Environmental Triaxial Testing System (ETTS)

Overview: The Environmental Triaxial Testing System (ETTS) is a temperature controlled testing system for stress path testing. Key features include:-

- Frozen Soil Testing
- Gas Hydrate Testing
- High Pressure Testing
- High & Low Temperature Testing

The -40°C cooling system provides ideal conditions for frozen soil testing. Its high pressure testing capability (up to 100MPa) along with low temperature provides the ideal environment for Gas Hydrate Testing. The system also has the option for a Heating only system.

Key Features:

	Benefits to the User:
Heating & Cooling Options: -40°C to +65°C -20°C to +80°C -10°C to +65°C	The cooling system uses a coiled tube section inside the cell, this is connected through the standard ports within the cell base to a glycol cooling unit allowing temperature transfer close to the specimen.
Optional Heating Only System: Ambient to 60°C Ambient to 100°C	The heating system works using thermal pads attached to the outside of the triaxial cell then enclosed within an environmental chamber to retain the heat. There are up to 4 temperature sensors relaying back to the control box for enhanced temperature accuracy.
High Pressure (Up to 100MPa):	High Pressure combined with low temperature make it ideal for Gas Hydrate testing.
Gas Hydrate Testing (Gaseous back pressures):	The ETTS be adapted for gaseous back pressures such as Air, Carbon Dioxide, Nitrogen or Methane for Gas Hydrate testing.
Frozen Soil Testing:	Cooling to -20°C provide ideal conditions for frozen soil testing.

Tests that can be Performed:

B-check, consolidated drained (CD) triaxial, consolidated undrained (CU) triaxial, consolidation (Triaxial), constant rate of loading (CRL), constant rate of strain (CRS), slow cyclic testing, K0 (K-Zero), multi-stage testing, quasi-static (low speed/creep) tests, stress paths and unconsolidated undrained (UU) triaxial. All tests can be performed with complete control of specimen temperature.

Upgrade Options:

LVDT strain set, cell top lifting frame, high pressure bishop & wesley (without heating & cooling).

Technical Specification:

Pressure range (MPa):	10
Sample Size (mm):	Max length: 100, Max diameter: 55
Available Temperature Ranges: Heating Only: Heating & Cooling:	 Ambient 65°C, Ambient to 100°C -40°C to +65°C, -20°C to +80°C, -10°C to +65°C

Fig 1. System set-up with Frozen Soil Testing

GDSLAB Software

GDSLAB is the control and data acquisition software. The software starts with a core application known as the kernel which, allows for data acquisition from your hardware, but no test control. Simply add the appropriate module or modules to complete the test suite functionality you require.

8 Channel Serial Pad

The standard GDS 8 channel data acquisition device, known as the "serial data pad", may be used within any system combination. This 16 bit device has 8 computer controlled gain ranges, specifically designed to suit transducers used in a triaxial test. i.e.

+/-10mV, +/-20mV, +/-30mV (load cells)
+/-100mV, +/-200mV (pressure transducers)
+/- 1V, +/- 5V, +/- 10V (displacement transducers)

Gaseous Back Pressures

- Carbon Dioxide
- Nitrogen
- Methane
- Air

Used in conjunction with a GDS PC Controlled pressure intensifier for gaseous pressure of up to 25MPa.

Pressure Volume / Controllers

- Enterprise Triaxial Automated System (ELETTS) which is based on 1MPa Enterprise Pressure /Volume Controller (ELDPC).
- Standard Triaxial Automated System (STDETTS) which is based on 3MPa Standard Pressure /Volume Controller (STDDPC).
- Advanced Triaxial Automated System (ADVETTS) which is based on 2MPa Advanced Pressure /Volume Controller (ADVDPC).
- High Pressure Triaxial Automated System (HPETTS) which is based on High Pressure Controllers (≥ 16MPa).

Load Frames & Triaxial Cells

- 7kN/2000kPa, for specimens up to 50mm (38mm and 50mm as standard).
- 25kN/2000kPa, for specimens up to 101.8mm (38, 50, 70 and 100mm as standard).
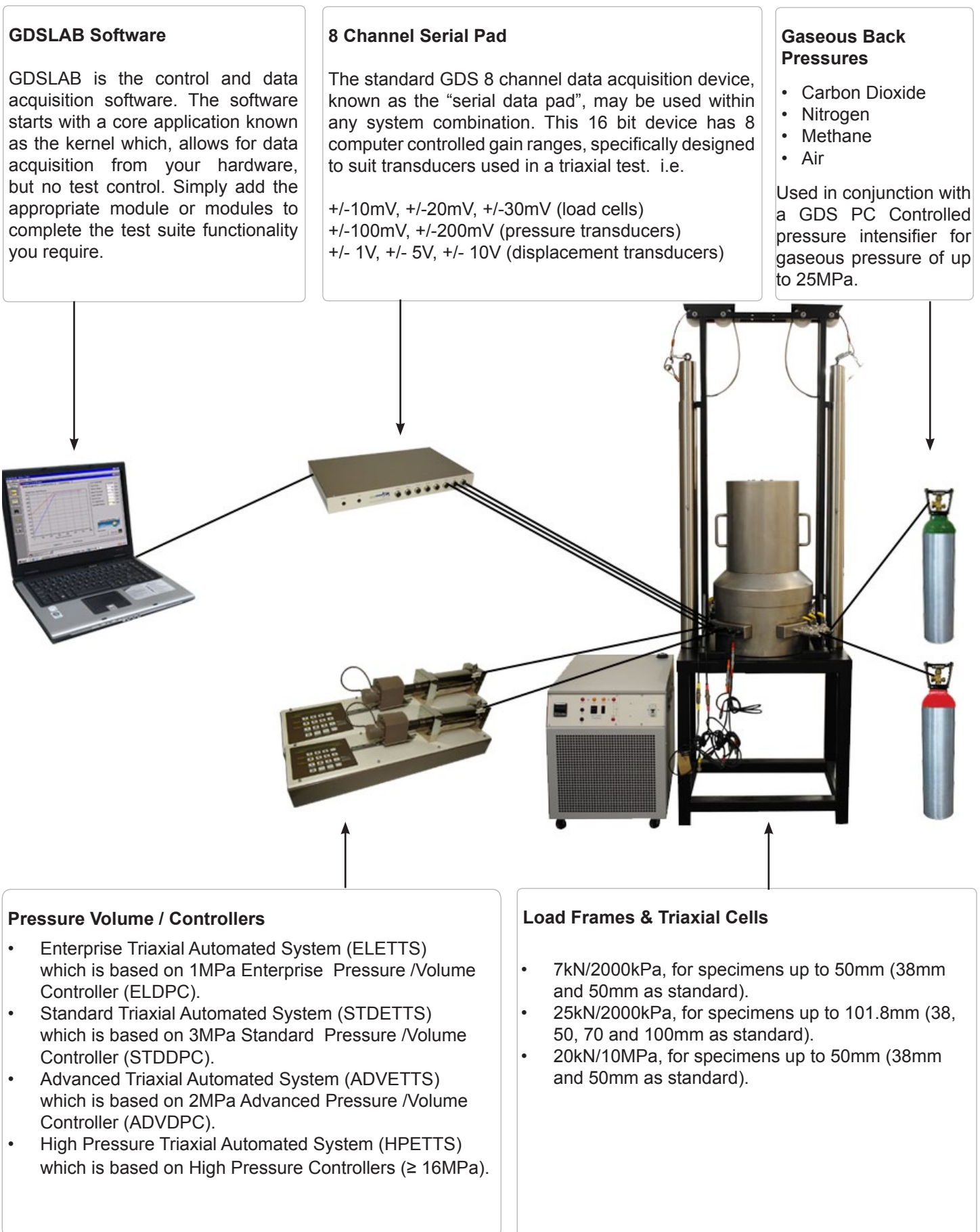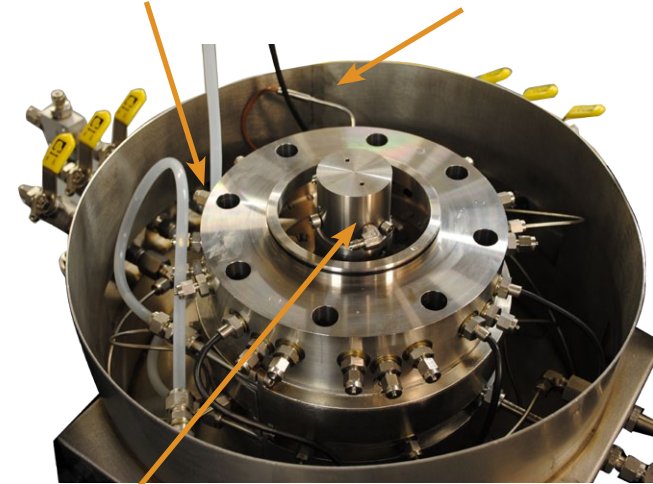- 20kN/10MPa, for specimens up to 50mm (38mm and 50mm as standard).

Fig 2. Key features of the ETTS

Optional: 24 port access ring for transducers, such as LVDT, temperature, acoustic, velocity or accustic emmissions.

Internal thermo couple

Counter balanced cell top lifting frame

Easy lift environmental isolation chamber

Base pedestal

Sufficient porting to allow liquid and gaseous echange
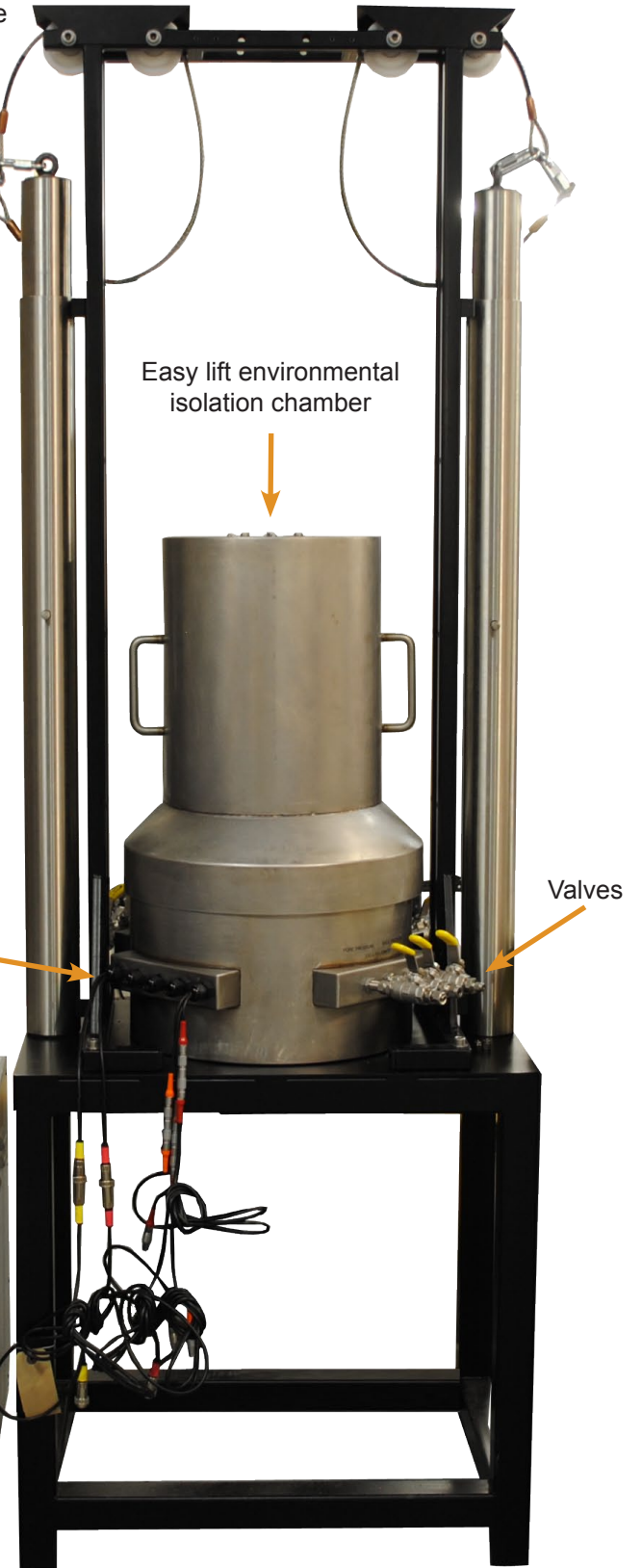
Access ports for additional instrumentation

Valves

Note: Low noise system ideal for accurate emissions testing

Optional: Heating and cooling system, controlled from GDSLAB

GDSLAB Control Software

GDSLAB is the control and data acquisition software for geotechnical laboratory applications. GDSLAB starts with a core application known as the kernel. The GDSLAB kernel allows for data acquisition from your hardware, but no test control. Simply add the appropriate module or modules to complete the test suite functionality you require. GDSLAB is compatible with all existing GDS equipment and furthermore key hardware from other manufacturers.

GDSLAB has the ability to be configured to your hardware of choice, no matter how unique the arrangement. A text file (*.ini) or initialisation file is created that describes the hardware connectivity to the PC. The hardware layout is available in graphical format via the GDSLAB 'object display'. This makes setting up the devices and checking the connectivity extremely simple.
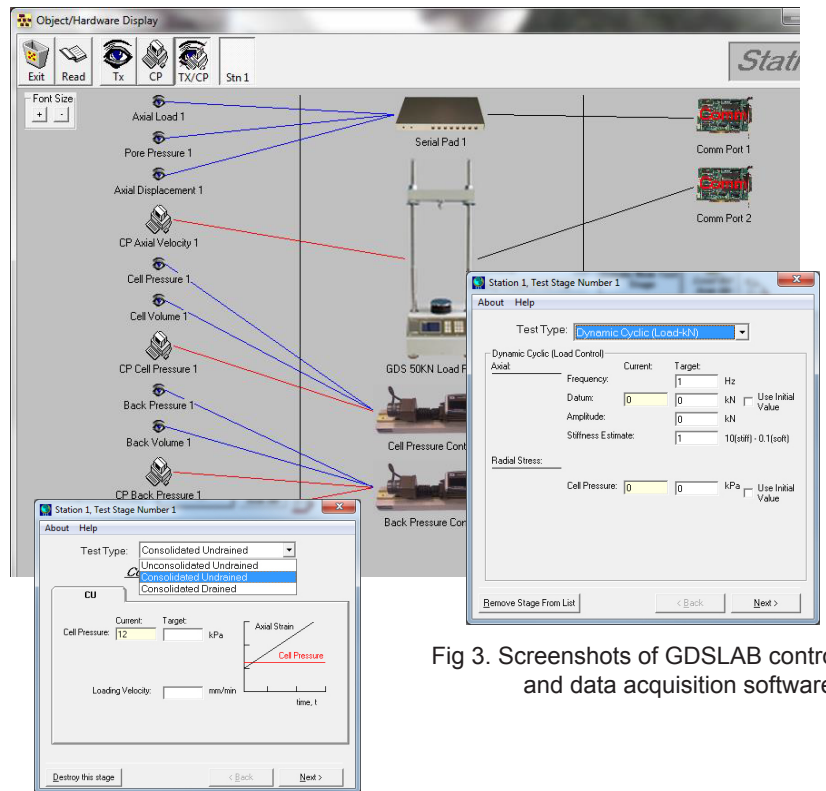
GDSLAB REPORTS
Presentation Software

GDSLAB REPORTS software presents data obtained by GDSLAB to the National Standard, BS 1377:1990. The program can be used to present data whether obtained from a GDSLAB data file or inputted by hand.

GDSLAB Reports can as be used with other manufacturer's dataloggers as well as all versions of GDS data logger. The results can be exported as a CSV file into Microsoft Excel, allowing the user to customise the layout of results.
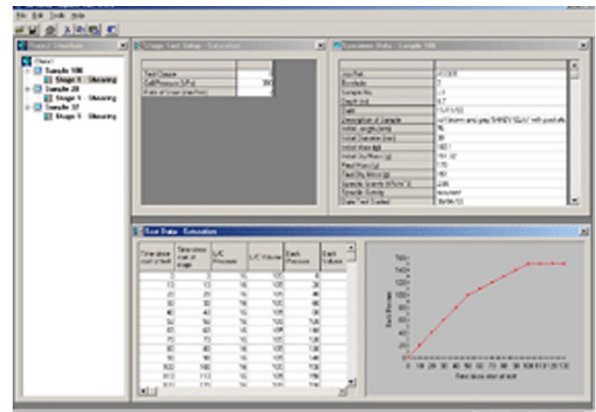

Fig 3. Screenshots of GDSLAB control and data acquisition software.

Fig 4. Screenshot from the GDSLAB Reports.

Note: Operating System: Windows XP SP3 or higher (We recommend that whichever version of Windows you are running, that it is up to date with the latest Service Pack). PC Spec Hardware: 1GHz (minimum) / 1GB Ram (minimum).

Applications

Images courtesy of : U.S. Geological Survey Department of the Interior/USGS
U.S. Geological Survey/photo by Suzanne Weedman (Frozen Soils) & J. Pinkston and L. Stern (USGS - Gas Hydrate &)

Frozen Soils   Gas Hydrate

Technical Specification

Load Frame & Triaxial Cell:

Load Range (kN):	Up to 2500
Pressure Range (MPa):	Up to 64
Sample Sizes (mm):	Up to 150 diameter

Temperature Control:

Combined Cooling / Heating:	-40°C to +65°C, -20°C to +80°C, -10°C to +65°C
Heating Only System:	Ambient to 65°C, Ambient to 100°C
Cooling Only System:	Ambient to -40°C
Computer Interface:	RS232 serial cable

Data Acquisition:

8 Channel Serial Pad:	May be used within any of the system combinations. This 16 bit device has 8 computer controlled gain ranges, specifically designed to suit transducers used in a triaxial test.

Pressure Controllers:

ELDPC:	Available in one configuration, 1MPa pressure and 200cc volume.
STDDPC:	Available in 200cc only, but with pressure ranges from 100kPa to 4MPa (default is 3MPa).
ADVDPC:	Available in pressure ranges from 100kPa to 8000KPa and a volumetric capacity of 200cm^3, or up to 2000kPa with avolumetric capacity of 1000cm^3.
HPDPC:	The high pressure version is available in pressure ranges from of 8MPa to 150MPa and a volumetric capacity of 200cm3. High pressure controllers can be used with water, oil or air.

Software:

GDSLAB:	Control and acquisition software.
GDSLAB Reports:	A program to produce results from data obtained by GDSLAB to National Standards, BS 1377:1990, ASTM D2850, D4767, D7181.
Available Test Modules:	SatCon (saturation & consolidation), Standard Triaxial (strain-controlled shearing), K0 Consolidation, Permeability, Stress Paths (q-p and s-t linear paths), Advanced Loading, 4D Unsat (stress paths for unsaturated soil).

Upgrade Options:

Bender Elements:	The system can be upgraded to perform P and S wave bender element testing.
Unsaturated Testing:	The system may be upgraded to perform Unsaturated Testing using Method A or D (Method B on request).
Local Strain Transducers:	Hall Effect transducers may be used in water up to 1700kPa. LVDT transducers come in 2 versions low pressure (up to 3500 kPa) version for use in water & high pressure (up to 200 MPa) version for use in nonconducting oil.
Gaseous Back Pressures:	Air, Carbon Dioxide, Nitrogen & Methane.