



# Instruction Manual Fuel Storage Tank Erection Procedure

Client: Peyvand Golestan Cement Co.

Consultant: IID Co.

Department: Heavy Fuel Oil Storage Tank



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## ۱) SCOPE

This specification covers the construction requirement for field erection of welded steel *fixed roof storage tank(s)* owned by Peyvand Golestan Cement Co.

## ۲) APPLICABLE CODE AND DOCUMENTS

The requirements of latest editions of following standards and codes, including Supplements or addenda there to, form a part of this specification and to the extent indicated Herein.

API Standard: ۶۵۰ (Ed. ۱۹۹۸).

ASME Section v: nondestructive examination.

ASME Section IX: Welding & brazing qualifications.

IID shop drawings approved by Peyvand Golestan Cement Co.

IID welding specification procedure approved by Peyvand Golestan Cement Co.

## ۳) GENERAL

۳-۱) Unless otherwise specified tanks shall be erected, tested and inspected in accordance with API STD. ۶۵۰. As modified herein.

۳-۲) Field erection shall conform to the requirements specified herein and applicable construction drawing.

When any requirements are stipulated in this specification and drawing call upon the same requirements. If any conflict exists between this specification and the drawings, it shall be Reported to client's supervisor and shall be solved by contractor under supervisor of Peyvand Golestan Cement Co. or Peyvand Golestan Cement Co. Authorized representative.

۳-۳) all materials and equipment delivered to the work site shall be carefully checked for quantity, size and specification with shipping documents and drawings, and shall be stored properly.

۳-۴) Handling of materials and equipments shall be performed carefully so as not to damage or lose them.

۳-۵) All temporary materials, equipment, and jigs to be used for erection work shall be carefully checked and adjusted before using them.

## ۴) DIMENSIONAL INSPECTION OF FOUNDATION

The foundation shall be checked carefully to examine shape, height, slope and level in accordance with below method to keep the tank true roundness to maintain buckle free bottom the foundation, accuracy is very importance. For this reason the foundation shall be checked, not only at the commencement of erection, but also at the various stages of tank erection.

#### ۴-۱) Center of the foundation

The spots in orientation of  $0^{\circ}$ ,  $90^{\circ}$ ,  $180^{\circ}$  &  $270^{\circ}$  must be exactly marked in external wall of foundation as per the relevant drawing.

By stretching wire between  $0^{\circ}$  -  $180^{\circ}$  and also  $90^{\circ}$ - $270^{\circ}$  (as below), the intersection point will be determined as center of the Tank.

#### ۴-۲) Radius of tanks pad

Radius of tanks pad shall be checked with a tape measure from the tank center.

#### ۴-۳) Slope of tank foundation

The shape of tank foundation shall be properly slope up or down as specified in foundation construction drawing.

#### ۴-۴) Level of foundation

The level shall be measured at equally spaced points and the level tolerance does not exceed ( ۳ mm in any ۱۰m of arc length or +۱mm ( -۱۳mm) between any ۲ point the tank ring.

### ۵) BOTTOM PLATES

#### ۵-۱) Arrangement of annular & bottom plate

۱) For arranging the annular & bottoms plates, care shall be taken not to damage the foundation. Piano chords shall be stretched out on the  $0^{\circ}$  -  $180^{\circ}$  and  $90^{\circ}$  -  $270^{\circ}$  the chords shall serve the datum lines in arrangement of the bottom plates, and mark – off the position of annular plates on the foundation, after being laid out. Plate lay-down should start from the outer circumference of tank toward the center.

\*\*\* Before arranging annular plates, back strips should be attached to underside of them as per the drawing, and then surface and surrounding of the weld should be cleared of weld troubles and other surface troubles. \*\*\*

۲) The overlap of bottom plates may be in excess of the dimensions on the drawing due to shrinkage of welding.

۳) Outer diameter of annular plate may be arranged in excess of the dimension in the drawing plus ۱۵ to ۲۵mm may be expected.

۴) After arrangement, tack welding shall be done about ۲۰۰ mm pitch and min. ۲۰ mm long.

۵) Arrangement of annular plates shall be done from ۰° point in clockwise direction due to settlement of annular plates.

۶) Preparation of there-plate lap joint shall cutting off work of top plates in accordance with follows.

When plate corners are flame-cut, take care not to damage the lower plate. Fit up shall be performed after take welding. Take weld for bending must be removed prior to permanent welding.

#### ۵-۲) Proper welding of annular plates

a. Principally, the welding must be started from the center of the tank toward the circumference.

b. After cleaning the roof opening the first pass of manual welding shall be by intermittent method with a pitch of about ۳۰۰ mm. on the second or further passes, continuous welding may be adopted.

c. Welding of annular Plate joints where shell plates are located, shall be completed and root welding shall be cleaned by grinding, etc.

d. Complete proper welding of annular plate to the extent of about ۳۰۰ mm long from periphery and welding seam welding seam to flat with grinder to the extent of ۱۵۰ mm long from periphery.

#### ANNULAR PLATE

Distortion-restraint jigs, such as strong back, key nut, etc shall be installed on annular plates before welding start.

## ANNULAR PLATE TESTS

Dimensional check shall be carried out before fit up and after fit up of annular plates and after welding radiographic test should be carried out according to paragraph ٦,١,٢,٩ of API ٦٥٠ that explained below. Suitable to annular type of this project (single welded butt joint with backup bar)

one spot radiograph shall be taken on ٥٠٪ of radial joints. Extra care must be exercised in the interpretation of radiographs of single welded joints that have a permanent backup bar. The minimum radiographic length of each radial joint shall be ١٥٠mm from outer edge of the joint where the shell plate and annular plate jointed. also roundness of annular plates shall be checked at four main quadrant points.

## BOTTOM PLATE JOINTS

Before welding start distortion-restraint jigs and appliance such as wedges and channels, shall be installed on the bottom pieces as shown. Arrangement and setup of bottom plates shall be done from tank circumference to center.

## VACUUM TEST

The completed welds shall be vacuum tested by vacuum box using soap suds. Vacuum pressure of the Vacuum box should be ٧ psig and over.

## ٦) INSTALLATION OF SHELL COURSES

٦-١) Prior to the assembly of the shell plates, the shell circular line shall be marked on the bottom annular plates or ring wall for erection. The radius marking should be large than the drawing considering the slope of foundation.

After marking, locate each shell plate joints on the shell circular line.

At the same time, reference line (gauge line) shall be marked ١٠٠mm inside the shell circular for later shell plate roundness. Temporary support on shell plates may be used as follow. Additional care shall be done during grinding and removal of all welded supports on shell plates.

ASSMEBLY of the course plates

- ۱) Shell plates shall be hung up and set at the position by crane, etc. using proper tools to save shell plates curvatures. After flush setting appliance are attached on the ground. In parallel with the plate positioning, the plates shall be flush-set and temporally assembled using strong back key plates.
- ۲) Temporary assembly between the ۱<sup>st</sup> course shell plates and the annular plates shall fixed by the metal clips for guide as shown. No tack welding shall be applied.
- ۳) After the ۱<sup>st</sup> shell course erection, if the shell plate appears to be lapped, gap correction shall be made for plates.
- ۴) After the erection, but before welding, ۱<sup>st</sup> shell course plate's roundness, level and plumpness shall be checked and adjusted to within tolerance shown in table one.

**ROUNDNESS TABLE ۱**

DIAMETER RANGE(m)	RADIUS TOLERANCE(mm)	REMARKS
۰-۱۲ exclusive	$\pm ۱۲,۷$	
۱۲-۴۵ exclusive	$\pm ۱۹$	
۴۵-۷۶ exclusive	$\pm ۲۵,۴$	
۷۶- over	$\pm ۳۱,۸$	

Levelness:  $\pm 6\text{mm}$

Plumpness: Project Specification =  $> ۱/۲۰۰$  of the total height

- ۵) First course vertical welding must be completed prior to ۲<sup>nd</sup> courses erection for the upper shell course, the same erection procedure as for ۱<sup>st</sup> course shell plates will be applied.
- ۶) For erection of ۲<sup>nd</sup> and successive courses each point shall be shift to  $۹۰^\circ$
- ۷) Subsequent shell erection shall be done after completion of weld on the previous shell course.

۶-۳) proper welding of shell plate

۱) First pass of all the vertical manual welding shall be done from tank outside by back setup method of up-hill weld. All stage shall be cleaned by using hand brush before depositing next successive bead.

۲) After completion of second pass for the vertical welding, the first pass of the weld metal may be gouged or chipped from the tank inside.

۳) All vertical butt joint, weather square, single-vee or double-vee shall have complete weld penetration through the full thickness of the parent plate.

۴) All horizontal square, single, or double bevel butt joint shall have complete penetration through the full thickness of the parent plate.

۵) Welding of shell circumferential welds shall be done using four welders from four main quadrant points in clockwise direction. Erection of each shell course shall be completed in a day to prevent deformation of formed shell plates.

#### ۶-۴) Assembly criteria

۱) Allowable misalignments of shell plate point shall be as follows:

I) Vertical seam: Shall not exceed ۱.۰% of the plate thickness of ۱,۳mm whichever is the greater.

II) Horizontal seam: Shall not exceed ۲.۰% of the plate thickness of the upper plate or ۳,۲ mm whichever is the Smaller, However shall not exceed ۳,۲mm for the Plate thickness more than ۱۹mm.

#### ۶-۵) SHELL WELDS TEST

The required test for shell welds should be done according to requirements of API ۶۵۰ standards, project welding and radiographic procedure.

After finishing shell plate assembly, wind girder shall be assembled. Roundness, plumpness and levelness of shell courses shall be inspected in accordance to paragraph ۶,۲ of specification. For upper shell courses outer temporary cables shall be used to support plates.

#### ۷) TOP ANGLE AND WINDGIRDER INSTALLATION



#### ۷-۱) Top angle

۱) After assembling shell plate, tack welding to applied to top angle and at such time tack welding will be done to fit stiffening plate to the joint of top angle, by paying due attention to from the correct circle.

۲) When welding the vertical joint of the uppermost top plate, the vertical joint of top Angle shall be welded.

#### ۷-۲) Wind girder

۱) Since wind girders are prefabricated in true roundness, cutting shall not be used unless it is absolutely necessary. Upper shell course vertical seam radiography shall be done before erection of wind girder.

۲) Welding of wind girder joint shall be completed prior to horizontal welding. The horizontal fillet welding shall be done by skip weld method of about ۱۰۰ pitch, the successive passes may continuously weld. After compellation of above activities shell plate to annular plate welds may be done.

### SHELL – TO – ANNULAR WELD

First pass of shell to bottom weld should be done by back step method. In all stage and between all passes weld cleaning from stages and maximum Inter pass temperature should be considered until weld compellation. After proper welding of annular plate or of shell plates and annular plates, complete proper welding between annular plates and bottom plates shall be done.

During these stages following tests should be carried out according to paragraph ۵,۶,۷,۸ of API ۶۵۰.

- a. Visually examine the initial weld pass (inside or outside)
- b. Visually examine the finished joint welded surfaces, both inside and outside the shell.
- c. Examine either side of the finished joint weld surface by liquid penetrate and right angle vacuum box.

### ۸) FIX ROOF INSTALLATION

#### ۸-۱) FIX ROOF ASSEMBLING AND INSTALLATION

According to available crane capacity at site diameter of fix roofs, they may be assembled and welded in one or four part (circle or quadrant of circle) on the ground and then erected on structure or shell. For welding as usual back step welding and symmetric welding should be done to achieve to minimum distortion roof plates.

#### ۸-۲) ROOF TESTS

- a- Dimensional test for plates, arrangement and assembling
- b- Visual inspection for welding edges, each weld pass.

#### ۹) INSPECTION AND TEST

Inspection and items to be witnessed by Peyvand Golestan Cement Co.

The record/report of inspection and testing shall be submitted to client for review and approval. Inspection and testing of the shell, roof, bottom, steel structure and vacuum testing shall be done in accordance with API 650 Std. for welded ground storage tanks.

#### ۱۰) WATER FILLING TEST

۱) Check points before water filling test are as follows:

- a) All welding work shall be finished.
- b) All radiographic inspection shall be completed.
- c) Temporary piping for water test shall be completed.
- d) Cleaning inside of tank and removal of temporary jigs and tools are completed.
- e) All shell opening shall be closed by block valves or by appropriate cover plates.
- f) Deck manhole shall be opened.
- g) Level of foundation under shell plates shall be measured at specified point.

۲) Water filling rate shall protect urgent uneven settlement, water filling rate an hour shall be less than ۱ meter in height.

۳) Inspection during the water filling

- a) Settlement of the tank foundation where it is anticipated that an extraordinary settlement will occur and cause bad effect to the tank.
- b) Leakage of weld seam.

c) Function of level gauge, sealing system and others.

Nondestructive examination such as X-ray, PT and etc. shall be carried out in accordance with ASME section V.

As last, blind of manhole will be fastened and the tank with inspection book will be delivered to employer.

## ۱۱) Closing manholes and "Inspection book" submission

Inspection book should contain below objects:

- Cover sheet
- Index
- Quality control plan
- Drawings
- W.P.S & P.Q.R & W.Q.T
- N.D.T Personnel qualification records
- Radiography Test Report
- Visual and Dimensional Test Reports
- Hydrostatic Test Reports
- Name Plate Print
- Material Certification