WORLDWIDE ELECTRIC CORPORATION

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worldwideelectric.com

NEMA Electric Motor Quick Reference Guide

National Electrical Manufacturers Association.

This document may contain condensed information. For complete NEMA standards please refer to official documentation at nema.org.

NEMA Enclosure Classifications

Relevant IEC IP Ratings for WorldWide Electric Motor Controls.

		Indoor Use					Outdoor Use									
		1	2	2	12/12k	13	3	3S	3X	3SX	3R	3rX	4	4X	6	6P
Solids	Incidental Contact	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Falling Dirt	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Circulating Dust				✓	✓							✓	✓	✓	✓
	Setting Airborne Dust			✓	✓	✓							✓	✓	✓	✓
	Windblown Dust						✓	✓	✓	✓			✓	✓	✓	✓
Liquids	Light Splash		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Hose-down & Splash												✓	✓	✓	✓
	Temporary Submersion														✓	✓
	Prolonged Submersion															✓
	Rain, Snow & Sleet						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Ice Laden							✓		✓						
Chemicals	Oil & Coolant Seepage				✓	✓										
	Oil & Coolant Splash					✓										
	Corrosion								✓	✓		✓		✓		✓
Approx. IP Cross Reference		20	22	53	54		55				24		66		67	68

Note! NEMA Enclosure Types are tested over a wider set of environmental conditions, it is not possible to obtain an exact equivalent NEMA Type from an IP code.

IP Ratings

Relevant IEC IP Ratings for WorldWide Electric Motors

Protection Provided	
IP10	Protected against solid objects up to 50 mm, e.g. accidental touch by hands.
IP11	Protected against solid objects up to 50 mm, e.g. accidental touch by hands. Protection against vertically falling drops of water e.g. condensation.
IP14	Protected against solid objects up to 50 mm, e.g. accidental touch by hands. Protection against water sprayed from all directions, limited ingress permitted.
IP23	Protected against solid objects up to 12.55 mm, e.g. Fingers or smaller objects. Protection against water sprayed at an angle of 60°, limited ingress permitted.
IP43	Protected against solid objects up to 2.5 mm, e.g. Tools and thick wires. Protection against water sprayed at an angle of 60°, limited ingress permitted.
IP52	Protected against dust limited ingress (no harmful deposit). Protection against direct sprays of water up to 15o from the vertical.
IP54	Protected against dust limited ingress (no harmful deposit). Protection against water sprayed from all directions, limited ingress permitted.
IP55	Protected against dust limited ingress (no harmful deposit). Protected against water jet spray.
IP56	Protected against dust limited ingress (no harmful deposit). Protected against heavy water jet spray.
IP66	Protected against dust limited ingress (2 - 8 hours). Protected against heavy seas or heavy water jet spray.
IP69K	Protected against dust limited ingress (2 - 8 hours). Protected against high-pressure washdown at high temps. up to 176°F/80°C

NEMA Motor Efficiency

Efficiency equals the ratio of mechanical power output to the electric power input.

Nominal Efficiency	Minimum Efficiency Based on 20% Loss Difference	Nominal Efficiency	Minimum Efficiency Based on 20% Loss Difference	Nominal Efficiency	Minimum Efficiency Based on 20% Loss Difference
99.0	98.8	95.4	94.5	81.5	78.5
98.9	98.7	95.0	94.1	80.0	77.0
98.8	98.6	94.5	93.6	78.5	75.5
98.7	98.5	94.1	93.0	77.0	74.0
98.6	98.4	93.6	92.4	75.5	72.0
98.5	98.2	93.0	91.7	74.0	70.0
98.4	98.0	92.4	91.0	72.0	68.0
98.2	97.8	91.7	90.2	70.0	66.0
98.0	97.6	91.0	89.5	680	64.0
97.8	97.4	90.2	88.5	66.0	62.0
97.6	97.1	89.5	87.5	64.0	59.5
97.4	96.8	88.5	86.5	62.0	57.5
97.1	96.5	87.5	85.5	59.5	55.0
96.8	96.2	86.5	84.0	57.5	52.5
96.5	95.8	85.5	82.5	55.0	50.5
96.2	95.4	84.0	81.5	52.5	48.0
95.8	95.0	82.5	80.0		

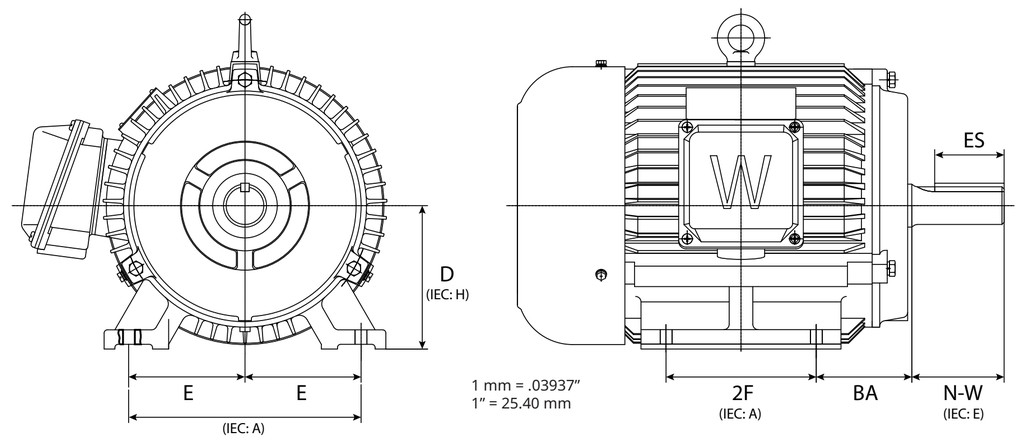
NEMA Frame Size vs hp

Standard NEMA Frame sizes vs horsepower.

HP	"T" FRAMES 1964					"U" FRAMES 1952				
	3600		1800	1200	900	3600		1800	1200	900
	ODP	TEFC	ODP/TEFC	ODP/TEFC	ODP/TEFC	ODP	TEFC	ODP/TEFC	ODP/TEFC	ODP/TEFC
1	-	-	143T	145T	182T	-	-	182	184	213
1.5	143T	143T	145T	182T	184T	182	182	184	184	213
2	145T	145T	145T	184T	213T	184	184	184	213	215
3	145T	182T	182T	213T	215T	184	1847	213	215	254U
5	182T	184T	184T	215T	254T	213	213	215	254U	256U
7.5	184T	213T	213T	254T	256T	215	215	254U	256U	284U
10	213T	215T	215T	256T	284T	254U	254U	256U	284U	286U
15	215T	254T	254T	284T	286T	256U	256U	284U	324U	326U
20	254T	256T	256T	286T	324T	284U	286U	286U	326U	364U
25	256T	284TS	284T	324T	326T	286U	324U	324U	364U	365U
30	284TS	286TS	286T	326T	364T	324S	326S	326U	365U	404U
40	286TS	324TS	324T	364T	365T	326S	364US	364U	404U	405U
50	324TS	326TS	326T	365T	404T	364US	364US	365US	405U	444U
60	326TS	364TS	364TS	404T	405T	365US	405US	404US	444U	445U
75	364TS	365TS	365TS	405T	444T	404US	444US	405US	445U	-
100	365TS	405TS	404TS	444T	445T	405US	445US	444US	-	-
125	404TS	444TS	405T	445T	-	444US	444US	445US	-	-
150	405TS	445TS	444TS	-	-	445US	445US	-	-	-
200	444TS	444TS	445TS	-	-	-	-	-	-	-
250	445TS	445TS	-	-	-	-	-	-	-	-

NEMA & IEC Motor Dimensions

Standardized motor dimensions established in 1984 that apply to all base-mounted motors that carry a NEMA frame designation. European IEC frame sizes are based on the shaft height (equivalent to NEMA "D" dimension) in millimeters.



NEMA Motor Enclosure Classifications

The enclosures of electrical motors are standardized by NEMA as follows:

Drip-Proof
- Ventilation openings in shield and/or frame prevents drops of liquid from falling into motor within up to 15 degree angle from vertical.
- Designed for reasonably dry, clean, and well ventilated (usually indoors) areas. Outdoors installation require the motor to be protected with a cover that does not restrict the flow of air to the motor.

Totally Enclosed Air Over (TEAO)
- Dust-tight fan and blower motors for shaft mounted fans or belt driven fans. The motors mounted within the airflow of the fan.

Totally Enclosed Non-Ventilated (TENV)
- No ventilation openings, enclosed to prevent free exchange of air (not airtight). No external cooling fan, relies on convection cooling.
- Suitable where the motor is exposed to dirt or dampness. Not suited in very moist humid or hazardous (explosive) air.

Toally Enclosed Fan Cooled (TEFC)
- Same as TENV with an external fan as an integral part of the motor. The fan provides cooling by blowing air on the outside of the motor.

Explosion-Proof Motors (TEXP)

- The motor ambient temperature shall not exceed +40°C. Motors are approved for the classes:
  - CLASS I (Gases, Vapors)
    - Group A - Acetylene
    - Group B - Butadiene, ethylene oxide, hydrogen, propylene oxide
    - Group C - Acetaldehyde, cyclopropane, diethel ether, ethylene, isoprene
    - Group D - Acetone, acrylonitrite, ammonia, benzene, butane, ethylene dichloride, gasoline, hexane, methane, methanol, naphtha, propane, propylene, styrene, toluene, vinyl acetate, vinyl chloride, xylem
  - CLASS II (Combustible Dusts)
    - Group E - Aluminum, magnesium and other metal dusts with similar characteristics.
    - Group F - Carbon black, coke or coal dust
    - Group G - Flour, starch or grain dust
  - CLASS III (Not Available from WorldWide Electric)

NEMA Motor Design Classifications

The four standard NEMA designs have unique speed-torque-slip relationships - making them suited for different type of applications.

NEMA design A
- maximum 5% slip
- high to medium starting current
- normal locked rotor torque
- normal breakdown torque
- suited for a broad variety of applications - like fans and pumps

NEMA design B
- maximum 5% slip
- low starting current
- high locked rotor torque
- normal breakdown torque
- suited for a broad variety of applications with normal starting torques - common in HVAC application with fans, blowers and pumps

NEMA design C
- maximum 5% slip
- low starting current
- high locked rotor torque
- normal breakdown torque
- suited for equipment with high inertia and high starting torques at start - like positive displacement pumps, conveyors

NEMA design D
- maximum 5-13% slip
- low starting current
- very high locked rotor torque
- suited for equipment with very high inertia starts - like cranes, hoists etc.

NEMA Frame	Dimensions (inches)					
	D	E	2F	BA	N-W	ES
42	2 5/8	1 3/4	1 11/16	2 1/16	1 1/8	
42C	2 5/8	1 3/4	1 11/16	2 1/16	1 1/8	
48	3	2 1/8	2 3/4	2 1/2	1 1/2	
48C	3	2 1/8	2 3/4	2 1/2	1 1/2	
48H	3	2 1/8	4 3/4	2 1/2	1 1/2	
56	3 1/2	2 7/16	3	2 3/4	1 7/8	
56C	3 1/2	2 7/16		2 3/4	1 7/8	
56H	3 1/2	2 7/16	5	2 3/4	1 7/8	
56HZ	3 1/2	2 7/16	5	2 3/4	2 1/4	2
56J	3 1/2	2 7/16		2 3/4	2 7/16	
66	4 1/8	2 15/16	5	3 1/8	2 1/4	
140T	3 1/2	2 3/4	4	2 3/4	2 1/4	
143T/TC	3 1/2	2 3/4	4	2 1/4[1]	2 1/4	2
145T/TC	3 1/2	2 3/4	5	2 1/4[1]	2 1/4	2
182	4 1/2	3 3/4	4 1/2	2 3/4	2 1/4	2
182T/TC	4 1/2	3 3/4	4 1/2	2 3/4[1]	2 3/4	2 1/2
184	4 1/2	3 3/4	5 1/2	2 3/4	2 1/4	2
184T/TC	4 1/2	3 3/4	5 1/2	2 3/4[1]	2 3/4	2 1/2
203	5	4	5 1/2	3 1/8	2 1/4	2
204	5	4	6 1/4	3 1/8	2 1/4	2
213	5 1/4	4 1/4	5 1/2	3 1/2	3	2 3/4
213AT	5 1/4	4 1/4	5 1/2	3 1/2	2 3/4	2 1/2
213T/TC	5 1/4	4 1/4	5 1/2	3 1/2[1]	3 3/8	3 1/8
215	5 1/4	4 1/4	7	3 1/2	3	2 3/4
215T/TC	5 1/4	4 1/4	7	3 1/2[1]	3 3/8	3 1/8
224	5 1/2	4 1/2	6 3/4	3 1/2	3	2 3/4
225	5 1/2	4 1/2	7 1/2	3 1/2	3	2 3/4
254	6 1/4	5	8 1/4	4 1/4	3 3/8	3 1/8
254T/TC	6 1/4	5	8 1/4	4 1/4[1]	4	3 3/4
254U	6 1/4	5	8 1/4	4 1/4	3 3/4	3 1/2
256T/TC	6 1/4	5	10	4 1/4[1]	4	3 3/4
256U	6 1/4	5	10	4 1/4	3 3/4	3 1/2
284	7	5 1/2	9 1/2	4 3/4	3 3/4	3 1/2
284T/TC	7	5 1/2	9 1/2	4 3/4[1]	4 5/8	4 3/8
284TS	7	5 1/2	9 1/2	4 3/4	3 1/4	3
284U	7	5 1/2	9 1/2	4 3/4	4 7/8	4 5/8
286T/TC	7	5 1/2	11	4 3/4[1]	4 5/8	4 3/8
286TS	7	5 1/2	11	4 3/4	3 1/4	3
286U	7	5 1/2	11	4 3/4	4 7/8	4 5/8
324	8	6 1/4	10 1/2	5 1/4	4 7/8	4 5/8
324TS	8	6 1/4	10 1/2	5 1/4	3 3/4	3 1/2
324U	8	6 1/4	10 1/2	5 1/4	5 5/8	5 3/8
326	8	6 1/4	12	5 1/4	4 7/8	4 5/8
326T	8	6 1/4	12	5 1/4	5 1/4	5
326TS	8	6 1/4	12	5 1/4	3 3/4	3 1/2
326U	8	6 1/4	12	5 1/4	5 5/8	5 3/8
364	9	7	11 1/4	5 7/8	5 5/8	5 3/8
364S	9	7	11 1/4	5 7/8	3 1/4	3
364T	9	7	11 1/4	5 7/8	5 7/8	5 7/8
364TS	9	7	11 1/4	5 7/8	3 3/4	3 1/2
364U	9	7	11 1/4	5 7/8	6 3/8	6 1/8
365	9	7	12 1/4	5 7/8	5 5/8	5 3/8
365T	9	7	12 1/4	5 7/8	5 7/8	4 7/8
324T	8	6 1/4	10 1/2	5 1/4	5 1/4	5
365TS	9	7	12 1/4	5 7/8	3 3/4	3 1/2
365U	9	7	12 1/4	5 7/8	6 3/8	6 1/8
404	10	8	12-1/4	6-5/8		6-1/8
405	10	8	13-3/4	6-5/8		6-1/8
404U	10	8	12-1/4	6-5/8	7-3/16	6-7/8
405U	10	8	13-3/4	6-5/8	7-3/16	6-7/8
404T	10	8	12-1/4	6-5/8	7-5/16	7
405T	10	8	13-3/4	6-5/8	7-5/16	7
404TS	10	8	12-1/4	6-5/8	4-1/2	4
405TS	10	8	13-3/4	6-5/8	4-1/2	4
444	11	9	14-1/2	7-1/2		6-7/8
445	11	9	16-1/2	7-1/2		6-7/8
444U	11	9	14-1/2	7-1/2	8-5/8	8-3/8
445U	11	9	16-1/2	7-1/2	8-5/8	8-3/8
444T	11	9	14-1/2	7-1/2	8-9/16	8-1/4
445T	11	9	16-1/2	7-1/2	8-9/16	8-1/4
447T	11	9	20	7-1/2	8-9/16	8-1/4
449T	11	9	25	7-1/2	8-9/16	8-1/4
444TS	11	9	14-1/2	7-1/2	4-13/16	4-1/2
445TS	11	9	16-1/2	7-1/2	4-13/16	4-1/2
447TS	11	9	20	7-1/2	4-13/16	4-1/2
449TS	11	9	25	7-1/2	4-13/16	4-1/2

[1]BA Frame Dimensions differ for actual TC motor fames

IEC Frame	Dimensions (mm)				
	D (IEC: H)	2E (IEC: A)	2F (IEC: B)		N-W (IEC: E)
63	63 mm	100 mm	80 mm		23 mm
71	71 mm	112 mm	90 mm		30 mm
80	80 mm	125 mm	100 mm		40 mm
90	90 mm	140 mm	100 mm (S)	125 mm (L)	50 mm
100	100 mm	160 mm	112 mm (S)	140 mm (L)	60 mm
112	112 mm	190 mm	114 mm (S)	140 mm (M)	60 mm
132	132 mm	216 mm	140 mm (S)	178 mm (M)	80 mm
160	160 mm	254 mm	210 mm (M)	254 mm (L)	110 mm

NEMA Insulation Classes

Insulation classes for recommended maximize allowable operating temperatures. Insulation Classes are directly related to motor life.

Temperature Tolerance Class	Maximum Operation Temperature Allowed		Allowable Temperature Rise at full load 1.0 service factor motor[2]	Allowable Temperature Rise 1.15 service factor motor[2]
	°C	°F	°C	°C
A	105	221	60	70
B	130	266	80	90
F	155	311	105	115
H	180	356	125	-
N	200	392	145	-

Conversion: T(°F) = [T(°C)](9/5) + 32

[2] Allowable temperature rises are based upon a reference ambient temperature of 40°C. Operation temperature is reference temperature + allowable temperature rise + allowance for "hot spot" winding.

A motor should not operate with temperatures above the maximum. Each 10 °C rise above the rating may reduce the motor lifetime by one half.

SCAN ME

Industrial Products **Proven Quality.**