Federal Aviation Administration, DOT  
Pt. 23, App. D

[C23.1 Basic landing conditions]

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tail wheel type</th>
<th>Nose wheel type</th>
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<tr>
<td></td>
<td>Level landing</td>
<td>Level landing</td>
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<td></td>
<td>Tail-down land-</td>
<td>with inclined</td>
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<td>reactions</td>
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<td></td>
<td>Level landing</td>
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<td></td>
<td>with nose wheel</td>
<td>just clear of</td>
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<td></td>
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<td>ground</td>
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<td>Tail-down land-</td>
<td>Tail-down land-</td>
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</table>

Tail (nose) wheel loads \((V_f)\) ............. 0 ................... \((n-L)\) \(W\) \(a/d\) ........ \((n-L)\) \(W\) \(b/d\) ........ (1) .......... (1) .......... 0 ................... 0. 0 ................... 0. 0. 0. 0. 0. 0. 0. (1), (3), and (4).

Tail (nose) wheel loads \((2n)\) ............. 0 ................... 0 ................... \((n-L)\) \(W\) \(b/d\) ........ \((n-L)\) \(W\) \(b/d\) ........ (1) .......... (1) .......... 0 ................... (4) .......... (1), (3), and (4) (4) .......... (1), (3), and (4).

**Notes**
- (1), (3), and (4).
- (4) .......... (1) .......... (1), (3), and (4) (4) .......... (1), (3), and (4) (4) .......... (1) .

**NOTE (1).** \(K\) may be determined as follows: \(K=0.25\) for \(W=3,000\) pounds or less; \(K=0.33\) for \(W=6,000\) pounds or greater, with linear variation of \(K\) between these weights.

**NOTE (2).** For the purpose of design, the maximum load factor is assumed to occur throughout the shock absorber stroke from 25 percent deflection to 100 percent deflection unless otherwise shown and the load factor must be used with whatever shock absorber extension is most critical for each element of the landing gear.

**NOTE (3).** Unbalanced moments must be balanced by a rational or conservative method.

**NOTE (4).** \(L\) is defined in §23.725(b).

**NOTE (5).** \(n\) is the limit inertia load factor, at the c.g. of the airplane, selected under §23.473 (d), (f), and (g).

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**APPENDIX D TO PART 23—WHEEL SPIN-UP AND SPRING-BACK LOADS**

D23.1 Wheel spin-up loads.

(a) The following method for determining wheel spin-up loads for landing conditions is based on NACA T.N. 863. However, the drag component used for design may not be less than the drag load prescribed in §23.479(b).

\[
F_{\text{max}} = \frac{1}{2} r_e \sqrt{2 I_w (V_f - V_c)} n F_{\text{max}}/s
\]

where—

- \(F_{\text{max}}\) = maximum rearward horizontal force acting on the wheel (in pounds);
- \(r_e\) = effective rolling radius of wheel under impact based on recommended operating tire pressure (which may be assumed to be equal to the rolling radius under a static load of \(n_j W_e\) in feet;

[D23.481(a)(2) TAIL DOWN LANDING]
(b) The equation assumes a linear variation of load factor with time until the peak load is reached and under this assumption, the equation determines the drag force at the time that the wheel peripheral velocity at radius \( r \) equals the airplane velocity. Most shock absorbers do not exactly follow a linear variation of load factor with time. Therefore, rational or conservative allowances must be made to compensate for these variations. On most landing gears, the time for wheel spin-up will be less than the time required to develop maximum vertical load factor for the specified rate of descent and forward velocity. For exceptionally large wheels, a wheel peripheral velocity equal to the ground speed may not have been attained at the time of maximum vertical gear load. However, as stated above, the drag spin-up load need not exceed 0.8 of the maximum vertical loads.

(c) Dynamic spring-back of the landing gear and adjacent structure at the instant just after the wheels come up to speed may result in dynamic forward acting loads of considerable magnitude. This effect must be determined, in the level landing condition, by assuming that the wheel spin-up loads calculated by the methods of this appendix are reversed. Dynamic spring-back is likely to become critical for landing gear units having wheels of large mass or high landing speeds.

[Doc. No. 4080, 29 FR 17965, Dec. 18, 1964, as amended by Ammdt. 23–45, 58 FR 42167, Aug. 6, 1993]