MOTOR and WIRE RATING DATA

Resistors — Service Classifications and Recommendations

SERVICE CLASSIFICATION OF RESISTORS

A. Resistors shall be designated by class numbers in accordance with Tables 1, 2, 3 and 4.

B. Starting- and intermittent-duty resistors are primarily designed for use with motors which require an initial torque corresponding to the stated per cent of full-load current on the first point and which require an average accelerating current (rms value) of 125 per cent of full-load current.

With a secondary-resistor alternating-current controller, the figures given in the tables for the per cent of full-load current on the first point, starting from rest, apply to rotor (secondary) current and to torque. The primary current will, in general, be a higher percentage of the full-load current.

C. Starting- and intermittent-duty primary resistors which are designed for use with squirrel-cage motors and which meet the test described in IC 1-13.42 (temperature test) are included in the tables.

D. Continuous-duty resistors shall be capable of carrying continuously the current for which they are designed.

E. An adjustable-speed motor having a given horsepower rating, when started with full field, generally requires a resistor having a larger ohmic value than does a constant-speed motor of the same horsepower rating. For this reason, the current on the first point and the capacity of the complete resistor of the same NEMA classification for an adjustable-speed motor may be different from that for a constant-speed motor of the same horsepower.

Note—A continuous-duty resistor shall be so designed that the controller may be operated continuously on any point when the load follows its normal speed-torque curve, except that it must not be operated continuously below the minimum speed specified.

TABLE 1 — Class Numbers of Resistors for Non-Reversing Service and Reversing Non-Plugging Service Without Armature Shunt or Dynamic Braking

Approximate Per Cent of Full-Load Current on First Point Starting from Rest	Class Numbers — Duty Cycles						
	5 Sec. On 75 Sec. Off	10 Sec. On 70 Sec. Off	15 Sec. On 75 Sec. Off	15 Sec. On 45 Sec. Off	15 Sec. On 30 Sec. Off	15 Sec. On 15 Sec. Off	*Continuous Duty
25	111	131	141	151	161	171	91
50	112	132	142	152	162	172	92
70	113	133	143	153	163	173	93
100	114	134	144	154	164	174	94
150	115	135	145	155	165	175	95
200 or over	116	136	146	156	166	176	96

*For speed-regulating duty, see Table 4.

When an armature shunt resistor is added, the class number shall include the suffix "AS". Example—Class 155-AS is a resistor which includes an armature shunt and which will allow an initial inrush of 150 per cent with the armature shunt open.

When a dynamic braking resistor is added, the class number shall include the suffix "DB". Example—Class 155-DB.

TABLE 2 — Class Numbers of Resistors for Reversing Plugging Service Without Armature Shunt or Dynamic Braking

Approximate Per Cent of Full-Load Current on First Point Starting from Rest with All Resistance in Circuit	Class Numbers — Duty Cycles			
	15 Seconds On 45 Seconds Off	15 Seconds On 30 Seconds Off	15 Seconds On 15 Seconds Off	Continuous Duty
25	151P	161P	171P	91P
50	152P	162P	172P	92P
70	153P	163P	173P	93P
100	154P	164P	174P	94P

Note—The class numbers apply to the complete resistor, but the duty cycles apply to the accelerating resistor only.

When an armature shunt resistor is added, the class number shall include the suffix "AS". Example—Class 153P-AS is a plugging resistor which includes an armature shunt and which will allow an initial inrush of 70 per cent with the armature shunt open.

When a dynamic braking resistor is added, the class number shall include the suffix "DB". Example—Class 153P-DB.

TABLE 3 — Class Numbers of Resistors for Dynamic Lowering Crane and Hoist Controllers

Approximate Per Cent of Full-Load Current on First Point Hoisting Starting from Rest without Armature Shunt	Class Numbers — Duty Cycles			
	15 Seconds On 45 Seconds Off	15 Seconds On 30 Seconds Off	15 Seconds On 15 Seconds Off	Continuous Duty
50	152DL	162DL	172DL	92DL
70	153DL	163DL	173DL	93DL

TABLE 4 — Class Numbers of Resistors for Continuous-Duty Speed-Regulating Services with Direct-Current Shunt Motors and Alternating-Current Wound Rotor Motors

Per Cent Speed Reduction	Class Numbers — Per Cent of Rated Motor Torque at Reduced Speed						
	40	50	60	70	80	90	100
5	405	505	605	705	805	905	1005
10	410	510	610	710	810	910	1010
15	415	515	615	715	815	915	1015
20	420	520	620	720	820	920	1020
25	425	525	625	725	825	925	1025
30	430	530	630	730	830	930	1030
35	435	535	635	735	835	935	1035
40	440	540	640	740	840	940	1040
45	445	545	645	745	845	945	1045
50	450	550	650	750	850	950	1050

Note I—See IC 1-2.04. NEMA standards for Industrial Control.

Note II—The stability of the motor speed obtained by simple rheostatic control is dependent upon the stability of the load on the motor. The degree of instability is directly proportional to the amount of speed reduction. Variations in load have a greater proportional effect on the speed when the load is light. For these reasons, Table 4 has not been carried beyond a speed reduction of 50 per cent and a load torque of 40 per cent.

Note III—With a direct-current shunt motor, the per cent of rated motor current which is obtained at the reduced speed is assumed to be the same as the per cent of rated torque.

With a wound-rotor motor and resistor in the motor circuit, the per cent of rated rotor (secondary) current which is obtained at the reduced speed is assumed to be the same as the per cent of rated torque.

Note IV—A speed-regulating resistor is so designed that it may be operated continuously at any point in the speed-regulating range when the load follows its normal speed-torque curve. When additional resistance is required to obtain the starting current specified, the additional portion of the resistor shall be designed for a duty cycle selected from Table 1. The resulting resistor may be completely specified by a compound number.

For example, 154/850 designates a resistor which is designed for starting and speed-regulating duty. The starting section is designed to allow 100 per cent of full-load current on the first point, starting from rest, and a duty cycle of 15 seconds on and 45 seconds off. The regulating section is designed to give 50 per cent speed reduction at 80 per cent of rated torque and for continuous duty when the load follows its normal speed-torque curve.

Note V—If the speed-regulating resistor alone is used, the approximate per cent of rated current which will be obtained on the first point of the controller, starting from rest, may be determined from the equation:

$$\text{Per Cent Current} = \frac{\text{Per cent torque at reduced speed}}{\text{Per cent speed reduction}} \times 100$$