

SPECIFICATION FOR GAS CHLORINATORS

- General
- Technical Requirements Gas Chlorinators

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SPECIFICATIONS FOR SUPPLY AND INSTALLATION OF GAS CHLORINATORS, BOOSTER PUMPS AND ACCESSORIES

1. GENERAL

1.1 SCOPE OF WORK

Total quality assurance system for manufacturing process of chlorinators, booster pumps and all other accessories to be supplied and installed under the scope of this bid shall comply with ISO 9001:2015 or “equivalent”

The contractor shall be responsible for installation of the units supplied by him in accordance with the specifications and drawings approved by the Board.

The supplying and fixing of all items such as brackets, supports, clamps, clips, plugs, bolts, screws etc. shall be carried out by the contractor. Details shall be submitted for approval by the Engineer before fixing.

The painting of all equipment, brackets, supports, etc; shall be done by the contractor. The contractor shall also carry out all Civil, Electrical and Mechanical works, adjustments and tests and provide his own tools and testing equipment for this purpose.

When completed all equipment shall be suitable in every respect for the service intended. The contractor shall supply all the material and do all work which may be reasonably implied as being incidental to this work.

1.2 ENVIRONMENTAL CONDITIONS

The equipment to be provided under this contract shall be suitable for installation and operation at site conditions and environmental conditions given in the Data Sheet.

1.3 INSTALLATION TESTING AND COMMISSIONING

1.3.1 INSTALLATION

The contractor shall provide the all equipment with necessary accessories and factory-trained personnel to supervise installation and initial operation of all components. The Gas chlorinators Booster Pumps and other accessories shall be connected and installed at the locations shown in the list of drawings in section 8 and in accordance with the manufacturer’s recommendations. Contractor shall certify that the equipment is installed in a manner to ensure proper operations.

1.3.2 INFORMATION TO BE PROVIDED AT THE COMMISSIONING

The contractor shall provide following in three copies at least **14 days** before handing over of the equipment.

1. Operation and Maintenance manuals of Booster Pumps and Motors.

2. Control wiring diagrams for Electrical Panels. (Including Automatic Controls).
3. Spare Parts Manuals and all other literature pertaining to the items supplied.

1.3.3 TESTING AND COMMISSIONING OF EQUIPMENT

After the completion of installation of Gas chlorinators, Booster Pumps and other accessories shall be field tested to ensure compliance with the performance requirements as specified.

When all installation work is satisfactorily completed the Contractor shall inform the Engineer in writing that the Gas chlorinators, Booster Pumps and other accessories are ready for handing over and then Engineer shall fix a date for taking over.

After the satisfactory completion of all tests, the Contractor shall operate the equipments and accessories for 7 days, and during this period, instruct, train any person nominated by the Engineer regarding the operation and maintenance of the equipment.

At the taking over, all equipment shall be tested for a period of 7 days to determine that the equipments are in satisfactory of all conditions.

If the Engineer is not satisfied with the performance of equipment or their installation he may refuse to take over until necessary improvements are effected. Any time necessary for this additional works will be considered as contractor's delay.

1.3.4 APPLICABLE STANDARDS

All installation work shall be carried out in accordance with international standards as stated in particular specification.

1.3.5 CERTIFICATION ON COMMISSIONING

Contractor shall supply test certificates demonstrating compliance with the performance specified herein.

1.3.6 WARRANTY

The contractor shall provide manufacturer's warranty to the employer that the Goods and Services Supplied under the contract will comply strictly with the Contract and shall be first class in every case and shall be free from defects. The supplier further warrants to the Purchaser that all materials, equipment and supplies furnished by the supplier for the purpose of the goods will be new, merchantable of the most suitable grade, and fit for their intended purposes. The supplier shall warrant that the services to be carried out under this contract will conform to generally accepted professional standards and engineering principals.

This warranty shall remain valid for the period mentioned in the Data Sheet. After the final acceptance, any part of the equipment which fails or does not give satisfactory performance during this period of warranty, shall be replaced within the number of days as mentioned in the **Data Sheet** from the date the Contractor has been notified to do so.

All expenses involved in this connection shall be borne by the contractor who should take this into consideration when bidding.

1.3.7 DEFECT LIABILITY

Maintenance of all the equipments and accessories supplied and installed under this contract to be carried out by the contractor for the period mentioned in the **Data Sheet**. Contractor shall submit the preventive maintenance schedule with the offer. Any spares used supplied under this contract and used for repair purposes during the defect liability period shall be replaced at no additional cost.

1.4 CALIBRATION OF INSTRUMENTS & METERS

All instruments & meters shall be calibrated in the Metric Units as follows:

- (i) Pressure in metric water column.
- (ii) Flow in lit/sec.
- (iii) Quantities cubic meters.
- (iv) Water level in meters.
- (v) Current in Amperes.
- (vi) Voltage in Volts.
- (vii) Chlorine dosage rate in Kilograms per hour or grams/hr.

1.5 MOTORS AND LT EQUIPMENT

1.5.1 MOTORS

Motor capacities less than 0.75 kW shall be **Continuous single phase**, Squirrel Cage, Induction type designed for **230V, 50 Hz**. Design of the motors shall be such that they can operate within **± 6%** of the nominal voltage continuously without damage.

Motor capacities above 0.75 kW shall be **Continuous three phase**, Squirrel Cage, Induction type designed for **400V, 50 Hz**. Design of the motors shall be such that they can operate within **± 6%** of the nominal voltage continuously without damage.

Synchronous speed shall be 3000 rpm or 1500 rpm. Each Motor shall be provided with a lifting eyebolt and shall have a service factor of 3.

1.5.2 INSULATION

Motors shall be of **class F** insulation of standard of the National Electrical Manufacturing Association but the operating temperature rise shall be restricted to that of **class B**

1.5.3 PROTECTION OF ENCLOSURE

Motor enclosures shall be protected to **IP68** for submersible pump motor and dry installed motor enclosures shall be protected to **IP55**.

Motors installed in areas exposed to dust (ex. dust o alum/Poly aluminium chloride /lime) shall be protected to **IP64**. Power & control panels in dust free in house areas shall be protected to **IP55** and especially for panels installed at dusty environment (Lime/Alum/Poly aluminium chloride dusts) shall have protection of **IP64**.

1.5.4 CONTROLS - INDICATORS AND ALARMS

1. Push Buttons for Start/Stop/Reset
2. Indicator lamps to indicate following,
 - Motor Running
 - Motor Stopped (Manual)
 - Motor Tripped (Overload/Thermal Tripped)

1.5.5 BOOSTER PUMPS

The supplier shall provide and install following electrical switchgear necessary for DOL (<3kW or above star-delta) starters wired for manual start and stop and automatic stop function of the pumps when the water level in the suction side is low.

- a) One suitable 3 phase MCCB with adequate breaking capacity to serve as the feeder for the starters
- b) Contactor wired for DOL (<3kW) starting / Contactor wired for Star Delta (>3kW) starting
- c) One three phase adjustable thermal over load
- d) Indicator lamps to indicate the following
 - * Pump Running - Red
 - * Pump Stop - Green
 - * Pump Tripped - Amber
 - * Solution level low - Blue
- e) Control relays, transducers, cables etc. necessary for realizing above shall be provided.

1.5.6 EARTHING TERMINALS

Earthing bar mounted in the lower part of the enclosure shall be marked as Main Earth Terminal and shall be completed with screw connections, for earthing conductors. Earthing terminal shall be connected to the site earthing system.

1.5.7 POWER SUPPLY

The main power shall be taken as directed by the engineer, and Panel board at chemical house shall be supplied with suitably sized MCCB for each motor and other electrical accessories. The panel for chlorinators and chemical equipment and all other connections shall be provided and fixed by the contractor.

All electrical equipment & wiring shall conform to the standards set by the I.E. E., U.K. and to Sri Lanka regulations and be acceptable to the Ceylon Electricity Board.

Equipment shall be rated to operate on 230V single-phase 50 Hz supply – 3 wire including “earth wire” or

Equipment shall be rated to operate on 400V three-phase 50 Hz supply – 4 wire including “earth wire”

1.5.8 POWER CABLES

All power cables shall be PVC insulated, with copper conductors. Cable sizes shall be determined in accordance with latest IEC wiring regulations and Engineer’s approval shall be sought in this regard.

All underground cables shall be PVC/SWA/2/4 core with copper conductors.

All power and control cables shall be supplied and installed/laid by the contractor to suit the existing site conditions and as instructed by the Engineer.

1.5.9 CABLE INSTALLATION

Method of installation for cables shall be selected in accordance with IEC wiring regulations to suit the specific application. However, the following requirements are to be met.

- (a) Cables which are to be run on walls, ceilings or other building structures shall be secured on cable trays, ladders or enclosed in conduits or trunking.
- (b) Where building structure incorporates covered trench system cable shall be laid on horizontal trays against the side(s) of the trench.
- (c) Every cable shall be permanently identified at each end by cable markers with semi rigid black PVC carrier strip, which shall be fixed axially by means of 2 PVC straps.
- (d) All power cables to be run external to the buildings shall be in type 250 PVC pipes so that the cable can be pulled out for inspection and easy replacement. Manhole openings shall be provided every **30m** or after a bend and top side of the cable path shall be covered by suitable concrete slabs.

1.5.10 EARTH CONDUCTORS

Earth conductors shall be sized in accordance with IEC regulations. PVC cable insulation shall be green. Cable armoring and screens shall not be used as sole earth protective conductor, and earthing shall be arranged in accordance with BS 7430 of 1998.

1.5.11 ITEMS TO BE EARTHED

The following equipment shall be connected to the main earth terminal by means of earthing conductor with cross sectional area as per requirement of IEE wiring regulations;

- a) All motor cases
- b) Any other metal object, which may become under faulty conditions.
- c) Panel boards
- d) Lightning protection system earth
- e) All surge protection devices of equipments
- f) Any other items

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2 TECHNICAL REQUIREMENTS FOR GAS CHLORINATORS AND ACCESSORIES

2.1 SCOPE

The contractor shall supply and install Chlorination equipment, located and installed as specified herein and shown in the drawings. All accessories not specifically mentioned herein that are required to make the system operable shall be furnished and installed by the contractor. The system provided shall meet the Chlorine Institute guidelines.

Chlorinators shall be of type/s as mentioned in the Data Sheet. Measuring glass, ejectors, booster pump with starter, weighing scale, change over unit, chlorine leak detector, chlorine gas resistant exhauster, gas respirator, chlorine test kit with 1,000 numbers DPD 1 (for measuring residual chlorine) tablets and all necessary appurtenances shall be provided with the chlorination system. The Contractor shall supply, install, commission and hand over all the equipment to the satisfaction of the Engineer.

2.2 TYPES

Types of the chlorinators & chlorine gas cylinders shall be as mentioned in the Data Sheet.

2.3 QUALITY ASSURANCE

The chlorinator manufacturers shall have total quality assurance of the manufacturing process from an accredited agency for the manufacturing facility of chlorinators and accessories.

Total Quality Management system shall comply with **ISO 9001: 2015**.

The certificates valid for current production years shall be produced with the offer.

All chlorinators and accessories to be supplied under this contract shall only be from the approved factory location.

2.4 UNIT RESPONSIBILITY

The Contractor shall cause all equipment specified under this contract to be furnished by the chlorinator manufacturer who shall be responsible for the adequacy and compatibility of all chlorination unit components. Any component of each chlorination unit not provided by the chlorinator manufacturer shall be designed, fabricated tested and installed by the manufacturer's authorized representatives experienced in design and manufacturer of such components. This requirement, however, shall not be construed as a relieving the contractor of the overall responsibility for this portion of work.

The chlorination system shall be a product of an experienced manufacturer.

2.5 SYSTEM DESIGN REQUIREMENT

The arrangements shown in the drawing is based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions particular to specific equipment unless otherwise shown or specified. Therefore, it may be anticipated that the structural supports, foundations connecting piping and valves shown in part or

whole, may have to be changed in order to accommodate the chlorination equipment furnished and shall be appropriately incorporated in the bid.

The complete chlorination unit shall be designed to operate without overload on any component at any point along the chlorination range specified.

2.6 FACTORY TESTING

The chlorinator units and other accessories shall be tested at manufacturer's works and the contractor shall provide the test results of the equipment prior to the shipment of the equipment.

The following testings shall be carried out.

Chlorinator unit	-	Capacity of unit
Booster pump	-	Pump characteristics

2.7 SUBMITTALS

The following technical requirements shall be submitted with the offer.

1. Technical details, catalogues together with detailed specification and data covering performance and materials of construction, parts devices and other accessories.
2. Technical details of respirators.
3. Technical details of Chlorine Test Kits.
4. Proposed panel layout (indicators, meters, switches etc.)
5. Technical details of Exhauster.
6. Printed literature-supporting details given in the questionnaire
7. Manufacturer's warranty

2.8 CHLORINATORS

2.8.1 Chlorinators

These specifications are for the Supply and Installation of Gas Chlorinators and accessories as shown in the list of drawings and as stated in the Bill of Quantities.

Chlorinators shall be suitable for continuous operation and capable of maximum dosing with a minimum meter range as specified in the Data Sheet.

Chlorinators with remote flow meters and change over switch shall be installed as per the drawings.

It shall incorporate a flow meter to indicate the dosing rate, Chlorine gas pressure and operating water pressure gauges, Chlorine gas filter and injector assembly with non-return valves and shall be complete with all connected pipe work (all chlorine solution piping & fittings shall be of suitably sized as given in the **Data Sheet**, 600 type PVC pipes), specials, injection fittings etc., for connecting up to the point of application of Chlorine solution.

Chlorine supply status shall be indicated by means of a loss-of gas indicator operated by the vacuum regulator.

Each chlorinator shall be fitted with a pressure and vacuum relief and vent connections. Vent lines shall extend to the exterior of the building, with ends turned down and covered with insect screens.

Safety precautions to be taken in connection with the storage and handling of chlorine should be provided in the form of warning notices to be mounted at the appropriate places. Please refer the Data Sheet for safety precautions required.

2.8.2 Water Supply and Solution Mixing

Booster pump's water requirements shall be met with the available facilities at site. Contractor should supply, install and fixing of all suction and delivery (up to the point where the chlorine solution is fed) pipe lines, fittings specials, valves etc necessary for the proper chlorination system as shown in the drawings and as instructed by the engineer.

Chlorine solution is fed / injected in the point as mention in the Data Sheet.

The ejectors shall be designed to mix the solution properly (equally distribute) with water. No. of booster pumps & ejectors shall be decided in such a way to assure 100% standby for each booster pump & ejector in operation.

Also the bidders are requested to provide following data with the offer, they are dimensioned layout showing lengths, Pipe sizes etc related to the ejector and comprehensive calculation sheet based on selection of suitable ejectors.

These pumps shall be suitably sized so that the required differential pressure is created to draw off the specified dose of chlorine. Relevant calculations shall be submitted with the offer.

Mode of operation of booster pumps is specified in Data Sheet and sequence of operation with necessary controls & displays of booster pumps shall be as instructed by the engineer.

2.8.3 ACCESSORIES

2.8.3.1 CHLORINE RESISTANT WEIGHING SCALES

Type and size of weighing scale shall be as mentioned in the Data Sheet.

Specification of duel cylinder weighing scale for 1000 kg chlorine cylinder.

- ▲ Maximum capacity of each deck shall not be less than 2000 kg
- ▲ Minimum reading 0.1 kg
- ▲ Capable of reading weight of each cylinder separately
- ▲ Double deck of hard load-rack, anti-impact.
- ▲ Brackets with nylon wheel for horizontal installation of chlorine cylinder
- ▲ C.S. surface: painted & baked or galvanized.
- ▲ S.S. surface: polished & brushed.
- ▲ Four load cells: stainless steel.
- ▲ Strong structure with buffering mechanism

Specification of duel cylinder weighing scale for 68 kg chlorine cylinder

- ▲ Maximum capacity of each deck shall not be less than 300 kg
- ▲ Minimum reading 0.1 kg
- ▲ Capable of reading weight of each cylinder separately

- ▲ Double deck of hard load-rack, anti-impact.
- ▲ provision for vertical installation of chlorine cylinder
- ▲ C.S. surface: painted & baked or galvanized.
- ▲ S.S. surface: polished & brushed.
- ▲ Four load cells: stainless steel.

2.8.3.2. AUTOMATIC CHANGE OVER SYSTEM

The automatic change over system shall be of type as stated in the **Data Sheet** provided to avoid interruption of chlorine feeding. It shall consist of a changeover modular which shall sense the low weight switch when the 'on line' container/s is/are (depending on need) empty and automatically switch the system over to the 'standby' container.

Container which is 'on line' and 'standby' shall be indicated.

One spare change over module shall be provided. The vacuum and vent pipes should be of plastic tubing.

2.8.3.3. KEYS AND TOOLS

All special spanners, keys and other tools required to dismantle and re-erect all equipment to the satisfaction of the Engineer should be supplied by the bidder in a wooden box.

A list of tools/keys supplied in this contract shall be submitted with the offer separately. Tools and other maintenance equipment provided under this item should not be used for the purpose of erection of the works under the contract.

2.8.3.4. CUPBOARD FOR TOOLS & EQUIPMENT

The cupboard shall be of sheet metal construction using 1.5 mm thick steel sheets and the approximate dimensions of 1500x 1200x 450 (H x W x D) mm. Fabrication shall be done using seam or spot welding and shall be finished with gloss white paint inside the cupboard and exterior shall be finished to color as directed by the engineer.

Painting process shall be complied to ISO 12944-2017

Doors shall be properly hinged to ensure uniform pressure right along the rubber beading. Doors shall be made with transparent glass sections and lockable. The rubber beading shall be flat type that provides protection against dust and drops of water. Hinges shall be zinc die-casting or stainless steel. The cupboard shall be partitioned as shown in the drawing, to accommodate the above supplied tools & safety equipment.

2.8.4 SAFETY EQUIPMENT

2.8.4.1 GAS RESPIRATORS

Two gas respirators of reputed make shall be provided for the safety of operators working in the chlorinator room. Respirators shall be of canister type, complete with gas masks and all necessary accessories. The respirators should be stored in labeled protective case and positioned in a readily accessible location close to the chlorinator room. (Bidder shall supply relevant literature pertaining to the Gas Respirators)

Contractor shall also install a safety water shower.

2.8.4.2 CHLORINE LEAK DETECTION SYSTEM

- a. The chlorine leak detection system shall be supplied and installed where the chlorine cylinders and chlorinators are installed. The panel and other accessories shall be

installed in separate room. Atmospheric chlorine gas detectors shall be supplied with a minimum sensitivity as mentioned in the Data sheet. The units shall be completely self-contained with a die cast aluminium or fibreglass case, for wall mounting. All materials of construction shall be entirely suitable for operation in an atmosphere as may be encountered in a chlorination room. The unit shall include an air-sampling pump, a rotameter electro-chemical sensing cell and indicating meter with alarm contacts and indicating light. A separate light shall indicate instrument failure. Three sets of independent contacts shall be provided for automatic actuation of alarms, exhausters and fans installed in the chlorine cylinder room.

- b. In operation the unit shall pump in a filtered air sample, the rate of which shall be set by a control valve. The air sample shall enter the sensing cell and produce a signal proportional only to the concentration of chlorine gas in the air. A sensing meter with adjustable contacts shall measure the generated signal, and actuate the alarm circuit (also provision for auto start of exhauster shall be provided). A one year supply of chemicals for sensor shall be included. Sufficient flexible sampling hose shall be provided to obtain the sample approximately 75mm above the floor in the locations shown on the plans.
- c. A warning audible alarm signal system shall be provided to indicate the chlorine gas leakage.

2.8.4.3 RESIDUAL CHLORINE TEST KIT

A residual chlorine test kit including all reagents suitable for 1000 tests shall be provided. The bidder shall supply relevant literature pertaining to the test kit.

2.8.4.4 EXHAUSTER

The bidder shall provide and install an electric motor driven exhausters of numbers as mentioned in the Data sheet, resistant to corrosion from chlorine to remove air from the chlorine room. Exhauster system shall be sized to have number of air changers per minute of the entire room as mentioned in the Data sheet. The exhauster should be installed just above the floor level and be able to operate manually from outside of the Chlorinator room and auto operation also to be provided as stated above in para 2.8.4.2.b. Noise level of the exhauster shall not be exceeding 65 dB at 1m.

2.8.5 BOOSTER PUMPS

2.8.5.1 GENERAL

2 Nos. booster-pumping units (one duty and one standby) shall be provided for each chlorinator sets to generate the pressure required. These pumps shall be suitably sized so that the required differential pressure is created to draw off the specified dose of chlorine. Contractor should provide the calculations and other factors which led to size the suitable booster pumps with the offer.

The contractor shall supply the booster pumps complete with suitably sized suction and delivery piping, valves, solution diffusers and other necessary fittings. Each booster pump shall be supplied with a push button DOL starter with overload protection. All booster pumps, starters, chlorinators and accessories shall be installed as shown in the relevant drawings.

Mode of operation of booster pumps is specified in the Data Sheet and sequence of operation with necessary controls & displays of booster pumps shall be as instructed by the engineer.

2.8.5.2 PUMP TYPE

Booster pump shall be an inline centrifugal type pumps. All pumps, motors and accessories to be supplied under this contract shall only be from the approved factory location and it shall be suitable for chlorine rich environment.

2.8.5.3 CONSTRUCTION MATERIALS

Shaft	-	Stainless steel conforming to BS 970 Grade 431S29
Impeller	-	Stainless steel conforming to BS 970 Grade 431S29
Casing	-	Cast Iron conforming to BS 1452: Grade 220/ Stainless steel conforming to BS 970 Grade 431S29
Shaft sleeves	-	Stainless steel conforming to BS 970 Grade 431S29
Gland Bush	-	Stainless steel conforming to BS 970 Grade 431S29

2.8.5.4 ELECTRIC MOTORS AND LT EQUIPMENT

All motors shall be of Energy Efficient Continuous three/single phase Squirrel Cage induction type suitable for direct-on-line/star-delta starting, with starting current not exceeding 6 times full load current unless specifically detailed in the relevant sections as an alternative arrangement.

Design of the motors shall be such that they can operate within + 6% of the nominal voltage continuously without damage. Synchronous speed shall be 3000/1500 rpm.

All motors shall be suitable for operation at 400 Volts 3 phase or 240 Volts single phase and 50 Hz supply and shall comply with following general standards and norms:

- IEC 34-1, 34-5, 34-6 and 34-8.

All motors shall be suitable for operation in the site climatic conditions.

Motors shall be of class F insulation of NEMA standards but the operating temperature rise shall be restricted to that of class B

Motor bearings shall be of high-precision manufacture, antifriction type designed for a continuous (24 hrs/day) duty life of 70,000 hours.

Motor enclosures shall be protected to IP55.

The motors shall be coupled to the pump through a semi flexible coupling.

Motors shall be continuous duty type (duty designation - S1) with minimum 6 starts per hour and the ratings of the Motors shall be at least 10% more than the power required by the pump at the specified duty point.

2.8.5.4.1 Starter and control panel for each booster pump

Following features shall be accommodated in the starter and control panel.

1. Indicator lamps to power supply
2. Indicator lamps to indicate following,
 - Pump Running
 - Pump Stopped (Manual)
 - Pump Tripped (Overload/Thermal Tripped)
3. Duty selector and mode selector switch for pumps as
 - P1/P2
 - Mode of operation as mentioned in the Data Sheet
4. Push Buttons for pumps
 - Start
 - Stop

- Reset
5. Any other control system as instructed by the engineer

2.8.5.5 SPARES

2.8.5.5.1 SPARES FOR CHLORINATORS

The following List of Spares for the Chlorinator shall be supplied with the offer separately.

1. O' Rings	02 Set
2. Gaskets	02 Set
3. Springs	02 Sets
4. Throat (Ejector)	01 No.
5. Tailway (Ejector)	01 No.
6. Diaphragms	06 Nos.
7. Regulating Cartridge Assembly	02 Nos.
8. Diaphragm body	06 Nos.
9. Flow Meter Tubes	02 Nos.
10. Vacuum Gauges	01 No.
11. Specific spares for type of chlorinator selected	

2.8.5.5.2 SPARES FOR BOOSTER PUMPS

Following spares shall be provided for booster pumps for each site.

1 Impeller	01 Set.
2 Shaft sleeves	02 Sets
3 Pump bearings	02 Sets
4 Impeller neck rings	01 Set
5 Lantern rings	01 Set
6 Couplings bushes	01 Set
7 Mechanical Seal	02 Sets
8 All gaskets, seals and packing	02 Sets
9 Stuffing box gland with nuts & bolts.	01 Set

An itemized price list should be attached with the offer.