

rotork®

Keeping the World Flowing
for Future Generations



A Range

Electrical data for
3-phase power supplies

Rotork is a market-leading global provider of mission-critical flow control and instrumentation solutions for the industrial actuation and flow control markets. These include oil and gas, water and wastewater, power, chemical, process and industrial applications.

Customers rely on us for innovative, high quality and dependable solutions for managing the flow of liquids, gases and powders. We help customers around the world to improve efficiency, reduce emissions, minimise their environmental impact and assure safety.

Our reliability record is second to none. Our products are designed with safety and performance at their core and are put through vigorous testing and certified to international standards. Our products are certified for use in the world's most dangerous and hazardous areas.

Partnering with us provides the following:

- Assured safety and reliability
- Industry leading accuracy and efficiency
- Proven technology that works with all network control systems
- Product range with solutions to suit every application
- Assistance with plant planning, development and maintenance through our local support services
- We have innovative research and development centers throughout the world

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Performance requirements

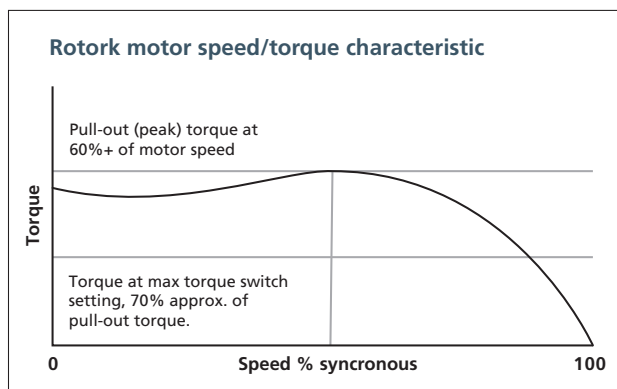
The operating torque of the average motorized valve essentially features the following four points:

1. Torque at the open position is low, as there is no differential pressure and gland friction force is the largest constituent.
2. The closing torque only begins to rise substantially as throttling takes place when the valve is about three quarters shut.
3. The closing force rises sharply with the last few turns as the valve seats.
4. If the valve has remained shut for long periods, wedging, corrosion or the 'flow' of soft seats may require higher momentary unseating force than was necessary to shut the valve. As no continuous running is possible on normal on/off duties, the motor need only be 15 minute rated to cover normal valve travel times of 1-5 minutes, and this will also give a generous allowance for inching on manual regulating duties.

The essential requirements of a motor to meet these needs are:

- a. A high stalling torque in comparison with that required to operate and seat the valve, to be available at high speed for unseating in combination with a lost motion hammerblow effect, achieved by allowing the motor to reach full speed before the drive is taken up.
- b. A relatively high starting torque to enable the valve to be inched when the backlash is taken up.

The graph shows the Rotork three phase motor speed/torque characteristic, designed to meet these performance requirements. It provides the highest possible stalling torque at high speed while providing a starting torque which is at least 80% of it. The torque available to seat the valve is shown as actuator rated torque, and it can be seen that the stalling torque gives a safety margin of up to 2:1 to ensure unseating, even if the voltage is low. (The stalling and starting torque vary approximately as the square of the voltage.)



In order to prevent valve damage in the event of incorrect wiring, particularly reversed phase rotation when torque and limit switches are rendered useless, Rotork uses motors with low kinetic energy, i.e. the rotor is long and thin rather than short and fat.

Motor performance data

For any valve actuator motor there are only three pieces of information which are factual, because they can be measured. They are locked rotor current, locked rotor torque and stalling torque. The first only is of any use to the customer, the others are part of the actuator makers' responsibility in selecting the motor in the first place. Quoting locked rotor current only is not very helpful for the selection of cables, fuses and control gear, where data is required on the ordinary full load running condition of an ordinary motor drive. To satisfy this requirement, an arbitrary basis for presentation must be chosen.

The seating torque, for which the actuator must be rated mechanically, is only required for a very brief period; the time rating has to relate to the average load of a valve which, in our experience is about 33% of seating torque. There are particular exceptions like regulating butterfly valves which may require a very high opening torque during travel but will be assisted in closing and lubricated plug valves which may need a higher proportion of torque through travel, but as a generalisation the 33% figure is quite conservative. If this is then worked out into mechanical horsepower, it provides a guide to the motor size which is independent of a supply voltage.

The equipment is suitable for connection to a mains supply within the specified rated range with maximum supply voltage fluctuations not exceeding $\pm 10\%$ of the nominal rated limits.

Rotork published motor currents

Rotork, therefore publishes the following three currents for actuators at any specified voltage.

1. Locked rotor (starting)

Maximum current demanded (lasting for approximately three cycles only, on an A.C. motor) during normal starting unless the motor is stalled. Locked rotor current should be used for sizing cables, to ensure that the voltage drop does not exceed approx. 15% during starting. See page 11.

2. Rated torque (seating)*

Current corresponding to maximum seating torque, which is also of brief duration at the end of valve stroke (for selection of thermal trips where required.)

3. Average load

Corresponds to 33% of maximum seating torque, and should be used for sizing motor control gear.

The following data is approximate and applies to standard 15 minute rated class F insulated motors for normal power supplies as specified.

* Torque at maximum torque switch setting.

Electrical Consumption Data

380 V 50 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	18	34	25	4	2.1	1.3	0.6	0.11	0.08	0.42	47
	24	34	25								
	36	31	23								
	48	27	20	2	4.2	1.9	1	0.21	0.16	0.43	55
	72	27	20								
	96	22	16								
11A	18	68	50	4	4.1	1.6	1.27	0.2	0.15	0.38	46
	24	68	50								
	36	61	45								
	48	54	40	2	6.3	2.2	1.65	0.32	0.24	0.42	52
	72	54	40								
	96	43	32								
13A	24	108	80	4	6.6	3.5	2.1	0.42	0.31	0.48	46
	36	95	70								
	48	81	60								
14A	18	163	120	4	7.8	2.7	2.1	0.5	0.36	0.39	66
	24	163	120								
	36	136	100								
	48	108	80	2	10	3.3	2.4	0.9	0.67	0.57	75
	72	108	80								
	96	81	60								
	144	61	45								
16A	18	305	225	4	14	5	3.5	1	0.75	0.52	63
	24	305	225								
	36	258	190								
	48	203	150	2	18	6.6	3.8	1.5	1.1	0.58	76
	72	203	150								
	96	149	110								
	144	108	80								
30A	18	542	400	4	25	6.9	4.6	1.7	1.25	0.58	71
	24	542	400								
	36	508	375								
	48	407	300	2	39	11	6.9	3	2.2	0.68	72
	72	407	300								
	96	325	240								
	144	258	190								
40A	18	1017	750	4	45	11	7.5	2.8	2.1	0.57	75
	24	1017	750								
	36	847	625								
	48	678	500	2	61	16.5	9.1	5	3.7	0.75	82
	72	678	500								
	96	542	400								
	144	407	300								
70A	18	1491	1100	4	61	15	10	3.7	2.75	0.56	74
	24	1491	1100								
	36	1288	950								
	48	1017	750	2	95	25	16	6.5	4.8	0.6	75
	72	1017	750								
	96	746	550								
	144	644	475								
90A	18	2034	1500	4	78	21	15	6	4.5	0.58	79
	24	2034	1500								
	36	1695	1250								
	48	1356	1000	2	138	35	21	10	7.5	0.67	82
	72	1356	1000								
	96	1017	750								
	144	868	640								
91AR	144	1356	1000	2	218	88	28.5	17.4	13	0.79	87
	192	1356	1000								
	24	2983	2200	4	78	22	15	6.5	4.8	0.56	86

*Torque at max. torque setting

Electrical Consumption Data

400 V 50 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	18	34	25	4	2.2	1.2	0.6	0.11	0.08	0.42	47
	24	34	25								
	36	31	23								
	48	27	20	2	4.4	1.8	1.1	0.21	0.16	0.40	51
	72	27	20								
	96	22	16								
11A	18	68	50	4	4.3	1.5	1.3	0.2	0.15	0.38	44
	24	68	50								
	36	61	45								
	48	54	40	2	6.6	2.1	1.7	0.32	0.24	0.42	49
	72	54	40								
	96	43	32								
13A	24	108	80	4	6.3	3.3	2.0	0.42	0.31	0.48	46
	36	95	70								
	48	81	60								
14A	18	163	120	4	7.2	2.6	2.0	0.5	0.36	0.38	66
	24	163	120								
	36	136	100								
	48	108	80	2	10.6	3.1	2.5	0.9	0.67	0.57	70
	72	108	80								
	96	81	60								
	144	61	45								
16A	18	305	225	4	13	4.7	3.6	1	0.75	0.48	63
	24	305	225								
	36	258	190								
	48	203	150	2	19	6.3	4.0	1.5	1.1	0.55	72
	72	203	150								
	96	149	110								
	144	108	80								
30A	18	542	400	4	24	6.6	4.2	1.7	1.25	0.65	67
	24	542	400								
	36	508	375								
	48	407	300	2	41	10.5	6.6	3	2.2	0.68	72
	72	407	300								
	96	325	240								
	144	258	190								
40A	18	1017	750	4	43	10.4	7.2	2.8	2.1	0.57	75
	24	1017	750								
	36	847	625								
	48	678	500	2	64	16	9.6	5	3.7	0.69	81
	72	678	500								
	96	542	400								
	144	407	300								
70A	18	1491	1100	4	58	14	9.5	3.7	2.75	0.56	74
	24	1491	1100								
	36	1288	950								
	48	1017	750	2	100	24	15.4	6.5	4.8	0.60	75
	72	1017	750								
	96	746	550								
	144	644	475								
90A	18	2034	1500	4	76	20	14.4	6	4.5	0.57	79
	24	2034	1500								
	36	1695	1250								
	48	1356	1000	2	145	33	19.9	10	7.5	0.67	82
	72	1356	1000								
	96	1017	750								
	144	868	640								
91AR	144	1356	1000	2	208	88	27.1	17.4	13	0.79	87
	192	1356	1000								
	24	2983	2200	4	76	21	14.4	6.5	4.8	0.56	86

*Torque at max. torque setting

Electrical Consumption Data

415 V 50 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	18	34	25	4	2.3	1.2	0.58	0.11	0.08	0.42	47
	24	34	25								
	36	31	23								
	48	27	20	2	4.6	1.75	1.2	0.21	0.16	0.38	48
	72	27	20								
	96	22	16								
11A	18	68	50	4	4.5	1.45	1.35	0.2	0.15	0.38	42
	24	68	50								
	36	61	45								
	48	54	40	2	6.8	2	1.75	0.32	0.24	0.42	46
	72	54	40								
	96	43	32								
13A	24	108	80	4	6	3.2	1.96	0.42	0.31	0.48	46
	36	95	70								
	48	81	60								
14A	18	163	120	4	6.7	2.5	2	0.5	0.36	0.38	66
	24	163	120								
	36	136	100								
	48	108	80	2	11	3	2.5	0.9	0.67	0.57	66
	72	108	80								
	96	81	60								
	144	61	45								
16A	18	305	225	4	12	4.5	3.7	1	0.75	0.45	63
	24	305	225								
	36	258	190								
	48	203	150	2	20	6.1	4.2	1.5	1.1	0.53	69
	72	203	150								
	96	149	110								
	144	108	80								
30A	18	542	400	4	23	6.3	3.9	1.7	1.25	0.7	64
	24	542	400								
	36	508	375								
	48	407	300	2	42	10.1	6.3	3	2.2	0.68	72
	72	407	300								
	96	325	240								
	144	258	190								
40A	18	1017	750	4	42	10	6.9	2.8	2.1	0.57	75
	24	1017	750								
	36	847	625								
	48	678	500	2	66	15.4	9.9	5	3.7	0.65	80
	72	678	500								
	96	542	400								
	144	407	300								
70A	18	1491	1100	4	56	13	9.2	3.7	2.75	0.56	74
	24	1491	1100								
	36	1288	950								
	48	1017	750	2	104	23	15	6.5	4.8	0.6	75
	72	1017	750								
	96	746	550								
	144	644	475								
90A	18	2034	1500	4	75	19	14	6	4.5	0.56	79
	24	2034	1500								
	36	1695	1250								
	48	1356	1000	2	150	31	19	10	7.5	0.67	82
	72	1356	1000								
	96	1017	750								
	144	868	640								
91AR	144	1356	1000	2	200	88	26	17.4	13	0.79	87
	192	1356	1000								
	24	2983	2200	4	75	20	14	6.5	4.8	0.56	86

*Torque at max. torque setting

Electrical Consumption Data

500 V 50 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	18	34	25	4	1.8	0.8	0.4	0.11	0.08	0.47	50
	24	34	25								
	36	31	23								
	48	27	20	2	2.8	1.5	0.8	0.21	0.16	0.47	50
	72	27	20								
	96	22	16								
11A	18	68	50	4	3.4	1.4	0.8	0.2	0.15	0.43	50
	24	68	50								
	36	61	45								
	48	54	40	2	5.2	1.8	1.4	0.32	0.24	0.48	52
	72	54	40								
	96	43	32								
13A	24	108	80	4	4.5	3.1	1.2	0.42	0.31	0.54	55
	36	95	70								
	48	81	60								
14A	18	163	120	4	6	2.4	1.6	0.5	0.36	0.49	53
	24	163	120								
	36	136	100								
	48	108	80	2	8.5	2.5	2.1	0.9	0.67	0.55	67
	72	108	80								
	96	81	60								
	144	61	45								
16A	18	305	225	4	11.6	3.8	2.7	1	0.75	0.55	58
	24	305	225								
	36	258	190								
	48	203	150	2	16	5	3.1	1.5	1.1	0.63	65
	72	203	150								
	96	149	110								
	144	108	80								
30A	18	542	400	4	20.3	5.3	4	1.7	1.25	0.6	60
	24	542	400								
	36	508	375								
	48	407	300	2	35	8	5.5	3	2.2	0.66	70
	72	407	300								
	96	325	240								
	144	258	190								
40A	18	1017	750	4	36.5	8.3	6.2	2.8	2.1	0.62	63
	24	1017	750								
	36	847	625								
	48	678	500	2	52	12.5	7.5	5	3.7	0.73	78
	72	678	500								
	96	542	400								
70A	144	407	300	4	52	14	8	3.7	2.75	0.63	66
	18	1491	1100								
	24	1491	1100								
	36	1288	950	2	78	20	11	6.5	4.8	0.69	73
	48	1017	750								
	72	1017	750								
	96	746	550								
90A	144	644	475	4	70	16	12	6	4.5	0.65	67
	18	2034	1500								
	24	2034	1500								
	36	1695	1250	2	120	30	17.5	10	7.5	0.68	73
	48	1356	1000								
	72	1356	1000								
	96	1017	750								
91AR	144	868	640	2	166	67	21.6	17.4	13	0.79	87
	18	732	540								
	96	1356	1000								
95AZ	24	2983	2200	4	70	18	13	6.5	4.8	0.56	86

*Torque at max. torque setting

Electrical Consumption Data

460 V 60 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	21	34	25	4	2.1	1.3	0.53	0.13	0.1	0.45	47
	29	34	25								
	43	31	23								
	57	27	20	2	4.2	1.9	1	0.25	0.19	0.46	48
	86	27	20								
11A	115	22	16	4	4.1	1.6	1.27	0.24	0.18	0.38	46
	21	68	50								
	29	68	50								
	43	61	45								
	57	54	40								
13A	86	54	40	2	6.3	2.2	1.65	0.38	0.29	0.42	52
	115	43	32								
	29	108	80								
	43	95	70								
	57	81	60								
14A	115	163	120	4	7.8	2.7	2.1	0.6	0.43	0.38	66
	21	163	120								
	43	136	100								
	57	108	80								
	86	108	80								
16A	115	81	60	2	10	3.3	2.6	1.1	0.8	0.5	68
	173	61	45								
	21	305	225								
	29	305	225								
	43	258	190								
30A	57	203	150	2	18	6.6	3.8	1.8	1.3	0.56	76
	86	203	150								
	115	149	110								
	173	108	80								
	21	542	400								
40A	29	542	400	4	25	6.9	4.6	2	1.5	0.62	66
	43	508	375								
	57	407	300								
	86	407	300								
	115	325	240								
70A	173	258	190	2	39	11	6.9	3.6	2.6	0.68	70
	21	1017	750								
	29	1017	750								
	43	847	625								
	57	678	500								
90A	86	678	500	2	61	16.5	9.3	5.9	4.4	0.7	83
	115	542	400								
	173	407	300								
	21	1491	1100								
	29	1491	1100								
91AR	43	1288	950	4	61	15	10	4.4	3.3	0.56	74
	57	1017	750								
	86	1017	750								
	115	746	550								
	173	644	475								
95AZ	230	542	400	2	95	25	16	7.8	5.8	0.6	75
	21	2034	1500								
	29	2034	1500								
	43	1695	1250								
	57	1356	1000								
95AZ	86	1356	1000	2	138	35	21	12	9	0.66	82
	115	1017	750								
	173	868	640								
	230	732	540								
	21	1356	1000								
95AZ	230	1356	1000	2	218	88	28.5	21	15.5	0.79	87
	29	2983	2200								

*Torque at max. torque setting

Electrical Consumption Data

575 V 60 Hz	rpm	Rated torque*		Motor poles	Approximate current amps			Average load			
		Nm	lb-ft		Locked rotor	Rated torque	Average load	Nominal hp	Nominal kW	Power factor	Efficiency %
7A	21	34	25	4	1.7	0.9	0.4	0.13	0.1	0.49	51
	29	34	25								
	43	31	23								
	57	27	20	2	3.8	1.4	1	0.25	0.19	0.4	50
	86	27	20								
	115	22	16								
11A	21	68	50	4	3.7	1.2	1	0.24	0.18	0.39	47
	29	68	50								
	43	61	45								
	57	54	40	2	5.1	1.75	1.4	0.38	0.29	0.4	50
	86	54	40								
	115	43	32								
13A	29	108	80	4	5	2.6	1.45	0.5	0.37	0.49	52
	43	95	70								
	57	81	60								
14A	21	163	120	4	7	2.8	1.8	0.6	0.43	0.45	67
	29	163	120								
	43	136	100								
	57	108	80	2	10	3	2.1	1.1	0.8	0.55	71
	86	108	80								
	115	81	60								
16A	21	305	225	4	14	4.8	3	1.2	0.9	0.48	63
	29	305	225								
	43	258	190	2	17	5.3	3.6	1.8	1.3	0.54	70
	57	203	150								
	86	203	150								
	115	149	110								
30A	21	542	400	4	24	6	3.8	2	1.5	0.56	71
	29	542	400								
	43	508	375	2	40	10.5	5.5	3.6	2.6	0.68	72
	57	407	300								
	86	407	300								
	115	325	240								
40A	21	1017	750	4	40	11	6	3.4	2.5	0.57	73
	29	1017	750								
	43	847	625	2	59	18	7.5	5.9	4.4	0.65	82
	57	678	500								
	86	678	500								
	115	542	400								
70A	21	1491	1100	4	58	17	8	4.4	3.3	0.56	74
	29	1491	1100								
	43	1288	950	2	80	21	13	7.8	5.8	0.6	75
	57	1017	750								
	86	1017	750								
	115	746	550								
90A	21	2034	1500	4	70	21	12	7.2	5.4	0.57	79
	29	2034	1500								
	43	1695	1250	2	124	31	17.5	12	9	0.65	81
	57	1356	1000								
	86	1356	1000								
	115	1017	750								
91AR	173	868	640	2	166	67	21.6	21	15.6	0.79	87
	230	732	540								
95AZ	29	2983	2200	4	70	22	13	7.8	5.8	0.57	78

*Torque at max. torque setting

Power Supplies

The table below lists the power supplies catered for by the current range of actuator motors.

rpm at 50 Hz rpm at 60 Hz	Actuator output speeds							
	18 21	24 29	36 43	48 57	72 86	96 115	144 173	192 230
Actuator size	50 Hz	60 Hz						
7A	✓	✓	✓	✓	✓	✓	–	–
	✓	✓	✓	✓	✓	✓	–	–
11A	✓	✓	✓	✓	✓	✓	–	–
	✓	✓	✓	✓	✓	✓	–	–
13A	–	✓	✓	✓	–	–	–	–
	–	✓	✓	✓	–	–	–	–
14A	✓	✓	✓	✓	✓	✓	✓	–
	✓	✓	✓	✓	✓	✓	✓	–
16A	✓	✓	✓	✓	✓	✓	✓	–
	✓	✓	✓	✓	✓	✓	✓	–
30A	✓	✓	✓	✓	✓	✓	✓	–
	✓	✓	✓	✓	✓	✓	✓	–
40A	✓	✓	✓	✓	✓	✓	✓	–
	✓	✓	✓	✓	✓	✓	✓	–
70A	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓
90A	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓
91AR	–	–	–	–	–	–	✓	✓
	–	–	–	–	–	–	✓	✓
95AZ	–	✓	–	–	–	–	–	–
	–	✓	–	–	–	–	–	–

Any power supply requirements other than the above can only be catered for by special motors or reduced time rating, and all enquiries should be referred to Rotork.

Reduced voltage

Note that when a reduced voltage condition is specified below 90% of the nominal voltage (in the preceding tables), the enquiry must be referred to Rotork.

Fuse selection

For most sizes of actuators, the motors are protected by the thermostat embedded in the motor windings and the sizing of fuses should be based on protecting the power cables connected to the actuators. However, on actuator sizes 30A and above where 2-pole motors are utilised, sizing of fuses to give a disconnect time of 10 seconds with locked rotor current will reduce the risk of severe heating of the motor rotor under cold stall conditions. The same approach should be applied when the use of magnetic trip devices is preferred.

The table below gives Rotork's suggested selection of fuse sizes for A Range actuators, based on EE type T, class Q1 HRC fuses, to provide stalled motor protection on 380 to 415 V 50 Hz supplies. For other power supplied, apply to Rotork. While it will be seen that on some actuator sizes below 30A the available HRC fuse ratings do not permit a disconnection time of approximately 10 seconds to be achieved, the motor thermostat will normally provide adequate protection for the rotor in addition to the stator on these smaller models. In these cases the fuse protection is more relevant to the power cables.

Actuator size	Actuator output	Approx. locked rotor current	Fuse size	Approx. disconnect time
	rpm	amps	amps	secs
7A	18, 24, 36	2.3	2	–
	48, 72, 96	4.6	2	4
11A	18, 24, 36	4.5	2	4
	48, 72, 96	6.8	4	700
13A	24, 36, 48	6	4	500
14A	18, 24	6.7	4	800
	36, 48, 72, 96, 144	11	6	200
16A	18, 24	12	6	100
	36, 48, 72, 96, 144	20	10	30
30A	18, 24, 36	23	10	6
	48, 72, 96, 144	42	15	3
40A	18, 24, 36	42	15	3
	48, 72, 96, 144	66	25	15
70A	18, 24	56	20	8
	36, 72, 96, 144, 192	104	35	15
90A	18, 24, 36	75	25	5
	48, 72, 96, 144, 192	150	40	4
91AR	144, 192	218	60	10
95AZ	24	75	25	5

Example

Based on selection of type T fuse rating for a size 40A actuator motor with a locked rotor current of 42 amps.

- 10A rated fuse would disconnect in about 0.01 seconds. Would not handle motor starting current.
- 15A rated fuse would disconnect in about 3 seconds. Acceptable, but check whether next higher rating gives nearer to 10 seconds.
- 20A rated fuse would disconnect in about 200 seconds. Would not disconnect in time to prevent excessive rotor temperature.

Recommended fuse rating 15A.



UK

Rotork plc
Brassmill Lane
Bath, BA1 3JQ

tel +44 (0)1225 733200
email mail@rotork.com

USA

Rotork Controls Inc.
675 Mile Crossing Blvd,
Rochester, NY 14624

tel +1 (585) 247 2304
email info@rotork.com

Contact us now

mail@rotork.com
www.rotork.com

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