

ESS Sales Reference Information

Foreword

Welcome to the ESS applications reference list. This document is continuously updated and intended to contain outline information on some of our key activities.

The document also contains a list of potential reference contacts whom you are most welcome to approach. I should make it clear however, that ESS have not approached any of the users listed here as referees. It is therefore, entirely at the discretion of the individual users to reply to any enquiry you may make.

The list is split in to three parts.

The first section contains one page summaries of key application areas split by application.

The second section lists users who MAY provide a reference if approached. This is also split by application.

The third section is simply a list of some key ESS accounts split by commercial and government/educational.

If you are viewing this document from the application notes CD, you will also be able to view more information on individual applications with application data and any relevant press releases by browsing the folders on the CD.

I hope you will find the contents to be of interest

Martin Norrey
(Director)

Remember to check out our web site at <http://www.essco.com>

For local contact details, see the last two pages of this document.

Application Areas in this note

Brewing

Complex Gas Mixtures

Environmental Monitoring

Fermentation

Food Grade Gases

Full Automation Options

Medical Systems

Military Systems

Pure Gas Analysis

Specials

Refrigeration Systems

Vacuum Process Certification

Brewing

ESS have supplied a number of highly specialised systems to the brewing industry. The systems are designed to detect very low level impurities in CO₂ gas used in the bottling or canning process.

Gases fall in to two main categories;

Chemical Gas: Gas produced as a waste product from Ammonium Nitrate or PET production processes. This type of gas may contain levels of Benzene, 1-3 Butadiene, Methanol, Xylene or Styrene.

Recovered Gas: This gas is recovered from the fermentation process and filtered to remove alcohol's. This gas may contain high levels of alcohol's and aromatics from the brewing process.

The analysis system consists of a combined on-line TD/MS and direct MS system for ultra low levels. Special software is used to give a simple user interface with alarms on all analytes and on each sample point. The purpose is to analyse incoming CO₂ before use and to monitor filter breakthrough in the recovery process.

Components Typically Analysed	Detection Limits(TD)	Direct
1-3 Butadiene	0.1ppb	1ppb
Benzene	0.1ppb	1ppb
CO ₂	0.5ppm	0.5ppm
COS	1ppb	5ppb
DME	0.1ppb	1ppb
DMS	1ppb	5ppb
Ethanol	0.1ppb	1ppb
H ₂ S	5ppb	5ppb
MEK	0.1ppb	1ppb
Methanol	0.1ppb	1ppb
MIBK	0.1ppb	1ppb
SO ₂	10ppb	10ppb
Styrene	0.1ppb	1ppb
Toluene	0.1ppb	1ppb
Xylene	0.1ppb	1ppb

Users with installed systems:	Number of systems
Anheuser Bush Brewing Inc (Budweiser) St Louis MO, USA	1
Guinness (Irish Bonding) Belfast, UK	1
Stag Brewing (Budweiser) UK, Richmond, London, UK	1

See the reference list at the end of this document for contact details.

Complex Gas Mixtures

ESS have many systems in complex gas mixture analysis applications where there may be many peak overlaps. Perhaps the best established and tested systems are those supplied to BP and others for fast gas phase monitoring and control in Polyethylene and Polypropylene Gas and Slurry phase reactors.

Gas mixtures in this application are complex but can be dealt with using the ability of the GeneSys software to calibrate multi-component complex matrices, even when many peak overlaps are present. The systems installed at BP and many other leaders in petrochemicals companies, are used to rapidly monitor and control the gas phase in PE and PET production reactors. They have a major advantage over traditional Gas Chromatographs since they offer very fast response. Using a GC means "flying blind" on the reactor for 20 minutes or so whilst waiting for data. The MS allows analysis in seconds giving much more information and allowing catalyst optimisation in the critical start-up phase. BP have run many comparison data sets with MS v GC results.

Systems of this type often incorporate DDE communication with a control (SCADA) system or industry standard outputs. The components listed are analysed within a mixture and not in simple mixture form.

Components Typically Analysed	Detection Limits
CO	1ppm
CO ₂	10ppm
Ethane	10ppm
Ethylene	10ppm
Heptane	10ppm
Hexene	1ppm
Hydrogen	50ppm
iButane	10ppm
Methane	20ppm
Nitrogen	10ppm
Octene	1ppm
PMH(solvent)	1ppm
Propane	10ppm
Propylene	10ppm

Users with installed systems:	Number of systems
Akzo Nobel Holand	4
BP Research, Sunbury UK	25
BP Research, Norwich UK	2 off 8 reactor automatic
BP SNC Lavera, France	10
DOW Chemical Inc, Texas and Midland, USA	3
Shell UK, Thornton, UK	2
Shell Holand, Amsterdam and Rotterdam	3
Alf Atochem, Various,	4
ICI Syntex, Runcorn and Billingham	3

See the reference list at the end of this document for contact details.

Environmental Monitoring

ESS supply the ecoSys-P range for environmental monitoring. Systems find a wide range of applications in both source and ambient applications.

The majority of these systems have been sold to private laboratories who then perform contract work for the UK Environment Agency or UK local authorities.

EcoSys has many remote operational features including full remote control via GSM modems, automatic uploading or downloading of data files and alarms, automatic re-calibration, etc. The low power consumption of ecoSys-p (just 96 Watts) makes it ideal for use from static power supplies such as battery packs, inverters or small diesel generators.

EcoSys is not troubled by water vapour and can be attached directly to un-filtered sample lines in many stack and duct applications.

A water probe system is available and is undergoing continuous assessment and development at ESS.

Components Typically Analysed	Detection Limits(TD)	Direct
1-3 Butadiene	0.1ppb	1ppb
Benzene	0.1ppb	1ppb
CL2	N/A	20ppb to 100%
CO2	0.5ppm	0.5ppm
COS	1ppb	5ppb
DME	0.1ppb	1ppb
DMS	1ppb	5ppb
Ethanol	0.1ppb	1ppb
H2S	5ppb	5ppb
HCL	N/A	20ppb to 100%
HF	N/A	20ppb to 100%
MEK	0.1ppb	1ppb
Methanol	0.1ppb	1ppb
MIBK	0.1ppb	1ppb
NOX	N/A	10ppb
SO2	10ppb	10ppb
SOX	N/A	10ppb
Styrene	0.1ppb	1ppb
Toluene	0.1ppb	1ppb
Xylene	0.1ppb	1ppb

Users with installed systems:	Number of systems
CRE Ltd, Stoke Orchard UK	1
Protea Ltd, Crewe, UK	1
ETI Ltd, Cheltenham UK	1 (with TD)
Markes International, Wales	1 (with TD)
ICI Syntex, Billingham	2
Government of Singapore	2 (Monitoring Stations with TD)

See the reference list at the end of this document for contact details.

Fermentation

ESS have a long association with the fermentation processes in various application areas from Bakery Yeast through to drug companies. Most equipment supplied is now quite old and ESS are embarked on a project to replace much of this equipment with a simple low cost version of GeneSys. This system is currently installed at the Dutch Giant DSM Bakery Ingredients located in Felixtowe UK.

DSM have been running the instrument as part of their process control system to detect small changes in the Yeast atmosphere. The reliability of the system is paramount as it forms the sensor in a full closed loop process control system with outputs to the plant SCADA computers.

Components Typically Analysed	Detection Range	
CO	0.5ppm to	100%
CO2	5ppm to	100%
Nitrogen	10ppm to	100%
Oxygen	10ppm to	100%

DSM plan to install this system on all plants by 2002. For further details contact:

**Paul Gibson, DSM Bakery Ingredients, Dock Rd, Felixtowe, Sussex, IP11 3QW, UK
Tel: +44 139 4676201 E-Mail:**

Food Grade Gases

The start of our involvement with food grade gas analysis was the discovery by the US FSA of 20ppb benzene in a consignment of CO2 destined for a world leader in the soft drinks industry. To this day, the players may not be mentioned because of on going legal disputes. We were contacted by the UK supplier who wanted to install fast, reliable low level detection systems in a very short period of time.

The problem with "chemical" CO2 as it is known in the industry, is the potential for Benzene slip from the Natural Gas used as raw material in the gas synthesis process in Ammonium Nitrate production. This is filtered in regenerative carbon filters on the finished CO2 product. Problems had arisen because the filter regeneration was timed based on constant Benzene levels from theory.

Practise showed massive variation in input Benzene concentration at the filter stage, resulting in frequent breakthrough at the filters before timed regeneration. Regeneration is now predicted by MS readings.

This precipitated the largest project in the history of ESS, the installation of three fully automatic systems to monitor a total of 32 sample points, over some 1000M of trace heated sample lines, all this under huge commercial pressure to resume gas shipments stopped by the FSA.

We produced a system which is now the benchmark in on-line continuous analysis, audited and accepted by:

**BOC
Messer Gas
Distillers MG
Hydrogas
Air Products**

The systems monitor CO2 quality at all points of the production (Ammonium Nitrate by-product) process and are able to shut down the plant if limits are exceed.

Over the installed period, the customer (who we cannot name) have become accustomed to the speed and accuracy of the MS. New lines have been added to control, the gas synthesis loop (used to be done by GC) with the rapid update times available from the MS.

Components Typically Analysed	Detection Range	
Benzene	1ppb to 100ppb alarms at 5ppb	(parts of process & finished product)
CO2	97 to 99.999%	(parts of process & finished product)
Hydrogen	20-60%	(Synthesis Loop)
Nitrogen	40-50%	(Synthesis Loop)
Methane	0-500ppm	(Synthesis Loop)
Ethane	0-100ppm	(Synthesis Loop)

We cannot give the company details here but any genuine enquiry will be able to contact them for reference

Full Automation Options

ESS are increasingly offering automated systems to provide solutions to customer application challenges, in these systems the MS forms the detector but functions are automated to give simple user interfaces for operators.

Typical examples of features which may be incorporated in to such systems are highlighted below. This type of software is available at extra cost on any ESS instrument.

Simple Sequence Programming:

Used to automate repetitive tasks such as zeroing and calibrating by prompting user for the next stage in a semi-automated process:

Typical Elements of Sequence Programming:

User Choice Buttons

User Input prompts (for filename or experiment name etc)

User messaging, system outputs simple messages to the user regarding status or required actions.

Advanced Automation.

All ESS systems can integrate seamlessly with process control or Supervisory Control and Data Acquisition Systems (SCADA).

Fully automated programs can exchange data and commands with external SCADA systems by various means.

Direct on-bus DDE communication between programs.

Serial or parallel port data exchange.

Analogue and Digital I/O.

Specialised User display designs.

Actions based on any process variable are possible.

E.G. Operate digital output 1 if Benzene reading exceeds a set level,etc

We are pleased to provide full or partial system design for any specialist application.
Please see the reference section where users with automation software are highlighted.

Medical Systems

ESS have a long standing involvement in the use of highly specialised MS systems for medical applications. Recently, we have developed a new medical system with some unique design features and highly specialised fast data acquisition software. Unlike GeneSys and EcoSys, MediSys utilises a fast parallel interface (RS232 is just too slow for medical data!) to get the high sample rates required when monitoring gas waveforms.

The generic base software allows calibration and monitoring of up to 8 individual inputs which may be any combination of mass spectrometer signals or external equipment such as Heart Rate Monitors or mouthpiece flow sensors etc. Applications software allows use of the acquired data in one of the following fields.

Exercise Testing:

Used for the calculation of Respiratory Quotient and arterial blood Oxygen and CO₂ in patients whilst at rest or undergoing graded exercise testing. This software finds applications in Sport Medicine, Post-Operative transplant patient care, assessment of chronic Heart and Lung diseases and clinical trials of Cardiovascular drugs.

Gases Measured	External Inputs	Data Output
O ₂	Flow as Volume	End Tidal CO ₂ & O ₂
CO ₂	Heart Rate	RQ
N ₂	MVP	VCO ₂
	USER Configured	VO ₂
		Minute Volume
		BPM

Response time for 5-95% signal is less than 80mS
Sampling frequency up to 50HZ

Functional Residual Capacity:

FRC in Neonates is an indicator of lung development in all neonates and of special interest for premature neonatal care.

Gases Measured	External Inputs	Data Output
O ₂	Flow as Volume	Endtidals and FRC
CO ₂		
N ₂		
Freon *		
Acetylene *		

* used as saturation volume markers.

Mucosal Bloodflow

A new joint project between ESS and Kings College Hospital London. We are currently developing software designed to detect very small changes in a low volume of gas retained in the throat. Mucosal blood flow in this region is considered to be a major indicator for asthma.

See reference list for collaboration group names.

Military Systems

ESS supply systems to many military applications. Unfortunately, many of these are classified and cannot be discussed in detail.

It is also difficult to supply a reference list for such applications due to their very nature.

In summary, ESS are able to supply systems for the following applications:

Military Filter Testing

ESS have supplied a number of systems which test the integrity and breakthrough characteristics of filtration systems for personal protection along with those used in APC, Ship and aircraft cabin filtration systems.

The majority of these devices have twin inlet configurations which are designed to monitor the "field" (external) air which is challenging the filtration system and the "personnel" (internal) side air after filtration. The systems can be used in on-line field applications or in lab based development tests.

Military Atmosphere Monitoring Systems.

ESS supply SAMS (Submarine Atmosphere Monitoring System) for the continuous analysis of personnel breathable air on board submarines and ships.

The instruments have full automation and multi-point monitoring with logging and alarms.

Designed to stringent military specifications and shock tested to over 9G, these systems are extremely robust.

Filter Testing

Components Typically Analysed	Detection Range
Chlorine	10ppm to 100%
Methylene Chloride	10ppm to 100%
Oxygen	0-25%
CO ₂	10ppm to 100%
CO	1ppm to 100%

SAMS

Components Typically Analysed	Detection Range
Nitrogen	10ppm to 100%
Hydrogen	50ppm to 50%
Oxygen	0-25%
CO ₂	10ppm to 100%
CO	1ppm to 100%
Freons	10ppb up

It is NOT possible to provide a reference list but contacts can be made upon application if suitable credentials are supplied. ESS have supplied more than 15 specialised military systems.

Pure Gas Analysis Systems

ESS have supplied a number of high purity gas analysis systems for measurement and certification of trace elements in pure gases.

These systems feature multi-gas type application software with automated user interactive software for calibration and analysis. Used in gas supply for general applications and in the Off-Shore gas supply field.

Similar systems are available for on-line use in pipeline applications where continuous monitoring of traces in one or more pure gas supply stream is required.

Pure gas systems utilise high pressure gas tight ion source designs to lower the detection limits on tough species such as CO₂.

Gases Analysed at trace level

Acetylene	0.5ppm to 100%
Argon	10ppm to 100%
CO	0.1 to 100% with auto correction for N ₂ and CO ₂ mass overlap
CO ₂	1ppm to 100%
Helium	1ppm to 100%
Hydrocarbons	1ppb up
Hydrogen	50ppm to 100%
Nitrogen	1ppm to 100%
Oxygen	0.5ppm to 100%

The GeneSys system is able to measure trace levels of any of the above in a high purity carrier comprising any one component or within mixtures such as Heliox or AR/O₂ mixtures.

Users can easily set pass / fail criteria for individual components and mixtures.

See reference list for details.

Specials

Unlike many suppliers, ESS is always prepared to discuss special system design and build packages. The incredible power and flexibility of GeneSys software makes incorporation of the instrumentation with other systems a relatively simple task.

Over the years, we have jointly developed many special systems of which we can be justifiably proud. These range considerably in size and scope and can be represented by the examples below:

Ground Drilling VOC monitor

ESS were asked by Subadra Ltd, a ground excavation company to develop a detection and logging system to use with a drilling probe. The probe consists of a series of tube section hammered in to the ground by a hydraulic hammer. The entire system is mounted within a modified pick-up truck.

A small ecoSys-P was used along with specialist software for automatic calibration. The system, which is hosted by a laptop also acquires data from a Geoprobe soil conductivity sensor and depth from the Geoprobe string- pot via a PCMCIA card.

The combined MS, Depth and conductivity data is combined on a single display for the user plotting MS data and conductivity against depth in an x-y plot. Acquired data is also automatically assembled in Excel spreadsheet format.

"Cracking" Systems

Many suppliers of evacuated products such as Lighting, Plasma Display Panels, thermionic valves etc have considerable interest in understanding the gas composition within a sealed unit after manufacture. Accordingly, any system which can take a sacrificial sample unit, "crack" it and analyse the contents is of considerable benefit to both R&D and Quality programs.

ESS have built and supplied a number of special systems to provide just this type of analysis on sealed units with automated process steps.

In general, these systems require a high vacuum chamber in which the component is placed and evacuated prior to "cracking" after this, the (often very small) volume of gas in the component is passed to the MS by a low volume inlet system for analysis.

ESS have supplied systems to Association of British Glass Manufacturers, Woree Lighting, Samsung, Philips and EEV for this type of application.

Please see the reference list for details

Residual Gas Analysers

ESS are pleased to announce our entry to the Residual Gas Analyser RGA market.

The RGA from ESS is a full featured, low cost, high performance unit designed with a fast parallel interface. Unlike many "Smart Head" designs, the RGA is available fully radiation hardened for synchrotron use.

Full details of the RGA and software can be found on our RGA demonstration CD available on request features in summary:

**Very Small Head Amplifier and RF measures just 110 X 90 X 160 mm for
300AMU Dual detector.**

100, 200 or 300 AMU dual detector

Analogue Scan

Histogram Scan

Ion V Time

Leak Detect

Multi-monitor Alarm Panel

Built in analogue and Digital I/O

User Inputs to IVT display mode

Excel data file format without conversion

Low Cost

Refrigeration Systems

How many cooling systems are there on this planet ?
The answer is a lot more than you think !

We have got Fridges, Freezers, shop cabinets, Aircon and what about that cold can of Coke from the machine in the street or your next pint of Guinness !. All of these devices require chillers and not just any old chiller, one with a guaranteed 12 year lifetime.

Chances are if you ever drank anything cold in the UK it would be from a system chilled by an IMI Cornelius product. To keep up the quality and the 12 year guarantee, IMI turn to ESS for high quality low detection, reliable Freon leak detectors.

ESS manufacture LeakSys and LeakSys2 portable single or dual inlet leak detection systems. These devices offer a perfect tool for production line monitoring of positive pressure micro-leaks in refrigeration manufacture.

Designed with simple operator software, LeakSys allows button interaction with the user via the on-screen menu or via the probe tip buttons. Leaksys 2 offers all of the features along with a second probe. Detection is so fast that the instrument is able to switch between probes and give output to two separate stations whilst avoiding any inter-station cross over. In short, two leak detectors for the price of one.

continued..

Refrigeration Systems continued

LeakSys is easy to use with robust probes. Buttons on the probe allow re-calibration and zeroing with Leak-Creep technology allowing users to "creep-up" and pinpoint big leaks which simply swamp many detectors.

The devices feature ultra fast response times and very low (sub 0.001g/yr) detection levels. Handset bargraph and alarm display allows the user to concentrate on the job without having to look up at the monitor display. Calibration takes seconds with user activation from the probe (against a standard leak) or on-board autocalibration against on-board standard leak.

On screen, button selection of gases and simple user gas addition is a standard feature of LeakSys.

LeakSys finds uses in many other Freon related applications such as workspace safety in water and other industrial plant along with low level leak checking of implantable medical pumps etc.

Typical Gases	Detection g/yr
Freon R11	0.01
Freon R114	0.01
Freon R12	0.01
Freon R13B1	0.01
Freon R245	0.01
Freon R21	0.01
Dimel Vertel Blend	0.01
Helium	0.01

Users:	Instruments
IMI Cornelius, Brighthouse & Sheffield UK	10
Infumedics Inc, Walpole MA, USA	2

Vacuum Process Certification

ESS were approached by Epichem Limited (at that time a special gas division of Air Products Inc) to design and build a system for the pump-down, bake, vacuum leak check, positive pressure leak testing and prepared atmosphere certification of their Organo-metal bubblers.

The bubblers, used to supply Organo-Metals to the semiconductor industry are small volume metal canisters with inlet and outlet valves. Because of the high vacuum ultra-clean nature of the supply, it is essential that bubblers are very clean prior to filling. It is also essential that the bubblers are Oxygen and leak free to avoid the risk of explosion.

We developed a special dual inlet GeneSys based system for this application which features a calibrated positive pressure leak test mode and an automatic high vacuum test mode.

First of all, bubblers are placed on the bench. Filled to a fixed pressure with Helium and all joints are "sniffed" with the positive pressure leak probe handset. Any detected leak is recorded against bubbler serial number and any leak exceeding the user defined maximum results in rejection.

Bubblers are then assembled on a line of ten units with an oil free backing pump and Turbomolecular pump. Under full software control the external line is evacuated and then held whilst the operator checks all joints with an external spray whilst the GeneSys monitors any He leak.

If the leak test is passed, the bubblers are pumped and baked. At the end of the test, the atmosphere in the bubblers and header line is automatically analysed by the GeneSys system. To pass, all bubblers must be below 1ppm on water, oxygen and solvent.

At the end of the test, the operator is notified of pass-fail and all data is logged for tracability..

Components Monitored	Detection Limit
Acetone	0.5ppm
Ethanol	0.5ppm
Helium	0.5ppm
Nitrogen	0.5ppm
Oxygen	0.5ppm
Trichloroethylene	0.5ppm
Water	0.5ppm

Principal Customer Epichem Ltd in UK, USA, Japan and Taiwan. Units Purchased 6

See Reference List

Reference List by Type:

Please note: contacts listed here have NOT been approached by ESS to provide references. You may contact any of them and they may or may not reply entirely at their own discretion.

Brewing:

Chris Buckingham (site engineer) & Nicola Staples (QA Manager)

Tel: +44 208 3925435

Fax: +44 208 3925549

E-mail: chris.buckingham@anheuser-busch.com or nicola.staples@anheuser-busch.com

Stag Brewery

Lower Mortlake Rd

Mortlake

London SW14 7ET

Ian Bell (Facility Manager)

Tel: + 447711433810

Fax: +442890404646

E-mail: ian.bell@guinness.com

Irish Bonding (Guinness)

3 Marshals Rd

BELFAST

Northern Ireland

BT5 6SL

Complex Gas Mixtures

Dr Roy Partington
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E-mail: partinSR@bp.com
BP International Ltd
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Sunbury-Upon-Thames
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DOW Chemical Inc
Building B-3827
2301 North Brazosport Blvd
FREEPORT
Texas 77451-3257 USA

Peter Jones
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ICI Chemicals
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Runcorn
Cheshire

Environmental Monitoring

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Subadra Ltd
66-70 White Lion Rd
Amersham
Bucks.
HP7 9JS
UK

Fermentation

Paul Gibson
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E-Mail:

DSM Bakery Ingredients
Dock Rd
Felixtowe
Sussex
IP11 3QW
UK

Food Grade Gases

Legal reasons prevent us from naming our client in any public media. We are certain however that they would be prepared to provide a reference to suitable applications if we requested them to do so. Please contact ESS with any inquiries.

Medical Applications

Professor Milner
Tel: +44 207 9289292
Fax: +44 2079228327

Newborn Respiratory Unit
St Thomas' Hospital
4th Floor North Wing
Lambeth Palace Rd
LONDON
SE1 7EH

Dr Ian Ketchell & Dr Graham Clarke
Tel: +44 207 346 3250
Fax: +44 207 346 3589
E-mail:

Respiratory Physiology
Kings College Hospital
Bessemer Rd
London
SE5 9PS

Steve Cockbill
Tel: +44 115 9709349
Fax: +44 115 9709384

Division of Cardiovascular Medicine
D-Floor, South Block
Queens Medical Centre
Nottingham
NG7 2UH

Military Systems

Once again we cannot publish reference contacts in any public domain format. We are confident however, that we will be able to arrange reference contacts for any genuine military enquiry.

Pure Gas Analysis

Erik Driesmans (head of analysis Europe)

Tel: + 32 22559111

Fax: +32 22559100

E-Mail: DRIESME@apci.com

Air Products NV

Houtemse Steenweg 20

B-1800

VILVOORDE

Belgium

Jon-Olav Birkeland

Tel: + 47 51632460

Fax: + 47 51632480

Gardner Cryogenics

Luramyrveien 27

N-4313 SANDNES

NORWAY

Specials

Adam Kelsall
Tel: + 44 1142686201
Fax: +44 1142681073

Confederation of British Glass Manufacturers
Northumberland Rd
Sheffield
S10 2UA
UK

Jay Chang
Tel: +82 3454916087
Fax: +82 3454926721

Wooree Lighting Co Ltd
636-3 Sunggok-Dong
ANSAN City, Kyunggy-Do
KOREA

Refrigeration

Roger Marsh
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Fax: +44 1484 721535

IMI Cornelius Ltd
Bradford Rd
Brighouse
West Yorkshire
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UK

Chuck Aubin
Tel: +1 801 595 0700
Fax: +1 801 595 4969
E-Mail: caubin@eastdevelopment.com

Infumedics Inc.
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East Walpole
MA 02032
USA

Vacuum Process Certification

Martin Skitt
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Epichem Ltd
Power Rd
Bromborough
Wirral
Merseyside
L62 3QF
UK

Ravi Kanjoli

Tel: +1 978 374 5200
Fax: + 1 978 374 6474
E-Mail: Kanjolir@epichem.com

Epichem Inc
26 Ward Hill Ave
HAVERIL
MA 01835
USA

A brief summary of Key Accounts (commercial)

ESS have a customer base which exceeds 1000 users and we trade in over 15 countries worldwide. The following is a short list of some of our key accounts...

**AEA Technology
Air Products
ALF Atochem
Anheuser-Bush Inc.
AWE Aldermaston
BAE Systems
Beverage Air Inc.
BOC
BP Chemicals
CBDE Porton Down
CRE
DOW Inc
DSM Bakery Products
Edwards GRC Ltd
Edwards High Vacuum
Epichem Inc.
ETI
Exxon Inc.
Guinness
Hunting Brae
ICI Syntex
IFR
IMI Cornelius
Infumedics Inc.
Motorola
Philips
Rolls Royce
Rover Group
Royal Ordnance Special Metals
Samsung
Shell Chemicals
Terra Industries Inc.
Vacuum Generators
VG Scientific
VG Semicon
Westaim Inc.**

A brief summary of Key Accounts (Government Research & University)

ESS have a customers in almost all UK Universities and many others worldwide. We are also key suppliers to Government research agencies and Hospitals. The following is a short list of some of our key accounts...

**Brunell University
Cavendish Labs (University of Cambridge)
CNRS Paris
Defence Engineering Research Agency (DERA)
Dublin University
Edinburgh Royal Infirmary
Eindhoven University
Engineering & Science Research Council (ESPRC)
Environment Agency
Friedrich Schiller University Berlin
Guys Hospital London
Harefield Hospital
Imperial College
Karl Franzens University
Kings College Hospital
Kobenhavn Universitet
Liverpool University
Max Planck Institute
Nuffield Department of Anaesthetics (Oxford University)
Queens Medical Centre Nottingham
Queens University Belfast
St Thomas's ("Tommys") Hospital London
Strathclyde University
UCL
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