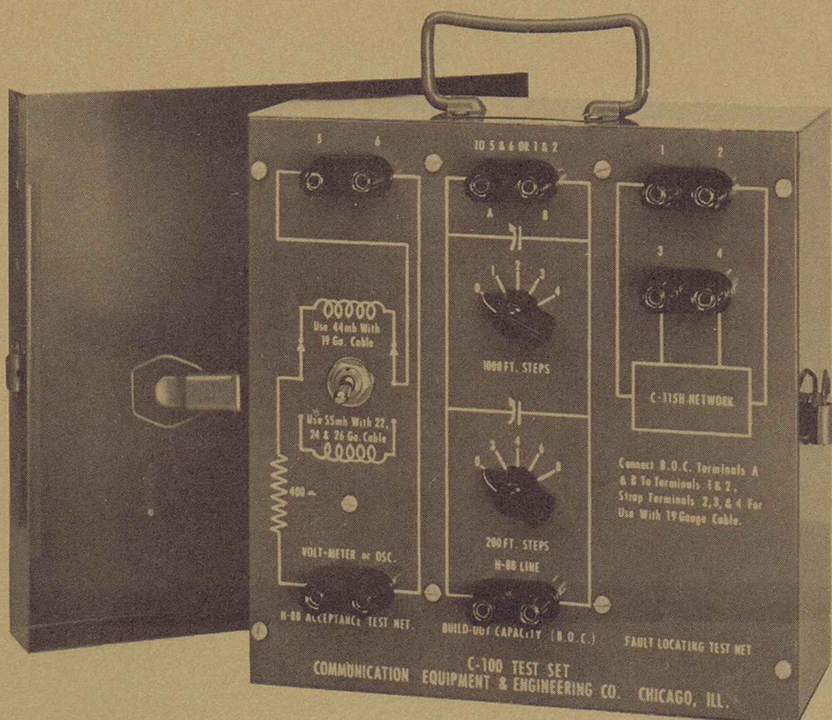
CEECO C-100 TEST SET



INSTRUCTIONS
for
H88 LOADED CABLE ACCEPTANCE TESTS
AND LOCATION OF LOADING IRREGULARITIES
using the
CEECO C-100 TEST SET

COMMUNICATION EQUIPMENT & ENGINEERING CO.
5646 West Race Avenue • Chicago 44, Illinois

CONTENTS

H88 Loaded Cable Acceptance Tests
and Location of Irregularities
using the CEECO C100 Test Set

ACCEPTANCE TEST - H88 LOADED CABLE

(Two C100 Test Sets are required.)

The following instructions outline a method of accurately making transmission loss measurements of loaded cable pairs to determine if irregularities are present.

> This method is based on the fact that the transmission loss variations of a loaded cable pair containing impedance irregularities will be greater than for a normally loaded pair. This will be particularly noticeable at frequencies near the cut-off point of the loading system.

To obtain accurate transmission measurements on loaded cable, it is necessary that an Acceptance Test Network (part of CEECO C100 Test Set) be used to properly match the cable impedance to the 600 ohm test equipment (see Fig. 2).

If 600 ohm test equipment is connected directly to the loaded cable pair, this mis-match itself causes appreciable error, particularly at the higher frequencies.

For this test, a balanced 600 ohm oscillator and 600 ohm voltmeter are required. If the oscillator or measuring set is unbalanced, an isolating transformer or repeating coil is required

PROCEDURE:

The measured loss is compared with the computed loss at 1000 and 3000 cycles per second for H88 loading. The amount of deviation indicates the magnitude of the impedance irregularity.

Step #1. Compute the loss at 1000 and 3000 cps for the gauge and length of the pairs to be tested (see attached CEECO Form 418).

Step #2. Calibrate the test equipment and check to determine that the level at 1000 and 3000 cps agree or determine the amount of correction to be applied to the readings (see attached Fig. 1).

Step #3. Connect the C100 Acceptance Test Networks and test equipment to both ends of the cable pair to be tested and adjust the capacitance Build-Out of the Test Sets to build-out the cable end-sections to 4800 feet. For use on low capacity cable (less than .075 mf/mile) multiply steps on B.O.C. dials by 0.8 (see attached Fig. 2).

The inductor switch should be in the 44mh position for use with 19 gauge cable and in the 55mh position for use with 22, 24 or 26 gauge cable.

It will be necessary, of course, to provide a talking circuit between the test locations.

Step #4. Measure the transmission loss of one cable pair at 1000 cps and 3000 cps and compare the measured loss with the computed loss figures obtained in Step #1. Then measure other similar cable pairs at 3000 cps only. Any readings that vary more than about 1 db from the first warrant further investigation.

ANALYSIS:

The measured deviation between 1000 and 3000 cps should not exceed the computed deviation by more than about 1 db.

Irregularities due to load coil spacings, bridged tap, or mixed gauge cable cause as much as about 2 db greater measured deviation than was computed.

However, if the measured deviation exceeds the computed deviation by more than 3 db, a major irregularity such as an omitted or incorrectly installed load coil is present and further tests are required to locate the fault. These tests are described in the section of this Memorandum entitled **LOCATION OF IMPEDANCE IRREGULARITIES - H88 LOADED CABLE.**

NOTE:

The two Acceptance Test Networks used in this test have a total transmission loss of 4.5 db. If the absolute loss of the loaded circuit is desired, substract 4.5 db from the readings obtained in Step #4.

LOCATION OF IMPEDANCE IRREGULARITIES - H88 LOADED CABLE

If after making H88 Loaded Cable Acceptance Tests, major irregularities are indicated, they can be located by the following method. This approach is adequate for loaded cable lengths up to about 12 load coils. Longer lengths should be sectionalized.

This method of locating faults causing impedance irregularities in loaded cable pairs is bassed on the fact that an irregularity causes some of the sending power to be reflected to the source. The reflected power may aid or oppose the sending power depending upon the phase relationship at any particular frequency.

The frequency difference between the aiding power and the opposing power can be detected by connecting a 600 ohm transmission measuring set in series with a 600 ohm variable frequency oscillator applying the test power to the cable pair. As the frequency is varied from 150 cycles to 3500 cycles, the variations in the measuring set readings at various frequencies can be used as a basis for computing the severity and the location of the fault.

TEST PROCEDURE:

The following procedure outlines a test method and the attached charts and figures will assist in the analysis of the results.

Before proceeding with the tests, make direct currents and Wheatstone bridge measurements to determine if the fault is due to an open, short, ground, cross or resistance unbalance. Correct all physical pair troubles and if the Acceptance Tests still indicate trouble, proceed with the following tests.

Step #1. At the testing end, connect the oscillator and measuring set in series directly to thé cable pair (see Fig. #3).

Step #2. The far end of the cable pair must be terminated in a C115H Network to provide a smooth termination. This is necessary to avoid reflections from the end of the line that would be caused by an open or short or just a resistor. The C115H Network in the C100 Test Set is the same type of balancing network as that used with hybrid type repeaters. Use of the C115H Network for low capacity cable (less than .075 mf/mile) results in negligible error.

The C115H Network requires a full 6000 foot section for proper termination, however, the Network has inherent capacitance equivalent to about 900 feet of cable so the loaded cable end-

Step #2 (Cont'd.)

section plus Build-Out Capacitor on the C100 Test should equal about 5100 feet. (An error of 100 feet is negligible.)

Connect the cable pair to the B.O.C. line terminals and the C115H network terminals to B.O.C. terminals A and B. Strap Network terminals 2, 3 and 4 are for use with 19 gauge and 16 gauge cable. No strapping is required for 22, 24 or 26 gauge cable.

Step #3. Use CEECO Form 419 (see Fig. 4A, B, etc.) or equivalent to record the measuring set readings at each frequency at which a minimum or maximum reading occurs. Start at 150 cycles and slowly increase the oscillator frequency and watch the measuring set reading. Plot the maximum and minimum db readings of peaks and valleys on the chart at the frequencies at which they occur up to 3500 cycles (see sample chart, Figures 4A, B, C, D, E, F).

Count the total number of prominent peaks between 200 and 3500 cycles. The number of peaks or valleys indicates the number of load coil points up to the irregularity.

FOR EXAMPLE: If the 4th coil is missing or is spliced incorrectly, there will be 3 peaks and 3 valleys.

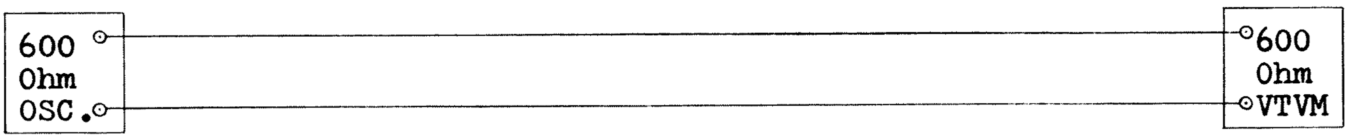
Step #4. Repeat the preceding 3 steps at the other end of the cable pair. This will provide a check on the location of the irregularity.

As it is impractical to find irregularities beyond the 6th load coil, measurements from both ends will allow a practical maximum test distance of 12 load sections.

Refer to Table 7 and compare the frequency location of the measured peaks and valleys with the approximate frequencies at which they theoretically occur. The faulty loading point is shown at the top of the frequency column.

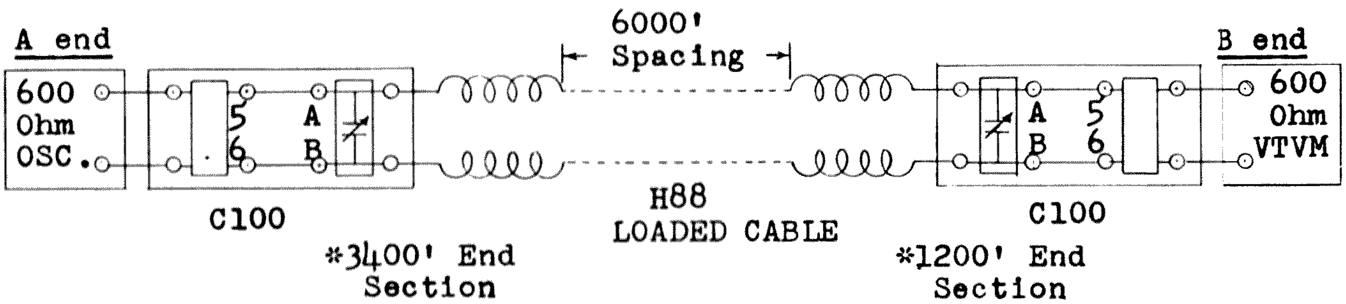
If the fault is at the first load point, no significant peaks or valleys will be measured.

The C100 was designed for use on H88 systems only in the belief that this would meet the great majority of requirements. A universal test set for use with all types of loading would have made the cost prohibitive for common usage. This would also complicate the instructions. C100 type test sets for other loading systems will be supplied on request at very reasonable prices.



To calibrate, adjust sending level of oscillator to read 0 dbm on VTVM at 1000 cps, then note change in VTVM reading with oscillator at 3000 cps without changing oscillator ouput level.

FIGURE 1

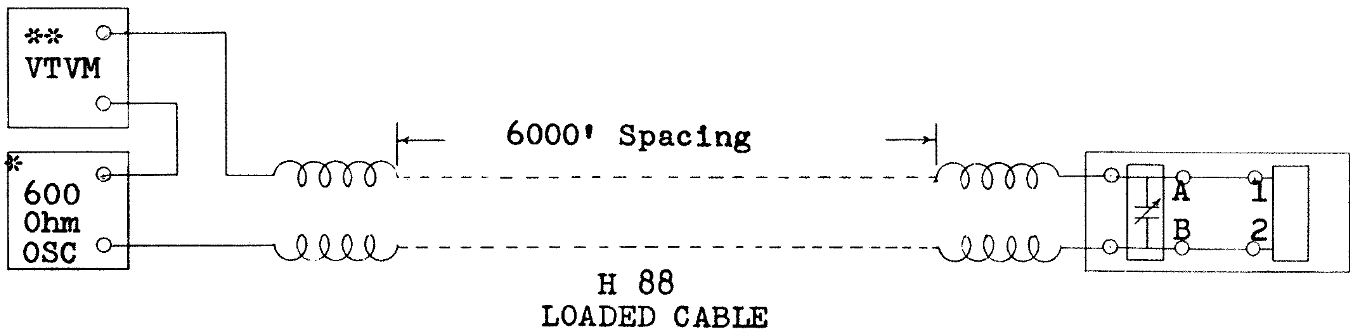


* Example:

At A end adjust Capacity Build-Out 1400' to equal .8 section or 4800'

At B end adjust Capacity Build-Out 3600' to equal .8 section or 4800'

FIGURE 2



Note 1: End section adjacent to measuring set should be less than 6000'

Note 2: Build-Out end section adjacent to C115H to approximately 5100' with Build-Out Capacitor on C100 Test Set

* Hewlett-Packard 2000CD or equivalent

** CEECO C16A
WECO 12B
Triplet)with 600 ohm re-
or)sistor across in-
Simpson)put. 3 volt scale.

or equivalent 600 ohm balanced VTVM without coil input.

FIGURE 3

Table 1

Position number of omitted or defective loading coil in relation to approximate frequency.

	Coil # 2	3	4	5	6
1st Valley	1100	600	420	320	250
1st Peak	2800	1750	1230	950	970
2nd Valley		2700	2000	1600	1300
2nd Peak		3300	2600	2100	1750
3rd Valley			3100	2600	2170
3rd Peak			3400	3000	2550
4th Valley				3300	2900
4th Peak				3420	3150
5th Valley					3360
5th Peak					3470

Approximate frequencies at which the peaks and valleys theoretically occur.

Cable No._____ Pairs_____thru_____ ·Number of Load Points_____

CABLE MAKE-UP

C100 Test Set X indicates load coil C100 Test Set

COMPUTED DEVIATION: 1000 CPS TO 3000 CPS.

Cable Gauge*	Length in Kilo feet	Transmission Loss (db) 1000 CPS	Transmission Loss (db) 3000 CPS
19 HC		x .080 =	x .103 =
19 LC		x .071 =	x .080 =
22 HC		x .149 =	x .168 =
24 HC		x .232 =	x .259 =
24 LC		x .215 =	x .230 =
26 HC		x .341 =	x .375 =
26 LC		x .320 =	x .340 =
Total			

Computed Deviation 3000 CPS - 1000 CPS =

Measured Deviation 3000 CPS - 1000 CPS =

* High Cap (HC) greater than .075 MF/mile;
Low Cap (LC) less than .075 MF/mile.

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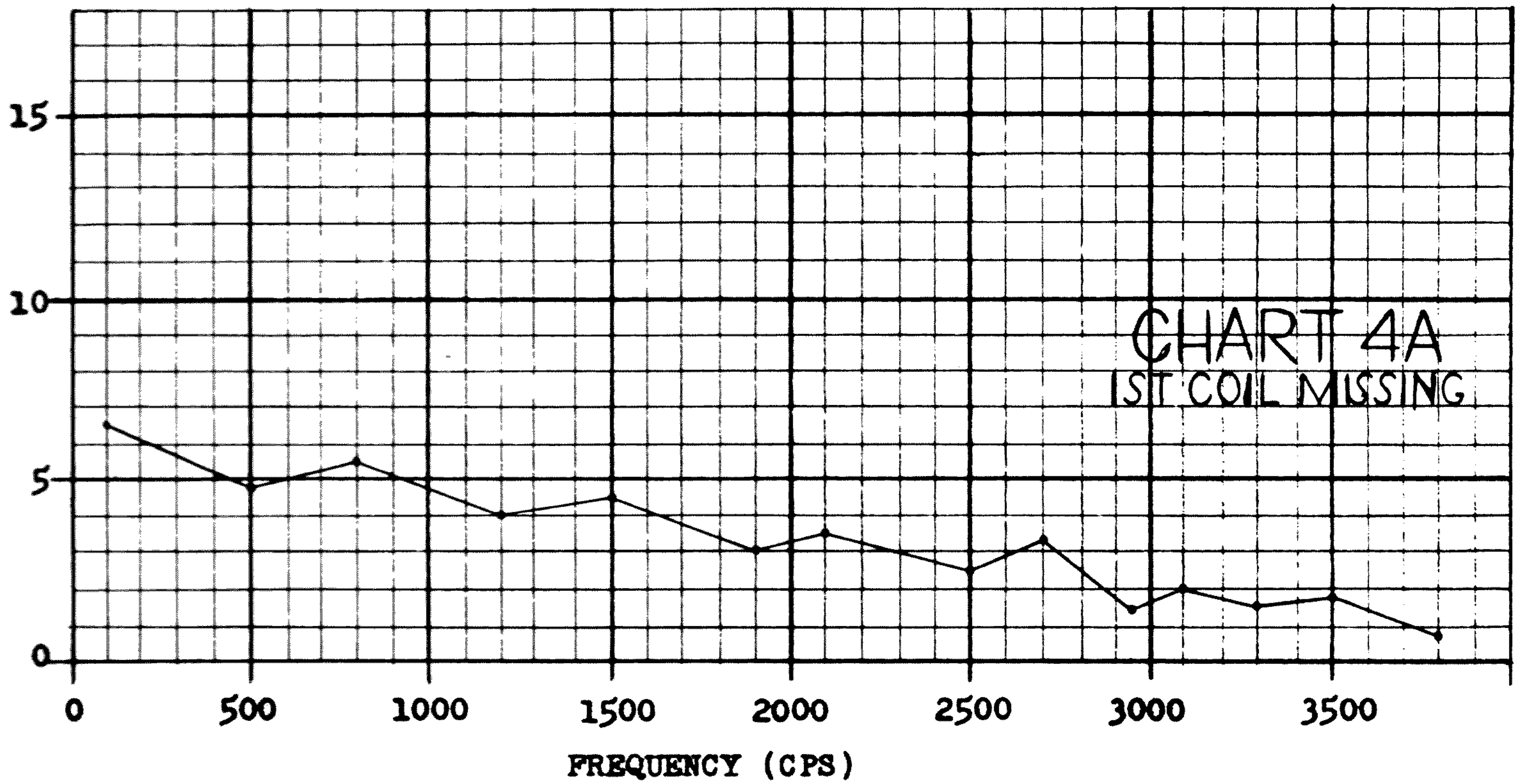
5646 W. RACE AVE.
CHICAGO 44, ILL.

H 88 LOADED CABLE ACCEPTANCE TESTS

3/22/60 | 1
CHECKED APPROVED ISSUE

FORM NO. 418



Cable No.____________ Loading System_________________

Pairs_______thru_____

C100 Test Set

Distance to Load Points

C.O. ——— C115H Net

Cable Length and Gauge

CABLE MAKE-UP

Build-Out Req.______________

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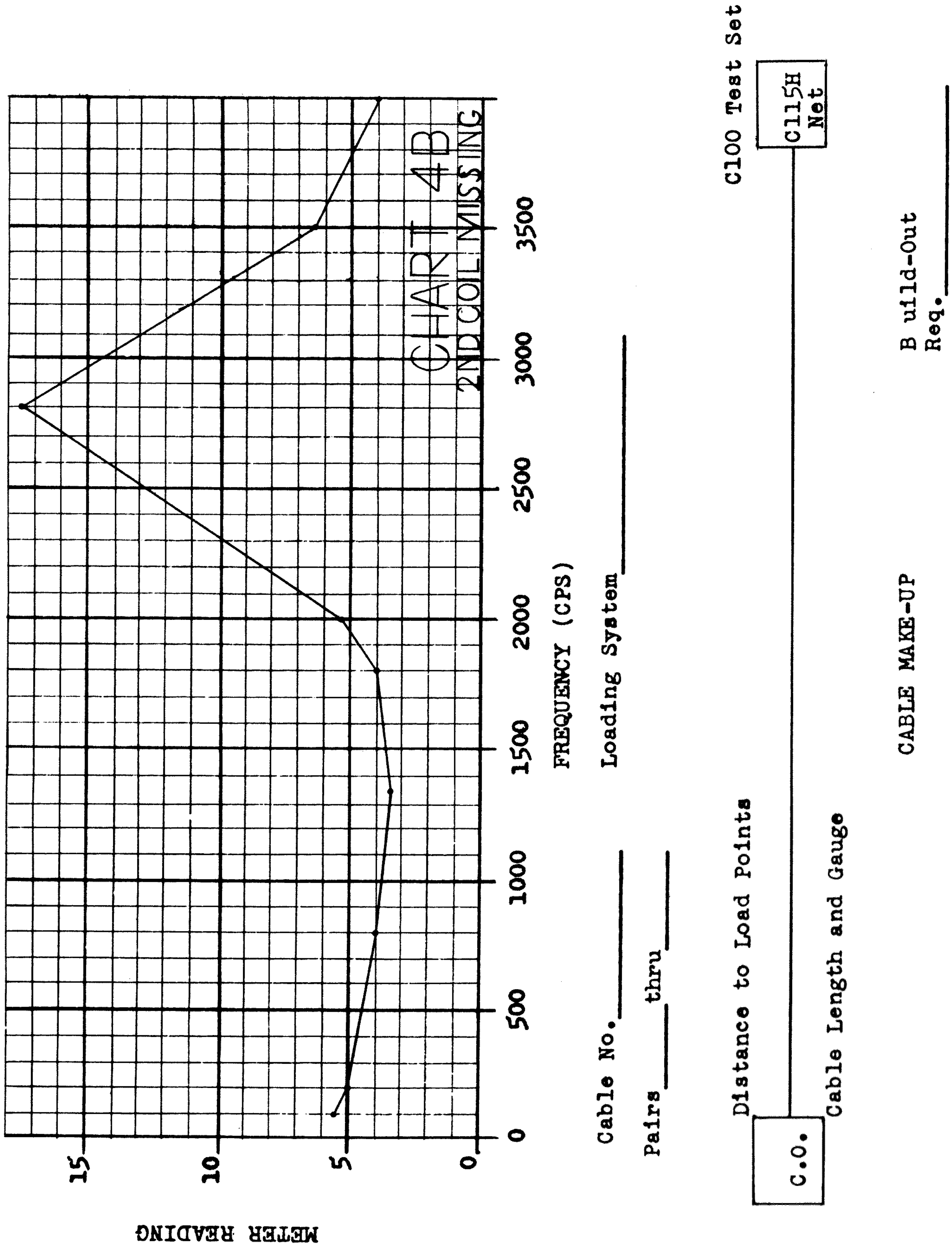
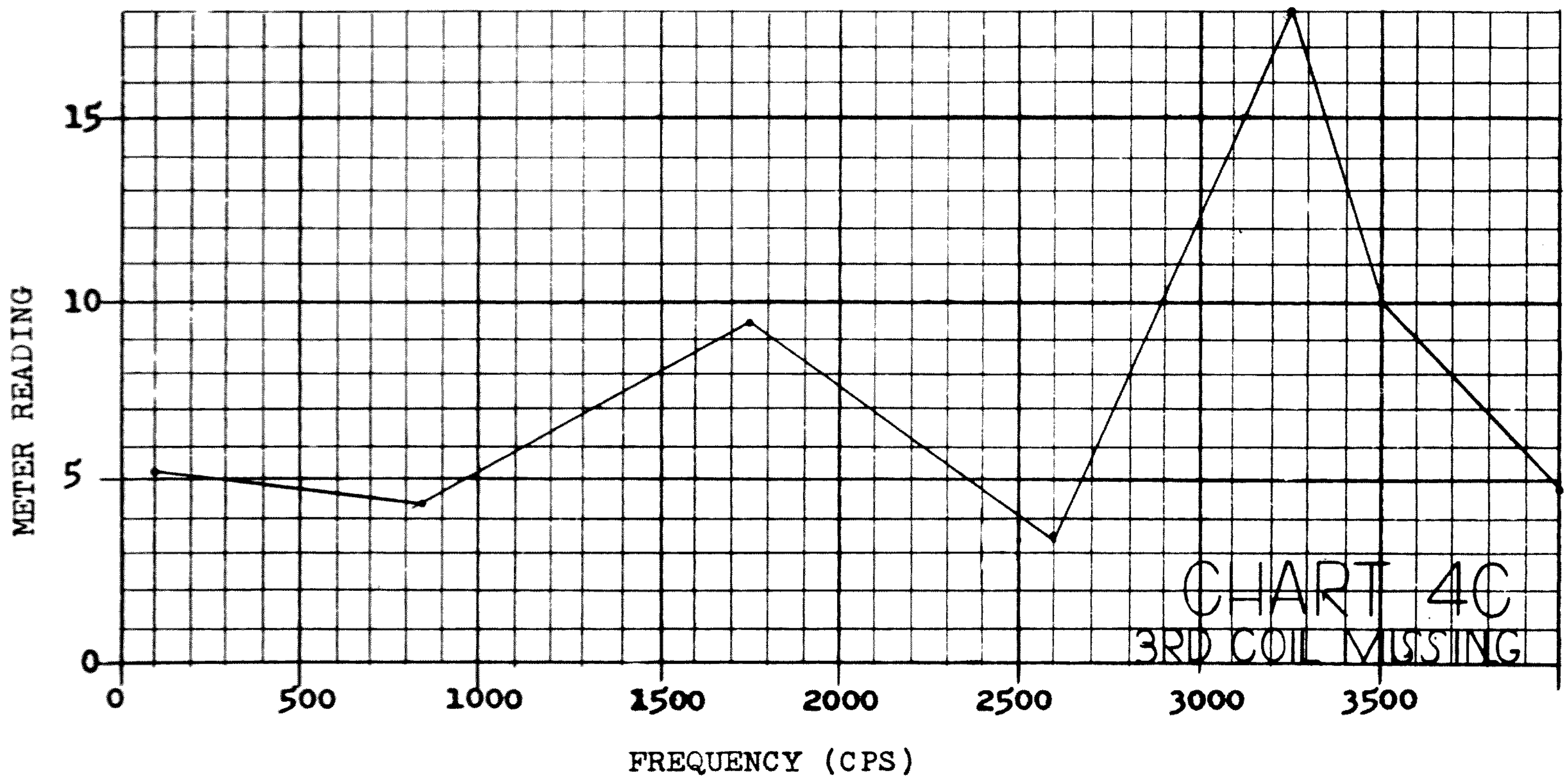
LOADED CABLE FAULT LOCATION MEASUREMENTS

2/1/60	1
CHECKED	APPROVED DK ISSUE

FORM 419



COMMUNICATION EQUIPMENT & ENGNRG. CO. 5646 W. RACE AVE. CHICAGO 44, ILL.	LOADED CABLE FAULT LOCATION MEASUREMENTS	2/1/60 — ISSUE 1 CHECKED APPROVED DK FORM 419



Cable No.____________ Loading System________________

Pairs______thru______

C100 Test Set

Distance to Load Points

Cable Length and Gauge

CABLE MAKE-UP

Build-Out Req.____________

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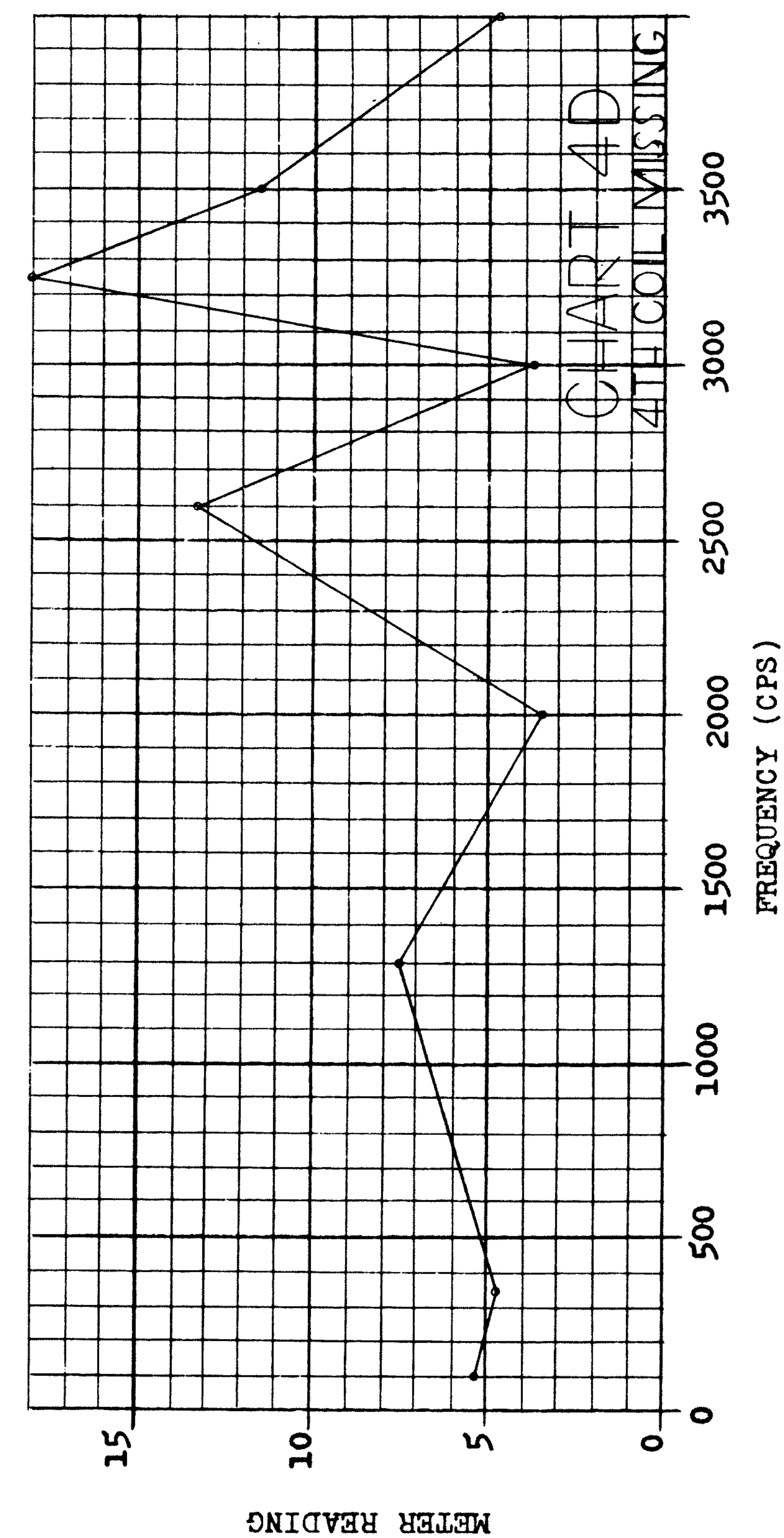
CHICAGO 44, ILL.

LOADED CABLE FAULT LOCATION MEASUREMENTS

.1/60		1
CHECKED	APPROVED RK	ISSUE
FORM 419		



Loading System ______

Cable No. ______

Pairs ______ thru ______

C100 Test Set

C115H Net

Build-Out Req. ______

CABLE MAKE-UP

Distance to Load Points

C.O.

Cable Length and Gauge

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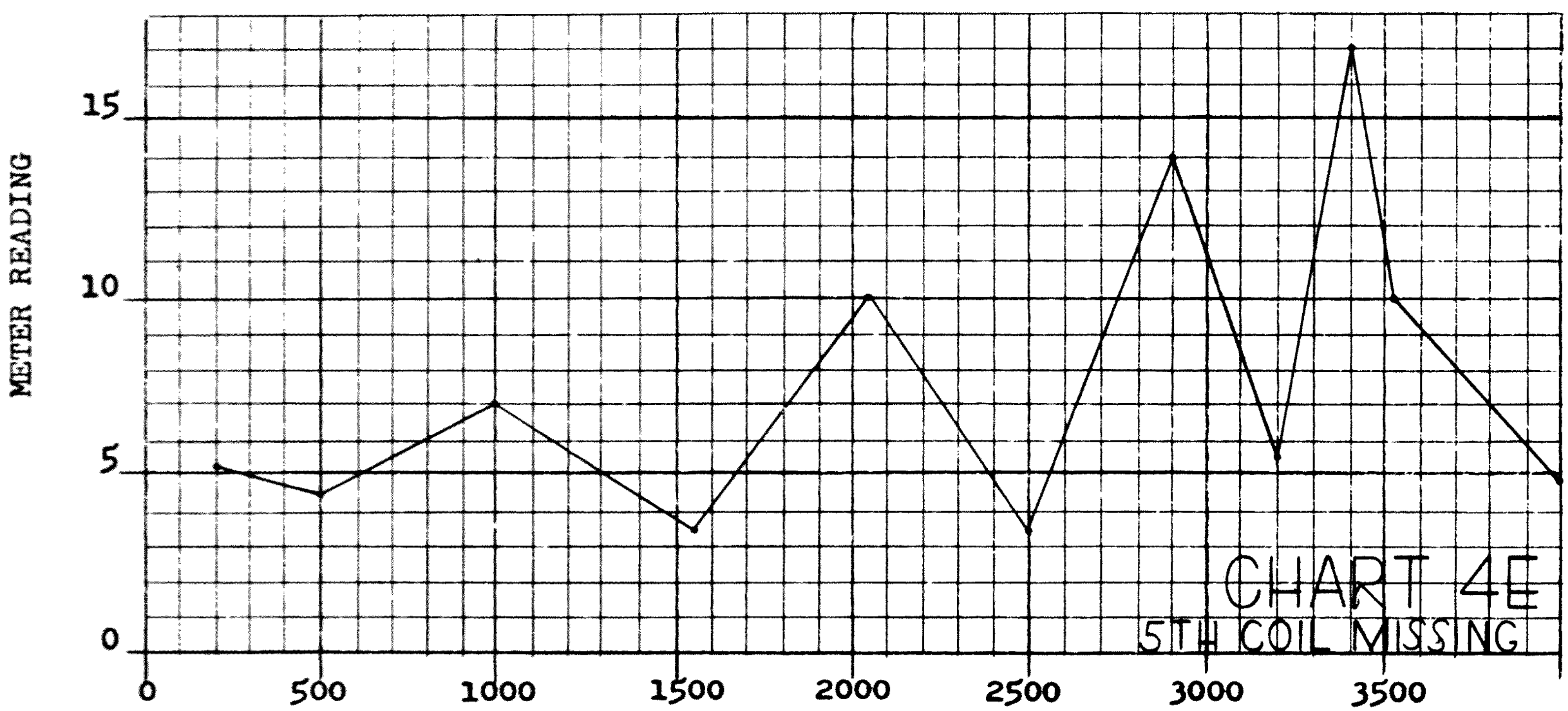
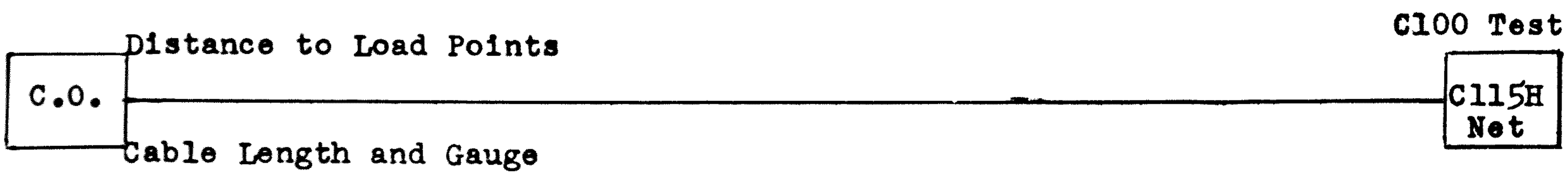


Cable No.____________ Loading System____________

Pairs________ thru_____



CABLE MAKE-UP

Build-Out Req.____________

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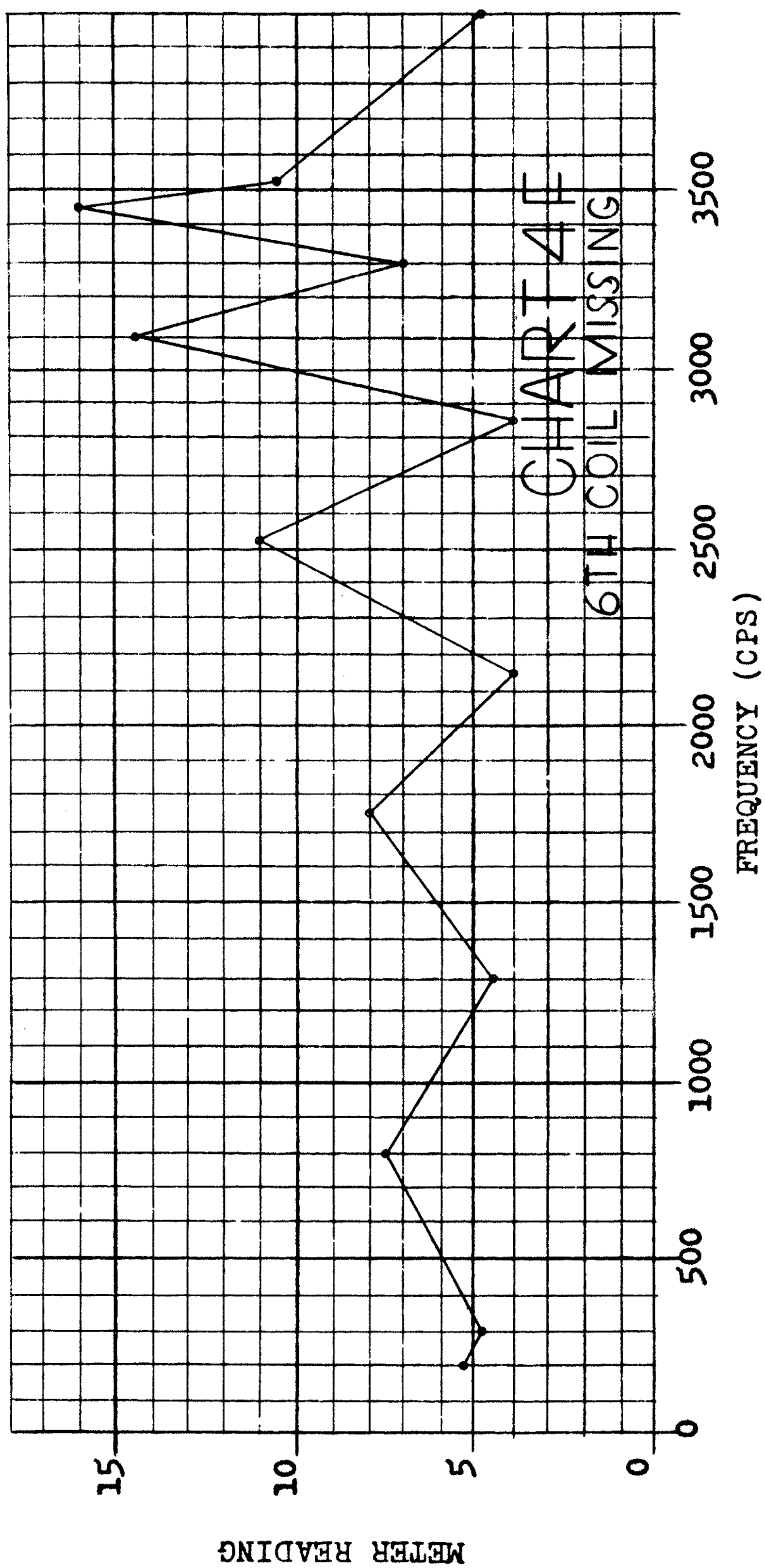
CHICAGO 44, ILL.

LOADED CABLE FAULT LOCATION MEASUREMENTS

2/1/60		1
CHECKED	APPROVED DK	ISSUE

FORM 419



Loading System ______

Cable No. ______

Pairs ______ thru ______

C100 Test Set

C115H Net

Distance to Load Points

C.O.

Cable Length and Gauge

CABLE MAKE-UP

Build-Out Req. ______

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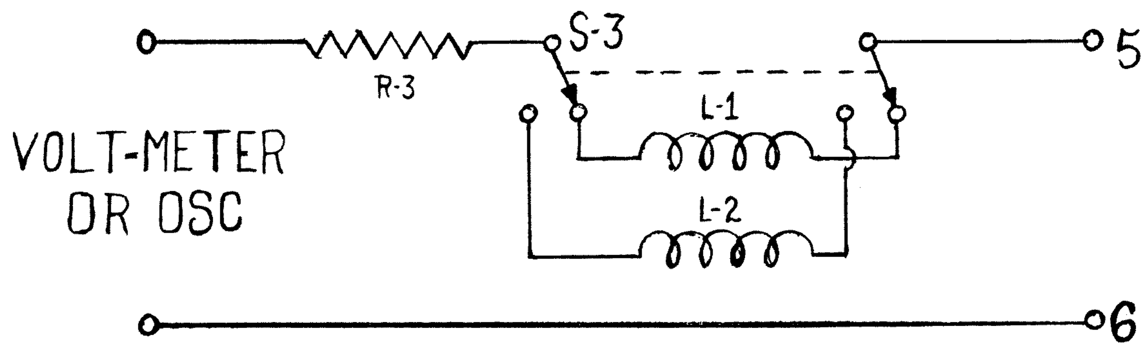
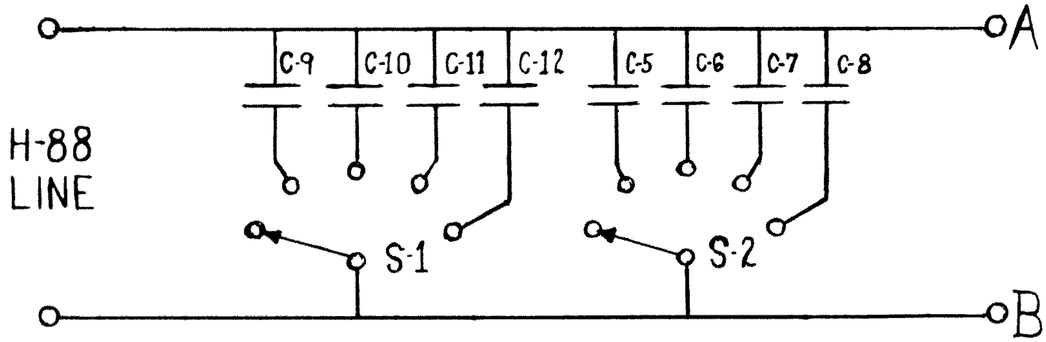
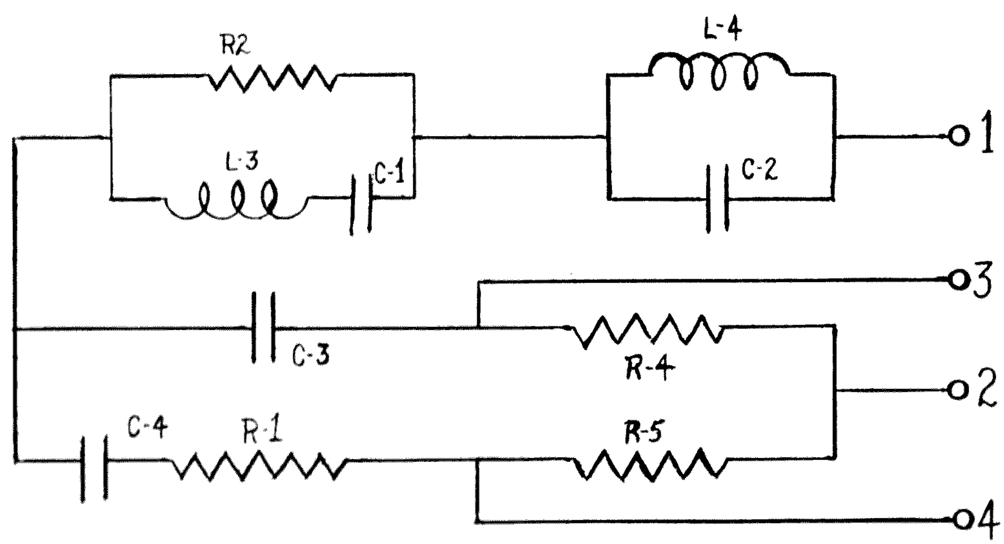


H-88 IMPEDANCE COMPENSATOR



BUILD-OUT CAPACITY



C-115H IMPEDANCE BALANCING NET

PART LIST 950-44A

COMMUNICATION EQUIPMENT & ENGNRG. CO. 5646 W. RACE AVE. CHICAGO 44, ILL.	C-100 TEST SET	1 - 30 - 60 ISSUE 1 BJS CHECKED HB APPROVED JK 950 - 43A

PARTS LIST

C-100 TEST SET

CODE	TYPE AND RATINGS	PART NO.
S-1	1 Pole 11 position Rotary Switch	PA 1001
S-2	" " " "	PA "
S-3	DP-DT Toggle Switch	CH-8363 K-8
L-1	44.00 MH Toroid	638
L-2	55.00 " "	P-3-152
L-3	257.20 " "	P-3-153
L-4	40.36 " "	P-3-151
C-1	.00790 MFG ± 10% 400 V. D.C.	
C-2	.0310 "	
C-3	.759 "	
C-4	1.08 "	
C-5	.0032 "	
C-6	.0064 "	
C-7	.0096 "	
C-8	.0128 "	
C-9	.016 "	
C-10	.032 "	
C-11	.048 "	
C-12	.064 "	
R-1	200 Ohm 1 W Carbon Resistor ± 10%	
R-2	1000 Ohm 1 W " "	
R-3	400 Ohm 1 W " ± 1%	
R-4	85 Ohm 1 W " "	
R-5	1600 Ohm 1 W " "	
Binding Post		Grayhill 29-1

See Drawing 950-43A

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CHKD: NB
APPD.: DK
1/30/60
Dwg. #950-44A