DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
IFR PILOT EXAM-O-GRAMS

8/77

Exam-O-Grams are brief and timely explanations of important aeronautical knowledge items. These items include concepts and procedures that are critical to aviation safety, common misconceptions among airman applicants, and areas which cause general difficulty in written tests.

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Exam-O-Grams Nos. 1, 3, 4, 9, 12, 13, and 20 have been deleted, since the subject areas are adequately treated in other FAA publications. The material in Exam-O-Gram No. 1 is covered in AC 90-1A. Advisory Circular 90-1A and certain other free Advisory Circulars, including the Advisory Circular Checklist, may be obtained from:

Department of Transportation
Federal Aviation Administration
Publications Section, TAD-443.1
Washington, D.C. 20590

Department of Transportation

FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 2

USE AND ABUSE OF RADAR

The following transmission (except for the ficticious names) was received on 121. 5 MHz by Approach Control in an area of high traffic activity:

> "FAA RADAR, THIS IS SKYCRAFT 1234 AT 4500 ON A 065 HEADING. I CAN'T LOCATE MY POSITION. WILL THIS HEADING TAKE ME TO BEDROCK?"

* * * * * * * * * * *

Fortunately for the pilot, this contact with radar control terminated in a safe landing, followed by suspension of his pilot's license after these additional facts emerged:

1. Radar had observed Skycraft 1234 approaching the airport traffic area well before receiving his initial call. Approach Control had made repeated attempts to establish radio contact without success. The pilot turned his radio on only to request a vector.
2. The pilot was directly over a metropolitan airport traffic area when two-way communications were established with Approach Control. Ceiling and visibility at the airport were 500 feet broken and 1 mile, PIREPS tops 12, 000.
3. The pilot had filed no flight plan and did not hold an instrument rating. Total instrument experience: 10 hours simulated.
4. The pilot had not checked the enroute weather prior to departure. Reasons? The route was familiar, and no weather service was located on the airport of departure.
5. His destination was below VFR minimums at the time of his request for a heading. He did not consider the situation an emergency.

Apart from the pilot's lack of good judgment, and his indifference to air traffic rules, the incident reflects a common misconception about the use of radar services. Radar is not to be considered a convenience for careless pilots who ignore the practice of careful flight planning, nor is it to be used only as a last resort for pilots who have run out of luck.

Because radar service is available to both VFR and IFR traffic, an understanding of radar functions and procedures is important to all pilots, whether instrument rated or not. Radar is used in the air traffic control system primarily to:

> maintain surveillance of enroute and terminal air traffic for more complete position information;
>
> vector departing aircraft for separation and radar navigation;
>
> vector enroute aircraft for maximum utilization of available airspace;
>
> vector arriving aircraft for transition to final approach;
>
> conduct precision or surveillance approaches.

* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

On a "workload permitting" basis, additional radar services are available to:

- provide pilots with information on traffic observed by radar;
- provide radar navigation to, or between, established fixes;
- provide radar navigation between airways and jet routes;
- provide assistance to pilots of aircraft in distress;
- provide pilots with information on storm and precipitation areas observed on the radar scopes;
- monitor instrument approaches;
- coordinate the flow of VFR and IFR traffic in terminal areas.

* * * * * * * * * * * * * * * * * *

Part 1 of the Airman's Information Manual contains general explanations of radar services. All pilots should read these pages frequently to know what to expect from radar services and what is expected of pilots by air traffic control when radar service is being provided.

The Airman's Information Manual is divided into four parts, which may be purchased separately:

Part 1 Basic Flight Manual and ATC Procedures; annual subscription
Part 2 Airport Directory; annual subscription
Part 3 Operational Data and Notices to Airmen; annual subscription
Part 4 Graphic Notices and Supplemental Data; annual subscription

Requests should be directed to the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Orders should be accompanied by check or money order made payable to the Superintendent of Documents.

FAA Aeronautical Center
Flight Standards Technical Division
Operations Branch
P. O. Box 25082
Oklahoma City, Oklahoma 73125
7/62

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

IFR PILOT EXAM-O-GRAM* NO. 5

AVIATION WEATHER REPORTS AND FORECASTS

The Instrument Rating Written Test emphasizes careful analysis of aviation weather reports and forecasts as an important requisite for planning an IFR flight. This Exam-O-Gram stresses the importance of the weather briefing and directs attention to the availability, source, and content of these reports and forecasts.

YOU AND YOUR WEATHER BRIEFER

Analysis of applicant performance on written tests, as well as the annual number of VFR and IFR flights trapped by unexpected weather, indicates that many pilots fail to study or use the available weather data and services. To serve you better, the weather briefer, or forecaster, should be made aware of at least the following items:

1. Your identification as a pilot--if telephoning.
2. Type of aircraft you are flying.
3. Your destination.
4. Intended route.
5. Proposed departure and arrival times.
6. Type of flight plan--VFR/IFR.
7. Proposed flight altitude.

One fact is obvious--the more theoretical and practical weather knowledge you possess, the better you are prepared for FAA tests and to discuss pertinent information with the forecaster or briefer. Use a checklist if you are not sure of what to ask. It will help you to remember items commonly overlooked--especially if pressured by time. The Preflight Pilot Checklist on the reverse side of the FAA Flight Plan Form provides a format for this purpose. Regardless of the format or method used in recording the information, your weather briefing should clearly answer at least the following points which are pertinent to your flight:

DEPARTURE WEATHER

1. Bases and tops of significant cloud layers.
2. Visibility.
3. Type and intensity of precipitation.
4. Height of freezing level.
5. Surface wind.
6. Surface temperature and density altitude.

EN ROUTE WEATHER

1. Hazardous weather.
2. Type and amount of cloud layers, including height of base and top.
3. Visibility--surface and aloft.
4. Significant weather systems.
5. Height of freezing level.
6. Temperature and wind at various altitudes.

DESTINATION AND ALTERNATE WEATHER

1. Bases and tops of significant cloud layers.
2. Visibility.
3. Surface wind.
4. Type and intensity of precipitation.
5. Height of freezing level.

DISTRIBUTION: ZC-307

* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

Rev. 7/77

AVAILABLE WEATHER SERVICES

Aviation weather is served up to you via the following formats:

1. Hourly and special weather reports--popularly known as sequence reports
    a. Scheduled Airways Observations (SA)
    b. Special Airways Observations (SP)
2. National Weather Service--weather and winds aloft forecasts
    a. Area Forecasts (FA)--usually parts of two or more states
    b. Terminal Forecasts (FT)--one airport
    c. Winds Aloft Forecasts (FD)--winds at various levels above selected stations
3. PIREPS--Pilot reports on icing, turbulence, cloud tops, etc. (UA)
    a. Appended as remarks to Scheduled Airways Observations
    b. Transmitted as soon as possible like any special weather report
    c. PIREP summaries
4. RAREPS--radar reports of significant convective activity; transmitted hourly (SD)
5. Weather maps--surface, weather depiction, radar summary

AVIATION WEATHER SOURCES

*1. National Weather Service
*2. FAA Flight Service Stations
*3. PATWAS--Pilot's Automatic Telephone Weather Answering Service
4. TWEB--Transcribed Weather Broadcasts
5. NAVAIDS voice channels--including the scheduled weather broadcasts at 15 minutes past each hour and the continuous transcribed broadcasts at selected radio beacons

NOTE: *Airman's Information Manual
Part 1 - Weather
Part 2 - FSS and NWS Telephone Listings

HOW ABOUT SOME PRACTICE?

After all of this, try your hand at decoding the following weather reports and forecasts. The National Weather Service "Key to Aviation Weather Reports and Forecasts" is reproduced here for your convenience in decoding these samples. For further study, we recommend the excellent texts--Aviation Weather, AC 00-6A and Aviation Weather Services, AC 00-45, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

```
SA32 051600
BOI 15 SCT E20 BKN 35 OVC 5SW- 176/29/26/0000/998/UA /SK OVC 060/SB40 BINOVC
SLC W3 X 1/2S 044/34/33/3622G27/968/R34LVV1/4
```

```
MKC FA 061240
13Z TUE-07Z WED
OTLK 07Z WED-19Z WED
```

ND SD NE KS WY CO

HGTS ASL UNLESS NOTED

SYNOPSIS. OCFNT NR SUX IA-CONCORDIA KS-GAG OK LN AT 13Z MOVG EWD 20 TO 25 KT RCHG ERN IA SERN KS BY 18Z MOVG OUT OF AREA BY 21Z.

SIGCLDS AND WX. E OF OCFNT OVR NE 30-40 SCT VRBL BKN AGL 100-120 BKN AGL BCMG CIGS 30-40 OVC TOPS 180 SCT LGT SHWRS 50 TO 75 MI E OF FNT. OVR KS 15 SCT VRBL BKN 40 BKN 120 BKN ALL AGL TOPS 200. LCLY CIGS 10 OVC SERN KS WITH WDLY SCT SHWRS. OTLK VFR.

W OF OCFNT. 100 SCT 250 SCT. OTLK VFR.

ICG. OCNL LGT ICGIC IN FNTL ZONE. FRZG LVL 100 E OF FNT AND 60-90 W OF FNT.

```
FT 222240
OKC 222323 45 SCT C80 BKN 2210 OCNL C40 BKN 3RW.  00Z C30 BKN 5RW- 3115.  03Z C25 BKN 3615.
17Z MVFR CIG..
```

```
FD WBC 301945
BASED ON 301200Z DATA
VALID 311200Z FOR USE 0900-1500Z.  TEMPS NEG ABV 24000

FT   3000      6000      9000     12000     18000     24000    30000    34000    39000

STL  9900    3005+17   3007+11   3009+05   3213-09   2722-18   273533   274442   265354
```

KEY TO AVIATION WEATHER REPORTS . . . .

NOAA/PA 73029

LOCATION IDENTIFIER AND TYPE OF REPORT*	SKY AND CEILING	VISIBILITY WEATHER AND OBSTRUCTION TO VISION	SEA-LEVEL PRESSURE	TEMPERATURE AND DEW POINT	WIND	ALTIMETER SETTING	RUNWAY VISUAL RANGE	CODED PIREPS
MKC	15 SCT M25 OVC	1R-K	132	/58/56	/1807	/993/	R04LVR20V40	/UA OVC 55

SKY AND CEILING

Sky cover contractions are in ascending order. Figures preceding contractions are heights in hundreds of feet above station. Sky cover contractions are:

CLR Clear: Less than 0.1 sky cover.
SCT Scattered: 0.1 to 0.5 sky cover.
BKN Broken: 0.6 to 0.9 sky cover.
OVC Overcast: More than 0.9 sky cover.
— Thin (When prefixed to the above symbols.)
—X Partial obscuration: 0.1 to less than 1.0 sky hidden by precipitation or obstruction to vision (bases at surface).
X Obscuration: 1.0 sky hidden by precipitation or obstruction to vision (bases at surface).

Letter preceding height of layer identifies ceiling layer and indicates how ceiling height was obtained. Thus:

E	Estimated height	V	Immediately following numerical value, indicates a variable ceiling.
M	Measured		
W	Indefinite		

VISIBILITY

Reported in statute miles and fractions. (V=Variable)

WEATHER AND OBSTRUCTION TO VISION SYMBOLS

A	Hail	IC	Ice crystals	S	Snow
BD	Blowing dust	IF	Ice fog	SG	Snow grains
BN	Blowing sand	IP	Ice pellets	SP	Snow pellets
BS	Blowing snow	IPW	Ice pellet showers	SW	Snow showers
D	Dust	K	Smoke	T	Thunderstorms
F	Fog	L	Drizzle	T+	Severe thunderstorm
GF	Ground fog	R	Rain	ZL	Freezing drizzle
H	Haze	RW	Rain showers	ZR	Freezing rain

Precipitation intensities are indicated thus: — Light; (no sign) Moderate; + Heavy

WIND

Direction in tens of degrees from true north, speed in knots. 0000 indicates calm. G indicates gusty. Peak speed of gusts follows G or Q when gusts or squall are reported. The contraction WSHFT followed by GMT time group in remarks indicates windshift and its time of occurrence. (Knots X 1.15=statute mi/hr.)

EXAMPLES: 3627=360 Degrees, 27 knots; 3627G40=360 Degrees, 27 knots, peak speed in gusts 40 knots.

ALTIMETER SETTING

The first figure of the actual altimeter setting is always omitted from the report.

RUNWAY VISUAL RANGE (RVR)

RVR is reported from some stations. Extreme values during 10 minutes prior to observation are given in hundreds of feet. Runway identification precedes RVR report.

CODED PIREPS

Pilot reports of clouds not visible from ground are coded with ASL height data preceding and/or following sky cover contraction to indicate cloud bases and/or tops, respectively. UA precedes all PIREPS.

DECODED REPORT

Kansas City: Record observation, 1500 feet scattered clouds, measured ceiling 2500 feet overcast, visibility 1 mile, light rain, smoke, sea-level pressure 1013.2 millibars, temperature 58°F, dewpoint 56°F, wind 180°, 7 knots, altimeter setting 29.93 inches. Runway 04 left, visual range 2000 feet variable to 4000 feet. Pilot reports top of overcast 5500 feet.

*TYPE OF REPORT

The omission of type-of-report data identifies a scheduled record observation for the hour specified in the sequence heading. An out-of-sequence, special observation is identified by the letters "SP" following station identification and a 24-hour clock time group, e.g., "PIT SP 0715 –X M1 OVC." A special report indicates a significant change in one or more elements.

U.S. DEPARTMENT OF COMMERCE– NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION – NATIONAL WEATHER SERVICE –REVISED MARCH 1, 1976

KEY TO AVIATION WEATHER FORECASTS . . .

TERMINAL FORECASTS contain information for specific airports on expected ceiling, cloud heights, cloud amounts, visibility, weather and obstructions to vision and surface wind. They are issued 3 times/day and are valid for 24 hours. The last six hours of each forecast are covered by a categorical statement indicating whether VFR, MVFR, IFR or LIFR conditions are expected. Terminal forecasts will be written in the following form:

CEILING: Identified by the letter "C"
CLOUD HEIGHTS: In hundreds of feet above the station (ground)
CLOUD LAYERS: Stated in ascending order of height
VISIBILITY: In statute miles but omitted if over 6 miles
WEATHER AND OBSTRUCTION TO VISION: Standard weather and obstruction to vision symbols are used
SURFACE WIND: In tens of degrees and knots; omitted when less than 10

EXAMPLE OF TERMINAL FORECAST

DCA 221010: DCA Forecast 22nd day of month—valid time 10Z–10Z.
10 SCT C18 BKN 5SW- 3415G25 OCNL C8 X 1SW: Scattered clouds at 1000 feet, ceiling 1800 feet broken, visibility 5 miles, light snow showers, surface wind 340 degrees 15 knots Gusts to 25 knots, occasional ceiling 8 hundred feet sky obscured, visibility 1 mile in moderate snow showers.
12Z C50 BKN 3312G22: At 12Z becoming ceiling 5000 feet broken, surface wind 330 degrees 12 knots Gusts to 22.
04Z MVFR CIG: Last 6 hours of FT after 04Z marginal VFR due to ceiling.

AREA FORECASTS are 18-hour aviation forecasts plus a 12-hour categorical outlook prepared 2 times/day giving general descriptions of cloud cover, weather and frontal conditions for an area the size of several states. Heights of cloud tops, and icing are referenced ABOVE SEA LEVEL (ASL); ceiling heights, ABOVE GROUND LEVEL (AGL); bases of cloud layers are ASL unless indicated. Each SIGMET or AIRMET affecting an FA area will also serve to amend the Area Forecast.

SIGMET or AIRMET messages warn airmen in flight of potentially hazardous weather such as squall lines, thunderstorms, fog, icing, and turbulence. SIGMET concerns severe and extreme conditions of importance to all aircraft. AIRMET concerns less severe conditions which may be hazardous to some aircraft or to relatively inexperienced pilots. Both are broadcast by FAA on NAVAID voice channels.

WINDS AND TEMPERATURES ALOFT (FD) FORECASTS are 12-hour forecasts of wind direction (nearest 10° true N) and speed (knots) for selected flight levels. Temperatures aloft (°C) are included for all but the 3000-foot level.

EXAMPLES OF WINDS AND TEMPERATURES ALOFT (FD) FORECASTS:

```
FD WBC 121745
BASED ON 121200Z DATA
VALID 130000Z FOR USE 1800-0300Z. TEMPS NEG ABV 24000
FT
3000    6000     9000    12000   18000   24000   30000   34000   39000
BOS
3127  3425-07  3420-11  3421-16  3516-27  3512-38  311649  292451  283451
JFK
3026  3327-08  3324-12  3322-16  3120-27  2923-38  284248  285150  285749
```

At 6000 feet ASL over JFK wind from 330° at 27 knots and temperature minus 8°C

TWEB (CONTINUOUS TRANSCRIBED WEATHER BROADCAST)—Individual route forecasts covering a 25 nautical mile zone either side of the route. By requesting a specific route number, detailed en route weather for a 12 or 18-hour period (depending on forecast issuance) plus a synopsis can be obtained.

PILOTS . . . report in-flight weather to nearest FSS. The latest surface weather reports are available by phone at the nearest pilot weather briefing office by calling at H+10.

U.S. DEPARTMENT OF COMMERCE– NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION – NATIONAL WEATHER SERVICE –REVISED MARCH 1, 1976

For sale by the Superintendent of Documents, U.S. Government Printing Office Washington, D.C. 20402 - Price 35 cents; $2.50 per 100 Stock Number 003-018-00069-5
☆ U. S. GOVERNMENT PRINTING OFFICE: 1976 O-207-787

DECODED WEATHER DATA

Scheduled Airways Observation--5th day; 1600 GMT

Boise: 1,500 feet scattered, estimated ceiling 2,000 feet broken, 3,500 feet overcast, visibility 5 miles in light snow showers, sea level pressure 1017.6 millibars, temperature 29°F., dewpoint 26°F., wind calm, altimeter setting 29.98 inches, pilot reports top of overcast 6,000 feet MSL, snow began 40 minutes past the hour, breaks in overcast.

Salt Lake City: Indefinite ceiling 300 feet, sky obscured, visibility one-half mile in moderate snow, sea level pressure 1004.4 millibars, temperature 34°F., dewpoint 33°F., wind 360 degrees at 22 knots gusting to 27 knots, altimeter setting 29.68 inches, Runway 34L visibility one-quarter mile.

Area forecast issued by Kansas City--6th day of month; 1240 GMT--period 1300 GMT Tuesday to 0700 GMT Wednesday (0700 CST to 0100 CST).

Area covered: N. Dakota, S. Dakota, Nebraska, Kansas, Wyoming, and Colorado.

Heights are above sea level (ASL) unless noted.

Occluded front from near Sioux City, Iowa, to Concordia, Kansas, to Gage, Oklahoma line at 1300Z (0700C) moving eastward 20 to 25 knots reaching eastern Iowa southeastern Kansas by 1800Z (1200C) and moving out of area by 2100Z (1500C).

East of occluded front over Nebraska clouds 3,000 to 4,000 scattered variable broken above ground level with higher 10,000 to 12,000 broken also above ground. Becoming ceiling (above ground) 3,000 to 4,000 overcast tops 18,000 (ASL) with scattered light rain showers 50 to 75 miles east of front. Over Kansas, 1,500 scattered variable broken 4,000 broken 12,000 broken all above ground. Tops 20,000 (ASL). Locally.... etc.

Terminal Forecast--22nd day; 2240 GMT.

Period: Valid from 2300Z on the 22nd to 2300Z on the 23rd.

Oklahoma City: Scattered clouds at 4,500 feet, ceiling 8,000 feet broken, visibility more than 6 miles, wind 220 degrees at 10 knots, occasional ceiling 4,000 feet broken, visibility 3 miles in moderate rain showers. After 00Z ceiling 3,000 feet broken, visibility 5 in light rain showers, wind 310 degrees at 15 knots. After 03Z ceiling 2,500 broken, wind 360 degrees at 15 knots. Outlook for the last six hours beginning at 17Z is for marginal VFR.

Winds Aloft Forecast issued on the 30th day of month to be used for flights between 0900Z and 1500Z on the 31st.

St. Louis	3,000 feet (ASL)	Light and variable (less than 5 knots)	
	6,000 feet (ASL)	300°/5 knots	+17°C.
	9,000 feet (ASL)	300°/7 knots	+11°C.
	12,000 feet (ASL)	300°/9 knots	+ 5°C.
	18,000 feet (Pressure Alt)	320°/13 knots	- 9°C.
	24,000 feet (Pressure Alt)	270°/22 knots	-18°C.
	30,000 feet (Pressure Alt)	270°/35 knots	-33°C.
	34,000 feet (Pressure Alt)	270°/44 knots	-42°C.
	39,000 feet (Pressure Alt)	260°/53 knots	-54°C.

Federal Aviation Administration
Flight Standards National Field Office, Examinations Branch
P.O. Box 25082
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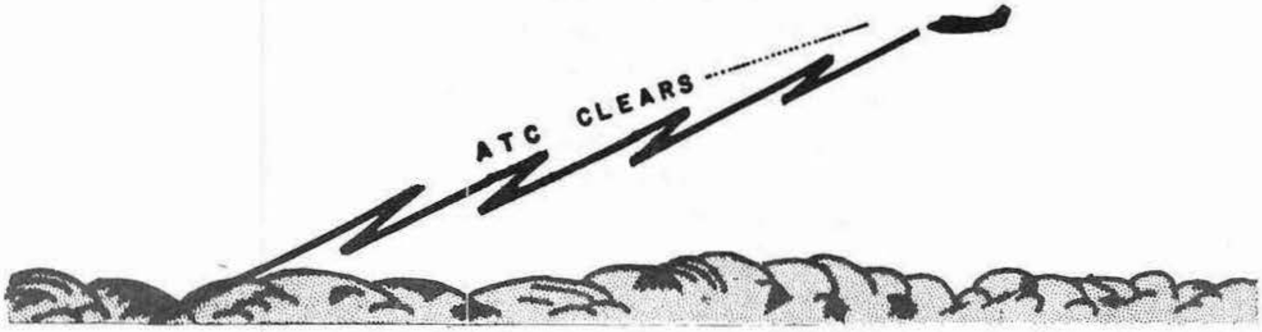
Department of Transportation

FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 6

VFR OPERATIONS on an INSTRUMENT FLIGHT PLAN



Analyses of answers to Instrument Pilot Written Examinations indicate that many applicants do not understand certain aspects of VFR and "VFR CONDITIONS ON TOP" operations while on IFR clearances. Applicants for the Instrument Rating should be able to answer the following questions relating to these operations. Answers and explanations follow.

* * * * * * * * * * * * * * * * * * *

1. Why request a "VFR CONDITIONS ON TOP" clearance?
2. When would a pilot request a clearance <u>to</u> "VFR CONDITIONS ON TOP"?
3. What restrictions apply to the pilot's choice of altitude while operating on an IFR clearance with provision to "MAINTAIN VFR CONDITIONS ON TOP"?
4. When can a "VFR CONDITIONS ON TOP" request be approved by ATC?
5. What separation from other aircraft is provided to a "VFR CONDITIONS ON TOP" flight?
6. What is the recommended position reporting procedure for "VFR CONDITIONS ON TOP" operation?
7. A pilot is flying on an IFR clearance, with an altitude assignment of "VFR CONDITIONS ON TOP". He anticipates that he will be unable to maintain flight in VFR conditions because of reduced visibility or increasing height of the tops. What should he do?
8. When may a pilot deviate from his route of flight while operating IFR with a "VFR CONDITIONS ON TOP" clearance?
9. Why would a pilot request a VFR climb or descent while on an IFR flight?
10. What are the procedures for radio communications failure during a "VFR CONDITIONS ON TOP" operation?

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*Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

Rev. 9/69

EXPLANATIONS (numbers correspond to questions):

1. In preparation for IFR flight above an overcast, or in an area of generally unlimited ceilings and visibility, pilots may request "VFR CONDITIONS ON TOP" to permit them to select an altitude, or altitudes of their choice, rather than specific ATC assigned altitudes. If during flight "in the clear" at a specific assigned altitude, turbulence or unfavorable ground speeds are encountered, or if icing in clouds ahead is expected, a "VFR CONDITIONS ON TOP" clearance may allow the pilot a greater choice of operating altitudes.

2. Departing instrument-rated pilots who wish an IFR clearance only to climb through a layer of overcast or reduced visibility, and then continue flight VFR, may request ATC clearance "TO VFR CONDITIONS ON TOP". - This request may be made through a Flight Service Station, by telephone to ATC, or by request to the Tower before taxiing out. The clearance, which authorizes IFR flight through the cloud layer, will contain a near-by clearance limit, routing, and a request to report reaching "VFR CONDITIONS ON TOP". When the pilot reaches "VFR CONDITIONS ON TOP" and desires to cancel the IFR portion of his flight, he should so state. This type of operation can be combined with a VFR Flight Plan to destination.

3. The pilot may fly at an altitude of his choice, provided the altitude is

   a. at or above the MEA, or MOCA if appropriate, and
   b. at least 1000 feet above the existing meteorological condition (cloud layer, smog, haze, etc.) if any, and
   c. at an altitude appropriate for the direction of flight (odd or even thousand, plus 500 feet) if operating at 3000 feet or more above the surface.

   Pilots should be especially alert for head-on traffic when climbing or descending on the airway centerline.

4. "VFR CONDITIONS ON TOP" may be approved by ATC when specifically requested by the pilot in flight provided pilot reports have not indicated that conditions are unsuitable.

4. (continued)

"VFR CONDITIONS ON TOP" may be approved by ATC when specifically requested by the pilot prior to departure, provided

- a. pilot reports have not indicated that conditions are unsuitable, and
- b. the pilot is advised of the height of the tops, or that height of tops is unreported, and
- c. if height of the tops is unreported, alternate altitude provisions are included in the clearance.

EXCEPTIONS:

ATC will not approve "VFR CONDITIONS ON TOP" operations

- a. to provide separation between aircraft holding at night, or
- b. to aircraft operating in Positive Controlled Airspace.

5. No separation is provided. However, the pilot may expect to receive traffic information on known IFR traffic. Any time a pilot is flying "in the clear", whether at a specific assigned altitude or at an altitude assignment of "VFR CONDITIONS ON TOP", collision avoidance is the pilot's responsibility.

6. Regardless of the altitude being flown, pilots on IFR Flight Plans report those fixes designated as compulsory reporting points for all altitudes, and additional position reports as requested by ATC. A pilot operating on an IFR Flight Plan with an altitude assignment of "VFR CONDITIONS ON TOP" would report in the following manner:

> SKYTWIN FOUR ONE ALPHA OVER OKLAHOMA CITY ONE EIGHT, VFR CONDITIONS ON TOP AT EIGHT THOUSAND FIVE HUNDRED, ESTIMATING SAYRE FOUR EIGHT, AMARILLO.

If position reports are made to a Flight Service Station for relay to the controlling facility (center or approach control), pilots should state that the flight is on an Instrument Flight Plan.

7. Pilots flying with a VFR restriction must not enter IFR weather conditions. In such situations, pilots must request a specific altitude assignment and maintain flight in VFR conditions until an appropriate amended clearance is obtained.

8. Remember that when flying on an IFR clearance with a VFR restriction, a pilot must comply with Instrument Flight Rules plus applicable Visual Flight Rules. A pilot operating "VFR CONDITIONS ON TOP" is expected to remain on the centerline of airways or routes described by his ATC clearance unless

    a. otherwise authorized by ATC, or
    b. maneuvering as necessary to clear the intended flight path, or
    c. the pilot exercises emergency authority.

9. If, at the start of an IFR flight, a pilot wishes to climb in VFR conditions, or if, while flying at a specific assigned altitude, he wishes to climb or descend in VFR conditions, he may request to do so (except in Positive Controlled Airspace). Sometimes such a procedure is considered a practical method of avoiding delay due to other traffic.

10. The procedures are the same as for operation at a specific assigned altitude. Pilot action in compliance with regulations is determined by existing weather conditions (VFR or IFR), as outlined in the Airman's Information Manual.

References:

Airman's Information Manual, "Air Traffic Control Procedures."
FAR 91 (Vol. VI.)

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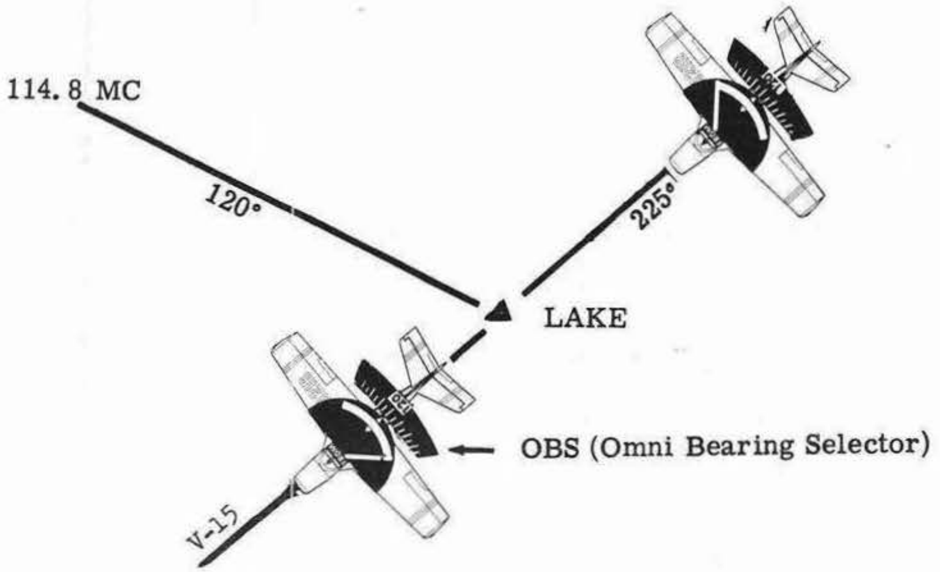
Department of Transportation
FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 7

CDI Interpretation

Recurring errors in Instrument Pilot Written Examination test items requiring interpretation of the CDI (course deviation indicator) of the VOR receiver indicate that many applicants do not thoroughly understand this portion of the instrument display. Errors are particularly prevalent in situations where it is necessary to relate aircraft position to an intersection, or to an ILS localizer course. The illustrations that follow will be helpful in preparing for test items in this area, and will be useful for practical application in flight.

ESTABLISHING POSITION AT INTERSECTIONS



In the above illustration, the aircraft is established on V-15 and the pilot wishes to determine position over Lake Intersection. A good procedure is to:

1. Set the frequency selector to the frequency of the VOR/VORTAC used to designate the intersection. Then identify the station.
2. Set the OBS to the published radial FROM the station.

With the receiver set up in this manner, the following statements will always be true:

1. The TO-FROM display will indicate "FROM."
2. Before passing the intersection, the CDI needle will be deflected in the direction of the station used for the intersection.
3. The CDI needle will begin movement toward the center when the aircraft is approximately 10° from the desired radial.
4. The CDI needle will center when the radial is crossed.
5. After passing the intersection, the CDI needle will move from the center to the side away from the station used for the intersection.

This method is used by many experienced pilots because it is simple and provides a good "picture." Equally successful, however, is the method of setting the OBS to the reciprocal of the published radial, in which case the CDI indications are reversed.

Rev. 9/69

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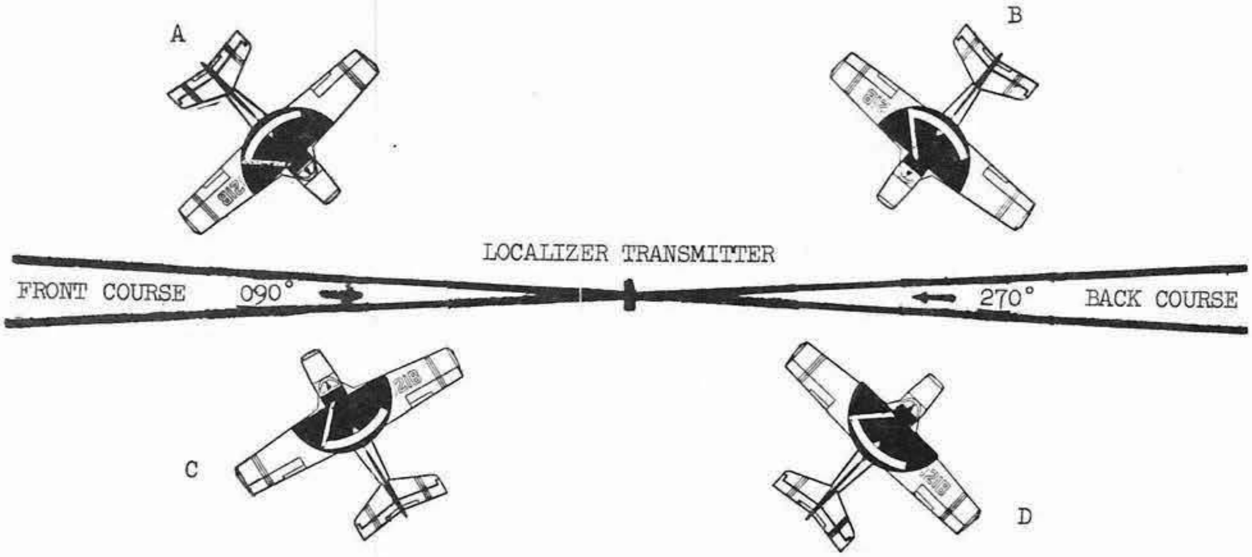
FLYING THE ILS

In most systems (except integrated flight systems) when the VOR/ILS receiver is tuned to an ILS frequency, the OBS and TO-FROM do not operate in the same manner as when tuned to a VOR. On some receivers the TO-FROM will indicate "TO," and on other receivers it will be blank. With the exception of the pictorial type instruments, such as King KPI 550 and Collins PN01, the CDI senses in relation to the inbound front course of the localizer, regardless of the OBS selection. This is true whether the aircraft is flying on the front course or the back course.

When the aircraft is headed within 90° of the published bearing of the inbound front course (see aircraft A and D), the CDI needle will be deflected in the direction of the localizer course. When the aircraft heading is within 90° of the reciprocal of the front course inbound bearing (see aircraft B and C), the CDI needle will be deflected away from the localizer course.



Look at it another way. If the aircraft is on the side to the right of the inbound front course localizer bearing (see aircraft C and D), the CDI needle will be deflected to the left, regardless of aircraft heading. If the aircraft is on the side to the left of the inbound front course localizer bearing (see aircraft A and B), the CDI needle will be deflected to the right, regardless of aircraft heading.

Remember that full left or full right deflection of the CDI needle occurs at approximately 2 1/2° (or more) from the centerline of the localizer course. This CDI sensitivity is four times greater than when flying VOR, where full left or full right deflection represents approximately 10° from the course centerline.

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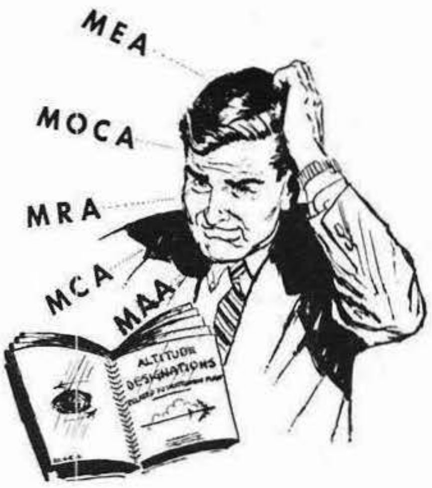
DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
IFR PILOT EXAM-O-GRAM* NO. 8

IFR ALTITUDES



Applicants for the Instrument Rating Written Test should expect to be examined on various altitude designations related to instrument flight. Analyses of responses to current written examinations indicate that doubt exists as to the meaning of these designations and why they are specified.

GENERAL

IFR altitudes are established by the Federal Aviation Administration for instrument flight along Federal airways and off-airway routes in controlled airspace. They are established after consideration of:

1. obstruction clearance criteria;
2. navigation signal coverage for accurate navigation; and
3. two-way radio communications.

Obstruction clearance is normally at least 1,000 feet (2,000 feet in designated mountainous areas) above the highest terrain or obstruction 4 miles either side of the centerline of the airway or route.

For instrument flight along routes not in controlled airspace and for which no specific minimum IFR altitude has been established, it is the pilot's responsibility to select altitudes which comply with obstruction clearance requirements.

DEFINITIONS

1. MEA (Minimum Enroute Altitude) is the minimum altitude in effect between radio fixes which
    a. meets obstruction clearance requirements;
    b. assures acceptable navigational signal coverage for accurate navigation; and
    c. assures two-way radio communication.

    Remember that the MEA is often higher than that required for obstruction clearance only. This is to assure reception of navigation and communications signals and to provide additional airspace for VFR operations below the airway during periods of less than 3 miles forward visibility. Remember also that the MEA is sometimes different for opposite directions along an airway due to rising or lowering terrain.

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Rev. 11/75

2. MOCA (Minimum Obstruction Clearance Altitude) is the specified minimum altitude in effect between radio fixes which

   a. meets obstruction clearance requirements; and
   b. assures acceptable navigational signal coverage only within 22 nautical miles of the VOR.

   A MOCA is shown (on National Ocean Survey IFR charts) directly below the MEA and is identified by an asterisk. The designation of a MOCA indicates that a higher MEA has been established for that particular airway or segment because of signal reception requirements. When no MOCA is shown on the chart, the MEA and MOCA are considered to be the same.

   Remember that a flight altitude at the MOCA may be requested by a pilot, or assigned by ATC for traffic control purposes, for use within 22 nautical miles of the VOR. The MOCA may be assigned beyond 22 nautical miles provided certain special conditions exist. Beyond 22 nautical miles, the MOCA assures only obstruction clearance.

3. MRA (Minimum Reception Altitude) is the lowest altitude required to receive adequate signals to determine specific fixes. Reception of signals from a radio facility located off the airway being flown may be inadequate at the designated MEA, in which case, an MRA is designated for the fix. A DME fix arrow (—▷ or ⊐▷) at a fix where an MRA is given, indicates that the fix may also be identified with DME. If DME is used to identify the fix, the MRA does not apply since it is not necessary to receive the facility off the airway.

4. MCA (Minimum Crossing Altitude) is the minimum altitude at which certain radio facilities or intersections must be crossed in specified directions of flight. If a normal climb, commenced immediately after passing a fix beyond which a higher MEA applies, would not assure adequate obstruction clearance, an MCA is specified. The normal climb criteria used for establishing an MCA are:

   Sea level through 5,000 feet - - - - - - - - - - - - 150 feet per nautical mile
   5,000 feet through 10,000 feet - - - - - - - - - - - 120 feet per nautical mile
   10,000 feet and over - - - - - - - - - - - - - - - - 100 feet per nautical mile

5. MAA (Maximum Authorized Altitude) is the highest altitude authorized for instrument flight for a particular segment of an airway or route for which an MEA has been designated in FAR Part 95. For example, a segment of a Jet Route on a High Altitude Enroute Chart might have an MAA designated due to interference from VOR navigation signals on the same frequency at altitudes above the MAA. MAAs are designated on some Low Altitude Enroute Charts due to military requirements above that altitude.

TRY THIS TEST. Correct answers are shown on the back page.

1. The MEA assures acceptable navigational signals for accurate navigation, ________________ ________________, ________________.

2. If the MOCA does not assure reliable navigation signal coverage between fixes, a higher altitude is designated as the ____________.

3. MRAs are designated at certain intersections where aircraft position cannot be determined accurately at the ____________.

4. The lowest altitude for crossing a radio fix beyond which a higher minimum applies (if no minimum crossing altitude is specified) is the ________________________.

5. Different MEAs for opposite directions of flight along an airway segment are sometimes specified due to ________________________________.

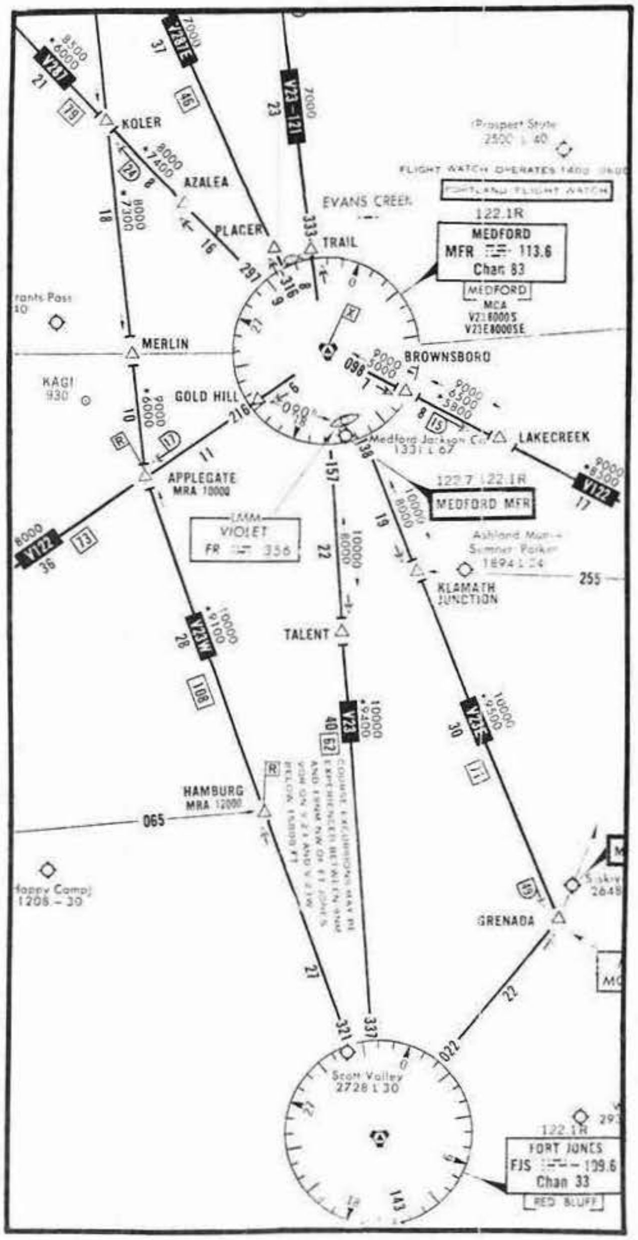
6. Acceptable navigational signal coverage at the MOCA is assured for a distance from the VOR of only ________________.

7. ATC may assign the MOCA when certain special conditions exist and when within ____________ ____________.

8. Why would ATC assign the MOCA? ________________________ , ____________ ________________________.

9. For flight outside controlled airspace, the responsibility for determining the minimum IFR altitude rests with the ________________.

10. The minimum IFR altitude for "VFR Conditions On Top" operation, except in an emergency, is the ____.



USE REPRODUCED PORTION OF ENROUTE LOW ALTITUDE CHART L-1, TO THE LEFT, FOR ANSWERING QUESTIONS 11 THROUGH 19.

11. A southbound flight on V23 must cross Medford VORTAC at or above ____________.

12. The MEA between BROWNSBORO and LAKECREEK (southeast of Medford) is ____________ ____________ and ____________ ____________.

13. The minimum altitude for a flight from LAKECREEK to BROWNSBORO on V122 with assurance of acceptable navigational signals is ____________.

14. A flight on V122 may not be able to determine APPLEGATE (southwest of Medford) at an altitude below ____________ if not equipped with DME.

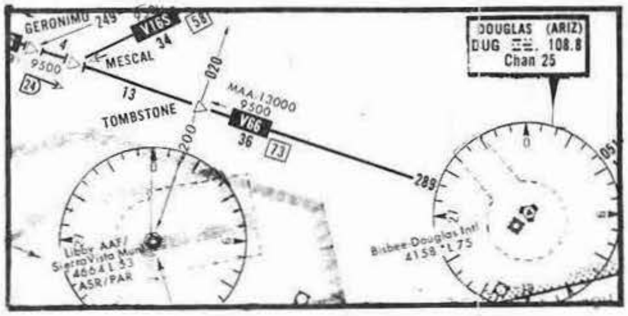
15. The MOCA from Fort Jones VORTAC to HAMBURG on V23W is ____________.

16. A northwest flight from Fort Jones on V23W may not be able to determine HAMBURG at an altitude below ____________.

17. What equipment is required to identify TALENT when flying north from Fort Jones on V23? ____________

18. What radio instrument indications may exist when flying north from Fort Jones on V23 or V23W at an altitude less than 15,000 feet? ____________ ____________.

19. What is the MEA from GRENADA to Fort Jones VORTAC? ____________



USE PORTION OF CHART TO THE LEFT FOR ANSWERING QUESTION 20.

20. What is the maximum altitude for a flight on V66 between Douglas VORTAC and MESCAL?

____

ANSWERS TO QUESTIONS:

1. obstruction clearance requirements, and two-way radio communication.
2. MEA.
3. MEA.
4. MEA at which the fix is approached.
5. rising or lowering terrain.
6. 22 NM.
7. 22 NM of a VOR.
8. For traffic control purposes, or at pilot's request.
9. pilot.
10. MEA, or published MOCA within 22 NM of a VOR.
11. 8,000 feet.
12. 6,500 feet northwest-bound and 9,000 feet southeast-bound.
13. 5,800 feet.
14. 10,000 feet.
15. 9,100 feet.
16. 10,000 feet (can use DME).
17. DME.
18. Course excursions may be experienced between 9NM and 19 NM northwest from Fort Jones.
19. 10,000 feet.
20. 13,000 feet.

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IFR PILOT EXAM-O-GRAM° NO. 10

ALTIMETRY

In spite of the importance of the pressure altimeter, almost fifty percent of the applicants taking the Instrument Pilot Written Tests demonstrate a knowledge deficiency concerning the effect of atmospheric pressure and temperature changes on this instrument. The effects of other altimeter errors will not be considered here since it is assumed that the static pressure system and altimeter of the aircraft being flown have been tested in accordance with FAR 91.170.

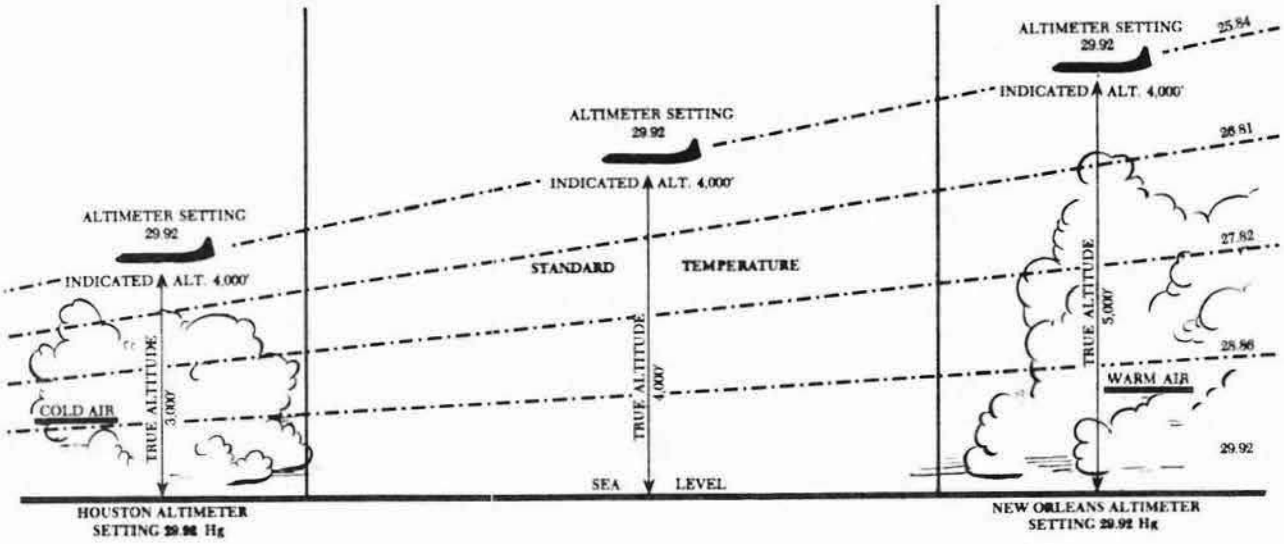
ATMOSPHERIC TEMPERATURE AND PRESSURE ERRORS: Normally the effects of atmospheric temperature and pressure changes may be summarized by the adage, "Cold or low, look out below." When flying from a warm area to a cold area (assuming little or no pressure change) or from a high pressure area to a low pressure area (assuming little or no temperature change), your aircraft is lower than indicated altitude, unless the altimeter has been adjusted to compensate for the change.

An altimeter is accurate at all altitudes only when the conditions of a Standard Atmosphere exist. In general, a standard atmosphere occurs when the

1. sea level barometric pressure is 29.92" Hg.,
2. sea level free air temperature is +15°C, and
3. temperature decreases 2°C with each 1000 foot increase in altitude.

Since the above conditions rarely exist, the altimeter requires correction.

The altimeter is a pressure measuring device and when set at 29.92 will indicate 4000 feet at a level where the atmospheric pressure is 25.84" Hg. The true altitude at which this pressure actually exists may be more or less than 4000 feet. As shown in Figure 1, on a warm day the expanded air is lighter in weight per unit volume than on a standard day or a cold day. Therefore, the pressure level where the altimeter will indicate 4000 feet is higher than it would be under standard conditions. On a cold day the reverse would be true and the 4000 foot pressure level would be lower.



True Altitude Decreases When Going Into Cold Air (Figure 1)

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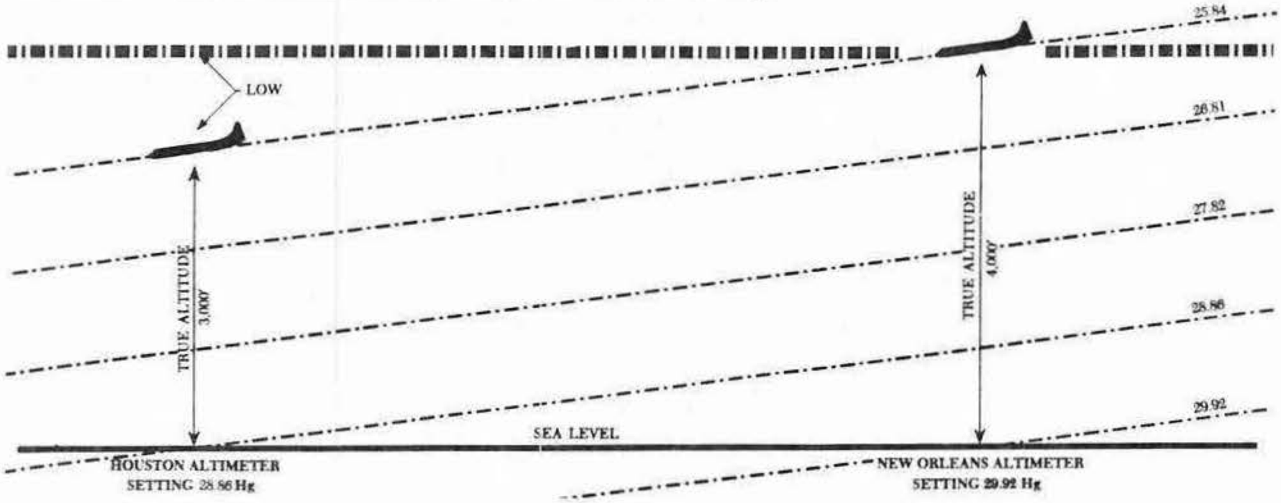
(Rev. 12/67)

Changes in surface pressure may also affect the pressure levels at altitude. You can see from Figure 2 that an aircraft flying into an area of lower pressure will be lower than indicated altitude unless the altimeter is adjusted to the local altimeter setting.



True Altitude Decreases When Going Into Low Pressure (Figure 2)

ALTIMETER SETTING: The local altimeter setting "corrects" for the difference between existing pressure and standard atmospheric pressure. Whether local pressure is higher or lower than standard, when the aircraft altimeter is set to the local altimeter setting (assuming no setting scale error) it will indicate true altitude (MSL) at ground level. The indicated altitudes above ground level are normally not true altitudes because of nonstandard lapse rates. The point to remember is that when all aircraft operating below 18, 000 feet are using the current local altimeter setting, they have a common reference for indicated altitude. (See ALTIMETRY - Airman's Information Manual for additional details.)

SUMMARY:

1. For normal operations (except to determine true airspeed, true altitude, engine operation, etc.) pilots should disregard the effect of nonstandard temperatures. However, both low temperatures and low pressures should be considered when selecting altitude for terrain clearance purposes.
2. If the local altimeter setting is lower than the setting on the kollsman dial, the aircraft will be lower than indicated altitude. A reverse situation is also true.
3. Both pressure and temperature must be considered when determining the relation of indicated altitude to true altitude.

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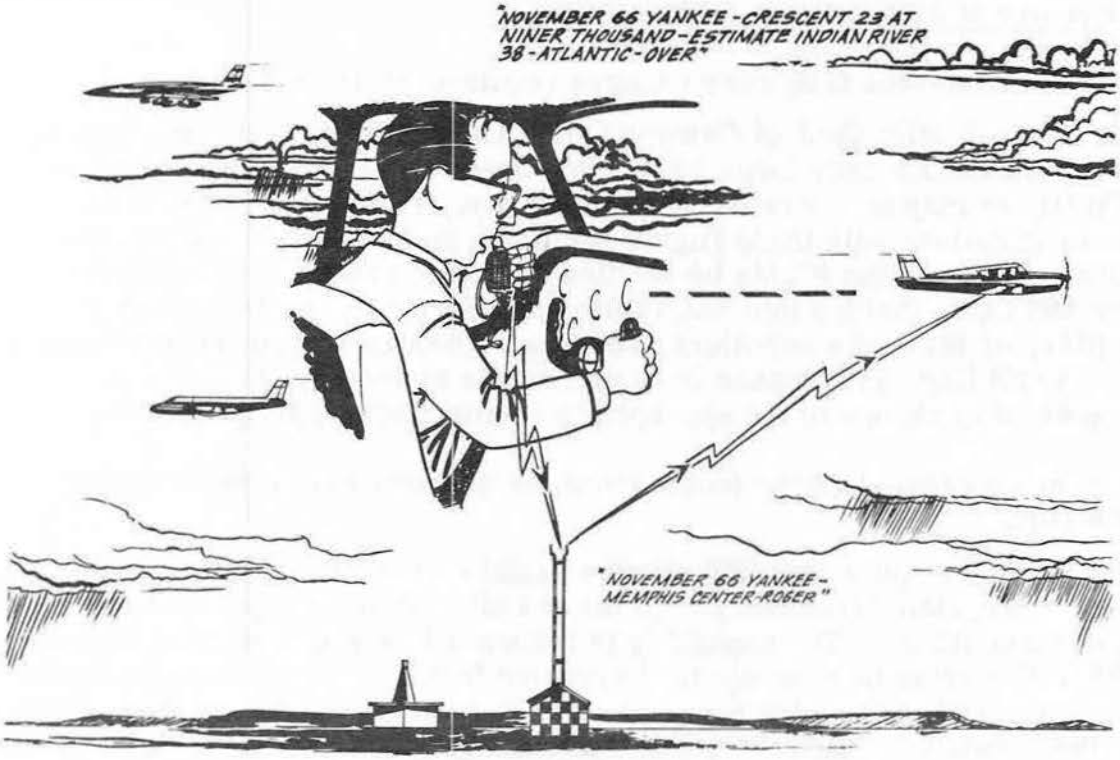
IFR PILOT EXAM-O-GRAM* NO. 11

Communications Procedures for Pilots on IFR Flight Plans



Many applicants taking the Instrument Pilot Written Examination have difficulty with test items concerning IFR radiotelephone procedures, techniques, and phraseologies. The services of Air Traffic Control (ATC), as well as the ability of a pilot to make maximum use of these services, are dependent on effective communications. Several pages in the Airman's Information Manual specify pilot actions and responsibilities in this area, and these pages should be studied carefully.

The following questions and answers cover many problems involving IFR radiotelephone communications and may help to increase pilot understanding in this important area.

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Rev. 2/71

1. How do IFR pilots know what frequencies to use and monitor?

   Departing pilots are instructed when, and on what frequencies, to contact CLEARANCE DELIVERY, TOWER, DEPARTURE CONTROL, and CENTER. ATC assumes that pilots will make frequency changes as directed, will "check in" or report on the newly assigned frequency, and will monitor the frequency at all times.

2. Why are numerous frequency changes required while enroute?

   Air Route Traffic Control Centers (ARTCCs handle most enroute flights) have jurisdiction over large geographic areas within which 100 or more IFR flights may be operating simultaneously. Direct pilot/controller communications with these flights cannot be maintained on any one frequency, nor can the flights be handled by one controller. Consequently, the ARTCC is divided into SECTORS; each sector is handled by one controller, or team of controllers, and has its own sector discrete frequency. As an IFR flight progresses from one sector to another, the pilot is requested to change to the appropriate sector discrete frequency.

3. How much radiotelephone (communications) equipment is required for IFR flight?

   Regulations require that IFR pilots maintain a communications watch on the "appropriate" frequency, and make radiotelephone reports at specified times and places. The capability to transmit to a Flight Service Station on 122. 1 (for relay of message to the control facility), and to receive on the voice channel of the VOR being used for navigation, meets the requirements of the regulation. However, this system imposes a severe handicap because of time lag and is impracticable in high density traffic areas.

   Transmitter/receivers with 90 channel capability (118. 0 to 126. 9) are suitable for most IFR operations, however, pilots will have occasional difficulty maintaining direct pilot/controller communications. This is because some sector discrete frequencies are higher than 126. 9. Radios with 180 channel capability (118. 0 to 135. 9) give more complete coverage, and radios with 360 channel capability (118. 00 to 135. 95) will provide all frequencies needed.

4. Pilots of aircraft not having 360 channel capability may be assigned frequencies on which they are "unable." What should the pilot do in this case?

   Pilots having only a 90 channel radio cannot accept a frequency assignment above 126. 9, and pilots with a 180 channel radio cannot accept a frequency assignment with hundredth megacycle spacing, such as 127. 55. Make a written record of frequency assignments--and do not accept a frequency for which your radio is not equipped.

5. How about pilots who, having the radio capability, are unable to establish communications on a newly assigned frequency?

   This occasionally happens and is a good reason for recording frequency assignments. If "unable" on an assigned frequency, re-contact the transferring controller or facility. If you are unable to re-contact the transferring facility, then try the appropriate FSS, and failing this--try for any ATC facility on 121. 5. Remember that if you contact an FSS for relay of message, it is well to state that you are IFR.

6. What is the proper procedure for establishing initial contact on a newly assigned frequency?

   To establish initial contact when no position report is required, pilots should (on the initial call-up) say:

   > (name) CENTER/APPROACH CONTROL - (aircraft identification)
   > AT (altitude/flight level) or AT (altitude/flight level)
   > CLIMBING/DESCENDING TO MAINTAIN (altitude/flight level) - OVER.

   When flying in a non-radar environment (not in radar contact), and the communications contact is to be followed by a position report, use the procedure as outlined in the Airman's Information Manual.

7. How do IFR pilots receive SIGMETS, AIRMETS, and other weather information while enroute?

   IFR pilots who are monitoring an FAA enroute navigation aid for ATC clearances will hear all special and scheduled weather broadcasts. These broadcasts do not interfere with the pilot's monitoring ATC, because the broadcasts may be interrupted to relay an air traffic clearance.

   Pilots in direct communication with the ARTCC should monitor the navigation aid voice feature at sufficient volume level to be aware of special and scheduled broadcasts, and possible interruption of the station identification. Pilots should not voluntarily interrupt their listening watch on the assigned discrete frequency. Centers may direct a pilot to contact an FSS for weather information, or may authorize a pilot's request to do so.

8. Why is standard phraseology important in ATC radiotelephone contacts?

   Standard phraseology helps pilots organize their transmissions, reduces the possibility of misunderstanding, and saves time on the frequency. Remember that the controller may be working with a dozen or more aircraft on the same sector discrete frequency, and other pilots may be waiting to use this "party line."

9. How should a pilot in flight, desiring to file an IFR flight plan, contact ATC?

A pilot in such a circumstance should contact the nearest FSS for relay of communications to ATC, or for assignment to the appropriate Center Sector Discrete Frequency.

Pilots in the vicinity (for example--20 miles) of a destination airport which is served by an Approach Control may expedite receipt of an ATC clearance by calling Approach Control on an appropriate frequency.

IFR flight plans filed in flight impose an extra load on ATC and often result in delaying the pilot. For this reason, IFR flight plans should be filed at least 30 minutes in advance of expected request time whenever possible. If it becomes necessary to file in flight, state that the flight is VFR (if in controlled airspace), give reliable position information, and maintain VFR conditions until clearance is received.

10. What may you do to develop good radiotelephone techniques?

1 - Study the pilot instructions and phraseology examples in the Airman's Information Manual.
2 - Practice correct phraseology for position reports, speak distinctly, and identify yourself positively.
3 - Know how to make the best use of the radiotelephone equipment in your aircraft.
4 - Monitor ATC on the appropriate frequency at all times.
5 - Listen to what is being said on the frequency.
6 - Be as brief as practicable in your contacts. Know what to say and how to say it.
7 - Always be alert to receive and copy instructions.
8 - Learn to copy clearances quickly and accurately.
9 - Don't accept a clearance unless you understand it and can comply with it.
10 - If your aircraft has limited frequency capability, advise ATC of this fact. Don't accept instructions to make contact on a frequency you don't have.

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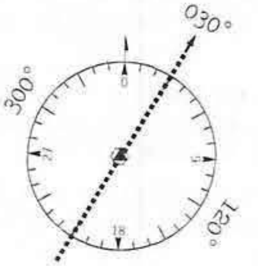
IFR PILOT EXAM-O-GRAM* NO. 14

VOR QUIZ

A thorough understanding of all information provided by the VOR receiver will be helpful in taking the Instrument Pilot Written Examination, and will save pilots time, work, and worry in flight. The questions and explanations that follow concern the basic problems and a few of the refinements of VOR receiver operation. Awareness of the points brought out in these explanations will help you obtain maximum utilization of this fine aid to air navigation.

1. Does the CDI (Course Deviation Indicator) relate the selected course and the aircraft heading?

   No, the CDI relates selected course and aircraft location. The illustration below represents a VOR station and the surrounding area. The course selector setting is always represented by an imaginary line (in this case, 030°) extended through the station; the aircraft is located on, or to either side of this line.



   The problem of interpreting the CDI may be confusing if aircraft heading and selected course are not the same. However, the true relationship is readily seen by mentally (or actually) turning the aircraft to the heading shown on the course selector.

2. How can pilots avoid "reverse sensing"?

   By keeping the course selector setting and the aircraft heading in approximate agreement. Only by this procedure will the CDI be deflected in the direction of the selected course. If the course selector and aircraft heading are approximately opposite, it is as though the pilot has done an "about face," and what was to his right is now to his left. He must now read the CDI in "reverse."

   NOTE: When flying an ILS localizer course, it is not always possible to avoid "reverse sensing." When the VOR receiver is tuned to an ILS frequency, the course selector becomes useless, and the CDI automatically senses to the inbound front course bearing. When the aircraft is headed in the opposite direction of the inbound front course bearing, the pilot must read the CDI in "reverse."

3. In the diagram above, assume that the aircraft is located somewhere along the 120° - 300° line, which is perpendicular to the course selector setting. Would the receiver indicate TO or FROM?

   Neither, there can be no TO-FROM resolution along a line through the station, perpendicular to the course selector setting. The area of no reliable TO-FROM indication may extend 20° on each side (40° total) of this perpendicular line. The indication could be: a red flag, OFF, a partial or intermittent TO-FROM, or no indication at all.

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4. What angular deviation from a VOR course is represented by 1/2 scale deflection of the CDI?

5°. The CDI is normally calibrated to indicate a full scale right or left deflection (from center) at 10° from the selected course. This information is useful when approaching an intersection or intercepting a radial. The needle will start movement toward the center at a position 10° from the radial set on the course selector. The rate of movement can be interpreted as an indication of distance from the station, and is a clue to the lead required for an interception turn.

If approximate distance to the VOR station is known, this angular sensitivity provides information on approximate distance off course. Based on the formula - 1 degree equals 1 mile in 60 miles - an aircraft which is 30 miles out, and shows a 1/2 scale (5°) CDI needle deflection, would be 2 1/2 miles from course centerline.

NOTE: Remember that the CDI is 4 times as sensitive when used in ILS localizer function, and the needle will move 4 times as fast, requiring the pilot to plan and act accordingly. A one-half scale deflection of the CDI represents approximately 1 1/4° from the localizer centerline.

5. What degree of accuracy can be expected in VOR navigation?

This depends on pilot technique and systems accuracy. The following table shows an example of accumulated system errors, and the approximate effect at 30 miles distance from the station:

VOR radial error 1° = .5 mi.
Airborne receiver error 4° = 2.0 mi.
5° = 2.5 mi. off course

(NOTE: In many cases system errors will have a canceling effect.)

Any error in pilot technique could be added to the total of the above system errors. The need for proper adjustment of the VOR receiver, and precise navigation by the pilot, is evident.

DEPARTMENT OF TRANSPORTATION
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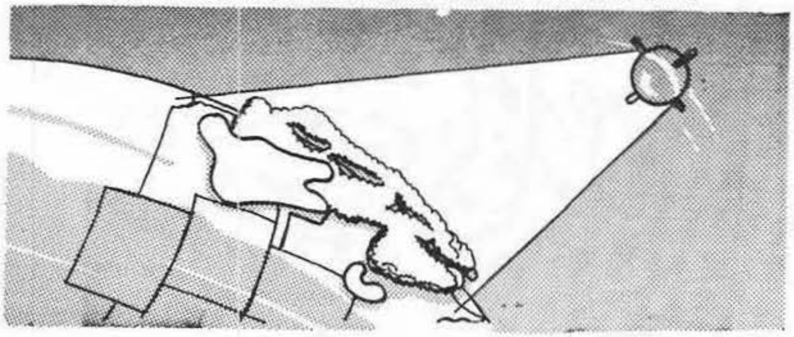
IFR PILOT EXAM-O-GRAM* NO. 15

THE WEATHER DEPICTION CHART IS FOR YOU



"Pictorial" weather charts are used to aid the IFR pilot in visualizing the overall weather situation; consequently, applicants need to be familiar with them. These graphic displays, available at Weather Service Offices, and most Flight Service Stations, are designed for rapid visual communication of weather conditions. Most important of these pictorial charts for weather briefing purposes are: WEATHER DEPICTION, SURFACE PROGNOSTIC, and RADAR SUMMARY. The WEATHER DEPICTION chart is discussed in this Exam-O-Gram; the other two charts are reviewed in Exam-O-Grams 16 and 17.

The "pilot oriented" picture of weather conditions on the WEATHER DEPICTION chart is made with you in mind. The chart provides at a glance basic information on areas and amount of cloud cover, heights of cloud bases, visibility and obstruction to vision. In addition, the chart shows major fronts and high and low pressure centers from the surface analysis for the preceding hour. This chart is a choice place to begin your weather briefing and flight planning. From it, you can determine general weather conditions more readily than from any other source. It gives you a "bird's eye" view at map time of areas of favorable and adverse weather and pictures frontal and pressure systems associated with the weather.

The chart may not completely represent enroute conditions due to (1) variations in terrain and weather between stations; and (2) weather changes that may have taken place after the data has been plotted. After you evaluate the general picture, your final flight planning must consider forecasts, progs, and the latest pilot, radar, and surface weather reports.

A typical Weather Depiction Chart appears on the next page. By learning the few symbols shown below, you can easily read every meteorological feature on the chart. Study the symbols for a few minutes--then test yourself on the Quiz that follows.

TOTAL SKY COVER

○ **Clear**
◔ **Scattered**
◕ **Broken, or thin broken**
◍ **Overcast, with breaks**
● **Overcast**
⊗ **Obscured**

OTHER

↟ Clouds Topping Ridges

WEATHER AND OBSTRUCTIONS TO VISION

△ - *Hail*
⛈ - *Thunderstorm*
•• - *Rain*
✳ - *Snow*
, - *Drizzle*
∞ - *Haze*
═ - *Fog*
∿ - *Smoke*
∽ - *Freezing Rain*
∽ - *Freezing Drizzle*
▽ - *Rain Shower*
▽ - *Snow Shower*
▲ - *Ice Pellets*
S - *Blowing Dust*
S - *Blowing Sand*
+ - *Blowing Snow*

Figures below the sky cover symbols are cloud heights in hundreds of feet--either the ceiling; or, if there is no ceiling, the height of the lowest scattered. Numbers and letters left of the symbols, represent visibility and weather or obstructions to vision. A height below a broken, overcast, or obscured sky cover always indicates a ceiling. Absence of a height below one of these symbols indicates thin sky cover or partial obscuration. Absence of visibility indicates the visibility is more than 6 miles.

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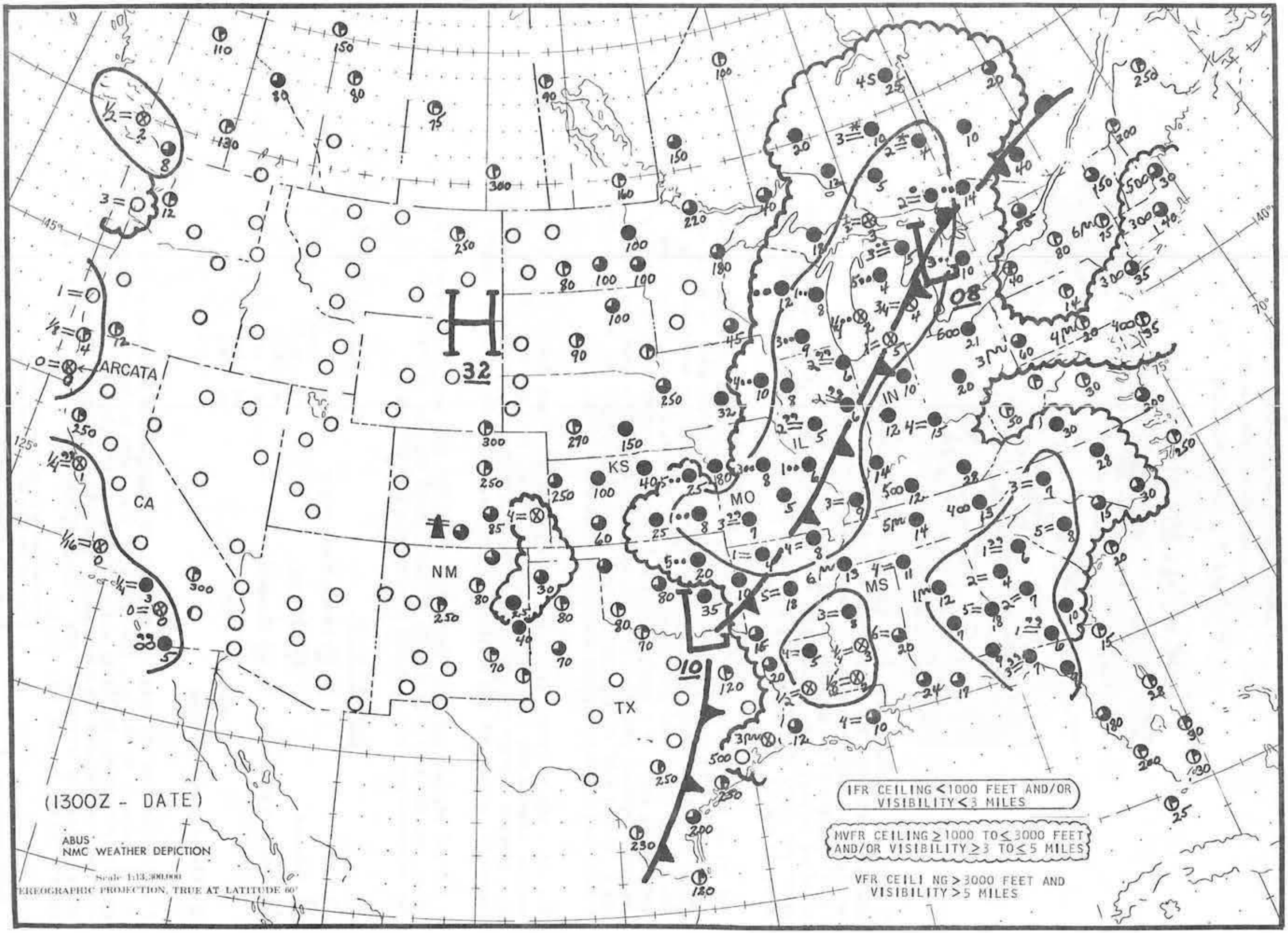
(1300Z - DATE)
ABUS
NMC WEATHER DEPICTION
Scale 1:13,300,000
STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 60°
IFR CEILING <1000 FEET AND/OR VISIBILITY <3 MILES
MVFR CEILING ≥1000 TO ≤3000 FEET AND/OR VISIBILITY ≥3 TO ≤5 MILES
VFR CEILING >3000 FEET AND VISIBILITY >5 MILES
H
32
L
08
10
ARCATA
CA
NM
KS
MO
IL
IN
MS
TX
145°
125°
140°
75°
70°

Vital Statistics:

WEATHER DEPICTION charts are issued eight times daily, at approximately 3-hour intervals. Each chart is marked with the hour of collection (GMT) of the weather data from which the chart was made. It is important to remember that the chart may not depict the present situation; each chart is approximately 1 1/3-hours old when it is distributed and will be approximately 4 1/3-hours old before it is replaced.

Tips on Using Weather Depiction Charts:

Remember that they are only one of many useful tools for weather briefing. The Weather Depiction Chart is simply a good place to start--a good place to get a picture of general weather conditions. By comparing this chart with the Surface Prognostic (a prediction of the weather situation at a specified time), by reviewing terminal and area forecasts, by studying the latest Aviation Weather reports for appropriate locations, and by checking available PIREPS, AIRMETS, SIGMETS, and RADAR information, you can reach a safe, sensible, and suitable decision for your flight.

QUIZ: (Answers on page 4.)

1. What are the sky conditions in New Mexico?
2. What ceiling and visibility categories exist in Kansas, progressing from the northwest to the southeast?
3. What is the ceiling and visibility in the southwest corner of Mississippi?
4. Describe the weather conditions at Arcata, California.
5. What can you determine from the chart regarding the visibility and height of the clouds just behind the front in the southeast corner of Texas?
6. What can be determined from the Sky Cover symbol of the station in northeast New Mexico?
7. Describe briefly the weather conditions associated with the front in Missouri and Indiana.
8. What kind of front or fronts are shown on the chart?
9. At approximately what time (CST) would this chart be available?
10. At 0900 CST, approximately how old is the data shown on this chart?
11. At what time (CST) will the next Weather Depiction Chart be available?

ANSWERS TO QUIZ:

1. Clear in the west and southwest, scattered clouds in the central and southeast, and overcast in the east central.
2. VFR, MVFR, and IFR.
3. Ceiling 200 feet; visibility 1/8 mile.
4. Sky obscured, fog, ceiling and visibility zero.
5. The visibility is more than 6 miles and the scattered clouds are at a height of 23,000 feet.
6. The clouds are thin broken.
7. IFR conditions exist.
8. A cold front in eastern Texas, a cold front from southeast Oklahoma to the center of the Low at Lake Huron, and a stationary front northeast from the Low.
9. 1300Z Chart available at approximately 1420Z or 0820 CST.
10. 1300Z is 0700 CST. The data is 2 hours old at 0900 CST.
11. Approximately 1120 CST (1600Z chart, available 1720Z).

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DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
IFR PILOT EXAM-O-GRAM* NO. 16

LOW LEVEL PROGNOSTIC CHARTS

- - Visual Weather Forecasts - -

Certain weather situation charts in the current Instrument Rating (Airplane) Written Tests require interpretation by the applicant. Recent analyses indicate that many applicants are incorrectly interpreting this information. This Exam-O-Gram will attempt to clarify the information contained on the LOW LEVEL PROGNOSTIC CHART.

As a pilot, you should be familiar with the weather charts which are designed for rapid visual communication of weather conditions which may affect your flight. Weather situations are presented on LOW LEVEL PROGNOSTIC, WEATHER DEPICTION and RADAR SUMMARY charts. They are important in a good weather briefing because they assist both the pilot and weather briefer to visualize existing and expected weather conditions. These charts are available at all Weather Service Offices and an increasing number of Flight Service Stations. This Exam-O-Gram will cover only the LOW LEVEL PROGNOSTIC chart. Refer to Exam-O-Gram #15 for discussion of the WEATHER DEPICTION chart; #17 for the RADAR SUMMARY chart.

The LOW LEVEL PROGNOSTIC charts, as the name implies, show a prediction of low level (below 24,000 feet) weather conditions. These charts are issued as 4 panels - - 2 panels show the 12-hour and 24-hour forecast of clouds and freezing levels, and 2 panels show the 12-hour and 24-hour forecast of significant weather conditions. These charts are issued 4 times daily with valid times (the actual time at which the charted situation is expected to exist) of 0000Z, 0600Z, 1200Z, and 1800Z. The valid time of the 12-hour Prog is approximately 6 hours after receipt due to the time required for chart preparation. To determine expected conditions beyond the valid time of the 12-hour Prog, you must interpolate between the 12-hour and 24-hour Progs.

A complete set of PROG charts is reproduced on the next page, followed by a list of symbols used on the charts and a short quiz.

The 12-hour and 24-hour SIGNIFICANT WEATHER PROGs (Panels A and B) contain forecasts of ceiling and visibility, areas of moderate or greater turbulence, and freezing levels. Icing is implied in clouds above the freezing level.

The 12-hour and 24-hour SURFACE PROGs (Panels C and D) contain forecasts of fronts, pressure centers and areas of precipitation. In areas of precipitation, thunderstorms imply moderate or greater turbulence.

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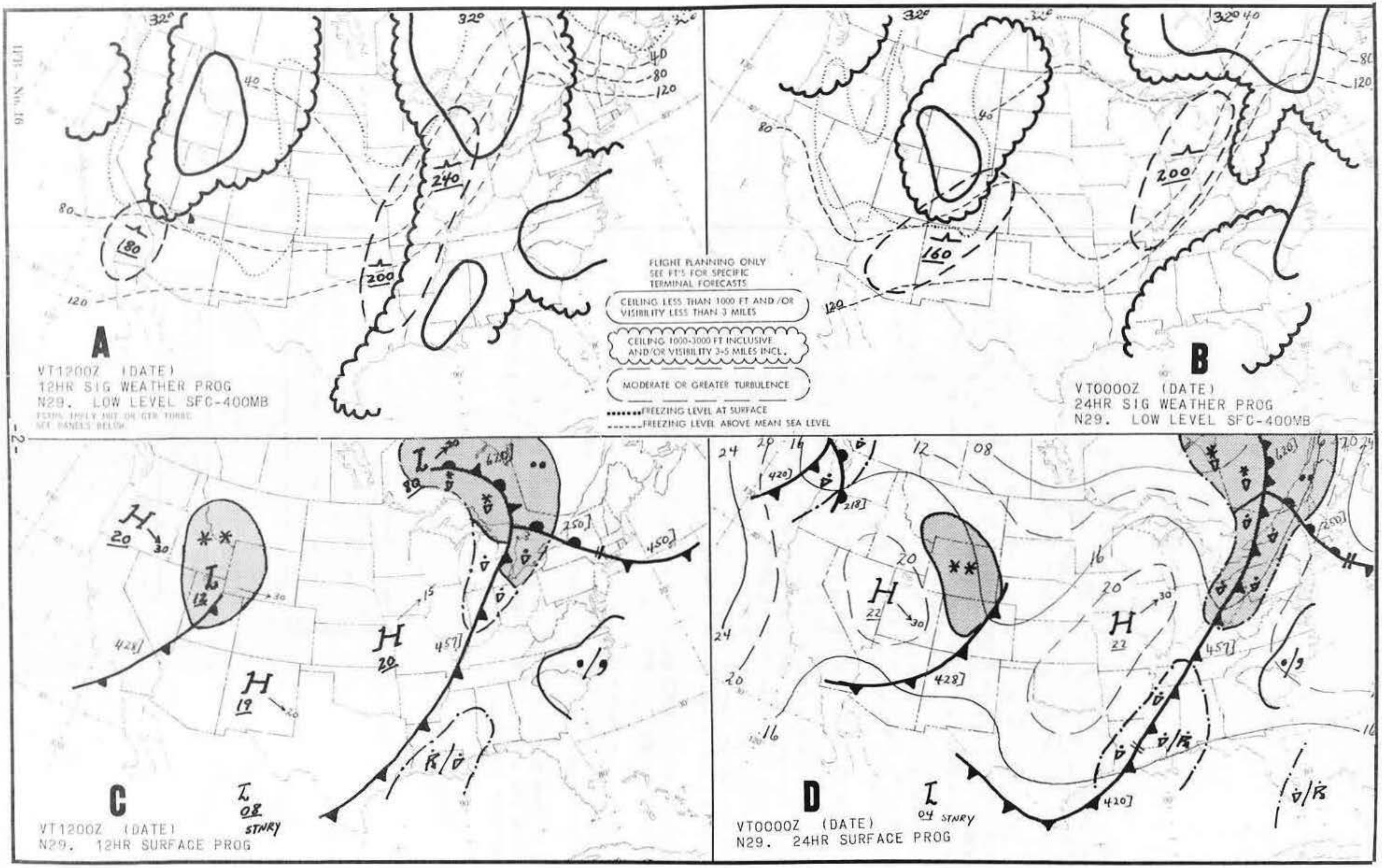
A
VT1200Z (DATE)
12HR SIG WEATHER PROG
N29. LOW LEVEL SFC-400MB
FCSTS IMPLY MDT OR GTR TURBC
SEE PANELS BELOW
32°
40
80
120
240
180
200
B
VT0000Z (DATE)
24HR SIG WEATHER PROG
N29. LOW LEVEL SFC-400MB
200
160
FLIGHT PLANNING ONLY
SEE FT'S FOR SPECIFIC
TERMINAL FORECASTS
CEILING LESS THAN 1000 FT AND/OR VISIBILITY LESS THAN 3 MILES
CEILING 1000-3000 FT INCLUSIVE AND/OR VISIBILITY 3-5 MILES INCL.
MODERATE OR GREATER TURBULENCE
FREEZING LEVEL AT SURFACE
FREEZING LEVEL ABOVE MEAN SEA LEVEL
C
VT1200Z (DATE)
N29. 12HR SURFACE PROG
H 20
L 12
H 19
H 20
L 08 STNRY
428]
457]
250]
450]
420]
D
VT0000Z (DATE)
N29. 24HR SURFACE PROG
H 22
H 22
L 04 STNRY
420]
218]
428]
457]
420]

THE FOLLOWING SYMBOLS ARE USED ON LOW LEVEL PROG CHARTS TO SHOW THE CONDITION INDICATED

SIG WEATHER PROG

(IFR)	*CEILING LESS THAN 1000 FT AND/OR VISIBILITY LESS THAN 3 MILES*
VFR	*AREAS NOT OUTLINED INDICATE CEILING ABOVE 3000 FEET AND VISIBILITY MORE THAN 5 MILES.*
(MVFR)	*CEILING 1000-3000 FT INCLUSIVE AND/OR VISIBILITY 3-5 MILES*
(- - - - -)	*MODERATE OR GREATER TURBULENCE*
—⋀—	*MODERATE TURBULENCE*
—⩓—	*SEVERE TURBULENCE*
– – – – – – –	FREEZING LEVEL ABOVE MSL
•••••••••••••	FREEZING LEVEL SURFACE

SURFACE PROG

CONTINUOUS OR INTERMITTENT PRECIPITATION

⬭	LESS THAN .5 AREA COVERAGE
▨	.5 OR MORE AREA COVERAGE
●	INTERMITTENT RAIN
● ●	CONTINUOUS RAIN
✳	INTERMITTENT SNOW
✳ ✳	CONTINUOUS SNOW

SHOWERS

(·—·)	LESS THAN .5 AREA COVERAGE
▨	.5 OR MORE AREA COVERAGE
● ▽	RAIN SHOWERS
✳ ▽	SNOW SHOWERS
Ꞧ	THUNDERSTORMS

QUIZ (answers on the next page)

1. Converted to local standard times, the valid (forecast) time for the 12-hour Prog is ________________.
2. Valid time (CST) for the 24-hour PROGs is ________________.
3. On a flight from KANSAS CITY to DALLAS, would you expect icing above 8,000 MSL in northeastern OKLAHOMA? ________________.
4. The freezing level in central KANSAS at 1800 CST on the current day is expected to be ________________________.
5. On a flight from OKLAHOMA CITY to LOS ANGELES, moderate or greater turbulence is forecast for 0400 PST in the general vicinity of ____________________.
6. What type of precipitation is expected in WYOMING at 1700 MST? ____________.
7. If you were planning a flight across northeastern WYOMING at 1700 MST, would you expect IFR, VFR, OR MVFR weather? ________________________.
8. By 0700 EST on the current day, the significant weather in WEST VIRGINIA and central PENNSYLVANIA is expected to be ____________________________.
9. Would you expect the weather inARKANSAS to be improving or deteriorating by 1800Z? ____________________.
10. Would you expect the weather in COLORADO to be improving or deteriorating by 2100Z? ____________________.

Answers to the QUIZ

1. 0700E, 0600C, 0500M, 0400P, 0200H, and 0200A.
2. 1800 CST.
3. Not likely (no clouds are forecast below 3000 feet and other clouds are unlikely in the high pressure area.
4. 8,000 feet MSL.
5. Western ARIZONA, southern CALIFORNIA and southern NEVADA.
6. Continuous snow over more than half the area.
7. MVFR.
8. Ceilings between 1,000 and 3,000 feet AGL and/or visibility 3 to 5 miles.
9. Improving (Interpolate between the 12-hour and 24-hour progs.
10. Deteriorating.

Remember that the LOW LEVEL PROGNOSTIC charts represent a forecast of weather conditions which are expected to -- but do not always -- develop. The meteorologist or pilot weather briefer on duty will help you examine current and pertinent weather details by referring to surface weather reports, terminal forecasts, radar information, AIRMETS, SIGMETS, and PIREPS. After making a decision to fly into an area of marginal weather, ALWAYS plan an alternate course of action in case the weather goes "Sour."

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration

IFR PILOT EXAM-O-GRAM* NO. 17

THE RADAR SUMMARY CHART

In addition to the WEATHER DEPICTION AND SURFACE PROGNOSTIC CHARTS (covered in INSTRUMENT PILOT EXAM-O-GRAMS 15 and 16), the RADAR SUMMARY Chart is used to present weather situations in Instrument Pilot Written Tests. The RADAR SUMMARY Chart deals primarily with weather of a potentially hazardous nature and, for this reason, it is important in pilot weather briefing. Anything shown on this chart along or near a pilot's route of flight must be taken into account and considered carefully.

Complete RADAR SUMMARY Charts are transmitted at 3-hour intervals. However, sections of the chart may be sent at 1-hour intervals when strong or significant radar echoes are observed. The analysis east of the Rocky Mountains is based on radar observations taken at over 90 weather radar locations. In western mountain regions, the analysis is based on observations taken by Weather Service Radar Meteorologists using FAA's Air Traffic Control Radars.

The charts show actual areas of radar echoes which are produced by a concentration of liquid or frozen water drops. These echoes represent the interior regions of moisture laden clouds and, the greater the concentration and size of the drops (as in cumulonimbus clouds), the stronger the echoes and the greater the probability of hazards.

Unlike the WEATHER DEPICTION Chart, which shows areas of low cloud cover and heights of cloud bases, the RADAR SUMMARY Chart shows precipitation areas and usually only the heights of echo tops. The RADAR SUMMARY Chart also distinguishes between gentle precipitation and the more hazardous showers and thunderstorms. Together, these two charts provide a three-dimensional picture of clouds and precipitation.

The echo pattern of the RADAR SUMMARY Chart is the arrangement of echoes. A pattern may be (1) a line of echoes, (2) an area of echoes, or (3) an isolated cell. A cell is a solid convective mass normally 20 nautical miles or less in diameter. Echo coverage indicates the extent of precipitation echoes within an area or line.

Movement of individual storms within a line or area often differs from the movement of the overall storm pattern. The movement of an isolated cell or individual echoes is shown by a direction arrow and a number representing speed in knots. Movement of a line or area is shown by an arrow with flags, a full flag for 10 knots, and a half flag for 5 knots.

A list of symbols used on the Radar Summary Chart appears on page 3. Symbols in the left and middle column are common to all plotted radar weather reports. Those in the top right column are used mostly east of the Rocky Mountains, and those in the lower part of the column are used with ARTCC Echo Reports.

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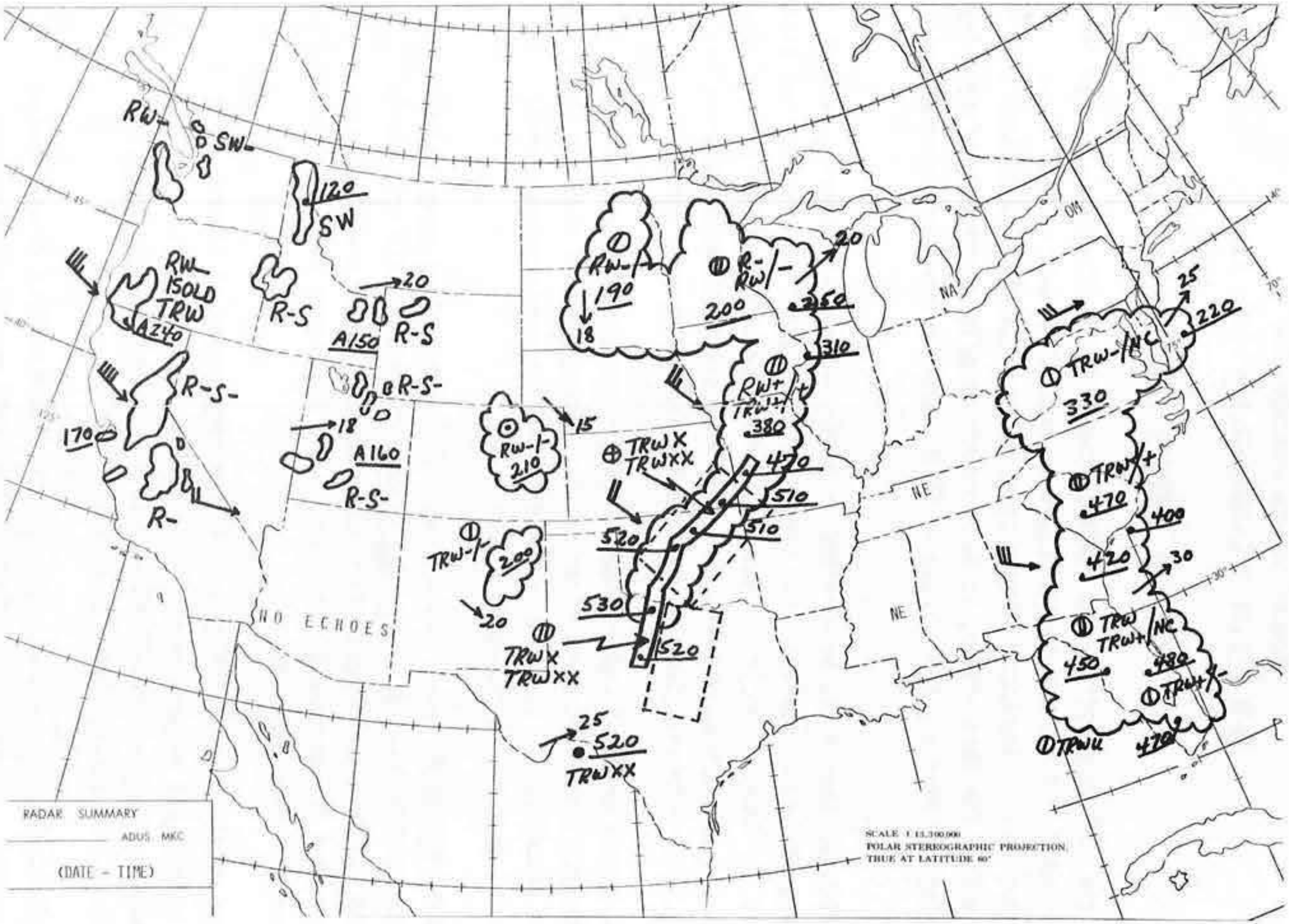
RADAR SUMMARY CHART



RADAR CHART LEGEND

SYMBOLS COMMON TO ALL PLOTTED RADAR WEATHER REPORTS

WEATHER SYMBOLS

A	Hail	IP	Ice Pellets
R	Rain	L	Drizzle
RW	Rain Showers	ZL	Freezing Drizzle
S	Snow	ZR	Freezing Rain
SW	Snow Showers	T	Thunderstorm

ECHO INTENSITY

-	Weak	X	Intense
(No symbol)	Moderate	XX	Extreme
+	Strong	U	Unknown
++	Very Strong		
Solidus (/)	Separates intensity from intensity trend		

TREND

+	Increasing	NC	No Change
-	Decreasing	NEW	New

Examples of
Precipitation Types, Intensity, and Trend

TRW+/-	Thunderstorm, heavy rainshower, decreasing in intensity.
R-/NC	Light rain, no change in intensity.
TRW-/NEW	Thunderstorm, light rain shower, newly developed.
S	Snow (No intensity or characteristic is shown for frozen precipitation.)

MOVEMENT OF ECHOES
(Examples)

Northeast at 15 knots. (Individual Echo)

East at 25 knots. (Line or area movement)

HEIGHTS OF ECHO BASES AND TOPS

Heights in hundreds of feet MSL are entered above and/or below a line to denote echo tops and bases respectively. Examples are:

$\underline{450}$	Average tops are 45,000 feet.
$\frac{200}{80}$	Tops 20,000 feet; bases 8,000 feet.
$\underset{\bullet\!\!-\!\!-\!\!-}{350}$	Top of individual cell, 35,000 feet.
$\llcorner 620 \lrcorner$	Maximum tops, 62,000 feet.
$\underline{A250}$	Tops 25,000 feet, reported by aircraft. Absence of a figure below the line indicates that echo base was not reported. Radar detects tops more readily than bases, since precipitation usually reaches the ground. Also, curvature of the earth prohibits the detection of bases of distant precipitation. Information from ATC radar shows tops only when reported by aircraft.

"Boxes" enclosed by dash lines indicate severe weather watch in effect. Refer to latest "WW" for specifics.

SYMBOLS INDICATING NO ECHOES

NE	No echo (equipment operating but no echoes observed).
NA	Observation not available.
OM	Equipment out for maintenance.

SYMBOLS USED WITH WEATHER SURVEILLANCE RADAR

A line of echoes

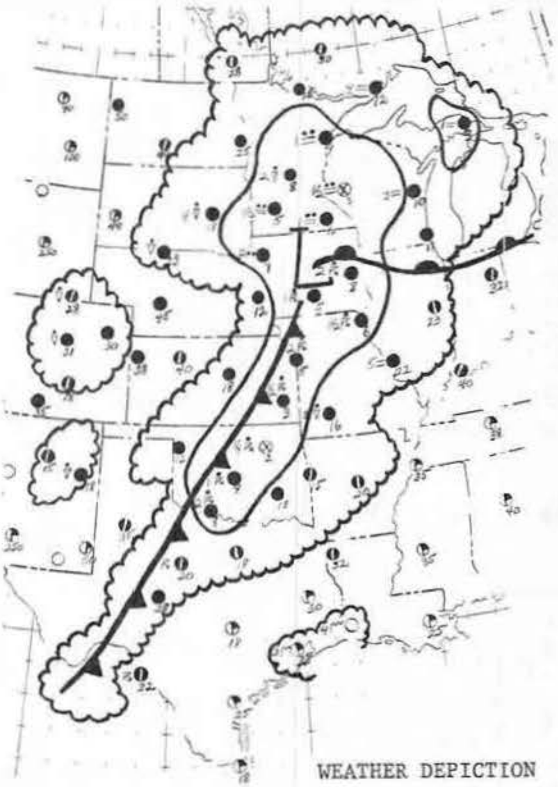
An area of echoes

○	Isolated cell
●	Strong cell detected by one radar
✱	Strong cell detected by two or more radars
⊕	Over 9/10 coverage
⦷	6/10 thru 9/10 coverage
⦶	1/10 thru 5/10 coverage
⊙	Less than 1/10 coverage

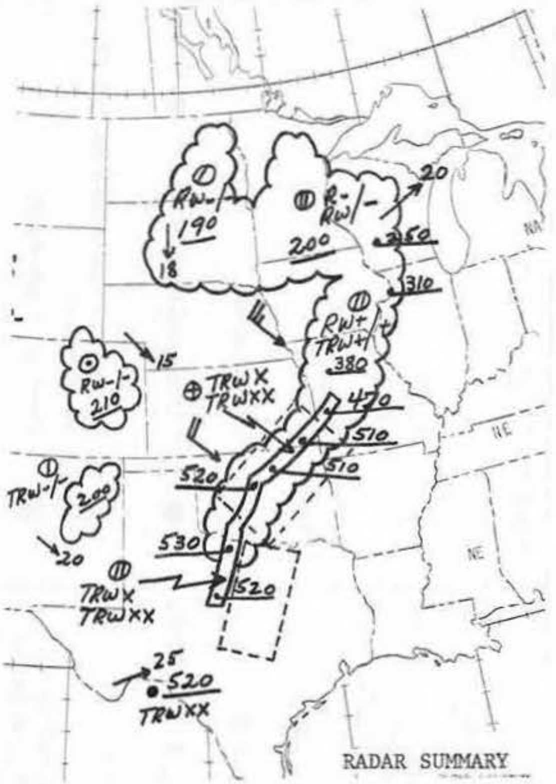
SYMBOLS USED WITH ARTCC ECHO REPORTS

(Solid line) Echo boundary from ARTCC scopes.

Line of echoes--possible squall line.



WEATHER DEPICTION



RADAR SUMMARY

From the excerpts above, you can see that the Weather Depiction Chart and the Radar Summary Chart complement each other--it takes both charts to obtain a three-dimensional picture.

The Weather Depiction Chart shows where the fronts are; a warm front extends east from the Low, and a cold front runs southwest. Thunderstorms are indicated ahead of the cold front, but from this chart we cannot determine the height of the buildups or the intensity. The Radar Summary Chart shows a solid line of thunderstorms just ahead of the front with buildups to 53,000 feet. The symbols on the chart indicate that the thunderstorms are intense to extreme along this line of echoes.

From the Weather Depiction Chart, you can see that north of the Low is an IFR area with both low ceilings and visibilities (ceilings from 3 to 9 hundred; visibilities 1 to 2 miles). The Radar Summary Chart indicates that the area of echoes northwest of this Low covers not more than five-tenths nor less than one-tenth of the area, and that the average tops of the echoes is 19,000. Also, only light rain showers are indicated. Notice that the area of thunderstorms is moving to the southeast at 20 to 25 knots. Also notice that no general movement is indicated for the area of showers north of the low. However, individual cells over the Dakotas are moving to the south at 18 knots, while over Wisconsin cell movement is toward the northeast at 20 knots.

By studying both charts, one can obtain a fair picture of the conditions to expect in a given area and especially the areas to be avoided.

For another example of how one chart complements the other, observe that the Weather Depiction Chart shows the area ahead of the front in central Texas to have VFR and MVFR weather conditions; but from the Radar Summary Chart, one can see there is a severe weather watch in this area.

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FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 18

"RATE OF TURN"

Many applicants who take FAA Instrument Pilot Written Examinations misinterpret the Turn and Slip Indicator and lack an understanding of the relationship between airspeed, angle of bank, and rate of turn. The purpose of this Exam-O-Gram is to remove some of this confusion.

Misinterpretation of the turn and slip indicator is caused by two major factors: (1) The marking and legend on the face of the instrument, and (2) misinterpretation of the "ball" (or slip/skid indicator). In general appearance, turn and slip instruments can be divided into two types: one having a center index only (see illustrations A and D of Figure 1), and the other having a center index and a two-needle-width deflection mark (doghouse) on either side (see illustrations B and C). A one-needle-width deflection on instruments having only the center index indicates a standard rate turn (3° per second). Instruments with doghouses may have different legends, e. g. "2-Min. Turn," "4-Min. Turn," "Turn and Bank;" regardless of the legend, if the instruments are properly calibrated, a one-needle-width deflection indicates a turn of 1.5° per second. A standard rate turn (3° per second) is indicated when the needle is aligned with the doghouse.

The turn needle indicates the "quantity" of the turn and is completely independent of the "ball." If the turn needle is properly calibrated, it shows the correct rate of turn regardless of the position of the ball. The ball indicates the "quality" of the turn. If the turn needle indicates a turn and the ball is not centered, and the pilot is using no pressure on the rudders, then the airplane is out of trim or rig. In this case, the pilot will have to use rudder pressure to center the ball and opposite aileron to keep the rate of turn constant. If the turn needle is centered and the ball is "out of center," the airplane is flying in a slip or wing low attitude. In airplanes without rudder trim, it is often necessary to hold rudder to center the ball; in this case the rudder is being used as a trimming device.

Assuming that the instruments in Figure 1 are properly calibrated and the airplane is properly trimmed for the speed and power setting, WHAT IS THE "RATE OF TURN" INDICATED BY EACH OF THE ILLUSTRATIONS, AND WHAT DOES THE BALL INDICATE?

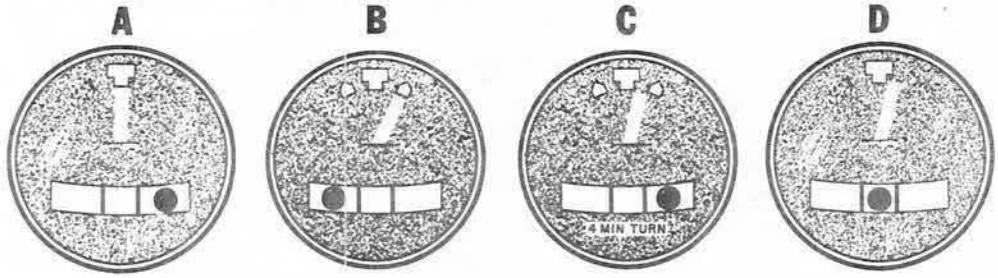

Figure 1

ANSWERS:

	Needle	Ball
A.	0° - no turn.	The ball indicates that the right wing is low. The pilot is holding left rudder.
B.	3° per second.	The ball indicates a skidding turn. If this occurs during the roll into a turn, the pilot is using too much right rudder; if the bank is already established, he is holding right rudder.
C.	1 1/2° per second.	The ball indicates a slipping turn. If the pilot is rolling into a turn, he is not using enough right rudder; if the bank is established, he is holding left rudder.
D.	3° per second.	The ball indicates a coordinated turn.

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Pilots should also understand the relationship of true airspeed and angle of bank to both rate of turn and radius of turn. Figure 2 shows three airplanes flying with the same bank at different airspeeds.

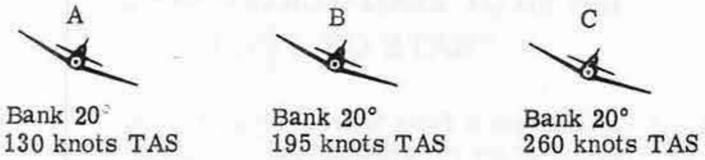

Figure 2

WHICH AIRPLANE HAS THE GREATEST RATE OF TURN?

ANSWER:

Airplane A, having the slowest airspeed and consequently the shortest radius of turn, has the greatest rate of turn.

Many people are misled into thinking that the fastest airplane would complete a 360° turn in the least time. This is not so! For example, one of our high speed jets flying at a true airspeed of 1, 750 knots, and utilizing the 20° bank of Figure 2, would require approximately 26-1/2 minutes to complete a 360° turn. Contrast this with the 2 minutes it would take airplane A to complete a 360° turn with a bank of 20° and an airspeed of 130 knots.

Most pilots know that the radius of turn increases with an increase in airspeed, but do not know the ratio of this increase to the airspeed. If the radius of turn increased in the same ratio as the airspeed, then the rate of turn would remain constant. The actual radius of turn, however, varies as the square of the true airspeed. Therefore, since the speed of airplane C is twice that of airplane A, the radius of turn of airplane C will be 4 times that of airplane A: ($2^2=4$). Consequently, it would take airplane C twice as long to complete a 360° turn, since C will travel four times as far as A but is moving only twice as fast.

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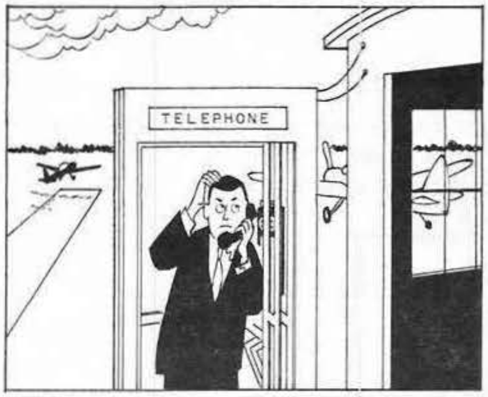
IFR PILOT EXAM-O-GRAM* NO. 19

TELEPHONE WEATHER BRIEFING



A pilot seeking a weather briefing may be compared to a buyer shopping for goods or services. If the buyer can clearly identify and state his needs, he is more easily and adequately served. If the seller can understand and assist in solving the buyer's specific problems, he will gain a satisfied and steady customer. So it is in a pilot briefing. The pilot must define his needs--not simply "HOW'S THE WEATHER EASTBOUND"--but "WHEN" (ETD & ETA) - "WHERE" (destination and route) - and "HOW" (VFR or IFR). The weather briefer in turn must speak in terms of weather elements that will affect the flight.

When the weather briefing is done by telephone, there is an added burden imposed on effective communication. In the telephone briefing it is most important that pilot and weather briefer take special care to cover specific items of critical information. It is essential that each person have a good idea of what he - and also the other fellow - really needs to know. Test items that deal with weather briefing in the INSTRUMENT PILOT WRITTEN TEST may be based on a telephone call, creating a situation which requires considerable initiative on the part of the pilot to obtain the necessary information. The following items are considered essential, and this list should be kept well in mind by instrument pilots and instrument pilot applicants.

WHAT DOES THE BRIEFER NEED TO KNOW?

WHO? 1. Aircraft identification or pilot's name
(Briefer needs this information for his log.)

WHEN? 1. Estimated time of departure - ETD
2. Estimated time enroute - ETE (or estimated time of arrival - ETA)

WHERE? 1. Destination
2. Route

HOW? 1. Type of flight plan (VFR or IFR)
2. Type of aircraft (non-turbocharged, turbocharged, turboprop, or jet)

Pilots should provide this information promptly, in a brief and well-organized manner.

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WHAT DOES THE PILOT NEED TO KNOW? --

1. Present weather conditions at destination, and along the proposed route of flight.
2. Trend and forecast at destination - also at the alternate, if required.
3. Trend and forecast of weather conditions along the proposed route of flight.
4. Freezing level, icing conditions, and turbulence.
5. Present and forecast thunderstorm activity.
6. Winds aloft at appropriate altitudes.
7. Escape routes - areas of good and/or improving weather.
8. NOTAMS & AIRADS

These items provide a basis for a picture of flight conditions and should enable the pilot to make suitable preflight decisions. This information is normally supplied by the pilot briefer; however, it is the pilot's responsibility to make sure that each appropriate item is covered - and that he understands the briefer's explanations.

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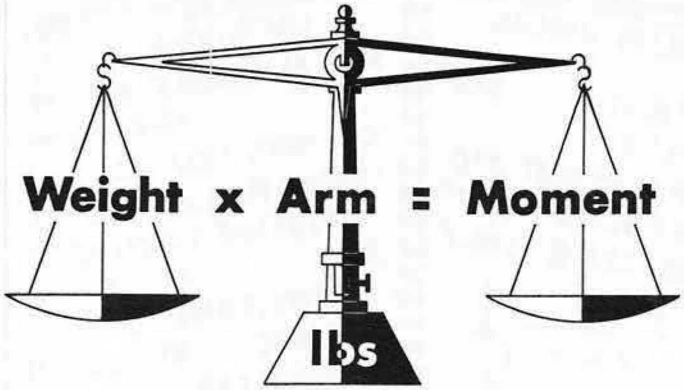
IFR PILOT EXAM-O-GRAM* NO. 21

IFR Weight and Balance Computations



Applicants preparing for the instrument pilot written examination should be familiar with weight and balance computations as they pertain to instrument flight. Although weight and balance is a prime consideration for every flight, instrument conditions make the consequences of improper loading particularly unsafe. If the total weight of the aircraft is beyond the maximum limit, there is an increase in stalling and landing speeds as well as a decrease in rate of climb, ceiling, and safety factor in turbulent air. If the center of gravity is located outside of allowable limits, the stability of the airplane may be affected and control forces may be erratic. Any of these adverse flight conditions add to the burden imposed on a busy pilot in an instrument environment.

When preparing for an instrument flight, the pilot should systematically check the weight and balance situation as part of his preflight planning. He should take into consideration:

1. Empty weight and center of gravity from airplane records.
2. Actual weights and seating locations of pilot and passengers.
3. Baggage weight and location.
4. Fuel as loaded, or at least a minimum to fly:
    a. To first airport of intended landing.
    b. To alternate (if required by FAR 91.83).
    c. Forty-five minutes at normal cruising speed.

He should apply this information to the charts, tables or instructions in the Airplane Owner's Manual. If limitations are not exceeded, he can conduct a safe operation. If the loading is over maximum design weight or out of allowable center of gravity range, an adjustment must be made in order to maintain safe operations.

A typical weight and balance problem found in the Instrument Pilot Written Examination, or on an actual Instrument Flight, is presented here as an example.

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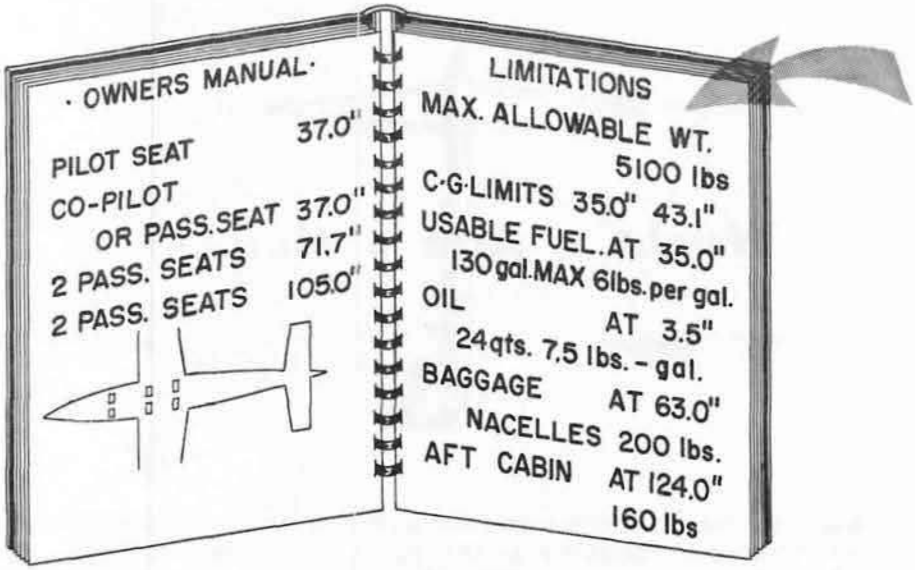
Assume that you are planning a flight in a light twin-engine airplane and that your load consists of four passengers, full fuel, and 360 lbs. of baggage. The weight and balance computations for this flight may be approached and solved as follows:

A. Check the limitations in the AIRPLANE OWNER'S MANUAL



· OWNERS MANUAL ·

PILOT SEAT 37.0"
CO-PILOT OR PASS. SEAT 37.0"
2 PASS. SEATS 71.7"
2 PASS. SEATS 105.0"

LIMITATIONS

MAX. ALLOWABLE WT. 5100 lbs
C·G·LIMITS 35.0" 43.1"
USABLE FUEL. AT 35.0"
130 gal. MAX 6lbs. per gal.
OIL AT 3.5"
24qts. 7.5 lbs. - gal.
BAGGAGE AT 63.0"
NACELLES 200 lbs.
AFT CABIN AT 124.0"
160 lbs

B. Determine the Empty Weight and the Empty Weight Center of Gravity from the latest weight and balance report in the Airplane's Records.

EMPTY WEIGHT	3450 lbs.
EMPTY WEIGHT CENTER OF GRAVITY	36.5" from datum

C. Determine if the Maximum Allowable Weight is exceeded:

Empty weight		3450
Pilot & passenger	155 + 165 lbs	320
Two passengers	160 + 200 lbs	360
One passenger	170 lbs	170
Baggage, Nacelles		200
Baggage, Aft Cabin		160
Fuel	Full	780
Oil	Full.	45
		5485 lbs

The maximum allowable weight limit of 5100 lbs. is exceeded by 385 lbs. This condition must be corrected before flight and before a check can be made on the center of gravity location. There are three parts of the useful load which can be off-loaded to reduce weight--fuel, baggage, or passengers. The selection of one or several of these possibilities depends upon the requirements for the flight.

If conditions are such that all passengers and their baggage need to go on the flight, you can carefully calculate your fuel requirements and reduce the fuel load to the minimum required by FAR 91.23.

FUEL REQUIRED FOR IFR FLIGHT

TO THE FIRST AIRPORT OF INTENDED LANDING	43 gals.
TO THE ALTERNATE AIRPORT (Assume ceilings are low at first airport)	27 gals.
TO FLY 45 MINUTES AT CRUISING SPEED	20 gals.
	90 gals.

You can reduce the fuel load to 90 gal., a reduction of 240 lbs. This helps, but it is not enough. Now you must insist that either some of the baggage be off-loaded or someone stay home. For the sake of the problem, let's assume that you remove 145 lbs. of baggage from the nacelles. The total weight is thereby reduced 385 lbs., bringing the airplane weight within the maximum allowable limit.

D. Determine if the Center of Gravity is within limits. Although many Owner's Manuals provide short-cut methods, Center of Gravity can always be calculated by dividing total moments by total weight. Moments are a product of weight times arm for each item, and the arm is an indication of the location of the item expressed in inches from a standard datum line. Using the arms given in the owner's manual and the weights calculated in step C above you obtain:

ITEM	WEIGHT (lbs.)	X	ARM (in.)	=	MOMENTS
Empty weight	3450		36.5		125925.0
Pilot & passenger	320		37.0		11840.0
Two passengers	360		71.7		25812.0
One passenger	170		105.0		17850.0
Baggage (Nacelles)	55		63.0		3465.0
Baggage (Aft cabin)	160		124.0		19840.0
Fuel	540		35.0		18900.0
Oil	45		3.5		157.5
	5100				223789.5

CENTER OF GRAVITY $223789.5 \div 5100 = 43.88$

Out of limits again! These calculations show that the center of gravity is located .78" behind the aft limit, and an unsafe flight condition exists.

You can make a correction by moving some of the heavier loads to relatively forward locations. This can be accomplished by having the passengers swap seats or by moving some baggage to forward compartments. In this case, we assume that you elect to shift 145 lbs. of baggage from the aft cabin to the nacelles; now, the moments for these items are:

	WEIGHT	ARM	MOMENTS
Baggage (Nacelles)	200	63.0	12600.0
Baggage (Aft Cabin)	15	124.0	1860.0

When these new moments are used in the calculations, we find that the total moments have changed to 214944.5, even though the total weight remained constant at 5100 lbs.

CENTER OF GRAVITY $214944.5 \div 5100 = 42.15$

Within limits! However, you should investigate the effect of fuel burn on Center of Gravity location for your particular aircraft.

The weight and balance problem for the flight has been solved--and a dangerous flight condition has been averted. By carefully limiting fuel to that required for the flight and by proper placement of the baggage, all limitations have been observed. All passengers can go on the flight, and you are assured that, as far as weight and balance is concerned, your preflight action will result in a safe IFR flight.

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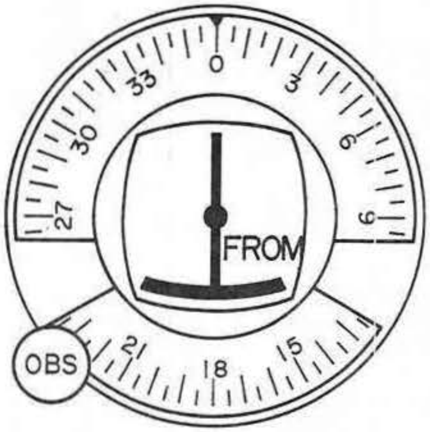
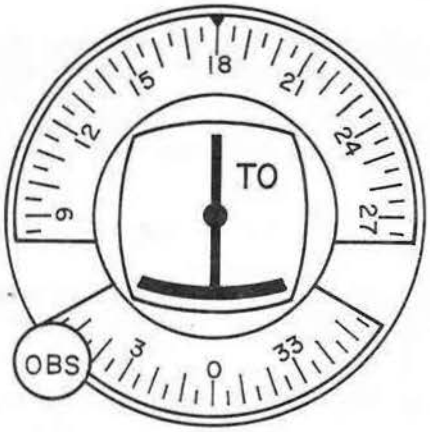
IFR PILOT EXAM-O-GRAM* NO. 22

VOR RECEIVER ACCURACY CHECK

VOT CHECK ±4° TOLERANCE



0° FROM



180° TO

In actual operations, Air Traffic Control has reported instances where IFR aircraft have been several miles from the center line of the airway. In some of these cases, it is suspected that this course error was due to the inaccuracy of the aircraft's VOR receivers. Results from the Instrument Pilot Written Tests indicate that many pilots need to review the correct procedures for checking their VOR receivers.

FAA regulations state that no person may operate a civil aircraft under IFR using the VOR system of radio navigation unless the VOR equipment in that aircraft--

(1) is maintained, checked, and inspected under an approved procedure; or

(2) has been operationally checked within the preceding 10 hours of flight time and within 10 days before flight, and was found to be within the limits of the permissible indicated bearing error set forth.... (FAR 91.25b and c).

* * * * *

Assume that your aircraft is not maintained, checked, and inspected under an approved procedure. You last checked your VOR receiver 11 days ago and, during the ensuing period, your aircraft has flown 6 hours. In this case,

(1) can you legally takeoff on an IFR flight before checking your VOR system?

(2) can you takeoff on an IFR flight when the weather is VFR if you check your receiver by a ground point after becoming airborne?

The answer to both of these questions is NO. You must comply with both aspects of the rule. The check must have been made within the preceding 10 hours of flight time, and also the check must have been made within the preceding 10 days.

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WHAT IS A VOT AND WHAT PROCEDURE SHOULD BE USED TO CHECK YOUR RECEIVER BY USE OF THE VOT OR A RADIATED TEST SIGNAL FROM AN APPROPRIATELY RATED REPAIR STATION?

The VHF Omnitest Equipment (VOT) is a complete facility for transmitting and monitoring a standard test signal used for checking VOR receivers. The VOT can be described as a low powered VOR facility which transmits omnidirectionally a zero (0) degree VOR course. When you tune in the VOT, you should get the same indications as you would for any VOR if you were on the 0 radial: If you set the Omnibearing Selector (OBS) to 0, then your receiver should indicate "From" on the "To-From" indicator, and the Course Deviation Indicator (CDI) should be centered. If you set the OBS to 180, then the "To-From" indicator should indicate "To" and the CDI should be centered.

The recommended procedure for using the VOT to check a VOR receiver is to tune the VOR receiver *to the published frequency of the test facility*, found in the Airport/Facility Directory of AIM. Next, turn the OBS until the CDI is centered. If the "To-From" indicator is "From," the OBS must be within ±4° of 0; if the "To-From" indicator is "To," the OBS must be within ±4° of 180. If the receiver does not check within these limits, it may not be used for an IFR flight.

CAN THE VOR RECEIVER BE CHECKED BY USE OF THE VOT WHEN AIRBORNE?

VOT frequencies are not protected; therefore, when airborne you might have interference from another transmitter. For this reason, you should make your VOT check on the ground.

WHAT OTHER METHODS CAN BE USED TO CHECK YOUR VOR RECEIVER WHEN ON THE GROUND?

(1) There are approximately 275 airports that have one or more points marked on the airport where a VOR receiver check can be made. A list of these airports, giving the certified radial and the point on the airport for checking VOR receivers is found in Part 4 of the Airman's *Information Manual*. If you are at one of these airports, you can check your receiver by taxiing to the designated point on the airport, tuning the VOR receiver to the VOR facility to be used, and then setting the OBS to the certified radial. The receiver should then read "From" on the "To-From" indicator and the CDI should be centered. If the OBS has to be turned more than 4°, right or left, to center the CDI, an IFR flight shall not be attempted without first correcting the source of the error in the VOR system.

(2) If you have dual system VOR (units independent of each other except for the antenna) and are able to obtain an adequate signal from a VOR facility, then you may check one receiver against the other. The maximum permissible variation between the two indicated bearings is 4°.

VOR RECEIVER CHECK POINTS

The list of VOR airborne check points and ground check points are included in this section. Use of these Check Points is explained in Part 1.

ARKANSAS

Airborne—

Blytheville (Muni Arpt): 004°; 5.8 mi. over hangar adj to Admin Bldg; 1300'.

Fayetteville (Drake Fld): 182°; 14.3 mi. white circle on arpt: 2500'.

Flippin: 051°; 5.0 mi. dual water twr at Mountain Home: 1000'.

Fort Smith (Muni Arpt): 233°; 5.2 NM, water tank at N edge of arpt; 1500'.

Monticello: 305°; 5.7 mi over white water twr; 1500'.

Texarkana (Muni/Webb Fld): 122°: 5.1 mi, over int rnwys 13-31 and 4-22; 1400'.

Ground—

El Dorado (Goodwin Fld): 228°; 3.8 NM, parking ramp at center twy.

Harrison (Boone Co. Arpt): 131°; 4.2 NM at int of N/S and E/W twys *in front of trml bldg.*

Little Rock (Adams Fld): 315°; 4.5 mi, on taxi strip adj to junction rnwy 14.

Jonesboro (Muni Arpt): 226°; 3.9 NM NE corner of terminal ramp.

Pine Bluff (Grider Fld): 180°; 4 mi int of ctr twy and N/S rnwy.

Walnut Ridge (Muni Arpt): 051°; 1.7 mi, taxi strip at parking ramp adj to tetrahedron.

WHAT PROCEDURE SHOULD BE USED TO CHECK YOUR VOR RECEIVER WHILE AIRBORNE?

NOTE: This check should be made on a VFR flight.

Suggested steps:

1. Check AIM (Part 4) for a checkpoint on the ground, the certified radial to use, and the minimum altitude to fly (if given).
2. Tune the VOR receiver to the proper facility.
3. Set the OBS to the certified radial.
4. Fly directly over the ground checkpoint.

When directly over the ground checkpoint, the CDI should be centered; if not, turn the OBS until the CDI is centered. If the indicated course with the CDI centered is more than ±6° from the certified radial, then the receiver is not performing satisfactorily and must be corrected before an IFR flight. Notice that a ±6° error is allowed for this airborne check while an error of only ±4° is allowed for the ground check. This additional error is allowed due to the difficulty of positioning your aircraft directly over the ground point.

NOTE: If no check signal or point is available while in flight--

1. Select a VOR radial that lies along the centerline of an established VOR airway;
2. Select a prominent ground point along the selected radial preferably more than 20 miles from the VOR ground facility and maneuver the aircraft directly over the point at a reasonably low altitude; and
3. Note the VOR bearing indicated by the receiver when over the ground point (the maximum permissible variation between the published radial and the indicated bearing is 6°).

WHAT PROCEDURE SHOULD BE FOLLOWED BY THE PILOT AFTER MAKING A VOR EQUIPMENT CHECK?

FAR 91.25d states: "Each person making the VOR operational check as specified...shall enter the date, place, bearing error, and his signature in the aircraft log or other permanent record."

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IFR PILOT EXAM-O-GRAM® NO. 23

Fundamental ADF Procedures

A review of errors being made on Instrument Pilot Written Tests reveals that many applicants are hazy about basic ADF procedures. Proficiency in Automatic Direction Finder (ADF) procedures is essential to the instrument pilot. A poor understanding of this important navigational tool can lead to critical errors under instrument conditions. An instrument pilot should be able to establish a track to a Radio Beacon (RBn) or to a Locator Outer Marker (LOM) by the use of ADF. During off-airways flying, beyond the range of VORs, the only electronic navigational aids available may be low or medium frequency homers. In an emergency the pilot may even have to use a commercial broadcast station. On flights beyond the borders of the United States, he frequently finds that ADF is still the primary radio aid to navigation. This Exam-O-Gram will cover fundamental ADF definitions and procedures. Refer to VFR Exam-O-Gram No. 39 for the use of ADF for VFR navigation.

ADF and VOR -- Before starting a discussion of ADF, a distinction should be made between the indications of the ADF and the VOR receivers. The ADF needle points to the station regardless of aircraft heading and position (Fig. 1). The VOR receiver, with the CDI centered, indicates the magnetic bearing from the aircraft to the station (Fig. 2 "315 TO"), or from the station to the aircraft (Fig. 2 "270 FROM"), regardless of aircraft heading. This Exam-O-Gram will cover ADF only.

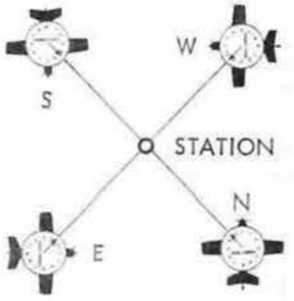

Fig. 1

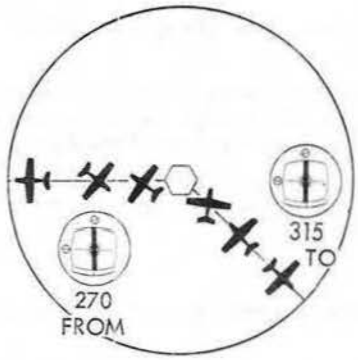

Fig. 2

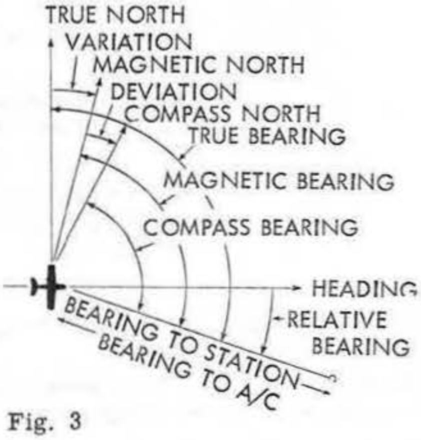

Fig. 3

WHAT IS A BEARING? -- This is the relation (direction) of one object or point to another object or point. As applied to ADF, it is simply the direction of a line from the aircraft to the station or from the station to the aircraft (Fig. 3).

HOW DO YOU FIND AN ADF RELATIVE BEARING? -- The relative bearing of the aircraft to the station is the angular relationship between the aircraft heading and the station, measured clockwise from the nose of the aircraft (Fig. 3). This bearing is read directly on the ADF dial, measured clockwise from zero.

Note: We shall consider only the fixed azimuth dial which is typical of most light plane installations.

HOW DO YOU FIND A MAGNETIC BEARING? -- A magnetic bearing is the direction of an imaginary line from the aircraft to the station or from the station to the aircraft, referenced to magnetic north. To determine the magnetic bearing to the station, add the magnetic heading of the aircraft to the relative bearing shown on the ADF dial (Fig. 3). If the sum is more than 360°, subtract 360. The reciprocal of this bearing is the magnetic bearing from the station to the aircraft. Any time the magnetic heading is "North," the ADF needle indicates the magnetic bearing to the station (Fig. 1 "N"). Any time the magnetic heading is "South," the ADF needle indicates the magnetic bearing from the station (Fig. 1 "S").

HOW DO YOU FIND TRUE OR COMPASS BEARINGS? -- Use the same procedure that has been described for finding magnetic bearings, substituting true heading or compass heading for magnetic heading. A compass bearing may be changed to a magnetic bearing by applying deviation. A

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magnetic bearing may be changed to a true bearing by applying variation (Fig. 3).

WHAT IS ADF HOMING? -- ADF homing is flying the aircraft on any heading required to keep the ADF needle on zero until the station is reached. Refer to VFR Exam-O-Gram No. 39.

WHAT IS ADF TRACKING? -- This is the ADF procedure of flying a straight geographical flight path inbound to or outbound from a low or medium frequency facility. A heading is established that will maintain the desired track regardless of wind drift.

HOW DO YOU TRACK INBOUND? -- (Fig. 4) Turn the aircraft until it is pointed directly toward the station with an ADF relative bearing of zero. While holding a constant heading, any deflection of the ADF needle indicates a crosswind. If the needle deflects right, the crosswind is from the right and vice versa. The needle indicates the direction of the turn required to intercept the track. The turn should be made when there is a definite needle deflection of 2 to 5 degrees. The angle of interception will depend on the rate at which the aircraft drifted from the track, the distance from the station and how quickly you wish to return to track. In the illustration a 20° correction is applied when a 5° drift is noted.

Position #1 -- Turn the aircraft until the ADF needle indicates zero.

Position #2 -- Maintain a constant heading until an off-course drift is indicated by a 5° needle deflection.

Position #3 -- Turn 20° in the direction of the needle deflection. Now the needle indicates a relative bearing on the opposite side of zero. As you approach track, the needle continues to move further away from zero.

Position #4 -- When the needle deflection equals the angle of interception, the aircraft is back on the desired track. In actual practice you should lead the turn to the inbound heading before the track is intercepted. The amount of lead will depend on distance from the station, rate at which track is approached, and rate of turn.

Position #5 -- The aircraft is turned to a heading which you estimate will compensate for wind drift. In the illustration, a 10° left correction for right drift has been applied. The ADF needle indicates a relative bearing of 10°. As long as the relative bearing remains constant, the aircraft is on track. If the wind is under-estimated and an off-course drift is indicated by a decrease in the relative bearing, turn to the original interception heading. When the track has been re-intercepted, turn to a heading which will include a larger drift correction, for example, 15°. If the original drift correction of 10° is an over-estimate, the ADF needle will show a gradual increase in relative bearing. To return to track, parallel it and let the wind drift you back. When the ADF needle is on zero, turn into the wind with a reduced drift correction angle, for example, 5°.

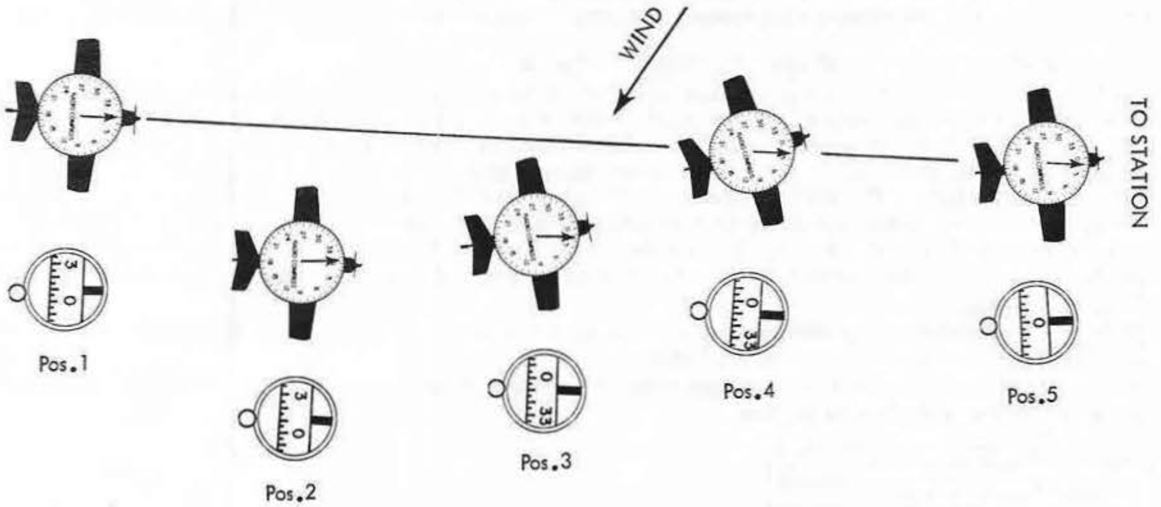

Fig. 4

HOW DO YOU TRACK OUTBOUND? -- (Fig. 5) The procedures are basically the same as for inbound tracking. The main difference is that the ADF needle moves further away from the 180° position as the change of heading is made toward the desired track.

Position #1 -- Turn the aircraft until the ADF needle is on the 180° position. The station is now directly behind.

Position #2 -- Maintain this heading until the needle deflects away from the 180° position. If the needle (pointer end) is deflected to the right of 180 (counter-clockwise), the crosswind is from the right and if the needle is deflected to the left of 180 (clockwise), the crosswind is from the left. In the illustration, a 5° left deflection is shown, indicating a left crosswind.

Position #3 -- Turn 20° in the direction of the needle deflection. After this turn has been made, notice the needle has moved further away from the 180° position in the same direction as the original deflection. As you approach the desired track, the needle moves back toward the 180° position.

Position #4 -- When the needle deflection equals the angle of interception, the aircraft is back on track. Lead the turn to the outbound heading using the same technique that was described earlier.

Position #5 -- The aircraft is turned to a heading which you estimate will compensate for wind drift. Minor corrections are made following the same technique that was described under inbound tracking.

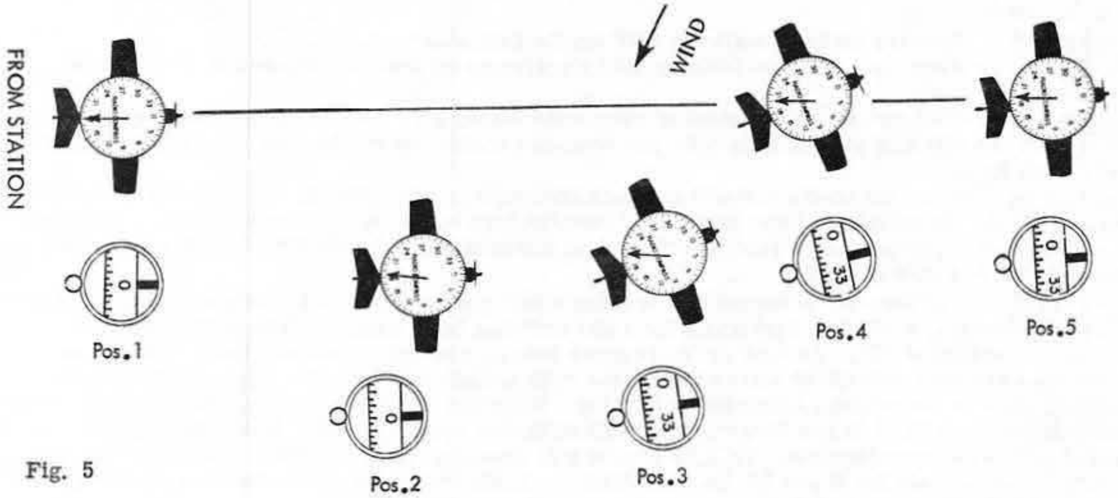

Fig. 5

HOW DO YOU INTERCEPT PRE-DETERMINED BEARINGS? -- You may be cleared to track inbound to or outbound from a radio fix on a definite magnetic bearing. The procedure for intercepting a desired bearing is the same as for simple tracking except the angle of interception is usually greater.

INTERCEPTION OF AN INBOUND BEARING -- (Fig. 6)

Position #1 -- Determine your position in relation to the station by turning the aircraft to the heading of the bearing to be intercepted. If the ADF needle is to the right of zero, the station is to your right and vice versa. Note the number of degrees the needle is deflected right or left from zero, then double this needle deflection. This is the interception angle. Since it is not feasible to intercept a bearing at more than a 90° angle, limit the angle of interception to 90°. An interception can be made at angles less than those calculated by this method, however, doubling the angle of needle deflection will normally result in an interception of a desired bearing at a comfortable distance from the station.

Position #2 -- Turn the aircraft toward the desired bearing the number of degrees determined for the interception angle.

Position #3 -- Maintain the interception heading until the ADF needle is deflected the same number of degrees from zero as the interception angle.

Position #4 -- Turn inbound and continue normal tracking procedures. Lead the turn using the same technique that was described earlier.

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INTERCEPTION OF AN OUTBOUND BEARING -- (Fig. 7)

Use the same procedures as for the inbound interception, substituting the 180° position for the zero position of the ADF needle. After you complete the intercepting turn, the ADF needle will move further away from the 180° position as was the case in intercepting an outbound track. Hold the heading until the angular deflection of the ADF needle from the 180° position is equal to the angle of interception. Now turn outbound and continue tracking procedures.

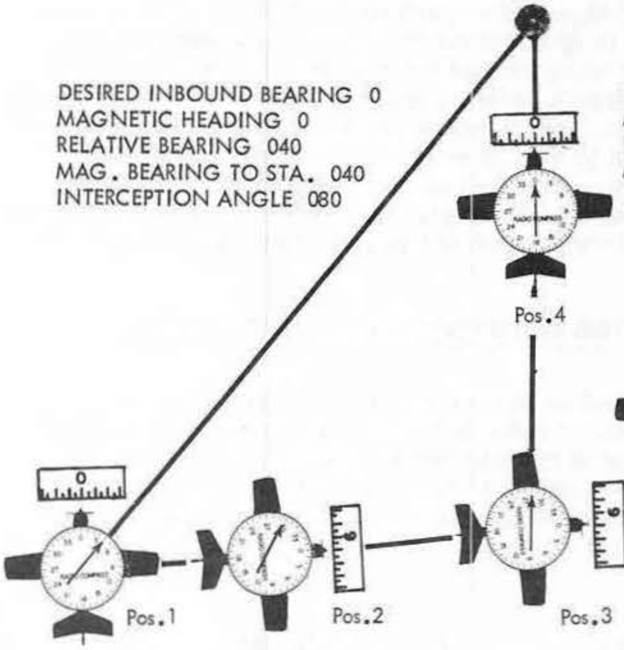

Fig. 6

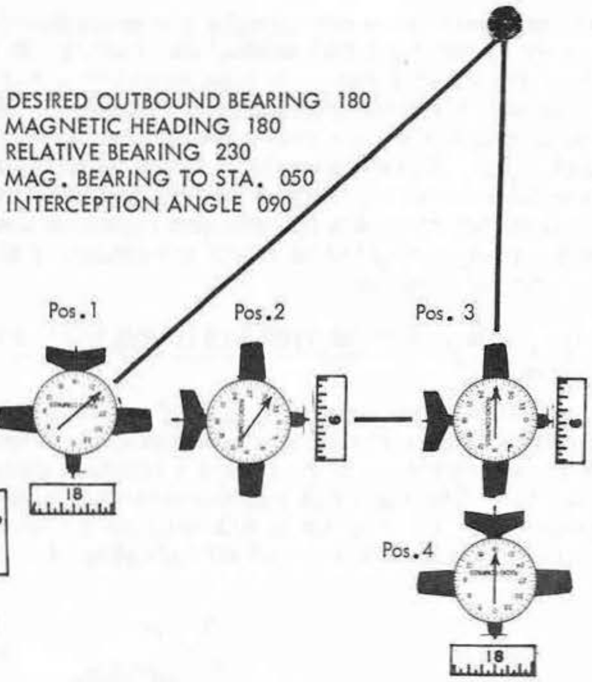

Fig. 7

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IFR PILOT EXAM-O-GRAM* NO. 24

THE ATTITUDE INDICATOR

An instrument pilot should have a working knowledge of the operating principles, limits, and errors of the flight instruments he is using. It is apparent from written test responses and interviews with instrument pilot examiners that many student instrument pilots are lacking in knowledge concerning the attitude indicator. Attitude indicators are either vacuum-driven or electric motor driven instruments. The principles of operation are basically the same for both types. Since the vacuum-driven instrument is still in more common use among light general aviation aircraft, it will be described in more detail in this Exam-O-Gram. The attitude indicator is a reliable and ingenious instrument. It provides an immediate, direct and corresponding indication of any change of aircraft pitch and bank attitude in relation to the natural horizon.

THE OPERATION OF THE ATTITUDE INDICATOR DEPENDS ON WHAT GYROSCOPIC PRINCIPLE?

The principle is "rigidity in space" which is based on Newton's first and second laws of motion. A universally mounted gyroscope (wheel or rotor mounted in three gimbals) turning at high speed tends to remain in a constant plane of rotation regardless of the movement of its base. The rotors of both vacuum-driven and electric instruments rotate in a horizontal plane. The horizon bar is linked to the gyroscope and thus also tends to remain in a constant plane regardless of aircraft attitude (Fig. 1).

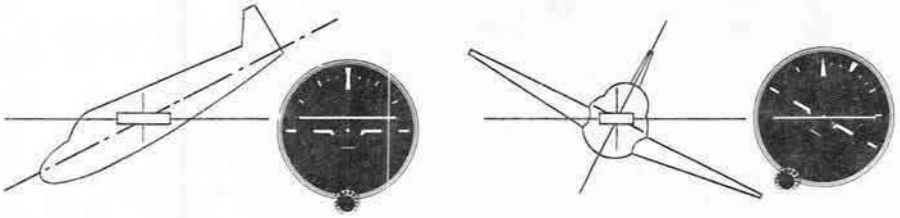
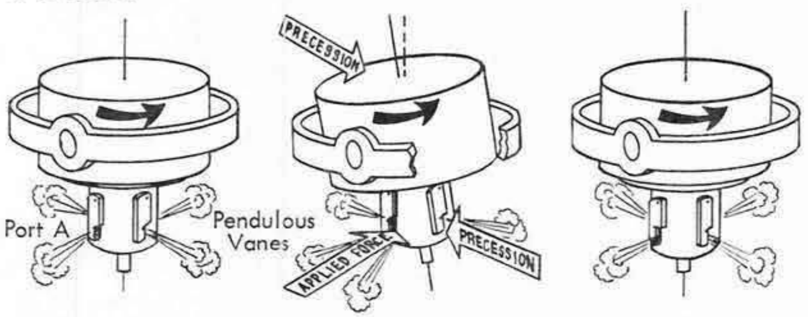


Fig. 1

WHAT IS THE EFFECT OF "PRECESSION" ON THE ATTITUDE INDICATOR?

A second principle of the gyroscope may be defined as follows: when a deflective force is applied to a rotating gyro, the resultant force will act at a point 90 degrees ahead and in the direction of rotation. Due to imperfections of the gyro mechanism and to forces applied to it, the rotor of the attitude indicator is constantly precessing from its proper plane of rotation. Without an erecting mechanism to correct for precession, the attitude indicator would be useless.

Vacuum-driven instrument -- Figure 2 is a diagrammatic view of the erecting device. Differential air flow from ports partially covered by pendulous vanes exerts a precessing force on the rotor to erect it.



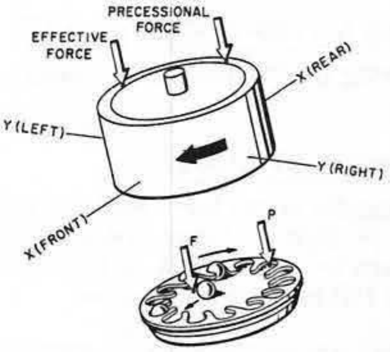
Exhaust Air Equal In All Directions Erect.

Gyro Precesses Increasing Exhaust From Port A.

Precessing Force At Port A Erects Gyro Exhaust Air Again Equal At All Ports.

Fig. 2

Electric instrument -- The erection system of a representative type is shown in Fig. 3.



POINT "F" Is The Center Of Gravity Of The Balls Where The Effective Erecting Force Is Applied.

POINT "P" Is The Precessional Force (Force "F" Rotated 90° In The Direction Of Rotation) Which Erects The Gyro.

Fig. 3

WHAT ARE THE ERRORS OF THE VACUUM-DRIVEN ATTITUDE INDICATOR?

Certain errors are always present in an attitude indicator due to the characteristics of the gyroscope and its erecting mechanism. Other errors may be caused by low suction, dirt, unbalance and worn bearings.

1. Skid error -- A skidding turn moves the pendulous vanes out of their vertical position precessing the gyro toward the inside of the turn. After return to straight-and-level flight, the miniature aircraft shows a bank in the direction opposite the skid. The maximum error is 3 to 4 degrees. When the skidding stops, the erecting mechanism soon returns the rotor to its normal plane of rotation.
2. Turn error -- During a normal coordinated turn, movement of the pendulous vanes by centrifugal force causes the gyro to precess toward the inside of the turn. The error is greatest in a steep turn. After rolling-out at the end of a 180 degree turn, the miniature aircraft shows a slight climb and a banked attitude opposite the direction of the turn. This precession error is quickly corrected by the erecting mechanism. The precession induced by a second 180 degree turn cancels the error of the first.
3. Acceleration error -- When the aircraft accelerates, the pendulous vanes of the erecting mechanism are moved out of position resulting in a precession of the gyro. The horizon bar moves down and the instrument indicates a climb.
4. Deceleration error -- Deceleration causes the erecting mechanism to react in such a manner that the horizon bar moves up, indicating a descent.
5. Haphazard error -- This error is caused by a defective erecting mechanism or low suction. There is a loss of rotor rigidity and the reaction of the instrument is unpredictable.

WHAT ARE THE ERRORS OF THE ELECTRIC ATTITUDE INDICATOR?

In normal turns, centrifugal force may cause precession errors up to 5 degrees of pitch and bank upon return to level flight. Acceleration and deceleration errors are also present. The horizon bar moves slightly down during acceleration and slightly up during deceleration. Upon return to cruising flight, the erecting mechanism quickly returns the gyro to its proper plane of rotation. The electric instrument is generally more efficient in operation and less subject to error than the vacuum-driven instrument.

WHAT ARE THE PITCH AND BANK LIMITS OF THE VACUUM-DRIVEN ATTITUDE INDICATOR?

The pitch limit is approximately 60 degrees and the bank limit is approximately 100 degrees. Rotation of the aircraft beyond these limits will cause the gyro to spill or tumble. Since these limits are beyond the attitude restrictions of "normal category" aircraft, the instrument should not tumble in normal instrument flight. An accurate and systematic cross-check of the other pitch and bank instruments will enable the pilot to recognize an "upset" attitude indicator.

WHAT ARE THE PITCH AND BANK LIMITS OF THE ELECTRIC ATTITUDE INDICATOR?

The limits depend on the design of the instrument. One type has approximately the same upset limits as the vacuum-driven instrument. Another type has full rotational freedom about both pitch and bank axes and therefore no upset limits.

DOES THE ATTITUDE INDICATOR TELL THE PILOT WHEN A TURN IS COORDINATED?

No, the pilot should always check his coordination by referring to the "ball" of the turn-and-slip indicator.

DOES THE ATTITUDE INDICATOR TELL THE PILOT HIS RATE OF TURN?

No, he determines his rate of turn by referring to the turn needle of the turn-and-slip indicator. Of course, he can establish a bank by the attitude indicator which should give him a desired rate to turn for a particular true airspeed. For example, if a turn is coordinated, a 15 degree bank will maintain a standard rate turn (3 degrees per second) at 100 knots true airspeed.

CAN THE ATTITUDE INDICATOR BE USED IN RECOVERING FROM UNUSUAL ATTITUDES?

Yes, if the instrument has not tumbled. During unusual attitude recoveries, the airspeed, altimeter, and turn needle should always be cross-checked closely to determine the accuracy of the indication given by the attitude indicator.

WHAT PRECAUTIONS SHOULD BE TAKEN WHEN CAGING AND UNCAGING THE ATTITUDE INDICATOR?

If the instrument has a caging knob and it becomes necessary to cage and uncage it in flight, be sure the aircraft is flying straight-and-level. The indications of the instrument depend on the position of a universally mounted gyro which if uncaged in an unlevel attitude tends to remain in an unlevel attitude due to rigidity. Several minutes may be required by the erecting mechanism to correct the rotor's plane of rotation. Be sure the instrument is fully uncaged otherwise the operational limits will be reduced and the gyro will tumble in otherwise safe maneuvers.

HOW IS THE ATTITUDE INDICATOR CHECKED FOR PROPER OPERATION PRIOR TO FLIGHT?

After starting the engine, make these checks: for a vacuum-driven instrument, the suction gage should read in the required range (usually between 3.75 and 5.0 inches of mercury, depending on the installation) -- for an electric instrument, check the generator and inverter for proper operation. Five minutes should be allowed for the rotor to attain normal operating speed. The horizon bar should stabilize in a horizontal position and should remain in the correct position for the attitude of the aircraft. The horizon bar should not tip more than 5 degrees during taxiing turns.

SUMMARY:

The attitude indicator is a reliable instrument. It is the single instrument that provides a direct indication of aircraft attitude. The small errors inherent in its design can readily be compensated for by an accurate cross-check with the other flight instruments and by having a knowledge of its operating principles and limits.

REFERENCES:

Instrument Flying Handbook, AC 61-27A
Instrument Pilot Exam-O-Gram No. 18

FAA Aeronautical Center
Flight Standards Technical Division
Operations Branch
P. O. Box 25082 12/67
Oklahoma City, Oklahoma 73125

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Department of Transportation

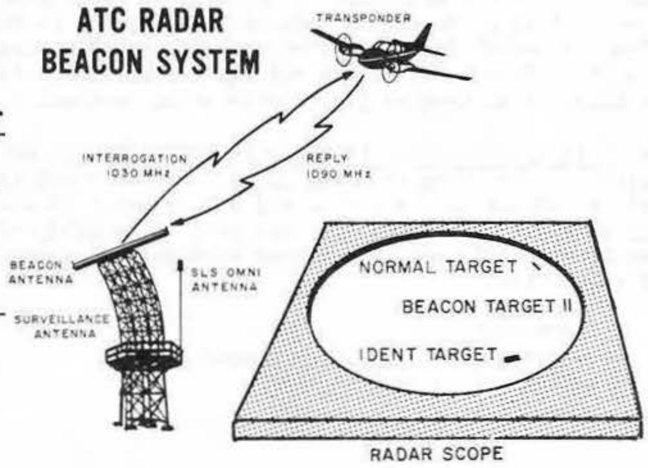
Federal Aviation Administration

IFR PILOT EXAM-O-GRAM® NO. 25

THE ATC TRANSPONDER

Written tests for the Instrument Pilot and Airline Transport Pilot ratings include questions pertaining to transponders and the operation of "Secondary" radar. Test analyses and responses to oral questions by instrument pilot examiners show that many applicants lack essential knowledge in this area. The installation of transponders in many aircraft has been a great help to ATC in safely handling the constantly increasing VFR and IFR traffic load. This Exam-O-Gram briefly explains the principles and functions of this valuable flight aid.

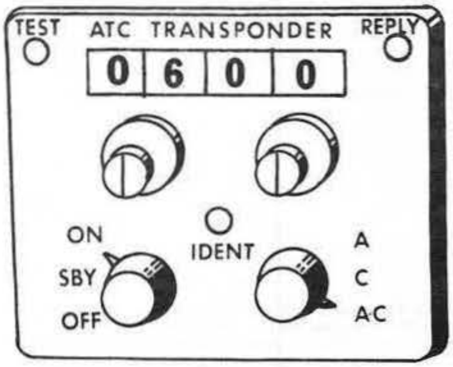
WHAT IS ATCRBS? This is an abbreviation referring to the Air Traffic Control Radar Beacon System, also known as Secondary Surveillance Radar. "Secondary" radar relies on the exchange of electronic signals between a ground radar beacon antenna (interrogator) and an aircraft transponder. A "Primary" radar system depends on "skin paint" or echo return from the aircraft structure, on a radar scope for identification. Secondary radar has these advantages: it reinforces the radar target, allows rapid target identification, and extends the radar coverage area. Secondary radar is usually slaved with the primary surveillance radars, a common pedestal supporting both antennae.



HOW DOES A TRANSPONDER WORK? The ground equipment transmits an ultra high frequency pulsed signal on 1030 MHz to the aircraft transponder which receives the signal, interprets it and replies by transmitting a coded signal on 1090 MHz to the ground receiver. This unit, in turn, decodes the signal and causes it to appear on the radar scope in a distinct pattern, normally two short parallel lines. The interrogator transmits only on 1030 MHz and the transponder replies only on 1090 MHz. Mode and code changes are made by varying the time interval between pulsed signals, not by frequency change. The transponder operates on "line of sight," therefore, range can be increased by climbing to a higher altitude. Another factor bearing on transponder operation is the attitude of the aircraft. In a bank, part of the aircraft structure may block signals from the interrogator.

WHAT BASIC "MODES" ARE AVAILABLE? Presently, there are six. Modes 1 and 2 are used exclusively by the military services. Mode A in the civil system is the same as military Mode 3 and is used exclusively for air traffic control. It is commonly designated Mode A/3. Modes B and D are still unassigned. Mode C is used for automatic altitude reporting in the NAS Stage A (enroute) and the ARTS III (terminal) systems. The radar scope displays for NAS Stage A and ARTS III are, of course, much more complex than the diagram shown above.

WHAT "CODES" ARE UTILIZED IN MODE A/3? The first Mode A/3 system utilized 64 codes, however, equipment utilizing 4096 codes is being rapidly phased into the system. As there are no 8's or 9's used, the numerical value of the codes range from 0000 to 7777 (from 00 to 77 in the 64 code system). Pilots of civil aircraft should never operate a transponder on code 0000. This is reserved for North American Air Defense (NORAD) use. When making code changes, you should avoid inadvertent selection of codes 7500, 7600, or 7700, thereby causing momentary false alarms at the automated ground facilities. These codes are designated as follows: 7500 - hijack code; 7600 - loss of communications code; 7700 - emergency or MAYDAY code. When filing an IFR flight plan, be sure to file the maximum transponder/navigation capability of your aircraft in the equipment suffix, so ATC can assign proper codes. Only codes with the last two digits as zeros will be assigned to 64 code capability aircraft, while 4096 code capability aircraft may be assigned discrete four digit codes; e.g., 0123. If your aircraft has only 64 code capability and ATC assigns you such a code, you should advise them of your transponder limitations and request an appropriate code.



WHAT IS THE PURPOSE OF THE "IDENT" BUTTON? You will be instructed to "Ident" whenever the controller wishes to

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positively identify your aircraft. Press, then immediately release, the "Ident" button, thereby transmitting a Special Position Identification pulse (SPI). The space between the parallel lines of your target on the radar scope will then fill in, identifying you unmistakably. Transmit this signal <u>only</u> when so instructed by the controller to avoid mistaken identification with another aircraft.

<u>WHAT IS THE PURPOSE OF THE "STANDBY" FUNCTION?</u> You may be asked to "Squawk Standby" if the controller wishes to have your transponder to stop replying to interrogation. By this means the radar scope can be selectively cleared.

<u>WHAT IS THE NORMAL SEQUENCE OF STEPS IN OPERATING A TRANSPONDER?</u> At a specified point on the aircraft checklist, the transponder is turned to the "Standby" position, and the internal circuitry of the set is checked by operating the "Test" switch. On a VFR flight, unless otherwise instructed by ATC, set in code 1200 regardless of altitude. On an IFR flight, set in the code specified by ATC. If your transponder is the 64 code type, disregard the last two zeros; e.g., if the code assigned is 2100, set in code 21. Just prior to takeoff, on either a VFR or an IFR flight, switch from "Standby" to "On." When under Approach Control's jurisdiction, the controller may tell you to "Stop Squawk" or switch off the transponder. If you are not so instructed, turn the transponder off as soon as practicable after landing.

<u>WHEN IS A TRANSPONDER REQUIRED BY REGULATIONS?</u> With certain exceptions, FAR 91.24 requires an aircraft operating in Group I, II, and III Terminal Control Areas and in all controlled airspace of the 48 contiguous states and the District of Columbia above 12,500 feet MSL, excluding the airspace at or below 2,500 feet AGL, to be equipped with a transponder having a Mode A/3 4096 code capability and be equipped with automatic pressure altitude reporting equipment having Mode C capability.

REFERENCES:
Airman's Information Manual, Part I
FAR, Part 91

Federal Aviation Administration
Flight Standards National Field Office
Examinations Branch
P.O. Box 25082
Oklahoma City, Oklahoma 73125
1/69

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
IFR PILOT EXAM-O-GRAM® NO. 26

RUNWAY MARKING

Analyses of performance on written tests indicate that many applicants have difficulty in connection with test items concerning runway marking systems.

To ensure safety, efficiency, and standardization of aircraft operation, it is essential that both certificated pilots and applicants for pilot ratings be thoroughly familiar with runway markings. With the introduction of Category II landing minimums, the ability of the IFR pilot to rapidly and accurately interpret runway markings has also become especially important.

Although this information is presently available to you as a pilot, the following runway marking quiz is provided to emphasize the subject and test your knowledge. The correct answers are given on the following page.

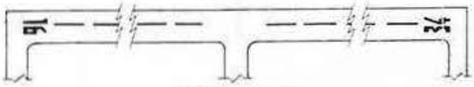

Figure 1

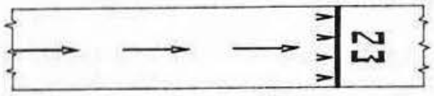

Figure 2

Figure 3

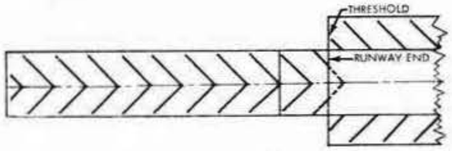

Figure 4

1. The numbers 16 and 34 on the approach ends of the runway illustrated in Figure 1 indicate that the runway is oriented approximately
   1- 160°/340° magnetic.
   2- 16°/34° true.
   3- 16°/34° magnetic.
   4- 160°/340° true.

2. Figure 2 is an illustration of a basic runway with a displaced threshold. The arrows appear in the area of the runway that
   1- is usable for taxiing, takeoff, and landing.
   2- cannot be used for landing but may be used for taxiing and takeoff.
   3- is available for landing at the pilot's discretion.
   4- may be used only for taxiing.

3. Runway 20L shown in Figure 3
   1- has Precision Instrument Runway markings.
   2- has Non-Precision Instrument Runway markings.
   3- is a runway marked to aid only air carrier jet aircraft during low visibility approaches.
   4- is 8,000 feet long with touchdown markings 500 feet apart.

4. In Figure 4, the area to the left of the threshold
   1- is an "over-run" with sufficient strength for all aircraft operations.
   2- appears usable but which, due to the nature of its structure, is unusable.
   3- is a "deceptive area" usable only for taxiing.
   4- is of sufficient strength for taxiing and takeoff but not for landing.

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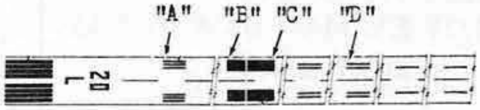
5. If you wished to land 1, 000 feet from the threshold of the runway illustrated below, you would plan to touch down at point



1- "B. "
2- "D. "
3- "C. "
4- "A. "

Answers to test items

1-1; 2-2; 3-1; 4-2; 5-1.

References:

Airman's Information Manual, Part I
Advisory Circular 150/5340-1C

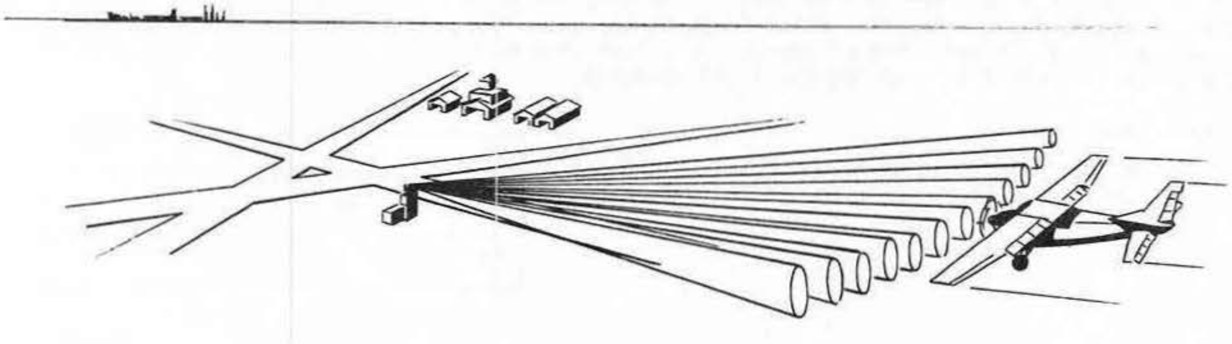
IFR – No. 26 10/71

FAA Aeronautical Center
Flight Standards Technical Division,
Operations Branch,
P. O. Box 25082
Oklahoma City, Oklahoma 73125

2/69

Department of Transportation
FEDERAL AVIATION ADMINISTRATION
IFR PILOT EXAM-O-GRAM* NO. 27

AIRPORT SURVEILLANCE RADAR (ASR) APPROACHES



A number of airports have facilities for the performance of Airport Surveillance Radar (ASR) approaches. Responses to questions in Instrument Pilot Written Tests concerning these approaches, indicate misconceptions on the part of many applicants. A clarification of some of the points in this area will be attempted in the following questions and answers.

WHAT PUBLICATIONS LIST AIRPORTS HAVING FACILITIES FOR ASR APPROACHES? The most important source of information is the first part of each Regional Instrument Approach Chart Booklet, in the pages titled CIVIL RADAR INSTRUMENT APPROACH MINIMUMS.

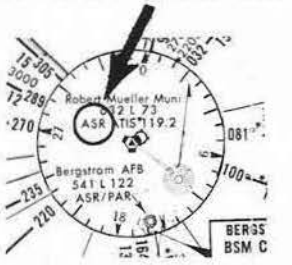
CIVIL RADAR INSTRUMENT APPROACH MINIMUMS

ROBERT MUELLER MUNI TX (Austin) Amdt. 11, APR 24, 1975

ELEV **632**			DH/	HAT/			DH/	HAT/	
	RWY	CAT	MDA-VIS	HAA	CEIL-VIS	CAT	MDA-VIS	HAA	CEIL-VIS
	12R	ABC	**1200–1**	570	(600–1)	D	**1200–1¼**	570	(600–1¼)
	30L	ABC	**920/24**	310	(300–1)	D	**920/50**	310	(300–1)
CIRCLING		AB	**1200–1**	568	(600–1)	C	**1200–1½**	568	(600–1½)
		D	**1240–2**	608	(700–2)				

▼

Airports having Airport Surveillance Radar (ASR) are also indicated on the National Ocean Survey Enroute Low Altitude Charts, Area Charts, and Instrument Approach Procedure Charts.



WHAT MINIMUM AIRBORNE RADIO EQUIPMENT IS REQUIRED FOR AN ASR APPROACH? Under normal conditions, the minimum is considered to be a functioning communications radio transmitter and receiver. However, since a radar approach is predicated entirely upon voice instructions from a ground radar controller, in an emergency, only an airborne receiver is required. Means of alerting civil and military radar facilities of an emergency are described in Part I of the Airman's Information Manual.

WHAT IS AN ASR APPROACH? An ASR approach is conducted by surveillance radar and provides navigational guidance in azimuth only. This type approach may be made to an airport or heliport having approved surveillance approach. At an airport, the pilot is furnished headings to fly to align the aircraft with the extended centerline of any runway that has been approved for an ASR approach. Guidance in elevation is not possible, but the controller will advise the pilot when to commence descent to the minimum descent altitude (MDA) or, if appropriate, to an intermediate "step-down fix" minimum crossing altitude and subsequently to the prescribed MDA. In addition, the pilot will be advised of the aircraft's position each mile from the runway,

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airport/heliport, or MAP, as appropriate. If requested by the pilot, recommended altitudes will be issued at each mile, based on the descent gradient established for the procedure, down to the last mile that is at or above the MDA. Controllers will terminate guidance and instruct the pilot to execute a missed approach unless, at the MAP, the pilot has the runway, airport/heliport in sight or, for a helicopter point-in-space approach, the prescribed visual reference with the surface is established. Missed approach and loss of communication instructions will be given by the controller prior to starting the final approach.

References:

1. Airman's Information Manual, Parts I and III
2. Instrument Flying Handbook, AC 61-27B

Federal Aviation Administration
Flight Standards National Field Office, Examinations Branch
P.O. Box 25082
Oklahoma City, Oklahoma 73125 6/69

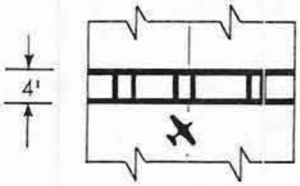
Department of Transportation
FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 28

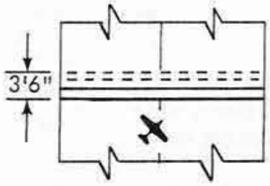
Category II Taxiway Holding Lines

With the advent of Category II operations, a new type taxiway holding line has been introduced. Since many pilots are unfamiliar with these lines, they frequently ignore them, and thereby create a safety hazard. This Exam-O-Gram describes Category II taxiway holding lines and compares them with the older conventional type holding lines.

HOW DO CATEGORY II AND CONVENTIONAL TAXIWAY HOLDING LINES DIFFER IN APPEARANCE? A diagram of each type holding line with its width dimension is shown below. Both types are painted yellow.

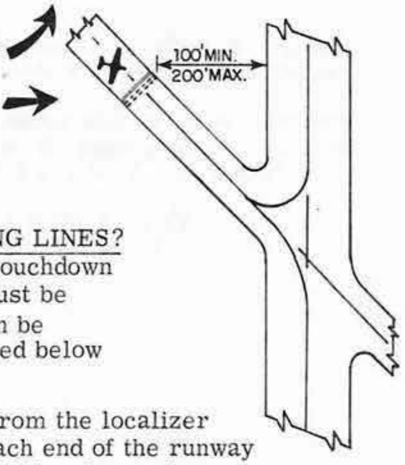


CATEGORY II



CONVENTIONAL

HOW FAR IS A CONVENTIONAL TAXIWAY HOLDING LINE FROM A RUNWAY? This type holding line is placed not less than 100 feet and not more than 200 feet from the nearest edge of the runway which the taxiway intersects. The distance is increased from the minimum 100 feet, as necessary, to provide adequate clearance between larger aircraft operating on the runway and the holding aircraft.



WHAT DETERMINES THE PLACEMENT OF CATEGORY II HOLDING LINES? To prevent interference with ILS guidance signals, and to keep the touchdown area clear during Category II approaches, three "critical areas" must be protected. Category II holding lines are placed so this objective can be accomplished. The critical areas and their dimensions are described below and shown in the illustration on page 2.

(1) Localizer Critical Area - is a rectangular area extending from the localizer transmitting antenna 1000 feet in the direction of the approach end of the runway and 200 feet on either side of the runway centerline. An additional area is described as a circular area with a radius of 250 feet from the center of the localizer and connecting to the parallel lines on either side of the runway.

(2) Glide Slope Critical Area - is a rectangular area extending from the glide slope transmitting antenna to:
  (a) 1000 feet in the direction of the approach end of the runway, or to the end of the runway, whichever is greater.
  (b) "0" feet in the opposite direction.
  (c) the near edge of the runway which the ILS serves.
  (d) 175 feet in the direction away from the runway.

(3) Obstacle Critical Area - is a rectangular area longitudinally centered on the runway centerline, extending from a point 200 feet outward from the Category II landing threshold (normal or displaced) and extending 3200 feet in the direction of landing, and having a total width of 800 feet (for exception, see Note 1 on page 2).

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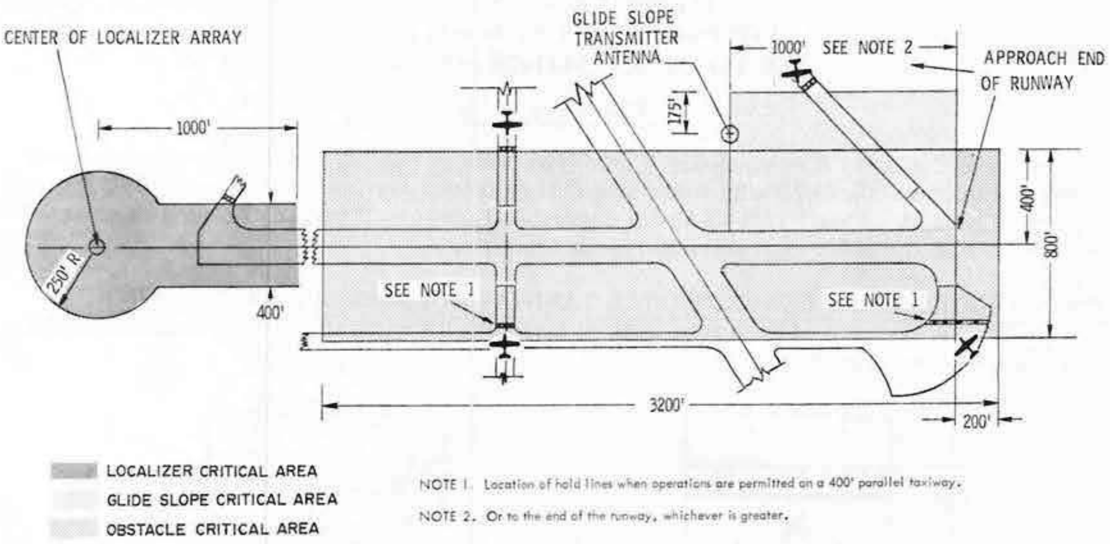

NOTE 1. Location of hold lines when operations are permitted on a 400' parallel taxiway.

NOTE 2. Or to the end of the runway, whichever is greater.

CATEGORY II CRITICAL AREAS AND TAXIWAY HOLDING LINES

Category II holding lines are used only when Category II operations are in progress. Otherwise, conventional holding lines should be used.

For more complete information, see the Advisory Circulars listed below. These publications may be obtained free of charge from the Department of Transportation, Federal Aviation Administration, Distribution Unit, TAD-484.3, Washington, D. C. 20590.

Advisory Circular AC 150/5340-1B
Advisory Circular AC 120-20, CHG 1 & 2

FAA Aeronautical Center
Flight Standards Technical Division, Operations Branch
P. O. Box 25082
Oklahoma City, Oklahoma 73125 (7/69)

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Department of Transportation

FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM® NO. 29

WHEN AN ALTERNATE AIRPORT IS NOT REQUIRED

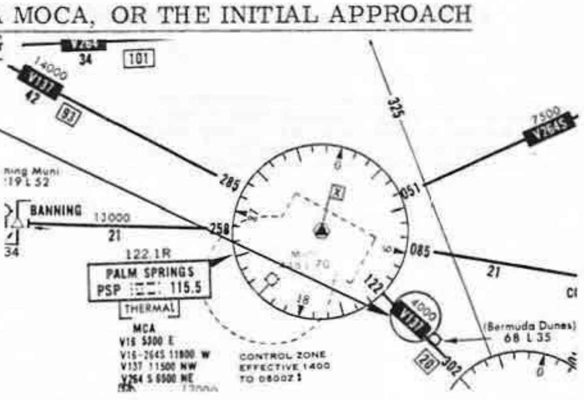
The instrument pilot must understand the rules pertaining to alternate airports set forth in FAR 91. Responses to questions in recent Instrument Written Tests concerning alternate airports indicate that many applicants are confused in this area. This Exam-O-Gram will attempt to clarify some of the points which have been giving applicants difficulty.

FAR 91.83 states that an alternate need not be listed under these conditions: the airport of first intended landing has a standard instrument approach procedure and the weather conditions for that airport are forecast to be, from two hours before to two hours after the estimated time of arrival, a ceiling of at least 1,000 feet above the lowest MEA, MOCA, or altitude prescribed for the initial approach segment of the instrument approach procedure for the airport and visibility at least three miles, or two miles more than the lowest authorized landing minimum visibility, whichever is greater

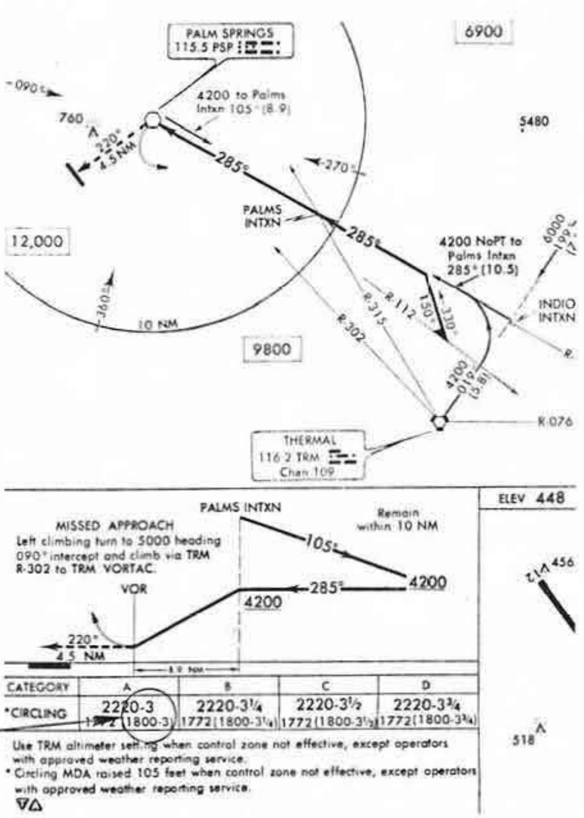
APPLYING FAR 91.83, SHOULD YOU USE A MEA, A MOCA, OR THE INITIAL APPROACH ALTITUDE TO DETERMINE THE MINIMUM CEILING AT PALM SPRINGS? The MEA of 4,000 feet on V-137 is used. In this case, the MEA is lower than the Initial Approach Altitude (4,200 feet).

HOW CAN THE INITIAL APPROACH SEGMENT ALTITUDE BE DETERMINED? In the initial approach, the aircraft has departed the enroute phase of flight and is maneuvering to enter the intermediate or final segment of the instrument approach. The procedure turn altitude, shown in the approach charts' profile views, is always an initial approach segment altitude. If no procedure turn is shown, inspect the charts' plan views. Transition, initial, and intermediate segments with their associated minimum altitudes are all found in the plan views. Transition and initial segment altitudes may be considered in applying FAR 91.83. Segments with the term "NoPT" cannot be used as an initial approach altitude since these may be intermediate segments.

IF THE FORECAST CEILING IS 4,800 FEET AND THE VISIBILITY IS 4 MILES FOR YOUR ETA AT PALM SPRINGS, IS AN ALTERNATE REQUIRED FOR CATEGORY "A" AIRCRAFT? Yes. Although the ceiling meets the requirements of FAR 91.83, the visibility does not. To determine the minimum ceiling required, proceed as follows: (1) Inspect the appropriate enroute and instrument approach charts for the destination airport, noting the altitudes given for the MEA, MOCA, and Initial Approach; (2) Select the lowest of these altitudes and add 1,000 feet; (3) Subtract the elevation of the airport and round-off to the next highest 100 foot figure. In the case of Palm Springs, this is 4,000 feet (lowest MEA), plus 1,000 feet, minus 448 feet (field elevation), or 4,552 feet. Since the forecast ceiling is given to the nearest 100 feet above the surface, a ceiling of at least 4,600 feet, forecast for two hours before to two hours after your ETA, is required. A ceiling of 4,500 feet could not be used since it would not be 1,000 feet above the MEA. The forecast visibility must be at least 5 miles. This is two miles more than the lowest visibility (3 miles) shown in the minimums section of the approach chart.



EXCERPT FROM ENROUTE CHART



CATEGORY	A	B	C	D
*CIRCLING	2220-3 1772 (1800-3)	2220-3¼ 1772 (1800-3¼)	2220-3½ 1772 (1800-3½)	2220-3¾ 1772 (1800-3¾)

Use TRM altimeter setting when control zone not effective, except operators with approved weather reporting service.

* Circling MDA raised 105 feet when control zone not effective, except operators with approved weather reporting service.

▽△

EXCERPT FROM APPROACH CHART

BELOW IS THE TERMINAL FORECAST VALID FROM TWO HOURS BEFORE UNTIL TWO HOURS AFTER YOUR ETA (21Z) AT PALM SPRINGS.

```
FT1
17Z FRI-05Z SAT
PSP 15⦶C50⊕5RW-F.  20Z 20⦶C50⦶5RW-.  22Z C40⊕5RW-
```

IS AN ALTERNATE AIRPORT REQUIRED ON YOUR FLIGHT PLAN? Yes. The visibility meets the 5 mile requirement for Palm Springs but the ceiling does not. At your ETA (21Z), the ceiling forecast is adequate (5,000 feet), but one hour after your ETA the ceiling forecast is 4,000 feet. This is lower than the required minimum (4,600 feet); therefore, an alternate is required.

References:

1. Federal Aviation Regulation 91.83
2. Civil Use of U.S. Government Instrument Procedure Charts, AC 90-1A.

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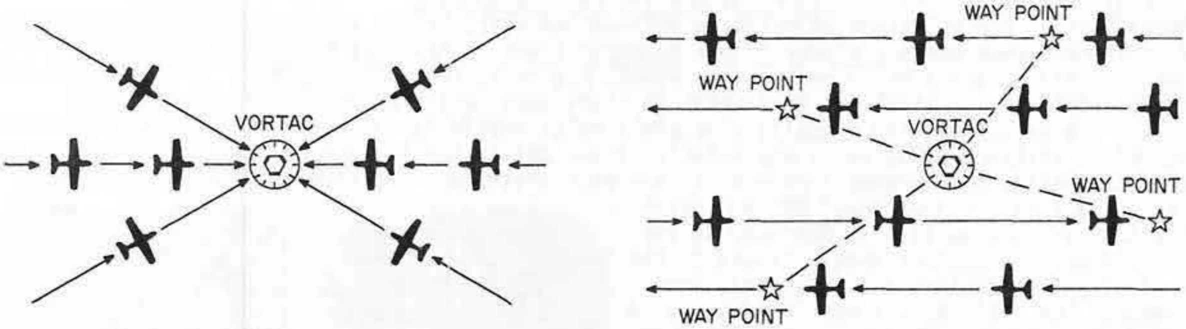
DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

IFR PILOT EXAM-O-GRAM® NO. 30

VORTAC AREA NAVIGATION

The purpose of this Exam-O-Gram is to acquaint pilots with Area Navigation. The concept of Area Navigation is not completely new. Pilots who use VOR/DME to establish checkpoints along a course line plotted directly from departure point to destination, are practicing Area Navigation. At present, however, most aircraft using VORTAC facilities fly straight courses from one station to another. The resulting convergence or "funneling" of traffic over the station limits the number of routes between points. The illustrations below compare the present system and Area Navigation.



PRESENT SYSTEM BASED ON VOR RADIALS

FIGURE 1

AREA NAVIGATION

WHAT IS AREA NAVIGATION? This is a system of navigation which allows a pilot to fly a selected course to a predetermined point without the need to overfly ground-based navigation facilities.

WHAT ARE SOME AREA NAVIGATION SYSTEMS? Doppler radar, inertial navigation systems, and course line computers are all classified as Area Navigation Systems.

WHICH AREA NAVIGATION SYSTEM WILL MOST GENERAL AVIATION PILOTS ENCOUNTER? The system coming into most common use, is the course line computer based on azimuth and distance information generated by the present VORTAC system.

WHAT IS A BASIC ADVANTAGE OF "COURSE LINE COMPUTER" AREA NAVIGATION? This system is based on a ground navigation system (VORTAC) already in place--a system that can be used for VORTAC radial navigation by aircraft having conventional Omni and DME equipment, and for Area Navigation, by aircraft having airborne course line computers.

CAN AIRCRAFT WITH ONLY CONVENTIONAL OMNI EQUIPMENT FLY FAA APPROVED AREA NAVIGATION ROUTES? No. An aircraft must have airborne Area Navigation equipment installed. A typical airborne system consists of a waypoint selector, a guidance display, and a vector analog computer. The computer is the heart of the system.

HOW DOES THE COMPUTER SOLVE A COURSE LINE PROBLEM? Area Navigation, based on the course line computer, is also called the "Rho-Theta" system. Rho (distance) is derived from the distance measuring feature of the VORTAC, and Theta (bearing) information is derived from the azimuth feature of the VORTAC. As shown in Figure 2, the value of side (A) is the measured DME distance to the VORTAC. Side (B), the distance from the VORTAC to the waypoint, and angle (1), the bearing from the VORTAC to the waypoint, are set in the cockpit control. The bearing from the VORTAC to the aircraft, angle (2), is measured by the VOR receiver. The airborne computer compares angles (1) and (2) and determines angle (3). With the above information, the computer, by means of simple trigonometric functions, continuously solves for side (C), which is the distance in nautical miles and magnetic course from the aircraft to the waypoint. This is presented as guidance information on the cockpit display.

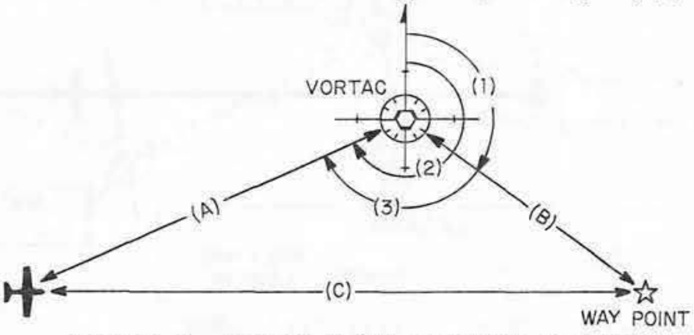


FIGURE 2. COURSE LINE COMPUTER GEOMETRY

WHAT IS A WAYPOINT? Advisory Circular 90-45, which sets forth the guidelines for the implementation of Area Navigation, defines a waypoint as... "a predetermined geographical position used for route-definition and/or progress-reporting purposes that is defined relative to a VORTAC station position." Waypoints are also defined by latitude and longitude coordinates for the use of airborne self-contained systems not dependent on VORTAC inputs. With his course line computer, the pilot effectively moves or off-sets the VORTAC to a desired location. He creates a "phantom station" by setting the distance (Rho) and the bearing (Theta) of the waypoint from a convenient VORTAC, in the appropriate windows of the "waypoint selector" or "off-set control" (Figure 3).

FIGURE 3

HOW IS COURSE LINE INFORMATION PRESENTED TO THE PILOT? Although cockpit presentations of guidance information vary, in all displays, the displacement of a vertical reference means distance from a selected track in nautical miles and not angular displacement. The guidance instrument of one model, Figure 4, features a symbolic aircraft and cross pointers. Both the vertical and horizontal pointers move rectilinearly, their intersection depicting the waypoint. The symbolic aircraft's relationship to the vertical pointer indicates across-track distance relative to the selected track set in the instrument and its position relative to the horizontal pointer indicates along-track distance. The direct distance to the waypoint is shown on a conventional DME indicator. A selector can be used to give distance to the master VORTAC. In another model, Figure 5, the cockpit display resembles a conventional omni indicator. The familiar CDI needle serves as a course line computer indicator in the CLC Mode. A lateral deflection of the needle indicates nautical miles right or left of the selected course. Each dot on the horizontal scale may have any value, such as .5, 1, 2, or 10 nautical miles. A DME indicator gives distance to the waypoint.

FIGURE 4

FIGURE 5

HOW MAY WAYPOINTS BE ESTABLISHED FOR VFR FLIGHT? Most general aviation aircraft flying cross-country are following the low altitude Victor Airways. This results in traffic congestion on the airways, particularly in the vicinity of the VORTACs near metropolitan areas. A great portion of the available airspace is virtually unused. With Area Navigation equipment, the VFR pilot can fly direct from departure point to destination with the same convenient electronic guidance he has on an airway. Where he establishes his waypoints depends on VORTAC location relative to his course, VORTAC signal coverage, and flight altitude (due to line-of-sight limits of VHF signal travel). Area Navigation courses can be plotted on WAC, Sectional, or Enroute Low Altitude Charts, taking prohibited areas and controlled airspace into consideration. A pilot flying VFR from Galesburg, Ill., to Lincoln, Nebr., (Figure 6), could establish his first waypoint on the 360° radial of the Burlington VORTAC at a distance of 14 nautical miles. As the flight progresses, subsequent waypoints could be set up from Ottumwa, Lamoni, Omaha, and Lincoln VORTACs by setting frequencies into the VOR receiver and programing radials and distances into the computer. Although the waypoints shown in Figure 6 are on either the 360° or 180° radials, they could be on any radial that intersects the selected track, providing distance limits are not exceeded. On this flight, the Area Navigation course is 24 nautical miles shorter than the Omni course. Remember, the above procedure of selecting waypoints applies to VFR flight only.

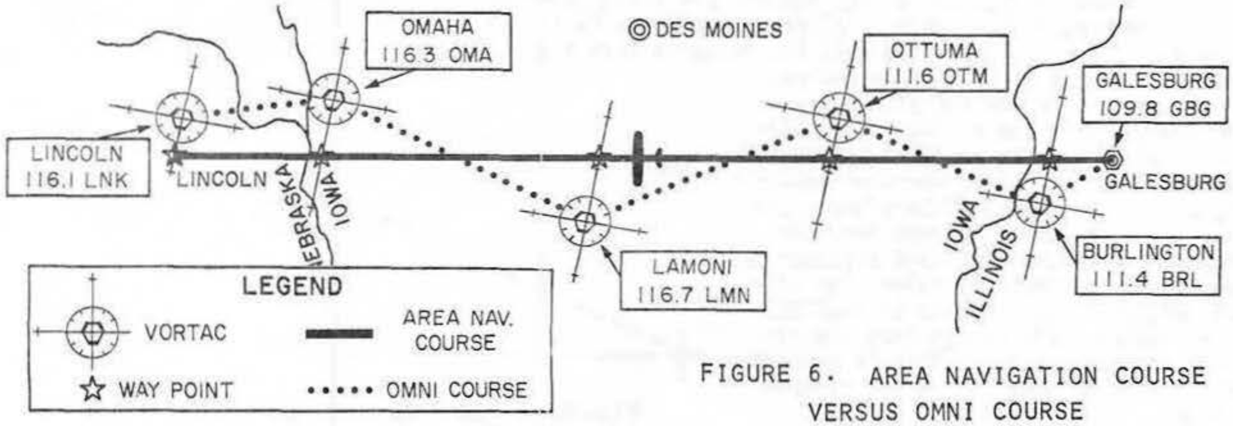


FIGURE 6. AREA NAVIGATION COURSE VERSUS OMNI COURSE

ARE AREA NAVIGATION ROUTES AVAILABLE FOR IFR FLIGHT? Yes. Series 700 (low altitude), and Series 800 and 900 (high altitude) routes, which are expected to be in frequent use by more than one user, are published on appropriate U.S. Government charts. Series 500 (low altitude) and Series 600 (high altitude) routes, which are planned for more than one user, but whose expected usage does not justify Government charting, are published in AIM, Part 4. Series 300 (low altitude) and Series 400 (high altitude) routes are established primarily for one user and are not carried on Government charts.

HOW IS WAYPOINT INFORMATION PRESENTED ON AN RNAV ENROUTE CHART? Figure 7 is an excerpt from an RNAV Enroute Chart depicting a waypoint (DIXIE), the reference facility (Shreveport VORTAC), and the identification box with waypoint data.

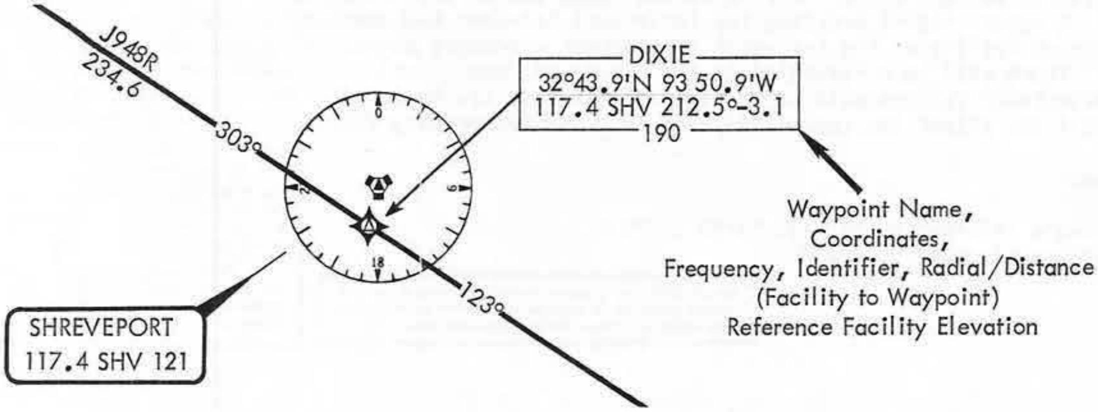


FIGURE 7. WAYPOINT (DIXIE) AND IDENTIFICATION BOX DATA

HOW SHOULD RNAV ROUTES BE LISTED ON AN IFR FLIGHT PLAN? If the airborne equipment has been approved in accordance with Advisory Circular 90-45, as is required for IFR flight, RNAV routes should be filed in the same manner as those for VOR airways. One of the following "Special Equipment Suffixes" should be entered in block 3 of the flight plan: (1) /C--Area Navigation with no code transponder, (2) /F--Area Navigation with 4096 code transponder, (3) /S--Area Navigation with 64 code transponder, or (4) /W--Area Navigation and no transponder.

IS VERTICAL GUIDANCE POSSIBLE WITH AREA NAVIGATION? Yes. For example, one manufacturer has designed an Ascent-Descent Director (ADD), which combined with the basic two-dimensional (lateral and longitudinal) Area Navigation system, provides vertical guidance information similar to a glide slope. With this device, a waypoint can be selected not only at a desired surface location but also at a desired altitude. Thus, the pilot can select and fly a pre-determined vertical profile to a pre-selected point in space. Among the benefits which ATC will derive from three-dimensional Area Navigation is the ability to: (1) establish precisely controlled "overpasses," "underpasses," and "corridors"; (2) call for pre-defined points in space at which the pilot can arrive at a specific altitude. Pilots will be able to: (1) fly pre-organized ascent and descent profiles in terminal areas as specified by SIDs and STARs; (2) create and accurately follow a computed variable glide slope for approaches. Figure 8 shows how aircraft having widely differing performance characteristics can be separated in three-dimensional corridors in or near a terminal area.

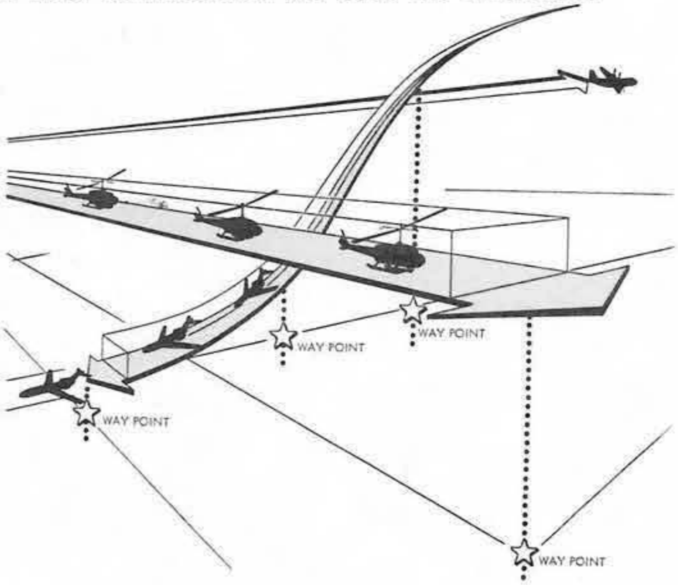


FIGURE 8. THREE-DIMENSIONAL AREA NAVIGATION

WHAT ARE THE ADVANTAGES OF AREA NAVIGATION? All the advantages described below stem from the ability of the airborne computer to, in effect, locate the VORTAC wherever convenient, if it is within reception range. The principle advantages of Area Navigation are:

(1) Pilots are able to fly accurate straight-line courses between geographical points without having to dogleg between VORTACs. On a flight of even moderate length, a significant reduction of enroute time results.

(2) Usable airspace is greatly expanded by allowing the use of routes not limited by facility location.

(3) Holding and orbiting is simplified.

(4) Course deviations for thunderstorm avoidance and traffic spacing may be accomplished more efficiently. With Area Navigation, the pilot (with ATC consent) can alter course himself without radar vectors. He is constantly aware of his position; this is not always true when being vectored.

(5) Changes in routing, such as the assignment of a parallel route, can be accomplished without radar vectors.

(6) Multiple and one-way routes may be established to reduce congestion on heavier traveled airways and to segregate traffic by aircraft speed and arrival airport.

(7) A capability is provided for instrument let-down and approach at airfields not equipped with approach facilities and for which no approach procedure is presently published.

(8) There will be a reduction in the number of communications between controller and pilot since fewer radar vectors will be required. This puts the responsibility for navigation back in the cockpit and allows the controller more time for his primary function--aircraft separation.

References:

Airman's Information Manual, Parts 1 and 4
Advisory Circular AC 90-45

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DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
IFR PILOT EXAM-O-GRAM* NO. 31

IS YOUR INSTRUMENT FLIGHT REALLY LEGAL?

More than an ATC clearance is required to make an IFR flight legal. Written test results indicate that many currency requirements, items of equipment, and equipment checks are often overlooked by pilots preparing for IFR flights. In this Exam-O-Gram, let's consider a trip in an AIRPLANE on which passengers are NOT carried "for hire." Commercial operators should consult the appropriate regulations for requirements applicable to their specific operation.

FIRST, LET'S EXAMINE YOU, THE PILOT.

1. Valid Pilot Certificate, Appropriate Ratings, and FCC Permit? Do you have an Instrument Rating? Are you rated for the Category (example-Airplane) and Class (example-Multiengine Land) to be used for this flight?
2. Current Medical? If a 2nd class medical is required, was it issued within the preceding 12 months? If a 3rd class is sufficient, was it issued within the preceding 24 months?
3. Current in Class? Have you made 3 takeoffs and landings in an airplane of the same class within the preceding 90 days? If any part of this flight will be conducted at night (one hour after sunset to one hour before sunrise), have you made 3 night takeoffs and landings to a full stop in an airplane of the same class during the preceding 90 days?
4. Current for Instrument? Within the preceding 6 months, have you passed an instrument competency check in an airplane or had 6 hours of instrument time and made 6 instrument approaches? At least three hours of the instrument time must be in flight in an airplane.

NOW, LET'S LOOK AT THE AIRPLANE.

1. Maintenance Inspection? Like the pilot, the airplane must have a current "physical." Has this "physical" (the annual inspection) been completed within the preceding 12 months?
2. Required Documents? Are the airworthiness and Registration Certificates, Weight and Balance data, approved Airplane Flight Manual or required Placards, and the FCC Radio Transmitter License all available in the airplane?
3. Altimeter System Tests and Inspections? Has each static system and altimeter been tested and inspected within the preceding 24 months in accordance with Part 91.170?
4. VOR Receiver Check? Have the VOR receivers been checked for accuracy within the preceding 10 days and the preceding 10 hours of flight time?
5. Installed Instruments, Equipment, and Systems? Are all of the required items installed or available in the airplane and in good working order?

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Rev. 11/73

a. Airspeed indicator.
b. Sensitive Altimeter adjustable for barometric pressure.
c. Magnetic direction indicator.
d. Gyroscopic direction indicator (directional gyro or equivalent).
e. Gyroscopic bank and pitch indicator (artificial horizon).
f. Gyroscopic rate of turn indicator (see FAR 91.33(d)(3) for exceptions).
g. Slip-skid indicator.
h. Clock with sweep-second hand.
i. Engine instruments appropriate to the type of engine(s) installed.
j. Fuel gauge indicating quantity of fuel in each tank.
k. Landing gear position indicator if the airplane has retractable gear.
l. Approved safety belts for all occupants.
m. Approved position lights if any part of the flight will be between sunset and sunrise.
n. Two-way radio communications system and navigation equipment appropriate to the ground facilities to be used.
o. Transponder, if the flight originates or terminates at the primary airport in a Terminal Control Area, at a designated high density airport, or will enter the Positive Control Area.
p. DME, if the flight will operate at or above FL 240 using VOR navigation.
q. One spare set of fuses, or three spare fuses of each kind required.
r. Generator of adequate capacity.
s. Oxygen equipment, if required for the altitude to be flown.

FINALLY, LET'S LOOK AT THE PREFLIGHT PLANNING.

1. Weather Reports and Forecasts? Have you checked the existing and forecast weather for your route of flight, destination, and if required, alternate airport? Have you selected an "ESCAPE ROUTE" to use in the event of complete radio failure, or other enroute emergency?

2. Maps and Charts? Do you have current enroute, area, and instrument approach procedures charts for the route, destination, alternate, and possible diversion areas and airports? Have you studied the instrument approach charts?

3. Fuel Quantity and Grade? Have you considered known traffic delays in computing the required fuel? Is the airplane serviced with the proper grade of fuel?

4. Weight and Balance? Is the airplane loaded within the prescribed weight and CG limits? Will the landing weight and CG be within limits?

5. Airplane Performance Data? Do you know the distance required for the airplane to takeoff and clear a 50-foot obstacle under the weather and load conditions that exist for this departure? Is the altitude required for this flight within the operating limits of the airplane? Will you be able to land and stop SAFELY within the available runway limits at your destination?

If you can answer "YES" to these questions, you are ready to file your flight plan and get your ATC clearance.

References: FAR Part 61, Part 91, Part 93, AC 61-27B, AC 91-23, and AIM, Part 1.

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FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 32

AIRCRAFT PERFORMANCE CHARTS

Applicants for the Instrument Pilot Written Test display a weakness in interpretation of Aircraft Performance Charts. This important knowledge should be fundamental to every Instrument Pilot for the safe and efficient operation of an aircraft.

TYPES OF AIRCRAFT PERFORMANCE CHARTS

TABLES are compact arrangements of conditions and performance values in orderly sequence, usually arranged in rows and columns. These charts require interpolation to determine intermediate values for particular flight conditions or performance.

GRAPHS are pictorial representations of the relationship between at least two variables. Aircraft performance graphs are usually the straight-line or curved-line types. The straight-line graph is a result of two values that vary at a constant rate (Figures 2 & 3), while a curved-line graph is a result of two values that vary at a changing rate (Figures 4 & 5). Like tables, graphs require interpolation to determine intermediate values.

INTERPOLATION OF AIRCRAFT PERFORMANCE CHARTS

To interpolate means to compute intermediate values between a series of given values. In other words, divide the distance or interval into as many units as necessary to include the desired value as one of the values. For example, find the value of X.

U	Z
12	22

U	V	W	X	Y	Z
12	14	16	18	20	22

X = 18

PERFORMANCE TABLE. For a practical problem, determine the take-off distance of a particular light twin from the table in Figure 1. Assume at take-off the pressure altitude is 3,000 feet, OAT is 65° F., and headwind is 10 MPH. Underlined on the table are the given values for altitude and headwind. Circled are the values that need interpolation.

TAKE-OFF DISTANCES - FEET
(Over a 50 Foot Obstacle)

$\frac{65°-50°}{75°-50°} = \frac{15}{25}$ or $\frac{3}{5}$

Use take-off power on both engines (limiting manifold pressure, 3400 RPM) with mixture in auto-rich position, cowl flaps full open, flaps set at 1/4 (10°). Attain full engine power before releasing brakes. Climb out at 106 MPH (92 knots) CAS. Limit power setting to 2 minutes.

TAKE-OFF GROSS WEIGHT - 8,000 POUNDS

Pressure Altitude Feet	Wind Velocity MPH	OUTSIDE AIR TEMPERATURE - °F					
		-25	0	25	50	75	100
3000	-10	2053	2282	2535	2808	3098	
	0	1758	1955	2172	2406	2656	
	+10	1481	1648	1832	2030	2242	
	+20	1225	1364	1517	1684	1860	
	+30	990	1104	1230	1365	1510	

2242
−2030
212

65° is the point 3/5 of the interval between 50° and 75°.

3/5 × 212 = 127.2

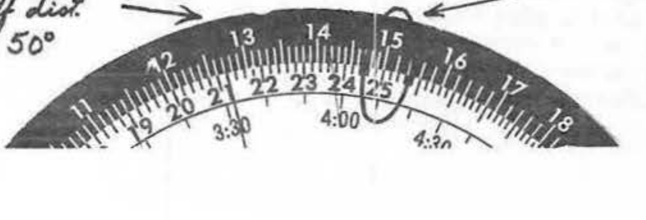
2030 + 127.2 = 2157.2

FIGURE 1

2157.2 is the point 3/5 of the interval between 2030 and 2242 feet.

In the margin to the right of the graph, a position or relationship of 65° with the two given values was determined. This relationship was applied to the two take-off distances given to find the take-off value for a 65° temperature. Under existing conditions, take-off distance is 2,157.2 feet. The same problem can be solved quickly on the computer by setting up a 15 to 25 ratio and observing the proportionate increased take-off distance opposite 212 as shown below.

127.2 ft. greater take-off dist. than for 50°

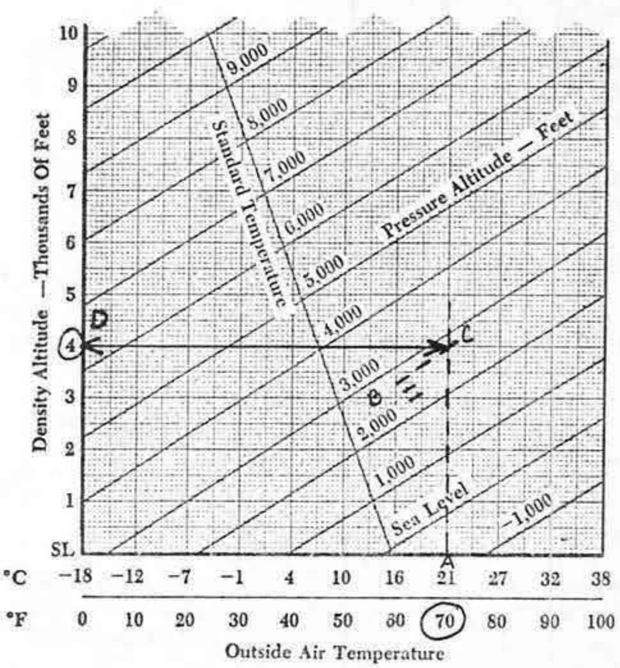


Rev. 3/71

PERFORMANCE GRAPHS. Aircraft Performance Charts which utilize a graph are made up of two components: a basic grid of vertical and horizontal lines, each representing a value of a condition, and either straight or curved lines at an angle to the grid lines representing values of a third condition. By plotting an intersection of known values of two conditions, the value of the unknown condition can be determined at the same intersection.

A practice problem - find the Density Altitude with these existing conditions: (Figure 2)

Airport elevation 2,545 feet, OAT 70° F., and Altimeter Setting 29.70.



PRESSURE ALTITUDE

AND

DENSITY CHART

FIGURE 2

Altimeter Setting in Hg.	Altitude Addition For Obtaining Pressure Altitude
28.3	1,535
28.4	1,435
28.5	1,340
28.6	1,245
28.7	1,150
28.8	1,050
28.9	955
29.0	865
29.1	770
29.2	675
29.3	580
29.4	485
29.5	390
29.6	300
29.7	205
29.8	110
29.9	20
29.92	0
30.0	−75
30.1	−165
30.2	−255
30.3	−350
30.4	−440
30.5	−530
30.6	−620
30.7	−710
30.8	−805

SOLUTION: The chart requires Pressure Altitude which is determined from the conversion table at the right of the graph. 2,545 + 205 = 2,750 feet Pressure Altitude.

Step 1. Draw a line parallel to the vertical lines from the 70° on the Fahrenheit Scale (A) to about the diagonal 3,000 feet Pressure Altitude line.

Step 2. Draw line B representing a value of 2,750 feet (interpolate 3/4 of distance from 2,000 to 3,000) parallel to the pressure altitude lines so that it intersects the line drawn in step 1.

Step 3. The intersection of these two lines (C) lies on the 4,000 foot value of the Density Altitude scale (D). THE DENSITY ALTITUDE IS 4,000 FEET.

COMBINED GRAPHS. Some Aircraft Performance Charts incorporate two or more graphs into one when an aircraft flight performance involves several conditions. A simple combination of graphs is illustrated in Figure 3. Choose the conditions that are appropriate and solve on that portion of the graph. Sample problems for several conditions are solved under the graph.

Another combined graph is illustrated in Figure 4. It requires three functions to solve for take-off distance with adjustments for air density, gross weight, and headwind conditions. The first function converts pressure altitude to density altitude. The right margin of this portion of the graph, even though it is not numbered, represents density altitude and starts the second function, the effect of gross weight on take-off distance. The right margin of this section represents take-off distance with no wind and starts the final phase of correcting for effect of headwind. A sample problem is illustrated below the graph.

A more complex graph combines many functions intermingled on one basic grid to avoid using several graphs. However complicated a graph may appear, the procedure for solution is the same as for the simple graph. In Figure 5, one grid is used with a choice of three different Altitude Scales. It also accommodates two conditions for oxygen consumption. To solve, construct an intersection using the appropriate altitude scale and the curved line representing the oxygen cylinder pressure for the condition of intended use. Transfer the intersection value to (Continued on page 4)

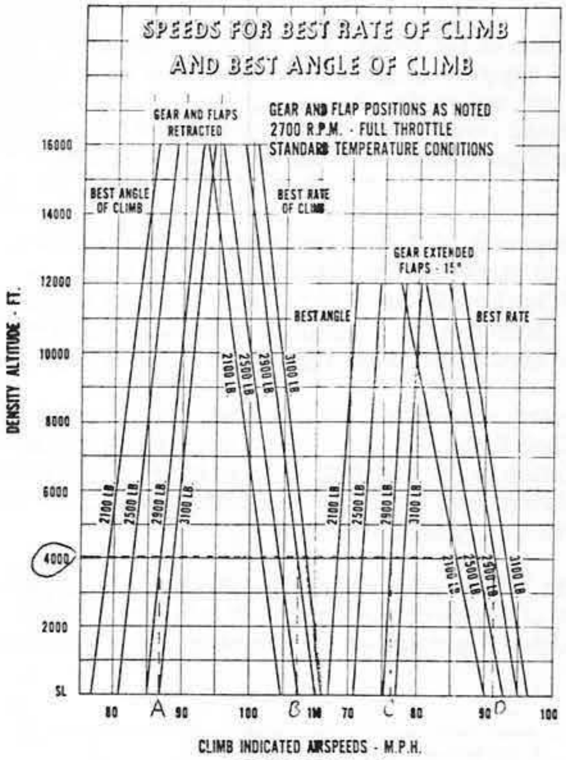


FIGURE 3

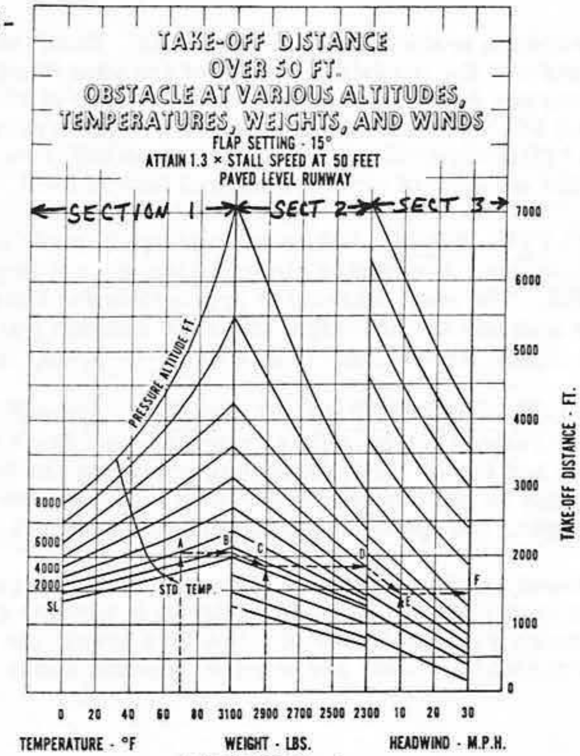


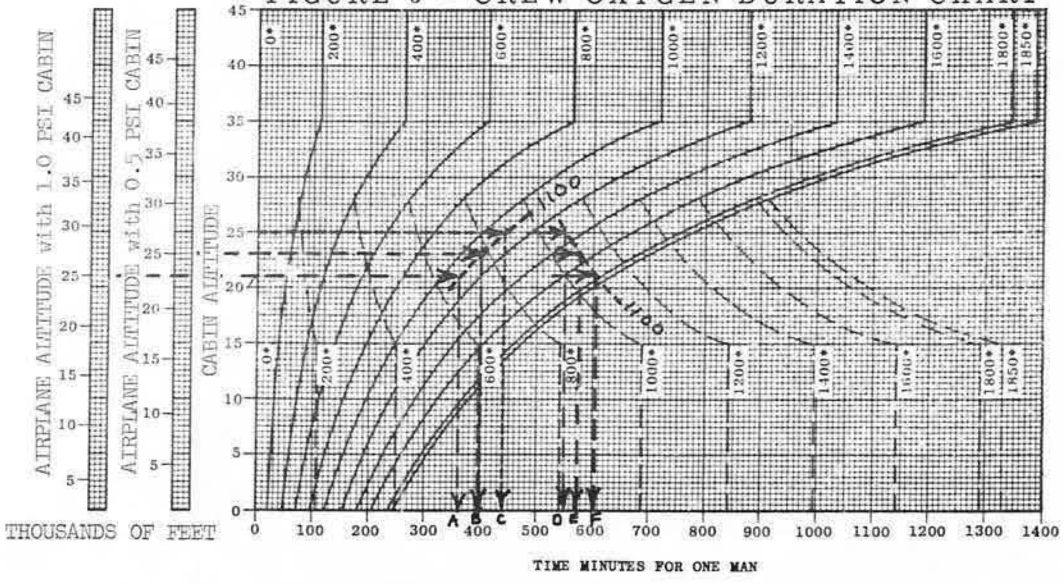
FIGURE 4

Conditions: Density Altitude 4,000 feet
Gross Weight 2,900 lbs.

BEST ANGLE IAS	BEST RATE IAS	GEAR	FLAPS
A - 87 MPH	B - 107 MPH	up	0°
C - 77 MPH	D - 92 MPH	down	15°

A - Conversion to Density Altitude.
B - Carry results to 2nd section of graph.
C - Parallel lines to gross wt. for loading.
D - Carry results to 3rd section of graph.
E - Parallel lines to headwind component.
F - Carry results to edge of graph for take-off distance readout.

FIGURE 5 - CREW OXYGEN DURATION CHART



— — — NORMAL OXYGEN
———— 100 PERCENT OXYGEN

*OXYGEN CYLINDER PRESSURE

CHART BASED ON ONE 111 CUBIC FOOT OXYGEN CYLINDER.

EXAMPLE: C
100 PERCENT OXYGEN
CABIN ALTITUDE = 25,000 FEET
OXYGEN CYLINDER PRESSURE = 1100 PSI
READ TIME FROM CHART = 440 MINUTES FOR ONE MAN
NUMBER OF MEN BREATHING OXYGEN = 3
TIME OXYGEN WILL LAST = 440/3 = 146.7 MINUTES

the bottom scale via the vertical lines. Read the duration of the oxygen for one man and divide the results by the number of users for the total duration of oxygen. Plotted on the graph are six values of oxygen duration obtained with an altitude of 25,000 feet and initial Oxygen Cylinder Pressure of 1100 PSI. The variable conditions are cabin pressure and flow of oxygen (Normal or 100%). Result "A" (360 minutes) is the duration resulting from 1.0 PSI pressurization and 100% oxygen flow. "F" is the duration of oxygen if normal flow is used.

HELPFUL HINTS. Before any attempt is made to interpret a performance chart, carefully check the scales. Sometimes, information you use is given in knots and the chart may be calibrated in MPH. The same warning is appropriate for Celsius (Centigrade) and Fahrenheit. Check the chart for foot notes which might affect the solution you get. Sometimes, it is not necessary to interpolate as closely as was done in this Exam-O-Gram, but you should round-off figures on the safe side.

VALUE OF PERFORMANCE CHARTS. Aircraft performance charts are of great value to determine performance for specific circumstances. Don't overlook the potential of these same charts to reveal and enrich the knowledge of operating characteristics of the aircraft. By plotting as many conditions as you have encountered or anticipate encountering, you will develop a better overall mental image of the operating characteristics and limits of your aircraft and equipment.

Graphs are somewhat like pictures in that a person can retain more knowledge through use of the sense of sight. It is much easier to remember trends of performance or aerodynamic principles through a mental image of a line on a graph than through the printed or spoken word. Like pictures, performance charts are worth a thousand words.

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DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration

IFR PILOT EXAM-O-GRAM* NO. 33

RUNWAY AND DISPLACED THRESHOLD LIGHTING

Pilot examiners, flight instructors, and FAA specialists who conduct flight training seminars indicate that many pilots and applicants for pilot ratings lack essential knowledge about runway and displaced threshold lighting. All pilots, particularly those operating under IFR conditions, should be thoroughly familiar with this important area of night operations, when runway markings are not visible.

The information given in the illustrations and sample test items can be remembered as follows:

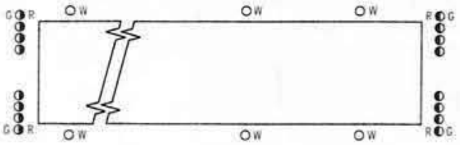
No landings - permitted short of displaced threshold lights.

No aircraft operations - permitted short of displaced threshold lights, if edge-of-runway lights (white or colored) are absent.

Takeoffs - permitted in area short of displaced threshold lights if edge-of-runway lights appear as--

a. red, when takeoff is toward visible displaced threshold lights.
b. white (normal), and no displaced threshold is visible (due to 180° obscuration of lights).

Taxiing only - permitted in area short of displaced threshold lights, if edge-of-runway lights appear as blue (taxiways and runway areas designated as taxiways are bounded by blue lights).



RUNWAY AND THRESHOLD LIGHTING CONFIGURATION

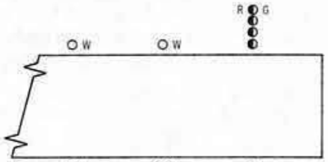


Fig. 2

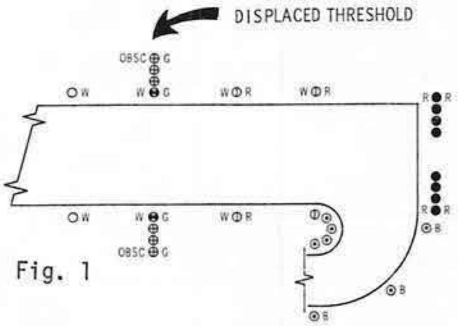


Fig. 1

LEGEND

○ WHITE 360
◉ BLUE 360
● RED 360
◐ RED 180 AND GREEN 180
⦶ WHITE 180 AND RED 180
⊖ WHITE 180 AND GREEN 180
⊕ OBSCURED 180 AND GREEN 180

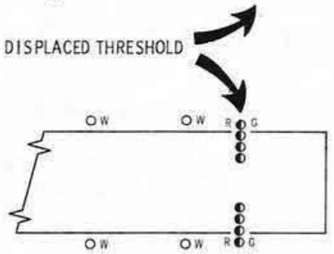


Fig. 3

SAMPLE QUESTIONS - SEE PAGE 2 FOR ANSWERS

1. The area east of the displaced threshold lights in Figure 1

1- may be used for takeoff west but not east.
2- is usable for takeoff and landing both west and east.
3- is unusable for landing, but may be used for taxiing, and for takeoff both west and east.
4- may not be used for any aircraft operations.

2. What aircraft operations are permitted east of the displaced threshold lights in Figures 2 and 3?

1- In Figure 2, taxiing only is permitted; in Figure 3, all operations are prohibited.
2- In both Figures 2 and 3, taxiing and takeoffs are permitted but not landings.
3- None. In both Figures 2 and 3, all operations are prohibited.
4- In Figure 2, taxiing is permitted if the runway centerline is maintained.

DISTRIBUTION: ZC-307

Below are explanations of seven terms commonly used in publications which deal with airport and runway lighting systems:

LIRL -- Low Intensity Runway Lights. This system is used at visual flight rule (VFR) airports having no instrument approach procedures.

MIRL -- Medium Intensity Runway Lights. This system is installed on runways having a non-precision instrument approach procedure for either circling or straight-in approaches. The lights are white except the last 2,000 feet, which are amber.

HIRL -- High Intensity Runway Lights. This system is installed on runways having precision instrument approach procedures and on runways which utilize runway visual range (RVR). The lights are white except the last 2,000 feet, which are amber.

LITL -- Low Intensity Taxiway Lights. These lights are used on taxiways and aprons where LIRL is used on the runways.

MITL -- Medium Intensity Taxiway Lights. These lights are used on taxiways and aprons at airports where either MIRL or HIRL is used on the runways.

REIL -- Runway End Identifier Lights. The system consists of two synchronized condenser-discharge flashing white lights, located laterally on each side of a runway threshold, facing the approach area. These lights are installed primarily to aid pilots in identifying runways during periods of reduced visibility. They are also installed on runways whose lights blend into a background of other lighting and on runways that lack contrast with the surrounding terrain.

TDZ/CL -- Touchdown Zone/Centerline Lights. A runway touchdown zone lighting system consists of 3,000 feet of unidirectional white three-light barrettes located symmetrically about the row of centerline lights. The centerline lighting system consists of bidirectional lights extending down the runway centerline from threshold to threshold. Viewed from the aircraft during an approach or a takeoff, the centerline lights appear as white up to the last 3,000 feet of runway. Then the lights appear as alternate red and white for 2,000 feet. The final 1,000 feet of lights appear as all red. Viewed from the opposite direction, all the lights appear as white.

ANSWERS TO SAMPLE TEST ITEMS: 1-3; 2-3.

For further information on airport and runway lighting, see the publications listed below.

1. Advisory Circular AC 150/5340-24
2. Airman's Information Manual, Part I

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Flight Standards National Field Office, Examinations Branch
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12/70

Department of Transportation

FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 34

IFR DEPARTURE CLEARANCES

This Exam-O-Gram is presented as a ground instruction aid to assist pilot and flight instructor applicants for the Instrument Rating Written Test. The information and advice given will also be of value to the newly-rated instrument pilot.

Instrument flight instructors can recall a variety of student reactions to an unexpected call from the controller with "your ATC CLEARANCE." This call may confuse the inexperienced pilot, particularly if he is already busy taxiing, performing instrument cockpit checks, and watching for other traffic. The point to remember is--DON'T SAY YOU ARE READY TO COPY UNTIL YOU ARE READY! Simply tell the controller to "Stand By" until you are fully organized and prepared to receive your departure clearance. The controller has no way of distinguishing between an inexperienced pilot and one who knows the local area as well as he knows his own back yard. The controller assumes that you are a competent instrument pilot, that you have learned--and are proficient in using--clearance shorthand, and that you are familiar with appropriate route data. Until you reach the level of competence necessary for flying under Instrument Flight Rules in areas of high density traffic, you should stay away from them. If you are a novice in copying clearances, alert the controller by telling him to "Go Slow." If you are flying without a co-pilot, you should keep some additional points in mind in connection with IFR departure clearances. "Ready to copy" should mean at least the following:

1. Your airplane is under control, preferably stopped, parking brake set.
2. You are ready with writing materials.
3. Your radio(s) are properly tuned, volume at a readable level.
4. Route data is at hand (including Enroute Chart, Area Chart, SIDs, and STARs as appropriate). The route specified in your clearance may differ with that you filed in your flight plan. If the routing is different, and you elect to read back the clearance, read it back as issued then check the routing. If you desire clarification or you have objection to the routing, question it then. In accepting a clearance, you assume responsibility for complying with it.

The IFR departure clearance you receive depends on several factors:

1. HAVE YOU INDICATED YOU WILL NOT ACCEPT A STANDARD INSTRUMENT DEPARTURE (SID)? Controllers may issue a clearance containing a published effective SID to any departing aircraft, unless otherwise requested verbally by the pilot or by inclusion of "NO SID" in the remarks section of the filed IFR flight plan. Therefore, if you do not indicate as stated above, you should be familiar with all SIDs for the departure airport and have copies of them in the cockpit. Be certain to note and adhere to all altitude restrictions.
2. HAVE YOU REQUESTED A "DETAILED CLEARANCE"? If you do not specifically request a detailed clearance from Ground Control or Clearance Delivery, you will probably be issued an "abbreviated departure clearance," provided the route filed in your IFR flight plan can be approved with little or no revision.
3. WILL THE FLIGHT BE IN A RADAR OR A NON-RADAR ENVIRONMENT?
   (a) If the flight is in a radar environment (and an abbreviated departure clearance is issued), the controller will state, "CLEARED AS FILED," followed by an assignment of an altitude/flight level and any additional instructions or information required.
   (b) If the flight is in a non-radar environment (and an abbreviated departure clearance is issued), the controller will state, "CLEARED AS FILED," and will specify one, two, or more fixes necessary to identify the initial route of flight, followed by an assignment of an altitude/flight level and any additional instructions or information required.

* * * * * * * * * * *

The clearances which follow are typical of those from airports in the Dallas/Ft. Worth area. See the excerpt from Enroute Low Altitude Chart L-13, on page 3, and the SID - BRIDGEPORT THREE DEPARTURE, on page 4. Have someone read the clearances to you to aid in developing your shorthand proficiency. The FAA Instrument Flying Handbook contains a clearance shorthand you may want to use if you do not already have a system.

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* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

MEACHAM FIELD - WILL ROGERS AIRPORT. . . V317 ADM - V163 OKC - DEPARTURE RUNWAY 36.

(The following is a "detailed clearance" and does not make use of radar, which would normally be provided.)

FLYBIRD TWO TWO CHARLIE CLEARED TO WILL ROGERS AIRPORT VIA NORTH COURSE MEACHAM LOCALIZER - VICTOR SIXTY-SIX VICTOR THREE SEVENTEEN ARDMORE - VICTOR ONE SIXTY-THREE OKLAHOMA CITY - MAINTAIN FOUR THOUSAND. REPORT FORT WORTH RADIO BEACON AND INTERCEPTING VICTOR SIXTY-SIX. DEPARTURE CONTROL FREQUENCY WILL BE ONE ONE EIGHT POINT ONE.

(The following is an "abbreviated clearance" for the same filed route with radar vectoring provided.)

FLYBIRD TWO TWO CHARLIE CLEARED AS FILED - MAINTAIN FOUR THOUSAND - MAINTAIN RUNWAY HEADING FOR VECTOR TO VICTOR THREE SEVENTEEN. SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE. DEPARTURE CONTROL FREQUENCY WILL BE ONE ONE EIGHT POINT ONE.

* *

GREATER SOUTHWEST INTERNATIONAL AIRPORT - MIDLAND-ODESSA REGIONAL AIR TERMINAL. . . V18 MQP - V16 ABI - V66 MAF - - DEPARTURE RUNWAY 17.

(The following is a "detailed clearance" and does not make use of radar, which would normally be provided.)

FLYBIRD TWO TWO CHARLIE CLEARED TO MIDLAND-ODESSA AIRPORT VIA VICTOR EIGHTEEN MILLSAP - VICTOR SIXTEEN ABILENE - VICTOR SIXTY-SIX MIDLAND. TURN RIGHT TO JOIN VICTOR EIGHTEEN - MAINTAIN FOUR THOUSAND. REPORT INTERCEPTING VICTOR EIGHTEEN. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.

(The following is an "abbreviated clearance" for the same route with radar vectoring provided.)

FLYBIRD TWO TWO CHARLIE CLEARED AS FILED - MAINTAIN FOUR THOUSAND - MAINTAIN RUNWAY HEADING FOR VECTOR TO VICTOR EIGHTEEN. SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.

* *

DALLAS-LOVE FIELD - AMARILLO AIR TERMINAL. . . V66 BPR - V355 SPS - V114 AMA - - DEPARTURE RUNWAY 31R.

(The following is a "detailed clearance" and does not make use of radar, which would normally be provided.)

FLYBIRD TWO TWO CHARLIE CLEARED TO AMARILLO AIRPORT VIA NORTHWEST COURSE DALLAS LOCALIZER - VICTOR SIXTY-SIX BRIDGEPORT - VICTOR THREE FIFTY-FIVE WICHITA FALLS - VICTOR ONE FOURTEEN AMARILLO. MAINTAIN FOUR THOUSAND. JOIN VICTOR SIXTY-SIX AT FOUR THOUSAND. REPORT INTERCEPTING VICTOR SIXTY-SIX. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.

(The following is an "abbreviated clearance" for the same route with radar vectoring provided.)

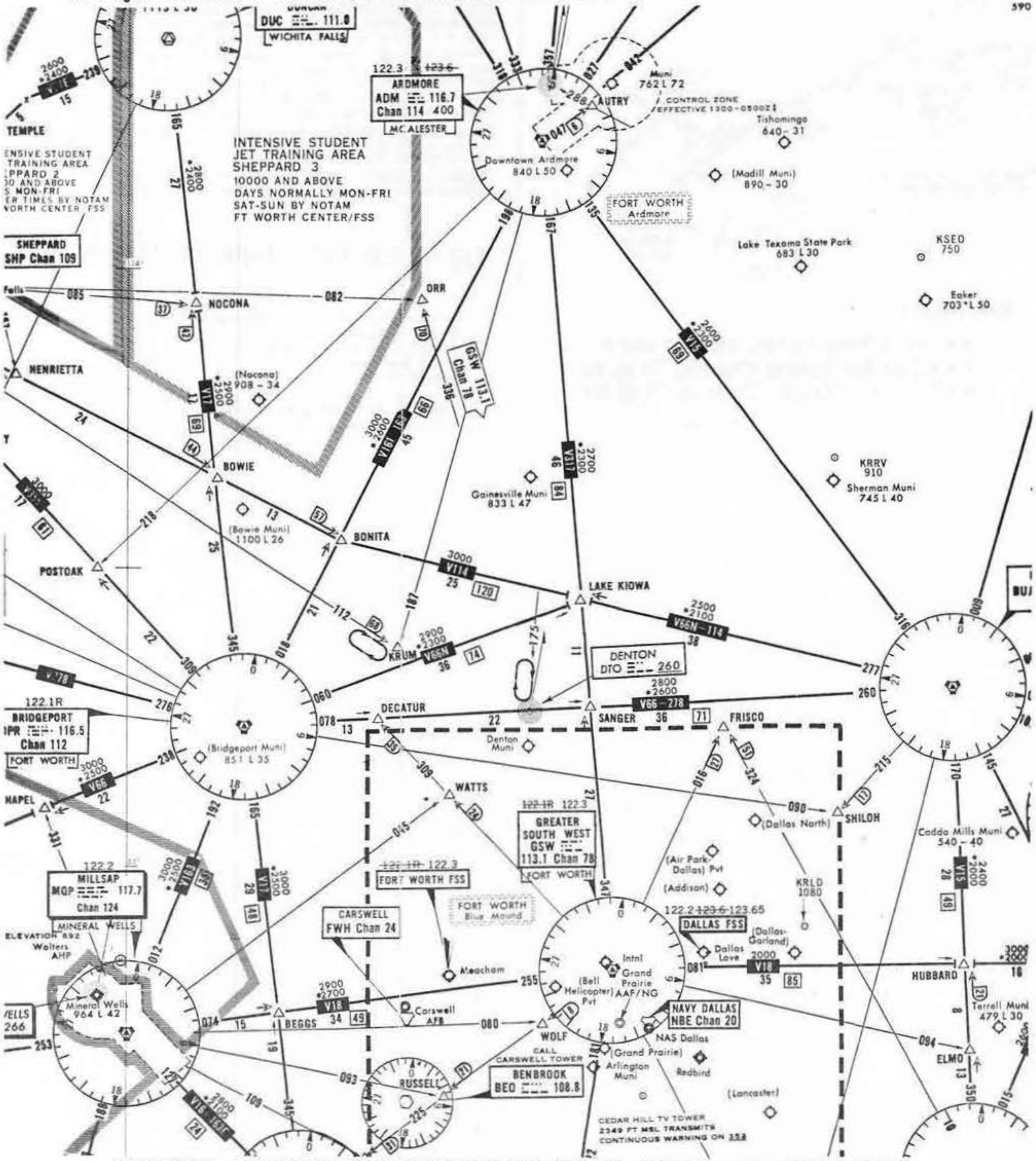
FLYBIRD TWO TWO CHARLIE CLEARED AS FILED - MAINTAIN FOUR THOUSAND - MAINTAIN RUNWAY HEADING FOR VECTOR TO VICTOR SIXTY-SIX. SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.

(The following is an "abbreviated clearance" from Dallas-Love Field to Amarillo Air Terminal with a SID assigned by ATC.)

FLYBIRD TWO TWO CHARLIE CLEARED AS FILED - BRIDGEPORT THREE DEPARTURE - CHILDRESS TRANSITION - MAINTAIN EIGHT THOUSAND. SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.

Although a departure clearance is normally to the destination airport, it may be to a fix just a few miles from the point of departure. A "short range" clearance is used to expedite departure while the flight is being further coordinated by ATC. On a short flight, the clearance may be to an approach fix serving the destination airport. An example of a "short range" clearance from Greater Southwest International Airport to RUSSEL INTERSECTION follows:

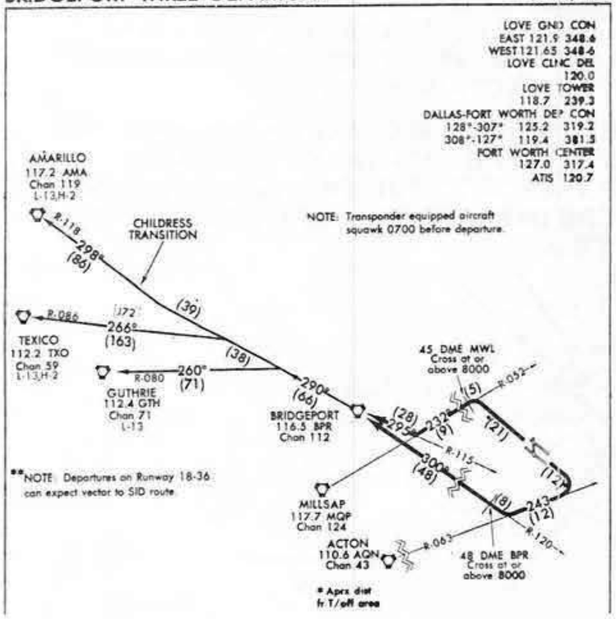
> FLYBIRD TWO TWO CHARLIE CLEARED TO RUSSEL INTERSECTION VIA THE TWO TWO FIVE RADIAL OF GREATER SOUTHWEST VORTAC - MAINTAIN THREE THOUSAND. TURN RIGHT HEADING TWO SEVEN ZERO FOR VECTOR TO THE TWO TWO FIVE RADIAL. SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE. DEPARTURE CONTROL FREQUENCY WILL BE ONE TWO FIVE POINT TWO.



EXCERPT - ENROUTE LOW ALTITUDE CHART L-13 (Meacham localizer added)

BRIDGEPORT THREE DEPARTURE

DALLAS-LOVE FIELD
DALLAS, TEXAS



NOTE: Transponder equipped aircraft squawk 0700 before departure.

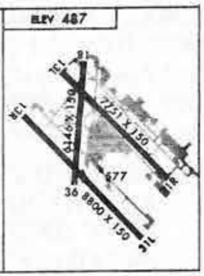
**NOTE: Departures on Runway 18-36 can expect vector to SID route.

* Aprx dist fr T/off area

References:

Airman's Information, Parts 1 and 3
Terminal Air Traffic Control, 7110. 8B
En Route Air Traffic Control, 7110. 9B

DEPARTURE ROUTE DESCRIPTION



Take-off Runways 13L/R,18:** Maintain runway heading to intercept and proceed southwest on the ACTON VORTAC 063 radial to the BRIDGEPORT VORTAC 120 radial, then proceed northwest on the BRIDGEPORT 120 radial to the BRIDGEPORT VORTAC. Thence via (assigned transition) or (assigned route). Cross the BRIDGEPORT 120 radial 48 DME Fix at or above 8,000 feet.

(Continued on next page)

Take-off Runways 31L/R,36: Maintain runway heading to intercept and proceed southwest on the MILLSAP VORTAC 052 radial to the BRIDGEPORT VORTAC 115 radial, then proceed northwest via the BRIDGEPORT 115 radial to the BRIDGEPORT VORTAC.** Thence via (assigned transition) or (assigned route). Cross the MILLSAP 052 radial 45 DME Fix at or above 8,000 feet.

CHILDRESS TRANSITION: From over the BRIDGEPORT VORTAC proceed northwest via the BRIDGEPORT VORTAC 290 radial and the AMARILLO VORTAC 118 radial to the AMARILLO VORTAC.

GUTHRIE TRANSITION: From over the BRIDGEPORT VORTAC proceed northwest via the BRIDGEPORT VORTAC 290 radial and the GUTHRIE 080 radial to GUTHRIE VORTAC.

TEXICO TRANSITION: From over the BRIDGEPORT VORTAC proceed northwest via the BRIDGEPORT 290 radial and J72 to TEXICO VORTAC.

SID - BRIDGEPORT THREE DEPARTURE

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Federal Aviation Administration

IFR PILOT EXAM-O-GRAM® NO. 35

CLEARANCE DELIVERY PROCEDURES

This Exam-O-Gram is presented to help clarify clearance delivery procedures for pilot and ground instructor applicants for the Instrument Rating Test. Analyses of written tests indicate that many applicants are unaware of the different procedures at different facilities.

At an uncontrolled airport with no A/G communications. There are two practical ways to receive your clearance in this situation. You may call the FSS on the telephone prior to takeoff or contact a nearby ATC facility after you are airborne. Discuss it with the FSS specialist while filing your flight plan and determine which procedure is most desirable.

OKLAHOMA CITY, CIMARRON (F29) 4SW 35°29'15'' FSS: OKLAHOMA CITY
97°49'00'' IFR
1353 H35/17L-35R (1) (S-17) S5 F12, 18
REMARKS: ARPT ATTENDED 0700-1800 RGT TFC RWY 17L, 19, 15, 17R FOR SVC AFT HRS CALL 354-6270/YUKON

OKLAHOMA CITY FSS 121.5 122.1R 122.2 122.6 123.6

Oke City Dep Con 124.6

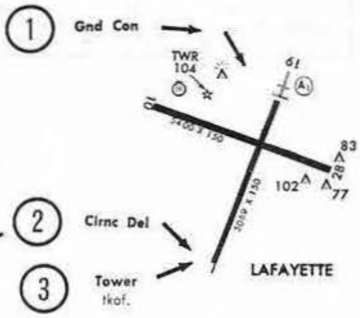
At an uncontrolled airport with a Flight Service Station on the field. Get your clearance from the FSS on the radio prior to takeoff.

MC ALESTER, MUNI (MLC) 4SW 34°53'24'' 95°46'56'' FSS: MC ALESTER ON FLD
IFR

McALESTER FSS 121.5 122.1R 122.2 122.6 123.6 **DF**

McALESTER (L) BVORTAC 112.0/MLC **FSS: McALESTER**

At a controlled airport without pre-taxi clearance procedures. When you make the initial call for taxi instructions, alert ground control that you are going to request your IFR clearance. Example: "LAFAYETTE GROUND CONTROL - THIS IS AIRPLOW TWO FOUR ONE - ON THE NORTH RAMP FOR TAXI INSTRUCTIONS - IFR TO KANSAS CITY - OVER." On the runup pad, call Clearance Delivery and request your clearance. The frequency is probably one specifically designated for clearance delivery; however, it may be the same as ground control. Some airports still do not have a clearance delivery listed in AIM. In this case, ground control will deliver your clearance at the runup pad without request.



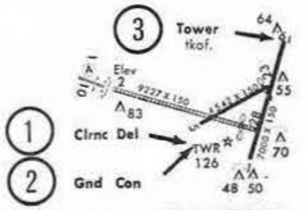
LAFAYETTE

Dayton Tower' 119.9 122.5R **Gnd Con** 121.9
Clrnc Del 120.35

Lafayette Tower 118.5 122.5R **Gnd Con** 121.7
Clrnc Del 121.7

Portland Tower 118.7 122.7R 119.0 **Gnd Con** 121.9
ATIS: 126.9

At a controlled airport with pre-taxi clearance delivery.** Contact clearance delivery to request your clearance before you taxi. If you are unable to contact clearance delivery, advise ground control. Ground control may then clear you to taxi and will either read your clearance or return you to clearance delivery.



NEW ORLEANS INTL (MOISANT FIELD)

Moisant Tower 119.9 122.7R **Gnd Con** 121.9
‡ **Clrnc Del:** 127.2

Rogers Tower 118.3 122.7R **Gnd Con** 121.9
‡**Clrnc Del** 121.9

**Locations where these procedures are in effect are indicated by a ‡ preceding "Clearance Delivery" in Part 3, "Airport/Facility Directory," AIM.

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Things to remember

When the controller states "CLEARANCE ON REQUEST," he is advising you that he does not have your clearance but has requested it from the ATC Center.

To help prevent a delay, allow 30 minutes for your IFR flight plan to be processed before you request your clearance.

Request your clearance within 10 minutes of your proposed taxi time.

Don't be surprised if you receive a SID in the departure clearance, or a STAR in the final phase of the enroute flight, without requesting one, because ATC can now issue one without a request. See Chapter 4, "Preflight" and "Departures" in Part 1 of AIM.

Pilot participation with pre-taxi clearance delivery is not mandatory; however, the procedure is performed at a time when there is less pressure on the pilot for other duties. In addition, any delay in receiving the clearance is spent on the parking ramp instead of the runup pad.

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FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM® NO. 36

LOST COMMUNICATIONS PROCEDURES - ALTITUDE REQUIREMENTS

Recent analyses of responses received on the Instrument Rating (Airplane) Written Test indicate that many applicants are confused regarding altitudes to be flown when two-way communications failure occurs. This Exam-O-Gram will attempt to clarify the most important procedures.

Assume you are planning a "round robin" IFR flight from Pueblo Memorial Airport, Pueblo, Colorado, by the route shown on your flight plan in Figure 1. The Enroute Low Altitude Chart segment route is shown in Figure 2. The FSS weather briefing you receive indicates IFR conditions for the entire route. Prior to taxiing, you contact "Clearance Delivery" and receive this clearance: AIR REAMER TWO ONE ONE TWO YANKEE CLEARED AS FILED - MAINTAIN SEVEN THOUSAND - MAINTAIN RUNWAY HEADING FOR VECTOR TO VICTOR TEN - SQUAWK ZERO SEVEN ZERO ZERO JUST BEFORE DEPARTURE - DEPARTURE CONTROL WILL BE ONE TWO FIVE POINT TWO.

FEDERAL AVIATION AGENCY
FLIGHT PLAN
Form Approved. Budget Bureau No. 04-R072.3

1. TYPE OF FLIGHT PLAN: ☐ FVFR ☐ VFR ☒ IFR ☐ DVFR
2. AIRCRAFT IDENTIFICATION: N2112Y
3. AIRCRAFT TYPE/SPECIAL EQUIPMENT: AIR REAMER 250/A
4. TRUE AIRSPEED: 150 KNOTS
5. POINT OF DEPARTURE: PUB
6. DEPARTURE TIME: PROPOSED (Z) 1400 ACTUAL (Z)
7. INITIAL CRUISING ALTITUDE: 120
8. ROUTE OF FLIGHT: V-10 TODD V-169 KING V-210 GORDON V-19 PUB VOR

Figure 1

After takeoff, you contact Departure Control and receive vectors to intercept V-10. Established on V-10, you receive further clearance from Departure Control: AIR REAMER TWO ONE ONE TWO YANKEE REPORT LEAVING SIX THOUSAND - EXPECT FURTHER CLEARANCE TO EIGHT THOUSAND AT ORDWAY INTERSECTION - CONTACT DENVER CENTER ON ONE TWO SIX POINT SIX NOW.

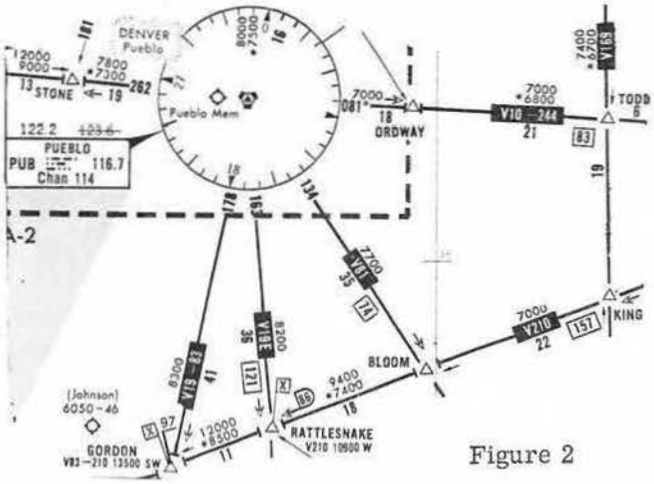

Figure 2

When you attempt to contact Denver Center, you experience complete two-way communications failure! What is the correct procedure? Let's consider the rules set forth in FAR Part 91 which you must know and follow. If you are in VFR conditions, or subsequently encounter VFR conditions, you ". . . shall continue the flight under VFR conditions and land as soon as practical." Since this Exam-O-Gram concerns only altitude requirements, consider the route to be ". . . AS FILED." According to FAR Part 91, you shall fly ". . . at the highest of the following altitudes for the route segment being flown: (1) the altitude last assigned; (2) the MEA; or (3) the altitude you were advised to expect in a further clearance (EFC).

Let's review your present situation. You requested 12,000 feet in the flight plan but were advised to ". . . EXPECT FURTHER CLEARANCE TO EIGHT THOUSAND AT ORDWAY INTERSECTION." Review the Low Altitude Chart segment (Figure 2) and note that you would fly the EFC altitude of 8,000 feet from ORDWAY to BLOOM Intersections. Why? Because the 8,000 feet in the EFC is higher than any of the MEAs before BLOOM Intersection. From BLOOM to RATTLESNAKE Intersections, the MEA of 9,400 feet is higher than the EFC altitude of 8,000 feet, so you would fly the MEA. Notice the Minimum Crossing Altitude (MCA) of 10,900 feet at RATTLESNAKE when flying West on V-210. You must observe this minimum altitude restriction also. Therefore, you must initiate a climb prior to reaching RATTLESNAKE to cross this Intersection at or above 10,900 feet. You encounter a still higher MEA of 12,000 feet between RATTLESNAKE and GORDON Intersections. You must continue the climb to 12,000 feet to comply with this MEA. For the remainder of your flight from GORDON Intersection to PUB VOR, you must descend to 8,300 feet to comply with the MEA altitude requirement for this segment of your route.

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Have you observed the rules regarding altitude requirements? Yes, you maintained the highest of the applicable altitudes for the ". . . route segment being flown." Obviously, your problem would have been much simpler had you received a clearance to 12,000 instead of 8,000 feet. The altitude you requested in the Flight Plan would have met, or exceeded, the altitude requirements along your route.

Consider some of the other procedures associated with complete two-way communications failure while on an IFR flight. Remember the procedures for transponder operation? Squawk Code 7600 if you have only two-way communications failure; Squawk Code 7700 if an emergency exists. Do not forget to monitor the navigational aids which are able to transmit voice. ARTC and FSS personnel will attempt to contact you on any means at their disposal. Help them to help YOU! As part of your preflight action, you should become familiar with the aids and facilities which are available along your route. To rephrase an old saying . . . "There are three things which are absolutely useless to a pilot: (1) the altitude above you, (2) the runway behind you, and (3) the preflight planning you DID NOT do!"

References: FAR Part 91 and AIM Part I.

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DEPARTMENT OF TRANSPORTATION

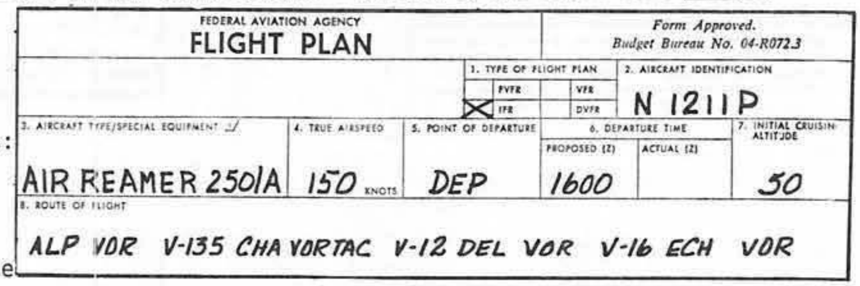
Federal Aviation Administration

IFR PILOT EXAM-O-GRAM® NO. 37

LOST COMMUNICATIONS PROCEDURES -- ROUTE REQUIREMENTS

When complete two-way radio communications failure occurs in an IFR environment, air traffic control is predicated on certain "anticipated pilot actions." These "actions" or procedures are set forth in FAR Part 91 and the AIM, Part I. In the interest of flight safety, it is your responsibility to know them. IFR Exam-O-Gram No. 36 concerned only altitude requirements. Analyses of responses received on the Instrument Rating (Airplane) Written Tests indicate that many applicants are confused regarding route requirements under two-way radio communications failure.

Today's airplanes operating IFR are usually equipped with dual communications and navigational equipment. The chance that you will be unable to receive any ATC instructions is rather remote; nevertheless, it does happen. Procedures have been established to follow when this "possibility" becomes a reality. Let us review these procedures as they apply to ROUTE requirements under conditions of complete two-way radio communications failure. Continued IFR operations in VFR conditions may adversely affect other users of the airspace. Why? Certain airspace must be reserved and protected for aircraft on IFR flight plans. Therefore, one basic rule always applies "...if you are in VFR conditions, or subsequently encounter VFR conditions, REMAIN VFR and land as soon as practicable." In IFR flight conditions, observe these rules: Follow (1) the last ATC clearance received, or (2) if being radar vectored, by the fix, route, or airway specified in the vector clearance, or (3) the "Expected Further Clearance" routing. In the absence of rules (1), (2), and (3), then proceed by the flight planned route you filed with ATC.



FEDERAL AVIATION AGENCY

FLIGHT PLAN

Form Approved.
Budget Bureau No. 04-R072.3

1. TYPE OF FLIGHT PLAN: ☐ FVFR ☐ VFR ☒ IFR ☐ DVFR

2. AIRCRAFT IDENTIFICATION: N 1211P

3. AIRCRAFT TYPE/SPECIAL EQUIPMENT 1/: AIR REAMER 250/A

4. TRUE AIRSPEED: 150 KNOTS

5. POINT OF DEPARTURE: DEP

6. DEPARTURE TIME: PROPOSED (Z) 1600 ACTUAL (Z)

7. INITIAL CRUISING ALTITUDE: 50

8. ROUTE OF FLIGHT: ALP VOR V-135 CHA VORTAC V-12 DEL VOR V-16 ECH VOR

Figure 1

Let us take some examples. You are on an IFR flight, in a radar environment, from Departure Municipal Airport to Destination Municipal Airport via the flight plan in Figure 1. The Enroute Low Altitude Chart segment is depicted in Figure 2. Example #1: Clearance Delivery gives you this IFR clearance: "AIR REAMER ONE ONE PAPA - CLEARED AS FILED...." Radio failure occurs after takeoff. In this situation, fly the "last ATC clearance" (Rule #1) which is the same as the "flight planned route." Example #2: Assume the takeoff clearance read: AIR REAMER ONE ONE PAPA - CLEARED TO BRAVO VOR - ....EXPECT FURTHER CLEARANCE PRIOR TO BRAVO VOR...." Radio failure occurs prior to receiving the EFC routing. You should follow "the last ATC clearance" (Rule #1) to Bravo VOR, then the "flight planned route" to the destination. Example #3: Assume now that you do receive an "EFC routing" prior to Bravo VOR which reads "...EXPECT FURTHER CLEARANCE VIA VICTOR ONE SIXTY NINE BEAR - VICTOR TWELVE DELTA - VICTOR SIXTEEN ECHO - DIRECT DESTINATION." You should proceed to Destination Municipal Airport via this EFC Routing (Rule #3). A radar vector clearance (Rule #2) is illustrated in Example #4: You are proceeding "AS FILED...." After passing Delta VOR, ATC issues this clearance: "AIR REAMER ONE ONE PAPA - TURN LEFT TO TWO ONE ZERO FOR VECTOR TO DESTINATION INITIAL APPROACH FIX...." Radio failure occurs after you acknowledge this clearance. Observe Rule #2 and proceed as specified in the ATC clearance.

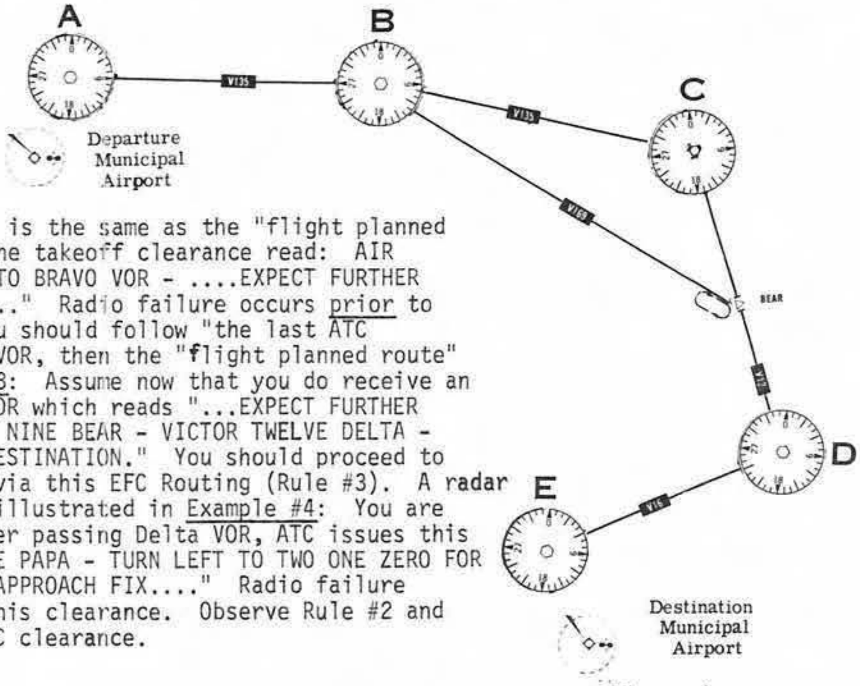


Figure 2

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If ATC did not receive your acknowledgement of the new route clearance, they would have to protect BOTH the old and new routes until they determined which route you were flying. Your acknowledgement of any ATC clearance will determine the procedure(s) you and ATC will use. Acknowledgement may be given (at ATC's request) by changing transponder code, "squawking" IDENT, or by executing an identifying turn. Contact with you in this case would probably be through some navigational aid frequency.

Review the AIM, Part I, EMERGENCY PROCEDURES. Always exercise sound judgment and good operating practices in all cases of two-way radio communications failure. You can be sure you will receive "top priority" handling from ATC. After you land, find a telephone and call the nearest ATC facility and tell them what happened. It is a very small price to pay for the service ATC has provided you. Remember...a search will be initiated 30 minutes after your ETA has expired if you have not been heard from. If you are found in a coffee shop some time after you have landed safely, it could prove to be embarrassing! A future Exam-O-Gram will discuss the procedures to use with regard to executing the instrument approach under conditions of two-way communication failure.

REFERENCES: FAR Part 91 and AIM Part I.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

IFR PILOT EXAM-O-GRAM® NO. 38

LOST COMMUNICATIONS PROCEDURES -- APPROACH REQUIREMENTS

This is the third and final in a series of IFR Exam-O-Grams pertaining to operations in an IFR environment with complete two-way communications failure. IFR Exam-O-Gram No. 36 deals with altitude requirements; No. 37 with route requirements. Responses received on the Instrument Rating (Airplane) Written Test indicate that many applicants do not know the correct procedures to follow in conjunction with descent and execution of an instrument approach when complete two-way communications failure occurs. This Exam-O-Gram will attempt to clarify the most commonly misunderstood procedures.

There are three situations that could exist when you reach your destination. Let's take an example of each. Example #1: You arrive at a designated approach fix and have NOT received an approach clearance or holding instructions. The time you should begin descent for the approach in this case is the flight planned ETA (as amended with ATC). Should you arrive ahead of the ETA, hold at the radio fix used for the approach in the holding pattern depicted on the approach chart. If no holding pattern is depicted, hold on the side of the final approach course on which the procedure turn is prescribed. If you should arrive after the ETA, descend for the approach immediately upon reaching the fix.

The next two situations involve holding instructions. If ATC issues holding instructions at your destination, they will include an Expect Approach Clearance (EAC), or Expect Further Clearance (EFC) time. Let's review these items. The EAC is "...the time at which it is expected that an arriving aircraft will be cleared to begin approach for landing." The EFC is "...the time at which it is expected that additional clearance will be issued to an aircraft." An EFC is not issued for an approach fix; only for fixes which are not considered part of the approach procedure in use, such as an outer limit or enroute navigational fix.

Example #2: If you are cleared to a holding fix with an EFC time (and experience two-way communications failure prior to reaching the fix), proceed to the fix and hold until the EFC time. At the EFC time, depart the holding fix and proceed to the fix from which the approach begins, then follow the procedure described in Example #1. A holding fix may or may not be the same as the approach fix, depending upon the type of approach used.

Example #3: If you receive an EAC, and the holding fix and the fix from which the approach begins are the same, begin descent for the approach at the EAC time. If the holding fix is NOT the same as the fix from which the approach begins, leave the holding fix to arrive over the fix from which the approach begins at, or as close as possible to, the EAC time received. Begin descent upon arrival at this fix where the approach begins, but not before the EAC time. The same would be true if due to navigation equipment failure you must execute another approach procedure.

Remember, it is pilot's discretion as to the type of approach that is to be made. The airspace will be cleared of other known IFR traffic for a period of 30 minutes. The simplified diagram may help you to understand when and where you should begin descent for an approach in the event of complete two-way communications failure.

SITUATION	LEAVE HOLDING	DESCENT FOR THE APPROACH	
		WHEN	WHERE
1- No holding instructions received	-------------	Not before ETA	At approach fix
2- Holding with an EFC	At the EFC time	Same as above	Same as above
3- Holding with an EAC (Holding fix is not the same as approach fix)	To arrive at the approach fix at the EAC time	Not before EAC	Same as above
4- Holding with an EAC (Holding fix is the same as the approach fix)	At the EAC time	Same as above	Same as above

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Your preflight actions should include a thorough check of pertinent NOTAMs and a review of the approach procedure(s) for the destination airport. The decision as to the type of instrument approach you plan to make at your destination should be based on the type of equipment installed in the airplane, weather conditions, and the operational status of the components and visual aids for the approach considered (NOTAM information). This item of the preflight planning should be as thorough as for the enroute portion of the proposed flight. Arrival at the approach fix is NOT the time to locate the procedures charts and try to figure out how the approach is to be flown! The preflight portion of your flight, therefore, should receive a dedicated effort.

* * * * * *

As a summation of the two-way communications failure procedures we have discussed in these three Exam-O-Grams, this simplified chart may be helpful.

ROUTE:
- A-Last ATC clearance received; or
- B-EFC routing received; or
- C-Flight planned route

ALTITUDE/FLIGHT LEVEL: (Observe the highest of)
- A-ATC assigned; or
- B-Minimum IFR altitude/flight level; or
- C-EFC altitude/flight level

LEAVE HOLDING FIX: (Instructions received)
- A-At EFC (if received); or
- B-To make EAC (if received)

DESCENT FOR APPROACH: (When reaching approach fix)
- A-At EAC time; or
- B-At ETA time (no EAC received); or
- C-Immediately (no EAC and ETA is past)

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IFR PILOT EXAM-O-GRAM* NO. 39

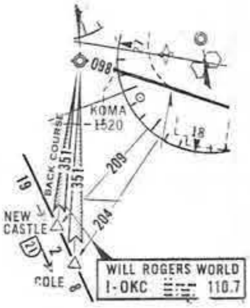
ENROUTE CHART INFORMATION

Analyses of Instrument Pilot (Airplane) Written Test results indicate that many pilots are unable to correctly interpret pertinent information of the Enroute Low Altitude Charts. Every pilot using these charts should be thoroughly familiar with all the information presented. Some of the symbols on the charts are listed here with appropriate explanations.

Aerodrome Information

This symbol (▷) indicates a published SDF (Simplified Directional Facility) procedure is available. The SDF approach is similar to a no-glide-slope localizer approach except that the SDF course is seldom aligned with the runway centerline. The course may be wider, thereby giving less precise guidance than an ILS localizer.

Two symbols are used to show that published ILS approach procedures are available. How the localizer course is used determines which symbol will be depicted.



This symbol (▷———) indicates that the localizer has an <u>ATC function</u> in addition to providing course guidance for an ILS or LOC approach. The localizer course is used in conjunction with another NAVAID to establish an intersection or reporting point, e.g., COLE Intersection. When the back course of the Localizer has this ATC function, the words "Back Course" are printed near this symbol, e.g., NEW CASTLE.

This symbol (➤) indicates that the localizer is used only to provide course guidance for an ILS or LOC approach and <u>does not</u> have an ATC function.

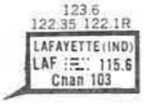
If the blue or feathered side is on the right portion of the symbol, a <u>front course</u> localizer is depicted; a symbol with the blue or feathered side on the left depicts a <u>back course</u>.

* * * * * * * * * * * * *

Radio Aids to Navigation and Communication Boxes

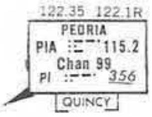
Recent significant changes have been made in the presentation of certain information pertinent to air/ground communications. These changes are discussed here with examples of each. The NAVAID information remains basically unchanged.

Air/Ground Communication Boxes



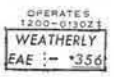
<u>Heavy line</u> boxes indicate Flight Service Stations. Air/ground frequencies normally available at all FSSs are 122.2 and 255.4; emergency frequencies are 121.5 and 243.0. Additional frequencies are listed above each box if they are available. All frequencies transmit and receive unless annotated with (R) receive only, or (T) transmit only. These letters indicate the capability of the FSS on that particular frequency.

Triangles in the upper corners of a heavy line box indicate that Enroute Flight Advisory Service is available on frequency 122.0. This frequency is <u>not</u> shown with the communications box. The voice call is "Seattle Flight Watch."



<u>Thin line</u> boxes indicate no Flight Service Stations unless communications frequencies are shown above the depiction and the controlling FSS name is shown below. Frequencies positioned above thin lined boxes are remoted to the NAVAID site (PEORIA) and are controlled by the FSS named below (QUINCY.)

Radio Aids to Navigation Boxes



A star before an LF/MF frequency indicates that operation is less than continuuous, or on request.

(NOTE: This Exam-O-Gram covers information previously covered in IFR Exam-O-Grams 12 and 13 which have been discontinued.)

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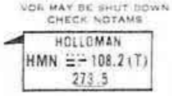
Slash marks through any frequency or channel indicate an abnormal operational status. Underprint and NOTAMs should be checked for affected data.

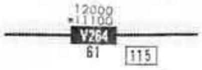


VOR, VORTAC, and TACAN aids are classified according to their use. A (T) indicates Terminal. Normal usable altitude is 12,000 feet and below within 25 NM. (Refer to AIM, Part I for a more detailed explanation.)

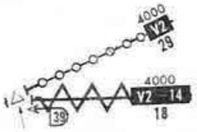
Note: Any frequency in a NAVAID box which is underlined indicates NO VOICE is transmitted on that frequency. TACAN channels have no voice capability but are never underlined.

* * * * * * * * * * * * * *

Air Traffic Services and Airspace Information

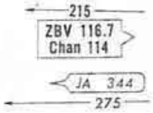


An airway with this overlay (——) indicates that a flight would penetrate Special Use Airspace and denotes an Airway Restriction. Refer to the Enroute Charts for pertinent operational information. ATC assumes the responsibility for issuing or denying you clearance to operate along this airway. Check NOTAMs for any change to the published information.



This symbol (-o-o-o-) indicates a Substitute Route Structure for an airway which is closed to normal navigation. Check current NOTAMs for NAVAID facility outages.

This symbol (⋀⋀) denotes the closed or unusable segment of an airway.



Offset arrows indicate the navigational facility forming the reporting point or intersection. When used in conjunction with a VHF/UHF facility, the arrow depicts a radial outbound; when used with an LF/MF facility, the arrow shows the bearing inbound. When the NAVAID used is not obvious, the name will be indicated in the Facility Locator adjacent to the radial or bearing arrow.

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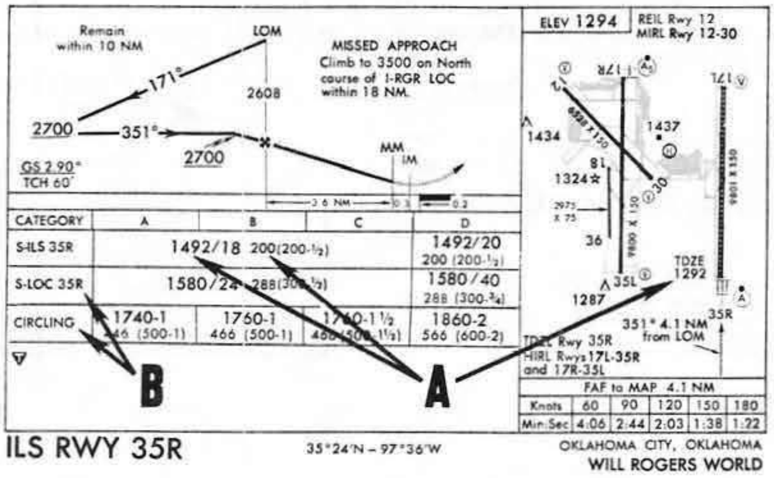
IFR PILOT EXAM-O-GRAM° NO. 40

The ILS Category II Approach Procedure - What is it?

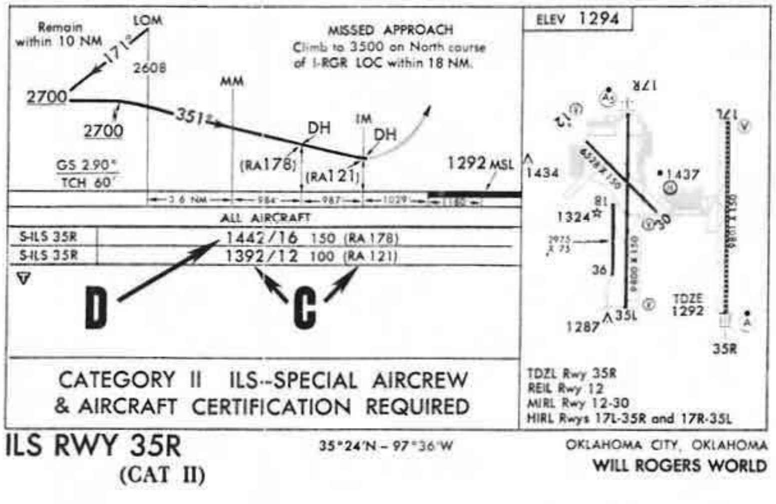
Analyses of written test results indicate that many applicants are not aware of the differences between the ILS Category I and ILS Category II instrument approach procedures. This Exam-O-Gram is intended to compare these two approaches. Your training and experience for the instrument rating should have familiarized you with the "normal" ILS Category I approach procedure which allows an airplane, using an electronic glide slope, to descend to decision heights (DHs) no lower than 200 feet above the highest elevation in the touchdown zone (TDZ), Figure 1, Arrow A. The minimum visibility requirements vary with approach and runway lighting, but are in no case lower than RVR 18 for approach category A, B, and C, and RVR 20 for approach category D. In addition, the ILS Category I approach procedure provides for localizer-only and circling approach minimum discent altitudes (MDAs), Figure 1, Arrow B.

FIGURE 1



How then, does the ILS Category II approach, commonly referred to as "CAT II," differ from the ILS Category I approach? A CAT II operation is defined as a straight-in ILS approach to a runway of an airport under an ILS instrument approach procedure that includes lower than Category I decision heights and visibility minimums. Compare the glide slope depictions in Figures 1 and 2. Notice that the CAT II approach allows descent to lower DHs. Specifically, for the "full" CAT II, the DHs are to 100 feet and the minimum visibility requirement is 1,200 feet RVR. The DHs are given in both barometric (MSL) and radio altimeter (RA) values (Figure 2, Arrow C). The barometric DH is referenced to the TDZE just as in the ILS Category I approach. The RA DH coincides with the MSL DH location and includes the height of the electronic glide slope above the terrain at that point.

FIGURE 2



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Because of SPECIAL AIRCREW & AIRCRAFT CERTIFICATION requirements, not all instrument rated pilots are authorized to execute a CAT II approach. Normally, only air carrier operators possess the training facilities and equipment necessary to accomplish the certification requirements. Even then, approval for use of the full CAT II minima is granted only after a record of consistently successful performance at CAT II "Interim" minima (Figure 2, Arrow D) which provides for DHs to 150 feet and a minimum visibility requirement of 1,600 feet.

For a "full" CAT II approach procedure to be approved, certain ground equipment is necessary, in addition to that required for ILS Category I operations. Included in this equipment are runway centerline lighting (RCL), touchdown zone lighting (TDZL), and sequenced flashers with the approach lighting system (ALS). Although a pilot may not be authorized to use the CAT II instrument approach procedure, these aids should greatly enhance the visual cues observed during a Category I approach to a runway certificated for CAT II operations under all visibility conditions.

Aircrew and aircraft requirements for ILS Category I and II operations are contained in FAR Parts 61 and 91. Additionally, information regarding Category II holding lines and ground operations in the vicinity of the Category II localizer and glide slope equipment is discussed in IFR Exam-O-Gram No. 28.

To accommodate future airplane and airport capabilities and requirements, Category III approach procedures are being formulated. These approaches and requirements are given below primarily for your information and to illustrate the degree of equipment sensitivity and aircrew certification that will be required.

	Decision Heights	Visibility/RVR
Category III A	None	700 feet
Category III B	None	150 feet
Category III C	None	None

References: FAR Parts 61, 91, and AIM Part I

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NATIONAL AIRMEN INFORMATION SYSTEM

Analyses of responses received on the Instrument Rating (Airplane) Written Tests indicate that many applicants do not fully understand the National Notices to Airmen (NOTAM) System. This Exam-O-Gram will attempt to explain how the NOTAM system keeps you informed of changes within the National Airspace System (NAS). The National Flight Data Center (NFDC) was established by the FAA to operate a central aeronautical information center for the collection, validation, and dissemination of aeronautical data in support of the activities of government, industry, and the aviation community. This information, which affects the NAS, is disseminated by three methods: (1) Aeronautical Charts, (2) Airman's Information Manual, and (3) the NOTAM system. These methods are designed to complement and support each other. The basic difference is the frequency of issuance. The NOTAM system is designed to inform pilots, as well as other users, of changes in the NAS that occur so rapidly that time does not permit issuance on a chart or in the appropriate publication. NOTAMs are categorized as follows: Landing Area NOTAMs, Lighting Aid NOTAMs, Air Navigation Aid NOTAMs, Special Data NOTAMs, and Regulatory (FDC) NOTAMs.

Data which is of a "time-critical" nature that could affect the safety of flight operations, and which is given all-circuit or "distant" dissemination, is a NOTAM (D). Such items might be: "ILS glide slope out of service," or "VOR out of service," or perhaps an airport or a particular runway closed. When changes such as these cannot be included in the AIM or Aeronautical Charts, they are appended to the hourly Aviation Weather Reports (SAs). Only NOTAM (D) data is presented in this manner. Below is a brief explanation of how this information can be interpreted and used for flight planning purposes.

(NOTAM symbols and codes used in the SA reports.)

(→) - Indicates that NOTAM information follows. This is either textual data, or reference, to a previous NOTAM. (Refer to Ⓐs below.)
(↘) - Indicates that NOTAM information is current. (Refer to Ⓑ below.)
9/32 - Accountability Number. Each NOTAM is assigned its own AC number. (Refer to Ⓒs below.)

Figure 1 - New NOTAM (D) information in textual form appended to the SA report.

```
IAH 55 SCT E250 OVC 5HK 179/70/60/1205/006/BINOVC→ IAH 9/32
IAH ILS GS 8 OTS                                 Ⓐ      Ⓒ
```

Figure 2 - Data which was previously transmitted in textual form in three separate NOTAMs; e.g., ACs 10/10, 10/15, and 10/17. (Refer to the NOTAM Summary (NOSUM), Figure 3, to determine the actual text.)

```
CLL SP E5 OVC 2RF 220/50/49/3615G25/018/ LE42 RB43 CIG RGD PK WND
3430/29→ CLL↘10/10 10/15 10/17
        Ⓐ    Ⓑ  Ⓒ     Ⓒ     Ⓒ
```

Figure 3 -

```
→ NOSUM 191702
→ DAL 9/23 GVT ILS LOM OTS
→ CLL 10/10 CLL 4-22 CLSD TURBO ACFT
→ CLL 10/15 LOA DME OTS 15-2000
→ CLL 10/17 CLL 10/28 CLSD
→ TUL 10/6  TUL 8-26 CLSD
→ TUL 10/10 MEE VOR OTS
```

(NOSUMs are transmitted hourly for a specific geographical area and immediately follow the SA reports.)

Data that is primarily of a "nice-to-know" nature, and does not meet NOTAM (D) criteria is disseminated as a NOTAM (L). This information receives only local coverage. Examples of this might be "men and equipment on runway," "large flocks of birds in the vicinity of the airport," or "a portion of a taxiway closed." Dissemination is by telautograph, telephone, control towers, and FSSs for airports without control towers and during periods when control towers are not in operation. NOTAM (L) data is available to pilots upon request, or on an "as needed" basis when departing, enroute, or landing. Information of this nature might also be included in local ATIS broadcasts. NOTAM (L) information is not appended to the hourly SA reports, nor is it included in, or referred to, in the hourly NOSUM.

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Information concerning changes that affect the enroute structure or instrument approach procedures is disseminated by the NFDC as FDC NOTAMs. They are issued in compliance with a Federal Aviation Regulation and are, therefore, considered regulatory in nature. FDC NOTAMs are initially given "all circuit" dissemination. If the data is still in effect at the publication dates, the FDC NOTAMs will appear in the AIM, Part 3A. FDC NOTAMs are classified as: Flight Information/Temporary (FI/T), and Flight Information/Permanent (FI/P), and each is identified as such on the teletype transmission and in the AIM, Part 3A. FI/T indicates conditions that are expected to exist for less than 45 days; FI/P, more than 45 days. The symbol (#) denotes a new FDC NOTAM. Refer to Examples A and B below.

Example A

```
FDC 6/1055  FI/T  MIAMI  INTERNATIONAL  MIAMI  FL.
RNAV  RWY 9L AMDT 6 RNAV RWY 27R AMDT 3 VOR RWY 12
AMDT 20 VOR RWY 30 AMDT 3 NDB RWY 9L AMDT  13  ILS
RWY  9L AMDT 21 ILS RWY 9R AMDT 1 ILS RWY 27L AMDT
16 ILS RWY 27R AMDT 6 RADAR-1  AMDT  16  CRCG  MDA
520FT HAA 510FT CAT A B C.
```

Example B

```
#FDC 6/1304 FI/P WYOMING ENROUTE LOW ALT  AIRWAYS.
V298  DBS  VORTAC  TO  DHW VORTAC CHANGEOVER POINT
15NM  DNW.   V298  DNW  VORTAC   TO   BOY   VORTAC
CHANGEOVER  POINT  15NM  DHW.  V298S DNW VORTAC TO
CROWHEART INT MEA 14000FT MOCA 13500FT  CHANGEOVER
POINT 15NM DNW.
```

Twice each day NFDC transmits a listing of FDC NOTAM numbers transmitted during the previous 12 and 24 hours. Notice that only the Accountability Numbers and location identifiers are given. (Refer to Example C.)

Example C

```
FDC LIST OCT 221330
→ FDC 6/1279 FDC LHW
→ FDC 6/1280 FDC ORH
→ FDC 6/1281 FDC BAF
→ FDC 6/1282 FDC LAX
```

FSS personnel are solely responsible for the classification, formatting, dissemination, and monitoring the currency of NOTAM (D)s and NOTAM (L)s. The NFDC has the primary responsibility for FDC NOTAMs. In the interest of flight safety, you should determine if any NOTAMs exist which could affect flight operations. For additional information, contact an FSS or other ATC facility.

References: AIM, Part 1

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