ENGINEERING STANDARD

FOR

AVIATION TURBINE FUEL STORAGE TANKS

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0. INTRODUCTION

"Storage Tanks" are broad and contain variable types and usages of paramount importance therefore, a group of engineering standards are prepared to cover the subject. This group includes the following standards:

STANDARD CODE	STANDARD TITLE
IPS-E-ME-100	"Atmospheric above Ground Welded Steel Storage Tanks"
IPS-E-ME-110	"Large Welded Low Pressure Storag Tanks"
IPS-E-ME-120	"Aviation Turbine Fuel Storage Tanks"
IPS-E-ME-130	"Pressure Storage Vessels and Spheres"

The storage tanks covered in this Standard consist of an internal floating deck protected by a fixed-type roof which, while permitting the cover to operate up and down, prevents the ingress of rainwater, sand or snow. In addition the internal floating cover tanks have the following attendant advantages:

-They reduce vapor losses.

-They permit highly volatile products to be stored at atmospheric pressure.

-They promote cleanliness of the product stored.

-They reduce internal corrosion.

Furthermore internal floating cover storage tanks where an internal deck is fitted in a tank containing a liquid such as turbine gasoline which, at ambient temperatures, is liable to form a flammable mixture above the liquid, the interposing of a floating deck between the liquid and the tank space will so reduce vapor evolution that the space is never likely to contain a flammable vapor mixture.

The requirements given in this Standard supplement and modify those of API Standard 650 Appendix H "Internal Floating Roofs" Eighth Edition Nov. 1988.

For ease of reference API Clause or Paragraph Numbers for items supplemented are mentioned at the begining of each Clause or Paragraph. Clauses in API 650 Appendix H not mentioned remain unaltered.

For the purpose of this Specification, the following definitions shall hold:

Sub. (Substitution) : The API Std. Clause is deleted and replaced by a new Clause.

Del. (Deletion) : The API Std. Clause is deleted without any replacement.

Add. (Addition) : A new Clause with a new number is added.

Mod. (Modification) : Part of the API Std. Clause is modified, and/or a new description and/or condition is added to that Clause.

1. SCOPE

1.1 (H.1 Sub.)

This Engineering Standard covers the minimum design requirements for aviation turbine fuel storage tanks.

1.2 (H.1 Add.)

This Engineering Standard is to be used in conjunction with Engineering Standard for Atmospheric above Ground Welded Steel Storage Tanks "IPS-E-ME-100"

2. SOURCES AND REFERENCES

2.1 Sources

In preparation of this Standard, in addition to the Referenced Codes and Standards mentioned in 2.2, the following standards and publications have also been considered:

NIOC (NATIONAL IRANIAN OIL COMPANY)

Engineering Std. SP-41-2 "Specification for Aviation Turbine Fuel Storage Tanks" June 1976.

API (AMERICAN PETROLEUM INSTITUTE)

Standard 650 Appendix H "Internal Floating Roofs" Eighth Edition Nov. 1988.

BSI (BRITISH STANDARD INSTITUTION)

BS 2654 "Manufacture of Vertical Steel Welded Nonrefrigerated Storage Tanks with Butt Welded Shell for Petroleum Industry" 1989.

ROYAL DUTCH/SHELL ENGINEERING STANDARD

DEP 34.51.01.31 Gen. "Standard Vertical Tanks Design and Fabrication" Dec. 1983.

2.2 References

Throughout this Standard the following standards and codes are refered to. The edition of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Consultnat.

API (AMERICAN PETROLEUM INSTITUTE)

API Standard 650 "Welded Steel Tanks for Oil Storage"
API 650 Appendix H "Internal Floating Roofs"

IPS (IRANIAN PETROLEUM STANDARDS)

M-ME-100	"Material and Equipment Standard for Atmospheric Storage Tanks"
M-ME-120	"Material and Equipment Standard for Aviation Turbine Fuel Storage Tanks"
C-ME-100	"Construction Standard for Atmospheric Storage Tanks"
C-ME-120	"Construction Standard for Aviation Turbin Fuel Storage Tanks"

3. UNITS

International system of units (SI) in accordance with IPS-E-GN-100 shall be used. Whenever reference is made to API / ASME or any other standards, equivalent SI unit system for dimensions, fasteners and flanges shall be substituted.

For pipe size the international nomenclature "diameter nominal" written as DN 15, 25, 40, 50, etc. has been used in accordance with ISO 6708 1980, ANSI / ASME B16.5 1981 and ANSI / ASME B31.3 1983 (see Appendix A). Also for pipe flanges pressure temperature ratings "pressure nominal" written as PN 20, 50, 68, etc. has been used in accordance with said Standards (see Appendix B).

4. MATERIAL SELECTION

4.1 (H.3.3 Add.)

All fasteners in contact with the product or product vapor shall be of stainless steel or aluminum.

5. DESIGN

5.1 General (H.4 Add.)

5.1.1 Floating covers in fixed-roof are normally used for the following applications:

a) reduction of ingress of rainwater, sand and snow into the product;
b) reduction of vapor losses**;**
c) to reduce the hazard of static ignition associated with highly charged liquid surfaces;
d) reduction of air pollution;
e) as an alternative to floating roofs in open-top tanks, in locations where excessive snow may be experienced.

5.1.2 For design of aviation fuel storage tanks the requirements of Section 5 of IPS-E-ME-100 shall also be fulfilled.

5.2 Design Data (H.4 Add.)

5.2.1 Aviation fuel storage tanks shall be of fixed self-supporting cone roof designed with internal metallic floating deck and inverted sloping floor at a gradient of 4% to a central drain sump.

5.2.2 The floating covers should be designed to support at least 3 men (300 kg over 3 m^2) anywhere over the surface of the cover in the floating (water testing only) and supported condition.

5.2.3 If not specified, the specific gravity of the contained liquid shall be taken as 0.7.

5.2.4 Pump-in rates should be restricted to fluid velocity of 1m/sec. at the inlet nozzle until the floating deck becomes fully buoyant.

5.3 Bottom Design (H.4 Add.)

5.3.1 Bottom design for aviation turbine fuel storage tanks shall be in accordance with Section 5.3 of IPS-E-ME-100 Standard.

5.4 Shell Design (H.4 Add.)

5.4.1 Design of shell for aviation turbine fuel storage tanks shall be in accordance with Section 5.4 of IPS-E-ME-100 Standard.

5.4.2 It is recommended that this type of tank be limited to a maximum diameter of 39 m.

5.5 Roof Design (H.5 Add.)

5.5.1 Design of roof (fixed and floating) for aviation fuel storage tanks shall be in accordance with Sub-sections 5.5 of IPS-E-ME-100 Standard.

5.5.2 The design should not allow the content to flow on the floating cover.

5.5.3 (H.4.7 Sub.)

The floating decks shall be provided with supports for a low level to be specified. The support shall be designed with the following characteristics:

a) The support legs of floating decks shall be set or adjusted so that the bottom of the rim section is just clear of the top of the tank shell manhole(s)

This will normally be between 1.12 m and 1.22 m. Other heights may be specified to clear other tank internals.

b) The design should ensure that all internal appurtenances such as side entry mixer, piping, inlet and outlet connections, etc. are clear of the cover in the low position.

c) Supports fixed to the cover or the tank bottom may be used. The supports, attachments and tank bottom should be designed to support a live load of 0.4 KN/m^2.

d) If the load on a support exceeds 2.5 KN, steel pads or other means should be used to distribute the load on the tank bottom. Pads should be continuously welded to the tank bottom to prevent corrosion under the pads. Supports fabricated from pipe shall be provided with a notch at the bottom for drainage.

5.5.4 (H.5.2.1 Mod.)

Floating decks shall be positively buoyant, and shall be of all metallic construction except for the flexible seal.

5.5.5 (H.5.1.5 Add.)

For aluminum non-contact floating deck design, the minimum pontoon volume shall be sufficient to maintain the roof floating with a buoyancy that will support twice the weight of the roof deck.

5.5.6 The minimum pontoon volume of single and double deck steel floating cover shall be sufficient to maintain the roof floating if the deck and any two pontoons are punctured or flooded.

5.5.7 Non-contact floating decks shall have a skirt (vapor seal) around the cover periphery extending 125 mm into the liquid. In addition all openings through all covers shall also have skirts extending 125 mm into the liquid.

5.5.8 Where fixed-roof support column(s) anti-rotation devices or other appurtenances pass through the cover, seals should be provided to ensure a reasonably close fit, taking into account horizontal and vertical movements of the cover.

5.6 Appurtenances and Accessories

5.6.1 Design of appurtenances and accessories for aviation fuel storage tanks shall be in accordance with Section 5.6 of IPS-E-ME-100 standard. The followings are supplementary requirements:

5.6.2 (H.6.8 Add.)

Permanent easily operable water draw-off facilities shall be provided. A DN 40 (1½ in.) sch. 80 drain pipe shall be fitted to siphon water from the sump with provision at drain to observe interface of hydrocarbon and water during water draw-off. Drain-pipe shall be fitted with a non-freeze valve in climates subject to freezing.

5.6.3 (H.6.9 Add.)

On tanks used for storing aviation fuels, a floating suction of the form of swing pipe e.g. fitted with floats shall be provided. The main object of the fitting is to minimize the risk of contamination by water.

5.6.4 (H.6.6 Add.)

Gaging and sampling facilities shall be provided. Additionally sidesampling facilities adjacent to spiral stairway shall be provided for normal operational sampling. Valve shall be as close to tank as possible and located before down-facing bend.

5.6.5 (H.6.10 Add.)

The tank inlet line shall have an inlet extension pipe according to Fig. 1 of this Standard in order to minimize turbulence during high tank filling rates.

5.6.6 (H.6.11 Add.)

Roof drains from floating decks to outside of the tank are not required. Emergency drains should be provided. Such drains must be manually operated from the fixed external roof or be automatic. Automatic drains must project into the liquid 125 mm to form a vapor seal.

5.6.7 (H.6.1.1 Sub.)

Access ladders from the fixed roof to the floating cover are not recommended. Access should be by way of the shell and cover manholes after the tank has been emptied and gas-freed.

5.6.8 (H.6.5.2 Sub.)

Floating decks shall be provided with one manhole with minimum 600 mm ID for decks up to 20 m dia and two manholes with the above ID for tanks over 20 m dia.

The manhole(s) should be designed to be opened from the underside of the cover. Loose covers may be used but the height of the manhole neck should be such that as to prevent the contents flowing on the cover.

5.6.9 (H.6.12 Add.)

Floating covers shall be electrically bonded or earthed to the outer tank. A minimum of two cables should be provided on tanks up to 20 m diameter and a minimum of four for larger diameter tanks. All movable metal parts such as column, sliding cover plates and loose manways covers must be bonded to the cover with suitable cables to avoid static accumulation.

5.6.10 (H.6.2 Mod.)

Where feasible (as in refineries and process plants) inert gas blanketing should be provided and in such case pressure/vacuum valves of adequate capacity shall be fitted taking into consideration maximum capacity of gas blanketing control valves. Otherwise the venting requirements of H.6.2 of Appendix H of API Standard 650 should be followed.

5.6.11 (H.6.13 Add.)

Fire fighting devices of approved installations shall be provided around the periphery of the tank. Reference is made to Section 5.6.22 of IPS-E-ME-100 Standard.

5.7 Tank Anchorage (H.8 Add.)

5.7.1 Design of tank anchorage, if required, shall be in accordance with Section 5.7 of IPS-E-ME-100 Standard.

6. FABRICATION (H.7.1 Add.)

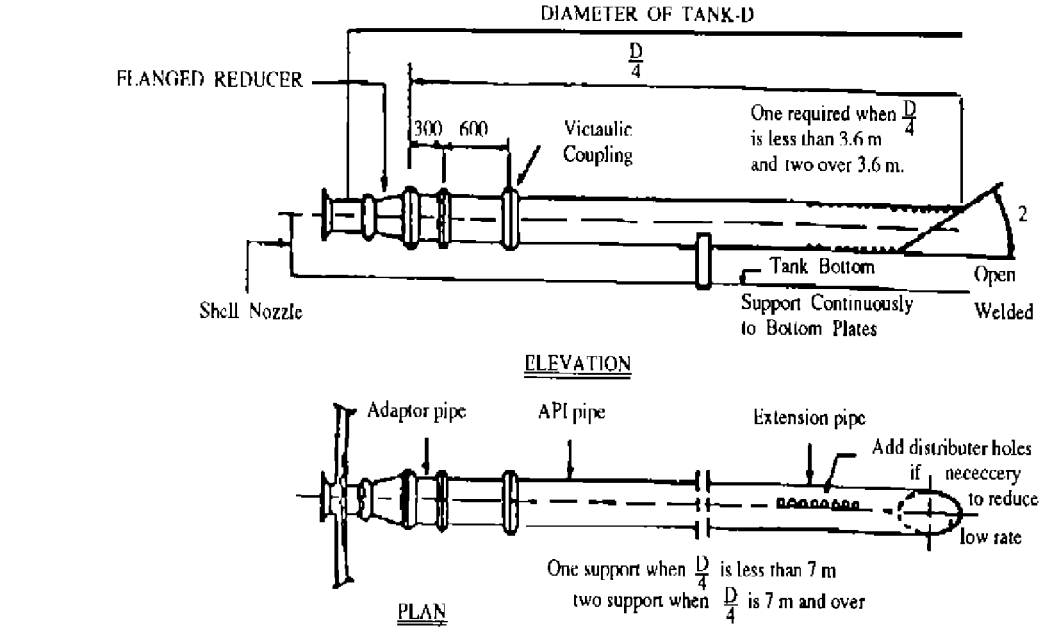
6.1 For fabrication of parts to be incorporated into aviation fuel storage tanks, The requirements of IPS-M-ME-120 Standard shall be fulfilled.

7. WELDING (H.7 Add.)

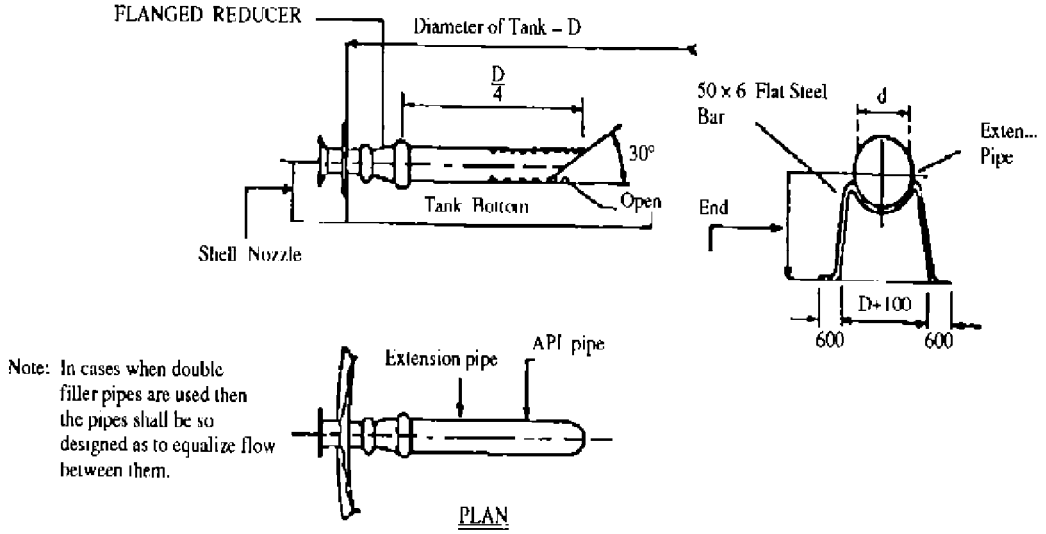
7.1 Welding of parts of aviation fuel storage tanks shall comply with Section 9 of IPS-M-ME-100 Standard.

8. SITE ERECTION (H.7 Add.)

8.1 Site erection of aviation fuel storage tanks shall be in accordance with IPS-C-ME-120 Standard.



INLET EXTENSION PIPE FOR TANKS 7.5 METERS DIAMETER AND OVER



INLET EXTENSION PIPE FOR TANKS 7.5 METERS DIAMETER AND UND

Pipe Size	Diameter in DN					
Shell Nozzle	75	100	150	200	250	300
Extension Pipe	100	150	200	300	350	460

All dimensions in mm unless otherwise stated.

DETAIL OF MAIN INLET EXTENSION PIPE
Fig. 1

9. INSPECTION AND TEST (H.7 Add.)

9.1 Inspection and test of aviation fuel storage tanks shall be in accordance with Section 9 of IPS-E-ME-100 standard.

9.2 All field fabricated pontoons shall be tested for leaks by penetrating oil or by any other approved method consistent with the design. All shop fabricated pontoons shall be pressure leak tested with a soap type detecting solution or by any other approved method consistent with the design.

10. TANK FOUNDATIONS (H.9 Add.)

10.1 design of tank foundation for aviation fuel storage tanks should be in accordance with Section 10 of IPS-E-ME-100 standard.

APPENDICES

APPENDIX A
PIPE COMPONENTS - NOMINAL SIZE

The purpose of this Appendix is to present an equivalent identity for the piping components nominal size in Imperial System and SI System.

TABLE

Nominal Size		Nominal Size		Nominal Size		Nominal Size	
DN (1)	NPS (2)	DN (1)	NPS (2)	DN (1)	NPS (2)	DN (1)	NPS (2)
15	½	100	4	500	20	1000	40
20	3/4	125	5	600	24	1050	42
25	1	150	6	650	26	1100	44
32	1¼	200	8	700	28	1150	46
40	1½	250	10	750	30	1200	48
50	2	300	12	800	32	1300	52
65	2½	350	14	850	34	1400	56
80	3	400	16	900	36	1500	60
90	3½	450	18	950	38	1800	72

(1) Diameter Nominal, mm.

(2) Nominal pipe Size, Inch.

APPENDIX B
PIPE FLANGES, PRESSURE - TEMPERATURE RATINGS

The purpose of this Appendix is to present an equivalent identity for the pipe flange nominal pressure temperature ratings in Imperial System and SI System.

TABLE

PN (1)	ANSI EQUIVALENT (2)
20	150
50	300
68	400
100	600
150	900
250	1500
420	2500

(1) Pressure Nominal (PN), bar gage.

(2) Pounds per square inch gage, (Psig).