ENGINEERING STANDARD

FOR

SANITARY SEWAGE TREATMENT

ORIGINAL EDITION

MAY 1997

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2003(1) and July 2012(2). The approved modifications are included in the present issue of IPS.

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

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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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, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the “Company" where this standard is a 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.

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1. SCOPE

This engineering standard specification covers the minimum requirements for design of small sanitary sewage treatment plants at oil industries and residential areas. Also the characteristics and chemistry of sewage and its treatment methods are prescribed.

Guidance is given for the disposal of final effluents discharged from sewage treatment works.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 203 on Dec. 2003. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on July 2012. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No 373 on July 2012. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

BSI (BRITISH STANDARDS INSTITUTION)

BS 6297: 1983	"Design and Installation of Small Sewage Treatment Works and Cesspools"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-CE-380	"Sewerage & Surface Water Drainage System"
IPS-E-GN-100	“Engineering Standard for Units”

3. DEFINITIONS AND TERMINOLOGY

3.1 Activated Sludge

A flocculent microbial/ mass, produced when sewage is continuously aerated.

3.2 Biochemical Oxygen Demand (BOD)

The amount of dissolved oxygen consumed by microbiological action when a sample is incubated, usually for 5 days at 20 C

3.3 Biological Filter

A bed of relatively inert material (such as slay, molded plastics, clinker, etc) to promote or assist natural aerobic degradation of sewage.

3.4 Cesspool

A covered watertight tank used for receiving and storing sewage from premises which cannot be connected to a public sewer and where ground conditions prevent the use of a small sewage treatment works including a septic tank. A fur there stage of treating sewage

3.5 Tertiary Treatments (Effluent Polishing)

A furtherer stayed of treating sewage by removing suspended solids. Consequential removal of residual BOD may occur.

3.6 Filter Medium

The material of which the biological filter is formed and on which a biological film containing bacteria and fungi develops.

3.7 Final Effluent

The effluent discharged from a sewage treatment plant.

3.8 Population Equivalent

The equivalent, in terms of a fixed population, of a varying or transient population, of a hospital or restaurant, based upon a figure of 0.06.kg BOD per head per 120L per head per day.

3.9 Primary Settlement Tank

A tank in which the majority of settable solids are removed form the crude sewage flowing through it.

3.10 Secondary Settlement Tank

A thank in which settable solids or humus is separated from the effluent flowing through it from biological filters or an activated sludge plant.

3.11 Septic Tank

A type of settlement tank in which sludge is retained for sufficient time for the organic matter to undergo anaerobic decomposition

3.12 Sewage

The water– borne wastes of a community.

3.13 Sludge

A mixture of solids and water produced during the treatment of wastewater

3.14 Suspended Solids (SS)

Solid in suspension in sewage liquors as measured by filtration either through a glass fiber filter paper followed by washing and drying at 105 C, or by centrifuging flowed by washing and removal of the supernatant liquid.

3.15 Top Water Level (TWL)

The maximum water level in a settlement tanks an aeration tank or a sludge storage tank.

For more definitions refer to clause 3 of BS 6297 together with IPS-E-CE-380

4. UNITS

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified.

5. COLLECTION OF INFORMATION

The following main items of basic information should be obtained before designing small sewage treatment works:

a) Requirements of the local building control and planning authority;

b) Requirements of the appropriate water/river authority or its agent;

c) Minimum and maximum number of persons (resident and non-resident) to be served;

d) Average 24 h water consumption, and any special conditions affecting the composition of sewage and peak rates of flow; data are obtainable from the local water undertaking in many instances;

e) Existence of infiltration water;

f) Particulars of site;

1) Distance from nearest habitable building

2) Prevailing winds

3) Levels

4) Information as to the nature of the ground including the level and variations of the water table

5) Access for vehicles and plant

g) Particulars of outfall, e.g. tidal or inland waters, rivers, streams, ditches or soakage; also the proximity, highest known flood level and minimum flow of any stream or other watercourse to which discharge of the effluent is possible;

h) Conditions under which the works will normally operate and be maintained;

i) Possibility of the need for future extensions of the works or of their elimination by a comprehensive scheme;

j) Availability of electric power and mains water;

k) Facilities for eventual disposal of sludge and screenings.

6. DESIGN: GENERAL

6.1 Climatic Considerations

Design factors in this standard are for average Iran temperate conditions only and the performance of treatment units will vary with changes in temperature, exposure and altitude. Design factors recommended should not therefore be adopted for use in non-temperate climates or in temperate climates with extremes of conditions without special consideration. The operation of works is also affected by the prevailing weather. For example, the desludging of tanks may have to be carried out more frequently in hot conditions, and during periods of frost, filters and mechanical plant may be affected by freezing.

7. GENERAL REQUIREMENTS FOR TANKS

It is essential that tanks constructed to hold or treat sewage, e.g. cesspools, septic tanks, primary and secondary settlement tanks and chambers, should be of watertight construction so that they permit neither ingress of ground water nor egress of sewage to the ground.

8. CESSPOOLS

8.1 General

8.1.1 It is essential that cesspools are, and remain, impervious to ingress of ground- or surface-water and to leakage.

8.1.2 Before deciding to provide a cesspool, the available local facilities for continual emptying should be carefully ascertained and whether such a service will be provided by public authority or private contractor.

9. SEPTIC TANKS

9.1 Capacity

Calculation of the total capacity of septic tanks for the populations covered by this code should be made on the basis of the number of persons to be served, and the following formula is recommended for general use, where desludging is carried out at not more than 12-monthly intervals:

$C = (180P + 2000)$

Where

C is the capacity of the tank (in L) with a minimum value of 2720 L; and

P is the design population with a minimum value of 4.

This formula allows for proportionately larger retention at the lower populations in order to cover the surges in flow which are experienced in small systems.

For schools, similar premises and hotels, capacity requirements can be evaluated separately or included in the general formula using population equivalent figures for *P* after taking into account factors such as part-time occupancy and shared cooking facilities; for example, in appropriate circumstances allowance might be made in the factor *P* on the basis of two part-time occupants being equivalent to one full-time occupant. Specialist advice is necessary for plants treating abnormal flows or non-domestic sewage.

Where waste disposal units are installed, additional sludge solids are discharged with the sewage and the capacity of septic tanks should be increased by 70 L for each person served.

Where multi-compartment tanks are used, the inlet (settlement) zone should have a capacity of not less than 2/3 *C* and the subsequent zones should have a combined capacity of not less than 1/3 *C*.

The calculated capacity C is recommended as a minimum for all types of septic tanks and the figure of 180 in the formula may be regarded as made up as follows:

	L	
Sludge storage capacity		90
Balance to cover		
a) 12 h storage of average domestic water usage of 120 L per head per day assumed as passing to drains	60	90
b) higher consumptions and/or 90 infiltration etc.	30	
		180

10. PRELIMINARY TREATMENT

Rags and floating debris will inevitably form part of the flow reaching the works and to reduce blockages and fouling of plant, particularly with larger installations, one of the following methods may be adopted.

a) The placing of a small metal screen with 30 mm to 75 mm clear spacing between the vertical bars in the inlet channel. Provision should be made for overflow or by-pass of the screen in the event of blockage. Provision should also be made for the regular and safe disposal of screenings.

b) The provision of a macerator in the inlet channel or pipe to chop up all the debris before it enters the plant.

c) If the sewage has to be pumped at any stage before treatment, a pump incorporating a cutting edge or a separate macerator unit.

Specialist design advice on the need for grit removal facilities may be necessary.

11. PRIMARY AND SECONDARY SETTLEMENT TANKS

11.1 General

Settlement tanks may be of the horizontal flow or upward flow type.

11.2 Primary Settlement Tanks

Primary settlement tanks are used to settle out solids prior to biological treatment and thus reduce the BOD load on following units. They should not normally be used for populations of fewer than about 100.

11.3 Capacities of Primary Settlement Tanks

11.3.1 Upward flow tanks

The arrangement of an upward flow settlement tank should be such that the nominal upward flow velocity through it is less than the settling velocity of the material to be removed. A figure of 0.9 m/h at maximum flow rate is recommended. Where the maximum flow rate is unknown, the surface area of the tank may be calculated from the formula:

$$\mathrm{A} = \frac{1}{10} P^{0.85}$$

Where

A is the minimum area (in m^2) of the tank at the top of the hopper; and

P is the design population.

11.3.2 Primary horizontal flow tanks

The calculation of the capacity of a horizontal flow tank should be based on the number of persons to be served and the dry weather flow. The detention period should not exceed 12 h at dry weather flow and the following formula is recommended:

$$C = 180\ P^{0.85}$$

Where

C is the gross capacity of the tank (in L); and

P is the design population

11.4 Capacities of Secondary Settlement Tanks

11.4.1 Upward flow tanks. The surface area should be not less than:

$$\mathrm{A} = \frac{3}{40} P^{0.85}$$

Where

A is the minimum area (in m^2) of the tank at the top of the hopper; and

P is the design population

11.4.2 Secondary horizontal flow tanks

The calculation of the capacity of a horizontal flow tank should be based on the number of persons to be served and the dry weather flow. The following formula is recommended:

$C = 135\ P^{0.85}$

Where

C is the gross capacity of the tank (in L); and

P is the design population

12. BIOLOGICAL FILTERS, INCLUDING

12.1 General. In a conventional biological filter, the effluent from a septic tank or a primary settlement tank is brought into contact with a suitable medium, the surface of which becomes coated with a biological film. The film assimilates and oxidizes much of the polluting matter through the agency of micro-organisms. The biological filter requires ample ventilation and an efficient system of underdrains leading to an outlet.

12.2 Volume of Filter

The volume of mineral medium required can be calculated by the formula

$V = 1.5\ P^{0.85}$

Where

V is the volume of medium (in m^3); and

P is the design population.

In Table 1 shown below, the volumes of medium required for representative numbers of users are given; intermediate values may be interpolated on a linear basis. The volume of medium per user is also given and it can be seen that surge flows are allowed for. When waste disposal units are installed, the volume of medium obtained from the formula or from the tables should be increased by 30 %, prorata for that part of the population equipped with waste disposal units.

Where

Function $V = 1.5\ P^{0.85}$

V is the volume of medium (in m^3)

P is the design population.

TABLE 1 - FILTER MEDIUM CAPACITY

P	4	6	8	10	15	20	25	30	40	50
V	4.7	6.6	8.4	10.1	14.2	18.0	21.7	25.2	32.0	38.6
V/P	1.18	1.11	1.05	1.01	0.95	0.90	0.87	0.84	0.80	0.77
P	100	200	300	400	500	600	700	800	900	1000
V	69	122	171	217	261	303	345	385	425	464
V/P	0.69	0.61	0.57	0.54	0.52	0.51	0.49	0.48	0.47	0.46

13. ACTIVATED SLUDGE UNITS

13.1 General

For the purposes of this standard, installations operating on activated sludge principles are those providing for the aeration of crude unsettled sewage with activated sludge.

14. TERTIARY TREATMENT

14.1 General

Conventional biological treatment can produce an effluent of 30 : 20 standard (SS : BOD), or better, after separation of solids, but for reliable production of higher quality effluents a tertiary or “polishing” stage of treatment is necessary before final disposal. Polishing processes rely mainly on flocculation, sedimentation or filtration of residual suspended solids. The BOD associated with the solids is removed and some methods also provide further biological purification.

Polishing is suitable only for dealing with good quality secondary effluents and, in general, will operate efficiently only at works where biological treatment is adequate. If a suitably chosen polishing process is applied to a good quality secondary effluent it should normally be possible to achieve at least a 10 : 10 standard.

Several methods are now available. These include slow sand filtration, rapid sand filtration, microstraining and retention in lagoons. In small sewage treatment works the following methods are more common:

a) Treatment over grass plots;

b) Upward-flow clarifiers (not normally used with activated sludge plants).

15. DISPOSAL OF FINAL EFFLUENT

15.1 General

After treatment, the disposal of final effluent should be by one of the methods.

15.2 Disposal to inland or tidal water

15.3 Disposal to underground strata

16. PUMPING

16.1 General

Where pumping is unavoidable because of site conditions the following points should be considered:

a) Availability of electricity (almost essential);

b) The location of pumps;

c) Availability of a suitable pump;

d) The advisability of installing pumping units in duplicate;

e) Suitable housing for equipment;

f) Lagging of all exposed pipework to prevent damage by frost;

g) Occurrence of septicity.