

TECHNICAL SPECIFICATION

Proposal No. 30009876 2080**Rev 0****Title:** Installation of Medical Oxygen Duplex System**Presented to:** WHISTON HOSPITAL
WARRINGTON ROAD
PRESCOT
L35 5DR**Prepared by:** Cillian Dunne
Project Engineer
UK Customer Engineering**Rev Date****On behalf of** Air Products PLC

Reviewed / Approved By			
Company	Name	Signature	Date
Air Products	Kelly Paul		05/11/2020
Customer			

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1 Summary

1.1 The site requirements are for Medical Oxygen.

1.2 Current usage data, provided by the customer, is:

- Current Consumption 460 l/hr
- Forecasted Consumption 2300 l/hr
- Usage Pattern 24.00 hr/day, 7 day/week (Continuous)

1.3 The Air Products scope of work is to supply labour and materials to install, pressure test and commission:

1.3.1 *1 off 29,800 litre Primary (or main) Liquid Oxygen Storage Tank (or nearest equivalent)*

1.3.2 *2 off VAI-836-FL12 Ambient Vaporisers for the main tank*

1.3.3 *1 off 6,500 litre Secondary (or back up) Liquid Oxygen Storage Tank (or nearest equivalent)*

1.3.4 *1 off VAI-836-FL12 Ambient Vaporisers for the backup tank*

1.3.5 *1 off Duplex SHTM / HTM 02-01 Pressure Control and Alarm Panel*

1.4 All interconnecting pipe work in the tank compound shall be Copper Tube to EN 1057 Table X or Y (Degreased), installed using Copper brazed fittings to Air Products PLC's procedures for the installation of Medical Gas Pipeline Systems.

1.5 Scope of Works – Responsibilities

Details of work – Civil	Responsibility
All civil engineering works including groundwork, plinth, impact protection and security fencing (where required). (ref to Tank Plinth Specification)	Customer
Ensuring compliance with the separation distances from typical hazards and the installation as recommended by the BCGA Code of Practice CP36 for the operational life of the installation	Customer
Details of Work – Mechanical	Responsibility
Interconnecting pipeline installation within the Air Products compound area.	Air Products
Pressure systems safety regulations (2000) Compliance	Air Products
Pressure Equipment Directive Compliance	Air Products
Delivery of equipment to installation site	Air Products
Supply suitable cranes for the offloading and positioning of equipment	Air Products
Details of Work – Electrical	Responsibility
Tanker offloading power requirement (415V TP-E 63A) including 5 pin socket with RCD. Refer to AL17.005.	Customer
Suitable electrical supplies to facilitate the use of technicians' power tools. (Normally 110 volt, 50Hz, Centre tapped earth).	Customer
All Earthing requirements	Customer
Suitable lighting of the area around the site to facilitate a safe working environment (ref to Tank Plinth Specification).	Customer
Single Phase 110/230V for telemetry system.	Customer
Single Phase 110/230V for Pressure Control / Alarm Panel.	Customer
Single Phase 110/23V for Vaporiser Auto Changeover Panel.	Customer
Onwards transmission of alarm signals from Air Products' alarm panel to the hospital alarm system.	Customer
Construction Design and Management 2015	Responsibility
Compliance with responsibilities of the 'Client' under CDM 2015	Customer

2 Performance Criteria

2.1 System Requirements:

2.1.1 *The system has been designed to meet the following conditions*

Design Flowrate (Norm)	138 NM3/Hr
Normal Flow Duration	24.00 hr
Design Flowrate (Peak)	138 NM3/Hr
Peak Flow Duration	24 hr
Design Pressure	25 barg
Supply Pressure	4.2 barg
Design Temperature	-196/+65°C
Minimum Supply Temperature (Ref 2.1.5)	-20°C
Maximum Downstream Pressure Ref 2.1.3	5.3 barg

2.1.2 *Projected increase 8 – 10% per annum in line with SHTM / HTM 02-01 A 6.22.*

2.1.3 *Flow rates quoted are at 0°C and 1atm. Product outlet temperature at the design flow rate shall be a nominal 10°C below the prevailing ambient temperature.*

2.1.4 *Fault pressure is provided above for guidance and shall be confirmed at project stage for the actual equipment installed. The customer is responsible for ensuring that downstream piping and equipment can withstand the fault pressure and should notify Air Products if this is not the case.*

2.1.5 *The vaporiser system is designed to provide the required flows at ambient environmental conditions at a 1% winter low of -5°C (3.65 Days per year). For periods where the ambient temperature falls below these conditions, de-icing may be required by the hospital.*

2.1.6 *The vaporiser system is designed to provide safe operation at the design flow rate; consequently, there is no provision in the design for a low temperature shut off device. It is the customer's responsibility to notify Air Products if the stated design conditions will be exceeded.*

3 Specification

3.1 Statutory Requirements

All work carried out in relation to this specification shall be in accordance with all relevant statutory requirements for an installation of this type as are in force at the time of system commissioning in the country within which the system will be operated, namely:

- 3.1.1 *Pressure equipment and assemblies in accordance with the Pressure Equipment Directive 2014/68/EC.*
- 3.1.2 *All information to support the Users instigation of their obligations under the PSSR 2000 legislation.*
- 3.1.3 *SHTM / HTM 02-01*

3.2 Air Products Standards

Air Products standards make provision for the production of Air Products standard documentation to meet the requirements of these standards (e.g. O&M Manuals, and Operational Readiness Inspections.), any editing, revision, rework or reformatting in line with any specific requirements not detailed within relevant Air Products standards and specifications will be treated as a variation from said standard and will require submission in accordance with a variation procedure to be agreed between the two parties.

3.3 Equipment Specification

3.3.1 Liquid Storage Tanks

3.3.1.1 The Main and Back Up Storage tanks delivered to site tested, purged and ready for intended service.

3.3.1.2 Tanks to be supplied complete with:

- Control valves, relief valves, and interconnecting pipe work.
- Liquid level gauge, pressure gauge and instrumentation.
- Pressure building vaporiser and control regulator.
- Economiser circuit on the back up tank.

3.3.1.3 The storage tank colour shall be white.

3.3.1.4 The tank capacities have been sized in accordance with SHTM / HTM 02-01 section 6 taking in to account distance from the depot and projected usage. The backup tank is sized for 48 hrs usage.

3.3.2 Product Vaporisers (Ambient Air)

- 3.3.2.1 Main and Back Up product vaporisers delivered to site tested, purged and ready for intended service. Vaporisers convert Liquid product to gaseous at a nominal 10°C below prevailing ambient conditions.
- 3.3.2.2 Vaporiser sized to meet process flow requirements based on a minimum ambient temperature of -5°C.
- 3.3.2.3 It is the hospital's responsibility to notify Air Products if the stated design conditions will be exceeded.
- 3.3.2.4 For construction details please refer to the equipment data sheet.

3.3.3 Medical Pressure Control / Alarm Panel

- 3.3.3.1 Medaes Pressure Control / Alarm Panel delivered to site tested, purged and ready for intended service. The manifold, which controls process pressure comprises of:
 - Pressure regulators, solenoid valves, relief valves and interconnecting pipework.
 - Tank pressure gauges, outlet line pressure gauge and pressure switches.
 - GEM10 Oxygen Pharmacy Test Point.
 - Locally mounted alarm panel.
- 3.3.3.2 For construction details please refer to the equipment data sheet.

3.3.4 Storage Tank Contents Monitoring

- 3.3.4.1 Air Products proprietary Telemetry system comprising:
 - 110/230V IP65 control panel complete with operator keypad, backlit LCD display and internal GSM modem.
 - Tank level and pressure transmitters providing 4-20mA outputs to Remote Telemetry Unit.
 - Interconnecting signal cabling and 110/230V power lead between customer-supplied power socket and remote telemetry unit (RTU).

3.3.5 Interconnecting Pipe Work

- 3.3.5.1 All interconnecting pipework shall be installed with fluxless brazed joints utilising end-feed fittings:
 - Material: Degreased table Y/X copper to EN 1057
 - Fittings: IMI Yorkshire Endex degreased for medical service
 - Supports: Steel angle brackets & heavy-duty nylon clamps
 - Cleaning: To Air Products standards
 - Testing: Pneumatic strength test at 1.1 x Relief Valve set pressure using pure dry nitrogen via calibrated test rig.

Leak test at working pressure using suitable foaming agent on all brazed and mechanical joints.

3.3.6 Vaporiser cycling system

3.3.6.1 Air Products standard automatic Vaporiser Cycling system comprised of:

- 110V/230V Control panel with internal transformer for 110V operation.
- 2 off extended spindle (liquid phase) & 2 off standard spindle (gas phase) manual isolation valves to enable isolation of individual vaporiser banks for maintenance activities.
- off 1" actuated cryogenic valves.

3.3.6.2 This system is designed to cycle 2 banks of vaporisers to ensure that each bank has a duty period followed by a recovery period, preventing excessive ice build-up. The system will be set to operate an 18 hrs duty/standby cycle to provide cycles in each 24-hour period. This setup ensures that both banks of vaporisers are exposed to daytime and nighttime ambient conditions for duty and recovery.

4 Scope of Work – Air Products

- 4.1 All equipment listed below shall be leased to the customer throughout the duration of the Bulk Gas Supply Agreement.
- 4.2 Air Product scope of work is to supply transport, cranes, labour and materials to deliver, offload, install, pressure test and commission the equipment listed in section 1.3 and detailed below:
- 4.2.1 *Air Products Storage Tanks as specified in 3.3.1.*
- 4.2.2 *Ambient air product vaporisers as specified in 3.3.2.*
- 4.2.3 *Medical Pressure Control / Alarm Panel as specified in 3.3.3*
- 4.2.4 *Air Products proprietary telemetry system for monitoring the system as specified in 3.3.4.*
- 4.2.5 *Interconnecting pipe work between the tanks, vaporisers and pressure control panel as specified in 3.3.5.*
- 4.2.6 *Vaporiser Auto Cycling System as specified in 3.3.6.*
- 4.2.7 *Pressure System Safety Regulation*
- 4.2.8 *Compliance with Pressure Equipment Directive*
- 4.2.9 *Equipment Identification - Air Products will label all equipment, pipework, valves and instrumentation in accordance with Air Products standard nomenclature.*
- 4.2.10 *Design & Installation Documentation*

Air Products shall supply their standard documentation, during the design and installation phase of the project, including:

- Process & Instrumentation Drawing, including valve and instrumentation schedules.
- General Layout Drawing
- Electrical Control Drawing limited to connection details only.
- Installation Method Statements / Risk Assessments.
- Equipment details, limited to drawings, electrical requirements, dimensions and weights.
- All documentation supplied shall be to Air Products or their sub supplier's standard.

4.2.11 Hand Over Documentation

Air Products shall supply their standard documentation package, on completion of the specified scope of works which shall include:

- Process & Instrumentation Drawing – As Built
- General Layout Drawing
- Installation, Operation and Maintenance Manuals for the system
- Completed/signed customer acceptance certificate for the bulk installation

4.2.12 Acceptance Tests

To be completed in accordance with Air Products operational readiness standards and procedures for systems of this type.

4.2.13 Training

Air Products have allowed for the provision of sufficient information, instruction and training on the day of the system commissioning to be undertaken in one session. The customer is responsible for providing suitable personnel to be trained. Air Products reserve the right to charge for any additional training required.

5 Scope of Work – Customer

5.1 Civil Works

All civil engineering works in providing tank, vaporiser plinth including tanker delivery apron to Air Products' specifications and security fencing (if required).

Plinth construction to be completed to ensure sufficient strength in time for the agreed installation date.

5.2 Ground Conditions

It shall be the responsibility of the customer to ensure that ground conditions are adequate for any associated crane operations on site. Particular attention should be taken with regard to ground bearing conditions under crane outriggers and any underground pipe work, ducts or tanks that could affect ground stability. Any additional costs resulting from unsuitability of ground bearing conditions shall be the responsibility of the customer. Responsibility for Ground Conditions can be undertaken by Air Products, at a rate to be advised, with written notice from the Customer.

5.3 Site Access

Sufficient site access for installing vehicles and cranes. Depending on the size of the installation this shall consist of, (as a minimum), 1 off 16.5m long articulated vehicles and 2 off mobile cranes sized to suit associated installation equipment.

On installation completion provision of a permanent roadway providing adequate access to the installation by an articulated delivery vehicle.

5.4 Electrical Supplies

All electrical supplies need to be installed & tested prior to the installation in locations detailed on the equipment layout drawing provided during the project stage.

5.4.1 Installation Supply

Suitable electrical supplies to facilitate the use of technician's power tools. (Normally 110 volt, 50Hz, Centre tapped earth). Any unusual or heavy current consuming equipment to be used will be specified in advance.

5.4.2 Tanker Power Supply

Installation of a tanker off-loading socket together with a 415V, 3 phase + earth electrical supply in accordance with current Air Products specification A.L.17.005. This must be completed prior to the installation of the tank.

5.4.3 Telemetry

Service requirements for telemetry supply as indicated on Air Products document F2618. This will consist of a 110/230-volt single-phase supply, terminated in an IP67, BS4343, and surface mounted socket and fused for 6A.

5.4.4 Alarm Panel Power Supply

This will consist of a 110/230-volt single-phase supply, terminated in an IP67, BS4343, and surface mounted socket and fused for 6A.

5.4.5 Vaporiser Auto Changeover Panel Power Supply

This will consist of a 110/230-volt single-phase supply, terminated in an IP67, BS4343, and surface mounted socket and fused for 6A.

5.5 Lighting

Provision of adequate lighting for the duration of Air Products' construction work on site and subsequent maintenance activities / product deliveries. Refer to Tank Plinth Specification.

5.6 Site Earthing

All information regarding the site earthing details (including the value of the earth resistance) and to carry out and provide Air Products with the value of the Earth Fault Loop Impedance for the site - as required by IEE Current Edition Wiring Regulations.

5.7 De-icing

All equipment and labour to de-ice tank pipe work, pressure building and product vaporiser during normal use to prevent excessive ice formation which can reduce system efficiency.

5.8 Downstream Pressure Protection

The customer is responsible for ensuring that the downstream piping and equipment is capable of withstanding the fault pressure detailed in section 2. Should additional pressure relief be required this should be provided by the customer following consultation with Air Products.

5.9 Statutory Maintenance

The customer shall provide access to our equipment when requested during normal working hours to allow Air Products to discharge our legal responsibilities for statutory maintenance in accordance with the Pressure System Safety Regulations (2000).

5.10 Alarm Connection

Onward transmission of alarm signals from the Air Products Alarm Panel to the hospital alarm system.

5.11 Analysis of Oxygen Supply

Analysis of Oxygen supplied by the system prior to commissioning. Air Products PLC will provide suitable connection points. Gas sampling equipment to be provided by the customer.

5.12 Connection Point to Distribution System

Air Products PLC will provide a suitable pipeline connection point from the outlet of the Medical Oxygen Control Panel for the hospital to connect on to for installation of the downstream pipeline. This will be in the form of a 22mm diameter copper stub.

5.13 Construction Design and Management 2015

The customer shall be responsible for fulfilling the duties of the 'Client' under the CDM 2015. This includes:

- Providing the necessary Pre-construction information to allow the system to be designed and construction phase to be planned.
- Appointment of the appropriate duty holders.

6 Supporting Documentation

6.1	Tank Data Sheets	G-EUCEDS-XXXCM
6.2	Vaporiser Data Sheets	G-EUCEDS-XXXM
6.3	Pressure Control/Alarm Panel Manual	G-EUCEDS-XXMMHS
6.4	Telemetry Service Requirements	F2618/6
6.5	Tanker Power Socket	A.L.17.005
6.6	Foundation Details	BE-604000XX-D
6.7	Generic Plinth layout	BE-604000XX-D
6.8	Tank Plinth Specification	320-08-016-GB
6.9	Material Safety Data Sheet	
6.10	Safety Distances Data Sheet	
6.11	Air Products Terms for Engineering Works	
6.12	Variation Template	

7 Notes

- 7.1 Should the customer wish to provide The Pressure Systems Safety Regulations (2000) Written Scheme of Examination and complete the initial examination they may do so. Air Products shall provide system drawings 4 weeks from receipt of order. The customer shall provide a copy of the scheme 2 weeks prior to commissioning and also complete the examination prior to commissioning.
- 7.2 After contract award, and throughout the period of the Bulk Gas Supply Agreement between the customer and Air Products, the customer is responsible for conforming to the responsibilities of a user of the Equipment in accordance with the Pressure Systems Safety Regulations (2000), or any modification, substitution or re-enactment of those regulations. Unless notified in writing, this will be carried out by Air Products at a rate to be advised at the time of conformance.
- 7.3 The installation shall comply with the BCGA Code of Practice CP36, SHTM or HTM 02-01, EN 737-3:2000 and BCGA Code of Practice CP34 The Application of the Pressure Equipment Regulations to Customer Sites. The code of practice allows for the utilisation of new and used pressure equipment and either a 'Statement of Compliance' or 'Declaration of Conformity' shall be issued for the installation dependent on the equipment installed. The customer shall be responsible for establishing any requirement to CE certify the complete installation prior to project commencement to enable Air Products to establish changes to scope, delivery and project costs.
- 7.4 The provision of a permanently connected reserve supply, if required in accordance with EN 737-3 paragraph 5.1.13, shall be the customer's responsibility.
- 7.5 It shall be the responsibility of the customer to ensure compliance with the separation distances from typical hazards and the installation as recommended by the BCGA Code of Practice CP36 for the operational life of the installation. Any changes to the area surrounding the installation which may affect its performance or breach the recommended separation distances should be notified to Air Products for review.
- 7.6 Air Products shall be responsible for ensuring that any electrical equipment under their ownership is maintained in a safe and serviceable condition, in accordance with the Electricity at Work Regulations 1989. The tanker offloading socket shall become the property of the customer and all subsequent maintenance shall be the responsibility of the customer.
- 7.7 It shall be the responsibility of the customer to ensure that any electrical supply to Air Products equipment is installed and maintained in accordance with the IEE Current Edition Wiring Regulations and also complies with any relevant sections of the Electricity at Work Regulations, 1989.

- 7.8 The Equipment as detailed in this specification shall be installed to comply with current Air Products standards and specifications in relation to system and component design including material suitability and finish. The equipment will satisfy agreed performance and will meet or exceed any statutory requirements.
- 7.9 Following satisfactory installation, Air Products shall provide sufficient information, instruction and training on product hazards, the operation of mechanical and electrical equipment, including fault finding and emergency contacts to ensure, so far as is reasonably practicable, the safety of operators. The customer shall be responsible for assisting in any initial fault finding activities to resolve a problem prior to a site visit.
- 7.10 Unless otherwise agreed, design validation shall be demonstrated by successful commissioning and recorded by customer acceptance.
- 7.11 All equipment owned and maintained by Air Products under the Bulk Gas Supply/Maintenance Agreement shall be maintained in accordance with the SHTM or HTM 02-01 in addition to the Pressure Systems Safety Regulations (2000). This must form part of the hospital's operational policy for which the hospital has ultimate responsibility.
- 7.12 All work will be carried out in accordance with the applicable BCGA Codes of Practice and to Air Products' procedures and specifications.
- 7.13 The costs supplied allow for normal weekday working from 8.45am to 5.15pm including travel time. For customer requests to operate outside these hours or at weekends, Air Products reserve the right to levy a charge for this time. This charge shall be at the prevailing engineering charge out hourly rate.
- 7.14 Air Products 'Terms for Engineering Works' apply.
- 7.15 The supplied costs are valid for 30 days
- 7.16 Air Products typical lead time for installation is 8 – 16 weeks from receipt of purchase order dependent on the use of refurbished or new equipment. Actual installation dates to be agreed with your site technical representative at project stage.
- 7.17 Should the installation need to be cancelled or postponed by the customer, 5 working days' notice is required or additional charges may apply.
- 7.18 Should the scope agreed within this document need to be changed the customer is requested to complete the attached variation scope document for review by Air Products to advise cost and time implications.

8 Exclusions

- 8.1 All civil engineering work.
- 8.2 All electrical work (unless specifically stated).
- 8.3 All earthing requirements.
- 8.4 Liquid required for first fill.
- 8.5 Welfare facilities.
- 8.6 Temporary supplies (unless otherwise agreed).
- 8.7 Site security.
- 8.8 Analysis of oxygen supplied.

9 Service Plus

Air Products offers the following as part of the Service Plus programme:

- Process Evaluation
- Process Optimisation
- Project Management
- Gas Handling, Control and Distribution Equipment
- Standard Installation Package
- Distribution Systems
- Telemetry
- Inspection
- Maintenance
- Pressure Testing
- APEX™ (Industrial Gas Services)
- Analytical Services
- Training
- Safety, Health and Environmental
- Emergency Cover
- Flow & Purity Trials
- Pressure System Generation or Written Schemes and Inspections for Users Equipment
- Dangerous Substances and Explosive Atmospheres Regulations (2002) Compliance Surveys

For details contact UK Customer Engineering:

Telephone: 0345 607 1207

E-mail: custeng@airproducts.com

TECHNICAL SPECIFICATION

Proposal No. VantageTag

Rev 0

Title: Installation of Medical Oxygen Simplex System

Presented to: VantageTag
VantageTag
VantageTag
VantageTag

Prepared by: VantageTag
Project Engineer
UK Customer Engineering

Date VantageTag

Rev Date

On behalf of Air Products PLC



Reviewed / Approved By			
Company	Name	Signature	Date
Air Products			
Customer			

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1 Summary

1.1 The site requirements are for Medical Oxygen.

1.2 Current usage data, provided by the customer, is:

- Current Consumption VantageTag VantageTag
- Forecasted Consumption VantageTag VantageTag
- Usage Pattern VantageTag hr/day, day/week (VantageTag)

1.3 The Air Products scope of work is to supply labour and materials to install, pressure test and commission:

1.3.1 off litre *Primary (or main) Liquid Oxygen Storage Tank (or nearest equivalent)*

1.3.2 off *Ambient Vaporiser(s)*

1.3.3 1 off 2 x *Oxygen cylinder back up manifold*

1.3.4 1 off *Simplex SHTM / HTM 02-01 Pressure Control and Alarm Panel*

1.4 All interconnecting pipe work in the tank compound shall be Copper Tube to EN 1057 Table X or Y (Degreased), installed using Copper brazed fittings to Air Products PLC's procedures for the installation of Medical Gas Pipeline Systems.

1.5 Scope of Works – Responsibilities

Details of work – Civil	Responsibility
All civil engineering works including ground work, plinth, impact protection and security fencing (where required). (ref to Tank Plinth Specification)	Customer
Separate compound or building enclosure complete with ventilation and/or oxygen atmosphere monitoring to house the cylinder manifold and pressure control / alarm panel adjacent to the main tank compound in accordance with HTM/SHTM 02-01.	Customer
Ensuring compliance with the separation distances from typical hazards and the installation as recommended by the BCGA Code of Practice CP36 for the operational life of the installation	Customer
Details of Work – Mechanical	Responsibility
Interconnecting pipeline installation within the Air Products compound area.	Air Products
Pressure systems safety regulations (2000) Compliance	Air Products
Pressure Equipment Directive Compliance	Air Products
Delivery of equipment to installation site	Air Products
Supply suitable cranes for the offloading and positioning of equipment	Air Products
Details of Work – Electrical	Responsibility
Tanker offloading power requirement (415V TP-E 63A) including 5 pin socket with RCD. Refer to AL17.005. (if required).	Customer
Suitable electrical supplies to facilitate the use of technicians' power tools. (Normally 110 volt, 50Hz, Centre tapped earth).	Customer
All Earthing requirements	Customer
Suitable lighting of the area around the site to facilitate a safe working environment (ref to Tank Plinth Specification).	Customer
Single Phase 110/230V for telemetry system.	Customer
Single Phase 110/230V for Pressure Control / Alarm Panel.	Customer
Onwards transmission of alarm signals from Air Products' alarm panel to the hospital alarm system.	Customer
Construction Design and Management 2015	Responsibility
Compliance with responsibilities of the 'Client' under CDM 2015	Customer

2 Performance Criteria

2.1 System Requirements:

2.1.1 *The system has been designed to meet the following conditions*

Design Flowrate (Norm)	VantageTag VantageTag
Normal Flow Duration	VantageTag VantageTag
Design Flowrate (Peak)	VantageTag VantageTag
Peak Flow Duration	VantageTag VantageTag
Design Pressure	25 barg
Supply Pressure	4.2 barg
Design Temperature	-196/+65°C
Minimum Supply Temperature (Ref 2.1.5)	-20°C
Maximum Downstream Pressure Ref 2.1.3	5.3 barg

2.1.2 *Projected increase 8 – 10% per annum in line with SHTM / HTM 02-01 A 6.22.*

2.1.3 *Flow rates quoted are at 0°C and 1atm. Product outlet temperature at the design flow rate shall be a nominal 10°C below the prevailing ambient temperature.*

2.1.4 *Fault pressure is provided above for guidance and shall be confirmed at project stage for the actual equipment installed. The customer is responsible for ensuring that downstream piping and equipment can withstand the fault pressure and should notify Air Products if this is not the case.*

2.1.5 *The vaporiser system is designed to provide the required flows at ambient environmental conditions at a 1% winter low of -5°C (3.65 Days per year). For periods where the ambient temperature falls below these condition, de-icing may be required by the hospital.*

2.1.6 *The vaporiser system is designed to provide safe operation at the design flow rate; consequently, there is no provision in the design for a low temperature shut off device. It is the customer's responsibility to notify Air Products if the stated design conditions will be exceeded.*

3 Specification

3.1 Statutory Requirements

All work carried out in relation to this specification shall be in accordance with all relevant statutory requirements for an installation of this type as are in force at the time of system commissioning in the country within which the system will be operated, namely:

- 3.1.1 *Pressure equipment and assemblies in accordance with the Pressure Equipment Directive 2014/68/EC.*
- 3.1.2 *All information to support the Users instigation of their obligations under the PSSR 2000 legislation.*
- 3.1.3 *SHTM / HTM 02-01*

3.2 Air Products Standards

Air Products standards make provision for the production of Air Products standard documentation to meet the requirements of these standards (e.g. O&M Manuals, and Operational Readiness Inspections.), any editing, revision, rework or reformatting in line with any specific requirements not detailed within relevant Air Products standards and specifications will be treated as a variation from said standard and will require submission in accordance with a variation procedure to be agreed between the two parties.

3.3 Equipment Specification

3.3.1 Liquid Storage Tank

3.3.1.1 The Main Storage tank delivered to site tested, purged and ready for intended service.

3.3.1.2 Tank to be supplied complete with:

- Control valves, relief valves, and interconnecting pipe work.
- Liquid level gauge, pressure gauge and instrumentation.
- Pressure building vaporiser and control regulator.
- Economiser circuit on the back up tank.
-

3.3.1.3 The storage tank colour shall be white.

3.3.1.4 The tank capacity has been sized in accordance with SHTM / HTM 02-01 section 6 taking in to account distance from the depot and projected usage. The cylinder backup is sized for 48 hrs usage.

3.3.2 Product Vaporisers (Ambient Air)

- 3.3.2.1 Product vaporiser(s) delivered to site tested, purged and ready for intended service. Vaporisers convert Liquid product to gaseous at a nominal 10°C below prevailing ambient conditions.
- 3.3.2.2 Vaporiser sized to meet process flow requirements based on a minimum ambient temperature of -5°C.
- 3.3.2.3 It is the hospital's responsibility to notify Air Products if the stated design conditions will be exceeded.
- 3.3.2.4 For construction details please refer to the equipment data sheet.

3.3.3 Oxygen Cylinder Backup Supply

- 3.3.3.1 Air Products medical oxygen cylinders connected via a Medaes Oxygen Cylinder Manifold supplied as part of the Pressure Control / Alarm Panel.

3.3.4 Medical Pressure Control / Alarm Panel

- 3.3.4.1 Medaes Pressure Control / Alarm Panel delivered to site tested, purged and ready for intended service. The manifold, which controls process pressure comprises of:
 - Pressure regulators, solenoid valves, relief valves and interconnecting pipework.
 - Tank pressure gauges, outlet line pressure gauge and pressure switches.
 - GEM10 oxygen pharmacy test point.
 - Locally mounted alarm panel.
- 3.3.4.2 For construction details please refer to the equipment data sheet.

3.3.5 Storage Tank Contents Monitoring

- 3.3.5.1 Air Products proprietary Telemetry system comprising:
 - 110/230V IP65 control panel complete with operator keypad, backlit LCD display and internal GSM modem.
 - Tank level and pressure transmitters providing 4-20mA outputs to Remote Telemetry Unit.
 - Interconnecting signal cabling and 110/230V power lead between customer-supplied power socket and remote telemetry unit (RTU).

3.3.6 Interconnecting Pipe Work

3.3.6.1 All interconnecting pipework shall be installed with fluxless brazed joints utilising end-feed fittings:

- Material: Degreased table Y/X copper to EN 1057
- Fittings: IMI Yorkshire Endex degreased for medical service
- Supports: Steel angle brackets & heavy-duty nylon clamps
- Cleaning: To Air Products standards
- Testing: Pneumatic strength test at 1.1 x Relief Valve set pressure using pure dry nitrogen via calibrated test rig.
Leak test at working pressure using suitable foaming agent on all brazed and mechanical joints.

4 Scope of Work – Air Products

- 4.1 All equipment listed below shall be leased to the customer throughout the duration of the Bulk Gas Supply Agreement.
- 4.2 Air Product scope of work is to supply transport, cranes, labour and materials to deliver, offload, install, pressure test and commission the equipment listed in section 1.3 and detailed below:
- 4.2.1 *Air Products Storage Tank as specified in 3.3.1.*
- 4.2.2 *Ambient air product vaporisers as specified in 3.3.2.*
- 4.2.3 *Oxygen cylinder back up supply as specified in 3.3.3.*
- 4.2.4 *Medical Pressure Control / Alarm Panel as specified in 3.3.4.*
- 4.2.5 *Air Products proprietary telemetry system for monitoring the system as specified in 3.3.5.*
- 4.2.6 *Interconnecting pipe work between the tank, vaporiser(s) and pressure control panel as specified in 3.3.6.*
- 4.2.7 *Pressure System Safety Regulation*
- 4.2.8 *Compliance with Pressure Equipment Directive*
- 4.2.9 *Equipment Identification - Air Products will label all equipment, pipework, valves and instrumentation in accordance with Air Products standard nomenclature.*
- 4.2.10 *Design & Installation Documentation*

Air Products shall supply their standard documentation, during the design and installation phase of the project, including:

- Process & Instrumentation Drawing, including valve and instrumentation schedules.
- General Layout Drawing.
- Electrical Control Drawing limited to connection details only.
- Installation Method Statements / Risk Assessments.
- Equipment details, limited to drawings, electrical requirements, dimensions and weights.
- All documentation supplied shall be to Air Products or their sub supplier's standard.

4.2.11 Hand Over Documentation

Air Products shall supply their standard documentation package, on completion of the specified scope of works which shall include:

- Process & Instrumentation Drawing – As Built
- General Layout Drawing
- Installation, Operation and Maintenance Manuals for the system
- Completed/signed customer acceptance certificate for the bulk installation

4.2.12 Acceptance Tests

To be completed in accordance with Air Products operational readiness standards and procedures for systems of this type.

4.2.13 Training

Air Products have allowed for the provision of sufficient information, instruction and training on the day of the system commissioning to be undertaken in one session. The customer is responsible for providing suitable personnel to be trained. Air Products reserve the right to charge for any additional training required.

5 Scope of Work – Customer

5.1 Civil Works

All civil engineering works in providing tank and vaporiser plinth including tanker delivery apron and security fencing to Air Products' specifications.

In addition, a separate, suitably sized compound or building enclosure, complete with ventilation and/or oxygen atmosphere monitoring, is to be provided by the hospital for the backup cylinder manifold and pressure control / alarm panel, adjacent to the tank compound, to comply with the requirements of HTM/SHTM 02-01.

Plinth construction to be completed to ensure sufficient strength in time for the agreed installation date.

5.2 Ground Conditions

It shall be the responsibility of the customer to ensure that ground conditions are adequate for any associated crane operations on site. Particular attention should be taken with regard to ground bearing conditions under crane outriggers and any underground pipe work, ducts or tanks that could affect ground stability. Any additional costs resulting from unsuitability of ground bearing conditions shall be the responsibility of the customer. Responsibility for Ground Conditions can be undertaken by Air Products, at a rate to be advised, with written notice from the Customer.

5.3 Site Access

Sufficient site access for installing vehicles and cranes. Depending on the size of the installation this shall consist of, (as a minimum), 1 off 16.5m long articulated vehicles and 2 off mobile cranes sized to suit associated installation equipment.

On installation completion provision of a permanent roadway providing adequate access to the installation by an articulated delivery vehicle.

5.4 Electrical Supplies

All electrical supplies need to be installed & tested prior to the installation in locations detailed on the equipment layout drawing provided during the project stage.

5.4.1 Installation Supply

Suitable electrical supplies to facilitate the use of technicians power tools. (Normally 110 volt, 50Hz, Centre tapped earth). Any unusual or heavy current consuming equipment to be used will be specified in advance.

5.4.2 Tanker Power Supply (if required)

Installation of a tanker off-loading socket together with a 415V, 3 phase electrical supply in accordance with current Air Products specification A.L.17.005. This must be completed prior to the installation of the tank.

5.4.3 Telemetry

Service requirements for telemetry supply as indicated on Air Products document F2618. This will consist of a 110/230-volt single-phase supply, terminated in an IP67, BS4343, and surface mounted socket and fused for 6A.

5.4.4 Alarm Panel Power Supply

This will consist of a 110/230-volt single-phase supply, terminated in an IP67, BS4343, and surface mounted socket and fused for 6A.

5.5 Lighting

Provision of adequate lighting for the duration of Air Products' construction work on site and subsequent maintenance activities / product deliveries. Refer to Tank Plinth Specification.

5.6 Site Earthing

All information regarding the site earthing details (including the value of the earth resistance) and to carry out and provide Air Products with the value of the Earth Fault Loop Impedance for the site - as required by IEE Current Edition Wiring Regulations.

5.7 De-icing

All equipment and labour to de-ice tank pipe work, pressure building and product vaporiser during normal use to prevent excessive ice formation which can reduce system efficiency.

5.8 Downstream Pressure Protection

The customer is responsible for ensuring that the downstream piping and equipment is capable of withstanding the fault pressure detailed in section 2. Should additional pressure relief be required this should be provided by the customer following consultation with Air Products.

5.9 Statutory Maintenance

The customer shall provide access to our equipment when requested during normal working hours to allow Air Products to discharge our legal responsibilities for statutory maintenance in accordance with the Pressure System Safety Regulations (2000).

5.10 Alarm Connection

Onward transmission of alarm signals from the Air Products Alarm Panel to the hospital alarm system.

5.11 Analysis of Oxygen Supply

Analysis of Oxygen supplied by the system prior to commissioning. Air Products PLC will provide suitable connection points. Gas sampling equipment to be provided by the customer.

5.12 Connection Point to Distribution System

Air Products PLC will provide a suitable pipeline connection point from the outlet of the Medical Oxygen Control Panel for the hospital to connect on to for installation of the downstream pipeline. This will be in the form of a 22mm diameter copper stub.

5.13 Construction Design and Management 2015

The customer shall be responsible for fulfilling the duties of the 'Client' under the CDM 2015. This includes:

- Providing the necessary Pre-construction information to allow the system to be designed and construction phase to be planned.
- Appointment of the appropriate duty holders.

6 Supporting Documentation

6.1	Tank Data Sheet	G-EUCEDS-XXXCM
6.2	Vaporiser Data Sheet	G-EUCEDS-XXXM
6.3	Pressure Control/Alarm Panel Manual	G-EUCEDS-XXMMHS
6.4	Telemetry Service Requirements	F2618/6
6.5	Tanker Power Socket (if required)	A.L.17.005
6.6	Foundation Details	BE-604000XX-D
6.7	Generic Plinth layout	BE-604000XX-D
6.8	Tank Plinth Specification	320-08-016-GB
6.9	Material Safety Data Sheet	
6.10	Safety Distances Data Sheet	
6.11	Air Products Terms for Engineering Works	
6.12	Variation Template	

7 Notes

- 7.1 Should the customer wish to provide The Pressure Systems Safety Regulations (2000) Written Scheme of Examination and complete the initial examination they may do so. Air Products shall provide system drawings 4 weeks from receipt of order. The customer shall provide a copy of the scheme 2 weeks prior to commissioning and also complete the examination prior to commissioning.
- 7.2 After contract award, and throughout the period of the Bulk Gas Supply Agreement between the customer and Air Products, the customer is responsible for conforming to the responsibilities of a user of the Equipment in accordance with the Pressure Systems Safety Regulations (2000), or any modification, substitution or re-enactment of those regulations. Unless notified in writing, this will be carried out by Air Products at a rate to be advised at the time of conformance.
- 7.3 The installation shall comply with the BCGA Code of Practice CP36, SHTM or HTM 02-01, EN 737-3:2000 and BCGA Code of Practice CP34 The Application of the Pressure Equipment Regulations to Customer Sites. The code of practice allows for the utilisation of new and used pressure equipment and either a 'Statement of Compliance' or 'Declaration of Conformity' shall be issued for the installation dependent on the equipment installed. The customer shall be responsible for establishing any requirement to CE certify the complete installation prior to project commencement to enable Air Products to establish changes to scope, delivery and project costs.
- 7.4 The provision of a permanently connected reserve supply, if required in accordance with EN 737-3 paragraph 5.1.13, shall be the customer's responsibility.
- 7.5 It shall be the responsibility of the customer to ensure compliance with the separation distances from typical hazards and the installation as recommended by the BCGA Code of Practice CP36 for the operational life of the installation. Any changes to the area surrounding the installation which may affect its performance or breach the recommended separation distances should be notified to Air Products for review.
- 7.6 Air Products shall be responsible for ensuring that any electrical equipment under their ownership is maintained in a safe and serviceable condition, in accordance with the Electricity at Work Regulations 1989. The tanker offloading socket shall become the property of the customer and all subsequent maintenance shall be the responsibility of the customer.
- 7.7 It shall be the responsibility of the customer to ensure that any electrical supply to Air Products equipment is installed and maintained in accordance with the IEE Current Edition Wiring Regulations and also complies with any relevant sections of the Electricity at Work Regulations, 1989.

- 7.8 The Equipment as detailed in this specification shall be installed to comply with current Air Products standards and specifications in relation to system and component design including material suitability and finish. The equipment will satisfy agreed performance and will meet or exceed any statutory requirements.
- 7.9 Following satisfactory installation, Air Products shall provide sufficient information, instruction and training on product hazards, the operation of mechanical and electrical equipment, including fault finding and emergency contacts to ensure, so far as is reasonably practicable, the safety of operators. The customer shall be responsible for assisting in any initial fault finding activities to resolve a problem prior to a site visit.
- 7.10 Unless otherwise agreed, design validation shall be demonstrated by successful commissioning and recorded by customer acceptance.
- 7.11 All equipment owned and maintained by Air Products under the Bulk Gas Supply/Maintenance Agreement shall be maintained in accordance with the SHTM or HTM 02-01 in addition to the Pressure Systems Safety Regulations (2000). This must form part of the hospital's operational policy for which the hospital has ultimate responsibility.
- 7.12 All work will be carried out in accordance with the applicable BCGA Codes of Practice and to Air Products' procedures and specifications.
- 7.13 The costs supplied allow for normal weekday working from 8.45am to 5.15pm including travel time. For customer requests to operate outside these hours or at weekends, Air Products reserve the right to levy a charge for this time. This charge shall be at the prevailing engineering charge out hourly rate.
- 7.14 Air Products 'Terms for Engineering Works' apply.
- 7.15 The supplied costs are valid for 30 days
- 7.16 Air Products typical lead time for installation is 8 – 16 weeks from receipt of purchase order dependent on the use of refurbished or new equipment. Actual installation dates to be agreed with your site technical representative at project stage.
- 7.17 Should the installation need to be cancelled or postponed by the customer, 5 working days' notice is required or additional charges may apply.
- 7.18 Should the scope agreed within this document need to be changed the customer is requested to complete the attached variation scope document for review by Air Products to advise cost and time implications.

8 Exclusions

- 8.1 All civil engineering work.
- 8.2 All electrical work (unless specifically stated).
- 8.3 All earthing requirements.
- 8.4 Liquid required for first fill.
- 8.5 Welfare facilities.
- 8.6 Temporary supplies (unless otherwise agreed).
- 8.7 Site security.
- 8.8 Analysis of oxygen supplied.

9 Service Plus

Air Products offers the following as part of the Service Plus programme:

- Process Evaluation
- Process Optimisation
- Project Management
- Gas Handling, Control and Distribution Equipment
- Standard Installation Package
- Distribution Systems
- Telemetry
- Inspection
- Maintenance
- Pressure Testing
- APEX™ (Industrial Gas Services)
- Analytical Services
- Training
- Safety, Health and Environmental
- Emergency Cover
- Flow & Purity Trials
- Pressure System Generation or Written Schemes and Inspections for Users Equipment
- Dangerous Substances and Explosive Atmospheres Regulations (2002) Compliance Surveys

For details contact UK Customer Engineering:

Telephone: 0345 607 1207

E-mail: custeng@airproducts.com

210CM Vacuum Insulated Storage Tank

Dimensions

	Metres	Feet
A	2.3 - 3.1	7.5 - 10.2
B	7.1 - 12.5	23.2 - 40.8
Gross capacity	29,800 litres	6,555 gals
Weight (unladen)	16,500 kg	36,376 lb (Max)
Net liquid capacity *	26,820 litres	5,900 gals

Liquified Gas Capacities

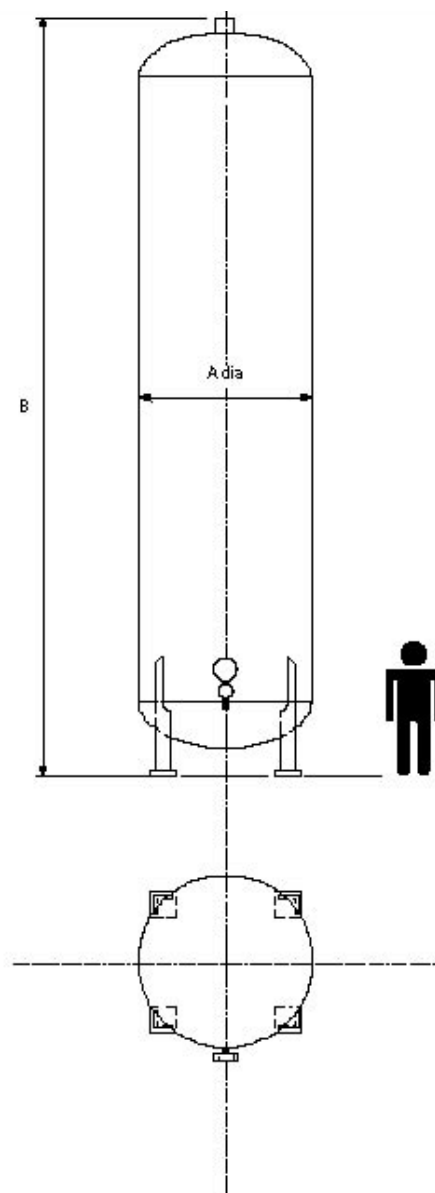
		Oxygen	Nitrogen	Argon
Weight of liquid **kg		30,596	21,589	37,673
Gaseous equivalent	Nm ³	21,433	17,274	21,138

Specification

MAWP	25.0 barg
Heat leak rate ***	0.28%
Pressure build-up vaporiser	Integral/External
Product vaporiser	Supplied separately: Type dependant on vaporisation rate.
Manufacturers	AGA Air Products Ferox

Notes

- * 5% vapour space allowed to accommodate liquid expansion due to changes in pressure/temperature equilibrium conditions.
- ** Weight calculated at atmospheric pressure.
- *** Expressed as a percentage of the full tank contents per day for liquid nitrogen at its equilibrium temperature for atmospheric pressure.



All stated dimensions are typical, some variations in dimensions are possible on specific tanks. Tank layouts shown on sketch may vary.

All data above is supplied for guidance only.

For further details contact Air Products PLC.

50CM Vacuum Insulated Storage Tank

Dimensions

	Metres	Feet
A	2.1	6.9
B	4.1	13.5
Gross capacity	6,500 litres	1,430 gals
Weight (unladen)	4,400 kg	9,700 lb (Max)
Net liquid capacity *	6,175 litres	1,358 gals

Liquified Gas Capacities

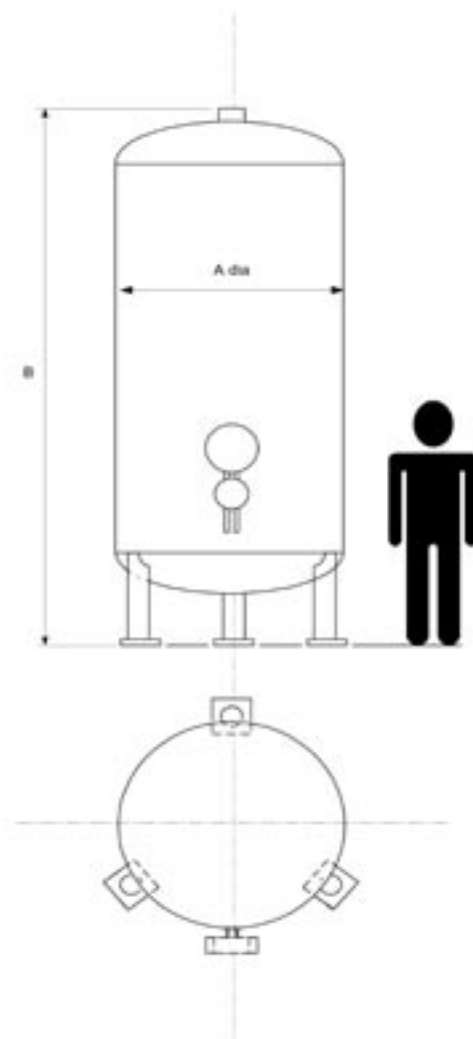
		Oxygen	Nitrogen	Argon
Weight of liquid **kg		7,044	4,971	8,674
Gaseous equivalent	Nm ³	4,935	3,977	4,867

Specification

MAWP	16.5 barg
Heat leak rate ***	0.50%
Pressure build-up vaporiser	Integral with tank
Product vaporiser	Supplied separately: Type dependant on vaporisation rate.
Manufacturers	Air Products Ferox

Notes

- * 5% vapour space allowed to accommodate liquid expansion due to changes in pressure/temperature equilibrium conditions.
- ** Weight calculated at atmospheric pressure.
- *** Expressed as a percentage of the full tank contents per day for liquid nitrogen at its equilibrium temperature for atmospheric pressure.



All stated dimensions are typical, some variations in dimensions are possible on specific tanks. Tank layouts shown on sketch may vary.

All data above is supplied for guidance only.

For further details contact Air Products PLC.

VAI-836-FB-L12 Ambient Product Vaporiser

Process Conditions	
Fluid(s)	LOX/LIN/LAR
Design Temperature	-195.5°C to +65.5°C (-320°F to +150°F)
Design Pressure	40 barg (580 psig)
MAWP	40 barg (580 psig) LIN/LAR 27.6 barg (400 psig) LOX*

*Max operating pressure LOX 20.7 barg (300 psig)

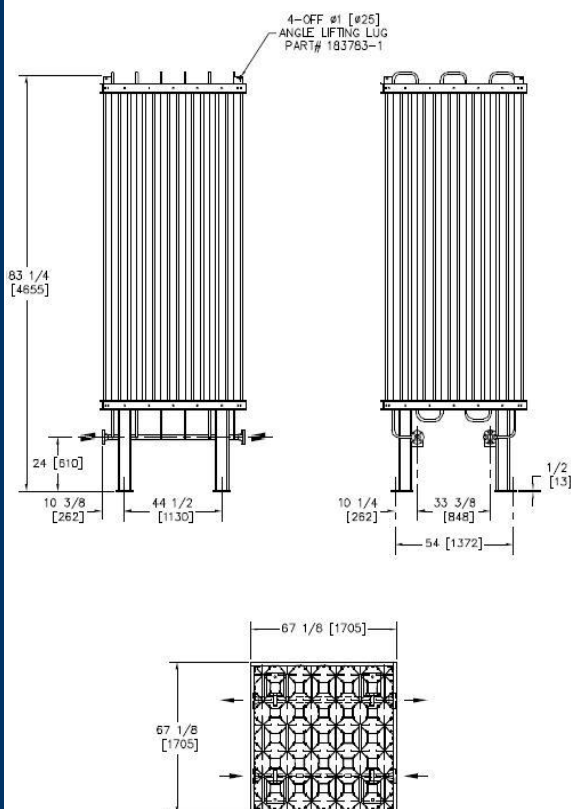
Wind/Seismic requirements	
Wind load	ASCE 7-05. V=56 m/s
Seismic load	IBC 2006. Zone 4

Construction	
Model number	VAI-836-FB-L12
External heat transfer area, m ² (ft ²)	195 (2101)
Number of extrusions	36
Length of single extrusion, m (ft)	3.7 (12)
Flow pass config (parallel x series x inlet hdr)	6 x 6 x 1
Hydraulic diameter, mm (in)	25.8 (1.02)
Fin spacing - center to center, mm (in)	283 (11.14)
Length x Width x Height, mm	1705 x 1705 x 4655
Tare weight, kg (lb)	980 (2160)
Iced weight, kg (lb)	2945 (6490)

Materials	
Pressure retaining parts	Aluminium
Frame and supports	Aluminium
Inlet connection	Dual 1 1/2" ANSI 300lb Flange (1 blind flange + 1 flange with 1" BSPT F thread)
Outlet connection	Dual 2" ANSI 300lb Flange (1 blind flange + 1 flange with 1 1/2" BSPT F thread)

Code requirements	
AP specification	4WEQ-1405
Design code	ASME SECTION VIII DIVISION 1
	Manufactured to PED and CE marked

Cleaning requirements	
Cleaning requirements	APCI 4WPI-SW70003



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Version 2.2
Revision Date 24.03.2020
Supersedes Version: 2.1

SDS Number 300000003825
Print Date 03.10.2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier : MEDICAL OXYGEN

CAS No. : 7782-44-7

Chemical formula : O₂

Synonyms : Oxygen, Oxygen gas, Gaseous Oxygen, GOX

REACH Registration Number: Listed in Annex IV / V REACH, exempted from registration.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Industrial and professional use. Perform risk assessment prior to use.
Restrictions on Use : Medical Applications
None.

1.3. Details of the supplier of the safety data sheet : Air Products Plc
2 Millennium Gate
Westmere Drive
Crewe
Cheshire

Email Address – Technical Information : GASTECH@airproducts.com

Telephone : +44(0)3457 020202

1.4. Emergency telephone number : +44(0)8085 020202
NHS Direct in England or Wales 0845 46 47 or NHS 24 in Scotland 08454 24 24

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Oxidizing gases - Category 1 H270: May cause or intensify fire; oxidiser.
Gases under pressure - Compressed gas. H280: Contains gas under pressure; may explode if heated.

2.2. Label elements

Hazard pictograms/symbols

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Signal Word: Danger

Hazard Statements:

H270: May cause or intensify fire; oxidiser.
H280: Contains gas under pressure; may explode if heated.

Precautionary Statements:

Prevention : P220: Keep away from clothing and other combustible materials.
P244: Keep valves and fittings free from oil and grease.

Response : P370+P376 : In case of fire: Stop leak if safe to do so.

Storage : P403: Store in a well-ventilated place.

2.3. Other hazards

High pressure, oxidizing gas.
Vigorously accelerates combustion.
Keep oil, grease, and combustibles away.
May react violently with combustible materials.
Substance does not meet the criteria for PBT and vPvB according to Regulation (EC) No 1907/2006, Annex XIII.

SECTION 3: Composition/information on ingredients

3.1. Substances

Components	EINECS / ELINCS Number	CAS Number	Concentration (Volume)
Oxygen	231-956-9	7782-44-7	100 %

Components	Classification (CLP)	REACH Reg. #
Oxygen	Ox. Gas 1 ; H270 Press. Gas (Comp.) ; H280	*1

*1: Listed in Annex IV / V REACH, exempted from registration.

*2: Registration not required: substance manufactured or imported < 1 t/y.

*3: Registration not required: substance manufactured or imported < 1 t/y for non-intermediate uses.

Refer to section 16 for full text of each relevant hazard statement (H).

Concentration is nominal. For the exact product composition, please refer to technical specifications.

3.2. Mixtures : Not applicable.

SECTION 4: First aid measures

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4.1. Description of first aid measures

- General advice : Remove victim to uncontaminated area wearing self-contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
- Eye contact : IF exposed or concerned: Get medical advice/attention.
- Skin contact : Adverse effects not expected from this product. IF exposed or concerned: Get medical advice/attention.
- Ingestion : Ingestion is not considered a potential route of exposure.
- Inhalation : Consult a physician after significant exposure. Move to fresh air. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately.

4.2. Most important symptoms and effects, both acute and delayed

- Symptoms : No data available.

4.3. Indication of any immediate medical attention and special treatment needed

- Treatment : If exposed or concerned: Get medical attention/advice.

SECTION 5: Firefighting measures

5.1. Extinguishing media

- Suitable extinguishing media : The product itself does not burn.
Use extinguishing media appropriate for surrounding fire.

- Extinguishing media which must not be used for safety reasons. : Do not use water jet to extinguish.

5.2. Special hazards arising from the substance or mixture

- : Upon exposure to intense heat or flame, cylinder will vent rapidly and or rupture violently. Oxidant. Strongly supports combustion. May react violently with combustible materials. Some materials which are noncombustible in air may burn in the presence of an oxidizer. Move away from container and cool with water from a protected position. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. If possible, stop flow of product.

5.3. Advice for firefighters

- : Wear self contained breathing apparatus for fire fighting if necessary. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. Standard EN 469 - Protective clothing for firefighters. Standard - EN 659: Protective gloves for firefighters.
- Further information : Some materials that are noncombustible in air will burn in the presence of an oxygen enriched atmosphere (greater than 23.5%). Fire resistant clothing may burn and offer no protection in oxygen rich atmospheres.

SECTION 6: Accidental release measures

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- 6.1. Personal precautions, protective equipment and emergency procedures : Clothing exposed to high concentrations may retain oxygen 30 minutes or longer and become a potential fire hazard. Stay away from ignition sources. Evacuate personnel to safe areas. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. Ventilate the area.
- 6.2. Environmental precautions : Do not discharge into any place where its accumulation could be dangerous. Prevent further leakage or spillage if safe to do so.
- 6.3. Methods and material for containment and cleaning up : Ventilate the area.
- Additional advice : If possible, stop flow of product. Increase ventilation to the release area and monitor concentrations. If leak is from cylinder or cylinder valve, call the emergency telephone number. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs.
- 6.4. Reference to other sections : For more information refer to Sections 8 & 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

All gauges, valves, regulators, piping and equipment to be used in oxygen service must be cleaned for oxygen service. Oxygen is not to be used as a substitute for compressed air. Never use an oxygen jet for cleaning purposes of any sort, especially clothing, as it increases the likelihood of an engulfing fire. Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperature to exceed 50°C (122°F). Before using the product, determine its identity by reading the label. Know and understand the properties and hazards of the product before use. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Use an adjustable strap wrench to remove over-tight or rusted caps. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Ensure the complete gas system is compatible for pressure rating and materials of construction. Ensure the complete gas system has been checked for leaks before use. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. Do not use containers as rollers or supports or for any other purpose than to contain the gas as supplied. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Do not smoke while handling product or cylinders. Never re-compress a gas or a gas mixture without first consulting the supplier. Never attempt to transfer gases from one cylinder/container to another. Always use backflow protective device in piping. When returning cylinder install valve outlet cap or plug leak tight. Never permit oil, grease, or other readily combustible substances to come into contact with valves or containers containing oxygen or other oxidants. Do not use rapidly opening valves (e.g. ball valves). Open valve slowly to avoid pressure shock. Never pressurize the entire system at once. Use only with equipment cleaned for oxygen service and rated for cylinder pressure. Never use direct flame or electrical heating devices to raise the pressure of

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a container. Containers should not be subjected to temperatures above 50°C (122°F).

7.2. Conditions for safe storage, including any incompatibilities

Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Full containers should be stored so that oldest stock is used first. Stored containers should be periodically checked for general condition and leakage. Observe all regulations and local requirements regarding storage of containers. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Containers should be stored in the vertical position and properly secured to prevent toppling. The container valves should be tightly closed and where appropriate valve outlets should be capped or plugged. Container valve guards or caps should be in place. Keep containers tightly closed in a cool, well-ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Full and empty cylinders should be segregated. Do not allow storage temperature to exceed 50°C (122°F). Display "No Smoking or Open Flames" signs in the storage areas. Return empty containers in a timely manner.

Technical measures/Precautions

Containers should be segregated in the storage area according to the various categories (e.g. flammable, toxic, etc.) and in accordance with local regulations.

7.3. Specific end use(s)

Refer to section 1 or the extended SDS if applicable.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

If applicable, refer to the extended section of the SDS for further information on CSA.

DNEL: Derived no effect level (Workers)
None available.

PNEC: predicted no effect concentration
None available.

8.2. Exposure controls

Engineering measures

Ensure adequate ventilation.

Personal protective equipment

- | | |
|------------------------|---|
| Respiratory protection | : Not required under normal use. Self contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmosphere.
Users of breathing apparatus must be trained. |
| Hand protection | : Wear work gloves when handling gas containers.
Gloves must be clean and free of oil and grease.
Standard EN 388 - Protective gloves against mechanical risk. |
| Eye/face Protection | : Safety glasses recommended when handling cylinders.
Standard EN 166 - Personal eye-protection. |

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Skin and body protection	: Safety shoes are recommended when handling cylinders. Standard EN ISO 20345 - Personal protective equipment - Safety footwear.
Special instructions for protection and hygiene	: Ensure adequate ventilation, especially in confined areas.
Environmental Exposure Controls	: If applicable, refer to the extended section of the SDS for further information on CSA.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

(a/b) Physical state/Colour	: Compressed gas. Colorless gas
(c) Odour	: No odor warning properties.
(d) Density	: 0.0013 g/cm ³ (0.081 lb/ft ³) at 21 °C (70 °F)
(e) Relative Density	: 1.1 (water = 1)
(f) Melting point / freezing point	: -362 °F (-219 °C)
(g) Boiling point/range	: -297 °F (-183 °C)
(h) Vapor pressure	: Not applicable.
(i) Water solubility	: 0.039 g/l
(j) Partition coefficient: n-octanol/water [log Kow]	: Not applicable for inorganic gases.
(k) pH	: Not applicable for gases and gas mixtures.
(l) Viscosity	: No reliable data available.
(m) Particle characteristics	: Not applicable for gases and gas mixtures.
(n) Upper and lower explosion / flammability limits	: Non flammable.
(o) Flash point	: Not applicable for gases and gas mixtures.
(p) Autoignition temperature	: Non flammable.
(q) Decomposition temperature	: Not applicable.

9.2. Other information

Explosive properties	: Not applicable.
Oxidizing properties	: Ci =1

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Molecular Weight	: 32 g/mol
Odor threshold	: Odour threshold is subjective and inadequate to warn of overexposure.
Evaporation rate	: Not applicable for gases and gas mixtures.
Flammability (solid, gas)	: Refer to product classification in Section 2
Specific Volume	: 0.7540 m ³ /kg (12.08 ft ³ /lb) at 21 °C (70 °F)
Relative vapor density	: 1.105 (air = 1) Heavier than air.

SECTION 10: Stability and reactivity

10.1. Reactivity	: No reactivity hazard other than the effects described in sub-sections below.
10.2. Chemical stability	: Stable under normal conditions.
10.3. Possibility of hazardous reactions	: Violently oxidises organic material.
10.4. Conditions to avoid	: None under recommended storage and handling conditions (see section 7).
10.5. Incompatible materials	: Flammable materials. Organic materials. Avoid oil, grease and all other combustible materials.
10.6. Hazardous decomposition products	: No data available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure

Effects on Eye	: In case of direct contact with eyes, seek medical advice.
Effects on Skin	: Adverse effects not expected from this product.
Inhalation Effects	: Breathing 75% or more oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty. Breathing pure oxygen under pressure may cause lung damage and also central nervous system effects.
Ingestion Effects	: Ingestion is not considered a potential route of exposure.
Symptoms	: No data available.

Acute toxicity

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Acute Oral Toxicity	: No data is available on the product itself.
Acute Inhalation Toxicity	: No data is available on the product itself.
Acute Dermal Toxicity	: No data is available on the product itself.
Skin corrosion/irritation	: No data available.
Serious eye damage/eye irritation	: No data available.
Sensitization.	: No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity	: No data available.
Reproductive toxicity	: No data is available on the product itself.
Germ cell mutagenicity	: No data is available on the product itself.
Specific target organ systemic toxicity (single exposure)	: No data available.
Specific target organ systemic toxicity (repeated exposure)	: Premature infants exposed to high oxygen concentrations may suffer delayed retinal damage that can progress to retinal detachment and blindness. Retinal damage may also occur in adults exposed to 100% oxygen for extended periods (24 to 48 hr). At two or more atmospheres central nervous system (CNS) toxicity occurs. Symptoms include nausea, vomiting, dizziness or vertigo, muscle twitching, vision changes and loss of consciousness and generalized seizures. At three atmospheres, CNS toxicity occurs in less than two hours and at six atmospheres in only a few minutes.
Aspiration hazard	: No data available.

SECTION 12: Ecological information

12.1. Toxicity

Aquatic toxicity	: No data is available on the product itself.
Toxicity to other organisms	: No data is available on the product itself.

12.2. Persistence and degradability

No data available.

12.3. Bioaccumulative potential

Refer to Section 9 "Partition Coefficient (n-octanol/water)".

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12.4. Mobility in soil

Because of its high volatility, the product is unlikely to cause ground pollution.

12.5. Results of PBT and vPvB assessment

If applicable, refer to the extended section of the SDS for further information on CSA.

12.6. Other adverse effects

No ecological damage caused by this product.

Effect on the ozone layer	:	No known effects from this product.
Ozone Depleting Potential	:	None
Effect on global warming	:	No known effects from this product.
Global Warming Potential	:	None

SECTION 13: Disposal considerations

13.1. Waste treatment methods : Return unused product in original cylinder to supplier. Contact supplier if guidance is required. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at <http://www.eiga.org> for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04*: gases in pressure containers (including halons) containing hazardous substances.

Contaminated packaging : Return cylinder to supplier.

SECTION 14: Transport information

14.1. UN number

UN/ID No. : UN1072

14.2. UN proper shipping name

Transport by road/rail (ADR/RID) : OXYGEN, COMPRESSED
Transport by air (ICAO-TI / IATA-DGR) : Oxygen, compressed
Transport by sea (IMDG) : OXYGEN, COMPRESSED

14.3. Transport hazard class(es)

Label(s) : 2.2 (5.1)

Transport by road/rail (ADR/RID)
Class or Division : 2
ADR/RID Hazard ID no. : 25
Tunnel Code : (E)

Transport by air (ICAO-TI / IATA-DGR)
Class or Division : 2.2

Transport by sea (IMDG)
Class or Division : 2.2

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14.4. Packing group

Transport by road/rail (ADR/RID) : Not applicable.
Transport by air (ICAO-TI / IATA-DGR) : Not applicable.
Transport by sea (IMDG) : Not applicable.

14.5. Environmental hazards

Transport by road/rail (ADR/RID)
Marine Pollutant : No

Transport by air (ICAO-TI / IATA-DGR)
Marine Pollutant : No

Transport by sea (IMDG)
Marine Pollutant : No
Segregation Group : None

14.6. Special precautions for user

Transport by air (ICAO-TI / IATA-DGR)
Passenger and Cargo Aircraft : Transport allowed
Cargo Aircraft only : Transport allowed

Further Information

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
Japan	ENCS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.

Other Regulations

REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT
AND OF THE COUNCIL of 18 December 2006 concerning the Registration,
Evaluation, Authorisation and Restriction of Chemicals (REACH),
establishing a European Chemicals Agency, amending Directive 1999/45/EC
and repealing Council Regulation (EEC) No 793/93 and Commission

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Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Regulation (EC) No 1272/2008 the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

Control of Substances Hazardous to Health Regulations 2002 (as amended)

Health and Safety at Work etc. Act 1974

Management of Health and Safety at Work Regulations (Northern Ireland) 2000 c.388, and as amended

Management of Health and Safety at Work Regulations 1999 (S.I. number 3242)

The Health and Safety at Work etc. Act 1974 (Application to Environmentally Hazardous Substances) Regulations 2002 (England and Wales and Scotland) 11 March 2002 c.282, and as amended

Health and Safety at Work Order (Application to Environmentally Hazardous Substances) Regulations (Northern Ireland) 2003 (Northern Ireland) 14 March 2003 c52, and as amended

The Control of Major Accident Hazards Regulations 2015 c483

The Control of Major Accident Hazards Regulations (Northern Ireland) 2015 c325

The Pressure Systems Safety Regulations 2000 (S.I. number 128) link to Pressure Equipment Directive (97/23/EC)

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2011 c1885, and as amended

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations with amendments (Northern Ireland) 2011 c365

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 c.407

The Water Environment Regulations (Northern Ireland) 2017 c.81

Pollution Prevention and Control Act 1999 c.24

The Fluorinated Greenhouse Gases Regulations 2015 c.310

The Fluorinated Greenhouse Gases Regulations (Northern Ireland) 2015 c.425

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The Acetylene Safety (England and Wales and Scotland) Regulations 2014
c.1639

The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations
1972 c.917

The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations
(Northern Ireland) 1975 c.256

Dangerous Substances and Explosive Atmospheres Regulations (Northern
Ireland) 2003 c.152

The Dangerous Substances and Explosive Atmospheres Regulations 2002
c.2776

Pollution Prevention and Control Act 1999

The Environmental Permitting (England and Wales) Regulations 2016

Ozone Depleting Substances Regulations 2015

15.2. Chemical safety assessment

A CSA does not need to be carried out for this product.

SECTION 16: Other information

Ensure all national/local regulations are observed.

Hazard Statements:

H270 May cause or intensify fire; oxidiser.

H280 Contains gas under pressure; may explode if heated.

Indication of Method:

Oxidizing gases Category 1 May cause or intensify fire; oxidiser. Calculation method

Gases under pressure Compressed gas. Contains gas under pressure; may explode if heated. Calculation method

Abbreviations and acronyms:

ATE - Acute Toxicity Estimate

CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008

REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 1907/2006

EINECS - European Inventory of Existing Commercial Chemical Substances

ELINCS - European List of Notified Chemical Substances

CAS# - Chemical Abstract Service number

PPE - Personal Protection Equipment

Kow - octanol-water partition coefficient

DNEL - Derived No Effect Level

LC50 - Lethal Concentration to 50 % of a test population

LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose)

NOEC - No Observed Effect Concentration

PNEC - Predicted No Effect Concentration

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RMM - Risk Management Measure
OEL - Occupational Exposure Limit
PBT - Persistent, Bioaccumulative and Toxic
vPvB - Very Persistent and Very Bioaccumulative
STOT - Specific Target Organ Toxicity
CSA - Chemical Safety Assessment
EN - European Standard
UN - United Nations
ADR - European Agreement concerning the International Carriage of Dangerous Goods by Road
IATA - International Air Transport Association
IMDG - International Maritime Dangerous Goods
RID - Regulations concerning the International Carriage of Dangerous Goods by Rail
WGK - Water Hazard Class

Key literature references and sources for data:
ECHA - Guidance on the compilation of safety data sheets
ECHA - Guidance on the application of the CLP Criteria
ARIEL database

Prepared by : Air Products and Chemicals, Inc. Global EH&S Department

For additional information, please visit our Product Stewardship web site at
<http://www.airproducts.com/productstewardship/>

This Safety Data Sheet has been established in accordance with the applicable European Directives and applies to all countries that have translated the Directives in their national laws. COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.

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Supersedes Version: 2.1

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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier : Oxygen (Refrigerated)

CAS No. : 7782-44-7

Chemical formula : O₂

REACH Registration Number: Listed in Annex IV / V REACH, exempted from registration.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Industrial and professional use. Perform risk assessment prior to use.
Restrictions on Use : Medical Applications
Not for consumer use.

1.3. Details of the supplier of the safety data sheet : Air Products Plc
2 Millennium Gate
Westmere Drive
Crewe
Cheshire

Email Address – Technical Information : GASTECH@airproducts.com

Telephone : +44(0)3457 020202

1.4. Emergency telephone number : +44(0)8085 020202
NHS Direct in England or Wales 0845 46 47 or NHS 24 in Scotland 08454 24 24

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Oxidizing gases - Category 1 H270: May cause or intensify fire; oxidiser.
Gases under pressure - Refrigerated liquefied gas. H281: Contains refrigerated gas; may cause cryogenic burns or injury.

2.2. Label elements

Hazard pictograms/symbols

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Signal Word: Danger

Hazard Statements:

H270: May cause or intensify fire; oxidiser.

H281: Contains refrigerated gas; may cause cryogenic burns or injury.

Precautionary Statements:

Prevention : P220: Keep away from clothing and other combustible materials.
P244: Keep valves and fittings free from oil and grease.
P282: Wear cold insulating gloves/face shield/eye protection.

Response : P370+P376 : In case of fire: Stop leak if safe to do so.
P336 : Thaw frosted parts with lukewarm water. Do not rub affected area.
P315 : Get immediate medical advice/attention.

Storage : P403: Store in a well-ventilated place.

2.3. Other hazards

Extremely cold liquid and gas under pressure.

Direct contact with liquid can cause frostbite.

May react violently with combustible materials.

Keep oil, grease, and combustibles away.

Substance does not meet the criteria for PBT and vPvB according to Regulation (EC) No 1907/2006, Annex XIII.

SECTION 3: Composition/information on ingredients

3.1. Substances

Components	EINECS / ELINCS Number	CAS Number	Concentration (Volume)
Oxygen	231-956-9	7782-44-7	100 %

Components	Classification (CLP)	REACH Reg. #
Oxygen	Ox. Gas 1 ;H270 Press. Gas (Ref. liq.) ;H281	*1

*1: Listed in Annex IV / V REACH, exempted from registration.

*2: Registration not required: substance manufactured or imported < 1 t/y.

*3: Registration not required: substance manufactured or imported < 1 t/y for non-intermediate uses.

Refer to section 16 for full text of each relevant hazard statement (H).

3.2. Mixtures : Not applicable.

SECTION 4: First aid measures

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4.1. Description of first aid measures

- Eye contact : In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
- Skin contact : In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash frost-bitten areas with plenty of water. Do not remove clothing. As soon as practical, place the affected area in a warm water bath- which has a temperature not to exceed 40 °C (105 °F). Cover wound with sterile dressing.
- Ingestion : Ingestion is not considered a potential route of exposure.
- Inhalation : Consult a physician after significant exposure. Move to fresh air.

4.2. Most important symptoms and effects, both acute and delayed

- Symptoms : No data available.

4.3. Indication of any immediate medical attention and special treatment needed

- Treatment : If exposed or concerned: Get medical attention/advice.

SECTION 5: Firefighting measures

5.1. Extinguishing media

- Suitable extinguishing media : The product itself does not burn.
Use extinguishing media appropriate for surrounding fire.

- Extinguishing media which must not be used for safety reasons. : Do not use water jet to extinguish.

5.2. Special hazards arising from the substance or mixture

- : Combustibles in contact with liquid oxygen may explode on ignition or impact. Some materials which are noncombustible in air may burn in the presence of an oxidizer. Contact with organic and most inorganic materials may cause fire. Move away from container and cool with water from a protected position. Do not direct water spray at container vent. If possible, stop flow of product. Gas is heavier than air and may collect in low areas or travel along the ground where there may be an ignition source present. Vapor cloud may obscure visibility.

5.3. Advice for firefighters

- : Fire resistant clothing may burn and offer no protection in oxygen rich atmospheres. Wear self contained breathing apparatus for fire fighting if necessary. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. Standard EN 469 - Protective clothing for firefighters. Standard - EN 659: Protective gloves for firefighters.
- Further information : Some materials that are noncombustible in air will burn in the presence of an oxygen enriched atmosphere (greater than 23.5%). Fire resistant clothing may burn and offer no protection in oxygen rich atmospheres.

SECTION 6: Accidental release measures

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- 6.1. Personal precautions, protective equipment and emergency procedures : Clothing exposed to high concentrations may retain oxygen 30 minutes or longer and become a potential fire hazard. Stay away from ignition sources. Evacuate personnel to safe areas. Ventilate the area. Monitor oxygen level. Spill will rapidly vaporize forming an oxygen rich vapor cloud. Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level. Personnel who have been exposed to high concentrations of oxygen should stay in a well-ventilated or open area for 30 minutes before going into a confined space or near an ignition source.
- 6.2. Environmental precautions : No data available.
- 6.3. Methods and material for containment and cleaning up : Ventilate the area.
- Additional advice : Increase ventilation to the release area and monitor oxygen level.
- 6.4. Reference to other sections : For more information refer to Sections 8 & 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

All gauges, valves, regulators, piping and equipment to be used in oxygen service must be cleaned for oxygen service. Oxygen is not to be used as a substitute for compressed air. Never use an oxygen jet for cleaning purposes of any sort, especially clothing, as it increases the likelihood of an engulfing fire. Know and understand the properties and hazards of the product before use. Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Before using the product, determine its identity by reading the label. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Do not remove or interchange connections. Prevent entrapment of cryogenic liquid in closed systems not protected with relief device. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Do not subject containers to abnormal mechanical shock. Only transfer lines designed for cryogenic liquids shall be used. Use only with equipment cleaned for oxygen service and rated for cylinder pressure. Never permit oil, grease, or other readily combustible substances to come into contact with valves or containers containing oxygen or other oxidants. All vents should be piped to the exterior of the building.

7.2. Conditions for safe storage, including any incompatibilities

Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Do not allow storage temperature to exceed 50°C (122°F). Full containers should be stored so that oldest stock is used first. Do not store in a confined space. Full and empty cylinders should be segregated. Store containers in location free from fire risk and away from sources of heat and ignition. Return empty containers in a timely manner. Stored containers should be periodically checked for general condition and leakage. Protect

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containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Cryogenic containers are equipped with pressure relief devices to control internal pressure. Under normal conditions these containers will periodically vent product. Where necessary containers containing oxygen and oxidants should be separated from flammable gases by a fire resistant partition.

7.3. Specific end use(s)

Refer to section 1 or the extended SDS if applicable.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

If applicable, refer to the extended section of the SDS for further information on CSA.

DNEL: Derived no effect level (Workers)
None available.

PNEC: predicted no effect concentration
None available.

8.2. Exposure controls

Engineering measures

Natural or mechanical to prevent oxygen-enriched atmospheres above 23.5% oxygen.

Personal protective equipment

- | | |
|---|---|
| Respiratory protection | : None necessary. |
| Hand protection | : Wear work gloves when handling gas containers.
Gloves must be clean and free of oil and grease.
If the operation involves possible exposure to a cryogenic liquid, wear loose fitting thermal insulated or cryo-gloves.
Standard EN 388 - Protective gloves against mechanical risk.
Standard EN 511 - Cold insulating gloves. |
| Eye/face Protection | : Safety glasses recommended when handling cylinders.
Wear goggles and a face shield when transfilling or breaking transfer connections.
Standard EN 166 - Personal eye-protection. |
| Skin and body protection | : Personnel who have been exposed to high concentrations of oxygen should stay in a well-ventilated or open area for 30 minutes before going into a confined space or near an ignition source.
Never allow any unprotected part of the body to touch uninsulated pipes or vessels which contain cryogenic fluids. The extremely cold metal will cause the flesh to stick fast and tear when one attempts to withdraw from it.
Safety shoes are recommended when handling cylinders.
Standard EN ISO 20345 - Personal protective equipment - Safety footwear.
Encapsulated chemical protective suit in emergency situations. |
| Special instructions for protection and hygiene | : Ensure adequate ventilation, especially in confined areas. |
| Environmental Exposure | : If applicable, refer to the extended section of the SDS for further information on |

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Controls

CSA.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

- (a/b) Physical state/Colour : Liquefied gas. blue
- (c) Odour : No odor warning properties.
- (d) Density : 0.0013 g/cm³ (0.081 lb/ft³) at 21 °C (70 °F)
Note: (as vapor)
- (e) Relative Density : 1.1 (water = 1)
- (f) Melting point / freezing point : -362 °F (-219 °C)
- (g) Boiling point/range : -297 °F (-183 °C)
- (h) Vapor pressure : Not applicable.
- (i) Water solubility : 0.039 g/l
- (j) Partition coefficient:
n-octanol/water [log K_{ow}] : Not applicable for inorganic gases.
- (k) pH : Not applicable for gases and gas mixtures.
- (l) Viscosity : No reliable data available.
- (m) Particle characteristics : Not applicable for gases and gas mixtures.
- (n) Upper and lower explosion /
flammability limits : Non flammable.
- (o) Flash point : Not applicable for gases and gas mixtures.
- (p) Autoignition temperature : Non flammable.
- (q) Decomposition
temperature :
Not applicable.

9.2. Other information

- Explosive properties : Not applicable.
- Oxidizing properties : Ci =1
- Molecular Weight : 32 g/mol
- Odor threshold : Odour threshold is subjective and inadequate to warn of overexposure.
- Evaporation rate : Not applicable for gases and gas mixtures.

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Flammability (solid, gas) : Refer to product classification in Section 2

Specific Volume : 0.7540 m³/kg (12.08 ft³/lb) at 21 °C (70 °F)

Relative vapor density : 1.105 (air = 1) Heavier than air.

SECTION 10: Stability and reactivity

10.1. Reactivity : No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability : Stable under normal conditions.

10.3. Possibility of hazardous reactions : Violently oxidises organic material.

10.4. Conditions to avoid : None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials : Avoid oil, grease and all other combustible materials.
Flammable materials.
Organic materials.
finely divided aluminium
Reducing agents.
Materials such as carbon steel, low alloy carbon steel and plastic become brittle at low temperatures and are subject to failure. Use appropriate materials compatible with the cryogenic conditions present in refrigerated liquefied gas systems.

10.6. Hazardous decomposition products : No data available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure

Effects on Eye : Contact with liquid may cause cold burns/frostbite.

Effects on Skin : Contact with liquid may cause cold burns/frostbite. May cause severe frostbite.

Inhalation Effects : Breathing 75% or more oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty. Breathing pure oxygen under pressure may cause lung damage and also central nervous system effects. Breathing 75% or more oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty. Breathing pure oxygen under pressure may cause lung damage and also central nervous system effects.

Ingestion Effects : Ingestion is not considered a potential route of exposure.

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Symptoms : No data available.

Acute toxicity

Acute Oral Toxicity : No data is available on the product itself.

Acute Inhalation Toxicity : No data is available on the product itself.

Acute Dermal Toxicity : No data is available on the product itself.

Skin corrosion/irritation : No data available.

Serious eye damage/eye irritation : No data available.

Sensitization. : No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity : No data available.

Reproductive toxicity : No data is available on the product itself.

Germ cell mutagenicity : No data is available on the product itself.

Specific target organ systemic toxicity (single exposure) : No data available.

Specific target organ systemic toxicity (repeated exposure) : No data available.

Aspiration hazard : No data available.

SECTION 12: Ecological information

12.1. Toxicity

Aquatic toxicity : No data is available on the product itself.

Toxicity to other organisms : No data is available on the product itself.

12.2. Persistence and degradability

No data available.

12.3. Bioaccumulative potential

Refer to Section 9 "Partition Coefficient (n-octanol/water)".

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12.4. Mobility in soil

Because of its high volatility, the product is unlikely to cause ground pollution.

12.5. Results of PBT and vPvB assessment

If applicable, refer to the extended section of the SDS for further information on CSA.

12.6. Other adverse effects

This product has no known eco-toxicological effects.

Effect on the ozone layer	:	No known effects from this product.
Ozone Depleting Potential	:	None
Effect on global warming	:	No known effects from this product.
Global Warming Potential	:	None

SECTION 13: Disposal considerations

13.1. Waste treatment methods : Return unused product in original cylinder to supplier. Contact supplier if guidance is required. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at <http://www.eiga.org> for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04*: gases in pressure containers (including halons) containing hazardous substances.

Contaminated packaging : Return cylinder to supplier.

SECTION 14: Transport information

14.1. UN number

UN/ID No. : UN1073

14.2. UN proper shipping name

Transport by road/rail (ADR/RID)	: OXYGEN, REFRIGERATED LIQUID
Transport by air (ICAO-TI / IATA-DGR)	: Oxygen, refrigerated liquid
Transport by sea (IMDG)	: OXYGEN, REFRIGERATED LIQUID

14.3. Transport hazard class(es)

Label(s) : 2.2 (5.1)

Transport by road/rail (ADR/RID)	
Class or Division	: 2
ADR/RID Hazard ID no.	: 225
Tunnel Code	: (C/E)

Transport by sea (IMDG)	
Class or Division	: 2.2

14.4. Packing group

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Transport by road/rail (ADR/RID) : Not applicable.
Transport by air (ICAO-TI / IATA-DGR) : Not applicable.
Transport by sea (IMDG) : Not applicable.

14.5. Environmental hazards

Transport by road/rail (ADR/RID)
Marine Pollutant : No

Transport by air (ICAO-TI / IATA-DGR)
Marine Pollutant : No

Transport by sea (IMDG)
Marine Pollutant : No
Segregation Group : None

14.6. Special precautions for user

Transport by air (ICAO-TI / IATA-DGR)
Passenger and Cargo Aircraft : Transport forbidden
Cargo Aircraft only : Transport forbidden

Further Information

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
Japan	ENCS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.

Other Regulations

REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation

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(EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Regulation (EC) No 1272/2008 the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

Control of Substances Hazardous to Health Regulations 2002 (as amended)

Health and Safety at Work etc. Act 1974

Management of Health and Safety at Work Regulations (Northern Ireland) 2000 c.388, and as amended

Management of Health and Safety at Work Regulations 1999 (S.I. number 3242)

The Health and Safety at Work etc. Act 1974 (Application to Environmentally Hazardous Substances) Regulations 2002 (England and Wales and Scotland) 11 March 2002 c.282, and as amended

Health and Safety at Work Order (Application to Environmentally Hazardous Substances) Regulations (Northern Ireland) 2003 (Northern Ireland) 14 March 2003 c52, and as amended

The Control of Major Accident Hazards Regulations 2015 c483

The Control of Major Accident Hazards Regulations (Northern Ireland) 2015 c325

The Pressure Systems Safety Regulations 2000 (S.I. number 128) link to Pressure Equipment Directive (97/23/EC)

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2011 c1885, and as amended

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations with amendments (Northern Ireland) 2011 c365

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 c.407

The Water Environment Regulations (Northern Ireland) 2017 c.81

Pollution Prevention and Control Act 1999 c.24

The Fluorinated Greenhouse Gases Regulations 2015 c.310

The Fluorinated Greenhouse Gases Regulations (Northern Ireland) 2015 c.425

The Acetylene Safety (England and Wales and Scotland) Regulations 2014 c.1639

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The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations
1972 c.917

The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations
(Northern Ireland) 1975 c.256

Dangerous Substances and Explosive Atmospheres Regulations (Northern
Ireland) 2003 c.152

The Dangerous Substances and Explosive Atmospheres Regulations 2002
c.2776

Pollution Prevention and Control Act 1999

The Environmental Permitting (England and Wales) Regulations 2016

Ozone Depleting Substances Regulations 2015

15.2. Chemical safety assessment

A CSA does not need to be carried out for this product.

SECTION 16: Other information

Ensure all national/local regulations are observed.

Hazard Statements:

H270 May cause or intensify fire; oxidiser.

H281 Contains refrigerated gas; may cause cryogenic burns or injury.

Indication of Method:

Oxidizing gases Category 1 May cause or intensify fire; oxidiser. Calculation method

Gases under pressure Refrigerated liquefied gas. Contains refrigerated gas; may cause cryogenic burns or injury.
Calculation method

Abbreviations and acronyms:

ATE - Acute Toxicity Estimate

CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008

REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 1907/2006

EINECS - European Inventory of Existing Commercial Chemical Substances

ELINCS - European List of Notified Chemical Substances

CAS# - Chemical Abstract Service number

PPE - Personal Protection Equipment

Kow - octanol-water partition coefficient

DNEL - Derived No Effect Level

LC50 - Lethal Concentration to 50 % of a test population

LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose)

NOEC - No Observed Effect Concentration

PNEC - Predicted No Effect Concentration

RMM - Risk Management Measure

OEL - Occupational Exposure Limit

PBT - Persistent, Bioaccumulative and Toxic

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vPvB - Very Persistent and Very Bioaccumulative
STOT - Specific Target Organ Toxicity
CSA - Chemical Safety Assessment
EN - European Standard
UN - United Nations
ADR - European Agreement concerning the International Carriage of Dangerous Goods by Road
IATA - International Air Transport Association
IMDG - International Maritime Dangerous Goods
RID - Regulations concerning the International Carriage of Dangerous Goods by Rail
WGK - Water Hazard Class

Key literature references and sources for data:
ECHA - Guidance on the compilation of safety data sheets
ECHA - Guidance on the application of the CLP Criteria
ARIEL database

Prepared by : Air Products and Chemicals, Inc. Global EH&S Department

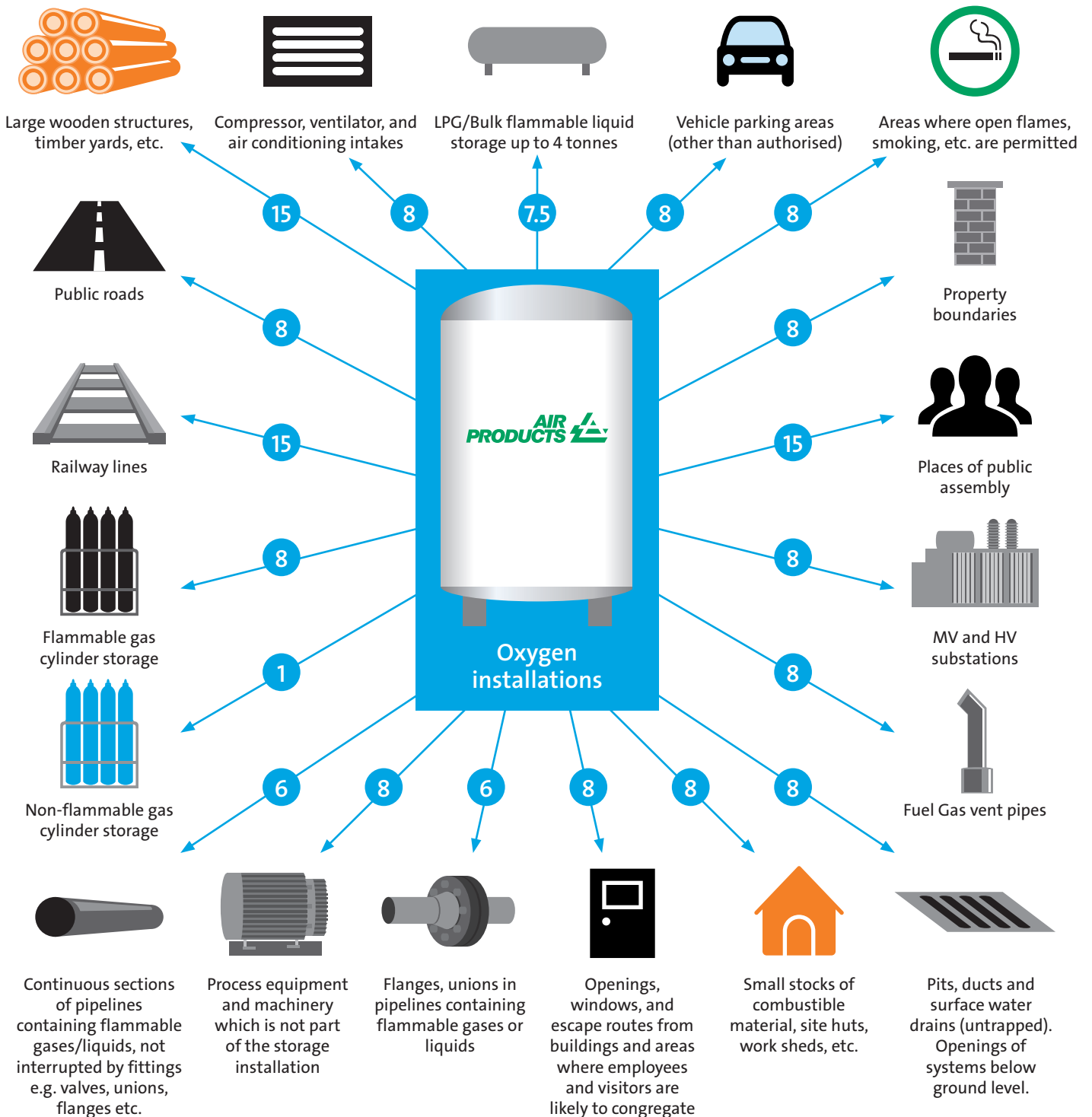
For additional information, please visit our Product Stewardship web site at
<http://www.airproducts.com/productstewardship/>

This Safety Data Sheet has been established in accordance with the applicable European Directives and applies to all countries that have translated the Directives in their national laws. COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.

Safety distances between liquid oxygen bulk tanks 160CM to 50KL and typical hazards

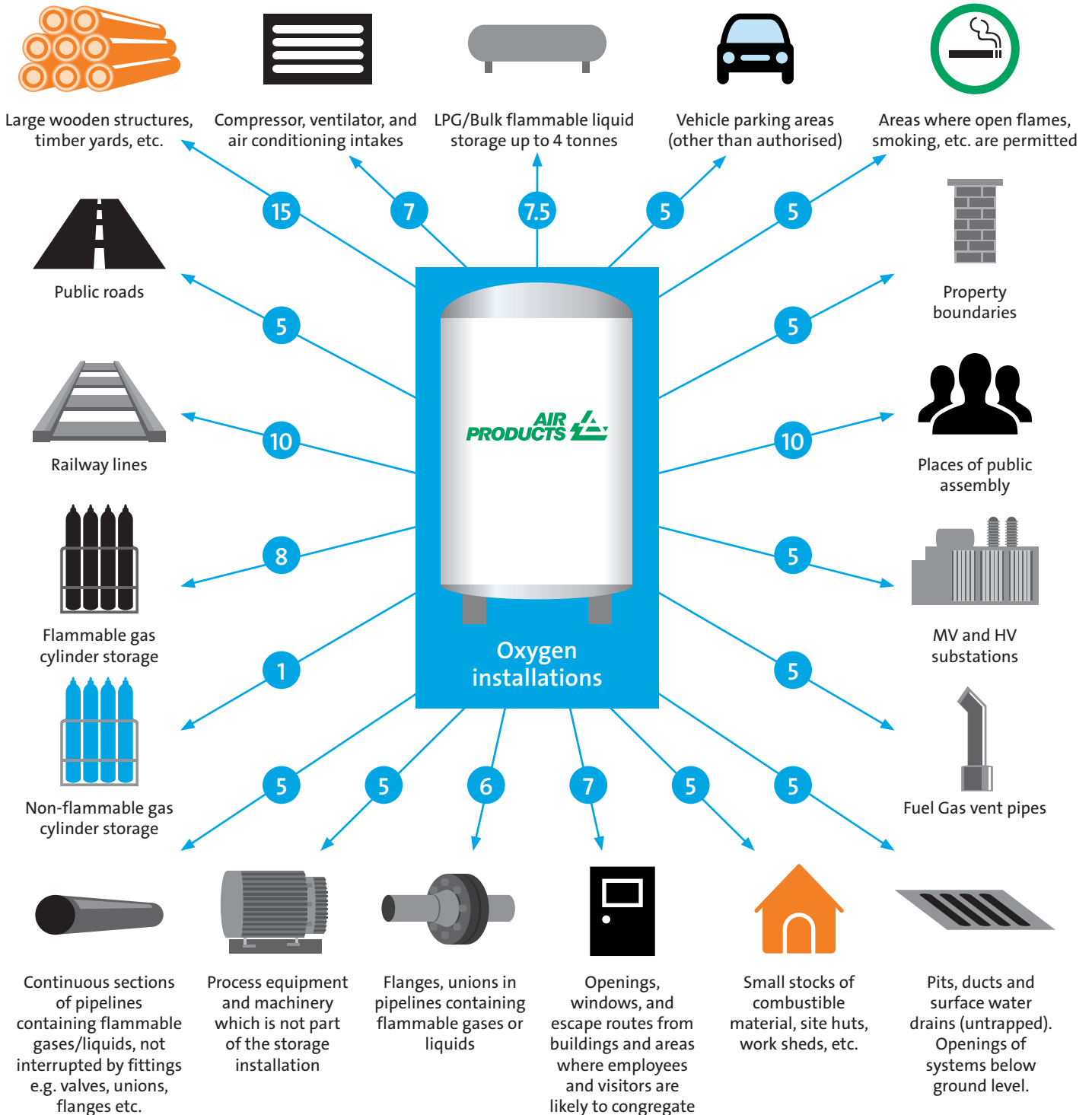
Distances in metres



Notes: Distances are from the shell of the tank or any point of release.
Information from BCGA CP36. Distances apply to bulk LOX tank volumes from 20,000L to 125,000L water capacities.

Safety distances between liquid oxygen bulk tanks 18CM to 140CM (inclusive) and typical hazards

Distances in metres



Notes: Distances are from the shell of the tank or any point of release.
Information from BCGA CP36. Distances apply to bulk LOX tank volumes from 2000L to 20,000L water capacities.



Cryogenic Tank Installation Specification

[tell me more](#)

Introduction

From industrial gases; Nitrogen, Argon, Oxygen, Carbon Dioxide, to medical and specialty gases Air Products has supplied product provision solutions to customers in a wide range of industries since our inception in 1940.

At Air Products we draw on decades of experience to ensure that our customers receive the optimum solution for their requirements.



What We Promise

Air Products engineers listen carefully to what our customers need in order to deliver systems that are specifically designed to provide our gas, or liquid, for their usage requirements through a range of diverse operating conditions.

We are able to provide systems which deliver any of our products; Nitrogen, Oxygen, Argon, Carbon Dioxide, Helium, Hydrogen through a broad range of pressures and flow rates in either a gaseous or liquid state. Our solutions usually take the form of at least one cryogenic storage tank linked to a pressure and flow control system. In a gaseous application a vaporiser is required. We can also provide temperature control if a downstream system is temperature sensitive and we are also able to offer mixing of a number of products at specified ratios through our mixing panels.

In order to ensure that our customer's do not lose supply of our product we monitor usage and aim to provide a delivery well before the cryogenic tank runs empty. We can also respond preemptively to expected future increases in demand by maintaining a close relationship with our customers.

Sizing and Design Criteria

Over the following pages you will see that we offer a wide range selection of tank and vaporiser sizes; the exact combination of these are chosen to reflect the amount, and usage patterns, of product our customers use.

Several criteria must be met in order to comply with regulations during an installation, these vary depending on a number of factors and are intended to ensure the system remains safe. The following pages will explain the criteria required and show the range of equipment we can provide.

Tank Plinth Specifics

Local Planning Authorities shall be consulted for permission to execute the works. The plinth dimensions specified assume a minimum ground bearing pressure of 100KN/m² and a maximum wind speed of 56m/s, different site conditions will require individual review.

The tank and vaporiser plinth should have a minimum fall of 1:200 towards a safe area to prevent pooling of water, which is a hazard. The joints between tank plinth and surrounding area shall be filled with a premixed non-shrink metallic grout.

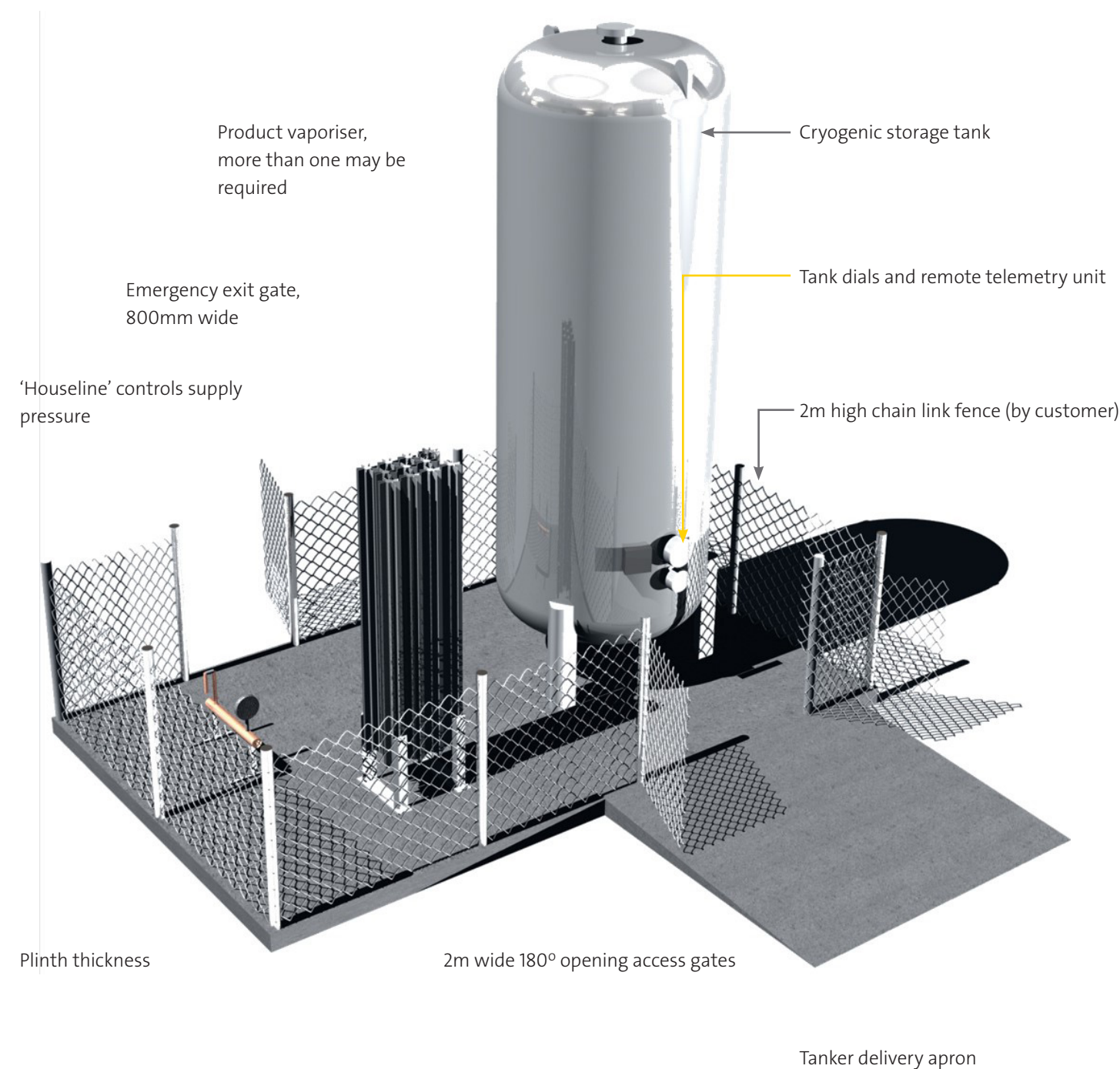
The concrete is required to be a minimum grade of C35 to EN 1992-1 with an air entrainment admixture. If the base is to be sited in an area of very severe exposure, the concrete specification should be verified by a Civil Engineer. Reinforcement is required to be compliant with BS 4449:2005 and mesh reinforcement required to be compliant with BS 4483:2005. Concrete cover to all reinforcement shall be 50mm. The vaporiser plinth, as a minimum, should be reinforced with one layer of A193 mesh top and bottom.

Sufficient lighting of the plinth area must be provided, so that deliveries and repairs can be performed at night. The lighting must provide lumination to a level of 100 lux, in accordance with BS EN 12464.

To avoid trip hazards, tanker delivery apron to be level with front of tank plinth. Otherwise a pedestrian access ramp or step is required in front of the tank/gates. Refer to BS5395-1 for step specification.

For oxygen installations, concrete tanker apron shall be 3500mm by 4500mm, 250mm thick, mesh reinforced. The long dimension being perpendicular to the centre line of the vehicle axis. Tanker apron shall drain surface water to one side.

Generic Tank Plinth Diagram



Air Product's Tanks

Tank sizing depends on a number of factors; flowrate of product required, type of usage – continuous or batch, the size and frequency of deliveries which Air Products can provide to our customer's site. The optimum tank size is chosen through strict procedure, checked by experienced engineers and salespersons to ensure our customers receive the best solution. The common range of tank sizes Air Products' offers are shown below:

Tank Model Number	Dimensions		Weight Unladen kg	Gas Capacity				Weight of Liquid						
	Height mm	Diameter mm		Oxygen m³	Nitrogen m³	Argon m³	CO² m³	Oxygen Kg	Nitrogen Kg	Argon Kg	CO² Kg			
Mini Tanks														
200 litre	1330	610	104	116	144	141	111	205	145	251	182	Flat area capable of withstanding tank Weight, with 600mm of free space around all sides		
250 litre	1330	660	154	181	224	219	172	319	226	390	283			
350 litre	1650	750	208	233	288	281	221	411	291	501	364			
700 litre	1913	1200	702	601	743	726	571	1061	751	1295	939			
1,000 litre	2335	1420	960	614	759	742	583	1084	768	1323	960			
1,800 litre	2240	1450	1630	1228	1518	1484	1167	2168	1535	2647	1919			
Bulk Tanks, up to 14.9 bar tank operating pressure														
3,000 litre	3990	1800	2700	1793	1534	1854	1457	2567	1818	3134	2273	3750	4150	250
6,000 litre	5826	1800	4200	4702	4017	4860	3803	6749	4750	8208	5984			
10,000 litre	6150	2200	7050	8448	7228	8954	6865	12095	8565	14766	10706	4300	4700	350
20,000 litre	9810	2200	10730	15816	13532	16351	12852	22643	16035	27644	20043			
30,000 litre	11770	2500	17290	23979	20515	24790	19485	34328	24309	41910	30387			
44,000 litre	15429	2500	22110	32891	28139	34003	26726	47087	33345	57486	41681	4700	5100	450
50,000 litre	9350	3450	22890	39582	33864	40921	32164	56667	40129	69182	50161			
60,000 litre	13925	3000	28000	48095	41003	50056	38894	68854	48773	84809	61216	5500	5500	
Bulk Tanks, up to 30 bar tank operating pressure														
3,000 litre	3990	1800	2700	2630	2250	2719	2137	3765	2666	4597	3333	3750	4150	250
6,000 litre	5826	1800	4200	4742	4057	4903	3853	6789	4808	8288	6010			
10,000 litre	6150	2200	6900	8640	7410	8734	7038	12399	8781	15138	10976	4300	4700	350
20,000 litre	9810	2200	11900	16402	14033	16957	13328	23482	16629	28668	20786			
30,000 litre	11790	2780	16000	23472	20081	24266	19073	33602	23796	41024	29745			
44,000 litre	15429	2500	26820	35092	30023	36279	28515	50238	35576	61334	44470	4700	5100	450
50,000 litre	12040	3000	28380	40615	34748	41989	33003	58145	41176	70987	51470			
60,000 litre	13925	3000	28000	49095	42003	50756	39894	70286	49773	85809	62216	5500	5500	

The tank chosen for your solution will be optimised for the installation and may differ in size from the size shown.

* Size of plinth for tank only. Additional plinths required for vaporisation

Air Product’s Product Vaporisers

Product vaporisers are used to turn cryogenic liquid into gas, most commonly by using ambient air temperature, and are needed for all gaseous use installations. In an ambient vaporiser, the cryogenic liquid flows through a series of parallel pipes which are exposed to atmosphere. The pipes have five to eight fins extruded along their length to increase the surface area of the pipe, and thus increase the heat transfer rate between the liquid and atmosphere.

The cold temperatures of the vaporisers combined with atmospheric moisture can cause them to “ice-up”; excessive water freezing onto their surface, reducing their operating performance. Therefore, in a continuous use application we supply two or more vaporisers, where one only is used whilst the other(s) de-ice.

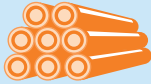
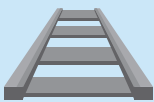
The range of product vaporiser sizes Air Products’ offers are shown below, the actual model provided will be decided by the Air Products Engineering team:

Vaporiser Model Number				Maximum Flowrate before Ice-up		
	Surface Area m²	Approx weight kg	Dimensions WxDxH mm	(8hr) Nm³/hr	(16hr) Nm³/hr	(Continuous) Nm³/hr
Ambient Vaporisers						
AV3M	25.6	100	419 x 1042 x 4143	86	68	28
VAI 806 FL 12	33	200	580 x 860 x 4500	105	84	35
AV6M	51	204	524 x 1096 x 3999	165	114	45
VAI 812 FL 12	67	295	1170 x 860 x 4500	205	164	69
VAI 836 FL 12	201	950	1750 x 1750 x 4800	605	484	203
AV24M	204	782	1140 x 1140 x 7141	754	546	301
AV36M	306	1098	1422 x 1705 x 5617	986	684	389
AV48M	408	1465	1422 x 1705 x 7141	1313	1060	439
VAI 864 FL 15	446	2180	2300 x 2300 x 5715	1420	1136	477
VAI 864 FL 23	669	3180	2300 x 2590 x 7230	1675	1290	552
Vaporiser Model Number				Maximum Recommended		
	Surface Area m²	Approx weight kg	Dimensions WxDxH mm	(8hr) Nm³/hr	(16hr) Nm³/hr	(Continuous) Nm³/hr
Electrical Vaporisers, Predominantly CO ₂						
HP3	3	41	272 x 415 x 420		13	
HP6	6	52	536 x 508 x 492		27	
HP12	12	97	536 x 508 x 764		55	
HP18	18	143	536 x 508 x 1037		82	
HP24	24	188	536 x 508 x 1310		109	
HP30	30	225	560 x 868 x 967		136	

Larger flowrates can be achieved with multiple vaporisers. Two or more vaporisers may be installed and switched between to reduce ice-up; this process can be manual or automated.

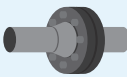
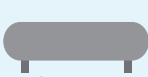
Safety distances

Safety distances are measured from possible release points, and are shown below in meters:

Hazard	Oxygen			Nitrogen		CO ₂	
	Up to 2,000L	2,000L to 20,000L	20,000L to 60,000L	Up to 2,000L	2,0001 to 60,0001	Up to 2,0001	2,0001 to 60,0001
 Large wooden structures	5	15	15	1	3	1	3
 Public Roads	3	5	8	1	5	1	5
 Railway Lines	3	10	15	3	5	3	5
 Flammable Gas Cylinders	5	8	8	1	1	1	1
 Non-flammable Gas Cylinders	1	1	1	1	1	1	1
 Continuous Piping Containing flammable fluids	1	5	6	1	1	1	1
 Untrapped Surface Water Drains	4	5	8	1	3	1	3
 Flue Gas Vent Pipes	5	5	8	1	3	1	3
 MV and HV Substations	4	5	8	1	3	1	3
 Places of Public Assembly	5	10	15	3	3	3	3
 Property Boundaries	3	5	8	1	3	1	3
 Areas Where Open Flames, Smoking, are Permitted	3	5	8	1	3	1	3

Safety distances

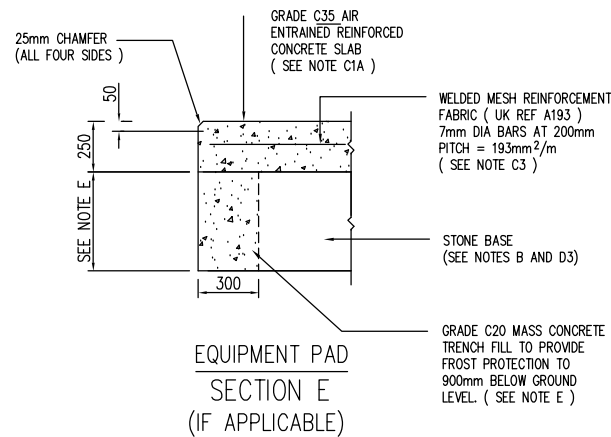
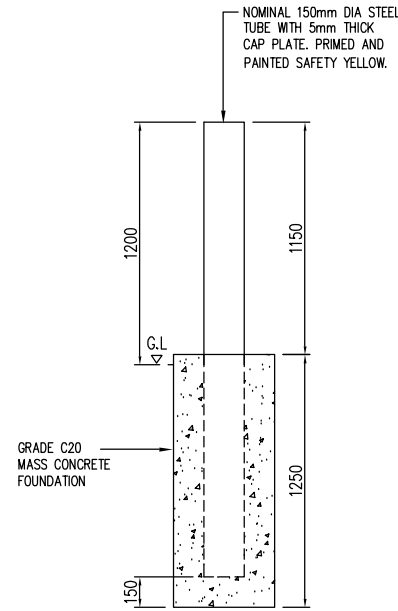
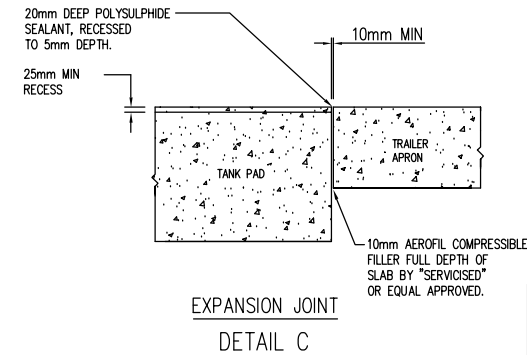
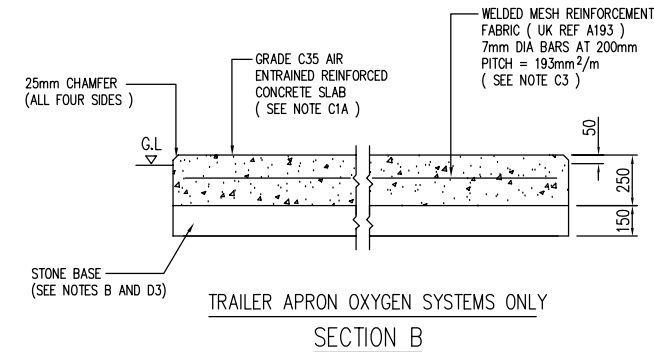
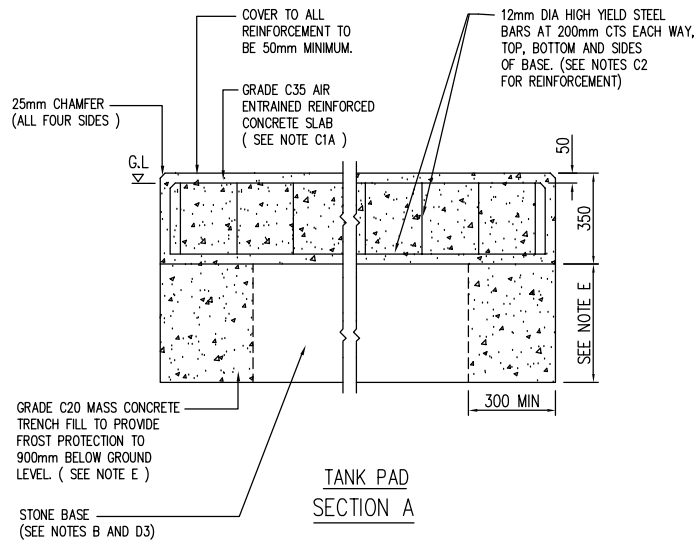
The safety distances are in accordance with BCGA Codes of Practice. Distances are measured from potential points of product release on the storage system. Where the safety distances cannot be met certain options can be reviewed to provide a solution to fit the space allocated for the installation. Most commonly this will require a partitioning wall be constructed, or relocation of the tank combined with an extended fill line.

Hazard	Oxygen			Argon, Nitrogen		CO ₂	
	Up to 2,000L	2,000L to 20,000L	20,000L to 60,000L	Up to 2,000L	2,000L to 60,000L	Up to 2,000L	2,000L to 60,000L
 Equipment and Machinery	4	5	8	1	3	1	3
 Flanges, Unions, Containing Flammable Fluids	6	6	6	1	3	1	3
 Openings, Windows, Into Building	5	7	8	3	3	3	3
 Small Stocks of Combustible Materials	3	5	8	1	3	1	3
 Vehicle Parking Areas	3	5	8	1	3	1	3
 LPG/Bulk Flammable Liquid Storage (<4T)	7.5	7.5	7.5	3	3	3	3
 Compressor, Ventilator, Air Conditioning Intakes	5	7	8	1	3	1	3

Service Plus

We also offer a range of solutions as part of our Service Plus program:

- Process Evaluation
- Process Optimisation
- Project Management
- Gas Handling, Control and Distribution
- Equipment
- Standard Installation Package
- Distribution Systems
- Telemetry
- Inspection
- Maintenance
- Pressure Testing
- APEXTM (Air Products Express Gas Service)
- Analytical Services
- Training
- Safety, Health and Environmental
- Emergency Cover
- Flow & Purity Trials
- Pressure System safety regulation compliance or Written Schemes and Inspections for Users Equipment
- Dangerous Substances and Explosive Atmospheres Regulations (2002) Compliance Surveys



FOUNDATION NOTES:

- DESIGN BASIS**
 - SOIL BEARING – 100kN/m²
 - WIND VELOCITY – V = 45m/s
 - ALL DESIGNS TO BE IN ACCORDANCE WITH THE PREVAILING LOCAL BUILDING STANDARDS AND ALL RELEVANT BRITISH AND EUROPEAN STANDARDS.
 - MAX TANK DIMS 12700 x ø2500mm, 18000KG NET WEIGHT
- STONE BASE:**

SHALL BE GRANULAR MATERIAL COMPRISING CRUSHED ROCK OR CRUSHED CONCRETE WITH A 10% FINES VALUE OF 50k_w OR MORE. MATERIAL GRADING SHOULD BE AS FOLLOWS:

 - 37.5mm–85 TO 100% PASSING
 - 10mm–40 TO 70% PASSING
 - 5mm–25 TO 45% PASSING
 - 600 MICRON–8 TO 22% PASSING
 - 75 MICRON–0 TO 10% PASSING
- CONCRETE:**
 - CONCRETE PROPERTIES:**
 - GRADE C35 AIR ENTRAINED TO BS 8110–CONCRETE TO ACHIEVE A CRUSHING STRENGTH OF 35 N/mm² AT 28 DAYS.
 - MIN. CEMENT CONTENT=310Kg/m
 - MAX. WATER CEMENT RATIO=0.55
 - MAX. AGGREGATE SIZE=20mm
 - AIR ENTRAINMENT ADMIXTURE TO PROVIDE 5% AIR CONTENT
 - GRADE C20 MASS CONCRETE TO BS 8110 CONCRETE TO ACHIEVE A CRUSHING STRENGTH OF 20 N/mm² AT 28 DAYS.
 - MAIN REINFORCEMENT**

REINFORCEMENT TO BE GRADE 460 IN ACCORDANCE WITH BS 4449: HIGH YIELD STEEL BARS WITH A SPECIFIED CHARACTERISTIC STRENGTH OF 460 N/mm²
 - SECONDARY REINFORCEMENT**

SECONDARY REINFORCEMENT TO BE WELDED MESH FABRIC IN ACCORDANCE WITH BS 4483: HIGH YIELD STEEL BARS WITH A SPECIFIED CHARACTERISTIC STRENGTH OF 460 N/mm²
- CONSTRUCTION:**
 - EXCAVATE TO REQUIRED FORMATION LEVEL. FORMATION TO BE PROOF ROLLED AND ANY SOFT SPOTS TO BE REMOVED
 - FORMATION TO BE INSPECTED AND APPROVED BY THE CUSTOMER OR HIS AGENT PRIOR TO LAYING OR HARCORE.
 - STONE BASE IS TO BE LAID AND COMPACTED IN MAX. 200mm THICK LAYERS. EACH LAYER IS TO BE THOROUGHLY COMPACTED PRIOR TO PLACING OF SUBSEQUENT LAYERS.
 - SET FRAMEWORK AND FIX REINFORCEMENT AND ANY HOLDING DOWN BOLTS WITH 50mm MINIMUM COVER TO ALL CONCRETE SERVICES.
 - INSTALL CABLE DUCT PIPING (REF DRAWING BE-60400060–D, AND 80–D)
 - PLACE CONCRETE AND MECHANICALLY VIBRATE.
 - FALL TO BE MIN 1:200 TOWARDS SAFE AREA. AND AWAY FROM DRIVERS ACCESS AREA. TOLERANCE +/- 3MM OVER A 3m STRAIGHT EDGE.
- FROST PROTECTION**

THE DEPTH REQUIRED FOR PROTECTION FROM FROST IS TO BE CONFIRMED BY THE CUSTOMER OR HIS AGENT AND WILL DEPEND ON THE PREVAILING CLIMATE CONDITIONS FOR THE SITE AND SURROUNDING FEATURES, (TYPICAL DEPTH WOULD BE 900mm BELOW GROUND LEVEL).

REFERENCE DRAWINGS

BE-60400060–D STANDARD FOUNDATION AND EQUIPMENT LAYOUT (LIQUID OFFTAKE ONLY)
BE-60400080–D STANDARD FOUNDATION AND EQUIPMENT LAYOUT

REV	REVISION	DATE	DRAWN	CHKD	APPD
2	AMEND TITLE & REF DRGS	12.1.99	MC	DF	
1	INCREASE SCALE	24.7.98	MW	DF	NC
0	ORIGINAL ISSUE	22.7.97	KB	MW	NC

THIS DRAWING IS THE PROPERTY OF AIR PRODUCTS (UK) PLC AND IT MUST NOT BE REPRODUCED OR USED FOR PURPOSES OTHER THAN FOR WHICH IT IS SUPPLIED.					
AIR PRODUCTS 					
TITLE STANDARD FOUNDATION DETAILS 350mm THICK TANK PAD FOR TANK SIZES IN RANGE 120 CM TO 265 CM (INCLUDING SPHERICALS) LOX, LIN, LAR TANKS AND EQUIPMENT					
SCALE ; N.T.S.		PROJECT	DRG.No.	BE-60400022–D	SHT 1 OF 1
DISC No.		CAD FILE 60400022.dwg			

Specification for the tanker power supply

These guidelines are issued for use by electrical personnel who are conversant with current standards and they are issued for guidance only.

The power supply point shall be owned, installed and maintained in accordance with the current IET regulations by the customer or his agent.

This guideline is applicable to installations located in safe areas only.

Air Products tankers with electric pumps are equipped with either star-delta starters and phase sequence sensitive relays or inverter drives.

The following is the preferred method of installation. Other methods may be used provided they comply with the current IET regulations.

Electrical Load

A 37KW supply is required for a 400V three-phase motor. A 400V three-phase and earth is required to supply the motor and associated control equipment. The cable should incorporate an earth conductor.

Motor characteristics – Full load current 40 amps
– Starting current 82.5 amps for 3 secs

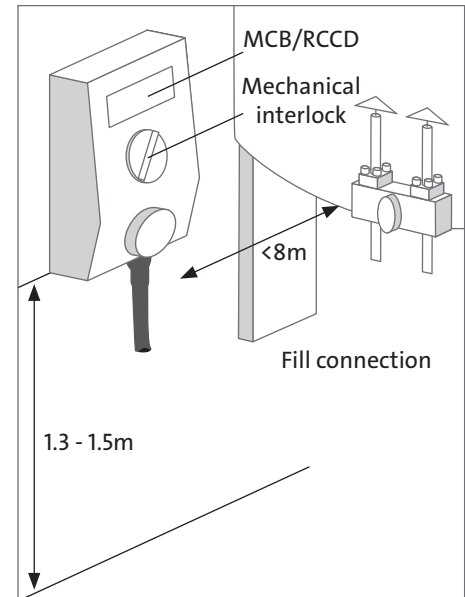
Specification

- Power supply – 400 volts 63 amps three-phase and earth only
- Fuses 63 amp to IEC 269 with gG characteristics
- Circuit breakers 63 amp 3 pole to EN60898 type D
- Residual current device 100 amp 3 pole (or 4 pole) 30 milli-amp to EN601008
- RCCD and MCB to be located within the tanker socket
- A 4 core cable is required. Selection of cable size to be determined by the site electrical engineer or electrical contractor.
- The cable shall enter the socket through the bottom connection
- IP rating to be IP67
- 5 pin socket. BS4343 63A socket. 5 pin and pilot, only L1, L2, L3 and earth used. The socket must incorporate an integral mechanical switch interlock isolator.

Example



Installation and location



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AIR PRODUCTS' TELEMETRY VMI TYPE

Service Requirements (Safe area installations)

Power Supply for mains VMI Telemetry only.

- A single phase supply 85 to 265V ac, terminated in an IP67, BS EN 60309 (BS4343) surface mounted socket rated for 16A.
An Example of this socket can be found at RS Components RS Part No 184-4211
- The power supply must be protected with an RCD/MCB rated at 6A, tripping current 30mA.
An Example of this socket can be found at RS Components RS Part No 157-9866 - for 230V
Other methods of protection are suitable in accordance with current IEE wiring regulations*.
- A socket is required in order to ensure safe isolation by physical disconnection. Other methods of isolation are unacceptable due to the difficulty in ensuring isolation in systems not under Air Products' direct control.
- A standard domestic 13 amp socket (even weather protected) is not suitable, as it is not possible to safely terminate the required flexible armoured power cable in a standard domestic 13 amp plug.
- The power supply will be used for electronic equipment which requires a clean supply free from spikes and surges.
- The supply should be located at the position shown on the plinth layout drawing. Cable entries should be through the bottom of the socket housing.
- The supply should be tested, labelled and certified in accordance with current IEE wiring regulations*. A certificate will be required before the telemetry installation is carried out.
- The regulations shown above with * symbol are local to the UK. In other geographic areas please use the appropriate electrical legislation for installations.
- Air Products employees or sub-contractors performing this installation procedure must have appropriate training in low voltage (<600V ac between conductor and earth) electrical systems and the hazards thereof.

1. Definitions

- 1.1 "Customer" means the legal or natural person(s) for whom AP is providing the Works or, if the Customer is procuring the Works expressly for and on behalf of another then the Customer shall be that other.
- 1.2 "AP" means Air Products PLC or such other affiliated company of Air Products PLC which has agreed to provide the Works.
- 1.3 "Contract" means the agreement between the parties comprising: these Terms for Engineering Works; the Special Conditions (if any); the Specification; and any other document expressly incorporated into such agreement.
- 1.4 "Specification" - the description of the Works specified in the Contract
- 1.5 "Equipment" means the materials and equipment defined in the Specification to be incorporated into, and forming part of, the Works and any additional or replacement parts supplied by AP.
- 1.6 "Services" means the design, supervisory, management and/or engineering work and services of AP and its subcontractors which are provided in the course of performing the Works.
- 1.7 "Works" means any Equipment, Services to be provided or performed by AP in accordance with the Contract.
- 1.8 "Site" means the place stated in the Contract where the Works are principally to be performed.
- 1.9 "Contract Price" means the price payable by the Customer to AP for performance of the Works.
- 1.10 "Drawings" - any and all drawings, data, models, samples and other information supplied by AP in any medium which is connected with the Works.
- 1.11 "Special Conditions" means any special conditions referred to in the Contract.
- 1.12 "Completion" means the time at which the Works have been completed by AP or are ready for any acceptance tests to be carried out, irrespective of any outstanding minor matters not preventing the effective use or testing of the Works remain.

2. Scope of Contract

- 2.1 AP shall provide and the Customer shall pay the Contract Price for the Works. AP may follow its normal sub-contracting procedure in providing the Works.
- 2.2 The Special Conditions (if any) shall take precedence over these Terms.
- 2.3 Any offer by AP to which these terms apply shall lapse on expiry of 30 days after the offer date unless the Customer has already accepted it in writing.

3. Drawings

- 3.1 The Customer shall treat all Drawings as confidential and shall not be shown or delivered to any third party without AP's prior written consent, and shall only be used by the Customer for the operation and maintenance of the Works. The Customer shall if AP so requires confirm in writing its acceptance of the Drawings to be used for the Works before they are implemented.
- 3.2 The Customer shall notify AP of any errors and inconsistencies in Drawings as soon as the Customer becomes aware of them. AP shall correct all such errors and resolve such inconsistencies without charge to the Customer. AP shall have no further or additional liability in respect of errors and inconsistencies in Drawings.

4. Access and Civil Works

- 4.1 The Customer shall ensure that AP and its sub-contractors have access to the Site at all times so that the Contract can be performed in accordance with its terms.
- 4.2 The Customer shall provide such civil works for the Equipment as AP may specify.
- 4.3 AP shall carry out any project work/maintenance/inspection/testing of equipment during normal working hours (weekday Mon-Fri-0900-1700). AP may charge for any work requested by the Customer outside normal hours.

5. Consents and Working Conditions

- 5.1 The Customer shall obtain all consents required for the full, proper and timely performance of the Contract and the operation of the Equipment.
- 5.2 The Customer shall ensure that:
 - (a) All work to be performed; and
 - (b) All materials, equipment and other things to be provided by the Customer or entities other than AP and its subcontractors in connection with the Works are performed and are provided in accordance with the Contract.
- 5.3 The Customer shall provide a safe working environment for AP personnel at the Site.

6. Delivery and Vesting

- 6.1 Unless, and except to the extent that, a Special Condition states otherwise dates for delivery of Equipment and dates for Completion are approximate and AP shall have no liability for delivery or Completion on a later date.
- 6.2 If the Equipment is being sold then title to it shall pass to the Customer when AP has received payment of the Contract Price in full. In all other cases AP shall retain title to the Equipment.
- 6.3 Risk in the Equipment shall pass to the Customer on delivery of the Equipment to Site. AP shall repair or replace the Equipment so damaged, contaminated or lost without charge to the Customer if after its delivery to Site the Equipment is damaged, contaminated or lost due to the negligence of AP or its subcontractors.
- 6.4 If delivery of the Equipment, performance of the Works or Completion is prevented or delayed for reasons other than AP's negligence then AP may store such Equipment and/or suspend the Works all at the Customer's risk and expense. Equipment so stored shall be deemed delivered and AP shall be entitled to be paid accordingly.

7. Delay in Performance

If AP's performance of the Contract is delayed, interrupted or otherwise prevented for reasons other than AP's, or its subcontractors', default then, except as provided in Article 13 (Force Majeure) AP shall be entitled to a reasonable extension of time for performance of the Contract and to reimbursement of any additional costs reasonably incurred due to this interference.

8. Taxes

- 8.1 All value added, sales and other taxes and duties applicable to AP's performance of the Contract shall be added to the Contract Price and shall be paid by the Customer.

- 8.2 If the cost to AP of performing the Contract is increased by the imposition, by a competent authority, of an additional, or new, tax, duty levy or imposition then such increase shall be added to the Contract Price and shall be paid by the Customer.

9. Contract Price

- 9.1 The Customer shall pay the Contract Price in accordance with the payment details in the Contract. If no such details appear then AP may invoice, no more frequently than monthly, for work performed in the immediately preceding month or period.
- 9.2 Unless the contrary is stated elsewhere in the Contract, each invoice submitted by AP shall be paid by the Customer, without any deduction or set-off whatsoever, within 30 days of the date of the invoice.
- 9.3 AP may vary the Contract Price by the amount of any change in its costs or expenses caused by the enactment or application of any statute, regulation, by-law or other provision having the force of law after the date of AP's tender for the Works.

10. Completion

- 10.1 AP shall notify the Customer in writing as soon as Completion has been achieved. Within 10 days of receipt of such notice, the Customer shall either:
- 10.1.1 Issue a certificate acknowledging Completion and the date thereof; or
 - 10.1.2 Give written notice to AP specifying and justifying in technical terms why the Customer believes Completion has not been achieved.
- 10.2 If the Customer fails to comply with Articles 10.1.1 or 10.1.2 Completion shall be deemed to have been achieved.
- 10.3 If the Customer gives notice in accordance with Article 10.1.2 then without prejudice to AP's right to dispute the Customer's notice, or any part thereof, AP shall take such action as is necessary to put the Works into a condition such that the Customer can give a certificate in accordance with Article 10.1.1.

11. Warranties

- 11.1 AP warrants that:
- 11.1.1 All Equipment manufactured and supplied by AP to the Customer shall be in accordance with the Specification and free from defects in design workmanship and materials except to the extent that any such design or materials were made or supplied by or on behalf of the Customer;
 - 11.1.2 The Equipment shall have such characteristics and shall achieve such performance as is stated expressly in the Contract but if no such characteristics or performance is expressed then no warranty or guarantee of any characteristics or performance is given;
 - 11.1.3 The Services (such as supervision of commissioning) shall be provided by qualified and/or experienced people in accordance with the part of the Specification in which such Services are described.
- 11.2 If within 12 months from Completion the Customer or Owner demonstrates to AP that the Equipment is in breach of with the warranty in Article 11.1.1 then AP shall rectify such breach without charge to the Customer or the Owner. AP's warranty referred to in Article 11.1.1 is subject to the following conditions:
- 11.2.1 The defect is not due to fair wear and tear, erosion or corrosion
 - 11.2.2 The Customer has used the Equipment properly in with good engineering practice or AP's operating instructions.
 - 11.2.3 The Equipment has not been repaired or altered without APL's prior written consent.
 - 11.2.4 The Customer has given notice in writing of the defect together with full particulars within seven (7) days of it becoming apparent.
 - 11.2.5 The Customer gives notice of the claim no later than 7 days after the end of the warranty period.
 - 11.2.6 Every facility will have been given to AP, to inspect any defective item of Plant and, if so requested by AP, to take possession of such item.
- 11.3 If the Equipment does not have the characteristics or fails to achieve the performance parameters stated expressly in the Contract then AP shall carry out such modifications as may be necessary to ensure that such characteristics or performance parameters are achieved
- 11.4 The obligations and warranties expressed in the Contract are the only obligations and warranties accepted and given by AP in connection with the Contract and no others shall be implied. The remedies expressed in the Contract are the only remedies available to the Customer in connection with the Contract. Particularly, all common law and statutory remedies (except as stated above) are excluded to the maximum extent permissible by law.

12. Loss and Damage

- 12.1 AP's liability for all claims by the Customer whether under the Contract, in tort (including negligence), or otherwise is limited to £250,000 for any one incident or series of connected incidents.
- 12.2 Notwithstanding any other provision in this Contract, AP shall have no liability, whether in contract, tort (including negligence) or otherwise for any loss of profit, loss of use or production, loss of contracts or any other indirect, consequential or pure economic loss or damage suffered or incurred by the Customer or the Owner in connection, directly or indirectly, with the Contract.

13. Force Majeure

If either party is prevented from performing all, or any part of, the Contract because of circumstances reasonably beyond its control ("Force Majeure") then such performance shall be suspended for a reasonable period (at least as long as the period of Force Majeure). Lack of funds shall not be a circumstance beyond a party's control although an inability to transfer funds because of government or other legitimate embargo will be such a circumstance.

14. General

- 14.1 This Contract shall be construed, enforced and governed in all respects by English Law and the English Courts shall have jurisdiction.
- 14.2 This Contract represents the entire agreement between the parties. Any terms and conditions issued by the Customer, whether in its purchase orders or otherwise, shall have no contractual effect.
- 14.3 Any amendment to the Contract shall be expressed as such, reduced to writing and signed by both parties.

15. Termination

- 15.1 Either party may terminate the Contract if the other party is in breach of any material term and has failed to remedy such breach within a reasonable period (not exceeding 30 days) of receiving written notice to remedy the breach specifying the intent to terminate if the breach is not remedied.
- 15.2 After the termination of this Agreement under Article 15.1, or for any other reason, AP shall issue an invoice to Customer for the Works performed by AP up to the date of termination (with credit being given for all sums already invoiced by AP). Customer shall pay such invoice within thirty (30) days after delivery thereof.