Electronic Blast Initiation Systems (EBIS) Guideline

*General User Information for Mining, Quarrying and Construction Applications*

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IME is a nonprofit association founded in 1913 to provide accurate information and comprehensive recommendations concerning the safety and security of commercial explosive materials. IME represents U.S. manufacturers and distributors of commercial explosive materials and oxidizers as well as other companies that provide related services. Although our member companies are based in North America, IME members operate globally with operations and distribution points on all continents except Antarctica.

IME was created to provide technically accurate information and recommendations concerning commercial explosive materials and to serve as a source of reliable data about their use. Committees of qualified representatives from IME member companies developed this information and a significant portion of their recommendations are embodied in regulations of state and federal agencies.

The Institute's principal committees are: Environmental Affairs, Government Affairs, Legal Affairs, Safety and Health, Security, Technical, and Transportation and Distribution.
# Table of Contents

Purpose ......................................................................................................................................................... 5
Definitions ..................................................................................................................................................... 6
Background ................................................................................................................................................... 8
Environmental Influences ........................................................................................................................... 11
  - Radio Frequency Energy ................................................................................................... 11
  - Electro Magnetic Pulse (EMP)........................................................................................... 11
  - Dynamic and Static Pressure Resistance .......................................................................... 13
Electronic Blast Initiation System Equipment ............................................................................................. 13
  - The Detonator ................................................................................................................... 13
  - On- Bench Field Testing and Programming Equipment .................................................... 15
  - Electronic Blasting Machines ............................................................................................ 17
  - Remote Firing Devices and Systems .................................................................................. 19
  - Underground Electronic Initiation Systems (UEIS) ........................................................... 20
  - Software and Firmware .................................................................................................... 21
General User Information / Training / Certification ................................................................................... 23
IME Recommendations and Reference Materials .......................................................................................... 23
Purpose

This IME Guideline has been developed to provide users of Electronic Blast Initiation Systems (EBISs) with a “plain language” source of information to clarify the technology associated with electronic detonators. The Guideline describes basic design features of EBISs, provides general use and handling recommendations, identifies possible risks associated with EBISs, and stresses the need for field awareness of the critical features and designs of the various systems available to ensure their safe use and correct application.

There are several blasting environments to which all detonator systems may be exposed that can influence their functionality and performance. This Guideline is designed to also heighten the awareness of these environments and the need for all blasters and users of any detonator system to be familiar with these environmental concerns to ensure that the systems are used safely and reliably. That said, this paper focuses particularly on environments affecting EBISs.

The Institute of Makers of Explosives (IME) has developed a series of Safety Library Publications (SLPs), including, SLP 4 Warnings and Instructions (2016), and SLP 17 Safety in the Transportation, Storage, Handling and Use of Explosive Materials (2011), that incorporate recommendations and best practices for the use of any electronic initiation system. Users should ALWAYS consult these resources prior to using any electronic initiation system in order to develop an understanding of the best practices for the safe application of electronic detonators. In addition to consulting IME SLP 4 and SLP 17 (which provide general guidelines and recommendations), users should ALWAYS consult the manufacturer’s user manuals specific to the system they will use / are using to ensure a complete understanding of that system’s design capabilities and limitations.

The following information is designed to provide users, regulators, and those handling and storing electronic detonators basic information and fundamental knowledge of the technology. A thorough understanding of the technology is key to conducting proper risk assessments and to ensuring the safe and practical use, handling and transportation of these types of systems.

The information provided herein is not intended to cover all hazards potentially associated with the use of EBISs. EBIS users should review and understand this Guideline and, as noted throughout this document, should always consult and follow the instructions and recommendations provided by the manufacturer of the particular EBIS being used.
Definitions

**ASIC** - An **application-specific integrated circuit (ASIC)**, is an integrated circuit (IC) customized for a particular use, rather than intended for general-purpose use.

**circuit board** – also known as a printed circuit board (PCB) is a circuit in which the interconnecting conductors and some of the circuit components have been printed, etched, etc., onto a sheet or board of dielectric material. The circuit board mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate.

**delay element** – the timing delay component of an initiation device or initiator (detonator).

**electric detonator** – any device containing an initiating or primary explosive that is used for initiating detonation in another explosives material and uses direct electrical energy from the device’s leads (wires, springs, contacts, etc.) to fire an igniter to initiate the device.

**electronic detonators** – any device containing an initiating or primary explosive that is used for initiating detonation in another explosives material and utilizes an integrated circuit and/or micro processing technology to provide communications, energy control and storage capability, timing delay information and commands in order.

**electronic blasting machine** – a blasting machine designed specifically to communicate to a full series of electronic detonators in a blast that also has the capability to communicate, interrogate, and program as well as charge and fire the device(s).

**EMP** - An **electromagnetic pulse (EMP)**, also sometimes called a transient electromagnetic disturbance, is a short burst of electromagnetic energy. EMP origination may be a natural occurrence or man-made and can occur as a radiated, electric or magnetic field or a conducted electric current, depending on the source.

**Faraday cage** - or **Faraday shield** is an enclosure formed by conductive material or by a mesh of such material, used to block electric fields.

**leaky feeder** – a communication system consisting of a coaxial cable run along tunnels which emits and receives radio waves, functioning as an extended antenna. The cable is "leaky" in that it has gaps or slots in its outer conductor to allow the radio signal to leak into or out of the cable along its entire length.

**logger** – a term used to describe a type of “on-bench” or field instrument designed to communicate with, record and/or program into, specific information for an electronic blast initiation component or detonator.

**match head** – the component in a detonator device used to ignite or fire the primary explosive mixture and base charge of the device from an electrical or electronic energy source.
microprocessor - a computer processor which incorporates the functions of a computer’s central processing unit (CPU) on a single integrated circuit (IC), or at most a few integrated circuits. The microprocessor is a multipurpose, clock driven, register based, programmable electronic device which accepts digital or binary data as input, processes it according to instructions stored in its memory, and provides results as output. Microprocessors contain both combinational logic and sequential digital logic. Microprocessors operate on numbers and symbols represented in the binary numeral system.

programmer - a term used to describe a type of “on-bench” or field instrument designed to communicate with, record and/or program, specific information for an electronic blast initiation component or detonator.

pyrotechnic initiation systems – initiating devices or combination of devices that contain materials capable of undergoing self-contained and self-sustained exothermic chemical reactions to produce heat and used primarily to ignite other, more difficult-to-ignite materials, e.g. primary explosives.

raise round – a type of blasting in underground mining in which the stoping process is completed in a vertical direction from bottom to top.

RF Energy - radiofrequency (RF) energy is another name for radio waves. It is one form of electromagnetic energy that consists of waves of electric and magnetic energy moving together (radiating) through space. The area where these waves are found is called an electromagnetic field.

stoping - any excavation made in a mine, especially from a steeply inclined vein, to remove the ore that has been rendered accessible by the shafts and drifts.

tagger - a term used to describe a type of “on-bench” or field instrument designed to communicate with, record and/or program, specific information for an electronic blast initiation component or detonator.

WiFi - a wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections.
Background

Electronic Detonators: NOT Electric and NOT Nonelectric

The functionality, risks, and safety benefits of electronic systems are not fully understood by all potential users. Some of this misunderstanding stems from the fact that the technology, components, and communication protocols used in electronic systems are not found in pyrotechnic-based technologies (fuse caps, electric and nonelectric systems).

Additional confusion stems from the inaccurate assumption that because both technologies incorporate wire as a lead, they must, therefore, be similar technologies. Even though electronic detonators (typically) utilize wire and/or wire harness components in their technology, these should not be confused with standard electric detonator technologies, especially in areas where response to stray/induced current, continuity testing, static electricity, and RF energy is identified as a hazard.

Further complicating matters, some existing government regulations and/or industry guidelines covering initiation systems may not be applicable or appropriate to electronic systems. Often, meaningful regulations specific to electronic systems simply do not exist. This can result in additional confusion for current and “would-be” electronic system users.

![Basic Detonator Construction Diagram](image)

For the foreseeable future, existing electric detonator regulations may continue to be mistakenly applied (or misapplied) to electronic detonator technologies.

To recognize the actual risks associated with EBISs, a basic understanding of the physical construction of the system components, starting with the detonator, is essential. Users should then develop a full understanding of all the test equipment, programming units and firing devices to fully appreciate the risks unique to electronic systems and to ensure the safe application of the technology.
After completing a training and education program, users will have a better appreciation of the enhanced level of protection and blast control capability offered by electronic systems. Users will also understand more fully that every electronic system design is different and that “not all electronic systems are created equal.” Users should ALWAYS know and fully understand the design capabilities and features of their EBISs.

The physical construction of an electronic detonator is the primary reason that electronic detonators should not be confused with electric or nonelectric detonator technologies. As seen in Figure 1, the electronic detonator wire leads do not attach directly to a match head or bridge wire, unlike electric detonators.

It is the direct connection to the matchhead or bridge wire by the external wire of an electric detonator that makes an electric detonator susceptible to initiation from static, stray current and/or RF energy in the field. IME SLP 20, Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps), was specifically developed to address the sensitivity of electric detonators to RF energy.

In addition to a physical separation from the bridge wire, electronic detonators generally have several other components as part of the design that further increases the level of protection from extraneous electrical energy sources and the risk of premature initiation.

Some of these protection devices include:

- a spark gap device to protect against static discharge events (high voltage spikes from static build up on personnel, equipment, etc.)
- the use of current limiting resistors
- detonator shell construction (Faraday cage – RF energy)

In addition to an electronic detonator’s design and construction, EBISs have other built-in features that provide a further level of safety and security that may not be found in other systems. EBISs incorporate a logic component in the detonator design in the form of a microchip technology or an ASIC (Application Specific Integrated Circuit) that provides not only a “logic” protection from premature initiation, but also provides a level of timing control and security from unauthorized use. Generally, the built-in logic circuits will allow operators to limit and control who can use the system though passcode protection.
Most will also require a “physical key” to gain access to firing circuits, which increases the level of security by limiting the use of equipment and detonators to ONLY authorized and fully trained blasters. The photos below show a cut-away of a typical electronic detonator as well as the full assembly with special connectors.
Environmental Influences

Electronic initiation systems and their associated equipment and components have been in use for many years and have seen a wide variety of field application challenges common with the introduction of any type of new technology. Many of these challenges or issues can be attributed to a lack of user familiarity with system capabilities and/or incomplete understanding of the system design limitations with respect to the environments in which they were designed to work.

Radio Frequency Energy

Lack of understanding of electronic initiation systems, along with some misguided warnings, including warnings from some mining/construction equipment manufacturers, has resulted in confusion and safety concerns for users who mistakenly believe that electronic detonators may prematurely initiate if exposed to RF energy sources.

Although RF energy may interfere with the communication of these systems, extensive testing by the manufacturers and independent laboratories have verified that electronic initiation systems will “fail to a safe” mode even if exposed to RF levels that exceed levels typically experienced in mining, quarrying, and construction applications.

To help clarify risks associated with RF energy sources and detonator technologies, IME has developed a suggested warning for equipment manufacturers, i.e., that electric detonators are clearly at risk of premature initiation from RF energy sources, and users should recognize and apply safe distances outlined in SLP 20, Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps). It is important to note that SLP 20 does NOT apply to electronic detonator technologies.

The need for the above clarification is illustrated by a confusing warning message recently encountered on some mobile equipment. The equipment manufacturer’s warning recommends that operators turn off communication devices when using both electric and electronic detonators, or to observe safe operating distances for vehicles with communication systems. The distances referenced are taken from SLP 20 which, as noted above, applies only to electric detonators.

EBISs provide not only a high level of immunity from premature detonation due to their design and construction (as discussed above), but also provide a high level of resistance to potential interference sources. However, not all electronic systems use the same construction and design concepts to provide this protection. Users should read and understand all aspects of the system they use and follow the manufacturer’s recommendations.

Electro Magnetic Pulse (EMP)

An electromagnetic pulse (EMP), also sometimes called a transient electromagnetic disturbance, is a short burst of electromagnetic energy. EMP origination may be a natural or man-made occurrence and can occur as a radiated, electric or magnetic field or a conducted electric current, depending on the
source. Electromagnetic fields can be generated from several sources including, natural atmospheric conditions such as thunderstorms, large solar storm (geomagnetic) events, and chemical or nuclear explosions. A powerful EMP event such as a lightning strike can damage physical objects.

EMP interference is generally disruptive or damaging to electronic equipment at higher energy levels. The management of EMP effects is an important branch of electromagnetic compatibility engineering. EMP has been identified as a source of damage and risk to the performance and reliability of electronic detonators. Today’s electronic detonators and initiation system equipment and technologies generally have built-in protection from this type of extraneous energy, but users should always consult the manufacturer of the product they are using to ensure that the product will meet the types of demands encountered in some blasting environments. Close boreholes, metallic orebodies and certain types of explosives products can enhance the production of EMP, which can damage an adjacent detonator’s circuitry or the firing equipment, potentially causing misfires. In rare cases, blasters have experienced short duration electrical shock when the EMP travels back through the firing line to the firing equipment.

EBIS manufacturers have studied EMP and have successfully reproduced the phenomena in controlled experiments. The voltages could be relatively high (+/- several kilovolts depending on the source) but very short in duration. No known fatalities or serious injury has ever been reported due to a known EMP from a blasting event. That said, basic precautions should be taken to avoid electrical shock and prevent misfires and equipment damage. These precautions may include; proper grounding of the equipment, avoiding standing in water, keeping clothing, gloves and hands dry, and the use of EMP protected detonators.

To weigh the risk of EMP, users should be familiar with the conditions that might produce it. The causes and characteristics of EMP are varied and complex. A thorough explanation is beyond the scope of this Guideline. A typical environment will consist of positive (+) and negative (-) charges in the atmosphere with both being equal (+/-). When a blast is detonated and especially when the blast is particularly violent, excitation of the gas particles and debris in the atmosphere may alter the (+/-) state and generate an electromagnetic field.

A short duration EMP event would take place in a somewhat similar form as a lightning strike. This EMP is seeking a ground source. The detonator wiring could become a conduit, and if the EMP is strong enough it may damage the circuits and shut down the remaining detonators before they fire.

This would be more common, for example, in underground development headings, tunnels and shafts where the holes are often closely spaced and/or un-stemmed. EMP has also been known to occur in surface operations, e.g., in un-stemmed pre-split holes or where oversized boulders are blasted with unconfined or minimally confined explosive charges. Even in stemmed holes, if conditions are conducive to EMP, blast holes can produce EMP which may then result in very violent results and/or unpredictable events.

While underground applications seem to be the most affected, EBISs have been used very successfully underground for many years in large and small scale bench, stoping or raise round blasting. They can be
used safely in the previously described conditions if the risks are understood and adequate precautions are taken.

Some detonator manufacturers have implemented built-in protections from EMP. Before using any EBIS, one should assess the risks of EMP, design the blast accordingly, and select a detonator type with adequate protections. Consult the detonator manufacturer for specific recommendations.

**Dynamic and Static Pressure Resistance**

Pyrotechnic initiation systems have been in use for centuries beginning with early forms of black powder fuse technologies to today’s chemical or pyrotechnic delay found in electric and nonelectric detonators. These technologies rely on mixtures of fuels and oxidizers consolidated in steel, lead, or other material sleeves to provide the timing required for blast initiation control and sequencing. These technologies have been developed over the years to not only provide a high degree of timing control and precision, but also to withstand the dynamic pressures associated with blasting environments.

As noted above, electronic detonators utilize microchip technology and logic to provide timing and firing control. These technologies have also been developed to provide a high level of reliability, but users should always consult the manufacturer for specific recommendations on the level and type of dynamic pressure and or shock that should be allowed for and protected against.

**EBIS Equipment**

**The Detonator**

A typical commercial electronic detonator can sometimes be confused with a commercial electric detonator since the construction of the detonator shell, bushings, and leads can be generally the same physical shape and size. A key difference between the two technologies is that in most all cases, an electronic detonator will incorporate a connector on the end of the wire leads to facilitate reliable connections as opposed to only stripped and shunted wires found on electric detonators. Some electronic detonator technologies will use a specially designed wire lead that may help to differentiate it from electric and/or other electronic detonators. Also, some electronic detonators will have a connector attached to the end of the unit that will help to distinguish electronic detonators from other conventional detonators.

Electronic detonators may use an aluminum shell or a copper alloy shell depending on the application or manufacturer, but the overall appearance will be similar to any commercial unit. The length of electronic detonators can vary from manufacturer to manufacture but the outside diameters are generally the same as all other standard commercial detonators (electric and nonelectric). Electronic detonators are also designed to be compatible with standard cast boosters (although some designs recommend specially designed boosters be used where there may be a risk of high dynamic pressure applications).
The photos below show examples of electric, nonelectric and electronic detonator technologies. Note the unique type of connectors that are only found on the electronics.

As discussed briefly above, the internal design and construction of an electronic detonator is what differentiates this technology from all others because the delay timing is provided by a circuit board and microchip technology versus a pyrotechnic delay composition which is generally jacketed in a steel or metal sleeve. The specific construction will differ from manufacturer to manufacturer but one unifying characteristic of all electronic detonators is the existence of a circuit board populated with electronic components in addition to an ASIC or microchip/microprocessor. Another key difference is the location of the bridge or match head technology relative to the delay element or timing circuit (pyrotechnic element v. electronic timing circuit).

The sketches below show the fundamental design difference and relative position of the match head relative to “delay elements”.

The difference in location of the “match head” in an electronic v. an electric detonator is critical for users to understand for two important reasons: 1) the “delay element” that is burning internally may be exposed to shock or dynamic pressures from adjacent boreholes. These pressures may have different effects on pyrotechnic delay elements v. electronic delay elements. Users should understand the design
capability of the detonator products being used as they can be affected by these dynamic pressures differently; and 2) the wire leads of an electric detonator are tied directly to the “match head” and subject to very different protection requirements relative to static, stray current, RF and other types of extraneous electrical energy sources. It is for this reason that SLP 20 was developed, and should only be applied to electric detonators.

An electronic detonator typically has several different forms of protection built into the design, e.g. spark gaps devices, internal electronic shunts, input resistors, etc., in addition to the fact that a circuit board physically separates the leads from the “match head.” Because of the built-in electronic protection devices and the physical separation of the match head from the external lead wires, electronic detonators are much less sensitive to extraneous energies. Generally, electronic detonators cannot be fired from common energy sources such as car batteries, wall circuits, static, stray current etc.

It should be noted however, as with any detonator or initiation technology, the same recommendations apply for the approach of electrical storms and lightning.

**On-Bench Field Testing and Programming Equipment**

Electronic and electric initiation system technologies vary significantly in the manner a detonator can be tested in the field prior to use. Users of electric detonators are familiar with the use of a “Blaster’s Galvanometer” to test for continuity as well as the level of resistance for each detonator and branches and circuits that are used while tying in a blast. While the galvanometer provides some level of continuity testing to ensure lead integrity following the borehole loading and stemming process, the testing is simply a measure of resistance in ohms of the wire lead and match-head or igniter.

Electronic detonators provide a much higher level of detonator and circuit testing capability due to the type of interrogation that can take place with the use of ASIC devices and microprocessor technologies within the electronic detonator. This fundamental difference in technology allows users to not only
check circuit integrity; the bench tester can actually conduct a “two-way” communication with an individual detonator or a series of detonators. This communication can provide the user with a significant level of information as well as the ability to program the detonator. The electronic bench testing unit which often may be called a “logger”, “tagger”, or “programmer” unit by individual manufactures, will provide the user with circuit tests to ensure communication with the detonator (wire breakage, leakage ranges, circuit board test protocols, match-head existence), as well as facilitating the programming of delay times and sequences of individual detonators. The methodology, sequence and type of communication varies between each manufacturer due to proprietary technologies, but EBISs, using “On Bench Testing and Programming Equipment,” provide a much higher level of information and communication capability than conventional electric or nonelectric initiation systems.

Typically, loggers, taggers, and testers can be used to test one detonator (as a pre-circuit test) prior to, during and after the borehole loading process. These on-bench testing units also can provide users with the ability to test a group of detonators, a series, and/or the entire blast allowing a blaster to check individual detonator information, the number of detonators in a circuit, and the full system integrity of a blast.

It should be noted and understood by users that all “On Bench Testers” are designed (and required) to be “inherently safe” devices. Inherently safe designs require that all electronic testing and communication is always done at a voltage and current level that is below the level needed to charge and fire a detonator. The tester by design does not have the capability to produce or deliver a high enough energy to fire a blast or a single detonator. This design feature, as well as the other detonator design features make electronics nearly impossible to accidentally fire from extraneous electrical energy found in normal mining, quarrying and construction activities, and provides users of EISs the highest possible level of safety and security.

It is the “On Bench” communication and interface between electronic detonators and the associated testing equipment that has allowed some users to refer to electronic detonators as “Smart Detonators.” Users can certainly have a much higher level of confidence in their ability to ensure “good” detonators are available following the loading and stemming process or, at a minimum, where suspect misfires could be anticipated and communicated prior to the blast. The systems today are also designed with proprietary methods of securing the communication and require passcode technologies and protocols to ensure that ONLY qualified and properly trained personnel use the systems. Although many users call these technologies Smart detonators or Smart Systems, they are only as smart as the users providing the programming and timing designs for each blast.
Some examples of “On Bench Testing Equipment” are shown below.

Electronic Blasting Machines

Following the successful “on bench” testing and programming of all electronic detonators in a blast, a specifically designed blasting machine must be used for firing the blast. As with all electronic systems, a proprietary blasting machine must be used with each manufacturer’s system. Blasting machines have unique design features and communication protocols that must be followed to ensure safe and reliable system level tests, final programming, charging and firing of the shot. Only fully qualified and trained personnel should attempt to use these systems.

Electronic blasting machines are the only devices designed to provide password protection, programming capability as well as the energy levels needed to charge the detonators in a circuit and send a fire command. It is the charging capability of the blasting machine that sets the units apart from all other field equipment for electronic detonators. They are not considered inherently safe devices, and as such, users must: **ALWAYS** clear the blast area of personnel, vehicles and equipment prior to hooking up to the firing device or blast controller. Refer to IME’s SLP 4 for other electronic initiation system **ALWAYS and NEVERS**.

Electronic blasting machines generally have the same characteristics and capabilities to test and interrogate electronic detonators as “on bench testers.” They also have the ability to test, interrogate and program the entire system or all units within a blast. This full scale testing is made possible by the blasting machine’s ability to communicate at a higher energy level which provides an adequate energy level for reliable communication as well as for charging of all firing circuits. Generally, a two-way communication is needed for full system testing as well as full charging of the individual detonator’s communication and/or firing capacitors. This allows for the reliable performance of the manufacturer’s system wide tests prior to the final charge and fire commands being sent.
Many systems will require both password protected firmware and/or software interfaces for the user as well as a physical key or manual device to ensure no accidental firing can occur. As mentioned above, each system is specific to a manufacturer’s design and users must understand and follow all protocols to ensure reliable, safe and secure use of electronic blasting machines.
Remote Firing Devices and Systems

Today’s EBISs offer users a full range of product features and solutions in terms of size of shots, programming times available, testing features and methodology of programming and firing. One such feature includes the ability to incorporate remote firing equipment into the user’s blasting protocol. As with other initiation systems, electronic blasting machines are available that allow a wireless interface between the “bench” and the preferred/safest location of the “Blaster-In-Charge” (BIC).

These systems have been designed with the highest level of communication reliability possible to ensure the same full scale testing, programming and firing of blasts. Users, however, must always ensure they are fully trained and understand the capabilities and limitations of these systems. Distance limitations, weather conditions, line of site requirements, RF interference, etc., can all play a factor in communication reliability and users should ALWAYS test and verify the system prior to use. As with any blasting machine use, the blast area must be cleared prior to connection. Remote firing devices can add additional challenges when clearing an area, therefore remote communication systems should be tested and verified prior to connecting to any blast circuit.

The following photos show a few examples of remote firing equipment used to ensure that the highest level of safety is achieved and that appropriate, safe distances are established for all personnel.

Remote firing systems and equipment
Underground Electronic Initiation Systems (UEIS)

Several developments have taken place over recent years with EBISs in underground use. Many underground mining operations have embraced UEISs for the safety and productivity benefits they provide. Generally, electronic detonators have built-in immunities to RF energy, static and stray currents and electromagnetic interference which exceed those found in the types of conventional electric detonators that are often used underground. The design flexibility that is inherent in an electronic system provides additional advantages. Nevertheless, the operator must always follow the manufacturer’s instructions for the specific system being used.

Several EBIS manufacturers have developed systems specifically for underground applications. Loading, programming, tie-in, testing and firing procedures differ significantly from typical surface operations. Extensive
theoretical and hands-on training is essential for the successful implementation of any UEIS.

One of the major driving forces of UEIS development is the need to fire blasts remotely from the surface, thus removing miners from the potential hazards of noise and concussion, rock fall, dust and fumes, and lost communication and isolation.

Two-way communication for the UEIS is essential in underground works. In addition to the standard central firing line, various methodologies have been developed for remote firing. This includes but is not limited to: Leaky Feeder, Wi-Fi, Fiber Optic Lines, PSTN (public switched telephone network), RS-485 and SHDSL (symmetrical high-speed digital subscriber line) modems.

Furthermore, sophisticated IT network systems can be set up, enabling the operator to store and share information as well as to monitor and manage multiple blasts independently or simultaneously on multiple levels at great distances from a single dedicated firing station. With a wide variety of mine specific requirements and communication systems already in place, a customized solution is often necessary.

Software and Firmware

One of the most beneficial features of an EBISs today is the ability of these systems to use and/or interface with many different types software technologies and information technologies. The fact that the detonator can be tested using two-way communication, programmed to any delay time, and re-programmed multiple times (based on changing circumstances just prior to the firing), makes software a unique and powerful tool for today’s blaster.

Today’s technologies provide user interfaces at all levels of the system which enhances the level of safety, security and programming flexibility for the blaster. To provide a high level of system reliability and functionality, today’s “on bench testers” and “blasting machines” utilize firmware that acts as the operating system for the detonators and devices to ensure robust communication and programming for reliability and safety.
The field user can interface with testers and blasting machines with easy to read and follow instructions to provide safe, reliable and secure testing and programming of detonators.

Many systems also provide programming options that allow users to manually or automatically input timing designs which not only increases the simplicity but can increase the reliability of data entry and lessen the chance of human error when programming a blast.

Finally, today’s electronic initiation systems can often interface with other software technologies to enhance the accuracy and simplicity of importing geological, drilling, and/or mine planning information from other software platforms. Mine drill plans and blast design information can be automatically uploaded into blast machine software where the BIC can then directly provide blast timing designs quickly and efficiently thereby reducing the chance of errors.
General User Information / Training / Certification

It is critical to understand that each manufacturer’s system is a unique design and that no technologies can be inter-changed with another. Unlike electric detonator systems, where a blasting machine simply provides a minimum current level to fire the blast, or nonelectric detonator systems that can be initiated by standard shock tube starters, each electronic “wired” system requires a specific blasting machine designed by the manufacturer of that system. Users need to be fully trained and qualified by the manufacturer in order to operate these systems.

Each system can vary considerably in design, functionality, complexity, and capability. It is critically important that every user understands all of the design features and characteristics of the system they will use to ensure a safe and reliable introduction into the workplace. These features may appear in physical detonator construction, (internal and/or external), and software code or system logic, and will certainly show up in the varied forms of blasting machines, controllers, programming devices, testers, etc.

Users must be fully trained and, in some cases, are required to be certified by the manufacturer to operate the system. ALWAYS consult your manufacturer for proper training information before attempting to operate any EBIS.

IME Recommendations and Reference Materials

IME has developed and incorporated several references, guidelines and recommendations for the safe use of electronic detonators for commercial blasting operations. Users of these products are encouraged to review, understand and, unless otherwise instructed by the system manufacturer, follow these recommendations. These recommendations can be found in several IME Safety Library Publications which are available on-line at www.ime.org.
Even though electronic detonators currently used in the oil and gas industry are generally of the same design as shown in Figure 1 and otherwise described herein, there are fundamental differences in the functionality from those used in the mining, quarrying and construction industry. That said, the enhanced level of protection against environmental influences is the same.

Details regarding electronic detonators currently used in the oil and gas industry can be found in API RP67, published by the American Petroleum Institute, in IME’s SLP 32, and on the manufacturers’ websites and data sheets.

The following reference documents should be reviewed by all users prior to using any electronic initiation system products:

**SLP 3  “Suggested Code of Regulations for the Manufacture, Transportation, Storage, Sale, Possession and Use of Explosive Materials”**

**SLP 4  “Warnings and Instructions for Consumers in Transporting, Storing, Handling and Using Explosive Materials” (ALWAYS and NEVERS)**

**SLP 17  “Safety in the Transportation, Storage, Handling and Use of Explosive Materials”**

**SLP 32  “Safety in the Transportation, Storage, Handling and Use of Oilfield Explosive Materials”**

IME’s Safety Library is comprised of 15 publications that address a variety of subjects pertaining to safety and its application to the manufacture, transportation, storage, handling, use of commercial explosive materials. Many of the industry recommendations set forth in these SLPs have been adopted by federal, state, and local regulatory agencies.

**ALWAYS** reference the latest version of the SLP which can be found at: www.IME.org. All IME SLPs are available for free download. Hardcopies may also be purchased from the Institute:

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