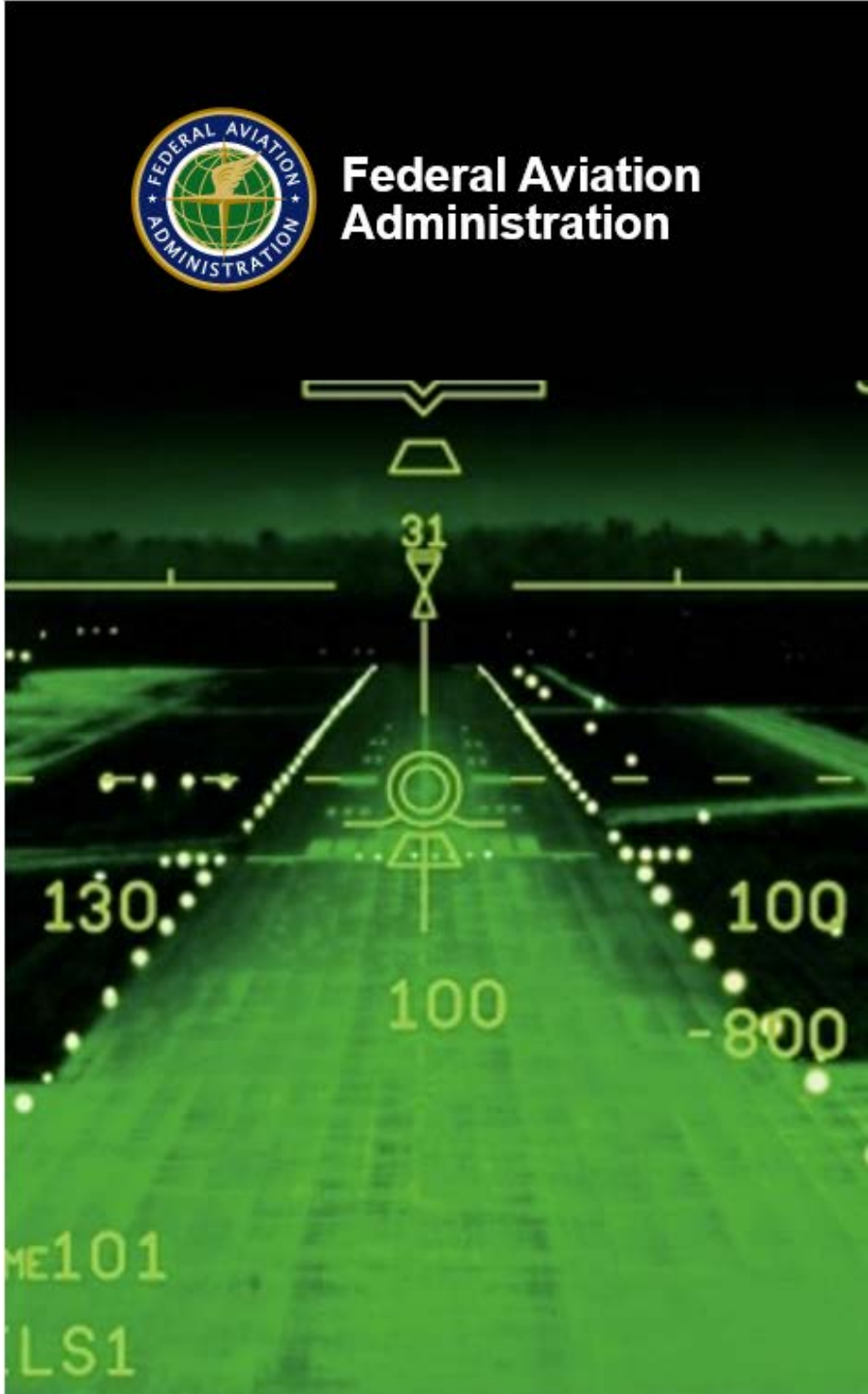
Enhanced Flight Vision Systems



Provided by

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Flight Operations Group
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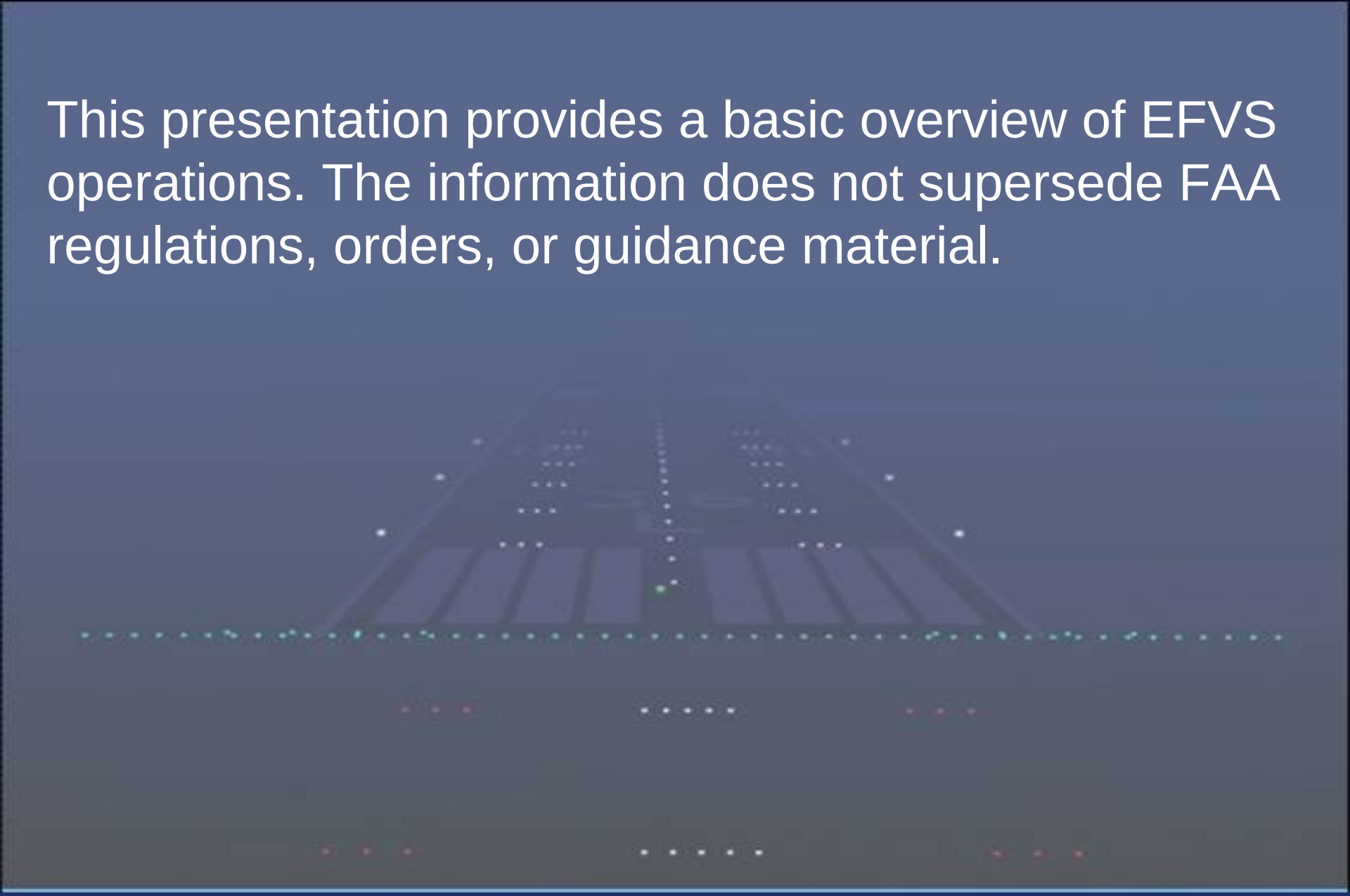
This presentation provides a basic overview of EFVS operations. The information does not supersede FAA regulations, orders, or guidance material.



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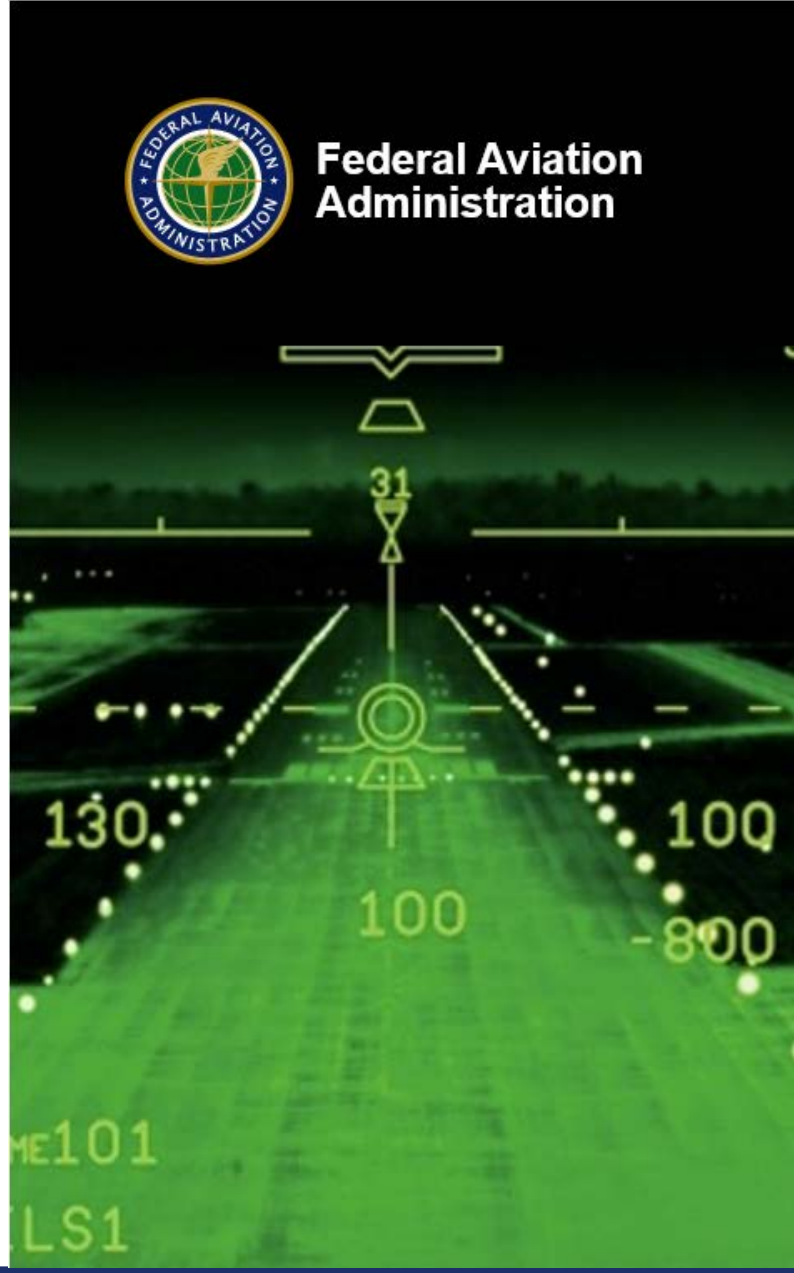


EFVS Basics

What is an EFVS?

Enhanced Flight Vision System.

An installed aircraft system that uses a HUD or equivalent display to present:

- Aircraft Information
- Flight Symbology
- Electronic real-time sensor image of the forward external scene

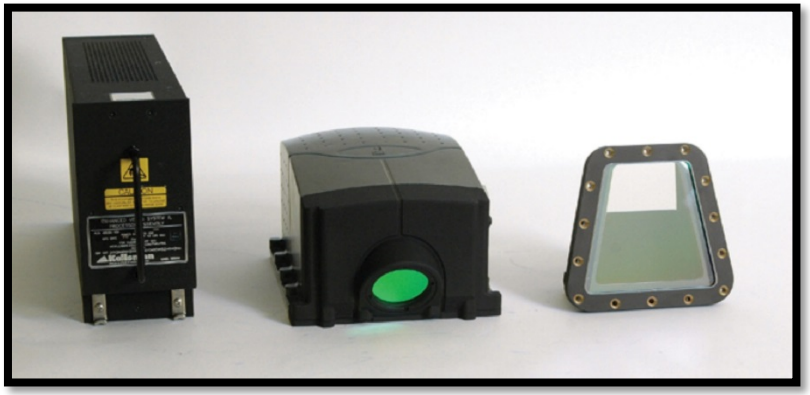
Imaging sensors can be forward-looking infrared, millimeter wave radiometry, millimeter wave radar, low-light level image intensification or other real-time imaging technologies.

What is NOT an EFVS?

- An image presented on a head-down display (HDD)
- An image displayed on a HUD without symbology or guidance information
- A Synthetic Vision System (SVS) or Synthetic Vision Guidance System (SVGS)
- A Night Vision Imaging System (NVIS)/Night Vision Goggles (NVG)

These advanced vision systems CANNOT be used to conduct EFVS operations.

Components of an EFVS



An EFVS includes the display element, sensors, computers, power supplies, indications, and controls.

What is Enhanced Flight Visibility?

Definition (14 CFR § 1.1):

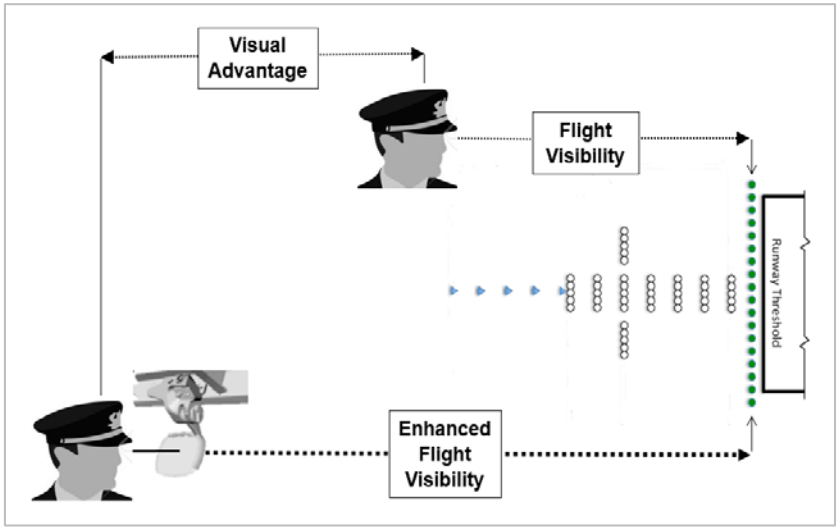
Enhanced flight visibility means the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent topographical objects may be clearly distinguished and identified by day or night by a pilot ***using an enhanced flight vision system*****.**

Flight Visibility refers to a pilot's visibility using natural vision

Enhanced Flight Visibility refers to a pilot's enhanced visibility using EFVS imagery

What is Visual Advantage?

It is a measure of EFVS performance. The visual advantage is the difference between the distance a pilot can see using an EFVS (enhanced flight visibility) compared to the distance the pilot can see without the use of the EFVS (flight visibility).



The visual advantage measurement supports concepts for part 121,125,and 135 operations designed to increase the likelihood the pilot will have the required enhanced flight visibility and be able to identify the required visual references when conducting EFVS operations.

What is an EFVS Operation?

An *EFVS operation* is conducted when a pilot uses the enhanced image provided by an EFVS to operate in the visual segment of an instrument approach and land because flight visibility is not sufficient the meet the requirements to do so with only natural vision. The regulatory definition is in 14 CFR § 1.1.

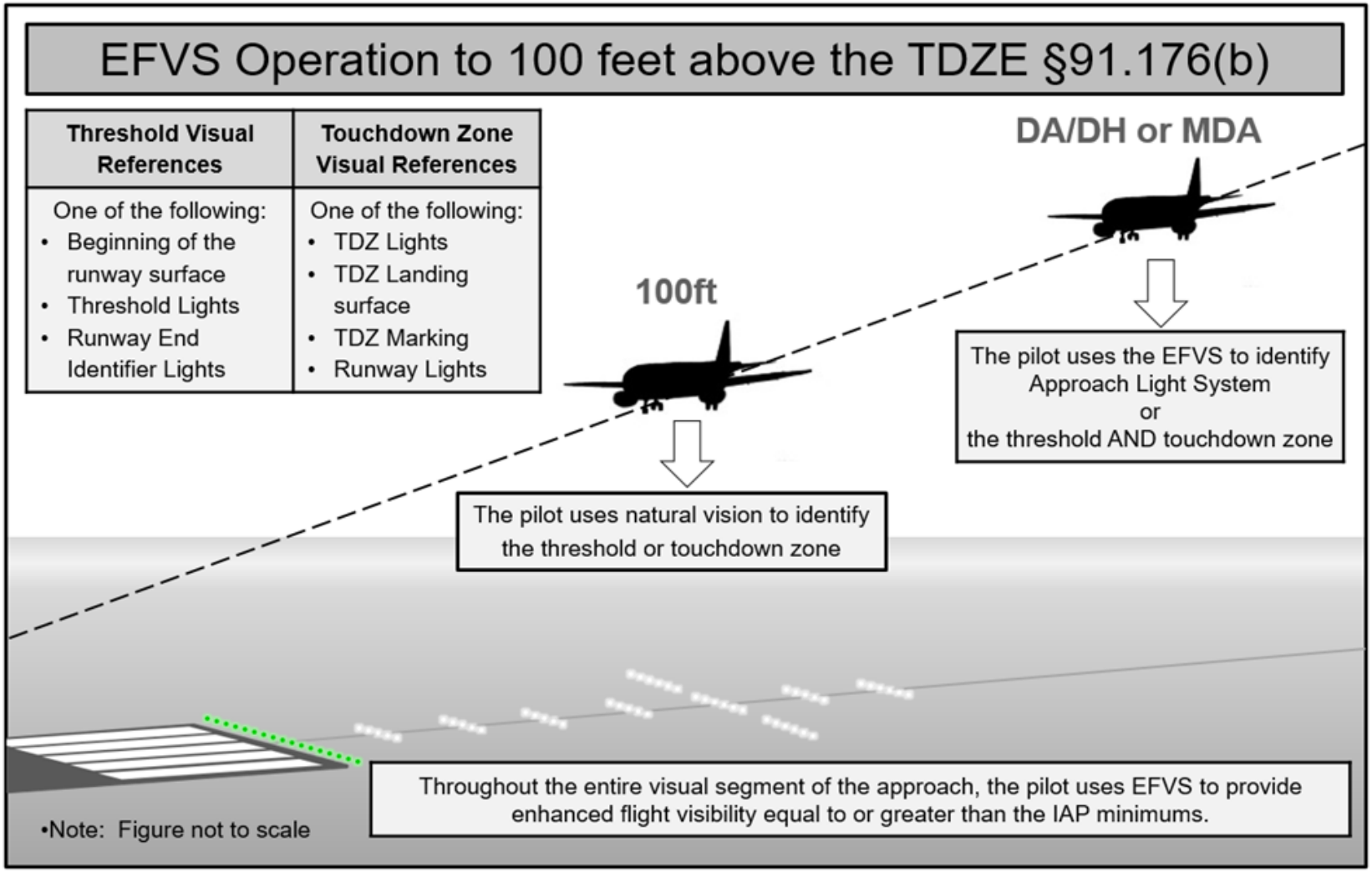
The Types of EFVS Operations?

1. EFVS Operation to 100 feet above the TDZE, § 91.176(b)
2. EFVS Operation to touchdown and rollout, § 91.176(a)

EFVS Operation to 100 feet above TDZE

- **Regulation.**14 CFR § 91.176(b).
- **Operation.** Enhanced vision imagery is used to descend below DA/DH or MDA. Natural visibility is used in addition to the enhanced vision imagery to continue below 100 feet above the TDZE.
- **Eligible Approaches.** Any straight in instrument approach procedure except category CAT II/III approaches.
- **Eligible Systems.** EFVS meeting the certification criteria in AC 20-167 for an EFVS Landing System or an EFVS Approach System.
- **Authorization (OpSpec/MSpec/LOA C048).** Except for part 91 operators, all operators require FAA authorization to conduct an EFVS operation under § 91.176(b). Part 91 operators may obtain an optional LOA to facilitate approvals and inspections by foreign authorities.

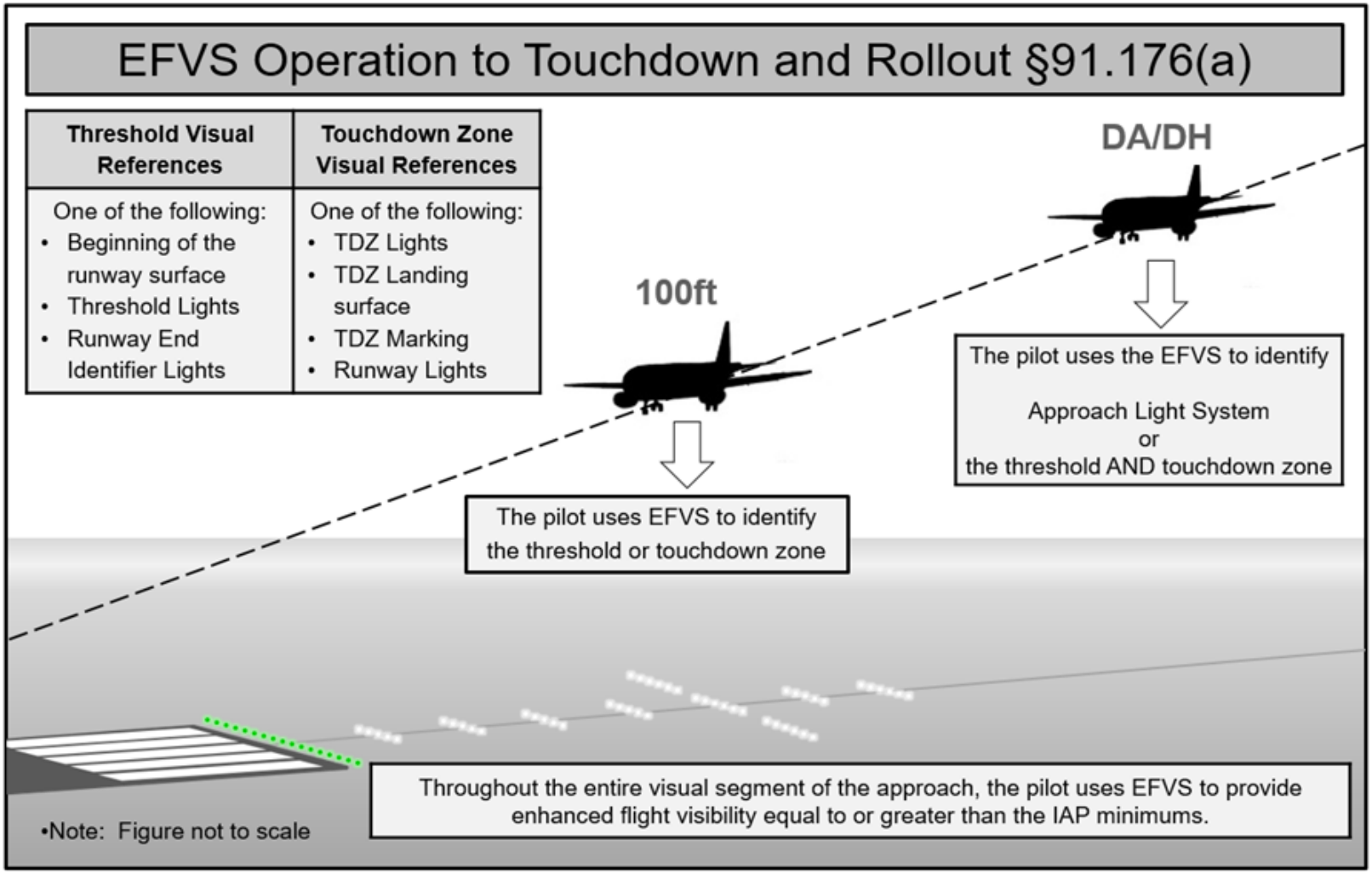
EFVS Operation to 100 feet above TDZE



EFVS Operation to Touchdown & Rollout

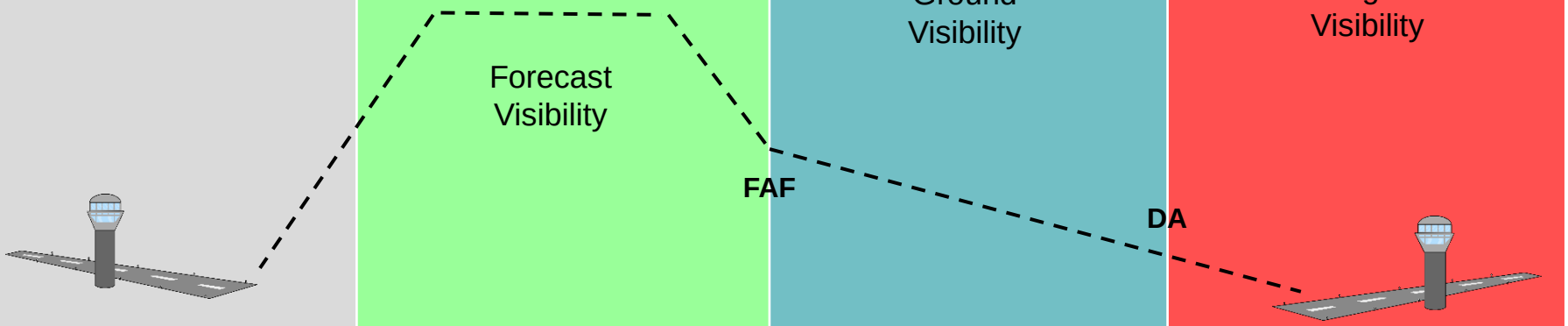
- **Regulation.** 14 CFR § 91.176(a).
- **Operation.** Enhanced vision imagery is used to descend below DA/DH to touchdown and rollout.
- **Eligible Approaches.** Any straight in instrument approach procedure with a published DA or DH.
- **Eligible Systems.** EFVS meeting the certification criteria in AC 20-167 for an EFVS Landing System.
- **Authorization (OpSpec/Mspec/LOA C048).** All Operators require FAA authorization to conduct an EFVS operation under § 91.176(a).
- **Minimum visibilities**. Minimum visibilities for the operation are specified in the authorization.

EFVS Operation to Touchdown & Rollout



The EFVS Regulations

Pilot Requirements	Flight Planning	Approach	EFVS Operation
§ 61.66	**§ 121.613** **§ 125.361** **§ 135.219**	**§ 121.651** **§ 125.325** **§ 135.225**	**§ 91.176**
Pilot requirements include • Ground Training • Flight Training • Recency of Flight	May dispatch/release a flight if the forecast visibility is equal to or greater than the minimum visibility for use with an EFVS (above authorized minimums)	May begin the approach if the reported visibility is equal to or greater than the minimum visibility for use with an EFVS	Descent below DA/DH or MDA
	Forecast Visibility	Reported Ground Visibility	Enhanced Flight Visibility



Pilot Requirements

Pilots conducting EFVS Operations are subject to the pilot requirements in this regulation which defines the types of EFVS training and recent flight experience required for conducting EFVS operations.

- § 61.66 *Enhanced Flight Vision System Pilot Requirements*

Flight Planning Regulations

Provisions of a certificate holder's operations specifications for EFVS operations may define authorized minimums for use with EFVS to dispatch/release an airplane.

- § 121.613 *Dispatch or flight release under IFR or over the top*
- § 125.361 *Flight release under IFR or over-the-top*
- § 135.219 *IFR: Destination airport weather minimums*

Approach Decision Regulations

Provisions of a certificate holder's operations specifications for EFVS operations will define the IAP minimum visibility for use with an EFVS.

- § 121.651 *Takeoff and landing weather minimums: IFR: All certificate holders*
- § 125.325 *Instrument approach procedures and IFR landing minimums*
- § 135.225 *IFR: Takeoff, approach and landing minimums*

EFVS Operation Regulations

An operator's authorization for EFVS operations (OpSpec/ MSpec/ LOA C048) authorizes EFVS operations to touchdown and rollout and/or EFVS operations to 100 feet above the touchdown zone elevation.

- § 91.176 *Straight-in landing operations below DA/DH or MDA using an enhanced flight vision system (EFVS) under IFR*

EFVS Authorizations

What is the EFVS Authorization?

- The EFVS Authorization is designated OpSepc C048, MSpec MC048, or LOA C048, *Enhanced Flight Vision System Operations*

- C048 Authorizes TWO types of EFVS operation
  1. § 91.176 (a) *EFVS Operations to Touchdown and Rollout*
  2. § 91.176 (b) *EFVS Operations to 100 feet above touchdown zone elevation*

- C048 authorizes EFVS Operational Credit and contains unique provisions that apply to Part 121,125, and 135 operations

- The authorization is issued by FAA oversight offices with the assistance of the Flight Technologies and Procedures Division, Flight Operations Group

Who needs an authorization ?

Operations Conducted Under:	EFVS Operations to Touchdown and Rollout § 91.176(a)	EFVS Operations to 100 Feet Above TDZE § 91.176(b)
Parts 121, 125, and 135	OpSpec C048	OpSpec C048
Part 125 LODA (125M)	LOA C048	LOA C048
Part 91 (subpart K)	MSpec C048	MSpec C048
Part 91	LOA C048	NONE NOTE: Optional LOA C048 is available on request and may be needed to obtain approvals with foreign authorities

What is EFVS Operational Credit?

- EFVS operational credit is credit for a portion of flight visibility prescribed by the IAP being flown that is satisfied by the enhanced image provided by the EFVS
- EFVS operational credit is annotated in Table 1 of part 121,125, 125M, and 135 authorizations

Sample C048 Table 1 – Authorized Airplanes, Equipment, and EFVS Operations

Airplane (M/M/S)	EFVS Equipment	EFVS Operation(s)	EFVS Operational Credit

- Recommended EFVS operational credit for an installed EFVS/Sensor may be found in the Operational Suitability Report, *Operational Credit for EFVS*

What is the purpose of EFVS Operational Credit ?

EFVS operational credit is used to determine the minimum visibilities that are authorized when using an EFVS to exercise specific provisions of FAA authorization C048. Parts 121, 125, and 135 certificate holders may use EFVS-equipped aircraft to:

1. Release a flight under IFR when the forecast weather is equal to or greater than the authorized minimums for use with an EFVS; and
2. Continue an approach when the weather is reported to be equal to or greater than authorized minimums for use with an EFVS.

The following two slides are examples of the tables found in the authorization that operators use to determine the minimum visibilities for use with EFVS.

Determining IAP Visibility Minimums with EFVS (RVR)

C048 Table 2A

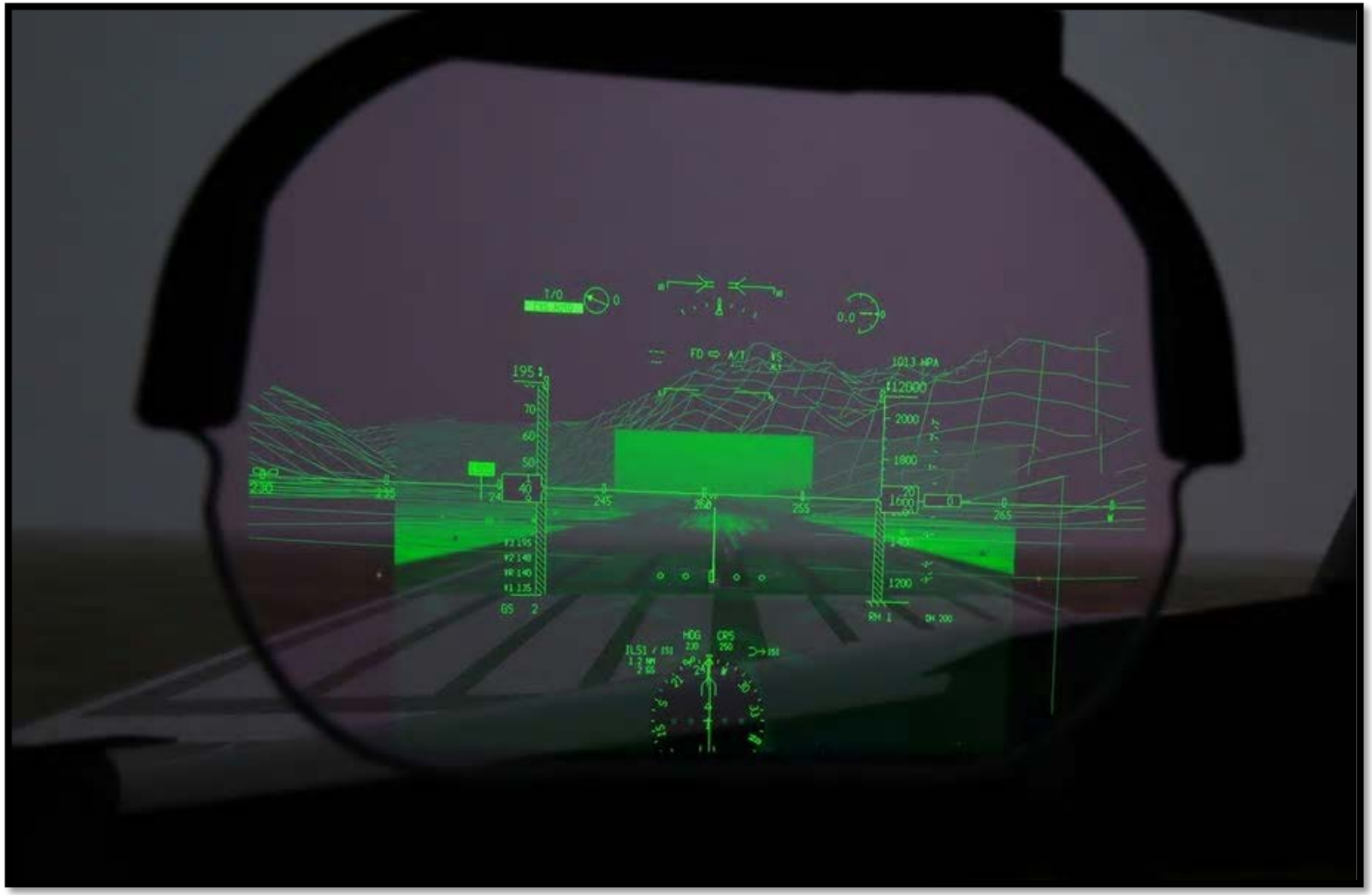
Visibility required without the use of EFVS	25% reduction Minimum visibility with the use of EFVS	33% reduction Minimum visibility with the use of EFVS	50% reduction Minimum visibility with the use of EFVS
1400	1100	1000	1000
1800	1400	1200	1000
2000	1500	1300	1000
2200	1700	1500	1100
2400	1800	1600	1200
2600	2000	1700	1300
3000	2300	2000	1500
3500	2600	2300	1800
4000	3000	2700	2000
4500	3400	3000	2300
5000	3800	3400	2500
5500	4100	3700	2800
6000	4500	4000	3000

Determining IAP Visibility Minimums with EFVS (SM)

C048 Table 2B

Visibility required without the use of EFVS	25% reduction Minimum visibility with the use of EFVS	33% reduction Minimum visibility with the use of EFVS	50% reduction Minimum visibility with the use of EFVS
½	⅜	¼	¼
⅝	½	⅜	⅜
¾	½	½	⅜
⅞	⅝	½	½
1	¾	⅝	½
1 ⅛	1	¾	⅝
1 ¼	1	¾	⅝
1 ⅜	1	1	¾
1 ½	1 ⅛	1	¾
1 ⅝	1 ¼	1	¾
1 ¾	1 ⅜	1 ⅛	⅞
1 ⅞	1 ⅜	1 ¼	1
2	1 ½	1 ⅜	1
2 ½	1 ⅞	1 ½	1 ¼
3	2 ¼	2	1 ½

Application for C048



Application Guidance

- **Advisory Circular (AC) 90-106 (current version)**
  - Primary industry document for operational EFVS Information
  - Contains recommended application requirements to obtain an authorization to conduct EFVS operations
- **FAA Order 8900.1 Volume 4 Chapter 17**
  - Instructions for aviation safety inspectors that are tasked with evaluating an EFVS application
  - Section 1 contains evaluation instructions
  - Section 2 contains administrative instructions for completing the authorization template in WebOpss
- **Operational Suitability Report, *Operational Credit for EFVS***
  - Contains recommendations for operational credit for eligible EFVS sensor installations. Located in FSIMS
- **Application Guide for Part 91 LOA C048**
  - Consolidates the items specified in AC90-106 (current version) necessary to process a part 91 LOA C048 application for operations under § 91.176(a) or (b), as applicable. Located on the EFVS website under the Application Guide Link.

Roles and Responsibilities

- **Applicants**
  - Provide the supporting information/documentation and conduct the necessary demonstrations to the FAA as outlined in the current version of AC 90-106

- **Principal Operations Inspectors**
  - Manage the evaluation;
  - Conduct the review; and
  - Issue the final authorization

- **Flight Technologies & Procedures Division, Flight Operations Group**
  - Provides technical and policy support when requested, and
  - Coordinates with other FAA offices as necessary

Phases of the evaluation

Applicant should expect the FAA to use a five-phase evaluation process described in FAA Order 8900.1, Volume 3, Chapter 1, Section 1 as a general guideline for conducting the evaluation. Each evaluation is unique and inspectors may adapt as necessary.

- **PHASE 1** - Applicant and FAA review requirements for the application
- **PHASE 2** - Applicant submits the formal application
- **PHASE 3** - FAA reviews the application
- **PHASE 4** – Demonstration phase - FAA observes operator's ability to perform in accordance with their application
- **PHASE 5** – Final approval for the authorization

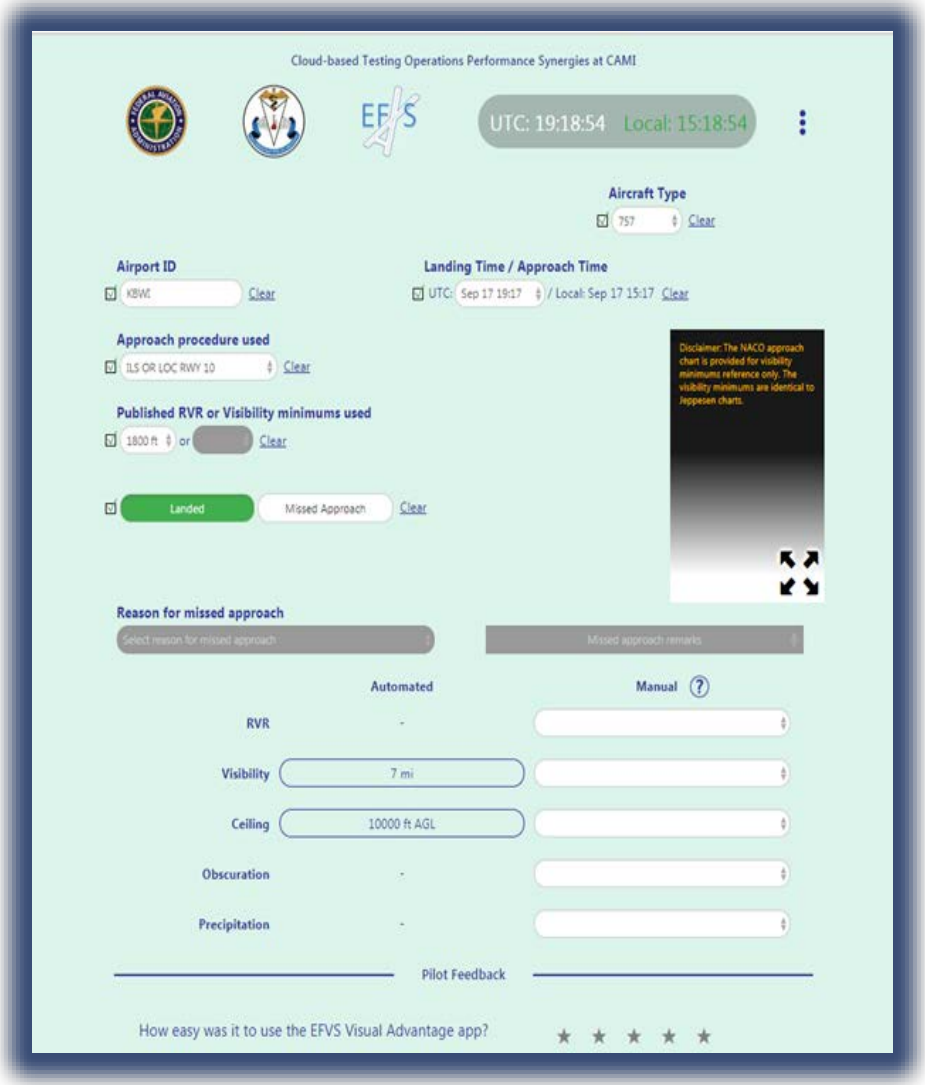
EFVS Performance Feedback

EFVS performance database

- The EFVS performance database is used to evaluate the effectiveness of operational concepts as well as to identify areas where EFVS operational credit can be expanded
- It is NOT used to evaluate individual pilot performance
- The development of the database and user interface is sponsored by the Flight Technologies and Procedures Division in collaboration with the Civil Aerospace Medical Institute's (CAMI) Human Factors Research Division

Pilot interface

- The interface was designed to allow pilots to provide the FAA with essential information about an EFVS operation that they conducted in an efficient and anonymous manner.
- The application is designed to be integrated with the technology commonly available in today's paperless cockpits.
- The user interface is a tablet application that can be utilized by a large airline or a single operator.



Uses for the feedback?

The tablet interface allows the FAA to collect information on sensor performance during operational flights that occur in a much wider variety of environmental conditions than possible in the certification process. Data may be analyzed to:

- Evaluate effectiveness of EFVS performance based concepts
- Consider improvements to EFVS policy based on data-driven decision making
- Improve operational reliability in low visibilities
- May facilitate operational demonstrations

Do you want to participate?

The FAA hopes that EFVS users will recognize the mutual benefits of collecting this information and therefore participation is voluntarily. Since any one pilot might experience only a few EFVS operations in a year the hope is that a collective effort by all EFVS users will provide meaningful data to be used in future policy development for the use of operational credit. Please contact the project lead if you are interested in learning more about participating.

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EFVS
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