

**Air Carrier Training Aviation Rulemaking Committee (ACT ARC)**

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**Recommendation 16-9: Manual Flight Operations**

**I. Submission**

The recommendations below were submitted by the Flight Path Management Workgroup (FPM WG) for consideration by the Air Carrier Training Aviation Rulemaking Committee (ACT ARC) Steering Committee at F2F-10. The ACT ARC Steering Committee adopted the recommendations with unanimous consent, and they are submitted to the Associate Administrator for Aviation Safety (AVS-1) as ACT ARC Recommendation 16-9.

**II. Background & Statement of the Issue**

Based on deficiencies noted in the training of manual flight operations, the ACT ARC Steering Committee assigned the following task to the FPM WG and incorporated it in the FPM Working Group (WG) Terms of Reference (TOR) document. (FPM WG TOR, II.2.a.).

***Recommend guidance for developing training for flight path management policy and procedures on manual flight operations, including training, practice and checking.***

The fundamentals of manual flight operations have been identified in various documents as an area for further training and review in an effort to increase safety and improve manual flight operation skills. The Flight Deck Automation Working Group (FltDAWG) identified that the lack of practice with automation has contributed to the degradation of manual flying skills. European Aviation Safety Agency (EASA) safety information bulletin 2013-05 comments that continuous use of automated systems does not contribute to maintaining pilot manual flying skills. Recommendations for the training of flight path management with regard to manual handling skills are presented in the International Civil Aviation Organization (ICAO) manual for Aeroplane Upset Prevention and Recovery Training (UPRT), Document 10011 (3-6). As concluded by the NASA study titled "The Retention of Manual Flying Skills in the Automated Cockpit," cognitive skills (e.g., navigation, failure recognition) erode quickly if not practiced. FAA SAFO for manual flight operations (13002) encourages the incorporation of manual flight operations into both line operations and training.

The recommendations provided here are focused specifically on the manual flight operations tasking from the ACT ARC Steering Committee. The WG recognizes that manual flight operations ties in closely with current FAA guidance, including;

- Advisory Circular (AC) 120-109A, Stall Prevention and Recovery Training
- AC 120-111, Upset Prevention and Recovery Training

For the purposes of this recommendation, the WG defines manual flight operations as managing the flight path through manual control of pitch, bank, yaw and/or thrust.

Manual flight operations requires foundational knowledge and skill proficiency in the following motor and cognitive areas:

1. Pitch and power basics
2. Energy management
3. High vs low altitude aircraft performance
4. Aircraft type-specific factors with an impact on handling (e.g., effects of swept- vs straight-wings, turbojet vs turbo prop vs piston prop engines, underwing vs tail mounted engines, trimmable stabilizer vs trimmable elevator, etc.)
5. Timing, coordination, anticipation
6. Steps required and corresponding instrument display changes that occur as automation levels are changed for manual flight operations

### **III. Recommendations**

The ACT ARC proposes the following recommendations for FAA consideration:

The ACT ARC recommends the FAA publish guidance for industry stakeholders recommending that operators develop training policies and line operations policies to ensure that pilot proficiency in manual flight operations is developed and maintained for pilots and instructors/evaluators.

The ACT ARC further recommends that operators conduct a formal Safety Risk Assessment of the threats relating to the practice of manual handling during line operations. This assessment will inform the policies that will be specified in the Operations Manual.

(See [Attachment A](#): Proposed Content for Flight Path Management Policy and Procedures on Manual Flight Operations.)

### **IV. Rationale**

Operators and training organizations have a number of options when providing opportunities for pilots to retain their manual handling skills.

During relevant training programs, opportunities for pilots to practice manual handling skills should be provided in a training environment where positive instructor input can have maximum effect. Training programs should be designed with the objectives of increasing knowledge and proficiency, molding attitudes and increasing pilot confidence.

An incremental approach should be used so that pilots can build from refreshing basic maneuvers to managing a complex procedural non-precision approach (NPA) to Circle to Land, to exploring the extremities of the flight envelope (and associated Warnings) to eventually managing an aircraft that is in an undesired state and /or in situations beyond the scope of non-normal checklists.

Emphasis should be placed on shaping the attitude of the pilot towards this training so that associated operational boundaries will be respected during line operations. These boundaries will be specified in Operator Training Manuals and Operations Manuals. They should be clear and easily comprehended.

Flight simulation training device (FSTD) equipment used during this training can vary depending on the nature of the training content. A flight training device (FTD) can be appropriate for some inflight manual handling practice. For more dynamic maneuver training such as crosswind landings or approach to stall recovery, a full flight simulator (FFS) is recommended. In accordance with Title 14 of the Code of Federal Regulations (14 CFR) 121.423, extended envelope training (e.g. full stall, UPRT, bounced landings, slow flight, loss of reliable airspeed) must be done in a FFS.

## V. Background Information

### FPM WG Scope of Work:

These recommendations partially address the following component of the FPM WG Scope of Work:

2. Recommend guidance for developing training for flight path management policy and procedures.
  - a. Manual flight operations, including training, practice, and checking.

### ACT ARC Initiatives:

These recommendations partially addresses the following initiative assigned to the FPM WG:

Initiative #35: Develop training/qualification to improve knowledge and skills for successful flight path management, to include:

- Manual flight operations, including training, practice, and checking.
- Management of automated systems for flight path management, especially autoflight mode awareness.
- Pilot monitoring and intervention for flight path management.
- Instructors/evaluator training for the development of skills and knowledge to teach and evaluate airplane flight path management, including use of automated systems.

### Source Report and Guidance Documents :

- Operational Use of Flight Path Management Systems, Performance-Based Operations Aviation Rulemaking Committee (PARC)/Commercial Aviation Safety Team (CAST) Flight Deck Automation Working Group (FltDAWG) final report, September 5, 2013.
- SAFO 13002, Manual Flight Operations, January 4, 2013
- Office of Inspector General Audit Report – Enhanced FAA oversight could reduce hazards associated with increased use of flight deck automation. Report Number: AV-2016-013, January 7, 2016.
- The Retention of Manual Flying Skills in the Automated Cockpit, National Aeronautics and Space Administration, December 2014
- EASA Safety Information Bulletin, SIB No. 2013-05, 23 April 2013. Manual Flight Training and Operations
- EASA Safety Information Bulletin, SIB 2010-33R1, 26 June 2015. Automation Policy – Mode and Energy State Management
- Manual on Aeroplane Upset Prevention and Recover Training, IATA Document 10011, 2014.
- IATA - Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training, 1<sup>st</sup> Edition, June 2015.

Attachment A: Proposed Content for Flight Path Management Policy and Procedures on Manual Flight Operations

The FPM WG proposes that advisory guidance for operators on manual flight operations include the following suggested content.

Training policy should incorporate the following:

- All curricula, but especially Qualification Training, should be designed in accordance with the philosophy that manual flying skill is the foundation upon which other technical flying skills are built. Therefore, the primacy of manual flying skills should be emphasized throughout all flight training syllabi.
- All curricula should include training and proficiency assessment of manual flying skills
- Potential training scenarios for manual flight operations could include the following, but should be based on the operator's specific circumstances (pilot demographics and operation environment):
  1. Stalls – High and low altitude (121.423)
  2. Out of trim conditions – how to recover
  3. Workload management during manual flight
  4. Go-arounds initiated at other than MDA/DA
  5. Visual approaches in various weather or light conditions
  6. Manually controlled slow flight (121.423)
  7. Manually controlled loss of reliable airspeed (121.423)
  8. Manually controlled instrument departure and arrival (121.423)
  9. Upset recover maneuvers (121.423)
  10. Recovery from bounced landing (121.423)
  11. Operations in all approved combinations of automation based on aircraft equipage, e.g.,
    - FD on, AP off, AT on
    - FD on, AP off, AT off
    - FD on, AP on, AT off
    - FD off, AP off, AT off
    - FD off, AP off, AT on
- Existing resources and guidance on manual flight operations listed in Section V of Recommendation 16-9 can assist operators in building programs based on the experience levels of their crews. The FPM WG recommends that the foundational skills listed in Section II of Recommendation 16-9 should be trained to proficiency.

Line operational policy should not only permit, but should encourage, the practice of manual flight operations for the necessary maintenance of proficiency. Appropriate policy guidance for manual flying practice during line operations should incorporate the following;

- During training and line operations ensure pilots are able to practice Manual Flight Operations with all approved combinations of automation based on aircraft equipage, e.g.,
  - FD on, AP off, AT on
  - FD on, AP off, AT off
  - FD off, AP off, AT off
  - FD on, AP on, AT off
- Encouragement to spend time manually flying the aircraft when conditions permit; i.e., not just the first 1,000' on departure and the last 1,000' on approach. Practice should (at least periodically) include the entire departure and arrival phases, and potentially the entire flight segment, if/when practicable and permissible.
- Acknowledgment that manual flight operations affects workload management for the flight crew. Therefore, when choosing appropriate times to fly manually, crews should apply basic threat & error management principles and take into account the various factors affecting operational workload. Factors to consider should include:
  - Weather conditions, terrain, and/or other environmental threats
  - Time of day
  - Level of crew fatigue and/or other psychological/physiological factors
  - Level of crew experience
  - Traffic density
  - Mechanical condition of the aircraft, and/or any non-normal conditions
  - Air Traffic Control and/or instrument procedural challenges
  - Any other operational threats
- A clear statement that the Captain's good judgment is required to consider the factors described above and to decide, on a case-by-case basis, when it is appropriate to conduct manual flying practice.

Appropriate policy guidance for manual flying during line operations should avoid the following;

- Overly general statements, such as “shall never manually fly at night,” or “shall always manually fly in day VMC if well-rested.” Appropriate policy should allow the Captain to weigh all the factors based on the situation and to apply his/her good judgment.
- Quotas for manual flying, unless based on scientific evidence (e.g., “shall fly manually at least 10 hrs. /month”). The working group is not aware of any current evidence to support a specific target. If in the future such evidence becomes available, this topic should be revisited.

#### Instructor Skills and Knowledge Required

It is clear from recent regulatory documents that current instructor training should be augmented to encompass new materials and requirements;

- FAA AC 120-111 states that “this advisory circular puts special emphasis on instructor training and qualification.”
- ICAO Document 10011, notes that “Operators and ATOs will be required to provide appropriate UPRT instructor training courses to their existing instructors before they can deliver UPRT.”
- The 2015 EASA draft on Loss of Control Prevention and Recover Training states that “it is of paramount importance that instructors have the specific competence to deliver UPRT during the type rating course, including the ability to demonstrate knowledge and understanding of the type-specific upset recovery procedures.”

Many of the instructor skills and knowledge elements needed for both manual flight operations and upset recovery are common. It is recommended that operators consider the following ICAO guidelines adopted from Document 10011 in establishing the necessary instructor skills and knowledge to deliver manual flight operations training.

Knowledge elements to include;

- Aerodynamics
- Energy management
- Flight path management
- Safety review of accidents and incidents involving manual flight operations
- Automation state/transition modes and when to consider manual flight

Instructor skill elements to include;

Instructor Skill Elements	Academic Instructor	Airplane Instructor	FSTD Instructor
Comprehensive knowledge of all applicable knowledge elements (see previous paragraph).	•	•	•
Training platforms (airplanes & devices)			
i. Limitations of training platform		•	•
ii. Operation of instructor operating station (IOS) and de-briefing tools			•
Review of LOC-I accidents/incidents	•	•	•
Energy management factors	•	•	•
Disorientation	•	•	•
Workload management	•	•	•
Distraction	•	•	•
UPRT recognition and recovery strategies	•	•	•
How to do a flight risk assessment (airplane)	• (as applicable)	•	
Recognition of trainee errors	•	•	•
Intervention strategies	•	•	•
Airplane type-specific characteristics	•	•	•
Operating environment	•	•	•
How to induce the startle and/or surprise factor		•	•
Value and benefits of demonstration	•	•	•