RMS™ Reloadable Motor System

Performance, Reliability, Flexibility, Availability ... at Half the Price!

Thousands of Flights!

Because RMS™ motors are of modular design, each reliable and durable motor can use a variety of RMS™ reload kits. Each RMS™ motor can also be varied in length to give you a greater range of performance options.

Now you can enjoy high power rocketry at greatly reduced cost, improved reliability and enhanced flexibility with the RMS™ Reloadable Motor System from INDUSTRIAL SOLID PROPULSION, INC. Using professional rocket motor technology, ISP™ makes the reloadable rocket motor with integral delay and ejection charge a reality.

Each RMS™ precision machined anodized aluminum motor can be flown again and again with easy to use reload kits. The AEROTECH™ WHITE LIGHTNING™, BLUE THUNDER™ and BLACK JACK™ propellant formula reload kits are about one-half the price of currently available “throwaway” motors!

RMS™ means unprecedented consumer interaction and enjoyment!

The RMS™ product line may be shipped via “UPS ground”. This eliminates the inconvenience and expense of Federal Express shipping as required for Class “B” explosives.

Send $5.00 for a complete catalog including a list of RMS™ dealers to:
Industrial Solid Propulsion, Inc. 1955 S. Palm St., Suite #15 Las Vegas, NV 89104 (702) 641-2302

INDUSTRIAL
SOLID
PROPULSION
Inc.
RELOADABLE MOTOR SYSTEM DESCRIPTION, SPECIFICATIONS & PRICE LIST
2/26/91

To all High-Power Rocketry Enthusiasts:

We would like to take this time to inform you of an exciting new product line that has been in the works for several years here at ISP. Industrial Solid Propulsion, Inc. is the parent company of AeroTech, Inc. and has been in business since 1985. We specialize in designing & manufacturing high-reliability rocket motors for commercial, industrial & military customers. These motors are used in diverse applications ranging from emergency parachute deployment for light civilian aircraft to boosters for remotely-piloted vehicles (RPV's) to guidance & control motors for the recently launched Pegasus space booster. ISP now offers this expertise to the high-power sport rocketry market.

ISP has recently introduced a line of reloadable high-power rocket motors based on technology that was developed for our professional programs. We refer to this product as the Reloadable Motor System (RMS). A typical designation for a motor would be RMS-29/180. The '29' refers to the motor diameter in millimeters. The '180' refers to the baseline total impulse of the motor. The exact delivered total impulse will vary somewhat depending on the propellant and grain design used. We intend to offer several different grain designs for these motors in the near future.

All these motors feature precision-machined anodized aluminum hardware, AeroTech's "White Lightning", "Blue Thunder" and "Blackjack" core/end burning propellant as the initial grain configurations for the line, AeroTech's "Copperhead" igniters, a disposable insulation system & nozzle insert, pressure safety margins of 300-500%, and fast & easy assembly. But the most important advantages of the system are:

* Motor "reload kits" (RK's) may be shipped by UPS ground as a Flammable Solid! No expensive Federal Express shipping required!

* The retail price of most reload kits has been established at about one-half that of many currently available "disposable" motors!

* Safety and reliability are greatly enhanced by use of high-margin hardware and proven designs.

* Unprecedented consumer interaction and enjoyment!

1955 S. PALM ST., SUITE 15 • LAS VEGAS, NV 89104 • (702) 641-2302
The Reloadable Motor System was successfully demonstrated at last years Black Rock II launch near Gerlach, Nevada, at LDRS-9 near Hartsel, Colorado, and at many launches since then. Consumer response has been overwhelming! The Tripoli Board of Directors voted to allow the use of reloadable motors by their membership based on a second-level confirmation process for a 6 month trial period last August. This trial period is now over and we are pleased to announce that reloadable motors may now be purchased and flown in the same manner as disposable motors!

Motors may be ordered in three ways. The first is to purchase the complete system for a particular motor diameter, say, 29mm. This would include one each forward & aft closure and one of each length casing, in this example the 180 & 240 N-sec. cases. The second is to purchase one complete motor (one each case, forward & aft closure). The third is to order the parts individually. This is primarily intended for those who want to add on to an existing system or to replace lost or damaged components: there is a 20% savings associated with purchasing a complete motor or system.

A smoke-producing time delay element and related material is supplied with each reload kit, and the delay time required must be specified when placing an order. Future developments will include the addition of separate delay kits so that the user has a choice of time delay at the launch site to suit specific flying conditions.

The following are a few commonly-asked questions about the system, and their answers:

Q. How is the RMS system assembled?
A. The internal components are loaded into the motor case and the end closures are threaded on. No tools are required.

Q. Is there a danger of the RMS case producing "shrapnel" if it fails?
A. No. The RMS case is made from a highly ductile aluminum alloy. If the unlikely event of overpressure exceeding the design limits should occur, the motor is engineered to blow out the nozzle insert.

Q. How many times can the RMS system be reloaded?
A. An indefinite number of times, as long as the hardware remains undamaged.

Q. How hot does the RMS get? Will it damage my motor mount tube?
A. The typical RMS stays below 200 deg. F during operation. Most "disposable" motors operate in the 300-400 deg. F range.
Q. How long does it take to assemble an RMS?
A. Most motors can be assembled in less than 10 minutes.

Q. Is the ejection charge provided?
A. Yes. It is shipped in a small capsule which is opened and dispensed into the ejection charge well of the motor.

Q. Is the RMS heavier than a comparable "throwaway" motor?
A. Depending on the motor type, the equivalent RMS motor will be 0-20% heavier than a standard motor. Rockets should be checked for their static stability margins before flying with an RMS.

Q. Aren't metal motors forbidden by the Tripoli safety code? What about NFPA 1122?
A. No in both cases. Metal airframes are prohibited by the Tripoli safety code, but not metal motors. There is a section in the code which does not allow reloading of a motor once spent, but this was intended to discourage reloading of "disposable" motors. We will be working closely with Tripoli to clarify and further define the code for reloadable motors. Tripoli is exempt from the provisions of NFPA 1122, which currently deal with the construction requirements for model rockets & motors. This will also be redefined in the near future.

We welcome your questions and comments about the RMS system. Feel free to call us if you would like to discuss them. I think you will agree that this is one of the most significant developments in high-power rocketry since its inception and one that presents many challenges and opportunities for all of us.

We appreciate your business and look forward to serving you!

Sincerely,

Gary Rosenfield
President, Industrial Solid Propulsion, Inc.

GCR/dms

enclosures
NOTES:
THIS MOTOR IS HEAVIER THAN AN EQUIVALENT POWER EXPENDABLE MOTOR. THE CENTER OF GRAVITY CENTER OF PRESSURE RELATIONSHIP SHOULD BE CALCULATED TO ENSURE ADEQUATE STATIC STABILITY MARGINS FOR FLIGHT APPLICATIONS.

TESTS:
WEIGHTS
- EMPTY LOADED 1.90 IN
- X E.G. LOADED 1.90 IN
- X E.G. EXPENDED 1.96 IN
- TOTAL: 112.210

PROPELLANT DATA
- T0: 3500 °R
- MOLECULAR WT: 272.982
- G: 1.137
- DENSITY: .0006 lb/in³
- C: 4236 ft/sec
- n: .0120 in/SEC
- .4490

PRELIMINARY THRUST VS. TIME CURVE

PRELIMINARY PERFORMANCE DATA
- AVERAGE THRUST: 5.84 Lb
- MAX THRUST: 7.50 Lb
- TOTAL IMPULSE: 13.88 Lb-SEC
- BURN TIME: 1.84 SEC
- AVERAGE PRESSURE: 510 PSI
- MAX PRESSURE: 644 PSI

RELOADABLE MOTOR
C: RMS-29/60
NOTES:
- This motor is heavier than an equivalent power expendable motor. The center of gravity should be calculated to ensure adequate static stability for flight applications.
- Center of pressure relationship.

WEIGHTS:
- C.G. Distance from head end:
  - X.g. Loaded: 2.39 in
  - X.g. Expended: 2.46 in

6225 Propellant Data:
- X: 3.692 °R
- Molecular Wt.: 27.252
- Gamma: 1.137
- Density: 0.066 lb/in³
- C+: 423 ft/sec
- E: 0.120 in/sec
- n: 0.4455

PRELIMINARY THRUST VS. TIME CURVES
PRELIMINARY PERFORMANCE DATA
- Average thrust: 10.78 lb
- Max. thrust: 14.35 lb
- Total impulse: 19.1 lb-sec
- Burn time: 1.76 sec
- Average pressure: 520 PSI
- Max. pressure: 671 PSI
NOTES:
THIS MOTOR IS HARDER THAN AN EQUIVALENT POWER EXPENDABLE MOTOR. THE CENTER OF GRAVITY/ CENTER OF PRESSURE RELATIONSHIP SHOULD BE CALCULATED TO ENSURE ADEQUATE STATIC STABILITY MARGINS FOR FLIGHT APPLICATIONS.

WEIGHTS:

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C.G. DISTANCE FROM HEAD END:

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8225 PROPELLANT DATA:

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PRELIMINARY THRUST VS. TIME CURVE:

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REVISIONS:

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RELOADABLE MOTOR:

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NOTES: THIS MOTOR IS HEAVIER THAN AN EQUIVALENT POWER EXPENDABLE MOTOR; THE CENTER OF GRAVITY/CENTER OF PRESSURE RELATIONSHIP SHOULD BE CALCULATED TO ENSURE ADEQUATE STATIC STABILITY. MARKING FOR FLIGHT APPLICATIONS.

WEIGHTS

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<td>7.02 IN</td>
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TOTAL: 1196.8 IB

8225 PROPPELLANT DATA

T* 3502 °R
MOLAR WEIGHT 27.252
GAMMA 1.17
DENSITY 0.066 LB/IN^3
C 4325 FT/SEC
n 0.0120 IN/SEC

PRELIMINARY THRUST VS. TIME CURVE

PRELIMINARY PERFORMANCE DATA

AVG. THRUST 421 N
MAX. THRUST 464 N
TOTAL IMPULSE 1205 N-SEC
BURN TIME 2.89 SEC
AVG. PRESSURE 528 PSI
MAX. PRESSURE 614 PSI

RELOADABLE MOTOR

C RMS-54/1280
Assembly and Operation Instructions

DO NOT OPEN RELOAD KIT UNTIL READY TO USE.

PARTS:

RELOADABLE MOTOR SYSTEM

Aft closure 1
Case 1
Forward closure 1
O-ring grease 1 tube

RELOAD KIT

Nozzle 1
Liner 1
Propellant grains *
Thin (aft) O-ring (1/16" thick X 1" dia.) 1
Thick (fwd) O-ring (3/32" thick X 1" dia.) 1
Outer delay O-ring (5/8" O.D.) 1
Inner delay O-ring (1/2" O.D.) 1
Delay element 1
Delay insulators 2
Forward & aft insulators (1" O.D.) 2
Delay spacer ring(s) (5/8" O.D.) 0,1 or 2
Ejection charge container 1
Ejection charge cap 1
COPPERHEAD™ igniter 1
Nozzle cap igniter holder 1
Pre-moistened towelette 1
Thermalite igniter booster ("H" only) 1

* Number of grains will vary depending on motor size.

SAVE THE RELOAD KIT PLASTIC BAG FOR THE USED RELOAD PARTS. DISPOSE OF THE PLASTIC BAG AND USED PARTS PROPERLY.

ALSO NEEDED FOR ASSEMBLY:

• 3/4" wide masking tape

BEFORE YOU BEGIN:

• Study the illustrations and sequence of assembly.

THE SEQUENCE OF ASSEMBLY IS EXTREMELY IMPORTANT. Review the parts list and become familiar with all parts before assembly. If any parts are missing or damaged, contact ISP™ at 1-800-752-8018.

• DO NOT MODIFY THE MOTOR IN ANY WAY. Modification of the motor or the reload kit parts could result in motor failure and lead to the destruction of both your rocket and motor. Modification of the motor or reload kit in any way will invalidate your motor warranty.

• USE ONLY ISP™ RELOAD KITS AND MOTOR PARTS TO REFURBISH YOUR RMS™. The ISP™ reload kits have been designed specifically for use in your particular ISP™ motor. Use of imitation components may destroy your motor, rocket and payload and will invalidate your motor warranty. Only use ISP™ reload kits intended for your specific ISP™ motor. DO NOT INTERCHANGE PARTS! Do not use ISP™ reload kits or motor components for any other purpose than to refurbish an ISP™ RMS™ motor.

• DO NOT REUSE ANY OF THE DISPOSABLE PARTS OF THE RMS™ RELOAD KIT. This includes the liner, nozzle insert and O-rings. These components have been designed for one use only and must be discarded after firing. Reuse can result in motor failure during subsequent operation and will invalidate your motor warranty.

• DO NOT USE ANY PARTS OF THE RMS™ SYSTEM THAT ARE DAMAGED IN ANY WAY. If in doubt, contact ISP™ at the number above for assistance.

• Motors are hot after firing. Although the RMS™ operates at a lower temperature than most disposable motors, the higher thermal conductivity of the aluminum motor parts may make it seem otherwise. If necessary to handle a motor before it has cooled down, use a rag or similar article.

• Read and follow the safety code of the Tripoli Rocketry Association (TRA) and comply with all federal, state and local laws in all activities with high power rockets.
FORWARD CLOSURE

1. Fig.-1: Apply a light coat of grease to the threads of the forward closure. This will facilitate assembly and prevent the threads from seizing.

2. Fig.-2: Insert both delay insulators into the cavity in the forward closure such that the chamfered inner edges face the outside of the cavity.

3. Fig.-3: Apply a light coat of grease to the inner and outer delay O-rings. Then drop the O-rings into the delay charge cavity. Be sure they are seated on the bottom. Also check that the O-rings are concentric with each other.

4. Fig.-4: With the delay cavity facing up, gently press the delay element into the cavity until it stops. Install the delay spacer ring(s), if provided, on top of the delay element. The delay element or delay spacer ring should protrude 1/32" to 1/16" above the delay insulator.

5. Fig.-5: Apply a light coat of grease to the threads of both ends of the motor case. Thread the forward closure assembly into one end of the motor case until it stops. DO NOT OVERTIGHTEN. Check to see that the delay spacer ring(s), if used, remain in the forward closure.

CENTRAL COMPONENTS

1. Fig.-6: Apply a light coat of grease to the thick 1" diameter (forward) O-ring. Drop the forward O-ring into the motor case. Be sure it is seated against the forward closure. (NOTE: If necessary, use the liner as a tool to help push the O-ring into position.)

2. Fig.-7: Drop the forward insulator into the motor case. Be sure it is seated against the thick (forward) O-ring and the forward closure.
3. Fig.-8: Insert the liner into the motor case and push it against the forward insulator. *(NOTE: If the liner does not fit into the case snugly, wrap a layer of masking tape around each end of the liner.)*

4. Fig.-9: Install the propellant grains into the liner.

**AFT END ASSEMBLY**

1. Fig.-10: Push the aft insulator into the motor case until it is seated against the end of the liner.

2. Fig.-11: Drop the nozzle insert into the motor case. Be sure it is seated against the aft insulator.

3. Fig.-12: Apply a light coat of grease to the thin 1" diameter (aft) O-ring. Place the aft O-ring into the matching groove in the nozzle insert.

4. Fig.-13: Apply a light coat of grease to the threads of the aft closure. Thread the aft closure into the motor case until it stops. DO NOT OVERTIGHTEN. There should be some resistance to threading in the closure during the last 1/32" to 1/16" of travel.

**EJECTION CHARGE INSTALLATION**

1. Fig.-14: Thoroughly clean the entire outside surface of the motor of any grease or other residue. Open the ejection charge container and dispense enough ejection charge into the ejection charge well of the forward closure to fill the well approximately 3/4 full.
EJECTION CHARGE INSTALLATION (CONT.)

2. Fig. -15: Apply the ejection charge cap to the center of the end of the forward closure over the ejection charge well. Put a layer of tape around the seam where the forward closure meets the motor case. **NOTE:** This tape layer is to discourage you or someone else from loosening the forward closure after the ejection charge has been put in the forward closure. Do not loosen the forward or aft closures once the ejection charge has been loaded. Loosening the closures can cause ejection charge to leak under the delay O-rings and lead to seal failure. If it becomes necessary to disassemble the motor before it is fired, remove the ejection charge, delay element and delay O-rings and reinstall per instructions prior to launch.

PREPARATION FOR FLIGHT

Fig.-16

1. Fig. -16: Attach the thermalite igniter booster (if supplied) to the coated end of the COPPERHEAD™ igniter using a small piece of masking tape.

2. Insert the coated end of the COPPERHEAD™ igniter into the motor nozzle until it stops against the delay element.

3. Push the nozzle cap igniter holder over the nozzle insert until it stops.

4. Install the motor into the rocket's motor mount tube. Secure the motor into the rocket and prevent it from being ejected at the time of ejection charge firing by using a motor hook, friction fit or wrapping tape around the junction of the motor with the rocket motor tube.

5. Prepare the rocket's recovery system and then launch the rocket in the normal manner.

POST RECOVERY CLEAN-UP

**NOTE:** Perform motor clean-up as soon as possible after motor firing. Propellant and delay residues become difficult to remove after 24 hours and could lead to corrosion of the metal parts. Place the spent motor components in the reload kit plastic bag and dispose of properly.

1. After the motor has cooled down, remove the forward and aft closures.

2. Remove the delay insulator and O-rings from the forward closure and discard. Discard the nozzle insert and aft O-ring. Using the pre-moistened towelette, remove all delay and propellant residue from the closures.

3. Remove the liner and aft and forward insulators from the casing and discard. Using the towelette, wipe the inside of the casing to remove all propellant residue.

4. Apply a light coat of grease to all threads. Reassemble metal parts and store motor in a dry place.

**NOTICE:** ISP™ certifies that it has exercised reasonable care in the design and manufacture of its products. As we cannot control the storage and use of our products, once sold we cannot assume any responsibility for product storage, transportation or usage. ISP™ shall not be held responsible for any personal injury or property damage resulting from the handling, storage or use of our product. The buyer assumes all risks and liabilities therefrom and accepts and uses ISP™ products on these conditions.

Industrial Solid Propulsion Inc.
Las Vegas, NV 89104

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Made in U.S.A.
BEFORE YOU BEGIN:

- Study the illustrations and sequence of assembly. THE SEQUENCE OF ASSEMBLY IS EXTREMELY IMPORTANT. Review the parts list and become familiar with all parts before assembly. If any parts are missing or damaged, contact ISP™ at 1-800-752-8018.

- DO NOT MODIFY THE MOTOR IN ANY WAY. Modification of the motor or the reload kit parts could result in motor failure and lead to the destruction of both your rocket and motor. Modification of the motor or reload kit in any way will invalidate your motor warranty.

- USE ONLY ISP™ RELOAD KITS AND MOTOR PARTS TO REFURBISH YOUR RMS™. The ISP™ reload kits have been designed specifically for use in your particular ISP™ motor. Use of imitation components may destroy your motor, rocket and payload and will invalidate your motor warranty. Only use ISP™ reload kits intended for your specific ISP™ motor. DO NOT INTERCHANGE PARTS! Do not use ISP™ reload kits or motor components for any other purpose than to refurbish an ISP™ RMS™ motor.

- DO NOT REUSE ANY OF THE DISPOSABLE PARTS OF THE RMS™ RELOAD KIT. This includes the liner, nozzle insert and O-rings. These components have been designed for one use only and must be discarded after firing. Reuse can result in motor failure during subsequent operation and will invalidate your motor warranty.

- DO NOT USE ANY PARTS OF THE RMS™ SYSTEM THAT ARE DAMAGED IN ANY WAY. If in doubt, contact ISP™ at the number above for assistance.

- Motors are hot after firing. Although the RMS™ operates at a lower temperature than most disposable motors, the higher thermal conductivity of the aluminum motor parts may make it seem otherwise. If necessary to handle a motor before it has cooled down, use a rag or similar article.

- Read and follow the safety code of the Tripoli Rocketry Association (TRA) and comply with all federal, state and local laws in all activities with high power rockets.

DO NOT OPEN RELOAD KIT UNTIL READY TO USE.

PARTS:

RELOADABLE MOTOR SYSTEM

- Aft closure
- Case
- Forward closure
- O-ring grease

1 tube

RELOAD KIT

- Nozzle
- Liner
- Propellant grains
- Thick (aft) O-ring (3/16" thick X 1-3/8" O.D.)
- Thin (fwd) O-ring (1/8" thick X 1-3/8" O.D.)
- Outer delay O-ring (5/8" O.D.)
- Inner delay O-ring (1/2" O.D.)
- Delay element
- Delay insulators
- Forward & aft insulators (1-3/8" O.D.)
- Delay spacer ring(s) (5/8" O.D.)
- Ejection charge container
- Ejection charge cap
- COPPERHEAD™ igniter
- Nozzle cap igniter holder
- Pre-moistened towelette
- Thermalite igniter booster

* Number of grains will vary depending on motor size.

SAVE THE RELOAD KIT PLASTIC BAG FOR THE USED RELOAD PARTS. DISPOSE OF THE PLASTIC BAG AND USED PARTS PROPERLY.

ALSO NEEDED FOR ASSEMBLY:

- 3/4" wide masking tape
FORWARD CLOSURE

1. Fig.-1: Apply a light coat of grease to the threads of the forward closure. This will facilitate assembly and prevent the threads from seizing.

2. Fig.-2: Insert both delay insulators into the cavity in the forward closure such that the chamfered inner edges face the outside of the cavity.

3. Fig.-3: Apply a light coat of grease to the inner and outer delay O-rings. Then drop the O-rings into the delay charge cavity. Be sure they are seated on the bottom. Also check that the O-rings are concentric with each other.

4. Fig.-4: With the delay cavity facing up, gently press the delay element into the cavity until it stops. Install the delay spacer ring(s), if provided, on top of the delay element. The delay element or delay spacer ring should protrude 1/32" to 1/16" above the delay insulator.

5. Fig.-5: Apply a light coat of grease to the threads of both ends of the motor case. Thread the forward closure assembly into one end of the motor case until it stops. DO NOT OVERTIGHTEN. Check to see that the delay spacer ring(s), if used, remain in the forward closure.

CENTRAL COMPONENTS

1. Fig.-6: Apply a light coat of grease to the thin 1-3/8" diameter (forward) O-ring. Drop the forward O-ring into the motor case. Be sure it is seated against the forward closure. (NOTE: If necessary, use the liner as a tool to help push the O-ring into position.)

2. Fig.-7: Drop the forward insulator into the motor case. Be sure it is seated against the thin (forward) O-ring and the forward closure.
3. Fig.-8: Insert the liner into the motor case and push it against the forward insulator. (NOTE: If the liner does not fit into the case snugly, wrap a layer of masking tape around the end of the liner that will be next to the forward closure.)

4. Fig.-9: Install the propellant grains into the liner.

**AFT END ASSEMBLY**

1. Fig.-10: Push the aft insulator into the motor case until it is seated against the end of the liner.

2. Fig.-11: Apply a light coat of grease to the thick 1-3/8" diameter (aft) O-ring. Drop the aft O-ring into the motor case. Be sure it is seated against the aft insulator.

3. Fig.-12: Push the nozzle insert into the aft O-ring and against the aft insulator.

4. Fig.-13: Apply a light coat of grease to the threads of the aft closure. Thread the aft closure into the motor case until it stops. **DO NOT OVERTIGHTEN.** There should be some resistance to threading in the closure during the last 1/32" to 1/16" of travel.

**EJECTION CHARGE INSTALLATION**

1. Fig.-14: Thoroughly clean the entire outside surface of the motor of any grease or other residue. Open the ejection charge container and dispense enough ejection charge into the ejection charge well of the forward closure to fill the well approximately 3/4 full.
2. Fig.-15: Apply the ejection charge cap to the center of the end of the forward closure over the ejection charge well. Put a layer of tape around the seam where the forward closure meets the motor case. (NOTE: This tape layer is to discourage you or someone else from loosening the forward closure after the ejection charge has been put in the forward closure. Do not loosen the forward or aft closures once the ejection charge has been loaded. Loosening the closures can cause ejection charge to leak under the delay O-rings and lead to seal failure. If it becomes necessary to disassemble the motor before it is fired, remove the ejection charge, delay element and delay O-rings and reinstall per instructions prior to launch.)

PREPARATION FOR FLIGHT

Fig.-16

1. Fig. - 16: Attach the thermalite igniter booster to the coated end of the COPPERHEAD™ igniter using a small piece of masking tape.

2. Insert the coated end of the COPPERHEAD™ igniter into the motor nozzle until it stops against the delay element.

3. Push the nozzle cap igniter holder over the nozzle insert until it stops.

POST RECOVERY CLEAN-UP

NOTE: Perform motor clean-up as soon as possible after motor firing. Propellant and delay residues become difficult to remove after 24 hours and could lead to corrosion of the metal parts. Place the spent motor components in the reload kit plastic bag and dispose of properly.

1. After the motor has cooled down, remove the forward and aft closures.

2. Remove the delay insulator and O-rings from the forward closure and discard. Discard the nozzle insert and aft O-ring. Using the pre-moistened towelette, remove all delay and propellant residue from the closures.

3. Remove the liner and aft and forward insulators from the casing and discard. Using the towelette, wipe the inside of the casing to remove all propellant residue.

4. Apply a light coat of grease to all threads. Reassemble metal parts and store motor in a dry place.

NOTICE: ISP™ certifies that it has exercised reasonable care in the design and manufacture of its products. As we cannot control the storage and use of our products, once sold we cannot assume any responsibility for product storage, transportation or usage. ISP™ shall not be held responsible for any personal injury or property damage resulting from the handling, storage or use of our product. The buyer assumes all risks and liabilities therefrom and accepts and uses ISP™ products on these conditions.

No warranty either expressed or implied is made regarding ISP™ products, except for replacement or repair, at ISP™ option, of those products which are proven to be defective in manufacture within one year from the date of original purchase. For repair or replacement under this warranty, please contact ISP™. Proof of purchase will be required. Note: Your state may provide additional rights not covered by this warranty.

Industrial Solid Propulsion Inc.
Las Vegas, NV 89104

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RELOADABLE MOTOR SYSTEM

Assembly and Operation Instructions

BEFORE YOU BEGIN:

- Study the illustrations and sequence of assembly.

THE SEQUENCE OF ASSEMBLY IS EXTREMELY IMPORTANT. Review the parts list and become familiar with all parts before assembly. If any parts are missing or damaged, contact ISP™ at 1-800-752-8018.

- DO NOT MODIFY THE MOTOR IN ANY WAY. Modification of the motor or the reload kit parts could result in motor failure and lead to the destruction of both your rocket and motor. Modification of the motor or reload kit in any way will invalidate your motor warranty.

- USE ONLY ISP™ RELOAD KITS AND MOTOR PARTS TO REFURBISH YOUR RMS™. The ISP™ reload kits have been designed specifically for use in your particular ISP™ motor. Use of imitation components may destroy your motor, rocket and payload and will invalidate your motor warranty. Only use ISP™ reload kits intended for your specific ISP™ motor. DO NOT INTERCHANGE PARTS! Do not use ISP™ reload kits or motor components for any other purpose than to refurbish an ISP™ RMS™ motor.

- DO NOT REUSE ANY OF THE DISPOSABLE PARTS OF THE RMS™ RELOAD KIT. This includes the liner, nozzle insert and O-rings. These components have been designed for one use only and must be discarded after firing. Reuse can result in motor failure during subsequent operation and will invalidate your motor warranty.

- DO NOT USE ANY PARTS OF THE RMS™ SYSTEM THAT ARE DAMAGED IN ANY WAY. If in doubt, contact ISP™ at the number above for assistance.

- Motors are hot after firing. Although the RMS™ operates at a lower temperature than most disposable motors, the higher thermal conductivity of the aluminum motor parts may make it seem otherwise. If necessary to handle a motor before it has cooled down, use a rag or similar article.

- Read and follow the safety code of the Tripoli Rocketry Association (TRA) and comply with all federal, state and local laws in all activities with high power rockets.

DO NOT OPEN RELOAD KIT UNTIL READY TO USE.

PARTS:

RELOADABLE MOTOR SYSTEM

Aft closure 1
Case 1
Forward closure 1
O-ring grease 1 tube
Nozzle adapter ring 1

RELOAD KIT

Nozzle 1
Liner 1
Propellant grains
Thick (aft) O-ring (1/8" thick X 2" O.D.) 1
Thick (fwd) O-ring (1/8" thick X 2" O.D.) 1
Linier O-ring (2" O.D. X 1/16") 1
Outer delay O-ring (1/16" X 1" O.D.) 1
Inner delay O-ring (1/16" X 7/8" O.D.) 1
Delay element 1
Delay insulator 1
Thermalite igniter booster 1
Forward and aft insulators (2" O.D. phenolic washer(s) with 5/8" hole) 2
Delay spacer ring(s) (small fiber washer(s) or paper ring) varies
Ejection charge container 1
Ejection charge cap 1
COPPERHEAD™ igniter 1
Nozzle cap igniter holder 1
Pre-moistened towelettes 2

* Number of grains will vary depending on motor size.

SAVE THE RELOAD KIT PLASTIC BAG FOR THE USED RELOAD PARTS. DISPOSE OF THE PLASTIC BAG AND USED PARTS PROPERLY.

ALSO NEEDED FOR ASSEMBLY:

- 3/4" wide masking tape
FORWARD CLOSURE

1. Fig.-1: Apply a light coat of grease to the threads of the forward closure. This will facilitate assembly and prevent the threads from seizing.

2. Fig.-2: Insert the delay insulator into the cavity in the forward closure as shown.

3. Fig.-3: Apply a light coat of grease to the inner and outer delay O-rings. Then drop the O-rings into the delay charge cavity. Be sure they are seated on the bottom. Also check that the O-rings are concentric with each other.

4. Fig.-4: With the delay cavity facing up, gently press the delay element into the cavity until it stops. Install the delay spacer ring(s), if provided, on top of the delay element. The delay element or delay spacer ring should protrude 1/32" to 1/16" above the delay insulator.

5. Fig.-5: Apply a light coat of grease to the threads of both ends of the motor case. Thread the forward closure assembly into one end of the motor case until it stops. DO NOT OVERTIGHTEN. Check to see that the delay spacer ring(s), if used, remain in the forward closure.

CENTRAL COMPONENTS

1. Fig.-6: Apply a light coat of grease to the thick 2" diameter (forward) O-ring. Drop the forward O-ring into the motor case. Be sure it is seated against the forward closure. (NOTE: If necessary, use the liner as a tool to help push the O-ring into position.)

2. Fig.-7: Drop the forward insulator into the motor case. Be sure it is seated against the thick (forward) O-ring and the forward closure.

3. Fig.-8: Apply a light coat of grease to the thin 2" diameter liner O-ring. Drop the liner O-ring into the motor case until it is seated against the forward insulator. (NOTE: If necessary, use the liner as a tool to help push the O-ring into position.)
4. Fig.-9: Insert the liner into the motor case and push it against the forward insulator. (NOTE: If the liner does not fit into the case snugly, wrap a layer of masking tape around forward end of the liner.)

5. Fig.-10: Install the propellant grains into the liner.

AFT END ASSEMBLY

1. Fig.-11: Push the aft insulator into the motor case until it is seated against the end of the liner.

2. Fig.-12: Place the nozzle adapter ring into the motor case so that it is seated against the aft insulator.

3. Fig.-13: Drop the nozzle insert into the motor case. Be sure it is seated against the aft insulator.

4. Fig.-14: Apply a light coat of grease to the thick 2" diameter (aft) O-ring. Place the aft O-ring into the matching groove in the nozzle insert.

5. Fig.-15: Apply a light coat of grease to the threads of the aft closure. Thread the aft closure into the motor case until it stops. DO NOT OVERTIGHTEN. There should be some resistance to threading in the closure during the last 1/32" to 1/16" of travel.

EJECTION CHARGE INSTALLATION

1. Fig.-16: Thoroughly clean the entire outside surface of the motor of any grease or other residue. Open the ejection charge container and dispense enough ejection charge into the ejection charge well of the forward closure to fill the well approximately 3/4 full.
EJECTION CHARGE INSTALLATION (CONT.)

2. Fig.-17: Apply the ejection charge cap to the center of the end of the forward closure over the ejection charge well. Put a layer of tape around the seam where the forward closure meets the motor case. (NOTE: This tape layer is to discourage you or someone else from loosening the forward closure after the ejection charge has been put in the forward closure. Do not loosen the forward or aft closures once the ejection charge has been loaded. Loosening the closures can cause ejection charge to leak under the delay O-rings and lead to seal failure. If it becomes necessary to disassemble the motor before it is fired, remove the ejection charge, delay element and delay O-rings and reinstall per instructions prior to launch.)

PREPARATION FOR FLIGHT

1. Fig.-18: Bend the thermalite igniter booster as shown and tape it to the coated end of the COPPERHEAD™ igniter using a small piece of masking tape.

2. Fig.-19: Insert the coated end of the COPPERHEAD™ igniter into the center motor nozzle until it stops against the delay element.

3. Push the nozzle cap igniter holder over the nozzle insert until it stops.

POST RECOVERY CLEAN-UP

NOTE: Perform motor clean-up as soon as possible after motor firing. Propellant and delay residues become difficult to remove after 24 hours and could lead to corrosion of the metal parts. Place the spent motor components in the reload kit plastic bag and dispose of properly.

1. After the motor has cooled down, remove the forward and aft closures.

2. Remove the delay insulator and O-rings from the forward closure and discard. Discard the nozzle insert and aft O-ring. Using the pre-moistened towelette, remove all delay and propellant residue from the closures.

3. Remove the liner and aft and forward insulators from the casing and discard. Using the towelette, wipe the inside of the casing to remove all propellant residue.

4. Apply a light coat of grease to all threads. Reassemble metal parts and store motor in a dry place.

NOTICE: ISP™ certifies that it has exercised reasonable care in the design and manufacture of its products. As we cannot control the storage and use of our products, once sold we cannot assume any responsibility for product storage, transportation or use. ISP™ shall not be held responsible for any personal injury or property damage resulting from the handling, storage or use of our product. The buyer assumes all risks and liabilities therefrom and accepts and uses ISP™ products on these conditions.

Industrial Solid Propulsion Inc.
Las Vegas, NV 89104

No warranty either expressed or implied is made regarding ISP™ products, except for replacement or repair, at ISP’s™ option, of those products which are proven to be defective in manufacture within one year from the date of original purchase. For repair or replacement under this warranty, please contact ISP. Proof of purchase will be required. Note: Your state may provide additional rights not covered by this warranty.

Made in U.S.A.
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ISP RELOADABLE MOTOR SYSTEM (RMS) RETAIL PRICE LIST

DESCRIPTION

MOTORS & MOTOR PARTS

Precision machined from high-strength aircraft aluminum alloy

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>RETAIL PRICE</th>
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<tbody>
<tr>
<td><strong>1-1/8&quot; (29mm) Dia. Reloadable Motor Systems</strong></td>
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<tr>
<td><strong>Complete Systems</strong></td>
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</tr>
<tr>
<td>Includes one forward &amp; one aft closure, casings for 60 &amp; 100 newton-seconds, CAT.# RMS-29/60-100</td>
<td>$102.00</td>
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<tr>
<td>Includes one forward &amp; one aft closure, casings for 180 &amp; 240 newton-seconds, CAT.# RMS-29/180-240</td>
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<td>W/time delay &amp; ejection charge cavities, CAT.# RMS-29FCE</td>
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**1-1/2" (38mm) Dia. Reloadable Motor System**

**Complete System (Does not include case for 600 newton-seconds)**

Includes one forward & one aft closure, casings for 240, 360 & 480 newton seconds, CAT.# RMS-38/240-480 | $198.00
Complete Motors

Approx. 240 N-sec., CAT.# RMS-38/240 $114.00
Approx. 360 N-sec., CAT.# RMS-38/360 116.00
Approx. 480 N-sec., CAT.# RMS-38/480 118.00
Approx. 600 N-sec., CAT.# RMS-38/600 120.00

Motor Parts

Forward closure
W/time delay & ejection charge cavities, CAT.# RMS-38FCE 49.00
Aft closure for 1.000” dia. nozzle insert, CAT.# RMS-38AC 42.00
Case for approx. 240 N-sec., CAT.# RMS-38C-240 46.00
Case for approx. 360 N-sec., CAT.# RMS-38C-360 49.00
Case for approx. 480 N-sec., CAT.# RMS-38C-480 51.00
Case for approx. 600 N-sec., CAT.# RMS-38C-600 55.00

2-1/8” (54mm) Dia. Reloadable Motor System

Complete System

Includes one forward & one aft closure, casings for 852, 1280 & 1706 newton-seconds, CAT.# RMS-54/852-1706 $295.00

Complete Motors

Approx. 852 N-sec., CAT.# RMS-54/852 165.00
Approx. 1280 N-sec., CAT.# RMS-54/1280 173.00
Approx. 1706 N-sec., CAT.# RMS-54/1706 179.00

Motor Parts

Forward closure
W/time delay & ejection charge cavities, CAT.# RMS-54FCE 63.00
Aft closure, CAT.# RMS-54AC 55.00
Case for approx. 852 N-sec., CAT.# RMS-54C-852 80.00
Case for approx. 1280 N-sec., CAT.# RMS-54C-1280 89.00
Case for approx. 1706 N-sec., CAT.# RMS-54C-1706 97.00
3-7/8" (98mm) Dia. Reloadable Motor System (Available Spring 1991)

Complete System
Includes one forward & one aft closure, casings for 2560, 5120, 7680 & 10240 newton-seconds. CAT.# RMS-98/2560-10240 $995.00

Complete Motors
Approx. 2560 N-sec., CAT.# RMS-98/2560 355.00
Approx. 5120 N-sec., CAT.# RMS-98/5120 381.00
Approx. 7680 N-sec., CAT.# RMS-98/7680 408.00
Approx. 10240 N-sec., CAT.# RMS-98/10240 443.00

Motor Parts
Forward closure
W/time delay & ejection charge cavities, CAT.# RMS-98FCE 116.00
Aft closure, CAT.# RMS-98AC 108.00
Case for approx. 2560 N-sec., CAT.# RMS-98C-2560 202.00
Case for approx. 5120 N-sec., CAT.# RMS-98C-5120 233.00
Case for approx. 7680 N-sec., CAT.# RMS-98C-7680 265.00
Case for approx. 10240 N-sec., CAT.# RMS-98C-10240 307.00
RELOAD KITS

Includes propellant grain(s), o-rings, fiber washers, nozzle insert, liner, igniter, nozzle cap igniter holder, time delay element, adapter ring(s), spacer ring(s) (if required), ejection charge, end cap and complete instructions

SEGMENTED CORE CONFIGURATION

Flammable Solid Shippable

For RMS-29/60

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For RMS-29/180

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<td>CAT.# M1939W-S, M, L, X</td>
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DELAY TIMES AVAILABLE

Please specify delay times desired when ordering RMS reload kits by referring to the list below:

RMS-29 & RMS-38 (all casing lengths)

"Short" time delay (approx. 6 second delay)
"Medium" time delay (approx. 10 second delay)
"Long" time delay (approx. 14 second delay)

RMS-54 (all casing lengths)

"Short" time delay (approx. 6 second delay)
"Medium" time delay (approx. 10 second delay)
"Long" time delay (approx. 14 second delay)
"Extra-long" time delay (approx. 18 second delay)

RMS-98 (all casing lengths)

"Short" time delay (approx. 10 second delay)
"Medium" time delay (approx. 14 second delay)
"Long" time delay (approx. 18 second delay)
"Extra-long" time delay (approx. 22 second delay)

PROPELLANT TYPES AVAILABLE

A "J" designation after the average thrust indicates "BlackJack".
A "W" designation indicates "White Lightning".
A "B" designation indicates "Blue Thunder".
ISP RMS RELOADABLE MOTOR SYSTEM SPECIFICATIONS (Preliminary)

Performance data shown using White Lightning segmented core reload kits

<table>
<thead>
<tr>
<th>MOTOR_TYPE</th>
<th>LENGTH</th>
<th>PROP. WT.</th>
<th>TOTAL WT.</th>
<th>TOTAL IMP.</th>
<th>BURN TIME</th>
<th>AVE. THRUS'</th>
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<tbody>
<tr>
<td>RMS-29/180</td>
<td>7.66&quot;</td>
<td>92.2g</td>
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<td>181 N-s</td>
<td>1.4 sec.</td>
<td>128 N</td>
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<td>123.0g</td>
<td>264g</td>
<td>240 N-s</td>
<td>1.3 sec.</td>
<td>180 N</td>
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<td>293g</td>
<td>245 N-s</td>
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<tr>
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<td>RMS-38/480</td>
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<td>250.0g</td>
<td>476g</td>
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**NOTE:** RMS specifications and prices subject to change without notice.
ISP HIGH POWER KIT PRICE LIST
SOUNDING ROCKET (SR) SERIES

JAN. 1991

ALL ISP KITS ARE COMPLETE WITH FIN-LOCK ASSEMBLY, PRE-SLOTTED AIRFRAMES, LABYRINTH BAFFLE SYSTEM AND SPECIAL MOUNTS FOR 29MM ISP RELOADABLE MOTOR SYSTEMS.

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<td>MIRAGE-SR</td>
<td>1.9&quot; X 43.5&quot;</td>
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<td>1.9&quot; X 43.5&quot;</td>
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<td>NOSTROMO-SR</td>
<td>2.6&quot; X 58&quot;</td>
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1.5" MOTOR MOUNT KIT FOR 2.6" DIA. TUBES $6.95
1.5" MOTOR MOUNT KIT FOR 1.8" DIA. TUBES $6.95
1.5" MOTOR MOUNT TUBE 34" LENGTH .07 WALL $3.50
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ADAPTUBE 1.5" MMT INTO 1.8" TUBE $1.20

PLEASE CALL (702)641-2301 OR ANY OF OUR CLASS B DEALERS FOR MORE INFORMATION.
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North Coast Rocketry
5500 Kenbridge Dr.
Highland Heights, OH 44143
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Rocket Research
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Attn: Dave McVeigh
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Stevensville, MI 49127
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