

SAMPLE 2.75"  
ROCKET PROBLEM

JOV-1C

ARMED MOHAWK

3/1965



OV-1 MOHAWK GUNNERY

The following problems pertain to the determination for a sight angle setting under varying conditions for the 2.75" FFAR.

The fundamental equation to be solved is:

$$S = D / E - L / B / P$$

Each term for this equation will be treated separately and discussed in detail.

S is defined as the sight angle for the given firing conditions.

D is defined as trajectory drop. D is determined by entering the appropriate firing table contained in OP 2532, Firing Tables. Air-to-Ground for 2.75" aircraft rockets mark 4 and MODs. The required information for entry into the appropriate tables is as follows:

The tables on pages 9 through 11 are for targets at sea level with a rocket propellant temperature of -10 DEG F to 130 DEG F. For propellant temperatures of -50 DEG F use the tables on pages 21 through 23. Additional information required is the Dive Angle, Altitude above the target, and calibrated airspeed in knots.

E is defined as the sighting allowance for the launcher angle of attack. To determine E the following equation must be solved:

$$E = f(A=L)$$

f is the launching factor determined from the ballistic data table on page 20, OP 2532. This factor is used to compute the trajectory jump or "bullet hop" which occurs when the projectile "weather vanes" into the relative wind. The



data necessary for entry into the table is the Dive Angle, calibrated airspeed in knots and altitude above the target in feet.

A is the armament angle of attack. The evolution of this quantity is derived from the WAV Graph. The required information for entry into the graph is the aircraft gross weight at the time of attack and the calibrated airspeed in knots.

L is the launcher angle. On the JOV-1C Armed Mohawk  $L = 0$ . (This information is probably contained in the aircraft handbook.)

L is used to evolve E and is also used with no modification in the basic formula. Since  $L = 0$  for the Mohawk this item is easy to handle in the basic equation.

B is the angle between the armament datum line and the zero sight line. On the JOV-1C Armed Mohawk  $B = 0$ . (This is handled exactly like L.)

P is the sighting allowance for parallax. Parallax is defined as an error incurred by the vertical displacement of the sight with respect to the armament (rockets, bombs, etc). The equation for P is:

$$P = \frac{1000h}{R} \quad \text{where}$$

h is the height of the sight above the launcher in feet and R is the slant range to the target. On the JOV-1C Armed Mohawk the outboard station is approximately 6 inches below the sight and the inboard station 9 inches. These height differences are so small that parallax on the Mohawk can be considered as zero (0).

There is one additional table which needs discussion. This is the correction to D (trajectory drop) for a target above sea-level. The tables are shown on pages 15 and 16.



Required information for the use of these tables is the altitude of release above the target, the calibrated airspeed in knots and the Dive Angle.

The number in the table reflects a correction for 1000 feet above sea level. If the target is 2000, 3000, 4000 feet, etc., above sea level the figure is multiplied by 2, 3, or 4 respectively. A similar approach is used for fractions of 1000 feet.

To demonstrate the use of these tables in a practical problem, the following examples are offered:

Dive Angle  $\theta_0$  - - - - -  $10^\circ$   
Calibrated Airspeed - - - - - 280 kts  
Release Altitude Above Target - - - - - 500 feet  
Target Height Above Sea Level - - - - - 0 feet  
Propellant Temperature - - - - -  $70^\circ$  F  
Aircraft Gross Weight at Take Off - - - - 15000 pounds  
Fuel Consumption Weight - - - - - 500\*/hour  
Time of Flight to Target Area - - - - - 2 hours

Determination of the sight angle(s).

$$S = D / E - L / B / P$$

D = 25 mils (page 9, OP 2532) Enter with CAS of 280 kts,  $10^\circ$  Dive Angle and 500 feet.

$$E = f(A/L)$$

f = .688 (page 20, OP 2532) Enter with CAS of 280 kts,  $10^\circ$  Dive Angle and 500 feet.



A = 12 mils (WAV Graph) Enter with CAS of 280 kts, Gross weight of 14000 pounds. (Take-off weight minus fuel consumed to target area.)

L = 0 (Always zero on the JOV-1C).

E = f(A/L)

E = .688 (12/0)

E = 8.3 mils.

$$\begin{array}{r} .688 \\ \underline{12} \\ 1376 \\ \underline{688} \\ 8.256 \end{array}$$

L = 0 (Always zero on the JOV-1C)

B = 0 (Always zero on the JOV-1C)

P = 0 (Negligible on the JOV-1C)

Therefore: S = D / E - L / B / P

S = 25 / 8 - 0 / 0 / 0

S = 33 mils.



JOV-1C (MOHAWK)

FIRING TABLES

AIR-TO-GROUND

FOR

2.75 INCH AIRCRAFT ROCKETS MARK 4 AND MODS.

Prepared By:

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USAAVNS

26 April 1963



These firing tables will provide a rapid means for determining sight angle settings for the JOV-1C Armed Mohawk.

The structure of these tables requires the following information for entry and are for targets at sea level:

Aircraft Weight

Dive Angle

Altitude Above  
Target

These tables are in four (4) parts. Part I is for 0° Dive Angle: 12,000 pounds; IB: 14,000 pounds; IC: 16,000 pounds. Part II is for 15° Dive Angle; IIA: 12,000 pounds; IB: 14,000 pounds; IIC: 16,000 pounds. Part III is for 30° Dive Angle; IIIA: 12,000 pounds; IIIB: 14,000 pounds; IIIC: 16,000 pounds. Part IV is for 50° Dive Angle; IVA: 12,000 pounds; IVB: 14,000 pounds; IVC: 16,000 pounds.

For Dive Angles, Weights and Altitudes above the target that are not shown directly in these tables interpolation is required.

Future Tables will include the following:

Part V	Time of Flight
Part VI	Correction to Sight Setting for 1,000 feet. Height of Target Above Sea Level.
Part VII	Correction to Time of Flight for 1,000 feet. Height of Target Above Sea Level.
Part VIII	Ground Firing Tables
Part IX	Same as Part I, except for -50 Deg F Rocket Propellant Temperature.



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 12,000 POUND AIRCRAFT  
 DIVE ANGLE 0°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
50	68	57	48	42	37	33	30	27	24	22	20	17
100	73	62	53	47	42	38	35	32	29	27	25	22
150	77	66	57	51	46	42	38	35	33	31	29	26
200	80	69	61	54	49	45	41	38	36	34	32	29
300	86	75	67	60	55	51	47	44	42	39	37	34
400	91	80	72	65	60	56	53	50	47	45	42	40
500	97	86	78	71	66	62	58	55	52	50	47	45
600	102	91	83	76	71	67	63	60	58	55	52	50
800	112	101	93	86	81	77	73	70	67	65	62	60
1000	123	111	103	96	91	87	83	80	77	74	71	69
1200	132	120	112	105	100	96	92	89	86	83	80	78
1400	141	129	121	114	108	104	100	97	96	91	88	86
1600	150	138	129	123	117	113	109	106	103	100	97	95
1800	158	145	137	131	125	121	117	113	110	107	104	102

JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 14,000 POUND AIRCRAFT  
 DIVE ANGLE 0°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
50	76	64	54	48	41	36	33	29	26	24	21	19
100	81	69	59	53	46	41	38	34	31	29	26	24
150	85	73	63	57	50	45	41	38	35	33	30	27
200	88	76	66	60	53	48	44	41	38	36	33	30
300	94	82	72	66	59	54	50	47	44	41	38	36
400	99	87	77	71	64	60	56	52	49	47	44	42
500	105	93	84	77	70	65	61	57	54	52	49	47
600	110	98	89	82	75	70	66	63	60	57	54	52
800	120	108	99	92	85	80	76	72	69	67	64	61
1000	130	118	109	102	95	90	86	82	79	76	73	71
1200	139	127	118	111	104	99	95	91	88	85	82	79
1400	148	136	127	119	112	107	103	99	96	93	90	88
1600	157	145	135	128	121	116	112	108	105	102	99	96
1800	165	152	143	136	129	124	120	116	112	109	106	104



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 16,000 POUND AIRCRAFT  
 DIVE ANGLE 0°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

Height Above Target Feet	CALIBRATED AIRSPEED (KNOTS)											
	160	180	200	220	240	260	280	300	320	340	360	380
50	83	70	61	53	46	41	36	32	29	26	23	21
100	88	75	66	58	51	46	41	37	34	31	28	26
150	92	79	70	62	55	50	44	41	38	35	32	29
200	95	82	73	65	58	53	47	44	41	38	35	32
300	101	88	79	71	64	59	53	50	47	44	40	38
400	106	93	84	76	69	64	59	54	52	49	46	44
500	112	99	90	82	75	70	64	60	57	54	51	49
600	117	104	95	87	80	75	69	66	63	60	56	54
800	127	114	105	97	90	85	79	75	72	69	66	63
1000	137	124	115	107	100	95	89	85	82	79	75	73
1200	146	133	124	116	109	104	98	94	91	88	84	81
1400	156	142	133	125	117	112	106	102	99	96	92	90
1600	165	151	141	134	126	121	115	111	108	105	101	98
1800	173	158	149	142	134	129	123	119	115	112	108	106

JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 12,000 POUND AIRCRAFT  
 DIVE ANGLE 15°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

Height Above Target Feet	CALIBRATED AIRSPEED (KNOTS)											
	160	180	200	220	240	260	280	300	320	340	360	380
200	59	47	39	32	27	23	20	17	14	12	9	7
300	63	51	43	36	30	27	23	20	17	14	11	10
400	65	53	45	38	33	30	26	23	20	17	14	12
500	67	56	48	41	35	31	28	25	22	18	16	14
600	69	58	50	43	37	33	29	26	24	21	18	16
800	72	60	52	45	39	35	31	28	26	23	20	19
1000	74	62	54	47	42	38	34	31	28	25	22	21
1500	80	68	60	53	47	43	39	36	33	30	27	25
2000	87	75	66	59	54	50	45	42	39	36	33	31
2500	94	82	73	66	60	55	51	48	45	42	39	37
3000	102	90	81	74	68	64	59	56	52	49	46	44
3500	111	98	89	81	75	71	66	63	60	57	53	50



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 14,000 POUND AIRCRAFT  
 DIVE ANGLE 15°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
200	67	53	45	38	31	26	23	19	16	14	11	8
300	70	57	49	42	35	30	26	22	19	16	13	11
400	73	59	51	44	38	33	29	25	22	19	16	13
500	75	62	54	47	40	34	31	27	24	21	18	15
600	77	65	56	48	41	36	32	28	26	23	20	17
800	80	67	57	51	44	38	34	30	28	25	22	20
1000	82	69	59	53	46	41	37	33	30	27	24	22
1500	88	75	66	59	52	46	42	38	35	32	29	26
2000	95	82	72	65	58	52	48	44	41	38	35	32
2500	102	89	79	71	64	58	54	50	47	44	41	38
3000	110	97	87	79	72	67	62	58	54	51	48	45
3500	119	105	95	87	80	74	69	65	62	59	55	51

JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 16,000 POUND AIRCRAFT  
 DIVE ANGLE 15°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
200	74	60	51	44	36	31	26	22	19	17	13	10
300	78	64	55	48	39	35	29	25	22	19	15	13
400	80	66	57	49	42	38	32	28	25	22	18	15
500	82	69	60	52	44	39	34	30	27	24	20	17
600	84	71	62	54	46	41	35	31	29	26	22	19
800	87	73	64	56	48	43	37	33	31	28	24	22
1000	89	76	66	58	51	46	40	36	33	30	26	24
1500	95	82	72	64	56	51	45	41	38	35	31	28
2000	102	88	78	70	63	58	51	47	44	41	37	34
2500	109	95	85	77	69	63	57	53	50	47	43	40
3000	118	104	94	85	77	72	66	61	57	55	50	47
3500	126	111	102	92	84	79	73	68	65	62	57	53

61 31 41  
 64 34 44

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JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 12,000 POUND AIRCRAFT  
 DIVE ANGLE 30°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
500	58	47	38	32	27	23	20	17	14	11	9	7
1000	64	53	44	38	33	29	25	22	20	17	14	13
1500	68	56	48	41	36	32	28	26	23	20	17	15
2000	71	59	51	44	39	35	31	28	25	22	20	18
2500	74	61	53	46	41	37	33	30	27	24	22	20
3000	76	64	56	49	43	39	35	32	30	27	24	22
3500	79	66	59	51	45	42	38	34	32	29	26	24
4000	82	70	61	53	48	44	40	37	34	31	28	26
4500	85	73	64	56	51	47	43	40	36	33	31	29
5000	88	77	67	59	54	50	46	43	39	36	33	31
5500	93	81	70	64	57	53	49	46	42	39	36	34
6000	97	84	74	68	61	57	52	48	45	42	39	37
6500	101	88	78	71	65	60	56	52	46	45	42	41
7000	105	92	82	75	69	64	59	56	52	49	46	44



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 14,000 POUND AIRCRAFT  
 DIVE ANGLE 30°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
500	66	54	44	38	31	26	23	19	16	13	11	8
1000	72	60	50	44	37	32	28	24	22	19	16	14
1500	76	63	54	47	40	35	31	28	25	22	19	16
2000	78	66	57	50	43	38	34	30	27	24	22	19
2500	82	68	59	52	45	40	36	32	29	26	24	21
3000	84	71	62	55	47	42	38	34	32	29	26	23
3500	87	73	65	57	49	45	41	36	34	31	28	25
4000	90	77	67	59	52	47	43	39	36	33	30	27
4500	93	81	70	62	55	50	46	42	38	35	33	30
5000	96	84	73	65	58	53	49	46	41	38	35	32
5500	101	88	76	69	61	56	52	49	44	41	38	35
6000	105	91	80	73	66	60	55	51	47	44	41	38
6500	109	95	84	76	70	63	59	55	48	47	44	42
7000	113	99	88	80	74	67	62	59	54	51	48	45



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 16,000 POUND AIRCRAFT  
 DIVE ANGLE 30°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

CALIBRATED AIRSPEED (KNOTS)

Height Above Target Feet	160	180	200	220	240	260	280	300	320	340	360	380
500	73	60	51	43	36	31	26	22	19	16	13	10
1000	79	66	57	49	42	37	31	27	25	22	18	16
1500	83	69	60	52	45	40	34	31	28	25	21	18
2000	86	72	63	55	48	43	37	33	30	27	24	21
2500	89	74	65	58	50	45	39	35	32	29	26	23
3000	91	78	69	61	52	47	41	37	35	32	28	25
3500	94	80	72	63	54	50	45	39	37	34	30	27
4000	97	84	74	65	57	52	47	42	39	36	32	29
4500	101	87	77	68	60	55	50	45	41	38	35	32
5000	104	90	80	71	63	58	53	48	44	41	37	34
5500	108	94	83	75	66	61	56	51	47	44	40	37
6000	112	97	87	79	70	65	59	53	50	47	43	40
6500	116	102	91	82	74	68	63	57	51	50	46	44
7000	120	106	95	86	78	72	66	61	57	54	50	47



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 12,000 POUND AIRCRAFT  
 DIVE ANGLE 50°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

Height Above Target Feet	CALIBRATED AIRSPEED (KNOIS)											
	160	180	200	220	240	260	280	300	320	340	360	380
1500	59	47	39	32	27	23	20	17	15	12	10	8
2000	60	48	41	34	29	26	22	20	17	14	11	10
2500	62	50	42	35	30	27	23	21	18	15	13	11
3000	63	51	43	36	32	28	24	22	19	16	14	12
3500	64	52	44	37	33	29	25	22	20	17	15	13
4000	65	53	45	39	34	30	26	23	21	18	16	14
4500	66	55	46	40	35	31	27	24	22	19	17	15
5000	68	57	48	42	36	32	28	25	23	20	18	16
5500	71	58	49	43	37	33	30	27	24	21	19	17
6000	72	60	50	44	38	34	31	28	25	23	20	18
6500	73	61	52	46	40	36	32	29	26	24	21	19
7000	75	62	53	47	41	37	33	30	28	25	22	20
7500	77	64	54	48	42	39	34	31	29	26	23	21
8000	78	66	56	50	44	40	36	33	30	27	24	22
8500	79	67	59	52	46	41	38	34	32	28	25	23
9000	81	69	61	54	47	43	39	36	33	30	27	24



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 14,000 POUND AIRCRAFT  
 DIVE ANGLE 50°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

Height Above Target Feet	CALIBRATED AIRSPEED (KNOTS)											
	160	180	200	220	240	260	280	300	320	340	360	380
1500	66	54	45	38	31	26	23	19	17	14	12	9
2000	67	55	47	40	33	29	25	22	19	16	13	11
2500	70	57	48	41	34	30	26	23	20	17	15	12
3000	71	58	49	42	36	31	27	24	21	18	16	13
3500	72	59	50	43	37	32	28	24	22	19	17	14
4000	73	60	51	45	38	33	29	25	23	20	18	15
4500	74	63	52	46	39	34	30	26	24	21	19	16
5000	76	64	54	47	40	35	31	27	25	22	20	17
5500	78	65	55	48	41	36	33	29	26	23	21	18
6000	80	67	56	49	43	37	34	30	27	25	22	19
6500	81	68	58	51	45	39	35	31	28	26	23	20
7000	83	69	60	53	46	40	36	32	30	27	24	21
7500	85	71	61	54	47	42	37	33	31	28	25	22
8000	86	73	63	56	49	43	39	36	32	29	26	23
8500	87	74	65	58	51	44	41	37	34	30	27	24
9000	90	76	67	60	52	46	42	39	35	32	29	25



JOV-1C  
 2.75 INCH ROCKET  
 SIGHT SETTINGS MILS  
 16,000 POUND AIRCRAFT  
 DIVE ANGLE 50°

PROPELLANT TEMPERATURES  
 -10 Deg F to 130 Deg F

Height Above Target Feet	CALIBRATED AIRSPEED (KNOTS)											
	160	180	200	220	240	260	280	300	320	340	360	380
1500	73	60	51	43	36	31	26	22	20	17	14	11
2000	75	61	53	45	38	34	28	25	22	19	15	13
2500	77	63	54	46	39	35	29	26	23	20	17	14
3000	78	65	55	48	41	36	30	27	24	21	18	15
3500	79	66	57	49	42	37	31	27	25	22	19	16
4000	80	67	58	51	43	38	32	28	26	23	20	17
4500	82	69	59	52	44	39	33	29	27	24	21	18
5000	84	70	61	53	45	40	35	30	28	25	22	19
5500	86	71	62	54	46	41	37	32	29	26	23	20
6000	87	73	63	55	47	42	38	33	30	28	24	21
6500	88	75	65	57	49	44	39	34	31	29	25	22
7000	91	76	66	59	50	45	40	35	33	30	26	23
7500	93	78	67	60	51	47	41	36	34	31	27	24
8000	94	80	69	62	53	48	43	38	35	32	28	25
8500	95	81	72	64	55	49	45	40	37	33	29	26
9000	97	83	74	66	56	51	46	42	38	35	31	27