

SECTION 4: ELECTRIC MOTOR & BATTERY RULES

4.0 Motors

Modified: Only brushed or brushless motors approved by IFMAR may be used.

4.0.1 **Brushed Motors:** *General definition of a Brushed Motor:*

4.0.2 Specifications; 05 sized displacement.

Can diameter to be a Maximum of 36.02mm

Can length to be maximum of 53mm measured from the mounting face of the motor to the furthest point not including solder, tabs or lead wires.

4.0.3 Current is supplied to the armature by two (2) brushes.

4.0.4 Armature – The rotor is to have three (3) poles with windings. Only copper wire is to be used.

No split rotors are allowed. The laminations have to be one on the other with nothing between. The thickness of the stack plates is 0.35mm +/- 0.05mm, a maximum of 63 laminations to be used.

The minimum stack thickness is 3.5mm

The Stack length without epoxy - minimum 21 mm and a maximum of 22.8mm.

Shaft diameter is .125 inch. Production tolerances allowed.

4.0.5 Ceramic magnets only (cobalt and rare earth magnets specifically not allowed).

4.0.6 Approved motors may be modified by re-winding, balancing, truing of commutators, epoxy, ball bearings, brushes and custom brush systems only.

4.0.7 Modifications to the original OEM/Manufacturer configurations, including but not limited to excessive drill holes, milling or turning to lighten the armature or enhance the performance of the full stack are not allowed.

4.0.8 No hybrid (mixing of parts from approved motors) allowed.

4.1.0 **Brushless Motors:** *General definition of a Brushless Motor:*

4.1.1 Sensored or sensorless motors are allowed.

4.1.2 The motor has to be rebuildable. Ball bearings are allowed.

4.1.3 If the motor is sensored, 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 power connector has to be clearly marked A, B, C.

A for phase A

B for phase B

C for phase C

4.1.4 **05` size specifications**

Can: Overall maximum diameter is 36.02mm measured at whatever point yields the maximum dimension, excluding solder tabs or lead wires. Overall minimum diameter is 34.00mm measured at whatever point yields the minimum dimension, excluding solder tabs or lead wires. Maximum length is 53.00mm 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.

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Minimum length is 50.00mm 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.

Stack/Stator: Stack minimum length 19.30mm, maximum 21.00mm. Stack inside diameter minimum 12.50mm, maximum 16.00mm. If a stack is used then it must be continuous. The laminations have to be one after the other without anything in between. The thickness of the stack plates is 0.35 +/- 0.05mm. All laminations must be of the same material.

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

Rotor: Shaft diameter must be 0.125 inches (3.175mm). Only one piece, two pole bonded Neodymium or Ferrite magnetic rotors are permitted. Magnet minimum length 23.00mm, maximum 27.00mm. Magnet minimum diameter 12.00mm, maximum 5.50mm.

- 4.1.5 All motors must have the original manufacturer's logo or name moulded into the end bell.
- 4.1.6 No hybrid (mixing of parts from approved brushless motors) allowed.
- 4.2.0 **Stock Motors. General definition of a Stock Motor:**
Motors submitted for approval as rebuildable stock 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 Stock class racing.
- 4.2.1 All rebuildable stock motors must be bushing-type with an end-bell that locks the timing at 24 degrees. The space between the magnets must be centered on one set of mounting holes, which will be marked on one side of the can to indicate zero degrees. The brush hoods will be aligned at 90 degrees from this mark, plus the allowed timing. The commutator slots must be aligned with the center of the individual poles. A two-degree tolerance will be allowed on the commutator, but not on the overall timing. End-bell must include a mark indicating 24-degree timing adjustment when motor is assembled.
- 4.2.2 End-bell and can must be designed with a method of locking the timing at 24 degrees. This feature is in addition to any method which secures the end-bell to the can (e.g., screws running through the side of the can). The end-bell must incorporate a molded tab that keys into a slot on the can — locking the timing at 24 degrees. End-bell timing may only be set at 24 degrees. Extra locking devices (e.g., extra notches in the motor can that allow timing to be changed to 36 degrees or 5 degrees) are not allowed.
- 4.2.3 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 manufacturer's name.
- 4.2.4 The hole for the bushing in both the end-bell and the motor can, must be no smaller than .210" 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.
- 4.2.5 Motor can must have inspection holes/slots between magnet tips so that the armature may be viewed for inspection of armature tag (see 5-39). These holes/slots may be no closer than .220" from the top or bottom edge of the motor can. View through inspection holes/slots must not be obstructed by anything covering the holes/slots (e.g. motor label).
- 4.2.6 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. Rings may not extend between magnet tips.
- 4.2.7 All rebuildable stock motor armatures must be wound using a "Mabuchi" cross wrap technique, and a process that locks the commutator and the armature stacks so that the timing cannot be changed without disassembling the motor. The legal stock wind is a minimum of 64 inches of round 22 AWG (American Wire Gauge) wire, having a maximum wire diameter (including insulation) of .67mm, resulting in no less than 27 continuous turns of wire on each pole. A production tolerance of one turn on

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one pole only is allowed. There is no tolerance, however, on the minimum length of wire, nor is there a plus tolerance allowed on the wire diameter.

- 4.2.8 Tabs on the armature's commutator may only be "compression welded". No after-market welding, silver soldering or brazing will be permitted.
- 4.2.9 Armature must be tagged in 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 standard motor cleaning agents. The tag should be positioned between two poles of the armature and must be a minimum of .500" in length. The tag must be printed with the OEM manufacturer's name and "27" (e.g., "EPIC 27", "YOK 27", etc.).
- 4.2.10 Armature shaft must extend .125" beyond the end-bell bushing when motor is assembled. The overall length of the armature shaft should be 2.775" with .385" extending beyond the end of the commutator. The commutator end of 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 .060" from the end of the shaft.
- 4.2.11 No modifications to the physical construction of the motor can, end-bell, or armature will be permitted (e.g. adding or removing material from the armature stack, changing the brush hoods from stand up to lay-down and visa-versa, relocating spring posts). Epoxy balancing of armatures for rebuildable stock motors will not be permitted.
- 4.2.12 The armature, motor can, and end-bell of a rebuildable stock motor must all be from the same motor manufacturer and can contain only components from the same model. No hybrid motors or mixing of parts from different models will be permitted.
- 4.2.13 All non-rebuildable stock motors must remain in sealed condition. Any sign of tampering at locking tabs or end bell or any other modification will not be accepted at AARCMCC events.

Stock Motor List			
Rebuildable Stock	GM Racing	GM Racing	Pinnacle Gold Rebuildable Stock #GM9682
Rebuildable Stock	GM Racing	GM Racing	Pinnacle Gold Rebuildable Stock #GM9682
Rebuildable Stock	Orion	Orion	Chrome stock rebuildable w/ machined arm
Rebuildable Stock	Orion	Orion	"CORE" TOP27, Black Can, Gray Endbell,.300 comm., ldn br.
Rebuildable Stock	Reedy	Yokomo	Reedy Rebuildable
Rebuildable Stock	Reedy	Yokomo	"MVP" rebuildable Stock # 298-001
Rebuildable Stock	Trinity	Epic	Paradox
Rebuildable Stock	Trinity	Epic	TM82B P2K Paradox 2k
Rebuildable stock	Trinity	Epic	Green Machine 3
Rebuildable Stock	Trinity	Epic	TM 90 P2PK rebuildable stock
Rebuildable Stock	Trinity	Epic	TB-01 Monster Horespower
Rebuildable Stock	Trinity	Epic	Ep1111 Epic 27, Satin Bronze Can, 4x5 ldn brush, .300comm
Rebuildable Stock	Trinity	Epic	Ep1112 Epic 27, Satin Bronze Can, 4x5 ldn brush, .300comm
Rebuildable Stock	Trinity	Epic	TRI12001/TRI12002, CO27, Blue Can,4x5 Ldn Br.,.300 Com
Rebuildable Stock	Trinity	Epic	Epic X-EP1166 Black can 2flats, laydown brush. .3 com
Non-Rebuildable Stock Motors			
Stock	Associated	Yokomo	Tru Stock R91
Stock	Associated	Yokomo	Sonic R91
Stock	Associated	Yokomo	Mach 1 R91
Stock	GM Racing	Yokomo	GM9678 Purple Bull Stock w/ laydown br.+ full length arm R96
Stock	GM Racing	Yokomo	GM9677 Purple Bull Stock w/ slotted arm ROAR 96

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Stock	GM Racing	Yokomo	Pinnacle 24 degree Stock #GM9680 R96
Stock	Hobbico	Kyosho	# KYOG2700 Ion Storm R96 Stock
Stock	Hobbico	Kyosho	# KYOG2040 Sport Rcg R96 Stock
Stock	Maxtec	Maxtec	Aftershock Stock R96
Stock	Nomad Int'l	Sagami	Nexus - Vented red can & endbell, slot arm, upright brush R91
Stock	PTI/CAM	Sagami	Vortex VOR-0001 laydown brush, Blue endbell R91
Stock	Race Prep	Race Prep	Orange Can R91
Stock	Race Prep	Race Prep	Race Prep#RP-244 Hack Attack R91, R96
Stock	Reedy	Yokomo	Reedy #300-001 R96 Stock
Stock	Reedy	Yokomo	Rage 24 degree, laydown brushes R96
Stock	Trinity	Epic	Green Machine R91
Stock	Trinity	Epic	Equalizer R91
Stock	Trinity	Epic	Slot Mach II – laydown brush, Silver Can R91
Stock	Trinity	Epic	Green Machine II R91
Stock	Trinity	Epic	Midnight R 96
Stock	Trinity	Epic	TM56/56A Silver can, Black endbell, laydown brush R96
Stock	Trinity	Epic	TM56/TM56A X-Star R96
Stock	Trinity	Epic	TM64 Midnight 2 Stock ROAR 98
Stock	Trinity	Epic	Epic 5-degree Stock Motor OEM#TM80B

Brushless Motor List

Brushless	Novak	Novak
Brushless	LRP/Reedy	LRP/Reedy

4.3.0 **19 Turn Motors** (Modified Class)

4.3.1 All motors must meet the relevant IFMAR modified motor specifications in 4.1.1.

4.3.2 A commercially available 19 turn armature must be used.

4.3.3 No modifications are allowed. (Capacitors and Diodes may be used.)

4.5.0 **540 Motors**

4.5.1 Only an unopened Johnson 540 (silver end bell) motor is classed as Production Class.

4.5.2 No modifications are allowed. (Capacitors and Diodes may be used.)

4.5.3 Non-ferrous heats sinks are permitted.

4.5.4 The use of oil, cleaning fluids and motor sprays is permissible when applied before the race.

4.5.5 Performance enhancing motor accessories such as, torque rings, or on-board fluid systems, are not allowed whether fitted directly to the motor or to the car.

4.5.6 A free running motor must not exceed 17.500 RPM on an AARCMCC approved dyno.

4.5.7 All tests to be carried out us in a regulated 7.2v power supply capable of producing at least 5 amps, continuously. RPM reading to be taken using a plastic disc approx. 60mm x 0.5 mm thick supported on a separate ball-raced shaft and read with a digital optical tachometer.

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- 4.5.8 At the Race Directors discretion, motors may be tested at the end of any heat. A maximum time of 15 minutes from the end of a heat will be allowed for a motor to cool. Motors must be allowed to cool naturally. The use of wet rags, water, ice, sprays, any lubricants etc., is not permitted.
- 4.5.9 Any motor exceeding specifications will result in the loss of that's heats results.
- 4.5.10 Any motor exceeding specifications in the Finals will result in disqualification from all three finals in the case of the A-final.
- 4.5.11 The use of Shellite or similar to run-in a motor is forbidden.

4.6.0 **19Turn "Super Stock" MOTORS**

- 4.6.1 Motors approved as 19Turn "Super Stock" motors must have the manufacturer's name in the form of "XXXX 19" (e.g. EPIC 19, YOK 19, etc.) permanently stamped into the mounting face of the motor can. "XXXX 19" designates the use of the can for 19Turn "Super Stock" class racing. The manufacturer name on the can will make hybrid motors easy to identify.
- 4.6.2 All rebuildable 19Turn "Super Stock" motors may be either bearing- or bushing-type with an endbell that locks the timing at 24 degrees. The space between the magnets must be centered on one set of mounting holes, which will be marked on one side of the can to indicate zero degrees. The brush hoods will be aligned at 90 degrees from this mark, plus the allowed timing. The commutator slots must be aligned with the center of the individual poles. A two-degree tolerance will be allowed on the commutator, but not on the overall timing. Endbell must include a mark indicating 24-degree timing adjustment when motor is assembled. Only single-piece (two magnets in a can), or split (four magnets in a can) ceramic magnets are allowed. With single piece magnets, the center of each magnet must be 90 degrees from the 0 degree timing mark on the can. Split magnets must have the split in the segments centered at 90 degrees from the 0 degree timing mark on the can and all four segments must be of the same length. Offsetting single piece or split magnets with the intent of increasing motor performance/ timing is not allowed.
- 4.6.3 Endbell and can must be designed with a method of locking the timing at 24 degrees. This feature is in addition to any method that secures the endbell to the can (e.g., screws running through the side of the can). The endbell must incorporate a molded tab that keys into a slot on the can, locking the timing at 24 degrees. Endbell timing may only be set at 24 degrees. Extra locking devices (e.g., extra notches in the motor can that allow timing to be changed to 36 degrees or 5 degrees) are not allowed.
- 4.6.4 Endbells may have inspection/cooling holes on each side between the negative and positive terminals. These holes would facilitate inspection of commutator tabs. Endbells must be marked with manufacturer's name.
- 4.6.5 The brush configuration may be of any type as long as that configuration appears on a previously ROAR approved modified or stock motor.
- 4.6.6 The motor can must have inspection holes/slots between magnet tips so that the armature may be viewed for inspection of armature tag (see 8.6.14). These holes/slots may be no closer than .220" from the top or bottom edge of the motor can. View through inspection holes/slots must not be obstructed by anything covering the holes/slots (e.g. motor label).
- 4.6.7 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 endbell to the motor can. Rings may not extend between magnet tips.
- 4.6.8 Rebuildable 19Turn "Super Stock" motor armatures must be machine-wound using a cross wrap technique. The legal 19Turn "Super Stock" wind is a minimum of 1170mm of round 19 AWG (American Wire Gauge) wire, having a maximum wire diameter (including insulation) of .914mm, resulting in no less than

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19 continuous turns of wire on each pole. There is no tolerance on the minimum length of wire, nor is there a plus tolerance allowed on the wire diameter.

- 4.6.9 Tabs on the armature's commutator may only be "compression welded". No after-market welding or silver brazing will be permitted. The Commutator must be locked to the armature laminations to prevent timing changes by twisting of the armature shaft.
- 4.6.10 The commutator slots must be aligned with the centre of the individual armature poles.
- 4.6.11 Full stack armatures only are permitted, made only of magnetisable materials. No split, skewed or tri-rotor armature stacks are allowed. Longitudinal slots parallel to the armature shaft in the pole crowns will not be allowed on any armature manufactured after January 1, 2002. The crowns of each armature pole must be symmetrical in cross section, with a constant crown radius. Steps in the crown or longitudinal holes in the crown are not allowed.
- 4.6.12 No modifications to the stack may be made other than the drilling of balancing holes. Modifications to the original OEM/Importer/Manufacturer configurations, including but not limited to excessive drill holes, milling or turning to lighten the armature or enhance the performance of the full stack are not allowed.
- 4.6.13 Armature must be tagged in 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 standard motor cleaning agents. The tag should be positioned between two poles of the armature and must be a minimum of .500" in length. The tag must be printed with the OEM manufacturer's name and "19" (e.g., "EPIC 19", "YOK 19", etc.).
- 4.6.14 Armature shaft must extend .125" beyond the endbell bushing/bearing when motor is assembled. The overall length of the armature shaft should be 2.775" with .385" extending beyond the end of the commutator. The commutator end of armature shaft must have a machined "step" that differs from the standard radius or taper currently used by OEM manufacturers in production of other stock or modified motors. The step should continue for a minimum of .060" from the end of the shaft.
- 4.6.15 No modifications to the physical construction of the motor can, endbell, or armature will be permitted (e.g. adding or removing material from the armature stack, changing the brush hoods from stand up to lay-down and visa-versa, relocating spring posts). If a motor shows signs of tampering during post race inspection, the driver will receive no score for that qualifier or main.
- 4.6.16 Epoxy balancing of armatures for rebuildable 19Turn "Super Stock" motors will not be permitted. No more than two balancing holes are permitted on any two pole faces (the third face may not have more than one hole).
- 4.6.17 The armature, motor can, and endbell of a rebuildable 19Turn "Super Stock" motor must all be from the same motor manufacturer and can contain only components from the same model. No hybrid motors or mixing of parts from different models will be permitted.

- 9.0.0 **Batteries** (all classes of electric cars must only use a maximum of 6 cells)
Only Batteries that appear on the AARCMCC approved battery list may be used.

Batteries Technical:

- 9.1.1 Cells must be sub-C size, nickel cadmium or nickel metal hydride construction, rated nominally at 1.2 volts and dimensions nominally at 44 mm. length and 23 mm. diameter with heat shrink fitted.
- 9.1.2 The heat shrink must clearly show the manufactures identification of the cell and show no signs of tampering. Cells with no clear external manufactures identification are not allowed for use at AARCMCC events.

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- 9.1.3 No modifications allowed to the outer or inner cell construction or modifications to the chemical composition.
- 9.1.4 Soldering for connections and wire is allowed.
- 9.1.5 The Organiser and AARCMCC Officials may check the legality of a competitor's cells at any time during a sanctioned event.
- 9.1.6 A weight scale will be available at all times during the event for competitors to carry out weight checks on cells.
- 9.1.7 Cells may not be charged or changed during the race.
- 9.1.8 An additional battery pack, to power the radio system only, is allowed.
- 9.1.9 Batteries of all A-finalists may be checked for capacity and the results made available for all.

BRAND	SHRINK WRAP COLOUR
<u>Panasonic</u>	
Panasonic P170	Purple
Panasonic P-170SCR	Yellow
Hit-Corporation - Powers Max (Panasonic P-170 SCR-Z)	Blue/Green
Panasonic P170SCR SP	Yellow/Black
Panasonic P180SCRZ EX	Orange
Hit-Corporation Power P-Max (Panasonic P-190 SCRZA01)	Purple
Panasonic 3000 NiMH (HHR300SCP)	Green
Hit-Corporation Powers Max 3000 (Panasonic 3000 NiMH/HHR300SCP)	Red
Panasonic 3000 Stock NiMH (HHR300SCZ)	Grey
<u>GP</u>	
Hit-Corporation Powers GT-3000R (Gold Peak HO300SCH)	Blue
GP 3300 SCHR	Magenta/Red/Green or Yellow/Green
Yokomo Z3300HVR (GP 3300 SCH)	Metallic Blue
Epic Monster Metal 3300 Plus	Black/White or Red/Green
GP 370SCHC	Green w/ Orange GP 370SCHC
GP 370SCHR	Green w/Purple GP 3700SCHR
GP430SCHC	Green, orange , black, black insulator
GP430SCHR	Purple-green-yellow-black, black insulator
<u>East Power</u>	
EP4200	Red-Black w/White-Silver Text, red insulator
<u>INFINITE POWER</u>	
IP3800SC	Red-white-silver, black, red isolator,
<u>IB POWER</u>	
EP4200IB/ Yokomo ZAP2 X4200IB	White-black-yellow-blue -red, black insulator, Blue-black-yellow-red, black insulator

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<u>Intellect</u>	
Intellect 3600	Blue w/Silver Intellect 3600
Intellect 3800, includes Trinity	Blue w/Silver Intellect 3800
Intellect 4200 SC4200	Blue-silver-white-yellow-black, black insulator,

<u>LRP</u>	
LRP / VTEC 3700UP	White-silver-blue-black, black insulator,
LRP / VTEC SC-3800UP "Fat Boy"	White/Blue/Silver/Red VTEC 3800
VTEC 4200 "Big Mama" SC-4200 UP	White-silver-blue-red-black, black insulator

<u>Sanyo</u>	
Sanyo N1700SCRC	Black
Sanyo N-SCRC	Black
Sanyo RC 2000	Purple
GM 2000 High Power (Sanyo N-1900SCR)	Black
Sanyo RC 2400	See note *** below
Sanyo RC 3000 H	White/Yellow/Green/Blue
Sanyo RC3000HV	Green/Yellow
Sanyo RC-3300HV	Black
Sanyo RC- 3600HV	Red