

(विस्फोटन प्रभाग)
सी एम पी डी आई (मुख्या)

पत्रांक : सीएमपीडीआई/ विस्फोटन/ 2016-17/ 137 E-18946 18966

दिनांक : 10.02.2017

विषय: Permission for wide circulation of Standard Operating Procedure for Random sampling and testing of explosives and accessories

CMPDIL (HQ) Blasting Cell is carrying out different field jobs related to measurement of technical parameters of random sampling and testing of explosives and accessories within CIL & outside CIL. Random sampling and testing of explosives and accessories is done as per well established internal Standard Operating Procedure keeping in line with the Running contract/ Indian standard 6609 guidelines in the most transparent manner.

Standard Operating Procedure for Random sampling and testing of explosives and accessories is submitted (End-1) for kind perusal and permission for onward submission to General Manager (Production) CIL, Kolkata.

CJha
(एम. के. झा)
10/02/2017

वरीय प्रबन्धक (खनन/ विस्फोटन अनुभाग)

महाप्रबन्धक(वि. एवं प्रौ. /विस्फोटन प्रभाग)

*Put up for kind perusal and necessary permission
for onward submission to CIL [End-1 & End-2]*

CJha
20/2/17

निदेशक तकनीकी (आरडी एण्ड टी)

20/2/2017

CMD has seen this file through eOffice and put
the following remarks/ action
• Approved as recommended!!

CJha

DT (RD & T)

*Pl. give copy to
GM (Tech) CIL 2 Stns
A. Roy, GM (Production) CIL*

*AM (Sectl.) to CMD
Dtd. 23/2/17*

23/2/2017

SOP FOR EXPLOSIVES

SOP FOR TESTING OF BULKEXPLOSIVES

REQUIREMENT FOR TESTING ARRANGEMENTS:

- a. VOD testing PVC plate/plastic plate having length 30 cm, breadth 6 cm and thickness of 6 mm.
- b. Poker for making holes.
- c. Scale (measuring tape) for marking distance.
- d. Marker for making reference points on plate, detonating fuse, PVC plate and cartridge.
- e. Break-wire/ Bobbin wire.
- f. Digital timer for measuring the known VOD of detonating fuse.
- g. Plastic tape.
- h. Weighing machine.

FIELD TESTING PROCEDURE:

1. STEPS TO MEASURE THE VELOCITY OF DETONATION OF THE DETONATING FUSE AS REFERENCE VOD

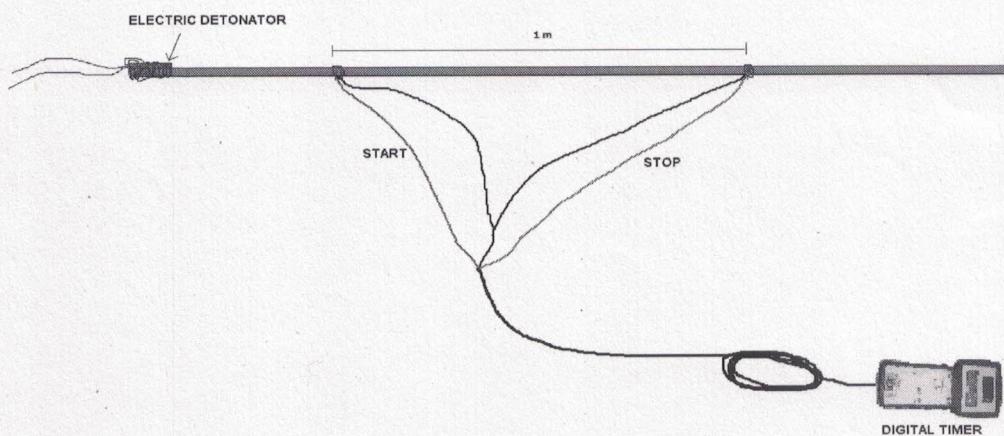


Fig 1: Typical photograph of experimental setup for VOD determination of detonating fuse

- a. Take a detonating fuse of minimum length of 2 meter.
- b. Mark two points on the detonating fuse at the distance of 1 meter with the help of a measuring tape and marker.
- c. Tie the break-wire/ Bobbin wire at these two marked ends separately in such way that start loop is near the detonator end.
- d. Switch on the digital timer to power on mode to bring the digital timer in ready state to capture the event data.
- e. Crimp the No. 6/8 detonator (CDD/CED/AED) to the detonating fuse as shown in figure 1 and shot is fired with the help of approved type exploders.
- f. The VOD of the detonating fuse is displayed on the screen of digital timer. This VOD will be used as reference or benchmark VOD for determining the unknown VOD of the Bulk explosives.

2. BULK EXPLOSIVES PREPARATION AND VOD MEASUREMENT OF BULK EXPLOSIVES

- a. Take a detonating fuse of length measuring two meters or more.
- b. Mark the centre point on the detonating fuse prominently with the help of a marker.
- c. Take a PVC plate measuring 30cmX6cmX6mm and mark a very thin/hair line on one end of the PVC plate.
- d. Place the center of duly marked detonating fuse exactly on the line marked on the plastic plate by observing due precision. Use cello tape to ensure firm contact between the detonating fuse and PVC plate.
- e. Take the Bulk explosives sample of unknown VOD into the 83mm poly lay flat tube preferably in cartridge form to the testing site and mark two points on the cartridge precisely at a known distance (preferably 10 cm). Make two radially driven holes of equal depth into the cartridge at two marked points on the cartridge by a suitable poker in such a way that the first hole is at least 1.5 times the diameter of the cartridge away from the detonator end of the cartridge.

- f. Insert the ends of the detonating fuse into the radially driven holes in such a way that the longer arm of the detonating fuse protruding out of the PVC plate is inserted into the hole near to the detonator end of the cartridge.
- g. Insert a Cast Booster along with detonator into the end hole of the cartridge and connect the leads of the detonator to the cable. Fire the shot.
- h. Collect the PVC plate and measure ΔL i.e. the distance of the meeting of the detonating fronts from the centre of the detonating fuse (the point where the two detonation fronts meet on the PVC plate and distinguished by sharp mark i.e. at the back of the plate).
- i. The typical sketch of the experimental set up in of Dautriche respect is shown in figure 2.

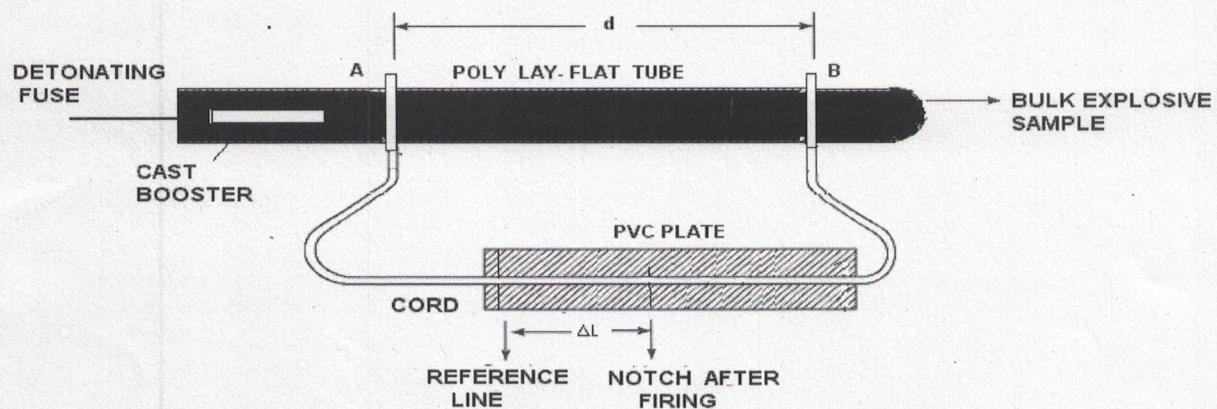


Fig 2: Typical photograph of experimental setup for Dautriche method

j. $\text{Velocity of Detonation (V) (m/s)} = d * V_0 / 2\Delta L$

Where, d = distance between two ends of detonating fuse,

V_0 = velocity of detonation of the detonating fuse in m/s

ΔL = Distance between middle point of standard detonating fuse to the point on the lead plate where two detonation fronts traveling in opposite directions meet

3. PRECAUTIONS:

- a. In case of misfire wait at least for 10 min.
- b. In case of incomplete detonation, collect all fragments of the explosives.
- c. In case of no mark on the PVC plate, repeat the VOD measurement exercise using a fresh length of detonating fuse.

4. Measurement of Density of Bulk Explosive By Water Displacement Method:

- a. Take a well graduated beaker of 500-1000 ml volume preferably.
- b. Fill the water up to the 100 ml mark preferably in the beaker.
- c. Measure the weight of beaker plus water by a reliable and duly calibrated weighing machine.
- d. Take a pinch of Bulk explosives sample and measure the mass using duly calibrated weighing machine and drop the explosives sample into the beaker containing water.
- e. Also measure the volume of water displaced by explosives sample. Divide the mass of explosives sample (in gm) by the volume of explosives sample (in ml) to obtain density. The generalised formula is mentioned below.

Density of explosives sample (ρ) in gm/cc = m / v

Where,

m = mass of explosives sample (in gm)

v = volume of explosives sample (in ml)

SOP FOR TESTING OF NON PERMITTED LARGE DIAMETER
(COLUMN) CARTRIDGE

SOP FOR TESTING OF NON PERMITTED LARGE DIAMETER (COLUMN) CARTRIDGE

REQUIREMENT FOR TESTING ARRANGEMENTS:

- a. VOD testing PVC plate/plastic plate having length 30 cm, breadth 6 cm and thickness of 6 mm.
- b. Poker for making holes.
- c. Scale (measuring tape) for marking distance.
- d. Marker for making reference points on plate, detonating fuse, PVC plate and cartridge.
- e. Break-wire/ Bobbin wire.
- f. Digital timer for measuring the known VOD of detonating fuse.
- g. Plastic tape.
- h. Weighing machine.

FIELD TESTING PROCEDURE:

1. STEPS TO MEASURE THE VELOCITY OF DETONATION OF THE DETONATING FUSE AS REFERENCE VOD

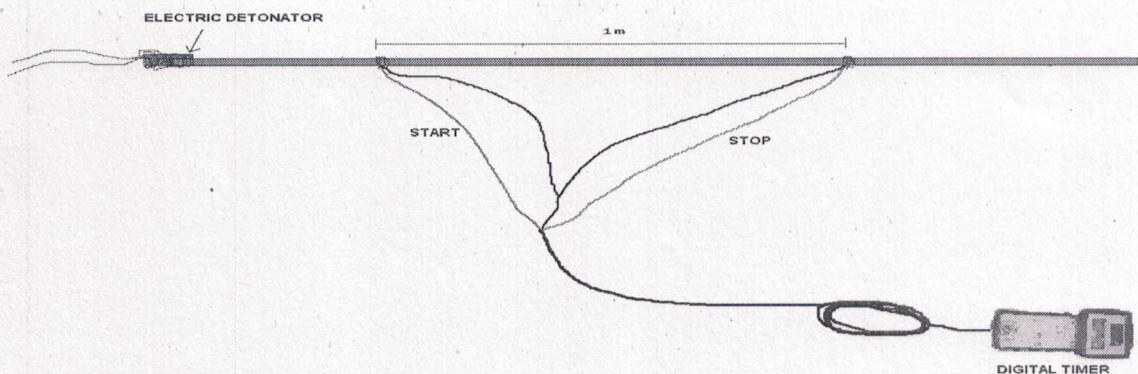


Fig 1: Typical photograph of experimental setup for VOD determination of detonating fuse

- a. Take a detonating fuse of minimum length of 2 meter.
- b. Mark two points on the detonating fuse at the distance of 1 meter with the help of a measuring tape and marker.
- c. Tie the break-wire/ Bobbin wire at these two marked ends separately in such way that start loop is near the detonator end.
- d. Switch on the digital timer to power on mode to bring the digital timer in ready state to capture the event data.
- e. Crimp the No. 6/8 detonator (CDD/CED/AED) to the detonating fuse as shown in figure 1 and shot is fired with the help of approved type exploders.
- f. The VOD of the detonating fuse is displayed on the screen of digital timer. This VOD will be used as reference or benchmark VOD for determining the unknown VOD of the cartridge explosives.

2. NON PERMITTED LARGE DIAMETER(NPLD) CARTRIDGE PREPARATION AND VOD MEASUREMENT OF NPLD CARTRIDGE

- a. Take a detonating fuse of length measuring two meters or more.
- b. Mark the centre point on the detonating fuse prominently with the help of a marker.
- c. Take a PVC plate measuring 30cmX6cmX6mm and mark a very thin/hair line on one end of the PVC plate.
- d. Place the center of duly marked detonating fuse exactly on the line marked on the plastic plate by observing due precision. Use cello tape to ensure firm contact between the detonating fuse and PVC plate.
- e. Take the NPLD (primer/booster) explosives cartridge along with NPLD column sample of unknown VOD to the testing site and mark two points on the NPLD column cartridge precisely at a known distance (preferably 10 cm). Make two radially driven holes of equal depth into the cartridge at two marked points on the cartridge by a suitable poker in such a way that the first hole is at least 1.5 times the diameter of the cartridge away from the detonator end of the cartridge.

- f. Insert the ends of the detonating fuse into the radially driven holes in such way that the longer arm of the detonating fuse protruding out of the PVC plate is inserted into the hole near to the detonator end of the cartridge.
- g. Insert a No. 6/8 detonator into the end hole of the cartridge and connect the leads of the detonator to the cable. Fire the shot.
- h. Collect the PVC plate and measure ΔL i.e. the distance of the meeting of the detonating fronts from the center of the detonating fuse (the point where the two detonation fronts meet on the PVC plate and distinguished by sharp mark i.e. at the back of the plate).
- i. The typical sketch of the experimental set up in respect of Dautriche method is shown in figure 2.

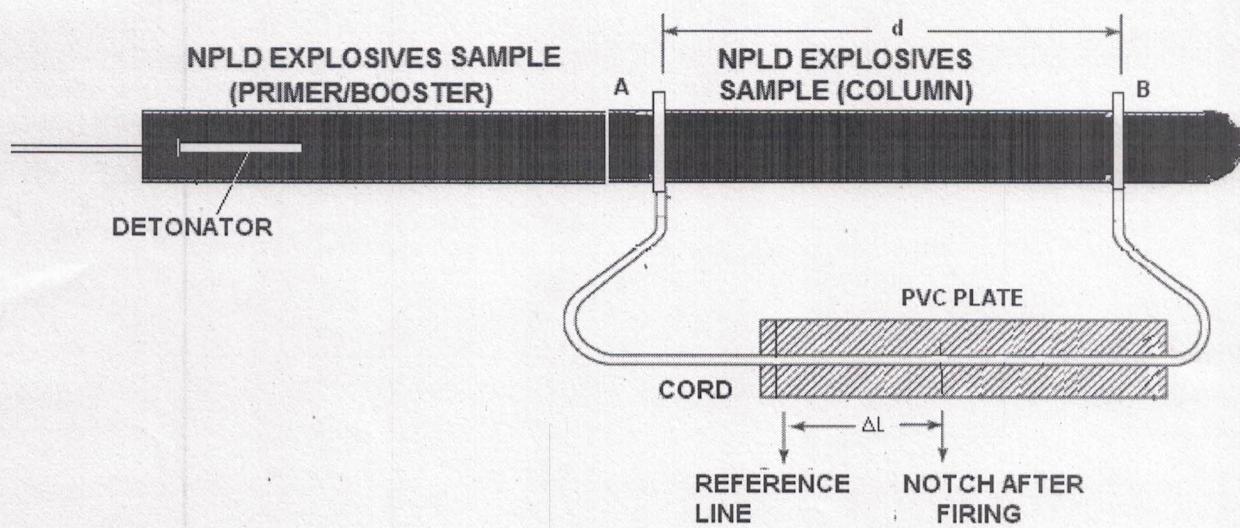


Fig 2: Typical photograph of experimental setup for Dautriche method

j. **Velocity of Detonation (V) (m/s)= $d * V_0 / 2\Delta L$**

Where, d = distance between two ends of detonating fuse,

V_0 = velocity of detonation of the detonating fuse in m/s

ΔL = Distance between middle point of standard detonating fuse to the point on the lead plate where two detonation fronts traveling in opposite directions meet

3. PRECAUTIONS:

- a. In case of misfire wait at least for 10 min.
- b. In case of incomplete detonation, collect all fragments of the explosive.
- c. In case of no mark on the PVC plate repeat the VOD measurement exercise after using a fresh length of detonating fuse.

4. Measurement of Density of NPLD Explosive By Water Displacement Method:

- a. Take a well graduated beaker of 500-1000 ml volume preferably.
- b. Fill the water up to the 100 ml mark preferably in the beaker.
- c. Measure the weight of beaker plus water by a reliable and duly calibrated weighing machine.
- d. Take a pinch of NPLD column explosives sample and measure the mass using duly calibrated weighing machine and drop the explosives sample into the beaker containing water.
- e. Also measure the volume of water displaced by explosives sample. Divide the mass of explosives sample (in gm) by the volume of explosives sample (in ml) to obtain density. The generalised formula is mentioned below.

Density of explosives sample (ρ) in gm/cc = m/v

Where,

m =mass of explosives sample (in gm)

v = volume of explosives sample (in ml)

**SOP FOR TESTING OF NON PERMITTED LARGE DIAMETER
(PRIMER/BOOSTER) CARTRIDGE**

SOP FOR TESTING OF NON PERMITTED LARGE DIAMETER (PRIMER/BOOSTER) CARTRIDGE

REQUIREMENT FOR TESTING ARRANGEMENTS:

- a. VOD testing PVC plate/plastic plate having length 30 cm, breadth 6 cm and thickness of 6 mm.
- b. Poker for making holes.
- c. Scale (measuring tape) for marking distance.
- d. Marker for making reference points on plate, detonating fuse, PVC plate and cartridge.
- e. Break-wire/ Bobbin wire.
- f. Digital timer for measuring the known VOD of detonating fuse.
- g. Plastic tape.
- h. Weighing machine.

FIELD TESTING PROCEDURE:

1. STEPS TO MEASURE THE VELOCITY OF DETONATION OF THE DETONATING FUSE AS REFERENCE VOD

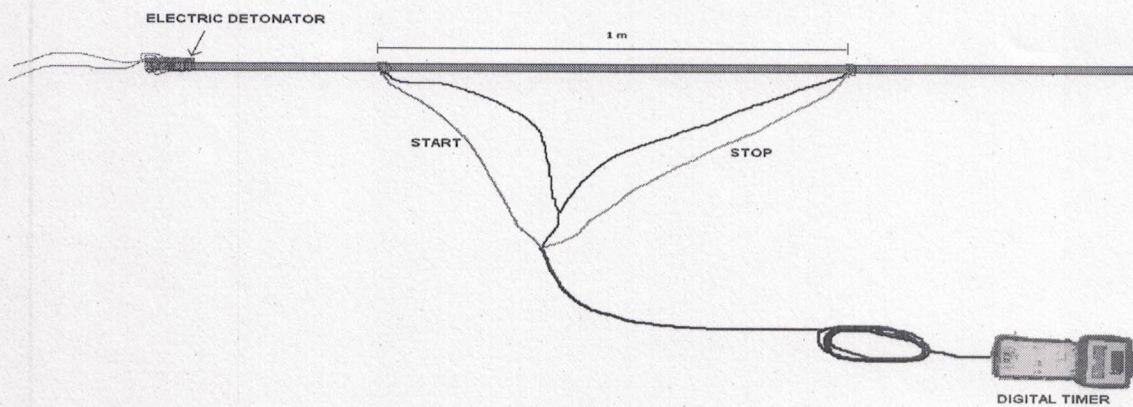


Fig 1: Typical photograph of experimental setup for VOD determination of detonating fuse

- a. Take a detonating fuse of minimum length of 2 meter.
- b. Mark two points on the detonating fuse at the distance of 1 meter with the help of a measuring tape and marker.
- c. Tie the break-wire/ Bobbin wire at these two marked ends separately in such way that start loop is near the detonator end.
- d. Switch on the digital timer to power on mode to bring the digital timer in ready state to capture the event data.
- e. Crimp the No. 6/8 detonator (CDD/CED/AED) to the detonating fuse as shown in figure 1 and shot is fired with the help of approved type exploders.
- f. The VOD of the detonating fuse is displayed on the screen of digital timer. This VOD will be used as reference or benchmark VOD for determining the unknown VOD of the cartridge explosives.

2. NON PERMITTED LARGE DIAMETER(NPLD) CARTRIDGE PREPARATION AND VOD MEASUREMENT OF NPLD CARTRIDGE

- a. Take a detonating fuse of length measuring two meters or more.
- b. Mark the centre point on the detonating fuse prominently with the help of a marker.
- c. Take a PVC plate measuring 30cmX6cmX6mm and mark a very thin/hair line on one end of the PVC plate.
- d. Place the center of duly marked detonating fuse exactly on the line marked on the plastic plate by observing due precision. Use cello tape to ensure firm contact between the detonating fuse and PVC plate.
- e. Take the NPLD (primer/booster) explosives sample of unknown VOD to the testing site and mark two points on the cartridge precisely at a known distance (preferably 10 cm). Make two radially driven holes of equal depth into the cartridge at two marked points on the cartridge by a suitable poker in such a way that the first hole is at least 1.5 times the diameter of the cartridge away from the detonator end of the cartridge.

- f. Insert the ends of the detonating fuse into the radially driven holes in such a way that the longer arm of the detonating fuse protruding out of the PVC plate is inserted into the hole near to the detonator end of the cartridge.
- g. Insert a No. 6/8 detonator into the end hole of the cartridge and connect the leads of the detonator to the cable. Fire the shot.
- h. Collect the PVC plate and measure ΔL i.e. the distance of the meeting of the detonating fronts from the centre of the detonating fuse (the point where the two detonation fronts meet on the PVC plate and distinguished by sharp mark i.e. at the back of the plate).
- i. The typical sketch of the experimental set up in respect of Dautriche method is shown in figure 2.

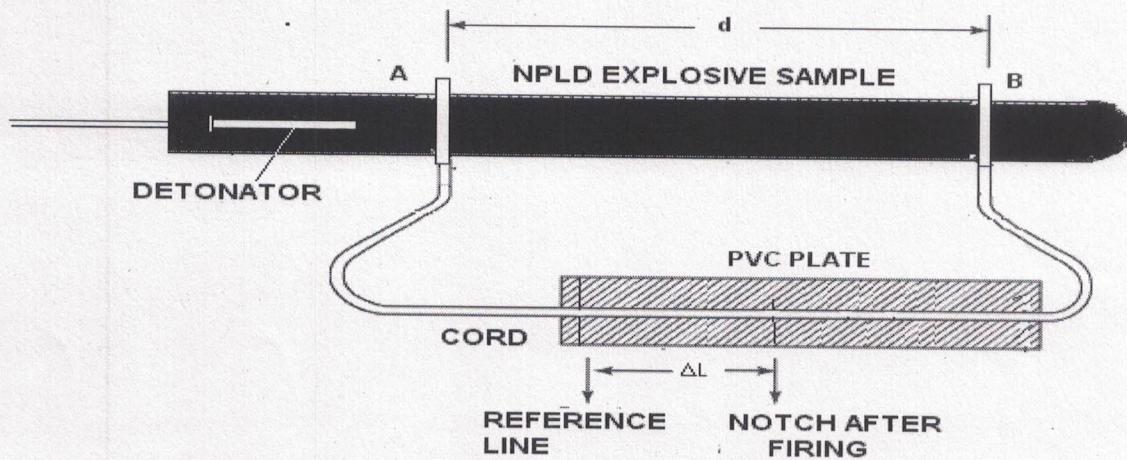


Fig 2: Typical photograph of experimental setup for Dautriche method

j. $V = d * V_0 / 2\Delta L$

Where, d = distance between two ends of detonating fuse,

V_0 = velocity of detonation of the detonating fuse in m/s

ΔL = Distance between middle point of standard detonating fuse to the point on the lead plate where two detonation fronts traveling in opposite directions meet

3. PRECAUTIONS:

- a. In case of misfire wait at least for 10 min.
- b. In case of incomplete detonation, collect all fragments of the explosives.
- c. In case of no mark on the PVC plate repeat the VOD measurement exercise using a fresh length of detonating fuse.

4. Measurement of Density of NPLD Explosive By Water Displacement Method:

- a. Take a well graduated beaker of 500-1000 ml volume preferably.
- b. Fill the water up to the 100 ml mark preferably in the beaker.
- c. Measure the weight of beaker plus water by a reliable and duly calibrated weighing machine.
- d. Take a pinch of NPLD explosives sample and measure the mass using duly calibrated weighing machine and drop the explosives sample into the beaker containing water.
- e. Also measure the volume of water displaced by explosives sample. Divide the mass of explosives sample (in gm) by the volume of explosives sample (in ml) to obtain density. The generalised formula is mentioned below.

Density of explosives sample (ρ) in gm/cc = m/v

Where,

m = mass of explosives sample (in gm)

v = volume of explosives sample (in ml)

SOP FOR TESTING OF PERMITTED SMALL DIAMETER (PSD)

CARTRIDGE

SOP FOR TESTING OF PERMITTED SMALL DIAMETER (PSD) CARTRIDGE

REQUIREMENT FOR TESTING ARRANGEMENTS:

- a. VOD testing PVC plate/plastic plate having length 30 cm, breadth 6 cm and thickness of 6 mm.
- b. Poker for making holes.
- c. Scale (measuring tape) for marking distance.
- d. Marker for making reference points on plate, detonating fuse, PVC plate and cartridge.
- e. Break-wire/ Bobbin wire.
- f. Digital timer for measuring the known VOD of detonating fuse.
- g. Plastic tape.
- h. Weighing machine.

FIELD TESTING PROCEDURE:

1. STEPS TO MEASURE THE VELOCITY OF DETONATION OF THE DETONATING FUSE AS REFERENCE VOD

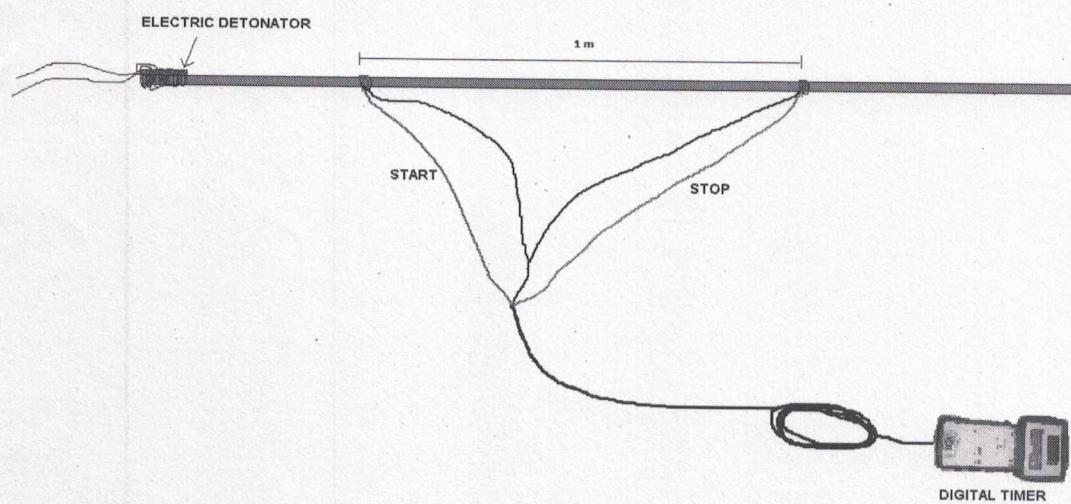


Fig 1: Typical photograph of experimental setup for VOD determination of detonating fuse

- a. Take a detonating fuse of minimum length of 2 meter.
- b. Mark two points on the detonating fuse at the distance of 1 meter with the help of a measuring tape and marker.
- c. Tie the break-wire/ Bobbin wire at these two marked ends separately in such way that start loop is near the detonator end.
- d. Switch on the digital timer to power on mode to bring the digital timer in ready state to capture the event data.
- e. Crimp the No. 6/8 detonator (CDD/CED/AED) to the detonating fuse as shown in figure 1 and shot is fired with the help of approved type exploders.
- f. The VOD of the detonating fuse is displayed on the screen of digital timer. This VOD will be used as reference or benchmark VOD for determining the unknown VOD of the cartridge explosives.

2. PERMITTED SMALL DIAMETER CARTRIDGE PREPARATION AND VOD MEASUREMENT OF PERMITTED SMALL DIAMETER CARTRIDGE

- a. Take a detonating fuse of length measuring two meters or more.
- b. Mark the centre point on the detonating fuse prominently with the help of a marker.
- c. Take a PVC plate measuring 30cmX6cmX6mm and mark a very thin/hair line on one end of the PVC plate.
- d. Place the center of duly marked detonating fuse exactly on the line marked on the plastic plate by observing due precision. Use cello tape to ensure firm contact between the detonating fuse and PVC plate.
- e. Take the PSD explosives sample of unknown VOD to the testing site and mark two points on the cartridge precisely at a known distance (preferably 10 cm). Make two radially driven holes of equal depth into the cartridge at two marked points on the cartridge by a suitable poker in such a way that the first hole is at least 1.5 times the diameter of the cartridge away from the detonator end of the cartridge.

- f. Insert the ends of the detonating fuse into the radially driven holes in such a way that the longer arm of the detonating fuse protruding out of the PVC plate is inserted into the hole near to the detonator end of the cartridge.
- g. Insert a No. 6/8 detonator into the end hole of the cartridge and connect the leads of the detonator to the cable. Fire the shot.
- h. Collect the PVC plate and measure ΔL i.e. the distance of the meeting of the detonating fronts from the centre of the detonating fuse (the point where the two detonation fronts meet on the PVC plate and distinguished by sharp mark i.e. at the back of the plate).
- i. The typical sketch of the experimental set up in respect of Dautriche method is shown in figure 2.

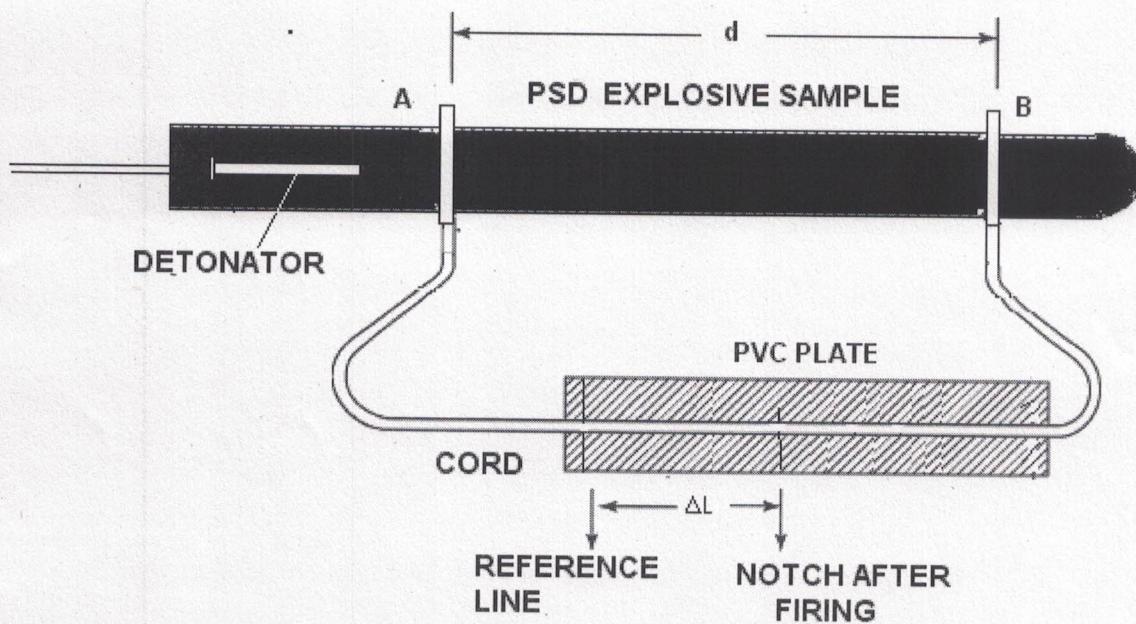


Fig 2: Typical photograph of experimental setup for Dautriche method

j. **Velocity of Detonation (V) (m/s)= $d * V_0 / 2\Delta L$**

Where, d = distance between two ends of detonating fuse,

V_0 = velocity of detonation of the detonating fuse in m/s

ΔL = Distance between middle point of standard detonating fuse to the point on the lead plate where two detonation fronts traveling in Opposite directions meet

3. PRECAUTIONS:

- a. In case of misfire wait atleast for 10 min.
- b. In case of incomplete detonation, collect all fragments of the explosive.
- c. In case of no mark on the PVC plate repeat the VOD measurement exercise after using a fresh length of detonating fuse.

4. Measurement of Density of PSD Explosive By Water Displacement Method:

- a. Take a well graduated beaker of 500-1000 ml volume preferably.
- b. Fill the water up to the 100 ml mark preferably in the beaker.
- c. Measure the weight of beaker plus water by a reliable and duly calibrated weighing machine.
- d. Take a pinch of PSD explosives sample and measure the mass using duly calibrated weighing machine and drop the explosives sample into the beaker containing water.
- e. Also measure the volume of water displaced by explosives sample. Divide the mass of explosives sample (in gm) by the volume of explosives sample (in ml) to obtain density. The generalised formula is mentioned below.

Density of explosives sample (ρ) in gm/cc = m / v

Where,

m = mass of explosives sample (in gm)

v = volume of explosives sample (in ml)

SOP FOR ACCESSORIES

SOP FOR DELAY DETONATOR TESTING

1. PRE TESTING REQUIREMENTS

Lead Plate

Fevi-quick

Lead plate holder

2. TESTING PROCEDURE FOR MEASURING STRENGTH OF THE DETONATOR

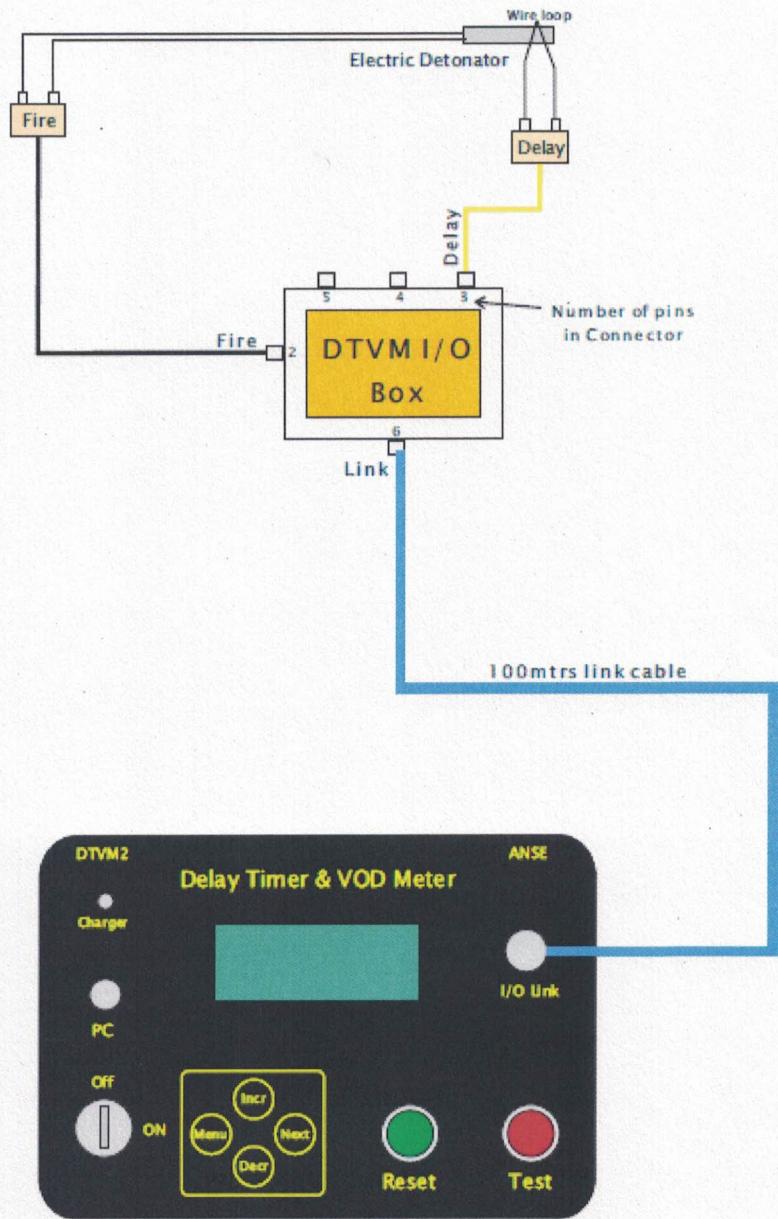
- a. Take a sample of detonator.
- b. Take a lead plate of dimensions 3.5cm length, 3.5cm breadth and 0.5cm thickness.
- c. Take a drop of fevi-quick on the lead plate.
- d. Place the detonator perpendicularly on the lead plate so that it gets stick to the plate.
- e. Connect the detonator to the Exploder and fire it.
- f. After the blast collect the lead plate and check dent/crater produced on the lead plate corresponded to C3 class.

3. TESTING PROCEDURE FOR SERIES FIRING OF DETONATOR

- a. Take a 10 number of detonators.
- b. Connect all the detonators in series.
- c. Connect the first detonator to the exploder.
- d. Fire the detonator.
- e. To pass the test, all the detonators should be fired successfully.

4. PROCEDURE FOR MEASURING DELAY TIMING OF DELAY DETONATOR

DTVM setup for Measuring Delay Timing of Delay Detonator



- a. Place the DTVM Main unit at a safe place (atleast 100mtrs) away from the blasting site keep the unit in power off mode and key switched off. Connect the link cable.
- b. Lay the 100mtrs. Cable as per the site layout.
- c. Place DTVM I/O Box at about 2 to 5 mtrs. Away from the sample under test. Connect the link cable.
- d. Connect the Yellow cable with splitter box to 3 pin connector labeled as Delay. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box attachment with push connectors for loop wire.
- e. Connect the black cable to 2 pin connector labeled as Fire. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connector for the ED wires.
- f. Take a piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the tip of the delay detonator shell and make sure that it does not slip off the shell. Connect the two ends of this wire loop to Delay splitter box push connectors. Ensure proper electrical contact.
- g. Connect the ED wires to fire cable splitter box push connectors. Ensure proper electrical contact.
- h. Lay all the cables as straight and as far away from detonator as possible.
- i. After making sure the site is ready for blasting, power ON the main unit by putting the key switch to ON. Press Reset (Green) button. Confirm Ready message is displayed on the screen. If not attend to the problem as shown on the display. Refer Error Messages. Once all OK, recheck site is ready for test. Press the Test (Red) button. Within 3-4 seconds firing impulse would be given which will cause the delay detonator to initiate and delay time of detonator will be displayed on the screen. Note the readings and Power Off the Unit. Turn the key switch to OFF position.
- j. Repeat steps f to i if further samples are to be tested.

5. TESTING PROCEDURE FOR MEASURING ELECTRIC RESISTANCE OF DELAY DETONATOR

- a. The electric resistance was determined by stretching the lead wire and connecting an ohmmeter across the base lead wires.
- b. The range of Electric Resistance of delay detonator shall be $5.5 \pm 1.0 \Omega$.

6. GENERAL PRECAUTIONS

- a. All blasting operations shall be done under the direct personal supervision of Blasting Officer / Assistant Manager in charge of blasting.
- b. Only those persons who are fully trained in random sampling & testing shall be deputed for these operations.
- c. Provisions of statute regarding blasting shall be strictly complied.
- d. The test procedure shall be followed in accordance with requirements as laid down in IS: 6609(part II/sec I) of 1973.
- e. Delay Detonator shall be used/ tested in the order of their dates of manufacture.
- f. Explosives when transported in vehicles shall be carried in an explosive van approved by the Petroleum and Explosives Safety Organisation (PESO). Explosive vans used for transport of explosives shall be in safe operating condition and should be driven by the competent licensed drivers. The explosive van shall be kept in isolated locations while loaded which shall be properly guarded and attended.
- g. No smoking or open flame shall be permitted in or near the explosive van containing explosives.

SOP FOR MS CONNECTOR/CORD RELAY TESTING

1. PRE TESTING REQUIREMENTS

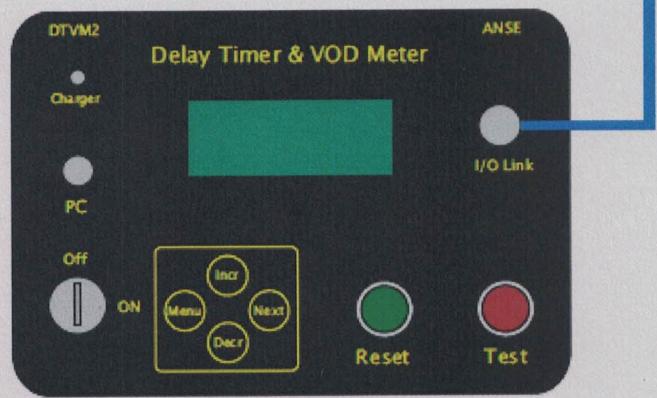
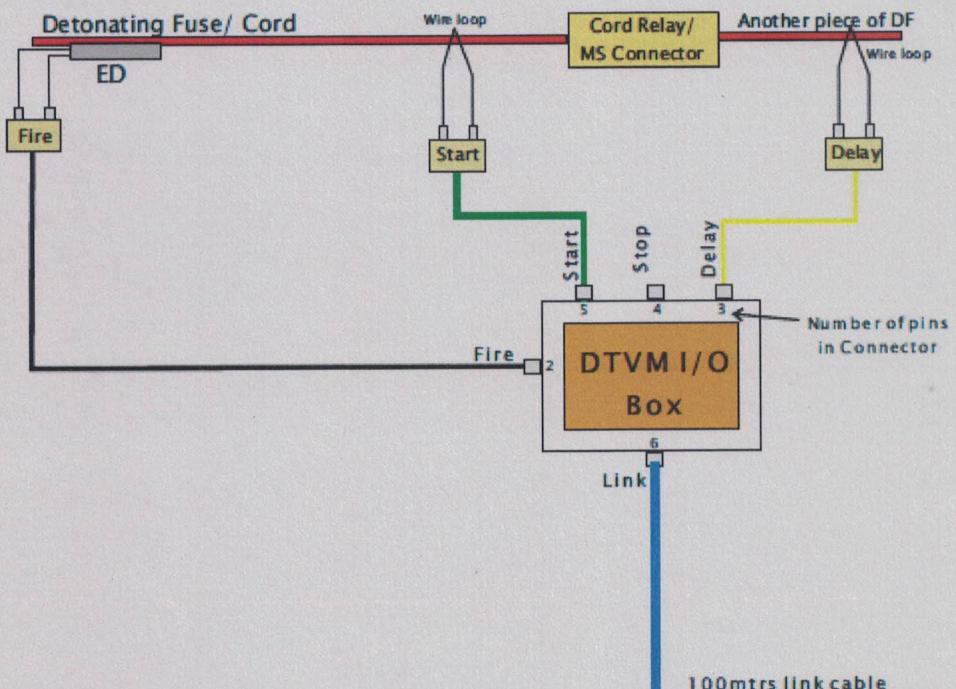
Plastic Tape

2. PROCEDURE FOR TRANSMISSION TEST OF MS CONNECTOR/CORD RELAY

- a. Take a 10 pieces of MS Connector or Cord Relay.
- b. Connect the 10 pieces in series with detonating chord acting as the couple. Each coupling joint should be covered with plastic tape.
- c. Connect the first piece with detonating chord and tie detonator with the chord.
- d. Fire the detonator.
- e. To pass the test, the entire 10 pieces of MS Connector or Cord relay should fire.

3. PROCEDURE FOR MEASUREMENT OF DELAY TIME OF MS CONNECTOR / CORD RELAY

DTVM setup for Measurement of Cord Relay/ MS Connector Delay Time



- a. Place the DTVM Main unit at a safe place (at least 100meters) away from the blasting site. Keep the unit in power off mode and key switched off. Connect the link cable.
- b. Lay the 100meters cable as per the site layout.
- c. Place DTVM I/O Box at about 2 to 5 meters. Away from the sample under test.
- d. Connect the Green cable with splitter box attachment to 5 pin connector labeled as Start. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connectors for wire loop.
- e. Connect the Yellow cable with splitter box attachment to 3 pin connector labeled as Delay. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connectors for wire loop.
- f. Connect the black cable to 2 pin connector labeled as Fire. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connectors for the ED wires.
- g. Take a piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the detonating cord about 1-2mtrs.from the ED initiating end. Connect the two ends of this wire loop to Start splitter box connectors. Ensure proper electrical contact.
- h. Take another piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the detonating cord/fuse attached to other end of Cord Relay/ MS Connector. Connect the two ends of this wire loop to Delay splitter box connectors. Ensure proper electrical contact.
- i. Tie the initiating ED to the detonating cord and connect the ED wires to Fire splitter box connectors.
- j. Lay all the cables as straight and as far away from detonators as possible.
- k. After making sure the site is ready for blasting, power ON the main unit by putting the key switch to ON. Press Reset (Green) button. Confirm Ready message is displayed on the screen. If not attend to the problem as shown on the display. Refer Error Messages. Once all OK, recheck site is ready for test. Press the Test (Red) button. Within 3-4 seconds firing impulse would be given which will initiate the ED and hence DF. Delay time of Cord Relay/ MS Connector will be displayed on the screen. Note the readings and Power off the Unit. Turn the key switch to OFF position.
- l. Repeat steps g to k if further samples are to be tested.

- m. The permissible limit of scattering in Cord Relay/MS Connector Shall be ± 5 m/s.
- n. Calibration of DELAY TIMER & VOD METER (DTVM) shall be done once in year or interval recommended by manufacture.

4. GENERAL PRECAUTIONS

- a. All blasting operations shall be done under the direct personal supervision of Blasting Officer / Assistant Manager in charge of blasting.
- b. Only those persons who are fully trained in random sampling & testing shall be deputed for these operations.
- c. Provisions of statute regarding blasting shall be strictly complied.
- d. The test procedure shall be followed in accordance with requirements as laid down in IS: 6609.
- e. Cord Relay/MS Connector shall be used/ tested in the order of their dates of manufacture.
- f. Explosives when transported in vehicles shall be carried in an explosive van approved by the Petroleum and Explosives Safety Organisation (PESO). Explosive vans used for transport of explosives shall be in safe operating condition and should be driven by the competent licensed drivers. The explosive van shall be kept in isolated locations while loaded which shall be properly guarded and attended.
- g. No smoking or open flame shall be permitted in or near the explosive van containing explosives.

SOP FOR ELECTRONIC DETONATOR TESTING

1. PRE TESTING REQUIREMENTS:

Lead Plate

Fevi-quick

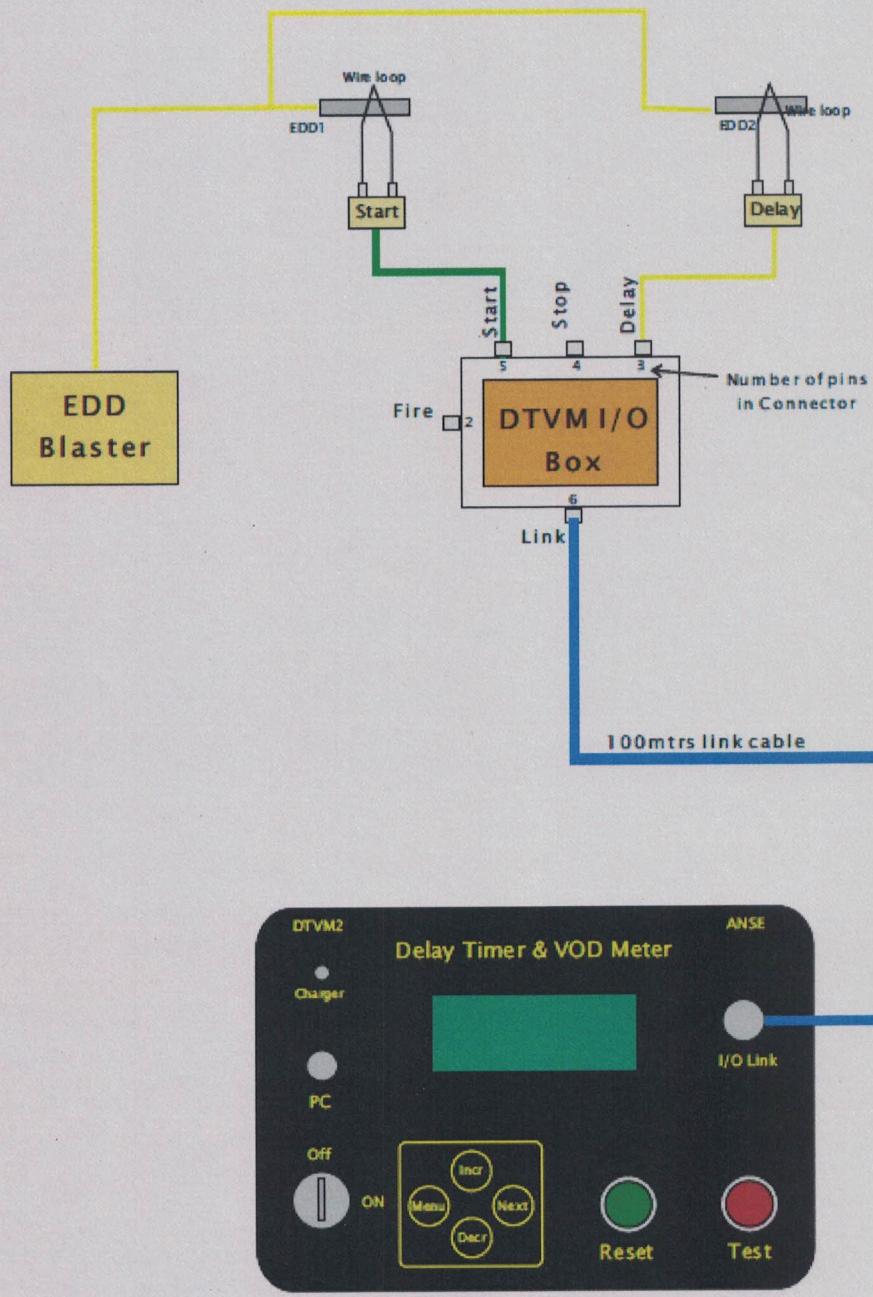
Lead plate holder

2. TESTING PROCEDURE FOR MEASURING STRENGTH OF THE ELECTRONIC DETONATOR

- a. Take a sample of electronic detonator.
- b. Take a lead plate of dimensions 3.5cm length, 3.5cm breadth and 0.5cm thickness.
- c. Take a drop of fevi-quick on the lead plate.
- d. Place the electronic detonator perpendicularly on the lead plate so that it gets stick to the plate.
- e. Connect the electronic detonator to the Exploder and fire it.
- f. After the blast collect the lead plate and check dent/crater produced on the lead plate corresponded to C3 class.

3. TESTING PROCEDURE FOR MEASURING DELAY TIME OF THE ELECTRONIC DETONATOR

DTVM setup for Measurement of Electronic Delay Detonator Delay Time



- a. Place the DTVM Main unit at a safe place (at least 100meters) away from the blasting site. Keep the unit in power off mode and key switched off. Connect the link cable.
- b. Lay the 100meters cable as per the site layout.
- c. Place DTVM I/O Box at about 2 to 5 meters. Away from the sample under test.
- d. Connect the Green cable with splitter box attachment to 5 pin connector labeled as Start. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connectors for wire loop.
- e. Connect the Yellow cable with splitter box attachment to 3 pin connector labeled as Delay. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connectors for wire loop.
- f. Take a piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the first EDD. Connect the two ends of this wire loop to Start splitter box connectors. Ensure proper electrical contact.
- g. Take another piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the second EDD. Connect the two ends of this wire loop to Delay splitter box connectors. Ensure proper electrical contact.
- h. Lay all the cables as straight and as far away from detonators as possible. Keep the electronic Detonator Blaster and DTVM unit side by side.
- i. After making sure the site is ready for blasting, power ON the main unit by putting the key switch to ON. Press Reset (Green) button. Confirm Ready message is displayed on the screen. If not attend to the problem as shown on the display. Refer Error Messages. Once all OK, recheck site is ready for test. Get the Electronic Detonator Blaster in ready to fire position. Press the Test (Red) button. Within 3-4 seconds the screen will show countdown mode. Press Fire button on the Blaster. EDD1 has to initiated first and then EDD2. Delay time of EDD2 with respect to EDD1 will be displayed on the screen. Note the readings and Power Off the Unit. Turn the key switch to OFF position.
- j. Repeat steps f to i if further samples are to be tested.
- k. The permissible limit of scattering in Cord Relay/MS Connector Shall be as specified by manufacturer $\pm 0.1\%$
- l. Calibration of DELAY TIMER & VOD METER (DTVM) shall be done once in year or interval recommended by manufacture.

4. GENERAL PRECAUTIONS

- a. All blasting operations shall be done under the direct personal supervision of Blasting Officer / Assistant Manager in charge of blasting.
- b. Only those persons who are fully trained in random sampling & testing shall be deputed for these operations.
- c. Provisions of statute regarding blasting shall be strictly complied.
- d. The test procedure shall be followed in accordance with requirements as laid down in IS: 6609.
- e. Electronic Detonator shall be used/ tested in the order of their dates of manufacture.
- f. Explosives when transported in vehicles shall be carried in an explosive van approved by the Petroleum and Explosives Safety Organisation (PESO). Explosive vans used for transport of explosives shall be in safe operating condition and should be driven by the competent licensed drivers. The explosive van shall be kept in isolated locations while loaded which shall be properly guarded and attended.
- g. No smoking or open flame shall be permitted in or near the explosive van containing explosives.

SOP FOR NON ELECTRIC DETONATOR TESTING

A

1. PRE TESTING REQUIREMENTS

Lead Plate

Fevi-quick

Lead plate holder

2. TESTING PROCEDURE FOR MEASURING STRENGTH OF THE DETONATOR

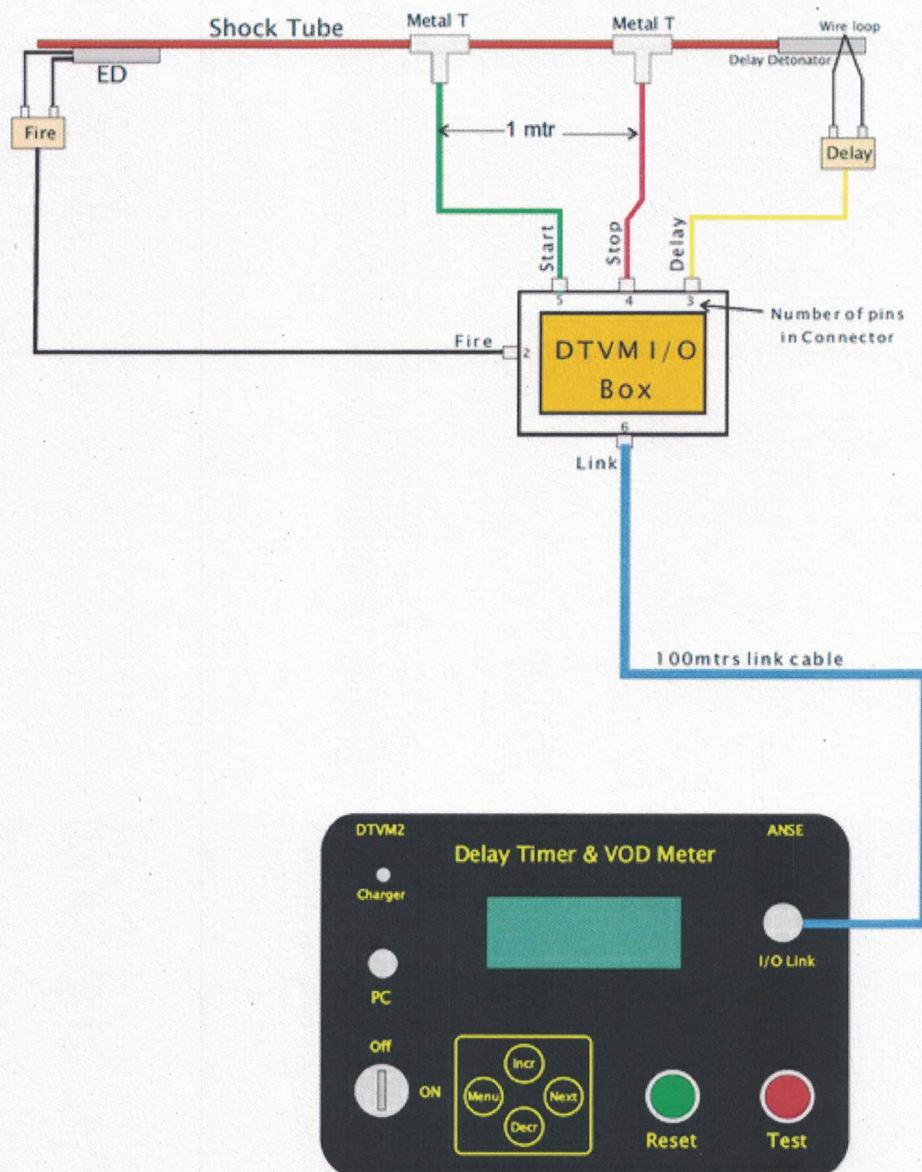
- a. Take a sample of non electric detonator.
- b. Take a lead plate of dimensions 3.5cm length, 3.5cm breadth and 0.5cm thickness.
- c. Take a drop of fevi-quick on the lead plate.
- d. Place the non electric detonator perpendicularly on the lead plate so that it gets stick to the plate.
- e. Connect the non electric detonator to the Exploder and fire it.
- f. After the blast collect the lead plate and check dent/crater produced on the lead plate corresponded to C3 class.

3. TESTING PROCEDURE FOR SERIES FIRING OF NON ELECTRIC DETONATOR

- a. Take a 10 number of non electric detonator.
- b. Connect the entire non electric detonator in series.
- c. Connect the first non electric detonator to the exploder.
- d. Fire the detonator.
- e. To pass the test, the entire non electric detonator should be fired successfully.

4. PROCEDURE FOR MEASURING DELAY TIMING OF NON ELECTRIC DETONATOR

DTVM setup for Measurement of Delay Time of Shock Tube (NONEL)



- a. Place the DTVM Main unit at a safe place (at least 100mtrs) away from the blasting site. Keep the unit in power off mode and key switched off. Connect the link cable.
- b. Lay the 100mtrs. Cable as per the site layout.
- c. Place DTVM I/O Box at about 2 to 5 mtrs. away from the sample under test. Connect the link cable.
- d. Connect the Green cable with metal T connector to 5 pin connector labeled as Start. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has metal T for inserting shock tube.
- e. Connect the Red cable with metal T connector to 4 pin connector labeled as Stop. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has metal T for inserting shock tube.
- f. Connect the Yellow cable with splitter box to 3 pin connector labeled as Delay. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connector for wire loop connection.
- g. Connect the black cable to 2 pin connector labeled as Fire. The connector has key slot and would mate in only one position/ orientation. The other end of the cable has splitter box with push connector for the ED wires.
- h. Thread the free end of shock tube from the Stop metal T through start metal T in a way so that the detonator is about 1to 2 mtrs. away from stop metal T. The distance between start and stop attachment is fixed at 1 mtrs.
- i. Take a piece of single strand wire about 2 mtrs. long. This wire could be lead wire of used ED. Wrap tightly a turn of this wire around the tip of the delay detonator shell and make sure that it does not slip off the shell. Connect the two ends of this wire loop to Delay splitter box push connectors. Ensure proper electrical contact.
- j. Tie the shock tube initiating ED to the shock tube and connect the ED wires to fire cable splitter box push connectors. Ensure proper electrical contact.
- k. Lay all the cables as straight and as far away from detonators as possible.
- l. After making sure the site is ready for blasting, power ON the main unit by putting the key switch to ON. Press Reset (Green) button. Confirm Ready message is displayed on the screen. If not attend to the problem as shown on the display. Refer Error Messages. Once all OK, recheck site is ready for test. Press the Test (Red) button. Within 3-4 seconds firing impulse would be given to ED which will initiate the shock tube and subsequently the delay detonator. VOD of shock tube and delay time of detonator will be displayed on the screen. Note the readings and Power Off the Unit. Turn the key switch to OFF position.

- m. Repeat steps h to l if further samples are to be tested.
- n. The permissible limit of scattering in Nonel shall be ± 10 m/s for long delay and ± 5 m/s for short delay.
- o. Calibration of DELAY TIMER & VOD METER (DTVM) shall be done once in year or interval recommended by manufacture.

5. GENERAL PRECAUTIONS

- a. All blasting operations shall be done under the direct personal supervision of Blasting Officer / Assistant Manager in charge of blasting.
- b. Only those persons who are fully trained in random sampling & testing shall be deputed for these operations.
- c. Provisions of statute regarding blasting shall be strictly complied.
- d. The test procedure shall be followed in accordance with requirements as laid down in IS: 6609(part II/sec I) of 1973.
- e. Nonel shall be used/ tested in the order of their dates of manufacture.
- f. Explosives when transported in vehicles shall be carried in an explosive van approved by the Petroleum and Explosives Safety Organisation (PESO). Explosive vans used for transport of explosives shall be in safe operating condition and should be driven by the competent licensed drivers. The explosive van shall be kept in isolated locations while loaded which shall be properly guarded and attended.
- g. No smoking or open flame shall be permitted in or near the explosive van containing explosives.

SOP FOR COPPER ELECTRIC DETONATOR TESTING

1. PRE TESTING REQUIREMENTS

Lead Plate

Fevi-quick

Lead plate holder

2. TESTING PROCEDURE FOR MEASURING STRENGTH OF THE DETONATOR

- a. Take a sample of detonator.
- b. Take a lead plate of dimensions 3.5cm length, 3.5cm breadth and 0.5cm thickness.
- c. Take a drop of fevi-quick on the lead plate.
- d. Place the detonator perpendicularly on the lead plate so that it gets stick to the plate.
- e. Connect the detonator to the Exploder and fire it.
- f. After the blast collect the lead plate and check dent/crater produced on the lead plate corresponded to C3 class.

3. TESTING PROCEDURE FOR SERIES FIRING OF DETONATOR

- a. Take a 10 number of detonators.
- b. Connect all the detonators in series.
- c. Connect the first detonator to the exploder.
- d. Fire the detonator.
- e. To pass the test, all the detonators should be fired successfully.

4. TESTING PROCEDURE FOR MEASURING ELECTRIC RESISTANCE OF DETONATOR

- a. The electric resistance was determined by stretching the lead wire and connecting an ohmmeter across the base lead wires.
- b. The range of Electric Resistance of detonator shall be $5.5 \pm 1.0 \Omega$.

5. GENERAL PRECAUTIONS

- a. All blasting operations shall be done under the direct personal supervision of Blasting Officer / Assistant Manager in charge of blasting.
- b. Only those persons who are fully trained in random sampling & testing shall be deputed for these operations.
- c. Provisions of statute regarding blasting shall be strictly complied.
- d. The test procedure shall be followed in accordance with requirements as laid down in IS: 6609(part II/sec I) of 1973.
- e. Detonator shall be used/ tested in the order of their dates of manufacture.
- f. Explosives when transported in vehicles shall be carried in an explosive van approved by the Petroleum and Explosives Safety Organisation (PESO). Explosive vans used for transport of explosives shall be in safe operating condition and should be driven by the competent licensed drivers. The explosive van shall be kept in isolated locations while loaded which shall be properly guarded and attended.
- g. No smoking or open flame shall be permitted in or near the explosive van containing explosives.