



AUSTIN POWDER



NON-ELECTRIC INITIATION SYSTEM

Shock★Star

USER'S GUIDE

CZECH REPUBLIC • December 2019

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INTRODUCTION

SHOCK*STAR IS A NON-ELECTRIC INITIATION SYSTEM DESIGNED BY AUSTIN DETONATOR S.R.O., CZECH REPUBLIC. THIS INITIATION SYSTEM INCREASES SAFETY AND ENSURES BETTER BLASTING RESULTS. THE SYSTEM WAS INTRODUCED TO THE MARKET IN 1993 AND SINCE THEN HAS SEEN THREE MAJOR MODIFICATIONS TO THE Surface CONNECTOR WHICH BROUGHT FURTHER RELIABILITY, PRECISION, AND SAFETY TO BLASTING IN FIELD. THE LAST VERSION OF THE Shock*Star Surface CONNECTOR BRINGS A NEW OPTIONAL FUNCTION OF SECURING CONNECTIONS BY LOCKING THE TUBES IN THE BLOCK IN ORDER TO ELIMINATE DISCONNECTIONS IN SOME SPECIAL APPLICATIONS, E.G. WHEN THE BLASTS NEED TO BE COVERED BY HEAVY MATS. THE CONNECTOR BLOCK ALSO FURTHER INCREASES USERFRIENDLINESS WHEN MAKING CONNECTIONS IN TEMPERATURES EXCEEDING - 15°C.

Using of non-electric system for blasting brings a number of benefits including:

- Higher safety of blast work, as the system is immune to initiation by foreign sources of electric energy (radio frequency, stray currents).
- Higher variability of timing patterns enabling “tailor-made“ blasts corresponding to the conditions in a given locality.
- More effective work from the point of view of logistics and storage (smaller product range necessary for achieving a given result).

All the mentioned benefits improve economy of blasting operations. Although the initial cost of using non-electric system may be higher, the overall economics of blasting and quarrying operations is more beneficial as opposed to traditional electric system.

The blasting results using non-electric system (fragmentation, vibration control) are much more positive. Before the non-electric system was introduced, the only way to perform a non-electric blast was using a detonating cord. The method is now almost abandoned as it has numerous undesired side effects. When initiating a blast using a detonating cord, the blast hole is opened from the top which creates excessive fly rock because the stemming is destroyed as the detonation passes through it. As a result, the energy created by detonation is used less effectively. In addition, when used to initiate relatively insensitive explosives such as ANFO and certain emulsion explosives, the detonating cord can cause dead-pressing of the explosive. Further disadvantages of using detonating cord for initiation include excessive noise. Using of non-electric system enables to initiate the blast hole from the bottom (see figure 0-1) which ensures better use of the blast energy.

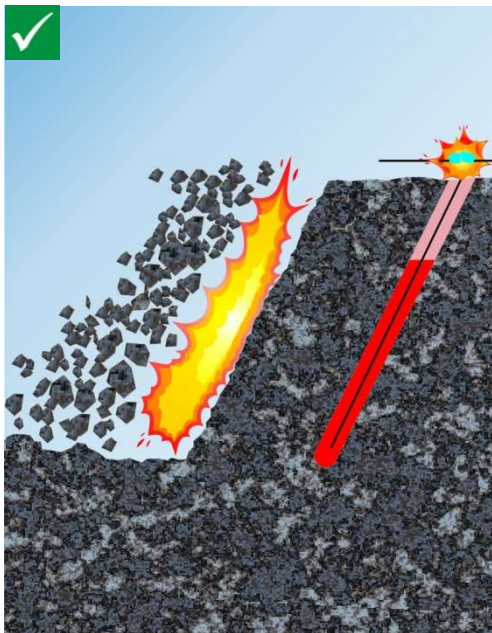


Fig. 0-1

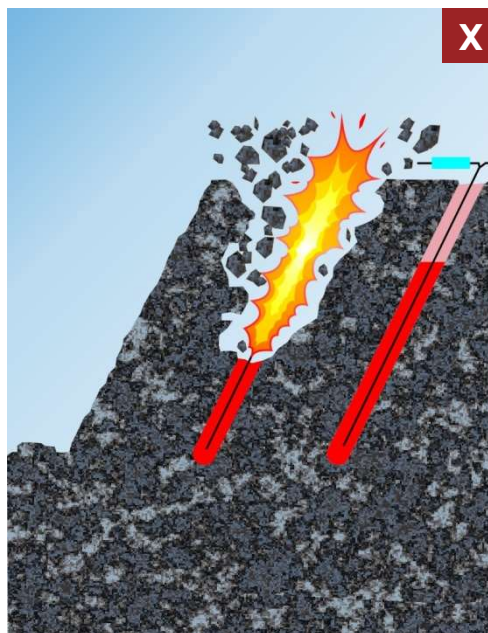


Fig. 0-2



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1 COMPONENTS OF NON-ELECTRIC INITIATION SYSTEM AND THEIR FUNCTION

Austin Shock Tube and all Austin Detonator products using Austin Shock Tube can be initiated by regular electric, electronic or non-electric detonator, detonating cord, plain detonator, **Shock*Star Bunch**, **Shock*Star Surface**, proper blasting machine (from an open end of the Shock Tube only) and **Rock*Star Starter**.

Shock*Star MS-Shock*Star TS-Shock*Star LP

These are in-hole detonators with millisecond delay (steps 25 ms and 50 ms) and long period delay (steps 100 ms, 200 ms and 500 ms) detonators used for initiation of explosive in a hole. **Shock*Star MS** is used for surface applications, **Shock*Star TS** in underground tunnel applications where are high accuracy of delay required. **Shock*Star LP** is used for underground mining applications, where is no emphasis for restriction of seismic impact of blasting. These detonators can be initiated either by **Shock*Star Surface**, **Shock*Star Bunch** detonators or by detonating cord. For initiation by detonating cord they can be fitted with a T-connector (available on request).

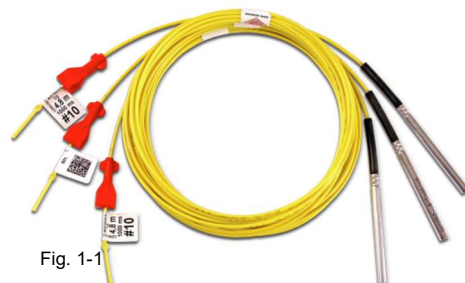


Fig. 1-1



Shock*Star Surface

Shock*Star Surface is a millisecond delay detonator enclosed in a color coded plastic block. This detonator has a smaller base charge designed for initiation of Shock Tube only.

Shock*Star Bunch

The base charge of these detonators is designed for initiation of a 5 g/m PETN detonating cord, which is attached to it. The detonator is enclosed in a plastic block and the detonating cord is inserted in the plastic block. The detonator is used for initiation of up to 20 Shock Tubes tied in a bunch, which is closely described later in this manual. The detonator is mostly used in underground applications.

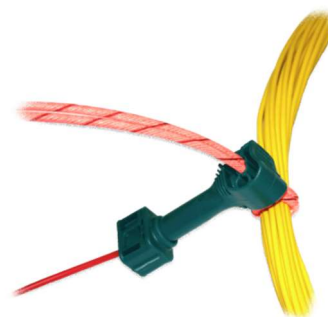


Fig. 1-3

Shock*Star Dual Delay

Shock*Star Dual Delay is composed of **Shock*Star Surface** and an in-hole detonator **Shock*Star MS** or **Shock*Star TS**. Dual Delay detonator is used in the same way as the two detonators of which it is composed. The benefits of Dual Delay detonators include faster handling, easier connections and decrease of excessive Shock Tube during connecting, thus making it easier to overview the connections on the blast site.



Fig. 1-4



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2 OPERATION PRINCIPLE OF A NON-ELECTRIC SYSTEM

The basic principle of initiation in blasting pattern is transferring initiation from Surface Connector to a detonator in a hole and to another surface connector.

The figure 2-1 shows properly timed blasting pattern - the holes are initiated well before the rock starts moving.

NOTICE

For a successful blast it is necessary that a hole is initiated well before the initiation network is destroyed by the blast itself. This is ensured by suitably designed blast pattern.

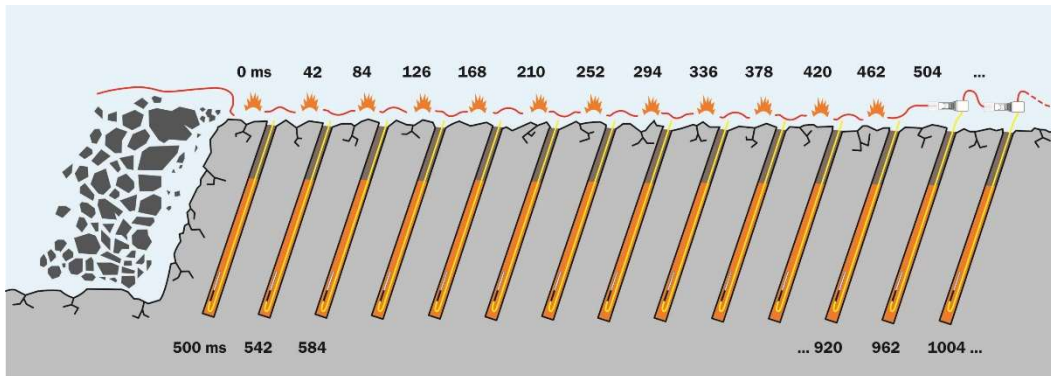


Fig. 2-1



Fig. 2-2



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3 CONSTRUCTION AND TECHNICAL DESCRIPTION OF NON-ELECTRIC DETONATORS

3.1 IN-HOLE DETONATORS

Shock*Star MS (with 25 or 50 ms delay interval)

Shock*Star TS (with 50, 100, 200 and 500 ms delay interval)

These detonators have base charge of 720 mg. The detonators are made of aluminum shell containing the primary charge, delay composition system, Shock Tube, antistatic sealing plug, stopper and delay tag.

The detonators can be fitted with a T-connector / "J" hook (see figure 3-2 and 3-3) for detonating cord compatibility and they are used to initiate primers (boosters) or directly commercial cap sensitive explosives.

The T-connectors are applied only during production in the factory.

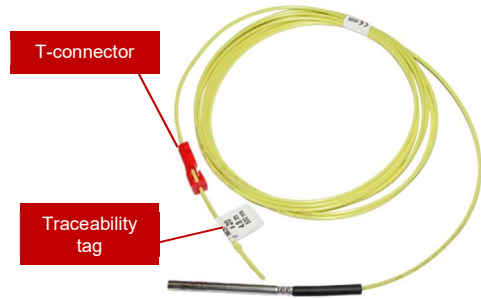


Fig. 3-1

TECHNICAL DATA

Detonator Shell

Material:	Aluminum
Marking:	nominal delay time letter „V“ at the shell bottom

Shock Tube

Color:	yellow
VOD:	2,000 m/s
Marking:	delay tag: <ul style="list-style-type: none"> ▪ production series number ▪ detonator type ▪ nominal delay time/delay number ▪ Shock Tube length ▪ traceability code

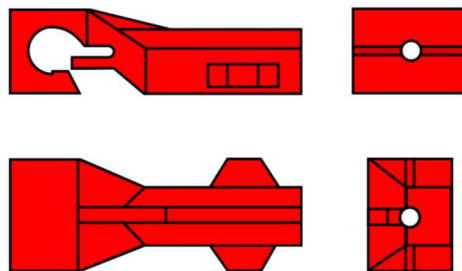


Fig. 3-2

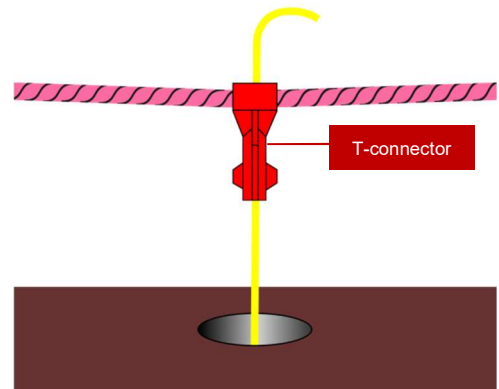


Fig. 3-3



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IN-HOLE DETONATORS DELAY TIMES

Shock*Star MS			Shock*Star TS		
Delay number	Nominal delay time (ms)	Delay interval (ms)	Delay number	Nominal delay time (ms)	Delay interval (ms)
0	0	-	0	25	-
1	25	25	1	100	75
2	50	25	1 ^{1/2}	150	50
3	75	25	2	200	50
4	100	25	2 ^{1/2}	250	50
5	125	25	3	300	50
6	150	25	3 ^{1/2}	350	50
7	175	25	4	400	50
8	200	25	4 ^{1/2}	450	50
9	225	25	5	500	50
10	250	25	5 ^{1/2}	550	50
11	275	25	6	600	50
12	300	25	6 ^{1/2}	650	50
13	325	25	7	700	50
14	350	25	7 ^{1/2}	750	50
15	375	25	8	800	50
16	400	25	8 ^{1/2}	850	50
17	425	25	9	900	50
18	450	25	9 ^{1/2}	950	50
19	475	25	10	1,000	50
20	500	25	11	1,100	100
21	550	50	12	1,200	100
22	600	50	14	1,400	200
23	650	50	16	1,600	200
24	700	50	18	1,800	200
25	750	50	20	2,000	200
26	800	50	25	2,500	500
27	850	50	30	3,000	500
28	900	50	35	3,500	500
29	950	50	40	4,000	500
30	1,000	50	45	4,500	500
			50	5,000	500
			55	5,500	500
			60	6,000	500
			65	6,500	500
			70	7,000	500
			75	7,500	500
			80	8,000	500
			85	8,500	500
			90	9,000	500

Tab. 1



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3.2 Shock*Star Surface

The **Shock*Star Surface** is a highly user-friendly product bringing substantial time-savings when connecting initiation network. The design of the connector virtually eliminates the shrapnel cut-off concerns, and makes easier the composition of initiation network. The connector has 9 delays. Base charge of **Shock*Star Surface** detonators is 120 mg. The detonators are composed of an aluminum shell containing a base charge and a highly accurate delay composition system, antistatic rubber plug, Shock Tube fitted with a stopper and a delay tag (see fig. 3-4). The stopper prevents the tube end from coming out of the connector block. The detonator is enclosed in a color coded plastic block. These units are specially designed for creating delay patterns and are used to initiate **Shock*Star MS** and **TS**, and to relay the initiation impulse to the next **Shock*Star Surface** connector(s) in sequence.

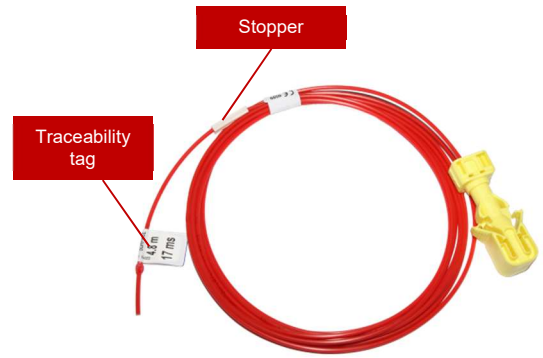


Fig. 3-4

TECHNICAL DATA

Detonator Shell

Material: Aluminum

Connector

Body color: as per nominal delay










Shock Tube

Color: red

VOD: 2,000 m/s

Marking:

- delay tag:
- production series number
 - detonator type
 - nominal delay time
 - Shock Tube length
 - traceability code

NOMINAL DELAYS Shock*Star Surface	
Nominal delay time (ms)	Color
0	green 
9	brown 
17	yellow 
25	red 
33	grey 
42	white 
67	blue 
100	black 
200	orange 

Tab. 2

NOTICE

The **Shock*Star Surface** is an assembly composed of two main parts: a plastic connector and a small detonator with a Shock Tube attached. The plastic connector houses the detonator. The entire unit is assembled by the manufacturer and makes a permanent assembly. The disassembly may result in damage to the unit. Surface detonators must not be used to initiate explosives and detonating cord!



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3.3 Shock*Star Bunch

This detonator is fitted with a Bunch Connector with a 5 g/m PETN detonating cord. The detonator base charge of 160 mg is designed to initiate the attached detonating cord. **Shock*Star Bunch** is available in the following delays: 0, 9, 17, 25, 33, 42, 67, 100, 200 ms.



Fig. 3-5

TECHNICAL DATA

Detonator Shell

Material: Aluminum

Connector

Body color: as per nominal delay










Shock Tube

Color: red

VOD: 2,000 m/s

Marking:

- delay tag:
- production series number
- detonator type
- nominal delay time
- Shock Tube length
- traceability code

NOMINAL DELAYS Shock*Star Bunch	
Nominal delay time (ms)	Color
0	green 
9	brown 
17	yellow 
25	red 
33	grey 
42	white 
67	blue 
100	black 
200	orange 

Tab. 3

3.4 Shock*Star Dual Delay

Shock*Star Dual Delay detonator is a combination of **Shock*Star Surface** (nominal delays 25, 100 ms) and **Shock*Star MS** or **Shock*Star TS** (nominal delays 475, 500, 9,000 ms). **Shock*Star Dual Delay** detonators are used in surface bench blasts and underground blasts. Their use results in smaller number of detonators needed for one blast.

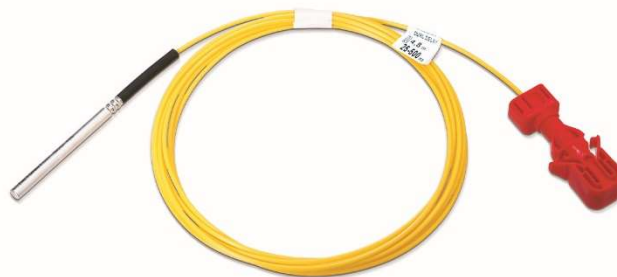


Fig. 3-6



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Use of **Shock*Star Dual Delay** detonators brings the following advantage:



- reduced handling and storage requirements
- faster composition of initiation network
- reduced number of connections between units
- easier and more reliable visual inspection of connection

TECHNICAL DATA

Shock Tube

Color: yellow
 VOD: 2,000 m/s
 Marking: delay tag

- production series number
- detonator type
- nominal delay time
- Shock Tube length
- traceability code

Shock*Star Dual Delay NOMINAL DELAYS	
Shock*Star Surface	Shock*Star MS Shock*Star TS
 25 ms	475, 500 ms
 100 ms	9,000 ms

Tab. 4

3.4.1 Bench blast design Using Shock*Star Dual Delay, Shock*Star MS and Shock*Star Surface

Shock Tube color:

- Shock*Star Surface
- Shock*Star MS
- Shock*Star Dual Delay

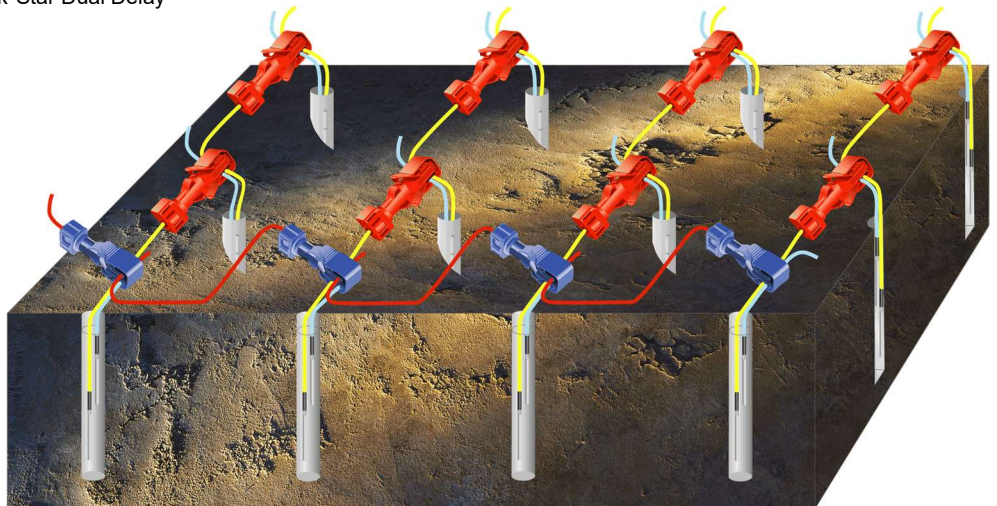


Fig. 3-7



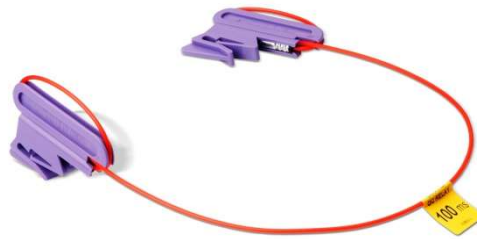
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3.5 Shock*Star DC Relay

Shock*Star DC Relay detonators are designed to provide accurate delay timing between the individual rows of blast holes using detonating cord as a primary initiation system. They can be used for developing various delay patterns.

DC Relay consists of a 45 cm Shock Tube, two detonators and two plastic blocks. The detonators are attached to each end of the Shock Tube and are inserted into plastic connector blocks. The connector blocks are specially designed for fast and easy detonating cord connections. This detonator is suitable for bidirectional use.



TECHNICAL DATA

Detonator Shell

Material: Aluminum

Connector

Body color: as per nominal delay

Suitable for

5 g detonating cord

Shock Tube

Color: red

Detonation velocity: 2,000 m/s

Marking:

- delay tag:
- production series number
- detonator type
- nominal delay time
- Shock Tube length
- traceability code

Nominal delay (ms)	9	17	25	35	50	65	100	200
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Tab. 5

3.5.1 Simple blasting pattern using detonating cord and Shock*Star DC Relay

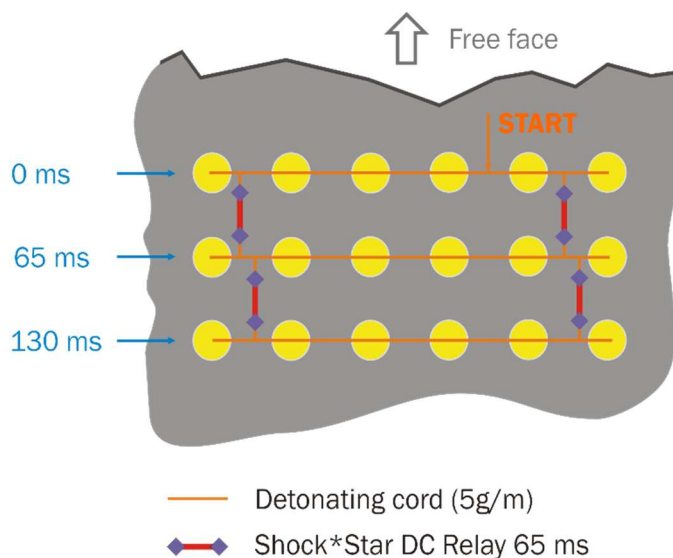


Fig. 3-9



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4 PRACTICAL USE OF NON-ELECTRIC DETONATORS AND THE BENEFITS OF USE

Shock*Star detonators are used for initiation of commercial explosives used for blasting both surface and underground.

Condition of use:

- temperatures ranging from -30 °C to +60 °C
- in water pressure of max 0.3 MPa / 7 days

Advantages:

- fit for use in wet conditions and under water
- high variability of timing
- highly safe product
- reduction of vibration during blast

WARNING

Non-electric detonators **Shock*Star** must not be used in underground worksites with a risk of ignition of coal dust and methane atmosphere under any condition.

4.1 INSTRUCTION FOR USE OF Shock*Star MS, Shock*Star TS

1. Prepare a hole in the middle of primer towards to center of primer using priming tool. (Fig. 4-1)

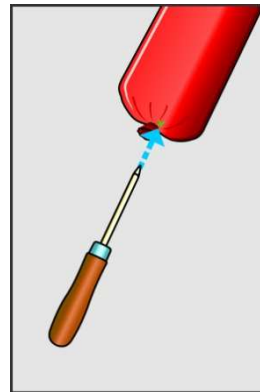


Fig. 4-1

2. Put the detonator into the hole. (Fig. 4-2)

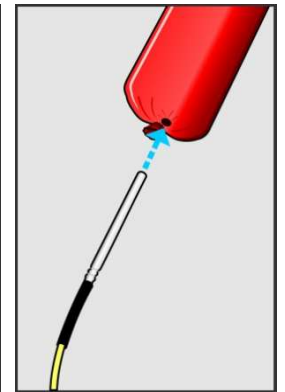


Fig. 4-2

3. Be sure that the detonator is in the correct position - whole length of shell must be inside the primer. (Fig. 4-3, Fig. 4-4)

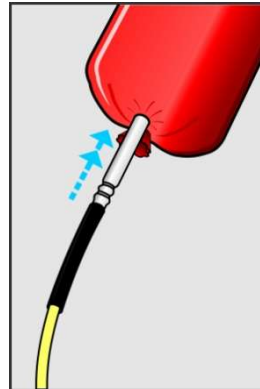


Fig. 4-3

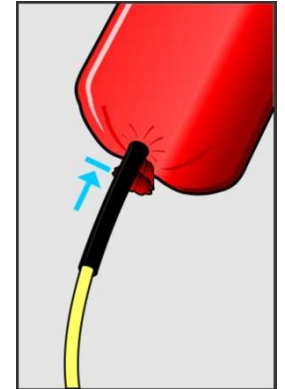


Fig. 4-4

4. Prepare a Shock Tube loop. (Fig. 4-5)

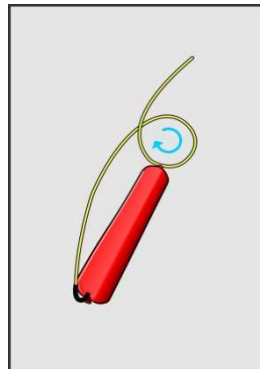


Fig. 4-5

5. Put a loop on the primer and tighten it. (Fig. 4-6)

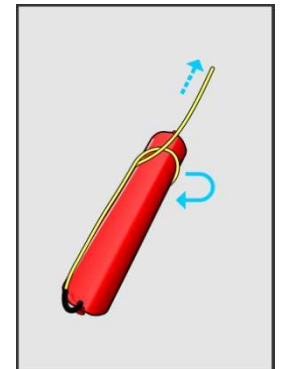


Fig. 4-6



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6. Use double loops for longer primers (≥ 700 mm). (Fig. 4-7)

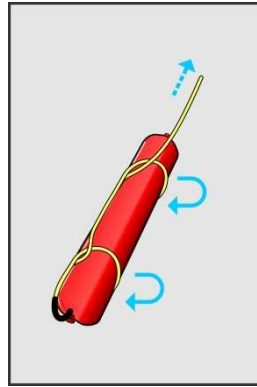


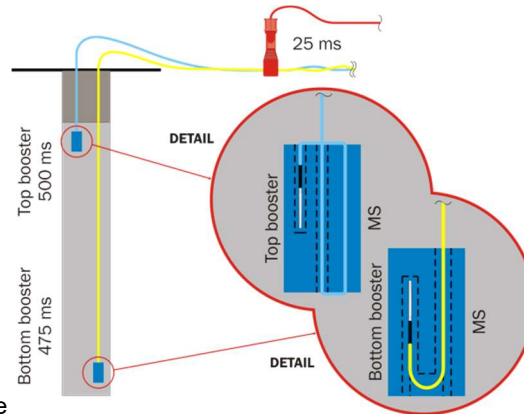
Fig. 4-7

4.2 USE of Shock*Star MS DETONATORS IN SURFACE APPLICATION

The explosive in the blast hole is usually initiated by two in-hole detonators **Shock*Star MS**. One detonator is located at the bottom (lower) part of the drill hole. The other detonator is positioned at the top (upper) part of the drill hole, under the stemming. Normally, a 475 ms detonator is used at the bottom and a 500 ms detonator at the top of the drill hole.

Detonators should be positioned such, that the detonator bottom is directed towards the longer part of the explosive column.

The lower detonator should point upwards and the upper detonator should point downwards. The in-hole detonators are initiated by **Shock*Star Surface-8**



The initiation of explosive in this fashion brings the most effective consumption of energy released during explosion.

The detonation velocity of the Shock Tube impulse is 2,000 m/s. The Shock Tube then presents a delay of 1 ms / 2 m of tube. The delay caused by Shock Tube therefore needs to be taken into consideration when designing the blasting patterns. See chapter 4.4 for more information. Where detonators of identical nominal delay time in drill hole are used, the explosive in the drill hole is initiated from the top causing less effective consumption of energy released during explosion.

PRECAUTIONS

- The detonator bottom must be directed towards the longer part of explosive charge column.
- When designing a blast pattern, a Shock Tube added delay time of 1 ms / 2 meters must be taken into consideration.
- With drill holes longer than 10 m, two priming assemblies should always be used. If the drill hole is shorter than 10 m, only one priming assembly may be used provided the drill hole walls are smooth and the risk of interruption of explosive column during charging is eliminated.
- The minimal length of the Shock Tube coming out of priming assembly and out of the drill hole is 0.6 m.
- Make sure that connector-to-connector distances are identical in all connections.
- Do not cut short the Shock Tube. Water or humidity may make the Shock Tube non-functional. Cut only the Shock Tube immediately prior the blast for testing the blasting machine and for the blast itself.



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NOTICE ON THE SAFETY OF SHOCK TUBE

Snap & Shoot Effect

- In the history of use of the non-electric (Shock Tube) initiation system, there occurred several instances of accidental tube initiation when the tube was pulled till its breakage. The instances were recorded during tubing production, detonator manufacture and also charging operations in the field.
- Based on the recorded events, a study was performed and published in the SAFEX newsletter No. 38, 3rd Qtr. 2011, where the phenomenon is reported in detail and is confirmed as existing.
- We advise the customers to study the phenomenon in that document, be aware of it and take all safety precautions to prevent the tube from SNAP (being pulled till breakage) and potential SHOOT (initiation by this breakage) or any other impact that might resemble this kind of condition during their operations.
- For advice or if in doubt, please contact us using the below mentioned contacts for technical support.
- It will be noted that this phenomenon is inherent in any Shock tubing from any manufacture and is not related to any particular Shock Tube brand or of manufacture method.

4.3 INSTRUCTION FOR USE OF Shock*Star Surface

CONNECTING

Prepare a loop as shown in the picture.

When connecting the tube in the connector, always pull the tube in the direction towards the middle of the connector block cavity for tubes. This method puts the least demand on strength needed for making a connection.

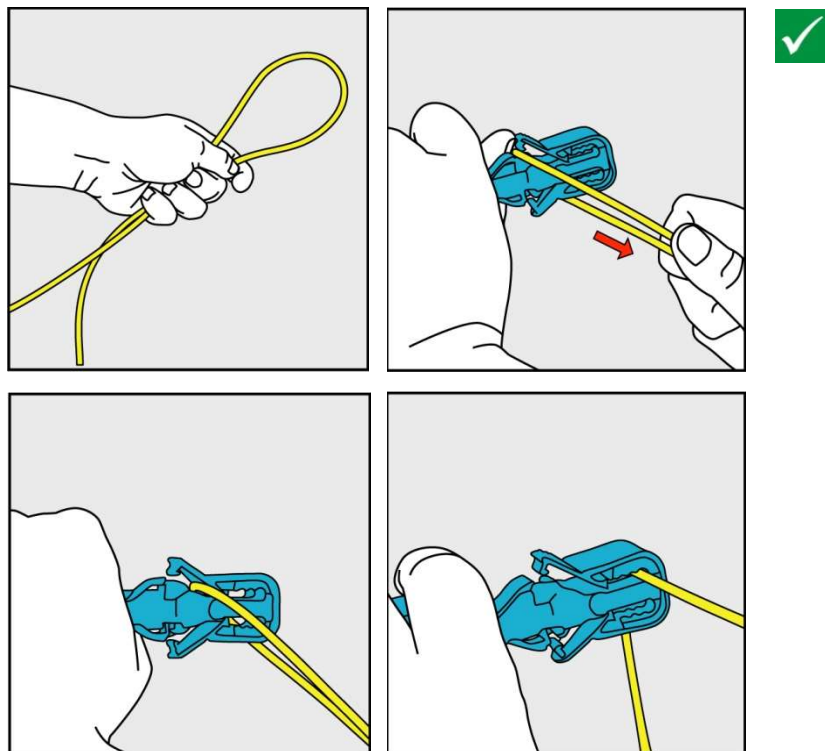


Fig. 4-9 Correct way to pull the tube

If needed, it is possible to lock the tubes in to secure the connection. The connector is however fully functional in both locked and unlocked position provided the tubes are inserted properly.



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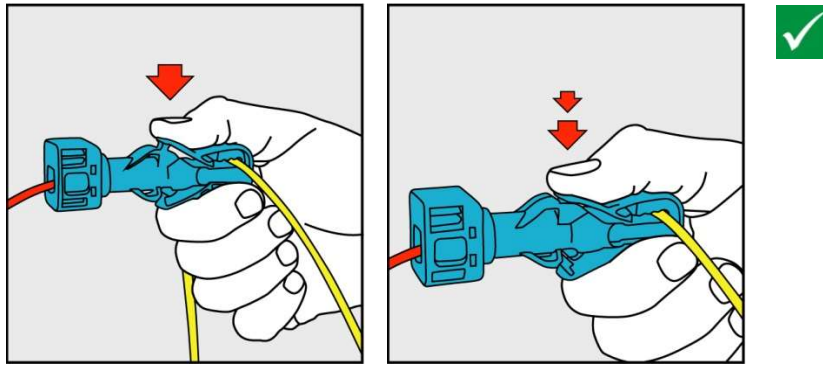


Fig. 4-10 Locking the tubes into connector

CAUTION

During connection make sure that the tubes are properly inserted into the connector block and that they are not crossed inside the connector block. Each side of the connector block can hold up to 4 tubes; the total capacity of the block is 8 tubes.

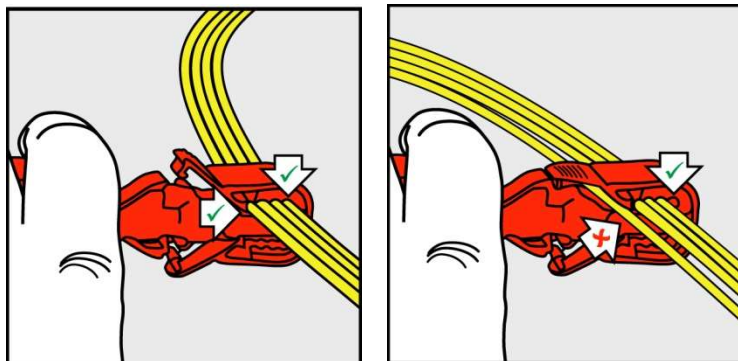


Fig. 4-11 Correct way to insert the tubes into the connector

CAUTION

Do not use any version of „double hooking“ as a safety precaution against preventing the Shock Tube from slipping out of the **Shock*Star** connector. For this purpose, every Shock Tube is fitted with a plastic sleeve (the stopper) at its end. **Double hooking is a nonstandard connection not compliant with the design of the Shock*Star product, and it may result in improper function.**

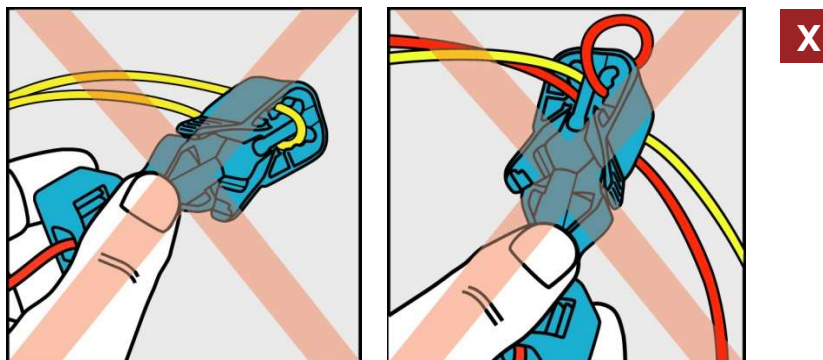


Fig. 4-12 Nonstandard connection of „double hooking“



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CAUTION

Connect, place the connector at the distance at least 60 cm from the next connector or in-hole detonator. (Fig. 4-13, 4-14)

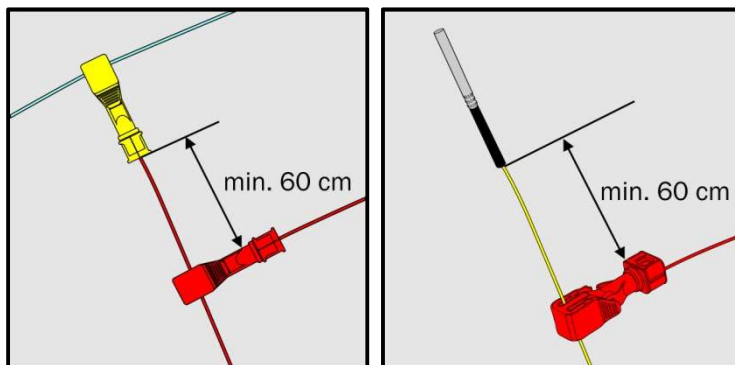


Fig. 4-13

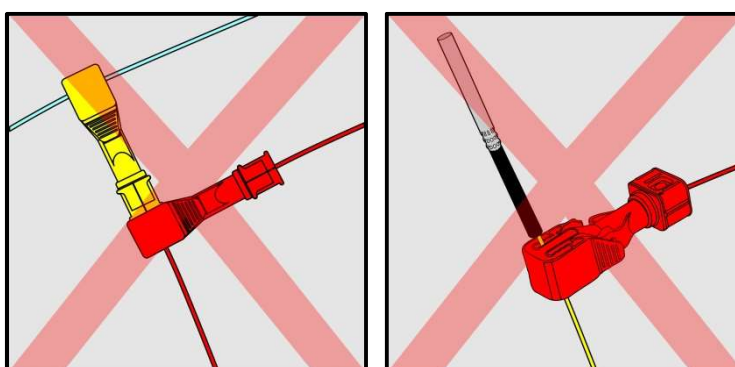


Fig. 4-14

DISCONNECTING

Hold the loop as when connecting and pull the tube out from the connector block.

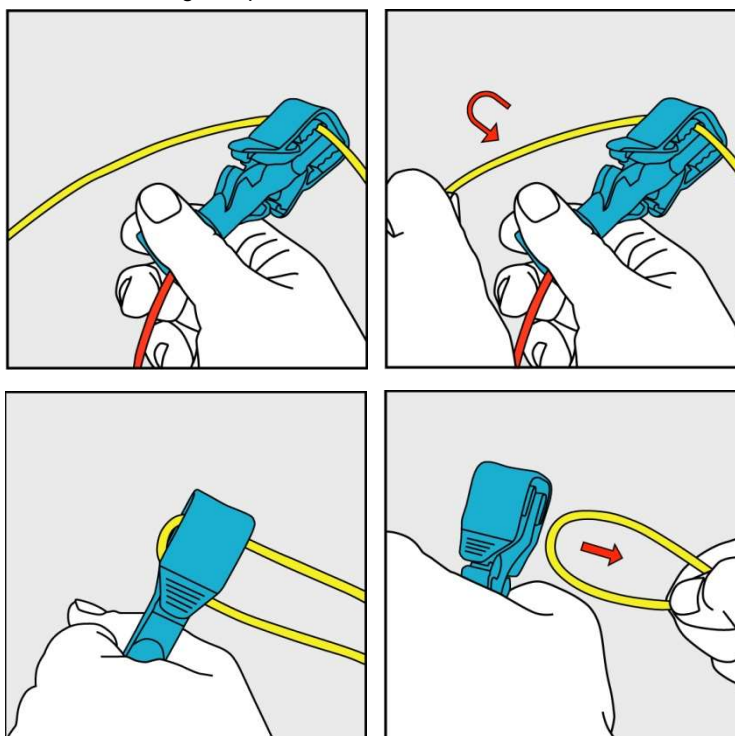


Fig. 4-15 Correct way to disconnect the tubes



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4.4 ADDED DELAY CREATED BY THE Shock Tube

As described Austin Shock Tube has velocity of detonation 2,000 m/s. This speed creates delay of 1 ms per every 2 m of Shock Tube. From this reason it is necessary to count with added delay by the Shock Tube and its variation based on place where connection to the **Shock*Star Surface** connector is been made. Practical examples are presented in figures below.

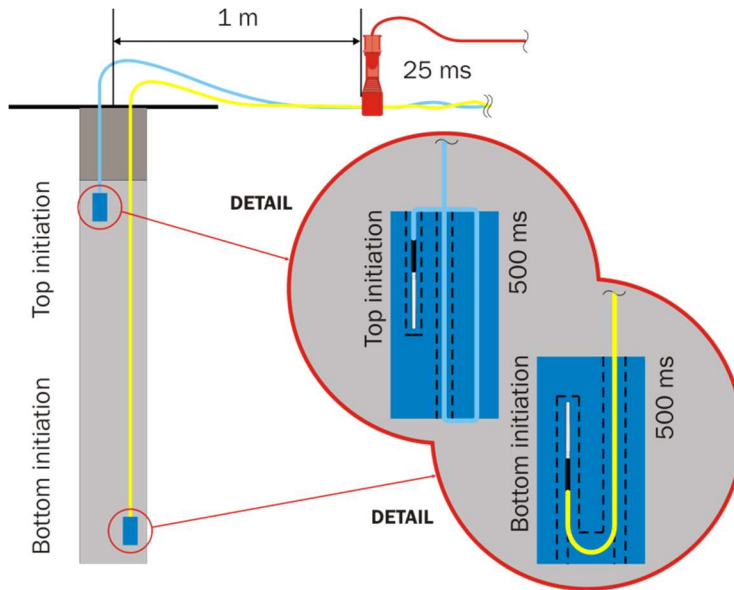


Fig. 4-16

In the case of figure 4-16 the delay for top initiation is 527.5 ms and for bottom initiation 536.5 ms instead of theoretical 525 ms (connector plus in-hole detonator delay). This will cause the hole to be started from the top.

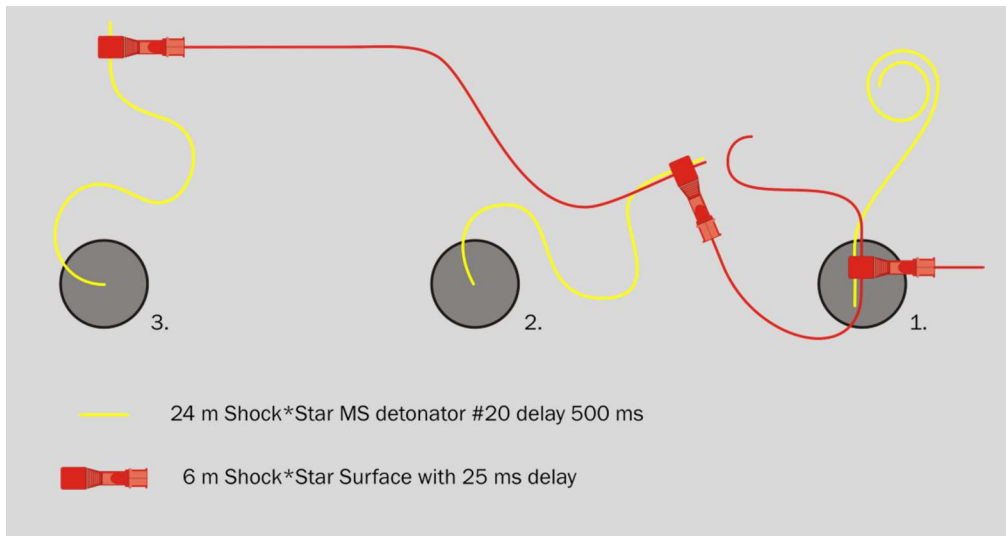


Fig. 4-17

Figure 4-17 display fragment of one row of 19 m long holes and variation in connection points of **Shock*Star MS** and **Shock*Star Surface** detonators. Such a connection has influence on final detonator timing as indicated in the table 6.

Hole number	Theoretical delay	Real delay
1	525 ms	534.5 ms
2	550 ms	563.5 ms
3	575 ms	591.5 ms

Tab. 6



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4.5 INSTRUCTION FOR USE OF T-CONNECTOR ("J" HOOK)

Steps to follow to make proper CONNECTION

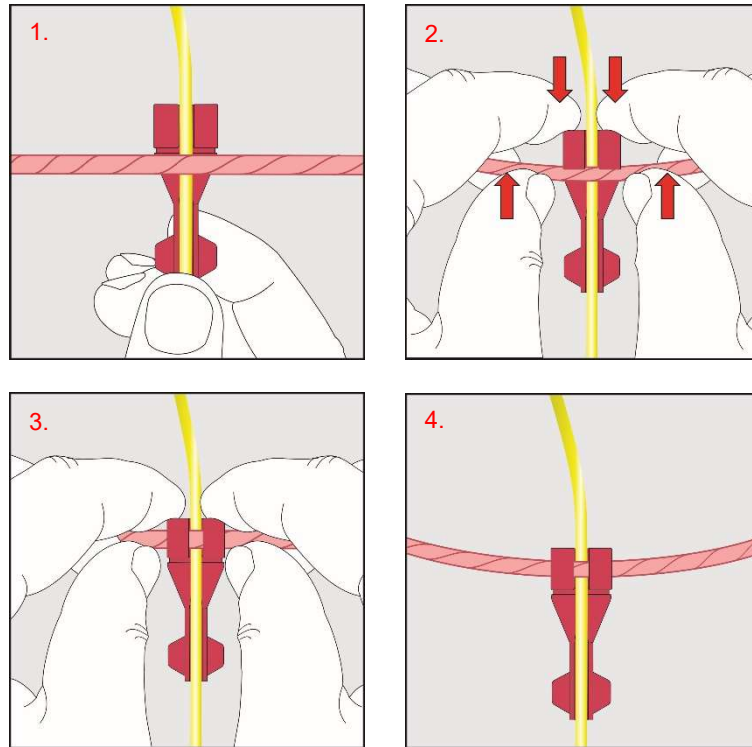


Fig. 4-18 Correct way to connect Shock*Star detonators equipped by T-connector ("J" hook) to detonating cord

NOTICE

Make sure that the detonating cord is straight in the T-connector ("J" hook) and well fixed. Do not connect the detonating cord twice or bent it in any way in the connector.

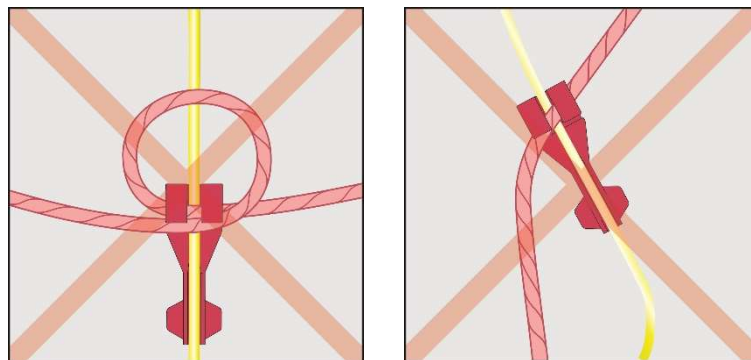


Fig. 4-19 Examples of incorrect connection of T-connector ("J" hook) to the detonating cord



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4.6 INSTRUCTION FOR USE OF Shock*Star DC Relay

Steps to follow to make proper CONNECTION

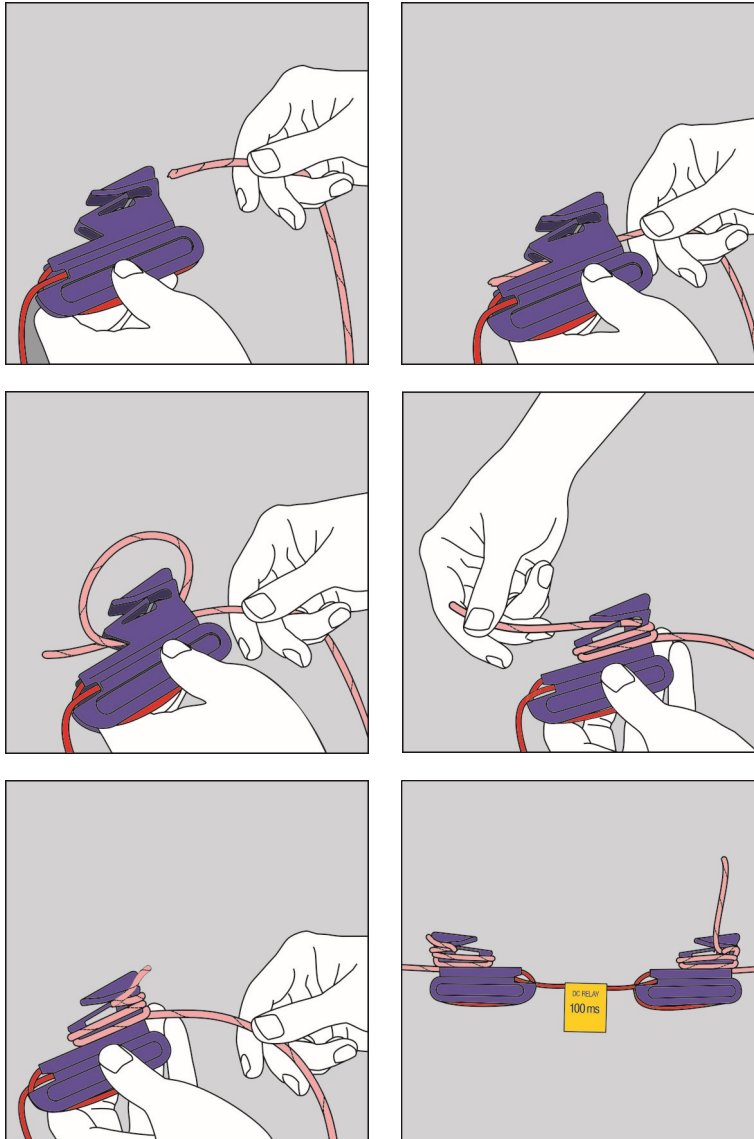


Fig. 4-20 Correct way to connect Shock*Star DC Relay

NOTICE

For easy connection it is important to have a clean cut of the detonating cord. Place the cord on a wooden plate and cut the cord at right angles using a sharp knife.

4.7 NOTES ON DESIGNING BLASTING PATTERNS IN SURFACE APPLICATIONS

4.7.1 Gradual initiation of blast holes

Very frequently, the blast pattern is designed such that rows are initiated from one side as shown in figure 4-19. This method brings time savings during connecting the blast pattern. The method has disadvantage however. If initiation is stopped in a row, the entire initiation process is not stopped but continues. Problem which results from an undetonated row in an otherwise finished blast could be costly.



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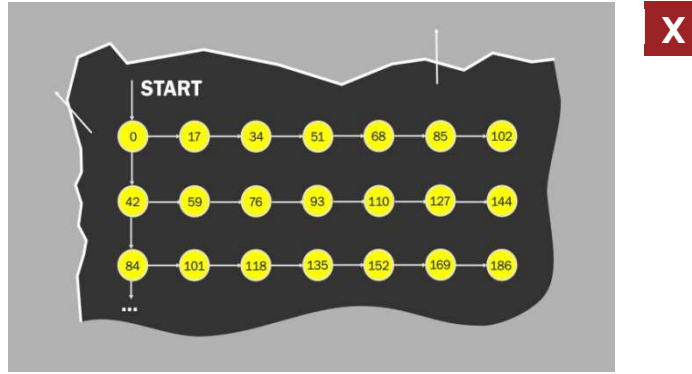


Fig. 4-21

Austin Detonator, on the other hand, recommends designing the blasting pattern in such a way, that if in one element, the initiation is stopped, entire initiation process is stopped and only properly initiated holes blast. This method is shown in figure 4-22 and is considered by blasters as an important preventive measure which could be taken to avoid problems with removing misfires.

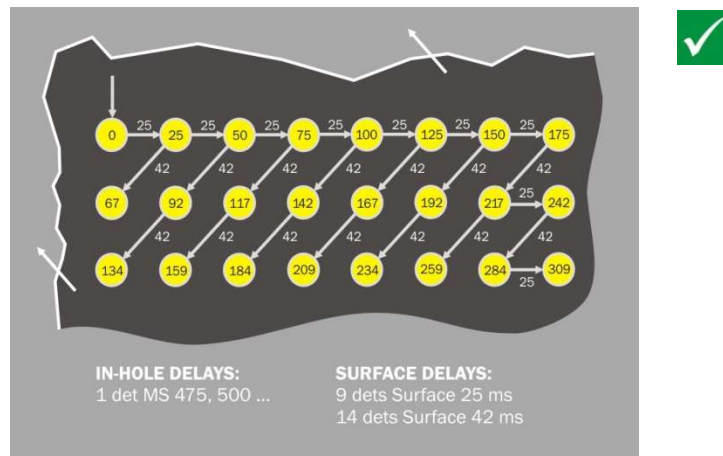


Fig. 4-22 Three-row one-side-initiated bench blast delay pattern

4.7.2 Coupled initiation blasting pattern

Another means of ensuring a successful blast is a blasting pattern is using initiation of a blast hole from two sources of initiation (two connectors). This blasting pattern can be used when two detonators are used in a hole. The initiation impulse is brought to the hole from two sources, bringing extra ensuring feature to blasting operations.

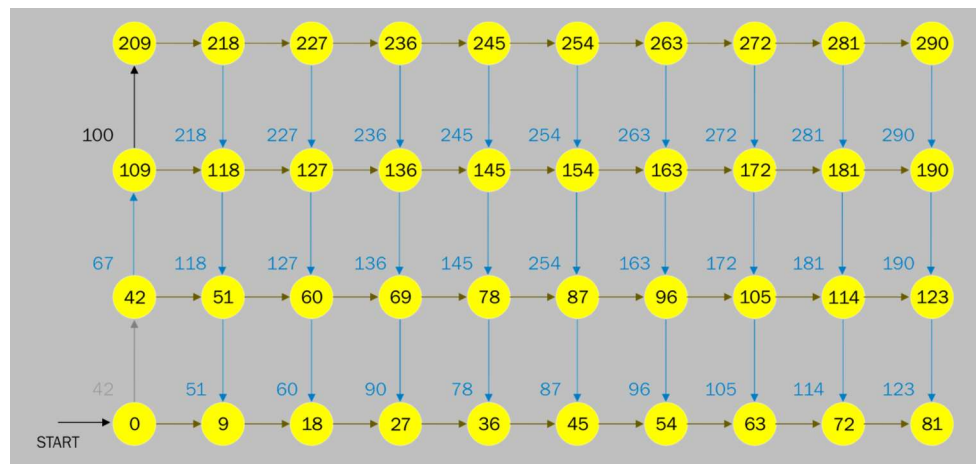


Fig. 4-23 Blasting pattern with coupled initiation



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4.7.3 The bench blasting examples

Three-row one-side-initiated bench blast

All blast holes are charged with detonators of identical nominal delay time. **Shock*Star Surface** provides individual blast hole timing. The delay between holes in the rows is 17 ms, the delay between rows is 67 ms and 100 ms. Holes are initiated by **Shock*Star MS**, 475 ms nominal delay and a primer. The value in the circle is a sum of **Shock*Star Surface** and **Shock*Star MS** nominal delay and **Shock*Star Surface** delays preceding the given point of initiation. Arrows indicate the direction of detonator connections and the detonation wave travel direction.

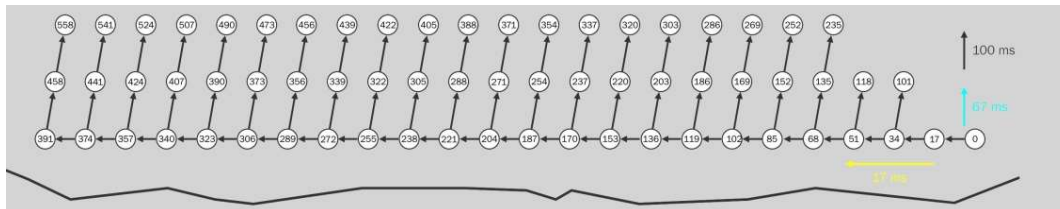


Fig. 4-24 Three-row one-side-initiated bench blast delay pattern

PRECAUTION

- The connector is designed to reliably initiate up to 8 Shock Tubes.
- It is highly recommended that the Shock Tubes between drill holes are not subject to mechanical stress (tension).
- A minimum of 0,6 m of additional Shock Tube per detonator should be included when considering the required length of Shock Tube.
- It is recommended to leave the connector locks open after the immediate connection. After the inspection the connector locks are closed by the master blaster = signify that the connection was checked.
- After all drill holes are connected, a careful visual inspection of all connections must be made. After the inspection, no one should be allowed to enter the blast area.
- The system can be initiated by special blasting machines (MICKO 1 - Fig. 4-37 and Mechanical blasting machines - Fig. 4-38) or special **Rock*Star Starter** detonator. It is also possible to use an electric detonator, fuse cap or electronic detonator fastened to Shock Tube by a tape. The bottom of the initiating detonator must point in the opposite direction of the blast pattern initiation.

Three-row center-initiated bench blast

Fig. 4-25 - the picture shows the same blasting pattern as in figure 4-24 except that the initiation start is in the center of the first row and the delays between holes in the first row are a combination of 9 and 17 ms. Rock movement is to the center of the field.

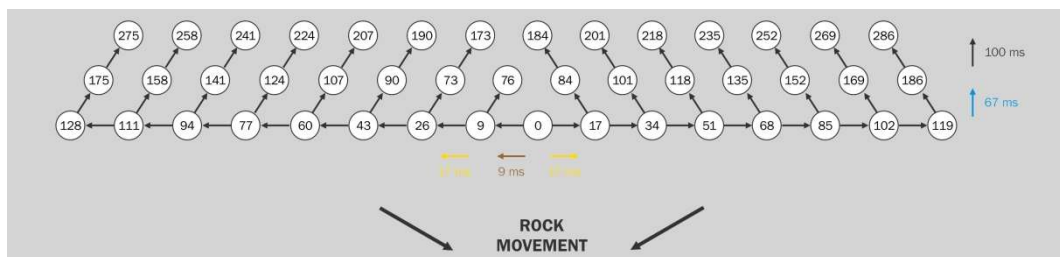


Fig. 4-25 Three-row center-initiated bench blast delay pattern



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Floor height leveling in one shot with bench blast

Fig. 4-26 shows ideal approach toward connection of a hump blasting together with production bench blast. The approach should be that the small blast goes before the production blast and that the production blast is connected to the hump. In this case if there is problem with blasting of the hump the muck pile from production blast will not cover charged holes and create problematic misfire solving.

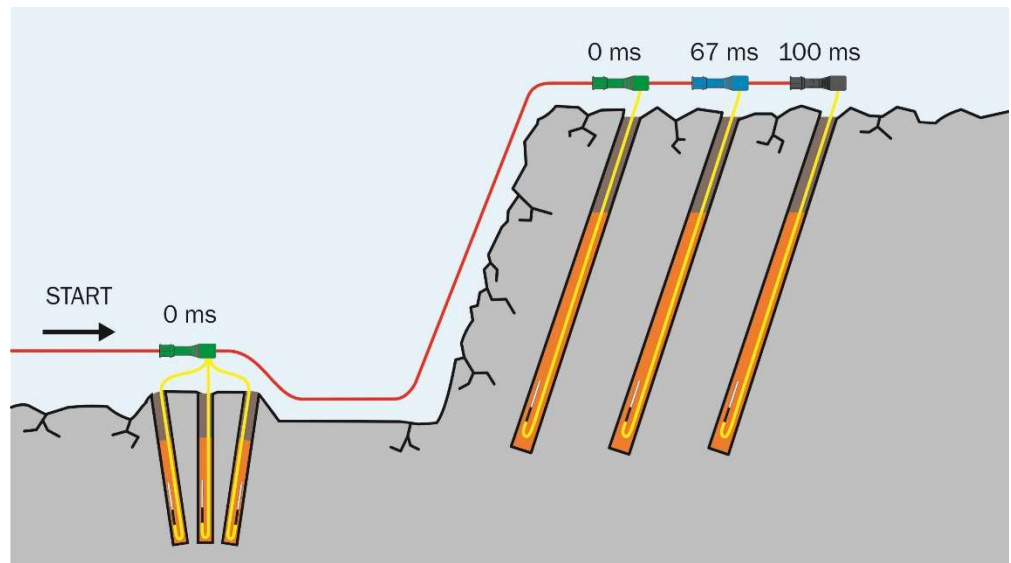


Fig. 4-26

Central-initiated pull shot

Fig. 4-27 - this pattern is one of many which are possible for this type of blasting operation. The system is initiated gradually from the center of the pattern. The initiation pattern should be connected from the center of the field - nominal delay 0 ms. The rock movement in this case is limited only to pile up and raise.

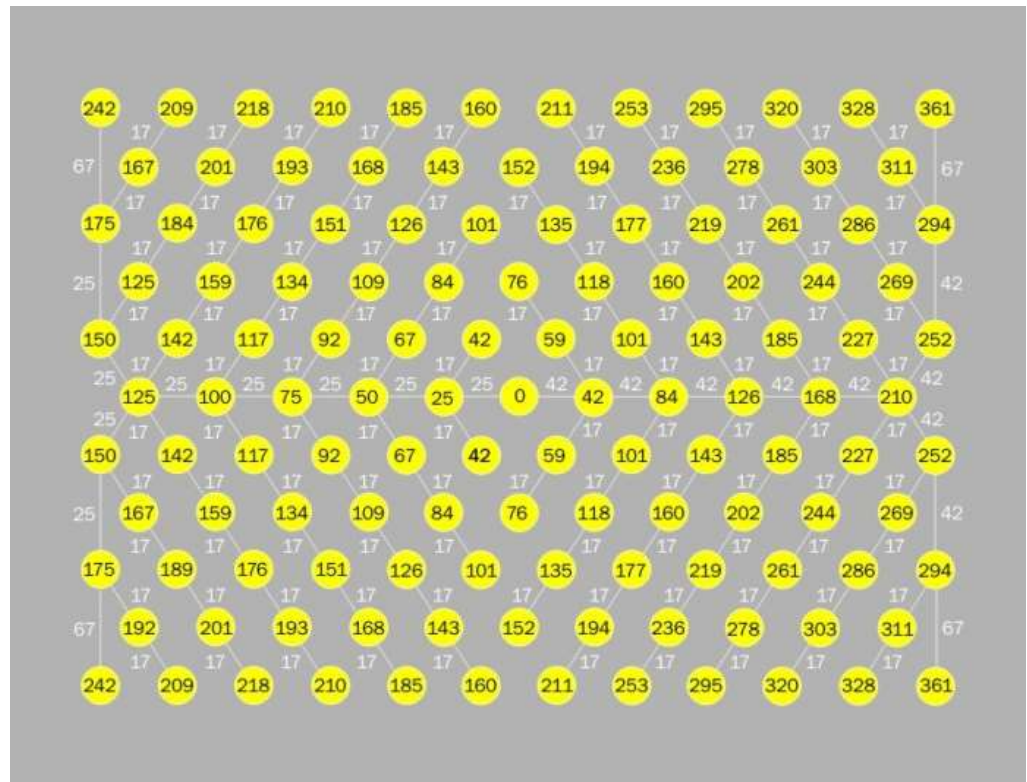


Fig. 4-27 Central-initiated pull shot



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4.8 USING Shock*Star IN UNDERGROUND APPLICATIONS

The advantage brought by non-electric initiation system Shock*Star can be conveniently used for tunneling and underground blasting as well.

Shock*Star TS has been especially designed for these applications. Normally, the detonator is inserted into a booster or an explosive charge to form a primer for the hole. The detonator bottom should always point towards the longer part of the explosive charge column to ensure efficient initiation.

The tubes coming out of the holes are bound together in bunches.

A bunch can be made from minimum of 5 to maximum of 20 tubes. Each bunch should be securely taped with electrical tape at two points 30 cm apart (see fig. 4-29). Each bunch of tubes, the section enclosed by electrical tapes, is then fed through a **Shock*Star Bunch**. In this way, all the Shock Tubes in a blast are assembled into bunches and connected to **Shock*Star Bunch**.

The number of **Shock*Star Bunch** is determined by the number of holes to be fired.

As shown in figure 4-28, there are 65 charged drill holes. Shock Tubes coming out of the detonators inside the holes, are fed into 4 **Shock*Star Bunch** units. The tubes coming out of the 4 **Shock*Star Bunch** units are connected into the **Shock*Star Surface** (start-line) of required Shock Tube length.

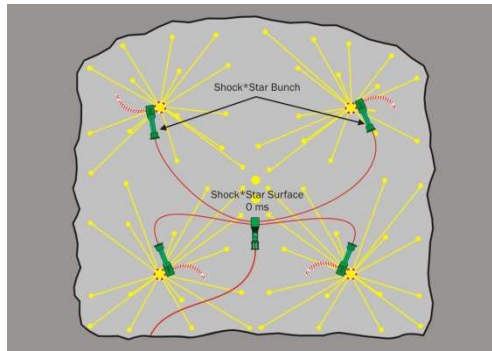


Fig. 4-28 Tunnel blast pattern

4.8.1 Creating the bunch and connection to bunch assembly

Collect tubes to create the bunch in such fashion that the bunch of the tubes can be pulled away from the face at the minimum distance of 30 cm while the minimum distance between the bunch and any drill hole is 30 cm. Apply the 1st tape in the point where all the tubes meet, see figure 4-29.

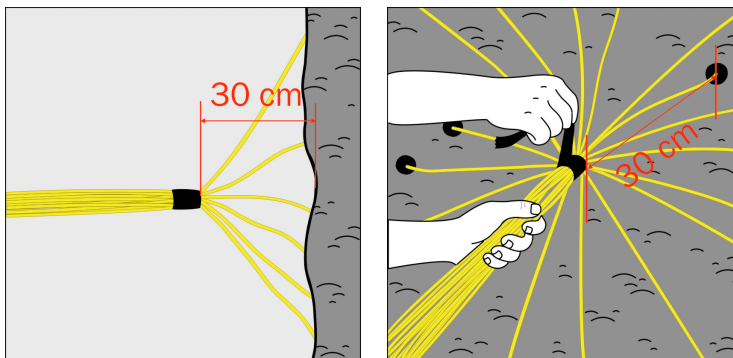


Fig. 4-29

Straighten the tubes parallel to each other and apply another tape approximately 30 cm away from the first tape. Fold the tubes together and drag the fold through the detonating cord loop. Unfold the tubes by dragging the free ends of the fold through the detonating cord loop. Tighten the detonating cord loop as shown in the figure and then lock connector block, see figure 4-30.

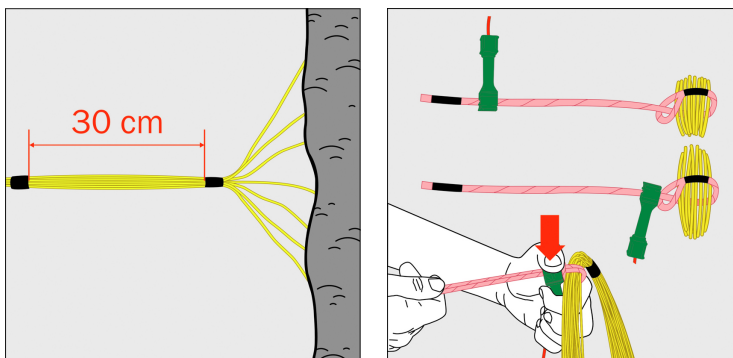


Fig. 4-30



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Ensure that remaining length of the detonating cord is not close to the Shock Tubes, see figure 4-31, and that the end of detonating cord is fixed either to Shock Tube of **Shock*Star Bunch** or to Shock Tube and distance between detonating cord and any in-hole detonator Shock Tube is 30 cm.

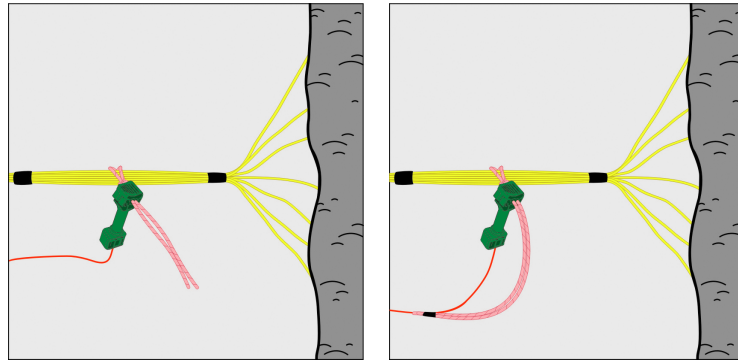


Fig. 4-31

Ends of detonating cord are fixed to two Shock Tube bundles, see figure 4-33. Ends of detonating cord are taped to be secured against pulling out.

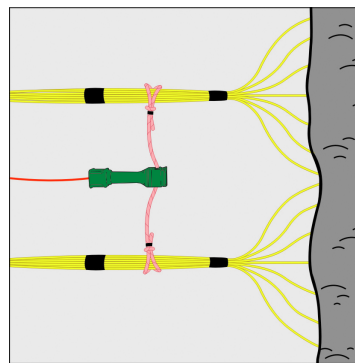
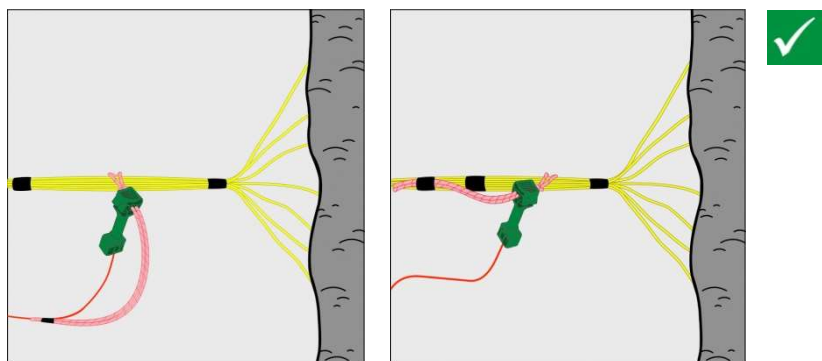


Fig. 4-32

4.8.2 Detonating cord end connection

End of detonating cord has to be fixed to Shock Tube of **Shock*Star Bunch** and distance between detonating cord and any in-hole detonator Shock Tube is 30 cm. Alternatively the end of detonating cord has to be fixed to Shock Tube of in-hole detonators on their free ends.



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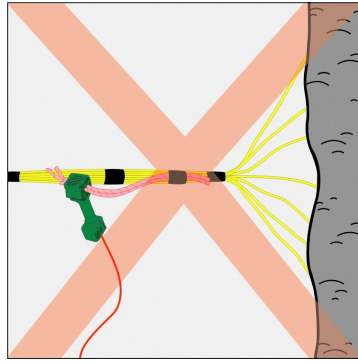


Fig. 4-33

4.8.3 Always and Nevers when using Shock*Star Bunch

- | | | | |
|---------------|--|--------------|--|
| ALWAYS | Use 5 g/m PETN detonating cord for creating bunches. | NEVER | Use more than 20 tubes in bunch. |
| ALWAYS | Have a minimum of 5 tubes in a bunch. | NEVER | Allow the free end of the DC in close proximity to, or to make contact with the tubes. |
| ALWAYS | Tie and type the free end of detonating cord to the tubes in the direction opposite to the face (opposite to the direction of initiation of the Shock Tube). | NEVER | Use excessive tension in the entire Shock*Star Bunch / Shock*Star Surface network assembly. |
| ALWAYS | Ensure that bunches are pulled away from the face at least 30 cm. You can do so by applying a slight tension at the Shock*Star Bunch through the Shock*Star Surface block. If needed use the tape to secure tension and prevent the tubes from moving. | | |



IMPORTANT NOTICE!

Be aware of properties of detonating cord and maintain the distances as shown in this instruction, i.e. away from the drill holes and away from the face. **The shockwave from the detonating cord may disrupt the Shock Tubes in the immediate vicinity without initiating them or project fragments that could cut the tube before the signal passes to the in-hole detonator.** Use a overspun detonating cord with 5 g/m core load. Higher core load increases the risk of cut-offs and subsequent misfires.

4.9 APPLICATION OF Shock*Star FOR DEMOLITION OPERATIONS

The advantage brought by non-electric initiation system **Shock*Star** can be conveniently used for demolition operations, especially in environments where foreign sources of electricity (stray currents, radio frequency, or electrostatic energy) may be present and use of electric detonators would present a hazard.

A very advantageous solution is a combination of detonating cord and non-electric detonator fitted with a T-connector. T-connector („J” hook) provides a quick and

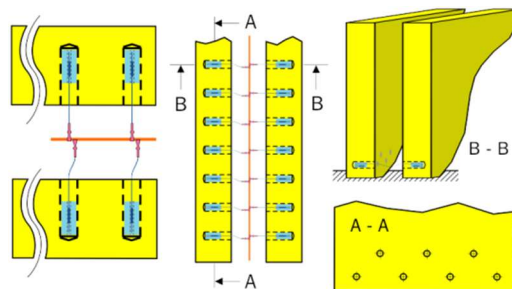


Fig. 4-34 Demolition of concrete beds



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reliable connection to detonating cord for initiation of detonators.

The detonating cord itself is then initiated by any detonator.

One of the advantages of using detonating cord/T-connector combination is easy and fast connecting resulting in increased safety of the whole blast work.

4.10 CONNECTING OF TWO Shock Tubes TOGETHER

Austin Shock Tubes are possible to connect with a plastic connecting tube supplied together with every lead line Shock Tube. Shock Tube with a connecting plastic tube can be used as a **StarTube** to initiation network created by non-electric **Shock*Star** detonators.

Shock Tube with a connecting tube must not be used as follows:

- in environments where flammable gasses, fumes or dust is present
- in materials and conditions with high temperatures
- for splicing the tubes in holes
- for systematic prolonging the tubes in the initiation network

Connecting

Connect the connecting tube to the 1st detonator or charge in the round in the direction of advance of the initiation in the following way:

1. Cut off minimum 3 cm of connecting plastic tube.
2. Using a non-sparkling knife and a firm pad, remove the sealing weld in the AUSTIN tube from the **StarTube** or **Shock*Star Surface** by cutting it off.
3. Press the AUSTIN tube into the connecting plastic tube by at least 1.5 cm.
4. Prepare the other tube which you wish to connect in the same fashion as the first tube. Insert the tube inside the connecting sleeve such as the Shock Tubes inside the connecting plastic tube touch each other.
5. Wrap the whole assembly in a tape.
6. Secure the assembly against mechanical stress and disconnecting (pulling strength) by fixing it to firm objects on both sides (e.g. stones) or creating a knot.

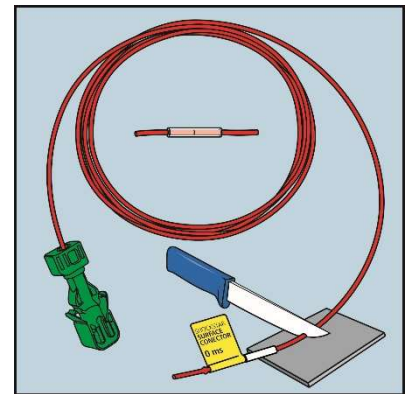


Fig. 4-35 Cutting of shocktube

IMPORTANT SAFETY NOTICE!

It is forbidden to cut short the Shock Tubes of detonators charged in the holes or connected to the blast under no circumstances. Cutting of Shock Tubes **MUST** be done **BEFORE** any **PRIMING** of boosters, loading of the holes or connecting to the blast.

4.11 INITIATION OF NON-ELECTRIC SYSTEM

The Shock Tube of non-electric detonators can be initiated by means of a regular electric detonator, non-electric detonator, fuse cap or electronic detonator fastened to Shock Tube by a tape, using electric detonator **Rock*Star Starter** or by means of a spark blasting machine (e.g. **MICKO 1**).

1. Initiation by means of an electric detonator

Ensure that the detonator bottom is pointing in the direction opposite to the StartLine signal propagation and opposite to the initiation network area.



Fig. 4-36 Initiation by means of an electric detonator



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2. Initiation by means blasting machine



Fig. 4-37 MICKO - 1, blasting machine for initiation of electric and non-electric detonators



Fig. 4-38 Mechanical blasting machines HR-22 and Mushroom stomper starter which are using #209 primers

3. Initiation by means of a non-electric detonator

Non-electric detonator with long Shock Tube supplied on spool is the best way for firing the blast. It is recommended to use **Shock*Star StartLine**.



Fig. 4-39 Shock*Star StartLine

NOTICE

Be aware when starting blast using **Shock*Star StartLine** or **StarTube** reeled on spools. Always reel off the necessary amount needed for the blasting and never initiate the Shock Tube reeled on the spool. The detonation wave passing through the tube creates heat which could inflate the spool, especially in high temperature environments.



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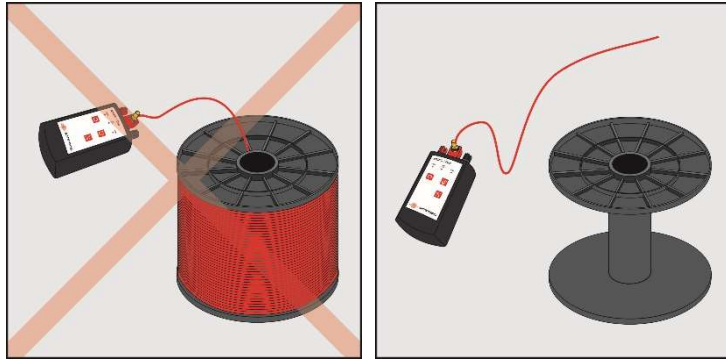


Fig. 4-40 Correct and Incorrect way how to initiate Shock Tube reeled on spool.

4. Initiation by Rock*Star Starter detonator

Electric detonator **Rock*Star Starter** consists of electric detonator **Rock*Star 25/50** and **Shock*Star Surface** connector block. It is designed to initiate Shock Tube or 5 gram detonating cord.

This product is designed to be used **only** with Austin Detonator **Rock*Star 25/50** electric detonator of delay number #3 (75 ms) of any group, wires length and shell material. Connector blocks of any color are supplied separately and it is necessary to assemble the product in filed prior to its use.

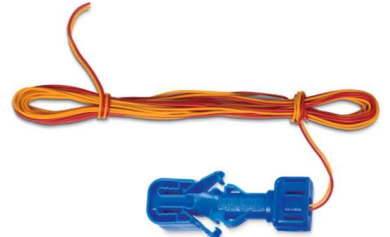


Fig. 4-41 Rock*Star Starter

4.11.1 Instruction how to assemble Rock*Star Starter detonator

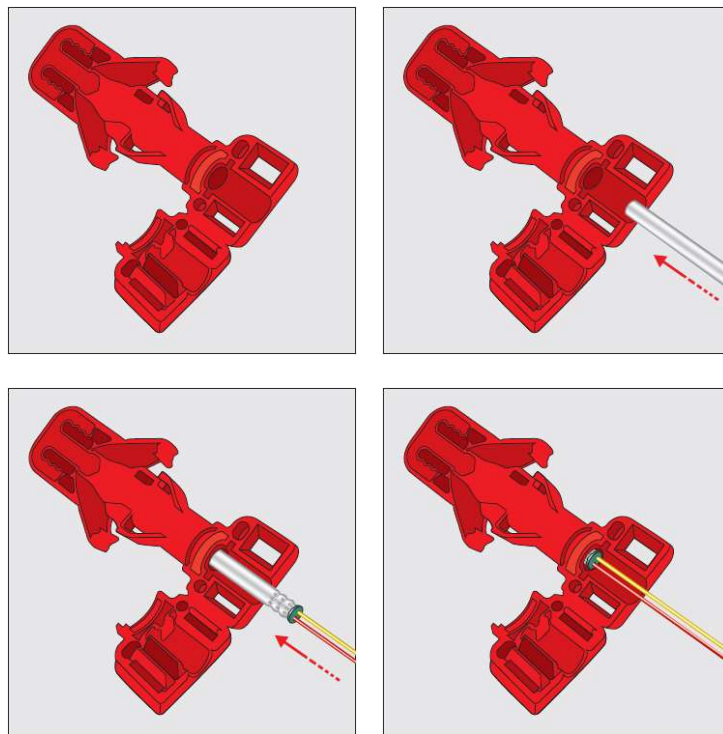


Fig. 4-42

Insert the electric detonator with its full shell length into the opened connector block until it reaches its bottom



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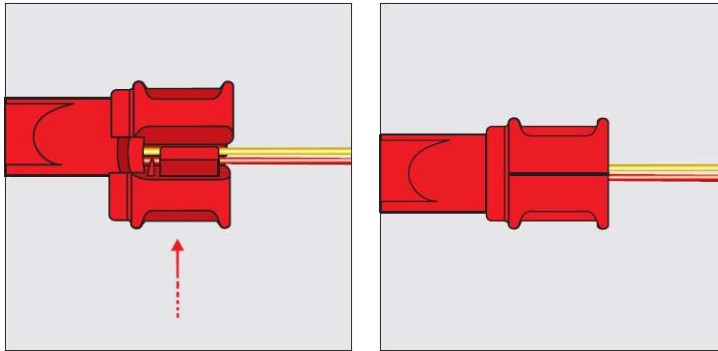


Fig. 4-43

Close the connector block

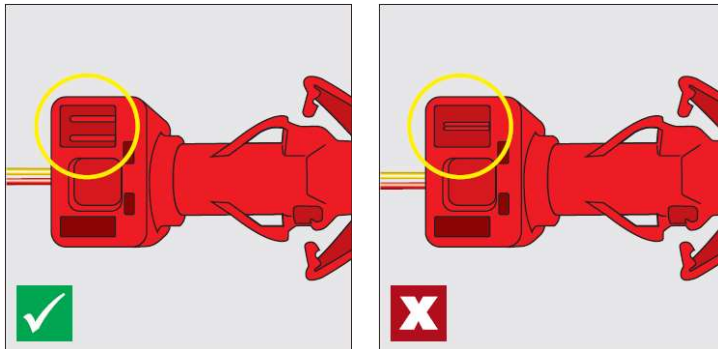


Fig. 4-44

Check that the lock is correctly closed

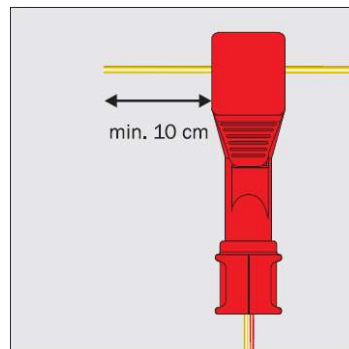


Fig. 4-45

Connecting point Shock Tubes or the detonating cord to the connector must be at least 10 cm from the Shock Tube or detonating cord end. Connect the Shock Tubes based on description in chapter 4.3 of this user's guide.

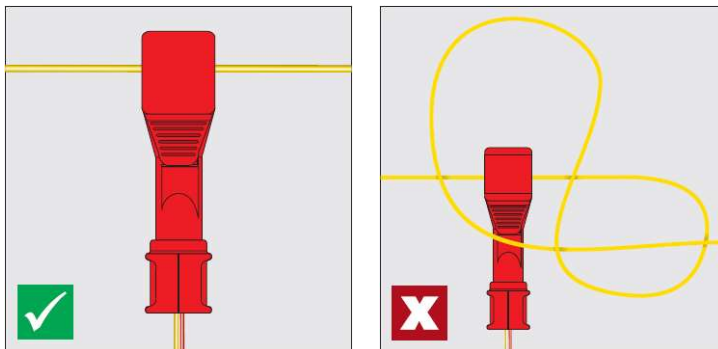


Fig. 4-46

Shock Tubes or detonating cord must be straightened in the vicinity of the connector.



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Initiation of **Rock*Star Starter** will cause shrapnel effect. It is necessary to cover the connector by inert material (gravel, soil, sand).

4.11.2 Always and Nevers when using Rock*Star Starter

- | | | | |
|---------------|---|--------------|---|
| ALWAYS | use electric detonator #3 (75 ms). | NEVER | use standard Shock*Star Surface for initiation of detonating cord. Only Rock*Star Starter is designed for detonating cord initiation. |
| ALWAYS | use electric detonator produced by company Austin Detonator. | NEVER | initiate more than one detonating cord by one Rock*Star Starter . |
| ALWAYS | straighten Shock Tubes or detonating cord in the vicinity of the connector. | NEVER | initiate more than 8 Shock Tubes. |
| ALWAYS | cover the connector with inert material. | NEVER | initiate other detonating cord than 5 g/m by Rock*Star Starter detonator. |
| | | NEVER | place the connector in distance smaller than 10 cm from the free ends of Shock Tubes or detonating cord. |

4.12 REMOVAL OF NON-ELECTRIC INITIATION SYSTEM REMAINS AFTER USE

Non-active (fired) remains of Shock Tubes are collected in a designated area and handed over to companies licensed for removal of industrial waste, catalogue No. 15 01 02, category O (plastic packages). Metal parts of detonators (shrapnel) are collected in a designated area and handed over to companies licensed for use of industrial waste, catalogue No. 17 04 07, category O (various metals).



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5 PACKAGE, STORAGE AND SHELF LIFE

5.1 PACKAGING

Assembled non-electric detonators are packed into cardboard cartons. Inside the cartons the detonators are packed in vacuum-sealed plastic bags. The quantity per carton is determined by the Shock Tube length (see product information brochures for each separate product). The cartons are tested and certified and are in strict conformity with the International Agreement of Road, Train, Sea and Air Transport (ADR, RID, IMDG, IATA). The cartons are marked with the appropriate UN code.

SHOCKSTAR Detonatori Neelectrici		MS	IHD IN-HOLE DELAY
D #	Treapta de intarziere	ms	Gross Weight Hrubá váha Bruttogewicht Poids brut • Peso bruto
Delay Zpoždění Verzögerung Retard Retardo	20	500	
L	Lungime tub de soc	m	Net Weight Čistá váha Nettogewicht Poids net • Peso neto
Length Délka Länge Longueur Longitud	7.8	100	
Q	Cantitate		Net Weight of Explosive Čistá váha výbuštiny Nettogewicht des Sprengstoffes Poids net d'explosif Peso neto del explosivo
Quantity Počet kusů Stückzahl Quantité Cantidad	100		
Date of manufacture Datum výroby • Herstellungsdatum Date de fabrication • Fecha de fabricación		180604	
Use by date Spotřební doba • Verbrauchsdatum (bis) Consumption period • Consumir hasta		200604	
Batch No. Číslo výrobní série • Serien-Nr. Serie No. • Serie No.		V82584-3-1	
Box No. Číslo kartonu • Karton-Nr. Emballage No. • Box No.		V82584-3-1-21	
		CE 0589	
		CE 0589 EXP 3378/99	
Se transporta și manipulează la temperaturi cuprinse între -30°C +50°C			
QR Code		CZ010 V82584-3-1-21	

SHOCKSTAR Detonatori Neelectrici		SURFACE	SC SURFACE
D	Treapta de intarziere	ms	Gross Weight Hrubá váha Bruttogewicht Poids brut • Peso bruto
Delay Zpoždění Verzögerung Retard Retardo	9		
L	Lungime tub de soc	m	Net Weight Čistá váha Nettogewicht Poids net • Peso neto
Length Délka Länge Longueur Longitud	4.8	90	
Q	Cantitate		Net Weight of Explosive Čistá váha výbuštiny Nettogewicht des Sprengstoffes Poids net d'explosif Peso neto del explosivo
Quantity Počet kusů Stückzahl Quantité Cantidad	90		
Date of manufacture Datum výroby • Herstellungsdatum Date de fabrication • Fecha de fabricación		180604	
Use by date Spotřební doba • Verbrauchsdatum (bis) Consumption period • Consumir hasta		200604	
Batch No. Číslo výrobní série • Serien-Nr. Serie No. • Serie No.		V82584-9-1	
Box No. Číslo kartonu • Karton-Nr. Emballage No. • Box No.		V82584-9-1-148	
		CE 0589	
		CE 0589 EXP 1160/98	
Se transporta și manipulează la temperaturi cuprinse între -30°C +50°C			
QR Code		CZ010 V82584-9-1-148	

Fig. 5-1 Outer cardboard box label



SHOCKSTAR MS # 20 21 m 500 ms CZ010 V570901-3-1-1000-1-3	SHOCKSTAR TS 4.8 m 3500 ms # 35 CZ010 V70501-1-1-1000-1-1
SHOCKSTAR SURFACE 3.6 m 17 ms CZ010 V70501-5-1-1000-1-1	SHOCKSTAR BUNCH CONNECTOR 2.4 m 0 ms CZ010 V70501-6-1-1000-1-1
SHOCKSTAR DUAL DELAY 4.8 m 100-9000 ms CZ010 V70501-4-1-1000-1-1	SHOCKSTAR DC RELAY 25 ms CZ010 V70501-7-1-1000-1-2

Fig. 5-2 Detonator traceability tag



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5.2 SHELF LIFE AND STORAGE CONDITIONS

- a) For non-electric detonators packed in original unopened aluminum foil bags, the shelf life is 2 years, if stored in temperatures between -30 and +40°C. After opening the foil bag, it is recommended to use the detonators within 3 months.
- b) For non-electric detonators packed in original unopened plastic bags, the shelf life is 2 years if stored in temperatures between -30 and +40°C and relative humidity not exceeding 65%. After opening the foil bag, it is recommended to use the detonators within 3 months.
- c) For non-electric detonators packed in paper boxes without aluminum foil bags, the shelf life is 3 months.

The storage place should be clean, well ventilated, dry, protected from fire, and securely locked when not in use.



Fig. 5-3

5.3 STORAGE AND TRANSPORTATION CLASSIFICATION

The detonators are classified for transport as follows:

Standard packaging

1.1B, UN 0360

Shock*Star MS, Shock*Star TS, Shock*Star Dual Delay, Shock*Star Bunch (with detonating cord)

1.4S, UN 0500

Shock*Star Surface, Shock*Star Bunch (without detonating cord), Shock*Star StartLine

1.4B, UN 0361

Shock*Star DC Relay

Special packaging (at special request)

1.4S UN 0500; 1.4B, UN 0361

Available for all in-hole products.

This classification also relates to transportation regulations as per RID, ADR, ADN and IATA DGR. The detonators should not be subject to temperatures higher than 50°C and should be protected from direct sunlight.

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