JRC Explosive Jet Cutters

with

Aluminum and/or Steel Housings
3.625 Inch (92.1 mm) to 8.188 (208.0 mm) O.D.

for

Casing and Tubing
4 1/2 (4.500) Inch (114.3 mm) to 9 5/8 (9.625) Inch (244.5 mm) O.D.

Field Loading Procedures
Casing Cutters

<table>
<thead>
<tr>
<th>O.D.</th>
<th>Description</th>
<th>SAP P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>mm</td>
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<tr>
<td>3 5/8 (3.625)</td>
<td>92.1</td>
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</tr>
<tr>
<td>4.000</td>
<td>101.6</td>
<td>Casing Cutter</td>
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<tr>
<td>4 1/2 (4.500)</td>
<td>114.3</td>
<td>Casing Cutter</td>
</tr>
<tr>
<td>4 3/4 (4.750)</td>
<td>120.7</td>
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</tr>
<tr>
<td>5 3/8 (5.375)</td>
<td>136.5</td>
<td>Casing Cutter</td>
</tr>
<tr>
<td>5 1/2 (5.500)</td>
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<td>Casing Cutter</td>
</tr>
<tr>
<td>6.000</td>
<td>152.4</td>
<td>Casing Cutter</td>
</tr>
<tr>
<td>6 1/8 (6.125)</td>
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<td>Casing Cutter</td>
</tr>
<tr>
<td>7 1/4 (7.250)</td>
<td>184.2</td>
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<tr>
<td>8 3/16 (8.188)</td>
<td>208.0</td>
<td>Casing Cutter</td>
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</tbody>
</table>

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1. Safety Warning

The JRC explosive jet cutters contain explosive compounds which are designed to explode when they receive, intentionally or unintentionally, stimuli capable of bringing the explosive compounds to detonation. As a result the cutters are capable of causing extensive bodily injury or death.

Do not attempt to use this product unless you have received training in the handling and use of oilfield explosive products.

Refer to and apply the procedures listed in the Recommended Practices for Oilfield Explosives Safety; API Recommended Practice 67 (RP67) and your company’s operations and safety procedures before assembling or using this product.

The following assembly procedures for casing cutters must be explicitly followed, without attempts to shortcut, alter, switch, or otherwise deviate in any way; or use alternate parts from those supplied by Jet Research Center for such assembly.

Failure to follow the assembly instructions can result in extensive bodily injury and death.

The assembly and arming of the cutters should only take place at the job site where they are to be used and immediately prior to running the cutter into the pipe. If there is any delay the device should be disarmed and safely stored.

Before beginning operations a stray voltage and current survey must be performed between the perforating unit to ground; the rig to ground; the wellhead to ground and any other structures to ground in the immediate work area. The voltages and currents measured must be below the acceptable limits. Providing the measurements are below the acceptable limits, grounding lines must be connected between the perforating unit, rig, wellhead and any other structure and ground.

The term ‘SAFE’ when used in this document is to referring to a combination of actions that are designed to render the initiating system incapable of sending power to the electric detonator. These actions typically involve the shorting of the mono conductor wireline conductor to ground via a power resistor (for multiconductor the conductors are connected to one another and ground via power resistors); a key system which prevents the initiating system from connecting power to the electric wireline; and disconnecting power to the initiating system. The key is held outside the unit and visible until the explosive assembly is safely 200 ft (70 m) below ground level or the sea bed; or the cutter and detonator have been removed and returned to storage.

The term ‘Radio Silence’ is used to refer to the combination of actions which involves the shutting down of radio frequency transmissions within 1000 feet (305 m); the shutting down and isolating of electric welding equipment and active cathodic protection.
Do not handle explosives when electric storms (thunder and/or lightning) are in the immediate area. Do not handle explosives in a sandstorm or similar situation that can result in the build up of static electric charges.

2. Description, Specifications and Recommendations

JRC's explosive jet casing cutters are designed to cut casing under a variety of conditions. The casing cutters can be run on electric wireline; wireline-in-coiled tubing; slickline; pipe or coiled tubing. Be sure to follow all the safety practices associated with the conveyance method and detonation method used to run the casing cutter. This procedure addresses the initiation of the casing cutters using electric detonators. The casing cutters can be adapted for use with JRC TCP firing heads using the adapter 100014468 (item 4a) and the parts and procedures in manual 100157156 (993.71036) 1 11/16" PAFH (Pressure Activated Firing Head) and any other relevant firing head procedures.

To achieve maximum performance JRC recommends the following. (All the recommendations may not apply to any one application and may not cover all aspects of the operation).

For every application choose the largest diameter cutter that can be run in the well. The named size of each cutter indicates its outside diameter, O.D.

Centralize the cutter in the casing where possible, especially when running smaller O.D. cutters because of restrictions in the pipe.

Run a gauge run prior to running the casing cutter. This helps to ensure that the cutter can reach the required cut depth and it will not be necessary to return a live cutter to surface. The tool used for the gauge run, dummy casing cutter, gauge cutter, gauge ring etc, should be of similar length and the same diameter or slightly larger than the diameter of the cutter.

The gauge run reduces the chance of getting a live cutter stuck in the pipe.

Avoid hitting obstructions in the pipe with the cutter. Do not run the cutter into an obstruction or restriction in an attempt to pass; often referred to as spudding. Never spud with an explosive tool.

The running-in-hole speed will often be determined by the small clearance between the cutter and the pipe and the viscosity of the fluid. Do not over-run the cutter with the cable. Slow down to pass restrictions and tools in the pipe string. Slow down at the fluid level.

Shoot casing cutters near a casing collar; 2 to 4 feet (0.6 to 1.2 m) above or below; to take advantage of the standoff between the casing and an outer casing to minimize the chance of damage to an outer casing string.
The actual depth of the cut relative to a collar will depend upon the next operations to be performed in the well. It is the client’s decision as to where to cut the pipe.

Do not shoot the cutter in a collar, or in an up-set close to the collar, the cutter will not cut the pipe.

Do not shoot a cutter in a size of pipe larger than the pipe it is designed for, the cutter will not cut the pipe. A casing cutter is more likely to successfully cut a pipe which is heavier than recommended but less likely to cut a pipe with a larger O.D. than recommended.

Where possible have the same pressure and weight of fluid inside and outside the pipe to be cut. Large pressure differences can result in the tool string being lost or stuck after cutting. If necessary shoot some circulation holes to equalize pressures and/or to circulate the fluids to equalize the pressures before cutting the pipe.

If the cutter fails to cut on the first attempt check that the pipe is free at the cut depth. Do not shoot a second cutter at the same depth. The cutter is unlikely to cut on the second attempt at the same depth because damage to the pipe is likely to have moved the pipe wall beyond the limit of the cutting jet. Shoot a second attempt about 3 feet (1 m) above or below the first attempt depending on how this will influence the next operations in the well.

The casing cutters are designed to cut with minimal flaring of the pipe. The amount of flare is a function of the pipe, cutter and well conditions. Shooting with low pressure or gas behind the pipe will result in the most significant flare. The larger cutters for each pipe size will generally result in a cleaner cut with little flare.

Applying tension to the pipe is generally going to result in a cleaner cut and increase the chance of making a cut when using an undersized cutter and/or decentralized cutter, or freeing a partially stuck pipe. In most situations it is not necessary to apply tension to the pipe to obtain a cut, but, where possible the pipe weight should be picked-up so that the pipe is at neutral weight or tension at the cut depth when the cut is make.

The JRC casing cutters made with RDX explosives have an operating temperature range up to 325°F (163°C) for one hour. The casing cutters made with HMX have an operating temperature range up to 400°F (204°C) for one hour. Pressure ratings for the casing cutters range from 8,000 PSI (55 MPa) to 17,000 PSI (117 MPa). See the specification table for the rating of each cutter. For the Time v Temperature chart for explosive compounds refer to the JRC catalog or website. For special applications and cutter designs contact JRC.

The JRC casing cutters have Aluminum and/or steel housings. The O.D. of the cutter after detonation will be slightly larger than it was originally, but the increase in the O.D. should not result in retrieval problems in the pipe for which the cutter was designed.
The JRC casing cutters can utilize an optional shock absorbing extension mandrel which minimizes damage to other tools in the tool string. The unique shock grooves absorb the detonation shock waves transmitted up the tool. The extension mandrel is recommended when shooting cutters with more than 20 grams of explosive load and in all cases when delicate tooling is being ran above the cutter. When shooting cutters with over 100 grams of explosive consider using two extension mandrels.

The JRC casing cutters utilize safety arming procedures, using resistorized detonator assemblies and safety assembly equipment. An o-ring secures the detonator ground wire into a groove on the mandrel, ensuring the detonator is properly grounded. A shunt plug keeps the system shunted during assembly as the detonator shunt wire is removed. A protective holder encompasses the detonator, shielding the worker while the electrical connection is made to the CCL. The casing cutters use resistorized detonators, minimizing the chance of an accidental firing.

The JRC casing cutters can also be initiated using a Top Fire version of the RED™ (Rig Environment Detonator) detonator which further minimizes hazards. A different adapter is required to adapt the Top Fire RED detonator to the casing cutters.

JRC’s casing cutters connect to the wireline through a 1.50 inch (38.1 mm) O.D. firing head which has a ‘GO’ 1 3/16” – 12UN thread box at the top.

Information on the explosives shipping classification and UN numbers is included in the specification table. For more detailed shipping information contact JRC customer service.

The shelf life of the casing cutters can be regarded as 5 years, providing the cutters are stored in original packaging and have not been subjected to moisture. After this period the cutters should be disposed of as explosive items. At 5 years the cutters are not significantly more or less sensitive than when new, they still contain explosive and all safety procedures still apply.

Specifications for the casing cutters are listed in a table on page 12.

3. Field Assembly and Arming Procedures with Electric Detonators

JRC’s casing cutters use a 49 to 61 ohm high temperature resistorized detonator which reduces the possibility of accidental firing by stray current and provides a broader operating range and an additional safety factor. All previously established safety rules and regulations should be followed.

JRC’s casing cutters can also be run with the Top Fire version of the Rig Environment Detonator (RED) detonator to further minimize hazards. A different adapter is required to run the Top Fire RED detonator with the casing cutters.
1. This field assembly procedure applies to JRC’s casing cutters. Be sure you have read and thoroughly understand all safety and assembly procedures before beginning any assembly. Ensure all required materials are identified and on hand before proceeding but keep the explosive items in safe storage until after the checks and ensure that the wireline has been put into ‘SAFE’ and ‘Radio Silence’ and all other safety procedures are in place before handling the explosive components. Do not attempt to disassemble any casing cutter charge assembly (item 5).

2. Refer to Figures 1 and 2.

3. Check the insulation and continuity of the firing head (item 1) and the extension mandrel (item 2).

4. Check o-rings (item 6, size 214), making sure there are no cuts, nicks or scratches, install and replace as necessary. Lubricate o-rings and male threads only with a thin coating of clean downhole grease.

5. Make up the firing head assembly to the extension mandrel, if used. (The extension mandrel is used to protect the running tools from the detonation shock. It is recommended to run the extension mandrel when running cutters with explosive weights of 20 grams of larger or when there are tools above which may be damaged by the shock. Consider using two extension mandrels when running cutters with 100 grams, or more, of explosive.)

6. Make up the firing head and extension mandrel to the running tools, making sure the firing head or CCL is made up to the electric wireline cable. Check fire and CCL function. Correct all problems before proceeding and recheck until correct.

7. Ensure that cable is in the ‘SAFE’ position. Ensure a stray voltage and current survey has been performed and grounding lines are attached. Ensure ‘Radio Silence’ is in place. Clear the assembly and arming area of non-essential personnel.

8. Check the firing circuit for the presence of stray voltage with a blasters multimeter (item 9) in the volts position, between the lower contact and the body of the extension mandrel; first in the DC and then in the AC voltage position. Ensure that no voltage is present between the conductor and ground.

9. Remove the firing head and extension mandrel from the tool string. Install the shunt plug (item 7) into the top of the firing head.

10. Attach the detonator assembly (item 3) to the end of the extension mandrel by pushing the boot of the detonator assembly onto the end of the extension mandrel. Wrap the ground wire clockwise, looking from the lower end, into the o-ring groove above the boot. Push the o-ring (the o-ring size 020 is included with the detonator assembly) up into the groove ensuring that the end and approximately 2 inches (50 mm) of ground wire is pressed between the o-ring and the mandrel.
11. Remove the tape and/or label and the temporary shunt wire from the detonator assembly.

12. Install the appropriate adapter (item 4) for the detonator assembly being used.

13. Make up the protective holder (item 8), hand tight, to the adapter, extension mandrel and detonator assembly. Wrench tighten the firing head, extension mandrel and adapter. The shunt plug and protective holder remain hand tight.

14. Remove the shunt plug.

15. Check the firing head, extension mandrel, detonator assembly and adapter for electrical continuity between the top contact and the body of the firing head using a blasters multimeter in the 200 ohm position. The meter should read the resistance of the detonator assembly, typically between 49 and 61 Ohms for the resistorized detonator.

16. With the protective holder still in position, make up the firing head, extension mandrel, detonator, adapter and protective holder assembly to the tool string wrench tight. The detonator is now connected to the firing circuit. The firing circuit must remain in ‘SAFE’ and ‘Radio Silence’ in force until the cutter is typically 200 feet (70 m) below ground level on land or 200 feet (70 m) below the seabed offshore; or the detonator has been removed from the wireline and all explosive components have been correctly stored.

17. Refer to Figure 2.

18. Remove the plastic cap or plug from the casing cutter charge assembly (item 5).

19. Remove the protective holder from the adapter, extension mandrel and detonator assembly.

20. Make up the casing cutter charge assembly to the adapter, extension mandrel and detonator assembly and tighten with a strap wrench. Do not use metal wrenches on the outside diameter of the casing cutter.

21. Measure and record the distance from the center of the casing cutter charge assembly to the measure point of the tool string; typically the CCL. Also record the part numbers and date codes of the explosive components used in the assembly.

22. The cutter assembly is now ready to be run into the pipe. The safety procedures must be maintained until the assembly has been ran below ground level: typically 200 feet (70 m) below ground on land or 200 feet (70 m) below the seabed offshore.

23. After Attempting to make the cut; even if there are good indications that the cutter functioned; it is still necessary to go back into ‘SAFE’ and ‘Radio Silence’ when coming out of the hole while still 200 feet (70 m) below ground level on land or 200 feet (70 m) below the seabed offshore. Check that the grounding lines are still in place and clear the disarming and disassembly area of non-essential personnel. The safety precautions
must remain in force until the explosives responsible person has seen that the cutter functioned and has confirmed that the cutter is no longer a potential explosive hazard. If the cutter did not function it must be disassembled and disarmed before the safety procedures are lifted. The disarming and disassembly procedure follows.

4. Disarming and Disassembly Procedures with Electric Detonators

In the event of having to disarm and disassemble the casing cutter use the following procedure.

If the casing cutter was ran in the well but was unable to detonate it is imperative to use these procedures to remove the cutter and detonator assembly before attempting to perform any investigation and testing to find the problem.

If the casing cutter is ran into a well and returned to surface without detonating JRC normally recommends the replacement of all explosive components and o-ring seals. JRC always recommends the replacement of all explosive components and o-ring seals if the cutter has been exposed to temperatures or pressures significantly above ambient conditions. Do not attempt to disassemble any casing cutter charge assembly (item 5)

a) The same safety procedures applied while assembling and arming the cutter apply for disarming and disassembly. While the cutter is still deeper than 200 feet (70 m) below the ground level on land or 200 feet (70 m) below the sea bed offshore; ensure that cable is in the ‘SAFE’ position; grounding lines are attached; ‘Radio Silence’ is in place; and that the disassembly and disarming area is clear of non-essential personnel.

b) Refer to figures 1 and 2.

c) Remove the casing cutter charge assembly (item5) from the adapter, (item 4) while monitoring the disassembly for indications of trapped pressure. Be aware of potential trapped pressure on this and other connections.

d) Install the protective holder (item 8) over the adapter, extension mandrel (item 2) and detonator assembly (item 3).

e) Install the plastic cap or plug (supplied with cutter) into the casing cutter charge assembly and lay safely aside while disarming the detonator.

f) Disconnect the firing head and extension mandrel, with detonator assembly adapter and protective holder attached, from the tool string and install the shunt plug (item 7) into the top of the firing head.

g) Remove the protective holder and adapter from the extension mandrel and detonator assembly and reinstall a shunt connection to the detonator assembly.

h) Disassemble the detonator assembly from the extension mandrel.
i) Return the detonator with associated labeling to its original packaging and label appropriately for further use or disposal and store appropriately.

j) Return the casing cutter charge assembly to its original packaging with appropriate labeling and store appropriately.

5. Parts List, Specifications and Assembly Drawings

When ordering JRC’s casing cutters use the SAP part numbers. (The IMS part numbers were replaced by the SAP part numbers in 1999. The IMS part numbers are included here for reference. Some documents refer to the IMS part numbers. Most explosive product labels will have a SAP and IMS part numbers on the label.) To order a casing cutter it is necessary to order:

Size of casing cutter charge assembly required (item 5),

Detonator required (item 3),

Adapter appropriate for the detonator being used (item 4),

Extension mandrel (item 2) and quantity required,

Along with the firing head (item 1) o-rings (item 6 size 214) shunt plug (item 7) protective holder (item 8), blasters multimeter (item 9) and the Field Loading Procedure, Casing Cutters (item 10, this document); if they are not already available.

The firing head can generally be re-run a number of times. The firing head should be disassembled, cleaned, inspected and redressed with new seals. Check the insulation and continuity.

The explosive assemblies, adapters and extension mandrels, and o-rings are all single use items.

All the casing cutters charge assemblies use the same firing head, extension mandrel, adapter (to match the detonator), o-rings, shunt plug and protective holder.
## Casing Cutters Charge Assembly Parts List

(Refer to figures 1 & 2)

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<tr>
<th>Item</th>
<th>Description</th>
<th>SAP P/N</th>
<th>IMS P/N</th>
<th>Qty</th>
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<td>1</td>
<td>Firing Head Assembly 1.50 inch O.D.</td>
<td>100000434</td>
<td>.40525</td>
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<td>2</td>
<td>Extension Mandrel Assembly 1.50 inches O.D.</td>
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<td>995.50072</td>
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<td>3a</td>
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<td>.40409</td>
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<tr>
<td>3b</td>
<td>Detonator Assembly RED Top Fire, HMX 375° F for 1 hr</td>
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<td>995.55093</td>
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<td>4a</td>
<td>Adapter (for resistorized detonator assy item 3a) Made-up length 3.29 inches (83.6 mm)</td>
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<td>Adapter (for RED Top Fire detonator assy item 3b) Made-up length 5.31 inches (134.9 mm)</td>
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<td>.94180</td>
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O-rings, for firing head, extension mandrel and adapter, one for each.

6a O-ring 214 Nitrile 90 Duro | 100001949 | 70.33958 |
6b O-ring 214 Viton 95 Duro | 100003922 | 600.33958 |

**Required Assembly Items**

7 Shunt Plug, 1 3/16” – 12UN ‘GO’ Pin | 100010861 | .40526  | 1   |
8 Protective Holder (for 1.50 Inch Firing Head) | 100010862 | .40528  | 1   |
9 Blasters Multimeter | 100009455 | .05187  | 1   |
10 Field Loading Procedure, Casing Cutters | 101227470 | (995.81008) | 1   |

Items 9 and 10 are not shown in the figures.

**Specifications JRC Casing Cutters, with Aluminum and/or Steel Housings**
<table>
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<tr>
<th>Cutter Description</th>
<th>Mat</th>
<th>SAP P/N (IMS P/N)</th>
<th>EXP Class UN No.</th>
<th>Explosive; weight Grams</th>
<th>Recommended Usage</th>
<th>Pressure rating</th>
<th>Temp Rating for 1 hr</th>
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<tr>
<td>3 5/8 (3.625) inch (92.1 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100010776 (.30444)</td>
<td>1.1D UN0059</td>
<td>RDX 54 4 ½ (4.500) inch (114.3 mm) O.D. 0.290 inch (7.4 mm) Wall N-80 13.5 lb/ft (20.1 Kg/m)</td>
<td>9,200 PSI 63 MPa 325° F 163° C</td>
<td></td>
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</tr>
<tr>
<td>4.0 inch (101.6 mm) O.D. Casing Cutter</td>
<td>S/A</td>
<td>100118410 (.40469)</td>
<td>1.1D UN0059</td>
<td>RDX 110 5.000 inch (127 mm) O.D. 0.362 inch (9.2 mm) Wall N-80 18 lb/ft (26.8 Kg/m)</td>
<td>17,000 PSI 117 MPa 325° F 163° C</td>
<td></td>
<td></td>
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<tr>
<td>4 ½ (4.500) inch (114.3 mm) O.D. Casing Cutter</td>
<td>S/A</td>
<td>100014494 (995.56523)</td>
<td>1.1D UN0059</td>
<td>HMX 100 5 ½ (5.500) inch (139.7 mm) O.D. 0.415 inch (10.5 mm) Wall N-80 23 lb/ft (34.2 Kg/m)</td>
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<td>4 ¾ (4.750) inch (120.7 mm) O.D. Casing Cutter</td>
<td>S/A</td>
<td>100013313 (707.17305)</td>
<td>1.1D UN0059</td>
<td>RDX 100 5 ½ (5.500) inch (139.7 mm) O.D. 0.275 inch (7.0 mm) Wall N-80 15.5 lb/ft (23.1 Kg/m)</td>
<td>17,000 PSI 117 MPa 325° F 163° C</td>
<td></td>
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<tr>
<td>5 3/8 (5.375) inch (136.5 mm) O.D. Casing Cutter</td>
<td>S/A</td>
<td>120037958 (707.17314)</td>
<td>1.1D UN0059</td>
<td>RDX 240 6.000 inch (152.4 mm) O.D. 0.238 inch (6.0 mm) Wall N-80 15 lb/ft (22.3 Kg/m)</td>
<td>13,000 PSI 90 MPa 325° F 163° C</td>
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<td>5 ½ (5.500) inch (139.7 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100013314 (707.17306)</td>
<td>1.1D UN0059</td>
<td>RDX 253 7.000 inch (177.8 mm) O.D. 0.453 inch (11.5 mm) Wall N-80 32 lb/ft (47.6 Kg/m)</td>
<td>9,000 PSI 62 MPa 325° F 163° C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0 inch (152.4 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100141981 (707.17308)</td>
<td>1.1D UN0059</td>
<td>RDX 280 7.000 inch (177.8 mm) O.D. 0.408 inch (10.4 mm) Wall N-80 29 lb/ft (43.2 Kg/m)</td>
<td>9,000 PSI 62 MPa 325° F 163° C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 1/8 (6.125) inch (155.6 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100011033 (.94134)</td>
<td>1.1D UN0059</td>
<td>RDX 253 7 5/8 (7.626) inch (193.7 mm) O.D. 0.375 inch (9.5 mm) Wall N-80 29.7 lb/ft (44.2 Kg/m)</td>
<td>15,000 PSI 103 MPa 325° F 163° C</td>
<td></td>
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</tr>
<tr>
<td>7 ¼ (7.250) inch (184.2 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100010858 (.40470)</td>
<td>1.1D UN0059</td>
<td>RDX 373 8 5/8 (8.625) inch (219.1 mm) O.D. 0.595 inch (15.1 mm) Wall P-110 52 lb/ft (77.4 Kg/m)</td>
<td>8,000 PSI 55 MPa 325° F 163° C</td>
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</tr>
<tr>
<td>8 3/16 (8.188) inch (208.0 mm) O.D. Casing Cutter</td>
<td>A</td>
<td>100011035 (.94180)</td>
<td>1.1D UN0059</td>
<td>RDX 407 9 5/8 (9.625) inch (244.5 mm) O.D. 0.545 inch (13.8 mm) Wall P-110 53.5 lb/ft (79.6 Kg/m)</td>
<td>8,000 PSI 55 MPa 325° F 163° C</td>
<td></td>
<td></td>
</tr>
</tbody>
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* Housing Materials: S = Steel  A = Aluminum  S/A = Steel and Aluminum
Figure 1. Electrical and Detonator Assembly

Figure 2. Casing Cutter Final Assembly