Bilateral Cooperation with Industrialised Countries

Project AV-EDEN

Pilot training best practices handbook

Table of contents

1. Upset recovery training

Several recent fatal accidents show deficiencies in pilot manual flying skills under high angle of attack or stall conditions. The most recent and most severe of these accidents are Colgan Air in Buffalo and Air France near Brazilian coast. These two accidents showed inability to recover from a stall, although there was enough altitude available, in case of the Air France even for several recoveries. A stall usually follows after insufficient speed and there are usually big roll variations throughout a deep stall. Both of these conditions are known as upset.

An upset attitude is one of these states:

- Aircraft pitch attitude greater than 25º nose up.
- Aircraft pitch attitude greater than 10º nose down.
- Aircraft bank angle greater than 45º
- Flight within the above parameters, but at airspeeds inappropriate for conditions.

Aircraft upset attitudes often lead into a loss of control in flight and subsequently an accident related to this state. As an evidence of this factor importance on total number of fatal accidents through the last decade, you can see Figure 1-1: Fatalities by main cause (2000 to 2009).

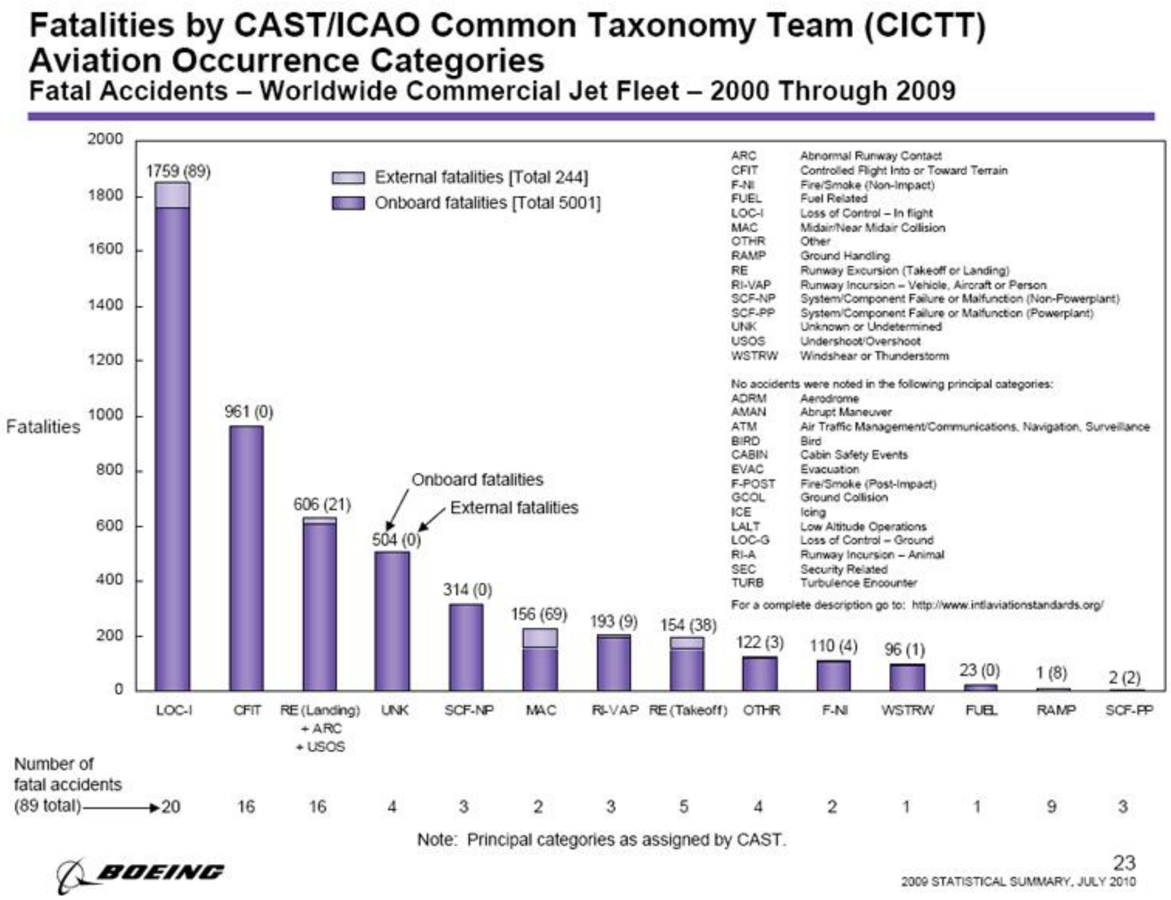


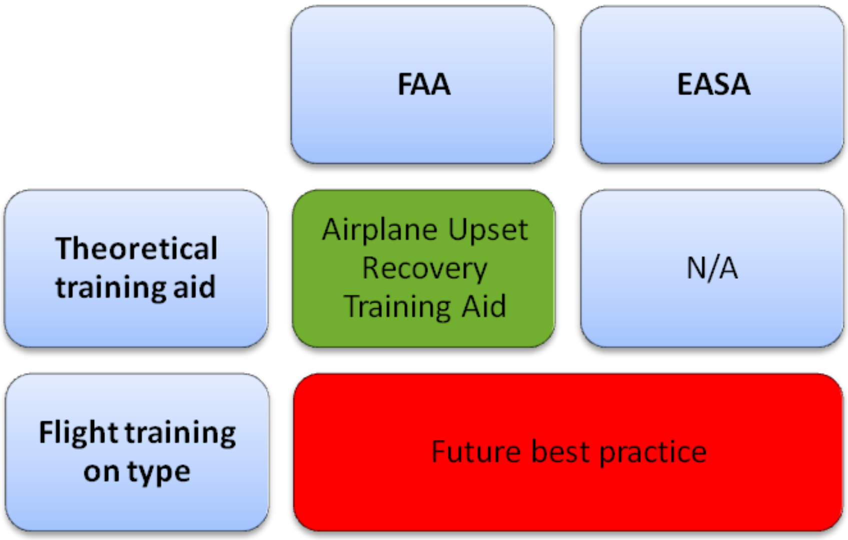
Figure 1-1: Fatalities by main cause (2000 to 2009) (1)

The FAA regulatory reaction for the Colgan Air accident was increasing the second in command minimum flight hours requirement to 1500 hours, an equivalent to ATPL. This reaction doesn´t provide solution for the primary problem of manual flight deficiency, and what is more, it doesn´t correspond to the actual crew experience in the time of the accident, as the co-pilot had almost 1500 flight hours logged. EASA´s reaction on the Air France accident is yet uncertain, as the investigation process commenced by BEA is not finished yet. The first outcome not relating to flight crew training is proposed by EASA as an Airworthiness Directive for an Airbus A330/A340 Flight Control Primary Computer (FCPC) software update. (2)

Currently the main stress during flight training aims at upset and especially stalls prevention. Pilots are taught how to avoid situations leading to stalls, but experience from last decades accidents shows that inattention, disorientation, lack of situational awareness, improper flight control reactions and other numerous factors often lead to a stall situation which needs to be dealt with. As pilots do not have stall recovery training on the type of aircraft being flown, it might lead to incorrect reactions or even unrecognized stall condition, in the worst case followed by a fatal accident. Stall recovery is a compulsory item during basic flight crew training. However, it is conducted on small single engine aircraft and later marginally on small multi-engine aircraft. Their flight characteristics are overly different from flight characteristics of large jets. Stall recovery training is totally absent during a type rating training, line and recurrent training. This is partially caused by majority of flight simulation training devices inability to simulate correctly stall behaviour, such as by general preference for upset prevention training instead of upset recovery training.

The outcome of lack of manual flight beyond stall during pilot career may lead to total inability to recognize and recover from such a situation in IFR conditions after several years. The pilot simply forgets the taught automatic reactions or misunderstands the situation presented by the instruments, even if it is obvious. This situation is particularly pronounced when flying a fly by wire controlled aircraft, where stall is impossible under normal flight conditions. These are the arguments for inclusion of upset recovery training into all major phases of pilot training conducted on a simulator, namely the type rating and the recurrent training, and also more extensively into MPL training curricula. It is important to know how to avoid upset attitudes, but it is more important to be able to recover from such conditions if they occur. Therefore upset recovery training may be considered to be the future best practice. There must be a significant improvement in flight simulation techniques used in FSTDs in order to achieve this goal, but recent achievements in personal computer simulations of modern airliners show us the way to go.

On the other hand, it is imperative for the pilots to know the required theory concerning in-flight upset attitudes and recovery. For this purpose a document was prepared jointly by The Boeing Company, Airbus and the Flight Safety Foundation (FSF) for the USA FAA. It can be downloaded from: http://www.faa.gov/other_visit/aviation_industry/airline_operators/training/media/AP_UpsetRecovery_Book.pdf. There are also several similar manuals and teachwares from private companies providing theoretical and practical upset recovery training.

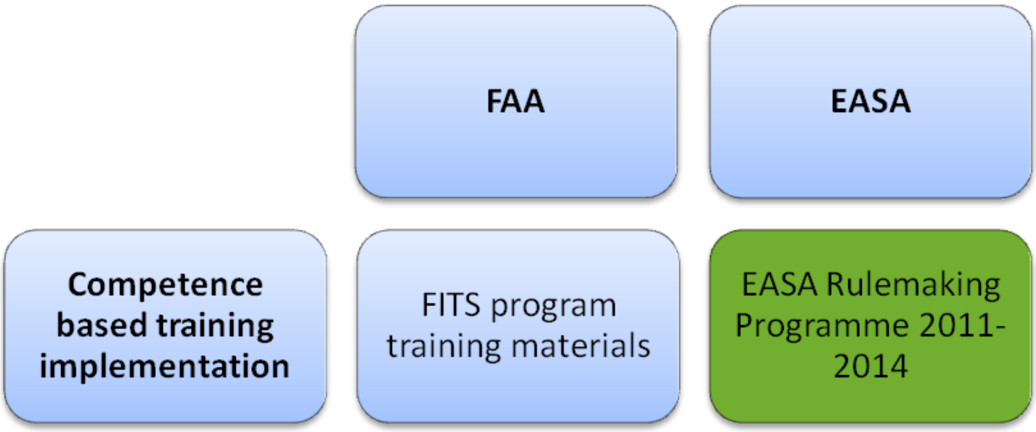


1. Competence based training

Competence based training was extensively used for several decades throughout various industry spheres and segments. However, this approach to training is relatively new in the field of pilot training. This technique moves away from a bottom-up, classroom approach through teaching candidates until they are deemed competent, rather than relying on prescriptive rules such as counting the number of hours trained. This training principle must be built around a well developed competency standard. This competency standard must be measurable and objective (there must be some set of values which mustn't be exceeded and set of actions or behaviours which must be correctly followed). The students must be assessed against these competency standards after every flight during the training. The student must know the outcome of this assessment, namely the mistakes or incorrect actions which he or she should improve. The student is also assessed after the completion of the course or part of the course. These assessments compare student's general performance to the competency standard. If all the criteria aren't met the training must continue and the student can't start the next portion of the training or obtain the licence. There is also a third type of assessment, which aims at specifying the correcting actions in case the student is unable to meet the competency criteria even after prolonged training. Another important criterion is that the training should reflect everyday activities and situations from normal operations as much as possible. Competence based training should encompass also threat and error management principles.

Competency based training contributes to safety of world aviation through bringing objective assessment of trainees against a defined standards whatever is the prescribed minimum of flight hours. This leads to more qualified graduates better suited for everyday tasks, and all these pilots meet the same criteria of required competency, skills and abilities. A very pleasant value added is inclusion of threat and error management, leading to even more competent pilots in terms of managing of unpredicted events and circumstances and own errors.

In an effort of incorporating competence based training principles into aviation training, in partnership with industry and academia, the FAA/Industry Training Standards (FITS) program creates scenario-based, learner-focused training materials that encourage practical application of knowledge and skills. The goal is to help pilots of technically advanced aircraft. (3) These syllabi are scenario based and are not regulatory requirements. They rather give an alternative opportunity for more efficient and quality training. They may be adopted by any flight school in any form deserved, however the final form of pilot training syllabus must fully comply with the appropriate FAA regulations. There are also similar efforts on the European side. Task number FCL.006 (a) in EASA Rulemaking Programme 2011-2014 states: "Extension of competency-based training to all licences and ratings and extension of TEM principle to all licences and ratings." (4) As we can see, there is a similar goal on both sides of the Atlantic, but the means of achieving this goal are considerably different. EASA opts for more regulatory approach, where competency based principles may be compulsory for every flight school in some not very distant future. On the other hand, FAA tries to offer such a possibility on a voluntary basis. The important question is which of these approaches will provide greater resulting level of safety. It is doubtful, weather small flight schools or individual instructors will have sufficient willingness to incorporate competence based training principles into their syllabi if it requires time, effort and often money to do so. From this point of view I think the European direct regulatory way will provide quicker and superficial expansion of this improved method of trainees assessment. Therefore I see the strict regulatory enforcement as the best practice for future years.



2. Multi-crew pilot license

MPL is a new approach to ab-initio training initiated by ICAO and incorporated into ICAO Annex 1 in 2006. The main requirement is close cooperation between flight training organisation and an airline. This airline will employ the trainees after completion of their training and SOPs (standard operating procedures) of this airline are used throughout the entire course. MPL focuses on multi-crew cooperation and threat and error management and is built around competence based training principles. A lot of flight hours, usually well above a half, are flown on a flight simulation training device (FSTD). Most of these hours are full flight simulator (FFS) hours supplemented with some flight and navigation procedures trainer (FNPT) hours.

The main advantages of MPL are:

- The airline can pick best students to accommodate their needs.
- The airline business culture and SOPs are built in from the beginning.
- Safety and threat and error management culture is integrated in the course.
- The environmental impact is reduced in comparison to other courses.
- The procedural and interpersonal competences of the trainees are taught throughout the entire course.

On figures Figure 2-1: Integrated ATP course learning curveFigure 2-2: MPL course hypothetical learning curve it can be seen that the students start with multi-engine and multi-crew training much sooner in MPL than in integrated ATP course. They sometimes even fly jet aircraft from almost the beginning of the instrument training. This puts more pressure on students to learn in a quickly manner. Figure 2-2 is largely hypothetical ideal situation, a target the founders of MPL aimed at. The real outcome will be notable after some amount of trainees finishes their training.

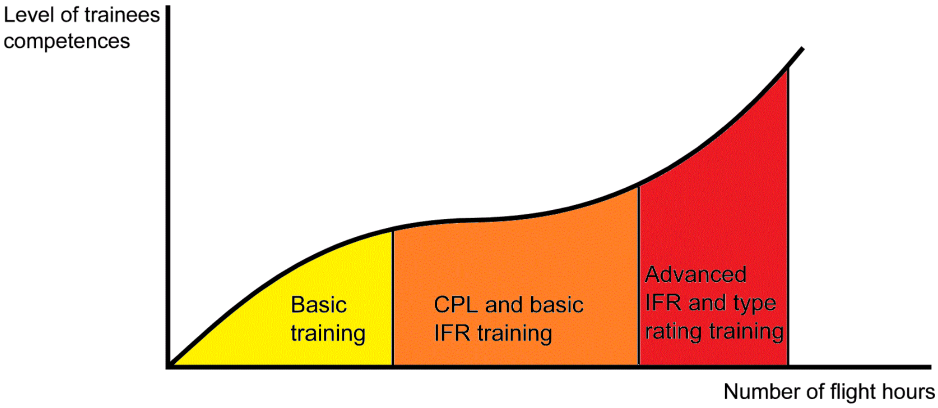


Figure 2-1: Integrated ATP course learning curve

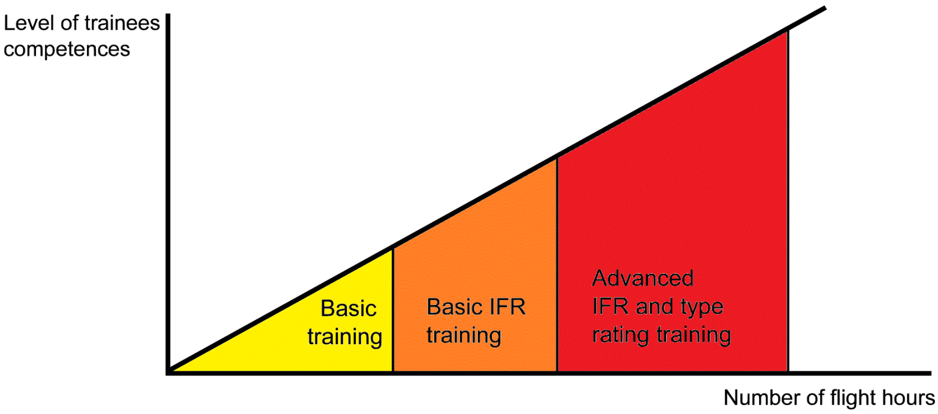


Figure 2-2: MPL course hypothetical learning curve

The total flight hour requirement is 240, which is approximately the same as for integrated ATP course plus type rating training. Type rating training is an integral part of MPL training. In comparison to integrated ATP course, students start their IFR training much sooner in MPL and fly more hours on complex aircraft with modern avionics and systems, although considerably more hours are flown on FSTDs. On the other hand, there exists a substantial lack of manual flying and solo flight time, which may be harmful in terms of upset recovery and prevention experience and independent decision making.

EASA implemented MPL training into JAR-FCL several years ago and first trainees recently finished their training. Generally, Asian and European countries have positive attitude to this new type of training. Some other countries such as Australia or Canada start to implement MPL courses into their national regulations and open first courses. Asia is a kind of exception in the way they tend to utilise this new type of training in order to increase safety. Asian civil aviation authorities usually require from 325 to 355 hours as a minimum for approval of an MPL course. This is far above ICAO Annex 1 requirement, allowing a considerable increase in flight time during critical phases of training and leads to much higher experienced first officers. It can be definitely considered as the best practice. The problem is substantial financial demands of such a solution.

The situation in the United States of America is contrary. Not only a long discussion about MPL leads nowhere, but what is more, there is a new initiative where The House of Representatives passed far-reaching legislation designed to boost the safety of the country's regional air carrier system as a response to a February 2009 crash near Buffalo. The bill pushed the Federal Aviation Administration to ensure that all airline pilots obtain airline transport pilot certificates, which require 1,500 hours of flight time. (5) This will come into force three years after this date and can in the end lead to total impossibility to implement multi-crew pilot licence in the USA. This is an opportunity to improve safety which may never be taken.

	FAA	EASA	ASIA
MPL implementation	Not possible	Implemented	325 to 355 hours minimum
Upset recovery and solo flight	N/A	Increase number of hours - possible future best practice	Sufficient

3. Evidence based pilot training

Recurrent training usually follows some prescribed syllabus and specific manoeuvres, but this doesn't allow for inclusion of operational-specific tasks and threats. On the other hand, evidence based training uses collected flight data, accident data, training feedback and other available relevant data to regularly adapt training sessions for the current fleet- and operation-specific risks This adaption is done through means of flight data monitoring analysis, air safety reports and instructor observations and is airline specific. Quality of the data collected for the purpose of evidence based training programme development is of extreme importance.

There are two programmes containing EBT principles. On European side it is Alternative Training and Qualification Programme (ATQP). Under FAA it is Advanced Qualification Program (AQP). Both regulatory agencies have established that when requesting training interval extensions or training reductions from present approved levels, the organization must support its request with valid statistical data, demonstrating level of safety (crew performance) didn't suffer from the extension. Such data must be continually collected and provided to the appropriate authority. The authority ensures that the crew performance wouldn't degrade through time.

Because EASA guidelines for ATQP are brief, the adoption of ATQP by airlines has been limited. The regulatory requirements of the two programmes differ in terms of structure. In particular the entry requirements of the ATQP are tightly controlled. In the AQP after initial qualification the follow-on training occurs within a scheduling interval called a continuing qualification cycle. Its initial duration is 26 months, but it may be subsequently extended by FAA in three-month increments to a maximum of 39 months.(6) This provides for consistent level of safety during the initial phase and allows adjusting the data collection or training mechanism if needed.

Evidence based training provides enhanced level of safety, because it provides for implementation of airline specific operational risks into training, leading to better pilot preparation for everyday tasks and possible threats. It also provides a possibility to reduce training time for unneeded tasks and focuses more on tasks that need more attention according to operational records. In my opinion, this principle should be established as a regulatory requirement instead of a means of training duration reduction or interval extension, because it is necessary to train for the most probable threats instead of just training for prescribed curricula, which do not have to reflect these threats at all.

	FAA	**EASA**
Evidence based training implementation	Established	Established
Transition period	26-39 months	N/A
EBT as a regulatory requirement?	Future best practice	

4. General regulatory requirements

One of the most striking differences in general regulatory requirements is the aviation English proficiency requirement. FAA states in part 61 that a person who applies for instrument rating has to "be able to read, speak, write, and understand the English language." (9) However, there are no strict principles of testing or otherwise determining language proficiency of a specific pilot. On the other hand, ICAO has developed a well defined system of language proficiency testing, where the language of pilots who demonstrate proficiency below the Expert Level (Level 6) shall be formally evaluated at intervals in accordance with an individual's demonstrated proficiency level. (6) It is recommended to evaluate language proficiency of those demonstrating Level 4 at maximum three years interval and those demonstrating Level 5 at maximum six years intervals. Considering the need to evaluate actual language performance in usual and emergency situations in aviation, the testing system established by EASA and based on ICAO Language Proficiency Rating should be considered a best practice in aviation.

FAA sets the requirement to possess instrument rating only for the pilot in command, opposite to EASA, which requires also the second in command to have such a rating. As the second in command can also be the pilot flying, it is imperative for him to know the applicable rules and to have required abilities to safely conduct the flight in IFR conditions.

	FAA	**EASA**
Language proficiency	Not precisely defined	ICAO level 4
IR requirement for IFR flight	Only PIC	Both crewmembers

5. Private pilot licence

There are a few differences in private pilot licensing between FAA and EASA. There is human performance missing from aeronautical knowledge on American side. Even for a private pilot it is important to know possible consequences of alcohol, drugs, cigarettes and fatigue. There is also a discrepancy in medical class requirement, which on the other hand, may not pose a great threat to safety, as only small aircraft are involved.

FAA included night training and instrument training in a limited number of flight hours into PPL syllabus, which should be considered as best practice, as even during VFR flight, an inexperienced pilot can accidentally fly into conditions requiring such abilities in order to safely complete the flight.

Private pilot licence		
	FAA	EASA
Medical class requirement	3	2
Aeronautical knowledge	Human performance missing	As per ICAO annex 1
Other category flight time crediting	N/A	10% PIC
Night training	Included in PPL training	Not required (separate qualification)
Instrument training	3 hours	N/A

6. Commercial pilot licence

As with the private pilot licence, even in CPL there is a mismatch in medical class requirements. Unlike in PPL, in CPL this can cause a significant reduction of safety in case of icapatitation in flight. Thus class 1 medical requirement under EASA should be a best practice. Human performance is also missing from aeronautical knowledge, which can harm safety, as was mentioned in the previous paragraph.

A very good rule is a preparation for skill test, which is compulsory under FAA and must not be commenced earlier than 2 months before skill test. This provides the student ability to try out the tasks required during skill test and the instructor an opportunity to test student's abilities before conducting the skill test itself.

There are some other deviations in required experience, which can influence safety, and even though more hours are always better, it is possible to discuss for a long time how many hours are required to perform the task correctly and safely.

Commercial pilot licence		
	FAA	EASA
Medical class requirement	2	1
Aeronautical knowledge	Human performance missing	As per ICAO annex 1
Required experience (hours)	250	200
PIC cross-country flight hours	50	20
Preparation for skill test	Max. 2 months before skilltest	N/A

7. Airline transport pilot licence

In ATPL there is a discrepancy in minimum age required for obtaining the license. The FAA´s 23 years are in my opinion better than 21 under EASA, because of the responsibility and possible psychical pressure accompanying leading of a team flying an airliner. On the other hand, FAA doesn´t have any requirement for multi pilot operations experience, which is necessary for successful crew resource management. Therefore EASA´s requirement of 500 hours minimum should be considered best practice, such as requirement for multi crew cooperation training prior to obtaining the licence. However, FAA´s requirement for 500 cross-country hours should be also considered, as cross country flight with its planning decisions forms considerable amount of work during airline operation. This requirement is missing from EASA regulations.

Airline transport pilot licence

	FAA	EASA
Minimum age	23	21
Multi pilot operations minimum	N/A	500 hours minimum
Cross country experience	500	200
Multi crew cooperation training	Not required	Required

8. Instrument rating

EASA is generally stricter than FAA in case of instrument rating training. The first difference is a requirement of night flight training, which can enhance spatial orientation in IFR conditions. Also it facilitates landings at night, which usually form a significant portion of IFR flights. Also the minimum flight hour requirement is higher by 10/15 hours (SE/ME) than under FAA, which, considering the complexity of IFR flight and associated procedures is outright. This is underlined by the medical requirement for hearing acuity per class 1, even though only medical class appropriate for the licence held is else required.

EASA also requires differential training of 5 dual training flight hours in order to transfer from single engine IR to multi engine IR. As the procedures applied are the same, this is justified only because of the different speeds of the aircraft, which does not seem to be a problem recently, as new faster single engine aircraft are produced. This differential training can be considered unnecessary and the FAA system should be considered best practice.

Instrument rating		
	FAA	EASA
Night training requirement	N/A	Must have night training
Instrument training time (hours)	40	50(SE)/ 55(ME)
Differential training required between SE/ME	no	yes
Medical requirements	Appropriate to the licence held	Hearing acuity as in class 1

9. Flight instructor rating

FAA and EASA have some distinctive principles for flight instructor certification. Under FAA, every flight instructor has to possess instrument rating. On the other hand, under EASA there is only ten hours instrument training requirement for obtaining of the flight instructor rating. This gives more sense, as instructors teaching only to PPL level do not need instrument capabilities except inadvertent flight into IMC. However, this is a difference which doesn't lead to different level of safety, thus we can say there is no need to determine best practice in this item.

FAA is generally less strict in various requirements or more commonly doesn't have these requirements defined at all. The first such item is cross country experience, where FAA doesn't require any (except included in previous training), but EASA requires at least 20 hours.

The training time requirement for FI rating differs only slightly, but absence of restricted period under FAA regulations is the most striking difference. EASA defines this period for 100 hours of provided flight training and 25 solo supervisions. For this period the newly trained instructor is under supervision of a more experienced instructor and has restricted authority.

An instructor has to have at least 500 hours of flight instruction in order to train another flight instructor under EASA. This is not defined under FAA regulations as well and it may impair quality and abilities of newly trained instructors.

Likewise, experience for night flight training is not defined under FAA, whereas EASA requires at least 200 hours of IFR flight. This does not pose such a great threat on student pilot training quality as on flight safety during the training itself.

At last but not least, required experience for commercial pilot licence training is defined under EASA as at least 500 flight hours including at least 200 hours of flight instruction. This requirement is also not defined under FAA.

As a conclusion, FAA is generally much less strict and leaves experience requirements for various types of training on training organizations, instructors and maybe customers themselves. This may lead to inadequate training quality which should be filtered out at the final practical exams of the trainees. From this point of view the EASA requirements shall be considered best practices in flight instructor certification.

Flight instructor rating

	FAA	EASA
Instrument experience	Must have IR	10
Cross country experience	N/A	20
Training for obtaining FI(A)	25	30
Restricted period	N/A	100 hours and 25 solo supervisions
Experience for CPL training	N/A	500 including 200 hours of flight instruction
Experience for training of FI(A)	N/A	500 hours of flight instruction