ने.गुण. ५९६ : २०७९

NS 596: 2079

नेपाल गुणस्तर

NEPAL STANDARD

Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes for Water Supply - Specification

Government of Nepal

Ministry of Industry, Commerce and Supplies

Nepal Bureau of Standards and Metrology (NBSM)

Kathmandu, Nepal

www.nbsm.gov.np

© Nepal Council for Standards (NCS), 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from NBSM at the address below.

Nepal Bureau of Standards and Metrology
Balaju, Kathmandu, Nepal
Phone: +977 1 4350445/4350818
Email: info@nbsm.gov.np
Website: www.nbsm.gov.np

Table of Contents

Forward III

1. Scope.....1

2. References.....1

3. Terminology.....1

4. Symbol and abbreviated terms.....3

5. Material 4

6. Classification of pipes.....5

7. General requirements of pipes.....6

8. Geometrical characteristics of pipes.....6

9. Mechanical characteristics of pipes Geometrical characteristics of pipe.....15

10. Physical and Chemical Characteristics.....15

11. Mechanical Characteristics of Assemblies Including Joints.....16

12. Elastomeric seals.....19

13. Sampling And Criteria For Conformity.....19

14. Marking 19

Annex A.....21

Annex B.....22

Annex C.....23

Annex D.....25

Annex E.....26

Annex F.....27

Annex G.....28

Annex H.....35

Foreword

NBSM (Nepal Bureau of Standards and Metrology) is the National Standard Body involved in the development of standards in the country. The standard development process involves committee consisting of multi-stakeholders both from public and private sectors.

This standard is developed by technical committee having multi-stakeholder participation and approved by Nepal Standard Council as per Nepal Standard (Certification) Act, 1980.

This standard pertains to Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes for Water Supply - Specification, for water supply use. This standard is based on ISO16422:2014 – Pipes and joints made of oriented unplasticized poly (vinyl chloride) (PVC – O) for the conveyance of water under pressure – Specification and IS 16647:2017 – Oriented Unplasticized Polyvinyl Chloride (PVC –O) Pipes for water supply – Specification.

This standard will benefit both the users and the producers to have product of appropriate design and dimension; and will provide assurance of quality of the products and variety of product for water supply as well. The standard covers materials, design and dimension, tests, and sampling requirements.

This standard contributes towards fulfilment of SDG goals.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. NBSM shall not be held responsible for identifying any or all such patent rights. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.nbsm.gov.np.

Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes for Water Supply - Specification

1 SCOPE

1.1 This standard specifies the requirements of Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes, for piping systems intended to be used underground, or above ground but not exposed to direct sunlight, for water supply. This standard covers requirement for pipes of sizes 63 mm to 1200 mm with maximum required strength (MRS) class 450 and 500 and design coefficient of 1.4 and 1.6.

1.2 The piping system according to this standard is intended for the conveyance of cold water under pressure and are suitable for conveyance of water, including potable water, up to and including 45 °C and especially in those applications where special performance requirements are needed, such as impact loads and pressure fluctuations, up to pressure of 2.5 MPa.

1.3 Joints constructed of other materials should meet requirements of relevant standards in addition to the fitness-for-purpose requirements of this standard.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following terms and definitions shall apply.

3.1 Nominal Outside Diameter (d_n) — Numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size.

3.2 Outside Diameter at Any Point (d_e) — Value of the measurement of the outside diameter through its cross-section at any point of a pipe or spigot, rounded up to the nearest 0.1 mm.

3.3 Mean Outside Diameter (d_{em}) — Value of the measurement of the outer circumference of a pipe or spigot end of a fitting in any cross-section, divided by a (- 3.142), rounded up to the nearest 0.1 mm.

3.4 Minimum Outside Diameter ($d_{em\ min}$) — The minimum value of the mean outside diameter as specified in this standard. The value is equal to the nominal outside diameter d and is expressed in mm.

3.5 Maximum Outside Diameter ($d_{em\ max}$) — The maximum value of the mean outside diameter as specified in this standard.

3.6 In side Diameter at any Point of a Pipe Socket (d_i) — Value of the measurement of the inside diameter through its cross-section at any point of a pipe socket, rounded up to the nearest 0.1 mm.

3.7 Nominal Wall Thickness (e_n) — Specified wall thickness, in mm.

Note: It is identical to the specified minimum wall thickness at any point $e_{y\ min}$.

3.8 Out of Roundness (Ovality) — The difference between the measured maximum and the measured minimum outside diameter in the same cross-section of the pipe or spigot.

3.9 Tolerance —Permitted variation of the specified value of a quantity expressed as the difference between the permitted maximum and the permitted minimum value.

3.10 Nominal Pressure (PN) — Alphanumeric designation related to the mechanical characteristics of the components of a piping system and used for *re*ference purposes.

3.11 Hydrostatic Pressure (p) — Internal pressure applied to a piping system.

3.12 Working Pressure — Maximum pressure which a piping system can sustain in continuous use under given service conditions without pressure surge.

NOTE— For thermoplastics piping systems, the value of the nominal pressure is equal to the working pressure at a temperature of 27°C, expressed in kg/cm^2.

3.13 Hydrostatic Stress (σ) — Stress, expressed in MPa, induced in the wall of a pipe when it is subjected to internal water pressure.

NOTE: It is calculated using the following approximate equation.

$$\sigma = \frac{P\,(d_n - e_n)}{2e_n}$$

where

p — applied internal pressure, in MPa;

d_n — nominal outside diameter of the pipe, in mm; and

e_n = nominal wall thickness, in mm.

3.14 Long-Term Hydrostatic Strength for 50 Years at 20°C (σ_{LTHS}) — Quantity with the unit of stress in MPa, which can be considered to be a property of the material under consideration.

NOTE— It represents the 97.5 percent lower confidence limit for the Long-term hydrostatic strength and equals the predicted average strength at a temperature of 20°C and for a time of 50 years with internal water pressure.

3.15 Lower Confidence Limit of the Predicted Hydrostatic Strength (σ_{LpL}) — Quantity with the dimension of stress, which represents the 97.5 percent lower confidence limit of the predicted hydrostatic strength for a single value at a temperature T and a time t.

NOTES:

1. It is denoted as $\sigma_{LPL} = \sigma(t,T, 0.975)$
2. The value of this quantity is determined by the method given in NS...(Applicable Nepal standard)

3.16 Minimum Required Strength (MRS) — Required value of σ_{lpl} for a temperature T of 20°C and a time t of 50 years.

3.17 Design Coefficient (C) — Coefficient with a value greater than one, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in σ_{lpl} •

3.18 Orientation Factor — Factor related to the stretch ratio used in orientation processing.

3.18.1 Axial Orientation Factor — Ratio between the length of the test piece before heat treatment and the *lowest measured length after the heat treatment (see 9.4):*

$$\lambda_a = \frac{L_0}{L_i}$$

3.18.2 Circumferential Orientation Factor — Ratio between the diameter of test piece before and after heat treatment (see 9.4):

$$\lambda_c = \frac{(D_{em} - e_{em})}{(D_i - e_i)}$$

The orientation ratio in tangential direction is the lowest measured value.

3.19 Type Tests — Tests carried out whenever a change is made in the composition or in the size/series in order to establish the suitability and the performance capability of the pipe.

3.20 Acceptance Tests — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.21 Virgin Material — Material in such form as granules or powder that has not been subjected to use or processing other than that required for it's from the production of pipes, which will be reprocessed in a manufacturer's plant by a process such as extrusion and for which the complete formulation is known.

3.22 Own Rework Material — Material prepared from rejected unused pipes, including the trimmings from the production of pipes, which will be reprocessed in a manufacturer's plant by a process such as extrusion and for which the complete formulation is known.

3.23 Nominal Pipe Length (l) — Effective length of pipes excluding the depth of the socket.

4 SYMBOLS AND ABBREVIATED TERMS

4.1 Symbols

C	=	Overall service (design) coefficient
d_e	=	Outside diameter at any point
d_{em}	=	Mean outside diameter
d_i	=	Inside diameter at any point
d_{im}	=	Mean inside diameter of the socket
d_n	=	Nominal outside diameter
e	=	Wall thickness at any point
e_m	=	Mean wall thickness
e_n	=	Nominal wall thickness
l	=	Nominal pipe length
f_A	=	Derating or uprating factor for application
f_T	=	Derating factor for temperatures
K	=	K-value
p	=	Hydrostatic pressure
p_t	=	Test pressure
PN	=	Nominal pressure
θ	=	Material density
σ	=	Hydrostatic stress
σ_s	=	Design stress
λ_a	=	Axial orientation factor
λ_c	=	Circumferential orientation factor
σ_{LPL}	=	Lower predicted confidence limit

4.2 Abbreviations

DN — Nominal size
MRS — Minimum required strength
PFA — Allowable operating pressure
PVC0 --- Oriented Unplasticized polyvinyl chloride
PVCU --- Unplasticized Polyvinyl Chloride

5 MATERIAL

5.1 The material from which the pipe is produced shall consist substantially of unplasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the pipe and the production of sound and durable pipe of good surface finish, mechanical strength and opacity under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, organoleptic or microbial growth hazard, or materially to impair the fabrication or welding properties of the pipe, or to impair its chemical and physical or mechanical properties (in particular long term mechanical strength and impact strength) as defined in this standard. The additives to be used shall be selected from NS 555 and shall be uniformly dispersed.

5.2 Rework Material

The use of the manufacturer's own reprocessed material, produced during the manufacture and works testing of products and conforming to the material requirements of this standard, is permitted. Reprocessed or recycled material obtained from external sources shall not be used.

5.3 VCM Content

The monomer content (VCM content) in the resin shall be within the limits specified in **3.1** of NS XX.....:XXXXwhen tested as per NSXX.....:XXXX

5.4 K- Value

The composition shall be based on *PVC* resin having a K-value of 64 or greater, when tested in accordance with NS... (Appropriate and Applicable Nepal standard).

NOTE - A test report or conformity certificate may be obtained from the resin manufacturer for the VCM content (see 5.3) and K-value (see 5.4) of the resin being used, unless the same is tested in an independent laboratory. The frequency of this test report or conformity certificate shall be once in every three months.

5.5 Density

When determined in accordance with NS 558 , the density of the pipe shall be between 1.40 g/cc and 1.46 g/cc.

5.6 Material Classification

5.6.1 MRS Value

Oriented pipes made from a defined PVC-U compound and with a well-defined orientation level in circumferential and axial direction, shall be evaluated according to the procedures specified in NS... (Appropriate and Applicable Nepal standard) on the basis of tests given in 9.1.1 *(see also* 5.6.3**).** Based on the minimum required strength (MRS) values, the material shall be classified in accordance with Table 1.

Table 1 Material Classification, Design Coefficient and DesignStress

(Clause 5.6.1)

S.N.	Minimum Required Strength (MRS) Mpa	Pipe Material Classification Number	Design Coefficient, C	Design Stress, σ_s=MRS/C
i.	45	450	1.4	32
			1.6	28
ii.	50	500	1.4	36
			1.6	31

5.6.2 Design Coefficient

The design coefficient of PVC-O pipes shall be either 1.4 or 1 .6 as specified by the manufacturer (see Table 1).

5.6.3 Design Stress

The design stress shall be based on the value of the lower confidence limit σ_{LPL} of the long term hydrostatic strength for the resistance to internal pressure as determined in accordance with NS... (Appropriate and Applicable Nepal standard).

This σ_{LPL} value shall be converted into a minimum required strength (MRS) in accordance with NS... (Appropriate and Applicable Nepal standard. The MRS shall be divided by an overall service (design) coefficient, C to give the design stress σ_s which is expressed by the following equation:

$$\sigma_s = \frac{MRS}{C}$$

6 CLASSIFICATION OF PIPES

The pipes shall be classified by their pressure rating Nominal Pressure (PN), at 27 °C, and their material class classification and design coefficient, as per Table 2.

Table: 2 Pressure Rating and Working Pressure of Pipes

(Clause 6)

S.N.	Design Coefficient, C	Pressure Rating									
i.	*For Material Classification - Class 450*										
	a) 1.4	PN 10		PN 12.5	--	PN 16	--	PN 20	--	PN 25	--
	b) 1.6	--	PN 10	--	PN 12.5	--	PN 16	--	PN 20	--	PN 25
ii.	*For Material Classification - Class 500*										
	a) 1.4	--	PN 12.5	--	PN 16	--	PN 20	--	PN 25	--	--
	b) 1.6	PN 10	--	PN 12.5	--	PN 16	--	PN 20	--	PN 25	--

Working pressure corresponding to various pressure ratings:

Pressure Rating	Working pressure
PN 10	1.0 Mpa (10 kg/cm^2)
PN 12.5	1.25 Mpa (12.5 kg/cm^2)
PN 16	1.6 Mpa (16 kg/cm^2)
PN 20	2.0 Mpa (20 kg/cm^2)
PN 25	2.5 Mpa (25 kg/cm^2)

NOTE: The above pipes are recommended for water temperatures ranging from 1 °C to 45 °C. At temperatures higher than 27 °C and up to 45 °C, the strength of the pipe reduces and the working pressure shall therefore he modified using the debating factor as obtained from the graph given in Annex B. Occasional rise in temperature as in summer season with concurrent corresponding reduction in temperature during nights has no deleterious effect on the life/working pressure of the pipes considering the total life of pipes.

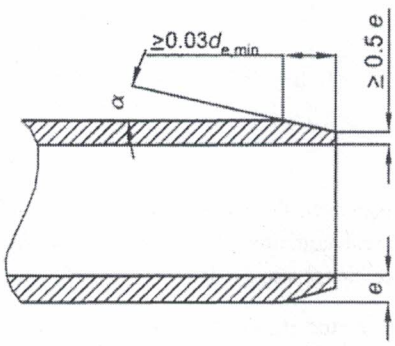


Fig:1 Spigot end of Pipe with Elastomeric Sealing Ring

7 GENERAL REQUIREMENTS OF PIPES

7.1 Visual Appearance

When checked without magnification glass, the internal and external surfaces of the pipe shall be smooth, clean, and free from scoring, cavities and other surface defects. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible provided the wall thickness remains within the permissible limits. The material shall not contain visible impurities. The ends of the pipe shall be either cut cleanly and reasonably square to the axis of the pipe or chamfered at the plain end at approximately 15° to the axis of the pipe (see 8.3 and Fig. 1).

7.2 Colour

The colour of the pipes shall be any shade of grey, blue or cream. The pipes may also be supplied in any other colour as agreed to between the manufacturer and the supplier. Slight variations in the appearance of the colour may be permitted.

7.3 Opacity

The wall of the pipe shall not transmit more than 0.2 percent of the visible light falling on it, when tested in accordance with NS 558.

8 GEOMETRICAL CHARACTERISTICS OF PIPES

8.1 Dimension of Pipes

8.1.1 Diameter

The nominal outside diameter, outside diameter at any point and their tolerances shall be as given in Table 3 and shall be measured according to the method given in NS 558.

8.1.1.1 Nominal outside diameter

The permissible variation $(d_{em} - d_n)$ between the mean outside diameter (d_{em}) and the nominal outside diameter (d_n) of a pipe shall be positive in the form +x, where x is less than or equal to the greater of the following two values:

a) 0.3 mm, and

b) $0.003d_n$ rounded off to the next higher 0.1 mm with maximum value of 2.0 mm.

8.1.1.2 Diameter at any point

The permissible variation between the outside diameter at any point (d_c) and the nominal diameter (d_n) of a pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

a) 0.5 mm, and

b) $0.012d_n$ rounded off to the next higher 0.1 mm.

Table 3 Outside Diameters and Tolerances
(Clause 8.1. 1)

S.N.	Nominal Outside Diameter, d_n, mm	Mean Outside Diameter, d_{em}, mm		Outside Diameter at any Point , d_e, mm	
		Min	Max	Min	Max
i	63	63	63.3	62.2	63.8
ii	75	75	75.3	74.1	75.9
iii	90	90	90.3	88.9	91.1
iv	110	110	110.4	108.6	111.4
v	125	125	125.4	123.5	126.5
vi	140	140	140.5	138.3	141.7
vii	160	160	160.5	158	162
viii	180	180	180.5	177.8	182.2
ix	200	200	200.6	197.6	202.4
x	225	225	225.7	222.3	227.7
xi	250	250	250.8	247	253
xii	280	280	280.9	276.6	283.4
xiii	315	315	316	311.2	318.8
xiv	355	355	356.1	350.7	359.3
xv	400	400	401.2	395.2	404.8
xvi	450	450	451.4	444.6	455.4
xvii	500	500	501.5	494	506
xviii	560	560	561.7	553.2	566.8
xix	630	630	631.9	622.4	637.6
xx	710	710	712	701.4	718.6
xxi	800	800	802	790.4	809.6
xxii	900	900	902	889.2	910.8
xxiii	1000	1000	1002	988	1012
xxiv	1200	1200	1202	1185.6	1214.4

Table 4 Wall Thicknesses (mm) for Material Class 450/C 1.4, {Clause 8.1.2}

SI No.	Nominal Diameter, d.	Class 450/C= 1.4 Wall Thickness, e.				
		Nominal Pressure, PN				
		10	12.5	16	20	25
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	63	1.1	1.3	1.7	2.1	2.6
ii)	75	1.3	1.6	2	2.4	3.1
iii)	90	1.5	1.9	2.4	2.9	3.7
iv)	110	1.8	2.3	2.9	3.6	4.5
v)	125	2.1	2.6	3.3	4.0	5.1

SI No.	Nominal Diameter, d.	Class 450/C= 1.4 Wall Thickness, e.				
		Nominal Pressure, PN				
		10	12.5	16	20	25
vi)	140	2.3	2.9	3.6	4.5	5.7
vii)	160	2.6	3.3	4.2	5.1	6.5
viii)	180	3	3.7	4.7	5.8	7.3
ix)	200	3.3	4.1	5.2	6.4	8.1
x)	226	3:01	4.6	5.8	'7.2	9.1
xi)	250	4.1	5.1	6.5	8	10.2
xii)	280	4.6	5.7	7.2	9	11.4
xiii)	315	5.1	6.4	8.1	10.1	12.8
xiv)	355	5.8	7.2	9.2	11.4	14.4
xv)	400	6.5	8.1	10.3	12.8	16.2
xvi)	450	7.4	9.3	11.6	14.4	18.2
xvii)	500	8.2	104	12.9	16.0	20.3
xviii)	560	9.2	11.6	14.4	17.9	22.7
xix)	630	10.3	13	16.2	20.1	25.5
xx)	7 10	11.6	14.7	18.3	22.7	28.7
xxi)	800	13.1	165	20.6	25.5	32.4
xxii)	900	14.7	18.6	23.1	28.7	36.4
xxiii)	1000	164	20.7	25.7	31.9	40.5
xxiv)	1200	19.6	24.8	30.8	38.3	48.5

8.1.2 Wall Thickness

The wall thickness of the pipes shall conform to values specified in Tables 4 to 7. The wall thickness shall be measured as per any test method specified in NS 558. The wall thickness of the pipe at any point shall confirm to the above requirement within tolerance specified at 8.1.2.1.

NOTES

I The wall thickness at any point may be measured either by cutting the pipe or by non-destructive method using suitable measuring instrument of desired least count and accuracy such as the use of ultrasonic wall thickness measurement gauge, etc.

2 The wall thicknesses have been calculated after applying a d-rating factor of 0.95 in view of standard temperature considered as 27°C.

8.1.2.1 Tolerance on wall thickness

The tolerance on nominal wall thickness, +y *[see* 8.1.2.1(a)**]**, shall as specified below unless these are specified by manufacturer.

a) The permissible variation between the minimum wall thickness (e_{min}) and the wall thickness at any point *(e),* (e - e_{min}) shall be positive in the form of +*y,* where y = 0.1e_{min} + 0.2 mm, and as per Table 8.

b) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values.

c) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

NOTE— Due to the additional processing step of the orientation of the material, the spread on mean wall thickness of the PVC-O pipe could be increased.

8.1.3 Length

The pipes shall be supplied with the length not less than the declared nominal pipe length. It is recommended that the nominal pipe length to be supplied may be 6 m, 10 m and 12 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

8.2 Dimension of Integral Socket:

The minimum depth of engagement of Integral Sockets with elastomeric sealing ring type joints shall conform to Table : 9.

Attention is drawn to the fact that the depths of engagement required by Table 9 could be insufficient for PVC-O pipes under certain circumstances. It is recommended that the suitability of depth of engagement be verified. In Annex C, an example for the calculation of depth of engagement is given.

NOTE— There is no minimum wall thickness requirement for sealing ring type sockets. It is considered as being more relevant to verify the strength of the sockets as being at least the same as the strength of the pipe in accordance with 9.1.2.

8.3 Pipe Ends

Pipes with plain end(s) to be used with elastomeric sealing ring type joints shall have a chamfer end at approximately 15° to the axis of the pipe conforming to Fig. 1 (α to be approximately 15°).

Table: 5 Wall Thicknesses (mm) for Material Class 500/ C=1.4

Clause 8.1.2

S.N.	Nominal Diameter, d	Nominal Presuure			
		PN 12.5	PN 16	PN 20	PN 25
1	63	1.2	1.5	1.8	2.3
2	75	1.4	1.8	2.2	2.7
3	90	1.7	2.1	2.6	3.3
4	110	2	2.6	3.2	4
5	125	2.3	2.9	3.6	4.5
6	140	2.6	3.2	4	5.1
7	160	2.9	3.7	4.6	5.8
8	180	3.3	4.2	5.2	6.5
9	200	3.6	4.6	5.7	7.2
10	225	4.1	5.2	6.4	8.1
11	250	4.5	5.8	7.2	9
12	280	5.1	6.4	8	10.1
13	315	5.7	7.2	9	11.4
14	355	6.4	8.2	10.1	12.8
15	400	7.2	9.2	11.4	14.4
16	450	8.3	10.3	12.8	16.2
17	500	9.2	11.4	14.2	18
18	560	10.3	12.8	15.9	20.2
19	630	11.6	14.4	17.9	22.7
20	710	13.1	16.2	20.2	25.6
21	800	14.7	18.3	22.7	28.8
22	900	16.5	20.6	25.5	32.4
23	1000	18.4	22.8	28.4	36
24	1200	22	27.4	34	43.2

Table: 6 Wall Thicknesses(mm) for Material Class 450/ C=1.6
(Clause 8.1.2)

		Nominal Pressure				
S.N.	Nominal Diameter, d	PN 10	PN 12.5	PN 16	PN 20	PN 25
1	63	1.2	1.5	1.8	2.3	2.9
2	75	1.4	1.8	2.2	2.7	3.4
3	90	1.7	2.1	2.6	3.3	4.1
4	110	2	2.6	3.2	4	5
5	125	2.3	2.9	3.6	4.5	5.6
6	140	2.6	3.2	4	5.1	6.3
7	160	2.9	3.7	4.6	5.8	7.2
8	180	3.3	4.2	5.2	6.5	8.1
9	200	3.6	4.6	5.7	7.2	9
10	225	4.1	5.2	6.4	8.1	10.1
11	250	4.5	5.8	7.2	9	11.2
12	280	5.1	6.4	8	10.1	12.5
13	315	5.7	7.2	9	1 1.4	14.1
14	355	6.4	8.2	10.1	12.8	15.9
15	400	7.2	9.2	11.4	14.4	17.9
16	450	8.3	10.3	12.8	16.2	20.1
17	500	9.2	1 1.4	14.2	18	22.3
18	560	10.3	12.8	15.9	20.2	25
19	630	11.6	14.4	17.9	22.7	28.1
20	710	13.1	16.2	20.2	25.6	31.7
21	800	14.7	18.3	22.7	28.8	35.7
22	900	16.5	20.6	25.5	32.4	40.2
23	1000	18.4	22.8	28.4	36	44.6
24	1200	22	27.4	34	43.2	53.5

Table: 7 Wall Thicknesses(mm) for Material Class 500/ C=1.6

(Clause 8.1.2)

		Nominal Pressure				
S.N.	Nominal Diameter, d	PN 10	PN 12.5	PN 16	PN 20	PN 25
1	63	1.1	1.3	1.7	2.1	2.6
2	75	1.3	1.6	2	2.4	3.1
3	90	1.5	1.9	2.4	2.9	3.7
4	110	1.8	2.3	2.9	3.6	4.5
5	125	2.1	2.6	3.3	4	5.1
6	140	2.3	2.9	3.6	4.5	5.7
7	160	2.6	3.3	4.2	5.1	6.5
8	180	3	3.7	4.7	5.8	7.3
9	200	3.3	4.1	5.2	6.4	8.1
10	225	3.7	4.6	5.8	7.2	9.1
11	250	4.1	5.1	6.5	8	10.2
12	280	4.6	5.7	7.2	9	1 1.4
13	315	5.1	6.4	8.1	10.1	12.8
14	355	5.8	7.2	9.2	1 1.4	14.4
15	400	6.5	8.1	1 0.3	12.8	16.2
16	450	7.4	9.3	1 1.6	14.4	18.2
17	500	8.2	10.4	1 2.9	16	20.3
18	560	9.2	1 1.6	14.4	1 7.9	22.7
19	630	10.3	13	16.2	20.1	25.5
20	710	1 1.6	14.7	1 8.3	22.7	28.7
21	800	13.1	16.5	20.6	25.5	32.4
22	900	14.7	18.6	23.1	28.7	36.4
23	1000	1 6.4	20.7	25.7	31.9	40.5
24	1200	19.6	24.8	30.8	38.3	48.5

Table:-8
Tolerance on Wall Thickness (mm)

Clause 8.1.2.1

S.N.	Minimum Wall Thickness (mm)		Tolerance + y (mm)
	>	≤	
1	_	1	0.3
2	1	2	0.4
3	2	3	0.5
4	3	4	0.6
5	4	5	0.7
6	5	6	0.8
7	6	7	0.9
8	7	8	1
9	8	9	1.1
10	9	10	1.2
11	10	11	1.3
12	11	12	1.4
13	12	13	1.5
14	13	14	1.6
15	14	15	1.7
16	15	16	1.8
17	16	17	1.9
18	17	18	2
19	18	19	2.1
20	19	20	2.2
21	20	21	2.3
22	21	22	2.4
23	22	23	2.5
24	23	24	2.6

S.N.	Minimum Wall Thickness (mm)		Tolerance + y (mm)
	>	≤	
25	24	25	2.7
26	25	26	2.8
27	26	27	2.9
28	27	28	3
29	28	29	3.1
30	29	30	3.2
31	30	31	3.3
32	31	32	3.4
33	32	33	3.5
34	33	34	3.6
35	34	35	3.7
36	35	36	3.8
37	36	37	3.9
38	37	38	4
39	38	39	4.1
40	39	40	4.2
41	40	41	4.3
42	41	42	4.4
43	42	43	4.5
44	43	44	4.6
45	44	45	4.7
46	45	46	4.8
47	46	47	4.9
48	47	48	5
49	48	49	5.1
50	49	50	5.2

Table:-9			
Dimension of Sockets for Elastomeric Sealing Ring Joints (mm)			
Clause 8.2			
S.N.	Nominal Diameter in mm d_n	Minimum Depth of Engagement m_{min}	Minimum Mean inside diameter of Socket, $d_{in\ min}$
1	63	58	63.4
2	75	60	75.4
3	90	61	90.4
4	110	64	110.5
5	125	66	125.5
6	140	68	140.6
7	160	71	160.6
8	180	73	180.7
9	200	75	200.7
10	225	78	225.8
11	250	81	250.9
12	280	85	281
13	315	88	316.1
14	355	90	356.2
15	400	92	401.3
16	450	95	451.5
17	500	97	501.6
18	560	101	561.8
19	630	105	632
20	710	109	712.1
21	800	114	802.1
22	900	120	902.1
23	1000	125	1002.1
24	1200	136	1202.1

The value of m_{min} is calculated from the equations given below and as applicable:

$m_{min} = 50\ mm + 0.22 d_n - 2e$ when $d_n \leq 280$,
$m_{min} = 70\ mm + 0.15\ d_n - 2e$ when $d_n > 280$.

The value obtained shall be rounded to the next greater 1 mm.

Table:10 Test Parameters for the Determination of Resistance to Internal Hydrostatic Pressure, (Clause 9.1.1)

S.N.	Test	Temperature	Duration	Circumferential	
		Min	Min	Stress/Hoop Stress, σ Mpa	
		°C	H	PVCO-450	PVCO-500
1	Acceptance	27	10	57	62
2	Type	60	1000	28	31

Table 11 Classified Striker Mass and Drop Height Conditions for the Falling-Weight Impact Test, (Clause 9.2)

S.N.	Nominal Diameter, d	Total Mass	Drop Height
	mm	kg	m
	1	2	3
1	63	4	2
2	75	5	2
3	90	5	2
4	1 10	6.3	2
5	125	6.3	2
6	140	8	2
7	160	8	2
8	180	10	2.0
9	200	10	2.0
10	≥ 225	12.5	2.0

NOTE: Impact characteristics can change over time. These values are applicable only at the time of manufacture.

Table: 12 Ring Stiffness of Pipes, (Clause: 9.3)			
S.N.	Nominal Diameter	Ring Stiffness [1]	Ring Stiffness [2] (for Specific Jointing Techniques)
		kN/m²	kN/m²
1	63	≥ 6	≥ 20
2	75		≥ 12
3	90		≥ 10
4	110	≥ 4	≥ 10
5	125		≥ 8
6	140		≥ 7
7	160		≥ 7
8	≥ 200		≥ 6

1. Pipes of stiffness less than 4 kN/m² might not be suitable where high vacuum or external pressure could be developed, and could need special installation techniques where installed below ground.

2. Due to specific jointing techniques in water supply and installation below ground, higher stiffness may be needed.

NOTE— Minimum stiffness of pipes could be required for installation with some type of fittings. The sample calculation for calculating nominal stiffness of the pipes is given in Annex D.

9 MECHANICAL CHARACTERISTICS OF PIPES

9.1 Resistance to Hydrostatic Pressure

9.1.1 Pipes

Resistance to hydrostatic pressure shall be verified using the induced stresses derived from the analysis of the test data in accordance with NS.... ((Applicable Nepal standard)). For a period of 10 h at 27 °C and 1000 h at 27 °C, the 99.5 percent LPL value shall be taken as the minimum stress level.

For a period of 1000 h at 60 °C, the 99.5 percent LPL value established from analysis of test data at 60 °C in accordance with NS.... (Applicable Nepal standard) can be taken as the minimum stress level. In case of lack of data, alternatively, a value of 0.625 times the MRS value shall be taken as the minimum stress level.

When tested using either end cap Type A or Type B in accordance with NS 558, and using the combinations of test temperatures and induced stresses so derived, the pipe shall not fail in less than the times stated above.

The test shall be carried out not earlier than 24 h after the pipes have been manufactured

NOTE— All pipes that meet the requirements of Table 10 are deemed to meet the MRS requirement till the time of implementation of NS... (Applicable Nepal standard) in this standard.

9.1.2 Pipes with Integral Socket

Pipes when tested in accordance with NS 558, using the test procedure as given in 9.1.1, integral sealing ring sockets formed on pipes shall not fail in less than the time according to 9.1.1. Sockets will be tested only to the acceptance test (27 °C and 10 h). The length of the pipe section shall meet the requirements or specification given in 9.1.1. failure shall not occur in either pipe or socket sections.

9.2 Resistance to External Blows at 0 °C

Pipes when tested at 0°C in accordance with NS 558 using striker mass as given in col 3 of Table 11 and drop height for various nominal sizes as per col 4 of Table 11, shall have a true impact rate (TIR) of not more than 10 percent. The radius of the striker nose, R shall be 12.5 mm. In case of socket ended pipes, this test shall be carried out on the plain portion of the pipes taken at least 100 mm away from the route of the socket.

9.3 Ring Stiffness

The minimum value of ring stiffness of pipes when determined in accordance with NS 558 shall be as specified in Table 12.

9.4 Orientation Factor

The determination of the stretch ratios (axial orientation factor and circumferential orientation factor) may be carried out as per Annex E.

NOTE— When determining the orientation degrees in the circumferential and axial direction of the pipe, use is made of the fact that the oriented pipe in the rubber phase (above the glass/rubber transition temperature) will shrink till the initial dimensions determined by the extrusion process.

10. Physical and Chemical Characteristics

When tested in accordance with the test methods as specified in Table 13 using the parameters indicated therein, the pipe shall have physical and chemical characteristics conforming to the requirements given in Table 13.

11 Mechanical Characteristics of Assemblies Including Joints

11.1 Assemblies with Non-End-Load-Bearing Joints

The following types of assemblies with non-end-load- bearing joints shall fulfil the fitness for purpose requirements given in 11.2 to 11.4 and Tables 14, 15 and 16 as applicable:

a) integrally socketed PVCO pipe to pipe assemblies with elastomeric ring seal joints conforming to this standard;
b) Metal fitting and PVC-O pipe assemblies with elastomeric ring seal joints;
c) Metal valve and PVC-O pipe assemblies with elastomeric ring seal joints; and
d) Mechanical joint assemblies with PVC-O pipes.

11.2 Short-Term Pressure Test for Leak Tightness of Assemblies

11.2.1 Test Procedure

When an assembly with one or more elastomeric sealing ring type joints is tested using a hydrostatic pressure and angular deflection in accordance with NS... Applicable Nepal standard, and the test conditions given in Table 14.

11.2.2 Test Pressure

The test pressures P_T shall be calculated by using the following equation:

$$P_T = f \times PN \times f_t$$

where

PN=nominal pressure,

F = multiplying factor (to be obtained from Fig. 2),

P_T =test pressure, and

f_t= de-rating factor.

11.3 Short-Term Negative Pressure Test for Leak Tightness of Assemblies

When an assembly with one or more elastomeric sealing ring type joints is tested using a negative pressure with angular deflection and the deformation in accordance with NS 558, and the test conditions given in Table 15, the assembly shall conform to the requirement given in Table 15. Procedure for calculating negative pressure capability of pipes for different class and design coefficient is given in Annex F.

Table 13 Physical and Chemical Characteristics
(Clause 10)

S.N.	Characteristics	Requirement	Test parameters	Test Method Refer to
i.	Vicat softening temperature *	≥ 80 °C	Shall conform to NS 558, arid Number of test pieces = 3	NS 558
ii.	Effect on water	As per NS 206	NS 558	NS 558
iii.	Resistance to Di-chloromethane at a specific temperature (degree of gelation*)	No attack at any part of the test piece,	Temperature of bath = 15 ± 1 °C, immersion time = 15 min, and minimum wall thickness = 1.5 mm	NS 558
iv.	Alternative test to resistance to di-chloromethaneiest Uni-axial tensile test	Minimum stress 48 MPa	In accordance with di-chloromethaneiest: NS 558	NS 558

* To be carried out on feedstock pipe or on reverted pipe.

Table 14 Test Conditions and Requirements for Short-Term Assemble Test

(Clause 11.2.1)

S.N.	Test Temeperature °C	Test Pressure Mpa	Test Time min	Test Requirement
i.	£ = 2 (where Z is any temperature between 20°C and 27 c	Pressure is Calculated in accordance with Fig. 2 and 11.2.2	One cycle in accordance with Fig 2	No leakage at and point of the jointing areas throughout the whole test cycle

NOTE— The pressure changes from one pressure level to the next shall take place within the periods indicated, but need not take place as strictly linear rates.

Table 15 Test Conditions and Requirements for Short-Term Negative - Pressure Assemble Test

(Clause 11.3)

Test Temperature °C	Test Pressure Mpa	Test Time min	Test Requirement
T ± 2 Where, T is any temperature between 20°C and 27°C	Pressure is Calculated in accordance with Fig. 3	One cycle in accordance with Fig 3	The change in negative pressure shall be not more than 0.005 MPa during each 15 min test period shown in Fig 3

Notes:

1 The pressure change from one pressure level to the next, need not take place at strictly Linear rates.
2 For pipes with integral sockets, there is no need for testing with angular deflection.
3 For pipes of ring stiffness less than 4 kN/m^2, it is a flowed to support the pipe to avoid collapsing during testing.
4 Sample calculation and method to be adopted for calculation of negative pressure capability of the pipes is given at Annex F.

11.4 Long-Term Pressure Test for Leak Tightness

When an assembly with one or more joints selected from elastomeric sealing ring type sockets and other end-load-bearing and non-end-load-bearing joints for oriented PVC-U components for a piping system is tested in accordance with NS 558, using the test conditions given in Table 16 for the test temperatures of 27°C and 40°C, the assembly shall conform to the requirement given in Table 16.

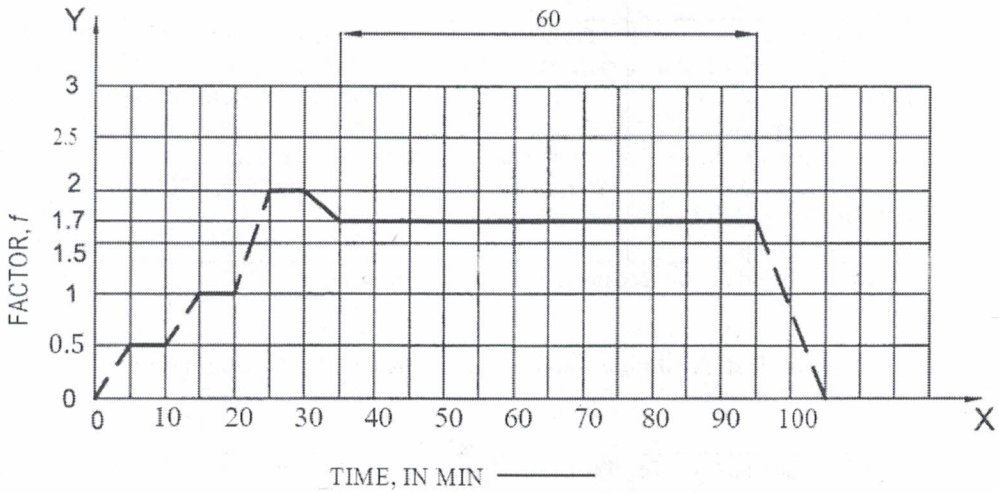


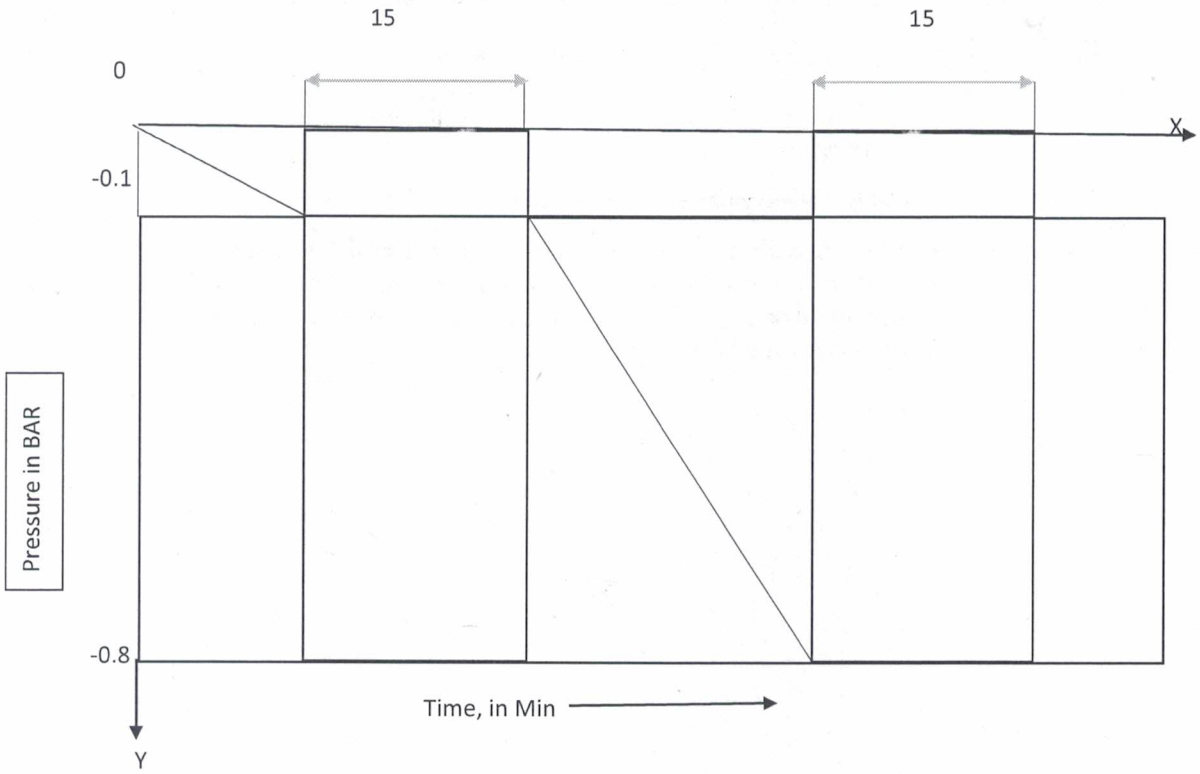
FIG. 2 HYDROSTATIC PRESSURE TEST REGIME

Table 16 Test Requirements for the Long-Term Pressure Testing of Assembled Joint

(Clause 11.4)

S.N.	Test Temperature °C	Test Pressure Mpa	Test Time Hour	Test Requirement
i.	27°C	1.3 PN	1000	No leakage at any point of the jointing areas at least for the test time
ii	40°C	1.1 PN	1000	No leakage at any point of the jointing areas at least for the test time

Note: The PN rating to be taken to calculate the test pressure shall be the PN rating of the fitting, and if pipe with an integral joint is being tested, it shall be the PN rating of the pipe.



Note: 1 bar=0.1 Mpa

Fig: -3 Negative-Pressure Test Regime

12 ELASTOMERIC SEALS

Elastomeric seals used for joining components shall conform to both the following requirements:

a) Rings shall conform to the material requirements specified in NS…. (Applicable NS).
b) Rings shall be free from chemical agents such as plasticizers that could have a detrimental effect on the pipes or fittings, or on the quality of the water.

13 SAMPLING AND CRITERIA FOR CONFORMITY

The sampling procedure and the criteria for conformity shall be as given in Annex G.

14 MARKING

14.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at an interval not more than 1 m. The markings shall include the following:

a) Manufacturer's name and/or trade-mark;
b) Pipe material and material classification number,
c) Nominal outside diameter, d_n
d) Nominal pressure, PN;
e) Reference to this standard;
f) C-factor; and
g) Batch number.

For example: Marking may be as given below: Trade-mark PVC-O 450 DN160 PN16 C1.6 Batch Number

14.1.1 The batch number shall include the details of production in the following manner:

Year	Month	Day	Machine No.	Shift
xxxx	xx	xx	xxx	xxx

14.2 NS Certification Marking

Each pipe may also be suitably marked with the Standard Mark.

14.2.1 The use of Standard Mark is governed by the provisions of the Nepal Standard (Certification Mark) Act 2037 and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Nepal Bureau of Standards and Metrology.

ANNEX A

(Clause 2)

List of Referred Standards

NS No.	Title	NS No.	Title
XX...:XXXX	Methods of tests for polyvinyl chloride resin	---------	----------
XX...:XXXX /ISO 24153:2009	Random sampling and randomization procedures (First Revision)	145	Random Sampling Method
XX...:XXXX	Unplasticized PVC pipes for potable water supplies- specification (First Revision)	206	Unplasticized PVC pipes for potable water supplies-specification
XX...:XXXX	Rubber sealing rings for gas mains, water mains and sewers (First Revision)	--------	----------
XX...:XXXX	Positive list of constituents of polyvinyl chloride resins and its copolymers for safe use in contact with foodstuffs, pharmaceuticals and drinking water	555	Positive List of Constituents of Polypropylene and its Copolymers in Contact with Foodstuffs, Pharmaceuticals and Drinking Water
XX...:XXXX	Specification for polyvinyl chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceutical and drinking water	XX.....: XXXX	Specification for Polypropylene and its Copolymers for its Safe use in Contact with Foodstuffs, Pharmaceuticals and Drinking Water
XX...:XXXX	Thermoplastics pipes and fittings – Methods of test (First Revision)	558	Thermoplastic Pipes and Fittings - Methods of Tests
(Part1):xxxx	Measurement of dimensions	Part 1	Measurement of dimensions
(Part2): xxxx	Determination of Vicat softening temperature	Part 2	Determination of Vicat softening temperature
(Part3): xxxx	Test for Opacity	Part 3	Test for Opacity
(Part4): xxxx	Determination of detrimental effect on the composition of water	Part 4	Determination of detrimental effect on the composition of water
(Part5/Sec1): xxxx	Longitudinal reversion, Section 1 Determination method	Part 5 Sec 1	Longitudinal reversion, Section 1 Determination method
(Part5/Sec2): xxxx	Longitudinal reversion, Section 2 Determination parameters	Part 5 Sec 2	Longitudinal reversion, Section 2 Determination parameters
(Part8/Sec1): xxxx	Resistance to internal hydrostatic pressure, Section 1 Resistance to internal hydrostatic pressure at constant internal water pressure	Part 8 Sec 1	Resistance to internal hydrostatic pressure, Section 1 Resistance to internal hydrostatic pressure at constant internal water pressure
(Part8/Sec2): xxxx	Resistance to internal hydrostatic pressure, Section 2 Leak-tightness of elastomeric sealing ring type socket joints under positive internal pressure and with angular deflection	Part 8 Sec 2	Resistance to internal hydrostatic pressure, Section 2 Leak-tightness of elastomeric sealing ring type socket joints under positive internal pressure and with angular deflection
(Part8/Sec3): xxxx	Resistance to internal hydrostatic pressure, Section 3 Leak-tightness of elastomeric sealing ring type socket joints under negative internal pressure and with angular deflection	Part 8 Sec 3	Resistance to internal hydrostatic pressure, Section 3 Leak-tightness of elastomeric sealing ring type socket joints under negative internal pressure and with angular deflection

(Part8/Sec4): xxxx	Resistance to internal hydrostatic pressure, Section 4 Leak-tightness of elastomeric sealing ring type socket joints under positive internal pressure and without angular deflection	Part 8 Sec 4	Resistance to internal hydrostatic pressure, Section 4 Leak-tightness of elastomeric sealing ring type socket joints under positive internal pressure and without angular deflection
(Part9): xxxx	Resistance to external blows (impact resistance) at 0^0C (round-the-clock method).	Part 9	Resistance to external blows (impact resistance) at 0^0C (round-the-clock method).
(Part10): xxxx	Determination of organotin as tin aqueous solution	Part 10	Determination of organotin as tin aqueous solution
(Part11): xxxx	Resistance to dichloromethane at specified temperature	Part 11	Resistance to dichloromethane at specified temperature
(Part13): xxxx	Determination of tensile strength and elongation	Part 13	Determination of tensile strength and elongation
(Part4): xxxx	Determination of density/relative density (specific gravity)	Part 14	Determination of density/relative density (specific gravity)
(Part18): xxxx	Determination of ring stiffness		
XX…:XXXX	Unplasticized non-pressure polyvinyl chloride (UPVC) pipes for use in underground drainage and sewerage system - specification	XX…: XXXX	Unplasticized non-pressure Polyvinyl Chloride (UPVC) pipes for use in underground drainage and sewerage system - Specification
16130:2014/ ISO 12162:2009	Thermoplastics materials for pipes and fittings for pressure applications – Classification and designation overall service (design) coefficient	---------	----------
16462:2016/ ISO 9080:2012	Plastic piping and ducting systems – Determination of the long term hydrostatic strength of thermoplastics materials in pipe form by extrapolation	---------	----------

ANNEX B

(Table 2)

B-1 Temperature de-rating information given in Fig. 4 may be used as a guide unless real figures from manufacturers are available

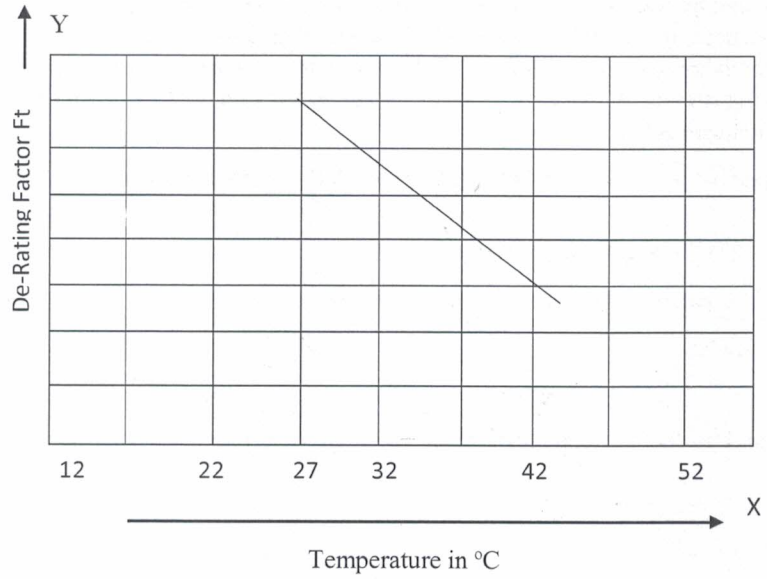


Fig:-4 DE-RATING FACTOR, AS A FUNCTION OF OPERATION TEMPERATURE

ANNEX C

(Clause 8.2)

MINIMUM DEPTH OF ENGAGEMENT OF SOCKETS

C-1 GENERAL

The minimum depth of engagement of integral sockets with elastomeric sealing ring type joints is given in [7.2.1.2(a) and Table 5 of NS... (Applicable Nepal standard). Attention is drawn to the fact that the depths of engagement required by NS... (Applicable Nepal standard) could be insufficient for PVC-O pipes under certain circumstances, particularly pipes of length greater than 6 m, and could result in pull-out and leakage under adverse conditions. Primarily, this is due to the higher strain levels developed at the higher operating stresses invoked in PVC-O pipes, compared with the PVC-U pipes covered in NS... (Applicable Nepal standard).

The potential for pull-out also exists with short- socketed fittings of PVC or other materials used in conjunction with PVC-O pipes.

C-2 CALCULATION OF DEPTH OF ENGAGEMENT

C-2.1 Depth of engagement, m, is calculated by: $m = m_p+m_t+m_a+m_c+m_s$

Where m is the sum of C-2.2 to C-2.6.

C-2.2 Poisson Contraction

Shortening of length, m_p, in millimeters, when pressurized shall be as given below:

$$m_p = \frac{L \times \mu \times \sigma}{E_c}$$

Where,
L =length of pipe, in m;
μ =Poisson's ratio (0.45);
σ =hydrostatic stress in the circumferential direction, in MPa; and
E_c = Elastic Modulus in the circumferential direction (2.0 GPa).
σ is usually taken as the long-term operating stress at working pressure, or the design stress for the pipe material, and as the long-term creep modulus.
Example: for an MRS 500 Pipe and C=1.6, σ_s=32 Mpa, then m_p= 6 X 0.45 X 32/2 = 43 mm

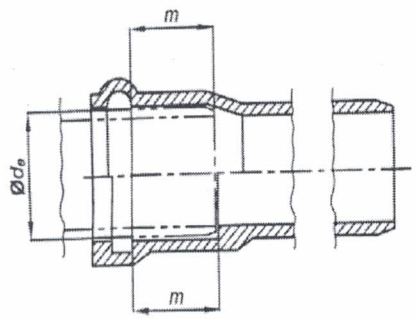


FIG:- 5 DEPTH OF ENGAGEMENT

For buried pipelines, resistance to contraction is offered by the soil and the full Poisson contraction is unlikely to be realized. However, an unrestrained above-ground pipeline can be subject to the full contraction. A worst- case situation arises during field testing of lines not yet back-filled, where a test pressure margin of 25 percent could be applied.

Example: With a short-term modulus of 4.0 GPa,
m_p= 6 X 0.45 X 32 X 1.25/2 = 27 mm
C-2.3 Temperature Contraction
Shortening due to drop in temperature, m_t in millimeters, is given as below:
$m_t = L \times \alpha \times \Delta T \times 10^3$
where,
L = length of pipe, in m;
α = coefficient of linear expansion = (7×10^{-5}) °C^{-1}; and
ΔT = temperature differential, in °C.

This can occur, for example, during construction as a result of filling the pipeline with water. Again, for buried pipelines, soil friction will reduce the range of movement, but above ground lines could realize the full contraction. Some specifications also require an expansion gap to be allowed between the spigot and the back of the socket to accommodate a possible rise in temperature.

Example— A total temperature differential ΔT of 50 °C gives $m_t = 6 \times 7 \times 10 \times 50 \times 10^3 = 21$ mm.

C-2.4 Angular Deflection

Retraction of one side of the spigot due to angular deflection of the spigot within the socket, in millimeters, is given by:

$$m_a = \frac{d_e \times \theta \times \pi}{180}$$

Where,

θ = Maximum angle of deflection of spigot within socket degrees.

Most parallel joints are capable of spigot/socket deflection of less than 1 °.
For a DN 315 joint, this gives = 315 X π / 180=5 mm

Deflection joints can have greater capability and require proportionately more allowance.

C-2.5 Chamfer Length

Length of chamfer, c, in millimeters, shall be included in the available depth of engagement, as per the manufacturer's specification.

Example– For DN 315, m_c =c = 25 mm.
C-2.6 Safety **Allowance (S)**
For construction error, m_s.
Example m_s = S = 20 mm.
C-2.7 The sum of the above allowances for a 6 m, DN 315 pipe,

$$m = m_p + m_t + m_a + m_s = 114 \text{ mm}$$

The standard engagement length should be 118 mm.
Where full Poisson contraction can occur, this joint would be inadequate for a 12 m pipe length.

ANNEX D

(Table 12)

RING STIFFNESS OF PIPES

D -1 CALCULATION OF INITIAL RING STIFFNESS

For design purposes, the calculated initial ring stiffness of the pipes can be derived from Table 19.

Table: 19 Initial Ring Stiffness of Pipes

(Clause D-1)

		Nominal Presuure (PN)				
S.N.	Class C	PN 10	PN 12.5	PN 16	PN 20	PN 25
1	450/1.4	1.6	3.1	6.3	12.1	25.2
2	450/1.6	2.2	4.4	8.5	17.5	34.5
3	500/1.4	--	2.2	4.4	8.5	17.5
4	500/1.6	1.6	3.1	6.3	12.1	25.2

These values are calculated from the formula:

$$\text{Scale} = \frac{E \times I}{(d_n - e_n)}$$

Where

S_{calc} = Calculated initial ring stiffness, in kN/m^2;

E = Young's modulus:

a) for pipe class 315, $E = 3.5 \times 10^6 kN/m^2$,

b) for pipe class 355 and higher, $E = 4 \times 10^6 kN/m^2$

I = moment of inertia $= 1/12\ e_n^3$, in cubic millimeter per meter (mm^3/m)

NOTE — The stiffness values are calculated on the basis of minimum wall thickness at any point $e_{y.min} = e_n$ (see 3.7). Since the stiffness is a function of the mean wall thickness, it is statistically not possible for these values to be realized in practice, and the real stiffness will be significantly greater. For a tolerance of 15 percent of wall thickness (Grade T), the mean could reasonably be expected to be around 5 percent over minimum, and the stiffness correspondingly 16 percent higher than the above results.

ANNEX E

(Foreword and Clause 9.4)

DETERMINATION OF AXIAL AND CIRCUMFERENTIAL ORIENTATION FACTOR

E-1 PRINCIPLE

A piece of pipe is measured under identical conditions before and after heating in the oven at a specified temperature for a specified duration. The reversion is calculated as the percentage variation in length, diameter, and wall thickness in relation to the initial values. The test pieces areexamined on any changes inappearance, forexample bubbles and cracks.

E-2 METHOD

The axial and circumferential orientation factor shall be determined according to NS 558.

E-3 TEST PARAMETERS

Specimen length : 300 mm

Distance between the marks : 200 mm

Test temperature :150 ± 2°C

where,

Medium: Air

Immersion time: 60 or 120 min

Number of test pieces :3

E-4 TEST PROCEDURE

The test is carried out according to NS 558.

The axial orientation factor, λis calculated as:

$$\lambda_a = \frac{L_0}{L_1}$$

L_0 = measured length before conditioning, in mm; and

L_1 = measured length after conditioning, in mm;

The circumferential orientation factor, λ_c, is calculated as:

$$\lambda_c = \frac{D_{em} - e_{em}}{D_i - e_i}$$

where

D_{em} — measured outside diameter before conditioning, in mm

e_{em} = mean wall thickness before conditioning, in mm

e_i = mean wall thickness after conditioning, in mm

E-5 SAMPLING

Three test pieces are cut at random from the pipes.

ANNEX F

(Clause 11.3)

NEGATIVE PRESSURE CAPABILITY OF PIPES

F-1 Pipes can be subjected to unstable buckling under negative pressure conditions due to vacuum and/or external or groundwater pressure, if unsupported by soil or other lateral stiffening devices (see Table 20).

Table: 20 Negative Pressure Capabilities of Pipes (Pcr) kPa

(Clause 11.3)

		Nominal Pressure (PN)				
S.N.	Class C	PN 10	PN 12.5	PN 16	PN 20	PN 25
1	450/1.4	48	93	190	364	758
2	450/1.6	66	132	256	527	1038
3	500/1.4	--	66	132	256	527
4	500/1.6	48	93	190	364	758

These values have been calculated from the formula:

$$P_{cr} = \frac{24\, S_{calc}}{(1-\nu^2)}$$

Where

$P_{cr\,=\,unsupported}$ critical buckling pressure, in kilopascals (kPa);
$S_{calc\,=}$ calculated initial ring stiffness, in kN/m^2; and
ν = Poisson's ratio, which can be assumed as 0.45.

NOTE— The critical buckling pressure may can likewise be expected to be around 16 percent higher than these values in practice. No other design coefficient is incorporated. When pipes are buried with cover exceeding two diameters, lateral soil support will increase buckling pressures significantly. Users should refer to appropriate engineering texts for advisory material.

ANNEX G

(*Clause* 13)

SAMPLING AND CRITERIA FOR CONFORMITY

G-1 ACCEPTANCE

Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

G-1.2 Lot

All PVC-O pipes in a single consignment of the same grade, same nominal pressure, same size and manufactured under essentially similar conditions shall constitute a lot.

G-1.3 For ascertaining conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately.

G-1.4 Visual and Dimensional Requirements

G-1.4.1 The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipes, and shall be in accordance with Table 21.

G-1.4.2 These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table shall be used. For guidance and use of random number tables, NS... (Applicable Nepal standard) may be referred to. In the absence of a random number table, the following procedure may be adopted:

Starting from any pipe in the lot, count them as 1, 2, 3, etc. up to *r* and so on, where *r* is the integral part of *N/n,* where N being the number of pipes in the lot, and *n* the number of pipes in the sample. Every r^{th} pipe so counted shall be withdrawn so as to constitute the required sample size.

G-1.4.3 The number of pipes given for the first sample in col 4 of Table 21, shall be taken from the lot and examined for visual appearance, colour and dimensional requirements given in 7.1, 7.2 and 8. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6 of Table 21. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 7 of Table 21. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7, a second sample of the size given in col 4 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 6, otherwise not.

G-1.5 Vicat Softening Test

G-1.5.1 The lot, having satisfied, the requirements for visual appearance and colour and dimensional requirements as per G-1.4, shall be tested for Vicat softening temperature in accordance with S. No. (i) of Table 13.

G-1.5.2 for this purpose, the number of pipes given for the first sample in col 4 of Table 22 shall be taken from the lot. The sample pipe failing the Vicat softening test shall be considered as defective. The lot shall be deemed to have met the requirements given in this specification for the Vicat softening test, if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection

number given in col 6. If, however, the number of defectives in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7, a second sample of size given in col4 shall be taken and examined for the requirement. The lot shall be considered to have satisfied the requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 6, otherwise not.

G-1.6 Density

G-1.6.1 The lot, having satisfied, the requirements for visual appearance and colour and dimensional requirements as per G-1.4, shall be tested for density in accordance with 5.5.

G-1.6.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be the same as that given in Table 22.

G-1.7 Resistance to External Blows at 0 °C

G-1.7.1 The lot, having been found satisfactory according to G-1.4, G-1.5 and G-1.6 shall be tested for resistance to external blows at 0°C as per 9.2.

G-1.7.2 For this purpose, the procedure adopted for sampling and criteria for conformity shall be as specified in Annex C of NS 206 and Table 23.

G-1.8 Resistance to Internal Hydrostatic Pressure Test (Acceptance Test) and Short Term Negative Pressure Test for Leak Tightness of Assemblies

G-1.8.1 The lot, having been found satisfactory according to G-1.4, G-1.5, G-1.6 and G-1.7 shall be subjected to the requirements of the acceptance test for resistance to internal hydraulic pressure [*see* S. No. (i) of Table 10] and short-term negative pressure test for leak-tightness of assemblies *(see* **11.3).** The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table 24.

G-1.8.2 The pipes shall be taken at random from the lot. In order to ensure the randomness of selection, procedures given in NS 145 may be followed.

G-1.8.3 Number of Tests and Criteria for Conformity

The number of test samples shall be as given in Table 24. The lot shall be considered to have satisfied the requirements for this test, if the number of test samples failing in this requirement is equal to the corresponding acceptance number given in col 4 of Table 24.

G-1.9 RESISTANCE TO DI-CHLOROMETHANE

The lot having satisfied the requirements for visual appearance and colour and dimensional requirements as per G-1.4 shall be tested for resistance to dichloromethane as per SI No. (iii) of Table 13. For this purpose, sub-sample from those already tested and satisfying the requirements of G-1.4 shall be drawn as given in col 5 of Table 24 or Table 25, as appropriate for the first/second sample size. The lot shall be deemed to have met the requirements given in the corresponding acceptance number given in col 6 of Table 24 or Table25, as relevant. The lot shall be deemed not to have met these requirements, if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 7 of Table 24 or Table 25. If, however the number of defectives found in the first samples lies between corresponding acceptance and rejection number given in col 6 and col 7 of Table 24 or Table 25, a second sample size given in col 4 of Table 24 or Table 25 shall be taken and examined for requirements. The lot shall be considered to have satisfied the requirements, if number of defective found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 6 of Table 24 or Table 25, as appropriate, otherwise not.

G-1.10 UNIAXIAL TENSILE STRENGTH

G-1.10.1 Number of Test Specimens

For this purpose, the procedure adopted for sampling shall be as per G-1.9 and the test shall be performed as per S.No. (iv) of Table 13. However, the number of sub-samples to be selected and criteria for conformity shall be as per Table 27.

G-1.11 Ring Stiffness Test

The lot having satisfied the requirements for visual appearance and colour and dimensional requirements as per G-1.4 shall be tested for requirements of ring stiffness as per 9.3. The number of pipes to be taken from the lot shall depend on the size of the lot and shall be according to Table 28. If the first sample drawn fails the test, resampling should be done from the lot which has satisfied the dimensional and visual requirements. The lot shall be considered to have met the requirements of these tests, if none of these samples tested fails.

G-2 TYPE TESTS

G-2.1 Type tests are intended to prove the suitability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of pipe is to be introduced. Type tests for compliance with G-2.2, G-2.3 and G-2.4 shall be carried out.

G-2.2 Opacity

For this test, the manufacturer or the supplier shall furnish to the testing authority, one sample of the pipe of the thinnest wall section, selected preferably from a regular production lot.

G-2.2.1 The sample so selected shall be tested for compliance with requirements for opacity as given in 7.3.

G-2.2.2 If the sample passes the requirements of the opacity test, the type of the pipe under consideration shall be considered to be eligible for approval, which shall be valid for a period of one year.

G-2.2.3 In case the sample fails in the test, the testing authority, at its discretion, may call for a fresh sample and subject the same to the opacity test. If the sample passes the repeat test, the type of pipe under consideration shall be considered eligible for approval. If the sample fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

G-2.2.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for a fresh sample for opacity test for the purpose of type approval.

Table 21 Scale of Sampling for Visual Appearance, Colour and Dimensional Requirements

(Clause G1.4.1 and G 1.4.3)

S.N	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
1	Upto 1000	First	13	13	0	2
		Second	13	26	1	2
2	1001 to 3000	First	20	20	0	2
		Second	20	40	1	2
3	3001 to 10000	First	32	32	0	3
		Second	32	64	3	4
4	10001 and above	First	50	50	1	4
		Second	50	100	4	5

Table 22 Scale of Sampling for Vicat Softening Temperature and Density Test

S.N	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
	i) for d upto and including 110 mm					
1	Upto 1000	First	5	5	0	2
		Second	5	10	1	2
2	1001 to 3000	First	8	8	0	2
		Second	8	16	1	2
3	3001 to 10000	First	13	13	0	2
		Second	13	26	1	2
4	10001 and above	First	20	20	0	3
		Second	20	40	3	4
	ii) for d above 110 mm					
a.	Upto 1000	First	3	3	0	2
		Second	3	6	1	2
b.	1001 to 3000	First	5	5	0	2
		Second	5	10	1	2
c.	3001 to 10000	First	8	8	0	2
		Second	8	16	1	2

Table 23 Scale of Sampling for Resistance to External Blows at 0°C

(Clause G 1.7.2)

S.N.	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
1	Upto 3000	First	3	3	0	2
		Second	3	6	1	2
2	3000 to 10000	First	5	5	0	2
		Second	5	10	1	2
3	10001 and above	First	8	8	0	2
		Second	8	16	1	2

NOTE: The numbers mentioned in col 4 to col 7 represent the number of times the test is to be carried out and do not represent either the number of pipe samples or number of blows or number of failures.

Table 24 Scale of Sampling for Internal Hydrostatic Test

(Clause G 1.8.1 and G 1.8.3)

S.N.	Number of Pipes in a lot	Sample size	Acceptance Number
1	Upto 3000	**2**	**0**
2	3001 to 10000	**3**	**0**
3	10001 and above	**5**	**0**

Table 25 Scale of Sampling for Resistance **to Dichloromethane Tests (For DN up to and Including** 110 **mm)**

(Clause G-1.9)

S.N.	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
1	Upto 1000	First	**5**	**5**	**0**	**2**
		Second	**5**	**10**	**1**	**2**
2	1001 to 3000	First	**8**	**8**	**0**	**2**
		Second	**8**	**16**	**1**	**2**
3	3000 to 10000	First	**13**	**13**	**0**	**2**
		Second	**13**	**26**	**1**	**2**
4	10001 and above	First	**20**	**20**	**0**	**3**
		Second	**20**	**40**	**3**	**4**

Table 26 Scale of Sampling for Resistance to Dichloromethane Tests (For DN above 110 mm)

(Clause G-1.9)

S.N.	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
1	Upto 3000	First	**3**	**3**	**0**	**2**
		Second	**3**	**6**	**1**	**2**
2	3000 to 10000	First	**5**	**5**	**0**	**2**
		Second	**5**	**10**	**1**	**2**
3	10001 and above	First	**8**	**8**	**0**	**2**
		Second	**8**	**16**	**1**	**2**

Table 27 Scale of Sampling for Uniaxial Tensile Test **(For DN 40 to 315 mm)**

(Clause G-1.10.1)

S.N.	Number of Pipes in a lot	Sample Number	Sample size	Cummulative Sample Size	Acceptance Number	Rejection Number
1	Upto 3000	First	3	3	0	2
		Second	3	6	1	2
2	3001 to 10000	First	5	5	0	2
		Second	5	10	1	2
3	10001 and above	First	8	8	0	2
		Second	8	16	1	2

Table 28 Scale of Sampling for Ring Stiffness Test

(Clause G- 1.11)

S.N.	Number of Pipes in a lot	Sample size for sizes less than or equal to 500 mm	Sample size for sizes greater than 500 mm
1	Upto 1000	2	1
2	1001 to 3000	3	2
3	3001 and above	4	3

G-2.3 Test for Effect on Water

For this type test, the manufacturer or the supplier shall furnish to the testing authority three samples of the smallest size of pipe taken from each machine (selected preferably from a regular production lot).

G-2.3.1 Three samples so selected shall be tested for compliance with the requirements for effect on water as given in S.No. (ii) of Table 13.

G-2.3.2 If all three samples pass the requirements for effect on water, the type test of the pipe under consideration shall be considered to be eligible for approval, which shall be normally valid for a period of one year.

G-2.3.3 In case any of the samples fails in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number, and subject them to the test for effect on water. If, in the repeat test, no single failure occurs, the type of pipe under consideration shall be considered eligible for type approval. If any of the samples fails in the repeat test, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

G-2.3.4 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for effect on water test for the purpose of type approval.

G-2.4 Short-Term Pressure Test for Leak Tightness of Assemblies and Long Term Pressure Test for Leak Tightness of Assemblies

G-2.4.1 For this test, the manufacturer or the supplier shall supply furnish to the testing authority, three samples of pipes of different diameters and different classes, selected preferably from a regular production lot.

G-2.4.2 Three samples, so selected, shall be tested for compliance with the requirements of the test given in **11.2** and **11.4.**

G-2.4.3 If all the three samples pass the requirements of the quality test, the type of pipe under consideration shall be considered to be eligible for approval, which shall be normally valid for a period of one year.

G-2.4.4 In case any of the samples fail in this test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to the type test. If, in the repeat test, no single failure occurs, type of pipe shall be considered for type approval. If any of the samples fails in the repeat tests, the type of pipe shall not be approved. The manufacturer or the supplier may be asked to improve the design and resubmit the product for type approval.

G-2.4.5 At the end of the validity period (normally one year) or earlier, if necessary, the testing authority may call for fresh samples for type test for the purpose of type approval.

ANNEX H

(Foreword)

GUIDE LINES FOR STORAGE AND INSTALLATION

H-1 STORAGE

The following guidelines for storage of PVC-O pipes is suggested:

a) Store the pipes horizontally on a flat surface and place supports every 1.5 m to avoid the bending of the product.

b) Avoid scratches especially in the crest of the socket, due to dragging the pipe on the ground, mainly if the surface is made of stone, concrete or asphalt.

c) Do not stack pipes more than 1.5 m height, as this can damage lower pipes or even the upper pipes can fall.

d) The sockets should be free, alternating sockets and ends.

e) In case of prolonged sun exposure, protect pallets with an opaque material. White colour is preferable le because it avoids the over- heating of the pipes.

H-2 REALIZATION OF THE TRENCH

The trench shall be free of stones at the bottom and at the sides. Stones smaller than 10 - 20 mm are allowed, but it cannot be the main size of the ground particles. Minimum width of the trench based on nominal diameter of pipes to be laid and/or depth of trench is specified in Table 29 and Table 30, respectively.

As a rule of thumb, when there is no road traffic involved, the pipes crown will be at a minimum depth of 0.6 m; with road traffic, the minimum depth is 1 m.

Table: 29 Minimum Trench Width Based on Nominal Diameter of Pipes

(Clause H-2)

S.N.	Nominal Diameter, d_n mm	Minimum Width of Trench, m
1	90 to 250	0.60
2	315	0.85
3	355	1.00
4	400	1.10
5	450	1.15
6	500	1.20
7	630	1.35
8	800	1.65
9	1000	1.80
10	1200	2.00

Table: 30, Minimum Trench Width Based on Depth of Trench

(Clause H-2)

	Depth of Trench	Minimum Width of Trench
1	$h < 1.00$	0.60
2	$1.00 \leq h < 1.75$	0.80
3	$1.75 \leq h < 4.00$	0.90
4	$h \geq 4.00$	1.00

Table:31 Maximum Particle Size

(Clause H-3)

S.N.	Nominal Diameter	Maximum Particle
1	$d_n < 100$	15
2	$100 \leq d_n < 300$	20
3	$300 \leq d_n < 600$	30
4	$d_n > 600$	40

H-3 BEDDING AND FILLING THE TRENCH

Pipes should be installed following the guidelines given below:

a) Before placing the pipe, a sand bed should be prepared (a fine granular material may be used instead of sand) with a thickness from 10 cm to 15 cm. The pipe should be well aligned and levelled.

b) The pipe shall lie on the sand bed. It shall be ensured that all the lower part of the pipe is settled on the sand bed trying to soak as much as possible in order to make the angle of sand that supports the kidneys of the pipe as big as possible.

c) Once the pipe is placed, chamberlain sides shall be filled with the selected material and compacted to achieve >95 percent Proctor normal (P. N.).

d) The trench shall be filled with the selected material and compacted laterally until the upper part of the pipe is buried at least 30 cm.

e) Steps (a) and (d) can be done with the same natural material obtained from the excavation, trying to avoid rocks and large stones, and checking that this natural material can support the forces produced by the pressure inside of the pipe.

Natural soil can be used as the selected filler material whenever it fulfils the following criteria:

1) The filler material should not consist of angular stones or similar material.
2) Filler material should not contain bigger particles than the ones shown in Table 31.
3) Filler material should not contain blocks of soil twice the size of the maximum dimensions of the particles given in the Table 31.
4) From 30 cm above the pipe until the surface of the ground, the trench can be filled with natural material not specifically selected and compacting directly over the whole surface of the trench.

The typical section showing various stages of bedding and filling the trench is shown in Fig. 6.

H-4 ASSEMBLY

a) Remove the protection caps (if any).

b) Verify that the pipe is clean and in good condition. Paying attention to the sockets and spigot ends.

c) Check that the chamfer is correct and free of cracks.

d) Verify that the seal is in its place, clean and free of foreign materials (stones, sand etc.).

e) Lubricate the chamfer of the spigot and the seal with joint lubricant.

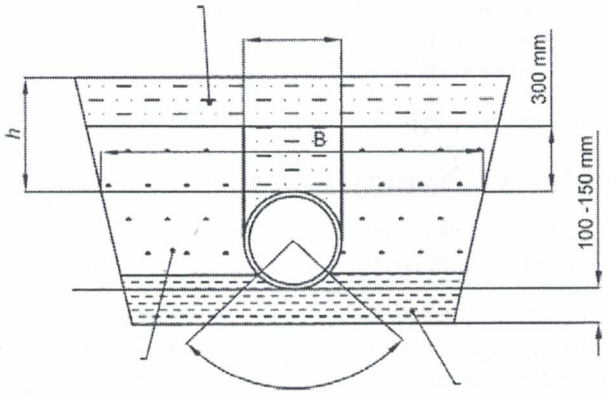
f) Line up the pipe as much as possible horizontal and vertically.

g) Insert only the chamfer edge of the socket, just to support the pipe but leaving the socket lip free.

h) In the case of pipes with nominal diameter $d_n \leq 250$ mm, a firm and dry push should be given to seize the momentum produced by the free movement in the lip of the socket and introduce it until the mark is hidden into the socket.

i) When installing diameters >250 mm, one should use mechanical means to introduce the pipe using materials such as wood, hoists, tackles or slings.

Natural, Tightly-Packed Filling 100 % P.N d_n



Selected Tightly-Packed Filling >95 %
Granular Tightly Packed Material > 95 % P.N.

2 α

Fig: 6 Typical section of Bedding and filling the Trench

नेपाल गुणस्तर परिषद्
Nepal Council for Standardization (NCS)

ने.गुण.५९६:२०७९ Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes for Water Supply - Specification

अध्यक्ष : माननीय श्री दिलेन्द्रप्रसाद बडू, मन्त्री, उद्योग,वाणिज्य तथा आपूर्ति मन्त्रालय

उपाध्यक्ष : श्री अर्जुन प्रसाद पोखरेल, सचिव, उद्योग,वाणिज्य तथा आपूर्ति मन्त्रालय

सदस्यहरु

सि.नं.	नाम	पद	संस्था
१.	श्री चन्द्रकला पौडेल	सह सचिव	उद्योग,वाणिज्य तथा आपूर्ति मन्त्रालय
२.	डा. नारायण प्रसाद रेग्मी	सह सचिव	उद्योग,वाणिज्य तथा आपूर्ति मन्त्रालय
३.	श्री केशवकुमार शर्मा	सह सचिव	भौतिक पूर्वाधार तथा यातायात मन्त्रालय
४.	श्री शवनम सिवाकोटी अर्याल	सह सचिव	कृषि तथा पशुपन्छी विकास मन्त्रालय
५.	श्री कोशलचन्द्र सुबेदी	सह-प्राध्यापक	कानुन,न्याय तथा संसदीय मामिला मन्त्रालय
६.	श्री इन्दु बिक्रम जोशी	सह सचिव	शिक्षा विज्ञान तथा प्रविधि मन्त्रालय
७.	प्रा.डा. दीपक प्रसाद सुवेदी	प्राध्यापक	काठमाडौं विश्वविद्यालय
८.	डा. अजय कुमार झा	सह-प्राध्यापक	भौतिक शास्त्र, त्रिभुवन विश्वविद्यालय
९.	श्री भरत राज आचार्य	-	नेपाल उद्योग बाणिज्य महासंघ
१०.	श्री दीपक श्रेष्ठ	उपाध्यक्ष	नेपाल चेम्बर अफ कमर्स
११.	श्री ध्रुव बहादुर शाह	-	नेपाली उपभोक्ता संरक्षण महासंघ

सदस्य सचिव

श्री दीनानाथ मिश्र, महानिर्देशक ,नेपाल गुणस्तर तथा नापतौल विभाग

ने.गुण. ५९६:२०७९ Oriented Unplasticized Polyvinyl Chloride (PVC-O) Pipes for Water Supply - Specification विषयक प्राबिधिक समितिका सदस्यहरु

सि.नं.	नाम	पद	संस्था
१.	श्री विश्ववावु पुडासैनी	महानिर्देशक	ने. गुण. तथा ना.तौ. विभाग
२.	श्री दीनानाथ मिश्र	उप-महानिर्देशक	ने. गुण. तथा ना.तौ. विभाग
३.	श्री कुमारी ज्योती जोशी	उप-महानिर्देशक	ने. गुण. तथा ना.तौ. विभाग
४.	श्री प्रभात कुमार सिंह	उप-महानिर्देशक	ने. गुण. तथा ना.तौ. विभाग
५.	डा.चण्डिका प्रसाद भट्ट	सि.डि.के.ई.	उद्योग वाणिज्य तथा आपूर्ति मन्त्रालय
६.	श्री आलोक कुमार मिश्र	निर्देशक	ने. गुण. तथा ना.तौ. विभाग
७.	श्री उदय कुमार गुप्ता	निर्देशक	ने. गुण. तथा ना.तौ. विभाग
८.	श्री किशु मानन्धर	निर्देशक	ने. गुण. तथा ना.तौ. विभाग
९.	श्री अनिल शाक्य	निर्देशक	ने. गुण. तथा ना.तौ. विभाग
१०.	श्री सुरत कुमार वंम	सि.डि.ई.	खानेपानी तथा ढल व्यवस्थापन बिभाग
११.	श्री भरतराज आचार्य	सभापति	उ.समिति,नेपाल उद्योग वाणिज्य महासंघ
१२.	श्री शरद शर्मा	-	नेपाल प्लाष्टिक उत्पादक संघ
१३.	श्री ईश्वर प्रसाद	ए. मेनेजर	नेपाल वाटर सप्लाइ कोर्पोरेशन
१४.	श्री देवेन्द्र साहू	ए.जी.एम.	पन्चकन्या प्लाष्टिक एंड आइरन ई.
१५.	श्री रविन्द्र झा	निर्देशक	हिलटेक प्लाष्टिक एण्ड पाईप ई.प्रा.लि.
१६.	श्री माधव तिमिल्सिना	अध्यक्ष	उपभोक्ता अधिकार अनुसन्धान मंच
१७.	श्री शुक्रराज अधिकारी	केमिष्ट	ने. गुण. तथा ना.तौ. विभाग
१८.	श्री सुजित कुमार चौधरी	प्रा.स.	ने. गुण. तथा ना.तौ. विभाग

नेपाल गुणस्तर तथा नापतौल बिभाग

बालाजु, काठमाडौं, नेपाल

फोन नं.०१-४३५०४४५, ४३५०४४७, ४३५०७२९, ४३५०८१८, ४३८५७२३

फ्याक्स नं. +९७७-०१-४३५०६८९

Email: nbsm@nbsm.gov.np

पो.ब.नं. ९८५

सर्वाधिकार सुरक्षित