

# Life Support Equipment Test Facility

(LSTF RB100)



## Introduction

The ANSTI Life Support Equipment Test Facility (LSFT RB100) is a fully integrated, laboratory system specifically designed to test and measure the dynamic breathing performance of a wide range of life support equipment.

EN 250 : 2014 (Regulators)  
 EN 14143 : 2013 (Rebreathers)  
 EN15333-1 : 2008 (Helmets)  
 US Navy Unmanned Testing Procedures

The tests are conducted accurately and efficiently at the surface and / or immersed in water to a maximum simulated depth of 100 msw.

The test vessel (nominal internal dimensions diameter 1000 x 1300mm deep) is sufficient to accommodate twin cylinder SCUBA diving equipment, diving helmets / masks with bailout cylinder and rebreathers (maximum dimensions 850 x 500mm) in both swim and head upright positions. Additionally, the system will also allow the breathing performance of a wide range of surface equipment e.g. filter masks and fire fighting BA etc to be measured.

**The above picture shows a 200 msw system with optional extras such as the underwater cameras / recording equipment / monitors and a modified mannequin with provision for remote operation.**

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The facility is supplied with a medium ISO head form with adapters to connect other types of life support equipment and a space frame mannequin.

The test vessel lid incorporates a quick release mechanism, which improves efficiency and minimises operator effort. The test vessel is fitted with a depth controller which allows automatic venting of air to accurately maintain the set depth. The depth controller is capable of discharging in excess of 10,000 litres/min of air safely to atmosphere and therefore acts as an emergency relief valve and fails safe in the event of any or all of the following; loss of electrical power, LP air supply, and high pressure seal failure.

The Stainless Steel Breathing Simulator utilises a pure sine wave drive linkage. It has variable tidal volume and push button control of breathing rate. The breathing system is fitted with a heating and humidification system and, with an environmental control system to cool / heat the water in the test vessel, the facility will test the extreme range of breathing performance required by the above standards.

The test facility incorporates an integrated CO<sub>2</sub> injection / O<sub>2</sub> mixture removal and measurement system. The system combines a range of instruments to allow fixed ventilation rate/depth simulation for O<sub>2</sub> removal and CO<sub>2</sub> generation whilst monitoring the response of the breathing apparatus under test. The system includes a computerised data acquisition system to allow both real-time monitoring and post-test analysis of the CO<sub>2</sub> breakthrough characteristics of CO<sub>2</sub> canisters, breath by breath CO<sub>2</sub> build up in full facemasks / diving helmets and inspired O<sub>2</sub> levels.

The test facility is simple and logical to use and, when combined with the computerised data acquisition system, allows the operator to undertake rapid testing of equipment. The computer is programmed to be a virtual instrument with key operator information, such as depth, cylinder pressure, exhaled gas temperature etc, displayed on the screen. The operator can view equipment performance via a range of multiple real-time displays. The acquired data can then be analysed, reviewed, archived, and / or printed in the form of Test Certificates.



## Specification

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### General

The system has approval to European and American design codes. It is supplied as an integrated, fully calibrated turnkey package. A Technical Manual is supplied with comprehensive details of the equipment and contains full Operating Instructions.

### Test vessel

The test vessel is fully constructed from Stainless Steel and rated to a maximum working pressure of 100 msw. The nominal internal dimensions are 1000 dia x 1300 deep. The lid system utilises the ANSTI proprietary quick release locking mechanism and incorporates a pneumatic lifting system with safety interlocks. The lid is also fitted with a manual vent / inter-lock safety device to prevent accidental pressurisation.

### Environment control system

The test vessel environment conditions are independently controlled by an external chiller / heater system. This will chill / heat the test vessel water prior to the cold / hot water tests and will maintain the set temperature during testing in accordance with EN 250:2014, EN 14143:2013 and the US Navy Unmanned Testing Requirements.

### Heating / humidification system

The Heating / Humidification system is designed to provide exhaled air temperatures and RH levels in accordance with EN 250:2014 and EN 14143:2013.

### Breathing simulator

The Breathing Simulator is fully constructed from Stainless Steel and rated to a maximum working depth of 100 msw. It is of piston design which provides a very accurate / repeatable volume displacement using a pure sine wave drive mechanism. It has adjustable tidal volume settings (1, 1.5, 2, 2.5, 3, 3.5, 4 and 4.5 litres) and push button control of breathing rate (10, 15, 20, 25, 30 & 40 breaths per minute) providing ventilations in the range of 10 to 180 litres per minute.

### CO2 Injection and measurement system

The CO2 Injection and Measurement System utilises a mass flow controller capable of injecting a calibrated flow of up to 5 lpm CO2 into the gas stream. The fast response carbon dioxide analyser used for breath by breath measurements is designed to operate from the surface to 100msw. The output from the analyser is displayed in real-time on a separate PC and the test data archived for post-test analysis. The system

includes all external pipe work and internal sample tubes but excludes rebreather inspired hose adapters, as they are specific to the apparatus under test.

### Oxygen uptake simulation / measurement system

The simulation of oxygen uptake is achieved via combination of instruments allowing the removal of gas mixtures from the test apparatus and the injection of a pure or mixed gas diluent. The system includes digital flow meter and mass flow controller as well as a fast response oxygen analyser integrated to function with the computerised data acquisition system. The system is again designed to function from 3msw to 100msw at 0.5-3lpm of O2 consumption for a ppO2 of 1.0 bar and includes all injection, removal, and sample probe tubes.

### Computer & instrumentation

The ANSTI data acquisition module is based on a PC linked to the USB high speed data acquisition card. The system generates a range of real time displays of Pressure-Volume diagrams and provides a data archiving and retrieval for visual display and optional printing of test results. The system is controlled via sub menu selection options.

### Control console

The main sub-systems are integrated into the control console module. The front fascia panel includes the test vessel lid controls, pre-set automatic depth controller and breathing machine controls etc. Access to the breathing simulator is via twin front panels each fitted with safety inter-locks to automatically isolate the breathing simulator if opened whilst in operation.

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