



GS 158-3

REFRIGERATED ETHYLENE STORAGE TANKS FOR CHEMICAL PROCESSING PLANT

October 1996

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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SCOPE AND PURPOSE This practice covers BP Chemical's minimum requirements for design, materials, shop and field fabrication, inspection, testing, cleaning, insulation and painting of "full containment" type ethylene tanks. This practice is a supplement to EEMUA 147 and tanks shall meet the requirements of EEMUA 147 as modified by this practice.											
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FOREWORD

Introduction to BP Group Recommended Practice and Specifications for Engineering

The Introductory volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

This Guidance for Specification is a supplement to [EEMUA 147](#) and is based on additional requirements developed from lessons learned within the specialist business.

Qualifications to Applicability

This Guidance for Specification although a Group document has been prepared and developed by BP Chemicals and is specifically designed for use in Chemical Plants.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity. It is to be used as a supplement to [EEMUA 147](#).

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Engineering Practices Group, Engineering Shared Service or the Custodian. See Quarterly Status List for contacts.



1. SCOPE AND PURPOSE

This practice covers BP's minimum requirements for design, materials, shop and field fabrication, inspection, testing, cleaning, insulation and painting of "full containment" type ethylene tanks.

1.1 Application of this Document

This practice is a supplement to [EEMUA 147](#) and tanks shall meet the requirements of [EEMUA 147](#) as modified by this practice.

2. QUALITY ASSURANCE

The following shall apply:

- The tank contractor shall operate a quality system based upon the principles of [ISO 9001](#) or an equivalent standard.
- The tank contractor shall submit his quality plan to the contractor with the bid. A quality plan prepared for a similar job, executed within the past two years may be sufficient at bid stage.
- After the award of the tank contract, the contractor shall prepare a detailed quality plan listing all construction and inspection on an item by item basis. The quality plan shall cover both shop and site activities.

As regards to traceability of materials, the following requirements shall govern:

- The tank contractor shall submit with his tender, his proposed traceability system. Such a system shall ensure that all tank materials and those materials attached to tank, are able to have their origins traced before, during and after fabrication.

As regards material certification, the requirement is:

- Only steel manufacturer's certificates are acceptable to tank materials including any items welded to the tank. Stockist certificates are unacceptable.

3. MATERIALS

3.1 Inner and Outer Tanks

The inner and outer tanks shall be of all welded construction and fabricated from 9% nickel steel. The steel shall meet the requirements



of type V material as defined in Section 5.0 of [EEMUA 147](#) and the following paragraphs:

- 3.1.1 The details of the grade of steel (including chemical composition and mechanical properties), supplier and production route shall be submitted with the contractor's tender. In general the steel shall be supplied in the quenched and tempered condition. Steels in the double normalised and tempered condition shall not be permitted. It should be noted that only improved grades of steel which have been produced to "clean steel" practice are acceptable.
- 3.1.2 The material used shall be capable of achieving a nil ductility temperature not higher than -145°C as measured by a drop weight test in accordance with [ASTM E208](#). Details of the orientation of the test piece and the frequency of the testing shall be submitted with the contractor's tender.
- 3.1.3 The specified transverse Charpy V notch impact requirements of the material shall meet the requirements of table 5.1.2 of [EEMUA 147](#). The thickness of the test pieces shall be the smaller of 20mm. or the maximum thickness of plate, including the compression ring, used for the tank.
- 3.1.4 The material shall exhibit adequate fracture toughness to meet the requirements of para. 5.2.1 (c).

3.2 Insulation

- 3.2.1 The load bearings insulation system beneath the base of the inner tank shall be installed by the vendor. The load bearing insulation system shall include cellular glass blocks - Foamglas R by Pittsburg Corning Inc. Grade HLB 115 or an equivalent. Each glass block layer shall be laid at 90° to the previous layer. An approved inorganic powder shall be used to fill the top and bottom surface of the glass blocks. PC85 by Pittsburg Corning or equivalent may be considered. Each glass block layer shall be separated from the other by an interleaving material.

Annular rings of perlite concrete or wood suitably impregnated to prevent loss of strength due to ingress of moisture may be used directly below the inner tank shells. The moisture content in perlite concrete to be restricted to 10% maximum, unless approved by BP.

- 3.2.2 The insulation system used in the annular space of the tanks shall consist of three annular layers made up as follows:
 - (a) A 'closed cell' foam structure type on the inside of the outer tank. The purpose of this insulation would be to prevent any



thermal shock on the outer shell should any leakage occur in the inner tank.

- (b) Insulation on the outer wall of the inner tank to minimise the compressive load exerted by insulation given in para. 3.2.2 (c) below.
- (c) Pearlite insulation between the above two annular layers.

3.2.3 The thickness, number and thermal properties of glass blocks in para. 3.2.1 and the thickness, thermal properties etc. of insulation in para. 3.2.2 shall be such that the product vaporisation due to the total heat gain through the outer wall including the bottom plate shall not be greater than 0.1% of the tank contents per day, when the ambient temperature is at 30°C. BP reserves the right to carry out a heat gain leak test within 18 months from the date of completion of the tank. If the test shows a heat gain of more than the guaranteed value of 0.1 % per day, the contractor shall pay liquidated damages.

3.2.4 Pipes and fittings which need to be insulated, whenever possible shall use preformed sections. Alternatively, foamed in-situ areas will be sectioned and surfaces prepared to permit future ease of removal. Cleating will be assembled with a soft compressible waterproof joining strip or compound.

3.3 Miscellaneous

3.3.1 The outer tank anchoring material (bolt or strap) shall be identifiable against mill certificates giving chemical analysis and mechanical properties.

3.3.2 Any components welded directly to the tanks shall be fabricated from material identical to that part of the tank to which the component is welded.

3.4 Material Traceability and Certification

3.4.1 As regards to traceability of materials, the following requirement shall govern:

- The tank contractor shall submit with his tender, his proposed traceability system. Such a system shall ensure that all tank materials and those materials attached to tank, are able to have their origins traced before, during and after fabrication.

3.4.2 As regards material certification, the requirement is:



- Only steel manufacturer's certificates are acceptable to tank materials including any items welded to the tank. Stockist certificates are unacceptable.

4. DESIGN

4.1 General

4.1.1 The tank shall be erected on an elevated piled concrete slab foundation. The top of the concrete shall be at an elevation of approximately 2.0 metres above the surrounding area. The foundation and tank shall be designed to withstand a full hydrostatic test of the tank.

4.1.2 Figure 1 provides the relative levels of normal max. level, HLA, HHLA etc.

The parameters used in the design of the tank shall be as follows:

Design pressure of vapour space	= 140 mbarg
Design external pressure of the outer tank	= -6 mbarg
Design temperature of tank	= -105°C/+50°C
Density of ethylene @ -105°C.	= 570 kg/m ³

4.1.3 The design of the inner tank shall be based on a product height to the maximum emergency level. However, it shall be noted that the hydrotest condition may govern the shell minimum thickness requirement. In which case, the design of inner tank shall be based on water fill to maximum emergency level, with the allowable stress not exceeding 85% of the yield or proof stress of the construction material.

4.1.4 Outer tank shall be designed for vapour pressure together with the equivalent height of product in the outer tank resulting from volume in the inner tank up to maximum emergency level, plus 0.5m. A check shall be made for test conditions with the allowable stress limit given in Para. 4.1.3. However, during hydrotest conditions, only one half of the design wind load needs to be considered.

4.1.5 The anchorage to resist uplift, due to internal gas pressure, wind or seismic forces shall be provided if there is a possibility for the shell and the adjacent bottom plate of the outer tank to lift off its seating under any conditions of operation or testing. No anchorage shall be provided for the inner tank.

4.1.6 The internal and external tanks shall be regarded as completely independent structures in which neither contributes anything to the other in the resistance to uplift.



- 4.1.7 The anchorage shall be attached to the shell and not to the bottom plate of the tank.
- 4.1.8 Anchor bars or straps shall have a minimum cross sectional area of 500mm². A corrosion allowance of 1mm shall be added to all surfaces or alternatively they may be made from corrosion resistant material.
- 4.1.9 Anchorage points shall be spaced at a minimum of one metre and at a maximum of 3 metres.
- 4.1.10 The tank design shall accommodate movements of the tank due to thermal changes and minimise induced bending stress in the shell.
- 4.1.11 The final welds or tightening of the anchor bolts shall be carried out when the tank is with water up to its design level.
- 4.1.12 The allowable stress limits for transient loading shall be as follows:

Component	Stress	Transient Loading	
		Wing Loading or OBE + All Other Loading	SSE + All Other Loading
Shell Plate	Tensile Stress	0.85 yield or Proof Stress	Yield or Proof Stress
	Compressive Stress	Para.E.5.3 of API 650	Lesser of Design Stress EEMUA 147 or (0.4 x Et/R)
Anchor	Tensile or Compressive Stress	0.85x Yield or Proof Stress	Yield or Proof Stress

OBE; Operating Basis Earthquake/SSE; Safe Shutdown Earthquake as defined in Appendix F, [EEMUA 147](#). E, t, R as defined in [API 650](#).

- 4.1.13 The contractor shall be responsible for providing a water deluge system fire protection for the tank. The system covering spray sizes and locations, automatic detection systems etc. shall be fully in accordance with [NFPA No. 15](#) - standard for water spray fixed system for fire protection. The main objective of the system shall be to keep the outer tank surfaces below 100°C under all environmental conditions.
- 4.1.14 The base insulation system described under para 3.2.1 shall be designed with a minimum safety factor of 3.0. The foamglass shall extend to the



full diameter of the outer tank unless other measures are taken to protect the perimeter. In any case the foamglass shall extend beyond the inner tank annular plate by a minimum of 400 mm.

4.2 Seismic Analysis

For installation in a region of seismic activity, a seismic analysis of the tanks and associated pipework shall be carried out. The inner tank shall be designed to avoid any anchoring. The method used for seismic analysis of the tanks shall be approved by BP at bid stage. For guidance the height/diameter of the tank should not be greater than 0.4.

4.3 Bottom Plates Design

4.3.1 The shell/bottom plate corner joint on both tanks shall be of the full penetration type weld.

4.3.2 The welded joints of the bottom plates of the outer tank shall be double pass welds. After the first pass, vacuum box testing shall be carried out. Any leaks or faults in the joint shall be made good prior to completion of the second weld pass.

4.3.3 The annular plates shall not be wider than 1000mm. All annular plates shall be ultrasonically inspected for laminations for a distance not less than 150mm from the outer edge and along the whole length. After examination each plate shall be stamped on its upper surface in a manner that would enable identification to be made even after the completion of construction. For this purpose only round nosed stamps shall be used.

4.4 Roof Design

4.4.1 The inner tank roof shall be a suspended deck type, supported from the outer tank roof and carrying insulation. The suspended roof shall be designed to support the following loads:

- Insulation
- Personnel and equipment during erection and maintenance
- Fittings
- Self weight of the structure
- Differential pressure of 24 N/m²

The minimum design superimposed load shall be taken as 1.4 KN/m² during erection and maintenance.

4.4.2 The design of the inner tank roof shall take into account the thermal contraction of the suspended roof system.



4.4.3 The outer tank roof, shall be domed in shape and self supporting. The outer tank roof shall be provided with a manway near the centre of the roof. Vertically below this manway, on the suspended deck roof, an access opening shall be provided. A permanent caged ladder shall be installed by the tank vendor to provide access from the manway to the access opening. A caged ladder or similar is required from the suspended deck to the bottom of the inner tank with rest platforms at 10 metres intervals.

4.4.4 The outer edge of the suspended deck shall be designed so that access can be gained to the annular space at not less than four equally spaced locations.

4.4.5 The outer tank roof plates shall be protected from possible impingement of liquid product by the provision of deflector plates extending beyond the tank perimeter.

4.5 Tank Pumps

4.5.1 The Contractor shall be responsible for the design and supply of the risers for the submerged pumps and for purging and lifting facilities to be installed on the roof of the tank to facilitate pump withdrawal for maintenance without the release of ethylene vapour. Provision shall be made to lower the pump to grade clear of the tank.

4.5.2 The potential for increasing pumpout rate by 100% at some future time will be incorporated in the tank design.

5. WELDING

5.1 General

5.1.1 The Contractor shall submit all welding procedure specifications for BP approval. Welding procedure qualification tests shall be carried out on the contract material. Pre-qualified welding procedures are not acceptable for this application.

5.1.2 Procedure qualification testing shall include all tests required by [ASME IX](#). In addition, a Vickers hardness survey shall demonstrate that 325 HV 10 is not exceeded at any point in the weldment.

5.1.3 The essential variables listed in [ASME IX](#) shall be applicable with the following additional requirements: For manual metal arc welding the electrode run out length shall be within a range of $\pm 20\%$ of that qualified in the procedure.



- 5.1.4 Consumables batch testing may be required depending on the composition of the consumables chosen.
- 5.1.5 Details of weld profiles for shell joints are given in Figure 5 of this Recommended Practice. Vertical joints in bottom shell courses shall be at least 300 mm away from any annular plate joint.
- 5.1.6 Butt welds between stiffening ring sections shall not be welded through to the shell. A mousehole shall be provided at each butt weld location and the weld between shell and stiffener continued through the mousehole. Butt welds joining ring stiffener sections shall be at least 150 mm away from any main shell seam.
- 5.1.7 Temporary attachments on the tanks shall be kept to an absolute minimum, and on removal the resultant scar shall be dressed smooth and subjected to a dye penetrant examination.

5.2 Additional Weld Acceptance Criteria

- 5.2.1 For welds in 9% nickel steel, welding procedure acceptance shall be based on the simultaneous achievement of the following requirements in addition to the requirements specified in other standards and specifications referred to herein.
- (a) A nil ductility temperature, not higher than -145°C at both weld metal and fusion line positions. This requirement may be waived by BP when austenitic filler materials are used.
 - (b) A Charpy V-notch impact value of 35 minimum average and 27J minimum individual at the weld metal centre line, fusion line, fusion line +2 mm and fusion line +5 mm all at -196°C . At each position, four specimens shall be considered.
 - (c) An equivalent K_{IC} value not less than $150\text{MNm}^{-3/2}$ resulting from a JIC testing in accordance with [ASTM E813](#). The location of testing and the number of specimens taken shall be as per para. 5.2.1 (b).

6. PIPING AND VALVES

- (a) The design and supply of piping and valves shall comply with the requirements of the project piping specification.
- (b) The piping connection at the roof shall only be fixed on the outer roof. The pipe penetration through suspended deck shall be left free.



- (c) The fixing of all piping connections at the outer tank shall be through a thermal sleeve. See Figure 3.
- (d) All piping shall be seamless and the wall thickness shall not be less than standard weight.
- (e) When nozzle necks are fabricated from welded pipe or plate the longitudinal butt welds shall be 100% radiographed.
- (f) All piping shall terminate with a flange external to the outer tank. The surface finish on all flanges shall be of the relevant project piping specification. All flanges shall be of the raised face weld neck type.
- (g) The possible interaction of differential settlement between the tank foundation and adjacent isolated pipe supports shall be taken into account.
- (h) Emergency shutdown valves shall be installed on all process lines to and from the tank.
- (i) As regards the safety relief valves and vacuum relief valves, the following requirements shall apply:
 - (i) The tank shall have one safety relief manifold located on the roof. One manifold shall relieve to atmosphere while the other to the vent/flare stack.
 - (ii) There shall be a minimum of three valves, each of 50% capacity, on the vent/flare stack manifold and all of the pilot operated type. The valves shall be installed between isolating valves which can be locked in either the open or closed position. The isolating valves shall be full bore ball valves flanged and drilled raised face. Gaskets shall be neoprene impregnated CAF, the valves shall be provided with an Ellis type of equivalent interlocking system so that at any time two valves would be left open.
 - (iii) There shall be a minimum of three valves, each of 50% capacity, on the atmosphere relief system manifold and the valves shall be of the dead weight type. Each valve shall be installed above an isolating valve which can be locked in either the open or closed position.
 - (iv) A minimum of four vacuum relief valves, each of 50% capacity, shall be provided for the tank.
 - (v) The design filling and withdrawal rates of the tank shall be taken as specified by the Contractor.



- (vi) Where appropriate, consideration shall be given to the need for cavity relief and the implications of unidirectionality. The performance of valves shall be demonstrated by cryogenic testing evidence.
- (vii) All gaskets used on flanges shall be Klingerit 1000 or equal. All manways and blind flanges shall be provided with two sets of spare gaskets.

7. CONNECTIONS

- (a) All connections to the inner tank shall be made through the roof. With the submerged pump design, there shall be no penetrations made through the inner tank shell and base.
- (b) One 24" NB manway, on the outer tank bottom strake, shall be provided. The need for local reinforcement shall be met by an integral thickened shell plate.
- (c) All shell (roof) to nozzle weld shall be of the full penetration type.
- (d) Provisions shall be made by the contractor for the installation, removal and maintenance of the product outlet submerged pumps.

8. INSTRUMENTATION

- (a) The instrumentation of the tank shall meet relevant project specifications.
- (b) All instrumentation and level gauges provided shall be clearly identified in the P&ID of the tank.
- (c) For all instrumentation, the contractor shall provide technical details and corresponding vendor information.

9. ELECTRICAL

The outer tank shall be provided with at least 3 earthing connections in accordance with BP Group [RP 12-16](#) Figure 5. The inner tank shall be connected to the outer tank by at least three flexible earthing connections.

The spiral stairway to the top of the tank, the top platform and other areas where personnel need access for maintenance, shall be provided with adequate lighting.



10. STAIRWAY, PLATFORM AND HANDRAILS

10.1 General Requirements

In addition to the requirement given below, stairways, platforms and handrails shall comply with the structural requirements of project civil specifications. Stair treads shall meet project specifications.

10.2 Stairway

The stairway to the top of the tank shall be a spiral type with the access tower as its axis.

10.3 Platforms

Platforms with access from the main stairway shall be provided such that necessary maintenance facilities to all accessories at the top of the tank can be provided. The design and coverage of this platform shall consider the safety of personnel working in the platform area.

11. SITE FABRICATION AND ERECTION

- (a) The method of construction shall be the erection of the outer tank and roof prior to installation of foundation insulation, followed by erection of the inner tank. Alternative procedures will be considered, but details of erection will be subject to BP approval.
- (b) No work shall be subcontracted out without the written approval from the contractor.

12. COMMISSIONING AND DECOMMISSIONING

- (a) A system shall be provided for purging the inner tank and outer annular space for both commissioning and subsequent in-service examination should the need arise.
- (b) Unless otherwise agreed with BP, an independent chill down system shall be provided for commissioning which will be separate from the normal operating fill system. Such a 'system' shall be removed from site after commissioning.
- (c) A low level pump-out provision shall be provided for emptying the tank prior to decommissioning.



13. ADDITIONAL INSPECTION

- (a) The inspection guidelines given under 7.1.5 of [EEMUA 147](#) shall be considered as mandatory. Ref. para. 7.1.5 (5) of [EEMUA 147](#), the following additional NDT tests shall be carried out:

- 100% Radiography on any welded joints in anchor straps.
- 100% Crack detection on anchor bolt attachments to shell.

All radiographic examination during fabrication shall be carried out with X-Ray equipment.

- (b) All plates for construction and test shall be surface inspected. Plates over 12mm thick shall be ultrasonically inspected by automatically recording equipment, transverse to the direction of rolling. The acceptance limits shall be as defined in [ASTM A578](#), acceptance level 1.

- (c) It shall be the responsibility of the contractor to maintain adequate inspection at tank vendor's works and erection site to ensure that the requirements of this Code and related documents are met. As a minimum the contractor's inspection scope shall cover the following activities:

- All activities covered under Para 7.1.5 of [EEMUA 147](#) and para 13. (a) above.
- Laying of base insulation.
- Position and squareness of termination point flanges.
- Cleanliness of inner tank, piping and annular space.
- Hydrotesting of tanks.
- Surface preparation and painting.
- Cleanliness and installation and operation of all safety relief (including vacuum valves) devices.

It should be noted that either the inspection by independent inspection authority or tank vendor's inspection is not a substitute for contractor's inspection.

14. PAINTING

- (a) All external surfaces of the outer tank shall be suitably prepared and painted in accordance with project painting specification after the testing of the tank is completed.
- (b) Specifically external surfaces of the outer tank and connected piping shall be blast cleaned to [BS 4232](#) second quality to match the pictorial standards shown in Swedish standard [055900 Sa 2½](#) . The tank surfaces shall then be primed with 2 coats of zinc phosphate, 2 pack epoxy primer, 65 microns dft per coat



and finished with 2 coats of micaceous iron oxide, 2 pack epoxy finish 75 microns dft per coat to give a total dry film thickness of 280 microns.

- (c) The paintwork shall be guaranteed for 5 years.

15. INDEPENDENT INSPECTION

BP shall nominate an Independent Inspection Authority (IIA) to carry out the inspection and testing of the tank together with necessary design approval. All cost incurred by IIA will be borne by BP. However, cost due to additional inspection resulting from tank vendor's/contractor's fault would be back-charged to the contractor. It shall be the tank vendors responsibility to submit necessary calculations, drawing, documents etc. to the IIA and receive the necessary approval. Also the tank vendor shall be responsible for arranging with the IIA to carry out the inspection at appropriate stages. It is to be noted by the tank vendor that BP shall be at liberty to carry out any inspection during the entire construction stage of the tanks.

As a minimum, the following inspection activities shall be carried out by IIA:

- (a) Before the start of any fabrication, all plates shall be examined and their certificates be checked against identification mark on materials. It is to be ensured that all materials are free from defects and that their thicknesses, other dimensions etc. are not less than those values in approved design calculations.
- (b) The detail of material properties listed in materials certificates shall be verified to ensure that they are not inferior to the requirements of the corresponding specifications of the material. Any additional requirements imposed by BP on material shall be taken into account.
- (c) All relevant weld procedures shall be approved.
- (d) Welder performance qualification certificates shall be reviewed. Welders shall be site qualified by the contractor's Site Welding Inspector. Acceptance will be on contract material based on X-ray examination.
- (e) All shell and roof plates shall be examined after forming.
- (f) The edges of all openings in shell and roof cut to incorporate nozzles shall be examined to ensure that they are free from any laminations.
- (g) Set up of weld seams shall be examined. The examination shall include edge preparation, alignment of plates, alignment of pipe welds etc.
- (h) All X-ray films shall be reviewed and unacceptable weld defects shall be reported.
- (i) 100% vacuum box testing and 100% crack detection shall be witnessed.



- (j) Installation of both shell insulation and bottom foam glass block insulation system shall be inspected.
- (k) Hydrostatic and leak testing per para. 8.0 of [EEMUA 147](#) shall be witnessed.
- (l) Details of nameplates shall be checked.
- (m). The contents of the construction dossier shall be reviewed for completeness and correctness.
- (n) A certificate of construction confirming that the design, construction etc. of the tank fully complies with the tank specification.

16. DRAWINGS AND SPECIFICATIONS

The contractor shall be responsible for supplying tank vendor's drawings and documents to BP. As a minimum the following documents need to be approved by BP:

- (a) Tank specification and quality plan.
- (b) Tank process/mechanical data sheet.
- (c) Enquiry requisition of the tank.
- (d) Purchase requisition of the tank.
- (e) Fabrication drawing to include procedure for foamglass block laying, inner and outer tank details, all connections, suspended deck and platforms together with stairway. All fabrication drawing where relevant shall include the thickness, specification and grade of all materials used including weld metal, design conditions, design code, weld procedures and their preparation, etc.
- (f) Detail mechanical calculation including seismic analysis and heat gain computation.
- (g) All welding procedures.
- (h) Repair procedures.
- (i) Test procedures.
- (j) Painting specification.



17. INFORMATION TO BE SUPPLIED BY THE CONTRACTOR WITH HIS TENDER

The contractor shall provide the following information with his tender:

- (a) Proposed tank vendor's list and their experience in the design and construction of similar type of tanks.
- (b) Contractor's standard technical specification for RLPG tanks.
- (c) Detail of quality system operated by tank vendor.
- (d) Preliminary diameter and height of both inner and outer tanks.
- (e) Design loadings (including internal and external pressure) of both tanks.
- (f) Type of safety valves and the names of suppliers.
- (g) Detail of materials and its source.
- (h) Scantling thicknesses.
- (i) Preliminary seismic analysis of the tank system.
- (j) Pump supplier's details, pump duty specification, number of pumps and arrangement.
- (k) Full technical specification of insulation (both foam glass blocks and shell insulation) their thicknesses.
- (l) P&ID and a schematic sketch of the tank system.
- (m) Process data sheet for tank with details of all connections.
- (n) All instrumentation data and the vendor list for instrumentation.
- (o) Proposals for the removal of liquid in the annular space of the tank resulting from ental spillage failure of the inner tank.
- (p) Synopsis of the deluge system provided.
- (q) Details of access opening on suspended deck.
- (r) Schedule for design, construction and commissioning of the tank.
- (s) Proposals for filling and removal of Perlite insulation.



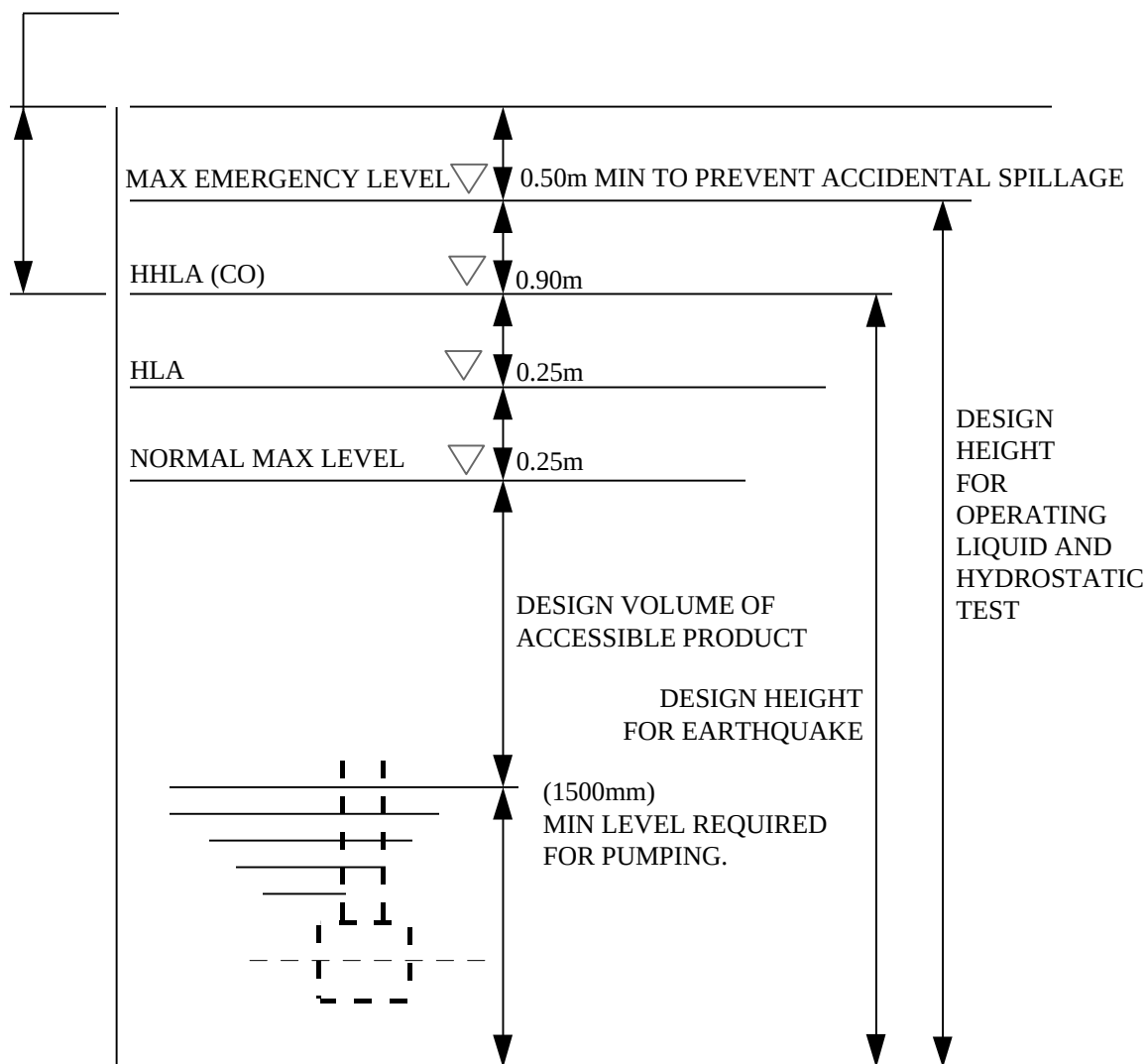
18. TANK DOSSIER

Before the tank is handed over to BP, the contractor shall be responsible for providing BP with the required number of tank dossiers, as specified in the contract documents. As a minimum, the dossiers shall contain the following information:

- (a) IIA design approval letter and certificate of acceptance of the tank.
- (b) Approved fabrication drawing.
- (c) Material identification chart.
- (d) Set of design calculations approved by IIA.
- (e) Radiograph identification chart.
- (f) Approved repair procedures.
- (g) Radiograph report.
- (h) Welder/seam identification chart.
- (i) Qualified welding procedure specifications.
- (j) Welder qualifications.
- (k) Weld crack detection report.
- (l) NDT personnel qualification.
- (m) Pressure test report and vendor's certificate.
- (o) Nameplate rubbing.



HEIGHT TO CONTAIN PRODUCT IN EARTHQUAKE. *



* NOT LESS THAN SLOSHING HEIGHT UNDER SEISMIC LOADING

FIGURE 1
INNER TANK LEVEL REQUIREMENTS



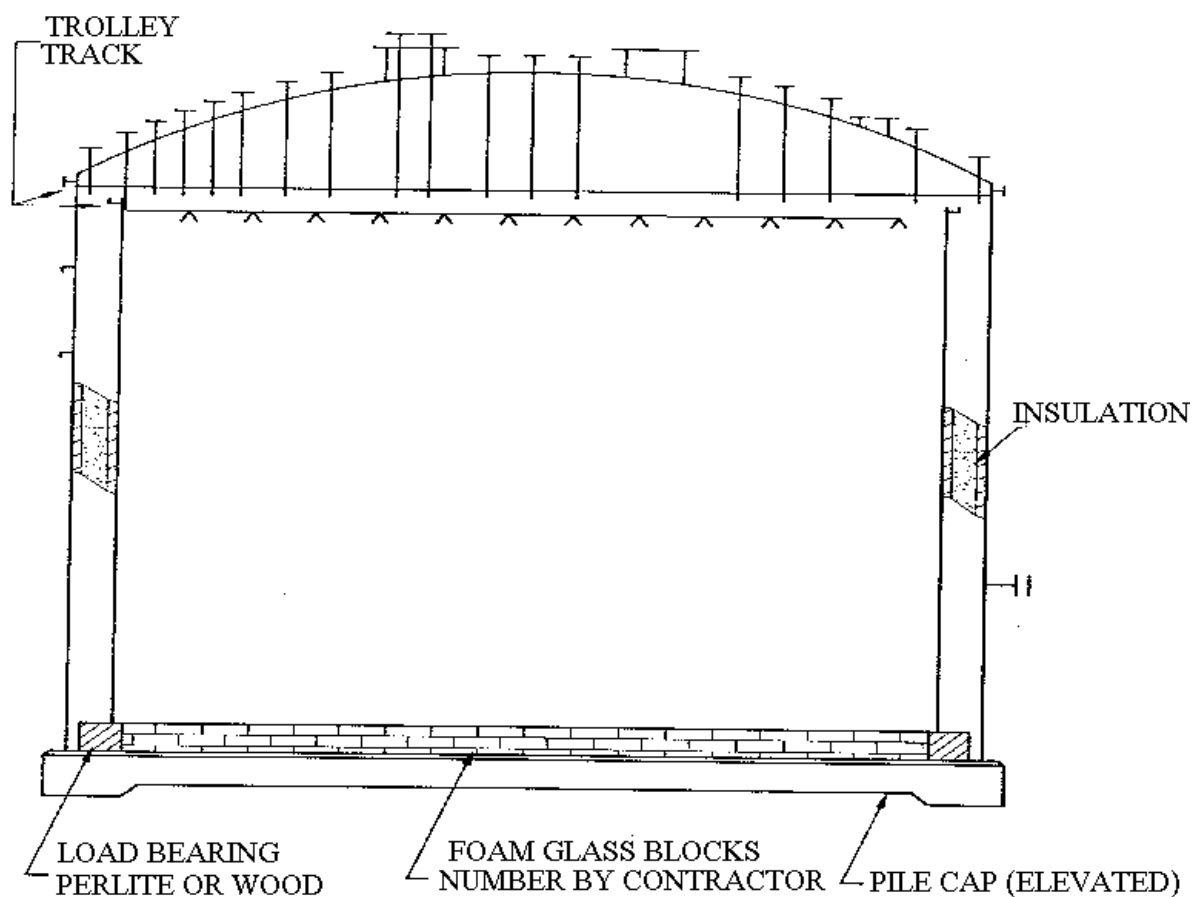


FIGURE 2
SCHEMATIC SKETCH OF TANK

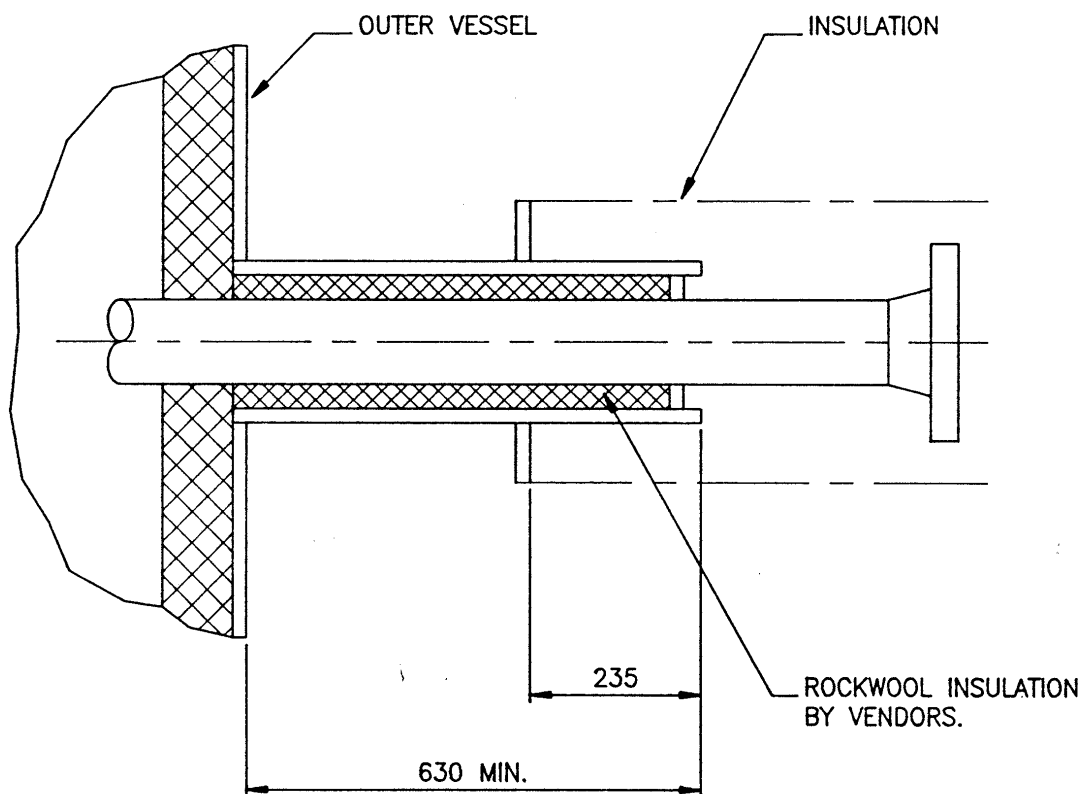


FIGURE 3
TYPICAL THERMAL SLEEVE ON NOZZLES

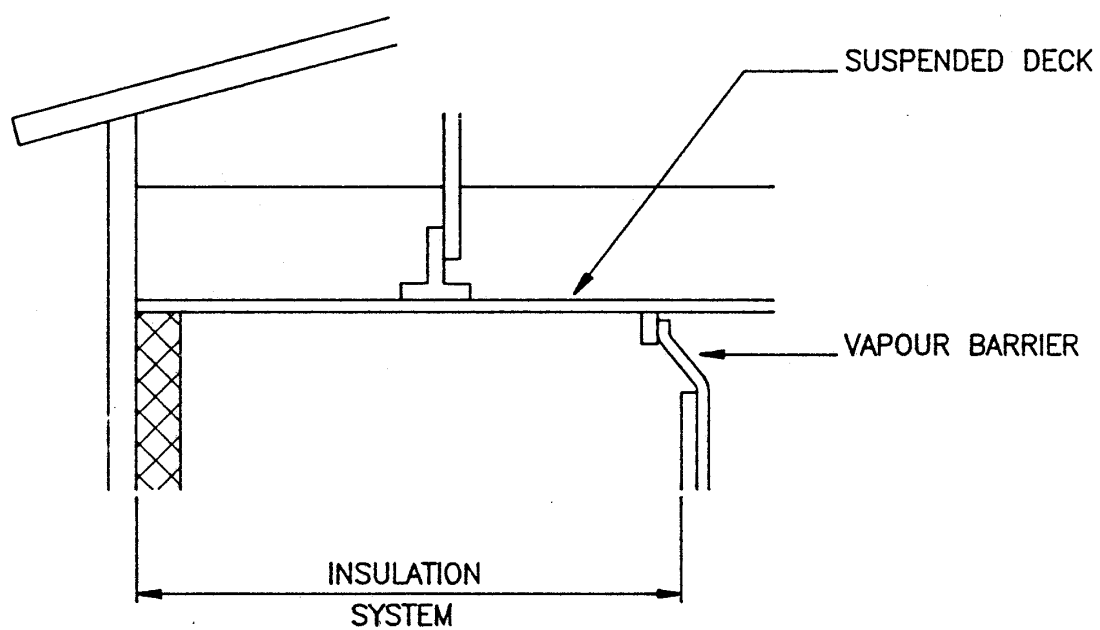


FIGURE 4

ARRANGEMENT OF VAPOUR BARRIER

JOINT DETAIL	WELDING PROCEDURE	WELD DETAIL
	ONE RUN EACH SIDE WITH 4.0mm OR ONE RUN EACH SIDE WITH 3.25mm WHEN $t_2 < 6.25\text{mm}$ THE JOINT SHOULD BE BACK CHIPPED TO ENSURE SOUND ROOT PENETRATION IF THE GAP CONTRACTS SUFFICIENTLY TO REQUIRE THIS PRECAUTION.	2ND RUN INSIDE 1ST RUN OUTSIDE FULL PENETRATION REQUIRED
	← 1ST & 2ND RUNS WITH 4.0mm →	2ND RUN INSIDE 1ST RUN OUTSIDE FULL PENETRATION REQUIRED
	TWO RUNS OUTSIDE AND ONE RUN INSIDE WITH 4.0mm PREFERRED. ALTERNATIVELY 1ST RUN OUTSIDE WITH 5.0mm 2ND RUN OUTSIDE WITH 4.0mm 1ST RUN INSIDE WITH 5.0mm	1ST RUN INSIDE 2 RUNS OUTSIDE FULL PENETRATION REQUIRED
	ROOT RUNS WITH 4.0mm FILLER RUNS (SHADED AREAS) WITH 4 OR 5.0mm	FILLER RUNS ROOT RUN INSIDE FILLER RUNS ROOT RUN OUTSIDE FULL PENETRATION REQUIRED
NOTE:- 't_1' = THICKNESS OF UPPER PLATE 't_2' = THICKNESS OF LOWER PLATE <u>UNDERCUT</u>: RUNS MARKED ⊗ TO FILL UNDERCUT WHERE NECESSARY MUST BE APPLIED WITH 3.25 OR 4.0mm		

FIGURE 5

APPROVED MANUAL WELDING PROCEDURES

(SHEET 1 OF 2)

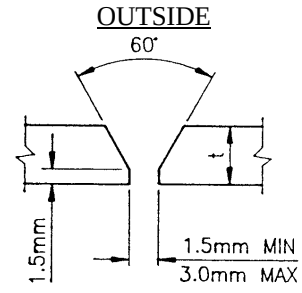
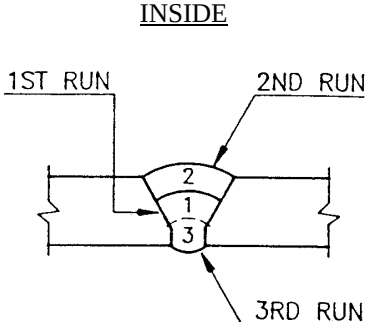
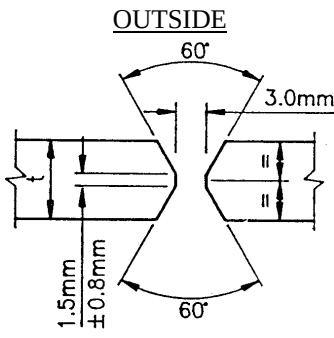
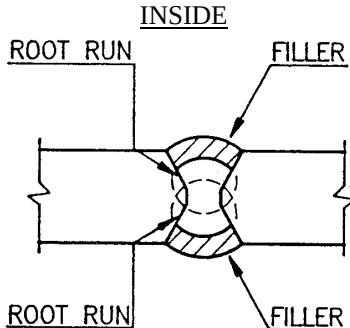
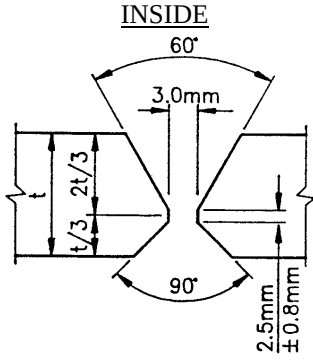
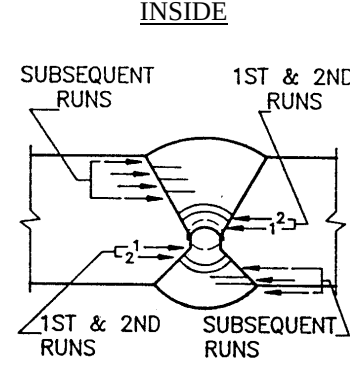
JOINT DETAIL	WELDING PROCEDURE	WELD DETAIL
5mm < t < 9mm THICK  OUTSIDE 60° 1.5mm 1.5mm MIN 3.0mm MAX INSIDE	2 RUNS OUTSIDE AND 1 RUN INSIDE WITH 3.25mm PREFERRED. ALTERNATIVELY 4.0mm PERMITTED. ALL RUNS APPLIED IN UPWARD DIRECTION.	 INSIDE 1ST RUN 2ND RUN 2 1 3 3RD RUN OUTSIDE
9mm < t ≤ 13mm THICK  OUTSIDE 60° 3.0mm 1.5mm ±0.8mm 60° INSIDE	ALL RUNS WITH 3.25mm ALTERNATIVELY ALL RUNS WITH 4.0mm. RUNS APPLIED IN UPWARD DIRECTION. FILLER RUNS (SHADED AREAS)	 INSIDE ROOT RUN FILLER ROOT RUN FILLER OUTSIDE
t > 13mm THICK  INSIDE 60° 3.0mm t/3, 2t/3 90° 2.5mm ±0.8mm OUTSIDE	TWO RUNS OUTSIDE AND ONE RUN INSIDE WITH 4.0mm PREFERRED. ALTERNATIVELY 1ST RUN OUTSIDE WITH 5.0MM 2ND RUN OUTSIDE WITH 4.0MM 1ST RUN INSIDE WITH 5.0MM	 INSIDE SUBSEQUENT RUNS 1ST & 2ND RUNS 1 2 3 1ST & 2ND RUNS SUBSEQUENT RUNS OUTSIDE
NOTE:- 't1' = THICKNESS OF PLATE		

FIGURE 5 (SHEET 2 OF 2)

APPROVED MANUAL WELDING PROCEDURES



DEFINITIONS AND ABBREVIATIONS**Definitions**

Standardised definitions may be found in the BP Group RPSEs Introductory volume.

Tank Contractor	The organisation responsible for the complete design, fabrication, supply and installation of the Tank.
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Abbreviations

ASTM	American Society for Testing Material
ASME	American Society of Mechanical Engineers
EEMUA	Engineering Equipment and Material Users Association
HHLA	High High Level Alarm
HLA	High Level Alarm
IIA	Independent Inspection Authority
NFPA	National Fire Protection Agency
NDT	Non-Destructive Testing
OBE	Operating Basis Earthquake
P&ID	Piping and Instrument Diagram
RLPG	Refrigerated Liquid Petroleum Gas
SSE	Safe Shutdown Earthquake



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

International Standards

[ISO 9001](#) Quality Systems - Specification for design/development, production, installation and servicing.

British Standards

[BS 4232](#) Surface Preparation

Other Country Standards

[O55900 Sa 2½](#) Pictorial surface preparation for painting steel surfaces.
(Sweden)

RP Group Documents

[RP 12-16](#) Electrical Systems and Installations - Earthing and Bonding

Industry Codes and Standards

[EEMUA 147](#) Recommendations for the Design and Construction of Refrigerated Liquified Gas Storage Tanks.

[ASME IX](#) Welding and Brazing Qualification

[ASTM E208](#) Specification for Drop Weight Test

[API 650](#) Welded Steel Tanks for Oil Storage

[NFPA 15](#) National Fire Protection Agency

[ASTM E813](#) JIC Testing Standard

[ASTM A578](#) Specification for Ultrasonic Examination of Plain and Clad Steel Plates.

