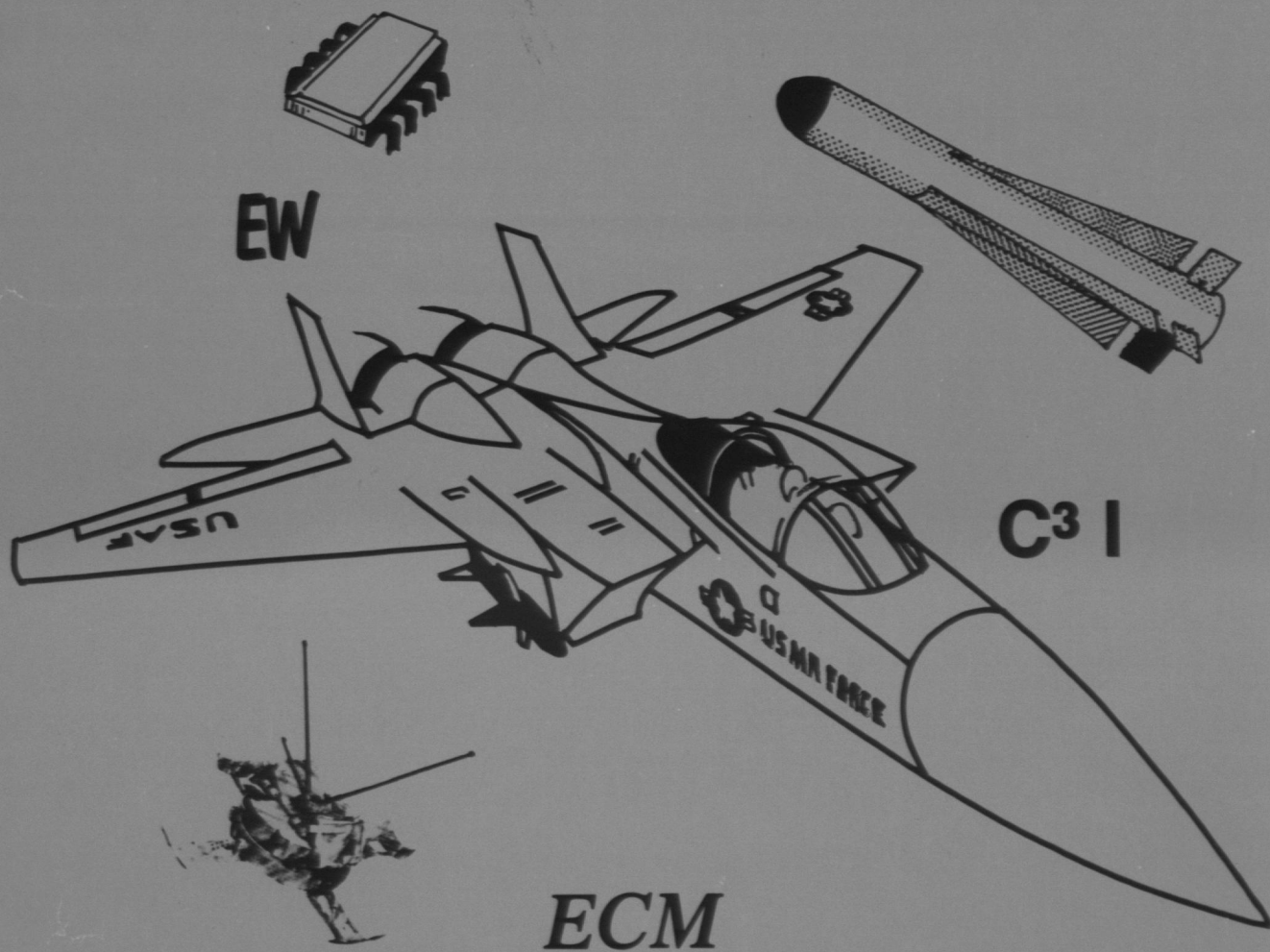



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GUIDE TO CANADIAN AEROSPACE RELATED INDUSTRIES



**USAF SYSTEMS COMMAND LIAISON OFFICE
OTTAWA ONTARIO CANADA
KIP 5M9**

This report has been reviewed by the USAF Systems Command Liaison Office (Ottawa) and is approved for publication and release to the National Technical Information Service (Unlimited Distribution).



DONALD J PEARSON, Lt Col, USAF
Chief, AFSC Liaison Office (Ottawa)

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J. C. BRADFORD
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This guide is a contracting source list of Canadian aerospace related industries to be used by USAF procurement offices, project engineers, and scientists. It provides company profiles, a company keyword index, and contact points for each company.			

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PREFACE

This Guide to Canadian Aerospace Related Industries presents a compilation of descriptive data on 153 companies located in Canada that have expressed interest in doing business with the United States Air Force. This Guide has been prepared with three main objectives in mind:

- a. To encourage Air Force Systems Command Project Officers to take advantage of the industrial capability of Canada.
- b. To engender interest within AFSC for participating in the US/Canada Defense Production and Development Sharing Programs.
- c. To encourage Canadian aerospace industry to take a more active role in presenting their capabilities to the USAF.

The companies profiled in this Guide represent a cross-section of Canadian industry and research facilities with capabilities that may be of interest to the USAF research & development and logistics communities. There are numerous guides to Canadian industry published in Canada by the Canadian Government and by various trade associations. A reference list of these publications is included in Section I.

Comments and/or suggestions concerning the format or content of this Guide are solicited. Questions concerning the US/Canada Defense Production and Development Sharing Program or the subject matter of this Guide should be directed to Lt Col Donald J Pearson, or Dr Robert L McKenney, Jr., AFSC Liaison Office; 110 O'Connor St, Suite #202; Ottawa, Ontario, Canada; K1P 5M9. Telephone contact can be made at (613) 593-7725 (commercial), or Autovon 676-6523.

The cooperation and assistance of the Canadian Department of External Affairs in the printing of this report is greatly appreciated.

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Section I

INTRODUCTION

One of the functions of the Air Force Systems Command Liaison Office in Ottawa is to stay current on Canadian industrial capabilities and trends, and to make this information available to the USAF R&D community. All data are provided by the respective companies while leads to new entries are obtained through newspapers, magazines and through contacts with various departments of the Canadian Government. This Guide presents a representative cross-section of the Canadian aerospace industry.

As would be expected for a modern, industrialized country, Canada's industrial base is very diversified. Their industries typically include:

- Aerospace
- Chemical
- Chemical Defense
- Communications
- Electronics
- Environmental
- Energy
- Fishing
- Medical
- Metal Working
- Ordnance
- Petroleum
- Space

Canada has a very large industrial commitment to the aerospace, communications, electronics, and space areas. As one might expect, these are primarily concentrated in the Ontario-Quebec corridor, extending from Windsor through Toronto and Ottawa and terminating in Montreal. Other locations with expanding industrial bases are the Winnipeg (Manitoba), Edmonton-Calgary (Alberta), and Vancouver (British Columbia) areas. Substantial contributions to the Canadian industrial capability are also afforded by the Quebec City (Quebec) and Halifax (Nova Scotia) areas.

As in the other editions of this Guide, this third edition does not attempt to group companies into specific categories such as aerospace or electronics. It simply associates their specific capability keywords with twenty general categories (See Section III). Neither does this Guide attempt to differentiate R&D capabilities from pure product lines. While most companies have product lines, some are very R&D oriented and seem eager to engage in R&D contracts. For those companies that appear primarily product oriented, it is assumed that they do have an R&D capability within their area of expertise.

Section II of this Guide presents Canadian industrial capabilities as a compilation of individual company profiles. The general format for the company profiles include the following subsections: NAME, ADDRESS, CONTACT POINT, AVERAGE WORK FORCE, GROSS SALES, PLANT SIZE, EQUIPMENT, EXPERIENCE, AND KEYWORDS.

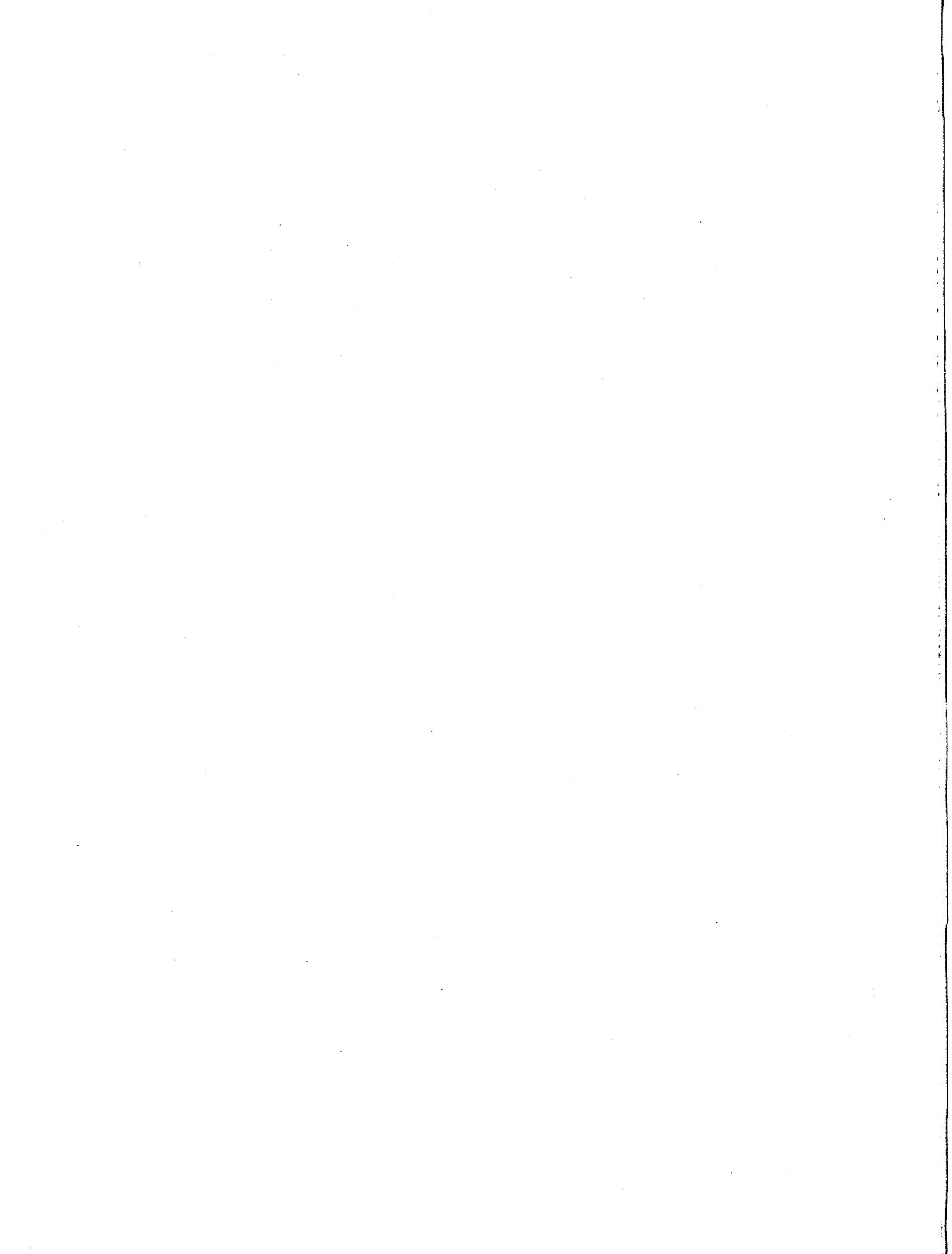
The KEYWORD subsection begins with general category names, each preceded by its identifying number (e.g., 1 = Aircraft, 2 = Armament . . . 20 = Miscellaneous), followed by specific capability keywords. Each of the latter words is followed by a number or series of numbers that refer to the appropriate general category with which the word is associated.

Section III (Company Keyword Index) relates company capabilities in the form of keywords to a series of twenty general category areas. The specific keywords are presented in columnar form in alphabetical order. The second column lists the identifying numbers associated with the general categories. The third column lists the company, in code form, associated with the keyword. The company code cross index forms Section IV.

Canadian trade publications that can be used to supplement this Guide, thereby providing a more complete listing of companies are listed below:

- *Canadian Defense Products Guide*, published by the Canadian Department of Industry, Trade and Commerce.
- *Canada in the World of Electronics*, 1982, distributed by the Canadian Department of Industry, Trade and Commerce.
- *Canada in Space*, prepared by the Interdepartmental Committee on Space, Ministry of State for Science and Technology.
- *Canada's Aerospace Industry: A Capability Guide - 1982*, produced by Creative Communications, a division of MacLean Hunter Ltd in cooperation with the Air Industries Association of Canada, the Canadian Department of Industry, Trade and Commerce, and Aerospace Canada Magazine.
- *The CATALOG*, Apr 1983, publication of the Canadian Advanced Technology Association.

For the most part, Canada's high-technology industrial capability is on an even par with that of the United States, but generally on a somewhat smaller scale. It may certainly be considered another source base for USAF R&D procurements, as well as for commodity buys. It is hoped that this Guide will help provide the user with some insight into the Canadian system and encourage its use if deemed appropriate. Increased competition and "new blood" can only reduce USAF procurement costs and hopefully lead to better products.



Section II

COMPANY PROFILES

A.E.I. TELECOMMUNICATIONS (Canada) Ltd

Code: AEI

Address: 419 Notre Dame Ave
Winnipeg, Manitoba, Canada R3B 1R3

Contact: Mr. K R Yates, President - (204) 942-7221

History: AEI, an established Canadian company for over 55 years, is a wholly owned subsidiary of the General Electric Company of England. There are no other Canadian locations.

Capability: AEI is involved in the engineering, manufacturing, distribution and installation of telecommunication switching systems. They have supplied major local and toll switching systems for Canadian metropolitan areas, as well as smaller dial offices, PABX systems, and peripheral equipment.

Average Work Force: Engineers - 10
Others - 122

Gross Sales: \$8-\$10M (Per Annum)

Plant Size: 40,000 sq ft

Equipment: The company has the following equipment available for use on projects:

- **Laboratory Equipment:** SWPT 6800 Computer Software System, Soroc Software Programming (Development) System, etc.
- **Machinery Equipment:** Ragen 750 Automatic Self Programmable PC Board Assembly System, Econopak 229 Automatic PC Board Soldering System, etc.
- **Test Facilities:** Environmental Chamber, adjustable from 0 to 70°C (32.0-158°F) for burn-in testing of various integrated circuits (PC boards).

Experience: AEI is involved in the production of Automatic Number Identification (ANI) systems and 911 Emergency Reporting Systems for world-wide markets. They have over 20 years of experience with ANI systems manufacture and have over 2.5 million lines of ANI equipment installed in North America and other world-wide markets.

Keywords: 5 = Communications; Telecommunications = 5; Switching = 5; PABX Systems = 5; Peripheral Equipment = 5; Automatic Number Identification Systems = 5; Telephone Gear = 5.

Revised: Dec 83

AEL MICROTEL Ltd Manutronics Division

Code: MAN

Address: 100 Strowger Blvd
Brockville, Ontario, Canada K6V 5W8

Contact: Mr. E R MacIntosh, Marketing & Sales Manager - (613) 342-6621

History: In 1980, the Manutronics Division of AEL Microtel Ltd, a Canadian owned company, was established to market custom electronic manufacturing services. A percentage of the total resources currently available to Manutronics will be expanded to meet future needs. Microtel, Canada's second largest manufacturer of telecommunications equipment is a wholly owned subsidiary of British Columbia Telephone Company.

Capability: Microtel's resources are available in the areas of PCB blank designs, layout & fabrication, PWC assembly & test, automatic backplane wiring, computerized wire verification, hybrid circuit assembly & test, and complete product development and assembly, etc. Manutronics offers Microtel's production expertise and facilities on a contract basis to industry to meet specialized needs such as military standards P 5510 and I45208.

Average Work Force: Total - 1200

Gross Sales: Manutronics - 1983 - \$6M +
Manutronics - 1984 - \$12M (Projected)
Manutronics - 1985 - \$13M (Projected)

Plant Size: 473,000 sq ft

Keywords: 7 = Electronics; 12 = Machining;
20 = Miscellaneous; Fabrication/Assembly/Test = 7;
PC Boards = 7; Automated Backplane Wiring = 7; Printed Wiring Card = 7; Sheet Metal = 12; Hybrid Assembly = 7; Plastic Molding = 12; Reed Capsule = 20; Relays = 7; Coils = 7; Custom Design & Development = 7.

Revised: Dec 83

AERO MACHINING Ltd

Code: AER

Address: 5411 Industrial Blvd
Montreal-North, Quebec, Canada H1G 3H7

Contact: Mr. Gerard Beausoleil - (514) 324-4260

History: Aero Machining Ltd is a small machining company incorporated in 1963 in the Province of Quebec. There are no other Canadian or US locations.

Capability: Aero Machining Ltd provides services in tool design, production, maintenance, sub-assemblies, die and mold development, and fabrication. They specialize in general machining, three axis profiling or four spindle profilers, high tensiles, titanium, and D-6-AC material. Their quality control is governed by the "Aero Machining Ltd" quality control manual in accordance with MIL-Q-9858A and MIL-C-45662A. The company is approved for the manufacture of aircraft hydraulic servos, landing gear components, and missile and airframe machined parts. Accumulative quality control records are kept to provide necessary traceability of inspection data. Their quality control policy is approved to meet the requirements of various US DOD QC specifications, as well as the Canadian DND 1015 specification, for the manufacture of aircraft mechanical parts and mechanical and hydraulic assemblies.

Average Work Force: Total - 120

Gross Sales: 1982 - \$2.8M

Plant Size: 27,000 sq ft

Equipment: Their equipment includes lathes, borers, milling machines, profilers, drills, honing machines, and grinders. They have a hydraulic assembly and test facility for all hydraulic assemblies and parts manufactured by the company. They are currently bringing their NC capability up to speed.

Experience: Aero principal customers include Air Canada, Canadair Ltd, Canadian Marconi, Douglas Aircraft, GE, United Aircraft, DeHavilland, Grumman Aircraft, and Canadian Vickers Ltd.

Keywords: 1 = Aircraft; 12 = Machining; 13 = Missiles; Titanium = 12; Tooling = 12; Die Fabrication = 12; Hydraulic Servos = 1, 12; Landing Gear Components = 1, 12; Airframe Parts = 1, 12; Missile Parts = 12, 13.

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ALBERTA RESEARCH COUNCIL

Code: ARC

Address: Executive Offices
7th Floor, Terrace Plaza
4445 Calgary Trail South
Edmonton, Alberta, Canada T6H 5R7

Contact: Ms. Dorothy M Hollands, Corporate Secretary & Dir of Public Relations - (403) 438-1666

History: The Alberta Research Council is a provincial Crown Corporation founded in 1921 to advise the Alberta Government on scientific affairs and to promote the economic growth of Alberta through scientific and engineering research. It has over 500 employees at offices and laboratories mainly in Edmonton, and at offices in Calgary, Red Deer, Nisku, and Lethbridge.

Capability: The Research Council has established in its Long Range Plan five major areas of research - industrial and engineering research and assistance, oil sands, coal, natural resources, and frontier sciences. The industrial and engineering research program includes research activities in transportation, surface water engineering, projects in forest products, alternate energy and energy conservation. It also runs a gasoline and oil testing laboratory and provides short-term advisory and technical services to manufacturing companies in Alberta. Oil Sands Research includes geology studies, heavy oil cracking, and in-situ recovery. Coal research includes geology studies, liquefaction, pyrolysis, coal property definition, and gasification. Natural resources research activities include geological survey, soils surveys, ground-water, and atmospheric sciences research. Frontier science projects include research into new catalysts, electro-organic reactions, low temperature biology, and enzyme design studies using genetic engineering techniques.

Average Work Force: Scientists, Engineers, & Research Technicians

Gross Sales: The Research Council operates on a \$38 million budget in 1983-84, half of which comes in the form of an annual provincial grant, and the other half which comes from contracts with provincial government departments and private industry.

Plant Size: 279,000 ft² (26,000 m²) (1982)
505,250 ft² (47,000 m²) (1984)
580,500 ft² (54,000 m²) (1987)

Equipment: The Research Council has a range of equipment for carrying out studies on oil sands and coal technology from fundamental science to bench scale pilot work; sophisticated chemical analytical instruments; distributed computing equip-

ment. Its digital weather radar data archived on magnetic tape. The overall display allows the analyst to examine radar echoes. These data are used for storm analysis, hail description, flood prediction, aircraft-storm interaction or avoidance and spacecraft re-entry.

Experience: Weather Modification - Contract with Alberta Agriculture.
Flood Forecasting - Contract with Alberta Environment.
Radar Development - Contract with Environmental Research and Development (US).
Digital Radar Data Processing - Contract with Fundacao Educacional de Bauru, Brazil.
Satellite/Radar Rainfall Measurement - Contract with Canadian Atmospheric Environment Service.

Experience in other areas of natural resources research and in research on oil sands, coal liquifaction, frontier sciences (biotechnology and hydrocarbon research), and industrial and engineering areas available on request (see keywords below).

Keywords: 4 = Chemistry; 8 = Energy; 9 = Environment; 15 = Radar; 17 = Software Services; 18 = Space Systems; 19 = Testing/Test Equipment; 20 = Miscellaneous; Meteorology = 15; Digital Data Processing = 9, 15; Computer Graphics = 9; Statistical Analysis = 9; Weather Forecasting = 9; Cloud Seeding = 9; Cloud Physics = 9; Weather Modification = 9; Convective Storms = 9; Hydrometeorology = 9; Precipitation Measurement = 9, 15, 18; Flood Forecasting = 9; Air Pollution = 9; Numerical Modelling = 9, 17; Biology = 20; Microbiology = 20; Chemical Processing = 4; Industrial Engineering = 20; Products Testing = 19; Materials Testing = 19; Transportation = 20; Oil Sands = 8; Coal Liquefaction = 8; Coal Pyrolysis = 8; Geology = 8, 9; Soils = 8, 9; Water = 8, 9; Ground Water = 8, 9; Surface Water = 8, 9.

Revised: Dec 83

AMTEK MANAGEMENT Inc

Code: AMI

Address: 120 Holland Ave
Ottawa, Ontario, Canada K1Y 0X6

Contact: Mr. L E McClare, VP Operations - (613) 728-1831

History: AMTEK was formed in 1981 as a wholly owned Canadian company. It was formed to provide services to governments and industries on Integrated Logistic Support (ILS); Automatic Test Equipment; and contract and program management.

Capability: AMTEK is a leader in Canada in the field of integrated logistic support having supplied services to Canada's major acquisition programs - CP140 Aurora purchased from Lockheed, CF18 from McDonnell-Douglas, the Canadian Patrol Frigate Program, Low Level Air Defense, and Gun alignment and control system. ILS development services have been provided to DND, Litton Systems Ltd, Canadian Marconi, and Leigh Instruments Ltd.

AMTEK has provided field service support to the Canadian government for Automatic Test Equipment. The company also provides training in electronics, ATE, procurement and contract management.

Average Work Force: 20 (Engineers & Technologists)

Gross Sales: 1983 - \$1.2M

Plant Size: 4,500 sq ft

Experience: AMTEK clientele includes Department of National Defense, Department of Supply and Services, Royal New Zealand Air Force, Canadian Marconi, Litton Systems

Ltd, Bristol Aerospace Ltd, Leigh Instruments Ltd, Lockheed Aircraft, Hughes Aircraft, British Aerospace, Aviation Electric (Bendise), and Sperry.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 19 = Testing/Test Equipment; 20 = Miscellaneous; Integrated Logistic Support = 1, 3, 20; ILS = 1, 3, 20; Program Management = 20; Logistic Support Analysis = 20; Level of Repair Analysis = 20; Training = 7; Automatic Test Equipment = 7; 19; Contract Management = 20.

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ANATEK ELECTRONICS Ltd

Code: ANA

Address: 240 Brooksbank Ave
North Vancouver, British Columbia,
Canada V7J 2C1

Contact: Mr. Scott C Lewis, General Manager -
(604) 980-7061

History: Anatek is a Canadian owned company incorporated in 1969. It is active in both the Canadian and US electronics markets. The company manufactures thick film hybrid microcircuits.

Capability: Anatek's expertise is in the areas of custom thick film hybrids, epoxy die attach, gold ball bonding, laser passive and active trimming, and ceramic packaging.

Average Work Force: 25 - Total

Gross Sales: \$2M

Plant Size: 10,000 sq ft

Experience: Custom microcircuits have been supplied to GTE Lenkurt Electric (Canada) Ltd, NCR, and a host of telecommunications and computer peripheral manufacturers. Anatek's future R&D efforts will be directed at the RF device and military market.

Keywords: 7 = Electronics; Thick Film Microcircuits = 7; Thick Film Hybrid Parts = 7; RF Components = 7; Amplifiers = 7; Filters = 7; PCM Filters = 7; Resistor Networks = 7; Active Filters = 7; RF Amplifiers = 7; Oscillators = 7.

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C. V. W. ARMSTRONG CONSULTANTS Ltd

Code: ACL

Address: 280 Albert St, 6th Floor
Ottawa, Ontario, Canada K1P 5G8

US OFFICE
8247 Lewiston
San Antonio, Texas 78250

Contact: Mr. Cedrick V W Armstrong, President -
(613) 230-3942

History: The company is Canadian owned and was incorporated in 1979. It has one Canadian office and one US office. The company started as purely a consulting company, but has recently branched out into both hardware and software engineering and development.

Capability: The company's technical capability is in research and development and systems engineering related to computer systems. Areas of expertise include distributed systems, fault-tolerant systems and systems for high speed data acquisition and radar signal processing.

Average Work Force: PhD - 1
Eng - 1
Others - 2 (Possible 6 in 1984)

Gross Sales: 1983 - \$250,000
1984 - \$500,000 (Projected)

Plant Size: 1,200 sq ft

Equipment: One word-processing & communications terminal and processor and microprocessor development system.

Experience: Major projects have included the high speed data acquisition system for a low-angle tracking radar system, a multiprocessor simulator for multi-target tracking studies and the evaluation of specialized computer systems for use in defense. Training course development and delivery has also been provided to a number of customers.

Keywords: 6 = Computers; 10 = Image Processing & Optics; 15 = Radar; 17 = Software Services; Consulting = 6; Special Purpose Processors = 6; Signal Processing = 6, 15; Image Processing = 6, 10; Multiprocessor Systems = 6; Firmware Design = 6; Microprogramming = 17.

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THE ARMSTRONG MONITORING CORP

Code: AMC

Address: 215 Colonnade Rd South
Nepean, Ontario, Canada K2E 7K3

Contact: Mr. David M Jenkins, Marketing Dir - (613) 225-9531

History: The AMC is a Canadian owned electronic gas detection firm founded in Jan 81. The company has offices throughout Canada and the US.

Capability: The AMC is primarily involved in the manufacturing of fixed and portable dangerous gas detection equipment. In the fixed, they offer rack and wall mount systems incorporating a remote calibration sensor/transmitter that produces a time and money-saving factor. In the area of sensors, they range from electrochemical, catalytic and solid state. Offered in the solid state is the specific H₂S sensor which is poison-proof. On the portable side, they range from hand-held units to the "amc 3000" series. In the 3000, AMC offers their exclusive 3 meter and 3 sensor concept which allows 3 separate conditions to be monitored simultaneously (oxygen deficiency, toxic and combustible gases). AMC's human resources allows them to comprehensively maintain all levels of manufacturing from in-house R&D (consisting of engineering staff and chief product technician), to Quality Control, Quality Assurance, right through to their on-the-job training program.

Average Work Force: Engineers - 4
Degrees - 7
Others - 15

Gross Sales: 1981 - \$ 92,000
1982 - \$360,000
1983 - \$660,000
1984 - \$924,000 (Projected)

Plant Size: 14,000 sq ft

Equipment: Calibration chambers, environmental chambers, Monroe OC8820 (In-house Computers), and analog electronics production facility.

Experience: Customers both US and Canadian, range from coal mining (methane) applications in Gillette, Wyoming to carbon monoxide detection in various institutions in major centers in Canada. They are interested in doing business with the USAF.

Keywords: 4 = Chemistry; 7 = Electronics; 9 = Environment; 16 = Security & Safety; 17 = Software Services; 20 = Miscellaneous; Hazardous Gas Detectors = 9, 16; Toxic Gas Detectors = 9, 16; Electronic Gas Detectors = 7, 9; Sensors = 9; Electrochemical Devices = 4, 7, 9; Catalytic Sensors = 4, 9; Solid State Devices = 7, 9; Hydrogen Sulfide Sensors = 7, 9, 16; Pollution Monitoring Equipment = 9; Combustible Gas Monitoring Equipment = 9, 16; Data Acquisition Capability = 7, 9, 17, 20; Repair & Overhaul = 7; Thermal Conductivity Devices = 7, 9; Calibration Capability = 9.

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ATHABASCA RESEARCH CORPORATION Ltd

Code: ATH

Address: 16900-107 Ave
P. O. Box 2405
Edmonton, Alberta, Canada T5J 2S1

Contact: Mr. T E Adams, President - (403) 483-3762/3506

History: Athabasca Research Corp Ltd is a Canadian owned high technology company with one subsidiary in Canada - Tanknology Canada Ltd. The company was incorporated in early 1976 primarily to provide specialized services in the design of instruments and systems for air quality monitoring, meteorological measurements, and data acquisition and control systems for the petroleum industry and government agencies.

Capability: Athabasca Research is actively engaged in the provision of multi-disciplined scientific and engineering systems and services. Their background experience includes the manufacture of geophones and recording seismographs for oil exploration purposes. A significant portion of their present activities are environment oriented; including research, data collection and interpretation, and the development and manufacture of associated instrumentation. They are active in the area of environmental monitoring program management and take responsibility for all aspects including hardware specification, procurement, operation and maintenance, and data reduction. They provide turnkey operation of complete environmental and meteorological monitoring systems.

Athabasca's products include:

- Weather radar data processing systems
- Ambient air quality monitoring and meteorological systems
- Ultraviolet spectrometers
- Meteorological instruments
- Pibal Tracking Systems
- Automated suspended sediment samplers

- Geophones and seismographs
- Leak detection system for underground petroleum products storage tanks
- Laser related devices

Their weather radar system correlates radar reflections from storms with antenna azimuth and elevation positions and reflections intensities to derive a comprehensive picture of the storm and its characteristics. The system includes a conventional S or C band radar, the interfacing electronics hardware package, and a PDP 11/34 computer. It features a strong interactive graphics capability.

Their ambient air quality monitoring systems generally include monitoring trailers equipped with instrument towers, data acquisition and computing terminals along with gas analysers, meteorological sensors, and peripheral devices. These systems are currently designed to detect SO₂, NO₂, NO, NO_x, O₃, H₂S, CO and CO₂ to less than 10ppb levels. The basis for detection is chemiluminescence, fluorescence, UV and IR absorption. Athabasca's meteorological instruments include a Windflo anemometer, Comprop anemometer (composite pitch propeller) for turbulence measurements, atmospheric flux monitor, and differential air temperature system. The automated suspended sediment sampler is designed to take water samples for later analysis. The device can either sample continuously (at preselected intervals) or in a "rain gauge" mode. In the latter mode, it remains dormant, consuming almost no power until it is activated by a tipping bucket type of rain gauge.

Their Pibal tracking system is used for the determination of wind speed and direction and/or temperature, at incrementally increasing altitudes. It basically consists of two theodolites on a 1000 ft base line tracking a balloon, each instrument being equipped with shaft encoders that measure azimuth and elevation angles. These data are conveyed to a data acquisition system (Athabasca designed) which is programmed to calculate and print out the altitude, wind speed and direction, downwind position, and temperature.

The Athabasca leak detection system utilizes the principle of vacuum induction of air bubbles to detect wall perforations in underground/enclosed storage tanks for petroleum products. The system consists of a monitoring van equipped with appropriate instrumentation and vacuum equipment and hydrophone probe that identifies the distinctive bubble signature induced by the reduced pressure, and simultaneously detects the presence of water. The test method is fast, economically acceptable and is initially evaluated by industry as being superior to other methods currently in use. The system detects pinhole size leaks as well as larger ones, and is not subject to most of the drawbacks of the other leak test procedures.

They have conceived, designed and are currently negotiating a contract with the Canadian Department of National Defense to develop a Tactical Target Scoring System. The system can accurately measure the impact position of air delivered ordnance, e.g., bombs, rockets, missiles, etc., on tactical test ranges. It utilizes a unique sensing and data acquisition system that can interpret and transmit objective impact information to the range control facility. The system is independent of visibility restrictions, lighting conditions and can detect the munition's impact with or without an accompanying blast or marking charge. It is self-contained, requiring no external power sources, can be remotely activated or deactivated, and conveys information by either conventional RF link or via a data collection platform.

Finally, they have demonstrated expertise in laser technology. Their Lasalign (or Lasaline) product expands a laser beam in one direction by an optical method to form a line that can be used as a reference line. They have also developed and manufactured a laser extinction-type particulate monitor. This device detects particulate matter in air and can give an accu-

rate concentration. It is particularly useful in pollution monitoring, e.g., particulates in stack emissions.

Average Work Force: Total - 12

Gross Sales: No Data

Plant Size: 7,000 sq ft

Experience: Athabasca Research has experience with both the Alberta and Canadian Governments, Universities and Canadian industry. Industrial clients include Petro Canada, Imperial Oil Company, Shell Canada Ltd, Amoco Canada Ltd, Texaco Canada Ltd, Gulf Oil Company, Dow Chemical, Sheritt Gordon Mines, Bell and Howell Canada Ltd, and Alberta Government Telephones. They have no experience with the USAF, but are interested in working with the USAF in the future.

Keywords: 7 = Electronics; 8 = Energy; 9 = Environment; 11 = Lasers; 15 = Radar; 17 = Software Services; 19 = Testing/Test Equipment; 20 = Miscellaneous; Geophones = 7, 8; Recording Seismographs = 7, 8; Acoustic Sensing = 7; Data Acquisition = 7, 9; Geophysics = 7, 8; Environmental Sensors = 7, 9; Meteorological Stations = 9, 20; Meteorological Equipment = 9, 20; Environmental Analysis = 9; Environmental Forecasting = 9; Leak Detection System = 9, 19; Pollution Sensing = 9, 19; Pollution Analysis = 9; Weather Radar = 9; Trace Gas Detection = 9, 19; Laser Optics = 11; Weather = 15; Environmental Programs = 17; Instrumentation = 9, 19; Monitoring = 9; Ultraviolet Spectrometer = 19, 10; Wind Speed Determination = 9; Wind Direction = 9; Underground Storage Tanks = 9, 19; Tactical Target Scoring System = 19; Range Instrumentation = 19; Ordnance Impact Position = 19.

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ATLANTIS FLIGHT RESEARCH Inc

Code: AFR

Address: 3924 Chesswood Drive
Downsview, Ontario, Canada M3J 2W6

Contact: Mr. Dale Simmons, General Manager -
(416) 630-8611

History: Atlantis is a wholly owned Canadian company incorporated in 1978. There are no other Canadian divisions or US subsidiaries.

Capability: Atlantis manufactures avionics test equipment, simulators/computer assisted training systems and specialized aerospace instrumentation.

The company has a firm commitment to the ongoing design and development of new products for the avionics test equipment line. A series of Interface Panels support bench test applications on a variety of avionics systems ranging from VHF navigation systems to cockpit voice recorders. Two new pieces of test equipment provide Autoland and Ground Proximity Warning System testing on the new digital avionics aircraft such as the Boeing 757/767, as well as on aircraft using analog avionics. Another unit now entering production in both manual and automatic test equipment versions, will support general purpose bench testing of the new digital avionics systems using the ARINC 429 bus. The company is now starting the development of test equipment to support military aircraft using digital MIL-1553 bus. Custom test equipment is also designed for specialized applications.

Cockpit procedure simulators, maintenance trainers/simulators and specialized simulator systems form a large portion

of the company's activities. Projects in this field include Animated Systems Trainers and a Cockpit Procedures Simulator for the Canadair Challenger business jet, an Environmental Control Systems Maintenance Simulator for the CF-18 fighter and an "Automated Pilot Selection System" for the Canadian Military.

Atlantis also offers research & design, and manufacturing services with custom microprocessor applications/instrumentation. They are currently designing and manufacturing a Digital Autopilot/Guidance System for a rocket-powered drone for the Canadian Department of Defense. Previous projects have included industrial control systems and software for nuclear power station monitoring systems.

Average Work Force: PhDs - 1
Engineering - 5
Manufacturing - 5
Others - 3

Gross Sales: 1979 - \$ 45K
1980 - \$180K
1981 - \$250K
1982 - \$315K
1983 - \$750K
1984 - \$1,100K (Projected)

Plant Size: 3,800 sq ft

Experience: Atlantis has supplied equipment to the Canadian Department of Defense, original equipment manufacturers (e.g., Canadair, Boeing), the corporate aviation sector, major avionics facilities and airlines. Current US sales have been mainly commercial with no sales to the USAF. They are interested in expanding their business to include the US military.

Keywords: 1 = Aircraft; 2 = Armament; 3 = Avionics; 6 = Computers; 7 = Electronics; 17 = Software Services; 19 = Testing/Test Equipment; 20 = Miscellaneous; Test Equipment = 3; Training Aids = 1; Radio/Radar Altimeters = 19; VHF Navigation Systems = 19; VHF Transceivers = 19; HF Transceivers = 19; Flight Data Recorders = 19; Cockpit Voice Recorders = 19; Engine Component Simulator = 19; Animated System Trainers = 1, 19; Simulators = 1, 20; Software Development = 17; System Simulation = 1, 20; Training Simulators = 1, 2, 3, 20; Research & Development = 6, 7, 19.

Revised: Dec 83

AVIATION ELECTRIC Ltd

Code: AVE

Address: Mailing: P. O. Box 2140
St Laurent, Quebec, Canada H4L 4X8

Plant: 200 Laurentien Blvd
St Laurent, Quebec, Canada H4M 2L5

Contact: Mr. John Beaven, Director, Marketing -
(514) 744-2811

History: Aviation Electric Ltd, a unit of the Bendix Aerospace Sector of Allied Corp, is a major supplier of aerospace/military components and systems to both domestic and international customers. Founded in 1931, the company is recognized today as one of the world's largest producers of fuel control systems for small gas turbine engines, and is a world leader in the design and manufacture of military ground systems.

Capability: Currently marketed are electronic on-board military vehicle compass systems and navigation systems. A technically advanced Artillery Gun Alignment and Control System designed and developed for the Canadian Department of National Defense provides rapid alignment of towed and

self-propelled artillery. This system is currently undergoing field trials and will be released to production in the near future.

Supporting the design engineering group is a large manufacturing operation equipped with the most modern 3- & 4-axis machining centers both horizontal and vertical, as well as fully automatic and/or programmable high precision cylindrical and internal grinders. As many components used in the Aviation Electric fuel control system must be machined to tolerances of 50 millionths of an inch or less, Aviation Electric is recognized in the industry as a highly reliable supplier of subcontract precision machining capability. Currently, several programs requiring extremely close tolerance machined parts are being undertaken for a number of selected US companies.

In addition to its high performance machining and design capabilities, Aviation Electric Ltd also operates one of the largest repair and overhaul facilities in Canada. In its shops, aircraft instruments, wheels, brakes, aircraft accessories, navigation aids, and airborne radars, produced by more than 300 different manufacturers are repaired, overhauled or modified for over 300 customers in 35 countries. The company also operates a large variety of test stands where the fuel control systems following overhaul are subjected to extensive testing to simulate actual flight conditions.

To supplement its line of aerospace products, Aviation Electric Ltd is the exclusive sales and service representative for a number of high technology electronic systems. These include automatic test equipment, liquid and gas chromatographs, marine and air traffic control radar simulators, and air pollution monitoring instruments.

The company is also a leader in quality assurance and is one of the first Canadian aerospace companies to institute the "Quality Circle" concept. Its quality assurance system meets the requirements of Canadian Government Specification DND 1015 and US Government Specification MIL-Q-9858, and it is also approved by the Department of Transport, the Federal Aviation Administration, and NATO.

Average Work Force: Engineering – 50
Production – 425
Marketing – 40
Others – 335

Gross Sales: 1980 – \$63M
1981 – \$66M
1982 – \$70M
1983 – \$60M (Est)

Plant Size: 220,000 sq ft

Experience: Aviation Electric Ltd's present customers include: Department of National Defense – repair and overhaul of aircraft instruments, accessories, navigation aids and airborne radar; Pratt and Whitney Canada – engine fuel control systems; Air Canada – wheel and brake parts and instruments; deHavilland – avionics equipment, flight and engine instruments and accessories; Canadair – electrical connectors, drone alignment systems and aircraft accessories; and General Electric (USA) – engine fuel control systems.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 12 = Machining; 15 = Radar; 20 = Miscellaneous; Repair & Overhaul = 1, 3, 15; Engine Fuel Control Systems = 1; Compass Systems = 20; Navigation Systems = 1; Artillery Alignment and Control Systems = 20; Precision Machining = 1, 12; Design = 1; Design to Requirements = 1; Wheel Parts = 1, 12; Brake Parts = 1, 12; Instruments = 1; Avionics Equipment = 3; Connectors = 7; Drone Alignment Systems = 1; Accessories = 1.

Revised: Dec 83.

AVTECH ELECTROSYSTEMS Ltd

Code: AVT

Address: (Mailing)
P. O. Box 5120, Station F
Ottawa, Ontario, Canada K2C 3H4

(Location)
15 Grenfell Crescent, Suite #205
Nepean, Ontario, Canada K2G 0G3

Contact: Dr. W J Chudobiak, President – (613) 226-5772

History: Avtech ElectroSystems Ltd is a small, private Canadian, high technology company incorporated in 1975. There are no other branches or affiliates in Canada or the US. The company is represented in France, W. Germany, Japan, Austria, the UK, and Italy.

Capability: Avtech was established for the purpose of designing and marketing nanosecond waveform instrumentation. Since its start, it has become recognized as a leading supplier of nanosecond waveform generators and accessories with over 100 models. Their product line includes pulse generators, impulse generators, monocyte generators, pulse amplifiers, transformers, power splitters, bias insertion units, and scope probes.

The all solid-state waveform generators are available as stand alone lab instruments, or as miniature DC powered modules. The amplitude and the voltage rate of rise for some of their units are at least an order of magnitude higher than those provided by standard tunnel diode pulse generators. The combination of some aspects of microwave integrated circuit technology with ultra-fast semiconductor device switching technology (including SRD, hot carrier diodes, avalanche, VMOS and bipolar switches), has yielded 100 psec rise and fall times, PRF beyond 250 MHz, amplitude to 350 volts, peak currents to 100 amperes, and single cycles of RF to 1500 MHz. They can design, develop and build to customer requirements.

Avtech's inverting and impedance transformers are designed to be used with general purpose laboratory pulse generators, with subnanosecond risetime pulse generators and circuits, and other units. They provide inverted output pulse with a magnitude equal to the input signal magnitude, and can match to other impedance levels or can obtain higher output currents.

Avtech's power splitters provide two outputs which are either both in phase (non-inverted) with the input signal, or with one output non-inverted and with one inverted. They are designed for use with nanosecond speed laboratory pulse generators, with CW signals, or with other units to frequencies as high as 1.0 GHz. Their bias insertion unit is designed for both CW and subnanosecond risetime baseband pulse applications. The scope probe was designed to be used with a 50 ohm sampling oscilloscope, to allow probing of test points in microstrip structures and in discrete RF circuits and subnanosecond pulse circuits, operating at frequencies as high as 5 GHz and with risetimes as low as 100 psec.

Average Work Force: Total – 5

Gross Sales: 1981 – \$320K
1982 – \$450K
1983 – \$600K
1984 – \$720K (Projected)

Plant Size: 3,000 sq ft

Experience: Approximately 98% of Avtech's sales are export. Their products have been supplied worldwide to companies, universities and government agencies, e.g., USAF, Harry Diamond Laboratories, Los Alamos Scientific

Laboratories, Hewlett Packard, Honeywell, Hughes Aircraft, Lawrence Livermore Laboratories, Martin Marietta, Bell Northern Research, etc.

Keywords: 7 = Electronics; Waveform Instrumentation = 7; Waveform Generators = 7; Nanosecond = 7; High Speed Pulsers = 7; Pulse Generators = 7; Impulse Generators = 7; Monocycle Generators = 7; Pulse Amplifiers = 7; Transformers = 7; Solid State = 7; Power Splitters = 7; Bias Insertion Units = 7; Scope Probes = 7; Stand Alone Lab Instrumentation = 7; DC Powered Modules = 7; Linear Pulse Amplifiers = 7; Inverting Transformers = 7; Impedance Transformers = 7.

Revised: Dec 83

BACHAN AEROSPACE OF CANADA Ltd

Code: BAC

Address: 300 East Pike Creek Road
P. O. Box 39
Emeryville, Ontario, Canada N0R 1C0

Contact: Mr. R W Innes, Marketing Administrator - (519) 727-6666

History: Bachan Aerospace of Canada Ltd was incorporated in the Province of Ontario in 1975 as a division of Bachan Aerospace Corporation. The company is owned by LGM Corporation.

Capability: Bachan Aerospace is a modern manufacturer engaged in the design, fabrication and test of gears, gear boxes and precision assemblies for the aerospace and defense industries. Bachan maintains a complete gear facility for design, manufacture and test of gear boxes, precision spur, helical and bevel gears. This facility includes CNC machining, gear grinding, and gear inspection equipment. Bachan operates to MIL-Q-9858A.

Average Work Force: 75 (Total)

Gross Sales: \$3.5-\$4.0M (Annually)

Plant Size: 35,000 sq ft

Equipment: CNC machining and turning centers, gear cutting, grinding and lapping equipment, OD grinding, ID grinding, surface grinding, milling, lathes, cutting, computer co-ordinate measuring machine, gear checking equipment, NDT testing, copper plating and complete inspection facilities.

Experience: Bachan manufactures flap actuator gears for the Boeing 767, pump gears for Pratt & Whitney's JT 15, PT 6 and PW 100 engines, gas turbine disks for United Technologies Power Systems Group, cable and shaft assemblies for the Bendix FJ-A fuel control system, and Radar Azimuth Drives for Norden systems. Bachan has been surveyed by Avco Lycoming, Bendix Energy Control, Cleveland Pneumatic, General Dynamics, Hamilton Standard, Hawker Siddeley, McDonnell Douglas, Norden, Pratt & Whitney, Plessey Dynamics, Rolls Royce, Sunstrand Aviation and TRW Power Accessories.

Keywords: 1 = Aircraft; 12 = Machining; 13 = Missiles; 15 = Radar; Gears = 1, 12; Gear Boxes = 1, 12; Machining = 12; Precision Machining = 12; CNC Machining = 12; Assemblies = 1, 12; Drives = 12, 15; Radar Azimuth & Pedestal Drives = 12, 15; Landing Gear Components = 1, 12; Missile Components = 12, 13; Shaft Assemblies = 1, 12; Cable Assemblies = 1, 12.

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BAKER ENGINEERING ENTERPRISES Ltd

Code: BEE

Address: 9620-27 Ave
Edmonton, Alberta, Canada T6N 1B2

Contact: Mr. Len Friedenber, President - (403) 463-0922

History: Baker Engineering is a Canadian owned company incorporated in 1973 with a US subsidiary (BEE Agra Corp) located in Denver, Colorado. The company's original aims were research, design and manufacture of electronic instrumentation, specifically for use in the agricultural industry.

Capability: Engineering expertise at Baker Engineering is directed towards the areas of mechanical electrical transducer design, analog & digital monitoring and control circuitry, microprocessor applications to monitoring control problems, and electro-mechanical servo component design. Baker Engineering product line includes a combined efficiency monitor, and liquid sprayer application monitor. Many other agriculturally oriented monitors are in the Baker Engineering product line. A second general area of product development was toward an electric fence controller that operates on existing fences with wood posts without the requirements for wire insulators and grass/brush free status. Particular attention is paid to production engineering & testing, and quality control with appropriate documentation.

Average Work Force: Engineers - 7

Gross Sales: \$1.5-\$2.0M

Plant Size: 12,600 sq ft

Equipment: In-house equipment to insure quality productivity includes computer controlled printed circuit board drilling; transformer and coil winding; printed circuit wave soldering facility; sheet metal shearing, punching, and forming; and a thermoplastic injection molding facility.

Experience: During the past two years, about 10 to 15% of sales have been to the US, primarily through their US affiliate. They have no experience with the US DOD.

Keywords: 7 = Electronics; 12 = Machining; Measurement Systems = 7; Control Systems = 7; Transducer Design = 7; Analog = 7; Digital = 7; Monitoring Systems = 7; Injection Molding = 12; Injection Molding Tools = 12.

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BARON COMMUNICATIONS Ltd

Code: BCL

Address: P. O. Box 82010
6939 East Hastings St
Burnaby, British Columbia, Canada V5C 5P3

Contact: Mr. Harry Baron, President - (604) 291-8272

History: Baron Communications (formerly Challenger Electronics) was formed in 1960 as a wholly owned Canadian Corporation with representatives in Washington, Oregon, California, Arizona, Texas, Michigan, and Illinois.

Capability: Baron specializes in the manufacture, design, and development of various types of tone signalling, alarm & status, and control systems, radio, and telephone interconnect terminals & associated mobile control heads.

Average Work Force: 14

Gross Sales: 1979 – \$0.58M
1980 – \$0.50M
1981 – \$0.40M
1982 – \$0.50M
1983 – \$0.50M (Projected)

Plant Size: 7,000 sq ft

Equipment: Baron's equipment consists of Exorcisor II – Computer Development System 96K RAM, 1M Disc Capacity Development Module for 6800-6802 & 6801 Processors, PROM Programmer, and EPROM Programmer with Exorterm 150 console & Model 703 printer. They also have the usual assortments of oscilloscopes, VTVMs, spectrum analysers, temperature environment chambers, transmission test sets, etc., necessary for the design and development of advanced circuitry.

Experience: Baron is a recognized and accredited supplier of tone signalling equipment and systems (DTMF, in band, singleton, two tone simultaneous or sequential) to – Motorola, GE, Pacific Northwest Bell Telephone Co, Michigan Bell Telephone Co, General Telephone & Equipment, Getty Oil Company, ALASCOM, AT & T, US Army Corp of Engineers, and the RCMP. They are also in the final stages of development of a signalling system (designed for CRC Ottawa) which will provide selective calling on HF/SSB.

Keywords: 5 = Communications; 6 = Computers; 7 = Electronics; Microprocessors = 6, 7; Tone Signalling = 5, 7; Telephone Systems = 5; Microwave Systems = 5; Status Systems = 5; Alarm Systems = 5, 7; Telephone Interconnect Terminals = 5; Mobile Control Heads = 5; Based Tone Signalling = 5, 7.

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BARRINGER RESEARCH Ltd

Code: BRL

Address: 304 Carlingview Drive
Rexdale, Ontario, Canada M9W 5G2

Contact: Mr. John Davies, Sr Vice President – (416) 675-3870

History: Barringer Research was founded in 1961 to develop geophysical/geochemical techniques and instrument systems relating to mineral exploration. Barringer Resources Inc (formerly Barringer Research Inc) was incorporated under the laws of the State of Delaware on 7 Sep 67 for the purpose of acquiring all of the issued and outstanding voting stock of Barringer Research Ltd, an Ontario (Canada) corporation.

Capability: Barringer has undertaken research projects primarily in the earth sciences in the disciplines of geology, geochemistry, electro-optics electromagnetics, magnetics and atmospheric physics. As a result of such projects, they have developed instrument systems and techniques in the fields of airborne and ground mineral exploration and environmental and process monitoring. They have recently devoted a substantial portion of their efforts toward adapting for oil and gas exploration instrument systems and technology that they initially developed for mineral exploration. They continue developing new oil and gas exploration instrument systems and technology.

Barringer's research and development activities have led to the following systems:

The INPUT® (INduced PULse Transient) – This system was the original development of Barringer and is the only commercial airborne electromagnetic prospecting system to use a pulsed field principle. The system has been successful in its application in the search for mineral deposits. The success of the system was recently recognized by the Society of Exploration Geophysicists

which awarded Dr Anthony R Barringer the Kauffman Gold Medal of the Society for his contributions to the science and practice of geophysics via the INPUT system. According to the Society's statistical returns, 70% of all the world's commercial airborne electromagnetic surveys are carried out with the INPUT system.

COTRAN® (CORrelation of TRANsients) – This system uses a new approach to signal processing that can only be achieved by digital techniques. The airborne computer analysis of the data is believed to give the system substantial advantages in terms of sensitivity and interpretability. Only one COTRAN system exists at the present time, and is currently undergoing evaluation in surveys that are part testing and part operational.

TIVAC – This system is aimed at detection of hydrocarbon leakage over oil deposits by geophysical remote sensing methods.

Metal detection systems have also been developed by Barringer as a spin-off from its airborne geophysical equipment. A modification of the original design was used for traffic counting and tramp metal detection on conveyor belts. Subsequently, this patent has been used as a metal detector in walk-through systems installed in airports. It has also been used on conveyor belts to protect ore crushers from damage caused by ingesting pieces of metal that accidentally get mixed in with the ore. A new prototype system has functioned well and has demonstrated a significant advantage in that it can be programmed to ignore pieces of metal, such as the clips of conveyor belt seams, which give a signal that will usually trigger a false alarm. It is anticipated that there will be further development of the COTRAN principle, possibly using new microcomputer technology, allowing production costs to be reduced so that the system can be supplied to a number of new applications. This system may also be used for military range clearance.

A new product known as a Ratioing Radiometer is an optical device for measuring the reflectance ratios of pairs of wavelengths in the visible and infrared region. The instrument has application in identifying clay minerals for mapping purposes when exploring for mineralization and in the follow-up of targets of interest selected from satellite imagery and aerial photography, particularly with regard to the forthcoming US Landsat-D satellite and the French SPOT (Système Probatoire pour Observation Terrestre) satellite. Both of these satellites use infrared channels that generate new kinds of information that can be checked on the surface with the Radiometer. The first production run is in progress.

RESPEC II – A microprocessor-controlled field reflectance spectrometer was added to Barringer's product line in 1983. This product provides graphs and tables of commonly sought spectral quantities – reflectance vs wavelength, averages of spectra, difference of spectra, mean reflectance over variable wavelength ranges, and standard deviations in time and wavelength-averaged spectra.

Barringer has for many years been involved in the manufacturing of certain exploration instrumentation and monitoring equipment. An increase in their product line is planned. Towards this end, 13,000 sq ft of space have been added to their Toronto facility.

Another product of the company is its range of on-stream heavy water monitors for monitoring the heavy water content of flow streams in nuclear reactors. Barringer is a supplier for the CANDU, Canadian heavy water reactor, which has seen expanded use in Canada and other countries.

COSPEC® (CORrelation SPECtrometers) – These are the only commercial available remote sensing devices for

the monitoring of atmospheric concentrations of sulphur dioxide and nitrogen dioxide. They perform a unique function in the monitoring of air pollution. The joint use of the networks of ground sensors and remote sensing equipment is used as a tool for modeling air pollution episodes and various research investigations of air pollution problems.

Additional specialized optical systems for monitoring gases are manufactured by the company, including the GASPEC® infrared system for remote detection of gases, and its Correlation Interferometer that is used in related areas. These instruments are generally manufactured on special order for governmental agencies such as NASA.

SURTRACE® – This system is a helicopter-mounted airborne geochemical technique which uses a long flexible probe mounted beneath the helicopter to vacuum surface microlayer samples of material off the ground. Special tape sampling equipment is carried in the helicopter to store the samples sequentially, and a technique known as LASERTRACE has been developed for providing 25 element analyses of the minute traces of material collected from the ground surface. The analytical technique is fully automated and computerized and is capable of high volume production. The system has already been used successfully in operational programs. Experience to date with the equipment has been restricted to mineral type surveys, however, potential applications in the hydrocarbon field have been established by the use of related ground equipment over oil fields. A ground version back-pack model has also been successfully used.

AIRTRACE® – This is a system that extracts and analyzes aerosol in the atmosphere and is a forerunner of the SURTRACE system. Although the AIRTRACE equipment is operational, its usage is limited to specific meteorological conditions. This limitation results in high costs of surveys and hence is a restriction on more general use of the AIRTRACE method.

AIRBORNE LASER FLUOROSENSOR – This is a successful airborne laser that has been constructed for a Canadian government organization and has functioned very effectively in tests and surveys designed to detect and classify oil slicks.

GASPEC – A remote sensing gas filter cell spectrometer which NASA Langley Research Center has used in flight tests and which has proven satisfactory in monitoring atmospheric carbon monoxide. This equipment was incorporated as one of the five experiments carried on board the first Space Shuttle. The experiment is based on Barringer's design, and the space flight hardware was constructed by TRW Systems Group. The experiment was very successful and new data on the global distribution of carbon monoxide has been published.

The GASPEC concept is also to be used in the ERBS (Earth Radiation Budget Satellite) wherein it will detect HF, HCl, CH₄, and NO by looking at the rising and setting sun from the satellite (the HALOE or HALogen Occultation Experiment).

MERCURY SPECTROMETER – A mercury spectrometer, and speciation train for separately analyzing for elemental mercury, mercuric chloride, methyl mercuric chloride and dimethyl mercury has been developed and a custom instrument delivered, complete with calibration system. The instrument is capable of detecting 5 picograms of mercury per second; more than adequate to monitor mercury in the natural (clean) environment.

MICROWAVE EMISSION DETECTOR – A new detector of both metals and non-metals (Br, Cl, C, F, Hg, P, S) for gas chromatography has been developed. It uses

a polychromator and a Beenakker cavity containing helium at atmospheric pressure stimulated by microwaves to provide simultaneous detection to limits of 5 to 30 picograms per second and dynamic ranges over a thousand.

Average Work Force: (Canada Only)
Engineers – Scientists – 36
Technical Support – 20

Barringer Research retains on staff a diverse group of Scientists and Engineers in the physical sciences. Barringer Magenta retains expertise in analytical chemistry, geochemistry and microbiology. The professional and supporting technical staffs shown above are for the metropolitan Toronto location only. The total US and Canadian professional strength is 52 Scientists and 13 Engineers.

Gross Sales: 1980 – \$6.3M (Business Volume-Canada)
1981 – \$5.3M
1982 – \$4.3M

Plant Size: Barringer Resources Inc, Barringer Research Ltd, and Barringer Magenta Ltd lease the following office and laboratory space:

Location	Sq Ft	Purpose
1626 Cole Blvd Golden, Colorado	15,200	Office & Laboratory
304 Carlingview Dr Rexdale, Ontario	28,700	Office, Laboratory & Mfg
1455 Deming Way Sparks, Nevada	7,200	Laboratory
5161 Ward Road Wheat Ridge, Colorado	3,000	Laboratory
3750 19th St, N. E. Calgary, Alberta	2,900	Laboratory
Field Aviation Hangar Malton (Toronto), Ontario	1,000	Avionics Workshop

Experience: Barringer experience is world-wide. Recent R&D clients include British Petroleum, Petro-Canada Explorations Inc; TRW Systems Group (USA); National Research Council of Canada; Canadian Department of National Defense; Ontario Hydro; Department of Supply & Services (Canada); Rexnord Inc (USA); Atomic Energy of Canada Ltd; NASA Langley Research Center (USA); and Atmospheric Environment Services (Canada). Previous contracts for the USAF include one for Wright-Patterson AFB, OH – "Remote Detection of Chemical Vapors using Correlation Interferometric Techniques" in 1969; and one contract for Brooks AFB, TX – "Development of a Hydrazine/Carbon Monoxide GASPEC" in 1976-1979.

Keywords: 7 = Electronics; 9 = Environment; 10 = Image Processing & Optics; 11 = Lasers; 17 = Software Services; Infrared Instrumentation = 7; Airborne Surveys = 9; Environmental Analysis = 9; Remote Sensing = 9; Trace Gas Detection = 9; Spectroscopy = 11; Geographic/Geologic Analysis = 17; Electro-Optics = 10; Signal Processing = 7; Data Analysis = 7; Metal Detection = 7; Instrument Manufacture = 7; Remote Gas Detection = 9; Airborne Laser Fluorosensor = 11; Hazardous Gas Detection = 9.

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BELL AEROSPACE CANADA TEXTRON (Division of Textron Canada Ltd)

Code: BEL

Address: P. O. Box 160
Grand Bend, Ontario, Canada N0M 1T0

Contact: Mr J B Timbrell, Managing Director - (519) 238-2333

History: Bell Aerospace was registered to do business in Canada in 1966. The parent company is Bell Aerospace Textron located in Buffalo, New York.

Capability: Bell Aerospace concentrates in the areas of design, development, manufacturing, and production. They specialize in air cushion vehicles and systems.

Average Work Force: Engineering - 6
G & A - 9
Others - 80

Gross Sales: 1982 - \$15M

Plant Size: 38,000 sq ft

Equipment: Data processing on all operations.

Experience: US Army (LACV-30 Program); deHavilland Aircraft (special components and tooling for Dash-8 Program); LACTA Program; Bell/Canadian Federal Government Joint Development Program (Light air cushion triphibious aircraft); Canadian/USAF Joint Defense Program (Air Cushion Equipment Transporter - ACET - Program); and Canadian Coast Guard - Voyageur.

Keywords: 1 = Aircraft; Air Cushion Vehicles = 1; Air Cushion Systems = 1; Air Cushion Equipment Transporters = 1.

Revised: Dec 83

F. G. BERCHA AND ASSOCIATES Ltd

Code: FGB

Address: 938-2nd Avenue N W
Calgary, Alberta, Canada T2N 0E6

Contact: Dr Frank G Bercha, President - (403) 270-2221

History: The company was incorporated in 1975 and is Canadian owned. There are branch offices in Cochrane, Alberta; Ottawa, Ontario; St John's, Newfoundland; and an affiliate corporation, F. G. Bercha and Associates Inc., located in Texas and Arizona. The US offices are wholly owned by Canadian principals.

Capability: The company specializes in research and development, and engineering and environmental consulting, with particular expertise in the areas of ice, mechanics, remote sensing, Arctic engineering, special structures development, system simulation and risk analysis. The company provides a totally integrated capability due to its multidisciplinary workforce consisting of engineers, environmental scientists and systems professionals.

Average Work Force: Professionals - 15
Support Staff - 5

Gross Sales: 1980 - \$1.0M
1981 - \$2.0M

1982 - \$2.0M
1983 - \$3.0M (Projected)

Plant Size: 8,000 sq ft (Head Office)

Equipment: Computer terminals and specialized graphic terminals.

Experience: The company is perhaps best known for its capability to generate strategic information in relation to Arctic operations. From remote sensing data, the company is able to generate environmental information on ice and ocean systems applicable to the engineering design of structures. On the basis of this information, company engineers are able to turn the information into specific structural design parameters, and carry out preliminary, as well as detailed engineering designs of structures for service in the Arctic frontier regions. In the area of arctic and ice engineering and consulting, the company has been employed by most of the major US companies, including Exxon, Amoco, ARCO, Sohio, Phillips, Mobile, and Chevron. In addition, principal Canadian clients in the Arctic include Dome, Petro-Canada, and Gulf Resources. Finally, the company is well known for its ability to develop novel structures for service in frontier conditions. Such structures have included portable aircraft shelters made of aerospace materials to military specifications. To date, such aircraft shelters have been developed for the Canadian Department of National Defense for military service in support of Arctic airborne operations.

Keywords: 1 = Aircraft; 9 = Environment; 17 = Software Services; 20 = Miscellaneous; Consulting = 9; Ice Mechanics = 9, 20; Remote Sensing = 9; Arctic Engineering = 20; Special Structures = 1, 20; System Simulation = 9, 20; Risk Analysis = 9, 20; Portable Shelters = 1, 20; Mapping = 9; Geographic Analysis = 17; Geologic Analysis = 17.

Revised: Dec 83

BOEING OF CANADA Ltd Winnipeg Division

Code: BOE

Address: 99 Murray Park Road
Winnipeg, Manitoba, Canada R3J 3M6

Contact: Mr. L L Bryson, Vice President - (204) 888-2300

History: The Boeing Winnipeg plant was established in 1971 and is a wholly owned subsidiary of The Boeing Company of Seattle. There is one other Canadian division located in Arnprior, Ontario.

CAPABILITY: Boeing is a Canadian leader in high strength/weight ratio fiber composite plastic components for aircraft, space, and other advanced technology applications. The company has the engineering, manufacturing and development expertise to design and build solid laminate or sandwich panel components. Glass, high-modulus graphite and organic fibers, and thermosetting resin systems, including epoxies, polyesters, phenolics or polyimides, are used with state-of-the-art capability. Structural and nonstructural glass fiber, and advanced fiber composite components are currently produced for a diversified range of products covering a technological spectrum from aircraft and satellite components, to thermoformed acrylic bathtubs, light rail vehicles, and farm machinery components.

A stated objective of the company's management team is to establish Boeing of Canada as a center of excellence for composites manufactured within the Boeing Company, and as the Canadian leader in the composite industry. To achieve this objective, an expanded research and development program and increased engineering tool design and fabrication capa-

bilities have been initiated. Further involvement in the manufacture of advanced composite components for the new Boeing 757/767 aircraft is anticipated.

The Winnipeg Division's Quality Assurance Program operates to one standard of quality which is in conformance with the requirements of the Ministry of Transport Engineering and Inspection Manual (FAR Part 21, Subpart G), the Department of National Defense Specification DND 1015 (equivalent to MIL-Q-9838A), and with the Boeing Company Corporate Policy 5H1. Quality is maintained throughout the manufacturing process by inspectors appointed by the Manager of Quality Assurance who in turn is approved by the Ministry of Transport. Complete laboratory tests are carried out on process test panels as required by customers and/or pertinent authorities. All raw materials are purchased from qualified suppliers and incoming shipments are subject to Quality Control receiving inspection to ensure that all requirements are met.

Average Work Force: Engineering Design – 11
Quality Assurance – 22
Production – 150
Admin – 84

Gross Sales: 1979 – \$18M
1980 – \$23M
1981 – \$25M
1982 – \$18M

Plant Size: 128,000 sq ft (Manufacturing Space)

Equipment: Boeing's major equipment includes:

- An autoclave 15 ft in dia, 35 ft long, capable of 95 psi pressure and 625°F ambient temperature.
- An autoclave 10 ft in dia, 30 ft long, capable of 95 psi and 625°F ambient temperature.
- An autoclave 4 ft in dia, 10 ft long, capable of 95 psi pressure and 625°F ambient temperature.
- Air-heated oven with two compartments 8 ft wide, 13 ft long and 8 ft high, with a maximum ambient temperature of 800°F.
- An air-heated oven with compartments 7 ft wide, 9 ft long, 7 ft high, with maximum ambient temperature of 800°F.
- 44 inch vertical core cutting bandsaw.
- Traverse saw capable of cutting up to 16 ft wide material with variable cutting speed.
- Core milling machine capable of handling core sheets 10 ft long, 6 ft wide and up to 6 inches thick, and capable of milling from 0 to 15 degrees \pm a tenth of a degree.
- Special taper core milling machine capable of handling sheets 6 ft long, 1.5 ft wide and 2 inches thick, and capable of milling from 0 to 15 degrees.
- Hydraulic core forming press with 4 ft x 4 ft platen.
- One 8 ft x 22 ft and one 8 ft x 15 ft waterfall spray painting booth.
- An 8 ft x 20 ft flame spray booth and apparatus capable of hard and soft ferrous and non-ferrous metal spraying.
- Assorted saws, routers' drills, punches, shears, finishing equipment, etc, equipped with tungsten carbide and diamond cutters.
- Automated through transmission, water jet scanning ultrasonic system with C-scan data acquisition.

- Assorted ultrasonic bond, thickness and flaw detection equipment.

- A McLean Anderson, Explorer Model D, Filament Winding Machine, capable of producing a part approximately 150 inches long and nine (9) inches in diameter.

Experience: Boeing-Winnipeg assumed production responsibility for the majority of all Boeing commercial aircraft. Significant contracts for graphite composites for Satcom and Anik D satellite programs were secured. A technology transfer program, including establishment of a tool design group and upgrading of tooling and part fabrication capability, was initiated in preparation for increased graphite and hybrid work on the new Boeing 757/767 aircraft programs.

Some of Boeing-Winnipeg customers include:

- *Canadair (Challenger)* – fairing flap hinge, assembly wing tips, leading-edge flap, access panels, smoke sensor, side console, cover assembly, inboard fairing, latch housing, aft wing-to-body fairing, and horizontal stabilizer tips.
- *deHavilland* – panels, fairings, DHC 7 kevlar trough, and nose avionics bay, DHC-8 Nose Equipment bay.
- *Hughes* – satellite components.
- *SPAR Aerospace* – graphite epoxy plates, and waveguides & satellite components.
- *Boeing Vertol* – rain gutters, and CH47 inlet screens.
- *Boeing* – 707, 727, 737, and 747.
- *Geonics* – magnetometer booms.
- *Geophysics* – magnetometer booms.
- *Aerodat* – magnetometer booms.
- *AVCO* – Graphite-epoxy missile components.

Keywords: 1 = Aircraft; 18 = Space Systems; 20 = Miscellaneous; Airframe Components = 1; Airframe Structures = 1; Composite Components = 1, 18, 20; Fiberglass Components = 1, 18, 20; Laminates = 1, 18, 20; Graphite Epoxy Components = 1, 18, 20; Sandwich Components = 1, 18, 20.

Revised: Dec 83

BRISTOL AEROSPACE Ltd

Code: BAL

Address: 660 Berry St
P. O. Box 874
Winnipeg, Manitoba, Canada R3C 2S4

Rockwood Propellant Plant
Stony Mountain, Manitoba, Canada
(20 miles from main plant)

Contact: Mr. Keith Burrows, Marketing VP – (204) 775-8331

History: Bristol was founded in 1930 and incorporated in Canada in early 1947. It is a wholly owned subsidiary of Rolls Royce Holdings, (Canada) Ltd. Bristol owns and operates the Rockwood Propellant Plant (not a separate division) at Stony Mountain, Manitoba. There are no other subsidiaries operated by the company.

Capability: Since inception in 1930, Bristol has moved from manufacturing and repairing seaplane floats (1930-1943) to a company with numerous distinct products and services:

Equipment: The equipment presently in use at CAD/CAM is a CALMA GDS I Interactive Graphics System that consists of: (1) Data General Eclipse CPU, (2) Four 48x60 inch digitizing tables with dual 19x11 inch CRTs, (3) Color design/edit station with tablet and CRT, (4) CALCOMP 970 pen plotter (on-line), (5) GERBER 4432 Photoplotter (off-line), and (6) Kodak film processing laboratory.

Plant Size: 5,000 sq ft

Experience: CAD/CAM has contract experience with various departments of the Canadian Government, including the Departments of National Defense and Transportation. Canadian industrial experience includes such companies as Northern Telecom, Bell Northern Research, Litton Systems, and AES Data Ltd. US industrial experience includes ITT Aerospace and IBM.

Keywords: 7 = Electronics; 17 = Software Services; Circuit Layout = 17; PC Board Design = 7; Thick Film Hybrid Parts = 7; Thick Film Hybrid Design = 7; Thin Film Hybrid Parts = 7; Thin Film Hybrid Design = 7.

Revised: Dec 83

CAE INDUSTRIES Ltd

Code: CAE

Address: Corporate Offices
Suite #3060
P. O. Box 30
Royal Bank Plaza
Toronto, Ontario, Canada M5J 2J1

CAE ELECTRONICS Ltd
8585 Cote de Liesse
P. O. Box 1800
Saint Laurent, Quebec, Canada H4L 4X4

Contact: Dr Murdoch McKinnon, R&D Manager -
(514) 341-6780

History: The company was incorporated in 1947 as Canadian Aviation Electronics Ltd to engage principally in the repair and overhaul of electronics and electro-mechanical equipment and devices. The name was changed to CAE Industries Ltd in 1963 to more accurately reflect its expanding interests in many diverse fields of industry. Diversification and acquisition began in 1961 with the formation of CAE Electronics GmbH in West Germany. Other subsidiaries include CAE Electronics Ltd, Northwest Industries Ltd, CAE Fiberglass Products Division, CAE Aircraft Ltd, Canadian Bronze Company Ltd, Welmet Industries Ltd, CAE Machinery Ltd, Webster Mfg (London) Ltd, Accurcast Die Casting Ltd, CAE-Montupet Diecast Ltd, CAE Morse Division, CAE Lubricators Division, Cleveland-CAE Metal Abrasive Ltd, USP Industries Inc, and CAE Magnesium Products Division. All are Canadian-based except the one subsidiary located in West Germany. This profile will concentrate on CAE Electronics Ltd.

Capability: CAE Electronics Ltd designs and manufactures sophisticated commercial and military aircraft flight simulators and airborne magnetic anomaly detection equipment. They have also become a major producer of computer-based data acquisition and control systems in the areas of electrical power generation and transmission, oil production, gas transmission, air traffic control, and space.

In the simulator area, they are a leading designer and producer of flight simulators. They have produced the first FAA approved phase III commercial aircraft simulator for United Airlines. Their simulators include state-of-the-art technology such as hydrostatic six-degree-of-freedom motion, general purpose computers, and CRT-based instructor's facilities. They reproduce aircraft performance in all flight regimes and, in particular, the critical landing phase. Digital flight simula-

tors have been developed for the A-300, B727, B737, B747, DC-8, DC-9, DC9-80, DC-10, L1011, F-28, CL-600, and the new generation A-310, B757 and B767. A wide range of simulators has also been supplied to different countries for various types of military aircraft, including tactical jet fighters, jet trainers, antisubmarine patrol aircraft, and transports.

They selectively pursue the US military flight simulator market. CAE also designs and produces simulators for helicopters such as the Agusta AB-205 and AB-212, Bell UH-1D, Boeing-Vertol CH-47, Sikorsky CH-53, and Westland Sea King MK41. In addition to flight simulators, CAE Electronics produces training simulators for nuclear power plants. They are used to train operators to develop experience in responding to all normal, abnormal and emergency conditions as well as to learn required operating procedures and techniques. In the avionics area, CAE Electronics develops and manufactures magnetic anomaly detection (MAD) systems used in antisubmarine warfare. Their cesium magnetometer system, which has been traditionally mounted in a stinger at the rear of the aircraft, can measure changes in the earth's magnetic field as small as one part in 5 million. The company now offers an integrated MAD system for inboard use on fixed wing aircraft and helicopters.

They have developed a "JETS" joint enroute/terminal data processing and display system for air traffic control. The system is modular and the displayed information is tailorable to user requirements. They are active in the space area as they are part of a Canadian consortium, responsible for developing and manufacturing the complete Manipulator Arm system for the NASA Space Shuttle. They have designed and are manufacturing the display and control panel, plus the rotational and translation hand controls that operate the manipulator itself. They have also designed and developed the simulation subsystem which is used as a design tool to test hardware and software modules of the system.

Average Work Force: Total (CAE Electronics) - 1,700
Technical Staff - 650

Gross Sales: CAE Industries - \$300M
CAE Electronics - \$ 90M

Plant Size: 300,000 sq ft

Experience: CAE Electronics customers include United Airlines, Air Canada, British Airways, KLM, Lufthansa, Swissair, TWA, FAA, Douglas Aircraft Co, Lockheed California, the Canadian Forces, NASA, US Navy, and other departments of the Canadian Government. Current R&D activities include working with the USAF (AFHRL) on a joint program - Design Project for the development of a Wide Field of View, Helmet-Mounted, Infinity Display System, incorporating Area of Interest high resolution imagery slaved to the pilots eye movements; a recently completed study of the LAMARS Air-to-Surface visual system for the USAF; a study for the CAF for a Turret Interactive Crew Simulator; development of computer-based training (CBT) and computer-aided learning technique (CAL); and a recently completed NASA study and development of a six-degree-of-freedom hand controller.

Keywords: 1 = Aircraft; 3 = Avionics; 6 = Computers; 7 = Electronics; 8 = Energy; 15 = Radar; 16 = Security & Safety; 17 = Software Services; 18 = Space Systems; 20 = Miscellaneous; Flight Simulators = 1, 3; Magnetic Anomaly Detection = 3, 16; Data Acquisition Systems = 1, 8, 18, 20; Data Control Systems = 1, 8, 18, 20; Training Simulators = 8, 20; Air Traffic Control Systems = 20; Control Systems = 18, 20; Repair & Overhaul = 3, 7; Video Display Systems = 7; Simulation Programs = 17; Air Traffic Control Simulators = 7, 20; Computer Graphics = 17; Graphics = 17; Hydraulics = 20; Nuclear Simulation = 6, 7, 17, 20; Simulators Training Simulators = 8, 20; Air Traffic Control Systems = 20; Control Systems = 18, 20; Repair & Overhaul = 3, 7; Video Display Systems = 7; Simulation Programs = 17; Air Traffic Control Simulators = 7, 20; Computer Graphics = 17; Graphics = 17; Hydraulics = 20; Nuclear

- The manufacture of "hot section" components for jet engines, afterburners and exhaust systems under contract to GE, Pratt & Whitney, and Rolls Royce.
- The complete restoration of "hot section" components for jet engines, afterburner assemblies and exhaust systems.
- The manufacture of light alloy structures for major aircraft including the DHC-8 and the P3/CP-140.
- The repair and overhaul of military and commercial fixed wing aircraft, sub and supersonic, and rotary wing aircraft.
- Wire Strike Protection system for rotary wing aircraft.
- The manufacture of CANDU reactor in-core components.
- The manufacture and design of high altitude research rockets.

Bristol's present involvement in engineered product manufacture includes – rocket engines and solid fuel propellants; electronic data instrumentation for payloads and satellites; and remote automatic inspection systems for steam generators. Bristol's services encompass mechanical, electrical, aeronautical and propulsion design and development engineering. Other services include – precision welding of high temperature, corrosion resistant materials including nickel alloys, cobalt alloys, carbon steels and other exotic material such as titanium and zirconium; vacuum brazing; vacuum heat treatment; and facilities for testing of helicopter transmission assemblies.

Bristol's past achievements include the manufacture of light alloy structures for the DHC-7 and L-1011 aircraft; and design and manufacture of electronic data instrumentation for remote site applications and vertical axis wind turbines. Bristol's proprietary products include – Black Brant (high altitude research rockets); CRV-7 (Air to Surface Rocket); WSPS (Wire Strike Protection System for helicopters); CANSCAN (Remote, Automatic Inspection System for nuclear and conventional steam generators); DCP (Electronic Data Collection for remote site application); and READAC® (Automatic Weather Station for unattended use in airport applications).

Average Work Force: Salaried – 463
Hourly – 599
Technical – 100

Gross Sales: N/A

Plant Size: Production – 451,000 sq ft
Warehouse – 6,000 sq ft
Office – 57,000 sq ft

Equipment: Complete facilities and equipment for metal forming, welding, machining and metal treating. Numerical Control Machining Center with equipment such as the Sundstrand S-80, S-60, and OM-2A, a Raycon NC EDM, Mazak V5 and V20 machine center, and 4 Giddings & Lewis 48" NC VTL. Also included is a PDP 11/70 computer with MDSI. "Action Central" McAuto CAD/CAM System with six design stations. Devine autoclave – working pressure of 132 psig and temperature of 400°F max; and working area of 6 ft diameter by 18 ft long. Special facilities include a helicopter transmission test cell, non-destructive test laboratory, and an electronic test laboratory.

Rockwood Propellant Plant – produces HTPB solid propellant for sounding rockets, JATO's drone booster motors, and small military rockets. Present annual propellant production is 1,000,000 pounds.

Experience: In 1981, approximately 30 percent of Bristol's sales were to the US, with over 85 percent of these sales to the US military. US business includes the manufacture of

combustion and exhaust components for the J85, J79, T64, T58 and TF39 engines, and the remanufacture of the TF30 afterburner and general component repair and overhaul.

Other customers in the US include – the Navy, NASA, Pratt & Whitney Aircraft Corp, Lockheed Aircraft Corp, Grumman Aircraft, Fairchild Hiller Corp, and General Electric.

Canadian customers include – DND, DSS, CCC, National Research Council, Pratt & Whitney of Canada Ltd, Atomic Energy of Canada, Boeing Canada Ltd, Canadair Ltd, DeHavilland Aircraft of Canada Ltd, and others. International clients include – Dornier GmbH, Germany, Royal Netherlands Air Force and the Swedish Space Corporation.

Bristol has been approved by the Canadian Ministry of Transport for Canadian Aircraft maintenance, and the Canadian Forces for manufacturing testing and overhaul. The quality requirements of MOT and FAA and the Canadian DND 1015 or MIL-Q-9858A are met for manufacturing, repair and overhaul.

Keywords: 1 = Aircraft; 2 = Armament; 7 = Electronics; 8 = Energy; 9 = Environment; 12 = Machining; 14 = Protective Equipment; 19 = Testing/Test Equipment; Airframe Components = 1; Airframe Structures = 1; Engine Components = 1; Engine Systems = 1; Helicopters/Subsystems = 1, 19; Hydraulics = 1; Repair & Overhaul = 1; Nuclear Reactor Components = 8; Wind Turbines = 8; Meteorological Stations/Equipment = 9; Remote Inspection Systems = 8; Metalworking = 12; Heat Treating = 12; Coating = 12; Stamping = 12; Spin Forming = 12; Titanium = 12; Tooling = 12; Die Fabrication = 12; Rockets = 2, 9; Rocket Propellant = 2, 9; Rocket Engines = 2, 9; Helicopter Wire Strike = 14; Non-Destructive Testing = 1, 19; Instrumentation = 7, 19; Transmissions = 1, 19; Gear Boxes = 1, 19; Data Collection = 7; Laboratory = 7, 19; Gas Turbine Components = 1.

Revised: Dec 83

CAD/CAM GRAPHIC SYSTEMS Ltd

Code: CGS

Address: 700 Industrial Avenue
Ottawa, Ontario, Canada K1G 0Y9

Contact: Mr. A H Jarvis, General Manager – (613) 526-0620

History: CAD/CAM Graphics Systems Ltd is a small Canadian owned high technology company incorporated in May 1979. There is a branch in Toronto and the company is incorporated in the US as CAD/CAM Graphic Systems Inc.

Capability: CAD/CAM Graphics is an engineering design group specializing in computer aided graphics design and artwork generation for printed circuit boards and/or hybrid micro-circuits. They also offer consulting services to assist clients in the development of design standards/criteria to suit their special needs. Their product services include: (1) Design from schematic to color-coded layout, (2) Digitizing of color-coded layouts for single, double or multilayered boards (prepared by either the customer or CAD/CAM), (3) Photoplotting of the following artwork masters – component and solderside, drill graphics, solder resist mask, silk screen and assembly, (4) Numerical control drill tapes to suit either Excellon or Digital Systems format, (5) Documentation packages and, (6) Prototype and production quantities of printed circuit boards.

Average Work Force: Total – 20

Gross Sales: 1981 – \$1.0M
1982 – \$1.4M
1983 – \$1.5M

Simulation = 6, 7, 17, 20; Simulators = 1, 15, 17, 18, 20; Software Development = 17; PC Board Design & Fabrication = 6, 7; Radar Simulation = 15, 17; Real Time Graphics = 17; Real Time = 6; Real Time Control Systems = 17; Real Time Monitor Systems = 17; Simulation = 6, 9, 17; Training = 1, 3, 15, 20.

Revised: Dec 83

CAMETOID Ltd

Code: COD

Address: 1449 Hopkins Street
Whitby, Ontario, Canada L1N 2C2

Contact: Mr. D G Newman, President & General Manager
- (416) 666-3400

History: Cametoid Ltd is a Canadian owned metal finishing company specializing in high quality metal coatings for the aerospace, electronics, nuclear, and general defense industries. Cametoid was incorporated in 1950 and was originally owned by Dowty Equipment of Canada Ltd, aircraft undercarriage manufacturers. In 1968, Cametoid was bought by the Newman family of Whitby, Ontario, and is today a wholly owned subsidiary of Newman Aerospace Inc.

Capability: Cametoid has two divisions:

- *The Electroplating Division* - produces high quality electroplating of cadmium, copper, nickel, nickel-cadmium, silver, tin, and zinc; electroless nickel coatings; chemical films on aluminum and magnesium; phosphates on steel; passivation of stainless steel; black oxide coatings on copper, steel, and stainless steel; dry film lubricants of moly disulfide; and Dupont Teflon® sprayed coatings.

- *The "Vacuum Coating" Division* - established in 1982 and is one of the few facilities in the world capable of ion vapor deposition of aluminum (Ivadizing™) on large parts (narrow parts up to 14 ft long, and flat parts 5 ft x 10 ft) as well as on parts as small as aircraft fasteners. This facility is supplemented by an R&D laboratory working to expand the applications of ion vapor deposition and physical vapor deposition technology to a wide variety of materials for use in optics, electronics, and solar energy. Measurement abilities include photomicrography; beta-backscatter, magnetic, and eddy current thickness testing; radiography; Taber abrasion; and salt spray (fog) testing. This division also houses a new processing line for anodizing, hard anodizing and chromating of aluminum components up to 12 ft long x 4 ft wide.

Average Work Force: Chemists - 2.
Physicist - 1
Engineer - 1
Technologist - 1
Administrative - 5
Operators - 15

Gross Sales: \$1.0-\$3.0M (Annually)

Plant Size: 21,000 sq ft

Equipment: Cametoid employs a complete electroplating and vacuum coating facility with baking ovens, exhaust systems, and in-house water treatment plant. Also employed are two laboratories - one for process and one for research and development with associated test equipment. Certain production and test equipment is computer related.

Experience: Cametoid has more than 25 years of active sub-contract experience in dealing with the aerospace, electronic, nuclear and general defense industries in Canada and the

US. With most of these companies, it has been a long relationship as an approved vendor. Its principal customers include Air Canada; Bata Engineering; Bell Aerospace; Boeing; CAE Electronics; Canadair, Canadian General Electric; Cleveland Pneumatic; Computing Devices; DAF Indal; deHavilland; Department of National Defense; Devtek; Dowty Equipment; Fleet; Garrett; Grumman; Hawker Siddeley; Irvin; ITT Cannon; Kaman Aerospace; Leigh Instruments; Litton; Magna; Martin Marietta; McDonnell Douglas; Pratt and Whitney; Rolls Royce; Sikorsky; Spar Aerospace; and Sperry. In addition, the company serves a number of precision machine shops related to the aerospace industry in Toronto, Ottawa and Montreal.

Keywords: 1 = Aircraft; 2 = Armament; 3 = Avionics; 6 = Computers; 7 = Electronics; 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 12 = Machining; 13 = Missiles; 18 = Space Systems; 19 = Testing/Test Equipment; 20 = Miscellaneous; Thickness Testing = 19; Conductivity Testing = 19; Electroplating = 1, 2, 7, 8, 12, 13, 18, 20; Chemical Films = 1, 2, 7, 8, 12, 13, 18, 20; Dry Film Lubricants = 1, 2, 7, 8, 12, 13, 18, 20; Ion Vapor Deposition = 1, 6, 9, 10, 13, 18; Ion Plating = 1, 6, 9, 10, 13, 18; Anodizing = 1, 2, 7, 8, 12, 13, 18, 20; Salt Spray (Fog) Testing = 19; Taber Abrasion Testing = 19; Metal Finishing = 20; Hydrogen Embrittlement Relief = 19, 20; Repair & Overhaul = 20; Metal Coatings = 20; Protective Coatings = 20; Multilayer Coatings = 3, 7, 10, 13, 18; Optical Coatings = 10, 18; Teflon Coatings = 1, 6, 7, 12; Materials Processing = 20; Vacuum Coating = 1, 6, 9, 10, 13, 18; Hardness Testing = 19.

Revised: Dec 83

CANADA WIRE & CABLE Ltd

Code: CWC

Address: Corporate Office
250 Ferrand Drive
Don Mills, Ontario, Canada M3C 3J4

Contact: Mr H O Coish, VP Corporate Affairs - (416) 424-5110

History: Canada Wire & Cable Ltd is a diversified manufacturer operating businesses across Canada and the US, with partners in associated companies overseas. The company is a subsidiary of Noranda Mines Ltd and is involved either directly or through its subsidiaries and associates in the manufacture of electrical, electronic and communication wires and cables, plastic pipe and fittings, optical fiber cables and components, magnet wire, transformers, lighting, and other products.

Canada Wire was incorporated in 1911 and began producing cables for the fledgling electrical industry. By the mid-1920s, it had expanded its product line and located sales offices and warehouses across Canada. In 1929, Canada Wire & Cable Ltd amalgamated with Standard Underground Cable and began producing a wide range of power cables. During subsequent years, the company integrated its operations by building a copper rod mill to supply basic conductor material. They expanded to a full product range in the 1950s when they established specialized product plants in many parts of Canada. Export activity grew and, during the past two decades, led to joint venture businesses in several overseas countries. More recently, Canada Wire has diversified through the development of new products and the acquisition of companies in related industries.

Capability: Canada Wire is the largest wire and cable company in Canada and is ranked by industry sources as the second largest in North America, not including its overseas associates' operations. It is among the hundred largest Canadian companies.

• *Wire and Cable Group* – the largest portion of its wire and cable business is organized on the basis of six divisions and one division of Grandview Industries Ltd, each with distinct products and markets. These divisions are:

- (1) **Power & Control Products** –
Markets: Electrical Utilities, Construction Industry
Plants: Quebec City, Quebec; Leaside, Ontario
- (2) **Communication Products** –
Markets: Telecommunication Utilities
Plants: Winnipeg, Manitoba; Weyburn, Saskatchewan; Vancouver, British Columbia
- (3) **General Products** –
Markets: Construction Industry, Industrial, Automotive, Equipment and Electronic Industries
Plants: Fergus, Ontario; Etobicoke, Ontario; Orangeville, Ontario
- (4) **Magnet Wire** –
Markets: Original Equipment Manufacturers
Plants: Simcoe, Ontario; Montreal, Quebec
- (5) **Copper Rod Products** –
Markets: Wire and Cable Manufacturers
Plants: Montreal East, Quebec
- (6) **Canstar Communications (Fiber Optics)** –
Markets: Telecommunications
Plants: Scarborough, Ontario; Winnipeg, Manitoba
- (7) **Plastic Pipe and Fittings Division** –
Grandview Industries Ltd
Markets: Municipalities, Irrigation, Slurry Transportation
Plants: Weyburn, Saskatchewan; Langley, British Columbia; Rexdale Ontario

In the area of development, Canada Wire continues to be an aggressive growing company. Several major investment projects have recently been completed and these include:

- Rebuilding of the Leaside Power and Control Cable Plant.
- Haxelett-Krupp continuous cast copper rod mill in Montreal.
- Research and production facility for fiber optics in Winnipeg.

These expansion projects, in addition to further acquisitions and international investments, demonstrate Canada Wire's determination to maintain its leadership in technology and business development.

Canada Wire & Cable Ltd subsidiaries include:

- *Carol Cable Company (US)* – manufacturers of wire and cable in the US. Acquired in 1981, it has eleven manufacturing plants specializing in portable cords, electronic wires and power cable, as well as associated products for the industrial, consumer, electronic, and automotive markets. Founded in 1920, Carol Cable has maintained strong growth through efficient manufacturing, prompt service, timely and innovative marketing, and increased preference for its products by industrial customers and consumers.
- *Canada Wire and Cable (International) Ltd* – active in joint ventures throughout the world. These partnerships developed from the past fifty years of exports and extensive overseas contacts. Although most began in the wire and cable industry, the associated companies

have become diversified producing other products such as metals, transformers, lighting, and plastics. The main associated wire and cable companies include:

- (1) Fadaltec (Colombia)
- (2) Conductores Monterrey (Mexico)
- (3) Alambres Dominicanos (Dominican Republic)
- (4) Nigerchin Electrical (Nigeria)
- (5) Tolley Holdings (New Zealand)
- (6) Irish Cable & Wire (Ireland)
- (7) Transage Wire (Pty) (South Africa)
- (8) Iconel (Venezuela)

In its joint ventures, the company provides managerial and technical expertise, as well as equity. Its engineers and technical specialists assist the associated companies to install new equipment, increase productivity, and improve product quality.

Canada Wire is represented in the USA by Canada Wire & Cable, Inc., The Bank of America Building, 5800 South Eastern Ave, Suite #370, Los Angeles, CA 90040. Phone (213) 727-5921.

Average Work Force: North America – 5,000
International – 10,000

Gross Sales: No Data

Plant Size: No Data

Experience: Canada Wire has developed export markets in sixty countries around the world in wire and cable, copper rod, electrical, and other products. Its export operations are organized in regions and directed primarily towards markets in the Middle East, Latin America, Caribbean, the Pacific Basin and the United States.

Some of the US customers of Canada Wire and Cable are – US Government, Houston Wire, American Cordset Co, American Cable Corp, T.W. Comcorp, Phelps Dodge, and Anixter.

Keywords: 1 = Aircraft; 7 = Electronics; 10 = Image Processing & Optics; 12 = Machining; 20 = Miscellaneous; Wiring = 7; Tubing = 7; Fiber Optic Cable = 7, 20; Plastic Pipe = 7, 20; Plastic Fittings = 20; Fiber Optic Components = 7, 20; Transformers = 7; Lighting = 7, 20; Copper Rod Products = 20; Cable = 7; Magnet Wire = 7.

Revised: Dec 83

CANADAIR Ltd

Code: CDR

Address: 1800 Laurentian Blvd
St Laurent, Quebec, Canada H4R 1K2

Mailing Address
P. O. Box 6087, Station A
Montreal, Quebec, Canada H3C 3G9

Contact: Mr. Gilbert S Bennett, President & CEO –
(514) 744-1511

History: Canadair was incorporated in late 1944 and is owned by the Canadian Government. Other Canadian locations are the Government Liaison Office in Ottawa and a Challenger Sales Office in Calgary. US offices include Challenger Sales Offices in Westport (CT), Atlanta, Houston, and San Francisco; and other Challenger related offices located throughout the US. A Challenger Service Center is located in Hartford, CT.

Capability: Canadair has a high technology R&D capability specializing in aerodynamics, flutter analysis, composite materials, remotely piloted vehicles, fracture analysis, and

computational design techniques. Their product line includes:

- Challenger business jet aircraft
- CL-215 multi-purpose amphibious aircraft
- CL-89, CL-227 and CL-289 unmanned airborne surveillance system

They have active subcontract work on the Boeing 767; Lockheed CP-140, P-3C, McDonnell Douglas F/A-18A, F-15, and Grumman EF-111A. They specialize in machining to close tolerances (0.001 inch) with a high degree of repeatability. They have an integrated heat treating and stretch-forming system capable of treating and forming aluminum alloy sheets 40 ft x 8 ft x 0.375 in.

Their CL-89 Airborne Surveillance System (unmanned) was designed for use at the Army Division level. It is fitted with either a photographic or infrared line scanning sensor and is reusable. It is launched from a mobile zero-length launcher and recovered with a two-stage parachute system employing inflatable air bags to absorb landing shocks. This drone is stocked in the arsenals of the UK, West Germany, France, and Italy.

The CL-289 is a longer updated version being developed jointly with Dornier GmbH of West Germany. This new vehicle will carry both a photographic sensor and an infrared line scan (IRLS) sensor and will cover a 150 kilometer range at speeds in excess of 700 kph. A real-time data transmission link is associated with the IRLS System. Onboard computers carry the flight instructions for both the CL-89 and CL-289.

The third model, CL-227, is an hourglass-shaped, remotely piloted vehicle still in the development stage. It is designed as a highly survivable surveillance and target acquisition system for use at medium range. It has VTOL capability and is launched and recovered from a mobile two-meter diameter platform. It can transmit real-time data.

Average Work Force: Engineers - 296
PhD - 12
Machinists - 300
Others - 3957

Gross Sales: 1980 - \$116.2M
1981 - \$265.7M
1982 - \$429.4M

Plant Size: 2,700,000 sq ft (under cover)

Equipment: Their special equipment includes:

- Two Cincinnati profilers; numerically-controlled; 5-axis: Each bed 212 ft long, 13 ft 4 in wide. Each bed has 3 gantries with 3 spindles each.
- One Ingersoll profiler; numerically-controlled; 3 axis: Bed 96 ft long, 17 ft 5 in wide. Single gantry with 3 spindles.
- Nine Wilson profilers; tracer-controlled; 3 axis: Some 6 spindle, some 4 spindle.
- Several Kearney and Trecker 3 and 5 axis profilers; numerically controlled.
- Two Autoclaves; one 15 ft dia, one 12 ft dia, for metal-to-metal, honeycomb and composite bonding.
- Heat-treat, stretch forming system. Electrically-heated furnace takes sheets 40 ft by 8 ft. 1000-ton stretch press takes sheets 50 ft by 8 ft and 1/2 in thick.

Experience: The Canadair experience over the past two years include subcontracts for vertical stabilizers for the EF-111A, components for the Lockheed P-3C and CP-140, rear fuselage sections for Boeing 747SP and 767, components for the McDonnell Douglas F-15 and F/A-18A, and shipsets of components for the Lockheed C-5A. Current products include

Challenger business jet, CL-215 multipurpose amphibian, three surveillance systems and subcontracts.

Keywords: 1 = Aircraft; 12 = Machining; 17 = Software Services; 19 = Testing/Test Equipment; Airframe = 1; Components = 1; Composites = 1; Extended Length = 12; Forging = 12; Heat Treating = 12; Metal Working = 12; Casting = 12; RPV = 1; Drones = 1; Computational Design = 1, 17; Aerodynamics = 1; Fracture Analysis = 19; Flutter Analysis = 19; Coating = 12.

Revised: Dec 83

CANADA SYSTEMS GROUP Advanced Technology Systems Division (Formerly Digital Methods Ltd)

Code: CSG

Address: 1736 Courtwood Crescent
Ottawa, Ontario, Canada K2C 2B5

Contact: Mr. P. Smithers, Director of Systems Development
- (613) 225-1171

History: Canada Systems Group is a Canadian owned high technology company. Their technical experience is in the field of computer systems and programming. CSG was established in 1971 to provide computer based information services to industry and government. The large parent company has its head office in Mississauga, Ontario, with branches and division in other Canadian and US cities.

Capability: The Advanced Technology Systems Division's expertise lies in the areas of - 1) analysis, design and specification of real time control systems; 2) analysis, design, specification & implementation of information retrieval and data base systems; 3) analysis and organization of associated manual systems; 4) project management; 5) technical support; and 6) training. The activities of the Division are mostly concerned with micro/minicomputers.

Average Work Force: Engineers - 40
Others - 10

Gross Sales: 1980 - \$3.5M
1981 - \$4.0M
1982 - \$4.0M
1983 - \$3.0M (Projected)

Plant Size: 12,000 sq ft

Equipment: Machines currently used by Canada Systems Group are Hewlett Packard 2114, 2116, 21MX, Series 3000, Digital Equipment Corp (LSI-11, PDP-10, PDP-11), Data General NOVA and ECLIPSE series, Motorola 6800, and Intel 8080.

Experience: Canada Systems Group has extensive experience with a large number of federal and provincial government agencies and with various business and industrial organizations. Private sector contracts include some in the US and UK. Typically, less than 5% of their sales are to the US. Typical projects handled by the Division are studies, simulator systems, systems software design and implementation, computer graphics for air traffic control, satellite ground control systems (software design and program and implementation), VTOL/STOL data handling system design & implementation, computer aided graphics, and telex switching systems (software development). Other project areas include computer dispatch, supervisory control, and data acquisition. The company has no past contracts with the USAF or other DOD agencies.

Keywords: 6 = Computers; 7 = Electronics; 17 = Software Services; 20 = Miscellaneous; Computer Dispatch = 6, 7; Supervisory Control = 6, 7; Data Acquisition = 6, 7; Air Traffic Control Systems = 6, 20; Graphics = 17; Real Time Graphics = 17; Telex Exchange Computer Systems = 6.

Revised: Dec 83

CANADIAN AIRCRAFT PRODUCTS Ltd

Code: CAP

Address: 2611 Viscount Way
Richmond, British Columbia, Canada V6V 1M9

Contact: Mr. D C Cameron, President - (604) 278-9821

History: Canadian Aircraft Products Ltd was founded in 1955 to design and produce aircraft floats. The company is Canadian owned and has no other Canadian locations or US subsidiaries.

Capability: The company designs, engineers and fabricates aircraft components and other allied and support items for the aerospace industry in both aluminum and composites. They maintain a design and engineering office capable of producing products to stated performance specifications and military specifications. They specialize in the design and manufacture of aircraft structures, tools and jigs, support equipment-ground, ancillary equipment-air, cargo handling equipment, aircraft modifications, and aircraft systems.

Modifications to aircraft include the design and installation of additional fuel systems, seats, engine replacement, and structure changes. They have also conducted analyses relative to aircraft/airport compatibility.

Average Work Force: Total - 160

Gross Sales: 1980 - \$8M

Plant Size: 75,000 sq ft

Equipment: Forming capability (3,000 ton rubber bed press), heat treating capability (3x4x18 ft gas-fired oven with water quench) and supporting services. NC milling machines, a composite facility that includes an oven (8x8x10 ft) and an autoclave (5x15 ft).

Experience: Canadian Aircraft Products Ltd has a long background of capability and expertise in repair, overhaul, manufacture and fabrication, as well as design and test of aircraft structures and components. They have designed, manufactured and repaired structures and components of a similar nature such as large aluminum boats, air cushion vehicles, etc. They have produced sheet metal fabricated parts for civil and military application. One such contract was for ammunition boxes for Kaiser Aluminum. They produce wing floats for the Canadair CL-215 water bomber and the floats for the DeHavilland Twin Otter aircraft. The company has built and structurally tested the complete airframe of the Trident Aircraft Ltd Trigull aircraft. Other contracts include the horizontal stabilizer and auxiliary fuel tanks for the Canadair CL-600 aircraft, control surfaces and airstair door for the DeHavilland Dash 7 STOL airliner, the horn assembly for the McDonnell Douglas DC-9, Saberliner detail parts for N. A. Rockwell, and the design, engineering and production of the horizontal stabilizer, elevators and rudders for the DeHavilland Dash 8 commuter aircraft.

Keywords: 1 = Aircraft; 12 = Machining; 17 = Software Services; Airframe Components = 1; Airframe Structures = 1; Cargo Handling Equipment = 1; Systems = 1; Helicopter Subsystems = 1; Repair &

Overhaul = 1; Aluminum Components = 1; Composite Components = 1; Modification = 1; Tooling = 12; Jig Fabrication = 12; Rudder Assemblies = 1; Structural Analysis = 17; Structural Design = 1; Flaps = 1; Design To Requirements = 17.

Revised: Dec 83

CANADIAN ASTRONAUTICS Ltd

Code: CAL

Address: 1024 Morrison Dr
Ottawa, Ontario, Canada K2H 8K7

Contact: Dr Michael A Stott, VP, Business Development - (613) 820-8280

History: Canadian Astronautics is a rapidly growing, wholly owned Canadian company incorporated in 1974. There are no Canadian divisions and no US subsidiaries.

CAL is primarily a systems level contractor with interests in four principal business areas - Space Hardware, Radar and Communications, Computer Systems, and Military Electronics. In addition to these development and manufacturing activities, the company performs engineering design/study work in all four areas.

Capability: As previously mentioned, Canadian Astronautics is divided into four business areas with capabilities as follows:

- *Space Hardware* - CAL has an excellent capability in development and manufacture of spacecraft units and subsystems. Particular examples include antennas, RF subsystems, electro-optical equipment, battery management systems (NiCd and NiH₂), power converters (high voltage and high efficiency), and spaceworthy rad-hardened microprocessors.
- *Radar and Communications* - CAL designs and manufactures airborne SAR and SLAR equipment and has a development capability for radar of all types, particularly those involving complex signal processing. CAL additionally has capabilities in phased arrays, having developed airborne planar arrays and MLS ground antennas, along with specialized thin film microstrip components, such as precision phase shifters, corporate feeds and radiating elements. Satellite communications station upgrades/retrofits on a turnkey basis and manufacture of custom Satcom equipment is another CAL specialty.
- *Advanced Systems* - EW and ASW are the main activities of this division, but others include processors for LANDSAT-D Thematic Mapper and remote unattended navigation/communications beacons. In EW, the company has developed the Tactical Signal Simulator (TASS), which is a fully programmable dynamic scenario stimulator for ESM receiver evaluation and operator training. Technology developments include fast tuning millimeter wave VCO's for ECM and simulator applications. In ASW, CAL has developed programmable sonobuoy processing systems and advanced processor architecture systems.
- *Commercial Systems* - The main activity of this division is the supply of Search and Rescue Satellite (SARSAT) ground stations. CAL provides a full capability station including processing channels for 121.5, 243, 406 MHz, and it is capable of remote unattended fully automatic operation. Other activities include custom software development, typically for real time signal or data processing applications. Experience is available in the normal languages, including Ada, and CAL has the capability to develop software to MIL SPEC 1679.

Average Work Force: Scientists & Engineers – 105
Others – 30

Gross Sales: 1982/83 – \$ 8.0M
1983/84 – \$14.0M

Plant Size: 52,000 sq ft (Including clean rooms, production area, development laboratories, antenna range, military secure area with TEMPEST shielded room)

Experience: CAL has developed an excellent reputation for performing challenging programs, in a professional, reliable manner. The company's record with respect to schedule and budgets is excellent. Their contracts have typically been divided between the Canadian Government (60%), NASA (20%) and others (20%). Canadian Government departments include Communications; National Defense; Environment; Energy, Mines and Resources; and National Research Council. Private customers include Telesat Canada, Atomic Energy of Canada, Marconi Space and Defense Systems (UK), MEL (Phillips, UK) European Space Agency, Intelsat, Bell Canada, and others. Cal has no direct contracts with the USAF, but are directly involved via the SARSAT Program. One of the four SARSAT ground stations provided to NASA is located at Scott AFB, IL. CAL can perform to military specifications.

Keywords: 5 = Communications; 6 = Computers; 7 = Electronic; 10 = Image Processing & Optics; 15 = Radar; 17 = Software Services; 18 = Space Systems; 19 = Testing/Test Equipment; Antennas = 7, 15; C3 Systems = 5; Computer Parts = 6; Navigation = 7; Solid State Devices = 7; Environmental Testing = 19; Simulators = 15; Phased Array = 15; Synthetic Aperture = 15; Design to Requirement = 17; Structural Analysis = 17; Structural Design = 17; Communications = 18; Data Reduction = 18; Radar = 15, 18; Ground Stations = 18; Satellite Electronics = 18; System Studies = 18; Remote Sensing = 18; Search & Rescue = 18; Design = 6; Microprocessors = 6, 7; Test Rigs = 19; Electromechanical Design = 19; Electronic Warfare = 7; Signal Processing = 7, 15; Spacecraft Units = 18; Spacecraft Subsystems = 18; Antennas = 18; RF Subsystems = 18; Electro-Optical Equipment = 10, 18; Battery Management Systems = 18; Power Converters = 18; Rad-Hardened Microprocessors = 6, 7, 18; Radar = 15; Planar Array = 15; Side-Looking Airborne Radar = 15; Tactical Signal Simulator = 7.

Revised: Dec 83

CANADIAN GENERAL ELECTRIC COMPANY Ltd

Code: CGE

Address: Aerospace Operations
Industrial Benefits Program-Defense Programs
396 Attwell Drive
Rexdale, Ontario, Canada M9W 5C3

Contact: Mr. Brian Noble, Spec Industrial Benefits Program
– (416) 675-7500 X210

History: Canadian General Electric Company was incorporated in 1892 and is ninety-two percent owned by General Electric Company.

Capability: The Cobourg (Ontario) Plant – one of the largest Canadian custom molders, specialize in thermoplastic injection molding, and thermoset injection & compression molding. They manufacture all types of composite molding for military purposes (e.g., rocket nozzles) and work to MIL SPEC 105.

The St Andrews (Quebec) Plant – specializes in fiberglass wound tubes for underground duct and high pressure pipes. They accept custom orders for military projects, such as,

launch tubes (pud and hand-held) and rocket motor casings, etc., for the US Army.

Average Work Force: 15,869 – Total

Gross Sales: 1982 – \$1.6B

Plant Size: Cobourg Plant – 125,782 sq ft
St Andrews Plant – 50,000 sq ft

Experience: Canadian General Electric works with the Canadian Government, US military and many US and Canadian prime contractors (e.g., General Motors, Xerox, etc.).

Keywords: 1 = Aircraft; 2 = Armament; 12 = Machining; 20 = Miscellaneous; Composite Components = 1, 2, 20; Injection Molding = 2, 12; Launch Tubes = 2; Rocket Nozzles = 2; Rocket Motor Casings = 2.

Revised: Dec 83

CANADIAN MARCONI COMPANY

Code: CMC

Address: 2442 Trenton Ave
Montreal, Quebec, Canada H3P 1Y9

Electronics Group
Avionics Division
Components Division
Radar Division
Data Communications Department
Communications Group
Commercial Communications Division
Special Services Division
Defense Communications Division

Contact: Mr. Jack Howlett, Vice President Admin –
(514) 341-7630, X204

History: Canadian Marconi was incorporated in Montreal in 1903 as the Marconi Wireless Telegraph Company of Canada, primarily for the purpose of operating a transatlantic communications link and a ship-to-shore communications service. The company maintained its interest in communications until the end of the 1950s. In the 1960s, products diversified to include marine radar and airborne navigation systems.

Canadian Marconi has two wholly owned subsidiaries in the US (CMC Electronics, Inc, Eatontown, NJ; and Sun World Circuits Inc, Altamonte Springs, FL). The General Electric Company P.L.C. of London, England owns 51.6% of Canadian Marconi's common stock. The remaining 48.4% is owned by shareholders in the US and Canada.

Capability: Canadian Marconi has expertise in two major fields – Electronics and Communications. The total company capability of potential interest to the USAF can best be shown by describing each of six divisions, all of which are located at the Montreal site, except for the Radar Division which is located at the Kanata, Ontario site.

Avionics Division: The Avionics Division is engaged in the development, engineering, production of aircraft navigation systems, monitoring and display systems, and integrated logistics support.

Doppler Navigation Systems – determine aircraft velocity in forward, side, and vertical axes by transmitting microwave energy to the scattered radiation picked up by a receiver. By feeding this velocity information combined with heading information, to a navigation computer, the aircraft position is calculated and displayed. Doppler Velocity computers and interactive CRT displays,

are available for all types of aircraft over a broad range of performance envelopes.

Systems Control and Data Acquisition Systems – the CMS-790 Modular Supervisory Control System is a new concept in microprocessor-driven display and control for energy management and process-control applications. Each display module comes complete with remote terminal equipment telemetry interface installed and tested.

Omega Navigation Systems – accept coded VLF signals from eight Omega ground stations, and by measuring the phase differences in the signal from a minimum of three stations, simultaneously produce a hyperbolic grid pattern from which the aircraft's position anywhere on the earth's surface can be determined. Several models of the receiver/computer/antenna components provide a complete range of systems suitable for worldwide navigation in military, general aviation, business, and commercial airline aircraft in both rotary and fixed wing. Options for additional use of VLF communication stations are available as are several versions of the basic Omega System for different operating models and user requirements. Extensions of the Omega System to very low cost vehicles, such as drones are under investigation.

Navstar Global Positioning Systems – receive signals from earth-orbiting satellites that continuously transmit information on their own position, orbital parameters, and time. When completed in 1987, the total constellation will be comprised of 18 satellites in several planes mutually inclined at 55 degrees. The airborne system processes the received signals and provides positional accuracy to within 16 meters in each of three planes.

Engine Instruments – use sub-miniature lamps and fiber optics to present information, and have eliminated all dependence upon mechanical devices. In addition to the main feature of saving space in overcrowded cockpits, these instruments are extremely flexible in that sections of the parameter range can be emphasized at will, and they can be color-coded to alert the pilot to dangerous situations and to provide easy readability, thus improving safety and reducing pilot workload. Digital readouts of parameters for very high resolution and redundancy can also be incorporated. A broad spectrum of applications and a variety of designs are features of this product line.

Intelligent Instruments – combine normal sensor inputs with pre-programmed and manually entered data, process them via micro-processors under software control, and display computed parameters to provide performance and analytical information. Typical examples include the Flight Advisory Computer, which calculates and displays the optimum airspeed and altitude for the present gross weight, the gross weight, and the time and fuel remaining. The Status Display Systems prioritizes and displays up to 110 warnings and cautions, up to 1,000 checklist items, and includes facilities for complete maintenance data logging. It features optional voice warning; automatic fault cancellation, storage, and recall; dual redundant processing and power supplies; and channel failure indication. The Data Collection Unit, which can be used in conjunction with the Status Display System, provides for all scheduled and unscheduled maintenance activities by means of plug-in memory modules.

It includes a self-contained, portable microprocessor with an integral thin-film electroluminescent screen, and interchangeable dedicated and general keyboards.

Components Division: The Components Division specializes in a range of custom-built components, products, and services (all to military specification):

Printed Wiring Boards – built to customer specifications with emphasis being placed on very complex designs in multilayer boards, rigid flex and polyimide. Boards are made to military and commercial specifications with a high level of quality control. Circuit packaging (CAD), and photoplotting services are available.

Microcircuits – designed and produced at CMC include thin-film and thick-film hybrid configurations, and microwave integrated circuits usable in applications up to 24 GHz. The products include amplifiers, oscillators, mixers, filters, resistor arrays, multipliers, matching networks, as well as many versions of digital circuits, all of which can be tested to full military specifications.

Magnetic Devices – designed and built to customer specifications. They include various types of transformers, filters, delay lines, and power modules.

Panels and Displays – integrally illuminated panels to MIL-P-7788, and high-brightness, ruggedized alphanumeric displays, tactile keyboards, and annunciators. New activities include night vision goggle compatible panels and electroluminescent display technology.

Military Power Supplies – designed and produced for aircraft, ground equipment, and missile applications. In-house magnetic, PCB, machining, and power hybrid component production ensure high-quality and effective cost and schedule control.

Radar Division: The Radar Division specializes in the development, engineering, and production of surveillance radar:

Naval Surveillance Radar – the AN/SPS 503 is a light-weight S-band surveillance radar for use on ships over 300 tons. It has a double curvature parabolic antenna enclosed in a radome, an MTI signal processor, and a frequency agile transmitter.

Data Communications Department – a product line introduced in 1975 that provides central office equipment for Telex/Data networks. The product design emphasizes large numbers of connections and non-blocking operation, with current designs allowing for up to 30,000 switched circuits connected through a fully folded, fully available switch block at speeds of 50 to 9,600 bps, with all current accepted protocols and special customer services and features.

Commercial Communications Division (CCD): CCD is primarily engaged in the production of high grade commercial communications and other radar equipment and systems. These products, however, frequently find application in military operations:

Radar – Comprises the LN66Hp, 75 kW surveillance radar used on the LAMPS MK1 helicopter. It has also been used in fast patrol boat fire control systems and other specialized applications. The LN66, 10 kW, is widely used by the US Navy as a type II radar on large ships and a type IV radar on small boats. The LN66SP, 3 kW, porta-

ble radar is currently installed as a secondary radar on the Trident submarines.

HF/SSB Radio – fully synthesized transmitters, receivers, and transceivers cover the frequency range 1.6 – 30 MHz in configurations including vehicle-mounted mobile stations and desk-top and rack-mounted fixed stations. Output powers are available from 100 Watts to 1000 Watts PEP. Optional facilities include remote controls, RTTY, low-speed data, and scramblers.

RACE (Adaptive HF/SSB) – this new product uses the HF/SSB transmitters/receivers listed above and complements them with a controller which has a real-time channel evaluation system as well as an Automatic Telephone Interconnect. There are two basic products – a single master system which can sustain one simultaneous telephone conversation, but serve up to 16 remote units – and a multiple master system which can sustain up to four simultaneous telephone conversations and serve up to 64 remote units. Telex and RTTY can be provided as optional features.

Communications Systems – the Commercial Communications Division designs and manufactures complete communication systems in the HF/UHF/VHF bands, including base stations, repeaters, mobiles, consoles, remote controls, supervisory equipment, etc. Full turnkey systems can be designed, manufactured, installed and commissioned.

Defense Communications Division: The Defense Communications Division specializes in military tactical communications:

Tactical Radio Relay – the AN/GRC-103 Radio Set operates in the 220 to 1850 MHz frequency range in four frequency bands. The radio set will accommodate frequency division multiplex (FDM) or time division multiplex (TDM) equipment. The TDM equipment may be pulse code modulation (PCM) or delta modulation (DM) multiplexers. Associated with the radio set is a test facility, the AN/GRM-95, used as a depot maintenance facility. The test facility is now available to test all four frequency bands of the radio. The AN/GRC-103 in conjunction with multiplexer equipment is configured into standard US Army systems, e.g., AN/TRC-113, AN/TRC-145.

Multiplexers – the TD-5064 is a 16-channel delta modulation multiplexer which replaces PCM equipment in TDM systems. By stacking 4 sets of the TD-5064, 63 traffic channels can be provided. The MTD-212M is a unit which combines the outputs of two 12-channel PCM multiplexers to provide a single 24-channel stream for ease of transmission and separates the two 12-channel streams at the receive end.

Tactical Switchboards – the SB-4170/TT is a microprocessor-controlled, 12-line semi-automatic, cordless field telephone switchboard. Two SB-4170s may be stacked to provide a 24-channel capability. A built-in Net Radio Interface (NRI) allows the SB-4170/TT to connect directly to a base radio without the need for a separate radio-wire integrator. This provides direct communication between the switchboard's landline subscribers and any compatible radios in the net.

Radio Wire Integrator – the C11416/G Radio Set Control provides a capability to enable single channel net radios to be connected to the switched telephone network.

Conditioned Diphas Adapter – this unit enables radio, multiplexer, crypto and secure orderwire units to be configured as a digital communications system.

Line Terminating unit – this unit allows the multiplexer to be separated from its radio by a distance of up to 2 km.

Special Services Division: The Special Services Division performs a variety of services including the installation, operation, maintenance of equipment and antennas at large radar and communications sites; repair and overhaul of all types of military electronic systems; repair, overhaul and calibration of electronic test instruments; and repair and calibration of secondary and primary standards, both mechanical and electronic. The Special Services Division has a long history of satisfactory transactions with USAF units.

Average Work Force: Engineers – 254
Technologists – 573
Others – 2054
Total – 2881

Gross Sales: 1979/80 – \$107.0M
1980/81 – \$123.0M
1981/82 – \$144.0M
1982/83 – \$198.0M

Plant Size: Montreal – 500,000 sq ft
Kanata – 50,000 sq ft

Equipment: CMC has a wide variety of specialized production and test equipment including an Anechoic Antenna Test Range, Automated Test Equipment, EMI/EMC testing to 1 GHz, and environmental testing facilities to all major MIL standards. In addition, complete facilities are available for component manufacture of specialized items, and assembly of electronic components and systems to customer design or specifications.

Experience: Canadian Marconi Company has provided systems, equipment, components and services to every branch of the US DOD and the US Coast Guard over the past 22 years, meeting all military specifications satisfactorily. The products of CMC, military and commercial, are exported regularly to 94 countries world-wide. The company has been granted every Mil Spec available.

Keywords: 1 = Aircraft; 3 = Avionics; 5 = Communications; 7 = Electronics; 10 = Image Processing & Optics; 12 = Machining; 13 = Missiles; 15 = Radar; 19 = Testing/Test Equipment; Doppler Navigation Systems = 3; Omega Navigation Systems = 3; Navstar/GPS = 3; Engine Instruments = 1, 3; Intelligent Instruments = 1, 3; Photogrammetry = 10; Data Communications = 5, 7; Tactical Radio Relay = 5; Multiplexer = 5; Tactical Switchboards = 5; Radio Wire Integrator = 5; ECCM Radio = 5; Digital Order Wire = 5; Power Supplies = 1, 7, 13; Radio Ancillaries = 5; Adapters = 5; Line Terminating Unit = 5; Surveillance = 15; PC Boards = 7; Circuit Packaging = 7; Microcircuits = 7; Thin Film Hybrid = 7; Thick Film Hybrid = 7; Magnetic Devices = 7; Transformers = 7; Displays = 1, 3; Illuminated Panels = 1, 3; Injection Molding = 12; Welding = 12; Precision Machining = 12; Radios = 5; Repair & Overhaul = 3, 7, 19; Calibration = 19; Components = 3, 5, 7; Photoplatting = 7; Navigation = 3; Radar = 15.

Revised: Dec 83

CANADIAN THERMOSTATS AND CONTROL DEVICES Ltd

Code: CTC

Address: 8415 Mountain Sights Ave
Montreal, Quebec, Canada H4P 2B8

Contact: Mr. Richard Marquis, General Manager -
(514) 739-3274

History: CanTherm was founded in late 1977 to continue the manufacturing and research program previously carried out by the defunct Multi-State Devices Ltd. They are closely associated with Microtherm GmbH of Pforzheim, West Germany, the leading European manufacturer of bimetallic temperature control devices.

Capability: With its acquisition of MSD, CanTherm inherited an active R&D department which has continued to expand in many areas of microelectronics and thermal control. Their first order of priority was to finalize the Moxie from a laboratory prototype to a reproducible chip. They have expertise in the fields of metallurgy, vacuum system depositions (sputtering), and semiconductor production techniques as a result of their initial projects. Early on, they were awarded a two year development grant from the Canadian National Research Council to develop a thin film thermister with tolerances $\pm 1\%$ at 25°C. Other specifications included maximum interchangeability and volume productibility at a market acceptable cost. The project was successfully completed within two years and the product is in the North American and European markets.

Average Work Force: Total - 12

Gross Sales: No Data

Plant Size: 5,000 sq ft (manufacturing)

Experience: CanTherm's product market is world wide. On the North American continent, they work with the Canadian Government, industry, and have an on-going contract with the USAF.

Keywords: 4 = Chemistry; 7 = Electronics; 9 = Environment; Microelectronics = 7; Thermal Control = 7; Chips = 7; Metallurgy = 4; Vacuum Deposition = 4; Sputtering = 4; Semiconductor = 7; Thin Film = 7; Thermister = 7; Environmental Sensor = 9; Solid State Devices = 7.

Revised: Dec 83

CARDION ELECTRONICS/DG INSTRUMENTS (Division of General Signal Ltd)

Code: DGI

Address: Regional Road 5
RR #2
Carp, Ontario, Canada K0A 1L0

Contact: John T Dale, Marketing Manager - (613) 839-5710

History: Formerly operated under the name DG Instruments Ltd, Cardion Electronics/DG Instruments is a Canadian owned company founded by four former employees of Leigh Instruments Ltd and incorporated in Jan 1974. DG Instruments was acquired by General Signal Ltd in February 1982. They report to Cardion Electronics, a unit of General Signal Corp, Woodbury, NY.

Capability: Cardion/DGI specializes in the design, development, test and manufacture of electronic instruments and systems for both military and commercial applications. Customers are primarily in Air Traffic Control, Avionics, Meteorological Marine, and Hydrographic Services. Systems include solid state ATIS recorder, portable ATC trainer, VOR ground check, solid state anemometer, helicopter air data system, electronic ice measurement, submersible tide gauge, hydrographic navigator, and ships propeller RPM indicating systems.

Average Work Force: Engineers - 8
Others - 32

Gross Sales: No Data

Plant Size: 13,800 sq ft

Experience: Cardion/DGI has completed a contract with Cubic Corporation to manufacture and test electronic subsystems associated with the ACMR tactical trainer for the CF-18A. They have completed delivery of a contract to supply Canadian DND with 27 Air Control Indicators - total value \$4M, and have commenced delivery of an additional five systems. Major customers in the Canadian Government include Departments of National Defense; Transport; Fisheries & Oceans; Energy, Mines & Resources; Communications; and Environment.

Keywords: 3 = Avionics; 7 = Electronics; 20 = Miscellaneous; Solid State Devices = 3, 7, 20; Recorders = 7; Air Traffic Control Simulators = 7, 20; VOR Ground Check Systems = 7; Anemometer = 7; Helicopter Air Data Systems = 3; Ice Measurement = 7; Tide Gauge = 20; Navigation = 7, 20; Ship Instruments = 7, 20; Tactical Trainer Subsystems = 20; Air Control Indicators = 7, 20; Instrumentation = 3, 7, 20.

Revised: Dec 83

CARR-TECH SERVICES Ltd

Code: CTS

Address: 450 Tapscott Road
Scarborough, Ontario, Canada M1B 1Y

Contact: Mr. R G Baldock, President - (416) 293-6400

History: Carr-Tech Services Ltd is a chartered, privately owned Canadian company with roots in the aerospace industry going back to 1947 when its founder, Mr. R J Carriere, first began servicing aircraft at Toronto Island Airport.

Capability: The company is engaged in engineering, manufacturing, repair, overhaul, and field service operations involving military and commercial aircraft electronic, electrical and hydraulic accessory equipment; electrically controlled hot water dispensing systems for aircraft; and diesel, gasoline, or electrically driven ground power equipment. Other capabilities include custom designed power generation equipment for standby and prime source applications together with related electronic control, monitoring and protection equipment for the industrial, commercial transportation and agricultural markets.

Carr-Tech can also undertake subcontract programs (including custom designed or built to specification) for the manufacture of power supplies, regulators, inverters, control and annunciator panels, air and ground rotating beacons, landing lights, portable and emergency lighting equipment.

Carr-Tech Services Ltd implements a well established quality assurance program to ensure that all products and services supplied by the company are controlled to obtain the best possible quality and reliability, commensurate with economical and competitive cost considerations. The Chief Inspector of their Quality Control Department has over 25 years experience in aerospace and industrial quality control practices and procedures.

Carr-Tech's inspection organization and facilities are approved by the Department of Transport in respect of products supplied for use in civil registered aircraft and their Quality Control operation is recognized by the Department of National Defense as meeting the requirements of DND Specifications 1015 (MIL-Q-9858A), 1016 (MIL-I-45208), 1017, and 1019. In

addition, their Quality Program standards meet or exceed CSA Standard 299.2.

Average Work Force: Engineers/Technicians - 6
Production - 18
Others - 16

Gross Sales: 1982 - \$2.0M
1983 - \$2.3M (Projected)

Plant Size: 27,000 sq ft

Equipment: Carr-Tech's production facilities are suitable for low quantity production runs and the manufacture of experimental and prototype equipment lathes, milling machines, drills, punch presses, shears, welding equipment, riveters, grinders, paint spray booth, ovens, etc.

Test instrumentation includes electrically driven test stands for generators, voltage regulators and control equipment; Bosch fuel injectors and fuel pump testers; hydraulic and fuel test stands for large capacity high pressure equipment; test stands for speed switches, tachometer generators and other instrumentation. Precision electrical and electronic measuring equipment is calibrated regularly to NRC standards.

Experience: Carr-Tech Services Ltd is an approved supplier of services and qualified products to such companies as Aerospatiale, Air Canada, Boeing Aircraft, Canadair, deHavilland, McDonnell Douglas and Wardair, plus the Canadian Government (DND and DOT), and various provincial government departments.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 8 = Energy; 9 = Environment; 14 = Protective Equipment; 16 = Security & Safety; 19 = Testing/Test Equipment; 20 = Miscellaneous; Repair & Overhaul = 1, 3, 7, 8, 14, 19; Solid State Devices = 7, 8, 14, 19; Design & Build To Requirements = 7, 8, 14, 19, 20; Standby Power Generating Equipment = 7, 8, 9, 14, 16, 19, 20; Beverage Dispensing Systems = 1, 7; Toilet Hot Water Systems = 1, 7; Lighting Equipment = 1, 7, 8, 9, 14, 16, 20; Prime Power Generating Equipment = 7, 8, 9, 14, 16, 19, 20; Power Generating Equipment = 7, 8, 9, 14, 16, 19, 20.

Revised: Dec 83

CASEY COPTER ACCESSORIES Ltd

Code: CCA

Address: P. O. Box 121
Montreal Airport
Dorval, Quebec, Canada H4Y 1A5

Contact: Mr. M J Casey, Vice President - (514) 636-6155

History: Casey Copter Accessories Ltd is a small Canadian owned company founded in 1975 with no other Canadian divisions. There is a US subsidiary that is currently inactive.

Capability: The sole product of this small Canadian company is the Casey Shroud Heater System. The system is designed for maximum reliability with minimal moving parts and positive mechanical linkages for all controls. This passive heater system is based on the air-to-air heat exchanger principle requiring minimal maintenance. Use of the heater system does not reduce range, restrict airspeed, nor reduce rate of climb because it does not require bleed air or fuel. The heater system will provide a cabin temperature of 15°C at an outside temperature of -40°C, a 30 pound weight saving over combustion heaters, and a high output (over 50,000 BTU/hr). It has proven reliability in Arctic conditions. The Casey Shroud Heater fits all Allison 250 series engines in fixed or rotary wing aircraft. It is Supplemental Type Certified by the US DOT/FAA.

Average Work Force: Engineers - 3
Others - 6
Inspection - 1

Gross Sales: \$1.0M (Historical)
\$1.1M (Projected)

Plant Size: 6,000 sq ft

Experience: The Casey Heater System is currently being used by various departments of the Canadian Federal and Provincial Governments, governments of other countries, US State Governments, and in wide use with Army National Guards and the US Army (Alaska area). It is estimated that 75-80% of the total sales are to the US (10% to the National Guards). Currently there has never been any sales to the USAF. They are interested in doing business with the USAF.

Keywords: 1 = Aircraft; Helicopter Heater Systems = 1; Repair & Overhaul = 1.

Revised: Dec 83

CHICOPEE MANUFACTURING Ltd

Code: CHI

Address: 975 Wilson Ave
Kitchener, Ontario, Canada N2C 1J1

Contact: Mr. David Belanger, VP Marketing & Operations - (519) 893-7575

History: Chicopee Manufacturing Ltd is a private, wholly owned Canadian company incorporated under the laws of Ontario in 1967.

Capability: The company specializes in precision machining of medium to large complex components to close tolerances from high strength steels, titanium and aluminum alloys for the aerospace and other related industries. Technical knowledge combined with state-of-the-art equipment enables the company to deliver a wide range of such quality products including aircraft structural components, landing gear components, helicopter hubs, helicopter retentions, hydraulic actuators, precision parts for Canada's space arm, and machined components for other space vehicles and equipment.

Chicopee maintains strict quality control and has approvals from most of the major aerospace companies and in addition, complies with the requirements of DND 1015, MIL-Q-9858, and CSA Z 299.3. Procedures call for first-off inspection of every manufacturing operation, as well as 100% final inspection of all critical dimensions. Reverse traceability of materials, parts and processes is guaranteed.

Average Work Force: 180 (Total)

Gross Sales: No Data

Plant Size: 100,000 sq ft

Equipment: Equipment consists of a full range of CNC and NC profile milling machines including a five-axis CNC gantry profile milling machine; a four-axis CNC travelling column machining center with automatic tool changer; hydraulic trace profile milling machines; vertical, horizontal and universal mills; CNC and conventional lathes; boring mills; drilling and grinding tools and all other necessary support equipment to produce precision custom products.

Experience: Present customers include: The Boeing Co, Boeing Military Airplane Co, Cleveland Pneumatic Co, DAF Indal Ltd, The deHavilland Aircraft of Canada Ltd, Ernst Leitz Canada Ltd, Fairchild Republic Ltd, Fleet Industries, Kaman

Aerospace Corp, Lockheed Aircraft Corp, McDonnell Douglas Canada Ltd, McDonnell Douglas Corp, Martin Marietta Aerospace, and Spar Aerospace.

1981/1982 - \$0.260M
1982/1983 - \$0.320M

Keywords: 1 = Aircraft; 12 = Machining; 18 = Space Systems; Precision Machining = 12; Machining = 12; High Strength Steels = 12; Titanium = 12; Aluminum Alloys = 12; Structural Components = 1, 12; Landing Gear Components = 1, 12; Helicopter Hubs = 1, 12; Helicopter Retentions = 1, 12; Hydraulic Actuators = 1, 12; Precision Parts = 1, 12, 18; CNC Machining = 12.

Revised: Dec 83

COLLINS & MOON Ltd

Code: CAM

Address: 435 Stone Road W, Suite #215
Guelph, Ontario, Canada N1G 2X6

Contact: Mr. Tim Lehan, General Manager - (519) 836-3844

History: Collins & Moon Ltd was incorporated in Ontario in mid-1978.

Capability: Collins & Moon is a computer systems development and sales organization with emphasis on Data Base Management Systems; Software Development; Spatial Information Systems; Numerical and Statistical Analysis, Digital Terrain Analysis and Mapping; Computer Graphics; Hydrologic Analysis and Mapping; Geographic Information Systems; and Thematic Analysis, Mapping and Display.

Collins & Moon has built a library of software on some fundamental ideas about the management and analysis of terrain-related data. For example, a paper by Collins appearing in a 1975 Canadian Surveyor describes an algorithm that provides a complete analysis of a watershed, including the areas and volumes of all potential water storage basins and the boundaries between them. It remains unique in the field of digital elevation model analysis, and several practical simplified methods of watershed analysis have been derived from it. One notable derivative of this algorithm is an extremely fast method of contour drawing that can be applied to dense grid models of nearly one million points.

Prior to incorporation, successive version of THEMAPS were developed. THEMAPS is a program system that derives thematic maps from a variety of input sources using logical or arithmetic algebra. The capabilities of THEMAPS are such that thematic mapping can be supported by simplified data structures. The THEMAPS system, for example, has been applied to mapping the speeds of traverse of army vehicles over varied terrain.

Collins & Moon has completed some unique programs for terrain analysis. An example is a program that finds the intersections of linear features stored in a raster format. This was a problem of long standing in computer cartography and has been solved in an extremely simple and competent way. Other programs determine adjacencies of terrain features.

Another program which was developed ab initio by the company is one that maps the depth-below-line-of-sight for a radar installation. It handles large terrain models in reasonable computer times.

Average Work Force: Engineer - 1
Agrologist - 1
Computer Scientists - 2
Others - 3
Others available
on part-time basis - 3

Gross Sales: 1979/1980 - \$0.127M
1980/1981 - \$0.163M

Plant Size: 800 sq ft

Equipment: Equipment employed by Collins & Moon include software development connections to Ahmdahl V5 computer; DEC VAX 11/780 computer, VMS operating system; DEC PDP 11 series, IBM 5150 and 68000 based computers; UNIX operating systems; PE 32 bit machine running UNIX; Digitizers; Plotters - Applicon, Versatec, Calcomp, Jet-ink; and Monochromatic and Color CRTs currently supporting Tektronix 4050 series and the 4027, Ramtek 6,000 series, Norpak VDP and RDS display systems.

Experience: In the areas of data base management, spatial analysis, and geographic information systems, Collins & Moon has completed the first phase of a multi-year contract that calls for the design of a complete spatial analysis system that will include a geographic formation system that will use as major components existing relational and other data base management systems. The system being designed will be called upon to provide interactive input of spatial information, compact and convenient storage of every type of multi-dimensional spatial data, very fast retrieval of some types of data for simulation of strategic and tactical situations and a full range of graphical and CRT display systems. This work is being carried out for the Canadian Defense and Civil Institute of Environmental Medicine.

Collins & Moon has developed a highly competent system of data entry, storage, retrieval and display that contains a powerful query and analysis system that is especially suitable for cartography and thematic mapping. The principal applications to date have been to Vehicle Mobility mapping for the Canadian Forces, and the system is now being applied to environmental mapping for the US Geological Survey. The system is highly interactive and thus can be used by untrained personnel. On the other hand, it provides the frame work of data input, management and display that may be effectively used by experienced scientists in carrying out extensive and complicated terrain analyses. This system accepts data in polygon or raster forms, stores it in well-designed file structures, applies a powerful querying system in logical or arithmetic algebra, provides output data in polygon or raster form (independent of the input format), and creates plot files and display data for computer driven plotters, raster plotters and raster (CRT) display systems of common types.

In the area of hydrology, Collins & Moon has completed work for the Ontario Department of Natural Resources. During the course of their work in the hydrographic analysis area, the company analyzed digital elevation models in dense grid format and the work was supportive of hydrological terrain assessment. The analysis of dense-grid digital elevation models, the methods of creating such models, are particular fields of expertise of the company. Software has been developed that carried out a complete watershed analysis from such a model, providing watershed boundaries, saddle points, runoff contributing areas, volumes and areas of water storage, flow quantities and drainage patterns, and other parameters.

Digital Elevation Model techniques have been developed and exploited for drawing contours, slope maps, maps of obstructions to vehicles, and Radar Masking (hidden ground and air space) maps. Programs have been developed for creating Digital Elevation Models from contours and characteristic lines, and a number of new algorithms for this purpose are now the subject of research. Programs have been delivered to the Canada Center for Remote Sensing that attach elevations to each of the pixels of Landsat imagery.

Collins & Moon has created and implemented programs for attaching thematic information, derived from line-drawn maps to pixels of Landsat images; and for the converse process, converting the pixels of a processed Landsat image into polygonal format for hard copy cartography and for CRT display.

Together with their thematic mapping programs, these programs effectively unite Landsat imagery directly with classical cartography, allowing the same methods of basic data management for both.

Collins & Moon has carried out projects for the Air Operations Research Branch of the Canadian Department of National Defense and for the Defense Research Establishment (Suffield). These projects involved the development of a program to produce maps of terrain visible from a long range radar, data base systems for terrain data computation and map production and a study for the creation and implementation of software for terrain analysis and display.

Keywords: 6 = Computers; 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 15 = Radar; 17 = Software Services; 20 = Miscellaneous; Mapping = 8, 9, 10, 15, 17, 20; Data Acquisition = 8, 9, 10, 15, 17, 20; Data Processing = 8, 9, 10, 15, 17, 20; Interactive Processing = 17; Geologic Analysis = 8, 9, 17, 20; Geographic Analysis = 8, 9, 17, 20; Thematic Analysis = 8, 9, 10, 15, 17, 20; Thematic Mapping = 8, 9, 10, 15, 17, 20; Thematic Display = 8, 9, 10, 15, 17, 20; Software Development = 17; Geographic Information Systems = 8, 9, 17, 20; Computer Graphics = 17; Digital = 8, 9, 17, 20; Spatial Information Systems = 9, 17; Numerical Analysis = 17; Statistical Analysis = 17; Systems Development = 6; Terrain Analysis = 8, 9, 10, 15, 17, 20; Hydrologic Analysis = 8, 9, 17, 20; Hydrologic Mapping = 8, 9, 17, 20; Data Management = 8, 9, 10, 15, 17, 20.

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COM DEV Ltd

Code: CDL

Address: 155 Sheldon Drive
Cambridge, Ontario, Canada N1R 7H6

Contact: Mr. M V O'Donovan, President - (519) 622-2300

History: COM DEV was incorporated federally in 1971 and is a Canadian high technology company.

Capability: COM DEV designs and manufactures microwave and SAW enhanced subsystems for communications satellites, earth stations and radar systems.

Communications Satellite Products - Contiguous and non-contiguous dual mode output multiplexers; group delay and amplitude equalized input multiplexers; high power waveguide and low power coax isolators; low pass harmonic reject filters; telemetry, command and preselect filters; adaptive variable power dividers and combiners; and polarization switches and beam reconfiguring subsystems.

Earth Terminal Products - High power microwave components and subsystems including filters, diplexers, combiners, isolators and terminations; low-loss transmit reject filters; interdigital and coax filter-isolator assemblies.

Surface Acoustic Wave (SAW) Products - Advanced signal processing components and subassemblies for radar and satellite communications, e.g., filters, delay lines, convolvers, SAW oscillators and synthesizers, code and chirp waveform generators.

Consulting Services - Studies undertaken on trade-offs, optimization and hardware design aspects of the microwave subsystems used in communications satellites.

Research and Development - Fin line techniques at frequencies above 20 GHz; SAW devices as signal pro-

cessing element in digital communications and radar systems; high power ferrite technology and beam reconfiguring networks.

Average Work Force: Technical Staff - 90
Manufacturing, Management
and Support Staff - 123

Gross Sales: 1980 - \$ 2.9M
1981 - \$ 4.6M
1982 - \$ 9.6M
1983 - \$18.0M

Plant Size: 40,000 sq ft - expansion to 69,000 sq ft to be completed by Mar 84.

Equipment: Computers are used extensively for design (CAD), manufacture (CAM) and testing (CAT). There are automatic test facilities to measure product performance, terminal vacuum chambers to test performance in a simulated space environment, and shock and vibration equipment to simulate conditions in the nose cone of a Delta or Atlas Centaur rocket or in the Space Shuttle. The MIC-SAW facility includes a specially lighted, class 10,000 clean room. The plating facility is equipped to produce very high quality nickel, copper and silver plating, primarily on invar and aluminum parts.

Experience: More than forty communications satellites scheduled for launch by 1986 will carry equipment designed and manufactured by COM DEV, and virtually every major builder of earth stations in the western world used some COM DEV components. Customers include Hughes Aircraft, RCA, Ford Aerospace, SPAR Aerospace, Marconi (UK), and the Canadian Government.

Keywords: 5 = Communications; 7 = Electronics; 15 = Radar; 18 = Space Systems; Satellite Subsystems = 5, 7, 18; Microwave Subsystems = 5, 7, 15, 18; Surface Acoustic Wave Subsystems = 5, 7, 15, 18.

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COMINCO Ltd (Electronic Materials Division)

Code: COM

Address: Cominco Ltd
Trail, British Columbia, Canada V1R 4L8

Cominco Electronic Materials Inc
E 15128 Euclid Ave
Spokane, Washington 99216

Contact: (Canada) Mr H E Hirsch, Manager, Technical Research - (604) 364-4426
(Canada) Mr R F Redden, Development Superintendent - (604) 364-4751
(US) Mr D L Guettinger, Manager, CEMI Sales - (509) 922-8614

History: Cominco Ltd was incorporated in 1906 and is 91% Canadian owned. Other Canadian locations include - a Head Office at 200 Granville St, Vancouver, British Columbia V6C 2R2; Group Offices in Trail, British Columbia - Calgary, Alberta - Yellowknife, NWT; and Research Centers in Trail, British Columbia and Sheridan Park, Ontario. Other US locations (Electronic Materials) can be found in California - Chicago, Ill - and Hartford, Conn.

Capability: Cominco is the world's largest producer of zinc and lead with significant output of many by-product metals and chemical fertilizers.

Electronic Materials Division Production:

- *High Purity Metals* – 17 different metals each in several degrees of high purity and shapes.
- *High Purity Arsenic* – 49 to 79 grade arsenic in various allotropic crystal forms and shapes. Largest plant of its kind in the world.
- *Semiconductors* – single crystal boules and polished wafers of gallium arsenide, indium antimonide, cadmium telluride, cadmium mercury telluride, gallium antimonide, and indium arsenide, germanium and epitaxial cadmium mercury telluride.
- *High Purity Metals Fabrication* – alloying, casting, rolling, extrusion, stamping and machinery operations to produce semiconductor processing and packaging materials e.g., evaporation charges, sputtering targets, solder preforms, bonding wires, and ribbons. A well equipped precision tool and die shop serves both Production and Development.

Electronic Materials Division Development:

R&D is directed toward new metal/metal compounds and semiconductor processes, product advancement, and production equipment.

Average Work Force: Whole Company – 10,797
Electronic Materials Div – 241

Electronic Materials Div
(Trail, British Columbia)
Engineers – 18
PhDs – 2
Machinists – 5
Others – 66

(Spokane, Washington)
Engineers – 5
PhDs – 4
Machinists – 7
Others – 134

Gross Sales: 1982 – \$1,235M (Whole Company)
1982 – \$37M (Electronic Materials Div)

Plant Size: Electronic Materials Division
(Trail, BC) – 80,000 sq ft
(Spokane, WA) – 80,000 sq ft

Equipment: Melbourn high pressure Czochralski Crystal Growers; custom built metal refining equipment; custom built crystal slicing, fabrication and polishing facilities; and high purity metals fabrication equipment.

Experience: Cominco has been in the electronic materials business since 1949 and has supplied materials to most major US electronic companies.

Keywords: 4 = Chemistry; 7 = Electronics;
20 = Miscellaneous; High Purity Metals = 4; Compound Semiconductor Wafers = 4, 7; Semiconductors = 4, 7; Infrared Materials = 7; Bonding Wire & Ribbons = 20; Sputtering Targets = 7; Solder Preforms = 7; Evaporation Charges = 4; Metallurgy = 4; Semiconductor Wafers = 4, 7.

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COMPUTING DEVICES COMPANY

Code: CDC

Address: P. O. Box 8508
Ottawa, Ontario, Canada K1G 3M9

Contact: Mr. G M Mount, Sr Vice President – (613) 596-7105
Mr. Jack G Warner, Dir, International Marketing – (613) 596-7060

History: Computing Devices is a high technology company that has been a division of Control Data Canada Ltd since 1969. The company was established in 1948. It is involved in the manufacture and supply of advanced electronic systems. The company maintains sales representatives in over twenty-three countries.

Capability: Computing Devices' technology areas include acoustic signal processing systems for ASW applications for airborne, shore and undersea vehicles; digital ballistic computer systems for vehicle & portable installations; air navigation display systems; electronic intrusion detection systems; command & control display systems for ships; and jet engine thrust measurement systems. Specifically, the company developed, and is manufacturing an acoustic data processor (Preselectable Mainband Processor, PMP-8). This ASW system is designed for monitoring omnidirectional passive sonobuoys from aircraft. The company also has similar, but more complex, acoustic processing ASW equipment in airborne platforms with the Royal Air Force and the Royal Australian Air Force. Another system, the Standard Multi-Sensor Digital Display, is designed for the Canadian Navy use under the concept of Shipboard Integrated Processing and Display System. They have also developed and manufactured a Micro-processor Digital Computer System according to a Chrysler specification for the fire control system of the M-1 main battle tank. They have produced approximately 3000 systems at this time. Their Projected Map Display is for use in a variety of aircraft from tactical fighters and helicopters, to supersonic transports. This system has been used on the US Navy A-7 aircraft for over 8 years and has been accepted for the USAF Pavelow III Rescue Helicopter Program. They are currently involved in the shared development Ported Coaxial Cable Sensor Program with the BISS SPO at Electronics Systems Division (ESD). The program goal is to develop and test buried cable detection systems for outside security application. The program start date was mid-1976 and is currently in the FSED phase. Initial production deliveries for DOD requirements are scheduled for the 1983-89 time frame. The program has had many spinoffs. GUIDAR is their commercial product. They also developed a system (Thrust Computing System) to compute (from measured pressures) the gross thrust of afterburning turbojet and turbofan engines. The technology has been proven in NASA high altitude test cells on the J85, J79, TF30 and F100 engines, and on the T38/J85-5 system on the Edwards AFB thrust stand. A maintenance application of the technology has been adopted by the USAF for its Air Training Command T-38 fleet for installed engine trimming on the flight-line called Thrust Computing Support Equipment (TCSE). NASA was also using the technology in the HIMAT program. This was also a shared development program between the USAF and the Canadian Government completed in late 1978. Their design, development and production capabilities have been effectively demonstrated. They perform to military specifications. Contract manufacturing (offset business) accounts for 20% of their business. This is currently accomplished for Hughes Aircraft Company for the joint Surveillance System.

Average Work Force: Professionals – 225
Total – 800

Gross Sales: \$54M (Historically)
\$62M (Current)
\$80M (Projected)

Plant Size: 295,000 sq ft (three buildings)
400 acres (Stittsville Research Facility)

Experience: As seen under Capability Section, CDC has experience with the US military (approx 50% of their total sales). They have considerable production capability.

Keywords: 1 = Aircraft; 3 = Avionics; 6 = Computers;
7 = Electronics; 15 = Radar; 16 = Security & Safety;

20 = Miscellaneous; Cockpit Displays = 3; Data Handling = 1, 3, 7; Data Analysis = 1, 3, 7; Engine Controls = 1; Flight Data Recorders = 1, 3; Voice Recorders = 1; Instruments = 1, 3; Navigation = 1, 3, 15; Performance Measuring Device = 1; Engine Thrust Measuring Device = 1; Acoustic Sensing = 7, 20; C3 Systems = 7, 20; Computer Systems = 3, 6; Computer Parts = 6; Data Acquisition = 1, 3, 7, 20; Repair & Overhaul = 3, 6, 7; Video Display Systems = 3, 7, 20; Voltage Transformers = 7; Regulators = 7; Projected Map Displays = 1, 20; Intrusion Detection = 16; Signal Processing Systems = 1, 20; Ballistic Computer Systems = 20; ASW System = 1, 20; Fire Control System = 20.

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CTF SYSTEMS Inc

Code: CTF

Address: 15-1750 McLean Ave
Port Coquitlam, British Columbia, Canada
V3C 1M9

Contact: Dr Max B Burbank, President - (604) 941-8561

History: CTF Systems is a high technology company created in 1970 by a group of young physicists from Western Canada. The primary goal of the company over the past decade has been the development and manufacture of instrumentation and systems allied to the fields of electronics and applied physics. This goal has materialized through various R&D contracts into three main areas of expertise:

- Cryogenic & SQUID (an acronym for Superconducting Quantum Interference Device) Technology.
- Ultrasonic Non-Destructive Evaluation (NDE).
- Applied Microprocessor Technology.

Capability: CTF's expertise is outlined below:

Cryogenic and SQUID Technology - CTF Systems has developed and/or advanced the technology through innovation in several areas of cryogenics and SQUID magnetometry. These areas include:

Cryogenic liquid containers (Dewars) with unusual designs such as:

Horizontal Dewar - a mobile, random orientation liquid Helium cryostat, suitable for airborne tests and designed to accommodate a 9-component gradiometer/magnetometer array using SQUID sensors.

Large Access Vertical Dewar - a non-magnetic, non-metallic 12 inch diameter dewar for ground testing the 9-component SQUID array.

Room Temperature Access Dewar - a two dewar combination with an "inverted" inner dewar to permit rock samples to be measured at room temperature inside a superconducting coil assembly.

Low Noise Biogradiometer Dewar - a cryostat with a 1 cm thermal gap at the lower end to allow positioning of the coil close to biomagnetic sources. Dewar tail materials are screened, selected and assembled so as to minimize the effect of environmental magnetic noise on the signal.

SQUID Sensor Design - The SQUID is an ultra-sensitive cryogenic device which exploits two properties of superconductors - the Josephson effects in tiny superconducting junctions and the quantization of magnetic flux in closed superconducting loops. A complete CTF SQUID system consists of a superconducting flux transformer; a basic SQUID sensor; RF amplifier/detector and analog feedback circuitry; and circuitry to digitize, filter, resample and transmit data to recording or signal processing equipment. The superconducting flux transformer (which is noiseless) can enhance the basic sensor flux sensitivity by a factor of 50 or more with true DC response. By appropriate configuration of this flux transformer, the SQUID system can sense specific magnetic field vectors, or 1st, 2nd, or 3rd spatial gradient tensor components. A number of specialized flux transformers have been designed and constructed by CTF in recent years, including the following advanced magnetometer systems:

Airborne Gradiometer - a 9-channel SQUID system (6 gradient tensor and 3 field vector components) suitable for mobile applications was designed and developed. Design work was guided by computer simulation to minimize intercomponent interference.

High Sensitivity Station Magnetometer - a 3-component vector magnetometer with a resolution of $10E-10$ gauss rms/SQR(Hz) and a 9-decade dynamic range, without range switching or external counting.

Third Order Biogradiometer - a biomagnetic sensor/dewar combination designed to detect the third spatial gradient with a high sensitivity only to very near sources, rejecting more distant ones. Low frequency (0.3 Hz) signals of the order of $10E-10$ gauss from the brain and other organs are detectable in the presence of more distant magnetic noise sources many orders of magnitude higher. A publication describing the Biogradiometer and its operations is available from CTF Systems Inc.

High Sensitivity Rock Magnetometer - a room temperature access design with sensitivity better than $10E-9$ gauss-cm³ rms/SQRT(HZ) moment for samples up to 7mm diameter, such as small rock samples or biological magnetite.

Digital SQUID Electronics - CTF is the only SQUID manufacturer presently making a digital SQUID control module capable of remote computer control of data sampling, digital filtering, and data transfer. Special features of this instrument, the DSQ-400, include a 9-decade dynamic range, a sophisticated second order digital filter with transient protection, and multichannel sampling synchronized to within 30 nanoseconds between channels. Up to 32,000 32-bit measurements per second can be recorded from each channel, and up to 15 channels controlled via one 16-line parallel computer I/O port. The DSQ-400's digital format and synchronized sampling permit multi-channel sensing with high temporal coherence. This makes possible advanced gradiometer compensation systems and the virtual elimination of coherent noise (e.g., 60 Hz) from data with the appropriate signal processing.

Designs for Cryogenic Elements of MAGLEV - Under contract to Transport Canada, CTF Systems has been analyzing cooling systems and

superconducting magnets for magnetic levitation transportation systems (electrodynamical MAGLEV), and has as a result generated a number of advanced designs for lightweight cryo-cooled superconducting magnets.

Ultrasonic Non-Destructive Evaluation (NDE) – CTF has been active in this field since 1975, carrying out research and development on behalf of the Canadian Department of National Defense with regard to a number of NDE problems. Projects of major importance include:

Naval Boiler Corrosion – a 3-mode system (manual to fully automatic) has been developed for rapid, thorough scanning of boiler tubes. The Model NDE-2 Analyzer contains a microprocessor which controls mechanical probe motion, data acquisition, storage and output, and features an ultrasonic transducer yielding clean unambiguous signals in small diameter tubes. Probe range is up to 8 feet (2.5m).

Acoustoelectric Transducer – a new phase-insensitive transducer has been developed for quality assurance applications in producing new high performance composites used in military aircraft. This new semiconductor transducer shows great promise for future routine aircraft inspection for micro-cracks and delaminations, and appears to be free of phase-related signal wash-out problems which plague piezoelectric transducers. Development of a production prototype is expected in the near future.

Applied Microprocessor Technology – Microprocessors have been exploited by CTF as an effective means of implementing complex measurement and control functions automatically and with minimal chance of human error. Systems which have resulted from this approach include – the NDE-2 Ultrasonic Tube Analyzer (described above); the XDC-1 (a portable dive support decompression calculator, which monitors and models various metabolic parameters using the "Kidd-Stubbs" hyperbaric exposure model); several instruments based on the XDC-1; and an automated SQUID rock magnetometer (being developed for the Department of Energy, Mines & Resources) capable of measuring magnetization, anisotropy of susceptibility and homogeneity of rocks, and including automated demagnetization.

CTF is now involved in developing a computerized biomagnetic scanning system for the Departments of Transport and National Defense, which will provide the capability of monitoring temporal and spatial variations in the evoked magnetic field patterns of the brain as a function of subject fatigue, stress and other factors. This is expected to have applications in such fields as personnel (e.g., pilot, controller) evaluation and in medical imaging. CTF's software-based environmental noise reduction system will be used to maintain high instrument resolution in the otherwise overwhelming magnetic environment.

As a result of much of the work undertaken in the past decade, CTF expertise in advanced signal processing techniques has grown considerably, and is now a major factor in the company's overall capability in data acquisition and software systems design.

Average Work Force: PhDs (Physics) – 4
Engineers – 4
BSc (Physics) – 3
Technical & Other – 15

Gross Sales: 1982 – \$1.1M

Plant Size: 9,600 sq ft

Equipment: CTF has a variety of general and specialized equipment and facilities necessary for electronic and cryogenic/NDT R&D. Some of the equipment/facilities are listed below:

Computer Facility:

- PDP 11-34; Dual 5Mb hard disks; 320 Mb Winchester; RSX-11m software
- PDP-8 E Intersil micro-6100 microprocessor development system

Electronic Equipment:

- Signal Generators (Audio, R.F.)
- Amplifiers (D.C., Audio, R.F.)
- Digital Multimeters
- Digital Counter/Timer
- Digital Logic Analyzer
- 10'x10'x8' RF Shielded Room
- Spectrum Analyzer
- Lock-in Amplifiers
- Microvoltmeters
- Oscilloscopes
- Power Supplies
- Filters, Mixers, Attenuators
- PC Board Assembly
- Wire Wrap Assembly

Cryogenic Equipment:

- Helium Leak Detector
- 100 Liter LHe Storage Dewar (2 units)
- 60 Liter LHe Storage Dewar
- LHe Transfer Lines
- Non-Metallic LHe Dewar Fabrication Facility
- Non-Metallic LHe Test Dewars

NDT Ultrasonic Facility:

- Multiple Frequency Ultrasonic Generator/Signal Conditioner/Receiver
- NDT Transducer Sensor Construction Facility
- Test Standards

Mechanical Equipment:

- Equipment necessary for in-house fabrication of most required items

General Equipment:

- Three Axis Helmholtz Coil (2m dia)
- Vacuum Deposition System (Fore-Pump, Diffusion Pump, Vacuum gauge to 10E-9 torr, High Current Heater Supply, High Voltage DC Sputtering Supply)
- Chemical preparation room with fumehoods and drybox
- Three Axis Micropositioners
- Shielded Room Facility

Special Test Facilities:

- A low magnetic gradient, low magnetic noise field test facility with associated instrumentation building
- High-order biogradiometer test and balancing facility

Equipment: CTF defense related experience has been primarily with the Canadian Department of National Defense. CTF has fulfilled more than 30 contracts with DND and with other Government agencies since 1971. CTF personnel also enjoy an active technical relationship with two local universities. Several dozen commercial systems and components have been sold to universities, governments, oil companies, hospitals, and research facilities around the world.

Keywords: 1 = Aircraft; 6 = Computers; 7 = Electronics; 16 = Security & Safety; 17 = Software Services; 19 = Testing/Test Equipment; 20 = Miscellaneous; Cryogenics = 7, 20; Superconductors = 20; SQUID Instrumentation = 16; Magnetometers = 16; Gradiometers = 16; Biomedical Instruments = 20; Ultrasonics = 19; Non-Destructive Evaluation = 19; Acoustoelectric Transducers = 1, 19, 20; Composite Evaluation = 1, 19, 20; Microprocessor = 6, 7, 20;

Automatic Measurement Systems = 7, 17; Signal Processing = 16, 17; Applied Physics = 20; Dive Support Instruments = 20; Cryogenic Liquid Containers = 20; Dewars = 20; Super Conducting Quantum Interference Device = 16; Digital Squid Control Module = 16; Magnetic Anomaly Detection = 3, 16; Metal Evaluation = 19; MAGLEV = 20; Superconducting Magnets = 20; Cryocoolers = 20.

Revised: Dec 83

DAF INDAL Ltd

Code: DAF

Address: 3570 Hawkestone Road
Mississauga, Ontario, Canada L5C 2V8

Contact: Mr. Frank Davenport, Director of Marketing -
(416) 275-5300

History: DAF was originally incorporated under the name Dominion Aluminum Fabricating Ltd in 1951. The company became a member of the Toronto based Indal Group of companies in 1968 and changed its name to DAF Indal Ltd in 1977. Indal is a diversified industrial holding company with 23 operating subsidiaries and divisions in Canada and 17 in the US.

Capability: Since its incorporation, DAF Indal has grown steadily through the development of facilities which provide a speciality range of engineered products. DAF Indal maintains a large engineering department staffed by professional engineers of many disciplines, including mechanical, electrical, structural, aerodynamics and hydraulic engineering. The company is engaged in many activities involving one or more of these disciplines, and those related to the aerospace industry area are listed below:

- *Specialty Fabrication Work* - DAF Indal has the reputation of being an acknowledged expert in the field of specialized aluminum structural fabrication work, and has been certified by the Canadian Welding Bureau as meeting the requirements of CSA Standard W47.2 "Aluminum Welding Qualification Code". Typical of the specialized structural design and fabrication work undertaken by DAF is a frangible ILS localizer support structure. This 112 ft long modular aluminum structure is designed to break away on impact and is now a designated fit where certain conditions prevail at Canadian airports. Other work for Transport Canada has included the design and fabrication of a 100 ft telescopic mobile monitoring tower, design of a frangible glide path monitoring antenna mast and range towers for coastal navigation. Other work performed by DAF in this field includes the design and fabrication of other antenna support towers, the fabrication of radar reflectors, radomes and space frame hangar systems.

- *Shipboard Helicopter Support Systems* - DAF is a world leader in the development and supply of shipboard helicopter support systems as employed on helicopter carrying ships operated by navies and coast guards world-wide. The helicopter recovery assist systems built by DAF Indal were originally developed in conjunction with the Department of National Defense for use on board Canadian Navy vessels. Variants of the systems are now employed on vessels operated by the Navies of the US, Japan, India, and Argentina - being a directed fit in many cases. These systems include any or all of the following - visual landing aids (including horizon reference system), firefighting systems, fueling systems, helicopter recovery assist and transversing systems, and telescopic hangars and hangar doors. The DAF Indal RAST (Recovery Assist, Secure and Traverse) system was selected as a key element of the US Navy's LAMPS III program where

it is intended to equip over 100 ships with this system to operate in conjunction with the new Sikorsky SH-60B Sea Hawk helicopter. DAF Indal is the originator of the unique telescopic helicopter hangar that is employed on many navy and coast guard vessels that have flight deck space limitations. Over 160 such hangars have been built and are in service with numerous agencies, principally the US Navy, US Coast Guard and Canadian Coast Guard.

- *Vertical Axis Wind Turbines* - DAF Indal has been a world leader in the design and manufacture of Vertical Axis Wind Turbines for over 10 years. The DAF Indal 50 kW unit is the most technically advanced and proven VAWT in the world today. A 500 kW machine modeled on a previous design of 230 kW VAWT built by DAF Indal is now in production and is gaining acceptance as a very viable source of alternate energy. The company has also pioneered the development of a hybrid wind turbine/diesel power generation system for use in remote areas.

- *Program Management and Quality Control* - DAF Indal has developed the appropriate project management control systems to administer large military contracts and is fully familiar with all aspects of government contracting. Their quality assurance procedures are maintained in accordance with CSA Standard Z.299.2 and DND 1015 requirements (equivalent to MIL-Q-9858A) are also met. There is a resident DND inspector staff based at the DAF Indal plant and the Department of Supply and Services Canada maintains an office adjacent to the DAF Indal facility to monitor ongoing domestic and international contracts. Production scheduling, material requirements and financial analyses are all controlled by a computer based system which is capable of handling the work in progress at any one time.

Average Work Force: Engineering - 50
Production - 160
Administration - 130

Gross Sales: 1981 - \$17M
1982 - \$38M
1983 - \$43M

Export sales represent more than 90% of DAF Indal's annual sales of which a large percentage is for the US military, principally the US Navy.

Plant Size: 120,000 sq ft (Manufacturing Plant)
30,000 sq ft (Office Complex)

The bays in the manufacturing plant have a headroom of 35' plus and are served by overhead gantry cranes. It is anticipated that more space will be added in 1984 to meet increased requirements.

Experience: DAF Indal serves many industries and their customers are invariably the leaders of those industries. The majority of their sales are made to government customers, either directly or through a third party subcontract. Principal customers include Navies and Coast Guards of Canada, the US, Japan, India, other NATO countries, Latin America, Australia, and New Zealand.

Keywords: 1 = Aircraft; 5 = Communications; 7 = Electronics; 8 = Energy; 12 = Machining; 15 = Radar; 20 = Miscellaneous; Shipboard Support Systems = 1; Hangars = 1; Helicopter Recovery Assist & Traversing Systems = 1; Antenna Support Structures = 5; Radar Reflectors = 5, 15; Control Systems = 7; Wind Turbines = 8; Specialized Fabrication = 12; Radomes = 15; Aluminum Fabrication = 12, 20.

Revised: Dec 83

DATA IMAGES Inc

Code: DII

Address: 1283 Algoma Road
Ottawa, Ontario, Canada K1B 3W7

Contact: Ms. Debbie O'Brien, Sales Office Manager -
(613) 744-3773

History: Data Images was incorporated in 1979 and is Canadian owned.

Capability: Data Images Inc designs and manufactures high reliability custom LCDs. They have proven expertise in high level multiplexing and meeting extreme environmental specifications. Their R&D staff is comprised of 2 PhDs in Physics/Electronics, 1 Phd in Organic Chemistry, and 3 technical support staff.

Average Work Force: Engineers - 6
PhDs - 3
Machinists - 3
Mgmt/Admin - 10
Production - 32
Drafting - 3

Gross Sales: \$1.0M (Historical)
\$1.5M (Present)
\$3.0M (Forecast)

Plant Size: 18,000 sq ft (Production)
3,000 sq ft (R&D)
9,000 sq ft (Admin)
30,000 sq ft (Total)

Experience: Data Images has experience with Sperry Flight, Bell Helicopter, the US Army (Multiplexed Multiline Cockpit Display for AHIP), Hughes Aircraft and is also involved in military development projects with Marconi Space & Defense (UK), L M Eriksson (Sweden), Grimes (US), Plessey West Leigh (UK), and Canadian Marconi.

Keywords: 3 = Avionics; 7 = Electronics; Liquid Crystal Displays = 3, 7; Displays = 3, 7; Multiplex Displays = 3, 7; LCDs = 3, 7.

Revised: Dec 83

DECADE INDUSTRIES Ltd

Code: DIL

Address: 7860 River Road
Richmond, British Columbia, Canada V6X 1X7

Contact: Mr. J A Cameron, President - (604) 278-3561

History: Decade Industries Ltd was founded in 1970 primarily as a manufacturing service company supporting the aero engine maintenance shops of locally based airlines.

In 1975, Decade moved to their present facilities and have since expanded their markets to include principle airlines of the US, the Pacific Rim, and the Far Eastern markets, as well as becoming a major tooling supplier directly to the aero engine manufacturers themselves. Their 1982 affiliation with Advanced Ground Systems Engineering Corp of Long Beach, CA, has broadened their capability in the area of aero engine handling and transport equipment.

Capability: Decade Industries' machine shop facilities include two numerically computer controlled three-axis machining centers, with capacity for deep milling, precision boring, and facing with close tolerances. Conventional mil-

ling and turning equipment, and a well equipped welding and fabrication shop is also maintained by Decade Industries.

A comprehensive quality assurance program in line with DND 1015/16, The Canadian Standards Association, and the specifications of their major customers in the US, ensures a reliable production of high quality, conforming products.

Non-destructive testing and proof load testing is carried out at Decade with certificates furnished for all inspections. Proof loading capability is to 25 tons in their universal tensile loading facility.

Major manufacturing capability is presently directed at production of precision tooling for aero engine maintenance departments of the major airlines, and to supplying bulk contract tooling as subcontractors to the Canadian Forces and specifically to Naval programs (CF-18 Aircraft Acquisition Program, and Canadian Frigate Program - Propulsion Systems). In addition to this, Decade Industries produced precision research equipment for regional nuclear accelerator projects, and Atomic Energy Canada's Radioisotope facilities.

Average Work Force: Consultant Engineers - 2
Resident Engineers - 1
Mechanical Engineering Technologist - 1
Machine Shop Personnel - 16
Administrative & Secretarial - As Required

Gross Sales: 1982 - \$1.8M
1983 - \$2.0M
1984 - \$2.5M (Est)

Experience: *Airlines* - Air Canada, Canadian Pacific, Pacific Western Airlines, United, Northwest Orient, Philippines, Singapore, WardAir, Okanagan Helicopters, Emery Air Freight, and Flying Tiger Air Freight.

Aero Engine Companies - General Electric, Pratt & Whitney, Garret, and SNECMA/CFMI.

Aircraft Manufacturing Companies - Boeing, McDonnell Douglas, and Lockheed.

Others - Westcoast Transmission Co, Dome Petroleum, National Research Council, and Universities of BC and Alberta.

Keywords: 1 = Aircraft; 8 = Energy; 12 = Machining; 14 = Protective Equipment; 18 = Space Systems; 19 = Testing/Test Equipment; Precision Tooling = 1, 12; Ground Support Equipment = 1, 12; Electrical Test Equipment = 1; 19; Repair & Overhaul Equipment = 1; Radioactive Waste Containment = 8, 12, 14; Isotope Dispensing Equipment = 8, 12, 14; Pipeline Control Components = 8, 12; Camera Systems Components = 12, 18; Non-Destructive Testing = 1, 14, 18.

Revised: Dec 83

THE deHAVILLAND AIRCRAFT OF CANADA Ltd

Code: DHC

Address: Garratt Blvd
Downsview, Ontario, Canada M3K 1Y5

Contact: Mr. J W Sandford, President - (416) 633-7310

History: The deHavilland Aircraft of Canada Ltd was established in 1928 as a sales outlet, assembly plant, and maintenance facility for aircraft of the British parent company's

design and manufacture. The company is owned by the Canadian Government. Its main plant is located in Downsview, Ontario, with other offices located in Ottawa.

Capability: The deHavilland Aircraft of Canada Ltd is a designer and manufacturer of both civilian and military aircraft. It is a leader in short takeoff and landing (STOL) aircraft technology, and is actively engaged in the design and manufacture of these aircraft. During the time period 1939-1945, the company built over 3,000 Mosquito bombers, Tiger Moth, and Anson trainers. Following this time, they designed and built the Fox Moth and later the DHC-2 Beaver. More than 1,600 of these latter aircraft were built for use in Canada, the US, and world-wide locations. Their work on the Beaver pioneered the concept of STOL. This aircraft was followed by the DHC-3 Otter and the twin-engine DHC-4 Caribou.

In the early 1960s, deHavilland combined the turbine power technology with their STOL technology and began to turn out the Buffalo, Twin Otter and Dash 7 aircraft. Today, the flight certification program for the Dash 8 is well underway. In total, the certification program will involve five aircraft for a total of 1,670 flying hours. The 36-passenger Dash 8 is slated for first customer delivery in the fall of 1984.

In the R&D area, deHavilland has designed and tested many two and three dimensional (airfoil section) wind tunnel models in various low speed wind tunnels. The tunnels mainly used are those operated by the National Aeronautical Establishment in Ottawa. This type of work has led to the development of an advanced powered lift system known as the Augmentor-Wing. A large Augmentor-Wing model incorporating a unique self-contained load compressor to provide large quantities of relatively cool air for test purposes was designed, built, and has been successfully tested in the 40 ft x 80 ft wind tunnel at NASA/Ames. At this time, a converted Buffalo incorporating the deHavilland Augmentor-Wing concept has completed over 700 hours of flight test research covering all aspects of STOL technology, airworthiness, handling and control, instrumentation, avionics, navigation, etc. They also designed and manufactured the complete power plant nacelle package that was incorporated in to the Augmentor-Wing Flight Test Vehicle.

Average Work Force: Engineers - 131
Machinists - 90
Tool & Die Makers - 75
Technicians - 215
Support Staff - 115
Others - 2329

Gross Sales: \$152M (To Dec 82)

Plant Size: 1,450,000 sq ft
271,000 sq ft

Equipment: For many years the DeHavilland plants have been engaged in the production of stressed skin aluminum alloy airframes, and in doing so, utilize equipment normally found in a well-equipped aircraft manufacturing complex. Their present shop equipment includes milling machines; engine, turret, and pre-programmed automatic lathes; drill presses; drop hammers; punch, hydro and stretch presses; magneform; shapers & rolls; jogglers; tube bending and swaging machines; precision grinders; planers; multi-spindle routers; spot and heli-arc welders; vertical and jig borers; and broaches and shears. In addition, heat treat, foundry, plating, painting, sandblasting, and other treatment equipment is available. Hydraulic, instrument, radio, plastic, and upholstery shops also form part of the complete facility. The plastic shop manufactures fiberglass and polycarbonate parts. It is also fully equipped with autoclaves, ovens, bonding and decorative applicator presses for the manufacture of structural kevlar composite parts and aircraft interiors. Numerically controlled equipment consist of drafting and digitizing machine, several multi-spindle profile mills which include a pair of dual gantry 3-spindle 5-axis vertical profiler, wire marking machine and a pipe bender complete with a tube data center.

deHavilland also maintains an Engineering Library, Metallurgical Laboratory, an Aerodynamics Laboratory, a Structural Testing Department, a Materials Research Laboratory, Environmental Chambers, and an Engineering Computer Center. In addition, an Engineering Development Shop, housed in a separate 11,000 sq ft building, consists of 100 skilled tradesmen experienced in working directly with the Engineering staff. The Data Center is equipped with an IBM 3031AP and an IBM 4341/12. The 4341/12 is dedicated to Engineering and each has a 12 MBytes and N/C of memory. In addition, the Engineering Department has a VAX 11/780 Computer used primarily for structural analysis.

Experience: Contracts for both aircraft purchases, and research & development programs have been negotiated with the USAF, NASA, US Department of Interior, USAF Academy, Alaska National Guard, Canadian Forces, Canadian National Research Council, and the Canadian Department of Transport. In addition to the above, the DeHavilland product line is presently being operated in over 70 countries world-wide and on all seven continents. Previous DOD contracts include:

- 981 L20 DHC-2 Mkl Beaver aircraft to the USAF/US Army.
- 165 DHC-4 Caribou aircraft to the US Army.
- CV7A Buffalo aircraft development.
- SC8A Air Cushion Landing System.

Keywords: 1 = Aircraft; 3 = Avionics; 12 = Machining; Aircraft Control = 1; Air Delivery Systems = 1; Airframe Components = 1; Airframe Structures = 1; Cargo Handling Equipment = 1; Cockpit Displays = 3; Composite/Fiberglass Components = 1; Data Handling = 1; Data Analysis = 1; Drones = 1; Engine Components = 1; Engine Systems = 1; Engine Controls = 1; Environmental Controls = 1; Fuel Systems = 1; Fuel Research = 1; Hydraulics = 1; Instruments = 1; Landing Gears = 1; Navigation = 1; Performance Measuring Devices = 1; Personnel Survival/Restraint = 1; Repair & Overhaul = 1; Simulators = 1; Training = 1; STOL Aircraft Manufacture = 1; Wiring = 1; Tubing = 1; Augmentor Wing = 1; Extended length = 12.

Revised: Dec 83

DEVTEK CORPORATION

Code: DEV

Address: 280 Rayette Road
Concord, Ontario, Canada L4K 2G7

Contact: Mr. H Trevor Pawson, Marketing Manager - (416) 669-4484

History: Devtek Corp is a wholly owned Canadian company founded in 1980. It was originally the Aerospace/Defense Group owned by Magna International Inc, a Toronto based high technology company. Companies affiliated with Devtek are Diemaco Inc, Hermes Electronics Ltd, Magna Electronics, Verral Metal Fabricators and West Height Manufacturing Inc. Brief descriptions of these companies are included in this report.

Capability: Devtek Corp has five modern plants, each specializing in various phases of high technology engineering and manufacturing products ranging from undersea detection devices to components for outer space projects. Having pursued markets in the aerospace/defense and commercial goods sectors, Devtek has relied on its people to develop unique, new highly efficient manufacturing techniques. This confidence has resulted in an average annual sales growth of 30% and has made Devtek one of the fastest growing international manufacturing corporations. Devtek's five companies offer a wide range of modern computer controlled machine tools, staffed with highly qualified people with unique

experience in fabricating critical components and sub-assemblies. A new technology center has added a unique engineering capability to the corporation's sophisticated, high precision manufacturing activities, including a CAD/CAM system. One of the Devtek companies has assembled extensive engineering and manufacturing skills for the design, development, testing and production of components and systems for military hardware. Another Devtek company holds a leading position in the development, design and manufacture of hydroacoustic sensors and data analysis and transfer systems as well as HF communication equipment to meet exacting military specifications. To complement the technical staffs of the companies in the corporation, Devtek provides the support of a special Corporate Engineering Group which conducts research and development and assists with problems of a highly sophisticated, technical, technological, process or production nature. Devtek's divisions and companies operate to the following Quality Specifications as appropriate DND-1015, MIL-Q-9858A, DND-1016, and MIL-I-45208. The divisions are recognized by the Department of National Defense for having quality programs within their facilities meeting the requirements of DND-1015 (MIL-Q-9858A).

Average Work Force: 15 (All Divisions - 780)

Gross Sales: 1982 - \$32.2M (All Divisions)
1983 - \$34.2M (All Divisions)

Plant Size: 300,500 sq ft (All Divisions)

Experience: Devtek's varied clientele includes - Bell Aerospace Co, Buffalo, NY; Boeing of Canada; Bristol Aerospace Ltd; CAE Electronics Ltd; Canadair Ltd, US Army, Ft Monmouth, NJ; US Navy, Indianapolis, IN; French Navy, Paris, France; Swiss Army Signal Corps, Australian Navy; Canadian General Electric Co; Computing Devices of Canada Ltd; The deHavilland Aircraft of Canada Ltd, Dowty Equipment Ltd, Emerson Electric, St Louis, MO; Fleet Industries; General Electric Co, Winooski, VT; B F Goodrich, Troy, OH; Hughes Aircraft, Los Angeles, CA; Honeywell Inc, St Petersburg, FL; Leigh Instruments; Ernst Leitz Canada Ltd, Litton Guidance & Control Systems, Woodland Hills, CA; Litton Systems (Canada) Ltd; Lumonics Research Ltd; Martin Marietta, Orlando, FL; McDonnell Douglas Corp, St Louis, MO; Motorola Inc, Tempe, AZ; Northern Telecom; Philips Electronics; Raytheon Co, Portsmouth, RI; Sanders Associates, Nashua, NH; Spar Aerospace; Sperry Univac, Salt Lake City, UT; Department of National Defense; and others.

Keywords: 1 = Aircraft; 2 = Armament;
5 = Communications; 7 = Electronics; 9 = Environment;
12 = Machining; 19 = Testing/Test Equipment;
20 = Miscellaneous; Landing Gear Components = 1, 12;
Alum Dip Brazed Heat Exchangers = 12, 20;
Machining = 12; HF Communications = 5; HF
Antennas = 5; Sonobuoys = 20; ASW = 20; Beacons = 5;
Environmental Laboratory = 19; PC Boards = 7; Weather
Stations = 9; Small Arms Components = 2, 12; Repair &
Overhaul = 2; Electronic Cabinets = 20; Weldments = 20.

Revised: Dec 83

DIEMASTER TOOL Inc

Code: DIE

Address: 160 Watline Avenue East
Mississauga, Ontario, Canada L4Z 1R1

Contact: Mr. F Hibbins, Manager, Special Projects -
(416) 273-7111

History: Diemaster is a Canadian owned company that has been in business for 10 years.

Capability: Diemaster is a precision engineering/machining firm specializing in machining to aerospace, military and

nuclear standards, jig boring, CNC machining, EDM machining, turning, and milling. They perform stamping operations from 16 to 500 metric tons. Diemaster also designs and fabricates production tooling, special purpose machines, jigs, fixtures, gauges, and dies. Their quality control meets CSA-Z-299.2, DND 1016 and MIL-I-45208A.

Average Work Force: Total - 120

Gross Sales: \$5-\$6M

Plant Size: 66,000 sq ft

Equipment: NC & CNC machines, CNC machining centers, and computing centers. Other typical equipment includes mills, grinders, borers, milling machines, drills, lathes, pantograph, presses, cutting, finishing and inspection equipment.

Experience: Diemaster customers include SPAR, AECL, TRW, Avco Lycoming, Sanders' Associates, Dupont, Orenda Engines, Bombardier, IBM, McDonnell Douglas, Pratt & Whitney, Xerox, Rockwell International, RCA and many more well known companies. Products to these companies have included aircraft engine parts, fuel tanks, critical components for aircraft navigation systems, components for nuclear industry, dies, gauges, test and production centers, and stampings.

Keywords: 12 = Machining; Precision Machining = 12;
CNC Machining = 12; Boring = 12; Turning = 12;
Milling = 12; Stamping = 12; Fabrication = 12; Design = 12;
Die Fabrication = 12; Gauges = 12.

Revised: Dec 83

DIFFRACTO Ltd

Code: DIF

Address: 6360 Hawthorne Drive
Windsor, Ontario, Canada N8T 1J9

Contact: Mr. T R Pryor, President - (519) 945-6373

History: Diffracto Ltd was incorporated in 1973 as an offshoot of work done at the University of Windsor. The company is Canadian controlled with a 20% interest owned by Otto Wolff AG of Cologne, Germany. An Otto Wolff subsidiary, Hommelwerke, is also the distributor of Diffracto products in Europe. They also have a US subsidiary, Diffracto Ltd, located at 19640 Harper, Grosse Point Woods, Michigan 48236. Most of the business of the company is conducted in the US through the US subsidiary which largely acts as a sales and service operation.

Capability: Diffracto has been a pioneer in the application of electro-optical inspection equipment to the manufacturing industry, primarily automotive, but also including nuclear, turbine engine, bearings, ordnance, and the like. These electro-optical units were originally developed on a custom basis, but are increasingly becoming more and more standardized. Many are finding their way into robotic applications and a separate subsidiary is being formed to handle these applications, including both inspection and robot guidance with visual sensing capabilities.

Diffracto currently produces a variety of standard sensor products. In addition are certain special machines, the most predominant example is the Programmable Airfoil Contouring System (PACS) for turbine blade inspection. The PACS was originally developed as a joint Canadian/US Defense Development Sharing project with the USAF (AFWAL/MLTM), General Electric, and Diffracto. This particular project has led to the sales of several such machines to manufacturers of blades in the US and is subject of intense current interest relative to both the inspection of new and rework blades (where additional Diffracto flaw detection equipment can be

combined into such machines). An off-shoot of the PACS is the Laser Gear Inspection Machine. It is touted as offering a revolutionary way of quantifying gear dimensions in minimal time.

DiffRACTO has devoted considerable effort to R&D activities and has received support in this area from the National Research Council of Canada, and the Department of Industry, Trade and Commerce. Current projects exist in the following areas:

- Electro-optical flaw detection
- E/O sorting machine development
- High resolution sensor development (profile image and triangulation)
- Robot guidance sensor development
- Fiber optic dimensional and CMM probe development
- Electro-optical sensors for machine tool feedback

In addition to the above, there are numerous customer sponsored projects and smaller internal projects. It should also be noted that a large percentage of their custom inspection machines delivered have substantial sensor R&D components. The company currently performs over one million dollars of R&D per year directly aimed at laser and electro-optical sensor development for measuring, inspection and robot guidance. Major applications for this type equipment within private industry and possibly within the USAF are as follows:

- Inspection and automatic adaptive control of turbine blade manufacture and rework.
- Inspection of turbine assemblies and components. For example, they have projects underway with General Electric for inspection of rotor shaft internal defects. Previous projects were concerned with tip clearance on rotors and for the automatic ultrasonic inspection of disks (laser/optical sensor control portion).
- Air frames and components.
- DiffRACTO has participated to a small degree with Boeing in the ICAM sheet metal center development program. Much of the hardware needed to actually implement such a center from the inspection and robot control point of view, already exists at DiffRACTO. They are currently in discussions with Lockheed Georgia on this same subject.
- Structural Integrity – DiffRACTO has completed laser-based, miniaturized strain gage for aircraft fatigue strain history monitoring for the Canadian Department of National Defense. This gage can be used for highly stressed air frames and gives real time as well as stored data directly in digital form. It can exist in a fiber optic based version having very low weight and freedom from electrical noise.
- Manufacturing Technology – applications include the inspection of parts on flexible machining centers and the inspection of tools in the changers. A line of "RoboGage" vision based inspection machines has been developed, which are being incorporated in flexible lines
- Ordnance – DiffRACTO inspection systems can be used for the inspection of ordnance. These normally high volume, high tolerance items require both dimensional and defect inspection, and are therefore ideally suited for electro-optical inspection. Some DiffRACTO sensing systems operate with fiber optics and can be utilized in remote areas, e.g., loaded munitions areas, etc. Sensors already exist for large caliber barrel straightness determination. Barrel bore dimensions and flaws are other areas for which sensors have been developed. Miniaturization of this technology to small caliber barrels (5.56mm to 40mm) has proved

successful.

- Inspection of rivet and fastener holes in aircraft skins – DiffRACTO has a bore probe system that can contour holes optically without requirement for all the channels of information needed in a capacitance probe. A unit has been provided to Grumman.
- Robot Guidance – A major project is currently underway to utilize the vision guidance system of the Canadarm used on the Space Shuttle to guide robots in plants. This project, in conjunction with the Government of Canada and a major automobile manufacturer, is expected to result in improved robots capable of much higher accuracy. A principle goal of the project is dynamic, flexible assembly and material handling. A project submission in this area applied to the F-16 has been jointly made with General Dynamics to the USAF.

DiffRACTO standard products include:

- *Standard Laser/Electro-Optical Sensors*
 - 'MAXAN' Matrix Array Computer Vision Units
 - Series S and D High Resolution Outer Diameter Sensors
 - 'LaserProbe' High Resolution Laser Triangulation Sensors
 - LaserSurf In-line Microfinish Sensors
 - Model SF and BF Surface and Bore Flaw Detection Equipment
 - K-Series Microcomputer Based Controller for Optical Sensors and Machines
 - Contact Optical Digital Bore Size Probes
- *Standard Machines*
 - PACS – Programmable Laser Airfoil Contour Systems
 - Laser Gear Inspection Machine
 - 'RoboSorter' Computer Vision Bolt Sorting Machine
 - 'RoboGage' Programmable Robotic Inspection Machine (vision-based)
- *Computer Controlled Marking Units*
 - Model 400 Laser Marker for Part Identification
 - 'TurboJet' Ink Printer

Average Work Force: Total – 100 (5 PhDs)

Gross Sales: FY 82 – \$5.0M
FY 83 – \$6.0M (Projected)

Plant Size: 66,000 sq ft

Experience: DiffRACTO has performed one contract with the USAF (AFWAL Materials Laboratory) through the Defense Development Sharing Program. They have worked with the US Army (Picatinny Arsenal) as well as with US industry, e.g., General Electric Co., Boeing Aircraft Co., Union Carbide, Uniroyal, Westinghouse, Bunker-Ramo, Battelle, and others. They also work with the Canadian Department of National Defense and National Research Council of Canada.

Keywords: 1 = Aircraft; 6 = Computers; 7 = Electronics; 10 = Image Processing & Optics; 12 = Machining; 19 = Testing/Test Equipment; 20 = Miscellaneous; Measurement & Control Systems = 7, 19; Laser Optics = 10, 19; Optics = 10, 19; Automated Precision Measuring = 12, 19; Precision Measuring = 12, 19; Inspection Equipment = 6, 10; Ordnance Inspection Equipment = 6, 10; Sensors = 19; Turbine Blade Inspection = 1, 7, 10, 19; Gear Inspection = 10, 19; Flaw Detection = 10, 19; Structural Integrity = 1, 10, 19; Robotics = 20; Robot Guidance = 20; Manufacturing Technology = 6, 10, 20; ICAM = 20; Machine Vision = 6, 10.

Revised: Dec 83

DIPIX SYSTEMS Ltd

Code: DIP

Address: 1785 Woodward Dr
Ottawa, Ontario, Canada K2C 0P9

Contact: Mr. R Cobold, Dir of Marketing – (613) 224-5175

History: Dipix is a Canadian owned company incorporated in September of 1978. They are presently represented on a world-wide basis by various companies. US offices are at: DIPIX Inc, Rivers Center, 10220 Old Columbia Rd, Columbia, MD 21046, Contact: Mr. L Robert (301) 596-0505.

Capability: Dipix Systems Ltd has an established capability in the field of digital image processing for remote sensing and digital terrain mapping applications. The company has developed a powerful family of image analysis systems capable of processing imagery from satellite data (e.g., Landsat), digitized imagery (e.g., Photographic), cartographic (Map Digitizer), seismic, and other sources. Dipix engineers, analysts and programmers have designed many unique features into its systems. As a result, the company has been able to establish and maintain a leading market position with export sales around the world.

Central to Dipix's highly regarded position in the image processing field, is its extensive technical and analytical experience in developing applications and utility software to address user operational needs. Dipix has an enviable in-house research and development track record. The ARIES-II Digital Image Analysis System was developed from scratch over a two year period.

Average Work Force: PhDs – 4
Masters – 6
Bachelors – 30
Others – 55

Gross Sales: FY 81 – \$3.4M
FY 82 – \$5.0M
FY 83 – \$7.5M (Projected)

Plant Size: 30,000 sq ft (new facility – Nov 82)

Equipment: Dipix has a full range of modern test equipment including a VAX-750 DEC computer, as well as a number of Dipix ARIES-II Systems used for program and engineering development.

Experience: Dipix personnel have many years of experience in digital image analysis going back to the early 1970s. The six original founders of the company were involved in the design and building of the ground station in Italy, as well as the original Aries image analysis system for the Canadian Forestry Service. Dipix has had a close relationship with the Canada Center for Remote Sensing, where they have been contracted for both hardware and software development. At present, Dipix has in excess of fifty turnkey digital image analysis systems installed world-wide. The largest of these systems are in Indonesia, Holland, and Canada.

Keywords: 7 = Electronics; 10 = Image Processing & Optics; 17 = Software Service; 18 = Space Systems; Digital Image Analysis = 7, 10, 18; Turnkey Systems = 7, 10, 18; Software Development = 17; Hardware Development = 7, 10, 18; Transmission of Digital Imagery = 7, 10, 18; Storage of Digital Imagery = 7, 10, 18; Image Processing = 7, 10, 18.

Revised: Dec 83

DMR and ASSOCIATES

Code: DMR

Address: 112 Kent St., Suite #2218
Ottawa, Ontario, Canada K1P 5P2

Contact: Mr. Neil Mustard, Senior Consultant –
(613) 238-2697

History: DMR is a Canadian owned company incorporated in 1973 with offices in Vancouver, Edmonton, Calgary, Toronto, Ottawa, Montreal, Quebec City, St John, and Halifax, as well as international offices in the US, Australia and Singapore. The US office is located in Boston with a Project Office in Los Angeles.

Capability: DMR provides consulting services exclusively in the field of information and data processing systems. They provide a broad range of services which can be placed under three main categories – Management consulting, technical, and project management. Approximately half of the DMR staff are consultants and project managers who provide advice and direction to client management. The remaining staff is comprised of experienced technical personnel, including computer software specialists, analysts, and analyst-programmers. They promote the use of structured methodologies and strong project control in all activities. A cross section of the services provided is as follows:

Management Consulting – organization planning, requirements analysis, feasibility studies, and executive education.

Technical Services – hardware/software evaluation, selection, and acquisition; data base systems; data communications systems; and data acquisition systems.

Project Management – Systems evaluation, analysis and design; development and implementation of computer systems; and office automation.

A unique feature of DMR and its employees is that they maintain full independence from all hardware, software and computer service suppliers. This gives the consulting staff the freedom they require to act on behalf, and in the best interests of the client, particularly in regard to the evaluation and selection of products and services.

Average Work Force: Professionals – 500
Support Staff – 80

Gross Sales: 1979/80 – \$12M
1980/81 – \$18M
1981/82 – \$27M

Plant Size: 60,000 sq ft (Office Space across Country)

Experience: During the past eight years over one thousand contracts involving over six hundred clients have been successfully completed by DMR for both private industry and government. Contracts included:

Canadian Department of Transport: Designed/programmed various aspects of the Gander Automated Air Traffic System (GAATS-2); performed major programming enhancements to the National Flight Data Processing Systems (NFDPS) for various aspects of Air Traffic Control; and analyzed communications interface requirements between Flight Display Systems (FDS-COM) and Joint Enroute Terminals System (JETS).

Canadian Department of National Defense: Performed feasibility studies in the areas of – (1) Computer based telemetry system for CF-18 Weapons Clearance Program at Cold Lake, Alberta; (2) Replacement of radar driven plot boards and cameras by graphics display packages; (3) Hardware and software modification requirements to update radar tracking and telemetry recording system at Cold Lake; and (4) Hardware and software requirements to make the New Brunswick Optical Satellite Tracking System Operational. Im-

plemented systems in the following areas – Cold Lake radar simulation program, and modifications to the Cold Lake radar tracking and telemetry recording system software; and real time data acquisition, display and control systems for New Brunswick Optical Satellite Tracking System.

Keywords: 1 = Aircraft; 5 = Communications; 6 = Computers; 7 = Electronics; 15 = Radar; 17 = Software Services; 18 = Space Systems; Consulting = 5, 6, 7, 15, 17, 18; Studies = 5, 6, 7, 15, 17, 18; Systems = 5, 6, 7, 15, 17; Data Acquisition = 17; Data Processing = 17; Air Traffic Control = 1, 17; Radar Simulation = 15, 17; Radar = 15, 17; Measurement & Control Systems = 7; Ground Stations = 17, 18.

Revised: Dec 83

DOCUMENTED CIRCUITS Inc

Code: DCI

Address: P. O. Box 8, Station "A"
Kingston, Ontario, Canada K7M 6P9

Contact: Mr. D J Mercer, General Manager – (613) 389-1032

History: DCI was incorporated in June 1980 and was fully operational during January 1981. The company is Canadian owned and operates from the design and manufacturing facility located in Kingston. Sales representatives are presently located in Toronto, Montreal, Ottawa, and Cleveland, OH.

Capability: The combination of sophisticated software, state-of-the-art hardware and experienced personnel enable DCI to provide reduced turnaround times, accurate phototools and complete compatible documentation packages at competitive prices. DCI provides a total service to industry including:

- Printed circuit design utilizing a powerful interactive CAD system.
- The color coded layout method of printed circuit board design.
- Digitizing and photoplotting from customer supplied color coded layouts.
- Photoplotting output tapes from customers CAD systems.
- PCB design consultation services.
- Assembly drawings.
- Component lists.
- Auto insertion reports.
- Test fixture reports.
- N/C drill tapes in Excellon, Trudrill and Digital formats.
- Precision phototooling for component and solder sides, silk screen, solder resist and drill graphic plots.
- Magnetic tapes to drive the multiwire process.

DCI will be manufacturing and marketing computer-aided engineering and design systems for the electronics industry. Their main objectives will be to:

- Offer industry state-of-the-art computer assisted printed circuit design and documentation.

- Manufacture and market a computer-aided engineering and design software system.

DCI has the capability to work to MIL, IEEE, JIC, IPC, and ANSI standards and specifications or to customer defined parameters.

Average Work Force: Design technicians, training and applications personnel, software development and support engineers, plus an experienced management team for a total staff of 44.

Gross Sales: 1981 – \$8M
1982 – \$1.3M
1983 – \$1.4M (Projected)

Plant Size: 17,000 sq ft

Equipment: The following equipment is employed by Documented Circuits Inc:

- Digital Equipment 2060 Computer with 512K of memory.
- RPO6 Disk Packs.
- TU77 Magnetic Tape Drive.
- LA120 Printer Terminal.
- 1055 Calcomp Pen Plotter.
- Digital Equipment: LP20 Line Printer.
- (6) Digital Equipment VT100 Terminals.
- (6) Tektronix 4014 Graphic Terminals.
- (2) 8602 Talos Digitizing Tables.
- (3) Gerber Scientific PC-800 Digitizing Systems.
- 732B Gerber Scientific Photoplotter with a 48" x 60" bed.
- Gerber Scientific 4300 Controller.
- (2) Digital Equipment VAX series 730 computers.
- (1) Digital Equipment VAX series 750 computer.
- (3) Orcatech raster graphics terminals.

Phototools are produced, inspected and packaged in a controlled environment.

Experience: DCI has processed designs for companies in the telecommunications, computer, medical, aerospace, and commercial electronics fields. Some of the major accounts include – Rockwell International, Northern Telecom Ltd, Spar Aerospace, and AES Data.

Keywords: 7 = Electronics; 17 = Software Services; CAD PC Design = 17; CAD/CAE Systems Software = 7, 17.

Revised: Dec. 83

DOUSERV GROUP INC

Code: DOU

Address: 1200 McGill College Ave, Suite #1930
Montreal, Quebec, Canada H3B 4G7

Contact: Mr. G Raymond Doucet, PEng, President – (514) 866-5836

History: The DOUSERV GROUP Inc was founded in 1974 by G Raymond Doucet as Doucet & Associates Consulting Ltd. The company evolved through acquisition and development of other firms leading to the establishment of offices in several Canadian cities and in the US. Incorporated in 1980 as DOUSERV GROUP Inc, the parent company along with its associated firms are well established in the fields of communications, energy, industry, and transportation serving various clients in government, public utilities and the private sector. The headquarters are in Montreal, Canada with field offices in St John's, Newfoundland; Halifax, Nova Scotia; Quebec City, Quebec; Montreal, Quebec; and Dallas, TX.

Capability: The DOUSERV GROUP undertakes large and small projects and is committed to provide clients with quality services for the best value in the shortest possible time. The Group comprises over 100 full-time employees and associates with highly regarded outside specialists. The professional and technical resources have access to the best available work tools, equipment and documentation.

The DOUSERV GROUP organization is characterized by its flexibility to undertake projects requiring multidisciplinary teams. It brings together under common leadership the resources from its associated firms to complete a project in the most effective manner. The individual offices operated by associated firms are also uniquely qualified to pursue a distinct specialization for a specific market area. The DOUSERV GROUP organization is therefore capable of serving all client requirements.

A description of their services is the following:

Studies – feasibility, technology assessment, investment, market, tariff, economic, financial, cost benefit, research and development.

Design – systems design and detail specifications, quantity and cost estimating, contract documents, and bid evaluation.

Construction – inspection, supervision, equipment installation, construction management, start-up operations and commissioning.

Management – project management services, procurement, technical assistance, advisory services, technology management and transfer, operations and maintenance planning and quality control.

Average Work Force: Over 100 employees, including engineers, technicians and support staff.

Gross Sales: 1980 – \$2,225,000
1981 – \$3,244,000
1982 – \$4,212,000
1983 – \$3,637,000

Plant Size: Offices located in cities named above.

Experience: Maritime Telephone & Telegraph Co, New Brunswick Telephone Co, Governments of New Brunswick and Newfoundland, Newfoundland Telephone Co, Canadian Pacific, Department of Communications of Canada and of Quebec, Quebec Telephone, Hydro Quebec, James Bay Energy Corp, Southwestern Bell, International Civil Aviation Organization, and others.

Keywords: 5 = Communications; 6 = Computers; 8 = Energy; 14 = Protective Equipment; 18 = Space Systems; 20 = Miscellaneous; Consulting = 5, 6, 8, 14, 18, 20; Civil Engineering = 20; Project Management = 5, 6, 8, 14, 18, 20; Professional Services = 5, 6, 8, 14, 18, 20; Radio Communications = 5; Telecommunications = 5.

Revised: Dec 83

DSMA ATCON Ltd

Code: DSM

Address: 4195 Dundas Street West
Toronto, Ontario, Canada M8X 1Y4

Contact: Mr. Varis Smiltnieks, Mgr, Business Development
– (416) 239-3012

History: DSMA Atcon Ltd is the advanced engineering affiliate of Dilworth, Secord, Meagher and Associates, which

began in 1952 as a high technology engineering organization and was incorporated in 1956 as Dilworth, Secord and Associates Ltd. It is a wholly owned Canadian firm controlled by its senior employees. A computer center, development laboratory, manufacturing facility, and domestic and foreign subsidiaries and affiliates complement the head office engineering resources. The company has the following branch offices:

- DSMA Atcon Ltd – 17704-103rd Ave, Room 202, Edmonton, Alberta T5S 1J9
- Atcon Services Ltd – 3235 Wharton Way, Mississauga, Ontario L4K 2B6
- American Atcon Inc – 1105 N Market St, P.O. Box 1347, Wilmington, DE 19899

Capability: DSMA Atcon Ltd is a firm comprised of engineers and advances technology consultants. Their services and fields of specialization are shown below:

Services – Feasibility and conceptual studies, equipment development, systems engineering, detailed design, manufacture supervision, quality assurance and commissioning, heat transfer, stress and seismic analyses, program management, procurement services, turnkey design and supply through a constructor affiliate.

Fields – Machinery design, emergency maintenance and remote handling equipment, controls systems engineering, R&D facilities, aerospace and transportation equipment, environmental studies, air pollution, toxic and hazardous products waste disposal; and nuclear, thermal solar, wind and wave energy projects.

Average Work Force: Principal – 1
Associates – 8
Controller – 1
Support Staff – 50 (mechanical, electrical, aeronautical, structural, nuclear, and health physics disciplines)

Gross Sales: \$3.0M (Annually)

Plant Size/Equipment: 10,000 sq ft of office space fully equipped for engineering and design. A computing facility is integrated in the design office to provide powerful stress analysis capabilities.

10,000 sq ft of laboratory space equipped to support development, design and manufacturing projects. Specialized equipment such as a small wind tunnel, a shaker table, and dynamometer rig are used to extend the engineering capabilities of the design office.

An engineering office in Edmonton serves clients in western Canada with its associated firm, Alacon Services Ltd, undertaking design and supply projects. American Atcon Inc of Wilmington, Delaware, serves clients in the US.

Experience: Typical projects include:

- Space shuttle RMS Component Engineering, Test Equipment Design and Supply
- Toxic Gas Dispersion Systems – Requirements, Design, Procurement, Commissioning
- Program Management of Canadian Electric Vehicle Demonstration and Evaluation
- Medical and Physics Accelerator Facilities – Feasibility, Concepts, Design
- Wind, Wave and Solar Energy R&D Programs and Facilities
- Nuclear Industry, Environmental Assessment, Engineering and Decontamination

- Design of Off-Road Transportation Equipment and Transportable Power Supplies
- Data Acquisition and Control System for a Petro-Chemical Extraction Plant
- Stress Analysis of Aircraft Structures & Nuclear Equipment Code Verification
- Design and Development of Heat Transfer Apparatus for Steel Mills
- Design of Nuclear Power Plant Equipment, Apparatus, Systems
- Special Industrial Air Handling and Ventilation Design and Development
- Remote Handling Systems Concepts and Design for Fission and Fusion Facilities
- Remote Maintenance and Repair Equipment Development, Design and Construction
- Test Rigs for Aircraft Components, Satellites and Nuclear Service Equipment
- Test and Research Facilities, Environmental Chambers, Wind-Wave Flumes, Particle Accelerators, Engine Test Stands, Hydrogen Fuel Test Facilities, Astronomical Observatories

Keywords: 1 = Aircraft; 8 = Energy; 9 = Environment; 18 = Space Systems; 19 = Testing/Test Equipment; 20 = Miscellaneous; Consulting = 1, 8, 9, 18, 19, 20; Stress Analysis = 1; Test Rigs = 1; Hydrogen Fuel Cells = 8; Transportable Power Supplies = 8; Particle Accelerators = 8; Radiation Protection = 8; Remote Handling = 18; Ground Support Equipment = 18; Payload Equipment Design = 18; Airframe Analysis & Testing = 19; Shaker Table = 19; Wing Tunnel Systems = 19; Engine Test Beds = 1, 19; Studies = 1, 8, 9, 18, 19, 20; Design = 1, 8, 9, 18, 19, 20.

Revised: Dec 83

EBCO INDUSTRIES

Code: EBC

Address: P. O. Box 9420
7851 Alderbridge Way
Richmond, British Columbia, Canada V6X 2A4

Contact: Mr. Helmut Eppich, Chairman & Ch Executive Officer - (604) 278-5578

History: EbcO Industries Ltd is a Canadian owned company formed in 1956 as a small tool and die shop in Vancouver. The company has had a compounded growth rate of 50% per year since that date and now it is a multi-million dollar concern comprising twelve companies. This highly diversified organization, including all subsidiaries and affiliates, has a wide range of expertise that includes all aspects of machining & fabricating, electro-plating, electronic data entry & processing equipment, electronic R&D, data processing, furniture, general & specialty construction, custom wheels & automotive accessories, real estate, upholstery, and stoves. This profile will concentrate only on their machining capability which can vary from a 20 minute grinding or polishing job to an 18 month multi-million dollar custom 50 ft dia atomic cyclotron.

Capability: EbcO Industries is a multi-faceted corporation with a major investment in the machining and fabrication business. Their skills and facilities include:

- Machining of all kinds - milling, grinding, planing, turning, boring, sawing, etc. They also have CNC capability (planer mills and machining center).
- Fabrication and medium and heavy plate work.
- Welding - manual, semi-automatic and automatic in steel, stainless steel, aluminum, T-1, nickel-chrome, titanium, copper, low-temperature steel, etc.
- Thermal stress relieving and heat treating.
- Sand blasting and painting.
- Tool and die work, engraving in metals and plastics.
- Mechanical and hydraulic assembly.
- Metal stamping.
- Tube bending and welding.
- Electro-plating - decorative chrome, brass, copper, zinc, bronze. Industrial hard chrome, cadmium, zinc, iron-manganese and zinc phosphating.
- Galvanizing plant - hot dip galvanizing. Centrifugal system for small hardware.

EbcO specializes in close tolerance machining utilizing Brunson optical transit squares and 3-axis digital readouts. Their quality assurance procedures meet CSA standards Z299.2, Z299.3, Z299.4, and ASME Section VIII. Their fabrication facility has the capability to shear, cut, burn, bend, shape and roll plate.

EbcO custom builds large and small assemblies, and machines and boasts the largest repair capability in Western Canada. This latter capability is especially applied to the repair and rebuilding of sawmill and pulpmill machinery, and mining equipment.

EbcO is developing a new Aerospace Division that will contain the largest and most sophisticated machining capability available. The main machines comprise two bed tables, each 90 ft long by 160 inches wide, having two gantries per table each with three spindles capable of five axis machining, that operate simultaneously by CNC control. They will also have available anodizing and ultrasonic immersion inspection systems.

Average Work Force: Total - 500

Gross Sales: Year ending Sep 83:
\$20.5M (EbcO Industries Ltd)
\$39.6M (EbcO Industries Ltd plus Subsidiaries)

Plant Size: 211,022 sq ft on 13 Acres (additional 52 acres for future development)

Equipment: Facilities: Crane capacity - maximum lift 150 tons, 40 ft under hook (in shops); maximum lift 70 tons, 36 ft under hook (in yard); Door Size maximum 24 x 24 ft; and Shipping facilities - road, rail and water loading capacity. EbcO's equipment list is too voluminous to itemize in this profile, however, the following is a brief summary - punch presses ranging from 15 to 250 tons; overhead cranes ranging from 5 to 80 tons; mobile cranes up to 7.5 tons; cutting equipment - Linde 4 & 8 head with tracers, plasma arc machine, ironworker, sheet metal and plate shears; and Stress Relief Furnace 50 ft, 20 ft wide, 16 ft high, maximum temperature 1000°C and maximum load 100 tons.

Other equipment includes welding manipulators, boring mills, planers, lathes, milling machines, drills, forming presses, plate rollers, welding equipment, planer mills, CNC machines with software preparation and programming system, and various inspection and quality control equipment.

Experience: EbcO's clients include - Boeing Co (MX transporter trailer for USAF and CNC - machined components for jetfoil vessel for USN), Hooker Chemical Co (Electrolytic cathode cells for Chlorine plants), DeHavilland Aircraft (CNC - machined aluminum components for Dash 7 and Dash 8 aircraft), University of British Columbia (56 ft vacuum tank and resonators for the Meson Facility - TRIUMF Project), Robbins Co (underground tunnel boring machines to 32 ft dia),

Lockheed Petroleum Services Ltd (wellhead cellars for sub-sea oil well drilling and exploration), plus many other companies and a variety of manufactured items.

Keywords: 12 = Machining; Extended Length Machining = 12; Metalworking = 12; Heat Treating = 12; Coating Specialized = 12; Precision Machining = 12; Stamping = 12; Tooling Fabrication = 12; Die Fabrication = 12; Titanium = 12; Mechanical Assembly = 12; Hydraulic Assembly = 12; Repair Capability = 12.

Revised: Dec 83

ENCHEM DEVELOPMENT Inc

Code: ENC

Address: 509 - 2024 Fullerton Avenue
North Vancouver, BC, Canada V7P 3G4

Contact: Dr Gerald B Porter, President - (604) 922-3844

History: The company was established in Nov 80 for scientific research and development in chemical energy and related fields of chemistry.

Capability: The company's expertise resides in Dr Porter. Until his resignation in Aug 81, Dr Porter was a Full Professor of Chemistry at the University of British Columbia. His basic research program in photochemistry there during the past 25 years has resulted in over 60 scientific publications. This work is being continued on a part-time basis, funded by the Natural Science and Engineering Council of Canada and Enchem.

Laboratory facilities are rented from Simon Fraser University and UBC in the greater Vancouver area. Research and development will be undertaken in applications of photochemistry, and in conversion of chemicals to other forms of energy and vice versa.

Average Work Force: Professionals - 1
Technicians - 1

Gross Sales: 1982 - \$50,000
1983 - \$60,000

Equipment: All laboratory equipment of the Department of Chemistry at Simon Fraser University and UBC is available to Enchem. This includes mass spectrometers, NMR, visible-uv spectrometers. Analytical services by Canadian Microanalytical and equipment construction by Sciema Technical Services, both in the Vancouver area.

Experience: The company has a current contract with the Canadian Federal Government for solar energy developmental work and for analytical work on plastics. Dr Porter's experience is in inorganic photochemistry and photophysics, spectroscopy and kinetics, using lasers of various types and highly sensitive detection systems. He is a cooperative user of a picosecond laser facility in Montreal at Concordia University. Enchem is also involved in a project on cyanide/gold mining.

Keywords: 4 = Chemistry; 8 = Energy; 11 = Lasers; 20 = Miscellaneous; Inorganic = 4; Photochemistry = 4, 8, 11; Photophysics = 8, 11; Energy Conversion = 8; Thermodynamics = 4; Studies = 4, 8, 20; Research = 4, 8, 20; Spectroscopy = 4, 8, 11, 20; Kinetics = 4, 11; Analytical Chemistry = 4.

Revised: Dec 83

ENHEAT Inc (Aircraft Division)

Code: ENH

Address: 1 Lusby St
Amherst, Nova Scotia, Canada B4H 3Y7

Contact: Mr. D I Sweetapple, VP & Gen Manager -
(902) 667-3315

History: Enheat Inc, Aircraft Division, is a high technology aircraft component manufacturing, repair and overhaul facility founded in 1952 by Enamel & Heating Products Ltd of Sackville, New Brunswick, Canada. It was originally owned by Rhodes & Curry Ltd, an Amherst based company, who sold it to Candian Car & Foundry Ltd of Montreal, Quebec. These companies manufactured railway wheels and cars for over 60 years prior to the Second World War.

Canadian Car & Foundry started an aircraft plant in 1940. Until the end of the war in 1945, the Canadian Anson was manufactured as well as many other types and makes of aircraft. Enamel & Heating Products Ltd changed its name to Enheat Ltd in 1972 and Enheat Inc in 1980.

Capability: Enheat Inc, Aircraft Division, is a high technology aircraft component manufacturing and repair & overhaul facility.

Average Work Force: Engineers - 2
Quality Control - 11

Gross Sales: 1980 - \$ 8.64M
1981 - \$11.05M
1982 - \$ 7.84M
1983 - \$ 7.00M

Equipment: Enheat Inc employs the following equipment: Auto-clave, drying ovens, temperature controlled layup room; process room, paint shop; brakes, presses, routers, rolls, shears; drophammers, stretch forming machines, lathes, millers, planers, jig borers; and grinders, dimplers, miscellaneous small and hand tools.

Experience: Enheat has 31 years of experience with major aircraft companies of North America. Present customers include: Canadian Department of National Defense, Boeing Airplane Co, Lockheed California Co, McDonnell Douglas Aircraft Co, Grumman Aerospace Co, Fleet Industries Ltd, The deHavilland Aircraft of Canada Ltd, and Canadair Ltd.

Keywords: 1 = Aircraft; 12 = Machining; 20 = Miscellaneous; Bonded Components (Metal) = 1, 12, 20; Bonded Components (Composite) = 1, 20; Repair & Overhaul = 1; Airframe Components = 1; Aircraft Components = 1.

Revised: Dec 83

ENVIRONMENTAL APPLICATIONS GROUP Ltd

Code: EAG

Address: 114 Avenue Road
Toronto, Ontario, Canada M5R 2H4

Contact: Mr. Richard J Kolomeychuk, Vice President -
(416) 968-3684

History: The Environmental Applications Gp Ltd was incorporated in 1977 to provide multidisciplinary environmental services to industry and government. It is entirely Canadian owned by four principals, with its sole office in Toronto.

Capability: The company was formed as a consulting firm with two major divisions - Atmospheric, and Life Sciences. The Atmospheric Division engages in R&D in pure and applied meteorology, climatology, cloud physics, air quality, and air-sea interaction. Scientific expertise includes numerical modelling of atmospheric phenomena, experimental design and field studies, instrumentation, data analyses, and environmental assessment.

Average Work Force: PhDs - 3
MD - 1 (Part-time)
MSs - 3
BSs - 3
Others - 4

Gross Sales: 1978 - \$0.25M
1979 - \$0.32M
1980 - \$0.45M
1981 - \$0.70M
1982 - \$0.50M
1983 - \$0.56M

Plant Size: 3,250 sq ft (Office Space)
750 sq ft (Laboratory/Workshop)

Equipment: Special equipment and facilities include the following:

- Atmospheric - tethersonde (Altitude to 1 Km) and airsonde (Altitude to 25 Km) systems utilizing radiotelemetry and optical theodolites for boundary layer and upper air measurements, and remote meteorological base station.
- Air Quality - high-volume particulate samplers, and SO₂ gas analyzers.
- Remote Field Facilities - winterized trailer, tents, snowmobiles, and electrical generator for a long term remote field camp capable of Arctic operations.
- Laboratory - equipped for physical, chemical, microbial, and biological analyses; and includes an atomic absorption spectrophotometer.
- Data Processing - includes a in-house Wang 2200 VP mini computer with access via timesharing to DEC, IBM, and CDC mainframes.

Experience: Environmental Applications Gp Ltd has experience with Canadian Environmental Protection Service, Atmospheric Environment Service, Transport Canada, Ontario Hydro, Onakawana Development Ltd, Potash Company of America, Oshawa Harbor Commission, Amoco Minerals Ltd, Polar Gas Project and Ontario Ministry of Environment.

Typical Projects of Environmental Applications Gp Ltd include:

- Toxic Organic Emissions Study
- Atmospheric Loadings and Emissions Studies
- Upper Atmospheric Experiments
- National Emissions Inventories - Natural Alkaline Particulate; Organic Compounds; Sulfur, Nitrogen and Mercury Compounds; and Great Lakes Atmospheric Deposition Model.
- Natural Gas Pipeline Associated Studies
- Meteorological Studies using Tethered Balloons
- Air Quality Studies - remote and urban

Keywords: 8 = Energy; 9 = Environment; Meteorology = 9; Micrometeorology = 9; Radar Meteorology = 9; Satellite Meteorology = 9; Climatology = 9; Air Quality = 9; Pollution Monitoring = 9; Environmental Assessment = 9; Dispersion Modelling = 9; Long Range Transport = 9; Boundary Layer = 9; Upper Air = 9; Cloud Physics = 9; Cloud Dynamics = 9; Weather Modification = 9; Solar Energy = 8; Wind Energy = 8; Acoustics = 9; Icing = 9.

Revised: Dec 83

EPIC DATA SALES Ltd

Code: EDS

Address: 7280 River Road
Richmond, British Columbia, Canada V6X 1X5

Contact: Mr. Norman A Cafik, General Manger -
(604) 273-9146

History: Epic Data Sales Ltd is a member of the Ebco group of companies (See Ebco Industries Ltd). They are a Canadian owned company incorporated in mid-1974. The large diversification of capability and products associated with Ebco Industries caused many problems in labor and material tracking. They looked for an automated system that would solve these problems and discovered there was no system available that would perform these functions at a reasonable price. They developed their own data collection system and Epic Data Sales Ltd was formed.

Capability: Epic Data Sales Ltd develops and manufactures data collection systems based on microprocessor technology. Their terminals and controllers are designed using solid state components. This enables them to keep down cost while maintaining reliability. The user terminals on the factory floor, the office, or other environments are simple and straightforward to use.

Each Multi-Function Terminal (MFT) model may be upgraded to provide new input devices (e.g., magnetic stripe reader), special interfaces (e.g., weight scale), or peripherals (e.g., CRTs or printers). In almost every case, adding capabilities to a system does not obsolete equipment already purchased. In addition to their MFT terminals, they have developed Single Function Terminals (SFT) and Environmentally Sealed Portable Terminals (ESPT). Their first SFTs collect data solely via a barcode wand. They are planning a single function barcode slot reader and a single function magnetic stripe reader terminal. The ESPT is a battery operated data collection terminal that can be used in hostile, harsh, remote environments where any other method of data collection is impractical. Epic's controller, the System Control Unit (SCU), controls terminal polling, sequencing, editing, transaction assembly, output to host or off-line storage, and time of day generation. A recent announcement is the capability to program the controller's sequencing, prompting and editing functions at the host computer, and down-line loading the new program to SCU. Epic has also developed a system control unit that will be able to perform validation via table lookups from a Winchester disk, a mini/micro computer and turnkey software package (e.g., time and attendance, job costing, and library application programs).

Epic's field of expertise lies in adapting microprocessor technology, both hardware and software, to the broad context of data collection. Specifically, engineering provides support to customers of standard products and in addition, have experience in project management of custom designs.

The capabilities of the assembly group include - PCB component insertion, wave soldering and board cleaning, terminal assembly, cable fabrication, and metallized foil label making. The Manufacturing Test Group performs board and terminal burn-in and test. Self Test Program (STP) prompts are utilized during the terminal burn-in process to check out and monitor

terminal functions. Customer orders are fully configured in-house and go through a full systems test prior to shipping. Multi-stage quality monitoring is provided by an independent QA/QC/Production Engineering group. This group is also responsible for field installations. Epic Data's manufacturing facility is augmented by its parent company, Ebco Industries Ltd. Ebco provides capabilities in the areas of metal fabrication, painting, and tool & die making.

Average Work Force: Total - 110

Gross Sales: 1980 - \$3.9M
1981 - \$1.8M
1982 - \$3.5M
1983 - \$7.2M

Plant Size: 14,500 sq ft

Equipment: Epic Data's equipment list include - Wave solder machine (Aqueous Flux); Aqueous PCB Washer and Contaminant Monitor; PCB dry and bake chamber; component prep machines; semi-automatic IC inserter; metalized foil processing equipment; automatic shorts checker; cable tester; power supply tester; PCB burn-in rack; walk-in terminal burn-in room; drill presses; flat cable press; crimp terminal machines; and miscellaneous meters, scopes, and debugging aids.

Experience: Epic Data is touted to be a world leader in the manufacture and design of data collection equipment. They have major clients throughout the world and their equipment is frequently recommended for use by such major computer companies as Xerox, Tandem, Digital Equipment Corp, and Sperry Univac. Epic Data customers include - General Electric, Monsanto, General Motors, Motorola, Mexican Government, Hughes Aircraft, Lockheed, Martin Marietta, City and County of San Francisco, Canadian Government, and others.

Keywords: 6=Computers; 7=Electronics; 17=Software Services; 19=Testing/Test Equipment; Solid State Devices=7; Design to Requirements=17; Data Collection Systems=7; Terminals=7; Portable Terminals=7; Controllers=7; System Controllers=7; Microprocessor Technology=6, 7; PC Boards=7; Component/System Testing=7, 19.

Revised: Dec 83

EPITEK ELECTRONICS Ltd

Code: EEL

Address: 100 Schneider Road
Kanata, Ontario, Canada K2K 1Y2

Contact: Mr. Lee Lockwood, Sales Manager - (613) 592-2240

History: Epitek Electronics was incorporated in 1969 with a US subsidiary, Epitek Electronics Inc, located in Ogdensburg, NY. The latter is a distribution center only. The company specializes in the design, development and production of thick film hybrid circuits and networks for the electronics industry. Epitek Electronics is a division of Epitek international Inc.

Capability: The Epitek custom design expertise is directed primarily towards the following market areas - (1) *Computer Communications* (terminator networks, modem hybrids, tone squelch hybrids); (2) *Telecommunications* (line matching networks, RF hybrids); (3) *Instrumentation* (ladder networks, input alternators, voltage dividers); and (4) *Military Devices* (oscillator hybrids, trimmable resistor networks, Codec hybrids). Their standard product line includes audio amplifiers, active filters, telephony hybrids, and SIP/DIP resistor and resistor-capacitor networks. Epitek strives for quality control and can design to meet MIL-M-38510, MIL-STD-883 and MIL-R-83401. Epitek has a thin film production facility in operation at its Kanata plant. They intend to develop expertise in solar cell and chip resistor line technology in the near future.

Approximately 5% of their budget is directed towards internal R&D. The company has a facility security clearance. They have had DND 1015 (MIL-S-9858) facility approval in effect since July 1983.

Average Work Force: PhDs - 4
Engineers - 5
Others - 200

Gross Sales: \$6.5M (Current)

Plant Size: 32,000 sq ft

Equipment: Epitek's manufacturing facility is equipped with all the standard production and test equipment to insure quality production. Special equipment includes two YAG laser trimmers and CO₂ ceramic laser scribe.

Experience: Epitek's sales are divided - 60% to the US and 40% to Canada. They have no direct sales to the US military, but about \$3M to the DOD through US primes. The indirect DOD sales are in the areas of mines and sonobuoys. Epitek is interested in doing business with the USAF.

Keywords: 5=Communications; 6=Computers; 7=Electronics; Solid State Devices=5, 6, 7; Custom Circuits=5, 6, 7; Microcircuits=5, 6, 7; Hybrid Circuits=5, 6, 7; Instrumentation=7; Telecommunications=5, 7; Sonobuoy Components=7; Mine Components=7; PC Board Design & Fabrication=5, 6, 7; Thick Film Hybrid=5, 6, 7; Thin Film Hybrid=5, 6, 7.

Revised: Dec 83

ERNST LEITZ CANADA Ltd

Code: ELC

Address: 328 Ellen St
Midland, Ontario, Canada L4R 2H2

Contact: Mr. David G Stephenson, Mgr, Special Products Sales - (705) 526-5401

History: Leitz Canada was established in Midland, Ontario in 1952 as a subsidiary of Ernst Leitz Wetzlar GmbH, West Germany. At that time, the company commenced operations with twelve personnel and since then, the company has expanded through internal growth in three major business areas:

- Photography
- Custom commercial optical assemblies and systems
- Military optical assemblies and instruments

Capability: Ernst Leitz Canada is a well integrated firm specializing in the design and manufacture of complex precision opto-mechanical and electro-optical components and assemblies. From a comprehensive suite of computerized optical design and CAD programs in the engineering departments, to complete opto-mechanical testing capabilities, Leitz is equipped with the most modern equipment to undertake both large volume production and prototype quantities for conventional, state-of-the-art and research programs. Full machining capabilities, surface treatment, optical grinding and polishing of spherical, aspherical and plano optics, in glass, metal and infrared materials, microprocessor controlled coating facilities, and optical measurement and testing apparatus enable Leitz to undertake the fabrication, assembly and test of this complex optical equipment. New developments are underway in weight reduction techniques for missile seeker systems using plastics as well as fabrication and coating of a variety of infrared optical materials for military applications.

Average Work Force: Professionals - 50
Total - 475

Gross Sales: 1984 – \$20M (Projected)

Plant Size: 110,000 sq ft

Equipment: Ernst Leitz' equipment include – In-house HP computing hardware, Eros IV MTF measuring bench, environmental test facilities, CNC machining centers, full set of optical measuring equipment including Tropol digital measuring interferometer, microprocessor controlled coating chambers, and Leitz 3-axis coordinate measuring machine.

Experience: Ernst Leitz' experience is outlined in three different areas:

Photography/Reconnaissance – design and manufacture of the Leica M camera and a family of photographic lenses for the Leica M and R cameras; production of cameras for instrumentation and event recording; design and manufacture of lenses used in underwater applications for military and commercial applications; and design and fabrication of lenses used in aerial reconnaissance, earth resources and space application with focal lengths from 18mm to 900mm.

Custom Commercial Assemblies and Systems – optics for optical data storage, x-ray equipment, image intensifiers and microfilm systems; and complex periscope viewing systems for use in high radiation nuclear environments.

Other Military Applications – design and manufacture of visual and infrared assemblies for guidance and fire control applications; binoculars, rifle sights, weapon sights, rangefinders; and HUD and HDD optics.

Keywords: 1 = Aircraft; 2 = Armament; 3 = Avionics; 10 = Image Processing & Optics; 13 = Missiles; 18 = Space Systems; 20 = Miscellaneous; Optics Visual = 1, 2, 3, 10, 13, 18; Optics Infrared = 1, 2, 3, 10, 13, 18; Electro-optics = 1, 2, 3, 10, 13, 18; Photography = 1, 2, 3, 10; Lenses (reconnaissance) = 1, 10; Lenses (underwater) = 10; Fire Control Optics = 1, 2, 10, 13; Remote Sensing = 1, 2, 10, 18; Sights = 1, 2, 10, 13; Opto-mechanical Precision Assemblies = 1, 2, 3, 10, 13, 18; Optical Research & Development = 1, 2, 3, 10, 13, 18, 20; Optical Coatings = 1, 2, 3, 10, 13, 18.

Revised: Dec 83

EXPLOSAFE AMERICA Inc

Code: EXP

Address: 230 New Toronto St
Toronto, Ontario, Canada M8V 2E8

Contact: Mr. Paul B Malloy, Military Sales – (416) 255-9193

History: Explosafe America Inc was formed in 1973 to handle the design, research & development, manufacture, and sale of the "Explosafe" Engineered Explosion Prevention System. Under the guidance of its engineering and technical staff, the "Explosafe" system underwent all the development, qualification testing, and evaluation cycles attendant to obtaining the USAF Wright Aeronautical Laboratories product approval documented in Report #AFWAL-TR-80-2043, and subsequently supported by specification MIL-B-87162 (USAF) with vendor sourcing as identified in Qualified Products Listing QPL 87162-1 issued in Apr 82.

Capability: "Explosafe" is a practical method of preventing containers of volatile liquids and gases (i.e., gasoline, naphtha, diesel, liquid petroleum gas (LPG), benzene) from explosion resulting from electrostatic discharge, fire bombing, gunfire, or post crash ignition, etc. The "Explosafe" system is based on a matrix of aluminum foil, slit and expanded to form a mesh of hexagonal openings. When layered, the mesh results in

an open-cell batt, cut and shaped into modules for incorporation into any sized container. By installing "Explosafe", the container's interior is transformed into a honeycomb of small cells or compartments. In the event of ignition, the "Explosafe" system acts as a heat dissipator, modifies flame propagation, and prevents explosion. Explosafe salient features include:

- Displaces maximum one percent of fuel capacity for any given volume.
- System is passive therefore offers permanent life time installation capability – low life cycle cost.
- Dissipates static electricity.
- Does not sustain fire and does not emit toxic fumes.
- Designed in modular form, facilitates retrofit in old or new fuel tank installations.
- Provides radical reduction of fuel slosh and facilitates elimination of fuel baffles.
- Facilitates reduction of tank stress and failure.

Average Work Force: Total – 35

Gross Sales: 1981 – \$38.5M

Plant Size: 30,000 sq ft

Equipment: Explosafe's modern facility is equipped with machinery of proprietary design to slit, expand, fanfold, stitch, and shape modular kits of "Explosafe" for all fuel tank shapes and sizes.

Experience: Through the past five years, Explosafe has participated with the Canadian Government/USAF evaluation of the aircraft fuel tank ullage explosion prevention system of "Explosafe". This effort has resulted in test/evaluation completion as documented in report #AFWAL-TR-80-2043. This has subsequently substantiated by US Government specification MIL-B-87162 and borne out by Qualified Products Listing QPL-87162-1.

Through prototype and production contracts, Explosafe has been included in the following vehicles – FMC – M113, LVTP-7A1; Cadillac Gage – "Peacekeeper"; Bombardier – Canadian Armed Forces two and one half ton military vehicle; Navy Sea Fox; and numerous others.

Keywords: 1 = Aircraft; 14 = Protective Equipment; 16 = Security & Safety; 20 = Miscellaneous; Explosion Suppression Systems = 1, 14, 16, 20; Explosafe = 1, 14, 16, 20.

Revised: Dec 83

EXPRO CHEMICAL PRODUCTS Inc

Code: ECP

Address: P. O. Box 5520
Valleyfield, Quebec, Canada J6S 4V9

Contact: Mr. J A MacGregor, Director of Marketing – (514) 371-5520

History: Expro Chemical Products Inc (formerly Valleyfield Chemical Products Corp) was started in 1940 and has been operating continuously ever since. The complex has undergone two multi-million dollar modernization programs – the first in 1950-1952 and the second in 1977-1978. It was incorporated under the former name in 1977. The company changed ownership on 15 March 1982. Because of the new

minority share interest held by CIL Inc, the company will have access to Nobel's Explosive Company, Ardeer, Scotland. The latter company has extensive capability for primary research.

Capability: Expro is a fully integrated commercial and military propellant and explosives complex. It has its own capability to produce nitric acid, nitroglycerine, nitrocellulose, propellants, and RDX. Nitrocellulose is produced by the batch process, utilizing wood pulp of high alpha cellulose content and nitric acid. It also has the capability to produce nitrocellulose from cotton linters. Present plant capacity for nitrocellulose production is 12 million pounds per year, with the capability to expand to 40 million pounds annually should the need arise.

Expro uses the in-house produced nitrocellulose in the manufacture of single-base, double-base and triple-base propellants. The former are primarily used in small arms munitions, military or sporting, in medium caliber military ammunition, and large caliber weapons in multi-perforated form. The double-base product is used mainly for small caliber guns. The plant produces its own nitroglycerine, using the Biazzi Process, for the manufacture of the double and triple base propellants. Nitroguanidine for triple-base propellant manufacture is purchased.

Expro produces RDX by the Bachmann Process. It is manufactured to military specifications in various granulations as required. The RDX is mixed with TNT to produce cyclotol. Other products include Composition B, Compositions A-3 & A-4, and Compositions C-4 & A-5. Demolition Block M5-A1 and M112 is also manufactured at the company's facilities.

Average Work Force: Total - 800

Gross Sales: No Data

Plant Size: 1,100 acre site

Experience: Though its prime client continues to be the Canadian Department of National Defense, Expro is one of the two accredited suppliers of propellant for the US Air Force GAU-8/A weapon system. With respect to the GAU-8 system, they supply Honeywell with both propellant and high explosive (Comp A-4) and Aerojet with Comp A-4. Other major clients in the US include Olin Corp (Nitrocellulose for ball propellant), and E. I. DuPont de Nemours (propellant). HE distribution in US is by direct sales. Expro has received orders for its propellants and explosives from the Netherlands, Belgium, Portugal, Italy, France, Greece, Turkey, Brazil and Venezuela.

Keywords: 2 = Armament; 4 = Chemistry; 20 = Miscellaneous; High Explosives = 4, 20; Ingredients = 2, 4, 20; Propellants = 4, 20; High Energy = 2, 4, 20; Nitrocellulose = 4, 20; Manufacture = 20; RDX = 4, 20; Single Base = 4, 20; Double Base = 4, 20; Triple Base = 4, 20; Composition B = 4, 20; (A-3) = 4, 20; (A-4) = 4, 20; (A-5) = 4, 20; (C-4) = 4, 20; Demolition Block = 4, 20.

Revised: Dec 83

FAG BEARINGS Ltd

Code: FAG

Address: 801 Ontario St
Stratford, Ontario, Canada N5A 6T2

Contact: Mr John Tsaltas, Customer Service, Sales -
(519) 271-3230

History: FAG Bearing Ltd has been in business since 1883 (Germany). The company is incorporated under the laws of the Dominion of Canada. Branch offices are located in

Vancouver, Edmonton, Winnipeg, Sudbury, Toronto, Hamilton, Montreal, and Truro. A US affiliate, FAG Bearings Corp, is located in Stamford, Conn.

Capability: FAG Bearings Ltd is involved in the manufacturing of precision ground anti-friction bearings including instrument & miniature bearings, waterpump shaft assemblies, and separate aircraft bearing assemblies.

Average Work Force: Engineering - 14
Production - 443
Admin & others (Stratford) - 151
Total - 608

Gross Sales: No Data

Plant Size: Manufacturing - 200,000 sq ft
Warehouse - 75,000 sq ft
Engineering - 4,000 sq ft
Laboratory - 2,500 sq ft

Equipment: FAG Bearings has complete facilities to manufacture precision ground anti-friction bearings from raw materials (bar stock or tubing). Tolerances to ABEC 9. Aircraft bearing production started in 1981 (heat treating, grinding, assembly, etc). They have well equipped heat treating facilities, a metallurgical laboratory, bearing testing facilities (life, noise, torque, etc.), complete Clean Room (Class IV), assembly for instrument bearings, and separate aircraft assembly. FAG Bearings also has:

- Material Control Laboratory - Microscope (mag 1250x) Leitz; Vickers Micro Hardness Tester; Rockwell Hardness Tester; and Eddy Current and Ultrasonic Devices.
- Heat Treating Furnaces - Vacuum (computer controlled), Batch with Endo Thermic Generators, continuous type (Nitrogen/Methane), Induction, Salt, and Carburizers (pack & gas).
- Deep Freeze.
- Mass Spectrometer - Leak Detector.
- Infrared Analyzers.

Experience: FAG Bearing has experience with many US and Canadian companies Garrett (Airesearch) in Phoenix, AR; Bendix Corp at various locations; GE in Wilmington, MA; Litton Industries at various locations; McDonnell Douglas in Grand Rapids, MI; Sperry at various locations; Varian Assoc in Beverly, MA; Canadian Marconi in Montreal, Que; Spar Aerospace in Toronto, Ont; DISC Defense Ind Supply Center in Philadelphia, PA; Dept of National Defense in Downsview, Ont; and US Army Aviation in Texarkana, TX. Final destinations of some contracts include numerous US Air Force Bases.

Keywords: 1 = Aircraft; 12 = Machining; 20 = Miscellaneous; Bearings = 1, 12, 20; Precision Bearings = 1, 12, 20; Anti-Friction Bearings = 1, 12, 20; Waterpump Shaft Assemblies = 12, 20; Instrument Bearings = 12, 20; Miniature Bearings = 12, 20.

Revised: Dec 83

FIELD AVIATION COMPANY Ltd

Code: FAC

Address: Field Aviation Co Ltd
Toronto International Airport
Box 6023
Toronto AMF, Ontario, Canada L5P 1B9

Field Aviation West Ltd
Calgary International Airport
Box 3186, Station B
Calgary, Alberta, Canada T2M 4L7

General Manufacturing Inc
2571 Northwest 4th Court
Fort Lauderdale, FL 33311

*Field Aviation Co Ltd
Standard Life Building
275 Slater St, Suite #320
Ottawa, Ontario, Canada K1P 5H9

Contact: *Mr. C H Wilkinson, Mgr, Gov't/Industry Relations
- (613) 236-9577

History: Field Aviation started in Canadian general aviation in 1947 in Oshawa, Ontario. They moved to Toronto International Airport in 1960, established a western facility in Calgary, Alberta in 1952, and expanded into precision machining with the purchase of General Manufacturing Inc in Ft Lauderdale in 1980. The company is one of the Hunting Group of Companies, a widely diversified group with headquarters in London, England and operations world-wide in many different segments of the manufacturing and service sectors.

Capability: Field Aviation provides a full range of aircraft sales, modification, repair and overhaul services to general aviation, regional airlines, corporate aviation departments, and governments. They are the exclusive Beechcraft distributor for Canada, and stock a considerable supply of Beechcraft spare parts at both their Toronto and Calgary facilities.

Field West has a top quality aircraft painting facility that will accommodate aircraft up to Boeing 737 size.

Field Aviation also has complete overhaul jigs for the deHavilland Twin Otter and the full line of commercial Bell helicopters. Recently, they have been engaged in major conversion of a number of Gulfstream G1 aircraft to commuter airliners. They have manufactured a wide range of standard and custom aircraft seats with emphasis on the Twin Otter and CASA 212. Specific capabilities include magnafluxing, NDT, electrical re-harnessing, hydraulic overhaul, customization/modification, and limited engine overhaul. Work is approved by Canadian Ministry of Transport, FAA and Department of National Defense standards.

Custom design of aerial survey installations and aerial spray or water bombing systems has been a Field Aviation specialty for many years. Both fixed and rotary wing aircraft have been fitted with custom designed systems and are currently flying world-wide.

Field Aviation has often been called to assess crash damage and undertake recovery/salvage operations in remote parts of the world varying from the Canadian Arctic to the mountains of South America or the Far East.

Specialized expertise exists for repair, overhaul and modification of: Aero Commander; Beechcraft; BH125; BEII 47, 204B, 205, 206, and 212; Bristol 170; Cessna; PBV-5A; deHavilland DHC-2, DHC-3, DHC-4, DHC-6, and DHC-7; Douglas DC-3, DC-4, and DC-6; Fairchild F27; Gates Learjet; HS748; Hughes 369; Lockheed Electra; MU-2B; Piper; Pilatus PC-6; Scottish Aviation Twin Pioneer; and Short SC-7 and SD3-30.

Average Work Force: Engineers - 2
Technologists/Design Spec - 8
Others - 260

Gross Sales: 1981 - \$42M
1982 - \$35M
1983 - \$36M

Plant Size: 175,000 sq ft (Toronto)
232,000 sq ft (Calgary)

20,000 sq ft (Ft Lauderdale, FL)

Equipment: Toronto - Refueling, ground power and other services for most military, general aviation and corporate aircraft; and in-house or ready access to all associated aviation shop facilities. Calgary - Refueling, etc., as above; major aircraft overhaul shops; assorted overhaul jigs (mainly Twin Otter and Bell helicopters); hydraulic test facility; NDT; specialized aircraft salvage equipment; and B737 size paint shop. Ft Lauderdale Assorted NC and CNC machining equipment, specializing in complex large turbine aircraft engine components (P&W and GE).

Experience: Field Aviation's current customers include - Canadian Department of National Defense; Canadian Department of Transport; US Navy; British Army; Royal Canadian Mounted Police; numerous regional airlines (world-wide); numerous other corporations; and P&W & GE.

Keywords: 1 = Aircraft; 19 = Testing/Test Equipment; 20 Miscellaneous; Fixed Based Operations = 1; Repair & Overhaul = 1; Modification = 1; Aerial Survey Systems = 1; Aerial Spray/Water Bombing = 1, 20; Non-Destructive Testing = 19; Hydraulics = 1, 19, 20; Seat Manufacture = 1, 20; Spares Supply = 1, 20; Survey Systems = 1.

Revised: Dec 83

FITTINGS (1980) Inc

Code: FIT

Address: 135 Bruce St
Oshawa, Ontario, Canada L1H 1R1

Contact: Mr. T A Santos, President - (416) 723-3433

History: Fittings Ltd was formed in 1901 to provide a variety of quality castings. The company changed its name to Fittings (1980) Inc to reflect a change in management.

Capability: The company furnishes complete support for total casting projects from functional concept to designing, material selection, and final finishing. Providing both malleable and pearlitic iron castings, from ounces to pounds, their main production runs are for castings from 1 to 10 pounds. Working to ATSM standards and using a tool and gauge calibration system traceable to the National Bureau of Standards, they emphasize complete quality control procedures for all phases of their operation. They have the capability to coin Victaulic-style iron fittings for pipe-ends to +.010, thus eliminating the formerly used expensive machining processes.

Average Work Force: Production - 211
Engineering - 2
Quality Control - 10

Gross Sales: 1980 - \$10M
1981 - No Data

Plant Size: 200,000 sq ft (165,000 sq ft devoted to manufacturing)

Equipment: Molding equipment - 8 automated matchplate machines, 3 turntables, and 3 roto-lift machines with conveyor lines; Sand facilities - 3 automatic batch sand mixers and automatic moisture control; Melting facilities - 3 coreless induction furnaces with 13.5 ton capacity each; Annealing facilities - 3 continuous, 30-hour cycle protective atmosphere ovens; and Space straightening facilities - 5, 300 & 500 ton hydraulic presses.

Experience: Fittings (1980) Inc has had wide experience dealing with US firms which include - Rockwell International, Massey-Ferguson, Chrysler, Dresser Industries, Cast Metal Industries, and others.

Keywords: 12 = Machining; Precision Casting = 12.

Revised: Dec 83

FLEET INDUSTRIES (A Division of Ronyx Corporation Ltd)

Code: FLT

Address: P. O. Box 400
Fort Erie, Ontario, Canada L2A 5N3

Contact: Mr. H B MacRitchie, Marketing Manager -
(416) 366-4435

History: Fleet Industries began operations in Canada in 1930 as Fleet Aircraft of Canada Ltd. Ronyx Corp Ltd, Box 125, Ft Erie, Ontario L2A 3M6, has two divisions - Fleet Industries (manufacturing), and Ronark Developments (real estate division).

Capability: Fleet Industries manufactures major components for the prime Canadian and US manufacturers of commercial and military aircraft; helicopters; satellites; and radar and sonar systems. Fleet was established in Canada in 1930 to design and manufacture aircraft for the world's civilian, transport, and military markets. Between 1930-1950, almost 4,000 complete aircraft were built at Fleet and flown from the company's 2,400-ft on-property runway.

Today the company concentrates its efforts on the production of major components. Fleet has enclosed facilities of approximately 500,000 sq ft, and about 650 employees. Assembly and test methods meet the latest requirements of both civil and military authorities in Canada and the US. Fleet's ability to produce quality products on schedule and at competitive prices has won a high reputation for the company in both commercial and defense work. In 1982, Fleet's sales were more than \$35M including new programs for Raytheon Aegis and Pave Paws radar programs.

Aircraft:

Boeing - 707 fin and rudder; 727 aft engine fairing; 747 SP wing-to-body fairing structure; Boeing E3A TF33 engine nacelles; and 757 APU doors.

Canadair - Challenger CL600 rudder assembly.

deHavilland - DHC-5 bonded components; DHC-6 bonded components; DHC-7 bonded components and engine nacelles; DHC-7 wing leading edges, ailerons; and DHC-8 bonded wing and fuselage panels, inboard and outboard flap assy.

Grumman - A6 inboard and outboard flaps, and bonded honeycomb assemblies.

Lockheed - L-1011 main landing gear doors (aft dorsal structure & aft engine cowlings), and CP140/P3C flight station.

McDonnell-Douglas - A4E speed brakes and flaps; F18A graphite avionics doors; and DC-9 flaps and ailerons (Canada).

Sikorsky Aircraft - Black Hawk UH60A Medevac kits, and blade sub-assemblies.

Radar:

General Electric - ASR welded antennas.

Lockheed Electronics - Gun fire control system antennas and cabinets.

Raytheon - Phased array antennas "Pave Paws" & "Cobra Judy", AEGIS.

Sperry - Gun fire control system antenna and cabinet.

Satellite:

Hughes Aircraft - Solar panel substrates, Anik C, SBS, NASA, Anik D, GOES/GMS, Westar/Palapa B, Leasat, and AT&T.

Spar Aerospace - Bonded panels/structures, Anik C, SBS, Anik D, and Westar, spun/despun assemblies for Brasilsat.

Sonar:

Dept of Supply & Services - Retractable fixed hull mounted, towed bodies, VDS systems and faired tow cables; and repair and overhaul.

EDO Corp - Transducer structure.

General Electric - Heat exchangers.

Westinghouse Canada Ltd - Retractable fixed hull mounted, towed bodies, VDS systems and faired tow cables.

Raytheon - Variable depth sonar (VDS) hoist system.

Average Work Force: Total - 650

Gross Sales: 1982 - \$35.3M

Plant Size: 500,000 sq ft

Equipment: Fleet Industries' equipment includes Kearney & Trecker, Sundstrand and Cincinnati numerically controlled equipment, autoclaves, mills, lathes, presses, furnaces and other special equipment associated with aerospace manufacturers. New bonding facility includes 10' x 31' autoclave, water jet cutting, 5-axis NC core cutting and C-scan inspection equipment.

Experience: In 1982, from sales of over \$35M, some 90% was exported to the US. Commercial sales accounted for 53% with 47% military.

Facilities and skills have been developed to produce a diversified list of mechanical structures which include radar, sonar, air cushion vehicles, and other defense and commercial assemblies. In the bonding field, Fleet Industries manufactures a wide range of structural components such as antennas, space satellites, electronic cabinets and other specialized items requiring composite technology.

The list of Fleet's customers reads like a "who's who" of the aerospace industry. Boeing, deHavilland, General Electric, Grumman, Hughes, Lockheed, McDonnell Douglas, Raytheon, Sikorsky, Westinghouse, and many others have placed their confidence in the ability of Fleet Industries to produce quality components.

Fleet Industries' Quality Assurance Program meets the requirements of both Canadian Government specification DND-1015 and US Mil Spec MIL-Q-9858A. The average ratio of inspection to direct labor is 1:10. To insure that production of components meets contractual requirements, the Quality Assurance department reviews and defines product quality with the engineering department; collaborates in the review of specifications; generates quality assurance procedures; reviews quality problems; and effects corrective action and reports on departmental quality performance. Standard mechanical inspection techniques are supplemented by magnaflux, fluorescent penetrant, radiography,

destruction testing, chemical analysis, and three-axis co-ordinate measuring equipment.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 15 = Radar; 18 = Space Systems; 20 = Miscellaneous; Components = 1; Rudder Assemblies = 1; Engine Fairings = 1; Doors = 1; Engine Nacelles = 1; Bonded Components = 1, 18; Ailerons = 1; Bonded Honeycomb Assemblies = 1; Cowlings = 1; Speed Brakes = 1; Flaps = 1; Graphite Avionics Doors = 1; Panels = 1; Helicopter Blade Subassemblies = 1; Medevac Kits = 1; Welded Antennas = 3, 15; Air Cushion Vehicles = 1; Composite Components = 1, 7, 15, 18; Cabinets = 7; Satellites = 18; Antennas = 3, 15; Sonar = 20; Repair & Overhaul (Sonar) = 20; Transducer Structure = 20; Heat Exchangers = 20; Variable Depth Sonar Systems = 20; VDS Hoist Systems = 20; Airframe Components = 1.

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FOOTTIT MITCHELL AND ASSOCIATES

Code: FMA

Address: 77 Metcalfe St, Suite #808
Ottawa, Ontario, Canada K1P 5L6

Contact: Mr. J C Bond, Senior Consultant - (613) 563-0236

History: Foottit-Mitchell and Associates is a Canadian owned company founded in 1976 with its office in Ottawa, Ontario. The objectives of the company are two fold:

- To provide an interface between industry and appropriate Canadian Government departments and agencies.
- To provide advice to industry on the establishment of liaison on company-to-company and company-to-government bases.

Capability: Senior members of the firm have had extensive experience in both Canadian Federal Government and industry in the fields of research, development and production. Much of this experience has been in the area of US-Canada defense-industrial cooperation. The combination of industrial and government experience is applied to the facilitation of government-industrial relationships and to company-to-company cooperation in the following areas Aerospace, Electrical and Electronic, Shipbuilding, General Manufacturing, Government Organization, and Systems Planning and Management Evaluation.

Foottit-Mitchell and Associates, in addition to the professional staff of four, has a number of associates with specialized functional knowledge who are called in for specific tasks.

Average Work Force: Professional - 4
Support Staff - As required

Gross Sales: No Data

Plant Size: 1,500 sq ft

Experience: Foottit-Mitchell and Associates currently provides service to twenty manufacturing companies of which several are located in the US. The provision of these services involves contact with most Canadian Federal Government departments and agencies, particularly with the Departments of National Defense and of Supply and Services. The work with these agencies is conducted at all organizational levels and has been concerned with policy, technology, marketing, funding and contracting.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 18 = Space Systems; Consulting = 1, 3, 7, 18;

Government Relations = 1, 3, 7, 18; Systems Planning = 1, 3, 7, 18.

Revised: Dec 83

FOUNDATION INSTRUMENTS Inc

Code: FII

Address: 24 Colonnade Road
Nepean, Ontario, Canada K2E 7J6

Contact: Mr. Attila J Szanto, President - (613) 226-4000

History: Foundation Instruments Inc is a corporation specializing in research, development and manufacturing for the communications industry, primarily in the area of fiber optics. They have distributors around the world and a plant in New York State.

Capability: Foundation Instruments Inc is a high-technology company that performs design and development of communications equipment and systems. The primary area of expertise is in fiber optic communications equipment and systems. Other areas of expertise and demonstrated capability are in custom design of energy use, monitoring and control instruments, and in industrial process control; including the use of computer or micro-computer technology.

Company capabilities are both varied and wide-ranging because of their extensive research and development background. The company product line reflects this capability and includes - portable microphone mixers for broadcast use; a sub-miniature time-date generator for video systems; military secure voice switchboard; telemetry and data acquisition systems, seismic recording equipment; broadband video switchers (to 100 MHz); and fiber optic communications equipment, systems and components.

The research capabilities with respect to fiber optic systems are best related by referring to systems that have been or are currently being designed by Foundation Instruments' personnel. These projects include - fiber optic transmission system; 20 MHz baseband analog with broadcast video performance; 100 mB/s digital link; bi-directional low speed (56 kB/s) data links; and special fiber optic system for a ship-board communications simulator. Secure data circuits using fiber optics, subscriber and central office terminals for telephone systems, T1 and T2 rate long haul fiber optic communications, tactical fiber optic communications systems and fiber optic performance measurement instruments, are also products which Foundation Instruments Inc is designing.

Foundation Instruments' capabilities are being expanded to include multi-channel fiber optic communications systems, microprocessor based instrumentation development, clean room facilities, environmental test facility and optical device handling and assembly.

Average Work Force: Engineers - 22
Production - 13
Admin - 5

Gross Sales: 1980 - \$1M
1981 - \$2.4M
1982 - \$1.5M
1983 - \$2.0M

Plant Size: 20,000 sq ft planned for new facility by Jan 1984

Experience: Foundation Instruments Inc has experience with government and commercial corporations, several of which are listed below:

- Department of National Defense
- Atomic Energy Canada Ltd (AECL)
- Northern Telecom

- IBM
- Hewlett-Packard
- US Army Corps of Engineers
- US Air Force
- Ontario Hydro
- Dome Petroleum
- Quebec Hydro
- National Research Council
- Texasgulf

Keywords: 5 = Communications; 6 = Computers; 7 = Electronics; 8 = Energy; 9 = Environment; 11 = Lasers; 15 = Radar; 18 = Space Systems; 19 = Testing/Test Equipment; Analog = 5; Fiber Optics = 5, 7; C3 = 5; Lasers = 5; Optical = 5; Radio = 5; Video Systems = 5; Telemetry = 5, 19; Digital = 5; Wideband = 5; Switching = 5; Secure = 5; Telephone = 5; Receivers = 5; Transmitters = 5; Modems = 5; Tactical = 5; Microprocessors = 6; Programming = 6; Instrumentation = 6, 9, 19; Applications = 6; Data Analysis = 6, 9, 19; Data Acquisition = 6, 9, 19; Data Handling = 6, 9, 19; Data Processing = 6, 9, 19; Real Time = 6; Process Control = 6; LEDs = 7; Avalanche Detectors = 7; Laser Diodes = 7, 11; Seismic Sensors = 7, 9; Fusion Splicers = 7; Power Measurement = 7; PCB = 7; Design = 7, 19; Development = 19; Manufacturing = 7; Systems = 7; Components = 7; Wind = 8; Automatic Weather Station = 9; Moisture Content = 9; Air Infiltration = 9; Communications = 11; Phased Array = 15; Ground Stations = 18; Laboratory = 19.

Revised: Dec 83

GARRETT MANUFACTURING Ltd

Code: GML

Address: 255 Attwell Drive
Rexdale, Ontario, Canada M9W 5B8

Contact: Mr. B W Atkinson, New Tech Sales Mgr –
(416) 675-1411

History: Garrett Manufacturing Ltd (GML) is a wholly owned subsidiary of the US based Garrett Corporation. The Garrett Corporation, Wheelabrator-Frye Inc., United Oil Products, and Ampex are the major components of the Signal Companies, one of the 100 largest US corporations with 1982 sales of \$6,670M.

A Garrett office was established in Canada in 1952 to provide sales and services support for Garrett products in Canada. One year later, the company established a repair and overhaul facility near Toronto International Airport and added an engineering department to support this endeavor.

Throughout the 1950s, Garrett expanded its engineering department, added a production department and began the design and manufacture of ground equipment for the Canadian aircraft industry. In 1961, Garrett Manufacturing Ltd assumed a world product mandate for design, development and production of electronic temperature controls. These controls are a major subsystem of the Garrett environmental control systems that fly on more than 70% of the commercial and military aircraft in the western world.

Garrett Manufacturing Ltd now supplies a broad mix of custom designed products and services to the world aerospace industry. Garrett's aerospace products include aircraft cabin, cockpit and compartment temperature controls; windshield heat controls; airflow sensing and control systems; engine speed sensors; radio communication equipment for personnel and air traffic control applications; specialized cockpit displays; ground test equipment for aircraft air data systems; and custom thick- and thin-film hybrid microcircuits. GML also provides precision electronic instrumentation for CANDU

nuclear reactors. GML is the Canadian repair and overhaul base for other Garrett products used in Canada. In addition, GML assembles and tests electronic equipment on a "built to print" basis, in support of offset procurement requirements.

Capability: The company is actively engaged in research and development in control systems, RF communications, and analog and digital circuit design, to support existing products and create new opportunities. Material and process research and development is carried out in support of hybrid micro-circuit technology. Environmental and EMI testing to military/aerospace standards is performed in Garrett's government approved test facilities.

A single standard quality control system conforming to DND 1015 and meeting the requirements of MIL-Q-9858 and NATO AQAP.1 is employed by the company. DND maintains a resident detachment in the plant which will on request, provide reciprocal inspection services for the US DOD and other NATO governments.

All of the major airframe manufacturers in the US have surveyed and approved GML's facility and control systems as being acceptable for the manufacture of both military and commercial aircraft equipment.

Garrett products include:

Microcircuits – GML's microelectronic products are produced in a fully integrated facility with dedicated engineering, sales and production staff. This facility produces custom thick- and thin-film hybrids to the latest military specifications, for the military and aerospace industries. GML's microcircuit facility is equipped with many million dollars worth of specialized manufacturing and research equipment including automatic laser trimming, computer-controlled testing, a CVC plasma enriched deposition system, semi-automated die attach equipment and thermosonic wirebonders equipped with programmable X-Y tables.

Temperature Control Systems – GML's temperature control systems usually consist of electronic control boxes; temperature and/or airflow sensors; and temperature selectors. The most recent designs, featuring microcomputer-based digital electronics for improved performance and increased reliability, are in production for Boeing's 757/767 programs. Garrett temperature controls are used in cabin, cockpit and compartment air conditioning systems; wing anti-ice temperature control systems; window heat control systems, and some liquid coolant systems. In addition to the Boeing 757/767, Garrett systems are in use on A300, A310, DC-9, DC-10, 727, 737, 747, F-14, F-15, F-16, F-18, Viggen, EF-111A, Gulfstream II/III, Challenger, HS-125, IAI 1124/1125, Sabreliner, Learjet 54/55, HU-25A Guardian, SRR, and Hughes AAH. Most of the major commercial, military and business aircraft in the western world use Garrett temperature control systems.

Communications Systems – Emergency Locator Beacons developed by GML are used throughout the world in military, commercial and general aviation applications. These low power transmitters automatically provide an emergency homing signal to assist search aircraft to locate an aircraft in distress. Personal Locator Beacons and Survival Radio Sets for military users permit two-way voice communication with search aircraft as well as providing an emergency homing signal. VHF/AM Single Channel Transmitters and Receivers are produced for civil and military aviation air traffic control communications. Installed at air radio facilities, this ground station equipment offers many performance and maintenance features not previously available.

Peripheral Vision Display – the PVD is a subliminal attitude change indicator for cockpit work-load reduction and pilot disorientation prevention. It operates on the principle that orientation information is sensed primarily by a person's peripheral vision system and is processed subconsciously by dedicated areas of the brain. The system is now in production for military applications.

Major System/Subcontract Manufacturing – the “Major System” aspect of this activity offers opportunities to foreign suppliers seeking to sell systems/equipment to the Canadian Government by utilizing Canadian manufacturing and systems engineering facilities and capabilities. Through licensing, teaming, joint venture agreements and by direct involvement through technology transfer, shared joint development, advanced R&D, the Canadian Offset/Industrial Benefits requirements of major procurements can be accomplished. Our Subcontract Manufacturing “build to print” service enables our customers to meet demanding delivery schedules, by employing GML’s experienced manufacturing groups and facilities including aerospace standard quality assurance and modern Automatic Test Equipment. These services, backed up by a high-technology team, employing the latest in design and manufacturing techniques provide more effective co-operation in major procurement programs.

Repair and Overhaul/Customer Support – GML’s customer support/repair and overhaul facility is unique in Canada. It is the only facility outside of Air Canada’s Montreal base and CP Air’s Vancouver facility that has the capability to simulate conditions for testing airborne air conditioning rotating machines and high temperature valves. These facilities are also equipped to repair and overhaul gas turbine auxiliary power units, actuators, starters, central air data computers, other aircraft systems, and turbochargers for tractor, truck and automotive applications.

Average Work Force: Engineering – 175
 Production – 525
 Qual Ins/Customer Support – 100
 Others – 100

Gross Sales: 1982 – \$62M
 Forecast growth pattern – 10 to 12%

Plant Size: Administration Building – 64,000 sq ft
 Engineering Facility – 33,000 sq ft
 Main Production Plant – 75,000 sq ft
 Microcircuit Plant – 21,000 sq ft
 Customer Support Plant – 34,000 sq ft

Experience: GML customers are world-wide and include both the commercial and military sectors.

Keywords: 1 = Aircraft; 3 = Avionics; 5 = Communications; 7 = Electronics; 16 = Security & Safety; 17 = Software Services; 19 = Testing/Test Equipment; Cockpit Displays = 3; Crash Position Indicator = 3, 16; Environmental Controls = 1; Environmental Instruments = 1; Beacons = 1, 3, 16; Repair & Overhaul = 3; Measurement & Control Systems = 3; Power Supplies = 7; PC Board Design & Fabrication = 7; Radio Communication Gear, Fixed, Mobile = 3, 5; Solid State Devices = 7; Thick Film Hybrid = 7; Thin Film Hybrid = 7; Voltage Transformers, Regulators, Hi/Lo Voltage = 7; Emergency Locator Beacons = 3, 16; Design to Requirements = 17; Test Equipment & Instrumentation = 19; Air Traffic Control Communications Systems = 5; Peripheral Vision Display = 3.

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GEAC CANADA Ltd

Code: GEA

Address: 466 Tremblay Road
 Ottawa, Ontario, Canada K1G 3R1

Contact: Mr. G Legault – District Mgr, Government Accounts
 – (613) 746-9791

History: GEAC was founded in 1971 on the principle of providing a total solution, both hardware and software. GEAC’s first computers were based on HP processors and in 1977, GEAC released its first GEAC made computer – “8000 System”. Since then, GEAC has released the “6000 and 2000” systems and in November 1983, its biggest system to date – the “9000”. The “9000” is a large capacity multi-processor system to compete with the non-stop tandem type systems. GEAC has also developed a number of communications and cluster controllers, plus a variety of special purpose terminals.

GEAC has also developed some major software which it actively markets today:

- Integrated Library Systems
- Integrated Office Systems
- Online Financial Systems (Banking)
- Signature Capture Systems

Capability: GEAC capabilities include custom software and hardware development for large online data bases that support large quantities of terminals with excellent response time with complete redundancy at the host level.

Average Work Force: Manufacturing – 200
 Engineering – 70
 Assembly – 90
 Management & Administration – 40
 Product Development & Software – 200
 Support & Services – 150
 Administrative Support – 110
 Sales and Marketing – 40

Gross Sales: 1981 – \$24.0M
 1982 – \$35.0M
 1983 – \$48.0M

Plant Size: 44,000 sq ft
 (Head Office – Software Development)
 52,000 sq ft
 (Hardware Manufacturing)

Equipment: GEAC employs GEAC Computer Systems “2000 through 9000” ranging from \$40K to \$500K. Also employed are communications and cluster controllers, specialized terminals, and local area networks (LANs).

Experience GEAC has experience in several areas including – Communications; hardware/software/product engineering; software development; large networks (PBX, LAN’s, X.25, X.75); large databases; transaction oriented systems; financial systems; and library systems. Financial systems have been installed at the Bank of America and the Bank of New York. Library systems have been installed at Yale and Princeton universities, USC, Westpoint Academy, and with the US 7th Army (Europe).

Keywords: 5 = Communications; 6 = Computers; 17 = Software Services; Communications = 5, 6, 17; Hardware Design = 6; Hardware Engineering = 6; Software Design = 17; Software Engineering = 17; PBX = 5; Local Area Network = 5; Networking = 5; Terminal Controllers = 5, 6; Computers = 6; Terminals = 5, 6; Video Disks = 17; Disks = 17; Printers = 6; Protocols = 6; Library Systems = 17; Integrated Office Systems = 5, 6, 17; Manufacturing = 6; Customization = 5, 6, 17; Software Maintenance = 17; Hardware Maintenance = 6; Minicomputers = 6.

Revised: Dec 83

GENERAL ALUMINUM FORGINGS Inc

Code: GAF

Address: 122 Paquin Road
Winnipeg, Manitoba, Canada R2J 3V4

Contact: Mr. John S Glover, Vice President, Forging Ops -
(204) 222-3201

History: General Aluminum Forgings Inc was established in 1979 by Sterlake Enterprises Ltd (the parent company). An initial plant in Huntington Beach, CA, serving as a pilot company for Winnipeg, began production in Mar 80, and is now at full production. Construction for the Winnipeg plant began in the fall of 1980 and was completed in Jun 81. Production began in Jun 82.

Capability: General Aluminum Forgings manufactures precision, no draft, seamless aluminum forgings as well as conventional forgings ranging in size up to 75 lbs or 175 square inches plan view surface area. The company covers all aspects of the production from die design to final inspection of the finished part. These parts are used primarily in the aerospace industry including both commercial and defense aircraft production, missiles and space vehicles, but because of the characteristics of precision aluminum forgings, which include strength, lightness and greater resistance to corrosion, their application to other industries is on the increase.

Average Work Force: Administration - 30
Production - 55

Gross Sales: 1981 - \$2.5M
1982 - \$3.5M
1983 - \$5.5M
1984 - \$6.75M (Projected)

Plant Size: 33,000 sq ft (design capability for additional 56,000 sq ft)

Equipment: General Aluminum Forgings maintains 300 - 3500 ton hydraulic presses.

Experience: General Aluminum Forgings customers include - Boeing Aircraft Corp, AVCO Aerostructures, Northrop Aircraft Corp, McDonnell Douglas, Bendix, Hydraulic Research, National Waterlift, Simular Inc, Garret Pneumatics, Hydraulic Units Inc, Rockwell International, Fairchild Republic, Whittaker Controls, Grumman Aerospace, Mitsubishi Heavy Industries, Heath-Techna, Lockheed California, Lockheed Georgia, E-Systems, Rohr Industries, Parker Hannifin, J E Ramsey Co, Sperry Vickers, Emerson, Hughes Helicopter, and Eldec Inc.

Keywords: 1 = Aircraft; 12 = Machining; 13 = Missiles, 18 = Space Systems; 20 = Miscellaneous; Forgings = 1, 12, 13, 18, 20; Aluminum Forgings = 1, 12, 13, 18, 20; Seamless Aluminum Forgings = 1, 12, 13, 18, 20; Die Design = 12; Conventional Forgings = 1, 12, 13, 18, 20.

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GENERAL MOTORS OF CANADA Ltd Diesel Division

Code: GMC

Address: P. O. Box 5160
1991 Oxford St East
London, Ontario, Canada N6A 4N5

Contact: Mr. W L Claggett, Sales Manager, Defense Products -
(519) 452-5184

History: Diesel Division, General Motors of Canada Ltd, was established in 1949 for the manufacture of Diesel-electric locomotives. Diesel Division is a division of General Motors of Canada Ltd, which is wholly owned subsidiary of General Motors Corporation.

Capability: Diesel Division is primarily involved in the engineering and manufacture of Diesel-electric locomotives, off-highway mining haulers, transit buses and military vehicles. They have advanced skills and techniques in shearing, forming, fabricating and welding of large and complex steel components.

Average Work Force: Engineers - 150
Others - 1850

Gross Sales: 1983 - \$358M (Model Year)

Plant Size: 1,400,000 sq ft (Spread over 4 major plants)

Experience: In 1982, Diesel Division won the competitive Light Armored Vehicle competition - a joint US Marine Corps/US Army program to deliver a base quantity of 969 eight-wheeled combat vehicles carrying a two-man 25 mm turret. The contract has options for a number of mission role vehicles including Maintenance Recovery, Logistics, Mortar, Command and Control and Anti-Tank. Prototypes of these vehicles have been delivered to the Marine Corps for test and evaluation. The baseline Light Armored Vehicle (LAV) has been selected for evaluation by the USAF mounting a General Electric 30 mm turret for the role of airfield defense (Mobile Weapon System).

The LAV25 has been type classified (M1047) Standard A by the US Army. The first production vehicle was delivered in October 1983.

In the Fall of 1982, Diesel Division completed the delivery of 491 6x6 armored vehicles to the Canadian Armed Forces. They were supplied in three variants - a Personnel Carrier, a Fire Support Vehicle and a Maintenance Recovery Vehicle.

Diesel Division has also been under contract with the US Navy for a design study for a hybrid Mobile Protected Weapon System. In addition, they have also participated in the MX Missile Carrier Program through Delco Electronics and bid on the US Army Infantry Fighting Vehicle Second Source Program.

More than 3200 locomotives have been delivered to 32 domestic customers and over 1000 locomotives have been exported to 22 railways in 17 countries. More than 10,000 transit buses have been produced by the division for customers in Canada and the US.

Diesel Division has the world product mandate for the design, engineering and manufacturing of TITAN haulers and has built for eight countries more than 325 of a 170 ton capacity hauler called the 33-15. Another hauler in the line is the 33-19, which with a carrying capacity of 350 tons, is the world's largest dump truck.

Keywords: 2 = Armament; 14 = Protective Equipment; 20 = Miscellaneous; Locomotives = 20; Off-Highway Vehicles = 20; Armored Vehicles = 20; GP Armored Vehicles = 20; Amphibious Vehicles = 20; Personnel Carrier = 20; Fire Support Vehicle = 14, 20; Maintenance Recovery Vehicle = 20; Hybrid Mobile Protected Weapon System = 2; Ground Transportation = 20; Transport Systems = 20; Light Armored Vehicles = 20.

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GLOBAL THERMOELECTRIC POWER SYSTEMS Ltd

Code: GTP

Address: P. O. Box 400
Bassano, Alberta, Canada T0J 0B0

Contact Mr. Donald W Peterson, President - (403) 641-3512

History: Global is a privately held Canadian company that was incorporated in 1975. The Global operation, originating employees, equipment, and thermoelectric science & technology, was originally a major part of the Thermoelectric Division of 3M Company of St Paul, Minnesota. All facilities are at the above Canadian location.

Capability: The Global corporate mission is the commercial application of mature, field-proven remote power technology, coupled with an ongoing commitment to research & development of promising remote power technologies. They are regarded as a complete manufacturing and marketing organization, and as a result of the above mission, are engaged in extensive R&D of thermoelectrics, combustion, and electronics. Their Bassano headquarters accommodates both administrative and production facilities, as well as an engineering department, and research & development laboratories.

Global's product is a line of high reliability thermoelectric power systems for remote unattended stations requiring 10 to 1000 watts continuously. They have provided the Sandia Laboratories with power systems for SALT-type monitoring in the USSR-systems that not only provide the required power, but cannot be undetectably tampered with. This latter property results from the fact that the Global power systems have no moving parts and generally do not malfunction. Their production capacity is about 16 generators per week. Manufacturing of the thermoelectric generators is accomplished through various stages of mechanical and electronic assembly, back-filling, lead checking, and basic machining. Their shop capabilities can easily hold tolerances to the required ± 0.001 inch. The high technology semiconductor thermoelectric materials and hermetically-sealed thermopile power units are manufactured entirely on site. This is predominately for reasons of quality control and due to the highly specialized skills and equipment required. They are apparently the world's sole commercial source for sintered, doped lead-telluride thermoelectric elements meeting the US Government's standard for 3M-type ES1101 characteristics. It is interesting to note that Global thermoelectric generators have powered telemetric transmissions back to earth during Apollo moon missions. Their systems are performing today in some 40 countries, accumulating a total of well beyond 15,000 years of reliable operations.

Recognize that while thermoelectrics is a relatively mature technology, the development of remote power in general is still in its infancy. The company is therefore striving for the development of lower cost, more widely applicable power sources incorporating proven thermoelectric technology with newly developing manufacturing techniques. Their applied research is directed toward the fields of solid state physics, heat transfer & storage, and gas & fluid dynamics while development is actively underway in combustion technology, thermoelectric metallurgy, piezoelectric ultrasonic atomization, electronic & electrical engineering, and new burner systems. An additional goal is to improve their attainable weight to power ratio by a factor of 2. Their current units range

from about one pound per watt for convection cooled units to 0.2 pound per watt for forced convection cooled units. Recent ongoing experiments were in the areas of fuel atomization and increasing the combustion characteristics of diesel fuel. This R&D has led to the production of 60 units for Nippon Electric Co of Japan delivered to Madagascar. These are convection cooled units using primarily Bunker C-Type fuel.

Global has recently been funded by the Alberta Government to a level of approximately \$2M (1982). This level of funding is expected to continue for the next five to six years. The goal is to lower the production cost of thermoelectric generators, thereby lowering the cost per watt of electrical power produced. The Canadian Government has assisted Global in obtaining \$800,000 in new CNC Automated Machinery and in the \$1.2M development of a light weight portable 100 watt generator for the US military use on the battle field. The Canadian Department of National Defense is buying \$6.5M of the 100 watt prototypes.

Average Work Force: PhDs - 1
Engineers - 21
Others - 58

Gross Sales: \$2.0M (Historical)
\$4.7M (Current - 1982)
\$5.0M (Projected - 1983)
\$2.5M (Funded R&D - 1983)

Plant Size: 77,000 sq ft

Equipment: Because of the special requirements associated with the manufacturing of long life, hermetically sealed semiconductor thermopiles, Global has special equipment/instruments such as a helium mass spectrometer, TIG & MIG welding equipment, induction heater (for preparation of special alloys), vacuum & back filling equipment, an extensive line of automated CNC equipment, and two 8'x8'x8' environmental chambers capable of military specification testing.

Experience: Global's power systems markets are in the areas of telecommunications (radio repeater sites); cathodic protection; telemetry; supervisory control & signals; and navigation & positioning. Customers include US EPA, US Army, Exxon Corp (US), Mountain Bell (Boise, Idaho), Continental Telephone of the West (Phoenix, AZ), Texas Instruments, Teledyne Geotech, Amoco Pipeline Co (New Mexico), Nippon Electric Co, ARAMCO/PETROMIN (Saudi Arabia), Algeria Post & Telegraph (Algeria), Abu Dhabi National Oil Co, Shell Canada, Marinav Corp (Canada), Offshore Navigation Canada Ltd, NNPC (Nigeria), and Dome Petroleum (Canada). As can be seen, Global has world-wide experience with major organizations. They are currently working with the US Army and indirectly with the USAF (ASD) through the USA. They are interested in working directly with the USAF and appear to have considerable technology and experience to offer. They are very R&D oriented in addition to offering a reliable product line.

Keywords: 4 = Chemistry; 5 = Communications; 7 = Electronics; 8 = Energy; 20 = Miscellaneous; Power Supplies = 5, 7, 8; Remote Power Supplies = 5, 7, 8; Auxiliary Power Units = 8; Thermoelectric Power Units = 8; Unattended Power Supplies = 8; Generators = 8; Thermoelectric Generators = 8; Applied Research = 4, 8, 20; Combustion Technology = 8, 20; Thermoelectric Research = 8; Power Sources = 5, 7, 8; Portable Power Supplies = 5, 7, 8; Portable Power Sources = 5, 7, 8.

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Section III

COMPANY

KEYWORD INDEX

This section presents in alphabetical order all keywords previously documented in the company profiles of Section II. The keywords are listed in the left-hand column of the pages that follow. The subject categories, to which the keywords apply are listed in the middle column. The numerical code for these categories is explained as follows:

- | | |
|-------------------------------|----------------------------|
| 1. Aircraft | 11. Lasers |
| 2. Armament | 12. Machining |
| 3. Avionics | 13. Missiles |
| 4. Chemistry | 14. Protective Equipment |
| 5. Communications | 15. Radar |
| 6. Computers | 16. Security & Safety |
| 7. Electronics | 17. Software Services |
| 8. Energy | 18. Space Systems |
| 9. Environment | 19. Testing/Test Equipment |
| 10. Image Processing & Optics | 20. Miscellaneous |

The right-hand column of the company keyword index presents the three letter code for the company concerned. The reader is referred to Section IV of this report for an index of these company codes.

COMPANY KEYWORD INDEX

Keyword	Category	Code
A-3	4, 20	ECP
A-4	4, 20	ECP
A-5	4, 20	ECP
Abradable Seals	1, 4, 12	SGM
Accessories	1	AVE
Acoustic Sensing	7	ATH
Acoustic Sensing	7, 20	CDC
Acoustic Sensing	7	SOC
Acoustics	9	EAG
Acoustoelectric Transducers	1, 19, 20	CTF
Active Filters	7	ANA
Active Sonobuoys	7, 20	SOC
Adapters	5	CMC
Adaptive Receivers	5	MCS
Aerial Spray/Water Bombing	1, 20	FAC
Aerial Survey Systems	1	FAC
Aerial Target Tracking System	1	SED
Aerodynamic Simulations	1, 3, 13	MRC
Aerodynamics	1	CDR
Aeronautical Engineering	1	INA
Ailerons	1	FLT
Air Traffic Control Simulators	20	LSL
Air Traffic Control Systems	20	LSL
Air Analysis	9	PHV
Air Control Indicators	7, 20	DGI
Air Cushion Equipment Transporters	1	BEL
Air Cushion Systems	1	BEL
Air Cushion Vehicles	1	BEL
Air Cushion Vehicles	1	FLT
Air Delivery Systems	1	DHC
Air Delivery Systems	1	IIC
Air Infiltration	9	FII
Air Pollution	9	ARC
Air Quality	9	EAG
Air Traffic Control	1, 17	DMR
Air Traffic Control	3, 5	MRC
Air Traffic Control	6, 17	PDS
Air Traffic Control Communications Syst	5	GML
Air Traffic Control Communications Syst	5	JAT
Air Traffic Control Simulators	7, 20	CAE
Air Traffic Control Simulators	7, 20	DGI
Air Traffic Control Systems	20	CAE
Air Traffic Control Systems	6, 20	CSG
Air Traffic Control Systems	5, 7, 20	SPE
Airborne Direction Finding Equipment	3	ROC
Airborne Imager	10	MON
Airborne Laser Fluorosensor	11	BRL
Airborne Surveys	9	BRL
Airborne Surveys	8, 9, 20	MAR
Aircraft Components	1	ENH
Aircraft Control	1	DHC
Aircraft Engine Overhaul	1, 12, 19	SAL
Aircraft Parts	1, 20	PAI
Airfoil	1, 3, 16	LEI
Airframe	1	CDR
Airframe Analysis & Testing	19	DSM
Airframe Components	1, 12	AER
Airframe Components	1	BAL
Airframe Components	1	BOE
Airframe Components	1	CAP
Airframe Components	1	DHC
Airframe Components	1	ENH
Airframe Components	1	FLT
Airframe Components	1	HSC
Airframe Components	1	IMP
Airframe Components	1	SPA
Airframe Structures	1	BAL
Airframe Structures	1	BOE
Airframe Structures	1	CAP
Airframe Structures	1	DHC
Airframe Structures	1	IMP
Alarm Systems	5, 7	BCL
Alloys	1, 4, 12	SGM
Alternate Fuels Research	4	INR
Alternate Fuels Research	1, 4	PWC
Alternate Fuels Technology	4, 8	OHR
Altimeter	1, 11	OPI
Aluminum Alloys	12	CHI
Aluminum Castings	12	SLA
Aluminum Components	1	CAP

Keyword	Category	Code	Keyword	Category	Code
Aluminum Components	1	RRC	Auxiliary Power Units	8	GTP
Aluminum Fabrication	12, 20	DAF	Auxiliary Power Units	8	PWC
Aluminum Forgings	1, 12, 13, 18, 20	GAF	Avalanche Detectors	7	FII
Aluminum Sand Castings	1, 20	HAL	Avionics Engineering	1, 3	INA
Ammunition	2	IVI	Avionics Equipment	3	AVE
Ammunition Smoke	2, 4	HFI	Avionics Programming	17	TIL
Amphibious Vehicles	20	GMC	Ballistic Computer		
Amplifier Subsystems	7, 18	VAR	Systems	20	CDC
Amplifiers	7	ANA	Ballistics	2, 13	MRC
Amplifiers	5, 7, 18	MAE	Based Tone Signalling	5, 7	BCL
Amplifiers	1, 5	PEP	Bathymeter	1, 9, 11	OPI
Amplifiers	7	VAR	Battery Management		
Analog	7	BEE	Systems	18	CAL
Analog	5	FII	Beacons	1, 3, 16	GML
Analog	5, 20	RMS	Beacons	5	HEL
Analog	5, 7	TIL	Beacons	1, 3, 16	LEI
Analysis	9	PED	Beacons	5	SCS
Analytical Chemistry	4	ENC	Bearings	1, 12, 20	FAG
Analyzer	1, 14	NAT	Belts	14	IIC
Anechoic Chambers	19	RSL	Beta Ray Monitors	9, 14	SCX
Anemometer	7	DGI	Beverage Dispensing		
Animated System			Systems	1, 7	CTS
Trainers	1, 19	AFR	Bias Insertion Units	7	AVT
Anodizing	1, 2, 7, 8, 12, 13, 18, 20	COD	Biological Environment	9	WNR
Antenna Support			Biological Research	9	OHR
Structures	5	DAF	Biology	20	ARC
Antennas	18	CAL	Biomass	8	OHR
Antennas	7, 15	CAL	Biomedical Instruments	20	CTF
Antennas	3, 15	FLT	Blister Packaging	20	INR
Antennas	7, 15	MPB	Bonded Components	1, 18	FLT
Antennas	3	NAT	Bonded Components	1	MDC
Antennas	20	PEP	Bonded Components		
Antennas	5	SCS	(Composite)	1, 20	ENH
Antennas	5, 7, 18	SPA	Bonded Components		
Antennas	5	VAL	(Metal)	1, 12, 20	ENH
Anti-Friction Bearings	1, 12, 20	FAG	Bonded Honeycomb		
Applications	6	FII	Assemblies	1	FLT
Applications	11	ULI	Bonded Honeycomb		
Applied Physics	20	CTF	Components	1	MDC
Applied Research	4, 8, 20	GTP	Bonding Wire & Ribbons	20	COM
Arc Lamps	8	MPB	Boring	12	DIE
Arc Lamps	8, 9	VOR	Boundary Layer	9	EAG
Arctic Engineering	20	FGB	Brake Parts	1, 12	AVE
Armored Vehicles	20	GMC	Brazed Aluminum		
Artillery Alignment and			Heat Sinks	3, 7, 15	VAI
Control Systems	20	AVE	Brushless DC Motors	20	PEP
ASME Codes	20	WNR	Build To Print	7	MCS
Assemblies	1, 12	BAC	Build To Print	7	SIM
ASW	20	HEL	Built-to-Print	3, 5	VAL
ASW	6, 17	PDS	C-4	4, 20	ECP
ASW	20	SOC	C3 Systems	5	LSL
ASW System	1, 20	CDC	C3 Systems	5	CAL
Atmospheric Optics	9, 10, 11	OPI	C3 Systems	7, 20	CDC
Atmospheric Research	9	OHR	C3 Systems	5	FII
Atomic Absorption			C3 Systems	5, 6, 17	PDS
Spectrophotometers	4, 9	SCX	Cabinet Testing	7, 19	SIM
Attenuators	5, 7, 18	MAE	Cabinets	7	FLT
Audio	3, 5	NAT	Cabinets	7	SIM
Augmentor Wing	1	DHC	Cabinets	7	VAR
Augmentor Wing	1	RRC	Cable	7	CWC
Automated Backplane			Cable Assemblies	1, 12	BAC
Wiring	7	MAN	Cables	1, 7, 10	CWC
Automated Monitoring			Cables	1, 7, 20	ITT
& Control Systems	5, 18	MCS	Cables	1	NAT
Automated Precision			CAD PC Design	17	DCI
Measuring	12, 19	DIF	CAD/CAE Systems		
Automatic Weather			Software	7, 17	DCI
Station	9	FII	Calibration	19	CMC
Automatic Measurement			Calibration	19	RRC
Systems	7, 17	CTF	Calibration Capability	9	AMC
Automatic Number			Camera Systems		
Identification Systems	5	AEI	Components	12, 18	DIL
Automatic Test			Cargo Handling		
Equipment	7, 19	AMI	Equipment	1	CAPC
Automatic Vehicles			Cargo Handling		
Monitoring (AVM)	5, 20	RMS	Equipment	1	DHC
Automation	20	TEK	Cartography	10	SYs

Keyword	Category	Code	Keyword	Category	Code
Cartography Processing & Database	10, 13	MRC	Command Active Sonobuoys	7, 20	SOC
Castings	12	CDR	Communications	18	CAL
Castings	1, 20	HAL	Communications	11	FII
Castings	12	RRC	Communications	5, 6, 17	GEA
Castings	20	SGM	Communications	18	MCS
Castings	12	SLA	Communications	5, 6, 17	PDS
Catalytic Sensors	4, 9	AMC	Communications	18	SPA
Cavity Enclosure	11	ULI	Communications	11	ULI
Center-Loaded Antennas	5	SCS	Communications Analysis	5, 18	MPB
Chemical Agent Detection	9, 16, 20	SCI	Communications Equipment	5	VAL
Chemical Airburst Simulators	2, 4	HFI	Communications Simulation	17	PTC
Chemical Analysis	4	WNR	Communications Systems	5	NAT
Chemical Dispersers	2, 4	HFI	Communications Systems	5	SCS
Chemical Films	1, 2, 7, 8, 12, 13, 18, 20	COD	Communications Systems	18	SED
Chemical Groundburst Simulators	2, 4	HFI	Compass Systems	20	AVE
Chemical Processes	4	WNR	Component Design	5, 7	MPR
Chemical Processing	4	ARC	Component Development	5, 7	MPR
Chemical Processing	4	RAY	Component Fabrication	1, 7	NWI
Chemistry	4	WNR	Component Fabrication	12	RRC
Chips	7	CTC	Component Parts	12	RRC
Chips	7	PML	Component/System Testing	7, 19	EDS
Circuit Layout	17	CGS	Components	1	CDR
Circuit Packaging	7	CMC	Components	3, 7, 5	CMC
Circulators	1, 5, 7, 15	MAE	Components	7	FII
Civil Engineering	20	DOU	Components	1	FLT
Civil Reserve Air Fleet Simulation	1	PTC	Components	1, 12	MCL
Clandestine	5	NAT	Components	1	MDC
Climatology	9	EAG	Components	5	VAL
Cloud Dynamics	9	EAG	Components Repair & Overhaul	1, 9, 19, 20	GHI
Cloud Physics	9	ARC	Composite Components	1, 18, 20	BOE
Cloud Physics	9	EAG	Composite Components	1	CAP
Cloud Seeding	9	ARC	Composite Components	1	CDR
CMOS	7	PML	Composite Components	1, 2, 20	CGE
CNC Machining	12	BAC	Composite Components	1, 7, 15, 18	FLT
CNC Machining	12	CHI	Composite Evaluation	1, 19, 20	CTF
CNC Machining	12	DIE	Composite/Fiberglass Components	1	DHC
CNC Machining	12	RRC	Composite/Fiberglass Components	1	MDC
CO2	11	LUM	Composition B	4, 20	ECP
CO2 Lasers	11	MPB	Compound Semiconductor Wafers	4, 7	COM
CO2 Lasers	11	ULI	Computer Aided Dispatch (CAD)	5	RMS
CO2 Optoacoustic Detector	11	ULI	Computer Aided Learning	16, 17	PTC
Coal Liquefaction	8	ARC	Computer Code Development	6	WNR
Coal Pyrolysis	8	ARC	Computer Design	1, 17	CDR
Coating	12	BAL	Computer Design	6, 17	PDS
Coating	12	HSC	Computer Design	6	SCI
Coating	12	MDC	Computer Design/Computer Manufacture	12	RRC
Coating	12	UDT	Computer Dispatch	6, 7	CSG
Coating Specialized	12	EBC	Computer Graphics	9	ARC
Coaxial Ferrite Devices	1, 5, 7, 15	MAE	Computer Graphics	17	CAE
Cobalt-Samarium Magnets	20	SGM	Computer Graphics	17	CAM
Cockpit Displays	3	LSL	Computer Graphics	6, 17	PDS
Cockpit Displays	3	CDC	Computer Parts	6	CAL
Cockpit Displays	3	DHC	Computer Parts	6	CDC
Cockpit Displays	3	GML	Computer Parts	6	SUD
Cockpit Displays	3	OPT	Computer Produced Maps	6	SPA
Cockpit Displays	1, 7	SUD	Computer Security	16	IPS
Cockpit Voice Recorders	19	AFR	Computer Systems	3, 6	CDC
Coils	7	MAN	Computer Systems	1, 6	NAT
Colloid Chemistry	4	WNR	Computer Systems	6	SED
Combat Control	5, 6, 7	MRC			
Combustible Gas Monitoring Equipment	9, 16	AMC			
Combustion	20	WNR			
Combustion Research	8, 9	OHR			
Combustion Research	1, 4	PWC			
Combustion Research	19	RRC			
Combustion Technology	8, 20	GTP			
Command & Control Systems	6, 17	IPS			

Keyword	Category	Code	Keyword	Category	Code
Computer Systems	5, 6	SYS	DAMA	5, 18	MCS
Computerized C3 System			Data Acquisition	7, 17	LSL
Definition	16	PTC	Data Analysis	3, 7	LSL
Computers	6	GEA	Data Acquisition	7, 9	ATH
Computers	6	MRC	Data Acquisition	8, 9, 10, 15, 17, 20	CAM
Computer Simulation	6, 17	PDS	Data Acquisition	1, 3, 7, 20	CDC
Concrete Technology	4, 19, 20	OHR	Data Acquisition	6, 7	CSG
Conductivity Testing	19	COD	Data Acquisition	17	DMR
Connectors	7	AVE	Data Acquisition	6, 9, 19	FII
Connectors	1, 7, 9, 20	ITT	Data Acquisition	17	IPS
Consulting	6	ACL	Data Acquisition	16	LEI
Consulting	5, 6, 7, 15, 17, 18	DMR	Data Acquisition	18	MCS
Consulting	5, 6, 8, 14, 18, 20	DOU	Data Acquisition	17	MON
Consulting	1, 8, 9, 18, 19, 20	DSM	Data Acquisition	6, 17	PDS
Consulting	9	FGB	Data Acquisition	1, 8, 9, 20	QSL
Consulting	1, 3, 7, 18	FMA	Data Acquisition	7	SIM
Consulting	5, 7	JAT	Data Acquisition	17	TIL
Consulting	6, 17	PDS	Data Acquisition		
Consulting	7	TIL	Capability	7, 9, 17, 20	AMC
Continuous Casting	12	SGM	Data Acquisition Systems	1, 8, 18, 20	CAE
Continuous Wave CO2	11	MPB	Data Acquisition Systems	7, 17, 18, 20	STI
Continuous Wave CO2	11	ULI	Data Analysis	7	BRL
Continuous Wave Lasers	11	MPB	Data Analysis	1, 3, 7	CDC
Sources	7	PRA	Data Analysis	1	DHC
Contract Management	20	AMI	Data Analysis	6, 9, 19	FII
Contract Research	7, 10, 11	PRA	Data Analysis	1, 8, 9, 20	QSL
Contract Research	4	RAY	Data Annotation Displays	3	OPT
Contract Research	4, 7, 9	SCI	Data Base	17	SYS
Contract Research	20	WNR	Data Collection	7	BAL
Control Cables			Data Collection	7	EDS
Fabrication	1	NWI	Data Communications	5, 7	CMC
Control Circuitry	7	VAR	Data Communications	5	RMS
Control Systems	7	BEE	Data Communications	17	TIL
Control Systems	18, 20	CAE	Data Control Systems	1, 8, 18, 20	CAE
Control Systems	7	DAF	Data Handling	1, 3, 7	CDC
Control Systems	1	MCL	Data Handling	1	DHC
Control Systems	17	TIL	Data Handling	6, 9, 19	FII
Controllers	7	EDS	Data Handling	1, 10, 18	MDA
Controllers	5	SYS	Data Links	10	OEI
Controls	1, 3, 5	NAT	Data Loggers	6, 7, 20	TES
Controls	18	SPA	Data Management	8, 9, 10, 15, 17, 20	CAM
Controls	5	VAL	Data Processing	8, 9, 10, 15, 17, 20	CAM
Convective Storms	9	ARC	Data Processing	17	DMR
Conventional Forgings	1, 12, 13, 18, 20	GAF	Data Processing	6, 9, 19	FII
Converter/Recorders			Data Processing	17	IPS
Systems	5, 20	PEP	Data Processing	16	LEI
Convertors	1, 7, 9, 20	ITT	Data Processing	18	MCS
Copper Rod Products	20	CWC	Data Recorder Systems	20	PEP
Copper Rod Products	20	CWC	Data Recorders	6, 7, 20	TES
Core Memory Arrays	7	SUD	Data Reduction	18	CAL
Core Wound Products	7	SUD	Data Reduction	17	MON
Corona Testing	7, 19	HMC	Data Reduction	1, 8, 9, 20	QSL
Corrosion	19	WNR	Data Terminals	17	TIL
Corrosion Control	1	IMP	DLDC Powered Modules	7	AVT
Corrosion Control	1	INA	Deceleration Systems	1	IIC
Corrosion Control	19	RRC	Defense Simulation	17	PTC
Corrosion Science	4, 8, 19	OHR	Demolition Block	4, 20	ECP
Coupler Control Units	5	VAL	Derived Release Limits	9	WNR
Couplers	5, 7, 18	MAE	Desalination	9, 16	SEA
Cowlings	1	FLT	Design	1	AVE
Crash Position Indicator	3, 16	GML	Design	6	CAL
Crash Position Indicator	3, 16	LEI	Design	12	DIE
Cryocoolers	20	CTF	Design	1, 8, 9, 18, 19, 20	DSM
Cryogenic Liquid			Design	7, 19	FII
Containers	20	CTF	Design	3, 5, 15, 16	LEI
Cryogenics	7, 20	CTF	Design	11	ULI
Cryptography	5, 20	MRC	Design & Build To		
Current/Pulse Capabilities	7	HMC	Requirements	7, 8, 14, 19, 20	CTS
Custom	7	PML	Design to Requirement	17	CAL
Custom Circuits	5, 6, 7	EEL	Design to Requirements	17	AVE
Custom Design &			Design To Requirements	17	CAP
Development	7	MAN	Design to Requirements	17	EDS
Custom Packaging	20	INR	Design to Requirements	17	GML
Custom Synthesis	4	RAY	Design to Requirements	17	IPS
Customization	5, 6, 17	GEA	Design to Requirements	17	SED
CW Agent Detection	9, 16, 20	SCI	Design to Requirements	17	TIL
			Detectors	7, 10	OEI

Keyword	Category	Code	Keyword	Category	Code
Detonation	20	WNR	Electromagnetics	1, 9, 15, 20	MPB
Development	19	FII	Electromagnetics	7, 8	SCX
Development	3, 5, 15, 16	LEI	Electromechanical Design	19	CAL
Development	5, 6, 17, 20	TEK	Electron Beam Welding	1, 3, 7, 8, 20	VAI
Dewars	20	CTF	Electronic Assembly	3, 5	VAL
Die Design	12	GAF	Electronic Equipment	3, 5	VAL
Die Fabrication	12	AER	Electronic Gas Detectors	7, 9	AMC
Die Fabrication	12	BAL	Electronic Test Equipment	19	OPT
Die Fabrication	12	DIE	Electronic Warfare	7	CAL
Die Fabrication	12	EBC	Electronic Warfare	5, 7	MCS
Die Fabrication	12	NWI	Electronic Warfare	6, 17	PDS
Dielectric Testing	7, 19	HMC	Electronics	19	VIC
Digital	7	BEE	Electronics Design	7	SCI
Digital	8, 9, 17, 20	CAM	Electronics Research	7, 8	OHR
Digital	5	FII	Electronics-Nuclear	7	WNR
Digital	1, 7, 15, 18	MDA	Electroplating	1, 2, 7, 8, 12, 13, 18, 20	COD
Digital	7	MPB	Emergency Locater Beacons	3, 16	GML
Digital	5	MPR	EMP Shielding	14	RSL
Digital	5, 20	RMS	Energy Conversion	8	ENC
Digital	5	TEK	Energy Conversion	8	OHR
Digital	5, 7	TIL	Energy Management	8, 17	SYS
Digital Communications	18	MCS	Engine Component Simulator	19	AFR
Digital Data Processing	9, 15	ARC	Engine Components	1	BAL
Digital Image Analysis	7, 10, 18	DIP	Engine Components	1	DHC
Digital Mapping	8, 9	SPA	Engine Components	1	HSC
Digital Modems	5	MCS	Engine Components	1	PWC
Digital Order Wire	5	CMC	Engine Components	1, 12, 19	RRC
Digital Squid Control Module	16	CTF	Engine Components	1	SGM
Digital Switches	15	SED	Engine Components	1	SPA
Digital Switching Systems	5	MPR	Engine Controls	1	CDC
Diplexer Combining Network	5, 7, 18	MAE	Engine Controls	1	DHC
Disks	17	GEA	Engine Emission Research	1, 9	PWC
Dispersion Modeling	9	EAG	Engine Fairings	1	FLT
Dispersion Strength Alloys	1, 4, 12	SGM	Engine Fuel Control Systems	1	AVE
Display Technologies	7	OPT	Engine Instruments	1, 3	CMC
Displays	1, 3	CMC	Engine Nacelles	1	FLT
Displays	3, 7	DII	Engine Overhaul	1, 12, 19	SAL
Displays	17	IPS	Engine Overhaul & Repair	1, 8	HSC
Displays	7	MPB	Engine Research	1, 19	PWC
Disposal	9	WNR	Engine Research	1, 19	RRC
Distillers	9	SEA	Engine Systems	1	BAL
Distributed Processing	1, 5, 18, 20	MRC	Engine Systems	1	DHC
Dive Support Instruments	20	CTF	Engine Systems	1	HSC
Documentation Development	20	PAC	Engine Systems	1	PWC
Doors	1	FLT	Engine Systems	1	SGM
Doppler Navigation Systems	3	CMC	Engine Test Beds	1, 19	DSM
Dosimeters	9, 14	SCX	Engine Testing	19	HSC
Double Base Propellants	4, 20	ECP	Engine Thrust Measuring Device	1	CDC
Drafting	6	SYS	Engineering Consultation	6, 17	PDS
Drives	12, 15	BAC	Engineering Sciences	4, 8, 9, 20	OHR
Drone Alignment Systems	1	AVE	Engines	1	PWC
Drone Recovery Systems	1	IIC	Engraving	12	NAT
Drones	1	CDR	Environment	9	WNR
Drones	1	DHC	Environmental Analysis	9	ATH
Drugs Detection	20	SCI	Environmental Analysis	9	BRL
Dry Film Lubricants	1, 2, 7, 8, 12, 13, 18, 20	COD	Environmental Analysis	9	MAR
ECCM Radio	5	CMC	Environmental Assessment	9	PEP
Electrical Engineering	1, 7	INA	Environmental Assessment	8, 9	OHR
Electrical System	1	NAT	Environmental Controls	1	DHC
Electrical Test Equipment	1, 19	DIL	Environmental Controls	1	GML
Electro-Optical Equipment	10, 18	CAL	Environmental Forecasting	9	ATH
Electro-Optical Instrumentation	7, 10, 19	PRA	Environmental Instruments	1	GML
Electro-Optics	10	BRL	Environmental Laboratory	19	HEL
Electro-optics	1, 2, 3, 10, 13, 18	ELC	Environmental Programming	17	TIL
Electro-Optics	7, 10	OEI	Environmental Programs	17	ATH
Electro-Optics	10	OPI	Environmental Sciences	9	OHR
Electrochemical Devices	4, 7, 9	AMC			
Electrochemistry	4	WNR			
Electrochromic Technology	7	OPT			
Electromagnetic Compatibility	3, 19	IMP			

Keyword	Category	Code	Keyword	Category	Code
Environmental Sensors	7, 9	ATH	Forgings	12	SLA
Environmental Sensors	9	CTC	Forming	12	HSC
Environmental Sensors	7	INR	Fracture Analysis	19	CDR
Environmental Sensors	7	SOC	Fracture Mechanics	19	WNR
Environmental Testing	19	CAL	Fuel Research	1	DHC
Evaporation	9	SEA	Fuel Systems	1	DHC
Evaporation Charges	4	COM	Fuel Systems	1	MDC
Excimer Lasers	11	LUM	Fuel Systems Research	1	PWC
Explosafe	1, 14, 16, 20	EXP	Fuels Research	1, 4	PWC
Explosion Suppression Systems	1, 14, 16, 20	EXP	Fusion Splicers	7	FII
Explosions	20	WNR	Future Systems Studies	1, 2, 20	PAC
Explosives Detection	16	SCI	GaAs FET Amplifiers	5, 7, 18	MAE
Extended Interaction			Gamma Ray Monitors	9, 14	SCX
Klystrons	7	VAR	Gas Chromatography	9	PHV
Extended Length	12	CDR	Gas Analysis	9	PHV
Extended Length	12	DHC	Gas Lasers	11	LUM
Extended Length	12	DHC	Gas Turbine Components	1	BAL
Extended Length	12	EBC	Gas Turbine Components	1, 12	HSC
Fabrication	12	MDC	Gauges	12	DIE
Fabrication/Assembly/Test	7	DIE	Gear Boxes	1, 12	BAC
Fabrications	1, 12	MAN	Gear Boxes	1, 19	BAL
Facility Management	20	HSC	Gear Boxes	1, 12, 18, 19, 20	SPA
Failure Mechanics	19, 20	IPS	Gear Inspection	10, 19	DIF
Far Infrared	11	OHR	Gears	1, 12	BAC
Fast Optical Detection	7, 10	MPB	General Testing	19	IMP
Fast Optical Sources	7, 10	OEI	Generators	8	GTP
Fault Diagnosis	3, 7	OEI	Geochemical Equipment	8	SCX
Feasibility Studies	6, 17	SPC	Geographic Analysis	8, 9, 17, 20	CAM
Feasibility Studies	17	IPS	Geographic Analysis	17	FGB
Ferrite Devices	1, 5, 7, 15	PDS	Geographic Information Systems	8, 9, 17, 20	CAM
FETs	7	MAE	Geographic/Geologic Analysis	17	BRL
Fiber Optic Cable	7, 10, 20	OPT	Geologic Analysis	8, 9, 17, 20	CAM
Fiber Optic Components	7, 10, 20	CWC	Geologic Analysis	17	FGB
Fiber Optic Systems	10	CWC	Geology	8, 9	ARC
Fiber Optics	5, 7	OEI	Geophones	7, 8	ATH
Fiber Optics	10	FII	Geophysical Equipment	8	SCX
Fiberglass Antennas	5	NAT	Geophysical Sensors	9, 19	PED
Fiberglass Components	1, 18, 20	VAL	Geophysics	7, 8	ATH
Fiberglass Composite Component Manuf.	1	BOE	Geophysics	7	INR
Film Annotation Systems	1	NWI	Geophysics	7	SOC
Filters	7	PEP	Geotechnical Engineering	20	OHR
Filters	5, 7, 18	ANA	Government Relations	1, 3, 7, 18	FMA
Filters	7	MAE	GP Armored Vehicles	20	GMC
Financial	17	PML	Gradiometers	16	CTF
Fire Control Optics	1, 2, 10, 13	SYS	Graphics	17	CAE
Fire Control System	20	ELC	Graphics	17	CSG
Fire Support Vehicle	14, 20	CDC	Graphics	17	IPS
Firmware Design	6	GMC	Graphics	7	MPB
Fixed	5	ACL	Graphics	6, 17	PDS
Fixed Based Operations	1	SCS	Graphite Avionics Doors	1	FLT
Flame Advection	2, 4	FAC	Graphite Epoxy Components	1, 18, 20	BOE
Flaps	1	MRC	Gravity	8	SCX
Flaps	1	CAP	Green Signal Smoke	2, 4	HFI
Flares	2, 4	FLT	Grenades Smoke	2, 4	HFI
Flat Panel Displays	3, 7	HFI	Ground Based Reproducers	5, 20	PEP
Flaw Detection	10, 19	OPT	Ground Control Equipment	18	SED
Flight Control Systems	1	DIF	Ground Station Antennas	18	VIC
Flight Data Recorders	19	MCL	Ground Stations	18	CAL
Flight Data Recorders	1, 3	AFR	Ground Stations	17, 18	DMR
Flight Data Recorders	1, 3	CDC	Ground Stations	18	FII
Flight Data Recorders	1	LEI	Ground Stations	7, 18	MCS
Flight Operations	1, 6	PEP	Ground Stations	18	MDA
Flight Recorder	1	MDA	Ground Stations	7	SED
Flight Simulation	3	NAT	Ground Stations	5, 18	SPA
Flight Simulators	1, 3	MRC	Ground Steering Systems	1	MCL
Flight Surface Manufacture	1	CAE	Ground Support Equipment	1, 12	DIL
Flood Forecasting	9	NWI	Ground Support Equipment	18	DSM
Floppy Disk Emulators	6, 7, 20	ARC	Ground Support Equipment	1, 19	GHI
Fluid Dynamics	20	TES	Ground Transportation	20	GMC
Fluid Dynamics	20	SCI			
Flutter Analysis	19	WNR			
Forging	12	CDR			
Forgings	12	MDC			
Forgings	1, 12, 13, 18, 20	CDR			
		GAF			

Keyword	Category	Code	Keyword	Category	Code
Ground Transportation	20	UTD	High Voltage Pulse		
Ground Water	8, 9	ARC	Techniques	7	OEI
Hand Grenades Smoke	2, 4	HFI	High Voltage Science	8	OHR
Hangars	1	DAF	High Voltage		
Hardness Testing	19	COD	Transformers	7, 15, 19	HMC
Hardware	5, 6	TEK	High Volume Smoke Pot	2, 4	HFI
Hardware Design	6	GEA	Horizon Reference		
Hardware Development	7, 10, 18	DIP	Systems	20	SPE
Hardware Engineering	6	GEA	Hybrid Assembly	7	MAN
Hardware Evaluation	6	IPS	Hybrid Circuits	5, 6, 7	EEL
Hardware Maintenance	6	GEA	Hybrid Mobile Protected		
Hardware Procurement	6, 17	PDS	Weapon System	2	GMC
Harnesses	14	IIC	Hydraulic Actuators	1, 12	CHI
Harnesses	1, 7, 20	ITT	Hydraulic Assembly	12	EBC
Harnesses	1	NAT	Hydraulic Servos	1, 12	AER
Harnesses	7	SUD	Hydraulics	1	BAL
Harsh Environment			Hydraulics	20	CAE
Equipment	6, 7, 20	TES	Hydraulics	1	DHC
Hazardous Gas Alarm			Hydraulics	1, 19, 20	FAC
System	9	INR	Hydraulics	1	HER
Hazardous Gas Detection	9	BRL	Hydraulics	1	MCL
Hazardous Gas Detection	4	INR	Hydraulics	1	MDC
Hazardous Gas Detection	9	MON	Hydraulics	19	NWI
Hazardous Gas Detection	9	MPB	Hydraulics	20	WNR
Hazardous Gas Detection	9	ULI	Hydrogen	4, 9	INR
Hazardous Gas Detectors	9, 16	AMC	Hydrogen Embrittlement		
Hazardous Gas Detectors	9	SCX	Relief	19, 20	COD
HC Smoke	2, 4	HFI	Hydrogen Fuel Cells	8	DSM
Health Physics	20	WNR	Hydrogen Gas Detection	9	INR
Heat Exchangers	20	FLT	Hydrogen Production	4	INR
Heat Treat	12	MDC	Hydrogen Sulfide Sensors	7, 9, 16	AMC
Heat Treating	12	BAL	Hydrologic Analysis	8, 9, 17, 20	CAM
Heat Treating	12	CDR	Hydrologic Mapping	8, 9, 17, 20	CAM
Heat Treating	12	EBC	Hydrometeorology	9	ARC
Heat Treating	12	HSC	Hydrophones	7, 20	SOC
Heat Treating	12	RRC	IC Design	7	PML
Heat Treating	12	UDT	Ice Detector	3, 16	LEI
Helicopter Air Data			Ice Measurement	7	DGI
Systems	3	DGI	Ice Mechanics	9, 20	FGB
Helicopter Blade			Icing	9	EAG
Subassemblies	1	FLT	Igniters	2, 4	HFI
Helicopter Heater			Illuminated Panels	1, 3	CMC
Systems	1	CCA	Illumination	1	NAT
Helicopter Hubs	1, 12	CHI	Illumination Signals		
Helicopter Magnetic			Smoke	2, 4	HFI
Gradiometer	1, 8, 9	QSL	ILS	1, 3, 20	AMI
Helicopter R&O	1	INA	Image Processing	6, 10	ACL
Helicopter Recovery			Image Processing	7, 10, 18	DIP
Systems	1	DAF	Image Processing	9, 10, 15, 18	MDA
Helicopter Retentions	1, 12	CHI	Image Processing		
Helicopter Subsystems	1, 19	BAL	Systems	6, 7, 9, 17, 18, 20	MSL
Helicopter Subsystems	1	CAP	Image Recorder	1, 7, 10, 18	MDA
Helicopter Subsystems	1	SPA	Impedance Transformers	7	AVT
Helicopter Systems	1	MCL	Impulse Generators	7	AVT
Helicopter Systems	1	PWC	Industrial Control		
Helicopter Wire Strike	1, 14	BAL	Instrumentation	7, 10	OEI
Helicopters	1	NAT	Industrial Engineering	20	ARC
Helium Neon Lasers	11	PRA	Inertial Navigation	3, 7	LSL
HF Adaptive Antenna			Inflatable Life Support		
Arrays	5, 7	MCS	Systems	1, 14	IIC
HF Antennas	5	HEL	Information Displays	17	IPS
HF Communications	5	MCS	Information Handling		
HF Modems	5, 7, 17, 18	MCS	Products	7	SUD
HF Packset	5	ROC	Infrared Diode Lasers	11	OEI
HF Radios	5	SCS	Infrared Instrumentation	7	BRL
HF Receivers	5	ROC	Infrared Instrumentation	7	OEI
HF Transceivers	19	AFR	Infrared Instrumentation	7	OPT
HF Transmitters	5	ROC	Infrared Instrumentation	7, 10, 20	SPA
HF Whip Antennas	5	SCS	Infrared Materials	7	COM
High Energy	2, 4, 20	ECP	Ingredients	2, 4, 20	ECP
High Explosives	4, 20	ECP	Injection Molding	12	BEE
High Intensity Light	8	MPB	Injection Molding	2, 12	CGE
High Intensity Light	8	VOR	Injection Molding	12	CMC
High Purity Metals	4	COM	Injection Molding	12	CWC
High Speed Pulsers	7	AVT	Injection Molding	12	IMP
High Strength Steels	12	CHI	Injection Molding	12	INR
High Voltage Engineering	8	OHR	Injection Molding Tools	12	KOS

Keyword	Category	Code	Keyword	Category	Code
Injecton Molding Tools	12	BEE	Landing Gear		
Inorganic	4	ENC	Components	1, 12	CHI
Inspection Equipment	10	DIF	Landing Gear		
Installations & Servicing	3, 7	NWI	Components	1, 12	MCL
Instrument Bearings	12, 20	FAG	Landing Gear Steering		
Instrument Manufacture	7	BRL	Systems	1	SIM
Instrument Repair	1	NWI	Landing Gears	1	DHC
Instrument Repair	3, 7	SPC	Landing Gears	1	HER
Instrument Servicing	1	NWI	Landing Gears	1	MCL
Instrumentation	9, 19	ATH	Landsat	18	MDA
Instrumentation	7, 19	BAL	Large Scale Integrated		
Instrumentation	7	CWC	Circuits	7	MPR
Instrumentation	3, 7, 20	DGI	Laser Altimeter	1, 11	OPI
Instrumentation	7	EEL	Laser Communications	11, 18	MPB
Instrumentation	6, 9, 19	FII	Laser Diode Sources	11	OEI
Instrumentation	7, 8, 9	MPB	Laser Diodes	7, 11	FII
Instrumentation	7, 10	OEI	Laser Film Image		
Instrumentation	18	SED	Recorder	1, 7, 10, 11, 18	MDA
Instrumentation	7, 9, 10, 12, 17, 18, 19, 20	STI	Laser Light Sources	11	OEI
Instrumentation &			Laser Optics	11	ATH
Techniques	4, 8, 9, 19, 20	OHR	Laser Optics	10, 11, 19	DIF
Instrumentation (Air/Gas)	19	PHV	Lasers	5, 11	FII
Instruments	1	AVE	Lasers	11	LUM
Instruments	1, 3	CDC	Launch Tubes	2	CGE
Instruments	1	DHC	LCDs	3, 7	DII
Instruments	1, 3	LSL	Leak Detection	9, 19	ATH
Instruments	1	NAT	Leak Detection	7, 19	HMC
Instruments	1	PEP	LED Displays	7	LSL
Instruments	4	SCI	LED Arrays	3, 7	OPT
Instruments-Nuclear	7	WNR	LED Materials	7	OPT
Integrated Circuits	7	PML	LEDs	7	FII
Integrated High Density			LEDs	10	NAT
LED Displays	3, 7	OPT	Lenses (reconnaissance)	1, 10	ELC
Integrated Logistic			Lenses (underwater)	10	ELC
Support	1, 3, 20	AMI	Level of Repair Analysis	20	AMI
Integrated Logistics			Library (Aircraft Parts)	1	PAI
Support	3, 20	SPE	Library Systems	17	GEA
Integrated Office Systems	5, 6, 17	GEA	Lidar	8, 9, 11	OPI
Integrated Processing &			Life Cycle Support	20	PDS
Display Systems	17, 20	SUD	Life Cycle Support	20	RRC
Intelligent Instruments	1, 3	CMC	Life Cycle Support	1, 20	SPA
Interactive Analysis	9, 10, 18	MDA	Light Alloy Sand Castings	1, 20	HAL
Interactive Processing	17	CAM	Light Analysis	7	PRA
Intercom	5	LEI	Light Armored Vehicles	20	GMC
Intercom	5	NAT	Light Detection	7	PRA
Interface	3	NAT	Light Generation	7	PRA
Interface Systems	5	IPS	Lighted Panels	1, 10	NAT
Interfaces	6, 7, 9	MSL	Lighting	7, 20	CWC
Interfacing	5	TIL	Lighting	7, 20	CWC
Intrusion Detection	16	LSL	Lighting Equipment	1, 7, 8, 9, 14, 16, 20	CTS
Intrusion Detection	16	CDC	Lightweight Antennas	5	VAL
Inverting Transformers	7	AVT	Line Terminating Unit	5	CMC
Iodine Lasers	11	MPB	Linear Pulse Amplifiers	7	AVT
Ion Molecule Chemistry	4	SCI	Liquid Crystal Displays	3, 7	DII
Ion Physics	9, 20	SCI	Liquid Crystals	7	OPT
Ion Plating	1, 6, 9, 10, 13, 18	COD	Liquid Sensors	10	OEI
Ion Vapor Deposition	1, 6, 9, 10, 13, 18	COD	Locan Area Network	5	GEA
IR Detectors	10	OEI	Locomotives	20	GMC
IR Sources	10	OEI	Logistic Support Analysis	20	AMI
Irradiations	20	WNR	Long Range Transport	9	EAG
ISO-CMOS(tm)	7	PML	Low Frequency Beacon		
Isolators	1, 5, 7, 15	MAE	Systems	5	SCS
Isotope Dispensing			Low Noise Amplifiers	5, 7, 18	MAE
Equipment	8, 12, 14	DIL	Low Voltage		
Isotopes	20	WNR	Transformers	7	HMC
Isotopic	11	ULI	Luminescence Decay		
Jamming	5	MCS	Systems	7	PRA
Jig Fabrication	12	CAP	Machining	12	BAC
Kinetics	4, 11	ENC	Machining	12	CHI
Klystrons	7	VAR	Machining	5, 12	VAL
Laboratories	19	HSC	MAGLEV	20	CTF
Laboratory	7, 19	BAL	Magnesium	12	RRC
Laboratory	19	FII	Magnesium Sand		
Laminates	1, 18, 20	BOE	Castings	1, 20	HAL
Landing Gear			Magnet Wire	7	CWC
Components	1, 12	AER	Magnetic	8	SCX
Landing Gear			Magnetic Anomaly		
Components	1, 12	BAC	Detection	3, 16	CAE

Keyword	Category	Code	Keyword	Category	Code
Magnetic Anomaly Detection	3, 16	CTF	Metalworking	12	HSC
Magnetic Anomaly Detection	16	PEP	Metalworking	12	MDC
Magnetic Devices	7	CMC	Metalworking	12	UDT
Magnetic Devices	7	HMC	Meteorological Equipment	9, 20	ATH
Magnetic Gradiometer	1, 8, 9	QSL	Meteorological Satellite Processing Sys	9, 10, 18	MDA
Magnetic Tape Transports	7	SUD	Meteorological Stations	9, 20	ATH
Magnetic Wire	7	CWC	Meteorological Stations	9	BAL
Magnetometers	16	CTF	Meteorology	15	ARC
Magnetometers	9	PEP	Meteorology	9	EAG
Magnetometers	8, 9	QSL	Meteorology	9	MRC
Magnets	20	SGM	Microbiology	20	ARC
Maintenance	1	INA	Microcircuits	5, 6, 7	EEL
Maintenance	17	PDS	Microcomputers	6	SUD
Maintenance Consoles	7	SUD	Microelectronics	7	CMC
Maintenance Recovery Vehicle	20	GMC	Microelectronics	7	CTC
Manpack Transceivers	5	ROC	Microelectronics	7	MPR
Manuals	5	HSC	Micrometeorology	9	EAG
Manufacturing	20	ECP	Micrometeorology	9	EAG
Manufacturing	7	FII	Microprocessor Circuits & Software	5, 7, 17, 18, 19, 20	STI
Manufacturing	6	GEA	Microprocessor Technology	6, 7	EDS
Manufacturing	2	IVI	Microprocessors	6, 7	BCL
Manufacturing	3, 5, 15, 16	LEI	Microprocessors	6, 7	CAL
Mapping	8, 9, 10, 15, 17, 20	CAM	Microprocessors	6, 7, 20	CTF
Mapping	9	FGB	Microprocessors	6, 7	FII
Mapping	8, 9, 20	MAR	Microprocessors	7	TIL
Mapping	8, 9	QSL	Microprogramming	17	ACL
Mapping	8, 9	SPA	Microwave Amplifiers	5, 7, 18	MAE
Marine Diesel Simulators	20	SPE	Microwave Components	5, 7, 18	MAE
Marine Simulators	20	SPE	Microwave Filters	5, 7, 18	MAE
Markers	2, 4	HFI	Microwave	5, 7, 15	MAE
Mass Spectrometry	4, 9, 16	SCI	Subassemblies	5, 7, 15	CDL
Mass Storage Systems	6, 7, 20	TES	Microwave Subsystems	5, 7, 15, 18	BCL
Materials Characterization	19	WNR	Microwave Systems	5	BCL
Materials Processing	20	COD	Microwave Systems	5	MPR
Materials Testing	19	ARC	Millimeter Wave Subsystems	7	VAR
Materials Testing	19	OHR	Milling	12	DIE
Materials Testing & Development	19	WNR	Mine Components	7	EEL
Mathematics	20	WNR	Miniature Bearings	12, 20	FAG
Measurement & Control Systems	7, 19	DIF	Minicomputers	6	GEA
Measurement & Control Systems	7	DMR	Mirror Mounts	11	ULI
Measurement & Control Systems	3	GML	Missile Components	12, 13	BAC
Measurement & Control Systems	7	IPS	Missile Parts	12, 13	AER
Measurement Systems	7	SUD	Mission Analysis	1, 20	PAC
Measurement Systems	7, 10	BEE	Mobile Communications	5	SCS
Mechanical Arms	8, 18, 20	OEI	Mobile Control Heads	5	BCL
Mechanical Assembly	12	SPA	Mobile Data Design	5, 6, 17, 20	TEK
Mechanical Mounts	7, 12	EBC	Mobile Laboratory Based Analytical Svc	4, 9, 20	SCI
Mechanical Testing	19	HMC	Modeling	11	ULI
Medevac Kits	1	WNR	Modems	5	FII
Medical Biophysics	20	FLT	Modems	5, 7, 17, 18	MCS
Medical Electronics	7	WNR	Modems	5	RMS
Medical Instrumentation	7	CWC	Modification	1	CAP
Memory	7	CWC	Modification	1	FAC
Metal Working	12	PML	Modification	1	INA
Metal Coatings	20	CDR	Modulation Systems	5	MPR
Metal Detection	7	COD	Module Design	17	PDS
Metal Evaluation	19	BRL	Moisture Content	9	FII
Metal Finishing	20	CTF	Monitoring Systems	9	ATH
Metal Plating	12	COD	Monitoring Systems	7	BEE
Metal Plating	8, 9, 10	RRC	Monitoring Systems	17	TIL
Metal Powders	4	VOR	Monocycle Generators	7	AVT
Metal Working	12	SGM	Monomers	4	RAY
Metallography	19	BAL	Motors	20	PEP
Metallurgical	19	WNR	Multi-Layered Board Assemblies	7	SUD
Metallurgy	4	WNR	Multicolor LED Displays	3, 7	OPT
Metallurgy	4	COM	Multilayer Coatings	3, 7, 10, 13, 18	COD
Metalworking	12	CTC	Multiplex Displays	3, 7	DII
		EBC	Multiplexer	5	CMC
			Multiplexers	5	MPR
			Multiplexers	5, 7	SPE
			Multiprocessor Systems	6	ACL
			Nanosecond	7	AVT

Keyword	Category	Code	Keyword	Category	Code
Navigation	7	CAL	Ordnance Detectors	4, 9, 14	SCX
Navigation	1, 3, 15	CDC	Ordnance Impact Position	19	ATH
Navigation	3	CMC	Ordnance Inspection Equipment	10	DIF
Navigation	7, 20	DGI	Organic Materials Research	4, 8, 9, 20	OHR
Navigation	1	DHC	Oscillators	7	ANA
Navigation	3, 7	LSL	PABX Systems	5	AEI
Navigation	7, 18	MCS	Painting	1	INA
Navigation	1	PEP	Panels	1	FLT
Navigation	15	SUD	Panels	1, 10	NAT
Navigation Systems	1	AVE	Parachutes	1, 14	IIC
Navigational Aids	5	SCS	Particle Accelerators	8	DSM
Navstar/GPS	3	CMC	Parts	1, 20	PAI
Network Systems	5	TIL	Parts	12	UDT
Networking	5	GEA	Passive Sonobuoys	7, 20	SOC
Neutron Activation	20	WNR	Pathways Analysis	9	WNR
Night Vision	1	NAT	Payload Design	18	SED
Nitrocellulose	4, 20	ECP	Payload Equipment Design	18	DSM
Noise	5	NAT	Payload Test Services	18	SED
Non-Destructive Evaluation	19	CTF	PBX	5	GEA
Non-Destructive Testing	1, 19	BAL	PC Board Design	7	CGS
Non-Destructive Testing	1, 14, 18	DIL	PC Board Design	7	PED
Non-Destructive Testing	19	FAC	PC Board Design	7	SUD
Non-Destructive Testing	1, 12	HSC	PC Board Design & Fabrication	6, 7	CAE
Non-Destructive Testing	1, 19	IMP	PC Board Design & Fabrication	5, 6, 7	EEL
Non-Destructive Testing	1, 19	INA	PC Board Design & Fabrication	7	GML
Non-Destructive Testing	1, 19	NWI	PC Board Fabrication	7	PED
Non-Destructive Testing	19	OHR	PC Board Fabrication	7	SIM
Non-Destructive Testing	19	RRC	PC Board Fabrication	7	SUD
Non-Destructive Testing	19	WNR	PC Boards	7	CMC
Non-Directional Beacon Systems	5	SCS	PC Boards	7	DEV
Non-Routine Analysis	4	RAY	PC Boards	7	EDS
Nuclear	8	WNR	PC Boards	7	FII
Nuclear Design	20	WNR	PC Boards	7	HEL
Nuclear Engineering	8	OHR	PC Boards	7	MAN
Nuclear Instrumentation	9, 19	PED	PC Boards	7	STI
Nuclear Reactor Components	8	BAL	PC Boards	7	ANA
Nuclear Reactor Components	8	HSC	PCM Encoders	5, 7, 18	
Nuclear Sensors	9, 19	PED	PCM Filters	7	
Nuclear Simulation	6, 7, 17, 20	CAE	Performance Measuring Devices	1	CDC
Nuclear Waster Management	4, 8, 9	OHR	Performance Measuring Devices	1	DHC
Numerical Analysis	17	CAM	Peripheral Equipment	5	AEI
Numerical Modelling	9, 17	ARC	Peripheral Mass Storage	6, 7, 20	TES
Oceanographic Instruments	9	MON	Peripheral Vision Display	3	GML
Off-Highway Vehicles	20	GMC	Personnel Carrier	20	GMC
Office Automation	6, 20	SYS	Personnel Restraint Equipment	1, 14, 20	IIC
Oil Filling	7	HMC	Personnel Survival Equipment	1, 14	IIC
Oil Sands	8	ARC	Personnel Survival/Restraint	1	DHC
Oil Vacuum Processing	7	HMC	Phased Array	15	CAL
Omega Navigation Systems	3	CMC	Phased Array	15	FII
Operational Simulation	1	PTC	Photo-Fabrication	20	NAT
Operations Analysis	1, 20	PAC	Photoacoustics	11	ULI
Optical	5	FII	Photocatalyst	4	INR
Optical Building Blocks	7, 10	PRA	Photochemistry	4, 8, 11	ENC
Optical Coatings	10, 18	COD	Photodetectors	10	OEI
Optical Coatings	1, 2, 3, 10, 18, 18	ELC	Photogrammetry	10	CMC
Optical Communications	5, 7	OEI	Photogrammetry	1	PEP
Optical Processing	10	VOR	Photogrammetry	10	SYS
Optical Research & Development	1, 2, 3, 10, 13, 18, 20	ELC	Photography	1, 2, 3, 10	ELC
Optical Switches	10	OEI	Photon Counting Systems	7	PRA
Optics	10, 19	DIF	Photophysics	8, 11	ENC
Optics Infrared	1, 2, 3, 10, 13, 18	ELC	Photoplatin	7	CMC
Optics Visual	1, 2, 3, 10, 13, 18	ELC	Physical Chemistry	4	RAY
Opto-mechanical Precision Assemblies	1, 2, 3, 10, 13, 18	ELC	Physics	20	WNR
Optoacoustic Trace Gas Analyzer	9, 11	ULI	Pin Diode Switches	5, 7, 18	MAE
Orange Signal Smoke	2, 4	HFI	Pipeline Control Components	8, 12	DIL
Ordnance	2, 4	HFI	Planar Array	15	CAL
Ordnance	2	IVI	Plasma Arc	8	VOR

Keyword	Category	Code	Keyword	Category	Code
Plasma Spray Coating	1, 8, 20	VAI	Premium Quality Sand		
Plastic Fabrication	12	NAT	Castings	1, 20	HAL
Plastic Fabrication	12	VIC	Prime Power Generating		CTS
Plastic Fittings	20	CWC	Equipment	7, 8, 9, 14, 16, 19 20	MAN
Plastic Fittings	20	CWC	Printed Wiring Card	7	GEA
Plastic Molding	12	MAN	Printers	6	FII
Plastic Pipe	7, 20	CWC	Process Control	6	TEK
Plastic Pipe	7, 20	CWC	Process Control	17	RAY
Plating	12	HSC	Process Development	4	RAY
Pollution	8, 9	QSL	Product Characterization	4	SCI
Pollution Analysis	9	ATH	Product Characterization	4	ARC
Pollution Control	8, 9	OHR	Products Testing	19	DOU
Pollution Detection	9	ULI	Professional Services	5, 6, 8, 14, 18, 20	SCI
Pollution Monitoring	9	EAG	Professional Services	4, 6, 7, 9, 16, 20	WNR
Pollution Monitoring	9	MON	Professional Services	20	FII
Pollution Monitoring	9	AMC	Programming	6	TIL
Pollution Monitoring	9	ATH	Programming	17	PDS
Pollution Sensing	9, 19	PEP	Project Development	17	AMI
Pollution Sensing	9		Project Management	20	DOU
Pollution Sensing &			Project Management	5, 6, 8, 14, 18, 20	IPS
Analysis	9	MPB	Project Management	6, 16	PAC
Polyolithic Crystal Filters	7	MPR	Project Management	1, 2, 3, 20	CDC
Polymer Chemistry	4	RAY	Projected Map Displays	1, 20	ECP
Porous Titania Glass	4	INR	Propellants	4, 20	IIC
Portable Antenna Masts			Protective Clothing	14	COD
(Surface)	18	VIC	Protective Coatings	20	GEA
Portable Shelters	1, 20	FGB	Protocols	6	PEP
Portable Supplies	5, 7, 8	GTP	Proton Magnetometers	9	AVT
Portable Terminals	7	EDS	Pulse Amplifiers	7	AVT
Powder Metallurgy	4, 12	SGM	Pulse Generators	7	LUM
Power Amplifiers	7	VAR	Pulsed Gas Lasers	11	PRA
Power Converters	18	CAL	Pulsed Light Sources	7	VAR
Power Generating			Pulsers	7	SEA
Equipment	7, 8, 9, 14, 16, 19, 20	CTS	Pumps	9	HFI
Power Klystrons	7	VAR	Pyrotechnics	2, 4	VIC
Power Measurement	7	FII	Pyrotechnics	1, 4, 16	SCI
Power Sources	5, 7, 18	GTP	Quality Assurance	20	WNR
Power Sources	5, 7, 8	GTP	Quality Assurance	19	
Power Splitters	7	AVT	Quantitative Interpret. Air		MON
Power Supplies	1, 7, 13	CMC	& Sat Imagery	17	
Power Supplies	7	GML	Rad-Hardened		CAL
Power Supplies	5, 7, 8	GTP	Microprocessors	6, 7, 18	CAL
Power Supplies	5, 7	MPR	Radar	15, 18	CMC
Power Supplies	7	PED	Radar	15	DMR
Power Supplies	7	PEP	Radar	15, 17	PDS
Power Supplies	6, 7	SOC	Radar	6, 15, 17	ULI
Power Supplies	7	SUD	Radar	15	
Power Supplies	11	ULI	Radar Azimuth &		BAC
Power Supplies	7	VAR	Pedestal Drives	12, 15	IPS
Power Systems	8	OHR	Radar Control Systems	6, 17	EAG
Practice Bomb Signal			Radar Meteorology	9	MSL
Cartridges	2, 4	HFI	Radar Rain Forecasting	7, 9, 17, 18	DAF
Pre-Wired Board			Radar Reflectors	5, 15	CAE
Assemblies	7	SUD	Radar Simulation	15, 17	DMR
Precipitation			Radar Simulation	15, 17	WNR
Measurement	9, 15, 18	ARC	Radiation	20	
Precision Bearings	1, 12, 20	FAG	Radiation Monitoring		SCX
Precision Casting	12	FIT	Systems	9, 14	DSM
Precision Casting	12	IMP	Radiation Protection	8	WNR
Precision Casting	12	SGM	Radiation Shielding	20	CMC
Precision Engraving	12	INR	Radio	5	FII
Precision Machining	1, 12	AVE	Radio	5	JAT
Precision Machining	12	BAC	Radio	5, 7	MPR
Precision Machining	12	CHI	Radio	5	CMC
Precision Machining	12	CMC	Radio Ancillaries	5	
Precision Machining	12	DIE	Radio Communication		GML
Precision Machining	12	EBC	Gear, Fixed, Mobile	3, 5	
Precision Machining	12	INR	Radio Communication		ROC
Precision Machining	12	KOS	Products	5	DOU
Precision Machining	12	RRC	Radio Communications	5	MCS
Precision Machining	12	UDT	Radio Communications	5, 18	RMS
Precision Measuring	12, 19	DIF	Radio Controls	20	RMS
Precision Opening			Radio Modems	5	CMC
Release Systems	1	IIC	Radio Wire Integrator	5	AFR
Precision Parts	1, 12, 18	CHI	Radio/Radar Altimeters	19	
Precision Tooling	1, 12	DIL	Radioactive Waste		DIL
Predictive Process			Containment	8, 12, 14	WNR
Control	1, 2, 18, 20	MRC	Radioactive Wastes	9	

Keyword	Category	Code	Keyword	Category	Code
Radiotelephone Equipment	5	SCS	Repair & Overhaul	1, 3, 7	NWI
Radomes	1, 5	DAF	Repair & Overhaul	1	PWC
Rail Transport	20	WNR	Repair & Overhaul	1, 20	RRC
Range Finder	8, 9, 20	OPI	Repair & Overhaul	1, 12, 19, 20	SAL
Range Instrumentation	19	ATH	Repair & Overhaul	1, 3, 7	SPA
Rare Earth Magnets	4	INR	Repair & Overhaul	3, 7	SPC
Rare Earth Magnets	20	SGM	Repair & Overhaul	3, 15	SPE
RDX	4, 20	ECP	Repair & Overhaul	7	SUD
Reactors	20	WNR	Repair & Overhaul	1, 12	VAI
Real Time	6	CAE	Repair & Overhaul	5, 19	VAL
Real Time	6	FII	Repair & Overhaul (Sonar)	20	FLT
Real Time Control Systems	17	CAE	Repair & Overhaul Equipment	1	DIL
Real Time Graphics	17	CAE	Repair and Overhaul	1, 3, 15	AVE
Real Time Graphics	17	CSG	Repair Capability	12	EBC
Real Time Monitor Systems	17	CAE	Report Development	1, 2, 3, 20	PAC
Real-Time	6, 17	PDS	Requirements Analysis	17	PDS
Real-Time Control Systems	17	IPS	Research	4, 8, 20	ENC
Real-Time Monitor Systems	17	IPS	Research	2	IVI
Receivers	5	FII	Research	4	RAY
Recorders	7	DGI	Research & Development	6, 7, 19	AFR
Recording Seismographs	7, 8	ATH	Research & Development	5, 7	JAT
Recovery Systems	1, 13, 18	IIC	Research & Development	6, 17	PDS
Red Signal Smoke	2, 4	HFI	Research & Development	4	RAY
Reed Capsule	20	MAN	Research & Development	20	RRC
Reference Library (Aircraft Parts)	1	PAI	Research & Development	6, 7	SCI
Reflex Klystrons	7	VAR	Resistor Networks	7	WNR
Regional Resource Databases	16	PTC	Reverse Osmosis	9	ANA
Regulators	7	CDC	RF Amplifiers	7	SEA
Relays	7	MAN	RF Components	7	ANA
Remote Control Systems	5, 7, 10, 17, 18	STI	RF Shielding	14	RSL
Remote Gas Detection	9	BRL	RF Subsystems	18	CAL
Remote Handling	18	DSM	Risk Analysis	9, 20	FGB
Remote Piloted Vehicles (RPV)	20	RMS	Risk Analysis	20	WNR
Remote Power Supplies	5, 7, 8	GTP	Rocket Propellant	2, 9	BAL
Remote Sensing	9	BRL	Rocket Engines	2, 9	BAL
Remote Sensing	18	CAL	Rocket Igniters	2, 4	HFI
Remote Sensing	1, 2, 10, 18	ELC	Rocket Motor Casings	2	CGE
Remote Sensing	9	FGB	Rocket Nozzles	2	CGE
Remote Sensing	8, 9	MAR	Rocket Subcommutators	20	PEP
Remote Sensing	1, 18	MDA	Rockets	2, 9	BAL
Remote Sensing	1, 8, 9, 20	QSL	Roller Bearings	1	PWC
Remote Sensing	9	SCX	RPV	1	CDR
Remote Sensing	7, 18, 20	SPA	Rudder Assemblies	1	CAP
Remote Sensing	5, 7, 9, 17, 18	STI	Rudder Assemblies	1	FLT
Remote Sensing	9	ULI	Ruggedized Mass Storage Systems	6, 7, 20	TES
Removable Media Mass Storage Systems	6, 7, 20	TES	Salt Spray (Fog) Testing	19	COD
Repair and Overhaul	3	LSL	Sand Castings	1, 20	HAL
Repair & Overhaul	7	AMC	Sandwich Components	1, 18, 20	BOE
Repair & Overhaul	1	BAL	SAR	1, 15, 18	MDA
Repair & Overhaul	3, 7	CAE	Satellite Communications	5, 18	MCS
Repair & Overhaul	1	CAP	Satellite Communications	11, 18	MPB
Repair & Overhaul	1	CCA	Satellite Communications Ground Stations	18	SED
Repair & Overhaul	3, 6, 7	CDC	Satellite Communications Power Amps	7	VAR
Repair & Overhaul	3, 7, 19	CMC	Satellite Communications Systems	5, 18	MPR
Repair & Overhaul	20	COD	Satellite Electronics	18	CAL
Repair & Overhaul	1, 3, 7, 8, 14, 19	CTS	Satellite Meteorology	9	EAG
Repair & Overhaul	2	DEV	Satellite Subsystems	5, 7, 18	CDL
Repair & Overhaul	1	DHC	Satellite Subsystems	5, 18	SPA
Repair & Overhaul	1	ENH	Satellite Telemetry Tracking Stations	18	SED
Repair & Overhaul	1	FAC	Satellites	18	FLT
Repair & Overhaul	1, 12, 20	GHI	Satellites	5, 18	SPA
Repair & Overhaul	3	GML	SCADA Equipment	5, 20	RMS
Repair & Overhaul	1	HER	Scope Probes	7	AVT
Repair & Overhaul	1	IMP	SCPC	5, 18	MCS
Repair & Overhaul	1	INA	Sealed CO2	11	ULI
Repair & Overhaul	3	LEI	Sealed-Off Lasers	11	MPB
Repair & Overhaul	7	MCS	Seamless Aluminum Forgings	1, 12, 13, 18, 20	GAF
Repair & Overhaul	3	NAT	Search & Rescue	18	CAL
			Seat Manufacture	1, 20	FAC

Keyword	Category	Code	Keyword	Category	Code
Seawater	9	SEA	Solar Collectors	8	ESM
Secure	5	FII	Solar Energy	8	EAG
Seismic Sensors	7, 9	FII	Solar Simulation	9	VOR
Selective Signalling	5	GEL	Solder Preforms	7	COM
Semiconductor Wafers	4, 7	COM	Solid State Devices	16	LSL
Semiconductors	4, 7	COM	Solid State Devices	7, 9	AMC
Semiconductors	7	CTC	Solid State Devices	7	AVT
Semiconductors	7	OPT	Solid State Devices	7	CAL
Sensors	9	AMC	Solid State Devices	7	CTC
Sensors	19	DIF	Solid State Devices	7, 8, 14, 19	CTS
Sensors	7, 10	OEI	Solid State Devices	3, 7, 20	DGI
Sensors	8, 9, 20	QSL	Solid State Devices	7	EDS
Shaft Assemblies	1, 12	BAC	Solid State Devices	5, 6, 7	EEL
Shaker Table	1, 9	DSM	Solid State Devices	7	GML
Sheet Metal	12	MAN	Solid State Devices	7	INR
Sheet Metal Cases	7, 12	HMC	Solid State Devices	7	JAT
Sheet Metal Fabrication	12	NWI	Solid State Devices	7	MPR
Sheet Metal Work	1, 12	INA	Solid State Devices	3, 7	OPT
Shielded Cabinets			Solid State Devices	7	TIL
& Wireways	14	RSL	Solid State Devices	7	VAR
Shielding	14	RSL	Solid State Memory	6, 7, 20	TES
Ship Instruments	7, 20	DGI	Solid State Systems	3, 20	NAT
Shipboard Support			Solid State Systems	7	OEI
Systems	1	DAF	Sonar	20	FLT
Side-Looking Airborne			Sonobuoy Components	7	EEL
Radar	15	CAL	Sonobuoys	20	DEV
Sights	1, 2, 10, 13	ELC	Sonobuoys	20	HEL
Signal Cartridges	2, 4	HFI	Sonobuoys	7, 20	SOC
Signal Identification			Spacecraft Subsystems	18	CAL
Systems	5	MCS	Spacecraft Units	18	CAL
Signal Processing	6, 15	ACL	Spares Supply	1, 20	FAC
Signal Processing	7	BRL	Spatial Information		
Signal Processing	7, 15	CAL	Systems	9, 17	CAM
Signal Processing	16, 17	CTF	Special Purpose		
Signal Processing	15	MCS	Parachutes	1, 14	IIC
Signal Processing			Special Purpose		
Systems	1, 20	CDC	Processors	6	ACL
Simulation	6, 9, 17	CAE	Special Structures	1, 20	FGB
Simulation	6, 17	PDS	Specialized Coating	12	UDT
Simulation	9	PED	Specialized Fabrication	12	DAF
Simulation	1, 17	PTC	Specialized Test		
Simulation Programs	17	CAE	Equipment	19	SIM
Simulation Programs	17	SED	Specialty Alloys	4, 12	SGM
Simulators	1, 20	AFR	Spectral Measuring		
Simulators	1, 15, 17, 18, 20	CAE	Devices	9	MON
Simulators	15	CAL	Spectroscopy	11	BRL
Simulators	1	DHC	Spectroscopy	4, 8, 11, 20	ENC
Simulators	15	LSL	Spectroscopy	11	ULI
Simulators	15	PEP	Spectrum Analysis	18	MCS
Single Base Propellants	4, 20	ECP	Speech	3	NAT
Single Sideband Radios	5	SCS	Speed Brakes	1	FLT
Site Or Regional			Spin Forming	12	BAL
Resource Databases	16	PTC	Splicers	10	PHD
Small Arms Components	2, 12	DEV	Spotting Charges	2, 4	HFI
Small Caliber	2	IVI	Spread Spectrum		
Small Gas Turbine			Modems	5, 7	MCS
Engines	1	PWC	Sputtering	4	CTC
Smoke Markers	1, 4, 16	VIC	Sputtering Targets	7	COM
Smoke Pots	2, 4	HFI	SQUID Instrumentation	16	CTF
Software	6, 17	PDS	SSMA	5, 18	MCS
Software	17	QSL	Stamping	12	BAL
Software	6	TEK	Stamping	12	DIE
Software Design	17	GEA	Stamping	12	EBC
Software Design	17	PAC	Stamping	12	HSC
Software Development	17	AFR	Stamping	12	SLA
Software Development	17	CAE	Stand Alone Lab		
Software Development	17	CAM	Instrumentation	7	AVT
Software Development	17	DIP	Standby & Power		
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Analysis	17	PAC	Steel Stampings	12	SLA
Soils	8, 9	ARC	Steer By Wire Systems	1	SIM
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Manufacture	1	DHC	Systems Interface Design	1, 3	INA
Storage of Digital Imagery	7, 10, 18	DIP	Systems Planning	1, 3, 7, 18	FMA
Stress Analysis	1	DSM	Systems Specification	17	PDS
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Structural Components		CHI	Tactical	5	FII
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Structural Design	17	CAL	Tactical Signal Simulator	7	CAL
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Keyword	Category	Code	Keyword	Category	Code
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Units	8	GTP	Supplies	8	DSM
Thermoelectric Research	8	GTP	Transportation	20	ARC
Thick Film Hybrid	7	CGS	Transportation Control		
Thick Film Hybrid	7	CMC	Systems	17	TIL
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			Videotex (Teledon)	10	SYS

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GODFREY HOWDEN Inc

Code: GHI

Address: 480 Montreal-Toronto Blvd
Lachine, Quebec, Canada H8S 1B8

Contact: Mr. L C Gillespie, Vice President - (514) 637-1122

History: Godfrey Howden Inc is a member of the Howden Canada Group of companies and is a wholly owned subsidiary of Howden Group Plc which is located in Glasgow, Scotland. It was established initially at the present address in 1947 to provide a sales and service facility for aircraft environmental control equipment manufactured by the then UK parent company, Godfrey Eng Co Ltd. The company became a member of the Howden Group in 1968 and expanded manufacturing and service support capabilities.

Capability: Godfrey Howden Inc is a major source for the design, development and manufacture of aircraft ground support equipment for the Canadian Armed Forces. Special expertise has been acquired in the field of hydraulic, pneumatic and refrigeration ground support equipment. The company also maintains a sophisticated facility providing full repair and overhaul support for a wide range of military and commercial aircraft components associated primarily with pressurization and environmental control systems. All inplant processes are subject to quality control surveillance and defect preventive procedures which meet the requirements of the most stringent Canadian, US and NATO specifications.

Average Work Force: Engineers - 4
Technicians - 8
Others - 68

Gross Sales: 1980 - \$4.8M
1981 - \$5.4M
1982 - \$5.8M
1983 - \$5.8M (Projected)

Plant Size: 33,000 sq ft

Equipment: Equipment and procedures used in the Godfrey Howden production facilities are categorized as follows - Chucking, Lathes, Milling, Drilling Machines, Grinders, Metal Forming, Special Equipment, Variable Speed Rigs, Leakage Test, Vacuum Test, Turbine Test, Altitude Test, High Pressure Air Test Rig, Hydraulic Test Rig, Power Supply Rig, Electrical Power Sources, Balancing, and Speed Measuring. A detailed list can be provided upon request.

Experience: Supplier of specialized equipment and services to the Canadian Government, Beech Aircraft Co, Grumman Aerospace, and major US and Canadian commercial air carriers for over twenty-five years.

Keywords: 1 = Aircraft; 9 = Environment; 12 = Machining; 19 = Testing/Test Equipment; 20 = Miscellaneous; Repair & Overhaul = 1, 12, 20; Ground Support Equipment = 1, 19; Components Repair & Overhaul = 1, 9, 19, 20.

Revised: Dec 83

HALEY INDUSTRIES Ltd

Code: HAL

Address: Haley, Ontario, Canada
K0J 1Y0

Contact: Mr. H W Murray, Vice President, Marketing - (613) 432-8841

History: Haley Industries Ltd is an aluminum and magnesium aerospace sand casting foundry. The company was originally formed by the Canadian Government in 1952. In 1968, the facility was purchased by private interests. Plant expansions/modernizations took place in 1969 and 1974. In 1981, the company went public in order to finance a further \$7M modernization program. In 1982, a major research and development effort was initiated to produce premium quality sand castings.

Capability: Haley Industries provides aerospace quality light alloy sand castings to an international customer base. Their castings are used in fixed wing and rotary wing aircraft for both military and civil applications. They specialize in producing complex gearbox and transmission castings in both aluminum and magnesium including constant speed drive housings (CSD), auxiliary power unit housings (APU), airframe mounted auxiliary drive system housings (AMADS), main propulsion engine gearbox housings and main transmission and tail rotor housings for helicopters. In order to supply lubricating oil to the gears in these various housings, Haley developed a sand pipe core process enabling them to cast internal oil passageways in the walls of the casting. Haley Industries' premium quality casting area permits them to produce castings with superior mechanical properties and excellent radiographic qualities. If required, this also gives them the ability to cast thinner walls with a fine surface finish.

The company is completely self-sufficient for all foundry operations. They have in-house capability for pattern making, heat treat, destructive and non-destructive testing, dimensional inspection, sand testing, spectrographic analysis and tensile testing with high temperature capabilities. The extensive use of computers and microprocessors throughout the foundry has enabled Haley to retain its prominent position in the international aerospace foundry industry.

Average Work Force: Staff - 100
Hourly - 250
Engineers - 14

Gross Sales: 1980 - \$20,506,973
1981 - \$24,516,402
1982 - \$23,249,149
1983 - \$19,177,685

Plant Size: 120,000 sq ft

Equipment: Haley Industries has the most modern foundry equipment available to meet or surpass the exacting aerospace material and design engineering requirements. Specific brochures will be furnished upon request.

Experience: Haley Industries has 31 years in operation serving the following customers - Garrett Turbine Engine Co, Avco Lycoming, Boeing Vertol, Bell Helicopter, Detroit Diesel - Allison, General Electric - Engine Group, Hispano-Suiza (France), Klockner-Humboldt-Deutz (Germany), Kaman Aerospace, Litton Precision, Moteren-Und Turbinen-Union (Germany), Pratt & Whitney Aircraft (Hartford, Conn), Pratt & Whitney Aircraft of Canada Ltd, Sikorsky Aircraft, Spar Aerospace, Sundstrand Aviation, Westinghouse, and Westland Helicopter (England).

Keywords: 1 = Aircraft; 20 = Miscellaneous; Light Alloy Sand Castings = 1, 20; Aluminum Sand Castings = 1, 20; Magnesium Sand Castings = 1, 20; Premium Quality Sand Castings = 1, 20; Sand Castings = 1, 20; Castings = 1, 20.

Revised: Dec 83.

HAMMOND MANUFACTURING COMPANY Ltd

Code: HMC

Address: Corporate Office
394 Edinburgh Road
Guelph, Ontario, Canada N1H 1E5

Electronic Transformer Division
95 Curtis Drive
Guelph, Ontario, Canada N1K 1E1

Contact: Mrs. Janice Husson, Marketing Services Manager
- (519) 822-2960

History: Hammond Manufacturing Company Ltd was formed in 1927. There are presently three divisions - Electronic Transformer Division, Electrical Transformer Division, Cabinetry Division; and sales and technical services offices in Montreal, Toronto, Winnipeg, Calgary, and Vancouver (Canada). There are also sales and technical service offices located in Buffalo, NY, and Dallas, TX. Hammond Manufacturing is a privately owned Canadian company.

Capability: The company is involved in the manufacture of a wide range of magnetic devices for the electrical/electronic industry. Specific areas are outlined below:

- High Voltage Design and Fabrication - high voltage transformers are designed, wound, assembled, and tested at the Electronic Transformer Division (Guelph). Fabrication of sheet metal cases and special mechanical mountings are manufactured by the Cabinetry Division (Guelph). The company has been manufacturing custom designed high voltage transformers since 1940 for functions such as radar, dielectric testing, HV power supplies, medical electronics, modulation transformers, electrostatic speakers, and electronic air cleaners. They have design and manufacturing capability for single and three phase units.
- High Voltage Testing - the Electronic Transformer Division has in-house test capabilities up to 50 KV RMS, 60 Hz dielectric testing, Corona testing at 60 Hz to 400 Hz per MIL-T-27 specification. Specification: Available for testing at the Electrical Transformer Division - dielectric up to 80 KV RMS, up to 200 KV DC (high impedance loading), and up to 175 KV impulse. Test equipment is of commercial and custom manufacture.
- Case design for containing special transformers and fabrication is available to withstand pressure due to liquid expansion. Includes water cooling.
- Leak detection per MIL-T-27.
- Vacuum processing is available for silicone and mineral transformer oils as well as mineral and epoxy varnishes and potting epoxy, or compounds.
- Oil filling available. At present, there is no gas filling of high voltage transformers.
- Low Voltage Transformers - power, trigger, Audio High Frequency, pulse, and reactors are designed

and fabricated at Electrical Transformer Division. Capabilities range from microwatt devices up to kilowatt level in single, two and three phase configurations at frequencies ranging from 10 Hz to 150 KHz. Physical characteristics range from standard EI laminations through "C" core, wound core, toroidal, pot core, etc., in materials of silicone steel, nickel alloy, mu metal, ferrite, powdered iron and air core transformers and reactors.

- Current and Pulse capabilities - Electronic Transformer Division, current to 10A, pulse to 10KV; and Electrical Transformer Division, current up to 50,000A.
- Military requirements - designed to meet MIL-T-27 available with certificate of conformance. The company inspection system is established to Department of National Defense specification DND 1016, (equivalent to MIL-I-45208). They are presently in the second stage of applying for recognition of a Quality Program to DND 1015 (equivalent to AQAP-1 NATO Quality Control Systems Requirement for Industry and Military Specification MIL-Q-9858A Quality Program Requirements).
- Source surveillance and government source inspection available by DND Canadian Forces Technical Service Depot 302 (Guelph).

Average Work Force: Corporate (Total) - 1100
Electronic Division - 130

Gross Sales: 1979 - Corporate/\$28.3M;
Electronic Division/\$2.9M
1980 - Corporate/\$33.7M;
Electronic Division/\$3.1M
1981 - Corporate/\$44.0M;
Electronic Division/\$4.3M
1982 - Corporate/\$50.0M;
Electronic Division/\$6.0M

Plant Size: Electronic Division - 20,000 sq ft
Electrical/Cabinetry Division - 175,000 sq ft
Other Manufacturing Plants - 50,000 sq ft
Warehouse Facilities - 100,000 sq ft

Equipment: Electronic Transformer Division - (Winding) multiple/gang coil winders, unit coil winders, toroidal coil winders, bobbin coil winders, RF choke winders; Automated stacking/laminating machines, vacuum impregnating/potting encapsulating/casting tanks; (Ovens) Baking and curing ovens; (Environmental) Heat, altitude, cold (plans for 1982 include a complete environmental lab, including shock, vibration, salt spray, humidity, etc.).

Experience: Hammond Manufacturing has been involved with military projects since 1939. They are presently supplying magnetics to Canadian and US manufacturers of the power supply for the gun turret fire control computer for the M-1 Main Battle Tank. Hammond Manufacturing also supplies magnetics for/to - Canadair Challenger Aircraft; Atomic Energy of Canada Ltd "THERAC" Series of Linear Accelerators; Satcomm Ground Communications Stations for NATO; Garrett Manufacturing; Collins Radio; Varian Canada; Bell Canada; Canadair; deHavilland Aircraft; Canadian General Electric; ITT; Computing Devices Company; National Research Council of Canada; Department of National Defense; Department of Supply & Services; Sperry Univac; Raytheon Canada; Atomic Energy of Canada; Ward Beck Systems; McCurdy Radio; McCurdy Communications; Litton Systems; and universities and research groups.

Keywords: 7 = Electronics; 12 = Machining; 15 = Radar; 19 = Testing/Test Equipment; Magnetic Devices = 7; High Voltage Transformers = 7, 15, 19; Sheet Metal Cases = 7, 12; Mechanical Mounts = 7, 12; Dielectric Testing = 7, 19;

Corona Testing = 7, 19; Leak Detection = 7, 19; Oil Vacuum Processing = 7; Oil Filling = 7; Low Voltage Transformers = 7; Current/Pulse Capabilities = 7.

Revised: Dec 83

HANDS FIREWORKS Inc

Code: HFI

Address: 221 Nipissing Road
Milton, Ontario, Canada L9T 1R3

Contact: Mr. R A Brown, President - (416) 878-2831
Mr. D E Crabtree, Vice President -
(613) 224-8753

History: Hands Fireworks Inc was established in 1873 for the purpose of making domestic display fireworks. Early in World War II, the company converted completely to the manufacture of military pyrotechnics which have been a major product ever since. Hands Fireworks Inc became the major pyrotechnics and fireworks producer in Canada. During WW II, a wide range of pyrotechnics were manufactured for most of the allied countries and included such items as US BM 8AI Flare, the 4.5 inch Reconnaissance Flare, 2 inch Parachute Illuminating Flares, Verey Pistol Cartridges of all types, and smoke signals.

In 1977, the company was purchased by Lorcon Inc and operated as a division, Hand Chemical Industries. Recently, the operations became an independent Canadian company and now operates as Hands Fireworks Inc.

Capability: Hands Fireworks Inc operates from three plants - one at Milton, Ontario (near Toronto), the main plant at Papineauville, Quebec (between Ottawa and Montreal), and a new plant at Edwardsburgh (50 miles south of Ottawa). The new plant also includes a R&D facility, Environmental Testing Laboratory, Quality Control Laboratory, and the company's central distribution warehouse. The production plants are typical for this industry, being constructed of fire resistant materials and consisting of many individual buildings thereby keeping the amount of explosive, flammable, dangerous or toxic materials and the number of operators involved to a minimum.

Each specific operation or storage area has been carefully analyzed for degree of hazard and is designed to minimize these hazards by steel or reinforced concrete walls, protective steel guards, remote control of operation, special protective devices such as explosive activated fire extinguishing equipment, protective screens between buildings, special electrical wiring, etc. The process, materials, quantities of explosive, type of protection, etc., are licensed yearly by the Federal Department of Energy, Mines and Resources, followed up by frequent plant inspections by this department throughout the year.

The Milton facility includes one laboratory/test building, one office building, two explosive storage magazines, and one raw materials storage building. The Papineauville facility includes one laboratory/test building, one office building, 50 process buildings, 9 explosive storage magazines and 32 raw material storage buildings. The Thurso facility includes one laboratory/test building.

The fireworks line is completely integrated starting with the basic raw materials, paper, and chemicals, and converting them into spiral wound paper tubes from 1/4 to 3 inch inside diameter, mixing the chemicals, pressing, drying, labelling and packaging. The plastic components which hold the delay charges and bursting charges are purchased from outside sources, but are produced from company molds. The smokeless and black powders used are purchased from outside sources.

Average Work Force: Professionals - 10
Others - 120

Gross Sales: 1983 - \$4.5M

Plant Size: 100,000 sq ft (Total at all locations - 120 Buildings)

Experience: Hands Fireworks Inc has worked very closely with the Department of National Defense (DND) and various Canadian Design and Development facilities such as the National Research Council; the Defense Research Establishments in Valcartier, Quebec and Suffield, Alberta; and the Chief Inspector of Explosives of the Department of Energy, Mines and Resources. Development work has been done for the Department of Agriculture. Some major projects have included:

- The design and development of the Grenade, Hand, Smoke (HC), and C1A1.
- The design and development of the Smoke Pot, SC39 and SC390. This long burning (11 to 18 minutes), high volume smoke pot has recently been tested by the DOD at Dugway, Utah.
- The design and development of the Disperser Chemical Groundburst, and Disperser Chemical Airburst, both of which are currently being used by DND.
- Design and development of a complete line of NBC Training Simulators with assorted chemical charges.
- The manufacture of the igniter for the Black Brant Rocket.
- The design, development and production of the Signal, Illumination 1 1/2 inch (plastic case) Red, Yellow, Green, etc., currently in service with the Canadian Forces.
- The design, development and manufacture of the Silver Rainmaker shell which was used successfully to produce rainfall to fill reservoirs for irrigation.
- The design, development and production of the 2 minute Smoke Pot Orange.
- The design and development of self-scuttling Marine Marker (Manual)

Keywords: 2 = Armament; 4 = Chemical; Chemical Airburst Simulators = 2, 4; Smoke Pots = 2, 4; Markers = 2, 4; Spotting Changes = 2, 4; Grenades Smoke = 2, 4; Hand Grenades Smoke = 2, 4; Signal Cartridges = 2, 4; Illumination Signals = 2, 4; Practice Bomb Signal Cartridges = 2, 4; Orange Smoke = 2, 4; Red Signal = 2, 4; Yellow Signal = 2, 4; Green Signal = 2, 4; Igniters = 2, 4; Rocket Igniters = 2, 4; Chemical Groundburst Simulators = 2, 4; High Volume Smoke Pot = 2, 4; HC Smoke = 2, 4; Pyrotechnics = 2, 4; Flares = 2, 4; Chemical Dispersers = 2, 4; Ammunition Smoke = 2, 4; Ordnance = 2, 4.

Revised: Dec 83

HAWKER SIDDELEY CANADA Inc (Orenda Division)

Code: HSC

Address: Box 6001
Toronto AMF, Ontario, Canada L5P 1B3

Contact: Mr. E Lyn Davies, Mgr, Sales & Contracts -
(416) 677-3250

History: Hawker Siddeley Canada Inc is a Canadian public company, listed on the Stock Exchanges in Montreal, Toronto and Vancouver. The head office is in Toronto and the company normally employs about 7,000 people in divisions across Canada, in the UK, and in the US. The company is engaged mainly in engineering and manufacture of heavy industrial products for domestic and export markets. The Orenda Division was established in 1946 to design, develop and manufacture jet engines for Canadian fighter aircraft. Orenda has built several thousand gas turbine engines of both its own design and under license for General Electric. They have designed and built the Lance Missile Launcher, conducted nuclear development work, and built parts for the Candu nuclear reactor; and designed and built industrial gas turbines for use in oil pipeline operations and for emergency power units.

Capability: The Hawker Siddeley Orenda Division's capabilities are outlined below:

Manufacturing. The Orenda Division is now a sub-contract manufacturer of major components for aircraft and industrial gas turbines. The facility includes a large machine shop, an extensive sheet metal fabricating shop, a heat treating department, quality assurance to MIL-Q-9858, and a comprehensive non-destructive testing department.

Repair & Overhaul. Orenda Division has contracts for the repair and overhaul of aircraft gas turbine engines J79, JB5-15, J85Can40, and was recently awarded a contract for the repair and overhaul of the F404. Also overhauled and repaired are industrial gas turbine engines. The plant has facilities for testing all these engines.

Publications. The Graphics Department prepares and prints manuals to Department of Defense standards, as well as commercial graphics work.

Laboratory. The laboratory is fully qualified by the Department of National Defense and performs chemical metallurgical and mechanical testing, and analysis in support of other departments and also for other customers.

Average Work Force: Technical Staff – 70
Total – 700 – 800

Gross Sales: 1980-1983 – \$50M + Annually

Plant Size: 440,000 sq ft
117,000 sq ft adjacent space immediately available

Equipment: Machine Shop facilities include: Turning up to 12 ft dia; NC & CNC machining centers; and EDM broaches. NC programming uses access to GE and Sundstrand time-sharing computers. Sheet metal fabricating has mechanical and hydraulic presses to 600 tons; fusion and resistance welding; and facilities for forming, shaping and joining. There is an environmental room with control of temperature, humidity and dust. Heat treating has atmospheric, inert gas and vacuum furnaces, and plating and coating facilities. Non-destructive testing includes fluorescent penetrant, magnetic particle, x-ray and ultrasonic equipment. Assembly has dynamic rotor balancing machines, gas turbine engine test cells, and facilities for testing fuel systems.

Experience: Orenda Division's customers for aeronautical parts and gas turbine repair and overhaul have included Pratt & Whitney, General Electric, Avco Lycoming, McDonnell Douglas, Rolls Royce, Lucas Aerospace, Canadian Department of National Defense, NAMSA, and the Air Forces of the Netherlands, Germany, Norway, Belgium, Pakistan, and Italy. Nuclear reactor component design and manufacture was performed for Atomic Energy of Canada.

Keywords: 1 = Aircraft; 5 = Communications; 8 = Energy; 12 = Machining; 19 = Testing/Test Equipment; Airframe Components = 1; Engine Components = 1; Engine Systems = 1; Engine Overhaul & Repair = 1; Metalworking = 12; heat Treating = 12; Coating = 12; Stamping = 12; Forming = 12; Welding = 1; Gas Turbine Components = 1, 12; Non-Destructive Testing = 1, 12; Nuclear Reactor Components = 8; Laboratories = 19; Engine Testing = 19; Fabrications = 1, 12; Manuals = 5; Plating = 12.

Revised: Dec 83

HERMES ELECTRONICS Ltd

Code: HEL

Address: 40 Atlantic St
Dartmouth, Nova Scotia, Canada B2Y 4A1

Contact: Mr. N R Wood, Marketing & Admin Mgr –
(902) 466-7491

History: Hermes is the successor of the Canadian branch of EMI Electronics of the UK. It was established in 1949 and has specialized in anti-submarine warfare products, certain areas of HF Communications, and oceans/environmental data systems products.

Capability: The company's products include:

Sonobuoys and Bathythermograph Buoys – production types include AN/SSQ-41A, AN/SSQ-41B, AN/SSQ-36, AN/SSQ-53B, AN/SSQ 525 VLA, and AN/SSQ 527B.

Ionospheric Sounding Equipment – vertical and oblique sounding equipment is manufactured and is in service on a worldwide basis. The AN/FPT-11 transmitters, AN/UPR-2 receivers, and their commercial counterparts represent the last generation of this equipment.

HF Antennas – a unique active broadband aperiodic loop array is produced. Various configurations of this system are in service in twenty-three countries and fifty-four agencies of various governments.

Moored and Drifting Data Buoy Systems – buoy vehicles for the collection, recording and retransmission of oceanographic, meteorological, and environmental data have been developed and systems engineered for government, institutional, and industrial users. Hermes developed the Canadian Ocean Data Systems Buoys for the Canadian Government in 1975.

Environmental Data Systems – ice stations and automatic weather stations have been developed and manufactured for industrial and government users.

Average Work Force: 400 (including 75 engineers, technicians, draftsmen and engineering support staff).

Gross Sales: No Data

Plant Size: 137,600 sq ft

Equipment: Hermes has a fully equipped environmental testing laboratory as well as a comprehensive manufacturing facility. Their environmental laboratory is one of the largest in Eastern Canada and contains vibration equipment, humidity and temperature chambers, shock and tensile testers, and high pressure testing tanks. The equipment meets the requirements of MIL-STD-810 for Environmental Test Methods. This is the prime military standard which establishes uniform environmental test methods for determining the resistance of equipment to the effects of natural or induced environments.

peculiar to military operations. Hermes cannot conduct testing for fungus and sand & dust, but arrangements can be made to have these carried out at other approved laboratories. The manufacturing facility has a chemical process capability, manufactures printed circuit boards, and can plate, paint, weld, stamp, magnetically form and machine. The plant is equipped to manufacture electronic and mechanical components and equipment as prototypes or in quantity production.

The company's quality control and inspection department has developed and implemented a complete quality assurance program, which ensures quality and compliance to customers specifications, often to military standard. A calibration and standards room is maintained and supervised by quality control and inspection. This facility checks all company instruments to ensure their accuracy by using standards with certified values. These are traced to N.R.C. and N.B.S. and are checked at regular intervals to ensure their accuracy. A quality assurance manual in accordance with DND 1015 and with MIL-G-9858A defines the QA operations of the company.

Experience: Hermes is a large scale producer of sonobuoys for the Canadian and US Governments, as well as other governments. They are presently completing a major order of AN/FPT-11 transmitters for the US Navy.

Keywords: 5 = Communications; 7 = Electronics; 9 = Environment; 19 = Testing/Test Equipment; 20 = Miscellaneous; HF Antennas = 5; Weather Stations = 9; Sonobuoys = 20; ASW = 20; Beacons = 5; Environmental Laboratory = 19; PC Boards = 7.

Revised: Dec 83

HEROUX Inc

Code: HER

Address: 755 Thurber
Longueuil, Quebec, Canada J4H 3N1

Contact: Mr. Emile L Desnoyers, Marketing Director –
(514) 679-5450

History: Heroux Inc was founded in 1942 and is a wholly owned division of Bombardier Inc.

Capability: Heroux is a fully integrated company involved in the manufacture, assembly and the testing of aircraft landing gears and hydraulic systems for the military and commercial markets. They also operate a landing gear and hydraulic repair and overhaul facility. This latter R&O facility handles such aircraft as the 707, 727, 737, DC8, DC9, DC10, L-1011, C130, KC135, P3 and the DHC-5 & DHC-6. They have complete onsite electroplating facilities.

Average Work Force: Total – 400

Gross Sales: \$15M/Year

Plant Size: 250,000 sq ft

Equipment: All necessary equipment for the manufacture, repair and testing of landing gear and hydraulic systems.

Experience: The company is involved in all major markets in North America, England, Europe and South America on both military and commercial basis. Major customers include the US Air Force, Canadian Forces, Air Canada, Canadair, de Havilland, McDonnell Douglas, Boeing, Lockheed, Grumman and other airlines (British Colodonian, Britannia, Avianca and Aero Peru).

Keywords: 1 = Aircraft; Hydraulics = 1; Landing Gears = 1; Repair & Overhaul = 1.

Revised: Dec 83

I. M. P. GROUP Ltd Aerospace Division

Code: IMP

Address: Head Office
7037 Mumford Road
Halifax, Nova Scotia, Canada B3L 2J1

(Mailing)
P. O. Box 1014
Dartmouth, Nova Scotia, Canada B2Y 4J3

Contact: Mr. H L Connor, Marketing Director –
(902) 861-2250, X277

History: The company, Industrial Marine Products, was formed in 1967 to purchase the assets of a group of Nova Scotia companies which had been manufacturing foundry and steel fabricated products since 1865. During the next few years, they expanded into the commercial fishing gear and marine equipment areas, and expanded operations into other locations in eastern Canada and the US. In the early 1970s, the company acquired the facilities, equipment, operational management and work force of a major aircraft company in the Halifax area, and thus, expanded into aircraft overhaul and repair, and aerospace manufacturing areas. The current operating divisions of IMP Group are:

Aerospace Manufacturing
Aerospace Engineering Services
Aircraft Repair and Overhaul
General Aviation Services
Foundry
Steel Fabrication & Machine Shop
Tool and Plastics
Marine
Offshore Services
Hotel
Properties and Investments
Research and Development

Capability: IMP Group's capabilities are described in the eight divisions listed below:

Aerospace Manufacturing Division – manufactures electronic wiring assemblies for various aircraft and electronics industries. Aerospace metal components are also manufactured.

Aerospace Engineering Services Division – offers integrated services for the other aerospace divisions that include repair schemes, corrosion control, weight and balance, modification development, systems installation design, aeronautical engineering, aircraft maintenance, stress analyses, fatigue studies, structural design, electrical and avionics engineering, systems interface design, electromagnetic compatibility testing, systems ground and flight testing, configuration and modification program control, and maintenance and technical publications for military aircraft.

Aircraft Repair and Overhaul Division – as the major fixed and rotary wing maintenance facility in eastern Canada, it offers repair and overhaul programs for military and commercial aircraft, as well as a full range of equipment modification.

General Aviation Services Division – offers aircraft servicing maintenance, hangarage, crew and passenger lounges for large and small commercial aircraft.

Foundry Division – equipped to produce cast iron, steel and steel alloy castings up to 2-tons with both cupola and electric induction furnaces.

Steel Fabrication and Machine Shop Division – essentially a custom shop, it is serviced by four 5-ton overhead cranes. Typical products include components for fishing trawlers from steel, stainless steel and aluminum, and a whole range of products, repairs and modifications for offshore oil industry.

Tool and Plastics Division – manufactures molded plastic parts using the injection molding technique.

Research and Development Division – the primary function is to identify and develop new products and processes related to the continued expansion of the IMP Group and the technical excellence of its products.

Other Divisions of IMP Group have no apparent relevance to USAF requirements and are therefore, not further defined in this section.

Average Work Force: No Data

Gross Sales: IMP Group Ltd – \$50M
Aerospace Manufacturing Div – \$2.5M
Aerospace Repair & Overhaul Div – \$3.0M

Plant Size: Aircraft Repair & Overhaul Div – 60,000 sq ft (2 hangars)
Steel Fabrication & Machine Shop – 14,000 sq ft
No data on other facilities

Experience: IMP Group's aerospace clients include the US Navy (P3 aircraft), Canadian Department of National Defense, Canadair, USAF, and McDonnell Douglas Canada. They are hopeful of participating in the CF-18 Program.

Keywords: 1 = Aircraft; 3 = Avionics; 12 = Machining; 17 = Software Services; 19 = Testing/Test Equipment; Airframe Components = 1; Airframe Structures = 1; Repair & Overhaul = 1; Wiring & Tubing = 1; Injection Molding = 12; Precision Casting = 12; Structural Analysis = 17; General Testing = 19; Non-Destructive Testing = 19; System Testing = 19; Corrosion Control = 1; Electromagnetic Compatibility = 3, 19; Systems Interface Design = 3.

Revised: Dec 83

INNTECH AVIATION Ltd

Code: INA

Address: Head Office
455 Michel Jasmin
Dorval, Quebec, Canada H9P 1C2

Contact: Mr. Douglas M McGregor, VP Marketing & Sales – (514) 636-4155

History: Innotech Aviation Ltd was incorporated in 1955 as Timmins Aviation Ltd. In 1967, the latter was acquired by Atlantic Aviation Corp of Wilmington, Delaware, resulting in a further name change to Atlantic Aviation of Canada Ltd. The present name came into being in 1974 when a group of the company's Canadian executives together with Innocan Investments Ltd purchased the shares held by Atlantic Aviation Corp. The company has offices and aircraft service facilities in six Canadian cities from coast to coast, including Vancouver, Calgary, Toronto, Ottawa, Montreal and St Johns.

Capability: The current operating divisions of Innotech Aviation Ltd include Aircraft Sales and Brokerage; Aircraft Management Services and Charter Operations; Aircraft Ground Services; and Technical Services. This profile describes the only the Technical Services Division which consists of:

Engineering & Design – A full range of aerospace related engineering services are offered which include repair schemes; corrosion control; weight and balance; systems installation design; aeronautical engineering; aircraft maintenance; modification development; structural design; electrical and avionics engineering; systems interface design; systems ground and flight testing; and custom designed aircraft interiors for commercial and military aircraft including air evacuation, hospital interiors, maintenance and technical publications for a wide range of commercial and military aircraft.

Aircraft Repair & Overhaul – This department's maintenance and service capabilities cover light single and twin engine aircraft, through to multi-engine turbo-props, turbo jets, and helicopters for civilian and military customers, as well as a full range of equipment modifications and non-destructive testing.

Modification – This department specializes in sheet metal work, aircraft welding, aircraft painting, cabinet making and upholstery of aircraft interiors and furnishings.

Quality Assurance – Innotech's quality assurance personnel hold Canadian Ministry of Transport (MOT) and the Department of National Defense Shop approvals (DOT). All aircraft inspectors are licensed by MOT, and thence through agreements between Canada and other countries, can approve work done for customers from outside Canada.

Average Work Force: Total – 490 (all locations)

Gross Sales: No Data

Plant Size: 500,000 sq ft (all locations)

Experience: Innotech Aviation Ltd customers include the US Coast Guard (Falcon Aircraft), Canadian Department of National Defense (and other departments of the Canadian Government), Canadair, de Havilland Aircraft of Canada, Falcon Jet, and many others.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 12 = Machining; 19 = Testing/Test Equipment; Corrosion Control = 1; Repair & Overhaul = 1; Weight & Balance = 1; Systems Installation Design = 1; Aeronautical Engineering = 1; Maintenance = 1; Modification Design = 1; Structural Design = 1; Electrical Engineering = 1, 7; Avionics Engineering = 1, 3; Systems Interface Design = 1, 3; Systems Ground Testing = 1, 3, 19; Systems Flight Testing = 1, 3, 19; Helicopter R&O = 1; Non-Destructive Testing = 1, 19; Sheet Metal Work = 1, 12; Welding = 1, 12; Painting = 1.

Revised: Dec 83

INRAD INDUSTRIAL RESEARCH & DEVELOPMENT Ltd

Code: INR

Address: #7 – 1329 Niakwa Road
Winnipeg, Manitoba, Canada R2J 3T4

Contact: Mr. Edward A Speers, President – (204) 255-7279

History: Inrad is a wholly owned Canadian company incorporated in 1975. There are no other Canadian locations. An affiliate company, Speers McGonigal (1980) Ltd, custom packager and plastic fabrication, is located at the same site.

Capability: The Inrad group is interested in new product development, particularly in the plastics, petroleum, chemi-

cal engineering, agricultural and energy spheres. They are also in the commercial packaging business. Some of their products include – a study of rare earth magneto-strictive materials for underwater transducers; photocatalytic conversion of water to hydrogen; the development of a high voltage fluorescent light switch; a farm fertilizer generator; and work on a high temperature solar collector suitable for a national grid system and for central heating.

A new material, porous titania glass, is available in research quantities. This acts as a photocatalyst when exposed to sunlight in the production of hydrogen from water at NTP. This material can be doped as required. Based on this technology, a portable hydrogen "sniffer" has been developed. The resistance of the detector changes on exposure to as little as 0.05% hydrogen in air. This instrument serves as an alarm for use near hydrogen producers such as batteries, hydrogen furnaces, and fuel cells. They are researching a humidity detector.

Other capabilities include precision machining and engraving, plastic fabrication (vacuum forming), custom packaging, and skin and blister packaging.

Average Work Force: PhDs – 2
Engineer – 1
Physicist – 1
Chemist – 1
Others – 7/15

Gross Sales: Annual – \$1.0M

Plant Size: 18,000 sq ft

Experience: Inrad has worked with the Canadian Department of National Defense, the National Research Council, Atomic Energy of Canada Ltd, universities, and with private industry. They have low sales to the US. They have been in contact with USAF primarily in the area of rare earth magnets.

Keywords: 4 = Chemistry; 7 = Electronics; 8 = Energy; 9 = Environment; 12 = Machining; 20 = Miscellaneous; Rare Earth Magnets = 4; Photocatalyst = 4; Alternate Fuels Research = 4; Geophysics = 7; Environmental Sensors = 7; Solid State Devices = 7; Solar = 8; Trace Gas Detection = 9; Titania Glass = 4; Porous Titania Glass = 4; Hydrogen Production = 4; Water/Hydrogen Conversion = 4; Hydrogen = 4, 9; Hazardous Gas Detection = 4; Hazardous Gas Alarm System = 9; Hydrogen Gas Detection = 9; Injection Molding = 12; Precision Machining = 12; Precision Engraving = 12; Custom Packaging = 20; Blister Packaging = 20.

Revised: Dec 83

IRVIN INDUSTRIES CANADA Ltd

Code: IIC

Address: 479 Central Ave
Fort Erie, Ontario, Canada L2A 3T9

Contact: Mr. John Swanigan, President – (416) 871-6510

History: Irvin Industries was incorporated in Canada in 1925 and is a subsidiary of Irvin Industries Inc of New York. The parent company not only operates many facilities in the US and one in Canada, but also in the UK, Italy, and Sweden.

Capability: Irvin Industries produces personnel parachutes (back & seat-type for ejection seats, military search and rescue units, paratroopers & military freefall), precision opening release systems, aerial delivery systems, inflatable life support systems, and aircraft, automobile & industrial restraint systems. Irvin has also designed and manufactured special purpose parachutes including sophisticated recovery

systems for supersonic jet transports; and multi-use high-reliability & patented deceleration systems for fighter aircraft.

Irvin's Production Department is equipped with more than 350 sewing machines capable of efficiently stitching the latest natural and man-made fabrics, tapes and webbings. Added to this are quality control test machines, cloth laying and cutting tables, grommet and eyelet machines, and jigs and fixtures to enable the company to produce highly dependable and durable life support equipment.

Additionally, an environmentally-controlled facility equipped with modern environmental test chambers, jigs, fixtures and inspection equipment accommodates the assembly, inspection and customer servicing of the FF-2 "Hitfinder" automatic parachute opening device.

A further enhancement to Irvin's capabilities in the inflatable products line has been realized through the firm's recent acquisition of the latest in frequency stabilized electronic heat sealing equipment. This advanced state-of-the-art production equipment now permits both prototype development and large scale manufacture of an extended range of inflatable products including – life rafts; inflatable boats; life vests and jackets; impact attenuation bags; air mattresses; anti-g suits; cooling suits; and partial pressure vests. Heat sealing techniques are likewise being applied to make product improvements upon Irvin's existing line of inflatables produced previously by conventional means.

Irvin's Quality Control Program has been designed to conform with the requirements of the Canadian Armed Forces standards as defined in DND Spec 1015, whose equivalent US Department of Defense standards are MIL-Q-9858 and MIL-I-45208. The quality audits conducted by independently assigned specialists, as well as full-time in-house quality assurance representatives assigned by the Department of National Defense, provides for the surveillance of Irvin's quality control program. Irvin Industries Canada Ltd has been listed by the military as an "approved" company since Dec 1938.

Irvin's Engineering Department is responsible for all projects from the proposal stage to production. This encompasses design, development, static testing, aerial & dynamic testing, drawing approval, preparation of procedures & specifications, and approval of the first-off specimen. Preliminary design work is facilitated by an in-house computer which is capable of simulating tests, thereby avoiding extensive trial & error testing. They also maintain Drafting and Customer Service/Product Support Departments.

Irvin's products include space vehicle recovery, drone recovery, missile recovery, deceleration (for high performance aircraft) systems, personnel parachute systems, special purpose parachutes – precision opening & release systems, air cargo delivery systems, and other miscellaneous items such as harnesses, belts, protective clothing, special suits/clothing, life rafts, and survival kits.

Average Work Force: Total – 125

Gross Sales: 1980 – \$5.13M
1981 – \$5.81M
1982 – \$5.95M

Plant Size: 39,000 sq ft

Experience: Irvin's customers include the USAF (AIM Parachute Program – joint USAF/Canadian program and the deceleration parachute for the F-105), the Canadian DND, Canadair, deHavilland, and many other off-shore customers (primarily military).

Keywords: 1 = Aircraft; 13 = Missiles; 14 = Protective Equipment; 18 = Space Systems; 20 = Miscellaneous; Air Delivery Systems = 1; Personnel Survival Equipment = 1, 14; Personnel Restraint Equipment = 1, 14, 20;

Parachutes = 1, 14; Precision Opening Release Systems = 1; Inflatable Life Support Systems = 1, 14; Special Purpose Parachutes = 1, 14; Recovery Systems = 1, 13, 18; Deceleration Systems = 1; Drone Recovery Systems = 1; Harnesses = 14; Belts = 14; Protective Clothing = 14; Survival Kits = 14.

Revised: Dec 83

ITT CANNON ELECTRIC CANADA (A Division of ITT Industries of Canada Ltd)

Code: ITT

Address: 4 Cannon Court
Whitby, Ontario, Canada L1N 5V8

Contact: Mr. Bruce D Vallillee, Manager of Marketing and Sales - (416) 668-8881

History: The company commenced operation in Canada in 1942 as Cannon Electric Company Ltd. The parent company, Cannon Electric Company (Los Angeles), was eventually purchased by ITT Corporation and the Canadian company became a wholly owned ITT subsidiary. In 1956, the company name was changed to its present name, and in 1967 the company began operation as a Division of ITT Canada Ltd. The company maintains Sales Offices in Montreal and Vancouver.

Capability: ITT Cannon Electric Canada is engaged in R&D, manufacture, and sales of electrical & electric connectors, cable harnesses, and interconnect devices for the hostile environment market. Cannon connectors are in virtually every passenger jet aircraft in the free world, deep in the earth & ocean, in space, in nuclear reactors, and in oil & gas drilling rigs - in other words, in the hostile environment.

Their manufacturing capability features both manufacturing & industrial engineering, tool design (plastic & metallic components), machining fabrication & assembly operations, machine & model shops, molding facilities, and electroplating. They have world-wide market responsibility and engineering design cognizance over, a) battery power connectors, b) fire-wall connectors, c) waterproof connectors, d) high temperature connectors, e) buffet series, f) aircraft firewall connectors, g) circular nuclear series, h) weatherproof series, i) Canadian design specials, j) environmental rack & panel DRA series, k) Cable TV-CATV connectors, l) geophysical-seismic, m) cryogenic connector series, and n) sonar-underwater tow connectors.

Product development has led to a variety of new and/or improved connectors. These include, a) a new series with proven results at elevated temperatures for nuclear applications; b) a connector to meet MIL-C28840 for seaboard applications (QPL); c) a connector (MS5015/3400D series) being used by the US Navy on new equipment as well as for retrofit, replacement & all power applications; d) the MIL-C-83723 series III connector designed for high performance aero applications; e) the "Downhole" connector designed for high pressure usage (hermetically sealed); f) the MR series connector - rugged, heavy duty & waterproof (designed to withstand severe environmental conditions); g) a geophysical hermaphroditic connector designed for the seismic exploration industry; and h) a connector to meet MIL-C-38999, III K.

Average Work Force: Not Specified.

Gross Sales: 1980 - \$18M
1981 - No Data
1982 - No Data

Plant Size: Production - 55,000 sq ft
Office - 15,000 sq ft

Experience: It suffices to say that Cannon connectors are designed to the specification of the electronic industry, and meet the requirements of the Canadian Department of National Defense, the US DOD, Canadian Ministry of Transport, and the Canadian Standards Association. Cannon plugs are used world-wide.

Keywords: 1 = Aircraft; 7 = Electronics; 9 = Environment; 20 = Miscellaneous; Connectors = 1, 7, 9, 20; Tubing = 1, 20; Wiring = 1, 7, 20; Cable = 1, 7, 20; Harnesses = 1, 7, 20.

Revised: Dec 83

IVI Inc

Code: IVI

Address: P. O. Box 790
Courcellette, Quebec, Canada G0A 1R0

Contact: Lt Gen J J Paradis, Dir, International Marketing - (514) 282-1396
Mr. T Tessier, Contracts Mgr, Military Products - (418) 844-3711

History: IVI Inc (Valcartier) carries on a tradition in the manufacture of small arms ammunition that dates back to 1880 when the Quebec Arsenals were established within the walls of the city. It was incorporated as Valcartier Industries Inc in 1966, later changed to IVI Inc, and is located on a 500 acre site at Val Belair, Quebec, 15 miles outside of Quebec City. IVI Inc, a wholly owned subsidiary of the SNC Group, is Canadian owned.

Capability: IVI Inc is a manufacturer of high quality, small arms ammunition, both military and commercial. It is the only Canadian small arms ammunition manufacturer and supplier to the Canadian Forces. They operate their own foundry and produce brass, lead and gilding metals required for the manufacture of ammunition. Valcartier ammunition conforms to NATO specifications. Their plant is equipped with its own water wells, water treatment plant and industrial waste treatment plant.

IVI Inc manufactures various small arms ammunition such as the NATO 7.62mm round. All dies, punches, tool holders and other tools are produced in-house. The precision tooling is used for both sporting and military small arms ammunition.

IVI maintains high quality control standards through rigid and numerous destructive and non-destructive inspection checks following the various stages in the manufacturing process. For example, during the production of the 7.62mm round, there are fifteen separate inspections, beginning with a test for impurities in the base metals after melting, right on through to a final inspection before packaging the finished rounds. They have a functioning Proof House and ranges for proof firing of all products.

IVI Inc has recently started an R&D department whose aim is to improve present products and techniques and to provide ammunition research facilities capable of responding to military requirements. The department is equipped with a manufacturing capability, testing facilities, measuring devices and indoor and outdoor ranges.

Average Work Force: 1,000 +

Gross Sales: Annual - \$45M

Plant Size: Manufacturing - 500,000 sq ft
Warehouse - 84,000 sq ft
Total Acreage - 500

Experience: IVI is the sole supplier of small arms ammunition to the Canadian Forces. They export small arms ammu-

dition to more than 20 countries, including the US, Norway, Belgium, Kenya and Indonesia.

Keywords 2=Armament; 19=Testing/Test Equipment; Ordnance=2; Ammunition=2; Small Caliber=2; Research=2; Manufacturing=2; Testing Ranges=2, 19.

Revised: Dec 83

JATEL COMMUNICATIONS SYSTEMS LTD

Code: JAT

Address: 39 Leacock Way
Kanata, Ontario, Canada K2K 1T1

Contact: Mr. J Ebrahimi, President - (613) 592-4331

History: Jatel Communications Systems Ltd was founded in 1976 and is 100% Canadian owned.

Capability: Jatel activities include consulting, systems studies, and applied research associated with telecommunications techniques. As a result of successful endeavors in the aforementioned, they initiated and brought to fruition, a research and development program that resulted in the development and production of their RX-32 Communication Switching System. This system is scheduled to undergo field trials with the Canadian Department of National Defense for air traffic control applications. The RX-32 system is a solid state, time division multiplex switching network. It has a stored program and is microprocessor controlled.

Jatel areas of scientific specialization include design and manufacture of customized telecommunications systems for both civilian and military applications. Typical applications include air traffic control communications, Coast Guard Ship-to-Shore communications and police radio dispatch communication systems.

Average Work Force: Professionals - 8

Gross Sales: 1983 - \$700,000 +

Plant Size: 1,500 sq ft

Experience: Jatel customers include the Canadian Departments of National Defense and Transport.

Keywords: 5=Communications; 7=Electronics; Switching=5, 7; Telephone=5, 7; Radio=5, 7; Solid State Devices=5, 7; Consulting=5, 7; Research and Development=5, 7; Air Traffic Control Communications System=5.

Revised: Dec 83

KOSS MACHINE & TOOL CO

Code: KOS

Address: 1765 Shawson Dr, Units 7 & 8
Mississauga, Ontario, Canada L4W 1N8

Contact: Mr. Dragomir Cajic, President - (416) 678-7236

History: Koss Machine & Tool Co was started in 1975 as a general machine shop and incorporated in 1976. The company ventured into defense and aircraft industry associated work in 1978 which today comprises 80% of their work. The company is a division of 333 111 Ontario Ltd.

Capability: Koss Machine is involved in milling and lathe operations primarily involved with defense and aerospace

related work. The CNC milling operation has a working travel of up to 20x40 inches and a vertical space up to 29.75 inches. Tolerances can be held to 0.0003 inch. A new Makino machine center is operational. It exhibits X, Y, Z axis lengths of 75.5, 27.5, and 23.6 inches, respectively.

Lathe operations are carried out with both CNC and conventional machines with maximum swing of 24 inches, maximum cross travel of 9.75 inches, and a maximum machining length of 21.5 inches. A quality assurance manual (quality level to DND 1016/MIL-I-45208) has been prepared.

Average Work Force: Machinists - 10
Quality Control - 1
Production Control - 1
Administrative - 2

Gross Sales: 1982 - \$0.750M

Plant Size: 6,000 sq ft

Equipment: Koss' equipment includes CNC machines, vertical milling machines, engine lathes, turret lathes, and other assorted equipment associated with machining operations.

Experience: Contractor approvals have been afforded by Canadair Ltd, the deHavilland Aircraft of Canada Ltd, and McDonnell Douglas.

Keywords: 12=Machining; Precision Machining=12; Tooling=12; Injection Molding Tools=12.

Revised: Dec 83

LEIGH INSTRUMENTS Ltd

Code: LEI

Address: 2680 Queensview Drive
Ottawa, Ontario, Canada K2B 8J9

Contact: Mr. Don Loughheed, Director of Marketing - (613) 820-9720

History: Leigh Instruments is a high technology electronics company engaged in the systems engineering, development and manufacture of equipment, products and systems principally for the aerospace, government and military markets. Leigh was founded in 1961 and is a publicly held, Canadian owned company. Approximately 50% of sales are for the export market. Leigh's engineering and aerospace operations, described further under capabilities, has engineering facilities in Ottawa together with the company's marketing and executive offices, and has a production facility in Carleton Place, Ontario; thirty miles west. Other facilities include the Frequency Control Division in Toronto, which manufactures crystals, crystal filters, and high environment glass-to-metal seals; a postal equipment plant in Waterloo, Ontario; and a plant in the UK near Heathrow Airport which supplies some products as well as support and repair and overhaul services to Leigh's European customers.

Capability: Leigh's aerospace and engineering systems operations supplies a range of products, systems and services to the aerospace, military and government sector. The company is organized into three product groups, two of which (Aerospace and Marine & Land) do business in this area. The Marketing Department services all three business areas and the Engineering Department, organized on discipline lines, supports the business areas on a project/program team basis. Cores of dedicated specialists are maintained to service specific technology areas.

The company developed initially as a flight recorder/crash locator systems company, building on a patent for a unique deployable crash position indicator.

The aerospace product group has developed its business base to include products and expertise in other areas such as helicopter CPIs, mechanical strain recorder systems and helicopter icing detection systems. In the latter instance, for example, Leigh won a US Army AISLIS (Advanced Icing Severity Level Indicating System) R&D contract on a competitive basis, as a result of its experience.

The company has, over thirty years, developed its capability also in the areas of data processing and display systems applications, communication switching systems, and radar-based surveillance and display systems as both a prime contractor and system integrator.

Average Work Force: 500 (Ottawa & Carleton Place, approx)

Gross Sales: 1983 - \$33M (Year ending Jun 30)

Plant Size: 122,000 sq ft (Ottawa & Carleton Place, Ontario)

Equipment: Leigh's production facility is qualified to DND 1015, which incorporates MIL-Q-9858B, and has a resident DND inspection detachment. The plant has a fully integrated production facility including machine shop with both NC and CNC equipment; mechanical and electrical inspection facilities; electrical and electromechanical assembly; and specialized foam/fiberglass production facilities. Electrical assembly facilities include component preparation, semi-automatic insertion, PCB flow soldering, conformal coating, semiautomatic wirewrap and harness shop. Test facilities include production ATE, cable and harness test facilities, various production test stations, test equipment calibration facilities, and a large RF anechoic chamber.

The plant also has a well equipped environmental test lab and a number of different types of AGREE production environmental test chambers. Engineering facilities include well equipped laboratories including a number of microprocessor development stations and a VAX 11-750 engineering computer facility.

Experience: Leigh Instruments Ltd's major customers include - US Navy, US Army, US Air Force, US Coast Guard, Canadian Forces, Canadian Coast Guard, Transport Canada, McDonnell Douglas, Lockheed, Boeing, RAF, FRG DOD, and Panavia. Source qualified by all of the foregoing.

Leigh's major projects in the aerospace government and defense areas include:

System Prime Contractor - Vessel Traffic Management Systems (radar surveillance, display, data processing, microwave backhaul) for Transport Canada for Vancouver, Tofino and Les Escoumins (1976-1982).

System Integrator - TRACS, Terminal Radar and Control System, for Department of National Defense. System engineering, integration, installation and test of seven modern ATC radar, processing, display and communication control facilities across Canada (1979-1982).

Systems Engineer - System definition contractor for VTM System for Port of Hong Kong (1982-present). Interior Communication System integrator for Canadian Patrol Frigate CD phase finalist (1981-1982).

Ships Interior Communications - Supply STM SHIN-COM (integrated system) to DND (1982-present). Contracted to supply system for new frigate program (1983).

Voice Recorders - Cockpit Voice Recorder to Panavia Tornado (1975-present).

Flight Recorder/Locator Systems - USN, Canadian, USAF and European programs (1970 to date). Aircraft include P3, C130, 707, F104G, Tornado (Joint program with Dornier), others. Contained Crash Survivable PDR/Maintenance Recorder: RAF Hawk.

Mechanical Strain Recorder - (present) - USAF F-16, others.

Helicopter Icing Detection Units - Various commercial North Sea, others. AISLIS R&D contractor for US Army.

Helicopter CPI - Various military, North Sea commercial.

Other CPI - Military and civil applications; Canada, the US and Europe.

Avionics Production - Subcontract manufacture of advanced avionics subsystems for CF18 (SMS and CSCS for LSI: 1982-present).

Keywords: 1 = Aircraft; 3 = Avionics; 5 = Communications; 15 = Radar; 16 = Security & Safety; Airfoil = 1, 3, 16; Beacon = 1, 3, 16; Data Acquisition = 16; Data Processing = 16; Traffic Management = 15; Ice Detector = 3, 16; Crash Position Indicator = 3, 16; Intercom = 5; Design = 3, 5, 15, 16; Development = 3, 5, 15, 16; Manufacture = 3, 5, 15, 16; Repair & Overhaul = 3; Flight Data Recorder = 1, 3.

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LITTON SYSTEMS CANADA Ltd

Code: LSL

Address: 25 Cityview Drive
Rexdale, Ontario, Canada M9W 5A7

Contact: Mr. B A Bisley, Dir of Marketing - (416) 249-1231

History: Litton Systems Canada Ltd (LSL), a major operating division of Litton Industries, has a long and successful history of designing and manufacturing highly sophisticated electronics equipment for military and commercial use in a world-wide market. LSL was launched nearly 25 years ago with a contract to assemble and test the guidance and control systems in the LN3 Inertial Navigation System (INS) for the Canadian Forces CF-104 Starfighter. LSL's facilities were rapidly expanded and improved, and super-clean assembly and test facilities were established to support the manufacture of gyroscopes, accelerometers and inertial platforms. The original INS has subsequently been modified and improved, and at LSL, a whole family of guidance systems has evolved to support the European Starfighter program and for use in aircraft manufactured by Grumman, Lockheed, McDonnell and General Dynamics. A Litton guidance system, the LN35, was the one chosen for the US Cruise Missile.

Capability: LSL has become a dominant force in the commercial INS marketplace. The LTN-72 system has achieved phenomenal success and is the most widely used INS throughout the world. The LTN-72 is a reliable, self-contained, all-weather, world-wide navigation system that is totally independent of ground-based navigation aids. LSL has recently undergone a major expansion and upgrading of its INS capabilities to allow the manufacture of the next generation of inertial systems, employing ring laser gyros in a strap-down configuration. This system, the LTN-90, is designed to meet the requirements of the all-digital aircraft, such as the A310 and B-767.

Utilizing the wealth of experience acquired in LN3 INS design and production testing, in 1962 LSL developed a punched-tape programmer controlled Mobile Automated Test Set for first level maintenance support of the INS. These systems were used to support the F-104 and P-3 Aircraft. LSL developed its first computer-controlled Automatic Test Equipment (ATE) in the late 1960s. This system, the Litton Automated Test Set (LATS), evolved into a highly capable, general purpose analog and digital level two and level three test set utilized by LSL as factory test equipment, as well as by a

number of commercial and military customers as depot test stations. The LATS is currently being expanded to accommodate the testing requirements of the F-18 Expanded Litton Automated Test Set (ELATS) for their depot test stations to support their new fighter programs.

In June 1967, the company began broadening the scope of the projects it pursued and competed for and won the contract for the supply of CCS-280 Command and Control System for the Canadian DDH-280 class destroyers. This program established the in-house capability for advanced systems engineering, software development, and display manufacture. A key part of this program was the creation of a Program Generation Center which led to the development of simulation programs and the subsequent marketing by the company of its line of ISIS Civilian Air Traffic Control Simulators and RIS Ground Control Intercept Military Simulators. Other systems engineering capabilities have been exploited on a variety of programs such as the DOT Regional Air Traffic Simulators, the Air Navigator Procedures Trainer for DND, and the Sea King Helicopter Tactical Simulator.

The expertise acquired in Systems Engineering was also responsible for the design and development of Litton Integrated Security Systems. These computerbased systems combine complete perimeter detection, surveillance, access control and radio communication to provide the necessary level of protection. The company has obtained contracts for these systems for implementation in Maximum Security Penitentiaries and Nuclear Power Generating Stations.

Previous indepth experience in the development of software in both the inertial and systems engineering fields made LSL the logical choice for the contract to develop the Data Interpretation and Analysis Center for the Maritime Command of the Canadian Forces. The DIAC correlates current and historical data enhancing mission planning and control.

In order to ensure that its products and areas of expertise stay abreast of the current technology, LSL is committed to a high investment in research and development. Recently, this effort, combined with assistance from a joint Canadian/US development contract, resulted in the next-generation aircraft cockpit displays. LSL has developed a solid-state, modular, flat panel display system using light emitting diode technology for use in the military environment. This system has recently been selected by General Dynamics for implementation in the F-16 aircraft.

Another successful R&D program that has also progressed to production is the Inertial Referenced Flight Inspection System (IRFIS). IRFIS is a self-contained enroute and terminal navaid calibration system. It performs calibration of Category I, II and III Instrument Landing Systems with higher accuracy and lower operating costs than other systems currently in use.

LSL's expertise in the development of specialized systems supported the award of the contract for the Automatic Data Link Plotting System (ADLIPS). ADLIPS is designed to meet the performance specification issued by the Canadian Navy as a retrofit system for a number of differing interface and installation requirements. ADLIPS is a complex, low-cost, shipborne computer-assisted, real-time command, control and tactical data communications system which can be fully integrated with existing ships' systems.

Another example of the successful implementation of R&D and systems engineering is the Litton family of Airborne Search Radar Systems. LSL entered the field in 1972 when, in conjunction with the AIL Division of Cutler-Hammer, it designed and developed radar systems for fleet fitment in the Canadian Forces CH-124 Sea King Helicopters. Since that time, a number of different systems have emerged with varying capabilities. The Litton radar is currently flying in eight different types of aircraft in fifteen countries around the world. LSL is continuing to evolve this product line and is presently working on a system with ASW capabilities.

LSL has recognized that an electronic system management capability is a national priority, and has taken the necessary steps to equip the company with the organizational structure, skilled management, technical personnel and specialized computer facilities to undertake the management of large, complex electronic and avionic programs.

Average Work Force: Engineers – 500
Mfg/Admin/Techs – 2,000

Gross Sales: 1981 – \$121M
1982 – \$156M
1983 – \$186M

Plant Size: 500,000 sq ft

Keywords: 1 = Aircraft; 3 = Avionics;
5 = Communications; 7 = Electronics; 15 = Radar;
16 = Security & Safety; 17 = Software Services;
19 = Testing/Test Equipment; 20 = Miscellaneous; Cockpit Displays = 3; Data Analysis = 3, 7; Instruments = 1, 3; Inertial Navigation = 3, 7; Simulators = 15; Training = 3, 15, 20; C3 Systems = 5; Data Acquisition = 7, 17; LED Displays = 7; Repair and Overhaul = 3; Solid State Devices = 16; Intrusion Detection = 16; Air Traffic Control Systems = 20; Air Traffic Control Simulators = 20; Navigation = 3, 7.

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LUMONICS Inc

Code: LUM

Address: 105 Schneider Road
Kanata, Ontario, Canada K2K 1Y3

Contact: Mr Roger Sandwell, Dir, Marketing, Scientific Products – (613) 592-1460

History: Lumonics Inc is a Canadian owned high technology company incorporated in 1970 with one subsidiary in the US. The company also has a subsidiary in the UK – JK Lasers – that specializes in a range of Nd:YAG and Ruby Lasers for general purpose research applications including holography. The company was formed to manufacture and sell the pulsed CO₂ lasers developed at the Defense Research Establishment Valcartier.

Capability: Lumonics specializes in pulsed gas lasers including excimer, CO₂ and HF/DF types. It is the third largest North American laser manufacturer serving both the scientific and industrial markets. They have twelve series of lasers available with various models within each series. A significant portion of their business is contract R&D, but it is carried out only when Lumonics anticipates and retains rights for commercial exploitation. Their scientific market includes university, government and corporate researchers. The two primary fields in which their customers are active are chemistry/isotope separation, material processing and plasma research. Lumonics has been manufacturing their excimer lasers for scientific application since 1978, and has received government funding to develop an industrial series over the next 4.5 years.

Lumonics' key functions of material procurement and control, electrical and mechanical assembly, and final preference testing are carried out in-house. Machined and sheet metal components are sub-contracted.

Average Work Force: Scientists & Engineers – 40
(In Canada)
Others – 100 (In Canada)
Others – 30 (In the US)
Others – 80 (In the UK)

Gross Sales: 1978/79 - \$ 4-5.9M
1981 - \$ 7M
1982 - \$11M
(with JK Lasers, approx \$15M)
1983- \$19M

Plant Size: 50,000 sq ft (In Canada)
10,000 sq ft (In the US)
30,000 sq ft (In the UK)

Experience: Lumonics is interested in working with the USAF and has done so in the past in the form of providing standard lasers. They have not undertaken any USAF-sponsored R&D. They carry out extensive in-house R&D for the Canadian Government.

Keywords: 11 = Lasers; Pulsed Gas Lasers = 11; Excimer Lasers = 11; Gas Lasers = 11; Lasers = 11; CO₂ Lasers = 11.

Revised: Dec 83

MA ELECTRONICS CANADA Ltd

Code: MAE

Address: 3135 Universal Drive
Mississauga, Ontario, Canada L4X 2E7

Contact: Mr. David I Strachan, Sales & Marketing Mgr -
(416) 625-4605

History: MA Electronics Ltd was established in January 1977 to support the Canadian communications industry's expanding needs for advanced technology components and subsystems. The company is part of the M/A-Com Inc operating companies.

Capability: MA Electronics is a major supplier of GaAs FET amplifiers for the satellite TVRO market and for a wide variety of industrial 3-14 GHz industrial requirements. Their Mississauga facility houses microwave design and test laboratories, an extensive machine shop, and plating and finishing facilities, complemented by engineering, administrative and sales offices. They have the capability to provide standard components from a diversified product line, design active and passive devices to customer specifications, and interface requirements and combine technologies into subsystems, thus maximizing overall performance and cost effectiveness. In general, they offer a comprehensive in-house product capability spanning DC to 40 GHz.

MA Electronics' products and technology programs include:

- *Microwave Components* - Waveguide transitions; pin diode switches; waveguide loads or terminations; waveguide bends, twists, tapers; waveguide attenuators; couplers; ferrite coax/isolators/circulators; resonance isolators; iso. adapters; motorized attenuators; magic tee assemblies; waveguide circulations; isolator/attenuators; and waveguide transducers.
- *Amplifiers* - Microwave amplifiers for 4, 12 and 14 GHz applications; and low noise amplifiers for satellite television reception.

Average Work Force: 294 (Total)

Gross Sales: 1983 - \$13.4M

Plant Size: 28,175 sq ft

Experience: MA Electronics' product market is world-wide.

Keywords: 1 = Aircraft; 5 = Communications;
7 = Electronics; 15 = Radar; 18 = Space Systems;

Microwave Components = 5, 7, 18; Waveguides = 5, 7, 18; Switches = 5, 7, 18; Pin Diode Switches = 5, 7, 18; Waveguide Attenuators = 5, 7, 18; Couplers = 5, 7, 18; Attenuators = 5, 7, 18; Waveguide Transducers = 5, 7, 18; Amplifiers = 5, 7, 18; Microwave Amplifiers = 5, 7, 18; Low Noise Amplifiers = 5, 7, 18; GaAs FET Amplifiers = 5, 7, 18; Diplexer Combining Network = 5, 7, 18; Filters = 5, 7, 18; Microwave Filters = 5, 7, 18; Ferrite Devices = 1, 5, 7, 15; Isolators = 1, 5, 7, 15; Circulators = 1, 5, 7, 15; Coaxial Ferrite Devices = 1, 5, 7, 15; Microwave Subassemblies = 5, 7, 15.

Revised: Dec 83

MACDONALD DETTWILER & ASSOCIATES Ltd

Code: MDA

Address: 3751 Shell Road
Richmond, British Columbia, Canada V6X 2Z9

Contact: Dr Marshall N Prentice, Sales Manager -
(604) 278-3411

History: MDA is a privately owned Canadian company formed in 1969 with a single plant in Vancouver, BC.

Capability: MDA is a leading supplier of digital systems in the fields of remote sensing from air and space, image data processing, and airline flight operations. It is a high technology firm whose main areas of business are: (1) remote sensing satellite processing systems (especially for the NASA Landsat series), (2) meteorological satellite processing systems for all the major satellites, (3) synthetic aperture radar (SAR) digital processors for airborne and spaceborne sensors, (4) aviation systems for flight operations support, (5) high speed film image recorders, and (6) electro-optical imaging scanners.

MDA is a leading supplier of Earth Resource Satellite Stations. The company has played a role ranging from that of prime contractor providing a fully integrated receiving and processing facility, to that of subcontractor supplying system design and subsystem components. The basic design of these satellite data systems is modular. Data can be processed at high speed from a variety of sources including the MSS and TM sensors of the current Landsat satellite. In addition to radiometric and geometric corrections, the processing permits accurate resampling to map projections so that various data fields can be overlaid and thematic imagery in map-format produced.

MDA supplies complete ground stations for the reception and processing of data from polar orbiting and geostationary meteorological satellites. Their systems include an analysis capability which permits extended interactive analysis of the meteorological satellite data, and provides for the overlay of conventional measured and forecast meteorological parameters on imagery to enhance its usefulness in forecasting.

MDA designs and manufactures digital processors for both airborne and spaceborne SARs. Their developmental designs are based on computer software and on high speed electronic hardware. This allows them to supply small fast units for aircraft use and larger ground based units for the processing of satellite generated radar data. Their IRIS product is a complete airborne SAR system with dual frequency transmit and the capability of image storage, downlink, or real-time hard copy on the aircraft.

MDA's flight operations digital equipment is used by the commercial aviation industry. Their major project is a Flight Operations Computer System (FOCUS) which automatically plans all scheduled and charter flights for an airline. FOCUS can minimize fuel consumption by calculating the optimal

flight path and flying altitude based on the forecast weather conditions. FOCUS files the flight plan with the air traffic control authorities and in turn monitors the progress of the flight.

The MDA FIRE 240 laser film image recorder exhibits high resolution, high geometric accuracy and high throughput. It is rugged, light weight, and allows for unattended operation. A color version has been produced with similar high resolution and high speed.

The airborne imaging scanner produced by MDA is an eight-channel, multispectral, pushbroom scanner with real-time data processing and high radiometric sensitivity. It contains no mechanical components and allows selection of spectral bands by means of interchangeable optical filters.

Average Work Force: Elect Eng - 60
Data Processing - 70
Systems Engs - 20
Scientists - 15
Admin - 95
TOTAL - 260

Gross Sales: 1983 - \$24M (50% exported outside North America) (growth rate 25% per year)

Plant Size: 69,613 sq ft

Equipment: MDA's equipment includes Digital Electronic Assembly & Test Facility; General Purpose Computer Facility; and Systems Integration Rooms.

Experience: MDA had served as prime contractor on large scale systems for Swedish Space Corp, Australia, National Research Council (Thailand), Indonesian Space Agency, German Space Agency, European Space Agency, Swissair Transport Co Ltd, Canada Center for Remote Sensing, and Atmospheric Environment Service Canada. They have served as subcontractor to Bendix, TRW Systems, General Electric Co, Jet Propulsion Laboratories, NASA, Messerschmitt-Bolkow-Blohm (W Germany), National Space Development Agency of Japan, and Hitachi.

Keywords: 1 = Aircraft; 6 = Computers; 7 = Electronics; 9 = Environment; 10 = Image Processing & Optics; 11 = Lasers; 15 = Radar; 18 = Space Systems; Landsat = 18; Image Processing = 9, 10, 15, 18; SAR = 1, 15, 18; Remote Sensing = 1, 18; Image Recorder = 1, 7, 10, 18; Flight Operations = 1, 6; Digital = 1, 7, 15, 18; Ground Stations = 18; Software Systems = 1, 7, 15, 18; Data Handling = 1, 10, 18; Meteorological Satellite Processing Systems = 9, 10, 18; Weather Forecasting Systems = 9, 18; Synthetic Aperture Radar = 1, 15, 18; Weather Image Processor = 9, 10, 18; Interactive Analysis = 9, 10, 18; Laser Film Image Recorder = 1, 7, 10, 11, 18.

Revised: Dec 83.

E. S. MANTIS RESEARCH CORP

Code: ESM

Address: 370 East Esplanade
North Vancouver, British Columbia, Canada V7L 1A4

Contact: Mr. E Sitnam, President - (604) 929-5245

History: A Canadian owned company, incorporated in April 1976.

Capability: E.S. Mantis Research Corp is engaged in the design, development and manufacture of solar collectors. They have developed a relatively small, light-weight collector that is touted as highly efficient. The unit produces working fluids up to 149°C (300°F) in a short time period without

tracking the sun. The unit can readily be incorporated into systems for water and space heating, air conditioning, desalination, and generation of electricity. They will be producing a semi-parabolic, high temperature solar collector in early March 1984.

Average Work Force: Professionals - 3
Labor Force - 12

Gross Sales: No Data

Plant Size: 12,000 sq ft

Experience: No Data

Keywords: 8 = Energy; Solar Collectors = 8; Solar Systems = 8.

Revised: Dec. 83

MARS AERIAL REMOTE SENSING Ltd

Code: MAR

Address: 938-2nd Avenue N W
Calgary, Alberta, Canada T2N 0E6

Contact: Dr Frank G Bercha, President - (403) 270-3006

History: The company was incorporated in 1980 in Calgary, Alberta, and currently has a branch office in Ottawa, Ontario; St Johns, Newfoundland; and Phoenix, Arizona. The company is 100% Canadian owned. It is affiliated with F G Bercha and Associates Ltd, a Canadian consulting company.

Capability: The company specializes in providing an integrated remote-sensing service. It owns and operates a Gulfstream G-1 aircraft equipped with a side-looking airborne radar of the APS-94D type, as well as, an assortment of other sensors including RC-8 cameras, multispectral camera, thermal scanner, and magnetometer. The side-looking radar is of aerospace technology caliber, and includes both analog and digital output. It is capable of storing the digital output for subsequent digital interpretation. The hardware system is the only one of its type in the world; as such, MARS possesses a unique capability in terms of hardware. In addition, the MARS approach to integrated remote sensing, providing a useful information product, has made it well known for its capability in solving information related remote-sensing problems through judicious design, execution, interpretation, and analysis of remote-sensing program images.

Average Work Force: Total - 20 (including executive, engineering staff, aircrew, mechanics, radar engineers, sensor technicians and support staff).

Gross Sales: 1980/1982 - \$3.0M (Per Annum)

Plant Size: Office Space - 2,500 sq ft
Industrial Space - 3,000 sq ft
Additional space is leased for aircraft maintenance, electronic shops and general operations.

Equipment: Grumman G-1 aircraft with APS/94D SLAR; RC-8 and I²S MS cameras; and TIR scanner constitute a unique commercial multi-sensor package.

Experience: The company has carried out work for most of the major US oil companies, including Exxon, ARCO, Amoco, Mobil, Chevron, Sohio, and Phillips, as well as selected projects for Burlington Northern and a number of mining companies. Its principal clients in Canada constitute the Federal Government, Dome Petroleum, Petro-Canada, and Gulf Canada Resources.

Keywords: 8 = Energy; 9 = Environment; 20 = Miscellaneous; Remote Sensing = 8, 9; Airborne Surveys = 8, 9, 20; Environmental Analysis = 9; Mapping = 8, 9, 20.

Revised: Dec 83

McDONNELL DOUGLAS CANADA Ltd

Code: MDC

Address: Box 6013
Toronto AMF, Ontario, Canada L5P 1B7

Contact: Mr. Garret G Ackerson, VP & General Manager - (416) 677-4341

History: McDonnell Douglas Canada Ltd (MDCAN), a wholly owned subsidiary of McDonnell Douglas Corp, St Louis, MO, was federally chartered in Jul 64 to manufacture aircraft and other aerospace products. The plant and head offices are located adjoining the Toronto International Airport.

Capability: MDCAN is a fully-integrated high technology manufacturer of major airframe structural components for both commercial and military jet aircraft. Capabilities include design assist for major components and full management and implementation of tooling concepts, and design and manufacture for McDonnell Douglas DC-8, DC-9/MD-80 and DC-10/KC-10 aircraft. On these programs, MDCAN has total project management responsibility, including material and subcontract management. MDCAN has been a pioneer in manufacturing methods and equipment development, including substantial application of numerically controlled machines. Extensive work also has been done in the area of bonded metal components, automated machine controlled drilling and riveting and milling of spars of extended length components.

MDCAN is a leader in the design and implementation of integrated computer-assisted Management Systems in the ongoing development of Information Resource Management.

Average Work Force: Engineers - 66
Machinists - 827
Tool Makers - 215
Others - 2,992

Gross Sales: 1981 - \$226.5M
1982 - \$150.5M

Plant Size: 1,780,000 sq ft

Equipment: MDCAN's equipment is progressively updated to state-of-the-art with the result that MDCAN is a leader in computer aided manufacturing in the Canadian aircraft industry. The equipment used at MDCAN is that of a well-equipped airframe manufacturing facility producing large sophisticated airframe components such as MD-80 and KC-10 wings. Special equipment includes:

Automated Hydraulic Powered Riveters - five 100' long machines; two 50' long machines.

Numerical Control Equipment - 51 mills and profilers; 2 lathes; 1 coordinate measuring machine; 1 digitizer plotter; and 2 tube benders.

Computing Equipment - 2 IBM 4341/(2); 2 DEC PDP11/70; 1 DEC VAX; and 2 Perkin Elmer 3250.

Hydraulic Presses - 6 vertical and stretch form, up to 300 tons.

Other facilities include the Engineering Laboratory, heat treat, paint and process, and mechanized penetrant inspection units up to 100 feet in length.

Experience: Since 1965, MDCAN has produced major fuselage structures for the DC-8 and major wing and fuselage structures for all commercial and military versions of the DC-9/MD-80 family. MDCAN was also active in the design and development of the DC-10, leading to design and manufacture beginning in 1968 of detail and assembly tooling for the DC-10 wing. Production deliveries of DC-10/KC-10 components have continued uninterrupted since 1970, including several versions, both commercial and military. Tooling and production of F/A-18 structural components was begun in 1982.

Keywords: 1 = Aircraft; 12 = Machining; Components = 1; Structures = 1; Composite/Fiberglass Components = 1; Fuel Systems = 1; Hydraulics = 1; Wiring = 1; Tubing = 1; Bonded Components = 1; Bonded Honeycomb Components = 1; Extended Length = 12; Forging = 12; Heat Treat = 12; Metalworking = 12; Coating = 12; Tooling Design & Fabrication = 1, 12.

Revised: Dec 83

MENASCO CANADA Ltd

Code: MCL

Address: 3495 Cote Vertu Road
St Laurent Montreal, Quebec, Canada H4R 1R3

Contact: Mr. Eric Eriksmoen, VP, Marketing - (514) 332-3330

History: Menasco is a wholly owned subsidiary of Menasco Inc (US) and was organized in 1971.

Capability: Menasco designs, develops, tests, and manufactures fixed-wing aircraft and helicopter landing gear systems. Also included in this capability are electro-hydraulic and hydro-mechanical systems related to primary and secondary flight controls; fly-by-wire electro-hydraulic flight controls; ground steering, including steer-by-wire; aircraft hydraulic systems; variable wing and wing sweep actuation and machining of aircraft and helicopter components. They meet contractor and quality control standards as specified by FAA, DOT, MIL-Q-9858A, NPC-200, and DND 1015. Physical and environmental testing is accomplished with, among other facilities, three drop test towers which can also measure landing gear shimmy and steering characteristics. Brochures available upon request.

Average Work Force: Engineers - 35
Manufacturing - 448
Others - 175

Gross Sales: No Data

Plant Size: 208,000 sq ft

Equipment: Complete physical and environmental testing laboratory for landing gear, flight controls and actuating devices, including facilities for vibration, structural, stress survey, fatigue testing, and full complement of NC equipment and a computerized production control system.

Experience: Menasco Canada has produced equipment for the following manufacturers and aircraft - Boeing (727, 737, 757, CH-47); Bell (YAH-63, XV-15); Canadair (CL-41, CL-84); deHavilland (DHC-4, DHC-5, DHC-7); Fairchild Republic (A-10); Fokker (F-28); General Dynamics (F-111); Lockheed (C-141, C-5A,B); McDonnell Douglas (DC-10); Short Bros (SD3-30); and Sikorsky (CH-53). Program and facilities have been approved by major military prime contractors and government agencies in the US and Canada.

Keywords: 1 = Aircraft; 12 = Machining; Landing Gear Components = 1, 12; Landing Gears = 1; Helicopter Systems = 1; Flight Control Systems = 1; Control Systems = 1; Hydraulics = 1; Ground Steering

Systems = 1; Wing Actuation Systems = 1;
Components = 1, 12.

Revised: Dec 83

MICROTEL PACIFIC RESEARCH Ltd

Code: MPR

Address: 8999 Nelson Way
Burnaby, British Columbia, Canada V5A 4B5

Contact: Mr. Mal Phillips, Custom IC Manager -
(604) 294-1471

History: Microtel Pacific Research Ltd is the wholly owned research and development subsidiary of AEL Microtel Ltd. The headquarters building of MPR is located in the Discovery Park Complex at Simon Fraser University on Burnaby Mountain near Vancouver, BC. In addition to the modern facilities available within the headquarters building, employees have open access to many of the services provided by Simon Fraser University. A branch office, whose staff are engaged primarily in telecommunications related planning studies and standards activities, is also maintained in Ottawa.

Capability: MPR's primary role as an R&D facility is to develop telecommunications, switching, transmission, and terminal equipment products for manufacture and marketing by its parent. However, the company also performs advanced systems studies in the areas of network planning, new services development and product planning for its parent and under contract to BC Tel, the Trans Canada Telephone System and other organizations. An important aspect of the development activities is the design and development of custom large scale integrated circuits, thick and thin film hybrids, polyolithic crystal filters and other critical components. The Pacific Microelectronics Center, a division of MPR, offers component design and development services to outside manufacturers. The principal areas of research and development are summarized below:

- Digital Switching Systems
- Subscriber Terminal Equipment including apartment entry systems (Enterphone), modems, and telephone sets
- Satellite Communication Systems
- Microwave Radios
- Frequency Division Multiplex Modulation Equipment
- Pulse Code Modulation Systems
- Power Supplies
- Business Information Systems including a variety of Telidon videotex terminals and converters
- Supervisory and Control Systems
- Systems Studies including network, services and product planning and human factors research
- Microelectronics and Component Design and Development
- Cellular Mobile Radio Control Systems
- Subscriber (Telephone) Data Communications
- Support Activities, such as computer services, model shop, library services, component evaluation and test

Average Work Force: Professionals - 272

Gross Sales: No Data

Plant Size: 95,000 sq ft (Systems Design Area)
5,000 sq ft (Clean Room Area)

Experience: Experience has been primarily with its parent company, AEL Microtel Ltd.

Keywords: 5 = Communications; 7 = Electronics; 18 = Space Systems; Systems Studies = 5; Large Scale Integrated Circuits = 7; Solid State Devices = 7; Thin Film Hybrid = 7; Thick Film Hybrid = 7; Polyolithic Crystal Filters = 7; Component Development = 5, 7; Component Design = 5, 7; Digital Switching Systems = 5; Switching = 5; Satellite Communications Systems = 5, 18; Radio = 5; Microwave Systems = 5; Multiplexers = 5; Modulation Systems = 5; Power Supplies = 5, 7; Supervisory Control = 7; Microelectronics = 7; Digital = 5; Cellular Radio Control Systems = 5.

Revised: Dec 83

MILLER COMMUNICATIONS SYSTEMS Ltd

Code: MCS

Address: 300 Legget Drive
Kanata, Ontario, Canada K2K 1Y5

Contact: Mr. Peter Rossiter, VP, Engineering -
(613) 592-3020
Mr. Bob Lyons, VP, Advanced Systems -
(613) 592-3020

History: Miller is a high technology company founded in 1974 with no US subsidiaries. It was originally formed as a systems engineering company specializing in the planning, design, and implementation of a wide range of communication systems.

Capability: MCS is involved in areas where voice and data signals are transmitted, detected, processed, measured, jammed or secured. The company is organized into five divisions, three of which are engaged in electronic warfare. The divisional activity is broken down as follows:

- *E W Division* - Radar ESM and Microwave Systems
- *Telemetry Division* - High-speed A/G Data Links
- *Monitoring Division* - Satellite Monitoring System, Spectrum Monitoring System, Automatic Test Equipment, Null Steering Systems, and Communications Jamming and Simulators.
- *Satcom Division* - Studies in error correction, digital transmission techniques and system architecture.
- *Signal Processing* - Digital modems and navigation systems development

The company has four basic products available - Analog Voice Security Devices, Low Rate TDMA, Air-to-Ground Telemetry Links, and a family of software simulation programs for Satellite Transmission Planning.

Average Work Force: Engineers/Computer Scientists - 40 +
Others - 20 +

Gross Sales: 1983 - \$3.2M

Plant Size: MCS is housed in a modern 15,000 sq ft plant (expandable to 40,000 sq ft on current site). The plant is well

equipped with a variety of computers, test equipment and production equipment.

Keywords: 5 = Communications; 7 = Electronics; 15 = Radar; 17 = Software Services; 18 = Space Systems; 19 = Testing/Test Equipment; Ground Stations = 7, 18; Navigation = 7, 18; Radio Communications = 5, 18; HF Communications = 5; Data Acquisition = 18; Data Processing = 18; Communications = 18; Test Equipment = 19; Test Instrumentation = 19; Signal Processing = 15; Satellite Communications = 5, 18; Adaptive Receivers = 5; Modems = 5, 7, 17, 18; Digital Modems = 5; Signal Identification Systems = 5; Electronic Warfare = 5, 7; Telecommunications = 5; Terminals = 5, 7, 18; Synthesizers = 5; HF Modems = 5, 7, 17, 18; HF Adaptive Antenna Arrays = 5, 7; Spread Spectrum Modems = 5, 7; Automated Monitoring & Control Systems = 5, 18; Digital Communications = 18; SCPC = 5, 18; DAMA = 5, 18; TDMA = 5, 18; SSMA = 5, 18; Voice Privacy Communications = 5; Jamming = 5; Repair & Overhaul = 7; Build To Print = 7; System Design = 5, 18; Spectrum Analysis = 18; UHF Telemetry Transmitters = 5.

Revised: Dec 83

MONITEQ Ltd

Code: MON

Address: 630 Rivermede Road
Concord, Ontario, Canada L4K 2H7

Contact: Dr. T V Ward, Vice President, Operations -
(416) 669-5334

History: Moniteq Ltd is a fast growing, innovative high technology company whose instruments and services encompass the field of environmental monitoring and remote sensing. Over a six year period, Moniteq has grown to an organization of over 45 people consisting of highly skilled scientists and engineers with expertise in optical physics, electronics and data processing, plus a full support staff. Moniteq is structured into three complementary divisions - Instrumentation, Applications and Manufacturing.

Capability: Moniteq's Instrumentation Division is responsible for the development of electro-optical instruments from initial concept to final commercial design. Applications of these instruments involve the many aspects of monitoring trace environmental gases, industrial process gases and remote sensing of the earth's resources.

The Applications Division offers services for the processing and interpretation of remotely sensed data from aircraft and satellites.

The Manufacturing Division manufactures and markets commercial instruments which have been developed by Moniteq. This product line is continually expanding with new developments in air pollutant monitoring, remote sensing, and industrial process measurement. Moniteq's products include:

- Air Quality Monitors
- Visible and Infrared Remote Sensors
- Visible and Infrared Spectroradiometers
- Water Quality & Depth Mapping
- Environmental Data Processing

Moniteq also provides consulting services for the implementation of remote sensing programs and air quality network management programs.

Average Work Force: PhDs - 6
Engineers - 10
Others - 20

Gross Sales: 1980 - \$1.1M
1981 - \$1.4M
1982 - \$1.7M
1983 - \$2.3M (Projected)

Plant Size: 8,100 sq ft

Equipment: Moniteq's equipment includes - Instrument research and development laboratory including Moniteq developed vacuum system; drafting office; machine shop including lathes and milling machines; optical clean room; computer room with a PDP 11/24; data reduction room; and custom manufacturing.

Experience: Moniteq's present and past customers include:

Government:

Canada Center for Remote Sensing, Sensor Development - Ottawa, Ontario
Atmospheric Environment Service - Downsview, Ontario
Environmental Protection Service - Ottawa, Ontario
Environmental Protection Service - Halifax, Nova Scotia
Canada Center for Inland Waters - Burlington, Ontario
Air Resources Branch, MOE - Toronto, Ontario
Department of Fisheries and Environment, DPAT Program - Ottawa, Ontario
Defense Research Establishment - Ottawa, Ontario
National Research Council - Ottawa, Ontario
Laboratory Services Branch, MOE - Rexdale, Ontario

Industry:

Environmental Data Corp - Monrovia, CA
The Steel Co of Canada - Hamilton, Ontario
Ontario Hydro - Toronto, Ontario
Texaco Canada Inc - Nanticoke, Ontario
Envirocon Ltd - Toronto, Ontario
Rayrock Mines Ltd - Toronto, Ontario
Alberta Research Council - Edmonton, Alberta
Heath Survey Consultants (Canada) Ltd - London, Ontario
Environment Ecology Inc - Buffalo, NY
Shell Canada Ltd - Sarnia, Ontario
Polysar Ltd - Sarnia, Ontario
Alcan Ltd - Arvida, Ontario
Willco - London, Ontario
Canadian Electrical Association - Montreal, Quebec

In addition, Moniteq personnel have carried out development programs for many private and government organizations in Canada, the US and Europe. A partial list includes:

Communications Research Center - Ottawa, Ontario
Bedford Institute of Oceanography - Bedford, Nova Scotia
Defense Research Establishment - Ottawa, Ontario
Forest Fire Research Institute - Ottawa, Ontario
NASA - Langley, VA
NASA - Cleveland, OH
NASA - Goddard Space Flight Center, MD
Environmental Protection Agency - North Carolina
Environmental Protection Agency - Las Vegas, Nevada
Texaco Exploration Ltd - Calgary, Alberta
Noranda Ltd - Toronto, Ontario
Central Electricity Generating Board - England
TRW Sensor Development - CA

Keywords: 9 = Environment; 10 = Image Processing & Optics; 17 = Software Services; 20 = Miscellaneous; Pollution Monitoring = 9; Hazardous Gas Detection = 9; Spectral Measuring Devices = 9; Oceanographic Instruments = 9; Water Depth & Quality & Bottom Type Mapping = 10; Airborne Imager = 10; Startracker = 10; Data Acquisition = 17; Data Reduction = 17; Quantitative Interpretation of Airborne & Satellite Imagery = 17; VUV Light Sources = 20.

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MPB TECHNOLOGIES Inc

Code: MPB

Address: 1725 N Service Road, Trans Canada Highway Dorval, Quebec, Canada H9P 1J1

Contact: Dr M P Bachynski, President - (514) 683-1490

History: MPB is a Canadian owned high technology company that was incorporated in 1976. It is a spin-off from RCA Ltd. There are no other locations in Canada and no US subsidiaries.

Capability: MPB occupies a modern 18,000 sq ft facility which includes a library, central computer room, machine shop, laboratories and production area. They are fully facilitated to conduct experimental, theoretical, and developmental work in a variety of fields. These include lasers, electromagnetics and radars, digital electronics, and instrumentation.

Laser work includes the design and development of CO₂ continuous wave lasers (1-20 watt range, >10,000 hours lifetime, sealed off) and CO₂ waveguide lasers with wide band width and good tunability (sealed off, 10,000 hours lifetime). They have a capability with iodine lasers in conjunction with mode locking experiments, and have conducted laser spectroscopic studies. They have also been involved with heterodyne detection techniques in conjunction with optical fiber hydrophones that can measure 1/500 of a fringe (phase shift: 360/500°). A program is in place for the development of far infrared lasers, a FIR heterodyne receiver breadboard, and the construction of advanced FIR detector packages including reflector mounts. They are involved in a program on the application of lasers to satellite communications (MILSAT-COM) and are developing a laser communications test bed and propagation measurement facility for a Canadian Government laboratory.

In the area of electromagnetics and radar technology, MPB has carried out research with synthetic pulse radar for airborne measurement of sea-ice thickness, and in the area of radar/chaff interaction and target enhancement. They have been involved with communications analysis (cross polarization effects, earth and satellite communications), and oil spill detection using electromagnetic techniques and antenna research (wide-band VLF antennas). The company recently delivered an airborne C-band scatterometer for measurements of ice surface roughness. The company is involved in projects related to target augmentation and to deployment of chaff including the NATO MACE Trials.

In the digital electronics area, MPB has expertise in electronic graphics, displays, training systems, and graphic composition. They have also been involved with special purpose communication terminals (transcontinental telex operator communications) and special purpose data recorders (based on microprocessor technology).

In the area of instrumentation, MPB is involved with a Space Shuttle experiment (wave injection facility), where their main responsibility is the software for the control electronics, the system test equipment, the plasma simulator, and various systems engineering tasks. Other projects include hazardous

gas detection, the Canadian Varennes Tokamak (data acquisition, preionization, diagnostic instrumentation - probes, lasers, microwave interferometry), and software development (controls and on-line data analysis).

MPB products include the VISTA 80 Graphics System, a versatile character generating system which utilizes a standard keyboard for message composition, and a magnetic diskette system for bulk storage of messages. The system is based on microprocessor technology. Primary use is for presenting alphanumeric information in news, weather, sports & election programs, and for titling & credits. The company recently introduced their VISTA 90 electronic graphics and composition system for applications to business and science. The system permits the composition of picture quality graphics by various input devices and hard copy through a choice of 35mm slides, printer, or video tape. Their laser communications system is capable of video, multiple voice channel, or high bit rate digital transmission. The system has a video signal to voice ratio greater than 60 dB and is immune to RF interference. They have made major sales to the US of their sealed-off CO₂ lasers that are long lived (greater than 38,000 hours) and have power ranges from 3 to 12 watts TEM⁰⁰ and 1 to 18 watts multimode. Suggested uses are optical communications, atmospheric research, spectroscopy, far infrared laser excitation, materials processing, surgery, etc. MPB has recently introduced a number of new laser products which include a 60 watt cw CO₂ laser, a low voltage mirror translator with control electronics and a low-cost closed-looped cooler for use with the family of CO₂ lasers. Their final product is a High Intensity Light Source. It is a long (450mm) self-starting vortex stabilized arc discharge. It has a continuous radiation spectrum, can be started instantaneously and can deliver a hundred times more light output than a high power mercury arc lamp light-head of comparable dimensions.

Average Work Force: PhDs - 18
Engs - 16
Others - 14

Gross Sales: 1979 - \$1.3M
1980 - \$1.5M
1981 - \$2.0M
1982 - \$2.7M
1983 - \$3.5M

Plant Size: 18,000 sq ft

Experience: MPB's typical clients include the Canadian Government (Dept of National Defense, Communications Research Center, National Research Council), AFOSR, CBC, SPAR Aerospace Ltd, Telesat Corp, Teleglobe Canada, plus others. Recent US customers have included the Department of Energy (Nevada Div), Hughes Aircraft, RCA Astroelectronics, and National Oceans & Atmospheric Administration.

Keywords: 1 = Aircraft; 5 = Communications; 7 = Electronics; 8 = Energy; 9 = Environment; 11 = Lasers; 15 = Radar; 18 = Space Systems; 20 = Miscellaneous; Digital = 7; Instrumentation = 7, 8, 9; Continuous Wave Lasers = 11; Waveguide Lasers = 11; Iodine Lasers = 11; Far Infrared = 11; Synthetic Pulsed Radar = 1, 15, 20; Communications Analysis = 5, 18; Antennas = 7, 15; Pollution Sensing & Analysis = 9; Graphics = 7; Displays = 7; Training Systems = 7; Satellite Communications = 11, 18; Laser Communications = 11, 18; CO₂ Lasers = 11; Sealed-Off Lasers = 11; High Intensity Light Source = 8; Arc Lamps = 8; Trace Gas Detection = 9; Hazardous Gas Detection = 9; Electromagnetics = 1, 9, 15, 20; Continuous Wave CO₂ = 11.

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MUIRHEAD SYSTEMS Ltd

Code: MSL

Address: 50 Galaxy Blvd, Unit #4
Rexdale, Ontario, Canada M9W 4Y5

Contact: Mr. J B Crampton, General Manager -
(416) 675-7450

History: Muirhead Systems is a wholly owned subsidiary of the UK based company, Muirhead plc. The Canadian subsidiary was founded in Canada in 1954. The company has a sister subsidiary located in Mountainside, NJ.

Capability: Muirhead Systems has a world product mandate to design and manufacture computer based image processing systems for applications primarily in meteorological satellite imagery, newspaper wirephoto and law enforcement finger print transmission. Additionally, the company designs and manufactures computer interfaces and graphical data distribution systems for meteorological applications such as satellite imagery, weather charts and precipitation radar.

Muirhead has developmental and design expertise in both software and hardware for image processing, data management, video display and graphical data distribution. These systems are currently in service with the Atmospheric Environment Service Canada, the Canadian Coast Guard and the Department of National Defense for their weather forecasting facilities.

Average Work Force: Graduate Engineers - 5
Technologists - 5
Others - 10

Gross Sales: 1981 - \$1.4M
1982 - \$2.2M
1983 - \$2.2M
1984 - \$2.4M (Projected)

Plant Size: 7,000 sq ft

Equipment: Muirhead employs digital electronics design and assembly facilities, microcomputer software development systems, and in-house DEC computer systems.

Experience: Muirhead's customer base includes the Atmospheric Environment Service and several other meteorological agencies around the world. Their military customer base includes the USAF - who has recently taken delivery of a computer interface for processing of GOES Satellite Imagery. Customers for relevant products include - Atmospheric Environment Service, Department of National Defense, Canadian Coast Guard, Ministry of Defense (UK) Meteorological, New Zealand Meteorological Department, Danish Meteorological Institute, USAF (Vandenberg AFB, CA), World Meteorological Agency, Italian Air Force, Israeli Air Force, and Saudi Arabia Meteorological Department (via International Aeradio).

Keywords: 6 = Computers; 7 = Electronics; 9 = Environment; 15 = Radar; 17 = Software Services; 18 = Space Systems; 20 = Miscellaneous; Image Processing Systems = 6, 7, 9, 17, 18, 20; Interfaces = 6, 7, 9; Graphical Data Distribution Systems = 6, 9, 15; Data Management = 6, 9, 17; Video Display = 6, 9, 17; Weather Forecasting Systems = 7, 9, 17, 18; Radar Rain Forecasting = 7, 9, 17, 18; Design To Requirements = 7, 17.

Revised: Dec 83

MYRIAS RESEARCH Corp

Code: MRC

Address: 10762 82 Ave
Edmonton, Alberta, Canada T6E 2A8

Contact: Dr J R Savage, Dir of Applications Research -
(403) 432-1758

History: Myrias Research Corp is a Canadian owned corporation established in 1982 to design, manufacture and sell computer hardware and software for high-speed parallel computing. It is a subsidiary of Chion Corporation, an Edmonton based software company which produces and markets the only full language checkout compiler for Algol 68.

Capability: In the third quarter of 1984, Myrias Research Corp will introduce the Myrias 4000, a very high speed parallel computer. The minimal configuration has over 4000 microprocessors (Motorola 68000's) and 512 Mbytes of memory. It is from 2 to well over 10 times faster than a Cray 1. For many defense applications such as transonic, shock and multidimensional flows, and scalar problems such as ray tracing (for sonar analysis), the higher speed range is applicable. For problems which can be done in fixed point arithmetic, such as signal processing and flight simulation, the Myrias 4000 is up to 50 times faster than a Cray 1. The Myrias 4000 has the first truly expandable computer architecture. Up to 16 times the minimal configuration can be configured to meet much higher speed and larger memory requirements. The Myrias 4000 has a very high bandwidth for handling real-time data and signal processing.

Component failures within the Myrias 4000 system are handled by high-level recovery strategies. The failure recovery mechanism ensures the system will not go down. Because the failure recovery is based on distributed hardware and software components (which can be physically distributed, since fiber optic communication links are used), the Myrias 4000 can survive hits in a combat situation.

Myrias parallel Fortran makes the Myrias 4000 very easy to program, especially compared to vector machines such as the Cray and Cyber 205. Existing programs can be run with little or no modification. The Myrias 4000 is physically small and consumes little power, so no elaborate cooling system or other expensive support is required. The architecture of the Myrias 4000 enables system performance to be improved as the microprocessors on which it is based become faster and more capable.

Average Work Force: PhD - 2
MSc - 2
Engineers - 2
Others - 10 (Presently expanding)

Gross Sales: No Data

Plant Size: 10,000 sq ft (under construction)

Equipment: Complete digital electronics laboratory and facility. In-house and time-shared computer systems include VAX and AMDAHL.

Experience: Present customers of Chion Corp are mainly universities in Europe, Japan, Canada and the US.

Keywords: 1 = Aircraft; 2 = Armament; 3 = Avionics; 4 = Chemistry; 5 = Communications; 6 = Computers; 7 = Electronics; 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 13 = Missiles; 15 = Radar; 18 = Space Systems; 20 = Miscellaneous; Computers = 6; Aerodynamic Simulations = 1, 3, 13; Flight Simulation = 3; Air Traffic Control = 3, 5; Combat Control = 5, 6, 7; Flame Advection = 2, 4; Vulnerability Analysis = 1, 2, 4, 13, 18; Ballistics = 2, 13; Sonar Analysis = 10, 20; Seismic Analysis = 8; Reservoir Modelling = 8; Meteorology = 9; SAR Processing = 10, 15, 18; Cryptography = 5, 20; Cartography Processing & Database = 10, 13; VLSI Simulation = 6, 7; Predictive Process Control = 1, 2, 18, 20; Distributed Processing = 1, 5, 18, 20; Rational Drug Design = 4, 20; Quantum Chemical Modelling = 4.

Revised: Dec 83

NORTHERN AIRBORNE TECHNOLOGY Ltd

Code: NAT

Address: 1839 1st Ave
Prince George, British Columbia,
Canada V2L 2Y8

Contact: Mr. W Shawlee, President - (604) 562-2232

Capability: Northern Airborne Technology Ltd has R&D expertise in avionics, flight recorders, computer systems (airborne), lighted panels (LED/fiber optics), and visual information devices. Their avionics products include external/internal airborne sound systems, communication systems (intercomm, audio cont), and custom avionics control & interface systems.

Average Work Force: Management - 3
Engineering - 4
Production - 6
Field Support Staff - 2

Gross Sales: 1980 - \$0.12M (6 months)
1981 - \$0.76M
1982/83 - \$0.85M
1983/84 - \$3.20M (forecast)
1984/85 - \$4.30M (forecast)

Plant Size: 6,800 sq ft

Equipment: Northern Airborne Technology Ltd's equipment include machine shop (metal and plastic), engraving shop, artwork studio, photo lab/photo fabrication lab, ship/size wiring harness production area (life size jigs for Bell 206, Aero-spatiale, Astar, Twinstar), and assembly & testing equipment for avionics products for in-house or vendor produced equipment.

Experience: Listed below are clients of Northern Airborne Technology Ltd and status of their projects:

Client: Wulfsberg Electronics, Quebec Provincial Police, Ontario Provincial Police, Department of National Defense. *Target:* Design a portable clandestine wide-band VHF FM communications system based on the RT7200/RT9600 transceiver core. *Completion:* Complete system designed and built incorporating a unique planar radiator antenna and all voltage switching power supply. The unit was indistinguishable from an ordinary briefcase in all aspects excluding weight, and was tremendously successful in extensive security agency field trials. On proof of concept, Wulfsberg has now offered the TC1 transit case as a standard product.

Client: Department of National Defense. *Target:* Re-design internal illumination of the C722/C962 FM control head to insure consistent performance with other cockpit lighting. *Completion:* Two step LED dimming circuit was modified to provide linear dimming while retaining correct daylight operation. Circuit redesign was simple and easily carried out by Department of National Defense as a field modification without major expense or rework. Adopted into all units in service.

Client: Canadian Coast Guard. *Target:* Provide a high capability audio inter-communication system for the SRN6/Search & Rescue Hovercraft that would interface fundamentally incompatible radios to standard headsets. Reliable multiple station intercom operation was required under extreme noise conditions. *Completion:* A modular, ultra-flexible audio system and interface were designed and installed in the SRN6. The resulting new performance levels and concepts now form the basic craft standards.

Client: National Research Council. *Target:* First hardware phase of the HSA70 Helicopter stress analyzer. The HSA70 is a self-adaptive micro-processor system that provides spoken advisory to helicopter pilots for accident avoidance. Flight data recorder capability via non-volatile storage is also scheduled. *Progress:* Initial hardware/software interaction underway, airframe interface circuitry designed.

Client: R&D. *Target:* Develop an all-attitude crashworthy ELT antenna system for helicopters. *Progress:* Planar antenna feasibility demonstrated, production techniques under consideration.

Client: Hughes Helicopters. *Target:* Design a technically improved, but harness compatible, audio controller to replace the C6533 Military Controller. *Progress:* Working prototypes of all functional blocks produced. Mechanical model demonstrated. Preproduction status at this time. Further research underway to demonstrate feasibility of all solid state 560 nm panel illumination to reduce interference with night vision systems.

Northern Airborne Technology Ltd has also acted as technical advisor in the following projects and assignments:

- Feasibility of low cost computer interface for photogrammetric digitizer.
- Design of solid state control system for Vinten airborne camera.
- Theory proposal for remote real estate monitoring system.
- Theory proposal for computer monitored home and business security system.
- Design of new electrical system for the Canadian Coast Guard SAR Hovercraft.

Keywords: 1 = Aircraft; 3 = Avionics; 5 = Communications; 6 = Computers; 10 = Image Processing & Optics; 12 = Machining; 14 = Protective Equipment; 20 = Miscellaneous; Analyzer = 1, 14; Audio = 3, 5; Cables = 1; Clandestine = 5; Communications Systems = 5; Computer Systems = 1, 6; Controls = 1, 3, 5; Fiber Optics Illumination = 1; Intercommunication Systems = 5; Lighted Panels = 1, 10; LEDs = 10; Noise = 5; Night Vision = 1; Panels = 1, 10; Photo-Fabrication = 20; Speech = 3; Stress Analyzer = 1, 14; Voice = 3; Wiring = 1; Helicopters = 1; Instruments = 1; Flight Recorder = 1; Visual Information Devices = 1; Interface = 3; Electrical System Solid State Systems = 1, 20; Antennas = 3; Plastic Fabrication = 12; Engraving = 12; Harnesses = 1; Repair & Overhaul = 3.

Revised: Dec 83

NORTHWEST INDUSTRIES Ltd

Code: NWI

Address: P. O. Box 9864
Edmonton International Airport
Edmonton, Alberta, Canada T5J 2T2

Contact: Mr. F A (Floyd) Maybee, Operations VP - (403) 955-6300

History: Northwest Industries Ltd, incorporated in 1943, is a subsidiary of CAE Industries Ltd, Toronto, Ontario, Canada.

Capability: Northwest Industries Ltd has the experienced personnel and facilities at the Edmonton International and Municipal Airports, to accommodate complete overhaul,

repair and modification of military and civil operators's aircraft. Extensive ground handling and testing equipment supported by an up-to-date technical publications library insures a turn-around with minimum of ground time. NWI's Mobile Repair Parties are equipped to service operator's fleets of aircraft off-site at any location with full technical support. The company is equipped to service the latest in radar, avionics and aircraft electronic equipment.

The manufacturing facility is capable of manufacturing aircraft components ranging from the floor assemblies and bulkheads of the wide body Lockheed L-1011 Tristar, the complete empennage of the Scottish Aviation Jetstream, and the center wings and aft fuselage of the Boeing 707 to composite fiberglass epoxy conditioned air ducts for the Lockheed L-1011, electronic component racks and miniaturized circuitry for Hughes Aircraft company and sophisticated mechanical cable assemblies incorporated in the Spar Aerospace remote manipulator arm of the Columbia Space Shuttle.

Average Work Force: Engineering - 15
P Eng (2)
Quality Control - 25
Production - 250
Admin & Other - 210

Gross Sales: \$18M

Plant Size: Edmonton Municipal Airport - 250,000 sq ft
Edmonton International Airport - 50,000 sq ft

Equipment: Test and Inspection Equipment - avionics electronics; electrical hydraulics and mechanical test equipment; NDT radiographic; and ultrasonic and X-ray equipment.

Production Equipment - three axis, three spindle NC milling machines (25ft x 8ft); autoclave (6ft dia x 18ft); precision jig boring machine (98 in x 48 in table); drop hammer table (63' x 36"); rubber pad hydraulic forming press table (76 in x 76 in); hydraulic stretch wrap forming machine (20 tons); precision tube bender up to 3 1/2" OD capacity; cable swaging, splicing and proof loading; and heat treatment, cadmium plating, and anodizing.

A complete 60 page listing of equipment is available from Northwest Industries Ltd on request.

Experience: Northwest Industries Ltd customers include, Government of Canada Department of National Defense, United States Air Force, Spar Aerospace, Lockheed California Co, Hughes Aircraft Co and other major aircraft manufacturers and operators. The company holds Canadian Department of National Defense Approval No. 686-1/44, Canadian Ministry of Transport Approval No. 3/57 and US Federal Manufacturers Code No. 35598.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics; 12 = Machining; 19 = Testing/Test Equipment; 20 = Miscellaneous; Structural Modification = 1; Repair & Overhaul = 1, 3, 7; Non Destructive Testing = 19; X-Ray = 19; Installations & Servicing = 3, 7; Instrument Repair = 1; Instrument Servicing = 1; Structural Components Manufacture = 1; Flight Surface Manufacture = 1; Tooling = 12; Die Fabrication = 12; Sheet Metal Fabrication = 12; Fiberglass Composite Component Manufacture = 1; Wiring Harness Fabrication = 1; Control Cables Fabrication = 1; Component Fabrication = 1, 7; Tubing Assembly Fabrication = 1; Technical Publications Production = 1, 3, 7; Technical Writing = 20; Hydraulics = 19; Technical Illustration = 20.

Revised: Dec 83

ONTARIO HYDRO (Research Division)

Code: OHR

Address: 800 Kipling Avenue
Toronto, Ontario, Canada M8Z 5S4

Contact: Dr A McMillan, Research Proposal Officer -
(416) 231-4111, X6055

History: Ontario Hydro was established by Provincial Legislation in 1906 and has the authority to generate, buy and distribute electricity throughout Ontario. The Research Division, which occupies the Dobson Research Laboratory, was founded in the 1920s and is one of the oldest and largest utility research laboratories on this Continent. Ontario Hydro is a financially self-sustaining Crown Corporation that derives no revenue from taxes.

Capability: The Research Division of Ontario Hydro is a fully integrated facility with a broad range of capabilities in research, development and testing. Extensive experience with solving utility-related problems has produced a staff with expertise in such areas as materials science, high voltage science and engineering, concrete technology, organic and inorganic chemistry, biology and geotechnical engineering to name a few. The keyword list gives a more detailed account of the Division's areas of expertise. Many of the techniques and skills developed at the Research Division, while developed in support of the utility, are applicable in other areas.

Average Work Force: Research Division:
Engineers, Physicists, Chemists
& Biologists - 266
Technicians & Technologists - 281
Support Staff - 85

Gross Sales: 1982 - \$3.2B (Estimated)
\$42.0M (Research Division's Operating Budget)

Plant Size: 30,000 sq meters
(Kipling Complex, plus other test sites)
43,000 sq meters
(Kipling Complex, projected by 1987)

Equipment: The following is a list of the major physical facilities. The Research Division also has various sophisticated test and measurement instruments in general use in its laboratories

Electrical/Electronic - High Voltage Laboratory, High Current laboratory, Industrial Processes Laboratory (high frequency power, impulse power, high temperature plasma), Electronics Development Laboratory, Mobile Cable Fault Location Laboratory, Mobile High Potential Test Facility, SF₆ Substation (full scale), and Battery Laboratory.

Mechanical/Metallurgical/Structural - Pump Test Complex (full-scale primary Heat Transport Pump Test Set up to 12,500 hp), Seismic Qualifying laboratory, Anechoic Chamber, Conductor Stress-Strain Laboratory, Heavy Mechanical Test laboratory, Non-destructive Evaluation Laboratory, Welding Laboratory, and Conductor Dynamics Full Scale Test Facility.

Chemical - Analytical Chemistry Laboratory, Radioactive Materials Laboratory, Scanning Electron Microscopes, Surface Analysis Facility, Oil Laboratory, and Combustion Test Facility.

Environmental - Mobile Environmental Monitoring Facility; Environmental Chamber; LIDAR, other Laser Systems; and Micrometeorological Instrumentation.

Civil - Soil and Concrete Analysis Laboratory.

Experience: In the past, the Research Division has won many research and development contracts from the Canadian Electrical Association, the Electric Power Research Institute, the Canadian Federal Government, and other public and private organizations, both domestic and foreign.

Keywords: 4 = Chemistry; 7 = Electronics; 8 = Energy; 9 = Environment; 19 = Testing/Test Equipment; 20 = Miscellaneous; Environmental Sciences = 9; High Voltage Science = 8; High Voltage Engineering = 8; Power Systems = 8; Nuclear Waste Management = 4, 8, 9; Nuclear Engineering = 8; Pollution Control = 8, 9; Energy Conversion = 8; Engineering Sciences = 4, 8, 9, 20; Non-Destructive Testing = 19 Environmental Assessment = 8, 9; Instrumentation & Techniques = 4, 8, 9, 19, 20; Concrete Technology = 4, 19, 20; Geotechnical Engineering = 20; Alternate Fuels Technology = 4, 8; Biomass = 8; Materials Testing = 19; Failure Mechanics = 19, 20; Atmospheric Research = 9; Biological Research = 9; Combustion Research = 8, 9; Corrosion Science = 4, 8, 19; Electronics Research = 7, 8; Organic Materials Research = 4, 8, 9, 20.

Revised: Dec 83

OPTECH Inc

Code: OPI

Address: 701 Petrolia Road
Downsview, Ontario, Canada M3J 2N6

Contact: Mr. S Sizgoric, General Mgr - (416) 661-5904

History: Incorporated in 1974, Optech Inc is Canadian owned. There is only one location at the above address.

Capability: Optech Inc has a broad capability in electro-optical systems with specialization in laser ranging systems. They have designed, developed and manufactured laser systems for atmospheric diagnostics (i.e., atmospheric lidars), water depth measurement, wave height analysis, terrain profiling and high resolution (0.1m) distance measurements. Custom fabrication and R&D capabilities. Primary capabilities are in research, development and systems engineering. Production to date has been limited to custom systems and small volume runs.

Average Work Force: PhDs - 5
Engs & Scs - 7
Techs - 5
Others - 3

Gross Sales: 1981 - \$0.75M
1982 - \$1.00M
1983 - \$1.2M (Projected)

Plant Size: 7,700 sq ft

Equipment: Laser fabrication, and test facilities; optical, electronic, and mechanical assembly areas. Laser propagation laboratories. PDP computer systems for data acquisition and analysis.

Experience: Mobile atmospheric lidars for Ontario Hydro and the Canadian Atmospheric Environment Service.

- Development and operation of Airborne Laser Bathymeter for Canada Center for Remote Sensing.
- Precision airborne Laser Surface Profilometer for the Canadian Department of the Environment, Ice Reconnaissance Branch.
- Laser Smoke Cloud Mapper for the Canadian Department of National Defense.
- Two channel Raman lidar for water content measurements in a maritime atmosphere developed for Memorial University, St John's, Newfoundland.
- Airborne laser wave height analysis system for the Defense Research Establishment Pacific.

- Raman lidar for hydrocarbon gas detection for British Gas Corporation.
- Gallium arsenide range finders for high resolution distance measurements delivered to a number of commercial customers.
- Precision laser altimeter/profilometer for airborne surveys, developed for customers in Canada and the US.
- Military electro-optic studies and laboratory measurement programs for Defense Research Establishment Valcartier.
- Water depth studies using Airborne Laser Bathymeter for Swedish Department of Defense.

Keywords: 1 = Aircraft; 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 11 = Lasers; 20 = Miscellaneous; Lidar = 8, 9, 11; Bathymeter = 1, 9, 11; Terrain Profiler = 1, 9, 11; Range Finder = 8, 9, 20; Electro-Optics = 10; Atmospheric Optics = 9, 10, 11; Laser Altimeter = 1, 11; Altimeter = 1, 11.

Revised: Dec 83

OPTO-ELECTRONICS Inc

Code: OEI

Address: 2538 Speers Road, Units 8, 9, & 10
Oakville, Ontario, Canada L6L 5K9

Contact: Dr B K Garside, President - (416) 827-6214

History: Opto-Electronics is a high technology company incorporated in late 1976 with no subsidiaries in the US. The company was formed with the primary goal of carrying out research, development, manufacturing, and marketing of high technology electro-optical components, devices, and instruments.

Capability: Opto-Electronics fields of expertise lie in the areas of industrial control instrumentation, fiber optic systems, optical communications, electro-optics & instrumentation, fast optical sources & detectors, high voltage pulse techniques, solid state electronics, laser devices, and sensors & transducers. Past year activities include new product development and manufacturing as well as contract research on special ultra-high speed photodetectors, ultra-high speed diode laser light sources, tunable infrared diode lasers, and a line of industrial electro-optical process monitors & controllers. The company has introduced an average of at least four products per year. Current research projects include ultra-fast photodetectors, ultra-fast laser diode sources, industrial monitors & controllers, a fiber optic data link, high voltage pulse measurements, an electronic streak camera, high-speed optical switches, fiber-based liquid sensors and infrared sources, and detectors based on lead salt materials.

Average Work Force: Scientists, Engs, & Techs - 19
Others - 2

Gross Sales: 1981 - \$0.8M
1982 - \$1.1M
1983 - \$1.3M

Plant Size: 12,000 sq ft

Equipment: OEI's capability consists of a machine shop, assembly room, dark room, & circuit etching, electronics test & optics test areas, stock room, and shipping & receiving rooms. Five persons are currently assigned to manufacturing. Their R&D facility consists of lasers, optics, electronics & optics design, electronic assembly areas, a chemistry laboratory, materials processing room, areas of microscope &

spectral analysis, vacuum work & measurement, and a high voltage shielded room. Also included are special rooms for furnace work, machining and modeling, and a library. The research staff consists of 7 PhDs; 3 Mech Eng; 1 MSc; 2 BSc; and 1 BEng.

Major equipment includes high vacuum evaporator, electron microscope, cryogenic, electrical and optical facilities, spectrophotometer, ellipsometer, diffusion furnace, vacuum furnace, optical microscopes, multiple beam interferometer, electrometers, oscilloscopes, and other associated instruments.

Experience: OEI's experience has for the most part been with the Canadian Government. Most products are exported. They have expressed interest in doing business with the USAF, and are currently negotiating fiber optic sensor work with NASA.

Keywords: 5=Communications; 7=Electronics; 10=Image Processing & Optics; 11=Lasers; Infrared Instrumentation=7; Industrial Control Instrumentation=7, 10; Fiber Optic Systems=10; Optical Communications=5, 7; Electro-Optics=7, 10; Instrumentation=7, 10; Fast Optical Sources=7, 10; Fast Optical Detection=7, 10; Detectors=7, 10; High Voltage Pulse Techniques=7; Solid State Systems=7; Sensors=7, 10; Transducers=7; Photodetectors=10; Laser Light Sources=11; Laser Diode Sources=11; Measurement Systems=7,10; Data Links=10; Infrared Diode Lasers=11; Optical Switches=10; IR Sources=10; IR Detectors=10; Liquid Sensors=10.

Revised: Dec 83

OPTOTEK Ltd

Code: OPT

Address: 1283 Algoma Road
Ottawa, Ontario, Canada K1B 3W7

Contact: Dr David I Kennedy, President - (613) 746-3100
Mr. P Gunnar Wareberg, VP, Operations (613) 746-3100

History: Optotek Ltd is a high technology company with no other divisions in Canada or the US. Optotek was incorporated in Oct 77 as a spin-off from Bowmar Canada Ltd, a Canadian subsidiary of Bowmar Instrument Corp.

Capability: Active - (1) Development and manufacture of LED materials and devices based on Group III-V and II-VI compounds, (2) design and manufacture of custom LED arrays for military and industrial applications, (3) design and manufacture of display-related electronic subsystems and test equipment, (4) design and manufacture of Gallium Arsenide field-effect transistors, and (5) design and manufacture of infrared photodetectors (Cadmium Mercury Telluride).

Latent - (1) Alternate (non-LED) applications of III-V compound semiconductors, e.g., FETs, and (2) alternate display technologies, e.g., liquid crystals, electrochromic technology, etc.

Future R&D - Current LED displays, both monochromatic and multicolor, range in resolution from 25 to 1000 lines-per-inch. Future expansion will encompass gallium arsenide field effect transistor and high-speed integrated circuit technology, as well as infrared photodetector technology based on cadmium mercury telluride.

Average Work Force: PhDs - 2
Engineers - 8

Gross Sales: Approx \$1.5M (Historical)
Approx \$2.0M (Current)
1984 - \$3.0M (Projected)
15% (to US Military)

Plant Size: 30,000 sq ft

Equipment: Optotek has a full complement of semiconductor processing equipment.

Experience: Optotek has experience with the USAF, USN and NASA. They are interested in continuing their business with the DOD and NASA. Past contracts have been in the LED materials, devices, and displays areas. Principal programs with the USAF have been the Multimode Matrix LED Display, the Video Flat-Panel LED Display, and the development of Multicolor LED Displays. The USN programs include manufacturing technology for advanced solid-state data annotation displays and a planned production program involving the RF-4 and P3 reconnaissance systems.

Keywords: 3 = Avionics; 7 = Electronics; 19 = Testing/Test Equipment; Cockpit Displays = 3; Infrared Instrumentation = 7; Integrated High Density LED Displays = 3, 7; Solid State Devices = 3, 7; LED Materials = 7; LED Arrays = 3, 7; Subsystems = 7; FETs = 7; Semiconductors = 7; Display Technologies = 7; Liquid Crystals = 7; Electrochromic Technology = 7; Flat Panel Displays = 3, 7; Multicolor LED Displays = 3, 7; Data Annotation displays = 3; Electronic Test Equipment = 19.

Revised: Dec 83

PACERLABS Ltd

Code: PAC

Address: 1496 Bedford Highway
Bedford Tower, Suite #200
Bedford, Nova Scotia, Canada B4A 1E5

Contact: Mr. Stephen E Rice, Technical Director -
(902) 835-7033

History: Pacerlabs of Canada Ltd was originally a wholly owned subsidiary of Pacer Systems Inc operating in Ottawa through the System Sciences and Engineering Division of Fort Washington, Penn. During the 1970s, Pacerlabs completed several tasks for the Department of National Defense (DND) on the CH-124A Sea King Modernization Program, as well as a major effort involving software design, specification, and test and evaluation (T&E) for the Canadian Forces Data Interpretation and Analysis Center (DIAC), the land-based command, control and support element of the Aurora weapon system.

In May 1980, IMP Group Ltd conducted negotiations with Pacer in concert with DND and the Department of Industry, Trade and Commerce, acquiring a controlling interest. The company was renamed Pacerlabs Ltd and the corporate registry moved to Nova Scotia where operations began in October 1981.

Capability: Pacerlabs provides a wide range of professional services to support National Defense Headquarters and IMP Group Aerospace Division in Mission and Weapon Systems Evaluations, Operational Analyses, Software Systems Analyses, Project Management, and Report Development/Production. Pacerlabs' principle activity includes the following military systems and software engineering:

- Software Design, Documentation and Quality Assurance
- Independent Verification and Validation
- Computer Program Performance, Design and Test Specifications
- Specialist Weapon System Software Support and Maintenance Analyses
- Operational Training System and Documentation Development
- Future Systems Studies

Average Work Force: 23

Gross Sales: \$1.0M

Plant Size: 5,000 sq ft

Equipment: Pacerlabs' facility has provisions for handling and storage of material up to and including NATO Secret in accordance with Supply and Services Canada - Security Branch requirements.

A Tempest-qualified WANG multistation word processing system is available for classified document and report preparation, augmented by numerous integrated terminals, extensive hard disk storage and two high quality printers in their WANG Office Information System. Additionally, Pacerlabs utilizes its 264K microprocessor for mathematical analyses or database applications, as required. Pacerlabs maintains a drafting, graphic arts and reproduction capability appropriate to quality document and report preparation.

Experience: Pacerlabs' major activities are outlined below:

- *CP-140 Aurora Antisubmarine Weapon System* - Prime mission vehicle software validation and documentation rewrite; development of Weapon System Manager Configuration Management policies and procedures - CF Technical Orders; development of Director General Aircraft Engineering and Maintenance Weapon System Software Documentation Standard - CF Technical Order.
- *CF-18 Hornet Fighter/Attack Aircraft System* - Indepth technical evaluation of proposal for autonomous Canadian software support facility and weapon system software support; preparation of a comprehensive Statement of Requirements for a CF-18 Weapon System Software Support Facility to provide second line software life cycle maintenance at Cold Lake, Alberta.
- *Canadian Sea King Replacement and Sea King Life Extension* - Conduct of a Sea King Replacement Mission Analysis Study, inclusive of Threat Definition, Development of 17 Antisubmarine and Antisurface Warfare Scenarios, and Evaluation of System-Subsystem Equipment and Armament to Conduct Canadian Warfare Roles; and support to IMP Group Aerospace Division in an indepth Sea King Update and Life Extension Study to upgrade the CH-124A to meet current Maritime Command operational commitments through the 1990s.
- *Other National Defense Activities* - Canadian Patrol Frigate Shore Facilities Survey on CPF Supportability; various Sonobuoy Specification, Manufacturing Cost-effectiveness, Feasibility and Operational Utilization/Maintenance Studies; and Naval Engineering Unit (Atlantic) Technical Investigation and Engineering Support for Automatic Test Equipment/Systems.

Keywords: 1 = Aircraft; 2 = Armament; 3 = Avionics; 17 = Software Services; 20 = Miscellaneous; Operations Analysis = 1, 20; Mission Analysis = 1, 20; Systems Engineering = 1, 2, 3, 20; Future Systems Studies = 1, 2, 20; Software Design = 17; Documentation Development = 20; Software Documentation = 17; Weapons Systems Evaluation = 1, 2, 20; Software Systems Analysis = 17; Project Management = 1, 2, 3, 20; Report Development = 1, 2, 3, 20; Studies = 1, 2, 3.

Revised: Dec 83

PACIFIC MICROCIRCUITS Ltd

Code: PML

Address: 1645-140 St
White Rock, British Columbia,
Canada V4A 4H1

Contact: Mr Tom Foxall, President - (604) 536-1886

History: Pacific Microcircuits is a new company incorporated in Apr 1982. It was set up as an affiliate of Mitel Corp for the sole purpose of integrated circuit design.

Capability: Pacific Microcircuits is a custom integrated circuit design group specializing in the design of CMOS circuitry. The company has the expertise and facilities to design digital and analog CMOS circuits. Typical design activities include the development of integrated circuits from customer schematics or the development of new circuits to meet customer specifications. Pacific Microcircuits has experience in all aspects of design, testing, packaging, and manufacturing to ensure the success of the customer's circuits.

Average Work Force: Engineers - 4
Layout Designer - 1
Technologist - 1

Gross Sales: 1982 - \$0.5M

Plant Size: 2,700 sq ft

Equipment: Pacific Microcircuits employs a VAX 11/780 for circuit simulation, logic simulation, rules checks, schematic verification, and switched capacitor filter design; and a CALMA GSDII Color Graphics System for IC layout, design, digitizing, & editing, plotting, and schematic entry.

Experience: Pacific's clients include Mitel Corp and several small companies from British Columbia and California. Specific IC design experience of the company's engineers include memory, telephony components, switched capacitor filters, DTMF receivers, modem design, and CCD devices.

Keywords: 7 = Electronics; IC Design = 7; Integrated Circuits = 7; CMOS = 7; Memory = 7; ISO-CMOS(tm) = 7; Filters = 7; Custom = 7; Chips = 7.

Revised: Dec 83

PATLON AIRCRAFT & INDUSTRIES Ltd

Code: PAI

Address: 5502 Timberlea Blvd
Mississauga, Ontario, Canada L4W 2T7

Contact: Mr. P B Mann, Executive Vice President - (416) 624-5572

History: Patlon Aircraft & Industries Ltd has been in business for 30 years and is 100% Canadian owned. It was originally located at 74 Six Point Road, but moved to a much larger facility at its present address. It has a wholly owned subsidiary located in Miami, FL.

Capability: Patlon is an engineering sales, servicing and warehousing distributor servicing the total aircraft industry which includes the Canadian Government, Canadian Forces, airlines, private aircraft users and electronic and communication companies. Over its 30-year history, it has built up and currently maintains excellent business and personal relationships at all levels of the aforementioned areas.

Patlon maintains one of the largest master reference libraries in Canada which includes most of the military vehicles and equipment purchased in the free world. This capability enables them to cross reference products replacing speci-

fied materials and equipment with qualified products from multiple sources, usually at a lower cost. Patlon has been particularly successful in this area with the Canadian military, airframe and engine repair and overhaul depots.

Its selling procedure includes meeting with management, procurement, engineering, sales, service and manufacturing personnel, depending upon the product and customer requirements. With its knowledge of the industry and personnel involved, it has the opportunity of discussing projects at the drawing board stage, and in many cases, has been successful in having its equipment specified.

To summarize, Patlon provides both spare support service as well as product support at the original equipment manufacturer level.

Average Work Force: Management – 4
Support Staff – 4
Sales – 10

Gross Sales: No Data

Plant Size: 6,000 sq ft (Toronto, Canada)
2,500 sq ft (Miami, FL)

Equipment: Patlon is equipped with all the required communications equipment to conduct business around the world.

Experience: Patlon provides the services mentioned above to several other countries. The list of foreign countries which it has sold to includes Germany, Turkey, Australia, Denmark, Indonesia, the US, and virtually all South and Central American countries. The Miami office of Patlon, which was opened in January 1980, has vastly improved Patlon's ability to service both the South and Central American countries.

Keywords: 1 = Aircraft; 20 = Miscellaneous; Aircraft Parts = 1, 20; Parts = 1, 20; Library (Aircraft Parts) = 1; Reference Library (Aircraft Parts) = 1.

Revised: Dec 83

PERLEY TECHNOLOGIES CORPORATION

Code: PTC

Address: 35 Holiday Drive
Constance Bay, Ontario, Canada K0A 3M0

Contact: Mr. Daniel R Perley, President – (613) 832-3500

History: PTC is a highly specialized systems consulting firm offering expertise in three areas – workplace technology, computer simulation and emergency planning. The company was founded in 1983 by Daniel R Perley, who during the past several years, has managed more than 20 projects in these areas ranging from feasibility and implementation studies, through definition, design, system implementation and installation. These projects were performed for private and public sector clients in Canada and the US. In addition, Mr. Perley has managed several hardware development/integration projects in the avionics and computer-assisted learning areas. PTC is supported by employee principals, consultants and support staff, as well as by consultants and resources of associated firms in closely related fields.

PTC provides a conceptual, but thoroughly practical approach to meeting client requirements, drawing on a variety of disciplines and specialties. The firm offers its services in Canada, the US and overseas, and operates in English, French, German and Spanish. The firm is also represented by local agents in South America, Europe, the Middle East and the Pacific Rim countries.

Capability: The simulation experience of Perley Technologies Corp principal consultants and associate consultants spans more than 25 years and the widest variety of civilian and military applications. Since the mid-1970s, a substantial number of professional papers and tutorials have been presented at simulation conferences and symposia throughout North America. It is thus possible for PTC to offer an extensive range of theoretical and practical experience in the application of simulation technology to a variety of fields. During the past five years, the use of computer simulation as a tool for training, planning and research has been extended to a large number of new application areas. In addition to providing proprietary and customized simulations for workplace technology projects, PTC conceptualizes, defines, designs and implements advanced computer simulations in the following areas:

- Air transport management and policy
- Air transport operations
- Surface transport management and policy
- Surface transport operations
- Inter-modal transport/energy modelling
- Military air-air and air-ground operational environments
- Communications system operations
- Emergency planning and civil defense
- Industrial emergency/security planning

In various other application areas, PTC consultants can quickly assess the feasibility and desirability of constructing simulations for training, research, strategic planning or other purposes. Such assessments include not only an estimation of the cost and quantitative benefits of the construction and use of a specific simulation, but also detail qualitative information as well.

The company is also the sole Canadian firm offering an extensive range of capabilities in the application of computer systems technology to emergency planning/civil defense based on a proven record of project success. Specific capabilities include:

- Feasibility and implementation studies of training, database, command and control, warning and other emergency planning systems.
- Critique of existing plans and procedures.
- Public participation coordination for emergency plan creation or revision.
- Creation or revision of computer systems and emergency procedures for use on industrial or military sites.
- Base warning system definition, design and implementation supervision.

Average Work Force: Consultant Level Personnel – 5/10
Associate & Staff Support –
As required

Gross Sales: No Data

Equipment: PTC employs in-house computing resources including Digital and Mitel computer systems and executive workstations.

Experience: PTC's clients include various Canadian and foreign government agencies in the transportation, communications and defense fields, as well as emergency planning.

Keywords: 1 = Aircraft; 16 = Security & Safety; 17 = Software Services; Operational Simulation = 1; Civil Reserve Air Fleet Simulation = 1; Transportation Simulation = 17; Communications Simulation = 17; Defense Simulation = 17; Simulation = 1, 17; Training = 16;

Computer Aided Learning Software & Courseware = 16,
17; Site Or Regional Resource Databases = 16; Regional
Resource Databases = 16; Computerized Communications
Command & Control System Definition = 16; Warning
System Definition & Design = 16.

Revised: Dec 83

PHOTOCHEMICAL RESEARCH ASSOCIATES Inc

Code: PRA

Address: 45 Meg Drive
London, Ontario, Canada N6E 2V2

Contact: Dr R C Miller, Director of Marketing -
(519) 686-2950

History: Photochemical Research was incorporated in
mid-1976. It is a Canadian owned high technology company
with a US sales office located in Oak Ridge, Tennessee.

Capability: PRA is involved in the design, development and
manufacture of electro-optical instrumentation systems;
specifically in light generation, detection and analysis. Their
present product lines consist of luminescence decay systems
for the reliable measurement of short lived fluorescence life
times; pulsed light sources with pulse widths from pico-
seconds to seconds and spectral ranges from the VUV to the
IR; CW light sources and a line of optical building blocks;
Photon Counting Systems for low light level detection; a line
of long-life Helium/Neon lasers; low power Argon ion lasers;
and Nitrogen and Dye lasers. PRA is currently developing third
generation spectroscopic analysis instrumentation. The latter
is nearing market readiness.

In addition to manufacturing standard products, they operate
research and laboratory facilities for custom manufacturing,
contract research, and consulting. PRA operates on an inter-
national basis through offices in Canada and the US, as well
as through distributor networks in Europe and the Far East.

Average Work Force: Scientists/Engineers - 25
Others - 55

Gross Sales: No Data

Plant Size: 22,500 sq ft

Experience: PRA has sold their off-the-shelf products to a
variety of academic, industrial, and government research
facilities including - Lawrence Livermore Laboratories, Oak
Ridge National Laboratories, Los Alamos Scientific Labora-
tories, Solar Energy Research Institute, Exxon Research, Bell
laboratories, Western Electric, Eastman Kodak, and Wright-
Patterson AFB, OH.

Keywords: 7 = Electronics; 10 = Image Processing &
Optics; 11 = Lasers; 19 = Testing/Test Equipment;
20 = Miscellaneous; Electro-Optical Instrumentation = 7,
10, 19; Light Generation = 7; Light Detection = 7; Light
Analysis = 7; Luminescence Decay Systems = 7; Pulsed
Light Sources = 7; Continuous Wave Light Sources = 7;
Optical Building Blocks = 7, 10; Photon Counting
Systems = 7; Helium Neon Lasers = 11; Contract
Research = 7, 10, 11; Spectroscopic Analysis
Instrumentation = 7, 19, 20; Low Power Argon Ion
Lasers = 11; Nitrogen Lasers = 11; Dye Lasers = 11.

Revised: Dec 83

PHOTOVAC Inc

Code: PHV

Address: 134 Doncaster Ave
Unit 2
Thornhill, Ontario, Canada L3T 1L3

Contact: Dr Richard C Leveson, President - (416) 881-8225

History: Incorporated in 1975; Canadian owned. Their US
subsidiary, Photovac International Inc, is located in Long
Island, NY.

Capability: Photovac's distinctive competence is in the ability
to: (a) design and manufacture instrumentation for the detec-
tion and analysis of gaseous and vaporous contaminants in
air, and in other gases, at extremely low concentration levels
(parts per billion); and (b) to apply this instrumentation,
together with technical knowledge, to specific R&D projects.
This competence is broadly based in research, product
development, systems engineering, and computer design
(from scratch); and software development capabilities as
these relate separately or in combination to photoionization
gas chromatography technology. Photovac's particular tech-
nology strength is based on a newly-developed, ultra-sensitive
photoionization system which overcomes problems previously
experienced with this technique.

Average Work Force: Phds - 2
Engineers - 4
Research Scientists - 7
Technicians - 8

Gross Sales: 1980 - \$250,000
1981 - \$400,000
1982 - \$1.0M
1983 - \$2.0M (Projected)

Plant Size: 7,000 sq ft (Plus 1,000 sq ft in Long Island, NY)

Equipment: Photovac Inc's equipment capability is described
below:

- Instrumentation for air and gas analysis of contami-
nants with sub part-per-billion detection capability.
- Available in field portable format including compu-
ter interpretation.
- Available for system installation to carry out multi-
point, continuous, high-speed surveillance of air
quality.
- Specialty equipment for investigating short wave-
length, ultra-violet phenomena, specially related to
gas analysis applications - vacuum UV monochro-
meter system and mass spectrometer.
- Machine shop capability.

Experience: Photovac Inc has had experience with:

- Development of ultra-sensitive (sub ppb) detector for
military applications (AGARD Proceedings #309
"Toxic Hazards in Aviation", B15-1, Sep 80).
- General Electric - continuous surveillance of arsine
and phosphine in new Research Triangle Park facility.
- Research on preconcentration for ion mobility spec-
trometer relating to detection of explosive vapors in
air at trace levels (Canadian Department of National
Defense).
- Anticipated contract (sole source) from NASA for
development of specialized breath analysis system
for future Space Shuttle flight.
- Miscellaneous semi-formal projects and special
assignments for EPA (US), Cal OSHA, USDA, US Gas
Research Institute.

Keywords: 9 = Environment; 19 = Testing/Test Equipment; Gas Chromatography = 9; Air Analysis = 9; Gas Analysis = 9; Instrumentation (Air/Gas) = 19.

Revised: Dec 83

PRATT & WHITNEY CANADA Ltd

Code: PWC

Address: P. O. Box 10
Longueuil, Quebec, Canada J4K 4X9

Contact: Mr. S Monaghan, Chief R&D Support -
(514) 647-7557

History: Established in 1928 as a Canadian center for the overhaul of Pratt & Whitney Aircraft radial piston engines, Pratt & Whitney Canada Ltd (P&WC) took over full responsibility for this function prior to moving into small gas turbine development and production. They are a wholly owned subsidiary of the Pratt & Whitney Aircraft Group, a division of United Technologies Corporation.

Capability: P&WC has the mandate to develop and produce all small gas turbine engines typically for general aviation, commuter and paramilitary use. Their primary business areas are:

- Small gas turbine engine development
- Small gas turbine engine production
- Small gas turbine engine oriented research

The development of gas turbine engines at P&WC started in the late 1950s with the early PT6. This turboprop engine was introduced to the commercial market in 1963. The military designation for this engine is the T74-CP-701. In 1979, the development started on the PW100 turboprop engine. This fuel efficient engine is used primarily in commuter and short-haul aircraft.

The JT15D turbofan engine was introduced in 1967. It is the power plant of the Cessna Citation corporate jet, as well as the Aerospatiale Corvette and the Mitsubishi Diamond 1 aircraft. P&WC has also developed a twin turboshaft engine for helicopter use. These are designated the PT6T-3 and -6 series (military designation is T400-CP-400, -WV-402).

By 1982, the company had delivered 23,000 engines for the world market.

Average Work Force: Company Total - 6,660
R&D Center - 1,840

Gross Sales: 1979 - \$463M
1980 - \$605M
1981 - \$770M

Plant Size: 1,809,640 sq ft (Total area)

Experience: P&WC has had experience with the following organizations:

United States Air Force - (1) Research on High DN Value Roller Bearings - a program to determine the influence of geometric variable etc., on small high speed roller bearings (carried out as a shared development program); and (2) Alternate Fuels Combustion Research - an experimental study of the effects of alternate jet fuels on small gas turbine combustion systems (carried out as a shared development program).

United States Army - (1) Subcontractor in Cooled Radial Turbine Program to Pratt & Whitney, Government Pro-

ducts Division (GPD) (1969-1971). Pratt & Whitney Canada Ltd was responsible for the Aerodynamic design and participated in the structural analysis and mechanical design of the turbine; (2) Consultant to P&W, GPD, on ST9 1500 horsepower demonstrator program for new US Army helicopter engine - first stage was scaled P&WC research rotor and second stage was centrifugal compressor (1966-1969); (3) Consultant to P&W, GPD, for the demonstration of a 10:1 Pressure Ratio single centrifugal compressor - P&WC provided data from previous in-house demonstrations of 10:1 Pressure Ratio Compressors carried in 1967 & 1970 (1970-1972); and (4) P&WC is currently contracted with the US Army at Ft Eustis for an advanced 15:1 Pressure Ratio Single Centrifugal Compressor.

United States Navy - (1) P&WC was a subcontractor to P&W, Commercial Products Division (CPD), on a demonstration of a regenerative, small turboprop engine based on the PT6 - P&W designed the regenerator, while P&WC designed the ducting, organized hardware fabrication, and demonstrated the concept (1964-1966); (2) P&WC won a contract to provide a twinned helicopter engine (T400/402 Twin Pac R) to the US Navy for Bell Aerospace helicopters where 1032 units have been supplied - also 2218 units in a civil version (PT6T3/6) have been produced to date - development of the engine is a continuous process and P&WC are performing component improvements through a US Navy contract (1969); and (3) P&WC has also performed as a subcontractor to P&W, CPD, on a demonstration of single crystal turbine blades for gas turbine operation.

Environmental Protection Agency - (1) P&WC carried out a combustion research program for small, single can, highly loaded combustors for automotive application with good performance and low emissions (1973-1974); (2) P&WC was subcontractor to United Technologies Research Center (UTRC) on a study of the automotive application of gas turbines carried out a series of cycle studies and supported experimental work on combustion (early 1970s); and (3) P&WC also supported the Environmental Protection Agency (EPA) (Triangle Park) on studies of the carcinogenic effect of small gas turbine emissions (1977-1978).

National Aeronautical Space Administration (NASA) - (1) P&WC was subcontractor to P&W, CPD, on a turbofan core noise program at Ames carried out on a NASA owned P&WC JT15D engine - P&WC designed and fabricated an alternate fan core stator to increase the axial spacing between rotor and stator, and the number of stator vanes (1977); (2) P&WC was subcontractor to P&W, CPD, on a program of nose cone telemetry for NASA Lewis Research Center as applied to a NASA JT15D turbofan - P&WC designed a transmitter to operate within the nose of a JT15D to study the difference between ground and flight noise measurements (1978-1980); (3) P&WC was also subcontractor to P&W, CPD, on a program to supply NASA Langley with copies of the telemetry units from item #2 for flight use with stringent manufacturing requirements (1979-1980); and (4) P&WC was also subcontractor to United Technologies Research Center on a Combustor soot program - all combustor hardware was designed and fabricated by P&WC, while United Technologies Research Center assembled the rig and carried out all testing (1980-1981).

Keywords: 1 = Aircraft; 4 = Chemistry; 8 = Energy; 9 = Environment; 19 = Testing/Test Equipment; Small Gas Turbine Engines = 1; Engines = 1; Turbine Engines = 1; Engine Components = 1; Engine Systems = 1; Fuel Systems Research = 1; Repair & Overhaul = 1; Alternate Fuels Research = 1, 4; Roller Bearings = 1; Combustion Research = 1, 4; Fuels Research = 1, 4; Helicopter Systems = 1; Auxiliary Power Units = 8; Engine

Research = 1, 8; Test Equipment Instrumentation = 19;
Engine Emission Research = 1, 9.

Revised: Dec 83

PRESENTY ENGINEERING PRODUCTS Ltd

Code: PEP

Address: 2784 Fenton Road
Ottawa, Ontario, Canada K1G 3N3

Contact: Mr. R Senayek, Chief Engineer -
(613) 822-1251

History: Presenty is a Canadian company incorporated in 1958 with no other Canadian branches or US subsidiaries.

Capability: Presenty engages as a prime contractor in a wide variety of activities including research, development, production, and consulting for both the military and private sectors. Over the years, the company has designed and produced an assortment of hardware items that include airborne voice recorders and ground based reproducers for the CF-104 aircraft, transmitter teletypewriter controls for shipboard use, low drift DC amplifiers, multi-channel memory/loop tape recorders for high performance jet aircraft, 14 channel FM/AM data recorder for high altitude research, magnetometers, proton magnetometers, dust monitoring systems, rocket sub-commutator, an ASW sonobuoy antenna, plus other items. They designed and produced the first Canadian air pollution monitor which is installed at various locations in the Ottawa, Toronto and Montreal areas.

Presenty was awarded all the contracts of a bankrupt electronics firm by the Canadian Government. All those contracts were successfully completed. At least two USAF contracts, transistorized missile check cards and radar target simulators, were part of that deal.

Recent projects include the design and development of the signal patch panel systems for the latest Canadian destroyers and a 64-channel A/D converter/recorder system. They have also been active in the fields of airborne photogrammetry, navigation aids and airborne photography film annotation systems. Another in-house product is a brushless DC motor. It is a low cost, high quality, long life, self-contained compact unit to be used in new equipment designs as well as a replacement for brush type motors in existing equipment. Applications include magnetic tape recorders, reels and capstan drives, film transports in cameras, airborne instruments, chart recorders, printers, blowers and various operations in hostile environments. The company is reasonably self-sufficient. They are equipped to carry out electronics work as well as to design and machine parts, tools, jigs and dies for production of parts, stampings and molds. Production equipment is available for electronics and mechanical operations. They also have the capability to design silicone elastomer molds and have made considerable progress in epoxies processing.

Average Work Force: Total - 21

Gross Sales: 1980 - \$1.0M
1981 - \$1.5M

Plant Size: 10,000 sq ft

Equipment: The company maintains a manufacturing capability in the electronics and mechanical areas. They are equipped with a machine shop for normal operations. They can carry out heat treating, stamping, tool and die cutting, oxyacetylene and electrical welding, and sheet metal operations. Limited environmental and vibration testing can be carried out.

Experience: Presenty has worked with the Canadian military and has had contracts with the USAF (AFLC). Currently they are under contract with the Canadian Forces to produce their brushless DC motor, and also to develop a brushless blower motor for use in land vehicles and in unattended locations. They have also developed a UHF power amplifier for man-pack radios in vehicle configuration. They are under contract with the Department of Transport to build 40 transmissometers to measure light transmissivity at airports. They are also building similar devices for the Canadian DND.

Keywords: 1 = Aircraft; 5 = Communications; 7 = Electronics; 9 = Environment; 15 = Radar; 16 = Security & Safety; 19 = Testing/Test Equipment; 20 = Miscellaneous; Voice Recorders = 1, 5; Voice Reproducers = 5, 20; Ground Based Reproducers = 5, 20; Transmitter Teletypewriter Controls = 5, 20; Amplifiers = 1, 5; Tape Recorders = 1, 5; Data Recorder Systems = 20; Magnetometers = 9; Proton Magnetometers = 9; Pollution Sensing = 9; Antennas = 20; Rocket Subcommutators = 20; Converter/Recorders Systems = 5, 20; Photogrammetry = 1; Film Annotation Systems = 1; Motors = 20; Brushless DC Motors = 20; Simulators = 15; Magnetic Anomaly Detection = 16; Test Equipment & Instrumentation = 19; Environmental Analysis = 9; Navigation = 1; Target Simulators = 15; Power Supplies = 7; Flight Data Recorders = 1; Instruments = 1; Transmissometers = 9.

Revised: Dec 83

PRIOR DATA SCIENCES Ltd

Code: PDS

Address: Bell Mews Plaza - Nepean
39 Highway 7
Ottawa, Ontario, Canada K2H 8R2

Contact: Larry E Hanlan, Manager, Military Systems -
(613) 820-7235

History: PRIOR Data Sciences Ltd was founded in early 1977 and has experienced steady growth to its current level of 40 employees (Nov 83). The company is Canadian owned and is located in both Ottawa (Headquarters) and Toronto. There are no US subsidiaries.

Capability: PRIOR has capabilities in:

- "Turnkey" computer systems development for real-time applications
- All phases of software project development and life cycle support
- Software engineering consultation and contact support services
- Software product development and sales

Computer systems development may range from microprocessors to mainframes. In the industrial field, PRIOR has considerable experience with the DEC PDP-11 family of computers, the RSX-11M, RT-11 and UNIX operating systems, and the Pascal and C programming languages. In the military field, PRIOR has significant expertise with the UYK-20 and associated computers, and the CMS-2 and ADA programming languages. They have assumed responsibilities as a software subcontractor, and as a turnkey system developer.

PRIOR has participated in all phases of software project development. This experience includes:

- Research and Development
- Feasibility studies and requirements analysis
- Systems analysis, systems specification, and hardware procurement
- Proposal preparation and evaluation

- System design and detailed module design
- Module code and testing
- System integration
- Acceptance test plan preparation
- Software maintenance and enhancements

Software engineering consultation and contract support services can be provided for all of the above phases of software project development, from requirements analysis to software maintenance.

Average Work Force: Professionals – 35
Others – 5

Gross Sales: 1981 – \$1.4M
1982 – \$1.9M
1983 – \$2.2M

Plant Size: 5,000 sq ft (Ottawa)
2,000 sq ft (Toronto)

Equipment: DEC PDP-11/44; Perkin-Elmer 7/32; and WICAT 68000.

Experience: PRIOR has participated in the following military application areas, Command and Control; Anti-submarine Warfare (ASW); Communications; Surveillance; Graphics; and Simulation.

PRIOR has worked directly for DND or as a subcontractor on many of DND's recent major projects. These include NFA, CPF, AURORA, ADLIPS, CANEWS and SHINCOM. PRIOR has successfully teamed with other members of Canadian industry such as Leigh Instruments, Litton Systems Canada Ltd, and Westinghouse.

In the area of military research and development, PRIOR has had a continuing involvement with projects at the Defense Research Establishment Ottawa and the Communications Research Center. These projects have been concerned with radar, direction finding, electronic warfare, counter-measures, analysis, navigation, graphics and simulation.

PRIOR's three major real-time application areas are the Military, Air Traffic Control, and Supervisory Control and Data Acquisition.

Sixty percent of the company's work is military-related. There has been no direct contact with the US military. All experience to date has been either with the Canadian Department of National Defense or as a subcontractor on a DND sponsored project.

Keywords: 5 = Communications; 6 = Computers; 15 = Radar; 17 = Software Services; Turnkey Computer Systems Development = 6; Project Development = 17; Life Cycle Support = 20; Engineering Consultation = 6, 17; Feasibility Studies = 17; Requirements Analysis = 17; Systems Analysis = 17; Systems Specification = 17; Maintenance = 17; System Integration = 17; System Design = 17; Module Design = 17; Hardware Procurement = 6, 17; C3 Systems = 5, 6, 15, 17; Surveillance = 6, 17; Graphics = 6, 17; Simulation = 6, 17; Consulting = 6, 17; Electronic Warfare = 6, 17; Radar = 6, 15, 17; Communications = 5, 6, 17; Computer Design = 6, 17; Air Traffic Control = 6, 17; Supervisory Control = 6, 17; Data Acquisition = 6, 17; ASW = 6, 17; Computer Graphics = 6, 17; Computer Simulation = 6, 17; Real-Time = 6, 17; Research & Development = 17; Software = 17; Software Development = 17.

Revised: Dec 83

PYLON ELECTRONIC DEVELOPMENT CO Ltd

Code: PED

Address: 147 Colonnade Road
Ottawa, Ontario, Canada K2E 7L9

Contact: Mr. E Pinnell, President – (613) 226-7920

History: The Pylon organization celebrated its first 25 years of business 21 Mar 80. Within two years of incorporation under Federal Charter in 1955, a development project was begun for the use of transistors in telephone equipment. By the end of 1957, the company was manufacturing solid state 20Hz Ringing Generators. Previously this was done by rotary machinery at high cost and with attending maintenance problems. The concept of a solid state "generator" stuck with the product. By 1959, Pylon was producing both static DC generators and static AC generators. These are frequently called DC-DC Converters or DC-AC Converters. As Pylon were the first to manufacture these devices, the name most commonly used by domestic phone companies was "Pylons", regardless of the type of equipment.

The use of solid state ringing and power conversion in the US came several years later. Telcos were quick to see the advantage of using one central office battery and the conversion method with redundancy for high reliability. In Canada, Pylon is the major supplier of DC-DC Converters and ringing machines.

With the acquisition of Armtrrol Ltd in 1970, Pylon entered into the manufacture of solid state switching equipment. A line of trunk concentrators of CAMA application and ROTS apparatus were introduced.

Manufacture of digital equipment began in 1965 with systems involving photoelectric badge readers. The first system formed the basis of data gathering systems for the Post Office. Pylon has supplied a vast range of specialized data equipment to customers in North America and overseas. Pylon offers a complete engineering support team from the system concept through to the end product.

In 1977, the company expanded by opening a division in Ottawa which specialized in the manufacture and development of instrumentation and Geophysical/Nuclear Measurement Systems. The Toronto division was opened in the fall of 1979.

In 1980 due to the growth of the Pylon market, it was decided to build a new development plant in Ottawa and to relocate the Pylon Head Office on completion of this facility. Eighteen months later, this objective was realized.

The company holds 18 Canadian, 12 US, and 3 miscellaneous patents. Approximately 25% of all telecommunication equipment, and over 80% of the geophysical/nuclear equipment is exported.

Capability: *Montreal Branch* – Telco Products, Ringing Generators, Ringing Talk Signal Supplies, UPS Systems, CO Power Plants, Custom Transit Cases.

Toronto Branch – Telecommunications Equipment, Custom Instrumentation.

Ottawa Head Office – Manufactures an instrument line of Time Code Generators, Distribution Amplifiers and Large Numerical Displays, the Nuclear Group produces calibrated Radon and Thoron gas generators, Alpha detection and contamination monitoring equipment, an R&D group is currently working on improved beta detection and ionizing radiation.

Average Work Force: Scientists/Engineers – 30
Others – 100

Gross Sales: \$4 to \$5M
Projected Sales
(2 year period) – \$6 to \$8M

Plant Size: Montreal – 18,000 sq ft
Toronto – 5,000 sq ft
Ottawa – 16,000 sq ft

Experience: Canada – Department of National Defense, National Environmental Agencies, National Research Council, Atomic Energy Control Board, Energy Mines & Resources, Bell Canada, Telesat, Trans Canada Tele System, Canadian Broadcasting Corp, and CNCP Telecom; US – Danray Inc, Harris Corp, CBS, NBC, and ABC; and Other Countries – South America, Central America, UK, West Germany, Austria, Italy, Greece, China, Philippines, and Australia.

Keywords: 5 = Communications; 7 = Electronics; 9 = Environment; 19 = Testing/Test Equipment; Nuclear Sensors = 9, 19; Geophysical Sensors = 9, 19; Nuclear Instrumentation = 9, 19; Analysis = 9; Simulation = 9; Power Supplies = 7; Telephone = 5; Voltage Transformers = 7; Voltage Regulators = 7; PC Board Design = 7; PC Board Fabrication = 7.

Revised: Dec 83

QUESTOR SURVEYS Ltd

Code: QSL

Address: 6380 Viscount Road
Mississauga, Ontario, Canada L4V 1H3

Contact: Mr. P G Lazenby, Chairman – (416) 676-9880

History: Originally a one aircraft operations section of a mining company, the company split in 1961 and formed a Contract Survey Services Division. During this period, the company operated one owned aircraft and three leased aircraft. In 1970, they began expanding operations, and in 1979 acquired the geophysics division of Northway Survey Corporation. During this period, they specialized in the use and development of the Barringer INPUT electromagnetic system. They are Canadian owned and have no subsidiaries.

Capability: Questor specializes in all state-of-the-art airborne sensing for base metal, uranium and oil. In addition to the Barringer INPUT system (Time-Domain electromagnetics), they also are capable of acquiring and analyzing data from airborne standard & high sensitivity magnetics, and standard & multi-channel spectrometry. They also design and build very high sensitivity magnetometers along with their associated data acquisition systems. Their aircraft fleet includes – two Skyvans, three Trislanders, three DC-3s and an Aero Commander. The INPUT systems generate a pulsed signal from a vertical dipole. The primary field induces eddy currents in conductive targets and these currents produce secondary fields. These secondary fields are then sensed. Through analysis of these secondary field anomalies, sulfide and graphite conducting pockets have been identified to a depth of 300 meters. Standard and high-sensitivity magnetometry provide detailed magnetic contour maps. Corrections for aircraft attitudes & maneuvers, and the use of precision clocks, etc., enable Questor to improve the normal high standard government contour maps by a factor of four in geologic resolution.

Gamma ray spectrometers are used to identify potential uranium deposits as well as for geologic mapping and identification of man-made radio-active wastes. Data reduction for all types of sensors/missions is provided by the company's specially developed algorithms and provides a variety of outputs depending on the users' needs.

Questor has recently organized an internal Research Division. They are presently working to improve the various sensors used by Questor to increase penetration, sensitivity and flexibility, and the new Division has recently developed a helicopter version of INPUT and vertical magnetic gradiometer system.

Average Work Force: PhD – 1
Prof Eng – 3
BsE – 10
Technicians – 15
Others – 91

Gross Sales: 1980 – \$6M
1981 – \$8M
1982 – No Data
1983 – No Data

Plant Size: 22,000 sq ft (plus rental hangar space)

Experience: Questor's clients include 49 different countries around the world for one or more of their surveys. Their surveys have led to the discovery of fourteen base metals, precious metals, or uranium deposits in a variety of geologic environments. In Canada, customers have included – Noranda Mines, Falconbridge Mines, Inco, Imperial Oil, Shell Oil, and Gulf Oil. They are interested in conducting research for the USAF.

Keywords: 1 = Aircraft; 8 = Energy; 9 = Environment; 17 = Software Services; 20 = Miscellaneous; Remote Sensing = 1, 8, 9, 20; Sensors = 8, 9, 20; Pollution = 8, 9; Software = 17; Mapping = 8, 9; Data Acquisition = 1, 8, 9, 20; Data Reduction = 1, 8, 9, 20; Data Analysis = 1, 8, 9, 20; Magnetometers = 8, 9; Helicopter Magnetic Gradiometer = 1, 8, 9; Magnetic Gradiometer = 1, 8, 9.

Revised: Dec 83

RAYLO CHEMICALS Ltd

Code: RAY

Address: 8045 Argyll Road
Edmonton, Alberta, Canada T6C 4A9

Contact: Dr J F Prescott, Technical Manager – (403) 465-7937

History: Raylo Chemicals Ltd was incorporated in 1966 and became a wholly owned subsidiary of Terochem Laboratories Ltd, a private Canadian corporation, in 1981. Raylo has no US subsidiaries.

Capability: Raylo Chemicals specializes in contract research, custom synthesis, and sales of manufactured products. Areas of expertise include bench scale pilot plant design & operation; Synthetic chemistry (natural products, pharmaceuticals & hydrocarbon chemistry); high pressure & temperature reactions; polymer chemistry (synthesis of novel monomers and their polymers, characterization and chemical stability testing); and non-routine analysis. A major contract activity is polymer chemistry applied stable high-strength polymers for composites, elastomers, water soluble polymers, flocculation studies, and electrolyte cell separators. Other principal projects include supercritical gas technology applied to coal liquefaction & analyses of heavy oil, and development of physical & physicochemical data in support of various commercial industrial processes.

Raylo Chemicals offers custom manufacture of complex chemicals and polymers from a few grams to several thousand kilograms, including process design and development. Raylo routinely handles highly reactive solid, liquid, and gaseous reagents, and can operate under vacuum and inert atmospheres. The following reactions are performed regularly:

- Acylation
- Alkylation
- Condensation
- Dissolved Metal Reduction
- Friedel-Crafts Reactions
- Grignard
- Halogenation (substitution and addition)
- High Vacuum Distillation
- Hydrogenation
- Hydrolysis
- Metal Hydride Reduction
- Optical Resolution

- Phosgenation
- Reductions

Raylo Chemicals products include specialty polymers and other fine chemicals for high technology industries. Over 150 compounds are currently in production and for many of these, Raylo is the sole or principal world manufacturer.

Average Work Force: PhDs - 8
Technicians & Operators - 11
Others - 5

Gross Sales: 1980 - \$1.2M
1981 - \$1.4M
1982 - \$2.5M
1983 - \$2.7M

Plant Size: 10,000 sq ft
6,000 sq ft (Laboratory + Library)

Equipment: Raylo Chemicals has well equipped laboratories with the following instruments - 60 MHz proton magnetic resonance spectrometer; infrared and ultraviolet spectrophotometers; high performance liquid chromatograph, equipped with a variable wavelength ultraviolet detector with stop-flow capability; gas chromatograph, both packed column and capillary column, with FID and TC detectors; size exclusion chromatography system with differential refractometer; and other up to date chemical, biochemical and physical equipment.

Under an established arrangement with the University of Alberta, high resolution instruments such as Fourier Transform Infrared Spectrometer; Fourier Transform (100, 200 and 400 MHz) and Carbon-13 magnetic resonance spectrometers; and low and high resolution mass spectrometers are available to Raylo's research staff. Raylo also has access to and experience in using a low angle laser scattering photometer (KMX-6), particularly useful for determination of absolute molecular weight and molecular weight distribution polymers.

Raylo's plant equipment includes multi-purpose glass and stainless steel, jacketed, stirred reactors in the 10-600 gallon range and a broad selection of separation equipment.

Experience: The company has produced 77 patents and 35 publications. Raylo's clients are government, universities, and industry in the US, Canada, Europe and Japan.

Keywords: 4 = Chemistry; Chemical Processing = 4; Contract Research = 4; Custom Synthesis = 4; Physical Chemistry = 4; Polymer Chemistry = 4; Monomers = 4; Non-Routine Analysis = 4; Supercritical Gas Technology = 4; Process Development = 4; Product Characterization = 4; Research = 4; Research & Development = 4.

Revised: Dec 83

RAYSHIELD Ltd

Code: RSL

Address: 2630 Royal Windsor Dr, Unit #4
Mississauga, Ontario, Canada L5J 1K7

Contact: Mr R E Webster, Sales Manager - (416) 822-6100

History: Rayshield is a wholly owned Canadian company incorporated in 1968 with no US subsidiaries.

Capability: Rayshield Ltd specializes in the construction of prefabricated RF shielded enclosures, and MIG welded rooms which are completely adaptable to all sizes and shapes of architectural spaces. The prefabricated system was developed to provide a quality-controlled technique for constructing shielding under adverse field conditions that would ensure a dependable performance. Manually operated doors require

a very minimum of effort and are available as single, double and custom units. "Hands-Off" or automatic powered door operators are also available. Performance is tailored to meet requirements. Complete installation and turnkey services including testing and certification are available. A complete line of accessories - vent panels, waveguide penetration, lighting, work benches, and connector panels are available. Power signal and communication line filters are available for all applications including tempest. Rayshield provides guaranteed performance installation, testing, and servicing. A line of RF shielded cabinets is also manufactured by Rayshield.

Average Work Force: Engineering - 4
Manufacturing - 15
Others - 5

Gross Sales: \$1.0-\$2.0M (Historical)
\$2.5M (Present)
\$3.0M (Forecast)

Plant Size: 10,000 sq ft

Equipment: Rayshield's Manufacturing Division is equipped with a laminating press to manufacture shielded panels, drill presses, cut-off saws, welders, and other equipment to enable them to manufacture all components of shielded enclosures. Test equipment includes generation and measurement from 20 Hz to 26 GHz.

Experience: Rayshield has been providing RF & EMP Shielding to major Governments and companies in North America, Europe and the Middle East for over fifteen years.

Keywords: 14 = Protective Equipment; 19 = Testing/Test Equipment; RF Shielding = 14; EMP Shielding = 14; Anechoic Chambers = 19; Shielded Cabinets & Wireways = 14; Shielding = 14.

Revised: Dec 83

RMS INDUSTRIAL CONTROLS Inc

Code: RMS

Address: 1100 Lansdowne St
Port Coquitlam, British Columbia,
Canada V3B 5E2

7538 Bath Road
Mississauga, Ontario, Canada L4T 1L2

Contact: Mr Harry Dunstan, President - (416) 673-1319 (Toronto)
Mr Peter Boorman, Vice President - (604) 464-2315 (Vancouver)

History: RMS Industrial Controls Inc was incorporated in 1976. The company has displayed steady growth in each succeeding year and has excelled in the field of specialized electronics engineering.

Capability: RMS particularly excels in the development of telemetry systems, using as transmission mediums both conventional wire and radio. They have developed their own series of unique radio modems to offer the user reliable and secure data radio communications. The company has developed and now manufactures its own unique direct synthesized UHF radio. This radio is rugged and capable of operating in harsh environments. The radio features unusual stability and has been designed to require minimal servicing.

RMS has also developed telemetry and control systems for use in offshore and undersea equipment. As much of this equipment is intended for use in critical conditions, emphasis has been placed on refinement and ruggedness of design. This equipment is used in the control of undersea vehicles and remotely operated manipulators.

Radio remote control of both on-off and analog types is manufactured by RMS for use in the resource, construction, and manufacturing industries. All signalling is digitally encoded and offers excellent security of control.

RMS offers unique capabilities in research and development involving new and unusual applications. The company has demonstrated the ability to solve problems using state-of-the-art techniques. This capability is provided to the user in a coordinated manner, from evaluation to development, and then to production and implementation.

Average Work Force: Total - 45 (Engineers 35% +)

Gross Sales: FY 1981/1982 - \$ 1.9M
Next 3 Years - 40-60% increase per year
(forecast)

Plant Size: 11,000 sq ft (Vancouver)
2,000 sq ft (Toronto)
Service Facilities - Houston, TX

Experience: RMS has been involved in the continuing development of sophisticated control equipment for unmanned and manned submersible vehicles used in offshore oil industry and by Government Departments. Projects have been completed for the Canadian Defense Research Establishment (Pacific), and for the US Navy. RMS has successfully developed and put into production a sophisticated state-of-the-art synthesized UHF radio transceiver which is in a wide variety of demanding applications. They company has also developed and put into production radio controls for a variety of applications from simple on-off commands to high resolution analog controls.

Keywords: 5 = Communications; 20 = Miscellaneous; Telemetry = 5; Data Communications = 5 Modems = 5; UHF Radios = 5; SCADA Equipment = 5, 20; Radio Controls = 20; Automatic Vehicles Monitoring (AVM) = 5, 20; Computer Aided Dispatch (CAD) = 5; Remote Piloted Vehicles (RPV) = 20; Radio Modems = 5, Wire Modems = 5; Digital = 5, 20; Analog = 5, 20.

Revised: Dec 83

ROCKWELL INTERNATIONAL OF CANADA Ltd

Code: ROC

Address: 150 Bartley Drive
Toronto, Ontario, Canada M4A 1C7

Contact: Mr. R Zanette, Marketing Manager - (416) 757-1101

History: Collins Radio of Canada Ltd was formed in 1954 as a wholly owned subsidiary of Collins Radio Company of Cedar Rapids, Iowa. With the acquisition of Collins Radio by Rockwell International in 1973, it became a Division of Rockwell International of Canada.

Capability: The Collins Canada Division is engaged in the manufacture of radio communications products, systems designs and support activities. Principal products are HF Receivers and Transmitters, Manpack Transceivers and Airborne Direction Finding equipment. Products and systems are sold world-wide.

Average Work Force: Engineers - 35
Technicians - 50
Others - 265

Gross Sales: \$40.0M (Approx)

Plant Size: 122,000 sq ft

Equipment: Rockwell's facility is equipped for all types of electrical and mechanical assembly employing advanced

techniques such as wave soldering, auto insertion for ICs and axial lead components. Product quality is assured by intensive in-process and completed item inspection. Test equipment is maintained and calibrated on regular cycles. Calibration is traceable to the Canadian National and US National Bureau of Standards. Requirements of the Canadian Government DND 1015 and by reciprocal agreement, US MIL-Q-9858A for quality standards are met. A detachment of the Canadian Forces Technical Services Agency is resident at the facility.

Experience: Since its inception as a manufacturing facility in 1955, Collins Canada has been providing UHF/HF equipment and systems to the Canadian Forces, the US military and a wide range of foreign countries. Current products are being supplied to the US Air Force, US Marine Corp, Canadian Forces and foreign countries. Products include military equipment such as the AN/PRC-515 HF Packset, the AN/PRC-75 VHF Packset, the UHF Direction Finder for the F-15 aircraft, and the general purpose DF-301E (OA-8697) VHF/UHF Direction Finder for other aircraft. The commercial line of HF products known as the HF-80 Series is also used in many military applications.

Keywords: 3 = Avionics; 5 = Communications; HF Receivers = 5; HF Transmitters = 5; Manpack Transceivers = 5; Airborne Direction Finding Equipment = 3; Radio Communication Products = 5; Systems Designs = 3, 5; Support Activities = 3, 5; VHF Packset = 5; HF Packset = 5; UHF Direction Finder = 3, 5; VHF/UHF Direction Finder = 3, 5.

Revised: Dec 83

ROLLS-ROYCE (CANADA) Ltd

Code: RRC

Address: 9500 Cote de Liesse Road
P. O. Box 1000
Montreal, Quebec, Canada H4Y 1B7

Contact: Mr. Ken Hartley, Dir, New Programs -
(514) 631-3541

History: Rolls-Royce Canada was founded in 1952 for the production and support of Nene engines powering the Canadian Armed Forces' T-33 trainer aircraft built by Canadair. From that specialized beginning, Rolls-Royce Canada has continually grown and diversified. Still expanding today, Rolls-Royce Canada is a modern broadly-based aero and industrial engine facility. The company is a wholly owned subsidiary of Rolls-Royce Ltd.

Capability: Repair and overhaul has always been and will continue to be the backbone of Rolls-Royce Canada's business. The company has the ability to overhaul the following engines:

Military - Nene; GE T64; R 1820; T56; and DDA 570K.

Civil - Spey; Dart; Viper; and Tyne.

Industrial - Avon; RB211; Spey; DDA 501; and DDA 570K.

A repair engineering group works closely with prime manufacturers and the repair industry to develop and apply new repair techniques and processes. Repairs are carried out in accordance with the original manufacturer's specifications. In addition, Rolls-Royce Canada has developed more than 3000 repair schemes on its own in an effort to increase component lives and to reduce overhaul costs.

A manufacturing facility with state-of-the-art machine tools is currently machining light alloy castings and hard, high temperature steels. The range of materials the center can handle includes titanium and speciality steels, as well as

magnesium and aluminum. The facility is supported by a wide range of equipment and processes. A CADAM graphic installation is used for mechanical design calculations, the preparation of detail drawings, production of NC programs and manufacturing instruction drawings.

Rolls-Royce Canada is the world source for the Industrial Spey and Industrial RB211 gas generators. These aero derivative gas turbines are manufactured to aerospace standards. The company has developed and manufactures the off-engine support systems for both industrial gas turbines.

Average Work Force: Salaried – 270
Hourly – 515
Management – 48

Gross Sales: No Data

Plant Size: 100,000 sq ft (Manufacturing)
15,000 sq ft (Engine Assembly)
150,000 sq ft (Engine Overhaul and Common Support Shops)
170,000 sq ft (Offices & Warehouses)

Equipment: The repair shop contains a wide range of general purpose machine tools to enable turning, milling, jig boring, grinding, and electrical discharge machining to be carried out on a wide range of materials. Welding capabilities include TIG weld, metallic arc resistance, needle arc, torch brazing and vacuum, or inert gas high temperature brazing. Heat treatment includes argon or hydrogen controlled atmosphere, low and high temperature vacuum heat and aluminizing. Metal spray capabilities are thermal spray (powder and wire) including 6P gun and plasma spray; erosion or wear resistant hard coatings; abrasible coatings; thermal barrier (ceramic) coatings and anti-corrosion coatings. Processing capabilities are – non-metallic coatings-rubber wear away and PL95, nickel, chrome, silver, cadmium, copper, SerMetal processing, tin, lead-tin and Tribomet wear resistant coatings; soft anodizing, alodine dichromate surface treatment and phosphating; vapor blasting, dry blasting and shot peening; electroless nickel plating; and aerofoil surface superfinish. Balance includes static/vertical and dynamic/horizontal.

Rolls-Royce Canada operates four diverse engine test facilities capable of testing a wide range of equipment encompassing piston engines, turboprops and turbfans. The company designs and engineers all supporting systems (starting, fuel, lubrication, cooling), equipment (cradles, carts, tooling), safety controls (interlocks, alarms, trips) and instrumentation.

The laboratory presently holds DND approval number 020-2/56 to act as a chemical, metallurgical and mechanical test establishment and offers a wide range of services encompassing tensile testing, hardness testing, metallography, electronic and instrumentation testing and, radiographic and ultrasonic testing.

The manufacturing facility machining capability includes OM2A four-axis, OM80 five-axis, 4-axis CNC jig mill, 3-axis NC jig mill, 2-axis NC mill, Horizontal Cintimatic, Vertical Cintimatic, 48-inch x 36-inch x 72-inch Webster and Bennett VTLs with Tracer, Swedturn CNC Chucker, various lathes and drills. Inspection function supported by Brown and Sharpe Validator Co-ordinate measuring machine and 1,000mm Horstman Rotary/Tilting Table.

Experience: Rolls-Royce Canada is highly export-oriented – over 70% of the company's business is with non-Canadian customers. Although 80% of the customer base is within the continental Americas, Rolls-Royce Canada customers now originate in the Middle and Far East, Europe and approvals can be carried out in accordance with D49-001-24/SF-001.

Quality approval conforms with the following specifications – MIL-Q-9858A, MIL-I-45208, MIL-C-45667, DAR 7-103-S; DOT approval no. 1/58, DND 1015/16/17/19; and CAA A1/2423/47.

Experience is offered in the field of fixture design for the manufacture of complex aero engine components, where accuracy and quality are of paramount importance. Some programs include machining and finishing of industrial RB211 and Spey engine casings; production of AGT 1500 nozzle assemblies for Avco Lycoming; and hot section machining work for marine and aero Tyne engine components.

Keywords: 1 = Aircraft; 12 = Machining; 19 = Testing/Test Equipment; 20 = Miscellaneous; Aluminum Components = 1; Augmentor Wing = 1; Calibration = 19; Castings = 12; CNC Machining = 12; Combustion Research = 19; Component Fabrication = 12; Component Parts = 12; Computer Design/Computer Manufacture = 12; Corrosion Control = 19; Engine Components = 1, 12, 19; Engine Research = 1, 19; Heat Treating = 12; Life Cycle Support = 20; Magnesium = 12; Metal Plating = 12; Non-Destructive Testing = 19; Precision Machining = 12; Repair & Overhaul = 1, 20; Research & Development = 20; Titanium = 12; Tooling Fabrication = 12; Turbine Blade Inspection = 1, 19; Welding = 12; Turbine Engines = 1, 12, 20.

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SCI-TEC INSTRUMENTS Inc

Code: STI

Address: 1526 Fletcher Road
Saskatoon, Saskatchewan, Canada S7M 5M1

Contact: Mr. Richard B Firth, Mgr, Marketing & Contracts – (306) 934-0101

History: Sci-Tec Instruments Inc is a Canadian owned high technology electronics company incorporated in 1981. There are no other Canadian or US facilities.

Capability: Sci-Tec Instruments was established to design, manufacture and market high quality scientific and industrial instrumentation and electronic systems. They can offer a broad range of capabilities in data acquisition, micro-processors, communication, remote sensing, remote control systems, as well as electronic system engineering and instrumentation from the conceptual stage through to delivery of a finished product. Along with the capability of machining components for their products, in-house machining experiences have included a range of intricate, close tolerance machining in satellite low noise amplifier housings, rocket payload extend/retract mechanisms, payload booms and payload prototyping.

The management objectives for the company comprises of continued market penetration for their three main products and diversifying its operations to include US Government solicited contracts in areas of research and development, off-load or subcontract opportunities in the scientific and industrial electronics fields.

Average Work Force: Scientists and Engineers – 4
Others – 11

Gross Sales: 1982 – \$0.6M
1983 – \$0.75M (Projected)
1984 – \$2.0M (Projected)

Plant Size: 7,200 sq ft

Equipment: Sci-Tec Instruments employs the following equipment:

Electronics – Microprocessor development system for development and test of software and hardware. Lab test equipment for the R&D and production testing of

products and prototypes. Optical assembly and alignment facility which includes a laminar air flow bench, lasers and optical benches. Drafting facilities for mechanical, electronic and printed circuit boards.

Machining – CNC Mill/Precision engine lathe and other machine shop facilities to manufacture precision components.

Experience: Sci-Tec's main experience has been its research and development, manufacturing and marketing involvement with its three main products. The "Brewer Ozone Spectrophotometer" was jointly developed by Sci-Tec and the Canadian Government. The Brewer is a highly sophisticated instrument capable of monitoring ozone (O₃) and sulfur dioxide (SO₂) atmospheric overburdens and vertical concentration profiles. In addition, this instrument is presently being used in monitoring the horizontal irradiance in the ultraviolet and has been further developed to provide automatic azimuth and elevation tracking with additional features allowing for unattended operation. The Brewer is sold world wide to various governments, universities and scientific organizations.

The "Cosmos Tracking System" was developed to meet demand for a two-axis, microcomputer controlled point/tracking system. Applications for this device include pointing specialized scientific or industrial instruments at celestial objects and tracking as it moves through the objects' trajectory. Because of the medium load capability (100 lbs maximum), they expect the market to expand in the near future to cover a wide range of industrial, space and military applications.

An exclusive manufacturing and marketing license was secured for the "High Line Data Acquisition System" (HILDA). This instrument is the foremost system for measuring vibration on high voltage (730 kV) transmission lines. The ability of the system to provide remote, unattended measurements over a long time frame is expected to increase utility and maintenance/installation groups' demand for this instrument.

Keywords: 5 = Communications; 7 = Electronics; 9 = Environment; 10 = Image Processing & Optics; 12 = Machining; 17 = Software Services; 18 = Space Systems; 19 = Testing/Test Equipment; 20 = Miscellaneous; PCM Encoders = 5, 7, 18; Telemetry Systems = 5, 7, 17, 18; Data Acquisition Systems = 7, 17, 18, 20; Microprocessor Circuits & Software = 5, 7, 17, 18, 19, 20; Remote Sensing = 5, 7, 9, 17, 18; System Design & Engineering = 5, 7, 9, 10, 17, 18, 19, 20; Instrumentation = 7, 9, 10, 12, 17, 18, 19, 20; Remote Control Systems = 5, 7, 10, 17, 18.

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SCIEX (Division of MDS Health Group Ltd (MDS))

Code: SCI

Address: 55 Glen Cameron Road, Unit 202
Thornhill, Ontario, Canada L3T 1P2

Contact: Dr N M Reid, Marketing VP – (416) 881-4646

History: Sciex was incorporated in 1970 under provincial charter (Ontario). In late 1981, Sciex amalgamated with MDS Health Group Ltd, a Canadian controlled public corporation. In early 1982, an associate company to MDS Ltd, Sciex Inc, was established in Amherst, New York, and will be conducting marketing operations in the US.

Capability: Sciex is engaged in the design, R&D, manufacture, servicing, and marketing of trace chemical analysis

systems, sample inlet systems, ionization modules, and custom designed application software for the industrial, environmental, health, medical, and military markets. The company currently has the world's leading Atmospheric Pressure Chemical Ionization (APCI) research capability. The Trace Chemical Analysis systems, TAGA® 3000 and TAGA® 6000 MS/MS, and the Elemental Analyzer, ELAN® ICP/MS, are the main products of the company. Both TAGA® systems can be fully mobile and are up to 1000 times more sensitive and 1000 times faster than other available systems. The TAGA® 3000 is primarily used for targeted compound analysis, while the TAGA® 6000 MS/MS is used for rapid mixture analysis and structure elucidation, and in many cases avoiding the preparative steps and time delays of chromatographic separation. The ELAN® system is an exceptionally sensitive instrument used for elemental analysis and the determination of isotopic ratios of elements.

Average Work Force: Engineers – 7
PhDs – 12
Systems Analysts – 7
Others – 54

Gross Sales: Confidential

Plant Size: 22,000 sq ft

Equipment: Facilities are geared to specific applications requiring rapid measurement, monitoring or investigation of specific trace components in complex mixtures. Sciex equipment includes:

- Three fully computerized atmospheric pressure ionization mass spectrometers – laboratory based and mobile. The TAGA® 3000 is a single quadrupole MS system. The TAGA® 6000 MS/MS is a triple quadrupole mass spectrometer. Unique features include – detection of compounds at sub-picogram or low parts per trillion level, minimal memory effects which facilitate high sample throughput, high ion transmission, cryogenic pumping, and gas dynamically confined CID target with collision energies to 150 eV. Total system control, data display and manipulation are achieved via the PDP-11/03 or PDP-11/23 DEC computers, with RT-11 (single user) or RSX-11M (multi-user) operating systems. The appropriate peripheral terminal, graphic and hardcopy capabilities are integrated with the system.
- With the mobile unit, trace compounds at any accessible site can be detected, identified and their concentrations measured. The extent of environmental air contamination can be plotted throughout an area rapidly to pinpoint sources of contamination.
- Elemental Analysis Laboratory, equipped with the computerized ELAN® instrument and preparative wet chemistry laboratory. The ELAN® is a hybrid instrument incorporating an Inductively Coupled Plasma ion source interfaced to a computer-controlled mass spectrometer. The ELAN® permits the determination of elemental composition at the part-per-billion level in complex sample matrices as well as the measurement of isotopic ratios.
- Good design capability and reliability backed up by a team of skilled professionals able to provide application-oriented hardware, software and methodology development.
- In-depth customer training and comprehensive documentation.
- Toxic Chemical Laboratory capable of handling hazardous and carcinogenic compounds.
- Analytical facilities – expertise in the field of gas chromatographic column technology enables preparation of both packed and open tubular capillary columns.

- Organic Laboratory.
- Electronic Circuitry Development Laboratory.
- Product testing facilities – experienced in testing vacuum systems involving cryogenics and ultra high vacuum.
- Effective working arrangement with the Aerospace Institute Laboratory of the University of Toronto. Work is carried out in this laboratory on fundamental questions pertinent to TAGA® and ELAN® developments.

Experience: Sciex sales of TAGA® 3000 and TAGA® 6000 MS/MS systems on an international basis include IBM, Xerox Corp, US Customs, National Research Council of Canada, Battelle (Edgewood Arsenal), Defense Research Establishment Valcartier, Defense Research Establishment Suffield, General Electric/New York State Environment, Ministry of Environment (Ontario), Ministry of Defense (UK), US Army Natick laboratories, and TRC Advanced Analytics.

Since the introduction of the ELAN® in March 1983, sales have been confirmed to the University of Alberta, National Research Council of Canada, XRAL Ltd, Geological Survey of Canada, Geological Survey of Ontario, Agriculture Canada, Ontario Ministry of the Environment, Eagle Pitcher Ltd (US), and the US Geological Survey (Denver).

The company has developed methods for real-time detection of explosives, illicit drugs, and CW agents in the parts-per-trillion range. In addition, Sciex has participated in special consulting studies including those dealing with pre-collected sampling systems in the field or workspace.

The company received the 1978 Canada Enterprise Award. In 1980, Sciex received an IR-100 Award for developing the TAGA® 3000 as one of the 100 most significant technical products in 1979.

Keywords: 4 = Chemistry; 6 = Computers; 7 = Electronics; 9 = Environment; 16 = Security & Safety; 20 = Miscellaneous; Mass Spectrometry = 4, 9, 16; Research & Development = 6, 7; Ion Physics = 9, 20; Ion Molecule Chemistry = 4; Contract Research = 4, 7, 9; Computer Design = 6; Fluid Dynamics = 20; Vacuum Technology = 20; Ultra-Trace Analysis = 4, 9, 20; Electronics Design = 7; Instruments = 4; Testing = 9; Mobile & Laboratory Based Analytical Services = 4, 9, 20; Product Characterization = 4; Quality Assurance = 20; Professional Services = 4, 6, 7, 9, 16, 20; Toxic Agent Detection = 9, 16; CW Agent Detection = 9, 16, 20; Explosives Detection = 16; Drugs Detection = 20; Trace Gas Detection = 9; Chemical Agent Detection = 9, 16, 20.

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SCINTREX Ltd

Code: SCX

Address: 222 Snidercroft Road
Concord, Ontario, Canada L4K 1B5

Contact: Dr. H Seigel, President – (416) 669-2280

History: Scintrex Ltd began as Sharpe Instruments Ltd in 1947 and was incorporated as Scintrex Ltd, a public Canadian owned company, in 1967.

Scintrex Defense Products Division is a supplier to the US DOD of high sensitivity portable (Mark 22) magnetometers for explosive ordnance detection. In addition, it supplies area radiation monitors (AN-GDQ-3) for the determination and transmission of the level of nuclear radiation around strategic locations. Similar military-specification radiation monitors are

being developed for mobile applications (ship and aircraft installations). An explosives vapor detector (bomb sniffer) has been developed in conjunction with the National Research Council of Canada and will be available in 1984 for defense against acts of terrorism. The potential application of laser-based, active remote sensing methods to certain defense problems is now being investigated.

Capability: The Contract Instrumentation Division of Scintrex began developing monitoring instrumentation in 1974 for CANDU nuclear power plants. Since then, the company has manufactured tritium monitors, reactivity control logic cabinets, shut-off rod logic modules, high radiation hand-held monitors and logic panels for safety shut-down systems. CANDU reactor operators in Ontario, Quebec, New Brunswick, Korea, and Argentina use this equipment.

The Exploration and Analytical Equipment Division of Scintrex is a major part of its business. It includes the design, development and manufacture of geophysical and geochemical instruments for the mining industry, and analytical instruments for chemical laboratories. Over the years, geophysics has become the key exploration tool for discovering new mineral deposits. The steady depletion of surface ore bodies and consequent need to detect buried deposits have produced a growing dependence on geophysical methods. Scintrex is a leader in the design, development and manufacture of mining exploration equipment. Its products, services and skills have contributed directly to numerous major mineral discoveries in different parts of the world. Out of this experience, there is an expertise in developing portable analytical equipment for remote, on site chemical analyses.

The Systems Engineering Group of Scintrex is highly experienced in the installation of sensing systems in aircraft, helicopters and vehicles for mobile applications. Many magnetic, electromagnetic, radiometric and laser installations have been made, operated and serviced.

Average Work Force: Electronic Engineers – 14
Mechanical Engineers – 2
Chemists – 4
Geophysicists – 4
Physicists – 4
Technicians – 50
Machinists – 20
Sales, Office Staff & Others – 101

Gross Sales: 1979 – \$ 9.0M
1980 – \$11.2M
1981 – \$12.5M
1982 – \$14.8M
1983 – \$ 9.1M

Plant Size: 46,000 sq ft (additional 20,000 sq ft projected)

Experience: Scintrex has had experience with the US Army and Navy (contracted to build nuclear radiation monitoring systems and explosive ordnance detectors); Ontario Hydro (contracted to supply hand-held radiation dosimeters for nuclear power plants); and other CANDU reactor users (contracted to build a variety of radiation monitoring devices).

Keywords: 4 = Chemistry; 7 = Electronics; 8 = Energy; 9 = Environment; 14 = Protective Equipment; Radiation Monitoring Systems = 9, 14; Dosimeters = 9, 14; Tritium Monitors = 9, 14; Gamma Ray Monitors = 9, 14; Beta Ray Monitors = 9, 14; Geophysical Equipment = 8; Electromagnetics = 7, 8; Magnetic = 8; Gravity = 8; Geochemical Equipment = 8; Atomic Absorption Spectrophotometers = 4, 9; Ultraviolet Fluorescence Systems = 4, 9; Toxic Gas Detectors = 9; Hazardous Gas Detectors = 9; Remote Sensing = 9; Ordnance Detectors = 4, 9, 14; Trace Gas Detection = 9.

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SEAGOLD INDUSTRIES Corp

Code: SEA

Address: 4008 Myrtle St
Burnaby, British Columbia, Canada V5C 4G2

Contact: Mr. John L Richardson, President and CEO - (604) 437-4445
Mr. John C Bowyer, Controller & Manager of Admin - (604) 437-4445

History: Seagold was formed in 1978 to carry out research related to reverse osmosis desalination. TDC Technology Development Corp acquired controlling interest in Seagold Industries Corp in 1979. The company began commercial production in 1981.

Capability: Seagold manufactures a full line of reverse osmosis desalinators from a hand operated unit for emergency use in life-rafts, to motorized desalination systems for making up to 100,000 gallons of fresh water per day from sea water or brackish water.

Average Work Force: Engineers - 7-10
Others - 5-10

Gross Sales: 1982/1983 - \$0.7M
1983/1984 - \$1.5M (Projected)

Plant Size: 7,500 sq ft

Equipment: Precision machine shop; Recirculating seawater test-bed system; and Analytical laboratory.

Experience: Seagold Industries Corp has supplied a broad range of units for various applications to various commercial, governmental and individual customers world-wide. These customers include the US Army (MERADCOM), US Navy, Canadian Coast Guard & Canadian Navy.

Keywords: 9 = Environment; 16 = Security & Safety; Reverse Osmosis = 9; Desalination = 9, 16; Evaporators = 9; Distillers = 9; Pumps = 9; Seawater = 9; Water Makers = 9.

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SED SYSTEMS Inc

Code: SED

Address: P. O. Box 1464
Saskatoon, Saskatchewan, Canada S7K 3P7

Contact: Mr. D H Kjosness, Vice President - (306) 244-0976

History: SED Systems Inc is a high technology systems engineering and production company located in Saskatoon, Saskatchewan, Canada. They evolved from the Space Engineering Division of the University of Saskatchewan. Originally, their activities consisted of the design and construction of rocket payloads for upper atmospheric research. Since their incorporation as a private company, SED has pursued a development policy which has led them increasingly into commercial markets with innovative products derived from aerospace technology. SED was incorporated in 1972.

Capability: SED supplies products and services to three principal markets - aerospace, communications, and agricultural instrumentation. They are organized along functional lines as follows:

- Advanced Systems Engineering Division (i.e. projects)
- Products Division

SED also has a wholly owned research subsidiary, SED Research Ltd. These groups are coordinated by a centralized corporate office. The major products and services offered in each area are:

Projects - Communications systems engineering, custom satellite communications earth stations, complete satellite telemetry tracking and command earth stations, satellite ground control equipment, customized telemetry and tracking systems, sounding rocket payloads, and scientific instrumentation for use on the space shuttle.

Products - TV satellite (cable, quality) receivers, TVRO systems and other microwave components, sub-systems for satellite earth stations, and agricultural instrumentation.

Diversification is one of SED's major strengths. A careful assessment of the range of the company's products and services demonstrates that they are based on a relatively narrow range of technologies that have been developed in depth. The specific technologies are highly complementary which allows the penetration of highly diversified markets with innovative products resulting from knowledge acquired in other fields. Complementary technologies have also strengthened SED by permitting staff mobility in response to market fluctuations and to facilitate employee development.

Average Work Force: Professional - 90
Technical - 210

Gross Sales: No Data

Plant Size: 76,000 sq ft

Equipment: SED has a variety of specialized facilities including - precision machine shop and chassis fabrication facility; metal finishing and painting shop; computer systems, earth stations and payload integration facilities; microwave clean room; and a medium volume PCB production facility.

Experience: SED experience in the space and defense areas include:

Space:

Payloads - Sounding rocket and balloon payloads (1965-present) (produced over 60, Canadian National Research Council); and Firewheel sub-satellite (1980 launch on Ariane), NRC (Max Planck Institute - Germany).

Mission Planning and Support - Communications Technology Satellite - CTS or Hermes (1970-1976) [planned attitude acquisition phase, designed ground control station and developed software, Canadian Department of Communication (DOC)].

Satellite Telemetry, Tracking and Command Stations - ANIK A (TAC station for A2 (1972), Telesat Canada); ANIK C/ANIK D (transportable tracking station - located in Guam (1982), Hughes Aircraft Co); and LAND-SAT/GOES (1972-present) [Canadian tracking station, Canadian Center for Remote Sensing (CCRS)]; and Brazil Telecommunications Satellite System Satellite Control Facility (1982-1985).

Ground Control Equipment - ANIK C, ANIK D, and SBS (1978-1982) (variety of equipment (50) including command generators and upconverters and telemetry displays, Hughes Aircraft Co).

Communications Earth Terminals - A wide variety of over 200 terminals including low cost 4 and 12 GHz TV receive only, and 2 way fixed and transportable terminals (4/6 and 12/14 GHz) (1974-present).

Satellite Systems Test Sets – ANIK C/SBS (12/14 GHz computerized payload test and integration support unit, Hughes Aircraft Co, and DOC); and ANIK D – 4/6 GHz (as for ANIK C, SPAR Aerospace and DOC) (1978-1981).

Defense:

Digital Switches – NORAD Joint surveillance System (1979-1981) (digital switches to handle up to 84 channels of digitized radar data, Hughes Aircraft Co); and *Miscellaneous Digital Switches* (1981-present) (as for JSS above, Hughes Aircraft Co).

Satellite Control Centers – SARSAT Canadian Mission Control Center (1981-1982) (installed at Trenton, Ontario as part of Canada's contribution to the international Search and Rescue Satellite (SARSAT) Program, provides control and monitoring capability for the entire Canadian SARSAT system, Department of National Defense).

Tracking Systems – Air Defense Aerial Target Tracking System (1981-present) (developing a tracking antenna, telemetry receiving system for use with target drones at the Defense Research Establishment Suffield in Alberta, Department of National Defense).

Communications Systems – Project Eureka (1981-1983) (designed, developed and installed a full, 2-way satellite communications ground system in Ottawa and Eureka to provide a data link for the DND (Project Hurricane), and Telesat Canada).

SED is the system designer and the system integration manager for the external and miscellaneous interior communications systems, and the meteorological systems for the six new Canadian Patrol Frigates for PARAMAX Electronics (a subsidiary of Sperry) (1983-Present).

Keywords: 5 = Communications; 6 = Computers; 7 = Electronics; 9 = Environment; 15 = Radar; 17 = Software Services; 18 = Space Systems; Ground Stations = 7; Telephone Communications = 5; 15; Design to Requirements = 17; Simulations Programs = 17; Communications Systems = 18; Instrumentation = 18; Systems Studies = 18; Satellite Communications Ground Stations = 18; Satellite Telemetry Tracking Stations = 18; Ground Control Equipment = 18; Payload Design = 18; Payload Test Services = 18; Computer Systems = 6; Digital Switches = 15; Aerial Target Tracking System = 1.

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SHARP SPECIAL SYSTEMS (Ottawa) I.P. SHARP ASSOCIATES Ltd

Code: IPS

Address: 265 Carling Ave, Suite #600
Ottawa, Ontario, Canada K1S 2E1

Contact: Mr. W W Bradbury, Mgr, Special Systems (Ottawa)
– (613) 236-9942

History: I. P. Sharp Associates Ltd is a Canadian owned company incorporated in 1964. The corporate headquarters is located in Toronto. Sharp Special Systems is a division of I. P. Sharp that began operation in 1973. All of the company's minicomputer-related activities are amalgamated in the division. Wholly owned subsidiaries of this Canadian company are located in Australia, Austria, Belgium, Denmark, France, the Far East, Germany, Italy, Mexico, The Netherlands, Norway, Sweden, Switzerland, the UK, and the US. The company has twelve Canadian locations in six provinces. There are nineteen US locations in twelve states and Washington, DC.

Capability: I. P. Sharp is a computer software company specializing in – (1) Provision of timesharing service called SHARP APL; (2) Development of software to handle projects ranging from large database applications to small real-time monitor and control systems; and (3) Research and development of software tools to aid in the production of trusted systems.

SHARP APL is offered in both interactive and batch modes and can be used at your own premises, using a variety of terminals, via a telephone connection. Each user has 256 kilobyte work-space that may contain both functions and data. Any number of work-spaces may be stored on disk for later retrieval. The file system is based on the principles of shared direct access and total security.

Development of turnkey computer systems now represents the major portion of the Special Systems activities. However, they continue to offer a wide range of services, including:

- Project Management
- Facilities Management
- Feasibility Studies
- System Specification and Design
- Hardware Evaluation, Selection and Acquisition
- Design and Selection of Communications Facilities
- System Operational Audits
- Contract Programming
- Complete Turnkey systems

Average Work Force: Total – 400 (Professionals plus Support Staff)

Gross Sales: 1980 – \$24M
1981 – \$35M
1982 – \$50M

Plant Size: 10,000 sq ft (Special Systems Office Space – all locations)

Equipment: Amdahl 480V8; 1 x IBM 3081-D; 2 x VAX 11/750; 1 x VAX 11/780; and n x PDP 11/34.

Experience: I. P. Sharp has experience in the following areas:

Timesharing – Using SHARP APL, many multi-national companies and governments access private and public data bases in Socio/Economic, Financial, Commodities, Airline Schedules, and Natural Resources.

Process Monitoring and Control – Warehouse Automation System for Liquor Distribution Center; Mail Handling Systems for Canada Post Office; Plant Monitoring System for General Electric Company; Process Monitoring Systems for Atomic Energy of Canada; Radar Control for Canadian Department of National Defense; and Command and Control System for Canadian Department of National Defense.

Real-Time Information Display – Operational Information Display System for airports administered by Canadian Ministry of Transport; MAX-PAK, a micro film information system developed for Illinois State Police; Aviation Communication Measurement System, an airborne communications monitor for Canadian Ministry of Transport; Schipol Airport Information System for the Amsterdam airport; and Computer Aided Dispatch and Records Entry for Police and Fire Departments.

Communications – The SHARPnet, designed and built by I. P. Sharp Associates Ltd to facilitate access to SHARP APL; and X.25 compatible front-end processors and Network Interface Machines for Canadian Department of National Defense.

Research and Development – Specification of trusted Database Management Systems for USAF project Guardian; Implementation of Euclid compiler jointly

funded by the US Defense Advanced Research Projects Agency (DARPA) and Canadian Department of National Defense; Front End Security Monitor for Canadian Department of National Defense; Formal Verification Methodology for Canadian Department of National Defense; and Integrated Verification System for the US Navy.

Keywords: 5 = Communications; 6 = Computers; 7 = Electronics; 16 = Security & Safety; 17 = Software Services; 20 = Miscellaneous; Facility Management = 20; Data Acquisition = 17; Data Processing = 17; Design to Requirements = 17; Graphics = 17; Displays = 17; Computer Security = 16; Measurement & Control Systems = 7; Timesharing Service = 17; Real-Time Monitor Systems = 17; Real-Time Control Systems = 17; Turnkey Computer System = 6, 17; Project Management = 6, 17; Feasibility Studies = 6, 17; System Specification = 6, 17; System Design = 6, 17; Hardware Evaluation = 6; Radar Control Systems = 6, 17; Command & Control Systems = 6, 17; Information Displays = 17; Interface Systems = 5.

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SHERRITT GORDON MINES Ltd

Code: SGM

Address: Fort Saskatchewan, Alberta, Canada T8L 2P2

Contact: Mr. Herbert Veltman, Dir, Sherritt Research Center - (403) 998-6432

History: Sherritt is a highly diversified company with a US subsidiary located in Portland, Oregon (Sherritt Fertilizers Inc). Sherritt was incorporated in 1927 as a mining company. In 1954, their processing plant at Fort Saskatchewan was opened. Located at this latter site is the Sherritt Research Center which is their R&D arm.

Capability: Besides mining copper, zinc & precious metals, and refining nickel & cobalt, Sherritt Gordon carries out R&D at their Research Center in the area of powder metallurgy. Also at Ft Saskatchewan, Sherritt has their Fabricated Metal Products Division which manufactures a wide range of secondary products based on Sherritt's raw materials and technology. These products include a wide range of special powders and composite powders, dispersion strengthened nickel, magnetic alloys and wear resistant materials. Sherritt is active in developing dispersion strengthened alloys and abrasible seals for turbine engines. They have recently expanded their research activities to include rare earth cobalt magnets, wear resistant materials, and ultra fine metal powders.

During 1983, Sherritt's research and development work continued in three areas and several new products reached commercial production - notably composite powders for turbine seals, and wear resistant materials for the mining industry.

Average Work Force: Total (Research) - 91
PhDs - 13
MSs - 3
BSs - 21
Others - 54

Gross Sales: (R&D Only)
1980 - \$3.5M
1981 - \$2.8M
1982 - \$2.8M
1983 - \$4.5M

Equipment: Sherritt's Research Center is well equipped for process research in hydrometallurgy and product research. This includes autoclaves, solvent extraction and ion exchange equipment, standard chemical laboratory equipment, and an

analytical laboratory. Also included are powder presses, sintering furnaces, rolling mills, vacuum induction melting equipment, and flame & plasma spray guns. Physical testing equipment includes tensile testing, stress rupture, wear resistance, metallography, transmission and scanning electron microscopes, electron microprobe, and x-ray diffraction.

Experience: A large portion of Sherritt's total metal sales go to the US which includes fabricated metal products, such as dispersion strengthened nickel and composite powders for turbine engines. The products, which may be used in military aircraft, are sold to engine manufacturers. Sherritt is interested in doing business with the USAF when the research area is consistent with their research objectives. Research and development projects have been carried under USAF contracts in the late 1960s and early 1970s. These contracts were in the area of dispersion strengthened nickel-chromium alloys. The research specifically dealt with improved oxidation resistance and mechanical properties.

Keywords: 1 = Aircraft; 4 = Chemistry; 12 = Machining; 20 = Miscellaneous; Engine Components = 1; Engine Systems = 1; Powder Metallurgy = 4, 12; Precision Casting = 12; Specialty Alloys = 4, 12; Dispersion Strength Alloys = 1, 4, 12; Alloys = 1, 4, 12; Abradable Seals = 1, 4, 12; Rare Earth Magnets = 20; Wear Resistant Materials = 1, 4; Continuous Casting = 12; Cobalt-Samarium Magnets = 20; Thermal Spraying = 1, 4; Magnets = 20; Casting = 12; Ultra Fine Metal Powders = 4; Metal Powders = 4.

Revised: Dec 83

SIMMONDS PRECISION CANADA Ltd

Code: SPC

Address: 2752 Slough St
Mississauga, Ontario, Canada L4T 1G3

Contact: Mr. Andrew Byrne, GM, Product Support Center - (416) 678-7430

History: Simmonds Precision Canada Ltd is a wholly owned subsidiary of Simmonds Precision Products Inc of Tarrytown, NY. The company has been in Canada since 1947 and has been at the current location since 1975.

Capability: Simmonds Precision Canada Ltd is the repair and overhaul center for most Simmonds products in Canada. This includes fuel quantity gauging systems, ignition exciters, torque indicators and, in 1984, actuators.

Average Work Force: Engineer - 1
Others - 4

Gross Sales: No Data

Plant Size: 5,000 sq ft

Equipment: Test equipment for electronic and electro-mechanical equipment.

Experience: Present customers include most Canadian airlines, many Canadian business aircraft operators, and Canadian Departments of Supply & Services and National Defense.

Keywords: 3 = Avionics; 7 = Electronics; 19 = Testing/Test Equipment; Repair & Overhaul = 3, 7; Instrument Repair = 3, 7; Fault Diagnosis = 3, 7; Testing/Test Equipment = 19.

Revised: Dec 83

SIMTRON Ltd

Code: SIM

Address: 494 The Queensway, Unit #1
Peterborough, Ontario, Canada K9J 7L9

Contact: Mr. W Czechowski – Contracts – (705) 743-6903

History: Simtron Ltd was formed in 1976 to design, manufacture and service electronic products for the communications, air, maritime and ground transportation markets. In 1982, Simtron Ltd was acquired by Dowty Equipment of Canada Ltd. Dowty specializes in the design, development, manufacturing, certifications testing and overhaul of landing gear, flight control systems and related aerospace and marine equipment.

Capability: Simtron's activities are divided into three major areas:

Aerospace – The design and manufacture of aircraft subsystems and black boxes. This is typified by the microprocessor-based "steer-by-wire" equipment presently in production for the standard equipment on the Canadair Challenger 601, and the deHavilland Dash 8 aircraft. Simtron is approved to DND-1016 levels which have direct equivalency to MIL-Q-9858.

Multiplex Alarm Systems – Simtron has developed a data acquisition system called Multiplex 490 alarm system that represents a major improvement over existing equipment in the market place. Systems are now installed and working in several major Canadian locations. Ongoing R&D and development activities are proceeding on this equipment.

Build to Print – Simtron is engaged in building-to-print for a number of large corporations. Built products include printed circuit board assembly, wire harnessing, cabinet assembly, test equipment and testing. The in-house engineering capability enables Simtron to offer redesign and substitution services on subcontract work.

Average Work Force: R&D – 3
Engineers – 2
Technicians – 1
Production – 59
Others – 9

Gross Sales: 1980 – \$0.69M
1981 – \$0.81M
1982 – \$1.24M
1983 – \$2.50M

Plant Size: 10,000 sq ft (capability to expand to 25,000 sq ft)

Experience: See Capability Section.

Keywords: 1 = Aircraft; 7 = Electronics; 19 = Testing/Test Equipment; Landing Gear Steering Systems = 1; Steer By Wire Systems = 1; Data Acquisition = 7; Build To Print = 7; PC Board Fabrication = 7; Test Equipment = 19; Specialized Test Equipment = 19; Wiring Harness Fabrication = 7; Cabinets = 7; Cabinet Testing = 7, 19.

Revised: Dec 83

SLACAN Division of Slater Steel Industries Ltd

Code: SLA

Address: 681 King St W
Hamilton, Ontario, Canada L8N 3E7

Contact: Mr. Wendell MacDonald, Manager OEM Sales – (416) 528-8888

History: Slacan was incorporated in the Province of Ontario in 1962.

Capability: Slacan is an operating division of Slater Steel Industries Ltd with its head office and manufacturing facilities located in Hamilton, Ontario. They are the largest Pole Line Hardware manufacturer in Canada, providing more than 2,000 different items for the electrical, transmission and communications markets. The division's product lines are engineering orientated. They claim a reputation for excellence of design, high quality of manufacture, and long service in the field. Their business areas of interest are – aluminum castings, steel forgings, and steel stampings. They operate under quality control levels outlined in CSA Z299.3 and under Military Specifications MIL-C-6021, Class 2A, 2B Grade B and D for castings. Specific capabilities are outlined below:

Aluminum Castings – permanent mold up to 50 pounds; sand mold up to 150 pounds; Feron, CO₂ and shell cores; and material poured 125, 135, 234, 432, 6377, Almag 35, B226, A357, etc. Reference: All aluminum castings for the ballistic fire control computer developed by Computing Devices for the US Army M-1 main battle tank.

Stampings/Steel – a total of 85 units comprised of open back inclines to 135 ton capacity, straight sided single action presses to 200 ton capacity, double acting deep draw to 300 ton punch and 200 ton blank holder capacity, hydraulic brakes to 400 ton capacity with 14 ft bed including 2 ft horn. The above equipped with air clutches, brakes and cushions.

Average Work Force: Total – 250

Gross Sales: No Data

Plant Size: 190,000 sq ft (manufacturing area)

Equipment: Slacan maintains the following equipment:

Forging Equipment – Four board hammers up to 2,000 pounds capacity; One electro-hydraulic hammer 4,000 pounds capacity; One forging press 700 tons capacity; Three hot headers 2" capacity; One hot header 1.5" capacity; and various trim presses and furnaces.

Finishing Equipment – Machining limited, however, includes milling, turning, drilling, threading and tapping. Other facilities include welding, cleaning, painting, hot dip galvanizing, heat-treating (Steel and Aluminum), and tool engineering.

Experience: No specific information was given on experience except for Slacan's work with Computing Devices Co (Aluminum castings for the ballistic fire control computer for the M-1 main battle Tank). Customers include private industries in the US and Canada.

Keywords: 12 = Machining; Castings = 12, Aluminum Castings = 12; Stamping = 12; Steel Stampings = 12; Forgings = 12; Steel Forgings = 12.

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SPARTON OF CANADA Ltd

Code: SOC

Address: P. O. Box 5125, Terminal A
100 Elm St
London, Ontario, Canada N6A 4N2

Contact: Mr. Lawrence R Staszak, President & General Mgr
- (519) 455-6320

History: Sparton, incorporated under Federal charter in 1930, is a wholly owned subsidiary of Sparton Corp, Jackson, MI.

Capability: Sparton specializes in the development, engineering, and manufacture of specialized electronic products for the military, industrial, and Original Equipment Manufacture (OEM) markets. Their R&D activities include development of a directional command active sonobuoy, new improved low noise passive sonobuoys, line array sonobuoys, depth-compensated ring shell acoustic projectors, and switch-mode electronic power supplies.

Sparton's Engineering Department staff covers professional disciplines of electrical/electronic engineering, mechanical engineering, physics, hydro-dynamics, and hydroacoustics. They are experienced in the preparation and management of engineering projects from proposal through to implementation (development, specifications, testing, and production).

Sparton of Canada Ltd is a qualified producer meeting the requirements of DND 1015 and US MIL-Q-9858A Quality Assurance Programs. There is a resident military QC detachment on the premises. Sparton is cleared by DSS Industrial Security for projects up to SECRET classification. Current product lines are active and passive sonobuoys for military customers, and switch mode and linear power supplies for large and small computer systems.

Average Work Force: Production - 150/200
Engineering Dept:
PhD - 2
MSc - 5
BSc - 10
Tech - 18
Others - 7

Gross Sales: No Data

Plant Size: 170,000 sq ft

Equipment: Sparton's engineering facilities include fully equipped laboratories, hydrodynamic test tank, RF shielded rooms, computer terminal access to a wide range of engineering software including FF2E, SPICE and OSCAR; and two IBM 370 systems and two Perkin Elmer Corporate computers.

Experience: Sparton is a supplier of passive sonobuoys to the Canadian Government; Range Only (RO) active sonobuoys (AN/SSQ-47B/522) to the Canadian Government, to the US Navy, and to other overseas users; OEM supplier of various types of regulated power supplies to Canadian manufacturers; responsible for the development of the Canadian Command Active Sonobuoy System for the Canadian Government; is now in advanced development of the Directional Canadian Command Active Sonobuoy (DICANCAS) for the Canadian Government; and is also manufacturing heavy duty depth compensated underwater Ring Shell Sound Projectors. Applications for the latter device are anti-submarine warfare (ASW) crew training, dipping sonar, and scientific investigations of ocean sound propagation characteristics or sound detection systems.

Keywords: 6 = Computers; 7 = Electronics;
20 = Miscellaneous; Sonobuoys = 7, 20; Hydrophones = 7, 20; Power Supplies = 6, 7; Active Sonobuoys = 7, 20; Passive Sonobuoys = 7, 20; Command Active Sonobuoys = 7, 20; Underwater Ring Shell Sound Projectors = 7, 20; Acoustic Sensing = 7; Environmental Sensors = 7; Geophysics = 7; ASW = 20.

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SPAR AEROSPACE Ltd

Code: SPA

Address: Executive Offices
Royal Bank Plaza, South Tower
P. O. Box 83
Toronto, Ontario, Canada M5J 2J2

Corporate Office
6303 Airport Road, Suite #403
Mississauga, Ontario, Canada L4V 1R8

*Government Relations Office
77 Metcalfe St, Suite #200
Ottawa, Ontario, Canada K1P 5L6

Satellite and Aerospace Systems Division
Communications Systems Division
21025 Trans-Canada Highway
Ste-Anne-de-Bellevue, Quebec, Canada
H9X 3R2

Remote Manipulator Systems Division
1700 Ormont Drive
Weston, Ontario, Canada M9L 2W7

Defense Systems Division
4100 Weston Road (Location)
Weston, Ontario, Canada M9L 1W7
P. O. Box 13050 (Mailing)
Kanata, Ontario, Canada K2K 1X3

Gears & Transmissions Division
Aviation Services Division
825 Caledonia Road
Toronto, Ontario, Canada M6B 3X8

The Copter Shop
1190 McTavish Road, Northeast
Calgary, Alberta, Canada T2E 7G6

Subsidiaries:

Astro Research Corporation
6390 Cindy Land
Carpinteria, California 93013

Northway-Gestalt Corporation
1450 O'Connor Drive
Toronto, Ontario, Canada M4B 2V2

Contact: *Mr. B R Machum, Dir, Gov't Relations & Mkg Support - (613) 563-0230

History: Spar commenced operations as a public company in January 1968, following the acquisition of the Special Products and Applied Research (SPAR) Division of The de Havilland Aircraft of Canada Ltd. The company developed by internal growth and through acquisitions including:

- 1969 - The assets of York Gears Ltd
- 1972 - Astro Research Corporation of California
- 1977 - The assets of the Government and Commercial Systems Division of RCA Ltd and certain assets of the space electronics manufacturing unit of Northern Telecom Ltd
- 1978 - The Copter Shop of Calgary, Alberta, Canada
- 1980 - Northway-Gestalt Corporation

Capability: Spar Aerospace Ltd is a Canadian owned company engaged in the design, development, manufacture and servicing of systems and products for the space, communications, defense, gears and transmissions, aviation and mapping markets. The company employs about 600 engineers and technicians, one of the largest technological groups in the private sector in Canada.

In sixteen years of growth, Spar has gained international recognition as a diversified technology company and has achieved financial stability by balancing the steady sales base of its gears and transmissions and aviation services operations with businesses serving the fast-growing markets of space and communications. Spar's areas of expertise are outlined below:

- *Space* – Spar's facility in Ste-Anne-de-Bellevue near Montreal is the principal supplier in Canada and a major international manufacturer of satellite communications systems, including satellites and satellite subsystems.

Spar and its predecessor companies have contributed to the design and manufacture of 50 satellites and subsystems, including the fabrication of structures and payloads for all the Canadian and many international satellites. The company's contract from Telesat Canada in 1979 to supply two 24-channel *Anik D* communications satellites was the first such prime contract to be granted to a Canadian company. *Anik D1* was successfully launched in August 1982 and *Anik D2* is scheduled for launching in 1984.

In 1982, Spar was awarded a prime contract to provide two satellites and a related ground control system for EMBRATEL, the Brazilian government-owned telecommunications company. The project known as Sistema Brasileiro de Telecomunicacoes por Satellite (SBTS) is scheduled to be completed in 1985. This is the largest satellite contract won by Spar and will be the first domestic communications satellite system in Latin America. In addition, Spar is working on the following major communications satellite projects – Intelsat VI; G-STAR; Olympus; and MSAT.

A major project being completed at Spar is the production of the Remote Manipulator Systems (RMSs) for the US Space Transportation System. This contract awarded in 1979 calls for the delivery of three systems to the National Aeronautics and Space Administration (NASA) through 1984. Canadarm, the original RMS, was successfully tested for the first time on the Space Shuttle "Columbia" in November 1981 and continues to perform flawlessly on space flights. It was produced in Canada under the agreement between the National Research Council of Canada (NRCC) and NASA. Spar was the prime contractor to NRCC for the design, development and manufacture of this flight system.

Since 1980, Spar has been working on a contract from Ontario Hydro to design a remote manipulator and control system to replace and repair fuel tubes in nuclear reactors. In addition, Spar, Ontario Hydro and the Canadian Fusion Fuels Technology Program are engaged in the concept definition stage of a project to apply remote manipulator technology to the Tokamak fusion reactor project in Princeton, NJ.

Spar's subsidiary Astro Research Corporation, designs and develops lightweight deployable structures for space and ground applications. These include the patented STEM antenna product line and Astromast deployable structures used in many spacecraft to deploy antennas, experiments and solar arrays.

- *Communications* – Spar designs and manufactures satellite earth stations and related projects. The development of its newest product – the Time Division Multiple Access/Digital Speech Interpolation (TDMA/DSI) equipment was largely completed during 1983 and the first terminal will be delivered to Teleglobe Canada in 1984. The system is now being offered in international markets.

SPARCOM, the company's low cost telephony satellite earth terminal developed in conjunction with the Department of Communications, offers unique advantages to users in remote locations and in private networks. The company is working on a SPARCOM and FM-SCPC program with Maritime Telegraph and Telephone and Newfoundland Telephone to improve communications with oil rigs operating off the east coast of Canada.

Spar has signed a multi-year joint development and technology transfer program with the People's Republic of China.

- *Defense* – Spar develops electro-optical defense products, builds electronic assemblies for satellites, and manufactures combat equipment for the Canadian Armed Forces. It also provides technical support to the Forces, particularly systems engineering. Facilities include a manufacturing plant, optical, electronics and systems laboratories, and a dedicated computer for developing military software and the real-time processing and display of complex optical data.

Spar is a leader in the field of remote heat sensing technology, having worked for 16 years to develop the unique ANISAR 8 infrared surveillance system for the passive detection of ships, missiles and aircraft for defense and navigation purposes. Following successful trials of the system by the Canadian and US Navies, a project agreement was signed by the two governments in 1983 to undertake, on a joint basis, the final development of this equipment.

Spar has been selected by Hollandse Signaalapparaten B.V., the Netherlands, to manufacture and support fire control or other equipment that may be selected for the new Canadian Patrol Frigate.

- *Gears and Transmissions* – Spar is an industry leader in the production of high precision aerospace gears and transmissions. The company manufactures and assembles lightweight, high-speed, high-torque power transmission systems and equipment for gas turbine engines and fixed and rotary wing aircraft. This facility also manufactures, assembles and tests the joints of the RMS.

In 1982, Spar signed an initial contract with Sikorsky Aircraft to produce the main, intermediate and tail gearboxes for the Sikorsky H-60 series helicopter. Under this agreement, Sikorsky has options to purchase additional hardware which, if fully exercised, will provide Spar with more than a dozen years of gear production. As well, the company manufactures the tail rotor, intermediate gearboxes and main rotor shafts for the Sikorsky S-76 commercial helicopter.

In 1983, General Electric Company awarded Spar six contracts for follow-on production of accessory gearboxes and other components for engines that power turboshaft helicopters and turboprop and turbojet aircraft. Spar produces accessory gearboxes for General Electric's J85-21 turbojet engine (used in the F-5E/F aircraft), the T700 turboshaft engine (used in the Black Hawk, Sea Hawk, Advanced Attack, and Bell 214ST helicopters), and the CT7 turboprop engine variants. Engine gearboxes are supplied for General Electric's new J79-17X engine development program, the CF6-80 commercial transport engine and for the CFM56 turbofan engine, a joint project of General Electric and SNECMA of France. Gearbox components are also manufactured for Avco Lycoming's T53, T55, and ALF 502 engines.

The company fabricates the transmission and components for the Boeing Vertol CH-46 helicopter, transmission gears for the Westland Lynx helicopter (UK) and gear box components for the Puma helicopter made by Aerospatiale of France.

- *Aviation* – Spar repairs and services aircraft components, sells aviation products and accessories, and overhauls helicopters.

Services cover engine and flight instruments; components of electrical, oxygen, navigational and autopilot systems; constant speed drives; accessory gearboxes; and components for flight control and heating systems. Customers are military and commercial operators in Canada, the US, Mexico, and Central and South America. A large part of Spar's business is with 17 aircraft equipment manufacturers in North America and Europe, which have appointed the company as a Canadian warranty and service station for their products.

For helicopters, Spar provides an authorized customer service facility for Bell, Aerospatiale and Hughes. Services include the sale of parts and accessories, the repair and overhaul of mechanical, hydraulic and avionic components, rebuilding and maintaining airframes, and providing field service. Customers are located in Canada, the US, Mexico, Central and South America, and Indonesia.

• **Mapping** – Northway-Gestalt Corporation, with offices in Toronto, Ontario; Vancouver, British Columbia; Dartmouth, Nova Scotia; and Denver, CO is in the business of acquiring, processing, analyzing and displaying data on the earth's terrain, including natural resources and man-made features, and producing, through remote sensing techniques, conventional graphic maps. In addition, the company provides digital mapping services, gathering information in digital form from aerial photos and maps to provide a data base for land information systems. Half of Northway-Gestalt's services and products are sold to the government for project design, resource evaluation and land use studies and the balance to private enterprise, such as engineering, natural resources, forestry and surveying companies.

Average Work Force: Engineers & Technicians – 600
Others – 1400

Gross Sales: 1980 – \$128M
1981 – \$123M
1982 – \$178M

Keywords: 1 = Aircraft; 3 = Avionics; 5 = Communications; 6 = Computers; 7 = Electronics; 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 12 = Machining; 18 = Space Systems; 19 = Testing/Test Equipment; 20 = Miscellaneous; Airframe Components = 1; Antennas = 5, 7, 18; Communications = 18; Computer Produced Maps = 6; Controls = 18; Digital Mapping = 8, 9; Engine Components = 1; Gear Boxes = 1, 12, 18, 19, 20; Ground Stations = 5, 18; Helicopter Subsystems = 1; Infrared Instrumentation = 7, 10, 20; Lift Cycle Support = 1, 20; Mapping = 8, 9; Mechanical Arms = 8, 18, 20; Remote Sensing = 7, 18, 20; Repair & Overhaul = 1, 3, 7; Satellite Subsystems = 5, 18; Satellites = 5, 18; Structures = 5, 18, 20; Systems = 5, 7, 10, 18; Transmissions = 1, 19.

Revised: Dec 83

SPERRY COMPUTER SYSTEMS Division of Sperry Canada Inc

Code: SUD

Address: 200 Saulteaux Crescent
Winnipeg, Manitoba, Canada R3J 3W3

Contact: Mr. G R Smith, Dir, Canadian Operations –
(204) 888-4222

History: Sperry's Winnipeg Manufacturing Plant was established in 1977 as the first facility of the Defense Systems Division of Sperry to be located outside the Continental US. The establishment of this plant was a direct result of the procurement policy of the Canadian Department of National Defense as it related to the CP-140 Aurora Patrol Aircraft. The company operates exclusively at the Tier 3 level of the industry. The initial plant charter was to assemble components for the Sperry CP-140 Computer which is the heart of the sophisticated computer technology developed for submarine detection. This computer is also deployed on the US Navy P3C and S3A Aircraft.

A Systems Engineering and Marketing facility was established in Ottawa in December 1980 to assist in the integration of the Engineering Systems requirements for the Canadian Patrol Frigate Program with hardware design, software

development, manufacturing, and system integration efforts in Winnipeg.

Capability: The charter of the Winnipeg Plant has expanded from assembly to complete design, software development, testing, and system integration of its own product line. Presently, the Winnipeg plant is engaged in assembly and test of coil wound products, core memory arrays, power supplies, magnetic tape transports, maintenance consoles, switches, printed circuit assemblies, harnesses, and the start up of a product mandated Microcomputer.

The rapid expansion of their areas of endeavor required a new facility which started operation in April 1981. The new plant has the latest in high technology manufacturing, test and office facilities, and is certified by the Department of National Defense as a manufacturer and repair facility of electronic equipment. The final test area contains environmental chambers that meet the complete range of military specifications and are large enough to accommodate entire computer and avionics systems. Random vibration capabilities will be installed to meet the workmanship screen required on all new Canadian and international avionics military procurements. Sperry recently started development of the AN/JYC-501 (V) SHINPADS (Shipboard Integrated Processing and Display System), a product conceived by the Canadian Forces for use on the new Canadian Patrol Frigates.

Average Work Force: Engineers – 39
Manufacturing – 141
Administrative – 23

Gross Sales: 1980 – \$ 1.5M
1981 – \$ 5.0M
1982 – \$10.0M
1983 – \$10.0M
1984 – \$15.0M (Projected)

Plant Size: 40,000 sq ft (Winnipeg Facility)
5,000 sq ft (Ottawa Facility)

Equipment: Sperry employs such equipment as Environmental Test Chamber; Random Vibration; Automated Card and Final Test Systems; Flow Solder; Component Lead Formers; Semi-Auto Dip Insertion; and Static Controlled Work Stations.

Experience: Sperry Defense Systems is a major supplier of high technology, reliable and ruggedized information handling products and systems. Customers include the US military, US industry, and International military procurements.

Keywords: 1 = Aircraft; 6 = Computers; 7 = Electronics; 15 = Radar; 17 = Software Services; 20 = Miscellaneous; Cockpit Displays = 1, 7; Computer Parts = 6; Measurement & Control Systems = 7; Multi-Layered Board Assemblies = 7; Pre-Wired Board Assemblies = 7; PC Board Design = 7; PC Board Fabrication = 7; Power Supplies = 7; Repair & Overhaul = 7; Video Display Systems = 7, 20; Surveillance/Navigation = 15; Core Wound Products = 7; Core Memory Arrays = 7; Magnetic Tape Transports = 7; Maintenance Consoles = 7; Harnesses = 7; Switches = 7; Information Handling Products = 7; Navigation = 15; Microcomputer = 6; Software Services = 17; Integrated Processing & Display Systems = 17, 20.

Revised: Dec 83

SPERRY Inc (Electronic Systems)

Code: SPE

Address: Highway 17, P. O. Box 1300
Rockland, Ontario, Canada K0A 3A0

Contact: Mr. David Tate, Dir, Marketing – (613) 446-6011

History: Sperry Inc is a wholly owned subsidiary of Sperry Corp of the US. They started design, development and manufacturing in Canada in 1951.

Capability: Sperry's Electronic Systems is primarily involved in the design, development and manufacture of Horizon Reference Systems, Air Traffic Control Systems, Time Division Multiplexers and Computer Aided Simulated Training Systems.

Sperry is also engaged in the logistic support, modification and repair & overhaul of airborne radar and all types of avionic systems including air data computers, flight directors and gyros.

Sperry's Air Traffic Control Systems are fitted at all control towers in Canada. The Horizon Reference Systems are fitted on all helicopter carrying Canadian destroyers, and are presently in quantity production for the US for use on the LAMPS III Program.

Sperry's facilities are approved under Canadian National Defense Quality Assurance, and staff resources permit Sperry to cover the broad areas of Integrated Logistic Support (ILS) systems management, software design, reliability and maintainability analysis, configuration control and training.

Average Work Force: Engineers – 20
Assembly – 120
Quality Assurance – 15
Field Service & Support – 30
Others – 100
TOTAL – 285

Gross Sales: 1980 – \$10.6M (US Dollars)
1981 – \$12.4M
1982 – \$13.7M
1983 – \$16.4M (Projected)

Plant Size: 89,000 sq ft
53,000 sq ft (added in 1981)

Equipment: Complete electronic assembly including semi-automatic printed wiring assembly capability. In-house computer systems include Sperry (Univac) and "Sperry Link".

Experience: Sperry's present customers include: The Canadian Government – National Defense, Ministry of Transport (Air), Ministry of Transport (Coast Guard), and Royal Canadian Mounted Police; the US Government – DOD (Navair); and other local industry – other US units of Sperry, Canadian National Telecommunications, Aeritalia (Italy), and Canadian Aircraft operators including CP Air. Sperry is interested in doing business with the US Coast Guard.

Keywords: 3 = Avionics; 5 = Communications; 7 = Electronics; 15 = Radar; 20 = Miscellaneous; Horizon Reference Systems = 20; Air Traffic Control Systems = 5, 7, 20; Time Division Multiplexers = 5, 7; Multiplexers = 5, 7; Repair & Overhaul = 3, 15; Integrated Logistics Support = 3, 20; Marine Diesel Simulators = 20; Marine Simulators = 20.

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SPILSBURY COMMUNICATIONS Ltd

Code: SCS

Address: 120 East Cordova St
Vancouver, British Columbia, Canada V6A 1L1

Contact: Mr R E Macpherson, International Sales Manager
– (604) 684-4131

History: Spilsbury is a Canadian owned company incorporated in 1941. A branch office is located in Halifax, Nova Scotia. There are no US subsidiaries.

Capability: Spilsbury specializes in radiotelephone equipment, antennas, and navigational aids for long range frontier and coastal marine communications. The company develops and manufactures HF single sideband radio communication equipment for land and marine use, fixed and mobile. They are also concerned with the overall concept of providing a system of communications rather than with the manufacture of specific units. One of the major areas of innovation in this field has been the design of a unique series of antennas which increases the effective communicating power of a radio by ten to fifteen times over a conventional installation. These Spilsbury, center-loaded, variable tuned, HF, whip, antennas are used in portable, mobile and fixed service on land, sea and air. In addition to the above, Spilsbury manufactures VHF/FM radiotelephone equipment for mobile and fixed station land or marine use. Other specialized equipment includes low frequency, non-directional beacon systems for medium range aeronautical or marine navigation installations.

Average Work Force: Professional (Technical) – 16
General Assembly – 20
Others – 29

Gross Sales: 1981 – \$4.0M
1982 – \$4.6M
1983 – \$4.2M (Projected)

Plant Size: 18,000 sq ft

Experience: Spilsbury equipment is used in over 50 countries including the US.

Keywords: 5 = Communications; Radiotelephone Equipment = 5; Antennas = 5; Navigational Aids = 5; HF Radios = 5; Single Sideband Radios = 5; Fixed = 5; Mobile = 5; Communications Systems = 5; HF Whip Antennas = 5; Variable Tuned Antennas = 5; Center-Loaded Antennas = 5; VHF/FM = 5; Beacon Systems = 5; Low Frequency Beacon Systems = 5; Non-Directional Beacon Systems = 5; Antennas = 5.

Revised: Dec 83

STANDARD AERO Ltd

Code: SAL

Address: 33 Allen Dyne Road
Winnipeg International Airport
Winnipeg, Manitoba, Canada R2Y 2G6

Contact: Mr. H T Goldie, Dir of Marketing & Sales –
(204) 775-9711

History: Standard Aero is Canada's largest overhauler of aircraft engines. The company is a wholly owned subsidiary of Federal Industries Ltd, a Canadian holding company. It was started in 1935 as an overhauler of reciprocating engines. Since 1960, it has been involved in the overhaul of turbine engines.

Capability: Standard Aero Ltd is involved in the overhaul of both piston and turbine aircraft engines. The company is an authorized Service Center for Allison Gas Turbine Operations, (Allison 250 and T56/501) and for the Lycoming T53, T55, and Alif 502 engines. In addition, the company overhauls the GE T58, the Garrett 85 Series APU'S, and all associated engine accessories.

Standard Aero is an authorized distributor and overhauler for Continental and Lycoming piston engines as well as overhaul-

ing the Pratt & Whitney R985, R1340, and R800 series radial engines. Piston engine related accessories are also overhauled.

The company overhauls the above mentioned engines for commercial operators, the Canadian Armed Forces and as such, has a complete engineering, quality control and parts remanufacturing operation. A complete field service capability is also provided to the companies world-wide customer base. Standard Aero Ltd has a complete test facility for both piston and turbine engines.

Average Work Force: Engineers – 31
Mechanics – 131
Others – 489

Gross Sales: 1980 – \$61,282
1981 – \$74,232
1982 – \$64,231
1983 – \$62,224 (Projected)

Plant Size: 265,000,000 sq ft

Equipment: Complete in-house machining operation including metal and plasma spray, turning, grinding and EDM equipment.

Experience: The company provides service to the Canadian Government, most helicopter operators in Canada, as well as those fixed wing operators using the Allison 501 engine. The company also deals with customers around the world and has service centers in England, Italy and Singapore.

Keywords: 1 = Aircraft; 12 = Machining; 19 = Testing/Test Equipment; 20 = Miscellaneous; Repair & Overhaul = 1, 21, 19, 20; Engine Overhaul = 1, 12, 19; Aircraft Engine Overhaul = 1, 12, 19.

Revised: Dec 83

SYSTEMHOUSE Ltd

Code: SYS

Address: Royal Bank Center
99 Bank St, 3rd Floor
Ottawa, Ontario, Canada K1P 6B9

Contact: Mr. John Owens, Mgr, Corporate Communications
– (613) 236-9734

History: Systemhouse is a public Canadian company incorporated in mid-1974. The head office is located in downtown Ottawa while branch offices are located across Canada (Vancouver, Edmonton, Calgary, Regina, Winnipeg, Toronto, London, Montreal, and Halifax) and in the US (Boston, Chicago, Los Angeles, San Francisco), with the US subsidiary located at 1655 North Fort Myer Drive, Arlington, VA – telephone: (703) 276-0500.

Capability: In the areas of consulting and custom system development, Systemhouse has a broad range of clients in the public and private sectors. Not constrained to any manufacturers' equipment, the Services Division provides solutions on a range of mini, micro, and mainframe systems. Areas of concentration are – financial management systems, social services management systems, health care, videotex (Telidon), office automation, building energy management, interactive data base, computer communications, and distributed processing.

Systemhouse began the development of proprietary products in 1977, and currently offers packaged solutions in the areas of distribution (order entry and processing, sales analysis, budgeting and general accounting), manufacturing (order entry, sales analysis, inventory control, materials management,

job scheduling, and materials processing), health care (financial management, and control of all functions related to the pre-admission, discharge and transfer activities of patients), information management (on-line data entry, correction and retrieval), photogrammetry & cartography (applicable to topographic maps and nautical charts, with an interactive graphics capability and wide range of peripherals) and computer assisted drafting for use by architectural and engineering firms. The company also markets its Resource Analysis and Mapping System (RAMS) which manages and graphically displays information relating to a region's natural resources, public utilities or physical ownership.

Of recent note, the company is undertaking a \$4M project to develop and install an office automation system which will automate departments and administrative functions for the Department of National Defense Headquarters in Ottawa and regional offices of DND in Quebec City, Quebec. The result of this project will be a software-based transportable OA system expected to be commercially available to large North American corporations and government departments by early summer of 1984.

Average Work Force: 750 employees (80% professional)

Gross Sales: 1981 – \$30.5M
1982 – \$39.0M
1983 – \$52.0M (Projected)

Experience: Systemhouse clientele includes US Federal Government, US Navy, US Army, State of Alaska, State of North Dakota, Canadian Federal and Provincial Governments, the Australian Government, and private industry. Approximately 25% of the sales are to the US.

Keywords: 5 = Communications; 6 = Computers; 8 = Energy; 10 = Image Processing & Optics; 17 = Software Services; 20 = Miscellaneous; Turnkey Systems = 6; Videotex (Teledon) = 10; Photogrammetry = 10; Cartography = 10; Office Automation = 6, 20; Financial = 17; Computer Systems = 5, 6; Controller = 5; Energy Management = 8, 17; Data Base = 17; Drafting = 6.

Revised: Dec 83

TARGA ELECTRONICS SYSTEMS Inc

Code: TES

Address: P. O. Box 8485, 3101B Hawthorne Road
Ottawa, Ontario, Canada K1G 3H9

Contact: Mr. Les Horn, Sales Manager – (613) 731-9941

History: Targa Electronics Systems Inc is a Canadian company founded in 1981.

Capability: Targa Electronics is the manufacturer of ruggedized, solid-state mass storage systems. Targa products provide small, low powered, mass memory recording systems for hostile environments. By eliminating the use of mechanically rotated memory and substituting solid-state technology (e.g., bubble technology, E² PROM, CMOS RAM, etc). Targa is able to meet the demands of applications where the quality and value of data is of paramount importance. Their equipment is ideally suited to handle either the rigors of field work (land, air and marine mobile), or the factory floor environment, while offering the convenience of small removable media cartridges of large capacity.

Targa offers three systems to meet different requirements:

The DR-series data recorders are self-contained bench-top or rack-mounted data storage systems with a variety of interfaces, software protocols and options.

The FDE-series solidrive emulators are solid-state memory units that are compatible in every respect with standard floppy disk drives.

The OEM-series interface units are suitable as low cost data storage components for integration into systems.

All systems come with removable memory cartridges that allow convenient transport of data. They are available in 128 kByte and 256 kByte versions now. A compatible 1 MByte version will be available in mid-1984.

Targa is also able to supply custom designs where the requirements are not met by the existing range of products.

Average Work Force: Engineering – 4
Manufacturing – 3
Others – 4

Gross Sales: 1982 – \$300K
1983 – \$1.2M (Projected)

Plant Size: 2,500 sq ft

Equipment: In-house computer systems include DEC, Hyperion, and Hewlett-Packard. Test equipment includes circuit emulation oscilloscopes, etc.

Experience: Targa products are presently used by automobile manufacturers in mobile onboard vehicle tests, by the Canadian Government for both airborne and shipborne survey work, by portable computer manufacturers for ruggedized peripheral mass storage, and by offshore technology companies in support of oil well drilling control systems.

Keywords: 6 = Computers; 7 = Electronics; 20 = Miscellaneous; Mass Storage Systems = 6, 7, 20; Harsh Environment Equipment = 6, 7, 20; Ruggedized Mass Storage Systems = 6, 7, 20; Removable Media Mass Storage Systems = 6, 7, 20; Solid State Memory = 6, 7, 20; Data Recorders = 6, 7, 20; Data Loggers = 6, 7, 20; Floppy Disk Emulators = 6, 7, 20; Peripheral Mass Storage = 6, 7, 20.

Revised: Dec 83

TEKLOGIX Inc

Code: TEK

Address: 1199 Fewster Dr
Mississauga, Ontario, Canada L4W 2A9

Contact: Mr. J R Coutts, President – (416) 625-5673

History: Incorporated in 1967, Teklogix Inc is Canadian owned, privately held and all shares are owned by active participants. The company was formed to provide special hardware and software for minicomputer users and has evolved with this industry.

Capability: Special hardware and software systems for process control, material handling, machine control, plant and warehouse control, and digital data communications systems. Products include digital radio links for remote control of cranes and locomotives, radio linked mobile data terminals for use aboard forklift trucks, etc. Primary capabilities are in systems design and engineering, development, production and related R&D. Normal Spec Level – CSA level 4. Mil Spec capability in selected areas.

Average Work Force: 30 (including Engineers, Mathematicians, Programmers, Technicians, Production, and Support Staff)

Gross Sales: \$1.8M (FY 83)

Plant Size: 12,000 sq ft (additional 6,000 sq ft available)

Equipment: Normal electronic lab and production equipment, including communication test sets. In-house data processing equipment used for systems design, development, and support include PDP11/34, PDP11/05 (two), PDP11/23, PDP8 and all normal peripheral equipment.

Experience: Sort and conveyor control systems for the Canada Post office in Calgary, Toronto, Montreal and Halifax; Steel plant control systems for LASCO (Canada), Irish Steel Ltd (Cork, Ireland), Chaparall Steel (Midlothian, Texas), and Raritan River Steel Co (New Jersey); area paging control system for Bell telephone; digital radio link systems for the Steel Company of Canada, Aluminum Company of Canada, and Boeing Aircraft; warehouse and material handling systems for Kellogg-Salada, Dylex and Dominion Stores; Warehouse automation systems for Digital Equipment Corp (Phoenix), Defense Logistics Agency (Richmond), and the Liquor Control Board of Ontario.

Keywords: 5 = Communications; 6 = Computers; 17 = Software Services; 20 = Miscellaneous; Automation = 20; Hardware = 5, 6; Software = 6, Process Control = 17; Digital = 5; Mobile Data Design = 5, 6, 17, 20; Development = 5, 6, 17, 20.

Revised: Dec 83

TRACKER INDUSTRIES Ltd

Code: TIL

Address: 246 Jane St
Toronto, Ontario, Canada M6S 3Z1

(Mailing Address)
P. O. Box 1094, Station A
Toronto, Ontario, Canada M5W 1G6

Contact: Mr. Lou Fedyna, President – (416) 762-8744, 364-2943

History: Tracker Industries was incorporated in 1974. It is a wholly owned Canadian company with no other Canadian locations.

Capability: Tracker is engaged in custom design/prototyping/manufacture of analog/digital/microprocessor circuits and systems. Specifically, the company R&D areas include microprocessor/microcomputer application engineering, evaluation and specification.

Real-time control programming using assembly and high-level languages has been implemented for use in office and plant automation, data communications, data acquisition, process control, and local area networks.

Software experience – UNIX, CP/M, and real-time multi-user/multi-tasking operating systems.

Hardware designs – Fiber-optics local area network, modems, multiplexers, data interface devices, analog and digital input/output control circuits, microcomputers, and hand-held portable data terminals.

Present activity (1983/84) – 68000/VME/UNIX/ADA/Versados applications, fiber-optics data control links, and vehicular microcomputer applications.

Average Work Force: Engineers – 3
Others – 2

Gross Sales: \$0.25M

Plant Size: 2,000 sq ft (expandable to 3,000 sq ft)

Experience: Tracker Industries' clients include General Motors of Canada, Bell Canada, other corporations, universities, and the Federal & Provincial governments. Products

include data communication networks, data terminals, microcomputers, local area networks (interfacing, systems design), and fiber-optics modems.

Keywords: 5 = Communications; 7 = Electronics; 17 = Software Services; Consulting = 7; Solid State Devices = 7; Microprocessors = 7; Interfacing = 5; Network Systems = 5; Programming = 17; Environmental Programming = 17; Avionics Programming = 17; Data Communications = 17; Data Acquisition = 17; Monitoring Systems = 17; Control Systems = 17; Data Terminals = 17; Systems Design = 5, 7; Telephone Communications = 5; Design to Requirements = 17; Transportation Control Systems = 17; Analog = 5, 7; Digital = 5, 7.

Revised: Dec 83

UDT INDUSTRIES Inc

Code: UDT

Address: 2125 East, St-Catherine East
Montreal, Quebec, Canada H2K 2H9

Contact: Mr. Alberto Stagnaro, Purchasing Agent -
(514) 526-9454

History: UDT was incorporated in 1942 under the name of Universal Die & Tool. Name was changed to UDT Industries Inc in 1975 to reflect more accurately their machine shop business. The company is Canadian owned and there are no other Canadian or US subsidiaries.

Capability: UDT's major product is machined parts ranging from light-medium to hard core items, such as fittings, splice plates, hinges, bulkheads, slat-tracts, spars, dog legs, spar caps, leg assemblies, etc., made from plate stock, forgings, extrusions, aluminum alloys, steels, titanium, etc. CNC and conventional equipment are utilized.

Aluminum alloys heat treating electrical air furnace is part of UDT's capability, 5 ft diameter by 18 ft high, it is continuously performing quench & age hardening of major structural parts for McDonnell Douglas & Lockheed Aircraft from AL-AL 7075 T 411 & 2014 T 411 condition F to T6 or T73 condition. UDT works to MIL-Q-9858A and DND 1016. Tolerances are maintained as per customer's requirements.

Average Work Force: Engineers - 1
Inspectors - 5
Machinists - 40
Programmers - 3
Others - 24

Gross Sales: 1979 - \$3.6M
1980 - \$4.4M
1981 - \$3.8M

Plant Size: 81,000 sq ft

Equipment: NC equipment includes vertical machining centers, horizontal machining center, vertical profiling milling machines, vertical profiler bed type (3 & 4 axis).

Experience: UDT's customers include McDonnell Douglas Canada Ltd (DC 9 & DC 10), Canadair (from T33 to Challenger), Enheat, deHavilland Aircraft, Fleet Industries (Lockheed Product), NATO, USAF, CCC, DND, Rohr, Research & Development Canada (Propulsion Pod), ITT Gilfillan (Antenna Radar), McDonnell Douglas Corporation - St Louis (F-18), and Grumman Aerospace.

Keywords: 12 = Machining; Precision Machining = 12; Metalworking = 12; Heat Treating = 12; Specialized Coating = 12; Coating = 12; Parts = 12.

Revised: Dec 83

ULTRA LASERTECH Inc

Code: ULI

Address: 6415-2 Viscount Road
Mississauga, Ontario, Canada L4V 1K8

Contact: Dr R A Crane, Director, Science & Technology -
(416) 677-8091

History: Ultra Lasertech is a small high technology company incorporated in 1979 with a laser technology base and licensing derived from RCA. There are no other Canadian divisions and no US subsidiaries.

Capability: Ultra Lasertech is engaged in the design and manufacture of custom CO₂ lasers and wave guide lasers. They are involved in R&D associated with laser photoacoustics, laser spectroscopy, and laser communications & radar. Other areas of expertise include remote sensing, pollution detection, ultra high power laser modeling and design, and laser applications. Their product line includes sealed, continuous wave, isotopic CO₂ lasers; tuneable CO₂ lasers; a CO₂ laser optoacoustic deflector; industrial type sealed CO₂ lasers; laser power supplies; and mirror mounts.

Average Work Force: Total - 7 full-time
3 part-time

Gross Sales: 1980 - \$300K
1981 - \$422K
1982 - \$320K

Plant Size: 3,000 sq ft (R&D Laboratories)
1,000 sq ft (Production Facility)

Experience: Since their start in 1979, Ultra Lasertech has been engaged in the development of a laser optoacoustic trace gas analyzer, a commercial laser cavity enclosure, and an industrial CO₂ laser. Other projects have included determining the laser optoacoustic signatures of PCBs, developing a tuneable sealed ¹³CO₂ laser system, a sealed ¹⁴CO₂ laser tube, and a balanced dual spectrophone chamber and measuring water vapor absorption at isotopic CO₂ laser wavelengths. Their optoacoustic trace gas analyzer is being designed specifically to measure nitric acid vapor, although it is applicable to a large number of contaminants of environmental concern. Their analyzer is being designed to detect the acidic vapor down to the lower limit of less than 1 ppb for field operational use. The present status is detection at 10 ppb. Other gases studied during development include several freons, sulfur hexafluoride, ethylene, ammonia, butane, some explosives, PCBs, Jet A fuel, and several other hydrocarbons. It is anticipated this technique will be suitable for detection of hydrazine.

Keywords: 9 = Environment; 11 = Lasers; 15 = Radar; CO₂ Lasers = 11; Waveguide Lasers = 11; Photoacoustics = 11; Spectroscopy = 11; Communications = 11; Remote Sensing = 9; Pollution Detection = 9; Ultra High Power Modeling = 11; Ultra High Power Design = 11; Applications = 11; Sealed CO₂ = 11; Continuous Wave CO₂ = 11; Tuneable CO₂ = 11; Isotopic CO₂ = 11; CO₂ Optoacoustic Detector = 11; Mirror Mounts = 11; Optoacoustic Trace Gas Analyzer = 9, 11; Cavity Enclosure = 11; Trace Gas Detection = 9; Toxic Gas Detection = 9; Power Supplies = 11; Hazardous Gas Detection = 9; Modeling = 11; Design = 11; Radar = 15; Lasers = 11, 15.

Revised: Dec 83

URBAN TRANSPORTATION DEVELOPMENT CORP Ltd

Code: UTD

Address: 2 St Clair Ave W
Toronto, Ontario, Canada M4V 1L7

Contact: Ms Debra Bennett, Information Officer –
(416) 961-9569

History: The Urban Transportation Development Corp Ltd (UTDC) was established in 1973 to design, develop and market new transit equipment and systems. Other locations include offices in Vancouver, British Columbia; Kingston, Ontario; Thunder Bay, Ontario; Detroit, MI; San Francisco, CA; and London, England.

Capability: As mentioned above UTDC's main objective is to develop new, rail-based transit systems. Some of their vehicles/systems are described below:

Intermediate Capacity Transit System – an automated system that has the capability of transporting in excess of 25,000 people per hour.

Canadian Light Rail Vehicle – a single ended, 4 axle rigid vehicle capable of operating singly or in trains of up to six units. Propulsion by two, 220-HP motors, each driving two axles (440 HP per car). Solid state chopper control with blended, regenerative braking.

Articulated Light Rail Vehicle – a 6-axle version of the CLRV (above).

All UTDC research and development in the ground transportation area is carried out at their Kingston facility by UTDC Research and Development Ltd. All projects are product delivery programs, and all exploitation of technology advances and designs already acquired, are carried out by Metro Canada Ltd. This division delivers all transit systems and related hardware products.

Average Work Force: 700 employees (All locations)

Gross Sales: No Data

Plant Size: 40,000 sq ft (Kingston, Ontario location)

Equipment: Training facilities, propulsion development laboratories, transit test track, SELTRAC-Vehicle command control and communication system, and energy test lab.

Experience: Major customers include – Toronto Transit Commission; BC Transit; Southeastern Michigan Transportation Authority; Santa Clara County Transit District; San Francisco Municipal Railway; Transport Canada; Royal Commission on Electric Power Planning; Ontario Northland Railroad; California Department of Transportation; Department of Transportation (US); and MBTA-Massachusetts Bay Transportation Authority.

Some major projects include:

SCCTD ALRV – 30 Articulated LRVs for San Jose, CA.

Vancouver ALRT – a turnkey rapid transit system from the Sea Bus Terminal to New Westminster – to open in 1986.

Detroit CATS – a turnkey rapid transit system running as a downtown loop – to open in 1985.

Scarborough RT – 24 vehicles for an extension to the existing rapid transit system running in Metro-Toronto.

Steerable Truck Retrofit Design – a preliminary design to modify an existing heavy rail transit truck to make it steerable for the US DOT.

Transit Management Advisory Services – a study (including recommendations) of San Francisco Municipal Railway Maintenance Procedures, and the implementation of improvements for the city of San Francisco.

LRT Training Program – an Operations Training Program for San Francisco's new underground light rail transit service for the city of San Francisco.

Transportation Advisory Services – evaluate and recommend ways and means to upgrade rail commuter services between San Francisco and San Jose for the California DOT.

Santa Clara County Life Cycle Costing Demonstration Project – a demonstration and validation of life cycle cost procurement methodology for the purchase of transit coaches for Santa Clara County, California.

Canadian Light Rail Vehicles – design, develop and delivery of 191 Light Rail Vehicles for the Toronto Transit Commission.

Hydrogen Powered Buses – develop hydrogen storage and fuel systems, and equip two demonstration transit buses to use hydrogen for the Ministry of Energy, Province of Ontario.

Composite Flywheel Materials – a development program for the design and testing of composite materials for flywheels for the National Research Council of Canada.

Rotary Powered Steerable Rail Truck – preliminary design of a steerable rail truck with AC rotary propulsion for Transport Canada.

Keywords: 20 = Miscellaneous; Ground Transportation = 20; Transit Systems = 20; Trucks = 20.

Revised: Dec 83

VAC-AERO INTERNATIONAL Inc

Code: VAI

Address: 1371 Speers Road
Oakville, Ontario, Canada L6L 2X5

Contact: Mr. Ross E Pritchard, President – (416) 827-4171

History: VAC-AERO is a Canadian owned, high technology company offering heat treating, brazing, electron beam welding, and repair and coating services to the aerospace, airline, avionics, electronics and other key industries throughout the US and Canada. In addition, VAC-AERO designs, manufactures and sells specialized heat treating and vacuum furnaces to these industries.

VAC-AERO was originally founded in 1959 in Oakville, Ontario, and a Montreal Division was established in 1967 to meet the growing demand for its services from Quebec area customers.

Capabilities: VAC-AERO holds processing approvals from all major aerospace manufacturers for the following services:

Thermal processing of OEM components:

Vacuum heat treatment of high strength steels – Landing gear components, structural airframe parts.

Vacuum heat treatment – Turbine parts, shafts, turbine blades, casings, nuclear components.

Vacuum Brazing – Turbine nozzles, compressor stators, afterburner casings, combustion cowls, wave guides, aluminum cold wall assemblies and heat exchangers, nuclear parts.

Electron beam welding – Turbine assemblies, electronic components.

Plasma spray coating – Combustion liners, fan and stator casings, miscellaneous parts.

Repair and overhaul of jet engine components:

VAC-AERO is approved by Transport Canada and various aerospace companies for a variety of repairs using plasma spray, vacuum brazing, tungsten arc and electron beam welding.

Specific components repaired include – compressor stators, turbine vanes and nozzles, combustion chambers, shafts and miscellaneous components.

Manufacture of new parts to print:

VAC-AERO can also manufacture brazed and electron beam welded assemblies to customer specifications and drawings. They specialize in components such as aluminum vacuum brazed heat sinks and cold wall assemblies for radar and avionics equipment.

VAC-AERO offers a complete line of cold wall vacuum furnaces ranging from small laboratory models to large bottom loading production units. They have supplied these furnaces to a wide variety of customers in the aerospace, nuclear and other high technology industries.

In addition, they can supply ancillary furnace equipment such as high temperature molybdenum fixtures, water recirculating units, and work handling systems. They also offer complete turnkey installation services, extensive operator training programs and post sale preventive maintenance service.

Average Work Force: Engineers – 6

Gross Sales: 1980 – \$3.5M
1981 – \$3.8M
1982 – \$3.9M
1983 – \$3.6M

Plant Size: 17,740 sq ft (Oakville Division)
9,250 sq ft (Montreal Division)

Equipment: VAC-AERO employs the following equipment:

Vacuum oil quenching furnaces capable of hardening part sizes to 72 in. dia. x 84 in. high, vacuum brazing and heat treating furnaces suitable for temperatures to 2700°F and ultra high vacuum levels to 1×10^{-6} torr.

Electron beam welding chamber size of 36 in. deep x 36 in. high x 52 in. wide can be extended to accommodate shafts and similar parts to 72 in. long.

Plasma coating equipment including Metco 3M, 45kW and Metco 7M, 80kW plasma guns.

In-house facilities for repair and overhaul including lathes, vertical mills, grinders, and EDM equipment for machining.

Complete metallurgical laboratory in addition to normal dimensional checking equipment, complements quality control capabilities.

Experience: Present customers include numerous companies in the aircraft, avionics, electronics and nuclear power generation industries. VAC-AERO holds current processing approvals from the following companies – Canadian Forces; Boeing Aircraft Co; Canadair; The deHavilland Aircraft of Canada Ltd; McDonnell Douglas Aircraft Co; General Dynamics; Grumman Aircraft; Pratt & Whitney Aircraft, Hartford, CT; Pratt & Whitney Canada; General Electric, Burlington, VT and Lynn, MA; Garrett Airsearch Mfg; Litton Systems (Canada); Litton Systems (USA); Hawker Siddeley Canada, Orenda Division; Menasco Canada Ltee; Menasco,

Burbank, CA; Spar Aerospace; Bristol Aerospace Ltd; McDonnell Douglas; Cleveland Pneumatic; Bell Aerospace, Fort Worth, TX; Sikorsky Aircraft, Stratford, CT; DAF Indal Ltd; Fleet Industries; Kaman Aerospace, Bloomfield, CT; and Avco Lycoming, Stratford, CT.

Keywords: 1 = Aircraft; 3 = Avionics; 7 = Electronics, 8 = Energy, 12 = Machining; 15 = Radar; 20 = Miscellaneous; Vacuum Brazing = 1, 3, 15; Vacuum Heat Treating = 1, 3, 7, 8; Repair & Overhaul = 1, 12; Electron Beam Welding = 1, 3, 7, 8, 20; Plasma Spray Coating = 1, 8, 20; Vacuum Furnaces = 1, 3, 7, 8, 20; Brazed Aluminum Heat Sinks = 3, 7, 15.

Revised: Dec 83.

VALCOM Ltd

Code: VAL

Address: P. O. Box 603
Guelph, Ontario, Canada N1H 6L3

Contact: Mr. Paul R MacPherson, President – (519) 824-3220

History: Valcom is a Canadian company founded in 1957. It custom designs, manufactures and markets electronic communication systems and components. By attracting skilled radio frequency (RF), digital and software engineers, they have developed the expertise to compete successfully in both the military and commercial segments of the international marketplace.

Capability: In addition to the above, Valcom extended its services to include a repair and overhaul facility to refurbish land tactical and shipboard communications equipment for the Canadian Department of National Defense (DND) in 1972. This facility was expanded in 1980 with the signing of a contract with Atmospheric Environment Service of Canada (AES) to overhaul meteorological test gear. Valcom's diversification into areas which utilize the firm's assembly and engineering skills continued in 1982 when it became the Canadian licensee for Radiosonde Meteorological instruments.

Valcom's general areas of expertise are categorized below:

- **Systems Engineering** – Valcom's management believes that the firm's distinctive competence lies in its ability to design complex equipment that will withstand the rigors of military use for many years. As an example, their engineers have designed one and ten kilowatt coupler control units which in combination with their whip antennas, interface efficiently with various transmitters. Valcom's 1 kW coupler system is fully automatic. It operates in the 2 to 30 MHz frequency range and features a non volatile amorphous memory. A military configuration of this system is now in service with the the Canadian Navy. Valcom's 10 kW coupler is designed for high power transmission applications such as maritime control and ground to air stations. This system, when interfaced with a 10 kW transmitter and Valcom's 54 ft whip antenna, can be controlled manually or automatically. It is capable of storing up to 20 pre-selected channels and is the only automatic coupler designed to handle output power to 10 kW. Seven of these systems have been in operation in Canada since 1978. They are currently upgrading their 1 and 10 kW couplers in order to provide frequency hopping capability.
- **Repair and Overhaul** – Valcom's technicians have through ongoing training programs, developed the ability to service LF, MF, HF, and VHF couplers, coupler control units, transmitter/receivers and a variety of other military equipment.

- **Quality Control** – Valcom's quality assurance plan meets the policies and procedures of DND 1015 specifications and US military standard MIL-Q-9858A. To ensure that the high quality standards set by customers and management are consistently achieved, the quality assurance staff and the engineering department determine product quality and design and implement inspection plans.
- **Manufacturing** –

– **Fiberglass Manufacturing Division:** In 1964, Valcom's management recognized the demand from organizations throughout the world for durable, lightweight antennas for transmitting/receiving applications and developed a line of fiberglass whip antennas which ensure mechanical strength and electrical stability in even the most severe operating conditions. Available in sizes ranging from 29 to 85 ft, these antennas operate in the 10 KHz – 30 MHz range. Having produced over 5,000 whips, Valcom has become the world's leading manufacturer of high quality MF, HF, VHF fiberglass whip antennas. The company's expertise in antenna design and manufacture has resulted in its 35 ft AS2537A/SR whip receiving MIL-A-24319A (EC) approval from the US Navy. The US Coast Guard, the US, Spanish, Greek, Australian, South Korean, Italian, British, and Canadian Navies, and many commercial organizations specify Valcom's free-standing antennas for ground-to-air, ship-to-shore, and ship-to-ship applications. They also manufacture the AS2108ARN directional-finding antenna for the US Army.

– **Electronics Assembly Division:** Valcom's electronics assembly personnel built the company's 1 and 10 kW coupler systems and are skilled in building a wide range of electro-mechanical and avionics equipment to customer's print.

– **Metal Fabricating and Production Machine Shop Division:** Valcom's machine shop staff produce metal assemblies on a custom basis. With a fully equipped machine shop and knowledgeable personnel, Valcom services customers whose production requirements range from several units to thousands of pieces.

Average Work Force: 85 Total

Gross Sales: \$7.5 to 8.0M

Plant Size: 45,000 sq ft
45,000 sq ft (HF, MF & VHF Antenna Facility Testing Site)

Experience: Valcom's customers include the Canadian Department of National Defense; US Navy, Army, and Coast Guard; the Navies of Spain, Greece, Australia, South Korea, New Zealand, Indonesia, Italy, and the UK; and the Canadian Atmospheric Environment Service.

Keywords: 3 = Avionics; 5 = Communications; 12 = Machining; 19 = Testing/Test Equipment; Communications Equipment = 5; Antennas = 5; Controls = 5; Electronic Equipment = 3, 5; Components = 5; Repair & Overhaul = 5, 19; Coupler Control Units = 5; Whip Antennas = 5; Lightweight Antennas = 5; Fiberglass Antennas = 5; Electronic Assembly = 3, 5; Build-to-Print = 3, 5; Machining = 5, 12.

Revised: Dec 83

VARIAN CANADA Inc

Code: VAR

Address: Varian Canada Microwave Division
45 River Drive

Contact: Mr. O J Caldarelli, Marketing Manager –
(416) 877-0161

History: Varian Canada Inc is a wholly owned subsidiary of Varian Associates of Palo Alto, CA. The Canadian operation, located near Toronto, Ontario, was originally incorporated in 1955 to supply microwave tubes to the Canadian military.

The engineering and manufacturing segment of the company, Varian Canada Microwave Division (VCMD), operates under the umbrella of the Electron Device Group of the parent company. This group forms the largest electron tube manufacturing operation in the free world. Since its inception, the Microwave Division has grown steadily and expanded its original charter to include many unique and customized products for world-wide markets (75% of sales are exported). Currently, the product line is split evenly between electron tubes and electronic equipment.

Capability: The following is a brief description of the major products manufactured at Varian Canada Microwave Division. Since many of the products were designed by the Division, full facilities and capabilities exist in-house for customizing to the needs of individual customers. Both MIL and commercial specifications can be met.

Travelling Waves Tubes: These tubes are produced for microwave Line-of-Sight (LOS) Communication applications and cover frequencies ranging from 3.5 GHz to 15 GHz at power levels up to 50 watts. The product line includes a complete selection of conventional technology TWTs as well as metal-ceramic high efficiency and high linearity tubes. The company has the capability to customize existing designs to meet customer's unique requirements, and to develop retrofit packages to upgrade older field installations.

Power Klystrons: This product line consists of a series of power klystrons used primarily as high power amplifiers in satellite earth stations and troposcatter communication applications. These are available at frequencies of 5, 6, and 14 GHz with power levels up to 3 kilowatts. Various channel tuner configurations are available, including a microprocessor-controlled, automatic-channel tuner.

Reflex Klystrons: VCMD has an extensive line of reflex klystrons typically used in communications and radar systems for airborne and ground based applications, plasma diagnostics, spectroscopy, meteorological instrumentation and other experimental and scientific applications. The line ranges from the lower frequency tubes (8 to 25 GHz) with power outputs from 10 to 450 mW up to millimeter reflex klystrons ranging from 30 to 220 GHz with out powers from 5 to 800 mW.

Extended Interaction Klystrons: This product line originated at the VCMD facility and extensive development efforts are continuing. The products address the very high frequency ranges for microwave applications, ranging from 30 GHz to 280 GHz. EIKs are rugged, lightweight, compact and are capable of generating medium rf power levels in either continuous or pulsed modes. The cw power levels of these klystrons range from 1 kW at 18 GHz to 1 watt at 280 GHz. Peak power outputs range from several kilowatts at 30 GHz to 60 watts at 220 GHz. These EIKs are well suited as rf power sources for a wide range of applications such as – Fire control radar; terrain following radar; illuminators; weather radar; plasma heating; radio astronomy; surveillance radar; satellite communications; tracking radar; radar modelling; and fusion diagnostics.

Millimeter Wave Subsystems: VCMD offers a range of millimeter wave transmitter subsystems which consist of a modulator, a power supply and control circuitry driving the Varian line of Extended Interaction Klystrons.

These transmitter systems operate in discrete frequency bands ranging from 30 to 220 GHz for pulsed and cw applications and can be designed to meet customer requirements to commercial or MIL specifications.

Power Supplies: The basis of this product line is a complete series of power supplies which complement VCMD's electron tubes. However, in addition, specialized, complex power supplies have been developed and manufactured by the Division to both MIL and commercial specifications, requiring capabilities such as - high and low voltage outputs; DC or AC inputs; multiple outputs; stringent noise and regulation requirements; and unique shapes and sizes. Power levels up to 30 kW and voltages up to 50 kV have been achieved.

Satellite Communications Power Amplifiers: A series of high power commercial amplifiers of VCMD design is available for satellite communications in frequencies ranging from 2 to 14 GHz with power levels up to 3 kW. These amplifiers consist of the power klystron, power supplies, cabinetry, waveguide/RF circuits, and control circuitry. A specialized military high power (10 kW) amplifier for satellite communications has also been designed and manufactured in Canada. The amplifier forms a complete subsystem incorporating an X-band klystron, power supplies, control circuitry, waveguide runs, and liquid cooling equipment consisting of a water-to-air heat exchanger and a purification loop.

VCMD is able to qualify and test to MIL and commercial specifications. Customized products are a specialty of the Division. Organizational and administrative systems are in place to ensure the smooth execution of commercial and military contracts requiring exceptional attention to detail. These include fully computerized and on-line Manufacturing Resources Planning and a complete Quality Assurance system appropriate for MIL requirements.

Average Work Force: Total - 300

Gross Sales: \$30.0M

Plant Size: 100,000 sq ft (2 Facilities)

Equipment/Facilities: VCMD has, in-house, all of the extensive facilities and capabilities needed for the manufacture of high quality electron tubes and electronic equipment. A few of the facilities which support such precise and delicate design and manufacturing activities are: "Watchmaker accuracy" machine shop; in-house manufacturing of high voltage transformers; test facilities for microwave tubes, subsystems and power supplies; clean rooms; vacuum sealing facilities; electric discharge machining; environmental test facilities; hydrogen and vacuum furnaces; and laser welding.

Experience: VCMD has in excess of twenty-five years of experience working with original equipment manufacturers of microwave and satellite telecommunications equipment. The Division has also been involved in various development programs for power supplies and other electronic subsystems to customers' specifications for many years.

Military programs have been a successful part of VCMD's operation. The largest single program lasted three and one-half years and was valued at approximately \$6.0M. In 1979, the company produced a space qualified instrument which was successfully flown on a NASA satellite designed to measure the earth's magnetic field. As well as private industry throughout North America, Europe and the Far East, the clientele also includes the Canadian, US and several European Governments, plus various agencies, laboratories and research institutions associated with these governments.

Keywords: 7 = Electronics; 18 = Space Systems; Solid State Devices = 7; Travelling Wave Tubes = 7; Klystrons = 7; Reflex Klystrons = 7; Power Klystrons = 7; Extended Interaction Klystrons = 7; Power Supplies = 7; Power Amplifiers = 7; Satellite Communications Power

Amplifiers = 7, 18; Pulsers = 7; Millimeter Wave Subsystems = 7, 18; Waveguides = 7; Amplifiers = 7; Amplifier Subsystems = 7, 18; Control Circuitry = 7; Cabinets = 7.

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VICTRIX Ltd

Code: VIC

Address: Box 1807
Guelph, Ontario, Canada N1H 7A1

OTTAWA OFFICE
29 Pellan Crescent
Kanata, Ontario, Canada K2K 1J7
C B Dowden, Engineering Manager -
(613) 592-3888

Contact: Mr. H Lawry, Dir of Marketing - (519) 836-1480

History: Incorporated in 1975 (100% Canadian owned).

Capability: Approximately 80% of their R&D and manufacturing is for the Canadian Department of National Defense. Typical engineering projects include:

- Technical investigations and engineering services to DND on marine weapon systems drives and controls.
- Engineering services to industry on control systems for machinery and large winches.
- Engineering services to industry on sound and vibration problems in gear systems.
- Design and prototype fabrication of 20 kW vertical axis windmill.
- Designed and developed 1.2 m plastic parabolic antenna for 11.6 GHz satellite receiving.
- Developed production techniques for fabrication of outdoor unit to house LNA of satellite receiving antenna.
- Investigated dielectric feed horn problems and developed modifications.
- Engineering services on avionics flight surfaces control systems.

Small manufacturing capability include the following items:

- Amplifiers, reactors, special transformers, & RF coils
- Fiberglass microwave dish antennas
- Small gears and gear reducer assemblies
- Extrusion and molding of miscellaneous plastic and rubber parts
- Aircraft smoke signal markers pyrotechnics
- Cable assemblies
- Marine projectile line throwing devices
- Inflatable mast antennas
- Marine weapon system drive and controls

Victrix also has an R&O capability for radar duplexers, precision electronic components and power supplies.

Average Work Force: 1 Senior Scientist (Electronics)
1 Mechanical Engineer
1 Telecommunications Engineer
2 Technologists
2 Technicians
3 Machinists
10-30 Production People
1 Quality Control Manager

Gross Sales: 1982 - \$4.50M
1983 - \$4.75M (Projected)

Plant Size: 14,000 sq ft (2 locations)

Equipment: Machining, vacuum molding, fiberglass layup and forming, & electronic laboratory to 20 GHz measurement, and pyrotechnic manufacturing.

Experience: DND - Marine Weapon System Drive Controls
- Aircraft Smoke Signal Markers
- Marine Line Throwing Device
- Portable Antenna Masts
- Modular Practice Bombs

DOC - Satellite M/W Parabolic Dishes

Keywords: 1 = Aircraft; 2 = Armament; 4 = Chemistry; 8 = Energy; 12 = Machining; 16 = Security & Safety; 18 = Space Systems; 19 = Testing/Test Equipment; Ground Station Antennas = 18; Pyrotechnics = 1, 4, 16; Smoke Markers = 1, 4, 16; Portable Antenna Masts (Surface) = 18; Weapon System Controls = 19; Windmills = 8; Electronics = 19; Plastic Fabrication = 12; Modular Practice Bomb = 2; Practice Bomb = 2.

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VORTEK INDUSTRIES Ltd

Code: VOR

Address: 1820 Pandora Street
Vancouver, British Columbia, Canada V5L 1M5

Contact: Dr G G Albach, President - (604) 251-2451

History: Vortek is a private Canadian company, incorporated in 1975 in the Province of British Columbia, with no other branches or US subsidiaries.

Capability: Vortek specializes in the manufacture and development of ultra-powerful arc lamps and related optical systems. The lamps operate at input powers of up to 160,000 watts, using a patented internal cooling method. Originally developed for outdoor floodlighting, the lamps have proven to be an excellent light source for solar simulation and industrial processes. Vortek also operates a high-power plasma arc laboratory. New product designs are tested prior to production, and radiation experiments are conducted for clients on a contract basis.

Average Work Force: PhDs - 3
Engineer - 1
Others - 5

Gross Sales: No Data

Plant Size: 6,000 sq ft

Equipment: The company has developed sophisticated fabrication techniques for liquid-cooled tungsten electrodes, and operates the only commercial tungsten electrode fabrication facility in Canada. Engineering of large, high-power optical systems is done using an in-house Data General Computer System. The company fabricates liquid-cooled optical assemblies, and maintains a large area rhodium metal plating facility for reflector production.

Experience: The company is an OEM supplier of ultra-power arc lamps and optics to Eaton Corp in Boston, for use in semiconductor annealing equipment. NASA and DOD use Vortek lamps for laser development and radiation testing. Large area solar simulators are installed in Canada and Europe.

Keywords: 8 = Energy; 9 = Environment; 10 = Image Processing & Optics; 20 = Miscellaneous; Arc Lamps = 8, 9; Tungsten Electrodes = 8, 20; Solar Simulation = 9; Metal Plating = 8, 9, 10; Optical Processing = 10; Plasma Arc = 8; Optics = 8, 9, 10; High Intensity Light Source = 8.

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WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT

Code: WNR

Address: Pinawa, Manitoba, Canada R0E 1L0

Contact: Mr. Raymond O Sochaski, Mgr, Commercial Ops Office - (204) 753-2311

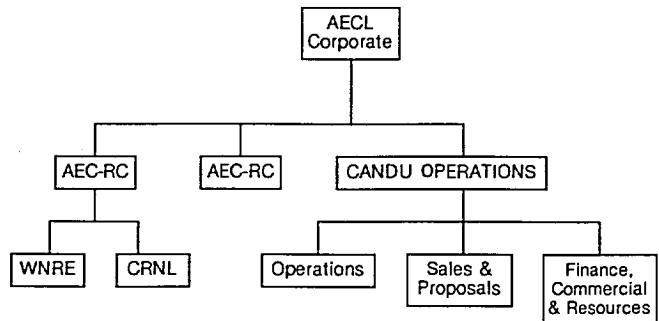
History: The Whiteshell Nuclear Research Establishment (WNRE) came into being in 1963 for the purpose of developing the organic cooled nuclear power reactor concept. WNRE is part of the Atomic Energy of Canada Research Company (AEC-RC), which in turn is a part of Atomic Energy of Canada Ltd (AECL). The latter is a crown corporation of the Government of Canada.

Canada's nuclear program had its beginning during the Second World War when a team of Allied scientists was assembled in Montreal for work related to the development of atomic weapons. With the end of the war, the Canadian effort was redirected, and since then all work on atomic energy has been concerned with peaceful uses.

The program was initially administered by the National Research Council of Canada, but by 1952 it had expanded so much it was placed under a new, specialized organization (AECL). In the fall of 1979, a commercial Operations Office was established at WNRE for the purpose of marketing site services, products and transferring technology.

AECL pursues a wide range of activities, from basic science to wholly commercial operations, with the main effort being devoted to the development, testing, commercialization and marketing of CANDU reactors, heavy water, isotopes, irradiation equipment a nuclear fuel.

AECL is a Crown Corporation with a total staff of approximately 7000 people. The Corporate Office is located in Ottawa, Ontario. It manages the five companies listed below:



AEC-RESEARCH CO (AEC-RC) - Head office is in Ottawa with sites at Chalk River, Ontario and Pinawa, Manitoba.

AEC RADIOCHEMICAL CO (AEC-RCC) - Head office and manufacturing facilities at Kanata, Ontario, with offices scattered in foreign countries.

AEC-CANDU OPERATIONS (Operations) - Head Office in Mississauga, Ontario.

AEC-CANDU OPERATIONS (Finance, Commercial & Resources) – Head Office in Mississauga, Ontario.

Capability: WNRE is an Research & Development site. It performs fundamental and applied research, develops processes, products and components, and has a large staff of experienced people in most disciplines and trades. Our greatest asset is the ability to innovate, develop, test, commercialize and market a concept.

Keywords that describe their capability are as follows:

ASME Codes
Biological Environment
Chemical Analysis
Chemical Processes
Chemistry
Colloidal Chemistry
Combustion
Computer Code Development
Contract Research
Corrosion
Derived Release Limits
Detonation
Disposal
Electrochemistry
Electronics, Nuclear
Environment
Explosions
Fluid Dynamics
Fracture Mechanics
Health Physics
Hydraulics
Instruments, Nuclear
Irradiations
Isotopes
Materials Characterization
Materials Testing & Development
Mechanical Testing
Medical Biophysics
Metallography
Metallurgical
Mathematics
Neutron Activation
Non-destructive Testing
Nuclear
Nuclear Design
Pathways Analysis
Professional Services
Physics
Quality Assurance
Rail Transport
Reactors
Radiation
Radiation Shielding
Radioactive Wastes
Research & Development (R&D)
Risk Analysis
Safeguards
Separation Processes
Surface Chemistry
Tailings
Thermal Analysis
Toxic Chemicals
Trace Analysis
Vitrification
Waste Management

Average Work Force: Professional – 300
Technical – 330
Clerical – 175
Prevailing Rate – 245

Gross Sales: 1981/1982 – Annual Budget – \$62M
Gov't Appropriation – \$55M
Commercial Revenues – \$7M

Plant Size: Approximately 10 major buildings which house R&D facilities – a research reactor (WR-1); engineering offices; machine, construction and maintenance work shops; administrative offices; protective services; fire department; and stores and warehousing. Very rough area of all facilities is 150,000m².

Equipment and Facilities: WNRE's major research facility is the western world's only reactor using an organic fluid to remove heat from the core. The reactor (WR-1) moderated by heavy water, as are all Canadian reactors, went into operation in 1965 and has proven to be a versatile and effective tool for the testing and development of nuclear fuels and materials. It has shown the potential of the organic-cooled reactor as a source of large quantities of steam for industry. One application that is receiving increasing attention is the use of steam generated by the reactor to recover bitumen from deposits of oil sands. The WR-1 reactor has been used to heat buildings at WNRE for several years and additional surplus heat could be used for other purposes such as heating greenhouses and drying agricultural crops.

In addition to the WR-1 reactor with its facilities for irradiating and testing materials, WNRE has a variety of facilities and expertise available for undertaking commercial work, e.g.:

- Other irradiation devices – a gamma-irradiator, Van de Graaf and fast neutron generator.
- "Hot Cell" facilities capable of handling up to 10⁶ Curies of radioactive material.
- Various test "loops" for materials, component and corrosion testing.
- Comprehensive metallurgical and mechanical testing facilities with expertise in testing ferrous and non-ferrous metals, ceramics, glasses, rocks and composites.
- Expertise in electron microscopy, acoustic emission, fracture mechanics, etc., that can be applied to solving problems involving deformation, hydrogen embrittlement, stress corrosion cracking, creep cracking and fracture.
- Extensive analytical chemistry facilities including micro-analytical, radiochemical, neutron activation, mass spectrometry, atomic absorption spectroscopy, plus a unique capability for the characterization of surfaces by such means as scanning electron microscopy, scanning auger microscopy, secondary ion mass spectrometry and photoelectron spectroscopy.
- A research chemistry group adept in the measurement of the thermodynamic properties of solutions at high temperature and pressure, in the application of electrochemical techniques to the study of corrosion and film formation, in the study of gas phase reactions, and in several areas of colloid and surface chemistry.
- Combustion test facilities to study the detailed deflagration and detonation behavior of mixtures of combustible gases from the fundamental chemistry of combustion to engineering scale verification or demonstration experiments.
- Environmental research laboratories and field test facilities with experienced staff to study the impact of chemical and radioactive effluents of the environment.

- Biophysical research laboratories with expertise in virology, cell biology, radiobiology, biochemistry and biophysics.
- A geotechnical research capability which, by 1986, will include an underground research laboratory for excavation damage experiments for different excavation techniques, development of in-situ stress measurement techniques, evaluation of rock thermal/mechanical properties, hydraulic conductivity and rock porosity measurements and various geochemistry experiments.
- Expertise in modelling fluid heat transport systems and high pressure steam/water behavior.
- Consulting service groups encompassing nuclear engineering, risk analysis, development of computer models, mathematical analyses and meteorological assessments.

Experience: AECL has been in existence for approximately 36 years. During this time, it has developed the CANDU-pressurized heavy water reactor system. It has helped to commercialize the radioisotope industry in the medical, pharmaceutical and industrial fields; developed and commercialized the Canadian heavy water industry. Canada is currently the world's largest producer of this commodity. In addition, AECL has been instrumental in developing the Canadian nuclear fuel industry and has played a large part in developing the US nuclear fuel designs, for both military and civilian reactors. It has also played a major role in developing and commercializing zirconium alloys.

More recently, AECL has been charged with the responsibility of managing the Canadian Waste Management program. It includes conceptual planning, fundamental research, development, testing, piloting, verification, acceptance, optimization, and providing specifications for the commercial system.

Spent fuel storage (wet and dry), transportation, fission products removal and waste disposal are sub-sets of the total program. All of this work is being coordinated from WNRE.

AECL's major assets are experienced staff and state-of-the-art facilities and equipment. Its reputation as a respected leader in the nuclear and non-nuclear industries is acknowledged both domestically and internationally.

Keywords: 4 = Chemistry; 6 = Computers; 7 = Electronics; 8 = Energy; 9 = Environment; 16 = Security & Safety; 19 = Testing/Test Equipment; 20 = Miscellaneous; ASME Codes = 20; Biological Environment = 9; Chemical Analysis = 4; Chemical Processes = 4; Chemistry = 4; Colloid Chemistry = 4; Combustion = 20; Computer Code Development = 6; Contract Research = 20; Corrosion = 19; Derived Release Limits = 9; Detonation = 20; Disposal = 9; Electrochemistry = 4; Electronics-Nuclear = 7; Environment = 9; Explosions = 20; Fluid Dynamics = 20; Fracture Mechanics = 19; Health Physics = 20; Hydraulics = 20; Instruments-Nuclear = 7; Irradiations = 20; Isotopes = 20; Materials Characterization = 19; Materials Testing & Development = 19; Mechanical Testing = 19; Medical Biophysics = 20; Metallography = 19; Metallurgical = 19; Mathematics = 20; Neutron Activation = 20; Non-Destructive Testing = 19; Nuclear = 8; Nuclear Design = 20; Pathways Analysis = 9; Professional Services = 20; Physics = 20; Quality Assurance = 19; Rail Transport = 20; Reactors = 20; Radiation = 20; Radiation Shielding = 20; Radioactive Wastes = 9; Research & Development = 20; Risk Analysis = 20; Safeguards = 16; Separation Processes = 4; Surface Chemistry = 4; Tailings = 9; Thermal Analysis = 20; Toxic Chemicals = 9; Trace Analysis = 4; Vitrification = 4; Waste Management = 9.

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