Enhanced Flight Vision System (EFVS)
Recommendations for EFVS Pilot Training

(Revision 0: 8/31/2020)

Purpose. Properly trained flightcrews are essential to successful EFVS operations. This document lists each pilot training requirement specified in § 61.66 along with recommended training content and sample endorsements.

Items included in this document:

1. At a minimum, pilot training must include the ground training subjects and flight training tasks listed in § 61.66; and
2. AC 90-106 includes information that pilots should be aware of when conducting EFVS operations. This information should be included in EFVS pilot training.

Any ground or flight training curriculum should consider the following, which are not included in this document:

1. The HUD operating proficiency of the pilot. The EFVS pilot training assumes the pilot is proficient in HUD operations. Extra training may be required for a pilot without any prior HUD experience;
2. Procedures and limitations in an Airplane Flight Manual or an EFVS supplement (AFM(S))should be incorporated into pilot training;
3. The recommendations in a Flight Standardization Board (FSB) report specific to the aircraft should be incorporated into pilot training; and
4. The training, testing, and qualification provisions of Part 91 subpart K, part 121, 125, or 135 if applicable.

EFVS Pilot Training
Ground Training Subjects

The following provides the regulatory text, a regulatory citation, and relevant subject matter for each ground training subject required under § 61.66(a). The suggested subject matter for the regulatory subjects is not all-inclusive and should be included in a pilot training curriculum.

Requirement: § 61.66(a)(2)(i)	*Regulations that relate to EFVS flight operations and limitations, including the Airplane Flight Manual (AFM) limitations.*
Suggested discussions:	An overview of the regulations relevant to EFVS operations.
	An overview of an AFM(S) or other manufacturer documentation that specify the type of EFVS operation the EFVS is certified to conduct, specify performance applicable to the use of operational credit, or define specific procedures, conditions or limitations associated with operating the EFVS. In some cases, procedures described in an AFM(S) may be more restrictive than the regulations.
Requirement: § 61.66(a)(2)(ii)	*EFVS sensor imagery and required aircraft flight information and flight symbology.*
Suggested discussions:	An overview of the characteristics of the enhanced imagery provided by an EFVS. An EFVS image must be real-time, conformal, and sensor-based. Other types of imagery, such as a synthetic image, is computer-generated from a database and cannot be used to conduct an EFVS operation.
	An overview of the symbology and equipment requirements to be used for EFVS operations to touchdown and rollout listed under § 91.176(a)(1).
	An overview of the symbology and equipment requirements of an EFVS to be used for EFVS operations to 100 feet above the touchdown zone elevation listed under § 91.176(b)(1).

Requirement: § 61.66(a)(2)(iii)	*EFVS display, controls, modes, features, symbology, annunciations, and associated systems and components*.
Suggested discussions:	A description of the controls for the EFVS image to include display brightness, contrast, and image modes.
	A description of the control for turning the EFVS image on or off. This control is important because if the sensor imagery were to obscure the pilot's view of the outside scene, the pilot should have a readily available means for immediately removing the sensor imagery from the Head-Up Display (HUD). However, in order to continue an EFVS operation the pilot should reactivate the image as soon as possible to be in compliance with § 91.176.
	A description of how computer-generated synthetic elements are presented in the image, if applicable. Some systems may integrate synthetic vision elements into the image displayed on the HUD. A pilot should be able to differentiate between the sensor-based elements and the computer-generated elements.
	A description of the runway and extended runway centerline symbology presented during the approach phase.
	A description of the field of view (FOV) of the EFVS display.
Requirement: § 61.66(a)(2)(iv)	*EFVS sensor performance, sensor limitations, scene interpretation, visual anomalies, and other visual effects*.
Suggested discussions:	A description of the imaging technology of the EFVS sensor and the related limitations (i.e., light detection, obstacle detection, weather types, and FOV). The AFM(S) may specify any limitations or demonstrated performance applicable to the installed EFVS. An EFVS can display imagery that may significantly improve a pilot's capability to detect approach lights and visual references of the runway environment that may not otherwise be visible using natural vision. Not all EFVS sensors have the same imaging capabilities. Some sensors may image particular materials and some may focus in specific energy spectrums. Some sensor technologies are more affected by certain weather conditions (e.g., obscurations and precipitation). Some systems utilize multiple sensors to combine the benefits from different technologies.
	An overview on interpreting a sensor-generated scene presented by the EFVS. Images may have characteristics and contain artifacts that are unique to the sensor technology, EFVS image processing software, or display characteristics (i.e., monochrome colors). An external scene generated from infrared technology may be different from a scene generated from another technology or combination of technologies.
	An overview of image anomalies of the installed EFVS. Anomalies such a as "noise," "blooming," parallax, and other visual effects may be more prevalent in different EFVS installations.

Requirement: § 61.66(a)(2)(v)	*Preflight planning and operational considerations associated with using EFVS during taxi, takeoff, climb, cruise, descent and landing phases of flight, including the use of EFVS for instrument approaches, operating below the DA/DH or MDA, executing missed approaches, landing, rollout, and balked landings*.
Suggested discussions:	On overview of flight planning considerations for sensor performance and limitations.
	A description of the optimal EFVS settings for different phases of flight and meteorological conditions.
	An overview of techniques for identifying visual references with natural-vision, at 100 feet above the TDZE, for EFVS operations to 100 feet above the touchdown zone elevation. Several techniques crews can use for ensuring visual references are seen with natural-vision while continuing use of the EFVS image. It is important that these techniques do not reinforce deactivating the EFVS image more than momentarily during the EFVS operation.
	An overview of considerations for conducting EFVS operations with a limited EFVS field of view. A combination of crosswind correction, approach course offset, and the lateral FOV may result in the inability of the pilot to acquire and maintain visual references.
	An overview of considerations for executing a go-around below a DA/DH or MDA. Whether a pilot is using an EFVS or natural vision, obstacle clearance should not be assumed when initiating a go-around below a DA/DH or MDA or after the missed approach point. The missed approach procedure should be thoroughly briefed, and accurately flown, and may need additional climb performance beyond the standard 200 feet per nautical mile to ensure adequate obstacle clearance.
	An overview of the considerations for visual segment obstacle clearance. Pilots using an EFVS should be careful not to conclude that the flightpath is free of obstacles because no obstacles are distinctly visible in the EFVS image. The approach procedure should be thoroughly briefed and accurately flown.
	An overview of the considerations for conducting EFVS operations on special IAPs. Operators that have a specific approval from the FAA to conduct instrument approaches using special IAPs should evaluate those instrument procedures to determine their compatibility with EFVS operations. These procedures may have nonstandard features or special conditions that may not be compatible with EFVS operations or the performance of an EFVS sensor.
	An overview of the considerations for conducting taxi operations after conducting an EFVS operation. Once the EFVS operation is complete, the pilot may have to taxi at an airport with Low-Visibility Operations (LVO)/Surface Movement Guidance and Control System (SMGCS) operations in affect. Although an EFVS may provide some increased situation awareness during taxi operations, natural vision is still essential.

Requirement: § 61.66(a)(2)(vi)	*Weather associated with low-visibility conditions and its effect on EFVS performance.*
Suggested discussions:	An overview of the effect of obscuration types, precipitation conditions, and low ceilings or cloud layers as contributing factors to the variable and unpredictable characteristics of EFVS sensor performance or EFVS sensor and image quality.
	An overview of visibility reporting equipment (e.g., Runway Visual Range (RVR), Automated Surface Observing System (ASOS), and Automated Weather Observing System (AWOS)) and their limitations, reporting increments, and relationship to actual flight visibility on the approach.
Requirement: § 61.66(a)(2)(vii)	*Normal, abnormal, emergency and crew coordination procedures when conducting EFVS operations.*
Suggested discussions:	A description of the operational concepts and the procedures used in EFVS operations to touchdown and rollout, as applicable.
	A description of the operational concepts and the procedures used in EFVS operations to 100 feet above the touchdown zone elevation, as applicable.
	A description of the following system preflight and in-flight procedures: 1. An integrity check of the sensor window; 2. System tests to include system warmup time requirements brightness; 3. System control adjustments to include appropriate setting of EFVS contrast and brightness and symbology; and 4. EFVS image alignment procedures with the natural vision image.
	A description of the following pilot flying (PF) and pilot monitoring (PM) communications: 1. Callouts for continuing descent below the DA/DH or MDA using the EFVS; 2. Callouts for transition from enhanced image to natural vision at 100 feet above the touchdown zone elevation (TDZE) during an EFVS operation to 100 feet above the touchdown zone elevation; 3. Callouts to clearly communicate the decision to land or go around; and 4. Callouts for abnormal EFVS operations.
	A description of the following items to be briefed prior to initiating an approach using the EFVS:

	1. Expectations of system performance and limitations in reported weather conditions and a minimum visibility for the use of an EFVS (if applicable); 2. EFVS callouts; 3. Other approach considerations that may affect EFVS operations such as final approach offsets and ground infrastructure; 4. Missed approach considerations and procedure; and **5.** The taxi operation considerations in reported weather conditions.
	A description of the PM use of the repeater display during EFVS operations to touchdown and rollout. The PM uses the display to assess the safe conduct of the approach, landing, and rollout, and intervene if necessary in visibilities where natural vision may not be sufficient.
	A description of the procedure used for determining minimum visibility for use of EFVS for the purpose of releasing the flight or executing an approach, as applicable.
	An overview of techniques for identifying EFVS system failures and corresponding procedures. A proper crosscheck of the HUD instrumentation presentations against the EFVS sensor image could help recognize malfunctions of the navigation equipment or improper presentation of elements in the visual scene during the approach. In the event any required component fails during an EFVS operation until touchdown, the PF should initiate a go-around. However, this does not preclude a pilot's authority to continue to a landing and rollout if the pilot considers that a safer course of action.
Requirement: § 61.66(a)(2)(viii)	*Interpretation of approach and runway lighting systems and their display characteristics when using an EFVS.*
Suggested discussions:	A curriculum include an overview of different light sources (e.g., light-emitting diode (LED) or incandescent) in airport and approach lighting systems and the ability of the EFVS to detect them. An EFVS based only on infrared sensor technology may not be capable of imaging LED lighting because energy is not emitted in an infrared spectrum. Pilots should be familiar with the potential use of LEDs at their destination and any corresponding limitations of their EFVS. Flight Standards InFO 11004, Enhanced Flight Vision System (EFVS), Enhanced Vision Systems (EVS), and Night Vision Goggles (NVG) Compatibility with Light-Emitting Diodes (LEDs) at Airports and on Obstacles. You can find InFO 11004 at https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info.

EFVS Pilot Training
Flight Training Tasks

The following provides the regulatory text, a regulatory citation, and relevant suggestions for each flight training task required under § 61.66(b). The flight training tasks should reinforce the lessons taught in the ground-training subjects. The suggestions for each regulatory task are not all-inclusive and should be included in a pilot training curriculum.

Requirement: § 61.66(b)(2)(i)	*Preflight and in-flight preparation of EFVS equipment for EFVS operations, including EFVS setup and use of display, controls, modes and associated systems, and adjustments for brightness and contrast under day and night conditions*.
Suggested tasks:	These tasks should be performed using the manufacturer's recommended procedures or procedures applicable to the operator.
Requirement: § 61.66(b)(2)(ii)	*Proper piloting techniques associated with using EFVS during taxi, takeoff, climb, cruise, descent, landing, and rollout, including missed approaches and balked landings*.
Suggested tasks:	Flight training should allow pilots to become familiar with the use of installed equipment such as an EFVS in all phases of flight.
Requirement: § 61.66(b)(2)(iii)	*Proper piloting techniques for the use of EFVS during instrument approaches, to include operations below the DA/DH or MDA as applicable to the EFVS operations to be conducted, under both day and night conditions*.
Suggested tasks:	Pilot should be proficient in piloting techniques using the flight director, flight-path vector cue, and flight-path angle reference cue and using the EFVS during the flare, touchdown, and rollout consistent with EFVS operations to 100 feet above the touchdown zone elevation or EFVS operations to touchdown and rollout under the following conditions: 1. A sample of approach types for the EFVS operation being trained (e.g., precision and non-precision, if applicable). 2. A sample of crosswind conditions and offset angles that emphasize the challenges of operating with the limited FOV with an EFVS. 3. EFVS operations in visibilities less than IAP minimum visibilities. This may not be practical if training is conducted in an aircraft. If the training is accomplished in a simulator, with the enhanced visibilities representative of the EFVS sensor performance.

Requirement: § 61.66(b)(2)(iv)	*Determining enhanced flight visibility.*
Suggested tasks:	Pilots should determine enhanced flight visibility using techniques and methods similar to the techniques and methods used for determining flight visibility when conducting an approach without an EFVS. The PM should be able to use the pilot monitoring display, if available, to assist the PF in this task.
Requirement: § 61.66(b)(2)(v)	*Identifying required visual references appropriate to EFVS operations.*
Suggested tasks:	Pilots should identify required visual references using an EFVS with techniques and methods similar to the techniques and methods used for identifying the required visual references when conducting an approach without the use of an EFVS. The PM should be able to use the pilot monitoring display, if available, to assist the PF in this task.
Requirement: § 61.66(b)(2)(vi)	*Transitioning from EFVS sensor imagery to natural vision acquisition of required visual references and the runway environment.*
Suggested tasks:	Pilots should acquire visual references with natural vison at 100 feet during an EFVS operation to 100 feet above the touchdown zone elevation. There are many acceptable techniques for identifying the visual references with natural vision while the pilot continues using the EFVS to provide the enhanced flight visibility required for the operation.
Requirement: § 61.66(b)(2)(vii)	*Using EFVS sensor imagery, required aircraft flight information, and flight symbology to touchdown and rollout, if the person receiving training will conduct EFVS operations under § 91.176(a).*
Suggested tasks:	The tasks should emphasize completing the operation using enhanced imagery and HUD symbology in conditions applicable to the lowest visibility associated with the EFVS being used.
Requirement: § 61.66(b)(2)(viii)	*Normal, abnormal, emergency and crew coordination procedures when using an EFVS.*
Suggested tasks:	Flight training tasks should emphasize crew procedures appropriate to the operator, to include: 1. Procedures applicable to the PF and PM, crew briefings, procedures, callouts, and coordination items for EFVS operations, including annunciation of published minimums during operation below the DA/DH or MDA. 2. Procedures at 100 feet, during an EFVS operation, to 100 feet above the touchdown zone elevation. 3. EFVS Failure Procedures. Procedures for an EFVS failure or a system degradation during an EFVS operation.

EFVS Pilot Training
Training Endorsements

Regulations specify that a logbook or training record endorsement from the authorized training provider is required. The endorsement must certify that the person has satisfactorily completed the ground training and has been found proficient in the use of EFVS in the category of aircraft, in which the training was provided and for the EFVS operation to be conducted. The following sample endorsement statements will help training providers develop the statements that should be provided to the pilots upon completion of the EFVS training. These endorsement statements can be found in AC 61-65H.

Sample Endorsement Statements

Ground Training Only
[Pilot name] has satisfactorily completed the ground training required by § 61.66(a) appropriate to the [appropriate aircraft category] category of aircraft for operations under [§ 91.176(a), (b), or both § 91.176(a) and (b)].
Flight Training Only
[Pilot name] has received the flight training required by § 61.66(b) and is proficient in the use of EFVS in the [appropriate aircraft category in which the flight training was conducted] category of aircraft for EFVS operations conducted under [§ 91.176(a), (b), or both § 91.176(a) and (b)].
Ground and Flight Training
[Pilot name] has satisfactorily completed the ground training required by § 61.66(a), received the flight training required by § 61.66(b) for EFVS operations, and is proficient in the use of EFVS in the [appropriate aircraft category in which the ground and flight training was conducted] category of aircraft for EFVS operations conducted under [§ 91.176(a), (b), or both § 91.176(a) and (b)].
Supplementary Training
[Pilot name] has satisfactorily completed the required ground and flight training required by § 61.66(c) for EFVS operations and is proficient in the use of EFVS in the [the appropriate aircraft category in which the supplementary ground and flight training was conducted] category of aircraft for EFVS operations conducted under [§ 91.176(a), (b), or both § 91.176(a) and (b)].