James E. Stewart and Associates, Inc.
CONSULTING ENGINEERS AND LAND SURVEYORS
Jacksonville, North Carolina

FLOW TEST REPORT

SHOWING

"C" FACTOR DATA

FOR

WATER MAIN CLEANING

NAVFAC SPEC. 05-82-2319

MARINE CORPS AIR STATION, NEW RIVER

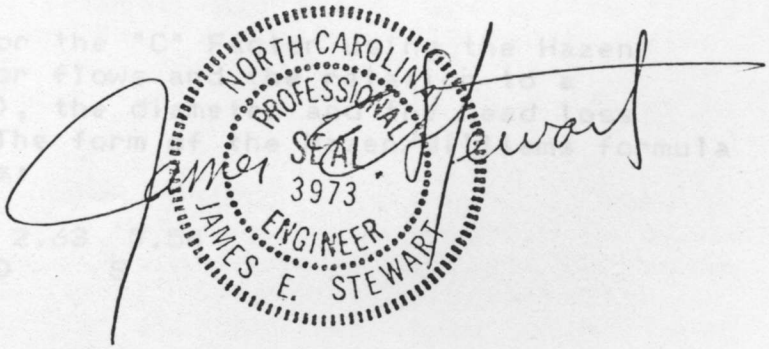
CAMP LEJEUNE, NORTH CAROLINA

CONTRACTOR:

J.P. SEWOROTOR, INC.

ROCKVILLE, MARYLAND

JUNE 29, 1984



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NARRATIVE:

Personnel from the Consulting Engineer firm of James E. Stewart and Associates, Inc., Jacksonville, North Carolina conducted a series of test at the Marine Corp Air Station(H), New River, Camp Lejeune, North Carolina for the contracting firm of J.P. Seworotor, Inc., Rockville, Maryland to determine the pressure and flow characteristics necessary to make calculations to determine the "C" Factor for the water mains which had been opened up, cleaned, and then put back into service.

The personnel from James E. Stewart and Assoicates, Inc. were accompanied by an employee of the Public Works Department at Camp Lejeune to assist in the location of the valves and the opening and closing of the valves and the fire hydrants. The personnel from James E. Stewart and Associates, Inc. made all the reading for flow and pressure.

The calculations for the "C" Factor using the Hazen/ Williams formula for flows and the relation to a constant factor (C), the diameter and the head loss characteristics. The form of the Hazen/Williams formula used was as follows:

$$Q = 0.432\ C\ D^{2.63}\ S^{0.54}$$

and then upon manipulation of that formula, the actual calculations were made using:

$$C = \frac{Q}{0.432\ D^{2.63}\ S^{0.54}}$$

Q = Flow of water in the pipe in gallons per minute.

S = Head loss due to friction in PSI.

D = Nominal inside Diameter of pipe in inches.

C = constant coefficient dependent upon surface roughness.

The test kit used was the Joseph G. Pollard Company's Test Kit for measuring pressure and flow at fire hydrants. The test consisted of the reading the static pressure with no water flowing after isolating two hydrants. This was followed by opening up the hydrant to it's maximum flow through the 2 1/2-inch fire hose connection nozzle and then reading the residual pressure with the water flowing.

Generally, the test were made between each of two adjacent hydrants. However, at some location where the results could be taken with confidence, one or more hydrants might be skipped with the test being made at a two or three hydrant interval. Also there were some instances where the tests were made between hydrants which were around the corner from each other on different loops.

The test data was taken and recorded and the calculations made without allowing for minor losses occurring at the bends, contractions into the hydrants, valves, fittings, and other such minor losses.

The fire hydrant locations, main sizes, and system layouts used is as shown on the map in the back of this report. The numbers shown thereon are the ones which will be used in the tables showing the "C" Factor data and calculations (Pages 1, 2, and 3 of 3 pages).

There were significant difficulties in trying to make the tests in the area of the 518 Maintenance Hanger, 515 Maintenance Hanger, and 504 Maintenance Hanger. No tests could be run in the area of Building 518 and 515 because of a combination of factors. One factor was that a connection could not be found between the 18-inch main and the 8-inch main in the vicinity of fire hydrants 1 and 2. In the area between hydrants 58 and 12 and 13 and on to hydrant number 24 either the valves could not be found or they could not be operated sufficient to isolate any of the areas for making the flow tests.

Also in this same area, it appeared from attempting to make the test that there were water lines taking off of the 12 and 16-inch mains which could not be found and were not shown on the plans. In the area of Hanger 504 and Warehouse 424, i.e., the area for hydrants 20, 19, etc., 14, and back to 61, no reliable test could be run (although they were attemped in all of these areas) because of the fact that there were obviously mains connected into the system that were not shown and could not be found, as well as the fact that they were also valves that could not be properly opened or closed for the isolation tests sections.

In the whole of the industrial area, that is, that portion lying South of Curtis Road, the test results cannot be considered reliable because of the many interference problems with isolating the hydrants, making reliable tests, etc. It was impossible to keep the pressures and flows constant enough to be confident in the data that was being collected because of the variations in water usage for the area, resulting in a differential of water available for making the tests, as well as a lack of confidence in the water mains shown being the actual system as is undergound and in use in the industrial area.

TABLE SHOWING C-FACTOR DATA AND CALCULATIONS

FIRE HYDRANT NO.	FLOW (gpm)	PIPE LENGTH (feet)	PIPE DIAMETER (inches)	STATIC PRESSURE (psi)	RESIDUAL PRESSURE (psi)	TOTAL LOSS (psi)	LOSS PER 1,000	"C"
42→ 48	710	1900	6"	(42) 67 (48) 67	48 18	30	36.47	135
42→ 43	700	1930	6"	(42) 72 (43) 72	48 17.5	30.5	36.51	134
42→ 62	580	4054	6"	(42) 72 (62) 72	52 12	40	22.79	142
60→ 53	740	615	6"	(60) 72 (53) 72	36 19.5	16.5	61.95	106
47→ 46	790	1653	6"	(47) 70 (46) 70	48 22	26	36.33	151
42→ 40	820	876	6"	(42) 67 (40) 67	42 24	18	47.47	136
42→ 39	630	3290	6"	(42) 70 (39) 70	51 14	32	22.47	156
38→ 34	670	1000	6"	(38) 72 (34) 72	33 16	17	39.27	123
32→ 33	965	450	6"	(32) 81 (33) 81	50 33	19	97.53	108
33→ 34	860	494	6"	(33) 82 (34) 82	43 26	17	79.49	108
34→ 35	810	488	6"	(34) 82 (35) 82	35 23	24	113.61	83
35→ 36	780	312	6"	(35) 82 (36) 82	30 21	9	66.63	108

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FIRE HYDRANT NO.	FLOW (gpm)	PIPE LENGTH (feet)	PIPE DIAMETER (inches)	STATIC PRESSURE (psi)	RESIDUAL PRESSURE (psi)	TOTAL LOSS (psi)	LOSS PER 1,000	"C"
28→ 26	1110	432	10"	(28) 84 (26) 84	55 44	11	58.82	43
26→ 24	1030	746	10"	(26) 83 (24) 83	50 38	12	37.16	45
24→ 2	1010	1023	8"	(24) 83 (2) 83	43 36	7	15.81	140
2 → 4	970	580	8"	(2) 84 (4) 84	42 33	9	35.84	87
24→ 23	1030	577	10"	(24) 83 (23) 83	45 38	7	28.02	60
23→ 22	1030	345	10"	(23) 83 (22) 83	43 38	5	33.48	54
22→ 60	980	244	10"	(22) 84 (60) 84	45 34	11	104.14	28
22→ 52	1000	1611	10"	(22) 83 (52) 83	47 35	12	17.21	76
21→ 56	1210	746	10"	(21) 65 (56) 65	57 53	4	12.39	109
56→ 57	1155	284	10"	(56) 67 (57) 67	57 48	9	73.20	40
57→ 50	1030	267	10"	(57) 67 (50) 67	57 38	19	164.38	23
53→ 51	1010	840	8"	(53) 74 (51) 74	53 36	17	46.75	78
51→ 59	920	1165	8"	(51) 70 (59) 70	46 30	16	31.73	88
53→ 31	880	720	8"	(53) 65 (31) 65	56 27	29	76.13	53

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FIRE HYDRANT NO.	FLOW (gpm)	PIPE LENGTH (feet)	PIPE DIAMETER (inches)	STATIC PRESSURE (psi)	RESIDUAL PRESSURE (psi)	TOTAL LOSS (psi)	LOSS PER 1,000	"C"
60→ 21	1090	360	16"	(60) 98 (21) 98	48 42	6	38.50	15
21→ 20	1190	351	16"	(21) 65 (20) 65	58 51	7	46.07	15
20→ 19	1210	375	16"	(20) 65 (19) 65	59 53	6	36.96	17
18→ 16	1200	294	14"	(18) 65 (16) 65	57 52	5	39.29	23
16→ 15	1200	219	14"	(16) 75 (15) 75	58 52	6	63.29	18
22→ 14	1010	1960	16"	(22) 72 (14) 72	49 36	13	15.32	23
22→ 14	1010	666	16"	(22) 71 (14) 71	56 36	20	69.37	10

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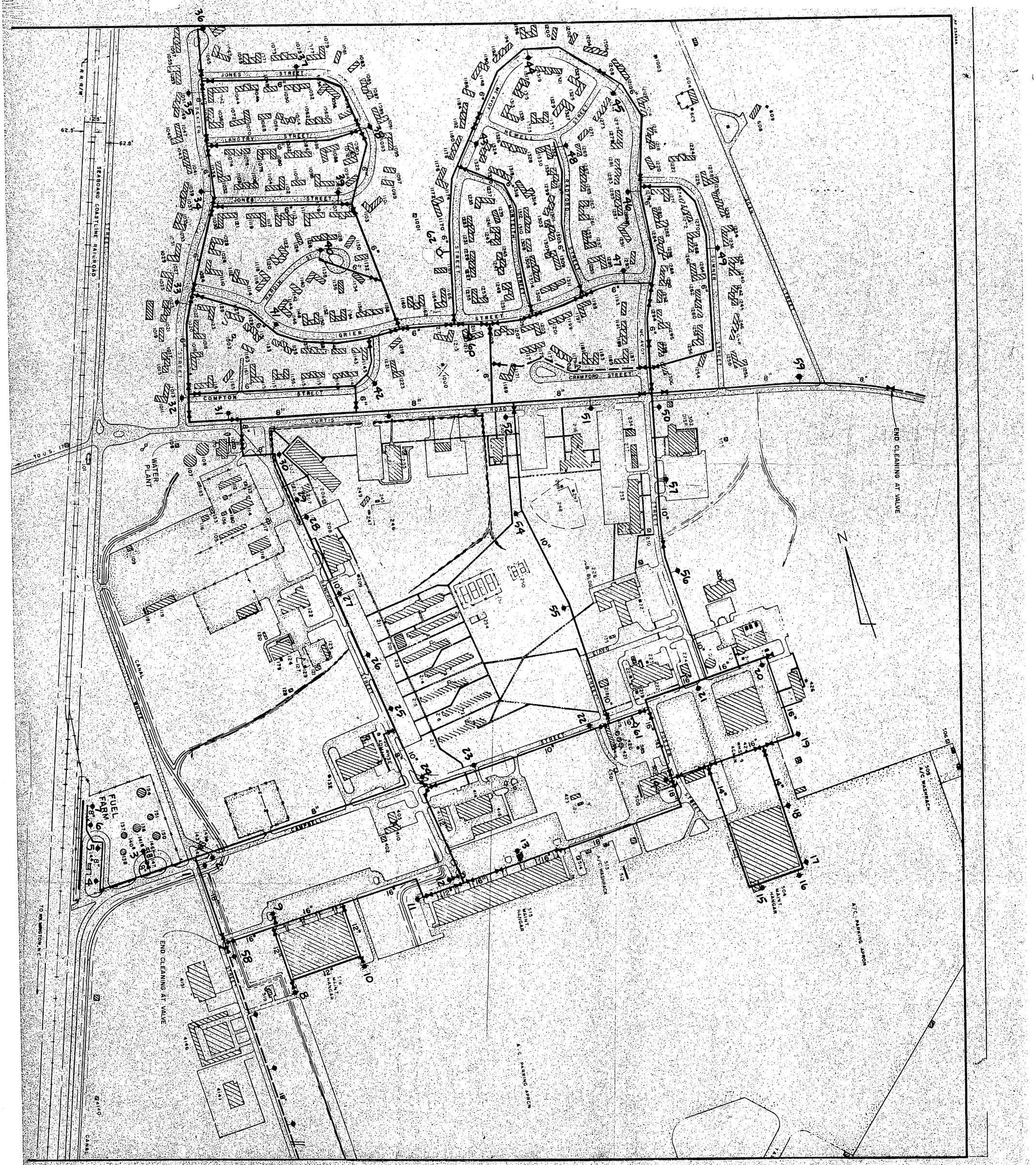

INDEX MAP SHOWING FIRE HYDRANT NUMBERS

FOR CONTRACTOR: J.P. SEWERCOTER, INC.
ROCKVILLE, MARYLAND.

PROJECT: CLEAN WATER MAINS
MARINE CORPS AIR STATION
NEW RIVER, NORTH CAROLINA
NAVFAC SPEC. NO. 05-82-2319

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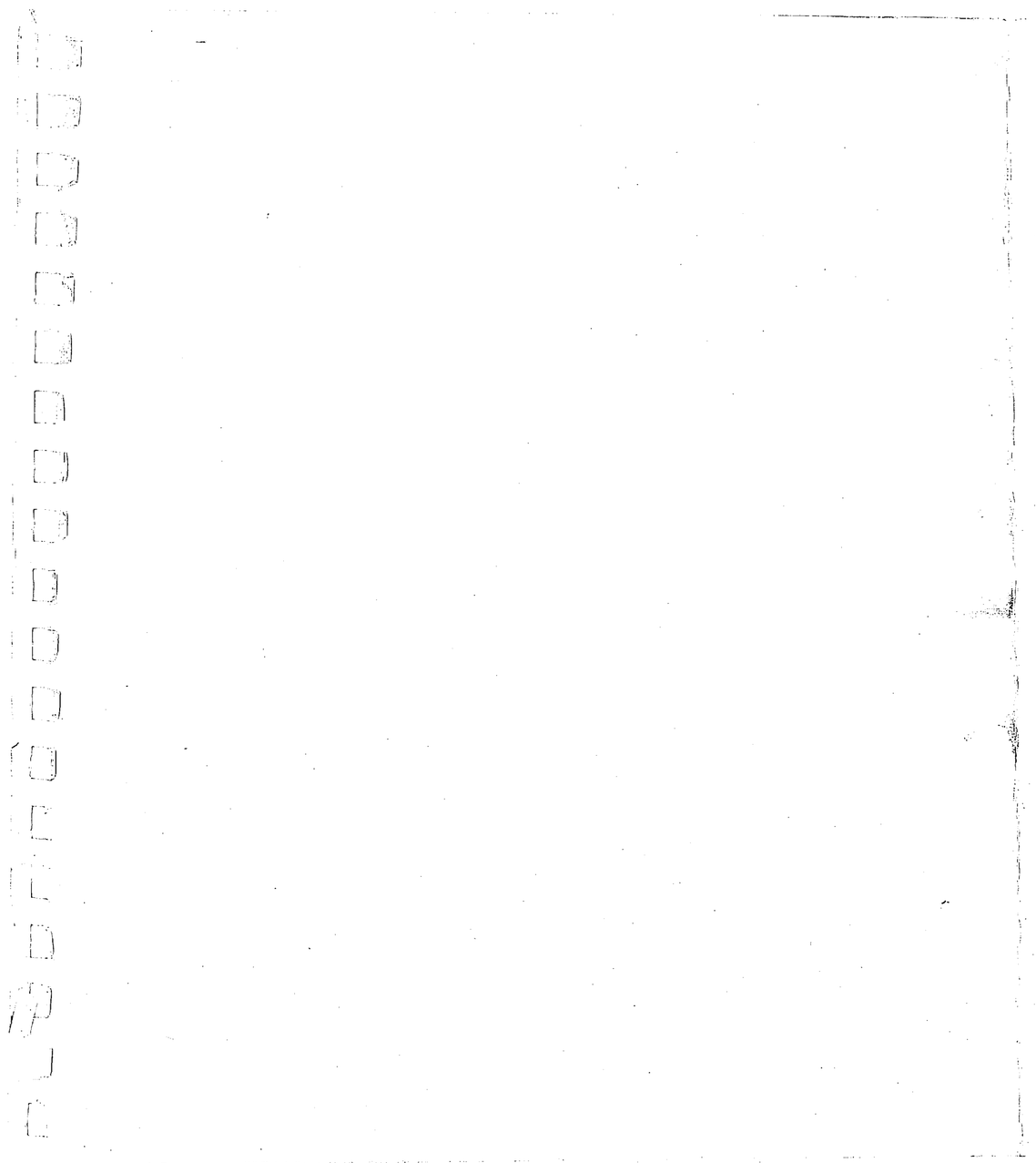

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