



GENERAL

1. I will not fly my model aircraft in competition or in the presence of spectators until it has been proven to be airworthy by having been previously successfully flight tested.
2. I will not fly my model higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. I will give right of way to, and avoid flying in the proximity of full scale aircraft. Where necessary an observer shall be utilized to supervise flying to avoid having models fly in the proximity of full scale aircraft.
3. Where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless, and/or dangerous manner.

RADIO CONTROL

1. I will have completed a successful radio equipment ground range check before the first flight of a new or repaired model.
2. I will not fly my model aircraft in the presence of spectators until I become a qualified flyer, unless assisted by an experienced helper.
3. I will perform my initial turn after takeoff away from the pit, spectator, and parking areas, and I will not thereafter perform maneuvers, flights of any sort, or landing approaches over a pit, spectator, or parking area.

FREE FLIGHT

1. I will not launch my model aircraft unless at least 100 feet downwind of spectators and automobile parking.
2. I will not fly my model unless the launch area is clear of all persons except my mechanic and officials.
3. I will employ the use of an adequate device in flight to extinguish any fuses on the model after it has completed its function.

CONTROL LINE

1. I will subject my complete control system (including safety thong, where applicable) to an inspection and pull test prior to flying.
2. I will assure that my flying area is safely clear of all utility wires or poles.
3. I will assure that my flying area is safely clear of all non-essential participants and spectators before permitting my engine to be started.

Academy of Model Aeronautics
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**OFFICIAL
 AIRCRAFT
 REGULATIONS**

1978

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 Contest Boards
 of the
 Academy of
 Model
 Aeronautics
 under the
 franchise of
 National
 Aeronautic
 Association
 and
 Federation
 Aeronautique
 Internationale

**Governing Sporting
 Model Aviation
 in America**

37. RC PATTERN

1. **Applicability.** All pertinent AMA regulations (see sections 1-4) of the National Competition, Records, Selection of National Champions, and General) shall be applicable, except as specified below.

2. **Objective.** To control by radio a model airplane so that various planned maneuvers may be accomplished. The criterion is the quality of performance, not the mechanism of control. RC competition shall be based on the excellence of performance of the model's maneuvers compared to similar maneuvers performed by a full size plane. Maneuvers shall be judged according to the AMA Radio Control Judges Guide.

3. **Licensing Requirements.** All radio equipment and operation must conform to the regulations of the F.C.C. AMA membership card and F.C.C. license of each entrant shall be checked at every sanctioned meet.

4. Model Aircraft Requirements.

4.1. **Power.** Models shall be powered by reciprocating or rotary piston internal combustion engine(s) or electric motor(s). Total displacement of a reciprocating or rotary piston internal combustion engine in a single-engine model shall not exceed .6102 cubic inch (10cc). In a model powered by two or more reciprocating or rotary piston internal combustion engines, the total displacement shall not exceed .8060 cubic inch (13.20cc), and none of these individual engines shall exceed .6102 cubic inches (10cc). Sixty percent of the actual piston displacement (volume swept by the piston) of four-stroke cycle engines shall be taken for determining maximum displacement allowed.

4.1.1. Each reciprocating or rotary piston internal combustion engine shall be equipped with a muffler.

4.2. **Weight.** No model may weigh more than 15 lbs. gross, ready for takeoff.

4.3. **Controls.** There shall be no radio equipment or aircraft control function limitations in any pattern class. *Radio equipment is only limited by F.C.C. regulations.*

4.4. **Number of Airplanes.** Two airplanes may be entered by a contestant and are to be numbered "1" and "2". The contestant may choose to enter either plane at the beginning of the meet and shall continue to use such plane unless, and until, said plane shall be damaged to the extent that it cannot be readily repaired. Contestant may then, upon approval of the Contest Director, substitute the second plane for the balance of the meet without penalty. Once this has been done, the contestant may not re-submit the first plane later in the same contest.

4.4.1. Substitution of basic components of the two entered aircraft, i.e., wings, fuselage, or tail surfaces, will be considered the same as switching airplanes, and therefore will only be allowed one time. In this connection, each basic, detachable component of each aircraft must be marked as "1" and "2". Substitution rule does not apply to radio and engine.

4.5. **The Builder of the Model Rule** shall not apply to the pattern events.

4.6. **Identification.** All models shall be identified by the contestant's AMA license number permanently affixed to the upper side of the right-hand lifting surface or to each side of the fuselage or ventral stabilizer. Height of the numerals must be at least one inch. Both stroke and width shall be such as to enable ready recognition. It is suggested that the letter "N" be placed front of the license number when the number is affixed to the side of the fuselage or ventral stabilizer.

5. **Safety Requirements.** Considerations of safety for spectators, contest persons, and other contestants are of the utmost importance in the event, and the following safety provisions must be observed.

5.1. All models must pass a general safety inspection by the Event Director or his representatives before they are allowed to compete.

5.2. The "Flight Line" shall be defined as a straight line, infinitely long in both directions in front of which all flyers is done, and in back of which all officials, contestants, and spectators are positioned. The judges shall be positioned on the "Flight Line," and in fact the line shall be established by the judges' position. If at any time during a flight, including the takeoff and landing, the plane goes behind the flight line, the maneuver being executed, or the previous maneuver (if the plane is between maneuvered) shall be scored zero. If two zeros are earned during the same flight for flight line infractions, the remainder of that flight shall be scored zero, and the pilot shall be ordered to land the plane. Continued flying behind the flight line shall result in disqualification of the contestant by the Contest Director.

5.3. **Dangerous flying** of any sort, or poor sportsmanship of

any kind, shall be grounds for disqualification of the contestant involved.

5.4. Pilots shall remain near the judges while flying, and in particular shall stay off the runway and/or landing area during maneuvers which call for flying (or taking off or landing) in line with the center of the runway and/or landing circle.

5.5. All planes entered must have rounded prop spinners, or some sort of safety cover on end of propeller shaft (such as a rounded "acorn nut"). Radius of point shall not be less than 1/4 inch.

5.6. Knife-edge wings are not allowed.

6. **Pattern Event Classes.** The pattern event shall be divided into four classes. They shall (in order of increasing difficulty) be referred to as Novice, Advanced, Expert, and Master.

6.1. The Expert class shall fly the 1977 FAI Pattern schedule of maneuvers.

6.2. The Masters class may fly one of two schedule choices: 1) the complete 1978 FAI "ABC" Pattern, or 2) the "Finals" schedule only of the 1978 FAI "ABC" Pattern. The 1978 FAI "ABC" Pattern is the 3-schedule system made official by the FAI in 1978. All contestants fly 2 rounds of Schedule A and 2 rounds of Schedule B. The finalists then fly 2 final rounds of Schedule C, a schedule made up by each finalist which consists of maneuvers selected from Schedules A, B and C.

6.3. For contests where the Masters Class is to be flown, but there is not time and/or person-power to conduct the six required rounds of the 1978 FAI "ABC" Pattern, the "Finals" schedule of the "ABC" Pattern shall be used for all rounds.

6.4. All pre-contest announcements for pattern events that will include the Masters class must clearly specify which Masters Pattern schedule will be used.

6.5. Competitors must also be advised prior to the start of the contest of any planned deviations from standard AMA or FAI rules pertaining to the events they have entered.

7. **Contestant Classification.** At his first pattern contest, a contestant may enter any one pattern class at his own option. *(This decision should be made with care, as no one in any class is once noted in 7-1.2, will be permitted to change to a lower class.)* Contestant committed to a certain class, however, will be allowed to move only to a higher skill class. A contestant will come about in one of two ways: (1) voluntary, (2) mandatory.

7.1. A contestant may promote himself voluntarily to a higher class at any time, however, once the move is made, he may not change back to a lower class.

7.1.1. Exception: A contestant may fly in the next higher class at a contest where his class is not being flown without committing himself to promote to the higher class.

7.1.2. Exception: For flyer to be reclassified to a lower rank, that flyer must make an application using a form supplied by AMA (HQ), to be signed by a Contest Director and forwarded to the district, Contest Board member and Vice President for their approval.

7.2. A contestant will be mandatorily advanced through the classes as follows: Upon placing first, second, or third in a sanctioned contest, he will receive 3 points for first place, 2 points for second place, or 1 point for third place. These points will be multiplied by the number of contestants who actually flew officially in the event and class. The resulting Classification Score goes into the contestant's accumulative record. When the accumulated Classification Score meets or exceeds 100 points, the contestant will automatically be advanced to the next competition class at the end of that calendar year.

7.2.1. A contestant may voluntarily move to the next higher class at the time he accumulates 100 points, but will not be required to do so until the end of the calendar year.

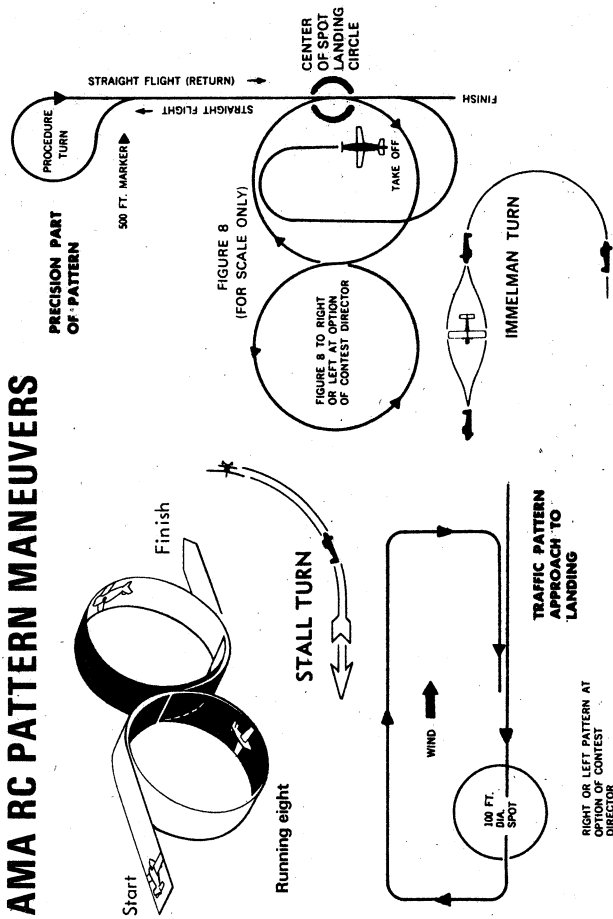
7.2.2. Time required to accumulate 100 Classification Points has no limit. A contestant's point accumulation does not start over again at the beginning of each year, but continues ad infinitum until, if ever, 100 points are accumulated.

Note: A contestant who flies in a higher class under the Exception Rule (7.1.1) above, and who places first, second or third, still acquires Classification Points in accordance with 7.2. above.

Examples
(1) Contestant is one of 8 who flies officially in a given class, and places first. He acquires 3 points times 8 contestants, equaling 24 Classification Points.
(2) Contestant is one of 3, and he places second. He acquires 2 points times 3 contestants, equaling 6 Classification Points.
(3) Contestant accumulates 99 points in 1974, and thus remains in his declared class into 1975. At the first 1975 contest he picks up 12 points. He may fly the rest of 1975 in his declared class, but will be advanced to the next higher class starting January 1, 1976. (He may move up sooner if he so desires.)

7.3. The Contest Director of each AMA sanctioned RC meet having Novice, Advanced, Expert or Master Class events is responsible for upkeep of the classification system. He must require

AMA RC PATTERN MANEUVERS



that only current AMA members be allowed to fly in the meet and that they all have valid F.C.C. licenses. As soon as the first second, and third place winners in each class are determined, the Contest Director shall fill out the appropriate spaces of their Classification Forms, indicating the date and location of the meet, and class, place won, number of contestants who made official flights in that class, and the resulting Classification Score. He will also affix his verifying signature and AMA CD number.

Note: Handy wallet-size Classification Advancement Record forms are available upon request from AMA HQ; please include a pre-addressed and stamped return envelope. Contest Directors of meets having RC Pattern events are also provided with a small supply of such forms.

8. **Number of Flights.** There shall be no limit on the number of land takeoff and landing, have been judged. An attempted maneuver yielding zero points is still considered "judged." A contestant is entitled to two attempts to make an official flight.

9.1. Definition of an Attempt. An attempt shall have been made once the clock starts for the flight.

10. **Time Limits.**
10.1. Novice and Advanced contestants are allotted a total of nine (9) minutes.

10.2. Expert and Master contestants are allotted a total of ten (10) minutes.

10.3. In all AMA classes the contestant must have his engine started and commence his flight within the first two minutes after his time has been started. When he fails to commence within the first two minutes, and is so informed by the timer, he must immediately clear the area for the next contestant.

10.3.1. No engine restarts are allowed after the wheels leave the ground on takeoff. Restarting is permitted within the first two minutes, but only if prior to takeoff.

11. Point System.

11.1. Novice and Advanced maneuvers shall be judged and scored on a zero to ten basis. Flight score is the sum of the individual maneuver scores.

11.2. Expert and Master maneuvers shall also be judged and scored on a zero to ten basis. However, each maneuver score shall be multiplied by a "K" factor. (See maneuver schedules and FAI maneuver descriptions). Flight score is the sum of the extended scores for each maneuver, after the K factor is applied.

12. Determining the Winner.

12.1. In all classes, the winner shall be the highest score if only

one flight is completed; the highest single score; if two flights are completed; the highest total of the best two flights; if three or more flights are completed; and the highest total of the best three flights, if four or more flights are completed. Maneuver points from repeat flights may not be added to earlier flights. Each flight is complete in itself in case of ties, the best non-scored flight of the contestant shall be used to determine the higher place. There is no minimum number of flights which must be scored.

13. **Flight Pattern.** The contestant must fly his entire flight according to the established Flight Pattern for his particular class and in the sequence listed. Maneuvers performed out of order will not be judged.

13.1. Contestant (or his helper) may not touch his plane after it has become airborne until completion of flight; i.e., he may not engine, trim, etc.

13.2. The contestant must call out each maneuver before he attempts to perform it. Call out shall be made just prior to execution. Also, the flyer should use the straight flight time at the end of each maneuver to announce, "maneuver complete." If a contestant fails to call a maneuver before its execution, the maneuver shall be scored zero.

14. Novice Pattern Maneuvers.

1. Takeoff (U)
2. Straight Flight Out (U)
3. Procedure Turn
4. Straight Flight Back (D)
5. Stall Turn (U)
6. Single Immelmann (U)
7. 3 Inside Loops (U)
8. Straight Inverted Flight (D)
9. One Outside Loop (U)
10. 3 Horizontal Rolls (D)
11. Rectangular Approach (U)
12. Landing and Spot (U)

Note: (U) means upwind; (D) means downwind.

15. Advanced Pattern Maneuvers.

1. Takeoff (U)
2. Double Stall Turn (U)
3. Cuban 8 (D)
4. Double Immelmann (U)
5. Four-Point Roll (D)
6. Outside Loops (U)
7. Slow Roll (D)
8. 3 Inside Loops (U)
9. Horizontal Rolls (D)
10. Spin (U)
11. Rectangular Approach (U)
12. Landing and Spot (U)

Note: (U) means upwind; (D) means downwind.

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been on the runway a few hours. He usually has a tired neck from looking at some maneuvers which must be followed overhead, and he is so tired that he is forced to look there unnecessarily. By the time he is back on the ground, he is usually so tired that he is forced to look there unnecessarily. The remainder of the maneuver after an aircraft crosses the sun overhead is unnecessary. There are also some places where the sun cannot be avoided, and he is completely justified in scoring zero if in his opinion the maneuver could have been placed elsewhere.

c. Size of Maneuvers. In the previous section it was pointed out that most maneuvers could be safely done at an average distance no greater than 300 feet from the competitor and judges. At altitudes such that the line of sight to the model will seldom exceed a 45° elevation angle. These criteria place an upper limit of about 350 feet for the total vertical size of a maneuver. Most competitors and judges will recognize this as more than ample. It should also be recognized that 300 feet of horizontal distance is a maximum value and not really the optimum. For example, an inside loop of 100 feet diameter at 150 feet longitudinal distance would stay within the 45° angle and a safe altitude and would be more clearly visible to the judge than at 300 feet distance. The competitor who performs loops in the 200 ft. region is therefore allowing the judge to evaluate them more critically and he should suffer no downgrading for positioning. On the other hand, a 100 ft. diameter loop at 300 ft. distance might be downgraded.

The optimum size of maneuvers is related to some extent on the size of the normal flying speed of the model. For example, loops of 20 to 30 ft. diameter done by a 2 ft. wingspan airplane would not necessarily look as good as loops of 50 ft. diameter done by a 30 ft. diameter loop by a 50 mph multi-jet. The impression that an imaginary pilot in full scale simulation would be downright uncomfortable if not "blackout" simulation due to the high "g" forces. Exceedingly small or tight maneuvers will unnecessarily high rates of roll, pitch or yaw do not simulate full scale performance and they should be downgraded accordingly.

d. Smoothness and Gracefulness. These two factors are related to the normal flying speed of the model. Various judges and competitors will have differing opinions of what actually constitutes smoothness and gracefulness. The most general definition must again be related to full scale simulation and the effects of the maneuver on an imaginary pilot or passenger in the plane. On a touch-and-go or landing, for example, the judge might imagine the airplane as a DC-8 in which he is a passenger. Many of the so-called "average" landings by RC models, in this equivalent situation, would result in clearing off of the landing gears and a total loss of the airline company's profits and equipment!

It is recognized that few RC judges have ever been passengers in full scale aerobically powered airplanes and therefore have no actual experience with the "g" forces in aerobically powered airplanes. Two to three "g" maneuvers such as a snap roll or spin. However, by comparison, a 30 ft. diameter loop at 30 mph results in about 10 "g's" which is close to the design limits of most full scale aerobically powered aircraft. Such tight maneuvers are not scale-like.

The matter of smoothness is basically related to scale like appearance. For example, a perfect loop or consecutive rolls should have a constant rate of rotation to finish. A perfect loop must have a constant radius defining a perfect circle. It cannot be made up of a series of straight flight paths. The "jerk" or angular velocity placed between such sudden jerks represents high "g" forces well in excess of full scale tolerances and maneuvers should be downgraded for this.

C. Accurate and Consistent Judging. The most important aspect of consistent judging is for each judge to establish his standards and then maintain that standard throughout the meet. It is advisable for the contest director or chief judge to hold a briefing prior to the start of the meet in order to make the standards as uniform as possible. This is done best by means of a practice flight which all judges score simultaneously and privately. After the flight, the defects in each maneuver should be discussed by all judges and a semblance of agreement reached about the severity of defects. Once this is done, however, and the contest is started, the individual judge should not alter his standards under any influence. The contest director should clearly define areas in which it is considered unsafe for competitors to perform, such as above spectators or over buildings, etc. It is highly recommended that these judges agree to register zero points for maneuvers done in these areas. Furthermore, for consistency, judges should exchange a "lover the contest" agreement to issue zeros immediately following an "over the contest" maneuver. Nothing can cause more unrest among contestants than a zero.

The responsibility for downgrading maneuvers of the same maneuver unsafely should be assigned to the judge who is present in flying areas of unsafe areas should be absolutely unambiguous. For the purpose, it should be stated that "maneuvers performed over the spectators area will be scored zero" and not that "maneuvers can be performed over the spectators at a safe altitude." Obeying such safety regulations is just one more of the many pressures associated

A. Purpose. The purpose of the AMA RC Judges' Guide is to furnish an accurate description of each maneuver not listed in the FAI RC Aerobatics Rules, and to provide a reference for use in developing a uniformly high standard of judging in all AMA sanctioned contests.

Study of this guide by the competitor will help him learn exactly what is expected, while study by the judges will help them decide precisely how well the competitor comes up to these expectations.

B. Principles. The principles of judging an RC model should be based on the perfection with which the model simulates full scale aircraft performance. The main criteria for perfection in an individual maneuver can be classified as follows:

1. Positioning of the maneuver.
2. Positioning or display of the maneuver.
3. Size or dimensions of the maneuver.
4. Smoothness or gracefulness of the maneuver.

All of these requirements must be met in order for a maneuver to be rated perfect. They are discussed below.

a. Precision. At the instant the contestant announces his next maneuver, the judge should form an image of the course the airplane should follow during the performance of the maneuver. The precision of the maneuver will then be based on how well the model tracks through this imaginary course.

Competitors should read this statement and exclaim, "How am I to know what the judge might be picturing?" The answer to this is that once the judge announces a maneuver, the straight and level entry portion of a maneuver and the competitor's image of the size of the maneuver, the judge will have some precision. However, the judge optimum size as discussed in a later section. However, the judge should modify his image if the first portion of the maneuver clearly demonstrates that the contestant intends to do a maneuver of much smaller or larger dimensions than the judge first imagined.

It will be noted that forming an image of the forthcoming maneuver is based on using the straight and level entry as a reference. If the contestant fails to go through this portion of the maneuver, it will be difficult and perhaps impossible to form an image before the start of the maneuver. The absence of a definite entry into a maneuver therefore increases the difficulty of judging its precision and competitors will recognize this as justification for downgrading.

The straight and level entry from a maneuver is one of the more valuable portions of the maneuver in evaluating how well the intended course of the maneuver was followed. The well-polished pilot will use it to announce, "Maneuver completed," while the less competent pilot will often skip it in hopes that the judge will not notice that the deviated with respect to his entry heading. The absence of a well defined straight and level entry therefore should also result in downgrading.

The judging of the precision of a maneuver shall not be dependent on the throttle setting or speed of the engine. Aircraft speed, which could affect the quality of the maneuver, is not to be confused with engine speed.

b. Positioning. To achieve perfection, the competitor must position his maneuver in a way that they can be easily judged. The first consideration is longitudinal distance from the competitor. It goes without saying that the judges should be located near the competitor so that they obtain identical views of the maneuver. The competitor should center his aerobically powered at an average distance of less than 300 feet from the judge.

In short, the judge should be unmerciful if the competitor's impression that the competitor is trying to hide his defects by flying at a great distance. Positioning of maneuvers involves more than mere distance. They should also be presented in a relative direction which displays the most difficult aspects of the maneuver. Specifically, maneuvers which have circular symmetry (such as Loops, Immelmans, Cuban Eights, and FAI Horizontal Eights) should have the "holes" in their circular path clearly visible, preferably in a plane exactly perpendicular to the line of sight to the model. The same applies to the Square Eight.

The diagrams used to describe these circular maneuvers in the official rule book define the best view to present to the judge. "End on" or "canted" presentation of these should result in downgrading since it increases the difficulty of judging the symmetry of figure 8's and the "tracking" of consecutive loops.

frequencies. Contestant shall have his name on List only once, at any one time; names may be moved to bottom of List on request, but trading of positions with other contestants is not allowed. When a contest is to be continued on a following day, the Flight List shall carry over from day to day.

18.4. Event Director shall carry out following procedure:
18.4.1. Numbers 1, 2 and 3 on Flight List shall be on flight line with their models, equipment, and one helper if desired. No 1 is contestant flying or ready to fly, No. 2 is next man to fly, etc.
18.4.2. No. 1 man shall have 3 minutes (4 minutes if FAI Pattern is being used) from completion of preceding flight in which to release model for the start of his flight. False starts are permitted within the 3 or 4 minute limit. Failing to start flight within this limit, contestant must immediately remove his plane and equipment to the pits. It shall be responsibility of Event Director or his representative to notify contestant of start and end of 3 or 4 minute period.

18.4.3. Numbers 4, 5, and 6 on the Flight List shall have their planes and equipment in a ready box located near the flight line. As soon as a flight is completed, the No. 4 man becomes No. 5 and shall be requested to move his model and equipment onto the flight line. If he is not on hand to do so, the slot be dropped from the Flight List, and the List advanced to fill his slot. The Event Director or his representatives shall be responsible for notifying contestants when they are to move to ready box or flight line.

18.5. When technically possible and when judges and space are available, it is strongly recommended that two or more flights be flown simultaneously under the following conditions:
18.5.1. Separate takeoff and landing areas sufficiently spaced across wind from each other to minimize engine noise and flight path interference.

18.5.2. Contestants flying simultaneously shall carefully check receiver and transmitter operation before takeoff, to be sure no interference between them is possible.
18.5.3. Contestants flying simultaneously must be no more than three positions apart on the Flight List. Event Director or representative shall, where possible, select contestants at top of Flight List so that contestants flying on compatible frequencies are on flight line together.

18.5.4. Should a contestant oppose flying simultaneously with someone else, he may cancel his turn and re-sign at the bottom of the Flight List.
18.6. Officials. An Event Director, a Dispatcher-Recorder and Dispatcher-Recorder should have at least two helpers.

18.7. Each flight should be judged by at least two judges, with their scores averaged to give final score for the flight. It is suggested that each maneuver be scored immediately after it is performed. Judges shall score maneuvers immediately and without consultation. This should be enough to establish a rotational procedure which will average out variations in judging.

Note: For Novice and Advanced, first contact with ground within the 100-foot circle results in automatic awarding of the same number of points for Spot as obtained in the Landing.

16. Expert Pattern Maneuvers. The maneuvers which are listed during an uninterrupted flight in the order in which they are executed, and the competitor must indicate in writing, before the start of the flight, any maneuver he will not execute. Maneuvers 2 through 14 should be flown in unbroken order, which means that each time the model passes the judges a maneuver must be executed. One maneuver must be made on each pass in front of the judges, except after Takeoff and before the Rectangular Approach where in each case a pass may be made without a maneuver being performed.

1. Takeoff (K = 10)
2. Figure M with 1/2 Rolls (K = 15)
3. Cuban Eight (K = 10)
4. Double Immelmann (K = 10)
5. Slow Roll (K = 15)
6. Three Outside Loops (K = 15)
7. Four-Point Roll (K = 15)
8. Three Inside Loops (K = 10)
9. Eight-Point Roll (K = 15)
10. Rolling Eight (K = 10)
11. Three Horizontal Rolls (K = 15)
12. Top Hat (K = 15)
13. Running Eight (K = 10)
14. Three-Turn Spin (K = 10)
15. Rectangular Approach (K = 10)
16. Landing (K = 15 within 15m circle; K = 10 outside 30m circle)

17. Masters Pattern. The Masters Pattern shall be all or part of the current FAI Pattern described elsewhere in this book.

Note: A detailed description of each maneuver specified in the Novice, Advanced, Expert and Masters Patterns, and reasons for downgrading when scoring, will be found either in the AMA RC Pattern Judges' Guide or in the FAI RC Aerobatics Rules.

18. Suggested Field Procedure. The procedures listed below are suggestions to Contest Directors for operation of an RC Pattern event, and may be altered to fit local conditions.
18.1. All RC contestants shall be set up in "pits" at spot assigned by Event Director, so they will be under his immediate control.

18.2. There will be no testing of transmitters or receivers during the flying period. Transmitters may be impounded at discretion of Event Director. Any person causing interference will suffer immediate disqualification. The Event Director will provide a monitor receiver to check for interference.

18.3. The flight order shall be determined by position of contestants' signatures on a single Flight List held by Event Director or his representative. This list shall include all classes and

RC FREQUENCIES AND FLAGS

The AMA has designated certain colors to be used in the form of a streamer or pennant (flag) as a means of indicating what frequency transmitter is assigned. It is recommended that 27 MHz flags be triangular. Transmitter antennas in the 50-54 MHz and 72-76 MHz bands will show two flags, each in the form of ribbons approximately 1" X 16"; one ribbon indicates the band while the other ribbon indicates the exact frequency.
The four frequencies indicated by asterisks (*) in the 72-76 MHz band are for model aircraft use only.

| | | |
|-------------------------------|--------------------------------|--------------------------------|
| 27 MHz Band | 26,995—Brown | 27,195—Green |
| | 27,045—Red | 27,255—Blue |
| | 27,095—Orange | 27,145—Yellow |
| 50-54 MHz Super-Het | 53,10—Black & Brown Ribbons | 53,40—Black & Orange Ribbons |
| | 53,20—Black & Red Ribbons | 53,50—Black & Yellow Ribbons |
| | 53,30—Black & Green Ribbons | |
| 50-54 MHz Super-Regen. | 51,20—Black & Light Blue | 52,04—Black & Violet Ribbons |
| 72-76 MHz Band | * 72,08—White & Brown Ribbons | 72,32—White & Violet Ribbons |
| | 72,18—White & Blue Ribbons | * 72,40—White & Orange Ribbons |
| | * 72,24—White & Red Ribbons | 72,98—White & Yellow Ribbons |
| | * 75,94*—White & Green Ribbons | |

Figure Eight. (Scale only). Directly after the Straight Flight Back and at the instant the plane crosses over the circle, the model starts into a horizontal, upright figure 8. The figure shall be perpendicular to the straight flight, and flow away from the spectators, i.e., the base of the 8 is over the circle and the first turn is made to left or right, depending on spectator location. Maneuver is finished on same heading as its entry. The Figure Eight should be downgraded for the following:

1. Entry not directly over the circle.
2. First half circle not smooth or round.
3. First half circle has gallops in pitch, roll or yaw.
4. First half circle changes altitude.
5. First half circle not complete second full circle at same cross-over point as finish of first half circle.
6. Model does not finish second full circle at same cross-over point as finish of first half circle.
7. Same as 2 thru 4 for third half circle.
8. Same as 2 thru 4 for fourth half circle.
9. Does not finish on same heading as entry.
10. Does not finish directly over circle.
11. Does not finish at same altitude as entry.
12. Does not fly straight and level to complete maneuver.
13. Does not finish on same heading as entry.
14. Does not finish on same heading as entry.
15. Does not fly straight and level to complete maneuver.

Teach and Go. (Scale only). After a smooth and gradual descent on a taxi line path into the wind, the model lands and slows down to taxi speed (approximately 1/4 the normal flight speed) but must not stop. Following this the model must accelerate and take off on the same heading as the entry. The maneuver may be downgraded for the following:

1. Approach during landing is too steep.
2. Gallops in pitch, yaw or roll during approach.
3. Model impacts or thuds onto ground due to lack of flare-out.
4. Model bounces on landing.
5. Model deviates left or right while rolling on ground.
6. Model fails to slow down to distinct taxi or "unairborne" condition.
7. Model stops on ground.
8. Changes in heading during the takeoff run.
9. "Jumping" from the ground.
10. Retouching the ground after becoming airborne.
11. Too steep a climb angle.
12. Gallops in pitch, roll or yaw during climb.
13. Changes in heading during climb.
14. Dropping a wingtip.
15. Model is too far away to be seen clearly at any time during the maneuver.

Stall Turn. The model starts from straight and level flight and noses up to a vertical position, yaws through 180°, then dives along a parallel path and finishes the maneuver with the plane level at the same altitude as the entry. The Stall Turn may be downgraded for the following:

1. Model not level at start.
2. Does not become exactly vertical.
3. Turns left or right during pull-up.
4. Does not yaw tightly through 180°.
5. Return path more than two wing-spans from entry path.
6. Return path not parallel to entry path.
7. Maneuver not finished at same altitude as entry.
8. Plane not level at finish of maneuver.
9. Model does not fly straight and level to complete maneuver.

Double Stall Turn. The model begins by performing a Stall Turn as described above. At the bottom of the pull-down, the plane pulls up, thus completing half of an inside loop, at which point pull-out. The Stall Turn is executed, followed by a quarter pull-out. The two Stall Turns shall be performed in opposite directions with respect to the ground. The maneuver may be downgraded because:

1. Model not flying straight and level at beginning and end of maneuver.
2. Maneuver does not become exactly vertical at points of turn.
3. Half-inside loop not round and consistent in heading.
4. Bottom of half-loop not at same altitude as entry and finish.
5. Model turns left or right during pull-ups.
6. Does not yaw tightly through 180°.
7. Return paths more than two wing-spans from entry path.
8. Return paths not parallel to entry path.
9. Maneuver not finished at same altitude as entry.

Immelman Turn. The model starts the Immelman flying straight and level, pulls up into half loop followed by a half roll and finishes flying straight and level exactly 180° from the heading at entry. The Immelman may be downgraded because:

1. Model not level at start.
2. Model deviates left or right during half-loop.
3. Half-loop not completed exactly above point of commencement of half-loop.
4. Half roll does not commence immediately after half-loop.
5. Plane deviates from a straight line during roll.
6. Model does not finish in level flight.
7. Model heading does not finish exactly opposite the direction of entry.

Straight Inverted Flight. The model starts in straight, level, upright flight, then rolls 180° (roll approximately one-second duration), stops in the inverted position, proceeding in straight, level, inverted flight for approximately three seconds, then rolls 180° (in same direction and at same rate as first roll) back to level, straight, upright flight for completion of maneuver. The maneuver may be downgraded because:

1. Model not level at start.
2. Half-rolls more or less than 180°.
3. Roll rate not constant during each half-roll.
4. Model takes less than 4 or more than 6 seconds to complete maneuver.
5. Model does not maintain same heading and altitude throughout maneuver.

Running Eight. Model starts in level flight and completes 1/4 outside loops, model then does 1/4 inside loops finishing at the bottom. The model passes through the intersection three times, then recovers on the same heading but at a lower altitude than entry. The maneuver should be downgraded for the following reasons:

1. Model not level at start.
2. First loop not round.
3. First loop deviates left or right.
4. Model does not become vertical at intersection.
5. Second loop not round.
6. Second loop deviates left or right.
7. Does not become vertical at intersection.
8. Second loop not at same altitude as first loop.
9. Second loop not same diameter as first loop.
10. Second and third intersections do not coincide with first.
11. Model not level at finish of maneuver.

Objective. To duplicate full-scale aerobatics with miniature radio-controlled aircraft in a realistic manner that is challenging for the contestants as well as interesting for the spectators.

RC General. All AMA regulations and FCC regulations covering the RC flyer, his plane and equipment shall be applicable to this event, except as noted herein. There shall be no limitation to the type of equipment fitted to the aircraft, nor the number of controls. The contestant shall be allowed the first model is not flyable. He can only use his alternate model if the first model is not flyable.

2.1. Consideration of safety for spectators, contest personnel, and other contestants is of the utmost importance in this event. Any unsportsmanlike conduct or hazardous flying over a controlled spectator area will cause for immediate disqualification of that flyer.

3. Model Aircraft Specifications.

3.1. Model must be of a realistic replica typical of the biplanes that have been built and flown. The bottom wing shall be at least 30% of the total wing area. Fixed landing gear only.

3.1.1. Model aircraft need not be of a scale type; however, the non-scale model aircraft shall resemble the "style" of biplane as specified in 3.1.

3.1.2. It will be the contestant's responsibility to show proof, if required by contest officials, that the bottom wing is of sufficient size.

3.2. Only one engine of the reciprocating internal combustion type with a total displacement not exceeding 6.102 cubic inches (10cc) shall be used.

3.3. An effective silencer shall be used in accordance with AMA standards of noise reduction.

3.4. Maximum weight less fuel is 11 pounds.

3.5. Builder of the model rule shall not apply in this event.

4. Optional Scale Bonus. Contest Director has the option to award a 10% flight score bonus to any entry meeting the standards required of a scale aircraft. The decision of the bonus point system will be made prior to the starting of the first official flight of the competition. It is recommended that if the bonus system is used, it be so noted in all publicity prior to the contest.

5. Proof of Scale.

5.1. To prove that the model resembles a particular aircraft, some proof of scale is required.

5.2. Proof of scale is the responsibility of the contestant.

5.3. The general outlines of the model shall approximate the full size outlines of the subject aircraft. Exact scale is not a required item. The model shall be judged for likeness at a distance of approximately 10 feet.

Rectangular Approach. The maneuver is commenced with the model flying into the wind over the landing circle, a left turn of 90° a crossing leg, a second turn of 90° a downwind leg, a left turn of 90° a crossing leg, a fourth 90° turn and a straight flight towards the point of touchdown. The first three legs shall be at constant altitude; the descent to touchdown will commence after the second crossing leg. The maneuver is finished just prior to touchdown. The circuit may be to the right if the Contest Director states so before the flight. The maneuver should be downgraded for the following reasons:

1. Legs of rectangle are not straight.
2. 90° turns not smooth and precise.
3. Turns more or less than 90 degrees.
4. Gallops in elevation.
5. If model does not land after approach, zero points.

Landing. The landing shall be judged according to the FAI section, except that the maneuver shall be considered complete once the plane has slowed below flying speed and has rolled straight for 50 feet. Landing will not be downgraded if plane rolls straight to a controlled stop in less than 50 feet.

Spot Landing. For Novice and Advanced, a landing with first contact with the ground within the 100-foot circle results in automatic awarding of the same number of points for Spot as obtained in landing perfection. All judges should show agreement on their score sheets (not on the amount of score, just whether or not a spot landing was accomplished) and in the event of disagreement, a majority vote by the judges should dictate.

Conclusion of Flight. The official flight is finished at the moment the plane stops at the end of its landing roll. At this point the contestant announces "flight complete" and immediately taxis his plane off the runway to whatever area the Contest Director designates. If landing was deadstick, pilot or helper shall retrieve plane as soon as permitted by official in charge of flight line.

38. RC SPORT BIPLANES (PROVISIONAL)

the contestant and the Contest Director can determine himself that the aircraft is a replica of a full-size aircraft, then the contestant will be allowed to have his entry to be considered for scale entry.

3.5. If the scale model is not considered a scale replica, the aircraft will be allowed to compete as a non-scale aircraft without the scale bonus.

6. Registration Numbers.

6.1. Registration numbers are the entrant's AMA number. If the entrant desires he may use the last one or two numbers of his AMA number and the initials of his name, such as NSJN.

6.2. If the aircraft has been built to conform to the scale regulations of the AMA or FAI, then registration requirements of that event will apply.

6.3. The registration number shall be displayed in a realistic manner typical of full-scale aircraft.

7. Material and Workmanship. Workmanship must be of satisfactory standards. Contest committees are empowered to refuse permission to fly, or to disqualify any aircraft which, in their opinion, is not of reasonably safe standards in materials, workmanship, detail design, radio installation or condition as a result of damage.

8. Pattern Event Classes.

8.1. The event shall be divided into three classes: in order of increasing difficulty, the classes are Sportsman, Advanced, and Unlimited.

8.2. Contest Directors and/or the sponsors of a sanctioned meet shall determine which of the classes will be flown. Such information must accompany all advance notices pertaining to the contest. Competitors must also be advised prior to the start of the contest of any planned deviations from standard rules.

9. Contestant Classification.

9.1. A contestant may enter any one pattern class at his own option. Advancement from the Sportsman Class to the Advanced Class is mandatory. Advancement from the Advanced Class to Unlimited Class is optional at any time. Contestant may return to Advanced class in future competitions when he so desires.

9.2. Advancement from the Sportsman Class to the Advanced Class occurs after winning first place in the Sportsman Class three times. There shall be at least five entries and at least five contestants making official flights before the first place victory is counted towards advancement to the Advanced Class. If the Sportsman Class is not offered at a competition, then the contestant can enter any class and then compete in the Sportsman Class in future contests until three first place wins are accumulated.

9.3. For a pilot to be reclassified from Advanced to Sportsman class, that person must make an application (using a form sup-

with winning a competition and the man who overcomes all pressures is myre expert than one who does not.

D. Judging Individual Maneuvers. The schedule or maneuvers to be performed is described in the RC Pattern Rules. Each maneuver is to be judged individually on a basis of 0 to 10 points according to the degree of excellence.

A common problem in judging is to score the first flights too high and then find there is no margin left to reward a superb flight. When in doubt give the lower score. Remember that perfection is not a relative thing. Perfection is that maneuver in which you see absolutely no flaws. It is not a common occurrence.

In the following section, a description of each maneuver is given and then a number of reasons for downgrading are listed. The maneuver should be downgraded according to (1) the number of defects observed; (2) the severity of the individual defects, and (3) the number of times any one defect occurs.

For example, a small single change in heading during the taxi portion of the touch and go would be considered one defect while two or three distinct turns would be considered two or three defects. It will be noted that for many maneuvers there are more than ten possible kinds of defects and that some of these can be repetitive. It will not be possible to negative one point for each defect or indeed we would have many negative scores.

A score of 10 should be given only if the maneuver is well positioned and no defects are observed. One or two minor defects should result in downgrading to least an impairment of three or four minor defects. Any downgrading should be decided at the start of the maneuver and also fed into the final score for the maneuver.

The following is a collation of all mandatory zero scores applicable to all pattern classes. Judges must agree unanimously on any zero scores.

1. Flying behind Flight Line during or between maneuvers (see 5.2).
2. Maneuver performed out of sequence.
3. Failure to call a maneuver before its execution.
4. Maneuver flown in sun if it could be flown elsewhere.
5. Maneuver not completed.
6. Engine not running throughout all maneuvers, except Spin, Approach, and Landing.
7. Less than 2, or more than 4 Spins.
8. Spiral Dive instead of Spin.
9. Model does not land after approach, zero the approach.
10. Model ends on its back when landing.
11. Any gear retracts during landing.
12. Time runs out prior to completion of a maneuver, zero maneuver and subsequent maneuvers.

E. Description of Maneuvers. The descriptions of maneuvers in the FAI RC Aerobatic section applies in the Novice, Advanced, Expert and Master classes. When the named maneuver is not contained in the FAI Schedule of Maneuvers, the description follows. Definitions of abbreviated FAI maneuvers used in Novice and Advanced classes (One Outside Loop and Non-Rolling Figure M) can be taken from the full description simply by deleting the portion not used.

Straight Flight Out. The model must be brought exactly over the center of runway and/or landing circle and flown in an absolutely straight path parallel with the flight line for a distance of approximately 300 feet before starting the Procedure Turn. (Distance does not have to be accurate; however, judges may specify start of turn if they wish). Straight Flight may be downgraded because:

1. Does not fly over center of runway and/or landing circle.
2. Plane deviates left or right.
3. Does not hold constant altitude.
4. Turns before permission is given by judge.
5. Gallops in elevation.

Procedure Turn. After the straight flight, the model must turn exactly 90° to the left or right, whichever will take the plane away from the spectator line (direction to be specified by the Contest Director), then exactly 270° to the right (or left) and cross over the point where the first turn commenced. The turn may be downgraded because:

1. Left turn not 90°.
2. Right turn not 270°.
3. Changes in altitude during turn.
4. Turns not smooth and circular.
5. Does not head back over exact outgoing path.

Straight Flight Back. The model should fly back toward the circle along the same line as the outgoing path and pass exactly over the circle. The Straight Flight Back may be downgraded because:

1. Turns or wiggles during straight flight.
2. Change in altitude.
3. Gallops in pitch, yaw or roll.
4. Flight not along original path.
5. Does not pass over circle.

39. RC PYLON RACING—FORMULA I AND II

- 4.3. **Engine Shut-Off.** Pilot must be able to shut off his engine by radio control with plane in upright position, on ground or in the air, without affecting flight path in any direction, upon official command. Engine must stop within five (5) seconds of command.
- 4.4. **Propeller.** Only wooden, fixed pitch, two blade propellers shall be permitted.
- 4.5. **Spinner.** A rounded spinner of at least 2 inches diameter is required on all Formula I aircraft and on prototype Formula II aircraft.
- 4.5.1. Formula II models of real aircraft need not use a 2 inch spinner, where such a spinner is inappropriate, but must at least meet the AMA prop nut rule.
- 4.6. **Fuselages.**
 - 4.6.1. Formula I: At the pilot's cockpit, a minimum depth of 7 inches and a minimum width of 3 1/2 inches is required.
 - 4.6.2. Formula II: A minimum depth of 7 inches and a minimum width of 3 1/2 inches is required. Both minimum dimensions must occur at the same cross section location.
 - 4.6.3. Note: Fillies are not considered part of the fuselage.
 - 4.6.4. Formula II prototype aircraft must have cheek cowl and the cross section at the engine shall be an oval at least 3 inches wide and 2 inches high overall.
 - 4.6.5. For both Formula I and II the engine shall be cowed at least to the extent that no more than the cylinder and head fins project beyond the fuselage outline. The exhaust side of cowl may be shaped to clear exhaust exit.
- 4.7. **Leading Gear.** At least two wheels, of 2 1/2 inch diameter or larger, must be used. Where applicable, a third wheel, of any size, may be used. A positive means of steering on the ground shall be provided. (A movable rudder fulfills this requirement.) Retracting of any landing gear, even on scale ships in Formula II, shall not be permitted.
- 4.8. **Wings.** The minimum area specified below must be used, including that area displaced by the fuselage but not including fillies or stall strips. Flaps are permitted but wing area is to be figured with flaps retracted.
- 4.8.1. **Area.**
 - 4.8.1.1. Formula I: Minimum area shall be 450 square inches.
 - 4.8.1.2. Formula II: Total minimum area shall be 600 square inches. On biplanes with different size wings, the area of the smaller wing shall be at least 1/2 the area of the larger wing.
- 4.8.2. **Span.**
 - 4.8.2.1. Formula I: No restrictions.
 - 4.8.2.2. Formula II: Minimum wing span shall be 50 inches for a monoplane and 30 inches for the largest wing of a biplane.
- 4.8.3. **Chord Thickness.**
 - 4.8.3.1. Formula I: Wing shall be at least one inch thick at the centerline. Thickness may be measured with wing on or off the aircraft. If wing is not removed for measurement, a "no-go" gauge set at 1/8 of an inch shall not "go" less than 3 inches from the wing centerline. The wing, from centerline (and/or outside of fillets) to tip, must be a straight line taper on both top and bottom surfaces. (The wing may have a convex taper.)
 - 4.8.3.2. Formula II: Wing thickness at the root shall be at least 1 1/2 inches for a monoplane and 1 inch for a biplane. On a biplane with different size wings, the smaller wing must be at least 3/4 inch thick at the root. Thickness of wings may taper in any straight line proportion to taper of chord length.
 - Note: In the Formula II specifications "root" shall be defined as the innermost wing section, not counting fillies. That may be measured without removing wing from fuselage. On a completely exposed wing, such as on a parasol monoplane or the top wing of most biplanes, the "root" is that section of the wing that is intersected by a projection of the outline of the fuselage as seen in the top view; i.e., the root section would be two inches from the centerline of an exposed wing on a plane with a 4 inch wide fuselage.
- 4.9. **Weight.** Planes shall be weighed immediately after an official flight, with whatever amount of the fuel remains and before being returned to the pit or ready area. Weight at this time shall be less than 5 pounds more than 6 1/2 pounds.
6. **Racing Numbers.** Racing numbers may be obtained from the National Miniature Pylon Racing Association secretary. The use of these numbers is highly recommended, but not mandatory. The numbers are located on the upper, left and lower right hand wing panel facing toward the left side. The number will be right side up with the model in a left bank. The numbers will be at least 3" on the wings. Area letters will be 1/2 inch high.
7. **Registration Numbers.** Registration numbers are the entrants' AMA numbers. If the entrant desires he may use the last two or

1. **Objective.** To run multiple plane races that will recapture the spirit and thrills of the great air races of the past and present, and that will be interesting for spectators as well as challenging for the contestants.
2. **General.** All AMA regulations (See sections titled Sanctioned Competition, Records, Selection of Venues, Championships, and General) and FCC regulations regarding air RC flying shall apply. There shall be no restriction on the type of equipment fitted to the plane, or the number of controls. The contestant shall be allowed two entries in this event. He can only use his alternate model if the first model is not flyable. The contestant may have someone else fly his model in competition if he desires to do so; however, if this is done they shall be entered as a team. Both the owner and the pilot shall have current AMA sporting licenses.
- 2.1. Consideration of safety for contestants, contest personnel, and other contestants are of the utmost importance in this event. Any unsportsmanlike conduct or hazardous flying over a controlled spectator area will be cause for immediate disqualification of that pilot.
3. **Model Aircraft Requirements.**
 - 3.1. Formula I: Models must be a replica of the 190 cubic inch class of full size Formula I racing aircraft.
 - 3.2. Formula II: Original prototypes, or models resembling known full scale aircraft that have raced or were designed for racing on a closed course. For the latter, contestant must provide event officials with proof of the plane's identity and its connection with racing.
 - 3.3. The Builder of the Model rule shall not apply to the Formula I and II events.
4. **Model Aircraft Specifications.**
 - 4.1. **Engine(s).** Maximum total nominal displacement shall be 4030 cc (246.6 cu. cm). Engines must be production units assembled from factory production parts. Engines and associated hardware must be of the same make and model as noted herein and all must be available through retail outlets in the U.S.A. Alterations shall be limited to catalog listed parts produced in quantities greater than 1,000 units and available commercially to anyone from the manufacturer of the engine being altered. Engines may only be altered by removing parts or material from the following paragraphs under this section.
 - 4.1.1. The "engine" is defined as the complete unit, ready to run, needing only prop, fuel, and starting voltage, except that the glow plug, carburetor, shut-off, exhaust extension, gaskets, head and crankcase bolts, drive washer, front washer, and prop nut need not be considered part of the production unit. These parts are not subject to the rules regarding quantity or source because engine manufacturers may or may not produce these parts which help make up the complete production engine.
 - 4.1.2. An exhaust extension may be used, provided its sole purpose is to carry exhaust fumes and residue out of the cowl.
 - 4.1.2.1. Rear exhaust engines may use an adapter not over 1 1/2 inches long (measured along centerline and from face of piston) followed by a constant inside diameter pipe which increases the total length of the complete extension to not over five inches as measured from face of piston to extreme exhaust end.
 - 4.1.2.2. Side exhaust engines may use a curved adapter not over 2 1/2 inches long (measured along centerline and from face of piston) followed by a constant inside diameter pipe which increases the total length of the complete extension to not over five inches, as measured from face of piston to extreme exhaust end.
 - 4.1.2.3. Any part of the exhaust extension may continue outside of the cowl.
 - 4.1.2.4. If a Contest Director feels that a particular exhaust extension does not meet the above physical specifications, he may require a test run of the engine with and without the extension. The extension shall be 200 RPM. Test runs with and without extension must take place within a 15-minute time period, and with all other conditions constant. Note: Contest Directors are cautioned that requiring the above test must come only as a result of suspecting the physical appearance of the extension, and not as a result of suspecting that the extension is causing an excessive increase in RPM. In other words, certain engines on occasion may pick up more than 200 RPM with a legal extension, but this alone is not a satisfactory reason for requiring the test.
 - 4.2. **Engine Inspection.** Any competitor at a contest may have another competitor's engine inspected for compliance with the rules by posting \$25.00. The engine will be inspected by the C.D. and someone selected by the C.D. If declared legal, the owner is not disqualified and gets the \$25.00 for his trouble. If declared illegal, the owner is disqualified and the prospector gets his \$25.00 back.
 - 4.2.1. The C.D. may at his discretion request an engine inspection prior to the trophy or award presentation without the \$25.00 fee above.

- 16.3. Contestant or helper shall call out each maneuver to the judges except during the free style portion where the calling is optional.
- 16.4. Takeoff is not to be considered a judged maneuver. It is not necessary for the judges to see the aircraft take off. The aircraft may be carried to the takeoff point, and carried from the landing area, if so desired.
- 16.5. No flybys are allowed during the aerobic sequence. If a flyby is performed then the next maneuver shall receive zero points (i.e. each upwind and downwind leg will consist of a maneuver). Flybys can be performed in the free style portion only.
- 16.6. Presentation is defined as a score of 0 to 10 that is given for how well the aircraft is kept within the boundaries of the 120-degree aerobic zone during the Free-style sequence. Boundary infringements, 2 points each.
- 16.7. Maneuver options are selected by contestants from a complete list which is graduated in difficulty for various categories. Contestants may select maneuvers from higher categories, but not lower categories. Options are flown in the normal manner, one on each pass before the judges.
- 16.8. Selected option maneuvers are not to be repeated in the Free-style sequence (turns excepted).
- 16.9. Free-style is defined as a continuous flow of recognizable maneuvers and turns, listed on the score sheet and flown entirely within the 120-degree box. It is an unrestricted, individually creative sequence.
17. **Maneuvers.**
 - 17.1. Sportsman
 1. Loop option
 2. Roll option
 3. Turn option
 4. Spin option
 5. Snap option
 6. Presentation
 7. Landing
 - 17.2. Advanced
 1. Unknown (5 maneuvers plus turns, one minute maximum)
 2. Unknown (5 maneuvers plus turns, two minutes maximum)
 3. Presentation
 4. Unknown (5 maneuvers plus turns, one minute maximum)
 5. Unknown (5 maneuvers plus turns, two minutes maximum)
 6. Presentation
 7. Unknown (5 maneuvers plus turns, one minute maximum)
 8. Presentation
 9. Unknown (5 maneuvers plus turns, one minute maximum)
 10. Presentation
 11. Unknown (5 maneuvers plus turns, one minute maximum)
 12. Presentation
 13. Unknown (5 maneuvers plus turns, one minute maximum)
 14. Presentation
 15. Unknown (5 maneuvers plus turns, one minute maximum)
 16. Presentation
 17. Unknown (5 maneuvers plus turns, one minute maximum)
 18. Presentation
 19. Unknown (5 maneuvers plus turns, one minute maximum)
 20. Presentation
- *Unknown maneuver to be announced the day of the contest.
- The following is an example flight plan for each class. This is a guide only, and individuals may create their own sequences by substitution, as they develop them.

| OPTIONS | SPORTSMAN | ADVANCED | UNLIMITED |
|------------|------------------------|----------------------|---------------------------|
| 1. LOOP | Inside Loop | Loop with snap | Square Outside Loop |
| 2. TURN | One Roll | 4-Point Roll | 360° Rolling Circle |
| 3. TURN | Half Cuban Eight | Hammerhead | Inv. Hammerhead |
| 4. SPIN | One Spin | Reverse Spin | Inv. 3-Turn Spin |
| 5. SNAP | One Snap | 45° Snap | 45° Snap |
| 6. | Free-Style (3) | Unknown | Unknown |
| 7. | Presentation | Free-Style (5) | Free-Style (5) |
| 8. | Landing | Presentation | Presentation |
| Typical | Square Loop | Cuban Eight | Loop OS Snap @ Top |
| FREE-STYLE | Immelmann | 180° Turn 1/4 Rls. | Horizontal Eight |
| (K-3) | Split - S | Slow Roll | Half Loop |
| | Half Rev. Cuban 8 | Immelmann | Inv. Snap |
| | | 3-Turn Spin | Split - S |
| | | | Circus Eight |
| | | | Triangular Loop & Roll |

- 16.1. The contestant must fly his entire flight according to the established flight schedule for his particular class, and in the sequence listed. Maneuvers performed out of order will be scored 0.
- 16.2. Contestant or anyone else may not touch his aircraft after it has become airborne until completion of flight. He may not land aircraft between maneuvers in order to make adjustments to engine, aircraft trim, etc.

FAI RC Aerobatics (F3A) (MASTER CLASS AMA RC Aerobatics)

Rules 1 through 12 and the FAI General Rules do not necessarily apply when FAI Pattern is flown as the Master class in AMA contests—they are basically world championship regulations. They may, however, be used if it is advertised that the event is to be run in accordance with these FAI regulations rather than the AMA pattern rules. For either the AMA Master class or FAI events, the FAI schedule of maneuvers shall be used. The AMA Master class may also consist only of Schedule C maneuvers.

1. **Definition of a Radio Controlled Aerobatic Power Model.** Model aircraft which is aerodynamically maneuvered by control surfaces in altitude, direction and altitude by a pilot on the ground using radio control, but not a Helicopter.

2. **Preparation of the Model.** Permitted: a plane which is assembled by the competitor from prefabricated parts and in which the competitor installs the equipment. Not permitted: models which are completely prefabricated and require only a few minutes of unskilled effort for their completion or complete ready-to-fly models which have been built by a person other than the pilot.

3. **General Characteristics of Radio Controlled Aerobatic Power Models.** Maximum surface area: 150 dm² (2325 sq. in.). Maximum total weight, without fuel: 5 kg. (11,023 lbs.). Maximum total swept volume of the engine(s): 10 cm³ (.61 cu. in.). The engine(s) must be fitted with effective silencer(s). The maximum noise level and method of measuring it is stated in Annex A.

4. **Number of Helpers.** Each pilot is permitted one helper during the flight. Two helpers may be present during the starting of the engine.

5. **Number of Flights.** See Annex A.

6. **Definition of an Attempt.** There is an attempt when:

- The pilot announces the start of the take-off maneuver.
- The model fails to commence the take-off maneuver within the 3 minutes allowed to the competitor.
- If the engine stops after the pilot has announced the start of take-off and before the model is airborne, it may be restarted (within the 3-minute period). However, no points will be awarded for the subsequent take-off maneuver.

7. **Number of Attempts.** Each competitor is entitled to one attempt for each official flight.

N.B. An attempt can be repeated at the judges' discretion only when, for any unforeseen reason outside the control of the competitor, the model fails to make a start (i.e. there is radio interference).

8. **Definition of an Official Flight.** There is an official flight when an attempt is made whatever the result.

9. **Marking.** Each maneuver may be awarded marks between 0 and 10 by each of the judges during the flight. These marks are multiplied by a coefficient which varies with the difficulty of the maneuver. Any maneuver not completed shall be scored 0. The judges will allow them to be seen clearly by the judges, approximately 60 degrees vertically and 90 degrees horizontally. The non-observance of this rule will be heavily penalized by loss of points. If a model is, in the opinion of the judges, unsafe or being flown in an unsafe manner, they may instruct the pilot to land.

10. **Classification.** See Annex A.

11. **Judging (for World Championships).**

- The organizer must appoint a panel of at least three judges for each flight. The judges shall preferably be of different nationalities and be elected from a list of operators who are approved by the National Aero Clubs and the CIAM. The specific system to be employed at a World Championship must be stated in advance by the organizers and must have prior approval by the CIAM or CIAM Bureau.
- There shall be a judges' briefing with training flights before every W.C.

12. **Organization for RC Aerobatic Contests.** All transmitters at the contest site must be checked and placed in a compound kept under observation. During the contest a Steward(s) must be in control of the transmitter compound(s) and will issue the transmitter to the competitor only when his name is called for him to make his flight. As soon as the attempt has ended the competitor must immediately return his transmitter to the Steward at the transmitter compound.

Any unauthorized transmissions during the period of the con-

test will result in automatic exclusion of the offender from the contest and render him liable to further penalties. During the flight the competitor must stay in the proximity of the judges and under the supervision of the Course Steward.

The order of starting of the various countries will be established by means of a draw before the start of the contest, compatible with transmitter frequencies.

Competitors must be called at least five minutes before they are required to occupy the starting area.

Once the competitor has been given permission to start, he may delay no longer than one minute before attempting to start his engine. The timer will notify the competitor when the minute is finished and immediately start timing the 3-minute starting time.

The organizer must provide an adequate radio monitor for the purpose of detecting radio interference and a means of communicating this information to the pilot.

13. **Schedule of Maneuvers for RC Aerobatic Power Models.** The maneuvers must be executed during an uninterrupted flight in the order in which they are listed. Each time the model passes in front of the judges a maneuver must be executed, except after take-off and before landing where in each case a pass may be made without a maneuver being performed. It is recommended that the pilot or helper should vocally indicate to the judges that the pilot is about to execute a maneuver. The competitor may make only one attempt at each maneuver during the flight. The pilot has fifteen minutes to start his engine and 10 minutes to complete his flight, the 10 minutes to start when the competitor attempts to start his engine.

N.B. A pass is made when the model flies over a line perpendicular to the center of the judges.

The schedule of maneuvers is given in Annex B and the descriptions of maneuvers in Annex C.

ANNEX A

3. **Noise Measurement.** The maximum noise level will be 84dB measured at 10 meters distance. The noise level will be measured in the following manner: on a rotatable platform 1.2m above the ground, and the microphone is placed 10m downwind from the model 1.2 m above the ground. With the engine running at full power, the noise level shall be taken at one position, 90° to the flight path, on the engine exhaust side of the model.

Measurements should be made over short grass.

The equipment used for measurement should comply with International Electronic Commission Document No. 179, "Precision-Noise Level Instruments."

10. **Classification.** Each competitor will have four flights, two from Schedule A, and two from Schedule B; the best scores from each schedule will be added together to determine the team places; the top 10%, or first five, of the competitors will then compete in a final to determine the individual winner. The final will consist of two flights for each competitor, the best of which will be added to the previous score to determine the winner. The final schedule will be chosen by each competitor from the complete list of maneuvers. Only 14 different maneuvers may be selected including take-off and landing, to give a maximum total score of 450 points. Only one Figure M may be included.

Before the final the competitor must submit the list of maneuvers he will fly to the Contest Director, maneuvers to be indicated by the numbers shown in Annex B.

ANNEX B

| Schedule A | K Factor |
|--------------------------------|----------|
| A1. Take-Off | 1 |
| A2. Double Immelmann | 2 |
| A3. Three Reverse Inside Loops | 3 |
| A4. Rolling Eight | 2 |
| A5. Slow Roll | 3 |
| A6. Top Hat | 2 |
| A7. Horizontal Eight | 2 |
| A8. Figure M with 1/4 Rolls | 2 |
| A9. Three-Outside Loops | 2 |
| A10. Three-Turn Spin | 2 |
| A11. Three Horizontal Rolls | 2 |
| A12. Landing | 1 |
| Total X 10 = | 290 |

| Schedule B | K Factor |
|--------------------------------------|----------|
| B1. Take-Off | 1 |
| B2. Reverse Double Immelmann | 2 |
| B3. Cuban Eight | 2 |
| B4. Three Inside Loops | 2 |
| B5. Straight Inverted | 2 |
| B6. Vertical Eight | 2 |
| B7. Four-Point Roll | 2 |
| B8. Three Reverse Outside Loops | 3 |
| B9. Two Rolls in Opposite Directions | 3 |
| B10. Figure M with 1/4 Rolls | 3 |
| B11. Cobra Roll | 2 |
| B12. Landing | 1 |
| Total X 10 = | 290 |

List of Extra Maneuvers for Finals

| | |
|--|---|
| 13. Avalanche | 3 |
| 14. Inverted Spin | 3 |
| 15. Square Horizontal Eight | 4 |
| 16. Eight-Point Roll | 3 |
| 17. Vertical Roll | 3 |
| 18. Altitude Turn | 3 |
| 19. Figure M | 3 |
| 20. Square Loop with Four 1/4 Rolls | 3 |
| 21. Two Sharp Rolls in Opposite Directions | 3 |
| 22. Reverse Knife Edge | 4 |
| 23. Reverse Top Hat | 4 |
| 24. Reverse Cuban Eight | 4 |
| 25. Reverse Point Roll | 2 |
| 26. Triangle Rolling Loop | 4 |

ANNEX C

Description of Maneuvers. All maneuvers will start and finish in straight and level flight and have the same altitude and heading for entry and exit unless otherwise stated.

All maneuvers will be downgraded if the start and finish are not straight and level and the altitude and heading are not the same for exit and entry.

All maneuvers which have more than one loop shall have the loops the same diameter; similarly all maneuvers which have more than one roll shall have the same roll rate. All consecutive rolls shall be at the same altitude.

Take-Off. The model must stand still on the ground with the engine running, without being held, and must then take off. The take-off run should be straight, the model lift gently from the ground and climb at a gradual angle. The take-off is completed when the model is approximately two meters (6 2/3 feet) from the ground. Downgrades:

- Model does not stand still when released.
- Changes heading during take-off and climb.
- Model jumps from the ground.
- Retouches ground after becoming airborne.
- Too steep a climb angle.
- Gallops in elevation during climb.
- Wings not level at any time.

Double Immelmann. Model pulls up into a half inside loop, half rolls to upright, flies straight and level for approximately one second, does a half outside loop and half rolls to level flight. Downgrades:

- Half loops deviate left or right.
- Half rolls not immediately after half loops.
- Model pauses more than one second before half outside loop.
- Half loops not at same altitude.

Three Reverse Inside Loops. Model half rolls from level flight, pauses for approximately one second, then does three consecutive inside loops downward, flies for approximately one second inverted then half rolls upright. All loops should be round and superimposed. Downgrades:

- Changes in heading during half rolls.
- Loops not round.
- Loops not superimposed.
- Wings not level during loops.
- Changes in heading during loops.

Rolling Eight. Model pulls up from level flight, completes an inside loop, at the bottom executes a half roll, makes a second inside loop, directly under the first, and half rolls back to level flight. Downgrades:

- Loops not round.
- Second loop not directly under first.
- Model not level at start and finish of half rolls.
- Changes in heading during loops and rolls.
- Wings not level during loops.

Slow Roll. Model rolls slowly through one complete revolution, in either direction; maneuver takes approximately five seconds. Downgrades:

- Changes in heading.

- Changes in altitude.
- Roll rate not constant.
- Model does not roll exactly 360 degrees.
- Roll takes less than 4 or more than 6 seconds.

Top Hat. Model pulls up into a vertical attitude, pauses, makes a half roll, pauses, pulls over to inverted flight for a short period, half rolls down, pauses, makes a half roll, pauses and recovers in level flight. Downgrades:

- Model not vertical before starting and finishing rolls.
- Rolls not exactly 180 degrees.
- Model does not fly straight and level inverted.
- Vertical and horizontal legs not the same length.
- Rolls not at same length.
- Changes in heading during maneuver.

Horizontal Eight. Model pulls up and completes 1/4 of an inside loop to a vertical position, then does a complete outside loop to a vertical position again and recovers by doing a 1/4 inside loop. Downgrades:

- Model not round.
- Model not vertical at crossover-point.
- Changes in heading during loops.
- Loops not same diameter.
- Loops not at same altitude.
- Model does not crossover at same point.

Figure M with 1/4 Rolls. Model pulls up into a vertical attitude, executes a 1/4 roll, stalls, turns through 180 degrees, 1/4 turns again in the same direction as the first roll, does a 1/2 outside loop to a vertical attitude again, 1/4 rolls in the same direction as the first two, does an inverted stall turn through 180 degrees, 1/4 rolls in the same direction as the other three, and recovers to level flight. Viewed from the side the model executes a figure M. Downgrades:

- Model not vertical at start and finish of rolls and stall turns.
- Stall turns not 180 degrees.
- 1/4 rolls not exactly 90 degrees.
- Bottom of outside loop not level with entry.
- Changes in heading during 1/2 outside loop or rolls.
- Stall turns not at same altitude.

Three Outside Loops. Model pushes over and executes three consecutive outside loops. All loops should be round and superimposed. Downgrades:

- Loops not round.
- Loops not superimposed.
- Wings not level during loops.
- Changes in heading during loops.

Three-Turn Spin. The model establishes a heading, power is reduced, the model is held in a slightly nose high attitude until it stalls and commences to spin. The model will autorotate through three complete turns and recover on the same heading but at a different attitude. Downgrades:

- Entry not level.
- Does not make three turns; less than two or more than four, score zero.
- Does not finish on same heading.
- Wings not level during recovery.
- Spiral dive scores zero.

Three Horizontal Rolls. Model rolls at a uniform rate through three complete revolutions in either direction; maneuver takes approximately five seconds. Downgrades:

- Changes in heading during rolls.
- Changes in altitude during rolls.
- Roll rate not constant.
- Model does not do exactly three rolls.
- Maneuver takes less than 4 or more than 6 seconds.

Reverse Double Immelmann. Model pushes over and executes 1/2 outside loop followed immediately by a 1/2 roll, pauses for approximately one second, does a 1/2 loop and immediately 1/2 rolls to level flight. Downgrades:

- Changes in heading during 1/2 loops and 1/2 rolls.
- 1/2 rolls not immediately after 1/2 loops.
- Model pauses more than one second before 1/2 inside loop.
- 1/2 loops not at same altitude.

Cuban Eight. Model pulls up and executes an inside loop, when at 45 degrees inverted model does a half roll, followed by another inside loop, when again 45 degrees inverted the model does another half roll and recovers to level flight. Downgrades:

- Loops not round and same size.
- Model not at 45 degrees before commencement of rolls.
- Changes in heading before commencement of rolls.
- Rolls do not cross over at same point.

Three Inside Loops. Model pulls up and executes three consecutive inside loops; all loops should be round and superimposed. Downgrades:

- Loops not round.
- Loops not superimposed.

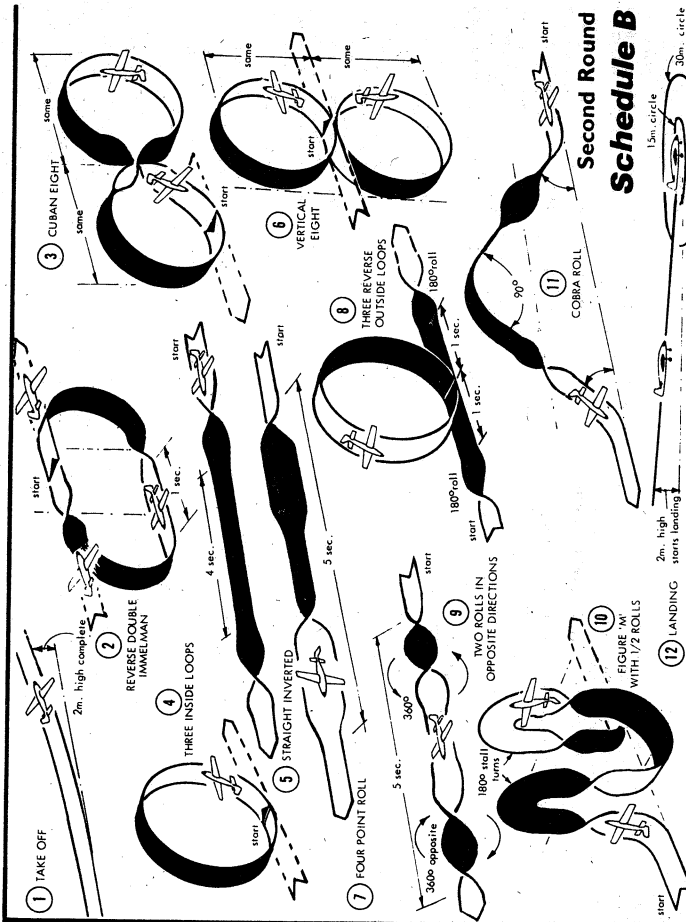
Figure M with 1/2 Rolls. Model pulls up into a vertical attitude, performs a 1/2 roll, stall turn through 180 degrees, another 1/2 roll, then executes a half inverted loop, followed by a third 1/2 roll, a second stall turn and a fourth 1/2 roll, recovering in level flight. The rolls may be in any direction but the stall turns must be in opposite directions. Viewed from the side the model executes a figure M. Downgrades:

1. Model not vertical at start and finish of rolls and stall turns.
2. Stall turns not exactly 180 degrees.
3. 1/2 rolls not exactly 180 degrees.
4. Bottom of outside loop not level with entry.
5. Changes in heading during 1/2 outside loop and rolls.

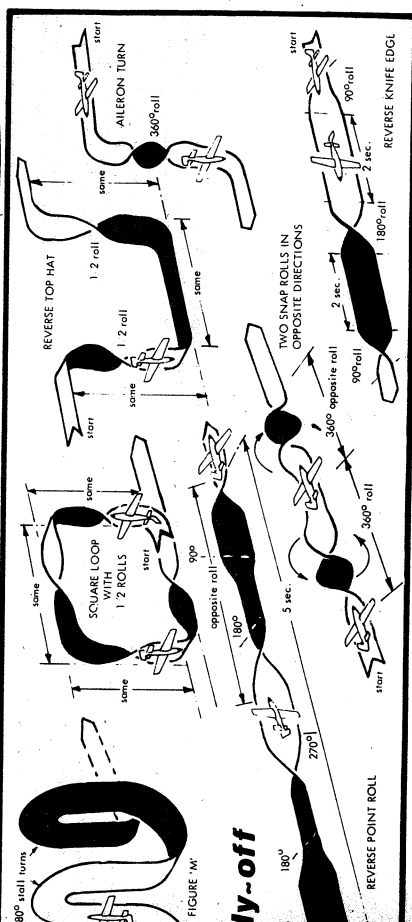
Cobra Roll. Model pulls up to a 45 degree angle, half rolls to inverted attitude, executes a 1/4 loop, half rolls to upright attitude and recovers in level flight. Downgrades:

1. Initial climb not 45 degrees.

Illustrations Courtesy of Radio Modeller



Second Round Schedule B



Downgrades:

1. Loops not superimposed.
2. Changes in heading during loops and rolls.
3. Wings not level during loops.
4. Model pauses more than one second before and after loops.

Two Rolls in Opposite Directions. Model rolls 360 degrees in the opposite direction, rolls to take approximately five seconds. Downgrades:

1. Changes in heading.
2. Roll rate not constant.
3. Second roll does not start immediately after first roll.
4. Rolls take less than 4 or more than 6 seconds.

Two Rolls in Opposite Directions. Model rolls 360 degrees in the opposite direction, then immediately after rolls 360 degrees in the opposite direction, rolls to take approximately five seconds. Downgrades:

1. Changes in heading.
2. Roll rate not constant.
3. Second roll does not start immediately after first roll.
4. Rolls take less than 4 or more than 6 seconds.

3. Wings not level during loops.
4. Outside loop not directly under inside loop.

Four-Point Roll. Model rolls through 360 degrees, hesitating at each 90 degree point; at each hesitation wings are parallel or vertical to the horizon; maneuver takes approximately five seconds. Downgrades:

1. 1/4 rolls less than 90 degrees.
2. Model does not hesitate after each 1/4 roll.
3. Roll rate not constant.
4. Roll takes less than 4 or more than 6 seconds.
5. Changes in altitude.

Three Reverse Outside Loops. Model half rolls to inverted, pauses for approximately one second and pushes up to execute three consecutive outside loops; pauses for approximately one second then half rolls to level flight; all loops to be round and superimposed. Downgrades:

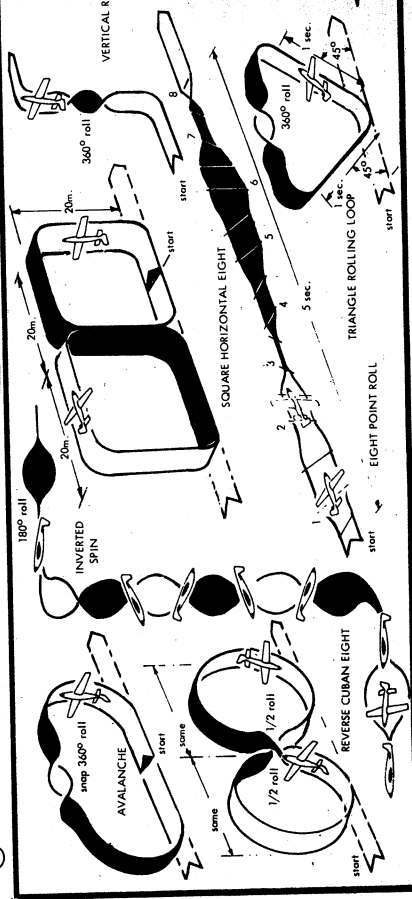
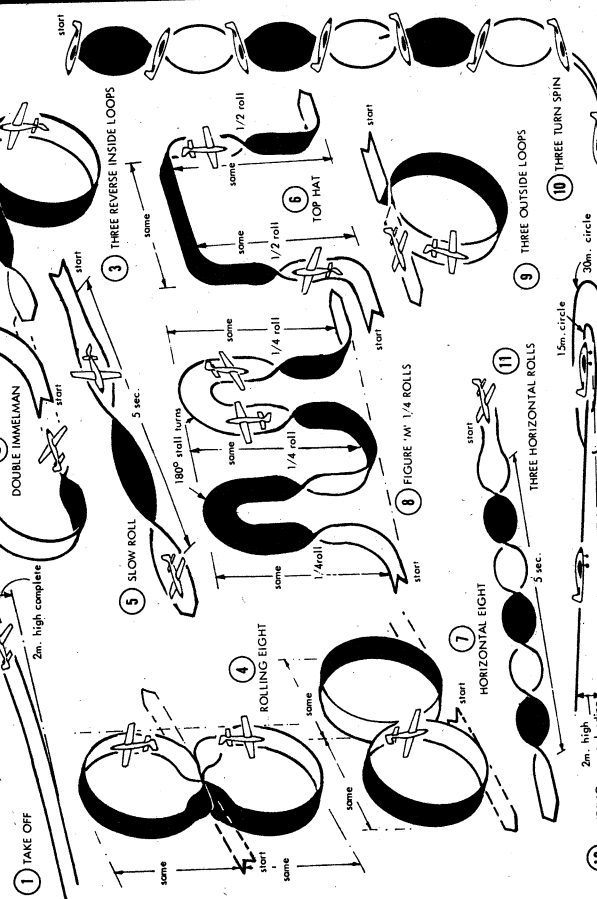
1. 1/2 rolls less than 90 degrees.
2. Model does not hesitate after each 1/4 roll.
3. Roll rate not constant.
4. Roll takes less than 4 or more than 6 seconds.
5. Changes in altitude.

Vertical Eight. Model pulls up and executes a complete inside loop, at the bottom pushes over and completes an outside loop directly under the inside loop. Downgrades:

1. Loops not round and same diameter.
2. Changes in heading during loops.

F.A.I. AEROBATIC SCHEDULE

Schedule A First Round



FAI RC AEROBATICS JUDGES' GUIDE

Purpose. The purpose of the FAI RC Judges' Guide is to furnish an accurate description of each maneuver and to provide a reference for use in developing a uniformly high standard of judging.

Principles. The principles of judging an RC model should be based on the perfection with which the model simulates full scale aircraft performance. The main criteria for perfection in an individual maneuver can be classified as follows:

1. Positioning of the maneuver.
 2. Orientation or display of the maneuver.
 3. Size or dimensions of the maneuver.
 4. Smoothness or gracefulness of the maneuver.
- All of these requirements must be met in order for a maneuver to be rated perfect.

Precision. At the instant the contestant announces his next maneuver, the judge should form an image of the course the model airplane should follow.

The judge should adjust his image if the first portion of the maneuver clearly demonstrates that the contestant intends to do a maneuver of much smaller or larger dimensions than the judge anticipated.

It will be noted that forming an image of the forthcoming maneuver is based on using the straight and level entry as a reference. The absence of a definite entry into a maneuver increases the difficulty of judging its precision, and competitors will recognize this as justification for downgrading.

The straight and level exit from a maneuver is one of the more valuable portions of a maneuver for evaluation of how well the intended course of the maneuver is followed. The pilot will use it to announce "maneuver completed." The absence of a well defined straight and level exit should also result in downgrading.

Positioning. In such a way that they can be easily judged. The first consideration on position is longitudinal distance from the competitor. All the judges should be located near the competitor so that they obtain identical views of the maneuver. The competitor should center his aerobatic maneuvers in such a way that they can be easily judged. The first consideration on position is longitudinal distance from the competitor. All the judges should be located near the competitor so that they obtain identical views of the maneuver. The competitor should center his aerobatic maneuvers at an average distance of less than 100 meters (328 feet) from himself. The judge should observe if the competitor is trying to hide his defects by flying at a distance.

Positioning of maneuvers involves more than distance. They should also be presented in a relative direction which displays the most difficult aspects of the maneuver. Specifically, maneuvers which have vertical symmetry (such as Loops, Immelmans, Cuban Eights and Horizontal Eight) should execute their circular path in a plane perpendicular to the line of sight to the model.

"End on" or "canted" presentation of the circular maneuvers should result in downgrading. The difficulty of judging the symmetry of figure 8's and the "tracking" of consecutive loops.

While no special bonus is justified for exceptionally low altitude, excessively high altitude is cause for downgrading. Most maneuvers can be done at less than 100 meters (328 feet) longitudinal distance at altitudes that would not force the judge to look up at more than about 45 degree angle. If maneuvers are executed at high altitudes and close to or above the transmitter way that they force the judge to look up vertically or near vertically, they should be downgraded. The main reason for this is that most maneuvers cannot possibly be properly oriented when performed directly overhead.

Size of Maneuvers. The established criteria places an upper limit of about 100 meters for the total vertical size of a maneuver. Most competitors and judges will recognize this as more than ample. It should also be recognized that 100 meters of horizontal distance is a maximum value and not really the optimum. For example, on inside loop of 30 meters (98') diameter at 45' meter (148')

1. Model not vertical before and after stall turns.
2. Small turns not 180 degrees.
3. Climbing and diving paths not parallel.
4. Bottom of outside loop at different altitude to entry.
5. Altitude of second stall turn different to first.

Square Loop in each side the model executes a 1/2 roll. Downgrades:

1. Loop not square.
2. Rolls not level during 1/4 loops.
3. Changes in heading during rolls and loops.
4. Wings not level during 1/4 loops.
5. Sides of square not of equal length.

Two Snap Rolls in Opposite Directions. Model snap rolls** through 360 degrees, recovers and immediately snap rolls in the opposite direction, and recovers in level flight. Downgrades:

1. Rolls not 360 degrees.
2. Roll not snap rolls**.
3. Changes in heading.
4. Changes in altitude.

Reverses Knife Edge. Model rolls 90 degrees and hesitates, then rolls 180 degrees in opposite direction and hesitates, then rolls 90 degrees to finish in level flight. Maneuver takes approximately 5 seconds. Downgrades:

1. Rolls more or less than 90 degrees.
2. Model does not hesitate in the two knife edge positions.
3. Roll rate not constant.
4. Maneuver takes less than 4 or more than 6 seconds.

Reverses Top Hat. Model pushes into vertical downward attitude, half rolls and loops as level inverted flight, flies inverted for the same distance as the downward path, loops upward to vertical attitude. Model not exactly 180 degrees. Downgrades:

1. Model not vertical at start and finish of half rolls.
2. Model does not fly straight and level inverted.
3. Vertical and horizontal legs not approximately the same length.
4. Wings not the same length and rate.
5. Rolls not at 45 degrees at commencement of rolls.
6. Changes in heading during maneuver.

Reverse Cuban Eight. Model pulls up into 45 degree climb, half rolls, executes a 1/2 loop, half rolls to inverted and loops back to level flight at the same point as entry. Downgrades:

1. Loops not at same point and same size.
2. Model not at 45 degrees at commencement of rolls.
3. Changes in heading during loops and rolls.

Reverse Point Roll. Model rolls through 270 degrees, hesitating at each 90-degree point, then rolls 270 degrees in opposite direction, hesitating at each 90-degree point to finish in level flight. Maneuver takes approximately 5 seconds. Downgrades:

1. 1/4 rolls more or less than 90 degrees.
2. Model does not hesitate at each 90-degree point.
3. Roll rate not constant.
4. Roll takes less than 4 or more than 6 seconds.

Triangle Rolling Loop. Model pulls up into 45-degree climb, holds the attitude for approximately one second, loops through 135 degrees, does one complete roll, loops through 135 degrees, holds the attitude for approximately one second and recovers in level flight at the same point that the maneuver started. The climbing and descending portions should be the same length. Downgrades:

1. Climbing and descending paths not 45 degrees.
2. Climbing and descending paths not same length.
3. Roll not 360 degrees.
4. Model changes heading during loops and roll.
5. Model does not start and finish maneuver at same point.

*** If initial entry to a spin is not smooth, or the spin itself is jerky and uncertain this is not a reason for downgrading, it is an indication that the spin is a true spin. A spiral dive is indicated by its smoothness and increasing airspeed; during a spin the airspeed does not increase appreciably.**

**** A snap roll is autorotation in the horizontal axis; the plane rolls very rapidly with a nose-high attitude; if the plane rolls along its axis it is not a snap roll.**

2. Rolls not 180 degrees.
3. 1/2 loop not 90 degrees.
4. Descent not at 45 degrees.
5. Changes in heading during rolls and 1/4 loop.

Landing. The model flies smoothly to touch the ground within the landing circle with no bouncing or changes in heading and rolls to a stop. Landing maneuver will start two meters (6 1/2 feet) from the ground. Downgrades:

1. Model impacts the ground due to lack of flare.
2. Model bounces after touchdown.
3. Wings not level.
4. Changes in heading.
5. If model ends on its back, zero points.
6. Model lands outside 30 meter circle.
7. If any undercarriage leg retracts on landing, zero points.

Avantache. Model pulls up and completes a half loop, at the top it executes a complete snap roll**, recovers and does another half loop to finish in level flight. Downgrades:

1. Loop not round.
2. Changes in heading during loop.
3. Wings not level during loop.
4. Snap roll not 360 degrees.
5. Roll not snap roll.

Inverted Spin.* Model establishes a heading, half rolls to inverted, power is reduced, the model is held in a nose high attitude until it stalls and commences to spin. The model will autorotate through three complete turns and recover on the same heading at a different altitude, then half rolls to an upright position. Downgrades:

1. 1/2 rolls not level.
2. 1/2 rolls not 180 degrees.
3. Wings not level during entry and exit.
4. Spiral dive scores zero.
5. Does not finish in same heading.
6. Does not make three turns; less than two or more than four score zero.

Square Horizontal Eight. Model pulls up and executes a square loop, when at the bottom of the third leg it does a complete square outside loop behind the inside loop, the model should rotate sharply at each corner and the straight paths should be at least 20 meters (65 1/2 feet) long. Downgrades:

1. Loops not square.
2. Vertical downward paths do not coincide.
3. Loops not same size.
4. Changes in heading.
5. Wings not level.
6. Loops not at same altitude.
7. Sides of squares not same size.

Eight-Point Roll. Model rolls through 360 degrees hesitating at each 45-degree point, the wings should be parallel, vertical to or 45 degrees to the horizon; maneuvers to take approximately 5 seconds. Downgrades:

1. Model does not hesitate after each 45 degrees.
2. Roll rate not constant.
3. Roll takes less than 4 or more than 6 seconds.
4. Roll takes less than 4 or more than 6 seconds.

Vertical Roll. Model pulls up and executes a 360-degree roll vertically upward and pushes over to finish in level flight. Downgrades:

1. Model not vertical at start and finish of roll.
2. Roll not exactly 360 degrees.
3. Roll not vertical.
4. Roll rate not constant.

Aileron Turn. Model pushes over and executes a 360-degree roll vertically downward and recovers to finish in level flight. Downgrades:

1. Model not vertical at start and finish of roll.
2. Roll not exactly 360 degrees.
3. Roll not vertical.
4. Roll rate not constant.

Figure M. Model pulls up into a vertical attitude and executes a 180-degree stall turn, in either direction, does a 1/2 outside loop, again executes a stall turn, in the opposite direction, and recovers

longitudinal distance would stay within the 45 degree angle and a safe altitude and would be more clearly visible to the judge than at 100 meters distance. The competitor who performs loops in the 45 meters circle is, therefore, allowed to judge to evaluate them more critically and he should be given no downgrading for positioning. On the other hand, a 30 meters diameter loop at 100 meters distance should be downgraded.

The optimum size of maneuvers is governed to some extent by the size and normal flying speed of the model. Executing high roll or tight maneuvers with unnecessarily high rates of roll, or which do not simulate full scale performance, and they should be downgraded accordingly.

Smoothness and Gracefulness. These two factors are inter-related with speed of the maneuver and therefore again are related to normal flying speed of the model. Various judges and competitors will have different ideas of what actually constitutes smoothness and gracefulness. The most general definition must again be related to full scale simulation and the effects of the maneuver on an imaginary pilot or passenger in a full scale aircraft.

A 10 meters (33') diameter loop at 80 km/h (50 m.p.h.) results in most full scale aerobatic aircraft.

The matter of smoothness is basically related to scale-like appearance. For example, a perfect set of consecutive rolls should have a constant roll rate from start to finish. A perfect loop must have a constant radius defining a perfect circle. It cannot be made up of a series of straight flight increments with sharp angular jerks placed between. Such sudden jerks represent high "g" forces well in excess of full scale tolerances and should be downgraded.

Accurate and Consistent Judging. The most important aspect of consistent judging is for each judge to establish his standards and then maintain that standard throughout the contest. It is advisable for the contest director or the chief judge to hold a conference prior to the start in order to discuss judging and make the standards as uniform as possible. This is effected by means of practice flights which all judges score simultaneously and privately. After these flights, the defects in each maneuver should be discussed by all judges and agreement reached about the severity of defects. Once the contest is started, the individual judge should not alter his standard of judgement.

The contest director should clearly define areas in which it is considered unsafe for spectators to perform, such as above spectators, or over buildings, etc. The definition of unsafe areas should be absolutely unambiguous.

Judging Individual Maneuvers. When in doubt, give the lower score. Perfection is not a common occurrence.

A description of each maneuver is given, and then a number of reasons for downgrading are listed. The maneuver should be downgraded according to:

- 1) the number of defects observed.
- 2) the severity of the individual defects.
- 3) the number of times any one defect occurs.
- 4) the positioning of the maneuver.
- 5) the size of the maneuver.

For example, a small single change in heading during the take-off might be considered one defect, while two or three distinct turns would be considered two or three defects. It should be noted that for many maneuvers there are more than ten possible kinds of defects and that some of these can be repetitive.

A score of 10 should be given only if the maneuver is well positioned and no defects are observed. One or two minor defects should result in downgrading to at least an 8, while one severe defect should put it down to 6, as should a combination of three or four minor defects. Any element in poor positioning should be decided at the start of the maneuver and also fed into the final score for the maneuver. Bad positioning should be considered as equal to as many as 3 or 4 small defects. In proper size observed during or at the end of a maneuver might also result in as many as 3 to 4 demerits.

Copies of FAI Provisional Rules, such as RC Pylon Racing, RC Helicopters, RC Slope Soaring, RC Scale Soaring, RC Electro-Powered Models, etc., are available upon request from AMA HQ. Requests must state which particular rules are wanted and be accompanied by a pre-addressed and stamped business-size return envelope.

RC PATTERN RULES

1978-79 Novice, Advanced and Expert Classes

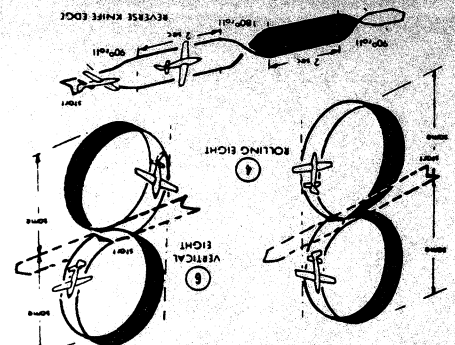
The AMA RC Contest Board chairman has advised that these Pattern classes must be isolated from the 1978 Masters (FAI) rules. Thus for 1978-79, the Novice, Advanced, and Expert maneuvers will be those listed in the 1978-79 AMA rule book, but are to be flown in accordance with the maneuvers described in the AMA RC Pattern Judges' Guide, pages 42 and 43, plus those in the 1976-77 rule book, pages 76-80. Applicable portions of the latter pages are reproduced here, to supplement the 1978-79 rule book.

Note: The 1978-79 Expert maneuvers are based on the original 1976-77 Masters class as per the 1976-77 AMA rule book. Although there were some changes made to these rules by the FAI, they are not to be applied for 1978-79 in order to minimize any further confusion (the FAI changes concerned K factors for Tackoff, 3-Turn Spin, and Landing, plus a revised description of the Rolling Eight). Thus the 1976-77 rule book maneuver descriptions, as reproduced here, are effective for the Expert class in 1978-79.

General. Use either the 30-meter or 100-foot landing circle—the difference is negligible.

1978 Masters (FAI) Class

Several of the maneuver diagrams in the rule book were incorrectly drawn. The corrected drawings are included here. Note: in cases of discrepancy between the written maneuver description and the illustration, the written description applies.



Note that the Rolling Eight illustration previously seemed to indicate a half roll going into the first inside loop. The two half-rolls occur after each loop. The shading (indicating bottom-side) was reversed on the bottom loop of the Vertical Eight. The Reverse Knife Edge illustration did not properly show that the 180-degree roll after the first knife-edge position is in the opposite direction to the entering and exiting 90-degree rolls.

Other notes for 1978 Masters. Some additional errors and conflicts have been noted since the 1978-79 rule book was printed. For AMA purposes, the following interpretations have been offered by the RC Contest Board chairman for clarification:

The 1978 FAI Top Hat contains a conflict between the maneuver description and the fourth-listed reason for downgrade, as it did previously. The maneuver should continue to be flown as a "tail" or "stove-pipe" Top Hat, as in the past, and not with the top equal in length to the sides.

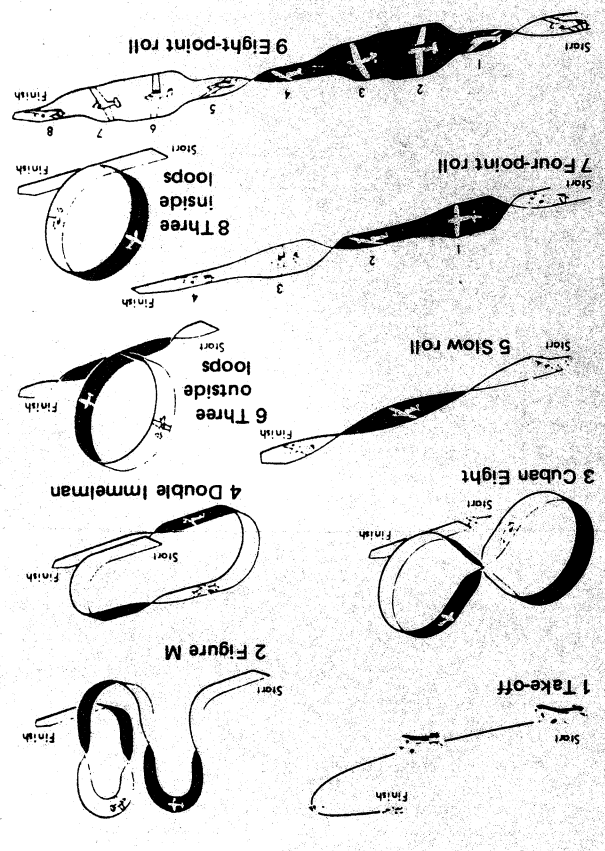
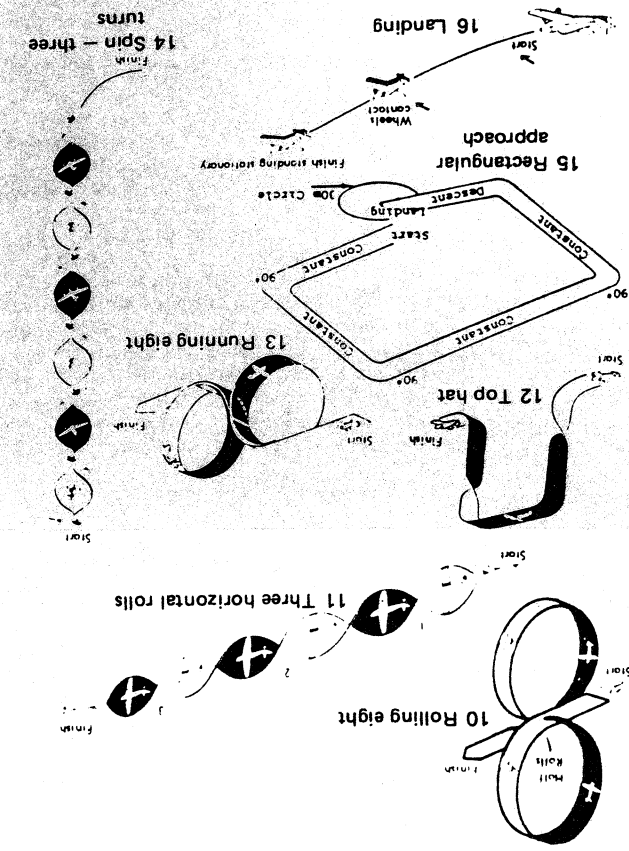
The Figure M with 1/4 Rolls calls for an

1. Tackoff (K = 5). The model must stand still on the ground with the engine running, without being held by the pilot or the mechanic and must lift gently from the ground and climb at a gradual angle. The tackoff is completed when the model is turned approximately 90 degrees out of the takeoff path. The takeoff should be downgraded for the following reasons:
 1. Model does not stand still when released.
 2. Changes in heading during the run.
 3. Model jumps from the ground.
 4. Rebounding the ground after becoming airborne.
 5. Too steep climb angle.
 6. Gallops in elevation during climb.
 7. Changes in heading during climb.
 8. Drooping a wing.
 9. Does not turn approximately 90 degrees out of takeoff path.
2. Figure "M" (K = 15). The model starts in straight and level flight, pulls up into a vertical attitude, then performs a half roll (left or right) then a stall turn, the model then executes a second half roll followed by a third half roll. The opposite direction to the first half roll is a fourth half roll after the stall turn and recovers in level flight on the same heading and altitude as the entry. When viewed from the side the model creates a figure "M". The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model not level at finish of maneuver.
 3. Changes in heading during half rolls.
 4. Turn radius at top of stall turns greater than two wing spans.
 5. Turns at top of stall turns less than 180 degrees.
 6. Bottom of dimming paths not parallel.
 7. Drooping and dimming paths not parallel.
 8. Altitude of second stall turn different to that of the first.
 9. Maneuver not finished at same altitude as entry.
 10. Model not level at finish of maneuver.
 11. Second stall turn in the same direction as the first.
3. Cuban Eight (K = 10). Model starts in straight and level flight, pulls up to an inside loop, continues until heading downwards at 45 degrees, does a half roll followed by another inside loop, at 45 degrees model does another half roll and recovers on the same altitude and heading as entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Loop deviates left or right.
 3. Loop deviates at commencement of roll.
 4. Model not at 45 degrees at same altitude as first loop.
 5. Second loop not at same altitude as first loop.
 6. Second loop deviates left or right.
 7. Second half roll not on 45 degree line.
 8. Model not level at finish of maneuver.
 9. Model does not finish on same heading and altitude as entry.
 10. Model not centered on cross over point.
 11. Rolls not centered on cross over point.
4. Double Immelman (K = 10). Model starts in level flight, pulls up into a half inside loop, followed by a half roll, rises straight and level for one second, then does a half outside loop, followed by a half roll and recovers on the same heading and altitude as entry.
5. Four Point Roll (K = 15). Model starts in level flight, then rolls one complete rotation heading at each quarter revolution, finishing in level flight on the same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. First loop not round.
 3. Loop deviates left or right.
 4. Wings not level at end of first loop.
 5. First not at same altitude as entry.
 6. Model drifts or changes in heading.
 7. Diameter of second loop different from first.
 8. Second loop not round.
 9. Loop deviates left or right.
 10. Wings not level at finish of second loop.
 11. Second loop not at same altitude as first loop.
 12. Model drifts or changes in heading.
 13. Diameter of third loop different from first and second loop.
 14. Third loop not round.
 15. Loop deviates left or right.
 16. Wings not level at finish of third loop.
 17. Third loop not at same altitude as first and second loop.
 18. Model drifts or changes in heading.
 19. Model changes heading during half rolls.
7. Four Point Roll (K = 15). Model starts in level flight, then rolls one complete rotation heading at each quarter revolution, finishing in level flight on the same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. First loop not round.
 3. Loop deviates left or right.
 4. Wings not level at end of first loop.
 5. First not at same altitude as entry.
 6. Model drifts or changes in heading.
 7. Diameter of second loop different from first.
 8. Second loop not round.
 9. Loop deviates left or right.
 10. Wings not level at finish of second loop.
 11. Second loop not at same altitude as first loop.
 12. Model drifts or changes in heading.
 13. Diameter of third loop different from first and second loop.
 14. Third loop not round.
 15. Loop deviates left or right.
 16. Wings not level at finish of third loop.
 17. Third loop not at same altitude as first and second loop.
 18. Model drifts or changes in heading.
 19. Model changes heading during half rolls.

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1. Tackoff (K = 5). The model must stand still on the ground with the engine running, without being held by the pilot or the mechanic and must lift gently from the ground and climb at a gradual angle. The tackoff is completed when the model is turned approximately 90 degrees out of the takeoff path. The takeoff should be downgraded for the following reasons:
 1. Model does not stand still when released.
 2. Changes in heading during the run.
 3. Model jumps from the ground.
 4. Rebounding the ground after becoming airborne.
 5. Too steep climb angle.
 6. Gallops in elevation during climb.
 7. Changes in heading during climb.
 8. Drooping a wing.
 9. Does not turn approximately 90 degrees out of takeoff path.
2. Figure "M" (K = 15). The model starts in straight and level flight, pulls up into a vertical attitude, then performs a half roll (left or right) then a stall turn, the model then executes a second half roll followed by a third half roll. The opposite direction to the first half roll is a fourth half roll after the stall turn and recovers in level flight on the same heading and altitude as the entry. When viewed from the side the model creates a figure "M". The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model not level at finish of maneuver.
 3. Changes in heading during half rolls.
 4. Turn radius at top of stall turns greater than two wing spans.
 5. Turns at top of stall turns less than 180 degrees.
 6. Bottom of dimming paths not parallel.
 7. Drooping and dimming paths not parallel.
 8. Altitude of second stall turn different to that of the first.
 9. Maneuver not finished at same altitude as entry.
 10. Model not level at finish of maneuver.
 11. Second stall turn in the same direction as the first.
3. Cuban Eight (K = 10). Model starts in straight and level flight, pulls up to an inside loop, continues until heading downwards at 45 degrees, does a half roll followed by another inside loop, at 45 degrees model does another half roll and recovers on the same altitude and heading as entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Loop deviates left or right.
 3. Loop deviates at commencement of roll.
 4. Model not at 45 degrees at same altitude as first loop.
 5. Second loop not at same altitude as first loop.
 6. Second loop deviates left or right.
 7. Second half roll not on 45 degree line.
 8. Model not level at finish of maneuver.
 9. Model does not finish on same heading and altitude as entry.
 10. Model not centered on cross over point.
 11. Rolls not centered on cross over point.
4. Double Immelman (K = 10). Model starts in level flight, pulls up into a half inside loop, followed by a half roll, rises straight and level for one second, then does a half outside loop, followed by a half roll and recovers on the same heading and altitude as entry.
5. Four Point Roll (K = 15). Model starts in level flight, then rolls one complete rotation heading at each quarter revolution, finishing in level flight on the same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. First loop not round.
 3. Loop deviates left or right.
 4. Wings not level at end of first loop.
 5. First not at same altitude as entry.
 6. Model drifts or changes in heading.
 7. Diameter of second loop different from first.
 8. Second loop not round.
 9. Loop deviates left or right.
 10. Wings not level at finish of second loop.
 11. Second loop not at same altitude as first loop.
 12. Model drifts or changes in heading.
 13. Diameter of third loop different from first and second loop.
 14. Third loop not round.
 15. Loop deviates left or right.
 16. Wings not level at finish of third loop.
 17. Third loop not at same altitude as first and second loop.
 18. Model drifts or changes in heading.
 19. Model changes heading during half rolls.
7. Four Point Roll (K = 15). Model starts in level flight, then rolls one complete rotation heading at each quarter revolution, finishing in level flight on the same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. First loop not round.
 3. Loop deviates left or right.
 4. Wings not level at end of first loop.
 5. First not at same altitude as entry.
 6. Model drifts or changes in heading.
 7. Diameter of second loop different from first.
 8. Second loop not round.
 9. Loop deviates left or right.
 10. Wings not level at finish of second loop.
 11. Second loop not at same altitude as first loop.
 12. Model drifts or changes in heading.
 13. Diameter of third loop different from first and second loop.
 14. Third loop not round.
 15. Loop deviates left or right.
 16. Wings not level at finish of third loop.
 17. Third loop not at same altitude as first and second loop.
 18. Model drifts or changes in heading.
 19. Model changes heading during half rolls.

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9. Second loop not same diameter as first loop.
 10. Model not level at finish of maneuver.
 11. Model not level at finish of maneuver.
14. Three Turn Spin (K = 5). The model establishes a heading by flying straight and level; power is reduced; the model is held in a slightly nose high attitude until it stalls and commences to spin. The model will autorotate through three complete turns and recover on the same heading in level flight. The maneuver should be downgraded for the following reasons:
 1. Initial heading not level.
 2. Does not do exactly three turns less than two or more than four.
 3. Does not finish on same heading.
 4. Not level at finish.
 5. If maneuver is spiral dive score zero.
 Note: If initial entry to spin is not smooth, or the spin itself is jerky and uncertain this is a true spin. A spiral dive is indicated by its smoothness and increasing airspeed. The maneuver should be downgraded for the following reasons:
 1. The maneuver is commenced with the model flying into wind over the landing circle; a left turn of 90 degrees; a crosswind leg; a second turn of 90 degrees; a fourth turn of 90 degrees; a downwind leg; a third left turn of 90 degrees; a crosswind leg. The maneuver is finished just prior to touchdown. The circuit may be to the right if the Contest Director states no "crosswind leg". The maneuver will commence after the second point of touchdown. The first three legs will be at a constant altitude. The descent to touchdown will be at a constant altitude. The circuit may be to the right if the Contest Director states no "crosswind leg". The maneuver is finished just prior to touchdown before the flight.
 1. Less of rectangular arc not straight.
 2. 90-degree turns not smooth and precise.
 3. Turns more or less than 90 degrees.
 4. Gallows in elevation.
 5. If model does not land at approach zero points.
16. Landing. The model flares smoothly to touch the ground and rolls to a stop. The maneuver should be downgraded for the following reasons:
 1. Model impacts ground due to lack of flare.
 2. Model bounces after touchdown.
 3. Wings not level at touchdown or during landing roll.
 4. Model deviates left or right during landing roll.
 5. If model ends on its back; zero points.
 6. If any wheel is retracted during landing maneuver; zero points.
 Note: Landing maneuver commences when aircraft is approximately 1 meter above ground.
 K = 5 within 30m (98.5°) circle.
 K = 1 outside 30m (98.5°) circle.

1. Model not level at start.
 2. Loop not round.
 3. Wings not level before and after first half roll.
 4. Second loop not round.
 5. Second loop not immediately under first loop.
 6. Model deviates left or right during loops.
 7. Model not level at finish.
 8. Model does not finish on same heading and altitude as entry.
11. Three Horizontal Rolls (K = 15). Model starts in level flight; then rolls at a uniform rate through three complete rotations finishing in level flight on the same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model changes heading or altitude during rolls.
 3. Roll rate not uniform.
 4. Does not roll exactly three rotations.
 5. Model takes less than 4 or more than 6 seconds to complete rolls.
 6. Model not level at finish of maneuver.
12. Top Hat (K = 15). Model starts in level flight; pulls up into a vertical attitude; then performs a half roll; pulls over into inverted flight for a short period; pulls down into a vertical dive; performs a half roll; and recovers in level flight in an upright position on the same heading and altitude as entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model not vertical before starting roll.
 3. Roll not exactly 180 degrees.
 4. Model not vertical after roll.
 5. Model not in a horizontal inverted position after 1/2 loop.
 6. Model does not fly inverted for the same distance as vertical climb and roll.
 7. Model not vertical before starting downward roll.
 8. Rolls not same length.
 9. Model deviates left or right at any point during maneuver.
 10. Model does not finish on same heading and altitude as entry.
13. Running Eight (K = 10). Model starts in level flight and completes 1 1/2 inside loops; model then does 1 1/2 inside loops finishing at the bottom. The model passes through the intersection three times; then recovers on the same heading but at a lower altitude than entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. First loop not round.
 3. First loop deviates left or right.
 4. Model does not become vertical at intersection.
 5. Second loop deviates left or right.
 6. Second loop not round.
 7. Does not become vertical at intersection.
 8. Second loop not at same altitude as first loop.

1. Model not level at start.
 2. Quarter rolls more or less than 90 degrees.
 3. Model does not hesitate after each quarter roll.
 4. Roll rate not constant during each quarter roll.
 5. Model takes less than 4 or more than 6 seconds to complete roll.
 6. Model does not finish on same heading and altitude as entry.
7. Model not level at finish of maneuver.
8. Three Inside Loops (K = 10). Model starts in level flight; pulls up and completes three inside loops; recovers on the same heading and altitude as entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Loop deviates right or left.
 3. Second loop not round.
 4. Second loop deviates left or right.
 5. Wings not level at finish of second loop.
 10. Wings not level at finish of second loop.
 11. Second loop not at same altitude as first loop.
 12. Model drifts or changes heading in second loop.
 13. Diameter of third loop different from first and second.
 14. Third loop deviates left or right.
 15. Loop deviates left or right.
 16. Wings not level at finish of third loop.
 17. Third loop not at same altitude as first and second.
 18. Model drifts or changes heading.
 19. Finish not on same heading and altitude as entry.
9. Eight Point Roll (K = 15). Model starts in level flight; then rolls one complete rotation hesitating at each eighth revolution (45 degrees). At each hesitation the wing will be parallel with, 45 degrees to the horizon. Model recovers on same heading and altitude as entry. The approximate time of the roll to be five seconds. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model does not hesitate after each eighth roll.
 3. Eighth rolls more or less than 45 degrees.
 4. Roll rate not constant during each eighth roll.
 5. Model takes less than 4 or more than 6 seconds for the roll.
 6. Model does not finish on same heading and altitude as entry.
10. Rolling Eight (K = 10). Model starts in level flight; pulls up into an inside loop; at the bottom of the loop downward; at the point of entry, 180 degrees, executes another inside loop downward; at the point of entry, 180 degrees, and recovers on same heading and altitude as entry. The maneuver should be downgraded for the following reasons:
 1. Model not level at start.
 2. Model does not hesitate after each eighth roll.
 3. Eighth rolls more or less than 45 degrees.
 4. Roll rate not constant during each eighth roll.
 5. Model takes less than 4 or more than 6 seconds for the roll.
 6. Model does not finish on same heading and altitude as entry.