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**14 CFR Parts 121 and 135
Airborne Low-Altitude Windshear
Equipment and Training Requirements;
Final Rule**

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 121 and 135

[Docket No. 19110; Amdt. Nos. 121-199, 135-27]

Airborne Low-Altitude Windshear Equipment and Training Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: The FAA amends Part 121 to require airborne low-altitude windshear warning and flight guidance equipment in airplanes and Parts 121 and 135 to require windshear training for flight crewmembers. The National Transportation Safety Board investigations show that low-altitude windshear has been a prime cause of air carrier accidents. This rule is expected to reduce windshear related accidents by training pilots in avoidance and escape techniques and by providing a low-altitude windshear warning system with flight guidance equipment in certain airplanes to increase the margin of safety if windshear is inadvertently encountered.

DATES: *Effective Date:* January 2, 1989.

Compliance Dates: 1. Training requirements in §§ 121.409, 121.419, 121.424, and 121.427; §§ 135.345 and 135.351. January 2, 1991.

2. Equipment requirements in § 121.358(a): January 2, 1991, unless certificate holder obtains an extension in accordance with § 121.358(b).

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SUPPLEMENTARY INFORMATION:

Background

On June 1, 1987 (52 FR 20560), the FAA published Notice of Proposed Rulemaking (NPRM) 79-11A proposing airborne low-altitude windshear equipment and training requirements. The NPRM was preceded by Advance Notice of Proposed Rulemaking (ANPRM) 79-11 (44 FR 25867, May 3, 1979). The ANPRM invited public participation in addressing low-altitude windshear in the following ways: (1) By placing windshear detection equipment on the ground and transmitting information to the pilot; and (2) by installing equipment aboard the aircraft

that would provide the pilot with windshear information in "real time."

The ANPRM and NPRM were actions in the FAA's continuing efforts to combat the windshear problem. A full discussion of studies, Advisory Circulars, accident/incident data, and NTSB recommendations on windshear appeared in the preamble to NPRM 79-11A. The following information briefly summarizes FAA efforts since 1975.

- In 1975, the National Aeronautics and Space Administration (NASA), in cooperation with the FAA, instituted the Aviation Safety Reporting System (ASRS) whereby safety-related incidents involving aircraft operation are submitted voluntarily and treated anonymously to identify safety problems. Windshear is among the problems identified by reports submitted under this system.

- In 1977, the FAA conducted a study of NTSB reports on aircraft accidents and incidents related to low-altitude windshear that had occurred from 1964 through 1975.

- In May 1977, the FAA amended Part 121 of the Federal Aviation Regulations (FAR) to require air carriers to adopt an approved system for obtaining forecasts and reports of adverse weather conditions, including low-altitude windshear, that could affect the safety of flights on the routes to be flown and at airports to be used.

- The FAA issued Advisory Circular (AC) No. 00-50A, Low Level Wind Shear, to provide guidance in recognizing meteorological conditions that produce windshear phenomena and to recommend certain pilot techniques to minimize the effects of windshear when encountered during takeoff or landing.

- The FAA established a research and development program to examine the hazards associated with low-altitude windshear, develop solutions to the windshear problem, and integrate those solutions into the National Airspace System.

- At 90 major airports within the United States, the FAA installed a ground-based Low-Level Windshear Alert System (LLWAS) capable of detecting the presence of hazardous windshear in the vicinity of the airport at the surface. The FAA intends to install an additional 20 LLWAS's at airports across the nation. In addition, the FAA is working on enhancements to the LLWAS and is cooperating with the National Center for Atmospheric Research on an operational evaluation of a Doppler radar windshear forecasting and alerting system.

- Before issuing ANPRM 79-11, the FAA, through a series of simulator

experiments, investigated the effectiveness of airborne low-altitude windshear systems designed to warn pilots of the existence of windshears and to assist them in transiting or avoiding such shears.

- In November 1983, the FAA issued AC No. 120-41, Criteria For Operational Approval of Airborne Windshear Alerting and Flight Guidance Systems, to provide industry with an acceptable means of obtaining operational approval for the use of various airborne windshear systems on air carrier aircraft.

- In 1983, in response to Public Law 97-369, the FAA contracted with the National Academy of Sciences (NAS) to study "the state of knowledge, alternative approaches and the consequences of windshear alert and severe weather conditions relating to takeoff and landing clearances for commercial and general aviation aircraft." The NAS Report, "Low-Altitude Windshear and Its Hazard to Aviation," was published in late 1983.

- In 1986, the FAA contracted with a consortium of aviation specialists from The Boeing Company, United Airlines, McDonnell Douglas, Lockheed-California, Aviation Weather Associates, and Helliwell, Inc., to produce the Windshear Training Aid document and windshear training videos. The Windshear Training Aid, published and distributed to industry by the FAA, provides guidance on developing flight crew windshear training curricula.

In accordance with FAA research findings and the National Transportation Safety Board (NTSB) recommendations that were based on accident investigations, the FAA proposed in NPRM 79-11A windshear training and airborne equipment requirements as part of a "systems concept" to solve the problem of low-altitude windshear. The concept includes an improved low-altitude windshear weather forecasting technique, ground-based windshear detection equipment, airborne windshear warning and flight guidance, and improved flight crew training.

The FAA has decided after thorough consideration of the comments received on the NPRM to proceed with the proposed windshear training and airborne equipment requirements with minor modifications. A detailed discussion of the major issues raised by commenters and the FAA response to the comments follows.

Discussion of Comments

Twenty-seven comments were received on the Notice of Proposed Rulemaking. The comments were submitted by air carriers, airline and pilot associations, manufacturers, individuals, and the NTSB. Most comments commended the FAA for taking action to reduce the hazards of windshear encounters. However, several commenters opposed certain proposed requirements. Specific issues that were addressed in the comments were those on applicability; airborne warning devices; flight guidance systems; training; the compliance date; and Advisory Circulars. Several comments also addressed the cost/benefit aspects of the proposed rule. A few comments recommended entirely different approaches to the windshear problem than the one the FAA proposed. Several comments were information on airborne low-altitude windshear warning and flight guidance systems. All issues and categories of comments are discussed below.

Applicability: Equipment

The proposed requirement in § 121.358 for low-altitude windshear equipment applied to any turbine-powered airplane operated under Part 121 except turbopropeller-powered airplanes. The FAA assumes that when commenters referred to "turbine-powered airplanes", they were using the term as it was defined in proposed § 121.358. The FAA did not propose windshear equipment requirements for any airplanes operated under Parts 91, 125, and 135 because accident history does not justify their inclusion.

- The Air Line Pilots Association (ALPA) objected to the exclusion of reciprocating engine powered and turbopropeller engine powered airplanes from equipment requirements in Part 121. It stated that the table provided in the NPRM showed that a sizeable percentage of the windshear accidents involved the types of airplanes that the proposed rule excluded. The comment also stated that the 1987 Annual Report by the Regional Airlines Association estimates that by 1997 61 million passengers will be carried by members of that Association. According to ALPA these airlines "traditionally use reciprocating engine and turbopropeller powered aircraft."

- The National Transportation Safety Board (NTSB) stated that the "exclusion of reciprocating engine and turbopropeller engine airplanes from this (equipment) requirement may be reasonable based upon the different performance characteristics of those

airplanes." However, NTSB did "not concur with the rationale used to exclude turbine-powered airplanes operated under Parts 91, 125, and 135 from this equipment requirement." NTSB stated that it believed that "the absence of accident data to support the need for including these operations may be due to the comparatively smaller population of turbine-powered airplanes used in those operations and, in some cases, an inability to evaluate accident circumstances because of the absence of flight recorder information." The Aerospace Industries Association (AIA) also objected to the exclusion of turbine-powered airplanes operated under Part 135.

The FAA's Response: Although the table provided in the NPRM shows a number of windshear accidents involving reciprocating engine powered and turbopropeller engine powered airplanes, the airplane types involved are older airplanes that have been in service for many years and that are rapidly being retired from Part 121 operations. As pointed out in the NTSB comment, reciprocating engine powered airplanes and turbopropeller engine powered airplanes currently in operation have "different performance characteristics." The FAA agrees with the NTSB that the performance characteristics of these airplanes generally make them less vulnerable in the event of inadvertent entrance into windshear conditions.

Turbine-powered airplanes that are operated under Parts 91, 125, and 135 are excluded from the equipment requirements for several reasons. Presently no accident/incident data exists to support requiring windshear equipment for these operations. The FAA recently issued a regulation (see 53 FR 26134, July 11, 1988) which requires flight and voice recorders in certain aircraft where they are not now required when those aircraft are operated under Parts 91, 121, 125, and 135. After this rule becomes effective, the FAA will be able to gather more complete data and take appropriate action.

At the present time only reciprocating engine powered and turbopropeller engine powered airplanes are being operated in commuter operations (scheduled operations) under Part 135. On-demand operations under Part 135 and operations under Parts 91 and 125 are conducted with turbine-powered airplanes, but there are fewer flights and these operations are unscheduled operations and therefore do not have the same degree of exposure to hazardous windshear conditions as do the operations covered by this final rule.

Therefore, consistent with the NPRM, the final rule excludes reciprocating engine powered and turbopropeller engine powered airplanes in § 121.358 and does not include any airplanes operated under Parts 91, 125, and 135.

In addition, the FAA has determined that a clarification of "turbopropeller-powered airplanes" as used in proposed § 121.358 is needed in the final rule and has accordingly added the words "with variable pitch propellers with constant speed controls." The addition of these words clarifies the essential design characteristic of turbopropeller-powered airplanes which makes them less vulnerable to the hazards of inadvertent entrance into windshear conditions. The FAA considers this addition necessary in the event that airplanes are manufactured in the future which may have some of the characteristics of turbopropeller-powered airplanes but not variable pitch propellers with constant speed controls. Any such future airplanes would not be excluded from the equipment requirements.

Airborne Low-Altitude Windshear Warning Devices

Sixteen comments specifically mentioned the proposed requirements for airborne warning devices. Ten favored the requirement, three opposed it, and three opposed certain aspects of the requirement. Opposition to the requirement was primarily directed at the need to retrofit existing airplanes. Concerns about the requirement for airborne warning devices were the following:

- One or more of the predictive systems now being developed could be installed on airplanes and validated for far less cost than present warning systems.
- No research has been conducted to show that a warning device system would add a significant margin of safety over training in windshear procedures.
- Airborne warning devices may be counterproductive to training since they may encourage a pilot to pursue a course that by observation alone he would conclude is dangerous.
- Conditions other than windshear may set off the warning, causing a pilot to abort a take-off or landing, thereby creating a potential hazard where none actually exists.
- Requiring installation of warning devices may slow development of predictive systems.
- Only predictive systems can provide a pilot with information early enough to allow escape.

The FAA's Response: The FAA does not agree with the overall position of these comments that requiring an airborne warning device is premature; that the FAA should wait until predictive systems are developed and in the meantime rely solely on training in windshear recognition and escape procedures. The FAA estimates that airborne windshear predictive systems will not be available for operational use for at least another ten years. In the meantime training alone is not enough. Windshear accidents have continued to occur even after windshear training has been incorporated into many certificate holders' training programs. Since windshear training alone cannot guarantee that a pilot will recognize, avoid, or escape windshear conditions, the addition of an airborne warning device will provide flightcrews with an increased margin of safety in inadvertent encounters with low-altitude windshear.

Two systems have already received FAA certification as airborne low-altitude windshear warning and flight guidance devices on various airplanes. In addition, several other manufacturers have made formal application for a Supplemental Type Certificate (STC) for other systems. Any of these systems could provide the flightcrew with enough warning and guidance to enhance the probability of successfully accomplishing the windshear escape procedure for the particular system.

One of the low-altitude windshear warning systems that has been certified and is being used has provided operational data. This data indicated that the warning system provides a significant benefit to the flight crew of the aircraft. This data also indicated that nuisance and false alerts were found to occur at an acceptably low rate to maintain flight crew confidence in the system. (For details see paper titled "Flight Experience with Windshear Detection", by Terry Zweifel presented to the SAE Aerospace Control and Guidance Systems Committee, March 8-11, 1988).

Because of the seriousness of the windshear problem, a regulatory proposal to require implementation of an available low-altitude windshear warning system that could alleviate the problem should not be delayed. The public must be given the maximum available protection from the catastrophic accidents which operating experience has demonstrated can occur.

The requirement for airborne low-altitude windshear warning systems does not mean that the FAA will reduce its commitment to other windshear equipment development. As stated in

the NPRM, the FAA will continue to foster research programs to design better flight guidance and control aids which will improve a pilot's ability to avoid an accident in the event of a windshear encounter. Future FAA action will place emphasis on fostering the development of predictive technology for use in systems to detect and avoid inadvertent entrance into windshear. The FAA will continue pursuing a "systems concept" which includes an improved low-altitude windshear weather forecasting technique, ground-based windshear detection equipment, airborne windshear detection equipment, and improved pilot training.

Flight Guidance

Except for the National Transportation Safety Board and the Air Line Pilots Association, virtually all of the commenters either opposed or expressed some reservations about the proposed requirement that the approved airborne low-altitude windshear warning system be equipped "with flight guidance." The overall thrust of the opposing comments, like the comments opposed to installing warning devices, was that the cost of retrofitting present aircraft with a flight guidance system far outweighed the potential benefits. ATA on behalf of its member airlines asserted that "the resources that would be required to install guidance systems could better be used for avoidance systems when they become available—an eventuality not too far in the future, according to some."

The FAA's response: The FAA does not agree that increased safety would be achieved in a more cost effective way by eliminating the flight guidance requirement and waiting for the windshear detection systems presently in development. As previously stated, the FAA does not believe that fully functional, tested, and reliable windshear detection systems are as close at hand as do several commenters. Nor does the FAA believe that a windshear detection system, if developed, would make a windshear flight guidance system unnecessary. While the FAA agrees that windshear avoidance is the most desirable solution to the windshear problem, 100% avoidance may never be achievable so that an effective flight guidance system may still be highly desirable even if a detection system is developed. The cost/benefit aspects of the flight guidance requirement are discussed under the economic evaluation portion of this preamble. Specific comments regarding the flight guidance requirement are discussed below.

- Several commenters stated that the cost to retrofit existing aircraft with flight guidance systems is disproportionate to the safety gain, especially for aircraft that do not now have go-around or takeoff flight guidance functions in their flight director systems. Some of these commenters pointed out that the Windshear Training Aid states that the manual technique (maximum power and establish a 15 degree body angle pitch on the attitude director indicator) comes within 5-10% of the potential performance using flight guidance. One commenter concluded that "the difference between manual (no guidance) recovery and optimal (but not practical) guidance is something at or less than 5%!"

The FAA's Response: The cost/benefit aspects of the flight guidance system requirement are discussed fully under the economic evaluation portion of this preamble. As more fully explained there, the FAA believes that flight guidance systems should be required for turbine-powered airplanes operating under Part 121. The remaining life span of many airplanes already operating under Part 121 is sufficiently long to justify the retrofitting expense of providing low-altitude windshear flight guidance in the event of an inadvertent windshear encounter. The Windshear Training Aid (WTA) statement does not refute this conclusion. However, it should be noted that the conclusions drawn in the WTA with respect to comparing the performance efficiency of the manual technique with flight guidance were based on the assumption that, for the manual technique, the transfer of learning effectiveness from the classroom to the airplane is 100 percent. The conclusion was then drawn that, based on the transfer of learning assumption, the manual technique would be effective 90-95 percent of the time for those few windshears encountered. The behavior pattern resulting from windshear training using various media (e.g. classroom instruction, training devices, cockpit procedures trainers, simulators, etc.) may be degraded over time. Thus, in an actual severe low-altitude windshear encounter, an individual pilot's reaction using the manual technique most likely would not approach the 90-95% potential described in the WTA.

- There is no general industry agreement on present flight guidance algorithms (that is, on just what directions the pilot should be given).

The FAA's Response: One hundred percent agreement on existing algorithms may not exist; however, software has been developed that is

adequate to obtain FAA approval. With flight guidance provided by this software, a pilot would have a better change of taking action necessary for the aircraft to survive an inadvertent encounter with low-altitude windshear.

- Adaptation and modification of older electro-mechanical flight director systems may affect the integrity of the existing systems, thereby derogating safety.

The FAA's Response: Modification of older flight director systems should not affect the integrity of those systems. The approved airborne low-altitude windshear warning with flight guidance system to be installed must have been certificated in accordance with the appropriate sections of Part 25 of the FAR and must meet the respective airworthiness and operational approval criteria addressed in AC 25-12 and AC 120-41 or their approved equivalent. This approval process would ensure that the integrity of those systems would not be compromised.

- FAA should not require flight guidance systems until it has completed its characterization of the windshear phenomenon which is not scheduled to be completed until 1991.

The FAA's Response: Enough has been learned about the windshear hazard to permit the certification of several windshear systems. The past accident scenarios are well understood and there has been an enormous amount of data generated by the Joint Airport Weather Studies (JAWS) program. While the potential hazards will continue to be studied and further defined there is an adequate base of knowledge to design and certificate a flight guidance system.

- "Optimal" flight guidance may not be practical at this time since many of the present systems require nose down control inputs very close to the ground.

The FAA's Response: Optimal flight guidance can only be developed when there is complete knowledge of the characteristics of the air mass in front of the aircraft. Optimal flight guidance is a time dependent variable state which must consider a rapidly changing air mass, as well as special situations (i.e., altitude, speed, configuration, etc.). In the certification process the FAA will evaluate all guidance commands, including nose down commands, for appropriateness. If the optimal guidance strategy for a particular windshear situation requires nose down control inputs so close to the ground that it would cause collision with the ground, the guidance strategy would be unacceptable and would not be certificated. It should be noted that "nose down" does not mean below the

horizon. It means to lower the nose from its present angle.

- While the flight guidance function provides a small increase in the magnitude of the windshear in which an aircraft can successfully operate, that increase only occurs at very high windshear values. Therefore, because of the serious turbulence what would be encountered, this small gain could easily be offset by the pilot's inability to closely follow the commands being given.

The FAA's Response: The FAA recognizes that in the worst cases of severe windshear escape may not be possible and, depending upon the cause of the windshear phenomena, flight guidance commands may not be readable because of severe turbulence. However, it is possible to have severe windshear without severe turbulence. Furthermore, for those windshears from which escape is possible, flight guidance provides an additional margin of safety. Between the moderate to severe levels of windshear, flight guidance can provide a gain in performance.

Training

Virtually all of the comments received favored the proposed training requirements. A number of comments addressed specific training requirements, particularly those requirements concerning simulator flight training. All specific comments are summarized below.

- Flight Safety International stated that helicopter operators should be excluded from the training requirements for recovery and escape procedures because not enough data exists to develop training in such procedures for helicopters.

The FAA's Response: The FAA agrees with the commenter. The FAA has decided to exclude helicopters from the escape training requirements because there are insufficient data on helicopter response to windshear encounters. Accordingly §§ 135.293(a)(7)(ii) and 135.345(b)(6)(ii) have been changed to include the words "except that rotorcraft pilots are not required to be trained in escaping from low-altitude windshear."

- Some comments showed confusion about the intended meaning of the proposed training requirements. Continental Express was concerned that the proposed rule excludes turbopropeller-powered airplanes in § 121.358 from low-altitude windshear equipment requirements without excluding them from the simulator windshear training requirements in subsequent sections of the rule. Flight Engineers' International Association

stated that the proposed flight training requirements do not apply to flight engineers and that the FAA probably intended that they should apply to all cockpit crewmembers. Another commenter was concerned that the required windshear training program might have to be a separate and therefore costly training program.

The FAA's Response: As proposed, the language of § 121.409(d) requires simulator windshear flight training only if the airplane is required to be equipped with low-altitude windshear equipment under § 121.358. Therefore, flight training would not be required for pilots flying those turbopropeller powered airplanes excluded from the coverage of § 121.358.

In response to the comment from Flight Engineers' International Association, the proposed amendments to Part 121 included requirements for initial, transition, and recurrent ground training in windshear recognition, avoidance, and escape procedures for pilots and flight engineers, but proposed requirements for flight training in windshear procedures and equipment use were intended only for pilots who are at the controls of the airplane. Current § 121.425 which covers flight training for flight engineers is not being amended by this rulemaking. Windshear ground training in § 121.419 is applicable to all flight crewmembers while windshear flight training in simulators applies only to pilots operating airplanes equipped with low-altitude windshear equipment. If a certificate holder wishes to provide flight training in windshear procedures and equipment for flight engineers, it may do so, but the FAA is not requiring such training.

Finally, in response to the comment concerning windshear training as a separate program, as the FAA explained in the preamble of the proposed rule, the phrase "an approved low-altitude windshear flight training program" was used to refer to the proposed upgraded flight training requirements. The phrase was not intended to mean that there should be a separate training program for those who must provide low-altitude windshear flight training. Instead, the intention is that the approved low-altitude windshear flight training be incorporated into the certificate holder's approved training program.

- The Air Transport Association (ATA) would like to see different wording than that proposed in §§ 121.409(d) and 121.424(d) which stated that a pilot must have training and practice in "at least" and "at least all of" the windshear escape maneuvers and procedures in the operator's approved low-altitude windshear flight

training program. ATA commented that if the FAA's intent was to require that every pilot receive training in every exercise a carrier develops, carriers might be discouraged from developing multiple exercises.

The FAA's Response: One means of approval of the windshear training portion of a certificate holder's approved training program is the Windshear Training Aid developed by the FAA and the industry team led by Boeing. In July, 1987, this material was widely distributed to all Part 121 operators and to part 135 operators conducting scheduled operations and within the FAA. The FAA intends that the minimum number of windshear escape maneuvers to be performed in an approved airplane simulator for approved windshear flight training would include at least the maneuvers and procedures associated with the four basic exercises set forth in the Windshear Training Aid. These exercises have the pilot encounter a windshear situation—(1) Before achieving rotation speed on takeoff; (2) during a rotation on takeoff; (3) during an initial climb shortly after takeoff; and (4) during a precision approach. Each certificate holder should develop sufficient variation in the exercises to avoid stereotyping in the training.

In §§ 121.409(d) and 121.424(d)(2) the phrase "at least" is retained, while "all of" has been deleted from § 121.424(d)(2). These changes should make the FAA intent clear, namely that each pilot must receive training in the minimum number of windshear escape maneuvers and procedures that constitute the certificate holder's approved low-altitude windshear flight training program. The "required" training would not include all the possible exercises that an operator might develop for its approved low-altitude windshear training program.

- While logically most windshear flight training should be conducted in a simulator, some commenters wanted an "escape option" in the event that simulators were not available for training. They did not think a pilot's training should be delayed if windshear training in a simulator is temporarily not available. If the pilot could substitute such training in an airplane, at least for some of the training requirements, this would be of help.

The FAA's Response: The FAA believes that windshear flight training cannot effectively be given in an airplane because the total environment of a windshear cannot be artificially reproduced in an airplane and it would be too dangerous, in addition to being impractical, to search out actual

windshear conditions. It is practice in the use of proper procedures and techniques under the extreme conditions of windshear that must be accomplished. This can be done safely only in a simulator.

To minimize the overall impact of the training requirements on simulator time, planning will be necessary. Part 121 certificate holders should plan for the downtime necessary to modify simulators and the increased training time, and should anticipate usual malfunction and maintenance downtime. With proper planning the training compliance date of two years after the effective date of the rule January 2, 1989 should allow for modification of simulators without delays in complying with current training requirements. Certificate holders should begin their planning as soon as this rule is published. They may have to begin their low-altitude windshear training as early as one year after the effective date so that they will not have to schedule special training for second-in-command pilots whose last previous recurrent training occurred less than a year earlier.

As a practical matter, most certificate holders use simulators now to meet the six-month training and proficiency check requirements for a pilot in command. The additional flight training required in windshear procedures will add approximately 15 minutes of simulator time. Approximately 80 percent of the pilots and copilots who will be subject to the windshear flight training requirements have at some time received some windshear flight training in simulators. Although certificate holders will have to revise their programs to meet the new requirements, for most pilots and co-pilots actual training time will not necessarily be significantly increased. Since current requirements for recurrent training allow for a 30-day grace period (14 CFR 121.401(b)), air carriers will have flexibility in meeting the recurrent windshear training requirements. Therefore, with proper planning, the simulator windshear flight training requirements should not significantly affect simulator use.

- Proposed § 121.409(d) stated that a certificate holder must use "an approved simulator for each airplane type * * *." Two commenters stated that if this means that each simulator must have the same windshear related avionics as the aircraft that operator is using, the requirement is too restrictive. They state there are two related problems. One, since simulator time is often leased, simulators that are now being leased by some operators may not be adapted

with windshear avionics for the type of windshear equipment the operator will have installed. Thus the operator may have difficulty getting simulator time on simulators with the appropriate windshear avionics. Second, Continental Airlines stated that the "escape maneuver should be generic and not dependent on the hardware installed in the aircraft or simulators."

The FAA's Response: While the responses of most trained pilots to windshear are very similar, the performance of the aircraft and the technical characteristics of the windshear equipment differ. Therefore, a pilot needs to practice in a simulator equipped with the same windshear equipment which will be installed in airplanes the pilot will fly. This is especially important since pilot responses to windshear must be performed within seconds. Pilot understanding of equipment differences and aircraft performance differences could be critical.

The availability of simulator time on simulators with the appropriate windshear avionics is a factor that a certificate holder will need to consider and plan for before installing windshear equipment. A certificate holder that is leasing simulator time will need to determine in advance if that simulator will be updated for the appropriate windshear avionic equipment. Also a simulator owner who wants to continue leasing will need to plan for certificate holders' new windshear flight training requirements. Current rules for simulator flight training require a certificate holder to use an approved simulator for each airplane type, and most simulators are capable of being adjusted to allow training for different windshear systems. Therefore, the FAA anticipates that with proper planning and coordination the industry will be able to provide training on a simulator for each airplane type with the appropriate windshear avionics by the compliance date.

- ATA's comment maintains that mandatory windshear escape training and current approach-to-stall maneuvers required in Part 121 may be redundant. Both types of maneuvers involve high power, low speed conditions, and once clear of the windshear, the cleanup recovery from the windshear escape maneuver is identical to the approach-to-stall cleanup recovery.

The FAA's Response: The FAA does not agree that these are redundant requirements. While some similarity of maneuvers may exist, the situations and objectives are different. Windshear occurs in a highly unstable environment

while stalls can occur at any time. Approach-to-stall maneuvers are a proficiency requirement while windshear escape maneuvers and procedures do not have a proficiency objective or a performance standard. In windshear flight training the objective is to practice windshear escape procedures in a real time dynamic environment, not to train to a proficiency standard.

- One commenter supported a six-month recurrent windshear ground training requirement but recommended only an annual requirement in an airplane simulator. The commenter stated that "recovery/escape from a low level windshear is basically a mechanical maneuver" and that "as long as the pilot remembers and understands the concept of recovery the probability of success is greatly increased." Therefore, the commenter maintained that "twice annually, monthly, or weekly practice of recovery maneuvers will not ensure one hundred percent" successful recovery.

The FAA's Response: To clarify, a six-month recurrent simulator windshear flight training requirement would apply only to a pilot in command (§ 121.427(d) and § 121.443(c)(1)(iii) and (d)). A second in command would be required to have annual recurrent training (§ 121.443(c)(1)). Demonstration of proficiency in escaping windshear is not the objective of the windshear flight training requirement. Adding windshear simulator flight training to pilot recurrency requirements will provide the pilot with practice in the correct procedures for an event which from a statistical standpoint will be infrequently encountered, but to which a pilot is potentially exposed at all times. The FAA believes that practice in windshear escape procedures will prepare pilots to respond immediately and appropriately in an inadvertent windshear encounter.

Effective and Compliance Dates

Several commenters who objected to the flight guidance portion of the windshear equipment requirement stated that the two-year compliance date was unacceptable for the following reasons:

- It would require too much downtime for aircraft within a fleet.
- It would be impossible for manufacturers of windshear equipment to supply the equipment within a two-year period.
- There are not enough trained mechanics and other technicians to accomplish the required work within two years, and it would be impractical to recruit and train persons for such a

peak-load project since they would likely be laid off afterwards.

- To meet the flight training requirements, simulators would have to be updated, software would have to be developed, and simulators would have considerable downtime. Considering how much simulators are used in pilot flight training and recurrent training and testing, the downtime might seriously interfere with pilot training. In addition, at least one commenter questioned whether the FAA or industry would be responsible for development of the windshear software.

- *The FAA's Response:* Because of the immediacy of the windshear problem, the FAA wants to ensure that there is no unnecessary delay in providing the traveling public with the additional margin of safety sought by these new requirements. However the FAA must allow sufficient time for the resolution of any technical problems with equipment, for production of the needed equipment, and installation and inspection on aircraft. Probably the major limiting factor, other than possible technical problems, is the availability of enough trained mechanics. The FAA recognizes that even if it were practical to train more mechanics to meet increased demand, the necessary training time would make a two-year compliance date for all airplanes impractical. Therefore, to allow time to resolve any technical problems with equipment, for equipment manufacture, order placement, delivery and installation of the equipment, the FAA is permitting a phased compliance schedule for retrofit requirements under certain conditions. The final rule (§ 121.358) requires compliance by two years after the effective date for all airborne equipment requirements unless an operator submits and obtains approval for a retrofit schedule that shows a phased compliance over a 4-year period from the effective date. A request for extension of the compliance date must be submitted no later than 18 months after the effective date. The phased retrofit compliance schedule applies only to airplanes whose date of manufacture was before the effective date of the rule. For the purpose of this section "date of manufacture" means the date the inspection acceptance records reflect that the airplane is complete and meets the FAA Approved Type Design Data. At least 50 percent of such airplanes which are listed on the certificate holder's maintenance operations specifications on the date of submission must be retrofitted within 2 years after the effective date, at least 25 percent more of those airplanes within 3 years, and all of the certificate holder's

affected airplanes within 4 years. Any certificate holder that obtains a compliance date extension must comply with the retrofit schedule and submit status reports every six months until completion of the schedule.

The ground and flight training provisions of the final rule will take effect two years after the effective date of the rule. To make sure that all operators are aware of the compliance dates for the training requirements, the final rule includes new § 121.404 and revised § 135.10 that state the exact date for compliance.

For certificate holders to meet the two-year compliance date for all of their pilots, most certificate holders will want to have the new windshear training program approved one year earlier (i.e., not later than one year from the effective date). In this way the certificate holder will be able to give second in command pilots their required windshear training as part of their regularly scheduled annual recurrent training. Otherwise a certificate holder will have to schedule special training for second-in-command pilots whose last previous recurrent training occurred less than a year earlier.

In order for certificate holders to meet this kind of orderly scheduling, it is important that they begin the approval process as soon as possible so that they will not be faced with last minute training and scheduling problems.

While the final rule does not contain a specific compliance date for the necessary conversion of simulators, it can be seen from the above discussion that most simulators will need to be converted within one year after the final rule takes effect.

Although the final rule allows for phased compliance for retrofits, the FAA assumes that planning will begin at the time of publication of the rule.

Advisory Circulars

- Two commenters suggested that advisory material being developed by the FAA needs to be seen and commented on before the FAA proceeds to final rule. One stated that it was difficult to discuss the proposal without an opportunity to comment in parallel on the AC defining criteria for approving airborne low-altitude windshear equipment. The second comment stated that the AC should be part of the public record and should receive public input.

The FAA's response: Before the NPRM was issued the FAA developed and issued AC 00-50A, Low Level Windshear, AC 120-41, Criteria for Operational Approval of Airborne Windshear Alerting and Flight Guidance

Systems, and the Windshear Training Aid previously discussed in this preamble. In November 1987, the FAA issued AC 25-12, Airworthiness Criteria for the Approval of Airborne Windshear Warning Systems in Transport Category Airplanes. Thus, all of the advisory material necessary for manufacturers and certificate holders to comply with the requirements of this final rule has already been published and by the time the rule takes effect will have been available for a sufficient length of time for all interested persons to be familiar with their contents.

Beyond the Scope of NPRM

Several comments submitted were beyond the scope of this proposed rulemaking. The FAA has considered these comments as informational and is not responding to them. A summary of such comments follows:

- One comment recommended that the proposed rule be withdrawn and "in its place a requirement adopted that all transport aircraft eventually be equipped with an EFIS instrumentation system." "EFIS" stands for Electronic Flight Information System. This is a flight instrumentation system and flight guidance system that simplifies the integration of information a pilot receives from his flight instruments.
- One comment recommended that all Part 121 aircraft should operate at reduced weights by limiting the fuel, number of passengers, and baggage and cargo anytime that thunderstorms are predicted for an arrival or departure area. According to the comment this would provide the Part 121 aircraft with maneuverability closer to that of Lear jets which have had relatively few windshear accidents.
- Three comments were received which the FAA determined were primarily information about predictive or flight guidance systems that are being developed or are currently on the market. One recommended that the final rule include a requirement for a predictive system with a compliance date two years after approval of such a system.
- One commenter recommended that the FAA require a flight procedure method for transiting windshears based primarily on airspeed/groundspeed comparison.
- NTSB commended the FAA and the industry, led by the Boeing Company, for development of the Windshear Training Aid and stated that it hopes the Training Aid will be the foundation for FAA approval of training curricula implemented by air carriers in complying with the rule. It recommends that an additional training requirement

be added on the use of airborne weather radar for thunderstorm and convective windshear avoidance. It considers this valuable equipment for weather detection during arrival and departure of flights.

- One commenter stated that ground training in windshear detection and escape maneuvers for Parts 125 and 135 pilots was not sufficient and that these pilots should also receive simulator training.
- TWA objected to the requirement to have 14 channels of recording capabilities on flight simulators. It stated that the FAA currently requires 8 channels for certification of flight simulators and that no benefit would be derived from having the additional capabilities. The FAA has not addressed this comment since there is nothing in this rulemaking that states the number of channels required in simulators.

Economic Summary

The following is a summary of the final cost impact and benefit assessment of a regulation to amend Part 121 of the Federal Aviation Regulations (FAR) to require that certain turbine-powered airplanes be equipped with an approved airborne system that warns a pilot of the presence of hazardous low-altitude windshear conditions and if such windshear conditions are inadvertently encountered, provides flight guidance for a missed approach procedure or an escape maneuver. In addition, the rule requires that all Part 121 operators conduct approved low-altitude windshear flight training in a simulator which has installed in it windshear equipment needed to conform to the airplane type being simulated. The rule further requires that Part 121 and 135 certificate holders' training programs be required to include training concerning flight crewmember recognition of, and escape from, inadvertently encountered hazardous low-altitude windshear conditions as part of their normal ground training.

The NTSB has determined that low-altitude windshear has been the prime cause or a contributing factor in numerous air carrier accidents in the last 20 years. The objective of these rules, therefore, is to prevent or reduce accidents attributed to inadvertent encounters with low-altitude windshear.

The methods and assumptions used to prepare the economic impact estimates for the various changes to Part 121 have been developed by the FAA. The estimates of economic impacts for the final rule revisions have been constructed from unit cost and other data obtained from air carriers, industry trade associations, and manufacturers.

Information for analysis of benefits was obtained from the safety records of the NTSB and the FAA. The costs calculated for these amendments have been projected over the 16-year period of 1989 to 2004. This analysis compares these costs to benefits accruing over the 15-year span of 1990 to 2004. The purpose of this is to account for the fact that in 1989, the first year after the rule is published, no airplanes equipped with the required avionics will be in service. In 1989, however, impacted entities will incur program and planning start-up costs.

In the Notice of Proposed Rulemaking (NPRM), the FAA invited public comments concerning the technical and operational considerations and economic impact assumptions as these apply to flight guidance systems equipment modification and replacement, the frequency and duration of Part 121 certificate holder's windshear simulator flight training, and the extent to which Part 135 operators provide instruction to their pilots in procedures to recognize and escape inadvertent encounters with low-altitude windshear. Comments on the proposal were submitted by individuals, foreign and domestic air carriers, air carrier and airline pilot associations, avionics manufacturers, and the National Transportation Safety Board. The majority of comments commended the FAA for taking action to reduce the hazards of windshear encounters. A number of commenters, however, opposed certain proposed requirements and disagreed with economic impact estimates presented in the proposal. The FAA has evaluated the public comments and made the final determination regarding their impact. The comments have caused the FAA to revise its analysis and increase compliance costs.

A substantial change in the final rule is the provision of a time-phased retrofit schedule for airborne windshear equipment requirements. The final rule requires compliance by 2 years after the effective date of the final rule for all airborne equipment requirements unless an operator submits a schedule to show phased compliance over a 4-year period from the effective date of the rule. Under § 121.358(b) at least 50 percent of a certificate holder's airplanes that were manufactured before the effective date of the rule must be retrofitted within 2 years, at least 25 percent more within 3 years, and the remainder of airplanes affected within 4 years. The final rule also established that the ground and flight training provisions of the rule will take effect two years after the effective date of the rule. The time permitted for

compliance with the ground and flight training requirements will allow certificate holders sufficient time to train flight crews and convert simulators in advance of the compliance date for the required airborne windshear warning and flight guidance equipment. The FAA believes that the time allowed for training and equipment installation and modification will reduce costs and facilitate compliance.

The FAA finds that with the exception of new § 121.358 and the amendments to §§ 121.407, 121.409, 121.424, and 121.427, the amendments affecting Part 121 operators will have a negligible cost or no cost impact. The FAA has also determined the cost of compliance with the upgraded testing and training requirements of the amendments to §§ 135.293, 135.345, and 135.351 to be minimal.

New § 121.358 and the amendments §§ 121.407, 121.424, and 121.427 have been analyzed independently. For the purpose of this evaluation, however, the costs associated with these revisions have been aggregated. The reason is that these amendments are inextricably related and share the common objective of improving the skills of pilots in recognizing and escaping from inadvertently encountered low-altitude windshear conditions.

New § 121.358 will have an economic impact on the approximate 3,800 airplanes expected to be in service in 1990 and 3,200 airplanes expected to be manufactured between 1991 and 2004 because they would be required to be equipped with an FAA-approved system providing airborne windshear warning and flight guidance. The estimated cost of this amendment is \$372.2 million in 1987 dollars and \$218.5 million at a present worth discount rate of 10 percent over the 16-year period of 1989 to 2004.

The amendment to § 121.407 would require that air carriers install approved windshear aerodynamic data programs in their flight simulators. The estimated cost of modifying the 150 flight simulators currently in use by Part 121 certificate holders is \$6.2 million in 1987 dollars.

The cost per hour of additional simulator utilization has been estimated under § 121.409 and added to the time captains and first officers would spend in a flight simulator to comply with the windshear simulator flight training requirements of §§ 121.424 and 121.427.

The FAA has determined that approximately 80 percent of the affected certificate holders already provide the windshear flight training required by §§ 121.424 and 121.427. Therefore, the amendments to these sections would

impact approximately 20 percent of the active and future captains and first officers of the 149 Part 121 certificate holders affected by the rule. The estimated cost of compliance with the initial, transition, and upgrade windshear flight simulator training requirements of § 121.424 would be \$13.4 million in 1987 dollars and \$7.1 million when discounted at 10 percent over the 15-year span between 1989 and 2004. The estimated cost of requiring the affected captains and first officers to undergo windshear simulator flight training pursuant to the recurrent training requirements specified in § 121.427 would be \$33.8 million in 1987 dollars and \$15.2 million at a present worth discount rate of 10 percent over the same time period.

This analysis indicates that the total cost of compliance with the equipment acquisition, installation, maintenance and flight training requirements contained in this rule is estimated to have a present value of \$246.5 million over the 16 year-period of 1989 to 2004.

To estimate the benefits for the NPRM, the FAA examined the safety record of Part 121 air carriers for the 15-year period between 1971 and 1985. At the time, this review indicated that 15 accidents attributed to windshear phenomena occurred during this period. A more recent review, however, reveals that two more accidents attributed to windshear have been added to the safety record by the NTSB for the same 15-year period in question. Accordingly, the losses associated with the 17 accidents are the basis for the benefits of this rule. Moreover, the analysis has been advanced to reflect the more recent 15-year period of 1972 to 1986.

To arrive at a loss rate indicative of the cost of these accidents, the total financial loss of these accidents was divided into the total number of turbine-powered airplane air carrier operations for the same 15-year period of 1972 to 1986. This calculation established a loss rate of \$4.34 per turbine-powered air carrier operation over the 15-year period of 1972 to 1986. Similarly, to estimate the future accident prevention value of this rule, the established loss rate was multiplied by the number of operations forecast for the 15 years from 1990 to 2004. This calculation reveals that the estimated potential discounted benefit associated with the prevention of casualty loss in accidents attributed to windshear to be \$451.6 million.

The FAA has been unable to quantitatively estimate the accident prevention effectiveness of these amendments. The total discounted cost of compliance of these amendments can be fully recovered if the rule is only 55

percent effective in reducing future casualty loss. The FAA believes that enactment of these amendments will significantly reduce the number of future windshear incidents and accidents and that benefits will exceed costs.

This regulatory evaluation focused on the rulemaking it supported. There are other programs which are also designed to reduce the risk of windshear accidents. These other programs are justified partially by benefits included in this analysis, and additional benefits over and above those necessary to justify the rulemaking. FAA does not believe this rulemaking would eliminate or reduce the need for other programs such as terminal Doppler weather radar and Low-Level Wind Shear Alert Systems.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 requires a review of rules to assess their impact on small business. The required Part 121 amendments will have a significant economic impact on a substantial number of small entities. However, the FAA finds that there are no viable alternatives for small air carriers to adopt that would reduce the cost of compliance yet achieve the level of protection sought by this rulemaking. The amendments to part 135 have been determined to impose only minimal costs. Therefore, Part 135 certificate holders would not incur a significant economic impact as a result of these amendments.

International Trade Impact Statement

These amendments will have little or no impact on trade opportunities of United States firms doing business overseas or for foreign firms doing business in the United States. These amendments apply only to Part 121 and Part 135 certificate holders and assign responsibility for the provision of the required equipment and windshear training programs specified in the rule to the operating certificate holder. Because most Part 121 and Part 135 certificate holders compete domestically for passenger and cargo revenues with other U.S. operators, this rule will not cause a competitive fare disadvantage for U.S. carriers.

Federalism Implications

The regulations herein would not have substantial direct effects on the states, on the relationship between the National government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined

that these regulations do not have federalism implications requiring the preparation of a Federalism Assessment.

Paperwork Reduction Act Approval

The recordkeeping and reporting requirements contained in this final rule (§ 121.358) have been submitted to the Office of Management and Budget for review since these provisions were not included in the notice of proposed rulemaking. Comments on these requirements should be submitted to the Office of Information and Regulatory Affairs (OMB), New Executive Office Building, Room 3001, Washington, DC 20503, Attention: FAA Desk Officer (Telephone 202-395-7340). A copy should be submitted to the FAA docket.

Conclusion

The FAA has determined that this amendment is not major under Executive Order 12291 but that it is significant under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 20, 1979). For the reasons discussed above, it also has been determined that the amendments to Part 121 will have a significant economic impact on a substantial number of small entities, but that the amendments to Part 135 will not have a significant economic impact on a substantial number of small entities.

List of Subjects

14 CFR Part 121

Air carriers, Air transportation, Aviation safety, Common carriers, Safety, Transportation, Windshear.

14 CFR Part 135

Air carriers, Air taxi, Air transportation, Aviation safety, Safety, Windshear.

The Rule

Accordingly, the Federal Aviation Administration amends Parts 121 and 135 of the Federal Aviation Regulations (14 CFR Parts 121 and 135) as follows:

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

1. The authority citation for Part 121 continues to read as follows:

Authority: 49 U.S.C. 1354(a), 1355, 1356, 1357, 1401, 1421-1430, 1472, 1485, and 1502; 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983).

2. By adding a new § 121.358 to read as follows:

§ 121.358 Low-altitude windshear system equipment requirements.

(a) Except as provided in paragraph (b) of this section, after January 2, 1991, no person may operate a turbine-powered airplane unless it is equipped with an approved system providing airborne windshear warning with flight guidance. For the purpose of this section, "turbine-powered airplane" includes, e.g., turbofan-, turbojet-, propfan-, and ultra-high bypass fan-powered airplanes. The definition specifically excludes turbopropeller-powered airplanes with variable pitch propellers with constant speed controls.

(b) A certificate holder may obtain an extension of the compliance date in paragraph (a) of this section for airplanes manufactured before January 2, 1989 if it obtains FAA approval of a retrofit schedule. For the purposes of this section, an airplane is considered manufactured on the date the inspection acceptance records reflect that the airplane is complete and meets the FAA Approved Type Design Data. To obtain approval of a retrofit schedule and show continued compliance with that schedule, a certificate holder must do the following:

(1) Submit a request for approval of a retrofit schedule by June 1, 1990 to the Flight Standards Division Manager in the region of the certificate holding district office. Final approval will be granted by the Director of Flight Standards (AFS-1).

(2) Show, for those airplanes subject to this section that are listed in the certificate holder's maintenance operations specifications on the date that the request for extension is submitted, that at least 50% of those airplanes manufactured before January 2, 1989 will be equipped by January 2, 1991, at least 25% more of those airplanes by January 2, 1992, and all of the certificate holder's airplanes required to be equipped in accordance with this section by January 4, 1993.

(3) Comply with its retrofit schedule and submit status reports containing information acceptable to the Administrator. The initial report must be submitted by January 2, 1991, and subsequent reports must be submitted every six months thereafter until completion of the schedule. The reports must be submitted to the FAA Flight Standards District Office charged with the overall inspection of the certificate holder's operations.

3. By adding a new § 121.404 to read as follows:

§ 121.404 Windshear training: Compliance dates.

After January 2, 1991, no certificate holder may use a person as a flight crewmember unless that person has completed—

(a) Windshear ground training in accordance with § 121.419 of this part.

(b) Windshear flight training, if applicable, in accordance with §§ 121.409, 121.424, and 121.427 of this part.

4. By amending § 121.407 by adding a new paragraph (d) to read as follows:

§ 121.407 Training program: Approval of airplane simulators and other training devices.

(d) An airplane simulator approved under this section must be used instead of the airplane to satisfy the pilot flight training requirements prescribed in the certificate holder's approved low-altitude windshear flight training program set forth in § 121.409(d) of this part.

5. By amending § 121.409 by adding a new paragraph (d) to read as follows:

§ 121.409 Training courses using airplane simulators and other training devices.

(d) Each certificate holder required to comply with § 121.358 of this part must use an approved simulator for each airplane type in each of its pilot training courses that provides training in at least the procedures and maneuvers set forth in the certificate holder's approved low-altitude windshear flight training program. The approved low-altitude windshear flight training, if applicable, must be included in each of the pilot flight training courses prescribed in §§ 121.409(b), 121.418, 121.424, and 121.427 of this part.

6. By amending § 121.419 by revising paragraph (a)(2)(vi) to read as follows:

§ 121.419 Pilots and flight engineers: Initial, transition, and upgrade ground training.

(a) * * *

(2) * * *

(vi) Procedures for—

(A) Recognizing and avoiding severe weather situations;

(B) Escaping from severe weather situations, in case of inadvertent encounters, including low-altitude windshear, and

(C) Operating in or near thunderstorms (including best penetrating altitudes), turbulent air (including clear air turbulence), icing, hail, and other potentially hazardous meteorological conditions;

7. By amending § 121.424 by revising paragraphs (a), (b), and (d) to read as follows:

§ 121.424 Pilots: Initial, transition, and upgrade flight training.

(a) Initial, transition, and upgrade training for pilots must include flight training and practice in the maneuvers and procedures set forth in the certificate holder's approved low-altitude windshear flight training program and in Appendix E to this part, as applicable.

(b) The maneuvers and procedures required by paragraph (a) of this section must be performed inflight except—

(1) That windshear maneuvers and procedures must be performed in a simulator in which the maneuvers and procedures are specifically authorized to be accomplished; and

(2) To the extent that certain other maneuvers and procedures may be performed in an airplane simulator, an appropriate training device, or a static airplane as permitted in Appendix E to this part.

(d) If the certificate holder's approved training program includes a course of training utilizing an airplane simulator under § 121.409 (c) and (d) of this part, each pilot must successfully complete—

(1) With respect to § 121.409(c) of this part—

(i) Training and practice in the simulator in at least all of the maneuvers and procedures set forth in Appendix E to this part for initial flight training that are capable of being performed in an airplane simulator without a visual system; and

(ii) A flight check in the simulator or the airplane to the level of proficiency of a pilot in command or second in command, as applicable, in at least the maneuvers and procedures set forth in Appendix F to this part that are capable of being performed in an airplane simulator without a visual system.

(2) With respect to § 121.409(d) of this part, training and practice in at least the maneuvers and procedures set forth in the certificate holder's approved low-altitude windshear flight training program that are capable of being performed in an airplane simulator in which the maneuvers and procedures are specifically authorized.

8. By amending § 121.427 by revising the introductory text of paragraph (d)(1) to read as follows:

§ 121.427 Recurrent training.

(d) * * *

(1) For pilots, flight training in an approved simulator in maneuvers and

procedures set forth in the certificate holder's approved low-altitude windshear flight training program and flight training in maneuvers and procedures set forth in Appendix F to this part, or in a flight training program approved by the Administrator, except as follows—

9. By amending § 121.433 by revising paragraph (c)(2) and adding a new paragraph (e) to read as follows:

§ 121.433 Training required.

(c) * * *

(2) For pilots, a proficiency check as provided in § 121.441 of this part may be substituted for the recurrent flight training required by this paragraph and the approved simulator course of training under § 121.409(b) of this part may be substituted for alternate periods of recurrent flight training required in that airplane, except as provided in paragraphs (d) and (e) of this section.

(e) Notwithstanding paragraphs (c)(2) and (d) of this section, a proficiency check as provided in § 121.441 of this part may not be substituted for training in those maneuvers and procedures set forth in a certificate holder's approved low-altitude windshear flight training program when that program is included in a recurrent flight training course as required by § 121.409(d) of this part.

10. By amending Part 121, Appendix E by revising the first paragraph to read as follows:

Appendix E—Flight Training Requirements

The maneuvers and procedures required by § 121.424 of this part for pilot initial, transition, and upgrade flight training are set forth in the certificate holder's approved low-altitude windshear flight training program and in this appendix and must be performed inflight except that windshear maneuvers and procedures must be performed in an airplane simulator in which the maneuvers and procedures are specifically authorized to be accomplished and except to the extent that certain other maneuvers and procedures may be performed in an airplane simulator with a visual system (visual simulator), an airplane simulator without a visual system (nonvisual simulator), a training device, or a static airplane as indicated by the appropriate symbol in the respective column opposite the maneuver or procedure.

PART 135—AIR TAXI OPERATORS AND COMMERCIAL OPERATORS

11. The authority citation for Part 135 continues to read as follows:

Authority: 49 U.S.C. 1354(a), 1355(a), 1421 through 1431, and 1502; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

12. By revising § 135.10 to read as follows:

§ 135.10 Compliance dates for certain rules.

After January 2, 1991, no certificate holder may use a person as a flight crewmember unless that person has completed the windshear ground training required by §§ 135.345(b)(6) and 135.351(b)(2) of this part.

13. By amending § 135.293 by revising paragraph (a)(7) to read as follows:

§ 135.293 Initial and recurrent pilot testing requirements.

(a) * * *

(7) Procedures for—

(i) Recognizing and avoiding severe weather situations;

(ii) Escaping from severe weather situations, in case of inadvertent encounters, including low-altitude windshear (except that rotorcraft pilots are not required to be tested on escaping from low-altitude windshear); and

(iii) Operating in or near thunderstorms (including best penetrating altitudes), turbulent air (including clear air turbulence), icing, hail, and other potentially hazardous meteorological conditions; and

14. By amending § 135.345 by revising paragraph (b)(6) to read as follows:

§ 135.345 Pilots: Initial, transition, and upgrade ground training.

(b) * * *

(6) Procedures for—

(i) Recognizing and avoiding severe weather situations;

(ii) Escaping from severe weather situations, in case of inadvertent encounters, including low-altitude windshear (except that rotorcraft pilots are not required to be trained in escaping from low-altitude windshear); and

(iii) Operating in or near thunderstorms (including best penetrating altitudes), turbulent air (including clear air turbulence), icing, hail, and other potentially hazardous meteorological conditions;

15. By amending § 135.351 by revising paragraph (b)(2) to read as follows:

§ 135.351 Recurrent training.

* * * *

(b) * * *

{2} Instruction as necessary in the subjects required for initial ground training by this subpart, as appropriate, including low-altitude windshear training as prescribed in § 135.345 of this part and emergency training.

* * * *

Issued in Washington, DC, on September 22, 1988.

T. Allan McArtor,

Administrator.

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Corrections

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DEPARTMENT OF TRANSPORTATION**Federal Aviation Administration****14 CFR Parts 121 and 135****[Docket No. 19110; Amdt. Nos. 121-199,
135-27]****Airborne Low-Altitude Windshear
Equipment and Training Requirements***Correction*

In rule document 88-22088 beginning on page 37688 in the issue of Tuesday, September 27, 1988, make the following corrections:

1. On page 37693, in the first column, in the second complete paragraph, in the fifth line, "§ 121.443(c)(1)(iii)" should read "§ 121.433(c)(1)(iii)", and in the eighth line, "§ 121.443(c)(1)" should read "§ 121.433(c)(1)".

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