



E*STAR Leakage Procedure

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1 What is Leakage?

A leakage occurs when current is lost through a leak. The leak is caused by the damage of insulation of the wires. It is an Achilles heel of all electronic blasting systems since they use of low energy to carry signals to the detonators.



Illustrative example of water leakage

Electronic detonator needs certain amount of current to charge its capacitor to communicate with the dedicated equipment (e.g. Logger). This current value is 0.09 mA per one det. When the Leakage is present in the wires, more current is needed to compensate for the amount leaked out of the wires. Higher current introduce more noise and higher noise means worse communication between the detonator and the dedicated equipment. This mean that high leakage can create a situation when the equipment does not recognize what is the detonator telling or the detonator does not understand what the equipment want from it.

2 Types of leakage

2.1 Ground leakage (Bus-Shell)

- ◆ Only one wire core is exposed - damage of insulation on that particular core
- ◆ It is detectable only when using ground rod connected to the E*STAR Tester, E*STAR Logger or E*STAR Logger 2
- ◆ Proper value, which has to be read on the equipment, is 0.00 mA. Higher value mean presence of ground leakage. Since it is damage of one wire it is important to know on what polarity the leakage exists.

2.2 Detonator leakage (Bus-Bus)

- ◆ Two wire cores are exposed - damage of insulation
- ◆ It is detectable by E*STAR Tester, E*STAR Logger or E*STAR Logger 2, no any other special tool is required
- ◆ Proper value, which has to be read on the equipment, is 0.09 mA
 - ◆ When the value is higher = leakage is present
 - ◆ When the value is lower = the wires are cut and the detonator lost

2.3 Voltage Relation

Amount of leakage is always depending on distributed energy to the wires.

If there is a low voltage introduced to the system, the leakage is small. When the voltage is raising, leakage is growing.

- ◆ Tester = 1.5 V
- ◆ Logger, Logger 2 = 7.5 V
- ◆ Blasting Machine = 42.5 V

The same wire damage causes different mA leakage measured by Tester compare to measuring by Logger.

There is no formula, coefficient to count what will be the leakage on Blasting Machine when the leakage measured by Tester is XX mA.



3 Leakage Tolerance

- ◆ **Logger, Logger 2 = max. 20 mA to read and program detonator or to do branch verification**

If you have 2 dets, each 12 mA, in the same branch. You will be able to program them but not verify the branch because total branch leakage will be higher than 20 mA.

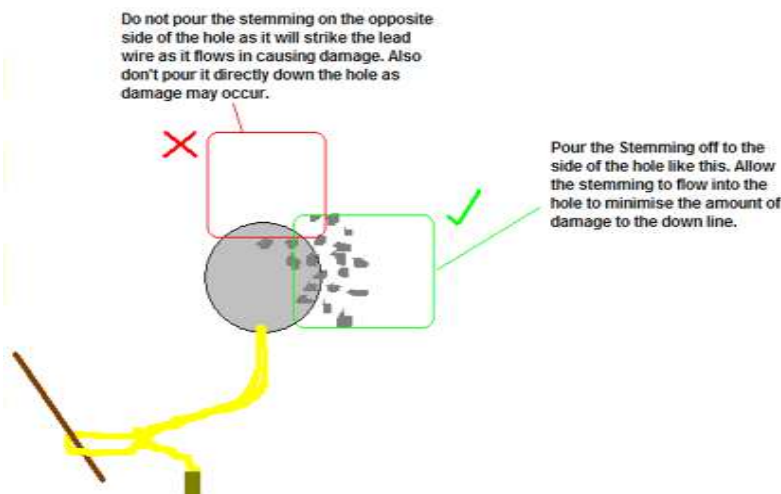
- ◆ **Blasting Machine = max. 500 mA to charge detonators and fire them**

If you will have 35 branches, each 18 mA. You will be able to verify them but not to fire them because total blast leakage will be higher than 500 mA. The real mA value on Blasting Machine will not be $35 \times 18 = 630$ mA but higher because Blasting Machine's voltage is much higher than Logger's voltage.

There is no 100% assurance that the detonators will be successfully charged until you see the green light Ready to Fire on Blasting Machine.

4 Precautions / Best Practice

- ◆ Always choose the right product for your application. If the wire damaged is predicted, use E*STAR Heavy Duty version
- ◆ If the wire damaged is predicted or something happened during the charging, use extra detonator/booster
- ◆ Consider to use 2 primers (dets) per deck
- ◆ Do not use metal object in hole after detonator priming
- ◆ In delivery of bulk product do not use hose with metal end
- ◆ During the priming, charging, stemming, be gentle as much as possible. Better to spend couple more minutes per hole then to spend way more time to solve the leakage issue
- ◆ Prevent rock falling when charging the holes
- ◆ Stemming should be of high quality and of correct and consistent size
- ◆ Avoid oversize in the stemming as this will cause major damage and excessive leakage
- ◆ When placing stemming into the blast hole, direct the stemming to the side of the hole and allow it to flow in to minimize damage to the down line
- ◆ Don't use Plastic Plugs (Plastic Spiders), if you have to, use the type with no sharp edges
- ◆ Check every detonator by Tester for Detonator and Ground Leakage prior to stemming





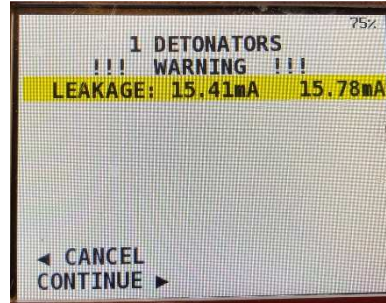
5 Detonator Leakage - What to Do?

5.1 Indication during the testing or programming of one detonator

It could be indicated on the Tester or Logger equipment as:



E*STAR Tester in Bus – Bus mode



E*STAR Logger 2 during the programming

It can be also manifested in error messages on both the E*STAR Logger and E*STAR Logger 2 during the detonator programming when the detonator is attached to the Logger's adapter:

- NO RESPONSE
- NO COMMUNICATION

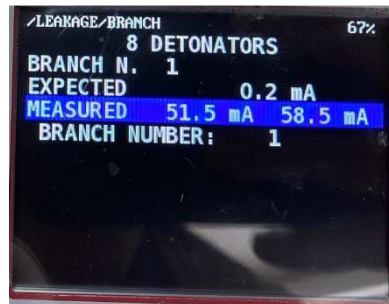
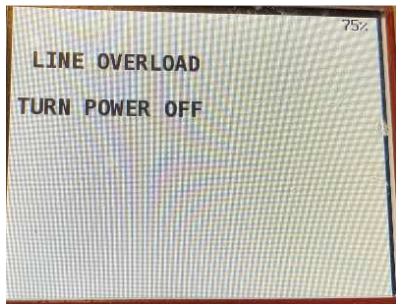
In all of the displayed cases it is clearly indicated that there is a problem with the detonator which needs to be addressed.

Note: These warning signs are possible to observe only when programming or testing of one detonator via direct contact of connector to the adapter (no RFID)

Note: Logger 2 measures automatically Detonator leakage during the programming. NOT GROUND LEAKAGE

5.2 Indication during the Branch verification

During VERIFICATION, the E*STAR Logger 2 could indicate high leakage of whole branch as:



E*STAR Logger indicates high Detonator leakage for whole branch during CURRENT measurement or VERIFICATION as:

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BRANCH 9
DIRECTION 1 --- 2
MEASURED 5 mA 5 mA
CANCEL< EXPECT 1 mA

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LINE OVERLOAD
TURN POWER OFF

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FAILED LINE TEST
CHECK DETONATOR TYPE
RESOLVE ERROR

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5.3 *Remedy the problem during the Testing or Programming of one detonator*

1. If this occurs during the programming, CANCEL it by arrow left
 2. Disconnect detonator
 3. Check the adapter and the connector for moisture, water, dirt or any other dirtiness
 4. Check the accessible wires for cuts or damage
 5. In case the wire is damaged above the ground, cut it short below the damaged area and reapply the connector, or attach the E*STAR Pronto Connector
 6. Connect the detonator to the dedicated equipment again
 7. If the problem continues, mark the position of the detonator on the timing / programming plan and on the connector (e.g. using color spray).
- ◆ During programming – reoccurring High Leakage Warning after doing steps 1 to 7
8. Press arrow right to CONTINUE
 9. Program the detonator – if possible
 - a. If error messages NO RESPONSE or NO COMMUNICATION appear, try to retrieve and replace the detonator, or apply second primer to the hole and do not use this detonator
 - b. Keep within the general rule for keeping the not remedied leaky detonators in the network (listed below)
 10. Continue in the programming

5.4 *Remedy the problem during the Verification of whole branch*

1. If during the verification or leakage (current) check occurs:
 - a. Slower verification than usual
 - b. Values of Measured Current are higher the Expected ones
 - c. Logger shows Line Overload or Failed Line Test
2. Disconnect
3. Check Bus-line ends for shorted circuit (when Line Overload or Failed Line Test)
4. Cut the Bus-line of the leaky branch in half and measure the leakage of every half using the E*STAR Logger 2 in mode “5 LEAKAGE” + “BRANCH” or E*STAR Tester in “BUS-BUS” mode
5. See the values and calculate the appropriate expected value based on the number of detonators remaining in the measured half of the Branch
6. If the value is OK, measure the 2nd half
7. Separate the half with the leakage to another 2 halves and repeat process of point 4 to 7 until the problematic detonator(s) are found
8. Disconnect detonator(s) from the Bus-line and proceed as described in point 5.3 of this document

5.5 *General rule for keeping not remedied detonators with the detonator leakage in the network*

Keep max. of 1 high leakage detonator in one branch and max. 5 detonators in the whole blast.

Any leakage for detonator amount above this recommendation has to be solved or the detonators has to be either replaced or removed from the circuit.

6 **Ground Leakage – What to Do?**

6.1 *Identification during the testing*

- ◆ There is no problem when one detonator has a Ground Leakage, system can handle it
- ◆ Problem can occur when more detonators have Ground Leakage and energy goes from one detonator to another detonator through the ground. This can be a problem only if one detonator is leaking through the wire 1, polarity 1 and second detonator is leaking through the wire 2, polarity 2
- ◆ **Use E*STAR Tester for Ground Leakage identification**
- ◆ Ground Leakage can be identified only by measuring with Ground Rod
- ◆ Ground rod should be made from copper or copper coated steel. Cable connecting rod to the dedicated equipment should be pure copper wire. It is not provided by Austin Powder as a standard E*STAR equipment/accessory



Ground Rod

6.2 Ground Leakage Measuring & Remedy

Use only E*STAR Tester to identify, measure and remedy any Ground Leakage. Other equipment (e.g. Loggers) are able to measure Ground Leakage as well, but are not primarily designed to this purpose and there might be problem with polarity identification, which is necessary for successful problem solution.

◆ Detonator Ground Leakage

1. Connect detonator to the E*STAR Tester using E*STAR ADAPTER model 1 (with wires)
2. Connect the wire of the Ground Rod to the terminal (red one) on the bottom of the Tester
3. Turn on the Tester
4. Short press of the button will switch Tester to Bus-Shell mode (Ground Leakage measuring)
5. Insert the Ground Rod into the ground near the hole and check mA value on the Tester display. Value must be 0.00 mA
6. Try different places around the hole or inserting the Ground Rod to the water in the hole vicinity
7. Do not touch the Ground Rod during measuring
8. If Ground Leakage is indicated, mark it on the connector (e.g. use color spray)

0.04mA	0.00mA	0.04mA	0.00mA
1 DIRECTION	2	1 BUS-SHELL	2

◆ Branch Ground Leakage Measuring – check on already connected detonators to the Bus-line

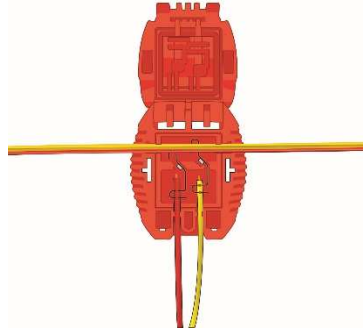
1. Measuring procedure is the same as one detonator measuring but all detonators are connected to the branch so you are measuring the whole branch
2. Measure every 5th detonator – connect the detonator connector to the Tester and put the Ground Rod to the ground
3. Check whole branch like that
4. If the Ground Leakage is found, disconnect all the detonators from the Bus-line and proceed as recommended for the Branch connection with the Ground Leakage, see below.

◆ When there is Ground Leakage discovered either at the detonator level or branch level, follow the procedure for the Branch Connection with the Ground Leakage:

1. Disconnect all the detonators from the branch Bus-line (if not done already)
2. Connect the end of the Bus-line to the E*STAR Tester – directly to the terminals, keep RED Bus-line wire on the left terminal
3. Connect the Ground Rod to the Tester
4. Insert the Ground Rod to the ground
5. Start to measure leakage in Bus-Shell mode (Ground Leakage measuring)
6. Start to connect detonators one by one to the Bus-line and check the mA value on Tester after connecting of every single detonator
7. Observe the direction in which the ground leakage increases (Tester shows 2 values, 1st value is 1 direction and 2nd value is opposite direction)
8. Focus on getting increase only in one direction (e.g. left value), if there is increase in other direction, change the Bus-line polarity of that detonator (switch the Bus-line wires inside the connector).



9. Every 5 – 10 detonators (depending on the distance) reconnect the E*STAR Tester to the Bus-line using the E*STAR Pronto Connector – place it after the last connected detonator
 - a. Remove one connector from the E*STAR Pronto Connector
 - b. Adjust the E*STAR Pronto Connector that way to clearly identify the polarity



10. Repeat the procedure – from step 4
11. Keep the polarity the same for all Leaky branches (e.g. polarity 1 on the RED wire)

6.3 Connecting branches with Ground Leakage to the Firing Line

1. Make sure your Ground Leakage is isolated to only one polarity on every Branch (previous steps)
2. Use Bus-line for the firing line
3. Use Pronto Connector to connect every branch to the firing line. Connect each branch in its middle. Be sure that you keep the same polarity on every connection, for example: Branch Bus-line RED wire at the bottom = Firing Line Bus-line RED wire at the bottom

7 Blasting Machine Is Not Able to Charge the Detonators – Situation Description

- ◆ During the detonator charging, Blasting Machine goes up to 5 charge cycles
- ◆ If the all detonators are still not charge, Blasting Machine show “Charge Error, some dets may not fire”
- ◆ First step is to press ABORT button and turn of the Blasting Machine. Then switch the Firing Line polarity and try the charging again, of this will not help, Charge error will appear again
- ◆ Press arrow right
- ◆ Calibrate Error message will appear, press arrow right
- ◆ 3 options will appear
 - ◆ 1_Scan all dets
 - ◆ 2_Proceed to firing
 - ◆ 3_Recharge
- ◆ Choose option n. 3 - Recharge. Blasting machine will go for another 5 charge cycles trying to charge all dets. Green light ready to fire appears when the charging is done successfully. If green light does not appear and the charge error message appears again, continue by arrow right
- ◆ Choose option number 1 - Scan all dets.
- ◆ Blasting machine will show leaking det(s)
- ◆ Take picture of the displayed detonator information or make note of it
- ◆ Abort the blasting procedure, wait for 5 minutes
- ◆ Go to the field and solve the Leakage issue as described above

It is not recommended to choose option number 2 - Proceed to firing. Only properly charged detonators will be fired. POTENTIAL MISFIRE.

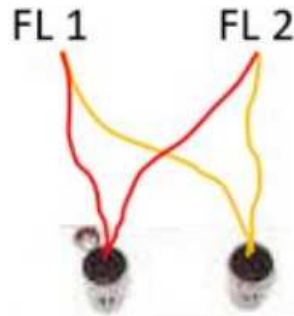
8 Blasting Machine Is Not Able to Charge the Detonators – What to Do, TIPS

- ◆ Switch firing line wires in the Blasting Machine terminals e.g. RED from left to right, YELLOW from right to left terminal
- ◆ Change all the Bus-lines, firing line
- ◆ Try to improve the energy distribution to the network



AUSTIN POWDER

- ◆ If you use Daisy Chaining connection – change it to Bus-line connection
- ◆ Cut the branches to smaller pieces and connect them directly to the firing line
- ◆ Connect each branch in its middle (not in the end of branch) to the firing line by Pronto Connector - be sure that polarity of connected Pronto Connectors is consistent
- ◆ Use 2 or more firing lines, just connect some branches to one firing line, some to the second firing etc. Insert all the firing lines to one Blasting Machine
- ◆ If you know which detonator is leaking but you cannot replace the detonator, connect this detonator directly to the firing line. If this will still not help, connect this detonator to the separate firing line. Then both firing lines insert to one Blasting Machine



- ◆ Use two synchronized Blasting Machines (equipment DIM-1 is needed for synchronization): connect half of the branches to Blasting Machine 1 and the rest to the Blasting Machine 2.

9 AD Technical Support

Vojtech "VJ" Kala

+420 731 623 616

vojtech.kala@austin.cz

Ondrej Cermak

+420 730 166 246

ondrej.cermak@austin.cz

Enes Kubat

+420 703 478 987

enes.kubat@austin.cz