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Guidance on Industry Standards for Welded Steel Atmospheric Tanks for Oil Storage

GIS 58-101

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 58-101. This Guidance on Industry Standards (GIS) is based on parts of heritage documents from the merged BP companies as follows:

British Petroleum

RP 58-1	Non-Refrigerated Petroleum and Petrochemical Storage.
GS 158-1	Internal Floating Decks for Storage Tanks.
GS 158-2	Vertical Storage Tanks for Non-Refrigerated Liquids.
RP 11-1-1	Atmospheric Storage Tanks.

Amoco

A FE-TK-00-E	Fabricated Equipment - Tanks - Engineering Specification.
A FE-TK-650B-P	Fabricated Equipment - Tanks - API 650, Appendix B, Foundation Procurement Specification.
A FE-TK-650E-P	Fabricated Equipment - Tanks - API 650, Appendix E, Seismic Design Procurement Specification.
A FE-TK-650H-P	Fabricated Equipment - Tanks - API 650, Appendix H, internal Floating Roofs - Procurement Specification.

ARCO

ES 900-97	Welded Oil Storage Tanks.
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1. Scope

- a. This Guidance on Industry Standards (GIS) provides guidance for atmospheric storage tanks for storage of hydrocarbons, made in carbon or carbon manganese steel, with diameter in excess of 15 m (50 ft) and uniformly supported base, with annular plates at base to shell junction.
- b. This GIS applies to tanks built to API Standard 650 and BS EN 14015, but use of other internationally recognised standards is not precluded if approved by appropriate BP Engineering Authority.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GIS 06-311	Guidance on Industry Standard for Cathodic Protection Goods and Services.
GIS 06-601	Guidance on Industry Standard for Painting of Metal Surfaces.
GP 30-25	Guidance on Practice for Field Instruments - General.
GIS 52-101	Guidance on Industry Standard for Insulation.

American Petroleum Institute (API)

API RP 652	Lining of Above Ground Petroleum Storage Tank Bottoms.
API Std 650	Welded Steel Tanks for Oil Storage.
API Std 653	Tank Inspection, Repair, Alteration, and Reconstruction.
API Std 2000	Venting Atmospheric and Low-Pressure Storage Tanks Nonrefrigerated and Refrigerated.

American Society of Mechanical Engineers (ASME)

ASME Sec IX	ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing.
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British Standards Institute (BSI)

BS EN 14015	Specification for the Design and Manufacture of Site Built, Vertical, Cylindrical, Flat-bottomed, Above Ground, Welded, Steel Tanks for the Storage of Liquids at Ambient Temperature and Above.
BS EN 288	Specification and Approval of Welding Procedures for Metallic Materials.

The Engineering Equipment and Materials Users Association (EEMUA)

EEMUA 159:2003	Users' Guide to the Inspection, Maintenance and Repair of Above Ground Vertical Cylindrical Steel Storage Tanks.
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International Organization for Standardisation (ISO)

ISO 9001 Quality Management Systems.

Process Industry Practices (PIP)

PIP STF05501 Details for Fixed Ladders and Cages.

PIP STF05521 Details for Angle Railings for Walking and Working Surfaces.

3. Terms and definitions

For the purposes of this GIS, the following terms and definitions apply:

annular plate

tank bottom peripheral plate supporting shell and to which shell is welded.

anti rotation device

guide pole(s) or cable system fixed to shell through pontoon of floating roof to prevent rotation.

approval

acceptance by BP.

BP will be defined at the time of order as BP or a contractor working on behalf of BP. The choice may vary depending on the type of equipment purchased or the individual site practices.

BP

BP p.l.c., associate, or subsidiary or other organisation as defined in Conditions of Contract for project.

coating

layer painted on or otherwise applied to surface for purpose of corrosion protection.

cone up/down

preformed shape of tank floor bottom.

corrosion allowance

thickness of material that can safely be allowed to corrode, having regard for operating environment and applied stresses.

curb angle (top angle)

reinforcement angle welded at top of shell.

design life

period during which item or component is intended to remain fit for service under specified design and operating process conditions.

double deck floating roof

floating roof structure with top and bottom deck and bulkheads forming compartments.

earthing lug/grounding lug

earth connection fitted to provide protection against static discharge.



emergency drain

drain on external floating roof tank, with upstand pipe to accommodate primary drain failure or overload or flanged nozzle if roof is in its landed position.

hose drain

flexible floating roof drain pipe.

internal floating cover

floating roof fitted inside fixed roof tank.

lining (or coating)

layer installed for internal corrosion protection on floor or shell.

may

indicates action that is recommended, but not mandatory, and requires confirmation.

normative

indicates section of code that should be complied with.

pontoon

tank roof flotation device, normally annular.

primary seal

main sealing device between floating roof and tank shell.

quality assurance

planned and systematic actions necessary to provide adequate confidence that product or service will satisfy given requirements for quality.

quality plan

document setting out specific quality practices, resources, and sequence of activities relevant to particular product, service, contract, or order.

quality system

organisation, structure, responsibilities, resources, and actions that together provide procedures and methods of implementation to ensure capability of organisation to meet quality requirements.

roof drain

device to remove (and prevent accumulation of) water from floating roof deck.

ring beam

concrete annular foundation ring.

sampling device

device to permit product sampling.

secondary seal

additional peripheral seal between floating roof and tank shell (to prevent vapour loss and rain water ingress).

shall

states mandatory requirement, deviation from which requires approval from BP.



shell

cylindrical wall of tank.

Vendor

person or organisation responsible to BP for design and/or supply of goods or services for complete project or installation, as well as organisation, purchaser, or agency that is contracted to provide vessel to BP.

weldment

weld, HAZ, and adjacent parent metal.

4. Symbols and abbreviations

For the purpose of this GIS, the following symbols and abbreviations apply:

CUI	Corrosion under insulation.
DN	Nominal pipe diameter.
Hv ₁₀	Vickers hardness measured with a 10 kgf indenter.
LFWN	Long forged weld neck flange.
MDMT	Minimum design metal temperature.
MT	Magnetic particle testing.
NDE	Nondestructive examination.
NPS	Nominal pipe size.
PMI	Positive material identification.
PQR	Procedure qualification record.
PT	Liquid or dye penetrant testing.
RT	Radiographic testing.
SMAW	Shielded metal arc welding.
UT	Ultrasonic testing.

5. General

- a. This GIS applies to all tanks within its scope.
- b. Conflict between this GIS and other contract or procurement documents, unless specifically stated as an exception, shall be submitted by Vendor to BP for written resolution.
- c. Foundations, leak detection, and cathodic protection may affect tank life but are not generally in scope of Vendor.



6. Codes and legislation

6.1. Codes

Design code and design life will be specified by BP.

Guidance on code selection is given in GP 58-10.

6.2. Legislation

Tanks shall comply with requirements of national or local authorities that apply at site where they are installed.

Customs and excise requirements shall be included, if applicable.

7. Safety in construction

Vendor and its workforce shall be familiar with BP's "Eight Golden Rules of Safety" and apply them at all times.

Tank Safety

The construction of new and the repair old storage tank should incorporate all of The BP Golden Rules of Safety.

International and national tank standards do not address safety in construction.

Fatalities have occurred while working on aboveground storage tanks. Some of these, for example, have been from working at heights. Complacency in all aspects of tank construction shall be avoided.

It is important that the tank constructor and the client proactively review tank safety at all times.

The Golden Rules will apply a more specific guidance in safety expectation. The use of risk assessments, certified equipment, competent, and authorised personnel is mentioned. We can see how they are linked with a basic guidance on our storage tank activities. Good housekeeping during construction or repair will reduce the probability of an accident.

Permit to work: *Cleaning and repair of tanks involve confined space entry. Foundation settlement and jacking problems can lead to ground disturbance.*

Hot works for repair are among the many activities requiring permit. All of the items below are linked with the permit to work.

Energy Isolation: *Ensuring there is no stored energy. The tank is safely blinded, and mixers are electrically isolated before removal. Compressors and welding plant are often used. These require frequent monitoring and maintenance.*

Ground disturbance: *Removal of tank floors on foundations other than concrete rafts or fully piled bases. The construction of new tanks, soil samples - history is required, as the tank may be constructed on a previously used plot. Underground hazards, e.g., electrical cables, pipelines.*

Cleaning a bunded area as a result of floor failure or overfilling.

Confined Space Entry: *This is closely linked with the permit to work. During, cleaning, maintenance, or inspection, a standby person is stationed at the manway or roof entry. In the event of an emergency, is supplied with an appropriate method of communicating to personnel (inside and out). Radios are often used for this.*

Working at Heights: *Review traditional methods of tank staging. Would the risk be reduced by jacking the tank?*

Daily examination of platforms and handrails by a competent person, ensuring compliance in the use of fall arrest equipment when required.



Shell course replacement, roof repair, and painting of the tank all require personnel to work from height.

***Lifting Operations:** Both construction and repair require the use of cranes, hoists, or other mechanical lifting devices. Lift methods should be previously determined and lifting devices certified. Many locations are situated on marshes or have poor local ground conditions. Ensure the ground is suitable for any heavy lifts.*

***Driving Operations:** This can often apply for activities *INSIDE* the tank, for example, tank cleaning. Vehicles delivering materials to a busy tank farm need to be aware of local conditions (bund walls, pipe tracks, ground conditions). Cranes (see lifting operations).*

***Management of Change:** The Golden rules mention the use of risk assessments conducted by all those impacted by such change. Some examples may apply to a change of service, redesigning of the roof, venting system, or foundation. Addition of nozzles, floating suction, or associated piping systems.*

8. Quality assurance

- a. Vendor shall operate quality system that is in accordance with relevant part of ISO 9001 or equivalent.
- b. Before start of fabrication, Vendor shall produce quality plan.
- c. Quality plan shall state:
 1. Quality related activities.
 2. Reference standards.
 3. Acceptance criteria.
 4. Names of responsible persons in Vendor. Spaces for signatures and dates relating to inspections shall be provided.

During the course of the contract, the following may be monitored through the quality plan:

- *Approval of any major subsuppliers.*
- *Approval of drawings, design data, procedures, and calculations.*
- *Latest issues of drawings and specification.*
- *Qualification of welders and NDT operators.*
- *Completion of approvals, clarifications, and quality related activities.*

- d. Quality plan shall be subject to BP approval.

9. Materials selection, corrosion allowance, and coatings

9.1. Materials selection

- a. For tanks in locations where lowest 1 day mean temperatures is equal to or lower than -30°C (-20°F), the following shall apply:
 1. Shell course plates and their plate accessories of 12 mm (1/2 in) or thicker shall be normalised.
 2. Tank bottom annular plate material shall be same as that used for its bottom shell course.
- b. Cast fittings or other components shall not be used in tank shell or bottom.
- c. Material without authentic test record shall not be used.
- d. Use of asbestos gaskets is prohibited.



- e. For tanks designed to codes other than API Std 650 and BS EN 14015, materials shall as a minimum comply with API Std 650, Paragraph 2.2.5 and Table 2-2.

9.2. Corrosion allowances

Internal and external corrosion allowances for base, shell, and roof will be specified by BP, based on anticipated service conditions.

Guidance on determination of the corrosion allowances is given in GP 58-10.

10. Design

10.1. General

10.1.1. Plating and curb angle

- a. Annular plates of sufficient size shall be ordered such that minimum of 75 mm (3 in) width projects beyond outside edge of weld attaching bottom to shell plate.
- b. There shall be no reduction in code requirement for internal projection of annular plate.
- c. Annular plate seals shall be applied to the external edge of the annular plate.

Annular plate seals can be mastic, mastic-backed metal flashing, or a combination of both. They can be effective in excluding water from reaching the tank bottom, however, they have a finite service life, and planning for periodic maintenance or replacement is required.

- d. Horizontal legs of curb (top) angle shall project outward.

10.1.2. Nozzles

- a. For nozzles DN 50 (NPS 2) and smaller, flanges shall be raised face, either slip on or weld neck.
- b. For process nozzles larger than DN 50 (NPS 2), raised face welding neck flanges are preferred.
- c. Minimum nozzle size shall be DN 40 mm (NPS 1-1/2) flanged connection.
- d. Unless specifically approved by BP, shell nozzles shall not be threaded.
- e. Use of stiffening ribs on nozzles shall be limited to only those cases in which it is shown by calculation that they are necessary.
- f. Ribs shall have drainage holes.
- g. Shell manholes shall be fitted in accordance with Table 1.
- h. Minimum manhole size shall be DN 750 (NPS 30).
- i. Manhole flanges shall be hubbed slip on type.



Table 1 - Number and location of shell manholes

Nominal tank diameter, D		Minimum number and location of shell manholes
m	ft	
$D \leq 42$	$D \leq 140$	One adjacent to main suction and fill nozzle and one at approximately 180° from first manhole.
$42 < D \leq 82$	$140 < D \leq 275$	One adjacent to main suction and fill nozzle and two at approx. 120° and 240° from first manhole.
$82 < D$	$275 < D$	One adjacent to main suction and fill nozzle and three at approximately 90°, 180°, and 270° from first manhole.

- j. Flat face slip on flanges may be used for interior piping.

10.1.3. Water drawoff

- At least one sump and water drawoff connection shall be provided.
- Location and design of sump depends on type of product.
- Sumps on crude oil storage shall comply with API Std 650, Figure 3-18.
- Sump may be any shape, provided it has volume at least equal to volume of sump specified in API Std 650.
- End of drawoff pipe shall be 100 mm (4 in) above bottom of sump.
- Minimum clearance of 150 mm (6 in) shall be provided between flange of sump and annular plates.
- Dished water draw off sumps in tank floors should be used when possible.

Sumps of the type of design shown in Figure 3-18 of API Std 650 promote coating failure and are difficult to repair and recoat because their geometry hinders the necessary access to the surfaces, particularly if the draw off pipe is in place. Figure O.5, BS EN 14015 shows the details of a dished sump. Experience with dished sumps has shown them to be much easier to maintain.

10.1.4. Flush type cleanout fittings

- BP will advise whether flush type cleanout fitting shall be provided.
- Size should be adequate to permit entry for equipment for sand/grit blasting or magnetic flux examination.

A flush type cleanout is an opening with liquid tight, bolted cover that is installed at the bottom of lowest shell course. The cleanout is located near or at low point of tank bottom. It is fitted if the stored liquid is expected to have large amount of sediment, and its primary purpose is to facilitate removal of bottom settlings after the tank has been emptied. It can also be used as an additional shell opening to provide access, light, and ventilation during erection, inspection, and repair of the tank.

10.1.5. Wind girders

- Wind girders shall be designed sloping downward with slope not less than 1:100.

This is to ensure that rainwater drains away from the tank shell.

- 40 mm (1-1/4 in) diameter drain holes on 1,5 m (5 ft) centres shall be located in wind girders close to shell.
- Wind girders that also serve as walkways shall be designed for additional load due to personnel.

