The Official Rules of

The Air Race 1 World Cup

The Top International Title for the Sport of Formula One Class Air Racing

Approved and Sanctioned 2015

By

Air Race CC Ltd **Contact: info@airrace1.com**

FORMULA ONE PROCEDURE RULES

PREPARED BY:

FORMULA ONE PYLON AIR RACING INC www.F1airracing.com
ASSOCIATION DES PILOTES D'AVIONS DE FORMULES www.apaf.info
FORMULA AIR RACING ASSOCIATION www.royalaeroclub.co.uk
AIR RACE CC LTD ("AIR RACE 1") www.airrace1.com

In accordance with and subject to the Sporting Code of the Federation Aeronautique Internationale (FAI)

FORWARD:

This set of Formula One Class Air Racing ("F1") rules was prepared in 2015 by the three official formula one air racing Associations as the recognized international body of rules for use in the Air Race 1 World Cup and other international events or series organized by Air Race 1.

These rules are almost entirely based upon the accepted rules developed over a period of many years by the International Formula One Pylon Air Racing Association (IF1) in the USA and contributed to significantly by the other organizations named above.

These rules may be scrutinized, adapted or amended, as may be necessary, by the parties named above to ensure safe and fair sporting competitions.

Where any rule may conflict with a regulation of the Civil Aviation Authority (or other regulatory body) in a country where an event is held, the rules or remedies of that authority and/or the national formula one association in that country will supersede and that organization may amend or supplement the rules accordingly to ensure that regulations are adhered to.

NOTE: For the avoidance of any unlikely doubt, any use of the abbreviated term "F1" and the phrase "Formula One" in these rules are to mean "Formula One Class Air Racing" and/or may refer to the sport in general or to the governing bodies (IF1, APAF, FARA, FAI) in aggregate. The term F1 in these rules is in no way a reference to any trademarks or events of any other discipline of motorsport. In particular, the term F1 does not refer to the Formula One Grand Prix in car racing nor Formula One Management nor any FIA event and in no way suggests or implies any connection or relation to any such organization or any third-party trademark. "Formula One" and "F1" are long-accepted and publicly recognized terms and names for the class of air race to which these rules pertain. More specifically the abbreviation "F1" is used herein to save space and ink.

Part 1: FORMULA ONE AIR RACING PROCEDURAL RULES

CONTENTS

1.1 **Operations Director** - Elected by the general membership and is responsible for organizing, overseeing, and designating operations personnel. He is responsible for all F1 ground movements and air operations at race sites. He cannot be a competing formula one owner or pilot. (See Bylaw 11)

1.1.1 Duties of the Operations Director

1.1.1.1 He shall be the F1 representative at races including FAA/CAA (or regulatory body), promoter, and Contest Committee liaison.
1.1.1.2 He shall be responsible for providing and installing, if required, pylons, flags and radios for communication between the Start line, Chief Judge, Home pylon and other key areas.
1.1.1.3 He shall ensure that all aircraft and pilots are properly inspected and certified prior to aircraft qualification.
1.1.1.4 He is responsible for race makeup (pairings) and grid arrangement. He may change grid assignments in the event of pilot or aircraft safety issues.
1.1.1.5 He is responsible for pilot certification at races in conjunction with the Pilot Committee Chairperson or his designee(s). He has the power to withdraw a racing pilot license for unsafe activities. (See Procedure Rule 3.8.3)
1.1.1.6 He has the power to withdraw F1 from races if unsafe conditions exist.

1.2 **Technical Director** - Elected by the general membership and is responsible for organizing, overseeing, and designating technical inspectors and inspections. He cannot be a competing formula one owner or pilot. (See Bylaw 12)

1.2.1 Duties of the Technical Director

1.2.1.1 The Technical Director shall procure, store and provide Technical inspection equipment as required to properly inspect aircraft.

1.2.1.2 The Technical Director's staff shall inspect all aircraft on arrival at the race. The Technical Director's staff will carry out all inspections in accordance with the Formula One Technical Inspection Handbook.

1.2.1.3 On the basis of this inspection the Technical Director is empowered to require the competing aircraft to be returned to conformity with the Formula One Technical Rules prior to official practice and qualification. If the discrepancies cannot be corrected, the Technical Director is empowered to refer them to the Contest Committee where they will be dealt with as a Protest.

1.2.1.4 At the conclusion of the racing, the Technical Director's staff will carry out such checks as they see fit in accordance with the Formula One Technical Inspection Handbook. Any discrepancies found will be automatically referred to the Contest Committee where they will be dealt with as a Protest.

1.3 **Chief Judge** - Presides over Contest Committee and has primary responsibility for all officiating functions and officiating personnel that are required.

1.4 **Contest Committee** - Chief Judge and 2 or more contest judges appointed by promoter or Executive Committee. Judges must have no business or personal relationships with competing owners or pilots. Has ultimate authority over all racing events. Not responsible for organization or execution of race, but acts in judicial capacity to settle protests, determine penalties, authorize deviations from rules, amend competition, and enforce rules of FAA/CAA or Regulatory Body waivers.

1.4.1 Meetings of the Contest Committee

1.4.1.1 The Chief Judge shall call a meeting of the Contest Committee no later than one (1) hour after termination of the day's racing.

1.4.1.2 The Contest Committee shall hear both sides of the matter of any formal protest, apply correctly the relevant regulations and the rules for the event and decide by vote.

1.4.1.3 Protests against a decision of the Chief Judge require a 2/3 majority to succeed.

1.4.1.4 If a Contest Committee meeting has to be held in the unavoidable absence of any of its members, the necessary quorum will be 2/3 of its total members.

1.5 **Chief Starter** - Appointed by promoter or Chief Judge and is responsible for supervising his assistants and initiating a safe start in accordance with the rules.

1.6 **Chief Pylon Judge** - Appointed by promoter or Chief Judge and is responsible for supervising all pylon judges in the performance of their assigned duties.

1.7 **Chief Timer** - Appointed by promoter or Chief Judge and is responsible for supervising timers and scorers in the performance of their assigned duties. He shall procure, store and provide timing equipment as required to properly time qualification and races.

1.8 **Chief Finish Line Judge** - Appointed by promoter or Chief Judge and is responsible for supervising all finish flaggers in the performance of their assigned duties.

1.9 **Chief Finish Flagger** - Appointed by promoter or Chief Judge and is responsible for supervising other finish flaggers in the performance of their assigned duties.

1.10 **Pilot Committee Chairperson** - Elected by the general membership and is responsible for supervising pilot certifications and procedures. The Chairperson shall assist the Operations Director and also be responsible for briefing the Operations Director prior to aircraft qualification as to the status of competing pilots in regards to pilot certification completeness. The Chairperson shall be empowered to appoint pilot evaluator designees for an individual event. (See Bylaw 15)

2. PROGRAM AND CHARTS

This chapter is a checklist to be filled in by the promoter of each race for the benefit of contestants. Program updates will be issued daily at the race office or briefing.

DATE TIME

2.1 **Closing Date for Entries**

2.2 **Registration of Competitors**

2.3 **Registration of Aircraft**

2.3.1 Technical Inspection of Aircraft (See Procedure Rule 3.6)

2.4 **Official Practice**

2.4.1 Pilot Certification (See Procedure Rule 3.3)
2.4.2 Aircraft Qualification

2.5 **Official Qualification for Grid Position**

2.6 **Racing: Round 1**

Racing: Round 2

Racing: Round 3

2.7 **Prize Giving**

2.8 **Charts**
Charts provided to the participants should include the following information:

2.8.1 AIRFIELD AND RUNWAY LAYOUT
2.8.2 POSITION OF COURSE PYLONS
2.8.3 POSITION OF SCATTER PYLONS
2.8.4 POSITION OF SCATTER PYLONS FOR ALTERNATE WIND DIRECTION
2.8.5 START/FINISH LINE AND TIMING PLOT
2.8.6 LANDMARKS AND ADJACENT OBSTRUCTIONS
2.8.7 PIT AREA
2.8.8 FUELING POINT
2.8.9 RACE OFFICE
2.8.10 EMERGENCY SERVICES
2.8.11 SPECTATOR LINES
2.8.12 PARKING FOR RACE CREW VEHICLES
2.8.13 HANGAR FOR RACE AIRCRAFT

3. GENERAL RULES AND REGULATIONS

3.1 Entry and Eligibility

3.1.1 Entry, which is open to all FAI Active and Associate Members will be accepted only if made out on the official entry form, accompanied by the entry fee in full, and received by the closing date, except that late entries may be accepted at the discretion of the promoter, if there are vacancies. Anyone who wants to race in an F1 sanctioned event must be a member of F1 Inc.

3.1.2 An entry by telegram, fax, e-mail or telex will be confirmed only if the official entry fee and form have been mailed the same day as the telegram, fax, e-mail or telex.

3.1.3 Uncompleted entry forms or those containing inaccurate information will not be accepted.

3.1.5 The entry fee covers all administration and insurance. Accommodations and subsistence must be individually arranged.

3.1.6 The entrant or competitor is expected to know, understand, and abide by the F1 Sanction Agreement issued for the event.

3.1.7 If the event does not take place, entry fees shall be returned in full. If, for reasons of force majeure, it is canceled or stopped, unused fees shall be paid back.

3.2 Contest Numbers

3.2.1 Each aircraft shall clearly display its current F1 assigned contest (race) number on both sides of the fuselage or tail. (See Bylaw 4.1.1 and Technical Rule 11.4)

3.3 Pilot Certification

3.3.1 A competing pilot must be a National of the entering country or have been a resident for not less than 3 consecutive years. (See Procedure Rule 3.5.1.2)

3.3.2 A competing pilot must have and be able to substantiate the following qualifications:

3.3.2.1 Current Pilots License - private or better or appropriate to the aircraft being flown according to the country of registration and event jurisdiction

3.3.2.2 Current Medical Certificate - Class III or better (class II may be required at some races) or appropriate to the pilot license being presented.

3.3.2.3 Current F1 Racing Pilot License or a Racing Pilot Skill Level Statement issued by the authorized official of a recognized F1 national body. (See Procedure Rule 3.3.4)

3.3.3 A competing pilot must have and be able to substantiate the following flying experience:

3.3.3.1 An absolute minimum of 100 hours pilot in command in fixed wing aircraft.
3.3.3.2 A minimum of 10 hours in a formula one aircraft type for every 100 hours short of 500 hours pilot in command in fixed wing aircraft.
3.3.3.3 A minimum of 10 hours in the same formula one aircraft type to be flown or 5 hours if already qualified in a different formula one aircraft type.

3.3.4 A competing pilot must hold a valid F1 Racing Pilot License or Skill Level Statement. This license or statement shall be issued to all pilots upon their successful completion of the F1 Racing Pilot License or Statement demonstration. This license or statement must be renewed as follows:

A. Every twenty-four months, except that an F1 racing pilot's license or statement will not expire until the calendar year end of the second year of the license or statement.
B. Upon agreement of the Pilot Committee Chairperson and the Operations Director or their appointees and/or in accordance with the process established by the recognized F1 national body issuing the license or statement.
C. Upon changing aircraft, if different in type to that in which an F1 Racing Pilot License or Statement was issued.

Issuance and renewal shall consist of demonstrating the following knowledge and skills to an official F1 pilot evaluator:

3.3.4.1 F1 Racing Pilot License or Skill Level Statement Demonstration: (See Appendix C)

A. Paperwork review and Oral Examination

1. Review pilot's logbook to determine total flying time and total time in the aircraft to be used for the demonstration.
2. Check for valid pilot's certificate, medical certificate, flight review and aircraft paperwork (current airworthiness, registration, operating limitations, weight and balance and "annual" condition inspection).
3. Review and discuss weight and balance information, engine and propeller limitations, G-load restrictions, operating limitations and the technical inspection requirements for the aircraft used in the flight demonstration.
4. Discuss personal motivation, philosophy and reason for becoming a race pilot.
5. Discuss past history of racing accidents and common causes.
6. Density altitude considerations.
7. Aircraft qualification procedures.
8. Race start procedures.

9. Pylon and scatter pylon procedures.
10. Passing procedures.
11. Methods of communicating emergency-in-progress information to participants and response required.
12. Methods of declaring any emergency and actions for various types of emergencies.
13. Methods of communicating termination of race to participants and response required.
14. Normal race termination procedures.
15. "Deadline" procedures.
16. Race briefing attendance requirements and outline of briefing contents:
    a. FAA/CAA regulations and waivers applicable to air racing.
    b. Crowd and race deadlines. ("showlines")
    c. Schedules and relation to staging.
    d. Aircraft ground safety precautions.
    e. Race and scatter pylon locations.
    f. Course obstructions.
    g. Emergency landing facilities.
    h. Coordination with fire/rescue.

B. General Preflight

1. Sufficient fuel (5 gallons minimum) and oil for proposed flight.
2. Seatbelts and shoulder harness.
3. Loose objects in aircraft. (Encourage the use of a checklist in cockpit)
4. Canopy and access latches.
5. Controls and aircraft structure.

C. Flight Observations

1. Aborted Start: Simulate an unassisted race start (no tail holder) and accelerate for approximately 300 feet before simulating an engine failure by closing the throttle. Bring the aircraft to a full stop without veering more than 20 feet either side of a straight line.
2. Race Start: Takeoff from a full stop at full throttle without veering more than l0 feet either side of a straight line.
3. Make three 180 degree turns of at least 60 degree bank at an altitude of 500 feet or higher at racing speeds without appreciable loss of altitude.
4. Demonstrate an aileron roll in each direction, followed by a half-roll to the left with a half-roll to the right recovery. All without loss of altitude exceeding 50 feet. Such demonstration should be performed in the aircraft type expected to be flown in a race. Where such a demonstration is prohibited in the aircraft expected to be flown (for example if the authority of the country of registration does not certify the aircraft type for intentional aerobatics) then the demonstration may be performed in an appropriate aerobatic aircraft (with or without an instructor onboard). In the latter case, an additional test will also be administered in a formula one type aircraft in which a quick sharp bank (which may be timed) will be executed to 90 degrees in one direction then immediately to 90 degrees in the other direction.
5. Demonstrate three laps on the race course at racing speeds without

climbing in turns.
6. Demonstrate formation flying ability and passing techniques on the race course.
7. Demonstrate a normal landing.
8. Demonstrate a simulated power-off landing from racing altitude and speed.

3.4 Aircraft Eligibility

3.4.1 A competing aircraft must possess a valid certification of airworthiness or equivalent of the country of origin or of entry and must comply with the Formula One Technical Rules.
3.4.2 Substitution of aircraft after aircraft qualification will not be allowed.
3.4.3 During an F1 sanctioned event, no competing aircraft shall change ownership or operational responsibility until the end of the total event.

3.5 Registration of Pilots and Officials on Arrival

3.5.1 All competing pilots, officials, and team leaders (if applicable) must register at the specified time with the Operations Director and the organizer with the following documents:

3.5.1.1 Passport or evidence of nationality or residence.
3.5.1.2 Nationals - A National of a country can represent only that country in international sporting events provided that if he has already represented a country, he may not represent another country unless:

A. His former country has been incorporated into another state.
B. He has become a naturalized citizen of another country and at least three years have elapsed from the date of his application for such naturalization.
C. Through marriage, a person changes his/her nationality and acquires the nationality of his/her spouse.

3.5.1.3 Persons without Nationality - Refer to FAI Sporting Code General Section.
3.5.1.4 Licenses and proof of pilot certification as in 3.3 above.

3.5.2 After the time specified no unregistered pilots will be allowed to compete.

3.6 Registration and Inspection of Aircraft on Arrival

3.6.1 All competing aircraft must be available for registration and inspection at the race site by the specified time together with the following documents:

3.6.1.1 Current Certificate of Airworthiness or national equivalent.
3.6.1.2 Permit to race or national equivalent if appropriate.
3.6.1.3 Engine(s) logbook(s) or equivalent document(s).
3.6.1.4 Airframe logbook or equivalent document.
3.6.1.5 Propeller logbook or equivalent document, if required by country of origin.
3.6.1.6 Valid liability insurance if, and as, required by host country.

3.6.2 All competing aircraft shall be inspected and approved by the Technical Director before official aircraft qualification in accordance with agreed procedures.

Details of procedures and special equipment to be used by the Technical Director when carrying out Technical Inspections are contained in the Formula One Technical Inspection Handbook.

3.7 Briefings

3.7.1 All competitors and officials must attend subsequent briefings as notified at Registration and daily at the Race Office. Any absentee risks exclusion from the race. If the reason for absence is regarded as adequate by the Operations Director, and there is time for a personal briefing, the competitor will be charged $10, and he will be permitted to race, if acceptable to the promoter.

3.8 Safety

3.8.1 All competitors must use seat belts and shoulder harnesses in all events as defined in technical rules.

3.8.2 All competitors must wear protective helmets, fire retardant flight clothing and gloves.

3.8.3 The Operations Director reserves the right to stop any pilot or aircraft from flying should he consider the situation unsafe.

3.8.4 Competitors will not ingest alcoholic beverages within the 8 hour period prior to a flight. No alcoholic beverages will be allowed in the pit area.

3.8.5 Pilots must be familiar, and abide by, the rules and regulations governing closed-course pylon air racing. F1 will recommend the disqualification of any pilot who, through drunkenness, hangover, recklessness or otherwise, is deemed a hazard to the other pilots and the public. Such pilots will be suspended from racing for a period of time and may be barred for all time from all races sanctioned by F1.

3.8.6 Aircraft will start all flights at a race site with a minimum of five (5) gallons (19 liters) of fuel on board.

3.8.7 Operational two-way radios are required for all participating formula one aircraft. All participating pilots and crews will use radios only in compliance with the following F1 radio use rules:

3.8.7.1 Radio use during formula one flights within waivered airspace will be limited to Race Control frequency and to calls made in the interest of safety, communications with the Operations Director and his/her designee, F1 officials, Timing officials and Race Control or their equivalent, landing position reports, and emergency use only.

3.8.7.2 Under no circumstances will radios be used by ground crews for communication with pilots during any flights within waivered airspace (practice, qualifications and races).

3.9 Flags and Signals

3.9.1 GREEN : Start of Race or Qualifying Run

3.9.2 WHITE : Start of Last Lap

3.9.3 BLACK/WHITE CHECKERED : Finish
3.9.4 YELLOW : Emergency in Process (caution)
3.9.5 BLACK : Direction to Pilot to Vacate Course
3.9.6 RED : Abandonment of Race
3.9.7 Yellow, Black and Red flags shall be displayed only on order of the Chief Judge.

3.10 Violation Procedures/Protest

3.10.1 Rules Violations

3.10.1.1 Technical Violations at Races - The Technical Director shall inform, in writing, the owner of any aircraft or engine found to have a noncompliance item.

A. If found prior to aircraft qualification, the owner will be required to bring the aircraft into compliance prior to qualification.
B. If found after aircraft qualification but prior to racing, the owner will be required to bring the aircraft into compliance and requalify.
C. If found after racing, a written report shall be submitted to the Contest Committee for their action.
D. The maximum penalty for racing with a technical noncompliance item shall not exceed a fine or disqualification from the race or races flown.

3.10.1.2 Other Violations - All other violations of competition rules shall be the sole responsibility of the Contest Committee.

3.10.2 Protests

3.10.2.1 Right of Protest - The right of protest is vested in competitors, pilots and principal owners only, except that the Contest Committee may always institute a protest by virtue of its judging authority even when no protest has been filed.

3.10.2.2 Protest Process - A protest must be in writing, accompanied by the prescribed protest fee, and delivered within one hour of posting the unofficial race results. The protest fee will be returned if deemed well founded by the Contest Committee. Otherwise, it will be given to the pilot protested against.

A. The protest fee will be $250.00.
B. Protestors against the legality of an engine or airframe will also be subject to expenses incurred by the protestees and/or class as a result of the protest if the engine or airframe is found to be legal.
C. Protests relating to an air racing event must be presented to the Contest Committee.
D. Technical protests of racing equipment will be submitted to the Technical Director. If the Technical Director considers it a valid protest, it will be sent to the Contest Committee for disposition.
E. The Technical Director may require additional inspections and teardowns.

3.10.2.3 Time Limits

A. Protests against the validity of an entry or qualification of participants must be lodged at least 24 hours before the first race. Such protests will

be filed at Race Headquarters.
B. Protests against the decisions or actions of the judges, timer, scorer, other officials, or other participants must be lodged within one hour of posting of decisions or results. Such protests will be filed at Race Headquarters.
C. Protest may be made only after a race has started except where it concerns entry.

3.10.3 Hearing of Protests - Upon receipt of a protest, the Contest Committee will notify all parties concerned of the hearing of the protest. They shall be entitled to call witnesses, and they and the witnesses shall be given an opportunity of being heard.

Persons knowledgeable in specialized areas pertinent to the contest may be called for testimony to the Contest Committee to assist them in reaching a fair and equitable judgment. All contestants will remain in the pits for a period of one hour after the posting of unofficial results of an event for the purpose of participating in a protest.
Failure to remain in the area to receive notice of a protest will not stop the hearing of a protest.

3.10.4. Finality of Decision - Any protest against any error or irregularity committed during a competition shall be decided upon by the Contest Committee, and their decision shall be final, provided that any penalty imposed by the Contest Committee is not revised as provided below in 3.10.5.

3.10.5. Review - All Contest Committee penalties shall be reviewed by the Board of Directors at a later date. They may reduce penalties imposed by the Contest Committee for technical noncompliance items, but not increase them. They may add penalties to those imposed by the Contest Committee only for cases of unsafe flying or unsportsmanlike conduct.

3.10.6 Prize Withholding - Any prizes won by a competitor who has been protested against will be withheld until a final decision has been pronounced on the protest.

3.11 **Penalties**

3.11.1 The Contest Committee may penalize a competitor by alteration of placing order, or disqualification and in some cases fine the competitor for infringement of the regulations, or for unsporting behavior. Fines may not exceed the sum of entry fees and prize money won. The severity of the penalty shall range from minimal to disqualification from the event and shall be appropriate to the infringement or misbehavior, i.e.:

3.11.1.1 Dangerous or hazardous flying
3.11.1.2 Cheating, falsification of documents, and deliberate breaches of aircraft specifications

3.11.2 Penalties shall be listed on the score sheet of the day on which they took place.

3.11.3 A competitor who has been disqualified shall not be able to claim back any part of his entry fee and will not be eligible for any prizes during the event.

NOTE: F1 Bylaw 19.4, Temporary Rule Changes, States: Rules may be temporarily changed at a race site for the duration of that event only by a unanimous vote of all F1 members

entered as pilots (or after aircraft qualification, a unanimous vote of all F1 members certified as pilots of the aircraft that have qualified to race in that event).
NOTE: F1 Bylaw 24.5, Conflict with Race Rules, States: Where F1 Bylaws or Rules conflict with the race rules of a particular event, the race rules, then the Bylaws, and then the Technical and Procedure Rules shall be binding.

4.1 Recommended World Course Layout

4.1.1 The course should be of "stretched" hexagonal shape of total length 5km (3- 1/8sm) +50m (65 ft.). It should have straights of no less than 1.5km (.94sm) long, radius no less than 378m (1246 ft.), and should be flown left handed. Resultant maximum "G" loading is 3.5 at 400 kph (250 mph). See attached charts on Pages P14 & P15.

4.1.2 The corners of the course should be marked by pylons at least 9m (30 ft.) high of conspicuous color which shall be positioned so as to be easily visible one from the other.

4.1.3 No direction change should exceed 60 degrees +2 degrees.

4.1.4 The first pylon after take-off shall not require a change of course of more than 10 degrees from take-off to reach it.

4.1.5 If the first pylon after take-off is a scatter pylon, it should be at least 1.6km (1sm) from the start line and shall not require a change of course of more than 10 degrees to reach it and no more than 120 degrees to reach the next scatter or course pylon.

4.1.6 The minimum distance from the start line of the grid to the first pylon shall be 1200m (.75sm) - plus 200m (660 ft.) for every 300m (990 ft.) aerodrome altitude above a base altitude of 300m (990 ft.).

4.1.7 Scatter pylons should be of different and distinctive color to course pylons, but will be treated as part of the course under these rules.

4.1.8 The finishing line shall be a conspicuous white line not less than 50m (165 ft.) long, which may be reinforced by a white or checkered pylon.

4.1.9 The course should be laid out in accordance with the attached charts for alternate wind direction.
Refer to Chapter 49 of FAA Order 8700.1 Waivers for Airshows.

FIGURE 4-1

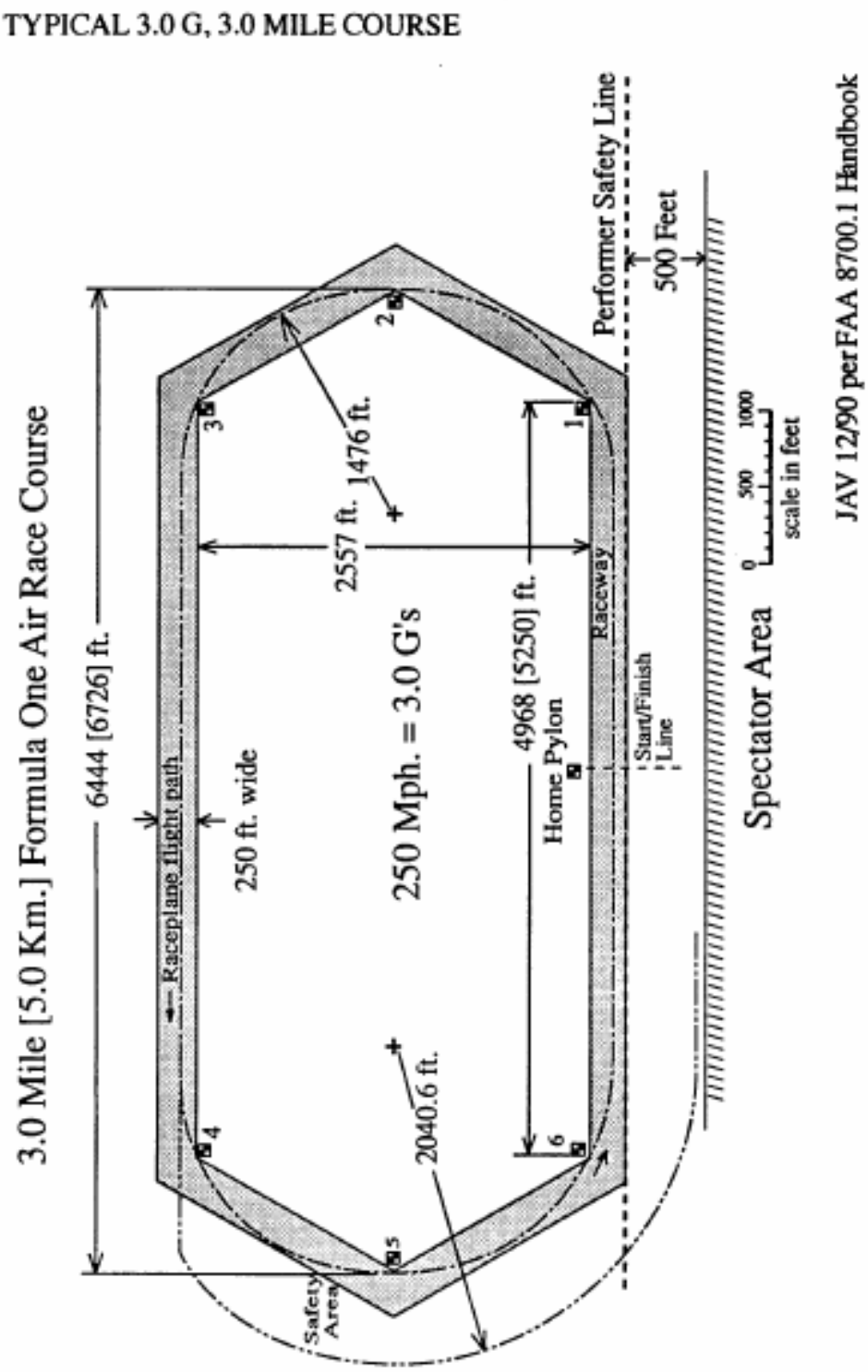
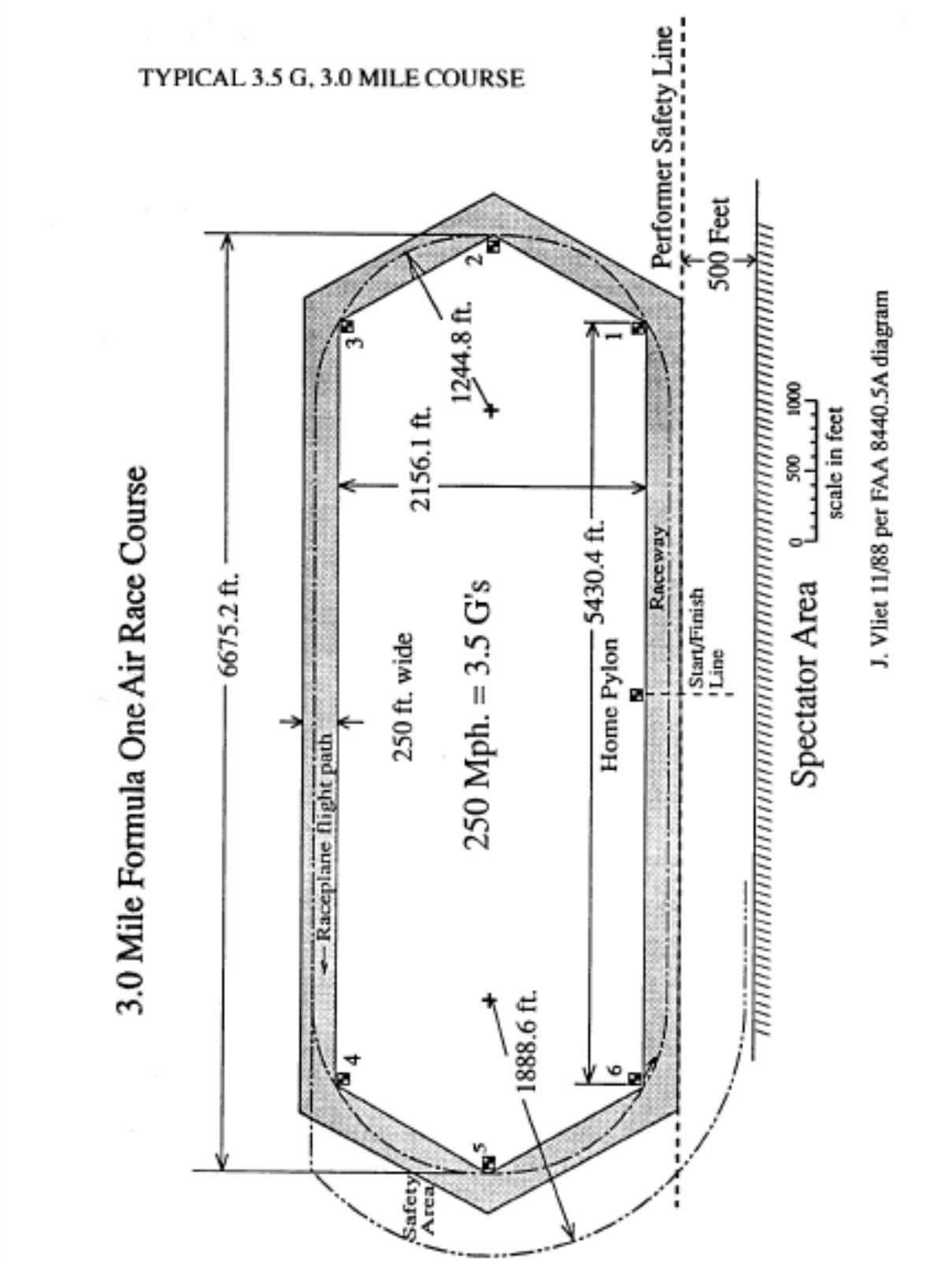

TYPICAL 3.0 G, 3.0 MILE COURSE
3.0 Mile [5.0 Km.] Formula One Air Race Course
6444 [6726] ft.
Raceplane flight path
250 ft. wide
250 Mph. = 3.0 G's
2557 ft.
1476 ft.
2040.6 ft.
4968 [5250] ft.
Home Pylon
Raceway
Start/Finish Line
Performer Safety Line
500 Feet
Spectator Area
0 500 1000
scale in feet
Safety Area
1
2
3
4
5
6
JAV 12/90 per FAA 8700.1 Handbook

FIGURE 4-2


TYPICAL 3.5 G, 3.0 MILE COURSE
3.0 Mile Formula One Air Race Course
6675.2 ft.
Raceplane flight path
250 ft. wide
250 Mph. = 3.5 G's
2156.1 ft.
1244.8 ft.
1888.6 ft.
5430.4 ft.
Home Pylon
Raceway
Start/Finish Line
Performer Safety Line
500 Feet
Spectator Area
0 500 1000
scale in feet
Safety Area
1
2
3
4
5
6
J. Vliet 11/88 per FAA 8440.5A diagram

4.2 **Aircraft Qualification Flights and Procedures**

4.2.1 Aircraft Qualification Flights

4.2.1.1 Comprises two timed laps of the course with the official qualification time taken from the fastest lap.
4.2.1.2 Each pilot is permitted one qualification flight in each aircraft he wishes to fly.
4.2.1.3 The maximum number of aircraft on qualification at one time is three.
4.2.1.4 In the event of pilot substitution, the qualification time stays with the aircraft.

4.2.2 Aircraft Qualification Flight Procedures

4.2.2.1 The pilot will signal his readiness for timing on a qualification lap by a wing-waggle approaching Home pylon.
4.2.2.2 Altitude will remain constant from pylon 4 to Home pylon prior to starting a qualification lap.
4.2.2.3 A qualification lap may be aborted any time prior to pylon 6 by pulling off the course.
4.2.2.4 A pylon cut automatically voids that lap time. If a pylon cut occurs on both laps the aircraft will be placed in last place. In the event of two voided lap times a second qualification attempt may be allowed, schedule permitting.
4.2.2.5 In the event of identical qualification times, the aircraft which first posts the speed will take precedence.
4.2.2.6 Aircraft unable to qualify due to weather or other conditions beyond their control will be placed behind qualified aircraft in order relative to entry date.

4.3 **The Grid**

4.3.1 The pilot of the aircraft with the fastest qualification time is offered choice of grid position, second fastest, second choice and so on down the list.

4.3.2 Grid patterns will be set depending on available runways.

4.3.3 The grid position for Round 1 is based on qualification times, for Round 2 on Round 1 overall race times, and for Round 3, if held, on Round 2 overall race times.

4.3.4 There will be no air starts.

4.3.5 A maximum of 8 aircraft may fly in one race.

4.3.6 Aircraft must be in position near the starting grid, available to come under starters orders not later than 10 minutes before flag. Aircraft which are not available 10 minutes before flag will be excluded. The Operations Director will ensure at least 10 minutes are available on the grid.

4.3.7 Alternate Aircraft: Aircraft unable to start a race will not be replaced by an alternate unless approved prior to the event by all competing pilots. If alternates are approved both the pilot and aircraft must be properly certified and qualified, respectively, and Procedure Rule 4.3.8 applies.

4.3.8 Alternate Aircraft: The alternate for any race will be the next fastest qualifier or the aircraft with the next fastest race speed if performed later. (See Procedure Rule 4.3.7)

4.3.8.1 In single row starts, the alternate will replace any aircraft not ready at T- 10 seconds.
4.3.8.2 In multiple row starts the alternate will replace any aircraft not ready at T- 1 minute. Front row aircraft must be removed at least 1 minute before start.
4.3.8.3 The alternate will start from the alternate position at the rear of the grid.

4.3.9 Aircraft spacing between rows and between aircraft will be established by the Operations Director.

4.3.10 Tail holders will not be allowed after T-1 minute.

4.4 Start Procedures

4.4.1 The red flag will come up at T-5 minutes. It will be replaced by the green flag at T-10 seconds. Drop of the green flag signals the start of the race.

4.4.2 The race starts when the starter's flag drops. The starting time for all aircraft will be taken from the time the first aircraft crosses the start line, in flight, after the scatter lap.

4.4.3 Premature starts within 5 seconds will be penalized 30 seconds but the race will not be stopped. Starts earlier than 5 seconds will result in disqualification.

4.4.4 All rows will launch simultaneously. Anyone aborting take-off will abort straight ahead and attempt to clear to the end of the runway expeditiously.

4.5 Weather Minimums

4.5.1 Visibility greater than 3 sm (4.8km).

4.5.2 Cloud base higher than 1500 ft (450m) AGL.

4.5.3 Surface wind less than 35 mph (56.7 kph) peak.

4.5.4 Cross wind component less than 20 mph (32 kph) peak.

4.5.5 Operations during questionable weather shall be at the discretion of the Operations Director.

4.6 Flying the Course

4.6.1 Circuit direction should be left handed unless local conditions prohibit it.

4.6.2 Minimum altitude during the race should be 30 ft (9m.) from the ground measured from the top of the canopy. Maximum altitude should be 200 ft (75m.). Greater altitude may be used when advisable for safety.

4.6.3 A minimum number of 6 laps and a maximum of 10 laps will be required for all races (excluding scatter lap).

4.6.4 Pylon Turns

4.6.4.1 All turns will be made outside the pylons. A pylon cut is defined as any portion of the aircraft being inside the inner edge of the pylon. Pylon cuts are not protestable.
4.6.4.2 A pilot cutting or missing a pylon may not turn back to retry.
4.6.4.3 A pilot who has cut a pylon will be penalized 4 seconds per race lap for each cut but may continue to race.
4.6.4.4 The rules for course pylons apply to scatter pylons.
4.6.4.5 Pilots must not change altitude in turns except when safety dictates.

4.6.5 Passing/Overtaking

4.6.5.1 The pilot overtaking shall be responsible for the safety of the maneuver.
4.6.5.2 An overtaken aircraft must hold its true course in order that it may not impede or interfere with a faster overtaking aircraft.
4.6.5.3 An aircraft overtaking a slower aircraft may not attempt to pass between the aircraft and a pylon unless the overtaken aircraft is flying wide so that a safe pass can be made.
4.6.5.4 A safe distance between aircraft must be maintained at all times.

4.6.6 Emergencies

4.6.6.1 Pylon judges or other officials will communicate with the Chief Judge regarding emergencies. The Chief Judge will declare emergencies and call for the yellow, black, or red flag as he considers appropriate.
4.6.6.2 On receipt of yellow flag, all aircraft should fly with caution, hold position and continue racing.
4.6.6.3 Any aircraft receiving the black flag will vacate the course immediately.
4.6.6.4 On receipt of the red flag, all aircraft will pull off the course in trail as each passes Home pylon and land as at the end of the race.

4.7 **Finish of a Race**

4.7.1 The finish of a race will be made by the nose of the aircraft passing the Home pylon, in flight, after completion of the race. This applies to the lead and all other aircraft.

4.7.2 If the flag signal indicating the end of the race is at variance with the number of laps previously agreed for that race, the flag signal should be taken as indicating the end of the race. At the end of the race all aircraft will pull up whether or not they have completed the same number laps as the winner.

4.7.3 The finish time will be taken as each aircraft passes the Home pylon in flight.

4.7.4 After finishing the race, all aircraft will pull up gently to attain prebriefed landing pattern.

4.7.5 The winner of first place in any race shall be the first pilot to pass the Home pylon with the least adjusted race time (to include penalties for pylon cuts.).

4.7.6 In the case of a dead heat, the competitors tying for a place shall have equal rights for that place and the purse will be the average of two places.

4.7.7 Positions will be determined first on the number of laps completed then in order of least adjusted race time (including penalties). For the purposes of determining pairings for subsequent races for aircraft which do not complete the required amount of laps, the average speeds will be used.

4.7.8 Any uncompleted race should be run again if possible. Completing more than half the scheduled laps on a given race by any aircraft constitutes completion.

4.8 **Allowable Substitutions** (See Procedure Rule 4.3.7 and 4.3.8 for Alternate Aircraft)

4.8.1 Fill-In Aircraft - Fill-ins are aircraft which volunteer to make-up numbers in a race. No contestant flying a fill-in position can displace another airplane that has previously qualified for the next higher event unless that airplane had an equal opportunity for an additional race to upgrade its speed. Fill-ins will be selected by lot.

Fill-in aircraft will only be awarded finish positions behind other scheduled event aircraft regardless of their finish position.

4.8.2 Makeup Aircraft - Makeup aircraft are faster aircraft that makeup numbers in a slower race when insufficient aircraft are available to fill the field. These airplanes will be used in order of the next fastest race speed or qualifying time ahead of the eligible aircraft. Makeup aircraft owners have the right of refusal to race.

The decision to use makeup aircraft shall be the responsibility of the Operations Director or his deputy and shall be made after consultation with the affected pilots and the race organizers.

4.8.3 Inverted Start Procedure (Showday) - Used when takeoff area precludes the use of a race horse start. Showday will be used at events with 16 airplanes or less. It shall also apply for finals if 100% of competing pilots approve.

4.8.3.1 All inverted starts shall be from a standing position (inverted air starts are prohibited) with slower airplanes starting first.

A. From start line abreast at equal time intervals, or
B. From longitudinally spaced and staggered positions with simultaneous release, or
C. From longitudinally spaced in pairs with release at intervals.

4.8.3.2 When longitudinal spacing is employed, the starts shall be unassisted. All crews shall clear the runway at the one minute warning.

4.8.3.3 The last aircraft must be released in time to assure that it can get "on course" before the first aircraft completes its first lap.

4.8.3.4 Release intervals should be such that the last aircraft released has a reasonable expectation of catching the first aircraft released, by half the number of laps in the race. The effects of traffic and takeoff performance shall be ignored in the determination. Basis shall be the most recent qualifying speed of the airplane.

4.8.3.5 Determination of inverted start release intervals shall be the responsibility

of the Operations Director or his deputy.

4.8.3.6 Showday - Additional Rules for "show" heats where fast airplanes start in the back to provide more exciting races.

A. Actual times of all airplanes over the race distance will be used to determine the gold and silver races.

B. The finishing positions in the heat shall be irrelevant, but aircraft which do not complete the heat will go to the back of the field.

C. Pairings for the gold and silver will be in order of heat speeds. A penalty of 10 seconds will be added to the race time for each pylon cut.

D. In the absence of Qualifying, the heat races will pay qualifying points, unless the aircraft does not finish.

5. SCORING FOR FORMULA ONE CHAMPIONSHIPS

5.1 Basis of Championship Competition

5.1.1 Eligibility - Active aircraft pilots and crew chiefs registered as members with Formula One are eligible.

5.1.2 Awards - The pilot and crew chief with the highest number of points accumulated during the year will receive an award.

5.2 Points Scoring

5.2.1 Points - Points will be awarded to the pilot and crew chief as follows:

5.2.1.1 10 points for officially qualifying as part of the field.

5.2.1.2

1st	-	12 points	7th	-	6 points
2nd	-	11 points	8th	-	5 points
3rd	-	10 points	9th	-	4 points
4th	-	9 points	10th	-	3 points
5th	-	8 points	11th	-	2 points
6th	-	7 points	12th	-	1 point

5.2.2 Races Eligible for Points - All races sanctioned by the F1 Board of Directors will be eligible.

5.2.2.1 Points will be awarded at each eligible event for the final series of races in which all aircraft compete (not for heats).

5.2.2.2 If a particular points race is not run for any reason, points will be awarded based on race makeup order.

5.2.2.3 If less than half of the final series of races are held, then points will be awarded on the last series of heats run.

5.2.3 Pilots Not Eligible for Points - In certain instances points will not be awarded.

5.2.3.1 Pilots who obtain qualifying times but do not make the field will not receive points for qualifying. (See Procedure Rule 4.3.7 and 4.3.8 for alternates)

5.2.3.2 Pilots who make the field without qualifying will not earn points for qualifying.

5.2.3.3 Pilots who are disqualified from a points race will not receive race points, however, other competitors will get credit for beating them.

5.2.3.4 Pilots of fill-in and make-up aircraft will not earn points. (See Procedure Rule 4.8)

5.2.4 Alternates - Alternates that run will keep any points earned, but will have to drop points in lower races.

5.2.5 Non-starters - Pilots who fail to gain an official start for any reason will gain points behind other runners in the race for which they qualified.

5.2.5.1 In the case of more than one non-starter, points will be earned on the basis of first, how far they proceeded, then their grid position.

5.2.6 Ties - Ties in the final points totals will be decided as follows: First on the number of race meets contested; then on the pilots record of first place finishes; then if necessary, second place finishes, etc.

5.2.7 For pilots/crew chiefs operating more than one aircraft at any meet, the highest number of points gained in any one aircraft will be counted. Points scored in other aircraft will be discounted but other contestants will not move up as a result.

APPENDIX C: F1 RACING PILOT LICENSE DEMONSTRATION

A. PAPERWORK REVIEW AND ORAL EXAMINATION

1. Review pilot's logbook to determine total flying time, and total time in the aircraft to be used for the demonstration.
2. Check for valid pilot's certificate, medical certificate, flight review, and aircraft paperwork (current airworthiness, registration, operating limitations, weight and balance, and "annual" condition inspection).
3. Review and discuss weight and balance information, engine and propeller limitations, G-load restrictions, operating limitations, and the technical inspection requirements for the aircraft used in the flight demonstration.
4. Discuss personal motivation, philosophy, and reason for becoming a race pilot.
5. Discuss past history of racing accidents and common causes.
6. Density altitude considerations.
7. Aircraft qualification procedures.
8. Race start procedures.
9. Pylon and scatter pylon procedures.
10. Passing procedures.
11. Methods of communicating emergency-in-progress information to participants and response required.
12. Methods of declaring any emergency and actions for various types of emergencies.
13. Methods of communicating termination of race to participants and response required.
14. Normal race termination procedures.
15. "Deadline" procedures.
16. Race briefing attendance requirements and outline of briefing contents:
    a. FAA/CAA regulations and waivers applicable to air racing.
    b. Crowd and race deadlines. ("showlines")
    c. Schedules and relation to staging.
    d. Aircraft ground safety precautions.
    e. Race and scatter pylon locations.
    f. Course obstructions.

g. Emergency landing facilities.
h. Coordination with fire/rescue.

B. GENERAL PREFLIGHT

1. Sufficient fuel (5 gallons minimum) and oil for proposed flight.
2. Seatbelts and shoulder harness.
3. Loose objects in aircraft. (Encourage the use of a checklist in cockpit)
4. Canopy and access latches.
5. Controls and aircraft structure.

C. FLIGHT OBSERVATIONS

1. Aborted Start: Simulate an unassisted race start (no tail holder) and accelerate for approximately 300 feet before simulating an engine failure by closing the throttle. Bring the aircraft to a full stop without veering more than 20 feet either side of a straight line.
2. Race Start: Takeoff from a full stop at full throttle without veering more than l0 feet either side of a straight line.
3. Make three 180 degree turns of at least 60 degree bank at an altitude of 500 feet or higher at racing speeds without appreciable loss of altitude.
4. Demonstrate an aileron roll in each direction, followed by a half-roll to the left with a half-roll to the right recovery. All without loss of altitude exceeding 50 feet. Such demonstration should be performed in the aircraft type expected to be flown in a race. Where such a demonstration is prohibited in the aircraft expected to be flown (for example if the authority of the country of registration does not certify the aircraft type for intentional aerobatics) then the demonstration may be performed in an appropriate aerobatic aircraft (with or without an instructor onboard). In the latter case, an additional test will also be administered in a formula one type aircraft in which a quick sharp bank (which may be timed) will be executed to 90 degrees in one direction then immediately to 90 degrees in the other direction.
5. Demonstrate three laps on the race course at racing speeds without climbing in turns.
6. Demonstrate formation flying ability and passing techniques on the race course.
7. Demonstrate a normal landing.
8. Demonstrate a simulated power-off landing from racing altitude and speed.

Aircraft Race #:

Pilot:

Renewal at:

Date:

Pilot Evaluator:

Signature:

FORMULA ONE TECHNICAL RULES

PREPARED BY:

FORMULA ONE PYLON AIR RACING INC www.F1airracing.com
ASSOCIATION DES PILOTES D'AVIONS DE FORMULES www.apaf.info
FORMULA AIR RACING ASSOCIATION www.royalaeroclub.co.uk
AIR RACE CC LTD ("AIR RACE 1") www.airrace1.com

In accordance with and subject to the Sporting Code of the Federation Aeronautique Internationale (FAI)

FORWARD:

This set of Formula One Class Air Racing ("F1") rules was prepared in 2015 by the three official formula one air racing Associations as the recognized international body of rules for use in the Air Race 1 World Cup and other international events or series organized by Air Race 1.

These rules are almost entirely based upon the accepted rules developed over a period of many years by the International Formula One Pylon Air Racing Association (IF1) in the USA and contributed to significantly by the other organizations named above.

These rules may be scrutinized, adapted or amended, as may be necessary, by the parties named above to ensure safe and fair sporting competitions.

Where any rule may conflict with a regulation of the Civil Aviation Authority (or other regulatory body) in a country where an event is held, the rules or remedies of that authority and/or the national formula one association in that country will supersede and that organization may amend or supplement the rules accordingly to ensure that regulations are adhered to.

NOTE 1: For the avoidance of any unlikely doubt, any use of the abbreviated term "F1" and the phrase "Formula One" in these rules are to mean "Formula One Class Air Racing" and/or may refer to the sport in general or to the governing bodies (IF1, APAF, FARA, FAI) in aggregate. The term F1 in these rules is in no way a reference to any trademarks or events of any other discipline of motorsport. In particular, the term F1 does not refer to the Formula One Grand Prix in car racing nor Formula One Management nor any FIA event and in no way suggests or implies any connection or relation to any such organization or any third-party trademark. "Formula One" and "F1" are long-accepted and publicly recognized terms and names for the class of air race to which these rules pertain. More specifically the abbreviation "F1" is used herein to save space and ink.

NOTE 2: Some exceptions to these technical rules may be made for particular events by acceptance of the event's Technical Committee that is appointed by the three official associations as instructed in a 'side letter'.

The Formula One racing class is designed and built to the following specifications:

1.ENGINES

1.1 Only Teledyne Continental "C" series or 0-200 engines (or their licensed versions) may be used for Formula One racing. The use of Teledyne Continental factory or other officially approved parts available to all contestants is mandatory. The "C" series engines may be modified with the above parts to provide the same horsepower as the 0-200 engine.

1.2 Each individual engine builder or worker must bear in mind that in substituting parts or modifying parts, as allowed by these rules, he is voiding the basic type approval of the part or engine. The owner, pilot and mechanic will assume all risks of modification.

1.3 3 Deleted

1.4 **Induction**

1.4.1 The engine induction system from and including the carburetor shall remain in the engine manufacturer's design locations. The spider will be mounted on the original manufacturer's studs. The spider height may be shorter but no longer than the original height (3.00 in., 76.0 mm) from the carburetor mount flange to the top of the case stud flange. Intake and exhaust elbows shall be mounted on the original factory position studs. Intake primer pads may be removed, welded and smoothed over. Smoothing of all intake and exhaust parts will be allowed and not subject to any checks except for the dimensional checks as detailed.

1.4.1.1 All primer and manifold pressure lines and their ports will be plugged for racing.

1.4.1.2 These ports may be welded up and smoothed over.

1.5 Engines must remain normally aspirated and no pump or blower to increase the induction air pressure will be allowed.

1.6 **Carburetor**

1.6.1 A Marvel MA-3 SPA carburetor of any model series must be used. Modifications to the carburetor in the following areas only will be allowed:

1.6.1.1 Alteration of the float level.

1.6.1.2 Smoothing of casting for air and fuel subject to 1.6.1.7.

1.6.1.3 Alteration of the main fuel discharge nozzle including drilling to a maximum of 0.098 in. (2.49 mm) diameter.

1.6.1.4 hanging of needle and seat with the manufacturers approved parts only. The dimensions may be modified as specified in 1.6.1.7.

1.6.1.5 The accelerator pump must be operating in the normal manner. The accelerator pump discharge tube may be cut down to a minimum of 3/4 in. (19.05 mm).

1.6.1.6 Electric fuel pumps may be installed.

1.6.1.7 The following carburetor dimensions must be met:

1.6.1.7.1 Throttle plate thickness .060" (1.52 mm), no radius on edge permitted.

1.6.1.7.2 Throttle shaft minimum O.D. .300" (7.62 mm) measured at plate. Marvel part #13-1520 or its equivalent.

1.6.1.7.3 Float valve needle seat maximum I.D. .140" (3.55 mm).

1.6.1.7.4 On a two piece carburetor venturi the primary maximum I.D. is .700" (17.78 mm) and the secondary maximum I.D. 1.505" (38.23 mm).

1.6.1.7.5 On a one piece carburetor secondary venturi maximum I.D. 1.530" (38.86 mm). Polishing is permitted, but metal removal is not.

1.6.1.7.6 Carburetor top flange bore maximum I.D. 1.815" (46.10 mm).

1.6.1.7.7 Float minimum depth 1.00" (25.4 mm) over entire length.

1.6.1.7.8 Float minimum length is 1.75" (44.45 mm).

1.6.1.7.9 Intake pipe 1.5" O.D. x .035" wall tubing (with manufacturer's tolerance).

1.6.1.7.10 No holes are permitted from the lower float bowl section of the carburetor into the carburetor intake section except for the main jet, accelerator pump nozzle, and idle discharge passage.

1.7 **Crankcase**

1.7.1 The crankcase width may vary due to wear or for other reasons. Shims may be used to rectify this or to adjust clearance volumes, subject to Rule 1.8.3.

1.7.1.1 The earlier "C" series engine crankcase must be strengthened with through bolts. One method is by drilling the crankcase through the center main bearing flange and using through bolts, 627275, with "0" rings for sealing (see Appendix A).

1.7.1.2 The crankcase breather must be open and aspirated to the outside of the crankcase.

1.8 **Cylinders**

1.8.1 Only Teledyne Continental "C" series or 0-200 cylinders (or their licensed versions) may be used in Formula One racing.

1.8.2 The minimum cylinder volume with the piston at top dead center is 135 cc.

1.8.3 The maximum swept volume per cylinder is 837 cc.

1.8.4 Maximum inside diameter of the valve seat inserts is 1.580 in. (40.13 mm) for intake, 1.450 in. (36.83 mm) for exhaust.

1.9 **Pistons**

1.9.1 Continental "C" series or FAA PMA 0-200 pistons are allowed. There will be four ring grooves, no more and no less, and each groove must contain at least one piston ring. These pistons are free of restrictions except for minimum weights.

Custom forged pistons are allowed. There will be three ring grooves, no more and no less, and each groove must contain at least one piston ring. These pistons are free of restrictions except for minimum weights.

1.9. 2 Piston rings may be replaced by automotive types including gapless, Teflon, etc. must remain free in their grooves. (A hand test will be applied here.)

1.9.3 The piston rings must remain free in their grooves. (A hand test will be applied here.)

1.10 **Smoothing**

1.10. Smoothing of all internal and external cast and forged parts will be allowed.

1.11 **Fit**

1.11.1 Any fit, clearance, or oil lubrication hole in the engine to compensate for increased heat and RPM will be allowed, including grooving.

1.12 **Valve Gear**

1.12.1 Camshaft. Any TMC stock or FAA PMA camshaft may be used as long as the valve lift falls within the following specifications: The lift may be measured at the intake or exhaust valve. The intake measurement will start at 40 deg. BTC and remain within the published profile. The exhaust measurement will start at 95 deg. after top dead center (ATC) and remain within the published profile.

Intake Valve Lift		Exhaust Valve Lift	
40 Deg. BTC	CLOSED	95 Deg. ATC	CLOSED
20 Deg. BTC	.030 in. (0.76 mm)	115 Deg. ATC	.030 in. (0.76 mm)
TDC	.090 in. (2.29 mm)	135 Deg. ATC	.090 in. (2.29 mm)
20 Deg. ATC	.195 in. (4.95 mm)	155 Deg. ATC	.195 in. (4.95 mm)
40 Deg. ATC	.295 in. (7.49 mm)	175 Deg. ATC	.295 in. (7.49 mm)
60 Deg. ATC	.375 in. (9.53 mm)	195 Deg. ATC	.375 in. (9.53 mm)
80 Deg. ATC	.430 in. (10.92 mm)	215 Deg. ATC	.430 in. (10.92 mm)
100 Deg. ATC	.455 in. (11.56 mm)	235 Deg. ATC	.455 in. (11.56 mm)
120 Deg. ATC	.455 in. (11.56 mm)	255 Deg. ATC	.455 in. (11.56 mm)
140 Deg. ATC	.430 in. (10.92 mm)	275 Deg. ATC	.430 in. (10.92 mm)
160 Deg. ATC	.375 in. (9.53 mm)	295 Deg. ATC	.375 in. (9.53 mm)
180 Deg. ATC	.295 in. (7.49 mm)	315 Deg. ATC	.295 in. (7.49 mm)
200 Deg. ATC	.195 in. (4.95 mm)	335 Deg. ATC	.195 in. (4.95 mm)
220 Deg. ATC	.090 in. (2.29 mm)	355 Deg. ATC	.090 in. (2.29 mm)
240 Deg. ATC	.030 in. (0.76 mm)	15 Deg. ATC	.030 in. (0.76 mm)
260 Deg. ATC	.015 in. (0.38 mm)	25 Deg. ATC	.015 in. (0.38 mm)
285 Deg. ATC	CLOSED	45 Deg. ATC	CLOSED

1.12.2 Valve Springs.

1.12.2.1. Valve springs, shims, spacers, and retainer washers are free of restrictions. Continental springs and matching hardware are recommended. Valve spring shimming is approved.

1.13 **Ignition Systems**

1.13.1 Any type of magneto or electronic ignition (or combination thereof) is allowed.
1.13.2 Fixed magneto timing beyond the manufacturer's specifications will be allowed.
1.13.3 Any type of ignition harness and routing is allowed.
1.13.4 Any type of spark plug is allowed.

1.14 **Weights**

1.14.1 The following minimum operating weights shall apply and it is permissible to lighten parts to these limits, though not necessarily advisable or possible.

1.14.1.1 Continental cast pistons "C" series or FAA PMA pistons - 675 grams or pistons with rings and wrist pin with end plugs - 967 grams or for a total of four pistons assemblies - 3868 grams.
Custom forged pistons – 610 grams or forged pistons with wrist pins with end plugs – 877 grams or for a total of four assemblies – 3508 grams

Addendum: Use caution when ordering over sized pistons to save worn cylinders, swept volume specifications must be maintained.
Suggested sources for forged pistons: LYCON: (559) 651-1070
PERFORMANCE ENGINES: (909) 593-5008

1.14.1.2 Wrist pins with end plugs - 200 grams (except that the matched set of piston + pin may be individually less but the two weighed together must be a minimum total of 875 grams).
1.14.1.3 Connecting rods with nuts, bolts, & locking devices and without rod bearings - 745 gm.
1.14.1.4 ankshaft with end plug and six prop bushings - 24.5 lb. (11.113 kg).
1.14.1.5 Push rods - 90 grams each or 720 grams total for all eight.
1.14.1.6 ocker arm - 125 grams or 1000 grams for all eight.
1.14.1.6.1 Rocker arms certified under PMA# SE8669-SW have minimum weight of 185 grams each.
1.14.1.7 Intake valve - 75 grams.
1.14.1.8 Exhaust valve - 102 grams.

1.15 **Fuel**

1.15.1 Only standard unmixed aircraft fuel available from an on-site common source will be allowed. Nothing may be added to the fuel, air or fuel/air mixture used in the engine. At any time a fuel sample may be taken from any or all airplanes from some logical and practical point in the fuel system. This sample may be analyzed or tested by the Technical Committee. If testing reveals a discrepancy, the sample may be sealed and sent to an accredited facility for analysis. If there are inaccessible or auxiliary tanks in the fuel system, they shall be blocked off.

1.16 **Starting Products**

1.16.1 Products to improve starting may be used if applied externally to the carburetor inlet scoop by the ground crew prior to starting.

1.17 **Oil System**

1.17.1 The oil system shall operate in the normal manner. No auxiliary oil system will be allowed to supplement the engine driven oil pump system.

1.17.1.1 Oil tanks may be any shape or size.

1.17.1.2 odified oil pick-up lines and hoses will be allowed.

1.17.1.3 Any type oil cooler may be used. Oil coolers may be mounted anywhere but must utilize air for cooling.

1.17.1.4 The Continental "C" series (-8) rear cover may be modified in order to accept 0-200 oil pump gears and to allow the use of an oil cooler.

1.17.1.5 There shall be no access from the cockpit to the oil system other than the oil pressure line, which shall be sealed from the firewall to the instrument panel.

1.17.1.6 Oil is free of restriction except as noted below.

1.17.1.7 Oil additives that do not increase combustion may be used.

1.17.1.8 Oil samples may be taken from the aircraft before and after a race or qualifying at the discretion of the Technical Committee.

1.18 **Miscellaneous**

1.18.1 The starter drive gear starter pinion, vacuum pump drive gear and starter mount casting in -12, -14, -16, and 0-200 crankcases may be removed.

1.18.2 Cover plates made from any non-combustible material may be used on the starter, generator, vacuum and fuel pump bosses.

1.18.3 The induction system may be insulated. It must be cooled by air only.

1.18.4 The use of different hose clamps, cylinder base nuts, crankcase bolts and nuts and other miscellaneous nuts and bolts will be allowed.

1.18.5 An engine safety cable at least 3/16 in. diameter (4.76 mm) must be fitted. Specifications for the engine retention cables may be obtained from the Design Guide.

2. **WEIGHT**

2.1 Minimum empty weight of the airplane is 500 bs. (227 kg) with no fuel or oil.

2.2 Minimum pilot weight is 160 lbs. (72.6 kg) ready for flight. Ballast must be added to meet minimum weight. Any such ballast, which may be inclusive of a parachute, must be adequately secured and removable for weighing. All ballast must be located within 12 in. (305 mm) of the pilot's seat position.

3.**PROPELLERS**

3.1 Propellers must be fixed pitch in operation.

3.2 Propellers constructed of a single piece of aluminum alloy are not permitted for any flights at a race site.

4.**WINGS**

4.1 Minimum of 66 square feet (6.132 square meters) of wing area must be used including the area displaced by the fuselage, but not including fillets or stall strips. A fillet is any deviation from the basic platform that starts inboard of 25 percent semispan. Flaps are permitted, but wing area is to be figured with the flaps retracted.

4.2 Ailerons must be 100 percent dynamically balanced. In lieu of this, 100 percent static balance with counterweight outboard of spanwise center of gravity of the aileron will be acceptable. Any other method of balance is subject to approval or rejection by the Technical Committee.

4.3 When demonstrating compliance with Rule 4.1, aircraft of canard configuration will only be allowed the area of one wing, which may be nominated by the owner. This wing will then be measured as indicated in Appendix B.

5.**LANDING GEAR**

5.1 The main landing gear must be non-retractable and fixed. The nose wheel, tail wheel or tail skid may be retracted.

5.2 Wheel brakes are required.

5.3 Aircraft must have two metal wheels: tires no smaller than standard 11.4 x 5 type will be used and both will touch the ground.

5.4 Wheel pant or fairings if used, must measure in width at least 6.5 in.(165 mm) at the inner and outer axle point line to nominal fairing lines on each side. Pants or fairings must provide unlimited access for wheel and brake inspection.

6.**VISION**

6.1 When seated in the cockpit with crash helmet, seat belt and shoulder harness on, the pilot must be able to scan a field of vision measured from a datum plane parallel to the aircraft longitudinal axis of at least:

6.1.1 5 degrees down over the nose.

6.1.2 25 degrees true down over the leading edge of the wing for conventional, non-canard aircraft. Canard aircraft must be designed to achieve maximum forward and down visibility for turns and racing formation maneuvers.

6.1.3 45 degrees vertically upwards.

6.1.4 270 degrees horizontally.

6.2. In the absence of a more rational analysis, the longitudinal axis of the aircraft will be considered parallel to the wing chord at 3/8 wing semi-span.

7.**NOSE OVER STRUCTURE**

7.1 Substantial protection for the pilot other than the fin must be provided either fore or aft of the pilot cockpit. The structure must not obstruct forward visibility.

8.**FUEL TANKS**

8.1 The fuel tank must have a minimum useable fuel capacity of 5 U.S. gallons (18.92 liters).

9.**PARACHUTE AND SAFETY EQUIPMENT**

9.1 The cockpit must be large enough to accommodate a pilot wearing a parachute and a crash helmet approved by his/her National Air Racing Association.

9.2 The cockpit must be equipped with a seat belt and shoulder harness.

10.**MATERIALS AND WORKMANSHIP**

10.1 Must conform to aircraft standards or equivalent. The Technical Inspection Committee is empowered to refuse permission to fly, attempt to pass flight test requirements or to qualify an aircraft, which in their opinion, is not up to reasonably safe standards in either materials, workmanship, detail design, or condition. This applies to new, modified, repaired or damaged aircraft.

11.**GENERAL DESIGN**

11.1 Aircraft with pilots in prone position will not be permitted. The minimum vertical outside dimension at the cockpit shall be thirty inches (76.2 cm) (see 6.2). Any protrusions, fairings or additions to the fuselage or canopy mold lines will be discounted.

11.2 Center of gravity location at racing gross weight must fall between 8% and 25% of MAC of wing unless deviations are permitted by the Technical Committee. Aircraft operating at c.g.'s aft of 25% may be required to comply with Rule 12.2.5 at the discretion of the Technical Committee.

11.3 The cockpit shall have a means of opening from both the outside and the inside of the aircraft in case of an emergency. A yellow Emergency Release marking at least 2 in. x 4 in. (5 cm by 10 cm) describing release procedures shall be provided on both sides of the aircraft exterior.

11.4 Contest Numbers: Each aircraft shall carry its number in accordance with the F1 Register of Air Racing Numbers, on both sides of the fuselage or tail. Each digit must be at least 16 inches (407mm) high vertically, with a minimum, single color, stroke of 2 inches (51mm). This number shall have a single color, highly contrasting background. Double digit numbers shall have a minimum 2 inches (51mm) of this background color between them.

12.**FLIGHT REQUIREMENTS**

12.1 Flight requirements apply to new and modified aircraft and at the discretion of the Technical Committee. All aircraft will fly in racing configuration.

12.2 The following items must be demonstrated:

12.2.1 Six-G pull-up. This needs only be applicable to aircraft that have been presented under an 'Experimental' airworthiness regime. Aircraft built under 'Permit to

Fly' regimes such as those in operation in the UK, France and Germany are exempt due to the airworthiness compliance processes already undergone to meet CAA requirements (i.e. stress analysis and inspections from design through to completion stages). Aircraft under 'Permit to Fly' regimes whose construction began after 1st January 2015 are advised to seek the necessary regulatory approvals to comply with demonstrating a 6G pull-up.

12.2.2 Dive at 1.1 x maximum speed in level flight (1.1 Vh).

12.2.3 Three tight 180 degree turns at full speed without loss of height or stalls.

12.2.4 An aileron roll in each direction. If such a demonstration is prohibited under the airworthiness certification by the granting authority then an alternative demonstration or engineering analysis may be allowed by the relevant F1 body in the country of registration or where the event is held. Upon request, the pilot must also perform an additional test, to be administered in the aircraft to be flown, in which a quick sharp bank (which may be timed) will be executed to 90 degrees in one direction then immediately to 90 degrees in the other direction.

12.2.5 Four laps on race course at full speed demonstrating good flight characteristics.

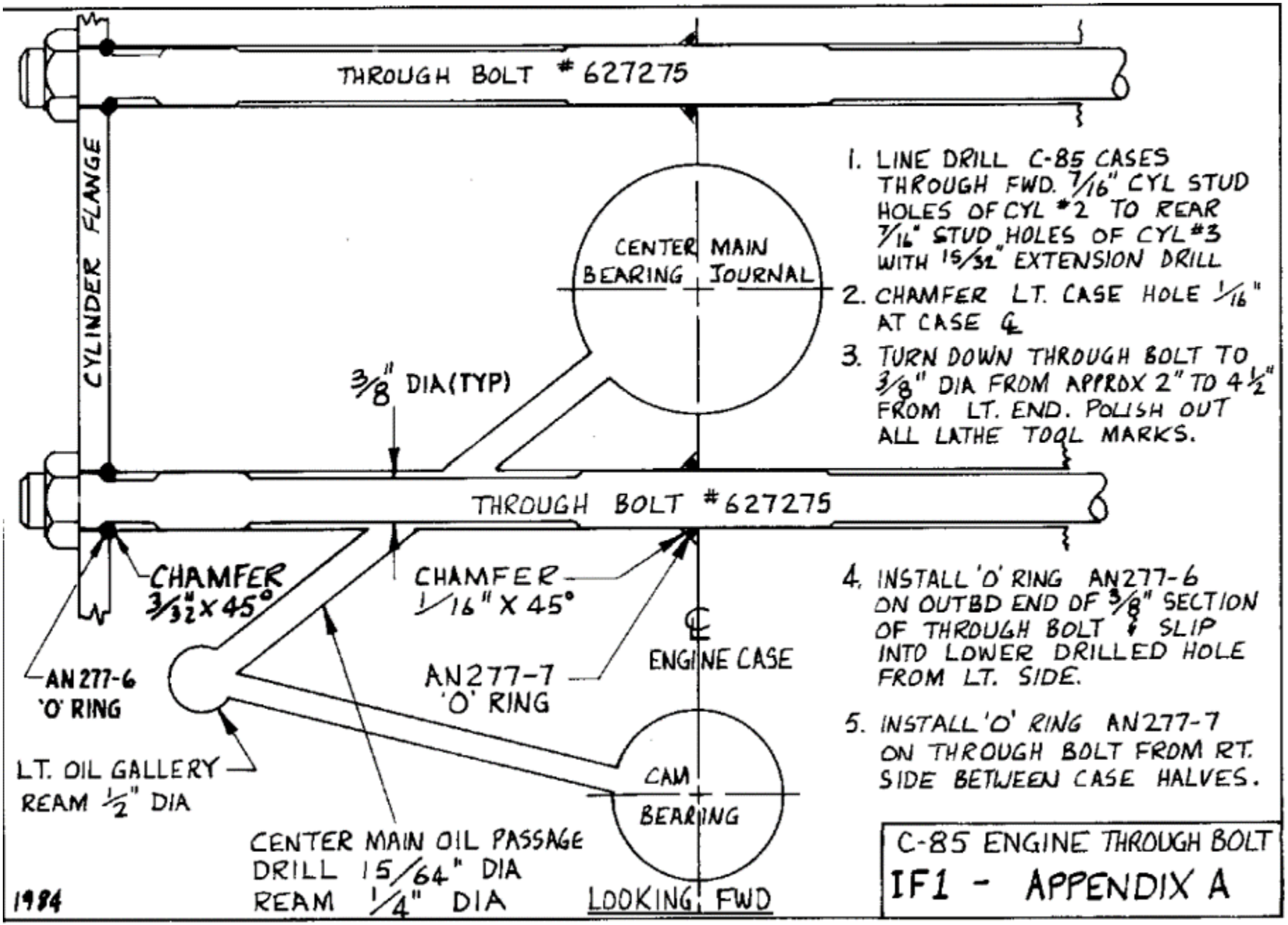
12.3 The flight requirements may be demonstrated concurrently with Pilot Certification (see Procedure Rules).

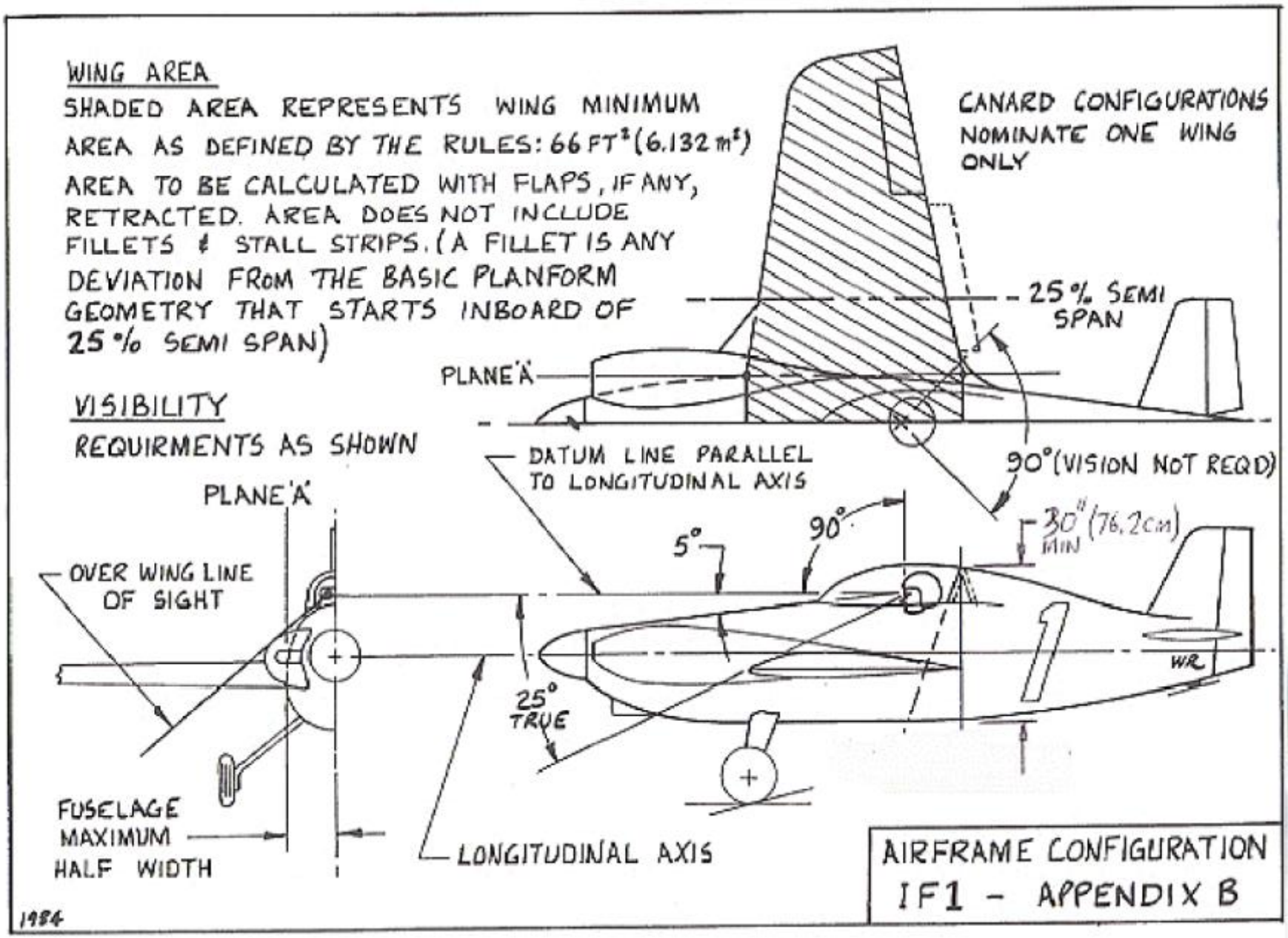
13.**SUPPLEMENTARY INFORMATION**

13.1 Specifications and installation prints on the Continental engines may be obtained from the Continental Motors Corp., Muskegon, Michigan/Rolls Royce Motors Limited, Light Aircraft Engine Division, Crewe, Cheshire.

Potential changes to these Technical Rules or corrections for errors should be communicated to the F1 Technical Rules Committee Chairperson.

NOTES:


THROUGH BOLT # 627275
CYLINDER FLANGE
CENTER MAIN BEARING JOURNAL
3/8" DIA (TYP)
THROUGH BOLT # 627275
CHAMFER 3/32" X 45°
CHAMFER 1/16" X 45°
AN 277-6 'O' RING
AN277-7 'O' RING
℄ ENGINE CASE
LT. OIL GALLERY REAM 1/2" DIA
CAM BEARING
CENTER MAIN OIL PASSAGE DRILL 15/64" DIA REAM 1/4" DIA
LOOKING FWD
1984
1. LINE DRILL C-85 CASES THROUGH FWD. 7/16" CYL STUD HOLES OF CYL #2 TO REAR 7/16" STUD HOLES OF CYL #3 WITH 15/32" EXTENSION DRILL
2. CHAMFER LT. CASE HOLE 1/16" AT CASE ℄
3. TURN DOWN THROUGH BOLT TO 3/8" DIA FROM APPROX 2" TO 4 1/2" FROM LT. END. POLISH OUT ALL LATHE TOOL MARKS.
4. INSTALL 'O' RING AN277-6 ON OUTBD END OF 3/8" SECTION OF THROUGH BOLT & SLIP INTO LOWER DRILLED HOLE FROM LT. SIDE.
5. INSTALL 'O' RING AN277-7 ON THROUGH BOLT FROM RT. SIDE BETWEEN CASE HALVES.
C-85 ENGINE THROUGH BOLT
IF1 - APPENDIX A


WING AREA
SHADED AREA REPRESENTS WING MINIMUM AREA AS DEFINED BY THE RULES: 66 FT² (6.132 m²)
AREA TO BE CALCULATED WITH FLAPS, IF ANY, RETRACTED. AREA DOES NOT INCLUDE FILLETS & STALL STRIPS. (A FILLET IS ANY DEVIATION FROM THE BASIC PLANFORM GEOMETRY THAT STARTS INBOARD OF 25 % SEMI SPAN)
VISIBILITY
REQUIRMENTS AS SHOWN
CANARD CONFIGURATIONS NOMINATE ONE WING ONLY
25 % SEMI SPAN
PLANE 'A'
90° (VISION NOT REQD)
DATUM LINE PARALLEL TO LONGITUDINAL AXIS
PLANE 'A'
5°
90°
30" (76.2cm) MIN
OVER WING LINE OF SIGHT
25° TRUE
WR
FUSELAGE MAXIMUM HALF WIDTH
LONGITUDINAL AXIS
AIRFRAME CONFIGURATION
IF1 - APPENDIX B
1984

APPENDIX C: F1 RACING PILOT LICENSE DEMONSTRATION

A. PAPERWORK REVIEW AND ORAL EXAMINATION

1. Review pilot's logbook to determine total flying time, and total time in the aircraft to be used for the demonstration.
2. Check for valid pilot's certificate, medical certificate, flight review, and aircraft paperwork (current airworthiness, registration, operating limitations, weight and balance, and "annual" condition inspection).
3. Review and discuss weight and balance information, engine and propeller limitations, G-load restrictions, operating limitations, and the technical inspection requirements for the aircraft used in the flight demonstration.
4. Discuss personal motivation, philosophy, and reason for becoming a race pilot.
5. Discuss past history of racing accidents and common causes.
6. Density altitude considerations.
7. Aircraft qualification procedures.
8. Race start procedures.
9. Pylon and scatter pylon procedures.
10. Passing procedures.
11. Methods of communicating emergency-in-progress information to participants and response required.
12. Methods of declaring any emergency and actions for various types of emergencies.
13. Methods of communicating termination of race to participants and response required.
14. Normal race termination procedures.
15. "Deadline" procedures.
16. Race briefing attendance requirements and outline of briefing contents:
    a. FAA/CAA regulations and waivers applicable to air racing.
    b. Crowd and race deadlines. ("showlines")
    c. Schedules and relation to staging.
    d. Aircraft ground safety precautions.
    e. Race and scatter pylon locations.
    f. Course obstructions.
    g. Emergency landing facilities.
    h. Coordination with fire/rescue.

B. GENERAL PREFLIGHT

1. Sufficient fuel (5 gallons minimum) and oil for proposed flight.
2. Seatbelts and shoulder harness.
3. Loose objects in aircraft. (Encourage the use of a checklist in cockpit)
4. Canopy and access latches.
5. Controls and aircraft structure.

C. FLIGHT OBSERVATIONS

1. Aborted Start: Simulate an unassisted race start (no tail holder) and accelerate for approximately 300 feet before simulating an engine failure by closing the throttle. Bring the aircraft to a full stop without veering more than 20 feet either side of a straight line.
2. Race Start: Takeoff from a full stop at full throttle without veering more than l0 feet either side of a straight line.
3. Make three 180 degree turns of at least 60 degree bank at an altitude of 500 feet or higher at racing speeds without appreciable loss of altitude.
4. Demonstrate an aileron roll in each direction, followed by a half-roll to the left with a half-roll to the right recovery. All without loss of altitude exceeding 50 feet. Such demonstration should be performed in the aircraft type expected to be flown in a race. Where such a demonstration is prohibited in the aircraft expected to be flown (for example if the authority of the country of registration does not certify the aircraft type for intentional aerobatics) then the demonstration may be performed in an appropriate aerobatic aircraft (with or without an instructor onboard). In the latter case, an additional test will also be administered in a formula one type aircraft in which a quick sharp bank (which may be timed) will be executed to 90 degrees in one direction then immediately to 90 degrees in the other direction.
5. Demonstrate three laps on the race course at racing speeds without climbing in turns.
6. Demonstrate formation flying ability and passing techniques on the race course.
7. Demonstrate a normal landing.
8. Demonstrate a simulated power-off landing from racing altitude and speed

Aircraft Race #:

Pilot:

Renewal at:

Date:

Pilot Evaluator:

Signature:

FORMULA ONE DESIGN GUIDE

Revised 1985, 1991
Reformatted with revisions 2002

GENERAL

This guide is intended to be used in conjunction with the rules by people designing or building aircraft for F1 class competition. It is not controlled and may be modified at any time by the Technical Director.

There have been cases in the past where members have built or modified designs, then submitted their aircraft for technical inspection in the field. Upon inspection it was determined the design or modification does not meet the requirements. Subsequent and further analysis proved this field action to be correct, and we wish to prevent this from happening. The Technical Director has the authority to approve or disapprove the modifications and/or new designs of F1 aircraft. This approval before submittal of aircraft for technical inspection and qualification is not mandatory, but highly recommended. The only cost of this assistance will be the "out-of-pocket" cost and expense of traveling to the project when necessary. The Tech Director is also a source of technical help and assistance for members who wish to design or modify F1 aircraft. Help can also be obtained from regional technical inspectors appointed in different areas, under the same conditions.

Every member receiving the benefit of advice or assistance from this organization must realize that all recommendations and conclusions are purely advisory. The suitability, integrity and condition of your airplane will be solely the responsibility of the owner, builder and the pilot. No responsibility is assumed by individuals or the F1 organization.

ITEM 1: ENGINE

Technical Rule 1.18.5 requires engine retention cables. Cables are required to retain the engine on the airframe in the event of a propeller failure. The objective of the requirements set out below is to provide a redundant, fail safe system that will work even if one side breaks.

1.1 **Cables**

Only bare 3/16 in. steel cable will be used - no plastic coated cable. Protective covering (split plastic tubing) may be used, provided it is readily removable for inspection. Use double nicopress, control-cable type end fitting or braided eyelet loop for making end loops.

1.2 **Routing**

The cable must be wrapped around the engine between the cylinders as shown in Figure 1. The cable should be crossed above the engine. The cable may be routed between the lugs on the spider, **looped around and back through the spider** to provide a fail-safe installation (see below). When making the installation consider engine removal.

1.3 **Fail-Safe Installation**

Provide clamps to prevent the engine from sliding off the cable if the airframe attachment fails on one side. Provide a clamp where the cables cross above the engine and/or clamps on the loop at the spider. An alternate approach is to use two separate cables (see Figure 2).

1.4 **Airframe Attachment**

Cables will be attached at two separate locations at the airframe side of the engine mount:

A. Connected to .090 in. thick 4130 steel lugs bolted by the engine mount/airframe attach bolts, (see Figure 3) or

B. Looped around one upper longeron tubing cluster behind the firewall, across the back of the firewall and looped around the other cluster, (see Figure 4) or

C. Wrapped around the tubing cluster at each upper longeron behind the firewall (see Figure 5) or

D. Attached to lugs welded or integrally bonded to the upper longeron or basic airframe structure or

E. Attached to gussets (.090 in. steel) welded between engine mount or frame tubes (minimum of four linear inches of weld per gusset).

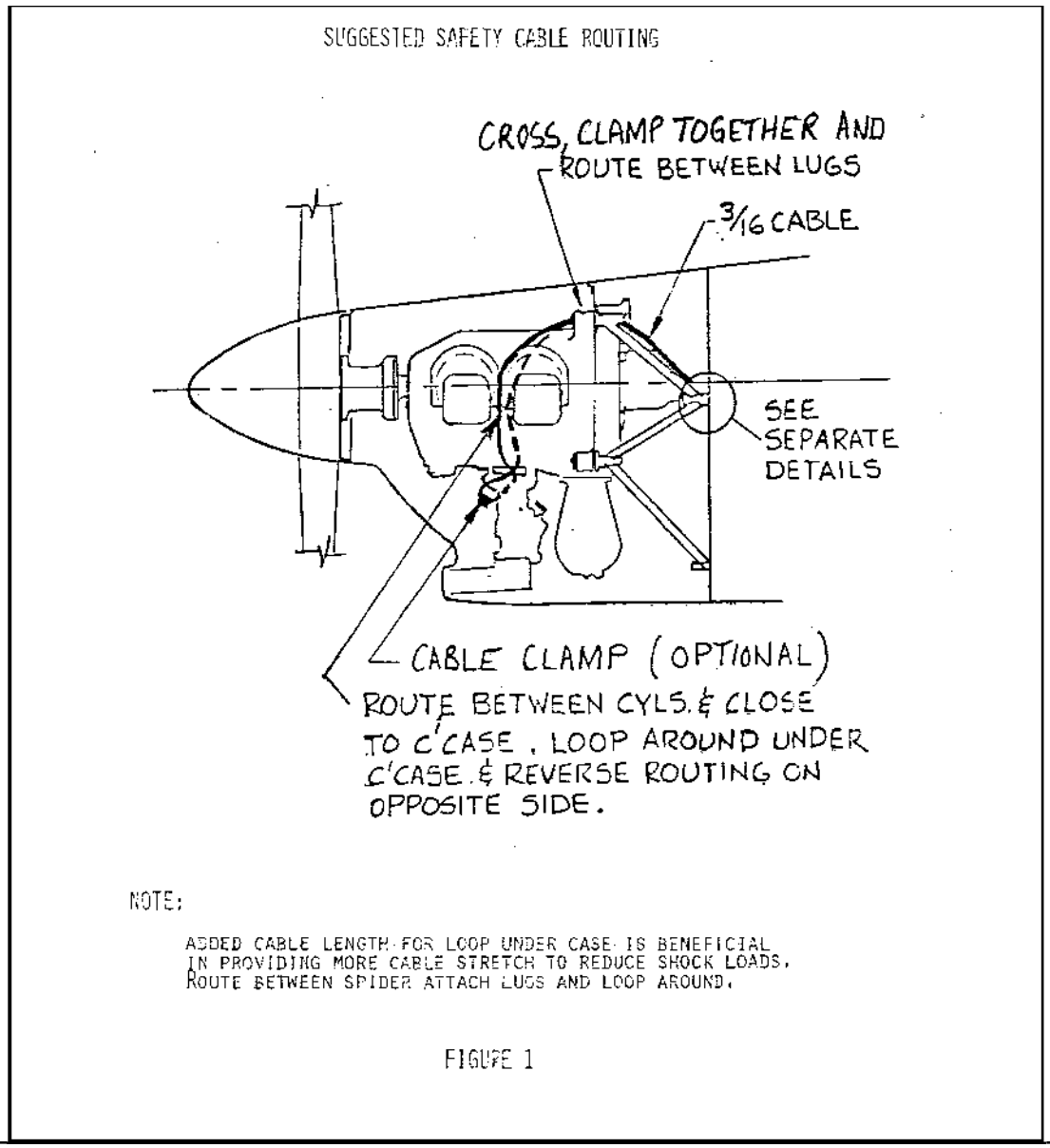


FIGURE 1

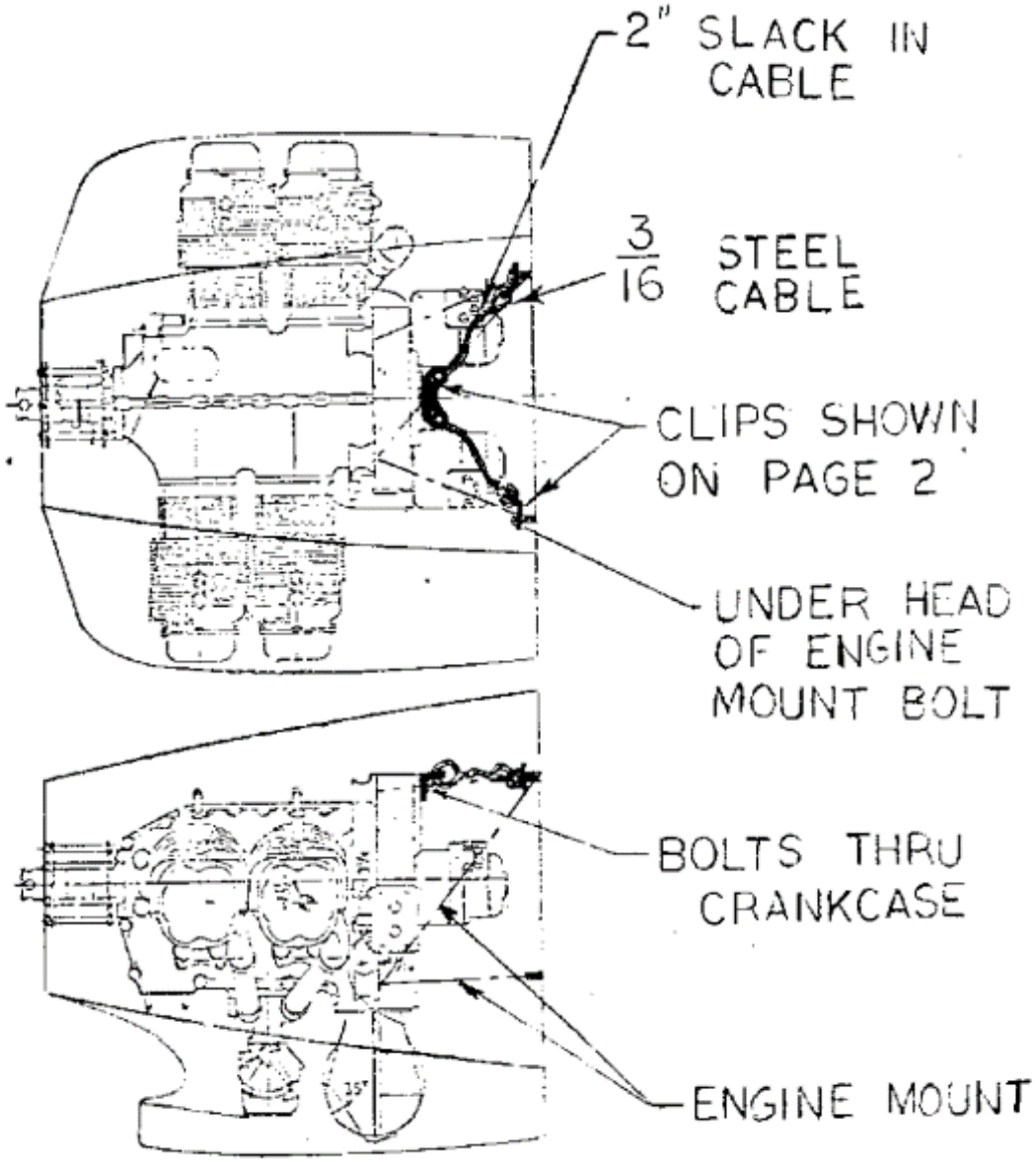

2" SLACK IN CABLE
3/16 STEEL CABLE
CLIPS SHOWN ON PAGE 2
UNDER HEAD OF ENGINE MOUNT BOLT
BOLTS THRU CRANKCASE
ENGINE MOUNT

FIGURE 2

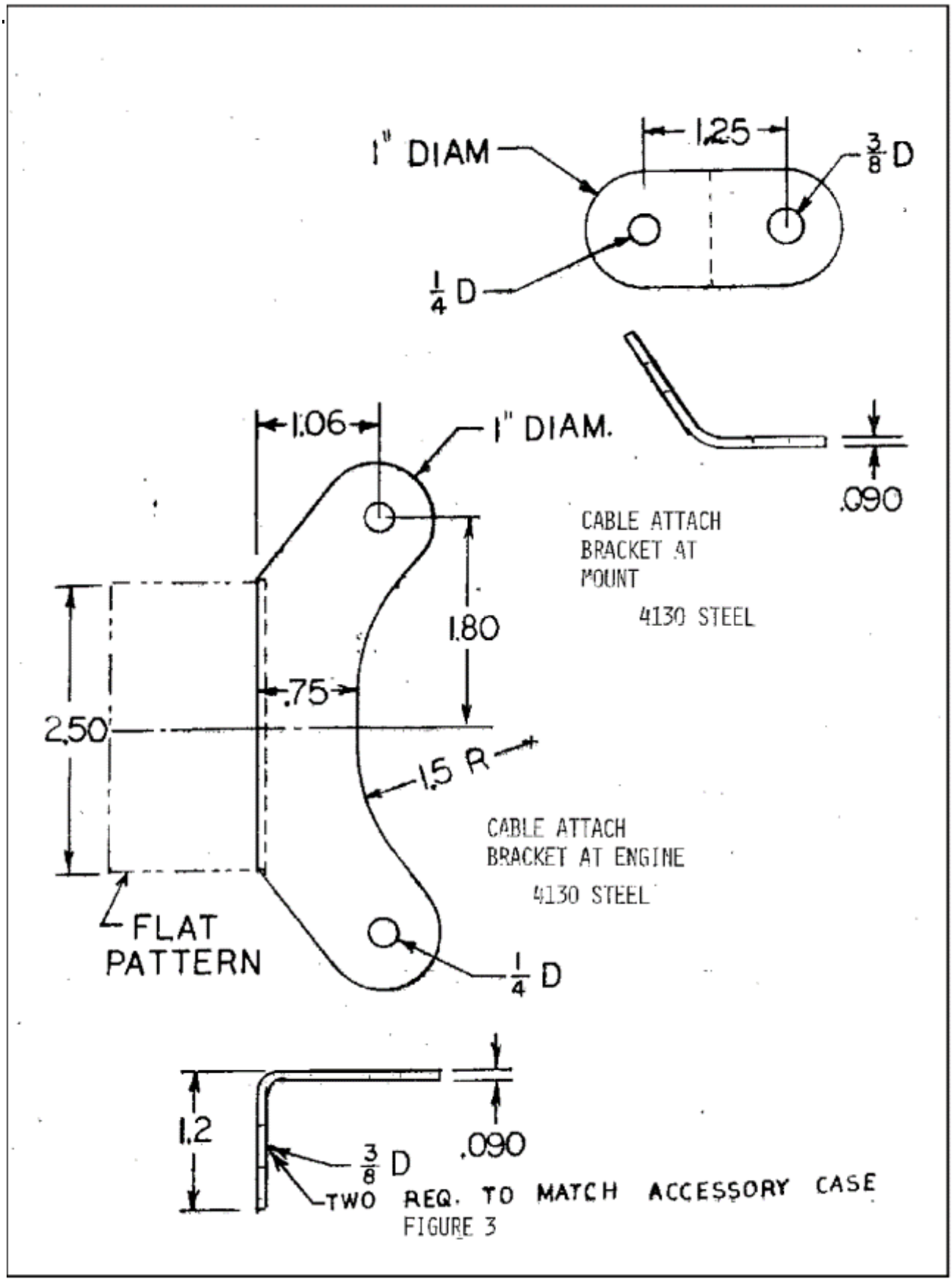
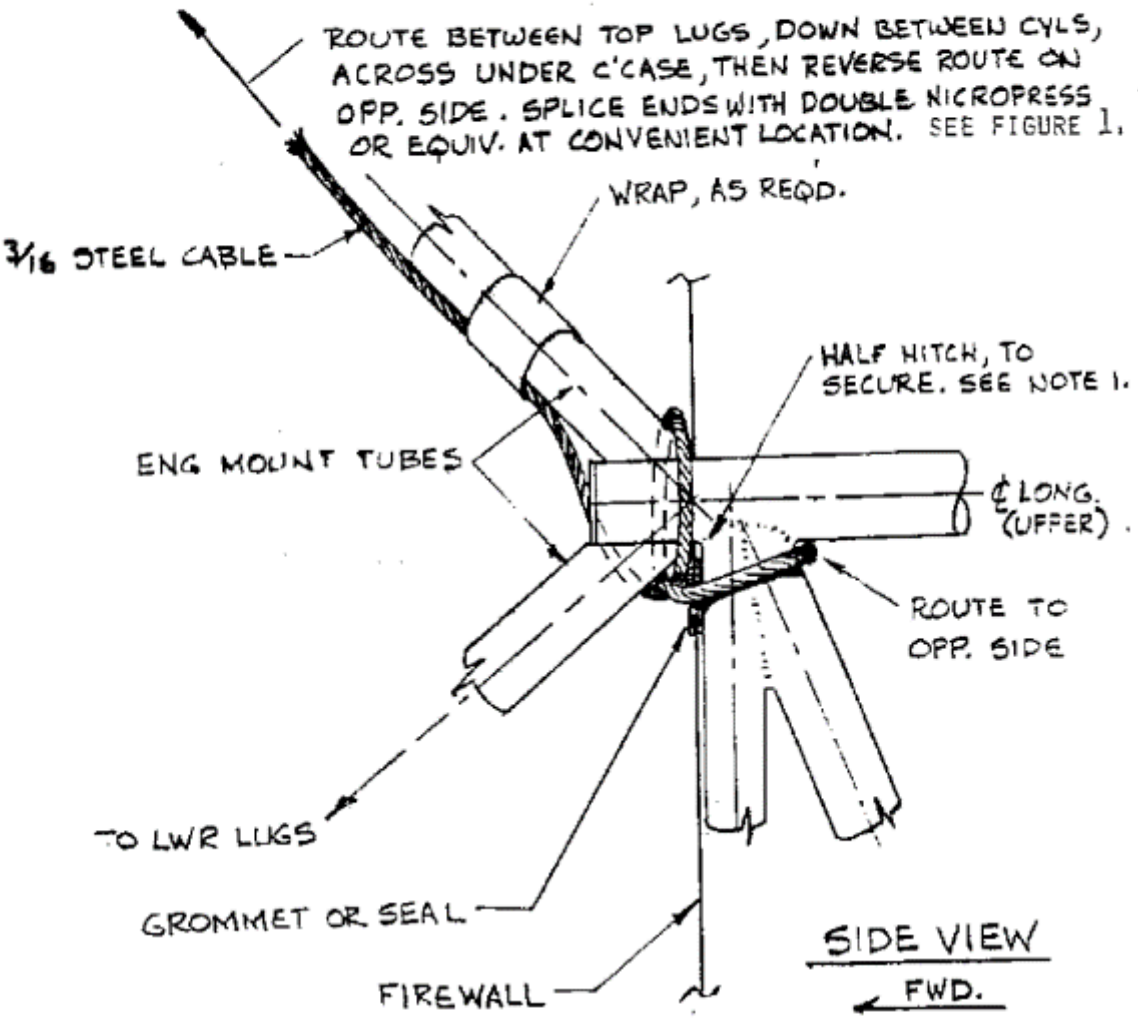

1" DIAM
1.25
3/8 D
1/4 D
1.06
1" DIAM.
.090
CABLE ATTACH
BRACKET AT
MOUNT
4130 STEEL
1.80
.75
2.50
1.5 R
CABLE ATTACH
BRACKET AT ENGINE
4130 STEEL
FLAT
PATTERN
1/4 D
1.2
3/8 D
.090
TWO REQ. TO MATCH ACCESSORY CASE

FIGURE 3

TYPICAL SAFETY CABLE INSTAL.

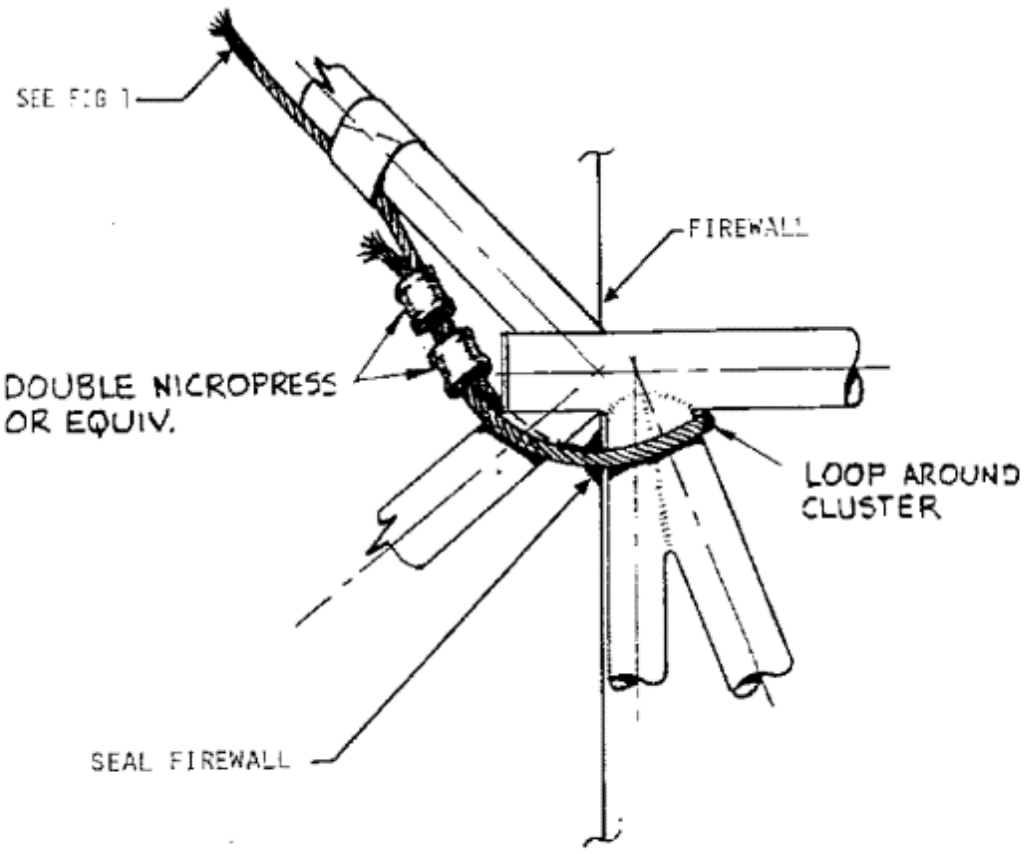


NOTES:

1. SECURE TO CLUSTER AS SHOWN, OR EQUIVALENT, TO PREVENT CABLE FROM SLICING DOWN THRU F'WALL IF ENGINE SEPARATES FROM AIRCRAFT. CROSS-SHIP SECTION OF CABLE BEHIND F'WALL WOULD THEN SLIDE DOWN TUBES AND PIN OR SEVER PILOTS LEGS, IF NOT SECURED. IT CAN BE ASSUMED THAT THE TOP MOUNT WILL NOT FAIL AT THE FIREWALL CLUSTER.
2. LEAVE 1" TO 1-1/2" SLACK EACH SIDE TO ASSURE THAT MOUNT TAKES INITIAL SHOCK.

FIGUPE 4

TYPICAL SAFETY CABLE INSTALLATION.



NOTE:

LEAVE 1" TO 1-1/2" SLACK AT EACH SIDE TO ASSURE THAT MOUNT TAKES INITIAL SHOCK.

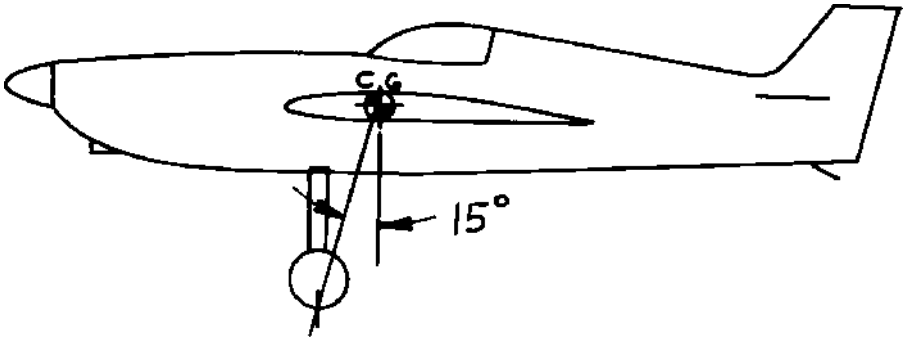
FIGURE 5

ITEM 2: AIRFRAME

2.1 **General** - It is recommended that all builders submit a three-view scale drawing (at least 1/20th scale) to the Technical Director for review and comment before construction of the ship is started. These drawings should include as much design data and detail information as possible. Drawings should show particularly details of wing structure and bracing, if any, giving type of materials, size and construction and spars, ribs, skin, drag bracing, fittings, etc. The location and construction of nose-over structure giving size of members, etc. should be shown and an estimate of weight and balance submitted. All materials submitted will be held strictly confidential.

2.2 **Center of Gravity** - Location of racing gross weight should fall within an 8% to 25% of MAC. CG locations aft of 25% MAC are subject to approval by the Tech Director.

2.3 **Landing Gear** - Past experience indicates that an aircraft with conventional landing gear, the contact point of the main wheels should be on a line 15 deg. forward of the CG location as shown below:



This provides adequate braking and acceptable ground handling if toe in is avoided.

2.4 **Recommended Design Criteria** - These are based on experience including load factors actually measured on aircraft in races.

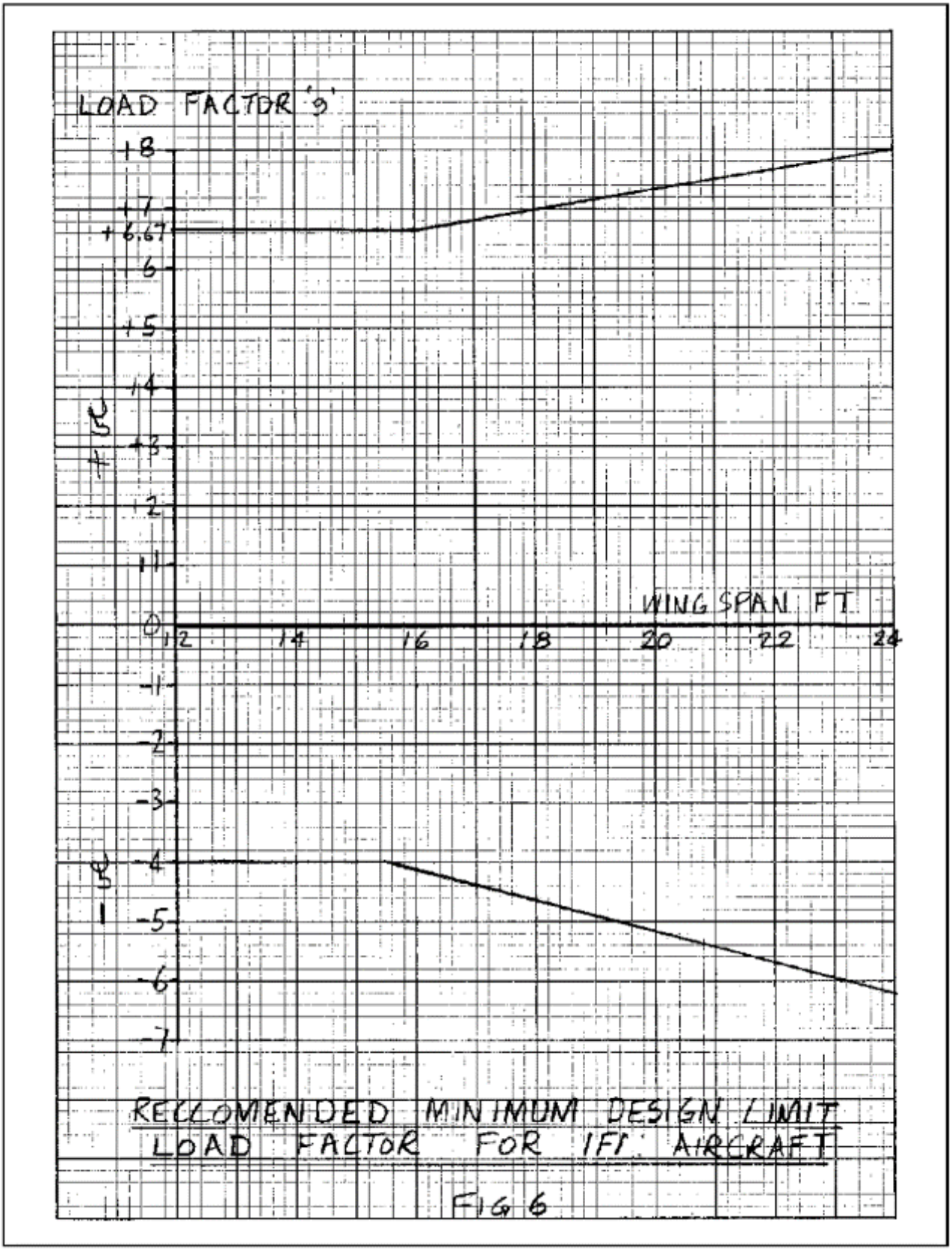
2.4.1 The design limit load factor should be not less than illustrated on Figure 6.

The design ultimate load factor should be not less than 1.5 x limit load factor. There should be no predictable catastrophic failure at the ultimate load factor. The design load factors should be applied to the aircraft racing weight. For wooden structures there is not really any limit load as such; so the compressive ultimate load and the modulus of rupture must be used to determine strength.

2.4.2 The wing structure, control system, fuselage structure and fittings should be designed to withstand, as a limit load, the abrupt application of aileron deflection at 240 mph TIAS. The minimum design deflection should be the least value resulting from the following conditions:

2.4.2.1 Full attainable travel (against the stop).

2.4.2.2 Same as 2.4.2.1 but reduced by the amount of control system deformation, under load, of that portion of the system between the aileron stop and the aileron.


LOAD FACTOR 'g'
+8
+7
+6.67
6
+5
+4
+3
+2
+1
0
-1
-2
-3
-4
-5
-6
-7
+ g
- g
WING SPAN FT
12
14
16
18
20
22
24
RECOMENDED MINIMUM DESIGN LIMIT
LOAD FACTOR FOR IFI AIRCRAFT
FIG 6

2.4.2.3 The deflection attainable with a 50 lb. "pilot effort" load applied laterally at the stick grip, including the effects of system deformations.

The torsional loads due to aileron deflection shall be combined with positive or negative wing lift and the torsional loads due to camber such that the most critical combination results.

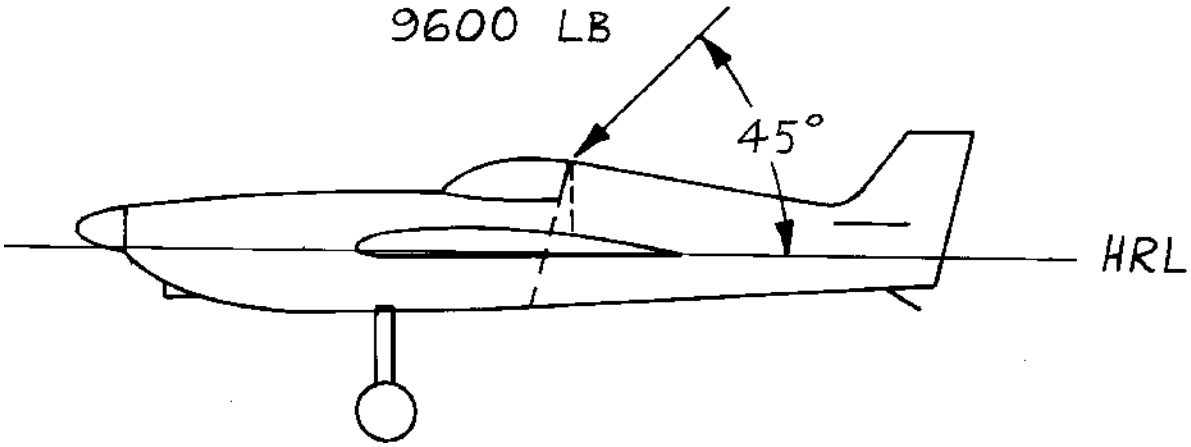
2.4.3 The horizontal and vertical tails and supporting structure should be designed to withstand a limit load resulting from an average normal force coefficient of +1.2 and a dynamic pressure corresponding to the predicted TIAS which will produce an accelerated stall at the aircraft design limit load factor. (Note: this condition approximates a panic recovery (forward stick) from such a stall, wherein zero downwash and sidewash are assumed to exist at the tail).

It will be acceptable to assume that the chordwise load distribution is as follows:
2/3 of the load should have a triangular distribution with the peak at the LE and zero load at the TE and 1/3 of the load should have a triangular distribution with the peak at the control surface hinge and zero load at the LE and TE.

The spanwise load distribution should be determined by a rationale or conservative analysis.

2.4.4 An alternative rule of thumb for the design of a horizontal tail for a 12g airplane is to take the empty weight of the airplane and apply it as a rectangular lift distribution.

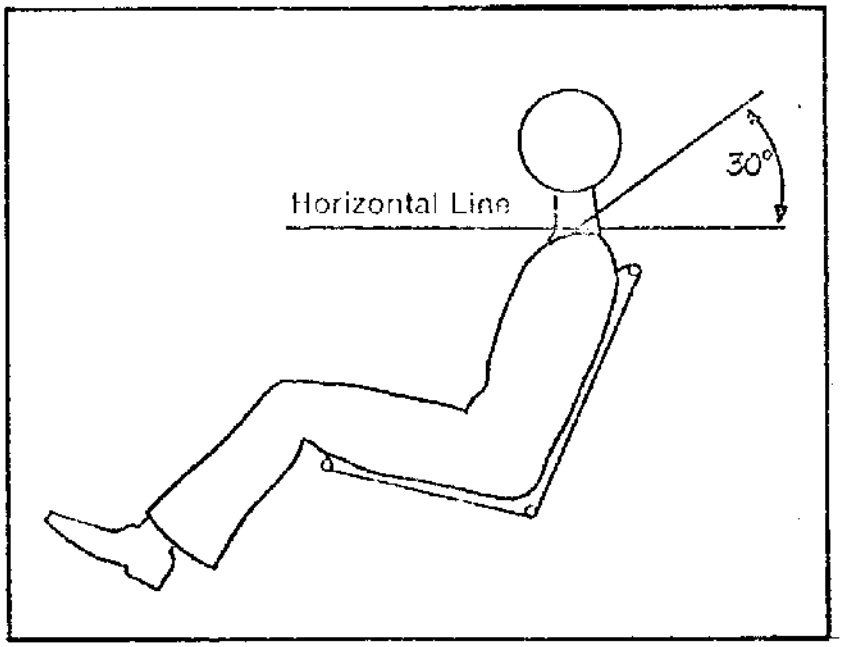
2.5 **Turn Over Structure** - It is recommended that structure behind the pilot's head be designed to support at least a 12g or 9,600 load applied down and forward at 45 Deg.



2.6 **Canopy** - It is required that the canopy be designed to have provision for unlatching from both the inside and outside in case of emergency. See Rule 11.3.

Technical Rule 11.3 requires a marking describing emergency canopy release procedures. One method of making a decal is to obtain some yellow "Scotchcal", use black rub-on letters for the marking and cover with clear self-adhesive material for protection. Rub-on letters can also be applied directly to paint and protected by clear spray material.

2.7 **Safety Harness** - It is recommended that each mounting point be designed to support at least a 12g load or 1300 lb. load in the direction of the belt (180 lb x 12 g x 60%). The rules require a shoulder harness. The shoulder straps should be designed to meet the shoulders at an angle of 0 deg. to 30 deg. **above** the horizontal to prevent download on the spine in an accident.



2.8 **Trailer Loads** - Many instances of damage to aircraft structures have been noted as a result of transporting racing aircraft on trailers. A common form of damage is fatigue cracks in upper longerons just aft of the firewall caused by vibration of the engine. If you anticipate extensive trailering of your aircraft, design in additional strength in affected areas. The most effective solution is probably to remove the engine entirely or support it separately from the airframe in some way during transportation.

2.9 **Breathing Tube** - In the event of catastrophic engine failure or fire, etc., smoke and fumes can enter the cockpit even if the firewall is carefully sealed. Some designers provide the pilot with a breathing tube connected to a fresh air source far enough out on the wing to preclude the intrusion of fumes from the engine compartment.

2.10 **Engine Mount** - The standard Cassutt engine mount is designed for a engine rear accessory case which lacks provision for starter or generator. If a stock 0-200 engine is used with a - 1 rear case, the starter and generator pads will hit the engine mount. Many people bend the tubes to clear the case; this is unacceptable since curved space frame tubes are very inefficient. The solution is either to use a -12 rear case or redesign the engine mount to clear the -12 case.

2.11 **Exhaust Insulation** - There have been instances where people have wrapped their exhaust systems with insulating material such as waterglass and then had their ability to fly the airplane severely hampered by fumes in the cockpit (see 2.9). Some of these materials take a considerable time to cure - some still outgas after more than 30 minutes of ground running the engine.

2.12 **Spinners** - Spinners are troublesome and prone to cracking:

1. Use a backplate and a front plate. Projecting mandrels are hard to align. Attach the spinner to both plates with fasteners.
1. Do not attach composite props to spinners.
2. Make sure the spinner is properly aligned.
3. If you bolt the prop through the front plate, use large area washers or steel inserts to prevent loosening of the prop bolts as the aluminum front plate material is extruded out from under the bolt heads.
4. Check that the bushing holes in the prop are deep enough to accept the crankshaft bushings and allow the prop to sit firmly on the crank flange.
5. Reinforce the prop cutouts with a doubler riveted to the spinner or a welded bead. Leave a 0.1 in. gap between the spinner and prop. Any seal should be flexible.

2.13 **Propellers** - In 1987 all-metal props were no longer allowed in F1 racing. This was due to frequent instances of cracking and dangerous failures. We do not recommend the use of metal props even for testing, but if you still choose to use one be sure to:

Inspect them visually **before each flight** - on the curved outer surface, leading and trailing edge from root to tip. Look for small chordwise dents or two dents with tiny crack between. Remember, one day its not there then after a flight or runup, it is.

On **Sensenich** propellers the most usual location for failures is on the curved front surface 14 to 18 inches from the tip.

On **Macauley** props the critical place is on the back side at the leading edge, again 14 to 18 inches from the tip.

Buy a dye check kit and inspect your propeller with it every three flights.

Always stay 200 rpm away from the vibration modes.

CARE AND MAINTENANCE OF F1 WOOD PROPELLERS (Courtesy of Fred Griffith, Great American Propeller Company)

1. Use a full size crush plate for best torque and first quality AN/MS propeller bolts, preferably AN76 series.
2. Crush plates of aluminum should be at least 1/4" thick.
3. Use washers under the bolt heads to prevent damage to crush plate.
4. Torque 3/8" propeller bolts to at least 20 ft. lbs. and check the propeller track. Prop should track to 1/32" because of high RPM.
5. Use 25 ft. lbs. to bring in track on one side if necessary.
6. Make sure spinner cut outs clear prop by 1/8" all around to prevent cutting propeller (they move in flight).
7. Make sure spinner screws are lined up properly, especially front spinner plates. If not, use spacers to bring in line.
8. Make sure propeller is clean and smooth. Use wet sanding, polishing compound and paste wax.
9. Do not handle or move propeller by the tips. This could cause un-seen internal fractures and possible in-flight failure.
7. When starting engine, hold propeller halfway between spinner and tip. (A little harder to do but well worth preventing damage to propeller.)
8. Inspect and re-torque your propeller, especially a new prop and always after the first flight.
7. If you go from a dry climate to a high humidity climate, your propeller will take on some moisture and swell slightly. No need to worry. Going from a high moisture climate to a dry

climate like Reno, etc., your propeller will shrink and the torque value will decrease. Make certain your torque is holding and re-torque as required.

9. On fairly new propellers the wood may shrink as at Reno and the finish may become bumpy over the glue lines. Wet sanding and polishing compound will take care of this problem.

10. When installing and removing your wood/composite propeller, always hold it in near the hub. Wrenching the propeller out farther on the blade could cause fractures which in turn could cause failures.

11. Use the proper diameter propeller for the temperature and altitude that you will be racing. The high drag of supersonic propeller tips is very costly in performance of the propeller and could even cause damage.

8. Inspect your propeller carefully before and after each flight. If you see something questionable, get an expert to look at the propeller and/or call the manufacture for help and advice.

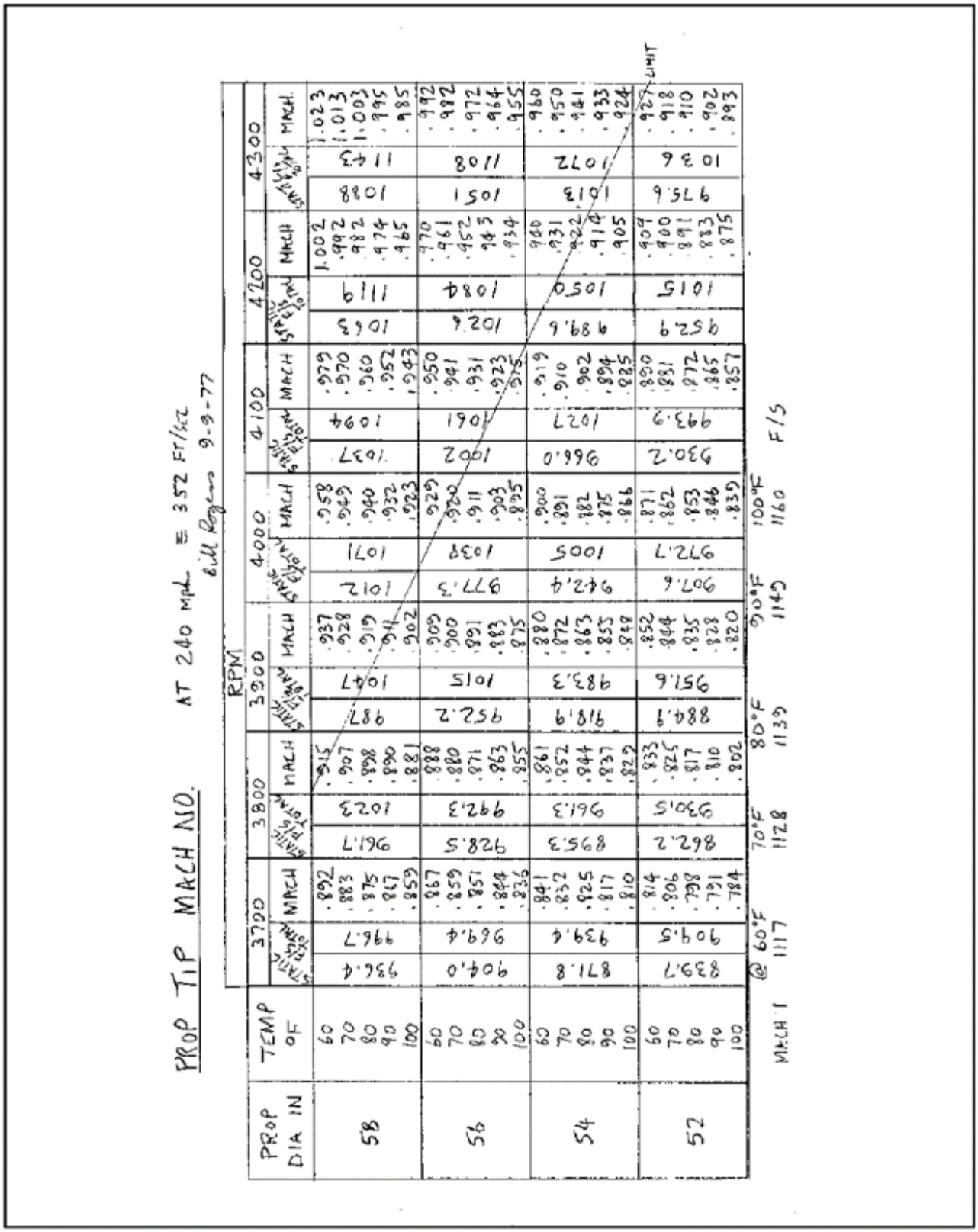
9. Remember, racing propellers are subjected to many kinds of loads and some are unknown dynamic loads and high G forces. Proper care of your propeller is critical.

12. A high visibility, padded propeller cover is suggested to protect your propeller from damage between flights.

13. Should your propeller become nicked or experience small areas where the paint is gone due to rocks, etc., be sure to fill these areas with epoxy or some finish to keep the wood and composite protected. If the damage is greater, call the manufacture for advice.

14. Your propeller should be perfectly balanced and to make sure it stays that way, always store horizontally on either flat side of the hub face. An alternate method is to hang it horizontally from the hub or bolt holes. NEVER stand it on blade end as the moisture will migrate to the low end and an out of balance condition will occur. After installation of the propeller, always leave propeller in the horizontal position when stopped.

Propeller performance is directly related to tip mach number. The following chart, Fig 7, shows the relationship between tip mach number, RPM, and prop diameter at 240 m/h. It is advisable to keep the tip mach below .92 or so to avoid the dramatic drag rise associated with compressibility effects.



PROP DIA IN	TEMP °F	3700 STATIC RPM	3700 MACH	3800 STATIC RPM	3800 MACH	3900 STATIC RPM	3900 MACH	4000 STATIC RPM	4000 MACH	4100 STATIC RPM	4100 MACH	4200 STATIC RPM	4200 MACH	4300 STATIC RPM	4300 MACH
58	60	986.4	.892	996.7	.915	987	.937	1012	.958	1037	.979	1063	1.002	1089	1.023
	70	975.8	.883	986.1	.907	977.2	.928	1002.2	.949	1027.4	.970	1053.1	.992	1078.8	1.013
	80	965.2	.875	975.5	.898	967.4	.919	992.3	.940	1017.5	.960	1043.2	.982	1068.9	1.003
	90	954.6	.867	964.9	.890	957.6	.911	982.5	.932	1007.6	.952	1033.3	.974	1059.0	.995
	100	944.0	.859	954.3	.881	947.8	.902	972.6	.923	997.7	.943	1023.4	.965	1049.1	.985
56	60	969.4	.867	979.7	.888	969.8	.909	994.9	.929	1020.0	.950	1045.1	.970	1070.2	.992
	70	959.0	.859	969.2	.880	959.9	.900	984.4	.920	1009.9	.941	1035.4	.961	1060.9	.982
	80	948.5	.851	958.7	.871	950.0	.891	974.0	.911	999.9	.931	1025.6	.952	1051.3	.972
	90	938.0	.844	948.2	.863	940.1	.883	963.5	.903	989.8	.923	1015.8	.943	1041.5	.964
	100	927.4	.836	937.7	.855	930.2	.875	953.1	.895	979.7	.915	1005.9	.934	1032.0	.955
54	60	939.4	.841	949.6	.861	940.0	.880	964.1	.900	989.6	.919	1015.0	.940	1040.5	.960
	70	929.1	.832	939.3	.852	930.2	.872	954.0	.891	979.1	.910	1004.7	.931	1030.4	.950
	80	918.7	.825	928.9	.844	920.4	.863	943.9	.882	968.9	.902	994.4	.922	1020.0	.941
	90	908.4	.817	918.6	.837	910.6	.855	933.8	.875	958.7	.894	984.2	.914	1009.7	.933
	100	898.0	.810	908.2	.829	900.8	.848	923.6	.868	948.4	.885	973.9	.905	999.4	.924
52	60	904.5	.814	914.7	.833	905.1	.852	929.2	.871	953.8	.890	978.3	.909	1002.9	.927 LIMIT
	70	894.2	.806	904.4	.825	895.4	.844	919.1	.862	943.7	.881	968.3	.900	992.9	.918
	80	883.9	.798	894.1	.817	885.7	.835	908.9	.853	933.6	.872	958.2	.891	982.8	.910
	90	873.6	.791	883.8	.810	876.0	.828	898.8	.846	923.5	.865	948.1	.883	972.7	.902
	100	863.3	.784	873.5	.802	866.3	.820	888.6	.839	913.4	.857	937.9	.875	962.5	.893

Fig 7

2.14 **High Aspect Ratio Wings** - As you decide to trade in the old barn door for one of those high tech foam and glass sailplane surfaces, you should consider a couple of items! *A change to a high aspect ratio wing reduces your margin of safety in several areas.*

2.14.1 Center of Gravity Range - For safety, our rules require you to maintain your gross weight CG between 8% and 25% of the Mean Aerodynamic Chord. The MAC is a mathematical approximation of a complex planform to reduce it to an equivalent rectangular wing, like the basic Cassutt. You can obtain 66 sq. ft. with a 5 ft. chord and l3.5 ft. span or a 32 in. chord and 25 ft. span. The allowable CG travel on the slab is About 10 in. but on your High AR it is only 5.4 in., a 46% reduction.

Fuel usage, although it usually moves the CG aft, seldom affects a stock Cassutt. With your new wing you must check the CG both full fuel **and empty** especially if you have a big tank. A heavier pilot (new or post-Christmas) also moves the CG aft. Your airplane is much less tolerant to a couple of pounds added to the aft end - like a paint job. If the CG is not always within the allowable range, you **must change** the airplane or ballast it. A wood prop is 10 lbs. lighter than its metal equivalent - more aft CG movement.

2.14.2 Structure - If your new long wing weighs less than your current wing, worry; find out why. It is probably due to modern, stronger materials, but as the span increases, bending moments and loads increase and you need additional structure to support the extra load. You will be asked to demonstrate a 6g load in flight, and perhaps see 9+g in turbulence during racing later. The analysis is fine for that theoretical paper wing but what about yours? Did all the bonds bond? Are all the voids filled? Did the epoxy mix properly on **your** wing?

Do a proof load test. Turn the wing upside down on a pair of strong saw horses and load sandbags equivalent to 7g x the airplane gross weight (5600 lbs or so) on the wings. If it breaks, you just saved your ***.

2.14.3 Stiffness - This new wing makes you faster right? Loads increase by the speed squared, i.e., a l00 lb load at 200 m/h will increase to 156 lbs at 250 m/h. The wing section is smaller and its stiffness, not only in bending, but in torsion is probably less. That does not mean that it breaks, but it does mean that it bends.

Aileron inputs add torsional load to the wing. Roll left, left aileron up twists wing LE up and increases wing incidence and lift. This rolls you to the right, but we wanted to roll left, remember! The result is reduced aileron effectiveness and possible tip stall.

2.14.4 Aerodynamics - Accelerated stalls: as you pull g, the stall speed increases, so in a turn you must keep the speed up to maintain your safety margin. Tight turns at low speeds are more dangerous since the inside wing slows down more for your high AR design. Consider building in some washout - less (or negative) incidence at the tip than the root. This will perhaps increase drag a little but may make your airplane work better. It is a basic rule of aero design that you do not want the tip to stall.

2.14.5 Ailerons - We have seen a few odd geometrical effects due to bending. Torque tubes will bend at the bearing or support points and try to remain straight in between. They will bend up under load and perhaps move the neutral point of the aileron without moving the stick. People have attempted to counteract this by rigging the system with the ailerons out of line statically so that under load they work better. You should consider, however, that in a low speed situation (dead stick) your ailerons will be unloaded and may alter the airfoil to the extent of **stalling** that portion of the wing. A push rod system is far less susceptible to these problems especially if you use lengths that can remain straight.

2.15 **Fuel Vents** - When the engine stops at 200' on takeoff, you have to hope there is plenty of runway ahead of you. If you survive this, the cause is often a blocked vent; either a design problem, someone forgot to uncover it or the tank was filled to the point that fuel enters the vent system. Keep the vent going straight up or straight down if possible and in a positive pressure area. Avoid sink traps and keep it at the front of the tank so that either tail down or with fuel slosh on takeoff acceleration, the vent should remain clear. Don't bring the vent into the cockpit.

ITEM 3: FLIGHT DEMONSTRATION

3.1 **General -** With a new aircraft, you will be required to demonstrate a 6g pull-up. Be prepared to provide a g meter, preferably panel mounted. If this is impractical, mount it solidly on top of the spar or longeron with racers tape.

Make sure the meter is unlocked. Use a hand induced g force. Attempting to pull 6g on a locked g- meter in the aircraft could be disastrous. Do not attempt the test without a parachute and helmet. Do not use a low speed parachute.

3.2 **Trim**

Sometimes with a new airplane or an old one with a new wing, trim is incorrect. The aircraft will want to climb or dive and has to be held with the stick. With a new wing, this is because you have moved either the center of lift or the center of gravity.

If you have a conventional aircraft without adjustable trim on the tail, you must change the incidence of the horizontal.
o Aircraft flies nose down - move leading edge of horizontal tail down. o Aircraft trims nose up - move tail up.

A quick fix is to tape a small section of 1/4 in. dowel rod or pencil (3-4 inches long) to the trailing edge of the elevator. This works as a neat and very effective trim tab that can be lengthened or shortened for fine tuning.

Sometimes these adjustments do not work well. This is probably because the tail volume (area x tail moment arm with respect to the wing) is insufficient. Add area to the tail and consider a tail with a similar aspect ratio to your wing and also with a proper section (i.e. not a flat plate!). This problem often occurs when you put a long taper wing on a Cassutt so increase the tail span at the same time.

Do not use sharp leading edges on the tail surfaces. At low incidences they buffet (flutter) due to unstable flow. Similarly sharp wing leading edges will produce a vicious stall.

3.3 New/Modified Aircraft Flight Test

Checks required for new aircraft are defined in the Technical Rules (12). Based on these requirements, checks for modified aircraft are at the sole discretion of the on-site Technical Director or his designate.

3.3.1 Check that the aircraft is designed to at least 9g. A proof load test of the wing structure on the ground to at least 7G, under the supervision of a qualified structural engineer is **strongly advised.** Obtain a high speed parachute and G meter. Check CG is within limits at gross weight; if not modify the plane.

3.3.2 Install the G meter per 3.1 of this Design Guide.

3.3.3 Select a test pilot. This is a demanding and potentially dangerous flight if the aircraft is not designed and built correctly. Flight test experience really helps.
Potential problems: Structural failure - control system, tail flutter, aileron flutter, wing. Loss of control - low torsional stiffness, accelerated stall, aft CG, yaw coupling, spin.

3.3.4 Test fit the pilot with a parachute and helmet in the aircraft - can he function well with the canopy closed? If not, find a new pilot - **do not fly without a chute.** Recheck center of gravity. Caution, new pilot and/or chute may move CG behind aft limit.

3.3.5 Conduct the test flight **PRIOR** to arriving at the race site in the privacy of your own airport if possible; this is much less stressful to all of us. In addition to F1 requirements, static and dynamic stability checks in 3 axes, max level speed, stalls, accelerated stalls, and wind-up turns should be successfully completed. Conduct initial flights at 10,000 ft. AGL. The actual approval flight will then be much easier and safer if you have tried everything beforehand.

3.3.6 At the race site, consult Technical Director and obtain agreement on what must be done and when, make sure inspectors are there ready to watch you.

3.3.7 Have a technical inspector come to your aircraft and observe that a G meter is set to zero and be sure that it is unlocked.

3.4 Typical Flight Card

- Check parachute, helmet, gloves, and harness

CAUTION: These tests can be hazardous and are taken at your own risk. In the event of loss of control and recovery is not immediate, jettison canopy, and bail out. If recovery is successful, return for investigation - do not continue flight.

3.4.1 TURNS AND ROLLS

3.4.1.1 Climb to a safe altitude, a minimum of 5000" AGL, position aircraft over field % mile from observers.
3.4.1.2 Accelerate to full speed in level flight, complete three 180 level turns with at least 60 deg. bank.
3.4.1.3 Aileron roll left, followed by aileron roll right.

3.4.2 DIVE FOR FLUTTER

CAUTION: In event of unusual vibration/noise, immediately reduce power gradually, pull up smoothly to reduce speed. Prepare to jettison canopy and bail out. If recovery is successful, return immediately for investigation.

3.4.2.1 Climb to a safe altitude, a minimum of 5500' AGL, position airplane over field, % mile from observers.
3.4.2.2 Shallow dive to 1.1 Vh (110% of max level speed)

3.4.3 6g TEST

CAUTION: Do not exceed dive speed previously cleared. The goal is to pull g while the aircraft is heading upwards not at the bottom of a dive. In the event of structural failure, prepare to bail out just as the aircraft just starts to fall.

3.4.3.1 Climb to a safe altitude, a minimum of 5500' AGL, position airplane over field, % mile from observers.
3.4.3.2 Accelerate the aircraft in a shallow dive to obtain the desired airspeed. Level out and set up a climbing windup turn with a bank angle of 80, 90 deg. or more. Begin applying load with a smooth and steady aft stick deflection to achieve a precise 6g on the meter; pull less than was tested on the ground. Several build up test flights are recommended prior to the F1 qualification demonstration.
3.4.3.3 If 6g is not achieved, check that G meter is free and repeat with a harder pull. Maintain altitude. If after 3 attempts, 6g is still not indicated, return for consultation.

3.4.4 LAPS

3.4.4.1 Gently move down onto the course, clearing for other aircraft, and complete four racing laps.

ITEM 4: SAFETY EQUIPMENT

4.1 **Clothing** - Fire retardant clothing and gloves are required by F1 and Reno rules. Formula aircraft have caught fire in the air and a fire resistant flight suit, boots and gloves could give you the seconds you need to get the airplane on the ground. In addition a smart driving suit adds immeasurably to the professional image we need to promote racing.

4.2 **Helmets** - Just because you see other people wearing worthless helmets does not mean that you should! Use a good full face helmet, approved for racing, and make the airplane so that you can wear it comfortably.

ITEM 5: MAINTAINABILITY

Most people worry about this with their second raceplane, because racing is often time constrained. You should design the trailer installation and aircraft assembly process such that it takes no more than two hours with three people working to unload and assemble the plane.

Flying to the race is fine until the Tech Crew needs to pull a cylinder. You will need Tech Inspection prior to flying and sometimes flying periods determined by the airshow are not very accommodating. The Tech Inspection Team will require you to drain all the fuel out and will want to look at your carburetor, cylinder and valve gear. The cylinder is chosen at random so it is useful to be able to remove any single cylinder and rocker cover without disturbing the whole baffle system.

You may have to turn the airplane between back-to-back races, so refueling and oil checks need to be accomplished quickly, rather than having to remove the whole engine cowl and half the upper fuselage. The ability to taxi unaided is also useful.

ACKNOWLEDGMENTS

My thanks to the several people who helped with the technical parts of this Guide, especially: George A. Owl, Jr., Ken Stockbarger, and Fred Griffith. The Flight section of this guide was contributed by world-class test pilots Deke Slayton, Hoot Gibson, Bob Drew and Dave Morss. Any suggestions for changes or improvements to this guide, are more than welcome.

END OF RULES DOCUMENT

Air Race CC Ltd Contact: info@airrace1.com