
	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
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1.0 General

All chemicals (Liquid Chlorine – Cl₂) shall be of a grade suitable for the treatment of drinking water and shall contain no soluble minerals or organic substances capable of producing deleterious or injurious effects on public health.

The Liquid Chlorine shall be in accordance to MS 171:2013; Liquid Chlorine for use in potable water supply – Specification (Second revision).

2.0 Scope

The specification for Water Treatment Chemical – Liquid Chlorine is a guideline for the Liquid Chlorine suppliers to comply — in order to supply the Liquid Chlorine for PBAPP's use in potable water supply service.

3.0 SPAN Requirements

All suppliers of the chemical must be registered in the Suruhanjaya Perkhidmatan Air Negara (SPAN) Listing / Registration of Suppliers, and the registration must be valid during period of supplying of the chemical.


4.0 Safety & Health Requirements

4.1 All suppliers shall fully comply with the clauses / requirements in:

- a) Occupational Safety and Health Act , 1994,
- b) Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013,
- c) Industry Code of Practice on Chemicals Classification and Hazard Communication 2014 (ICOP 2014),
- d) Garis Panduan Keselamatan Pembekalan dan Penggunaan Bahan Kimia Klorin untuk Sistem Bekalan Air (published by SPAN, year 2021)
- e) Any Regulations / Orders; and
- f) As well as other applicable laws

5.0 Halal Certificates Requirements

All chemicals (Liquid Chlorine) shall have valid HALAL certificate.

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

6.0 Chemical Requirement

6.1 Physical Properties

6.1.1 Appearance -

Chlorine shall be clear amber liquid, vaporizing to a greenish yellow gas, 2.5 times heavier than air at normal temperature and pressure. It has strong suffocating and characteristic odor.

6.1.2 Solubility in water – 7.26 g/l at 20 °C and 100 kPa.

6.1.3 Bulk Density -

Liquid : 1.409 g/ml at 20 °C.
Gas : 2.945 kg/m³ at 20 °C.

6.2 Chemical Properties


6.2.1 Chlorine is a very strong oxidizing agent and can react violently with some gases such as hydrogen. Almost all metals form chlorides in the presence of chlorine. Organic compounds including mineral oils and greases react very quickly with chlorine.

6.3 Purity Criteria

6.3.1 Liquid Chlorine shall not contain any impurities and additives in such concentrations that are capable of producing deleterious or injurious effects on the health of those consuming water that has been properly treated with the product. Any quantity exceeding the impurity limit shall be notified to the user.

6.3.3 Liquid Chlorine shall be chemically pure, anhydrous and must comply with the requirements as specified in Table 1.

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	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

Parameter	PBAPP Specifications	Test Method
<u>Chemical Requirement</u>		
Chlorine content, % (v/v)	99.7% (minimum)	Annex A MS 171:2013
Water content, % (w/w)	0.01% maximum	Annex B MS 171:2013
<u>Impurities</u>		
Non-volatile residue, mg/kg	300 maximum	Annex C MS 171:2013
Nitrogen trichloride (NCl ₃) content, mg/kg	30 maximum	Annex D MS 171:2013
Note: The contribution of toxic substances in the chemical used for treatment of drinking water should not be more than 10% of the maximum allowable concentration of those toxic substances to the drinking water (‘the 1/10 th rule’)		

Table 1: Requirements for Liquid Chlorine

7.0 Marking, Labeling and Packaging

7.1 Marking


7.1.1 The following information shall be marked legibly either on each container (drum / cylinder):

- Chemical solution, trade name and grade
- Tare and gross weight
- Name, address and telephone number of supplier and manufacturer
- Batch number
- The date of manufacturing; and shall bear such other markings as required by applicable laws
- The statement ‘Potable grade’
- Expiry date of the chemical

7.1.2 In the case of shipment in bulk, every consignment shall carry a certificate setting out the above-mentioned information.

7.2 Risk and Safety Labeling and Safety Data Sheet (SDS)

7.2.1 Labeling requirements (written in both Bahasa Malaysia and English) shall apply to Liquid Chlorine and shall comply with the requirements of the Regulations 6, 7, 8, 9, 10, 11 and 12 of the Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013, Industry Code of

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

Practice on Chemicals Classification and Hazard Communication 2014 (ICOP 2014), Occupational Safety and Health Act 1994 (Act 514) and Regulation and Orders.

7.2.2 Suppliers shall furnish dual languages (English and Bahasa Malaysia) of an up-to-date Safety Data Sheet (SDS) complying with Regulation 13 of the Occupational Safety and Health (Classification, Labeling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013 for each chemical before their first delivery to PBAPP Sdn. Bhd.

7.3 Packaging, Chemical Handling during Transportation, Labeling and Certificate of Analysis

7.3.1 Packaging, Chemical Handling during Transportation and Labeling

7.3.1.1 All suppliers must prepare packaging according to the below Table 2: Requirement of Packaging.

Type of Packing of Liquid Chlorine	Packing Description
- 68 kg / Cylinder	(i) Packed under pressure in dry and clean steel drum and/or cylinder. (ii) Dew point of the gas $\geq -40^{\circ}\text{C}$.
- 930 kg / Drum	(iii) Filling ratio of the container $\leq 1,250 \text{ kg/m}^3$. (iv) Temperature of container $\leq 50^{\circ}\text{C}$.

Table 2: Requirement of Packaging

7.3.1.2 The packaging shall be securely sewn at both ends to provide sufficient sealing at ends to prevent leaking and also be with stand rough handling.

7.3.1.3 No contamination of Liquid Chlorine by toxic substances or other foreign substances shall occur during transportation.


7.3.1.4 Broken bags, drums, containers, rebadged chemicals or other poor packing conditions shall be rejected and PBAPP reserves the right to reject any good that in their opinion is considered poorly packed.

7.3.1.5 It is mandatory requirement to state the lot number, manufacturer date and expiry date at all packages of shipments.

7.3.1.6 The supplier is required to collect back all the empty used chemical drum / cylinder from the PBAPP WTP's chemical store for proper re-fill or disposal according to relevant legal requirements.

7.3.1.7 The supplier shall provide recommendations for appropriate materials of constructions for the transportation, storage, handling and packaging of the product.

7.3.1.8 Containers shall not have been used previously for any other different product or it shall have been specially cleaned and prepared before use.

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

7.3.2 Certificate of Analysis (COA)

7.3.2.1 A certificate of analysis, with the indication of country of origin (where applicable) shall accompany all deliveries for the chemical and to be given to the end users.

7.3.2.2 The contents of the certificate of analysis shall include the following:

- Chlorine content, % (v/v)
- Water content , % (w/w)
- Residual on evaporation, mg/kg
- Nitrogen trichloride (NCl₃) content, mg/kg

7.3.2.3 The COA shall contain the Batch No., parameter, PBAPP Specification, Actual Results and a column stating comparison of the result against PBAPP specification (Compliance to PBAPP specification). Supplier must provide the COA according to the Sample Format as tabulated in Table 3.


Customer / Location of Chemical Delivered to :			
Tanker / Lorry Number :			
Delivery Date :			
Delivery Order Number :			
Name of Chemical :			
Batch Number :			
Country of Origin :			
Manufacturing Date :			
Expiry Date :			
Parameter	PBAPP Specifications	Actual Result	Compliance
Chlorine content, % (v/v)	99.7% (minimum)		
Water content , % (w/w)	≤ 0.01 %		
Residual on evaporation, mg/kg	≤ 300		
Nitrogen trichloride (NCl ₃) content, mg/kg	≤ 30		

Table 3 : Sample Format of COA Report

7.4 Storage Requirement

7.4.1 Storage

7.4.1.1 Chlorine drum / cylinder must be store in a well-ventilated, non-combustible constructed area, away from direct sunlight and chemically incompatible materials. If mixed with water, chlorine will form acidic solution and supports combustion.

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

7.4.2 Stability

7.4.2.1 Product must be stable up to 12 months under proper storage conditions.

8.0 Safety & Health Support

8.1 Emergency Response Team

8.1.1 The supplier shall provide a fully equipped and trained Emergency Response Team that will respond to chlorine leak emergencies and/or chlorine leak drills organized by PBAPP.

8.1.2 The requirements of the supplier's Emergency Response Team are as follows:


- 24 hours daily availability
- 24 hour daily Hotline number for PBAPP to contact in case of emergencies
- Response time to arrive at PBAPP facilities from the time of request shall be 2.5 hours or less
- Fully equipped emergency response vehicle with beacon lights duly registered with the authorities for emergency response
- Minimum 2 fully trained emergency response crew to be present during chlorine leak emergencies and/or drills
- All emergency response crew shall be fully equipped with personal protective equipment, self-contained breathing apparatus (SCBA) and refilling equipment to handle chlorine leak emergencies and/or drills
- Fully equipped emergency response kits to handle all types of chlorine leak possibilities including but not limited to body clamp, valve clamp and related accessories and tools.

8.2 Training Requirement to PBAPP Personnel

8.2.1 Safe Handling Training

8.2.1.1 Due to its hazardous and toxic nature, a theoretical training on safe handling of liquid chlorine shall be carried out at least once per year. The training shall be conducted at manufacturing facilities and at PBAPP premise. The training syllabus shall include the following:

- Physical properties of liquid chlorine,
- Chemical properties of liquid chlorine,
- Exposure limits and health effects,
- Personal Protective Equipment (PPE) requirements and its proper usage,
- Chlorine leaks – type of chlorine leaks, method of detection and handling of chlorine leaks,
- Emergency response plan,
- Requirement of a chlorine installation,
- Key local legislation and
- First aid

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

8.2.2 Chlorine Emergency Training

8.2.2.1 Supplier shall provide advance training to PBAPP's Personnel on proper technique of addressing liquid chlorine emergencies. This training is targeted for members of PBAPP's Emergency Response Team (ERT) and therefore include mainly practical sessions. The training syllabus should include in general topics in 8.2.1.1 and also the following:

- Proper usage of PPE; i.e. self-contained breathing apparatus, canister gas mask and etc,
- Use of Chlorine Emergency Tool Kit and,
- Simulation exercises on neutralizing chlorine leaks.


8.2.2.2 8.2.2. will cover the methods of using all the tools in the Emergency Tool Kit (refer to Table 4a and 4b). It is critical that the Emergency Tool Kit is suitable to be used on the drums and cylinders being utilized. Each WTP must have a set of any of these tools, depending on the type of chlorine container being used.

8.2.3 Chlorine Emergency Response Kit

8.2.3.1 The supplier shall provide and hand over chlorine drum and cylinder emergency response kits similar with that available with the Emergency Response Team. This is to enable first responder action by the PBAPP Emergency Response Team and/or the authorities to quickly mitigate the chlorine leak before the expert intervention by the successful tenderer's expert Emergency Response Team. This emergency response kit shall include but not limited to body clamp, valve clamp and related accessories and tools for cylinders and drums.

**Table 4a - Chlorine Emergency Tool kit (for drum) –
List of tools packed in a stainless steel box**


No	Description	Quantity
1.	No.4 spanner	1
2.	No. 5 claw key	1
3.	Leather gloves	1
4.	1-1/2 hammer	1
5.	26 mm socket c/w handle (Stanley) or 33 mm and 29 mm box spanner with handle	1
6.	5/8" wide cold chisel	1
7.	Gland packing extractor	1
8.	No.6 adjustable spanner – 12" size (Stanley)	1
9.	Body clamp with plate	1
10.	Exit adaptors	3
11.	Cover nuts	6
12.	Gland packing	12
13.	Gland nut	2
14.	Lead joint 1" x 53/64 x 1/8" for item 11	5
15.	Lead joint 7/16" x 7 x 7 x 16" x 1/6" for item 12	10
16.	1/8" diameter lead wire	2

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

No	Description	Quantity
17.	Ammonia polythene bottle	1
18.	Gland locking springs	3
19.	Medium grade emery cloth	1
20.	PTFE tape	1
21.	Steel plate for item 9	2
22.	Lead plate for item 9	2
23.	Gland seal	1
24.	Wire brush	1
25.	Stainless steel box	1
26.	Rags	2
27.	File c/w handle	1
Optional items :		
i	Chimb clamp and plate – for the disk end leaking	
ii	Flexible hose (optional) – to transfer Cl ₂ to another drum	
iii	Valve heating iron	

Table 4b - Chlorine Emergency Tool Kit (for cylinder) -
List of tools packed in a stainless steel box

No	Description	Quantity
1.	No. 4 spanner	1
2.	No. 6 spanner	1
3.	Spindle grip	1
4.	1-1/2 lb hammer	1
5.	26 mm socket c/w handle (Stanley)	1
6.	5/8" wide cold chisel	1
7.	Gland packing extractor	1
8.	No. 6 adjustable spanner – 6" size (Stanley)	1
9.	Valve heating iron	1
10.	Cover nuts	6
11.	Gland packing for cylinder	4
12.	Cylinder gland nut	2
13.	Lead joint 7/16" x 7/16" x 1/16" for item 10	10
14.	1/8" diameter lead wire	1
15.	Ammonia polythene bottle	1
16.	Medium grade emery cloth	1
17.	PTFE tape	1
18.	Gland seal for cylinder valve	1
19.	Semi-leather gloves	1
20.	Cylinder dome cover without hole	1
21.	Stir-up connector for cylinder c/w blank plug	1
22.	Rubber joint for item 21	5
23.	Wire brush	1
24.	Stainless tool box	1
25.	Rags	2
26.	Distance piece for item 3	2
Optional items:		
i	All the parts below (need for cover the upper body of the cylinder)	

	Procedure : Specification for Water Treatment Chemical – Liquid Chlorine	
	Department : Material Evaluation Technical Committee (METC)	
	Document No: PBA/CHEM.SPEC/LC	Revision No : 00
	Classification : Public	Effective Date : 04 Oct 2021

No	Description	Quantity
	and vent the Cl ₂) a) Base assembly with chains b) Cap Screw c) Yoke #2 d) Patch e) Gasket f) Chain g) Wrench 400	
ii	For repair of the body of the cylinder a) Wrench 200 and 300 b) Hood with vent valve c) Hood gasket Yoke # 1, Yoke screw #1, Yoke	

8.2.4 Chlorine Hazard Signboard

8.2.4.1 Supplier shall replace the chlorine hazard sign boards at the water treatment plant with new signboards made with aluminium composite material that will last throughout the duration of the contract. The supplier is responsible to maintain the signboard.

8.2.4.2 The signboard shall contain the following:

- a) Chemical name
- b) UN No.
- c) Hazchem code
- d) Emergency services contact
- e) Hazard signage according to Occupation Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013
- f) Specialist advice contact number
- g) Manufacturer / Successful Tenderer's Logo
- h) Contract Period
- i) Covered acrylic box attached next to signboard with a copy of the Safety Data Sheet