ETSO-C62d

Date : 24.10.03

European
Aviation
Safety
Agency

European Technical Standard Order

Subject: AIRCRAFT TYRES

1 - Applicability

This ETSO gives the requirements which tyres excluding tailwheel tyres that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None.

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the attached Appendix 1: „Federal Aviation Administration Standard for Aircraft Tyres“ dated September 7, 1990.

3.1.2 - Environmental Standard

As stated in the Federal Aviation Administration Standard.

3.1.3 – Computer Software

None

3.2 - Specific

None.

4 - Marking

4.1 - General

In lieu of the marking requirements of CS-ETSO Subpart A paragraph 1.2, a tyre must be legibly and permanently marked at least with the following:

(1) Brand name or registered trademark of the manufacturer responsible for compliance.

(2) Speed rating, load rating, size, skid depth, serial number, date, manufacturer’s part number and plant code, and nonretreadable, if appropriate.

(3) Applicable ETSO number.

4.2 - Specific

None.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

APPENDIX 1. FEDERAL AVIATION ADMINISTRATION STANDARD FOR AIRCRAFT TIRES DATED SEPTEMBER 7, 1990

1.0 Purpose. This document contains minimum performance standards for new and requalified aircraft tires, excluding tailwheel tires, that are to be identified as meeting the standards of TSO-C62d.

2.0 Scope. These minimum performance standards apply to aircraft tires having speed and load ratings that are established on the basis of the speeds and loads to which the tires have been tested.

3.0 Material requirement. Materials must be suitable for the purpose intended. The suitability of the materials must be determined on the basis of satisfactory service experience or substantiating dynamometer tests.

4.0 Design and construction.

4.1 Unbalance. The moment (M) of static unbalance in inch-ounces may not be greater than the value determined using the formula, moment (M) = $0.025D^2$, rounded off to the next lower whole number: where D = maximum outside diameter of the tire in inches.

4.2 Balance marker. A balance marker, consisting of a red dot, must be affixed on the sidewall of the tire immediately above the bead to indicate the lightweight point of the tire. The dot must remain for any period of storage plus the original tread life of the tire.

4.3 Overpressure. The tire shall withstand for at least 3 seconds a pressure of at least 4.0 times the rated inflation pressure (as specified in paragraph 5.2) at ambient temperature.

4.4 Temperature.

4.4.1 Ambient. It shall be substantiated by applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to the temperature extremes of not higher than -40°F and not lower than +160°F for a period of not less than 24 hours at each extreme.

4.4.2 Wheel rim heat. It must be substantiated by the applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to a wheel-bead seat temperature of not lower than 300°F for at least 1 hour, except that low-speed tires or nose-wheel tires may be tested or analyzed at the highest wheel-bead seat temperatures expected to be encountered during normal operations.

4.5 Tread design. Moved. (See paragraph 7.0)

4.6 Slippage. A tire tested in accordance with the dynamometer tests provided in paragraph 6.0 may not slip on the wheel rim during the first five dynamometer cycles. Slippage that subsequently occurs may neither damage the gas seal of the tyre bead of a tubeless tire nor otherwise damage the tube or valve.

4.7 Leakage. After an initial 12-hour minimum stabilization period, the tire must be capable of retaining inflation pressure with a loss of pressure not exceeding 5 percent in 24 hours from the initial pressure equal to the rated inflation pressure.

5.0 Ratings.

5.1 Load ratings. The load ratings of tyres shall be established. The applicable dynamometer tests in paragraph 6.0 must be performed at the selected rated load.

5.1.1 Load rating (helicopter tires). Airplane tires qualified in accordance with provisions of this standard may also be used on helicopters. In such cases, the maximum static load rating may be increased by 1.5 with a corresponding increase in rated inflation pressure without any additional qualification testing.

5.2 Rated inflation pressure. The rated inflation pressure shall be established at an identified ambient temperature on the basis of the rated load as established under paragraph 5.1.

5.3 Loaded radius. The loaded radius is defined as the distance from the axle centerline to a flat surface for a tire initially inflated to the rated inflation pressure and then loaded to its rated load against the flat surface. The nominal loaded radius, the allowable tolerance on the nominal loaded radius, and the actual loaded radius for the test tire shall be identified.

6.0 Dynamometer test requirements. The tyre may not fail the applicable dynamometer tests specified herein or have any signs of structural deterioration other than normal expected tread wear except as provided in paragraph 6.3.3.3.

6.1 General. The following conditions apply to both low-speed and high-speed tires when these tires are subjected to the applicable dynamometer tests:

6.1.1 Tire test load. Unless otherwise specified herein for a particular test, the tire must be forced against the dynamometer flywheel at not less than the rated load of the tire during the entire roll distance of the test.

6.1.2 Test inflation pressure. The test inflation pressure must be the pressure required at an identified ambient temperature to obtain the same loaded radius against the flywheel of the dynamometer at the loaded radius for a flat surface as defined in paragraph 5.3. Adjustments to the test inflation pressure may not be made to compensate for increases created by temperature rises occurring during the tests.

6.1.3 Test specimen. A single tire specimen must be used in the applicable dynamometer tests specified herein.

6.2 Low-speed tire. A tire operating at ground speeds of 120 mph or less must withstand 200 landing cycles on a dynamometer at the following test temperature and kinetic energy and using either test method A or test method B.

6.2.1 Test temperature. The temperature of the gas contained in the tire or of the carcass measured at the hottest point of the tire may not be lower than 105°F at the start of at least 90 percent of the test cycles. For the remaining 10 percent of the test cycles, the contained gas or carcass temperature may not be lower than 80°F at the start of each cycle. Rolling the tire on the flywheel is acceptable for obtaining the minimum starting temperature.

6.2.2 Kinetic energy. The kinetic energy of the flywheel to be absorbed by the tire must be calculated as follows:

K.E. = CWV^2 = 162.7W = Kinetic energy in foot-pounds.

where:

C = 0.0113,

W = Load rating of the tire in pounds, and

V = 120 mph.

6.2.3 Test method A - variable mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges shown below. If the exact number of flywheel plates cannot be used to obtain the calculated kinetic energy value or proper flywheel width, a greater number of plates must be selected and the dynamometer speed adjusted to obtain the required kinetic energy.

6.2.3.1 Low-speed landings. In the first series of 100 landings, the maximum landing speed is 90 mph and the minimum unlanding speed is 0 mph. The landing speed must be adjusted so that 56 percent of the kinetic energy calculated under paragraph 6.2.2 will be absorbed by the tire. If the adjusted landing speed is calculated to be less than 80 mph, the following must be done: the landing speed must be determined by adding 28 percent of the kinetic energy calculated under paragraph 6.2.2 to the flywheel kinetic energy at 64 mph, and the unlanding speed must be determined by subtracting 28 percent of the kinetic energy calculated under paragraph 6.2.2 from the flywheel kinetic energy at 64 mph.

6.2.3.2 High-speed landings. In the second series of 100 landings, the minimum landing speed is 120 mph and the nominal unlanding speed is 90 mph. The unlanding speed must be adjusted as necessary so that 44 percent of the kinetic energy calculated under paragraph 6.2.2 will be absorbed by the tire.

6.2.4 Test method B - fixed mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges indicated below. Each landing must be made in a time period, T, calculated so that the tire will absorb the kinetic energy determined under paragraph 6.2.2. The time period must be calculated using the equation:

$$T_c = \frac{KE_c}{\left[\dfrac{KE_{W(UL)} - KE_{W(LL)}}{T_{L(UL)} - T_{L(LL)}}\right] - \left[\dfrac{KE_{W(UL)} - KE_{W(LL)}}{T_{W(UL)} - T_{W(LL)}}\right]}$$

For the 90 mph to 0 mph test, the equation reduces to:

$$T_c = \frac{KE_c}{\left[\dfrac{KE_{W(UL)}}{T_{L(UL)}}\right] - \left[\dfrac{KE_{W(UL)}}{T_{W(UL)}}\right]}$$

Where:

Tc = Calculated time, in seconds, for the tyre to absorb the required kinetic energy.

KE_c = Kinetic energy, in foot pounds, the tyre is required to absorb during each landing cycle.

KE_w = Kinetic energy, in foot pounds, of the flywheel at given speed.

T_L = Coast down time, in seconds, with rated tyre load on flywheel.

T_w = Coast down time, in seconds, with no tyre load on flywheel.

(UL) = Subscript for upper speed limit.

(LL) = Subscript for lower speed limit.

6.2.4.1 Low-speed landings. In the first series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 90 mph. The flywheel deceleration must be constant from 90 mph to 0 mph in the time Tc.

6.2.4.2 High-speed landings. In the second series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 120 mph. The flywheel deceleration must be constant from 120 mph to 90 mph in the time T_c.

6.3 High-speed tire. Except as provided in the alternate test, a tire operating at ground speeds greater than 120 mph must be tested on a dynamometer in accordance with paragraph 6.3.3. The curves to be used as a basis for these tests shall be established in accordance with paragraph 6.3.3.2. The load at the start of each test must be equal to the rated load of the tire. Alternate tests involving a landing sequence for a tire operating at ground speeds greater than 120 mph and not over 160 mph are set forth in paragraph 6.3.4.

6.3.1 Test temperature. The temperature of the gas contained in the tire or of the carcass measured at the hottest point of the tire may not be lower than 120°F at the start of at least 90 percent of the test cycles specified in paragraph 6.3.3.4 and at least 105°F at the start of the overload test (6.3.3.3) and of at least 90 percent of the test cycles specified in paragraphs 6.3.3.2 and 6.3.4. For the remaining 10 percent of each group of cycles, the contained gas or carcass temperature may not be lower than 80°F at the start of each cycle. Rolling the tire on the dynamometer is acceptable for obtaining the minimum starting temperature.

6.3.2 Dynamometer test speeds. Applicable dynamometer test speeds for corresponding maximum ground speeds are as follows:

Maximum Ground Speed of Aircraft, mph		Speed Rating of Tire, mph	Minimum Dynamometer Speed at S_2,mph
Over	Not Over		
120	160	160	160
160	190	190	190
190	210	210	210
210	225	225	225
225	235	235	235
235	245	245	245

For ground speeds over 245 mph, the tire must be tested to the maximun applicable load-speed-time requirements and appropriately identified with the proper speed rating.

6.3.3 Dynamometer cycles. The test tire must withstand 50 take-off cycles, 1 overload take-off cycle, and 10 taxi cycles described below. The sequence of the cycles is optional.

6.3.3.1 Symbol definitions. The numerical values which are used for the following symbols must be determined from the applicable aircraft load-speed-time data:

L_0 = Tire load at start of take-off, pounds (not less than rated load).
L_1 = Tire load at rotation, pounds.
L_2 = Zero tyre load (lift-off).
RD = Roll distance, feet.
S0 = Zero tyre speed.
S1 = Tire speed at rotation, mph.
S_2 = Tire speed at liftoff, mph (not less than speed rating).
T_0 = Start of takeoff.
T1 = Time to rotation, seconds.
T2 = Time to liftoff, seconds.

6.3.3.2 Takeoff cycles. For these cycles the loads, speeds, and distance must conform to either Figure 1 or Figure 2. Figure 1 defines a test cycle that is generally applicable to any aircraft. If Figure 2 is used to define the test cycle, the loads, speeds, and distance must be selected based on the most critical takeoff conditions established by the applicant.

6.3.3.3 Overload takeoff cycle. The cycle must duplicate the takeoff cycles specified under paragraph 6.3.3.2 except that the tire load through the cycle must be increased by a factor of at least 1.5. Upon completion of the overload takeoff cycle, the tire must be capable of retaining inflation pressure with the loss of pressure not exceeding 10 percent in 24 hours from the initial test pressure. Good condition of the tire tread is not required after completion of this test cycle.

6.3.3.4 Taxi cycles. The tire must withstand at least 10 taxi cycles on a dynamometer under the following test conditions:

Number of Test Cycles	Minimum Tire Load, 1bs.	Minimum Speed, mph	Minimum Roll Distance, ft.
8	Rated load.	40	35,000
2	1.2 times rated load.	40	35,000

6.3.4 Alternative dynamometer tests. For a tire with a speed rating of 160 mph, test cycles which simulate landing may be used in lieu of the take-off cycles specified in paragraphs 6.3.3.2 and 6.3.3.3. The tire must withstand 100 test cycles at rated load in accordance with paragraph 6.3.4.1 followed by 100 test cycles at rated load in accordance with paragraph 6.3.4.2.

6.3.4.1 Low-speed landings. In the first series of 100 landings, the test procedures for low-speed landings established under paragraph 6.2.3 or 6.2.4, as appropriate, must be followed.

6.3.4.2 High-speed landings. In the second series of 100 landings, the test procedures for low-speed landings established under paragraph 6.2.3 or 6.2.4, as appropriate, must be followed, except that the tire must be landed against the flywheel rotating at a speed of 160 mph with the rated load applied for the duration of the test. The unlanding speed must be adjusted as necessary so that 44 percent of the kinetic energy, as calculated in paragraph 6.2.2, is absorbed by the tire during the series of tests.

7.0 Requalification tests. A tire shall be requalified unless it is shown that changes in materials, tire design, or manufacturing processes could not affect performance. Changes in materials, tire design, or manufacturing processes that affect performance or changes in number or location of tread ribs and grooves or increases in skid depth, made subsequent to the tire qualification, must be substantiated by dynamometer tests in accordance with paragraph 6.0. Requalification in accordance with paragraph 6.0 of a given load rated tire required as a result of a tread design or material change will automatically qualify the same changes in a lesser load rated tire of the same size, speed rating, and skid depth provided —

7.1 The lesser load rated tire has been qualified to the applicable requirements specified in this standard; and

7.2 The ratio of qualification testing load to rated load for the lesser load rated tire does not exceed the same ratio for the higher load rated tire at any given test condition.

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Appendix 1

FIGURE 1
GRAPHIC REPRESENTATION OF A UNIVERSAL LOAD-SPEED TIME TEST CYCLE

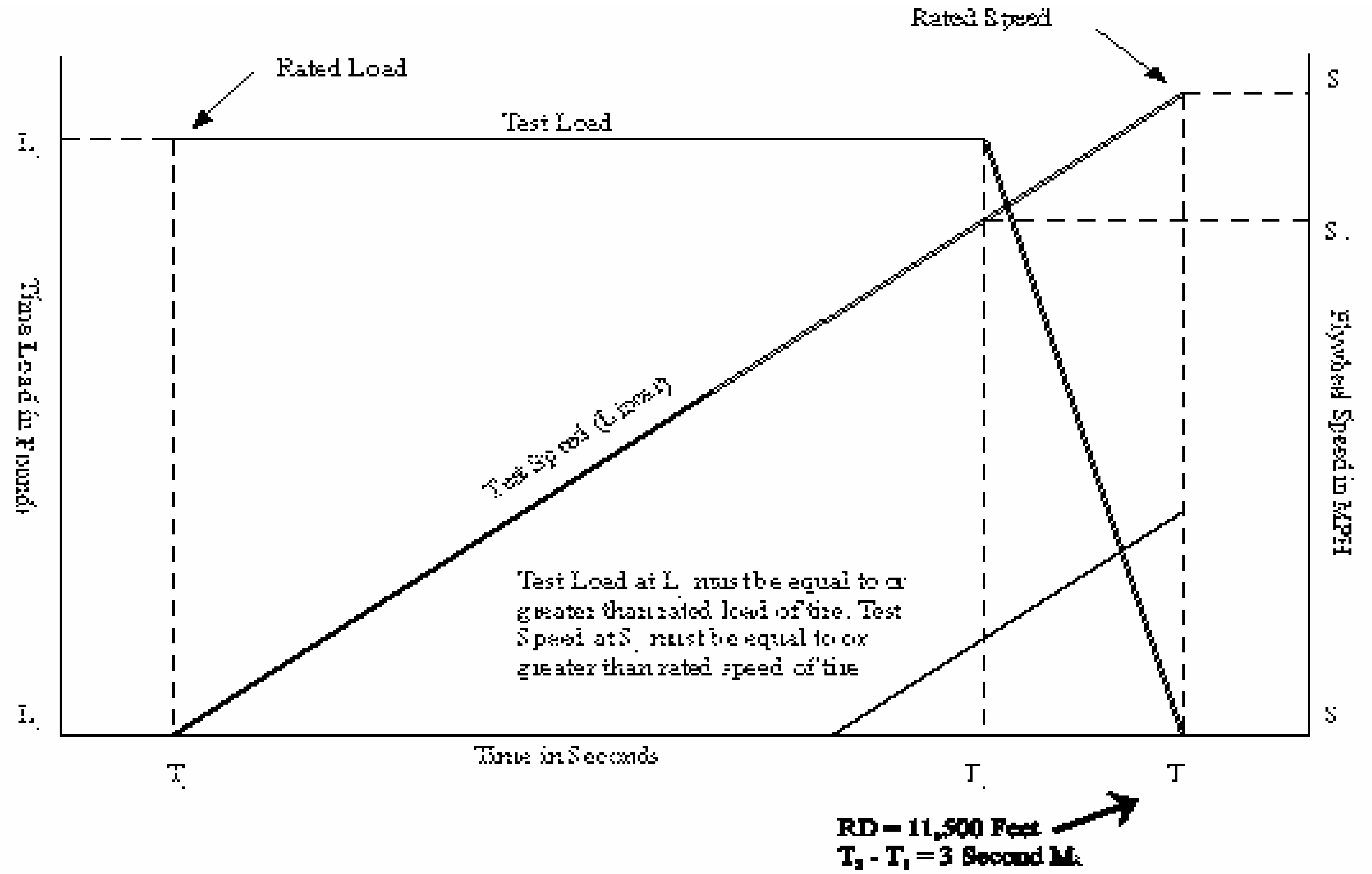

FIGURE 2
GRAPHIS REPRESENTATION OF A RADIONAL LOAD-SPEED-TIME TEST CYCLE