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Civil Engineering

STANDARDS FOR MARKING AIRFIELDS

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This instruction implements Air Force policy directive (AFPD) 32-10, *Installations and Facilities*. It provides Air Force standards for marking airfield pavements and obstructions. It gives the minimum level of marking necessary for paved surfaces of runways, taxiways, helipads, and the surfaces of obstructions. (See Engineering Technical Letter (ETL) 04-7, *C-130 and C-17 Landing Zone (LZ) Dimensional, Marking, and Lighting Criteria*, for landing zone marking requirements.) It applies to all Air Force activities except those operating at airports owned and controlled by an authority other than the Department of Defense (DoD). For airports under Federal Aviation Administration (FAA) jurisdiction, use FAA Advisory Circular (AC) 150/5340-1, *Standards for Airport Markings*. For DoD facilities overseas, if a written agreement exists between the host nation and DoD that requires application of North Atlantic Treaty Organization (NATO), International Civil Aviation Organization (ICAO), or FAA standards, those standards shall apply as stipulated within the agreement. For cases where a Status of Forces Agreement (SOFA) specifically requires international standards, use ICAO Annex 14, Volume I, *Aerodromes* (for fixed wing runways) or Annex 14, Volume II, *Heliports* (for rotary wing helipads and runways), as appropriate. Air Force tenant organizations on civil airports should use these standards on the military portion of the airfield to the maximum extent practicable; otherwise, FAA criteria apply. Use this instruction in conjunction with the layout criteria provided in ETL 04-2, *Standard Airfield Pavement Marking Schemes*. Users should send comments and suggested improvements on AF Form 847, **Recommendation for Change of Publication**, through major commands (MAJCOM) to HQ AFCESA/CES, 139 Barnes Dr, Suite 1, Tyndall AFB, FL 32403-5319. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with AFPD 37-1, *Air Force Information Management*, and AFMAN 37-123, *Management of Records*, and disposed of in accordance with the Air Force Records Disposition Schedule (RDS) located at <https://webrims.amc.af.mil>.

**SUMMARY OF REVISIONS**

**This document is substantially revised and must be completely reviewed.** This revision of Air Force instruction (AFI) 32-1042 clarifies the application of criteria in the purpose paragraph; changes the waiver approval authority for waivers (paragraph **2.1.**); clarifies waiver processing procedures (paragraph **2.1.1.**,

2.2., and 2.4.4.); clarifies and updates information for marking obstructions on joint-use airfields (paragraph 2.3.); updates references to related documents (paragraphs 3.6. and 3.7.); clarifies obstruction marking requirements for groups of obstructions (paragraph 11.2.); and updates the references, acronyms, abbreviations, and terms provided within the instruction. A bar ( | ) indicates a revision from the previous edition.

**1. Background.** This instruction uses standards developed from:

- 1.1. FAA Advisory Circulars (AC).
- 1.2. NATO Standardization Agreements (STANAG).
- 1.3. Air Standardization Coordinating Committee (ASCC) Air Standards.
- 1.4. Annex 14 of the ICAO Convention on International Aviation.

**2. Responsibilities.**

2.1. The MAJCOM Director of Operations (MAJCOM/DO) is the approval authority for waiver requests for marking deviations, including application of non-standard markings. Non-standard markings are those not defined within any Air Force, Department Of Transportation (FAA and Federal Highway Administration [FHWA]), ICAO, ASCC, or NATO standard appropriate for application at the given installation.

2.1.1. MAJCOM civil engineer representatives make recommendations for action and process waiver requests for coordination with ground safety, weapons safety (to ensure quantity-distance criteria are met), flight safety, airfield management, and flight operations at the MAJCOM level prior to MAJCOM/DO consideration.

2.1.2. MAJCOM civil engineer representatives also provide oversight to:

- 2.1.2.1. Ensure that bases comply with this instruction.
- 2.1.2.2. Recommend approval or disapproval of temporary and permanent waiver requests.
- 2.1.2.3. Provide technical guidance to base-level personnel.

2.2. MAJCOM civil engineering, safety, airfield management, and flight operations should provide input to MAJCOM/DO, and must coordinate on all waiver requests for decision and final action.

2.3. Installation commanders make a formal request for waivers to MAJCOM/DO. They may also exempt objects penetrating the airfield's imaginary surfaces from the requirements in paragraph 11. **EXCEPTION:** Installation commanders may not exempt obstructions from obstruction marking requirements at joint-use airfields. For this instruction, a joint-use airfield is defined as an installation where written agreement between the military department and a local government agency authorize use of the military runways for a public airport. For joint-use installations, all obstructions as defined within Federal Aviation Regulation Part 77, *Objects Affecting Navigable Airspace* (see extract in Unified Facilities Criteria [UFC] 3-260-01, *Airfield and Heliport Planning and Design*, Attachment 6) or ICAO Annex 14, as applicable, must be marked in accordance with either FAA AC 70/7460-1, *Obstruction Marking and Lighting*, or ICAO Annex 14, as appropriate.

2.4. The base civil engineer's (BCE) representative is responsible for:

2.4.1. Ensuring that airfield markings:

2.4.1.1. Comply with this instruction and ETL 04-2.

2.4.1.2. Facilitate aircraft operations for the appropriate weather minimums (see paragraph 7.).

2.4.1.3. Clearly delineate closed and hazardous areas, especially during construction projects.

2.4.2. Developing a schedule with local flight safety office and airfield manager for monitoring and periodic inspection of airfield signs, markings, and obstructions.

2.4.3. Scheduling maintenance and remarking of airfield and vehicular access roadway pavements.

2.4.4. Preparing, coordinating, and submitting requests for waivers as follows:

2.4.4.1. Forwards copies of waiver requests and supporting documentation to airfield management, safety (flight, ground, and weapons), and flight operations for coordination before requesting the installation commander's approval for processing at the MAJCOM.

2.4.4.2. A final copy of all waiver requests should be sent to all interested offices at base and MAJCOM levels. At minimum, copies must be provided to civil engineering, airfield management, and safety.

### 3. Related Documents.

3.1. UFC 3-260-01 describes an airfield's imaginary surfaces, defining the protected airspace surrounding the airfield. These surfaces define obstacles that must be marked and lighted as obstructions.

3.2. AFI 32-1044, *Visual Air Navigation Systems*, and Air Force manual (AFMAN) 32-1076, *Design Standards for Visual Air Navigation Facilities*, give information on lighted signs required for runways, taxiways, and aprons.

3.3. ETL 97-18, *Guide Specification for Airfield and Roadway Marking*, provides guidelines for drafting contract documents for airfield-marking projects. You may obtain a copy at <http://www.afc-es.a.af.mil/library/etl.asp?Category=Engineering%20Technical%20Letters>.

3.4. FAA AC 70/7460-1 outlines the requirements for marking and lighting hazards to air navigation. Electronic copies can be obtained at <http://www.faa.gov/ats/ata/ai/index.html>. To order a free paper copy, send a request to:

DOT, M-443.2

General Services Section

Washington DC 20590

3.5. Air Force Technical Order (T.O.) 36-1-191, *Technical and Managerial Reference for Motor Vehicle Maintenance*, provides guidance for marking and lighting vehicles used on and around airfields.

3.6. FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD) provides information for marking and signing roadways and streets (also available as American National Standards Institute [ANSI] D6.1). It is available for download at <http://mutcd.fhwa.dot.gov/pdfs/2003r1/pdf-index.htm>.

3.7. ETL 04-2 provides dimensions, colors, and layout details for standard airfield pavement marking schemes.

3.8. Air Force joint pamphlet (AFJPAM) 32-8013, *Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations*, Volume 2, *Airfield and Heliport Design*, provides information for design and construction of airfields in the theater of operations.

#### 4. Materials. Mark your pavements with:

4.1. Lead-free pavement marking paints, available under Federal Specification TT-P-1952, *Paint, Traffic and Airfield Marking, Waterborne*. Select Type I, "Ten Minute No Pick-up Time" or Type II, "Fast Dry, High Humidity Formula." Apply at 12 to 14 mils wet film thickness for coverage of 121 ( $\pm 6$ ) square feet per gallon (2.96 square meters per liter [ $\pm 165$  square millimeters per liter]).

4.2. Glass beads, available under Federal Specification TT-B-1325, *Beads, Retroreflective*. Apply to painted or extruded markings using 8 to 9 pounds per gallon of paint, or 121 square feet (3.6 to 3.9 kilograms per 11.24 square meters). Use Type I, gradation A beads, which have a 1.5 index of refraction, for all markings that must be reflective.

4.3. You may use preformed materials such as thermoplastics and retroreflective tapes on helipads, taxiways, and aprons, or in some cases for temporarily displaced threshold markings (see ETL 04-2). **Do not** use these materials on runways.

4.4. Other materials, if they conform with or exceed these requirements.

#### 5. Colors of Markings and Retroreflective Requirements.

5.1. Use black paint to hide extraneous markings that cannot be removed without damaging the pavement. You can also use black paint to outline markings with a 150-millimeter (6-inch) wide border on light-colored pavements. This makes the markings more prominent. Mark obstructions in the contrasting colors specified below to make them more conspicuous to pilots during daylight hours.

5.2. Use the following color chip numbers from Federal Standard 595, *Colors*, when ordering or specifying paint for airfield applications:

##### 5.2.1. Pavements:

5.2.1.1. White - 37925

5.2.1.2. Yellow - 33538

5.2.1.3. Red - 31136

5.2.1.4. Black - 37038

##### 5.2.2. Obstructions:

5.2.2.1. White - 17875

5.2.2.2. Orange - 12197

5.3. Use retroreflective white for all runway markings. **EXCEPTIONS:** Use retroreflective yellow on:

5.3.1. Displaced threshold arrowheads and chevrons.

5.3.2. Aircraft arresting system warning markings.

5.3.3. Runway shoulder markings (deceptive surfaces), including the double yellow stripes described in the note to paragraph 6.5 in ETL 04-2, and closed runway markings.

5.4. Use retroreflective white for helipad markings. **EXCEPTION:** Use red for the letter "H" and the optional borders around the cross and boundary markings on hospital helipads.

5.5. Use retroreflective yellow for all primary taxiway, apron, and taxi-lane markings. **EXCEPTION:** Retroreflective beads are not required on:

5.5.1. Secondary taxiway and secondary apron markings (taxiways or aprons not used during periods of reduced visibility or darkness).

5.5.2. Overrun chevrons.

5.5.3. Closed pavement markings.

5.5.4. Shoulder markings (deceptive surfaces).

**6. Striated Markings.** You may paint striated markings 3 feet (0.9 meter) and wider on all runways except those in instrument categories II and III. To do this, paint multiple longitudinal stripes 6 inches (150 millimeters) wide with gaps from 4 inches (100 millimeters) to 6 inches (150 millimeters) wide.

**7. Runway Markings.** Consult with the airfield manager when determining the level of markings needed for each runway.

7.1. Determine the extent of runway markings based on the level of operations planned during day, night, and instrument meteorological conditions (IMC). Also consider the available electronic navigation and visual approach lighting aids.

7.2. Closed runways must also be marked to reflect their non-operational status. Markings must be visible to aircrew for all planned missions. Runways should be marked in a manner that will allow the aircrew to successfully locate, identify, and respond to hazards according to the mission type being flown (i.e., night IMC or night vision goggle [NVG] operations). Reflectivity and marker angles must be anticipated from an airborne perspective.

7.3. The installation commander may authorize additional markings. Non-standard markings must be approved by the MAJCOM/DO, publicized in the DoD Flight Information Publication (FLIP), and must not interfere with standard runway markings.

7.4. For a basic runway, mark, at minimum:

7.4.1. A centerline.

7.4.2. Designation numbers.

7.4.3. Aircraft arresting system warning markings.

7.4.4. Runway/runway hold positions (when the runway is used as a taxiway or is approved for simultaneous operations with an intersecting runway).

7.4.5. Overruns.

7.4.6. Fixed distance markings (required on runways at least 4,000 feet [1,200 meters] long).

7.5. For an instrument (nonprecision) approach runway, also mark thresholds and expand the center-line width to 3 feet (0.9 meter).

7.6. For a precision approach runway, mark for all weather operations. In addition to the instrument (non-precision) approach and basic requirements, provide side stripes, touchdown zone markings, and instrument hold lines.

7.7. Shoulder markings (deceptive surface markings) are also required if there is a lack of distinction between the load-bearing and non-load-bearing pavement, or if the paved shoulder is wider than the standard dimension required by UFC 3-260-01.

7.8. For runways that intersect or share a common end, interrupt or adjust markings on the runway with the lower priority. Give precedence in this order:

7.8.1. Precision approach runway markings:

7.8.1.1. Category III.

7.8.1.2. Category II.

7.8.1.3. Category I.

7.8.2. Instrument (nonprecision) approach runway markings.

7.8.3. Basic runway markings.

7.8.4. Interrupt taxiway or other markings that conflict with runway markings 3 feet (0.9 meter) either side of the runway marking. Taxiway centerline is interrupted 5 feet (1.5 meters) either side of threshold markings or numbers.

## 8. Taxiway and Apron Markings.

8.1. Mark taxiways and aprons to guide aircraft movement and parking and vehicular traffic supporting airfield operations. Use, at minimum, markings for:

8.1.1. The centerline.

8.1.2. Holding positions.

8.1.3. Closed pavement.

8.1.4. Vehicular access roadways and stop bars.

**NOTE:** Use the FHWA MUTCD (also available as ANSI D6.1) to lay out and mark service roads on the airfield.

8.2. Use taxiway edge stripes if you cannot distinguish paved taxiway shoulders (non-load-bearing pavements) from operational surfaces or if the paved shoulder is wider than the standard dimension required by the design criteria in UFC 3-260-01.

8.3. The installation commander may authorize additional markings. Non-standard markings must be approved by the MAJCOM/DO, publicized in the DoD FLIP, and must not interfere with standard runway markings.

8.4. Runway and holding position markings have precedence over other markings. Interrupt taxiway markings 3 feet (0.9 meter) from either side of these markings.

8.4.1. Where taxiway centerline markings meet threshold marking or numbers, interrupt the taxiway markings 5 feet (1.5 meters) short of the higher priority marking.

8.4.2. Where taxiways cross, intersect the taxiway stripes.

8.4.3. Where a taxiway crosses a runway, interrupt the taxiway stripe at all runway markings as described in paragraph 8.4.

## **9. Helipad and Rotary Wing Runway Markings.**

9.1. Install helipad perimeter and identification markings to accommodate the overall length of the largest helicopter using the facility.

9.2. Mark rotary wing runways in accordance with ICAO standards contained within Annex 14 to the Convention on International Civil Aviation, Volume II. You can contact Headquarters, Air Force Civil Engineer Support Agency (HQ AFCESA) for assistance or obtain a copy of the standard from:

International Civil Aviation Organization (ICAO), Attention: Document Sales Unit

999 University Street, Montreal, Quebec, Canada H3C 5H7

Telephone (514) 954-8022

## **10. Marking Dimension Tolerances.**

10.1. Apply mandatory markings in standard dimensions.

10.2. New markings may deviate a maximum of 10 percent above the standard dimension.

10.3. The maximum deviation allowed when painting over an old marking is up to 20 percent larger than the standard dimension.

10.4. You may not use less than standard dimensions.

## **11. Marking Obstructions.**

11.1. Mark objects or structures that penetrate an airfield's imaginary surfaces (described in UFC 3-260-01) in contrasting colors and patterns so they are conspicuous during day visual flight rules (VFR) conditions. For guidelines, use FAA AC 70/7460-1, within the continental United States (CONUS), Alaska, Hawaii, or any U.S. Territory. For locations outside the continental United States (OCONUS), use Annex 14 to the Convention on International Civil Aviation, Volume I.

11.2. Do not mark obstructions shielded by surrounding objects if you have marked the surrounding objects. (See [Attachment 1](#) for the definition of "shielded" as used in this instruction.) See FAA AC 70/7460-1, paragraph 56, "Group of Obstructions."

11.2.1. Partial marking of obstructions such as storage tanks and chimneys is adequate when the lower portion is hidden by surrounding objects or terrain, or the size of the upper portion is significantly larger than the supporting structure.

11.2.2. Do not paint critical surfaces on obstructions, such as ladders, maintenance decks, or radar-sensitive surfaces.

11.2.3. Although control tower obstruction lighting must meet the requirements of AFI 32-1044, AFMAN 32-1076, and UFC 3-535-01, *Airfield Lighting Systems*, marking control towers is not necessary, based on their shape, size, and location.

DONALD J. WETEKAM, Lt. General, USAF  
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**Attachment 1****GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

Federal Aviation Regulation Part 77, *Objects Affecting Navigable Airspace*

Federal Aviation Regulation Part 139, *Certification and Operations: Land Airports Serving Certain Air Carriers*

FAA AC 70/7460-1, *Obstruction Marking and Lighting*

FAA AC 150/5340-1, *Standards for Airport Markings*

FHWA *Manual on Uniform Traffic Control Devices* (MUTCD) (also ANSI D6.1)

Federal Specification TT-P-1952, *Paint, Traffic and Airfield Marking, Waterborne*

Federal Specification TT-B-1325, *Beads, Retroreflective*

Federal Standard 595, *Colors*

ICAO Annex 14 to the Convention on International Civil Aviation, Volume I, *Aerodrome Design and Operations*

ICAO Annex 14 to the Convention on International Civil Aviation, Volume II, *Heliports*

ASCC Air Standard 90/28, *Aerodrome Pavement Markings*

NATO STANAG 3111, *Airfield Marking Tone Down*

NATO STANAG 3158, *Day Marking of Airfield Runways and Taxiways*

NATO STANAG 3316, *Airfield Lighting*

NATO STANAG 3346, *Marking and Lighting of Airfield Obstructions*

NATO STANAG 3601, *Criteria for Selection and Marking of Landing Zones for Fixed Wing Transport Aircraft*

NATO STANAG 3619, *Helipad Marking and Lighting*

NATO STANAG 3685, *Airfield Portable Marking*

NATO STANAG 3711, *Airfield Marking and Lighting Colour Standards*

AFI 32-1044, *Visual Air Navigation Systems*

AFJMAN 32-8013, *Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations*, Volume 2, *Airfield and Heliport Design*

AFMAN 32-1076, *Design Standards for Visual Air Navigation Facilities*

AFPD 32-10, *Installations and Facilities*

Air Force Technical Order 36-1-191, *Technical and Managerial Reference For Motor Vehicle Maintenance*

ETL 04-2, *Standard Airfield Pavement Marking Schemes*

ETL 04-7, *C-130 and C-17 Landing Zone (LZ) Dimensional, Marking, and Lighting Criteria*

ETL 97-18, *Guide Specification for Airfield and Roadway Marking*

UFC 3-260-01, *Airfield and Heliport Planning and Design*

UFC 3-535-01, *Airfield Lighting Systems*

### ***Abbreviations and Acronyms***

**AC**—advisory circular

**AFI**—Air Force instruction

**AFJPAM**—Air Force joint pamphlet

**AFMAN**—Air Force manual

**AFPD**—Air Force policy directive

**ANSI**—American National Standards Institute

**ASCC**—Air Standardization Coordinating Committee

**BCE**—base civil engineer

**CONUS**—continental United States

**DoD**—Department of Defense

**ETL**—Engineering Technical Letter

**FAA**—Federal Aviation Administration

**FHWA**—Federal Highway Administration

**FLIP**—Flight Information Publication

**HQ AFCESA**—Headquarters, Air Force Civil Engineer Support Agency

**HQ AFSOC**—Headquarters, Air Force Special Operations Command

**ICAO**—International Civil Aviation Organization

**IMC**—instrument meteorological conditions

**MAJCOM**—major command

**MAJCOM/DO**—major command, director of operations

**MUTCD**—Manual on Uniform Traffic Control Devices

**NATO**—North Atlantic Treaty Organization

**NVG**—night vision goggles

**OCONUS**—outside the continental United States

**SOFA**—Status of Forces Agreement

**STANAG**—Standardization Agreement

**T.O.**—technical order

**UFC**—Unified Facilities Criteria

**VFR**—visual flight rules

**VMC**—visual meteorological conditions

### ***Terms***

**Instrument Meteorological Conditions (IMC)**—Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minimums specified for visual meteorological conditions (VMC).

**Retroreflective**—The property of a material that indicates its ability to reflect light so that the paths of the rays are returned to the source on a plane parallel to the incident rays.

**Runway/Runway Hold Position**—An aircraft holding position designated on a runway which intersects with another runway. It is used to protect against incursions on the primary runway when the intersecting secondary runway is used for taxiing or "land and hold short" operations.

**Shielded**—As used in this instruction, "shielded" refers to objects that may not need to be marked in obstruction marking colors and patterns if the marking and or lighting of a predominant permanent building, structure, or object is assessed as providing sufficient warning to pilots that, in avoiding the dominant obstruction, they will also avoid the unmarked obstructions in the immediate surrounding area without risk of collision.

**Visual Flight Rules (VFR)**—Rules that govern the procedures for conducting flight under visual conditions. This term is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements.

**Visual Meteorological Conditions (VMC)**—Weather conditions in which visual flight rules apply; expressed in terms of visibility, ceiling height, and aircraft clearance from clouds along the path of flight. Also see *Visual Flight Rules*.