Guidelines for Use of DC Machine Specification Tables

1. To determine the equivalent circuit parameters for a dc machine with given horsepower and speed ratings, look first at last table identified as "Horsepower Rating and Frame Sizes". Find the frame size number associated with machine of interest based on the rated power and rated speed.

2. Refer to the first table under the heading "DC Machine Parameters and Performance Data" and find that section that is associated with the frame size number identified in the first step above. For the frame size number of interest, find the row corresponding to the machine speed rating. The values of the armature resistance at 25ºC (R_{am}), the unsaturated armature inductance (L_{am}), and the motor torque/motor constant (K) can be identified in this row.

3. Using the same frame size number in the middle table identified as "Nominal Performance Constants", the values of the field winding losses under full-field-excitation conditions (W_f) and the machine armature inertia (J_m) can be read. Note that the inertia value is given in pound-feet-second^2, making it necessary to convert the value to kg-m^2 for calculations in MKS units.

DC Machine Parameters and Performance Data

rpm Machine base speed in revolutions per minute = Machine speed at rated output power
R Machine armature resistance in ohms at 25^{o} (x 1.2 for hot value at 85 degC)
L Machine armature inductance in henrys (unsaturated)
K Machine torque constant in Newton-meters per Ampere @ Rated field flux
= Machine voltage constant, CEMF, in volts/radian/second @ Rated field flux

Frame	rpm	R	L	K
283	3500	0.153	0.0013	0.605
	2500	0.301	0.0023	0.85
	1750	0.615	0.0045	1.21
	1150	1.426	0.0104	1.84
	850	2.608	0.0192	2.5
	500	7.56	0.055	4.23
	300	19.5	0.153	7.07
284	3500	0.142	0.0011	0.59
	2500	0.279	0.0021	0.82
	1750	0.570	0.0043	1.17
	1150	1.36	0.0100	1.78
	850	2.42	0.0185	2.42
	500	6.71	0.0532	3.98
	300	19.34	0.147	6.85
286	3500	0.070	0.00070	0.655
	2500	0.137	0.00140	0.917
	1750	0.280	0.00281	1.31
	1150	0.657	0.00650	1.98
	850	1.19	0.0120	2.69
	500	3.32	0.0344	3.99
	300	9.5	0.095	7.60
288	3500	0.045	0.00073	0.610
	2500	0.089	0.00144	0.850
	1750	0.180	0.00293	1.22
	1150	0.415	0.00677	1.85
	850	0.762	0.0125	2.50
	500	2.21	0.0360	4.27
	300	6.1	1.00	7.10
365	3500	0.022	0.00055	0.63
	2500	0.041	0.0011	0.88
	1750	0.086	0.0022	1.26
	1150	0.199	0.0051	1.91
	850	0.368	0.0094	2.6
	500	1.06	0.027	4.42
	300	2.91	0.075	7.3

Frame	rpm	R	L	K
366	3500	0.0168	0.00026	0.64
	2500	0.0328	0.00050	0.896
	1750	0.067	0.0010	1.28
	1150	0.155	0.0024	1.95
	850	0.284	0.0044	2.56
	500	0.772	0.013	4.37
	300	2.27	0.035	7.25
367	2500	0.0203	0.00052	0.88
	1750	0.0415	0.0011	1.26
	1150	0.0963	0.0025	1.92
	850	0.176	0.0046	2.58
	500	0.478	0.013	4.3
	300	1.41	0.036	7.35
368	1750	0.0363	0.00085	1.26
	1150	0.0964	0.0020	1.92
	850	0.153	0.0036	2.60
	500	0.417	0.011	4.41
	300	1.24	0.29	7.33
503	1750	0.0144	0.0011	1.27
	1150	0.089	0.0025	1.95
	850	0.066	0.0045	2.77
	500	0.168	0.013	4.35
	300	0.500	0.036	7.4
504	1750	0.0100	0.00085	1.27
	1150	0.0237	0.0020	1.95
	850	0.0420	0.0036	2.6
	500	0.115	0.011	4.45
	300	0.342	0.029	7.4
505	1750	0.0099	0.00073	1.27
	1150	0.0206	0.0017	1.95
	850	0.0380	0.0031	2.6
	500	0.109	0.0090	4.45
	300	0.350	0.025	7.4
506	1150	0.0125	0.0012	1.95
	850	0.0230	0.0023	2.63
	500	0.0660	0.0065	4.47
	300	0.188	0.019	7.5

Nominal Performance Constants

T_{pu}	1.0 per unit torque in pound-feet (continuous torque only of DC 1150 rpm or above or blower-ventilated)
W_f	Power for full field in watts
J_m	Motor inertia in pound-feet second^2 Note: Multiply by 1.355 for value in kg-m^2
T_m	Motor inertia time constant in seconds (JR, /K_t, K_v)
Cfm	Forced air in cubic feet per minute
P	Static pressure drop in inches of water
1/T	Bandwidth in radians per second (w)

Frame	W_f	J_m	Ventilation	
			Cfm	P
283	150	0.050	150	1.00
284	160	0.065	150	1.00
286	180	0.087	150	1.00
288	200	0.115	150	1.00
365	210	0.218	350	1.25
366	220	0.292	350	1.25
367	230	0.340	350	1.25
368	242	0.412	350	1.25
503	325	1.34	800	1.9
504	410	1.43	800	1.9
505	430	1.63	800	1.9
506	500	2.08	800	1.9

Note: For an application requirement, the horsepower rating and frame size can be chosen from the table. Considerations are ventilation, enclosure, continuous rms torque (or horsepower) and peak torque. Ventilation and enclosure affect the continuous rms torque capacity of a given frame size.

The rms torque or the peak momentary overload torque may be the limiting requirement. Using the rated or 1.0 per unit torque (T_{pu}) for the frame size chosen for thermal rating, use the maximum momentary load curves of Figure A to identify the overload capability. peak torque = T x (per cent overload/100). If the peak torque capability is not sufficient, then a new frame size must be chosen based on peak torque.

The curves of Figure A are defined as follows:

1. Instantaneous loads are defined as 0.5 seconds duration or less repeated not oftener than once every minute.
2. Occasionally repeated loads are defined as 5 seconds duration or less repeated not oftener than once every 5 minutes.
3. Frequently repeated loads are defined as 1 minute duration or less repeated not oftener than once in a period 20 times the duration.
4. Curves apply regardless of whether speed is obtained by armature voltage or shunt field control.
5. Curves also apply for regenerating operations.

With the frame and base speed chosen, performance data can be taken from the table.

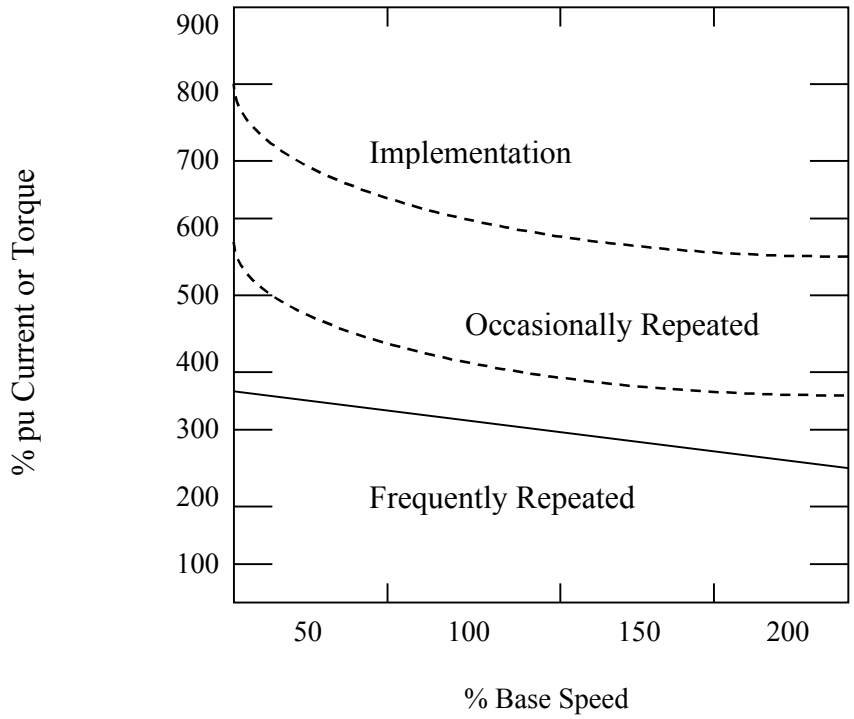

Figure A Maximum momentary loads

Horsepower Rating and Frame Sizes
Drip-proof 60°C Rise

	Frame Size Speed in rpm					
hp	3500	2500	1750	1150	850	500
1	-	-	-	-	-	283
2	-	-	-	-	283	284
3	-	-	-	283	284	286
5	-	-	283	284	286	288
7 1/2	-	283	284	286	288	366
10	-	283	284	286	288	367
15	283	284	286	365	366	368
20	284	286	288	366	367	503
25	286	288	365	366	368	504
30	286	288	366	367	368	505
40	288	366	366	368	503	506
50	-	366	367	503	504	-
60	-	367	368	503	505	-
75	-	-	503	504	505	-
100	-	-	503	505	-	-
125	-	-	504	506	-	-
150	-	-	505	-	-	-

From Electric Machinery, FK+U, 5th Ed.

appendix C

Table of Constants and Conversion Factors for SI Units

CONSTANTS

Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ H/m
Permittivity (capacitivity) of free space	$\epsilon_0 = 8.854 \times 10^{-12}$ F/m
Acceleration of gravity	$g = 9.807$ m/s^2

CONVERSION FACTORS

Length	1 m = 3.281 ft = 39.37 in
Mass	1 kg = 0.0685 slug = 2.205 lb (mass)
Force	1 N = 0.225 lb = 7.23 poundals
Torque	1 N · m = 0.738 lb · ft
Energy	1 J (W · s) = 0.738 ft · lb
Power	1 W = 1.341×10^{-3} hp
Moment of inertia	1 kg · m^2 = 0.738 slug · ft^2 = 23.7 lb · ft^2 = 0.738 lb·ft·s^2
Magnetic flux	1 Wb = 10^8 maxwells (lines)
Magnetic flux density	1 Wb/m^2 = 1 T = 10,000 gauss = 64.5 kilolines/in^2
Magnetizing force	1 A · turn/m = 0.0254 A · turn/in = 0.0126 oersted