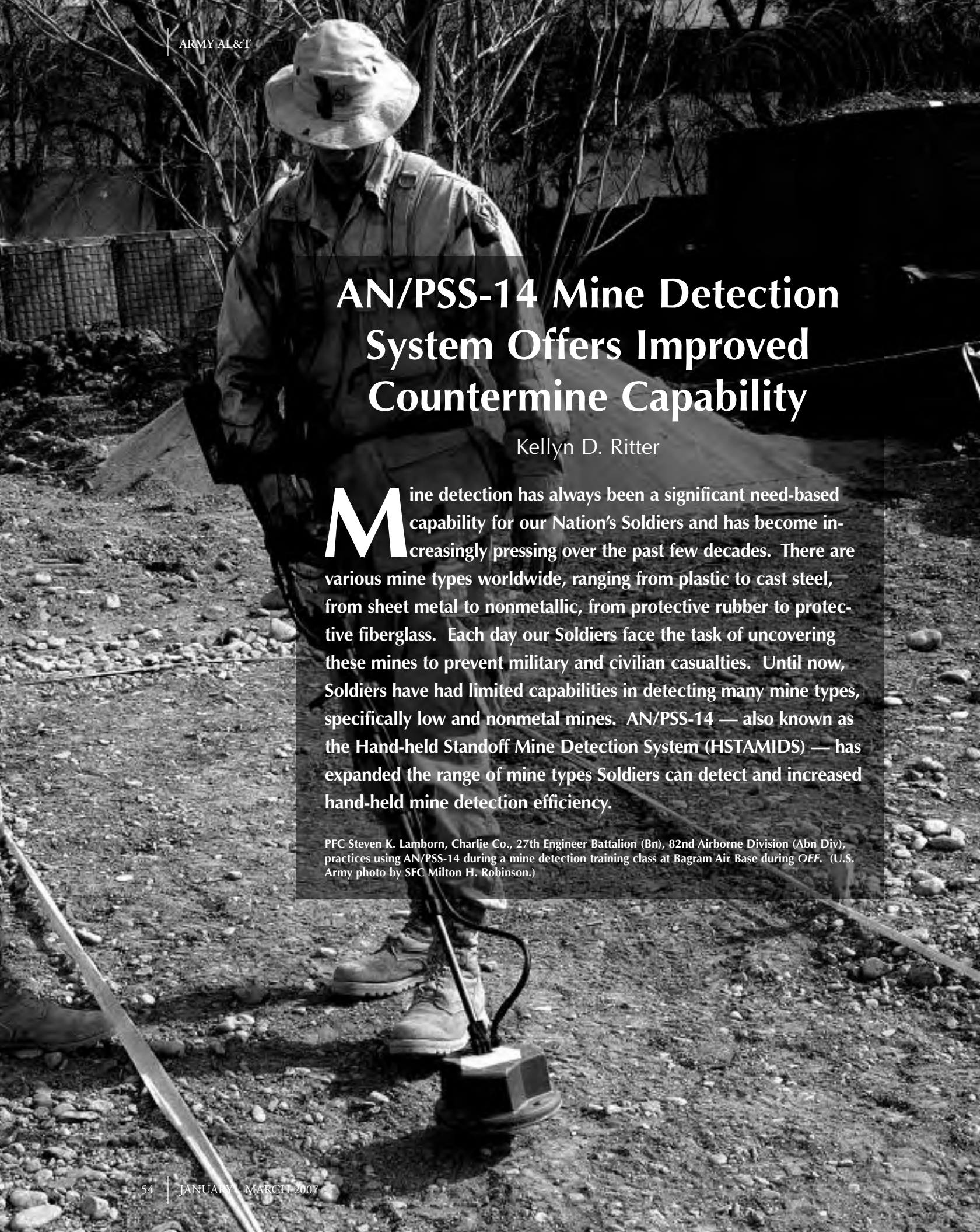

AN/PSS-14 Mine Detection System Offers Improved Countermine Capability

Kellyn D. Ritter

Mine detection has always been a significant need-based capability for our Nation's Soldiers and has become increasingly pressing over the past few decades. There are various mine types worldwide, ranging from plastic to cast steel, from sheet metal to nonmetallic, from protective rubber to protective fiberglass. Each day our Soldiers face the task of uncovering these mines to prevent military and civilian casualties. Until now, Soldiers have had limited capabilities in detecting many mine types, specifically low and nonmetal mines. AN/PSS-14 — also known as the Hand-held Standoff Mine Detection System (HSTAMIDS) — has expanded the range of mine types Soldiers can detect and increased hand-held mine detection efficiency.

PFC Steven K. Lamborn, Charlie Co., 27th Engineer Battalion (Bn), 82nd Airborne Division (Abn Div), practices using AN/PSS-14 during a mine detection training class at Bagram Air Base during *OEF*. (U.S. Army photo by SFC Milton H. Robinson.)

Phil Purdy, Deputy Product Manager for Countermine, Project Manager Close Combat Systems, and Mark Locke, AN/PSS-14 Project Management Engineer, met with *Army AL&T* Magazine to discuss the importance of the Army's most advanced hand-held countermine system.

Hand-Held Countermine History

Hand-held mine detection originated during WWII when the use of mines became more prevalent in battle, increasing the need to counteract this threat. During this period, all mines contained a large quantity of metal and the first mine detectors functioned as metal detectors. Beginning in the 1970s, foreign enemies created plastic case mines that had a much lower metallic consistency, rendering them much harder to detect with conventional mine detection equipment. The fatality threat changed for Soldiers, who were now exposed to mines that were undetectable or inaccurately detectable with their previously dependable equipment.

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The Army sought to create a hand-held mine detector that would counter the new endangerment posed by nonmetal mines and, in response, fielded the AN/PRS-7. However, in the midst of deploying these units, the Army recalled all AN/PRS-7 devices because they were unreliable and error prone. As Purdy explained, "a mine detection device has to be considered sufficiently reliable with a 92-plus percent success rate, as well as portray a high level of confidence by the Soldiers who use it, for it to be successful." The AN/PRS-7 failed to meet these stipulations, and the nonmetal mine threat continued to increase. Nearly 10 years passed as the Army sought a functional hand-held countermine system that would be rugged, durable and operable in all environments.

AN/PSS-12 — a metal detector bought as a commercial-off-the-shelf item from Schiebel Corp. of Austria and fielded in the early 1990s — promised new advances in the field. It was the most advanced metal detector on the market, but still could only detect metal mines. "AN/PSS-12 was much more advanced than any previous metal detector but still did not provide the needed capability for our Soldiers — that of accurate nonmetal mine detection," Locke explained.

Unit Development

Beginning in 1992, development of what would become the AN/PSS-14 device revitalized the mine detection technology effort. The development was originally a science and technology objective sponsored by the Defense Advanced Research Projects Agency (DARPA). DARPA examined new technologies to combat nonmetal mine threats, such as ground penetrating radar (GPR) and chemical, metal or thermal neutron activation, and found that GPR was the most reliable source of mine detection, because many of the other technologies had specific limitative regulations.

AN/PSS-14 was the first modern-day countermine device to use radar detection. Older systems, such as AN/PSS-11 and -12, lacked GPR, enabling only metal mine detection. The device's technological development was extremely complex and took years of engineering testing to perfect. Purdy explained that, "as AN/PSS-14 was being tested, our engineers kept hitting different roadblocks in which one seemingly minute detail would affect the system's functionality." Eventually, the engineering succeeded and the Army contracted CyTerra Corp., a technology provider specializing in military defense and homeland security, to produce AN/PSS-14. The device was first fielded in 2001 at the onset of *Operation Enduring Freedom (OEF)*.

Combat engineers from the Army's 10th Mountain Division (Light) (10th Mtn Div (L)) work in teams of two while clearing mine fields at Bagram Air Base, Afghanistan. One Soldier initially probes the area, and the other Soldier sweeps it with an AN/PSS-14. (U.S. Army photo by SGT Greg Heath, 4th Public Affairs Detachment (PAD).)

Life-Cycle Speed

AN/PSS-14 technology was so valuable to Soldiers that it was approved for field use before undergoing the customary regulatory steps for production. When Soldiers began deploying for *OEF* in 2001, they needed a more advanced capability for mine detection than what AN/PSS-12 technology was providing. The AN/PSS-14 program entered into the engineering and manufacturing development (EMD) phase of its life cycle in 2000-01. "Normally, the EMD process takes three more years of development before the product is classified and deployed for

When mine-clearing vehicles such as the Meerkat, Husky and Buffalo couldn't handle the rough terrain near Bagram Air Base, 10th Mtn Div (L) combat engineers cleared land mines using the AN/PSS-14. (U.S. Army photo by SGT Greg Heath, 4th PAD.)

Soldier use," Purdy explained. "However, the need for advanced mine detection technology was so critical that the Army Requirements Oversight Council (AROC) accelerated the life-cycle process of AN/PSS-14 and surpassed the normal processing time frame." AROC awarded CyTerra Corp., (now L-3 Communications) $2 million to field 210 AN/PSS-14 systems, and the life-cycle process was shortened to one year of low-rate production.

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Even after deployment, the system had to be tested operationally in CONUS to reach Milestone C for completion of its proper life cycle. After approximately two years of developmental, operational and production testing, AN/PSS-14 was type classified and ready for massive deployment. L-3 Communications was awarded a contract in July 2006 for full-rate production and is currently constructing thousands of units for *OEF/Operation Iraqi Freedom (OIF)*.

Technological Logistics

AN/PSS-14's revolutionary aspect is that it consists of both a metal detector and GPR, giving it dual capability. The pulsed electromagnetic metal detector portion of the device is extremely sensitive, "probably the number two or three metal detector in the world," Purdy explained. Previous devices could not pick up the smallest traces of metal composites — a feat AN/PSS-14 could accomplish. AN/PSS-14 can detect even the most diminutive piece of metal and GPR enables it to detect the explosive part of the mine instead of just the metal part. The combination of the metal detector and GPR enables AN/PSS-14 to detect anything below the surface with mine-like characteristics, thereby essentially detecting metallic and low-metallic mines.

The addition of GPR has extensively reduced the mine detection margin of error. The dual-detection capability enables AN/PSS-14 to sustain a low false-alarm rate. David Elliot, Operations Manager for the HALO (Hazardous Areas Life-Support Organisation) Trust in Sri Lanka, a charitable organization that specializes in humanitarian land mine removal, contends that "the addition of GPR to mine detecting devices poses a sixfold increase in the productivity/clearing rate."

AN/PSS-14 also has the unprecedented capability to reject metal clutter that is detected by the device's metal detector portion. "Previous mine detectors, because they were designed to identify any metal substance, could not discriminate between clutter metal and mine metal," Locke explained. "Soldiers spent endless amounts of time marking and uncovering any pieces or scraps of metal, which frequently were not actual mines. The process was tedious and inefficient."

AN/PSS-14 indicates to the user whether metal is detected but will not signal a mine detection unless GPR identifies other mine-like material. When AN/PSS-14 detects mine-like material, it alerts the operator through audio signals — the first, a sound that indicates metal has been detected. The second sound, of a different pitch and tone, is the aided target recognition, which signifies that the combination of metal detector and GPR signals indicates the presence of a mine. These sounds are all filtered through earpieces, which the Soldier wears under his/her helmet. An advanced microprocessor allows readings to be accomplished quickly and accurately, thereby immensely decreasing the margin of error, making AN/PSS-14 an enormously time- and monetary-saving device.

The dual-detection system also prevents environmental factors that previously inhibited accurate readings from standard mine detectors. "Metallic soil, which exists in climates such as those in Bosnia, Afghanistan and Cambodia, presents hazardous dilemmas as it essentially renders mine detectors useless because they cannot distinguish metal objects from substances contained in the metallic soil," Locke said. AN/PSS-14 balances out the soil's metallic components, which in turn makes the soil "invisible" in light of its detection scheme.

The AN/PSS-14 continuously adapts to small changes in soil conditions. If a significant change occurs (for example, moving from clay soil to sand soil), the device's microprocessor automatically warns the operator to recalibrate the system. Guided by voice commands from the microprocessor, the operator moves AN/PSS-14 over the new soil as he/she normally would to scan for potential mines. This "retrains" the microprocessor to read new terrain and results in more accurate mine-like material detection.

AN/PSS-14 Versatility

AN/PSS-14 was engineered to aid Soldiers in a variety of environments worldwide, from Afghanistan to Cambodia. Thus, the mine detector can

CyTerra civilian contractor Larry D. Perry, left, explains AN/PSS-14's mechanics to SPC Alva J. Gwinn, Charlie Co., 27th Engineer Bn, 82nd Abn Div, at Bagram Air Base during *OEF*. (U.S. Army photo by SFC Milton H. Robinson.)

operate in virtually all environmental conditions, including ice, water, sand, snow, heat, mud and clay. The device is also lightweight (9.6 pounds) and compact, folding up effortlessly and quickly for easy transportation.

Unlike previous countermine devices, AN/PSS-14's detection function penetrates walls. When placed on one side of the wall, the device's GPR detects movement on the other side of the wall, which "is especially valuable when Soldiers are guarding against enemies in new or urban territory," Purdy contends.

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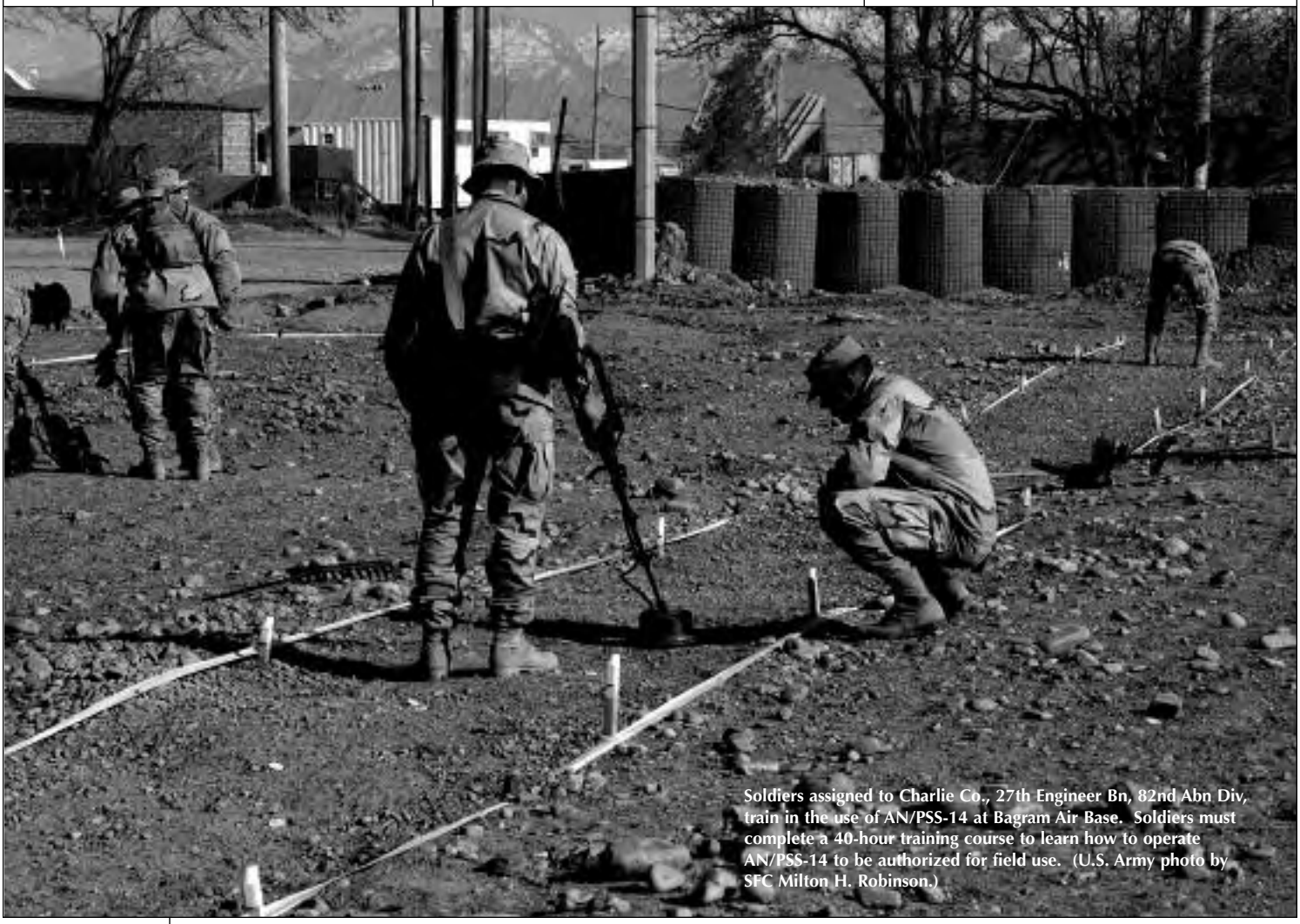
AN/PSS-14 works in congruence with other countermine systems and devices to give Soldiers the most range of capability possible. Larger, multi-person operated systems, such as the Meerkat, Husky and Buffalo, use metal detector technology to detect potential mines and, if possible, destroy them. Systems such as the Aardvark and Hydrema then detonate or destroy those mines to eliminate danger to troops and civilians. Soldier units that use these expansive countermine systems also have hand-held AN/PSS-14s for mine detection. Unlike larger, bulky machinery, AN/PSS-14 functions on rugged and uneven terrain or through thick vegetation. The device is operated by a single Soldier, instead of a crew, making it the prominent device used for off-road path mine detection. In a world of countermine giants, AN/PSS-14 is the hand-held version that enables Soldiers to clear terrain that was previously left unchartered by countermine systems.

Training and Repair

Forward repair facilities are set up in theater for damaged AN/PSS-14s. Locke advises that "there are very few items Soldiers can repair on their AN/PSS-14s." Soldiers bring the damaged AN/PSS-14 to the forward repair facilities, where the problem usually can be amended. More serious technical complications are sent to Tobyhanna Army Depot, PA, for diagnosis



Soldiers assigned to Charlie Co., 27th Engineer Bn, 82nd Abn Div, train in the use of AN/PSS-14 at Bagram Air Base. Soldiers must complete a 40-hour training course to learn how to operate AN/PSS-14 to be authorized for field use. (U.S. Army photo by SFC Milton H. Robinson.)

and repair. Soldiers keep spare devices on hand in case of breakage.

Unlike standard weapons or defense devices that all troops use, not all Soldiers are trained in AN/PSS-14's use. Most often, combat engineering Soldiers receive training and operate the device in the field, although some nonengineers also have authorization to use the device. In theater AN/PSS-14 operators take a 40-hour training course in which they learn about the devices' physical and electronic logistics, as well as receive extensive training on proper use. Soldiers practice using AN/PSS-14 in a terrain similar to the operational environment to gain a full understanding of its operability.

While in training, Soldiers learn to apply safety precautions when in doubt. Soldiers are taught to use cautionary judgment and if not absolutely certain, mark any questionable objects as mines for further investigation. Once in theater, Soldiers are limited in the amount of AN/PSS-14 operation time. Because of the mental strain AN/PSS-14 use renders on Soldiers, they are trained to only operate the device in rotating increments of 20 minutes to prevent loss of concentration and exhaustion.

Humanitarian Demining (HD)

The humanitarian world has seen great success with AN/PSS-14. Locke indicates that "unlike Soldiers in wartime, those working to demine humanitarian areas use the countermine technology all day, every day." The responsibility of these users is to demine unchartered mine-filled territory in countries worldwide. Soldiers in theater sometimes have skill erosion, but HD users constantly use AN/PSS-14 so their skills stay sharpened. However, similar to Soldiers' reactions, the HD world has seen positive reactions to the demining device. Purdy projected that "the Army's HSTAMIDS excellent performance in support of HD operations should bolster Soldier confidence in ongoing *OEF/OIF* mine detection operations."

Future Endeavors

The Army has currently fielded approximately 3,000 AN/PSS-14 units. In July 2006, they awarded a production contract to L-3 Communications to proceed with full-rate production. Over the next five to six years, the Army plans to field an additional 15,000 units. Purdy and Locke confirm that the feedback from Soldiers in theater has been positive and reassuring, and they believe this can be attributed to the Army's strong focus on both initial and sustainment training for Soldiers operating AN/PSS-14. "The vigorous training our Soldiers go through really helps maximize their performance operating AN/PSS-14 once they are in theater," Purdy contended.

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Both Purdy and Locke agree that the foreseeable future will establish AN/PSS-14 as the replacement for all hand-held mine detectors. Currently, there are no other technological developments for a hand-held device that surpass the capability of AN/PSS-14. Other technologies, while they may seem better equipped for mine detection, are not practical for hand-held means in an in-theater environment, whether these systems be too cumbersome, powerful or time constraining. AN/PSS-14 is currently the only hand-held system that provides an efficient rate of accuracy at 95 percent or above.

"The next step for the advancement of countermines," Purdy advised, "is to put AN/PSS-14 technology into robotic form — an autonomous mine detection platform — which would remove Soldiers from the hazardous terrain of mine fields and have the responsibility of physical labor and danger fall to machines." Application of this technology into robotic form will greatly enhance the warfighter's ability to concentrate on other missions while the machinery protects Soldiers from mines. Soldiers will be removed from the physical process through robotic operation and joystick control. This is not new technology — the Army already uses robotic forms in scientific systems such as the Mobile Detection Assessment Response System (see "Robotic Guards Protect Munitions," *Army AL&T* Magazine, October-December 2006, Page 62). However, implementing robotics into countermines is a new application of that technology. AN/PSS-14 certainly promises to progress into the "next generation" of mine detection and help save countless civilian and military lives.

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