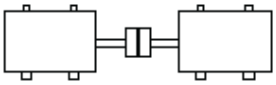
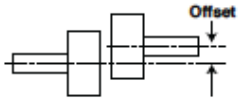
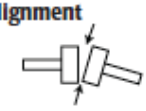
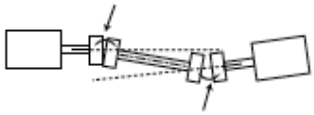
alignment and mechanical placement will reduce vibration, maximize bearing life, and increase the overall life of the motor and driven machine. To prevent frame distortion, increased vibration and reduced bearing life, correct for "soft foot" when mounting the motor.

■ **Suggested Alignment Tolerances.** Use dial indicators or laser systems to check the alignment of directly-coupled shafts. The following suggested alignment tolerances are the desired values, whether such values are zero or a targeted offset. Use them only if machinery manufacturer alignment tolerances are not available.

Table 5. Suggested Alignment Tolerances For Directly-Coupled Shafts

	RPM	Installation	In Service
Soft Foot (mils)*	All	±1.0	±1.5
Short Couplings			
Parallel Offset (mils) 	**RPM**	**Installation**	**In Service**
	1200	±1.25	±2.0
	1800	±1.0	±1.5
	3600	±0.5	±0.75
Angular Misalignment (mils/inch)** 	1200	0.5	0.8
	1800	0.3	0.5
	3600	0.2	0.3
Couplings With Spacers			
	RPM	**Installation**	**In Service**
Parallel Offset Per Inch of Spacer Length (mils/inch)	1200	0.9	1.5
	1800	0.6	1.0
	3600	0.3	0.5

* "Soft foot" describes the condition where the mounting feet are not all in the same plane. Measured in mils (1 mil. = .001 inches).

** To find the angular misalignment in mils/inch of coupling diameter, measure the widest opening in mils, then subtract the narrowest opening in mils, and divide by the diameter of the coupling in inches. (Note: Up and down motion of driving and driven shafts with temperature may be in either direction.)

4. From Table 3, C = 58.
5. The minimum rest or "off time" between starts is therefore 58 seconds.

Table 4. Allowable Load Wk^2 (Squirrel-Cage Induction Motors)

HP	Synchronous Speed, RPM						
	3600	1800	1200	900	720	600	514
	Allowable Load Wk^2 (Exclusive of Motor Wk^2), LB-FT^2						
1	—	5.8	15	31	53	82	118
1.5	1.8	8.6	23	45	77	120	174
2	2.4	11	30	60	102	158	228
3	3.5	17	44	87	149	231	335
5	5.7	27	71	142	242	375	544
7.5	8.3	39	104	208	356	551	798
10	11	51	137	273	467	723	1048
15	16	75	200	400	685	1061	1538
20	21	99	262	525	898	1393	2018
25	26	122	324	647	1108	1719	2491
30	31	144	384	769	1316	2042	2959
40	40	189	503	1007	1725	2677	3881
50	49	232	620	1241	2127	3302	4788
60	58	275	735	1473	2524	3819	5680
75	71	338	904	1814	3111	4831	7010
100	92	441	1181	2372	4070	6320	9180
125	113	542	1452	2919	5010	7790	11310
150	133	640	1719	3456	5940	9230	—
200	172	831	2238	4508	7750	—	—
250	210	1017	2744	5540	—	—	—
300	246	1197	3239	—	—	—	—
350	281	1373	3723	—	—	—	—
400	315	1546	—	—	—	—	—
450	349	1714	—	—	—	—	—
500	381	1880	—	—	—	—	—

Reference: NEMA MG 1, Table 12-6.

The allowable Wk^2 is the moment of inertia of the load, referred to the motor shaft. The manufacturer of the driven machinery can usually provide the load Wk^2 value.

■ **Alternative Starting Methods.** Using a clutch to engage and disengage the drive allows the motor to continue running and eliminates the heat generated by a succession of starts. Starting devices such as solid-state or electromechanical reduced-voltage starters can reduce some stresses associated with motor starting. By doing so, they may help motors last longer. However, they generally don't increase the number of allowable starts per hour.

Adjustable-speed drives reduce mechanical stresses but usually increase the electrical and thermal stresses in motors. Harmonics generated by such drives are the primary cause of these stresses.