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ORDNANCE PAMPHLET NO. 770

O.C.L. ENTERED
CHANGE ENTERED

16-INCH RANGE TABLE

2,500 F.S. INITIAL VELOCITY
TO 42,345 YARDS



OCTOBER 1941

Classification (canceled) (class 1-15)

by authority of
10/1/68 *[Signature]*
(Date) (Signature) (Rank)
NAVAL ORDNANCE SYSTEMS COMMAND
Department of the Navy

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OP-770

TITLE
16-inch range table; 2,500 FS initial
velocity to 42,345 yards

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PREFACE

This Ordnance Pamphlet No. 770 was prepared from data furnished by the Bureau of Ordnance. No change was made in lithoprinting this pamphlet.

OCTOBER, 1941.

NAVY DEPARTMENT
BUREAU OF ORDNANCE
October, 1941.

W. H. P. BLANDY,
Chief of Bureau.

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BUREAU OF ORDNANCE
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OP 770

CHANGE 2

24 February 1945

W. H. King
Acting Chief of Bureau

1 Page — Page 1

ORDNANCE PAMPHLET 770
is changed as follows:

16-INCH RANGE TABLE
2500 F.S.I.V.
(16"/50 Cal. Gun)

1. Following page 51, insert the attached erosion data, N.P.G. Photos No. 24079 and 24083 (pages 51a and 51b).

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W. T. King
Acting Chief of Bureau

OP 770 CHANGE 1

11 April 1944

Page: _____ Page: 1

ORDNANCE PAMPHLET 770 16-INCH RANGE TABLE
is changed as follows: 2500 F.S. INITIAL VELOCITY

1. On page 3 add the following note:

The drift given in Column 6 is correct for Target projectiles only. To obtain the correct drift for A.P. projectiles, multiply the tabular drift by 1.07.

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NAVY DEPARTMENT

BUREAU OF ORDNANCE

WASHINGTON, D. C.

871-1(53)
(Re 44)

2 September 1943

BUREAU OF ORDNANCE CIRCULAR LETTER NO. F8-43

Subject: Range Ballistic Corrections due to curvature and rotation of the earth---method of handling

Reference: (a) O.P. No. 757 - 16" Range Table
(b) Exterior Ballistics, 1935 Edition by E. E. Herrmann
(c) Buord Circular ltr A-175, Ballistics - Effect of rotation of the earth on flight of projectiles

Enclosure: (A) Curvature of Earth Table
(Herewith)

1. It has come to the attention of the Bureau that there is some question as to the proper method of handling certain small corrections in the range ballistic. Although in most cases these corrections are undoubtedly being properly applied by the forces afloat, it is considered advisable to outline them briefly.

2. CURVATURE OF THE EARTH - U. S. Navy range tables are based on the assumption that the gun trunnions and target are in the horizontal plane tangent to the earth's surface at the gun. Thus, when using pointer fire or direct fire in elevation, the range table range should be used without any correction for curvature of the earth. However, when using the stable vertical type of director for indirect fire in elevation, a correction for curvature must be applied to the range table range since the guns are laid with respect to the horizontal, rather than with respect to the line of sight.

3. To determine range correction for curvature of the earth, enclosure (A) should be used in conjunction with column 19 of the range tables, as follows:

$$\text{Correction (Yds.)} = \frac{\text{curvature (ft. from enc. (A))} \times 100}{\text{Column 19}}$$

This correction represents the amount which the range of the projectile exceeds the range as shown in the range table. The correction is thus applicable as a "down" correction.

4. To illustrate a specific example assume a range of 19,800 yds. From enclosure (A) the curvature of the earth at this range is 85 ft.

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Using the table on pages 24 and 25 of reference (a), column 19, a correction of range can be computed to compensate for this 85 ft. correction in elevation. Thus $\frac{85}{95} \times 100 =$ approximately 89 yds. in range represent the amount which the actual range of the projectile exceeds the range as shown in the range table.

5. Actually the curvature of the earth varies as R^2 (where $R =$ range in yards) so that the correction in minutes varies as R ; and the elevation correction for earth's curvature (in minutes of arc) can be sufficiently well approximated as the range in yards divided by 4000. For example, at 19,800 yards, the curvature would be 4.95 minutes which by Column 2b of reference (a) gives a correction of 86 yards as compared with 89 yards for the more accurate calculation above.

6. PARALLAX CORRECTION FOR THE MEAN TRUNNION HEIGHT OF GUNS ABOVE THE WATERLINE - Neither the range table nor the fire control equipment include the correction for the mean trunnion height of the guns above the waterline, and since this height in some battleships is 32 ft., this height should be compensated for and added to the correction as calculated in paragraph 2.

7. To illustrate a specific example assume the same range of 19,800 yds. From pages 24 and 25 of reference (a), Column 19, any change in impact must be made from a horizontal reference plane which has the same height as the mean trunnion height of the guns above the waterline. Assume this height to be 32 ft. Thus if it is desired to have the point of impact at the waterline the following correction should be made:

$\frac{32}{95} \times 100 =$ Approximately 34 yards in range must be applied as a down correction.

8. Typical Values - In the following table (for a mean trunnion height of 32 ft.) the combined corrections for "earth curvature" and for "trunnion height" in automatic fire are shown for several guns at various ranges. And from this it is interesting to note, for range of 15,000 yds. and over, how the subject correction tends to remain approximately constant.

TABLE I

Range in yds.	16"/50 2700 lb. proj. I.V. = 2500 f.s.	16"/45 2700 lb. proj. I.V. = 2300 f.s.	8"/55 335 lb. proj. I.V. = 2500 f.s.	8"/55 260 lb. proj. I.V. = 2700 f.s.
5000	288 yds.	250 yds.	250 yds.	288 yds.
10000	178	149	134	145
15000	154	129	100	100
20000	147	122	81	79
25000	144	118	69	66
30000	140	111	54	53
35000	134	99		
40000	124			

9. In practice it would possibly be simpler to add trunnion height to earth curvature so as to permit the calculation of the combined corrections in a single operation.

10. EFFECT OF ROTATION OF THE EARTH - This subject has been previously covered by reference (c) and section included in late range tables gives the value of this correction.

W. H. P. BLANDY
Rear Admiral, U.S. Navy
Chief of Bureau

W. H. P. Blandy
acting

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ENCLOSURE (A)

CURVATURE OF EARTH, FEET

R.yds.	0	100	200	300	400	500	600	700	800	900
1000	.2	.3	.3	.4	.4	.5	.6	.6	.7	.8
2000	.9	.9	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8
3000	1.9	2.1	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.3
4000	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2
5000	5.4	5.6	5.8	6.1	6.3	6.5	6.8	7.0	7.2	7.5
6000	7.8	8.0	8.3	8.5	8.8	9.1	9.4	9.7	10.0	10.3
7000	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.8	13.1	13.4
8000	13.8	14.1	14.5	14.8	15.2	15.6	15.9	16.3	16.7	17.1
9000	17.4	17.8	18.2	18.6	19.0	19.4	19.9	20.3	20.7	21.1
10000	21.5	22	22	23	23	24	24	25	25	26
11000	26	27	27	28	28	29	29	30	30	31
12000	31	32	32	33	33	34	34	35	35	36
13000	36	37	38	38	39	39	40	41	41	42
14000	42	43	44	44	45	46	46	47	47	48
15000	48	49	50	51	51	52	53	53	54	55
16000	55	56	57	58	58	59	60	61	61	62
17000	62	63	64	65	66	66	67	68	69	69
18000	70	71	72	73	73	74	75	75	76	77
19000	78	79	80	81	81	82	83	84	85	85
20000	86	87	88	89	90	91	92	93	94	94
21000	95	96	97	98	99	100	101	102	103	103
22000	104	105	106	107	108	109	110	111	112	113
23000	114	115	116	117	118	119	120	121	122	123
24000	124	125	126	127	128	129	131	132	133	134
25000	135	136	137	138	139	141	142	143	144	145
26000	146	147	148	149	150	152	153	154	155	156
27000	157	159	160	161	162	163	164	165	167	168
28000	169	171	172	173	174	175	177	178	179	180
29000	181	183	184	185	186	188	189	190	192	193
30000	194	195	197	198	200	201	202	203	205	206
31000	207	209	210	211	213	214	215	217	218	219
32000	221	222	224	225	226	228	229	231	232	233
33000	235	236	238	239	240	242	243	245	246	247
34000	249	251	252	253	255	257	258	259	261	263
35000	264	265	267	269	270	272	273	275	276	277
36000	279	281	282	284	286	287	289	290	292	293
37000	295	297	298	300	302	303	305	307	308	309
38000	311	313	315	317	318	319	321	323	325	326
39000	328	329	331	333	335	336	338	340	342	343
40000	345									
R.yds	0	100	200	300	400	500	600	700	800	900

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Ordnance Pamphlet No. 770

16-INCH RANGE TABLE

2,500 F.S. INITIAL VELOCITY
TO 42,345 YARDS

WEIGHT OF PROJECTILE = 2700 POUNDS
LENGTH OF PROJECTILE = 4.5 CALIBERS
RADIUS OF OGIVE = 9.0 CALIBERS

*This publication is RESTRICTED and will be handled in accordance with
Article 76, United States Naval Regulations, 1920*



October 1941

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PREFACE

This Ordnance Pamphlet No. 770 was prepared from data furnished by the Bureau of Ordnance. No change was made in lithoprinting this pamphlet.

OCTOBER, 1941.

NAVY DEPARTMENT
BUREAU OF ORDNANCE
October, 1941.

W. H. P. BLANDY,
Chief of Bureau.

EXPLANATORY NOTES

1. Columns 1 to 8 give the elements of the standard trajectories. With the exception of column 6 these columns need no explanation. Column 6 gives the drift for guns rifled with a final twist of one turn in 25 calibers; to obtain the drift for guns rifled with a final twist of one turn in 32 calibers, multiply the figures in column 6 by 0.78.

2. Columns 10 to 19 give the differential effects due to variations from standard conditions. In these columns the effects are proportional to the variations. For example, the effect on range of a 10-knot wind is tabulated in column 13; to obtain the effect of a 20-knot wind, multiply the tabular values by 2.

3. Column 10, although computed for a velocity loss, may be used to determine the change in range due to either plus or minus variations in initial velocity. It is listed as a positive effect in order to avoid minus tabulations.

4. Column 11 gives the effect on the range for a change of $\pm$ ten pounds in weight of projectile, the charge remaining the same.

5. The standard air density at the surface of 1.2034 kg/m³, used in the computations for this range table, corresponds to a temperature of 59°F, a barometric pressure of 29.53 and a humidity of 78%. The standard density aloft is given on page 111, Bulletin of Ordnance Information, O.P. No. 561-I of May, 1923.

6. In entering column 12, which gives the mean effect on the range of $\pm$ 10 per cent variation in the density of the air, a ballistic density should be used. A ballistic density is a single fictitious air density, constant in magnitude, which would have the same total effect on the projectile during flight as the actual densities at the various altitudes. A method of making up a ballistic density is given in Bulletin of Ordnance Information, O.P. No. 561-I of May, 1923.

7. When ballistic density is not available and surface conditions only are known use Plate 1, which gives results corresponding to an AVERAGE ballistic density.

8. Column 12 also gives the mean effect on the range of $\pm$ 10 per cent variation in the ballistic coefficient.

9. Column 13 and 16 give the effects of a 10-knot ballistic wind, which is the combined weighted winds in the several

vertical zones of the trajectory. When, however, no measured or estimated upper air winds can be obtained, the surface true wind must necessarily be used in entering these columns. Methods of making up ballistic wind are given in Bulletin of Ordnance Information, O.P. No. 561-I of May, 1923, and in Method of Computing Range Tables, O.P. No. 500 of April, 1929.

10. Column 19 shows how much the point of impact is raised or lowered on a vertical screen by raising or lowering the sight bar 100 yards, the actual range remaining fixed.

11. The change in range due to a variation of ± 1 minute in the angle of elevation may be deduced from column 2b.

12. The effects of the rotation of the earth on range and deflection are given in two supplementary tables which follow the range table proper.

13. The powder is assumed to give normal velocity at 90°F. For each degree increase in temperature the initial velocity is increased approximately 2 f.s.; a decrease in temperature causes a corresponding decrease in velocity.

14. The firings upon which this range table is based are summarized below:

Target Projectiles Mark IX Mods.

Ranging Sheet	No.of Rounds	Elevation	I.V. F.S.	Fall of Shot (Actual)		
				Range Yds.	Mean Error Yds.	Pattern Yds.
16"/50 Cal. Gun Mark D, Rifling 1/25						
222	5	10°	2502	17402	±40	115
222	5	15°	2502	23642	±40	111
222	5	25°	- -	32971	±69	270
222	5	45°	- -	42643	±43	175
224	5	15°	2478	23182	±96	282
224	5	20°	2476	28110	±58	244
224	5	25°	2481	32544	±106	288
224	4	30°	2475	36539	±105	371
224	5	45°	2475	43188	±55	200
226	3	15°	2439	23023	±75	78

PLATE 1

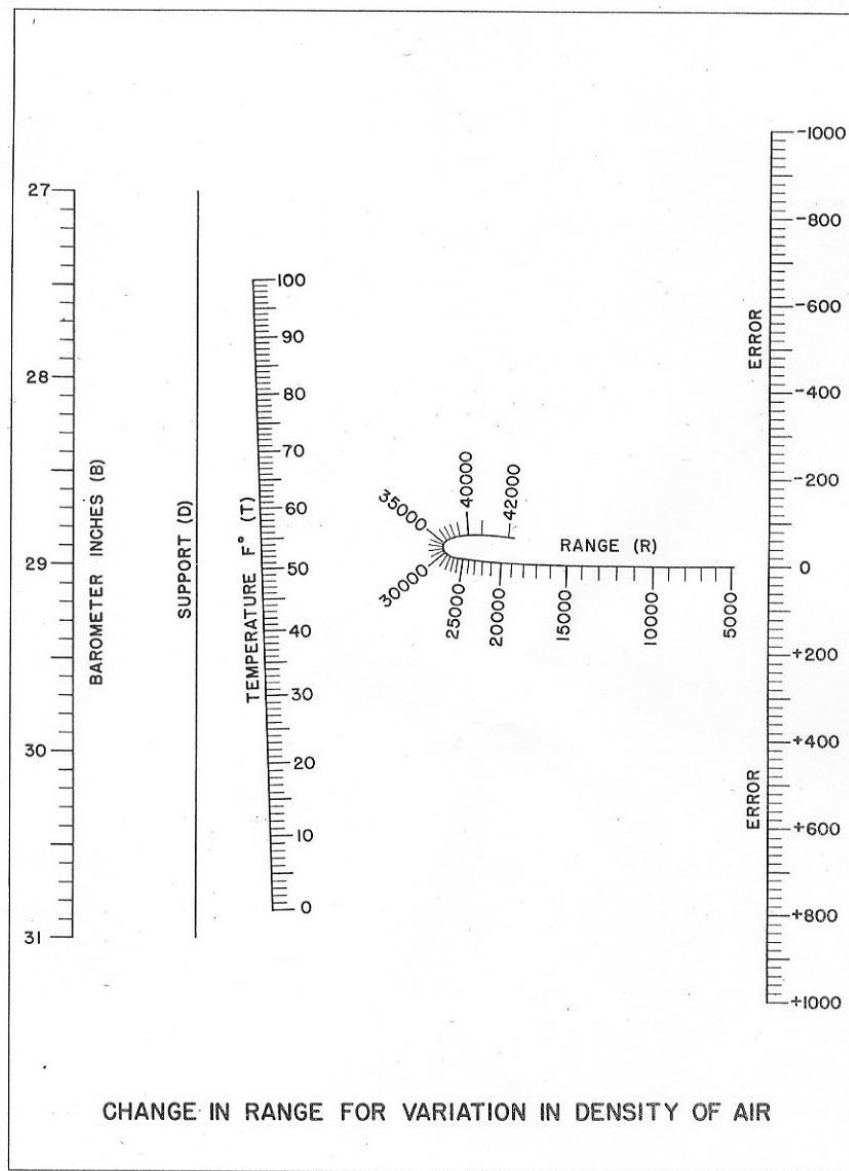
INSTRUCTIONS

Align B and T to get point on support D.
Align D with R to get error in yards due to change in density of air.

EXAMPLE:

Given--Barometer-	- - - - -	inches	= 28.4
Temperature-	- - - - -	degrees F	= 85
Range	- - - - -	yards	= 25000
Result--Error	- - - - -	yards	= +420

NOTE: The best estimate of ballistic density to different altitudes is in very close, but not in exact agreement with standard density when surface conditions are standard. When surface density is not standard, the disagreement is usually greater and is a function of surface density and maximum ordinate. In O.P. 561-I of May, 1923, pp. 98-114, corrections for density are discussed. The use of Plate 1 will not give agreement with results obtained from column 12 and surface observations only, but should be a more accurate figure, in that it takes into account the ratio between mean measured and standard density for the actual maximum ordinate obtained.



RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maximum ordinate
1	2	2a	2b	3	4	5	6	7	8
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
1000	26.9	26.9	2.7	27	1.21	2454	.2	1000	6
1100	29.6	29.6	2.7	30	1.33	2449	.2	1100	
1200	32.3	32.3	2.7	33	1.45	2445	.2	1200	
1300	35.0	35.0	2.7	36	1.58	2440	.3	1300	
1400	37.7	37.7	2.8	38	1.70	2436	.3	1400	
1500	40.5	40.5	2.8	41	1.82	2431	.4	1500	13
1600	43.3	43.3	2.8	44	1.95	2427	.4	1600	
1700	46.1	46.1	2.8	47	2.07	2423	.5	1700	
1800	48.9	48.9	2.8	49	2.20	2418	.6	1800	
1900	51.7	51.7	2.8	52	2.32	2414	.6	667	
2000	54.5	54.5	2.8	55	2.45	2409	.7	578	24
2100	57.3	57.3	2.8	58	2.57	2405	.8	522	
2200	1 00.1	60.1	2.8	1 01	2.70	2400	.8	479	
2300	1 02.9	62.9	2.8	1 04	2.82	2396	.9	444	
2400	1 05.7	65.7	2.8	1 07	2.95	2391	1.0	414	
2500	1 08.5	68.5	2.8	1 10	3.07	2387	1.1	388	38
2600	1 11.3	71.3	2.8	1 13	3.20	2383	1.2	365	
2700	1 14.1	74.1	2.8	1 16	3.33	2378	1.3	345	
2800	1 16.9	76.9	2.9	1 19	3.45	2374	1.4	327	
2900	1 19.8	79.8	2.9	1 22	3.58	2370	1.5	311	
3000	1 22.7	82.7	2.8	1 25	3.71	2365	1.6	297	55

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for varia- tion of + 10 feet per second initial velocity	Change of range for varia- tion of - 10 pounds in weight of pro- jectile	Change of range for varia- tion in density of air of - 10 per cent	Change of range for wind com- ponent in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Devia- tion for lateral wind com- ponent of 10 knots	Devia- tion for lateral motion of gun perpen- dicular to line of fire, speed of 10 knots	Devia- tion for lateral motion of target perpen- dicular to line of fire, speed of 10 knots	Change in height of impact for varia- tion of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
7	3	2	1	6	6.8	.1	6.7	6.8		2
8	3	2	1	7	7.5	.1	7.4	7.5		3
9	4	3	1	7	8.2	.1	8.1	8.2		3
10	4	3	1	8	8.9	.2	8.7	8.9		3
10	4	3	1	9	9.6	.2	9.4	9.6		3
11	4	4	1	9	10.3	.2	10.1	10.3		4
12	5	4	1	10	11.0	.2	10.8	11.0		4
13	5	4	1	10	11.7	.2	11.5	11.7		4
14	5	5	2	11	12.4	.3	12.1	12.4		4
14	6	5	2	11	13.1	.3	12.8	13.1		5
15	6	6	2	12	13.8	.3	13.5	13.8		5
16	6	6	2	13	14.5	.3	14.1	14.5		5
17	6	7	2	13	15.2	.4	14.8	15.2		5
17	7	7	2	14	15.9	.4	15.5	15.9		6
18	7	8	2	15	16.6	.4	16.1	16.6		6
19	7	8	2	15	17.3	.5	16.8	17.3		6
20	8	9	2	16	18.0	.5	17.5	18.0		6
20	8	10	2	16	18.7	.5	18.2	18.7		7
21	8	10	2	17	19.4	.6	18.9	19.4		7
22	8	11	2	18	20.2	.6	19.6	20.2		7
23	9	12	3	18	20.9	.6	20.3	20.9		7

8
RANGE TABLE FOR 16-INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maximum ordinate	
1	2	2a	2b	3	4	5	6	7	8	
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet	
3000	1 22.7	82.7	2.8	1 25	3.71	2365	2	297	55	
3100	1 25.5	85.5	2.9	1 29	3.84	2361	2	285		
3200	1 28.4	88.4	2.9	1 32	3.96	2357	2	274		
3300	1 31.3	91.3	2.9	1 35	4.09	2352	2	264		
3400	1 34.2	94.2	2.9	1 38	4.22	2348	2	255		
3500	1 37.1	97.1	2.9	1 41	4.35	2344	2	246	75	
3600	1 40.0	100.0	2.9	1 44	4.48	2340	2	238		
3700	1 42.9	102.9	2.9	1 48	4.60	2335	2	230		
3800	1 45.8	105.8	2.9	1 51	4.73	2331	3	223		
3900	1 48.7	108.7	2.9	1 54	4.86	2326	3	216		
4000	1 51.6	111.6	2.9	1 57	4.99	2322	3	209	99	
4100	1 54.5	114.5	2.9	2 00	5.12	2318	3	203		
4200	1 57.4	117.4	2.9	2 04	5.25	2313	3	197		
4300	2 00.3	120.3	3.0	2 07	5.38	2309	3	191		
4400	2 03.3	123.3	3.0	2 10	5.51	2305	4	186		
4500	2 06.3	126.3	3.0	2 13	5.64	2300	4	181	127	
4600	2 09.3	129.3	3.0	2 17	5.77	2296	4	176		
4700	2 12.3	132.3	3.0	2 20	5.90	2292	4	171		
4800	2 15.3	135.3	3.0	2 23	6.03	2287	4	167		
4900	2 18.3	138.3	3.0	2 27	6.16	2283	4	163		
5000	2 21.3	141.3	3.0	2 30	6.29	2279	5	159	158	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
	23	9	12	3	18	21	1	20	21	7
	23	9	13	3	19	22	1	21	22	8
	24	9	13	3	19	22	1	21	22	8
	25	9	14	3	20	23	1	22	23	8
	26	10	15	3	21	24	1	23	24	9
	26	10	16	3	21	24	1	24	24	9
	27	10	17	3	22	25	1	24	25	9
	28	10	17	3	23	26	1	25	26	9
	28	11	18	4	23	27	1	26	27	10
	29	11	19	4	24	27	1	26	27	10
	30	11	20	4	24	28	1	27	28	10
	31	12	21	4	25	29	1	28	29	10
	31	12	22	4	26	30	1	28	30	11
	32	12	23	4	26	30	1	29	30	11
	33	12	24	4	27	31	1	30	31	11
	34	13	25	4	27	32	1	30	32	12
	34	13	26	4	28	32	1	31	32	12
	35	13	27	4	29	33	1	32	33	12
	36	13	28	4	29	34	1	33	34	12
	36	14	29	4	30	35	2	33	35	13
	37	14	30	5	30	35	2	34	35	13

RANGE TABLE FOR 16-INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate	
1	2	2a	2b	3	4	5	6	7	8	
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>	
5000	2 21.3	141.3	3.0	2 30	6.29	2279	5	159	158	
5100	2 24.3	144.3	3.0	2 33	6.42	2275	5	155		
5200	2 27.3	147.3	3.0	2 37	6.55	2270	5	151		
5300	2 30.3	150.3	3.0	2 40	6.69	2266	5	148		
5400	2 33.3	153.3	3.1	2 44	6.82	2262	5	145		
5500	2 36.4	156.4	3.1	2 47	6.95	2258	6	141	193	
5600	2 39.5	159.5	3.1	2 51	7.08	2253	6	138		
5700	2 42.6	162.6	3.1	2 54	7.22	2249	6	135		
5800	2 45.7	165.7	3.1	2 58	7.35	2245	6	132		
5900	2 48.8	168.8	3.1	3 01	7.48	2241	7	129		
6000	2 51.9	171.9	3.1	3 05	7.62	2237	7	127	232	
6100	2 55.0	175.0	3.1	3 08	7.75	2232	7	124		
6200	2 58.1	178.1	3.1	3 12	7.89	2228	7	122		
6300	3 01.2	181.2	3.1	3 16	8.02	2224	7	119		
6400	3 04.3	184.3	3.1	3 19	8.16	2220	8	117		
6500	3 07.4	187.4	3.1	3 23	8.30	2216	8	115	275	
6600	3 10.5	190.5	3.2	3 27	8.43	2211	8	113		
6700	3 13.7	193.7	3.2	3 30	8.57	2207	9	111		
6800	3 16.9	196.9	3.2	3 34	8.71	2203	9	109		
6900	3 20.1	200.1	3.2	3 38	8.85	2199	9	107		
7000	3 23.3	203.3	3.2	3 42	8.98	2195	9	105	322	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
	37	14	30	5	30	35	2	34	35	13
	38	14	31	5	31	36	2	35	36	13
	39	14	32	5	32	37	2	35	37	13
	39	15	33	5	32	38	2	36	38	14
	40	15	34	5	33	38	2	37	38	14
	41	15	36	5	34	39	2	37	39	14
	42	15	37	6	34	40	2	38	40	15
	42	15	38	6	35	41	2	39	41	15
	43	16	39	6	36	42	2	40	42	15
	44	16	41	6	36	42	2	40	42	16
	44	16	42	6	37	43	2	41	43	16
	45	16	43	6	37	44	2	42	44	16
	46	17	45	6	38	45	2	42	45	17
	46	17	46	6	39	46	3	43	46	17
	47	17	47	7	39	46	3	44	46	17
	48	17	49	7	40	47	3	44	47	18
	49	18	50	7	40	48	3	45	48	18
	49	18	51	7	41	49	3	46	49	18
	50	18	53	7	42	49	3	46	49	19
	51	18	54	8	42	50	3	47	50	19
	51	18	56	8	43	51	3	48	51	19

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate	
1	2	2a	2b	3	4	5	6	7	8	
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>	
7000	3 23.3	203.3	3.2	3 42	8.98	2195	9	105	322	
7100	3 26.5	206.5	3.2	3 45	9.12	2191	10	103		
7200	3 29.7	209.7	3.2	3 49	9.26	2187	10	101		
7300	3 32.9	212.9	3.2	3 53	9.40	2182	10	99		
7400	3 36.1	216.1	3.2	3 57	9.54	2178	11	98		
7500	3 39.3	219.3	3.2	4 01	9.67	2174	11	96	374	
7600	3 42.5	222.5	3.2	4 04	9.81	2170	11	94		
7700	3 45.7	225.7	3.3	4 08	9.95	2166	12	93		
7800	3 49.0	229.0	3.3	4 12	10.09	2162	12	91		
7900	3 52.3	232.3	3.3	4 16	10.23	2158	12	90		
8000	3 55.6	235.6	3.3	4 20	10.37	2154	12	89	430	
8100	3 58.9	238.9	3.3	4 24	10.51	2150	13	87		
8200	4 02.2	242.2	3.3	4 28	10.65	2146	13	86		
8300	4 05.5	245.5	3.3	4 32	10.79	2142	14	85		
8400	4 08.8	248.8	3.3	4 36	10.93	2138	14	84		
8500	4 12.1	252.1	3.3	4 40	11.07	2134	14	82	491	
8600	4 15.4	255.4	3.3	4 44	11.21	2130	15	81		
8700	4 18.7	258.7	3.3	4 48	11.36	2126	15	80		
8800	4 22.0	262.0	3.4	4 52	11.50	2122	15	79		
8900	4 25.4	265.4	3.4	4 56	11.64	2118	16	78		
9000	4 28.8	268.8	3.4	5 00	11.79	2114	16	77	557	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
	51	18	56	8	43	51	3	48	51	19
	52	19	57	8	44	52	3	49	52	20
	53	19	59	8	44	53	3	49	53	20
	54	19	61	8	45	53	3	50	53	20
	54	19	62	8	45	54	4	50	54	21
	55	19	64	9	46	55	4	51	55	21
	56	20	66	9	47	56	4	52	56	21
	56	20	68	9	47	57	4	53	57	22
	57	20	69	9	48	57	4	53	57	22
	58	20	71	9	48	58	4	54	58	22
	58	20	73	10	49	59	4	55	59	23
	59	21	75	10	50	60	4	55	60	23
	60	21	77	10	50	61	4	56	61	23
	61	21	78	10	51	61	5	56	61	24
	61	21	80	10	51	62	5	57	62	24
	62	21	82	11	52	63	5	58	63	24
	63	22	84	11	53	64	5	59	64	25
	63	22	86	11	53	65	5	59	65	25
	64	22	88	11	54	65	5	60	65	25
	65	22	90	11	54	66	5	61	66	26
	65	22	92	12	55	67	5	62	67	26

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate	
1	2	2a	2b	3	4	5	6	7	8	
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>	
9000	4 28.8	268.8	3.4	5 00	11.79	2114	16	77	557	
9100	4 32.2	272.2	3.4	5 04	11.93	2110	17	76		
9200	4 35.6	275.6	3.4	5 09	12.08	2106	17	75		
9300	4 39.0	279.0	3.4	5 13	12.22	2102	17	74		
9400	4 42.4	282.4	3.4	5 17	12.37	2098	18	73		
9500	4 45.8	285.8	3.4	5 21	12.51	2094	18	72	628	
9600	4 49.2	289.2	3.4	5 25	12.66	2090	19	71		
9700	4 52.6	292.6	3.4	5 29	12.80	2086	19	70		
9800	4 56.0	296.0	3.4	5 34	12.95	2082	19	69		
9900	4 59.4	299.4	3.5	5 38	13.09	2078	20	68		
10000	5 02.9	302.9	3.5	5 42	13.24	2074	20	67	703	
10100	5 06.4	306.4	3.5	5 47	13.39	2070	21	66		
10200	5 09.9	309.9	3.5	5 51	13.53	2066	21	65		
10300	5 13.4	313.4	3.5	5 56	13.68	2063	22	64		
10400	5 16.9	316.9	3.5	6 00	13.83	2059	22	64		
10500	5 20.4	320.4	3.5	6 05	13.98	2055	23	63	783	
10600	5 23.9	323.9	3.5	6 09	14.12	2051	23	62		
10700	5 27.4	327.4	3.5	6 14	14.27	2047	24	61		
10800	5 30.9	330.9	3.5	6 18	14.42	2043	24	61		
10900	5 34.4	334.4	3.6	6 23	14.57	2039	25	60		
11000	5 38.0	338.0	3.6	6 27	14.72	2035	25	59	869	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
10	11	12	13	14	15	16	17	18	19
<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
65	22	92	12	55	67	5	62	67	26
66	23	94	12	56	68	5	62	68	26
67	23	96	12	56	68	6	63	68	27
67	23	98	12	57	69	6	63	69	27
68	23	100	13	57	70	6	64	70	27
69	23	102	13	58	71	6	65	71	28
69	24	104	13	59	72	6	65	72	28
70	24	106	13	59	73	6	66	73	29
71	24	109	13	60	73	6	67	73	29
71	24	111	14	60	74	7	67	74	29
72	24	113	14	61	75	7	68	75	30
72	24	115	14	62	76	7	69	76	30
73	25	117	14	62	77	7	69	77	31
74	25	120	15	63	77	7	70	77	31
74	25	122	15	63	78	7	71	78	31
75	25	124	15	64	79	8	71	79	32
76	25	127	15	64	80	8	72	80	32
76	25	129	16	65	81	8	73	81	33
77	26	131	16	66	82	8	74	82	33
78	26	134	16	66	82	8	74	82	33
78	26	136	16	67	83	8	75	83	34

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards' increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate	
1	2	2a	2b	3	4	5	6	7	8	
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet	
11000	5 38.0	338.0	3.6	6 27	14.72	2035	25	59	869	
11100	5 41.6	341.6	3.6	6 32	14.87	2032	26	59		
11200	5 45.2	345.2	3.6	6 37	15.02	2028	26	58		
11300	5 48.8	348.8	3.6	6 41	15.17	2024	27	57		
11400	5 52.4	352.4	3.6	6 46	15.32	2020	27	57		
11500	5 56.0	356.0	3.6	6 51	15.47	2016	28	56	960	
11600	5 59.6	359.6	3.6	6 55	15.62	2012	28	55		
11700	6 03.2	363.2	3.6	7 00	15.77	2009	29	55		
11800	6 06.8	366.8	3.6	7 05	15.93	2005	29	54		
11900	6 10.4	370.4	3.7	7 10	16.08	2001	30	53		
12000	6 14.1	374.1	3.7	7 14	16.23	1997	31	53	1057	
12100	6 17.8	377.8	3.7	7 19	16.39	1994	31	52		
12200	6 21.5	381.5	3.7	7 24	16.54	1990	32	52		
12300	6 25.2	385.2	3.7	7 29	16.70	1986	33	51		
12400	6 28.9	388.9	3.7	7 34	16.85	1983	33	51		
12500	6 32.6	392.6	3.7	7 39	17.01	1979	34	50	1160	
12600	6 36.3	396.3	3.7	7 43	17.16	1975	34	50		
12700	6 40.0	400.0	3.7	7 48	17.32	1972	35	49		
12800	6 43.7	403.7	3.8	7 53	17.47	1968	36	49		
12900	6 47.5	407.5	3.8	7 58	17.63	1964	36	48		
13000	6 51.3	411.3	3.8	8 03	17.78	1961	37	48	1269	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
	78	26	136	16	67	83	8	75	83	34
	79	26	139	17	67	84	8	75	84	34
	79	26	141	17	68	85	9	76	85	35
	80	26	144	17	68	86	9	77	86	35
	81	27	146	17	69	86	9	78	86	35
	81	27	149	18	70	87	9	78	87	36
	82	27	151	18	70	88	9	79	88	36
	82	27	154	18	71	89	9	80	89	37
	83	27	157	19	71	90	10	80	90	37
	84	27	159	19	72	91	10	81	91	37
	84	27	162	19	72	91	10	81	91	38
	85	28	165	19	73	92	10	82	92	38
	86	28	168	20	74	93	10	83	93	39
	86	28	170	20	74	94	10	84	94	39
	87	28	173	20	75	95	11	84	95	39
	87	28	176	21	75	96	11	85	96	40
	88	28	179	21	76	97	11	86	97	40
	89	29	182	21	77	97	11	86	97	41
	89	29	184	22	77	98	11	87	98	41
	90	29	187	22	78	99	11	88	99	41
	90	29	190	22	78	100	12	88	100	42

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi-mum ordi-nate	
1	2	2a	2b	3	4	5	6	7	8	
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>	
13000	6 51.3	411.3	3.8	8 03	17.78	1961	37	48	1270	
13100	6 55.1	415.1	3.8	8 08	17.94	1957	37	47		
13200	6 58.9	418.9	3.8	8 13	18.10	1954	38	47		
13300	7 02.7	422.7	3.8	8 18	18.25	1950	39	46		
13400	7 06.5	426.5	3.8	8 24	18.41	1947	40	46		
13500	7 10.3	430.3	3.8	8 29	18.57	1943	40	45	1385	
13600	7 14.1	434.1	3.9	8 34	18.73	1940	41	45		
13700	7 18.0	438.0	3.9	8 39	18.88	1936	42	44		
13800	7 21.9	441.9	3.9	8 44	19.04	1933	43	44		
13900	7 25.8	445.8	3.9	8 49	19.20	1929	43	43		
14000	7 29.7	449.7	3.9	8 54	19.36	1926	44	43	1505	
14100	7 33.6	453.6	3.9	9 00	19.52	1922	44	42		
14200	7 37.5	457.5	3.9	9 05	19.68	1919	45	42		
14300	7 41.4	461.4	3.9	9 10	19.84	1915	46	41		
14400	7 45.3	465.3	4.0	9 15	20.00	1912	47	41		
14500	7 49.3	469.3	4.0	9 20	20.16	1909	47	40	1635	
14600	7 53.3	473.3	4.0	9 26	20.33	1905	48	40		
14700	7 57.3	477.3	4.0	9 31	20.49	1902	49	40		
14800	8 01.3	481.3	4.0	9 36	20.65	1899	50	39		
14900	8 05.3	485.3	4.0	9 41	20.81	1895	51	39		
15000	8 09.3	489.3	4.0	9 47	20.98	1892	52	39	1770	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of pro- jectile	Change of range for variation in density of air of -10 per cent	Change of range for wind com- ponent in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Devia- tion for lateral wind com- ponent of 10 knots	Devia- tion for lateral motion of gun perpen- dicular to line of fire, speed of 10 knots	Devia- tion for lateral motion of target perpen- dicular to line of fire, speed of 10 knots	Change in height of impact for varia- tion of 100 yards in sight bar
10	11	12	13	14	15	16	17	18	19
<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
90	29	190	22	78	100	12	88	100	42
91	29	193	22	79	101	12	89	101	42
92	29	196	23	79	102	12	90	102	43
92	29	199	23	80	103	12	90	103	43
93	29	202	23	81	104	12	91	104	44
93	30	205	24	81	105	13	92	105	44
94	30	208	24	82	105	13	92	105	45
95	30	211	24	82	106	13	93	106	45
95	30	214	24	83	107	13	94	107	46
96	30	217	25	83	108	13	94	108	46
96	30	220	25	84	109	14	95	109	47
97	30	223	26	85	110	14	96	110	47
98	31	226	26	85	111	14	97	111	48
98	31	230	26	86	112	14	97	112	48
99	31	233	27	86	112	14	98	112	49
99	31	236	27	87	113	15	99	113	49
100	31	239	27	87	114	15	99	114	50
101	31	243	28	88	115	15	100	115	50
101	31	246	28	89	116	15	101	116	51
102	31	249	28	89	117	15	101	117	51
102	31	253	29	90	118	16	102	118	52

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate
1	2	2a	2b	3	4	5	6	7	8
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet
15000	8 09.3	489.3	4.0	9 47	20.98	1892	52	39	1770
15100	8 13.3	493.3	4.0	9 52	21.14	1889	52	38	
15200	8 17.3	497.3	4.1	9 58	21.30	1885	53	38	
15300	8 21.4	501.4	4.1	10 03	21.47	1882	53	38	
15400	8 25.5	505.5	4.1	10 09	21.63	1879	54	37	
15500	8 29.6	509.6	4.1	10 15	21.80	1876	55	37	1910
15600	8 33.7	513.7	4.1	10 20	21.96	1872	56	37	
15700	8 37.8	517.8	4.1	10 26	22.13	1869	57	36	
15800	8 41.9	521.9	4.1	10 32	22.29	1866	58	36	
15900	8 46.0	526.0	4.1	10 37	22.46	1863	59	36	
16000	8 50.1	530.1	4.1	10 43	22.63	1859	60	35	2060
16100	8 54.2	534.2	4.2	10 49	22.79	1856	61	35	
16200	8 58.4	538.4	4.2	10 55	22.96	1853	62	35	
16300	9 02.6	542.6	4.2	11 01	23.13	1850	63	34	
16400	9 06.8	546.8	4.2	11 07	23.30	1846	64	34	
16500	9 11.0	551.0	4.2	11 12	23.46	1843	64	34	2215
16600	9 15.2	555.2	4.2	11 18	23.63	1840	65	33	
16700	9 19.4	559.4	4.2	11 24	23.80	1837	66	33	
16800	9 23.6	563.6	4.3	11 30	23.97	1834	67	33	
16900	9 27.9	567.9	4.3	11 36	24.14	1830	68	32	
17000	9 32.2	572.2	4.3	11 42	24.31	1827	69	32	2375

RANGE TABLE FOR 16-INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Deviation for lateral wind component of 10 knots	Deviation for lateral motion of gun perpendicular to line of fire, speed of 10 knots	Deviation for lateral motion of target perpendicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
10	11	12	13	14	15	16	17	18	19
Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
102	31	253	29	90	118	16	102	118	52
103	32	256	29	90	119	16	103	119	52
104	32	259	29	91	120	16	104	120	53
104	32	263	30	92	121	16	104	121	53
105	32	266	30	92	122	17	105	122	54
105	32	270	31	93	123	17	106	123	54
106	32	273	31	93	124	17	106	124	55
107	32	277	31	94	125	17	107	125	55
107	32	281	32	94	125	18	108	125	56
108	33	284	32	95	126	18	108	126	56
108	33	288	32	95	127	18	109	127	57
109	33	292	33	96	128	18	110	128	57
110	33	295	33	97	129	18	111	129	58
110	33	299	33	97	130	19	111	130	58
111	33	303	34	98	131	19	112	131	59
111	33	307	34	98	132	19	113	132	59
112	33	310	34	99	133	19	113	133	60
113	33	314	35	99	134	20	114	134	60
113	33	318	35	100	135	20	115	135	61
114	34	322	36	100	136	20	116	136	61
114	34	325	36	101	137	20	117	137	62

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF
PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

Range	Angle of elevation		Increase in angle of elevation for 100 yards increase in range	Angle of fall	Time of flight	Striking velocity	Drift	Danger space for a target 20 feet high	Maxi- mum ordi- nate	
1	2	2a	2b	3	4	5	6	7	8	
<i>Yards</i>	<i>° ' "</i>	<i>Minutes</i>	<i>Minutes</i>	<i>° ' "</i>	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>	
17000	9 32.2	572.2	4.3	11 42	24.31	1827	69	32	2380	
17100	9 36.5	576.5	4.3	11 48	24.48	1824	70	32		
17200	9 40.8	580.8	4.3	11 54	24.65	1821	71	32		
17300	9 45.1	585.1	4.3	12 00	24.82	1818	72	31		
17400	9 49.4	589.4	4.3	12 07	24.99	1815	73	31		
17500	9 53.7	593.7	4.3	12 13	25.16	1812	74	31	2550	
17600	9 58.0	598.0	4.4	12 19	25.33	1808	75	31		
17700	10 02.4	602.4	4.4	12 25	25.51	1805	76	30		
17800	10 06.8	606.8	4.4	12 32	25.68	1802	77	30		
17900	10 11.2	611.2	4.4	12 38	25.85	1799	78	30		
18000	10 15.6	615.6	4.4	12 44	26.03	1796	79	29	2730	
18100	10 20.0	620.0	4.4	12 50	26.20	1793	80	29		
18200	10 24.4	624.4	4.5	12 57	26.38	1790	81	29		
18300	10 28.9	628.9	4.5	13 03	26.55	1787	82	29		
18400	10 33.4	633.4	4.5	13 09	26.73	1784	83	28		
18500	10 37.9	637.9	4.5	13 16	26.90	1781	84	28	2920	
18600	10 42.4	642.4	4.5	13 22	27.08	1779	86	28		
18700	10 46.9	646.9	4.5	13 29	27.26	1776	87	28		
18800	10 51.4	651.4	4.5	13 35	27.43	1773	88	28		
18900	10 55.9	655.9	4.5	13 42	27.61	1770	89	27		
19000	11 00.4	660.4	4.6	13 48	27.79	1767	90	27	3120	

RANGE TABLE FOR 16 -INCH GUN

INITIAL VELOCITY = 2500 F. S. WEIGHT OF PROJECTILE = 2700 POUNDS. LENGTH OF PROJECTILE = 4.5 CALIBERS. RADIUS OF OGIVE = 9 CALIBERS

	Change of range for variation of +10 feet per second initial velocity	Change of range for variation of -10 pounds in weight of projectile	Change of range for variation in density of air of -10 per cent	Change of range for wind component in plane of fire of 10 knots	Change of range for motion of gun in plane of fire of 10 knots	Change of range for motion of target in plane of fire of 10 knots	Devia- tion for lateral wind component of 10 knots	Devia- tion for lateral motion of gun perpen- dicular to line of fire, speed of 10 knots	Devia- tion for lateral motion of target perpen- dicular to line of fire, speed of 10 knots	Change in height of impact for variation of 100 yards in sight bar
	10	11	12	13	14	15	16	17	18	19
	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
	114	34	325	36	101	137	20	117	137	62
	115	34	329	36	102	138	21	117	138	62
	116	34	333	37	102	139	21	118	139	63
	116	34	337	37	103	140	21	119	140	63
	117	34	340	38	103	141	21	119	141	64
	117	34	344	38	104	142	22	120	142	65
	118	34	348	39	104	143	22	121	143	65
	119	34	352	39	105	144	22	121	144	66
	119	34	356	39	106	145	22	122	145	66
	120	35	359	40	106	146	23	123	146	67
	120	35	363	40	107	147	23	124	147	68
	121	35	367	41	107	148	23	124	148	68
	122	35	371	41	108	149	23	125	149	69
	122	35	375	41	109	150	24	126	150	69
	123	35	379	42	109	151	24	126	151	70
	123	35	383	42	110	152	24	127	152	71
	124	35	387	43	110	153	25	128	153	71
	125	35	391	43	111	154	25	129	154	72
	125	35	395	44	111	155	25	129	155	72
	126	35	399	44	112	156	25	130	156	73
	126	36	403	44	112	157	26	131	157	74

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