



DEFENCE BIO-ENGINEERING AND ELECTROMEDICAL LABORATORY

Defence Bioengineering and Electromedical

Laboratory (DEBEL) was formed in April 1982 by bringing together the Aero Bioengineering Unit (ABEU) located in ADE campus and the Electromedical Instrumentation Division (EMID) of LRDE located at LRDE campus. Today DEBEL is one of the few DRDO laboratories dedicated to both R & D work for the Services and also Technology spin offs for civilian application.

ABOUT THE LAB

The genesis of research and development in Bioengineering and Electromedical Technology related to Defence can be traced to two units. In 1958, a very small group called Aeromedical Section was formed as part of DTD&P (AIR), Ministry of Defence, New Delhi. It functioned from the premises of the then Institute of Aviation Medicine (IAM), Bangalore. In 1974, it was renamed as Aero Bioengineering Unit (ABEU). In 1980, it was brought under the Directorate of Food and Applied Sciences, DRDO. It shifted to an accommodation in the Aeronautical Development Establishment (ADE) Complex, CV Raman Nagar, Bangalore, in September 1980. During this period, the unit had been undertaking indigenization of aircrew flying, protective and survival clothing and equipment for the Air Force, Indian Navy and Hindustan Aeronautics Limited, Bangalore.

When the Electronics Research and Development Establishment (LRDE) was formed in 1958, it had a special equipment division called EMID which was also in charge of the R&D activities related to Electro-medical Equipment. A modest programme for the design and development of a small number of biomedical instrumentation as well as personal protective systems for aircrew was initiated. The broad specialized areas of work scheduled to be taken up in the future included Aeromedical Engineering & Life Support Systems, NBC Protection, Underwater Systems and so on.

The then Scientific Advisor, Dr. Raja Ramanna, in 1982, visualized that a complex R&D activity of this nature, involving multidisciplinary fields, can make rapid progress to meet the challenging requirements of Service Combatants, only when the concerned groups operate under one roof with special impetus. Hence, in January 1982, EMID was transferred with its staff to ABEU. Thus was born the Defence Bioengineering and Electromedical Laboratory (DEBEL), in April 1982, by the merger of ABEU and EMID. The Laboratory started functioning from its own premises located at the ADE campus with effect from 17 June 1994 and is rigorously pursuing R&D activities in the above mentioned areas of specialization and more.

AEROMEDICAL Engineering

INTEGRATED LIFE SUPPORT SYSTEM(ILSS)



On-Board Oxygen Generating System (OBOGS) Centric Integrated Life Support System provides enhanced physiology protection to aircrew of combat aircrafts. OBOGS preplaces Liquid Oxygen System (LOX) & generates oxygen enriched breathing gas by utilizing conditioned bleed air from the aircraft engine & separating its components using molecular sieve Pressure Swing Adsorption (PSA). The ILSS consists of 11 subsystems integrated together to provide desired protection. Use of OBOGS technology in fighter aircraft eliminates the logistic tail associated with liquid oxygen system, improves safety, reduces aircraft turn-around time, extends mission duration & significantly lowers operational cost.

HELICOPTER OXYGEN SYSTEM



Provides oxygen enriched breathing gas on demand to the helicopter pilot with appropriate O₂ concentration which varies with altitude. Consists of high pressure light weight composite cylinders of 2L (WC) and 200 bar working pressure.

- ▶ Chest mounted demand dilution oxygen regulator
 - ▶ Meets JSSG 2010 and DEF STD 970 for oxygen concentration with altitude and flow requirement
 - ▶ Work satisfactorily upto 30000 ft altitude
 - ▶ Caters for 40lpm average and 120lpm peak flow
 - ▶ Provides endurance of 2 hrs
- Flexible oxygen compatible hose with dolls eye flow indicator

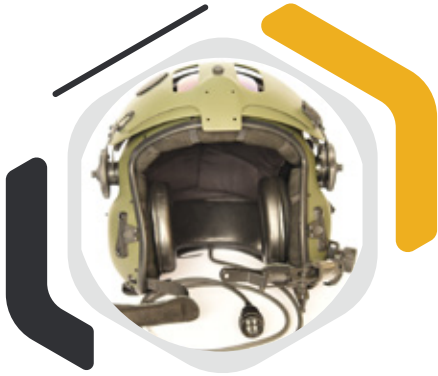
COMBAT FREE FALL OXYGEN SYSTEM



Oxygen system and protective equipment to protect combat free fall paratroopers against decompression sickness, hypoxia, hypothermia during bailout. The breathing system supplies oxygen on demand for enhanced breathing time and can support breathing of 6-8 paratroopers for approximately one hour during pre-breathing of 100% O₂.

The system has in-built Automatic control of oxygen concentration in breathing gas with respect to altitude and hands free communication through the Helmet –Mask-Radio set combination. The Oxygen system provides breathing gas to paratrooper for more than 50 minutes during descent from 30,000 ft altitude to ground. Inner and outer jump suit for protection from extreme low temperature. Specially designed boots for protection from leg injuries and landing shock

LIGHT WEIGHT INTEGRATED HELMET



Salient Features

- ▶ Protection from Open jet windblast up to 600 KEAS {tested at France in 6 different configurations as per MIL-V-29591/1(AS)}
- ▶ Maximum Neck load is 1200N against 3300 N (AGARD AR 330)
- ▶ Weight of the Helmet \leq 1.45 kg (excluding R/T & adjustment pads & HMSD mount)
- ▶ Protection against Impact & Penetration tests as per MIL-DTL-87174A
- ▶ Equipped with clear & tinted Polycarbonate visors for selection & meets various Optical parameters as per MIL_DTL-43511D
- ▶ Provision to mount HMSD
- ▶ Equipped with EMI/EMC qualified Preamplifier
- ▶ Helmet has 5 adjustments for comfort fit
- ▶ Meets Noise attenuation requirements in low to high frequency

PRESSURE BREATHING OXYGEN MASK



Salient Features

- ▶ Holds positive pressure breathing
- ▶ Fitted with Flame retardant fabric laminated hose
- ▶ Low breathing resistance as per Mil-V-27296C & MIL-M-87163A
- ▶ Compatible R/T to the aircraft



COMMON HELMET MASK FOR AIRCREW

Salient Features

- ▶ Manufactured out of aramid & other high performance fibres
- ▶ Protection against Impact & Penetration tests as per DEF-05-102
- ▶ Polycarbonate Visors meets various Optical parameters as per MIL_DTL-43511D
- ▶ Provision to mount NVG (GEN2 & GEN3)
- ▶ Meets noise attenuation test as per MIL-DTL-83425A
- ▶ Helmet has 7 adjustments for comfort fit
- ▶ Weight of the Helmet ≤ 1.7 kg

ON BOARD INERT GAS GENERATING SYSTEM (OBIGGS)



On-Board Inert Gas Generating System

(OBIGGS) The On-Board Inert Gas Generating System (OBIGGS)

produces inert gas (nitrogen) or fuel tank inerting of fighter aircraft. It polymeric uses hollow fiber membranes for generating Flow rate : 350 LPM nitrogen for blanketing the ullage space of fuel tanks to prevent fires/explosion

Brief Specification

Operating Pressure:

Nominal : 6 bar(g)

Max.: 11 bar(g) (Proof Pressure)

%N₂: 95±2% (350 LPM)

prevent fires/explosion.

Inlet air flow rate: 750 LPM

Salient Features

- ▶ System to be designed to lower the oxygen concentration in the fuel tank ullage to less than 9%
- ▶ Uses Hollow Fibre Membrane Technology for Nitrogen generation
- ▶ Hollow fiber design allows high membrane surface area per unit volume of container
- ▶ Hollow fibers are self-supporting, eliminate the need for expansive support Hardware
- ▶ Separation based on selective permeation across the membrane wall
- ▶ Passive separation: no moving parts are required for separation to take place
- ▶ Advantages of HFM systems includes high reliability, low weight, low cost and Lack of any substantial time lag in system start-up

Operating Pressure:

Nominal : 6 bar(g)

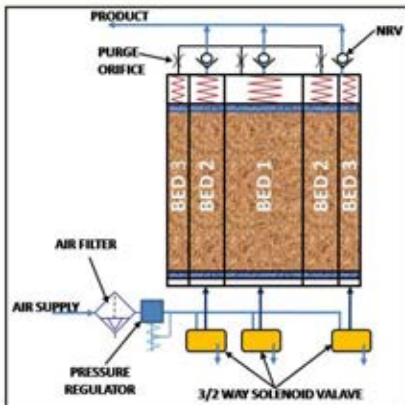
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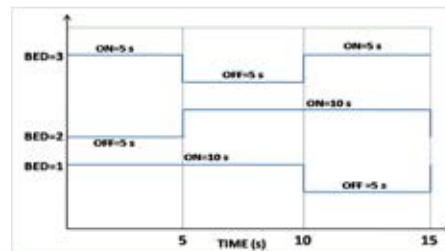
prevent fires/explosion.

Inlet air flow rate: 750 LPM

THREE BED ON-BOARD OXYGEN GENERATING SYSTEM (TBOGS)



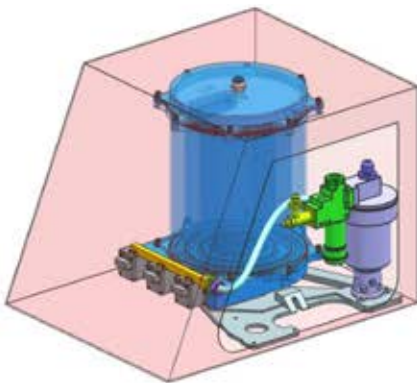
Schematic Of Three Bed OBOGS



Typical cycling arrangement



3D exploded view



3D model



Prototype

Technologies Involved :

- pressure swing absorption (psa)
- zeolite molecular sieves
- li-based low silica x-type (li-lsx)
- embedded technology for controlling and monitoring

Specification:

- oxygen purity : 95% @ 20 lpm
- flow rate : 200 lpm (max)
- pressure : 1.0 to 3.0 bar (g)
- co2 : < 50 ppm
- co: <1ppm
- dew point : < -50 °c

INTEGRATED LIFE SUPPORT SYSTEM FOR TEJAS



BIOMEDICAL Engineering

PORTABLE TELEMEDICINE SYSTEM

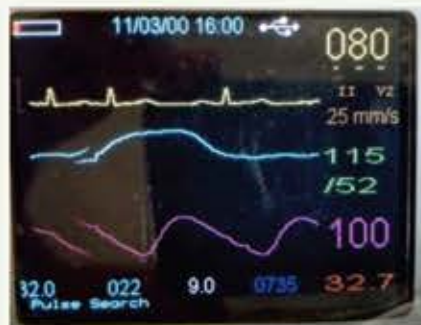
Telemedicine is the ideal technology to access remote medical expertise for management of severely injured and casualties, in forward areas and on-board ship.



Salient Features

- ▶ Biomedical Data acquisition System (BioDAS) to acquire vital parameters of patients
- ▶ Web Architecture
- ▶ Real-Time, Store & Forward and Scheduling modes
- ▶ Video Conferencing
- ▶ Live transmission of videos from medical devices

PORTABLE HANDHELD VITAL PARAMETER MONITOR



Vital Parameters Measurable :

- 12-Lead Diagnostic ECG
- Blood pressure - Sys/Diastole
- Pulse Oximetry - O₂ Saturation
- Skin temperature Capnography (Optional)
- End Tidal Volume CO₂ Value
- Respiration Rate
- Galvanic skin response (Optional)

Salient Features :

- Unit weight-600 grams
- 48 Hrs of Trend Data Storage
- 10 second of 12 lead ECG data storage and Wireless thermal printing
- 5-8 Hrs battery Back up
- Application & Viewing Software
- Wireless thermal printing

NBC RESPIRATORY MASK

PURPOSE :

Used to protect the respiratory tract and face against Nuclear Biological and Chemical (NBC) Warfare agents



Salient Features

- Materials of face piece and components have BTT > 48 hours
- Breathing resistance < 20 mmwc.
- Field of vision >70%.
- Manual speech diaphragm provides 75% voice transmission.
- NIOSH complaint Electronic voice enhancer can be attached.
- Operating Temp range -10°C to 45°C.
- Available in three sizes
- Provision for spectacle frame attachment.
- Provision for drinking water pouch attachment.
- Mask is decontaminable easily.

NBC INTEGRATED HOOD MASK

Integrated Hood Mask (IHM) Mk-II forms an integral part of NBC warfare protective suit and provides additional protection against the toxic agents used in NBC warfare



Salient Features

- ▶ IHM mainly consists of a Mask, Canister/Cartridge and the Hood
- ▶ The Hood Mask with the Canister provides protection to the face and respiratory tract against agents used in chemical warfare
- ▶ Hood is fabricated out of 2 layered material consisting of Disruptive printed, Oil and Water repellent (OWR) Nomex III A fabric and Activated Carbon Spheres (ACS) Coated and laminated fabric
- ▶ Hood is fabricated in 3 sizes: small, medium and large
- ▶ Hood is detachable and has to be discarded after one exposure to the contaminated environment

MANUAL RESUSCITATOR



PURPOSE :

Used to resuscitate the personnel who cannot breathe on their own in the NBC environment

Salient Features

- Modular system
- Materials used have BTT > 24 hours
- Breathing resistance less than 20 mmwc
- Bladder is capable of providing more than 500ml of filtered air per stroke
- Face piece is made up of transparent materials to see the face, with rubber bladder at the peripherals for comfort
- Pressure Relief Valve (PRV) to avoid overinflation of lungs
- One way valve for filtered air from external environment through NBC canister and rubber bladder to face piece
- Resuscitator is decontaminable

Protective Equipment & Flying Clothing

FLAME RETARDANT OVERALLS



Salient Features

- ▶ Made out of inherently flame retardant meta aramid fabric
- ▶ Comfort finish to meet wicking and moisture vapour transmission
- ▶ Available in different sizes
- ▶ Low heat release rate and sufficient escape time in the event of fire accident

AIR CREW PROTECTIVE CLOTHING



FR Anti G Suit



FR Autoatic inflatable life jacket



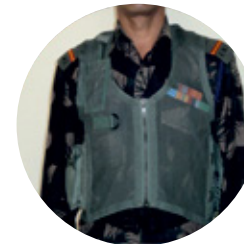
FR Gloves



Upgraded NATO Suit



Protective Clothing Aircrew



FR Aircrew Survival Jacket



Heated Gloves



Heated Insoles



Garter Leg Restrain

Flame Retardant personal protective clothing for fighter aircraft & aircrew is intended to provide protection to the aircrew in case of unforeseen fire hazards. The protective clothing encompasses FR Overalls, FR Gloves, FR G Suits, FR Life Jackets, FR Survival Jackets & also Leg garter restraint. The complete ensemble is intended to meet specific requirements & acts as an important life saving equipment. The ensemble is essentially made out of inherently flame retardant meta aramid fabric with comfort finish to meet wicking and moisture vapor transmission properties (FR Overalls). Anti-g suit is another important lifesaving equipment of overall ensemble of fighter aircraft pilot which is designed to enhance the +Gz tolerance of fighter pilots by 1 to 1.5G. The suit is designed to meet stringent endurance cycle.

Advanced Micro Climatic Conditioning System

AMCCS is a thermal protective device used for the mitigation of extreme heat stress faced by Armed Forces personnel operating in Battle Tanks Submarines: Ships etc, where ambient temperature can go beyond 50 Deg C and air- conditioning is not possible due to large energy requirement

AMCCS consists of an active chiller unit and a Liquid Cooled Garment (LCG) connected through a detachable umbilical cord through QDC connectors

Mitigates heat stress and helps maintain optimal cognition and situational awareness

Found useful for Battle Tank application during recent evaluation. AMCCS has been found suitable for Induction Into Indian Navy Submarines in ceiling mounted AMCCS configuration.



- Transfer of Technology to Indian industries under process
- Power Requirement-24VDC or 170 to 360VDC/AC mains
- Power consumption-Less than 200 Watts Weight:3 kg
- Available with 200 Watts and 400 watts heat removal capacity.

UPGRADED COLD WEATHER SUIT & THERMAL WEAR



Challenges of Military flying include Hypoxia, Acceleration, decompression, windblast, crash, extreme temperature and the threat of fire. Appropriate Protective Equipment & Flying Clothing (PE&FC) like Flame Retardant (FR) Overalls, FR Automatic Inflatable Life Jacket, FR Anti G Suit, FR Aircrew Survival Jacket, FR Gloves, Boots flying, Light Weight Integrated Helmets & Pressure Breathing Oxygen Masks based on Technical Textiles developed by DEBEL provide protection and enhance mission effectiveness & are in regular use by IAF.

Cold weather protective clothing is intended to provide protection to aircrew positioned at high altitudes. They have been designed to provide protection and maintain the temperature within physiological comfort.



ONE MAN HAPO CHAMBER



Indian Armed Forces personnel deployed in high altitude mountainous regions face a fatal condition known as High Altitude Pulmonary Oedema (HAPO) that occurs when rapid ascent is coupled with physical exertion.

One man HAPO chamber is a life saving device that provides emergency treatment to HAPO as the condition is rapidly fatal if not attended to immediately. HAPO chamber when inflated to 130 mm Hg, provides a virtual descent of 6000-8000 ft.

HAPO chamber can be inflated using foot pump and light weight automation unit in backpack configuration (6.5 ± 1 kg) that works with built-in rechargeable battery or with AC mains. HAPO chamber developed by DEBEL avoids strenuous manual inflation and helps treat multiple patients simultaneously. HAPO chamber can be used/adapted for mountaineering & many civilian applications

UNDERWATER Systems

INDIVIDUAL UNDERWATER BREATHING APPARATUS FOR T-90 TANK CREW (IUWBA)

Individual Under Water Breathing Apparatus (IUWBA) is a life saving equipment which provides underwater breathing support to tank crew in a situation where the tank is struck and unable to move to the surface.

SALIENT FEATURES

- ▶ The apparatus is a closed circuit system.
- ▶ IUWBA supports breathing of a crew up to 60 minutes.
- ▶ Two mode breathing i.e. from set and from atmosphere.
- ▶ It is fitted with a regenerative canister for exhaled CO₂
- ▶ Provide positive buoyancy to each crew member during emergency underwater escape.
- ▶ Modular and Compact.
- ▶ The apparatus weight is 5 kg



SUBMARINE ESCAPE SYSTEM (SES)

RDO SES provides individual under water life support system for submariners while escaping from an abandoned submarine from 100 m depth. SES mainly consists of Hydro suit & Breathing apparatus.

SALIENT FEATURES

- ▶ Hydro suit is made of neoprene coated nylon fabric to protect the submariner from marine environment. Provides adequate buoyancy for flotation on the surface.
- ▶ Breathing apparatus is a closed circuit breathing system which supplies required composition of breathing gases for corresponding depths to a submariner to protect from physiological ill-effects.
- ▶ SES is a positively buoyant which helps the submariner to ascend at 1 m/s.
- ▶ The SES weight is 24.5 kg.



Technology Spin Offs

CRITICAL CARE VENTILATOR

Salient Features

- ▶ Apnea backup ventilation
- ▶ Single gas ventilation when one of the gases fail
- ▶ Software controlled pressure limit function
- ▶ Mechanical pressure relief for additional safety
- ▶ Sub-ambient valve for emergency air intake
- ▶ Built-in battery backup for 4 Hrs
- ▶ Indigenous system
- ▶ Development by collaboration of DMRI, NIMHANS and PSG
- ▶ Technology transferred and is currently manufactured and marketed by M/s. Skanray Healthcare Pvt Ltd.



MEDICAL OXYGEN PLANT (MOP)

The plant is based on Onboard Oxygen generation technology developed by DEBEL for fighter aircrafts and uses zeolite molecular sieve and pressure swing adsorption principle for generating Medical grade breathing gas.



SALIENT FEATURES

- ▶ Reduces logistics & cost, requires minimum maintenance
- ▶ Absolutely oil free and safe
- ▶ Filters particles as fine as 1 micron
- ▶ Onsite production of oxygen is instantaneous from ambient air
- ▶ Stored oxygen supply for transient power failures
- ▶ Compliance with ISO 10083: 2006(E), European, US and Indian pharmacopeia
- ▶ Frame built, skid mounted design
- ▶ Suitable for COVID-19 management in hospitals
- ▶ DRDO has installed 931 plants at 869 sites in every state & UT covering all the districts across the country
- ▶ Oxygen capacity of more than 1400 MT established in the country
- ▶ IoT devices provided in the plant for real time monitoring.



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