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BALLISTIC RECOVERY SYSTEMS, INC.

GENERAL INSTALLATION GUIDE
FOR
BRS-6™ EMERGENCY PARACHUTE RECOVERY SYSTEMS
(Model: 600, 800, 1050, 1350, 1350HS, 1600, & 1800)

BRS Part N° 020001-03, Revision D
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This guide complies with applicable sections of ASTM F 2316, “Standard Specification for Airframe Emergency Parachutes for Light Sport Aircraft”

This guide supersedes and replaces all previous BRS Installation Guides

WARNING

Use of the BRS (ballistic recovery system) unit is for emergency situations only. Such use may subject you to mishap, injury, and even death. Since BRS cannot govern use of the unit, BRS hereby disclaims all liability.

Modification of any component part of the BRS unit, or failure to strictly follow the procedures and directions set forth in this guide or supplemental material provided by BRS, can result in deployment failure and personal injury or death to the pilot and any passengers aboard the aircraft.

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# TABLE OF CONTENTS

## Introduction

BRS SYSTEM BASICS ........................................................................................................7  
1. *The Parachute* ........................................................................................................7  
2. *The Slider* .............................................................................................................9  
3. *The Rocket Assembly* ........................................................................................10  
4. *The Activation Assembly* ....................................................................................13  
5. *The Bridles and Harnesses* ..................................................................................15

## Installation Guide

PROPER SYSTEM SELECTION ..................................................................................18  
1. *Size of System* ......................................................................................................18  
2. *Style of System* .....................................................................................................18  
   A. Canister (Sleeve Deployed) .............................................................................18  
   B. Softpack (Sleeve Deployed) ...........................................................................19  
   C. Softpack (Bag Deployed) .................................................................................20  
   D. VLS (Vert. Launch System, Sleeve Deployed) ..............................................20  
SYSTEM MOUNTING .................................................................................................21  
1. *Normal Operations* .............................................................................................21  
2. *Pilot and Passenger Safety* ................................................................................21  
3. *Weight and Balance* ..........................................................................................22  
4. *Structural* ............................................................................................................22  
5. *Direction of Fire* .................................................................................................23  
6. *Egress* ................................................................................................................25  
7. *Service and Inspection Access* ..........................................................................26  
PARACHUTE ATTACHMENT ....................................................................................27  
2. *Aircraft Structure Analysis* ...............................................................................28  
3. *Harness Design Analysis* ..................................................................................29  
   A. Aircraft Dynamics at Deployment ..................................................................30  
   B. Aircraft Descent and Touchdown Attitude ....................................................34  
   C. Propeller or Empennage Entanglement .........................................................35  
4. *Harness Routing* ................................................................................................36  
5. *Harness Styles* ....................................................................................................38  
ACTIVATION HANDLE MOUNTING .......................................................................39  
ACTIVATION HANDLE ROUTING ........................................................................40  
FINAL NOTES ............................................................................................................41  

BRS™-6 System Parameters  
Customer Loads Determination Worksheet
INTRODUCTION

Thank you for considering the new BRS-6™ Emergency Parachute System, the highest quality, most innovative product of its kind. With worldwide sales exceeding 20,000 units and over 206 saved lives to its credit, BRS has the most successful and popular systems available.

BRS™ Emergency Parachute Systems utilize a manually activated, solid propellant rocket motor to extract a round, non-steerable parachute and recover the aircraft in life-threatening emergency situations. With adequate altitude, it is designed to lower it to the ground at a survivable rate of descent. Current products are the result of more than 25 years of BRS experience in designing, testing, manufacturing, and servicing ballistically deployed parachutes for aircraft. Functional and structural reliability have been essential to their successful development.

BRS has sold units for over 300 different types of ultralight aircraft, experimental aircraft, and military unmanned aerospace vehicles (UAVs). In addition, there are FAA-certified systems currently installed on every Cirrus Design SR20 and SR22 aircraft, and select Cessna models (C150, C172, and C182) as an aftermarket STC product. The use of proven parachute and rocket motor technology has been a key factor in this endeavor. The materials, components, design methods, and production methods used in the BRS solid propellant rocket motors, parachutes, and related components have been adapted from military applications that have evolved through hundreds of projects over the past several decades. BRS maintains that our units have been tested under more conditions, in a greater selection of aircraft, and through a broader variety of potential use modes than any other emergency backup parachute system intended to recover aircraft and occupants together.

While the BRS™ Emergency Parachute System will not make your flying absolutely safe, it will provide you with additional safety, if used according to this guide and with common sense.

BRS Incorporated is a publicly held company based in South St. Paul, Minnesota. A full-time staff is available to assist you with any needs you may have relative to your purchase of a BRS unit. If you have questions of any type, feel free to contact the company using the following information:

Ballistic Recovery Systems, Incorporated
300 Airport Rd
South Saint Paul MN 55075-3551 • USA

Telephone: (651) 457-7491
(763) 226-6110 (Emergency Only)
FAX: (651) 457-8651

Email: info@BRSparachutes.com
Website: www.BRSparachutes.com

Hours: Mon-Fri, 8:00 AM to 5:00 PM CT
This document contains important information for both current and potential owners, as it gives a general overview of the most critical aspects of a parachute installation to be considered when planning the integration with your aircraft. This guide should be used in conjunction with the BRS™-6 Owner’s Manual to provide the most complete and accurate information about our systems.

Please keep in mind that this document is not tailored to any particular aircraft and was kept generic enough to cover most applications. BRS may have additional installation instructions or guides for your particular aircraft to supplement this document. These instructions will give specific direction and use illustrations or photographs of the aircraft. However, for custom orders, it is very likely that BRS will not have any supplemental instructions, since it is cost-prohibitive to develop a complete set of instructions for an order of one.

IMPORTANT NOTICE: All current owners MUST completely read this guide. As an owner of a BRS system, it is absolutely mandatory that you completely read this guide before installing or using your new unit. Failure to install, maintain, and/or use the BRS could result in personal injury or even death to you or your passengers, and damage to your aircraft.

Before purchasing a BRS product for non-certified aircraft, each customer shall understand and accept in writing the following disclaimer:

- BRS products are not designed for a specific aircraft
- BRS’s representations and warranties regarding this product, including, without limitation, the performance specifications of this product shall only apply to the extent the product is used within the scope of its formal Product Specification. BRS Product Specifications may be obtained by contacting BRS.
- Any reference by BRS to an aircraft model, including, without limitation, illustrations and installation guidance, is based on the informal accumulation of customer experiences that have been shared with BRS and are now being passed on to subsequent customers without any formal testing by BRS, without any agreement with the manufacturer of such aircraft model, and without ongoing scrutiny or formal consideration by BRS.
- The customer shall be responsible for the appropriate installation and maintenance of this product. BRS will not, in any event, be responsible for any installation or maintenance even if the customer has discussed the specific installation with BRS and received what the customer believes to be specific instructions.
- The installation of a BRS product will affect the weight and balance of the aircraft and its handling.

If you have any questions or are unsure of any portion of this guide, please call or write before proceeding in error. BRS wishes for you to fully understand the proper use of the BRS system for your safety and that of your passengers.

In addition to boldface type, important information will be highlighted with: 🧵
BRS SYSTEM BASICS

The following discussion is useful to better understand the basics of what you are about to consider installing on your aircraft. You'll come to depend on it and you'll want to understand it. This information is also repeated in the BRS™-6 Owner’s Manual.

1. **The Parachute**

Round, non-steerable parachutes are used for aircraft recovery because their purpose is simple, to slow an aircraft to a descent speed that is conducive to a safe touchdown. It is this simplicity that enhances their reliability.

Parachutes are fabricated from woven textiles in the form of fabrics, tapes, webbing, and thread. The basic structure of a round parachute (shown in Fig. 1) consists of the canopy and suspension lines. The **canopy**, which creates the aerodynamic drag, is made up of a series of fabric panels or “gores” sewn together to form its desired shape. The canopy has a **vent** at its center to allow some air to escape in a controlled manner and thus reduce oscillations and provide a stable descent. **Vent lines** are attached to the perimeter of the vent and routed symmetrically across its center to provide structural support and maintain its shape.

The **suspension lines** are attached to the “skirt” of the canopy and converge to a **riser** or set of risers at the opposite end. The canopy structural integrity is enhanced by a “skeleton” of tapes and webbings sewn nearly perpendicular to each other to the top surface of the canopy fabric. **Radial bands** run from opposite suspension line attachment points, across the top of the canopy. The **skirt band**, **vent band**, and **circumferential bands** run around the circumference of the canopy. The precise geometry of the canopy shape, positioning of the structural reinforcement and choice of materials are all adjusted for each particular application, striking a balance between opening characteristics, strength, stability and rate of descent.
Figure 1.
BRS Parachute Assembly
With a few minor exceptions, all of the textile components in our parachute systems are fabricated from either Kevlar® or Nylon. The materials used in BRS parachutes, including the fabric, reinforcement tapes, suspension lines, and threads, are all woven to military or industry specifications that define specific parameters such as raw fiber materials, yarn count, yarn twist, weave type, and finish.

Parachute material strength requirements are ultimately based on deployment characteristics, or specifically, deployment loads. A typical deployment load profile begins with a snatch force which occurs when the parachute assembly is initially extracted from its container and pulled to full line stretch. This is usually not felt by the pilot/passenger. When air begins to fill the canopy, higher inflation loads result. The number and magnitude of the peak loads is dependent on airspeed at deployment, payload weight, and atmospheric conditions.

2. **The Slider**

After the parachute is completely extracted and exposed to the relative wind, it begins to inflate, generating drag forces to decelerate the airplane. The magnitude of these drag forces, or inflation loads, for a particular parachute design is a function of the airplane’s weight, the airspeed at deployment, and the rate of inflation.

The inflation rate of BRS parachutes is controlled by a proprietary slider, an annular shaped fabric panel with metal grommets along its perimeter. The parachute suspension lines are routed through the grommets such that the slider is free to move along the suspension lines. The parachute is packed with the slider positioned at the top of the suspension lines. Since the diameter of the slider is significantly less than the open diameter of the canopy, it limits the initial open diameter of the parachute and its rate of inflation as shown in Fig. 2. Once the dynamic pressure acting on the system decreases to a safe level, the slider moves down the lines, allowing the parachute to inflate to its full diameter.

![Maximum Reefed Condition](image)
![Disreefing](image)
![Full Canopy Deployment Condition](image)

*Figure 2. BRS Annular Slider*

Sliders can be “tuned” for a particular set of deployment conditions by adjusting their geometry. For example, increasing the size of the slider’s vent will increase the airflow into the parachute and therefore increase the initial rate of inflation. Decreasing the fabric area will decrease the drag on the slider and allow it to disreef at a higher dynamic pressure, thereby increasing the final rate of inflation.
3. **The Rocket Assembly**

All current BRS rocket motors use stored chemical energy in the form of a solid propellant to provide the thrust forces necessary to rapidly remove any enclosure cover and extract the parachute from its container. These rocket motors use a composite propellant, a heterogeneous mixture of ammonium perchlorate (AP) and aluminum powder (Al), the oxidizer and fuel. These are the most commonly used types of ingredients in modern solid propellants. A synthetic rubber binder is also necessary to provide a structural matrix to hold these ingredients together. Other typical propellant additives include burn rate modifiers to accelerate or decelerate combustion, curing agents to solidify the propellant at different rates, plasticizers to improve the processing properties, bonding agents to improve the chemical properties, and antioxidants to reduce chemical deterioration. The size, shape, and size distribution of the propellant's solid particles are also key factors in its burning characteristics.

Two versions of our larger rocket assemblies, the BRS600 and BRS900, illustrated in Fig. 3, consist of the igniter, rocket motor base, and rocket motor. The rocket motor components consist of the motor case, aft bulkhead, propellant, and nozzle. The motor case/aft bulkhead contains the propellant and serves as a pressure chamber when the propellant is burning. The composite propellant is cast into grains, or solid shaped masses that fit snugly inside the motor case. To provide consistent dimensional tolerances, the grains are cast inside a filament wound internal liner that also acts as an insulator to limit heat transfer to the motor case.

Our smaller rocket motors, the BRS-300, BRS-301, BRS-440 and BRS-460, do not utilize a rocket motor base, but instead attach directly to the igniter. They consist of a motor case, propellant, nozzle, and both an aft bulkhead and forward bulkhead, illustrated in Fig. 4.
Figure 3: BRS-600/900 Rocket Diagram

Figure 4: BRS-300/301/440/460 Rocket Diagram
The igniter, illustrated in a cut-away view in Fig. 5, is a mechanical device which requires no electrical source. The igniter consists of a firing pin actuator, a steel spring, a plunger to which the activation cable is attached, and two firing trains. Each firing train consists of a firing pin and primer which ignites a primary booster at the end of the igniter. In its normal position the firing pin actuator and plunger are interlocked with two small ball bearings held in place by the inner wall of the igniter body.

Pulling the activation cable compresses the spring and cocks the plunger. One half inch of plunger travel is required to release the ball bearings and allow the plunger to strike the firing pins with the stored energy of the compressed spring. The firing pins then strike the shot-gun primers which ignites a black powder and magnesium primary booster in the end of the igniter. The igniter is unarmed in its normal configuration since the spring is uncompressed and the plunger is separated from the firing pins by a 0.060-inch gap.

In the BRS-600 and BRS-900, the igniter primary booster ignites a secondary black powder and magnesium booster contained in the rocket motor base. The extra booster material is used to insure ignition of the larger rocket motor. The rocket motor base has a conical protrusion which sprays hot particles past the rocket nozzle and across the surface of the rocket motor's solid propellant grains. This extra booster is not present in the smaller BRS-300/301/440/460 rockets.

Figure 5: Igniter Activation Diagram
Once ignited, the grains will burn on all exposed surfaces to form hot gases that are exhausted through the nozzle. The propellant’s performance is a function of its burning rate and the burning surface area of the grain. The geometry of the grain is therefore critical to achieving the desired thrust profile. Our rocket motors use grains with a cylindrical bores through their centers, or internal burning grains, to achieve the desired burn surface area.

The rocket motor nozzle provides for the expansion and supersonic acceleration of the hot gases. The rocket motor’s performance is a function of the propellant performance and the nozzle design and can be defined by its thrust versus time curve and the total impulse, \( I_t \), which is the thrust force, \( F \) (which can vary with time) integrated over the burning time, \( t \). Each BRS rocket motor has been designed with a thrust-time curve and total impulse that specifically meet the extraction requirements of the particular parachute.

Solid fuel motors have a flame, but this is not the problem some imagine for two reasons; one simple, one more complex. With an extremely high departure velocity in the first tenth of a second, the flame is gone before it can cause problems. The more complex explanation involves a pressure front set up by the ignited fuel. The main content of the rocket’s exhaust is water vapor and non-flammable gases. These expand so rapidly that they will literally push away fuel fumes before they can get warm enough to ignite.

BRS currently certifies its solid-fuel rockets for twelve (12) years of service life. At the time of expiration, the old rocket must be properly disposed of and replaced with a new one. However, this means that a rocket shipped from BRS to a customer need never be returned to the factory for service, eliminating any owner difficulty in shipping hazardous goods.

4. **The Activation Assembly**

The rocket motor is activated by pulling a red activation handle mounted securely within reach of the pilot/passenger. This handle is connected to the rocket motor igniter with a flexible, stainless steel aircraft grade cable routed through a Teflon-lined housing. The handle is usually the only part of the system accessible to the pilot in flight.

![Figure 6: BRS Activation Handle/Holder](image)

Two separate and deliberate pilot actions are required to deploy BRS parachutes. The first action requires that the pilot remove the safety pin from the activation handle holder during the pre-flight inspection. The second action requires the pilot to pull the activation handle several inches out of the holder. The first few inches of motion take up cable slack that has been intentionally built into the system to prevent inadvertent activation due to flexing of the
system or bumping the handle. The remaining motion (approximately ½”) activates the rocket motor. Typical pull force requirements range from 30 to 70 lbs., depending upon friction variations in the routing, temperature, and overall length of cable/housing.

The mechanical activation can be best compared to a firing pin on a gun. While the analogy is not exact, the sequence is similar in that a cocking action occurs, followed by detonation of the primer (by propelling a hammer into dual igniters). In turn, the primers ignite the solid fuel. To the user, the two actions are transparent... one pull seems to do everything. Nonetheless the system indeed first cocks itself, and then releases the hammer to contact the dual primers.

Proper installation of the activating housing and handle is imperative to proper operation. BRS owners should never tamper with the activation housing and handle assembly. The design intent of the assembly must be maintained for it to work properly. Any misassembled components could lead to serious injury or death.

As you can see in Figure 7 and 8 below, removing the screw holding the handle twist plate onto the handle holder affects the function of the assembly. Any reassembly requires that the nylon nut threaded over the end of the plastic housing be retained behind the screw on both the handle holder (Figure 7) and cone adapter (Figure 8) that threads onto the rocket launch tube. It is extremely important that the retaining screws be long enough to stop the nut from moving, yet short enough so that they do not crush the activation housing into the cable.

Figure 7: Section of Handle Holder  Figure 8: Section of Cone Adapter

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Figure 7: Section of Handle Holder  Figure 8: Section of Cone Adapter
5. **The Bridles and Harnesses**

*Bridle* is a term that BRS uses in two ways. In some cases (ultralights only), it describes a single section of webbing between the *riser* (previously mentioned) and an attachment point on the aircraft. In all other cases, it describes a single section of webbing attaching the riser to a set of 2-4 *harnesses*, which are attached directly to multiple points on the aircraft. Connections between the riser and bridle, or bridle and harnesses are typically made using a large steel “Quick Link”.

Depending upon the particular system and aircraft, BRS uses Nylon or Kevlar® webbing for risers, bridles, and aircraft connection harnesses. BRS also uses stainless steel cable for bridles on certain, older aircraft designs.

Nylon webbing is used:
- whenever adequate elongation is necessary for absorbing opening loads.
- for aircraft connection harnesses in situations where the strength and cut resistance of Kevlar® is unnecessary and a bit more stretch is preferred.

Kevlar® webbing is used:
- mostly for aircraft connection harnesses, as it is a high-modulus (low elasticity), low weight material with minimum breaking strength of 13,500 lbs per Parachute Industry Association (PIA) standard.
- for risers in larger systems where more tensile strength is necessary and equivalent strength Nylon is prohibitively heavy.
- for bridles that may come in contact with sharp metal or fiberglass (i.e. propellers).

Stainless steel cables are used:
- in applications where the bridle must be routed along an existing, smaller brace cable and using the webbing would add more drag.
- Kevlar® or nylon does not offer enough resistance to cutting or abrasion and the additional weight/bulk is not a concern.

All fabric webbing is protected against ultraviolet light damage (exposure to the sun) by full-length nylon sheathing. After final assembly sewing, the thread is covered by opaque shrink tubing to prevent UV damage.
INSTALLATION GUIDE

BRS has helped experimental aircraft manufacturers and builders with installation and mounting guidance for over 300 different aircraft designs in the last 25 years. However, this represents only a small fraction of the aircraft designs that are currently flying or being built. It is a very daunting task for BRS to keep up to date with every single aircraft design, especially those with only a few owners or builders in the entire world. Due to the nature of experimental aircraft, almost every one of these designs has something unique for that particular aircraft.

Most builders are aware that BRS has documented many of our designs with specific installation instructions. We continue to sell systems based on robust installations that have been repeated for years on aircraft kits manufactured by some of the more established companies (i.e. Quicksilver, Challenger, Kolb, Kitfox, RANS). For many of these aircraft, there may be more than one option that will work and it is up to the buyer’s discretion which to choose. For instance, one builder may want an internal softpack to save money and weight while another builder wants to save luggage space and opt to mount an external canister or VLS. In some cases, there is really only one option and it will be highly recommended that the builder use it. However, we are often approached by potential customers who wish to mount a BRS system to their aircraft, but don’t know which one is best and what is required to do it properly.

This section of our manual addresses the fundamental items that BRS considers when designing or modifying an installation and will help prepare a potential BRS customer to evaluate his aircraft design for an installation that will stand the test of time and function properly if ever needed. As with the rest of this document, it is written assuming our customer is a mechanically-capable and safety-conscious builder and/or pilot.

Remember, the aircraft owner is ultimately responsible for ensuring that the installation design (whether provided by BRS, the aircraft manufacturer, or the customer) is sound. If you have any concerns or questions, please call BRS before completing your installation.

You may view the installation of our systems as simple and straightforward. Others may not. Whatever your view, please be assured that BRS engineers do not take their jobs lightly. In many cases, they are pilots like you and realize the importance of installing a parachute system that will work when needed. Some of the many challenges BRS engineers face when helping design an installation for a particular aircraft are:

- Aircraft are usually not designed for rearward and upward point loads that an inflating parachute imparts onto the airframe (up to 3-7 g’s!)
- Aircraft are not necessarily designed to impact the ground with a 21-25 ft/sec. descent rate
- Aircraft manufacturers frequently incorporate minor design changes and do not consider the effect upon a customer’s need for a parachute (i.e. add or remove tubing, move fuel tanks, etc)
- Aircraft manufacturers increase gross weight capabilities for identical models of aircraft
- Aircraft builders modify their aircraft to better suit their needs, not realizing the impact on the parachute and/or harness mounting and routing (i.e. changing engine sizes)
- Aircraft are usually not locally available for BRS engineers to work with
- Some aircraft have no weight and balance information available to the builder
Regardless of the obstacles, a safe, sound installation can most likely be accomplished if the BRS owner plans ahead and begins thinking about the installation before he/she purchases our life saving devices. The following are items to consider prior to a purchase, or at the least, prior to installation:

**PROPER SYSTEM SELECTION**

The appropriate BRS emergency parachute system for a given aircraft is initially based on two important specifications, dictated by the manufacturer or builder:

1. **Maximum GTOW (gross takeoff weight)** - the weight of a fully loaded aircraft will contribute directly to the loads that the parachute canopy will experience during inflation. It also affects descent rate, since each canopy shape and overall area is sized for a particular load range to maintain a survivable rate of descent. A canopy that is too small for the aircraft weight will cause the aircraft to hit the ground faster than designed!! THIS IS AN ABSOLUTE LIMIT!!

2. **V_{ne} (maximum speed to never exceed)** - remaining under the maximum tested deployment speed of a particular canopy is critical. The potential to increase speed beyond rated is going to exponentially increase the dynamic pressure on the canopy and reduce design safety factors. AGAIN, THE PLACARDED MAXIMUM DEPLOYMENT SPEED IS AN ABSOLUTE LIMIT!!

These factors together determine the potential maximum loads that may be applied to the canopy during various phases of the deployment. **Exceeding either of these conditions could seriously damage or even destroy the parachute during inflation.**

1. **Size of System**

A detailed chart of the BRS-6 models currently available for sale to the ultralight, LSA, and experimental market can be found at the end of this document. Additional CAD drawings with overall dimensions are also available from BRS.

2. **Style of System**

Once it is determined which size is appropriate, the style of BRS system is your next decision. Each style has its advantages and disadvantages, depending upon: size and weight restrictions, level of weather protection necessary, likely mounting location, maintenance requirements, aesthetics, and more. BRS systems are typically purchased in one of (4) styles:

A. **Canister (Sleeve Deployed)**

The parachute canopy, suspension lines, and riser are first folded and inserted into a nylon sleeve. This sleeved assembly is then S-folded (or “sausaged”) into a plastic liner and packed with hydraulic assistance into a steel jig. A set of nylon straps and closing pin secure the compressed shape and allows the ‘chute to be transferred and inserted into a cylindrical aluminum tube, closed at one end. The design uses the straps to keep the parachute compressed over time and a frangible ABS plastic cap is sealed onto the open end.

Models 600, 800, and 1050
Since it is a sealed container, it can withstand exposure to the elements and needs only be inspected and repacked every 6 years. It is very popular for open frame ultralights and trikes. The shape of the canisters (7” or 8” diameter x 18-22” long) lends itself to fitting into tight areas and results in a fairly small frontal profile with allows for smaller egress areas. It is heavier than an equivalent softpack. Models currently available in this style: 600, 800, and 1050.

B. Softpack (Sleeve Deployed)

The parachute canopy, suspension lines, and riser are first folded and inserted into a nylon sleeve. This sleeved assembly is then S-folded and packed into a durable, shaped, fabric bag by hand or hydraulic pressure. The packs are typically rectangular in shape, but variations are available at extra cost. The use of the fabric bag vs. the heavier aluminum canister results in an advantageous weight savings of 2-3 lbs. The downside to using the fabric containers, however, is that they are not sealed and can be susceptible to moisture, mold, insect, and/or rodent damage. For installations where the pack is external, the chute will require yearly inspections and repacks. Other installations may allow anywhere from two year to six year service intervals, depending upon the mounting location and its level of protection from the elements.

The smaller models (600, 800, and 1050 (shown above)) are supplied in a nylon bag attached to an aluminum “L” frame with nylon straps. The frame can be attached to one of many mounting plates available from BRS or to an existing bulkhead or other flat surface. The frame also acts as a mount for the ballistic rocket.

The smaller bags also have the ability to be removed from the frame if desired and mounted directly to the aircraft structure with these same straps or a set of flaps with (4) evenly spaced grommet holes on either side. Because there is no “L” frame, the rocket must be mounted separately to a sufficiently strong member near the bag mounting location.

The larger 1350 model (shown at left) is supplied in a nylon bag attached to an aluminum “U” frame with nylon straps. Because of its weight, there are no provisions for flaps with grommet holes. The rocket is attached directly to the frame and it is recommended that it not be mounted separately.
C. **Softpack (Bag Deployed)**

For larger chutes, BRS prefers to use fabric bags rather than the nylon sleeves for deployment. For this design, the parachute canopy, suspension lines, and riser are S-folded and pressure packed into a rectangular steel jig. After heating to remove excess moisture and create a “set”, or form, to the jig dimensions, the ‘chute assembly is then transferred into a deployment bag and secured with locking pins. The deployment bag is surrounded by a retaining bag which is attached to an aluminum frame, via buckles or grommets. In the event of deployment, the entire deployment bag with the parachute is extracted. Again, as a fabric container, these units are not sealed from any environmental contamination and should only be installed internally, or under a protective cover. An external installation will require yearly repacks which, for this style, can be quite expensive. When installed internally, they should be inspected and repacked every 6 years. Models currently available in this style: 1350HS, 1600, and 1800.

NOTE: These (4) styles have been extensively tested and are readily available. Customized packaging may be used in certain situations where the aircraft manufacturer is involved and the market will bear the additional costs associated with designing, building, and testing such units. Contact the BRS factory for more information.

D. **VLS (Vert. Launch System, Sleeve Deployed)**

This style is really a lightweight softpack sealed within a container. It utilizes a sleeved, S-folded canopy that is pressure packed inside a light fabric bag. This bag is then installed into a rectangular fiberglass lower shell and topped with a shaped, frangible ABS plastic cap. The overall profile is lower and it lends itself well to external applications where the chute is located directly in the airflow over the aircraft wings. It is sealed and has the same level of protection as the cylindrical canister. Unlike the other styles, the VLS can only be mounted horizontally as it is designed to fire and extract vertically. Models currently available in this style: 600, 800, 1050, and 1350.
SYSTEM MOUNTING

Mounting your BRS parachute and rocket may at first seem like a simple task. However, it is one of the most important tasks, and each BRS owner should consider the following:

1. Normal Operations

The first, most obvious thing to consider is the effect on normal operations required to fly safely. The unit should not be mounted where attachment brackets and or ultimate harness routing could lead to interference with control surfaces, cables, or hardware. You should not compromise the structural integrity of the aircraft by drilling or cutting unnecessary or poorly located holes and slots into tubing, sheet aluminum, or fiberglass. BRS has many sizes of mounting clamps and bands that require no drilling for square and round tubes. There are also stainless steel mounting plates that can be attached to these and positioned or rotated at various angles to clear obstacles. In the case of a pre-stressed aircraft skin (aluminum or composite), the installer should contact the aircraft designer/manufacturer to determine if removal of material will compromise the design, either structurally or aerodynamically. Adding a large parachute canister in the wrong location on top of an airfoil can create enough turbulence to cause excessive vibration or buffeting of control surfaces in the tail. Locating the system in front of cooling radiators or air cooled engines can cause engine temperatures to be higher than normal. There have even been instances where stall characteristics were affected by the presence of the parachute container in the airflow. If you have concerns over excessive drag caused by the parachute, move it inside the aircraft.

2. Pilot and Passenger Safety

Along with the aircraft, it is equally important that the safety of the pilot and passenger is considered. It is recommended that the intended location of the parachute and attached rocket not be so closely mounted to the pilot or passenger(s) that it could be a burn hazard if the rocket were fired. Even though the rocket has a very fast exit, it still has the ability to scorch any body part that comes in contact with the rocket flame. For anything mounted closer than 16” from the pilot or passenger(s), an additional “blast” shield of Lexan®, aluminum, fiberglass, or even wood should be considered to protect from the rocket plume as it departs.

The mount should not require that harnesses be routed as to endanger the occupants head and limbs. It is a good idea to keep all attachments and routing outside of the fuselage “cage” or inner structure if possible. Another thing to remember is not to place your unit in a location where the direction of fire could be blocked by an arm or leg that is flailing about in a chaotic, emergency situation.
3. **Weight and Balance**

As a rule, the BRS system is most commonly placed near the root tube, keel tube, or axle members of an open-cockpit ultralight, or in the fuselage of partially or fully enclosed aircraft. It should be located so as to not adversely affect aircraft weight and balance with regards to the center of gravity (CG). You may even find that the parachute system itself, positioned in a key location, may be useful in correcting an otherwise unbalanced aircraft.

It is the responsibility of the pilot to ensure that the airplane is loaded properly. Operation outside of prescribed weight and balance limitations could result in an accident and serious or fatal injury.

4. **Structural**

The attachment method and structure should be adequate to bear the weight of the parachute/rocket unit while flying, but also while taxiing on bumpy turf runways or in the event of hard or emergency landings. 14 CFR Part 23, which spells out design requirements for certified aircraft, requires that items attached inside the cabin, or occupied area, of an aircraft be able to remain secure during a downward load of up to 6g, forward load of 9g, sideward load of 1.5g, and upward load of 3g during emergency landings. The force of the rocket recoil must also be considered, but will typically be of smaller magnitude than what is required to secure the parachute. Attachment of the canister, softpack, or VLS mounts to structural aluminum plate or steel tubing is common. Avoid drilling into small tubes and use clamps whenever possible. Aluminum sheet, wood, or composite materials have different load carrying capabilities depending upon thickness or bend characteristics. Individual aircraft installation design diagrams may give specific guidance if BRS has this information to offer. Some aircraft will require structural enhancement to bear the weight.
If you are unsure of the strength requirements for your particular system, do not proceed without first contacting BRS for further advice.

5. **Direction of Fire**

The rocket and parachute must have a clear path to exit the aircraft. The egress path must be clear of structure, tubing, control linkages, cables, and wiring. The only thing that can be in its path is a predictably frangible or easily torn material. The rocket is generally intended to fire to the rear, slightly downward, and slightly to the side (to avoid hitting any tail structure). It is very important to avoid propeller entanglement... meaning that the whole prop arc must be considered. (It is assumed that though pilots should kill the engine before deployment, this may not always be achieved by a distressed pilot.)

Ideally, the rocket and parachute should have a cone-shaped safety zone that, at about a 10’ distance, would be 5’ wide. The rocket path is not entirely arrow-straight when it first exits the aircraft, as there are factors that can affect its travel. The rocket may deviate slightly when it hits the end of the cable lanyards attaching it to the parachute, due to the mass being off-center to the initial rocket path. Also, the slipstream and relative wind will be hitting the parachute canopy as it exits the aircraft and this can affect rocket trajectory. Do not allow for a corridor that is too small for parachute egress.

Not only must the existing configuration of the aircraft be considered when you aim the system, but any potential changes due to a catastrophic failure must be taken into account. BRS units mounted on top of the aircraft, and intended to deploy above it, would be compromised by a failure of one or both wings in a positive mode. Therefore, the preferred direction of fire should be downward and to the rear.

**IMPORTANT NOTE FOR OWNERS OF FLOAT-EQUIPPED AIRCRAFT:**

Float-equipped aircraft (or “flying boats”) can present a dilemma when considering the optimum mounting location. If the BRS unit is placed very low on the craft, firing down and to the rear, the BRS may constantly get wet. Even though the BRS-5 is virtually waterproof, constant exposure to water should be avoided.

Also, the presence of floats may hinder a clean extraction and the required routing of harnesses could be more difficult. It may be that the only acceptable location is near the top of the aircraft, firing up.

The parachute does not care which direction from the aircraft it is fired...it will always inflate downwind (see Figures 9 and 10)! This is good as you can never predict which side will be up when the need for the parachute arises anyway. Please be assured that the parachute will always be above you and you will hit the ground first.
Figure 9: Deployment Sequence for Top Mounted Units

Figure 10: Deployment Sequence for Bottom Mounted Units
6. **Egress**

BRS rockets have incredible penetrating ability, but still need to tow the parachute out of the aircraft as well. Using up a significant portion of the rocket’s total thrust energy to get out of the aircraft will hinder its ability to completely remove the deployment sleeve or bag as designed. The parachute can also become hung-up or damaged passing through an opening that is partially blocked or too small. Therefore, it is imperative that careful consideration be given to creating a large enough port of exit or weakened panel for the specific unit being installed. All possible resistance or interference with the rocket’s flight path should be avoided.

BRS has tested the rocket’s penetrating ability through two layers of unmodified 1.7 oz./sq. yd. aircraft fabric (Ceconite, Stits, Poly-Fiber). BRS has also experienced actual “saves” where several layers have been penetrated. However, a removable or weakened panel is highly suggested for anything heavier than 1.7 oz./sq. yd., especially pre-sewn sailcloth. This will prevent an excessive amount of the rocket’s power being used merely to penetrate the “skin.”

Some acceptable ideas for proper egress through medium or heavyweight fabrics (1.7 oz./sq.yd. or more):

- Completely remove a section of fabric 1” larger than the profile of the appropriate parachute and rocket. Leave open.
- Completely remove a section of fabric 1” larger than the profile of the appropriate parachute and rocket. Replace with lightweight fabric.
- Add small perforations in a pattern at least 1” larger than the profile of the appropriate parachute and rocket, using a “hot knife” or soldering iron. Perforations should be at most ½” apart. DO NOT USE THIS METHOD FOR MYLAR-BACKED DACRON® FABRIC.
- Completely remove a section of fabric 1” larger than the profile of the appropriate parachute and rocket. Line the perimeter of the new hole with a strip of ½” Velcro® (sewn on is better). Add a new, larger piece of fabric with mating ½” Velcro® sewn on to cover the hole. Make sure that rocket will contact the new Velcro® attached cover along the edge and not in the center. The cover needs to peel back, not be pushed off.
- Cut a section of fabric 2” larger than the profile of the appropriate parachute and rocket, but leave the lower side intact, creating a flap. Add a strip of ½” Velcro® to the three sides of the flap and a larger strip (1-1/2” to 2”) to the three edges of the hole.

Should your aircraft have a metal or composite skin, the port of exit will have other considerations. For example, on many composite aircraft, the skin is “stressed,” that is, meant to be part of the structure. Cutting a hole without thinking may cause a serious loss of structural integrity. For such aircraft, probably only the airframe manufacturer can advise you adequately. Usually such a hole can be cut only if the adjacent area has been built up properly to carry the loads around the hole. With metal skins, the surface may or may not be structural. If yes, the same concerns apply as with composite structures. For these types of materials, it will most likely require a blow-off (blow-out) cover. Such a cover may be flush mounted if a recessed “ledge” is fabricated around the perimeter of the hole and the cover is set down in it. The cover should be made and secured in such a way that the rocket will push it out of the way, rather than punch through it. The cover may need a fairly thick
(>.100") piece of aluminum adhered to the cover over the rocket to ensure that it cannot penetrate the fiberglass. If necessary, contact BRS for viable options and suggestions for such removable covers, doors, etc.

BRS has tested rocket extraction through thin sheets (up to .063” thick) of ABS haircell plastic. ABS is brittle enough that “scoring”, or cutting part way through one side with a sharp knife, will allow it to break along a predefined pattern when impacted from the inside with the rocket body. This is the same “frangible” material used to make the inner caps for the canisters and the top cover for the VLS style. Make sure that the rocket contact point is near the edge of the panel and not in the center.

BRS has performed countless parachute extraction tests through various combinations of materials and construction and has over 25 years of experience and exposure to thousands of builders. We know that the egress design on one aircraft may not necessarily apply to another. In some cases, we may have the option to do test firings through samples provided by the manufacturer or builder. Please contact BRS for advice and suggestions before cutting into your aircraft.

7. **Service and Inspection Access**

Since all systems need to be inspected and repacked at least every 6 years (sometimes every year), it will save you time and frustration if you consider mounting locations and methods that will make the parachute and rocket easy to access for inspection and/or removal. Putting an internally mounted softpack in an area completely covered with fabric will look nice, but will require cutting the fabric at least every 6 years. A visual inspection of the system every time you fly is a good idea and your installation should allow you to see what you need to.
PARACHUTE ATTACHMENT

1. **Ultimate Loads, Rated Loads, and Safety Factors**

BRS has tested each of the canopies referenced in this guide to meet the requirements of the new ASTM (American Society of Testing and Materials) Standard F 2316, “Standard Specification for Airframe Emergency Parachutes for Light Sport Aircraft”. Part 6.2.1 requires multiple drop tests to verify the parachute canopy strength. This standard also mandates that these drop tests be successful when performed with combinations of weight and deployment speed that will result in a design safety factor of at least 1.5. For these drop tests, on-board data acquisition equipment was used to monitor force (in Gs) imparted onto the test weight by the parachute during the deployment sequence. The maximum force measurements in both the reefed and disreefed conditions (see Figure 11) are considered the **ultimate loads**, since the test incorporated the design safety factor. **NOTE:** Ultimate load should not be confused with ultimate strength because, unlike other mechanical testing, the ultimate loads may be near, but never at the failure point.

![Figure 11: Typical Inflation Load vs. Time Profile](image)

If additional drop tests are done with deployment weights and speeds at limits prescribed on BRS placards and marketing literature, the resultant forces are called **rated loads**. Rated loads have no safety factor added. For some canopies, BRS may not have rated load information.
Since performing even a small series of flight tests with each aircraft is usually cost prohibitive, our prescribed aircraft attachment strength minimums is normally calculated from rated or ultimate loads obtained from these dead-weight drop tests. Due to drag differences of a small, dead weight (usually pallets with barrels or lead-filled steel slugs) vs. a disabled aircraft with a significant surface area, the ultimate loads from drop tests will most likely be conservative. This may lead to fairly conservative strength requirements that some home-builders or manufacturers may have trouble meeting. Additional engineering work may have to be done to distribute these loads onto more points on the aircraft or optimize harness lengths.

Now, after reading the above, if you are thinking that you should use the parachute size (or manufacturer) that offers the lowest ultimate (or opening) load, please consider this:

The magnitude of an ultimate load is relative to what you are trying to accomplish. You can put a larger parachute onto your aircraft and, due to a longer time required to fill and inflate the canopy, opening loads will be lower. However, a longer opening time equates to increased altitude loss before complete inflation...not something you want if you are only 100-200 ft. in the air. A lower descent rate and opening load will do you no good if you hit the ground before it inflates.

In automobiles, the faster you want to stop, the harder you need to hit the brake pedal. In parachutes, the quickest opening possible, given the deployment conditions, comes from the smallest, hardest-opening canopy. However, now your aircraft will have to be built to withstand the higher loads and the higher descent rates and this is not possible in some cases.

Therefore, it is a tradeoff, and BRS designs canopies to optimize a combination of opening time, load, and descent rates, not just one aspect. Aircraft builders need to choose the parachute that will most likely survive the deployment and lower them down at a safe rate of descent. They must then design their attachments as necessary.

2. **Aircraft Structure Analysis**

Aircraft are designed to fly. They are designed to take their greatest loads vertically through the aircraft structure, as these are the lift loads. The requirement to resist excessive drag loads is much less. Unfortunately, that is exactly what an inflating parachute puts onto an airframe: significant drag and force in a direction most likely never designed for.

During the initial deployment sequence, the force vector coming from the inflating parachute (directly inline with the parachute riser) is always with the relative wind. The initial position of the parachute riser could then very easily be nearly parallel (<10° from horizontal) to the aircraft’s longitudinal axis if deployed from an aircraft flying straight and level. From our test experience, this tremendous initial force, or "reefed" force, from the parachute drag could be as high as 3-7 g’s! Imagine (for a 1000 lb aircraft) a force of 3-4 tons pulling on the airframe rearward, trying to force the aircraft center of gravity to align with it. Now imagine if this aircraft was constructed of thin plywood or fiberglass!
When designing the harness assembly and attachment location(s), you must always keep in mind the magnitude and direction of the loads that will be applied to the aircraft during deployment. Due to the potential of high loads pulling on the airframe in the aft direction, the addition of simple, structural compression members may be necessary, especially in wooden and fiberglass aircraft. Most aircraft are also not designed for the localized point loading that parachutes induce. The more the load can be spread out into the airframe, the better. You must contact the aircraft manufacturer for input if you are concerned about your aircraft’s construction and strength.

It is also critical to have the harness(es) placed so that it takes maximum advantage of the natural balance of the aircraft. Load distribution among multiple attachment points can be adjusted by changing the location of attachment points and lengths of harnesses. More on this subject is found in “Harness Design Analysis”.

When an object is suspended from a cable, the object will always adjust its position until its center of gravity (CG) is in line with the suspension cable. The same holds true for an aircraft attached to a parachute. During the entire extraction and inflation sequence, the force magnitude and vector will be constantly shifting with time as the parachute inflates and the aircraft moves to keep the CG in line with the parachute riser. Since there are an infinite number of possible deployment weight and speed combinations for each emergency, it is impossible to determine exact minimum strength requirements for any given aircraft structure. In almost all cases, conservative data from ultimate load dead-weight drop tests (as discussed in the previous section) is the only method of determining how strong the structure of the aircraft must be to successfully survive a parachute opening.

With this data, BRS can provide anticipated loads for your particular application using aircraft geometry and performance information supplied by the manufacturer/builder. At the end of this manual, you will find a blank “Loads Determination” form. You should complete this and send in to BRS to help you determine how strong your attachment points must be. This requires knowledge of the aircraft center of gravity envelope as well as dimensional relationships between the CG and the proposed attachment points.

3. **Harness Design Analysis**

For many ultralight aircraft, a single “keel” or “root” tube runs forward and aft along the aircraft centerline. This tubing is usually aluminum or steel alloy and can be either square or round. If the aircraft maximum gross weight and speed are low enough, a single harness (main bridle) attached at the fully loaded CG is typically sufficient to handle the opening loads and balance the aircraft for descent.
For heavier (and wooden or composite) ultralights, multiple attachment points are preferred to help distribute the loads and allow for a proper descent attitude. Two shorter harnesses attached to opposite ends of the “root” tube is common. Other recommended locations may include gear legs, longerons, firewalls, engine mounts, spar carry-thrus, and/or cabanes. The multiple harnesses should converge to a point that is usually 4-8 ft. above the aircraft and directly overhead of the CG, with the aircraft in the desired touchdown attitude. They are coupled together with a large, stainless steel quick link and joined to the parachute riser with a single, main bridle and another quick link.

At least (3) or (4) separate attachment points are recommended for wooden or composite ultralights as there is commonly no single “strong” structural member. In some cases, a “basket” or “hammock” of webbing is made to sling underneath a wooden fuselage to minimize destruction at the time of deployment. For composite frames, adding structural hard points using steel or aluminum will most likely be necessary to handle the loads in the aft and upward direction. Reinforcement with additional compression and/or tension members or additional plies of fiberglass or wood may be needed.

A few things to consider when designing your harness configuration:

A. **Aircraft Dynamics at Deployment**

The proper location of the multiple harness attachments can actually help reduce the loads that a parachute may apply to the airframe, and even help reduce the loads on the canopy itself. By attaching the front harness(es) to points above and forward of the aircraft CG, an inflating parachute will tend to pitch the aircraft nose up (Figures 12-14), thereby presenting the bottom of the aircraft to the relative wind (due to the CG alignment characteristic described earlier). This creates a condition similar to an accelerated stall and immediately slows the forward speed of the aircraft. A slower aircraft speed at the point of full inflation equates to lower loads on the canopy and translates to lower loads on the airframe. The rear harness(es) will act to limit the degree of the stall and also keep the tail positioned correctly for touchdown.

![Figure 12: Deployment, Reefed (with recommended attachments)](image-url)
Figure 13: Inflation, Disreef (with recommended attachments)

Figure 14: Descent (with recommended attachments)
The designs of high-wing aircraft are well suited for the preferred attachment method described above. Typically, a main front wing spar connection on either side of the fuselage is ideal for the front attachments, as its location is well above and forward of the aircraft CG. In many cases, the rear wing spar connection or carry-thru may be used as the rear harness attachment location. If not, there is typically sufficient structure near the tail-cabin interface.

![Figure 15: Attachment Locations, High-Wing Aircraft](image1)

Unfortunately, the designs of low-wing aircraft are not as straightforward. The strongest part of the aircraft - the front spar and carry-thru, is usually below and may be only slightly ahead of the aircraft CG. If one were to attach to the spar in this case, the nose of the aircraft will be forced down to allow the aircraft to align its CG with the parachute riser. Nosing over will only ACCELERATE the aircraft during the initial deployment instead of decelerating as desired. If the parachute and aircraft actually survive the increased loads, you will still be faced with a nose-down touchdown attitude.

![Figure 16: Deployment, Reefed (w/ incorrect attachments)](image2)
Figure 17: Inflation, Disreef (w/ incorrect attachments)

Figure 18: Descent (w/ incorrect attachments)
To avoid this, it is recommended that front attachments for low-wing aircraft be at or near the top of the engine firewall. This location will again allow the aircraft to pitch up upon deployment (although not as severe as a high-wing) and stall the aircraft. The rear attachment(s) should be at or near the bulkhead separating the tail of the aircraft from the main fuselage cabin.

![Figure 19: Attachment Locations, Low-Wing Aircraft](image)

In many cases, BRS can provide anticipated loads using geometry information supplied by the manufacturer/builder. It is then highly recommended to complete a structural analysis of the aircraft, with these loads applied. BRS is not the aircraft designer, nor builder, and can only make educated suggestions based on past experience. It is the responsibility of the BRS owner to determine if these suggestions apply to his/her aircraft.

**B. Aircraft Descent and Touchdown Attitude**

Determination of this touchdown attitude should consider the following:

1. In most cases, the touchdown angle should be such that the lower spine (lumbar region) does not carry the impact load in direct compression. The greater the touchdown angle, either nose or tail first, the less the spine will have to endure. However, the initial touchdown angle may only constitute a part of the entire touchdown event, as the aircraft may rotate after initial contact and create a secondary impact at an entirely different angle.

2. The gear design of the aircraft is critical in determining which end should descend first. For tricycle gear aircraft, the nose gear should contact first. At the rate of descent of most BRS parachutes, a nose-first, initial impact will most likely collapse the nose gear as well as the supporting structure (i.e. engine mounts, firewall, etc). This will help absorb a significant amount of energy upon landing. There is little data suggesting the preferred angle of descent for tail wheel aircraft. Some testing in Germany for sailplanes showed that aircraft with a tail-
low attitude were somewhat unstable during descent, causing the tail to guide the aircraft erratically. For the purpose of stability and predictability, it is best if “tail dragger” aircraft descend under canopy in a generally level or slight nose-low condition.

3. If a nose-down touchdown is desired, the aircraft should be equipped with at least a “4-point” individual restraint system for each occupant. A “3-point” restraint, similar to a car lap and shoulder belt, may be insufficient to avoid contact with glare shields, control yokes, or the instrument panel.

4. A tail-down touchdown would likely require the rear harness to be longer. Increasing the length of the rear harness can be detrimental if it is too long and allows the aircraft to be flipped on its back during initial deployment.

C. Propeller or Empennage Entanglement

For aircraft with the engine up front (“tractor” type), propeller entanglement is not a serious concern when determining harness and bridle lengths. This is mainly because of the tendency of the parachute canopy to open behind and above the aircraft, except in cases of severe tumbling or other catastrophic conditions. For those with the engine behind the pilot (“pusher” type), the parachute behavior is a major concern and needs to be heavily considered when designing bridles for such aircraft.

AGAIN, IT IS VERY IMPORTANT THAT THE ENGINE BE SHUT OFF BEFORE DEPLOYING A BRS PARACHUTE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH. The Kevlar® or stainless steel cable that BRS uses for harnesses and bridles is very resilient to cutting, yet could still be severed. Unfortunately there is nothing that can be done to guarantee that this won’t happen. However, there are a couple of steps that must be taken to increase the probability that your chute (and you!) will survive.

1. BRS insists that, for single attachment designs (ultralights only), there be at least a 10 foot* section of Kevlar® or stainless steel cable bridle between the aircraft attachment point(s) and the nylon riser of the parachute assembly. In the case of pusher aircraft, if the propeller is still turning, there is a very high possibility that the bridle will come into contact with it. By keeping the nylon riser far enough away from the prop after extraction, it ensures that the Kevlar®, not the nylon, will bear the prop strike. If the Kevlar® or stainless steel cable survives contact with a turning propeller, it may wrap up into the hub of the propeller and stop it, break off the propeller blade, or just glance off. In these cases, you are thankfully still attached to the parachute, although possibly descending at a nose down attitude.
2. For aircraft with multiple attachment points, the same 10 foot* rule must be used from the convergence point of the front and rear harnesses or attachments that are down to gear legs. Obviously all attachments should be on the forward side of the propeller.

* Some instances may require more distance to clear the propeller. Please contact BRS for a recommended length if you are unsure.

3. When you are mounting and aiming your parachute and rocket, make sure that the trajectory will carry the parachute well out of the path of the propeller. Keeping your mounting location as far away from the propeller as possible will always be safer.

4. If your aircraft has a T-tail, it is also imperative that sufficient length be used for the bridle to help the nylon riser clear and avoid contact with the tail. The Kevlar® bridle will be better suited for contact with potentially sharp or jagged parts on the aircraft.

5. If your aircraft has had a catastrophic structural failure or mid-air collision, the results may be such that the aircraft wings or tail section is whipping about and causing the parachute harnesses to be wrapped up within the wreckage. Using a lengthy Kevlar® bridle/harness system will help keep the nylon riser and suspension lines at a sufficiently safer distance.

4. **Harness Routing**

Once the harness attachment points and minimum lengths have been established, it is important to decide how the harnesses will be routed and protected/concealed as they travel from the attachment point to where the parachute is mounted and installed. For many open air ultralights and trikes where the attachment locations are near the parachute, the harnesses are simply S-folded and stowed, using plastic tie wraps to secure them. However, for more complex routing, the following “best practices” need to be followed:

A. Because of the importance of bridle and harness routing, BRS will usually advise a specific path which is least likely to conflict with control mechanisms or entangle with the propeller and drive train. On some aircraft, especially those that were modified from the airframe manufacturer’s design, the suggested routing path may not be appropriate. If you feel the BRS-suggested routing is wrong for your aircraft, please contact BRS before installing.

B. Harnesses should not be routed as to endanger the occupants head and limbs. It is a good idea to keep all attachments and routing outside of the fuselage “cage” or inner structure if possible.

C. If you were sent a single steel bridle, do not coil any excess steel cable (for example, extra length is purposely provided with top-mounted BRS units). Excess cable should be “figure-S” folded to avoid tangling or knotting on rapid deployment. Most models use Kevlar® bridles and harnesses in lieu of steel cable, especially on enclosed cabin aircraft. Kevlar® should be S-folded or laid flat for compact storage and, if possible, should be shielded to help keep it from being exposed to the sun or other elements. The bridle should fit without excessive length and without coming up short. If
you feel you have been supplied the wrong lengths of bridle or harnesses, please contact BRS before installing.

D. Assure the bridle or harness routing does not interfere with the rocket firing. For example, do not route the bridle directly in front of the exit end of the parachute canister (over the plastic caps for the canister and VLS, or over the softpacks Velcro flap). The rocket may be deflected considerably if it strikes the bridle, and this may cause a malfunction of the extraction.

E. Assure the airframe bridle or harnesses will not rub against abrasive metal parts or components of your airplane. Make sure this is true not only in its fixed routed position, but once it starts to transition behind and, eventually, overhead of the aircraft. BRS engineers have already considered such potential when designing the installation; following those guidelines should avoid problems. The routing should keep the harnesses and bridles from being damaged during disassembly and/or transport of the aircraft. If you feel the provided instructions won’t work on your aircraft, please contact BRS before proceeding.

F. Assure the main bridle is routed to the same side of the aircraft as the rocket discharge (so the aircraft is not flipped over on canopy opening). Visualize the parachute deploying from its container. When the bridle is pulled tight by the opening forces, it should be free to straighten out without wrapping under the airframe. Routing the bridle on the same side the rocket will fire is key to the correct unleashing motion.

G. After the above items are taken into consideration, plan your routing and measure the necessary lengths for each harness in its stowed configuration. Usually the longest required length will help us determine the minimum length of the front harnesses. The rear harnesses are usually sized according to desired touchdown attitude.

H. When the optimal routing is determined and lengths are verified, secure the airframe bridle and harnesses with the provided nylon tie wraps so that they are very well attached. Use enough to keep the harnesses in place, but not too many that they will hinder a deployment. They should be no less than 6-8” apart, especially the ones holding the main bridle. In some situations, you may double them up, where failure of one would be an inflight safety issue. Ultraviolet light damage will seriously weaken nylon tie wraps. Assume that over a period of time, some of these ties may come loose or break off. If so, the owner must assure the bridle should still not interfere with the operation or strength of the aircraft. This suggests you should replace all nylon tie wraps at least annually if they have any exposure to sunlight.

I. Again, be absolutely sure the bridle does not interfere with the prop arc. If a propeller should strike the bridle with any force, the integrity of the BRS bridle may be weakened dangerously. Though testing has not revealed any particular vulnerability, any propeller has the ability to undermine the strength of BRS bridles or severe them completely.
5. **Harness Styles**

Regarding not the attachment location but rather the means of connection to the airframe, you have three choices for harness terminations:

A. **“A” End** - In some cases, where there is a desire to attach to a flat structure (i.e. firewall or fuselage skin of a composite or aluminum aircraft), a metal tab is sewn into a loop at one end of the harness. This tab has a ½” dia. hole for an AN-8 bolt (or AN-6 with a bushing). Other uses include attachment to existing bolts at wing spars and gear legs, or welded tabs on tube frame aircraft. The opposite end of the harness is always a “C” end loop.

B. **“B” End** - This style is intended to be routed around some part of the airframe (tubing, spar carry-thru, gear leg) and the short loop (“C”) end of the harness is passed back through a large loop (“B”) end. This is cinched up tight and the harder you pull on the one end, the tighter it gets. The “B” end loop is typically 8” in length and has one half-twist to keep the weave of the Kevlar® from receiving uneven load. This is the most common style.

C. **“C” End** - This is a short loop (3” in length) designed to be used with the large stainless steel quick links that are common with BRS systems. Both ends are of this style.

On some designs, specific attachment points may require custom attachment fittings that are not available from BRS. Special situations require consultation with BRS engineers and fittings may have to be sent to BRS for sewing onto the harness prior to installation.
ACTIVATION HANDLE MOUNTING

As with bridle and harness routing, the placement and mounting of the activating handle is best done with some preplanning. It is paramount, of course, that the handle be in a place easily accessed by the pilot or passenger in a situation of great stress. The most obvious mount location is in some place where the pilot and/or passenger can physically see the mount. You must also assume that the aircraft may be experiencing high G-loads which may not permit you to easily raise your hand above your head or to places that are otherwise awkward.

It is probably best to actually sit oneself in the cockpit, and physically consider where the optimum location is. BRS can suggest specific locations but handle placement is a rather personal decision. Assure you can reach the selected position from all seats. Place the handle in a location that can’t be easily bumped while entering or performing normal aircraft control movements. For best leverage, place the handle so that it is facing you and you will have to pull it towards you to activate it. Keep it low to allow you to reach it in a high G-load emergency situation.

With the current handle design, the activating handle may be freely rotated in its holder to provide a better position for activation. This is may not be true for older models series (i.e., BRS-4 and earlier).

BRS can provide handle mount clamps for various sizes of tubing or can supply a simple standoff to mount the handle holder to a flat surface with an existing fastener. Either mount is equally desirable; again, the primary consideration is ease of access and use. If you have further questions about its installation, contact BRS.

The safety pin only secures the firing handle to its mount. It does not prevent triggering if the housing is pulled forcefully. For example, if you were to remove the canister mount and pull the whole canister and rocket away from the handle, the rocket could fire because the action is the same as if the handle was pulled. Of course, you should not remove and pull the canister; this is merely an example to explain the possibility. If the housing (the plastic sheath protecting the activating cable inside) is properly secured along its path with durable attachments, the unit has little likelihood of deployment by force exerted on the housing itself.

Installations with sloppy or dangling housings are not adequately safeguarded against activation by a force pulling directly on the housing. If you have any questions on this subject please contact BRS for advice.
ACTIVATION HANDLE ROUTING

Ideally, it is best to run the cable housing in a straight course from the rocket to the mounting location. However, this is usually not possible or practical on most aircraft. In these cases, you must assure that the housing routing follows these simple rules:

1. The housing should be secured along its route. To prevent any chance of firing the rocket because the housing—not the handle—is pulled forcefully, it is preferred that the housing be attached or secured.
2. Whenever the housing makes a turn (90° bends or even 180° bends), it is optimal if that turn goes outside of a tubing member so that the turn has a “pulley” point (a point you pull against when the housing makes a turn).
3. While it can meander somewhat getting to the optimum placement for pilot actuation, too circuitous a route may adversely affect the operation of the BRS unit. If the housing has curves and loops, friction will definitely increase and it is possible that a harder pull of the handle will be necessary to take up any slack before the rocket motor is triggered.

Never coil the activating housing as this will adversely affect the operation of the BRS unit.

4. When the optimal routing is found, secure the activating housing with the provided nylon tie wraps so that the housing is securely attached. Assume that over a period of time, some of these ties may come loose or break off. If so, the housing must still remain secured. Therefore, use more ties than may seem necessary at the outset, or carefully inspect their integrity at frequent intervals. Attachments other than nylon tie wraps may be used so long as they don’t restrict the movement of the cable inside the housing. If unsure about alternative housing attachments, consult BRS before using them.

NOTE: If you find the housing to be the wrong length—short or long—consult the drawing again. The wrong length probably indicates that the recommended installation was not followed exactly. While every attempt has been made to supply the correct housing, it can be changed by purchasers if necessary. Before ordering a different housing length, it is strongly recommended you consult with BRS first. Engineers will accommodate your request if they find no error with the method you suggest.

Generally you will follow the instructions provided by BRS engineers for your aircraft. If such instructions are not available, it will be necessary for you or the airframe manufacturer to work with BRS to find the optimal routing of the activating housing.
FINAL NOTES

In addition to this manual, you should receive a set of separate and specific guidelines for installing your BRS unit onto a particular aircraft (except for most custom orders). These instructions are generally not highly detailed, but give you general direction to aid in your installation. Please make note of the following:

a) The additional information you receive may be for a different aircraft. If there are similar aircraft with similar installation guidelines, BRS may opt to use one document for both aircraft.

b) The depiction of your unit on the drawing may differ from the actual product received due to product enhancements or generic configurations that are set up at the factory.

c) In some cases, the desired location and/or orientation of the rocket to the parachute container may differ from what was received. In trying to streamline our production processes, BRS has chosen to deliver all canisters with the rocket at the 12 o’clock or top position (opposite modular mounting plate) and all softpacks with the rocket positioned horizontally. Instructions on how to modify these factory defaults will be included with each unit.

It is imperative that you follow the provided installation guidelines as closely as possible, using common sense and good mechanical aptitude as necessary.

Again, thank you for considering BRS for your ballistically-deployed emergency whole-airframe parachute needs. We look forward to serving you if we aren’t already.
BRS™-6 System Parameters

All BRS-6 models are designed to produce an approximate sea-level descent rate of 21 ft/sec (6.4 m/sec) and an approximate 5,000 ft (1,500 m) density altitude descent rate of 25 ft/sec (7.6 m/sec), at maximum gross takeoff weight.

### SYSTEM Parameters

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>600</th>
<th>800</th>
<th>1050</th>
<th>1050</th>
<th>1350</th>
<th>1350HS</th>
<th>1600</th>
<th>1800</th>
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<tbody>
<tr>
<td></td>
<td>Maximum aircraft weight</td>
<td>600 lbs</td>
<td>272 kg</td>
<td>800 lbs</td>
<td>363 kg</td>
<td>1050 lbs</td>
<td>475 kg</td>
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<td></td>
<td>Maximum deployment speed</td>
<td>138 mph</td>
<td>222 km/h</td>
<td>138 mph</td>
<td>222 km/h</td>
<td>138 mph</td>
<td>227 km/h</td>
<td>138 mph</td>
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<tr>
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<td>Canister Weight (1)</td>
<td>22 lbs</td>
<td>10.0 kg</td>
<td>23 lbs</td>
<td>10.4 kg</td>
<td>28 lbs</td>
<td>12.7 kg</td>
<td>28 lbs</td>
</tr>
<tr>
<td></td>
<td>VLS Weight (1)</td>
<td>23 lbs</td>
<td>10.4 kg</td>
<td>25 lbs</td>
<td>11.3 kg</td>
<td>29 lbs</td>
<td>13.2 kg</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Softpack Weight (1)</td>
<td>18 lbs</td>
<td>8.2 kg</td>
<td>19 lbs</td>
<td>8.6 kg</td>
<td>24 lbs</td>
<td>10.9 kg</td>
<td>24 lbs</td>
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<td>Canister Dimension</td>
<td>18x7 in</td>
<td>46x18 cm</td>
<td>21.5x7 in</td>
<td>55x18 cm</td>
<td>21.5x7 in</td>
<td>55x18 cm</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Softpack Dimension</td>
<td>11x10x6 in</td>
<td>28x25x15 cm</td>
<td>12x10x6 in</td>
<td>30x25x15 cm</td>
<td>13x10x6 in</td>
<td>33x25x15 cm</td>
<td>16x10x6 in</td>
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### CANOPY Parameters

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<th>1350HS</th>
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<td></td>
<td>Gores (panels)</td>
<td>28</td>
<td>28</td>
<td>30</td>
<td>30</td>
<td>32</td>
<td>32</td>
<td>36</td>
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<tr>
<td></td>
<td>Nominal diameter</td>
<td>26.9 ft</td>
<td>31.2 ft</td>
<td>35.4 ft</td>
<td>35.4 ft</td>
<td>38.7 ft</td>
<td>38.7 ft</td>
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<td></td>
<td>Square area</td>
<td>57.1 ft²</td>
<td>76.5 ft²</td>
<td>99.0 ft²</td>
<td>99.0 ft²</td>
<td>1182 ft²</td>
<td>1182 ft²</td>
<td>1460 ft²</td>
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<td>Repack cycle</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
<td>6 yr. or 1 yr.</td>
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<tr>
<td></td>
<td>Riser</td>
<td>9,800 lbs</td>
<td>9,800 lbs</td>
<td>9,800 lbs</td>
<td>9,800 lbs</td>
<td>13,500 lbs</td>
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<td></td>
<td>Suspension lines</td>
<td>400 lbs</td>
<td>400 lbs</td>
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<td>400 lbs</td>
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<td>550 lbs</td>
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<td>Exclusive device “Slider”</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Service life</td>
<td>24 years</td>
<td>24 years</td>
<td>24 years</td>
<td>24 years</td>
<td>24 years</td>
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## ROCKET 600 800 1050 ASTM 1050 DAeC 1350 1350HS 1600 1800

<table>
<thead>
<tr>
<th>Solid Fuel Rocket</th>
<th>a) BRS-300 b) BRS-301</th>
<th>a) BRS-300 b) BRS-301</th>
<th>a) BRS-460 b) BRS-440</th>
<th>a) RDS-285 b) BRS-300 c) BRS-301 d) BRS-460 e) BRS-440</th>
<th>a) BRS-460 b) BRS-440</th>
<th>BRS-600</th>
<th>BRS-600</th>
<th>BRS-600</th>
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<tbody>
<tr>
<td>Minimum Total Impulse</td>
<td>al 260 NSec b) 298 NSec</td>
<td>al 260 NSec b) 298 NSec</td>
<td>a) 400 NSec b) 431 NSec</td>
<td>a) N/A b) 260 NSec c) 298 NSec d) 400 NSec e) 431 NSec</td>
<td>a) 400 NSec b) 431 NSec</td>
<td>700 NSec</td>
<td>700 NSec</td>
<td>700 NSec</td>
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<tr>
<td>Minimum Peak Thrust</td>
<td>a) 67 lbs b) 87 lbs</td>
<td>a) 67 lbs b) 87 lbs</td>
<td>a) 79 lbs b) 87 lbs</td>
<td>a) N/A b) 67 lbs c) 87 lbs d) 79 lbs e) 87 lbs</td>
<td>a) 79 lbs b) 87 lbs</td>
<td>135 lbf</td>
<td>135 lbf</td>
<td>135 lbf</td>
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<tr>
<td>Minimum Burn Time</td>
<td>a) 1.0 sec b) 0.85 sec</td>
<td>a) 1.0 sec b) 0.85 sec</td>
<td>a) 1.3 sec b) 1.25 sec</td>
<td>a) N/A b) 1.0 sec c) .85 sec d) 1.3 sec e) 1.25 sec</td>
<td>a) 1.3 sec b) 1.25 sec</td>
<td>1.7 sec</td>
<td>1.7 sec</td>
<td>1.7 sec</td>
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<tr>
<td>Service life</td>
<td>a) 12 years b) 13 years</td>
<td>a) 12 years b) 13 years</td>
<td>a) 12 years b) 13 years</td>
<td>a) N/A b) 12 years c) 13 years d) 12 years e) 13 years</td>
<td>a) 12 years b) 13 years</td>
<td>12 years</td>
<td>12 years</td>
<td>12 years</td>
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</tbody>
</table>

(1) All weights are approximate and include appropriate rocket. Overall system weights will increase with inclusion of activation assembly, mounting hardware, and attachment bridles.

(2) All dimensions are approximate and do not include appropriate rocket, frame (softpack only), and rocket mount.
### CUSTOMER LOADS DETERMINATION WORKSHEET

**AIRCRAFT NAME:**

**MANUFACTURER:**

<table>
<thead>
<tr>
<th>AIRCRAFT SPECIFICATIONS</th>
<th>VALUE</th>
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<tbody>
<tr>
<td>Maximum Gross Takeoff Weight</td>
<td></td>
</tr>
<tr>
<td>Cruise Speed (specify units)</td>
<td></td>
</tr>
<tr>
<td>(Vne) Speed (specify units)</td>
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</tr>
<tr>
<td>Wingspan</td>
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<table>
<thead>
<tr>
<th>REQUIRED MEASUREMENTS</th>
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<tbody>
<tr>
<td>DIM 1 (Horz. Distance from aircraft CG to Front Attachment Point)</td>
<td></td>
</tr>
<tr>
<td>DIM 2 (Vert. Distance from aircraft CG to Front Attachment Point)</td>
<td></td>
</tr>
<tr>
<td>DIM 3 (Horz. Distance from aircraft CG to Rear Attachment Point)</td>
<td></td>
</tr>
<tr>
<td>DIM 4 (Vert. Distance from aircraft CG to Rear Attachment Point)</td>
<td></td>
</tr>
<tr>
<td>DIM 5 (Horz. Distance from Front Attachment Point to Aft of Tail)</td>
<td></td>
</tr>
<tr>
<td>DIM 6 (If Known, Existing Front Harness Length)</td>
<td></td>
</tr>
<tr>
<td>DIM 7 (If Known, Existing Rear Harness Length)</td>
<td></td>
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</table>