Apron. **FAC: 1131**

CATCODE: 113321
OPR: AFCEC/COS
OCR: AF/A3O-A

1.1. **Description.** Aprons are paved areas provided for aircraft parking, servicing/fueling, loading/unloading, and boarding/deplaning. The area includes parking lanes, taxi lanes, exits and entrances. Although the use of the apron is covered by specific regulations (e.g., required lighting on vehicles transiting the area), it is typically more accessible to users than the runway or taxiway. Apron space is necessary for operational aircraft; alert aircraft; transient aircraft; the loading and unloading of cargo aircraft; mission support aircraft (Base Flight); aircraft undergoing depot maintenance; and aircraft access to hangars, docks, and shelters.

1.2. **Requirements Determination.** Aprons are individually designed to support specific aircraft and missions at a particular installation. The actual dimensions of an apron are based on the number of authorized aircraft, maneuvering space, and type of activity the apron serves. See Chapter 6 of UFC 3-260-01 for further guidance.

1.2.1. **Cargo Loading.** Air Mobility Command (AMC) aircraft are authorized an apron for terminal operations. Apron size is determined by the type of cargo aircraft involved, the volume of traffic, the nature of the loading and unloading operation, and associated equipment and facilities.

1.2.2. **Commercial Aircraft.** Commercial aircraft operations under Air Force contract are provided an additional apron for terminal operations. Apron size is based on individual projects and missions but does not exceed the size required to operate ten large commercial aircraft.

1.2.3. **Hazardous Cargo.** Aircraft carrying hazardous cargo do not use the apron. Separate facilities, such as Dangerous Cargo Pad (**CATCode 116662**), serve this need.

1.2.4. **Mission Support Aircraft (Base Flight).** All assigned mission support aircraft are provided apron space.

1.2.5. **Transient Aircraft.** Transient aircraft such as courier aircraft, personnel airlifts, administrative flights, AMC aircraft, and en route aircraft delayed by bad weather are provided an apron. The apron is designed to accommodate the average daily number of transient aircraft requiring parking space. The average daily number is determined from base records from previous years. A maximum of 16,700 m^2 (20,000 yd^2) is permitted at new bases where the demand cannot be predicted.

1.3. **Scope Determination.** A proper apron allowance is the amount required to afford maximum operational efficiency with a minimum amount of paving. The paragraphs below describe the basis for calculating apron allowances for various types of operations. Paragraph 1.3.7 describes a method for estimating apron requirements for broad planning purposes. High threat areas may require additional pavement to meet aircraft dispersal requirements.

1.3.1. **Access to Hangars, Docks, and Shelters.** Apron configuration is influenced

by the size of the door openings and by the dimensions and turning radius of the largest aircraft using the buildings. A mass apron or a taxiway configuration is used depending on access requirements. To avoid building non-usable pavement, design for adequate wingtip clearances of any obstacles near the apron.

1.3.2. **Assigned Aircraft.** Assigned aircraft consist, at a minimum, of the Primary Assigned Aircraft (PAA) inventory established from the funded flying program for the base. Many bases have other aircraft inventory that require a parking apron. This inventory varies by base and depot repair cycles. These aircraft may be annotated as backup inventory, ready reserve, or attrition reserve. Account for the monthly average of these non-primary assigned aircraft remaining on station in determining apron requirements.

1.3.3. **Operational Aircraft.** Operational aircraft are parked on mass aprons, strip aprons, or where authorized, on dispersed stubs. To determine how many operational aircraft require apron space, proceed as follows: Begin with 100 percent of the assigned aircraft as established by official documents (see exceptions in paragraph 1.3.6 for AMC aircraft); subtract the number of aircraft located on separate aprons, such as alert aircraft; subtract the number of aircraft located in maintenance hangars or docks under normal maintenance schedules; and finally, subtract aircraft that are parked elsewhere on existing paving of a suitable nature and location. Other factors affecting the size and configuration of aprons for operational aircraft follow:

1.3.4. **Aircraft Parking Arrangements.** On a typical mass apron, aircraft are parked in rows and spaced according to the dimensions given in Table 1, 2, 3, and 5 (***NOTE:*** Additional criteria can be found in Army ETL 1110-3-394, *Engineering and Design – Aircraft Characteristics for Airfield- Heliport Design and Evaluation,* and in Chapter 6 of UFC 3-260-01). This spacing permits aircraft to move in and out of parking places under their own power. Parking arrangements should be studied carefully to achieve the parking layout that requires the least amount of pavement per parked aircraft. One example of the possibilities for economy is changing the parking arrangement on an apron for eight aircraft from four rows of two aircraft to two rows of four aircraft, resulting in reduced pavement requirements by 20 percent.

1.3.5. **Parking for Fighter Type Aircraft.** Some aircraft are often parked at an angle. This is an efficient way to achieve adequate clearance to dissipate the temperature and velocity of jet blast to levels that do not endanger aircraft or personnel; that is, about 38°C (100°F) and 56 kph (35 mph). To achieve adequate dissipation of heat and blast, some aircraft require a wider lane than shown in Figure 1 (below). To achieve a safe lane width, obtain the minimum safe distance to the rear of a jet engine operating at 80 percent power from the appropriate aircraft technical order. If this distance exceeds 38.1 m (125 ft), minimize pavement requirements by parking aircraft so that two rows of aircraft blast into a common lane, with alternate lanes of minimum taxiway width. See paragraph 6-13 of UFC 3-260-01 and ETL 07-3, *Jet Engine Thrust Standoff Requirements for Airfield Asphalt Pavements*, for additional information on jet engine thrust standoff requirements.

1.3.6. **Parking for Air Mobility Command (AMC) Aircraft Tanker Aircraft.** Parking for all large AMC Aircraft (e.g., C-17, KC-10, and like-size aircraft) requires apron parking spots for 75 percent of the difference between PAA and the number of covered maintenance spaces. CONUS parking spots should be sized for the AMC Generic Aircraft (e.g., C-17 Wing Span, KC-10 Length, KC-10 Height). This provision specifically does not apply to C-5 and C130 aircraft. This provision does not limit authorization for additional apron parking required to support transient, back-up inventory, or other mission-needs as described above. The load-bearing pavement extends 11.4m (37.5 ft) beyond the centerline of the aircraft (the same as the peripheral taxiway). Any pavement beyond is shoulder pavement.

1.3.7. **Estimating New Apron Requirements.** For broad planning purposes, use the following method to estimate new apron requirements. Multiply the wingspan of the selected aircraft by its length. Multiply the product by a factor of 5.3 (use a factor of 4.4 for fighter type aircraft). ***EXAMPLE:*** To estimate apron requirements for ten (10) C-17 aircraft, multiply 51.8 m x 52.7 m x 10 aircraft x 5.3 factor = 145,000 m^2 of apron needed. This is a planning tool for sizing new aprons only and should not be used to estimate the number of aircraft (specifically, large aircraft) that can park on an existing apron. Many variables such as length, width, and taxi lane locations determine an existing apron's suitability to support specific aircraft types. At existing bases, develop a conceptual aircraft parking plan to determine the apron square meter requirements.

1.4. **Dimensions.**

1.4.1. **Parking Dimensions.** Table 1 presents the minimum geometric criteria for fixed-wing apron design. When designing new aprons for AMC bases hosting C- 5, C-17, KC-10, and KC-135 aircraft, provide 15.3 m (50 ft) of wingtip separation. ***EXCEPTION:*** When you are rehabilitating an existing apron, provide the maximum wingtip separation the existing apron size allows (up to 15.3 m [50 ft] but not less than 7.7 m [25 ft]). This additional separation is both desirable and permitted.

1.4.2. At non-AMC bases, the maximum separation which can reasonably be provided for these aircraft is desirable. At a minimum, ensure these separations always meet current aircraft Technical Order (TO) requirements.

Table 1. Aircraft Block Dimensions.

Aircraft[1]	Wingspan		Length		Height		Min. Distance Between Wings, Parked Aircraft[6]	
	m	ft	m	ft	m	ft	m	ft
B-1	22.7 to 41.7	77.8 to 136.7	46	150.7	10.3	33.6	6.1	20.03
B-2	52.1	172	20.9	69	5.1	17.0	See MAJCOM	
B-52	56.4	185	47.8	156.6	12.4	40.8	7.7	25.03
C-5	67.9	222.7	75.6	247.8	19.9	65.1	7.7 to 15.3	25 to 50
C-9	28.5	93.4	36.4	119.3	8.4	27.5	3.1	10.0
C-17	51.8	170	52.7	173	16.8	55.1	7.7 to 15.3	25 to 50
C-21	12	39.5	14.8	48.6	3.7	12.25	3.1	10.0
C-27J (JCA)	28.7	94.16	22.7	74.48	9.7	31.82	6.1	20.0
C-130	40.4	132.6	30.4	99.5	11.7	38.5	6.1	20.0
C-130J	40.4	132.6	32.34	106.1	12	39.4	6.1	20.0
KC-135	39.9	130.8	41.5	136.2	12.7	41.7	15.3	50.04
KC-10	50.4	165.3	55.5	182.1	17.7	58.1	15.3	50.04
E-3	44.4	145.7	46.6	152.9	12.9	42.2	6.1	20.0
E-4	59.7	195.7	70.7	231.8	19.6	64.3	6.1	20.0
T-1A	13.3	43.5	14.7	48.4	4.1	13.8	3.1	10.0
T-3A	10.6	35	7.3	24.8	2.4	7.8	3.1	10.0
T-6	10.2	33.5	10.2	33.4	3.26	10.7	3.1	10.0
T-37	10.3	33.8	8.9	29.3	2.8	9.2	3.1	10.0
T-38	7.7	25.3	14.1	46.3	3.9	12.9	3.1	10.0
T-41	10.9	35.8	8.2	26.9	2.7	8.8	3.1	10.0
T-43	28.4	93	30.5	100	11.3	37.0	3.1	10.0

NOTES:

1. Dimensions vary for different models and configurations of aircraft.
2. Setback distances for peripheral or through taxi lanes should be based on the largest wingspan of aircraft that frequently uses the taxiway. Example: If E-4s taxi past a ramp of KC-10, taxilane should be based on the wingspan of the E-4.
3. See paragraph 1.4.5.3.
4. Tankers require a 15.2 m (50 ft) separation from wingtip to wingtip to accommodate fuel load change requirements. (See paragraph 1.4)
5. For aircraft not listed, the minimum wingtip clearance is 3 - 7.7 m (10 - 25 ft) for wingspans < 33.5 m (110 ft) and 7.7 - 15.3m (25 - 50 ft) for wingspans 33.5 m (110 ft) or more.
6. The criteria within Table 2 do not apply during contingencies. In these cases, refer to the current aircraft Technical Order. In locations where the mix of aircraft changes during contingencies, consider the use of universal aircraft servicing pit locations to maximize hydrant utilization and reduce turn times.

Table 2. Wingtip Clearances for Taxiing Aircraft[1].

Minimum Clearance Where Taxi Lanes are Marked on the Pavement	Aircraft with Wingspans ≥33.5 m	Aircraft with Wingspans ≥110 ft	Aircraft with Wingspans <33.5 m	Aircraft with Wingspans <110 ft
	m	ft	m	ft
Wingtip clearance of moving aircraft taxiing on peripheral or through length of apron taxi lanes	15	50	9	30
Wingtip clearance on each side of moving aircraft taxiing in lanes between parked aircraft	9	30	6	202

NOTES:
1. Another factor requiring evaluation when developing aircraft parking plans is aircraft exhaust wake velocity. Check the particular aircraft performance guide for wind velocity and temperature ranges to assess safe distances for nearby aircraft facilities.
2. For transient aircraft, the minimum clearance is 7.6 m (25 ft).

Table 3. Angled Aircraft Parking, Aircraft Dimensions and Separation Distances.

Aircraft[1]	Wing Space		Length		Height		Dimension C[2]		Dimension D[2]	
	m	ft	m	ft	m	ft	m	ft	m	ft
A-10	17.5	57.5	16.2	53.3	4.5	14.9	14.3	47.0	29.3	96.0
ATA	see MAJCOM									
F-5	8.5	28	15.8	51.7	4.0	13.2	12.2	40.0	16.5	54.0
F-15	13	42.8	19.4	63.8	5.9	19.2	16.5	54.0	22.9	75.0
F-16	10	32.8	14.5	47.6	5.0	16.4	12.2	40.0	18.6	61.0
F-22A	13.6	44.5	18.9	62.1	5.1	16.6	16.8	55.0	24.4	80.0
F-35A	10.7	35	15.7	51.5	4.3	14.2	13.7	45.0	19.8	65.0
F-117	13.2	43.4	19.8	65.1	3.8	12.4	Note 3		Note 3	

NOTES:
1. Dimensions vary between different models and configurations of aircraft.
2. See Figure 1 for parking layout and dimensions C and D.
3. Not known at time of publication. Contact AF/A4L.

1.4.3. **Taxi Lanes.** Interior and peripheral taxi lanes must exceed the required width for aircraft parked in the area if larger aircraft must taxi through en route to docks, hangars, or pads. Confine this width variation to the fewest taxi lanes possible.

1.4.4. **Peripheral Taxi Lanes.** Taxi lanes are not provided along the rear edge of aprons unless required for access to docks or hangars or to meet a critical need for alternate circulation routes for aircraft operating on the apron. On peripheral taxi lanes where the apron is designed for aircraft with wingspans up to 33.5 m (110 ft), the aircraft are expected to taxi along the outer 15.24 m (50 ft) of pavement. Where the apron is designed for aircraft with wingspans of 33.5 m (110 ft) or more, the peripheral taxi lane is the outer 22.9 m (75 ft) of pavement. Therefore, wing overhang areas beyond the paved shoulder are not normally paved, but they may require stabilization to prevent damage from jet blast.

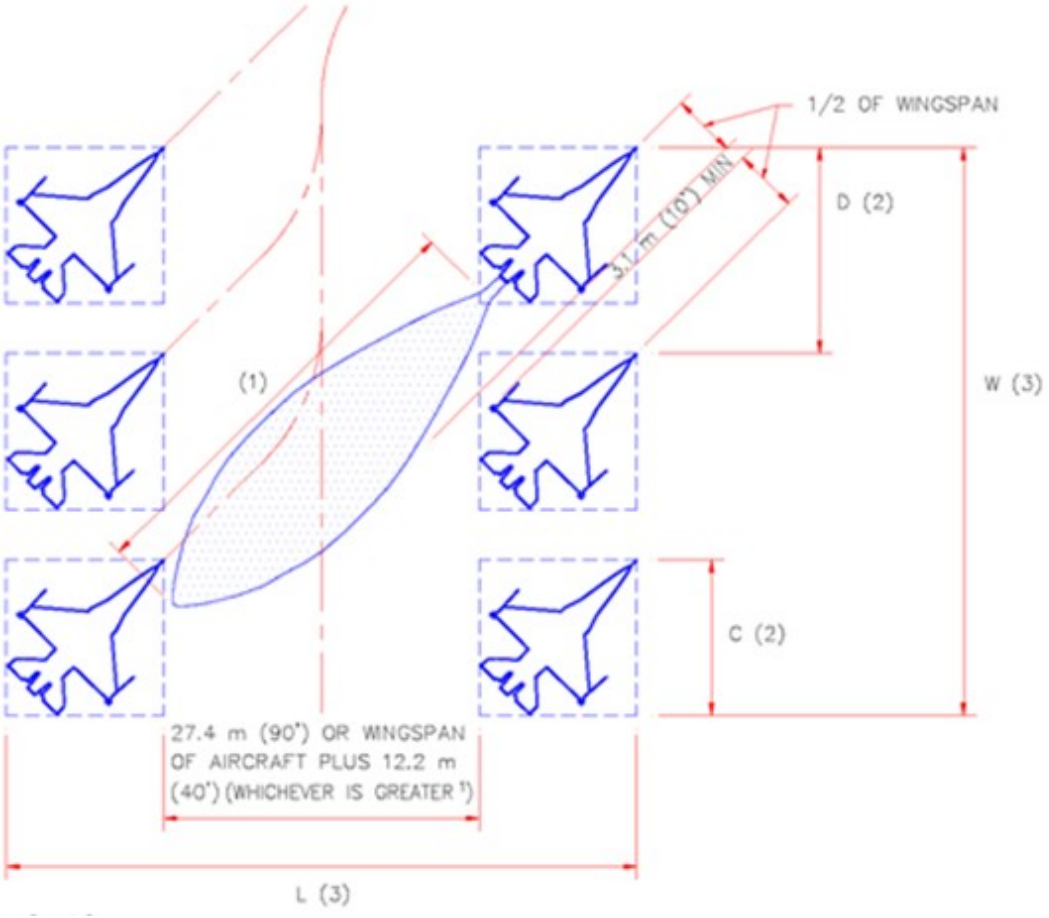
1.4.5. **Air Combat Command (ACC) Alert Area Parking Criteria.** Alert Pad Apron layout criteria are provided in paragraph 6-13 of UFC 3-260-01. Ensure the established, day-to-day, ACC alert parking areas conform to the standards stated below as well as those outlined in Table 4, which shows the distance from the nose or wingtip of the parked aircraft to the centerline of the egress taxiway, measured perpendicular to the taxiway centerline.

1.4.5.1. Nose or wingtip to centerline criteria are based on the largest aircraft taxied along the egress taxiway regardless of the type of aircraft being parked.

1.4.5.2. Desired distances are reduced, as required, down to, but not below, the specified minimum when space is limited due to a lack of ramp area.

1.4.5.3. The wingtip clearance between parked alert aircraft is 15.2 m (50 ft). Distances are measured along a line perpendicular to the aircraft centerline to provide a 15.2 m (50 ft) wingtip passing clearance when aircraft exit the parking spot.

Figure 1. Angled Parking of Typical Jet Fighter Aircraft[5].



NOTES:

1. See paragraph 1.3.5 for additional criteria.
2. See Table 3 for Dimensions C and D.
3. Find dimensions W and L as follows:
W = D*(NW -1) + C
L = C*(NL - 1) + IT
Where:
W = Width of operational parking apron.
L = Length of operational parking apron.
C = Block dimension of aircraft.
D = 1.414 (wingspan + 3.1 m (10 ft)).
NW = Number of aircraft per row in width of apron.
NL = Number of aircraft per row in length of apron.
IT = 27.4 m (90 ft) or wingspan plus 12.2 m (40 ft) if greater than 27.4 m (90 ft). (Also consider safe distance for jet blast which may be a greater distance.)
4. Aircraft with forward-firing munitions should be reviewed as to safety concerns and a Commander's Risk Assessment performed according to AFMAN 91-201.
5. The criteria in Figure 1 are minimums. Further separation is permitted and desired.

Table 4. Nose-to-Centerline Distances.

Aircraft Types	Desired Separations		Minimum Separations	
	m	ft	m	ft
B-52 or B-52 mixed force B-1 B-2	45.7	150.0	38.1	125.0
KC-135	38.1	125.0	30.5	100.0
KC-10	30.5	100.0	22.9	75.0

1.4.6. **ACC Waivers.**

1.4.6.1. ACC Numbered Air Force (NAF) Director of Operations may grant waivers to the 15.2 m (50 ft) wingtip clearance when sufficient ramp area is unavailable. In no case may the wingtip clearance be waived to less than 9.1 m (30 ft).

1.4.6.2. If the distance between the nose or wingtip and the egress taxiway centerline is below the desired distance stated in Table 4, increase the NAF minimum waiverable wingtip distance, 9.1 m (30 ft), by 0.31 m (1 ft) for each 0.31 m (1 ft) reduction in nose-to-taxiway centerline distance. For example, the B-52 nose-to-taxiway centerline of 43 m (140 ft) is 3.1 m (10 ft) below the desired distance; therefore, the minimum NAF waiverable wingtip distance is12.2 m (40 ft). If the B-52 nose-to-centerline distance is 39.6 m (130 ft) or less, the minimum wingtip clearance of 15.2 m (50 ft) would be required.

1.4.7. **Apron for Helicopters.**

1.4.7.1. Parking space is provided for helicopters as follows: for six or more assigned helicopters, provide apron space for 80 percent of the total assigned helicopters; for fewer than six assigned helicopters, provide apron space for all. Apron dimensions are based on the separation distances for parked helicopters given in Table 5 or the US Army rotary wing criteria presented in Chapter 6 of UFC 3-260-01.

1.4.7.2. For a rough estimate of the apron area needed, obtain the block area each helicopter occupies by multiplying its operating length by its operating width, then multiply each block area by 13.

1.4.7.3. The apron is usually part of, or contiguous to, the main airfield apron. Helicopter Pads (**CATCode 116663**) are built for isolated operations.

Table 5. Helicopter Apron Parking.

Helicopter Type[1]	Operating Length		Operating Width		Minimum Distance Between Centerline of Parked Aircraft[2]		Minimum Interior and Perimeter Taxi Lane Width[3]	
	m	ft	m	ft	m	ft	m	ft
CH/HH-53B/C	26.9	88.3	22.0	72.3	44.0	144.5	55.1	180.7
HH-1H	17.4	57.1	14.7	48.3	29.5	96.7	44.2	145.0
UH-1N 57	17.5	57.3	14.6	48.0	29.3	96.0	43.9	144.0
UH/TH-1F/P	17.4	57.1	14.6	48.0	29.3	96.0	43.9	144.0
HH-60	19.8	64.9	16.4	53.7	32.7	107.4	40.9	134.2
HH-47	30.1	98.9	18.3	60.0	36.6	120.0	45.7	150.0
CV-22	17.5	57.3	25.9	85.0	38.9	127.5	74.7	245.04

NOTES:
1. Dimensions vary between different models and configurations of helicopters.
2. Distances represent two rotor diameters between center lines of parked aircraft, except for CV-22.
3. Widths represent two and one-half rotor diameters for wheeled helicopters and three-rotor diameters for skid-mounted helicopters.
4. For CV-22, interior, or secondary peripheral taxilane width, including rotor tip clearance is 51.8 m (170 ft). Through, or primary peripheral taxilane width, including rotor tip clearance is 74.7 m (245 ft.). Centerlines of peripheral taxilanes are positioned 7.62 m (25 ft) inward from the apron boundary marking. See UFC 3-260-01, Figure 6.38.

1.5. **Design Considerations.** All aprons are built of heavy, modified heavy, medium, light load, and auxiliary-load pavement as described in Chapter 3 of UFC 3- 260-02. Apron shoulders are constructed of existing soils, thoroughly compacted, and covered with turf or a soil binder. Paved shoulders are authorized as indicated under Paved Shoulders (**CATCode 116642**).

1.5.1. Hangar access aprons and floors are designed to support a maximum aircraft load of 163,000 kg (360,000 pounds) for heavy and modified heavy-load pavements and a maximum load of 118,000 kg (260,000 pounds) for a medium-load pavement. This pavement is capable of supporting the basic, empty weight of all aircraft undergoing maintenance, including the largest aircraft. (The basic empty weight is the weight of the aircraft stripped of cargo, ammunition, and all but entrapped fuel.)

1.5.2. Pavement for alert hangar and shelter floors are designed for either light- load, medium-load, modified heavy-load, or heavy-load as specified earlier in this chapter.

1.5.3. Layout of aircraft parking locations and taxi lanes should consider aircraft taxiing routes when an aircraft is refueled. Refueling operations should not prevent an aircraft from leaving the parking apron.

1.5.4. Other factors include the arrangement of refueling outlets, explosives clearances, required clearances to fixed or mobile objects (see UFC 3-260-01), and the siting of blast deflectors.