

Post Glover Wound Rotor Motor Resistors

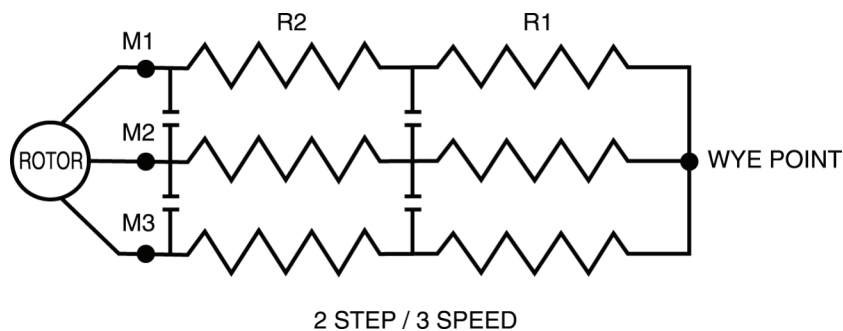
Wound rotor motors, as opposed to AC induction motors, generate the same torque in both forward and reverse. They are commonly used on fans, pumps, conveyors and crane systems.

The motors are rated according to their primary and secondary windings. The primary ratings are given in volts and power (kilowatts), while the secondary ratings are specified in terms of voltage and current (the secondary current is defined by the locked rotor output, verified during testing of the motor).

Resistance Calculation

To calculate the total resistance per phase, the following information is required:

1. Secondary voltage
2. Secondary current
3. The number of speeds/steps required for the application. The number of steps is the actual number of resistor stages to be switched through, whereas the number of speeds is the number of steps plus one (the "extra" speed being no resistors at all in the circuit.)
4. Duty class, according to NEMA
5. Starting torque, (which can also be specified as the last digit of the classification number.)



Formula for Total Resistance

$R_{tot} = \text{Secondary Voltage} / (\text{Secondary Current} \times 1.713 \times \text{Percentage Starting Torque})$

The total resistance is then divided into the requisite number of steps. The size is not uniform to allow for smooth transitions of motor speed as the load's inertia changes. The most common breakdowns are given below, with the first step being that closest to the secondary AC power source and then moving progressively toward the motor.

The amperage associated with each step is determined by the amount of current seen by the individual steps, as dictated by how long they are left in the circuit and by the duty class of the motor. These values listed below are percentages of the rated secondary current. As a general rule, pumps, fans and conveyor systems are Class 130, while crane systems can be Class 160, 170 or 190.

One note concerning the secondary current: if the starting torque is greater than 100%, remember to also use this factor in sizing the individual resistor steps. For example, if the starting torque is 150% of nominal, the amperage used for designing the resistor sizes will be 1.5 times the rated secondary current of the motor.



4750 Olympic Blvd. • Erlanger, KY 41018 • USA
Phone: 800-537-6144 / 859-283-0778 • Fax: 859-283-2978
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The following table is for selecting the NEMA Class for an application in relation to starting torque and duty cycle.

| NEMA Classification of Resistors | | | | | | | | |
|---|---------------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------|
| Approximate Percent of Full-Load Current on First Point Starting @ Rest | Class Numbers Applying to Duty Cycles | | | | | | | |
| | 30 sec. on Out of each 15 min. | 5 sec. on Out of each 80 sec. | 10 sec. on Out of each 80 sec. | 15 sec. on Out of each 90 sec. | 15 sec. on Out of each 60 sec. | 15 sec. on Out of each 45 sec. | 15 sec. on Out of each 30 sec. | Continuous Duty |
| 25 | 101 | 111 | 131 | 141 | 151 | 161 | 171 | 91 |
| 50 | 102 | 112 | 132 | 142 | 152 | 162 | 172 | 92 |
| 70 | 103 | 113 | 133 | 143 | 153 | 163 | 173 | 93 |
| 100 | 104 | 114 | 134 | 144 | 154 | 164 | 174 | 94 |
| 150 | 105 | 115 | 135 | 145 | 155 | 165 | 175 | 95 |
| 200 or over | 106 | 116 | 136 | 146 | 156 | 166 | 176 | 96 |

| NEMA Resistor Application Standards | | | | | |
|--------------------------------------|------------|---------------------------------|------------|-------------------------------|------------|
| APPLICATION | NEMA CLASS | APPLICATION | NEMA CLASS | APPLICATION | NEMA CLASS |
| Blowers | | Food Plants | | Rubber Mills | |
| Centrifugal..... | 133-93 | Butter Churns, Dough Mixer..... | 135 | Banbury, Crackers..... | 135 |
| Constant Pressure..... | 135-95 | Hoists | | Calenders..... | 155 |
| Brick Plants | | Winch..... | 153 | Mixing Mills, Washers..... | 135 |
| Augers, Conveyors..... | 135 | Mine Slope..... | 172 | Steel Mills | |
| Dry Plans, Pug Mills | | Mine Vertical..... | 162 | Accumulators..... | 153 |
| By-product Coke Plants | | Contractor's Hoists..... | 152 | Casting Machines-Pig..... | 153 |
| Door Machine, Leveler Ram..... | 153 | Larry Cars | 153 | Charging Machines | |
| Pusher Bar, Valve Reversing Machines | | Lift Bridges | 152 | Bridge..... | 153 or 163 |
| Cement Mills | | Machine Tools | | Peel..... | 153 or 163 |
| Conveyors..... | 135 | Bending Rolls..... | 163 or 164 | Trolley..... | 153 or 163 |
| Crushers..... | 145 | Boring Mills..... | 135 | Coiling Machines..... | 135 |
| Elevators..... | 135 | Bulldozers..... | 135 | Converters-Metal..... | 154 |
| Rotary Dryers..... | 145-95 | Drills, Gear Cutters..... | 115 | Conveyors..... | 135-155 |
| Grinders and Pulverizers..... | 135 | Grinders..... | 135 | Crushers..... | 145 |
| Kilns..... | 135-95 | Hobbing Machines, Lathes..... | 115 | Furnace Door, Gas Valves..... | 155 |
| Coal and Ore Bridges | | Milling Machines | | Gas Washers | |
| Bridge..... | 153 | Presses, Punches..... | 135 | Hot Metal Mixers..... | 163 |
| Closing, Holding..... | 162 | Saws, Shapers..... | 115 | Ingot Buggy, Kickoff..... | 153 |
| Trolley..... | 162 or 163 | Metal Mining | | Levelers | |
| Coal Mines | | Ball, Rod and Tube Mills..... | 135 | Manipulator Fingers..... | 153 or 163 |
| Car Hauls..... | 162 | Car Dumpers-Rotary..... | 153 | Pickling Machine..... | 153 |
| Conveyors..... | 135 or 155 | Converters-Copper..... | 154 | Pilars-Slab, Racks | |
| Cutters..... | 135 | Crushers..... | 145 | Reelers..... | 135 |
| Crushers..... | 145 | Conveyors..... | 135 | Saws-Hot or Cold..... | 155 |
| Fans..... | 134 or 95 | Tilting Furnace..... | 153 | Screw Downs..... | 153 or 163 |
| Hoists | | Paper Mills | | Shears, Shuffle Bars..... | 155 |
| Slope..... | 172 | Beaters..... | 135 | Side Guards..... | 153 or 163 |
| Vertical..... | 162 | Calenders..... | 154-92 | Sizing Rolls, Slab Buggy..... | 155 |
| Jigs, Picking Tables..... | 135 | Chippers..... | 145 | Soaking Pit Covers | |
| Rotary Car Dumpers..... | 153 | Pipeworking | | Straighteners..... | 153 |
| Shaker Screens..... | 135 | Cutting and Threading..... | 135 | Tables | |
| Compressors | | Expanding and Flanging..... | 135-95 | Approach..... | 153 |
| Constant Speed..... | 135 | Power Plants | | Lift..... | 153 or 163 |
| Varying Speed | | Clinker Grinders..... | 135 | Main Roll..... | 153 or 163 |
| Centrifugal..... | 93 | Coal Crushers..... | 135 | Roll..... | 153 |
| Plunger Type..... | 95 | Conveyors | | Shear Approach..... | 153 or 163 |
| Concrete Mixers | 135 | Belt, Screw..... | 135 | Transfer..... | 153 |
| Cranes-General Purpose | | Pulverized Fuel Feeders..... | 135 | Tilting Furnace..... | 153 |
| Hoist..... | 153-163 | Pulverizers | | Wire Stranding Machine..... | 153 |
| Bridge or Trolley with | | Ball Type..... | 135 | Woodworking Plants | |
| Sleeve Bearings..... | 153-163 | Centrifugal..... | 134 | Boring Machines, Lathe..... | 115 |
| Roller Bearings..... | 152-162 | Stokers..... | 135-93 | Mortiser, Moulder, Planers, | |
| Flour Mills | | Pumps | | Power Trimmer and Mitre, | |
| Line Shafting..... | 135 | Centrifugal..... | 134-93 | Sanders, Saws, Shapers, | |
| | | Plunger..... | 135-95 | Shingle Machine | |



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