

# BALMORAL TANKS

## STAINLESS STEEL CYLINDRICAL TANK OPERATION AND MAINTENANCE MANUAL



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# 1 INTRODUCTION

Stainless steel storage tanks are a recognized and reliable solution in providing bulk commodity storage for many types of content. These tanks are used in a wide range of industries, typically covering water and waste water treatment, potable water storage and related mediums.

# 2 SCOPE

This document has been prepared for guidance only for the inspection and preventative maintenance of stainless steel tanks. Only authorised persons/contractors who are adequately supervised, correctly equipped, and trained in all aspects of the risks involved and the equipment to be used should be employed to carry out inspection and maintenance work. They must also be familiar with all the safety data sheets of all products used.

It is the responsibility of the person/contractor undertaking these works to consider each installation, its environment and the specific risks involved.

Whilst every care has been taken to ensure the accuracy of this manual, Balmoral shall have no liability for any loss or damage (direct, indirect, special or consequential) arising out of or in connection with this manual.

# 3 HYDROSTATIC TESTING

Upon completion of installation, the initial hydrostatic test fill should be carried out in line with the recommendations below. Failure to do so may result in accelerated expansion of the tank wall seams causing the mastic seal to be compromised.

## 3.1 Inspection of the base

3.1.1 Prior to filling, the base should be visually inspected and free from any tools or foreign items.

## 3.2 Sealant cure

3.2.1 It is essential that full sealant curing period has elapsed prior to the commencement of hydraulic testing. This is usually one week, subject to weather conditions. Contact Balmoral Tanks Limited for advice if in doubt.

## 3.3 Vacate and seal the tank

3.3.1 The tank must be checked to ensure that all materials, tools and equipment have been removed, a final check must be made to **ensure that no personnel remain inside the tank**. The access panel or manway, if removed, should now be repositioned and fixed using the gasket and fixings supplied.

## 3.4 Blanking off pipework connections

3.4.1 Fit all blanking plates using gaskets.  
3.4.2 Turn all valves connected to pipe work adjacent to tank to stop/off position.

## 3.5 Vacuum or pressurisation avoidance

3.5.1 (Where applicable) Ensure that there is sufficient ventilation to the roof space volume to ensure that no negative or positive pressure is obtained in the roof void during the filling or emptying process.

## 3.6 Filling the tank

3.6.1 The tank should be filled with the test media at a rate of no greater than two metres of tank height per 24 hour period. On

no account should the tank be allowed to fill to a level above the Top Water Line (T.W.L.) as detailed on the approved general arrangement drawings.

- 3.6.2 During the filling process the test media must be directed away from the tank wall to avoid impinging on the tank walls and tank/base sealant.
- 3.6.3 It is recommended that if substantial amounts of further work are being considered inside the tank after hydraulic testing, clean or irrigation water is used for the hydraulic test to avoid the hazards and complications involved in working within the confines of a tank previously filled with sludge or effluent.
- 3.6.4 The test media must be of an equal or lesser density than the originally specified contents of the tank.
- 3.6.5 The test media must be no more chemically aggressive or have no more abrasive properties than the originally specified contents of the tank.
- 3.6.6 The tank should not be left unsupervised during the filling or draining processes.
- 3.6.7 Equipment and machinery used should not be left unattended for long periods whilst in operation.

## 3.7 Signs of leakage

- 3.7.1 In the unlikely event of a major leak during filling, the filling operation should be stopped and Balmoral Tanks should be notified. The filling process should not be resumed until appropriate advice has been provided by Balmoral Tanks. Once filling is complete the tank should be left to stand for a minimum of 24 hours with a visual inspection for leaks one hour after filling and at the end of the test period.
- 3.7.2 Any leaks from the tank wall are to be reported to Balmoral Tanks who will provide guidance on repair methods.

## 3.8 Draining down following testing

- 3.8.1 Water should be disposed of at, or transferred to, an agreed location upon completion of hydrostatic testing.

# 4 ROUTINE INSPECTION

One of the benefits of an above ground vessel is the ease of making a visual check.

To validate the warranty a detailed inspection must be undertaken and recorded not earlier than six months or later than 12 months after installation in accordance with the standard inspection report.

Prior to any inspection or remedial work an assessment of the risks specific to this installation must be carried out. This is to provide a safe system of entry and to ensure the safety of those carrying out the tasks involved. Due to the continuing changes in circumstances the risks must be reassessed each time work is considered. In order to carry out a meaningful internal inspection the tank should be completely emptied and cleaned. Any person in control of these works who is not fully conversant with the risks involved with storage/treatment vessels and the measures to be taken to provide a safe system of work is advised to contact the local Health and Safety Advisory Body.

Using the inspection procedure described in this manual the tank or silo should be checked for any defects or structural damage with particular attention given to the panel surface, joints, joint sealant and fixings. If there is any doubt about the structural integrity of the stainless steel tank or silo, professional help should be sought. If repairs are required refer to Sections 7 and 9; repair procedures.

The corrosion resistance of stainless steel relies on the ability of the chromium content to form chromium oxide when combining with oxygen on the surface.

If sludge deposits are allowed to collect on the surface, this may lead to localised deaeration and undermine the protective nature of the passive layer. The chemistry of any deposits may cause chloride absorption and build-up a higher local chloride level that causes localised degradation of the stainless steel.

Therefore; in certain circumstances an annual inspection may be required inside the tank and if necessary thorough flushing and cleaning of the stainless steel surface.

It would be beneficial to enter into a routine maintenance agreement which provides for inspection of the goods and maintenance in accordance with the advice/procedures included within this manual.

#### 4.1 Longer term inspection schedule

- 4.1.1 Balmoral recommend in line with process/planned shutdowns that a full inspection of the tank interior is carried out after a period of five years operation but no greater than 10 years, this inspection should then be carried out at future intervals of no less than five years but again no greater than 10 years in line with planned/process shutdowns from each subsequent previous inspection.

## 5 ROUTINE MAINTENANCE

Even premium products will not work indefinitely without routine maintenance, but unlike other equipment, an unidentified problem in a storage system can lead to environmental damage, cost and business disruption. A routine maintenance program may help to prevent such a problem and give peace of mind in the years ahead. Replacement and repairs of panels mechanically damaged during use and other remedial work can substantially improve the life expectancy of your stainless steel tank or silo

## 6 INTERNAL INSPECTION

### 6.1 Observations

- 6.1.1 All observations should be recorded for future evaluation.

### 6.2 Special attention

- 6.2.1 Special attention should be paid to, but not limited to the following:
- 6.2.2 The condition of the concrete base/steel floor and perimeter seal.
- 6.2.3 Evidence of damage or erosion caused by the contents on the internal surface of the tank and/or roof sheets.
- 6.2.4 The condition around the bolt heads and the sheet joints/edges. The condition of the mastic fillets and sheet edge coverage with particular attention to hardening, cracking, lack of adhesion and evidence of chemical degradation.
- 6.2.5 The general condition of any other permanent fixtures, eg, flanges, manways, throughthewall agitators, etc.
- 6.2.6 The condition of the bolt caps and the presence of mastic squeeze out around the bolt heads.

## 7 REPAIR PROCEDURE (INTERNAL SURFACE)

### 7.1 Minor damage on surface of the sheet

- 7.1.1 Fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 7.1.2 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 7.1.3 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 7.1.4 Apply SABA Ecosal Bio HM or SIKA TS+ over the affected area.

### 7.2 Major damage on surface of the sheet

- 7.2.1 For badly affected areas you may wish to consider a patch plate.
- 7.2.2 Patch plates are available in 300mm<sup>2</sup> and 700mm<sup>2</sup> panels.
- 7.2.3 The appropriately sized internal 'patch' plate is offered to the tank wall and the bolt locations are marked on the tank wall ready for drilling.
- 7.2.4 The holes marked on the tank wall are drilled to the necessary size (Ø14mm) to accept the silo bolts.
- 7.2.5 Fully remove all signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 7.2.4 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 7.2.6 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 7.2.7 Seal using a suitable sealant (SABA Ecosal Bio HM/ SIKA TS+ sealant or equivalent). Apply to both the 'patch' plates and offer to the tank wall plate.
- 7.2.8 The 'patch' plate(s) are secured to the tank plate using silo bolts, nuts and washers.
- 7.2.9 The 'patch' plates are then pointed using the same sealant to provide a secondary protection to the 'patch' plate edges to give an aesthetically pleasing appearance.

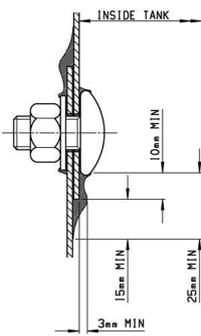
### 7.3 Damage around bolt head, nuts and washers

- 7.3.1 Fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 7.3.2 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 7.3.3 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent)
- 7.3.4 Install a new bolt/nut and washer with application of mastic around the inside of the bolt head and beneath the washer on the outside. Ensuring adequate mastic squeeze out, tighten to the correct torque, which is a guideline setting of 70Nm (51lbs.ft). This torque setting has been set as a general requirement and has proven satisfactory for the majority of standard constructions. Over point with SABA Ecosal Bio HM or SIKA TS+.

### 7.4 Mastic, fillets and sheet edges

- 7.4.1 Whilst the sheet edge mastic fillets are there as a secondary protective layer, if deteriorated, due to hardening, cracking or chemical degradation then it is prudent to repair/replace as necessary.
- 7.4.2 Carefully remove old mastic with a scraper.
- 7.4.3 If the sheet edges have minor corrosion, fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 7.4.3 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 7.4.4 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 7.4.5 Reapply a new mastic fillet using a suitable sealant (SABA Ecosal Bio HM/ SIKA TS+ sealant or equivalent). Ensure that the fillet sufficiently covers the edge of the sheet as per figure 1.

Figure 1 | Mastic fillet



## 7.5 Inner peripheral seal

- 7.5.1 If deteriorated, due to hardening, cracking or chemical degradation then it is prudent to repair/replace as necessary.
- 7.5.2 Deteriorated, hardened, cracked, damaged areas should be cut away 500mm (20in) either side of the affected area and exposed concrete and tank sheet must be thoroughly cleaned and dried.
- 7.5.3 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 7.5.4 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 7.5.5 Prime the affected concrete using a suitable primer (SABA 9002/SIKA 3N primer or equivalent). Apply to areas that are to receive the sealant.
- 7.5.6 Reapply a new mastic fillet using a suitable sealant (SABA Ecoséal Bio HM/ SIKa TS+ sealant or equivalent). Ensure that the fillet sufficiently covers the internal cold joint of the sheet.

# 8 EXTERNAL INSPECTION

## 8.1 Observations

- 8.1 All observations should be recorded for future evaluation.

## 8.2 Special attention

- 8.2.1 Special attention should be paid to, but not limited to the following:
  - 8.2.2 The condition of the stainless steel on the face of the tank sheets.
  - 8.2.3 The condition of the stainless steel around the bolt heads and the sheet joints/edges.
  - 8.2.4 The condition of the external plastic bolt caps, and the presence of mastic squeeze out around the bolt heads.
  - 8.2.5 The condition of the mastic fillets and sheet edge coverage with particular attention to hardening, cracking, lack of adhesion and evidence of environmental degradation.
  - 8.2.6 Visual signs of joint leakages via strains or sheet surfaces.
  - 8.2.7 The general condition of any other permanent fixtures, eg, ladder and platform, flanges, manways, throughthewall agitators, etc.
  - 8.2.8 The general condition of serviceable and replaceable items such as manway gaskets, roof vents and pressure relief valves.

# 9 REPAIR PROCEDURE (EXTERNAL SURFACE)

## 9.1 Minor damage on surface of the sheet

- 9.1.1 Fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 9.1.2 Cleanse and remove all grease using a suitable cleansing

solution (SABA 48/ Sika 205 cleaner or equivalent).

- 9.1.3 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 9.1.4 Apply SABA Ecoséal Bio HM or SIKa TS+ over the affected area.

## 9.2 Major damage on surface of the sheet

- 9.2.1 For badly affected areas you may wish to consider a patch plate.
- 9.2.2 Patch plates are available in 300mm<sup>2</sup> and 700mm<sup>2</sup> panels.
- 9.2.3 The appropriately sized internal 'patch' plate is offered to the tank wall and the bolt locations are marked on the tank wall ready for drilling.
- 9.2.4 The holes marked on the tank wall are drilled to the necessary size (Ø14mm) to accept the silo bolts.
- 9.2.5 Fully remove all signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 9.2.6 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 9.2.7 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 9.2.8 Seal using a suitable sealant (SABA Ecoséal Bio HM/ SIKa TS+ sealant or equivalent). Apply to both the 'patch' plates and offer to the tank wall plate.
- 9.2.9 The 'patch' plate(s) are secured to the tank plate using silo bolts, nuts and washers.
- 9.2.10 The 'patch' plates are then pointed using the same sealant to provide a secondary protection to the 'patch' plate edges to give an aesthetically pleasing appearance.

## 9.3 Damage around bolt head, nuts and washers

- 9.3.1 Fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 9.3.2 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 9.3.4 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 9.3.5 Install a new bolt/nut and washer with application of mastic around the inside of the bolt head and beneath the washer on the outside. Ensuring adequate mastic squeeze out, tighten to the correct torque, which is a guideline setting of 70Nm (51lbs.ft). This torque setting has been set as a general requirement and has proven satisfactory for the majority of standard constructions. Over point with SABA Ecoséal Bio HM or SIKa TS+.

## 9.4 Mastic, fillets and sheet edges

- 9.4.1 Whilst the sheet edge mastic fillets are there as a secondary protective layer, if deteriorated, due to hardening, cracking or chemical degradation then it is prudent to repair/replace as necessary.
- 9.4.2 Carefully remove old mastic with a scraper.
- 9.4.3 If the sheet edges have minor corrosion, fully remove any signs of corrosion from the affected areas using a suitable scraper, wire wool or brush, and emery cloth.
- 9.4.4 Cleanse and remove all grease using a suitable cleansing solution (SABA 48/ Sika 205 cleaner or equivalent).
- 9.4.5 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).
- 9.4.6 Reapply a new mastic fillet using a suitable sealant (SABA Ecoséal Bio HM/ SIKa TS+ sealant or equivalent). Ensure that the fillet sufficiently covers the edge of the sheet as per figure 1.

## 9.5 Visible evidence of leaks from bolt holes

- 9.5.1 If there is a leak evident from a bolt hole, remove the nutcap (if required), nut and washer.
- 9.5.2 Clean the bolt, nut and washer thoroughly using a suitable cleaner (SABA 48 or SIKa 205) or replace the fixing with new.
- 9.5.3 Prime using a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent).

9.5.4 Refit the fixing with mastic around the bolt head washer and re-tighten ensuring adequate mastic squeeze out, tighten to the correct torque, which is a guideline setting of 70Nm (51lbs.ft). This torque setting has been set as a general requirement and has proven satisfactory for the majority of standard constructions.

## 9.6 Leaks from joints

- 9.6.1 If the leak is evident on a joint check the bolt torque for 500mm (20in) either side of the leak. Carefully cut away and replace the internal mastic fillet 500mm (20in) either side of the leak.
- 9.6.2 In severe cases it may be necessary to remove the bolts and replace with mastic sealant around the bolt heads. Retighten the bolts and reapply mastic fillet on the sheet edge.
- 9.6.3 If there is a leak at the corner joint, first check that the bolt is tight and tighten if necessary.
- 9.6.4 If the tightness of the bolts doesn't seem to be the obvious cause of the leak and the bolts are within reasonable tolerance of the recommended guideline torque, then carefully remove the internal mastic, clean thoroughly with a suitable cleaner (SABA 48/ SIKA 205 or equivalent), prime with a suitable primer (SABA 9102 primer/Sika 210 primer or equivalent) and reapply with mastic (SABA Ecoséal Bio HM/ SIKA TS+ or equivalent).
- 9.6.5 For persistent leaks it may be necessary to slacken the bolts off and open the corner joint in order to reseal the joint.

## 9.7 Ladders, platforms and access steelwork

- 9.7.1 Check all bolts for tightness.
- 9.7.2 Any bolts that are damaged or corroded should be replaced.
- 9.7.3 Severe damage from impact etc. should be either repaired or replaced as necessary.
- 9.7.4 Check for general condition of the galvanising or surface finish and touch up any defects as necessary.

## 9.8 Inspection of replaceable items

- 9.8.1 Perishes or badly distorted manway gaskets should be replaced as and when required.
- 9.8.2 Air vents should be checked routinely to ensure that there is adequate free flow of air for operation.
- 9.8.3 Pressure relief valves should be routinely checked by experienced personnel for operational safety.

### **Note**

*All mastic repairs require a minimum of 10 days to cure before re-filling. For temperature below 15°C (60°F) an extended period for curing will need to be allowed for. Please refer to the manufacturer's technical data sheet for further information.*

# INSPECTION AND MAINTENANCE REPORT

Distributor/customer \_\_\_\_\_

Project reference \_\_\_\_\_ Job No. \_\_\_\_\_

## TANK INFORMATION

Diameter(m) \_\_\_\_\_ Height(m) \_\_\_\_\_

Usage \_\_\_\_\_ Contents \_\_\_\_\_

Stainless steel grade \_\_\_\_\_ Mastic grade \_\_\_\_\_

Installation date \_\_\_\_\_

To be completed by the distributor/customer:

Internal inspection check list (See section 2 of this manual)	If problem identified, mark box with a ✓	If problems are identified, provide a brief description of the remedial work undertaken and provide photographic evidence of the repair
1 Inspect both the condition and finish of the concrete base for signs of cracks or erosion which may develop leakage.		
2 Check the tank to base joint perimeter seal to confirm adhesion of mastic to both tank wall and the base civils. Also check that the mastic seal is not showing any visual signs of deterioration.		
3 Check all tank wall and roof connections/cut outs and any other permanent fixtures (eg, flanges, manways and agitators, etc) for mastic application, damage and leakage.		
4 Inspect the condition of the stainless steel on the surface of the tank/roof panels and confirm that no defects are evident.		
5 Check the bolt caps and ensure mastic squeeze out around all bolt heads.		
6 Check the sheet edge mastic fillet to ensure protection of all tank/roof sheet edges and also confirm that the mastic is not showing any visual signs of deterioration.		
7 Inspect all joints to confirm that there are no visual signs of damage around/between bolts.		
8 Where a roof is fitted inspect the condition of the stainless steel around the interconnection/top angles and confirm that no evidence of damage exists.		

### Warning

Only authorised persons/contractors, adequately supervised, correctly equipped and trained in all aspects of the risks involved and the equipment to be used should be employed to carry out this inspection/remedial work.

Prior to commencing an inspection or entering part of the storage/process system, you must read this operation and maintenance manual and act accordingly.

### Note

Failure to complete the inspection (including any minor remedial works) and return this form within 14 months of installation will invalidate the warranty agreement.

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