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REPORT OF THE Ad Hoc  
COMMITTEE ON

# TERMINOLOGY

Compiled Under the Direction of  
ROBIN K. RANSONE

JULY 1967

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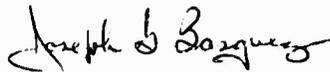
**THE REPORT OF THE  
Ad Hoc COMMITTEE  
ON  
VSTOL TERMINOLOGY  
JULY 1967**

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**Ad Hoc Committee on VSTOL Terminology  
Air Force Flight Test Center (FTTE)  
Edward Air Force Base, California**

**Submitted for the  
Ad Hoc Committee:**

  
**ROBIN K. RANSONE  
VSTOL Project Test Engineer**

  
**JOSEPH G. BASQUEZ  
Major, USAF  
Project Test Pilot**

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## FOREWORD

An Ad Hoc Committee, formed at the Air Force Flight Test Center (AFFTC), Edwards Air Force Base, California, has prepared this compilation of VSTOL terminology for use at the AFFTC. In order to encourage its widespread adoption, this effort was publicized widely. The resulting suggestions and comments of 24 other government and industry agencies were used in preparing this present listing. This list is based on the ideas of many people, and every effort has been made to make it useful and acceptable in the VSTOL field.

Industry and government agencies contributing to this terminology listing were:

Bell Helicopter Company  
Boeing Company (Seattle)  
Boeing Company (Vertol Division)  
Curtiss-Wright Corporation  
Hawker Siddeley Aviation Limited  
LTV Vought Aeronautics Division  
McDonnell Aircraft Corporation  
NASA/Ames Research Center  
NASA/Langley Research Center  
North American Aviation, Inc., Columbus Division  
North American Aviation, Inc., Los Angeles Division  
Norair Division of Northrop Corp (Hawthorne)  
Research Analysis Corporation  
Ryan Aeronautical Company  
US Air Force Aerospace Research Pilot School (EAFB)  
US Air Force Flight Dynamics Laboratory (WPAFB)  
US Air Force Flight Test Center (EAFB)  
US Air Force Directorate of Science and Technology (Wash D.C.)  
US Army (Kestrel Evaluation Squadron)  
US Army Foreign Science and Technology Center (WPAFB)  
US Army Aviation Materiel Laboratories (Fort Eustis)  
US Army Aviation School (Fort Rucker)  
US Naval Air Test Center (Patuxent River)  
XC-142A Tri-Service VSTOL Test Force (Edwards AFB)

The help of these people is gratefully acknowledged, especially since it was purely voluntary in response to the publicity given the effort through various symposia and publications.

The Ad Hoc Committee responsible for gathering opinions, interpreting comments, and preparing the definitions included the following people:

Cochairmen

Mr. Robin K. Ransome, USAF  
Robert L. Baldwin, Major USAF  
Joseph G. Basquez, Major USAF

Members

Mr. William A. Anderson, USA  
Paul J. Balfe, Major USAF  
Robert A. Chubboy, Major USA  
Mr. Harry W. Down, USN  
Erik Larsen, Major USMC  
Mr. Richard S. Leighton, USN  
Roger L. Rich, Lt USN  
David H. Tittle, Major USAF  
Donald P. Wray, Major USA

The publication of this document does not constitute Air Force approval of its findings or conclusions. It is published only for the exchange and stimulation of ideas in the field of VSTOL terminology.

## **ABSTRACT**

This report is a standardized list of definitions associated with Vertical Short Takeoff and Landing aircraft. Contributions were made from among the several military services and aircraft companies.

## **INTRODUCTION**

A need exists for a standardized set of VSTOL definitions. Considerable confusion has been experienced at meetings where VSTOL matters are discussed because terms used often have different meanings in different programs. A set of definitions that may satisfy one group often does not and cannot satisfy another group. To date, definitions of VSTOL terms have been too limited in scope and, therefore, unsuitable for general use.

In an effort to improve the situation, the Tri-Service VSTOL Test Force at Edwards AFB organized an "Ad Hoc Committee" to look into the problem. The membership of this committee was carefully selected to reflect a cross section of viewpoints from the various VSTOL test programs and represent each of the military services. The program was initiated by Major Baldwin and Mr. Ransone, cochairmen of the committee.

The Committee first determined that it would not be satisfactory to wait for the usage of current terms to stabilize before assigning definite meanings to VSTOL terms. It was further decided that it would not be possible to publish a set of definitions with the expectation of having them accepted unless the needs of each VSTOL program were taken into account. Finally, it became apparent that writing an acceptable set of definitions was not a simple task.

The stated objective of the Ad Hoc Committee on VSTOL definitions was to establish a standardized set of VSTOL definitions which might be generally acceptable, solicit comments on the definitions from contractors and governmental agencies currently involved in VSTOL activities (including Europe), resolve conflicting definitions wherever possible, discard those terms which do not have a well stabilized usage, and seek wide recognition for the resulting list of definitions.

To obtain wide dissemination of the committee's effort for comment from industry and other governmental agencies, the first list of definitions was presented to the Ninth Annual Symposium of the Society of Experimental Test Pilots in Los Angeles, California, on 24 September 1965, the First Annual VSTOL Symposium on 3 and 4 November 1965 at

Wright-Patterson AFB, Ohio, and published in the 15 November 1965 issue of Aviation Week. The response was excellent, and in all cases showed an intense interest in the effort. The comments reflected the considerable thought put into solving the problem and were most helpful to the committee. These comments were used to revise the listing and make the May 1966 revision. The May revision was then sent out to each of the 24 agencies who had made comments. Fifteen agencies responded again, and it is these comments which the Ad Hoc Committee reviewed in preparing this published listing. Many of the comments were included and all comments were carefully considered. In all cases, each resulting definition is a composite of several comments and suggestions.

#### **RECOMMENDATION**

The Ad Hoc Committee recommends that this VSTOL Terminology listing be given wide dissemination and adoption.

Comments should be directed to:

VSTOL Terminology  
AFFTC (FTTEE)  
Edwards AFB, California  
93523

# **VSTOL TERMINOLOGY**

## **BASIC LETTER TERMS**

VTOL - Abbreviation for vertical takeoff and landing. Pronounced by letter or as a word and used as an attributive adjective designating heavier-than-air aircraft which have VTOL capability.

STOL - Abbreviation for short takeoff and landing. Pronounced by letter or as a word and used as an attributive adjective designating heavier-than-air aircraft which have STOL capability.

VSTOL - Abbreviation for vertical and short takeoff and landing. Pronounced by letter or as a word and used as an attributive adjective designating aircraft which have both VTOL and STOL capability.

ATOL - Abbreviation for airplane-type takeoff and landing. Pronounced by letter or as a word and used as an attributive adjective designating a takeoff and landing in which lift is derived primarily by the forward flight dynamic pressure ( $q$ ) acting on nonrotating aerodynamic surfaces (wings).

## **FLIGHT REGIMES**

Powered Lift Flight Regime - That flight regime of any aircraft in which controlled, level flight is possible below the power off stall speed and in which part or all of the lift and/or control moments are derived directly from power plant(s).

Hovering Flight - Flight primarily supported by power plant(s) derived lift.

Hover - To remain stationary relative to the air mass.

Spot Hover - To remain stationary relative to a point on the ground.

Translation - Horizontal movement in any direction relative to a fixed point.

Air Taxi - Forward translations in close proximity to the ground, in the powered lift flight regime.

Transition Flight - Flight at airspeeds below the power off stall speed, where lift is derived both from power plant(s) and the dynamic pressure (q) resulting from forward flight.

Transition - The act of going from the powered lift flight regime to the aerodynamic flight regime and vice versa.

Conversion - The act of making the configuration changes to a VTOL, STOL, or VSTOL aircraft necessary to go from the appropriate takeoff configuration to the aerodynamic flight regime.

Reconversion - The act of making the configuration changes to a VTOL, STOL or VSTOL aircraft necessary to go from the aerodynamic flight regime to the appropriate landing configuration.

Aerodynamic Flight Regime (Conventional Flight Regime) - Flight supported primarily by the forward flight dynamic pressure (q) acting on nonrevolving aerodynamic surfaces (wings) at airspeeds above the power off stall speed.

## **AIRCRAFT CAPABILITIES**

VTOL Capability - The capability of an aircraft to make vertical takeoffs and landings over a 50-foot obstacle with zero ground roll, where there is not over one aircraft major dimension clearance between the aircraft and the obstacle.

Maximum VTOL Weight - The maximum weight at which an aircraft has VTOL capability.

STOL Capability - The capability of an aircraft to make takeoffs and landings over a 50-foot obstacle in not over 1000 feet total distance.

Maximum STOL Weight - The maximum weight at which STOL capability is possible.

VSTOL Capability - The capability of an aircraft to meet both VTOL and STOL requirements.

## **MANEUVERS**

Air Run Takeoff (ARTO) - A takeoff using the technique of a vertical lift-off followed immediately by a forward acceleration in ground effect.

Air Run Landing (ARL) - A landing using the technique of a final deceleration in ground effect, followed immediately by a vertical touch-down.

Verticircuit - A vertical takeoff, conversion, reconversion, and a vertical landing.

## **SPECIAL TERMS**

Conversion Angle (CA) - The angle measured from the longitudinal axis of the aircraft to some meaningful reference in the lift mechanism. This angle is approximately 90 degrees in hover and approximately zero degrees in aerodynamic flight. (NOTE: This is a general term. The name of the angle will vary with types of aircraft, such as duct angle, tilt angle, vector angle, wing/flap angles, etc.).

Conversion Speed - The minimum speed for aerodynamic flight.

Ground Effect - Any effect on the aircraft performance, stability and control or systems operation due to its proximity to the ground, caused by the aircraft itself.

IGE - Abbreviation for in ground effect.

OGE - Abbreviation for out of ground effect.

Ground Cushion - The phenomena of increased buoyancy experienced close to the ground.

Height Velocity Diagram (Deadman's Zone) - That height and airspeed envelope in the powered lift flight regime which defines unsafe operation in the event of power plant failure.

Recirculation - The phenomenon in which engine exhaust or propeller-/fan-generated windblast remains in or returns to the immediate proximity of the aircraft.

Reingestion - Ingestion of engine exhaust or propeller-/fan-generated windblast into the engine inlet(s), usually occurring in ground effect.

Transition Envelope - That portion of the aircraft's flight envelope in which trimmed, controllable flight is possible in the powered lift flight regime. The envelope is defined by such factors as airspeed, height, rate of climb or descent, conversion angle, power, control margins, angle of attack, etc.

Downwash - The downward component of power plant(s) derived windblast directly under the aircraft.

Groundwash - The outward flow of the power plant(s) derived windblast over the ground.

## **ENGINEERING TERMS**

Rate Damping - The negative reciprocal of the time taken to reach 63 percent of the final steady state angular or linear velocity resulting from a step control input.

Control Displacement - The displacement from trim of the pilot's control element in the cockpit.

Control Effectiveness - The capability of trimming and maneuvering the aircraft throughout its design envelope.

Control Power - The maximum angular or linear acceleration for full control displacement from any trim condition.

Control Response - The change in aircraft attitude, position, or height in one second from the initiation of a specified control displacement, usually determined for both one inch and full control displacements.

Control Sensitivity - The initial angular or linear acceleration per unit step control displacement from a given trim condition.

Damping Ratio - Ratio of actual damping to critical damping (exponential attenuation envelope for oscillatory modes).

Rate Response - The stabilized angular or linear rate per unit control displacement from any trim condition.

Control System Time Constant - The time required for a control moment to reach 63 percent of its commanded value after a step control displacement from a trim condition.

Control Force Sensitivity - Control sensitivity per unit applied control force.

Control Lag - Any time delay experienced between control application and initial aircraft response.

Control Authority - The amount of power a given input has over a control system, usually expressed in percent, force, or displacement.

## **EXPLANATORY NOTE FOR THE 1,000-FOOT STOL CRITERION**

This is the most controversial definition in the list, as was expected. Of 15 respondents, six disagreed with the 1000-foot criterion. The Ad Hoc committee has studied many different definitions. Among these were such references as "takeoff and land below the power off stall speed", "takeoff and land in the powered lift flight regime", and references to aircraft size, or aircraft weight divided by ground roll, etc. All of these references were to some phenomena resulting from the basic, primary requirement of "short" takeoff and landing, and the means and paraphernalia used to achieve it. Also, each of these references proved to be ambiguous in some cases when evaluated against specific examples. It was felt that STOL should therefore be defined in terms of the basic requirement - a given distance. The committee agreed that it is a more stringent requirement for a 200,000 pound, 200-foot long aircraft to takeoff or land over a 50-foot obstacle in 1,000 feet than for a 2,000 pound, 20-foot aircraft. Nevertheless, the extra cost and complexity of STOL requirements will be accepted for only one reason, and that is due to a lack of runway space. It would be inconsistent to accept these penalties for a small aircraft if the larger aircraft require 2,000 feet anyway. The 1,000-foot criterion was the longest distance agreeable to the committee which still satisfied a feeling of "short", and does not prevent the use of such designations as "Super STOL" for aircraft with even better performance. A 500-foot or 200-meter criterion would be too restrictive because probably only VSTOL aircraft (i.e., with power for VTOL) could meet it. The fixed length (1,000 feet) criterion should also be consistent with a "STOL Field" criteria for which aircraft performance requirements and climbout requirements would be consistent.

Some interesting sidelights became apparent: A STOL aircraft at very heavy weight or high density altitude may require more than 1,000 feet, in which case it does not have STOL capability. This prompted the inclusion of the maximum STOL weight definition. A "conventional" aircraft may be able to achieve STOL capability at light weight, cold day conditions, or with RATO assist. It must be remembered that the objective of STOL is to provide a capability which is safer and/or more efficient than VTOL and yet require a minimum of runway preparation.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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VSTOL Aircraft STOL Aircraft VTOL Aircraft Helicopters Terminology Definitions						

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