European Aviation Safety Agency

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Attn: Mr Darrin Broadwater
Hearing Officer, Office of Aviation Safety
Board of Enquiry concerning Empire Airlines 8284
Public Hearing

Cologne, 15 December 2009
PBL/ein/C(1.1) 2009(D)75747

Subject: Empire Airlines Flight 8284 NTSB Public Hearing. EASA additional information regarding original French FGAC ATR42-320 Special Conditions B5 and C6.

Dear Sir,

As agreed during the 22-23 September 2009 NTSB Public Hearing (Empire Airlines Flight 8284), we submit to the NTSB the EASA additional information requested concerning original DGAC France Special Conditions B5 and C6 for the ATR42-320 aircraft model.

ATR42-200/-300/-320 French DGAC Special Condition B5 "*Stick Pusher*"

Original French DGAC "*ATR42 Special Condition B5 for devices affecting stall identification and recovery characteristics*" can be found in Appendix I to this letter at Issue 4 (Doc GATR/C-N 0001/82).

This Special Condition refers to original JAR 25 Change 8 paragraphs 25.103 to 25.201 and to 25.207 and in addition imposed specific requirements on the stick pusher system for:

- System automatically armed for configurations in which operation of the system is necessary
- Provide mean for the crew to readily disarm the system.
- Specific reliability values of the system concerning failure to operate when required and for unwanted operation.
- Indicating and warning devices.
- Handling characteristics.
- System tolerances and AFM procedures.

Regarding the ATR42-200/-300/-320 Stick Pusher System/Stall Warning architecture's main features in accordance with these requirements, a summary is included below.

The aircraft Centralised Crew Alerting System (CCAS) is continuously monitoring for if a high angle of incidence is sensed (two angle of attack probes provide inputs directly to the CCAS) and when a first threshold (AoA 12,5°) is reached an aural alert (cricket) sounds and both columns' stick shakers are activated.

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A second higher threshold (AoA 15°) is provided for the Stick Pusher activation by means of the CCAS sending a signal to one stick pusher electrical actuator available on the captain's control column that pushes too the F/O's control column through the pitch coupling mechanism.

For the ATR42-200/300/320 the stick shaker's AoA threshold is lowered in case one or both anti-icing horn pushbuttons are selected ON (level 2 of anti/de-ice protection) and this circumstance becomes evident for the crew because on doing that ICING AOA green light is on. The reduced AoA threshold in this "icing" case is initially 8,5°during and after take-off, changing later on (10 minutes after take off or when selecting flaps to 0, whichever happens first) to 7,5°for the en route /approach and landing phase.

Regarding systems' inhibitions the aural stall alarm and the stick shaker activation are inhibited while aircraft is on ground, whereas the stick pusher is inhibited while aircraft is on ground and during the first 10 seconds just after take-off.

In the case there of a pitch uncoupling between the two control columns (a differential force of 52daN between the 2 columns for example could cause that), then only the captain's control column will push forward.

There is a Stick Shaker/Pusher Pushbutton that lights amber in case of failure of any shaker or pusher system and which if selected OFF switches OFF both systems (Stall Warning aural alert is lost too). Finally, there is a green light called "Stick Pusher" to indicate the stick pusher system is operative.

ATR42-200/-300/-320 French DGAC Special Condition C6 "*High Lift Devices*"

Original French DGAC "*ATR42 Special Condition C6 for high lift devices*" can be found in Appendix II to this letter at Issue 4 (Doc GATR/C-N 0001/82).

The purpose of this SC C6 was simply to delete subparagraph JAR 25.345(e) of the original applicable JAR 25 Change 8 (see a copy of this JAR25.345 at Change 8 in Appendix II). The content was based on the draft of JAA NPA 25C.171.

This subparagraph 25.345(e) was calling for structural requisites applicable to flaps during the "*procedure flight conditions*" phase, in addition to en route requisites asked by JAR 25.345(c) and the take-off, approach and landing flaps requisites defined by the rest of JAR 25.345.

This subparagraph JAR 25.345(e) for "*procedure flight conditions*" was introduced since the beginning of JAR 25 (at Change 1, 01st August 1974) as a difference with regards FAR 25 on which a similar dedicated subparagraph for intermediate holding conditions between en route and approach/landing phases never existed.

In a rationalization effort to simplify the designations and descriptions of these structural requisites on flaps throughout the different flight phases and in order to harmonise JAR 25 with FAR 25, the JAA NPA 25C.171 was drafted and discussed in order to remove and withdraw this Subparagraph JAR 25.345(e).

NPA 25C.171 was subsequently implemented through JAR 25 Change 12 Orange paper 88.1 and its adoption later on definitively consolidated at JAR 25 Change 13 (15 October 1989) that is practically identical to FAR 25.345 Amendment 25-46 (please find a copy of JAR 25.345 Change 13 and FAR 25.345 Amdmnt 25-46 on Annex III).

Therefore, this ATR42-200/300/320 Special Condition SC C6 simply anticipated in time this rationalization and harmonization effort for the ATR42-200/300/320 case, at a time when the NPA was already written but not formally incorporated.

I hope that the explanations above satisfy the action taken at the hearing and that it may be considered closed.

If you have any other questions related to the ATR42 arising from your investigations please do not hesitate to contact me. I look forward receiving the final NTSB report in due course.

Yours Sincerely,

Philip Blagden
Certification Manager Large Aeroplanes

Copies (via email): NTSB, Mr Timothy Burtch
FAA, Mr Don Stimpson, Mr Tom Rodriguez
ATR, Mr Vincenzo Panico, Mr Didier Cailhol

Attachments:
Appendix I - French DGAC SC B5
Appendix II - French DGAC SC C6 and JAR 25.345 at Change 8
Appendix III - JAR 25.345 at Change 13 and FAR 25.345 Amdt. 25-46

Appendix I

ATR42-200 / -300 / -320 French DGAC Special Condition B5
"*Stick Pusher*"

ATR 42 SPECIAL CONDITION B 5 FOR DEVICES
AFFECTING STALL IDENTIFICATION AND RECOVERY CHARACTERISTICS

1 - GENERAL

ATR 42 which incorporates a stick pusher which modifies the stallin characteristics by acting directly on the longitudinal control system must comply with the requirements of JAR 25.103 and JAR 25.201 through 25.207 with the device operating normally. In addition the aeroplane and the system for operating the device must comply with the requirements of these Special Conditions.

2 - System Design

2.1. Arming an Disarming

2.1.1. The sytem for operating the device must be such that the system is automatically armed, and will remain armed, in each configuration in which operation of the system is necessary to show compliance with the stalling requirements, except that the system may bedisarmed at air speeds at and above which the risk of stalling as a result of an atmospheric disturbance is Extremely Remote (e.G. a 66 : ft/sec gust), in which case the system should automatically re-arm when the airspeed falls below those speeds.

2.1.2. A means of disarming the system must be provided, and must be capable of being readily selected by the pilots. It must be effective at all times, and must be capable of preventing the system from making any input to the longitudinal control system, and of removing any input which has already been applied (whether as a result of failure or, normal operation of the system).

2.2. Failures and Malfunctions

2.2.1. The design of the system must be such that compliance can be shown with 2.2.2. and 2.2.3. This must be established by means of failure and reliability analyses of the system and its components.

2.2.2. Failure to operate

The probability of the stick pusher failing to operate at a time when it is designed to operate without warning must be less tan 10-4.

This must be assessed taking into acount all possible failures and combination of failures

NOTE : The standard of reliability specified in 2.2.2. is the minimum necessary to provide an adequate level of protection for unintended stalls. The Authority should be consulted on the standard of protection required for deliberate stalls (e;g; in the course of test flying and crew training) including fault survival capability of the system, and any additional instrumentation, inspection, and operating procedures.

DGAC will assess the severity of the requirements to be applied to the case of unwanted operation of the device in the light of the predicted rates of occurence of unwanted operation. The principles outlined in ACJ N° 1 to JAR 25.1309 will apply.

NOTE : No single failure should result in unwanted operation of the device, and in order to avoid prejudicing the confidence of flight crews in the system, the probability of unwanted operation, from all causes, should not exceed 10-5. If unwanted operation, with corrective pilot action, would result in the total normal acceleration of the aeroplane becoming negative, or in the design limit load in any part of the aeroplane structure being exceeded, the probability of unwanted operation should not exceed 10-7. In the climb, cruise and descent flight regimes, corrective pilot action should not be assumed to be initiated until 3 seconds after unwanted operation has been recognised. During final approach this minimum time may be reduced to 1 second.

2.3. Indicating and Warning Devices

2.3.1. An unmistakable and immediate warning must be given that the device is being actuated.

NOTE : The aim is to indicate to the flight crew that the stick has moved because of the action of the system, and not for some other reason

2.3.2. Warning that the system for operating the device has failed shall be provided. As far as is practicable, this warning shall cover all failure modes.

2.3.3. Clear and distinctive indication shall be given, ans shall continue to be given, that the means ofdisarming the system required by 2.1.2. has been operated.

3 - HANDLING CHARACTERISTICS

3.1. The operation of the device, in straight and turning flight stalls and in dynamic stalls with total normal acceleration up to 1.5g, must be such that the aeroplane with the system operating normally complies with all relevant stalling requirements

3.2. The design of the system must be such that flight in turbulence, up to the most severe that is likely to be encountered, is unlikely to result in such operation of the device as would significantly increase the difficulty of flying in those conditions

3.3. The effect of operation of the device must be to reduce the angle of attack to a substantial margin below the stall, so as to make an inadvertent return to the stalled condition unlikely.

3.4. The characteristics of the device must be such that it is unlikely that a member of the flight crew will prevent or delay its operation.

NOTE : a stick force of the order of 80 pounds applied virtually instantaneously (0.1 second) has been accepted as providing this characteristic.

3.5. The longitudinal manoeuvring capability of the aeroplane in reasonably steady manoeuvres, at all speeds likely to be encountered in normal operations, shall be substantially the same as would be expected to be available at the same speed for an aeroplane having conventional stalling characteristics (i;e; the manoeuvre capability should not be reduced below a normal level because of the operating characteristics of the system).

4 - SYSTEM TOLERANCES

Flight tests to determine the stalling speeds under JAR 25.103 may be conducted with the system adjusted to operate at the nominal angle of attack within an acceptably narrow design range (e;g; corresponding to ± 2 knots). Flight tests to determine stalling characteristics must be made with the system adjusted to the upper limit of tolerance on angle of attack.

5 - Airplane flight manual procedure.

Limitation and procedures in view to reduce the probability of stalling the aircraft when the system for operating the device has failed during a flight must be established and included in the aeroplane flight munual.

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Appendix II

French DGAC SC C6 and JAR 25.345 at Change 8

SPECIAL CONDITION C6

HIGH LIFT DEVICES

Delete PARAGRAPH JAR 25-345 (e)

JAR 25.341 (c) (continued)

a = slope of the aeroplane normal force co-efficient curve C_{NA} per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope C_L per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads [are treated as a separate condition. (See ACJ 25.341 (c) and (G) ACJ 25.341 (b) and (c) (United Kingdom).)]

[*(G)* (d) (United Kingdom) *The dynamic response to a tuned discrete gust must be taken into account (see (G) ACJ 25.341 (d) (United Kingdom). The analysis must take account of unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body motions.*]

JAR 25.343 Design fuel and oil loads

(a) The disposable load combinations must include each fuel and oil load in the range from zero fuel and oil to the selected maximum fuel and oil load. A structural reserve fuel condition, not exceeding 45 minutes of fuel under the operating conditions in JAR 25.1001 (i), may be selected.

(b) If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements as prescribed in this Subpart. In addition —

(1) The structure must be designed for a condition of zero fuel and oil in the wing at limit loads corresponding to —

(i) A manoeuvring load factor of +2.25; and

(ii) Gust intensities equal to 85% of the values prescribed in JAR 25.341; and

(2) Fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of sub-paragraph (b) (1) of this paragraph; and.

(3) The flutter, deformation, and vibration requirements must also be met with zero fuel.

JAR 25.345 High lift devices

(a) If wing-flaps are to be used during take-off, approach, or landing, at the design flap speeds established for these stages of flight under JAR 25.335 (e) and with the wing-flaps in the corresponding positions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

JAR 25.345 (a) (continued)

(1) Manoeuvring to a positive limit load factor of 2.0; and

(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight.

(b) The aeroplane must be designed for the conditions prescribed in sub-paragraph (a) of this paragraph, except that the aeroplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of —

(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F, and with take-off power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and

(2) A head-on gust of 25 fps velocity (EAS).

(c) (See JAR 25.373.) If flaps or other high lift devices are to be used in en-route conditions, and with wing-flaps in the appropriate position at speeds up to the wing-flap design speed chosen for these conditions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

(1) Manoeuvring to a positive limit load factor of 2.5; and

(2) Positive and negative, derived gusts as prescribed in JAR 25.341 acting normal to the flight path in level flight.

(d) The aeroplane must be designed for a manoeuvring load factor of 1.5 g at the maximum take-off weight with the wing-flaps and similar high lift devices in the landing configuration at maximum approach speed.

(e) When high lift devices such as flaps or slats are used under procedure flight conditions the aeroplane with these high lift devices in the appropriate position must withstand the loads associated with the conditions prescribed in sub-paragraphs (1) and (2).

(1) *Up to V_F1 speed*

(i) Manoeuvre up to a positive loading factor of between 0 and the positive limit manoeuvre factor n_1 prescribed by JAR 25.337 (b).

(ii) Gusts as indicated in JAR 25.341 (a) (2).

(2) *Above V_F1 speed.* In the absence of a more rational investigation of possible speed excursions beyond V_F1 the following condition will be applied. At the speed reached starting from level flight at speed V_F1 and engine rating

JAR 25.345 (e) (continued)

appropriate to this condition with the landing gear retracted and performing a dive of 7.5 for 10 seconds.

(i) Manoeuvre up to a loading factor of between 0 and the positive limit manoeuvre factor n_1 prescribed by JAR 25.337 (b).

(ii) Gusts as indicated in JAR 25.341 (a) (3).

The foregoing calculations will be carried out for an aeroplane weight not exceeding the landing weight and an altitude not exceeding 20,000 ft.

(G) JAR 25.345 High lift devices (United Kingdom)

(a) If wing-flaps are to be used during take-off, approach, or landing, at the design flap speeds established for these stages of flight under JAR 25.335 (e) and with the wing-flaps in the corresponding positions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

(1) Manoeuvring to a positive limit load factor of 2.0;

(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight; and

(3) The checked manoeuvre of JAR 25.331 (c) (2) up to the positive limit load of 2.0.

(b) The aeroplane must be designed for the conditions prescribed in sub-paragraph (a) of this paragraph, except that the aeroplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of —

(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F, and with take-off power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and

(2) A head-on gust of 25 fps velocity (EAS).

(c) (See JAR 25.373.) If wing-flaps or other high lift devices are to be used in en-route conditions, (see (G) ACJ 25.345 (c)) and with wing-flaps in the appropriate position at speeds up to the wing-flap design speed chosen for these conditions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

(1) Manoeuvring to a positive limit load factor of JAR 25.337(b).

(G) JAR 25.345 (c) (continued)

(2) Positive and negative derived gust as prescribed in JAR 25.341 acting normal to the flight path in level flight.

(3) The checked manoeuvre of JAR 25.331 (c) (2), up to the positive limit load factor prescribed by JAR 25.337 (b) and separately down to a load factor of zero.

(d) The aeroplane must be designed for a manoeuvring load factor of 1.5 g at the maximum take-off weight with the wing-flaps and similar high lift devices in the landing configuration at maximum appropriate approach speed.

(e) Where the wing-flaps are intended to be extended in en-route flight conditions, additional alternative values of V_A, V_B, Vc and V_D (identified by V_{fA}, V_{fB}, V_{fc} and V_{fD}) must be selected and shall be appropriate to the en-route wing-flap positions. The criteria for these en-route speeds must be based on the criteria of JAR 25.335, as amended by JAR 25.335 (b), account being taken of the en-route wing-flap positions.

(f) In the absence of any better information hold-off conditions immediately prior to landing and prolonged periods immediately following take-off or prior to landing (procedures normally carried out at a height greater than 2000 ft) are considered to be en-route flight.

JAR 25.349 Rolling conditions

The aeroplane must be designed for rolling loads resulting from the conditions specified in sub-paragraphs (a) and (b) of this paragraph. Unbalanced aerodynamic moments about the centre of gravity must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.

(a) *Manoeuvring.* The following conditions, speeds, and aileron deflections (except as the deflections may be limited by pilot effort) must be considered in combination with an aeroplane load factor of zero and of two-thirds of the positive manoeuvring factor used in design. In determining the required aileron deflections, the torsional flexibility of the wing must be considered in accordance with JAR 25.301 (b):

(1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for aeroplanes with engines or other weight concentrations outboard of the fuselage. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the manoeuvre.

Appendix III

JAR 25.345 at Change 13 and FAR 25.345 Amdt. 25-46

JAR 25.345 High lift devices

(a) If wing-flaps are to be used during take-off, approach, or landing, at the design flap speeds established for these stages of flight under JAR 25.335 (e) and with the wing-flaps in the corresponding positions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

(1) Manoeuvring to a positive limit load factor of 2.0; and

(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight.

(b) The aeroplane must be designed for the conditions prescribed in sub-paragraph (a) of this paragraph, except that the aeroplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of —

(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F, and with take-off power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and

(2) A head-on gust of 25 fps velocity (EAS).

(c) (See JAR 25.373.) If flaps or other high lift devices are to be used in en-route conditions, and with wing-flaps in the appropriate position at speeds up to the wing-flap design speed chosen for these conditions, the aeroplane is assumed to be subjected to symmetrical manoeuvres and gusts within the range determined by —

(1) Manoeuvring to a positive limit load factor as defined in JAR 25.337 (b); and

(2) Positive and negative derived gusts as prescribed in JAR 25.341 acting normal to the [flight path in level flight. (See ACJ 25.345 (c).)]

(d) The aeroplane must be designed for a manoeuvring load factor of 1.5 g at the maximum take-off weight with the wing-flaps and similar high lift devices in the landing configuration at maximum approach speed.

JAR 25.349 Rolling conditions

The aeroplane must be designed for rolling loads resulting from the conditions specified in sub-paragraphs (a) and (b) of this paragraph. Unbalanced aerodynamic moments about the centre of gravity must be reacted in a rational or

JAR 25.349 (continued)

conservative manner, considering the principal masses furnishing the reacting inertia forces.

(a) *Manoeuvring.* The following conditions, speeds, and aileron deflections (except as the deflections may be limited by pilot effort) must be considered in combination with an aeroplane load factor of zero and of two-thirds of the positive manoeuvring factor used in design. In determining the required aileron deflections, the torsional flexibility of the wing must be considered in accordance with JAR 25.301 (b):

(1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for aeroplanes with engines or other weight concentrations outboard of the fuselage. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the manoeuvre.

(2) At V_A, a sudden deflection of the aileron to the stop is assumed.

(3) At V_C, the aileron deflection must be that required to produce a rate of roll not less than that obtained in sub-paragraph (a) (2) of this paragraph.

(4) At V_D, the aileron deflection must be that required to produce a rate of roll not less than one-third of that in sub-paragraph (a) (2) of this paragraph.

(b) *Unsymmetrical gusts.* The condition of unsymmetrical gusts must be considered by modifying the symmetrical flight conditions B' or C' (in JAR 25.333 (c)) whichever produces the critical load. It is assumed that 100% of the wing air load acts on one side of the aeroplane and 80% acts on the other side.

JAR 25.351 Yawing conditions

The aeroplane must be designed for loads resulting from the conditions specified in sub-paragraphs (a) and (b) of this paragraph. Unbalanced aerodynamic moments about the centre of gravity must be reacted in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces:

(a) *Manoeuvring.* At speeds from V_{MC} to V_D, the following manoeuvres must be considered. In computing the tail loads, the yawing velocity may be assumed to be zero;

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Sec. 25.345

Part 25 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES	
Subpart C--Structure	Flight Maneuver and Gust Conditions

Sec. 25.345

High lift devices.

(a) If flaps are to be used during takeoff, approach, or landing, at the design flap speeds established for these stages of flight under Sec. 25.335(e) and with the flaps in the corresponding positions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by--
(1) Maneuvering to a positive limit load factor of 2.0; and
(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight.
(b) The airplane must be designed for the conditions prescribed in paragraph (a) of this section, except that the airplane load factor need not exceed 1.0 taking into account, as separate conditions, the effects of--
(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F and with takeoff power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and
(2) A head-on gust of 25 feet per second velocity (EAS).
[(c) If flaps or similar high lift devices are to be used in en route conditions, and with flaps in the appropriate position at speeds up to the flap design speed chosen for these conditions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by--**]**
(1) Maneuvering to a positive limit load factor of 2.5; and
(2) Positive and negative derived gusts as prescribed in Sec. 25.341 acting normal to the flight path in level flight.
[(d) The airplane must be designed for landing at the maximum takeoff weight with a maneuvering load factor of 1.5g and the flaps and similar high lift devices in the landing configuration.**]**

Amdt. 25-46, Eff. 12/1/78

Comments

Document History

Notice of Proposed Rulemaking Actions:

Notice of Airworthiness Review Program No. 2; Notice No. 75-10; Issued on 02/27/75.
Notice of Airworthiness Review Program No. 3; Notice No. 75-19; Issued on 05/13/75.
Notice of Airworthiness Review Program No. 5; Notice No. 75-23; Issued on 05/19/75.
Notice of Airworthiness Review Program No. 7; Notice No. 75-26; Issued on 06/09/75.
Notice of Airworthiness Review Program No. 8; Notice No. 75-31; Issued on 06/30/75.

Final Rule Actions:

Final Rule. Docket No. 14324, 14606, 14625, 14685, 14779; Issued on 10/10/78.