

The provisions of this rewritten Section 8.4 will become effective October 1, 2017 except where otherwise noted in the rules.

## **8.4 ELECTRIC BRUSHLESS MOTOR RULES**

### **8.4.1 General:**

8.4.1.1 Sensor based motors only are allowed in classes that specify a spec wind motor (25.5t, 21.5t, 17.5t, 13.5t and 10.5t). Sensored or sensorless motors may be used in all other classes (mod classes). Only circular (round) pure copper magnet wire permitted.

8.4.1.2 The owner shall be able to easily replace the rotor, bearings and front end bell on all motors using commonly available tools. These parts shall be available for separate purchase. Ball bearings are allowed.

8.4.1.3 Motors used in 10<sup>th</sup> scale classes other than 4x4 Short Course Truck will be 540 (05) sized motors as defined in the following sections of the rules. Motors used in 4x4 Short Course Truck may be 540 or 550 size as defined herein. Motors used in 8<sup>th</sup> scale classes will conform to rules for 8<sup>th</sup> scale motors.

### **8.4.2 Motor approvals**

8.4.2.1 All motors used in ROAR competition must be on the list of approved brushless motors posted on the ROAR website. Instructions and requirements for submitting motors for approval can be found on the ROAR website. **Motor approvals shall be valid for 4 years from date of approval. Manufacturers can renew an approval for motors still in production for no additional fee or inspection for an additional 4 years.**

8.4.2.2 All motors must have the original manufacturer's logo or name molded, engraved or etched into the end bell. Spec wind motor (25.5t, 21.5t, 17.5t, 13.5t and 10.5t) must have a distinguishing feature or mark not easily removed/altered on the stator stack or collection ring designating the wind number. For motor designs where the stator stack cannot be removed from the sleeve this wind number must be visible with the sleeve in place.

8.4.2.3 Changes, other than normal production variations, to any area of an approved motor require re-approval of the motor. Examples of specific changes which require re-approval include, but are not limited to: addition of epoxy or other compounds to windings, can color; end piece construction and color; stator length; number of stator laminations; thickness, diameter or shape of stator laminations; wire diameter; can length and can diameter.

8.4.2.4 Modification of approved motors from their approved configuration and materials by manufacturers, importers or competitors is not permitted. No part of the motor may be replaced, altered or omitted except as noted below; this includes alterations to increase timing capability, addition of epoxy or other coatings, rewinding or shortening of wires, etc. No hybrid motors (mixing of parts between approved brushless motors) allowed.

Motors may be rebuilt as follows:

- Fasteners may be replaced with other fasteners of similar type and size
- Bearings may be replaced with any bearing of the same size as originally used.
- Sensor assemblies, end caps, sleeves, stators may be replaced with components identical in construction and function to that used in the original motor approval
- Rotors may be replaced with any rotor approved for the motor in question. Rotors from other motors or which have not been approved may not be used.

8.4.2.5 Resistance measurements will be made during the approval process on all spec wind motors. The approval listing for each spec wind motor will specify the minimum resistance obtained during the approval process for each motor part number submitted for approval. At event inspections, spec wind motors will not be allowed in competition which have a measured resistance less than 99% of the resistance listed in the approval data for that motor when measured at 25 degrees Centigrade using an Instek GOM 802 milliohm meter.

### **8.4.3 Availability for Member Purchase**

8.4.3.1 Manufacturers, distributors or commercial-level motor tuners who submit motors for approval must provide suitable evidence (for example, a commercial invoice) of having manufactured or imported a minimum of **200 complete motors of each spec wind being considered for approval or a total of 200 complete motors of all mod winds combined** following confirmation of conformance to specifications by the Independent Lab and before final approval by the Executive Committee.

In cases where availability is confirmed more than 30 days following completion of inspection; ROAR reserves the right to make the official approval date the date on which evidence of availability is confirmed rather than the date motors were submitted.

### **8.4.4 Maximum retail pricing for ROAR approved motors.**

8.4.4.1 Approved motors must be commercially available to consumers through hobby dealers and / or retail web shops nationwide for a retail price not exceeding the prices listed below. The maximum price includes any aftermarket tuning, preparation and “blueprinting” to specifications.

In the case where a manufacturer / importer sells versions of a specific motor to consumers at prices above the maximum listed, the approval of that motor will be revoked.

8.4.4.2 The maximum retail price of a “05 or 540” brushless motor shall be \$150.00.

8.4.4.3 The maximum retail price of a 1/8th brushless motor shall be \$299.00.

### **8.4.5 Optional Rotors – approval and use**

8.4.5.1 Motor Manufacturers are offering optional or tuning rotors for brushless motors. Many of these rotors may not be approved products for use in ROAR sanctioned events. The only rotors ROAR Approved for any BL motor are the one(s) submitted during the original motor approval process. Importers/Manufacturers may include any Option/Tuning Rotors for inspection and listing, when motor samples are submitted, or they can submit at a later date for inclusion.

8.4.5.2 Affiliate Importers / Manufacturers who have developed Option / Tuning Rotors and wish to add them for use in their Spec Wind motors, should contact ROAR and the Motor Lab immediately to have these items considered for approval. The Motor Lab will require 3 rotors and a list of the winds in which they are being offered. Each rotor must include the appropriate part number of the tuning and original rotor.

8.4.5.3 For our Members using Tuning Rotors be advised, ROAR Technical Inspection Team will treat Rotor Inspection as a serious part of race inspection at the nationals and all of the technical data from the original Motor/Rotor Submissions is cataloged. The Inspection Team has and will continue to deny the use of non-approved "option" rotors at ROAR Nationals because they have not been submitted for inspection by the Manufacturer.

#### **8.4.6 General technical specifications for brushless motors**

8.4.6.1 If the motor is sensed:

It must use a six position JST ZH connector model number ZHR-6 or equivalent connector with 6 JST part number SZH-002T-PO.5 26-28 awg contacts or equivalent. Wire sequence must be as follows:

Pin #1- ground potential

Pin #2- phase C

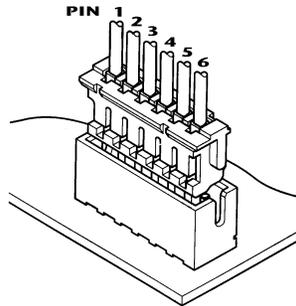
Pin #3- phase B

Pin #4- phase A

Pin #5- temp control, 10 k Thermistor referenced to ground potential

Pin #6- + 5.0 volts  $\pm$  10%

For clarification pin #1 is on the left hand side of the above connector with the wires exiting the top of the connector and the plastic tangs that hold the contacts in the housing are facing forward. See drawing below.



Sensored type compatible speed controls must use the six position JST header part number X-6B-ZRSMX-TK (where X denotes the style of the header) or equivalent. The power motor wire connections must be clearly marked A, B, C on both speed control and motor. A for phase A; B for phase B; C for phase C

8.4.6.2 The sensor assembly and associated electronics may not provide dynamic timing (i.e. timing which varies with motor speed or load).

8.4.6.3 If the stator cannot be easily removed from the outer sleeve of the motor for inspection, then the outer sleeve must have:

- Slots or holes that allow measurement of the stator length using conventional measuring tools
- Slots or holes to allow visual inspection of the laminations and the number of laminations used in the stator

8.4.6.4 If the stator laminations are coated with an insulating material then the manufacturer must provide two areas which are clear of the insulating material approximately 180 degrees apart and in line with any slots or holes to facilitate measurement of the stator stack length.

8.4.6.5 If the nodal (common ring) is coated with an insulating material then the manufacturer must provide an area clear of this material to facilitate measuring the resistance between each motor tab and the nodal ring.

8.4.6.6 The stator lamination plates must be constructed in a manner where they are symmetrical (all 3 slots must be of the same size and shape) and must be arranged so that the slots for the wires are parallel to the axis of the rotor (i.e. may not be skewed around the rotor axis).

8.4.6.7 Motor Cooling: Any active (powered) motor cooling (such as Peltier devices and liquid coolin) other than a single standard 30mm fan are strictly prohibited. Motor heat sink devices directly contacting/attached to the motor must be made of cast aluminum only, no other materials are allowed. Air scoops, ventilation slits, and other passive cooling efforts are allowed. Motor must be at ambient or higher temperature before the start of the race.

#### **8.4.7 540 (05) Motor Size Specifications:**

8.4.7.1 Overall outer diameter of the motor is 36.02mm maximum and 34.00 mm minimum when measured at whatever point yields the maximum dimension, excluding solder tabs, screw heads or lead wires. The outer sleeve of the motor must be round within 0.3mm.

The outer diameter must be concentric with the space formed for the rotor by the stator laminations.

Maximum length is 53.00mm, Minimum length is 50mm measured from the mounting face of the motor to the furthest most point of the end bell, not including solder tabs, lead wires or original manufacturer's logo or name. Motor mounting holes must be on (25.00-25.40mm) centers.

#### **8.4.7.2 540 (05) Spec Wind Motors**

8.4.7.2.1 For ROAR Spec motors defined in these regulations, the stator construction must be continuous laminations having the same overall shape, one after the other without anything in between. The laminations must be of one homogeneous material without cut-outs, holes or hollow sections other than the three slots for the round copper coil wires and three slots for the screws used to hold the entire can together. Unless otherwise defined in the specifications for a particular Spec Motor the overall stator length parallel to the motor shaft shall be a minimum of 19.3mm and a maximum 21.0 mm. The thickness of the laminations shall be 0.35+/- 0.05mm. A 'go-no-go' gauge 14.500 +0.000/-0.005 mm diameter shall pass into the stator, clearing the stator plus its windings and the electrical collection ring at the end of the stator.

8.4.7.2.2 Only three slot "Y" wound stators are permitted for all spec winds. No delta wound or slot less stators are allowed. Only circular (round) pure copper magnet wire permitted.

8.4.7.2.3 Rotors for ROAR Spec Motors: External shaft diameter must be 0.125 inches (3.175mm). Only one piece, two pole Neodymium sintered, or Ferrite (Ceramic) magnetic rotors are permitted. The magnet length shall be 25.0 +/- 1.00mm not including any non- magnetic balancing material. The magnet outside diameter shall be a maximum of 12.51 mm, minimum of 12.20mm no tolerance, for the entire length of the magnet. The shaft outside diameter, where the magnet is mounted, shall be 7.25 +/- 0.150mm for the entire length of the magnet. This dimension must be measurable without destroying the rotor.

8.4.7.2.4 Effective 01/01/2018, rotors for spec wind motors will be identified with the manufacturers name or logo and the unique part number of the rotor. All rotors should also have markings on the flat portion of the output shaft which allows for identification of the rotor without removal from the motor.

8.4.7.2.5 **ROAR Spec 25.5 motor:** The three slotted stator must be wound with 25.5 turns of two strands of wire with a maximum diameter of .643mm per slot. No motor will be approved with a resistance less than 101 milliohms between any 2 phases of the motor (AB, AC, BC), when measured at 25C with an Instek GOM 802 milliohm meter. The stator stack length must be a minimum of 19.7mm and a maximum of 21.0mm. Only 12.3 mm diameter rotors will be permitted in 25.5 Spec motors and the diameter must measure 12.30 +/- .05 mm. The rotor magnet length must be between a minimum of 25.0mm and a maximum of 26.0mm, not including any balancing material.

8.4.7.2.6 **ROAR Spec 21.5 motor:** The three slotted stator must be wound with 21.5 turns of two strands of a maximum diameter of 0.724mm per slot. No motor will be approved with a resistance less than 55.6 milliohms\* between any 2 phases of the motor (AB, AC, BC), when measured at 25C with an Instek GOM 802 milliohm meter.

8.4.7.2.7 **ROAR Spec 17.5 motor:** The three slotted stator must be wound with 17.5 turns of 2 strands of a maximum diameter of .813 mm per slot. No motor will be approved with a resistance less than 35.6 milliohms\* between any 2 phases of the motor (AB, AC, BC), when measured at 25C with an Instek GOM 802 milliohm meter.

8.4.7.2.8 **ROAR Spec 13.5 motor:** The three slotted stator must be wound with 13.5 turns of 2 strands of a maximum diameter of 0.724mm and two strands of a maximum diameter of 0.574mm per slot. No motor will be approved with a resistance less than 20.6 milliohms\* between any 2 phases of the motor (AB, AC, BC), when measured at 25C with an Instek GOM 802 milliohm meter.

8.4.7.2.9 **ROAR Spec 10.5 motor:** The three slotted stator must be wound with 10.5 turns of 2 strands of a maximum diameter of 0.813mm and two strands of a maximum diameter of 0.643mm per slot. No motor will be approved with a resistance less than 14.6 milliohms\* between any 2 phases of the motor (AB, AC, BC), when measured at 25C with an Instek GOM 802 milliohm meter.

\* minimum allowable resistance for each wind may be adjusted based on inspection experience of motors received for approval prior to September 1, 2017.

### 8.4.7.3 **540 (05) Modified 2 pole Motors**

8.4.7.3.1 For ROAR Modified motors defined in these regulations the stator construction must be continuous laminations having the same overall shape, one after the other without anything in between.

The laminations must be of one homogeneous material without cut-outs, holes or hollow sections other than the 3 slots for the round copper coil wires and 3 slots for the screws used to hold the entire can together. Overall stator length parallel to the motor shaft shall be a minimum of 19.3mm and a maximum 21.0 mm. The thickness of the laminations shall be 0.35+/- 0.05mm. Stack inside diameter to be a minimum of 12.50mm to a maximum of 16.00mm

8.4.7.3.2 Rotors for 2 pole Modified Motors: External shaft diameter must be 0.125 inches (3.175mm). Only one piece, two pole Neodymium sintered, or Ferrite (Ceramic) magnetic rotors are permitted. The magnet length shall be 23.00mm – 27.00mm not including any non- magnetic balancing material. The magnet outside diameter shall be a maximum of 15.50 mm, minimum of 12.00mm no tolerance, for the entire length of the magnet.

#### 8.4.4.4 540 (05) Modified 4 pole Motors

8.4.4.4.1 The stator construction must be continuous laminations having the same overall shape, one after the other without anything in between. Laminations must be of one homogeneous material without cut-outs, holes or hollow sections other than the twelve (12) slots for the round copper coil wires and three slots for the screws used to hold the entire can together. **The overall stator length parallel to the motor shaft shall be a maximum of 25.0mm.** The thickness of the laminations shall be a minimum of 0.18 +/- 0.05mm. A “go / no go” gauge 18.00 +0.00 / -0.005mm diameter shall pass into the stator, clearing the stator plus its windings and the electrical collection ring at the end of the stator.

8.4.4.4.2 Only twelve (12) slot stators are permitted. No slot-less stators are allowed. Only circular (round) pure copper magnet wire permitted.

8.4.4.4.3 Only four (4) piece, four-pole magnetic rotors are permitted. The magnet length shall be a minimum of 20.5mm and a maximum of 25.5mm not including any nonmagnetic material. The magnet outside diameter shall be a maximum of 19.0mm, no tolerance, for the entire length of the magnet. This dimension must be measurable without destroying the rotor.

8.4.4.4.4 Motors using rotors with .125 inch (3.175mm) shafts are allowed in all 10<sup>th</sup> scale mod classes. Motors using rotors with 5mm shafts are only allowed in the 4x4 SCT class.

#### 8.4.8 1/8th Brushless Motor Dimensions

8.4.8.1 Can: Maximum overall length is 77.00mm measured from the mounting face of the motor to the furthest most point of the end bell, not including solder tabs, lead wires or original manufacturer's logo or name. Motor mounting holes must be on 1.00- inch (25.40mm) centers.

8.4.8.2 Stator: Motor stator maximum outside diameter is 39mm.

8.4.8.3 Rotor: External shaft diameter shall be 5mm (.197 in.). It may only be either a 2 pole or a 4 pole design with a maximum 12-slot stator.

#### **8.4.9 10th scale 4x4 Short Course Truck (SCT) 550 Motor**

The rules contained in this section apply to 550 motors for use in the SCT 4X4 class only.

8.4.9.1 Can: Diameter is 36.02mm, maximum. Overall length is 73.0mm, maximum, measured from the mounting face of the motor to the furthest most point on the endbell, not including solder tabs, lead wires, sensor plug or housing, or the manufacture's logo or name. Motor mounting holes must be on 25.00mm-25.40mm centers.

8.4.9.2 Stator: Motor stator minimum length is 34.85 mm with a maximum length of 42mm. The thickness of the laminations shall be 0.35mm +/-0.05mm. A 'go-no-go' gauge 14.500 +0.000/-0.005mm diameter shall pass into the stator, clearing the stator plus its windings and the electrical collection ring at the end of the stator.

8.4.9.3 Rotor: External shaft diameter may be either 0.125 inches (3.175mm) or 0.197 inches (5mm). Only one piece, two or 4pole Neodymium sintered, or Ferrite (Ceramic) magnetic rotors are permitted. The magnet length shall be a minimum of 39.0mm and maximum of 46.0mm not including any nonmagnetic balancing material. The magnet outside diameter shall have a minimum of 12.3mm and a maximum of 14.0mm, no tolerance, for the entire length of the magnet.