unbalanced yawing moments assumed to be resisted by airplane inertia forces.

(d) For other than the nose gear, its attaching structure, and the forward fuselage structure, the loading conditions are those prescribed in paragraph (b) of this section, except that—

(1) A lower drag reaction may be used if an effective drag force of 0.8 times the vertical reaction cannot be reached under any likely loading condition; and

(2) The forward acting load at the center of gravity need not exceed the maximum drag reaction on one main gear, determined in accordance with § 25.493(b).

(e) With the airplane at design ramp weight, and the nose gear in any steerable position, the combined application of full normal steering torque and vertical force equal to 1.33 times the maximum static reaction on the nose gear must be considered in designing the nose gear, its attaching structure, and the forward fuselage structure.

§ 25.507 Reversed braking.

(a) The airplane must be in a three point static ground attitude. Horizontal reactions parallel to the ground and directed forward must be applied at the ground contact point of each wheel with brakes. The limit loads must be equal to 0.55 times the vertical load at each wheel or to the load developed by 1.2 times the nominal maximum static brake torque, whichever is less.

(b) For airplanes with nose wheels, the pitching moment must be balanced by rotational inertia.

(c) For airplanes with tail wheels, the resultant of the ground reactions must pass through the center of gravity of the airplane.

§ 25.509 Towing loads.

(a) The towing loads specified in paragraph (d) of this section must be considered separately. These loads must be applied at the towing fittings and must act parallel to the ground. In addition—

(1) A vertical load factor equal to 1.0 must be considered acting at the center of gravity;

(2) The shock struts and tires must be in their static positions; and

(3) With \( W_T \) as the design ramp weight, the towing load, \( F_{TOW} \), is—

(i) 0.3 \( W_T \) for \( W_T \) less than 30,000 pounds;

(ii) \( (6W_T + 450,000)/70 \) for \( W_T \) between 30,000 and 100,000 pounds; and

(iii) 0.15 \( W_T \) for \( W_T \) over 100,000 pounds.

(b) For towing points not on the landing gear but near the plane of symmetry of the airplane, the drag and side tow load components specified for the auxiliary gear apply. For towing points located outboard of the main gear, the drag and side tow load components specified for the main gear apply. Where the specified angle of swivel cannot be reached, the maximum obtainable angle must be used.

(c) The towing loads specified in paragraph (d) of this section must be reacted as follows:

(1) The side component of the towing load at the main gear must be reacted by a side force at the static ground line of the wheel to which the load is applied.

(2) The towing loads at the auxiliary gear and the drag components of the towing loads at the main gear must be reacted as follows:

(i) A reaction with a maximum value equal to the vertical reaction must be applied at the axle of the wheel to which the load is applied. Enough airplane inertia to achieve equilibrium must be applied.

(ii) The loads must be reacted by airplane inertia.

(d) The prescribed towing loads are as follows:
§ 25.511 Ground load: unsymmetrical loads on multiple-wheel units.

(a) General. Multiple-wheel landing gear units are assumed to be subjected to the limit ground loads prescribed in this subpart under paragraphs (b) through (f) of this section. In addition—

1. A tandem strut gear arrangement is a multiple-wheel unit; and

2. In determining the total load on a gear unit with respect to the provisions of paragraphs (b) through (f) of this section, the transverse shift in the load centroid, due to unsymmetrical load distribution on the wheels, may be neglected.

(b) Distribution of limit loads to wheels; tires inflated. The distribution of the limit loads among the wheels of the landing gear must be established for each landing, taxiing, and ground handling condition, taking into account the effects of the following factors:

1. The number of wheels and their physical arrangements. For truck type landing gear units, the effects of any seesaw motion of the truck during the landing impact must be considered in determining the maximum design loads for the fore and aft wheel pairs.

2. Any differentials in tire diameters resulting from a combination of manufacturing tolerances, tire growth, and tire wear. A maximum tire-diameter differential equal to \( \frac{3}{4} \) of the most unfavorable combination of diameter variations that is obtained when taking into account manufacturing tolerances, tire growth, and tire wear, may be assumed.

3. Any unequal tire inflation pressure, assuming the maximum variation to be 6 percent of the nominal tire inflation pressure.

4. A runway crown of zero and a runway crown having a convex upward shape that may be approximated by a slope of 1½ percent with the horizontal. Runway crown effects must be considered with the nose gear unit on either slope of the crown.

5. The airplane attitude.

6. Any structural deflections.

(c) Deflated tires. The effect of deflated tires on the structure must be considered with respect to the loading conditions specified in paragraphs (d) through (f) of this section, taking into account the physical arrangement of the gear components. In addition—

1. The deflation of any one tire for each multiple wheel landing gear unit, and the deflation of any two critical tires for each landing gear unit using four or more wheels per unit, must be considered; and

2. The ground reactions must be applied to the wheels with inflated tires except that, for multiple-wheel gear units with more than one shock strut, a rational distribution of the ground reactions between the deflated and inflated tires, accounting for the differences in shock strut extensions resulting from a deflated tire, may be used.

(d) Landing conditions. For one and for two deflated tires, the applied load to each gear unit is assumed to be 60 percent and 50 percent, respectively, of the limit load applied to each gear for

<table>
<thead>
<tr>
<th>Tow point</th>
<th>Position</th>
<th>Load Magnitude</th>
<th>No.</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main gear</td>
<td></td>
<td>0.75 ( F_{GOW} ) per main gear unit.</td>
<td>1</td>
<td>Forward, parallel to drag axis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Forward, at 30° to drag axis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Aft, parallel to drag axis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Aft, at 30° to drag axis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Forward.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Aft.</td>
</tr>
<tr>
<td>Auxiliary gear</td>
<td>Swiveled forward</td>
<td>1.0 ( F_{GOW} )</td>
<td>7</td>
<td>Forward.</td>
</tr>
<tr>
<td></td>
<td>Swiveled aft</td>
<td></td>
<td>8</td>
<td>Aft.</td>
</tr>
<tr>
<td></td>
<td>Swiveled 45° from forward</td>
<td>0.5 ( F_{GOW} )</td>
<td>9</td>
<td>Forward, in plane of wheel.</td>
</tr>
<tr>
<td></td>
<td>Swiveled 45° from aft</td>
<td></td>
<td>10</td>
<td>Aft, in plane of wheel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Forward, in plane of wheel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>Aft, in plane of wheel.</td>
</tr>
</tbody>
</table>