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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY  
NATIONAL IRANIAN OIL ENGINEERING  
& CONSTRUCTION COMPANY

# NIOEC SP

## NIOEC SPECIFICATION FOR PROCESS DESIGN OF LIQUID & GAS TRANSFER & STORAGE

SECOND EDITION

MARCH, 2015

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**IN THE NAME OF GOD****FOREWORD**

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

## REVISION INDEX

| REV.<br>PAGE | 1 | 2 | 3 | 4 | 5 | REV.<br>PAGE | 1 | 2 | 3 | 4 | 5 | REV.<br>PAGE | 1 | 2 | 3 | 4 | 5 | REV.<br>PAGE | 1 | 2 | 3 | 4 | 5 |
|--------------|---|---|---|---|---|--------------|---|---|---|---|---|--------------|---|---|---|---|---|--------------|---|---|---|---|---|
| 1            |   | × |   |   |   | 26           |   |   |   |   |   | 51           |   |   |   |   |   | 76           |   |   |   |   |   |
| 2            |   | × |   |   |   | 27           |   |   |   |   |   | 52           |   |   |   |   |   | 77           |   |   |   |   |   |
| 3            |   | × |   |   |   | 28           |   |   |   |   |   | 53           |   |   |   |   |   | 78           |   |   |   |   |   |
| 4            |   | × |   |   |   | 29           |   |   |   |   |   | 54           |   |   |   |   |   | 79           |   |   |   |   |   |
| 5            |   | × |   |   |   | 30           |   |   |   |   |   | 55           |   |   |   |   |   | 80           |   |   |   |   |   |
| 6            |   | × |   |   |   | 31           |   |   |   |   |   | 56           |   |   |   |   |   | 81           |   |   |   |   |   |
| 7            |   | × |   |   |   | 32           |   |   |   |   |   | 57           |   |   |   |   |   | 82           |   |   |   |   |   |
| 8            |   | × |   |   |   | 33           |   |   |   |   |   | 58           |   |   |   |   |   | 83           |   |   |   |   |   |
| 9            |   | × |   |   |   | 34           |   |   |   |   |   | 59           |   |   |   |   |   | 84           |   |   |   |   |   |
| 10           |   | × |   |   |   | 35           |   |   |   |   |   | 60           |   |   |   |   |   | 85           |   |   |   |   |   |
| 11           |   | × |   |   |   | 36           |   |   |   |   |   | 61           |   |   |   |   |   | 86           |   |   |   |   |   |
| 12           |   | × |   |   |   | 37           |   |   |   |   |   | 62           |   |   |   |   |   | 87           |   |   |   |   |   |
| 13           |   | × |   |   |   | 38           |   |   |   |   |   | 63           |   |   |   |   |   | 88           |   |   |   |   |   |
| 14           |   | × |   |   |   | 39           |   |   |   |   |   | 64           |   |   |   |   |   | 89           |   |   |   |   |   |
| 15           |   | × |   |   |   | 40           |   |   |   |   |   | 65           |   |   |   |   |   | 90           |   |   |   |   |   |
| 16           |   | × |   |   |   | 41           |   |   |   |   |   | 66           |   |   |   |   |   | 91           |   |   |   |   |   |
| 17           |   |   |   |   |   | 42           |   |   |   |   |   | 67           |   |   |   |   |   | 92           |   |   |   |   |   |
| 18           |   |   |   |   |   | 43           |   |   |   |   |   | 68           |   |   |   |   |   | 93           |   |   |   |   |   |
| 19           |   |   |   |   |   | 44           |   |   |   |   |   | 69           |   |   |   |   |   | 94           |   |   |   |   |   |
| 20           |   |   |   |   |   | 45           |   |   |   |   |   | 70           |   |   |   |   |   | 95           |   |   |   |   |   |
| 21           |   |   |   |   |   | 46           |   |   |   |   |   | 71           |   |   |   |   |   | 96           |   |   |   |   |   |
| 22           |   |   |   |   |   | 47           |   |   |   |   |   | 72           |   |   |   |   |   | 97           |   |   |   |   |   |
| 23           |   |   |   |   |   | 48           |   |   |   |   |   | 73           |   |   |   |   |   | 98           |   |   |   |   |   |
| 24           |   |   |   |   |   | 49           |   |   |   |   |   | 74           |   |   |   |   |   | 99           |   |   |   |   |   |
| 25           |   |   |   |   |   | 50           |   |   |   |   |   | 75           |   |   |   |   |   | 100          |   |   |   |   |   |

## NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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| 1    | MARCH,<br>2015 | M.CHAVOSHI   | M.H.MANSHADI | M.KAREGAR<br>NAJAFI | A.ARMAN<br>MOGHADAM |
| 0    | JULY, 2005     | M.A.A.SAJEDI |              | M.R.FARZAM          | M.A.A.SAJEDI        |
| REV. | DATE           | PREPARED     | CHECKED      | APPROVED            | AUTHORIZED          |

**CONTENTS:****PAGE NO.**

|                                   |   |
|-----------------------------------|---|
| INTRODUCTION.....                 | 2 |
| 1. SCOPE .....                    | 2 |
| 2. REFERENCES.....                | 2 |
| 3. UNITS .....                    | 4 |
| 4. ADDENDUM TO IPS-E-PR-360 ..... | 5 |

## INTRODUCTION

To satisfy the requirements of this NIOEC Specification, Iranian Petroleum Standard IPS-E-PR-360 (First Revision, March 2009) with the modifications as specified herein after shall be strictly followed.

Articles 1 and 2 of this document replace entirely the related article in the referenced IPS Standard.

## 1. SCOPE

This NIOEC Specification is intended to cover the minimum requirements and criteria to be considered in process design of liquid and gas transfer and storage facilities. The requirements outlined in this Specification deal with individual items of equipment and other facilities such as storage tanks and accessories, pumps/compressors and piping connection, instrumentation, fire protection and safety instruction, layout and spacing and other aspects, but all to the extent of process design consideration limits.

This Specification covers the following sections:

- Section A:** Storage and Handling of Crude Oil and Refinery Products.
- Section B:** Storage and Handling of Liquefied Petroleum Gases; 'LPG'.
- Section C:** Liquefied Natural Gas 'LNG' or 'NGL' Storage and Transfer Facilities.
- Section D:** Storage and Handling of Ethane and Ethylene.
- Section E:** Storing and Handling of Ethanol and Gasoline-Ethanol Blends.
- Section F:** Storing and Handling of Gasoline-Methanol/Cosolvent Blends.

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IPS and the international standards, shall be made through written consent and approval of NIOEC.

## 2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the vendor/contractor.

### API (AMERICAN PETROLEUM INSTITUTE)

API Standard 620 "Design and Construction of Large Welded Pressure Storage Tanks"

API Standard 650 "Welded Tanks for Oil Storage"

API Standard 2508, 2<sup>nd</sup> Ed., 1985 "Design and Construction of Ethane and Ethylene Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries, Petrochemicals Plants, and Tank Farms"

API Standard 2510 8th Ed., 2001 "Design and Construction of LPG Installations"

API RP 520 "Sizing, Selection and Installation of Pressure- Relieving Devices in Refineries"

- Part I, .8<sup>th</sup> Ed., Dec.2008 "Sizing and Selection"
- Part II, 5<sup>th</sup>. Ed., Aug. 2003 "Installation"

API RP 521 "Pressure-relieving and Depressuring Systems"

API RP 1626 "Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Filling Stations"

API RP 1627 "Storage and Handling of Gasoline-Methanol/Cosolvent Blends at Distribution Terminals and Service Station"

API Publication 2015 "Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks"

API Publication 2015B "Cleaning Open-Top and Covered Floating Roof Tanks"

API Publication 2510A 2nd Ed., 1996 "Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities"

API RP 2003, 7<sup>th</sup> Ed. Jan. 2008 "Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents"

#### **BSI (BRITISH STANDARDS INSTITUTION)**

BS 470, Ed. 1999 "Specification for Inspection, Access and Entry Openings for Pressure Vessels"

BS 5429, Ed. 1988 "Code of Practice for Safe Operation of Small Scale Storage Facilities for Cryogenic Liquids"

BS EN 14015 "Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, aboveground, welded, steel tanks for the storage of liquids at ambient temperature and above"

#### **ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)**

ASME B31.3, Ed., 2012 "Process Piping"

ASME B31.4, Ed., 2012 "Pipeline Transportation System for Liquids & Slurries"

ASME Codes, Section VIII, Division 1 and 2 "Boiler and Pressure Vessels Codes"

#### **NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)**

NFPA 30, Ed., 2012 "Flammable and Combustible Liquids Code"

NFPA 30A Ed., 2012 "Code for Motor Fuel Dispensing Facilities and Repair Garages"

NFPA 59A Ed., 2013 "Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)"

NFPA 58 Ed., 2011 "Liquefied Petroleum Gas Code"

**ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIAL)**

D-1250 "Standard Guide for Use of the Petroleum measurement Tables – Vol.XI/XII"

**ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)**

ISO 4266-1 "Petroleum and liquid petroleum products measurement of level and temperature in storage tanks by automatic methods-Part 1: Measurement of Level in Atmospheric Tank"

**IPS (IRANIAN PETROLEUM STANDARDS)**

IPS-E-PR-360 "Engineering Standard for Process Design of Liquid & Gas Transfer Storage"

**NIOEC-SP (NIOEC SPECIFICATIONS)**

NIOEC-SP-00-01 "NIOEC Specification Civil Design Criteria"

NIOEC-SP-00-10 "NIOEC Specification for Units"

NIOEC-SP-00-53 "NIOEC Specification for Layout & Spacing"

NIOEC-SP-00-75 "NIOEC Specification for Pressure & Vacuum Relief Devices"

NIOEC-SP-00-50 "NIOEC Specification for Design Criteria for Process and Mechanics"

NIOEC-SP-41-01 "NIOEC Specification for Storage Tanks Field Erected"

NIOEC-SP-41-06 "NIOEC Specification for Large Welded Low Pressure Storage Tanks"

NIOEC-SP-46-08 "NIOEC Specification for Centrifugal Compressors in General Refinery Services"

**2.1. EQUIVALENT TO IPS STANDARDS**

Substitute the following IPS Standards as referred to throughout IPS-E-PR-360 for the relevant NIOEC's Specifications as follows:

| <b><u>IPS Standard</u></b> | <b><u>Relevant NIOEC Specification</u></b> |
|----------------------------|--------------------------------------------|
| IPS-E-GN-100               | <a href="#">NIOEC-SP-00-10</a>             |
| IPS-E-PR-190               | <a href="#">NIOEC-SP-00-53</a>             |
| IPS-E-PR-450               | <a href="#">NIOEC-SP-00-75</a>             |
| IPS-E-PR-750               | <a href="#">NIOEC-SP-46-08</a>             |
| IPS-G-ME-100               | <a href="#">NIOEC-SP-41-01</a>             |
| IPS-G-ME-110               | <a href="#">NIOEC-SP-41-06</a>             |

**3. UNITS**

International system of units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

**4. ADDENDUM TO IPS-E-PR-360**

This addendum revises the below listed articles of the referenced standard as follows:

**5. UNITS (Delete)****6.2.3.1 (Modification)**

Earthquake load shall be specified in the job specification according to NIOEC-SP-00-01.

**6.2.7 Design Condition (Addition)**

The design pressure and design temperature shall be considered based on NIOEC-SP-00-50.

**6.3.1.1 (Substitution)**

The standard and recommended size of tanks should conform to the Table 1 and Table 2 of Appendix 1 of this specification.

**6.3.1.2.4 (Addition)**

Some complementary information about capacity and level of liquid is provided in Appendix 3 of this specification.

**6.3.2 Part 1 (Modification)**

Inter-tank spacing and separation distances between tank and boundary line and tank and other facilities are of fundamental importance (For detail information, refer to NIOEC-SP-00-53).

**6.3.3 Spacing of tanks for petroleum stocks (Substitution)**

For layout and spacing of storage tanks refer to NIOEC-SP-00-53.

Also Fig. 1 to 4 should be deleted. (Page 21, 22)

**6.3.4 Types of Storage Tanks (Substitution)**

Tanks must be built to design criteria that ensure physical integrity of the tank against all reasonably expected forces such as tank contents, ground settlement or movement, wind and snow. Suitable codes relating to the design and construction of tanks and their associated fittings are BS EN 14015 and API Standard 650. The Type and classification of Atmospheric storage tanks according to their shapes is shown in Appendix 2 of this specification.

The main types of storage are as follows:

**6.5.1 Manholes (Modification)**

Refer to NIOEC-SP-41-01, NIOEC-SP-41-06 for details.

**6.5.1.1 (Delete)****6.6.1 (Modification)**

Manholes should be provided to permit entry to tanks, and to facilitate gas-freeing and tank cleaning operations. Such manholes should be large enough to permit entry when full protective clothing is worn. Reference should be made to BS 470 and API Standard 650. At least one manhole should be provided in the lowest shell strake and one in the roof of a vertical tank.

**6.6.1 Manholes (Modification)**

Refer to NIOEC-SP-41-01, NIOEC-SP-41-06 for details.

**6.6.1.1 (Delete)****6.6.1.2 (Delete)****6.6.1.3 (Delete)****7.3.2 Layout and spacing (Modification)**

Spacing and design of LPG facilities shall be in accordance with NIOEC-SP-00-53.

**7.3.3.2 (Addition)**

A typical calculation method for capacity and level of liquid is provided in Appendix 4.

**7.4.1.5.5 (Modification)**

Piping connections between container and manifold shall be designed to provide adequate allowances for construction, expansion, vibration, and settlement.

**7.4.1.7.6 (Modification)**

All safety provisions given by NFPA 58, Chapter 5 under paragraph 5.7.2 and applicable to spring-loaded safety relief valves installation on LPG storage vessels shall be considered to the extent of process design requirements

**7.4.1.8.3.3 (Modification)**

All other safety requirements relating to liquid level gaging specified in NFPA 58 under Paragraph 6.19.4.4 through 6.19.4.6 and Paragraph 5.7.5 shall be considered.

**7.4.6.2.1 (Modification)**

Indirect vaporizers shall comply with Clause 5.21.2 of NFPA 58 and the followings:

**7.4.6.3.1 (Modification)**

Direct fired vaporizers shall be designed in full conformity with requirements given in NFPA 58 under Paragraph 5.21.3.

## APPENDIX 1 (Addition)

Table 1: Nominal Capacity of Atmospheric Storage Tanks

a) Nominal Capacity and Size of Fixed Roof Storage Tank According to N.I.O.C. Standard

| Nominal Capacity | m3<br>(Barrel) | 105<br>(660) | 160<br>(1,000) | 250<br>(1,600) | 480<br>(3,000) | 1,070<br>(6,800) | 2,150<br>(13,500) | 2,990<br>(19,000) | 5,970<br>(38,000) | 8,610<br>(55,000) | 11,720<br>(74,000) | 15,980<br>(100,000) | 22,140<br>(140,000) |
|------------------|----------------|--------------|----------------|----------------|----------------|------------------|-------------------|-------------------|-------------------|-------------------|--------------------|---------------------|---------------------|
| Diameter         | m<br>(ft)      | 6.1<br>(20)  | 6.1<br>(20)    | 7.6<br>(25)    | 9.14<br>(30)   | 12.2<br>(40)     | 14.6<br>(48)      | 17.1<br>(56)      | 24.4<br>(80)      | 29.3<br>(96)      | 34.1<br>(112)      | 36.6<br>(120)       | 43.9<br>(144)       |
| Height           | m<br>(ft)      | 3.6<br>(12)  | 5.5<br>(18)    | 5.5<br>(18)    | 7.3<br>(24)    | 11<br>(33)       | 12.80<br>(42)     | 12.81<br>(42)     | 12.81<br>(42)     | 12.81<br>(42)     | 12.81<br>(42)      | 14.63<br>(48)       | 14.63<br>(48)       |

b) Nominal Capacity and Size of Floating Roof Storage Tank According to N.I.O.C. Standard

| Nominal Capacity | m3<br>(Barrel) | 1,230<br>(7,800) | 2,820<br>(18,000) | 5,730<br>(36,000) | 8,300<br>(52,000) | 11,330<br>(71,000) | 16,660<br>(105,000) | 21,470<br>(135,000) |
|------------------|----------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------------|---------------------|
| Diameter         | m<br>(ft)      | 12.2<br>(40)     | 17.1<br>(56)      | 24.4<br>(80)      | 29.3<br>(96)      | 34.1<br>(112)      | 41.5<br>(136)       | 43.9<br>(144)       |
| Height           | m<br>(ft)      | 11<br>(36)       | 12.8<br>(42)      | 12.8<br>(42)      | 12.8<br>(42)      | 12.8<br>(42)       | 12.8<br>(42)        | 14.63<br>(48)       |

**Table 2: Recommended Capacity of Atmospheric Storage Tanks****a) Capacity and Size of Fixed Roof Storage Tank (Recommended)**

|                         |                    |           |             |             |               |               |                |                |                |                |                |                |
|-------------------------|--------------------|-----------|-------------|-------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Nominal Capacity</b> | <b>m3 (Barrel)</b> | 105 (660) | 250 (1,600) | 480 (3,000) | 1,070 (7,000) | 1,415 (8,900) | 2,150 (13,500) | 2,990 (19,000) | 3,593 (22,600) | 4,770 (30,000) | 5,970 (38,000) | 6,837 (43,000) |
| <b>Diameter</b>         | <b>m (ft)</b>      | 6.1 (20)  | 7.6 (25)    | 9.14 (30)   | 12.2 (40)     | 12.8 (42)     | 14.6 (48)      | 17.1 (56)      | 18.9 (62)      | 21.8 (72)      | 24.4 (80)      | 26.1 (86)      |
| <b>Height</b>           | <b>m (ft)</b>      | 3.6 (12)  | 5.5 (18)    | 7.3 (24)    | 11 (33)       | 11 (33)       | 12.80 (42)     | 12.8 (42)      | 12.8 (42)      | 12.8 (42)      | 12.8 (42)      | 12.8 (42)      |

|                         |                    |                |                |                 |                 |                  |                  |                  |                  |                  |                  |
|-------------------------|--------------------|----------------|----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|
| <b>Nominal Capacity</b> | <b>m3 (Barrel)</b> | 7,950 (50,000) | 8,610 (55,000) | 10,652 (67,000) | 11,720 (74,000) | 15,980 (100,000) | 19,100 (120,000) | 22,140 (140,000) | 23,850 (150,000) | 31,798 (200,000) | 45,138 (284,000) |
| <b>Diameter</b>         | <b>m (ft)</b>      | 28.1 (92)      | 29.3 (96)      | 32.5 (107)      | 34.1 (112)      | 36.6 (120)       | 40.8 (134)       | 43.9 (144)       | 45.6 (150)       | 52.7 (173)       | 63 (207)         |
| <b>Height</b>           | <b>m (ft)</b>      | 12.8 (42)      | 12.8 (42)      | 12.8 (42)       | 12.8 (42)       | 14.6 (48)        | 14.6 (48)        | 14.6 (48)        | 14.6 (48)        | 14.6 (48)        | 14.6 (48)        |

Table 2 – b) Capacity and Size of Floating Roof Storage Tank (Recommended)

|                         |                    |                  |                   |                   |                   |                   |                    |                    |                    |
|-------------------------|--------------------|------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|
| <b>Nominal Capacity</b> | <b>m3 (Barrel)</b> | 1,230<br>(7,800) | 3,196<br>(20,100) | 4,850<br>(30,500) | 5,730<br>(36,000) | 8,300<br>(52,000) | 10,175<br>(64,000) | 11,330<br>(71,000) | 12,800<br>(80,500) |
| <b>Diameter</b>         | <b>m (ft)</b>      | 12.2<br>(40)     | 17.8<br>(58)      | 22<br>(72)        | 24.4<br>(80)      | 29.3<br>(96)      | 31.8<br>(104)      | 34.1<br>(112)      | 35.7<br>(117)      |
| <b>Height</b>           | <b>m (ft)</b>      | 11<br>(36)       | 12.8<br>(42)      | 12.8<br>(42)      | 12.8<br>(42)      | 12.8<br>(42)      | 12.8<br>(42)       | 12.8<br>(42)       | 12.8<br>(42)       |

|                         |                    |                     |                     |                     |                     |                     |                     |                     |                     |
|-------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| <b>Nominal Capacity</b> | <b>m3 (Barrel)</b> | 16,660<br>(105,000) | 19,000<br>(120,000) | 21,470<br>(135,000) | 23,850<br>(150,000) | 31,800<br>(200,000) | 40,290<br>(250,000) | 47,700<br>(300,000) | 79,500<br>(500,000) |
| <b>Diameter</b>         | <b>m (ft)</b>      | 40.7<br>(134)       | 41<br>(135)         | 43.9<br>(144)       | 43.9<br>(144)       | 52.7<br>(173)       | 53.7<br>(176)       | 64.5<br>(212)       | 83.2<br>(273)       |
| <b>Height</b>           | <b>m (ft)</b>      | 12.8<br>(42)        | 14.6<br>(48)        | 14.6<br>(48)        | 14.6<br>(48)        | 14.6<br>(48)        | 14.6<br>(48)        | 14.6<br>(48)        | 14.6<br>(48)        |

## APPENDIX 2 (Addition)

## Type of the Atmospheric Tanks

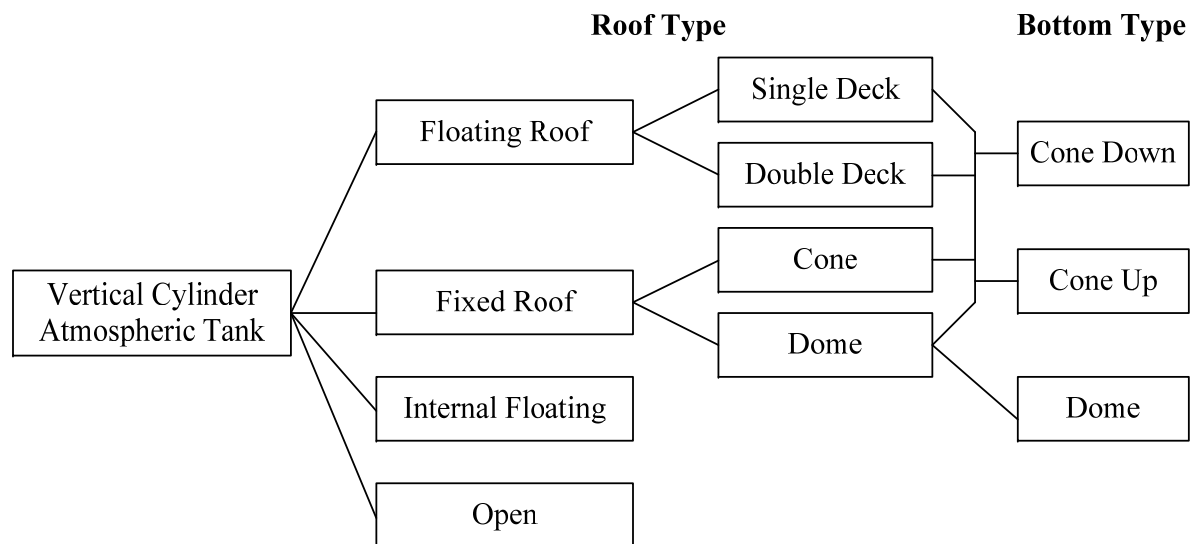
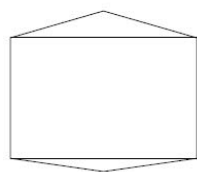
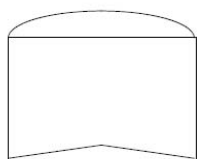
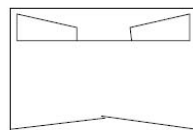
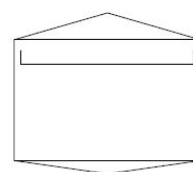
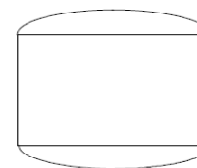


Figure A2- 1 Classification of Storage Tanks Depending on the roof and buttom type

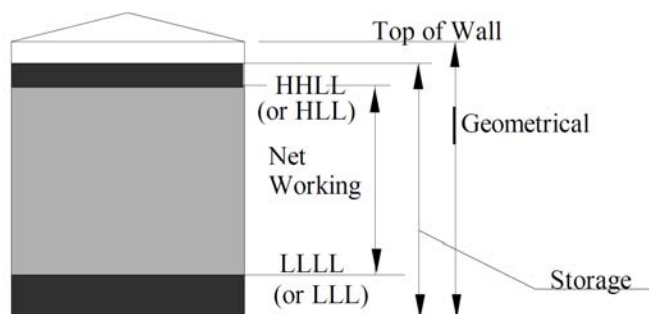
Cone Roof Tank  
Bottom cone-downDome Roof Tank  
Bottom cone-upFloating Roof Tank  
Bottom cone-upInternal Floating  
Cone Roof tankDome Roof tank  
Bottom dome

## APPENDIX 3 (Addition)

**a) Definition of Capacity**

- Nominal Capacity : This capacity is usually used as tank name.
- Geometrical Capacity: The volume of vertical cylindrical section.
- Storage Capacity: The volume from the tank bottom to the maximum design level.
- Net Working Capacity: The volume between HLL and LLL or HHLL and LLLL.

Figure A3- 1

**b) Liquid Level**

Refer to Figure A3-2

**1) Fixed Roof Tank :**

- H1: Normally zero (0 mm) or fixed air foam chamber (if the chamber is provided) inlet nozzle bottom.  
(Note 3).
- H2: 150 mm or 30 minutes from the maximum filling volume (Note 2).
- H3: Greater of 300 mm for 12" and larger nozzle sizes and 150 mm for 10" and smaller nozzle sizes or  
NPSH requirement.
- H4: Top of largest nozzle (Note 3).

**2) Floating Roof Tank (including Internal Floating Tank)**

- H1: Free board for floating roof.
- H2: 500 mm or 30 minutes from the maximum filling volume (Note 2).
- H3: 300 mm or NPSH requirement.
- H4: Greater of top of largest nozzle or low position of floating roof (Note 3).

**Notes:**

- Note 1: High and low level (HLL and LLL) alarm will be set in the area of H2 and H3 respectively. If high high and low low level (HHLL and LLLL) for an emergency shutdown or an automatic diversion system are provided, the set points will also be selected in the area of H2 and H3 respectively, but, of course, outside the set point of HLL or LLL.

Note 2: It is assumed that filling flow rate from an export tanker (Crude or product receiving case) is very high, so the recommended time of 30 minutes shall be calculated using the slow unloading rate (approx. 30% of the maximum unloading rate).

Note 3: Assumption of H4 and H1 for CRT based on API 650 is shown in Figures A3-3 and A3-4 of this appendix. Actual height for the nozzles may be changed due to detailed design such as plate and welding line arrangement, so it shall be confirmed with detailed engineering group, if necessary.

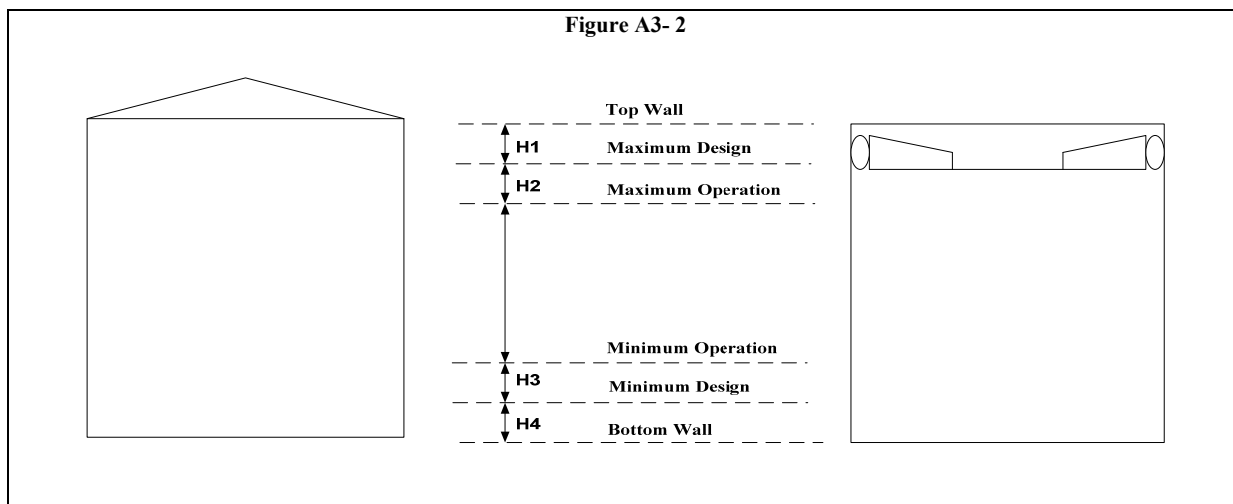
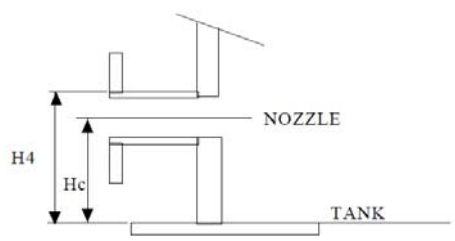
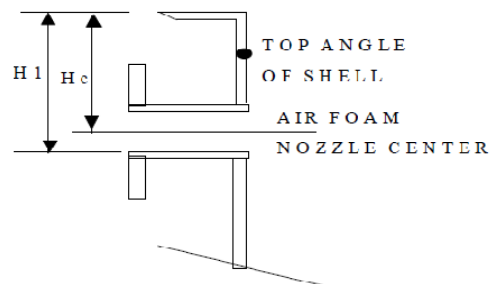


**Figure A3- 3 Shell Nozzle Height (Typical) ( Refer to API 650- Section “Design” for detail)**



| NOZZLE SIZE |           | REGULAR TYPE |           | LOW TYPE |          | NOZZLE SIZE |         | REGULAR TYPE |         | LOW TYPE  |         |
|-------------|-----------|--------------|-----------|----------|----------|-------------|---------|--------------|---------|-----------|---------|
| Inch        | Hc (inch) | H4 (mm)      | Hc (inch) | H4 (mm)  | Inch     | Hc (inch)   | H4 (mm) | Hc (inch)    | H4 (mm) | Hc (inch) | H4 (mm) |
| 48          | 52        | 1930         | 48-3/8    | 1840     | 18       | 22          | 790     | 18-3/4       | 705     |           |         |
| 46          | 50        | 1855         | 46-3/8    | 1760     | 16       | 20          | 710     | 16-3/4       | 630     |           |         |
| 44          | 48        | 1780         | 44-3/8    | 1690     | 14       | 18          | 635     | 14-3/4       | 550     |           |         |
| 42          | 46        | 1700         | 42-3/8    | 1610     | 12       | 17          | 585     | 13-1/2       | 495     |           |         |
| 40          | 44        | 1625         | 40-3/8    | 1535     | 10       | 15          | 510     | 11-1/2       | 420     |           |         |
| 38          | 42        | 1550         | 38-3/8    | 1460     | 8        | 13          | 430     | 9-1/2        | 345     |           |         |
| 36          | 40        | 1475         | 36-3/8    | 1380     | 6        | 11          | 355     | 7-7/8        | 275     |           |         |
| 34          | 38        | 1340         | 34-3/8    | 1305     | 4        | 9           | 280     | 6            | 205     |           |         |
| 32          | 36        | 1320         | 32-3/8    | 1230     | 3        | 8           | 240     | 5-1/4        | 170     |           |         |
| 30          | 34        | 1245         | 30-3/8    | 1150     | 2        | 7           | 205     | 3-1/2        | 115     |           |         |
| 28          | 32        | 1170         | 28-3/8    | 1080     | 1.5      | 6           | 170     | 3            | 95      |           |         |
| 26          | 30        | 1090         | 26-3/4    | 1010     | Threaded |             |         |              |         |           |         |
| 24          | 28        | 1020         | 24-3/4    | 935      | 3        | 9           | 265     | 5-5/8        | 180     |           |         |
| 22          | 26        | 940          | 22-3/4    | 860      | 2        | 7           | 205     | 3            | 100     |           |         |
| 20          | 24        | 865          | 20-3/4    | 780      | <1.5     | 6           | 170     | 3            | 95      |           |         |

Figure A3- 4 Air Foam Nozzle (Typical)



| Tank Dia. (m)<br>Air<br>Foam Size | CRT | $D \leq 18$ | $18 < D \leq 60$ | $60 < D$        |                  |                  |                  |          |
|-----------------------------------|-----|-------------|------------------|-----------------|------------------|------------------|------------------|----------|
|                                   | DRT | $D \leq 6$  | $6 < D \leq 9$   | $9 < D \leq 11$ | $11 < D \leq 14$ | $14 < D \leq 21$ | $21 < D \leq 26$ | $26 < D$ |
| 2-1/2"                            | Hc  | 284         | 294              | 309             | 319              | 349              | 369              | 419      |
|                                   | H1  | 320         | 330              | 350             | 360              | 390              | 410              | 460      |
| 3"                                | Hc  | 284         | 294              | 309             | 319              | 349              | 369              | 419      |
|                                   | H1  | 330         | 340              | 665             | 375              | 405              | 425              | 475      |
| 4"                                | Hc  | 303         | 313              | 328             | 338              | 368              | 388              | 438      |
|                                   | H1  | 360         | 370              | 385             | 395              | 425              | 445              | 395      |
| 6"                                | Hc  | 350         | 360              | 375             | 385              | 415              | 435              | 485      |
|                                   | H1  | 435         | 445              | 460             | 470              | 500              | 520              | 570      |
| 8"                                | Hc  | 392         | 402              | 417             | 427              | 457              | 477              | 527      |
|                                   | H1  | 500         | 510              | 525             | 535              | 565              | 585              | 635      |
| All figures are rounded to 5 mm.  |     |             |                  |                 |                  |                  |                  |          |

CRT: Cone Roof Type

DRT: Dome Roof Type

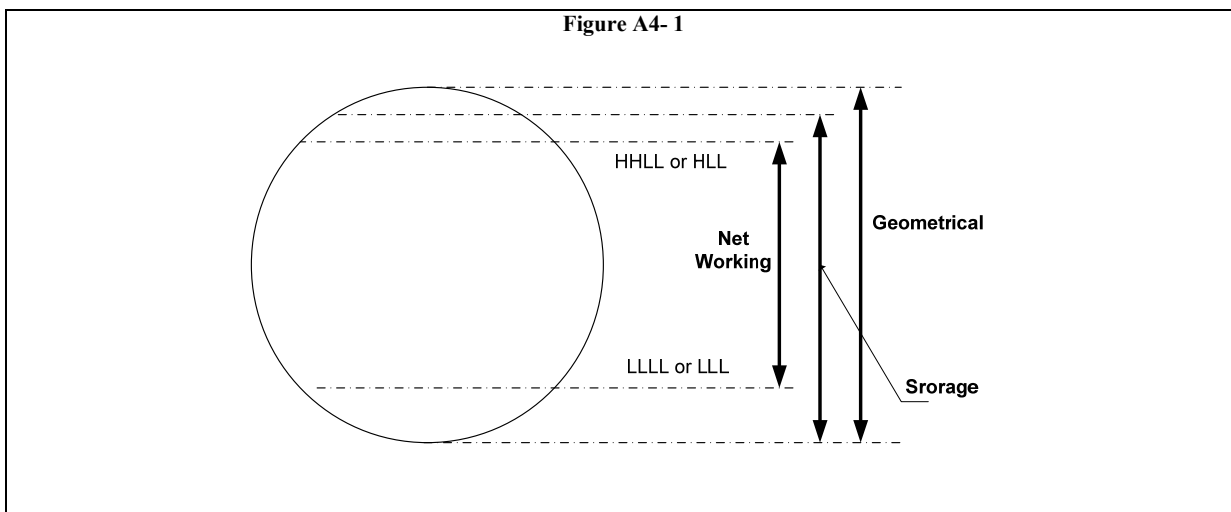
## APPENDIX 4 (Addition)

## (LPG Storage Tanks, Capacity and Level)

## A4.1 Definition of Capacity

|                       |                                                                                                                     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------|
| Nominal Capacity:     | This capacity is usually used as tank name.                                                                         |
| Geometrical Capacity: | Volume inside a vessel which is called "a water volume" in NFPA.                                                    |
| Storage Capacity:     | The volume from the tank bottom to the maximum design level. This volume varies depending on operating temperature. |
| Net working Capacity: | Volume between HLL and LLL or HHLL and LLLL.                                                                        |

Figure A4- 1



## A4.2 Liquid Level

## A4.2.1 Maximum liquid level (maximum Storage Capacity) (Typical)

The following typical information may be used for calculation of maximum storage capacity. It is recommended to specify that a vapor space of 10% be secured under the severest conditions, resulting the following equation:

$$V_{Geo} = \frac{W}{0.9 \rho_{mt}}$$

Where,

$V_{Geo}$  : Tank geometrical volume (m<sup>3</sup>)

$W$  : Storage capacity (kg)

$\rho_{mt}$  : Density at the maximum temperature (kg/m<sup>3</sup>) (Note1)

**Notes:**

- 1) Maximum temperature: Highest temperature during operation under severe climatic conditions in summer. The following values can be used after approval of the Company:

| Condition                                                          | Maximum Temperature (°C) |
|--------------------------------------------------------------------|--------------------------|
| Storage Capacity $\leq 1000 \text{ m}^3$                           | 55                       |
| $1000 \text{ m}^3 < \text{Storage Capacity} \leq 3000 \text{ m}^3$ | 48                       |
| Storage Capacity $> 3000 \text{ m}^3$                              | 40                       |

## A4.2.2 Minimum levels

Refer to Figure. A4-2

**H2:** 150 mm or 10 minutes from the maximum filling volume

**H3:** A height of Dead Stock Area. The height shall be calculated by the reasonable dead stock volume.

The recommended height for spherical tank is shown below:

| Tank diameter                    | Recommended height (H3) | Dead stock volume |
|----------------------------------|-------------------------|-------------------|
| Less than 12 m                   | 1.0 m                   | More than 2 %     |
| 12 and lager but not exceed 19 m | 1.5 m                   | 1.8 to 4.5%       |
| 19 m and larger                  | 2.0 m                   | Less than 3 %     |

The volume is calculated by the following equations.

$$\text{Tank Volume(Sphere)} = \frac{\pi}{6} D^3$$

$$V_b = \pi \left( \frac{DH^2}{2} - \frac{H^3}{3} \right)$$

Where:

D: Tank Diameter

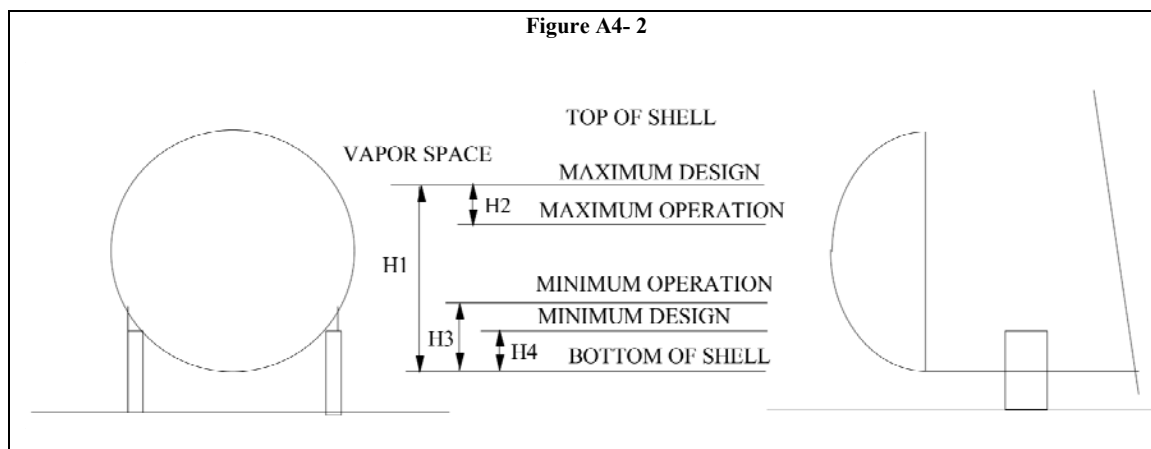
H: Height of Level

$V_b$  : Sectional Volume of Height H

**H4:** The height should be taken as the unusable volume below the pump suction internal extension, plus the additional allowance necessary to prevent vortexing (not less than 300 mm).

**Note:**

High and low level (HLL and LLL) alarm should be set at the maximum and the minimum operation respectively. If high high and low low level (HHLL and LLLL) for an emergency shutdown or an automatic diversion system are provided, set points should be selected at lower than the maximum and higher than the minimum design, but not inside of the maximum and the minimum operation.





IRANIAN PETROLEUM STANDARDS

استانداردهای نفت ایران

**IPS**

**IPS-E-PR-360 (1)**

ENGINEERING STANDARD  
FOR  
PROCESS DESIGN OF LIQUID & GAS  
TRANSFER AND STORAGE

FIRST REVISION  
MARCH 2009

استاندارد مهندسی  
برای  
طراحی فرآیندی و انتقال  
مایع و گاز و ذخیره سازی

ویرایش اول

اسفند ۱۳۸۷

## FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

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## پیش گفتار

استانداردهای نفت ایران ( IPS ) منعکس کننده دیدگاههای وزارت نفت ایران است و برای استفاده در تأسیسات تولید نفت و گاز ، پالایشگاههای نفت، واحدهای شیمیایی و پتروشیمی، تأسیسات انتقال و فراورش گاز و سایر تأسیسات مشابه تهیه شده است.

استانداردهای نفت، براساس استانداردهای قابل قبول بین المللی تهیه شده و شامل گزیده‌هایی از استانداردهای مرجع در هر مورد می باشد. همچنین سایر الزامات و / یا اصلاحات مورد نیاز براساس تجربیات صنعت نفت کشور و امکانات تأمین داخل در استانداردها گنجانده شده است، مواردی از گزینه های فنی که در متن استانداردها آورده نشده است در داده برگها بصورت شماره گذاری شده برای استفاده مناسب کاربران آورده شده است .

استانداردهای نفت، بشکلی کاملاً انعطاف پذیر تدوین شده است تا کاربران بتوانند نیازهای خود را با آنها منطبق نمایند. با این حال ممکن است در مواردی همه نیازهای پروژه ها را پوشش ندهند. در این گونه موارد باید الحاقیه ای که نیازهای خاص آنها را تأمین مینماید تهیه و پیوست نمایند. این الحاقیه همراه با استاندارد مربوطه، مشخصات فنی آن پروژه و یا کار خاص را تشکیل خواهند داد .

استانداردهای نفت تقریباً هر پنج سال یکبار مورد بررسی قرار گرفته و روز آمد میگردند. در این بررسی ها ممکن است استانداردی حذف و یا الحاقیه‌ای به آن اضافه شود و بنابراین همواره آخرین ویرایش آنها ملاک عمل میباشد.

از کاربران استاندارد، درخواست میشود نقطه نظرها و پیشنهادات اصلاحی و یا هرگونه الحاقیه ای که برای موارد خاص تهیه نموده اند، به نشانی زیر ارسال نمایند. نظرات و پیشنهادات دریافتی در کمیته های فنی مربوطه بررسی و در صورت تصویب در تجدید نظرهای بعدی استاندارد منعکس خواهد شد .

ایران، تهران، خیابان کریمخان زند، خردمند شمالی کوچه  
چهاردهم ، شماره ۱۹

اداره تحقیقات و استانداردها

کدپستی : ۱۵۸۵۸۸۶۸۵۱

تلفن : ۶۰ - ۸۸۸۱۰۴۵۹ و ۶۶۱۵۳۰۵۵

دور نگار : ۲۱-۸۸۸۱۰۴۵۷

[Standards@nioc.org](mailto:Standards@nioc.org)

پست الکترونیک:

## General Definitions:

Throughout this Standard the following definitions shall apply.

### Company :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, and National Petrochemical Company etc.

### Purchaser :

Means the "Company" Where this standard is part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract document.

### Vendor And Supplier:

Refers to firm or person who will supply and/or fabricate the equipment or material.

### Contractor:

Refers to the persons, firm or company whose tender has been accepted by the company.

### Executor :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

### Inspector :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

### Shall:

Is used where a provision is mandatory.

### Should

Is used where a provision is advisory only.

### Will:

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

### May:

Is used where a provision is completely discretionary.

## تعاریف عمومی :

در این استاندارد تعاریف زیر به کار می رود.

### شرکت :

به شرکت های اصلی و وابسته وزارت نفت مثل شرکت ملی نفت ایران، شرکت ملی گاز ایران، شرکت ملی صنایع پتروشیمی و غیره اطلاق میشود.

### خریدار:

یعنی "شرکتی" که این استاندارد بخشی از مدارک سفارش خرید مستقیم آن "شرکت" میباشد و یا "پیمانکاری" که این استاندارد بخشی از مدارک قرارداد آن است .

### فروشنده و تامین کننده:

به موسسه و یا شخصی گفته میشود که تجهیزات و کالاهای مورد لزوم صنعت را تامین مینماید .

### پیمانکار:

به شخص ، موسسه و یا شرکتی گفته میشود که پیشنهادش برای مناقصه و یا مزایده پذیرفته شده است.

### مجری:

مجری به گروهی اطلاق می شود که تمام یا قسمتی از کارهای اجرایی و یا راه اندازی پروژه را انجام دهد.

### بازرس:

در این استاندارد بازرس به فرد یا گروهی اطلاق می شود که کتباً توسط کارفرما برای بازرسی ساخت و نصب تجهیزات معرفی شده باشد.

### باید:

برای کاری که انجام آن اجباری است استفاده میشود.

### توصیه:

برای کاری که ضرورت انجام آن توصیه میشود.

### ترجیح:

معمولاً در جایی استفاده میشود که انجام کار مطابق با نظر شرکت ترجیح داده میشود.

### ممکن است :

برای کاری که انجام آن اختیاری میباشد .

**ENGINEERING STANDARD**  
**FOR**  
**PROCESS DESIGN OF LIQUID & GAS**  
**TRANSFER AND STORAGE**

**FIRST REVISION**  
**MARCH 2009**

استاندارد مهندسی  
برای  
طراحی فرآیندی و انتقال  
مایع و گاز و ذخیره سازی

ویرایش اول  
اسفند ۱۳۸۷

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این استاندارد متعلق به وزارت نفت ایران است. تمام حقوق آن متعلق به مالک آن بوده و نباید بدون رضایت کتبی وزارت نفت ایران، تمام یا بخشی از این استاندارد، به هر شکل یا وسیله از جمله تکثیر، ذخیره سازی، انتقال، یا روش دیگری در اختیار افراد ثالث قرار گیرد.

| CONTENTS :                                                      | Page No | فهرست مطالب :                                                  |
|-----------------------------------------------------------------|---------|----------------------------------------------------------------|
| 0. INTRODUCTION .....                                           | 5       | ۰- مقدمه .....                                                 |
| 1. SCOPE.....                                                   | 6       | ۱- دامنه کاربرد .....                                          |
| 2. REFERENCES .....                                             | 7       | ۲- مراجع .....                                                 |
| 3. DEFINITIONS AND TERMINOLOGY .....                            | 11      | ۳- تعاریف و واژگان .....                                       |
| 3.1 Design Pressure.....                                        | 11      | ۳-۱ فشار طراحی .....                                           |
| 3.2 Dike .....                                                  | 11      | ۳-۲ دیوار حائل .....                                           |
| 3.3 Liquefied Natural Gas (LNG) .....                           | 11      | ۳-۳ گاز طبیعی مایع شده LNG .....                               |
| 3.4 Liquefied Petroleum Gas (LPG or LP-Gas) .....               | 11      | ۳-۴ گاز مایع شده نفتی (LPG یا LP-GAS) .....                    |
| 3.5 Natural Gas Liquid (NGL).....                               | 11      | ۳-۵ مایع همراه گاز طبیعی (NGL) .....                           |
| 3.6 Standard Condition .....                                    | 11      | ۳-۶ شرایط استاندارد .....                                      |
| 3.7 Vaporizer .....                                             | 11      | ۳-۷ تبخیر کننده .....                                          |
| 4. SYMBOLS AND ABBREVIATIONS .....                              | 12      | ۴- نشانه ها و اختصارات .....                                   |
| 5. UNITS.....                                                   | 12      | ۵- واحدها .....                                                |
| SECTION A:                                                      |         | قسمت الف:                                                      |
| 6. STORAGE AND HANDLING OF CRUDE OIL AND REFINERY PRODUCTS..... | 13      | ۶- ذخیره سازی و جابجایی نفت خام و فرآورده های پالایشگاهی ..... |
| 6.1 General .....                                               | 13      | ۶-۱ عمومی .....                                                |
| 6.2 Design Requirements .....                                   | 14      | ۶-۲ الزامات طراحی .....                                        |
| 6.3 Tank Dimensions, Capacities and Layout.....                 | 15      | ۶-۳ ابعاد، ظرفیت و جانمایی مخزن .....                          |
| 6.4 Shell Attachments and Tank Appurtenances .....              | 23      | ۶-۴ ملحقیات بدنه و متعلقات مخزن .....                          |

|                                                                                                   |    |                                                                                 |    |
|---------------------------------------------------------------------------------------------------|----|---------------------------------------------------------------------------------|----|
| 6.5 Fixed Roof Fittings.....                                                                      | 24 | ۵-۶ اتصالات سقف ثابت                                                            | ۲۴ |
| 6.6 Floating Roof Fittings .....                                                                  | 26 | ۶-۶ اتصالات سقف شناور                                                           | ۲۶ |
| 6.7 Safe Entry and Cleaning of Petroleum Storage Tank .....                                       | 27 | ۷-۶ ورود ایمن و تمیز کردن مخزن ذخیره نفت                                        | ۲۷ |
| 6.8 Piping System .....                                                                           | 28 | ۸-۶ سامانه لوله کشی                                                             | ۲۸ |
| <b>SECTION B:</b>                                                                                 |    |                                                                                 |    |
| قسمت ب:                                                                                           |    |                                                                                 |    |
| 7. Storing And Handling Of Liquefied Petroleum Gases; LPG.....                                    | 30 | ۷- ذخیره سازی و جابجایی گازهای مایع شده نفتی (LPG)                              | ۳۰ |
| 7.1 General .....                                                                                 | 30 | ۱-۷ عمومی                                                                       | ۳۰ |
| 7.2 Physical Properties and Characteristics ..                                                    | 30 | ۲-۷ خواص فیزیکی و ویژگیها                                                       | ۳۰ |
| 7.3 Requirements.....                                                                             | 30 | ۳-۷ الزامات                                                                     | ۳۰ |
| 7.4 Design Considerations.....                                                                    | 33 | ۴-۷ ملاحظات طراحی                                                               | ۳۳ |
| 7.5 Transfer of LPG Within the Off-Site Facilities of OGP Plants .....                            | 43 | انتقال LPG در تأسیسات خارج از محوطه کارخانجات نفت، گاز و پتروشیمی               | ۴۳ |
| <b>SECTION C:</b>                                                                                 |    |                                                                                 |    |
| قسمت ج :                                                                                          |    |                                                                                 |    |
| 8. LIQUEFIED NATURAL GAS (LNG); AND "NGL" NATURAL GAS LIQUID STORAGE AND TRANSFER FACILITIES..... | 45 | ۸- تأسیسات ذخیره و انتقال گاز طبیعی مایع شده "LNG" و مایع همراه گاز طبیعی "NGL" | ۴۵ |
| 8.1 Introduction.....                                                                             | 45 | ۱-۸ مقدمه                                                                       | ۴۵ |
| 8.2 General Considerations.....                                                                   | 45 | ۲-۸ ملاحظات عمومی                                                               | ۴۵ |
| 8.3 Criteria and Requirements .....                                                               | 46 | ۳-۸ معیارها و الزامات                                                           | ۴۶ |
| 8.4 Transfer of LNG and Refrigerants.....                                                         | 50 | ۴-۸ انتقال LNG و مبردها                                                         | ۵۰ |
| 8.5 Fire PROTECTION.....                                                                          | 51 | ۵-۱ حفاظت در برابر آتش                                                          | ۵۱ |

**SECTION D:**

قسمت د:

**9. STORAGE AND HANDLING OF ETHANE**

**AND ETHYLENE..... 53**

**9.1 General ..... 53**

**9.2 Applicable Design Codes on Temperature  
and Pressure ..... 53**

**9.3 Distance Requirements and Exposure  
Limitations..... 54**

**9.4 Tank Accessories..... 55**

**9.5 Piping requirements..... 57**

**9.6 Transfer, Loading and Unloading Facilities 58**

**9.7 Refrigeration System ..... 59**

۹- ذخیره سازی و جابجایی اتان و اتیلن ..... ۵۳

۹-۱ عمومی ..... ۵۳

۹-۲ آیین نامه‌های طراحی کاربردی برای دما و فشار ۵۳

۹-۳ الزامات فاصله و محدودیت های در پیش رو .... ۵۴

۹-۴ تجهیزات جانبی مخزن ..... ۵۵

۹-۵ الزامات لوله کشی ..... ۵۷

۹-۶ تأسیسات انتقال، بارگیری و تخلیه ..... ۵۸

۹-۷ سامانه تبرید ..... ۵۹

**SECTION E:**

قسمت ه:

**10. STORING AND HANDLING OF**

**ETHANOL AND GASOLINE – ETHANOL**

**BLENDS ..... 60**

**10.1 General ..... 60**

**10.2 SCOPE..... 60**

**10.3 Material Selection ..... 60**

**10.4 Requirements..... 61**

**10.5 Safety and Fire Protection..... 62**

۱۰- ذخیره سازی و جابجایی اتانل و بنزین حاوی اتانل ... ۶۰

۱۰-۱ عمومی ..... ۶۰

۱۰-۲ دامنه کاربرد ..... ۶۰

۱۰-۳ انتخاب مواد ..... ۶۰

۱۰-۴ الزامات ..... ۶۱

۱۰-۵ ایمنی و حفاظت در برابر آتش ..... ۶۲

**SECTION F:**

قسمت و:

**11. STORING AND HANDLING OF**

**GASOLINE-METHANOL/ CO-SOLVENT**

**BLENDS ..... 63**

۱۱- ذخیره سازی و جابجایی مخلوط های بنزین

حاوی متانل / متک اتانل ..... ۶۳

|                                                                                                   |    |                                                                                      |
|---------------------------------------------------------------------------------------------------|----|--------------------------------------------------------------------------------------|
| 11.1 General .....                                                                                | 63 | ۱-۱۱ عمومی ..... ۶۳                                                                  |
| 11.2 Material Selection .....                                                                     | 63 | ۲-۱۱ انتخاب مواد ..... ۶۳                                                            |
| 11.3 Requirements .....                                                                           | 64 | ۳-۱۱ الزامات ..... ۶۴                                                                |
| APPENDICES:                                                                                       |    |                                                                                      |
| APPENDIX A .....                                                                                  | 66 | پیوست ها :                                                                           |
| APPENDIX B TYPICAL LAYOUT LPG<br>PRESSURE STORAGE WITH<br>COLLECTION PIT/RETAINING<br>SYSTEM..... | 67 | پیوست الف ..... ۶۶                                                                   |
| APPENDIX C ARRANGEMENT OF DRAIN<br>FACILITIES .....                                               | 68 | پیوست ب نمونه جانمایی مخزن LPG تحت فشار با<br>گودال جمع آوری/سامانه نگهداشت ..... ۶۷ |
| APPENDIX D AIR - DRYER INSTALLATION<br>FOR ETHANOL STORAGE<br>TANKS AT TERMINALS.....             | 69 | پیوست ج چیدمان تأسیسات تخلیه ..... ۶۸                                                |
| APPENDIX E REFINERIES LIQUEFIED<br>PETROLEUM GAS<br>SPECIFICATION .....                           | 70 | پیوست د نصب هواخشک کن برای مخازن ذخیره<br>اتانول در پایانه ها ..... ۶۹               |
|                                                                                                   |    | پیوست ه مشخصات فنی گاز مایع شده نفتی<br>پالایشگاه ها ..... ۷۰                        |

## 0. INTRODUCTION

"Process Design of Offsite Facilities for OGP Industries" is broad and contains various subjects of paramount importance. Therefore, a group of Process Engineering Standards are prepared to cover this subject. This group includes the following Standards:

| <u>Standard Code</u>         | <u>Standard Title</u>                                                                        |
|------------------------------|----------------------------------------------------------------------------------------------|
| <a href="#">IPS-E-PR-360</a> | " Engineering Standard for Process Design of Liquid & Gas Transfer & Storage"                |
| <a href="#">IPS-E-PR-370</a> | " Engineering Standard for Process Design of Loading & Unloading Facilities for Road Tankers |
| <a href="#">IPS-E-PR-380</a> | " Engineering Standard for Process Design of Solids Handling Systems"                        |

This Engineering Standard Specification covers:  
 "Process Design of Liquid and Gas Transfer and Storage"

## • - مقدمه

"طراحی فرآیند تاسیسات خارج از محوطه برای صنایع نفت، گاز، پتروشیمی بسیار گسترده و دارای موضوع های مختلف با اهمیتی است که برای پوشش آن یک گروه استانداردهای مهندسی فرآیندی، تهیه شده است. این گروه شامل استانداردهای زیر می باشند :

| <u>آیین نامه استاندارد</u>   | <u>موضوع استاندارد</u>                                                              |
|------------------------------|-------------------------------------------------------------------------------------|
| <a href="#">IPS-E-PR-360</a> | "استاندارد مهندسی برای طراحی فرآیندی انتقال مایع و گاز و ذخیره سازی"                |
| <a href="#">IPS-E-PR-370</a> | "استاندارد مهندسی برای طراحی فرآیندی تجهیزات بارگیری و تخلیه برای تانکرهای جاده ای" |
| <a href="#">IPS-E-PR-380</a> | "استاندارد مهندسی برای طراحی فرآیندی سامانه های جابجایی مواد جامد"                  |

این استاندارد مهندسی مشخصات شامل :  
 "طراحی فرآیندی انتقال مایع و گاز و ذخیره سازی" میباشد.