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PART 11

~~H-A-R-K-E-N~~ P-R-O-J-E-C-T

BOMBING ANALYSIS AND RELATED SUBJECTS

AMERICAN AND BRITISH PHASE

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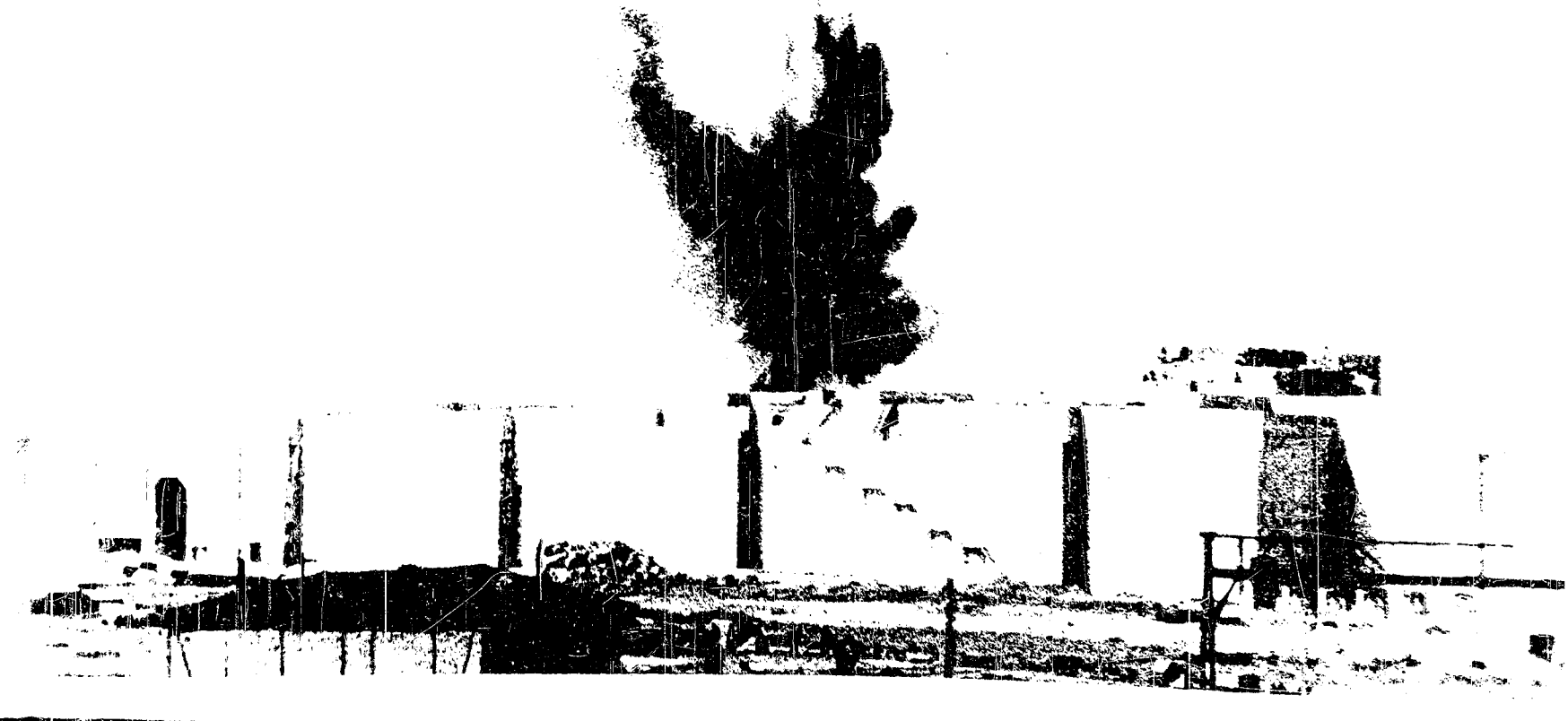

BOMBING ANALYSES AND RELATED SUBJECTS

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b. Bombsights

c. C-1 Autopilot

d. Photo Equipment

e. Radar Altimeters

SECTION VI. Summary - Bombing Accuracy and Analysis, American and British Phases.

BOMBING ANALYSIS AND RELATED SUBJECTS

SECTION I

1. INTRODUCTION

This section of the final report consists of two phases; one for the British bombs, and one for the American bombs. Because of the different aspects and conditions encountered, it was deemed best to consider the two phases seperatoly, except for the Bombing Accuracy and Analysis Section.

2. BOMBING FLIGHT RECORDS SECTION

For each of the two phases there is a seperate bombing flight records section which includes the following:

a. A composite bomb plot which shows the location of all bombs dropped in relation to the aiming point used, bomb number, bombing altitude for each bomb dropped and the name of the bombardier. All British bombs are consolidated on one plot. In the case of the American bombs, there is one plot for all Amazon type bombs and one plot for all Samson type bombs.

b. A consolidation of individual Bombing Flight Record Forms (forms 12C, modified) segregated according to the name of the bombardier, plus a bomb plot for each bombardier which shows the exact location of each bomb impact in relation to the track of the aircraft.

c. A weather Pibal graph section which shows the measured winds from ground to flight level as recorded during the approximate time of bombing by weather stations in the target vicinity. One Pibal Graph will appear for each day of bombing to cover the effective hours during which bombing occurred. For instance, if three aircraft bombed on one particular day, only one Pibal Graph will appear for that day of bombing.

3. BOMBING EQUIPMENT OPERATIONAL SUMMARY SECTION

For each of the two phases there is a summary covering the operation of the following pertinent bombing equipment:

a. Armament

b. Bombsights

c. C-1 Autopilot

d. Photo equipment

e. Radio Altimeters

4. BOMBING ACCURACY AND ANALYSIS SECTION

The accuracy of bombing and summary of bombing analysis is contained in a seperate section of this report which includes all bombs dropped during the entire project.

5. THE BOMBING FLIGHT RECORD FORM (FORM 12C, MODIFIED)

Because of the special and detailed type of information desired, a Bombing Flight Record Form was prepared especially for the Harken Project. In the report to follow, a Bombing Flight Record Form has been prepared for each bomb dropped; therefore, a complete, detailed treatise is available for each particular bomb.

a. Page one of each Bombing Flight Record Form includes all of the standard bombing data, plus a plot of the bomb impact, a plot of the analyzed (theoretical) bomb impact, and a breakdown to show analysis of errors in range and deflection. Deviations from the standard Form 12C are as follows:

(1) MISSION NO: Usually one Albert aircraft carried two British 1650 lb. model bombs on each mission; therefore, in some cases the same mission number will appear on two seperate bombing flight record forms.

(2) LISTED UNDER SIGHT DATA: Column headed "Synchronization" shows the bombsight crosshairs in relation to the aiming point at the instant of bomb release. The circle is representative of a 100 foot radius, and the caret (^) marks indicate the applicable crosshair to be synchronized at the point of bomb release. If a caret (^) mark does not appear beside one of the lines representing a crosshair, it indicates that the particular crosshair was not perfectly synchronized.

(3) LISTED UNDER SIGHT DATA: Column headed "Bubbles." Bubble errors are indicated Right (R) or Left (L) in the case of the lateral bubble, and plus (+) or Minus (-) in the case of the fore and aft bubble. A plus fore and aft bubble error indicates that the bubble was off the lubber line toward the nose of the aircraft.

Magnitude of bubble errors is recorded as a fraction of one (1) full bubble length. The value of one (1) bubble length is assumed to be 36 mils for both the fore and aft and the lateral bubble. Therefore, a bubble error reported as being ¼ length is equal to 9 mils.

(4) RANGE ERRORS: Are indicated Plus (+) or Minus (-). A plus range error indicates that the impact was over. Deflection errors are indicated Right (R) or Left (L). A Right deflection error indicates that the bomb impact was to the right of the aiming point.

(5) LISTED UNDER SPEED (MPH): Column headed "Groundspeed". The groundspeed indicated is the measured groundspeed, not the one obtained with the bombsight.

(6) THE BOMB PLOT: The solid black dot represents the measured bomb impact. The solid black square represents the analyzed (theoretical) impact.

b. Page two of the Bombing Flight Record Form contains a summary of bombing analysis, a record of all difficulties, malfunctions, and unusual conditions encountered by the bombardier during preflight and in-flight operation of the bombing equipment. It also contains a commentary as to what the malfunction was determined to be and the corrective action that was taken to remedy the reported malfunction.

S E C T I O N II

BRITISH PHASE OF HARKEN PROJECT

THE BRITISH PHASE OF HARKEN PROJECT

1. THE PURPOSE

The purpose of the British phase was to determine the altitude at which the British 1650 lb. Model bomb would break up on impact and to further test the penetration qualities of the bomb.

2. MISSION REQUIREMENTS

The British desired two good assessable hits on the roof of the Farge Submarine Assembly Plant from an absolute altitude of 30,000 feet. A total of 13 bombs were provided for this phase of the test and if the first two strikes on the target did not break up on impact, and bombs remained, it was further desired that two more good hits be obtained from an absolute altitude of 35,000 feet.

3. THE FARGE TARGET

Although the overall dimensions of the Farge Sub Assembly Plant are approximately 1400 feet in length by 300 feet in width, only the Western 600 foot portion of the roof could be used because the high speed cameras installed were limited in coverage to that particular portion of the roof. Inasmuch as a bomb impact outside of the camera range would have been of little practical value to the British, it was decided to use only the wide end of the structure as an aiming point. Effectively, this reduced the size of the target dimensions to approximately 600 feet in length by 300 feet in width.

4. RESULTS

Of the first five bombs dropped, two hits were obtained on the wide portion of the roof but hit number two was not considered good enough for purposes of assessment and one more hit was desired from 30,000 feet. Hit number three was obtained with the eighth bomb dropped and it was a good hit. None of the strikes from 30,000 feet broke up; subsequently, missions were flown at 35,000 feet absolute altitude and two more good hits were obtained with the five remaining bombs. This completed the British phase of the Harken Project.

BOMBING FLIGHT RECORDS

BOMBARDIERS

1ST LT ROBERT E. SCHLAEBITZ

1ST LT ROBERT C. BLAIR

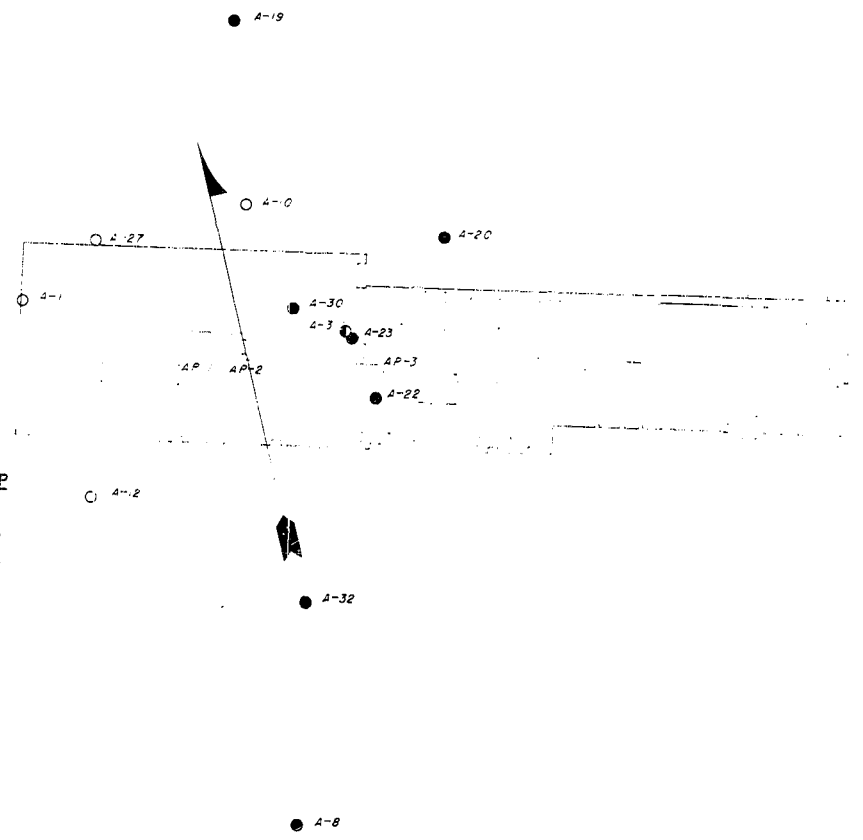
1ST LT CHARLES H. BARKLEY

HARKEN BOMB PLOT

BRITISH PHASE

FARGE TARGET

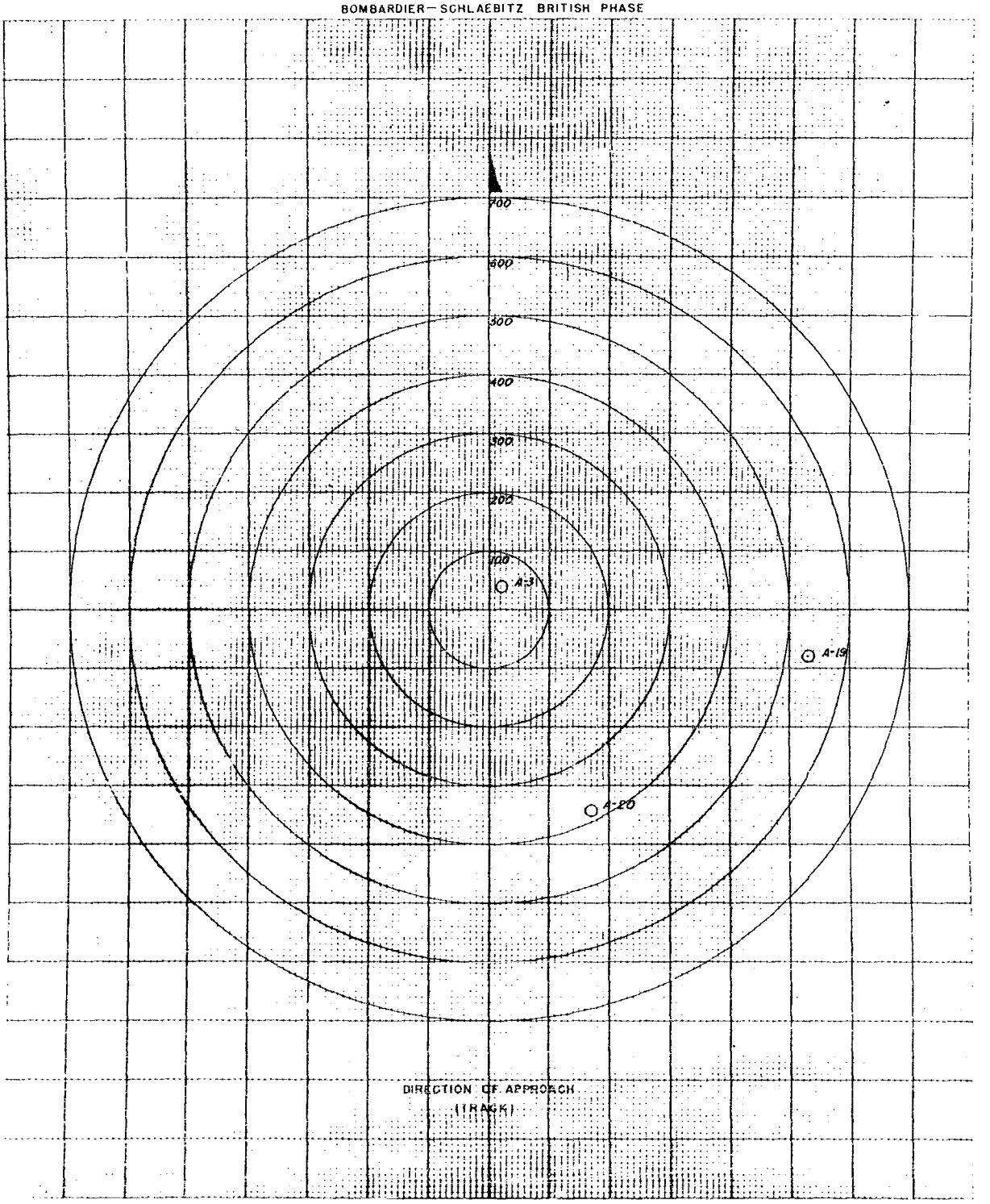
BOMB TYPE 1650LB GP/RA (MODEL)



-LEGEND-

A/C	ALT	BOMBARDIER	AP
A-1	30,000	LT BARKLEY	1
A-3	30,000	LT SCHLAEBITZ	3
A-8	35,000	LT BLAIR	2
A-10	30,000	LT BLAIR	1
A-12	30,000	LT BARKLEY	1
A-13	35,000	LT SCHLAEBITZ	2
A-19	35,000	LT SCHLAEBITZ	2
A-20	30,000	LT SCHLAEBITZ	2
A-22	30,000	LT BLAIR	2
A-23	35,000	LT BARKLEY	2
A-27	30,000	LT BARKLEY	1
A-30	35,000	LT BARKLEY	2
A-32	30,000	LT BLAIR	2

BOMBARDIER—SCHLAEBITZ BRITISH PHASE



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HAR[illegible] FLIGHT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt.	A/C: BOYD, WILLIS G. CAPTAIN.

Date:	22 July 1947	Bombsight (type):	Norden
Mission No:	2 - British	(model):	M-9
Target:	Farge Sub Ass'y Plant	(no.):	R-449
Aircraft No:	45-21751	Bomb(type,size&no.)	CP/RA 1650, A-3

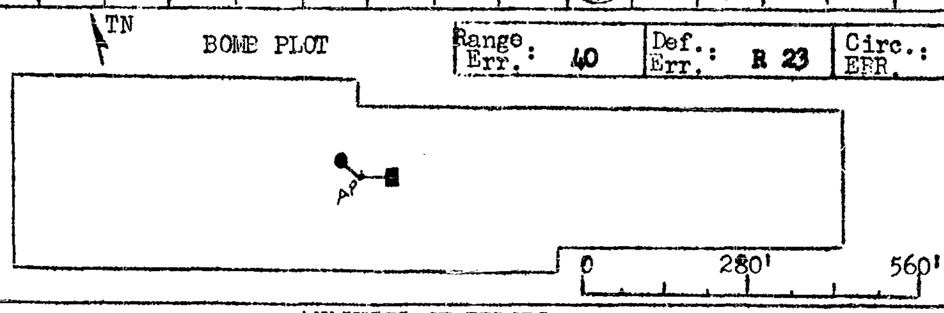
COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-7.8	CIAS	195	Direction	289
Alt Sett.	30.19	Corr F.L. Temp	-35.8	TAS	313	Velocity	25
Ind. P.A.	28800	Grnd. Temp.	23	Trail	21.5		
P.A.T.	-190	Mean Temp.	-6.3	WEATHER		SCORING METHOD	
P.A.A.T.	28990	Bomb. Alt.	30000	Visibility	Fair	Survey	X
F.L. Temp.	-28	Disc Speed	120.5	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	297	28800	30000	195	313	288	21.5	120.5		.60	-	1/2	-	-	1425

BOMB PLOT

Range Err.: 40	Def. Err.: R 23	Circ. ERR.: 45



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DS. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-65	-	-	-	-	-65	-	-	-	-	0

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 40 feet over from the offset aiming point used. The bombardier was instructed to aim at a point 600 feet from the west wall of the target, along the center line. This AP was 300 feet short of the standard aiming point in use at that time. The groundspeed synchronized for was 289 MPH as compared to the measured groundspeed of 288 MPH. This one (1) MPH range synchronization error produces an analyzed range error of 65 feet short as compared to a measured range error of 40 feet over. This places the analyzed impact 105 feet short of the actual impact; this amount of range error remains indeterminate. Although the bombardier reported no fore and aft bubble error, it is felt that the probable cause of the 45 foot measured error over was a compensating bubble error not detected by the bombardier.

DEFLECTION ANALYSIS:

a. The measured deflection error was 23 feet to the right of the aiming point. The amount of drift synchronized for and the measured drift are the same. The bombardier reported no bubble error to which the measured deflection error might be attributed. The 23 foot deflection error to the right remains indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS.

   a. DIFFICULTY: The rear bomb doors buffeted during climb to 4000 feet, then only intermittent buffeting was detected. Door latching mechanism out of adjustment.

   b. CORRECTIVE ACTION: Adjusted tolerance of door latching mechanism.

2. RACKS AND RELEASE SYSTEM.

   a. DIFFICULTY: Second bomb could not be released due to British carrier malfunction. Buffeting of bomb bay doors caused micro switches to break contact.

   b. CORRECTIVE ACTION: Adjusted micro-switches so that they protruded. This allowed doors to buffet slightly but still make contact with micro-switches.

3. CAMERAS:

a. DIFFICULTY: Left B-2 not installed. Motor governor weight broke loose and wrecked governor during ground check. Rear B-2 broke film. Intermittent sprocket shaft bearing appeared loose.

b. CORRECTIVE ACTION: Left B-2: No replacement or camera parts available. Camera out of operation. Rear B-2: Pulled camera. Sprocket and gate clearances checked. Bearing peened slightly to minimize shaft play.

4. RADIO ALTIMETER:

a. DIFFICULTY: At bombing altitude the times one scale reading was accurate but the times ten scale reading was 50,000 feet. This was 20,000 feet higher than the actual altitude and was caused by Indicator I-152-C being out of calibration.

b. CORRECTIVE ACTION: Indicator calibrated correctly. Circle forms and reference pips adjusted on both scales.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 30,000 feet on times one scale.

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HARKEN [illegible] BOMBING FLIGHT RECORD

Bombardier: SCHLAERITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

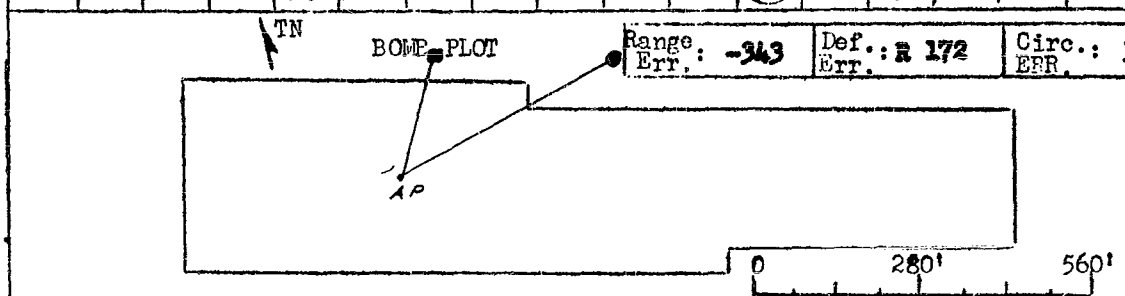
Date: 24 July 1947
Mission No: 5 - British
Target: Farge Sub Ass'y Plant
Aircraft No: 45-217 51

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb(type,size&no.) CP/RA 1650 lb #A-20

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-7.8	CIAS	195	Direction	262
Alt Sett.	30.16	Corr F.L. Temp	-35.8	TAS	315	Velocity	41
Ind. P.A.	29195	Grnd. Temp.	20	Trail	21.5		
P.A.T.	-155	Mean Temp.	-7.9	WEATHER		SCORING METHOD	
P.A.A.T.	29040	Bomb. Alt.	30,000	Visibility	Good	Survey	X
F.L. Temp.	-28	Disc Speed	120.5	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	281	29040	30000	195	314	276	21.5	120.5		.57	-	1½	R1/16	-	1003



Range Err.: -343 | Def. Err.: R 172 | Circ. EER.: 384

ANALYSIS OF ERRORS

RANGE								DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR		Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-65	-	-	-	-	-65		L 50	R 300	L 66	R 11	R 195

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 343 feet short. Analysis shows that the bombardier synchronized for a groundspeed of 277 MPH as compared to a measured groundspeed of 276 MPH. This one (1) MPH groundspeed synchronization error amounts to a range error of 65 feet short. The remaining 278 feet of range error short is indeterminate. Although the bombardier reported no fore and aft bubble error, it is assumed that the fore and aft bubble must have been responsible for the majority of the indeterminate range error short.

DEFLECTION ANALYSIS:

a. The measured deflection error was 172 feet right. Analysis shows that the bombardier synchronized for 1½ degrees right drift as compared to a measured right drift of 3 degrees. This error in deflection synchronization accounts for a deflection error to the right of 300 feet. Incorrect drift in the cross-trail mechanism due to the drift error accounts for 11 feet more of right deflection error which makes the total deflection error 311 feet right. However, the bombardier offset the fore and aft crosshair 50 feet to the left and also had a compensating lateral bubble error of 66 feet left, both of which somewhat compensated for some of the right deflection error to produce an ultimate analyzed deflection error of 195 feet to the right. This placed the theoretical impact 25 feet to the right of the actual measured error. This 25 feet or error remains indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM.

a. DIFFICULTY: Right British carrier would not release second bomb. Tried release after operating door opening switch; also closed doors, but could not obtain second release this mission. Believe door micro-switches were not making contact.

b. CORRECTIVE ACTION: Leads to the micro-switches were wired together so as to eliminate the micro-switches from the bomb rack circuit.

2. CAMERAS

a. DIFFICULTY: All cameras operated OK but film loosened on the take up spool in the rear B-2 camera.

b. CORRECTIVE ACTION: None possible. Malfunction due to sudden stop of reel plus inertia.

3. RADIO ALTIMETER

a. DIFFICULTY: Operated OK until 10,000 feet reading then blips faded out entirely. Receiver section of transmitter-received BC 788C inoperative.

b. CORRECTIVE ACTION: New transmitter-receiver installed.

REMARKS

Flight Level Radio Altimeter Reading - (NONE)

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HARKEN BOMBING FLIGHT RECORD

Bombardier: SCHLAERITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

Date: 28 July 1947 | Bombsight (type): Norden

Mission No: 7 - British | (model): M-9

Target: Forge Sub Assly Plant | (no.): R-449

Aircraft No: 45-21751 | Bomb(type,size&no.) GP/RA 1650 lb #A-19

COMPUTATIONS

ALTITUDE

Tgt Elev.	80	Comp. Error	-8.1
Alt Sett.	30.12	Corr F.L. Temp	-16.1
Ind. P.A.	33975	Grnd. Temp.	19
P.A.T.	-120	Mean Temp.	-14
P.A.A.T.	34095	Bomb. Alt.	35,000
F.L. Temp.		Disc Speed	111.57

AIRSPEED

CIAS	180
TAS	320
Trail	24

WEATHER

Visibility Good

Turbulence Smooth

WIND(MPH)

Direction 300

Velocity 59

SCORING METHOD

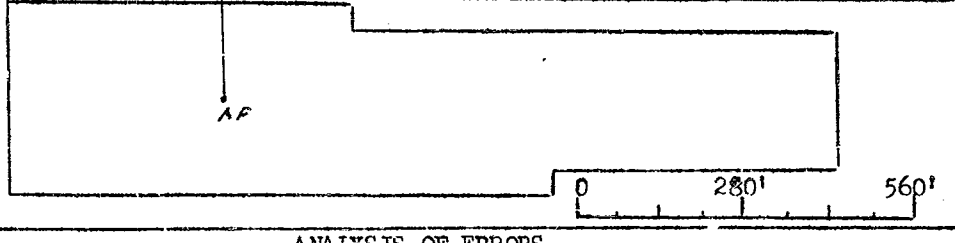
Survey X

Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA									
													DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	280	33975	35000	180	320	264	24	111.5		.43	7	-	L ½		1015

BOMB PLOT

Range Err.: -80 | Def. Err.: R 530 | Circ. EER.: 540



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
Wind obtained not of sufficient accuracy to analyze range or deflection error											

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BOMBING ANALYSIS SUMMARY

Bomb cannot be analysed accurately for range or deflection error because an accurate measured wind was not obtained during this mission.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

   a. DIFFICULTY: Light circuit breaker popped. The right B-2 did not operate because of a sheared pin, and the rear B-2 had a broken star gear which caused an intermittent drive. All malfunctions were attributed to cold temperatures and extreme altitude. All cameras were preflighted OK before the mission and had been previously lubricated with low temperature lubricants. Heaters operated OK but were apparently inadequate.

   b. CORRECTIVE ACTION: Circuit breaker reset. Lights operated OK. Replaced pin in steady drive sprocket of right B-2. Replaced star gear in rear B-2.

2. RADIO ALTIMETER:

   a. DIFFICULTY: Return blip disappeared completely after 15,000 feet reading. Gain level in transmitter-receiver low. This was possibly due to a bad tube.

   b. CORRECTIVE ACTION: Due to lack of test and maintenance facilities, entire unit was replaced from stock. Ground checked OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: (NONE) INOPERATIVE.

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HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

Date: 28 July 1947
Mission No: 7- British
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21751

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb(type,size&no.) CP/RA 1650 lb. #A-13

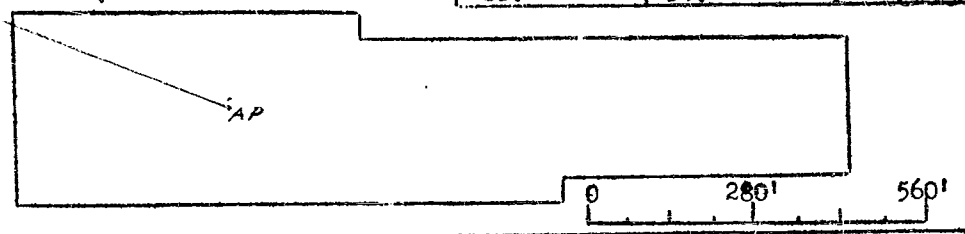
COMPUTATIONS

ALTITUDE				AIRSPEED	WIND(MPH)
Tgt Elev.	80	Comp. Error	-8.1	CIAS 180	Direction 300
Alt Sett.	30.12	Corr F.L. Temp	-46.1	TAS 320	Velocity 59
Ind. P.A.	33975	Grnd. Temp.	19	Trail 24	
P.A.T.	-120	Mean Temp.	-14	WEATHER	SCORING METHOD
P.A.A.T.	34095	Bomb. Alt.	35000	Visibility Good	Survey X
F.L. Temp.	-38	Disc Speed	111.5	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
4	2	A	274	33975	35000	180	320	264	24	111.5		.44	10	-	11/8	-1/8	0042

BOMB PLOT

Range Err.: 953 | Def. Err.: R 570 | Circ. ERR.: 1204



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
Cannot analyze this bomb for range or deflection error.											

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BOMBING ANALYSIS SUMMARY

This bomb cannot be accurately analyzed for range or deflection error. Bomb was a delayed release or was released manually. In addition, measured wind obtained was of insufficient accuracy for purposes of analysis.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM.

   a. DIFFICULTY: Because of failure of British carrier rack to release on previous mission, a manual release system was installed. The carrier was ground tested and functioned normally. To insure positive bomb release, the manual release "T" handle was pulled when the bombsight indices crossed. The bomb was either a delayed release, or released manually because the bombsight showed a larger tangent of dropping angle for this bomb than for the first bomb dropped on this mission, and the first release hit SHORT of the aiming point.

   b. CORRECTIVE ACTION: The British carrier was completely disassembled, all wiring checked, and reinstalled, but no reason could be found for the malfunction. The carrier released OK during the ground check.

2. CAMERAS

   a. DIFFICULTY: Same as for Bomb A-19 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-19 this mission.

3. RADIO ALTIMETER:

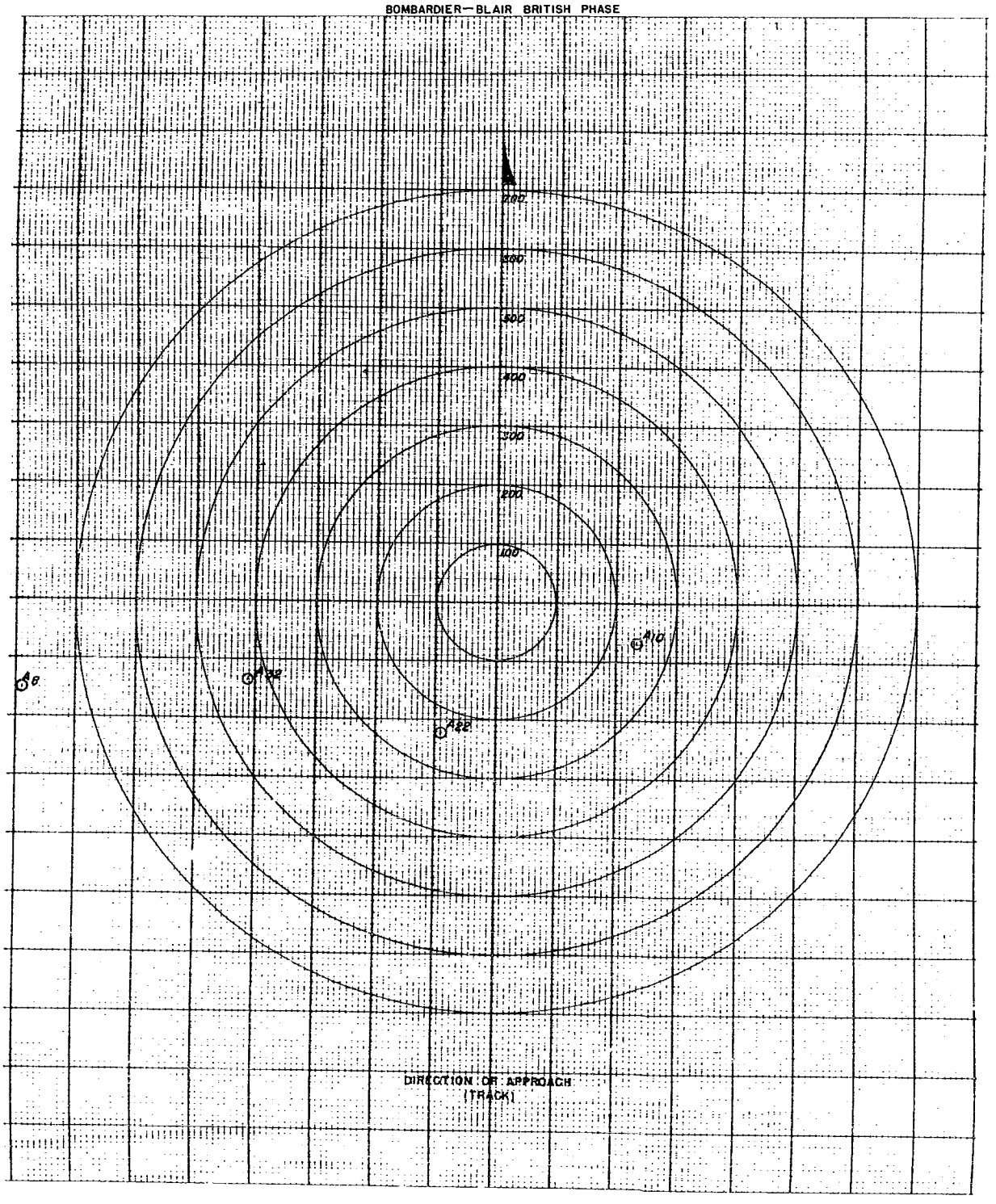
   a. DIFFICULTY: Same as for bomb A-19 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-19 this mission.

REMARKS

Flight Level Radio Altimeter reading: NONE (INOPERATIVE)

The measured wind obtained was not of sufficient accuracy for purposes of analysis; wind reported on page one of this form is from metro data. Manual release "T" handle was pulled by radio operator upon signal from the bombardier when the bombsight indices crossed to insure positive bomb release because of previously difficulty encountered with electrical release of same British carrier.


BOMBARDIER—BLAIR BRITISH PHASE
200
300
400
500
600
700
100
410
432
422
68
DIRECTION OF APPROACH
(TRACK)

CONFIDENTIAL

HARKEN [illegible] SIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt. | A/C: HILL, MARCUS L. 1st Lt.

Date: 22 July 1947 | Bombsight (type): Norden

Mission No: 3 - British | (model): M-9

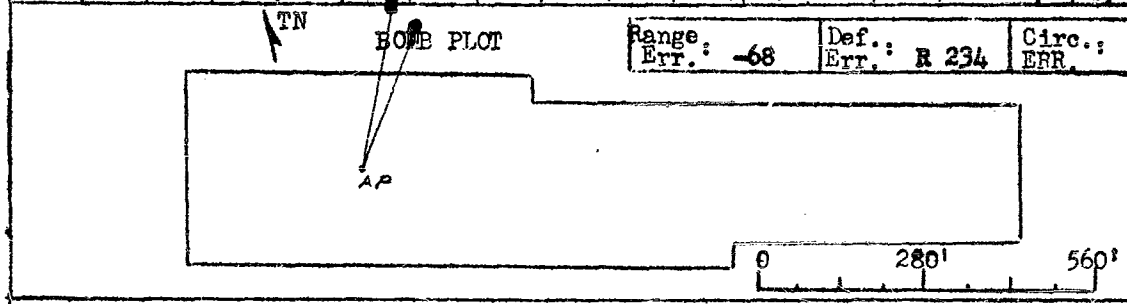
Target: Fargo Sub Ass'y Plant | (no.): M-10382

Aircraft No: 45-21747 | Bomb(type,size&no.) GP/RA 1650 lb. #A-10

COMPUTATIONS

ALTITUDE				AIRSPEED	WIND(MPH)
Tgt Elev.	80	Comp. Error	-8	CIAS 195	Direction 289
Alt Sett.	30.17	Corr F.L. Temp	-35	TAS 316	Velocity 24
Ind. P.A.	28930	Grnd. Temp.	27	Trail 20	
P.A.T.	-170	Mean Temp.	-4	WEATHER	SCORING METHOD
P.A.A.T.	29100	Bomb. Alt.	30300	Visibility Fair	Survey X
F.L. Temp.	-27	Disc Speed	120.7	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA									
													DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	288	28930	30300	195	316	292	20	120.7		.60	1	-	11/8	1/8	1642



Range Err.: -68 | Def. Err.: R 234 | Circ. ERR.: 244

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-	-	-136	102	-	-	-34	-	R 160	R 136	-	R 296

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 68 feet short. Analysis shows that the synchronized groundspeed and the measured groundspeed were the same. An error of 136 feet short is attributed to fore and aft bubble error, but this was somewhat compensated for by an error of 102 feet over caused by an error in the bombardier's altitude computation. The combination of errors show a total range error of 34 feet short. The remaining 34 feet of range error short is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 234 feet to the right of the aiming point. The bombardier synchronized for 1 degree of left drift as compared to a measured drift of 0 degrees. This was responsible for 160 feet of the deflection error to the right. An additional deflection error of 136 feet right is attributed to the lateral bubble being 1/8 of a bubble length to the left. The combination of errors gives a total determinate deflection error of 296 feet to the right which is 62 feet more than the actual measured deflection error. This difference is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM:

a. DIFFICULTY: Could not release second bomb because of broken ground wire in British carrier system. Believe this was caused by buffeting.

b. CORRECTIVE ACTION: Repaired break and taped shackle wires to side of carrier to prevent further buffeting.

2. PNEUMATIC DOORS SYSTEM:

a. DIFFICULTY: Both sets of doors opened OK at altitude but could not be closed. Forward doors closed at low altitude. Rear compressor was burned out. It was necessary, however, to land with the rear doors open.

b. CORRECTIVE ACTION: Rear compressor replaced. Replaced damaged rubber washer in latch actuator which was responsible for leak and consequent malfunction of the compressor motor.

5. RADIO ALTIMETER:

a. DIFFICULTY: Inoperative above 2,000 feet. Altitude blips faded out. Indicator I-152-C out of calibration.

b. CORRECTIVE ACTION: Indicator I-152-C calibrated. Circle form on both scales adjusted. Operational check OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: (INOPERATIVE)

BOMBING ANALYSIS: Under Range Error, Altitude Error Column. Error was due to a mistake in the bombardier's altitude computations. Disc speed set in the sight was for 30,000 feet when actual bombing altitude was 30,300 feet.

CONFIDENTIAL

HARKEN PRODUCT TESTING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt	A/C: HILL, MARCUS L. 1st Lt.

Date: 25 July 1947
Mission No: 6 - British
Target: Farge Sub Ass'y Plant
Aircraft No: 45-21747

Bombsight (type): Norden
(model): M-9
(no.): N-10382
Bomb(type,size&no.) CP/RA 1650 lb #A-32

COMPUTATIONS

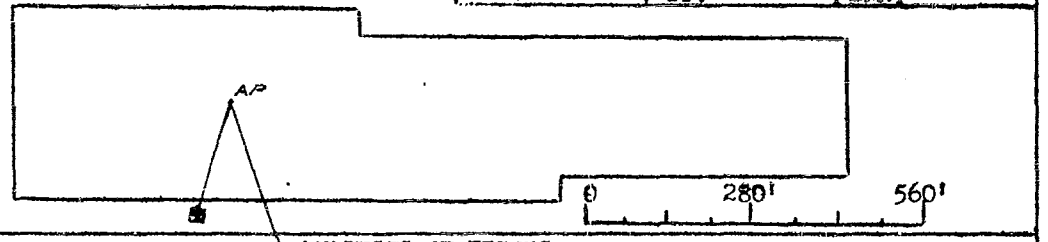
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-8	CIAS	195	Direction	267
Alt Sett.	30.15	Corr F.L. Temp	-35	TAS	316	Velocity	50
Ind. P.A.	2900	Grnd. Temp.	24	Trail	20		
P.A.T.	-150	Mean Temp.	-5.5	WEATHER		SCORING METHOD	
P.A.A.T.	29150	Bomb. Alt.	30000	Visibility	Haze Scat	Survey	X
F.L. Temp.	-27	Disc Speed	120.6	Turbulence	Clds Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA									
													DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	2	A	284	29000	30000	195	316	269	20	120.6	0	.555	-	3	R1/8	-	1145

BOMB PLOT

TN

Range Err.: -134 | Def. Err.: L 412 | Circ. ERR.: 435



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DES or ATF)	Trail Error (Airspeed)	ROOT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	65	-				65	L 50	-	L 135	-	L 185

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 134 feet short. Analysis shows that the bombardier synchronized for a groundspeed of 268 MPH as compared to a measured groundspeed of 269 MPH. The one (1) MPH error in range synchronization gives a theoretical impact of 65 feet over. No other possible cause for range error was reported. The difference between the analyzed range error of plus 65 feet and the actual impact of minus 134 feet leaves an indeterminate range error of 199 feet short. Although the bombardier reported no fore and aft bubble error, it is believed that he must have had a compensating bubble error which produced the ultimate 134 feet range error short.

DEFLECTION ANALYSIS:

a. The measured deflection error was 412 feet left. The drift obtained by measured wind and the drift synchronized for are the same, but the position of the fore and aft crosshair at release was 50 feet left of the aiming point. This 50 foot left error, plus 135 feet of left error attributed to lateral bubble error produces a total determinate deflection error of 185 feet left. The remaining 227 feet of deflection error is indeterminate. It is believed however, that the lateral bubble error was probably greater in magnitude than reported.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

   a. DIFFICULTY: Same as for bomb A-22 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-22 this mission.

2. CAMERAS:

   a. DIFFICULTY: Same as for bomb A-22 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-22 this mission.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: Unable to read within plus or minus 200 feet of 30,000 feet because size of reference lobe restricted readings within that range. Reading was within that bracket.

HARKEN PROJECT BOMBING RECORD

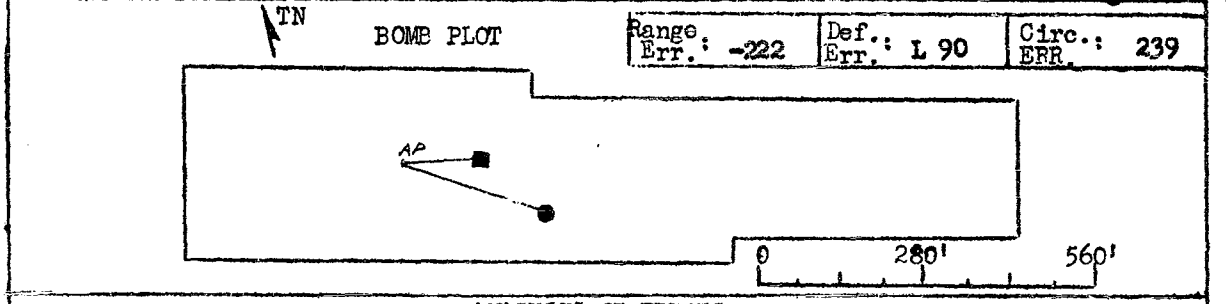
CONFIDENTIAL

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.
Date: 25 July 1947	Bombsight (type): Norden
Mission No: 6 - British	(model): M-9
Target: Farge Sub Ass'y Plant	(no.): N-10382
Aircraft No: 45-21747	Bomb(type,size&no.) GP/RA 1650 lb # A-22

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-9	CIAS	195	Direction	267
Alt Sett.	30.15	Corr F.L. Temp	-35	TAS	316	Velocity	50
Ind. P.A.	29000	Grnd. Temp.	24	Trail	20		
P.A.T.	-150	Mean Temp.	-5.5	WEATHER		SCORING METHOD	
P.A.A.T.	29150	Bomb. Alt.	30000	Visibility	Haze Scat. Clds.	Survey	X
F.L. Temp.	-27	Disc Speed	120.6	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	280	29000	30000	195	316	268	20	120.6		.555	-	2½	0	0	1230



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-	-	-135	CONFIDENTIAL			-135	-	-	-	-	0

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 222 feet short. The synchronized groundspeed and the measured groundspeed are the same. The fore and aft bubble was 1/8 of a bubble length off causing error of 135 feet short. The remaining 87 feet of range error short is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 90 feet left. The drift synchronized for and the measured drift are the same, consequently, no error is attributed to imperfect deflection synchronization. The bombardier reported no lateral bubble error. The entire 90 feet of left deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

a. DIFFICULTY: The aircraft kept dropping the left wing and could not be trimmed about the aileron axis. It was necessary to turn off aileron locking switch, re-center and re-engage, just prior to each bombing run. Malfunction was attributed to aileron amplifier.

b. CORRECTIVE ACTION: Replaced aileron amplifier.

2. PNEUMATIC DOORS:

a. DIFFICULTY: Pressure in rear door accumulator was depleted after one operation at 30,000 feet. Could not close doors at that altitude. Modified latch actuator on rear door had burr inside which caused wear on rubber washer and allowed air to escape.

b. CORRECTIVE ACTION: Removed burr in actuator. Replaced rubber washer.

3. CAMERAS:

a. DIFFICULTY: Floodlights in both bomb bays continued to burn after all camera switches were turned off. Lights did not go out until aircraft battery switches were turned off. This was caused by a stuck relay in P-2 lighting circuit.

b. CORRECTIVE ACTION: Replaced relay. Checked OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: Within plus or minus 200 feet of 30,000 feet. Size of reference lobe prevented accurate reading.

CONFIDENTIAL

HARKEN PROJECT — BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.
Date: 28 July 1947	Bombsight (type): Norden
Mission No: 9-British	(model): M-9
Target: Farge Sub Assly Plant	(no.): N-10382
Aircraft No: 45-21747	Bomb(type,size&no.) GP/RA 1650 lb #A-8

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-8	CIAS	180	Direction	304
Alt Sett.	30.27	Corr F.L. Temp	-45	TAS	321	Velocity	78
Ind. P.A.	33800	Grnd. Temp.	24	Trail	22		
P.A.T.	-170	Mean Temp.	-10.5	WEATHER		SCORING METHOD	
P.A.A.T.	33870	Bomb. Alt.	35000	Visibility	Good	Survey	X
F.L. Temp.	-37	Disc Speed	111.4	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	290	33800	35000	180	321	246	20	111.4	⊕	.472	2	-	-	-	1430

BOMB PLOT

TN

AP

Range Err.: -150 | Def. Err.: L 778 | Circ. EER.: 802

0 280' 560'

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
0	-140	0	0	0	0	-140	0	L652	0	L-33	L-685

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 150 feet short. Analysis shows that the bombardier synchronized for a groundspeed of 248 MPH; actual groundspeed was 246 MPH. A range error of 140 feet short was caused by the 2 MPH error in range synchronization. No other possible cause for range error was reported by the bombardier. The remaining 10 feet of range error are indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 778 feet to the left. Analysis shows that the bombardier synchronized for 2 degrees of left drift; the actual drift according to the measured wind should have been 4 1/4 degrees left. This accounts for an error of 652 feet left. An additional error of 33 feet left is attributed to too small a drift angle in the sight crosstrail mechanism. The analyzed deflection error is 685 feet left. The remaining 117 feet of left deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

a. DIFFICULTY: Autopilot unstable and wallows after completing pilot's turn control turn.

b. CORRECTIVE ACTION: Adjusted bombsight stabilizer autopilot clutch tension.

2. PNEUMATIC DOORS:

a. DIFFICULTY: Rear door accumulator pressure low after opening at altitude. Used interconnect valve to close doors. Leak in system.

b. CORRECTIVE ACTION: Malfunction due to leak in latch actuator. Replaced rubber washer in latch actuator.

3. CAMERAS:

a. DIFFICULTY: Camera floodlights inoperative and rear B-2 camera failed to operate. Broken star gear.

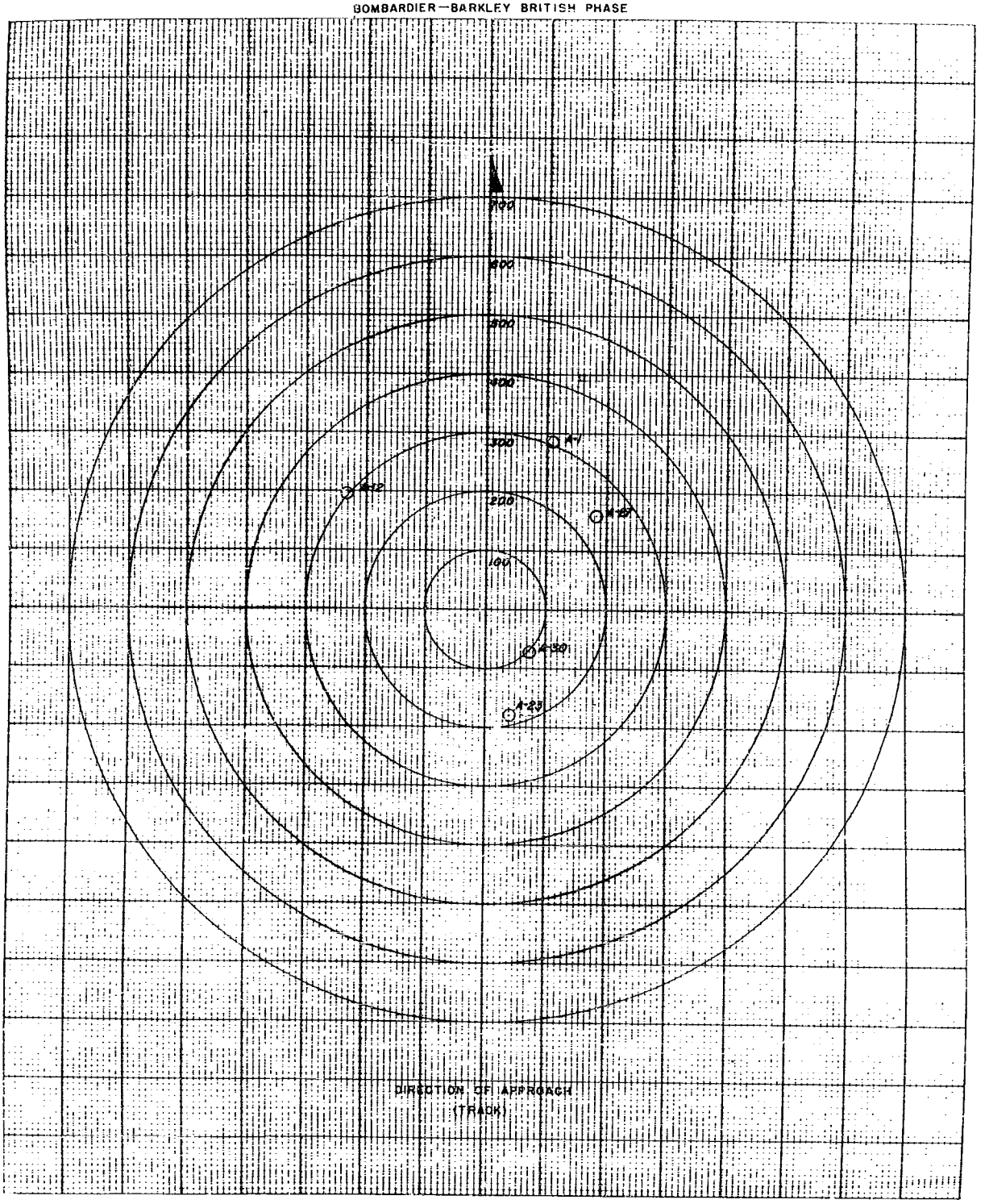
b. CORRECTIVE ACTION: Floodlight malfunction due to light circuit breaker popping. Breaker reset. Lights operated OK. Camera malfunction due to low temperature effects. Replaced broken star gear.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 55,000 Feet.

Bombardier reduced trail setting 2 mils from the computed trail in order to compensate for an estimated 26 MPH Range Differential Ballistic Wind.

BOMBARDIER—BARKLEY BRITISH PHASE



CONFIDENTIAL

HARKEN PROJECT - BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 22 July 1947
Mission No: 1 - British
Target: Farge Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): N-8914
Bomb(type,size&no.) CP/RA 1650 lb #A-27

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-8	CIAS	195	Direction	289
Alt Sett.	30.16	Corr F.L. Temp	-34	TAS	316	Velocity	40
Ind. P.A.	28680	Grnd. Temp.	27	Trail	21.5		
P.A.T.	-160	Mean Temp.	-3.5	WEATHER		SCORING METHOD	
P.A.A.T.	28840	Bomb. Alt.	30000	Visibility	Good	Survey	X
F.L. Temp.	-26	Disc Speed	120.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	280	28710	30030	194	315	276	20.5	120.7	5	.570	R	-	-	-	1312

BOMB PLOT

TN

AP

Range Err.: 161 | Def. Err.: R 183 | Circ. Err.: 246

0 280' 560'

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	65	-	10	-	-	75	-	-	-	-	-

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS.

a. The measured range error was 161 feet over. The groundspeed synchronized for was 275 MPH as compared to measured groundspeed of 270 MPH. This one (1) MPH error in groundspeed synchronization accounts for a range error over of 65 feet. In addition, a 10 foot range error over is attributed to the pilot flying 30 feet too high on the bombing run. The combination of errors produces a total range error of 75 feet over. The remaining 85 feet of range error over is indeterminate.

DEFLECTION ANALYSIS.

a. The measured deflection error was 183 feet right. The measured drift and the amount of drift synchronized for are the same, and the bombardier reported no lateral bubble error. Consequently, there is no determinate deflection error for this bomb. However, the scanner reported moderate fishtailing of the bomb until it passed out of his range of vision. This could possibly have been the reason for the deflection error.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS.

a. DIFFICULTY: Left rear door would not remain closed during climb to bombing altitude. Door latched and remained closed after bombs were released. Could not determine any reason for the malfunction other than buffeting.

b. CORRECTIVE ACTION: None. Doors checked thoroughly and found to be OK on ground check.

2. CAMERAS

a. DIFFICULTY: K-22. Broken spring tooth in camera case drive. Left B-2 failed to feed film through gate; camera drive gear badly worn.

b. CORRECTIVE ACTION: Replaced K-22 camera. Adjusted motor mount on left B-2 to narrow gear clearance, but operation of camera still not dependable.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 30,000 Feet.
Scanner reported the bomb fishtailed moderately until it passed out of his range of vision.

Bombardier reduced trail setting 1 mil from computed trail to allow for 13 MPH differential ballistic range wind.

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HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN
Date: 22 July 1947	Bombsight (type): Norden
Mission No: 1 - British	(model): M-9
Target: Forge Sub Ass'y Plant	(no.): M-8194
Aircraft No: 45-21750	Bomb (type, size&no.) CP/RA 1650 lb [illegible]-12

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-8	CIAS	195	Direction	289
Alt Sett.	30.16	Corr F.L. Temp	-34	TAS	316	Velocity	40
Ind. P.A.	28680	Grnd. Temp.	27	Trail	20.5		
P.A.T.	-160	Mean Temp.	-3.5	WEATHER		SCORING METHOD	
P.A.A.T.	28340	Bomb. Alt.	30000	Visibility	Good	Survey	X
F.L. Temp.	-26	Disc Speed	120.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	2	A	281	28725	30015	193	314	27 3	20.5	120.7		.57	1	-	R1/8	L1/8	1340

BOMB PLOT

TN

AP

0 280' 560'

Range Err.: 195	Def. Err.: L 241	Circ. EPR.: 306

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	135	18	-	-	153	-	-	L 135	-	L 135

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS.

a. The measured range error was 195 feet over. The synchronized ground speed and the measured groundspeed were the same. No range error is attributed to range synchronization. An error of 135 feet over is attributed to the fore and aft bubble being off 1/8 length, and an additional 18 feet range error over was caused by the pilot flying 45 feet higher than the correct altitude. The total gives a determinate error of 153 feet over as compared to the measured error of 195 feet over. The remaining 42 feet of range error is indeterminate.

DEFLECTION ANALYSIS.

a. The measured deflection error was 241 feet left. The synchronized drift and the measured drift are the same. An error of 135 feet left is attributed to the lateral bubble being off 1/8 bubble length to the right. The remaining 106 feet of left deflection error cannot be determined.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS.

   a. DIFFICULTY: Same as for bomb A-27 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-27 this mission.

2. CAMERAS:

   a. DIFFICULTY: Same as for bomb A-27 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-27 this mission.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 30,000 Feet.

CONFIDENTIAL

HARKEN R[illegible]HT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 23 July 1947
Mission No: 4 - British
Target: Fargo Sub Ass'y Plant
Aircraft No: 45 - 21750

Bombsight (type): Norden
(model): M-9
(no.): M-8194
Bomb(type,size&no.) GP/RA 1650 lb #A-1

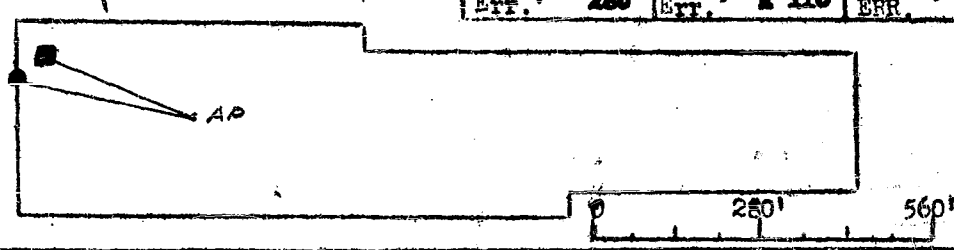
COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-7.9	CIAS	195	Direction	270
Alt Sett.	30.16	Corr F.L. Temp	-35	TAS	314	Velocity	30
Ind. P.A.	28700	Grnd. Temp.	24	Trail	20.5		
P.A.T.	-160	Mean Temp.	-5.9	WEATHER		SCORING METHOD	
P.A.A.T.	28660	Bomb. Alt.	30000	Visibility	Hazy	Survey	X
F.L. Temp.	-25	Disc Speed	120.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
1	1	A	277	28840	30140	195	314	284	20.5	120.7		.59	-	-	1/8	1 1/8	1201

BOMB PLOT

Range Err.: 286 | Def. Err.: R 110 | Circ. Err.: 306



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS, or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
50	-	135	60	-	-	245	-	-	± 135	-	± 135

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS.

a. The measured range error was 286 feet short. Analysis shows that the total error was a combination of small errors. The groundspeed synchronized for and the measured groundspeed were the same, but the bombardier displaced the lateral crosshair 50 feet over the standard aiming point; the fore and aft bubble caused an error of 135 feet over, and an additional error of 60 feet over was caused by the pilot flying too high during the bombing run. Total determinate error was 245 feet over. The remaining 41 feet of range error over cannot be determined.

DEFLECTION ANALYSIS.

a. The measured deflection error was 110 feet to the right. Analysis shows that the measured drift and the drift synchronized for were the same. The bombardier reported the lateral bubble off 1/8 of a bubble length to the left; this caused an error of 135 feet to the right which is 25 feet greater than the measured error. The difference in deflection remains indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. BOMBSIGHT.

a. DIFFICULTY: Pilot's PDI inoperative due to too little tension on the bombsight PDI coil.

b. CORRECTIVE ACTION: Increased tension of bombsight PDI coil.

2. PNEUMATIC DOORS.

a. DIFFICULTY: Left rear door came open on takeoff. Door did not latch properly; could not be closed upon completion of mission. Latching cable too short.

b. CORRECTIVE ACTION: Replaced cable pulley with smaller size.

3. CAMERAS.

a. DIFFICULTY: Right B-2 broke film in three different places. The brittleness of the film believed due to low temperature. Left B-2 failed to feed film through gate. This was caused by a worn main camera drive gear.

b. CORRECTIVE ACTION: Right B-2. All gate sprocket clearances checked and found OK. Left B-2. Motor mount adjusted to narrow gear clearances but operation still not dependable.

[redacted]

FLIGHT LEVEL RADIO ALTIMETER READING: 30,000 Feet.

Clouds obscured target on bombing run. Approximately seven tenths overcast. Bombed through breaks in overcast.

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HARKEN PROJECT BOMBING MISSION RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt. | A/C: BARENTINE, GEORGE T. CAPTAIN

Date: 28 July 1947 | Bombsight (type): Norden

Mission No: 2 - British | (model): M-9

Target: Fargo Sub Assly Plant | (no.): M-8194

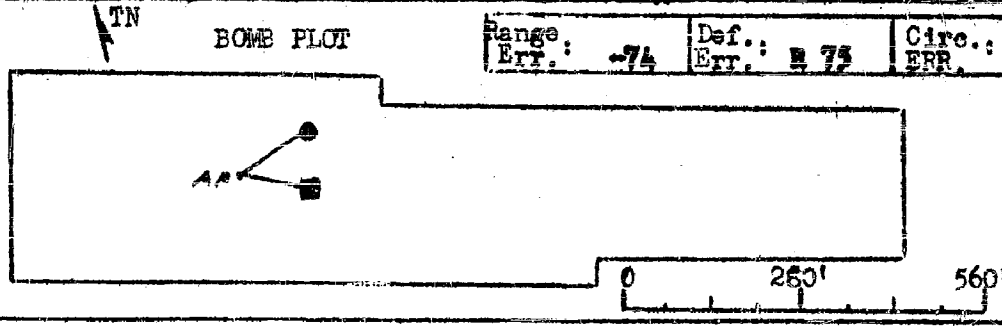
Aircraft No: 45-21750 | Bomb(type,size&no.) CP/RA 1/450 lb # A-30

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-9.2	CIAS	190	Direction	212
Alt Sett.	Not Given	Corr F.L. Temp	-46.2	TAS	338	Velocity	94
Ind. P.A.	33840	Grnd. Temp.	21	Trail	24		
P.A.T.	-160	Mean Temp.	-12.6	WEATHER		SCORING METHOD	
P.A.A.T.	34000	Bomb. Alt.	35000	Visibility	Good	Survey	X
F.L. Temp.	-37	Disc Speed	111.5	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	299	33840	35000	190	338	246	22	111.5		.47	48	-	-	-	1231

BOMB PLOT



Range Err.: -74 | Def. Err.: R 75 | Circ. Err.: 106

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-105	-	-			-	-105	-	-	-	-	-

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 74 feet short. The bombardier synchronized on a point offset 100 feet short of the standard aiming point. There is no other analytical range error inasmuch as the synchronized groundspeed and the measured groundspeed agree. The bombardier reported no fore and aft bubble error. The remaining 26 feet of range error is indeterminate.

DEFLECTION ANALYSIS.

a. The measured deflection error was 75 feet right. The amount of synchronized drift and the measured drift are the same. The bombardier reported no lateral bubble error. The 75 feet right deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS:

a. DIFFICULTY: The right rear door would not remain latched in flight. Doors were closed by hand before takeoff to insure clearance of fins.

b. CORRECTIVE ACTION: Right rear door latching hook was off center. Adjusted position of hook. Operated OK.

2. CAMERAS:

a. DIFFICULTY: All B-8's failed to function in flight. Right B-8 blew a fuse. Left B-8 had worn gear. Rear B-8 ran off approximately ¼ roll. Low temperatures plus worn condition of cameras considered cause of failure. All cameras had checked OK during preflight in loaded condition.

b. CORRECTIVE ACTION: All cameras checked mechanically and electrically. Fuse replaced in right B-8. Clearances rechecked.

3. RADIO ALTIMETER:

a. DEFICIENCY: Radio altimeter cut off at 12,000 feet. Instrument went completely dead. Main fuse in transmitter-receiver RC 73B-C was blown, apparently from momentary high voltage surge.

b. CORRECTIVE ACTION: Fuse replaced and altimeter given operational preflight check. Checked OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: NONE (Inoperative)

Flight of Bomb: Bomb fishtailed moderately for about 5,000 feet, then appeared to straighten out and fall true. Trail as read from the bombing tables was reduced 2 MILS to compensate for estimated 27 MPH Range Differential Ballistic WIND.

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HARKEN PROJECT — BOMBING MISSION RECORD

Bombardier: BARKLEY, CHARLES R. 1st Lt. | A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 28 July 1947
Mission No: 8 - British
Target: Farge Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): N-8194
Bomb (type, size & no.) CP/RA 1650 lb #A-23

COMPUTATIONS

ALTITUDE

Tgt Elev.	80	Comp. Error	-9.2
Alt Sett.	Not Given	Corr F.L. Temp	-46.2
Ind. P.A.	33840	Grnd. Temp.	21
P.A.T.	-160	Mean Temp.	-12.6
P.A.A.T.	34000	Bomb. Alt.	35000
F.L. Temp.	-37	Disc Speed	111.5

AIRSPEED

CIAS 190
TAS 338
Trail 24

WEATHER

Visibility Good
Turbulence Smooth

WIND (MPH)

Direction 308
Velocity 94

SCORING METHOD

Survey X
Photo

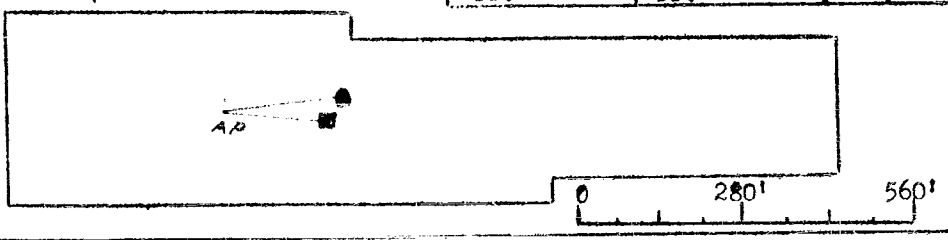
SIGHT DATA

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	2	A	296	33800	35000	190	338	246	22	111.5	K	.465	3½	-	-	-	1305

BOMB PLOT

TN

Range Err.: -180 | Def. Err.: R 41 | Circ. EER: 186



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-100	-	-	-	-	-	-100	-	-	-	-	-

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS.

a. The measured range error was 180 feet short. The bombardier synchronized on a point offset 100 feet short of the standard aiming point. There is no other analytical range error inasmuch as the synchronized groundspeed and the measured groundspeed agree. The bombardier reported no fore and aft bubble error. The remaining 80 feet of range error short is indeterminate.

DEFLECTION ANALYSIS

a. The measured deflection error was 41 feet to the right of the aiming point. The amount of synchronized drift and the measured drift are the same. No lateral bubble error was reported. The entire 41 feet of deflection error to the right is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS:

   a. DIFFICULTY: Same as for bomb A-30 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-30 this mission.

2. CAMERAS:

   a. DIFFICULTY: Same as for bomb A-30 this mission.

   b. CORRECTIVE ACTION: Same as for bomb A-30 this mission.

3. RADIO ALTIMETER:

   a. DIFFICULTY: Same as for bomb A-30 this mission.

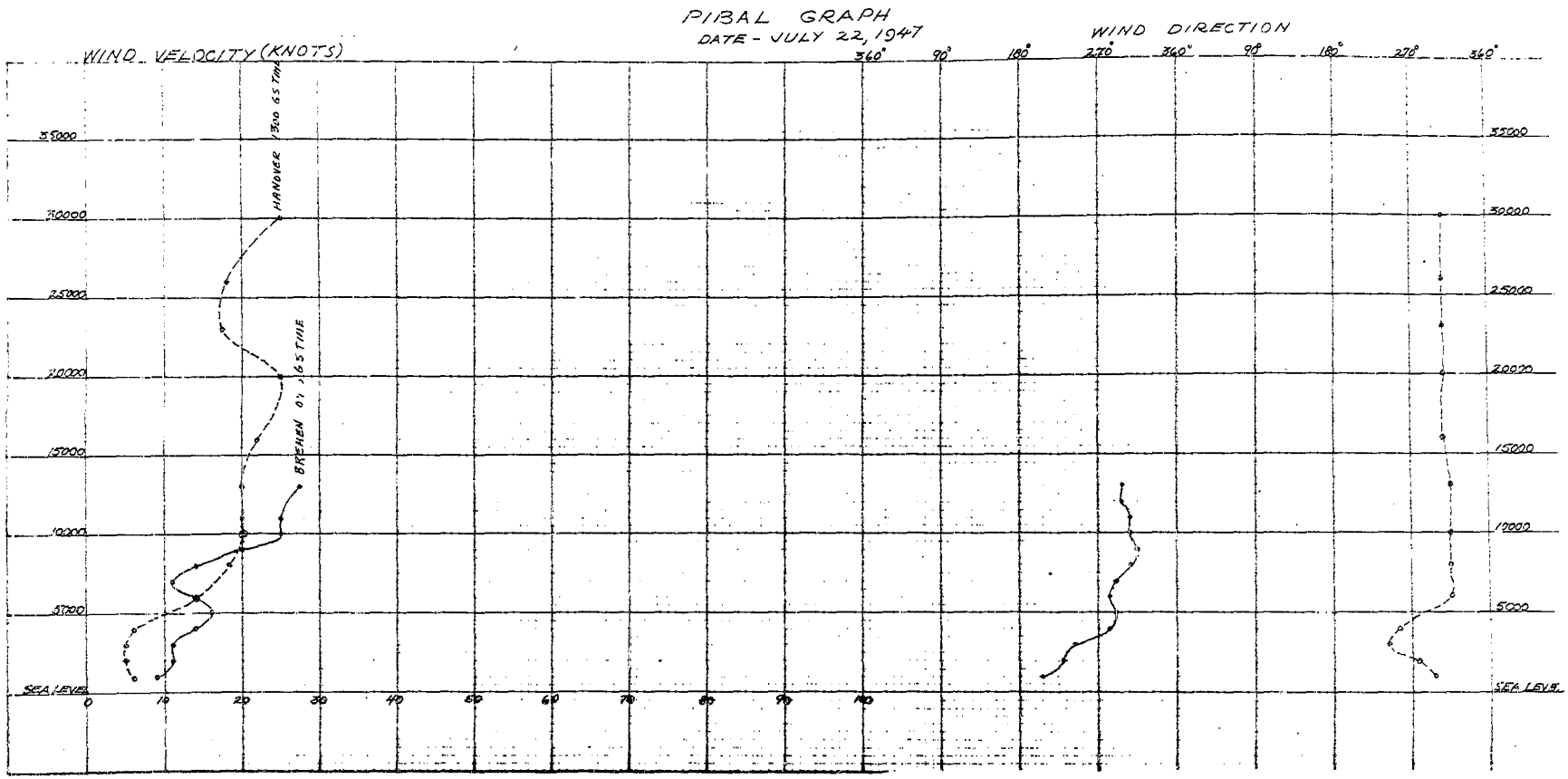
   b. CORRECTIVE ACTION: Same as for bomb A-30 this mission.

REMARKS:

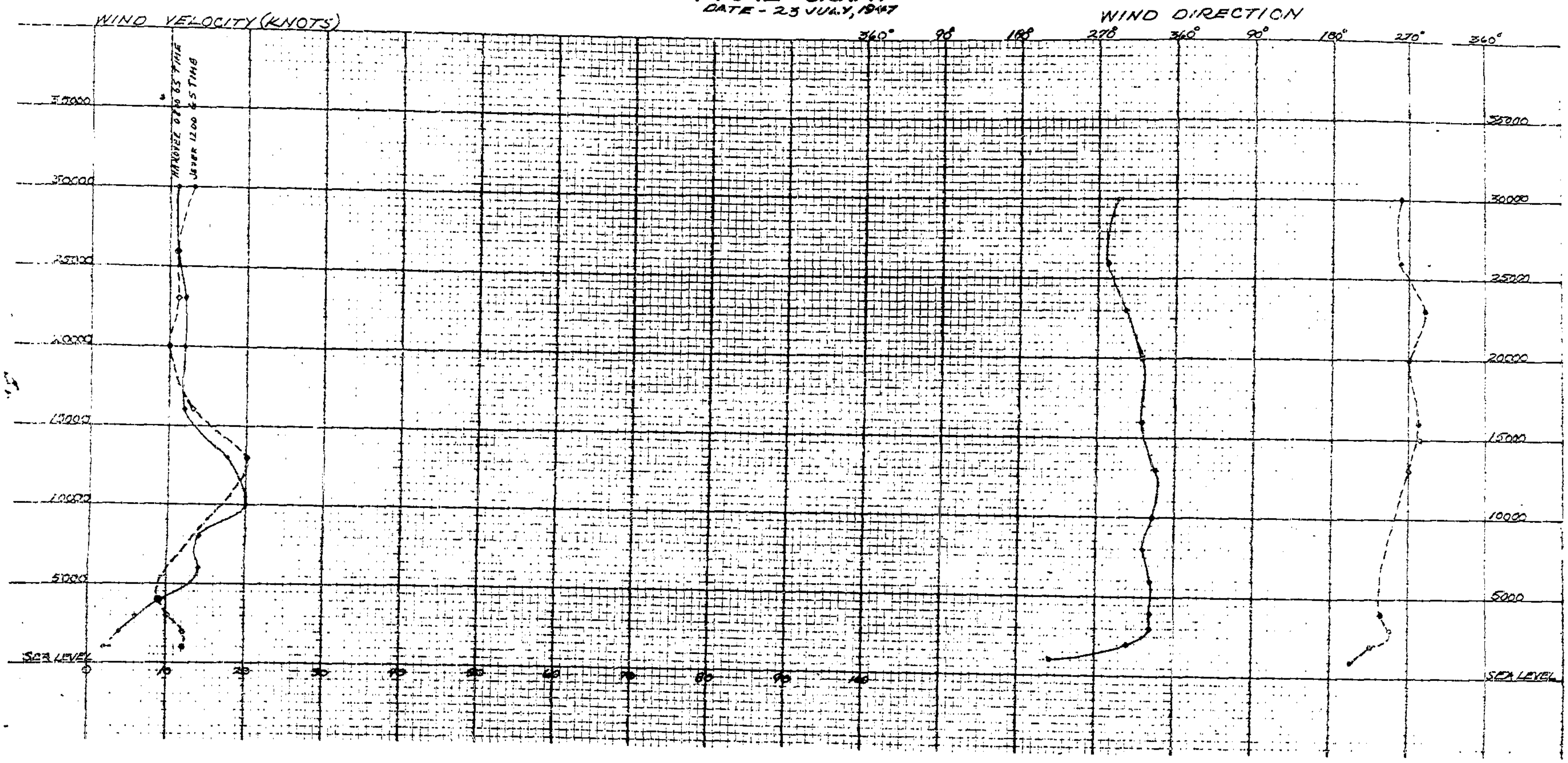
FLIGHT LEVEL RADIO ALTIMETER READING: NONE (Inoperative)

Trail setting as read from the bombing tables was reduced 2 MILS to compensate for an estimated 30 MPH Differential Ballistic Wind.

PIBAL GRAPHS

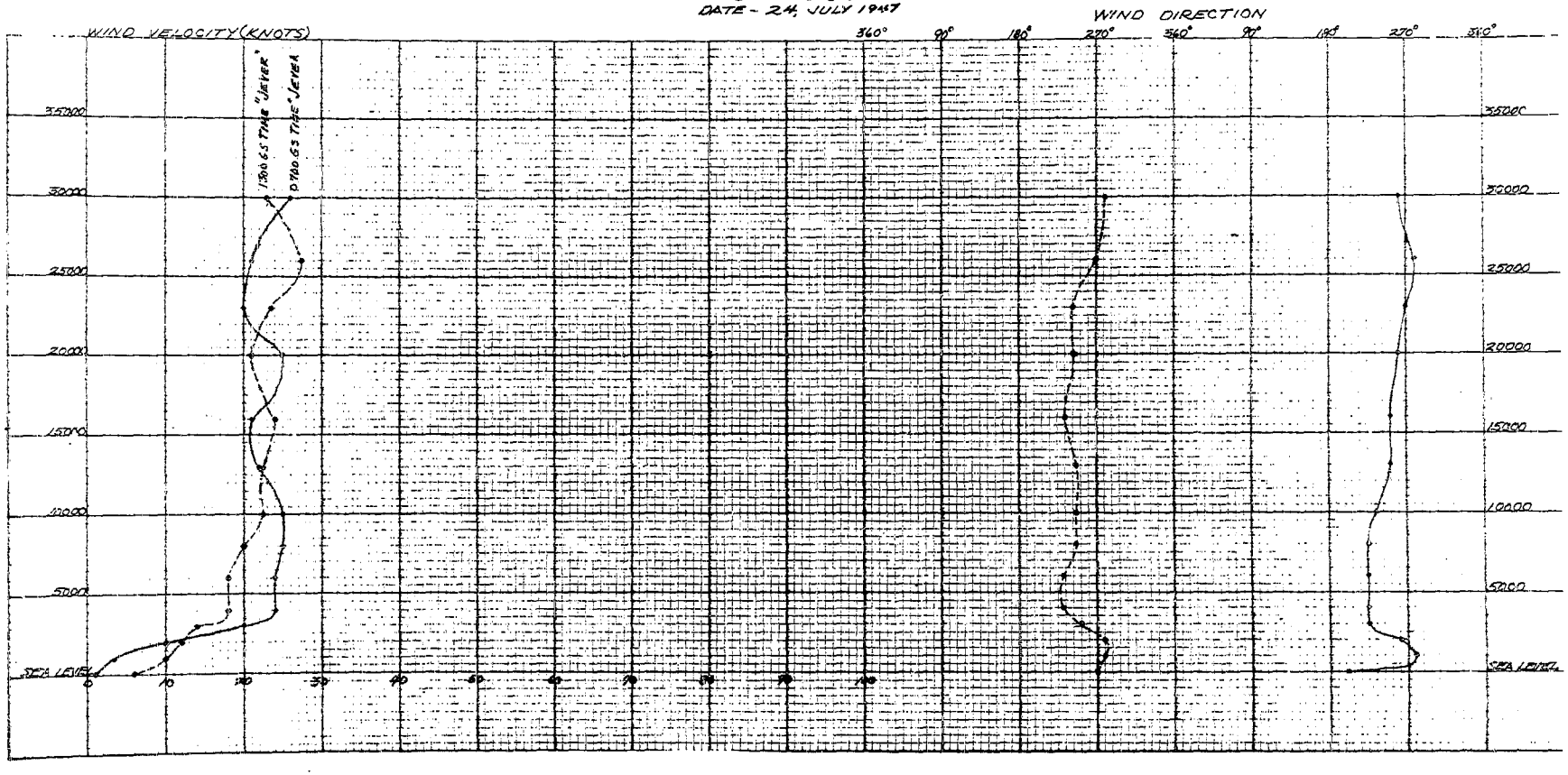

PIBAL GRAPH
DATE - JULY 22, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
HANOVER 1300 GST 70
BREMEN 01,165 THE
35000
30000
25000
20000
15000
10000
5000
SEA LEVEL
0
10
20
30
40
50
60
70
80
90
100
360°
90°
180°
270°
360°
90°
180°
270°
360°

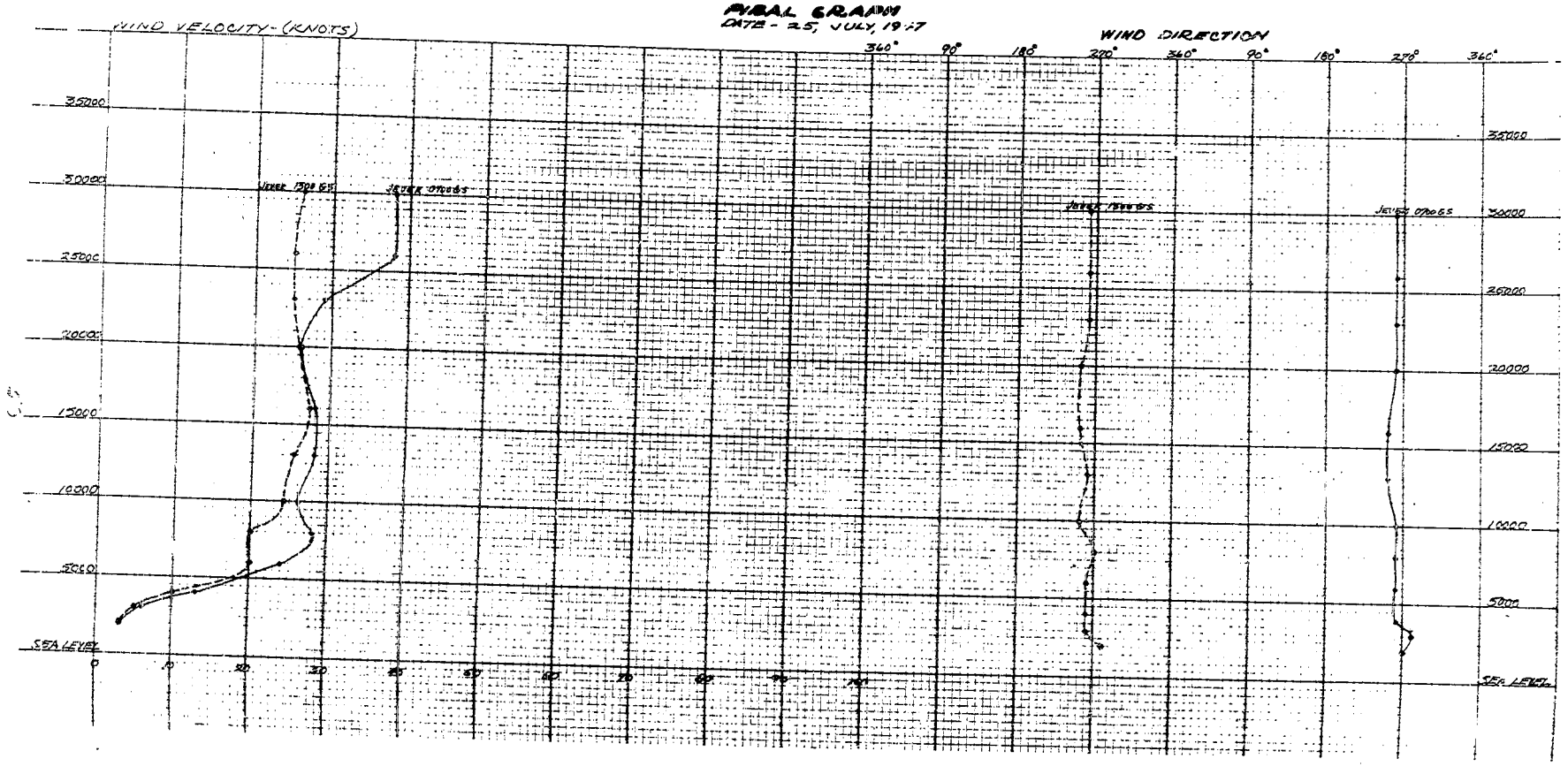
PIBAL GRAPH
DATE - 23 JULY, 1947



PIBAL GRAPH

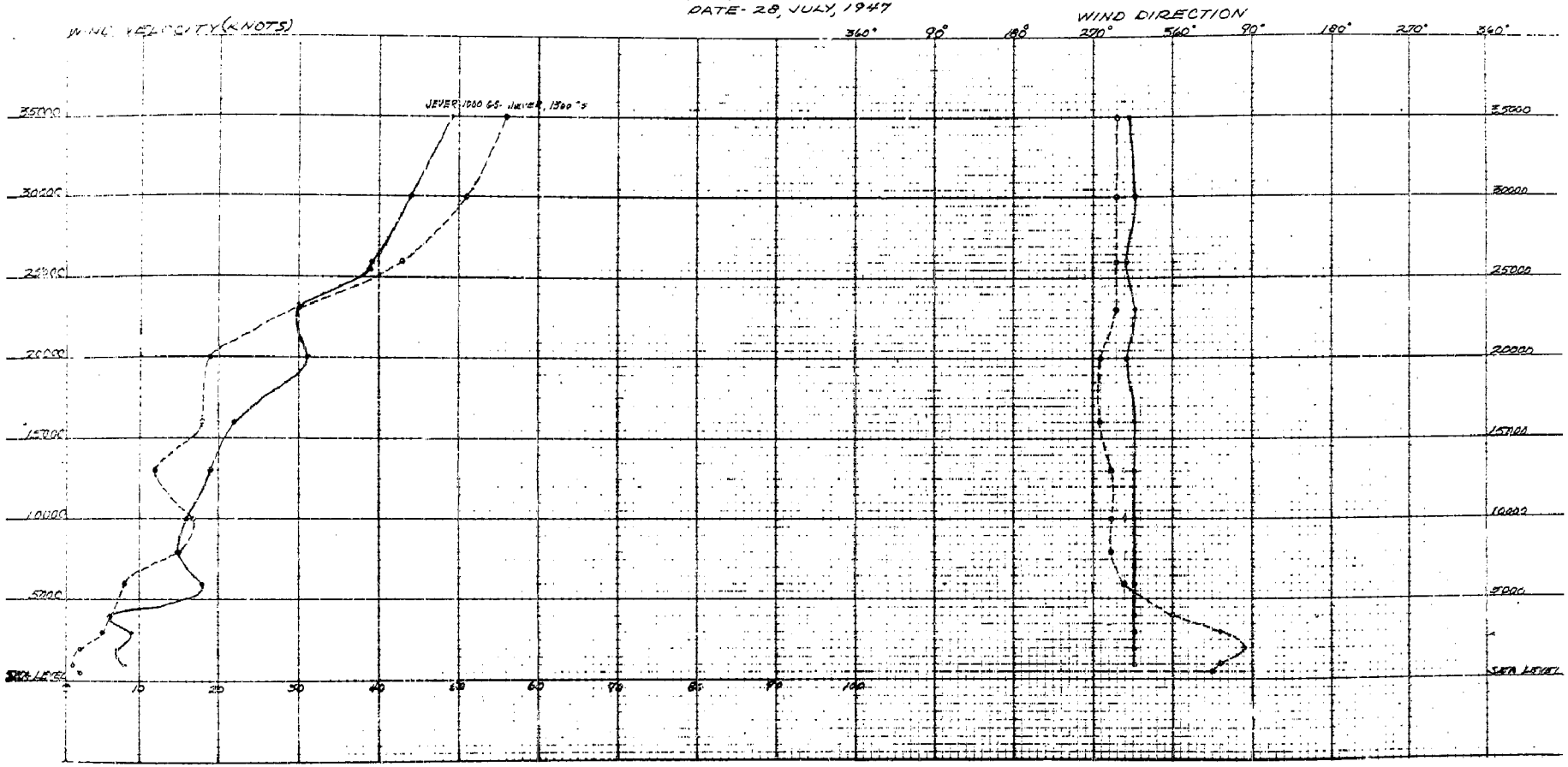
DATE - 24, JULY 1947




PIBAL GRAM
DATE - 25, JULY, 19 47
WIND VELOCITY - (KNOTS)
WIND DIRECTION
340°
90°
180°
270°
360°
35000
30000
25000
20000
15000
10000
5000
SEA LEVEL
0
10
20
30
40
50
60
70
80
90
100
JEVER 1308 GT
JEVER 0700 GS
JEVER 1308 GS
JEVER 0700 GS

PIBAL GRAPH

DATE- 28, JULY, 1947



S E C T I O N III

BRITISH PHASE

OPERATIONAL SUMMARY---BOMBING EQUIPMENT

ARMAMENT

BOMBSIGHTS

C-1 AUTOPILOT

PHOTO EQUIPMENT

RADAR ALTIMETERS

OPERATIONAL SUMMARY-ARMAMENT AND ALLIED EQUIPMENT

1. OPERATION:

a. The British bomb carrier, Type MK. II, was supported by one three-eighths inch bolt attached to the adapter frame. The single point of support allowed a slight play between the slots in the adapter frame and the top of the nose and tail crutches.

b. The E.M. release unit, Type C, MK. III, contains the electrical equipment of the MK. II carrier. The British five-strand cable was replaced with two-strand cable. The right hand release unit was wired in series with the station number one A-2 receptacle input wire, B-515, on the right rear rack of the front bomb bay. The left hand release unit was wired in series with the station number one A-2 receptacle input wire, B-515, on the left rear rack in the front bomb bay. There were three release failures, one due to a severed ground wire leading to the release unit and two due to the failure of the bomb bay door micro switches to complete the release circuit.

c. The buffer doors operated satisfactorily in flight, but the buffer door latches had to be forced open on the ground.

d. It was necessary for the tail fins of the British bomb to be at an angle of forty-five degrees from the vertical before the rear bomb bay doors could be closed. Inasmuch as the angle of the tail fins varied, it was necessary to change the position of the tail fins before closing the rear bomb bay doors, thereby, throwing the bombs out of alignment with the longitudinal axis of the airplane.

2. CORRECTIVE ACTION:

a. The cable leading to the release unit was taped to the side of the carrier to prevent buffeting.

b. The micro switches were removed from all bomb bay doors.

c. Shims were wedged between the carrier nose and tail crutches and the adapter frame to prevent movement of the bomb and carrier.

3. CONCLUSIONS:

a. The MK. II carrier operated satisfactorily.

b. The adaptor frame modification was unsatisfactory.

c. The MK. III release unit operation was not entirely satisfactory.

d. Ground operation of the buffer door latches was unsatisfactory.

e. The bomb bay door modification on the Albert aircraft is unsatisfactory for use with the 1650 lb. C.P.R.A. British bomb.

4. RECOMMENDATIONS:

a. The adapter frame be modified to hold the MK. II carrier more securely in position.

b. The MK. III release unit be wired directly to the bomb-sight.

c. The buffer door latches be modified to provide for smoother operation.

d. When carrying the 1650 lb. model British bomb, recommend the standard front and rear bomb bay doors be installed, with the necessary portion cut out of the rear bomb bay doors to insure proper clearance between the rear doors and the bomb fins. This modification would also eliminate the necessity of using the buffer doors.

OPERATIONAL SUMMARY - BOMBSIGHTS

1. OPERATION:

   a. Operation of the bombsights during this phase of the project was very good. No maintenance difficulties or malfunctions were encountered.

2. CORRECTIVE ACTION:

   None

3. CONCLUSIONS:

   None

4. RECOMMENDATIONS:

   None

OPERATIONAL SUMMARY - C-1 AUTOPILOT

1. OPERATION:

a. In general, operation of the C-1 Autopilot at 30,000 feet and 35,000 feet levels was considered to be very good. The only maintenance required was of a normal nature and was confined to one aircraft, No. 42-21747. The malfunctions were:

(1) Improper autopilot clutch tension.
(2) Aileron amplifier out of adjustment.

b. A modification known as the "Rate Gyro" had been installed at Wright Field prior to departure, for extensive service testing during high altitude operation. The purpose of the modification was to eliminate the wallow and instability generally found in all C-1 autopilots during operation at extreme altitudes. The "Rate Gyro" is a 24000 RPM booster directional gyro and is wired into the C-1 rudder circuit. It is extremely sensitive to deviation in azimuth, and is in effect, a gyroscopic dash-pot. No maintenance difficulties were encountered with the modification.

2. CORRECTIVE ACTION:

a. Only two malfunctions were encountered during this phase:

(1) The autopilot clutch tension was adjusted to T.O. specifications.
(2) A new amplifier unit was installed.

3. CONCLUSIONS:

a. All pilots and bombardiers were unanimously agreed that the "Rate Gyro" modification does materially reduce wallow and instability at extreme altitudes, and it is concluded that the installation does provide a much more stable bombing platform than the unmodified version of the C-1 autopilot.

4. RECOMMENDATION:

a. That the "Rate Gyro" be installed as a retroactive modification on all operational B-29 bombardment aircraft equipped with the Type C-1 Autopilot.

OPERATIONAL SUMMARY - PHOTO EQUIPMENT

1. OPERATION:

a. K-22 type aerial cameras operated satisfactorily on every mission.

b. The B-2 Recording Camera set-up afforded incomplete coverage of the bomb's fall. The poor mechanical condition of the majority of the cameras, electrically and especially mechanically was the cause of numerous minor and major malfunctions, and introduced a large factor of unreliability into the photographic phase of the operation. Specifically, some of the malfunctions were:

(1) Broken star gear.
(2) Intermittent drive.
(3) Broken taper pins.
(4) Variable film clearance caused by worn bearings in sprocket assemblies.
(5) Broken wiring.
(6) Chewed wiring caused by wiring slipping into governor arms.
(7) Damaged governor caused by governor weight breaking loose.
(8) Effects of altitude plus low temperatures encountered added a further hindrance especially for the missions flown at 35,000 feet.

2. CORRECTIVE ACTION:

a. Every action noted in pertinent Tech Orders was taken to insure successful performance. Cameras were not installed until it was certain that they were functioning properly in all respects, both in loaded and unloaded condition. Therefore, operational failures occurred after take-off during actual in-flight operation.

3. CONCLUSIONS:

a. Jerome B-2 Recording Cameras 35 MM. were not in good mechanical condition when furnished for project.

b. Low temperatures encountered at 35,000 feet was a contributing factor to majority of malfunctions during this phase.

4. RECOMMENDATIONS:

a. A modification to the present type Jerome B-2 recording camera to prevent unrolling of exposed film from take-up spool. This could be accomplished by some sort of lightly loaded roller resting on the film on the spool at all times with the camera in any position.

b. Jerome B-2 recording camera be equipped with more heaters or a type heater with greater wattage if cameras are to be used at altitudes above 20,000 feet.

OPERATIONAL SUMMARY - RADAR EQUIPMENT

1. OPERATION:

a. Radar altimeters operated unsatisfactorily on about 33% of the missions flown. Most cases of malfunction were of a minor nature which could not be detected during operational ground checks.

b. The indicator unit I-152-C of the SCR 718 Radar Altimeter frequently went out of calibration after take off. The condition of the units indicated that no shop level maintenance or calibration had been performed prior to the initiation of the project. Also, several stock units, though tagged operational, were definitely non-operational. Most frequent malfunctions were:

(1) Calibration drift in indicator I-152-C.
(2) Poor signal reception at medium and high altitudes.
(3) Bad cathode ray tube in indicator I-152-C.
(4) Weak tubes in transmitter-receiver unit BC 788 C.
(5) Blown fuse.

2. CORRECTIVE ACTION:

a. Every action noted in pertinent available Tech Orders, within the limits of available test and maintenance facilities, was taken prior to every mission to insure satisfactory performance. In every instance of malfunction, equipment had ground checked OK, but went out of operation after tak off. Due to the limited amount of test equipment available, corrective action consisted mainly of calibration of units and replacement of inoperative units with units known to be operational.

3. CONCLUSIONS:

None

4. RECOMMENDATIONS:

a. Test sets TS-10-APN and TS-23-APN be made available to operating personnel. Without subject test sets, shop is prone to be unreliable.

SECTION IV

THE AMERICAN PHASE OF HANKEN PROJECT

THE AMERICAN PHASE OF HARKEN PROJECT

1. THE PURPOSE

The purpose of the American phase was to test the penetration qualities of the 25000 lb T28E1 Amazon II bomb and the 25200 lb T26EII Samson bomb against the 14' -9" and 23' -0" roof thickness of the Fargo Submarine Assembly Plant.

2. MISSION REQUIREMENTS

A total of 30 bombs were originally provided for this test; fifteen of the Amazon II type, and fifteen of the Samson type. It was desired that a total of four good hits be obtained with each type of bomb. Two hits on the 14' -9" roof thickness, and two hits on the 23' -0" roof thickness. Bombs were to be dropped from an absolute altitude of 17,000 feet so that impact velocities would be comparable to those of the original T28 Amazon bomb, with which previous penetration tests had been conducted. If the desired hits were obtained with each type of bomb, and bombs remained, it was directed that the remaining bombs be dropped from 25,000 feet absolute altitude in an attempt to penetrate the 23' -0" roof thickness.

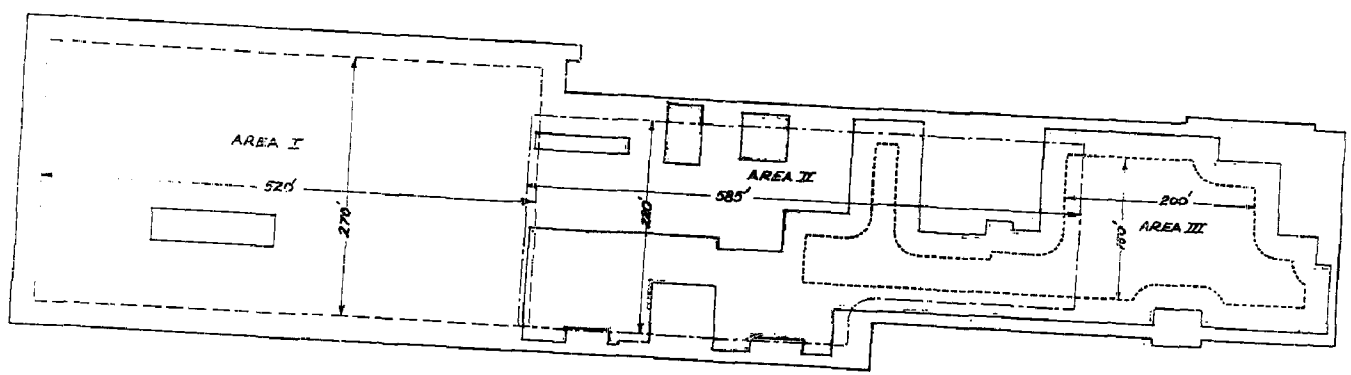
3. THE FARGO TARGET

The overall dimensions of the Fargo Target are approximately 1400 feet in length by 300 feet in width. The roof was divided into 3 specific aiming areas because hits were desired on each type of roof thickness. Reference is made to accompanying diagram, entitled "Fargo Roof Areas", which clearly outlines the 3 roof areas. Area I contains the thin, 14' -9" roof structure. Area II bounds that region of the roof which contains approximately equal concentration of thin, 14' -9" roof and the thick 23' -0" roof. Area III contains the greatest concentration of thick, 23' -0" roof.

a. AMAZON TYPE BOMBS

(1) When hits were desired on the thin (14' -9") roof (Area I), it was decided to aim specifically at the western end of the building which contains the major part of the 14' -9" roof structure.

FARGE ROOF AREAS



LEGEND

BOUNDRY OF AREA I (14'9" THIN ROOF)

BOUNDRY OF AREA II (14'9" & 25'9" THICK & THIN ROOF)

BOUNDRY OF AREA III (25'9" THICK ROOF)

BOUNDRY OF 25'9" ROOF AREA

SCALE

The aiming point was located 375 feet from the west wall along the longitudinal center line of the target. The approximate overall dimensions of the thin roof area were 580 feet (long) by 320 feet (wide).

(2) When hits were desired on the thick (23'-0") roof, (Area III), it was decided to aim specifically at the narrow eastern end of the target which contains the greatest concentration of 23'-0" roof. Although various sized sections of the thick roof extend for approximately half of the overall target length, it may be easily be seen by reference to accompanying diagram entitled "Farge Roof Areas", that the only thick roof concentration with any width of consequence is located at the extreme Eastern end of the building. For the first five Amazon bombs aimed at the thick roof, the aiming point was located 259 feet from the East wall of the target, and 24 feet south of the longitudinal center line. Reason for locating the aiming point 24 feet south of the longitudinal center line was due to previous bomb damage to the northwestern edge of the thick roof concentration. After the first five bombs were dropped, it was decided that the location of the aiming point did not permit sufficient deflection error on the south side of the target, so for the remaining 10 Amazon bombs, the aiming point was located 259 feet from the East wall along the longitudinal center line. The overall dimensions of the thick roof concentration was approximately 250 feet in length by 200 feet in width.

b. SAMSON TYPE BOMBS

(1) It was decided to aim first at the center portion of the roof (Area II, "Farge Roof Areas") which encompassed approximately equal portions of thick (23'-0") and thin (14'-9") roof concentrations. Reason for aiming at this portion of the roof first was to attempt dispersion hits on either the thick or thin roof surface, after which, the aiming point could be moved accordingly. For hits in Area II, the aiming point was located 555 feet from the East wall, 24 feet South of the target longitudinal center line.

The approximate overall dimensions of the thick and thin roof area were 635 feet long by 270 feet wide.

(2) After dispersion hits were obtained on the thick and thin roof area, the aiming point was shifted to the center of the thin 14'-9" roof (Area I). The aiming point was located 300 feet from the west wall, along the longitudinal center line of the target. The overall dimensions of Area I were approximately 580 feet long by 320 feet wide.

(3) After hits were obtained on the thin roof, the aiming point was relocated on the thick roof, Area I, at a point 259 feet from the East wall along the longitudinal center line of the target. Overall dimensions of Area I were approximately 250 feet in length by 200 feet in width.

4. BOMBING PROBABILITIES REQUIRED

It was estimated by assessor that for a so-called good hit, i.e., an assessable hit on either roof thickness, a bomb impact would have to be 25 to 30 feet in from any given edge of the roof. Otherwise, the bomb in penetrating, would take the path of least resistance, turn and break out the side wall, rather than penetrate vertically. In the accompanying diagram, entitled "Large Roof Areas", each of the aiming areas used is reduced by 25 feet in order to show the area within which an impact had to fall to be considered a good assessable hit. By reference to the diagram, it may easily be seen that the greatest liklihood for a good hit on the thick roof area required that the bomb impact be confined to an area 200 feet in length by 150 feet in width. Conversely, a good hit on the thin roof area had to be confined to an area 520 feet in length by 270 feet in width.

The following discussion of bombing probabilities is included so as to present a mathematical analysis of the bombing accuracy necessary to meet the minimum mission requirements. Information and figures for the bombing probabilities listed were extracted from TM 1-251, "Handbook for Bombardiers". In order to obtain a basis for the figures, certain assumptions were made; range and deflection single shot probability were considered to be equal, and the direction of bombing approach was assumed to be along the longitudinal axis of the target.

a. AMAZON BOMBS.

(1) Probability for good hits on Area I, 14'-9" roof thickness:

Number of bombs allowed - 2.

Number of good hits required - 2.

Target dimensions - 520 feet long by 270 feet wide.

Single shot probability required - 100%.

DEFLECTION	RANGE
Single shot probability required - 100%.	Single shot probability required - 100%.
Probable error required - 34 feet.	Probable error required - 65 feet.
Average error required - 39 feet.	Average error required - 75 feet.

Required probable circular error - 82 feet.

Required average circular error - 87 feet, or 5.1 mils.

(2) Probability of good hits on Area III, 23'-0" roof thickness:

Number of bombs allowed - 15.

Number of good hits required - 2.

Target dimensions - 200 feet long by 150 feet wide.

Single shot probability required - 40%.

DEFLECTION	RANGE
Single shot probability required - 63%.	Single shot probability required - 63%.
Probable error required - 58 feet.	Probable error required - 77 feet
Average error required - 67 feet.	Average error required - 89 feet.

Required probable circular error - 116 feet.

Required average circular error - 123 feet or 7.2 mils.

b. SAMSON BOMBS.

(1) Probability of good hits on Area II, 14'-9" and 23'-0" roof thickness:

Number of bombs allowed - 5.

Number of good hits required - 2.

Target dimensions - 585 feet long by 220 feet wide.

Single shot probability required - 81%.

DEFLECTION	RANGE
Single shot probability required - 90%.	Single shot probability required - 90%.
Probable error required - 44 feet.	Probable error required - 117 feet.
Average error required - 51 feet.	Average error required - 136 feet.

Required probable circular error - 126 feet.

Required average circular error - 136 feet or 8 mils.

(2) For good hits on Area I, 14'-9" roof thickness:

Number of bombs allowed - 1.

Number of good hits required - 1.

Target dimensions - 520 feet long by 270 feet wide.

Single shot probability required - 100%.

DEFLECTION	RANGE
Single shot probability required - 100%.	Single shot probability required - 100%.
Probable error required - 34 feet	Probable error required - 65 feet
Average error required - 39 feet.	Average error required - 75 feet.

Required probable circular error - 82 feet.

Required average circular error - 87 feet or 5.1 mils.

(5) For good hits on Area III, 23'-0" roof thickness:

Number of bombs allowed - 8.

Number of good hits required - 1.

Target dimensions - 200 feet long by 150 feet wide.

Single shot probability required - 49%.

DEFLECTION	RANGE
Single shot probability- 70%.	Single shot probability- 70%.
Probability required- 50 feet.	Probability required- 67 feet.
Average error required- 58 feet.	Average error required- 77 feet.

Probable circular error required - 101 feet.

Average circular error required - 107 feet or 6.3 mils.

5. RESULTS:

a. AM ON TYPE BOMBS.

(1) The first two bombs dropped were aimed at the 14'-9" roof thickness. Both bombs were good, assessable hits.

(2) The remaining thirteen bombs were aimed at the 23'-0" roof thickness. Three hits were obtained, but the impacts were too close to the edge, and in each case the bomb either turned and broke out the side, or glanced off the edge of the roof. Two of the bombs which hit the building were found to be in good condition, and it was decided to recover the bombs, add new fin assembly, and redrop them in an attempt to obtain good hits on the thick roof area.

The bombs were redropped. One of them hit the top of the south wall of the building but was not an assessable hit. In all, a total of fifteen Amazon II type bombs were aimed at the thick roof. Four hits were obtained, but none were sufficiently good for assessment purposes.

b. SAMSON TYPE BOMBS:

(1) The first five bombs were aimed at the center section of the building which contains areas of 14'-9" roof and 23'-0" roof. Of the five bombs dropped, two hits were obtained on the roof, and one bomb glanced off the south wall of the building. The two hits on the roof were both good, assessable hits. One hit the thick roof, and the other hit the thin roof section.

(2) The next bomb was aimed at the 14'-9" roof thickness and was a good, assessable hit.

(3) The remaining eight bombs were aimed at the 23'-0" roof thickness. One good, assessable hit was obtained out of the first three bombs aimed at this area. This completed the requirements for hits with the Samson type bomb from an absolute altitude of 17,000 feet. It was directed to drop the remaining five bombs from an absolute altitude of 25,000 feet in an attempt to completely penetrate the 23'-0" roof. This was done, but no hits were obtained from this altitude.

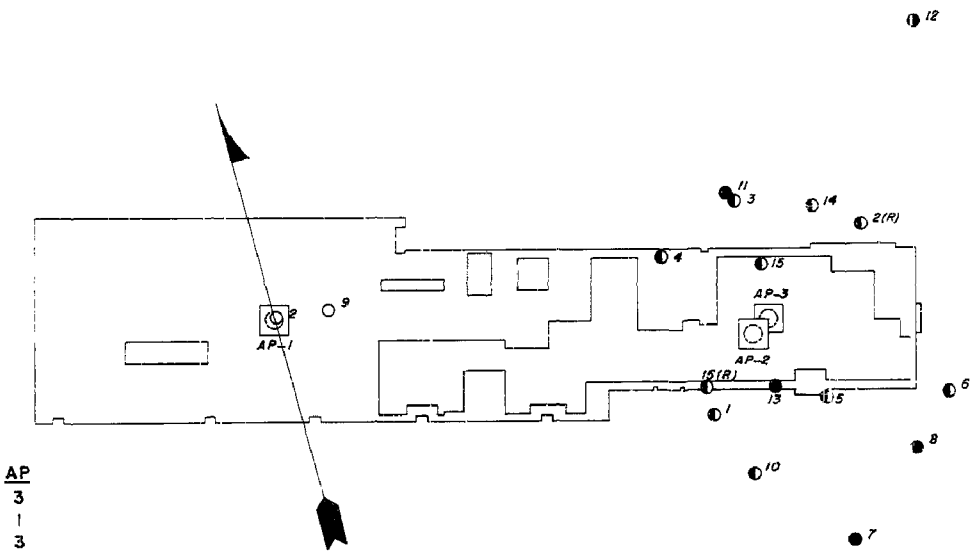
(4) One other Samson type bomb was a malfunction release, caused by failure of the D-9 Shackle. This bomb fell approximately 20 miles from the target.

HARKEN BOMB PLOT

AMERICAN PHASE

FARGE TARGET

BOMB TYPE 25,000LB AMAZON—II (T28E1)



—LEGEND—

NO.	ALT.	BOMBARDIER	AP	
1	17,000	LT BARKLEY	3	
2	17,000	LT SCHLAEBITZ	1	
3	17,000	LT SCHLAEBITZ	3	
4	17,000	LT SCHLAEBITZ	3	
5	17,000	LT BARKLEY	3	
6	17,000	LT BLAIR	3	
7	17,000	LT BLAIR	2	
8	17,000	LT SCHLAEBITZ	2	
9	17,000	LT BLAIR	1	
10	17,000	LT BLAIR	3	
11	17,000	LT BARKLEY	2	
12	17,000	LT SCHLAEBITZ	2	
13	17,000	LT BARKLEY	2	
14	17,000	LT BARKLEY	3	
15	17,000	LT BLAIR	3	
2(R)	17,000	LT SCHLAEBITZ	3	(RE-DROP)
15(R)	17,000	LT BLAIR	3	(RE-DROP)

—SYMBOLS—

		AP
○	BOMBS AIMED AT	1
◉	BOMBS AIMED AT	2
◐	BOMBS AIMED AT	3

SCALE
0 100' 200'

HARKEN BOMB PLOT

AMERICAN PHASE

FARGE TARGET

BOMB TYPE 25,200 LB SAMSON (T28E2)

—LEGEND—

	ALT	BOMBARDIER	AP
	17,000	LT BARKLEY	3
2	17,000	LT BARKLEY	2
4	25,000	LT BLAIR	3
5	17,000	LT BLAIR	2
[illegible]	25,000	LT BARKLEY	3
[illegible]	25,000	LT BARKLEY	3
8	17,000	LT SCHLAEBITZ	2
9	17,000	LT SCHLAEBITZ	2
10	17,000	LT BARKLEY	2
12	25,000	LT BARKLEY	3
13	17,000	LT BLAIR	3
14	17,000	LT SCHLAEBITZ	3
15	17,000	LT BARKLEY	1
16	25,000	LT SCHLAEBITZ	3

—SYMBOLS—

○ BOMBS AIMED AT

● BOMBS AIMED AT

◐ BOMBS AIMED AT

SCALE

0 100' 200'

BOMBING FLIGHT RECORDS

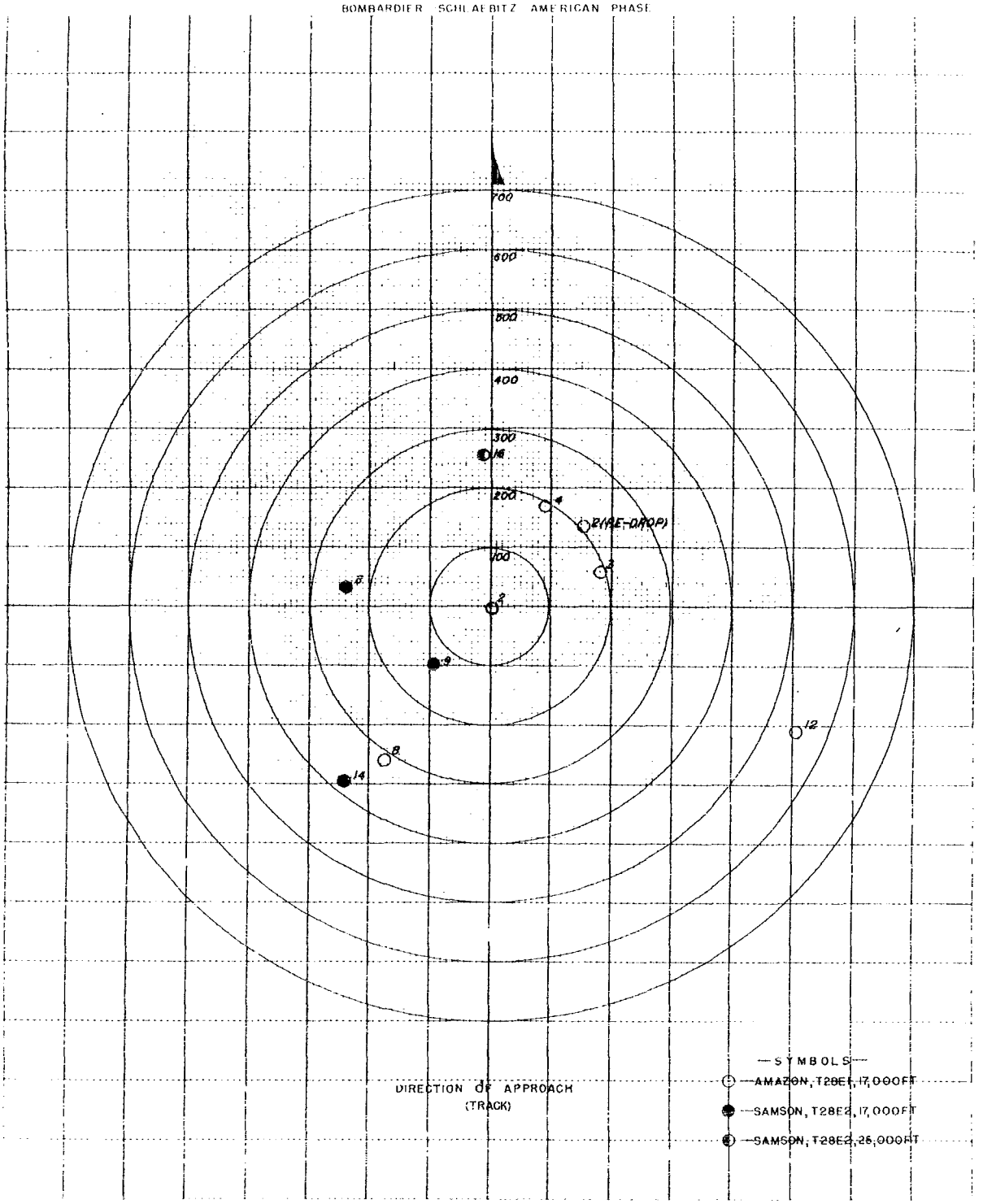
BOMBARDIERS

1ST LT ROBERT E. SCHLAERITZ

1ST LT ROBERT C. BLAIR

1ST LT CHARLES H. HARKLEY

BOMBARDIER SCHLAEBITZ AMERICAN PHASE



CONFIDENTIAL

HARKE[illegible] SCHLAEHITZ FLIGHT RECORD

Bombardier: SCHLAEHITZ, ROBERT E. 1st Lt | A/C: BOYD, WILLIS C. CAPTAIN

Date: 4 August 1947 | Bombsight (type): Norden
Mission No: 1- Amagen | (model): M-9
Target: Farge Sub Ass'y Plant | (no.): R 449
Aircraft No: 45-21751 | Bomb (type, size & no.) T26E1, 25000 lb #2

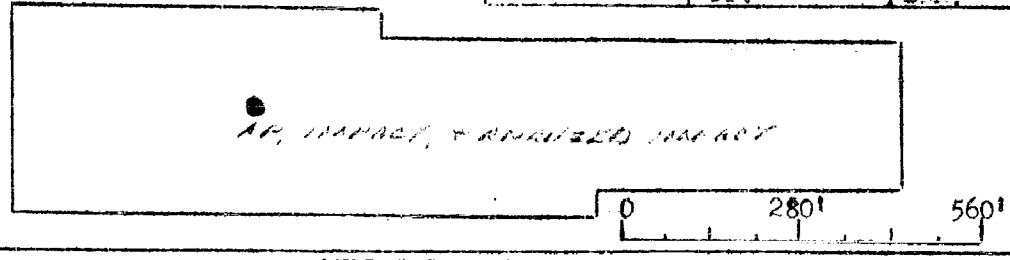
COMPUTATIONS

ALTITUDE				AIRSPEED	WIND (MPH)
Tgt Elev.	80	Comp. Error	-4	CIAS 190	Direction 252
Alt Sett.	29.92	Corr F.L. Temp	-5	TAS 247	Velocity 32
Ind. P.A.	16480	Grnd. Temp.	22	Trail 8.5	
P.A.T.	80	Mean Temp.	8	WEATHER	SCORING METHOD
P.A.A.T.	16400	Bomb. Alt.	17000	Visibility Good	Survey X
F.L. Temp.	-2	Disc Speed	161.75	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	280	16400	17000	190	247	222	8.5	161.7	K	.62	-	4	-	-	1259

BOMB PLOT

Range Err.: -3 | Def. Err.: R 3 | Circ. Err.: 4



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (P.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-	-	-	-	-	-	0	-	-	-	-	0

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

LARGE ANALYSIS:

None required.

DEFLECTION ANALYSIS:

None required.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

   a. DIFFICULTY: Rear F-2 had broken star gear, broken governor, and intermittent drive.

   b. CORRECTIVE ACTION: None possible, removed camera because no replacement parts were available.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

CONFIDENTIAL

HARKEN [illegible] FLIGHT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt.	A/C: BOYD, WILLIS G. CAPTAIN

Date: 11 August 1947
Mission No: 4 - Amazon
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21751

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb (type, size & no.) T28E1, 25000 lb #3

COMPUTATIONS

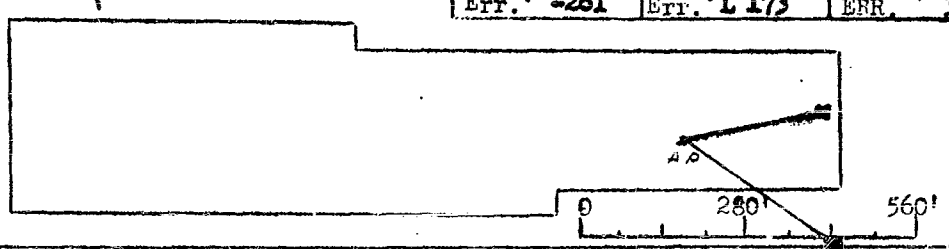
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-4.9	CIAS	195	Direction	342
Alt Sett.	30.11	Corr F.L. Temp	-8.9	TAS	255	Velocity	26
Ind. P.A.	16450	Grnd. Temp.	18	Trail	8.5		
P.A.T.	-110	Mean Temp.	4.5	WEATHER		SCORING METHOD	
P.A.A.T.	16610	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-4	Disc Speed	161.75	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	292	16450	17000	195	255	244	8.5	161.7	⊕	.70	6	-	R 4	-	1005

BOMB PLOT

TN

Range Err.: -261 | Def. Err.: L 173 | Circ. ERR.: 316



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Lef. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-241	-	-	-	-	-241	-	R 210	L 153	-	R 57

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 261 feet short. The bombardier synchronized for a groundspeed of 249 MPH as compared to the measured groundspeed of 244 MPH. This 5 MPH error in range synchronization was the cause of a 241 foot shortage. No other cause for range error was reported. The remaining 20 feet of range error is an indeterminate error.

DEFLECTION ANALYSIS:

a. The measured deflection error was 173 feet left of the aiming point. Analysis shows that the bombardier synchronized for 6 degrees of left drift as compared to a measured drift of 5 degrees left. This one degree drift synchronization error was responsible for 210 feet of right deflection error. However, the lateral bubble was off ½ length to the right, and this caused a deflection error of 153 feet to the left, compensating somewhat for the drift error. The combination of errors places the analyzed impact 57 feet to the right as compared to an actual impact of 173 feet left. This leaves an indeterminate deflection error of 230 feet left.

OPERATION OF BOMBING EQUIPMENT

No bombing equipment malfunctions were reported for this mission.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

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HARKNESS ... FLIGHT RECORD

Bombardier: SCHLAEHITZ, ROBERT E. 1st Lt | A/C: BOYD, WILLIS G. CAPTAIN

Date: 11 August 1947
Mission No: 7 - Amazen
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21751

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb(type,size&no.) T28E1, 25000 lb # 12

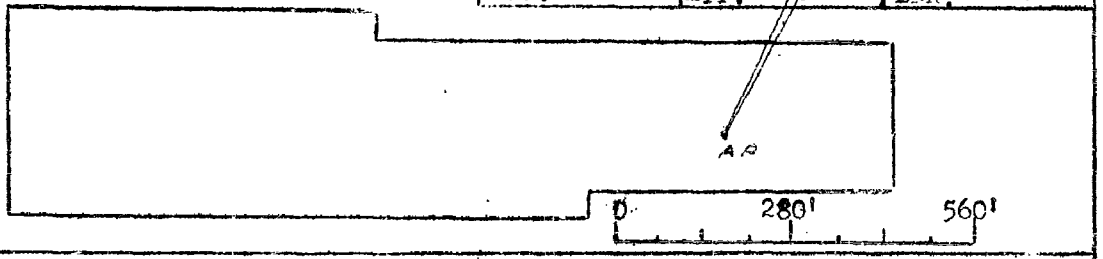
COMPUTATIONS

ALTITUDE				AIRSPEED	WIND (MPH)
Tgt Elev.	80	Comp. Error	-5.2	CIAS 195	Direction 018
Alt Sett.	30.11	Corr F.L. Temp	-2.2	TAS 256	Velocity 19
Ind. P.A.	16360	Grnd. Temp.	24	Trail 8.5	
P.A.T.	-110	Mean Temp.	7.4	WEATHER	SCORING METHOD
P.A.A.T.	16470	Bomb. Alt.	17000	Visibility Good	Survey X
F.L. Temp.	-4	Disc Speed	161.75	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	295	16360	17000	195	256	255	8.5	161.7		.72	5	-	L1/8	-	1527

BOMB PLOT

Range Err.: -211 | Def. Err.: R 508 | Circ. Err.: 556



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gaspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-97				-	-97	R 25	R 157	R 76	-	R 258

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS

a. The measured range error was 211 feet short. The bombardier synchronized for a groundspeed of 257 MPH as compared to the measured groundspeed of 255 MPH. This 2 MPH error in groundspeed synchronization caused a range error of 97 feet short. No fore and aft bubble, altitude, or trail error was reported. The remaining 114 feet of range error short is indeterminate.

DEFLECTION ANALYSIS

a. The measured deflection error was 508 feet right of the aiming point. Analysis shows that the bombardier synchronized for 5 degrees left drift as compared to a measured reading of 4¼ degrees left. This error caused a 157 feet right deflection error. In addition, the fore and aft crosshair was offset 25 feet to the right of the aiming point at bomb release and the lateral bubble was off 1/8 bubble length left which caused another 76 feet of deflection error to the right. The total of the combination of analyzed errors shows a theoretical impact of 258 feet right as compared to a measured impact of 508 feet right. The remaining 250 feet of right deflection error cannot be determined. However, the bombardier reported that the bomb did not fall true (REMARKS) and this may have been the cause for the disparity between the analyzed deflection impact and the measured deflection impact.

OPERATION OF BOMBING EQUIPMENT

No malfunctions were reported for this mission.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

BOMBING ANALYSIS: Bombardier aimed 25 feet right of the standard AP to offset constant left deflection error for previous bombs.

FLIGHT OF BOMB: Bombardier observed that nose of bomb appeared to transcribe small circles after falling true for approximately 5,000 feet. Bomb also appeared to spin considerably more rapidly than usual for entire flight. Other observers do not bear this out.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: SCHLAERITZ, ROBERT E. 1st Lt.	A/C: BOYD, WILLIS G. CAPTAIN

Date: 26 August 1947
Mission No: 10 - Amazon
Target: Fargo Sub Assy Plant
Aircraft No: 45-21751

Bombsight (type): Norden (Lukas-Harold)
(model): M-9
(no.): L-7608
Bomb (type, size & no.) T26E1, 25000 lb # 4

COMPUTATIONS

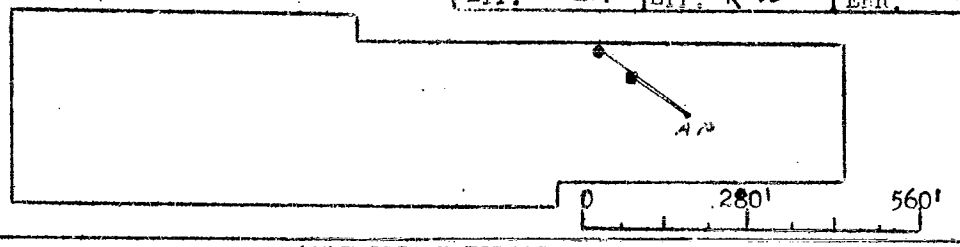
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	195	Direction	29
Alt Sett.	30.30	Corr F.L. Temp	-11.2	TAS	255	Velocity	31
Ind. P.A.	16350	Grnd. Temp.	21	Trail	8.5		
P.A.T.	-275	Mean Temp.	4.9	WEATHER		SCORING METHOD	
P.A.A.T.	16625	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-6	Disc Speed	161.75	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA					DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.		Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	293	16350	17000	195	255	258	8.5	161.7	3	.72		.7	-	L 1/6	-	1024

BOMB PLOT

TN

Range Err.: +167 | Def. Err.: R 93 | Circ. Err.: 195



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (I.A.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	98	-	-	-	-	98	L 15	-	R 76	-	R 61

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 167 feet over. Analysis shows that the bombardier synchronized for a ground-speed of 256 MPH as compared to a measured ground-speed of 258 MPH. The 2 MPH error in range synchronization was responsible for a 98 foot range error over. No cause for the remainder of the range error was reported. The 69 feet difference between the analyzed impact and the actual impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 93 feet to the right of the aiming point. No error was attributed to deflection synchronization. A 76 foot right deflection error was attributed to the lateral bubble being 1/8 length left, but this error was reduced to 61 feet right because the bombardier offset his aiming point 15 feet to the left of the standard aiming point. The remaining 32 feet of right deflection error cannot be determined inasmuch as no further cause for deflection error was reported.

OPERATION OF BOMBING EQUIPMENT

1. BOMBSIGHT:

a. DIFFICULTY: Sight M-9B 8449 showed excessive lateral bubble precession during the preflight check, caused by the vertical gyro being unbalanced dynamically.

b. CORRECTIVE ACTION: Installed new bombsight. Removed old sight, and balanced gyro.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

CONFIDENTIAL

HARKEN PRODUCT BOMBING FLIGHT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt	A/C: BOYD, WILLIS G. CAPTAIN

Date: 2 September 1947
Mission No: 15 - Amazon
Target: Farge Sub Ass'y Plant
Aircraft No: 45-21751

Bombsight (type): Norden (Lukas-Harold)
(model): M-9
(no.): L-7608
Bomb(type,size&no.) T28E1, 25000 lb #3

COMPUTATIONS

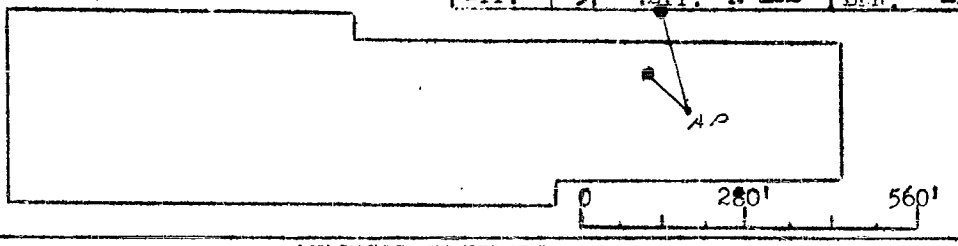
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	190	Direction	042
Alt Sett.	30.09	Corr F.L. Temp	-10.8	TAS	248	Velocity	8
Ind. P.A.	16610	Grnd. Temp.	17	Trail	8.5		
P.A.T.	-90	Mean Temp.	3.1	WEATHER		SCORING METHOD	
P.A.A.T.	16700	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-5.6	Disc Speed	161.75	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA									
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	DRIFT Left	DRIFT Right	BUBBLES Lateral	BUBBLES Fore & Aft	Time of Impact Hr, Min,
2	1	A	285	16610	17000	190	248	252	8.5	161.7		.695	1½	-	L1/8	1/8	1009

BOMB PLOT

TN

Range Err.: + 57 | Def. Err.: R 182 | Circ. EPR: 193



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (D.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	144	-77	-	-	-	67	L 10	-	R 77	-	R 67

CONFIDENTIAL

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 67 feet over. The bombardier synchronized for a groundspeed of 249 MPH as compared to a measured groundspeed of 252 MPH. The 3 MPH error in range synchronization caused a 144 foot error over. However, this error was somewhat compensated for by a fore and aft bubble error of 4.5 mils which caused a 77 foot shortage. This reduced the ultimate analyzed impact to 67 feet over. The 10 foot discrepancy between the analyzed impact and the measured impact cannot be determined. No further cause for range error was reported.

DEFLECTION ANALYSIS:

a. The measured deflection impact was 182 feet to the right of the aiming point. No deflection error was attributed to improper course synchronization. A 77 foot error to the right was caused by the lateral bubble being off 1/8 length (4.5 mils) to the left. This error was compensated for slightly because the bombardier offset his aiming point 10 feet to the left of the standard aiming point. The total analyzed deflection error was 67 feet right as compared to the measured deflection error of 182 feet right. The difference of 115 feet remains indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. RADIO ALTIMETER:

a. DIFFICULTY: Radio altimeter inoperative. Indicator I-152-C found to be inoperative.

b. CORRECTIVE ACTION: Defective indicator removed and replaced.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: None (Inoperative)

HARKEN CONFIDENTIAL SIGHT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

Date: 11 October 1947 | Bombsight (type): Norden
Mission No: 3 - Samson | (model): M-9
Target: Fargo Sub Ass'y Plant | (no.): R-449
Aircraft No: 45-21751 | Bomb(type,size&no.) T28E2, 25200 lb #9

COMPUTATIONS

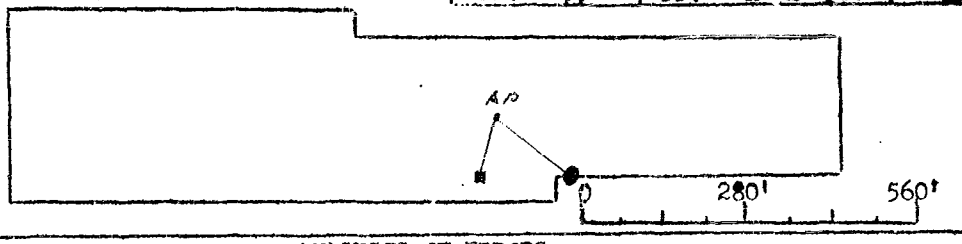
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.3	CIAS	195	Direction	316
Alt Sett.	30.54	Corr F.L. Temp	-10.3	TAS	254	Velocity	23
Ind. P.A.	16160	Grnd. Temp.	19	Trail	5		
P.A.T.	-540	Mean Temp.	3.8	WEATHER		SCORING METHOD	
P.A.A.T.	16700	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-5	Disc Speed	162.2	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	290	16160	17000	195	254	234	5	162.2	A	.6°	3	-	R ½	-	1609

BOMB PLOT

TN

Range Err.: -99 | Def. Err.: L 92 | Circ. EPR: 135



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gaspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	47	-	-	-	-	47	R 100	R 95	L 306	-	L 111

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 99 feet short. The bombardier synchronized for a groundspeed of 233 MPH as compared with a measured groundspeed of 234 MPH. The 1 MPH range synchronization error places the analyzed range impact 47 feet over. No further cause for range error was reported. Inasmuch as the analyzed impact was 47 feet over and the measured impact 99 feet short, an indeterminate range error of 146 feet short remains. It is believed that a range error of such magnitude must have been caused by a fore and aft bubble error which was present but not detected by the bombardier.

DEFLECTION ANALYSIS:

b. The measured deflection error was 92 feet left. The lateral bubble was off ½ bubble length to the right (18 mils) which caused a 306 foot left deflection error. However, this error was reduced by a 100 foot right error purposely induced when the bombardier shifted the fore and aft crosshair 100 feet right of the aiming point in order to compensate for the bubble error. In addition, the bombardier synchronized for a drift of 3 degrees left as compared with the measured drift of 2½ degrees left; the ½ degree drift synchronization error caused a 95 foot right deflection error. The total 195 foot right deflection error due to synchronization error reduces the 306 foot left error caused by the lateral bubble, placing the ultimate theoretical impact 111 feet left of the aiming point. The 19 foot difference between the analyzed impact and the measured impact cannot be determined.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,050 feet.

BOMBING ANALYSIS: The bombardier offset the fore and aft hair 100 feet right of the aiming point in order to compensate for a lateral bubble error detected just prior to bomb release.

HARKEN PROJECT BOMBING FLIGHT RECORD

CONFIDENTIAL

Bombardier: SCHLAERITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

Date: 13 October 1947
Mission No: 6- Samson
Target: Farge Sub Assly Plant
Aircraft No: 45-21751

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb(type,size&no.) T28E2, 25200 lb #8

COMPUTATIONS

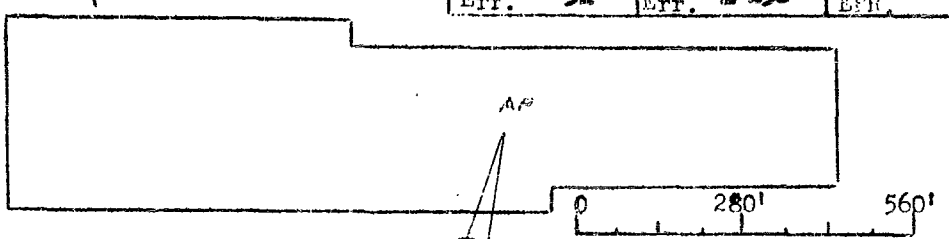
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	195	Direction	250
Alt Sett.	30.36	Corr F.L. Temp	-8.2	TAS	256	Velocity	31
Ind. P.A.	16235	Grnd. Temp.	20	Trail	5		
P.A.T.	-360	Mean Temp.	5.9	WEATHER		SCORING METHOD	
P.A.A.T.	16595	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-3	Disc Speed	162.2	Turbulence	Rough	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	280	16200	17000	195	256	230	5	163.2		.64	-	5	-	-	1547

BOMB PLOT

TN

Range Err.: 31 | Def. Err.: L 238 | Circ. Err.: 240



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (I.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	CONFIDENTIAL				75	-	L 192	-	-	L 192

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 31 feet over. Analysis shows that the synchronized groundspeed and the measured groundspeed were the same. No fore and aft bubble error was reported. The only cause for error was purposely induced by the bombardier in order to compensate for a consistent range error short. A disc speed 1 RPM faster than that called for by the bombing tables was set into the bombsight. This disc speed change was equivalent to 75 feet over. Cause for the 41 foot difference between the measured impact and the analyzed impact cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 238 feet left. The bombardier synchronized for a drift of 5 degrees right as compared to the measured drift of 4 degrees right. The one (1) degree drift error caused a 192 foot left deflection error. No lateral bubble error was reported nor could further cause for the remainder of the deflection error be found. Reason for the 46 foot discrepancy between the measured deflection error and the analyzed deflection error cannot be determined.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 feet.

CONFIDENTIAL

HARKEN [illegible] BOMBING FLIGHT RECORD

Bombardier: SCHLAERITZ, ROBERT E. 1st Lt	A/C: BOYD, WILLIS G. CAPTAIN

Date:	15 October 1947	Bombsight (type):	Norden
Mission No:	8 - Semaon	(model):	M-9
Target:	Fargo Sub Ass'y Plant	(no.):	R-449
Aircraft No:	45-21751	Bomb(type,size&no.)	T26E2, 25200 lb #14

COMPUTATIONS

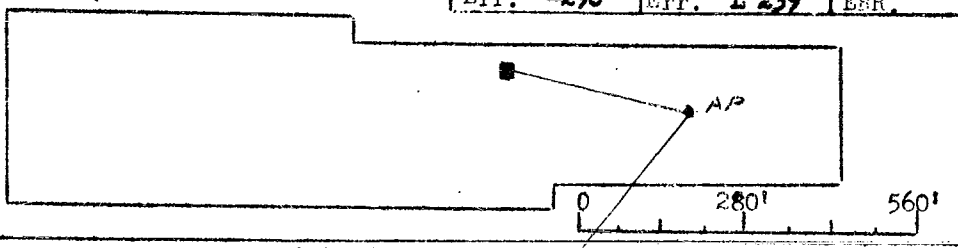
ALTITUDE				AIRSPEED		WIND (MPH)	
Apt Elev.	80	Comp. Error	-5.1	CIAS	195	Direction	281
Alt Sett.	30.12	Corr F.L. Temp	-14.8	TAS	255	Velocity	31
Ind. P.A.	16780	Grnd. Temp.	14	Trail	5		
P.A.T.	-120	Mean Temp.	-.4	WEATHER		SCORING METHOD	
P.A.A.T.	16900	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-9.7	Disc Speed	162.2	Turbulence	Rough	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA								
													DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	006	16780	17000	195	255	251	5	163.2		.70	-	8½	-	-	1129

BOMB PLOT

TN

Range Err.:	Def. Err.:	Circ. Err.:
-296	L 239	381



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-	81	-	-	81	-	L 307	-	-	L 307

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 296 feet short. The measured groundspeed and the synchronized groundspeed were the same. The bombardier reported no cause for range error other than a purposely induced disc speed change which was 1 RPM faster than the computed disc speed. This disc speed change represented an overage of 81 feet. The bombardier further reported that the fore and aft bubble was definitely level. This being the case, the entire 375 foot discrepancy between the analysed range impact of 81 feet over, and the measured impact of 296 feet short is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 239 feet left. Analysis shows that the bombardier synchronized for a drift of 8½ degrees right as compared to the measured drift of 7 degrees right. The 1½ degree drift synchronization error caused a 307 foot left deflection error. No lateral bubble error or further cause for deflection error was reported. The analyzed impact of 307 feet left is 68 feet further left than the measured impact. The reason for the discrepancy is indeterminate.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

BOMBING ANALYSIS: The rate was perfectly synchronized and the fore and aft bubble was observed to be level several times just prior to bomb release. There is no apparent reason for the measured range error.

HARKEN PRECISION BOMBING FLIGHT RECORD

CONFIDENTIAL

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt	A/C: BOYD, WILLIS G. CAPTAIN

Date: 19 October 1947
Mission No: 17 - Amazon
Target: Fargo Sub Ass'y Plant
Aircraft No: 45- 21751

Bombsight (type): Norden
(model): M-9
(no.): R-449
Bomb(type,size&no.) T26E1, 25000 #2REDROP

COMPUTATIONS

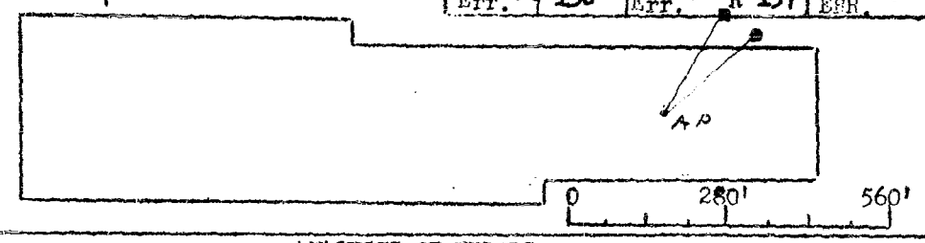
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.14	CIAS	195	Direction	005
Alt Sett.	30.64	Corr F.L. Temp	-10.8	TAS	253.5	Velocity	39
Ind. P.A.	16310	Grnd. Temp.	11	Trail	8.5		
P.A.T.	-640	Mean Temp.	.1	WEATHER		SCORING METHOD	
P.A.A.T.	16950	Bomb. Alt.	17000	Visibility	7/10 Clouds	Survey	X
F.L. Temp.	-5.66	Disc Speed	161.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
5	1	A	010	16310	17000	195	253.5	216	8.5	162.7	K	.59		1	R1/8	-	1455

BOMB PLOT

TN

Range Err.: + 136 | Def. Err.: R 157 | Circ. EPR.: 208



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DRS, or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	96	-	71	-	-	167	-	R 175	L 76	-	R 99

CONFIDENTIAL

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range impact was 136 feet over. Analysis shows that the bombardier synchronized for a ground-speed of 214 MPH as compared to the measured ground-speed of 216 MPH. The 2 MPH range synchronization error caused a 96 foot overage. In addition, a 71 foot overage was purposely induced by the bombardier by setting a disc speed into the bombsight which was 1 RPM too fast in order to compensate for a consistent range error short. The combination of range errors places the analyzed impact 167 feet over as compared to the measured impact of 136 feet over. Reason for the 31 foot discrepancy cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 157 feet right. The bombardier synchronized for a drift of 1 degree right as compared to the measured drift of 2 degrees right. The one degree drift synchronization error caused a 175 foot right deflection error, but this was reduced by a lateral bubble error of 1/8 length right (4.5 mils) which caused a 76 foot left deflection error. Consolidation of the two deflection errors places the analyzed impact 99 feet right. The 58 foot discrepancy between the analyzed impact and the measured impact cannot be determined.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM:

a. DIFFICULTY: Bomb carrying chains hung, could not be retracted, caused by frayed retracting cable.

b. CORRECTIVE ACTION: Spliced retraction cable.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

Bombing run was of approximately one minute duration due to cloud coverage. Estimate overcast at 7/10.

CONFIDENTIAL

HARKEN PROVING GROUND BOMBING REPORT RECORD

Bombardier: SCHLAEBITZ, ROBERT E. 1st Lt. | A/C: BOYD, WILLIS G. CAPTAIN

Date: 30 October 1947 | Bombsight (type): Norden

Mission No: 14 - Samson | (model): M-9

Target: Fargo Sub Ass'y Plant | (no.): R-449

Aircraft No: 45-21751 | Bomb(type,size&no.) T28E2, 25200 lb #16

COMPUTATIONS

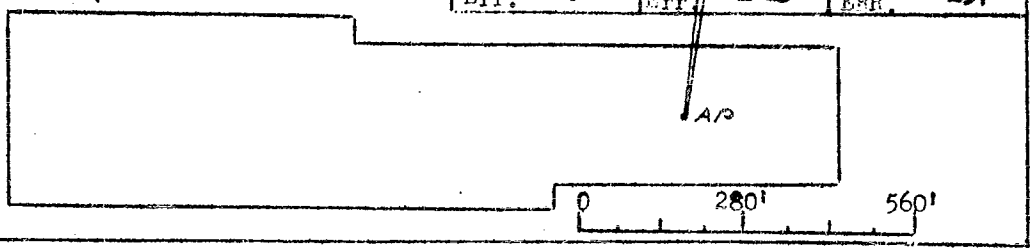
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-7	CIAS	195	Direction	159
Alt Sett.	30.66	Corr F.L. Temp	-31	TAS	296	Velocity	14
Ind. P.A.	24430	Grnd. Temp.	10	Trail	6		
P.A.T.	-680	Mean Temp.	-10.5	WEATHER		SCORING METHOD	
P.A.A.T.	25110	Bomb. Alt.	25000	Visibility	Good	Survey	X
F.L. Temp.	-24	Disc Speed	133.3	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	022	24430	25000	195	296	306	8	134		.70	1½	-	-	-1/8	1328

BOMB PLOT

TN

Range Err.: 256 | Def Err.: L 13 | Circ. Err.: 257



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (I.P.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	113	110	-	-	223	-	-	-	-	0

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 256 feet over. The measured groundspeed and the synchronized groundspeed were the same, but the bombardier reported that the fore and aft bubble was off 1/8 of a bubble length (4.5 mils) which caused a 113 foot range error over. In order to compensate for a consistent range error short, the bombardier purposely induced a 110 foot range error over by setting a disc speed into the bombsight which was .7 RPM too fast. The combination of errors places the analyzed range impact 223 feet over. The reason for the 33 foot difference between the analyzed and measured impacts is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 13 feet left. The synchronized drift and the measured drift were the same. No bubble error or other cause for deflection error was reported. Reason for the 13 foot deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

a. DIFFICULTY: Could not keep bombsight FDI centered. Required continual recentering. Caused by excessive stabilizer gyro precession.

b. CORRECTIVE ACTION: Stabilizer gyro dynamically balanced.

2. CAMERAS:

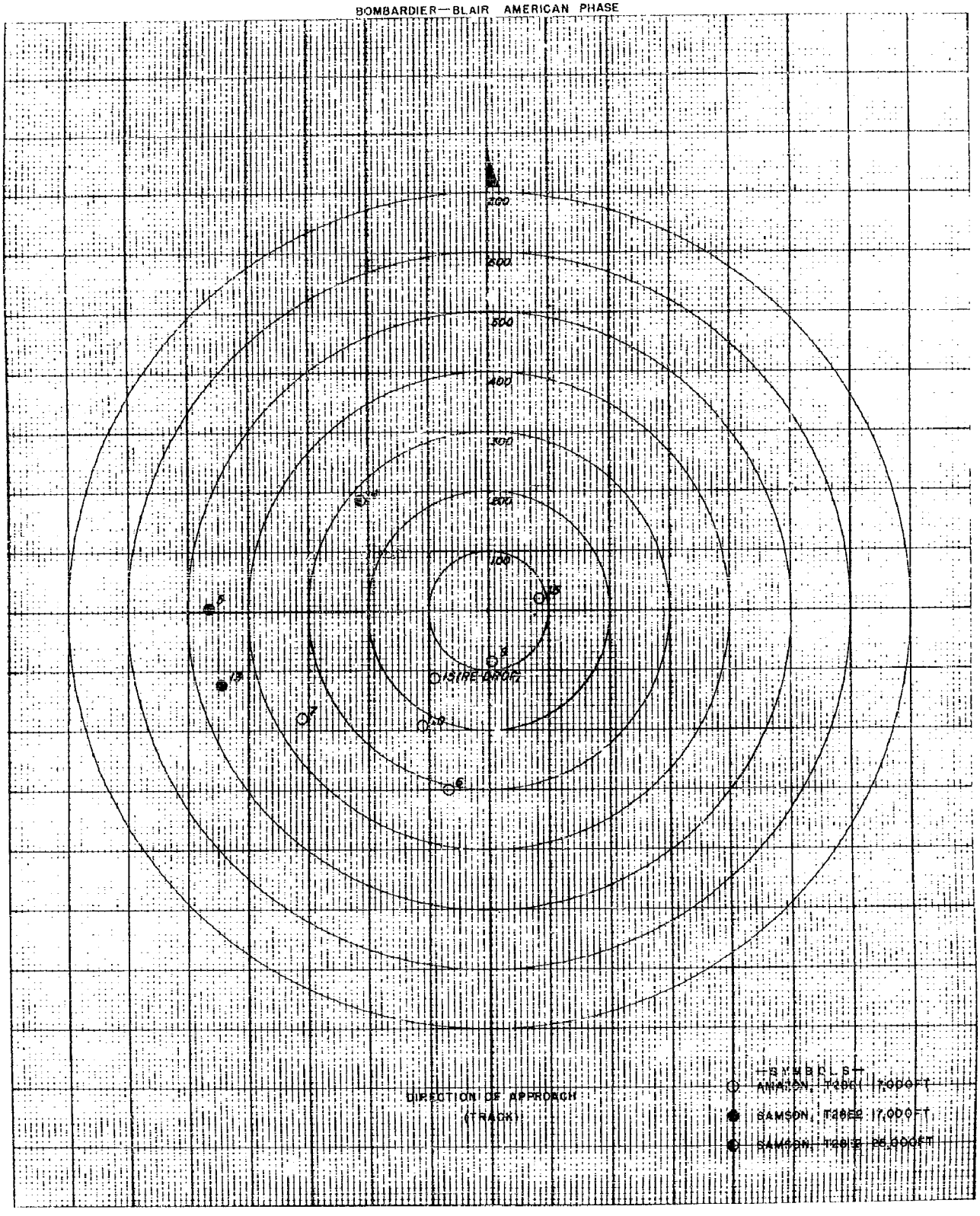
a. DIFFICULTY: Left B-2 broke star gear. Caused by wear and excessive drag due to low temperature.

b. CORRECTIVE ACTION: Replaced camera with spare.

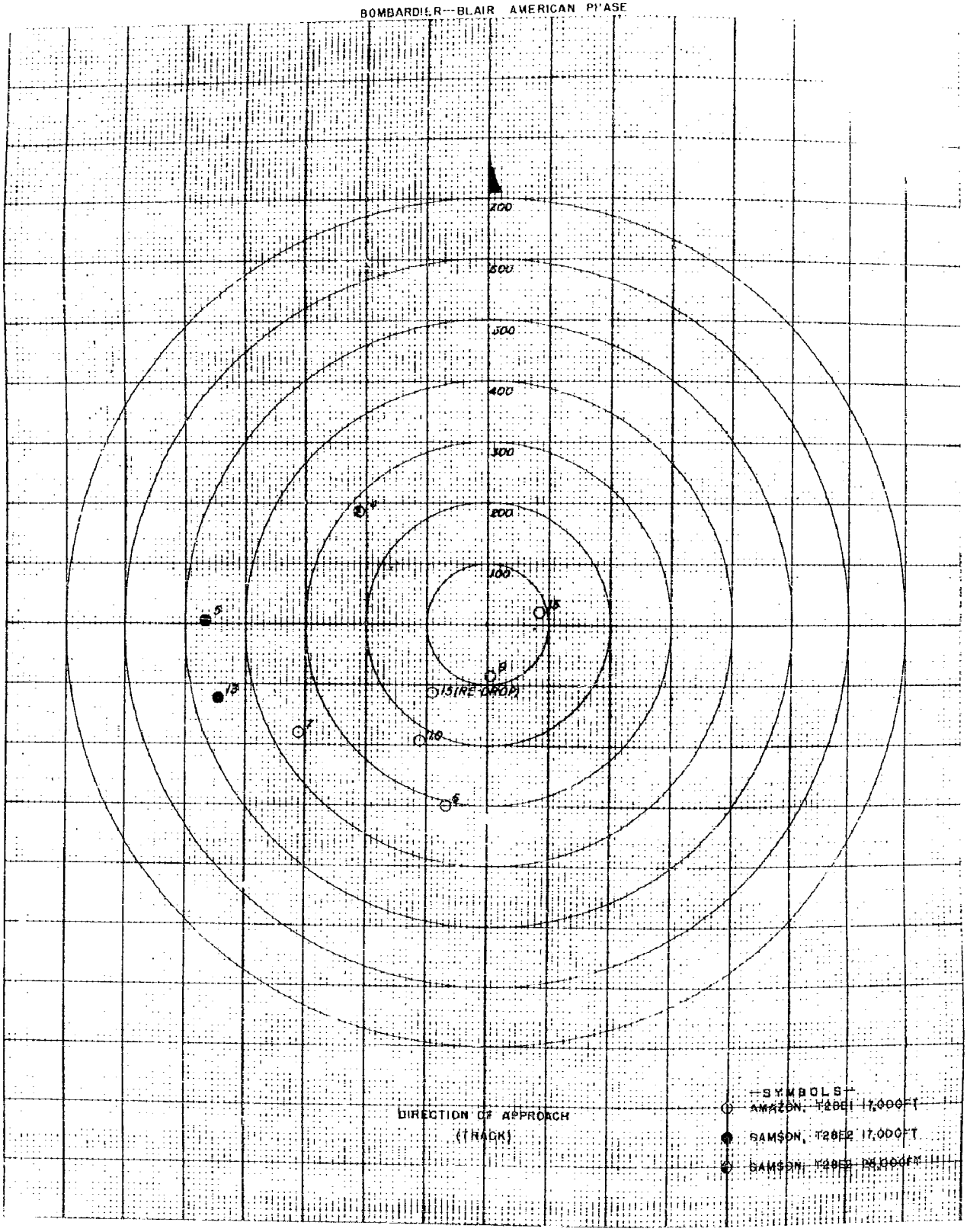
REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 25,000 Feet.

BOMBARDIER—BLAIR AMERICAN PHASE



BOMBARDIER--BLAIR AMERICAN PHASE



HARKEN CONFIDENTIAL BOMBSIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.

Date: 4 August 1947 — Bombsight (type): Norden

Mission No: 2 - Amazon — (model): M-9

Target: Fargo Sub Ass'y Plant — (no.): M-10382

Aircraft No: 45-21747 — Bomb(type,size&no.) T28E1, 25000 lb #9

COMPUTATIONS

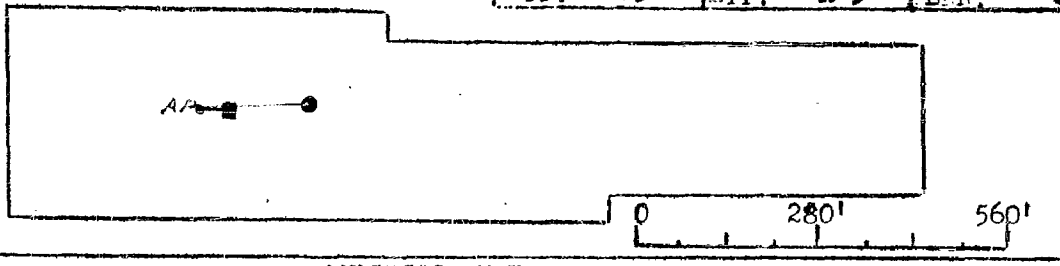
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	190	Direction	245
Alt Sett.	Not Given	Corr F.L. Temp	-7	TAS	250	Velocity	21
Ind. P.A.	16500	Grnd. Temp.	28	Trail	9		
P.A.T.	110	Mean Temp.	10.5	WEATHER		SCORING METHOD	
P.A.A.T.	16390	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-2	Disc Speed	161.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA								
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	DRIFT Left	DRIFT Right	BUBBLES Lateral	BUBBLES Fore & Aft	Time of Impact Hr, Min,
4	1	A	276	16500	17000	190	250	225	9	161.7	K	.63	-	4	-	-	1535

TN

BOMB PLOT

Range Err.: -85 | Def. Err.: R 5 | Circ.: EFF. 87



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-48	-	-	-	-	-48	-	-	-	-	0

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 85 feet short. Analysis shows that the bombardier synchronized for a groundspeed of 226 MPH as compared to the measured groubdspeed of 225 MPH. This caused a range error of 48 feet short. No further cause for the remainder of the range error was reported. The 37 foot difference between the measured range error and the analyzed range error cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 5 feet to the right of the aiming point. The measured drift and the synchronized drift were the same. No reason for deflection error could be determined.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

a. DIFFICULTY: Right B-2 inoperative because of broken drive pin.

b. CORRECTIVE ACTION: Attempted replacement of pin but it was not a success. Removed camera. No replacement available.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

HARKEN [illegible] CONFIDENTIAL GHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt. | A/C: HILL, MARCUS L., 1st Lt.

Date: 11 August 1947 | Bombsight (type): Norden

Mission No: 5 - Amazon | (model): M-9

Target: Fargo Sub Ass'y Plant | (no.): N-10382

Aircraft No: 45-21747 | Bomb (type, size & no.) T28E1, 25000 lb # 7

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	190	Direction	34
Alt Sett.	30.11	Corr F.L. Temp	-8	TAS	250	Velocity	24
Ind. P.A.	16530	Grnd. Temp.	20	Trail	8.5		
P.A.T.	-100	Mean Temp.	6	WEATHER		SCORING METHOD	
P.A.A.T.	16630	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-3	Disc Speed	161.75	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	295	16530	17000	190	250	256	8.5	161.7	K	.76	6½	-	-	-	1145

TN

BOMB PLOT

Range Err.: -179 | Def. Err.: L 310 | Circ. ERR.: 359

No analysed impact of this bomb.

AP

0 280' 560'

ANALYSIS OF ERRORS

RANGE								DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (D.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
Unable to perform accurate analysis of this bomb.											

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.03

BOMBING ANALYSIS SUMMARY

This bomb cannot be accurately analyzed. The bomb hit 310 feet to the left in deflection and all indications point to an analyzed deflection impact of approximately the same magnitude to the right. In addition, the sudden lurch of the aircraft at the instant of release is known to have caused the bombardier to inadvertantly move the rate knob setting a considerable amount. For these reasons it was considered best not to attempt an analysis of this bomb.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

   a. DIFFICULTY: The heater switch would not remain in the "ON" position. Switch had to be held manually. Heater circuit breaker switch broken.

   b. CORRECTIVE ACTION: Replaced heater circuit breaker switch.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

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HARKEN PR[illegible] FOR FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt | A/C: HILL, MARCUS L. 1st Lt.

Date: 20 August 1947
Mission No: 9 - Amazon
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21747

Bombsight (type): Norden
(model): M-9
(no.): N-10382
Bomb (type, size&no.) T28E1 25000 lb # 10

COMPUTATIONS

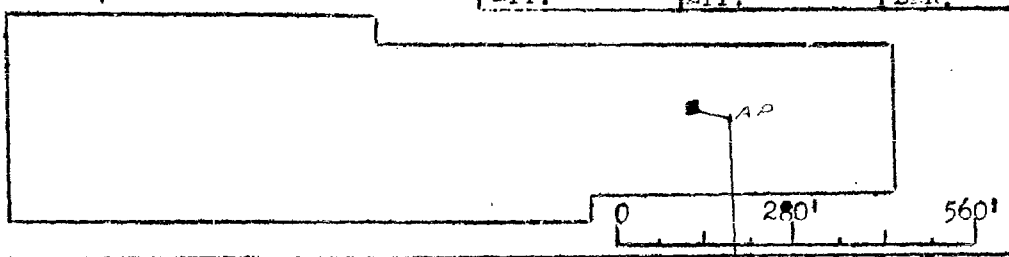
ALTITUDE				AIRSPEED	WIND (MPH)
Tgt Elev.	80	Comp. Error	-5	CIAS 190	Direction 347
Alt Sett.	Not Used	Corr F.L. Temp	-2	TAS 249	Velocity 6
Ind. P.A.	16510	Grnd. Temp.	21	Trail 8.5	
P.A.T.	-150	Mean Temp.	6	WEATHER	SCORING METHOD
P.A.A.T.	16660	Bomb. Alt.	17100	Visibility Good	Survey X
F.L. Temp.	-4	Disc Speed	161.7	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	345	16510	17100	190	249	241.5	8.5	161.7		.665	½	-	-	-	1250

BOMB PLOT

TN

Range Err.: -192 | Def. Err.: L 110 | Circ. Err.: 220



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-	38	-	-	38	L 50	-	-	-	L 50

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 192 feet short. The synchronized groundspeed and the measured groundspeed were the same. A 38 foot range error over is attributed to a 100 foot error in the bombardier's altitude computation. No other cause for range error was reported. The difference of 230 feet between the analyzed impact and the actual impact cannot be determined, but an error of such magnitude was most likely a fore and aft bubble error which the bombardier did not detect.

DEFLECTION ANALYSIS:

a. The measured deflection error was 110 feet left of the aiming point. The drift computed by the bombardier and the measured drift were the same, but the bombardier reported that the fore and aft crosshair was approximately 50 feet left of the aiming point at the time of release. No other cause for deflection error was reported. The remaining 60 feet of left deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

No bombing equipment difficulties were encountered during this mission.

REMARKS

FLIGHT LEVEL RADION ALTIMETER READING: 17,100 Feet.

BOMBING ANALYSIS: The altitude error was due to a mistake in the bombardier's altitude computation. He originally computed the bombing altitude to be 17,000 feet and set a diso speed for that altitude into the bombsight. After the bomb was dropped, a recheck showed that the correct absolute altitude was 17,100 feet.

CONFIDENTIAL

HARKEN [illegible] BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.
Date: 26 August 1947	Bombsight (type): Norden
Mission No: 12 - Amazon	(model): M-9
Target: Fargo Sub Ass'y Plant	(no.): M-10382
Aircraft No: 45-21747	Bomb(type,size&no.) T26E1 25000 lb #6

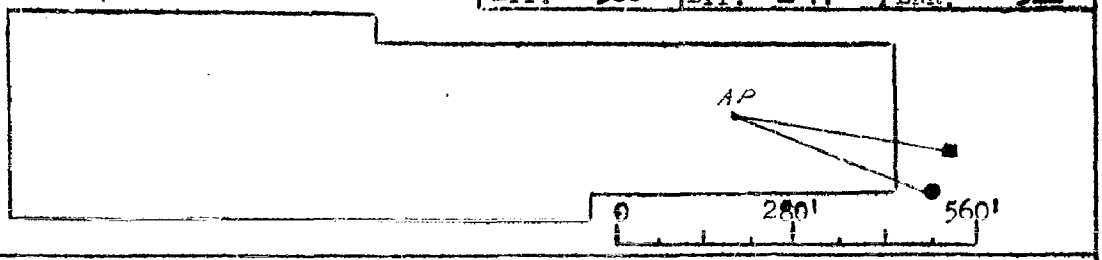
COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	60	Comp. Error	-5	CIAS	190	Direction	045
Alt Sett.	Not Used	Corr F.L. Temp	-9	TAS	249	Velocity	29
Ind. P.A.	16220	Grnd. Temp.	24.5	Trail	8.5		
P.A.T.	-270	Mean Temp.	7.5	WEATHER		SCORING METHOD	
P.A.A.T.	16490	Bomb. Alt.	17000	Visibility	Poor	Survey	X
F.L. Temp.	-4	Disc Speed	161.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
8	1	A	298	16220	17000	190	249	259	14	161.7		.745	6	-	-	-	1450

BOMB PLOT

Range Err.: -300 | Def. Err.: L 77 | Circ. ERR.: 311



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-	-435	-	-	93	-	-342	-	-	-	R 7	R 7

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 300 feet short. Analysis shows that the bombardier synchronized for a groundspeed of 268 MPH as compared to a measured groundspeed of 259 MPH. This nine MPH error in groundspeed synchronization caused a 435 foot range error short. However, this error was compensated for somewhat because the bombardier intentionally set 5½ mils too much trail in the bombsight to reduce a consistent range error short, which reduced the 435 foot synchronization error by 93 feet, placing the analyzed range impact 342 feet short. The 42 foot difference between the analyzed impact and the actual impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 77 feet left of the aiming point. No error was attributed to deflection synchronization error or lateral bubble error. The only deflection error reported was a 7 foot right error due to the 5½ mils too much trail in the sight crosstrail mechanism. The 84 foot discrepancy between the measured deflection impact and the analyzed deflection impact cannot be determined. See "Remarks" section for this bomb as to possible cause for the remainder of the deflection error.

OPERATION OF BOMBING EQUIPMENT

No bombing equipment malfunctions were reported for this bomb.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

BOMBING RUN: Seven dry runs were taken before break could be found in the overcast. Cloud coverage estimated at seven tenths. Run was short, but bomb had to be dropped at that time or salvo in North Sea would have been necessary.

FLIGHT OF BOMB: Scanner and Navigator reported that this bomb rotated considerably more rapidly than usual and that it fishtailed moderately in flight. It was noted before takeoff that bomb body contour was extremely uneven through the main section of the case.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt	A/C: HILL, MARCUS L. 1st Lt
Date: 29 August 1947	Bombsight (type): Norden
Mission No: 13 - Amazon	(model): M-9
Target: Fargo Sub Ass'y Plant	(no.): N-10382
Aircraft No: 45-21747	Bomb(type,size&no.) T28E1, 25000 lb #15

COMPUTATIONS

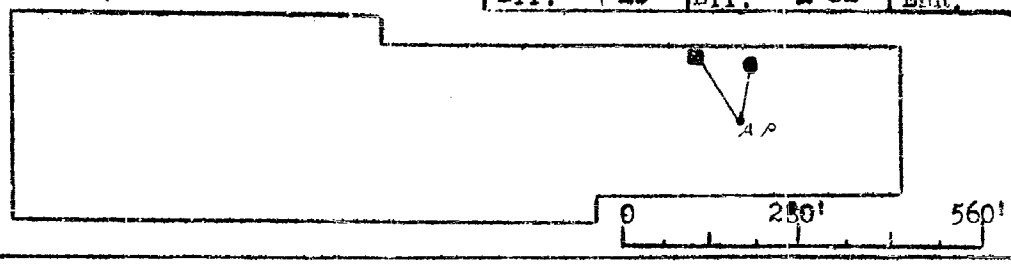
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	200	Direction	013
Alt Sett.	Not Used	Corr F.L. Temp	-6	TAS	262	Velocity	37
Ind. P.A.	16330	Grnd. Temp.	23	Trail	9		
P.A.T.	-150	Mean Temp.	7.5	WEATHER		SCORING METHOD	
P.A.A.T.	16480	Bomb. Alt.	17000	Visibility	5 to 6 Ovcst.	Survey	X
F.L. Temp.	-3	Disc Speed	161.7	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
6	1	A	300	16330	17000	200	262	254	14	161.7		.705	8	-	L1/8	-	1705

BOMB PLOT

TN

Range Err.:	Def.:	Circ.: ERR
+20	R 82	87



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-			85	-	85	-	-	R 77	R 12	R 89

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 20 feet over. The synchronized groundspeed and the measured groundspeed were the same. The only attributable range error was caused by 5 mils too much trail set in the bombsight which was intentionally introduced to compensate for a consistent range error short. The intentional trail error places the analyzed impact 85 feet over as compared to the measured impact of 20 feet over. The 65 foot discrepancy between the analyzed impact and the actual impact remains interminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 82 feet right of the aiming point. There was no error in the bombardier's deflection synchronization, but a 77 foot error to the right was caused by the lateral bubble being off 1/8 length (4.5 mils) to the left. In addition, a 12 feet error to the right was induced because of the 5 mils too much trail in the crosstrail mechanism. The combination of errors was responsible for a total analyzed deflection error of 89 feet to the right. This is 7 feet greater than the measured deflection error. The discrepancy remains indeterminate.

OPERATION OF BOMBING EQUIPMENT

No bombing equipment malfunctions were reported for this mission.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,100 feet.

BOMBING RUN: Five dry runs were made as a result of clouds obscuring the target during the bombing run. Estimated cloud coverage was five-tenths to six-tenths.

BOMBING ANALYSIS: Bombardier set trail at 5 mils greater than the computed trail in order to compensate for consistent range error short.

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HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt | A/C: HILL, MARCUS L. 1st Lt.

Date: 5 September 1947 | Bombsight (type): Norden

Mission No: 2 - Samsen | (model): M-9

Target: Forge Sub Ass'y Plant | (no.): M-10382

Aircraft No: 45-21747 | Bomb(type,size&no.) T28E2, 25200 lb # 3

COMPUTATIONS

ALTITUDE

Tgt Elev.	80	Comp. Error	-5
Alt Sett.	30.12	Corr F.L. Temp	-3
Ind. P.A.	16340	Grnd. Temp.	20
P.A.T.	-110	Mean Temp.	6
P.A.A.T.	16540	Bomb. Alt.	17000
F.L. Temp.	-3	Disc Speed	162.1

AIRSPEED

CIAS 195
TAS 256
Trail 5

WIND (MPH)

Direction UNK
Velocity UNK

WEATHER

Visibility Good
Turbulence Smooth

SCORING METHOD

Survey -
Photo -

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
This bomb was a malfunction release. Bomb fell from aircraft approximately 20 miles from the target due to failure of the M-9 shackle.																	1234

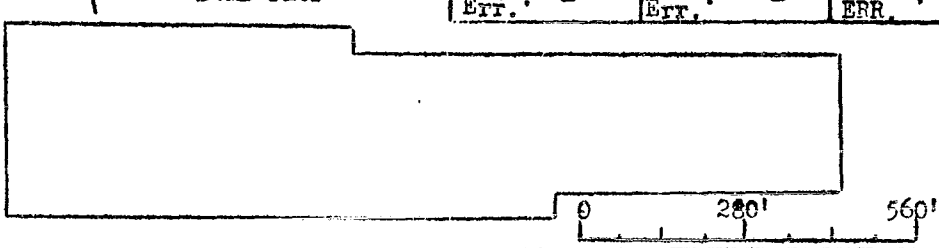
BOMB PLOT

TN

Range Err.: -

Def. Err.: -

Circ. ERR.: -



ANALYSIS OF ERRORS

RANGE								DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR		Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
Malfunction release.								Malfunction release.				

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BOMBING ANALYSIS SUMMARY

Bomb was a malfunction release and fell approximately 20 miles West of target.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM:

   a. DIFFICULTY: Malfunction release. D-9 shackle lock-hook broke and allowing bomb to release accidentally.

   b. CORRECTIVE ACTION: All D-9 shackle locking hooks replaced with modified type hook. Complete explanation is included under Armament summary.

REMARKS:

Bomb fell from aircraft approximately 20 miles West of the target. Time: Approximately 1234. Altitude: 16,500 indicated. True heading: Approximately 160 degrees.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.

Date: 13 October 1947 — Bombsight (type): Norden

Mission No: 4- Samson — (model): M-9

Target: Fargo Sub Ass'y Plant — (no.): N-10382

Aircraft No: 45-21747 — Bomb(type,size&no.) T28E2, 25200 lb # 5

COMPUTATIONS

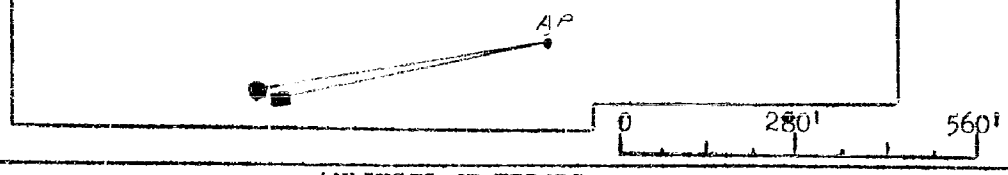
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	195	Direction	215
Alt Sett.	30.36	Corr F.L. Temp	-7	TAS	256	Velocity	20
Ind. P.A.	16200	Grnd. Temp.	19	Trail	5		
P.A.T.	-360	Mean Temp.	6	WEATHER		SCORING METHOD	
P.A.A.T.	16560	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	- 2	Disc Speed	162.2	Turbulence	Rough	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	000	16200	17000	195	256	273	5	163.3	2V	.765	3	32	R 4	-	1400

BOMB PLOT

TN

Range Err.: 4 — Def. Err.: L 465 — Circ. EPR.: 466



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-94		85		-	-9	L 50	L 230	L 153	-	L 433

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 4 feet over. The bombardier synchronized for a groundspeed of 275 MPH as compared to the measured groundspeed of 273 MPH. The 2 MPH error in range synchronization caused a 94 foot range error short. However, the bombardier purposely set a disc speed into the bombsight which was 1.1 RPM too fast (equal to an induced error of 85 feet over) and the increased disc speed compensated for the synchronization error, reducing the analyzed impact to 9 feet short. The 13 foot discrepancy between the measured impact and the analyzed impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 466 feet left. The bombardier synchronized for 3½ degrees right drift as compared to the measured drift of 2⅓ degrees right. The 1 degree error in drift synchronization caused an error of 230 feet left. In addition, the fore and aft crosshair was 50 feet left of the aiming point at the instant of release, and the lateral bubble was ¼ bubble length right (9 mils) which caused an additional 153 foot left error. The total of the combination of analyzed errors was 433 feet left as compared to the measured error of 466 feet left. The 33 foot difference between the measured and the analyzed error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

No bombing equipment malfunctions were reported.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,100 Feet.

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HARKEN GROUP BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt. | A/C: HILL, MARCUS L. 1st Lt

Date: 15 October 1947 | Bombsight (type): Norden

Mission No: 9 - Samson | (model): M-9

Target: Fargo Sub Ass'y Plant | (no.): M-10382

Aircraft No: 45-21747 | Bomb (type, size&no.) T28E2, 25200 lb #13

COMPUTATIONS

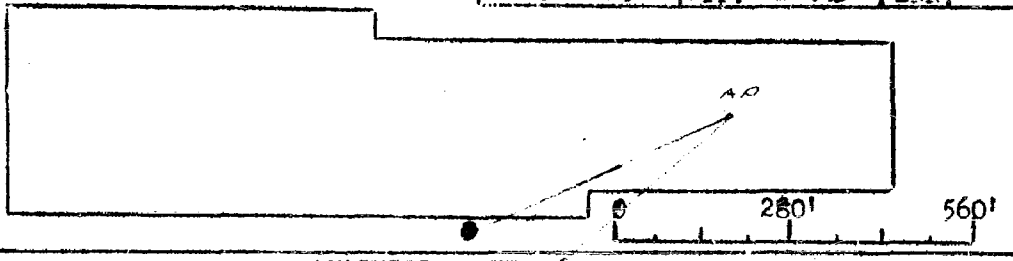
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	195	Direction	280
Alt Sett.	29.2	Corr F.L. Temp	-15	TAS	255	Velocity	32
Ind. P.A.	16900	Grnd. Temp.	14	Trail	5		
P.A.T.	-120	Mean Temp.	-.5	WEATHER		SCORING METHOD	
P.A.A.T.	17020	Bomb. Alt.	17100	Visibility	Scat. Clouds	Survey	X
F.L. Temp.	-10	Disc Speed	161.8	Turbulence	Rough	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
4	1	A	357	16900	17100	195	255	250	5	163.3	⊕	.725	-	8	R ½	-½	1305

BOMB PLOT

TN

Range Err.: -123 | Def. Err.: L 443 | Circ. Err.: 460



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-480	154	123	-	-	-203	-	L 225	L 154	-	L 379

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 123 feet short. The bombardier synchronized for a groundspeed of 260 MPH as compared to the measured groundspeed of 250 MPH. The 10 MPH error in range synchronization caused a 480 foot range error short. However, the fore and aft bubble was off ½ bubble length (9 mils), which caused a 154 foot range error over. The bombardier purposely set a disc speed into the bombsight which was 1.5 RPM too fast, and this caused an additional 123 foot range error over. The disc speed and bubble errors combined to produce 277 feet over, which compensated somewhat for the groundspeed synchronization error of 480 feet short, and reduced the ultimate analyzed impact to 203 feet short. The 80 foot discrepancy between the measured and analyzed impacts remains indeterminate inasmuch as no further cause for range error was reported.

DEFLECTION ANALYSIS:

a. The measured deflection error was 443 feet left. The bombardier synchronized for 8 degrees right drift as compared to the measured drift of 7 degrees right. The 1 degree drift synchronization error caused a 225 foot left deflection error. In addition, the lateral bubble was off ½ bubble length right (9 mils), which caused a 154 foot left deflection error. The combination of errors places the analyzed impact 379 feet left as compared to the measured impact of 443 feet left. Reason for the 64 foot discrepancy cannot be determined inasmuch as no further cause for deflection error was reported.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

a. DIFFICULTY: Aircraft started to turn when the turn control knob was moved from "center" to the "zero" position. Pot wiper was not properly centered.

b. CORRECTIVE ACTION: Turn control pot wiper centered.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 feet.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.
Date: 19 October 1947	Bombsight (type): Norden
Mission No: 16 - Amazon	(model): M-9
Target: Fargo Sub Ass'y Plant	(no.): L-10362
Aircraft No: 45-21747	Bomb(type,size&no.)T28E1,25000#15 REDROP

COMPUTATIONS

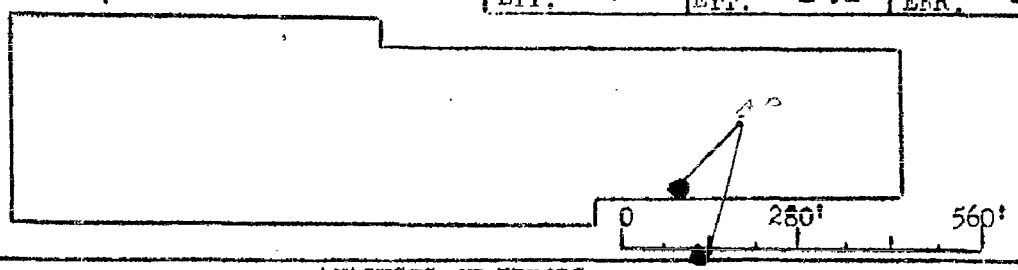
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-5	CIAS	195	Direction	003
Alt Sett.	30.61	Corr F.L. Temp	-11	TAS	254	Velocity	35
Ind. P.A.	16210	Grnd. Temp.	15	Trail	8.5		
P.A.T.	-610	Mean Temp.	2	WEATHER		SCORING METHOD	
P.A.A.T.	16820	Bomb. Alt.	17000	Visibility	Good	Survey	I
F.L. Temp.	-6	Disc Speed	161.8	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	M	016	16210	17000	195	254	220	8.5	162.9	+	.625	+	2	R1/8	-	1250

TN

BOMB PLOT

Range Err.: -112 | Def. Err.: L 91 | Circ. EER.: 145



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS, or A/T)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-288	-	79	-	-	-209	R 25	-	L 76	-	L 51

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 112 feet short. The bombardier synchronized for a groundspeed of 226 MPH as compared to the measured groundspeed of 220 MPH. The 6 MPH error in groundspeed synchronization caused a 288 foot range error short. The bombardier purposely induced a 79 foot range error over by setting a disc speed into the bomb sight which was 1.1 RPM too fast. Reason was to compensate for a consistent range error short. The combination of errors places the analyzed impact 209 feet short, which is 97 feet further short than the measured impact. Reason for the 97 foot difference between the measured and analyzed impacts is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 91 feet left. The measured drift and the drift synchronized for were the same, but the lateral bubble was off 1/8 bubble length to the right (4.5 mils) which caused a 76 foot left deflection error. This error was reduced by 25 feet because the bombardier offset his aiming point 25 feet to the right of the standard aiming point in order to compensate for the lateral bubble error. The combination of errors places the analyzed impact 51 feet left as compared to the measured impact of 91 feet left. Reason for the 40 foot discrepancy cannot be determined.

OPERATION OF BOMBING EQUIPMENT

1. C-1 AUTOPILOT:

a. DIFFICULTY: Locking solenoid engaged when autopilot was turned on and could not be disengaged until master switch was turned off. Caused by sticking points in the triple leaf switch of the pilot's turn control.

b. CORRECTIVE ACTION: Points adjusted and polished. Ground checked OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

Mission flown manually because of autopilot malfunction.

Bomb hit on South wall of building.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BLAIR, ROBERT C. 1st Lt.	A/C: HILL, MARCUS L. 1st Lt.

Date: 20 October 1947
Mission No: 13 - Samson
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21747

Bombsight (type): Norden
(model): M-9
(no.): L-10382
Bomb(type,size&no.) T28E2, 25200 lb # 4

COMPUTATIONS

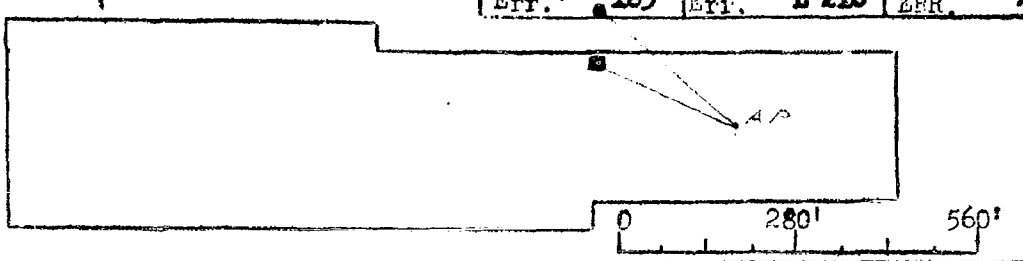
ALTITUDE				AIRSPEED	WIND(MPH)
Tgt Elev.	80	Comp. Error	-7	CIAS 190	Direction 057
Alt Sett.	Not Used	Corr F.L. Temp	-30	TAS 283	Velocity 16
Ind. P.A.	24560	Grnd. Temp.	9	Test 8	
P.A.T.	- 540	Mean Temp.	-10.5	WEATHER	SCORING METHOD
P.A.A.T.	25100	Bomb. Alt.	25000	Visibility Good	Survey X
F.L. Temp.	-23	Disc Speed	133.3	Turbulence Smooth	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	018	24500	25000	190	283	271	8	134		.62	2	-	½	-	1230

BOMB PLOT

TN

Range Err.:	183	Def. Err.:	L 210	Circ. EFR:	279



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
-	-	-	88	-		88	-	-	L 225	-	L 225

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 183 feet over. The measured groundspeed and the synchronized groundspeed were the same. No cause for range error was reported other than an 88 foot range error over purposely induced by the bombardier by setting a disc speed .7 RPM too fast into the bombsight in order to compensate for a consistent range error short. The reason for the 95 foot difference between the measured range error and the analyzed range error cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 210 feet left. The synchronized drift and the measured drift were the same, but the lateral bubble was off 1/4 bubble length right (9 mils) which caused a 225 foot left error. No further cause for deflection error was reported. Reason for the 15 foot discrepancy between the measured impact and the analyzed impact cannot be determined.

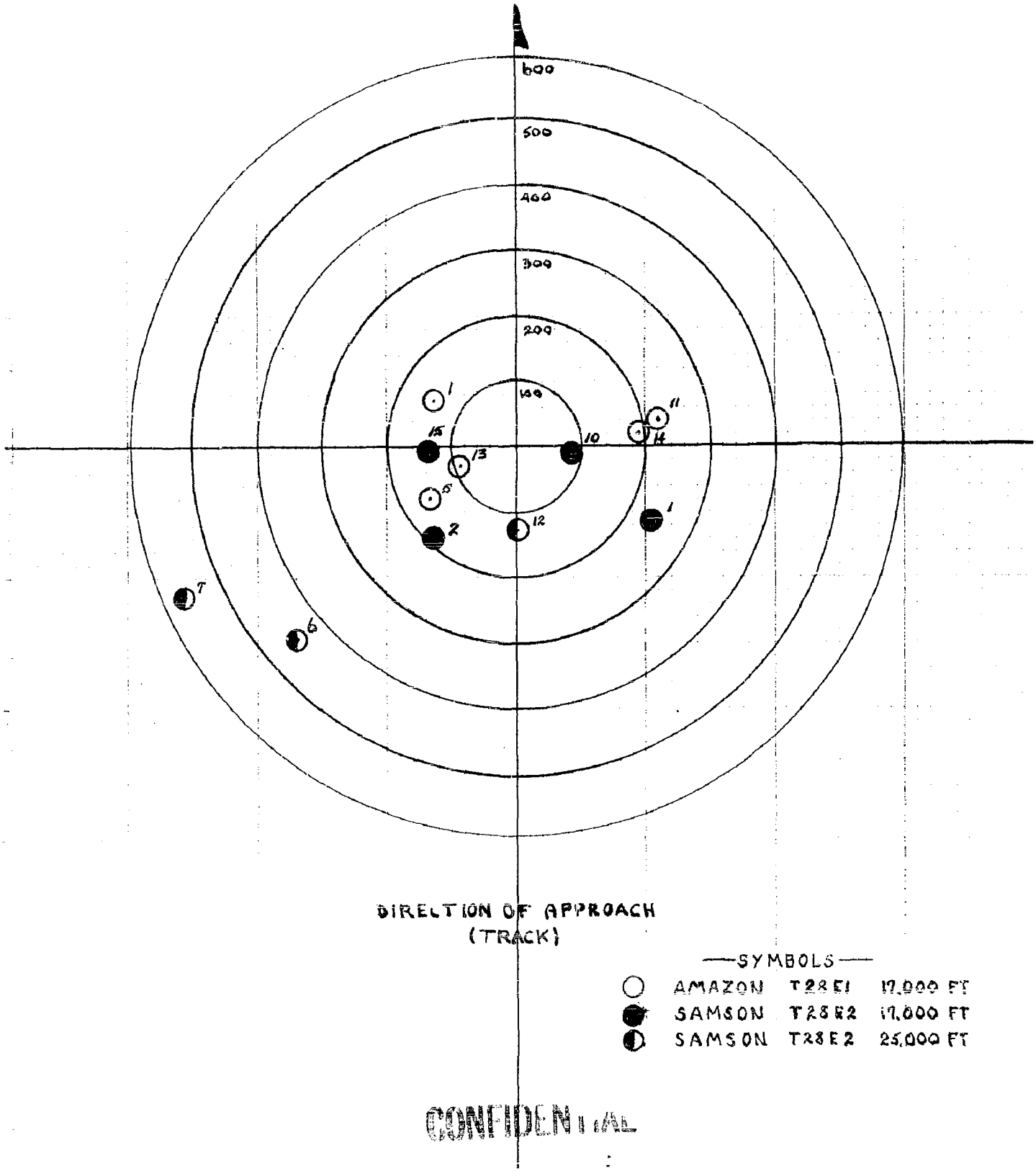
OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 25,000 Feet.

BOMBARDIER — BARKLEY AMERICAN PHASE



DIRECTION OF APPROACH
(TRACK)

—SYMBOLS—

○	AMAZON	T28E1	17,000 FT
●	SAMSON	T28E2	17,000 FT
◐	SAMSON	T28E2	25,000 FT

CONFIDENTIAL

HARKEN PROJECTION BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt	A/C: BARRENTINE, GEORGE T. CAPTAIN
Date: 10 August 1947	Bombsight (type): Norden
Mission No: 3 - Amazon	(model): M-9
Target: Fargo Sub Ass'y Plant	(no.): 8194
Aircraft No: 45-21750	Bomb(type,size&no.) T28E1,25000 lb #1

COMPUTATIONS

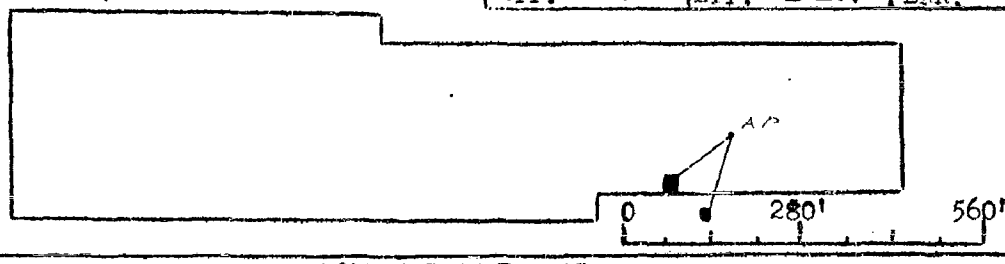
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.3	CIAS	195	Direction	340
Alt Sett.	Not Given	Corr F.L. Temp	-7.8	TAS	257	Velocity	25
Ind. P.A.	16600	Grnd. Temp.	18	Trail	8.5		
P.A.T.	-50	Mean Temp.	5.1	WEATHER		SCORING METHOD	
P.A.A.T.	16650	Bomb. Alt.	17060	Visibility	Hazy	Survey	X
F.L. Temp.	-2.5	Disc Speed	161.8	Turbulence	Rough	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	288	16600	17060	195	257	242	8.5	161.8		.675	4½	-	R1/8	-1/8	1050

BOMB PLOT

TN

Range Err.: 66 | Def. Err.: L 124 | Circ. Err.: 141



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	77	20	-	-	97	-	-	L 77	-	L 77

CONFIDENTIAL

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 66 feet over. Analysis shows that the synchronized groundspeed and the measured groundspeed were the same. The bombardier reported a fore and aft bubble error of 1/8 bubble length which caused a 77 foot range error over. In addition, the bombardier computed the absolute altitude 60 feet too low, and this mistake caused another 20 foot range error over. No other cause for range error was reported. The total analysed range error was 97 feet over; 31 feet greater than the measured range error. The discrepancy between the analyzed error and the measured range error cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 124 feet left. The measured drift and the synchronized drift were the same. The bombardier reported a lateral bubble error of 1/8 length righ which caused an error of 77 feet to the left. No other cause for deflection error was present. The remaining 47 feet of left deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT.

1. C-1 AUTOPILOT:

   a. Difficulty: Pilot could not keep the PDI centered. PDI remained off one degree to the right at all times. Rudder potentiometer unbalanced.

   b. Corrective Action: Balanced rudder potentiometer.

2. RADIO ALTIMETER:

   a. Difficulty: Instrument went completely dead at 6,000 feet. Transmitter fuse blown.

   b. Corrective Action: Main transmitter fuse replaced. Unit checked OK.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READIN: None (INOPERATIVE)

Slight cloud cover over target caused short bombing run.

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HARKEN PROJECTED BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 11 August 1947
Mission No: 6- Amazon
Target: Farge Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9B
(no.): 8194
Bomb(type,size&no.) T28E1,2500O lb #13

COMPUTATIONS

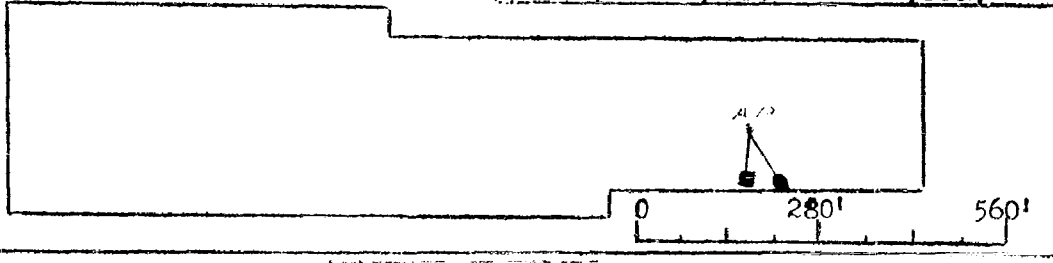
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	50	Comp. Error	-5.3	CIAS	195	Direction	360
Alt Sett.	Not Used	Corr F.L. Temp	-9.3	TAS	255	Velocity	26
Ind. P.A.	16400	Grnd. Temp.	22	Mach	8.5		
P.A.T.	-100	Mean Temp.	6.3	WEATHER		SCORING METHOD	
P.A.A.T.	16500	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-4	Disc Speed	161.6	Turbulence	Slight	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
2	1	A	288	16410	17010	196	256	250	8.5	161.6	0	.695	.5	-	R1/8	-	1340

BOMB PLOT

TN

Range Err.: 2 | Def. Err.: L 82 | Circ. EER: 92



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (IAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-	-	-	-	0	-	-	L 77	-	L 77

CONFIDENTIAL

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BOMBING ANALYSIS SUBJECT

RANGE ANALYSIS:

a. The measured range error for this bomb was 32 feet short. The groundspeed synchronized for and the measured groundspeed are the same, and the bombardier reported no fore and aft bubble error, altitude error or trail error. Therefore, the 32 feet range error short cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 82 feet left of the aiming point. The drift synchronized for and the measured drift are the same. However, the lateral bubble was off 1/8 bubble length to the right which accounts for a 77 foot deflection error to the left. The remaining 5 feet of left deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS

a. DIFFICULTY: Right B-2 broke film and blew fuse; probable cause was insufficient slack between sprockets and gate which caused motor overload. Left floodlight burned out.

b. CORRECTIVE ACTION: Pulled right B-2, checked, reloaded, and ground checked OK. Replaced fuse and floodlight bulb.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

Air was slightly turbulent; several levels were required during the bombing run.

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HARKEN PROJECT HOPPING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN
Date: 20 August 1947	Bombsight (type): Norden
Mission No: 8 - Amazen	(model): M-9B
Target: Fargo Sub Ass'y Plant	(no.): 8194
Aircraft No: 45-217 50	Bomb(type,size&no.) T28E1, 25000 lb #11

COMPUTATIONS

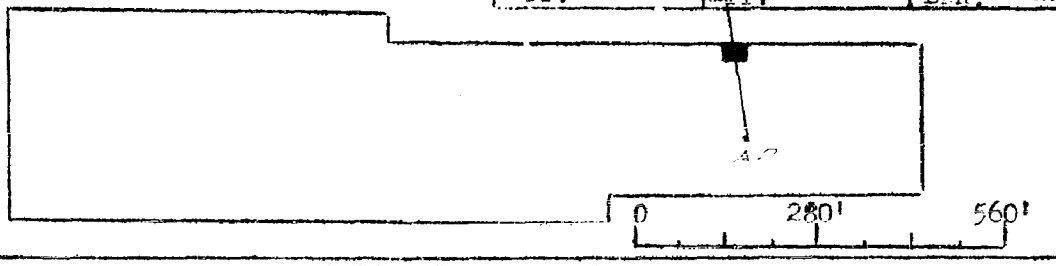
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.3	CIAS	195	Direction	308
Alt Sett.	Not Used	Corr F.L. Temp	-11.3	TAS	255	Velocity	18
Ind. P.A.	16550	Grnd. Temp.	18	Trail	8.5		
P.A.T.	-150	Mean Temp.	3.3	WEATHER		SCORING METHOD	
P.A.A.T.	16700	Bomb. Alt.	17000	Visibility	Good	Survey	X
F.L. Temp.	-6	Disc Speed	161.8	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact, Hr, Min,
2	1	A	286	16570	17000	194	254	238	8.5	161.8		.665	1½	-	L1/8	-	1015

BOMB PLOT

TN

Range Err.: 42 | Def. Err.: R 220 | Circ. Err.: 225



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gaspd Error	Fore & Aft Bubble Error	(Alt. Error) (DPS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	CONFIDENTIAL			-	7	R 50	-	R 76	-	R 126

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured impact was 42 feet over. Analysis shows that the synchronized groundspeed and the measured groundspeed were the same. The only cause for range error reported was a 7 foot range error over caused by the pilot flying 20 feet too high on the bombing run. The remaining 35 feet of range error over cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 220 feet right. The synchronized drift and the measured drift were the same, but the bombardier offset the aiming point 50 feet to the right of the standard aiming point. In addition, the lateral bubble was off 1/8 bubble length left which caused another 76 feet of deflection error to the right. The combination of errors places the analysed impact 126 feet to the right of the aiming point as compared to a measured impact of 220 feet right. The remaining 94 feet of right deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. RACKS AND RELEASE SYSTEM:

a. DIFFICULTY: Carrier chains could not be fully retracted after bomb release. Safety wire on turnbuckle broke, allowing chain to twist preventing retraction.

b. CORRECTIVE ACTION: Safety wires and turnbuckle lock nuts checked for security after loading.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,050 feet.

Bombing run was longer than usual. Several levels were taken. It is believed that the last level produced a false lateral bubble level.

BOMBING ANALYSIS: Bombardier offset AP 50 feet to the right of the standard AP.

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HARKEN PROJECT BOMBING RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 26 August 1947
Mission No: 11 - Amazon
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9B
(no.): 8194
Bomb (type, size&no.) T28E1, 25000 lb #5

COMPUTATIONS

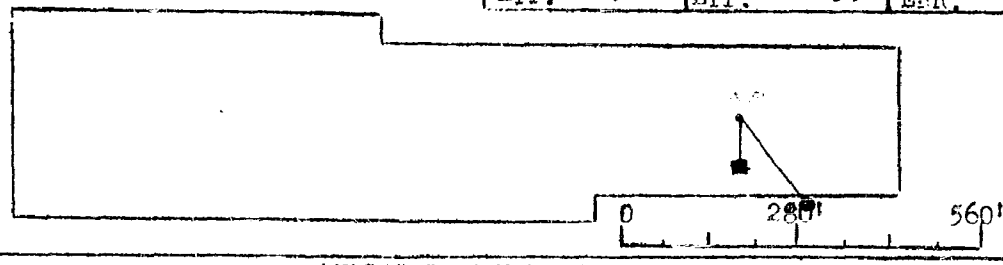
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	195	Direction	21½
Alt Sett.	Not Used	Corr F.L. Temp	-11.2	TAS	255	Velocity	26
Ind. P.A.	16250	Grnd. Temp.	24	Trail	8.5		
P.A.T.	-270	Mean Temp.	6.4	WEATHER		SCORING METHOD	
P.A.A.T.	16520	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-6	Disc Speed	161.8	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	280	16280	17030	195	255	261	8.5	161.8		.73	5½	-	R1/8	-	1205

BOMB PLOT

TN

Range Err.: -70 | Def. Err.: L 137 | Circ. Err.: 153



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (PAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-	12	12		12	-	-	L 76	-	L 76

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 70 feet short. No cause for range error was reported other than the 12 foot range error over caused by the pilot flying 30 feet too high on the bombing run. The 82 foot discrepancy between the analysed impact and the actual impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 137 feet left of the aiming point. The synchronised drift and the measured drift were the same, but the bombardier reported a lateral bubble error of 1/8 bubble length (4.5 mils) right which caused 76 feet of the left deflection error. The remaining 61 feet of left deflection error cannot be determined inasmuch as no further cause for deflection error was reported.

OPERATION OF BOMBING EQUIPMENT

1. BOMBSIGHT:

   a. DIFFICULTY: Vertical gyro lateral bubble precessed 1/4 bubble length (9 mils) during preflight check.

   b. CORRECTIVE ACTION: Sight removed and checked. Found to have gyro bearings slightly worn. Installed new sight and stabilizer.

2. PNEUMATIC DOORS:

   a. DIFFICULTY: Rear doors could not be closed after bomb release. Caused by leak in latch actuator.

   b. CORRECTIVE ACTION: Replaced rubber washer in latch actuator.

3. CAMERAS:

   a. DIFFICULTY: K-22 camera did not operate. B-2 master circuit breaker popped. B-2s did not operate.

b. CORRECTIVE ACTION: Ground checked K-22. Operated satisfactorily. Removed and replaced master circuit breaker. Checked OK with full roll of film.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

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Bombardier: BARKLEY, CHARLES H. 1st Lt	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date:	29 August 1947	Bombsight (type):	Norden
Mission No:	14 - Amazon	(model):	M-9
Target:	Fargo Sub Ass'y Plant	(no.):	L-977
Aircraft No:	45-21750	Bomb(type,size&no.)	T28E1,25000 lb #14

COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	195	Direction	353
Alt Sett.	Not Used	Corr F.L. Temp	-11.2	TAS	255	Velocity	35
Ind. P.A.	16460	Grnd. Temp.	21	Trail	8.5		
P.A.T.	-150	Mean Temp.	4.9	WEATHER		SCORING METHOD	
P.A.A.T.	16610	Bomb. Alt.	17000	Visibility	Very Poor	Survey	X
F.L. Temp.	-6	Disc Speed	161.8	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA								
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	PLOT Left	PLOT Right	BUBBLES Lateral	BUBBLES Fore & Aft	Time of Impact Hr, Min,
5	1	A	318	16490	17090	195	255	227	8.5	161.7	UNK	.635	6	-	-	-	2836

BOMB PLOT

TN

Range Err.: 20 | Def. Err.: R 190 | Circ. Err.: 192

0 280' 560'

ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
Cannot perform accurate analysis of this bomb for range or deflection.											

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BOMBING ANALYSIS SUMMARY

Accurate analysis of this bomb cannot be made because the bombardier could not be positive of the exact aiming point used. Bombardier estimated the approximate position of the aiming point on the bombing run because he could not see the target clearly due to haze, glare, and approaching dusk. See "REMARKS" section for complete explanation of difficulty.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

   a. DIFFICULTY: K-22 camera not operated because of vacuum failure. Camera could have been operated. B-2 main circuit breaker popped; circuit breaker was found to be of 15 amp. capacity instead of required 35 amps.

   b. CORRECTIVE ACTION: Camera vacuum valve stuck, repaired valve. 15 amp main circuit breaker was replaced with required 35 amp capacity circuit breaker.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17, 050 Feet.

BOMBING RUN: Bombing conditions in the target vicinity were extremely poor. Could not see aiming point on the target until past the bomb release point because of haze and glare. Would not have released bomb if landing with bomb had been possible. Various bombsight lens filters were tried without success. Cannot perform an accurate analysis of this bomb because bombardier could not be positive of the exact aiming point used. Had to estimate approximate position of aiming point on bomb run because target almost completely obscured by haze, glare and approaching dusk.

CONFIDENTIAL

HARKEN [illegible] BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt. | A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 5 September 1947 | Bombsight (type): Norden

Mission No: 1 - Samson | (model): M-9

Target: Fargo Sub Ass'y Plant | (no.): I-977

Aircraft No: 45-21750 | Bomb(type,size&no.) T28E2, 25200 lb # 2

COMPUTATIONS

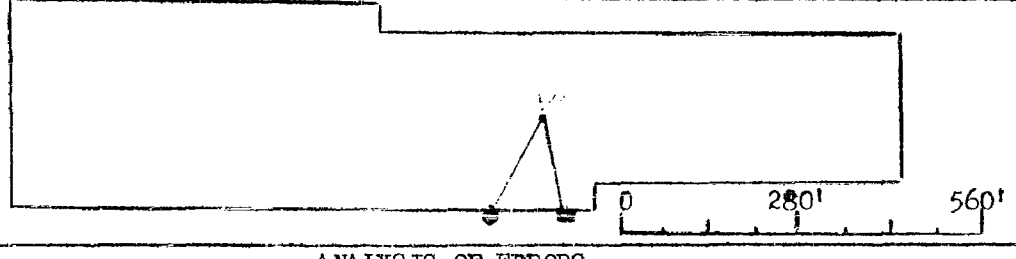
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.2	CIAS	195	Direction	100
Alt Sett.	Not Used	Corr F.L. Temp	-7.2	TAS	257	Velocity	9
Ind. P.A.	16480	Grnd. Temp.	17	Trail	5		
P.A.T.	-130	Mean Temp.	4.9	WEATHER		SCORING METHOD	
P.A.A.T.	16610	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-2	Disc Speed	162.2	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
4	1	A	004	16480	17000	195	257	259	5	162.2		.725	2	-	-	+4	1110

TN

BOMB PLOT

Range Err.: -120 | Def. Err.: L 133 | Circ. Err.: 179



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Grnd Error)	Fore & Aft Bubble Error	(Alt. Error) (D.S. or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-153	-	-	-	-153	-	-	-	-	0

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BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 180 feet short of the aiming point. Analysis shows that the bombardier synchronized for the same groundspeed as the measured groundspeed, but that the fore and aft bubble was ¼ bubble length off (9 mils) which caused an error of 153 feet short. No further cause for range error was reported. The 33 foot difference between the measured range error and the analyzed range error cannot be determined.

DEFLECTION ANALYSIS:

b. The measured deflection error was 133 feet left of the aiming point. The measured drift and the drift synchronized for were the same and the bombardier reported no lateral bubble error. The entire amount of deflection error cannot be determined. It is believed that the majority of the deflection error was caused by a lateral bubble error, present, but not detected by the bombardier.

OPERATION OF BOMBING EQUIPMENT

1. BOMBSIGHT:

a. DIFFICULTY: Fore and aft bubble precessed ¼ bubble length in 2 minutes, just within T.O. limits. Vertical gyro slightly unbalanced dynamically.

b. CORRECTIVE ACTION: Bombsight calibrated and gyro balanced.

2. PNEUMATIC DOORS:

a. DIFFICULTY: When rear doors were closed in flight excessive vibration resulted. Attributed to the fact that the buffer doors had been removed for repair.

b. CORRECTIVE ACTION: Replaced buffer doors.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,000 Feet.

HARKEN BOMBARDMENT FLIGHT RECORD

CONFIDENTIAL

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 13 October 1947
Mission No: 5 - Samson
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): L-7608
Bomb(type,size&no.) T28E2, 25200 lb # 10

COMPUTATIONS

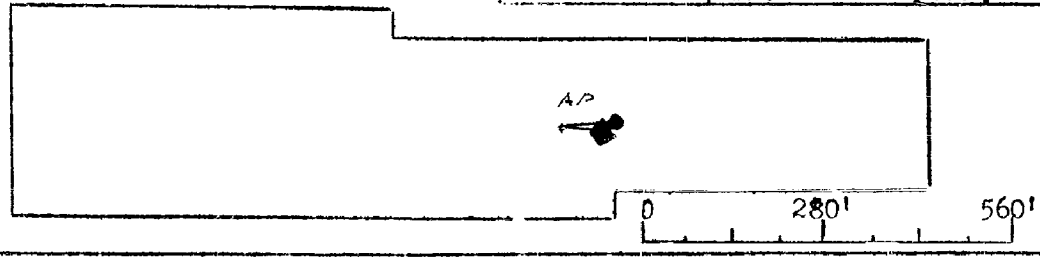
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-2.1	CIAS	195	Direction	265
Alt Sett.	Not Used	Corr F.L. Temp	-10	TAS	255	Velocity	15
Ind. P.A.	16290	Grnd. Temp.	20	Trail			
P.A.T.	-330	Mean Temp.	5	WEATHER		SCORING METHOD	
P.A.A.T.	16620	Bomb. Alt.	17000	Visibility	Hazy	Survey	X
F.L. Temp.	-4.9	Disc Speed	162.2	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
5	1	A	004	16320	17030	195	255	258	5	162.2		.725	-	3½	-	-	1501

BOMB PLOT

TN

Range Err.: -7 | Def. Err.: R 82 | Circ. EPR.: 83



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (PAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
25	-47	-	12	-	-	-10	R 50	-	-	-	R 50

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 7 feet short of the aiming point. Analysis shows that the bombardier synchronized for a groundspeed of 259 MPH as compared to the measured groundspeed of 258 MPH. The 1 MPH error in range synchronization was the cause of a 47 foot range error short. However, the lateral crosshair was 25 feet over at the instant of release, and the pilot flew 30 feet too high on the bombing run which caused another 12 foot range error over, making a total compensating error of 37 feet over, which places the ultimate analyzed impact 10 feet short. The 3 foot discrepancy between the measured impact and the analyzed impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection impact was 82 feet right. The drift synchronized for and the measured drift were the same, but the fore and aft crosshair was 50 feet right of the aiming point at the instant of release. No further cause for deflection error was reported. Reason for the 32 foot difference between the analyzed impact and the measured impact cannot be determined.

OPERATION OF THE BOMBING EQUIPMENT

All equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17, 100 Feet.

Wind was changing rapidly due to frontal movement through the target area. Four wind runs were taken with a different result each time. Slight haze in target area.

CONFIDENTIAL

HARKEN PROJECT — BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt. | A/C: DARDENTINE, GEORGE T. CAPTAIN

Date: 14 October 1947 | Bombsight (type): Norden

Mission No: 7 - Samson | (model): M-9

Target: Fargo Sub Ass'y Plant | (no.): L-7608

Aircraft No: 45-21750 | Bomb(type,size&no.) T28E2, 25200 lb # 15

COMPUTATIONS

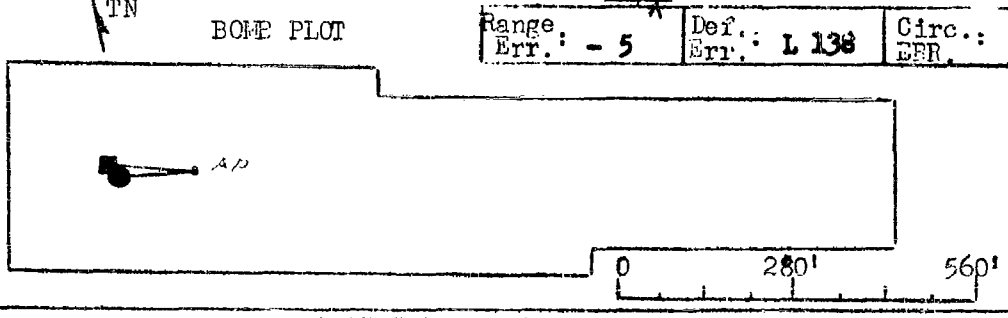
ALTITUDE				AIRSPEED	WIND (MPH)
Tgt Elev.	80	Comp. Error	-5.2	CIAS 195	Direction 273
Alt Sett.	Not Used	Corr F.L. Temp	-12	TAS 255	Velocity 16
Ind. P.A.	16660	Grnd. Temp.	15	Devil 5	
P.A.T.	-140	Mean Temp.	1.5	WEATHER	SCORING METHOD
P.A.A.T.	16800	Bomb. Alt.	17000	Visibility Ovcst. Hazy	Survey X
F.L. Temp.	-6.8	Disc Speed	162.2	Turbulence Rough	Photo

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
6	1	A	010	16650	16990	195	255	258	5	162.2		.725	-	4	R ¼	-½	1201

BOMB PLOT

TN

Range Err.: - 5 | Def. Err.: L 138 | Circ. Err.: 139



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-300	-	306				6	-	-	L 153	-	L 153

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was five feet short. The measured groundspeed and the synchronized groundspeed were the same. The bombardier reported that the bomb was released on a very short bombing run of approximately 30 seconds duration or less, and therefore he did not have sufficient time to obtain an accurate level. Just before the release of the bomb, it was noted that the fore and aft bubble was off 1/2 bubble length to the fore, so the bombardier displaced the lateral crosshair 300 feet short to compensate for the 306 foot range error over. The theoretical impact was six feet over as compared to the measured impact of five feet short. The reason for the eleven foot difference between the measured impact and the theoretical analysed impact cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 153 feet left. The measured drift and the synchronized drift were the same. The only reported cause for deflection error was due to the lateral bubble being off 1/4 bubble length to the right (9 mils) which caused an error of 153 feet left. No further cause for deflection error could be determined. The 14 foot discrepancy between the analyzed impact and the measured impact cannot be determined.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,100 Feet.

Bombing conditions on this mission were very poor. Runs were limited to approximately 30 seconds or less because of an 8/10 cloud coverage. The bombardier could not see the target until a 50 degree sighting angle was reached, and did not have sufficient time for an accurate level during the run. The bomb had to be released on this run or possible salvo would have become necessary.

CONFIDENTIAL

HARKEN PROJECTION BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 18 October 1947
Mission No: 10 - Samson
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): L-7608
Bomb(type,size&no.) T28E2, 25200 lb # 1

COMPUTATIONS

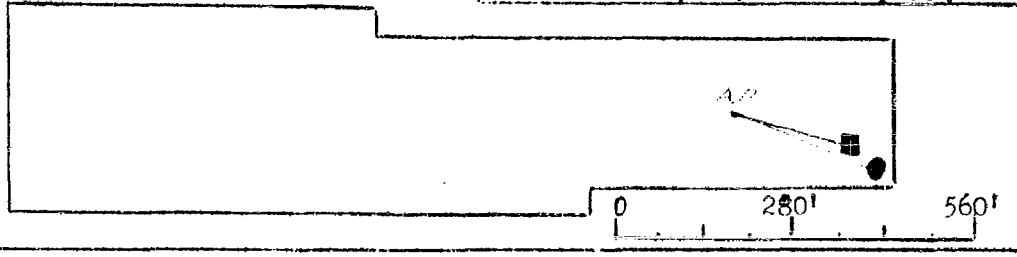
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-5.1	CIAS	195	Direction	340
Alt Sett.	Not Used	Corr F.L. Temp	-17	TAS	253	Velocity	85
Ind. P.A.	16840	Grnd. Temp.	9	Trail	5		
P.A.T.	-330	Mean Temp.	-4	WEATHER		SCORING METHOD	
P.A.A.T.	17170	Bomb. Alt.	17000	Visibility	4/10 Cloud	Survey	X
F.L. Temp.	-11.9	Disc Speed	162.2	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA								
													MRT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
8	1	A	356	16840	17000	195	253	173	5	162.2		.430	-	8	L1/8	1/8	1359

BOMB PLOT

TN

Range Err.: -116 | Def. Err.: R 210 | Circ. EPR.: 240



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error)	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-76				-76	R 100	-	R 76	-	R 176

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 116 feet short of the aiming point. The groundspeed synchronized for and the measured groundspeed were the same. The bombardier reported that the fore and aft bubble was off 1/8 bubble length (4.5 mils) which caused a 76 foot range error short. No further cause for range error was reported. Reason for the 40 foot discrepancy between the measured range error and the analyzed range error cannot be determined.

DEFLECTION ANALYSIS:

a. The measured deflection error was 210 feet right. The measured drift and the drift synchronized for were the same, but the bombardier offset his fore and aft cross-hair 100 feet right of the aiming point. In addition, the lateral bubble was off 1/8 bubble length left (4.5 mils) which caused a 76 foot deflection error right. The combination of deflection errors places the analyzed impact 176 feet right. Reason for the 34 foot difference between the analyzed impact and the measured impact is indeterminate.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 17,100 Feet.

Bombardier used an aiming point 100 feet right of the standard aiming point.

Cloud conditions over target were approximately 4/10. Bomb was dropped through large hole in overcast. Bomb run was less than 1 minute duration.

CONFIDENTIAL

HARKEN PROJECT BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt. | A/C: HARRENTINE, GEORGE T. CAPTAIN

Date: 19 October 1947
Mission No: 11 - Samson
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): L-7608
Bomb(type,size&no.) T28E2, 25200 lb #7

COMPUTATIONS

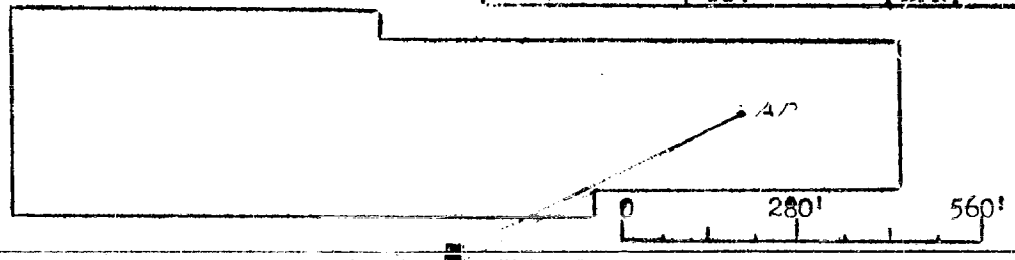
ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-6.9	CIAS	195	Direction	351
Alt Sett.	Not Used	Corr F.L. Temp	-30.9	TAS	289	Velocity	34
Ind. P.A.	24510	Grnd. Temp.	11	Trail	8		
P.A.T.	-540	Mean Temp.	-9.95	WEATHER		SCORING METHOD	
P.A.A.T.	25050	Bomb. Alt.	25000	Visibility	Good	Survey	X
F.L. Temp.	-24	Disc Speed	133.3	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
6	1	A	006	24550	25040	195	289	257	8	133.3		.595	-	2	R ½	-	1620

BOMB PLOT

TN

Range Err.: -228 | Def. Err.: L 512 | Circ. Err.: 562



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-25	-175	-	+14	-	-	-186	-	-	L 450	-	L 450

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 228 feet short. The bombardier synchronized for a groundspeed of 260 MPH as compared to a measured groundspeed of 257 MPH. The 3 MPH range synchronization error caused a 175 foot range error short. In addition, the lateral crosshair was 25 feet short of the aiming point at the instant of release, making a total range synchronization error of 200 feet. This error was reduced by a 14 foot range error over caused by the pilot flying 40 feet too high on the bombing run. The ultimate analyzed impact is 186 feet short. Reason for the 42 foot difference between the analyzed impact and the measured impact is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 512 feet left. The measured drift and the synchronized drift were the same, but the bombardier reported that the lateral bubble was 1/2 bubble length right (18 mils) which caused a 450 foot left deflection error. No further cause for an error in deflection could be found. The 62 foot discrepancy between the analyzed impact and the measured impact is indeterminate.

OPERATION OF BOMBING EQUIPMENT

1. PNEUMATIC DOORS SYSTEM:

a. DIFFICULTY: Pressure would not build up after doors were opened at bombing altitude. Build up OK after descent to lower altitude. Caused by high altitude leak in rear door pneumatic system.

b. CORRECTIVE ACTION: None possible. Doors ground-checked OK. Could not find source of high altitude leak.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 25,000 Feet.

Could not obtain accurate bubble level due to constant turbo power surge.

CONFIDENTIAL

HARKEN FIELD, BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt.	A/C: BARRENTINE, GEORGE T. CAPTAIN
Date: 20 October 1947	Bombsight (type): Norden
Mission No: 12 - Samson	(model): M-9
Target: Forge Sub Ass'y Plant	(no.): L-7608
Aircraft No: 45-21750	Bomb(type,size&no.) T28E2, 25200 lb # 12

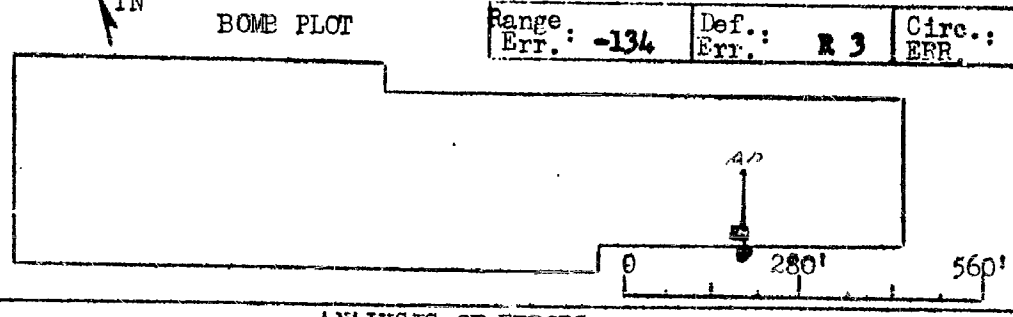
COMPUTATIONS

ALTITUDE				AIRSPEED		WIND(MPH)	
Tgt Elev.	80	Comp. Error	-6.9	CIAS	195	Direction	054
Alt Sett.	Not Used	Corr F.L. Temp	-30.9	TAS	290	Velocity	11
Ind. P.A.	24,580	Grnd. Temp.	9	Trail	8		
P.A.T.	-540	Mean Temp.	-10.95	WEATHER		SCORING METHOD	
P.A.A.T.	25120	Bomb. Alt.	25000	Visibility	Good	Survey	X
F.L. Temp.	-24	Disc Speed	133.3	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA								
													DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press.Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
4	1	A	013	21640	25060	195	290	282	8	133.3		.655	1½	-	-	+1/8	1156

BOMB PLOT

Range Err.:	Def. Err.:	Circ. ERR:
-134	R 3	134



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos.at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift)	TOTAL DEFLECTION ERROR
-	-	-113	23	-	-	-90	-	-	-	-	0

CONFIDENTIAL

BOMBING ANALYSIS SUMMARY

RANGE ANALYSIS:

a. The measured range error was 134 feet short. The measured groundspeed and the groundspeed synchronized for were the same, but the fore and aft bubble was off 1/8 bubble length (4.5 mils) which caused a 113 foot range error short. This error was reduced somewhat by a 23 foot range error over caused by the pilot flying 60 feet too high on the bombing run. The combination of errors places the analyzed impact 90 feet short. Reason for the 44 foot discrepancy between the measured and analyzed impacts is indeterminate.

DEFLECTION ANALYSIS:

a. The measured deflection error was 3 feet right. The measured drift and the drift synchronized for were the same. No cause for deflection error could be found. Reason for the 3 foot right deflection error is indeterminate.

OPERATION OF BOMBING EQUIPMENT

All bombing equipment operated satisfactorily.

REMARKS

FLIGHT LEVEL RADIO ALTIMETER READING: 25,000 Feet.

Turbo Power surge made conditions very difficult for obtaining bubble level. It is believed that the aircraft is approaching the critical altitude at this weight.

CONFIDENTIAL

HARKEN FIELD BOMBING FLIGHT RECORD

Bombardier: BARKLEY, CHARLES H. 1st Lt | A/C: BARRENTINE, GEORGE T. CAPTAIN

Date: 20 October 1947
Mission No: 15 - Samsen
Target: Fargo Sub Ass'y Plant
Aircraft No: 45-21750

Bombsight (type): Norden
(model): M-9
(no.): I-7608
Bomb (type, size&no.) T28E2, 25200 lb # 6

COMPUTATIONS

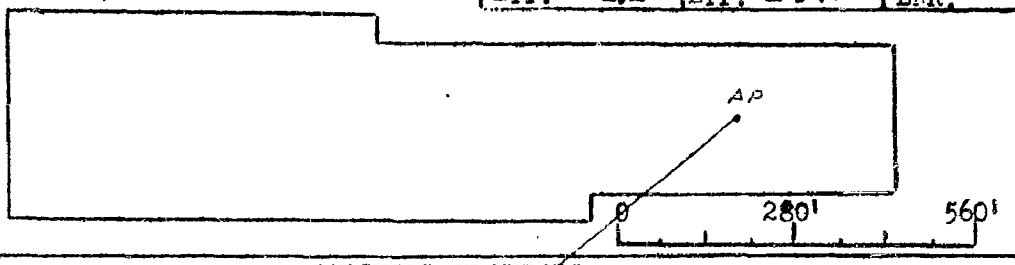
ALTITUDE				AIRSPEED		WIND (MPH)	
Tgt Elev.	80	Comp. Error	-6.9	CIAS	195	Direction	076
Alt Sett.	Not Used	Corr F.L. Temp	-31.4	TAS	290	Velocity	11
Ind. P.A.	24660	Grnd. Temp.	10	Trail	8		
P.A.T.	-440	Mean Temp.	-10.7	WEATHER		SCORING METHOD	
P.A.A.T.	25100	Bomb. Alt.	25000	Visibility	Fair	Survey	X
F.L. Temp.	-24.5	Disc Speed	133.3	Turbulence	Smooth	Photo	

MISC.				ALT.		SPEED (MPH)			SIGHT DATA				DRIFT		BUBBLES		
Approach No.	Release No.	Bomb Approach Control	True Heading	Indicated Press. Alt.	Bombing Altitude	CIAS	TAS	Groundspeed	Trail	Disc Speed	Synchronization	Tangent D.A.	Left	Right	Lateral	Fore & Aft	Time of Impact Hr, Min,
3	1	A	015	24680	25000	195	290	286	8	133.3	2	.66	2	-	UNK	UNK	1652

BOMB PLOT

TN

Range Err.: -292 | Def. Err.: L 342 | Circ. Err.: 450



ANALYSIS OF ERRORS

RANGE							DEFLECTION				
Lateral Crosshair Pos. at Rel.	Range Synch. (Gdspd Error	Fore & Aft Bubble Error	(Alt. Error) (DAS or ATF)	Trail Error (Airspeed)	RCCT	TOTAL RANGE ERROR	Fore & Aft Crosshair Pos. at Rel.	Def. Synch. (Drift Err.)	Lateral Bubble Error	Crosstrail Error (Trail&Drift	TOTAL DEFLECTION ERROR
Unable to analyze bomb for range or deflection error.											

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BOMBING ANALYSIS SUMMARY

This bomb cannot be accurately analyzed for range or deflection error. Aircraft turbo power surge made it extremely difficult for bombardier to obtain an accurate level. Oscillations were so bad that the bombardier could not determine the bubble position prior to release, and for this reason bomb cannot be accurately analyzed.

OPERATION OF BOMBING EQUIPMENT

1. CAMERAS:

   a. DIFFICULTY: Right B-2 blew fuse. Attributed to altitude effects. Caused by high drag which overloaded the circuit.

   b. CORRECTIVE ACTION: Fuse replaced.

REMARKS

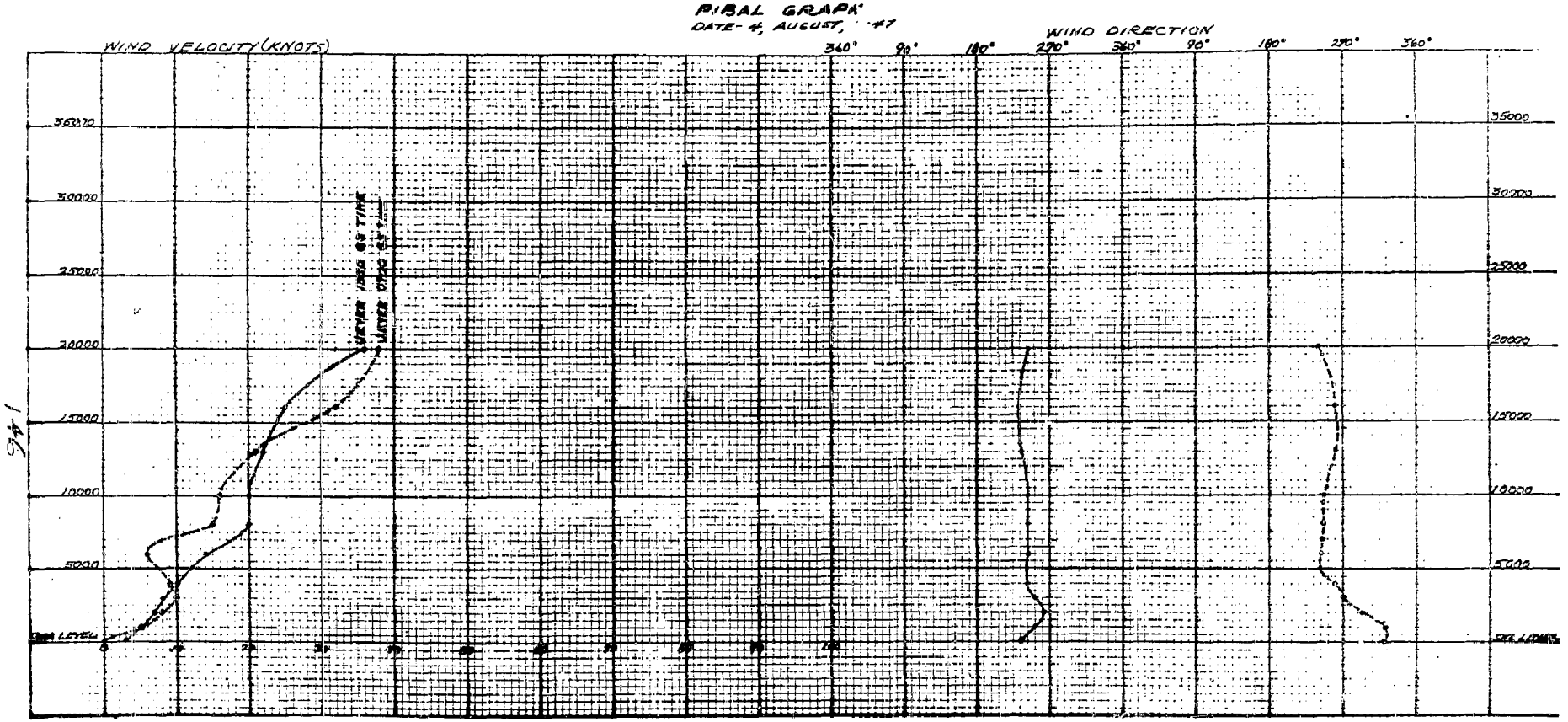
FLIGHT LEVEL RADIO ALTIMETER READING: 25,000 FEET.

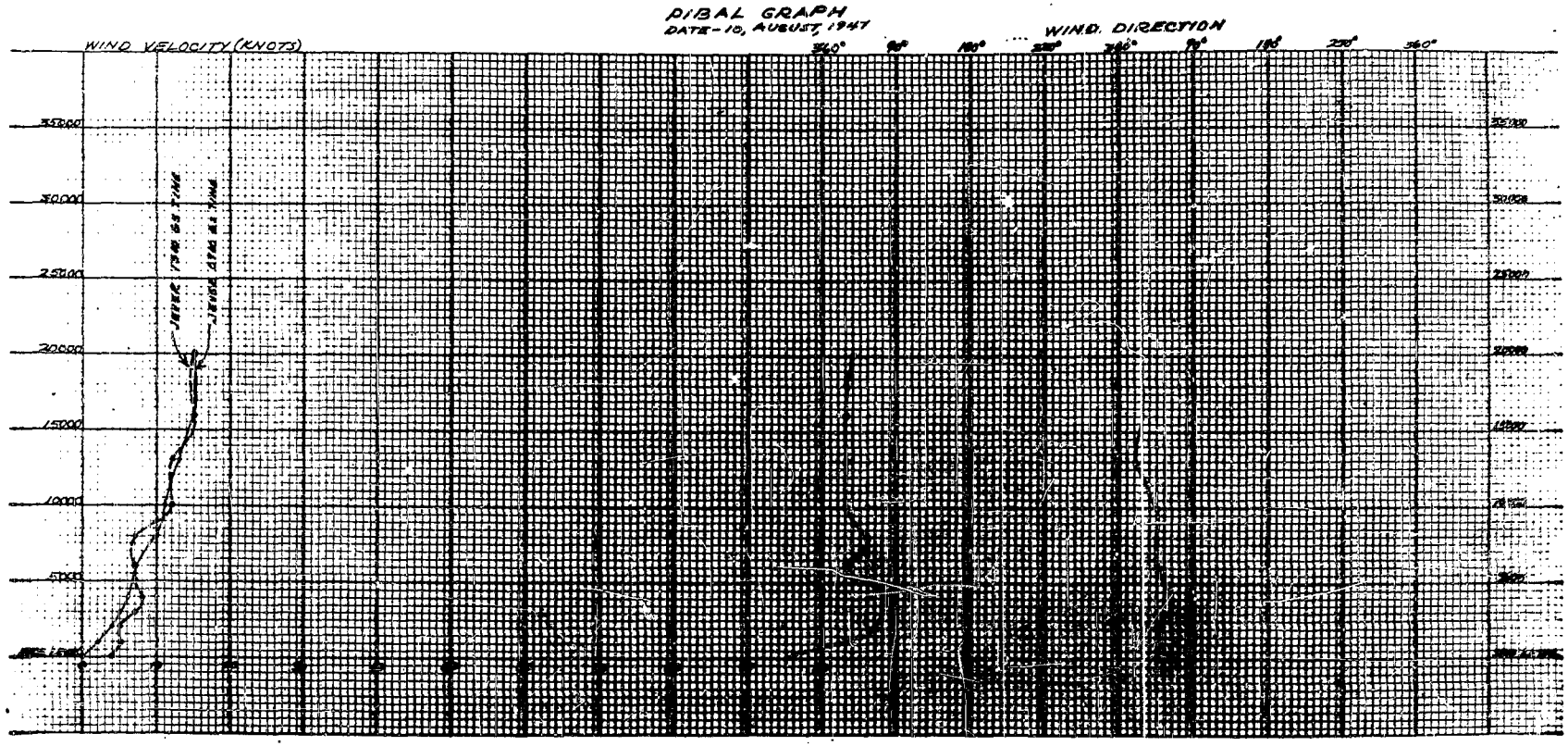
Turbo surge made it extremely difficult for the bombardier to obtain a level. It is believed that this particular aircraft is approaching its critical altitude at this level and weight.

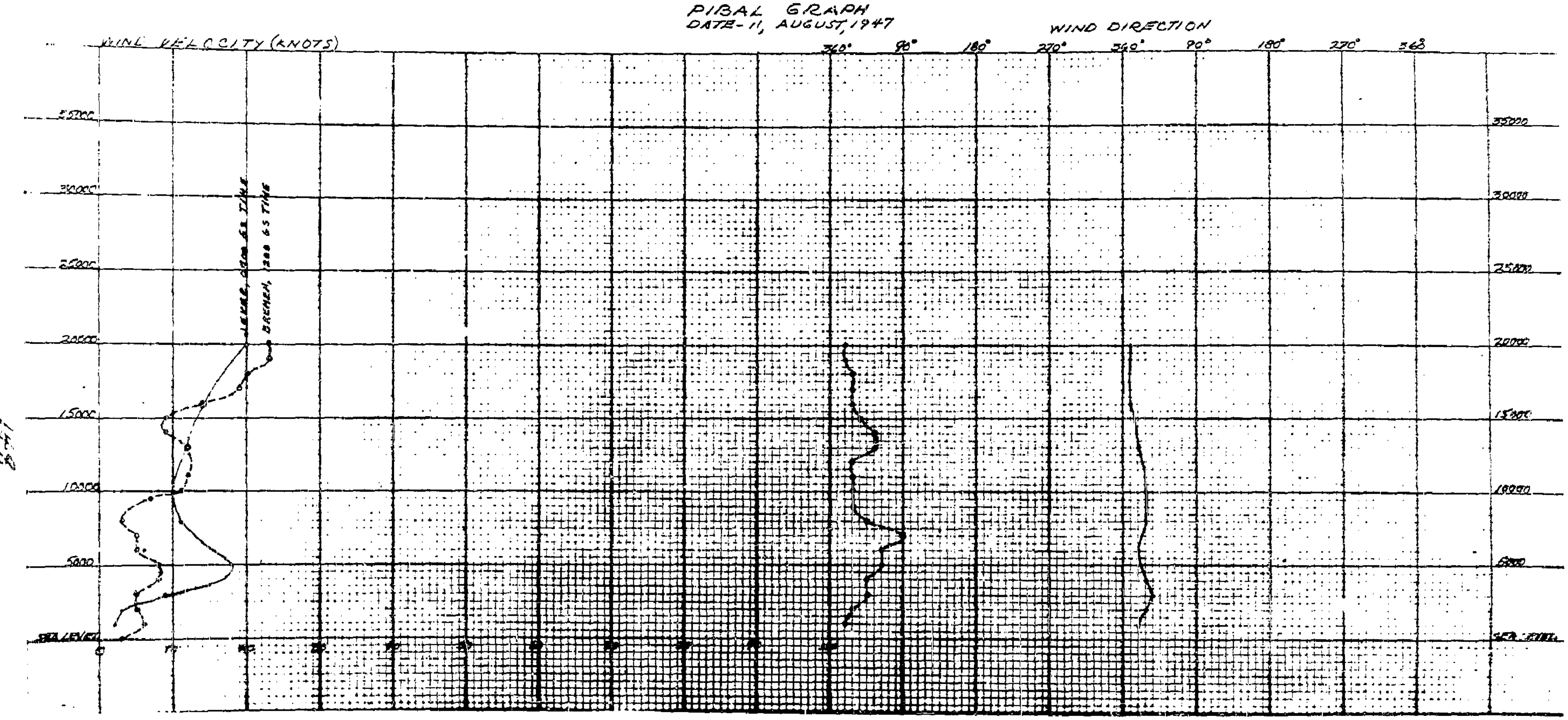
PIBAL GRAPHS

PIBAL GRAPH

DATE- 4, AUGUST, '47

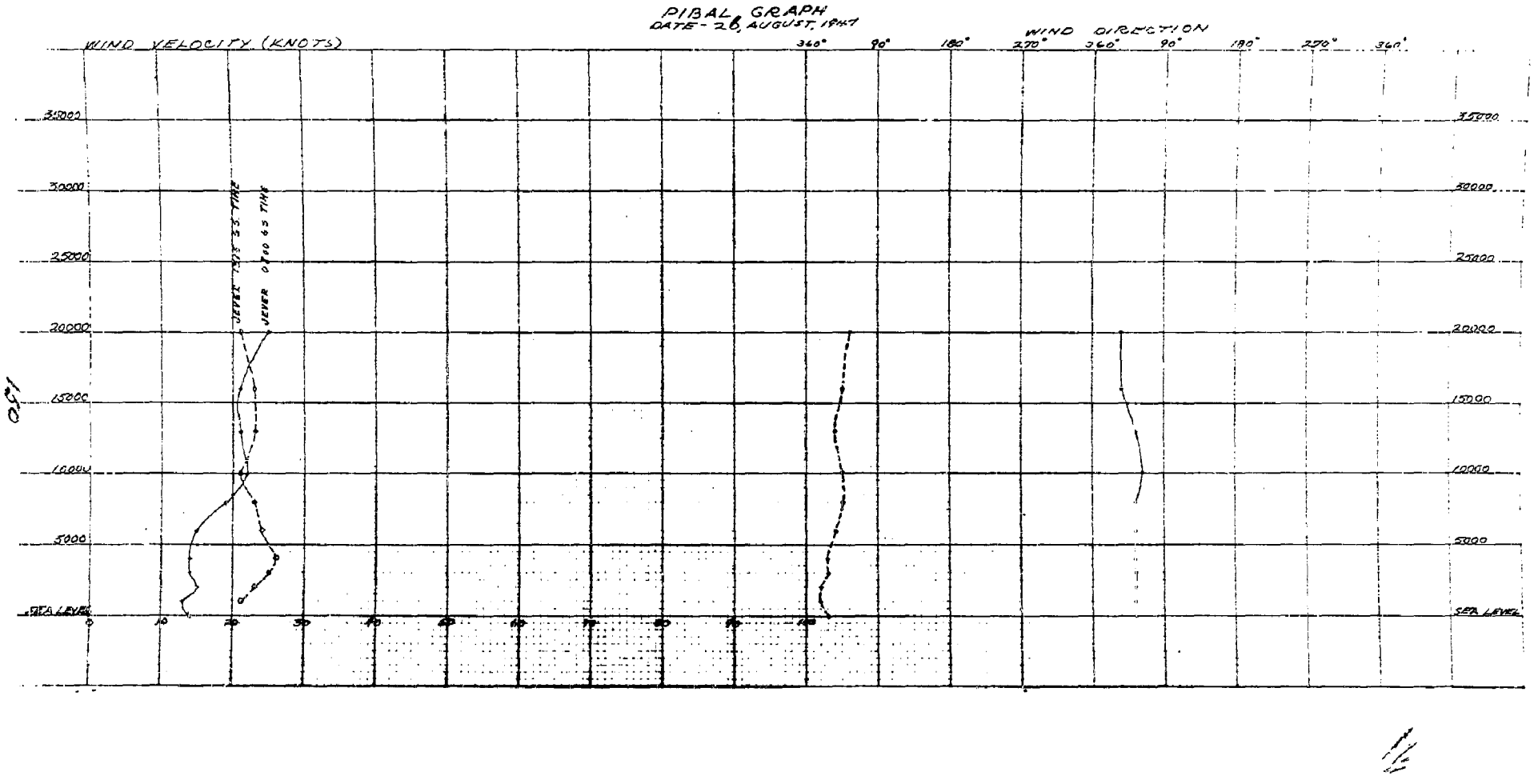



DIBAL GRAPH
DATE-10, AUGUST, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
35000
30000
25000
20000
15000
10000
5000
360°
90°
180°
270°
360°

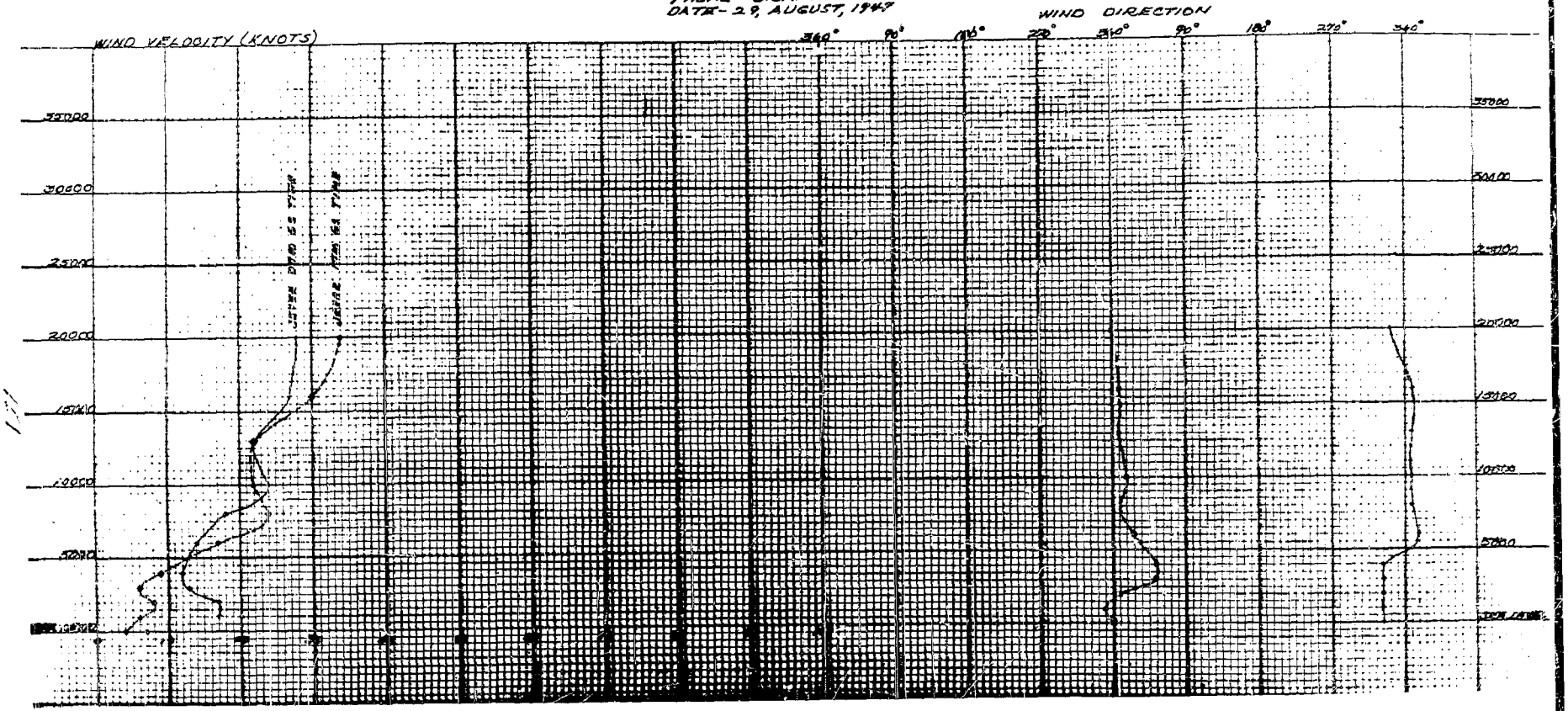

PIBAL GRAPH
DATE-11, AUGUST, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
SEA LEVEL
5000
10000
15000
20000
25000
30000
35000

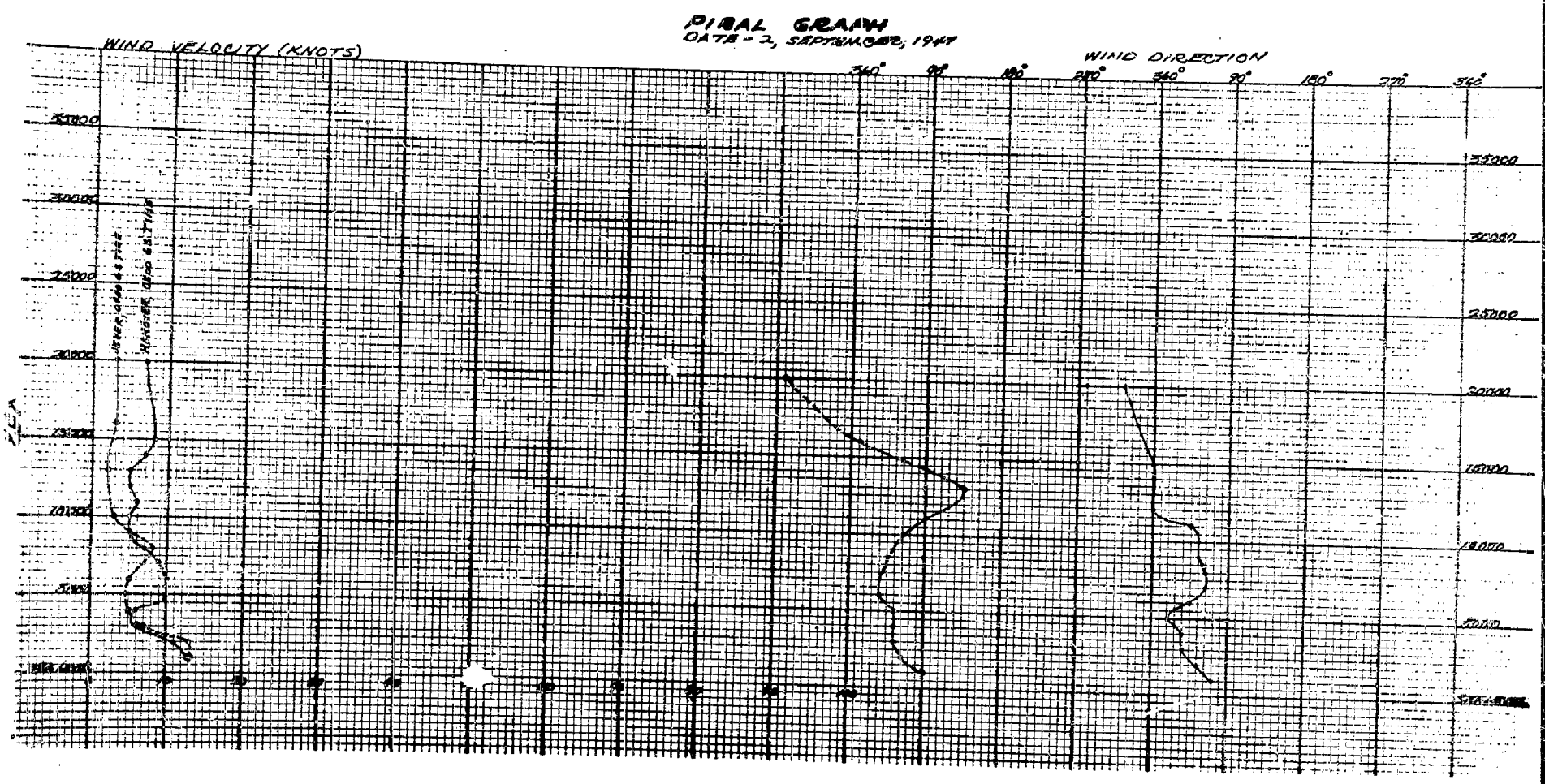
PIBAL GRAPH

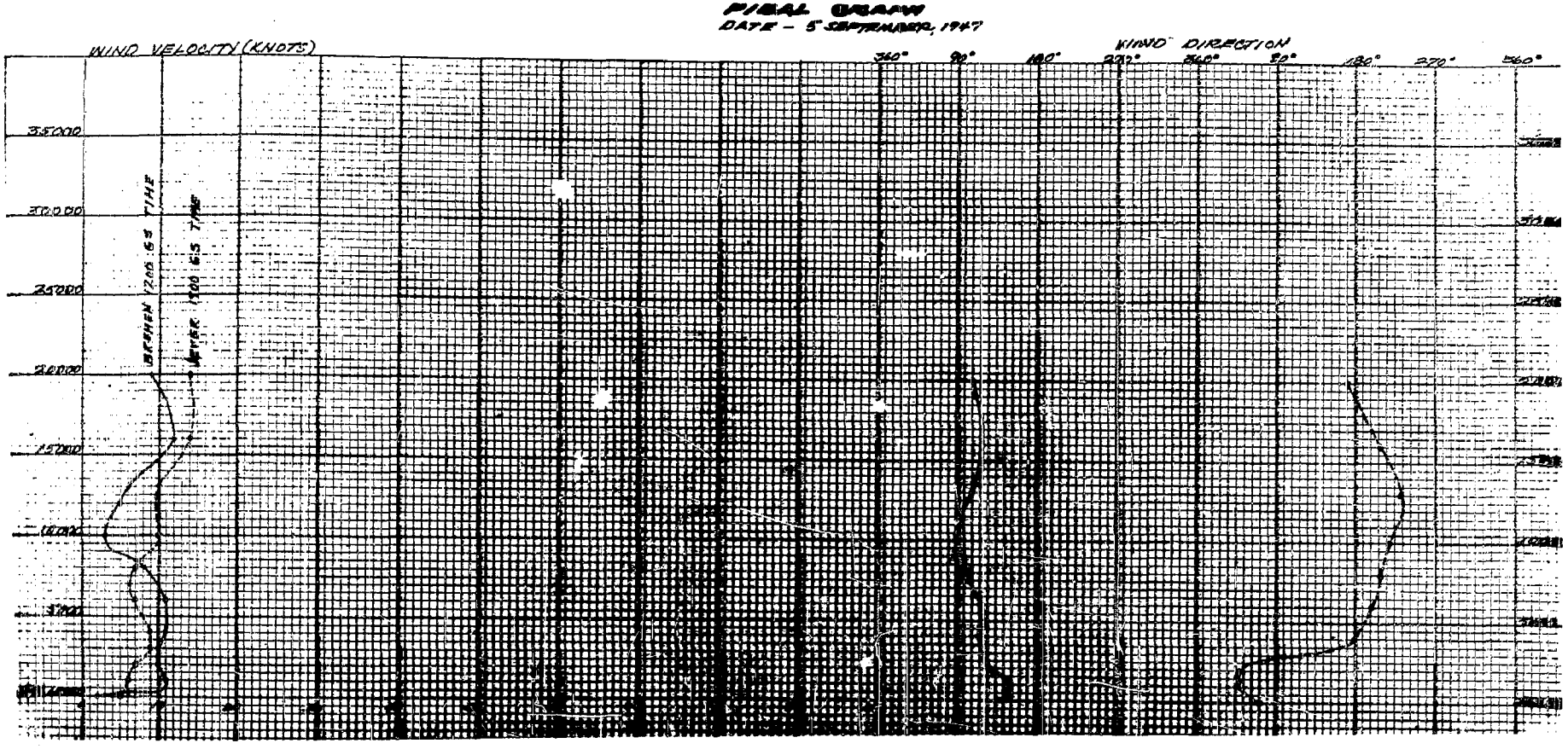
DATE- 20, AUGUST, 1944


PIBAL GRAPH
DATE - 26, AUGUST, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
360°
90°
180°
270°
360°
90°
180°
270°
360°
35000
30000
25000
20000
15000
10000
5000
SEA LEVEL
0
10
20
30
40
50
60
70
80
90
100
JEVER 1915 GS TIME
JEVER 0900 GS TIME

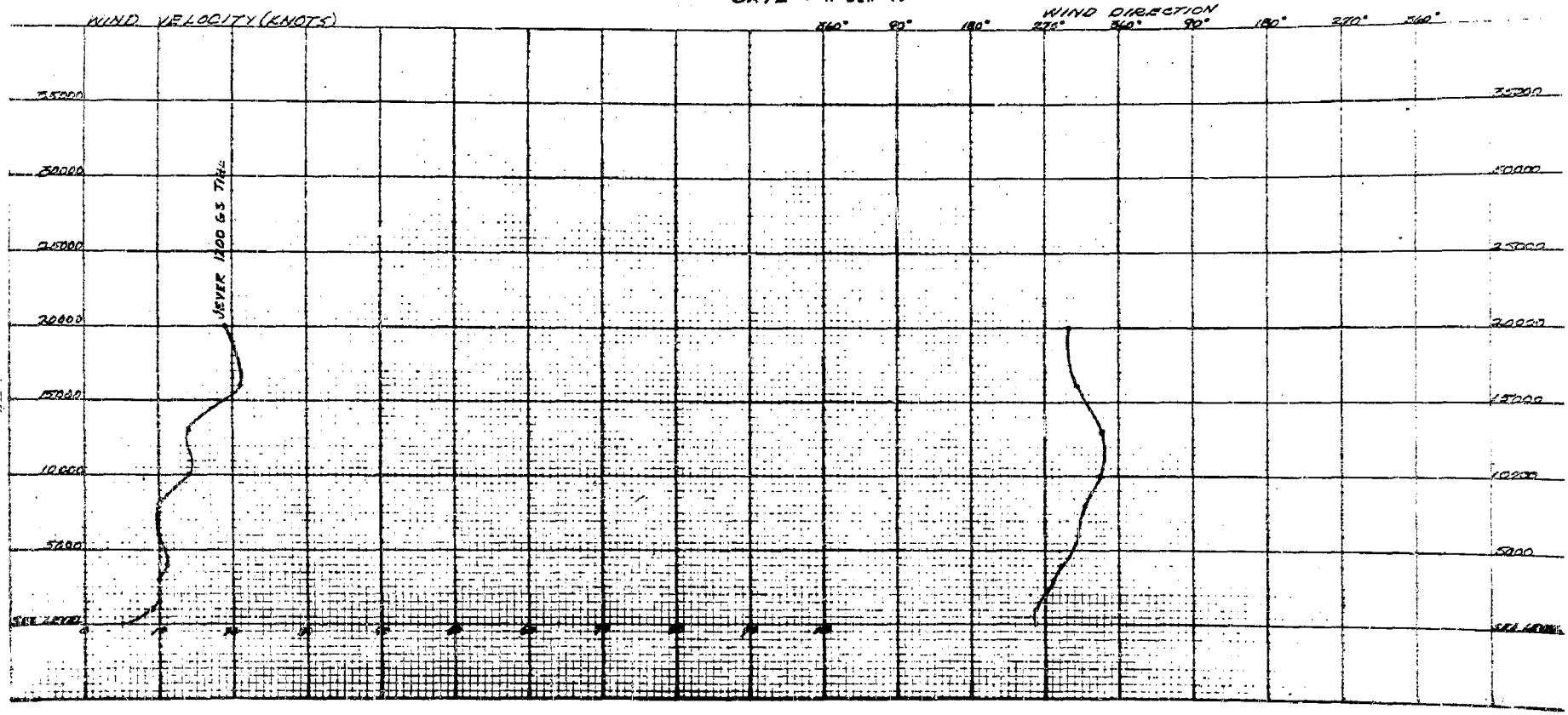
PIBAL GRAPH
DATE- 29, AUGUST, 1947




PIBAL GRAPH
DATE - 2, SEPTEMBER, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
360°
90°
180°
270°
360°
90°
180°
270°
360°
35000
30000
25000
20000
15000
10000
5000
0
10
20
30
40
50
60
70
80
90


FINAL GRAPH
DATE – 5 SEPTEMBER, 1947
WIND VELOCITY (KNOTS)
WIND DIRECTION
360°
90°
180°
270°
360°
35,000
30,000
25,000
20,000
15,000
10,000
5,000
BEFORE 1200 GCT TIME
AFTER 1100 GCT TIME

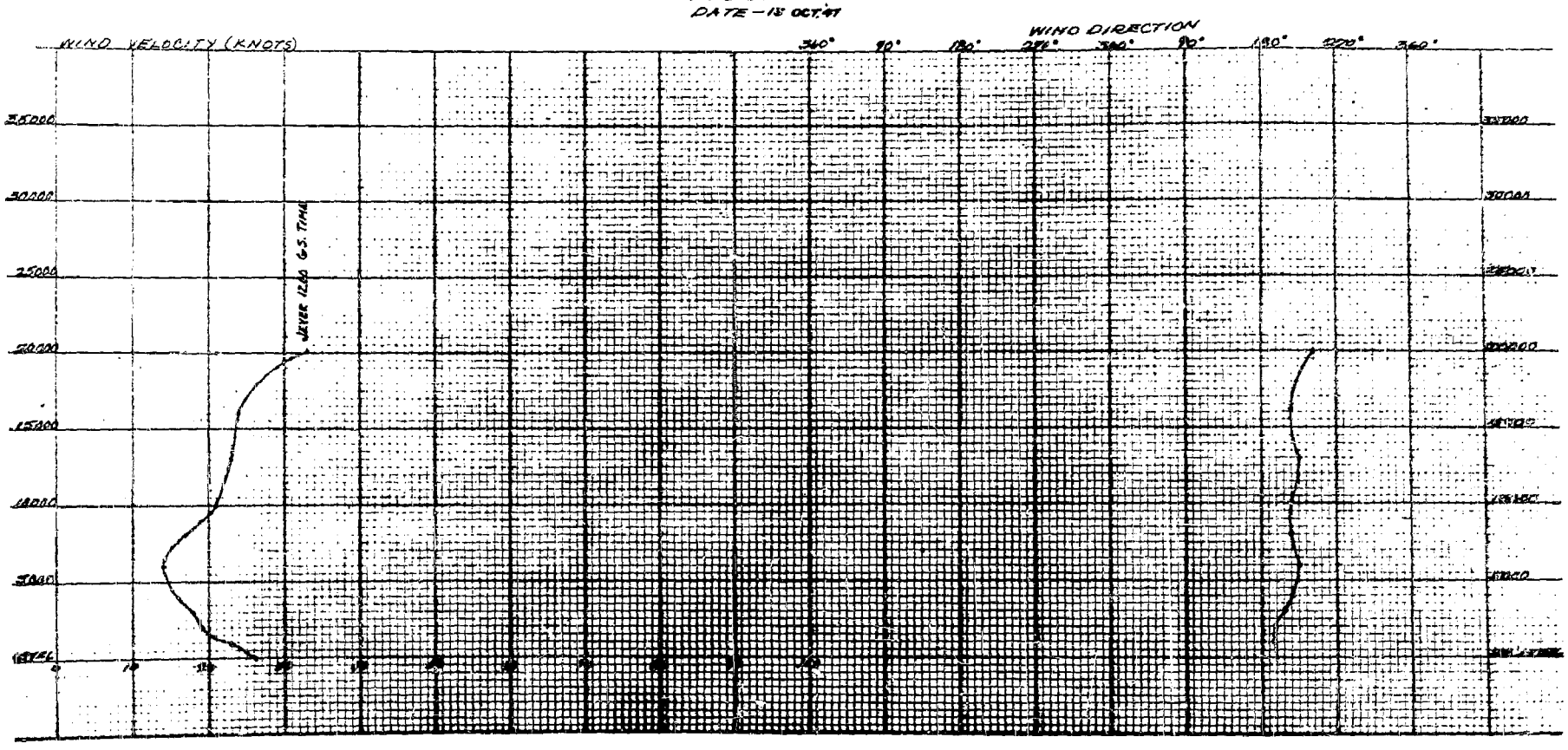
PIBAL GRAPH
DATE - 11 OCT '47

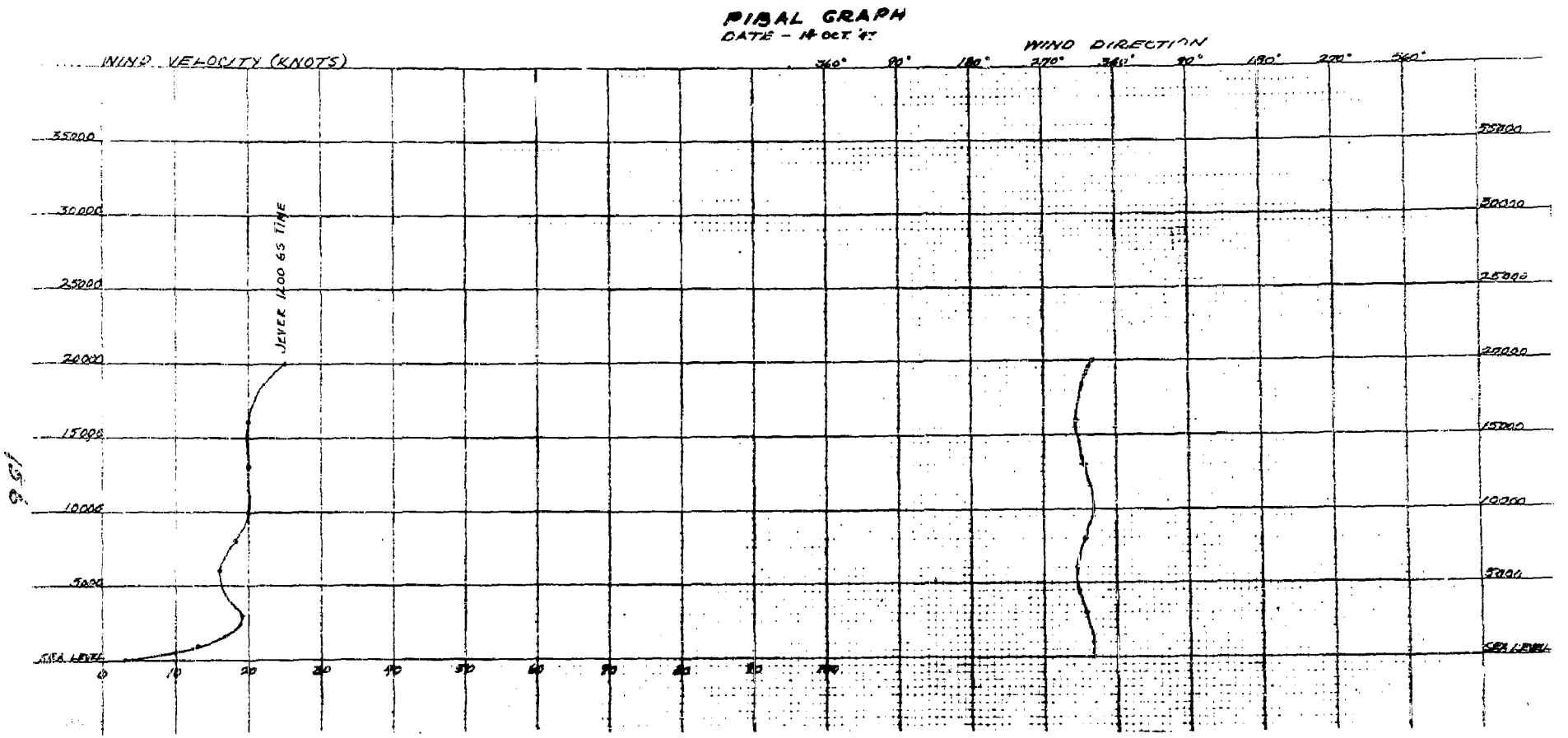


#C1

PIBAL GRAPH

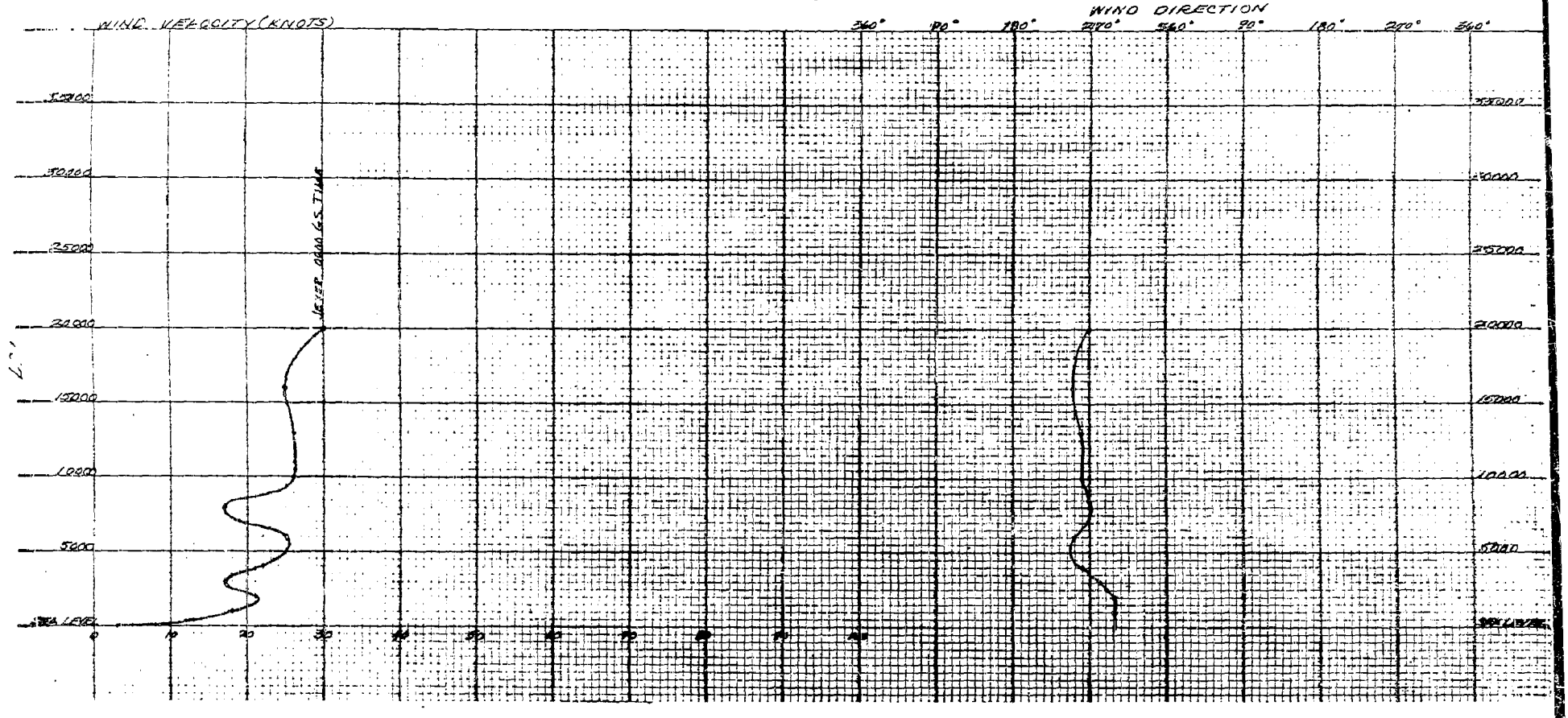
DATE – 18 OCT. 47




PIBAL GRAPH
DATE - 4 OCT '47
WIND VELOCITY (KNOTS)
WIND DIRECTION
35000
30000
25000
20000
15000
10000
5000
SEA LEVEL
JEVER 1200 GS TIME
0
10
20
30
40
50
60
70
80
90
100
110
120
360°
90°
180°
270°
360°
90°
180°
270°
360°

PIBAL GRAPH

DATE- 15 OCT. '47



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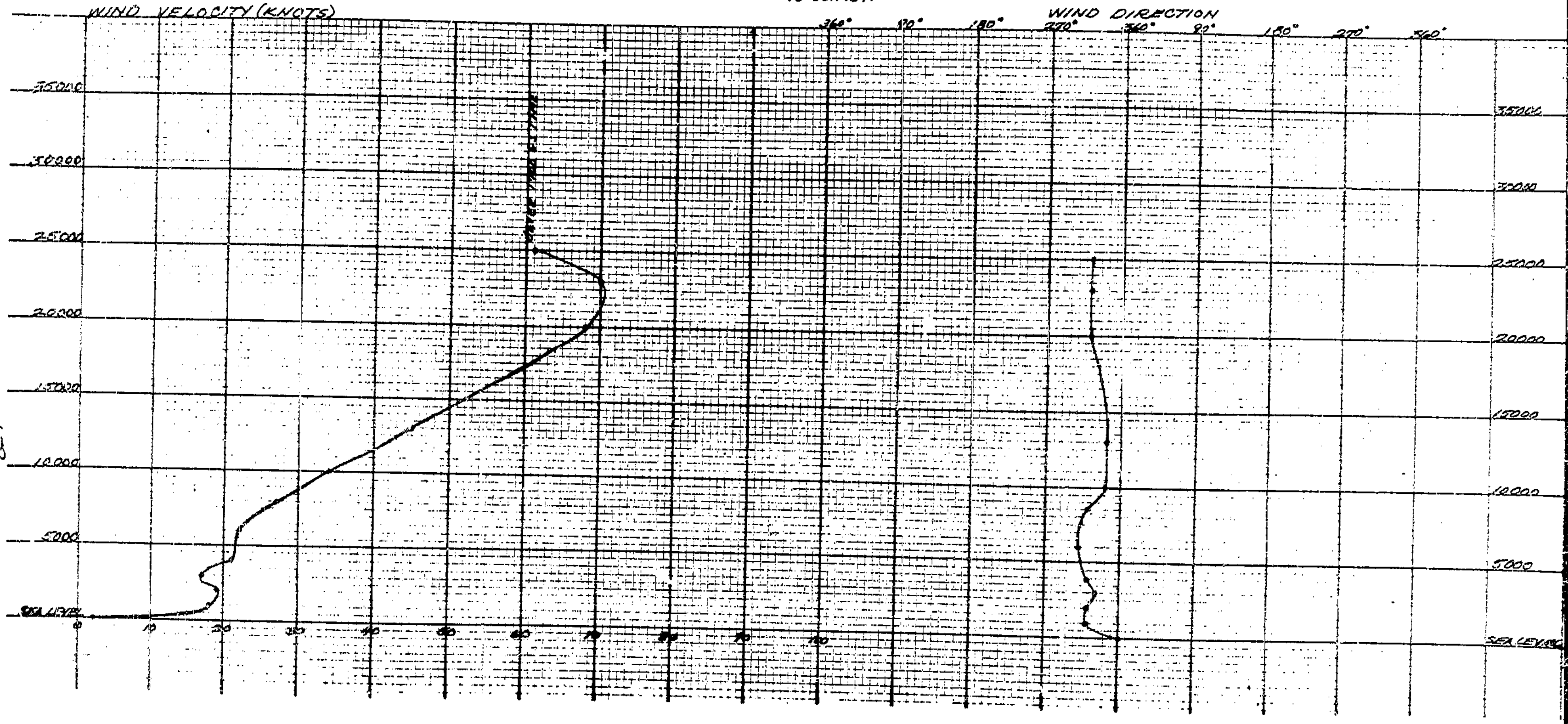
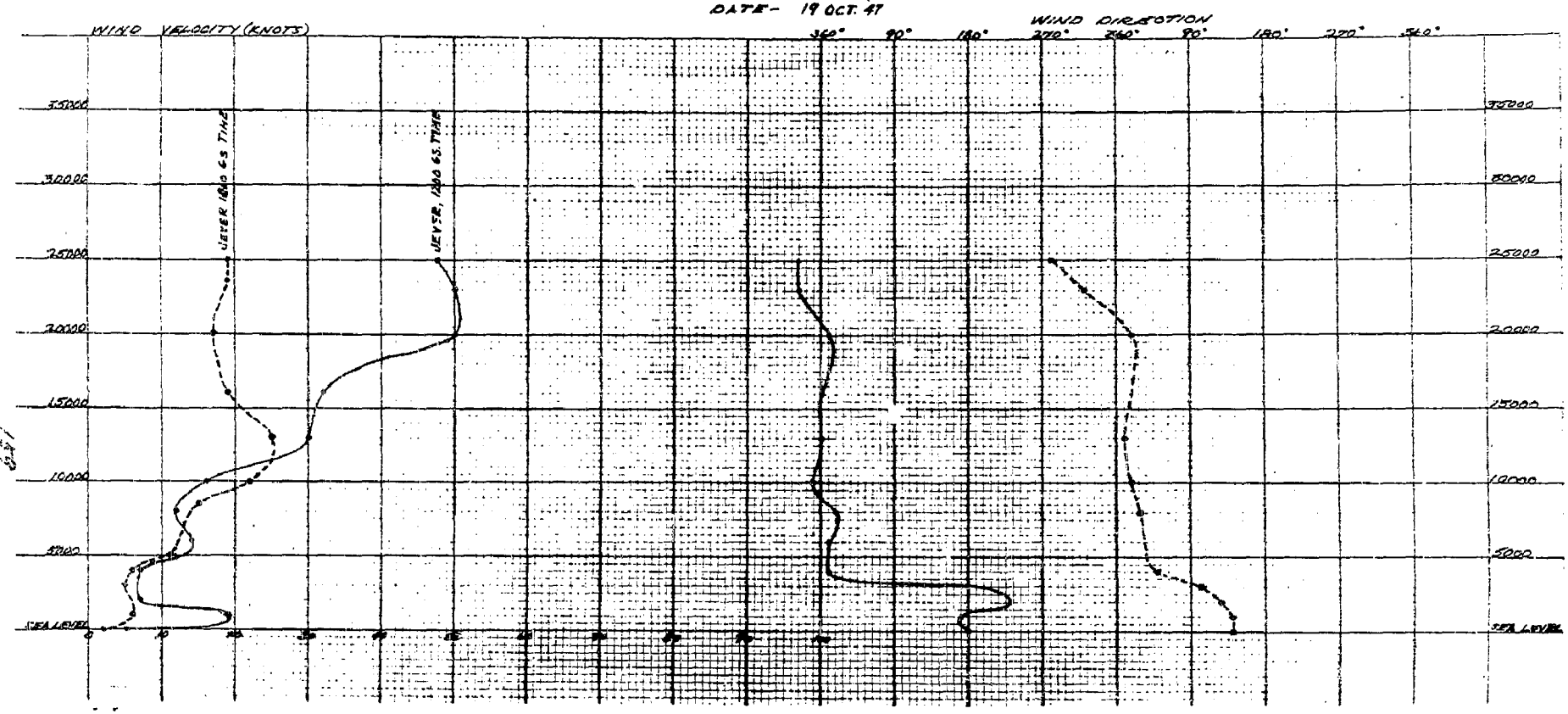
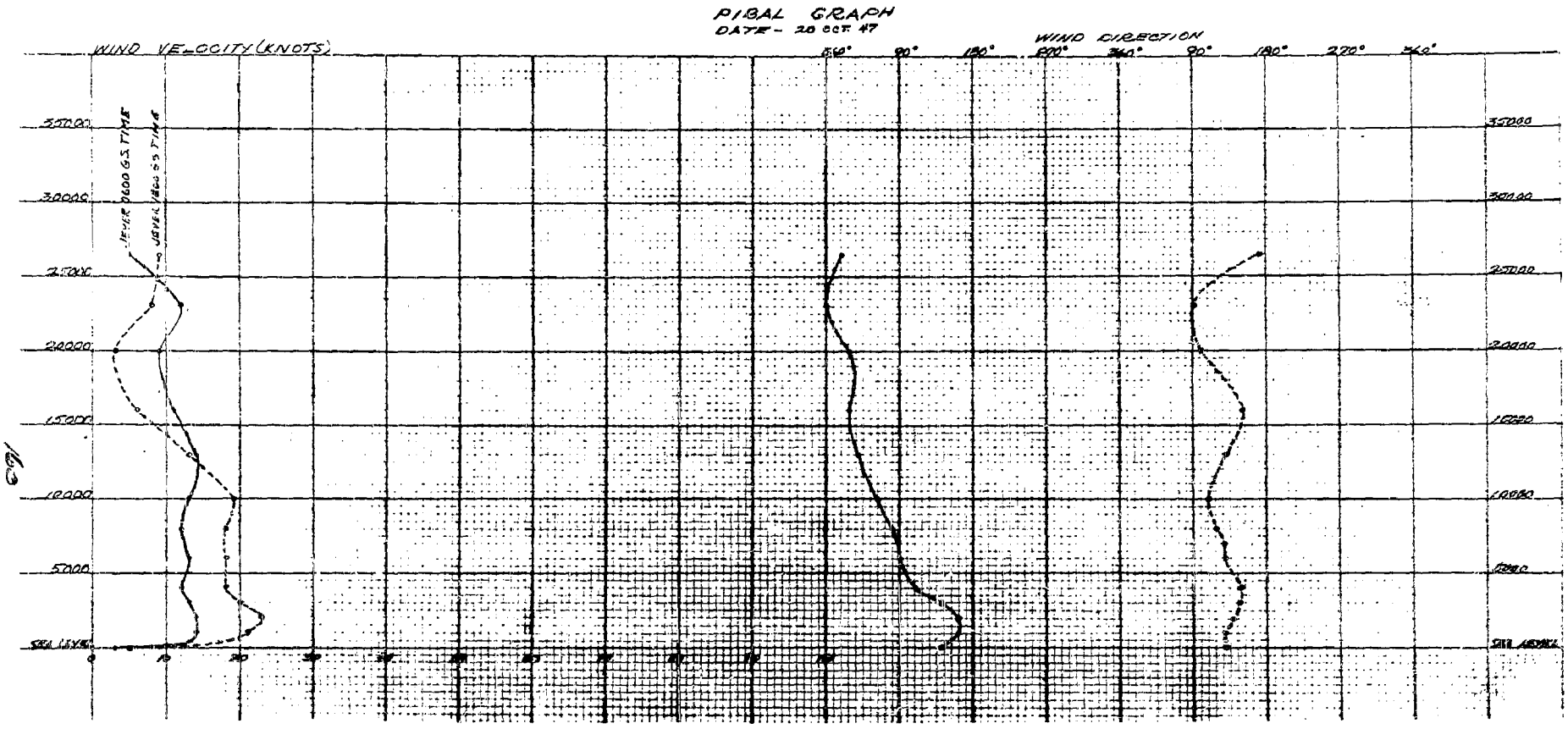
DATE - 18 OCT. 1947



DIBAL GRAPH

DATE- 19 OCT. 47




PIBAL GRAPH
DATE - 20 OCT 47
WIND VELOCITY (KNOTS)
WIND DIRECTION
NEVER 0600 G.S. TIME
SAME 1800 G.S. TIME
35000
30000
25000
20000
15000
10000
5000
SEA LEVEL
0
10
20
30
40
50
60
70
80
90
180°
270°
360°

S E C T I O N V

AMERICAN PHASE

OPERATIONAL SUMMARY---BOMBING EQUIPMENT

ARMAMENT

BOMBSIGHTS

C-1 AUTOPILOT

PHOTO EQUIPMENT

RADIO ALTIMETERS

OPERATIONAL SUMMARY-ARMAMENT AND ALLIED EQUIPMENT

1. OPERATION:

a. The locking hook on the D-9 Bomb Shackle (modified), fractured on two occasions, once in flight and once immediately after carrying chains had been secured. The resultant modification of the locking hook was considered satisfactory. No other malfunctions of the D-9 Shackle were encountered. (See "Malfunction Report of D-9 Shackle-Modified". Part IV).

b. During ballistics tests at Muroc, California, prior to departure for overseas, it was proven that the spring tension within the standard A-4 release was of insufficient strength to overcome the bind in the moving parts of the D-9 shackle and trip the release arm. Upon recommendation, the Wright Field Armament Labratory modified the A-4 release so that the mechanical force exerted by the levers and springs on the shackle latches was increased from the range of 22-35 pounds to the range of 60-65 pounds with a minimum life of 1000 releases. The modified version of the A-4 release operated satisfactorily throught the entire project.

c. The operation of the retraction windlass and cable was considered satisfactory. Two retraction cables were spliced when strands snapped and frayed.

d. All buffer door latches were inoperative after they had been used several times. The latching arms were driven through the wooden portion of the door, caused by the pressure of the slipstream in closing the doors after the bomb had been released. The metal hinges attached to the airplane fuselage were torn and bent.

e. The operation of the front bomb bay doors was considered satisfactory.

f. The operation of the rear bomb bay doors was considered unsatisfactory due to extreme buffeting of rear doors and faulty latch actuators. The additional port in the latch actuator, leading to the opening valve on the actuator arm, caused excessive wear on the rubber washer encircling the latch actuator piston. Buffeting was caused partially by the leak in the latch actuator but primarily by the removal of the wind deflectors from the rear bomb bay doors.

2. CORRECTIVE ACTION:

a. The locking hook of D-9 Shackle was modified by Oberfaffenhoffen Air Depot under the personal supervision of Lt. Colonel Hans. Kirshner, in accordance with Wright Field recommendations and specifications.

b. A steel plate was riveted to each side of the buffer doors at the point where the latching arms are connected to the doors. The metal hinges were doubled in thickness.

c. Rubber washers in latch actuator were constantly replaced.

3. CONCLUSIONS:

a. The D-9 Shackle with the modified locking hook is satisfactory for use with the Amazon and Samson bombs.

b. The modified A-4 release is satisfactory for use with the type D-9 Shackle.

c. The retraction cable and windlass are satisfactory.

d. The type buffer doors provided with the Albert aircraft are unsatisfactory.

e. The latch actuator system used on the rear bomb bay doors is unsatisfactory.

4. RECOMMENDATIONS:

a. That S-4 shackle release be installed in Albert aircraft as soon as they are available.

b. The buffer door latches be modified with metal plates installed on each side of buffer doors and the metal hinges doubled in thickness.

c. That the standard latch actuator be installed in Albert aircraft, with the air line from the actuator arm opening valve running directly to the T connection on the four-way valve. The other port in the T connection should lead to the latch actuator.

OPERATIONAL SUMMARY - BOMBSIGHT AND ACCESSORIES

1. OPERATION:

   a. Five M-9 type bombsights and one M-9B type bombsight were used during the Harken Project. Operation of all sights was considered satisfactory, with no abnormal malfunctions occuring. Approximately ninety per cent of the malfunctions reported were due to the precession of the bombsight gyro. Most of the precession difficulties were due to bad bearings in the gyro and gyro cardan.

   b. The operation of the bombsight stabilizers was considered satisfactory.

   c. The operation of the B-7 mount was considered unsatisfactory due to the weak, or fatigued Lord Mounts. On bombing runs it proved to be too flexible to allow proper leveling of the bombsight stabilizer. It also caused excessive oscillation of the bombsight gyro bubbles. This condition made it difficult for the bombardier to set up his runs accurately.

2. CORRECTIVE ACTION:

   a. Twenty-five and fifty hour inspections were performed, in addition to the usual preflights, and periodic tests.

   b. It was necessary to replace one B-7 mount in airplane Number 750.

   c. A UR has been submitted by the Bombsight Department, Smoky Hill Air Field, Salina, Kansas, on the B-7 Mount.

3. CONCLUSIONS:

   a. The Lord Shock Mounts installed with the present type B-7 mount are unsatisfactory because they fatigue too easily, and are too flexible.

4. RECOMMENDATIONS:

   a. That heavier and stronger Lord Mounts be installed with the B-7 Mount.

OPERATIONAL SUMMARY - C-1 AUTOPILOT

1. OPERATION:

   a. Operation of the C-1 Autopilot in Airplanes Number 750 and 751 was considered satisfactory.

   b. Operation of the C-1 Autopilot in Airplane Number 747 was erratic on aileron control due to leaky circuit in the Pilot's Turn control unit.

   c. A modification known as the "Rate Gyro" had been installed at Wright Field prior to departure, for extensive service testing during high altitude operation. The purpose of the modification was to eliminate the wallow and instability generally attributed to all C-1 autopilots during high altitude operation. The "Rate Gyro" is a 24000 RPM booster directional gyro and is wired into the C-1 rudder circuit. It is extremely sensitive to deviation in azimuth, and is in effect, a gyroscopic dash pot. No maintenance difficulties were encountered with the modification during the American Phase.

2. CORRECTIVE ACTION:

   a. The usual preflights in addition to the twenty-five and fifty hour inspections were performed.

   b. The Autopilot Control Panel was removed and replaced with a serviceable unit.

   c. No maintenance instructions were provided with the "Rate Gyro." It was necessary to clean the potentiometer and isolated sector during the course of normal autopilot maintenance checks.

3. CONCLUSIONS:

   a. That the installation of the "Rate Gyro" modification does materially reduce wallow and instability in the C-1 Autopilot, and that it provides a much more stable bombing platform than the unmodified version of the C-1 Autopilot.

4. RECOMMENDATIONS:

   a. That the "Rate Gyro" be installed as a retroactive modification on all operational B-29 bombardment aircraft equipped with the type C-1 Autopilot.

OPERATIONAL UTILITY-PHOTO EQUIPMENT

1. OPERATION:

The photographic coverage of the Amazon II and Samson bombs was much more complete than that of the British model bomb for the following reasons:

a. Arrival of five (5) replacement Jerome B-2 Recording Cameras, 35 MM, requisitioned from A-4, Strategic Air Command.

(1) Prior to the departure of the Harken Project for Germany, replacement cameras and spare parts were requisitioned on Blue Streak Priority. Both camera and parts are listed as Dead Items in current Air Forces Stock Lists. Air Materiel Command reported no cameras or spare parts available.

(2) At completion of British Phase, cameras in operating condition had been reduced from the required nine (9) to six (6) for lack of replacement parts.

b. Bombing operations at lower altitudes - 17,000 feet as compared with 30,000 and 35,000 feet.

(1) Average temperatures at flight level:

17,000 feet	-4.8°C
25,000 feet	-23.9°C
30,000 feet	-27.1°C
35,000 feet	-37.4°C

c. Availability of processed 35 MM Jerome film before completion of Amazon II bombing:

(1) There were no facilities available to process confidential 35 MM motion picture film in the U.S. Occupied Zone of Germany. All film of British bomb and Amazon II bomb was sent to the R.A.E., Farnsbrough, England, for processing.

(2) Altho test strips were made in the Harken Photo Labratory, this situation made it impossible, until such time as processed film was available, to immediately recognize and adjust any possible errors in installation, exposure, etc.

2. CORRECTIVE ACTION:

a. Failure of all three Jerome B-2 Cameras on two successive missions of aircraft Number 21750, was traced to the installation of a "Camera Master" circuit breaker switch where amperage capacity was ten amperes less than the valve specifies in electrical circuit diagram covering the Jerome installation. The 15 ampere main circuit breaker was replaced with required 35 ampere capacity circuit breaker.

b. K-22 type aerial cameras operated satisfactorily on all missions except one. Vacuum valve was stuck. Camera could have operated but bombardier was improperly instructed and did not turn camera on. Vacuum valve was repaired.

3. CONCLUSIONS:

a. The Jerome B-2 Recording Camera 35 MM is fairly adequate for medium altitude work, but is unreliable at altitudes above 20,000 feet.

b. K-22 type Aerial Camera can be satisfactorily operated at altitude of 35,000 feet with -40°C temperature.

4. RECOMMENDATIONS:

a. For any future operations of this nature, a Recording Camera be used for which parts and complete assemblies are readily available.

b. That processing facilities for film be made immediately available to operating personnel.

OPERATIONAL SUMMARY--RADAR EQUIPMENT

1. OPERATION:

Throughout this phase of the operation the Radar Altimeters functioned satisfactorily, with no more than the normal malfunctions being experienced. Most malfunctions occurred during flight and were difficult to detect during operational ground checks. Most frequent malfunctions were:

a. Low Signal Reception, or poor sensitivity at altitudes of 10,000 feet and above.

b. Non-circular or elliptical track on indicator I-152-C.

c. Bad or weak tubes in transmitter-receiver Unit RC-788 C.

d. Blown fuse.

2. CORRECTIVE ACTION:

a. Every action noted in available pertinent Technical Orders was taken, within the limits of available test and maintenance facilities, to insure satisfactory operation. In every instance of malfunction, equipment had ground-checked OK, but went out of operation during flight. All routine inspections, daily, 25, 50, and 100 hour, were performed. Due to limited maintenance and test facilities, most maintenance was performed on the 1st and 2d echelon level, and consisted mainly of calibrating units, checking circuits for shorts, and replacing units known to be inoperative with units known to be operational.

3. CONCLUSIONS:

a. The majority of the malfunctions occurred during the British phase when operating at altitudes of 30,000 and 35,000 feet. The only conclusion that can be made, due to the lack of maintenance facilities and equipment, is that the Radar Altimeter SCR 718 is more reliable at medium altitudes than at altitudes above 20,000 feet.

4. RECOMMENDATIONS:

a. Test sets TS-10-APN and TS-23-APN be made available to operating personnel. Without subject test sets, shop level maintenance is prone to be unreliable.

S E C T I O N VI

SUMMARY

BOMBING ACCURACY AND ANALYSIS

AMERICAN AND BRITISH PHASE

SUMMARY --- BOMBING ACCURACY AND ANALYSIS

In the section to follow, no attempt has been made to differentiate between the two large bomb types, the Amazon and the Samson, as to relative accuracy because it is the opinion of Harken personnel that the ballistic accuracy of the two bomb types is so nearly the same that any difference is infinitesimal.

1. BOMBING ACCURACY:

BRITISH PHASE: The average circular error for all British bombs, (total 12) exclusive of the one manual release, was 10 mils. This is equal to an average unconverted circular error of 300 feet at 30,000 feet absolute altitude.

AMERICAN PHASE: The average circular error for all American bombs, (total 31) exclusive of one malfunction release, was 13.2 mils. This is equal to an average unconverted circular error of 224 feet at 17,000 absolute altitude.

A consolidation of the circular errors for all bombs dropped, (total 43), British and American, shows that the average circular error for both phases of the project was 12.3 mils. This is equal to an average unconverted circular error of 210 feet at 17,000 feet absolute altitude or 370 feet at 30,000 feet absolute altitude.

a. BOMBARDIER ----- SCHLAKRITZ

The average circular error of the total of 13 British and American bombs dropped was 13.2 mils.

(1) BRITISH BOMBS:

Average circular error for the total of 3 British bombs was 9.9 mils:

30,000 feet
No. of bombs - 2
Average circular error - 7.1 mils, 214 feet.

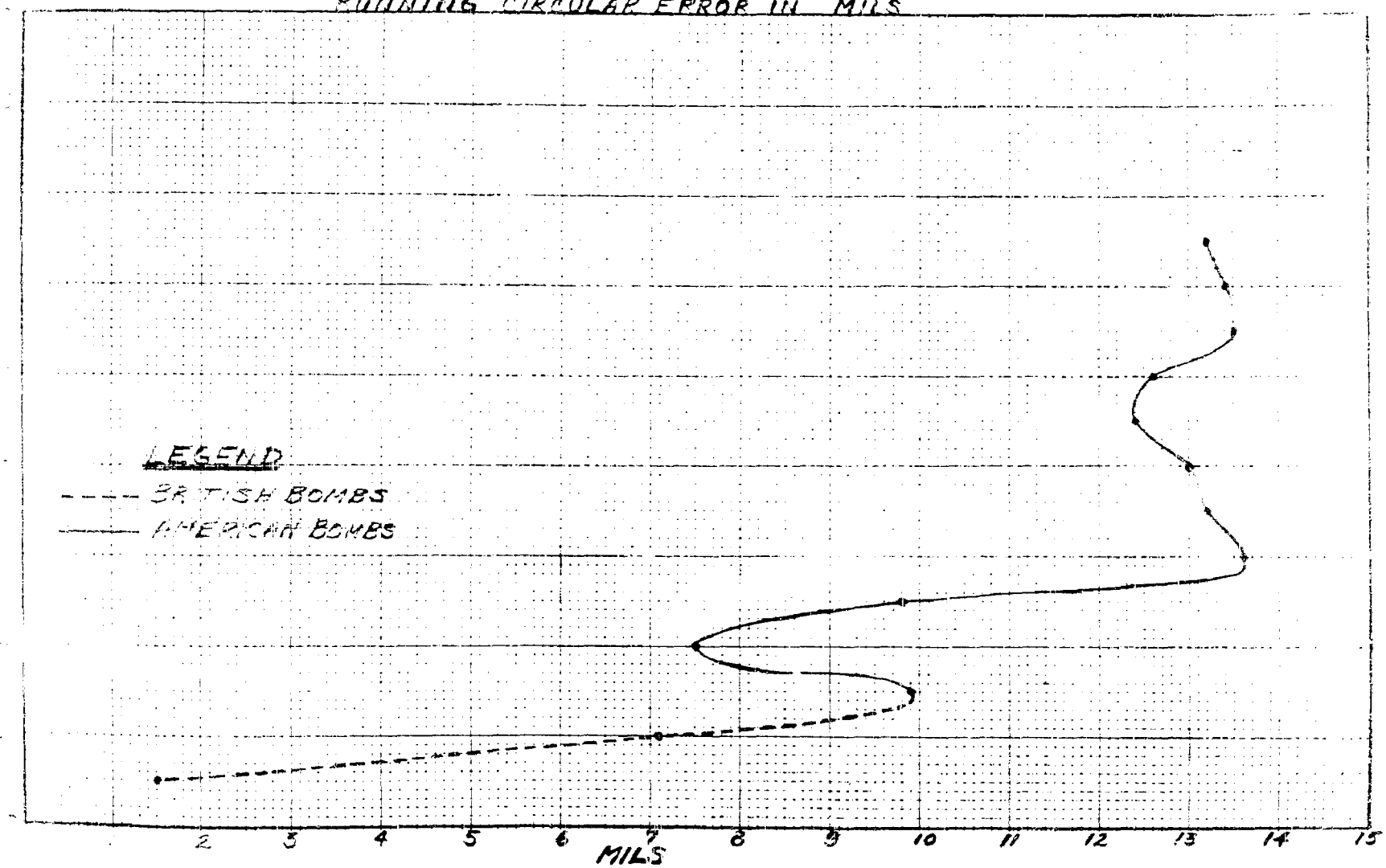
35,000 feet
No. of bombs - 1.
Average circular error - 15.4 mils, 540 feet.
NOTE: One additional bomb was manually released from this altitude.

(2) AMERICAN BOMBS:

The average circular error for the total of 10 American bombs was 14.1 mils:

BOMBARDIER – SCHLAEBITZ

RUNNING CIRCULAR ERROR IN MILS



17,000 FEET
No of bombs - 9 (6 Amazon II, 3 Samson).
Average circular error - 14.5 mils; 240 feet.

25,000 FEET
No of bombs - 1 (Samson)
Average circular error - 10.3 mils; 257 feet.

b. BOMBARDIER--- BLAIR

The average circular error for the total of 13 British and American bombs was 14.6 mils:

(1) BRITISH BOMBS:

The average circular error for the total of 4 British bombs was 13.4 mils:

30,000 FEET
No of bombs - 3
Average circular error - 10.2 mils; 306 feet.

35,000 FEET
No of bombs - 1
Average circular error - 22.9 mils; 802 feet.

(2) AMERICAN BOMBS:

The average circular error for the total of 9 American bombs was 15.2 mils:

17,000 FEET
No of bombs - 8 (6 Amazons II, 2 Samsons)
Average circular error- 15.7 mils; 267 feet.
NOTE: One additional bomb was a malfunction release at this altitude.

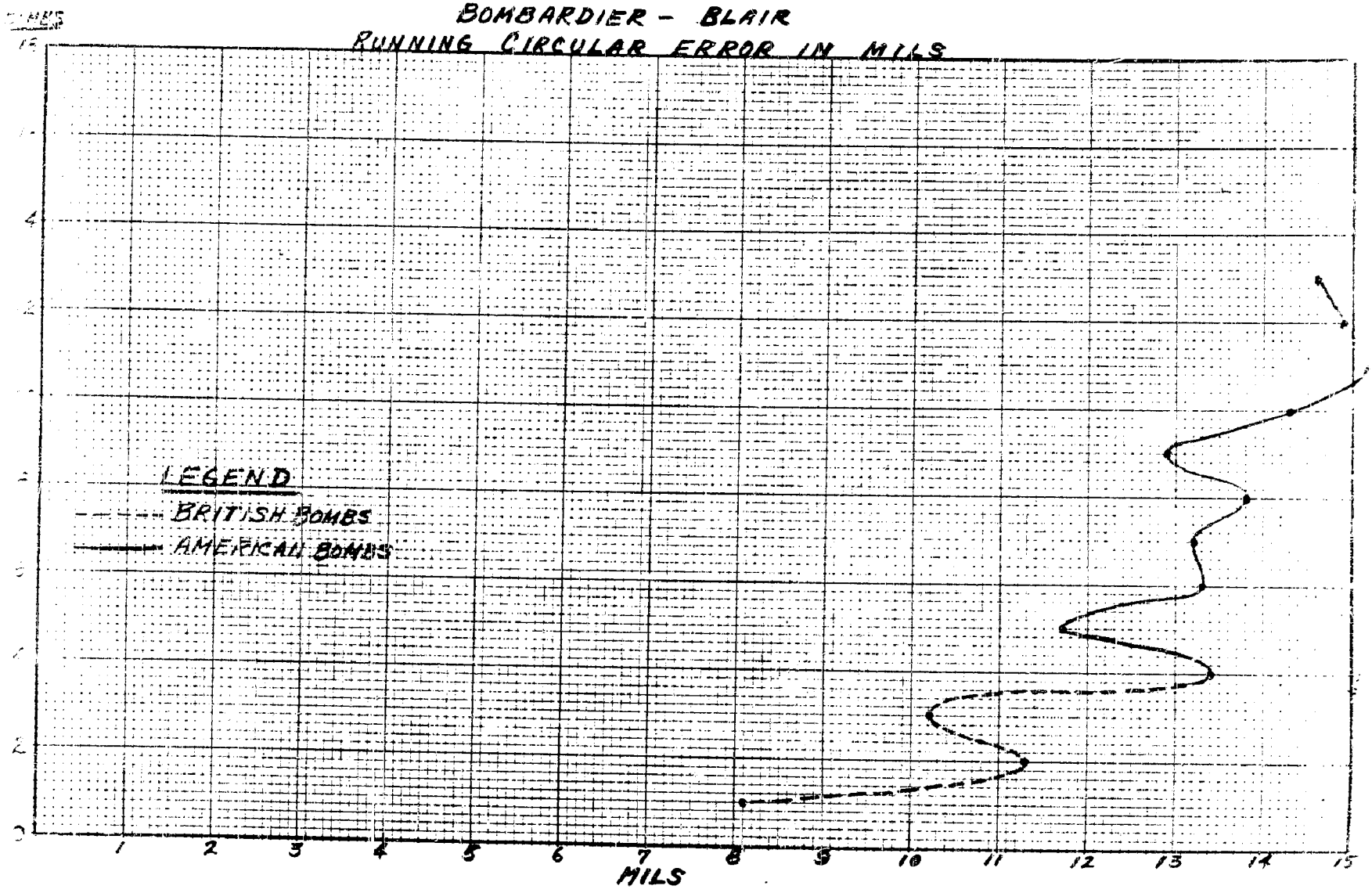
25,000 FEET
No of bombs - 1 (Samson)
Average circular error - 11.1 mils; 279 feet.

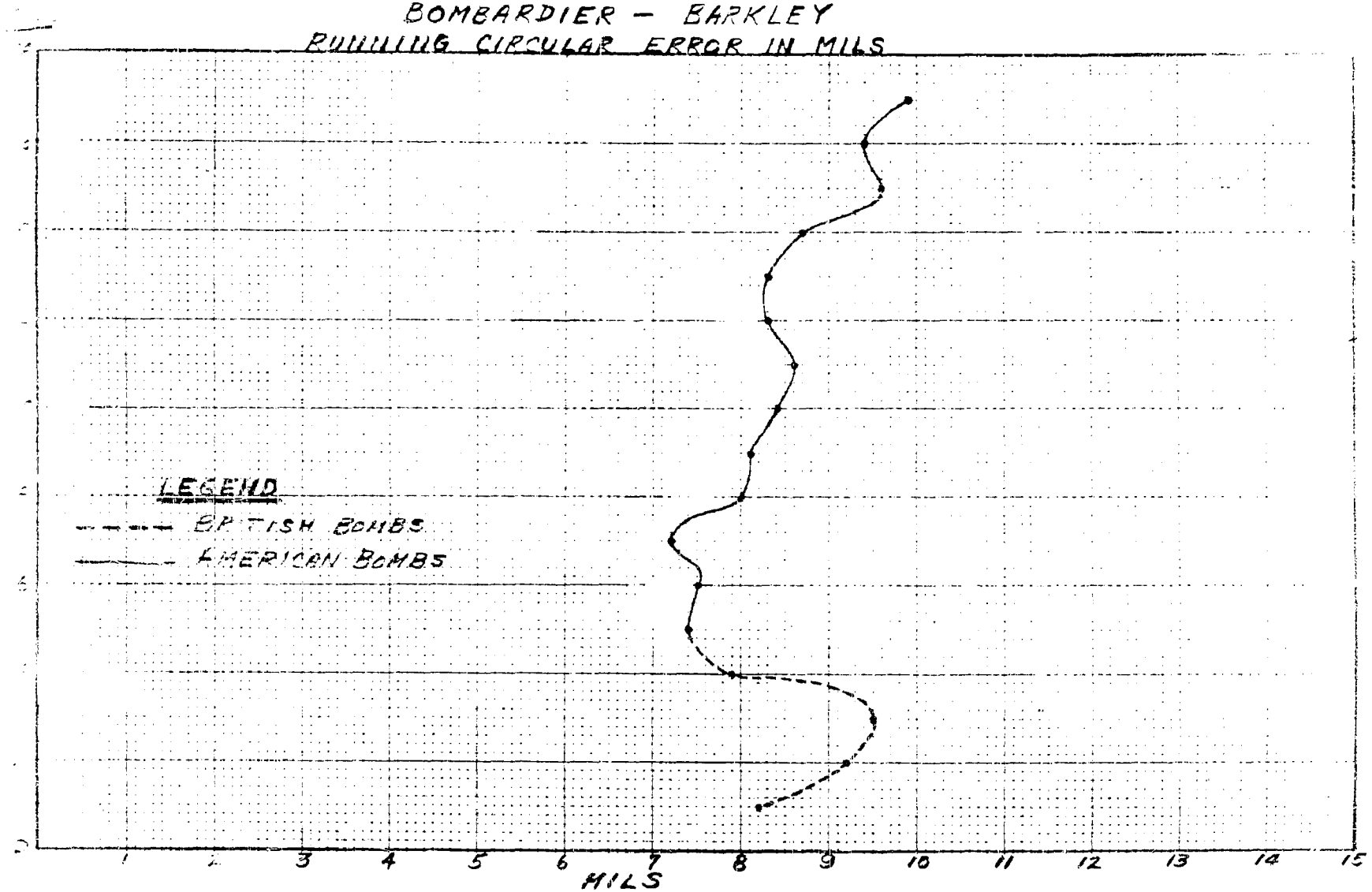
c. BOMBARDIER--- BARKLEY

The average circular error for the total of 17 British and American bombs dropped was 9.9 mils.

(1) BRITISH BOMBS:

The average circular error for the total of 5 British bombs was 7.4 mils:


BOMBARDIER - BLAIR
RUNNING CIRCULAR ERROR IN MILS
LEGEND
BRITISH BOMBS
AMERICAN BOMBS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
MILS


BOMBARDIER – BARKLEY
RUNNING CIRCULAR ERROR IN MILS
LEGEND
BRITISH BOMBS
AMERICAN BOMBS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
MILS

30,000 feet
No. of bombs - 3
Average circular error - 9.5 mils; 286 feet.

35,000 feet
No. of bombs - 2
Average circular error 4.2 mils; 146 feet.

(2) AMERICAN BOMBS:

The average circular error for the total of 12 American bombs was 12.9 mils:

17,000 feet
No. of bombs - 9 (5 Amazon II, 4 Samsons).
Average circular error - 9.4 mils; 160 feet.

25,000 feet
No. of bombs - 3 (Samsons)
Average circular error - 15.2 mils; 382 feet.

2. REASONS FOR ACCURACY:

It is believed that the primary reasons for the overall bombing accuracy obtained were as follows:

a. The high level of individual skill of all personnel and the intensive training of the bombing teams.

b. The fact that every possible precaution such as dry runs, upwind bombing, wind runs, and long bombing approaches, was taken to insure ultimate accuracy.

c. Installation of the C-1 Autopilot "Rate Gyro" modification.

d. The very good ballistic accuracy of the type bombs dropped.

e. The fact that differential ballistic winds have virtually no effect on bombs of this size and type.

3. BOMBING ANALYSIS:

a. Measured Range and Deflection Errors:

(1) BRITISH BOMBS, 30,000 FEET AND 35,000 FEET

Total Number of Bombs - 12.

Average Range Error	Average Deflection Error
161 Feet	240 Feet

It appears at first that the average deflection error for the British bombs was considerably greater than average range error. Actually, the reason that average deflection error exceeded average range error is traceable to two bombs, #A-19 & #A-8, both of which had excessively large deflection errors. In fact, the deflection error for the two bombs equalled a total of 1308 feet which was 45% of the total deflection error for all bombs dropped. It is believed that over a period of time, a large number of bombs released from the extreme altitudes will produce average range and deflection errors which will be substantially equal.

(2) AMERICAN BOMBS, 17,000 FEET

Total Number of Bombs - 26.

Average Range Error	Average Deflection Error
176 Feet	237 Feet

It is evident that from the intermediate altitudes, with the large type bombs, that average deflection error will exceed average range error. The average deflection error was considerably affected by three (3) bombs (Amazon #12, Samson #5 & #13) with excessively large deflection errors, two of which were dropped by the same bombardier. The deflection error for the three bombs totaled 1416 feet which was 31% of the total deflection error for all bombs dropped. However, if the 3 bombs referred to had been entirely deleted from the averages, the deflection error would still have been slightly larger than range error. It is believed that over a period of time, a large number of bombs released from the intermediate altitudes, i.e; 10,000-20,000 feet absolute altitude, will produce average deflection errors which will exceed average range errors by approximately 15%.

(3) AMERICAN BOMBS, 25,000 FEET

Total Number of Bombs - 5.

Average Range Error	Average Deflection Error
219 Feet	216 Feet

Although the number of bombs dropped was not of sufficient quantity for the results to be conclusive,

It will be noted that when the higher altitudes are approached, the average range and deflection errors approach equality (despite the fact that one bomb, Samson #7, was responsible for 47% of the total deflection error). It is believed that over a period of time, a large number of bombs released from the higher altitudes, i.e, above 20,000 feet absolute altitude, will produce average range and deflection errors which are substantially equal in magnitude.

(4) DISCUSSION:

(a) All three of the Harken Project Bombardiers finished the project with mean points of impact short of the aiming point.

NAME	NO OF BOMBS	MPI
LT BARKLEY	17 Bombs	28 feet short
LT BLAIR	13 Bombs	104 feet short
LT SCHLAEBITZ	13 Bombs	48 feet short

Bombsight malfunctions were definitely ruled out as the cause for the consistent range error short.

(b) It is the opinion of all Harken Project bombardiers that a distortion in the plate glass window of the B-29 bombardier's nose section is responsible for a general tendency among bombardiers to synchronize for a false groundspeed faster than the actual groundspeed flown, thus causing a consistent range error short. The distortion in the plate glass window becomes most apparent as the size of the sighting angle decreases, and becomes very apparent at sighting angles in the proximity of 30 degrees. The distortion takes effect in such a manner as to cause the rate synchronization to appear slow, (lateral crosshair moves away from the bombardier). In order to keep the bombsight synchronized, the bombardier adjusts the rate for the false apparent groundspeed, ultimately setting up a dropping angle which is consistently too large.

(c) Inasmuch as the amount of error caused by the distortion increases as the size of the dropping angle decreases, it is a variable, and can only be approximately corrected for by disc speed or trail adjustments. Two different methods of correcting for the distortion error were tried.

1 Lt Blair used the disc speed adjustment method whereby the disc speed was increased an amount sufficient to compensate for 75% of the average consistent range error short. This method was successful, but a number of bombs must be dropped before the correction can be computed and then it is applicable only to the individual for whom it is computed.

2 Lt Barkley used a personally developed technique whereby the bombardier makes no corrective adjustment in disc speed or trail. With this method, the bombardier synchronizes for range as usual until the false motion of the lateral crosshair is detected just before the bombsight indices meet. When the false motion is detected, no further rate corrections are made. This method requires some practice, but is the most adaptable method, and produces the best results.

3 Lt Schlaebitz used both the disc speed correction method, and the synchronization technique method. This officer is of the opinion that the synchronization technique method is the better of the two.

b. Breakdown of Analyzed Bombing Errors:

It was possible to accurately analyze 89% of the total of all bombs dropped. It must be realized that a perfect analysis of a given bomb impact is a rare condition. At least, the theoretical (analyzed) impact of a bomb very seldom agrees with the measured impact as to the magnitude of the range and deflection errors. The primary reason for this is attributed to the fact that all figures used for analysis were visual readings obtained by the bombardier. Although every possible precaution was taken to insure accurate instrument and bombsight readings, inaccuracies are bound to exist, especially in the case of bombsight bubble readings. Since it is extremely difficult for the bombardier to determine the exact amount of bubble error present, it is believed that the major amount of the indeterminate range and deflection errors may be attributed to improper assessment of the bubble errorsat the moment of release.

At best he can give only an approximation, and the natural tendency is to underestimate the magnitude of the bubble error. Listed below is a breakdown of the causes of average analyzed range and deflection errors for the two phases of the project, British and American. It should be understood that the errors listed below are analyzed errors, not actual errors, and that the sum total of all the causes will not equal the average measured range or deflection errors:

(1) BRITISH BOMBS, 30,000 FEET AND 35,000 FEET

RANGE ERRORS

Average Fore and Aft Bubble	Average Range Synchronization Error	Average Altitude and Trail Error	Average Indeterminate Error
49 Feet	59 Feet	17 Feet	78 Feet

DEFLECTION ERRORS

Average Lateral Bubble Error	Average Deflection Synchronization Error	Average Cross-trail Error	Average Indeterminate Error
49 Feet	101 Feet	4 Feet	88 Feet

(2) AMERICAN BOMBS, 17,000 FEET AND 25,000 FEET

RANGE ERRORS

Average Fore and Aft Bubble	Average Range Synchronization Error	Average Altitude and trail Error	Average Indeterminate Error
38 Feet	94 Feet	36 Feet	67 Feet

NOTE: 32 feet of the 36 foot average altitude and trail error was a purposely induced error in order to compensate for consistent range errors short.

DEFLECTION ERRORS

Average Lateral Bubble Error	Average Deflection Synchronization Error	Average Cross-trail Error	Average Indeterminate Error
87 Feet	74 Feet	2 Feet	54 Feet

4. FACTORS AFFECTING ACCURACY:

Bombing accuracy declined from an average circular error of 10 mils for the British phase, to an average of 12.3 mils to include the American phase.

a. It is the opinion of Harken Personnel that a major portion of the decline in accuracy is traceable to the lack of continuity in bombing during the entire American phase of the project. Major causes for delay were:

(1) The large type bombswere not shipped from the U. S. until after the project departed the ZI. Upon delivery from the manufacturer, they were shipped in lots of 2, 3, and 4 at a time. Consequently, the supply of large bombs did not catch up with the demand until a one month bombing delay was encountered and 60% of the large bombs had been dropped.

(2) The D-9 shackle locking hook broke, and the redesign and manufacture of new parts necessitated a bombing cessation for a 5 week period.

(3) Unsuitable bombing weather.

b. Marginal weather was in part responsible for the decline in accuracy. During the latter weeks of the project, crews often encountered very rapid deterioration of weather in the target vicinity, and were thus forced to hurry the release, or to bomb through a break in the overcast. In addition, haze and glare often made bombing conditions difficult during the late afternoon hours. A total of 4 bombs were dropped through breaks in the overcast, and one bomb was released under such extremely poor conditions of visibility that the bombardier could not see the aiming point until past the bomb release point.

5. CONCLUSIONS:

a. That under similar bombing conditions, the B-29 lead crew bombardier should maintain an average circular error of 15 mils or less when dropping either the Amazon or Samson type bomb.

b. That under similar bombing conditions, the B-29 lead crew bombardier should maintain an average circular error with the large bomb types which is approximately 3 mils or 19% lower than his average circular error attained using the standard M 38A2 100 pound practice bomb.

This figure is based on a comparison between the 16.2 mil circular error averaged by the 5 Harken Project bombardiers during the preliminary practice bombing phase, and the 15.2 mil average circular error obtained by the same bombardiers using the Amazon and Samson type bombs.

c. That comparatively more accurate average circular errors will be obtained by a bombardier with the large bomb types than with the standard demolition or practice type bombs.

d. That the "Rate Gyro" C-1 Autopilot modification is a materiel aid to increased bombing accuracy, especially at altitudes above 20,000 feet.

e. That with the stripped Albert B-29, carrying either the Amazon or Samson bomb, the maximum absolute altitude should not exceed 25,000 feet if precision bombing accuracy is to be achieved. In fact, one Harken Aircraft Number 45-21750, encountered such severe turbo power surging at 25,000 feet that bombing accuracy was considerably impaired due to the resulting difficulty in obtaining accurate bubble levels and synchronizations.

6. RECOMMENDATIONS:

a. That future production models of the large bomb types be equipped with an azimuth steering device similar to AZON. It is apparent that the cost per unit bomb would be increased, but the bombing objectives could be achieved with a considerably smaller expenditure of bombs, which would eventually prove the installation to be an economy measure.

b. That for increased bombing accuracy, the "Rate Gyro" be installed as a retroactive modification on all combat operational bombardment type aircraft.

c. That for maximum bombing accuracy, the absolute altitude for a particular B-29 type aircraft should not be within the altitude regions wherein turbo power surging is encountered. For some combat operational B-29's carrying either large type bomb, this altitude may be below 25,000 feet.

d. That a project be initiated to investigate the effects of the theorized optical distortion caused by the plate glass window in the bombardier's nose section; so that the theories advanced upon the subject may be proven or disproven.

e. That future projects of this nature avoid unnecessary delays in bombing continuity such as were encountered by Harlem. Delays could have been avoided by:

(1) Use of thoroughly tested and proven armament equipment.

(2) Shipment of all bombs prior to departure of project personnel from ZI so as to insure a constant bomb supply.

(3) Departure of project in early spring months to take advantage of favorable bombing weather.

f. That for future projects of this type, if a very accurate analysis of bombing accuracy is desired, a series of automatic motion picture cameras be mounted to record the exact information required for purposes of analysis.

(1) One camera with a prism should be mounted on the eyepiece of the bombsight so as to obtain a photograph of the target and the bombsight crosshairs for the last fifteen seconds of the bomb run to include the final synchronization at the point of release.

(2) Another camera should be so mounted as to obtain photographs of the bombsight bubbles for the last 30 seconds of the bombing run. This camera should be mounted and wired to take bubble photograph only when the bombardier is not making course corrections.

(3) A third camera should be located in position to take automatic motion pictures of the aircraft flight instruments for the last 30 seconds of the bombing run.

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