

# NOTICE

U.S. Department of Transportation  
Federal Aviation Administration

N 7110.157

7/16/96

Cancellation  
Date: 7/16/97

## SUBJ: WAKE TURBULENCE

1. **PURPOSE. THIS IS A SAFETY NOTICE.** The guidance contained herein supersedes the guidance provided in the current edition of Order 7110.65, Air Traffic Control, relating to selected wake turbulence separations and aircraft weight classifications. This Notice will work in conjunction with Order 7110.65J. Guidance contained in Order 7110.65J will continue to apply where not superseded by this Notice. With minor exception, the new classifications and separation standards are developed for application to IFR arrivals. The information contained in this notice will be incorporated into Order 7110.65J, Change 5.

2. **DISTRIBUTION.** This directive is distributed to the division level in Washington and Regional Air Traffic and Flight Standards offices, the William J. Hughes Technical Center, the Mike Monroney Aeronautical Center, Air Traffic and Flight Standards field offices, selected DoD offices, and FAA contract towers.

3. **BACKGROUND.** Several safety recommendations have been made by the Associate Administrator for Regulation and Certification, (AVR-1), relating to wake turbulence. These recommendations included changes to aircraft weight classes in order to provide additional protection for aircraft weighing 41,000 pounds or less; increased separation for small aircraft following an arriving Boeing 757, and the cancellation of approval authority when a pilot requests to deviate from prescribed wake turbulence separation when departing behind a Boeing 757 or an aircraft weighing more than 255,000 lbs (Heavy).

4. **ACTION.** Apply wake turbulence procedures to aircraft operating behind heavy jets, Boeing 757's, and where indicated to small aircraft behind large aircraft. (Reference para. 2-1-19, Wake Turbulence, of Order 7110.65J).

a. For the purposes of Wake Turbulence Separation minima, the weight classification definitions of Heavy, Large, and Small are as follows:

(1) Heavy. Aircraft capable of takeoff weights of more than 255,000 pounds whether or not they are operating at this weight during a particular phase of flight.

Distribution: A-W(AT/TO/TR/TA/TX/FS)-2; A-X(AT/FS)-2;  
A-YZ-1; A-FAT/FFS-O(MAX); DOD (select);  
ZAT-464

Initiated By: ATO-120

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(2) Large. Aircraft of more than 41,000 pounds maximum certificated takeoff weight, up to 255,000 pound.

(3) Small. Aircraft of 41,000 pounds or less maximum certificated takeoff weight. (Reference, Pilot/Controller Glossary, Aircraft Classes).

**NOTE:** The SF-340 and ATR-42 will be exempt from the small category and will be classified as large aircraft for separation purposes. On-going studies by NASA may exempt other aircraft in the future.

b. In addition to paragraph 5-5-3, Minima, separate a small aircraft landing behind a Boeing 757 aircraft landing on the same runway, or making a touch-and-go, stop-and-go, or low approach by ensuring a minimum of 5 miles will exist at the time the preceding aircraft is over the landing threshold.

c. In addition to paragraph 3-9-7, Wake Turbulence Separation for Intersection Departures, separate a small aircraft weighing 12,500 lbs or less taking off from an intersection on the same runway (same or opposite direction takeoff) behind a preceding small aircraft weighing more than 12,500 lbs by ensuring the following small aircraft does not start takeoff roll until at least 3 minutes after the preceding aircraft has taken off. Specific pilot initiated requests to deviate from the 3 minute wake turbulence interval may be approved.

d. Air traffic controllers shall not approve pilot requests to deviate from the required wake turbulence time interval/distance if the preceding departing aircraft is a Boeing 757 or an aircraft classified as Heavy.

**NOTE:** Aircraft listed in Order 7110.65, Appendix A, Aircraft Information, have changed to a new weight class as indicated in Appendix 1, New Weight Class, of this Notice.

5. The information contained in this notice will be incorporated into Order 7110.65J, Change 5.

  
C. Roger Wall  
Program Director for Air Traffic Operations

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Appendix 1

APPENDIX 1, NEW WEIGHT CLASS

Aerospaciale NOVO-262 Super Broccard	NO26	Small
Aerospaciale SN 601 Conv.	6601	Small
Aerospaciale Tempico	T809	Small
Avions Cap 10/b	CP10	Small
BAe HS 125 Series 400A	HS25	Small
BAe HS 125 Series 600A	HS25	Small
BAe HS 125 Series 700A	HS25	Small
BAe HS 125 Series 800/1000	BA10	Small
BAe Jetstream 31	B31	Small
BAe Model 4100 Jetstream	BA41	Small
Beech Airliner 1900-C	BE02	Small
Beech Super King Air 300	BE30	Small
Beech Super King Air 350	BE3B	Small
Beech Starship, Model 2000	BEST	Small
Beechjet 400	BE40/BJ40	Small
Bushmaster Model 2000	BU20	Small
Casa C-212-200 Aviocar	CA21/CS12	Small
Cessna Citation II	C850	Small
Cessna Citation III	C850	Small
Cessna Citation V	C860	Small
Dassault FAL-10	DA01	Small
Dassault FAL-20	DA02	Small
Dassault FAL-200	DA20/HU25	Small
Dassault FAL-50	DA05	Small
DHC-4 Caribou	DH4	Small
Domier Do 228-200 Series	DO82	Small
Embraer EMB-120	E120	Small
Fairchild Merlin IVC	SW3	Small
Fairchild Metro III	SW3	Small
Gates Learjet 24	LR24	Small
Gates Learjet 25	LR25	Small
Gates Learjet 28/29	LR28/LR29	Small
Gates Learjet 31	LR31	Small
Gates Learjet 35A/36A	LR35/LR36	Small
Gates Learjet 54-55-56	LR55	Small
Grumman Albatross	G84/U16	Small
Grumman Goose/Super Goose	G21	Small
Gulfstream I	G159	Small
Grumman Mallard	G73	Small
Grumman Widgeon/Super Widgeon	G44	Small
HFB-320 Hansa	HF32	Small
IAI 1123 Westwind	WW23	Small
IAI 1124 Westwind	WW24	Small
IAI Arava 201	RV01	Small
IAI Astra 1125 Westwind	AJ25	Small
Learfan 2100	LRF	Small
MDC Super DC-3	DC35/C117	Small
MDC-DC-3	DC3	Small
Messner-Bolkow-Blohm HFB 320	ME32	Small
Mitsubishi Diamond MU-300	MU3	Small
Piaggio PD-808 Vespa Jet	P808	Small
Rockwell Jet Commander	AC21	Small

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\* Dehavilland Dash-8 DHC-8

DH-8  
D328  
LR60

\*\*\* Dornier DO 328 100  
\*\*\* Gates Learjet 40

Small Large  
Small  
Small Page 1

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## Section 5. RADAR SEPARATION

### 5-5-1. APPLICATION

a. Radar separation shall be applied to all RNAV aircraft operating on a random (impromptu) route at or below FL 450.

b. Radar separation may be applied between:

1. Radar identified aircraft.

2. An aircraft taking off and another radar-identified aircraft when the aircraft taking off will be radar-identified within 1 mile of the runway end.

3. A radar-identified aircraft and one not radar-identified when either is cleared to climb/descend through the altitude of the other provided:

(a) The performance of the radar system is adequate and, as a minimum, primary radar targets or ASR-9/Full Digital Radar Primary Symbol targets are being displayed on the display being used within the airspace within which radar separation is being applied, and

(b) Flight data on the aircraft not radar-identified indicate it is a type which can be expected to give adequate primary/ASR-9/Full Digital Radar Primary Symbol return in the area where separation is applied, and

(c) The airspace within which radar separation is applied is not less than the following number of miles from the edge of the radar display:

(1) When less than 40 miles from the antenna—  
6 miles;

(2) When 40 miles or more from the antenna—  
10 miles;

(3) Narrowband radar operations— 10 miles,  
and

(d) Radar separation is maintained between the radar-identified aircraft and all observed primary, ASR-9/ Full Digital Radar Primary Symbol, and secondary radar targets until nonradar separation is established from the aircraft not radar identified, and

(e) When the aircraft involved are on the same relative heading, the radar-identified aircraft is vectored a sufficient distance from the route of the aircraft not radar identified to assure the targets are not superimposed prior to issuing the clearance to climb/descend.

#### REFERENCE-

FAAO 7110.65, EXCEPTIONS, Para 4-1-2.

FAAO 7110.65, ROUTE USE, Para 4-4-1.

FAAO 7110.65, APPLICATION, Para 5-3-1.

FAAO 7110.65, ADDITIONAL SEPARATION FOR FORMATION FLIGHTS, Para 5-5-7.

FAAO 7110.65, APPROACH SEPARATION RESPONSIBILITY, Para 5-9-5.

### 5-5-2. TARGET SEPARATION

Apply radar separation:

a. Between the centers of primary radar targets; however, do not allow a primary target to touch another primary target or a beacon control slash.

b. Between the ends of beacon control slashes.

#### NOTE-

At TPX-42 sites, the bracket video feature must be activated to display the beacon control slash.

c. Between the end of a beacon control slash and the center of a primary target.

d. All-Digital Displays: Between the centers of digitized targets. Do not allow targets to touch.

#### REFERENCE-

FAAO 7110.65, SIMULTANEOUS ILS/MLS APPROACHES- DUAL & TRIPLE, Para 5-9-7.

### 5-5-3. MINIMA

Separate aircraft by the following minima:

#### NOTE-

Wake turbulence procedures specify increased separation minima required for certain classes of aircraft because of the possible effects of wake turbulence.

a. Broadband Radar System or ASR-9/Full Digital Terminal Radar System:

1. When less than 40 miles from the antenna— 3 miles.

2. When 40 miles or more from the antenna— 5 miles.

#### EN ROUTE

b. Stage A / DARC and EARTS Mosaic Mode:

#### NOTE-

Mosaic Mode combines radar input from 3 to 15 sites into a single picture utilizing a mosaic grid composed of radar sort boxes.

1. Below FL 600— 5 miles.

2. At or above FL 600— 10 miles.

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3. Within 40 miles of the antenna and below FL 180- Facility directives may specify 3 miles.

**NOTE-**

Where a significant operational advantage is obtained by modifying a radar site adaptation to single site coverage, facility directives are required to define the areas where 3-mile separation applies.

**REFERENCE-**

FAAO 7210.3, SINGLE SITE COVERAGE STAGE A OPERATIONS, Para 10-20.

4. When transitioning from terminal to en route control, 3 miles increasing to 5 miles or greater, provided:

- (a) The aircraft are on diverging routes/courses, and/or,
- (b) The leading aircraft is and will remain faster than the following aircraft, and,
- (c) Separation constantly increasing and the first center controller will establish 5 NM or other appropriate form of separation prior to the aircraft departing the first center sector, and,
- (d) The procedure is covered by a letter of agreement between the facilities involved and limited to specified routes and/or sectors/positions.

c. EARTS Sensor Mode:

**NOTE-**

- 1. Sensor mode displays information from the radar input of a single site.
- 2. Procedures to convert Earts Mosaic Mode to EARTS Sensor Mode at each PVD will be established by facility directive.

- 1. When less than 40 miles from the antenna 3 miles.
- 2. When 40 miles or more from the antenna 5 miles.

**WAKE TURBULENCE APPLICATION**

d. Separate aircraft operating directly behind, or directly behind and less than 1,000 feet below, or following an aircraft conducting an instrument approach by:

**NOTE-**

Consider parallel runways less than 2,500 feet apart as a single runway because of the possible effects of wake turbulence.

- 1. Heavy behind heavy- 4 miles.

- 2. Small/large/heavy behind B-757- 4 miles.

- 3. Small/large behind heavy- 5 miles.

(See FIG 5-5-1 and FIG 5-5-2).

- 4. Small behind B-757 - 5 miles.

**Aircraft Separation**

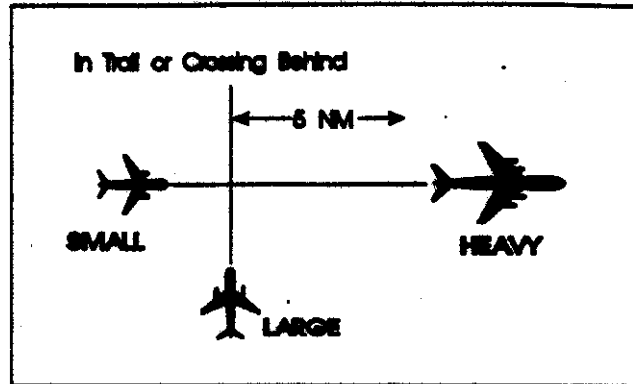


FIG 5-5-1

**Aircraft Separation**

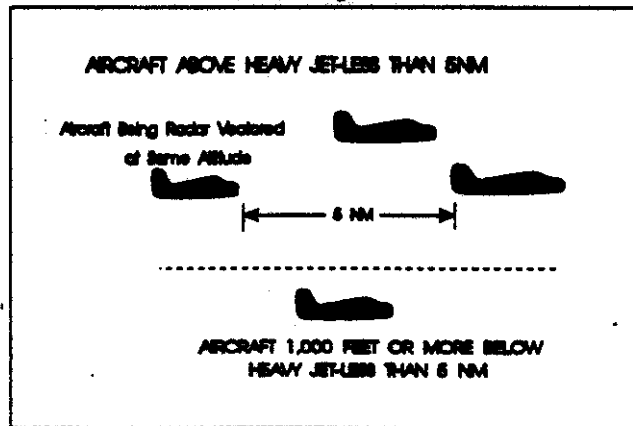


FIG 5-5-2

**WAKE TURBULENCE APPLICATION**

e. **TERMINAL:** In addition to subpara d, separate an aircraft landing behind another aircraft on the same runway, or one making a touch-and-go, stop-and-go, or low approach by ensuring the following minima will exist at the time the preceding aircraft is over the landing threshold:

**NOTE-**

Consider parallel runways less than 2,500 feet apart as a single runway because of the possible effects of wake turbulence.

- 1. Small behind large- 4 miles.
- 2. Small behind A B-757 - 5 miles.
- 3. Small behind heavy- 6 miles.

f. **TERMINAL:** 2.5 nautical miles (NMs) separation is authorized between aircraft established on the final

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approach course within 10 NMs of the landing runway when:

1. The leading aircraft's Weight Class is the same or less than the trailing aircraft;
2. Heavy aircraft and the Boeing 757 are permitted to participate in the separation reduction as the trailing aircraft only;
3. An average runway occupancy time of 50 seconds or less is documented;
4. DBRITE/BRITE/TCDD displays are operational and used for quick glance references;

**REFERENCE-**  
USE OF TOWER RADAR DISPLAYS, Para 3-1-9c.

5. Turnoff points are visible from the control tower.

**REFERENCE-**  
FAAO 7110.65, WAKE TURBULENCE, Para 2-1-19.  
FAAO 7110.65, SAME RUNWAY SEPARATION, Para 3-9-6.  
FAAO 7110.65, PASSING OR DIVERGING, Para 5-5-6.  
FAAO 7110.65, SEPARATION FROM OBSTRUCTIONS, Para 5-5-8.  
FAAO 7110.65, SUCCESSIVE OR SIMULTANEOUS DEPARTURES, Para 5-8-3.  
FAAO 7110.65, APPROACH SEPARATION RESPONSIBILITY, Para 5-9-5.  
FAAO 7110.65, SEQUENCING, Para 7-6-7.  
FAAO 7110.65, SEPARATION, Para 7-7-3.  
FAAO 7110.65 SEPARATION, Para 7-8-3  
FAAO 7210.3, REDUCED SEPARATION ON FINAL, Para 12-46.

#### 5-5-4. VERTICAL APPLICATION

Aircraft not laterally separated, may be vertically separated by one of the following methods:

- a. Assign altitudes to aircraft, provided valid mode C altitude information is monitored and the applicable separation minima is maintained at all times.

**REFERENCE-**  
FAAO 7110.65, VERTICAL SEPARATION MINIMA, Para 4-5-1.  
FAAO 7110.65, VALIDATION OF MODE C READOUTS, Para 5-2-18.  
FAAO 7110.65, SEPARATION, Para 7-7-3.  
FAAO 7110.65, SEPARATION, Para 7-8-3.  
FAAO 7110.65, SEPARATION, Para 7-9-4.

- b. Assign an altitude to an aircraft after the aircraft previously at that altitude has been issued a climb/descent clearance and is observed (valid Mode C), or reports, leaving the altitude.

#### NOTE-

① Consider known aircraft performance characteristics, pilot furnished and/or Mode C detected information which indicate that climb/descent will not be consistent with the rates recommended in the AIM.

② It is possible that the separation minima described in para 4-5-1, para 7-7-3, para 7-8-3, or para 7-9-4 might not always be maintained using subparagraph b.

However, correct application of this procedure will ensure that aircraft are safely separated because the first aircraft must have already vacated the altitude prior to the assignment of that altitude to the second aircraft.

**REFERENCE-**  
FAAO 7110.65, PROCEDURAL PREFERENCE, Para 2-1-3.  
FAAO 7110.65, VERTICAL SEPARATION MINIMA, Para 4-5-1.  
FAAO 7110.65, VALIDATION OF MODE C READOUTS, Para 5-2-18.  
FAAO 7110.65, APPLICATION, Para 6-6-1.

#### 5-5-5. EXCEPTIONS

- a. Do not use Mode C to effect vertical separation with an aircraft on a cruise clearance, contact approach, or as specified in FAAO 7110.65, para. 5-15-4 e.

**REFERENCE-**  
FAAO 7110.65, EXCEPTIONS, Para 6-6-2.  
FAAO 7110.65, CONTACT APPROACH, Para 7-4-6.  
PICG TERM- CRUISE.

- b. Assign an altitude to an aircraft only after the aircraft previously at that altitude is observed at or passing through another altitude separated from the first by the appropriate minima when:

1. Severe turbulence is reported.
2. Aircraft are conducting military aerial refueling.

**REFERENCE-**  
FAAO 7110.65, MILITARY AERIAL REFUELING, Para 9-3-10.

3. The aircraft previously at that altitude has been issued a climb/descent at pilot's discretion.

#### 5-5-6. PASSING OR DIVERGING

- a. **TERMINAL:** Vertical separation between aircraft may be discontinued when the following conditions are met:

1. Aircraft are on opposite/reciprocal courses and you have observed that they have passed each other or; aircraft are on same or crossing courses and one aircraft has crossed the projected course of the other and the angular difference between their courses is at least 15 degrees.

2. The tracks are monitored to ensure that the primary targets, beacon control slashes, or full digital terminal system primary and/ or beacon target symbols will not touch.

**REFERENCE-**  
FAAO 7110.65, COURSE DEFINITION, Para 1-2-2.

- b. **EN ROUTE:** Vertical separation between aircraft may be discontinued when they are on opposite courses as defined in paragraph 1-2-2; and

1. You are in communications with both aircraft involved; and

2. You tell the pilot of one aircraft about the other aircraft, including position, direction, type; and

3. One pilot reports having seen the other aircraft and that the aircraft have passed each other; and

4. You have observed that the radar targets have passed each other; and

5. You have advised the pilots if either aircraft is classified as a heavy/B757 aircraft.

6. Although vertical separation may be discontinued, the requirements of para 5-5-3d. and e. must be applied when operating behind a heavy/B757 jet.

#### EXAMPLE-

"Traffic, twelve o'clock, Boeing seven twenty seven, opposite direction. Do you have it in sight?"

(If the answer is in the affirmative):

"Report passing the traffic."

(When pilot reports passing the traffic and the radar targets confirm that the traffic has passed, issue appropriate control instructions).

#### 5-5-7. ADDITIONAL SEPARATION FOR FORMATION FLIGHTS

Because of the distance allowed between formation aircraft and lead aircraft, additional separation is necessary to ensure the periphery of the formation is adequately separated from other aircraft, adjacent airspace, or obstructions. Provide supplemental separation for formation flights as follows:

a. Separate a standard formation flight by adding 1 mile to the appropriate radar separation minima.

**REFERENCE-**  
FAA ORDER 7110.65, FORMATION FLIGHTS, PARAGRAPH 2-1-13.  
FAA ORDER 7110.65, APPLICATION, PARAGRAPH 5-5-1.  
FAA ORDER 7110.65, SEPARATION, PARAGRAPH 7-7-3.  
PICG TERM- FORMATION FLIGHT.

b. Separate two standard formation flights from each other by adding 2 miles to the appropriate separation minima.

c. Separate a nonstandard formation flight by applying the appropriate separation minima to the perimeter of the airspace encompassing the nonstandard formation or from the outermost aircraft of the nonstandard formation whichever applies.

d. If necessary for separation between a nonstandard formation and other aircraft, assign an appropriate beacon code to each aircraft in the formation or to the first and last aircraft in-trail.

#### NOTE-

The additional separation provided in para 5-5-7 is not normally added to wake turbulence separation when a formation is following a heavier aircraft since none of the formation aircraft are likely to be closer to the heavier aircraft than the lead aircraft (to which the prescribed wake turbulence separation has been applied).

#### REFERENCE-

FAAO 7110.65, MILITARY AERIAL REFUELING, Para 9-3-10.

#### 5-5-8. SEPARATION FROM OBSTRUCTIONS

a. Except in En route Stage A / DARC or Stage A / EDARC, separate aircraft from prominent obstructions depicted on the radar scope (displayed on the video/geo map, scribed on the map overlay, or displayed as a permanent echo) by the following minima:

1. When less than 40 miles from the antenna- 3 miles.

2. When 40 miles or more from the antenna- 5 miles.

b. Except in En route Stage A / DARC or Stage A / EDARC,, vertical separation of aircraft above a prominent obstruction displayed as a permanent echo may be discontinued after the aircraft is passed it.

c. En route Stage A / DARC or Stage A / EDARC,: Apply the radar separation minima specified in paragraph 5-5-3b. 1.

#### NOTE-

The determination of what constitutes a prominent obstruction is made locally after coordination with appropriate flight standards representatives. Prominent obstructions shall be displayed as permanent echoes on the radar display using parrots, MTI reflectors, or RTQC symbols. Digital map marks (DMM) may be used to mark obstructions. DMM'S are not to be used alone for map alignment but in conjunction with one or more of the permanent echo marking devices. When RTQC alone is used for obstruction marking, it shall be certified by airway facilities per the appropriate certification manual.

#### 5-5-9. ADJACENT AIRSPACE

a. If coordination between the controllers concerned has not been effected, separate radar-controlled aircraft from the boundary of adjacent airspace in which radar separation is also being used by the following minima:

#### REFERENCE-

FAAO 7110.65, COORDINATE USE OF AIRSPACE, Para 2-1-14.