CHAPTER 300
SANITARY SEWER CONSTRUCTION STANDARDS

SECTION 300.01
GENERAL

The standards and specifications found in this Chapter are for the materials and construction of sanitary sewers within the Village of Lombard, Illinois.

These specifications cover pipe for sanitary sewers and service connections, sewer fittings, manholes, and all appurtenances normally used for sanitary sewer collection systems. Special considerations will be covered in the detailed plans and special provisions covering the proposed construction. Sanitary sewers shall be installed in accordance with the latest edition of the "Standard Specifications for Water and Sewer Main Construction in Illinois", and applicable ordinances of the Village of Lombard.

For specifications regarding information to be included on engineering plans, refer to the Subdivision and Development Ordinance, Section 154.403.

A) REGULATIONS

Additional rules and regulations governing the construction of sanitary sewers in the Village of Lombard can be obtained from the Village of Lombard's Code of Ordinances, Chapter 50: Combined water and sewer system.

B) START OF CONSTRUCTION

Construction shall not start before acquiring an IEPA permit number, nor before all building permits have been issued and all applicable fees have been paid.

C) SANITARY SEWERS

All sanitary sewage of domestic and other waterborne wastes shall be collected and conveyed in a sanitary sewer pipe system to a point of discharge into an existing sanitary sewer system, Village of Lombard interceptor, or sewage treatment plant. No sanitary sewage shall be allowed to enter any storm sewer system or discharged onto the ground or into receiving streams without first being treated in accordance with Village, county, state and federal regulations.

D) EASEMENTS

All Village owned and/or maintained sanitary sewer main shall be centered in a thirty (30) foot wide easement.

SECTION 300.02
MATERIALS

All sanitary sewer pipe materials shall conform to the latest applicable ASTM, ASA, AWWA, AASHTO, or other nationally accepted standards. Only the following sanitary sewer pipe and joint materials are approved for use in the Village of Lombard, Illinois.

	MATERIALS	JOINTS
_____a.	Reinforced Concrete Sewer Pipe (ASTM C-76), Over 12"	ASTM C-443 Flexible gasket Material 'O'-Ring
b.	Ductile Iron Pipe ANSI A-21.51 Class 52	AWWA C-104, Mechanical or rubber ring (slip seal or push on) joints
c.	Polyvinyl Chloride Pipe (PVC SDR-26) ASTM D-3034	ASTM D-3212 Flexible elastomeric seals
d.	Polyvinyl Chloride Pipe (PVC SDR-26) Class 160 PSI ASTM D2241	ASTM D-3139 Flexible elastomeric seals

Nothing herein shall constitute or imply an endorsement by the Village of Lombard of any one material over another or an opinion by the Village regarding equality or superiority of the performance qualities of any of the materials.

The name of the manufacturer, class, and date of issue shall be clearly identified on all sections of pipe. All supplied pipes must be from the same manufacturer. All supplied fittings must be from the same manufacturer. Pipe and fittings dated over one year old shall not be permitted for use. Also, the contractor shall submit bills of lading, or other quality assurance documentation when requested by the Private Engineering Services Division.

SECTION 300.03
PROTECTION OF WATER MAINS

Water mains and water service lines shall be protected from sanitary sewers, storm sewers, house sewer service connections and drains. See Standards and Requirements as outlined in Chapter 400, "Water Distribution", as well as the Subdivision and Development Ordinance, Sections 154.306 to 154.406.

SECTION 300.04
CONSTRUCTION REQUIREMENTS

A) SURVEY LINES AND GRADES

Survey lines and grade hubs shall be placed at maximum fifty (50) foot intervals and at all changes in line and grade, regardless of whether or not a laser beam is used.

B) DEPTH OF PIPE COVER

All pipe shall be laid at a depth sufficient so as to prevent freezing, while providing an outfall for all sanitary sewage within the ultimate service area, both existing and future.

C) PIPE BEDDING

Granular pipe bedding material or granular cradle shall be required on all sanitary sewers installed in the Village of Lombard. Granular pipe bedding shall be a minimum of six (6) inches. The trench shall be backfilled with granular material, CA-7 gradation, to a minimum of twelve (12) inches over the top of the pipe. (see Standard Detail SANITARY 5)

D) SELECTED GRANULAR BACKFILL

All trenches for falling under or whose edges fall within two feet of proposed or existing paved surfaces, stabilized shoulder, curb or sidewalk, shall be backfilled with select granular material. The material shall meet the requirements of the Illinois Department of Transportation "Standard Specifications for Road and Bridge Construction" for course aggregate, CA-7 gradation from the spring line of the pipe to 12" below the bottom of the pavement. From 12" below the bottom of the pavement to the top of the trench it shall be CA-6., or as otherwise directed by the Private Engineering Services Division. No recycled concrete will be allowed. Selected granular backfill shall be placed in uniform layers not exceeding twelve (12) inches (loose measure) and compacted with mechanical equipment to 95% of the standard proctor density in accordance with the applicable AASHTO or ASTM requirements.

SECTION 300.05
HANDLING OF PIPE

Sanitary sewer pipe shall be handled in a manner that will prevent damage. Damaged or defective material on the job site shall be rejected and replaced to the satisfaction of the Private Engineering Services Division. Methods of construction conducive to the damage of sewer pipe shall be corrected when called to the attention of the contractor. All pipe fittings shall be examined by the contractor above grade before placement in the trench.

A) LAYING OF PIPE

Sanitary sewer pipe shall be laid true to line and grade as set forth in Section 31, paragraph 31-1.02 of the "Standard Specifications for Water and Sewer Main Construction in Illinois". Dirt and other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations.

Any pipe or fitting that has been installed with dirt or foreign material in it shall be cleaned and re-inspected. At times when pipe laying is not in progress, and at the end of each working day, the open end of the pipe shall be closed with a water tight plug to ensure absolute cleanliness inside the pipe. The Private Engineering Services Division may request mechanical cleaning (jet flushing) and/or televising if necessary to ensure clean, acceptable pipes, at the contractor's expense. During the design of the system, an effort shall be made to specify a pipe gradient slightly greater than the allowable minimum to afford a factor of safety during construction.

SECTION 300.06
SANITARY SEWER MANHOLES

Manholes for sanitary sewers shall have a minimum inside diameter of forty-eight (48) inches and be constructed of precast concrete units or cast-in-place Portland cement concrete in accordance with Section 32 of the latest editions of the "Standard Specifications for Water and Sewer Main Construction in Illinois", and shall follow the Lombard Sanitary Sewer Standards. Inverts of similar size pipe are to match other inverts. A smaller size pipe's springline shall meet the springline of the larger pipe unless otherwise directed by the Private Engineering Services Division. This is also to be done when tapping into an existing manhole. (see Standard Detail SANITARY 1).

A) MANHOLE LOCATION

Manholes shall be located at the junction of two sanitary sewer pipes or at any change in grade, alignment, or size of pipe. The maximum spacing of manholes shall be three hundred (300) feet for sanitary sewers.

B) CONSTRUCTION

Sanitary manholes shall have poured-in-place or precast inverts made to conform accurately to the sewer grades with smooth, well rounded junctions and transitions satisfactory to the Private Engineering Services Division. If the invert is to be poured in place, the sanitary sewer pipe shall be extended through the manhole, the concrete poured and formed, and the pipe, sawed out through the manhole. The sewer pipe to manhole joint must be a flexible gasket or boot to ensure a leak-proof joint. The completed manhole shall be rigid, true to dimensions, and watertight.

C) MANHOLE APPURTENANCES

The following items shall apply to all manhole structures:

1. Manholes shall be furnished with a self-sealing frame and solid cover (Neenah Foundry R-1772, East Jordan Iron Works 1022, or equal as approved by the Private Engineering Services Division) with the word "Sanitary" imprinted on the cover in raised letters. (see Standard Detail SANITARY 3) Combined sewers shall be marked “SEWER”.

2. Both the manhole frame and cover shall have machined horizontal and vertical bearing surfaces. Inverted manhole frames are not allowed.

3. Pick holes shall not create openings through the manhole cover.

4. Manholes located in areas subject to inundation shall be furnished with waterproof, bolt-down frames and covers (Neenah Foundry R-1916 East Jordan Iron Works 1022 or equal as approved by the Private Engineering Services Division. Frames are to be bolted to cone if possible.

5. All manholes shall have an external manhole chimney seal provided and installed in accordance with Cretex Specialty Products specifications or equivalent as approved by the Private Engineering Services Division. (See Standard Sanitary Detail 6)

6. Manhole frames shall be adjusted to proper grade utilizing rubberized adjusting rings or reinforced, precast concrete rings. Brick, metal shims or concrete blocks shall not be allowed.

7. All manhole frames and adjusting rings shall be securely sealed to the cone section or top barrel section of the manhole using resilient , flexible, non-hardening, non-preformed, Butyl Mastic (Rub R Nek, EZ Stick, or equal as approved by the Private Engineering Services Division). This mastic shall be applied in such a manner that no surface water or ground water inflow can enter the manhole through gaps between the top barrel section or cone section and the first adjusting ring, between adjusting rings, or between the last adjusting ring and the manhole frame. Up to twelve (12) inches of adjusting rings may be installed on a given manhole. No more than three (3) adjusting rings in total shall be used.

8. A continuous layer of non-hardening, preformed bituminous mastic material (Rub R Nek, E Z Stick or equal, as approved by the Private Engineering Services Division) shall be applied to each manhole barrel, cone and top section to provide a watertight seal. All exterior joints shall be sealed with EZ Wrap

9. A non-shrink hydraulic cement or Portland cement mixture shall be used on all manhole interior pipe joints. No mortar shall be applied above the cone section or flat top.

10. Manhole steps are to be plastic polymer.

11. Manhole steps on maximum sixteen inch (16") center shall be furnished with each manhole, securely anchored in place, true to vertical alignment, in accordance with the Lombard Standard Detail STORM 13.

12. Rubber boots/seals shall be used where the pipe enters the manhole. The connection shall be dressed up inside and outside of the manhole with non-shrink mortar.

13. Hydraulic cement, mortar, and concrete shall be of strength and water tightness quality per ASTM standards.

D) DROP ASSEMBLIES

Drop manhole assemblies are not allowed within the Village of Lombard without written approval from the Private Engineering Services Division.

Drop manhole assemblies shall be provided at the junction of sanitary sewers where the difference in pipe inverts is two (2) feet or more (inclusive). The drop assembly shall follow Lombard Standards with filleted inverts. Drops are to be made outside of the structure unless approved by the Private Engineering Services Division. Drop structures shall be concrete encased, and constructed in accordance with the Lombard Standard Detail SANITARY 2.

E) INSPECTION OF MANHOLES

All manholes shall be thoroughly cleaned of dirt and debris and all visible leakage eliminated before final inspection and acceptance.

SECTION 300.07
ADJUSTMENTS

In no instance shall a structure be constructed entirely of adjusting rings.

When adjustments are necessary, rubberized or concrete adjusting rings shall be used for final adjustment. One concrete ring not less than three inches thick may be used. Maximum height of adjustment is twelve (12) inches. A maximum of three (3) rings (all rubber and/or rubber and concrete mix) rings will be allowed. The rings shall be set in a bed of performed non-hardening mastic (Rub-R-Nek or approved equal).

Under no circumstances shall frames be set to grade using miscellaneous construction material, i.e.: rubber shims, concrete blocks, etc.

SECTION 300.08
TESTING AND ACCEPTANCE OF SANITARY SEWERS

All sanitary sewers twenty-one (21) inches and smaller including service lines shall pass a low pressure air test and mandrel test before acceptance. In addition, the Village may at their discretion require televising and an exfiltration test as described in section 300.12 C and G prior to final acceptance. Sanitary sewers twenty-four (24) inches and larger shall pass an exfiltration test described herein and be subject to a physical inspection by the Village. In addition to the above, manholes are subject to physical inspection.

A) LOW PRESSURE AIR TEST PROCEDURES AND REQUIREMENTS

The procedure for low pressure air testing shall follow that set forth in section 31, paragraph 1.11B (3) of the state "Standard Specifications for Water and Sewer Construction in Illinois". External wrapping with plastic sheeting shall not be allowed. All plugs, including those in sanitary services, shall be carefully braced to prevent leakage and blowout. The line being tested shall be deemed acceptable when the time taken for the one pound pressure drop (gauge) is not less than that shown in Table 1 on the following page.

TABLE 1

AIR TEST TABLE
Based on Equations from ASTM C 828
(For Ductile Iron Pipe and Concrete Pipe Only)
(See Section 300.12 for PVC Pipe)
SPECIFICATION TIME (min:sec) REQUIRED FOR PRESSURE DROP FROM 3.5 TO 2.5 PSIG WHEN TESTING ONE PIPE DIAMETER ONLY

PIPE DIAMETER, INCHES

	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:05	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	---	---
175	0:31	1:09	2:03	3:13	4:37	7:05	---	---	---
200	0:35	1:19	2:21	3:40	5:17	---	---	---	12:06
225	0:40	1:29	2:38	4:08	5:40	---	---	10:25	13:36
250	0:44	1:39	2:56	4:35	---	---	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	---	---	9:21	12:44	16:38
300	0:53	1:59	3:31	---	---	---	10:12	13:53	18:09
350	1:02	2:19	3:47	---	---	8:16	11:54	16:12	21:10
400	1:10	2:38	---	---	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	---	---	6:48	10:38	15:19	20:50	27:13
500	1:28	---	---	5:14	7:34	11:49	17:09	23:09	30:14

B) TEST RESULTS

If the sanitary sewer installation fails to meet the test requirements specified, the contractor shall determine the cause or causes of the defect and shall, at his own expense, repair or replace all materials and workmanship in accordance with the applicable construction requirements and standards to yield acceptable test results.

SECTION 300.09
CERTIFICATION

It shall be the responsibility of the pipe manufacturers to certify that pipe and joint materials furnished are capable of meeting the low pressure air test, infiltration test, and exfiltration test and is manufactured in conformance with the ASTM, ANSI, AWWA, or AASTHO test(s) specified.

SECTION 300.10
UTILITY IDENTIFICATION

a. A wood stake two (2) inch by four (4) inch by six (6) foot with not less than the top two (2) feet painted green shall be installed next to each sanitary sewer manhole, clean-out, and at the end of each sewer stub (termination's at the end of the line). The stake shall be maintained in an upright position until Village acceptance of the utility structures. Upon acceptance the contractor is to remove the stakes.

b. When newly poured curbs are installed the contractor shall use a Village approved stamp to indent the wet concrete with an "S" to identity the location of each sanitary sewer stub. The letter "S" shall be indented at the top of the curb, one and one-half (1 1/2) inches to two (2) inches in height and width at a depth of three-eighths (3/8) inch deep.

   If the developer and/or the contractor fail to indent the curbs as outlined above, the Village may then require that identification medallions or other symbols as approved by the Private Engineering Services Division, be affixed to the curb.

SECTION 300.11
INSTALLATION SPECIFICATIONS

The “Standard Specifications for Water and Sewer Main Construction in Illinois” shall be followed except where the Village of Lombard specifications are more restrictive. This specification includes requirements for trench excavation, pipe embedment, joining and installing pipe and accessories, and backfill placement. This recommended practice is also appropriate for PVC pipe complying with ASTM D2241-86 (6"-16"). PVC pipe cannot be used in Class V soils, i.e. organic silt, organic clay and peat, as defined according to the Unified Soil Classification System in ASTM D2487. Solvent cement joints will not be allowed in the Village of Lombard. This specification applies to PVC sanitary sewers installed in the public right-of-way or publicly dedicated easement. Since SDR 26 pipe in sizes 18"-27" is not available, consultants seeking to use PVC pipe 18" and larger will be required to submit their design to the Private Engineering Services Division for review on a case by case basis.

A) WORK INCLUDED

The work to be performed includes the furnishing of all labor, equipment, and materials necessary to complete the work as stipulated in this Manual and other contract documents. The Contractor shall remove pavement or other improved surfaces; excavate the trenches; provide for the maintenance of traffic and utilities; protect public and private property; sheet, brace, and support the

adjoining ground or structures where necessary; handle all surface and ground water; guard the site; furnish, unload, haul, and distribute the pipe and appurtenances; replace or repair all damaged drains, sewers, utilities, or other structures; embed the pipe; install services and appurtenances; backfill the trench; remove surplus excavated material, and clean the site or other improved surface areas over the trenches. It is the responsibility of the contractor to maintain visible locates until completion of the work.

B) PIPING MATERIALS

B1) RESPONSIBILITY FOR MATERIALS

The Contractor shall be responsible for the acceptability and storage of all materials furnished by him and shall assume responsibility for the replacement of all such material found damaged in shipping or on job site or defective in manufacture. This shall include the furnishing of all material and labor required for the replacement of installed material discovered to be defective prior to the final acceptance of the work.

B2) STORAGE OF PIPING MATERIALS

The interior, as well as all sealing surfaces of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter. Pipe bundles shall be stored on flat surfaces with uniform support. Pipe stored outside and exposed to prolonged periods of sunlight (two years or longer) should be covered with canvas or other opaque material. Clear plastic sheets shall not be used. Air circulation shall be provided under covering. Gaskets shall be kept away from oil, grease, electric motors (which produce ozone), excessive heat, and direct rays of the sun. Consult the Manufacturer for specific storage recommendations.

B3) HANDLING OF PIPING MATERIALS

Piping materials shall be unloaded, hauled and distributed at the site of the project by the Contractor. Materials shall at all times be handled properly to prevent damage, in accordance with manufacturer's recommendations. Pipe and fittings shall not be thrown, dropped, or dragged.

B4) CONTROL OF MATERIALS

PVC pipe and fittings will be consistent with Section 6 of the “Standard Specifications for Water & Sewer Main Construction in Illinois”.

C) MARKING

When the product is marked with ASTM designation D2241- 86 (6"-16") the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

Pipe in compliance with this specification shall be clearly marked as follows at intervals of 1.5m (5') or less:

Manufacturer's name or trademark and code,
Nominal pipe size,
The PVC cell classification, for example 12454-B,
The legend "Type IPS SDR-26 PVC 1120 Sewer Pipe", and
This designation "Specification D2241"

NOTE:"IPS" means Iron Pipe Size
NOTE:PVC Fittings SDR-26. A higher SDR number is not allowed. Project design engineer must verify need for a given SDR number on the engineering plans.

D) TRENCH CONSTRUCTION

D1) GENERAL

Trenches shall be excavated to the alignment and elevations as indicated on the drawings with any deviations approved by the Project Design Engineer and the Village. All trench excavation shall comply with applicable regulations, laws, and ordinances. Specified herein are standard construction requirements covering a broad range of both normal and unusual conditions that can be anticipated in sewer trench excavation and construction. The Project Design Engineer may specify exceptions to the above on the drawings or in the special conditions of the contract documents subject to the approval of the Private Engineering Services Division.

D2) CONFLICTING OBSTRUCTIONS

Conflicting obstructions may be encountered when excavating and constructing sewers without deviations from the location established by the drawings. The Contractor shall be responsible for conflicting surface and sub-surface structures, utilities, and obstructions. He shall bear all expense arising from obstructions encountered and shall perform all locating or causing to be located, protection, repair of damage, and necessary removal, adjustment and relocation. When a conflicting publicly or privately owned utility is required to be located by its owner, the Contractor shall cooperate with the utility owner and shall locate, excavate, protect, and expose the utility at the Contractor's expense. The Contractor shall not be due claims for damages arising from any delays encountered thereby.

D3) REMOVAL OF IMPROVED SURFACES

Unless specified otherwise, the Contractor shall remove all pavement or other improved surfaces which require removal for the excavation.

D4) STOCKPILING EXCAVATED MATERIAL

All excavated material shall be stockpiled in a manner that will not endanger the work. Hydrants under pressure, water and gas valves, manhole covers, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept open or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed. Unless otherwise approved, stockpiles shall not obstruct adjacent streets, walks or driveways.

D5) DISPOSAL OF DEBRIS, REMOVED PAVEMENT AND WASTE EXCAVATION

No debris shall be disposed of in the trench backfill. Debris, removed pavement and excavation which is surplus or unsuitable for backfill shall be disposed of by the contractor in accordance with prevailing laws and ordinances and in a manner suitable to the owner of the disposal location property and which is approved by the Private Engineering Services Division.

D6) DEWATERING

Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps and suitable means such as well points or previous under drain bedding until the pipe has been installed and the backfill has been placed to a sufficient height necessary to prevent flotation of the pipeline. Care shall be taken that any under drain is of proper gradation and thickness to prevent migration of material between the under drain, pipe embedment and native soils in the trench below and at the side of the pipe.

E) TRENCH EXCAVATION AND SUPPORT

The maximum earth load on flexible pipe results from the consolidated prism of earth directly over the pipe, which is only as wide as the pipe. The load on flexible pipe does not increase in excess of the prism load as it does with rigid pipe.

E1) NARROW, UNSUPPORTED, VERTICAL-WALLED TRENCH

This procedure will be allowed for PVC sanitary sewer pipe, as well as all other allowable sanitary sewer pipe as outlined in Section 300.02, pending depth of installation.

E2) WIDE TRENCH

Wide trenches are classified as trenches whose width at the top of the pipe is greater than 2 1/2 pipe diameters on each side of the pipe or a total of 6 pipe diameters. Although there is no width of trench beyond which the load on a flexible pipe exceeds the prism load, accepted installation practices usually dictate narrow trench construction. In isolated circumstances it may be more cost effective to use wide trench construction, i.e., in areas where narrow trench walls cannot be maintained. If trench width at the top of a small diameter pipe (4"-10" diameter) must exceed 6 pipe diameters, the embedment up to the pipe spring line should be compacted to a point approximately 2 1/2 pipe diameters from each side of the pipe. For large diameter PVC pipe (12"-48" diameter) installed in wide trenches, the embedment up to the pipe spring line should be compacted to a point at least one pipe diameter or 2 feet (600mm) from each side of the pipe, whichever is greater.

E3) SUPPORTED TRENCH

Where an unstable or flowing soil condition is encountered in the trench wall, such as may be found by excavation below ground water or in weak or non-cohesive soils, this condition shall be stabilized before laying the pipe. Depending upon the severity of the condition, the Engineer or Contractor may elect to use tight sheeting, skeleton sheeting, stay bracing, trench jacks, or a trench shield or box to support the trench during pipe laying operations. If the condition is too severe, it may be necessary to leave any sheeting in place or to use chemical or cement grouting of the soil adjacent to the excavation to prevent migration between the material used beneath and around the pipe and trench wall material. To allow sufficient working room plus trench wall supports, the minimum excavated trench width to the outside of the sheeting or shield box shall be as shown in Table 2.
See following page.

TABLE 2
SUPPORTED TRENCH WIDTHS, MINIMUM

Nominal Pipe Size	No. of Pipe Diameters	Inches
4	8.5	36
6	5.7	36
8	4.3	36
10	4.0	42
12	3.4	42
15	3.1	48
18	2.7	48
21	2.4	50
24	2.2	52
27	2.1	56
30	2.0	60
33	1.9	63
36	1.9	68
40	1.8	72
48	1.7	81

Table 2 widths are based upon 8 to 10 inches (200 to 250 mm) clearance on each side of the pipe to the inner face of trench supports. The trench supports are assumed to be 6 inch (150mm) thick trench box or shield walls or 4 inch (100 mm) walls inside of 2 inch (50 mm) sheeting. Exceptionally deep trenches with thicker sheeting and bracing or other systems of trench support may require the Project Design Engineer to vary these trench widths. Timber sheeting, where used below the top of the pipe, shall be driven approximately 2 feet (67 cm) below the bottom of the pipe and be left in place approximately 1.5 feet (45 cm) above the top of the pipe. In supported trenches compaction of foundation and embedment materials should extend to the trench wall or sheeting left in place.

E4) MOVABLE SHEETING, TRENCH BOXES OR SHIELDS

When using movable trench support, do not disturb the pipe location, jointing or its embedment. Removal of any trench protection below the top of the pipe and within 2 1/2 pipe diameters of each side of the pipe shall be prohibited after the pipe embedment has been compacted. For this reason, movable trench supports shall only be used in either wide trench construction where supports extend below the top of the pipe or on a shelf above the pipe with the pipe installed in a narrow, vertical-wall subditch. When permitted by the Engineer, any voids left in the embedment material by support removal shall be carefully filled with granular material which is adequately compacted. Removal of bracing between sheeting shall only be done where backfilling proceeds and bracing is removed in a manner that does not relax trench support. When advancing trench boxes or shields, longitudinal pipe movement or disjointing shall not be permitted.

F) TRENCH BOTTOM

The soil surface at the trench bottom shall be free of any protrusions which may cause point loading on any portion of the pipe or bell, and shall provide a firm, stable and uniform support for the pipe.

F1) SPECIAL TRENCH FOUNDATION

Where an unstable trench bottom condition is encountered, it shall be stabilized or alternative special trench foundation methods used. The Project Design Engineer may elect to require a special foundation upon which bedding shall be provided.

F2) OVER EXCAVATION

During the course of construction, should the Contractor inadvertently over-excavate the trench more than 6 inches (150 mm) below the bottom of the pipe, but less than 12 inches (300mm) below the bottom of the pipe, he shall fill that area of over-excavation with acceptable embedment material and compact to a density approximately equal to the native soil. The Contractor shall fill any area of over-excavation more than 12 inches (300mm) below the bottom of the pipe with processed stone or processed gravel in the same manner as required above for special foundation but at his expense.

F3) ROCK SUBGRADE

Ledge rock, hard pan, cobbles, boulders or stones larger than 1 1/2 inches (40mm) shall be removed from the trench bottom to permit a minimum bedding thickness of 8 inches (200mm).

G) PLACEMENT AND COMPACTION METHODS OF SOILS AND PIPE EMBEDMENT MATERIALS

Where compaction measurement or control is desired or required, the recommended references are: (1) ASTM D 2049, Standard Method of Test for Relative Density of Cohesionless Soils, (2) ASTM D 698, Standard Method of Test for Moisture - Density Relations of Soils Using 5.5 - lb. (2.5 kg) Rammer and 12 - in. (204.8 mm) Drop, (3) ASTM D 2167, Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method, (4) ASTM D 1556, Standard Method of Test for Density of Soil in Place by the Sand-Cone Method, and (5) ASTM D 2922, Standard Method of Test of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow Depth). The in place density of embedment materials in Class I should be measured by ASTM D 2049 by percent of relative density.

G1) BEDDING

Class I bedding or other than concrete embedment shall consist of gravel, crushed gravel, or crushed stone 1/4" - 1" (6-25 mm) in size. As a minimum, the material shall conform to the requirements of the "Standard Specifications for Road and Bridge Construction" of the State of Illinois for course aggregate. The gradation shall conform to gradation CA-7 of the Illinois Standard Specifications. The pipe shall be laid so that it will be uniformly supported and the entire length of the pipe barrel will have full bearing. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bedding shall be required for all sewer construction, and shall be of a thickness equal to 1/4 of the outside diameter of the sewer pipe with a maximum thickness of eight (8) inches (200 mm) but shall not be less than six (6) inches (100 mm). Where unsuitable material is encountered at the grade established, all such unsuitable soil shall be removed under the pipe and for the width of the trench, and shall be replaced with well-compacted bedding material. (See Section 300.11 F2 "Over Excavation").

The size range and resulting high voids ratio of Class I material make it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine-grained natural material from the trench walls and bottom or migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than 1/4 inch (6 mm) and the gradation properly designed to limit the size of the voids. Bedding materials shall be placed to provide uniform and adequate longitudinal support under the pipe. Bell holes at each joint shall be provided to permit the joint to be assembled properly while maintaining uniform pipe support. When the joint has been made, the void under the bell will be filled with bedding or haunching material.

G2) HAUNCHING

The most important factor affecting pipe performance and deflection is the haunching material and its density. Place and consolidate the material under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. The same coarse materials as used for initial backfill shall also be used for haunching. Place haunching up to the pipe spring line. See Table 3 on following page.

TABLE 3

APPROXIMATE GUIDE FOR ESTIMATED RANGE OF DEGREE OF COMPACTION VERSUS EMBEDMENT CLASS AND METHOD OF PLACEMENT AS PERCENT OF STANDARD PROCTOR DENSITY OR RELATIVE DENSITY

CLASS OF EMBEDMENT	I
MATERIAL DESCRIPTION	Manufactured Granular Materials
Soil Consolidation Method	% of Proctor (or relative) Density Range
Compact by Power Tamper or Rammer	95-100 (75-100)
Density by Portable Vibrators	80-95 (60-75)
Consolidate by Saturation	80-95 (60-75)
Hand Placing	60-80 (40-60)
Dumping	60-80 (40-60)

NOTES:

1) Relative density is noted in parenthesis.

2). This table serves as an approximate guide defining average Proctor densities attained through various methods of soil consolidation in different classes of soil. The table is intended to provide guidance and is not recommended for design use. Actual design values should be developed by the Project Design Engineer for specific soils at specific moisture content.

3). Buoyant forces must be considered before, during, and after the compaction process as it relates to each succeeding piece of pipe.

G3) INITIAL BACKFILL

Initial backfill begins above the spring line of the pipe and extends to a point twelve (12) inches above the top of the pipe and shall be CA-7 stone gradation,

carefully placed so as to completely fill the space around the pipe, in eight (8) inch layers, loose measurements, and compacted to the satisfaction of the Project Design Engineer. Use little or no tamping of the initial backfill since this area will provide little or no additional side support. (See Standard Sanitary Detail 5)

G4) FINAL BACKFILL

Final backfill under paved areas will be CA 7 from the spring line of the pipe to 12" below the bottom of the pavement. From 12" below the bottom of the pavement to the top of the trench it shall be CA-6 compacted to the satisfaction of the Project Design Engineer to the pavement subgrade. Compaction will be sufficient to ensure that the pavement subgrade will not settle and adversely affect the pavement. Final backfill under unpaved areas is earth backfill.

G5) BACKFILL COMPACTION

Unless otherwise specified, the final backfill shall use special compaction under improved surfaces (parking lots), and shoulders of streets, roads, aprons, curbs, and walks, and natural compaction shall be used under open fields, lawns, and wide shoulders, unimproved rights-of-way, or neutral grounds which are free of traffic. Compaction requirements must be defined by the Project Design Engineer. Natural compaction is attained by the loose placing of material (usually pushed or bladed) into the trench, rolling the surface with the placement equipment, mounding the surface, and filling and maintaining all sunken trenches until final acceptance of the work. In natural compaction, the main consolidation results from rainfall and ground water fluctuations.

G6) MINIMUM COVER FOR LOAD APPLICATION

Provide at least forty-eight (48) inches (1200 mm) of cover before using mobile trench compactors of the hydrohammer or impactor type. Use such compactors only when the pipe embedment has previously been compacted to at least 87% of Standard Proctor Density (see ASTM D698 or AASHTO T99).

G7) SATURATION

If flooding, jetting, or puddling is employed for compaction, care should be taken to provide drainage and prevent flotation of the pipeline. Saturation shall not be permitted during freezing weather. Erosion of support at the pipe sides and bottom by water jetting shall be prevented. Apply only enough water to give complete saturation. Allow time for the saturated soil in each layer to dewater and solidify until it will support the weight of workers.

G8) USE OF COMPACTION EQUIPMENT

Take care to avoid contact between the pipe and compaction equipment. Do not use compaction equipment directly over the pipe until sufficient backfill has been

placed to assure that such equipment will not damage or disturb the pipe. This will be interpreted to mean a minimum of twelve (12) inches of backfill over the top of the pipe.

H) LAYING AND JOINING PIPE AND FITTINGS

H1) GENERAL PROCEDURE

Before being set in place, each component of piping shall be inspected for damage and cleaned. Damaged components shall be rejected or repaired. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes, service branches, or clean outs. Trenches shall be dewatered, if necessary, and pipe shall be laid under water only with approval from the Private Engineering Services Division. Whenever pipe laying is interrupted, the end of the pipe shall be temporarily plugged to prevent the entrance of water, mud, or foreign matter, and the pipe shall be secured to prevent its being dislodged.

H2) LOCATION AND ALIGNMENT

Pipe and fittings shall be embedded in the trench with the invert conforming to the required elevations, slopes, and alignment, and with the pipe bottom uniformly and continuously supported by a firm bedding and foundation.

H3) CURVED ALIGNMENT

The joints must be manufactured so that they fit together squarely without deflection. Impromptu and improper bending of the pipe in the field will not be allowed.

H4) ASSEMBLY OF JOINTS

Assemble all joints in accordance with recommendations of the manufacturer. If a lubricant is required to facilitate assembly it shall have no detrimental effect on the gasket or on the pipe when subjected to prolonged exposure. Proper jointing may be verified by rotation of the spigot by hand or with a strap wrench. If unusual joining resistance is encountered or if the insertion mark does not reach the flush position, the joint shall be disassembled, and inspected for damage, the joint components shall be recleaned, and the assembly steps shall be repeated. Note that fitting bells may permit less insertion depth than pipe bells (NOTE: When mechanical equipment is used to assemble joints, care should be taken to prevent over insertion).

H5) BRANCH FITTINGS

Fittings for service branches in new construction shall be molded with all gasketed connections. (See Standard Detail SANITARY 4) Taps into existing

lines shall use a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle wye or tee with all stainless steel clamps. When connecting to an existing sewer main by means other than an existing wye or tee, one of the following methods shall be used:

a. Circular Saw-cut of the sewer main by proper tools ("Sewer-Tap" machine or similar) and proper installation of hub-wye saddle or hub-tee saddle.

b. Remove of an entire section of pipe (breaking only the top of one bell) and replacement with a wye or tee branch section.

c. With pipe cutter, neatly and accurately cut out desired length of pipe for insertion of proper fitting, using "Band-Seal" or similar couplings to hold it firmly in place.

"Band-Seal" or similar flexible-type couplings shall be used in the connection of sewer pipe of dissimilar materials. Typical couplings include Indiana Seal 102-66, Fernco 1002-66 or equal. A typical connection would involve a PVC "T" fitting, another one (1) foot (or more) extension of PVC pipe, depending on depth of cover, the coupling and the clay pipe. Details of direct connections to Village interceptors shall be provided and construction procedures for protecting Village structures shall be shown. Clay/plastic pipe connections must be water tight. Holes for wye saddles shall be laid out with a template and shall be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting. The Contractor will be permitted to use fittings which include factory molded saddles and tee with alignment rings, and factory molded wyes. Field fabricated fittings will not be used. No service connections to manholes is permitted unless authorized by the Private Engineering Services Division.

H6) BUILDING SERVICES

When main line bedding, haunching, and initial and final backfill must be disturbed to install fittings and service lines, the contractor is directly responsible to ensure that the bedding, haunching, and initial and final backfill are appropriately compacted are restored properly to eliminate the possibility of deflection or movement which could cause future pipe failure.

H7) PIPE CAPS AND PLUGS

All caps and plugs shall be braced, staked, anchored, wired on or otherwise secured to the pipe to prevent leakage under the maximum anticipated thrust from internal abnormal operating conditions or test pressures from water or air.

H8) MANHOLES

Manhole connections can be made as follows:

a. Manhole couplings providing elastomeric gasket seal. Unit is grouted into manhole wall. Pipe inserts into coupling.

b. Water stop in various forms (e.g. flexible boot or sleeve, O-ring or gasket) produced from elastomeric compound is grouted or locked into manhole wall. Pipe inserts into water stop.

c. Precast manhole with connection ports with elastomeric seals precast into manhole wall. Pipe inserts into connection port.

All manhole connections should be made using proper water stops. If portland cement grout is incorporated in the manhole connection, the grout shall be of a type that expands, rather than shrinks, upon curing. Water stops shall be installed in accordance with manufacturer's recommendations. Hinged connections which use short pipe bell stubs outside the manhole face will not be required to prevent shear breakage in PVC sewer pipe because of its flexibility. Excessive manhole settlement can cause excessive deflection and should be prevented or accommodated. Direct bonding between PVC pipe and concrete manhole is not allowed. Contractors will be required to core the manhole wall.

H9) INSTALLING PIPE THROUGH CASINGS

Encasements for pipes under highways or railroads shall conform to the requirements of the Village of Lombard. Runners or cradles shall be used to support the pipe in the casing. A minimum of two supports shall be used per joint of pipe providing a maximum span of six and one-quarter (6 ¼) feet (1.9 m) for PVC pipe lengths of twelve and one-half (12 ½) feet (3.8 m). The maximum span between supports for pipe lengths of twenty (20) feet (6.1 m) shall not exceed that shown in Table 4 on following page.

TABLE 4
MAXIMUM RECOMMENDED SUPPORT SPACING FOR 20 FOOT LENGTH OF PVC SEWER PIPE AT A MAXIMUM TEMPERATURE OF 73.4-F (23-C)

Nominal Pipe Size Inches	Unsupported Span
4	6.0
6	7.8
8	9.5
10	11.0
12	12.4
15	14.2
18	16.2
21	18.1
24	19.6
27	20.0*
30	20.0*
36	20.0*
40	20.0*
48	20.0*

*NOTE : Each joint must be supported. Therefore, the maximum unsupported span will always be limited by pipe length.

both ends bricked and mortared, or concreted, to provide a watertight seal.

For pipe crossings where less than 18" of vertical clearance exists with another utility, the PVC sanitary sewer line must be either Class 52 ductile iron pipe for 10' on either side of the crossing point, or PVC SDR 26 class 160 pressure pipe. A special adapter may be required at the transition between different pipe materials. The adapter should be Indiana Seal 151 or Fernco 1051 or equal.

I) RESTORATION AND CLEAN UP

I1) RESTORATION OF SURFACES AND/OR STRUCTURES

The Contractor shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod, or other disturbed surfaces or structures to a condition equal to that which existed before the work began and to the satisfaction of the Private Engineering Services Division. The Contractor shall furnish all labor, materials, and incidentals.

I2) CLEAN-UP

Surplus pipeline materials, tools and temporary structures resulting from the work shall be removed by the Contractor. All debris, pavement, and excess earth from excavations shall be removed and disposed of by the Contractor in compliance with applicable regulations, laws, and ordinances. The construction site shall be left clean, to the satisfaction of the Project Design Engineer and the Village Inspector.

I3) ENGINEERING PLAN CHANGES

Any changes to the Village' approved engineering plans shall be reviewed and approved by the Village of Lombard Private Engineering Services Division prior to implementation.

SECTION 300.12
PVC TESTING SPECIFICATIONS

A) GENERAL

All projects shall be tested upon completion of installation. The Inspector will designate the locations of tests and extent of the system to be tested, and the extent of recording test results. Equipment for performing tests and making measurements shall be furnished by the Contractor. Sections of sewer which fail to pass the tests shall have defects located and repaired or replaced and be retested until the sections are within the specified allowance. Testing Procedures for polyvinyl chloride (PVC) pipe shall include the following:

The individual lines to be tested shall be so tested no sooner than 30 days after they have been installed by the Contractor. During the first year of implementation, additional testing may be performed by the Village Water and Sewer Utilities Department.

Wherever possible and practical, the testing shall initiate at the downstream lines and proceed towards the upstream lines.

B) CLEANING

Prior to testing, all sewer lines and structures shall be cleaned and inspected for major defects. Precleaning by appropriately sized sewer cleaning ball or by high velocity jet or other method may be necessary.

C) VISUAL TEST

The Village of Lombard may require that sewer lines be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The percentage of sewer lines inspected will be designated by the Underground Utilities Division of the Department of Public Works. The full diameter of the pipe for straight alignments shall be visible when viewed between consecutive manholes. The method of test shall be either photography, closed circuit television, or visual lamping with mirrors and lights, unless a specific method is required by the special provisions and approved by the Private Engineering Services Division.

D) DEFLECTION TESTING

The Inspector shall randomly select portions of the project to be deflection tested. Such portions shall consist of the manhole intervals for the initial sewer construction, up to 1,200 linear feet and not less than 20% of the remainder of the sewer project. The Village of Lombard reserves the right to test more or less pipe if considered appropriate by the Private Engineering Services Division.

Unless specified otherwise, the maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 5%. A mandrel test is required by the Village of Lombard. (See Section 300.12 F).

In event that the deflection exceeds the 5% limit in 10% or more of the manhole intervals tested, the total sewer project shall be tested.

Where deflection is found to be in excess of 5% of the Base Inside Diameter, the contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, after the initial testing, should the deflected pipe fail to return to the original size (inside diameter) the line shall be replaced.

E) LEAKAGE TEST

Methods of test which are suitable for various conditions are low pressure air exfiltration or water exfiltration. Explicit instructions for the following methods of test will be supplied by the Project Design Engineer. Plugs, caps, and branch connections must be secured against blow-off during leakage test.
(See Section 300.8)

F) MANDREL TESTING

All sewers constructed under permits issued by the Village shall be subject to inspection, testing, and approval by the Village to ensure compliance with the applicable requirements. All testing shall be made, or caused to be made, by the

Permittee or Co-Permittee at no cost to the Village and in the presence of the Village Inspector.

The 5% deflection test for pipe sizes six (6) to fifteen (15) inches in diameter is to be run using a nine-arm mandrel having a diameter equal to 95% of the base inside diameter of the pipe as established in ASTM D-2241-86. (See Table 5)

TABLE 5

SDR 26 PIPE

NOMINAL SIZE IN.	AVERAGE INSIDE DIAMETER (IN.)	BASE* INSIDE (IN.)	AVERAGE OUTSIDE (IN.)	TOLERANCE ON AVERAGE	MINIMUM WALL THICKNESS
6	6.084	6.028	6.625	0.011	0.255
8	7.922	7.841	8.625	0.015	0.332
10	9.874	9.790	10.750	0.015	0.413
12	11.711	11.624	12.750	0.015	0.490
16	14.696	14.527	16.000	0.019	0.615

* Base inside diameter is a minimum pipe inside diameter derived by subtracting a statistical tolerance package from the pipe's average inside diameter. The tolerance package is defined as the square root of the sum of squared standard manufacturing tolerances.

Average inside diameter = average outside diameter -2 (1.06)t
Tolerance package = (A2 +2 B2 + C2)1/2

where:

t = minimum wall thickness
A = outside diameter tolerance
B = excess wall thickness tolerance = 0.06t, and
C = out-of-roundness tolerance

The values for C were derived statistically from field measurement data and are given as follows for various sizes of pipe:

Nominal Size, in.	Value for C
6	0.050
8	0.075
10	0.075
12	0.075
16	0.160

For pipe sizes eighteen (18) to twenty-seven (27) inches in diameter, the developer's consultant will be required to work with the Village staff on a case by case basis.

G) EXFILTRATION TESTING

Exfiltration testing is an acceptable method of test only in dry areas or when the ground water level is suitably low. The allowable water exfiltration for any length of sewer pipe between manholes shall be measured and shall not exceed 50 gallons per inch of internal pipe diameter per mile of pipe per day (4.6 liters/mm/km/day). During exfiltration testing, the maximum internal pipe pressure at the lowest end shall not exceed twenty-five (25) feet (7.6m) of water or 10.8 psi (0.76 kgf/cm) and the internal water head shall be two feet higher than the top of the pipe or two feet higher than the ground water level, whichever is greater.

H) AIR TESTING

This recommended practice defines the proper procedures for acceptance testing of installed gravity sewer pipe, using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test methods and minimum holding times. This recommended practice does not cover the testing of manholes. Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. (See also Section 300.08).

I) RESPONSIBILITIES

I1) RESPONSIBILITY OF THE CONTRACTOR

Unless otherwise specified, the Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests and other required tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed sewer without the prior approval of the Private Engineering Services Division.

I2) RESPONSIBILITY OF THE PROJECT DESIGN ENGINEER

An Inspector shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. The Project Design Engineer should inform the Contractor regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test. The Project Design Engineer

should also report to the owner regarding the acceptability of the Contractor's work.

I3) REGULATORY AGENCIES

Regulatory Agencies at the State, Federal, and/or local level may be legally entitled to witness any air testing and/or review the results. The owner or his Project Design Engineer should check to see that the low pressure air test specified for his installation is at least as stringent as those which may be required by such regulatory bodies.

J) SAFETY

J1) PLUG RESTRAINT

It is extremely important and essential that all plugs be installed and braced in such a way that blowouts are prevented. As an example of the hazard, a force of 250 pounds is exerted on an 8 inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24 inch plug by an internal pressure of 5 psig. It must be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line. It is further recommended that no internal pressure of more than 9 psig be permitted except for leak location equipment where the plugs are firmly tied together.

J2) RELIEF VALVE

All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)

K) EQUIPMENT

K1) PLUG DESIGN

Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

K2) SINGULAR CONTROL PANEL

To facilitate test verification by the inspecting Project Design Engineer, all air used shall pass through a single, above-ground control panel.

K3) EQUIPMENT CONTROLS

The above-ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of 0.04 psi.

K4) SEPARATE HOSES

Two separate hoses shall be used as follows: (1) one hose to connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

K5) PNEUMATIC PLUGS

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above-ground control panel.

L) LINE PREPARATION

L1) LATERALS, STUBS AND FITTINGS

During sewer construction, all service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged so as not to allow for air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps and tie-rods, or wire harnesses over the pipe bells.

L2) PIPE WETTING

Air may pass through some porous pipe materials. If such materials are used, the pipe walls may be wetted to temporarily reduce the porosity of the material. Non-porous pipe materials need not be wetted.

M) TEST PROCEDURE

The procedure for low pressure air testing shall follow that set forth in section 31, paragraph 1.11B (3) of the state Standard Specifications for Water and Sewer Construction in Illinois.

M1) PLUG INSTALLATION AND TESTING

After a manhole-to-manhole reach of pipe has been backfilled to final grade, and prepared for testing and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing.

It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high ground water situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.

M2) LINE PRESSURIZATION

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig.

M3) PRESSURE STABILIZATION

After a constant pressure of 4.0 psig (greater than the average ground water back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

M4) TIMING PRESSURE LOSS

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average ground water back pressure), the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average back pressure of any ground water over the pipe). At a reading of 3.5 psig, or any convenient observed pressure reading between 3.5 psig and 4.0 psig (greater than the average ground water back pressure), timing shall commence with a stop watch or other timing device that is at least 99.8% accurate.

A predetermined, required time for a specified pressure drop shall be used to determine the lines acceptability. Traditionally, a pressure drop of 1.0 psig has been specified. However, other pressure drop values may be specified, provided that the required holding times are adjusted accordingly. If the specified pressure drop is 0.5 psig rather than the more traditional 1.0 psig, then the required test times for a 1.0 psig pressure drop must be halved. Specifying a 0.5 psig pressure drop is desirable in that it can reduce the time needed to accomplish the air test without sacrificing test integrity. Therefore, the following subsection contains provisions for the traditional 1.0 psig pressure drop and the more efficient 0.5 psig pressure drop would be half (1/2) the value of the 1.0 psig. (See Table 6)

TABLE 6

AIR TEST TABLE
SPECIFICATION TIME (min:sec) REQUIRED FOR PRESSURE DROP FROM 3 1/2 to 2 1/2 PSIG WHEN TESTING ONE PIPE DIAMETER ONLY
PIPE DIAMETER, INCHES

Length of Sewer Pipe In Feet	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	--	--
175	0:31	1:09	2:03	3:13	4:37	7:05	--	--	--
200	0:35	1:19	2:21	3:40	5:17	--	--	--	-- --
225	0:40	1:29	2:38	4:08	5:40	--	--	10:25	13:36
250	0:44	1:39	2:56	4:35	--	--	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	--	--	9:21	12:44	16:38
300	0:53	1:59	3:31	--	--	--	10:12	13:53	18:09
350	1:02	2:19	3:47	--	--	8:16	11:54	16:12	21:10
400	1:10	2:38	--	--	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	--	--	6:48	10:38	15:19	20:50	27:13
500	1:28	--	--	5:14	7:34	11:49	17:01	23:09	30:14

M5) DETERMINATION OF LINE ACCEPTANCE

If the time shown in Table 6 (Air Test Table), for the designated pipe size and length elapses before the air pressure drops 1.0 psig (or 0.5 psig); the section undergoing the test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the 1.0 psig (or 0.5 psig) drop has not occurred.

M6) DETERMINATION OF LINE FAILURE

If the pressure drops 1.0 psig (or 0.5 psig) before the appropriate time shown in air test table, the air loss rate shall be considered excessive and the section of pipe has failed the test.

M7) LINE REPAIR OR REPLACEMENT

If the section fails to meet these requirements, the Contractor shall determine at his own expense the source or sources of leakage and shall repair or replace all defective materials and/or workmanship to the satisfaction of the Private Engineering Services Division. The extent and type of repair which may be allowed, as well as the results, shall be subject to the approval of the Private Engineering Services Division. The completed pipe installation shall then be retested and required to meet the requirements of this test.

M8) REQUEST FOR FINAL INSPECTION

Upon completion of construction, the Permittee shall submit to the Village a properly executed request for final inspection and approval on the form prescribed by the Village. No sewer shall be put in service until it has been approved by the Village and until all the conditions of the permit have been satisfactorily met.