, and their respective mountings to which factory cabling is to be soldered either by the shop or the installer is listed directly below the cable requirements for the associated circuit or group of circuits. (411, 450, 485, 711 and 750 specs. only.)

After editing the order for a particular run of cable, a check mark should be placed on the cable convention on the circuit drawing.

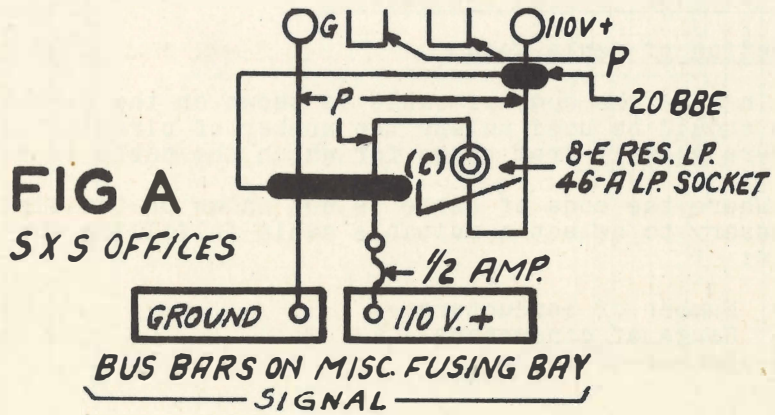


FIG A
SXS OFFICES

c. Indication of Completion

Having prepared all the necessary cabling information associated with a particular wiring list item the completion of this operation is indicated by adding the character C in the Job Progress Indicator, thus \LOC

9. Preparation of Miscellaneous Information

a. Interrupter, Alarm, and Wire Information

Wherever the circuit drawing shows connections to an interrupter circuit, (Panel & SxS) or an alarm frame (SxS), it becomes necessary to pass along information to the engineers writing these specifications. In Panel, information is written to the Floor Alarm Board (483 spec.) only when some unusual interrupter circuit is required. Also under the heading of miscellaneous information comes wire editing, which is prepared for the 92 spec. engineer.

This information and the 69 and 70 spec. information discussed before, is usually prepared on forms made for that purpose. Complete, concise, and accurate information is necessary, inasmuch as when the time comes for the other engineer to use this information, it is usually inconvenient to re-check the circuit and it wastes the time of both engineers. In general when no information is required for one of these specs., it is proper to inform the other engineer of that fact by writing "No Information Required."

In Panel and Crossbar, one carbon copy is required. The original goes to the engineer writing the spec., while the carbon copy is filed in the job folder. In Step-by-Step only one copy is made which goes into the job folder where it is available for anyone to refer to.

b. Method of Editing Interrupter and Alarm Information

The information for the interrupter circuits (427 or 730 spec.) and the Office Alarm Frame (783 spec.) should be covered on the sheets provided for that purpose in most spec. forms. In case no sheets are available, the same information should be written on blank paper.

In either case all the available information should be passed along. This would include the frame cabled to, the number and designation of leads, the connecting circuit name, drawing number, and figure number where shown.

Examples:

Information for -H427 spec. miscellaneous interrupter frame No. 1
From -H411 spec.
Aud. and Flash Recall - conn lead FR to Miscellaneous Interrupter Circuit
T-90458-11 Pos 1-9 (9 ckts) T-514290 Fig. 5

Information for -H783 spec. Office Alarm Frame 1st floor
From -H726 spec.
Please arrange for Traffic Regular Alarm per T-31613-11 Fig. 3
Please arrange for Line Mess. Regular Fuse Alarm T-31613-11 Fig. 4

Occasionally a connecting lead is shown to some other frame, such as the sender frame. In this case it is advisable to consult the engineer writing the other spec. to make certain that the circuits will work together.

c. Method of Editing Wire

All wire shown on the circuit figures that is required by the installer is edited for a particular wiring list item in the following manner:

Each color of wire on a circuit drawing figure not included in a local cable or shop wired unit is chosen individually, and the necessary amount as determined in a study of the equipment arrangement is tabulated in the editing form. The corresponding circuit drawing, for which the individual amount of wire is to be used, is included in the tabulation. To indicate the provision of the necessary amount for a particular color of wire, a check mark is placed on the color of wire on the circuit drawing figure.

d. Indication of Completion

After editing the interrupter and alarm information and all the necessary wire associated with a particular wiring list item, the completing of the operation is indicated by adding the character M in the Job Progress Indicator, thus \LOCM

10. Locating and Ordering Framework and Non-Circuit Apparatus

a. Assembly and Framework Parts

The supporting assemblies and framework parts that are to be ordered in the job specification have been tentatively determined while locating the associated circuit apparatus. Some these parts, such as section assemblies, keyshelves, rear equipments, roof equipments, relay rack framework, test board unit assemblies, etc., must be determined before the locating sketches are made. Others, such as connecting details, bus bar details, etc., that are not required in locating equipment should be determined at the time this framework is required.

When the framework parts have been definitely determined, they should be located and designated on the equipment drawing, and a check mark placed at the location assignment to indicate that the framework as selected meets the job requirements.

As the equipment drawing shows the assembly drawing numbers of all framework, the ordering should be done directly from this drawing. Upon entering the order in the specification summary, a cross line is placed on the check mark at the location of each framework item on the equipment drawing.

b. Non-Circuit Apparatus

Non-circuit apparatus, such as apparatus blanks, jack spaces, key spaces, number plates, etc., is tentatively determined at the time the circuit apparatus is located.

When the code of this apparatus is found to be satisfactory, a check mark is placed opposite the designation of this apparatus on the equipment drawing. This apparatus should be ordered from the equipment drawing in the same manner as all other equipment and a cross line placed on the check mark at its location.

11. Listing of Drawings and Reference Papers

a. Framework and Standard Equipment Specification Drawings

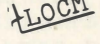
With the job specification summary as a guide, these drawings and their associated supplementary drawings are listed in the drawing list. To indicate that the drawing and its supplementary drawings have been listed, a check mark is placed at the left of the summary item.

b. Circuits, Schematics and Method of Operation Sheets

With the wiring list as a guide, the circuits are arranged in numerical order and listed with their associated schematics in the drawing list.

While the circuit drawings are being listed the issue number on the print worked from should be listed. The SD drawing and its latest issue as shown on the circuit drawing should also be listed at this time.

Later when the specification comes back for issue check, it is then easy to check whether the latest issues were used in working up the spec. If later issues are available than the ones used in the spec., then the issues in the spec. are raised. However, it is then necessary to check these later issues to find out what effect it has on the spec. and make any necessary changes. When there isn't time to wait for the new issue of the drawing, form letters, CD sheets and SD drawings in the Line Eng. Drawing File will generally indicate what the new issue consists of.

To indicate the slection of a circuit to be listed, a cross line is placed on the Job Progress Indicator, thus 

c. Equipment Drawings

All equipment drawings required in connection with the wiring or assembly of equipment as specified in the wiring list associated with the specification should be listed and their issue numbers shown.

d. Installers' Reference Papers

Drawings and specifications required by the installer in connection with the installation, modification, or removal of equipment may be determined in a review of the job specification wiring list, installer's notes, and apparatus summary, and listed in the job specification.

12. Completion of Longhand Specification

The title page, having been edited initially in the preparation of the specification, is checked for correctness at this time.

Under the heading "General," a concise and complete outline of what is ordered in the specification should be given.

The editing under all headings is checked for completeness.

The "Framework and Summary" notes are prepared to cover the conditions applying to the specification.

A check is made of the completeness of the editing of all items in the job summary. Those that are at present listed as several quantities are totalled to form one summary item.

Example: 23 - 139-A Cond

2 - T-21230-41
1 - T-21125-10
20 - T-90530-12

13. Drafting Information

a. Issuance of Drawing Orders and Change Supplements
(See Engineering Handbook, Section 19)

When any addition or modification in equipment is made, new drawing order or change supplement is prepared. When blanket orders on new drawings have been issued, no new drawing order is required unless it is one not taken care of by the blanket order.

After issuing the drawing order, a check mark is placed at the left of the corresponding drawing number in the specification drawing list.

When drawing orders are to be issued by the line engineer on other than job drawings, the order should be prepared at the time the need for the change becomes apparent.

Wherever possible it is advisable to include all information on the drafting order. Where this is not possible, supplementary sketches or marked prints may be used. Standard forms should be used for providing the supplementary sketches. After completion the longhand specification and associated papers are held by the engineer until called for by the checker. All drawings used in engineering the job should be arranged in numerical order.

b. Completeness

Information to the drafting organization must of necessity be complete and accurate to insure a thorough and efficient drafting job. Reference to drawings and other papers that will assist the draftsman should be made in the drafting information. Legible drawing sketches will also materially aid the draftsman. However, wherever possible, more work and responsibility should be delegated to the draftsman.

c. Approval of Tracings

The responsibility for the accuracy and completeness of the engineering information, as interpreted and shown on the tracing by the draftsman, rests with the engineer. For this reason, it is advisable for the engineer to check and approve the tracings. In the case of minor changes, however, final approval may be delegated to the draftsman by placing a check mark in the space provided for this purpose on the change supplement.

SECTION 3. JOB COMPLETION

Having completed the preparation of the specifications and drawing information, it is essential that a general review of the job be made to obtain an overall picture of its completeness. Any unusual conditions which have had an affect on the engineering performance and which may not as yet have been recorded in the Job Folder should be recorded at this time.

As an assurance that the job as a whole has been properly coordinated in accordance with the plan previously prepared, it is advisable that the switchboard, cabling and power engineers discuss, in common, their respective portions of the job, giving special consideration to the interpretation of the information forms passed between themselves, and to the provisions made for any customer's changes.

1. Review of Telephone Company's Specification and Job Folder

The Telephone Company's specification and the job folder should be reviewed to make sure that proper action has been taken on all items. In case there are any items that cannot be completed, a follow-up record should be made of them to insure their completion at the earliest possible date.

2. Arrangement of Papers for Future Reference

The Telephone Company's specification, the job folder and copies of the typed job specifications should be accurately designated and filed in an orderly manner to facilitate ready reference. This information may be retained until the time of final billing, when the specifications should be sent to file and all other papers destroyed, first checking the job folder to see that no original copies of correspondence have been filed therein.

3. Appendices

Appendices are written to a job specification when, due to changes by the Telephone Company, due to errors in the Equipment Engineering Departments, due to information not being available at time spec. was written, etc., it is necessary to add, remove, or change any of the information or material ordered. (See Eng. Handbook for details.)

4. Answering Complaints (Including JIM's from Installer) (See Engineering Handbook, Section 11)

The engineering job is not finished until the central office is turned over to the Telephone Company. During the manufacturing and installing periods some complaints due to misunderstanding, faulty information, and unforeseen events are to be expected. The proper attitude toward these complaints is essential to a happy and well-balanced existence. The engineer must realize that a complaint means that the installer or shop is unable to proceed with the particular item until more information is forthcoming. It is well worth the engineer's time to cultivate the good will of the shop people, the installer, and all other employees whom he contacts in his work.

When answering letters from the Installer (JIM's) avoid abrupt replies. Give full information so that the Installer will understand the solution to his problem. When writing requisitions ordering additional equipment, refer to the specification and item numbers, show why ordered, and sign with name and department number.

5. Final Correction of Office Records

Changes in records arising during the course of the installation and which may affect other jobs in process should be made as soon after their receipt as possible.

At the time of receiving the final marked prints from the installer it is important that all necessary changes be made in the job records. The prints as received from the installer should be examined closely, to determine any possible effect of the location changes on other jobs on which the engineering has been started, or possibly completed.

The active cooperation of both the engineer and the installer is necessary in using this means to provide the basis for orderly and efficient work on all subsequent orders.