ORDER

7130.3A

HOLDING PATTERN CRITERIA

March 18, 1998

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

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RECORD OF CHANGES

DIRECTIVE NO. **7130.3A**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL USE

FOREWORD

This order primarily serves as a planning document for airspace planners by setting forth criteria for determining holding pattern airspace area dimensions and instructions for their use. In addition, it provides application criteria for use by procedures specialists in developing holding airspace for instrument procedures.

Sufficient holding airspace areas shall be planned and established to meet IFR traffic requirements within a facility's area of jurisdiction.

Holding airspace areas shall be determined by applying the criteria contained within this document.

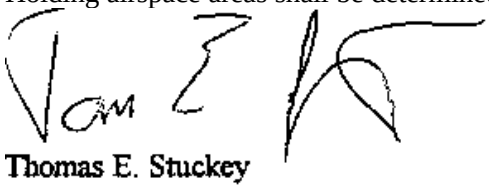

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TABLE OF CONTENTS

Page No.

Page No.

CHAPTER 1. GENERAL

SECTION 1. OBJECTIVE

1-1. PURPOSE. This order prescribes criteria for determining holding pattern airspace area dimensions and instructions for their use. These criteria apply to all IFR holding operations conducted within airspace where domestic Federal Aviation Administration air traffic control procedures are used. Personnel responsible for planning holding airspace areas shall adhere to these criteria.

1-2. DISTRIBUTION. This order is distributed in Washington headquarters to the branch level of the Offices of System Safety; Aviation Policy and Plans; Air Traffic Systems Development; Aviation Research; Communications, Navigation, and Surveillance Systems; Airport Safety and Standards; and to Flight Standards, Air Traffic, and Airway Facilities Services; to the National Flight Procedures Office and to the National Airway Systems Engineering and Regulatory Standards and Compliance Divisions at the Mike Monroney Aeronautical Center; to the branch level in the regional Flight Standards, Air Traffic, Airway Facilities, and Airports Divisions; to all Flight Inspection Offices; International Flight Inspection Office; the Europe, Africa, and Middle East Area Office; Flight Standards District Offices; Airway Facilities Field Offices; and special Military and Public addressees.

1-3. CANCELLATION. This order cancels and supersedes Holding Pattern Criteria, 7130.3, dated August 28, 1967, including Changes 1 through 9.

1-4. EXPLANATION OF CHANGES.

a. Propeller driven aircraft standard holding speed of 175 KIAS has been eliminated. Three standard civil holding speeds have been established.

b. Criteria for global positioning system (GPS) holding has been developed.

c. Application of short take-off and landing (STOL) holding has been expanded to include helicopters.

d. Additional military aircraft have been added to maximum holding speed table.

e. Civil turbojet holding speeds of 175 and 210 KIAS have been established for special use in certain air traffic regions where airspace constraints exist.

1-5. INFORMATION UPDATE. Any deficiencies found, requests for clarification, or suggested improvements regarding the content of this order shall be forwarded for consideration to:

DOT/FAA
Flight Procedure Standards Branch, AFS-420
P.O. Box 25082
Oklahoma City, OK 73125

a. Your Assistance is Welcome. FAA Form 1320-19, Directive Feedback Information, is included at the end of this order for your convenience.

b. Use the "Other Comments" block of this form to provide a complete explanation of why the suggested change is necessary.

CHAPTER 2. CONVENTIONAL HOLDING CRITERIA

SECTION 1. BASIC FACTORS CONSIDERED

2-1. DEVELOPMENT CONCEPT. Efficient and economical use of airspace requires standardization of aircraft entry and holding maneuvers. Factors which affect aircraft during these maneuvers are incorporated in the criteria.

2-2. TURN EFFECT. Pilot procedures contained in the Aeronautical Information Manual (AIM) specify 30° of bank (or a standard rate turn, whichever requires the least bank) for entry and holding pattern turns. However, due to factors such as instrument precision, pilot technique, ballistic effect, etc., a constant 30° of bank is seldom achieved. To compensate for this, these criteria are based upon 25° of bank.

2-3. NAVIGATIONAL AID (NAVAID) GROUND AND AIRBORNE SYSTEM TOLERANCE. Criteria in this chapter apply to conventional NAVAID's such as very high frequency (VHF) omni directional radio range (VOR), distance measuring equipment (DME), and/or nondirectional radio beacon (NDB). These criteria contain allowances for:

a. Cone of ambiguity: related to altitude, and

(1) System error: ± 5°

(2) Aircraft Course Indicator: ± 10° for full instrument deflection.

(3) Total tolerance of (1) and (2): 15°

b. Intersection disparity: related to system error and distance of the holding point from the furthest NAVAID.

c. Overhead "to-from" error: 4°.

d. Delay in recognizing and reacting to fix passage: 6 seconds for entry turn, applied in the direction most significant to protected airspace.

2-4. EFFECT OF WIND. Analysis of winds recorded at various levels over a five-year period led to the adoption of a scale of velocities beginning with 50 knots at 4,000' MSL and increasing at a rate of 3 knots for each additional 2,000' of altitude to a maximum of 120 knots.

2-5. FLIGHT PROCEDURES DEVELOPMENT. Flight procedures are developed to accommodate the performance capabilities of pertinent civil and military aircraft. The full size of the holding pattern shall be evaluated for obstacle clearance. No fix-end or outbound-end reduction is authorized.

2-6. APPLICATION IN THE AIR TRAFFICE CONTROL (ATC) SYSTEM. Holding airspace area dimensions were developed to permit use of all types of en route NAVAID's, reduction of holding airspace when optimum direction of entry is made, compatibility between patterns flown by reference to time and those flown by reference to DME, and selection/application of tailor-made airspace by furnishing several pattern sizes.

SECTION 2. PATTERN COMPONENTS

2-7. OUTBOUND LEG LENGTH. Length is based on time or distance. Standard time values are 1 minute for altitudes from the minimum holding altitude (MHA) through 14,000' and 1-1/2 minutes at altitudes above 14,000'. Distance value of an outbound leg is not standard but shall be established at a distance appropriate to the holding situation and consistent with appendix 1 or 2.

2-8. MAXIMUM HOLDING AIRSPEED.

a. Holding patterns are developed based upon maximum airspeeds of table 1.

Table 1. MAXIMUM HOLDING AIRSPEEDS

a. Civil Aircraft	
(1) MHA through 6,000'	200 KIAS
(2) Above 6,000' through 14,000'	230 KIAS
(3) Above 14,000'	265 KIAS
b. Military Aircraft	
(1) All - Except Aircraft Listed below	230 KIAS
(2) T-38, F-15, and F-16	265 KIAS
(3) USAF F-4 Aircraft	280 KIAS
(3) B-1, F-111, and F-5	310 KIAS
(4) T-37	175 KIAS

b. Where operationally necessary, civil holding patterns may be restricted to the following speeds:

(1) 175 KIAS at altitudes from MHA to 30,000' MSL. Where this is done, the affected holding pattern will be depicted with an appropriate cartographic icon; i.e., "175K".

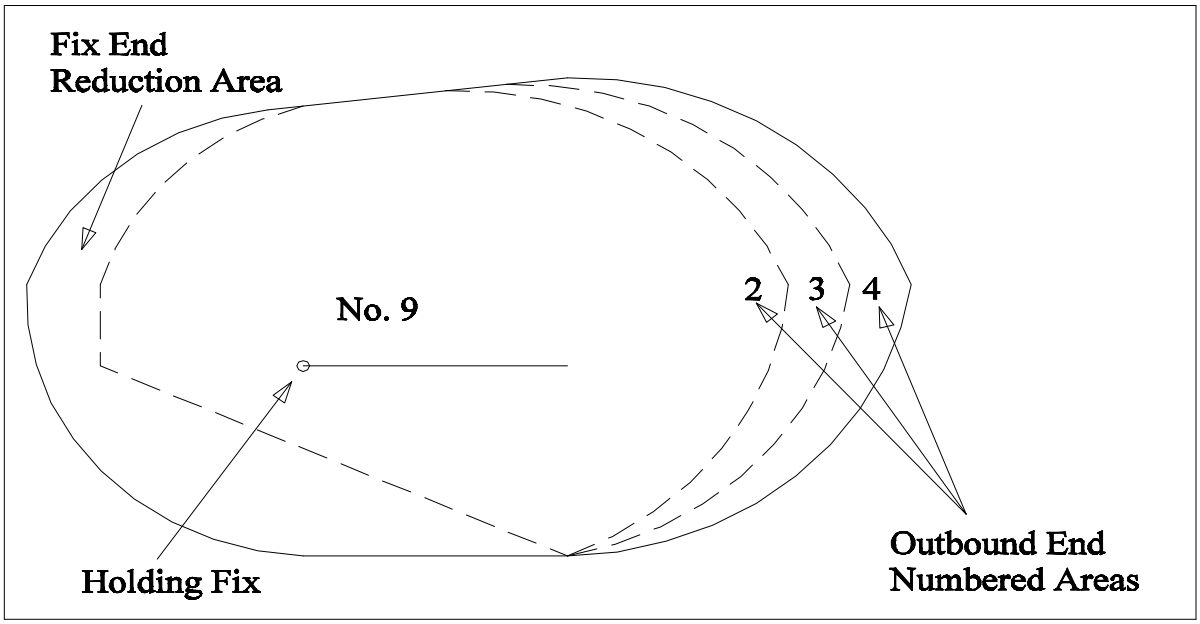
(2) 210 KIAS at altitudes above 6,000' through 14,000' MSL. Where this is done, the affected holding pattern will be depicted with an appropriate cartographic icon; i.e., "210K".

SECTION 3. AIRSPACE DETERMINATION

2-9. SIZE AND NUMBERING. There are 31 holding airspace sizes. Each is related to one or more even-numbered altitudes/flight levels and is identified by a template number for easy reference.

2-10. TEMPLATES-SCALING AND TRACING. Templates numbered to correspond with pattern numbers were developed in sectional chart scale (1:500,000) and should be used to determine protected holding airspace. Details for tracing templates are contained in chapter 2, section 7. Figure 1 shows a typical template.

Figure 1. TYPICAL TEMPLATE



2-11. ALTITUDE LEVELS. Holding levels from MHA to 50,000' are provided at intervals of 2,000'. Holding at 2,000' and below requires use of the appropriate pattern for 2,000'. Holding at higher even altitudes requires use of appropriate altitude/flight level patterns as listed in table 2. Holding at odd altitudes above 2,000' is determined by use of the next higher even altitude/flight level pattern.

Table 2. HOLDING PATTERN SELECTION CHART

Fix-to-NAVAID Distance					
0-14.9 NM		15-29.9 NM		30 NM and Over	
Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.
		175 Knots IAS			
2 - 1	18 - 8	2 - 1	18 - 9	2 - 2	18 - 10
4 - 1	20 - 8	4 - 2	20 - 9	4 - 3	20 - 10
6 - 2	22 - 9	6 - 3	22 - 10	6 - 4	22 - 11
8 - 3	24 - 10	8 - 4	24 - 11	8 - 5	24 - 12
10 - 4	26 - 11	10 - 5	26 - 12	10 - 6	26 - 13
12 - 5	28 - 12	12 - 6	28 - 13	12 - (7)	28 - 14
14 - 6	30 - 13	14 - (7)	30 - 14	14 - (8)	30 - 15
16 - 7		16 - 8		16 - 9	
		200 Knots IAS			
2 - 3		2 - 4		2 - 5	
4 - 4		4 - 5		4 - 6	
6 - 5		6 - 6		6 - (7)	

For explanation of pattern numbers in parentheses, see paragraph 2-29.

(Table 2. Continued)

Fix-to-NAVAID Distance					
0-14.9 NM		15-29.9 NM		30 NM and Over	
Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.
		210 Knots IAS			
8 - 6		8 - 7		8 - 8	
10 - 7		10 - 8		10 - 9	
12 - 7		12 - 8		12 - 9	
14 - 8		14 - 9		14 - 10	
		230 Knots IAS			
2 - 5		2 - 6		2 - 7	
4 - 6		4 - 7		4 - 8	
6 - 7		6 - 8		6 - 9	
8 - 8	30 - 19	8 - (9)	30 - 20	8 - (10)	30 - 21
10 - (9)	32 - 20	10 - (10)	32 - 21	10 - (11)	32 - 22
12 - (9)	34 - 21	12 - (10)	34 - 22	12 - (11)	34 - 23
14 - (10)	36 - 22	14 - (11)	36 - 23	14 - (12)	36 - 24
16 - 12	38 - 23	16 - 13	38 - 24	16 - 14	38 - 25
18 - 13	40 - 24	18 - 14	40 - 25	18 - 15	40 - 26
20 - 14	42 - 25	20 - 15	42 - 26	20 - 16	42 - 27
22 - 15	44 - 26	22 - 16	44 - 27	22 - 17	44 - 28
24 - 16	46 - 27	24 - 17	46 - 28	24 - 18	46 - 29
26 - 17	48 - 28	26 - 18	48 - 29	26 - 19	48 - 30
28 - 18	50 - 28	28 - 19	50 - 29	28 - 20	50 - 30
		265 Knots IAS			
2 - (7)	26 - 20	2 - (8)	26 - 21	2 - (9)	26 - 22
4 - (8)	28 - 21	4 - (9)	28 - 22	4 - (10)	28 - 23
6 - (9)	30 - 22	6 - (10)	30 - 23	6 - (11)	30 - 24
8 - (10)	32 - 23	8 - (11)	32 - 24	8 - (12)	32 - 25
10 - (11)	34 - 24	10 - (12)	34 - 25	10 - (13)	34 - 26
12 - (12)	36 - 25	12 - (13)	36 - 26	12 - (14)	36 - 27
14 - (13)	38 - 26	14 - (14)	38 - 27	14 - (15)	38 - 28
16 - 15	40 - 27	16 - 16	40 - 28	16 - 17	40 - 29
18 - 16	42 - 28	18 - 17	42 - 29	18 - 18	42 - 30
20 - 17	44 - 28	20 - 18	44 - 29	20 - 19	44 - 30
22 - 18	46 - 29	22 - 19	46 - 30	22 - 20	46 - 31
24 - 19	48 - 31	24 - 20		24 - 21	

For explanation of pattern numbers in parentheses, see paragraph 2-29.

(Table 2. Continued)

Fix-to-NAVAID Distance					
0-14.9 NM		15-29.9 NM		30 NM and Over	
Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.
		310 Knots IAS			
2 - (11)	22 - 22	2 - (12)	23 - 23	2 - (13)	22 - 24
4 - (12)	24 - 22	4 - (13)	24 - 23	4 - (14)	24 - 24
6 - (13)	26 - 24	6 - (14)	26 - 25	6 - (15)	26 - 26
8 - (14)	28 - 24	8 - (15)	28 - 25	8 - (16)	28 - 26
10 - (15)	30 - 25	10 - (16)	30 - 26	10 - (17)	30 - 27
12 - (17)	32 - 26	12 - (18)	32 - 27	12 - (19)	32 - 28
14 - (18)	34 - 27	14 - (19)	34 - 28	14 - (20)	34 - 29
16 - 19	36 - 28	16 - 20	36 - 29	16 - 21	36 - 30
18 - 20	38 - 29	18 - 21	38 - 30	18 - 22	38 - 31
20 - 21	40 - 30	20 - 22	40 - 31	20 - 23	

For explanation of pattern numbers in parentheses, see paragraph 2-29.

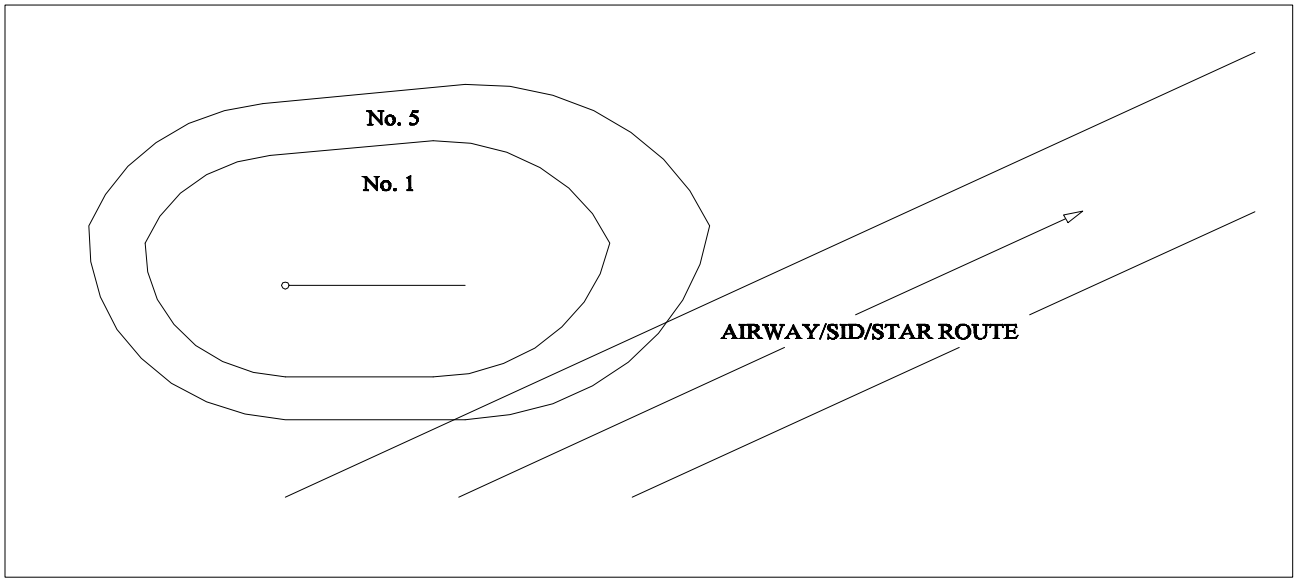
2-12. FIX DISTANCES. Fix distance is the measured ground distance in nautical miles from the holding fix to the NAVAID. Template sizes are shown for three ranges of fix-to-NAVAID distances: 0-14.9 NM, 15-29.9 NM, and 30 NM and over. When a fix is based on two NAVAID's, the greatest fix-to-NAVAID distance shall be used for pattern/template determination. This applies to any type or combination of NAVAID's used to establish a holding fix.

2-13. PATTERN APPLICABILITY AND EXAMPLE PROBLEMS. Speed group, fix distance, altitude level, and pattern/template number relationship for conventional holding are contained in table 2. Special purpose holding patterns for turbulent air, helicopter/STOL and Global Positioning System (GPS) are contained in the appropriate chapter.

a. Example Problem. Assume that civil aircraft are to hold at a fix located 32 NM miles from the farthest NAVAID used to form the fix. Altitudes involved are 8,000' through 14,000'. From table 1, an airspeed of 230 KIAS is selected. By reference to table 2, select template number 10 to determine the area to be protected for 8,000'; number 11 for 9,000'/10,000'; number 11 for 11,000'/12,000'; number 12 for 13,000'/14,000'. Each template may then be applied to the fix individually to determine the effect of holding airspace on other operations.

b. Example Problem. Assume that a 175 KIAS restricted holding pattern is to be developed at a fix located 12 NM from the farthest NAVAID used to form the fix. Altitudes involved are 2,000' through 12,000'. Reference to table 2, indicates use of template number 5 (12,000'). When it is applied to the fix, no conflict with other operations is indicated between 12,000' and 5,000'. However, a standard instrument departure (SID) route 4,000' and below is affected. Reference to table 2, indicates use of template number 1 (4,000' and below). Figure 2 depicts this problem and shows only two patterns were necessary in determining the solution. The holding pattern shall be charted with the holding speed restriction.

Figure 2. HOLDING PATTERN PROXIMITY TO AIRWAY/SID/STAR ROUTE



SECTION 4. DME APPLICATION

2-14. SLANT-RANGE EFFECT. An airborne DME reading of 5 NM at 30,000' would indicate that an aircraft is directly over the NAVAID. If the aircraft maintained 5 NM DME distance during descent, the flightpath would form an arc beginning over the NAVAID to a point on the surface 5 NM horizontal distance from the NAVAID. Therefore, near the surface a holding fix could be 5 NM horizontally from the NAVAID, but at 13,000' it would be 4.5 NM horizontally from the NAVAID. In this instance, 5 NM is the fix-to-NAVAID distance, and 4.5 NM is the slant-range/geographical distance. When establishing a DME holding fix, the difference between fix-to-NAVAID and slant-range/geographical distance shall be determined. Differences shall be governed by requirements in paragraph 2-17.

2-15. DETERMINING DME DISTANCES. The slant-range chart, appendix 3, shall be used to accurately determine slant-range, fix-to-NAVAID, and slant-range/geographical distances.

2-16. NO-COURSE-SIGNAL ZONE. No-course-signal zone information is depicted on the slant-range chart in appendix 3. DME fixes shall not be established within the no-course-signal zone. Course information may be available at distances less than the minimum derived from the chart; however, no waiver of these minimums is permitted.

2-17. FIX DISTANCE VARIANCES. For the purpose of accurate plotting of holding pattern airspace, differences between fix-to-NAVAID and slant-range/geographical distance can be significant within 45 NM of the NAVAID. When establishing or changing the use of a DME holding fix, distance differences shall be governed by the following:

a. Use whole nautical miles for slant-range distance.

Example: It is desired to hold aircraft at the minimum DME distance at 10,000'. Reference to appendix 3 shows the intersection of the 10,000' altitude line and the edge of the no-course-signal zone occurs at a slant-range of 2.9 NM. Holding shall be based on a 3 NM DME fix.

b. When slant-range/geographical distance differs .25 NM or less from fix-to-NAVAID distance, the difference may be disregarded 14,000' and below. A difference of .5 NM or less may be disregarded above 14,000'.

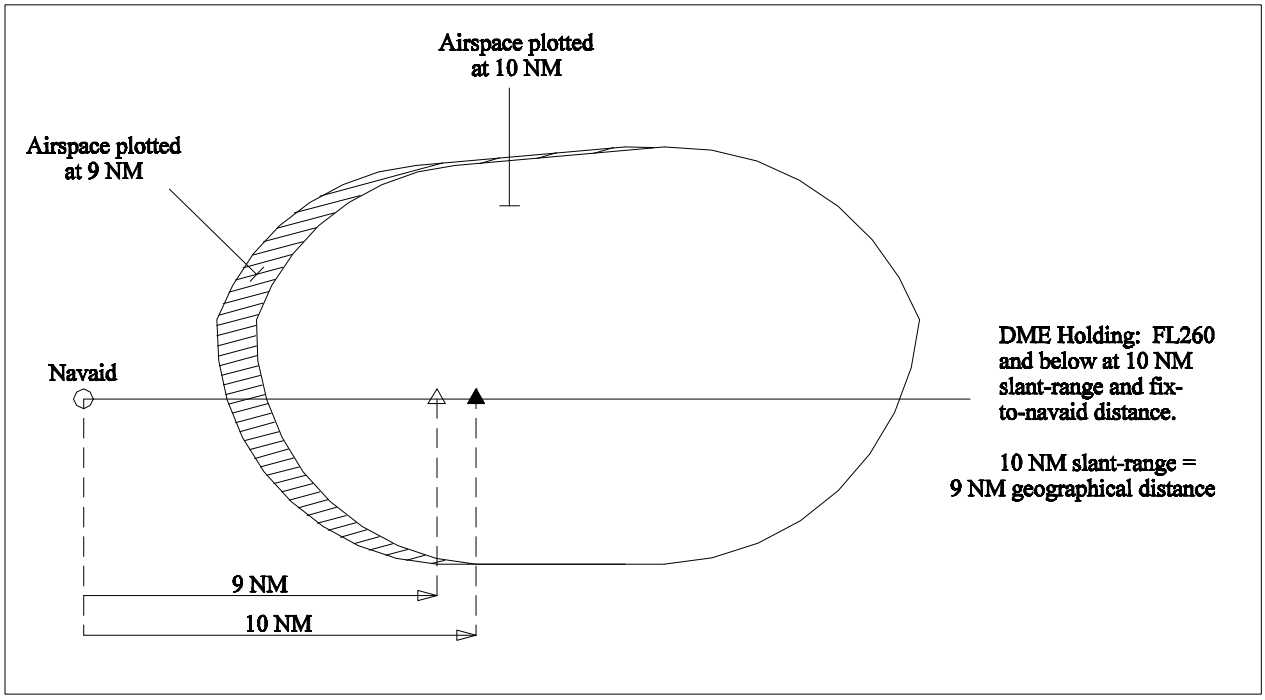
Example: It is desired to establish a DME fix for holding at 20,000' and below, at 30 NM fix-to-NAVAID distance. Reference to appendix 3 shows the slant-range/geographical distance associated with 30 NM is 29.8 NM.

The difference of .2 NM may be disregarded in protected airspace plotting. However, if the desired fix-to-NAVAID distance was changed to 10 NM, the slant-range/geographical distance becomes 9.4 NM, which creates .6 NM difference. This difference is significant; therefore, protected airspace would be based on 9.4 NM fix-to-NAVAID distance.

c. When a DME holding fix will be collocated with another established fix, and the distance from the fix to the NAVAID forming the holding course is also used as the DME slant-range distance, significant variances per subparagraphs 2-17a and b may exist. Plotting of protected holding pattern airspace may be affected. Significant variances shall be governed by the following:

(1) When desirable to use a single distance with respect to both DME and VOR intersection holding, protected holding airspace shall be plotted at the VOR intersection and re-plotted at the slant-range/geographical distance. The perimeter of the two plots outline the airspace to be protected. Figure 3 shows a typical example.

Figure 3. COLLOCATED FIX WITH COMPOSITE HOLDING AIRSPACE

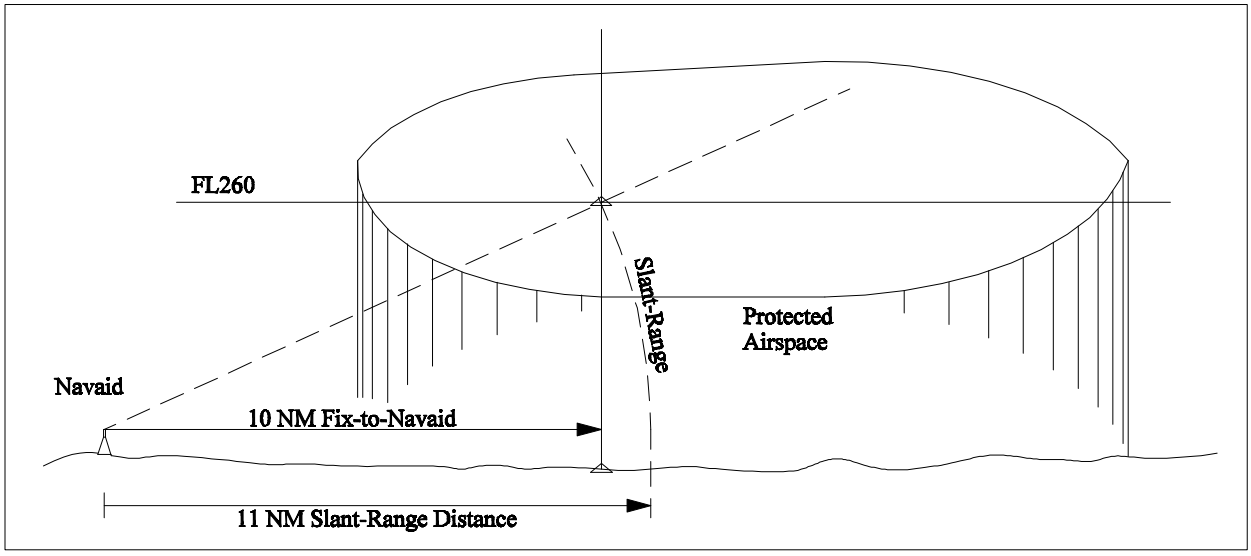


NOTE: Figure 3 shows holding toward the NAVAID with extended airspace at the fix end; when holding away from the NAVAID, the extended airspace would be on the outbound end.

NOTE: The airborne location of the DME fix moves away from the NAVAID during descent; however, holding aircraft will not leave protected airspace.

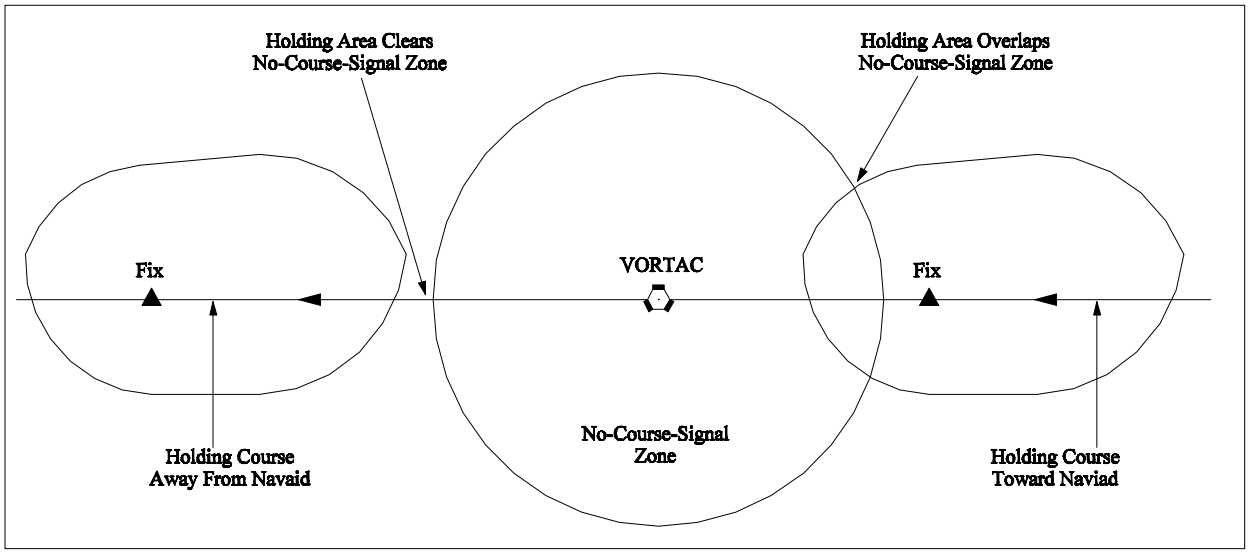
(2) When it is desirable to contain DME and non-DME holding within a single pattern size, use a slant-range distance different from the fix-to-NAVAID distance. Select a slant-range distance which is coincident with the fix-to-NAVAID distance at the highest altitude to be used for DME holding. Figure 4 depicts a typical situation.

Figure 4. COLLOCATED HOLDING FIX



2-18. HOLDING TOWARD/AWAY FROM THE NAVAID. Holding may be accomplished inbound to a DME fix either toward or away from a NAVAID. See figure 5.

Figure 5. DME HOLDING



a. Toward the NAVAID. When the DME holding course is toward the NAVAID, the fix end of the holding area, but not the fix itself, may lie within the no-course-signal zone; provided that entry to the pattern is normally made from a direction other than through the no-course-signal zone. Where entry is normally made through the no-course-signal zone, no part of the holding area may lie within the zone.

b. Away from the NAVAID. When the DME holding course is away from the NAVAID, no part of the pattern area may lie within the no-course-signal zone.

2-19. DME LEG LENGTHS. Table 2 provides pattern/template number information applicable to both time and DME patterns. The outbound leg of a time pattern is standard according to altitude (see paragraph 2-7); however, outbound leg distances for DME patterns vary depending on the fix-to-NAVAID distance and the pattern number being used. Appropriate leg length information can be found in appendix 1, holding course toward the NAVAID; or in appendix 2, holding course away from the NAVAID.

2-20. OUTBOUND END REDUCTION AREAS. Appendices 1 and 2 provide several usable DME leg lengths for each pattern number. Associated with each leg length is an outbound end numbered area. These areas are numbered in reverse sequence beginning with 4 at the outbound end of the pattern and progressing inward toward the fix (see figure 1). The numbered area listed, and all lower numbered areas, for a specific leg length of a pattern/template shall be used to determine DME holding airspace; e.g., 6/3 means that a 6 NM DME leg length requires use of numbered areas up through 3. No reduction is authorized for obstacle clearance purposes.

2-21. HOW TO USE APPENDICES 1 AND 2. Each appendix consists of several pages of DME information.

a. Numbers extending horizontally across the top of each page represent usable fix-to-NAVAID distances (geographical distances).

b. Vertical numbers on the left side of each page represent pattern/template numbers.

c. Appropriate leg lengths are determined by locating the fix-to-NAVAID distance at the top of the page, then reading vertically down until opposite (horizontally) a selected pattern/template number. Leg length information is listed at this point, or to the left of this point.

Example: In appendix 1, locate fix-to-NAVAID distance 8.5 NM. Read vertically down until opposite pattern number 4, then follow the horizontal lines to the left until reaching listings 4/3 and 5/4; i.e., leg length 4 NM (requiring numbered areas up through 3) and leg length 5 NM (requiring numbered areas up through 4).

2-22. DME EXAMPLE PROBLEMS. Two problems are set forth below with step-by-step solutions. Solution to the first problem is simple and requires one pattern size. The second problem is complex containing three parts. It involves the high, intermediate, and low altitude structures. Several pattern sizes and changes to leg length are needed for its solution. A third problem outlines some additional steps required.

a. Problem 1: The holding course is toward the NAVAID, maximum aircraft holding speed is restricted to 175 knots, altitudes are MHA through 8,000', and fix-to-NAVAID distance is 6 NM.

Solution: Refer to table 2, speed group 175 knots, distance group 0-14.9 NM, altitude 8, . . pattern/template number 3 is indicated. Refer to appendix 1, fix-to-NAVAID distance 6 NM, pattern number 3, . . .4/3 and 5/4 are listed. If no conflict with other operations is indicated when pattern number 3 is applied, a 5 NM leg length can be selected and the full dimensions (all numbered areas) of the pattern can be used. However, if numbered area 4 of pattern number 3 conflicts with other operations, then the 4 NM leg length must be selected since it requires only numbered areas up through 3 (numbered area 4 is omitted).

b. Problem 2: The holding course is toward the NAVAID, maximum aircraft holding speed is 230 knots, and fix-to-NAVAID distance is 30 NM.

Part 1: Find the correct pattern size and related leg lengths for FL 390.

Solution: Refer to figure 4. At FL 390 and 30 NM fix-to-NAVAID distance, determine slant-range distance, . . . 30.75 NM. The .75 NM difference shall receive consideration consistent with paragraph 2-17. Refer to table 2, and determine the pattern number/altitude relationship for the 230 knot speed group at fix-to-NAVAID distance 30 NM, . . . pattern number 26 is indicated. Refer to appendix 1. For 30 NM and pattern number 26, . . . leg lengths/numbered areas 13/1, 14/1, 15/2, 16/2, 17/3, 18/3, 19/4, and 20/4 are listed.

Part 2: Find the correct pattern/template size and leg lengths for 23,000', giving consideration to protected airspace for flight operations crossing the holding course between 54 and 68 NM.

Solution: Refer to table 2, and determine the appropriate pattern, . . . number 18. Refer to appendix 1, and find leg lengths . . . 7/2, 8/2, 9/3, 10/3, 11/4, and 12/4. When template number 18 is applied to the fix, it shows that numbered areas 3 and 4 overlap the protected airspace for the flight operation which takes place between 54 and 68 NM. This will make it necessary, in the final solution, to choose a leg length for which numbered areas 3 and 4 are not required.

Part 3: Find the correct pattern/template size for 13,000'.

Solution: Refer to table 2, and determine the appropriate pattern . . . number 12. Refer to appendix 1, and find leg lengths . . . 5/2, 6/3, 7/3, 8/4, and 9/4. When template number 12 is applied to the fix, it shows no conflict with other flight operations.

Final Solution to Problem 2: The range of leg lengths listed in part 1 (FL 390) are: 13 NM through 20 NM. Compare the findings of part 1 with part 2; i.e., the 13 NM minimum leg length with the maximum leg length not requiring numbered areas 3 and 4, . . . 8 NM. Since the leg lengths are not compatible, a change will be required when aircraft descend below FL 240. Any leg length in the 13 NM to 20 NM range can be selected for aircraft holding between FL 390 and FL 240. Part 3 (14,000') findings indicate a maximum leg length of 9 NM. However, this conflicts with restrictions noted in the solution to part 2 which limited the pattern to a maximum leg length of 8 NM. It follows, then, that the part 3 solution must also be restricted; in this case to maximum leg length of 8 NM; i.e., leg length "9/4" cannot be used. Therefore, an 8 NM leg length is selected to serve MHA through 23,000'.

Summary of Solution: Protected airspace and leg lengths for a 30 NM fix-to-NAVAID fix, shall be based upon:

(1) FL 390 - FL 240 inclusive, pattern number 26 including all numbered areas, any leg length 13 NM through 20 NM inclusive.

(2) 23,000' - 15,000' inclusive, pattern number 18 excluding numbered areas 3 and 4, 8 NM leg length. (7 NM also could be used).

(3) 14,000' - MHA inclusive, pattern number 12 including all numbered areas, maximum 8 NM leg length. (7 NM also could be used).

c. Problem 3: The holding course is away from the NAVAID. Application of criteria to these situations are handled in the same manner as outlined in subparagraphs 2-22a and b, with two exceptions:

(1) Appendix 2, holding course away from the NAVAID, shall be used to determine leg length and numbered area information.

(2) Templates shall be used to determine:

(a) That appropriate numbered areas do not infringe on the no-course-signal zone and/or,

(b) The location of a holding point which will keep the holding area from infringing on the no-course-signal zone.

SECTION 5. OPTIONAL REDUCTION AREAS

2-23. FIX END REDUCTION AREA. Figure 6 depicts an area that may be eliminated when entry is made from directions within the area of entry shown in figure 7. No reduction is authorized for obstacle clearance purposes.

Figure 6. OPTIONAL AREA (FIX END REDUCTION)

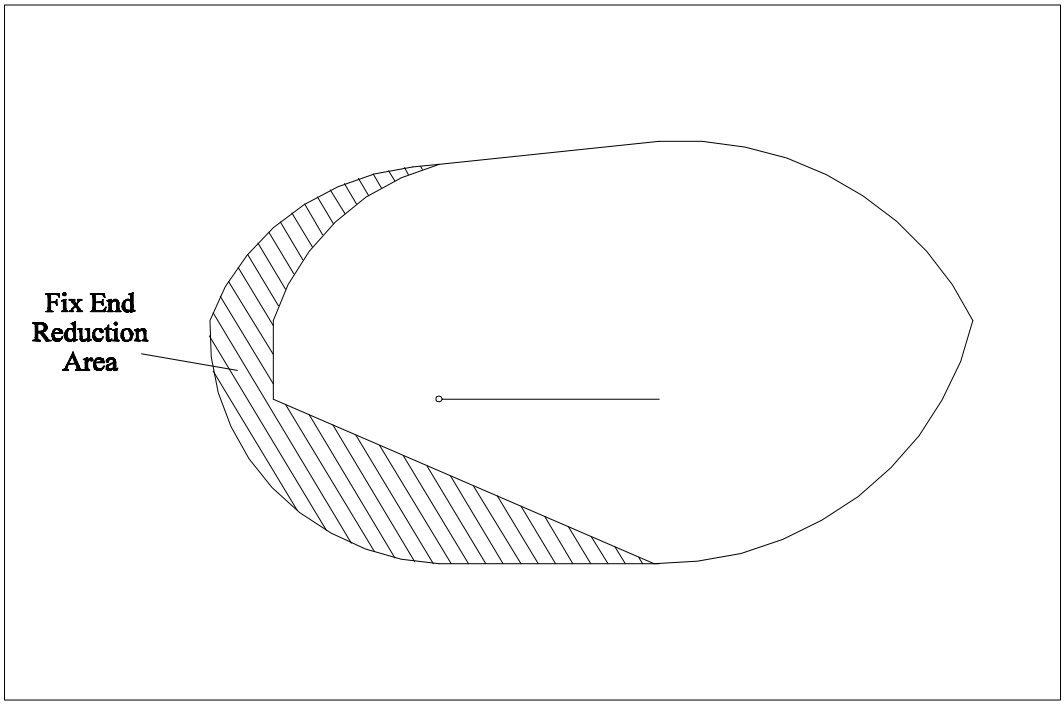
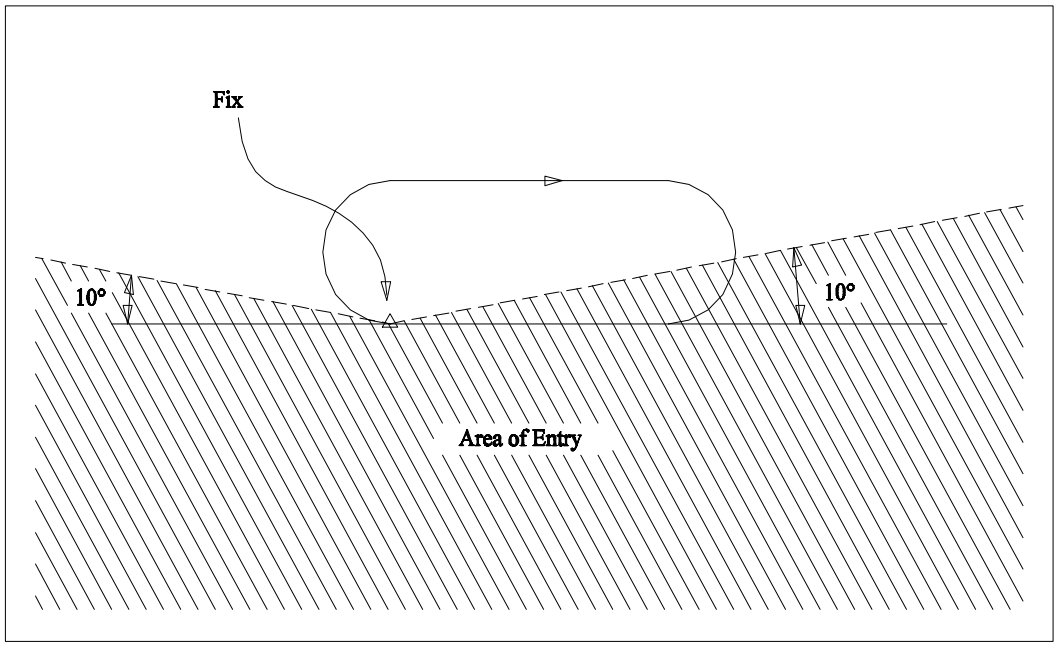


Figure 7. AREA OF ENTRY (FIX END REDUCTION)



2-24. OUTBOUND END REDUCTION AREA. In addition to the fix end reduction area, numbered area 4 in figure 8 also may be eliminated from each pattern when entry is made from directions within the area of entry shown in figure 9. See paragraph 2-27 for exceptions. No reduction is authorized for obstacle clearance purposes.

Figure 8. OPTIONAL AREA (OUTBOUND END REDUCTION)

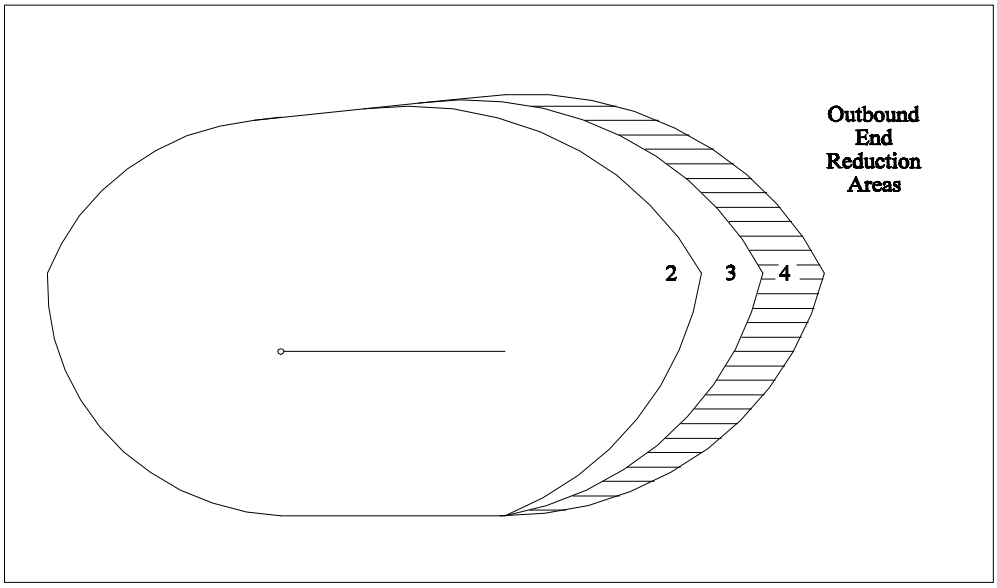
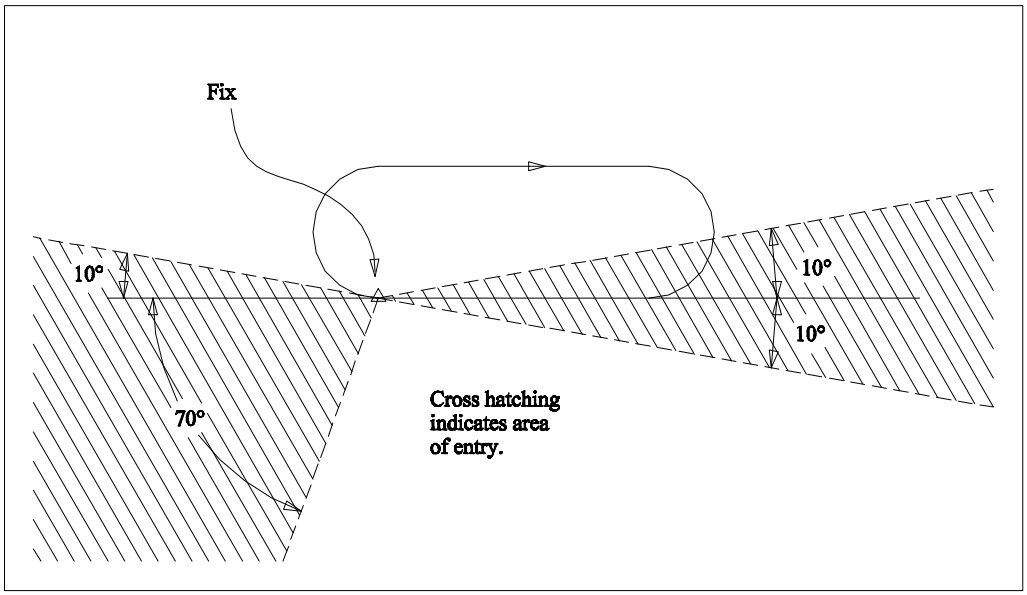


Figure 9. AREA OF ENTRY (OUTBOUND END REDUCTION)



2-25. ADDITIONAL REDUCTION AREAS. Under the conditions of paragraph 2-24, numbered area 3 also may be eliminated from pattern numbers 7 and 8 when these patterns are used at or below 14,000'. See paragraph 2-27 for exceptions. No reduction is authorized for obstacle clearance purposes.

2-26. REDUCTION AREAS NOT RELATED TO ENTRY PROCEDURES. Reduction areas may be eliminated as follows:

a. When aircraft enter the holding area from directions other than described in paragraph 2-23, protection of the fix end reduction area may be discontinued after entry is completed and the holding aircraft is established in a racetrack pattern.

b. When aircraft enter the holding area from directions other than described in paragraph 2-24, protection of numbered area 4 may be discontinued after the holding aircraft initially becomes established on the inbound holding course, subsequent to entry.

c. The provisions of paragraph 2-26b also apply to numbered area 3 when numbered patterns 7 and 8 are used at or below 14,000'.

d. No reduction is authorized for obstacle clearance purposes.

2-27. DME EXCEPTIONS. DME leg lengths in appendices 1 and 2, which require numbered area 4, do not qualify for the provisions of paragraph 2-24. Leg lengths for patterns number 7 and 8 requiring numbered area 3, do not qualify for the provisions of paragraph 2-25.

SECTION 6. CLIMBING IN A HOLDING PATTERN

2-28. CLIMB IN HOLD AIRSPEED DETERMINATION. Required climb speeds, particularly for turbojets, often exceed the maximum level holding speeds in table 1. Therefore, the following criteria shall be used to provide for such operations.

a. The 200 KIAS pattern for altitudes 6,000' and below and the 230 KIAS pattern for altitudes above 6,000' shall be used for holding patterns restricted to 175 KIAS.

b. Except as provided in paragraph 2-28a, the 310 knot pattern shall be used for climb-in-hold evaluations.

Example: Departing aircraft must climb to 18,000' in a holding pattern. The fix-to-NAVAID distance is 22 NM.

Solution: Refer to table 2, . . . pattern/template number 21 is indicated.

2-29. PATTERN AREA. When parenthetically enclosed pattern/template numbers of table 2 are used for purposes described in paragraph 2-28, numbered area 4 may be eliminated from the holding area. This reflects allowance for 1-1/2 minute patterns used at 1- minute pattern altitude levels. It applies only to non-DME holding. Obstacle clearance determination for procedures development requires evaluation of the full size of the pattern - no outbound reduction is allowed.

SECTION 7. TEMPLATE TRACING

2-30. BASIC PERIMETER. The perimeter of the template contains four radii and two straight lines. Position the holding fix grommet hole (figure 1) over the fix, and align the solid black line with the holding course, and trace the pattern perimeter.

a. Right turn patterns: trace with imprinted numbers face-up and readable.

b. Left turn patterns: trace with imprinted numbers face-down.

2-31. REDUCTION AREAS. Each outbound end reduction area is formed by two radii. The fix end reduction area is formed by a radius and two straight lines. These may be traced as follows:

a. Outbound end: Step 1 - place a mark in the specific numbered area, grommet hole, and related half-moon holes. Step 2 - slide the template toward the fix end until the grommet hole mark and one of the half-moon marks are connected by the perimeter of the template, then trace the radius. Step 3 - pivot the template slightly and trace the other radius to complete the outbound end reduction area.

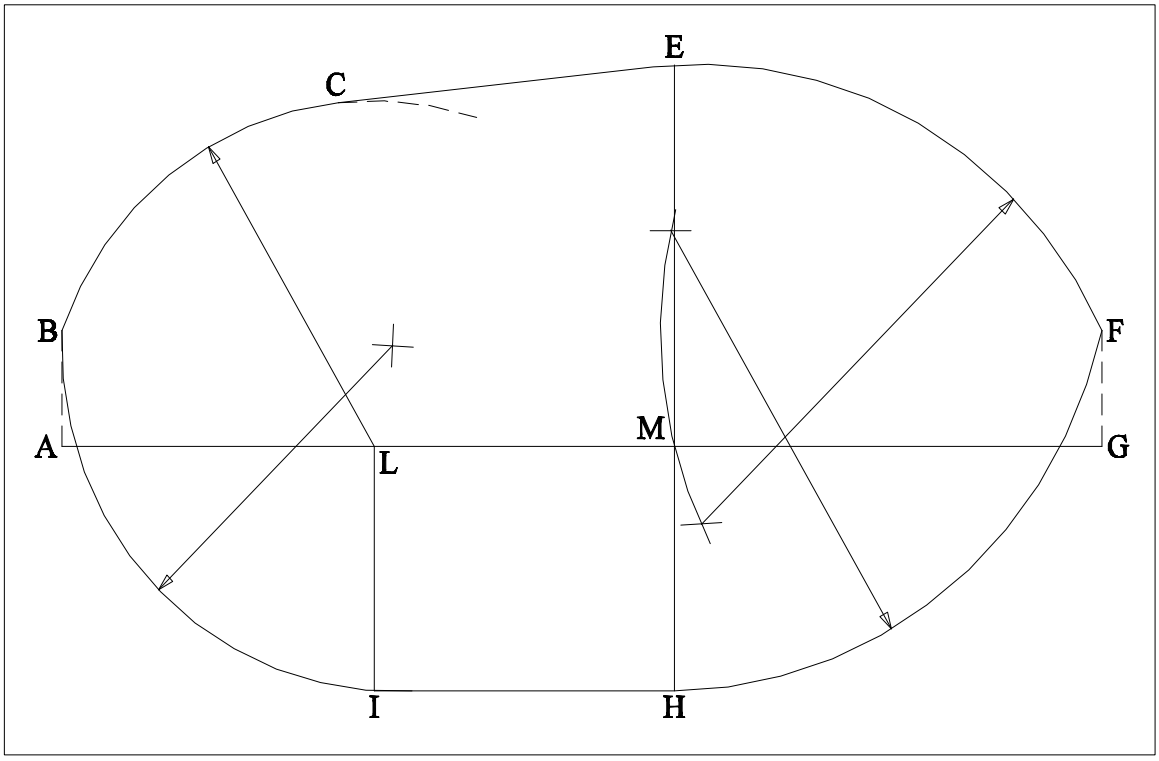
b. Fix end: Step 1 - place a mark in each of the grommet holes and related half-moon holes. Step 2 - trace the radius (similar to paragraph 2-31a, step 2) using the fix end of the template. Step 3 - complete the fix end reduction area by drawing the two straight lines.

SECTION 8. MANUAL CONSTRUCTION OF PATTERNS/TEMPLATES

2-32. REQUIREMENT. Standard plastic holding area templates are available at a scale of 1:500,000, Sectional Aeronautical Chart size. When a different scale is desirable/necessary, patterns/templates may be manually constructed as outlined in this section.

2-33. BASIC AREA CONSTRUCTION. Each size may be constructed by using figure 10, dimensions of table 3, and the following directions:

Figure 10. CONSTRUCTION CODE FOR BASIC AREA



a. Identify and mark holding fix as letter L.

b. Draw course line; A to L, L to M, and M to G.

c. At a 90° angle from the course line locate: B above A, F above G, E above M, H below M, and I below L.

d. Connect I and H with a straight line.

e. Place compass center at L, set for distance L-B, and draw an arc from B to beyond C.

f. Draw a straight line from E to a point of tangency with the B-C arc.

g. Set the compass for distance L-B; place compass center at B and draw a short arc above L; relocate compass center at I and draw a short arc across the first arc; relocate compass center at the intersection of the arcs and connect I-B.

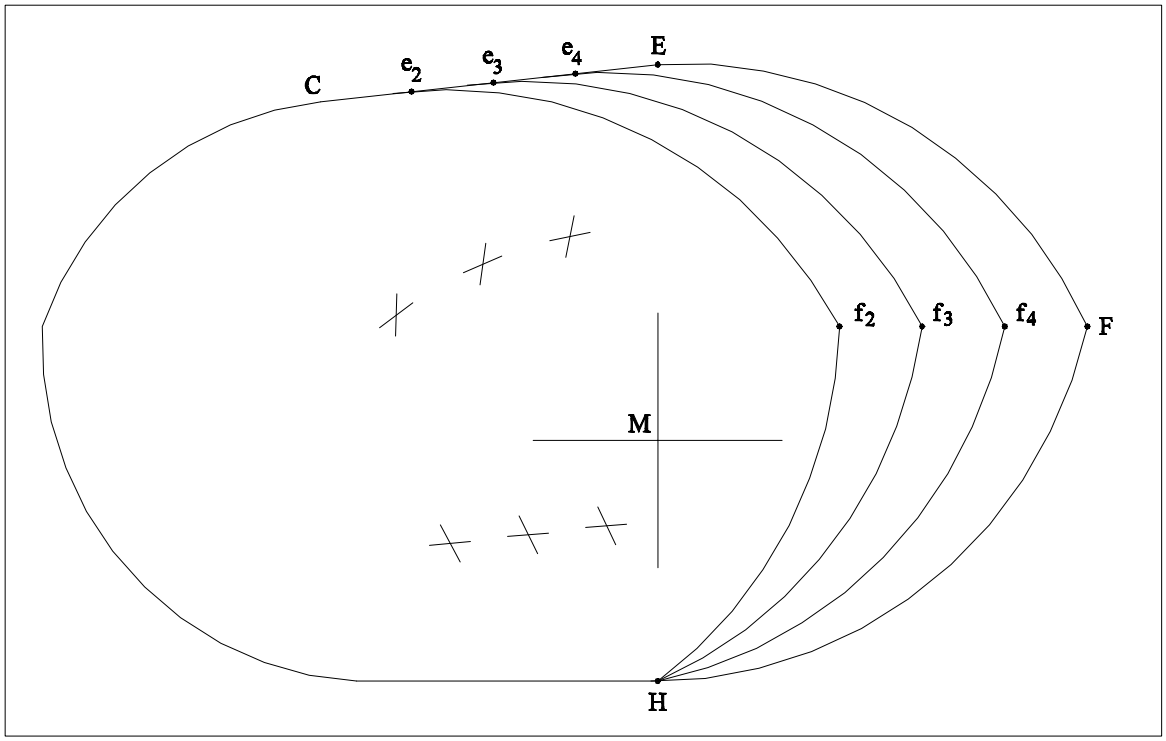
h. Place compass center at F and set for distance between F and M; draw an arc from above H to below E. Place compass center at E and draw a short arc above M. The arcs formed from E and H intersect the arc formed from F. Place compass center at the appropriate intersection of these arcs and connect E-F; place compass center at the other intersection and connect F-H.

Table 3. HOLDING AREA AIRSPACE DIMENSIONS (NM)

Pattern/ Template No.	A - L	L - M	M - G	L - I M - H	M - E	A - B G - F (J - K)	(J - L)	Total Length	Total Width
1	3.5	3.7	4.4	2.6	4.1	1.2	2.5	11.6	6.7
2	3.8	3.9	4.8	2.9	4.5	1.3	2.8	12.5	7.4
3	4.2	4.1	5.2	3.2	4.9	1.4	3.0	13.5	8.1
4	4.5	4.3	5.6	3.5	5.3	1.5	3.3	14.4	8.8
5	4.9	4.5	6.1	3.8	5.7	1.7	3.6	15.5	9.5
6	5.6	4.8	6.5	4.2	6.4	2.0	4.1	16.9	10.6
7	6.0	6.6	8.2	4.6	7.2	2.2	4.4	20.8	11.8
8	6.5	6.8	9.3	4.9	7.7	2.3	4.7	22.6	12.6
9	7.0	7.0	9.7	5.3	8.3	2.5	5.1	23.7	13.6
10	7.6	7.3	10.4	5.7	8.9	2.7	5.5	25.3	14.6
11	8.0	7.5	11.1	6.2	9.6	2.9	5.9	26.6	15.8
12	8.7	7.8	11.7	6.5	10.2	3.1	6.3	28.2	16.7
13	9.2	8.6	12.1	7.0	10.9	3.3	6.7	29.9	17.9
14	9.9	8.9	12.8	7.5	11.6	3.6	7.1	31.6	19.1
15	10.4	9.6	13.1	7.7	12.1	3.8	7.5	33.1	19.8
16	11.1	9.9	13.7	8.2	12.8	4.0	7.8	34.7	21.0
17	11.9	10.1	14.8	8.6	13.6	4.3	8.3	36.8	22.2
18	12.7	10.5	15.7	9.2	14.6	4.5	8.9	38.9	23.8
19	13.8	11.1	16.8	9.9	15.7	4.8	9.5	41.7	25.6
20	14.5	11.5	18.0	10.5	16.5	5.2	10.1	44.0	27.0
21	15.5	11.8	18.8	11.2	17.6	5.5	10.7	46.1	28.8
22	16.5	12.1	21.2	11.9	18.8	5.9	11.4	49.8	30.7
23	17.6	12.4	21.6	12.7	20.1	6.3	12.2	51.6	32.8
24	19.2	12.9	23.4	13.7	21.7	6.9	13.1	55.5	35.4
25	21.2	13.3	25.5	14.7	23.4	7.4	14.2	60.0	38.1
26	22.9	13.8	27.6	16.1	25.7	8.1	15.4	64.3	41.8
27	24.6	14.4	29.5	17.3	27.3	8.8	16.5	68.5	44.6
28	26.9	15.2	32.6	18.9	30.2	9.6	18.2	74.7	49.1
29	28.0	15.8	34.6	20.1	32.0	10.0	19.3	78.4	52.1
30	29.2	16.4	35.3	21.3	33.2	10.4	20.2	80.9	54.5
31	30.9	17.0	37.0	22.5	34.5	11.0	21.9	84.9	57.0

2-34. OUTBOUND END REDUCTION AREAS. Construct reduction areas by using figure 11 and the following directions:

Figure 11. CONSTRUCTION CODE FOR OUTBOUND END AREA



a. For patterns 1 through 6, locate points f4 and f3 at one mile intervals from point F along a line parallel to the holding course. Locate points e4 and e3 at one mile intervals from E along line E-C.

b. For patterns 7 through 18, proceed as in paragraph 2-34a, except locate "f" and "e" points at two mile intervals.

c. For pattern 19 and above, locate points f4, f3, and f2 at two mile intervals from point F along a line parallel to the holding course. Locate points e4, e3, and e2, at two mile intervals from E along line E-C.

d. Use distance F-M for the radius of all arcs formed per the following:

(1) Place compass center at H and draw a short arc above M.

(2) Place compass center at f4 and draw an arc across the arc formed in step 1.

(3) Place compass center at intersection of arcs formed by steps 1 and 2, and connect f4-H.

(4) Place compass center at e4 and draw a short arc below M.

(5) Place compass center at f4 and draw an arc across the arc formed in step 4.

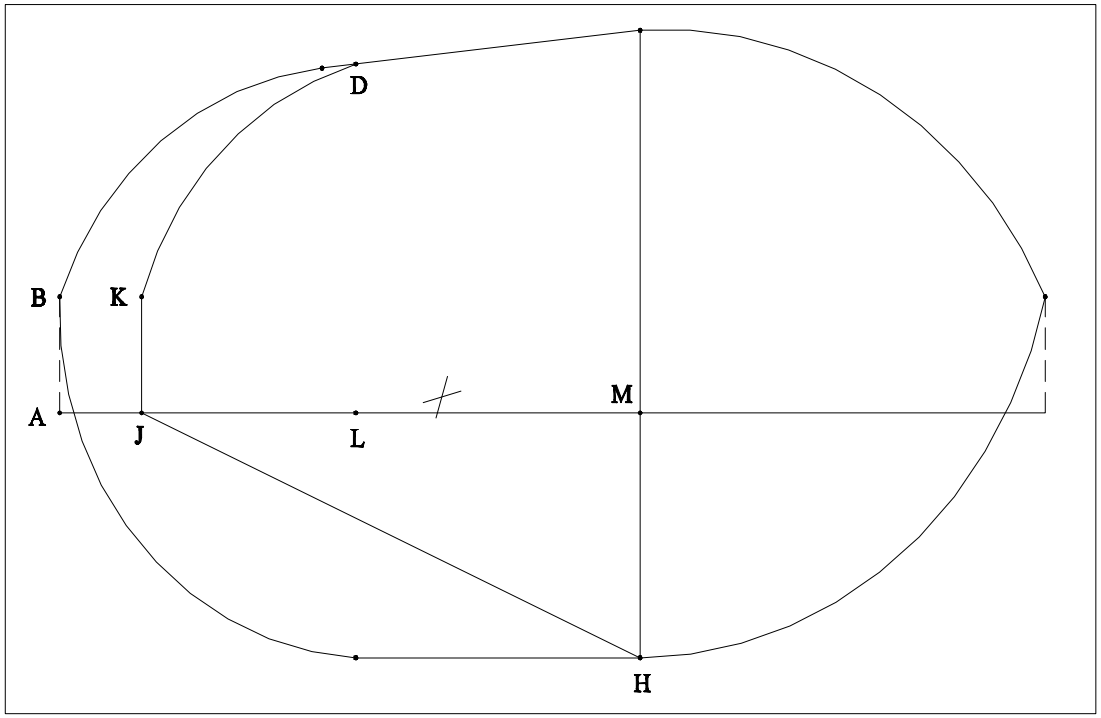
(6) Place compass center at intersection of arcs formed by steps 4 and 5, and connect f4-e4.

(7) Repeat steps (1) through (6), using appropriate "e" and "f" points to form the other e-f and f-h arcs.

e. Label the arcs formed by following paragraph 2-34d as the outbound end numbered areas. These areas are numbered 2 through 4 for patterns 1 through 18, and 1 through 4 for patterns 19 and above. These arcs are shown as dashed lines on standard plastic holding area templates.

2-35. FIX END REDUCTION AREA. Construct reduction area by using figure 12, table 3, and the following directions:

Figure 12. CONSTRUCTION CODE FOR FIX END AREA



a. Locate and mark point J.

b. Locate D above L, on the pattern perimeter, at 90° to the course line. Locate K above J, 90° to the course line.

c. Set compass for distance between L and B; place compass center at K and draw a short arc between L and M above, but close to the course line; place compass center at D and draw a short arc across the arc previously drawn; place compass center at the intersection of these arcs and connect D-K.

d. Draw a straight line from K to J, and from J to H.

e. **Label lines/arcs D-K, K-J, and J-H** as the fix end reduction area. This area is shown as dashed lines on standard plastic holding area templates.

CHAPTER 3. TURBULENT AIR OPERATION HOLDING PATTERNS

3-1. TURBULENT AIR OPERATION. Holding speeds listed in table 1, provide a safe margin of speed for normal holding conditions. Certain turbulent conditions can, in effect, cause an aircraft's weight to be suddenly increased with a resultant increase in stall speed during this critical period. To account for these stall possibilities, higher holding speeds are needed in certain conditions of turbulence.

3-2. MAXIMUM HOLDING SPEED IN TURBULENT AIR CONDITIONS. Holding airspace has been developed based on 280 knots IAS or Mach 0.8 maximum holding speed, whichever is lower, together with other factors and components listed in sections 1 and 2 of chapter 2. This special speed category provides airspace sizes for holding operations conducted in turbulent air conditions by aircraft whose normal maximum holding speed does not exceed 265 knots IAS. Appropriate holding patterns are listed in table 4. These patterns also serve for normal holding by USAF F-4 aircraft.

Table 4. TURBULENT AIR/USAF-F4 HOLDING PATTERN SIZES

Fix-to-NAVAID Distance					
0-14.9 NM		15-29.9 NM		30 NM and Over	
Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.	Alt.-No.
2 - 9	24 - 20	2 - 10	24 - 21	2 - 11	24 - 22
4 - 10	26 - 21	4 - 11	26 - 22	4 - 12	26 - 23
6 - 11	28 - 22	6 - 12	28 - 23	6 - 13	28 - 24
8 - 12	30 - 23	8 - 13	30 - 24	8 - 14	30 - 25
10 - 13	32 - 24	10 - 14	32 - 25	10 15	32 - 26
12 - 14	34 - 25	12 - 15	34 - 26	12 - 16	34 - 27
14 - 15	36 - 25	14 - 16	36 - 26	14 - 17	36 - 27
16 - 16	38 - 26	16 - 17	38 - 27	16 - 18	38 - 28
18 - 17	40 - 27	18 - 18	40 - 28	18 - 19	40 - 29
20 - 18	42 - 28	20 - 19	42 - 29	20 - 20	42 - 30
22 - 19	44 - 29	22 - 20	44 - 30	22 - 21	44 - 31

3-3. WHEN TO APPLY.

a. Except for USAF F-4 aircraft, normal holding conditions do not require the pattern sizes of table 4. However, the 280-knot patterns should be pre-planned and available for use when turbulent air conditions are known to exist, or are forecast to occur.

b. When specifically notified by a pilot that a higher holding speed is necessary due to turbulent air conditions, the controlling facility should apply the appropriate pattern size indicated in table 4, provided other handling methods, such as radar, are not available/feasible.

3-4. OPERATIONAL USE.

a. One pre-planned method for handling turbulent air holding is to correlate the holding pattern size currently used at individual holding fixes within a facility's area with the information in table 4. For example, pattern number 20 is being used at a fix 20 NM from the NAVAID (265 knots IAS speed group, from MHA through 24,000'); correlating pattern number 20 to table 4 discloses that it is usable from MHA through 22,000' at 280 knots IAS. The holding airspace at such a fix would accommodate normal holding at 24,000' and below, or turbulent air holding at 22,000' and below.

b. Adding captions to current depictions can easily convey turbulent air holding information to the controller; e.g., the illustration of figure 15, can portray the situation of paragraph 3-4a by adding the following caption: 280 knots - 16,000'.

c. Another method of handling turbulent air holding is to establish separate patterns for this purpose at locations where these larger pattern sizes can be accommodated. It may be desirable to do this for each altitude strata in situations where a different holding fix is needed for each strata.

d. Where 280 knot patterns involve uncontrolled airspace, initiate appropriate action to designate controlled airspace for these patterns.

CHAPTER 4. OPERATIONAL APPLICATIONS

4-1. ESTABLISHING FIXES. Establish holding pattern fixes as follows:

a. Overhead the NAVAID fixes are authorized only for LF and VOR facilities and, when DME is not used, for VOR holding at VORTAC facilities.

b. DME fixes shall not be established overhead the NAVAID from which inbound holding course information would be derived.

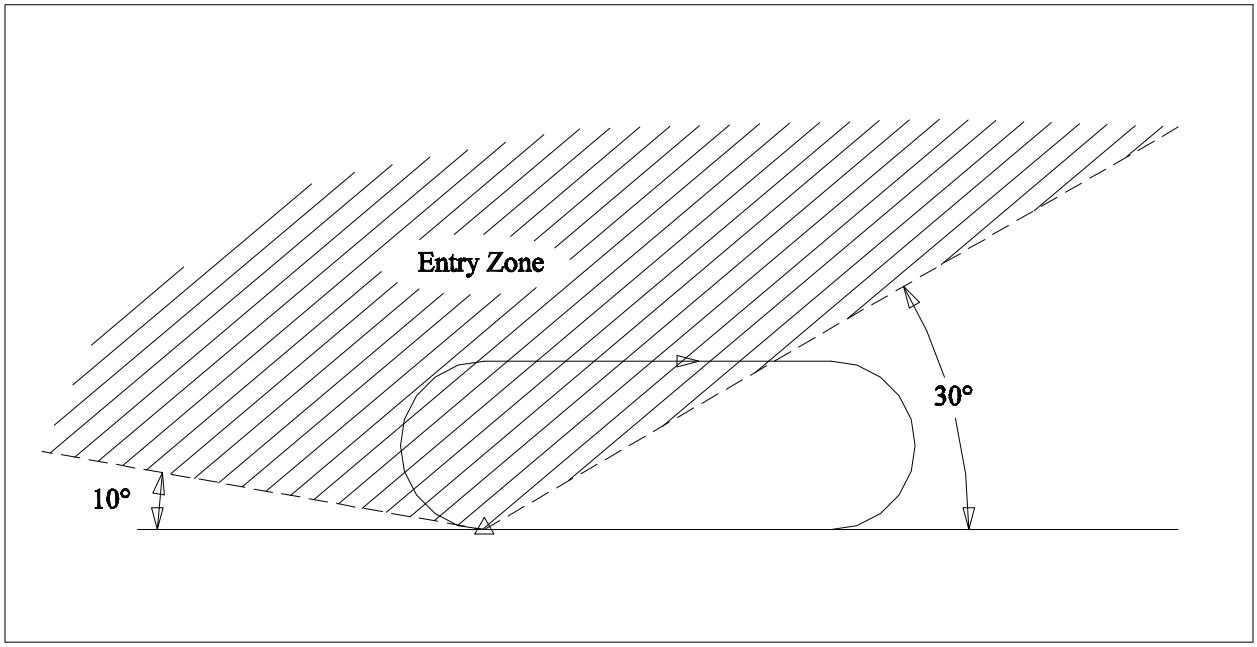
c. Intersection fixes shall, whenever possible, be formed by radials/courses/bearings which are at an angle of not less than 45° to each other.

d. Controlled Airspace. Contain holding areas within controlled airspace, or take action to have controlled airspace designated where uncontrolled airspace is involved.

4-2. PATTERN ALIGNMENT. Whenever possible, the holding pattern shall be aligned to accommodate entry to the holding area along the inbound holding course, its reciprocal, or at a relatively small angle thereto.

4-3. OPTIMUM ENTRY ROUTING. Planning per paragraph 4-2 may not accommodate all entry aircraft. Therefore, aircraft which normally will enter the holding area within the zone set forth in figure 13 should be routed to intercept the inbound holding course or its reciprocal at not less than 5 NM from the holding fix at and below 14,000', and not less that 10 NM above 14,000'.

Figure 13. ZONE FOR ENTRY REROUTING



4-4. DME LEG LENGTH SELECTION. Whenever possible use a leg length longer than the minimum listed. This will enhance inbound course bracketing.

4-5. DME HOLDING DIRECTION. An inbound holding course toward the NAVAID has the following advantages over an inbound holding course away from the NAVAID.

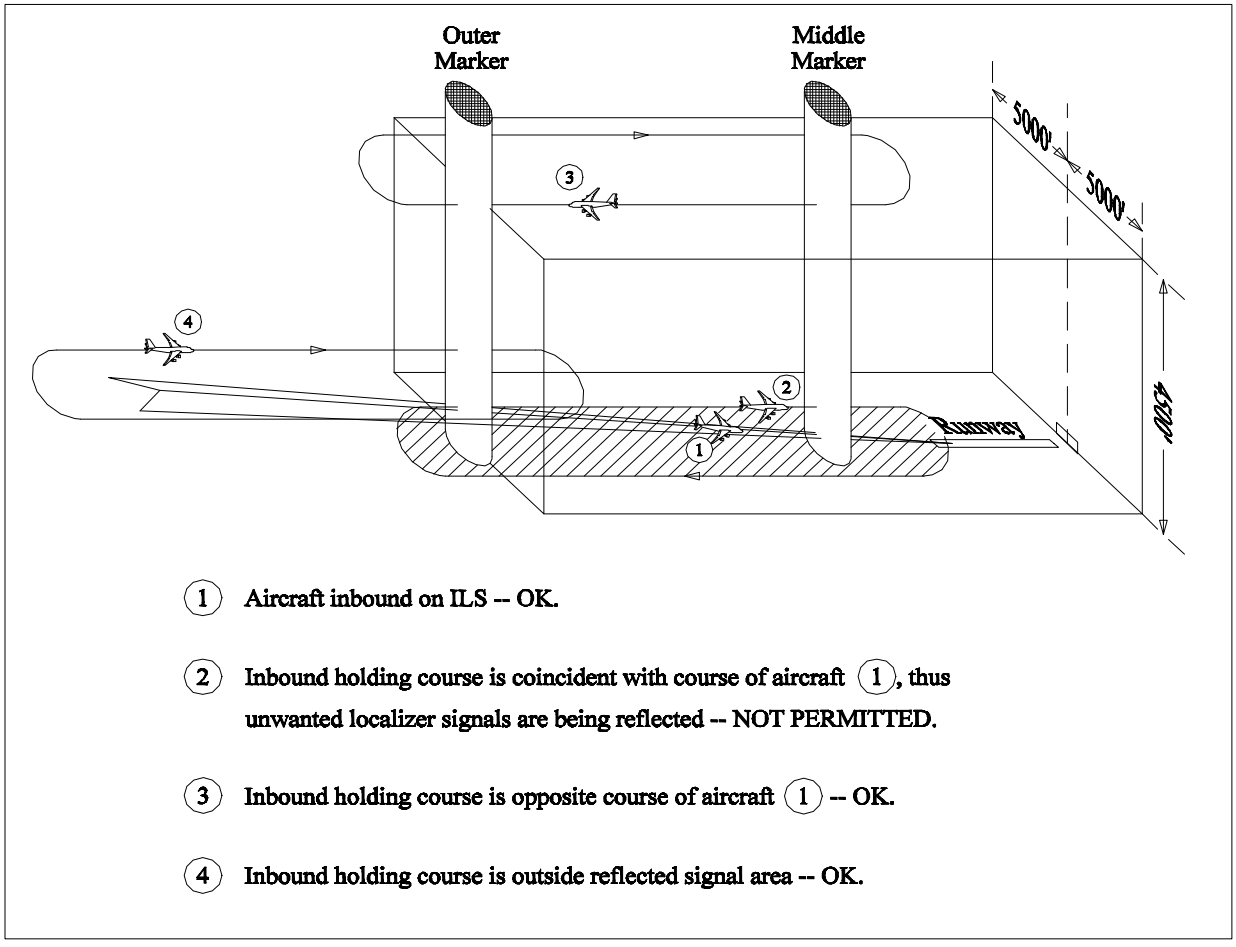
a. It provides a greater choice of leg lengths.

b. When associated with an instrument approach, the aircraft on the inbound holding course will normally be on-course toward the approach NAVAID.

4-6. ESTABLISHING MINIMUM ALTITUDES. MHA's are determined by the National Flight Procedures Office.

4-7. HOLDING PATTERNS ON ILS COURSES. Do not establish a holding pattern inbound on an ILS localizer between the outer marker and the localizer antenna below 5,000 feet above the antenna elevation. Holding patterns opposite to the inbound course are acceptable. This is to avoid creating unwanted reflected signals (see figure 14). An outer marker by itself shall not be used to identify the point from which holding is to be executed.

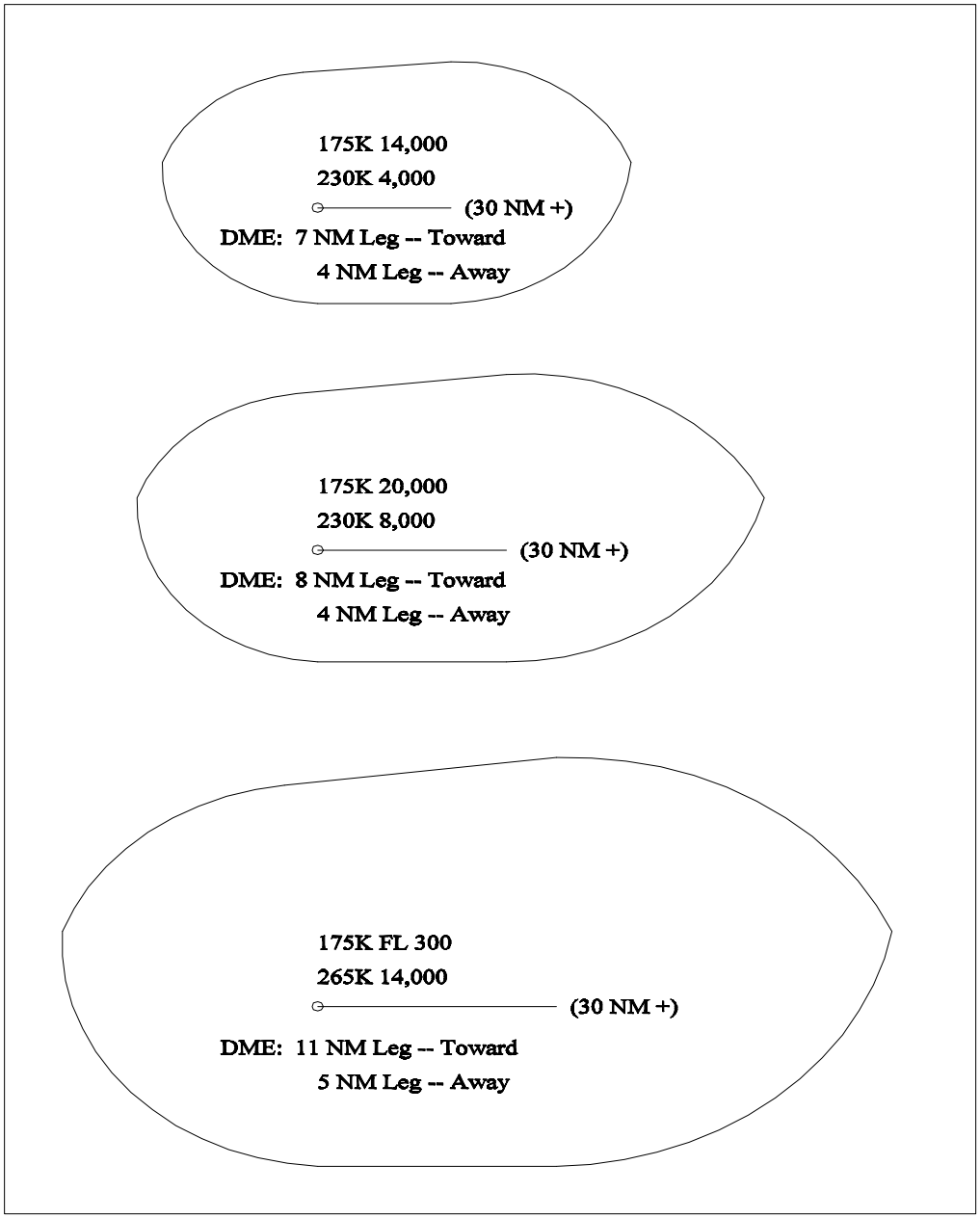
Figure 14. REFLECTED SIGNAL AREA



4-8. UNPLANNED HOLDING. Good facility area planning minimizes the need for "quick fixing" (unplanned holding) at the control position. Unusual circumstances may require occasionally "quick fixing"; therefore, each control position should be analyzed according to altitude controlled and holding speeds normally encountered. When an analysis has been made, appropriate template sizes can be selected and captioned. The following guidelines are recommended concerning templates/facsimiles prepared for use at control positions:

a. Caption each according to its use (see figure 15).

Figure 15. EXAMPLE TEMPLATE CAPTIONING



b. Use no more than three sizes per control position.

c. Use the 30-nautical mile and over portion of table 2 for the fix-to-NAVAID distance, thus permitting use at any fix distance.

d. Show a separate DME leg length for: inbound course toward the NAVAID, and inbound course away from the NAVAID. A review of appendix 1 will normally reveal a common leg length which can serve all fix-to-NAVAID distances for a specific template size. The same is true of appendix 2.

e. For quick reference, the template(s) captioned for a specific control position should be located near that position.

CHAPTER 5. HELICOPTER/STOL HOLDING PATTERNS

5-1. GENERAL INFORMATION. Helicopter and short takeoff and landing (STOL) aircraft can fly standard holding patterns. However, helicopter and STOL aircraft are able to hold at much lower speeds than those listed in table 1, upon which pattern numbers 1 through 31 are based. A savings in holding pattern airspace is realized by developing pattern sizes based on lower holding speed capability of helicopter and STOL aircraft. Apply criteria in this chapter to procedures developed solely for helicopters or STOL aircraft.

5-2. CRITERIA DEVELOPMENT.

a. Helicopter/STOL pattern sizes were determined consistent with applicable parts of chapter 2. Main differences involved lower speeds, no optional reduction areas, and simplified construction of patterns.

b. A maximum speed of 100 KIAS is assumed.

5-3. LIMITING FACTORS.

a. The helicopter/STOL patterns developed under this order are relatively small. Only very minor additional airspace savings would be involved if advantage was taken of the optional reduction areas. Fractional mile dimensions and the small scale of charted holding patterns make use of most helicopter/ STOL optional reduction areas impractical.

b. Geometry needed to depict the perimeter of helicopter/STOL patterns would also involve fractional mile measurements and be affected by small chart scales. These factors make such geometry very difficult to plot. Therefore, for ease of application, simple rectangular shaped areas are used to depict most sizes of helicopter/STOL holding pattern airspace.

5-4. AIRSPACE DETERMINATION.

a. Sizes. There are five rectangular patterns and two standard numbered patterns to cover helicopter/ STOL holding situations. The numbered patterns refer to the holding patterns used by all aircraft.

b. Identification. Pattern sizes are identified by letters A through E and standard numbered patterns 1 and 2.

c. Plotting. Due to their rectangular shape, patterns A through E are easy to plot. Templates already exist for numbered patterns 1 and 2.

d. Altitude Levels. Helicopter/STOL holding levels from MHA to 10,000' are provided at intervals of 2,000'. Patterns apply at specific altitudes listed in table 5, and all altitudes below. The next higher even altitude pattern applies to holding at specific odd numbered altitudes.

e. Fix Distances. The information in paragraph 2-12 also applies to helicopter/STOL planning.

f. Relationship. Fix distance, altitude, and pattern identification/template number relationships are contained in table 5.

Table 5. HELICOPTER/STOL PATTERN SELECTION CHART

Fix-to-NAVAID Distance					
0-14.9 NM		15-29.9 NM		30 NM and Over	
Altitude	Identification Number	Altitude	Identification Number	Altitude	Identification Number
		100 Knots IAS			
2	A	2	B	2	C
4	B	4	C	4	D
6	C	6	D	6	E
8	D	8	E	8	1
10	E	10	1	10	2

5-5. DME APPLICATION. An inbound holding course toward the NAVAID has the following advantages over an inbound holding course away from the NAVAID.

a. It provides a greater choice of leg lengths.

b. When associated with an instrument approach, the aircraft on the inbound holding course will normally be on-course toward the approach NAVAID.

5-6. DME LEG LENGTHS. Maximum outbound leg lengths to be used for STOL holding are as follows:

a. Patterns A and B . . . 3 mile leg.

b. Patterns C, D, and E . . . 4 mile leg.

c. Numbered patterns 1 and 2 leg lengths are covered in appendices 1 and 2.

5-7. MANUAL CONSTRUCTION OF STOL PATTERNS.

a. Patterns A through E may be constructed by using figure 16, construction code, and table 6 dimensions.

b. Location L is the holding fix, and location G is the outbound end of the holding area.

Figure 16. CONSTRUCTION CODE FOR HELICOPTER/STOL AREA

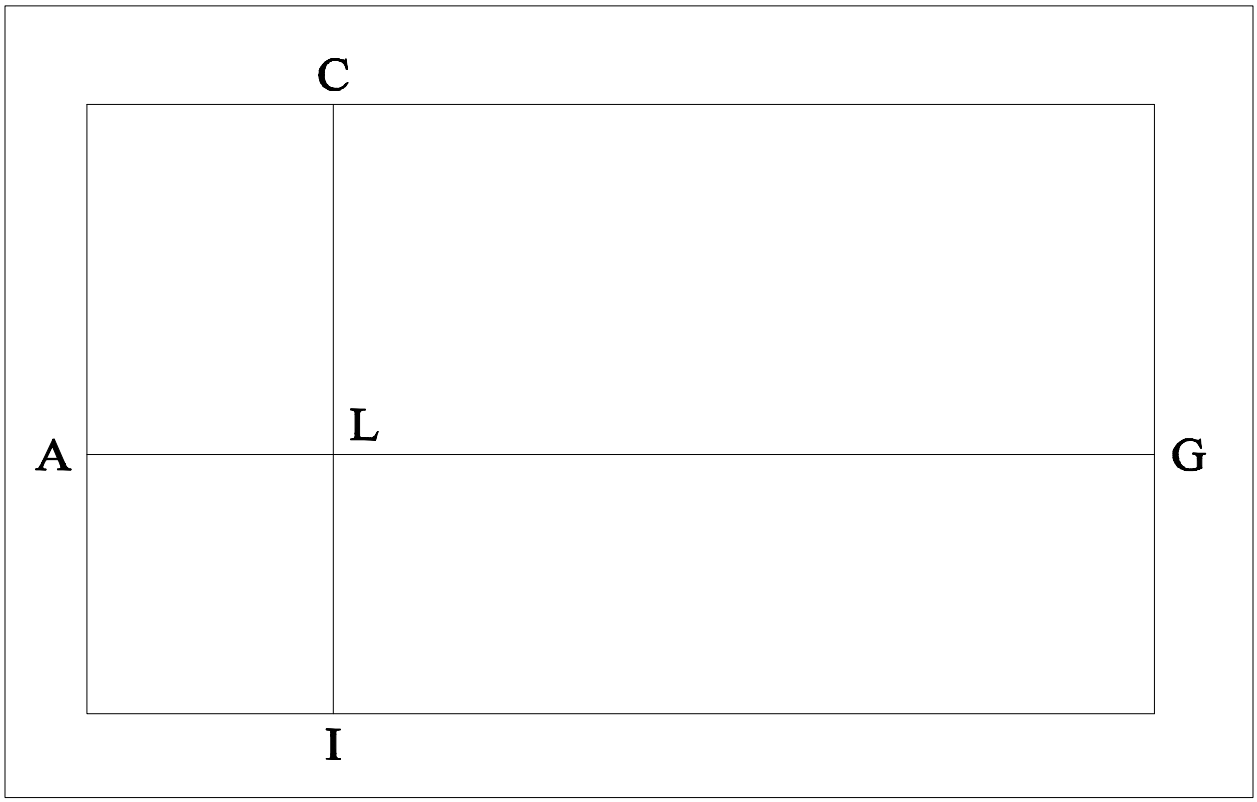


Table 6. HELICOPTER/STOL HOLDING AREA DIMENSIONS (NM)

Pattern Ident.	A - L	L - G	L - C	L - I	Total Length	Total Width
A	**1.3**	**4.6**	**2.0**	**1.5**	**5.9**	**3.5**
B	**1.4**	**4.8**	**2.1**	**1.6**	**6.2**	**3.7**
C	**1.5**	**5.0**	**2.3**	**1.7**	**6.5**	**4.0**
D	**1.6**	**5.4**	**2.5**	**1.8**	**7.0**	**4.3**
E	**1.7**	**5.7**	**2.8**	**1.9**	**7.4**	**4.7**

5-8. CHARTING OF HELICOPTER/STOL HOLDING PATTERN. Helicopter/STOL holding pattern shall be depicted on aeronautical charts with a cartographic icon showing the maximum speed of "100K".

CHAPTER 6. GPS HOLDING PATTERNS

6-1. GENERAL INFORMATION. This chapter contains criteria for holding patterns associated with Global Positioning System (GPS) equipment certified under TSO C-129. The criteria contained in this chapter applies to GPS en route, terminal, and approach holding.

6-2. CRITERIA DEVELOPMENT. Basic holding pattern assumptions in chapter 2 are used for GPS holding pattern except a constant fix error of .5 NM is used.

6-3. GPS HOLDING PATTERNS. Refer to table 7.

TABLE 7. GPS HOLDING PATTERN SELECTION CHART

Alt.-No.	Alt.-No.
175 Knots IAS	
2 - 3 **4 - 3** **6 - 3** **8 - 4** **10 - 5** **12 - 5** **14 - 6** **16 - 7**	**18 - 7** **20 - 8** **22 - 8** **24 - 10** **26 - 10** **28 - 11** **30 - 12**
200 Knots IAS	
2 - 4 **4 - 5** **6 - 5**	
210 Knots IAS	
8 - 7 **10 - 7** **12 - 7** **14 - 7**	

TABLE 7. GPS HOLDING PATTERN SELECTION CHART (CONTINUED)

Alt.-No.	Alt.-No.
230 KIAS	
2 - 7 4 - 7 6 - 7 8 - 7 10 - 7 12 - 7 14 - 8 16 - 12 18 - 13 20 - 13 22 - 14 24 - 15 26 - 16	28 - 17 30 - 18 32 - 19 34 - 20 36 - 21 38 - 22 40 - 23 42 - 24 44 - 25 46 - 26 48 - 27 50 - 27
265 KIAS	
2 - 7 4 - 7 6 - 7 8 - 8 10 - 8 12 - 10 14 - 11 16 - 15 18 - 16 20 - 17 22 - 18 24 - 19 26 - 19	28 - 20 30 - 21 32 - 22 34 - 23 36 - 24 38 - 25 40 - 26 42 - 27 44 - 27 46 - 28 48 - 29 50 - 30
310 KIAS	
2 - 9 4 - 10 6 - 11 8 - 12 10 - 13 12 - 13 14 - 14 16 - 19 18 - 19 20 - 20 22 - 21	24 - 22 26 - 23 28 - 24 30 - 25 32 - 25 34 - 26 36 - 27 38 - 28 40 - 28 42 - 29

6-4. GPS LEG LENGTH DETERMINATION. Table 8 contains the maximum leg length which may be specified for a GPS holding pattern based on distance rather than time. Enter table 8 with the holding pattern number from table 7 and read the maximum leg length.

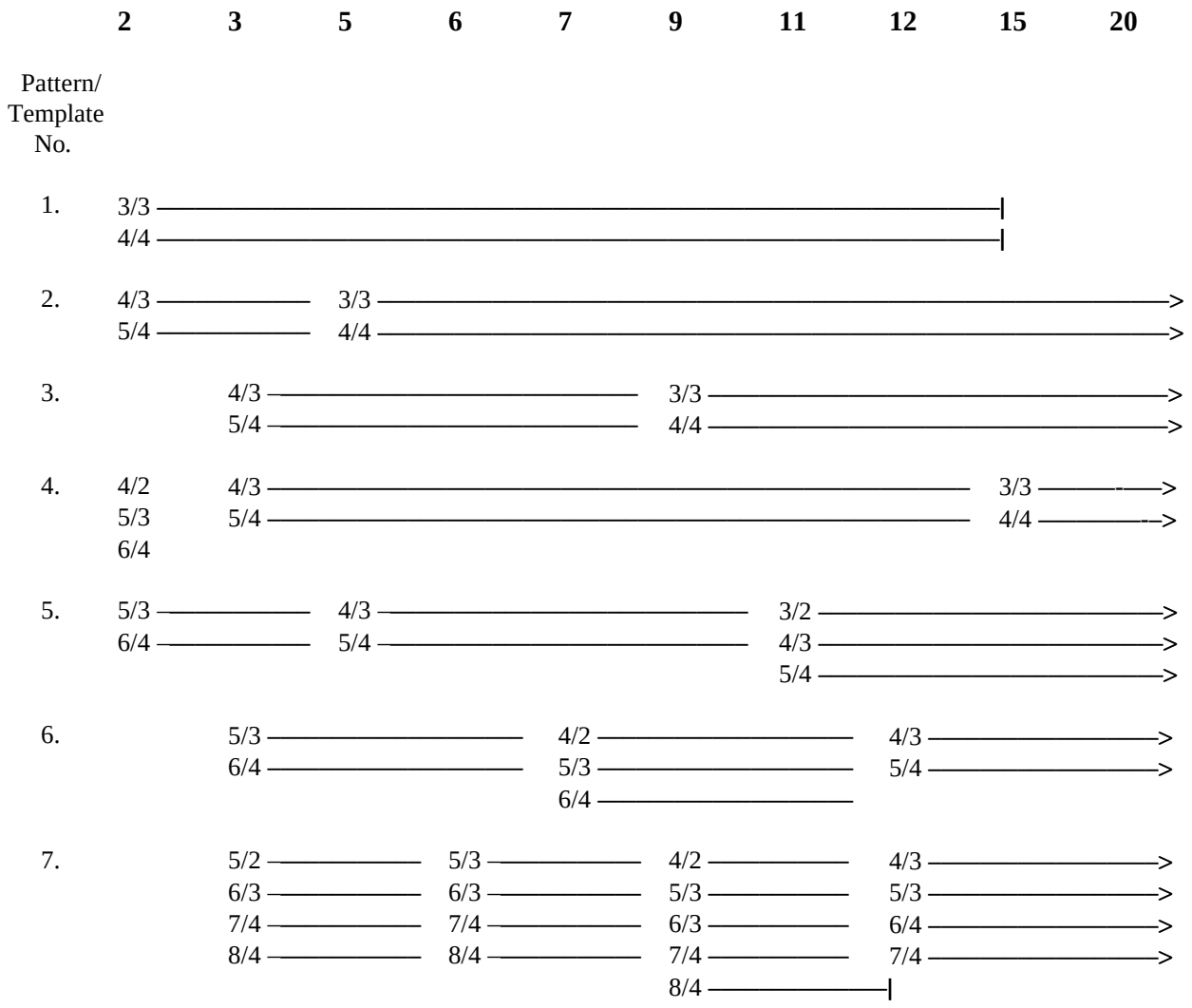
TABLE 8. GPS HOLDING MAXIMUM OUTBOUND LEG LENGTH

Pattern Number	Maximum Outbound Leg Length (NM)	Pattern Number	Maximum Outbound Leg Length (NM)
3	4	17	10
4	4	18	11
5	4	19	11
6	5	20	12
7	6	21	12
8	6	22	12
9	7	23	12
10	7	24	13
11	8	25	13
12	8	26	14
13	9	27	14
14	9	28	15
15	10	29	16
16	10	30	16

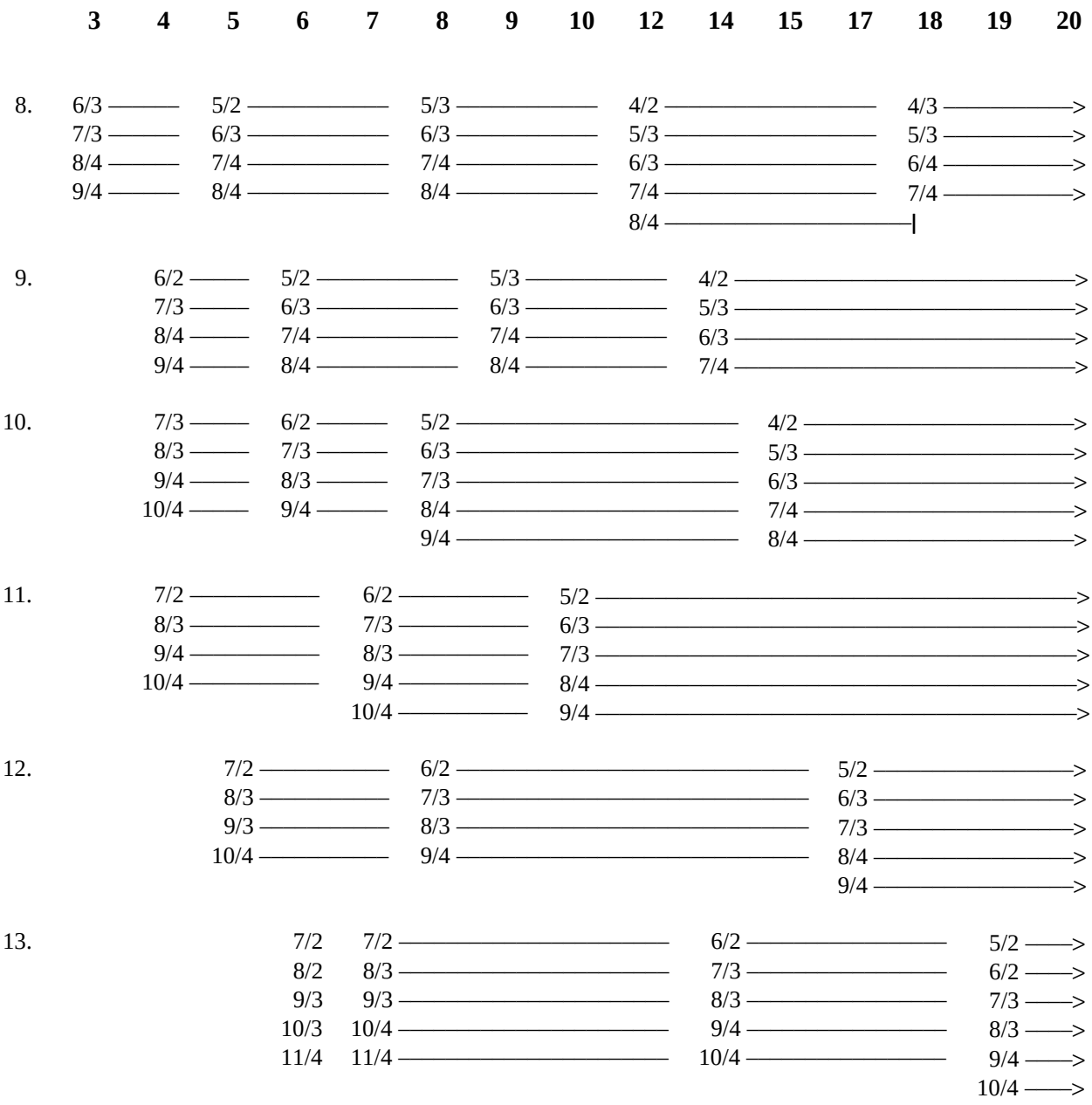
APPENDIX 1. DME LEG LENGTH/OUTBOUND END REDUCTION AREA CODE

(Holding course toward the NAVAID)
(See paragraph 2-21 for explanation and use.)

Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



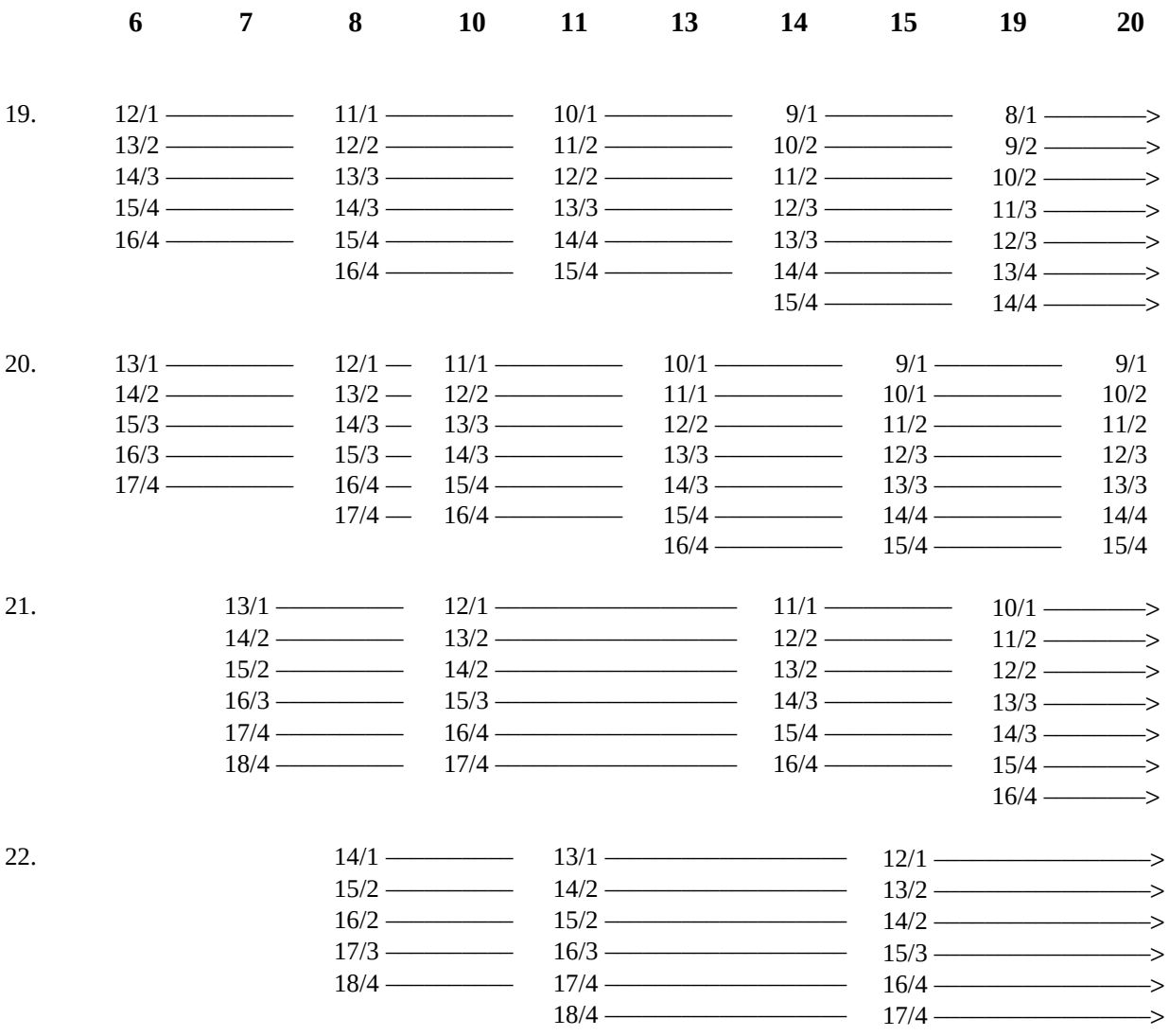
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	4	5	6	7	8	9	11	12	14	15	16	19	20
14.				8/2			7/2				6/2		
				9/3			8/2				7/2		
				10/3			9/3				8/3		
				11/4			10/4				9/3		
				12/4			11/4				10/4		
											11/4		
15.	9/2				8/2				7/2				6/2
	10/2				9/2				8/2				7/2
	11/3				10/3				9/3				8/3
	12/4				11/3				10/3				9/3
	13/4				12/4				11/4				10/4
									12/4				11/4
16.		10/2			9/2			8/2		7/2			
		11/3			10/3			9/2		8/2			
		12/3			11/3			10/3		9/3			
		13/4			12/4			11/3		10/3			
		14/4			13/4			12/4		11/4			
								13/4		12/4			
17.			10/2			9/2		8/2				7/2	
			11/2			10/2		9/2				8/2	
			12/3			11/3		10/3				9/3	
			13/4			12/3		11/3				10/3	
			14/4			13/4		12/4				11/4	
						14/4		13/4				12/4	
18.		12/2		11/2		10/2		9/2				8/2	
		13/3		12/2		11/2		10/2				9/2	
		14/3		13/3		12/3		11/3				10/3	
		15/4		14/4		13/3		12/3				11/3	
				15/4		14/4		13/4				12/4	
								14/4				13/4	

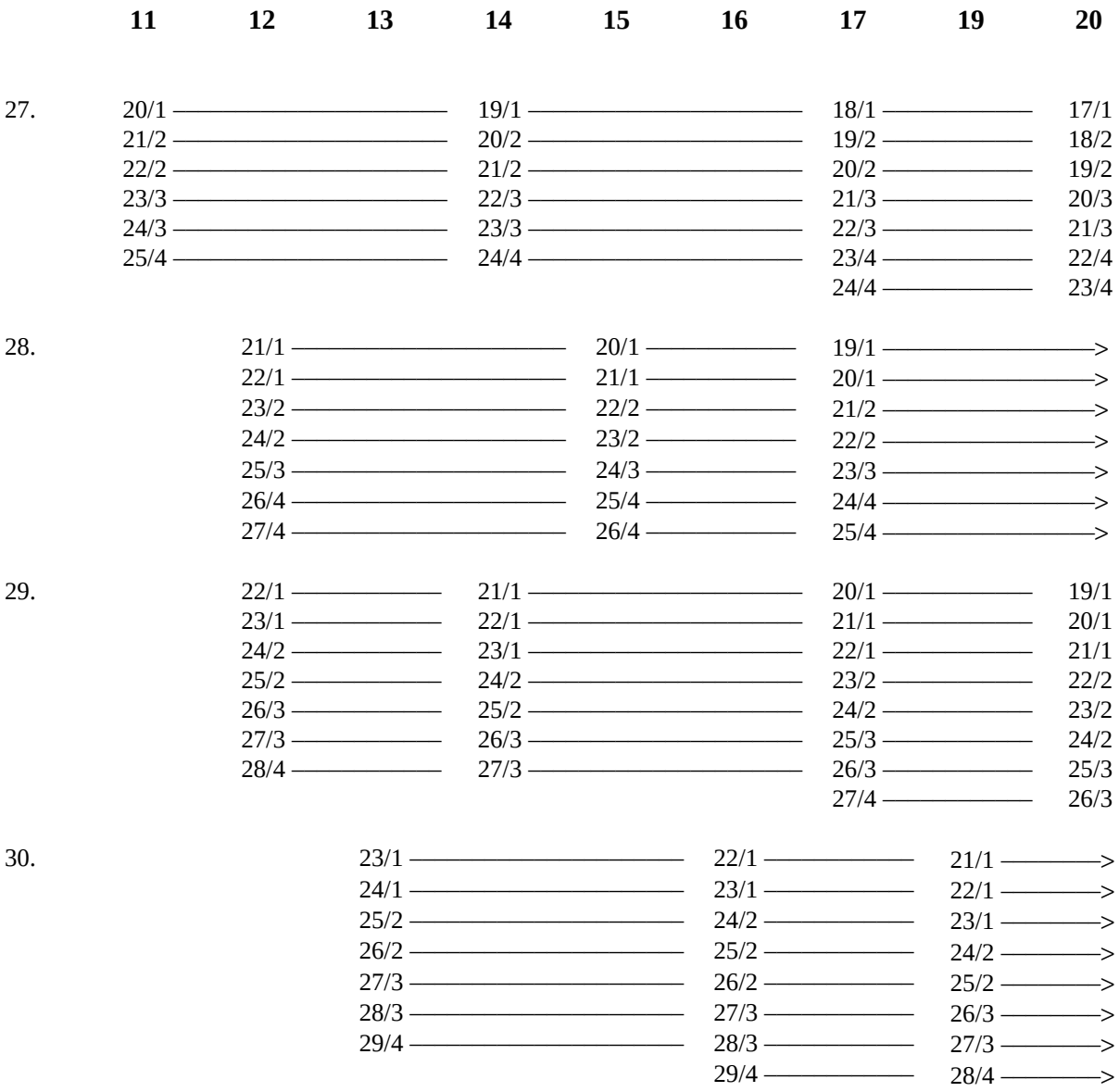
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	8	9	10	12	13	14	15	17	18	19	20
23.	14/1 ——			13/1 ——			12/1 ——		11/1 ——>		
	15/1 ——			14/1 ——			13/1 ——		12/1 ——>		
	16/2 ——			15/2 ——			14/2 ——		13/2 ——>		
	17/2 ——			16/3 ——			15/3 ——		14/2 ——>		
	18/3 ——			17/3 ——			16/3 ——		15/3 ——>		
	19/3 ——			18/4 ——			17/4 ——		16/3 ——>		
	20/4 ——			19/4 ——			18/4 ——		17/4 ——>		
									18/4 ——>		
24.		15/1 ——		14/1 ——				13/1 ——>			
		16/1 ——		15/1 ——				14/2 ——>			
		17/2 ——		16/2 ——				15/2 ——>			
		18/2 ——		17/2 ——				16/3 ——>			
		19/3 ——		18/3 ——				17/3 ——>			
		20/4 ——		19/4 ——				18/4 ——>			
		21/4 ——		20/4 ——				19/4 ——>			
25.		16/1 ——			15/1 ——		14/1 ——			13/1 ——>	
		17/1 ——			16/1 ——		15/1 ——			14/1 ——>	
		18/2 ——			17/2 ——		16/2 ——			15/2 ——>	
		19/2 ——			18/2 ——		17/2 ——			16/2 ——>	
		20/3 ——			19/3 ——		18/3 ——			17/3 ——>	
		21/4 ——			20/3 ——		19/3 ——			18/3 ——>	
		22/4 ——			21/4 ——		20/4 ——			19/4 ——>	
							21/4 ——			20/4 ——>	
26.			18/1 ——			17/1 ——		16/1 ——			15/1
			19/1 ——			18/1 ——		17/1 ——			16/1
			20/2 ——			19/2 ——		18/2 ——			17/2
			21/2 ——			20/2 ——		19/2 ——			18/2
			22/3 ——			21/3 ——		20/3 ——			19/3
			23/4 ——			22/4 ——		21/4 ——			20/3
			24/4 ——			23/4 ——		22/4 ——			21/4

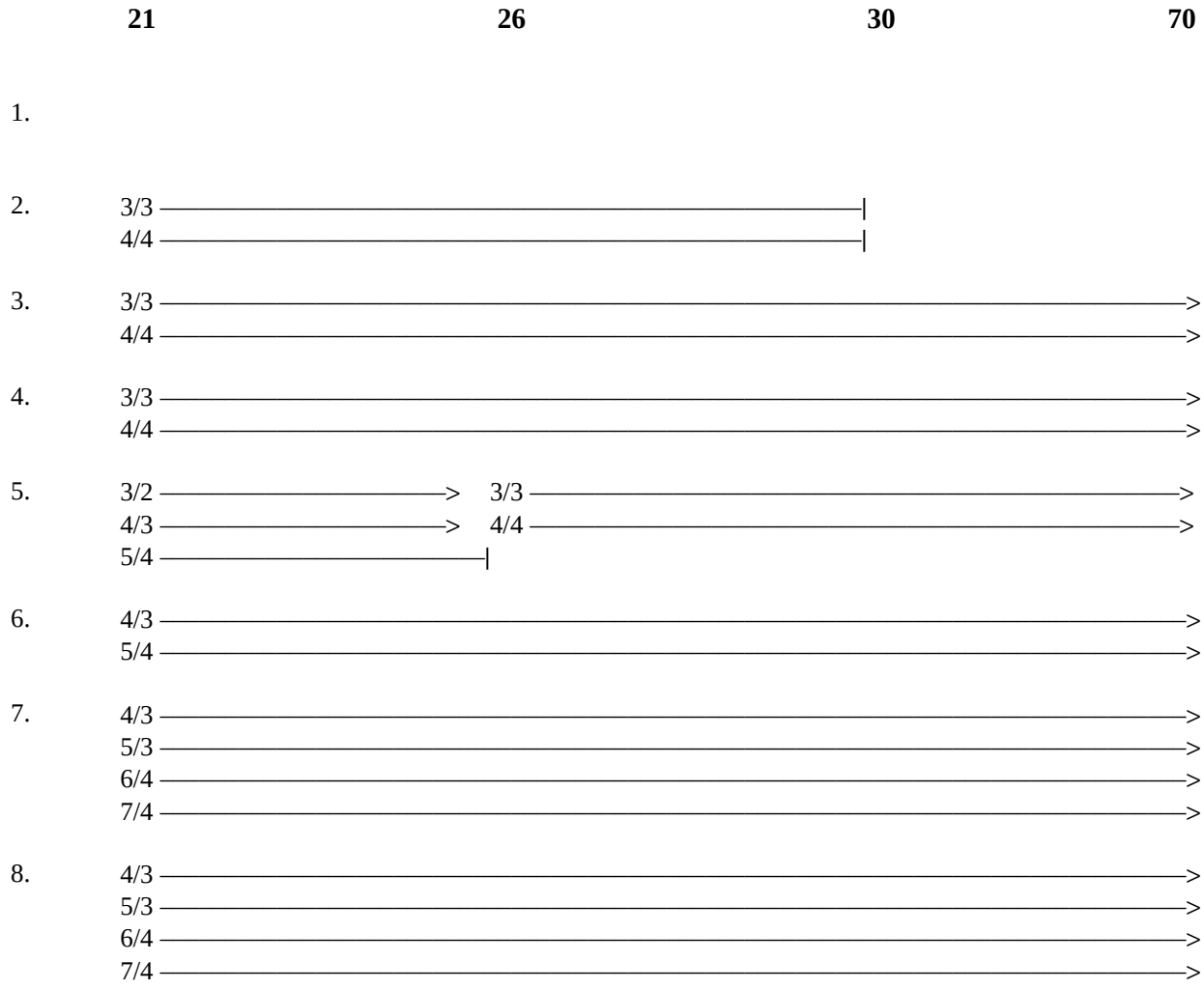
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



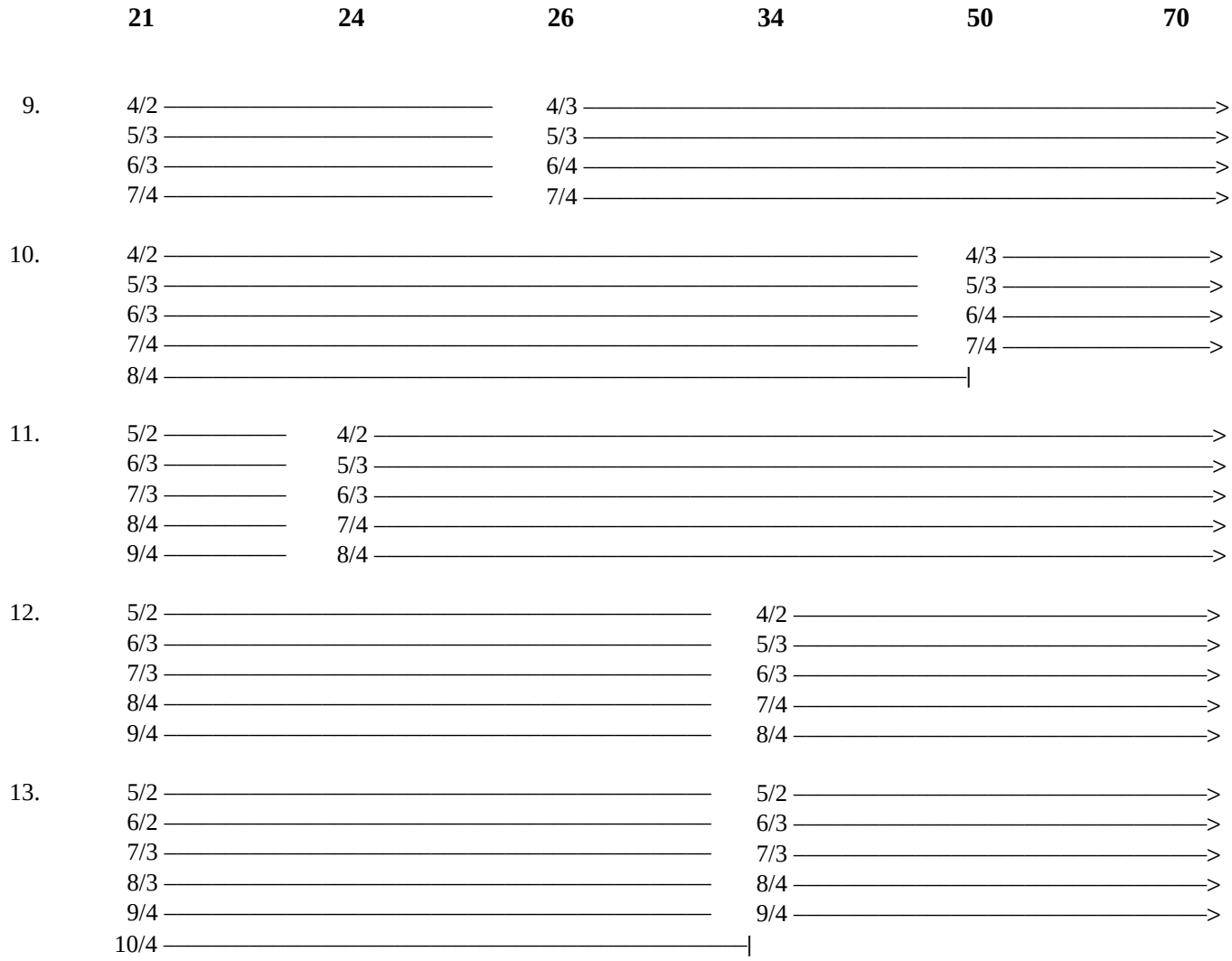
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	14	16	19	20
31.	24/1 ———————	23/1 ———————	22/1 ———————>	
	25/1 ———————	24/1 ———————	23/1 ———————>	
	26/2 ———————	25/2 ———————	24/1 ———————>	
	27/2 ———————	26/2 ———————	25/2 ———————>	
	28/2 ———————	27/2 ———————	26/2 ———————>	
	29/3 ———————	28/3 ———————	27/2 ———————>	
		29/3 ———————	28/3 ———————>	

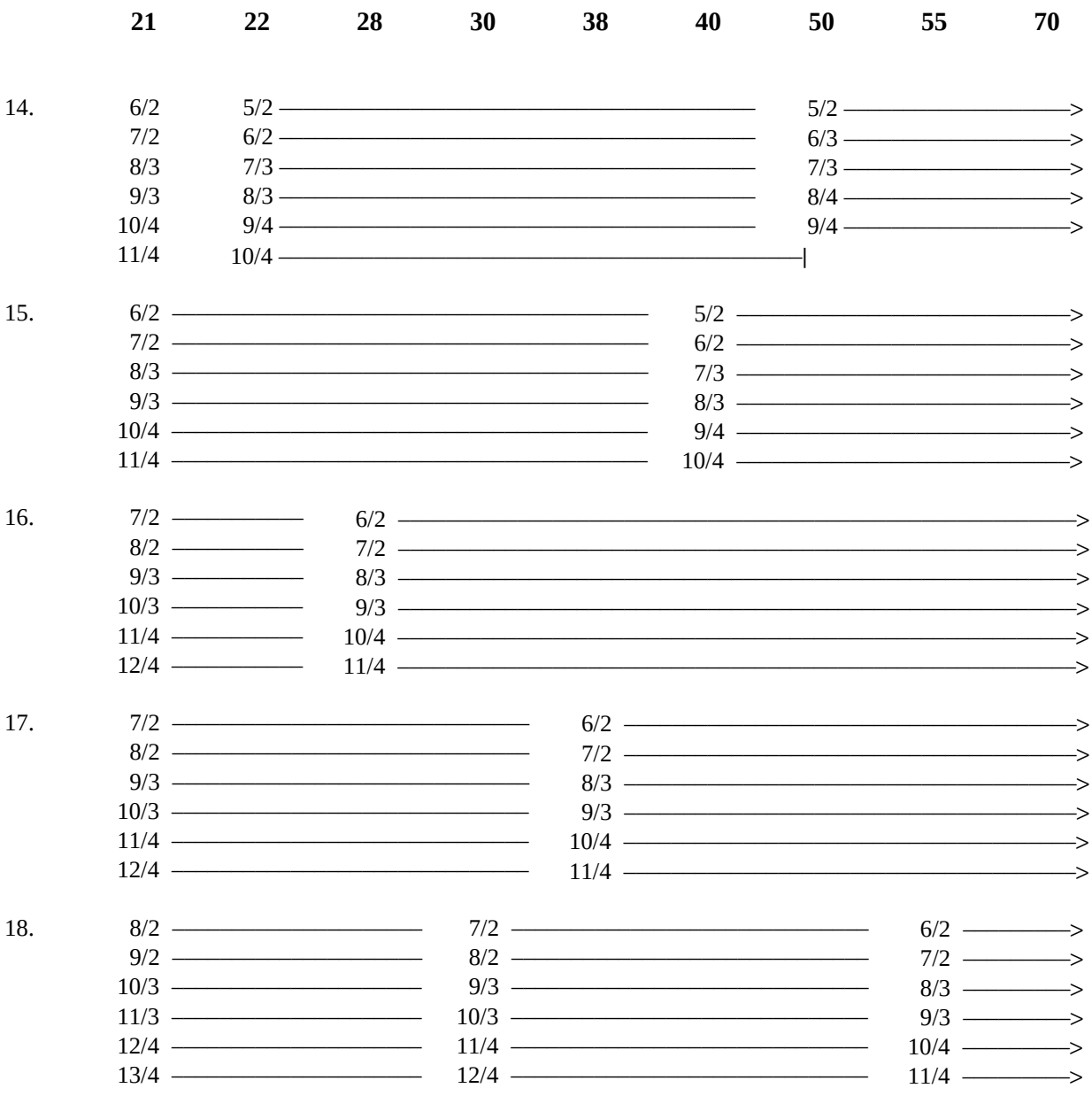
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



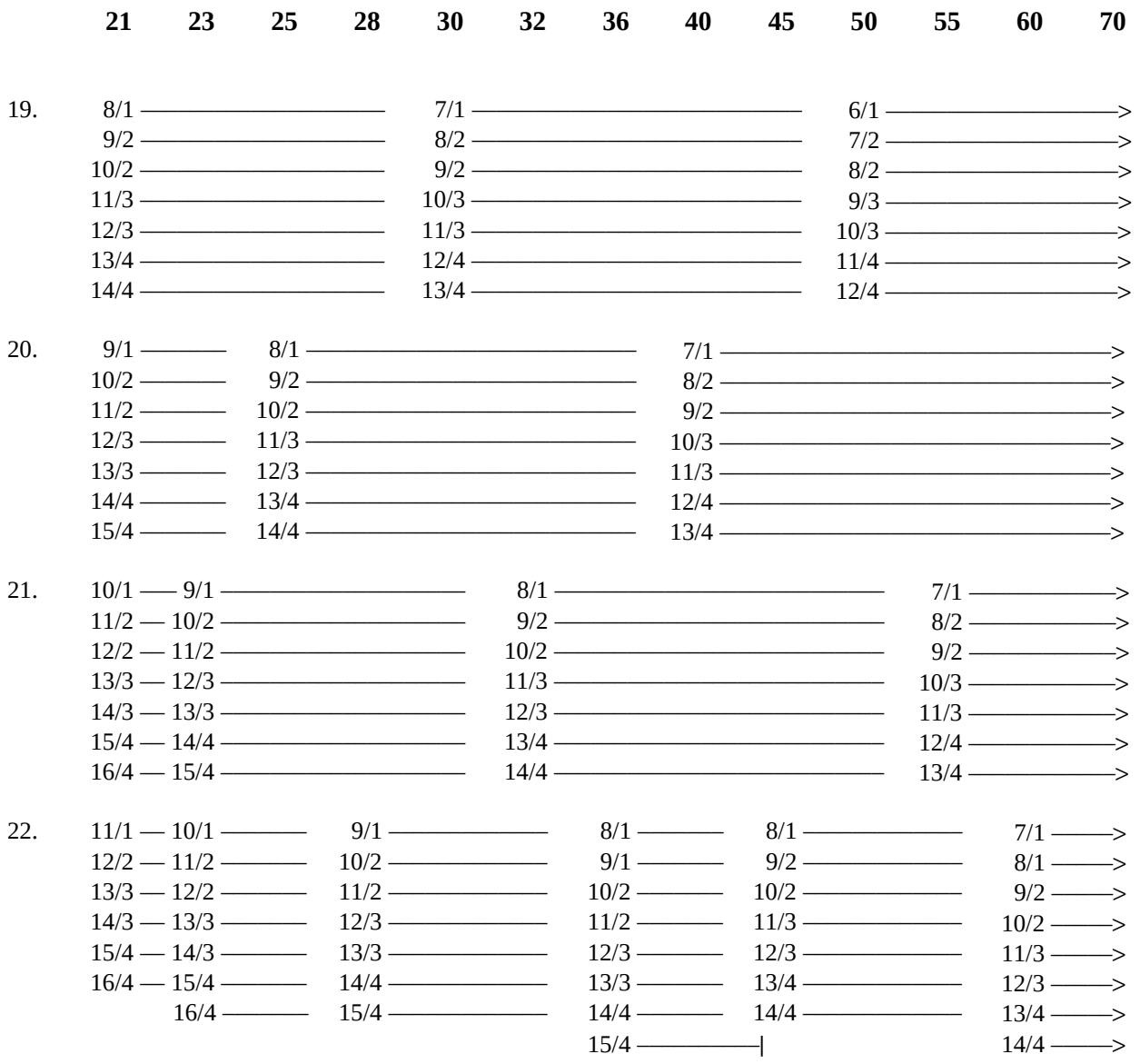
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



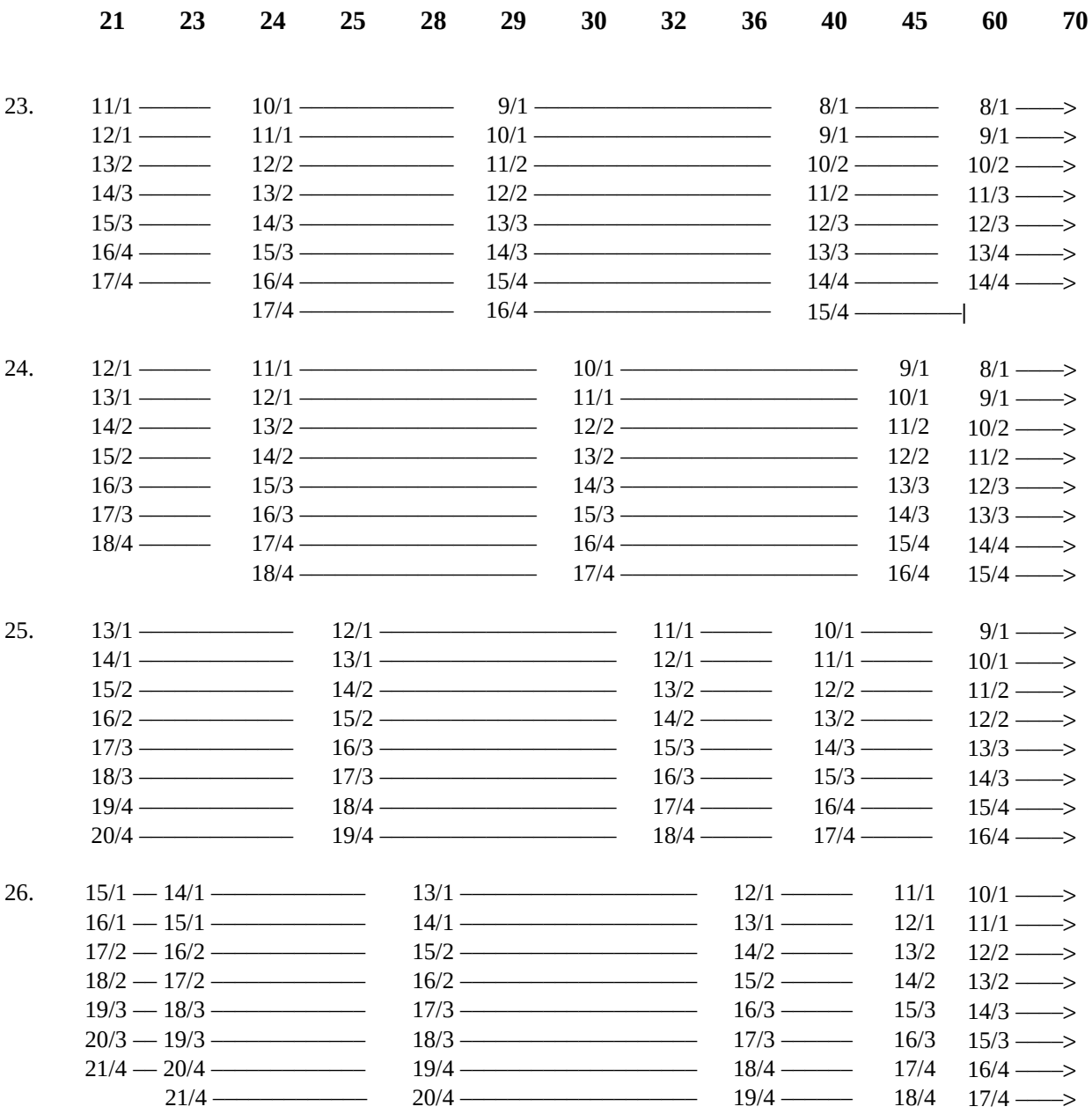
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	21	23	24	25	27	28	32	34	36	40	50	60	70
27.	17/1 ———		16/1 ———————			15/1	14/1 ———————			13/1	12/1	11/1 ———>	
	18/2 ———		17/2 ———————			16/1	15/1 ———————			14/1	13/1	12/1 ———>	
	19/2 ———		18/2 ———————			17/2	16/2 ———————			15/2	14/2	13/2 ———>	
	20/3 ———		19/3 ———————			18/2	17/2 ———————			16/2	15/2	14/2 ———>	
	21/3 ———		20/3 ———————			19/3	18/3 ———————			17/3	16/3	15/3 ———>	
	22/4 ———		21/4 ———————			20/3	19/3 ———————			18/3	17/3	16/3 ———>	
	23/4 ———		22/4 ———————			21/4	20/4 ———————			19/4	18/4	17/4 ———>	
							21/4 ———————			20/4	19/4	18/4 ———>	
28.	18/1 ———————			17/1 ———————			16/1 ———		15/1	14/1	13/1	12/1 ———>	
	19/1 ———————			18/1 ———————			17/1 ———		16/1	15/1	14/1	13/1 ———>	
	20/2 ———————			19/2 ———————			18/2 ———		17/1	16/1	15/2	14/2 ———>	
	21/2 ———————			20/2 ———————			19/2 ———		18/2	17/2	16/2	15/2 ——— >	
	22/3 ———————			21/3 ———————			20/3 ———		19/2	18/2	17/3	16/3 ———>	
	23/3 ———————			22/3 ———————			21/3 ———		20/3	19/3	18/3	17/3 ———>	
	24/4 ———————			23/4 ———————			22/4 ———		21/3	20/3	19/4	18/4 ———>	
							23/4 ———		22/4	21/4——			
29.	19/1	18/1 ———————			17/1 ———————			16/1 ———		15/1	14/1	13/1 ———>	
	20/1	19/1 ———————			18/1 ———————			17/1 ———		16/1	15/1	14/1 ———>	
	21/1	20/1 ———————			19/1 ———————			18/1 ———		17/1	16/1	15/1 ———>	
	22/2	21/2 ———————			20/2 ———————			19/2 ———		18/2	17/2	16/2 ———>	
	23/2	22/2 ———————			21/2 ———————			20/2 ———		19/2	18/2	17/2 ———>	
	24/2	23/3 ———————			22/3 ———————			21/3 ———		20/3	19/3	18/3 ———>	
	25/3	24/3 ———————			23/3 ———————			22/3 ———		21/3	20/3	19/3 ———>	
	26/3	25/4 ———————			24/4 ———————			23/4 ———		22/4	21/4	20/4 ———>	
30.	20/1 ———		19/1 ———————			18/1 ———		17/1 ———		16/1	15/1	14/1 ———>	
	21/1 ———		20/1 ———————			19/1 ———		18/1 ———		17/1	16/1	15/1 ———>	
	22/1 ———		21/1 ———————			20/1 ———		19/1 ———		18/1	17/1	16/1 ———>	
	23/2 ———		22/2 ———————			21/2 ———		20/2 ———		19/2	18/2	17/2 ———>	
	24/2 ———		23/2 ———————			22/2 ———		21/2 ———		20/2	19/2	18/2 ———>	
	25/2 ———		24/2 ——————— –			23/3 ———		22/2 ———		21/3	20/3	19/3 ———>	
	26/3 ———		25/3 ———————			24/3 ———		23/3 ———		22/3	21/3	20/3 ———>	
						25/4 ———————							

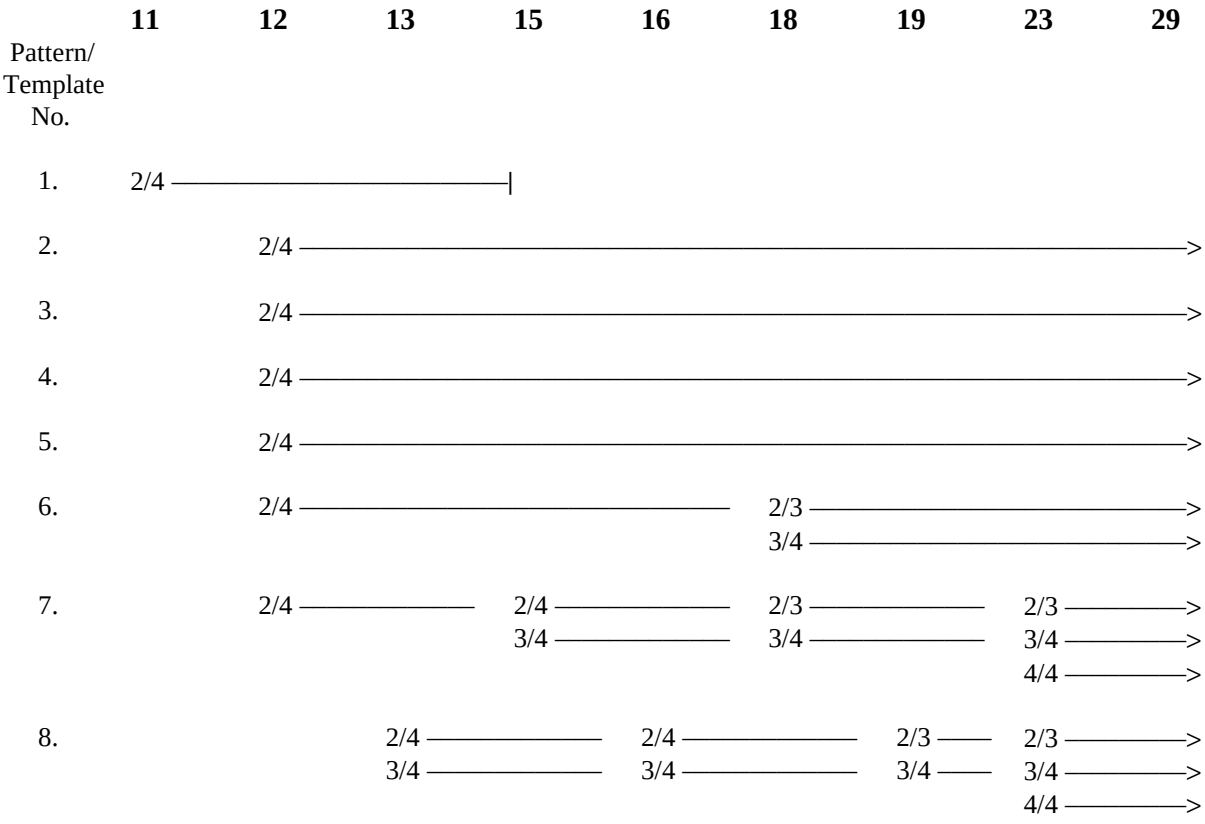
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	21	22	26	30	38	45	55	60	70
31.	22/1 ——	21/1 ——	20/1 ——	19/1 ——	18/1 ——	17/1 ——	16/1 ——	15/1 ——	14/1
	23/1 ——	22/1 ——	21/1 ——	20/1 ——	19/1 ——	18/1 ——	17/1 ——	16/1 ——	15/1
	24/1 ——	23/1 ——	22/1 ——	21/1 ——	20/1 ——	19/1 ——	18/1 ——	17/1 ——	16/1
	25/2 ——	24/2 ——	23/2 ——	22/2 ——	21/2 ——	20/2 ——	19/2 ——	18/2 ——	17/1
	26/2 ——	25/2 ——	24/2 ——	23/2 ——	22/2 ——	21/2 ——	20/2 ——	19/2 ——	18/2
	27/2 ——	26/3 ——	25/3 ——	24/3 ——	23/3 ——	22/3 ——	21/3 ——	20/3 ——	19/2
	28/3 ——	27/3 ——	26/3 ——	25/3 ——	24/3 ——	23/3 ——	22/3 ——	21/3 ——	20/3

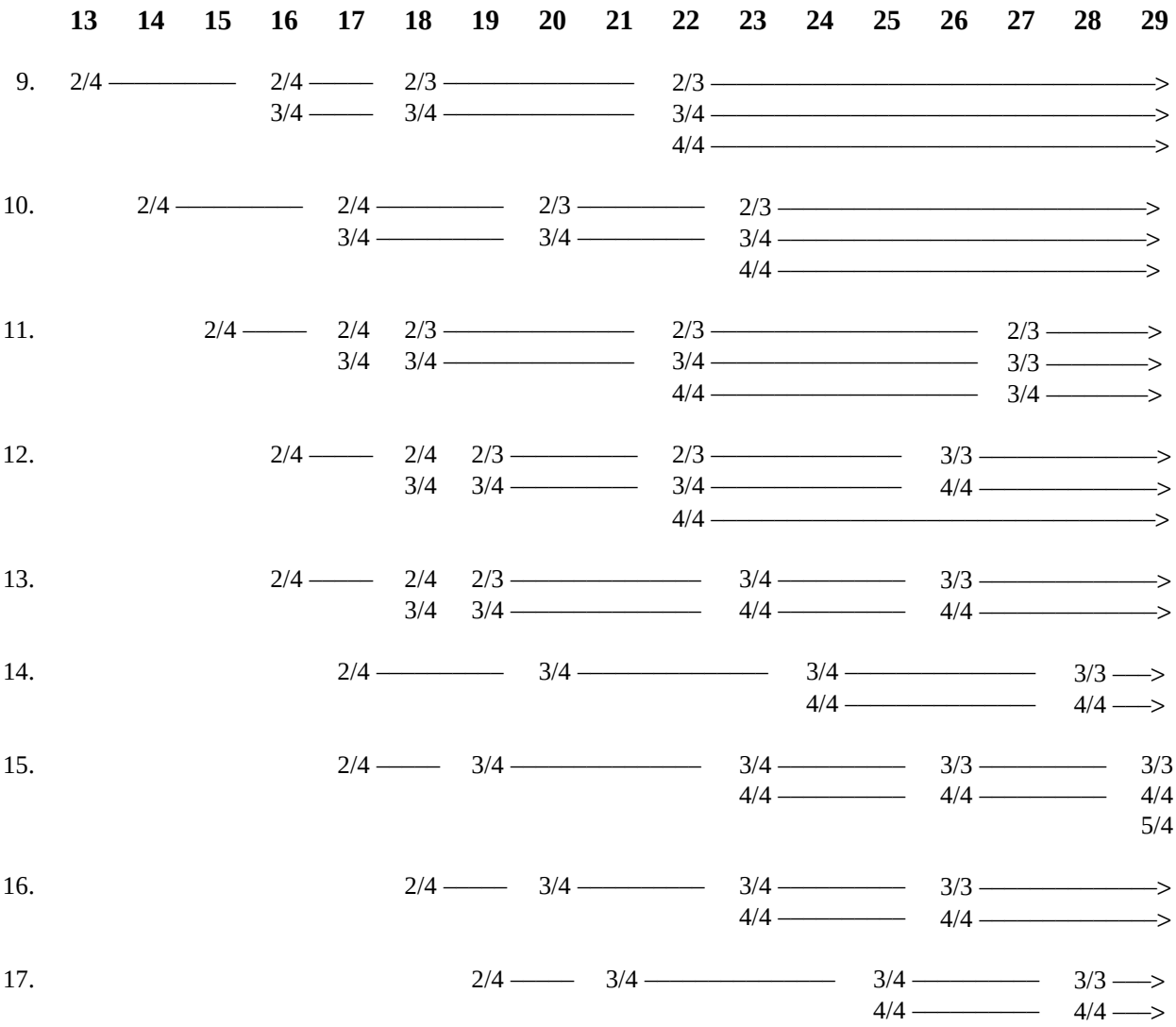
APPENDIX 2. DME LEG LENGTH/OUTBOUND END REDUCTION AREA CODE

(Holding course away from the NAVAID)
(See paragraph 2-21 for explanation and use.)

Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



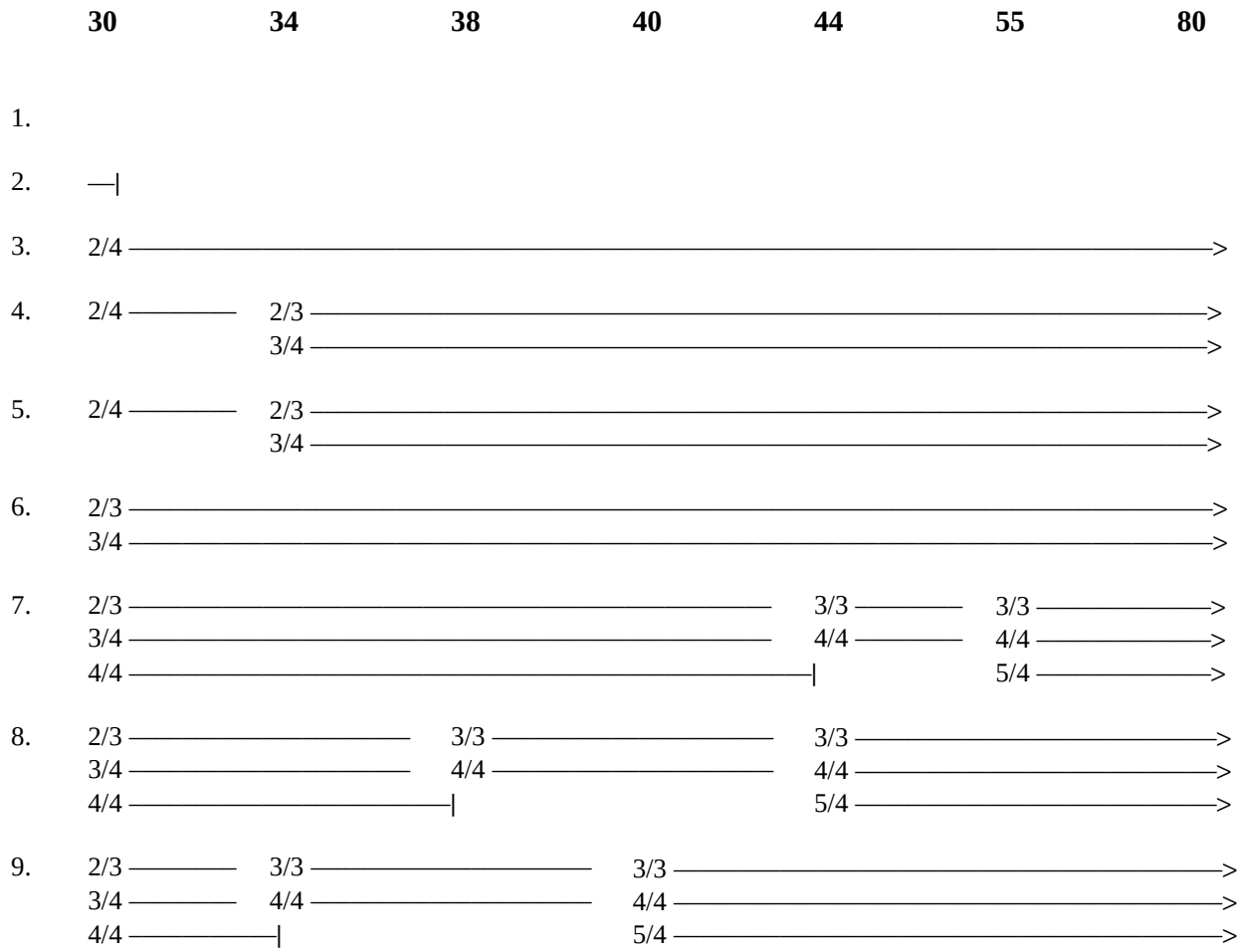
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



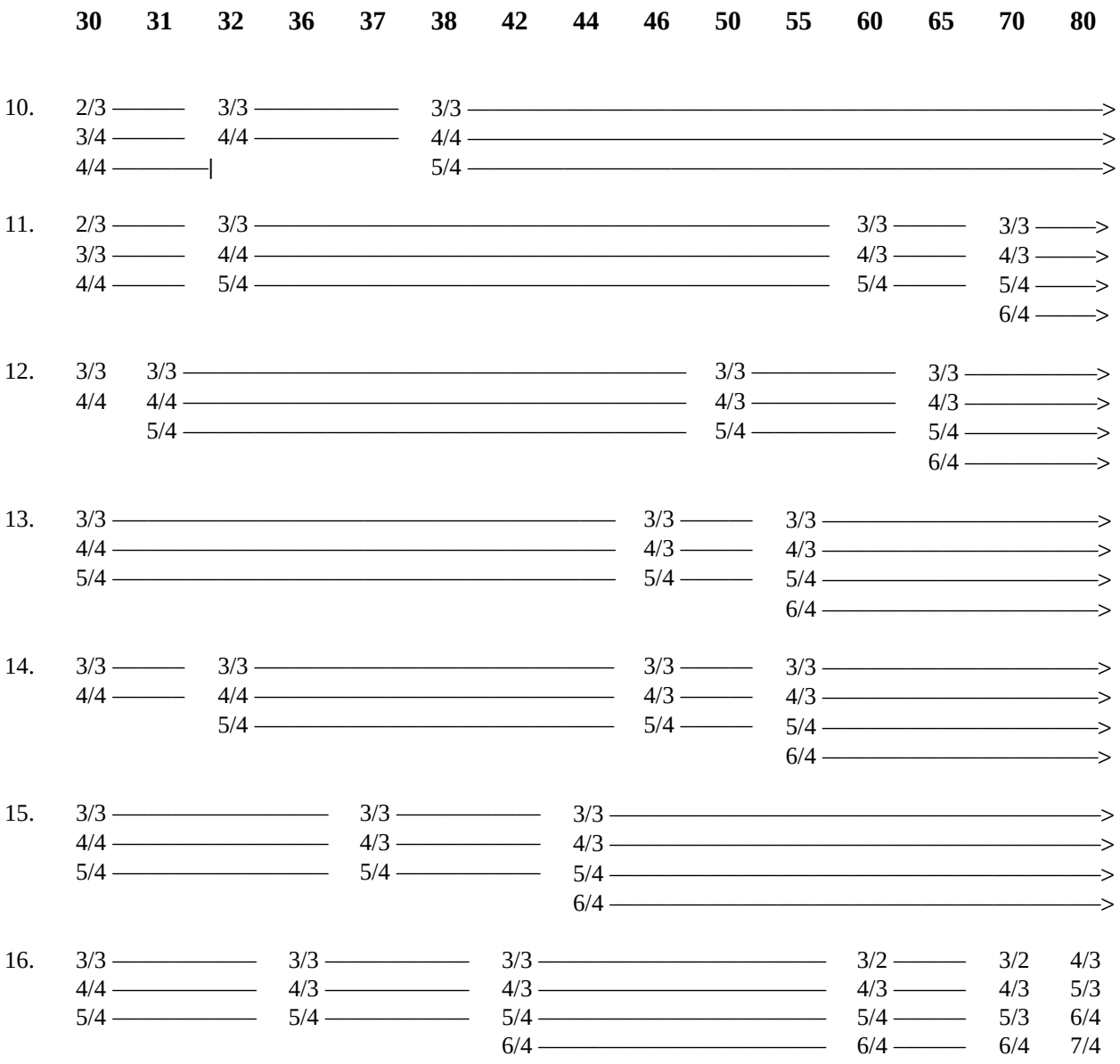
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	11	20	21	22	23	24	25	26	27	28	29
18.		2/4 ———		3/4 ———			3/4 ———		3/3 ———>		
							4/4 ———		4/4 ———>		
19.			2/4 ———			3/4 ———			3/4 ———		3/3
									4/4 ———		4/4
20.				2/4 ———			3/4 ———				3/4
											4/4
21.					2/4 ———			3/4 ———>			
22.						2/4 ———				3/4 ———>	
23.									2/4 ———>		
24.											2/4
25.											
26.											
27.											
28.											
29.											
30.											
31.											

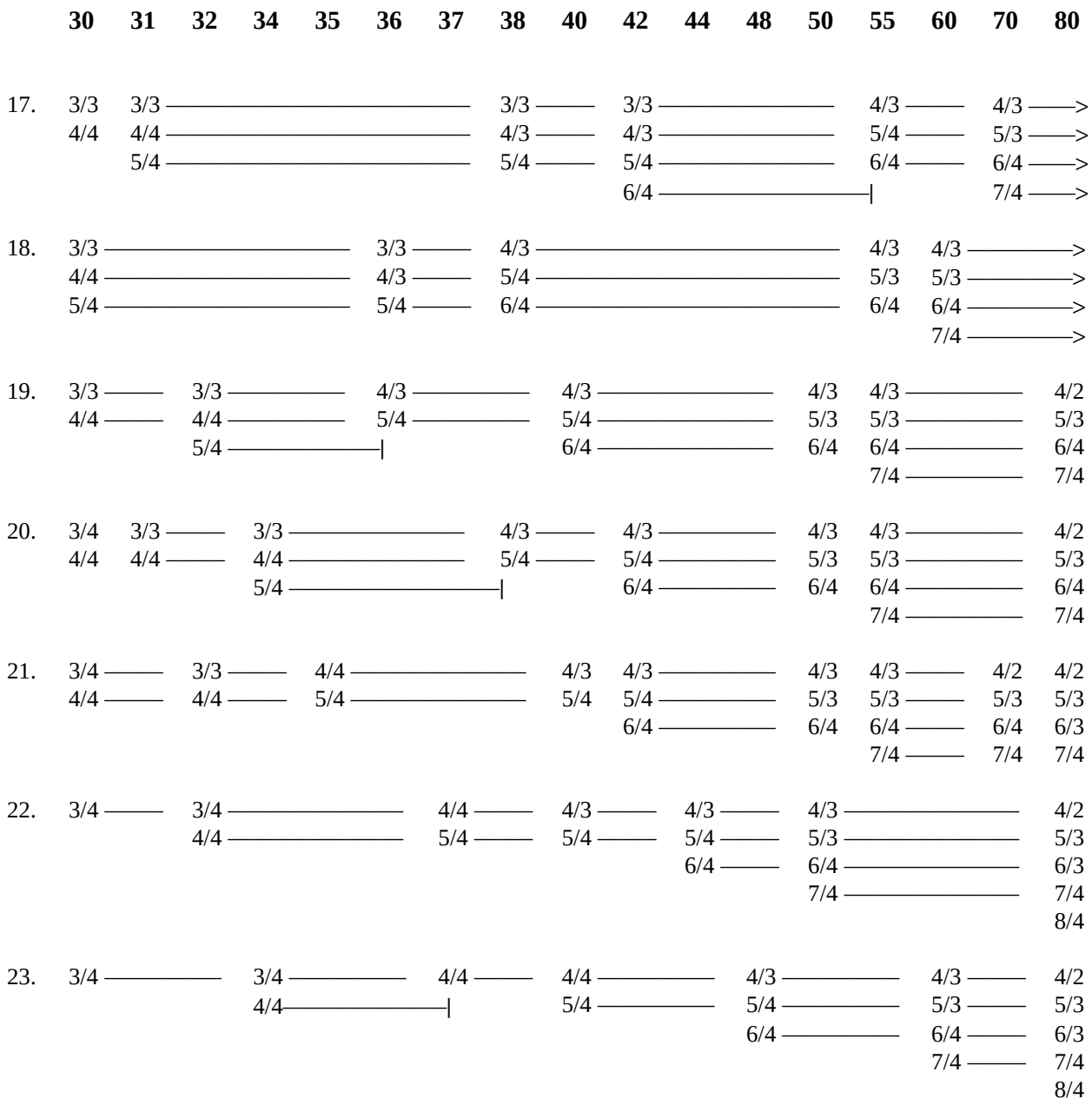
Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles



Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

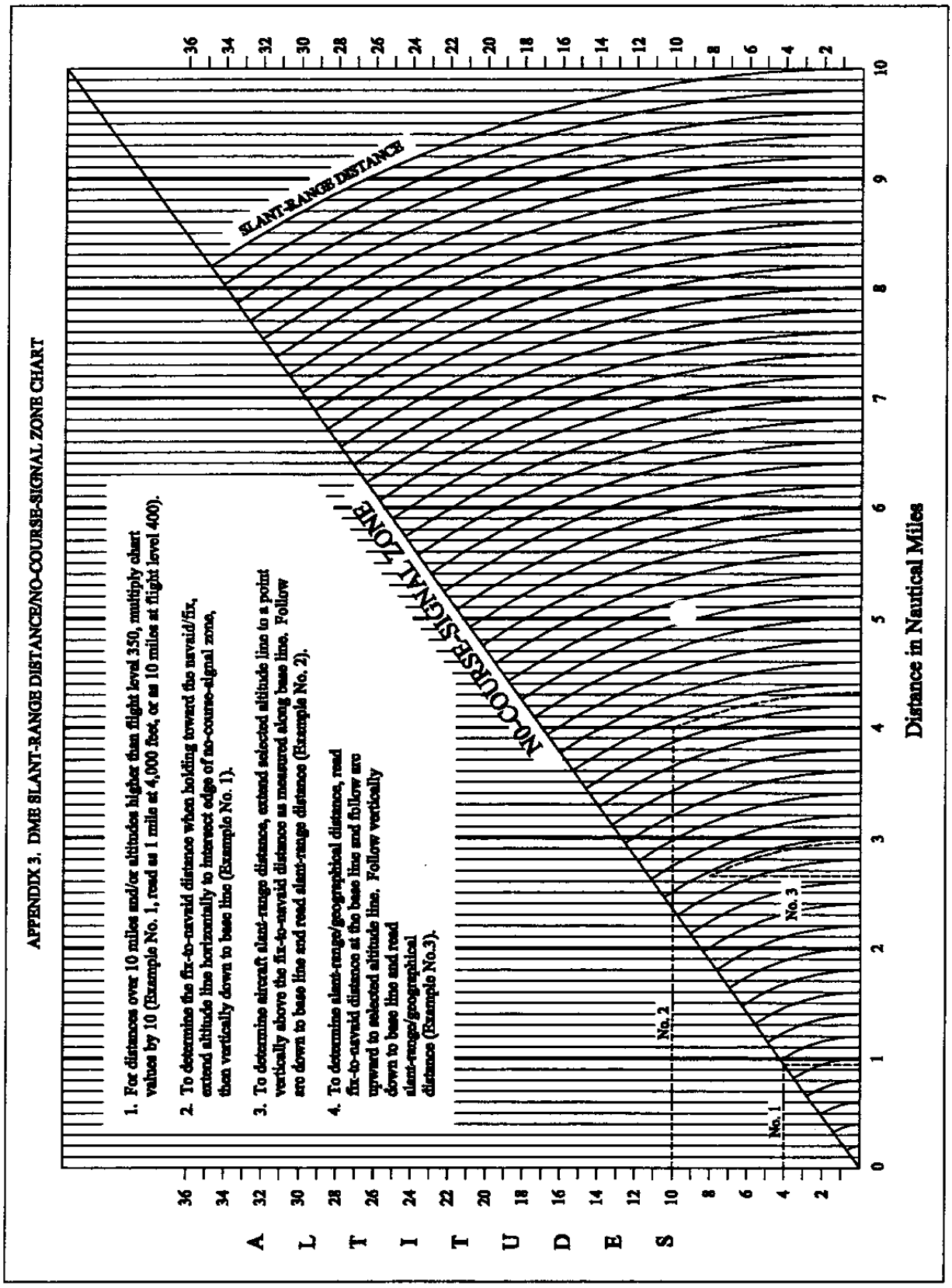


Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	30	32	34	35	36	37	38	40	42	44	46	48	50	55	60	65	70	80
24.	2/4	3/4 ——			3/4 ——				4/4 ——				4/3 ——		4/3 ——		4/2	4/2
					4/4 ——				5/4 ——				5/4 ——		5/3 ——		5/3	5/3
													6/4 ——		6/4 ——		6/4	6/3
															7/4 ——		7/4	7/4
																		8/4
25.		2/4 ——		3/4 ——				4/4 ——			4/4 ——		4/3	4/3	4/3	4/3 ——		4/2
											5/4 ——		5/4	5/4	5/3	5/3 ——		5/3
														6/4	6/4	6/4 ——		6/3
																7/4 ——		7/4
26.			2/4 ——				3/4 ——		4/4 ——			4/4 ——		4/3 ——		4/3 ——		4/2
												5/4 ——		5/4 ——		5/3 ——		5/3
														6/4 ——		6/4 ——		6/3
																7/4 ——		7/4
27.						2/4 ——			3/4 ——		4/4 ——			4/4	4/3 ——		4/3 ——	
														5/4	5/4 ——		5/3 ——	
															6/4 ——		6/4 ——	
																	7/4 ——	
28.									2/4 ——		3/4 ——		4/4 ——		4/3	4/3	4/3	4/2
															5/4	5/4	5/3	5/3
																6/4	6/4	6/4
																		7/4
29.										2/4 ——			3/4	4/4	4/4	4/3	4/3	4/3
															5/4	5/4	5/4	5/3
																	6/4	6/4
																		7/4
30.										2/4 ——		3/4 ——		4/4	4/4	4/3 ——		4/3
															5/4	5/4 ——		5/3
																		6/4
																		7/4

Fix-to-NAVAID (geographical - not DME) Distance in Nautical Miles

	30	48	55	60	65	70	80
31.		2/4 ———	3/4 ———	4/4 ———	4/4 ——— 5/4 ———	4/3 ——— 5/4 ——— 6/4 ———	4/3 5/3 6/4 7/4


APPENDIX 3. DME SLANT-RANGE DISTANCE/NO-COURSE-SIGNAL ZONE CHART
1. For distances over 10 miles and/or altitudes higher than flight level 350, multiply chart values by 10 (Example No. 1, read as 1 mile at 4,000 feet, or as 10 miles at flight level 400).
2. To determine the fix-to-navaid distance when holding toward the navaid/fix, extend altitude line horizontally to intersect edge of no-course-signal zone, then vertically down to base line (Example No. 1).
3. To determine aircraft slant-range distance, extend selected altitude line to a point vertically above the fix-to-navaid distance as measured along base line. Follow arc down to base line and read slant-range distance (Example No. 2).
4. To determine slant-range/geographical distance, read fix-to-navaid distance at the base line and follow arc upward to selected altitude line. Follow vertically down to base line and read slant-range/geographical distance (Example No.3).
SLANT-RANGE DISTANCE
NO-COURSE-SIGNAL ZONE
No. 1
No. 2
No. 3
ALTITUDE IN THOUSANDS
Distance in Nautical Miles

U.S. Department
of Transportation

**Federal Aviation
Administration**

Directive Feedback Information

Please submit any written comments or recommendations for improving this directive, or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

Subject: Order 7130.3A, Holding Pattern Criteria

To: DOT/FAA
Flight Procedure Standards Branch, AFS-420
P.O. Box 25082
Oklahoma City, OK 73125

(Please check all appropriate line items)

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:
(*attach separate sheet if necessary*)

☐ In a future change to this directive, please include coverage on the following subject:
(*briefly describe what you want added*):

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____

FTS Telephone Number: _____ Routing Symbol: _____

FAA Form 1320-19 (8-89)