

BRCA Electric Board

The BRCA Electric Board will be known by the acronym EB.

1. Electric Board Principles

1.1 The powers of this committee are exclusive to the areas of electric motors, rechargeable batteries and the electronic devices used in the control of electric scale models. It will serve the BRCA sections that use these items.

1.2 All BRCA Sections that use items listed in (1.1) above are entitled to be represented on the EB. The representatives are expected to give a true impression of the usage, availability and worth of named components so that the committee as a whole can decide what effect their use has on the sport element of the BRCA as a whole.

1.3 Manufacturers and/or their UK representatives may be invited to present or introduce new items at these meetings.

1.4 The EB will draw up homologation lists for motors and rechargeable batteries that are for the use of the BRCA Electric Sections.

1.5 The EB will investigate tools and procedures and provide such to the BRCA sections to enable them to control the use of items on homologation lists. Funding for this will be raised from homologation fees.

1.6 The EB will not allow the use of any components that would compromise any single section's rules, but any single section may choose not to allow the use of items on the homologation lists.

1.7 All findings, homologation lists or announcements will be published on the official BRCA website.

1.8 Anything not itemised by the EB on the relevant homologation list is specifically not allowed for use.

1.9 The EB reserves the right to remove products from the relevant homologation lists, if it is found that :-

Items are not readily available for purchase within acceptable lead times.

The technical specification/design differs from the homologated sample.

Incorrect information being supplied relating to any item.

This would not include items that ceased to be available due to being superseded by new products.

1.10 Any proposals to the EB for changes to principles or rules have to come via an Electric Section. All proposals will be circulated to all Electric Sections before a decision is taken.

2. Homologation Procedure & Price Limits.

2.1 Before any item is added to the homologation lists, the BRCA Electric Board Homologation Officer will need to be satisfied that any new Motor or Battery submitted for approval, has originated from a recognised distributor and will be available for purchase via retail premises in the UK. Trading by internet sales only is not acceptable.

New items submitted for homologation/approval should be sent to :-

Paul Worsley, 23 Prince Rupert Road, Stourport-on-Severn, Worcs. DY13 0AS.

The EB will review and set maximum retail price limits for Motors and Batteries. These prices may be amended, subject to any UK fiscal changes. The maximum retail prices for the year starting 1st.Jan. 2009 are as follows :-

6 Cell rechargeable battery pack. -- £65.00
(Price pro-rata for other denominations)

Modified Brushed Motors.	-- £62.00
Stock Brushed Motors 27 Turn, (sealed).	-- £31.50 (inc. any tweaks)
Rebuildable Stock Brushed Motors 27 Turn.	-- £31.50 (")
'19' Turn Spec. Brushed Motors.	-- £36.00 (")
Modified Brushless Motors.	-- £85.00
'Spec.' Brushless Motors.	-- £80.00
Lithium Based (LiPo) 7.4v Pack.	-- £85.00
Lithium Based (LiPo) 3.7v Pack.	-- TBA.

Motors

2.2 Manufacturers, Importers and Distributors should note, that if a range/type of motor is to be retailed with a choice of armature design, then a sample of each armature design must be submitted. The same criteria applies to the magnetic Rotors in Brushless motors. Any design variants are required to be submitted for homologation before being allowed at BRCA sanctioned events. All variants homologated must be available for retail purchase.

Standard or Stock motors, including the Rebuildable and '19' Turn Spec. types, should be accompanied by a fee of £20.00 payable to the BRCA. Modified and Brushless motors should be accompanied by a fee of £40. This fee is payable for each and every individual type or range of motor, and will entitle that type or range to be included on the homologation list when the EB Homologation Officer is satisfied with the eligibility and availability of the motor. The motor will remain on the relevant homologation list for a period of five years from the date of first registration with no further fees being payable during this time.

2.3 Manufacturers and importers will be invited to review the homologation lists annually and advise the EB Homologation Officer when a particular type or range ceases to be available for sale. That type or range will then be deleted enabling the current lists to be maintained at a manageable size. [It is not intended that previously homologated motors cease to be eligible when they are removed from the lists – event scrutineers within the UK should not turn away competitors using old motors just because they are no longer shown on the current homologation lists].

Batteries – NiCd & NiMH Cells

2.4 Any new rechargeable NiCd or NiMH cells have to be received by the BRCA Electric Board Homologation Officer by the 1st December each year. No fee is payable.

2.5 Subject to 2.1 & 2.4 (above), the new battery will be included on the homologation list for the following year, and can be legally used at BRCA sanctioned events from the 1st April of that following year. It follows that any new battery becoming available during a calendar year can only be used from the 1st April in the subsequent year. i.e. No new batteries will be homologated during the calendar year or racing season.

2.6 In addition to batteries included on the homologation list, sports/starter level packs of cells that do not have OEM heatshrink, will be allowed at BRCA sanctioned events. These packs must have the original suppliers label intact, stating that they are NiCd or NiMH and the pack capacity. Maximum capacity is 3700mah. These batteries will be allowed at sanctioned events from 1st Jan. 2008.

Batteries – Lithium Based (LiPo) Packs.

2.7 With 2009 being the first year that the BRCA (EB) has officially formulated rules and approval lists for Lithium based (LiPo) batteries, the submission date for samples is extended. Any new rechargeable LiPo battery has to be received by the BRCA Electric Board Homologation Officer by the 31st Jan. 2009. No fee is payable.

2.8 Subject to 2.1 & 2.7 (above), the new battery will be included on the homologation list for the following year, and can be legally used at BRCA sanctioned

events from the 1st April of that following year. It follows that any new battery becoming available during a calendar year can only be used from the 1st April in the subsequent year. i.e. No new batteries will be homologated during the calendar year or racing season. For 2009, the option of a 3.7v LiPo pack may be included with specifications to be confirmed, and a 'rolling' homologation list for the first year.

3. Rules – Rechargeable Batteries.

Individual Electric Sections to decide which battery rules are used within their classes of racing.

NiCd & NiMH Cells.

3.1 The following technical specifications apply to any cells submitted to the BRCA for inclusion onto the BRCA approved list for 2008 onwards.

Only rechargeable NiCd or NiMH cells rated at 1.2 volts nominal will be allowed.

The size of the individual cell(s) to be:-

Diameter -- 23.0 mm +0/-1mm.

Overall length -- 43.0 mm +0/-1.5mm.

Measurements include original manufacturer's heat shrink, which must be substantially intact. Overall length is the maximum length of the complete cell including the positive button, before attaching/soldering any link wires, connectors or battery bars. Dimensions taken at ambient temperature and at 90 degrees to the centre-line of the cell. The original manufacturer of cells are allowed a maximum of +/- 2 grms. tolerance on the nominal weight of the cell stated on the technical specification/data sheet submitted at the time of approval. Weights to conform to BRCA cell approval list for cells approved from Jan. 2007 onwards. Existing approvals having a weight tolerance outside +/- 2 grms. will be adjusted accordingly. NOTE :- It is known that fast charging may result in cell distortion. However from 1st April 2008, cells used at BRCA National events may never exceed 43.0 mm length and 23.0 mm diameter.

3.2 All rechargeable batteries must meet BRCA specifications before they will be approved by the BRCA Electric Board. Details of newly approved rechargeable batteries will be published on the BRCA website. Only batteries appearing on the official BRCA website homologation list published in January will be legal for use at BRCA sanctioned events from 1st.April of that calendar year.

Lithium Based (LiPo) Battery Packs.

The storage, charging and use of Lithium based batteries (LiPo) can give rise to serious safety implications. The BRCA will publish guidelines for the safe use of these batteries on the BRCA website. It is imperative that the guidelines are studied and adhered to.

3.3 Lithium based (LiPo) battery packs must have a hard, protective case that completely envelopes the cell(s). The case should be made from ABS or a similar material. The two halves of the case must be factory sealed in a way that any attempt to open the case will destroy the case. The only opening in the case that is allowed, is for the exit of wires.

3.4 For 7.4v Packs: The maximum case sizes allowed are as follows: -

Length: 139.0mm.

Width: 47.0mm. (The max. width includes any side exit wires).

Height: 23.5mm. (In addition, chassis location protrusions are allowed)

Saddle-Pack cells are allowed, and must comply with the above width and height dimensions. Saddle-Pack cells must have a combined length dimension of 139.0mm max when placed end to end.

For 3.7v Packs: The maximum case sizes allowed are as follows :-

Length: 93.0 mm

Width: 47.0 mm

Height: 20.0 mm

3.5 Individual cells used in the construction of the battery pack shall be rated at 3.7 volts nominal. Individual cells may be wired in parallel.

For 7.4v Packs: The maximum connection 'In Series' is two, to give a Final pack voltage of 7.4v nominal.

For 3.7v Packs: Cells can only be connected in parallel, to give a Final pack voltage of 3.7v nominal.

3.6 The battery pack shall have leads extending from the case for the positive and negative electrical connections using wire of adequate size to handle discharge rates acceptable to racing applications. Alternatively, the case shall have internal connection points for these wires clearly marked positive and negative so the user can apply the lead wires. It is strongly advised that the link wire for Saddle Pack cells utilises a plug which will separate with any undue force.

3.7 The case must have the original suppliers label intact, stating the rated voltage and the pack capacity. Maximum capacity is 5,500 mah. The Brand name/logo shall be easily readable.

3.8 All LiPo batteries must be charged with a LiPo-capable charger using the industry standard CC/CV (Constant Current/Constant Voltage) charge profile.

3.9 LiPo batteries may be charged to a maximum of:-

8.40V for cells/batteries connected in series giving a pack voltage of 7.4v nominal.

4.20V for cells/batteries connected in parallel giving a pack voltage of 3.7v nominal.

Overcharging is a serious safety hazard and will not be tolerated.

3.10 Any competitor found to be charging cells using a charger that is not specifically designed for LiPo batteries, or using a charge profile other than the industry standard CC/CV, will be disqualified from the event.

Any competitor found to have charged LiPo batteries to above 8.40V or 4.20V (as detailed in 3.9) will be disqualified from the event.

4. Rules – All Classes of Electric Motors.

4.1 There are currently six classes of Electric Motors, for which the EB approve and control homologation lists:-

Modified Brushed Motors.

'27' Turn Standard or Stock Brushed Motors. (sealed Endbell)

'27' Turn Rebuildable Standard or Stock Brushed Motors

'19' Turn 'Spec.' Brushed Motors

Modified Brushless Motors.

'Spec.' Brushless Motors

The first four of these classes must comply with all the specifications in this section (4). In addition, each class of motor has further rules covered by sections 5 – 10 inc. Brushless Motors are covered by rules detailed in sections 9 & 10. Brushless Motors do not have to comply with rules 4.3 & 4.8 in this section (4).

4.2 All motors must meet BRCA specifications before they will be approved by the BRCA Electric Board. Newly approved motors must be included in the homologation lists published on the BRCA website prior to being legal for use in BRCA sanctioned meetings.

4.3 Only industry standard '05' motors may be used, the specifications of which are as follows :-

The Can and Endbell: The basic can diameter, before any surface finish is applied, is 36.02 mm maximum. The overall length of the assembled motor is 53.0 mm maximum, measured from the mounting face of the motor to the furthest point of the end bell, not including solder, tabs or lead wires. Only ceramic, Neodymium or Ferrite magnets can be used (Cobalt and other rare earth magnets are not allowed). There is no limit on the number of magnets used. Current is supplied to the armature commutator by 2 brushes.

The Armature: The shaft diameter is 3.175 mm (.125 inches), production tolerances are allowed. The rotor has to have three poles with windings. Length of stack is to be 21.00mm min. to 22.80mm max (both dimensions measured with epoxy/hysol insulation coating removed). The thickness of the 'stack' laminations is 0.35mm +/- 0.05mm. Only Copper wire is to be used for the winding. All motors submitted for approval from 01.01.06. must use round copper wire. The armature has to be permanently marked by the manufacturer, showing the number of windings and the name of the manufacturer. It is acceptable to use a permanently fixed 'Tag' giving this information.

[These above specifications provide the basic description of an '05' motor on which the Homologation Officer will base his eligibility decisions. It is not intended that event scrutineers should attempt to carry out any checks regarding the above measurements, rather, once the motor has been accepted by the Homologation Officer and detailed on the relevant homologation list, then the details on that list will be a sufficient check for event eligibility.]

General.

4.4 If an approved type/range of motor is changed in any substantial way, it must be resubmitted for approval, and must be available at retail outlets incorporating such changes. Examples:- can colour, label design, brush dimensions, orientation of the brushes, stack or stator designs, rotor designs or design change of any of the major components or assemblies. Any variants of interchangeable components produced by the motor manufacturer, must be available at retail outlets and be submitted for approval before being allowed. Addition or removal of screw-fixing heatsinks is allowed. Change of end-bell colour is allowed providing all design features are maintained.

4.5 The swapping of components between approved motors, (a.k.a. hybrids) is not allowed.

4.6 All approved motors are subject to checking at any time by the BRCA Homologation Officer to verify that they are still in compliance with BRCA specifications.

4.7 All motors used in BRCA sanctioned meetings must have their original motor builders label(s) substantially intact to be eligible.

4.8 The method of attaching brushes (eg. solder, screw fixing) and the choice of brushes and springs is not restricted, providing the original end bell assembly is retained and the changes do not contravene 4.4 above.

5. Rules - Modified Brushed Motors

5.1 All motors must conform to the specifications contained in section 4.

5.2 The base motor may be modified by re-winding, epoxying, balancing, adding cooling holes or ball bearings, providing the changes do not contravene section 4 rules.

5.3 Replacement armatures are allowed, providing they have been approved and are available from the manufacturer of that motor.

NOTES.

(a) 19Turn Spec. and 27Turn Stock motors can be used at BRCA sanctioned events that run to 'modified' rules providing :- they are included on their respective homologation lists and the event rules do not specifically ban their use.

(b) At EFRA sanctioned events:

The armature has to be permanently marked by the manufacturer, showing the number of windings and name of the manufacturer. The manufacturers name on the armature must be the same name as on the motor label.

Split rotors are not allowed. There is no 'wind' limit.

6. Rules - Standard Or Stock Brushed Motors (sealed Endbell)

6.1 All motors must conform to the specifications contained in section 4.

No new motors in this class have been submitted for homologation since Dec. 2000, and it is thought unlikely that there will be any in the future. The homologation list for approved motors in this class will be maintained and published on the official BRCA website, but the rules and specifications applying to this class are no longer considered necessary. The rules/specifications can be obtained from the EB secretary if required.

7. Rules - Rebuildable Standard/Stock Brushed Motors (RSS)

Various rules within this section were amended for 2006 onwards, to reflect the manufacturing restrictions and tolerances that currently exist with RSS motors.

7.1 All motors must conform to the specifications contained in section 4.

The Can.

7.2 Motors submitted for approval as RSS motors must have the manufacturer's name in the form of "XXXX 27" (e.g. EPIC 27, YOK 27, etc.) permanently stamped into the mounting face of the motor can. "XXXX 27" designates the use of the can for standard or stock class racing. The manufacturer's name on the can will make hybrid motors easy to identify. Any deliberate violation of this rule will be cause to remove all motors of that manufacturer from the approved motor homologation list for a minimum of one year.

7.3 All RSS motor cans must be of the bushing type, (ball bearings are not allowed). The can will have two pairs of mounting holes. The pairs of mounting holes can be positioned by either of the following :-

a) Both pairs within the space between the magnets. The line through the mid-point between each pair of mounting holes must pass through the centre of the can and is determined as being zero degrees.

b) One pair within the space between the magnets. The line through the centre of these holes must pass through the centre of the can and is determined as being zero degrees. The second pair will be at 90 degrees to the zero degree line.

The zero degree line will be marked on one side of the can to indicate zero degrees. The centre of each magnet (or assembly of magnets) on each side of the can will be at 90 degrees to the 0 degree centre-line, with a tolerance of +/- 3 degrees. The can will incorporate a slot to positively lock the end bell at a designated timing advance of 24 degrees.

7.4 Magnets must be permanently glued to the motor can and may not be removed. No magnet shims are allowed (e.g. an extra shim that could be added on the end of the magnet or between the tips to change performance). Flux collector/timing rings are allowed as long as their only purpose is to secure the end bell to the motor can. Such rings may not extend between the magnet tips.

7.5 The motor can must have inspection holes/slots between magnet tips so that the armature may be viewed for inspection of the armature tag. These holes/slots may be no closer than 5.00mm from either the open end or mounting face of the motor can. The view through the inspection holes/slots must not be obstructed by anything covering the holes/slots (e.g. motor label).

The End-Bell.

7.6 All RSS motor end-bells must be of the bushing type, (ball bearings are not allowed). The end bell will incorporate a moulded 'tab' (or machined 'tab' for metal end-bells), which when assembled to the slot in the can (detailed in 7.3) must positively lock the timing of the assembly at a designated timing advance of 24 degrees. (This feature is in addition to any method that secures the end bell to the can, e.g. screws running through the side of the can). When the end-bell assembly is secured to the can, the brush hoods will be aligned at 90 degrees to the can zero

line, plus the allowed timing of 24 degrees ± 1 degree. Extra locking devices (e.g. extra notches in the motor can that allow timing to be changed are not allowed. Brush hoods/tubes will be assembled at 180 degrees apart. The centre of the brush hood/tube will be in-line with the centre of the armature. Modification to the brush gear components to give alternative alignment is not allowed.

7.7 The end bell may have inspection/cooling holes on each side between the negative and positive terminals. These holes would facilitate inspection of commutator tabs. End bells must be marked with the manufacturer's name.

The Armature.

7.8 All RSS armatures have to comply with the stack length dimensions and laminate thickness as detailed in 4.3. Additionally :-

- (a) Motors submitted for approval from 01.01.06 onwards will have a minimum stack web width of 3.5mm with epoxy/hysol insulation removed.
- (b) Motors approved prior to 01.01.06 that have a minimum stack web width of less than 3.5mm (with insulation removed) will have a minimum of 1626mm of wire per. pole.

7.9 All RSS armatures will incorporate a design which locks the commutator to the armature stack so the timing cannot be changed. The commutator slots must be aligned with the centre of the individual poles, with a tolerance of ± 2 degrees.

7.10 All RSS motor armatures must be machine wound using a "Mabuchi" cross wrap technique. Only round copper wire of 22 AWG (American Wire Gauge) can be used, resulting in no less than 27 continuous turns of wire on each pole. A production tolerance of one turn on one pole only is allowed. There is no plus tolerance allowed on the wire diameter. 'Hand winding' is not permitted.

7.11 Tabs on the armature's commutator may only be "compression welded". No after-market welding, soldering or silver brazing will be permitted.

7.12 The armature must be tagged in such a way that it is easy to identify both in and out of the motor. The tag must be permanently affixed to the armature and made of a material that will not self destruct from the heat of the motor or propriety motor cleaning agents. The tag should be positioned between two poles of the armature and must be a minimum of 12.7mm in length, printed with the OEM manufacturer's name and "27" (e.g. "EPIC 27", "YOK 27", etc.).

7.13 The armature shaft must extend 3.175mm minimum, beyond the end bell bushing when the motor is assembled. The overall length of the armature shaft should be 70.49mm with 9.78mm extending beyond the end of the commutator. The commutator end of the armature shaft must be coned (tapered) and must differ from the standard radius currently used by OEM manufacturers in production of other motors. The taper should continue for a minimum of 1.52mm from the end of the shaft. Dimensions are not critical, production tolerances allowed.

7.14 Epoxy balancing of armatures for RSS motors will not be permitted.

7.15 No modifications to the OEM armature stack may be made, other than the drilling/grinding of balancing holes. Modifications to the OEM designs, including (but not limited to) excessive drill holes, milling or turning to lighten or enhance the performance of the armature are not allowed.

Timing.

7.16 The overall timing of the assembled motor is determined by the allowed tolerances of the individual assemblies. I.e. Magnet position, Commutator position, location of End-bell to can.

General.

7.17 The visible hole for the bushing, in both the end bell assembly and the motor can, must be no smaller than 5.33mm diameter. This will allow easy verification that the motor bushings have not been replaced with ball bearings and inspection will not require disassembly of the motor.

7.18 No modifications to the OEM construction/design of the motor can, end bell, or armature will be permitted. (e.g. adding or removing material from the armature stack, changing the dimensions or orientation of brushes or brush hoods, relocating spring posts).

7.19 The armature, motor can, and end bell of an RSS motor must all be from the same OEM and can contain only components from the same model. No hybrid motors or mixing of parts from different models will be permitted.

7.20 An RSS motor that shows any sign of tampering will be disqualified. At events where RSS motors are provided, the driver is responsible for any signs of tampering.

8. Rules - '19' Turn Spec. Brushed Motors.

Various rules within this section were amended for 2006 onwards, to reflect the manufacturing restrictions and tolerances that currently exist with 19T Spec. motors.

8.1 All motors must conform with the specifications contained in section 4. All motors within this class must conform with the specifications detailed in section 7, (Rebuildable Standard or Stock Motors) with the following exceptions.

The Can.

8.2 The can should ideally be permanently stamped with the name of manufacturer and '19' similar to section 7.2. This is not mandatory.

8.2.1 The can will incorporate a slot(s) to locate the end bell at a designated timing advance. The slot or slots can allow any timing advance, up to a maximum of 24 degrees.

8.3 Ball-raced bearings are allowed.

The End-Bell.

8.4 Ball-raced bearings are allowed.

The Armature.

8.5 All 19T Spec. armatures have to comply with the stack length dimensions and laminate thickness as detailed in 4.3. Additionally :-

- (a) Motors submitted for approval from 01.01.06 onwards will have a minimum stack web width of 3.5mm with epoxy/hysol insulation removed.
- (b) Motors approved prior to 01.01.06 that have a minimum stack web width of less than 3.5mm (with insulation removed) will have a minimum of 1170mm of wire per. pole.

8.6 Only full stack armatures with no cut-outs are allowed. No split, skewed, tri-rotors etc. are allowed. Longitudinal slots/grooves parallel to the armature shaft in the pole crowns are not allowed on any armature introduced after 01.01.02. The crowns of each pole must be symmetrical in cross section, with a constant crown radius. Steps in the crown are not allowed.

8.7 The armature will be wound using a single wind of round 19 AWG (American wire Gauge) copper wire giving 19 Turns. It is not mandatory to use the 'Mabuchi' cross wrap technique for winding the armature, (as stated in section 7.10). There is no plus tolerance on the wire diameter. Armatures must be machine wound, 'hand winding' is not permitted. It is not mandatory to use a locking device between the commutator and the armature stack., (as stated in section 7.9)

8.8 Armatures have to be either :- stamped with the wind and name of manufacturer by the manufacturer, or can be 'tagged' (as per rule 7.12 but with '19').

8.9 The armature shaft does not have to extend beyond the end bell, but any extension has to have a reduced diameter to form a parallel step. (The 'cone shape and dimensions in section 7.13 do not apply).

Timing.

8.10 The overall timing of the assembled motor is determined by the allowed

tolerances of the individual assemblies. I.e. Magnet position, Commutator position, location of End-Bell to Can.

9. Rules - Modified Brushless Motors.

The following rules have been agreed by EFRA and various International organisations.

9.1 All motors are subject to the applicable rules in section 4. (4.2, 4.4, 4.5, 4.6, 4.7)

9.2 Sensored or sensorless motors are allowed.

9.3 The motor has to be rebuildable. Ball bearings are allowed. The motor must be constructed to allow easy replacement of the: rotor, bearings and front end-bell/plate.

9.4 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-P0.5 26-28 awg. contacts or equivalent.

Wire sequence must be as follows:-

Pin #1 - Black wire ground potential

Pin #2 - Orange wire phase C

Pin #3 - White wire phase B

Pin #4 - Green wire phase A

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

Pin #6 - Red wire + 5.0 volts d.c. +/- 10%.

Compatible speed control must use the 6 position JST header part number X-6B-ZR-SMX-TF (where the X denotes the style of the header), or equivalent.

The motor power connectors have to be clearly marked A, B, C.

A for phase A. B for phase B. C for phase C

9.5 The Can. (Based on `05` size specifications).

The overall dimensions of the assembled motor do not include :- solder tabs, lead wires or the original manufacturers logo or name.

Overall maximum diameter is 36.02mm measured at whatever point yields the maximum dimension. Overall minimum diameter is 34.0mm measured at whatever point yields the minimum dimension. Maximum length is 53.0mm measured from the mounting face of the motor to the furthest point of the end bell. Minimum length is 50.0mm measured from the mounting face of the motor to the furthest point of the end bell. Motor mounting holes must be on nominal 25.0/25.4mm centres.

9.6 The Stack/Stator : The stack or back-iron must be continuous. The laminations have to be one after the other without anything in between. Stack/back-iron minimum length 19.3mm, maximum 21.0mm. The thickness of the stack/back-iron laminations is 0.35 +/- 0.05mm. All laminations must be of the same material. Inside diameter of stack or windings equals the central space between the laminations or assembly of windings and must accept 'plug' gauges of 12.5mm minimum, 16.0mm maximum. These dimensions to be measured with the centre of the 'plug' gauge in-line with the centre of the motor can. (ie. concentric to can).

9.7 The Winding: Only three slot (phase) "Y" (star) or delta wound stators are allowed. Only circular (round) pure copper wire permitted. No turn limit.

9.8 The Rotor: Shaft diameter must be 3.175mm where the pinion gear locates. Only one piece, two pole Neodymium or Ferrite magnetic rotors are permitted (bonded or sintered). Magnet minimum length 23.0 mm, maximum 27.0 mm. Magnet minimum diameter 12.0mm, maximum 15.5mm. The original Rotor can be changed providing the replacement: complies with the above specifications, has been approved, is supplied by the motor manufacturer and is available retail.

9.9 All motors must have the original manufacturer's logo or name moulded/engraved into the end bell/plate.

10. Rules - Spec. Brushless Motors.

(21.5T, 17.5T, 13.5T and 10.5T)

The following rules have been agreed by EFRA and various International organisations. Motors in the Brushless Spec. classes have specific design features that differ from modified versions. Brushless Spec. motors must conform to Section 9 rules (Brushless modified) with the following exceptions.

10.1 All motors are subject to the applicable rules in section 4, (4.2, 4.4, 4.5, 4.6, 4.7)

10.2 Only sensed motors are allowed in the Brushless Spec. classes. Sensor connection requirements are as 9.4 (Brushless Modified)

It is not mandatory that sensed Speed Controls have to be used, or that the sensor 'harness' has to be connected.

10.3 The Stack/Stator: Slot-less stators are not allowed. The stator must be continuous laminations having the same overall shape, being 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 for the three slots of copper coil wires and the three grooves for the screws used to hold the entire assembly together. Stator minimum length 19.3mm, maximum 21.0mm. The thickness of the stator laminations is 0.35 +/- 0.05mm. The Inside diameter of the stator must accept a 'plug gauge' of 14.50mm +0/-0.005 diameter, clearing the stator, plus its windings and the electrical collection ring at any end of the stator.

10.4 The Winding: Only three slot (phase) "Y" (star) wound stators are allowed. No delta wound stators allowed. Only circular (round) pure copper wire permitted. The three slotted stator must be wound with: -

21.5T Class:- 21.5 turns of 2 x 21 awg. (or 0.71mm)

17.5T Class:- 17.5 turns of 2 x 20 awg. (or 0.80 mm).

13.5T Class: - 13.5 turns of 2 x 21 awg. (or 0.71mm), & 2 x 23 awg. (or 0.56mm).

10.5T Class: - 10.5 turns of 2 x 20 awg. (or 0.80mm), & 2 x 22 awg. (or 0.65mm).

10.5 The Rotor: Shaft diameter must be 3.175mm where the pinion gear locates. Only one piece, two pole Neodymium bonded or sintered, or Ferrite (ceramic) magnetic rotors are permitted. Magnet length will be 25.00 +/- 1.00mm, not including any non-magnetic balancing aids. Magnet outside diameter will be 12.20/12.51mm (min./max. with no further tolerance) for the entire length of the magnet. The shaft outside diameter where the magnet is mounted will be 7.25mm +/- 0.15mm, with this diameter extending beyond the magnet to facilitate measurement.

10.6 All motors must have the original manufacturer's logo or name moulded/engraved into the end bell/plate. A unique marking or feature that is difficult to remove must be incorporated into the assembled motor to identify the motor is either a 21.5T, 17.5T, 13.5T or 10.5T Spec. class motor.

NOTE: The above rules form the basis for Brushless Spec. motors. If it is found that variations of these motors from different manufacturers, give large differences in performance, then electrical tests may be adopted.