"INITIATION SYSTEM "?

It is a means of starting off bulk explosives reliably, and at the correct time and in the correct sequence ....

Initiating Explosives System

• A combination of detonators, signal tube, detonating cord, safety fuse, igniter cord or other devices designed to initiate the detonation of a charge or combination of charges in blasting
• Usually a chain reaction of smaller charges initiating larger charges with communication between the initiators and the main charges via some signal line either electrical, a core loaded explosive or a confined dust explosion
**INITIATION SYSTEMS**

- **Starter unit**
  - initial signal to start the blast (Exploder)

- **Surface systems**
  - transmission of signal & delay timing across the surface of the blast (Det-cord)

- **In hole unit**
  - transmission of signal down the hole, plus delay timing & detonator energy

**INITIATING DEVICES**

**Nonelectric**
Capped Fuses
Why, why not?
How, ... tools?
Rules?
Delays?
Hazards?

Cap & Fuse

Cap & Fuse

Detonating Cord Construction
PETN Core
Plastic Extrusion
Plastic Yarns
Overwrapping
### Detonating Cords

<table>
<thead>
<tr>
<th>Product</th>
<th>Colour</th>
<th>Nominal Core Load g/m PETN</th>
<th>External Diameter mm</th>
<th>UVD mm</th>
<th>Tensile Strength KgF</th>
<th>Grit Weight</th>
<th>Application and Special Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniflex</td>
<td></td>
<td>3.6-4.0</td>
<td>7.0</td>
<td>105-110</td>
<td>27.0 KgF</td>
<td>3.6 g/m</td>
<td>A light grade cord used mainly for trunk lines on the surface.</td>
</tr>
<tr>
<td>Powerflex</td>
<td>Red</td>
<td>4.5-4.8</td>
<td>7.1-7.5</td>
<td>110-115</td>
<td>26.0 KgF</td>
<td>5 g/m</td>
<td>Universal usage – trunk and branch lines — surface and underground.</td>
</tr>
<tr>
<td>Trunkcord</td>
<td>White</td>
<td>4.6-5.3</td>
<td>7.1-7.5</td>
<td>125-130</td>
<td>34.6 KgF</td>
<td>5 g/m</td>
<td>As for REDCORDER where extra strength and abrasion resistance are required. Fire-off instructions vary from order.</td>
</tr>
<tr>
<td>Redcord</td>
<td></td>
<td>4.6-5.3</td>
<td>7.1-7.5</td>
<td>175-180</td>
<td>20.2 KgF</td>
<td>10 g/m</td>
<td>Mining iron ore and other very abrasive materials. Has a tough braided cover over the plastic sheathing.</td>
</tr>
<tr>
<td>Shearcord</td>
<td>Orange</td>
<td>10.5</td>
<td>6.4</td>
<td>120</td>
<td>26.9 KgF</td>
<td>70 g/m</td>
<td>Pre-cutting and smooth blasting. Stripping to finishing lines.</td>
</tr>
</tbody>
</table>

### Detonating Chords

<table>
<thead>
<tr>
<th>Product</th>
<th>Colour</th>
<th>Nominal Core Load g/m PETN</th>
<th>External Diameter mm</th>
<th>UVD mm</th>
<th>Tensile Strength KgF</th>
<th>Grit Weight</th>
<th>Application and Special Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE &quot;CORTEX&quot;</td>
<td>Blue</td>
<td>3.6-4.0</td>
<td>7.0</td>
<td>105-110</td>
<td>27.0 KgF</td>
<td>3.6 g/m</td>
<td>A light grade cord used mainly for trunk lines on the surface.</td>
</tr>
<tr>
<td>REDCORDER</td>
<td>Red</td>
<td>4.5-4.8</td>
<td>7.1-7.5</td>
<td>110-115</td>
<td>26.0 KgF</td>
<td>5 g/m</td>
<td>Universal usage – trunk and branch lines — surface and underground.</td>
</tr>
<tr>
<td>FLEXCORD</td>
<td>White</td>
<td>4.6-5.3</td>
<td>7.1-7.5</td>
<td>125-130</td>
<td>34.6 KgF</td>
<td>5 g/m</td>
<td>As for REDCORDER where extra strength and abrasion resistance are required. Fire-off instructions vary from order.</td>
</tr>
<tr>
<td>TUFFCORD</td>
<td>Yellow</td>
<td>4.6-5.3</td>
<td>7.1-7.5</td>
<td>175-180</td>
<td>20.2 KgF</td>
<td>10 g/m</td>
<td>Mining iron ore and other very abrasive materials. Has a tough braided cover over the plastic sheathing.</td>
</tr>
<tr>
<td>&quot;GEOFLEx&quot;</td>
<td>Green</td>
<td>20.5-6.7</td>
<td>6.5-7.3</td>
<td>226</td>
<td>10.9 KgF</td>
<td>20 g/m</td>
<td>Land and marine seismic prospecting. Direct linear vibration of ANFO.</td>
</tr>
<tr>
<td>&quot;GEOFLEx&quot;</td>
<td>Pink</td>
<td>40.7-6.8</td>
<td>6.1-6.8</td>
<td>250</td>
<td>20.9 KgF</td>
<td>40 g/m</td>
<td>Land and marine seismic prospecting. Direct linear vibration of ANFU.</td>
</tr>
<tr>
<td>&quot;SHEARCORD&quot;</td>
<td>Orange</td>
<td>10.5</td>
<td>6.4</td>
<td>120</td>
<td>26.9 KgF</td>
<td>70 g/m</td>
<td>Pre-cutting and smooth blasting. Stripping to finishing lines.</td>
</tr>
</tbody>
</table>
Detonating Chord

Detonating Cord Properties

Strength - 70 - 100 kg
Stretch - ~10%
Compare to Signal Tube
Impact Resistance - 20 kgF
Compatibilities.

VOD - 7000 ms
Water Resistance
Oil Resistance

9.5 min
Detonating Cord Knots

- Double Clove Hitch: For Tying Downline to surface Trunkline
- Reef Knot: For Trunkline Extending

Cutting Detonating Cord

- Plastic Jaw: ✔️
- Other tools: ✗
Detonating relay Connectors (DRC)
Millis second Connector

- Plastic Cleats
- Yellow EXEL signal tube
- Nonelectric delay detonator

# 8 Strength cap
Fire Detonating cord ONLY

Surface Detonating Cord

- Delays: 9ms, 17ms, 25ms, 35ms, 42ms, 65ms, 100ms, 125ms, 150ms, 175ms, 200ms
**Signal Tube NONEL Detonator**

- **Hollow multi layered plastic tube**
- **Inside tube coated with HMX/aluminium dust**
- **Shock wave - 2100 m/s**
- **Cut tube allows in moisture causing misfire**

**Nonel Tube Construction**

92% Cyclo tetra methylene tetra nitramine\(^{[\text{HMX}]}\)
8% Paint Fine Aluminium
Coreload Limits 13mg/m +/- 2
10

**ELECTRIC DETONATORS**

a) Instantaneous Elect Det  
b) “L” Series Millisecond Delay Det  
c) Half Second (LP) Delay Det  
d) Electronic Detonators

a) Magnadet Detonators  
b) Magna Primer
**Electric Detonator Systems**

**Instantaneous Electric Detonator Construction**

1. **Ignition Composition**
   - Lead Mono-Nitro Resorconate + Potassium Chlorate

2. **Flashing Composition**
   - Potassium Chlorate + Charcoal

3. **Protective Coating**
   - Nitro Cellulose

**Electric Detonator**

- Base charge
- Neoprene plug
- Leadwires
- Fusehead
- Cnmp
- Metal foil
- Shorted & sheathed
- Bridgewire
- Solder
- Protection
- "Protected"
MS Delay Electric Dets

Half Second Delay Elect Dets
Electric Det

- Carrick coal mine detonators
- Ten delays (0-10)
- Delay interval = 30 sec

Exploders

Fig. 6: 'BEETHOVEN' Exploder
Fig. 7: NISSAN P-3-30 Shot Exploder
Exploders

What could Fire a Det?

- Batteries, power sources
- Electric equipment, cables
- Steel pipes, rail, conductors
- Lightning, ground currents
- Firing cables, leads alongside power lines
What could Fire a Det?

- Rock falls
- Pinch in machine
- Drop object, tools
- Drive, walk, crush
- Rough charging

What could Fire a Det?

- Friction on plastics, fabrics
- Sparks from equipment
- Hot exhaust
- Fires, welding
4. Generation of Electrostatic Charges

Charges may be generated on a person by static electricity. Materials such as plastic (PVC), rubber, wood, paper, clothing, fur, hair, etc. which might separate from each other may cause static electricity to accumulate on a person or earthed objects - a bench top or piece of equipment - in such a situation, static electricity may pass through to earth and cause a stray current of 10^-7 amperes for short periods under very favorable conditions. (Figure 1)

\[
I = 10^{-7} \text{ A}
\]

\[
R = 10^{10} \text{ Ohm}
\]

\[
V = 1000 \text{ V}
\]

\[
E = 0.6 \text{ mJ}
\]

\[
C = 300 \text{ pF} = 300 \times 10^{-12} \text{ F}
\]

Under dry conditions 5,000V was obtained. In this case 5 - 7.5kV - almost enough to provoke a normal feeling of discomfort.

Thus static charges on a person may cause the body to feel a sensation of discomfort or unpleasantness. However, if the charge is of such magnitude that it sparks to earth, it may cause a stray current of 10^-7 amperes for short periods under very favorable conditions. (Figure 1)

If the conductors are earthed it may cause a stray current of 10^-7 amperes for short periods under very favorable conditions.

This is a high value but quite capable of initiating some static electrical effects.

If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects.

If the conductors are earthed it may cause a stray current of 10^-7 amperes for short periods under very favorable conditions.

This is a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects. If in another case a person takes 10 steps on a carpet and acquires a potential of 2.5kV then the energy would be:

\[
E = \frac{1}{2} CV^2 = \frac{1}{2} \times 300 \times 10^{-12} \times (2.5 \times 10^3)^2 = 6.25 \text{ mJ}
\]

This is not a high value but quite capable of initiating some static electrical effects.
Connecting an Electric Starter Detonator.

- Secure Exploder
- Run out Firing Cable.
- Test (both open and closed circuit)
- Ensure exploder end "twitched"
- Attach electric detonator to firing line.
- Attach electric detonator to EXEL Signal tube.

Magnadet High Frequency Electric Det.

Concept:
Detonator wires are connected to a ring transformer consisting of a ferite ring – TOROID.

Toroid is frequency sensitive activated by the special AC powered exploder operating in the frequency range of 12 000 – 25 000 Hz. [AC]
Electronic detonator

Micro Chip
**Electronic Detonators**

- Loading, as for non-elecs, universal detonator.
- Fully programmable delay times using computer.
- Fully testable.
- Immune to stray currents - coded firing signal.

---

**Initiation Summary**

... a means of starting off bulk explosives *reliably*, and at the correct *time* and in the correct *sequence* ....
What would happen if a detonator fired in your hand?
Workshop

Initiation System

What is an initiation system?
What are the types of systems?
What is a delay detonator?
What types of delay detonators are there?
Describe safety aspects?
What hazards should you be aware of?

Top (Collar) Vs Bottom Initiation

Fig. 9 Collar initiation

Fig. 10 Collar promated ring detonated initiation
• Anzomex boosters are cast water proof primers, made principally of cast pentolite (mixture of PETN, TNT and other miner ingredients
  – High strength, and high densi
  – High VOD (7000 m/s)
  – Lower shock sensitivity, friction, impact.