



**Installation Guide For
ASTM D3034 PVC
Sewer Pipe**

www.dpcpipe.com

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SEWER PIPE

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SEWER PIPE

INTRODUCTION:

This document has been developed by the Diamond Plastics Corporation for use as a field installation guide. General information regarding the correct installation of gasketed-joint solid-wall PVC sewer pipe is included. The relevant product standard for Diamond Plastics gravity sewer pipe is ASTM D3034 "Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings".

Technical data contained in this Installation Guide is furnished without charge and is given and accepted at the recipient's sole risk. Every effort has been made to verify the information contained herein, however, Diamond Plastics Corporation makes no representation about and is not responsible or liable for use of information contained in this Installation Guide, or for which this guide was not intended. In no event shall Diamond Plastics Corporation be liable for incidental or consequential damages. Diamond Plastics Corporation reserves the right to update or change literature and this guide without notice. To assure accurate and current information, contact Diamond Plastics Corporation.

Installation of Diamond PVC pipe for sewers or other gravity flow applications should be in accordance with ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications" This guide is meant as a supplement only—ASTM D2321 should be considered the governing document.

SEWER PIPE

RECEIVING:

When a load of pipe arrives at the job site, it is your responsibility to check it thoroughly. If possible, inspect each piece for damage. Check quantities against the shipping list. Each pipe shipment should be inspected carefully upon arrival. The carrier is responsible for delivering the pipe. Make certain all material listed on the bill-of- lading has arrived. The receiver must make certain there has been no loss or damage. It is important to note any errors or damage, on both the driver's copy and the delivery receipt. Make claim in accordance with the carrier's instruction. Do not dispose of any damaged material. Carrier will advise you of the procedure to follow for freight damage.



SEWER PIPE

UNLOADING AND HANDLING:

Pipe should be lowered, not dropped, from trucks to the ground or into a trench. **Do not cut bands that hold each unit together while the unit is on the truck.**

The forklift truck, boom and sling, or other material handling equipment should be equipped to avoid excessive swinging.

DO NOT USE CHAINS AS A SLING. DO NOT ATTEMPT TO HANDLE PIPE BUNDLES BY PULLING ON STRAPPING OR PACKAGING MATERIAL. Avoid all impact blows, gouging, or abrasions caused by metal surfaces, rocks, material handling equipment, or any other source. **Do not roll the pipe off the truck**

Cold Weather Handling: Extra care should be used in handling during cold weather.

WARNING: Carelessly unloading pipe can be hazardous. Use appropriate equipment and stay clear when removing tie-downs, banding, and dunnage material. Forklift tines must be long enough to support the bottom of all pipe within the bundle. The tines must have a vertical pad.



SEWER PIPE

The tables below are provided for use as guides in selection of handling equipment:

APPROXIMATE WEIGHT OF PIPE LENGTHS (lbs)

Pipe Size	20-Foot Lengths		14-Foot Lengths	
	DR35	DR26	DR35	DR26
4 in.	22	30	16	21
6 in.	50	67	35	47
8 in.	89	120	62	84
10 in.	140	190	98	130
12 in.	200	270	140	190
15 in.	290	390	200	270

Pipe Size	20 (22*)-Foot Lengths			14-Foot Lengths		
	PS 46	PS 75**	PS 115	PS 46	PS 75	PS 115
18 in.	410	480	650	290	340	460
21 in.	570	670	900	400	470	630
24 in.	720	840	1100	500	590	770
27 in.	970	1100	1500	680	770	1100
30 in.	1300	1500	2000	910	1100	1400
36 in.	1800	2100	2800	1300	1500	2000
42 in.	2400	2800	3800	1700	2000	2700
48 in.	3200	3800	5100	2200	2700	3600
*54 in.	4700	5400	6500	3000	3400	4100
*60 in.	5500	6100	7400	3500	3900	4700

*54" and 60" standard length is 22', 14' also available as special order.

**PS75 special order item

SEWER PIPE

STORAGE:

If you can unload the shipment in unit packages, the pipe will be easier to store. Stack the packages on reasonably level ground. If you unload one piece at a time, place the pipe bevel to bell. Never stack over eight feet in height. Do not stack the pipe next to heat sources or engine exhausts. Gaskets should also be protected from heat, oil, and grease.

When prolonged exposure to direct sunlight is anticipated, PVC pipe should be covered with a light colored breathable material which will permit adequate air circulation to prevent heat accumulation.



SEWER PIPE

TRENCHING:

Proper installation procedures and trench preparation are essential to successful PVC pipe performance. Trench preparation procedures for PVC pipe do not vary substantially from procedures used with other piping products. No more trench should be prepared than the footage of pipe that can be laid in a day.

Do not let the excavated material block sidewalks, drives, or utility outlets. Follow all safety rules and regulations. Protect workers by using sheeting and trench boxes in hazardous areas and by sloping the trench walls in dry soils. When sheeting or a trench box is moved, make sure that the pipe is not moved and that the side-support material is not disturbed.



SEWER PIPE

DEWATERING:

Keep the trench as dry as possible until the pipe has been installed and enough backfill placed to prevent the pipe from floating. PVC pipe will float if not filled with water or weighted down. The height of loose backfill material required to prevent flotation of empty pipe is conservatively equal to $1\frac{1}{2}$ times the pipe diameter.



SEWER PIPE

FIELD CUTTING:

PVC pipe can be easily cut with a power handsaw or power-driven abrasive disc. Be sure you make a square cut. Bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Re-draw the insertion line on the spigot using a factory-marked spigot as a guide.



LARGE - DIAMETER FIELD CUTTING:

Large diameter pipe's combination of size, weight and wall thickness means that cutting techniques that have been used for smaller pipe may no longer be safe or efficient. The following considerations become even more important:

- **Pipe Movement:** It is necessary to roll a pipe to cut it all the way around its circumference. However, uncontrolled pipe movement should be prevented for safety reasons and may break a partially cut pipe.
- **Pipe Support:** Support of the pipe and drop off piece must be maintained. Large diameter pipes can weigh in excess of 350 pounds per foot which will cause the pipe to break when nearing the end of the cut if the drop off is not kept in line with the pipe and supported.
- **Saw Kerf:** Proper support of the pipe being cut is necessary to prevent the saw kerf from closing (binding the saw blade) or opening (potentially cracking the pipe).

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LOWERING PIPE INTO THE TRENCH:

Place the pipe and fittings into the trench using ropes and skids, slings on the backhoe bucket, or by hand. Do not use chains as a sling. Do not throw the pipe or fittings into the trench or allow any part of the pipe to take an unrestrained fall onto the trench bottom. At this point, the pipe and other accessories are in a good position for final inspection. Ensure there are no damaged materials before assembly begins.



SEWER PIPE

CLEANING AND INSPECTION:

Remove any mud, sand, or other foreign material from the bell interior and spigot exterior that could prevent an effective seal between the bell and spigot. Carefully clean the gasket area. Do not remove the gasket from the bell. Make sure the gasket is seated uniformly in the groove by running your finger around the inner edge of the gasket.



SEWER PIPE

LUBRICATION:

An even, uniform application of gasket lubricant must be applied to the spigot including the bevel and to the insert reference mark as well as the contact surface of the gasket. Gasket lubricant may be applied with a swab, brush, or roller. An adequate amount of gasket lube is furnished with each truckload of pipe. Additional lubricant may be purchased from your distributor.



SEWER PIPE

JOINT ASSEMBLY:

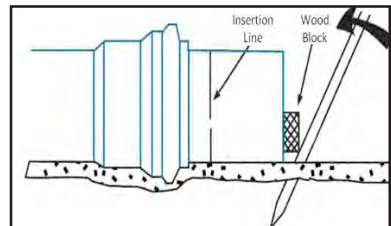
Assembly is made by sliding the lubricated spigot end into the gasketed bell end. The gasket seals the joint against leaks, into or out of the pipeline. Insert the spigot end into the socket so that it is near contact with the gasket. The bell hole should be large enough to prevent any bedding material from sticking to the lube on the spigot. Keep the pipe lengths in proper alignment. Brace the bell while the spigot end is pushed through the gasket so that previously completed joints in the line will not be “stacked” or “over belled”. Push the spigot end in until the insertion line is adjacent to the lip of the bell. If the spigot is inserted beyond the insert reference mark laying length will be lost. Loss of laying length can be significant on long footage projects. Joint flexibility is reduced when the spigot is inserted beyond the insert reference mark. Some joints may require barring to seat the joint. If so, use a wood block to protect the end of the pipe. A come-a-long may be preferred to the bar and block, but a swinging stab is not recommended. Where the physical weight or trench conditions make the recommended methods unsafe, joints may be assembled using mechanical equipment provided that the pipe is properly lubed and aligned. The end must be protected from damage, and the joint must not be “over belled” or inserted beyond the insert reference mark. If a backhoe is used for assembly, the backhoe should be “walked” forward to push the spigot into the bell. This gives the operator greater control over the speed of insertion than extending the arm of the backhoe. It is likely the joint will be over-inserted if the operator extends the hydraulic arm instead of “walking” the machine forward.



If the insertion mark is not visible after assembly, the pipe was over-inserted. The spigot needs to be pulled back until the assembly mark is visible. Likewise, if the mark falls short of the lip of the bell, the spigot end needs to be pushed a little further until the lip of the bell is at the insertion line on the spigot.

If the pipe is misaligned during insertion, over-inserted, or assembled with excessive force, the following are possible consequences:

- rolled gaskets
- failure to pass acceptance testing (e.g., low-pressure air testing and deflection-mandrel testing)
- over-insertion of previously assembled joints

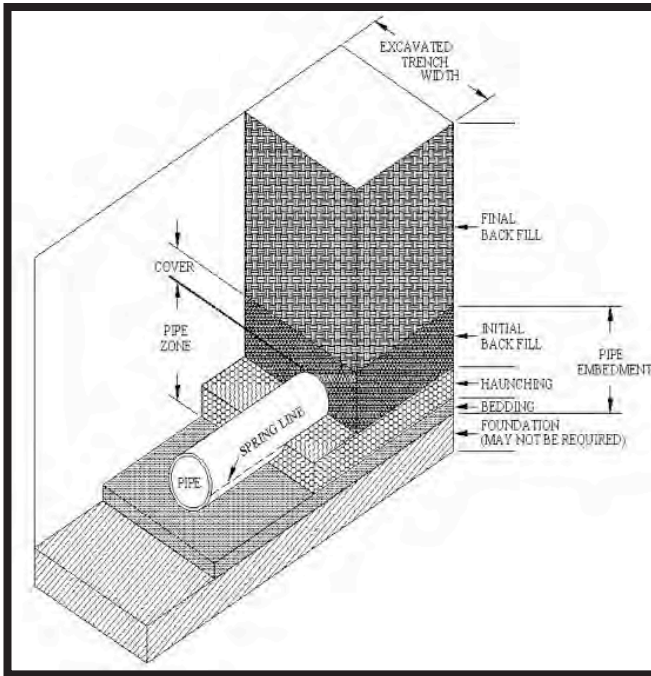


Manual Bar-and-Block Method

SEWER PIPE

TRENCH CONSTRUCTION:

Terms used in pipe installation are illustrated in the trench cross-section below. The use of proper embedment materials is very important to trouble-free operation of pipe systems. The particle size of material in contact with the pipe shall not exceed 1½ inches.



FOUNDATION:

A foundation is required when the trench bottom is unstable. The bottom of the trench is over-excavated and brought back up to grade with suitable material. Where over-excavation occurs, ensure that the elevation under the entire length of the pipe is brought up (rather than only at the bells). Proper placement of new foundation materials will support the pipe and prevent sagging between joints.

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BEDDING:

Bedding may be used to bring the trench bottom up to grade before the pipe is installed. Its purpose is to provide continuous and uniform support. Where bedding is required, a maximum compacted depth of 4 to 6 inches is typical for smaller diameter sewer pipe. Up to 10" of compacted bedding may be required for larger diameter sewer pipe to accommodate the larger bells. Holes for pipe bells should be provided at each joint to ensure uniform support for the pipe. Bell holes should be no larger than necessary for pipe assembly. Maximum particle size for embedment, which includes bedding, haunching, and initial backfill, is limited to material passing a 1½ inch sieve. (Limiting particle size to ¾ inch or less enhances placement of em-bedment material for nominal pipe sizes 8 inch through 15 inch. For smaller pipe, a particle size of about 10% of the nominal pipe diameter is recommended.) Unstable trench bottoms shall be stabilized by methods and with materials, required by the specifying engineer, to provide adequate and permanent support for the conditions encountered.

HAUNCHING:

Haunching should be completed as the pipe is laid. The haunching material should consist of an evenly graded, free flowing, granular material which is free of large stones, frozen clods or other hard particles. If imported material is required, haunching material should be the same as the bedding. Placement and compaction of the haunching material are the most important factors affecting pipe performance and deflection. Proper placement and compaction of material in the haunch reduce voids and increase pipe support. Granular materials may be properly placed using techniques such as shovel slicing. Place material under the haunches and at least halfway up the pipe to provide side support. Make sure material is properly compacted. **DO NOT DISTURB SIDE SUPPORT WHEN MOVING SHEETING OR TRENCH BOX.**



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INITIAL BACKFILL:

Keep the initial backfill free from rocks which could damage the pipe during final backfill. Depth of the initial backfill should be at least 6 inches over the top of the pipe's bell. Initial backfill protects the pipe from damage during final backfill. Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe. Adequate cover will depend on the type of compaction equipment. For adequate cover to prevent pipe damage or deflection, consult the project engineer.



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FINAL BACKFILL:

Final backfill is often specified by the project engineer based on site design. Material selection, placement, and compaction should meet the project requirements. After placement and compaction of pipe embedment materials, the balance of backfill materials may be returned to the trench. The material should not contain large stones or rocks, frozen materials, or debris. Compaction procedures of the remainder of the backfill should be in accordance with the contract specification.

ACCEPTANCE TESTING:

After the installed PVC pipeline is thoroughly cleaned, one or more of the following tests may be performed:

- Visual inspection
- Deflection test
- Leakage test

Visual Inspection Sewer pipelines can be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The test is typically performed by closed-circuit TV.

Deflection Testing Deflection testing is usually performed with a properly sized “go/no-go” mandrel. Mandrel sizes for 7½% deflection of the base inside diameter are found in the ASTM product standard (ASTM D3034) and are also given in the Handbook of PVC Pipe: Design and Construction.

The following table provides base inside diameters for SDR35/PS46 pipe and the subsequent mandrel dimensions, which are derived from them.

Size and Mandrel Dimensions

Pipe size (in.)	(mm)	Average O.D. (in.)	Base I.D.*		7.5% Mandrel Size		5% Mandrel Size	
			(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
6	150	6.275	5.742	145.8	5.31	134.9	5.45	138.4
8	200	8.400	7.665	194.7	7.09	180.1	7.28	184.9
10	250	10.500	9.563	242.9	8.84	224.5	9.08	230.6
12	300	12.500	11.361	288.6	10.51	266.9	10.79	274.1
15	375	15.300	13.898	353.0	12.86	326.6	13.20	335.3
18	450	18.701	17.054	433.2	15.77	400.6	16.20	411.5
21	525	22.047	20.098	510.5	18.59	472.2	19.09	484.9
24	600	24.803	22.587	573.7	20.89	530.6	21.46	545.1
27	675	27.953	25.445	646.3	23.54	597.9	24.17	613.9
30	750	32.000	29.151	740.4	26.96	684.8	27.69	703.3
36	900	38.300	34.869	885.7	32.25	819.2	33.13	841.5
42	1050	44.500	40.491	1028.5	37.45	951.2	38.47	977.1
48	1200	50.800	46.209	1173.7	42.74	1085.6	43.90	1115.1
54	1350	57.560	52.359	1329.9	48.43	1230.2	49.74	1263.4
60	1500	61.610	55.961	1421.4	51.76	1314.8	53.11	1350.3

* Base I.D. is a minimum pipe inside diameter derived by subtracting a statistical tolerance package from the pipe's average inside diameter.

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Leakage Testing Low-pressure air testing is an acceptable method of insuring integrity of the installed sewer system. ASTM F1417 “Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low- Pressure Air” provides procedures for leakage testing of plastic sewer lines. Water-infiltration testing is an alternative method which is accurate only when the pipe is completely under water. Water-exfiltration testing is a rarely used method that can be complicated by entrapped air.

With large diameter pipe the duration of the test can become excessively long. **It is the industry recommendation that if there is no loss of pressure after one hour of testing that the test section shall be accepted and the test ended.** If there is any loss of pressure during the first hour the test should run its full duration.

If any test section loses more air pressure than specified the contractor shall, at his own expense, locate and repair the defective section. If a failure is noted the first things to check are the hoses, gauges, and valves and plugs associated with the test equipment. After these are ruled out as the problem any laterals on the system should be checked. After this is ruled out individual pipe joints should be checked. Isolating the individual section which is leaking is the key to resolving the problem.

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SPECIAL CONSIDERATIONS:

Changes in Direction

1. Pipe bending – Some changes in direction may be accomplished without the use of bends, sweeps, or other fittings. Controlled bending within acceptable limits can be accommodated by PVC pipe. A general rule of thumb for the minimum bending radius (Rb) calculation is $Rb = 200 \text{ OD}$. Tighter bending radii may be achieved for certain products. Consult the manufacturer for specific product information. In most cases, bending should be accomplished manually. It is not recommended to attempt bending pipes greater than 12 inches in diameter due to the forces required.
2. Joint deflection – During construction, it may become necessary to make very slight changes of direction. Changes in direction may also be accomplished through joint deflection. Allowable joint deflection is dependent on pipe size and joint design. Neither the pipe nor the joint should be axially deflected in any manner to cause stress at the joint. Diamond “Solid-Wall” PVC Sewer Pipe will accommodate a 1° change in direction per joint. With 22’ joints this is a 4.5” offset, 20’ joints this is a 4” offset, and with 14’ joints this is approximately $2 \frac{3}{4}$ ” offset.
3. Combined pipe bending and joint deflection – Either joint deflection or longitudinal bending may be used for changes in direction, BUT NOT BOTH on the same length of pipe.

Manhole Connections: Proper manhole connections are essential to good system performance. The following precautions are recommended:

- Insure stable foundation and bedding for the manhole and connecting pipe to prevent shifting which could damage the connection.
- Use a water-stop gasket produced from elastomeric material which prevents leakage while allowing longitudinal pipe movement.
- Use a non-shrinking or expansive type grout for making connections of pipe and water-stop to manhole walls.

Manhole construction techniques may vary from one region to another. However, the smooth surface of Diamond “Solid-Wall” PVC Sewer Pipe facilitates an easy connection. A watertight system requires a flexible seal or waterstop between the PVC pipe and the manhole structure. With precast or poured in place concrete manholes, use an elastomeric seal, or flexible boot to facilitate a seal as concrete will not bond directly to PVC. Fiberglass or polyethylene manholes may be connected to Diamond PVC Sewer Pipe by using a properly sized rubber coupling. The manhole foundation and bedding material should be compacted to 95% Proctor Density. Compaction of the bedding and haunch material at the manhole connection is critical in controlling settlements. Settlements can cause shear failures and/or excessive deflection

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Cold Weather Installation: Extremely cold temperatures result in increases in pipe stiffness and tensile strength and decreases in impact strength. The decrease in impact strength requires care in handling during installation in cold temperatures.

Risers: Sewer risers or vertical stacks may be required in deep sanitary sewers to minimize excavation for services lines. Risers are generally permitted where the main sewer line is deeper than 7 feet.

The vertical riser pipe creates a load scenario not common in other sewer installations. Any settlement of material alongside the riser produces a “drag-down” load due to the frictional forces at the pipe/soil interface. Additionally, settlement of the lateral fitting assembly produces a similar drag-down load. These loads must be mitigated or transferred harmlessly off the stack to prevent problems such as over-insertion, fitting fracture, main sewer line deflection/misalignment, etc.

The following practices are considered appropriate for all riser installations:

- Transitions from horizontal to vertical should be smooth and well supported. This may be accomplished with fitting combinations, gradual bends and/or trench geometry.
- Service laterals from the main sewer should exit at an angle no greater than 45 degrees from the horizontal. A single length of lateral pipe should be used for the riser section whenever possible.
- To minimize or eliminate settlement and the resulting loading, compaction is critical beneath the main line sewer and lateral connections.

Soil Migration Where running or standing water occurs in the trench or substantial seasonal water table changes are expected, consideration must be given to preventing soil migration. Migration could cause loss of soil support for installed pipe. Materials used for underdrains, bedding, and haunching should be of proper gradation and thickness to prevent migration of material from fine-grained native soils. A properly designed system using a filter fabric to prevent soil migration is also acceptable.

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CHECKLIST:

- Take all precautions necessary to protect workers and materials.
- Plan ahead for fittings.
- Use trench boxes or shoring in unstable conditions.
- Do not disturb installed pipe when moving trench boxes or shoring materials.
- Properly assemble pipe joints by inserting the spigot end until the insertion line is even with the bell lip.
- Insure watertight seals at manhole connections.
- Keep the trench bottom as dry as possible.
- For detailed installation recommendations, see ASTM D2321 “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.”
- Consult the pipe manufacturer for specifics regarding gaskets and lubricants.
- Check with the project engineer regarding specifications and procedures.

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Recommended Standards

UNI-B-1 “Recommended Specifications for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications”

ASTM F1417 “Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air.”

Technical Reports

UNI-TR-1 “Deflection: The Pipe/Soil Mechanism”

UNI-TR-3 “Maintenance of PVC Sewer Pipe”

UNI-TR-5 “The Effects of Ultraviolet Radiation on PVC Pipe”

LIMITED WARRANTY AND LIABILITY

Diamond Plastics Corporation, 1212 Johnstown Road, P. O. Box 1608, Grand Island, NE 68802, does hereby warrant, subject to the limitations hereinafter stated, its PVC Pipe to be free from defects in material and workmanship under normal use and service for a period of twelve (12) months from the date of invoice. This limited warranty extends only to the original purchaser for use, and will be void if the product is used under conditions other than those for which it was designed or if it is not used in compliance with all instructions contained in any operating manual or specification sheets provided for such product.

Alteration or modification of the PVC Pipe in any manner, (other than as may be specifically authorized by Diamond Plastics Corporation or permitted in accordance with the installation guide provided by Diamond Plastics Corporation for such product), will void this limited warranty.

The sole obligation of Diamond Plastics Corporation, under this limited warranty, and the exclusive remedy of the purchaser under this limited warranty is the repair or replacement, without charge, F.O.B. shipping point, of such products or parts of products only, specifically excluding any labor or installation thereof, which Diamond Plastics Corporation, after inspection, determines to be defective.

Purchaser must notify Diamond Plastics Corporation, in writing at its address shown above within ten (10) days from the date of discovery of any claimed defect specifically stating the details of such defect, and, if requested by Diamond Plastics Corporation, return the defective product, freight prepaid, to Diamond Plastics Corporation, F.O.B. shipping point as shown on Diamond Plastics Corporation's order acknowledgment.

Diamond Plastics Corporation shall not be liable for any other damages, whether direct or consequential. Specifically, but without limitation, Diamond Plastics Corporation shall not be liable for any crop damage or any other incidental or consequential damages resulting from any breach of warranty, express or implied, or from any defects in its products.

No statement, remark, agreement, representation, promise or understanding, oral or written, made by Diamond Plastics Corporation, or any agent, representative or employee thereof, which is not contained herein, will be recognized by, or be enforceable or binding upon Diamond Plastics Corporation.

There are no understandings or undertakings of any kind with respect to the products or any part thereof which are not expressly set forth and contained herein, and all sales are made without any representation or warranty by Diamond Plastics Corporation that the goods are suitable for any particular purpose. In the event any provision of this LIMITED WARRANTY AND LIMITATION OF LIABILITY is held to be illegal or unenforceable by any court of competent jurisdiction, the remaining provisions shall remain in full force and effect.

STATUTE OF LIMITATION: Any action for breach of this LIMITED WARRANTY AND LIMITATION OF LIABILITY must be commenced within one (1) year after the cause of action has accrued.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES BY Diamond Plastics CORPORATION, OTHER THAN THOSE SPECIFICALLY SET OUT ABOVE. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE IN CONNECTION WITH ANY SALE EXCEPT AS SET FORTH ABOVE.



WARNING



***DO NOT UNLOAD BED ON UNEVEN
GROUND.***



***DO NOT STAND OR WALK BESIDE THE TRUCK
WHILE UNLOADING.***



FALLING PIPE CAN CAUSE SERIOUS INJURY OR DEATH

DO NOT ROLL PIPE TO UNLOAD



***DO UNLOAD WITH FORKS THAT EXTEND TO
SUPPORT ALL OF THE PIPE IN THE BUNDLE.***

