SPECIFICATION

FOR

TROMSBURG SPECIAL SCHOOL

LIQUID PETROLEUM GAS INSTALLATION: SCHOOL SECTION

Submitted by:	**Submitted to:**
GLADAFRICA CONSULTING ENGINEERS (PTY) LTD Head Office: GladAfrica House (Block G, 2nd & 3rd Floor) Hertford Office Park, 90 Bekker Road Midrand 1685 Postal Address: P.O. Box 6723, Halfway House Midrand 1685	**PUBLIC WORKS AND INFRASTRUCTURE FREE STATE PROVINCE** Salga Building 21 Nelson Mandela Dr CBD Bloemfontein 9301 Postal Address: P.O. Box 690 Bloemfontein 9301

QUALITY REVIEW

Client Reference:

GladAfrica Reference

Project Name: Trompsburg School LP Gas Specification

Report Heading: Specification for Trompsburg Special School Liquid Petroleum Gas Installation: School Section

Compiled by: Khanyo Hlatshwayo Signature:_____ **Date:** _____

Reviewed by: Brian Tugwete Signature:_____ **Date:** _____

Released by: Jyothi Voolla Signature:_____ **Date:** _____

_____

Received and accepted by a duly authorized representative of the Client representative's

_____
_

Signature:_____ Date: _____

Report Status

Draft		Revision Number	2	Final	✓

CONTENTS

KITCHENS AND LABORATORY GAS INSTALLATION

1 GENERAL

This Standard Specification forms part of, and shall be read in conjunction with, Project Specification, schedules, drawings and other standard specifications as mentioned hereunder.

In so far as the conditions and specifications contained herein are at variance with anything contained in: Project specification, together with all drawings and schedules, the project specification shall take precedence over this standard specification.

2 STANDARDS AND REGULATIONS

All apparatus, component parts, fittings and materials shall conform in all respects of quality, manufacture, tests and performance with the requirements of the appropriate South African (SANS) or British Specifications (BS) whether mentioned in this specification or not. The installation shall comply with the following as a minimum:

SANS 064 : The preparation of steel surfaces for coating
SANS 1091 : National colour standards for paintwork
SANS 1067 : Copper based fittings for copper tubes, Part 1 and part 2
SANS 1186 : Symbolic Safety Signs Part I-V
SANS 1200 HC : Corrosion protection for structural steel work
SANS 1453 : Copper tubes for Medical gas and vacuum services
SANS 24 : Soft Solders
SANS 1123 : Pipe Flanges
SANS 1237 : Single-stage low-pressure regulators for liquefied petroleum gas (LPG)
SANS 1152-2 : Hose for Liquefied Petroleum Gas (LPG)
SANS 10006: Colour marking and identification of medical gas cylinders and anaesthetic apparatus
SANS 10140-1 : Identification colour marking, Part 1: General
SANS 10140-3: Identification colour markings Part 3: Contents of pipelines
SANS 10400 : The application of the National Building Regulations

SANS 10087-1: The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic and industrial installations
Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 litres and a combined water capacity not exceeding 3 000 litres per installation
SANS 199: Cylinder shut off valves for liquefied petroleum gas
SANS 1539 : Appliances operating on liquefied petroleum gas - safety aspects
SANS 1237 : Single stage low pressure regulators for liquefied petroleum gas (LPG)
SANS 1156-2: Hose for liquefied petroleum gas Part 2: Hose and tubing for use in LPG vapour phase and LPG-air installations
SANS 199:1972: Cylinder shut-off valves for liquefied petroleum gas
SANS 1156-1: Hose for liquefied petroleum gas (LPG) Part 1:
SANS 1156-2: Hose for liquefied petroleum gas (LPG)
SANS 10087-7: The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations. Storage and filling premises for refillable

liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.
SANS 10263-2: The warehousing of dangerous goods Part 2: The storage and handling of gas cylinders
SANS: 10019: Transportable containers for compressed, dissolved and liquefied gases - Basic design, manufacture, use and maintenance
SANS 10232: Dangerous Goods - Initial Emergency Response Guide
SANS 10234: Global harmonised system of classification and labelling of chemicals

OHS Act	: The Occupational Health and safety Act; No 85 of 1993 latest edition
NFPA 45	: Standard on Fire Protection for Laboratories Using Chemicals
NFPA 51	: Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes
NFPA 55	: Standard for the Compressed Gases and Cryogenic Fluid Code
NFPA 58	: Liquefied Petroleum Gas Code
NFPA 400	: Hazardous Materials Code
NFPA 430	: Code for the Storage of Liquid and Solid Oxidizers
NFPA 497	: Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapours and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

3 DRAWINGS

The drawings that accompany this specification are schematic and do not necessarily indicate the exact position, size or detail of equipment. Drawings issued for tender purposes are sufficient to show the extent of the new work and equipment.

Unless otherwise specified, the Engineer's drawings are not manufacturing drawings and the dimensions given are only sufficient for tendering purposes or to enable the contractor to complete manufacturing drawings. The contractor shall produce, and submit for approval, comprehensive, detailed, dimensional manufacturing (workshop) drawings of the LP gas system. It is the responsibility of the contractor to verify all dimensions from drawings with actual on-site dimensions, and to ensure the final installation satisfies the relevant regulations. All site dimensions shall be taken from easily identifiable fixed points or hinges, e.g. walls or columns.

3.1 Builder's Work Drawing

The contractor shall prepare on a scale not less than 1:50 drawings indicating all works to be done by others. These shall include but not limited to bases, foundations, holes in concrete and masonry showing sizes, capacities, and positions of service connections such as electrical, water or drainage to be provided by others

3.2 Shop Drawings

The gas installation contractor shall, upon appointment, produce detailed shop drawings based on the general arrangement layout drawings and schedules, and shall be required to show in detail the construction of all the parts of the works, method of assembly where applicable, erection and construction, materials and connections, welds, gaskets, sealants, fastenings, reinforcing and any other detail necessary for the completion of the installation of these works. The following information with dimensions shall be indicated on the drawing(s):

- Marked up routes showing sizes and kind of pipes used.
- All equipment to be shown, manifolds, valves, regulators, gauges, etc.

Any work done by the contractor without approved and signed drawings shall be completely at risk. Progress payments shall only be made for the portions of the works certified on the approved drawings.

3.3 As-Built Drawings

The contractor shall update all drawings ("as built") on an on-going basis.
On completion of the installation, the Contractor shall furnish the mechanical engineer with a complete set of as built drawings. Three (3) sets of final paper prints plus a compact disc copy of all the
drawings in AutoCAD or newer format shall be supplied to the mechanical engineer as part of the
Operating and Maintenance Manual.
The final recommendation for payment shall not be made before the afore-mentioned drawings have been handed to, checked and approved by the Engineer.

4 GENERAL TECHNICAL; REQUIREMENTS

The whole installation shall be in accordance with the Factories, Machinery and Building Works Act of 1941 (as amended) and in the case of liquid petroleum gas installations it shall also comply with SANS 10087-6 (as amended) in which cognisance shall be taken of provisions of Government, Provincial or Municipal Regulations where applicable.

4.1 Testing of the Installation

The contractor shall make provision in his tender for the supply of instrumentation, materials and tests required to commission the installation. The contractor shall ensure that the installation complies with the specification and has been carried out in workmanlike manner. Should any part of the installation fail during a test, or should the equipment in the opinion of the Engineer or Client not meet with the requirement, the Contractor shall replace, repair or correct such equipment at his own expense, to the satisfaction of the Engineer.

4.2 Inspection and Handing Over Procedure

When the Contractor has satisfied himself that the whole installation complies with all the requirements of the specification and workmanship is of the required standard, the Principal Agent, Engineer and Client shall be invited to perform the handing over inspection.
The form on which the application is made for the handing over shall have space to fill in the following particulars:

- Area of building
- Date(s) of inspection(s)
- Client Representative
- Inspection number and date
- Areas handed over: Yes / No

The installation shall then be inspected in the presence of the representative of the Client's representative, LP Gas Contractor and Engineer. Should the installation not pass inspection

in whole or in part, the contractor shall rectify such faults and apply for re-inspection. One (1) re-inspection of the contract as a whole shall be allowed without an inspection cost implication.

A penalty of R1000-00 (one thousand rand) for every subsequent re-inspection required on the installation shall be applicable. This amount shall be deducted from the next payment due to the contractor. The installation will be inspected in accordance with the workshop drawings. A visual inspection shall be done confirming the specification of installed equipment and the installation layout.
Handing over, i.e. Practical Completion, Works Completion, Defects and Liability Periods, Final Completion, etc., shall be as per the Conditions of Contract. The Contractor shall provide compliance certificates for each of the installations. **The final hand-over procedure and final account payments will not take place before the compliance certificates have been handed over to the Principal Agent.**

4.3 Disruption of Service

Contractors carrying out alterations and additions to existing piped gas systems must exercise extreme caution to prevent disrupting the functioning of the system in the rest of the building. If shut down is unavoidable, arrangements must be made with the appropriate authorities for a convenient time for the shut down of the gas supply.

5 OPERATING AND MAINTENANCE MANUAL

The following documentation must be complete, and one copy shall be delivered to the Engineer for scrutiny prior to the site inspection. The Operating and Maintenance Manual documentation shall include:

- Table of contents
- Operating instructions
- Details of installer(s)
- Contact details for call outs
- General project details
- Manufacturers details and specification of equipment
- Suppliers details
- Detailed maintenance schedule of plant and equipment
- As built drawings
- Training attendance register.

Three (3) sets of comprehensive operating instructions and maintenance procedures shall be provided on completion of the commissioning phase of the installation. It is again stressed that the Completion Certificate will NOT be issued unless the O&M manuals are complete and approved by the Engineer.
Manuals will be in paper format, and each manual will include a CD containing an electronic copy of the complete set of documents.

6 TRAINING OF STAFF

The successful tenderer shall provide for the training of the client's staff regarding the operation and maintenance of the equipment installed. In addition, three durable manuals containing the full maintenance instructions and maintenance schedules of all equipment shall be handed to

the maintenance staff at the institution before handing over of the installation.

A third copy shall be kept by the Engineer. A draft copy of this manual shall be submitted to the Engineer for approval before the final copies are printed.

The contractor shall provide a suitably qualified and trained person to train the Employer's staff in the correct operation and user maintenance of the installation.

The training shall be recorded and an attendance register included into the documentation.

7 PERIOD OF LIABILITY / GUARANTEE

The period of liability / guarantee shall be twelve (12) months from date of practical completion.

The tenderer shall maintain the system for a period of twelve (12) months from the date of practical completion.

8 MAINTENANCE DURING THE GUARANTEE PERIOD

The contractual guarantee period on faulty equipment, materials and workmanship shall be twelve (12) months. The guarantee period on material, equipment and labour commences on the date of the practical completion certificate issued by the Engineer and expires twelve (12) months later.

During the guarantee period, the contractor shall be responsible for the complete maintenance of equipment and plant according to the suppliers / manufacturer's specifications.
The contractor shall immediately, on the day of first call-out, attend to breakdown/emergency calls. In the event of non-performance by the contractor in this respect, the owner shall be entitled to make such other arrangements as are necessary, the cost of which shall be for the contractor's account or deductible from any outstanding retention monies.

A logbook shall be kept and all servicing and repairs shall be recorded in this logbook with meticulous care. The logbook shall at all times be put at the disposal of the mechanical engineer. The contractor shall issue the logbook with full record of all services and repairs to the Employer
after the guarantee period has expired.

9 ELECTRICAL WORK

Refer to Particular Technical Specification below.

10 PAINTWORK

Refer to Particular Technical Specification below.

11 CLEANING OF SYSTEMS

Gas, compressed air and vacuum reticulation systems shall be blown clear of moisture and foreign matter with compressed air or nitrogen. Reticulation systems shall finally be blown out with its specific type of gas prior to handover. All gases for this purpose form part of this

contract.

12 TESTS

All piping shall be tested to 1,5 times the system's operating pressure. There shall be no drop, in pressure within 24 hours after disconnecting the test equipment for the gas and compressed air installations.

12.1 Manifold Test

With only the low-pressure outlet valves closed and all gas bottles connected, both sides of the manifold shall be brought to full operating pressure. All cylinder valves shall be closed tightly. There shall be no drop, in pressure indicated on the high-pressure gauge after a period of 24 hours.

Leaks at screw connections shall be rectified by redoing the coupling.

Leaks at solder connections shall be rectified by cutting out the connection and redoing same. Plugging of leaks is not acceptable.

Test instruments shall be tested for accuracy by an approved institution or by the manufacturers. Test certificates are to be provided upon request.

Test instruments and equipment shall be provided by the sub-contractor.

13 WORKING AT HEIGHT

Contractor to allow for the costs of working at height.

14 HEALTH AND SAFETY

Contractor to allow for the costs of Health and Safety.

15 PROGRAM

The Contractor shall provide a contract within seven days of the contract being awarded. This program shall become contractually binding. This program may be amended from time to time to meet specific site exigencies. Such amendment must however take place by mutual agreement between the Contractor and the Client.

The contract work will be executed mainly during normal working hours. Work undertaken outside normal working hours shall in all instances only take place with the prior arrangement with and approval of the client’s representative or the mechanical engineer.

No claims for additional overtime work other than the above will be entertained without the prior written approval of the Engineer or Principal Agents.

Overtime and work done during weekends can only be claimed for in instances when work during normal operating hours are restricted due to the usage of the building. Overtime and weekend work done will NOT be approved if the contractor has to work after hours due to

falling behind program.

16 GENERAL PARTICULAR PROJECT SPECIFICATION

The scope of this installation includes:

The L.P Gas supply, installation and commissioning including all interconnecting pipe work, valves, fittings and controls required for the system to operate as required.

All equipment shall be designed to meet the above design conditions and shall be installed and mounted as indicated on the drawings.

17 SCOPE OF WORK

The work performed under this Contract comprises of everything necessary for the supply, delivery, installation, painting, testing and commissioning, twelve (12) months guarantee and scheduled maintenance servicing, supply of "as built" drawings, Operation and Maintenance Manuals and Training applicable to the following works described in more detail later:

The Contractor shall be responsible for the following L.P Gas Installation in the School Section;

- Two Block Science Laboratory,
- DNC Kitchen Equipment
- Main Hall
- Consumer Studies & Food Production

18 CYLINDER MANIFOLDS AND PRESSURE REDUCING VALVES FOR LP GAS SYSTEMS

18.1 General

The installer must be registered with the Liquid Petroleum Gas Association of South Africa. The minimum grade of registration must be Commercial Installer (up to and including 4 x 48kg LPG cylinders installation).

The contractor shall supply and install the following LP gas installations in accordance with of SANS 10087-Part 1, 2008, edition 5, “The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations” including the related drawings and bill of quantities (BOQ’s);

A 60 000 Btu/hour (63 303 kJ/hr equivalent to 17.6 kW) four burner LP gas boiling table of about 2100mm long x 600mm deep complete with 4 x 48 kg LP Gas cylinders a sturdy, long nose refillable lighter. The above mentioned four-burner installation shall be inside the DNC Kitchen

A Hob LP gas 4 burner with total gas consumption of 7.9kW with 2 x normal burners (2000W), one rapid burner (2900W) and one auxiliary burner (1000W) in the following buildings:

- 5 units in the Consumer Studies Building
- 1 unit in the Main Hall Kitchen Scullery

Consumer studies buildings at the School Section. An air extract canopy installation shall be

provided as noted under the Kitchen Equipment Specification.

Bunsen burner with the capacity of 0.06 kg/hr plus purpose made cabinet set in each of the two Science Laboratories complete with matching 1.4kg LP gas cylinder. The above-mentioned Bunsen burner installation shall be housed in the cabinet inside each Store Room.

All LP Gas piping shall be schedule 80 steel piping and all fitting LPGA and SABS approved.

- Unless specified to the contrary of the specification, all liquefied petroleum gas (LPG) cylinder manifolds shall be of the manual change over type i.e., change over from the empty bank of cylinders to standby bank of cylinders shall take place automatically without the assistance of an external energy source. Furthermore, it shall only be necessary to transpose one lever or mechanical switch to constitute the newly installed cylinder bank as the standby bank.

- The manifold shall supply gas to the system at a final pressure of 3 kPa (300 mm water gauge) or at an intermediate pressure of 100 kPa as specified. If the former type is required, the manifold shall possess both primary and secondary regulators so that the final distribution pressure remains constant at 3 kPa and is not subject to a drop-in distribution pressure when automatic change over-takes place.

18.2 Regulators

All manifolds regulators shall be sized assuming an inlet pressure calculated with the bottles 15% full, and at specified temperature at maximum specified draw- off.

The minimum outlet pressure under the above conditions for intermediate pressure regulators shall be 90 kPa and for final pressure regulators, 2.75 kPa (275mm wg). All regulators shall be provided with mounting feet which shall be bolted to the supporting channel specified below.

18.3 Manifold Construction

Cylinder manifolds shall accommodate the number of cylinders (45kg) specified in in the BOQ and shall be arranged as shown on the drawings.

The header assemblies shall be mounted on an angle or channel iron support, which in turnshall be bolted to the gas bank room wall or bolted onto vertical stands for layouts not positioned against a wall. These stands shall be made from 65mm or 80mm diameter Class B pipe fitted with a flange at the base and bolted to the floor with three or four 10mm diameter raw bolts. The distance between supports shall not exceed 2 meters.

Manifold tubes shall be constructed of steel tube to SANS 62-1:2003 and SANS 62–2: 2009 heave class steam tube. The complete manifold tube shall be of welded construction using weld-in wrought steel T pieces for the pigtail connections, a screwed socket being welded onto the branch of the T to receive the pigtails. The manifold tubes shall be bolted to the angle or channel iron support described above.

For this purpose, mounting feet manufactured from 20 X 3 steel bar shall be welded to the back -of each pigtail T, each so constructed foot being bolted to the support with two bolts.
The height of the feet shall be such that the manifold tubes connect directly into the regulators without offsets. The regulators shall likewise be bolted to this support.

18.4 Pigtails

Pigtails for connecting the manifold to the cylinders shall consist of flexible braded hose, suitable for the purpose, long enough to allow for easy connection to the cylinder without having to strain the tube. Pigtails consisting of annealed copper tube are not permissible.

Each pigtail shall be fitted with a standard valve connection for coupling to the cylinder. This latter connection shall be fitted with a permanent handle not less than 200 mm long, fixed to the tube end which can be held whilst the connecting nut to the cylinder is tightened thus preventing the tube from following the nut and becoming twisted.

Pigtails shall be screw connected to the manifold tubes using PTFE tape applied as specified in this specification.

19 MANIFOLD INSTALLATION

Each manifold shall be fitted with the following: The required regulators and change over device to allow the system to operate as called for. The changeover lever shall, besides changing each side of the manifold from standby to first call, also clearly indicate which side is on first call.

A mechanically operated ‘flag’ which shall indicate when one-cylinder bank is exhausted.

A flame-proof pressure switch sensing the intermediate pressure after the primary regulators for operating the electric alarm signal. This switch shall switch on, on pressure fall to 5 kPa above the pressure setting of the second call regulator.

A pressure gauge reading the intermediate pressure and a pressure gauge reading the final pressure, should the manifold distribute at final pressure. These pressure gauges shall have dials not les than 65mm dia and the scale range shall be not more than double the normal pressure which it is requires to read.

A relief valve to prevent the distribution pressure rising above 4kPa or 125kP respectively. Relief valves may be incorporated in the regulators themselves.

This discharge from relief valves shall be piped to outside the gas bank room if this is no it a simple roofed wire enclosure. The end of the discharge pipes shall face downwards and shall be fitted with a copper or stainless-steel sieve to prevent ingress of water or insects.

An EXCESS FLOW valve mounted downstream of the final regulator, but before the main isolating valve. This excess flow valve shall be selected with a closing flow of 1.5 times the maximum draw-off specified.

A main isolating valve after the excess flow valve in the main line to the reticulation system.

A full-sized branch after the main isolating valve fitted with a shut off valve with a male threaded outlet over which a sealing cap shall be screwed. This is for the connection of the pressure testing device, and to exhaust the reticulation system.

A flash arrester to protect against flashback in the event of a fire. It shall consist of a built-in

check valve to stop flow, flush extinguisher and flash-check shut-off mechanism.

19.1 Secondary Reducing Stations

When gas is supplied at intermediate pressure secondary reducing stations, reducing the gas to the final pressure of 3kPa are required. These shall be installed wherever shown on the drawings.

If mounted inside habitable areas as opposed to ducts, such secondary reducing stations shall be mounted inside metal cabinets as specified in this specification

Regulators for secondary reducing stations shall be selected so that the outlet pressure does not drop below 2,80 kPa when passing the load stated on the drawings next to each station with an inlet pressure of 70 kPa.

Regulators shall be provided with mounting feet integral with the valve body which can be bolted to the metal cabinet or to a galvanised or corrosion free mounting bracket for regulators mounted in ducts.

All regulators mounted inside or in internal ducts must be provided with vent pipes from the relief valves to outside as shown on the drawings. The ends of the vent pipes shall face downwards and shall be provided with copper or stainless-steel screens to prevent the ingress of water and insects.

An isolating valve is required before and after each secondary reducing regulator. These shall be housed inside the metal cabinets called for above.

They shall be connected to the pipework as specified under isolating valves section and shall be of equal nominal bore to the pipes into which they are fitted. A Union coupling is not required at the floor take-off points as the union required for the isolating valves will also allow the removal of the solenoid valves.

They shall be similar or equal to ASCO WP SC8210D9 solenoid valves with 24 volt AC Coils drawing 15,6 V.A. holding current.

NOTE: The valves must be installed upstream of the pressure regulators on the L.P. Gas system as they will not operate at the reduced pressure of 3kPa.

20 BUNSEN BURNERS

20.1 Bunsen Burners

Bunsen burner plus purpose made cabinet set in each of the two Science Laboratories complete with matching 1.4kg LP gas cylinder. The above-mentioned Bunsen burner installation shall be housed in the cabinet inside each Store Room.

The Bunsen burner installation shall comply DIN 30665 titled “Gas-appliances; gas-burners for laboratory use (laboratory burners)” including related codes of practice and the client’s baseline specifications.

The Bunsen burners shall be complete with air regulators and needle valves. The gas flow must not be completely interrupted. Thus, the flame can only be adjusted between the maximum and the minimum intensity, but cannot be totally extinguished

The gas inlet pressures for Bunsen burner shall be capable of operating under the following conditions

DESCRIPTION OF GAS	PRESSURE (in mBar)
Natural Gas	18 to 25
Propane	47.5 to 57.5

The Bunsen burner shall be complete with suitable rubber-tubing an adjuster for opening and closing the air inlet and the main gas tap for allowing the passage of gas.

The Bunsen burner produce roaring flames (when the air inlet is opened) and luminous flames (when the air inlet is closed).

The table below show the average consumption of propane or natural gas (pressure variations could affect these figures)

BURNER TYPE	Gas Consumption			
	Propane		Natural	
	Litre/hr	Kg/hr	Litre/hr	Kg/hr
Bunsen	26	0.0596	80	0.0560

The cabinet for the Bunsen shall house both the burner and the matching 1.4kg LP gas cylinder.

The Bunsen burners must be kept under constant supervision. The main gas tap must be opened before use and must be closed immediately after use. The Bunsen burner must never be operated inside the cabinet.

21 PIPING

21.1 General

The piping used shall be schedule 8 steel piping. The following items will be addresses in this project and the contractor should factor this in when pricing the bill of quantities (BOQ).

The sections of pipe running in the floor void shall be installed in casted ducts where it is fully accessible for maintenance purposes. The contractor should factor in the possibility of leaks being detected and the time it will take to investigate and rectify.

The sizes of the pipes for the main runs and branch runs are indicated on the drawings and are nominal bore pipe sizes. Connections to single or double outlet wall mounted points shall not be less than 8 mm.

All droppers and horizontal runs to wall outlet points must either be embedded in the walls or concealed within surface mounted duct casings.

Piping in concealed or inaccessible positions shall not be allowed on site.

21.2 Pipe Material and Dimensions

All piping shall be of suitable material for the gas distributed and shall conform to the requirements of the relevant section of SAN 10260 for distribution of the gas or the latest amendment of the standard.

All piping given on the drawing are nominal bore sizes and shall conform to the following

Nominal Bore	Actual Tube Sizes (mm)		
	Outside dia	Wall thickness	Inside dia
8	9.53	0.71	8.11
10	12.70	0.76	11.18
12	15.88	0.81	14.26
15	19.05	0.89	17.27
20	22.23	1.02	20.19
25	28.58	1.02	26.54
32	34.93	1.22	32.49
40	41.28	1.40	38.48
50	53.98	1.65	50.68
65	66.68	1.78	63.12
80	79.38	2.03	75.32

Branch-off piping may be in the half-hard condition to facilitate bending.

All piping must be supplied and cleaned as specified and capped. Caps may only be removed when the joint is made. When a first joint is made on a pipe length, the remaining end shall remain capped.

All valves and fittings shall be cleaned and degreased and delivered to site in individual heat-sealed plastic bags which may only be opened prior to installation.

All joints in piping installations except for those at equipment requiring screw connections, wrought copper capillary sockets with internal stop ends, shall be used. All tee joints, short bends and pipe reducers shall only be manufactured from wrought copper capillary fittings with internal stop ends. Butt brazing of pipes will not be **acceptable.**

Compression unions shall be of the cone type or "Yorkshire No 11" manufacture, or similar capillary type. "O" ring unions shall also be acceptable.

Compression unions shall be installed in vacuum line systems at the following points:

- On all branch lines to wall service points where these are connected to main lines.
- At the top and bottom of a riser main.
- In mains at not less than 18 m.
- In pipes to all pendants where these pass through the ceiling (to facilitate the removal of the pendant). This sub-clause is also applicable to medical gas and compressed air piping.

21.3 Pipe Bends

Where the radii of bends in pipelines and pipe systems must be less than five pipe diameters,

wrought copper capillary bends shall be used. For bends with radii of five pipe diameter and larger, the tubing can be bent. Such bends shall be free from flattening, creasing, buckling or thinning of the tube wall at any point.

21.4 Pipe Supports

All visible, interior wall mounted piping shall be secured in chromium plated or white plastic Sprague type holder batts.

All pipe runs in roof spaces, covered ways, under roof eaves and on the external wall surfaces of buildings shall be secured in brass Sprague type holder batts.

Alternative type holder batts which the sub-contractor may wish to offer must first be approved by the mechanical engineer.

The centre distance of pipe supports shall not exceed the lengths as stipulated below:

21.5 Emergency shut off valves

Emergency shut off valves shall always be accessible, unobstructed and should be placed as close as possible to where the main pipe enters the building.

Outside diameter mm (mm)	Maximum intervals for vertical runs(metres)	Maximum intervals for horizontal runs (metres)
12	1.2	1.0
15	1.8	1.2
22	2.4	1.8
28	2.4	1.8
35	3.0	2.4
42	3.0	2.4
54	3.0	2.7
76	3.6	3.0

22 SERVICE OUTLET VALVES

All wall mounted service outlet valves shall be positioned 1 500 m above floor level in positions as indicated on the drawings.

Service outlet points on the pendants shall be as indicated on the drawings.

Service outlet points shall be flush mounted, non-protruding, quick-coupling, self-isolating types with safety-keyed connections.

The service outlet valves and fittings shall be similar and equivalent to "Dräger" manufacture and shall conform to SANS 1409-1986 as amended.

The outlet service valves and connectors shall be constructed in such a manner that it would be impossible to insert the connector from a different gas service into the outlet valve of another

gas, e.g. it shall not be possible to insert an O_2 connector into a N_2O outlet valve or vice versa.

The connectors and outlet valves shall also be such that instantaneous identification is possible. This shall be achieved by easily distinguishable configuration or shape of connector and socket or by permanent colouring of the connector and socket by means of a vitreous enamel insert or ring or other approved means. Colour coding shall be according to SANS 06-1957. Furthermore, each outlet and connector shall have permanently and clearly engraved upon it the chemical symbols for the service in both Afrikaans and English.

When a group of service outlets are installed adjacent to each other, the order as given in the above sequence shall always be adhered to.

The service outlets shall be such that the valve mechanism is easily accessible for maintenance purposes without having to unsolder pipe connections or break into walls.

All service outlet valves shall first be approved by the Engineer before installation.

22.1 Isolating Valves

Isolating valves shall be installed as indicated on the drawings or as required in general practice. All valves shall be of the same size as the pipeline into which they are installed. Where ball valves are used, the ball bore shall be the same diameter as the internal pipe diameter

All valves, with the exception of those mounted in roof spaces and gas bank rooms, shall be housed in sheet metal cabinets.

All valves should be heavy duty type. Lever-operated ball type with clear “ON” and “OFF” position valves will be preferred for all gas lines except vacuum. Diaphragm or bellow type may also be acceptable, but they should be of a type which gives a clear indication of the extent to which the valve is open, and direction of opening and closing.

Valves for vacuum services shall be of the through-way ball cock type with neoprene, nylon or teflon rings. Globe valves with bronze bodies and which positively open the seats under vacuum conditions will also be accepted. Globe valves shall, however, only be mounted with their spindles in a horizontal position. Diaphragm valves and taper seated throughway cocks will not be accepted for vacuum services.

All gas isolating valves with sizes up to and including 20 mm shall be provided with a mounting flange.

For gas line services up to 25 mm diameter, the following shall apply:

Capillary silver soldered joints. This method is only acceptable for valves, which are specially manufactured for this type of coupling and with the correct size of socket clearance for accepting the pipe. The clearances shall be between the limits of 0,025 mm to 0,10 mm.

Flare nut compression ring connections for valves which have been specially provided with this facility.

Screw connection. In this instance, O-ring or taper unions with silver solder capillary outer valves for connections to the piping must be used. This method is not acceptable for vacuum valves.

23 CERTIFICATE OF COMPLIANCE (COC)

It is the responsibility of the contractor to produce a COC after work is done. This will include the approval from the local authorities. Any discrepancies or shortcomings found in the drawings or specification that is in direct contradiction with the legislation should be brought under the attention of the mechanical engineer in timeously manner.

24 PRESSURE TESTING

This specification requires that all areas be pressure tested upon completion. Where pre-piped headwall units are to be installed, two pressure tests will be required – one before the dry walling is started and the other after the headwall unit is installed. The first test is required so that any leaks can be found before the dry walling is started. The second test is required because the headwall unit cannot be installed until after the drywall is complete. After the first test the lines should remain under pressure with a gauge attached and the pressure in the system shall be logged on a daily basis.

Each area must be leak tested at 150 psi for all systems, except nitrogen, which should be tested at 300 psi.

A final 24-hour pressure test must be applied with all components connected, including alarm sensors and finish outlets. Test pressure for this test is 60 psi for all gases and vacuum, except nitrogen, which is 200 psi. No pressure fluctuation is allowed within the 24 hours except that which is caused by temperature fluctuations. These final tests must be documented and witnessed.

A pressure switch tee or a valve box with a pressure gauge tapping should be used to provide convenient places to install test gauges.

The cylinder and regulator used to fill the system for the pressure tests must be physically disconnected from the system before the start of the test.

The line pressure may be reduced after the test to about 50 psi and an area alarm, if there is one in that area, could be used to automatically monitor that system for sudden pressure drop.

Components that are not rated for the various test pressure such as vacuum gauges and switches, alarm panels, etc. should not be pressurised.

Manifolds and pump packages will not normally be included in 24-hour pressure tests.

The contractor shall make provision in his tender for the supply of instrumentation, materials and tests required to commission the installation. The contractor shall ensure that the installation complies with the specification and has been carried out in workmanlike manner.

Should any part of the installation fail during a test and/or should the equipment in the opinion of the mechanical engineer or Client not meet with the requirement, the Contractor shall replace, repair or correct such equipment at his own expense, to the satisfaction of the mechanical engineer.

24.1 Cross-connection Testing

This test shall be performed by the gas installer and later by the testing agency to determine

that no cross-connection exists between piping systems used for different gases, the systems shall be tested as follows:

The pressure in piping systems other than the system under investigation shall be reduced to atmospheric.

Test the system with Nitrogen at a pressure of 50 psi.

Test each individual station outlet of every piping system to determine that the test gas is being dispensed only from the outlet of the system under investigation. The actual pressure shall be measured with a gauge attached to the specific adaptor for that Medical Gas system. Cheater adaptors are not to be used. Screwdrivers or other damaging implements are not to be used

24.2 Purging

After completing the foregoing tests on each system, the test gas shall be disconnected, and the system bled down to atmospheric pressure. The proper gas shall immediately be connected to each system. Following this, each system shall be purged for enough times to remove the test gas. Once purging is complete, leave the piping pressurized, awaiting analysis by the Testing Agency.

The last purging will remove any particulate that might have collected between the time it was previously purged and the connection of the wall outlets (and/or pre-piped headwall units). The final 24-hour pressure test could also be performed at this time.

24.3 Colour Code Identification of pipelines

- **Standards**

  All gas pipes and gas outlets should be colour coded with the appropriate colour code in accordance to ANSI and ASME standards and should comply with the latest edition of BS1710 or it's local equivalent. Colour banding may be used for pipelines outside plant rooms. Where such bands are used, they should be applied near to valves, junctions, walls. Each pipe should be identified with lettering not less than 6 mm in height.

- **Use and Application**

  A primary color warning shall appear on dangerous piping systems and on fire protection materials in any installation which is color coded in accordance with this standard. Primary color warnings shall consist of a single color applied as a band or bands which completely encircle the piping system. Color bands shall be applied in conformance with dimensional information shown on figure 1. In lieu of color bands, all pipe and covering on an entire system, including encircling or partially encircling straps, hangers, and supports, may be painted with the primary color warning. However, the use of color bands is preferred because they will indicate dangerous systems to color-blind personnel.

- **Location on piping systems**

  Immediately adjacent to all operating accessories such as valves, regulators, flow checks, strainers, cleanouts, pumps, dispensing points, and vents, coded piping systems shall be painted with a primary color warning. In addition, primary color warnings shall be painted throughout the system at convenient intervals, e.g., where branch lines join the system,

where the system passes underground or through walls, and at any other conspicuous places where warnings are required by safety authorities. If desired, operating accessories may also be painted with the primary color warning.

- **Arrows and secondary color warnings**

  An arrow shape shall appear on coded piping systems in any installation which is color coded in accordance with this standard. Any material system possessing an outstanding hazard of a type distinctly different from that indicated by its primary color warning shall have a secondary color warning applied in the shape of an arrow. The color of the arrow shall be selected according to the definitions for warning colors specified in 4.2. Systems which do not involve such additional hazards shall have arrows either the same color as the primary warning, or black or white. When bands are used for the primary warnings, the colored arrows shall appear adjacent to each primary color warning applied to the piping system. When the entire piping system is painted with the primary color warning, the colored arrows shall appear in locations specified in herein. The arrows shall indicate the normal directions of flow of material in the system. A double-headed arrow shall be placed on lines subject to reverse flow. Dimensional information is shown on figure 1. Tails may be emitted on arrows, creating triangles with one corner indicating the normal direction of flow. Operating accessories may also be painted with the secondary color warning.