

INCH-POUND

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SUPERSEDING

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MILITARY SPECIFICATION

COMPUTER, AIR NAVIGATION, DEAD RECKONING
TYPE MB-4A AND TYPE CPU-26A/P

This specification is approved for use by all Department and Agencies of the Department of Defense

1. SCOPE

1.1 Scope. This specification covers a dead reckoning computer.

1.2 Classification. The computer shall be of the following types, as specified (see 6.2).

Type MB-4A	Overall length	11.125 inches
	Width	4.790 inches
	Slide	0 to 200 knots airspeed
Type CPU-26A/P	Overall length	7.416 inches
	Width	3.190 inches
	Slide	0 to 800 knots airspeed

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the

beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Oklahoma City Air Logistics Center TICLA, Tinker AFB, OK 73145-5090, using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC: 6005

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extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement, thereto, cited in the solicitation (see 6.2)

SPECIFICATIONSFederal

L-P-375	Plastic Film, Flexible, Vinyl Chloride
L-P-575	Plastic Sheeting (Sheeting) Vinyl Chloride Polymer and Vinyl Chloride-Vinyl Acetate Copolymer, Rigid
QQ-A-250/BE	Aluminum Alloy Plate and Sheet 5052
QQ-S-781	Steel Strapping, Flat
PPP-B-566	Boxes Folding, Paperboard
PPP-B-536	Boxes, Shipping, Fiberboard

Military

MIL-F-116	Preservation, Methods Of
DOD-D-1000P	Drawing, Engineering And Associated Lists
MIL-A-8625	Anodic Coatings For Aluminum And Aluminum Alloys

STANDARDSFederal

FED-STD-101	Preservation, Packaging And Packing Materials: Test Procedures
FED-STD-595	Colors

Military

MIL-STD-129	Marking For Shipment And Storage
MIL-STD-173	Identification Marking Of U.S. Military Property
MIL-STD-883C	Standards And Specifications Order Of Precedence For The Selection Of
MIL-STD-2000 1A	DDI Material Procedures For Development And Application Of Packaging Requirements
MS2-514	Computer, Air Navigation, Dead Reckoning, Type MB-4A And Type DPL-26A/F

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Ave, Building #4, Section D, Philadelphia, PA 19111-5094.

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated

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2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.4), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.1.1 Referenced documents. In the event the documents referenced herein conflict with this specification, the requirements of this specification shall take precedence over all referenced documents.

3.2 Materials. Materials shall be non-magnetic, and as specified herein, except for the center eyelet, the leaf springs, the rivets holding the spacers and slide holder together, and the screws and nuts. These items may be either non-magnetic or magnetic. The surface finish of all aluminum sheet parts shall be Type II, Class 1, anodic coating, in accordance with MIL-A-8625, which shall be applied processed prior to lithographing, etching, or engraving the finishing. When specifications and standards are not specifically designated, selection of materials and processes shall be in accordance with MIL-STD-970.

3.2.1 Recycled, virgin and reclaimed materials. Recycled and reclaimed materials are utilized to the maximum extent possible without jeopardizing the intended end use of the item.

3.3 Design and construction. The types MB-44 and CPU-26A/F computers shall conform to MSC6514. The types are identical, except in size. All dimensions shall be as shown on MSC6514 with the exceptions that dimensions H, L, and N on this drawing may be varied downward to a minimum of $\phi .040$ inch and dimension "D" may be varied downward to a minimum of $\phi .020$ inch. The computer shall be a hand-held mechanical device, consisting of a slide and slide holder. The slide and slide holder shall be either full-hard or half-hard temper, aluminum conforming to QQ-A-254/6, or ASTM E209 alloy 5005. The other side of the holder, which has the rotatable dial, shall be designed for use with either side of the slide in making speed, drift, wind, heading and track computations. The holding brackets may be eliminated by the method of construction described in a paragraph 3.3.2.2. All numerals on the slide holder shall be in boldface type.

3.3.1. Slide holder, rotating dial side.

3.3.1.1. LOGARITHMIC scales. The logarithmic scales shall form a circular slide rule with the C and D scales for speed and distance computations. The

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fixed outer logarithmic scale shall be marked MILES, and the movable inner logarithmic scale MINUTES. (See Table I and Figure 1 and 2). The scales on the computer shall be arranged to utilize the two logarithmic scales in solving the true air speed, corrected altitude, and crosswind component. The angular valves used in laying out the various scales shall be in accordance with Tables I through VIII.

TABLE I. LOGARITHMIC SCALES

Miles and Minutes	Angle Degrees-Minutes		Miles and Minutes	Angle Degrees-Minutes		Miles and Minutes	Angle Degrees-Minutes	
100	00	00	121	29	48	142	54	49
101	01	33	122	31	05	143	55	55
102	03	06	123	32	22	144	57	01
103	04	37	124	33	38	145	58	06
104	06	08	125	34	53	146	59	10
105	07	38	126	36	08	147	60	14
106	09	07	127	37	22	148	61	18
107	10	35	128	38	36	149	62	21
108	12	02	129	39	49	150	63	24
109	13	28	130	41	01	152	65	28
110	14	54	131	42	17	154	67	30
111	16	19	132	43	24	156	69	31
112	17	43	133	44	35	158	71	31
113	19	06	134	45	45	160	73	29
114	20	29	135	46	55	162	75	26
115	21	51	136	48	04	164	77	21
116	23	12	137	49	17	166	79	14
117	24	33	138	50	21	168	81	07
118	25	53	139	51	29	170	82	58
119	27	12	140	52	36	172	84	47
120	28	30	141	53	43	174	86	36
170	88	27	252	144	31	270	204	33
178	90	00	254	145	44	275	206	39
180	91	54	256	146	58	280	208	47
182	93	38	258	148	11	285	210	48
184	95	21	260	149	27	290	212	47
186	97	04	262	150	38	295	214	46
188	98	42	264	151	47	300	216	44
190	100	21	266	152	57	305	218	41
192	103	59	268	154	08	310	220	38
194	105	37	270	155	17	315	222	37
196	108	15	272	156	27	320	224	32
198	106	48	274	157	35	325	226	27
200	108	22	276	158	44	330	228	23
202	109	55	278	159	51	335	229	51

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204	111	28	280	160	59	440	231	39
206	113	00	282	162	05	445	233	25
208	114	30	284	163	12	450	235	09
210	116	00	286	164	18	455	236	53
212	117	29	288	165	23	460	238	36
214	118	57	290	166	28	465	240	17
216	120	24	292	167	32	470	241	57
218	121	51	294	168	36	475	243	37
220	123	16	296	169	40	480	245	15
222	124	41	298	170	43	485	246	52
224	126	05	300	171	46	490	248	28
226	127	29	305	174	21	495	250	03
228	128	51	310	176	53	500	251	38
230	130	13	315	179	24	505	253	11
232	131	35	320	181	51	510	254	44
234	132	55	325	184	17	515	256	15
236	134	15	330	186	40	520	257	46
238	135	34	335	189	01	525	259	15
240	136	53	340	191	20	530	260	44
242	138	10	345	193	37	535	262	12
244	139	28	350	195	52	540	263	40
246	140	44	355	198	05	545	265	06
248	142	00	360	200	16	550	266	32
250	143	16	365	202	26	555	267	57
560	269	21	680	299	42	840	332	44
565	270	44	690	301	59	850	334	35
570	272	07	700	304	14	860	336	25
575	273	29	710	306	27	870	338	14
580	274	50	720	308	38	880	340	01
585	276	11	730	310	48	890	341	47
590	277	30	740	312	55	900	343	32
595	278	50	750	315	01	910	345	15
600	280	08	760	317	06	920	346	58
610	282	43	770	319	08	930	348	39
620	285	16	780	321	14	940	350	20
630	287	46	790	323	05	950	351	56
640	290	17	800	325	07	960	353	37
650	292	39	810	327	07	970	355	14
660	295	1	820	328	50	980	356	50
670	297	27	830	330	52	990	358	26

2.2.1.1. Lines The beginning (number 10) of the miles scale shall be located on the vertical center line of the slide holder (see MSC-514 and Figure 2) within $\pm .25\%$. The dash mark indicating this position shall be the referenced for all other markings and data contained in Tables I, III, IV, VI, and Temperature portion of Table VII. The number 10 of the miles scale shall be at the top of the computer. It shall be marked by natural

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color aluminum digits in a black square approximately 1/8-inch, on the type MB-4A computer, and proportionally smaller on the CPU-26A/P computer. The square shall not interfere with any scale divisions. The 66, 76, and 122 divisions on the miles scale shall be arrows pointing toward the center of the computer. The 66 and 76 arrows shall be joined by a conspicuous arc which clears the numeral 70. The 66 arrow shall be marked NAUT, and the 76 marked STAT. The 122 arrow shall be marked k.m. This provides a means for converting kilometers into miles. The miles scale shall be subdivided and numerals provided as in Figure 2.

3.3.1.1.2. Minutes. The minutes scale is located on the rotating dial. The beginning of the minutes scale shall be designated by a number 10, marked by natural color aluminum digits in a black square approximately 1/8-inch, on the CPU-26A/P computer. The minutes scale shall be subdivided and numerals provided to correspond with the miles scale, and as shown in Figure 1. A small arrow shall point outward on the minutes scale at 36 marked SEC, and at 76 marked STAT. The word MINUTES shall be printed in boldface type between the numbers 10 and 11, and (on the opposite side of the rotating dial) between 30 and 35. The legend CAL. A.S. shall be printed at approximately 90° from the index (number 10) on the minutes scale, and (directly opposite) the legend CAL. ALT. A prominent index shall be placed at the 00-minute mark to facilitate computations.

3.3.1.1.3. Hours. Adjacent to the minute scale there shall be a scale marked HOURS, subdivided in 5-minute intervals from 1 to 2 hours, and in 10-minute intervals from 2 to 10 hours, except the 2-hour 40-minute marking and the 2-hour 50-minute marking shall be omitted. Integral hour divisions and between 2 and 5 hours, in 30-minute divisions. The hour scale shall be oriented that the 1-hour division coincides with the 00-minute division of the minute scale. (See Table II and Figure 1.)

3.3.1.2. Drift correction scales. Scales for computing drift from miles off course, miles flown, and course miles to go, shall be located between arrows (one pointing inward and one pointing outward) on the rotating dial. An opening shall be cut in the rotating dial for drift correction values to be visible. The extremities of the opening shall be radii with 101 to 107 and 141 to 142 minutes. The arrows shall be placed at 29 degrees 01 minute, measured clockwise from the zero position at 10 on the minutes scale (See Figure 1). The drift correction scales shall consist of an outer and an inner scale, located on the slide holder. The outer scale range shall be from 1.0 to 7.5 degrees, and shall be continuous from this point up to 45 degrees, except that from 9 to 45 degrees the numbers and graduations shall be on the inner scale. The scales shall be in accordance with Table III and Figure 3, and the following:

- a. The numerals and graduations shall be as large as practicable.

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Leave small radius in
these windows to give
strength for stamping
purposes

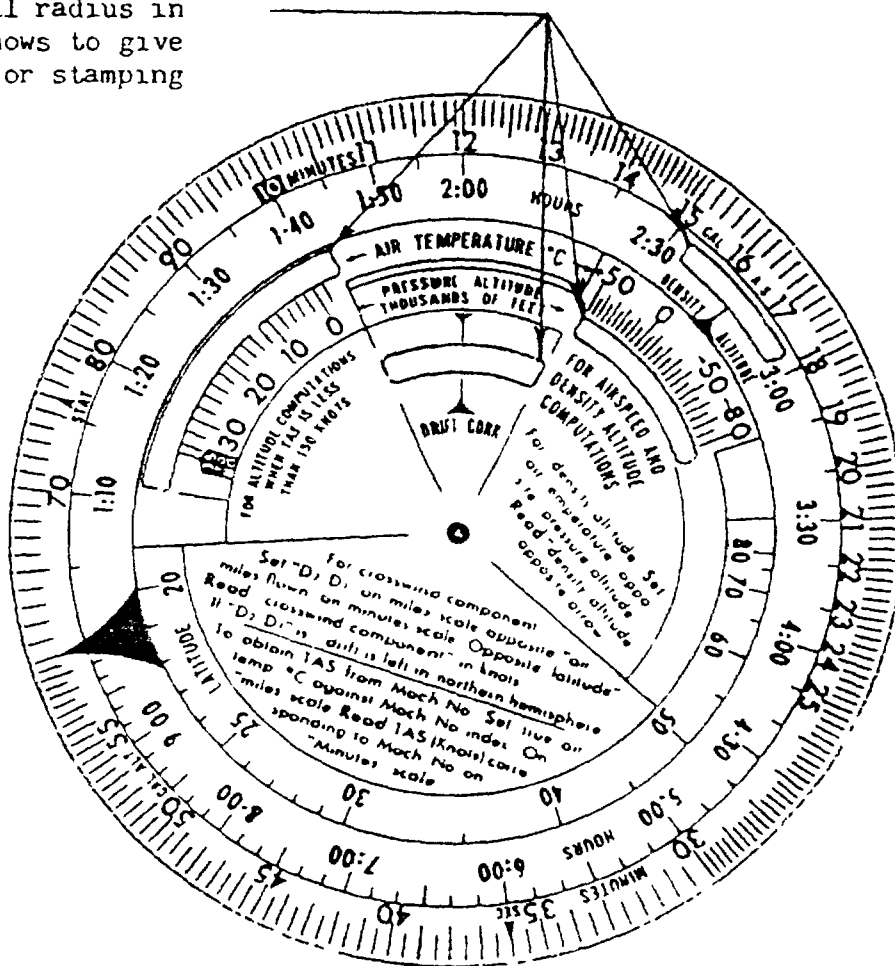


FIGURE 1. Rotating Dial, location of scale windows

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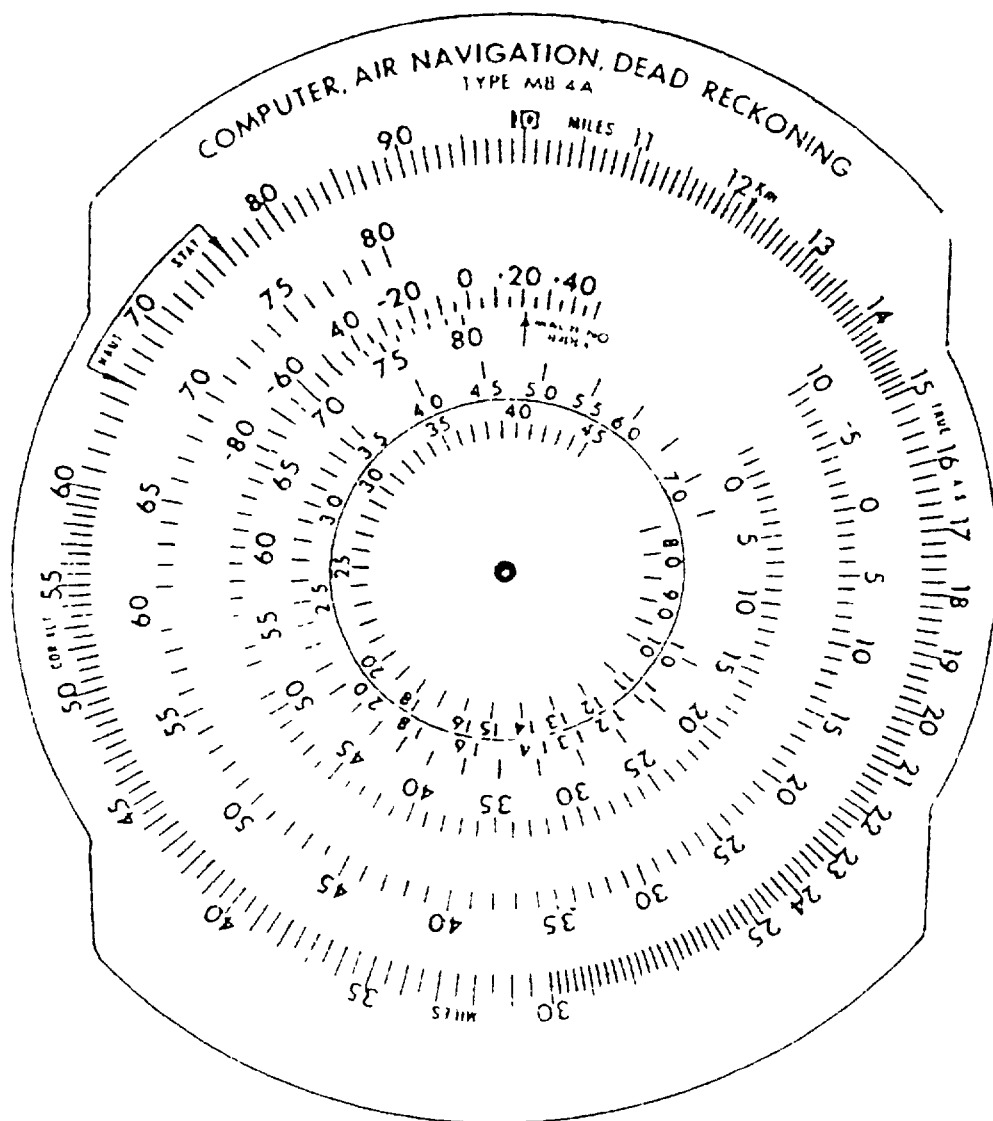


FIGURE 2. Slide Holder, front face.

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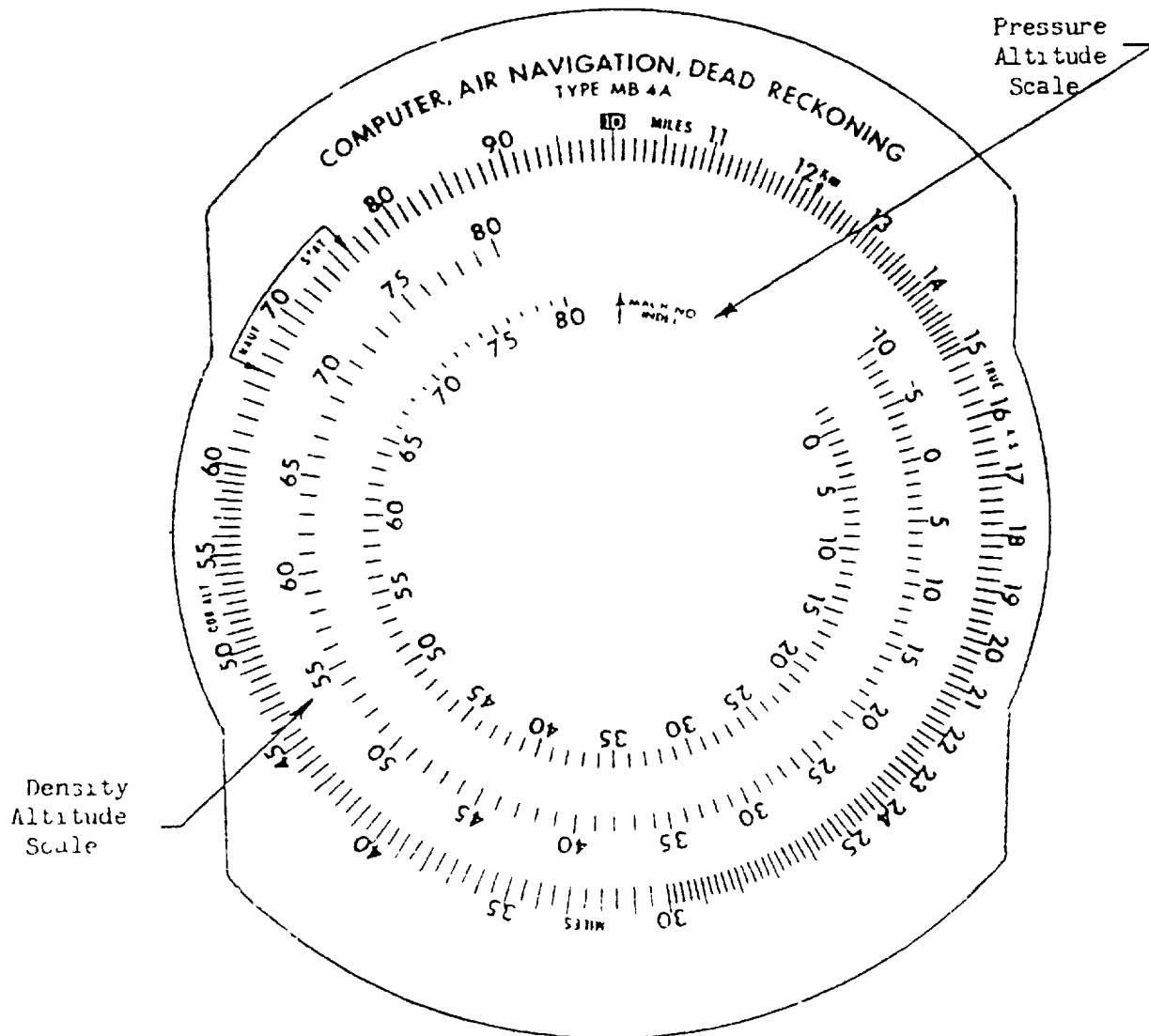


FIGURE 1. Slide Rule view of Density Altitude and Pressure Altitude Scales.

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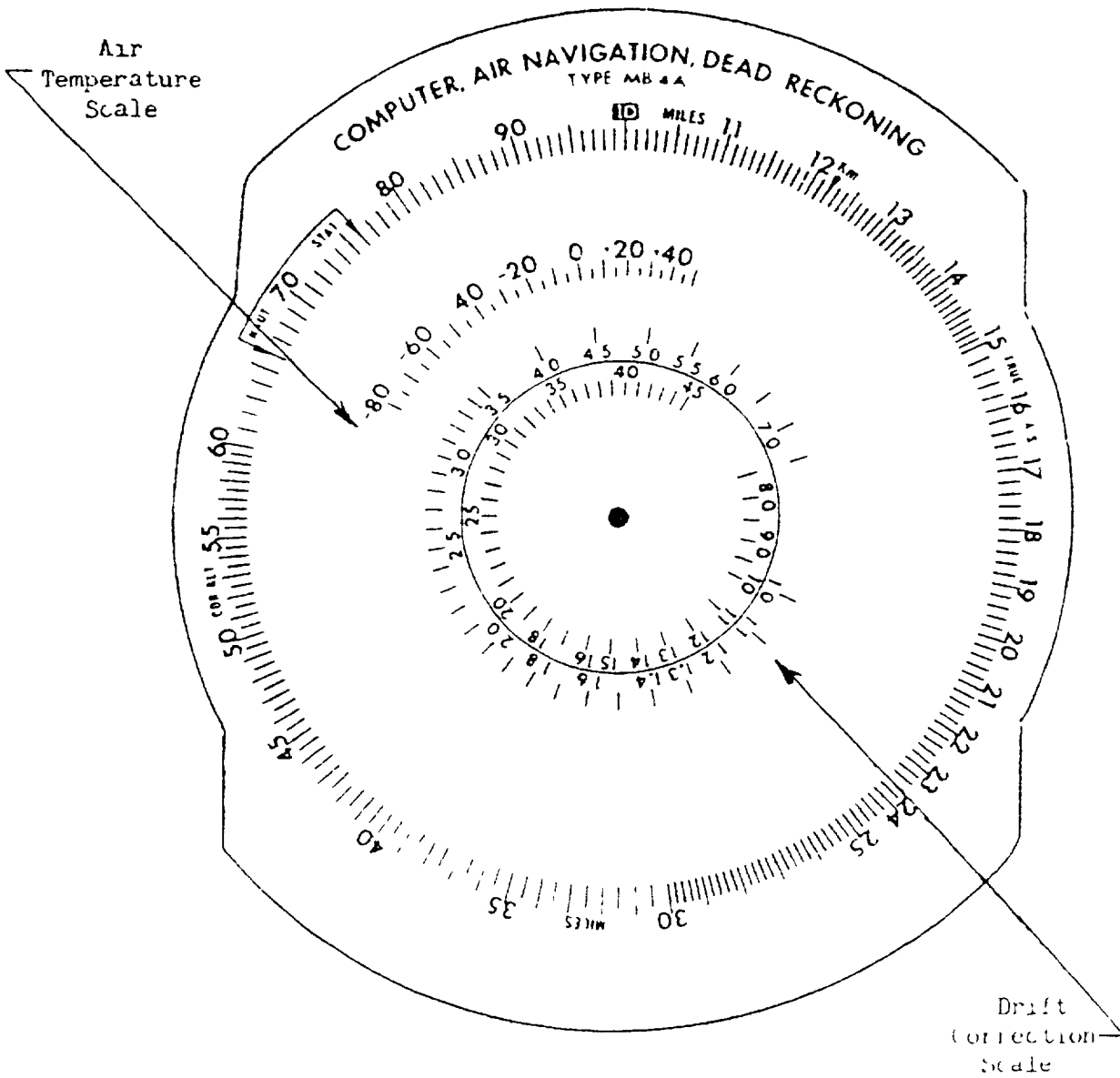


FIGURE 1. Slide Holder, view of Drift Correction and Air Temperature scales.

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b. Numerals shall be placed at every graduation from 1 to 1.4, and 1.6, 1.8, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, and at every whole number graduation from 6 through 16, 18, and 20. Every fifth whole graduation from 25 through 45 shall also be numbered.

TABLE II. HOUR SCALE

Hours	Angle		Hours	Angle	
	Degrees	Minutes		Degrees	Minutes
1:05	292	39	2:00	28	30
1:10	304	14	2:10	41	01
1:15	315	01	2:20	52	36
1:20	325	47	2:30	63	24
1:25	334	36	2:40	73	29
1:30	342	22	2:50	82	58
1:35	351	59	3:00	91	54
1:40	000	00	3:10	100	21
1:45	007	38	3:20	108	22
1:50	014	54	3:30	116	00
1:55	021	51	3:40	125	16
2:00	130	13	3:50	134	22
4:00	136	53	7:10	226	03
4:10	143	16	7:20	231	39
4:20	149	23	7:30	235	09
4:30	155	17	7:40	238	36
4:40	160	59	7:50	241	57
4:50	166	28	8:00	245	15
5:00	171	46	8:10	248	28
5:10	176	53	8:20	251	38
5:20	181	51	8:30	254	44
5:30	185	41	8:40	257	45
5:40	191	20	8:50	260	45
5:50	195	52	9:00	263	40
6:00	200	16	9:10	266	32
6:10	204	33	9:20	269	21
6:20	208	43	9:30	272	07
6:30	212	47	9:40	274	50
6:40	215	45	9:50	277	30
6:50	220	31		280	15

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TABLE III. DRIFT SCALE FOR DRIFT COMPUTATION

Drift Angle in degrees	Angle Degrees-Minutes		Drift Angle in degrees	Angle Degrees-Minutes	
1.0	116	06	2.1	232	09
1.1	131	00	2.2	239	25
1.2	144	36	2.3	246	23
1.3	157	07	2.4	253	03
1.4	168	43	2.5	259	26
1.5	179	30	2.6	265	34
1.6	189	36	2.7	271	29
1.7	199	05	2.8	277	11
1.8	208	02	2.9	282	40
1.9	216	29	3.0	287	59
2.0	224	31	3.1	293	07
3.2	298	06	20	230	59
3.3	302	55	21	239	18
3.4	307	16	22	247	19
3.5	312	08	23	255	02
4.0	333	04	24	262	29
4.5	351	33	25	269	43
5.0	008	06	26	276	45
5.5	023	05	27	283	35
6.0	036	47	28	290	15
6.5	049	24	29	296	45
7.0	051	06	30	303	07
7.5	072	00	31	309	21
8.0	082	17	32	315	29
8.5	091	49	33	321	30
9.0	100	54	34	327	26
9.5	109	30	35	333	17
10.0	117	40	36	339	07
11	132	55	37	344	46
12	146	53	38	350	25
13	159	40	39	356	01
14	171	50	40	361	14
15	183	06	41	367	06
16	195	42	42	373	12
17	207	43	43	379	05
18	217	14	44	385	12
19	228	19	45	391	06

3.3.1.3. True airspeed scales. Scale for computing true airspeed from indicated airspeed, air temperature, and pressure altitude shall be provided. The air speed computations shall provide corrections for standard pressure altitude in 1,000-foot steps from 2,000 feet below to 20,000 feet above sea

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level, and for air temperature from -80° to $+50^{\circ}$ C., in 5-degree steps. Pressure altitude scales (see Table IV and Figure 4) and air temperature scales (see Table V and Figure 1) shall be provided. An opening shall be cut in the rotating dial for pressure altitude values to be visible. The extremities of the opening shall be radial with 140 to 142 and 190 to 192 minutes. An arrow shall point outward on fixed surface of the slide holder, under the rotating dial, at an angular position of 1 degree, 45 minutes, measured clockwise from the zero position at 10 on the miles scale, to be visible in the pressure altitude window. The words MACH NO. INDEX shall appear in the clear space on the right side of the arrow, and INDEX shall be centered under MACH NO.

3.3.1.4 Density altitude. A scale for computing density altitude from the air temperature and pressure altitude scales used in solving true air speed opposite an arrow pointing outward on the rotating dial. An opening shall be cut in the dial between $2:30$ and $3:00$ on the hours scale for the density altitude scale to be visible. The extremities of the opening shall be radial with 153 to 154 and 176 to 177 minutes. (see Table VI and Figures 1 & 4).

3.3.1.5. Altitude correction. A scale for correction of indicated altitude for air temperature shall provide correction of the observed altimeter value, using either the free air temperature and assuming the standard temperature lapse rate, or the actual mean temperature of the atmosphere. The temperature scale shall extend in 5-degree steps from -80° to $+50^{\circ}$ C and the altitude scale in 2,000-foot steps from 2,000 feet below to 35,332 feet above sea level. A SOLID black figure marked 35 to 80 in a natural color aluminum, shall be placed at the 35,332-foot mark on the rotating dial. The temperatures scales shall be on the fixed surface of the slide holder, under the rotating dial, and the pressure altitude values on the rotating dial. An opening shall be cut in the rotating dial for temperature values to be visible. The extremities of the opening shall be radial with 72 to 73 and 103 to 105 minutes. (see Table VII and Figures 1 & 3).

3.3.1.6. Latitude scale. A scale marked LATITUDE shall be provided on the rotating dial inside the minute and the hour scales. The scale shall be marked for 20 to 90 degrees latitude, in 1-degree increments from 20 to 30 degrees, and in 5-degree increments from 30 to 90 degrees. This scale is for finding the crosswind component of the wind (see Table VIII and Figure 1). The angular values listed in these tables are referenced from the position of the applicable logarithmic index (number 10).

3.3.1.7. Construction. The rotating dial shall be formed slightly concave in shape in order to force the edge of rotating dial flush (without binding) when attached to the slide holder. A circular vinyl washer 0.110 to 0.115 -inch thick, of a diameter that will prevent the washer extending into the drift correction opening, shall be installed between the rotating dial and the rest of the holder to prevent chafing.

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3.3.2. Slide holder, rotatable disk.

3.3.2.1. Drift computations. A rotatable disk shall be provided for use in conjunction with the slide for speed and drift computation. The circumference of the rotatable disk shall be graduated in 1-degree divisions through 360 degrees to within an accuracy of one-fourth degree. The fixed portion of the slide holder shall be provided with an index relative to the scale on the rotatable disk, which shall track over the zero drift line of the slide holder, relative to the scale on the rotatable disk, shall extend from 45 degrees left to 45 degrees right of the index in 1-degree steps to within an accuracy of one-fourth degree. This scale on the left of the index shall be marked DRIFT LEFT and VAR EAST and on the right side, VAR WEST and DRIFT RIGHT. All degree scales shall have each 10-degree division numbered. The index or zero division of the fixed scale shall be conspicuously marked TRUE INDEX. (See Figure 5).

3.3.2.2 Construction of rotatable disk. The rotatable disk shall be provided with a circular integral transparent plastic rigid sheet, 0.020 inch thick, conforming to composition B, type I, class 2 of L-F-535. Two methods of construction are approved.

3.3.2.2.1 Use of holding brackets in accordance with MS26514. If holding brackets are used, the plastic sheet shall be attached to the rear of the compass rose by eight equally spaced (a) brass, nickel plated or (b) aluminum eyelets on the CPJ-26A/P; a minimum of twelve either (a) or (b) eyelets on the MB-4A with approximately equal spacing; with the location of the eyelets not to interfere with the lettering on the compass rose. The rear of the compass rose shall be milled out to a depth of 0.021 inch to ensure that the plastic disk and the rear of the compass rose are flush. Pressure shall be maintained on the rotatable disk by a leaf spring under each holding bracket. Each spring shall be fastened at only one end and be in friction contact with the front of the compass rose.

TABLE IV. PRESSURE ALTITUDE SCALE FOR TRUE
AIRSPEED AND DENSITY ALTITUDE COMPUTATIONS

Pressure altitude in 1,000 feet	Angle Degrees-Minutes	Pressure altitude in 1,000 feet	Angle Degrees-Minutes
1	57 50	11	165 35
2	67 40	12	171 17
3	68 30	14	175 50
4	69 15	15	178 35
5	72 10	16	183 20
6	75 03	17	187 05

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4	77	57	38	190	50
5	80	51	39	194	36
6	83	48	40	198	21
7	86	45	41	202	07
8	89	44	42	205	52
9	92	44	43	209	38
10	95	45	44	213	23
11	98	48	45	217	09
12	101	52	46	220	54
13	104	57	47	224	39
14	108	04	48	228	25
15	111	12	49	232	10
16	114	22	50	235	56
17	117	33	51	239	41
18	120	46	52	243	27
19	124	00	53	247	12
20	127	16	54	250	57
21	130	33	55	254	42
22	133	52	56	258	28
23	137	13	57	262	14
24	140	35	58	265	59
25	143	59	59	269	45
26	147	24	60	273	30
27	150	51	61	277	16
28	154	20	62	281	01
29	157	51	63	284	46
30	161	24	64	288	32
31	164	58	65	292	17
66	296	03	74	325	55
67	299	49	75	329	39
68	303	37	76	333	24
69	307	17	77	337	09
70	311	41	78	340	44
71	314	48	79	344	28
72	318	29	80	348	13
73	322	12			

TABLE IV. TEMPERATURE SCALE FOR TRUE
AIRSPEED AND DENSITY ALTITUDE COMPUTATIONS

Temperature C	Angle Degrees-Minutes	Temperature C	Angle Degrees-Minutes
+50	57 31	-20	76 36
+45	58 44	-25	79 10
+40	59 59	-30	79 45
-35	61 14	-35	81 27

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+30	62	31	-40	83	02
+25	63	49	-45	84	44
+20	65	08	-50	86	28
+15	66	29	-55	88	14
+10	67	51	-60	90	00
+5	69	15	-65	91	54
0	70	40	-70	92	48
-5	72	06	-75	95	45
-10	73	35	-80	97	45
-15	75	05			

TABLE VI. DENSITY ALTITUDE SCALE FOR
DENSITY ALTITUDE COMPUTATIONS

Altitude in 1,000 feet	Angle Degrees-Minutes		Altitude in 1,000 feet	Angle Degrees-Minutes	
-10	55	31	26	147	05
-9	57	40	27	145	52
-8	59	50	28	142	41
-7	62	00	29	151	31
-6	64	12	30	154	22
-5	66	24	31	157	15
-4	68	37	32	160	10
-3	70	51	33	162	07
-2	73	06	34	166	04
-1	75	22	35	169	04
0	77	39	36	172	04
1	79	57	37	175	07
2	82	15	38	179	11
3	84	35	39	182	12
4	86	56	40	186	15
5	89	17	41	190	19
6	91	40	42	194	25
7	94	17	43	199	31
8	96	28	44	204	38
10	101	20	46	209	24
11	107	58	47	217	08
12	106	17	48	216	52
13	108	47	49	221	57
14	111	18	50	224	21
15	117	50	51	228	05
16	115	37	52	233	51
17	118	58	53	235	34
18	121	34	54	239	18
19	124	11	55	242	03
20	125	49	56	245	47

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21	129	28	57	250	31
22	132	09	58	254	15
23	134	09	58	254	15
24	137	34	60	261	44
25	140	19	61	265	28
62	269	12	72	307	06
63	272	56	73	310	54
64	276	40	74	314	42
65	280	24	75	318	30
66	284	09	76	322	17
67	287	59	77	326	04
68	291	50	78	329	51
69	295	39	79	333	37
70	299	29	80	337	23
71	302	17			

TABLE VII. SCALES FOR ALTITUDE COMPUTATIONS

Pressure altitude in 1,000 feet	Angle Degrees-Minutes	Temperature C.	Angle Degrees-Minutes	
-2	358	+50	16	13
0	358	+45	17	47
2	356	+40	11	18
4	351	+35	8	47
6	351	+30	6	17
8	346	+25	7	57
10	347	+20	0	58
12	344	+15	358	17
14	342	+10	356	33
16	340	+5	352	45
18	337	0	349	55
20	335	-5	347	02
22	331	-10	344	05
24	329	-15	341	05
26	327	-20	338	02
28	324	-25	334	54
30	322	-30	331	43
32	319	-35	328	28
34	316	-40	325	09
36 to 37	314	-45	321	46
		-50	318	18
		-55	314	45
		-60	311	07
		-65	307	32
		-70	302	38
		-75	299	44
		-80	295	44

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3.3.2.2.2 Construction without holding brackets. The holding brackets may be eliminated by extending the plastic of the rotatable disk beyond the edge of the compass rose to form a lip and modifying the spacers to clear this lip, so that the rotatable disk will be retained by the curved metal pieces that are attached with screws. The plastic disk shall be attached to the rear of the compass rose by a suitable plastic-to-metal adhesive.

3.3.2.2.3 Other details. In either type of construction, the front of the plastic disk which is surrounded by the compass rose shall be surface ground or suitably matte finished to withstand repeated pencil markings and erasures while retaining sufficient transparency for visibility of the slide markings. The center of the rotatable disk shall be marked with a black circle no larger than 1/16 inch in diameter. This center marking shall be in the true center within ± 0.010 inch. The upper and lower fixed portions of the slide holder shall have screw holes slightly larger than the screws to allow adjustment of the true index to track the centerline of the slide, and to allow adjustment of friction on the rotatable disk. The lower fixed portion of the slide holder shall bear the following inscriptions:

	+ Drift left		+ Var west
TH* = TC		MH* = Tr	
	- Drift right		- Var east
	+ Var east		+ Draft right
TH* = MH		TC* = TH	
	- Var west		- Drift left

(Where TH, MH, and TC are marked (*), they shall be printed in boldface type.)

3.3.3 Slide. Shall be constructed of 0.047 inch thick aluminum sheet (see 3.3 and MS26514). The lines, arcs and numbers on both sides shall be engraved or etched, filled with durable black material and protected by an epoxy resin coating. The epoxy resin shall be Egyptian Lacquer Manufacturing Company part number EP I-L-4 (clear semi-gloss), or equivalent.

3.3.3.1 Front side. The front side of the slide shall be provided with:

a. Drift lines in:

One-degree steps for speeds between 15 and 27 knots, numbered in 5-degree increments.

Two-degree steps for speeds between 10 and 15 knots, numbered in 10-degree increments.

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Five-degree steps for speeds between 10 and 30 knots, numbered in 10-degree increments.

Ten-degree steps between 4 and 10 knots, numbered in 10-degree increments.

Twenty-degree steps for speeds below 4 knots, numbered in 20-degree increments.

b. Arcs representing speed in 2-knot steps from 0 to 270 knots, numbered in 10-knot increments.

c. A chart and directions placed directly above the drift lines and speed arcs, as shown:

F Correction Factors for TAS

PRESS. ALT FEET	Calibrated Airspeed knots							
	200	250	300	350	400	450	500	550
10,000	1.0	1.0	.99	.99	.98	.98	.97	.97
20,000 .....	.99	.98	.97	.97	.96	.95	.94	.94
30,000 .....	.97	.96	.95	.94	.92	.91	.90	.89
40,000 .....	.96	.94	.92	.90	.88	.87	.87	.86
50,000 .....	.95	.90	.87	.86	.84	.84	.84	.84

DIRECTIONS

Use calibrated airspeed and Press. Alt to obtain F factor. Multiply F factor by TAS obtained with computer to obtain TAS corrected for compressibility.

1.1.2 Reverse side. The reverse side of the slide shall have provided:

a. Drift lines in:

One-degree steps for speeds between 250 and 800 knots, numbered in 5-degree increments.

Two-degree steps for speeds between 150 and 250 knots, numbered in 10-degree increments.

Five-degree steps for speeds below 150 knots, numbered in 10-degree increments.

b. Arcs representing speed in 10-knot steps from 70 to 800 knots, numbered in 50-knot increments.

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c. A rectangular grid placed directly below the drift line and speed arcs, as shown on MS26514.

3.3.3.3 Construction. The slide shall be constructed so that the top of one side of the card is opposite the bottom of the reverse side. The holder and slide shall be assembled in a manner to produce and maintain sufficient friction to readily permit setting and to prevent accidental shift. The zero drift line of the slide shall track under the center marking on the rotatable disk to within ± 0.010 -inch throughout its travel.

3.4 Instructions on faces of computer. The following instructions, as indicated on MS26514, shall appear on the rotating dial (all underlined words shall be in boldface letters):

FOR DENSITY ALTITUDE. SET AIR TEMPERATURE OPPOSITE PRESSURE ALTITUDE.
READ DENSITY ALTITUDE OPPOSITE ARROW.

FOR CROSSWIND COMPONENT, SET D2-D1 ON MILES SCALE OPPOSITE AIR MILES FLOWN ON MINUTES SCALE. OPPOSITE LATITUDE READ CROSSWIND COMPONENT.

IF D2-D1 IS +, DRIFT IS LEFT IN NORTHERN HEMISPHERE.

TO OBTAIN TAS FROM MACH NO., SET TRUE AIR TEMPERATURE *C. AGAINST MACH NO. INDEX. ON MILES SCALE READ TAS (KNOTS) CORRESPONDING TO MACH NO. ON MINUTES SCALE.

3.5 Spaces. The two molded plastic spacers which separate the two faces of the computer and provide a holding ring, shall be constructed of black nylon molding plastic conforming to ASTM D4060 or approved equivalent, and shall be in accordance with MS26514 or as modified by variations allowed in dimensions I, L, N & O (paragraph 3.3) and/or elimination of the holding brackets. The side of the slide holder with the rotating dial shall be riveted to the spacers with one rivet at each end of each spacer, the rivets extending through the side of the slide holder with the rotating dial and the spacers. Adjacent to each rivet, at the end of each spacer, a screw shall extend through the bracket holding the rotatable disk in place, and through the lower portion of the slide holder or that part on which True Index is inscribed. Each screw shall be inserted into a threaded hexagon nut with a round spani and held in place in a counterbored hole on the reverse side of the spacer. Each screw shall be provided with a lock washers. Lock washer dimensions shall not exceed 2/16-inch outside diameter and 1/64-inch thick. The holes in that portion of the bottom of the slide holder that are comparable to that portion on which True Index is inscribed shall be such that the part may be adjusted to hold the compass rose firmly in position.

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3.6 Case. The carrying case shall be of flexible vinyl film conforming to Type II, Class 2 of L-P-375 and .030-inch thick, $\pm .005$ inch. The color shall be No. 20252 of FED-STD-595. Edges shall be heat-sealed a minimum of 3/32-inch, except the opening shall be reinforced by widening the seal to 5/12-inch. The following instructions (3- by 7-inch area) shall be silk-screened to one face of the case:

SET NUMBER OF MILES OFF COURSE1 ON MILES SCALE OPPOSITE COURSE
MILES FLOWN ON MINUTES SCALE. READ ANGLE 2 TO PARALLEL COURSE
IN DRIFT WINDOW. SET NUMBER OF MILES OFF COURSE ON MILES SCALE
OPPOSITE COURSE MILES TO GO ON MINUTES SCALE. READ ANGLE FROM
PARALLEL TO INTERCEPT COURSE IN DRIFT WINDOW.

1. If course miles flown, or course miles to go, are more than 10 times the distance off course, read the smaller drift angle in window.
2. Total correction angle is equal to sum of angle to parallel plus angle to intercept.

3.7 Interchangeability of parts. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of DOD-D-1000.

3.8 Performance. The computer shall operate satisfactorily when tested in accordance with section 4.

3.9 Marking and labeling. The lines, arcs, and numbers of the slide and slide holder shall be engraved or etched, filled with durable black material, and protected by an epoxy resin coating.

3.9.1 Lines and figures. Lines and figures shall be sharply defined and legible. Figures shall preclude any ambiguity as to the scale graduations to which they apply. The numbers on the rotating dial logarithmic (miles and minutes scales, hour scale, latitude scale, and compass rose) shall be not less than 1/16-inch high. All other numbers shall be as large as space permit.

3.9.2 Marked surfaces. All marked surfaces of the computer, including the plastic dial, shall accept pencil markings and withstand repeated erasures.

3.10 Identification of product. The computer shall be identified on the filed portion of the slide holder directly below the rotating dial, in accordance with MIL-STD-130.

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3.11 Workmanship. Workmanship, marking, and lettering shall ensure accuracy of assembly and legibility of scales.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3.3)
- b. Quality conformance inspection (see 4.4)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in this specifications.

4.3.1 Test samples. The test samples shall consist of three (3) computers of the type specified (see 6.2), identified with the manufacturer's part number and any other information required by the procuring activity.

4.3.2 First article inspection. The first article inspection shall consist of the following tests:

- a. Examination of product.
- b. Dimensions.

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- c. Scale accuracy.
- d. True airspeed.
- e. Density altitude.
- f. Calibrated altitude.
- g. Compass rose.
- h. Materials.

4.4 Quality conformance inspection. Quality conformance shall be based on the following:

- a. Individual tests.
- b. Sampling test plans.

4.4.1 Individual tests. Each computer shall be subjected to the following tests:

- a. Examination of product.
- b. Dimensions.
- c. Scale accuracy.

4.4.2 Sampling test plans. These plans shall be followed:

4.4.2.1 Plan A. The first five production units shall be subjected to the tests specified in 4.5. These computers shall be the equivalent of the approved first article samples in respect to design, construction, performance, and workmanship. Failure of any sample to pass any of the tests specified in 4.5 shall be cause for rejection of the samples. Quality conformance inspection (see 4.4.2.2) on subsequent computers shall be withheld pending approval of these tests.

4.4.2.2 Plan B. Tests specified in 4.4.2.2.1 shall be performed individually on each computer until five consecutive computers comply with all the tests. Then one computer shall be selected at random from each lot of 50 produced thereafter. When a defective computer is found, this procedure shall be followed. A minimum of 50 computers adjacent to the defective unit shall be tested, and if one or more defects are found, the lot represented by the samples shall be rejected. From subsequent production following a rejected lot, all computers shall be subjected to sampling tests until 50 computers have passed all sampling tests, after which the one in 50

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sampling phase shall be resumed, commencing with the first unit following the six consecutive computers which were accepted.

4.4.2.2.1 Sampling plan B tests. The sampling plan B tests shall consist of the following:

- a. True airspeed.
- b. Density altitude.
- c. Calibrated altitude.
- d. Compass rose.
- e. Materials.

4.5 Test methods.

4.5.1 Examination of product. Each computer shall be examined to determine conformance with this specification.

4.5.2 Dimensions. Each slide shall be measured to determine that the overall width and the width from the zero drift line to the outside edge conform to the dimensions shown on MS26514.

4.5.3 Scale accuracy.

4.5.3.1 Logarithmic scales. Accuracy of the outer scales shall be tested by successively aligning the index of the inner logarithmic (minutes) scale with lines on the outer logarithmic (miles) scale and checking the coincidence of the two scales at points in each quadrant. The two scales shall be accurate within 0.2 percent, as shown by the following limits specified in Table IX.

4.5.3.2 Drift scale. The drift correction scale shall be accurate within 0.2 percent as shown below:

- a. Set the drift correction arrow at 1 degree on the drift correction scale. Opposite 17 on the minutes scale, read 175 ± 1 mile.
- b. Set the drift correction arrow at 2.5 degrees on the drift correction scale. Opposite 17 on the minutes scale, read 406 ± 1 mile.
- c. Set the drift correction arrow at 5 degrees on the drift correction scale. Opposite 17 on the minutes scale, read 105 ± 0.2 mile.
- d. Set the drift correction arrow at 15 degrees on the drift correction scale. Opposite 17 on the minutes scale, read 268 ± 1 mile.

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e. Set the drift correction arrow at 30 degrees on the drift correction scale. Opposite 10 on the minutes scale, read 577 ± 2 miles.

f. Set the drift correction arrow at 45 degrees on the drift correction scale. Opposite 10 on the minutes scale, read 100 ± 1 mile.

4.5.4 True airspeed. True airspeed computations shall be tested as follows:

	Maximum	Minimum
Set 0-foot pressure altitude opposite +15°C.; opposite 10 on minute scale, read 10 on miles scale.	10.05	9.95

Set 40,000-foot pressure altitude opposite -60°C.; opposite 100 calibrated airspeed, read true 200 airspeed	201.00	199.00
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Set 75,000-foot pressure altitude opposite +30°C.; opposite 100 calibrated airspeed, read true 550 airspeed	557.00	547.00
---	--------	--------

4.5.4.1 MACH NUMBER INDEX. The MACH NUMBER INDEX test shall be as follows:

a. Set the MACH NUMBER INDEX arrow opposite -15°C.; opposite 1.0 on the minutes scale read 051 + 1 on the miles scale.

b. Set the MACH NUMBER INDEX arrow opposite -50°C.; opposite 0.8 on the minutes scale read 465 + 1 on the miles scale.

c. Set the MACH NUMBER INDEX arrow opposite +50°C.; opposite 1.5 on the minutes scale read 1050 - 2 on the miles scale.

TABLE 1X. CENTERING ACCURACY TEST

Settings	Readings	Maximum	Minimum
Set 10 minutes opposite 10 miles, opposite	20 minutes read	20.04	19.96
	20 miles		
	40 minutes read	40.08	39.92
	40 miles		
	60 minutes read	60.12	59.88
	60 miles		

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Set 10 minutes opposite 20 miles; opposite	20 minutes read	40.08	39.92
	40 miles		
	40 minutes read	80.16	79.84
	80 miles		
	60 minutes read	120.24	119.76
	120 miles		
	Set 10 minutes opposite 50 miles; opposite	20 minutes read	60.12	59.88
	60 miles		
	40 minutes read	120.24	119.76
	120 miles		
	60 minutes read	180.36	179.64
	180 miles		
	Set 10 minutes opposite 50 miles; opposite	20 minutes read	100.20	99.80
	100 miles		
	40 minutes read	200.40	199.60
	200 miles		
	60 minutes read	300.60	299.40
	300 miles		

4.5.5 Density altitude. Density altitude computations shall be tested as follows:

	Maximum	Minimum
Set 0-foot pressure altitude opposite + 15°C; opposite arrow on density altitude window read 0 feet on density.	+150	-150
Set 17,000-foot pressure altitude op- posite -10°C.; opposite arrow read 18,000-feet on density altitude scale.	18,150	17,850
Set 70,000-foot pressure altitude op- posite -55°C.; opposite arrow, read 70,100-feet on density altitude scale.	79,250	78,950
Set 45,000-foot pressure altitude op- posite +5°C.; opposite arrow, read 78,350-feet on density altitude scale.	57,600	57,700
Set 70,000-foot pressure altitude op- posite +5°C.; opposite arrow, read 57,450-feet on density altitude scale.	78,000	79,200

4.5.6 Calibrated altitude. Calibrated altitude computations shall be tested as follows:

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	Maximum	Minimum
Set 0-foot pressure altitude opposite +15°C.; opposite 10 on minutes scale, read 10 on miles scale.	10.05	9.95
Set 0-foot pressure altitude opposite +40°C.; opposite indicated altitude 3,500 feet, read 3,800 true altitude.	3,820	3,780
Set 4,000-foot pressure altitude opposite 0°C.; opposite indicated altitude 16,400, read 16,000 true altitude.	16,000	15,900

4.5.7 Compass rose. Compass rose test shall be as follows:

Set N, E, S, W successively opposite TRUE INDEX. All graduations on the movable scale shall coincide with markings on the drift scale to within one-fourth degree.

4.5.8 Materials. It is not mandatory that all materials be tested in conformance with the referenced specifications in each individual case. However, the Government inspector will require these referenced tests whenever, in his judgment, they are necessary to ascertain that the quality of the materials used conforms to the referenced specification.

4.6 Inspection of preparation for delivery. Preparation for delivery shall be inspected for compliance with section 5 of this specification.

4.6.1 Inspection and test. Test of methods of preservation and packaging shall be accomplished in accordance with Section 4 of MIL-F-116 to ensure compliance with Section 5 of this specification.

5. PACKAGING.

5.1 Preservation. Preservation shall be level "A" or "C", as specified. (see 6.2)

5.1.1 Preservation-packaging. Unless otherwise specified by the contracting activity, item shall be packaged in quantity unit pack (QUF) of one each and intermediate container quantity (ICQ) of fifty (50) each. Each item will be provided a preservation method III in accordance with IAW MIL-F-116.

5.1.2 CLEANING. Item shall be cleaned IAW MIL-F-116 C-1 process.

5.1.3 Drying. Immediately after cleaning, the item shall be dried following any one or combination of the drying procedures listed in MIL-F-116. The drying procedures employed shall not be injurious to the item.

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5.1.4 Level A. Item shall be preserved IAW MIL-P-116 and MIL-STD-2073-1 to provide a method III.

5.1.5 Level C. Item shall be individually preserved in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment from the supply source to the first receiving activity as specified in MIL-P-116 and MIL-STD-2073-1.

5.2 Packing. Packing shall be level "A", "B", or "C", as specified. (see 6.2)

5.2.1 Container-Cushioning. Unless otherwise specified by the contracting activity, each item shall be supplied with its individual carrying case. Unit container shall be large enough to allow for application of sufficient cushioning/wrap material, between the carrying case (with item) and unit container, to provide a snug-fit. Unit container shall conform to PPP-B-566, folding paperboard box, unless otherwise specified. Intermediate/shipping container requirements shall conform to PPP-B-636, weather-resistant, unless otherwise specified by the contracting activity. Intermediate/shipping container shall be large enough to accommodate fifty (50) each PPP-B-566 cartons containing carrying case and item.

5.2.2 Level A Fiberboard containers do not meet level "A" container criteria.

5.2.3 Level B. Item will be preserved as specified in 5.1 and shall be packed in exterior containers conforming to PPP-B-636, weather-resistant unless otherwise specified by the contracting activity. Exterior container shall be uniform shape, size and minimum tare and cube. Consistent with the protection required. Closure shall be in accordance with appropriate PPP-B-636 procedures, as specified by contractor, special packaging instructions (SPI), and contracting activity.

5.2.4 Level C Item will be packed in such a manner that will afford adequate protection against physical damage during direct domestic shipment from the supply source to the first receiving activity. These packs shall conform to MIL-STD-2073-1.

5.3 Marking. Unit, intermediate, and exterior containers shall be marked IAW special markings required by the contractor, special packaging instructions (SPI) and MIL-STD-129.

5.4 Inspection and Test. Test of methods of preservation shall be accomplished in accordance with section 4 of MIL-P-116 to ensure compliance with section 5 of this specification. Packaging tests shall be conducted IAW rough handling as specified in FED-STD-101.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The computer is intended for use by air crew members for speed and distance computations; for calibrated altitude, density altitude, and true airspeed corrections; and for solution of drift problems by the vector and pressure gradient methods.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
 - b. Type computer required (see 1.2 and 4.3.1).
 - c. Office to which test samples should be sent.
 - d. Level of preservation and packaging, and of packing (see 5.1 and 5.2).
 - e. Whether special marking is required (see 5.3).
- f. Issue or DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

6.4 First article. First articles are required for inspection and test (see 7.1). The first article sample should consist of three units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations and test approval of the first articles.

6.5 Subject term (key word) listing.

Air navigation
 Computer
 Dead reckoning
 Handheld
 Type MB-4E
 Type CPL-26A F

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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Custodians:

AIR FORCE -99
Army -AV
Navy -AS

Preparing Activity:

AIR FORCE -71

Project Number:

6685-0447

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I. RECOMMEND A CHANGE:		1. DOCUMENT NUMBER M-2414G	2. DOCUMENT DATE (YYMMDD) - FEB 93
3. DOCUMENT TITLE Computer, Air Navigation, Dead Reckoning Type MB-4A and Type CPU-26A/p			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code, (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME OC-ALC/TICLA		b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON	
c. ADDRESS (Include Zip Code) Tinker AFB OK 73145-5990		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	