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Industria Metalurgica Del Norte (Metalnor) - Archived 9/99

Outlook

- With Metalnor facing significant fallout from revelations about deals made with Iraq and similar customers over the past decade, the company has kept a low profile over the past few years, revealing little about itself publicly
- Currently, Metalnor's public relations efforts tend to dwell on the group's diversified activities, which include an aircraft-leasing company, a bank, a clothing factory, civil engineering work, fruit exports, hotels and tourism, a match factory and mining activities

Sales & Net Income Trends

Information Unavailable

Headquarters

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Industrias Cardoen Ltda was founded by Dr. Eng. Carlos Cardoen. In the late 1970s, Dr. Cardoen, a US-trained mining engineer (University of Utah) who had recently left Ireco Chemicals, a US mining company, started a mining explosives company in Chile. As a result of the US arms embargo in effect at that time, Chile began to look for indigenous sources of arms supply. His first defense contract, for anti-tank mines (designed using existing dies from another product coupled to a simple fuze), came in 1978. At the request of the Chilean Air Force and with low-interest government loans, Dr. Cardoen was soon producing a cluster bomb that he offered on the market for \$7,000, as compared to the \$26,000 charged for comparable French models.

From this small start the product line blossomed as Dr. Cardoen developed his corporate philosophy. According to him, this corporate philosophy is based on looking for customer needs and then designing tailor-made products to meet those needs. The development of such a product either uses technology that Cardoen

itself produces, or else is bought from another company. However, at times it is difficult to pinpoint any actual involvement by the company whose product appears in question. For instance, both efforts to develop gunships based on the MBB Bo.105 and Bell 206 helicopters were initiated without the knowledge of the helicopter manufacturers. The naval mine was touted as a copy of the Marconi Stonefish until further investigation revealed that the Cardoen version was but a pale imitation. Once the requisite technology is identified, and if necessary, acquired, Industrias Cardoen's R&D department designs the components and subcomponents, and directs and coordinates the activities of about 50 other Chilean companies in supplying these components and subcomponents. Dr. Cardoen points to the company's production of customized products for the Third World, an exception in the defense sector, as one of the most important reasons for Cardoen's success.

In 1991, after the invasion of Kuwait by the Iraqi forces, Industrias Cardoen officially changed its name to Industria Metalurgica del Norte Ltda (Metalnor).

Although the name has changed, the company continues to be involved with the same products. However, since the Gulf War, Industria Metalurgica del Norte has

become even more secretive with respect to its product line, research and development, and largely Third World customers. Metalnor continues to develop and produce its products, most notably cluster bombs of

various sizes, for worldwide export. According to published reports, the firm employs approximately 800 persons in its factories worldwide.

Structure and Personnel

Dr. Carlos Cardoen Cornejo
President
Jorge Neira
General Manager

Cristian Silva
Commercial Counselor

Product Area

Cardoen has been involved in a wide variety of defense-related products. These have included explosives, general-purpose aviation bombs, submunition-carrying aviation bombs, mechanical and electric fuzes, naval mines, armored vehicles, mini-submarines, howitzers, fuel-air explosives, grenades, land mines (tank and personnel) and several abortive efforts to build

helicopters. Due to the secrecy that surrounds much of Cardoen's operations, it is quite often difficult to determine whether a particular product even exists. It seems to be a characteristic of the company to offer certain speculative projects for potential sale, but which subsequently do not seem to go beyond the prototype stage.

Facilities

Chile

Iquique. 17,000 square meters of covered facilities (440,000 square meters of uncovered area) for production of armored vehicles, bombs, artillery, and infantry weapons. At least some of the facilities are located in the Iquique Economic Free Zone.

Santiago. Facilities include corporate headquarters in the Torre Santa Maria, a fuze plant at Macul, an

aerodynamic flow tunnel and wind tunnel at Cerillos plant, and a test facility at Peldehue.

Greece. An explosives factory was acquired in 1987.

Spain. Facilities include a bomb fuze factory and a robot production plant.

Corporate Overview

The 1977 law that banned US weapons sales to Chile because of the human rights violations (during the Pinochet military dictatorship) created the need for Chile to find alternative means of arming the nation's forces. The result was a major Chilean effort to provide for its own weapons requirements, with Dr. Cardoen being at the forefront of private sector initiatives. Dr. Cardoen diversified his product line through the 1980s, offering a full line of cluster and general-purpose bombs, fuzes, and armored vehicles, ending the decade by introducing howitzers and naval mines. By 1987, employment was up to 1,200 in Chile, with annual sales of between \$100 and \$150 million a year. More than 98 percent of arms sales were to foreign customers, with 75 percent going to Iraq.

Currently, Metalnor's public relations efforts tend to dwell on the group's diversified activities, which

include an aircraft-leasing company, a bank, a clothing factory, civil engineering work, fruit exports, hotels and tourism, a match factory, and mining activities. In 1990, employment was put at 3,500, with estimated sales for the year between \$100 and \$120 million, of which defense accounted for \$25 million. After the Iraqi invasion of Kuwait, Industrias Cardoen officially changed its name to Industria Metalurgica del Norte Ltda (Metalnor). Currently, Industria Metalurgica del Norte has cut its work force in its six factories to 800 persons. However, observers remain skeptical of Dr. Cardoen's avowed move away from defense products. This skepticism has been reinforced by information that Cardoen had tested a fuel-air explosive bomb in September 1990, and the revealing of the sale of up to 1,680 cluster bombs to the Marxist Mengistu government in Ethiopia (the sale was ultimately suspended by the Chilean Government).

New Products and Services

No information concerning new products or services has been released by Metalnor in the past few years.

Plant Expansion/Organization Update

There is no specific information as to any recent plant expansion or modernization activity. It is likely that there has been some sort of recent reorganization as a result of the change in focus for product areas from defense to the commercial sector.

Mergers/Acquisitions/Divestitures

Cosmos Acquired. Cardoen acquired the Italian mini-sub manufacturer Cosmos sometime in late 1989 or early 1990. While details are scanty, industry rumors point to Iraqi investment capital providing a major share of the financing, along with British money. Apparently, the main reason for Iraqi involvement was a previous deal that did not come to fruition. In the mid- to late 1980s, the Saudi Government had loaned the Iraqi Government \$40 million for the purchase of two large mini-submersibles from Cosmos. Although the mini-submersibles were completed, the Iraqis made only a 30-percent down-payment and a 20-percent progress payment, and then ceased to make any further payments. The subs were then put into storage and forgotten. Upon Cardoen's acquisition of Cosmos the subs disappeared.

Teaming/Competition/Joint Ventures

Due to the lack of information on many aspects of Cardoen's activities, it is often impossible to determine whether a particular product put out by Cardoen is simply a copy of another or whether there is an actual agreement involved. Therefore, listed below are those Cardoen activities that appear to have the involvement of other companies, although the extent of this involvement is impossible to determine.

HMX Greece. There appears to be a collaborative effort with a company called HMX. While it is not definite that HMX is the company involved, Cardoen has an

agreement in Greece for exchanging technology, especially in the area of industrial explosives.

Luchoire. The Mk 82 general-purpose bomb bears a close resemblance to the Luchoire LU 250 EG-FT bomb.

Mercedes-Benz. Cardoen offers the VTP-2 4x4 armored car whose chassis is based on the Mercedes-Benz Unimog cross-country vehicle.

Toyota. Cardoen offers a light armored vehicle whose chassis is based on the Toyota Land Cruiser.

NORINCO. Industria Metalurgica del Norte has a joint venture with NORINCO (China North Industries Corporation) where a Cardoen Piranha 6x6 armored car was offered with NORINCO Red Arrow-8 anti-tank missiles (priced between \$255,000 and \$500,000, depending on quantity and fit). The missile was also offered on the abortive 206L-III helicopter project. No known sales have occurred.

Exuane Spain. There is a collaborative effort with a company called Exuane. While we are uncertain if this involves Exuane, Cardoen, in association with an unnamed Spanish company, established a company that produces robots and production lines for different types of products. There was also to be Spanish-based participation in the abortive effort to build a light attack helicopter based on the Bell 206. The company Spitfire Aircraft was mentioned as a possible candidate for Spanish production.

Häggglunds Sweden. Metalnor license-produces Häggglund Vehicles AB BV206 all-terrain vehicles for Chilean requirements.

ISC. There is unsubstantiated evidence that the US company ISC (now part of the British company Ferranti) was involved in the transfer of cluster bomb manufacturing technology to Iraq via Cardoen. The deal apparently involved James Guerin, the then head of ISC, who sold to Cardoen certain technology that may have facilitated mass production of cluster bombs.

Financial Results/Corporate Statistics

Due to the highly controversial state of the company's dealings in domestic and international markets, no information concerning the financial performance of Industria Metalurgica del Norte has been made available by the firm.

Strategic Outlook

With Metalnor facing significant fallout from revelations about deals made with Iraq and similar customers over the past decade, the company has kept a low profile over the past few years, revealing little about itself publicly.

Most of Metalnor's problems stem from sales to Iraq prior to the Gulf War. As a result of Cardoen's extensive dealings with Iraqi dictator Saddam Hussein (which at one time accounted for 95 percent of Cardoen's total sales), the Metalnor organization has become highly secretive in its dealings since the war against Iraq. The lack of information concerning the activities of Cardoen could also be attributed to the fact that it now operates in a difficult business environment, without the benefit of a significant captive customer such as Iraq. One Metalnor representative has told Forecast International that "it is clear that the invasion of Kuwait by Iraq, and the immediate cancellation of all our products there due to UN and our government's restrictions, had a significant effect in our financial resources, with losses of more than \$40 million." According to this Metalnor source, the firm's average annual sales have dropped to \$3 million. However, it is difficult to determine how accurate this figure may be, given the fact that Metalnor has maintained a high level of secrecy since its beginnings in the late 1970s.

Cardoen continues to have significant public relations problems stemming from revelations of the various questionable deals that the company had participated in during the last decade. Its prospects for doing business in the US especially are dim, primarily because of the

Iraqi connection, and Cardoen may lose its US investments, especially real-estate holdings. The company has also encountered much more competition with its product lines as the overall world arms market shrinks, and Cardoen has begun a shift toward much more commercial activity, including a blue jeans factory and fruit export assistance for Cuba. In 1992 Cardoen renamed the defense products division of Industrias Cardoen as Metalnor, with observers speculating that the move came in an effort to disassociate the Cardoen name from weapons production. In May 1993 Cardoen and Teledyne were indicted by a US federal grand jury for illegally exporting military goods from the US during the 1980s, specifically the sale of the restricted metal zirconium to Cardoen, which subsequently used it to manufacture about 24,000 cluster bombs that were sold to Iraq.

In a January 1993 interview with Cardoen published in the Chilean newspaper *La Nacion*, Cardoen claimed that he had not manufactured weapons for the last four years. The truth of this statement cannot be verified; however, the shadowy nature of much of Cardoen's business activities and his business history leaves considerable skepticism as to the veracity of this claim. As an example of the limits to his veracity, Cardoen was accused of supplying arms to Ecuador in the midst of Ecuador's border conflict with Peru in early 1995. He denied this vociferously, but happened to mention that there had been contacts between his company and Ecuadoran military officers in November 1994 during the course of a visit by the Ecuadoran defense minister to Chile.

Prime Award Summary

Unavailable.

Program Activity

Some important aerospace and defense programs currently under way are listed below. The briefs are intended to provide a listing of programs that are of major importance to the company. For detailed information or analysis of specific aerospace and defense programs or equipment, please refer to the appropriate FORECAST INTERNATIONAL binder (for example, AIRCRAFT, MILITARY VEHICLES, WARSHIPS, MISSILES, ELECTRONICS, and GAS TURBINES). The following is an outline of the company's business interests:

- Rotary Wing Aircraft
- Explosives
- General-purpose aviation bombs, submunition-carrying aviation bombs
- Mechanical and electric fuzes
- Naval mines
- Land mines
- Military Vehicles

- Mini-submarines
- Howitzers
- Fuel-air explosives
- Grenades

Aircraft Programs

Cardoen Helicopter

Industrias Cardoen launched a project to develop a single-seat light attack helicopter, based on the Bell 206 JetRanger, since earlier work on the MBB Bo.105 fell through. The new helicopter, dubbed the Cardoen 206L-III, was in the process of being FAA certified in the US, and differs from the Bell model in that it features a single-seat cockpit, rather than a two-seat configuration. Since Cardoen did not want to jeopardize the export of Bell airframes to Chile, the new helicopter was touted as an anti-drug operations aircraft. It was earlier reported that there was Iraqi support of an anti-tank version (armed with Chinese Hong Jian 8 missiles) as part of a \$500 million deal by the company to help Iraq enhance its defense industry. Cardoen reportedly was planning to begin assembly in 1990, with the company's new subsidiary in Spain handling most of the work. This overseas role apparently was an attempt to avoid certain political restrictions that would curtail supply of components if the helicopter were actually manufactured in Chile. However, in mid-1991 it was revealed that US Customs had seized the sole copy of the Cardoen 206 (in fact, the helicopter remains confiscated). The aftermath of the Iraqi invasion of Kuwait and Cardoen's involvement with Iraqi military sales made Cardoen suspect in the eyes of the US Government in regard to the 206 project. Thus, it would appear that the sales prospects for this helicopter are dim, to say the least, especially since the lack of FAA certification is a real impediment to generating sales.

T-35 Pillan

Production of this license-built Piper PA-28P-300 XBT basic trainer, designated the T-35 Pillan, began in Chile in 1980. The major modification for the Chilean aircraft entails the provision of two underwing hard points to accommodate two A-6 rocket launchers manufactured by Cardoen Industries.

Military Vehicle Programs

BMS-1 Alacran

The Alacran half-track is intended to be reliable, easy to maintain and inexpensive to operate. It can be driven on a 60-degree slope, ford water up to five feet and can attain altitudes of up to 15,000 feet. Powered by a Detroit Diesel 225 kW 6V-53T supercharged diesel or a Cummins 170 kW 6V-555 supercharged diesel, the

vehicle has a maximum speed of 45 mph and a fuel capacity of 300 liters. The hull is of welded armor steel plate, which protects the occupants against both 5.56 mm and 7.62 mm shells. The Alacran can be configured in a number of ways, such as troop transport for up to 10 fully equipped soldiers plus commander and driver, logistics vehicle with a payload of up to 2.5 tons, or fighting vehicle armed with a variety of weapons. These can include a 25 mm anti-aircraft gun, machine guns, an anti-tank gun, or anti-aircraft or anti-tank missile launchers. The first 9.6-ton vehicle was supplied to the Chilean Army in 1983; however, the vehicle does not appear to have entered production, with the Chilean Army inventory not exceeding six.

Light Armored Vehicle

The 4x4 LAV is based on the chassis of a Toyota Land Cruiser and is designed to offer light armor protection (up to 7.62 mm) for both military and police applications, transporting five or six men at high speed (maximum road speed of 120 km/h). Range is 350 kilometers. A four-liter engine developing 75 hp at 4,200 rpm is standard, as well as an air-conditioning system. Other types of chassis are also being considered, including one based on the British Land Rover. There are no known customers.

MOWAG Piranha

This 6x6 wheel armored car is license-produced (since 1983) from MOWAG of Switzerland. While basically identical to the original model, for Chilean applications the fuel capacity has been increased from 250 liters to 400, extending operational range from 600 kilometers to between 1,000 and 1,200 kilometers. While Cardoen builds most of the vehicle itself, some components such as the engine are still imported. Cardoen Piranha production basically has been for supplying the needs of the Chilean Army. Variants already delivered to the Army include the basic armored personnel carrier (174), 120 mm mortar carrier (50), command post vehicle (5), and armored car armed with French F1 or Brazilian ET-90 90 mm guns, depending on the source consulted (20). There have been numerous other variants built to the prototype stage or converted from production versions for trials. These include an air defense radar platform, rocket launchers (70 mm and 102 mm), air defense gun platform (Israeli TCM-20 twin 20 mm turret, Oerlikon-Buhrle GAD-AOA single 20 mm turret), and several 90 mm turrets (Hispano-Suiza, Cardoen-designed and built turret using a Cockerill Mk III 90 mm gun). Other proposed versions include an ambulance, anti-tank vehicle (in 1988 Cardoen offered a Piranha mounting a one-man turret equipped with four Chinese NORINCO Red Arrow 8 anti-tank guided missiles), and workshop and repair variants.

VTP-1 Orca

Designed as a logistic support vehicle for ground forces, the 6x6 Orca also is designed to be both durable and cheap. Principally designed to transport troops and supplies, the Orca can also be fitted with a 120 mm mortar with stowage space for up to 100 rounds, or towing a 105 mm or 155 mm gun, along with crew and ammunition. The vehicle has an unloaded weight of 13,000 kilograms and can carry a normal payload of up to 5,000 kilograms. Maximum road speed is 100 km/h. Fuel capacity is 400 liters, yielding a range of 1,000 kilometers. The Orca is powered by a Detroit Diesel 6V-53T six-cylinder supercharged diesel. The standard armor is made of high-resistance sheet steel, varying in thickness between 6 mm and 12 mm, depending on the position of a given section of the armor. Protection is provided from shells up to 7.62 mm. The Orca can carry up to 16 men, plus two crew. The vehicle entered production in January 1985. The Chilean Army is understood to have ordered 100, with about 70 presently in inventory.

VTP-2 Escarabajo

This 4x4 armored vehicle was designed for combat patrol, or as a communications, quick reaction, ambulance or base protection vehicle, and can be adapted for a wide variety of roles. It is available in a fully enclosed body version or an open truck-type body. The chassis is based on the Mercedes-Benz Unimog cross-country vehicle, making for good spare parts availability worldwide. The 5.37-meter-long, 2.3-meter-wide and 2.22-meter-high vehicle has an empty weight of 6,600 kilograms (8 mm armor) and a full load weight of 8,600 kilograms (8 mm armor). The vehicle is also available with 6 mm armor. The VTP-2 can protect its occupants from all small arms up to 7.62 mm in caliber, while allowing the crew to fire their weapons from inside using gun ports on both sides and topside removable hatch covers. Maximum road speed is 100 km/h. Fuel capacity is 150 liters, yielding a range of 600 kilometers. The vehicle can carry 12 fully equipped men (including two crew) in its transport version and is normally equipped with a Mercedes-Benz OM-352 six-cylinder diesel engine (120 hp at 2,800 rpm). As an option, the VTP-2 can now be ordered in a version with a four-cylinder Detroit Diesel 4-53 turbocharged diesel engine (179 hp at 2,800 rpm), reinforced axles, improved braking system, and hydraulic steering. The vehicle is used by the Chilean Air Force. The first prototype was completed in 1981-82.

Hägglunds Vehicles AB BV206

Cardoen license-produces this all-terrain tracked carrier under the designation of BY-206. Some parts are locally produced, although the proportion is uncertain. This fully amphibious vehicle (propelled in water by its tracks) is made up of two tracked main units, each of which consists of a body mounted via four rubber elements to a chassis. Various configurations are possible. The vehicle is able to travel in water, sand, snow and mountains, with a transport capacity of 2,000 kilograms and 17 soldiers. The vehicle's unit price is about \$150,000. It is uncertain how many have been produced by Cardoen, but the main customer appears to have been the Chilean armed forces.

Ordnance Programs

Cluster/Fragmentation Bombs

Cluster bombs have been one of Cardoen's main products, and probably its most notorious because of some of the customers. The genesis of the cluster bomb product line came in the early 1980s when Cardoen developed the PJ-1 small, hand-dropped bomb for use from helicopters and small aircraft, as per a Chilean Air Force requirement. The company then proceeded to place quantities of these bomblets into a container, which resulted in the first line of Cardoen cluster bombs, the CB-60-K (130 pounds), CB-250-K (500 pounds), and the CB-500-K (1,000 pounds). The CB-250-K has 400 submunitions and a kill area of up to 80,000 square meters. Around the 1988 time-frame, several improvements were introduced, including a new version of the 1,000-pound bomb, the CB-500K2. While still the same weight, this features a smaller size with more submunitions (431 versus 240 in earlier models) and improved anti-personnel effect (53 percent better) resulting from a prefragmented container. The bomb stabilizers were aerodynamically improved, thus reducing drag, and the installation of a new mechanical device to allow simultaneous opening of the winglets means that trajectories are improved for both the mother bomb and the bomblets.

About this time development work was completed on a new series of cluster/fragmentation bombs. The CB-770-PM area denial weapon (also known as the SLEEPER-bomb) contains 121 submunitions which can be preset to explode with time delays ranging from 30 seconds to 72 hours. The PM3 bomblets weigh 2.2 kilograms each (filled with RDX/TNT explosive), with the casing of each bomblet exploding into about 970 fragments (especially effective against soft targets), with bomb-effect covering up to 50,000 square meters (depending on altitude of release). The main product of this area denial weapon family is the medium-

range MR-SO-CB, which is equipped with a rocket propulsion system to augment aircraft attack range and to allow attack aircraft to leave dangerous areas more rapidly. It can be launched from up to 3,000 meters away.

Fuel-Air Explosive Device

Very little information is available on this new product, but Cardoen is known to have tested such a device in the Atacama Desert in September 1990. A month later reports surfaced that Libya was negotiating with Cardoen to obtain fuel-air explosives for Iraq. Cardoen later confirmed that it was negotiating with Libya. Fuel-air explosives work on the aerosol principle where a fuel is misted to disperse over a sizable area and then lit off, creating a very powerful shockwave, also suffocating anyone within 400 yards.

Fuzes

Cardoen has developed a wide range of mechanical and electronic fuzes. One of the most significant products in this area is a nonaligned digitally programmable electronic fuze. Because the triggering device is not aligned with the detonator, a high degree of safety is offered. A nonaligned mechanical fuze has been developed for cluster bombs, ensuring a minimum activation time for submunitions after the casing is ruptured.

Howitzers

Cardoen has acquired the right to license-produce ARMSCOR (South Africa) G5 towed and G6 self-propelled 155 mm howitzers. The Cardoen versions are named the CC-45 and CC-SP-45, respectively. Cardoen is able to produce the guns at a more competitive price than ARMSCOR due to lower labor costs in Chile, as well as tax and grant incentives that are part of the Iquique Economic Free Zone where the Cardoen production facility is located. The CC-45 is essentially similar to the G5, although it appears that a flick rammer is not fitted to the CC-45. It is uncertain just how much of the CC-45 is produced in Chile (possibly more than 50 percent according to a 1989 estimate), and the first locally produced prototype included key components supplied by ARMSCOR. Cardoen successfully trailed the first prototype in March 1989, and by early 1990 about a half-dozen examples had been assembled/produced by Cardoen. ARMSCOR is supplying the associated equipment such as certain types of ammunition (ERFB, ERFB-BB), the fire control system, and data links. Basic G5 specifications include a 45-caliber barrel based on an SRC GC-45 and designed around the Extended Range Full Bore (ERFB) round, a maximum range of 30,000 meters with regular ammunition and 39,000 with base bleed ammunition, a single-baffle muzzle brake, maximum rate of fire of

three rounds per minute for 15 minutes, crew of five, and a 16 mph speed when using the APU mode. There have been no known orders for the CC-45, although the Iraqis had been expected to be a prime customer. While the Chilean Army is understood to have a requirement for 50 155 mm howitzers, the Israeli Soltam is understood to also be in the running (the Army already fields 24 Israeli F71s). The events resulting from Iraq's invasion of Kuwait put paid to this potential customer.

The CC-SP-45 is identical to the G6. While much of the system will be locally produced, major components such as the engine and gearbox will be obtained on the open market. A production capacity of 150 CC-SP-45s per year has been estimated, although there is no indication of any sales to date. The first prototype was completed and tested by Cardoen in 1989. While there has been some speculation that the Chilean Army may purchase the system, weight restrictions mean that the CC-SP-45 could be deployed only in certain areas of Chile. Basic specifications for the G6 are: the same gun as the G5, an all-welded steel armor hull with protection against shell splinters and land mines, permanent 6x6 drive, crew of six, combat weight of 46,000 kilogram, maximum road speed of 90 km/h, fuel capacity of 700 liters giving a road range of 700 km, air-cooled diesel engine developing 525 hp, automatic transmission with six forward and one reverse speed, turret traverse of 180° (however, only 90° used), and a capacity of 45 rounds. The complete system includes the vehicle itself, the ammunition, a fire control system, a meteorological station, a muzzle velocity analyzer, and a specially designed helmet radio communications system. Maximum rate of fire is four rounds per minute for 15 minutes with a well-trained crew.

General-Purpose Bombs

Several types of general-purpose bombs have been offered, with the Mk 81-84 family representing the first generation. The Mk 81 was a 250-pound bomb, the Mk 82 was a 500-pound bomb, and the Mk 83 was a 1,000-pound bomb. A number of different fuzes have been offered for these bombs. These include the M-904 nose fuzes (programmable delay of 0.025 to 0.25 seconds), the M-905 instantaneously acting tail fuze, the FMU-54-B instantaneously acting nose and tail fuze, and the programmable FMU-72-B tail fuze (delay of 20 minutes to 36 hours). These bombs can be fitted with different tail brakes for low-altitude bombing, or laser guidance or servo-controlled fins for high-precision bombing. The Mk 82 with folding metal brake fins and a balloon-type retarding system bears more than a superficial resemblance to the French Luchaire LU 250 EG-FT bomb.

In about 1989, Cardoen introduced a new-generation family, the APF 82/83/84, which are anti-personnel fragmentation bombs rated by Dr. Cardoen as being three to four times as effective as the previous generation, spreading a high density of shrapnel balls over a larger area. The new bombs feature a fiberglass casing containing 10.5 mm diameter steel balls weighing five grams. The APF82 weighs 230 kilograms and contains 33,000 balls, offering a maximum lethal area of 32,000 square meters. The APF83 weighs 436 kilograms and contains 60,000 balls, offering a maximum lethal area of 61,500 square meters. The APF84 weighs 900 kilograms and contains 125,000, offering a maximum lethal area of 80,000 square meters.

Grenades

Cardoen manufactures a variety of hand grenades which have been sold to the Chilean armed forces as well as other unidentified armies. There is an offensive/defensive grenade in which the removal of a steel fragmenting case turns it into a defensive device relying upon blast and shock for effect. The grenade can also be used as a small hollow-charge demolition munition when stood on end with the hollow cone in the lower end facing down. The grenade can also be used as a booby trap or anti-personnel mine when special igniter assemblies are used. The charge is 100 grams of TNT. Another grenade bears a close resemblance to the US M2 "pineapple" grenade, and, like the offensive/defensive grenade, can be fitted with special igniters for use as booby traps or anti-personnel mines.

The grenade is filled with 115 grams of high explosives. Cardoen also offers a mini hand grenade which is designed to obtain the maximum throw range consistent with good fragmentation effect. The charge consists of 77 grams of TNT, with the cast iron body providing all-

around lethal coverage. As with Cardoen's other grenade products, it can be converted to an anti-personnel mine or booby trap.

Warship Programs

Midget Submarines

As the result of the acquisition of the Italian midget submarine manufacturer Cosmos in late 1989 or early 1990, it is understood that Cardoen is planning to build midget submarines in Chile for export to the rest of Latin America, depending on whether or not it receives permission from the new civilian government. No details are available as to what models may be offered, but Cosmos has the ability to manufacture two types of mini-subs, as well as a swimmer delivery sub.

Naval Mines

In mid-1990 Cardoen revealed that it had developed a prototype version of the GEC-Marconi Stonefish naval mine. However, GEC-Marconi has strenuously denied supplying any "information, drawing, design or technology" to any Cardoen entity. Subsequent investigation has revealed that the Cardoen mine only bears a resemblance to the Stonefish, being equipped with only a simple contact fuze, making it the most basic of naval mine designs. The Stonefish is an "intelligent" modular mine that can be configured for a variety of tactical situations. It uses digital signal processing and includes acoustic, magnetic and pressure sensors. The warhead weighs 600 kilograms. The mine can last for 700 days when laid on the sea bottom. The Cardoen mine is nowhere near as sophisticated. Some of the confusion apparently stems from the fact that Cardoen's product brochure for its mine copied the format used by Marconi in its product brochure for the Stonefish.

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