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Transnet Pipelines

Specification No. PL 831/B

Specification for the Inspection of Aboveground Accumulator Tanks.

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TABLE OF CONTENTS

1. SCOPE

This specification covers Transnet Pipelines' requirements for the inspection of aboveground storage tanks. The evaluation and inspection are to be in accordance with API standard 653 / Latest.

2. TANK ROOF EVALUATION

2.1 The structural integrity of the roof and roof support system is to be evaluated.

2.2 The minimum average thickness of roof plates is 2.3 mm in any 645-cm^2 area (0.09 inch in any 100 square inch area).

3. FLOATING ROOF EVALUATION (FLOATING BLANKETS)

3.1 Roof plates and pontoons are to be checked for cracks, through-pitting and or punctures, in accordance with API standard 653 paragraph 2.2.3.

3.2 Roof support systems, perimeter seal systems, appurtenances such as anti - rotation devices, antistatic cables, water drain systems (if applicable) and venting systems are to be evaluated for needed repairs or replacements.

4. TANK SHELL EVALUATION

4.1 Distortions

Shell distortions include out of roundness, buckled areas, flat spots, and peaking and banding at welded joints. The possible cause of the distortion is to be ascertained and determined if the specific conditions are considered acceptable for continuing tank service and / or the extent of corrective action.

4.2 Flaws

Flaws such as cracks and laminations shall be thoroughly examined and evaluated to determine their nature and extent and the need for repair. All cracks in the shell to bottom weld are critical.

4.3 Shell Stiffeners (if applicable)

The condition (corrosion or the attachment welds to the shell) of the wind girders or shell stiffeners is to be determined.

4.4 Shell Welds

The condition of the tank shell welds shall be evaluated for suitability for service. Any deterioration of the existing welds that results from corrosion or pitting must be evaluated. The welds are also to be evaluated for cracks. In the case of the tank being fitted with a floating roof and flexible seals, the shell is to be inspected for excessive weld reinforcement.

4.5 Shell Penetrations

The condition of existing penetrations (nozzles, manholes, cleanout openings, etc.) is to be evaluated. Shell penetrations shall be reviewed for structural adequacy and compliance with API standard 650.

4.6 Shell Corrosion

4.6.1 Tank shell shall be evaluated for flaws, deterioration, scattered pits, and or corrosion in accordance with API standard 653 paragraph 2.3.1.

4.6.2 Each corrosion event shall be evaluated for suitability. The tank shell thickness shall be compared with the calculated minimum thickness in accordance with API standard 653 paragraphs 2.3.2 and 2.3.3. The results are to be included in the inspection report.

5. TANK BOTTOM EVALUATION

5.1 Evaluation of Tank Bottom Settlement

5.1.1 Edge Settlement

This is any settlement that has occurred around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction. The permissible settlement is to be determined in accordance with API standard 653, *Appendix B.*

5.1.2 Internal bottom settlements or bulges

The bulge or depression is to be measured. The permissible bulge or depression is to be determined in accordance with API standard 653, *Appendix B.*

5.1.3 Shell and Bottom Plate Settlements

5.1.3.1 These settlements are to be recorded by taking elevation measurements around the tank circumference and across the tank diameter, in accordance with API standard 653, *Appendix B*.

5.1.3.2 Shell settlement shall be evaluated to determine if they are the result of either one or a combination of the following components:

(a) Uniform settlement, which induces stress in piping and tank shell attachments.
(b) Rigid body tilting of tank (planar tilts), which increases hoop stress in the tank shell.
(c) Out-of-plane settlement, which induces additional stress and can cause ovality.

5.1.3.3 The graphical representation of the tank shell settlement is to be developed in accordance with API standard 653, *Appendix B*.

5.2 Tank Foundation Evaluation

The foundations are to be examined for settlement, erosion, cracking and deterioration of concrete initiated by: calcimining, attack by underground water, attack by frost, and attack by alkalies and acids, in accordance with API standard 653 paragraph 2.5.

5.3 Annular Plate Ring

The annular plate is to be inspected for uniform loss of metal, in accordance with API standard 653 paragraph 2.4.8.2 and table 2.3.

5.4 **Tank Bottom Plate Evaluation**

5.4.1 Magnetic flux leakage (MFL) floor scanners and manual Ultrasonic Thickness (UT) test methods shall be used to survey the tank bottom.

5.4.2 The MFL method is to be done without removing the tank floor coating. If the MFL method show signs of severe corrosion both on bottom surface and underside, then the usage of the ultrasonic testing shall be required on that area to confirm the MFL survey of the tank bottom.

5.4.3 Tenderers to supply details of the inspection technique and rates per tank for each method of inspection. Equally effective or better methods of inspection can also be offered as an alternative at the time of tender.

5.4.4 The minimum bottom plate thickness is to be determined in accordance with API standard 653 - 2014 table 4-4.

5.5 **Tank Bottom Lining**

The lining is to be examined for discontinuities using the holiday test method. For thin linings, holiday testing should be performed with a low voltage (67,5 volts) wet sponge detector. The possible cause and extent of any failure must be established and recorded.

6. RECORDS

The inspection records are to include all measurements taken, the condition of all parts inspected, and a record of all examinations and tests. A complete description of any unusual conditions, with recommendations for correction of details that caused the conditions shall also be included. The report shall be compiled as follows:

- Cover
  - Contractor Name
  - Contract number
  - Depot
  - Tank number
  - Tank Asset number
  - Inspection Date
- Index
  - Summary
    - Examination of Plant
    - Nature of tests performed
    - Overview of results
    - Observations or Pertinent findings
  - Tank Bottom plates scanned by MFL Scanner, capable to distinguish between top and bottom side defects and 10% of MFL results cross-checked by UT. (MFL Sketches and details)
  - Magnetic Particle Inspection of floor plate T-joints, 100% sump, internal nozzles and shell to floor plate including first strake welding
  - Vacuum box inspection of all floor welds and shell to floor welds, where applicable. If tank floor is coated, ACFM inspection of welds to done.
  - AUT Scanning (C-Scan) of shell and Roof (B-Scan) using crawlers.

- EODR Tank Survey for settlement survey in accordance with API 653 Annexure B
- Details of repairs (if any)
- API 653 checklist, Visual Inspection and Remaining Life calculations, findings and recommendations

7. REPORT

The contractor must provide a report with the Records as outlined in Section 6 above.
There must be one hard copy (PDF) and one soft copy.

7.1 Internal Inspection

In addition to the information required in Section 6 above, the report shall include the following:

7.1.1 The information on bottom and shell thickness assessments determined by using the ultrasonic sensor, and or magnetic flux leakage test.

7.1.2 The drawings for the tank floor drawn to scale and showing all the defects on the bottom plates. The size of the drawings shall be A3 page minimum.

7.1.3 The estimated inspection intervals determined by the anticipated corrosion rates based on experience with tanks in similar service.

7.2 General Inspection

7.2.1 The inspection report recommending repairs shall include reasons for the repairs, and sketches showing location of the defects and the extent.

7.2.2 General inspection report shall include metal thickness measurements, conditions found, repairs, any settlement measurements, and recommendations

TANK OUT-OF-SERVICE INSPECTION CHECKLIST			
Item		**Completed**	**Comments**
1.	**OVERVIEW**		
(a)	Check that tank has been cleaned, is gas free and safe for entry		
(b)	Check that the tank is completely isolated from product lines and all electrical power.		
(c)	Check that roof is adequately supported, including fixed roof structures and floating roof legs.		
(d)	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges etc.		
(e)	Inspect for slipping hazards on the bottom and roof decks.		
(f)	Inspect structural welds on access ways and clips.		
(g)	Check surfaces needing inspection for a heavy-scale build-up and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting.		
2.	**BOTTOM INTERIOR SURFACE**		
(a)	Visually inspect and randomly perform the ultrasonic test on the entire tank bottom.		
(b)	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered etc.).		
(c)	Mark areas requiring patching or further inspection.		
(d)	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld.		
(e)	Locate and mark voids under the bottom.		
(f)	Record bottom data on a layout sketch using the existing bottom plates as a grid.		
(g)	Vacuum test the bottom lap welds. (only applicable for new welds or modifications)		
(h)	Hammer test or ultrasonically examine any slightly discoloured spots or damp areas.		
(i)	Check for reinforcing pads under all bottom attached clips, brackets and supports.		
(j)	Inspect floating roof leg pads for pitting or cutting and excessive dimpling (indicating excessive loading).		
(k)	Check the column bases of fixed roof supports for adequate pads and restraining clips. (If applicable).		
(l)	Identify and report low areas on the bottom that do not drain adequately.		
(m)	Inspect coating for holes, disbonding, deterioration and discolourisation.		
3.	**SHELLS**		
3.1	**External Visual Inspection**		
(a)	Visually inspect for paint failures, pitting and corrosion		
(b)	Clean off the bottom angle area and inspect for corrosion and thinning on plate and weld.		
(c)	Inspect the bottom-to-foundation seal for condition, if any.		

TANK OUT-OF-SERVICE INSPECTION CHECKLIST - Continued		
3.2 Shell Seams and Plate		
(a) On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water).		
(b) Measure to the depth of pitting on each course.		
(c) Inspect for vertical grooving damage from seal assembly protrusions.		
(d) Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space).		
(e) Inspect existing protective coatings for damage, deterioration and disbonding.		
(f) Visually inspect the shell plates and seams for indications of leakage.		
(g) Survey the tank shell to check for roundness and plumb.		
4. ROOF INTERIOR SURFACE		
4.1 **General**		
(a) Visually inspect the underside surface of the roof plates for holes, scale build-up and pitting.		
(b) Hammer test or ultrasonically examine to check for thin areas, particularly in the vapour space of floating roofs and at edge of roof on cone roof tank.		
(c) Check all clips, brackets, braces etc. welded to the roof deck (plate) for welded reinforcing pads and see that they have not broken free.		
(d) If no pad is present, penetrant tests for cracking of the weld or deck plate.		
(e) Inspect protective coating for break, disbondment and deterioration (if applicable).		
4.2 **Fixed Roof Support Structure**		
(a) Inspect the support columns for thinning in the upper two feet. (If applicable).		
(b) Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad.		
(c) Inspect and gauge rafters for thinning, particularly near the centre of the roof. Report metal loss.		
(d) Check for loose or twisted rafters.		
(e) Inspect girders for thinning and check that they are attached securely to the top of the columns. (If applicable)		
5. FIXED ROOF APPURTENANCES		
5.1 **Inspection and Light Hatches**		
(a) Inspect the hatches for corrosion, paint and coating failures, holes and cover sealing.		
(b) On loose covers, check for a safety chain in good condition.		
(c) On light hatches over 30 inches across, check for safety rods.		
(d) Inspect the condition of the gaskets on bold or latched down hatch covers		

TANK OUT-OF-SERVICE INSPECTION CHECKLIST - Continued		
5.2 **Breathers and Vents**		
(a) Inspect the breather		
(b) Inspect screens on vents and breathers		
5.3 **Sample Hatch**		
(a) Inspect sample hatch for corrosion		
(b) Check that the cover operates properly.		
(c) If the tank has no gauge well, check for a hold of distance marker and check measurement.		
(d) Test operation of the system.		
6. FLOATING ROOF (if applicable)		
6.1 **Floating Roof Pontoons (float)**		
(a) Visually inspect each pontoon (float) for liquid leakage.		
(b) Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open.		
(c) Inspect lockdown latches on each cover.		
(d) Check and report each pontoon is :		
(1) Vapour tight (bulkhead seal welded on one side on bottom, sides and top).		
(2) Liquid tight seal welded on bottom and sides only, or		
(3) Unacceptable (minimum acceptable condition is liquid tight).		
6.2 **Floating Roof Supports**		
(a) Inspect fixed low and removable high floating roof legs for thinning.		
(b) Inspect for notching at bottom of legs for drainage		
(c) Inspect for leg buckling or felling at bottom.		
(d) Inspect pinhole in roof guide for tears.		
(e) Check that all legs are plumb.		
(f) Inspect for adequate reinforcing gussets on all legs through a single portion of the roof.		
(g) Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck place on the underside.		
6.3 **Floating Roof Seal Assemblies**		
(a) Inspect hanger attachment to roof rim for thinning, bending, broken welds and wear of pinholes.		
(b) Inspect clips welded to roof rim for thinning.		
(c) Shoes-inspect for thinning and holes in shoes.		
(d) Seal fabric-inspect for deterioration, stiffening, holes, and tears in fabric.		
(e) Inspect shoes for damage caused by striking shell nozzles, mixers etc.		
6.4 **Floating Roof Appurtenances**		
6.4.1 Roof Manholes (if applicable)		
(a) Inspect walls of manholes for pitting and thinning.		
(b) On tanks with interface auto gauges. Check seal around gauge tape cable and guide wires through man way cover.		
TANK OUT-OF-SERVICE INSPECTION CHECKLIST - Continued		

	(c) Inspect cover gasket and bolts.		
6.4.2	Vacuum Breaker (if applicable)		
	(a) Check operation of breather valve.		
6.4.3	Drain System		
	(a) Inspect for thinning and pitting.		
	(b) Inspect for scale/debris plugging		
7.	**MECHANICAL GAUGE SYSTEM**		
(a)	Check float for leakage.		
(b)	Test float guide wire anchors for spring action by pulling on wire and releasing.		
(c)	Check that the gauge tape is firmly attached to the float.		
(d)	Inspect the tape cable and float guide wire fabric seals through the float well cover.		
(e)	Inspect the bottom guide wire attachment clip.		
(f)	Inspect board-type auto gauge indicators for legibility and freedom of movement of indicator.		
(g)	Identify floating roofs where the tape is connected directly to the roof.		
(h)	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation. (If applicable)		
8.	**COMMON TANK APPURTENANCES**		
8.1	**Gauge Well**		
(a)	Inspect gauge well guide in floating roof for pitting and thinning.		
(b)	Inspect the guide rollers and sliding plates for freedom of movement.		
(c)	Inspect condition of gauge well pipe seal system.		
8.2	**Sampling Systems : Roof Sample Hatches**		
(a)	Inspect roof mounted sample hatches for reinforcing pads and cracking.		
(b)	Inspect cover for operation.		
(c)	Inspect visible portion of the gauge well for thinning, size of slots, and cover condition.		
(d)	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches.		
(e)	Inspect the sealing system on the internal floating roof sample hatch cover (if applicable)		
8.3	**Man ways and nozzles**		
(a)	Inspect for cracks or signs of leakage on weld joint at nozzles, man ways and reinforcing plates.		
(b)	Inspect for shell plate dimpling around nozzles, caused by excessive pipe deflection.		
(c)	Inspect for flange leaks and leaks around bolting.		
(d)	Inspect sealing of insulation around man ways and nozzles.		
(e)	Check for inadequate man way flange.		
8.4	**Shell Nozzles**		
(a)	Inspect shell nozzles for thinning and pitting.		
(b)	Inspect hot tap nozzles to trimming of holes. (If applicable).		
TANK OUT-OF-SERVICE INSPECTION CHECKLIST - Continued			

8.5	**For Nozzles Extended into the Tank**		
(a)	Inspect pipe support pads welded to tank bottom.		
(b)	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate.		
(c)	Inspect nozzle valves for packing leaks and damaged flange faces.		
(d)	In internal elbow-down fill line nozzles; inspect the wear plate on the tank bottom.		
(e)	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapour space. Inspect impact area for erosion.		
8.6	**Diffusers**		
(a)	Inspect diffuser pipe for erosion and thinning.		
(b)	Check holes in diffuser for excessive wear and enlargement.		
(c)	Inspect diffuser supports for damage and corrosion.		
(d)	Check that diffuser supports restrain, not anchor, longitudinal line movement.		
8.7	**Tank Piping Manifolds**		
(a)	Inspect manifold piping, flanges, and valves for leaks.		
(b)	Inspect fire fighting system components.		
(c)	Check for anchored piping which would be hazardous to the tank shell or bottom connections during earth movements.		
9.	**ACCESS STRUCTURES**		
9.1	**Handrails**		
(a)	Inspect for pitting and holes, paint failure.		
(b)	Inspect attachment welds.		
9.2	**Platform Frame and Grating**		
(a)	Inspect frame for corrosion and paint failure.		
(b)	Inspect the attachment of frame to supports and supports to tank for corrosion and weld failure.		
(c)	Check reinforcing pads where supports are attached to shell or roof.		
(d)	Inspect the surface that deck place or grating rests on, for thinning and holes.		
(e)	Inspect grating for corrosion-caused thinning of bars and failure of welds.		
9.3	**Stairway**		
(a)	Inspect spiral stairway for corrosion, paint failure and weld failure.		
(b)	Inspect stairway supports to shell welds and reinforcing pads.		
(c)	Inspect steel support attachment to concrete base for corrosion.		
10.	**FOUNDATION**		
	Measure foundation levelness and bottom elevations (see Appendix B for extent of measurements).		
	TANK OUT-OF-SERVICE INSPECTION CHECKLIST - Continued		
10.1	**Concrete Ring**		

(a) Inspect for broken concrete, spalling, and cracks, particularly under backup bars used in welding butt-welded annular rings under the shell.		
(b) Inspect drain openings in ring, back of waterdraw basins and top surface of ring for indications of bottom leakage.		
(c) Inspect for cavities under foundation and vegetation against bottom of tank.		
(d) Check that runoff rainwater from the shell drains away from tank.		
(e) Check for settlement around perimeter of tank.		
10.2 **Asphalt**		
(a) Check for settling of tank into asphalt base which would direct runoff rainwater under the tank instead of away from it.		
(b) Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.		
10.3 **Oiled Dirt or Sand**		
Check for settlement into the base that would direct runoff rainwater under the tank rather than away from it.		
10.4 **Rock**		
Presence of crushed rock under the steel bottom usually results in severe underside corrosion. Make a note to do additional bottom plate examination (ultrasonic, hammer testing, or turning of coupons) when the tank is out of service.		
10.5 **Site Drainage**		
(a) Check site for drainage away from the tank and associated piping and manifolds.		
(b) Check operating condition of the dike drains.		
10.6 **Housekeeping**		
Inspect the area for build-up of trash, vegetation and other inflammable build-up.		