# EFRA HANDBOOK 2025

# EFRA ASSOCIATE MEMBERS EFRA

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# APPENDIX 4
# LITHIUM BATTERIES FOR ALL ELECTRIC CLASSES - TECHNICAL, RACE PROCEDURES & HOMOLOGATION.

# BRUSHLESS MOTORS 05 SIZE FOR 1/12th AND 1/10th ELECTRIC CLASSES.

**1 LITHIUM BATTERIES - TECHNICAL SPECIFICATIONS:**

EFRA approved cells will be Lithium based (LiPo/LiFe). Each Electric Section will define the number of cells and the maximum nominal rated voltage.

1.1 Lithium Based (LiPo/LiFe) Batteries can be approved, but must conform to the following :-

Lithium Based (LiPo/LiFe) 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 exit wires or pin type connections. The outline shape of the battery 'hard-case' must be 'cuboid' (six flat surfaces with all angles 90 deg.), edges and corners can be radiused and a 'step' or 'recesses' are allowed in the area of tube connectors in the interest of safety to prevent any short circuit.

1.2 The maximum case sizes, including any manufacturer incorporated plugs or connections are as follows:

4S Batteries:

Length: 139.0mm.
Width: 47.0mm (the max. width includes any side exit wires).
Height: 48.2mm (Chassis location features additional to this dimension are allowed).

2S Batteries:

Length: 139.0 mm.
Width: 47.0 mm, (the max. width includes any side exit wires).
Height: 25.10 mm (Chassis location features additional to this dimension are allowed).
Saddle-Pack cells are allowed, but must comply with the above dimensions. Saddle-Pack cells must have a combined dimension of 139.0mm max when placed end to end.

1S Batteries:

Length: 93.0mm.
Width: 47.0mm (Side exit wires are allowed outside this dimension).
Height: 18.5mm (Chassis location features additional to this dimension are allowed).

1.3 Batteries to comply with the weights specified on the EFRA homologation list, (maximum tolerance for manufacturers is +/- 4%).

1.4 Individual cells used in the construction of the battery pack shall be rated with a nominal voltage of no more than (LiPo 3.8v/LiFe 3.3v). Individual cells may be wired in parallel.

For 4S Packs:- the maximum connection "In Series" is four, to give a maximum pack nominal voltage of - LiPo 15.2v & LiFe 13.2v.

For 2S Packs:- the maximum connection "In Series" is two, to give a maximum pack nominal voltage of - LiPo 7.6v & LiFe 6.6v.

For 1S Packs:- cells can only be connected in parallel to give a maximum pack nominal voltage of - LiPo 3.8v & LiFe 3.3v.
NOTE: Cells with a nominal voltage of no more than 3.8v have been allowed at EFRA events since 1st. April 2017. All previously approved cells with a nominal voltage of no more than 3.7v maintain their approval.
**The maximum charging cut-off will remain at 4.20v per cell.**

1.5 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. Any type of metal connections that are incorporated in the battery pack by the manufacturer must be substantially below the major surface of the plastic casing, to prevent any "short circuit" if placed on a conductive surface. Any type of connection adaptors added, that are conductive and protrude above the level of the plastic case must be removed before the battery is removed from the car.

1.6 The case must have the original suppliers label intact, clearly stating:- the Part # of the pack, the rated nominal voltage, the chemistry (Lipo/LiFe), the rated energy capacity of the pack in Wh. and the 'C' rating of the pack. The Brand name/logo shall be easily readable.
NOTE: From 2017 onwards; Saddle Pack batteries that are 'hard wired together can state the nominal voltage of the combined number of batteries, BUT Saddle Pack batteries supplied as individual batteries (not hard wired together), MUST show the correct nominal battery voltage for each individual battery on the labels, not the combined voltage.

1.7 As EFRA events are International, EFRA will only accept batteries for approval that comply with the maximum energy capacities required by passenger airlines.

**2. LITHIUM BATTERIES - RACE PROCEDURES:**

EFRA will publish approved Battery Lists each year, showing all the batteries that have been homologated and are eligible for use at EFRA sanctioned events. This includes any batteries that are included on any 'official archive' lists. Only batteries shown on the official EFRA website will be legal for use at EFRA sanctioned events.
All Lithium Batteries must comply with the published data shown on the EFRA Approved Battery Lists. Batteries that are not compliant with the dimensional rules or published weights will not be allowed.

2.1 Modifications to the original battery case, by removal of material or any modification that could be deemed to affect safety is not allowed.

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

2.3 Any competitor found to be charging cells using a charger that is not specifically designed for LiPo/LiFe cells, or using a charge profile other than the industry standard CC/CV, will be penalised at the event.
Any competitor found to have charged LiPo/LiFe cells to above the voltage values detailed in rule 2.7 (below) will be penalised.

2.4 LiPo/LiFe drive batteries must be in a 'Lipo sack' at all times when being charged or discharged. This applies to any discharging procedures except during a race or when using organiser supplied resistors. Anybody not doing this, will be penalised at the event.

LiPo sack is defined as a receptacle designed for the purpose of charging LiPo/LiFe batteries and of a suitable construction as to contain a LiPo/LiFe fire.

2.5 The use of any additional heating of any type, to heat a LiPo/LiFe Battery is not allowed. The use of any cooling devices or "freeze" sprays of any type to cool a LiPo/LiFe battery is not allowed.

2.6 If multiple individual batteries are connected together (in parallel or series), then all batteries used must be of the same manufacturer brand and same Part Number.

2.7 4S LiPo/LiFe Batteries: may be charged to a maximum of 16.80v (LiPo) resp. 14.80v (LiFe).
2S LiPo/LiFe Batteries: may be charged to a maximum of 8.40v (LiPo) resp. 7.40v (LiFe).
1S LiPo/LiFe Batteries: may be charged to a maximum of 4.20v (LiPo) resp. 3.70v (LiFe).
Overcharging is a serious safety hazard and will not be tolerated.

2.8 Batteries cannot be charged or changed during a race.

2.9 It is only allowed to charge the batteries at maximum 12A or the maximum charge rate as stated by the manufacturer as stated on the homologation lists, discharge at maximum 20A. This is a matter of safety. If, during a control, someone is caught violating this rule, he will be asked to leave the accommodation immediately. Result for this person is DQ for the whole event.

**3. LITHIUM BATTERIES – APPROVAL PROCEDURES:**

3.1 From 2009, EFRA only homologates Lithium based batteries. Lithium based (LiPo or LiFe) batteries must be submitted to EFRA for approval and be listed on the EFRA homologation lists before being allowed at EFRA sanctioned events. Manufacturers or their agents will be responsible for paying all approval fees. The approval fees for each individual battery are detailed in General Rule 3.5.7.

3.2 Submission dates:-
4S Batteries - A minimum of one individual battery has to be received by 1st Dec.
2S Batteries - A minimum of one individual battery has to be received by 1st Dec.
1S Batteries - A minimum of one individual battery has to be received by 1st Dec.
Cells received after the above submission dates (1st Dec.) will not be included on the EFRA approved list for the following year

3.3 Each individual battery sample must be supplied with :
(a) Lithium based batteries must be covered by their safety test certification in accordance with UN Manual of Test and Criteria ST/SG/AC.10/11/Rev.8 (or Rev.7/Amend.1), Part 3, Sub-Section 38.3, Tests T1 to T8.
(b) Technical Spec. sheet detailing; the recommended maximum charging rate, the maximum voltage when charging, case material, case wall thickness and method of sealing the case, the battery weight (max tolerance +/- 4%).
(c) Name and contact details of a minimum of two appointed distributors for the batteries in EFRA member countries.

3.4 New batteries have to be submitted to the EFRA Battery Homologation Officer for approval. Subject to the Homologation Officer being satisfied that the new battery conforms with technical specifications and commercial availability, the battery will be legal for use at EFRA sanctioned events from:
4S Batteries - the following April 1st.
2S Batteries - the following April 1st.
1S Batteries - the following March 1st.

3.5 Any changes to the technical specifications or visual appearance of the battery or casing after the original approval ,will require re-approval.

3.6 All previously approved batteries may be used for their lifetime or until their specifications no longer comply with the original one that was approved. It is the driver's responsibility to prove the legality of his batteries in case of doubt.

**4. BRUSHLESS MOTORS (05 Size) FOR ELECTRIC 1/12th & 1/10th SCALE CARS:**

All EC and GP events will clearly state which class of motors to be used. From May 2016, only motors included on the EFRA Homologation Lists are allowed at EC and GP events in the 1/12th. & 1/10th. Electric Classes.

4.1 EFRA homologate two types of Brushless Motors -- 'MODIFIED' & 'SPEC.'

(a) For MODIFIED motors: sensored or sensorless motors are allowed.

(b) For 'SPEC' Class motors: only sensored motors are allowed.

4.2 When the motor is sensored:-

It must use a six position JST ZH connector model number ZHR-6 or equivalent connector with 6JST 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, 10K thermistor referenced to ground potential
Pin #6- Red wire +5.0 Volts DC +/-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 header), or equivalent. The power connector has to be clearly marked A, B, C: A for phase A, B for phase B and C for phase C.

**ALL MODIFIED & 'SPEC' Class Brushless Motors 05 size must comply with the following:-**

4.3 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.

4.4 All motors must have the original manufacturer's name or logo permanently marked by the manufacturer into the end bell or end-plate.

4.5 No hybrid motors allowed (mixing of parts from different manufacturers), with the exception of Rotors in Modified Motors only that were approved prior to 01.04.15.

4.6 No modifications, designs changes or removal of materials are allowed to any approved motor. Only 'optional' parts or rotors detailed on the EFRA Approved Lists are allowed. Any changes or modifications will require the motor to be re-submitted for approval.

4.6.1 It is the competitor's responsibility to ensure that any motor used at an EFRA sanctioned event complies with all EFRA rules. If any motor is found to NOT comply with the EFRA motor rules, any results using such motor will be disqualified, regardless if the motor is included on the EFRA homologation list. If there is definitive proof available; that the motor manufacturer supplied a motor (to the competitor) that does not comply with EFRA rules, then sanctions could be taken against the specific manufacturer(s).

4.7 Can Assembly (not including rotor shaft):- Overall maximum/minimum diameter is 36.02mm./34.00mm. measured at whatever point yields the

maximum /minimum dimension, excluding solder tabs or lead wires.
Overall maximum/minimum length is 53.0mm./50.00mm. measured from the mounting face of the motor to the furthest most point of the end bell/plate, not including solder tabs, lead wires or original manufacturer's logo or name.
Motor mounting holes must be on nominal 25.0 to 25.4mm centres.

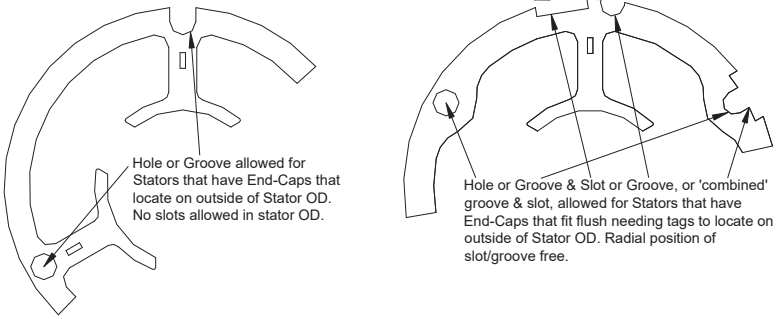
4.8 Can/Casing design requirements to allow verification of stator sizes, design and construction.
Rule has been updated many times to accommodate various manufacturer design changes:-

a) Before 2012, motors were not required to have any holes or slots for stator verification. Stators did not have to be removable.
b) From 2012, if the stator cannot be easily removed from the assembled motor, the Can/Casing was required to have holes or slots to allow measurement of the stator and visual appraisal of the laminates. Then from 01.03.18 a minimum two pairs slots or holes (each exposing 3mm of stator ends minimum), in line with the centre-line of the stator, that will allow measurement of the stator length. And slots or holes to allow visual appraisal of the laminates.
c) Starting 01.03.21, any new motor submitted for homologation must have a minimum of one full length slot in the motor casing, parallel to the centre-line of the stator, to allow all laminates to be viewed. This slot(s) must have length and width dimensions sufficient to allow stator length measurement using conventional measuring tools.

Older approved motors without all the above features retain their homologation status.

4.8.1 From 01.01.25. Whilst the design of the Can/Casing or separate End-Caps is not restricted, these items must be of a circular design with the outer circumference unbroken in area's diametrically opposite, to allow direct measurement of the outer diameter at several points with conventional instruments.

4.9 Stator: 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 (if needed) the three grooves or holes for the screws used to hold the entire assembly together.
If the motor design comprises of a stator assembly with separate End-Caps directly clamped flush to the stator end laminates, it is allowed for the stator laminates to have maximum three (3) slots or grooves at maximum width of 5.0mm. in the stator outer circumference, to locate the End-Caps concentric with the stator. These location slots or grooves can be incorporated in the area used for clamping screws, or in an area of the circumference separate from the grooves or holes used for clamping screws. All laminates must include any slots or grooves used. No other slots in the stator outer circumference are allowed.
Stator minimum length 19.30mm, maximum 21.00mm measured across the metal surfaces of the laminates and not including any coatings. The faces of the end laminates of the stator must be free of any coatings or mouldings for minimum 1mm from the outer circumference to allow direct measurement across the metal faces of the stator ends (to be applied to any new motor range submitted from 01.03.18). The outer circumference edges of the end laminates must be complete with no material removed, to allow accurate measurement.
The thickness of the stator laminations is 0.35 +/- 0.05mm. All laminations must be of the same material.




NOTE : Whilst all laminates in the stator must have the 'same overall shape/ design', removal of sharp edges is allowed in the winding area on the end laminates (only) to offset damage to wire coatings. This is clarified as follows:- The top and bottom laminate in the stator stack of Brushless Motors covered by these rules may be deburred or chamfered only on the wire winding web/ leg, so long as the overall thickness of these end laminates is the same as other laminates in the stator and so long as the overall measured width of the wire winding web/leg of these end laminates is the same as other laminates in the stator. This requirement effectively restricts any deburring or chamfering to only the top and bottom laminates in the stator.

**MODIFIED BRUSHLESS MOTORS - 05 SIZE**
**Specific Requirements & Dimensions.**

4.10 Inside diameter of the stator must accept "plug" gauges of 12.5mm minimum, 16.0mm maximum.

4.11 The winding: Delta and Y wounded stators are permitted. Only circular (round) pure copper is permitted. There is no turn limit, but individual Classes may restrict the number of turns to a specific minimum.
No solid glue or 'filler' can be added to the wires of the final winding assembly. When the stator has been 'cut' to gain access to the wires, unwinding of the wires must be possible by normal 'hand' procedures. A small amount of lacquer added to the winding is allowed, providing unwinding by hand is possible.

4.12 The Rotor: Shaft diameter where the pinion gear mounts must be 3.175mm. Only one piece, two poles Neodymium bonded or sintered, or Ferrite magnetic rotors are permitted. The rotor will be identified with the manufacturers name or logo and the unique part number. Applies to all rotors in new motors or new optional rotors starting from 1st. April 2015 onwards.
Starting 01.03.21, any new motor or new optional rotor submitted for homologation must have the unique part number of the rotor etched/stamped on the external flat area of the rotor shaft (where the pinion is located). This must be the listed part number as shown on the homologation list. Rotor sizes/ dimensions are not acceptable.
Magnet: Minimum length 23,0mm. Maximum 27,0mm. Magnet minimum diameter 12,0mm, maximum 15,5mm. not including any non-magnetic balancing aids.

**'SPEC' CLASS BRUSHLESS MOTORS - 05 SIZE**
**Specific Requirements & Dimensions.**

The following rules have been agreed by various International organisations.
Applicable to motors of :- 21.5T, 17.5T, 13.5T and 10.5T wind limit.

4.13 Only sensored motors are allowed in the Spec. classes. It is not mandatory that sensored Speed Controls have to be used, or that the sensor "harness" has to be connected.

4.14 The Inside diameter of the stator must accept a "plug gauge" of 14.50 mm +0/-.005 diameter, clearing the stator, plus its windings and the electrical collection ring at any end of the stator.

4.15 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 slots of the stator must be wound with: -

21.5T Class:- 21.5 turns of - 2 wires at: 0.724 mm. maximum wire dia.
17.5T Class:- 17.5 turns of - 2 wires at: 0.813 mm. maximum wire dia.
13.5T Class:- 13.5 turns of - 2 wires at: 0.724 mm. maximum wire dia.
and - 2 wires at: 0.574 mm) maximum wire dia.
10.5T Class: - 10.5 turns of - 2 wires at: 0.813 mm. maximum wire dia.
and - 2 wires at: 0.643 mm) maximum wire dia.

Wire dimensions are before lacquer coating.

No solid glue or 'filler' can be added to the wires of the final winding assembly. When the stator has been 'cut' to gain access to the wires, unwinding of the wires must be possible by normal 'hand' procedures. A small amount of lacquer added to the winding is allowed, providing unwinding by hand is possible.
The electrical circuit through the windings can only be from the ends of the wires forming the designated number of turns. NOTE: The above metric wire diameter sizes are direct equivalents to the nominal AWG sizes previously shown. (Reference to AWG sizes removed for simplicity).

4.16 The Rotor: Shaft diameter where the pinion gear mounts must be 3.175mm. Only one piece, two pole Neodymium bonded or sintered, or Ferrite magnetic rotors are permitted.
The rotor will be identified with the manufacturer's name or logo and the unique rotor part number. Applies to all rotors in new motors or new optional rotors from 1st. April 2015 onwards.
Starting 01.03.21, any new motor or new optional rotor submitted for homologation must have the unique part number of the rotor etched/stamped on the external flat area of the rotor shaft (where the pinion is located). This must be the listed part number for the rotor as shown on the homologation list. Rotor sizes/dimensions are not acceptable
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.
From 01.11.2017 only one 'optional' rotor will be allowed for any range of new motor submitted (includes all wind Classes). Manufacturer to specify the optional rotor.

4.17 All 'SPEC' motors must have a unique marking or feature that is difficult to remove incorporated into the assembled motor to identify the motor is either a 21.5T, 17.5T, 13.5T or 10.5T Spec. Class motor. But motors introduced from 2011 onwards must have the "wind #" etched/engraved onto the outer surface of the motor on a part of the motor that cannot easily be separated from the stator windings.

**5. BRUSHLESS MOTOR 05 Size - HOMOLOGATION PROCEDURE:**

As agreed AGM 2015, EFRA will homologate '05' size Brushless Motors. Competitors at EC and GP events in 1/12th., 1/10th. Touring Cars and 1/10th. Off-Road Classes can only use '05' size Brushless Motors that are included on the EFRA Homologation Lists, starting 01.06.16.

5.1 Motors must comply with the following rules:
Modified Brushless Motors -- All requirements of App.4, Rules 4.2 to 4.12.
'Spec' (stock) Brushless Motors --All requirements of App.4, Rules 4. 2 to 4.9 and 4.13 to 4.17.

5.2 All 'Spec.' (stock) motors must have a unique Part Number which will be included on the homologation lists.

5.3 Any optional rotors must be submitted for approval. Only optional rotors listed will be allowed at EC and GP events.

5.4 When a motor (or rotor) has been approved and included on the relative list, the manufacturer must not change the; technical specification, visual appearance or description. Any changes will require a new Part Number and the motor (or rotor) will have to be resubmitted for approval.

5.5 New motors or optional rotors will NOT be added to the homologation lists within the four weeks preceding any EC event for any Class at which the motor (or rotor) can be used.
The 'cut-off' date will be at midnight 28 days before the first day that cars use the track detailed by any official schedule. Homologation fees have to be received by EFRA before any motor will be added to the homologation lists.
Sample motors must be received by the homologation officer a minimum of six weeks before any event, to allow time for all technical checks, availability checks, invoices raised and records to be completed.

5.6 Sample motors (or optional rotors) for homologation will only be accepted directly from the original manufacturer or an appointed distributor within the EFRA countries. Motors (or rotors) must be commercially available from the appointed distributors or shops throughout the EFRA countries , before being added to the homologation lists. Therefore availability must be confirmed when samples are submitted.

5.7 New motors have to be submitted to the EFRA Motor Homologation Officer as listed in the EFRA Handbook. Minimum one (1) sample must be submitted for each motor class requiring approval (Modified, Spec. - 10.5T, 13.5T, 17.5T, 21.5T).

The homologation fee for each class of motor will be as shown in General Rule 3.5.7.

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