"Field comparison of shallow seismic sources"
by Miller, Pullan, Waldner and Haeni
Geophysics, Vol 51, p 2067-2092, 1986

"An in-hole shotgun source for engineering seismic surveys"
by Pullan and MacAulay
Geophysics, Vol 52, p 985-996, 1987

"Field comparison of shallow seismic sources near Chino, California"
by Miller, Pullan, Steeplees and Hunter
Geophysics, Vol 57, p 693-709, 1992

"Feasibility of CDP reflection to image structures in a 220-m deep,
3-m thick coal zone near Palau, Coahuila, Mexico"
by Miller, Saenz and Huggins
Geophysics, Vol 57, p 1373-1380, 1992

"A versatile shotgun source for engineering and
groundwater seismic surveys"
by Parker, Pelton and Dougherty
Geophysics, Vol 58, p 1511-1516, 1993

"Field comparison of shallow P-wave seismic sources near Houston, Texas"
by Miller, Pullan, Steeplees and Hunter

"Seismic surveys assess earthquake hazard in the New Madrid area"
by Williams, Odum, Pratt, Shedlock and Stephenson
The Leading Edge, Vol 14, p 30-34, 1995

"Exploring Earth’s Shallow Subsurface
with Geophysical Diffraction Tomography"
by Alan J. Witten
Geotimes, Vol 40, No. 1; p 14-17, January 1995

"Near Surface Geophysics: Special Issue"
The Leading Edge, Vol. 14, No. 4, April 1995

"From Camels to Computers: A Short History of Archaeological Method"
by Thomas E. Levy
Biblical Archaeology Review, Vol 21, No. 4, p 44, July/August 1995

"Near Surface Geophysics"
The Leading Edge, Vol. 16, No. 11, November 1997

"Shallow VSP work in the U. S. Appalachian coal basin"
by Lawrence M. Gochioco

"Shallow Seismic Reflection Papers – Special Section"
Betsy Downhole Percussion (BDP) Firing Rod

U. S. Patent No. 4857266

Striker head cover
Striker head nut
Plunger rod retainer spring
Safety clamp screw knob

Hand grip
to lower and lift firing rod

Shot depth numbers
in feet on one side,
in centimeters on other side

(Scale break)

Plunger rod housing
chromed tubing

Spatter shield,
rubber

Plunger/firing pin housing
chromed stainless steel

Scale:

0 1 2 3 4 5 6 7 inches
0 5 10 15 20 cm
Betsy Downhole Percussion (BDP) Firing Rod - Enlarged Detail

---

**Striker head nut**

**Plunger rod**

**Washer, top**

**Plunger rod retainer spring**

**Washer, bottom**

**Plunger rod housing chromed tubing**

**Safety clamp screw**

---

**Safety Clamp Screw:**
Snug tight only!
Undue force can freeze the clamp screw.

**Safety First**

Tighten safety clamp screw to freeze plunger/firing pin action before loading live shells onto BDP and going down hole.

Loosen safety clamp screw to free plunger/firing pin action before shooting.

---

**Plunger/firing pin housing, chromed stainless steel**

**Wrench flat**

**Firing pin plunger**

**O-ring**

**Washer, neoprene**

**Firing pin**

---

Scale: 0 1 2 3 4 5 6 inches 0 5 10 15 cm
Betsy Downhole Percussion (BDP) Firing Rod - Parts & Specs

Striker head cover  BMX 09432  Bicycle hand grip
Striker head nut  NAPA 6412026
Plunger rod  Aluminum, 1/2 inch, 20 thread top and bottom ends
Washer 1/2"ID, 7/8" OD
Plunger rod retainer spring  NAPA-United 80719
Washer 1/2"ID, 7/8" OD

Safety clamp screw
5/8" 18 thread

Essential Maintenance

Remove plunger/firing pin housing, thoroughly clean inside; replace o-ring and washer in proper position on clean firing pin; screw onto rod snug-tight.

Gun powder residue accumulates inside housing, draws moisture, expands, and will ultimately freeze pin action. If action freezes, soak housing in bore cleaner solvent to loosen, then detach and clean.

Apply pipe thread compound to all male threads to preserve threads and to avoid corrosion and seizing.

Wrench flat  1-1/8 inch
Firing pin, 17-4 stainless, hardened to Rockwell 44
O-ring  2-202, N-70 Nitrile
Washer  3/8L beveled, Neoprene
Threading, 1-1/8 inch, 12 threads per inch
**OPERATION:**

1. **TIGHTEN safety clamp screw.**
2. Screw loaded shell holder, steel or plastic, firmly onto BDP rod bottom; shell head must be in firm contact with plunger/pin housing.
3. Lower rod into hole; tamp hole, the wetter the better.
4. Use hole cover mat to catch hole blow, diminish blast noise and air wave.
5. **LOSEN safety clamp screw.**
6. Fire with firm blow of hammer on BDP striker head.

**Shell holder:**

Steel: permanent, reusable; 12-gauge or 8-gauge
Plastic: expendable, fragmented.

**SAFETY FIRST**

NEVER screw on a live load without first tightening the safety clamp screw to freeze firing pin action.
NEVER drop, ram or pound on a loaded rod with the safety clamp screw loose, in or out of a shot hole.
NEVER leave a live load on an unattended rod not in a shot hole or on a rod being transported or stored.
NEVER retrieve or remove a "no fire" until after at least one minute has passed.
NEVER detonate a shell above ground.
NEVER leave fired shell hulls where they might be ingested by, and fatal to, large animals.
BDP SOURCE SENSOR

Horizontal Tube Mount

Assembly:

Part No. 1: Brass end plug: Red wire through coil spring to insulated brass contact tip; wire and spring permanently sealed inside brass end plug with thermosetting plastic.
2: Aluminum tube (ground), .75-inch OD x 2.75-inch length.
3: End cap, plastic, slips over brass end plug inserted into aluminum tube and slips over aluminum tube; .75-inch ID.
4: End cap, plastic, slips over opposite open end of the aluminum tube; .75-inch ID.

Recommended Mount: Secured in the horizontal to the underside of one BDP cross arm hand grip. May also be secured to hammer handle.

Secure hookup wires to sensor tube and/or BDP rod to prevent direct pull on the hookup wires.

If the contact tip becomes off center of the tube, the coil spring can be adjusted by slight bending to return the contact tip to center of the tube.

Scale:

0 1 2 3 4 5 inches

0 5 10 12 cm
Betsy Downhole Percussion (BDP) Firing Rod

General Recommendations

Slim shot holes are recommended for good ground couple; a 1.75 inch/4.5 cm diameter hole will accommodate the BDP steel shell holder or plastic screw-on capsule.

Minimum hole depth of 18 inches/45 cm to top of charge in well tamped hole is recommended. Firm earth or water tamp improves ground couple - the wetter the better.

Hold-down weight, if needed: Hang from BDP hand grip cross arm a bag weighted with sand, soil, rocks or lead shot.

Firm hammer blow is required to fire the percussion shell. A shell primer dented by a weak hammer blow can rarely be fired by subsequent blows.

Hammer switch usually operates better when taped to BDP rod handle rather than to the hammer handle.

Rotate rod only to the right when going in or out of the shot hole. Rotation to the left may unscrew the shell holder.

Hole cover mat up to about 3 ft or 1 meter diameter, of scrap shag rug, astro turf, or similar material, with shag side down, will minimize hole blow debris and noise.

BDF Firing Rod Maintenance

Clean plunger housing threads with wire brush. Use pipe thread compound on male threads when in use. Cover with thread protector when the firing rod is not in use.

Plunger rod retainer spring and safety clamp screw may be lubricated with white lithium grease or light oil.

Clean inside of plunger/pin housing after each use. Replace o-ring and washer in proper positions to avoid bent firing pin. Apply pipe thread compound to all male threads.

Keep the firing rod and attachments clean and dry. Never put the equipment away wet.

Plunger/firing pin housing

Shell holder, steel or plastic
SPECIAL INSTRUCTIONS:

**SLEDGE HAMMER SWITCHES** are often too insensitive for use with the BDP firing rod and dead blow impact hammer.

Either adjust the switch for greater sensitivity or get a new more sensitive switch or other source sensor.

**DO NOT USE SLEDGE HAMMER BLOWS** on the BDP firing rod which can deform the aluminum plunger rod, strip the plunger rod threads, compact the plunger rod retainer spring and render the firing rod inoperable.

A firm blow with a 1.5 lb dead blow hammer is sufficient to fire percussion shells and should trigger the source sensor for time break.

**DO NOT PUT THE BDP FIRING ROD AWAY WET:**

Burnt powder residue + moisture = frozen pin action, even when the firing rod appears dry on the outside. Daily cleaning after use is the best practice.

1. Remove plunger rod/firing pin housing with wrench.
2. Clean and dry firing pin, inside of plunger/pin housing and firing pin hole.
3. Replace o-ring and neoprene washer in proper positions on firing pin.
4. Apply pipe thread compound to firing rod threads.
5. Screw plunger/pin housing back onto firing rod and tighten with wrench.

**STANDING AWAY FROM THE SHOT HOLE** may be desirable if the hole blow is large particulate matter. A three-foot length of PVC plastic pipe, 2-1/4 to 2-1/2 inch ID, can be slipped over the hammer handle as a handle extension which will allow the firing rod operator to stand some five feet or more away from the shot hole.

**WATERPROOFING SHELLS:**

Shot shells with metal head and plastic or paper hulls are most susceptible to water leakage where the metal encircles the hull and through the wad end. Waterproof the shells by (1) greasing the entire shell with white lithium grease, or (2) slip a plastic sandwich bag over the loaded shell holder and secure to the BDP rod bottom with a rubber band or strip of tape.

**HOLD DOWN WEIGHTS:**

Any hold down weight, such as a bag weighted with sand, rocks or dirt, should be suspended from the hand grip cross arms as close as possible to the center where the cross arms are joined to the vertical plunger rod housing.

Any weights hung from the outer ends of the hand grip cross arms will eventually bend the arms downward and even break the arms loose from the vertical plunger rod housing pipe.
SHELF LIFE OF SHOT SHELLS

Temperate Zones:
Under normal clean, dry and ventilated temperate storage conditions, shot shells will remain usable from ten to twenty years.

Tropic Zones:
Under constant high humidity, near and above the 80% range, the propellant charge could deteriorate in a few months. A dehumidifier in the shell storage is recommended.

Torrid Zones:
Under constant high temperatures of 120°F/50°C or higher, the primer material could deteriorate in a few months. Shaded, well ventilated shell storage is recommended.

Frigid Zones:
Under constant low temperatures of -40°F/-40°C and lower, no deterioration of primer material or propellant charge, but the powder burn rate will be slowed, yielding low pressure detonations and possible no-fires. Warm shell storage is recommended. In the field, shells should be kept warm in vehicle units or in pockets under outer garments.

SHELL STORAGE
Store shells in clean, dry area, preferably under lock and key, well away from flammable liquids or solids, oxidizing materials, high voltage wires, hot pipes, ducts or machinery or welding equipment.

In storage, transport, or in the field, keep shells clean and dry and well protected from spillage of gasoline, diesel fuel, light oils, solvents or other similar penetrating fluids. DO NOT USE SHELLS SOAKED BY ANY SUCH FLUIDS.

SHELL CLASSIFICATION: RESTRICTED ARTICLES, DANGEROUS GOODS

Via UPS ground: Box markings and shipping record:
SMALL ARMS AMMUNITION, ORM-D
Maximum weight per box: 65 lbs gross

Via Fedex Air: Box markings and shipping record:
CARTRIDGES, SMALL ARMS, ORM-D-AIR
Blanks: 1.4S Label, UN0014, Pkg 130, PG II
Projectiles: 1.4S Label, UN0012, Pkg 130, PG II
Maximum weight per box: 55 lbs/25 kgs net
Authorization: Remington shells: USDOT CA-860520
Winchester shells: USDOT CA-860549

U. S. Dept. of Commerce Commodity No. 9306.90.0040 5
(Betsy shells) "other ammunition and projectiles" (NOT FOR WEAPONS)

U. S. Dept. of Commerce Commodity No. 9015.90.0000 5
(BDP Firing Reds) "geophysical instruments and appliances,
(Betsy M3's) parts and accessories"
BLANK ENERGY - EXPLODED SHELL

FFFFg (4Fg) Black Powder Charge:

<table>
<thead>
<tr>
<th>Grains</th>
<th>Ounces</th>
<th>Grams</th>
<th>Calories</th>
<th>Ft-lbs</th>
<th>Joules</th>
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<tbody>
<tr>
<td>150</td>
<td>.343</td>
<td>9.72</td>
<td>6,590</td>
<td>20,363</td>
<td>27,591</td>
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<tr>
<td>200</td>
<td>.457</td>
<td>12.96</td>
<td>8,787</td>
<td>27,152</td>
<td>36,789</td>
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<td>250</td>
<td>.571</td>
<td>16.20</td>
<td>10,984</td>
<td>33,941</td>
<td>45,988</td>
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<tr>
<td>300</td>
<td>.686</td>
<td>19.44</td>
<td>13,180</td>
<td>40,726</td>
<td>55,182</td>
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<tr>
<td>350</td>
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<td>22.68</td>
<td>15,377</td>
<td>47,515</td>
<td>64,380</td>
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<tr>
<td>400</td>
<td>.914</td>
<td>25.92</td>
<td>17,574</td>
<td>54,304</td>
<td>73,578</td>
</tr>
<tr>
<td>437.5</td>
<td>1.000</td>
<td>28.35</td>
<td>19,221</td>
<td>59,393</td>
<td>80,474</td>
</tr>
<tr>
<td>500</td>
<td>1.143</td>
<td>32.40</td>
<td>21,967</td>
<td>67,878</td>
<td>91,971</td>
</tr>
</tbody>
</table>

(500 grains is the legal maximum load for SMALL ARMS AMMUNITION)

FFFFg (4Fg) Lab Test Data:

Composition: 75% Potassium Nitrate, 15% Charcoal, 10% Sulphur
Auto-ignition: 500°F, 260°C
Maximum temperature: 3014° Kelvin
Heat of combustion: Theoretical maximum: 726 calories per gram
                      Actual test range : 665 to 690 cal/gram
                      Average in use : 678 calories per gram
Propagation velocity: 1850 ft/sec, 549 meters/sec
Peak pressure, 80 grains in closed chamber: 15,000 psi
Time to peak: .001 sec

Black powder grades are Fg (coarse), FFg (fine), FFFg (finer), and FFFFFg (4Fg - finest). 4Fg is used for BSI seismic blanks because it weighs heavier by volume than the coarser grades. 4Fg black powder is an explosive, burns completely under minimal confinement and is the most suitable for seismic blanks.

Propellant charges in projectile shells will not release maximum energy from complete burn except in severe confinement down the length of a gun barrel. Propellant energy is largely consumed in driving the projectile down the barrel. Projectile shells fired in no-barrel devices yield little energy as the shell primer usually blows the projectile and unburned propellant out the muzzle at low velocity.

Propagation or explosion velocity of 4Fg black powder, about 1850 ft/sec or 549 meters/sec, induces a higher conversion of energy into elastic radiation than an equivalent charge of higher velocity explosives. As a rule, the higher the propagation velocity, the higher the loss of energy in the useful seismic band, depending on charge size, charge depth and the nature of the surrounding medium.
4Fg Energy:
Load charge in grams x calories per gram = Total Calories
Total Calories x 3.09 = Energy in ft-lbs
Total Calories x 4.1868 = Energy in joules

Conversions:
4Fg black powder average heat of combustion: 678 calories/gram
15.43 grains = 1 gram
437.5 grains = 1 ounce = 28.35 grams

Comparisons: 1 grain, 4Fg black powder: 136 ft-lbs, 184 joules
1 grain, 60% nitro dynamite: 170 ft-lbs, 230 joules

Data Sources:
U. S. Arsenal, Dover, NJ
GOEX Inc., Explosives Div., Moosic, PA
Hercules Powder Co., Kenvil, NJ
Hodgdon Powder Co., Shawnee Mission, KS
Winchester Div., Olin Corp., East Alton, IL
Remington Arms Co., Lonoke, AR
Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard,

IDENTITY (As Used on Label and List)
All Shotshell Ammunition

Section I: "Small Arms Ammunition"
Manufacturer's Name
Remington Arms Co., Inc.
Address (Number, Street, City, State, and ZIP Code)
I-40 & Highway 15
Lonoke, Arkansas 72086

Emergency Telephone Number
(501) 676-3161

Telephone Number for Information
(501) 374-2246

Date Prepared
8-12-86

Signature of Preparer (optional)
W.G. Bell, Chem Lab - Technical Section

Section II — Hazardous Ingredients/Identity Information
Hazardous Components (Specific Chemical Identity; Common Name(s))
OSHA PEL ACGIH TLV Other Limits Recommended % (optional)
Lead, Inorganic and lead compounds 50mg/M³
Arsenic and compounds 10mg/M³
Antimony and compounds 500 mg/M³
Barium and compounds 500 mg/M³
Nitroglycerin (0.05 ppm skin) 500 micrograms/M³ of air

Section III — Physical/Chemical Characteristics
Boiling Point Not applicable
Vapor Pressure (mm Hg) Not applicable
Vapor Density (AIR = 1) Not applicable
Specific Gravity (H₂O = 1) Not applicable
Melting Point Not applicable
Evaporation Rate (Buyl Acetate = 1) NO T APPLICABLE

Solubility in Water
Lead & Lead Styphnate - Insoluble; Lead Nitrate - 127 gm/100cc Water - 100°C

Appearance and Odor
Grayish, Gray, Silvery Material - No odor

Section IV — Fire and Explosion Hazard Data
Flash Point (Method Used) Not applicable
Flammable Limits Not applicable
LEL NA UEL NA

Extinguishing Media
Material is self oxidizing; flood with water to fight fire and cool shells.

Special Fire Fighting Procedures
Evacuate immediate area and deluge with water, wear protective clothing for shrapnel.

Unusual Fire and Explosion Hazards
Shells will detonate when exposed to flame and high temperatures.
Section V — Reactivity Data

Stability | Unstable | Stable | Conditions to Avoid
---|---|---|---
| | | Flames, sparks, percussion or shock and high temperatures (130°C)

Incompatibility (Materials to Avoid)
Strong mineral acids and alkalis

Hazardous Decomposition or Byproducts
Oxides of carbon, nitrogen and lead fumes.

Hazardous Polymerization
May Occur | Conditions to Avoid
---|---
| Heat, fire, static, friction and percussion.

Will Not Occur | X

Section VI — Health Hazard Data

Route(s) of Entry:
Inhalation: Fumes
Skin: Skin? Cuts or abrasions - Ingestion?

Health Hazards (Acute and Chronic)
Anemia, fatigue, nocturia, embryotoxin, malnutrition, weakness, mental confusion, pallor

treat per general lead exposure; headache and nausea

Cardiogenicity: Not known
NTP? IARC Monographs? OSHA Regulated?

Lead — Yes

Signs and Symptoms of Exposure
Refer to health hazard above.

Medical Conditions
Generally Aggravated by Exposure
Gastrointestinal tract; kidneys, blood and central nervous system. (CNS)

Emergency and First Aid Procedures
Skin — flush with water; if swallowed seek medical attention immediately.

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
Use non-sparking equipment to cleanup and store shells - avoid ignition sources.

Waste Disposal Method
Material may be burned per appropriate federal, state and local regulatory agency contact.

Precautions to Be Taken in Handling and Storing
Refer to released or spilled data above.

Other Precautions
Label containers — "Small Arms' Ammunition" wear gloves and shrapnel protection.

Section VIII — Control Measures

Respiratory Protection (Specify Type)
OSHA SA/HI/SCBA

Ventilation
Local Exhaust: Not required
Mechanical (General): Not required

Special: Not applicable
Other: Not applicable

Protective Gloves
Not applicable

Eye Protection
Safety glasses when shooting

Other Protective Clothing or Equipment
Use hearing protection when discharging cartridges.

Work/Hygiene Practices
Wash hands after skin contact with cartridges.
INDUSTRIAL SEISMIC TOOL, ACCESSORIES
AND SPARES, KIT AND CASE

<table>
<thead>
<tr>
<th>Piece Description</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>carton 1 - Carrying case, Contico, 52x13x4&quot; black plastic; 4 latches, 2 lock studs; foil cushion interior containing the following:</td>
<td>1 - Betsy Downhole Percussion (BDP) firing rod No. 207; chromed pipe with depth marks and numbers in ft and cm; safety clamp screw and knob; head cover, hand grips, spatter shield, thread protector (NOT A FIREARM)</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Shell holder No. 217 (12), stainless steel, knurled finish; permanent screw-in 12-gauge bushing insert installed</td>
<td>1 - Dead blow hammer, 1.5 lbs</td>
</tr>
<tr>
<td>29 lbs 1 - Ejector rod, .75x12&quot; wood, leather thong</td>
<td>1 - Source Sensor No. 53, aluminum tube, horizontal mount, wired</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Wrench, 1-1/8&quot; open end (for plunger/pin housing)</td>
<td>1 - Brush, fiber bristle, plastic handle (thread cleaner)</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Brush, nylon bristle, round, wire handle (shell holder cleaner)</td>
<td>1 - Grease, white lithium, tube</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Pipe thread compound, tube</td>
<td>1 - Shop cloth</td>
</tr>
<tr>
<td>53x17x5&quot; 2 - O-ring, 2-202, N70 Nitrile (spares)</td>
<td>2 - Washer, 3/8L beveled, Neoprene (spares)</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Spring, NAPA-United 80719 (spare)</td>
<td>1 - Tote bag, Sturm, flap &amp; strap</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Field Manual</td>
<td>Extra Equipment:</td>
</tr>
<tr>
<td>53x17x5&quot; 1 - Shell holder No. 218 (8), stainless steel, knurled finish; permanent screw-in 8-gauge bushing insert installed</td>
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</tbody>
</table>

Shipment: 1 piece/29 lbs, 28 Sept 1999
Via: UPS, prepaid
P.O.: PO-724-2000A01619 WELXM

By: [Signature]

BETSY SEISGUN INC.
P.O. Box 471143 Phone (918) 622-6865
Tulsa, OK 74147-1143 USA Fax (918) 664-6262

Received by: ________________________________
Date: ________________________________
PRICE SCHEDULE - BETSY DOWNHOLE PERCUSSION (BDP) FIRING ROD - 1 JAN 1997

All prices FOB Tulsa

Terms: Net cash, 30 days

BDP FIRING ROD, KIT AND CASE

1 - Carrying case, high impact hard plastic, 52x13x4 inches, 132x33x10 cm, four latches, two lock studs; foam cushion interior containing the following:
1 - BDP firing rod, chromed pipe with depth marks and numbers in feet (to 3 ft) and centimeters (to 90 cm); safety clamp screw and knob; plunger/firing pin housing with thread protector; striker head cover, hand grips, spatter shield. Complete and assembled. Accommodates screw-on steel shell holder or screw-on PVC encapsulated blank shells.
1 - Shell holder, stainless steel, knurled finish; four inches/ten centimeters length, 1-5/8 inches, 4 centimeters OD, with permanent bushing insert of either 12-gauge or 8-gauge size.
1 - Dead blow impact hammer, 1.5 lb/.7 kg
1 - Ejector rod, 12 inches/30 cm, wood, leather thong
1 - Wrench, 1-1/8 inch, open end, for plunger/firing pin housing
1 - Brush, wire bristle, thread cleaner
1 - Brush, nylon bristle, shell holder cleaner
1 - Grease, white lithium, tube
1 - Pipe thread compound, tube
1 - Shop towel
2 - O-ring, 2-202, N70 Nitrile (spares)
2 - Washer, 3/8L beveled, Neoprene (spares)
1 - Spring, NAPA-United 80719 (spare)
1 - Tote bag
1 - Field Manual

BDP Kit and Case shipping weight: 24 lbs/11 kgs

BDP SPARE PARTS

Shell holder, stainless steel, knurled finish, with permanent 12-gauge or 8-gauge bushing insert, each $ 175.00
Plunger rod, aluminum, 1/2x41.5 inches, 20 thread, each $ 19.00
Spring, plunger rod retainer, NAPA-United 80719, each $ 1.50
Washer, plunger rod, 1/2 inch ID, flat steel, HBW-87A $.85
Striker head nut, NAPA 6412026, each $ 1.00
Striker head cover, CPC-09432, each $ 5.50
Plunger/firing pin housing, stainless steel, each $ 88.00
Firing pin, tempered stainless, each $ 42.00
O-ring, 2-202, N70 Nitrile, each $.50
Washer, 3/8L beveled, Neoprene, each $.50
Thread protector, 1-1/8 inch ID cup, each $ 1.00
Spatter shield, each $ 6.00
Hand grips, pair $ 7.50

Address all orders to: BETSY SEISGUN INC.
P.O. BOX 471143
TULSA, OK 74147 - 1143
Phone: 918-622-6865
FAX: 918-664-6262
BDP RENTAL (U.S.A. Only)

BDP Firing Rod, kit and case, as listed on the Price Schedule, including one steel shell holder of one shell size: $300.00 per month, one month minimum. Rental may be applied to purchase if renter opts to retain possession of the BDP kit and case.

Renter pays transportation costs from and return to Tulsa and is responsible for any loss or damage other than that due to normal field use. Terms: Net cash, 30 days.

Address all return shipments to: BETSY SEISGUN INC.
7739-D EAST 38TH ST.
TULSA, OK 74145

OPTIONAL EQUIPMENT - HAND AUGER

All steel, hand operated earth auger digs 2 inch/5 centimeter hole to 3 ft/1 meter depths. Overall length: 42 inches/107 cm. Weight: 7 lbs 3 kgs

Fishtail 2 inch/5 cm bit is detachable, replaceable.

Continuous spiral blade is 25 inches/64 centimeters long.

Handle attachment is detachable for shipping.

Purchase: $195.00 FOB Tulsa
Rental: $75.00 per month.

Handle length, 18 in/46 cm

Handle attachment,
3/8-16x1-1/4 inch machine screw (5/16 hex wrench for screw included)
Substitute: 5/16x2" bolt and nut

Continuous spiral blade
2-inch/5 cm diameter

Fishtail blade bit, detachable
**SOURCE TEST - RAMSAYVILLE, ONT**

Results of a source test conducted at Ramsayville, Ontario, with 100 Hz geophones and the analog filters on the seismograph set at all-pass.

(Geological Survey of Canada)
12-GAUGE "BUFFALO GUN" (2 stacks) SHOT IN DRY ROAD BED

12-GAUGE "BUFFALO GUN" (1 stack) SHOT IN WATER FILLED DITCH (165 grains)

Two field records obtained by shooting into the same geophone spread in the Fraser delta area near Vancouver, British Columbia.

(Geological Survey of Canada)
20 lb SLEDGEHAMMER

Analog Low Cut Filter

Open

110 Hz

220 Hz

amplitude

750

375

0

frequency (Hz)

0 200 400

0 200 400

0 200 400

air blast

air blast

air blast

Chino, CA 1988
REMINGTON 8-GAUGE. P&E INDUSTRIAL BLANK
Percussion & Electric Primers
In the Same Shell

P&E shell: 8-gauge industrial, high brass head, plastic body
Head rim OD: 1 inch/25 mm
Brass length: 7/8 inch/22 cm. Total length: 3 inches/75 mm
Load capacity: 400 grains 4Fg black powder

Percussion: Standard Remington center fire percussion primer.

Electric AC: Carbon film resistor is sealed inside bottom end of the shell
under a card wad, paper seal and body crimp. This resistor
is unaffected by humidity and operates in a temperature range of -67°F to
310°F, -55°C to 155°C. It cannot be ignited by heat, friction, impact,
static electricity or radio signal.

Power supply: 110 VAC, 60W or higher, from utility lines or 12-volt DC to
110-volt AC inverter. One outlet inverters that plug into
auto cigarette lighter sockets work well with a rated output of 110 VAC,
70 to 100W, 60 Hz.

Wire hookup: Remove paper seal on shell bottom to access two half-inch
bare hookup wires. Do not remove card wad or crimp seal.
Small needle-nose pliers are recommended to remove paper seals and make
tight twist connections.

BETSY SEISGUN INC.
P.O. Box 47143 Phone (918) 622-6865
Tulsa, OK 74147-1143 USA Fax (918) 664-6262

Patent No: US 6,497,180 B1
SAFETY FIRST

NEVER hook up electric shells until the firing line is disconnected from the power supply and shorted out.

NEVER retrieve a "no fire" until at least one minute has passed.

NEVER leave shell hulls where they could be ingested by, and fatal to, large animals.

NEVER forget the shock danger of high wattage 110 VAC, especially in damp to wet field conditions.

NEVER use small gauge, high resistance speaker type wire for firing line. Use common lamp cord, two conductor, multiple copper strands.

---------

SURE FIRE MULTIPLE BLANKS

WIRE ONE P&E blank for electric detonation. Bind one or more blanks to the wired blank with vinyl tape. Severe confinement in a metal can or glass jar, buried and tamped, guarantees simultaneous detonation of all the bundled blanks. A small slit in the shell hulls aids propagation.

---------

WATER PROOFING

Grease the shell with white lithium grease and wrap the greased shell tightly in a plastic sandwich bag.
Galen:

Re: Shot boosters

Some P&E users report using volatile liquids in the shot hole with a P&E shell to increase energy output at low cost.

Gasoline, kerosene and diesel have been used but apparently the best is "quick start" which is ether based, extremely volatile, evaporates quickly, comes in a pressurized can and is intended for quick starting gasoline engines with a quick squirt on the air intake filter.

The best results, as described to me were achieved by:
1. Wadding up coarse paper towels
2. Stuff the wad into a zip-lock plastic bag
3. Soak the wad with quick start, quickly
4. Close the bag tight and plant it with the charge
5. Tamp the shot hole, the firmer the better; some users place a hold-down weight over the hole ... a two or three foot round cut of plywood or solid steel grill with a rope or chain attached so it can be dragged, not carried ... some say they stand on the cover for extra hold-down weight ...(if you do so, bend your knees, they advise.) Whatever ... DO BE CAREFUL!

--- phil
To: University of Texas at El Paso  
Dept of Geological Sciences  
500 West University  
El Paso, TX  79902

Attn: Galen Kaip/Accounts Payable; FAX #915-747-5073

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Freight: UPS charge for shipment of the following items, Tulsa to El Paso, prepaid</td>
<td>$ 25.00</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
<td>Remington R8BL/400BP, 8-gauge industrial percussion blank</td>
<td>$195.00</td>
</tr>
<tr>
<td></td>
<td>100 rounds at $1.95 each, FOB Tulsa</td>
<td></td>
</tr>
</tbody>
</table>

INVOICE TOTAL: $ 220.00

This invoice faxed to UT/El Paso as instructed by Galen Kaip at 915-474-0554, 30 Sept 2015

2 Oct: Credit for overcharged freight ($ 5.63)

INVOICE TOTAL: $214.37
RESTRICTED ARTICLES, DANGEROUS GOODS CARTRIDGES, SMALL ARMS, BLANK; ORM-D For seismic use only/Not for weapons

<table>
<thead>
<tr>
<th>Piece</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 4G ctn</td>
<td>100 - Remington R8BL/400BP; 8-gauge industrial percussion blank with 400-grain 4Pg black powder load</td>
</tr>
<tr>
<td>11 lbs</td>
<td>10x10x4&quot;</td>
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<tr>
<td>1 - Shell specs, instructions, price list</td>
<td></td>
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</tbody>
</table>

Shipment: 1 pc/11 lbs/100 shells
Via: UPS, Prepaid $19.37
Per: Galen Kaip, phone order, 30 Sept 2015