

**DRAFT II**  
**ASRA INC. AIRWORTHINESS REQUIREMENTS FOR**  
**APPROVED GYROGLIDER**

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**ABBREVIATIONS AND DEFINITIONS**

Primary structure:	Those parts of the structure the failure of which would endanger the gyroglider.
Cockpit:	The position from which the pilot controls the gyroglider, whether it is enclosed or not.
FAS	Equivalent air speed
IAS	Indicated air speed
VD	The Maximum Design Speed, EAS
VDF	The Maximum Demonstrated Flight Speed, EAS
VNE	The Never Exceed Speed, IAS
VMIN	Minimum Level Flight Speed, IAS

An acceptable "History of safe operation" is defined as a minimum of 5 units (identical in all significant respects to the unit being proposed) with over 100hrs service, one of which must have over 500hrs service, all without failure of the particular unit being tested.

**Note:** A "one off" can never fulfil this standard, regardless of hours flown.

## **Subpart A**

### **GENERAL**

#### **A1 Purpose**

The Australian Sport Rotorcraft Association Inc. Airworthiness Requirements comprise the minimum requirements for the issue of an airworthiness certificate for an Approved Gyroglider.

Gyrogliders, which conform to the airworthiness requirements, are restricted in the use of airspace as defined in the Association's Operations Manual.

Only Gyrogliders, which have been shown to comply with these requirements, will be eligible for a Type Acceptance Certificate.

#### **A2 Applicability**

For the purpose of these airworthiness requirements, such Gyroplanes are referred to as Gyrogliders.

- (a) These requirements shall be applicable to gyrogliders having:
  - (i) Not more than two occupants; and
  - (ii) A maximum take-off weight not exceeding 350kg.
- (b) A gyroglider is defined as a non self-powered rotorcraft with rotor blades that are not engine driven in flight, and is supported in flight by the reaction of the air on one of more rotors which rotate freely on substantially vertical axes, when the aircraft is in normal level flight.
- (c) These requirements apply to gyrogliders of orthodox design. Aircraft having the following basic features will be so regarded:
  - (i) Non-power driven rotors of either fixed pitch or pitch control that is not adjustable in flight;
  - (ii) Dual seating and dual controls.
- (d) Where these requirements are inappropriate to particular design and construction features it will be necessary to reconsider the validity of the requirements for each particular case, and the Association must be consulted as to the applicable requirements.

Where it can be shown that a particular feature is similar in all significant respects to one which is part of a previously accepted design, and can be considered a separate entity in terms of its operation, the Association will take this into account when assessing the acceptability of the feature, and it may then not be necessary to test or otherwise substantiate to the level set out in the appropriate requirement.

#### **A3 Permitted Operations.**

These requirements apply to gyrogliders designed for non-aerobatic operation, including any manoeuvre necessary for normal gyroglider flight training.

#### **A4 Responsibilities**

It is entirely the responsibility of the Instructor to ensure the suitability and reliability of the tow car and of the qualifications of the tow car driver and observer, and the Instructor is responsible for the overall conduct of the Glider training operations.

## Subpart B

### FLIGHT

#### B1 Proof of Compliance

- (a) Each requirement of this subpart must be met by test upon the Gyroglider, or a Gyroglider of the type for which a Type Acceptance Certificate is requested, at the most adverse combination of weight and balance within the range of loading conditions within which the gyroglider will be operated.

**Note:**

- (a) Flight tests may also be required to show compliance with other subparts of these requirements.
- (b) At an early stage the accuracy of the airspeed indicator should be determined.

#### B2 Flight Endurance Test

- (a) The applicant shall conduct a comprehensive flight test on a gyroglider of the type for which an Acceptance Certificate is sought. The gyroglider must not experience any significant problems or failures during the test. This test must be to a flight schedule which is representative of operational use. If any problems or failures occur extra flying may be necessary to ensure that the proposed solution had been tested without recurrence of the problem.
- (b) For new designs of rotor system the applicant shall conduct an endurance test on a suitable test vehicle, to a rigid test schedule representative of operational use.
- (c) It shall be confirmed by flight tests that the proposed tow car and rotor system operating limitations are compatible with the satisfactory functioning of the gyroglider over the proposed range of operating conditions and flight envelope. The applicant must ensure that the tow car is compatible with the gyroglider, functions in a satisfactory manner and can be operated safely.
- (d) The towrope must have a minimum safety factor of 3 with respect to the maximum drag likely to be encountered during gliding operations at maximum all up weight. The towrope must not be made from materials with "elastic" properties.

**Note:** Evidence of safe and satisfactory operation of the tow car and gyroglider combination without significant problems is an acceptable means of demonstrating compliance. Note that if any significant changes are made, additional flying may be necessary to ensure that evidence exists of safe operation.

#### B3 Load Distribution Limits

- (b) The applicant must select the range of weight and balance within which the gyroglider is to be safely operated.
- (c) The selected range must be within the range of that which corresponds to the minimum placarded weight for a pilot alone (plus ballast if required) up to the maximum placarded weight. The maximum placarded weight must include pilot and passenger. The weight of pilot and passenger must be considered to be not less than 90kg per person.
- (d) The horizontal centre of gravity is normally determined by a balance or hang test and the normally accepted range is between 9 and 12 degrees nose down, measured on the horizontal datum line (normally the keel).

#### B4 Weight Limits

Maximum weight - The maximum weight must be established so that it is:

- (a) Not more than: The design maximum weight, which is the highest weight at which compliance with each applicable structural loading condition and each applicable flight requirement is shown.
- (b) Not less than the weight which results from the empty weight of the gyroglider, plus a weight of occupant/s, plus the required minimum equipment.

## **B5 Empty weight.**

- (a) The empty weight must be determined by weighing the gyroglider (with fixed ballast if required); and excluding weight of occupant(s).
- (b) The condition of the gyroglider at the time of determining empty weight must be one that is well defined and easily repeated.

## **B6 Removable Ballast**

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

## **B7 Rotor Speed Limits**

At the critical combinations of weight, altitude and airspeed the rotor speed must remain within the established safe range that would permit any expected manoeuvre to be performed safely. The "established safe range" must be determined by: -

- (a) the rotor blade manufacturer or,
- (b) acceptable "history of safe operation".

Compliance may also be shown by use of acceptable aircraft manufacturing practices and by correct use of materials of known design strength and fatigue properties.

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## **Subpart C**

### **PERFORMANCE**

#### **C1 General**

The performance prescribed in this Subpart must be determined –

- (a) With normal piloting skill under average conditions;
- (b) For still air at sea-level in the standard atmosphere;
- (c) At the most critical weight;
- (d) With the most unfavourable centre of gravity for each condition.

#### **C2 Take-off and Climb**

The tow car must have sufficient performance to enable the Gyroglider to take off and climb safely at a rate that would be equivalent to a climb rate of 250ff/min., without the tow car losing any speed.

#### **C 3 Glide**

An angle of descent and the associated airspeed must be determined at the maximum all up weight such that the correct glide angle can be maintained in the event of tow line failure.

#### **C4 Minimum Speed for Level Flight**

The minimum air speed for level flight must be determined.

#### **C 5 Landing Distance**

The distance required to land and come to rest from the normal training speed, with zero wind and normal tow car operation, must be determined

#### **C 6 Height-Speed Envelope**

The combinations of height and forward speed, from which a safe landing cannot be made following towline breakage, must be established as a limiting height-speed envelope (graph).

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## Subpart D

### CONTROLLABILITY AND MANOEUVRABILITY

#### D1 General

- (a) The Gyroglider must be able to maintain any required flight condition and make a smooth transition from one flight condition to another (including turns) without exceptional piloting skill, alertness or strength, and without danger of exceeding the limit manoeuvring load factor, under any operating condition probable for the type including the effect of power changes (and sudden tow line failure). Normal variations in pilot techniques must not cause unsafe flight conditions.
- (b) Any unusual flying characteristics observed during the flight tests required to determine compliance with the flight requirements must be investigated.
  - i. The controls must not exhibit excessive breakout force, friction or free play.
  - ii. There must be no overbalance of the pitching and rolling controls.
- (c) A technique must be established, and demonstrated, for landing the gyroglider at maximum all up weight, with no assistance from the tow car, without hazard to the occupants.
- (d) The gyroglider shall not exhibit any tendency to enter a pitch oscillation at any airspeed, at the critical weight and centre of gravity, during any manoeuvre appropriate for the type.

#### D2 Longitudinal Lateral and Directional Control

In no case may the control forces exceed those prescribed in the following table.

A maximum wind speed, maximum cross wind and maximum tail-wind must be established in which the gyroglider can be operated without loss of control near the ground in any manoeuvre appropriate to the type (such as cross wind take-offs and landings), with:

- i. Critical weight; and
- ii. Critical centre of gravity.

These wind velocities must be specified in the Gyroglider Flight Manual.

#### D3 Pitch Control Force in Manoeuvres

The pitch control forces during turns or when recovering from manoeuvres must be such that at constant speed an increase in load factor is associated with an increase in control force.

	<b>Pitch</b>	<b>Roll</b>	<b>Yaw</b>
(a) Temporary application	150N (34 lbs. force)	90N (20 lbs. force)	670N (150 lbs. force)
(b) Prolonged application	45N (10 lbs. force)	45N (10 lbs. force)	220N (50 lbs. force)

## Subpart E STABILITY

#### E1 General

- (a) The gyroglider must be able to be flown without undue piloting skill, alertness or strength in any normal manoeuvre for a period of time as long as that expected in normal operation.
- (b) There must be no tendency for the gyroglider to rapidly increase the turn rate, stick fixed, during a turn with normal accelerations of up to 1.5g at any allowable air speed.

#### E2 Longitudinal, Lateral and Directional Stability

The longitudinal, directional and lateral stability should be sufficient to prevent dangerous flight conditions following abrupt control displacements, at any attitude or airspeed likely to be encountered during training operations.

### **E 3 Dynamic Stability**

Any short-period oscillations occurring under any permissible flight condition must be heavily damped with the primary controls fixed or free.

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#### **Subpart F**

### **GROUND HANDLING CHARACTERISTICS**

#### **F1 Directional Stability and Control**

The gyroglider must have satisfactory ground handling characteristics, including freedom from uncontrolled tendencies in any condition expected in operation, particularly in all take-off conditions. It is recommended that nose wheel steering be linked to both sets of rudder pedals and should operate in the "correct sense" (i.e. push right to go right)

#### **F2 Taxiing Condition**

- (a) The gyroglider must be safely controllable and manoeuvrable when it is towed over the roughest ground that may reasonably be expected in normal operation.
- (b) The ground speeds up to which it is safe to taxi, take-off and touch down must be determined.

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#### **Subpart G**

### **STRUCTURE**

#### **G1 Loads**

- (a) Strength requirements are stated as limit loads (the maximum load to be expected in service) and ultimate loads (limit loads multiplied by factors of safety). Unless told otherwise, loads stated are limit loads.
- (b) Unless stated otherwise, the inertia loads resulting from each major item of mass in the Gyroglider must balance with the flight and ground loads. (i.e. ground or flight disturbances should not cause unsafe conditions due to out of balance inertia loads).

#### **G 2 Factor of Safety**

Unless otherwise provided, a factor of safety of 1.5 must be used.

#### **G 3 Strength and Deformation**

- (a) The structure and control systems must be able to support limit loads without permanent deformation. At any load up to limit loads, the deformation must not interfere with safe operation.
- (b) The structure must be able to support ultimate loads without failure for at least three seconds. When proof of strength is shown by dynamic tests simulating actual load conditions, the three-second limit does not apply.

#### **G 4 Limit Manoeuvring Load Factors**

The gyroglider's rotor must be designed for positive limit manoeuvring load factor of 3.5, at all forward speeds from zero to the Maximum Design Speed VD. A "history of safe operations" would be an acceptable method to show compliance with this subpart.

The rest of the gyroglider must be designed for positive and negative limit manoeuvring load factors of +3.5 and -0.5 respectively, at all forward speeds from zero to the Maximum Design Speed VD.

Compliance may be shown by use of acceptable aircraft manufacturing practices and by correct use of materials

of known design strength and fatigue properties.

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## **Subpart H**

### **CONTROL SURFACES AND SYSTEM LOADS**

#### **H1 Primary Control System**

- (a) The part of each control system from the pilot's controls to the control stops must be designed to withstand pilot forces of not less than the forces specified in H 2
- (b) The part of each control system from the control stops to the attachment to the rotor hub (or control areas) must be designed to at least:
  - (i) Withstand the maximum pilot forces obtainable in normal operation; and
  - (ii) If operational loads may be exceeded through jamming, ground gusts, control inertia, or friction, support without yielding, 1.6 times the limit pilot forces specified in H 2

#### **H2 Limit Pilot Forces**

For primary flight controls. The limit pilot forces are as follows:

- (a) For foot controls, 580N (130 pounds force); and
- (b) For stick controls, 445N (100 pounds force) fore and aft, and 300N (67 pounds force) laterally.

#### **H3 Dual Control Systems**

Dual control systems must be designed to withstand the loads that result when each pilot applies 0.75 times the load specified in H 2, with:

- (a) The pilots acting together in the same direction; and
- (b) The pilots are acting in opposition.

#### **H4 Secondary Control Systems**

Secondary control systems such as those for brakes, trim controls etc., must be designed for supporting the maximum forces that a pilot is likely to apply to those controls.

#### **H 5 Control Surface Loads**

- (a) Each stabilizing and control surface, (e.g. Rudder, fin and horizontal stabiliser) and its supporting structure, must be designed so that limit loads are not less than 720N (160 lbs. force) per square metre (evenly distributed over the control surface).

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**Subpart I**  
**GROUND LOADS**

**I1 Landing Gear - Shock Absorption**

It shall be determined that the landing gear is capable of absorbing the energy which would result from the Gyroglider being dropped at its maximum permitted take off weight from a height of 220mm (8 inches). This should simulate a drop contact velocity equal to the greatest probable sinking speed likely to occur at ground contact in less than perfect landings.

**Subpart J**

**MAIN COMPONENT REQUIREMENTS**

**J I Rotor Structure**

- (a) The rotor structure must be designed to withstand the critical flight loads prescribed in G 4.
- (b) The rotor structure must be designed to withstand loads simulating, for the rotor blades and hub bar, the impact force of each blade against its teetering stops during ground operation.
- (c) The rotors and rotor head structure must be designed to withstand the maximum limit torque likely to be transmitted by any rotor spin-up device or rotor brake at all speeds from zero to maximum at which the device is designed to be engaged. This limit torque must be distributed to the rotor blades in a rational manner.

**J 2 Fuselage, Landing Gear and Rotor Pylon Structures**

- (a) Each fuselage, landing gear and mast structure must be designed as prescribed in this section. Resultant rotor forces may be represented as a single force applied at the rotor hub bar attachment point (teeter bolt).
- (b) Each structure must be designed to withstand:
  - (i) The critical loads prescribed in Subpart K.
  - (ii) The applicable ground loads prescribed in Subpart I.
  - (iii) The loads prescribed in Subpart J.

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**Subpart K**

**EMERGENCY LANDING CONDITIONS**

**K 1 General**

The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a crash landing, when proper use is made of belts and harnesses provided for in the design, in the following conditions:

Each occupant experiences ultimate inertial forces corresponding to the following load factors:

<b>Direction</b>	<b>Load Factor</b>
Upward	4.5
Forward	9.0
Sideward	3.0
Downward	4.5

These forces are independent of each other and are relative to the surrounding structure.

The supporting structure must be designed to restrain each item of mass (including ballast if used) that could injure an occupant if it came loose in a minor crash landing.

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## **Subpart L**

### **DESIGN AND CONSTRUCTION**

#### **L1 Fatigue Strength**

The detail design of the blade and hub bar of the gyroglider should be such that as far as reasonably practicable features that cause high stresses are avoided, especially if it cannot be shown that features of a similar design have accumulated considerable satisfactory service experience in a similar application.

With the exception of the rotor head, bolts or threaded parts shall not be used in the construction of the rotor hub or blades in any application where they are subject to an alternating tensile stress, (unless it can be shown that parts of a similar design specification and use have a "history of safe operation").

The rotor head shall have an ultimate reserve factor in excess of 10.

Materials known to have poor crack propagation properties shall not be used in any part of the primary structure.

All parts of the primary structure shall be easily accessible for inspection.

Paints or coatings shall not be used on the external surfaces of the critical parts of the primary structure if they are flexible enough to inhibit crack inspection.

#### **L2 Locking of Connections**

An acceptable means of locking must be provided on all connecting elements in the primary structure and in control and other mechanical systems which are essential to safe operation of the gyroglider. In particular self-locking nuts must not be used on any bolt subject to rotation in operation, unless a non-friction locking device is used in addition to the self-locking device.

#### **L3 Inspection**

Means must be provided to allow inspection (including inspection of principal static and rotating structural elements and control systems), close examination, repair and replacement of each part requiring periodic inspection, maintenance, adjustments for proper alignment and function, lubrication or servicing.

#### **L4 Provisions for Rigging and De-rigging**

The design must be such that where any rigging and de-rigging may be expected to be carried out on a routine basis, the probability of damage or incorrect assembly is minimized. It must be possible to inspect the gyroglider easily for correct assembly.

When using only two hinges at each control surface, the safety factor for these hinges and the attached parts of the primary structure must be multiplied by a factor of 1.5.

#### **L5 Cable Factor**

An ultimate factor of safety of 2.0 on nominal cable strength must be applied to cables used for structural applications and for all primary control systems.

#### **L6 Flutter Prevention and Structural Stiffness**

Each major part of the gyroglider must be free from flutter and resonance under any appropriate speed, and this must be demonstrated by flight tests at speeds up to VDF.

## Subpart M

### CONTROL SURFACES AND ROTORS

#### M 1 Drainage

For each rotor blade:

- (a) There must be a means for venting the internal pressure of the blade,
  - (ii) Drainage holes must be provided for the blade, and
  - (iii) The blade must be designed to prevent water from becoming trapped in it.
- (b) Sub-paragraphs (a)(i) and (ii) of this paragraph do not apply to sealed blades capable of withstanding the maximum pressure differentials expected in service.

#### M2 Control Surface Installations (other than rotor blades)

- (a) Movable control surfaces must be installed so that there is no interference between any surfaces or their bracing's when one surface is held in any position and the others are operated through their full angular movement.

#### M 3 Mass Balance

- (a) The span wise balance of the rotor blades must be such that excessive out-of-balance vibration is prevented.
- (b) The chord wise balance of the blades must be such that the blades can not be induced to flutter or weave in all flying conditions. The chord wise balance of each blade in a pair must be the same. The aerodynamic centre should be at or very close to the 25% chord.
- (c) The supporting structure and the attachment of rotor blade mass balance weights must have an ultimate reserve factor in excess of 10 when subjected to the combined loads resulting from:
  - (i) Accelerations of plus or minus 20 g in the flap plane of the rotor;
  - (ii) Accelerations of plus or minus 20 g in the lag plane of the rotor; and
  - (iii) The centrifugal force at the maximum rotor speed.

Compliance may be shown by "history of safe operations" (e.g. weights made to Benson plans and used on blades made to Benson plans).

#### M 4 Rotor Blade Clearance

There must be enough clearance between the rotor blades and other parts of the structure to prevent the blades from striking any part of the structure or passing through any area likely to cause injury to occupants during any operating conditions (including blade flap).

#### M 5 Rotor Head Bearings

All rotor head bearings: -

- (a) Must have specifications that ensure that they have the strength and other properties assumed by the gyroglider designer, and
- (b) Must have their suitability established by experience or tests.

## **Subpart N**

### **CONTROL SYSTEMS**

#### **N 1 General**

Each control must operate easily, smoothly and positively enough to allow proper performance of its functions. The joystick should have a minimum of 300mm fore and aft and 250mm side to side movement.

#### **N 2 Stops**

- (a) Each control system must have stops that positively limit the range of motion of the pilot's controls.
- (b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely effect the control characteristics of the gyroglider because of a change in the range of travel of the control.
- (c) Each stop must be able to withstand any loads corresponding to the design conditions for that control.
- (d) Joystick stops must be in the rotor head to avoid excessive control rod and joystick loads.

#### **N 3 Trim System**

If a trim system is fitted which is operable in flight, proper precautions must be taken to prevent inadvertent, improper, or abrupt trim operation. There must be means near the trim control to indicate to the pilot the direction of trim control movement relative to the gyroglider motion. In addition, there must be means to clearly indicate to the pilot the position of the trim device with respect to the range of adjustment.

In addition, trimmed range must be limited so that stick force cannot exceed 2.27 kg (5 lbs.) on take off or during level flight.

#### **N 4 Control System Details**

- (a) Each detail of each control system must be designed and installed to prevent jamming, chafing and interference from passengers or loose objects.
- (a) There must be means to prevent the slapping of cables, tubes, or rods against other parts.
- (d) Each element of the flight control system must have design features, or must be distinctively and permanently marked, to minimize the possibility of incorrect assembly that could result in malfunctioning of the control system.

#### **N 5 Spring Devices**

Experience or tests simulating service conditions must establish the reliability of any spring device used in the control system, unless failure of the spring will not cause unsafe flight characteristics.

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## **Subpart O**

### **EQUIPMENT**

#### **O1 Rotor Spin-up and Brake Systems**

- (b) If a rotor spin-up or brake system is installed, it must be designed to prevent: (i) It remaining engaged on take-off, and (ii) It becoming engaged in flight.
- (c) Limitations on the use of any rotor spin-up or brake systems must be specified.

#### **O2 Seats and Safety Harnesses**

- (a) Each seat and its supporting structure must be designed for an occupant weight in accordance with B 3 and for the maximum load factors corresponding to the specified flight and ground conditions including the emergency landing conditions prescribed in Subpart K.
- (b) Seats including cushions must not deform under flight loads to such an extent that the pilot is unable to reach the controls safely, or that the wrong controls are operated.

- (c) The strength of the safety harness must not be less than that following from the ultimate loads for the flight and ground load conditions and for the emergency landing conditions prescribed in Subpart K, taking into account the geometry of the harness and seat arrangement.
- (d) Each safety harness must be attached so that the wearer is safely restrained in the initial sitting position under flight and emergency landing accelerations.

### **O3 Protection from Injury**

Rigid structural members or rigidly mounted items of equipment must be padded where necessary to protect the occupant/s from injury during minor crash conditions.

- (a) **O 4                      Miscellaneous Equipment**  
There must be an effective means of communication between the Instructor and the tow car driver.
- (b) A tow line release mechanism must be fitted to the gyroglider that can be readily operated by the Instructor when buckled in the seat.

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### **Subpart P**

### **INSTRUMENTS**

#### **P 1    Flight Instruments**

Recommended flight instruments:

- (a) An air speed indicator.
- (b) A yaw indicator.

#### **P 2 Arrangement and Visibility**

Flight instruments if fitted must be plainly visible to both occupants when buckled in.

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### **Subpart Q**

### **OPERATING LIMITATIONS AND INFORMATION**

#### **Q 1 General**

The operating limitations and other information necessary for safe operation must be made available to the pilot as prescribed in R 1.

#### **Q 2 Air-speed Limitations**

- (a) All flight speed must be stated in terms of indicated airspeed (IAS).
- (b) The never-exceed speed, VNE, must not exceed 0.90 times the maximum speed demonstrated in flight tests (VDF).

#### **Q 3 Flight Manual**

A Flight manual containing all the information required for proper operation, maintenance, service and adjustments must be provided.

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## **Subpart R**

### **MARKINGS AND PLACARDS**

#### **R 1 Operating Limitations, Placards and Instrument Markings**

Limitations essential to the safe operation of the gyroglider must be plainly visible to the pilot. Where this cannot be achieved by instrument markings a placard must be provided. Where these limitations are shown by instrument markings each maximum and minimum safe operating limit must be marked by a red line.

#### **R 2 Control Markings**

- (a) Each control, other than primary flight controls, must be clearly marked as to its function and method of operation.
- (b) Towline release control must be coloured red and placarded as to method of operation.

#### **R 3 Miscellaneous Markings and Placards**

- (a) Loading: If removable ballast is used, the place for carrying ballast must have a placard stating instructions for the proper placement and securing of the removable ballast under each loading condition for which each removable ballast is necessary. The following must be placarded in each gyroglider so that they are plainly visible to the pilot: - Maximum cockpit load and cockpit load conditions for the gyroglider flown solo.
- (b) Occupant warning: For a two place gyroglider a placard showing an occupant warning must be plainly visible to both occupants when occupying the control seats, as follows:

**Neither the Authority nor the ASRA guarantee the airworthiness of the Gyroglider and the occupants operate the Gyroglider at their own risk.**

## INSTALLATION OF SHOULDER HARNESS

Figures 1, 2 and 3 show the recommended installation geometry for this type of restraint.

