



ITSO-C62e

Effective
Date: July 1, 2010

Government of India
Directorate General of Civil Aviation
Aircraft Engineering Directorate
New Delhi

Indian Technical Standard Order

Subject: AIRCRAFT TYRES

1. **PURPOSE.** This Indian Technical Standard Order (ITSO) is issued for manufacturers applying for an ITSO authorization (ITSOA), and lays down the minimum performance standards (MPS) for aircraft tyres (excluding tail wheel tyres) for approval and identification with the applicable ITSO marking.

2. **APPLICABILITY.** This ITSO is effective from the date of issue.

Major design changes to aircraft tyres approved under this ITSO will require a new authorisation according to CAR 21.611(b).

3. REQUIREMENTS.

a. New models of aircraft tyres identified and manufactured on or after the effective date of this ITSO must meet the MPS qualification and documentation requirements as given in Appendix 1 to this ITSO.

b. **Deviations.** Applicant can use alternate or equivalent means of compliance to the criteria in the MPS of this ITSO. Under such circumstances, it must be shown that the equipment maintains an equivalent level of safety. A deviation (if any), may be applied as per the requirements of CAR 21.610, together with the data package.

4. **MARKING.** Tyres manufactured under this ITSO shall be marked legibly and permanently with the following information instead of the marking requirements of CAR 21.609(e):

- a. Applicable ITSO number.
- b. Balance marker (consisting of a red dot) on the sidewall of the tyre immediately above the bead to indicate the lightweight point of the tyre.
- c. Brand name and the name, or registered trademark of the manufacturer responsible for compliance.
- d. Production date code (may be included in the established serial number).

- e. Part number.
- f. Plant code: May be encoded in the serial number.
- g. Ply rating. If the ply rating is marked on the tyre, the load rating marked on the tyre must be consistent with the ply rating established.
- h. Serial number : the plant code and production date code may be included.
- i. Size and load ratings.
- j. Skid depth in mm (inches) as defined in Appendix 1.
- k. Speed rating [in Kmph (MPH)] as identified in Appendix 1, para 4. b that is equal to or less than the speed at which the tyre has been qualified.
- l. Tyre type (Mark tyres requiring a tube with the words “Tube type”).
- m. Marking of non-re-treadable tyres.

5A. APPLICATION DATA REQUIREMENTS. The ITSO manufacturer-applicant shall furnish following information to DGCA alongwith a statement of conformance, as specified CAR 21.605(a) to support design and production approval:

- a. Size.
- b. Ply rating (if specified).
- c. Tyre speed rating.
- d. Load rating.
- e. Rated inflation pressure.
- f. Tyre outside diameter measurement.
- g. Tyre section width measurement.
- h. Skid depth.
- i. Tyre shoulder diameter and shoulder width measurement or envelope drawing.
- j. Nominal loaded radius at rated load and inflation pressure and permissible tolerance on the nominal loaded radius.
- k. Actual loaded radius of the test tyre at rated load and inflation pressure.
- l. Weight of tyre.
- m. Casing burst pressure as per Appendix 1, para 4.c
- n. Test tyre static unbalance.
- o. Wheel rim size designation.
- p. Tyre manufacturer part number.
- q. Load deflection curve at loads up to 1.5 times the load rating at rated pressure.
- r. Summary of the load-speed-time parameters used in the dynamometer tests.
- s. Material and process specifications list.
- t. Maintenance instructions: The maintenance data must include inspection criteria for the new tyre to determine eligibility for in-service tyres to remain in operation. Special non-destructive inspection techniques and re-treading procedures, if applicable, may also be included in the maintenance information with any special repair methods applicable to the tyre. Known or potential problems with in-service tyres that may affect safety of aircraft operation shall also be notified in accordance with CAR 21.3A.
- u. Limitations: ITSO approval does not automatically constitute authority to install and use the tyre on an aircraft. DGCA may require further aircraft testing or analysis to approve installing a re-qualified tyre (with a new part number) on an aircraft. Such aircraft tests would be appropriate to substantiate changes in tyre materials, design and/or manufacturing processes that could:

(1) Alter the basic mechanics of the tyre (such as supporting of load by the tyres, distribution of load in the footprint, and transmission of torsional and lateral forces to the landing gear structure), and

(2) Affect previously established performance levels (such as handling and stopping distance).

v. The following statement may be included:

The conditions and tests for ITSO approval of this article are minimum performance standards. Those installing this article, on a specific type or class of aircraft, must determine that the aircraft operates under conditions within the ITSO standards. ITSO articles must have separate approval for installation in an aircraft according to the applicable airworthiness requirements.

5B. MANUFACTURER DATA REQUIREMENTS. The following technical data shall be made available for review by AED, DGCA:

- a. Functional qualification specifications for qualifying each production article to ensure compliance with this ITSO.
- b. Equipment calibration procedures.
- c. Corrective maintenance procedures.
- d. Schematic drawings and a photograph with a resolution suitable for identification of key characteristics of the tyre cross-section.
- e. Material and process specifications.

6. FURNISHED DATA REQUIREMENTS. If furnishing one or more tyres manufactured under this ITSO to one entity (such as an operator or repair station), provide one copy of the data in paragraphs **5A.a, b, c, d, e, h, j, l, o, p and t** and **5B.c and d** of this ITSO for each tyre. Add any other data needed for the proper installation, certification, use, or for continued airworthiness of the aircraft tyres.

7. AVAILABILITY OF REFERENCE DOCUMENTS.

- a. CAR 21, Subpart O (www.dgca.nic.in).
- b. TRA yearbook publications from the Tyre and Rim Association Inc., 175 Montrose West Avenue, Suite 150, Copely, Ohio 44321. (<http://www.us-tra.org>).
- c. ETRTO standards manual from the European Tyre and Rim Technical Organisation, 32/2 Avenue Brugmann B-1060, Brussels, Belgium. (www.etrto.org).



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APPENDIX 1. DGCA STANDARD FOR AIRCRAFT TYRES

1. **PURPOSE**. Minimum performance standards for new and re-qualified radial and bias tyres (excluding tailwheel tyres) meeting the standards of ITSO-C62e.

2. **SCOPE**. Minimum performance standards apply to aircraft tyres having speed and load ratings based on the speeds and loads to which the tyres have been tested.

3. **DEFINITIONS**.

Bias tyre: A pneumatic tyre whose ply cords extend to the beads and are laid at alternate angles substantially less than 90° to the centerline of the tread.

Radial tyre: A pneumatic tyre whose ply cords extend to the beads and are laid substantially at 90° to the centerline of the tread. The carcass is stabilized by an essentially inextensible circumferential belt.

Load rating: Maximum permissible static load at a specific inflation pressure. Rated load combined with the rated inflation pressure should be used when selecting tyres for aircraft application and for testing to the performance requirements of this ITSO.

Rated inflation pressure: Specified unloaded inflation pressure which will result in the tyre deflecting to the specified static loaded radius when loaded to its rated load against a flat surface.

Static loaded radius (SLR): Perpendicular distance between the axle centerline and a flat surface for a tyre initially inflated to the unloaded rated inflation pressure and then loaded to its rated load.

Ply rating: An index of tyre strength from which a rated inflation pressure and its corresponding maximum load rating are determined for a specific tyre size.

Speed rating: Maximum ground speed at which the tyre has been tested in accordance with this ITSO.

Skid depth: Distance between the tread surface and the bottom of the deepest groove as measured in the mould.

4. **DESIGN AND CONSTRUCTION**

a. **General Standards**. Tyres selected for use on a specific aircraft must demonstrate suitability through appropriate laboratory simulations described in paragraphs **5.a** or **5.b** of this Appendix, as appropriate. Material suitability should be determined by:

(1) **Temperature:** It must be shown by tests or analysis that the physical properties of the tyre materials are not degraded by exposure to temperature extremes of -40°C (-40°F) and +71°C (+160°F) for a period of not less than 24 hours at each extreme.

(2) **Wheel rim heat:** It must be substantiated by the applicable tests or shown by analysis that the physical properties of the tyre materials have not been degraded by exposure of the tyre to a wheel-bead seat temperature of not lower than 149°C (300°F) for at least one hour, except that low-speed tyres or nose-wheel tyres may be tested or analyzed at the highest wheel-bead seat temperatures expected to be encountered during normal operations.

b. Speed Rating. Table 1 may be referenced for applicable dynamometer test speeds for corresponding maximum takeoff ground speeds. For takeoff speeds over 394 Kmph (245 mph), the Tyre must be tested to the maximum applicable load-speed-time requirements and identified with the proper speed rating.

TABLE 1. Applicable Dynamometer Test Speeds

Max Takeoff Speed at liftoff over: kmph(mph)	<i>But not over:</i> Kmph(mph)	Max takeoff Speed Of Aircraft Max Tyre kmph (mph):	Min Dynamometer Speed (Figures 1, 2 or 3) Min Tyre kmph (mph):
0	193 (120)	193 (120)	193 (120)
193 (120)	257 (160)	257 (160)	257 (160)
257 (160)	306 (190)	306 (190)	306 (190)
306 (190)	338 (210)	338 (210)	338 (210)
338 (210)	362 (225)	362 (225)	362 (225)
362(225)	378 (235)	378 (235)	378 (235)
378 (235)	394 (245)	394 (245)	394 (245)

c. Overpressure. The tyre must successfully withstand a hydrostatic pressure of at least four times its rated inflation pressure for 3 seconds without bursting.

d. Helicopter tyres. Aircraft tyres qualified according to this ITSO may be used on helicopters also. In such cases for standard tyres, the maximum static load rating may be increased by a factor of 1.5 with a corresponding increase in rated inflation pressure without additional qualification testing (round loads to the nearest 4.5 kg (10 lbs) and inflation pressures rounded to one decimal point of kg/cm² (whole psi)). If significant taxi distance is expected, these guidelines may not apply. Care should be taken for appropriate tyre size selection. Maximum permissible inflation for aircraft tyres used on helicopters is 1.8 times the rated inflation pressure.

e. Dimensions. Maintain the tyre size (outside diameter, shoulder diameter, section and shoulder width), within specified tolerances.

(1) Outside diameter, shoulder diameter, section width and shoulder width: For the bias ply tyre, outside diameter and section width are specified to a maximum and minimum value after a 12 hour growth period at rated inflation pressure. Shoulder diameter and width dimensions are specified to a maximum value after a 12-hour growth period at rated inflation pressure. Radial tyre dimensions are limited by the grown tyre envelope according to the static loaded radius (SLR) requirements in paragraph 4.e.(3) below.

(2) Due to the increased inflation pressures permitted when using an aircraft tyre in a helicopter application, we permit tyre dimensions to be 4% larger.

(3) Static loaded radius (SLR):

(a) Bias tyres: provide the nominal SLR. The actual SLR is determined on a new tyre stretched for a minimum of 12 hours at rated inflation pressure.

(b) Radial tyres: provide the nominal SLR. The actual SLR of a radial tyre is determined at rated inflation pressure after running 50 takeoffs, following paragraph 5.a.(2) requirements.

(4) Helicopter tyres: maximum dimensions for new tyres used on helicopters are 4% larger than maximum aircraft tyre dimensions. (In calculating maximum overall and shoulder diameters, rim diameter should be deducted before applying 4%.)

f. Inflation retention: After an initial 12-hour minimum stabilization period at rated inflation pressure, the tyre must retain the inflation pressure with a loss of pressure not exceeding 5% of the initial pressure for 24 hours. Measure the ambient temperature at the start and finish of the test to ensure that any pressure change was not caused by an ambient temperature change.

g. Balance: Test all tyres for static unbalance. A balance marker, consisting of a red dot, must be affixed on the sidewall of the tyre immediately above the bead to indicate the lightweight point of the tyre. The dot must remain for any period of storage plus the original tread life of the tyre.

(1) Auxiliary tyres (not main or tailwheel tyres): the moment of static unbalance (M) for auxiliary tyres shall not be greater than the value determined using this equation:

$$M = 0.002736D^2 \quad [M^*=0.025D^{#2}]$$

Round the computed equation values to the next lower whole number where M is in N-cm (inch-ounces*) and D is the standardized maximum new tyre inflated outside diameter in cm (inches[#]). The design must include requirements to measure the level of unbalance on each tyre, and approved procedures to correct the unbalance within the above limits if necessary.

(2) All main tyres and all tyres with 117 cm (46 inches) and larger outside diameter: the moment of static unbalance (M) for main tyres shall not be greater than the value determined using this equation:

$$M = 0.003831D^2 \quad [M^{**}=0.035D^{##2}]$$

Round the computed equation values to the next lower whole number where M is in N-cm (inch-ounces**) and D is the standardized maximum new tyre inflated outside diameter in cm (inches^{##}). The design must include requirements to measure the level of unbalance on each tyre, and approved procedures to correct the unbalance within the above limits if necessary.

5. TYRE TEST REQUIREMENTS.

a. Use a single test specimen for a qualification test. The tyre must withstand the following dynamometer cycles without detectable signs of deterioration, other than normal expected tread surface abrasion, except when the overload takeoff condition is run last (see paragraph 5.a.(8) below).

(1) Dynamometer cycle requirements: all aircraft tyres must satisfactorily withstand 58 dynamometer cycles as a demonstration of overall performance, plus 3 overload dynamometer cycles as a demonstration of the casing's capability under overload. The 58

dynamometer cycles consists of 50 takeoff cycles, per **5.a.(2)**, and 8 taxi cycles, per **5.a.(7)**. The overload cycles consist of 2 taxi cycles, per **5.a.(7)** at 1.2 times rated load and 1 overload takeoff cycle per **5.a.(8)** starting at 1.5 times rated load. Run the dynamometer cycles in any order. However, if the overload takeoff cycle is not run last, the tyre must not show detectable signs of deterioration after the cycle completion, other than normal expected tread surface abrasion.

(2) Takeoff cycles: The 50 takeoff cycles shall realistically simulate tyre performance during runway operations for the most critical combination of takeoff weight and speed, and aircraft center-of-gravity position. When determining the most critical combination of the above, be sure to account for increased speeds resulting from high field elevation operations and high ambient temperatures, if applicable. Specify the appropriate load-speed-time data or parameters that correspond to the test envelope in which the tyre is to be tested. Figures 1, 2, and 3 are graphic representations of the test. Starting at zero speed, load the tyre against the dynamometer flywheel. The test cycles must simulate one of the curves illustrated in Figure 1 or 2 (as applicable to speed rating), or Figure 3.

- Figure 1 defines a test cycle that applies to any aircraft Tyre with a speed rating of 193kmph (120 mph) or 257 kmph (160 mph).

- Figure 2 defines a test cycle that applies to any aircraft Tyre with a speed rating greater than 257 kmph (160 mph).

- Figure 3 defines a test cycle that applies for any speed rating, is based on the most critical takeoff loads, speeds, and distances, and is aircraft specific.

(3) Test load: the minimum allowable load at the start of the test is the rated load of the tyre. The test loads must conform to Figures 1 or 2 (as applicable), or Figure 3. Figures 1 and 2 define a test cycle generally applicable to any aircraft. If you use Figure 3 to define the test cycle, select the loads based on the most critical takeoff conditions you established. At any speed throughout the test cycle, the ratio of the test load to the operational load must be the same as, or greater than, the ratio at the start of the test.

(4) Test inflation pressure: the pressure needed to provide the same loaded radius on the flywheel as was obtained on a flat surface at the rated tyre load and inflation pressure. Make both determinations at the same ambient temperature. Do not adjust the test inflation pressure to compensate for changes created by temperature variations during the test.

(5) Test temperatures and cycle interval: the temperature of the gas in the tyre or the casing temperature measured at the hottest point of the tyre may not be:

- (a)** Lower than 40.5°C (105°F) at the start of the overload takeoff cycle and at the start of at least 45 of the 50 takeoff cycles, and

- (b)** Lower than 48.9°C (120°F) at the start of at least 9 of the 10 taxi cycles.

For the remaining cycles, the contained gas or casing temperature may not be lower than 26.7°C (80°F) at the start of each cycle. Rolling the Tyre on the dynamometer flywheel is an acceptable method for obtaining the minimum starting temperature.

(6) Dynamometer takeoff cycle speeds: see Table 1 for the dynamometer test speeds for the corresponding maximum aircraft takeoff speeds.

(7) Taxi cycles: Tyre must withstand 10 taxi cycles on a dynamometer under the test conditions in Table 2 below.

TABLE 2. Test Conditions

Number of Taxi Runs	Min Tyre Load (kg)	Min Speed Kmph (mph)	Tyre speed rating 193/257 Kmph (120/160 mph) Min Rolling Distance in metre (feet)	Tyre speed rating Over 257 Kmph (160 mph) Min Rolling Distance in metre (feet)
8	Rated	64 (40)	7620 (25,000)	10668 (35,000 feet)
2	1.2 x Rated	64 (40)	7620 (25,000)	10668 (35,000 feet)

(8) Overload takeoff cycle: the overload takeoff cycle shall duplicate the test described in paragraph 5.a.(2) with the test load increased by a factor of 1.5 throughout. Good condition of the Tyre tread is not required after completion of this test cycle, if you run this test last. If the overload takeoff cycle is not run last, the tyre must withstand the cycle without detectable signs of deterioration, other than normal expected tread surface abrasion.

(9) Diffusion test: after completing the 61 test cycles, the tyre must retain the inflation pressure to within 10% of the initial test pressure for a period of 24 hours. Measure the ambient temperature at the start and finish of this test to ensure that any pressure change was not caused by an ambient temperature change.

(10) Tyre/wheel slippage: Tyres should not slip on the wheel rim during the first five dynamometer cycles. Any slippage that subsequently occurs must not damage the tube valve of tube type tyres, or the gas seal of the tyre bead of tubeless tyres.

b. Alternate qualification procedures: 193 Kmph (120 mph) rated tyres. For 193 Kmph (120 mph) speed rating tyres, the following variable mass flywheel procedure may be used:

(1) Test load: load must meet or exceed the Tyre rated load throughout the entire test roll distance.

(2) Test inflation pressure: pressure needed to provide the same loaded radius on the flywheel as was obtained on a flat surface at the rated tyre load and inflation pressure. Make both determinations at the same ambient temperature. Do not adjust the test inflation pressure to compensate for changes created by temperature variations during the test.

(3) Temperature and cycle interval: the temperature of the gas in the tyre, or the casing temperature measured at the hottest point of the tyre, may not be lower than 40.5°C (105°F) at the start of at least 180 of the 200 landing cycles. For the remaining cycles, the contained gas or casing temperature may not be lower than 26.7°C (80°F) at the start of each cycle. Rolling the tyre on the dynamometer is an acceptable method for obtaining the minimum starting temperature.

(4) Kinetic energy: calculate the kinetic energy of the flywheel to be absorbed by the Tyre using this equation:

$$KE = CW(V)^2 = \text{Kinetic energy in N-m (feet-lbs)}$$

where

$C = 0.01304 (0.0113)$

$W =$ Load rating of the Tyre in Kg (lbs)

$V = 193$ Kmph (120 Mph)

(5) Dynamometer cycle requirements: Tyre must satisfactorily withstand 200 landing cycles on a variable mass dynamometer flywheel. If you cannot use the exact number of flywheel plates to obtain the calculated kinetic energy value, select a greater number of plates and adjust the dynamometer speed to obtain the required kinetic energy. Divide the total number of dynamometer landings into two equal parts having the speed ranges provided in paragraphs **5.b.(5)(a)** and **5.b.(5)(b)**.

(a) Low speed landings: in the first series of 100 landings, the maximum landing speed is 145 Kmph (90 mph) and the minimum unlanding speed is 0 Kmph (Mph). Adjust the landing speed so the tyre will absorb 56% of the kinetic energy calculated using the equation in paragraph **5.b.(4)** above. If the adjusted landing speed is calculated to be less than 129 Kmph (80 mph), then determine the landing speed by adding 28% of the calculated kinetic energy (see paragraph **5.b.(4)** above) to the flywheel kinetic energy at 103 Kmph (64 mph), and determine the unlanding speed by subtracting 28% of the calculated kinetic energy from the flywheel kinetic energy at 103 Kmph (64 mph).

(b) High speed landings: in the second series of 100 landings, the minimum landing speed is 193 Kmph (120 mph) and the nominal unlanding speed is 145 Kmph (90 mph). Adjust the unlanding speed as needed to ensure that the tyre will absorb 44% of the calculated kinetic energy (see paragraph **5.b.(4)** above).

6. REQUALIFICATION TESTS.

a. Re-qualify altered tyres, with changes in materials, design and/or manufacturing processes that could adversely affect the performance and reliability, to the dynamometer tests described under paragraph **5**. Some examples include (1) or (2) below, or both:

(1) Changes in casing construction, such as the number of plies and/or bead bundles, ply cord makeup (material, denier, number of strands) and configuration (radial and bias).

(2) Changes in tread construction, such as number or composition of tread reinforcing and/or protector plies, tread compound formulations, number and location of tread grooves, and an increase in skid depth.

b. Re-qualification by similarity (based on load rating). Re-qualifying a given load rated tyre due to a change in material or tread design, automatically qualifies the same changes in a lesser load tyre of the same size, speed rating, and skid depth, if:

(1) The lesser load rated tyre was qualified to the applicable requirements specified in this ITSO, and

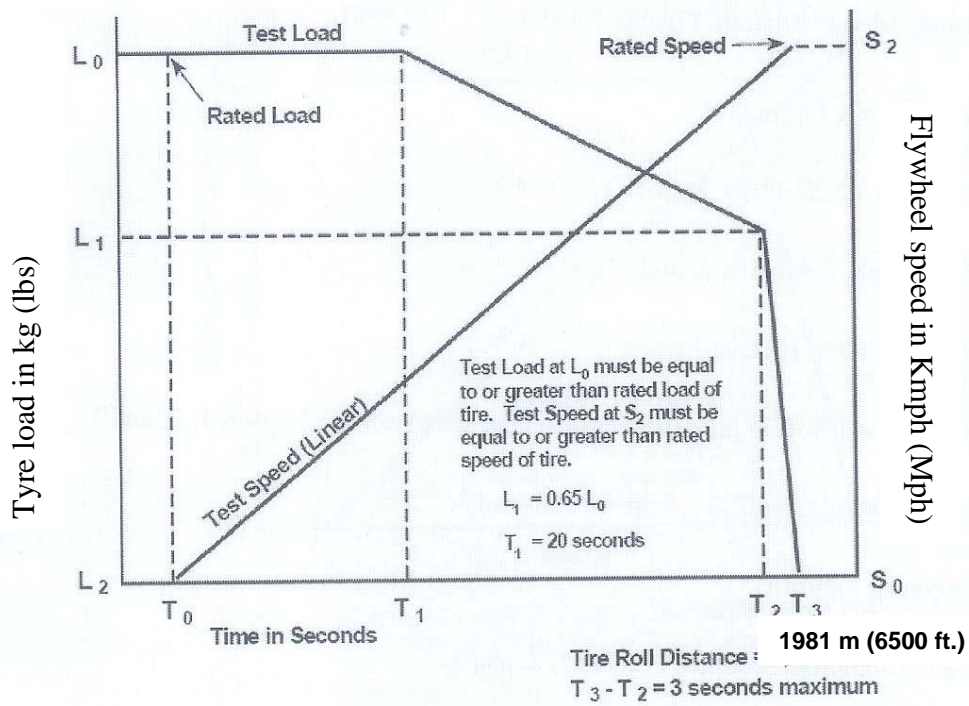
(2) The ratio of qualification test load to rated load for the lesser load rated tyre does not exceed the same ratio to the higher load rated tyre at any given test condition.

c. Re-qualification by similarity (blanket change). Re-qualification of any change that affects all sizes by similarity can be gained, if:

(1) Five representative sizes, including tyres of the highest load rating, speed rating and angular velocity, were qualified to the minimum performance standard with the change, and

(2) Data supporting the change in the listed sizes is submitted to this office.

Figure 1
Graphical Representation of a Typical Universal Load-Speed-Time Test Cycle
(For 193 Km/h (120 Mph) and 257 Km/h (160 Mph) Tyres)



Symbol Definitions (Figures 1, 2, and 3):

L_0 Tyre load in kg (lbs) at start of takeoff (not less than the load rating), Figures 1, 2, and 3.

L_0^1 Tyre load in kg (lbs) at start of takeoff for the operational load curve, Figure 3.

L_1 Tyre load in kg (lbs) at rotation, Figures 1 and 3.

L_1^1 Tyre load in kg (lbs), Figure 3.

L_2 Tyre load at lift off, 0 kg (lbs), Figures 1, 2, and 3.

S_0 Zero (0) Kmph (mph), Figures 1, 2, and 3.

S_1 Speed at rotation in Kmph (mph), Figure 3.

S_2 Tyre speed at liftoff in Kmph (mph) (not less than the speed rating), Figures 1, 2, and 3.

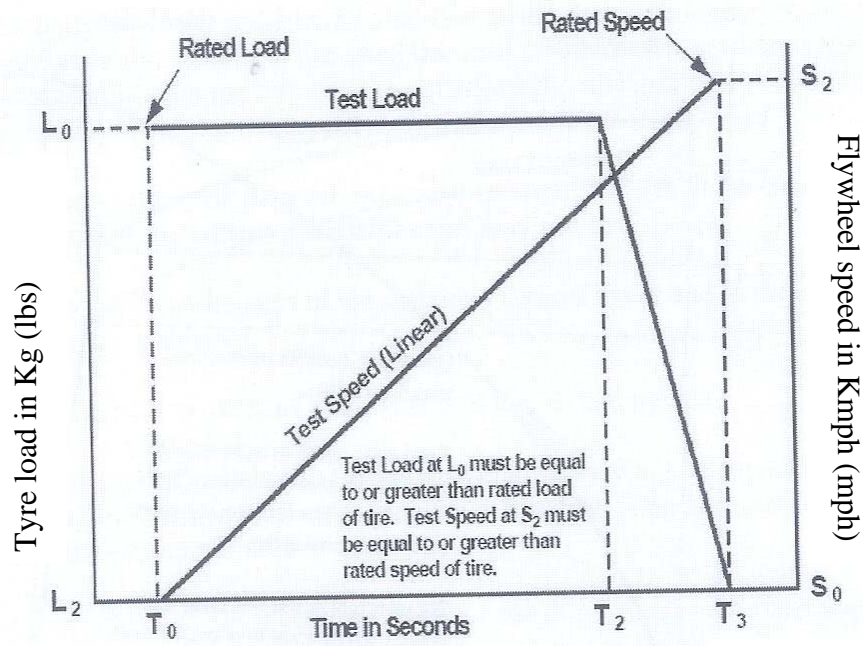
T_0 Time at start of takeoff, 0 s, Figures 1, 2, and 3.

T_1 20 seconds, Figure 1.

T_2 Time to rotation in seconds, Figures 1, 2, and 3.

T_3 Time to liftoff in seconds, Figures 1, 2, and 3.

Figure 2
Graphical Representation of a Typical Universal Load-Speed-Time Test Cycle
(For Tyres rated above 257 Km/h (160 Mph))



Tire Roll Distance = **3505m(11500 ft)**
 $T_3 - T_2 = 3$ seconds maximum

Figure 3
Graphical Representation of a Typical Rational Load-Speed-Time Test Cycle

