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CENTRAL M & R CONTROL NO

4762

INTER-OFFICE MEMORANDUM

Date: 5 October 1949

04017

RS3154-4/897

TO: Sandia Research and Development Board

FROM: R. A. Bice, Manager, Engineering Department

SUBJECT: PRELIMINARY ANALYSIS OF MK IV MOD 0 BARO SWITCH DROP DATA

REF. SYMBOL: SLE-3 (3108)

REF: Memo dated 26 September 1949 "Proposed Interim Baro Switch Setting for the MK IV Bomb" SLE-3 (3076)

Pressure pickup data, instead of baro switch data, were used in the analysis for determination of the mean and the deviation of the pressure in the plenum chamber for two reasons:

1. More pressure pickup data exist.

2. It is felt that pressure pickup data are more applicable because continuous readings were obtained over the total altitude range.

The baro switches are actuated by the pressure recorded by the pressure pickup within the accuracy of instrumentation and data reduction.

The data from 13 test drops were used as being directly applicable for the MK IV Mod 0 bomb. Five of these were F&F drops made from B-29 aircraft, and eight were ballistic drops made from an XB-47 aircraft. In fig. 1 (for B-29 drops) and in fig. 2 (for XB-47 drops), the difference between chamber pressure and true altitude is plotted against true altitude; and the difference between chamber pressure and ambient pressure is plotted against pressure altitude. When plotted against pressure altitude, the pressure readings are corrected for barometric pressure variations and present a picture of the relationship between baro switch actuating pressure and ambient pressure throughout the drop.

The mean internal pressure for the B-29 drops is different from that for the XB-47 drops. The analysis to date has not proved the cause of the difference; however, it is expected that the factor or factors causing this difference can be determined and that the data can be corrected to have one mean. Two factors - release velocity and free air temperature - are being considered as principle causes of the variation.

The release velocities varied from 400 to 540 mph true air speed for the XB-47 drops and was near 310 mph for the B-29 drops. Drop data have indicated a possible trend toward an increase in the chamber pressure at baro switch closure altitude

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AUTHORITY R.B. Carlson
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DATED 7/30/97

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of approximately 440 feet altitude per 100 mph increase in release velocity. No definite trend has been found, to date, of the effect of atmospheric temperature variation on chamber pressure.

The approximate standard deviation from 2,000 to 10,000 feet altitude for the pressure readings from the two groups of tests are shown in Table I. The standard deviation for the thirteen tests when corrected for variation in release velocity and when corrected to one mean are also shown.

The data from 18 F&F drops for which both baro switch and pressure pickup data exist were analyzed in order to obtain a correlation between pressure pickup and baro switch readings. The results of the analysis are shown in Table II. The baro switch data for all F&F drops are tabulated in Table III.

Since the actual effects of release velocity and temperature variations have not been established as yet, the baro switch setting in relation to ambient pressure altitude was determined from the B-29 drop data. The mean internal pressure lagged ambient pressure by an average value of 350 feet over the altitude range from 2,000 to 10,000 feet. The difference between baro switch closure data and pressure pickup data for 18 F&F drops showed that the baro switch closure lagged internal pressure readings by an average value of 150 feet. The baro switch should, therefore, be set 500 feet above ambient pressure at desired baro switch closure altitude for B-29 dropping conditions.

Study is being continued to determine the effects of release velocity and temperature variations in order to determine if baro switch settings can be refined.

TABLE I

Deviation of Baro Switch Pressure - MK IV Mod 0 Test Drops

No. of Drops	Port Size (inches)	Fin Type	Release Altitude (feet)	Release Velocity (mph)	Standard Deviation* Pressure Pickup (feet)
5	3/8	DWLP	32,000	310	400
8	"	"	35,000-40,000	400 - 540	500
13	"	"	32,000-40,000	corrected to 310 **	375
13	"	"	"	310 - 540	450 ***
13	"	"	"	"	560 ****

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* Corrected for variations in barometric pressure.
** Assuming that pressure is sensitive to release velocity and that all readings can thus be corrected to one velocity.
*** Corrected to one mean. Assuming that the mean for one group is superimposed upon the mean of the other group.
****Applying no corrections. Assuming that all readings are not sensitive to predictable variables and are of one universe.

Contains to a certain degree the following errors:

1. Calibration errors of pressure pickup.
2. Sensitivity of pressure pickup to temperature changes, vibration, etc.
3. Errors in barometric pressure data.
4. Sensitivity of orifice manifold system to variations in Mach and aerodynamic characteristics.

TABLE II

Correlation Between Pressure Pickups and Baro Switches

No. of Drops	Port Size (inches)	Fin Type	Standard Deviation* Pressure Pickup (feet)	Standard Deviation* Baro Switch (feet)
5	3/8	D LP	500	500
6	5/8	D LP	510	480
7**	1/2	LP & TF S	525	770

* Not corrected for variations in barometric pressure.
**Different fins induced variations in ballistics and thus in pressure characteristics.

Contains to a certain degree the following errors:

1. Calibration errors of pressure pickups and baro switches
2. Sensitivity of pressure pickup and baro switch to temperature changes, vibration, etc.
3. Variation of barometric pressure.
4. Sensitivity of orifice manifold system to variations in Mach and aerodynamic characteristics.

TABLE III

CHART OF FUZING AND FIRING DROP TESTS (B-29 DROPS)

DROP ST. NUMBER	DATE	FIN TYPE	RELEASE ALTITUDE (FT.)	BARO PORT DIA. (INS.)	BARO CLOSURE ALTITUDE (FT.)	BARO SETTING ALTITUDE (FT.)	BARO (1) PRESSURE (FT.)
185	10/21/48	DWLP	32,164	5/8	10,539	7,000	6,800
189 (2)	10/22/48	DWLP	31,898	5/8	11,329	7,000	7,400
192 (2)	11/3/48	DWLP	36,237	5/8	10,169	7,000	7,000
193 (2)	11/3/48	DWLP	34,333	5/8	(3)	7,000	-----
194 (2)	11/4/48	DWLP	36,635	5/8	11,250	7,000	7,000
195 (2)	11/18/48	DWLP	31,812	5/8	11,306	7,000	7,200
196 (2)	11/5/48	DWLP	32,056	5/8	10,996	7,000	7,000
197	4/21/49	DWLP	32,171	3/8	4,156	4,000	3,800
198	4/22/49	DWLP	31,824	3/8	3,131	4,000	3,900
199	4/28/49	DWLP	31,911	3/8	3,123	4,000	3,600
200	4/28/49	DWLP	31,794	3/8	3,152	4,000	4,000
201	5/10/49	DWLP	31,919	3/8	3,925	4,000	3,900
202	5/10/49	DWLP	32,126	3/8	1,699(4)	4,000	3,700
203	5/11/49	DWLP	31,825	3/8	1,992(4)	4,000	-----
204	5/11/49	DWLP	32,047	3/8	1,019(4)	4,000	3,700
182	10/13/48	LPWM	31,614	5/8	9,671	7,000	6,300
180	10/12/48	LPWM	32,043	5/8	9,325	7,000	-----
190 (2)	10/14/48	SDP	32,098	5/8	8,650	7,000	6,800
191	11/23/48	CDP	32,009	5/8	9,636	7,000	6,800
162	9/23/48	LPW	36,023	1/2	9,761	7,000	6,800
167	8/13/48	LPW	31,862	1/2	8,008	7,000	6,600
169	8/3/48	LPW	31,617	1/2	7,838	7,000	6,900
174	8/6/48	LPW	31,870	1/2	9,353	7,000	6,730
181	8/18/48	LPW	37,134	3/4	10,636	7,000	7,200
161	8/23/48	TFWS	36,779	1/2	7,143	7,000	-----
166	7/20/48	TFWS	31,869	1/2	4,428(5)	7,000	-----
168	7/27/48	TFWS	32,051	1/2	5,360(6)	7,000	-----
173	8/12/48	TFWS	32,000	1/2	8,647	7,000	6,750
177	8/12/48	TFWS	32,089	1/2	8,494	7,000	7,000
178	8/17/48	TFWS	31,864	1/2	7,727	7,000	6,670

(1) Altitude indicated by pressure pickup at time of Baro Closure. This is a measure of the accuracy of the baro switch net, pressure pickup, and data reduction.
(2) Fuzing and Firing Circuitry was made independent of Baro Closure. Baro indication difficult to discern because of telemetry.
(3) Not Discernible on Telemetering Record.
(4) Baro - operation delay was due to case leakage caused by failure of poor quality split-band gasket. Quality of gasket has since been improved.
(5) Desiccator installed incorrectly.
(6) It is believed as in (5)

LPW - Large Plan Wedge
CDP-LPW and Circular Drag Plate
SDP - LPW and Square Drag Plate
DWLP - Double Wedge Large Plan
LPWM - Large Plan Wedge Modified Leading Edge.
TFWS - Thin Fin Wedge with Wedge Shroud

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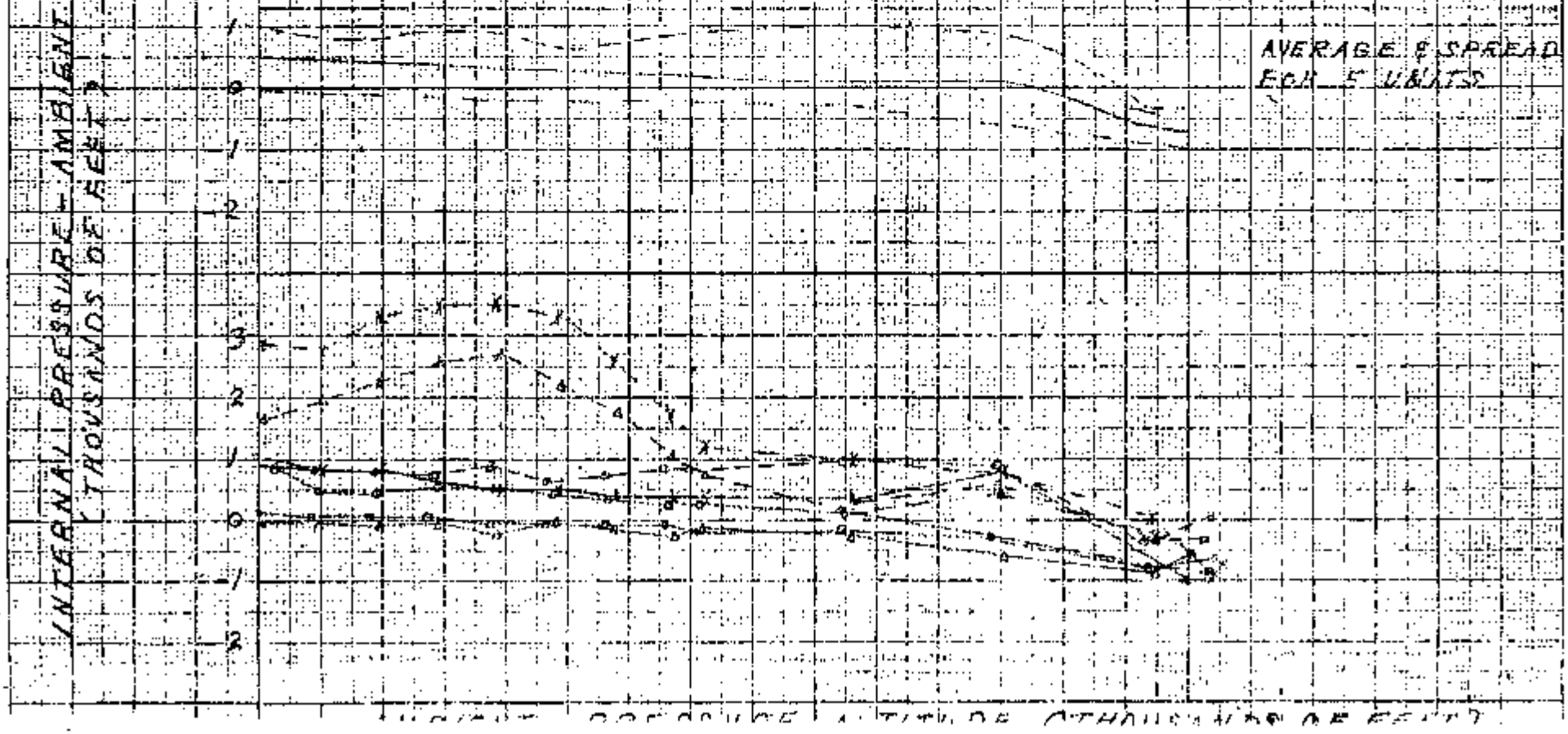
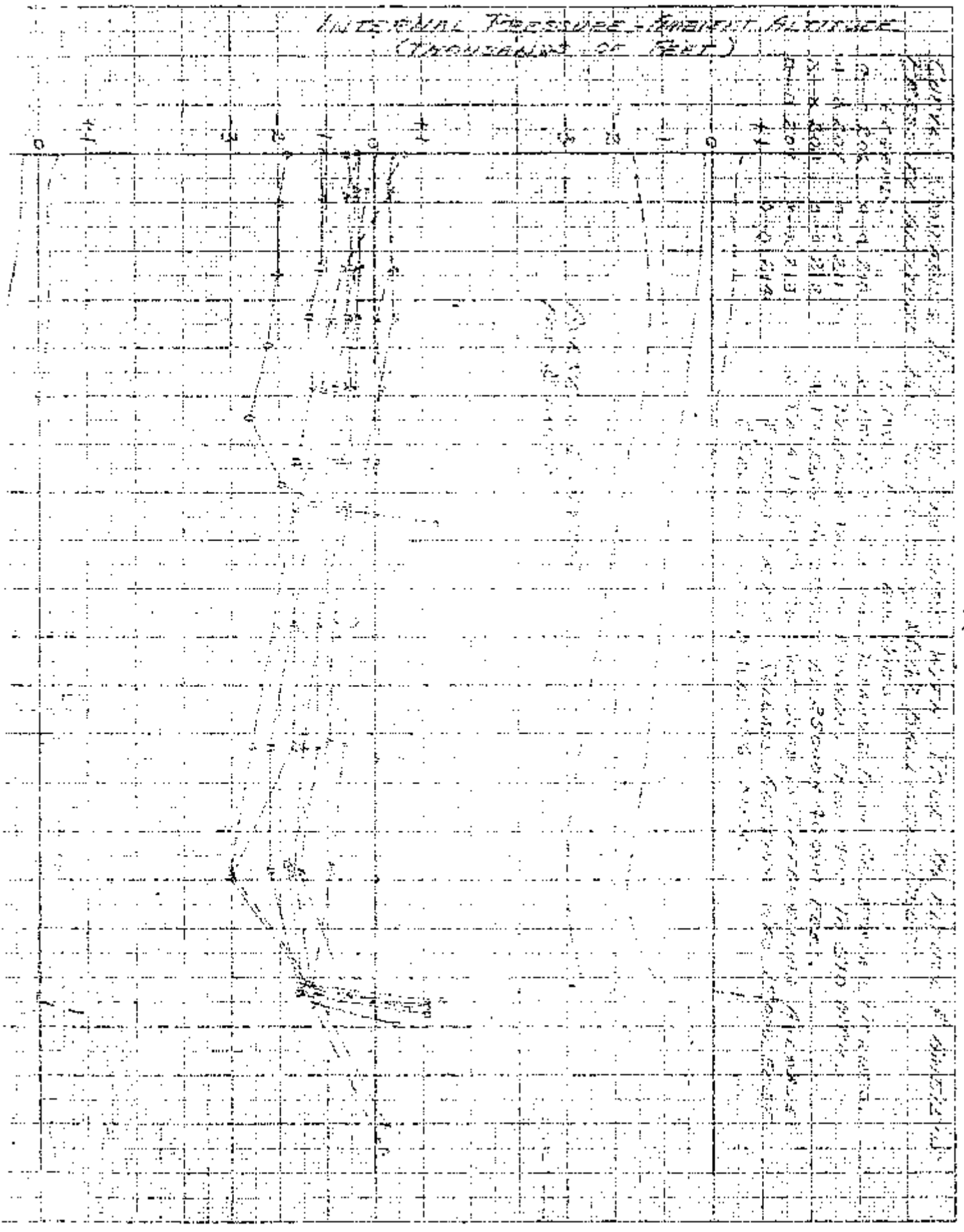
CURVES COMPARING INTERNAL PRESSURE WITH TRUE ALTITUDE & AMBIENT PRESSURE ALTITUDE FOR 318 PORTS

LEGEND:

- ST-197
- ST-198
- ST-199
- ST-201
- ST-201
- ST-202
- ST-204

1. F&F B-29 TEST DROPS.
2. DWIP FINS ON ALL UNITS.
3. PRESSURE READINGS OBTAINED FROM PICKUPS CALIBRATED AT ONE POINT.
4. NOMINAL RELEASE VELOCITY - 310 MPH
5. NOMINAL RELEASE ALTITUDE - 32000 FT.
6. DATA FROM 202 & 204 NOT USED IN DETERMINING AVERAGE & SPREAD SINCE IT IS BELIEVED THAT EXCESSIVE CASE LEAKAGE OCCURED FROM FAILURE OF POOR QUALITY SPLIT BAND GASKETS.





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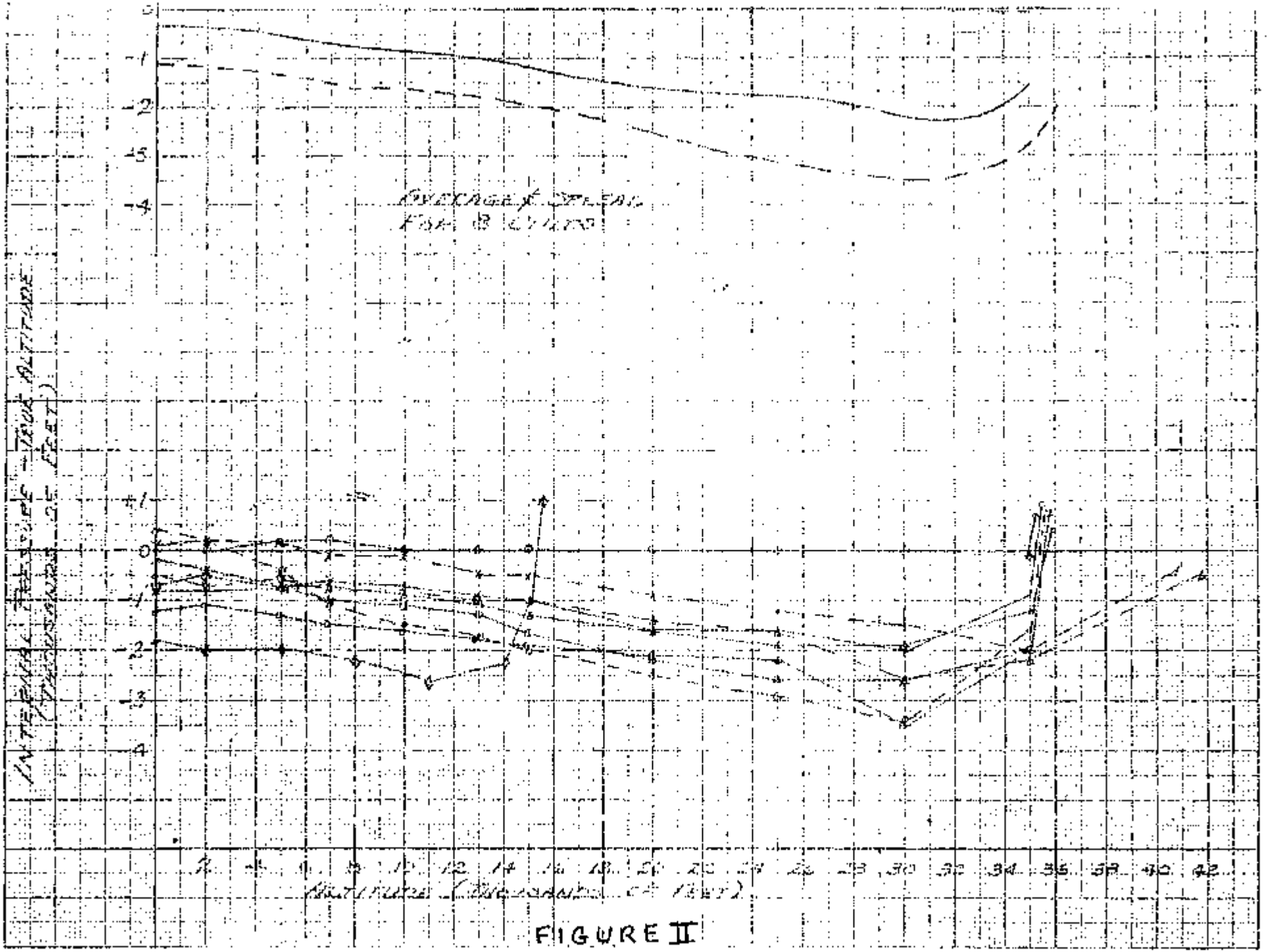

FIGURE II

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