



*Critical Equipment and Technologies
Developed by DRDO for Combating COVID19
Pandemic
20/04/2020*

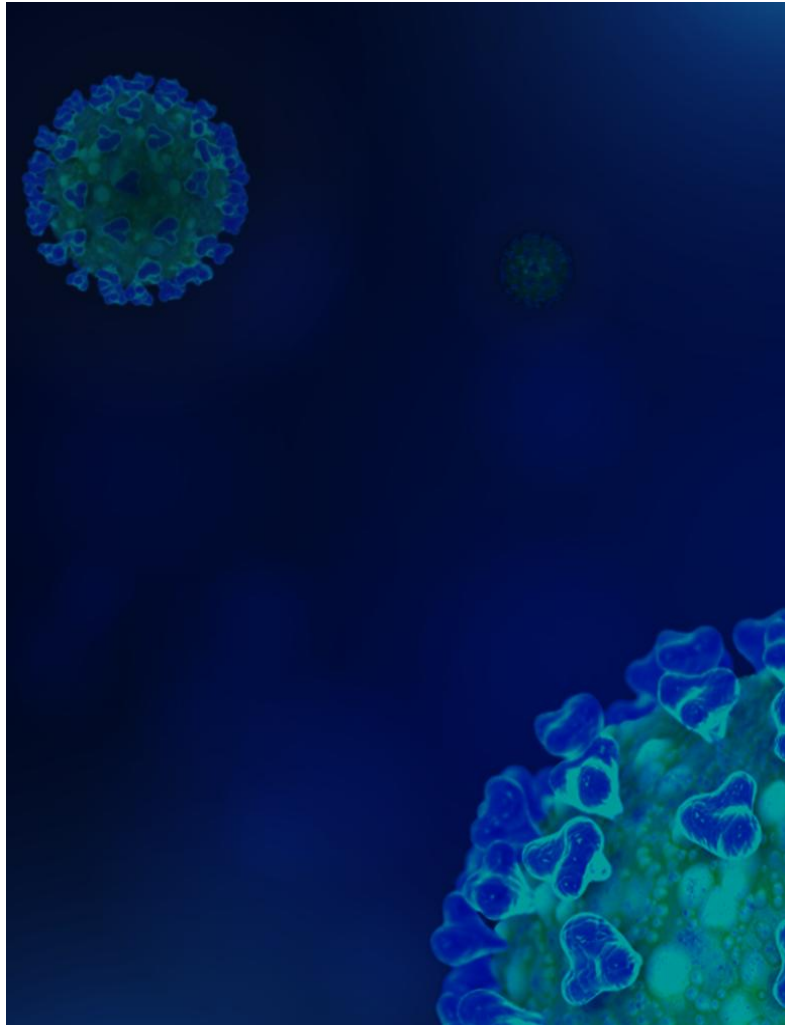


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1 INTRODUCTION

DRDO has been tracking the alarming spread of COVID-19, since the world media started reporting its devastating impact in China's Wuhan Province. DRDO has been on alert since the detection of the 1st case of COVID-19 in India, reported on 30th January 2020. DRDO Laboratories working under life sciences cluster and many other labs with the possibility of producing spin-off technologies geared to support national mission to combat COVID-19.

By first week of March 2020 the number of affected people in India had crossed 30 and DRDO took a decision to accelerate and enhance products and countermeasures to combat the spread of COVID-19 in India. Efforts were focused on creating required solutions without losing time, within the given constraints and available resources.

As a result of this approach, DRDO is ready with technologies which can be utilized for combating COVID-19. DRDO is working with industry for volume production of some of the products which are applicable for containment of COVID-19. We are providing information about the products developed for combating COVID19, innovative interventions for specific applications. Many services are being provided to the city administrations on request. The industry working with DRDO has been activated to produce the DRDO developed products.

2 HAND & SURFACE SANITIZER

- To address the need of WHO compliant and certified hand sanitization solution for personal and surface decontamination, DRDE, Gwalior and CFEES, Delhi have prepared hand sanitizer compliant to WHO guidelines for local production.
- The sanitizer units produced by DRDO units and with the help of its industry partners have been supplied to Indian Armed forces, Armed Forces Medical Corps, Defence Security Corps, Ministry of Defence, Parliament, Delhi Police, Security Establishments and State Governments



Hand Sanitizer

- Ethyl alcohol base formulation and process is shared with industries and production in bulk has been initiated.
 - The capacity is scaled to more than 30,000 Litres per day
 - Raw material sourcing can help increase the production
- Cost – Approx. Rs 120 /- per Litre (including GST).
- DRDO Laboratories across the country, based on DRDE guidelines are producing a large amount of hand sanitizers and distributing to local administration for fight against the pandemic.
- M/s Gwalior Alco, Gwalior and M/s Shreenath Ji Chemicals, Bhopal have been given ToT
- Other industries working with DRDO in Hyderabad, Kochi, Jodhpur etc are given on DRDO Website.
- About 3.9 Lakh units have been distributed till today. These include re-usable bottles of various approved sizes. Also, many drums and 20 litre bottles have also been supplied for refilling the earlier supplied bottles.

3 ADVANCED FACE MASKS

- DRDE, Gwalior has developed five layered N-99 masks using a nano web filter layer which is being produced by two of the industry partners. Manufacturing of masks is in progress and about 1 lakh masks are being produced.
- Production is ramped to 2 lakh N-99 masks per week through the Industry Partners.
- INMAS, Delhi has designed 3-ply surgical masks, and producing through Industry partner.
- N95 Masks are being produced by industry as per DRDO design
- About 1.7 Lakh masks are distributed to various agencies. About 70,000 3-ply masks are distributed to Police, Armed Forces and Government Agencies. About 1 Lakh, N95, and N99 Masks are distributed to central and state government authorities for distribution to health care professionals and various hospitals directly.
- M/s INTEC Safety, Kolkata and M/s Venus Safety Raigad have been given ToT



4 PERSONAL PROTECTIVE EQUIPMENT

4.1 PERSONAL PROTECTIVE EQUIPMENT (PPE) BIO SUIT

- DRDE, Gwalior has developed Bio Suits, which are being produced by three industry partners namely M/s Shiva Texyarn, Coimbatore, M/s Arvind Mills, Ahmedabad and M/s Aeronav, Noida and is being supplied to MOH&FW, GOI.

4.2 PERSONAL PROTECTIVE EQUIPMENT (PPE) MKI

- INMAS, Delhi and ADRDE, Agra have developed PPE MkI for protection of medical professionals and paramedics handling COVID-19 patients
- The material is PU coated Nylon/Polyester
- Production of the PPE MkII is done by two of the industry partners.
- Production capability is ramped up to 15-20000 PPEs per day after 15th April.
- M/s Gokuldas, Bengaluru and M/s Kusumgarh, Mumbai are manufacturing these PPEs

4.3 PERSONAL PROTECTIVE EQUIPMENT (PPE) MKII

- DRDE, Gwalior have developed PPE MkII for protection of medical professionals and paramedics handling COVID-19 patients
- The material is Tri-Laminate Highly Breathable - Breathable Polyethylene Film laminated on both sides of poly propylene SS type non-Woven fabric of total 52 GSM
- M/s Pioneer Hygene, Surat is identified as the industry partner for production

4.4 PERSONAL PROTECTIVE EQUIPMENT (PPE) MKIII

- DRDE, Gwalior have developed PPE MkIII for protection of medical professionals and paramedics handling COVID-19 patients
- It includes full body Suit with zipper, shoe covers, eye protection (either sheet or goggle), sterilized surgical gloves etc. A three ply face mask is in-built with the suit. A thumb loop is also provided to hold the sleeve providing complete protection against infections.

- The fabric is totally impermeable but at the same time allows air for easy breathing.
- This coverall suit is improvised DRDO product for protection of medical professionals and paramedics handling COVID-19 patients
- Technology has been transferred to Industry for mass production as per WHO standards
- The material is TPU film laminated poly propylene non-woven fabric 90 GSM
- M/s Entremonde Polycoaters, Nashik is identified as the industry partner for production



4.5 FULL FACE SHIELD

- RCI, Hyderabad and TBRL, Chandigarh, have developed face protection mask for health care professionals handling COVID-19 patients. Its light weight construction makes it convenient for comfortable wear for long duration.
- This design uses commonly available A4 size Over-Head Projection (OHP) film for face protection.
- The holding frame is manufactured using Fused Deposition Modeling (3D printing). Polylactic Acid filament is used for 3D printing of the frame. This thermoplastic is derived from renewable resources such as corn starch or sugarcane and is biodegradable.
- The face mask is mass produced using injection molding technique.
- Approximate Cost: Approximately from Rs 75-120/-
- About 2000 are given to PGIMER, Chandigarh by TBRL and about 10,100 are given to Telangana hospitals and police departments.
- Industry: Various Industries in Chandigarh, Hyderabad, Delhi - Contact and address given on DRDO Website.



4.6 ENCLOSURE FOR INTUBATION PROCEDURE – AEROSOL CONTAINMENT BOX

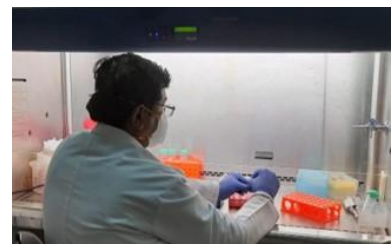
- RCI, Hyderabad and TBRL, Chandigarh have developed a product to protect doctors and medical healthcare providers from the aerosol released during intubation of the patients.
- The demonstration was done on request of doctors at ESI Hyderabad and PGIMER Chandigarh.
- It consists of a transparent acrylic/perspex cube which covers patient's head upto chest and act as a safety barrier against transmitting droplets from patients while giving treatment. The two circular ports allow the health worker's hands to pass and perform the airway procedures. The material used here is 50 percent lighter thermoplastic compared to glass making it easy to handle.
- This Box can be used while taking samples from a suspected patient, during intubation, observation or during treatment to completely avoid droplets and aerosols emanating from them due to cough & sneeze. Two sizes of Aerosol Box are designed and developed by DRDO for use by adult patients and child patients.
- The use of Aerosol Box could safeguard against spread of viral contamination of Covid-19 to reach on gown, gloves, face mask, eye shield, shoes and also on the floor of the hospitals effectively safeguarding our health care workers.

- DRDO has manufactured prototype units at laboratory and is now being produced by local industry partners at Hyderabad
- A demonstration is carried out by a team of doctors at ESI Medical College, Hyderabad and PGIMER, Chandigarh and the design is validated and accepted.
- Approximate Cost: Size 1 Rs 6350/- + GST; Size 2 Rs 5950/- + GST
- About 60 numbers are given to PGIMER, Chandigarh and ESIC, Hyderabad
- Industry capacity: 60 per day
- Industries manufacturing this have been identified in various cities. These are listed on DRDO days time



5 SAMPLE TESTING FOR COVID 19

- DRDE, Gwalior is functioning as a center for detection of COVID 19 positive cases from samples provided by Madhya Pradesh Health Service. DRDE has potential to perform confirmatory test akin to NIV, Pune on authorization by GOI.
- Daily testing is being done positive cases are being reported to the referring hospitals.
- INMAS and DIPAS, Delhi of DRDO are also equipped with COVID-19 testing and are notified as test centers for detection. These laboratories can undertake 700 tests per day.
- Almost 850 tests have been conducted till today



6 TESTING FACILITIES

DRDO has been at the forefront of testing important PPE testing due to its expertise at DRDE, Gwalior. DRDE has standard and approved test facilities for three items.

6.1 SYNTHETIC BLOOD PENETRATION TEST FACILITY

- DRDE has 'synthetic blood penetration test' facility for testing and certifying facility for PPEs. This facility is supporting testing of PPEs as per standards.
- The testing for PPE suits was being carried out at DRDE Gwalior. The facility has been shifted to INMAS, Delhi to meet the emerging requirements.
- As on 17 April 2020, 129 tests were carried out at DRDE, Gwalior. After shifting to Delhi, 90 tests for PPE suits have been conducted.

6.2 FACE MASK TESTING

- DRDO is engaged by GoI in testing some of the test of face masks as per standards.

6.3 SANITIZER TESTING

- Quality check as per standards is carried for the sanitizers by DRDE Gwalior

7 SAMPLE COLLECTION ENCLOSURES

7.1 COVID-19 SAMPLE COLLECTION KIOSK (COVSACK)

- Defence Research & Development Laboratory (DRDL), Hyderabad has developed COVID Sample Collection Kiosk (COVSACK). The unit has been developed by DRDL in consultation with the doctors of Employees' State Insurance Corporation (ESIC), Hyderabad.
- The COVSACK is a kiosk for use by healthcare workers for taking COVID19 samples from suspected infected patients. Patient under test walks into the Kiosk and a nasal or oral swab is taken by health care professional from outside through the built in gloves.

- The Kiosk is automatically disinfected without the need for human involvement, making the process free of infection spread. The shielding screen of kiosk cabin protects the health care worker from the aerosols/droplet transmission while taking the sample. This reduces the requirements of PPE change by health care workers. After the patient leaves the Kiosk, four nozzle sprayers mounted in the kiosk cabin disinfect the empty chamber by spraying disinfectant mist for a period of 70 seconds. It is further flushed with water & UV light disinfection. The system is ready for next use in less than two minutes.
- Voice command can be given through two-way communication system integrated with the COVSACK.
- The COVSACK costs nearly Rs. one lakh and the identified industry based at Belgaum, Karnataka can support 10 units per day.
- The DRDO has designed and developed two units and handed over these to ESIC Hospital, Hyderabad after successful testing.

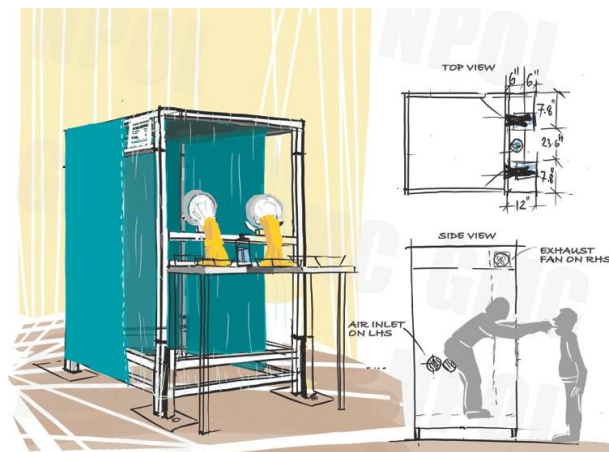


7.2 WALK-IN SWAB COLLECTION KIOSK (WISK)

- The WISK caters to physical and psychological security for personnel involved in swab collection and also saves the amount of PPE consumption.
- NPOL after detailed discussions with GMC, Ernakulam, WISK was made as a cost effective solution for affordability by small PHCs / rural clinics and ensure ease of transportability rapidly.
- The Econo-WISK is designed as an assembly of a plastic sheet (durable rexine and transparent UPVC sheet) over an easy-to-assemble frame made of 1" square tube of mild steel. There is a wooden base with linoleum sheet, as well as detachable tables both within and outside the kiosk. The cost-effective and low cost materials configured as "knock-

down kit” are easy to transport as multiple units, requiring lower transit space envelopes.

- The product is easy to assemble at site, has better internal air circulation scheme and can be installed outdoors also.
- The amenities provided include exhaust fan, air inlet with N95 mask filters, lighting, 5A power plug, sanitizer for glove decontamination, glove box outside the kiosk (for disposable gloves) and a collection tray for ‘swab vials’.
- High end and mobile WISKs are being worked out
- Industry Identified: M/s AJ Designs & Constructions & M/s Uniplast Industries



8 BODY TEMPERATURE PROBE (CONTACT TYPE)

- NPOL has developed a cost-effective solution to detect personnel with fever, by quickly innovating a body temperature measurement probe using miniature high resolution thermometer. The product is a spin-off from the Expendable Bathy Thermograph (XBT) developed by the laboratory.
- The body temperature probe consists of a very small thermistor on a pen-like attachment which can detect the body temperature by placing the tip on the mid-arm or forehead region. A hand-held processing unit displays the temperature, and based on the same, highlights whether the person is normal or feverish.
- The kit has high accuracy with a very short response time
- The cost-effective product has been designed in two variants

- The first variant is for industrial use, in which the probe and display-cum processing unit are separate units connected by a cable. Both the persons, the one whose temperature is measured and the one noting the measurement, are thus separated apart. This unit draws power from the general 230 V AC mains. The probe is inserted in a holder which contains sanitizing medium
- In the second variant, the probe and the display-cum processing unit are integral in a single casing. This variant draws power from a small battery and can be used for domestic purposes also



- Industry – M/s Keltron

9 VENTILATORS

- DEBEL, Bangalore a DRDO laboratory and Society for Biomedical Technology (SBMT) - A DRDO funded and managed initiative) have developed a ventilator.
- Technology is transferred to Industry to M/s Scanray, Mysore.
- Defence PSU, M/s BEL has joined the efforts for large scale production of ventilators.
- DEBEL, Bangalore has undertaken the initiative to develop the critical components of the ventilators which are not available in the country. These will be produced with the help of industry.
- Production can reach a capacity of 10,000 ventilators per month.
- About 30,000 ventilators will be produced in 3 months



10 PERSONNEL, VEHICLE AND AREA SANITIZATION EQUIPMENT

10.1 PERSONNEL SANITIZATION ENCLOSURE (PSE)

- VRDE, Ahmednagar, CFEEs, and INMAS Delhi have designed full body disinfection chambers called as Personnel Sanitization Equipment. This walk through enclosure is designed for personnel decontamination, one person at a time. Approximate size is 9 X 7 x 9 feet (floor area 60 square feet)
- Decontamination action is started using a foot pedal at the entry. On entering the chamber, electrically operated pump creates a disinfectant mist.
- The mist spray is calibrated for an operation of approximately 25 secs and stops automatically indicating completion of operation.
- As per procedure, personnel undergoing disinfection will need to keep their eyes closed while inside the chamber.
- This system can be used for disinfection of personnel at the areas of controlled ingress and egress such as entry and exit to hospitals, malls, office buildings and critical installations.
- Industry capacity: Can be scaled as per demand
- Various models have been configured based on the features and special fittings. From Rs 50000/- + GST to Rs 3,50,000/- + GST. Basic model costs Rs 50,000/- and cost varies based on the features fitment.
- Three industries have been identified for manufacturing. Details have been provided on DRDO website.



10.2 PORTABLE BACKPACK AREA SANITIZATION EQUIPMENT

- CFEES, Delhi with the help of its industry partner has developed a portable sanitization equipment for spraying decontamination solution consisting of 1% Hypochlorite (HYPO) solution for sanitization of suspected area.
- The portable system can be mounted as a backpack and carried by the operations personnel.
- This system incorporates low pressure twin fluid (air & disinfectant liquid) technology to generate very fine mist. The system is capable of disinfecting an area upto 300 m².
- The application areas can include hospital reception, doctor chambers, office spaces dealing with general public, corridors, pathways, metro and railway stations, bus stations etc.
- Approximate Cost: Rs 1,50,000/- + GST
- Production capacity: About 200 Numbers per month
- Two units given to Delhi Police
- Industry has been identified and given on the DRDO website



10.3 TROLLEY MOUNTED LARGE AREA SANITIZATION EQUIPMENT

- CFEES, Delhi with the help of the industry partner has also developed a higher capacity which is carried on a trolley.
- This system incorporates low pressure single fluid (disinfectant liquid) technology generating very fine mist. The system is capable of disinfecting an area up to 3000 m².
- It has a tank capacity of 50 Litres and has a lancing (throw) distance



of 12-15 m.

- This is useful for disinfecting hospitals, malls, airports, metro stations, isolation areas, quarantine centers and high-risk residential areas.
- Approximate Cost: Rs 1,80,000/- + GST
- Production Capacity: About 200 per month
- Two units given to Delhi Police
- Industry has been identified and given on the DRDO website

10.4 VEHICLE SANITIZATION ENCLOSURE

- VRDE has conceived and established an indigenous system assembled using locally available material based on the existing 4-men tent (Ordnance Supply). A very light weight system with portable canopy, this can be made operational in less than 3 hours.
- An electrically operated positive displacement pump is utilized to create a disinfectant mist inside the tent canopy through which the vehicles are passed. A separate tank of 500 Ltr capacity for storage of disinfectant is used which requires refilling after 200 number vehicles are disinfected. The system is noise free and needs 10 minutes break every 4 hours operation.
- The system can be utilized at any location including entry location for Sanitization of vehicles. Hospitals, army units and administrative offices having high ingress and egress can deploy this system.
- Approximate Cost – Rs 1,00,000/- + GST
- Industry – If requirement is there, industry is willing to produce
- One Unit given to Ahmednagar Police



10.5 MOBILE AREA SANITIZATION SYSTEM

- Based on the experience of dust suppression systems for use in deserts by Army, Defence Laboratory, Jodhpur (DLJ) has joined the fight against Covid-19, by developing a 'Mobile Area Sanitization System' which uses Sodium Hypochlorite solution to sanitizes larger area.
- Two variants have been developed, one for outdoor use mounted on a 'B' class vehicle and another for indoor use mounted on a battery operated cart. The former can spray to a distance of 6-7 m distance and the later to 2-3 m distance.
- The performance of the system has been demonstrated to Indian Army. At present six systems has been developed through local industry and delivered to the Army to ensure safety and hygiene of the wide area of the Wellness Centers in and around Jodhpur, Rajasthan.



10.6 LMV MOUNTED AREA SANITIZATION UNIT

- To sanitize large areas, NPOL has conceptualized a scheme wherein the disinfectant is sprayed on to the outdoor surfaces using a kit that is mounted on light motor vehicles (LMV) like cars, SUVs etc.
- The product consist of a tank of 50 to 100 litres (depending on size of vehicle), mounted at the back, and two sprinkler devices attached at the sides of the vehicle. The power for the sprinkler devices are drawn from the 12V DC available in the vehicle. The disinfectant can be filled in the tank before the operation.
- The scheme for decontamination using automated disinfecting fluid dispersal provides a simple and affordable solution, as the kit can be

easily assembled and disassembled on to the LMVs, which are easily available in multiple numbers.

- This provides a quick and economical means to sanitize outdoor areas in the lab campus as well as Campuses of defence units / industrial establishments etc., besides frequented locations like bus stops, railway parks, roads etc.

11 UV BASED SANITIZATION BOX AND HAND-HELD UV DEVICE

11.1 UV SANITIZATION BOX AND HAND-HELD UV DEVICE

- Defence Institute of Physiology & Allied Sciences (DIPAS) and Institute of Nuclear Medicine & Allied Sciences (INMAS), DRDO laboratories in Delhi have designed & developed Ultraviolet C Light based sanitization box and hand held UV-C (ultraviolet light with wavelength 254 nanometres) device. The UV-C consists of a shorter, more energetic wavelength of light. It is particularly good at destroying genetic material in COVID-19. The radiation warps the structure RNA which prevents the viral particles from making more copies of themselves. The UV-C kills microbes quickly. Sanitization of the items by employing UV-C light avoids the harmful effects of the chemicals used for the disinfection. This is environment friendly and is a contact free effective sanitization method.
- The UV-C box is designed for disinfecting personal belongings like mobile phone, tablets, purse, currency, cover of office files, etc. COVID-19 virus will be deactivated by using UVC lamps in one minute placed equidistantly in a box with UV dose of 100 mJ/cm². The UV lamps used in the sanitisation box also emits 185 nm which produces ozone and is able to take care of the unexposed area on the surfaces of the objects placed in the box.



- The hand held device having eight watt UV-C lamp disinfects office and house hold objects like chairs, files, postal delivered items and food packets with an exposure of 45 second at a 100 mJ/cm² irradiance placed at a distance of less than two inches. This measure can reduce the transmission of Coronavirus in office and public environment which is required to work in all conditions.



- These devices can help reduce the transmission of Corona viruses.

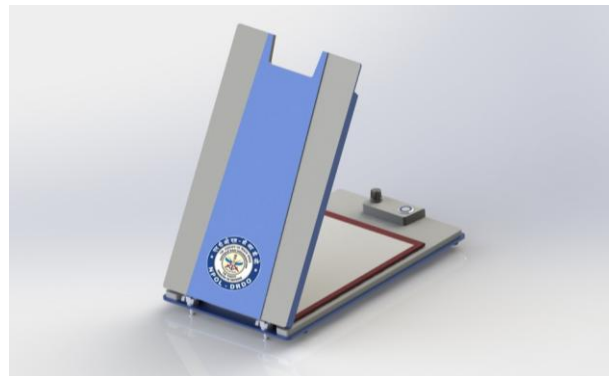
11.2 COVID-19 UVC SANITIZER CABINET

- Research Centre Imarat (RCI) has developed a UVC Sanitizer cabinet called DRUVS (Defence Research Ultraviolet Sanitizer) which can be used to sanitize any object without using chemicals viz N-95 Masks, Mobile phones, iPad, Laptop, Currency Notes, Check leafs, challans, Passbooks, Paper, envelopes and many more items etc.
- It has Fail safe design in which UV cannot be switched on if Cabinet drawer is in open condition.
- Dimensions :515mm x width 565mm x height 220 mm; Weight: 15Kg
- Touch Free Automatic Operation
- Total Irradiation: 9000 μ Watt/cm² (Calculated value)
- Gives 360 Degree Exposure
- It is Ozone Free

11.3 PAPER DISINFECTOR

- To meet the imminent need to disinfect daily paper-based items entering an establishment, a product called Paper Disinfector is being developed at NPOL.
- Paper / envelopes up to A4 size can be disinfected using the device.
- The device consists of two foldable halves - an upper lid and a lower lid.

- To disinfect various paper-based items entering the establishment at the security office or the central registry, like entry passes, DAK, tender documents, currency notes etc., the operating person lifts the upper lid and asks the incoming visitor to place the item on the lower lid. He then closes the upper lid. The paper-based item is heated in between the two lids.
- Heating is done by means of Nichrome wire of selected resistivity which is placed inside a glass wool / mica sleeve, and sandwiched on a conductive cloth, and further wrapped in velvet for retention of heat. Two such sets of heating pads are used, one fixed on the bottom of the upper lid and the other on the top surface of the lower lid.
- The system draws electrical power of approximately 120 Watts, and has controls including ON/OFF switch & Indicators, fuse and timer control. There are different operation modes for the type of item like paper, currency, envelope etc. depending on the settings for temperature and exposure time.

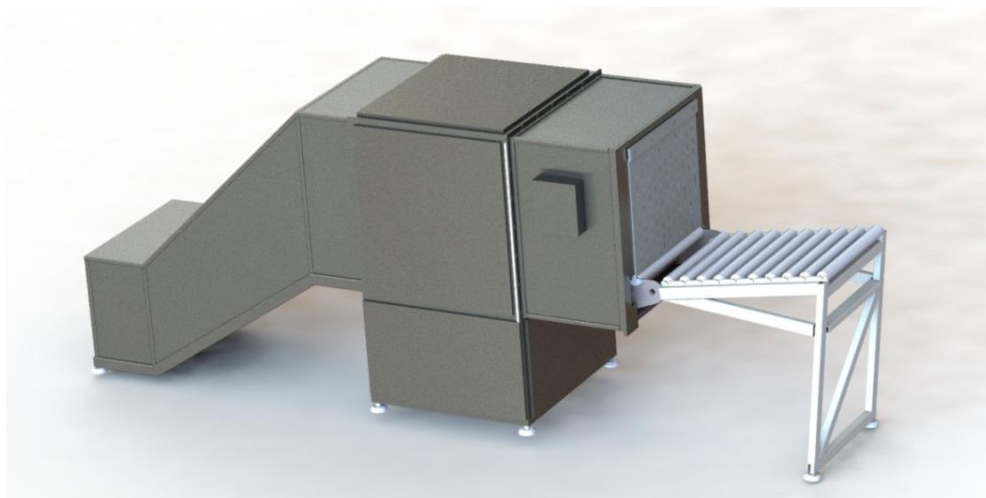


- Industry Identified: M/s Keltron

11.4 AUTOMATED LUGGAGE DISINFECTOR USING UV-BATH

- NPOL has designed a kiosk using UV bath which can disinfect the baggage or other objects being carried inside. This system can be used for sanitization of luggage entering the campus of industrial establishments / defence units etc., as well as disinfection of items being carried onto naval ships and submarines.

- The system consists of a roller based conveyor carriage moving inside a chamber which is configured with UV bath of calibrated dosage.
- The type of UV used for the purpose is Far-UVC, which according to literature is effective against Corona virus.
- The items to be disinfected are carried on the conveyor to the chamber such that there is scanning and sanitisation of the item all around the object surface.
- For ensuring that the exposure of the item to the UV rays is maintained on all areas as per the intensity level and exposure time required for the sanitisation process, the movement of the conveyor is automated, along with necessary electrical and mechanical safety interlocks.
- Although Far-UVC is claimed to be harmless to human beings, sufficient precautionary measures are introduced to prevent leakage of UV beyond the chamber.



- Industry Identified: M/s Apollo Micro Systems, Hyderabad

12 MEDICAL OXYGEN PLANT (MOP)

The Medical Oxygen Plant (MOP) is a technology which is an offshoot of the On Board Oxygen Generation System (OBOGS) project for medical grade oxygen generation on board Tejas, fighter aircraft. It utilises Pressure Swing Adsorption (PSA) technique and molecular sieve technology to generate oxygen directly from atmospheric air.

This is approved by safety certification agency CEMILAC. The oxygen generator components have been developed by DEBEL and technology has been transferred to a Coimbtore based firm.

The technology is being used to install oxygen plants on some of the army sites on North East and Leh-Ladhakh Region. Two plants have been installed in North East and Leh Region respectively. The first plant is operational since 2017. The plant complies with international standards like ISO 1008, European, US and Indian Pharmacopeia.

This oxygen plant will be useful to provide oxygen supply during corona pandemic in hospital in urban and rural areas. The installation of medical oxygen gas plant helps in avoiding hospital dependency of scarce oxygen cylinders especially at high altitude and inaccessible remote areas. Benefits include reduced logistics of transporting cylinders to these areas, low cost, continuous and reliable oxygen supply available round the clock.

The facility can be used for filling the cylinders in addition to direct installations at the hospitals.

Salient Features

- High Reliability, full independency and automation
- Reduced Logistics, low cost, minimum maintenance
- Absolutely Oil free and safe
- 24/7-365 days operation, Onsite production of oxygen instantaneously from ambient air
- Electric Oxygen compressor to charge the cylinders upto 200 bar(g)
- High Performance molecular sieve (Li-LSX: Lithium based Low Silca X-Type zeolite)
- Stored oxygen supply for transient power failures
- Compliance with European/Indian Pharmacopeia and ISO 1008
- Low Energy consumption
- Frame Built, Skid Mounted design
- High Quality Touch screen control unit and remote control access

Brief Specification of MOP

- Product Oxygen Concentration : 93±3 %

- Outlet Pressure : 4-6 bar 'g'
- Capacity : 18 NM³/hr (300 LPM)
- Oil Content : ≤ 0.1 ppm
- Dew Point : < -50 °C
- Oxygen Compressor to charge oxygen cylinders of 47 Litre water capacity at the rate of 20 cylinders per 8 hours.

Major Components of Oxygen Plant



Capacity

Each plant can fill 47 lts (water capacity) cylinders at a rate of 60 per day on 24X7 operation. If each cylinder with 3000lts of oxygen, it is about 180000 Lts. The oxygen capacity depends on the pressure of filling, which is about 150-200bar.

Cylinders

Standard oxygen cylinders and standard pressure control regulators are required for operations and distribution. No special parts are required for the system.

Industry Capability

The industry M/s Trident Pneumatics Coimbtore, needs to be enabled to produce numbers. The industry has projected that given all constraints are overcome:

- 4 plants can be installed by second week
- 20 plants can be installed in 5 weeks

Industry can ramp up the production with support.

Approximate cost is about Rs 66,00,000/-

Plant Capacity

The Oxygen plant is designed for a capacity of **18 NM³/hr**. The system caters for **60 patients at a flow rate of 5 LPM** and can charge **60 cylinders per day** as per the calculation given below. The capacity can be varied as per hospital requirement, if required.

- The oxygen plant capacity is 18NM³/hr (18000litres/hr or 300 LPM at NTP). The NTP refers to Normal Temperature and Pressure i.e 1.0 bar absolute pressure and 21.1 °C Temperature. The plant will provide oxygen for 60 patients at a flow rate of 5LPM per person.
- No. of persons = $\text{Plant Capacity}/\text{Flow rate per person}=300/5=60$

Cylinder Charging Capacity

- The oxygen capacity depends on the pressure of filling, which is about 150-200bar.
- Capacity of standard jumbo cylinder = 47 litres
- Cylinder pressure = 150 bar
- Volumetric capacity of cylinder = $150 \times 47 = 7,050$ litres (at NTP)
- Oxygen capacity of plant for 24 hours = $18000 \times 24 = 4,32,000$ (at NTP)
- No. of cylinders that can be charged in 24 hours = $432000/7050 \cong 60$

The details of Oxygen Cylinders which could be charged by the MOP are as following. These are designed by DRDO (DEBEL, Bengaluru) and technology transferred for bulk production to Industry partners as following:-

Cylinders

Standard oxygen cylinders and standard pressure control regulators are required for operations and distribution. No special parts are required for the system. Following describes the types of cylinder which can be used.

Type-I: Aluminium cylinder (6061-T6)

- Service Pressure : 150 bar
- Burst Pressure : 400 bar
- Cost (2.3 to 5 liters capacity) : Rs. 5,000/ to 6,000/ unit
- (10 liters capacity) : Rs. 11,000/ unit

(21 liters capacity) : Rs. 16,000 to 18,000/unit

- Production Capacity : 3000 cylinders/month
- Development partner : M/s Alcan Exports, Mumbai

Type/ Design-II: Aluminium cylinder

- Max. Operating Pressure : 150 bar
- Proof pressure : 225 bar
- Burst pressure : 400 bar
- Cylinder volume (Water Capacity) : 2.3±0.2 Liter
- Volumetric expansion at proof pressure: < 10 %
- Empty weight of the cylinder : Max. 1.5 Kg

Type-III: Carbon fibre based composite cylinder

- Service Pressure : 200 bar
- Burst Pressure : >600 bar
- Cost (2.3 to 5 liters capacity) : Rs. 25,000/ to 30,000/ unit
- Max Weight : 1.65 Kg
- Production Capacity : 1000 cylinders/month/ industry
- Development partner : M/s Allen Reinforced Plastics and
M/s CNC Techniques Hyderabad

13 ANYWHERE ERECTABLE ISOLATION SHELTERS

- R&DE (E), Pune, has developed various Shelters, green power sources, Chemical toilets, Quick erectable medical complex under various projects related to field-defence and CBRN protection. These products with minor modifications / customisation, can be utilised for activities pertaining to containment of COVID 19.
- R&DE (E) has also established the industry partners who are capable and willing to take up productionisation of these products to meet the emergent requirements.
- These products will be useful especially in the remote locations, where there is no medical /electrical facility available. The details of these products in standalone mode and as an integrated system, are given below.

13.1 STANDALONE SHELTER

- Three Bed Quarantine Shelter
- Quick erectable 3 bed shelter with Power connection. Accessories (optional) :Fan, Light, 3 Beds & Buckets
- Can be used as extension of city hospital to accommodate patients
- Approximate Cost: Rs 1 Lakh/-
- Production Capability: 10 Per day



13.2 MEDICAL EXAMINATION SHELTER WITH GREEN POWER SOURCE

- This metallic structure with water proof fabric shelter is of size 12'x12'x9' and can be utilised as medical examination and check up of suspected COVID19 patients.
- This shelter can be erected within 1 hr with 4 persons.
- Upto 1.5 KW green energy power source for 24x7 operations is in-built ready to use along with all essential electrical devices and gadgets.
- One bed, table chair and other essential accessories will be housed in this shelter.
- This can be readily used in remote and field areas. This can also be used as remote monitoring and control centre.
- Approximate Cost: Rs 4.5 Lakh/-
- Production Capability: 10 Per day



13.3 TWO BED QUARANTINE MODULE

- Shelter of size 14'x14'x9' can be utilised as a quarantine shelter for two patients.
- This shelter will have essential electrical gadgets, 2 beds, tables and other minimum accessories.
- This total facility can be deployed within 2 hrs time with 6 person
- Approximate Cost: Rs 1.5 Lakh/-
- Production Capability: 10 Per day



13.4 FOUR BEDS QUARANTINE MODULE

- Shelter of size 20'x20'x9' can be utilised as quarantine shelter for four patients.
- This shelter will have essential electrical gadgets, 4 beds, tables and other minimum accessories.
- This total facility can be deployed within 3 hrs time with 6 persons.

- Approximate Cost: Rs 2.5 Lakh/-
- Production Capability: 10 Per day



13.5 INFLATABLE SHELTER MODULE

- The shelter can be utilised as quarantine centre ward for 10 patients.
- It can be erected in one hour with team of 10 personnel.
- This has inbuilt toilet module.
- Approximate Cost: Rs 10 Lakhs
- Production Capacity: 5 Nos per months



13.6 INTEGRATED MEDICAL COMPLEX

- This will be a genset-powered, quick deployable, air conditioned medical facility suitable for remote locations
- Capacity to accommodate 16 patients
- This has inbuilt toilet modules
- Approximate Cost: Rs 30 Lakhs
- Production Capacity: Combination of 13.6 and 13.7

- In this way many combinations of these shelters can be worked out to scale the facilities.

14 NEGATIVE PRESSURE INFLATABLE ISOLATION SHELTER FOR TEN OCCUPANTS

- DEBEL, Bangalore has developed a Negative Pressure Shelter intended for isolating and treating the patients without the risk of spreading the contamination to others.
- This system is suitable for isolating COVID 19 patients since the system is based on negative pressure and the materials used have passed Synthetic Blood penetration Test
- The system consists of Negative pressure based Air Handling Unit, and Inflatable Multiple Chambers
- The system has five numbers of Air Sterilizer Units and ducts are uniformly distributed to provide filtered air.
- It covers a total area Approx. 1000sft and is manufactured out of two layer water-airproof fabric
- The structure has separate rooms for decontamination & medical waste
- The structure is equipped with modular rest rooms and is illuminated with sufficient light throughout.
- Production Industry: M/s Sure Safety (India) Ltd., Vadodara
- Production Capacity: 20 to 25 Units per month
- Cost:
 - 4-men capacity: Rs. 21 lakh with Air Sterilizer Unit, Modular Rest Room and Negative Pressure Air Handling Unit.
 - 10-men capacity: Rs. 26 lakh with Air Sterilizer Unit, Modular Rest Room and Negative Pressure Air Handling Unit.



15 AUTOMATIC MIST BASED HAND SANITISER DISPENSING UNIT

- Centre for Fire Explosive & Environment Safety (CFEES), Delhi using its expertise in mist technology for fire suppression, has developed automatic mist based sanitiser dispensing unit. It is a contactless sanitiser dispenser which sprays alcohol based hand rub sanitiser solution for sanitisation of hands while entering the buildings/office complexes, etc.
- It is based on water mist aerator technology, which was developed for water conservation. The unit operates without contact and is activated through an ultrasonic sensor. A single fluid nozzle with low flow rate is used to generate aerated mist to dispense the hand rub sanitiser. This sanitises the hands with minimum wastage. Using atomiser, only 5-6 ml sanitiser is released for 12 seconds in one operation and it gives the full cone spray over both palms so that disinfection operation of hands is complete.
- It is a very compact unit and bulk fill option makes it economical and long lasting product. It is easy to install system as wall-mountable or on a platform. As an indication of operation an LED illuminates the spray.
- The unit was manufactured with the help of M/s Riot Labz Pvt Ltd, Noida, and one unit has been installed at DRDO Bhawan. The unit can be used for sanitisation of hands at entry and exit to hospitals, malls, office buildings, residential buildings, airports, metro stations, railway stations, bus stations and critical installations. The product is also expected to be very useful for entry/ exit of isolation and quarantine centres.



16 INNOVATIVE TECHNOLOGY INTERVENTIONS

- PPE Seam Sealant Development to overcome shortage of sealant tape and its Applicator Assembly
- METRICS (Mathematical Estimation for Tracking Infections of COVID-19 Spread in India) is developed by INMAS and ISSA of Delhi for generating

a daily estimation report based on data available. The models are being tuned on the basis of data.

- Agradoot is developed by young scientists laboratory for predicting the number of infections. The model is still being tuned to the Indian environment and the results will be published once the model is table.
- Alternative textile material developed and tested for PPEs
- A seam sealant applicant is developed for applying the sealant on the PPEs.

17 PACKED FOOD TECHNOLOGY

- DFRL has expertise in preparing long lasting food for armed forces. The food products are prepared in stringent hygienic conditions while following suitable protocols.
- The Ready to Eat (RTE) food products are packed in multi layer retort pouches and processed in a special retort to internationally accepted food standards. After processing, the food products are tested for their microbiological quality and cleared for supplies. The shelf life of these products is one year under room temperature.
- DFRL, Mysore has processed and supplied 1.5 Tonnes of Meals of Ready-to-Eat (RTE) comprising Tomato Rice, Vegetable Pulav, Sooji Halwa, Khichidi, Combo Meals (White Rice + Dal Fry) and Ready-to-Drink Pineapple juice were handed over to Shri. V.S. Sunil Kumar, Hon'ble Minister of Agriculture, Govt of Kerala. The food products were distributed to health professionals by NPOL, Kochi

18 CONTAINERISED TEST LAB MODULE

- R&DE Engineers, Pune has configured a containerized test lab module for COVID-19 related testing mobile laboratory
- The can be utilised as testing lab and accommodating doctors/paramedics.
- One module can accommodate 06 persons at a time
- The module can be transported to remote locations
- Approximate Cost: Rs 20 lakh

- Production Capacity: 1st within first month and thereafter 25 Nos per Month



18.1 MOBILE VIRAL RESEARCH AND DIAGNOSTIC LABORATORY (MVRDL)

- To carry out the COVID-19 screening, virus culturing for drug screening, convalescent plasma derived therapy, diagnostic kits and vaccine development, a laboratory on mobile vehicular platform is being developed by RCI, Hyderabad.
- MVRDL lab will be able to carry out testing of 2000 samples per day. The expected date of readiness for MVRDL is 20th April.
- Approvals are being worked out from competent authorities. This system is configured based on the donations from various companies and is integrated with the help of DRDO scientists. Doctors at ESIC, Hyderabad are evaluating and getting the approvals.

19 MULTI PATIENT VENTILATION (MPV) KIT

- Multi Patient Ventilator Kit has been developed which can convert single ventilator to be used for multiple patients at the time of emergency.
- The MPV kit has been successfully tested at Apollo hospital and ESIC hospital in Hyderabad.
- The MPV Kit can convert single ventilator for use by multiple patients at the time of emergency.
- It can regulate pressure for each patient. UV filters are integrated on each line to avoid contamination.

- This product will give a big boost on health care capacity against Covid-19.

20 MOBILE APP FOR QUARANTINE TRACKING

- CAIR, Begnaluru has developed a Mobile based application called SAMPARC (Smart Automated Management of Patients and Risks for COVID-19) for tracking of COVID-19 suspects under isolation or quarantine.
- The App is installed on the smart phones of the patients, and a server-side application is used by the state authorities to track the patients.
- The App does not collect any private information of the patient except his/her location of quarantine and the current location of the patient.
- The application works effectively by enabling Geo-fencing and Artificial Intelligence based automated face recognition between picture of patient taken during registration and subsequent selfies taken by the patient.
- The location information is displayed on a map which can be color coded to depict hotspots and containment zones.
- From the perspective of the patients, honest usage of SAMPARC could give them an option of home isolation instead of isolation in a government facility. From the perspective of the state officials, SAMPARC is expected to drastically reduce the overhead of tracking every patient under home isolation.
- The authorities may need to keep a check on the violators which can be shown in different color on a map when the patients break the Geo-fence or their Selfie does not match or when patient's smart phones stop sending periodic updates.
- Many state governments are exploring the utilization of the SAMPARC system.
- The development of the software has been done by consortium of DRDO labs including contributions from a young scientist lab which was set up recently on directions by Hon'ble PM.

Indicative Nationwide/Statewide/Region wide deployment

