



## FLEET SAFETY AND SECURITY MANUAL

### 7.0 DEVELOPMENT OF PLANS FOR SHIPBOARD OPERATIONS

#### 7.F.12 POTABLE WATER QUALITY

##### 1 PURPOSE

- 1.1 To ensure that potable water supplied aboard Coast Guard ships for drinking or food preparation meets the standard established in the *Marine Occupational Safety and Health Regulations – Section 7.24(1)*.

##### 2 RESPONSIBILITIES

- 2.1 The **Regional Director, Operational Services** is to maintain and provide to vessels, information pertaining to the quality of water at specific locations where the vessel intends to load potable water.
- 2.2 The **Commanding Officer** must ensure that potable water taken aboard the vessel, or potable water manufactured aboard the vessel is provided as detailed in this procedure and is tested on a regular basis to ensure that water quality meets the standards prescribed in the *MOSH Regulations*.
- 2.3 The **Commanding Officer** shall ensure that all documents concerning potable water quality are adequately completed, checked, and maintained aboard.
- 2.4 The **Chief Engineer** is to ensure that fitted water production and purification equipment is maintained to the manufacturer's standard and that potable water tanks are inspected.
- 2.5 The **Chief Engineer**, or their delegate, is to ensure that all maintenance performed on the potable water system is logged and that only approved parts and "potable water" coatings are properly applied and used.
- Note: Consult *CCG Paint and Coating Standards (18-080-000-SG-003 Formerly DFO/5884)* for accepted coating products.
- 2.6 The **Chief Engineer** is to ensure that water obtained for the ship from hydrants or fill stations is water that is provided by a recognized drinking water system.
- 2.7 The **Engineer Officer-of-the-Watch** will manufacture water only when advised by the Chief Officer that the geographic and operational limitations are favourable. The Engineer Officer-of-the-Watch will stop manufacturing water immediately upon being advised by the Chief Officer that conditions are no longer favourable.
- 2.8 The **Regional Operations Centre** is the emergency contact point for laboratories reporting contamination in ships' test water samples. The Operations Centre shall

immediately notify the ship of any report of contamination so that the ship can take the appropriate measures to discontinue use and to flush tanks.

### **3 PROCEDURE**

- 3.1 All faucets accessible to the ship's complement that are not connected to a supply of potable water are to be clearly marked to indicate that the water provided from that faucet is not suitable for drinking or food preparation.
- 3.2 To ensure potable water safety in empty cabins or seldom-used spaces, ship work instructions shall:
  - 3.2.1 provide for a member of the ship's complement to visit on a weekly basis for the purpose of flushing any potable water supply taps in those areas; or
  - 3.2.2 require that a placard be placed above the potable water source and reference is made in the ship orientation instructions to the effect that the taps shall be flushed by the new occupant of the cabin before initial use.
  - 3.2.3 procedure 7.D.6 shall also be referenced for potable water quality (i.e. water coolers)

### **3.3 Shore Supply**

- 3.3.1 The shore-supplied source of potable water aboard Coast Guard ships shall be water that has been obtained from an approved municipal drinking water supply system.
- 3.3.2 Dock hydrants or fill stations are to be flushed for at least five minutes at full volume before being connected to the ship's fill hose to ensure than standing water in the system has been cleared from the pipe.
- 3.3.3 Water that is obtained from dock hydrants or fill stations shall be carried from the hydrant to the ship in hoses that have been specifically marked for the carriage of potable water and are used exclusively for that purpose. When not in use these hoses are to be drained, kept capped, and are to be stored in a clean secured locker used only for potable water equipment. Potable water fill stations and all exterior potable water sounding pipes shall be fitted with a locking mechanism that shall be in use at all times and checked regularly for any breach to security.
- 3.3.4 If it, at any time, becomes necessary to temporarily supplement the vessel's potable water supply hose with additional lengths, or to connect to a tank operator's hose, the additional hoses shall be dosed with unscented bleach (1 cup per hose filled with water and let sit for 30 minutes) and then flushed with the equivalent of five volumes of water or for two minutes.

### **3.4 Water Produced Aboard**

- 3.4.1 Potable water production equipment shall be operated and maintained in accordance with the manufacturer's instructions and the ship-specific work instructions.
- 3.4.2 When ships manufacture water aboard, the following conditions shall be considered:

- a) The ship shall be underway.
  - b) The ship shall be outside of known shipping channels.
  - c) The ship shall be a minimum of one (1) nautical mile from shore.
  - d) The ship shall not be in an area where there is a red tide or algae bloom warning.
- 3.4.3 Where raw water for producing potable water is being drawn from a shared seabay that is also used for sea water cooling, the sea water cooling system must not be in recirculation mode.
- 3.4.4 Regionally specified local prohibitions must be observed.
- 3.4.5 When water production equipment is observed to be malfunctioning (operating outside manufacturer's specifications) the equipment is to be tagged and locked out from the potable water system (see Procedure #7.D.19 for lock-out standards) until the malfunction has been corrected and the equipment functions acceptably.

### 3.5 Disinfection

- 3.5.1 All potable water, whether bulk purchased or produced aboard, shall be disinfected prior to use. Acceptable disinfection procedures are those provided by the manufacturer of the production equipment. If the manufacturer specifies no disinfection procedure, then disinfection shall be by either chlorination (automatic or manual) or by ultraviolet irradiation.

Note: Chlorination standard is 0.2 to 0.5 mg/L. To attain a free chlorine level of 0.5 mg/L add unscented bleach [ $\sim 5\%$  sodium hypochlorite] at a rate of 1L/100m<sup>3</sup>. Chlorine is a hazardous chemical and must be handled with care. Material Safety Data Sheets (MSDS) in the ship's *Workplace Hazardous Material Information System (WHMIS)* must be consulted. Do not store with organic chemicals such as paint.

Irradiation standard is 254 nm at a minimum ultraviolet dosage of 16,000  $\mu\text{W}\cdot\text{s}/\text{cm}^2$ .

- 3.5.2 After entry to a potable water tank for any purpose, the tank must be cleaned and superchlorinated with bleach to a level of 50 mg/L of free chlorine. All taps from this tank shall be turned on to supply superchlorinated water to all pipes. It may be necessary to bypass charcoal filtration to ensure chlorinated water is in all parts of the system. The superchlorinated water must be allowed to sit in the tanks for a minimum of 4 hours.

Note: Superchlorination is achieved by adding unscented bleach [ $\sim 5\%$  sodium hypochlorite] at a volume of 1L/m<sup>3</sup> of water in the tank.

- a) Discharges of wastewater containing free chlorine are restricted by the *Canadian Environmental Quality Guidelines*. The maximum acceptable tolerance for free chlorine levels in overboard discharge wastewater is "undetectable" or less than 0.1mg/L.
- b) If superchlorinated water cannot be treated for overboard discharge as outlined in this procedure, then the water must be removed by tanker truck for disposal in accordance with provincial or territorial regulations.

- c) Superchlorinated water must be de-chlorinated to a free chlorine level below levels of detection ( $<0.1\text{mg/L}$ ) for discharge in saltwater commercial harbours provided that the discharge takes place a least 100 meters from any seawater intake or aquaculture holding area. Chlorinated wastewater may not be discharged to a freshwater body or in any sensitive area.
- d) Water can be dechlorinated by the introduction of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ).
- 71 grams of free chlorine are removed by 34 grams of hydrogen peroxide.
  - $1\text{m}^3$  of water at  $50\text{mg/L}$  free chlorine contains 50 grams of free chlorine
  - $1\text{L}$  of 35% strength hydrogen peroxide contains 350 grams of  $\text{H}_2\text{O}_2$
  - To ensure complete free chlorine removal, 33% overdosing with hydrogen peroxide is the Fleet standard.
  - Use the following formula to determine the dosing level  
$$Y \times 0.478 \times 2.857 \times 1.33 = \text{ml of } \text{H}_2\text{O}_2 \text{ solution}$$
$$Y = \text{amount of free chlorine (in grams) to be removed}$$
  - To treat  $1\text{m}^3$  of water containing  $50\text{mg/L}$  of free chlorine requires approximately  $91\text{mL}$  of 35% hydrogen peroxide  
$$50 \times 0.478 \times 2.857 \times 1.33 = 90.81 \text{ ml } \text{H}_2\text{O}_2$$
- e) Hydrogen Peroxide is a hazardous corrosive oxidizing chemical and must be handled with care. Material Safety Data Sheets (MSDS) in the ship's *Workplace Hazardous Material Information System (WHMIS)* must be consulted. Do not store with organic chemicals such as paint.
- f) The procedure to be followed for dechlorination is as follows:
- Using the formula given above, add the calculated amount of hydrogen peroxide required to a mixing tank (a ballast tank is suggested but the potable water tank can be used).
  - Using a hose and a quick connect backflow prevented fitting on the potable water tank drain, dump the potable water tank through the valve manifold to the mixing tank. (Permanent connections between the potable water tank and any other tank without anti siphoning device or backflow preventers are not permitted.)
  - Test water in the mixing tank for free chlorine level – must be less than detectable level.
  - If any free chlorine is detected add an additional amount of hydrogen peroxide (50% of the original amount used) through the appropriate tank vent(s) and retest
  - If the free chlorine level in the mixing tank is less than  $0.1\text{mg/L}$ , discharge water in accordance with 3.5.2.c above.

- If the free chlorine level in the mixing tank is above 0.1mg/L, advise the Chief Engineer and lockout the tank from potential for overboard discharge. Unless in an emergency affecting the safety of the ship, the water in the mixing tank will now have to be discharged to a tanker truck ashore for disposal.
- g) Record volume of water discharged, location, and results of tests (specify type of kit) showing free chlorine levels less than detection (<0.1mg/L) for a minimum of three samples (beginning, middle, and end of discharge)

### 3.6 Potable Water Testing

- 3.6.1 Regardless of the source of supply, ships using chlorine as a disinfection agent shall conduct weekly checks of free chlorine level of on board potable water to ensure that free chlorine in drinking water is generally maintained between 0.2 and 0.5 mg/L, but never exceeds 5 mg/L. Tests shall be conducted at the tank and on at least two other downstream outlets: one selected at random; and one on the longest run of pipe.
- 3.6.2 If the ship uses ultraviolet irradiation for disinfection, the level of irradiance shall be checked daily to ensure that it is within the manufacturer's specification for adequate drinking water disinfection, and the result shall be logged. If chlorine is not introduced to establish a residual chlorine level for maintaining disinfection in the distribution system, then weekly checks shall be made for Escherichia coli (E. Coli) and total Coliform bacteria. Tests shall be conducted on at least two downstream outlets: one selected at random; and one on the longest run of pipe.
- 3.6.3 Free chlorine test kits shall have sufficient accuracy to determine 0.1 mg/L of free chlorine.
- 3.6.4 When free chlorine levels are observed to be below 0.2 mg/L, tanks shall be re-chlorinated with a secondary chlorine source (i.e. Javex) to be brought back to approximately 0.5 mg/L by dosing the tank as outlined in Section 3.5.1 above. If doubts as to the acceptability of the water as being safe for drinking exist, the tank shall be dumped, flushed with fresh water, shocked at a level of up to 50 mg/L free chlorine as outlined in Section 3.5.2 above, and then recharged.
- 3.6.5 Coast Guard ships shall have potable water tested at least every three months, when in service, by an independent laboratory that has been accredited for the purpose of testing water quality. Tests shall be conducted on at least two downstream outlets: one selected at random, and one on the longest run of pipe.
- 3.6.6 Three of the quarterly tests, identified in Section 3.6.5 above, will test in five (5) parameters.
  - a) E. Coli must be 0 detectable per 100ml
  - b) Total Coliform must be 0 detectable per 100ml
  - c) Total Dissolved Solids must be less than 500 mg/L
  - d) pH must be between 6.5 and 8.5 pH units
  - e) Iron shall be below 0.3 mg/L

- 3.6.7 One of the quarterly tests, conducted at least once annually, will test for contamination in twenty-eight (28) parameters. Acceptable maximum values from *Canadian Drinking Water Quality Guidelines* are shown to the right of each test parameter.

#### Health-based Objectives

• E. Coli	0 per 100ml	• Nitrate/Nitrite	45 mg/L
• Total Coliform	0 per 100ml	• Mercury	0.001 mg/L
• Turbidity	1 NTU	• Selenium	0.01 mg/L
• Antimony	0.006 mg/L	• Uranium	0.02 mg/L
• Barium	1.0 mg/L	• Benzene	0.005 mg/L
• Boron	5.0 mg/L	• Xylenes	0.3 mg/L
• Cadmium	0.005 mg/L	• Fluoride	1.5 mg/L
• Chromium	0.05 mg/L	• Lead	0.04 mg/L
• Ethylbenzene	0.09mg/L		

#### Aesthetic Objectives

• Copper	1.0 mg/L	• Sodium	200 mg/L
• Iron	0.3 mg/L	• Zinc	5 mg/L
• Manganese	0.05 mg/L	• Toluene	0.024mg/L
• pH	6.5 – 8.5 pH Units	• Sulphates	500 mg/L
• Colour	15 TCU	• Chloride	250 mg/L
• Total Dissolved Solids	500 mg/L		

Note: Aesthetic quality guidelines address parameters which may affect consumer acceptance of drinking water, such as taste, odour and colour.

- 3.6.8 When forwarding water test samples to laboratories for analysis, ships shall ensure that the Regional Operations Centre is shown as the immediate contact point for the ship in the event that samples indicated that contamination is present.
- 3.6.9 Stations with potable water supplied by a municipality shall complete the annual test for the twenty-eight parameters identified in 3.6.7 above. No other tests are required for stations with municipal water supply.
- 3.6.10 Stations with potable water that is supplied by a source other than a municipality, shall have their potable water tested at least every three months by an independent laboratory that has been accredited for the purpose of testing water quality. Annually, one of these tests will be to the twenty-eight parameters identified in 3.6.7 above. Subsequent tests will be to the five parameters identified in 3.6.6 above. Tests shall be conducted on at least two downstream outlets: one selected at random; and one on the longest run of pipe.

### 3.7 Connections to the Potable Water System

- 3.7.1 When potable water is delivered under pressure to a non-potable system, the potable water system shall be protected against backflow by either backflow preventers or anti siphoning device. Backflow preventers shall be located so that they can be serviced and maintained and shall be included in the ship's predictive maintenance system for regular inspection.



3.7.2 Backflow preventers shall be fitted on potable water connections to

- a) Ice Machines
- b) Coffee Machines
- c) Chilled water fountains
- d) Steam tables
- e) Dishwashers
- f) Garbage grinders
- g) Self-cleaning range hoods
- h) Laundry equipment
- i) Sick Bays and their associated equipment
- j) Boiler feed water tanks
- k) Fire systems
- l) Toilets
- m) Ballast systems
- n) Bilge or other waste water connections
- o) International shore connection

**3.8 Potable Water Tank Inspections**

- 3.8.1 At the time of the potable water tank inspection, a verification shall be made of the physical piping (bulkhead, vent, load lines, hoses, etc.) to ensure that no repairs or alterations have been made to the system that are not in conformance with acceptable practices for the storage and distribution of drinking water.

**3.9 Variances**

- 3.9.1 There may be occasions where, due to the nature of the operations being conducted or the physical capacities of the ship, parts of this procedure cannot be followed exactly. In such situations, the Commanding Officer shall ensure, by taking all prudent measures, that the potable water provided to the ship's complement is safe for consumption.
- 3.9.2 When the vessel is in a contracted refit where the contractor is to supply potable water to the crew, the Commanding Officer shall ensure that the contractor supplies the necessary certificates.

**3.10 Record Retention**

- 3.10.1 Potable water testing records shall be maintained for a period of five years from date of last entry.

3.10.2 All results from potable water testing shall be transcribed to the Potable Water Trending tool to assist in the trending of the ship's potable water supply.

#### 4 DOCUMENTATION

- Deck Log Records of Water Taken Aboard
- Engineroom Log of Water Produced Aboard
- Laboratory Test Certificates
- Records of On Board Testing
  - (Disinfection Tests – free chlorine or ultraviolet levels)
  - (Dechlorinated water discharge tests)
- Records of any repairs, modifications, or maintenance
- Records of annual audits conducted on the drinking water system and control documentation that confirm compliance with this procedure
- Potable Water Trending Tool

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## ANNEX A

## Potable Water Trending Tool

Please input the results from your water tests using this tool. Fill in the parameters marked by an asteriks depending on which test is being input. QT stands for quarterly test and AT stands for annual test. This table will be examined during audits.

QT	AT	Health Based Objectives		2010				2011				2012			
		Parameter	MAC	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
*	*	E. Coli	0 per 100ml												
*	*	Total Coliform	0 per 100ml												
	*	Turbidity	1 NTU												
	*	Antimony	0.006 mg/L												
	*	Barium	1.0 mg/L												
	*	Boron	5.0 mg/L												
	*	Cadmium	0.005 mg/L												
	*	Chromium	0.05 mg/L												
	*	Nitrate/Nitrite	45 mg/L												
	*	Mercury	0.001 mg/L												
	*	Selenium	0.01 mg/L												
	*	Uranium	0.02 mg/L												
	*	Benzene	0.005 mg/L												
	*	Xylenes	0.3 mg/L												
	*	Fluoride	1.5 mg/L												
	*	Lead	0.01 mg/L												
	*	Ethylbenzene	0.09 mg/L												

QT	AT	Aesthetic Objectives		2010				2011				2012			
		Parameter	MAC	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
*	*	Iron	0.3 mg/L												
*	*	pH	6.5 - 8.5 pH Units												
*	*	Total Dissolved Solids	500 mg/L												
	*	Copper	1.0 mg/L												
	*	Manganese	0.05 mg/L												
	*	Colour	15TCU												
	*	Sodium	200 mg/L												
	*	Zinc	5 mg/L												
	*	Toluene	0.024 mg/L												
	*	Sulphates	500 mg/L												
	*	Chloride	250 mg/L												