

UNCLASSIFIED

RESTRICTED

Ordnance Pamphlet No. 770

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# 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

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Article 76, United States Naval Regulations, 1920*



Classification (canceled) (changed to \_\_\_\_\_)  
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(Date) (Signature) (Rank)  
NAVAL ORDNANCE SYSTEMS COMMAND  
Department of the Navy

October 1941

UNCLASSIFIED

## P R E F A C E

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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/m<sup>3</sup>, 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  $\pm 1$  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	23028	±75	78

## PLATE 1

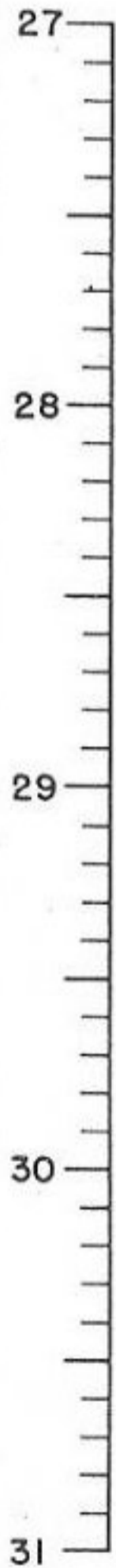
## INSTRUCTIONS

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.

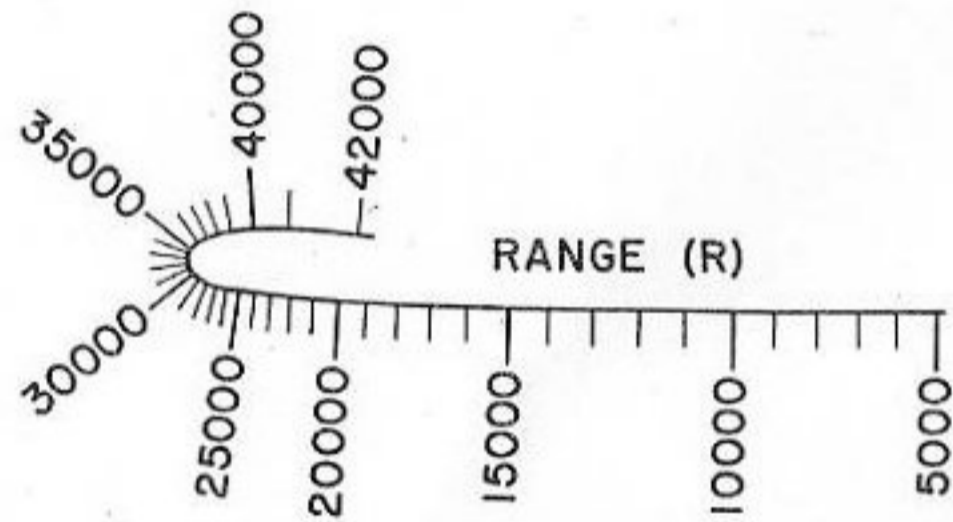
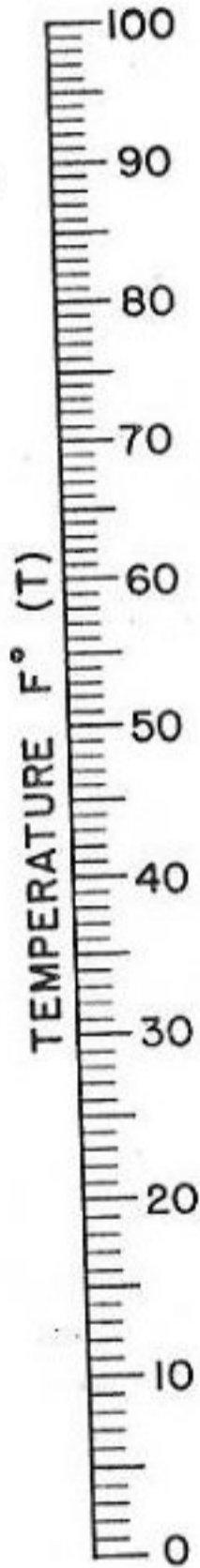
## EXAMPLE:

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.



SUPPORT (D)



CHANGE IN RANGE FOR VARIATION IN DENSITY OF AIR

## 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
<i>Yards</i>	°	'	<i>Minutes</i>	<i>Minutes</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 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
7	7	3	2	1	6	6.8	.1	6.7	6.8	2
8	8	3	2	1	7	7.5	.1	7.4	7.5	3
9	9	4	3	1	7	8.2	.1	8.1	8.2	3
10	10	4	3	1	8	8.9	.2	8.7	8.9	3
10	10	4	3	1	9	9.6	.2	9.4	9.6	3
11	11	4	4	1	9	10.3	.2	10.1	10.3	4
12	12	5	4	1	10	11.0	.2	10.8	11.0	4
13	13	5	4	1	10	11.7	.2	11.5	11.7	4
14	14	5	5	2	11	12.4	.3	12.1	12.4	4
14	14	6	5	2	11	13.1	.3	12.8	13.1	5
15	15	6	6	2	12	13.8	.3	13.5	13.8	5
16	16	6	6	2	13	14.5	.3	14.1	14.5	5
17	17	6	7	2	13	15.2	.4	14.8	15.2	5
17	17	7	7	2	14	15.9	.4	15.5	15.9	6
18	18	7	8	2	15	16.6	.4	16.1	16.6	6
19	19	7	8	2	15	17.3	.5	16.8	17.3	6
20	20	8	9	2	16	18.0	.5	17.5	18.0	6
20	20	8	10	2	16	18.7	.5	18.2	18.7	7
21	21	8	10	2	17	19.4	.6	18.9	19.4	7
22	22	8	11	2	18	20.2	.6	19.6	20.2	7
23	23	9	12	3	18	20.9	.6	20.3	20.9	7

## 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

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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

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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
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

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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

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1	2	2a	2b	3	4	5	6	7	8
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet
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

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	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	Maximum ordinate
1	2	2a	2b	3	4	5	6	7	8
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet
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
	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Yards	Feet
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	Maximum ordinate
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	Maximum ordinate
1	2	2a	2b	3	4	5	6	7	8
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet
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 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
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	Maximum ordinate
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
	<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>
	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	Maximum ordinate		
	1	2								2a	2b
Yards	°	'	Minutes	Minutes	°	'	Seconds	F. S.	Yards	Yards	Feet
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	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>
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	

## 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
19000	11 00.4	660.4	4.6	13 48	27.79	1767	90	27	3120
19100	11 05.0	665.0	4.6	13 55	27.97	1765	91	27	
19200	11 09.6	669.6	4.6	14 02	28.15	1762	93	27	
19300	11 14.2	674.2	4.6	14 08	28.33	1759	94	26	
19400	11 18.8	678.8	4.6	14 15	28.51	1756	95	26	
19500	11 23.4	683.4	4.6	14 22	28.69	1754	96	26	3320
19600	11 28.0	688.0	4.6	14 28	28.87	1751	97	26	
19700	11 32.6	692.6	4.6	14 35	29.05	1748	99	26	
19800	11 37.2	697.2	4.7	14 42	29.23	1745	100	25	
19900	11 41.9	701.9	4.7	14 49	29.41	1743	101	25	
20000	11 46.6	706.6	4.7	14 55	29.59	1740	102	25	3530
20100	11 51.3	711.3	4.7	15 02	29.78	1737	103	25	
20200	11 56.0	716.0	4.7	15 09	29.96	1735	105	25	
20300	12 00.7	720.7	4.8	15 16	30.14	1732	106	24	
20400	12 05.5	725.5	4.8	15 23	30.33	1730	107	24	
20500	12 10.3	730.3	4.8	15 30	30.51	1727	108	24	3750
20600	12 15.1	735.1	4.8	15 37	30.70	1725	110	24	
20700	12 19.9	739.9	4.8	15 44	30.88	1722	111	24	
20800	12 24.7	744.7	4.8	15 51	31.07	1720	112	23	
20900	12 29.5	749.5	4.8	15 58	31.26	1717	114	23	
21000	12 34.3	754.3	4.8	16 05	31.44	1715	115	23	3980

## 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>
126	36	403	44	112	157	26	131	157	74	
127	36	407	45	113	158	26	131	158	74	
127	36	411	45	114	159	26	132	159	75	
128	36	415	46	114	160	27	133	160	75	
129	36	419	46	115	161	27	134	161	76	
129	36	423	47	115	162	27	134	162	77	
130	36	428	47	116	163	27	135	163	77	
130	36	432	48	116	164	28	136	164	78	
131	36	436	48	117	165	28	137	165	78	
132	36	440	49	117	166	28	137	166	79	
132	36	445	49	118	167	29	138	167	80	
133	36	449	50	118	168	29	139	168	80	
133	37	453	50	119	169	29	140	169	81	
134	37	458	51	120	170	30	140	170	81	
135	37	462	51	120	171	30	141	171	82	
135	37	467	52	121	172	30	142	172	83	
136	37	471	52	121	173	30	143	173	83	
136	37	476	53	122	174	31	143	174	84	
137	37	480	53	122	175	31	144	175	85	
138	37	485	54	123	176	31	145	176	85	
138	37	489	54	123	177	32	145	177	86	

## 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
21000	12 34.3	754.3	4.8	16 05	31.44	1715	115	23	3980
21100	12 39.1	759.1	4.9	16 12	31.63	1713	116	23	
21200	12 44.0	764.0	4.9	16 19	31.82	1710	118	23	
21300	12 48.9	768.9	4.9	16 27	32.01	1708	119	23	
21400	12 53.8	773.8	4.9	16 34	32.19	1706	120	22	
21500	12 58.7	778.7	4.9	16 41	32.38	1703	122	22	4220
21600	13 03.6	783.6	4.9	16 48	32.57	1701	123	22	
21700	13 08.5	788.5	5.0	16 55	32.76	1699	124	22	
21800	13 13.5	793.5	5.0	17 03	32.95	1697	126	22	
21900	13 18.5	798.5	5.0	17 10	33.14	1694	127	22	
22000	13 23.5	803.5	5.0	17 17	33.33	1692	129	21	4470
22100	13 28.5	808.5	5.0	17 24	33.52	1690	130	21	
22200	13 33.5	813.5	5.1	17 31	33.72	1688	132	21	
22300	13 38.6	818.6	5.1	17 39	33.91	1685	133	21	
22400	13 43.7	823.7	5.1	17 46	34.10	1683	135	21	
22500	13 48.8	828.8	5.1	17 54	34.30	1681	136	21	4730
22600	13 53.9	833.9	5.1	18 01	34.49	1679	138	20	
22700	13 59.0	839.0	5.1	18 09	34.69	1677	140	20	
22800	14 04.1	844.1	5.1	18 16	34.88	1674	141	20	
22900	14 09.2	849.2	5.2	18 24	35.08	1672	143	20	
23000	14 14.4	854.4	5.2	18 31	35.27	1670	145	20	5010

## 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
	138	37	489	54	123	177	32	145	177	86
	139	37	494	55	124	178	32	146	178	87
	139	37	498	55	125	179	32	147	179	87
	140	37	503	56	125	180	33	148	180	88
	141	37	507	56	126	181	33	149	181	89
	141	37	512	57	126	182	33	149	182	89
	142	38	516	57	127	183	34	150	183	90
	142	38	521	58	127	184	34	151	184	91
	143	38	525	58	128	186	34	152	186	92
	143	38	530	59	128	187	35	152	187	92
	144	38	534	59	129	188	35	153	188	93
	144	38	539	60	130	189	35	154	189	94
	145	38	543	60	130	190	35	155	190	94
	146	38	548	61	131	191	36	155	191	95
	146	38	552	61	131	192	36	156	192	96
	147	38	557	62	132	193	37	157	193	97
	147	38	561	62	132	194	37	157	194	97
	148	38	566	63	133	195	37	158	195	98
	149	38	570	63	133	196	38	159	196	99
	149	38	575	64	134	198	38	160	198	100
	150	38	580	64	135	199	38	161	199	100

## 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
Yards	°	'	Minutes	Minutes	°	'	Seconds	F. S.	Yards	Yards	Feet
23000	14	14.4	854.4	5.2	18	31	35.27	1670	145	20	5010
23100	14	19.6	859.6	5.2	18	39	35.47	1668	146	20	
23200	14	24.8	864.8	5.2	18	47	35.67	1666	148	20	
23300	14	30.0	870.0	5.2	18	54	35.86	1664	150	19	
23400	14	35.2	875.2	5.3	19	02	36.06	1662	151	19	
23500	14	40.5	880.5	5.3	19	10	36.26	1660	153	19	5300
23600	14	45.8	885.8	5.3	19	17	36.46	1658	155	19	
23700	14	51.1	891.1	5.3	19	25	36.66	1656	156	19	
23800	14	56.4	896.4	5.3	19	33	36.86	1654	158	19	
23900	15	01.7	901.7	5.4	19	41	37.06	1652	160	19	
24000	15	07.1	907.1	5.4	19	48	37.26	1650	162	19	5600
24100	15	12.5	912.5	5.4	19	56	37.46	1649	163	18	
24200	15	17.9	917.9	5.4	20	04	37.67	1647	165	18	
24300	15	23.3	923.3	5.4	20	12	37.87	1645	167	18	
24400	15	28.7	928.7	5.5	20	20	38.07	1643	169	18	
24500	15	34.2	934.2	5.5	20	28	38.28	1641	171	18	5910
24600	15	39.7	939.7	5.5	20	35	38.48	1639	172	18	
24700	15	45.2	945.2	5.5	20	43	38.69	1637	174	18	
24800	15	50.7	950.7	5.5	20	51	38.89	1636	176	18	
24900	15	56.2	956.2	5.5	20	59	39.10	1634	178	17	
25000	16	01.7	961.7	5.6	21	07	39.30	1632	180	17	6230

## 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
150	38	580	64	135	199	38	161	199	100	
150	38	584	65	135	200	39	161	200	101	
151	39	589	65	136	201	39	162	201	102	
151	39	593	66	136	202	39	163	202	103	
152	39	598	66	137	203	40	164	203	103	
153	39	602	67	137	204	40	164	204	104	
153	39	607	68	138	205	40	165	205	105	
154	39	612	68	138	206	41	166	206	106	
154	39	616	69	139	208	41	167	208	107	
155	39	621	69	140	209	41	167	209	107	
155	39	626	70	140	210	42	168	210	108	
156	39	630	70	141	211	42	169	211	109	
156	39	635	71	141	212	43	170	212	110	
157	39	640	72	142	213	43	171	213	111	
158	39	644	72	142	214	43	171	214	111	
158	39	649	73	143	215	44	172	215	112	
159	39	654	73	143	216	44	173	216	113	
159	39	658	74	144	218	44	174	218	114	
160	39	663	75	144	219	45	174	219	115	
161	39	668	75	145	220	45	175	220	115	
161	39	673	76	146	221	45	176	221	116	

## 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							
Yards	° ' "	Minutes	Minutes	° ' "	Seconds	F. S.	Yards	Yards	Feet
25000	16 01.7	961.7	5.6	21 07	39.30	1632	180	17	6230
25100	16 07.3	967.3	5.6	21 15	39.51	1630	182	17	
25200	16 12.9	972.9	5.6	21 23	39.72	1629	183	17	
25300	16 18.5	978.5	5.6	21 31	39.92	1627	185	17	
25400	16 24.1	984.1	5.6	21 39	40.13	1625	187	17	
25500	16 29.7	989.7	5.7	21 48	40.34	1623	189	17	6560
25600	16 35.4	995.4	5.7	21 56	40.55	1622	191	17	
25700	16 41.1	1001.1	5.7	22 04	40.76	1620	193	16	
25800	16 46.8	1006.8	5.7	22 12	40.97	1618	195	16	
25900	16 52.5	1012.5	5.8	22 20	41.18	1617	197	16	
26000	16 58.3	1018.3	5.8	22 28	41.39	1615	199	16	6910
26100	17 04.1	1024.1	5.8	22 36	41.60	1613	201	16	
26200	17 09.9	1029.9	5.8	22 45	41.81	1612	203	16	
26300	17 15.7	1035.7	5.8	22 53	42.02	1610	205	16	
26400	17 21.5	1041.5	5.9	23 01	42.23	1609	207	16	
26500	17 27.4	1047.4	5.9	23 09	42.44	1607	209	16	7270
26600	17 33.3	1053.3	5.9	23 18	42.65	1606	211	15	
26700	17 39.2	1059.2	5.9	23 26	42.87	1604	214	15	
26800	17 45.1	1065.1	5.9	23 34	43.09	1603	216	15	
26900	17 51.0	1071.0	6.0	23 43	43.31	1601	218	15	
27000	17 57.0	1077.0	6.0	23 51	43.53	1600	220	15	7640

## 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
161	39	673	76	146	221	45	176	221	116	
162	40	677	76	146	222	46	177	222	117	
162	40	682	77	147	223	46	177	223	118	
163	40	687	78	147	225	46	178	225	119	
163	40	692	78	148	226	47	179	226	119	
164	40	697	79	148	227	47	180	227	120	
165	40	701	79	149	228	48	180	228	121	
165	40	706	80	150	229	48	181	229	122	
166	40	711	81	150	230	48	182	230	123	
166	40	716	81	151	232	49	183	232	124	
167	40	721	82	151	233	49	184	233	124	
167	40	726	82	152	234	50	184	234	125	
168	40	730	83	152	235	50	185	235	126	
169	40	735	84	153	236	50	186	236	127	
169	40	740	84	154	238	51	187	238	128	
170	40	745	85	154	239	51	188	239	129	
170	40	750	85	155	240	52	189	240	130	
171	40	755	86	155	241	52	189	241	130	
171	40	760	87	156	242	52	190	242	131	
172	40	765	87	157	244	53	191	244	132	
172	40	770	88	157	245	53	192	245	133	

## 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	
27000	17	57.0	1077.0	6.0	23 51	43.53	1600	220	15	7640
27100	18	03.0	1083.0	6.0	24 00	43.75	1599	222	15	
27200	18	09.0	1089.0	6.0	24 08	43.97	1597	225	15	
27300	18	15.0	1095.0	6.0	24 17	44.19	1596	227	15	
27400	18	21.0	1101.0	6.1	24 25	44.41	1595	229	15	
27500	18	27.1	1107.1	6.1	24 34	44.63	1593	231	15	8030
27600	18	33.2	1113.2	6.1	24 43	44.85	1592	234	14	
27700	18	39.3	1119.3	6.2	24 51	45.07	1591	236	14	
27800	18	45.5	1125.5	6.2	25 00	45.29	1590	238	14	
27900	18	51.7	1131.7	6.2	25 09	45.51	1588	241	14	
28000	18	57.9	1137.9	6.2	25 17	45.73	1587	243	14	8430
28100	19	04.1	1144.1	6.2	25 26	45.95	1586	245	14	
28200	19	10.3	1150.3	6.3	25 35	46.17	1585	248	14	
28300	19	16.6	1156.6	6.3	25 44	46.39	1584	250	14	
28400	19	22.9	1162.9	6.3	25 52	46.61	1583	252	14	
28500	19	29.2	1169.2	6.3	26 01	46.84	1581	255	14	8850
28600	19	35.5	1175.5	6.4	26 10	47.07	1580	257	14	
28700	19	41.9	1181.9	6.4	26 19	47.30	1579	260	13	
28800	19	48.3	1188.3	6.4	26 28	47.53	1578	262	13	
28900	19	54.7	1194.7	6.4	26 36	47.76	1577	265	13	
29000	20	01.1	1201.1	6.5	26 45	47.99	1576	268	13	9290

## 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
172	40	770	88	157	245	53	192	245	133	
173	41	775	89	158	246	54	193	246	134	
174	41	780	89	158	247	54	193	247	135	
174	41	785	90	159	249	55	194	249	136	
175	41	790	91	159	250	55	195	250	137	
176	41	795	91	160	251	55	196	251	137	
176	41	800	92	161	252	56	197	252	138	
177	41	805	93	161	253	56	197	253	139	
177	41	810	93	162	255	57	198	255	140	
178	41	815	94	162	256	57	199	256	141	
178	41	820	94	163	257	57	200	257	142	
179	41	825	95	164	259	58	201	259	143	
180	41	830	96	164	260	58	202	260	144	
180	41	835	97	165	261	59	202	261	145	
181	41	840	97	165	262	59	203	262	145	
181	41	845	98	166	264	59	204	264	146	
182	41	850	98	167	265	60	205	265	147	
183	41	855	99	167	266	60	206	266	148	
183	41	860	100	168	267	61	207	267	149	
184	41	865	101	168	269	61	207	269	150	
184	41	870	101	169	270	62	208	270	151	

## 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
29000	20 01.1	1201.1	6.5	26 45	47.99	1576	268	13	9290
29100	20 07.6	1207.6	6.5	26 54	48.22	1575	270	13	
29200	20 14.1	1214.1	6.5	27 03	48.45	1574	273	13	
29300	20 20.6	1220.6	6.5	27 12	48.68	1573	276	13	
29400	20 27.1	1227.1	6.6	27 21	48.91	1572	278	13	
29500	20 33.7	1233.7	6.6	27 30	49.14	1571	281	13	9740
29600	20 40.3	1240.3	6.6	27 39	49.37	1571	284	13	
29700	20 46.9	1246.9	6.6	27 48	49.60	1570	286	13	
29800	20 53.5	1253.5	6.6	27 57	49.84	1569	289	13	
29900	21 00.1	1260.1	6.7	28 06	50.08	1568	292	12	
30000	21 06.8	1266.8	6.7	28 15	50.32	1567	294	12	10210
30100	21 13.5	1273.5	6.7	28 24	50.56	1566	297	12	
30200	21 20.2	1280.2	6.8	28 34	50.80	1566	300	12	
30300	21 27.0	1287.0	6.8	28 43	51.04	1565	303	12	
30400	21 33.8	1293.8	6.8	28 52	51.28	1564	306	12	
30500	21 40.6	1300.6	6.8	29 01	51.52	1563	309	12	10700
30600	21 47.4	1307.4	6.9	29 10	51.76	1563	311	12	
30700	21 54.3	1314.3	6.9	29 19	52.00	1562	314	12	
30800	22 01.2	1321.2	6.9	29 29	52.24	1561	317	12	
30900	22 08.1	1328.1	7.0	29 38	52.48	1561	320	12	
31000	22 15.1	1335.1	7.0	29 47	52.72	1560	323	12	11210

## 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
184	41	870	101	169	270	62	208	270	151	
185	41	875	102	170	271	62	209	271	152	
186	41	880	103	170	272	62	210	272	153	
186	42	885	103	171	274	63	211	274	154	
187	42	890	104	171	275	63	212	275	155	
187	42	895	105	172	276	64	213	276	156	
188	42	900	106	173	278	64	214	278	157	
189	42	905	106	173	279	65	214	279	158	
189	42	910	107	174	280	65	215	280	159	
190	42	915	107	175	282	66	216	282	160	
190	42	920	108	175	283	66	217	283	161	
191	42	925	109	176	284	66	218	284	162	
192	42	930	110	176	286	67	219	286	163	
192	42	935	110	177	287	67	220	287	164	
193	42	940	111	178	288	68	220	288	165	
194	42	946	112	178	290	68	221	290	166	
194	42	951	112	179	291	69	222	291	168	
195	42	956	113	180	293	69	223	293	169	
196	42	961	114	180	294	70	224	294	170	
196	42	966	115	181	295	70	225	295	171	
197	42	971	115	182	297	71	226	297	172	

## 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
Yards	°	'	Minutes	Minutes	°	'	Seconds	F. S.	Yards	Yards	Feet
31000	22	15.1	1335.1	7.0	29	47	52.72	1560	323	12	11210
31100	22	22.1	1342.1	7.0	29	56	52.96	1560	326	12	
31200	22	29.1	1349.1	7.0	30	06	53.20	1559	329	11	
31300	22	36.1	1356.1	7.1	30	15	53.45	1559	332	11	
31400	22	43.2	1363.2	7.1	30	24	53.70	1558	335	11	
31500	22	50.3	1370.3	7.1	30	34	53.95	1558	338	11	11740
31600	22	57.4	1377.4	7.2	30	43	54.20	1557	341	11	
31700	23	04.6	1384.6	7.2	30	53	54.45	1557	344	11	
31800	23	11.8	1391.8	7.2	31	02	54.70	1556	347	11	
31900	23	19.0	1399.0	7.3	31	12	54.95	1556	351	11	
32000	23	26.3	1406.3	7.3	31	21	55.20	1556	354	11	12290
32100	23	33.6	1413.6	7.3	31	31	55.45	1555	357	11	
32200	23	40.9	1420.9	7.4	31	40	55.70	1555	360	11	
32300	23	48.3	1428.3	7.4	31	50	55.95	1555	364	11	
32400	23	55.7	1435.7	7.4	31	59	56.21	1555	367	11	
32500	24	03.1	1443.1	7.5	32	09	56.47	1555	370	11	12860
32600	24	10.6	1450.6	7.5	32	18	56.73	1554	374	11	
32700	24	18.1	1458.1	7.5	32	28	56.99	1554	377	10	
32800	24	25.6	1465.6	7.6	32	38	57.25	1554	381	10	
32900	24	33.2	1473.2	7.6	32	47	57.51	1554	384	10	
33000	24	40.8	1480.8	7.7	32	57	57.77	1554	388	10	13460

## 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
197	42	971	115	182	297	71	226	297	172	
197	42	976	116	182	298	71	227	298	173	
198	43	982	117	183	299	71	228	299	174	
199	43	987	118	184	301	72	229	301	175	
199	43	992	118	184	302	72	230	302	177	
200	43	997	119	185	304	73	231	304	178	
200	43	1002	120	186	305	73	232	305	179	
201	43	1007	121	186	306	74	233	306	180	
201	43	1013	121	187	308	74	234	308	181	
202	43	1018	122	188	309	75	235	309	182	
203	43	1023	123	188	311	75	236	311	183	
204	43	1028	124	189	312	76	236	312	185	
204	43	1033	124	190	314	76	237	314	186	
205	43	1039	125	190	315	77	238	315	187	
206	43	1044	126	191	317	77	239	317	188	
206	43	1049	127	192	318	78	240	318	189	
207	43	1054	127	192	319	78	241	319	190	
208	43	1060	128	193	321	79	242	321	192	
208	43	1065	129	194	322	79	243	322	193	
209	43	1070	130	194	324	80	244	324	194	
210	44	1076	130	195	325	80	245	325	195	

## 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
33000	24 40.8	1480.8	7.7	32 57	57.77	1554	388	10	13460
33100	24 48.5	1488.5	7.7	33 07	58.03	1554	391	10	
33200	24 56.2	1496.2	7.7	33 16	58.29	1554	395	10	
33300	25 03.9	1503.9	7.8	33 26	58.55	1554	399	10	
33400	25 11.7	1511.7	7.8	33 36	58.82	1554	402	10	
33500	25 19.5	1519.5	7.9	33 46	59.09	1554	406	10	14080
33600	25 27.4	1527.4	7.9	33 55	59.36	1554	410	10	
33700	25 35.3	1535.3	7.9	34 05	59.63	1554	414	10	
33800	25 43.2	1543.2	8.0	34 15	59.90	1554	417	10	
33900	25 51.2	1551.2	8.0	34 25	60.17	1554	421	10	
34000	25 59.2	1559.2	8.1	34 35	60.44	1554	425	10	14730
34100	26 07.3	1567.3	8.1	34 45	60.71	1554	429	10	
34200	26 15.4	1575.4	8.2	34 55	60.98	1555	433	10	
34300	26 23.6	1583.6	8.2	35 05	61.26	1555	437	9	
34400	26 31.8	1591.8	8.3	35 15	61.54	1555	441	9	
34500	26 40.1	1600.1	8.3	35 26	61.82	1555	445	9	15410
34600	26 48.4	1608.4	8.4	35 36	62.10	1555	449	9	
34700	26 56.8	1616.8	8.4	35 46	62.38	1555	453	9	
34800	27 05.2	1625.2	8.5	35 56	62.66	1556	457	9	
34900	27 13.7	1633.7	8.6	36 06	62.94	1556	461	9	
35000	27 22.3	1642.3	8.6	36 16	63.22	1556	465	9	16120

## 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
210	44	1076	130	195	325	80	245	325	195	
210	44	1081	131	196	327	80	246	327	196	
211	44	1086	132	197	328	81	247	328	198	
212	44	1092	133	197	330	81	248	330	199	
212	44	1097	133	198	331	82	249	331	200	
213	44	1103	134	199	333	82	250	333	201	
214	44	1108	135	199	334	83	251	334	202	
214	44	1114	136	200	336	83	252	336	204	
215	44	1119	137	201	337	84	253	337	205	
215	44	1125	137	202	339	84	254	339	206	
216	44	1130	138	202	340	85	255	340	207	
217	44	1136	139	203	342	85	256	342	209	
217	44	1141	140	204	343	86	258	343	210	
218	45	1147	140	205	345	86	259	345	211	
219	45	1152	141	205	346	87	260	346	212	
219	45	1158	142	206	348	87	261	348	214	
220	45	1163	143	207	350	88	262	350	215	
221	45	1169	143	208	351	88	263	351	216	
222	45	1174	144	209	353	89	264	353	218	
222	45	1180	145	210	354	89	265	354	219	
223	45	1185	146	210	356	90	266	356	220	

## 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	
35000	27	22.3	1642.3	8.6	36 16	63.22	1556	465	9	16120
35100	27	30.9	1650.9	8.7	36 27	63.50	1556	470	9	
35200	27	39.6	1659.6	8.7	36 37	63.79	1556	474	9	
35300	27	48.3	1668.3	8.8	36 47	64.08	1557	478	9	
35400	27	57.1	1677.1	8.8	36 58	64.37	1557	483	9	
35500	28	05.9	1685.9	8.9	37 08	64.66	1557	487	9	16860
35600	28	14.8	1694.8	9.0	37 18	64.95	1558	491	9	
35700	28	23.8	1703.8	9.0	37 29	65.24	1558	496	9	
35800	28	32.8	1712.8	9.1	37 39	65.53	1559	500	9	
35900	28	41.9	1721.9	9.2	37 50	65.83	1559	505	9	
36000	28	51.1	1731.1	9.2	38 00	66.13	1560	509	9	17640
36100	29	00.3	1740.3	9.3	38 11	66.43	1560	514	8	
36200	29	09.6	1749.6	9.4	38 21	66.73	1561	518	8	
36300	29	19.0	1759.0	9.5	38 32	67.03	1562	523	8	
36400	29	28.5	1768.5	9.5	38 42	67.33	1562	528	8	
36500	29	38.0	1778.0	9.6	38 53	67.64	1563	532	8	18450
36600	29	47.6	1787.6	9.7	39 03	67.95	1564	537	8	
36700	29	57.3	1797.3	9.7	39 14	68.26	1564	542	8	
36800	30	07.0	1807.0	9.8	39 25	68.57	1565	547	8	
36900	30	16.8	1816.8	9.9	39 35	68.88	1566	552	8	
37000	30	26.7	1826.7	10.0	39 46	69.20	1567	557	8	19300

## 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
	223	45	1185	146	210	356	90	266	356	220
	224	45	1191	147	211	358	90	267	358	222
	224	45	1196	148	212	359	91	268	359	223
	225	45	1202	148	213	361	91	270	361	224
	226	45	1207	149	214	362	92	271	362	226
	226	45	1213	150	214	364	92	272	364	227
	227	46	1218	151	215	366	93	273	366	228
	228	46	1224	151	216	367	93	274	367	230
	229	46	1229	152	217	369	94	276	369	231
	229	46	1235	153	218	371	94	277	371	232
	230	46	1241	154	219	373	95	278	373	234
	231	46	1246	155	219	374	95	279	374	235
	232	46	1252	155	220	376	96	280	376	237
	232	46	1258	156	221	378	96	282	378	238
	233	46	1263	157	222	379	97	283	379	240
	234	46	1269	158	223	381	97	284	381	241
	235	47	1275	159	224	383	98	285	383	243
	235	47	1280	160	225	385	98	286	385	244
	236	47	1286	160	226	386	99	288	386	246
	237	47	1292	161	227	388	99	289	388	248
	238	47	1298	162	228	390	100	290	390	249

## 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>Minutes</i>	<i>Minutes</i>	° ' "	<i>Seconds</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards</i>	<i>Feet</i>
37000	30 27	1827	10	39 46	69.20	1567	557	8	19300
37100	30 37	1837	10	39 57	69.52	1568	562	8	
37200	30 47	1847	10	40 08	69.84	1569	568	8	
37300	30 57	1857	10	40 19	70.16	1570	573	8	
37400	31 07	1867	10	40 29	70.48	1571	578	8	
37500	31 17	1877	10	40 40	70.81	1572	584	8	20200
37600	31 27	1887	10	40 51	71.14	1573	589	8	
37700	31 37	1897	11	41 02	71.47	1574	595	8	
37800	31 48	1908	11	41 13	71.80	1575	600	8	
37900	31 59	1919	11	41 24	72.13	1576	606	8	
38000	32 10	1930	10	41 35	72.47	1577	611	8	21160
38100	32 20	1940	11	41 46	72.81	1579	617	7	
38200	32 31	1951	11	41 57	73.15	1580	623	7	
38300	32 42	1962	11	42 08	73.49	1581	628	7	
38400	32 53	1973	11	42 19	73.84	1582	634	7	
38500	33 04	1984	11	42 30	74.19	1583	640	7	22190
38600	33 15	1995	11	42 41	74.55	1585	646	7	
38700	33 26	2006	11	42 52	74.91	1586	652	7	
38800	33 37	2017	12	43 04	75.27	1587	659	7	
38900	33 49	2029	12	43 16	75.64	1589	665	7	
39000	34 01	2041	12	43 28	76.01	1590	672	7	23290

## 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
238	47	1298	162	228	390	100	290	390	249	
238	47	1303	163	229	392	100	291	392	251	
239	47	1309	164	230	394	101	293	394	253	
240	47	1315	164	231	395	101	294	395	254	
241	47	1321	165	232	397	102	295	397	256	
242	48	1327	166	233	399	103	297	399	258	
242	48	1332	167	234	401	103	298	401	259	
243	48	1338	168	235	403	104	299	403	261	
244	48	1344	169	236	404	104	301	404	263	
245	48	1350	169	237	406	105	302	406	265	
246	48	1356	170	238	408	105	303	408	266	
247	48	1362	171	239	410	106	305	410	268	
248	48	1367	172	240	412	106	306	412	270	
248	49	1373	173	241	414	107	307	414	272	
249	49	1379	174	242	416	107	309	416	273	
250	49	1385	174	244	418	108	310	418	275	
251	49	1391	175	245	420	108	312	420	277	
252	49	1397	176	246	422	109	313	422	279	
253	49	1403	177	247	424	109	315	424	281	
254	49	1408	178	248	426	110	316	426	282	
255	49	1414	179	249	428	110	318	428	284	

## 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	
39000	34	01	2041	12	43 28	76.01	1590	672	7	23290
39100	34	13	2053	12	43 40	76.38	1591	679	7	
39200	34	25	2065	12	43 52	76.76	1593	685	7	
39300	34	37	2077	12	44 04	77.14	1595	692	7	
39400	34	49	2089	12	44 16	77.53	1596	699	7	
39500	35	01	2101	12	44 28	77.92	1598	706	7	24480
39600	35	13	2113	13	44 40	78.32	1600	713	7	
39700	35	26	2126	13	44 52	78.72	1601	720	7	
39800	35	39	2139	13	45 04	79.13	1603	728	7	
39900	35	52	2152	13	45 16	79.54	1605	735	7	
40000	36	05	2165	14	45 28	79.96	1607	743	7	25770
40100	36	19	2179	14	45 41	80.38	1609	751	7	
40200	36	33	2193	14	45 54	80.81	1611	759	6	
40300	36	47	2207	15	46 07	81.25	1613	767	6	
40400	37	02	2222	15	46 20	81.69	1615	776	6	
40500	37	17	2237	16	46 33	82.14	1617	784	6	27190
40600	37	33	2253	16	46 47	82.60	1619	793	6	
40700	37	49	2269	16	47 01	83.07	1621	802	6	
40800	38	05	2285	17	47 15	83.55	1624	812	6	
40900	38	22	2302	17	47 29	84.04	1627	821	6	
41000	38	39	2319	18	47 44	84.54	1630	831	6	28800

## 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
255	49	1414	179	249	428	110	318	428	284	
256	50	1420	179	251	430	111	319	430	286	
256	50	1426	180	252	432	112	321	432	288	
257	50	1432	181	253	434	112	322	434	290	
258	50	1438	182	254	436	113	324	436	292	
259	50	1444	183	256	439	113	326	439	294	
260	50	1450	184	257	441	114	327	441	296	
261	51	1455	184	259	443	114	329	443	298	
262	51	1461	185	260	445	115	331	445	301	
263	51	1467	186	262	448	115	333	448	303	
264	51	1473	187	263	450	116	334	450	305	
265	51	1479	188	264	452	117	336	452	308	
266	51	1485	189	266	455	117	338	455	310	
267	52	1491	189	268	457	118	340	457	312	
268	52	1497	190	270	460	118	342	460	315	
269	52	1503	191	271	462	119	344	462	317	
270	52	1508	192	273	465	119	346	465	320	
271	52	1514	193	275	468	120	348	468	322	
272	53	1520	194	277	470	120	350	470	325	
273	53	1526	195	279	473	121	352	473	327	
274	53	1532	195	281	476	121	355	476	330	

## 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 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
41000	38	39	2319	18	47	44	84.54	1630	831	6	28800
41100	38	57	2337	19	47	59	85.06	1633	841	6	
41200	39	16	2356	19	48	15	85.60	1636	852	6	
41300	39	35	2375	20	48	31	86.15	1639	863	6	
41400	39	55	2395	21	48	48	86.72	1642	874	6	
41500	40	16	2416	22	49	06	87.31	1646	886	6	30720
41600	40	38	2438	24	49	25	87.93	1650	899	6	
41700	41	02	2462	25	49	45	88.58	1654	912	6	
41800	41	27	2487	27	50	07	89.26	1658	926	6	
41900	41	54	2514	29	50	30	89.98	1662	941	5	
42000	42	23	2543	33	50	56	90.78	1666	958	5	33210
42100	42	56	2576	40	51	26	91.70	1671	978	5	
42200	43	36	2616	52	52	01	92.79	1676	1001	5	
42300	44	28	2668		52	48	94.44	1682	1037	5	
42345	45	00	2700		53	14	95.32	1686	1057	5	36610

## 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
274	53	1532	195	281	476	121	355	476	330	
275	53	1538	196	283	479	122	357	479	333	
276	53	1544	197	285	482	123	360	482	336	
277	54	1550	198	287	485	123	362	485	339	
278	54	1556	199	290	488	124	364	488	342	
279	54	1562	200	292	492	124	367	492	346	
280	54	1568	201	294	495	125	370	495	350	
281	54	1574	202	297	499	125	374	499	354	
282	55	1580	203	300	503	126	377	503	359	
283	55	1586	203	304	507	126	381	507	364	
284	55	1592	204	307	511	127	384	511	370	
286	55	1598	205	311	516	128	388	516	376	
287	56	1604	206	316	522	128	394	522	384	
288	56	1611	207	325	532	129	403	532	395	
288	56	1612	207	330	537	129	408	537	402	

I.V. = 2500 F.S.

\*EFFECT IN YARDS OF RANGE DUE TO ROTATION OF THE EARTH.

True Target Bearing, Degrees							Range, Yards	True Target Bearing, Degrees						
0	15	30	45	60	75	90		0	15	30	45	60	75	90
180	165	150	135	120	105	90	180	165	150	135	120	105	90	
Latitude 0°								Latitude 10° (North or South)						
0	10	20	28	35	39	40	4,000	0	10	20	28	34	38	39
0	19	37	52	64	71	74	8,000	0	19	36	52	63	70	73
0	27	52	74	90	100	104	12,000	0	27	51	72	89	99	102
0	33	65	91	112	125	129	16,000	0	33	63	90	110	123	127
0	39	75	106	130	145	150	20,000	0	38	74	104	128	143	148
0	43	84	118	145	161	167	24,000	0	43	82	116	142	159	165
0	47	91	128	157	175	181	28,000	0	46	89	126	154	172	178
0	49	95	134	165	184	190	32,000	0	48	93	132	162	181	187
0	50	97	137	168	187	194	36,000	0	49	95	135	165	184	191
0	48	93	131	160	179	185	40,000	0	47	91	129	158	176	182
0	41	79	112	137	153	158	42,000	0	40	78	110	135	150	156
Latitude 20° (North or South)								Latitude 30° (North or South)						
0	10	19	27	33	36	38	4,000	0	9	17	24	30	33	35
0	18	35	49	60	67	70	8,000	0	17	32	45	56	62	64
0	25	49	69	85	94	98	12,000	0	23	45	64	78	87	90
0	31	61	86	105	117	121	16,000	0	29	56	79	97	108	112
0	36	71	100	122	136	141	20,000	0	34	65	92	113	126	130
0	41	78	111	136	152	157	24,000	0	37	72	102	125	140	145
0	44	85	120	147	164	170	28,000	0	41	78	111	136	151	157
0	46	89	126	155	173	179	32,000	0	43	82	116	143	159	165
0	47	91	129	158	176	182	36,000	0	43	84	119	146	162	168
0	45	87	123	151	168	174	40,000	0	41	80	113	139	155	160
0	38	74	105	129	143	149	42,000	0	35	68	97	119	132	137
180	195	210	225	240	255	270	180	195	210	225	240	255	270	
360	345	330	315	300	285	270	360	345	330	315	300	285	270	
True Target Bearing, Degrees								True Target Bearing, Degrees						

\*For bearing at top of table the range is increased.

For bearing at bottom of table the range is decreased.

I.V. = 2500 F.S.

## \*EFFECT IN YARDS OF RANGE DUE TO ROTATION OF THE EARTH.

True Target Bearing, Degrees							Range, Yards	True Target Bearing, Degrees						
0	15	30	45	60	75	90		0	15	30	45	60	75	90
180	165	150	135	120	105	90	180	165	150	135	120	105	90	
Latitude 40° (North or South)							Range, Yards	Latitude 50° (North or South)						
0	8	15	22	27	30	31		0	7	13	18	22	25	26
0	15	28	40	49	55	57	0	12	24	34	41	46	48	
0	21	40	56	69	77	80	0	17	33	47	58	65	67	
0	26	49	70	86	95	99	0	21	41	59	72	80	83	
0	30	57	81	99	111	115	0	25	48	68	84	93	96	
0	33	64	91	111	124	128	0	28	54	76	93	104	107	
0	36	69	98	120	134	139	0	30	58	82	101	112	116	
0	38	73	103	126	141	146	0	32	61	86	106	118	122	
0	38	74	105	129	144	149	0	32	62	88	108	120	125	
0	37	71	100	123	137	142	0	31	59	84	103	115	119	
0	31	61	86	105	117	121	0	26	51	72	88	98	102	
Latitude 60° (North or South)							Range, Yards	Latitude 70° (North or South)						
0	5	10	14	17	19	20		0	4	7	10	12	13	14
0	10	19	26	32	36	37	0	7	13	18	22	24	25	
0	13	26	37	45	50	52	0	9	18	25	31	34	36	
0	17	32	46	56	62	65	0	11	22	31	38	43	44	
0	19	38	53	65	72	75	0	13	26	36	44	50	51	
0	22	42	59	72	81	84	0	15	29	40	49	55	57	
0	23	45	64	78	87	91	0	16	31	44	54	60	62	
0	25	48	67	82	92	95	0	17	32	46	56	63	65	
0	25	49	69	84	94	97	0	17	33	47	57	64	66	
0	24	46	65	80	89	93	0	16	32	45	55	61	63	
0	20	40	56	68	76	79	0	14	27	38	47	52	54	
180	195	210	225	240	255	270	180	195	210	225	240	255	270	
360	345	330	315	300	285	270	360	345	330	315	300	285	270	
True Target Bearing, Degrees							Range, Yards	True Target Bearing, Degrees						
0	15	30	45	60	75	90		0	15	30	45	60	75	90
180	165	150	135	120	105	90	180	165	150	135	120	105	90	

\*For bearing at top of table the range is increased.

For bearing at bottom of table the range is decreased.

I.V. = 2500 F.S.

## \*DEFLECTION IN YARDS DUE TO ROTATION OF THE EARTH.

True Target Bearing, Degrees							Range, Yards	True Target Bearing, Degrees						
0	30	60	90	120	150	180		0	30	60	90	120	150	180
360	330	300	270	240	210	180		360	330	300	270	240	210	180
Latitude 0°								Latitude 10°						
0	0	0	0	0	0	0	4,000	0	0	0	0	0	0	0
0	0	0	0	0	0	0	8,000	1	1	1	1	1	1	1
0	0	0	0	0	0	0	12,000	2	2	2	2	3	3	3
-1	-1	-1	0	1	1	1	16,000	3	3	4	4	5	5	6
-3	-2	-1	0	1	2	3	20,000	4	5	6	7	8	9	10
-5	-5	-3	0	3	5	5	24,000	5	6	8	11	13	15	16
-10	-8	-5	0	5	8	10	28,000	5	7	10	15	20	23	25
-17	-15	-8	0	8	15	17	32,000	4	6	12	21	29	35	37
-29	-25	-14	0	14	25	29	36,000	-1	3	13	28	42	52	56
-52	-45	-26	0	26	45	52	40,000	-14	-7	12	37	63	81	88
-78	-67	-39	0	39	67	78	42,000	-32	-22	6	45	83	111	121
Latitude 20°								Latitude 30°						
0	0	0	0	0	0	0	4,000	1	1	1	1	1	1	1
2	2	2	2	2	2	2	8,000	3	3	3	3	3	3	3
4	4	4	5	5	5	5	12,000	6	6	7	7	7	7	7
7	8	8	9	9	10	10	16,000	11	12	12	13	13	14	14
11	12	13	14	15	16	16	20,000	18	18	19	20	21	22	23
16	16	18	21	23	25	26	24,000	26	26	28	30	33	34	35
20	21	25	29	34	37	39	28,000	35	36	39	43	47	50	51
24	27	32	40	48	54	56	32,000	44	46	52	59	66	72	74
27	31	41	54	68	78	81	36,000	54	58	67	79	92	101	104
25	31	49	73	97	115	122	40,000	62	68	85	107	129	146	152
15	24	51	88	125	151	161	42,000	61	70	95	129	162	187	196
180	150	120	90	60	30	0		180	150	120	90	60	30	0
180	210	240	270	300	330	360		180	210	240	270	300	330	360
True Target Bearing, Degrees								True Target Bearing, Degrees						

\*Deflections to the right are positive.  
 Deflections to the left are negative.  
 Deflections are tabulated for north latitude,  
 for south latitude use opposite sign.  
 For north latitude use bearing at top of table.  
 For south latitude use bearing at bottom of table.

TENTATIVE EROSION DATA  
 16/50 CALIBER GUNS MARK 7  
 SERVICE CHARGE FOR 2700 LB. PROJECTILE-2500 F/S  
 2700 LB. PROJECTILES  
 VELOCITY LOSS vs. ENLARGEMENT AT ORIGIN

U.S. NAVAL PROVING GROUND  
 DAHLGREN, VA  
 MARCH, 1944

-51a-

VELOCITY LOSS FROM 2500 F/S

$\Delta V = 378 \Delta D_{o,16}$

INDIVIDUAL INDEX CORRECTION  
 CERTAIN INDEXES OF POWDER NEED CORRECTION TO BRING THEM TO THE STANDARD USED IN CONSTRUCTION OF THIS CURVE. TO OBTAIN VELOCITY LOSS FOR ANY SPECIFIC INDEX ADD CORRECTION LISTED BELOW TO VELOCITY LOSS GIVEN BY CURVE. [FOR EXAMPLE: GIVEN INDEX 5577 AND A GUN WITH BORE ENLARGEMENT OF 200 THE CORRECT VELOCITY LOSS WILL BE  $60 + 3 \cdot 63 F/S$ ]

POWDER INDEX	CORRECTION
2837 (CHARGE WT 668 LBS)	-13 F/S
2837 (CHARGE WT 660 LBS)	+9 F/S
4549, 4550, 4581, 4582, & 5449	+9 F/S
5577 & 5914	+3 F/S
ALL OTHERS	0

110077M

20

10

0

0 .020 .040 .060 .080 .100 .120 .140 .160 .180 .200 .220 .240 .260 .280 .300 .320 .340 .360 .380 .400 .420 .440 .460 .480 .500

BORE ENLARGEMENT AT ORIGIN IN INCHES

SUBMITTED  
~~224~~  
 ORDNANCE OFFICER

APPROVED:  
 CAPTAIN U.S.N. *David J. Kernick* CAPTAIN U.S.N.  
 COMMANDING OFFICER

-51b-  
BORE ENLARGEMENT AT ORIGIN IN INCHES

TENTATIVE WEAR CURVE  
16/50 CALIBER GUNS MARK 7  
BORE ENLARGEMENT AT ORIGIN  
VS  
EQUIVALENT SERVICE ROUNDS

RECOMMENDED PROCEDURE:

- I ENTER WITH BORE ENLARGEMENT AT ORIGIN OBTAINED ON LAST STARGAUGING OF GUN, AND FIND THE CORRESPONDING PSEUDO ESR.
- II AND NUMBER OF ESR FIRED SINCE STARGAUGING TO THIS PSEUDO ESR.
- III ENTER CURVE WITH THIS SUM AND GET ESTIMATED PRESENT BORE ENLARGEMENT AT ORIGIN.
- IV ENTER PROPER EROSION DATA CURVE WITH THIS BORE ENLARGEMENT AND OBTAIN DESIRED VELOCITY LOSS.

NOTE:  
THIS WEAR CURVE IS FOR AN AVERAGE GUN. ANY PARTICULAR GUN MAY DIFFER FROM IT CONSIDERABLY. THIS, HOWEVER, WILL NOT APPRECIABLY AFFECT THE ACCURACY OF VELOCITY LOSS DETERMINED BY THE ABOVE PROCEDURE.

U.S. NAVAL PROVING GROUND  
DAHLGREN, VA  
MARCH, 1944

SUBMITTED:  
*[Signature]*  
ORDNANCE OFFICER CAPTAIN, U.S.N.

APPROVED:  
*[Signature]*  
COMMANDING OFFICER CAPTAIN, U.S.N.

EQUIVALENT SERVICE ROUNDS

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350

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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) (~~changed to~~)

10/2/68 [Signature] [Rank] by authority of  
(Date) (Signature) (Rank)  
NAVAL ORDNANCE SYSTEMS COMMAND  
Department of the Navy

UNCLASSIFIED

19/83:12-2  
3148  
35

SOURCE Bureau of Ordnance

NAVORD  
OP-770

TITLE  
16-inch range table; 2,500 FS initial  
~~velocity to 12,345 yards~~

BORROWER	CODE	EXT.	DATE DUE
<del>3-11-68</del>	ORD 9152	<del>67061</del>	<del>11-25-68</del>

REPORT CHARGE NAVAIR FORM 5070/1 (2-67)

## P R E F A C E

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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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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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Acting Chief of Bureau

OP 770      CHANGE 1  
11 April 1944  
Page: \_\_\_\_\_ Page 1

ORDNANCE PAMPHLET 770  
is changed as follows:

16-INCH RANGE TABLE  
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.

D I S T R I B U T I O N

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NAVY DEPARTMENT  
BUREAU OF ORDNANCE  
WASHINGTON, D. C.

871-1(53)

(Re/a)

**RESTRICTED**

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