Table 5.21a—Uplift Loads (SI)

Uplift Load Case	Net Uplift Formula, U (N)	Allowable Anchor Bolt or Anchor Strap Stress (MPa)	Allowable Shell Stress at Anchor Attachment (MPa)	
Design Pressure	$[P_i \times D^2 \times 785] - W_1$	$^5/_{12} \times F_y$	$^2/_3\ F_{ty}$	15
Test Pressure	$[P_t \times D^2 \times 785] - W_3$	$^5/_9 \times F_y$	$^5/_6\ F_{ty}$	15
Wind Load	$P_{WR} \times D^2 \times 785 + [4 \times M_{WS}/D] - W_2$	$0.8 \times F_y$	$^5/_6\ F_{ty}$	15
Seismic Load	$[4 \times M_{rw}/D] - W_2\ (1 - 0.4A_V)$	$0.8 \times F_y$	$^5/_6\ F_{ty}$	15
Design Pressure[a] + Wind	$[F_p\ (P_i + P_{WR}) \times D^2 \times 785] + [4\ M_{WS}/D] - W_1$	$^5/_9 \times F_y$	$^5/_6\ F_{ty}$	15
Design Pressure[a] + Seismic	$[F_p\ P_i \times D^2 \times 785] + [4\ M_{rw}/D] - W_1\ (1 - 0.4A_V)$	$0.8 \times F_y$	$^5/_6\ F_{ty}$	15
Frangibility Pressure[b]	$[3 \times P_f \times D^2 \times 785] - W_3$	F_y	F_{ty}	

where

A_v is the vertical earthquake acceleration coefficient, in % g;

D is the tank diameter, in meters;

F_p is the pressure combination factor;

F_{ty} is the minimum yield strength of the bottom shell course, in MPa;

F_y is the minimum yield strength of the anchor bolt or strap; bolts are limited to specified material minimum yield strength or 380 MPa, whichever is less, in MPa; anchor strap material minimum yield strength shall not exceed the minimum yield strength of the shell; 14

H is the tank height, in meters;

M_{WS} equals $P_{WS} \times D \times H^2/2$, in N-m; 15

M_{rw} is the seismic moment, in N-m (see Annex E); 14

P_i is the design internal pressure, in kPa (see Annex F); 15

P_f is the failure pressure, in kPa (see Annex F); 14

P_t is the test pressure, in kPa (see Annex F);

P_{WR} is the wind uplift pressure on roof, in kPa;

P_{WS} is the wind pressure on shell, in N/m^2;

W_1 is the corroded weight of the roof plates plus the corroded weight of the shell and any other corroded permanent attachments acting on the shell, in N;

W_2 is the corroded weight of the shell and any corroded permanent attachments acting on the shell including the portion of the roof plates and framing acting on the shell, in N; 15

W_3 is the nominal weight of the roof plates plus the nominal weight of the shell and any other permanent attachments acting on the shell, in N.

[a] Refer to 5.2.2 concerning the pressure combination factor applied to the design pressure.

[b] Frangibility pressure applies only to tanks designed to 5.10.2.6 d.

Table 5.21b—Uplift Loads (USC)

Uplift Load Case	Net Uplift Formula, U (lbf)	Allowable Anchor Bolt or Anchor Strap Stress (lbf/in.^{2})	Allowable Shell Stress at Anchor Attachment (lbf/in.^{2})
Design Pressure	$[P_i \times D^2 \times 4.08] - W_1$	$^5/_{12} \times F_y$	$^2/_3\ F_{ty}$
Test Pressure	$[P_t \times D^2 \times 4.08] - W_3$	$^5/_9 \times F_y$	$^5/_6\ F_{ty}$
Wind Load	$P_{WR} \times D^2 \times 4.08 + [4 \times M_{WS}/D] - W_2$	$0.8 \times F_y$	$^5/_6\ F_{ty}$
Seismic Load	$[4 \times M_{rw}/D] - W_2\ (1 - 0.4A_V)$	$0.8 \times F_y$	$^5/_6\ F_{ty}$
Design Pressure[a] + Wind	$[(F_p\ (P_i + P_{WR}) \times D^2 \times 4.08] + [4\ M_{WS}/D] - W_1$	$^5/_9 \times F_y$	$^5/_6\ F_{ty}$
Design Pressure[a] + Seismic	$[F_p\ P_i \times D^2 \times 4.08] + [4\ M_{rw}/D] - W_1\ (1 - 0.4A_V)$	$0.8 \times F_y$	$^5/_6\ F_{ty}$
Frangibility Pressure[b]	$[3 \times P_f \times D^2 \times 4.08] - W_3$	F_y	F_{ty}

where

A_v is the vertical earthquake acceleration coefficient, in % g;

D is the tank diameter, in feet;

F_p is the pressure combination factor;

F_{ty} is the minimum yield strength of the bottom shell course, in psi;

F_y is the minimum yield strength of the anchor bolt or strap; bolts are limited to specified material minimum yield strength or 55,000 psi, whichever is less, in psi; anchor strap material minimum yield strength shall not exceed the minimum yield strength of the shell;

H is the tank height, in feet;

M_{WS} equals $P_{WS} \times D \times H^2/2$, in ft-lbs;

M_{rw} is the seismic moment, in ft-lbs (see Annex E);

P_i is the design internal pressure, in inches of water column (see Annex F);

P_f is the failure pressure, in inches of water column (see Annex F);

P_t is the test pressure, in inches of water column (see Annex F);

P_{WR} is the wind uplift pressure on roof, in inches of water column;

P_{WS} is the wind pressure on shell, in lbs/ft^2;

W_1 is the corroded weight of the roof plates plus the corroded weight of the shell and any other corroded permanent attachments acting on the shell, in lbf;

W_2 is the corroded weight of the shell and any corroded permanent attachments acting on the shell including the portion of the roof plates and framing acting on the shell, in lbf;

W_3 is the nominal weight of the roof plates plus the nominal weight of the shell and any other permanent attachments acting on the shell, in lbf.

[a] Refer to 5.2.2 concerning the pressure combination factor applied to the design pressure.

[b] Frangibility pressure applies only to tanks designed to 5.10.2.6 d.