



# Explosive Safety In Logging Operation

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## Summary

When an Explosive explodes it does not recognize who are the people that are being affected. So, it is the responsibility of the people who are handling it and the people around the explosive activity who are prone to be affected for its explosion to visualize its damaging power. To understand the activity, it is prudent to be acquainted with some of the terminologies used in the oil industry for this purpose, to make it more accessible to everybody irrespective of rank and file. From Rig up to rig down, the GOI and ONGC guidelines has to be adhered to and the explosive rules laid down in the explosive act and the amendment by the comptroller of explosive if any from time to time has to be followed. Safety, Health and Environment is a mandatory requirement for our organization and the compliance of the same is a routine job, which is auditable at a regular interval. An indifferent approach to safety may prove fatal not only to the individual but also to the Organization as well. A safe perforation procedure results in optimum production of Hydrocarbon from the zone of interest inside the well.

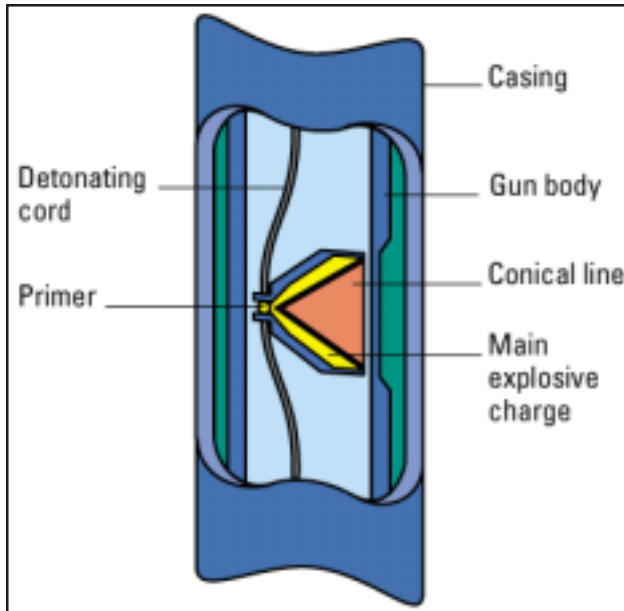
## Safety Measures

- Explosives should be transported by the licensed Explosive van (in case of land transport) only, the design of which should be strictly as per the norms laid out by the comptroller of explosives. The duly authorized and licensed explosive boxes should be used both for onshore and offshore transportation (mode B magazine).
- The area of explosive activity should be invariably marked with Explosive Danger signboard for awareness of others, nearby.
- Ground the Logging unit for dissipation of any stray current.
- Ensure that no high power voltage is live over or under head the activity.
- All the power engines are shut-off.
- The Radio communication should be powered off during the activity. No high power transmission or T.V. tower is in the vicinity.
- No chopper should takeoff or land during the operation. Boat is not approaching during the operation.
- Utmost precaution is warranted during charging the guns and arming the same with detonator/fuse. Avoid using multimeter to check the gun for continuity after arming the same.
- Safety switch should always be with the party chief and he should carry it physically and ensure not to leave it in the logging cabin.
- Ensure the least jerking of the charged gun while dragging the same with the help of the cat line from the catwalk to the rotary table. Ensure the mud level before lowering the gun in the well mouth.
- Carry out the activity only at daylight and preferably under a clear sky.
- Change the 'o' rings always after each run, be it the Cable head, Bull nose, firing head, Bridge plug/packer setting tool . Extra care to be ensured in High temperature-pressure wells (like Gandhar, Agartala, Assam ,Mumbai high fields etc) .Switch-off the cell phones to avoid possible interference
- Use the Rig to Unit Voltage measuring device and ensure the voltage less than 0.25V.
- It is a mandatory requirement to conduct safety meeting with rig-staff before starting the real perforation operation.
- Use the Safety Tube for carrying Detonator & while arming the gun.
- Use Blaster's galvanometer for checking the detonator for its internal resistance while the Deto is still in safety tube
- Use Hydraulically activated Switch that is to be connected between C/Head & CCL.
- Keep unit engine in idle during the process and not to start the Logging Unit Alternator unless the Gun is lowered to a depth not less than 200 mts
- For a better understandability across the section of our industry let us define and explain the purpose of our effort. Explosives we use in any wire line operation are mainly the shaped charges while perforating a well under well completion, or to squeeze a formation under scrutiny. Detonating chords are used to connect the shaped charges within the gun or carrier assembly and in the events of Back-off of casing or tubing. Casing or tubing cutters are used to cut apart the same in a precise manner. Primary and secondary explosives are

used to set Bridge plug, Cement retainer or Packer in the well at a desired depth.

### What is perforation ?

Perforation is carried out to create tunnel in the reservoir formation with the help of safe explosive charges. The explosive charge produces an extremely high pressure jet or slug that penetrates the casing or liner into the reservoir formation. The shaped charge is contained in a perforating gun or carrier assembly which is conveyed on wire line, tubing or coiled tubing, depending on the application and the wellbore condition



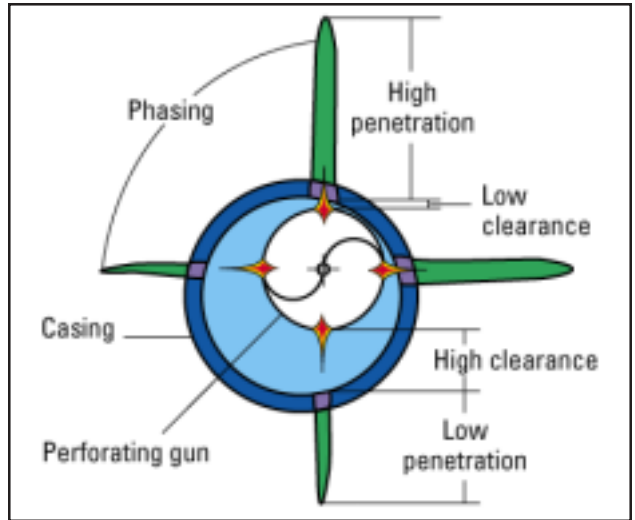
### Perforating charges

An explosive device that utilizes a cavity-effect explosive reaction to generate a high-pressure, high velocity jet or slug that creates a perforation tunnel. The shape of the explosive material and powdered metal lining determine the shape of the jet/slug and performance characteristic of the charge. The extremely high pressure and velocity of the jet/slug cause materials like steel, cement and rock formations to flow plastically around the jet path, resulting in creation of perforation tunnel.

### Perforating geometry

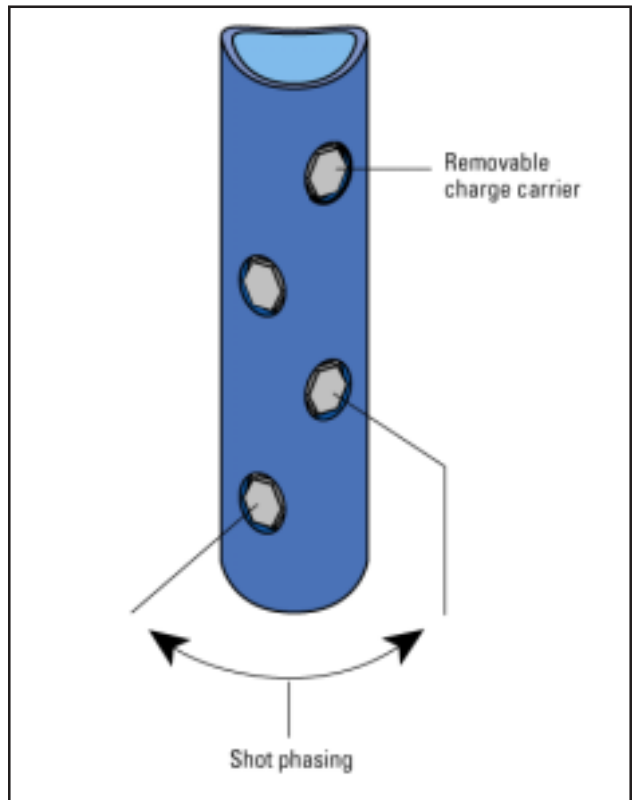
#### Detonator

Detonator is a small electrically activated explosive charge. This is called a cap or a blasting cap.



### Casing Gun

A perforating gun assembly designed to be used in a well bore before the production tubulars or the completion equipments are installed, thus allowing the access for a larger diameter gun assembly. Casing guns are typically 3-5 inches and carry up to four perforating charges per foot. HSD(High shot density) gun systems are of





different sizes viz, 7- in ,6 5/8-in,5-in,4.72-in,4 5/8-in,4 1/2-in, 3.67-in,3 3/8-in,3 1/2-in,3 1/6-in,2 7/8-in,2 1/2-in,2 1/4-in,2-in, 1.56-in. and are used depending on the size of the passage of gun conveyance.

## Perforation density

The number of perforation per linear foot. This term is used to describe the configuration of perforating guns or the placement of perforation, and is often abbreviated to spf (shots per foot). An example will be a 8 spf of casing gun.

## Effective shot density

A value that reflects the number of perforation per unit of length (feet) that are producing, or injecting efficiently. Perforation efficiency may be compromised by gun failure or charge misfire, perforation debris, excessive standoff or poor orientation or by combination of all these. The effective shot density may be used in treatment design models or to calculate likely Productivity response.

## High explosives

Chemical explosive material having an extremely high reaction rate that creates very high combustion pressures, unlike low explosives that have much lower reaction rate and are commonly used as propellants. High explosives are further categorized as Primary-and Secondary- high explosive. Primary high explosives are very sensitive, can be detonated easily and are generally used only in percussion and electrical generators. Secondary-high explosives are less sensitive, require a high-energy shock wave to achieve detonation and are safe to handle. Secondary- high explosives are used almost all elements of a ballistic chain, other than the detonator, such as in detonating cord and shaped charges. These explosives we use while dressing the Bridge- Plug or Cement Retainer or a Packer to set the same in a well at a desired depth.

## Tubing conveyed perforation

Deep, hot wells often have a long section of liner. The packer is set in the casing above the liner hanger, and the production tubing a few feet inside the top of the liner. This type of installation prevents conventional conveyance of tubing- conveyed perforating TCP guns. The tubing conveyed perforating system consists of a standard gun string mechanically latched at the end of the production

tubing, and a gun string anchoring a release section. This allows the gun string to be conveyed through the tubing to the top of the liner using large high-performance guns. Then, when the well is ready for production, the gun string is unlatched with wire line, conveyed by wire line to the perforating depth and anchored. After the wire line is pulled out, the gun string is pressure fired and automatically dropped at bottom, if desired.

## Underbalance perforation

To create holes in the liner or casing under conditions in which the hydrostatic pressure inside the casing or liner is less than the reservoir pressure. When the perforation is made, there will be a tendency for the reservoir fluid to flow into the well bore.

## Conclusions

- Explosive safety starts from designing the Safety magazine strictly as per the norms laid out which is not falling under the present scope, followed by storing, safeguarding, and then transporting to the site. All these steps including the liquidation of explosives has to be done under the strict guidelines laid down by the comptroller of explosives available in the rule book of explosive act and the GOI and the ONGC guidelines.
- If at all the guns are charged in the office premises (which is again not recommended) make sure that the same is not armed and transport the same invariably in an explosive van and not in the Logging unit or by any other transport means to the site.
- The casing to unit voltage has to be monitored less than 0.25V through out the operation.
- Slapper actuated detonator of M/S SASL is a safe approach when other activities on the site may continue.
- Hydraulic Safety switch is a must to be used during perforation job.
- In case of a misfire of gun, pulling out the same from the well needs extreme precaution because the gun, which is coming out from the well, is already armed. Unscrew the bull plug with caution and disarm the gun immediately(Adhering all the safety norms discussed above).
- It is needless to mention that the hardwares used (both ferrous and non-ferrous accessories) should be of

sound metallurgy and quality.

- If the well becomes active immediately after the perforation, clamp the cable on the well head, release the cable from the drum and chop-off the cable from the winch side and let loose the gun or strip fall inside the well and handover the well to production for further precautionary action. Wind up and clear the site immediately.

To conclude with a phrase, “***Experience is not what happens to you; it is what you do with what happens to you***”.

*Views expressed in this paper are that of the author(s) only and may not necessarily be of ONGC.*