RUNWAY END, STOPWAY END, AND DISPLACED THRESHOLD IDENTIFICATION FOR SURVEYORS

First Edition
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This document has been prepared by the National Geodetic Survey (NGS) to provide guidelines to NGS personnel on runway/stopway surveys. These guidelines shall be complied with, to the extent practical, until changed by formal NGS change action.

Approved by:

Charles W. Challstrom
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CHANGES

Comments and recommendations regarding this document should be directed to:

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Changes will be authorized by:

Director
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Changes will be implemented as "Change Notices." The Change Notice protocol follows:

1. The change will be briefly described on a log page to be inserted in the front of this document. This page will also include the Change Notice number, the effective date of the change, the affected pages, and the authorizing signature.

2. New pages that reflect the change, and which are to be inserted into the body of the document, will be issued with the effective date in the upper left corner of each page.

3. New pages with substantive changes will be identified by the Change Notice number listed in the lower left corner of each page, for example, "CHG 1."

4. New pages without substantive changes will be identified by "TYP CHG" in the lower left corner of each page to indicate a typographic change only. Cases where "TYP CHG" is appropriate include those instances where a page has spelling or syntax corrections or where the page is rearranged because text has been moved forwarded from the previous page. "TYP CHG" will not be shown when substantive changes are also included on the page.

RUNWAY END, STOPWAY END, AND DISPLACED THRESHOLD IDENTIFICATION FOR SURVEYORS

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1. PURPOSE

The purpose of this document is to provide National Geodetic Survey (NGS) personnel with guidelines for accomplishing runway/stopway surveys for the Federal Aviation Administration (FAA). These surveys, which furnish data critical to the operation of the National Airspace System, are accomplished in accordance with a series of FAA/NGS Interagency Agreements.

Included in this document are basic guidelines for:

- operating on airports

- identifying the precise survey point (SP) for runway ends, displaced thresholds, and stopway ends

- resolving runway/stopway conflicts with airport authorities

- resolving runway/stopway conflicts with official U.S. Government aeronautical publications.

2. BACKGROUND

Accurate runway/stopway surveys are critical to aircraft and airport operations. Fundamental to a good survey is the correct identification of runway ends, stopway ends, and displaced thresholds. In many cases, the location of these points is not intuitively obvious and the precise survey point selection may not be consistent among surveyors. Without basic guidelines, this inconsistency will likely continue.

The positions and elevations of runway/stopway points are used to determine runway length, Accelerate Stop Distance Available (ASDA), Takeoff Distance Available (TODA), Takeoff Run Available (TORA), Landing Distance Available (LDA), and runway gradient. In addition, runway end and threshold information is used to orient the Obstruction Identification Surfaces that define critical obstructions to navigation for arriving and departing aircraft.

Operational uses of runway/stopway data include determining maximum takeoff weights for civil aircraft, developing instrument arrival and departure procedures, certificating airports for certain operations, such as those conducted under Federal Aviation Regulations Part 139, and updating official U.S. Government aeronautical publications and data bases.

Inaccurate data can result in unnecessary operational limitations or dangerous misassumptions. For example, a misidentified runway end that results in a surveyed length being shorter than the true length could cause unnecessary takeoff weight restrictions or could prevent certain aircraft from operating from a runway or airport entirely because of insurance requirements or other runway length related limitations. A misidentified runway end that results in a surveyed length being longer than the true length could lead to the dangerous assumption that the ASDA, or other declared distance, is sufficient for safely conducting certain operations when it is not.

Incorrectly surveyed runways can also result in a runway not being identified during a computer search. In some cases, this situation could have safety implication. For example, a pilot with a low fuel state or other in-flight emergency, may initiate a computer search for the nearest runway at least 5,000 feet long. If a nearby 5,000 foot runway was incorrectly surveyed and published at less than 5,000 feet, it would not be identified during the search and would remain unknown to the pilot.

The Federal Aviation Administration (FAA) has issued a series of Advisory Circulars (AC) that establish standards for construction, markings (painting), lighting, signage, and other items pertaining to runways/stopways. However, compliance with AC standards varies widely. For airports certificated under Federal Aviation Regulations Part 139, AC compliance is generally good. AC compliance is also generally good when it is required under terms of an FAA grant. In many other cases however, AC guidelines may be loosely followed or not followed at all.

Complicating this matter further are situations where runway/stopway changes have occurred, but repainting is delayed for some reason, leaving inappropriate painting in place at the time of the survey.

Other situations occur when AC compliance is intended, but the marking standard is misinterpreted or applied incorrectly. For example, a threshold bar may be incorrectly painted on a blast pad adjacent to a runway end instead of on the runway.

Hopefully, these guidelines will help surveyors correctly identify runway/stopway survey points, not only when standard markings exist, but also in the many cases where nonstandard situations are encountered.

3. TERMINOLOGY

The precise meaning of terms is always important to a clear understanding of spoken or written information. This understanding is especially critical in technical areas where safety is involved.

It is vital that the surveyor be familiar with runway/stopway terminology and that definitions be clearly understood. Certain terms and expressions used in this document have specific meanings that must not be misconstrued or applied incorrectly.

Definitions are presented in the glossary at the end of this manual. Many of these definitions have come from the "Aeronautical Information Manual," or the FAA Advisory Circulars, both published by the Federal Aviation Administration. Other definitions are from the "Geodetic Glossary," published by the National Geodetic Survey. When adequate definitions were not available from an official source, they were carefully developed as needed for this document.

Throughout this document reference is made to the "approach side" or "touchdown side" of a feature. For example, "Threshold lights show green from the approach side." Correct understanding of these terms is extremely important. The "approach side" of a feature is the side occupied by a landing aircraft before the aircraft has passed the feature. The "touchdown side" of a feature is the side occupied by a landing aircraft after the aircraft has passed the feature. These terms are always referenced to a landing aircraft and the approach end, not the stop end, of the runway.

In addition to the word usage as defined in the Glossary, the meanings of two other words must be understood when these words are used in relation to an action:

- the term "should" implies a first choice or preference but does not imply mandatory compliance.

- the term "shall" means that compliance is mandatory.

4. PRESURVEY INTERVIEWS WITH AIRPORT AUTHORITIES AND AIRPORT TRAFFIC CONTROL TOWER PERSONNEL

Before the survey observations begin, and before entry into an airport secure area, the survey shall be discussed with appropriate airport authorities and permission obtained to operate on the airport. If an Airport Traffic Control Tower (ATCT) will be in operation during the time of the survey, the survey must be discussed with ATCT personnel, as well.

Specific points to address with airport authorities include:

- runway designations
- locations of displaced thresholds
- locations of runways with aligned taxiways
- locations of stopways
- location and status of closed runways
- location and status of runways/stopways under construction or planned
- location of out-of-service lights or approach facilities
- location of nonstandard marking
- existence of any unusual situation or operating procedures
- communications frequencies

In addition to the specific items listed above, the runway/stopway data published in the latest editions of the Airport/Facility Directory (A/FD), and U.S. Terminal Procedures (TPP), both United States Government Flight Information Publications, should be discussed with airport authorities. (See Section 8.2. for resolution of conflicts).

5. OPERATING ON AIRPORTS

Anyone operating on an airport should become familiar with the FAA document "A Guide to Ground Vehicle Operations on the Airport," issued by the Federal Aviation Administration, Office of Airport Safety and Standards, Airport Safety and Operations Division, Washington, D.C. 20591.

Do not enter any airport area that is off limits to the general public without authorization from appropriate airport authorities. In addition, if an ATCT is in operation, do not enter any aircraft movement area (see Glossary) without an Air Traffic Control (ATC) clearance.

Before entry onto the airport, obtain, and become familiar with, a runway/taxiway diagram. At larger airports, the best diagram is probably the Airport Diagram in the TPP or an airport plan provided by airport personnel. At smaller airports, the best diagram may be the FAA 5010 Form - Airport Master Record or the Airport Sketch (small diagram in lower right corner of individual approach plates) in the TPP.

A runway/taxiway diagram will not only assist in orientation and movement on the airport but will also reduce the chances of a dangerous, inadvertent runway incursion. It is very easy to become disoriented on an airport, especially at night.

If at any time on an uncontrolled airport (no operating control tower) you become uncertain of your location, verify that you are not on a runway. If you are on a runway, drive clear immediately. Once clear of all runways, quickly reestablish orientation. Do not continue to operate on the airport until your position is precisely known.

If at any time on a controlled airport (operating control tower) you become disoriented, are uncertain of your ATC clearance, or are uncertain that the clearance is being precisely followed, contact ATC immediately. If necessary, ask ATC for "progressive taxi" instructions which provide guidance issued in stages as you proceed along your route. This service is usually provided only in aircraft movement areas.

6. FEATURES ASSOCIATED WITH RUNWAY/STOPWAY USAGE AND SURVEY POINT LOCATION

Runway/stopway usage, or intended usage, is usually indicated by one or more features existing on the airport. These features include surface markings, lights, signs, navigational aids, and physical construction.

A runway/stopway survey point (SP) is the intersection of the runway/stopway centerline and a feature that precisely defines the SP, such as the approach side of a threshold bar. The feature that precisely defines the SP is called the Survey Point Locator (SPL).

An SPL may be tangible, such as the approach side of a threshold bar, or intangible, such as an imaginary line constructed relative to a tangible feature or features like outboard (see Glossary) runway end lights.

A supporting feature is a feature that is associated with a runway/stopway SP but which does not precisely define the point, such as threshold lights located near a displaced threshold. There may be several supporting features for each SP. Supporting features provide confidence that the SP was correctly selected.

The most useful supporting features are usually one or more of the following: (1) threshold bar and other threshold paintings, (2) runway number, (3) threshold and runway end lights, and (4) runway edge lights. Less useful features include: (1) signs, (2) visual glideslope indicators, (3) electronic navigational aids, and (4) taxiways.

Some features can be either an SPL or a supporting feature, depending on the situation For example, when a threshold bar is located at a displaced threshold, the approach side of the bar defines the threshold. However, when a threshold bar is located near the end of pavement, the end of pavement usually defines the threshold and the bar is only a supporting feature that provides confidence that the threshold is located at the end of pavement and not at some other location on the runway.

Specific features that either define an SP or are useful in supporting SP selection are discussed in this section.

Because of the many nonstandard situations and configurations that may be encountered in the field, selecting the correct SP can be somewhat complex. When considering the features discussed below and their applicability to SP location, it may be useful to refer to Figures 1 through 8 in this document, as well as appropriate FAA Advisory Circulars.

6.1. LIMIT OF CONSTRUCTION

The limit of construction is usually the SPL for the ends of concrete runways when there is no aligned taxiway (AT).

Runways and stopways are built to design criteria. There is an operational benefit to the airport sponsor and aircraft operators to have the maximum runway/stopway length possible. The limit of construction, or the runway end Trim Line (see below) usually provides this maximum.

The limit of construction is indicated by a surface discontinuity. Be careful not to locate the runway end beyond this discontinuity and on a blast pad, stopway, or other nonrunway surface.

6.2. TRIM LINE

A Trim Line is an imaginary line, constructed perpendicular to the runway/stopway centerline, which establishes the location of a runway/stopway end or displaced threshold.

A Trim Line is most frequently used to "square off" the ends of an Apparent Runway/Stopway Surface (ARS) (see Glossary) thereby establishing the runway/stopway ends. Most ARS' that are not concrete, have ends that are not perpendicular to the runway/stopway centerline, are breaking up, or are otherwise unsuitable as a runway/stopway. Occasionally, the ARS may also narrow toward its end. This narrowing is most likely to occur on shorter runways at smaller airports. In all of these cases, a Trim Line must be constructed perpendicular to the runway/stopway centerline at "First Good Pavement (FGP)" (see Glossary). This Trim Line may be only a few inches or may be many feet from the ARS end.

In practice, the surveyor is not qualified to accurately determine the load bearing integrity of a surface. So as a practical matter, the Trim Line should be established at a point on the ARS that is inside any disintegrating or otherwise questionable surface that appears to be below the full load bearing capacity of the runway/stopway.

Other uses of the Trim Line include: (1) establishing a runway end at outboard runway end lights when an AT exists and there is no threshold bar or the approach side of the bar is located on the approach side of the runway end lights, (2) establishing a runway end at a location determined by operational requirements, such as defining a runway end short of a second runway when abutting surfaces exist, and (3) defining a displaced threshold when there is no threshold bar, such as may be the case with unpaved runways with outboard threshold lights.

6.3. SURFACE MARKINGS

THRESHOLD BAR

A threshold bar is used to delineate the beginning of the runway that is available for landing (threshold) when there is pavement aligned with the runway on the approach side of the threshold. This pavement may be runway, taxiway, or stopway or may be a nonusable surface, such as a blast pad.

Threshold bars precisely delineate displaced thresholds, but in many cases do not precisely delineate runway ends even when a bar is located near the runway end. When a threshold bar does define a threshold or runway end, the approach side of the bar is the SPL, the bar being entirely on the landing surface.

Threshold bars define runway ends on paved runways with an AT and no displaced threshold, provided the approach side of the bar is aligned with, or is on the touchdown side of the runway end lights. In no other case does the threshold bar precisely define the runway end. (See Threshold and Runway End Lights in Section 6.4. for the use of runway end lights in defining the runway end SP).

The threshold bar is only a supporting feature for runway ends with no AT since these bars are often not painted precisely at the runway end (as defined by the limit of construction or a Trim Line). A threshold bar that is painted "close" to the end may be satisfactory for the painting contractor but is not sufficient for precisely defining a runway end.

Occasionally, a threshold bar may even be painted on a blast pad or other nonrunway surface. Because of the variability and unreliability of threshold bar locations at runway ends with no AT, the bars should not be used to define the runway end SP in these situations.

It is important to remember that correct painting on runways is white, while correct painting on taxiways, stopways, or blast pads is yellow. If a displaced threshold exists on a runway with an AT, the runway end may be marked with a yellow demarcation bar. If painted correctly, this demarcation bar is not on the runway surface.

RUNWAY NUMBERS

The runway number is a supporting feature.

Runway numbers are especially useful and reliable as supporting features since most paved runways, even if unlighted, are painted with runway numbers near the threshold. If a runway number is painted on the runway at a location other than near the apparent threshold, a serious conflict exists that must be resolved.

OTHER SURFACE MARKINGS

Other surface markings are supporting features.

Many surface markings, such as threshold markings (specific markings other than the threshold bar), runway side stripes, displaced threshold arrows and arrowheads, the lines and arrowheads on taxiways aligned with runways, and the chevrons on stopways and blast pads are associated with runway/stopway ends and thresholds. While none of these markings precisely define runway/stopway SP's, many can be useful as supporting features that provide confidence in SP selection.

6.4. LIGHTS

Caution - when using lights for runway/stopway SP identification, verify that the lights are not out-of-service. Be especially vigilant for redundant lights or lights that seem to be out-of-place. Occasionally, a threshold or runway end may be moved and the original lights placed out-of-service but not physically removed. If this situation is not recognized, it could lead to confusion and incorrect SP location.

THRESHOLD LIGHTS

Threshold lights are fixed green lights arranged symmetrically left and right of the runway centerline and identify the approximate runway threshold (but not necessarily the runway end).

These lights are frequently in multipurpose fixtures that show green from the approach side of the threshold and may show red, white, or amber, or may be obscured from the touchdown side of the threshold, depending on additional function.

Threshold lights are usually supporting features for SP's on paved runways. However, they may define the SP for displaced thresholds when a threshold bar is missing, such as may occur on unpaved runways. (Displaced thresholds on unpaved runways are uncommon).

Light characteristics can be useful in distinguishing between a displaced threshold and a runway end with an AT. The displaced threshold will include lights that show green from the approach side and white, amber, or obscured from the touchdown side. The runway end with an AT will include lights that show green from the approach side and red from the touchdown side.

When threshold lights are located at the runway end, they are usually combined with runway end lights into one fixture. In these cases, threshold lights show green from the approach side, while the runway end lights show red from the touchdown side. Special lens or filters are used to give the desired coverage.

In the rare case where the light units define a Trim Line for a displaced threshold SP (no threshold bar), the two units nearest to the runway (one on each side of the runway) shall be used. The Trim Line must always be perpendicular to the runway centerline. If the Trim Line connecting the lights (or markers if runway is unlighted) is not perpendicular to the runway centerline, then the line must be best fit to the defining lights or markers.

When there is no displaced threshold or runway end with an AT, threshold and runway end lights are normally located across the runway end and about 10 feet on the approach side of the runway. When there is a displaced threshold or a runway end with an AT, these lights are normally located to the side of the runway but are often offset along the runway by 10 feet or more from the true threshold or runway end.

RUNWAY END LIGHTS

Runway end lights are fixed red lights arranged symmetrically left and right of the runway centerline and identify the approximate runway end, or in some cases, the precise runway end. They show red from the runway side and may show red from the approach side, as well if the runway end is not the threshold. If the runway end is also a threshold, the light unit will show green from the approach side. (See Threshold Lights in previous section).

FAA guidelines or regulations do not authorize a runway to extend to the approach side of the runway end lights. Therefore, the runway end cannot be on the approach side of the runway end lights regardless of threshold bar or runway end light location. (Do not confuse this situation with that of threshold lights at a displaced threshold where the approach side of the threshold bar defines the threshold and the lights are only supporting features).

In most cases where there is no AT, the limit of construction, or a Trim Line, on the touchdown side of the lights defines the runway end and the runway end lights are supporting features only.

In some cases, however, runway end lights can define a runway end SP. For runways with an AT, runway end lights (which can be situated either outboard or flush mounted inboard) define the runway end SP if there is no threshold bar or if the approach side of the threshold bar is on the approach side of the lights. (If the bar is entirely on the touchdown side of the lights, the approach side of the bar defines the runway end SP).

In the rare cases where there is no AT but the runway end lights are outboard and on the touchdown side of an apparent runway end, the lights define the runway end. The surface on the approach side of the lights is not runway.

RUNWAY/STOPWAY EDGE LIGHTS

Runway edge lights are white, except on instrument runways, where amber replaces white in the last 2,000 feet, or half the runway length, whichever is less, to form a caution zone for landing.

Runway/stopway edge lights are supporting features and do not precisely define SP's. However, in some cases, their color characteristics may identify a section of pavement as either runway or taxiway. The edge lights for taxiways are blue, while the edge lights for runways are white or amber.

Stopway lighting is inconsistent and unreliable in stopway SP identification.

RUNWAY END IDENTIFIER LIGHTS

Runway End Identifier Lights (REIL) consist of a pair of synchronized flashing lights located laterally on each side of the runway threshold but are typically not aligned precisely with the threshold. They may be either omnidirectional or unidirectional facing the approach area

REIL's are supporting features and do not precisely identify SP's. REIL's may be useful in determining runway usage since they are located near the threshold.

6.5. SIGNS

Signs are supporting features and do not precisely identify SP's. Occasionally, signs may be useful in indicating that a runway end, especially a runway end with an AT, is nearby. They can also indicate the direction to a runway end.

6.6. VISUAL GLIDESLOPE INDICATORS

Visual glideslope indicators are light sources which project directional light into the approach area, providing pilots with visual vertical guidance in the final approach phases of flight. The locations and characteristics of visual glideslope indicators vary depending on type. However, all are located beside the runway on the touchdown side of the threshold. Visual glideslope indicators are supporting features and do not precisely define SP's. Occasionally, these indicators may be useful in determining runway usage since they indicate the approximate touchdown area for landing aircraft.

6.7. ELECTRONIC NAVIGATIONAL AIDS (NAVAIDS)

The Instrument Landing System Glideslope (ILS-GS) antenna is the emission source for electronic signals which provide pilots with electronic vertical guidance in the final approach phases of flight.

ILS-GS antennas are typically located approximately 400 feet off the runway centerline and approximately 1,000 feet on the touchdown side of the threshold. However, most runways do not use this facility.

Electronic navigational aids, including the ILS-GS, do not precisely identify SP's. Occasionally, the ILS-GS antenna may be useful in determining runway usage since most are sited near the touchdown area for landing aircraft.

The locations and use of most other NAVAIDS vary so greatly that they are virtually useless in SP identification.

6.8. TAXIWAYS

Taxiways are movement areas that provide access to runways from aircraft parking, maintenance, and other areas on the airport. Taxiways do not precisely identify SP's. However, since runway ends are usually

accessed by adjacent taxiways, the location of a taxiway may suggest the proximity of a runway end.

While many runway ends coincide with the extension of the taxiway edge onto the runway, this is not always the case. Often a runway extends slightly beyond the taxiway edge, making the SPL for the runway end the limit of physical construction, a Trim Line, or a threshold bar and not the taxiway extension onto the runway.

It is not unusual to have a runway end without direct taxiway access. One common case occurs when a runway has been extended, but the taxiway has not been extended to the new runway end. This situation is most likely to occur at smaller airports. While taxiway/runway intersections do not define runway points, unusual taxiway/runway configurations can alert the surveyor that an atypical situation may exist.

7. LOCATION OF SPECIFIC SURVEY POINTS

The location of the following runway/stopway SP's is defined by the intersection of the runway/stopway centerline and one of the indicated Survey Point Locators. When the SP has been determined, it shall always be verified by the presence of supporting features.

Occasionally, a supporting feature will conflict with the selected SP or another supporting feature. For example, a runway number may be located near the end of pavement, but threshold lights and a threshold bar are located down the runway at an apparent displaced threshold. These conflicts should be resolved before leaving the airport. Discuss the conflict with airport authorities and, if necessary, contact the field supervisor for assistance.

In the presentation that follows, reference is made to "inboard" or "outboard" threshold and runway end lights. These terms are defined in the glossary.

If light units are used to construct the Trim Line that defines an SP, as may be the case for the end of a runway with an aligned taxiway, the two units nearest to the runway (one light on each side of the runway) shall be used. The Trim Line must always be perpendicular to the runway centerline. If a line connecting the lights (or markers if the runway is unlighted) is not perpendicular to the runway centerline, then the Trim Line must be best fit to the defining lights or markers.

When using the following guidelines, select the first "Survey Point Locator" listed that is applicable. While all possible situations cannot be covered, these guidelines should lead to correct SP selection in most of the cases encountered in the field.

7.1. RUNWAY END

- CONCRETE RUNWAY
- NO ALIGNED TAXIWAY

Survey Point Locator:

- Limit of construction, provided this line is not located on approach side of runway end lights.

- Trim Line at FGP, provided this line is not located on approach side of runway end lights.

Supporting Features:

- Runway end lights near runway end

- Threshold bar near runway end (usually present only if nonrunway pavement is aligned with runway)

- Threshold lights near runway end and usually in same fixture as runway end lights (if threshold not displaced)

- Runway number near runway end (if threshold not displaced)

- Runway edge lights (white or amber) extending to runway end

Comments:

The limit of construction usually defines the SP for the ends of concrete runways.

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The limit of construction is indicated by a surface discontinuity. Do not confuse the runway end with the end of a blast pad, stopway, or other nonrunway surface

7.2. RUNWAY END
- PAVED/NONCONCRETE RWY
- NO ALIGNED TAXIWAY

Survey Point Locator:

- Limit of construction, provided this line is not located on approach side of runway end lights.

- Trim Line at FGP, provided this line is not located on approach side of runway end lights.

Supporting Features:

- Runway end lights near runway end

- Threshold bar near runway end (usually present only if nonrunway pavement is aligned with runway)

- Threshold lights near runway end and usually in same fixture as runway end lights (if threshold not displaced)

- Runway number near runway end (if threshold not displaced)

- Runway edge lights (white or amber) extending to runway end

Comments:

While the limit of construction is the first choice, a Trim Line at FGP is usually required to define the ends of paved, nonconcrete runways since the ends of these surfaces are almost always crumbling and/or nonorthogonal to the runway centerline to some degree.

7.3. RUNWAY END
- UNPAVED RUNWAY
- NO ALIGNED TAXIWAY

Survey Point Locator:

- Trim Line 10 feet on touchdown side of inboard runway end lights

- Trim Line connecting outboard runway end lights

- Trim Line 10 feet on touchdown side of inboard runway end day markers

- Trim Line connecting outboard runway end day markers

Supporting features:

- Threshold lights near threshold (if runway lighted and threshold not displaced)

Comments:

If no lights or markers exist, the existence of a runway must be questioned. By FAA definition, a runway is a defined area. Not all areas used for takeoff/landings are runways.

7.4. RUNWAY END
- PAVED RUNWAY
- ALIGNED TAXIWAY

Survey Point Locator:

- Approach side of threshold bar provided this line is not located on approach side of runway end lights and threshold is not displaced

- Trim Line connecting outboard runway end lights.

- Runway side of yellow demarcation bar provided this line is not located on approach side of runway end lights. (This bar usually occurs only if a displaced threshold and an AT both exist).

Supporting Features:

- Threshold lights near runway end and usually in same fixture as runway end lights (if threshold not displaced)

- Runway number near runway end (if threshold not displaced)

- Yellow AT painting on approach side of threshold bar

- Taxiway edge lights between runway end and taxiway end

- Absence of runway side stripes between runway end and end of pavement on Precision Instrument Runways

Comments:

Use caution, especially on smaller, poorly marked airports, not to confuse a displaced threshold and a runway end for a runway with an AT.

7.5. RUNWAY END
- UNPAVED RUNWAY
- ALIGNED TAXIWAY

Survey Point Locator:

- Trim Line connecting outboard runway end lights

- Trim Line connecting outboard runway end day markers

Supporting Features:

- Threshold lights near threshold (if threshold not displaced)

- Runway/taxiway edge lights (if runway lighted)

Comments:

Unpaved runways with aligned taxiways are unusual. If this situation is suspected, verify that an area immediately adjacent to, and aligned with, the runway is used for taxi onto the runway and is marked appropriately for this purpose.

7.6. DISPLACED THRESHOLD
- PAVED RUNWAY

Survey Point Locator:

- Approach side of threshold bar

- Trim Line connecting outboard threshold lights

Supporting Features:

- Threshold lights near threshold

- Runway end lights sited at another location on approach side of threshold lights

- White or amber runway edge lights, not blue taxiway lights, between threshold and end of runway

- Runway number near threshold

- White displaced threshold markings on approach side of threshold bar

- Runway side stripe on Precision Instrument Runways

Comments:

Use caution, especially on smaller, poorly marked airports, not to confuse a displaced threshold with the end of a runway with an aligned taxiway.

7.7. DISPLACED THRESHOLD - UNPAVED RUNWAY

Survey Point Locator:

- Trim Line connecting outboard threshold lights

- Trim Line connecting outboard threshold day markers

Supporting features:

- Runway end lights sited at another location on approach side of threshold lights (if runway lighted)

- Runway end day markers located at another location on approach side of threshold (if runway unlighted)

Comments:

Displaced thresholds on unpaved runways are unusual. If this situation is suspected, verify that the runway end is identifiable at another location on the approach side of the threshold.

7.8. STOPWAY END - CONCRETE STOPWAY

Survey Point Locator:

- Limit of construction

- Trim Line

Supporting Features:

- Stopway chevrons

Comments:

The stopway end SP must be on the runway centerline extended. Stopways must be at least as wide as the runway but may be wider.

See Section 8.2 and Section 8.3 for further discussion related to stopway surveys.

7.9. STOPWAY END
- PAVED/NONCONCRETE STOPWAY

Survey Point Locator:

- Limit of construction

- Trim Line at FGP

Supporting Features:

- Stopway chevrons

Comments:

See Comments under 7.8.

7.10. STOPWAY END
- UNPAVED STOPWAY

Survey Point Locator:

- Trim Line at ARS end

Supporting Features:

- Usually none

Comments:

See Comments under 7.8.

8. PRELIMINARY COMPUTATIONS AND DATA CONFLICTS

8.1. COMPUTATION METHODS

Before leaving the area, runway, displaced threshold, and stopway lengths should be computed using the new survey data. These lengths shall be determined using a 3D geodetic inverse computation between end points. This computation corrects for the elevation of the points and difference in elevation between points. These lengths should be compared to the runway lengths published in the Airport/Facility Directory (A/FD) and the U.S. Terminal Procedures (TPP), both U.S Government Flight Information Publications, and the lengths provided by the airport authorities.

The official runway, stopway, or displaced threshold length is the straight line distance between end points. This line does not account for surface undulations between points.

8.2. CONFLICTS WITH PUBLISHED DATA

Computed lengths seldom match published lengths exactly. Discrepancies of less than 5 feet are most likely caused by interpretation of runway/stopway SP location, remarking of thresholds, or less accurate published data. As the magnitude of discrepancies increases, the probability also increases that physical changes have occurred to the runways/stopways or that the thresholds have been moved.

Differences with published data should be considered as an alert that there may be a problem in the survey. However, published lengths are often not as accurate as the new surveyed lengths and are occasionally obsolete or otherwise grossly erroneous. Therefore, the validity of the published data must always be questioned when comparing it with the new survey data, especially if the SP's have been selected correctly.

Even though published data is often incorrect or obsolete, new survey data should be carefully reexamined when discrepancies between published and surveyed data occur. The reasons for discrepancies of less than 5 feet are often difficult or impossible to identify. As discrepancies becomes larger, the reasons typically become more apparent. Even though the source of the discrepancy may not be identified, the reexamination should be conducted to provide the highest level of confidence that accurate runway data has been provided.

Stopway conflicts pose a special problem, largely because of issues related to the stopway definition and the protocols required by the FAA in declaring a stopway.

If either of the following situations occur, contact the field supervisor for assistance:

- The apparent stopway dimensions on the ground differ from the stopway dimensions as published in either the A/FD or TPP by more than 10 percent of the published dimensions.

- A published stopway does not appear to meet the definition of a stopway, including the requirement to support an aircraft during an aborted takeoff , without causing structural damage to the aircraft.

If the field supervisor or NGS staff personnel cannot resolved a situation, final resolution may ultimately require FAA intervention.

See Section 8.3 for additional discussion regarding stopway conflicts.

8.3. CONFLICTS WITH AIRPORT AUTHORITIES

Because of the importance of runway/stopway data, runway/stopway surveys should always be discussed with appropriate airport authorities. Conflicts that occur between the judgement of the surveyor and the opinions, understandings, or intentions of the airport authorities should be resolved. It may be necessary to revisit the field with airport personnel and explain the survey and SP selection. If a conflict with the airport authorities still cannot be resolved, assistance should be sought from the field survey supervisor. In some cases, final resolution may ultimately require FAA intervention.

Stopway conflicts pose a special problem. Before an area can be officially declared a stopway and published in official U.S. Government documents, such as the A/FD and TPP, the request for a stopway must be filed by airport authorities with appropriate FAA offices. The FAA will conduct an Airspace Review and approve or disapprove the request.

If either of the following situations occur, contact the field supervisor for assistance:

- Airport authorities request that an area be surveyed as a stopway but the stopway is not published in either the A/FD or TPP current at the time of the field survey.

- Airport authorities request a change to, or do not concur with, the published stopway data or data resulting from the new survey.

As with conflicts with published data, if the field supervisor or NGS staff personnel cannot resolved a situation, final resolution may ultimately require FAA intervention.

8.4. COMPARISON WITH CRITICAL RUNWAY LENGTH

Runway lengths that are whole thousands of feet (5,000, 8,000, etc.) or whole thousands of feet plus 500 feet (5,500, 8,500, etc.) often have special operational significance. For purposes of this document, these lengths are called critical lengths. Many aircraft operations require a minimum runway length, which is often a critical length, and many runways are built to these lengths. If a runway is incorrectly published shorter than a critical length, certain operations could be unnecessarily restricted.

In addition to imposing unnecessary operational limitations, incorrectly surveyed runways may not be retrieved during a computer search. This situation is especially likely to occur with critical length runways. In some cases, this failure could have safety implications. For example, a pilot with a low fuel state or other emergency, may initiate a computer search for the nearest runway at least 5,000 feet long. If a nearby 5,000 foot runway was incorrectly surveyed and published at less than 5,000 feet, it will not be identified during the search and will remain unknown to the pilot.

While all runway/stopway lengths should be accurate, even small errors in critical lengths

could have significant and far reaching ramifications. Runway lengths that are determined to be less than, but within 20 feet of, a critical length should be carefully reexamined to provide the highest level of confidence that the survey is correct. This reexamination should include an inspection of the runway end SP's to ensure that the longest runway length possible was provided.

FIGURES

GLOSSARY

GLOSSARY

A, B, C

Accuracy - The degree of conformity with a standard, or a value accepted as correct. Precision is the degree of uniformity of repeated measurements or events. For example, repeat measurements of the distance between two points may exhibit a high degree of precision by virtue of the relative uniformity of the measurements. However, if a "short" tape were used in the measurements, accuracy would be poor in that the measured distance would not conform to the true distance between the points.

Surveying and mapping accuracy standards should include three elements, (1) a stated variation from a true value or a value accepted as correct, (2) the point to which the new value is relative, and (3) the probability that the new value will be within the stated variation. For example, "Horizontal accuracy will be 10 cm relative to the nearest Continuously Operating Reference Station (CORS) station at the 95 percent confidence level."

Abeam Point - The point on a line that is nearest to an off line point. For example, a point on the runway centerline is "abeam" the Glide Slope Antenna when the distance from the centerline point to the antenna is a minimum.

Accelerate-Stop Distance Available (ASDA) - See Declared Distances

Aeronautical Beacon - A visual navigational aid displaying flashes of white and/or colored light to indicate the location of an airport, a heliport, a landmark, a certain point of a federal airway in mountainous terrain, or an obstruction. (See Airport Rotating Beacon under Airport Lighting.)

Air Navigation Facility - Any facility used in, available for use in, or designed for use in, aid of air navigation, including landing areas, lights, any apparatus or equipment for disseminating weather information, for signaling, for radio-directional finding, or for radio or other electrical communication, and any other structure or mechanism having a similar purpose for guiding or controlling flight in the air or the landing and takeoff of aircraft. (See Navigational Aid.) Airport - An area on land or water that is used or intended to be used for the landing and takeoff of aircraft and includes its buildings and facilities, if any.

Airport Elevation - The highest point of an airport's usable runways measured in feet from mean sea level (technically, from the vertical datum.) This elevation may be on an unpaved runway.

Airport Lighting - Various lighting aids that may be installed on an airport. Types of airport lighting include:

Airport Rotating Beacon (APBN) - A visual navigational aid operated at many airports. At civil airports, alternating white and green flashes indicate the location of the airport. At military airports, the beacons flash

alternately white and green, but are differentiated from civil beacons by dualpeaked (two quick) white flashes between the green flashes.

Approach Light System (ALS) - An airport lighting facility which provides visual guidance to landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on his final approach for landing. Condenser-Discharge Sequential Flashing Lights/Sequenced Flashing Lights may be installed in conjunction with the ALS at some airports.

Types of Approach Lights include:

Omnidirectional Approach Light System (ODALS) - Seven omnidirectional flashing lights located in the approach area of a nonprecision approach. Five lights are located on the runway centerline extended with the first light located 300 feet from the threshold. The other two lights are located, one on each side of the runway threshold, at a lateral distance of 40 feet from the runway edge, or 75 feet from the runway edge when installed on a runway equipped with a VASI.

Precision Approach Path Indicator (PAPI) - A visual approach slope indicator normally consisting of light units similar to the VASI but in a single row of either two or four light units set perpendicular to the runway centerline. The row of light units is normally installed on the left side of the runway. Indications are as follows: Below glide path - all lights red; Slightly below glide path - three lights closest to runway red, other light white; On glide path - two lights closest to runway red, other two lights white; Slightly above glide path - light closest to runway red, other three lights white; Above glide path - all lights white.

Runway Alignment Indicator Lights (RAIL) - Sequenced Flashing Lights which are installed only in combination with other light systems.

Pulsating Visual Approach Slope Indicator (PVASI) - A pulsating visual approach slope indicator normally consisting of a single light unit projecting a two-color visual approach path into the final approach area of the runway upon which the indicator is installed. The on glide path indication is a steady white light. The slightly below glide path indication is a steady red light. If the aircraft descends further below the glide path, the red light starts to pulsate. The above glide path indication is a pulsating white light. The pulsating rate increases as the aircraft gets further above or below the desired glide slope.

Runway End Lights - Fixed red lights arranged symmetrically left and right of the runway centerline identifying the runway end.

Runway End Identifier Lights (REIL) - Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.

Threshold Lights - Fixed green lights arranged symmetrically left and right of the runway centerline identifying the runway end. When all light units are located outside the runway edge, or runway edge extended, the runway end lights are considered to be “outboard.” If any light unit is located inside the runway edge, or runway edge extended, the lights are considered to be “inboard.”

Tri-Color Visual Approach Slope Indicator (TRVC) - A visual approach slope indicator normally consisting of a single light unit projecting a three-color visual approach path into the final approach area of the runway upon which the indicator is installed. The below glide path indication is red, the above glide path indication is amber, and the on glide path indication is green.

Visual Approach Slope Indicator (VASI) - An airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing by radiating a directional pattern of high intensity red and white focused light beams which indicate to the pilot is ""on path" if he sees red/white, "above path" if white/white, and "below path" if red/red. Some airports serving large aircraft have three-bar VASI's which provide two visual glide paths to the same runway.

Airport Location Point (ALP) - The permanent position, usually expressed in latitude and longitude, of an airport for identification and reference purposes. The ALP coincides with the original Airport Reference Point. (See Airport Reference Point.)

Airport Reference Point (ARP) - The approximate geometric center of all usable runways. ARP is usually not monumented, therefore not recoverable on the ground.

Airport Surface Detection Equipment (ASDE) - Radar equipment specifically designed to detect all principal features on the surface of an airport, including aircraft and vehicular traffic, and to present the entire image on a radar indicator console in the control tower. Used to augment visual observation by tower personnel of aircraft and/or vehicular movements on the runways and taxiways.

Airport Surveillance Radar (ASR) - Approach control radar used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 nautical miles.

Air Route Surveillance Radar (ARSR) - Air route traffic control center (ARTCC) radar used primarily to detect and display an aircraft's position while en route between terminal areas.

Air Route Traffic Control Center (ARTCC) - A facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

Apparent Runway/Stopway Surface (ARS) - The surface that approximates a runway or stopway before the surface is squared off, shortened to good pavement, or otherwise adjusted to meet the criteria of a runway or stopway.

Apron - A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

Area Navigation - A method of navigation that permits aircraft operation on any desired course within the coverage of station-referenced navigational signals or within the limits of a self-contained system capability. Area navigation systems include GPS, Inertial, and LORAN-C.

Area Navigation Approach (ANA) - An instrument approach procedure using an Area Navigation System.

Azimuth

Astronomic - At the point of observation, the angle measured between the vertical plane through the celestial pole and the vertical plane through the observed object. The astronomic azimuth is established directly from observations on a celestial body and is measured in the plane of the horizon. Astronomic azimuths differs from geodetic azimuths because of the deflection of the vertical which can be greater than one minute of arc in extreme cases. Astronomic azimuths may be reckoned clockwise or counterclockwise, from either north or south, as established by convention.

Geodetic - For the geodesic line A to B, the angle between the tangent to the geodetic meridian at A and the tangent to the geodesic line at A. It may be reckoned clockwise from either geodetic north or south as established by convention. Because of earth curvature, the geodetic azimuth from A to B (forward azimuth) differs from the geodetic azimuth from B to A (back azimuth) by other than 180 degrees, except where A and B have the same geodetic longitude or where the geodetic latitude of both points is zero. The geodesic line is the shortest surface distance between two points on the reference ellipsoid. A geodetic meridian is a line on the reference ellipsoid defined by the intersection of the reference ellipsoid and a plane containing the minor axis of that ellipsoid.

Grid - The angle in the plane of projection between a straight line and the central meridian of a plane-rectangular coordinate system. Grid azimuths may be reckoned clockwise from either geodetic north or south as established by convention.

Magnetic - At the point of observation, the angle between the vertical plane through the observed object and the vertical plane in which a freely

suspended symmetrically magnetized needle, influenced by no transient artificial magnetic disturbance, will come to rest. Magnetic azimuths are reckoned clockwise from magnetic north.

Bench Mark - A relatively permanent natural or artificial material object bearing a marked point whose elevation above or below an adopted surface (datum) is known.

Blast Fence - A barrier that is used to divert or dissipate jet or propeller blast.

Blast Pad - A specially prepared surface placed adjacent to the ends of runways to eliminate the erosive effect of the high wind forces produced by airplanes at the beginning of their takeoff rolls.

Catenary - The curve theoretically formed by a perfectly flexible, uniformly dense and thick, inextensible cable suspended from two points. Also a cable suspended between two points and having the approximate shape of a catenary.

Clearway - An area beyond the takeoff runway under the control of airport authorities within which terrain or fixed obstacles may not extend above specified limits. These areas may be required for certain turbine-powered operations and the size and upward slope of the clearway will differ depending on when the aircraft was certificated.

Compass Locator - A low power, low or medium frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

Control Station - A point on the ground whose position and/or elevation is used as a basis for obtaining positions and/or elevations of other points.

Continuously Operating Reference Station (CORS) - A permanent GPS facility whose GPS receiver continuously provides observables from the GPS satellites, allowing stations occupied temporarily by GPS receivers to be differentially positioned relative to it. CORS are related to the NAD 83 coordinate system at the 1-3 cm level either by being co-located at VLBI sites which were used to define the coordinate system, or by being differentially positioned relative to such a co-located GPS station. The precise location of the CORS is usually considered to be at the L1 phase center.

D, E, F

Datum - In general, a point, line, surface, or set of values used as a reference. A geodetic datum is a set of at least eight constants specifying the coordinate system used for geodetic control (See Control Station): three to specify the location of the origin of the coordinate system, three to specify the orientation of the coordinate system, and two to specify the dimensions of the reference ellipsoid. Any point has a unique X,Y,Z datum coordinate which can be transformed into latitude, longitude, and ellipsoidal height (height relative to the ellipsoid).

A vertical datum is a theoretical equipotential surface with an assigned value of zero to which elevations are referenced. (See Geoid).

North American Datum of 1983 (NAD 83)

NAD 83 is a geodetic datum developed by the Office of National Geodetic Survey, NOAA, and became the official geodetic datum for North American in the mid 1980's. It replaced the North American Datum of 1927 (NAD 27) when a more precise datum was required to support satellite positioning. NAD 83 was adopted by the Federal Aviation Administration for the National Airspace System in October 1992.

World Geodetic System 1984 (WGS 84)

WGS 84 is a geodetic datum developed by the Department of Defense (DOD) in response to accuracies attainable with satellite positioning. It replaced the World Geodetic System 1972 (WGS 72), an earlier datum also developed by DOD.

National Geodetic Vertical Datum of 1929 (NGVD 29)

NGVD 29 is an adjustment of approximately 107,000 km of Canadian and U.S. leveling observations, holding fixed the local mean sea level values at 21 tide stations in the U.S. and 5 tide stations in Canada. NGVD 29 has been replaced in the United States by the North America Vertical Datum of 1988 (NAVD 88).

North American Vertical Datum of 1988 (NAVD 88)

NAVD 88 is an adjustment of approximately 650,000 km of Canadian-Mexican-U.S. leveling observations, holding fixed the local mean sea level value at one tidal benchmark, Point Au Pere/Rimouski, Quebec Canada, located in the mouth of the St. Lawrence River. NAVD 88 replaced NGVD 29 as the official vertical datum in North America in the early 1990's. In the conterminous United States, NAVD 88 and NGVD 29 differences range from -40 cm to +150 cm. In Alaska, the differences range from +94 cm to +240 cm.

Datum Tie - The process of determining, through appropriate survey methods, a position (horizontal tie) or elevation (vertical tie) of a new point relative to the position/elevation of a control station with

established datum values, such as, a control station in the National Spatial Reference System (NSRS). The new point may be a permanent survey monument. This process ensures that the new point will have proper relativity to NSRS and to all other points tied to NSRS.

Declared Distances - The distances the airport owner declares available for the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. The distances are:

Takeoff Run Available (TORA) - the runway length declared available and suitable for the ground run of an airplane takeoff.

Takeoff Distance Available (TODA) - the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA.

Accelerate-Stop Distance Available (ASDA) - the runway plus stopway length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff.

Landing Distance Available (LDA) - the runway length declared available and suitable for a landing airplane.

Note: The full length of the TODA may not be usable for all takeoffs because of obstacles in the departure area. The usable TODA length is aircraft performance dependent and, as such, must be determined by the aircraft operator before each takeoff.

Direction Finder (DF) - A radio receiver equipped with a directional sensing antenna used to take bearings on a radio transmitter.

Distance Measuring Equipment (DME) - Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid. DME is usually frequency paired with other navigational aids, such as a VOR or localizer.

Ellipsoid - See Reference Ellipsoid

Ellipsoid Height - The distance, taken along the perpendicular to the ellipsoid, between a point and the reference ellipsoid. Ellipsoid heights are positive if the point is above the ellipsoid. Ellipsoid heights are the heights resulting from GPS observations. Ellipsoid height = Geoid Height + Orthometric Height.

Federal Base Network (FBN) - A fundamental reference network of permanently monumented control stations in the United States at a 1 degree x 1 degree nominal spacing, established, maintained, and monitored by the National Geodetic Survey, providing precise latitude, longitude, ellipsoidal height, orthometric height, and gravity values. The FBN is a very precise subset of the National Spatial Reference System.

First Good Pavement (FGP) - The first point on a paved surface through which a perpendicular to the surface centerline can be constructed to define a runway or stopway end. While this point need not be on the runway/stopway centerline, it must be located

so that the resulting runway/stopway surface is rectilinear with full structural integrity to the end. The FGP location is a fundamental factor in establishing runway/stopway length and width.

Flight Path - A line, course, or track along which an aircraft is flying or intended to be flown.

Frangible Fixture - A fixture designed to break at a redetermined point when struck by a predetermined force to minimize damage if accidently struck by an aircraft.

Geoid - The theoretical surface of the earth that coincides everywhere with approximate mean sea-level. The geoid is an equipotential surface to which, at every point, the plumb line is perpendicular. Because of local disturbances of gravity, the geoid is irregular in shape.

Geoid Height - The distance, taken along a perpendicular to the reference ellipsoid, between the reference ellipsoid and the geoid. The geoid height is positive if the geoid is above the reference ellipsoid. For the United States, geoid height is negative for the conterminous United States and southeast Alaska, southeast of approximately Petersburg, and positive for the remainder of Alaska and the land areas of Hawaii.
Geoid Height = Ellipsoidal Height - Orthometric Height .

Global Positioning System (GPS) - A space-based radio positioning, navigation, and time-transfer system. The system provides highly accurate position and velocity information, and precise time, on a continuous global basis, to an unlimited number of properly equipped users.

Ground Controlled Approach (GCA) - A radar approach system operated from the ground by air traffic control personnel transmitting instructions to the pilot by radio. The approach may be conducted with airport surveillance radar (ASR) only or with both surveillance and precision approach radar (PAR).

G, H, I

Helipad - A small designated area, usually with a prepared surface, on a heliport, airport, landing/takeoff area, apron/ramp, or movement area used for takeoff, landing, or parking of helicopters.

Heliport - An area of land, water, or structure used or intended to be used for the landing and takeoff of helicopters and includes its buildings and facilities if any.

Heliport Reference Point (HRP) - The geographic position of the heliport expressed in latitude and longitude at, (1) the center of the final approach and takeoff (FATO) area or the centroid of multiple FATO's for heliports having visual and nonprecision instrument approach procedures, or (2) the center of the final approach reference area when the heliport has a precision instrument approach.

Inboard/Outboard Lights - Used in reference to runway end and threshold lights. The light configuration is considered "inboard" if the center of any light unit in the light array is located inside the runway edge or edge extended. The light configuration is considered "outboard" if all light centers in the light array are located outside the runway edge or edge extended. In this definition, "light array" includes the lights on both sides of the runway.

International Civil Aviation Organization (ICAO) - A specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport.

Instrument Landing System (ILS) - A precision instrument approach system which normally consists of the following electronic components and visual aids:

Localizer
Glide Slope
Outer Marker
Middle Marker
Approach Lighting

Instrument Runway - A runway equipped with electronic and visual navigational aids for which a precision or nonprecision approach procedure having straight-in landing minimums have been approved.

J, K, L

Landing Area - Any locality either on land, water, or structure, including airports/heliports, and intermediate landing fields, which is used, or intended to be used, for the landing and takeoff of aircraft whether or not facilities are provided for shelter, servicing, or for receiving or discharging passengers or cargo.

Landing Direction Indicator - A device, often a tetrahedron, which visually indicates the direction in which landings and takeoffs should be made.

Landing Distance Available (LDA) - See Declared Distances

Leveling - The process of determining the difference in elevation between two points. In geodetic leveling, this process results in a vertical distances from a vertical datum.

Differential - The determination of differences in elevation by means of a series of horizontal observations on a graduated rod, using a leveling instrument. The rod is observed while it is resting on a point of known elevation (backsight) and then, without disturbing the elevation of the leveling instrument, is observed a second time while resting on the unknown point (foresight). The differential in rod readings is applied to the starting elevation to determine the elevation of the unknown.

Indirect - The determination of differences in elevations by means other than differential leveling, such as trigonometric leveling. In trigonometric leveling, the vertical angle and distance from the instrument to the point of unknown elevation are measured and the difference in elevation between the instrument and the unknown point is then computed using trigonometry.

Local Control - A control station or network of control stations in a local area used for referencing local surveys. Local control may or may not be tied to the National Spatial Reference System. (See Control Station).

Localizer (LOC) - The component of an ILS which provides course guidance to the runway.

Localizer Back Course - The course line defined by the localizer signal along the extended centerline of the runway in the opposite direction to the normal localizer approach course (front course).

Localizer Type Directional Aid (LDA) - A navigational aid used for nonprecision instrument approaches with utility and accuracy comparable to a localizer but which is not part of a complete ILS and is not aligned with the runway.

Long Range Navigation (LORAN) - An electronic navigation system by which hyperbolic lines of position are determined by measuring the difference in the time of reception of synchronized pulse signals from two fixed transmitters. LORAN A operates in the 1750 - 1950 kHz frequency band. LORAN C and D operate in the 100 - 110 kHz frequency band.

M, N, O

Marker Beacon - An electronic navigational aid transmitting a 75 MHz vertical fan or boneshaped radiation pattern. Marker beacons are identified by their modulation frequency and keying code, and when received by compatible airborne equipment, indicate to the pilot, both aurally and visually, that he is passing over the facility.

Back Course Marker (BCM) - When installed, normally indicates the localizer back course final approach fix where approach descent is commenced.

Inner Marker (IM) - A marker beacon, used with an ILS Category II precision approach, located between the middle marker and the end of the ILS runway and usually at the point of decision height for ILS Category II approaches. It also marks progress during an ILS Category III approach.

Middle Marker (MM)- A marker beacon that defines a point along the glide slope of an ILS normally located at or near the point of decision height for ILS category I approaches.

Outer Marker (OM) - A marker beacon at or near the glide slope intercept altitude of an ILS approach. The outer marker is normally located four to seven miles from the runway threshold on the extended centerline of the runway.

Mean Sea Level (MSL) - The average location of the interface between the ocean and atmosphere, over a period of time sufficiently long so that all random and periodic variations of short duration average to zero.

Minimum Safe Altitude Warning (MSAW) - A function of the ARTS III computer that aids the controller by alerting him when a tracked Mode C equipped aircraft is below or is predicted by the computer to go below a predetermined minimum safe altitude.

Minimums - Weather condition requirements established for a particular operation or type of operation; e.g., IFR takeoff or landing, alternate airport for IFR flight plans, VFR flight etc.

Missed Approach - A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing.

Movement Area - The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with a tower, specific approval for entry onto the movement area must be obtained from ATC.

National Airspace System (NAS) - The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations, and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

National Flight Data Center (NFDC) - A facility in Washington, D.C., established by FAA to operate a central aeronautical information service for the collection, validation, and dissemination of aeronautical data in support of the activities of government, industry, and the aviation community. The information is published in the "National Flight Data Digest."

National Flight Data Digest (NFDD) - A daily (except weekends and Federal holidays) publication of flight information appropriate to aeronautical charts, aeronautical publications, Notices to Airmen, or other media serving the purpose of providing operational flight data essential to safe and efficient aircraft operations.

National Spatial Reference System (NSRS) - A network of permanent survey monuments located throughout the United States with accurately determined positions (horizontal network) and/or elevations (vertical network). Gravity values, not always monumented, are also part of NSRS.

Responsibility for establishing and maintaining NSRS rests with the National Geodetic Survey under the U.S. Department of Commerce. Current authority is contained in United States Code, Title 33, USC 883a as amended, and specifically defined by Executive Directive, Bureau of the Budget (now the Office of Management and Budget) Circular No. A-16 Revised.

Navigable Airspace - Airspace at and above the minimum flight altitude prescribed in the FARs, including airspace needed for safe takeoff and landing.

Navigational Aid (NAVAID) - Any visual or electronic device airborne or on the surface which provides point to point guidance information or position data to aircraft in flight. (See Air Navigation Facility.)

Nondirectional Beacon (NDB) - An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" or track to or from the station. When the NDB is installed in conjunction with an Instrument Landing System marker, it is normally called a Compass Locator.

Nonprecision Approach Procedure - A standard instrument approach procedure in which no electronic glide slope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDS, and SDF approaches.

Notice to Airmen (NOTAM) - A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

Obstruction - Any object that penetrates an Obstruction Identification Surface.

Obstruction Identification Surface (OIS) - Any imaginary surface authorized by the Federal Aviation Administration to identify obstructions. Any object that penetrates an OIS is an obstruction, by definition.

Specified OIS - Any OIS other than a Supplemental OIS.

Supplemental OIS - An OIS designated by appropriate FAA authorities as a supplemental OIS. A supplemental OIS, when implemented, will normally lie below a specified OIS and is intended to provide additional obstruction information. An object that penetrates a supplemental OIS only is a supplemental obstruction.

Offset NAVAID - A NAVAID used during the final approach segment of a straight in instrument approach and not located on the runway centerline or centerline extended.

Orthometric Height - The distance, taken along the plumb line, between a point and the geoid. Orthometric heights are positive if the point is above the geoid.
Orthometric Height = Ellipsoid Height - Geoid Height.

Outboard Lights - See Inboard/Outboard Lights.

P, Q, R

Planimetry - The plan detail of a map that has no indication of relief or contour.

Plot Point - A point that represents the position of a feature on a chart or map. This point may be located on the feature or located between feature components. For example, the plot point for a Precision Approach Path Indicator (PAPI) system is the center of the light array. This point falls between light units.

Precision Approach Procedure - A standard instrument approach procedure in which an electronic glideslope/glidepath is provided; e.g., GPS, ILS, and PAR approaches.

Precision Approach Radar (PAR) - Radar equipment, in some ATC facilities operated by FAA and/or the military services at joint use civil/military locations and separate military installations to detects and displays azimuth, elevation, and range of aircraft on the final approach course to a runway. The controller issues guidance instructions to the pilot based on the aircraft's position relative to the final approach course (azimuth), glidepath (elevation), and distance (range) from the touchdown point on the runway as displayed on the radar scope.

Primary Airport Control Station (PACS) - A control station established in the vicinity of, and usually on, an airport, and tied directly to the National Spatial Reference System. PACS must be declared PACS by the National Geodetic Survey and must meet the specific siting, construction, and accuracy requirements for PACS.

Progressive Taxi - Precise taxi instructions given to a pilot unfamiliar with the airport or issued in stages as the aircraft proceeds along the taxi route.

Published Data - Data officially issued for distribution to the Federal Aviation Administration, the public, or other data users.

Radio Detection and Ranging (RADAR) - A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulse.

Primary Radar - A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at the site for processing and display at an air traffic control facility.

Secondary Radar/Radar Beacon (ATCRBS) - A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility.

Radar Approach - An instrument approach procedure which utilizes Precision Approach Radar (PAR) or Airport Surveillance Radar (ASR).

Radio Beacon - See Nondirectional Beacon

Ramp - See Apron

Reference Ellipsoid (formerly called Reference Spheroid) - A geometric figure comprising one component of a geodetic datum, usually determined by rotating an ellipse about its shorter (polar) axis, and used as a surface of reference for geodetic surveys. The reference ellipsoid closely approximates the dimensions of the geoid, with certain ellipsoids fitting the geoid more closely for various areas of the earth. Elevations derived directly from satellite observations are relative to the ellipsoid and are called ellipsoid heights.

Remote Communications Outlet (RCO) - An unmanned communications facility remotely controlled by air traffic personnel. RCO's serve flight service stations. Remote Transmitter/Receivers (RTR) serve terminal ATC facilities.

Remote Transmitter/Receiver (RTR) - See Remoter Communications Outlet.

Runway - A defined rectangular area on a land airport prepared for the landing and takeoff run of aircraft along its length.

S, T, U

Secondary Airport Control Station (SACS) - A control station established in the vicinity of, and usually on, an airport, and tied directly to the Primary Airport Control Station. SACS must be declared SACS by the National Geodetic Survey and must meet the specific siting, construction, and accuracy requirements for SACS.

Simplified Directional Facility (SDF) - A navigational aid used for nonprecision instrument approaches. The final approach course is similar to that of an ILS localizer except that the SDF course may be offset from the runway, generally not more than 3 degrees, and the course may be wider than the localizer, resulting in a lower degree of accuracy.

Specially Prepared Hard Surface (SPHS) - A concrete, asphalt, or other paved surface, or an unpaved surface that has been specially treated to stabilize the surface, protect the subsurface, or provide a smoother rolling surface for aircraft. Unpaved SPHS' include compacted gravel, and gravel treated with a stabilizing bituminous material.

State Plane Coordinate System - A series of plane-rectangular coordinate systems established by the U.S. Coast and Geodetic Survey for the entire United States, with a separate system for each state. A mathematical relationship exists between state plane and geodetic coordinates, one being easily transformed into the other. The advantage of the State Plane Coordinate System is that it permits survey computations for small areas to be performed using plane trigonometry (as opposed to more complex spherical trigonometry), while still yielding very nearly the true angles and distances between any two adjacent points.

Stopway - An area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

Supplemental Profile Point - A runway/stopway point selected so that a straight line between any two adjacent published runway/stopway points will be no greater than one foot from the runway/stopway surface.

Supporting Feature - A feature, such as a runway number or threshold light set, that does not precisely define a runway/stopway survey point but provides evidence that the survey point was correctly selected.

Survey Point Locator (SPL) - A tangible feature, such as the approach side a threshold bar, or intangible feature, such as a Trim Line, whose intersection with the runway/stopway centerline defines a survey point.

Take-off Distance Available (TODA) - See Declared Distances

Take-off Run Available (TORA) - See Declared Distances.

Tactical Air Navigation (TACAN) - An ultra-high frequency electronic rho-theta air navigational aid which provides suitably equipped aircraft a continuous indication of bearing and distance to the TACAN station.

Taxiway - A defined path established for the taxiing of aircraft from one part of an airport another.

Tetrahedron - A device normally located on uncontrolled airports and used as a landing direction indicator. The small end of the tetrahedron points into the wind thereby indicating the direction of landing.

Threshold (THLD) - The beginning of that portion of the runway available for landing. A displaced threshold (DTHLD) is a threshold that is located at a point on the runway other than the designated beginning of the runway.

Touchdown Zone (TDZ) - The first 3,000 feet of the runway beginning at the threshold.

Touchdown Zone Elevation (TDZE) - The highest elevation in the Touchdown Zone FAA No. 405 standards require that the TDZE will be determined only for runways with specially prepared hard surfaces equal to, or greater than, 3,000 feet in length.

Traffic Pattern - The traffic flow that is prescribe for aircraft landing at, taxiing on or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach.

Transmissometer (TMOM) - An apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR) and runway visibility value (RVV).

Trim Line - An imaginary line, constructed perpendicular to the runway/stopway centerline, which establishes the location of a runway/stopway end or displaced threshold.

V, W, X, Y, Z

V_1 - takeoff decision speed. If a system failure occurs before V_1, the takeoff is aborted. If the failure occurs at or above V_1, the pilot is committed to continue the takeoff.

Vertical Takeoff and Landing (VTOL) Aircraft - Aircraft capable of vertical climbs and/or descents and of using very short runways or small areas for takeoff and landings. These aircraft include, but are not limited to, helicopters.

Very High Frequency Omnidirectional Range Station (VOR) - A very high frequency, navigational aid which provides suitably equipped aircraft a continuous indication of bearing to the VOR station.

Very High Frequency Omnidirectional Range/Tactical Air Navigation (VORTAC) - A navigational facility providing VOR azimuth, TACAN azimuth, and TACAN distance measuring equipment (DME) at one site.

Visual Approach - An approach conducted on an instrument flight rules (IFR) flight plan which authorizes the pilot to proceed visually and clear of clouds to the airport. The pilot must, at all times, have either the airport or preceding aircraft in sight.

Visual Glideslope Indicator - A navigational aid that provides vertical visual guidance to aircraft during approach to landing by either radiating a directional pattern of high intensity light into the approach area, or providing lighted or unlighted panels which can be aligned by the pilot, thereby allowing the pilot to determine if the aircraft is above, below, or on the prescribed glidepath. (See Airport Lighting).

Waypoint - A predetermined geographical position used for route/instrument approach definition, or progress reporting purposes, that is defined relative to a VORTAC station or in terms of latitude/longitude coordinates.

Wide Area Augmentation System (WAAS) - The total FAA system designed and built to meet the mission needs of insuring satellite integrity for using GPS for required navigation performance (RNP) in the National Airspace System and of improving accuracy to support precision approaches using GPS augmented with the WAAS.