INTERNATIONAL 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 IF1 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 IF1 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 IF1 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 IF1 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.

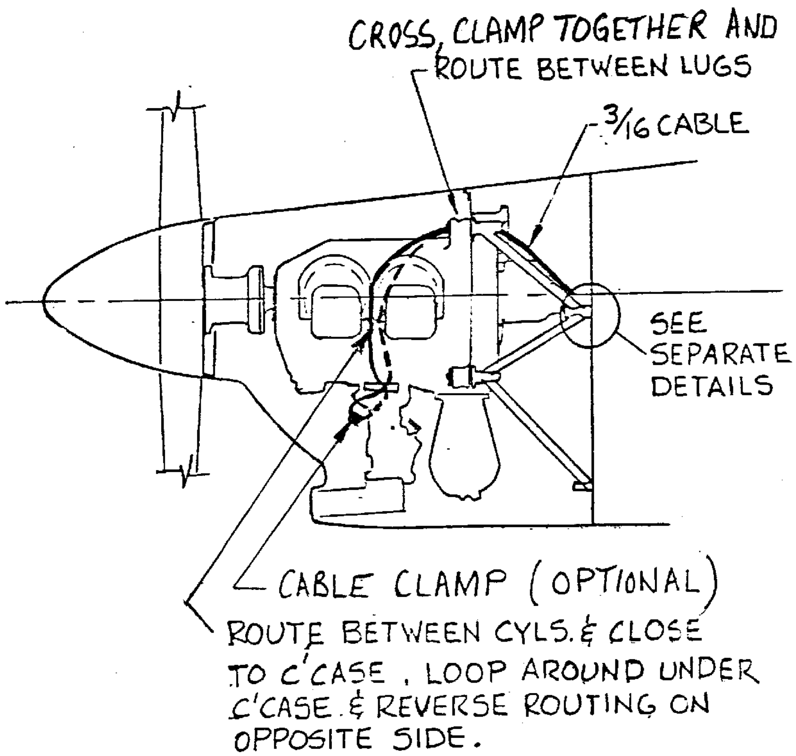
1.3 **Fail-Safe Installation**
Provide clamps to prevent the engine from sliding off the cable if the airframe attachment fails on one side. Provide a clamp where the cables cross above the engine and/or clamps on the loop at the spider. An alternate approach is to use two separate cables (see Figure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

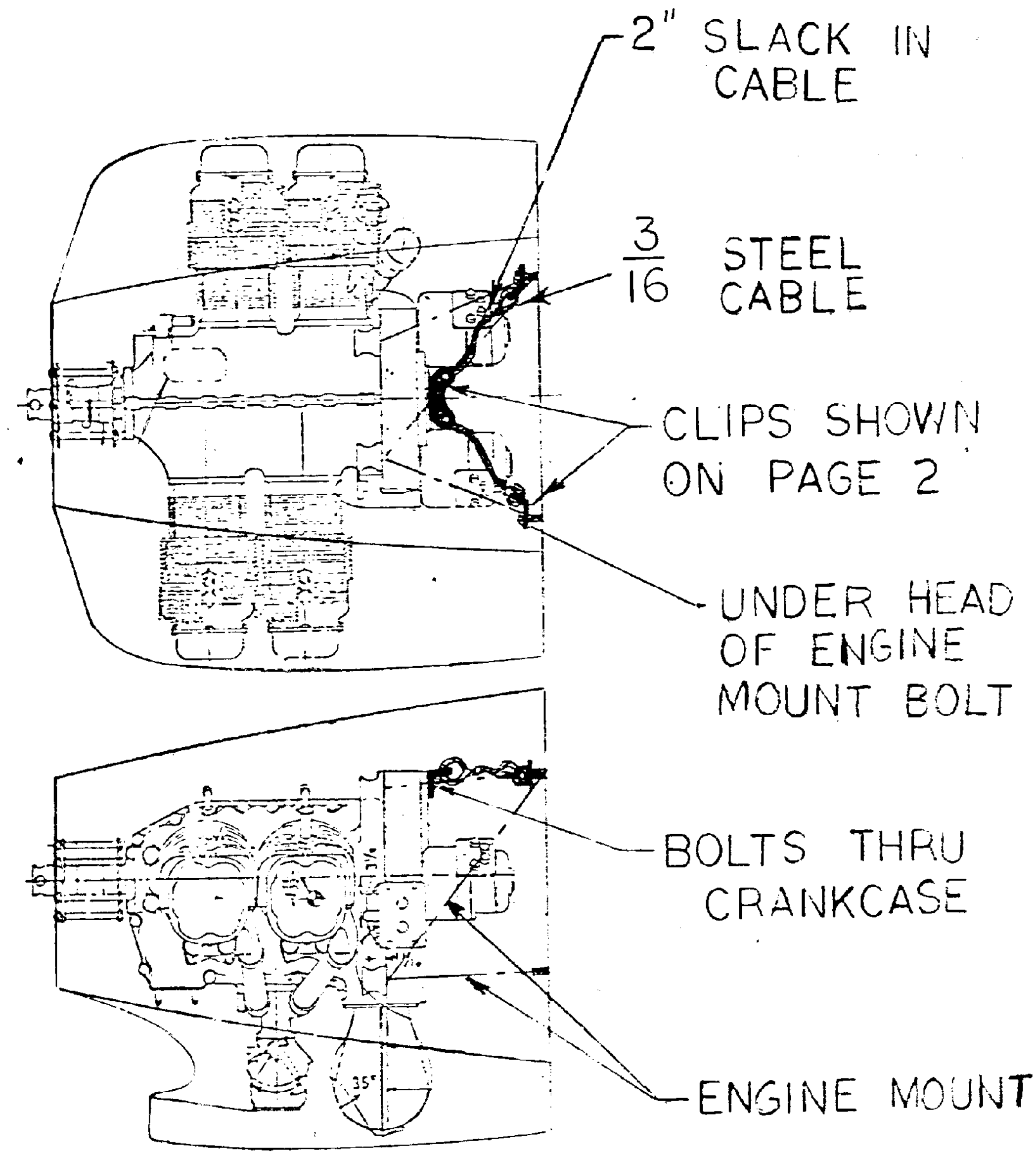
SUGGESTED SAFETY CABLE ROUTING



NOTE:

ADDED CABLE LENGTH FOR LOOP UNDER CASE IS BENEFICIAL IN PROVIDING MORE CABLE STRETCH TO REDUCE SHOCK LOADS. ROUTE BETWEEN SPIDER ATTACH LUGS AND LOOP AROUND.

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
35°

FIGURE 2

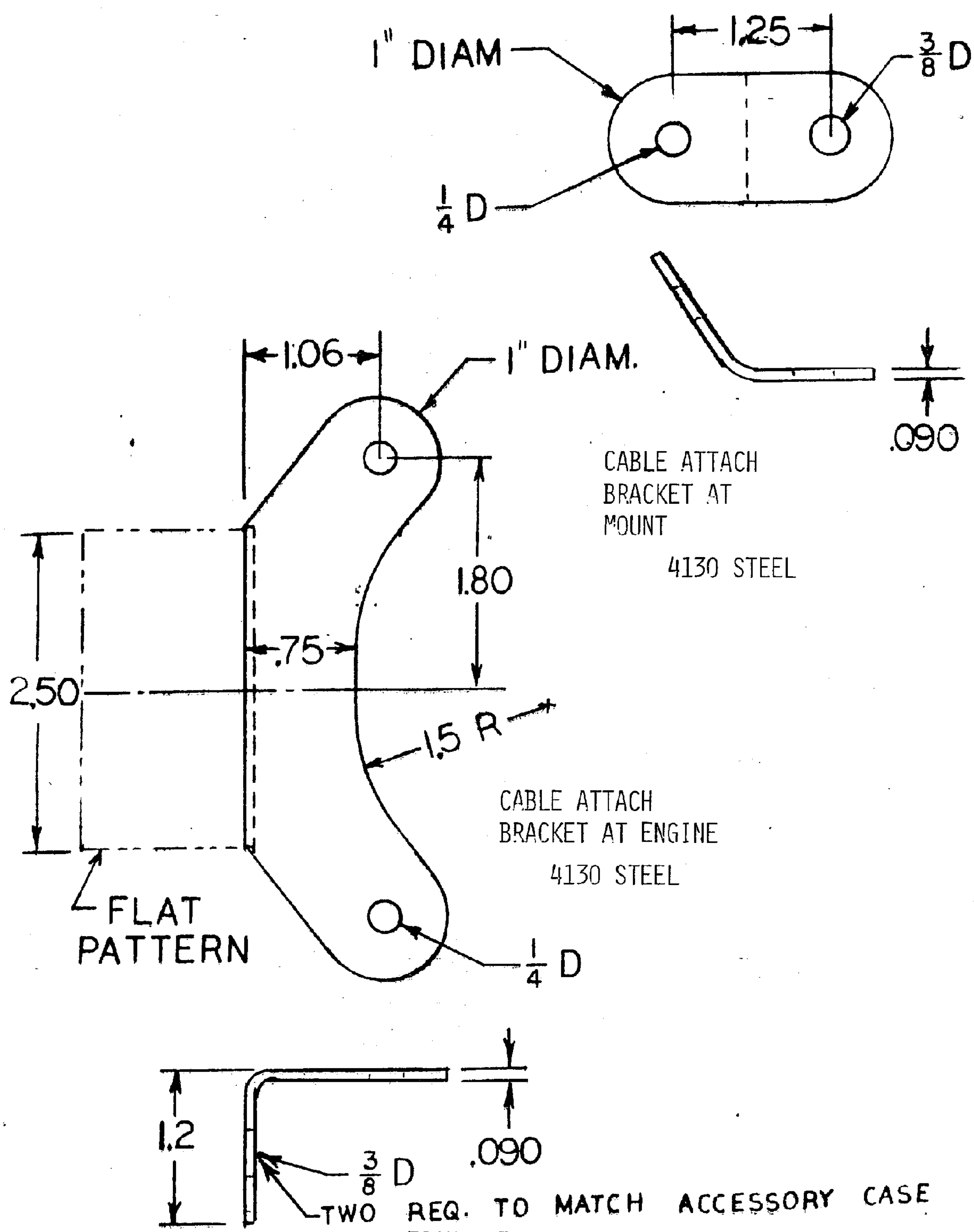
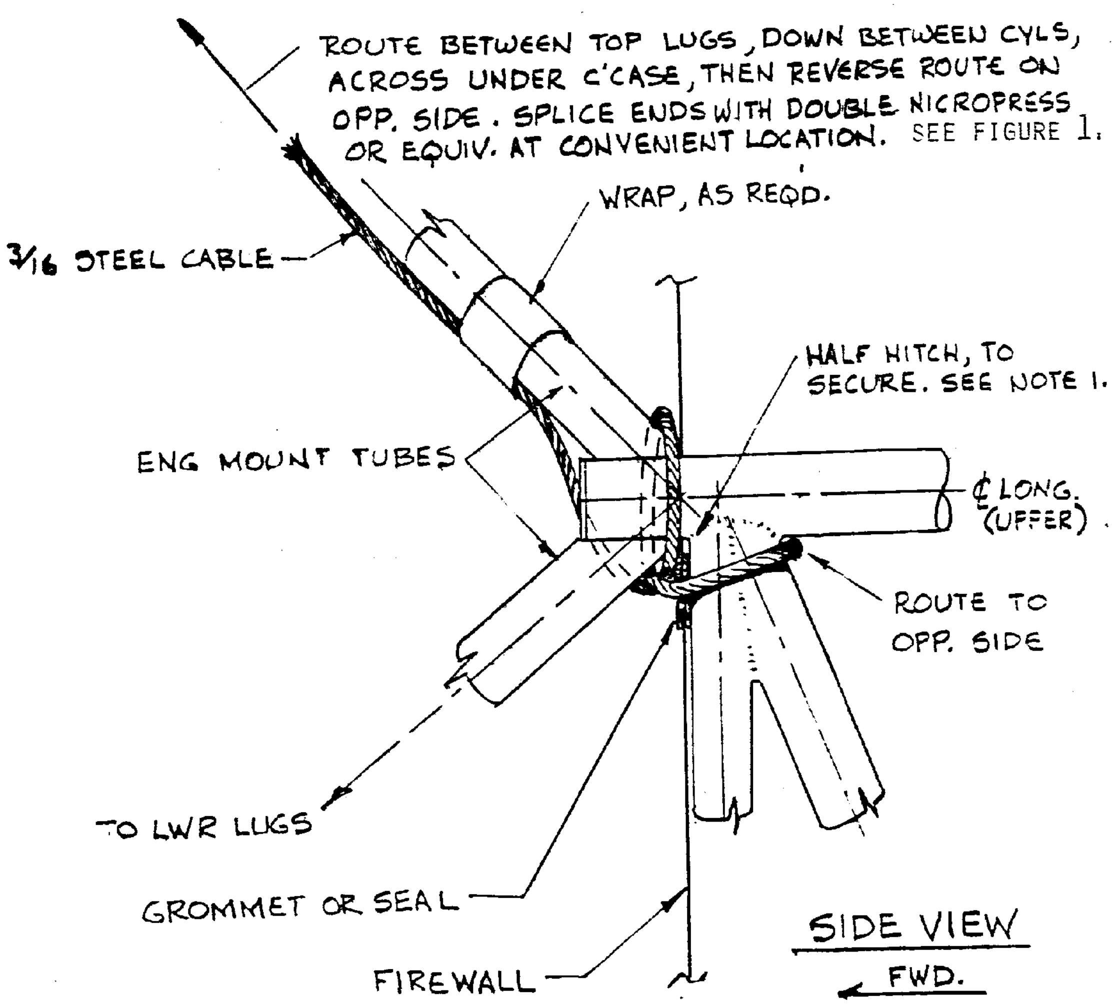

1" DIAM
1.25
3/8 D
1/4 D
1.06
1" DIAM.
.090
CABLE ATTACH
BRACKET AT
MOUNT
4130 STEEL
1.80
2.50
.75
1.5 R
CABLE ATTACH
BRACKET AT ENGINE
4130 STEEL
FLAT
PATTERN
1/4 D
1.2
.090
3/8 D
TWO REQ. TO MATCH ACCESSORY CASE

FIGURE 3

TYPICAL SAFETY CABLE INSTAL.

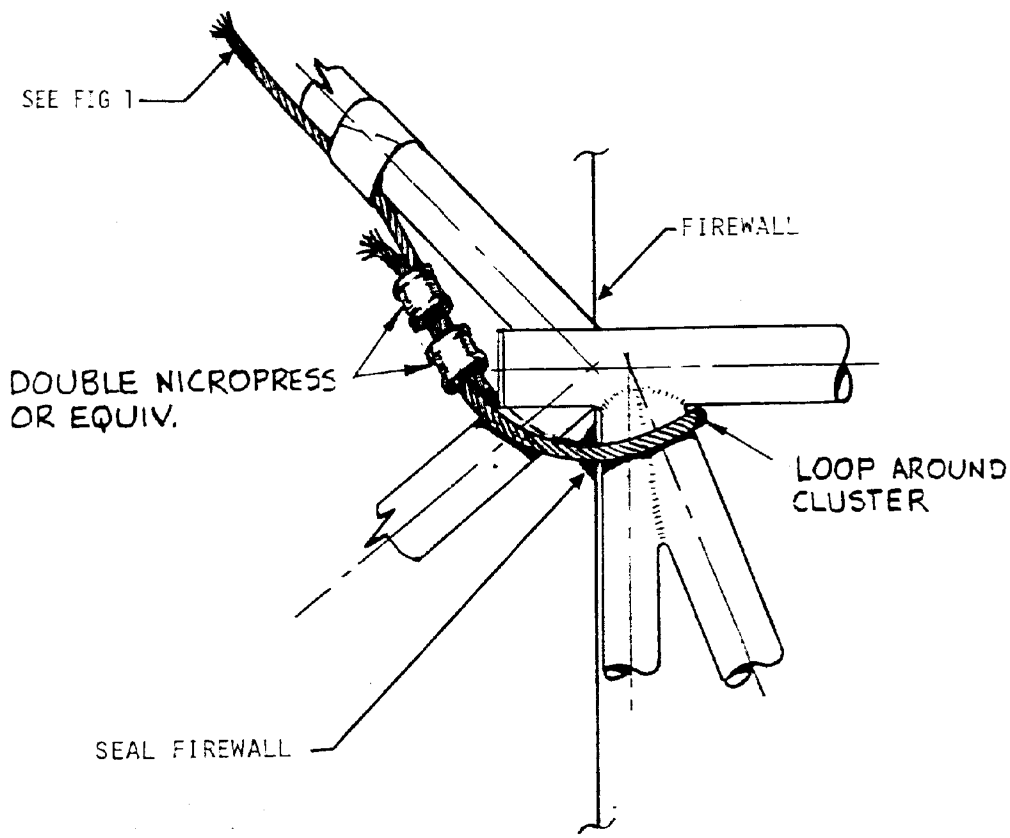


NOTES:

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.

FIGURE 4

TYPICAL SAFETY CABLE INSTALLATION.



NOTE:

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

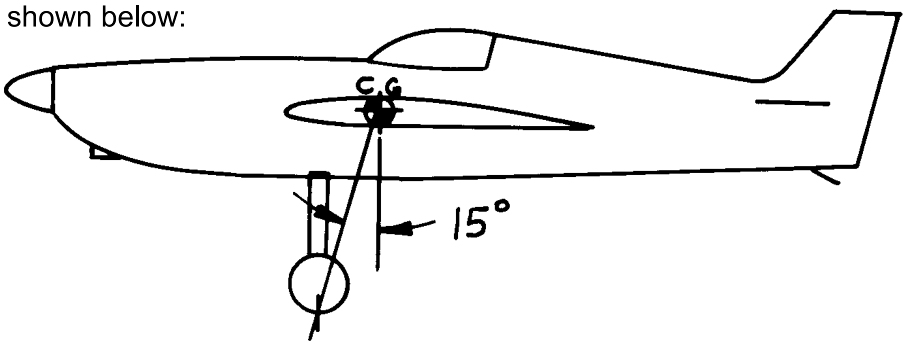
FIGURE 5

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.

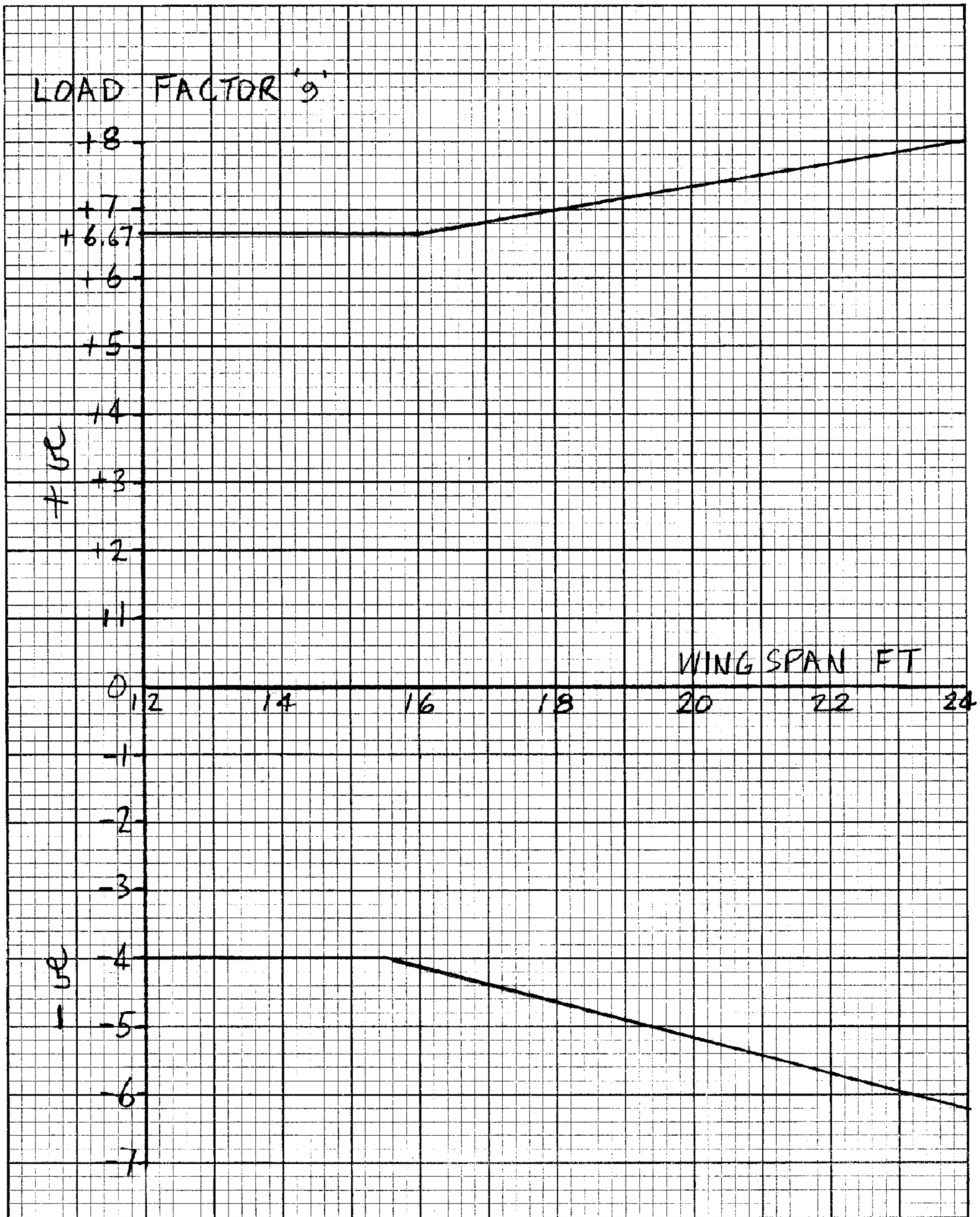
2.4.1 The design limit load factor should be not less than illustrated on Figure 6.

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.



RECCOMENDED MINIMUM DESIGN LIMIT LOAD FACTOR FOR IF1 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.

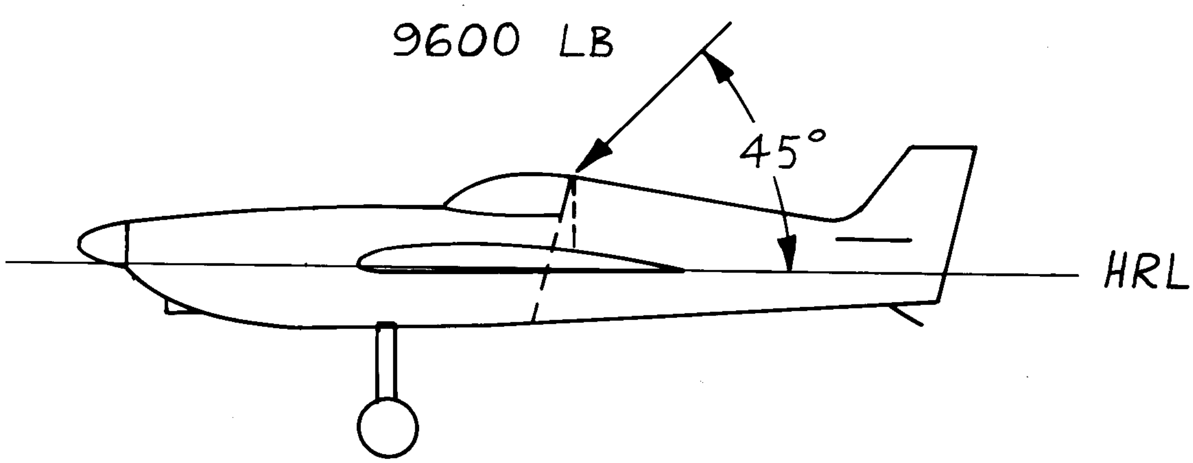
2.4.3 The horizontal and vertical tails and supporting structure should be designed to withstand a limit load resulting from an average normal force coefficient of +1.2 and a dynamic pressure corresponding to the predicted TIAS which will produce an accelerated stall at the aircraft design limit load 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.

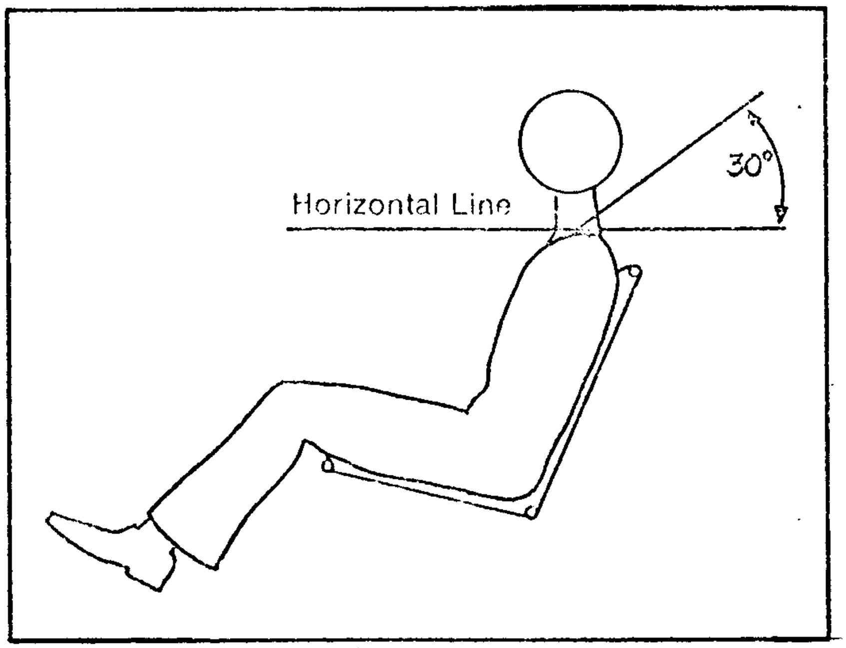
2.5 **Turn Over Structure** - It is recommended that structure behind the pilot's head be designed to support at least a 12g or 9,600 load applied down and forward at 45 Deg.



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.
2. Do not attach composite props to spinners.
3. Make sure the spinner is properly aligned.
4. 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.
5. 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.
6. 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.
10. When starting engine, hold propeller halfway between spinner and tip. (A little harder to do but well worth preventing damage to propeller.)
11. Inspect and re-torque your propeller, especially a new prop and always after the first flight.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.
18. A high visibility, padded propeller cover is suggested to protect your propeller from damage between flights.
19. 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.
20. 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 TIP MACH NO.

AT 240 mph ≡ 352 FT/SEC

Bill Rogers 9-9-77

PROP DIA IN	TEMP °F	3700 RPM STATIC	3700 F/S TOTAL	3700 MACH	3800 RPM STATIC	3800 F/S TOTAL	3800 MACH	3900 RPM STATIC	3900 F/S TOTAL	3900 MACH	4000 RPM STATIC	4000 F/S TOTAL	4000 MACH
58	60	936.4	996.7	.892	961.7	1023	.915	987	1047	.937	1012	1071	.958
	70			.883			.907			.928			.949
	80			.875			.898			.919			.940
	90			.867			.890			.911			.932
	100			.859			.881			.902			.923
56	60	904.0	969.4	.867	928.5	992.3	.888	952.2	1015	.909	977.3	1038	.929
	70			.859			.880			.900			.920
	80			.851			.871			.891			.911
	90			.844			.863			.883			.903
	100			.836			.855			.875			.895
54	60	871.8	939.4	.841	895.3	961.3	.861	918.9	983.3	.880	942.4	1005	.900
	70			.832			.852			.872			.891
	80			.825			.844			.863			.882
	90			.817			.837			.855			.875
	100			.810			.829			.848			.866
52	60	839.7	909.5	.814	862.2	930.5	.833	884.9	951.6	.852	907.6	972.7	.871
	70			.806			.825			.844			.862
	80			.798			.817			.835			.853
	90			.791			.810			.828			.846
	100			.784			.802			.820			.839

PROP DIA IN	TEMP °F	4100 RPM STATIC	4100 F/S TOTAL	4100 MACH	4200 RPM STATIC	4200 F/S TOTAL	4200 MACH	4300 RPM STATIC	4300 F/S TOTAL	4300 MACH
58	60	1037	1094	.979	1063	1119	1.002	1088	1143	1.023
	70			.970			.992			1.013
	80			.960			.982			1.003
	90			.952			.974			.995
	100			.943			.965			.985
56	60	1002	1061	.950	1026	1084	.970	1051	1108	.992
	70			.941			.961			.982
	80			.931			.952			.972
	90			.923			.943			.964
	100			.915			.934			.955
54	60	966.0	1027	.919	989.6	1050	.940	1013	1072	.960
	70			.910			.931			.950
	80			.902			.922			.941
	90			.894			.914			.933
	100			.885			.905			.924
52	60	930.2	993.9	.890	952.9	1015	.909	975.6	1036	.927 LIMIT
	70			.881			.900			.918
	80			.872			.891			.910
	90			.865			.883			.902
	100			.857			.875			.893

	@ 60°F	70°F	80°F	90°F	100°F	
MACH 1	1117	1128	1139	1149	1160	F/S

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 IF1 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**

o 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 ½ 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, ½ 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, ½ 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 IF1 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 IF1 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.

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