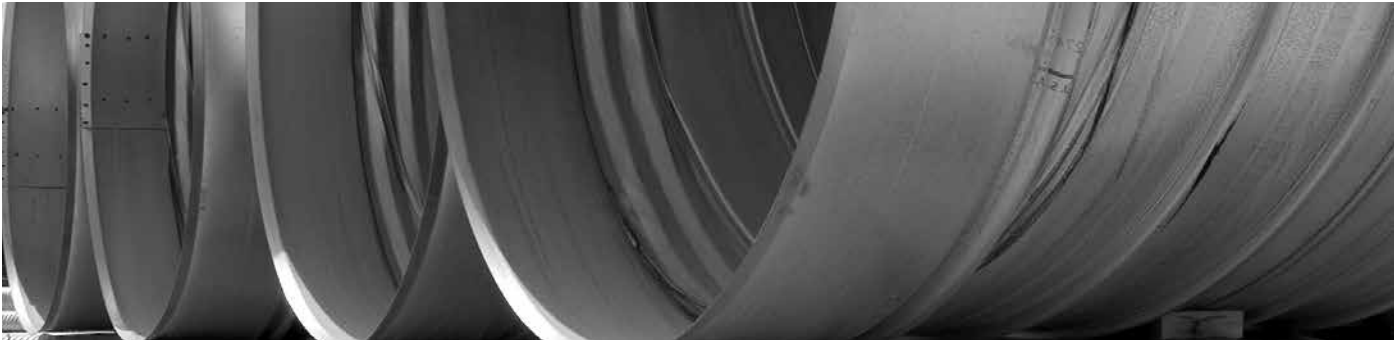


ULTRA FLO[®] & Corrugated Metal Pipe Handling and Installation Guide for Reline





PREFACE

This instruction book is for your crews. Distribute it to help them install Contech® ULTRA FLO® and CMP Liner pipe correctly. ULTRA FLO is a spiral ribbed steel or aluminum segmental pipe that is inserted (sliplined) into an existing deteriorated pipe or into a casing pipe or tunnel as a carrier pipe. ULTRA FLO features very low wall friction to provide the greatest water flow and is the most common metal reline pipe. In addition to ULTRA FLO, other corrugated metal pipe (CMP) products can be used for liner pipe. These additional CMP products include SmoothCor™, HEL-COR®, MULTI-PLATE®, Aluminum Structural Plate and Tunnel Liner Plate. Your Contech representative can assist in using these guidelines along with other CMP products.

Don't assume experienced workers know all the answers. Review these instructions with your supervisors and crews. It can mean a safer and better job for you and your customer.

We recommend holding a preconstruction meeting with your Contech representative and all interested parties to ensure everyone involved in your project has a high level of understanding on what means and methods will be used to prepare for, install and grout the new structure(s).

If you have any questions about these instructions, call your Contech Representative.

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TERMS YOU SHOULD KNOW

▲WARNING

Alerts you to hazards or unsafe practices that CAN result in severe personal injury or property damage.

SAFETY INSTRUCTIONS

Messages about procedures or actions that must be followed for safe handling and installation of ULTRA FLO and CMP Liner Pipe. Failure to follow these instructions can result in serious injury or death and/or damage to the pipe.

UNLOADING AND HANDLING

The following equipment is recommended for unloading pipe or pipe bundles:

- Forklift
- Front-end loader with fork adapters
- Backhoe with fork adapters
- Cranes
- Non-metallic slings

Other unloading methods such as lifting lugs, chains, wire rope, cinching or hooks in the end of the pipe should not be used.

SAFETY INSTRUCTIONS

1. Only trained and authorized equipment operators are to be permitted to unload the trailer.
2. Wear approved safety hat and shoes, gloves and eye protection.
3. **▲** Pipe ends may be sharp. Workers handling pipe must wear gloves made from cut-resistant materials.
4. Park the truck and trailer on level ground before you start unloading. It is the responsibility of the consignee to direct the driver to level ground for parking the truck.
5. Keep all unauthorized persons clear of the area when the driver releases the binders from the trailer and during unloading.
6. **▲** Sometimes pipes are bundled together on the truck with steel straps. Do not cut the steel strapping around the bundles until the bundles have been placed on level ground, blocked or secured, and will not be moved again as a unit. It is recommended that the steel strapping be cut with appropriate sized cutting tools. Stand to the side when cutting a strap. Always be aware that pipe may move, roll or fall when a strap is cut.
7. **▲WARNING** Do not lift bundles or sections of pipe by the steel strapping around the bundles.
8. Know the capabilities and rated load capacities of your lifting equipment. Never exceed them.
9. **▲WARNING** Do not stand or ride on the load of pipe while it is being unloaded. Do not stand beneath or near the pipe while it is being unloaded.
10. If unloading at multiple drop-off points, secure the remaining load and pallets between drop off points. Always unload the top pallets or bundles first.
11. The contractor shall be responsible for the safety of his/her employees and agents. Adequate safety indoctrination is his responsibility and shall be given to all personnel employed by his firm.
12. Safe practices on construction work as outlined in the latest edition of the "Manual of Accident Prevention in Construction," published by the Associated General Contractors, shall be used as a guide and observed.
13. The contractor shall comply with all applicable city, state, and federal safety codes in effect in the area where he is performing the work. This conformance shall include the provisions of the current issue of the "OSHA Safety and Health Standards (29 CFR 1926/1910)" as published by the U.S. Department of Labor.

GENERAL

1. Contech recommends the use of non-metallic slings for all pipe handling requirements.
2. Hooks, chains or wire rope may damage the pipe.
3. **▲WARNING** Do not push bundles off the trailer or permit pipe to drop to the ground.

PREPARATION FOR SLIPLINING

Follow all requirements of the project plans and specifications. Prior to sliplining, the following procedures should be performed to ensure satisfactory results are obtained.

1. **▲ Ensure continued space assessment procedures are followed prior to entry.**
2. The existing sewer line should be inspected to determine the condition of the line and identify problem areas or obstructions such as displaced joints, crushed pipe, protruding service laterals, roots, debris, out-of-roundness or inside diameter reductions.
3. Verify and record the location, number and size of all inlets and connections.
4. Where the pipe is to be pushed through existing manholes, check the alignment and clearance.
5. Remove any obstructions in the existing line that will prevent insertion of, or cause damage to, the new liner pipe. Large joint offsets or severely deteriorated pipe may need to be removed or repaired prior to installing the pipe. These may be good locations for insertion pits or point repairs.
6. Thoroughly clean the existing line as required (high-pressure water, buckets, reamers or other mechanical methods). Not cleaning the line thoroughly can result in excessive jacking/pulling loads or liner pipe hang ups that can damage the new pipe.
7. Verify adequate clearance for the liner pipe. Measure the inside diameter (ID) of the existing pipe at the worst location and compare the dimension to the liner pipe outside diameter (OD). Depending on the condition of the existing pipe and the obstructions present, it may be desirable to pull a trial liner or mandrel of the same outside diameter as the liner pipe (outside diameters are listed on Page 19). The trial liner may be a short section of ULTRA FLO or CMP pipe and should be attached to pulling cables at each end. If external bands are used, be sure there is adequate clearance for the band hardware.



SLIPLINING PROCESS

The best specifications allow for creativity on how to go about the reline process. When designed correctly, a project will have critical performance requirements and information within the project documents that will provide limitations, guidance, and perhaps some suggestions on how to approach the project.

The information contained herein is intended to introduce some of the techniques that have been used successfully in the past, and to provide limited guidance on what needs to be evaluated when considering a particular reline project. This information does not represent project specific recommendations from Contech and cannot be construed as a complete set of guidelines on how to successfully reline a drainage structure.

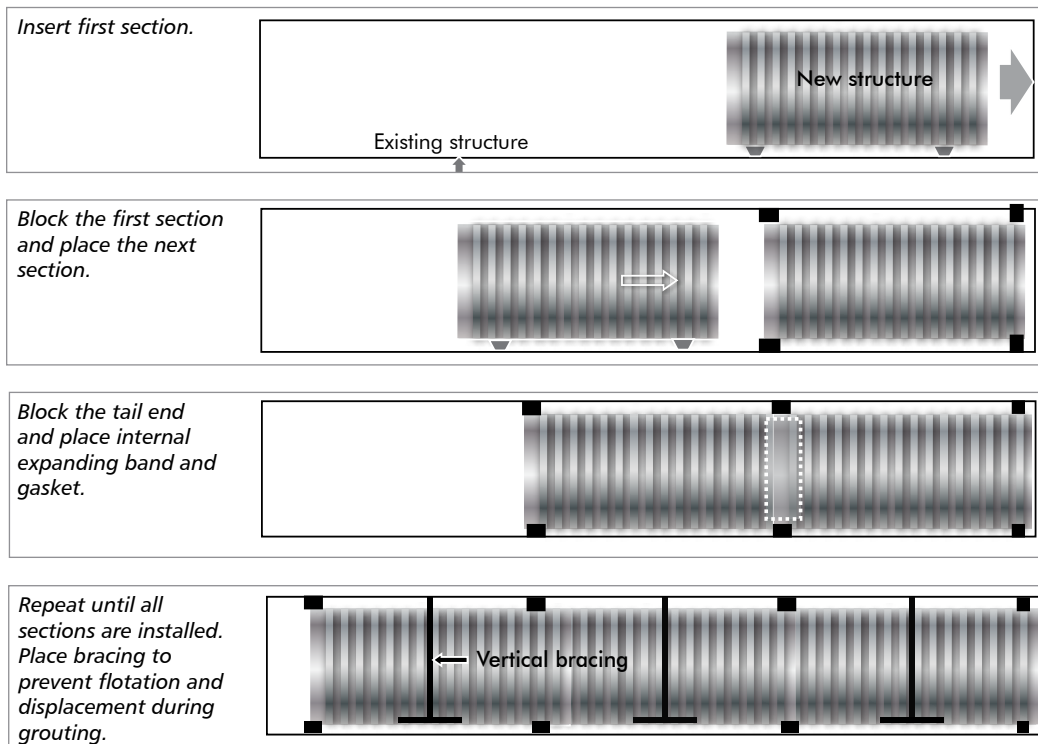
Complete and independent project specific evaluations must be conducted by a qualified contractor prior to them drawing any conclusions about how to approach a reline project.

The most common method of slipling with CMP is to place liner pipe one section at a time through the inlet or outlet end (for culverts) or through an insertion pit (for closed systems) and to push or pull the single sections into final position. Handling just one section at a time is normally the most efficient as it minimizes the amount of weight being pushed or pulled.



SEGMENTAL SLIPLINING PROCESS FOR CMP

Consult your local Contech representative for more detail.



EXCAVATING INSERTION PITS

ULTRA FLO and CMP liner pipe are installed from an excavated insertion pit or other location allowing access to the existing pipe (i.e. manholes, culvert ends).

When insertion pit locations have not been designated by the engineer or owner, the following conditions should be considered when selecting locations:

- Changes in line and grade
- Large joint offsets
- Severely deteriorated pipe sections
- Manholes being replaced
- Service laterals
- Pushing and pulling distances
- Accessibility (structures, traffic and existing utilities)
- Soil conditions

It is possible to reduce the number of insertion pits by sliplining in both directions from one location. Depending on the pipe diameter, the condition of the existing line or casing pipe and compressive/jacking loads, sliplining up to 2,000 feet or more from a single location is possible. In some cases (tunnels, long runs of large diameter pipe, etc.) it may be desirable to insert and position individual pipe sections into the existing pipe and then join the sections together to extend the allowable work distance from one location.

After insertion pit locations have been designated or selected, the required size of the pit should be determined.

ULTRA FLO and helical CMP comes in lengths up to 40 feet. Shorter lengths are available for easier handling. Structural plate CMP lengths vary by material. The insertion pit length should allow for the longest length of pipe being used, clearance for joining pipe sections, adequate space for pushing/pulling equipment and trench sheeting or shoring. The width of the insertion pit should be sufficient to accommodate the new pipe diameter plus provide safe working room for the crew. The depth of the insertion pit should allow for exposing and removing the existing pipe's top down to the spring line. The remaining bottom half of the existing pipe can serve as an open channel to maintain sewage flow. Bypass pumping is generally not required for segmental sliplining. A clean, level work area between the existing pipe and trench shoring will prevent dirt and debris from being washed back into the opened pipe.

ULTRA FLO AND CMP LINING INSERTION

After the existing line has been properly prepared for liner pipe insertion and the insertion pit(s) have been excavated, liner insertion (installation) can begin. ULTRA FLO or CMP liner pipe can be either pushed or pulled through the existing line.

External skids are recommended to protect the liner pipe from abrasion during the insertion process. Factory attached metal skids are available through Contech as an option. Suitable skids can also be developed and installed at the jobsite by the installer.

Pushing Method

1. Bands connecting pipe segments may be either internal or external. External bands must be assembled outside of the host pipe. Be sure there is adequate clearance in the annulus between the liner and the host pipe.
2. Internal bands can be assembled after the segment is positioned in the host pipe. After grouting the internal band can be removed or re-used.
3. If internal bands are used, the ULTRA FLO or CMP liner pipe will have annular re-rolled ends that will accept a corrugated band. If the liner pipes are match-marked position them correctly, otherwise either end can be inserted as the leading end. Guide rails will help the liner pipe ride over small joint misalignments and other small obstructions and inconsistencies in the existing pipe. If liner passage is questionable, a steel cable can be threaded through the liner pipe during installation and attached to the leading edge. This allows the liner pipe to be retracted (pulled backward) if the liner pipe gets caught on an obstruction. A pushing ring should be used in the tail end to evenly distribute the load from the pushing equipment. The pushing ring can be a short, sacrificial piece of liner pipe or a timber frame.
4. See the "Assembling Gasketed Joints" section for more information on joining pipe sections.
5. Bulkheads should be formed to seal the annular space between the liner pipe and the existing pipe at each culvert end, all manhole and insertion pit entries and exits as required. If the entire annular space between bulkheads is to be filled with grout, then bulkheads should be constructed to provide adequate resistance to grouting pressures and to provide appropriate vent and drainage tubes. When service and lateral connections are to be connected, it may be desirable to complete downstream bulkheads for the line segment after connections have been reinstated to provide an outlet for sewage/drainage between the pipes.

Pulling Method

The pulling method is similar to the pushing method. A steel cable is threaded through the existing pipe and attached to a pulling ring or plate positioned against the far end of the liner pipe or to the skid rails or pulling hardware that can be attached to the pipe segments. Pulling hardware must be positioned at or near the invert.

The pipe pushing/pulling loads should be monitored. Excessive force can "telescope" pipe joints and/or buckle the liner pipe. On some installations, small diameter (1" to 2") plastic pipe can be installed as runner rails.

The cable is attached to a winch assembly to facilitate pulling the liner through the existing pipe section. After each pull, the steel cable is disconnected from the pulling ring and threaded through the next liner pipe section to be joined. After the pulling ring is reconnected to the cable, the process is repeated.



Table 1 – Jacking Loads and Pushing Distances

Dia. (in)	Steel ULTRA FLO			Aluminum ULTRA FLO		
	Safe Jacking Load (lbs)	Allowable Jacking Distance ¹ (ft)	Allowable Jacking Distance ² (ft)	Safe Jacking Load (lbs)	Allowable Jacking Distance ¹ (ft)	Allowable Jacking Distance ² (ft)
18	3,220	860	2,140	1,610	640	1,610
21	3,660	820	2,030	1,830	610	1,520
24	4,070	810	2,030	2,940	650	1,630
30	4,950	790	1,970	4,380	580	1,460
36	5,090	550	1,370	7,800	670	1,690
42	4,950	330	830	8,510	650	1,630
48	4,750	280	700	9,050	600	1,500
54	5,090	270	670	9,540	560	1,400
60	5,510	260	660	10,040	540	1,350
66	10,260	440	1,110	10,110	490	1,230
72	10,180	400	1,010	10,520	460	1,160
78	10,290	380	950	11,030	450	1,120
84	14,650	500	1,260	11,480	440	1,100
90	14,840	470	1,180	---	---	---
96	14,020	420	1,050	---	---	---
102	14,420	410	1,030	---	---	---

¹ Based on Sliding Coefficient of 0.25

² Based on Sliding Coefficient of 0.10

ASSEMBLING GASKETED JOINTS

ULTRA FLO and CMP liner pipe gaskets are fitted on the annular re-rolled end of the pipe. Follow these steps:

External Bands

1. Confirm that there is enough clearance for the pipe with the band and clamp to pass through the host pipe.
2. Lubricate gaskets and outside of pipe. Gaskets tend to get stiff in cold weather.
3. Remove any foreign matter that might be lodged between the pipe and the band.
4. Position gaskets around and into the first annular corrugation of the pipe end.
5. Snap the gasket several times to seat into the corrugation.
6. Lubricate the inside of the band.
7. Check the bars on the band clamp for position and align as needed.
8. Use seam sealant tape at the band laps
9. Align band clamps and position band laps. Band corrugation should be located in the second annular corrugation next to the gasket. Hand-tighten bolts.
10. While tightening the bolts, adjust the band by tapping to seat the band in corrugations.
11. Torque bolts between 25' and 30'-pounds and inspect for adequate seating of the band in the corrugations.

FIELD CUTTING PIPE

If ULTRA FLO or CMP liner pipe is field cut, the annular re-rolled ends may be removed. Bands and gaskets may not seal the joints to keep fluid grout in place. All voids under the band will have to be plugged prior to grouting. Field cutting should only be done at the end of pipe runs.

1. The recommended cutting tool is a chop saw and abrasive saw blade. Refer to the Operating Instructions from the saw manufacturer for additional information.
2. Blade thickness should be no less than 1/8" thick and is recommended to be made of 2-ply material that is used to cut steel pipe (see figure 1).
3. Use the leading edge of the blade to cut into the ribs of the pipe.
4. Bury the blade as much as possible into the pipe as you proceed.
5. The alternative cutting tool is a handheld reciprocating saw with bi-metal blade suited for cutting steel.



Always use safety glasses when cutting ULTRA FLO and CMP pipe and use protective gloves in case sharp edges are exposed.

Internal Bands

1. After two liner pipe segments are positioned check the spacing between the first annular corrugation on either side of the joint.
2. Clean the corrugations and remove any foreign matter.
3. Place a flat gasket evenly across the joint. Mastic or spray adhesive may be used to tack the gasket in place.
4. Lubricate the overlap section of the band.
5. Locate the corrugations and position the internal band over the pipe joint.
6. Turn the bolts to expand the band. Tap the band to make necessary adjustments and seat the corrugations.
7. If any gaps are detected, plug with oakum, silicone sealant or similar material.
8. After grouting the internal bands may be removed and reused. Be sure to clean all surfaces and threads before reusing. Inspect gaskets for reuse. Plan on having extra gaskets as some may be damaged beyond reuse during grouting and removal of the band.



Figure 1

BRACING & BLOCKING THE NEW PIPE

Bracing and blocking isn't always the best option but it is often the quickest and lowest risk way to get the structure grouted. Quick is a relative term here, since multiple grout stages and balanced, controlled grout placement are usually required. The notable exception is when a foaming agent is used to lighten the fluid unit weight of the grout, in which case the dead weight of the new pipe and perhaps sand bags in the invert can offset the buoyancy forces.

Another possible alternative to full bracing and blocking is to float the new structure to the crown of the existing. This can be done with little hydraulic impact on lengthy structures because the grades at the inlet and outlet ends can be transitioned with appropriate blocking/bracing while most of the structure can be allowed to float. When this technique is used, care must be taken to keep the joints sealed and to control the shape of the new structure against the buoyant loads by strutting the inside (as opposed to running a brace through the top of the structure. Floating to the crown of the old structure might also be a good option when an increase in elevation of the overall invert grade line of the structure doesn't negatively impact the hydraulic performance.

HOW TO DETERMINE BUOYANT LOADS DURING STAGED GROUTING

It is absolutely necessary to keep stray rocks out of the pump. Always use a screen on the pump hopper to sift out any larger aggregate that could inadvertently be mixed in the grout. The transport truck that delivers grout was likely carrying normal concrete as its prior load. A couple of 1-1/2" stones can clog a 2" grout line resulting in significant back pressure which can result in a sudden 'blow out' of the reline pipe (see figure 4).

A reasonable yet conservative approach is to make a vertical projection from the new structure at the lowest point where a particular depth of fluid grout touches the structure to the top of the fluid lift, or to the springline for any lift that tops the springline. The spring line is the elevation at which maximum span occurs. For round pipe, it is at 1/2 way up the pipe. On a structural plate pipe arch or underpass the spring line can be approximated as the 'B dimension' from the NCSPA handbook. This volume of 'displaced' fluid (the area resulting from the projection described herein) times the fluid unit weight of grout is the resulting upward buoyant force that must be resisted. To analyze each lift, consider the prior lift to have solidified. The shop drawings by Contech normally show this information. On a single radius arch less than 180°, there are no buoyant forces. However, lateral fluid pressures must be considered with arches.

To determine grout quantities, geometric properties of the existing structure need to be known or estimated in addition to consideration given to the slope of the new and old structures, and the use of intermittent bulkheads that are occasionally used between the inlet and outlet bulkheads.

Flotation

When project plans and specifications require the liner pipe to be positioned on the invert of the existing pipe, flotation of the liner pipe resulting from grouting operations should be addressed. Depending on the type of grout and the grouting method being used, it may be necessary to perform one or more of the following to offset buoyant forces on the pipe:

1. Fill the liner pipe with water, partially or fully, depending on the grout density and grout lift thickness. For monolithic grouting, the liner pipe should be full of water, and the grout density must be lower than that of the pipe when full of water.
2. Stage grout with a suitable lift thickness, depending on grout density.
3. Attach blocking or spacers to the pipe exterior with strapping.
4. Use internal jacks that pass through a liner grout port (12 o'clock position) to offset buoyant forces.

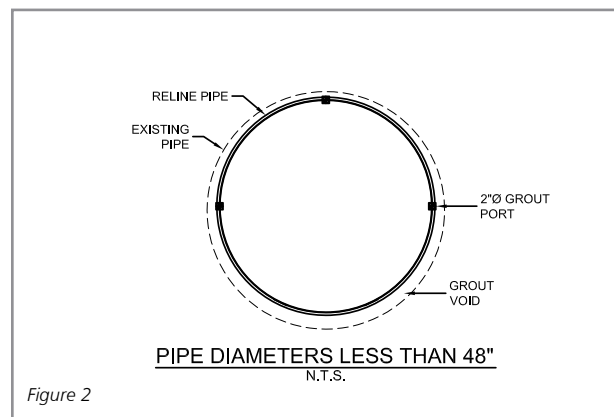


Figure 2

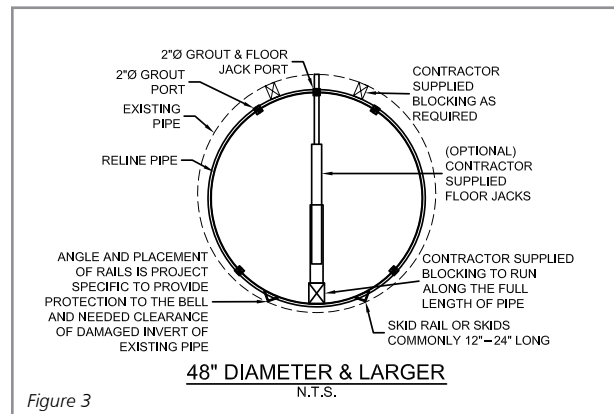


Figure 3

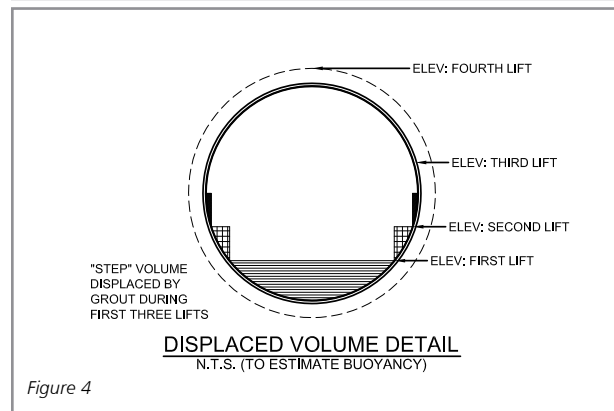


Figure 4

Placement

There are many acceptable grouting methods, and they usually fall under two general categories: monolithic grouting and stage grouting.

Diameters less than 48 inches

Monolithic grouting (in one step) involves filling the entire annular space with one lift. Grout is injected, under low pressure, from the upstream end of the pipe run from manhole to manhole, or from an insertion pit to manhole. The grout moves down the annulus in a wave-like fashion pushing any ground water ahead of the grout (see figure 2).

Diameters equal to or greater than 48 inches

Staged grouting involves placement of the grout in lifts and when done properly can eliminate liner flotation. The liner pipe is grouted into a cradle in the first stage. After the first lift of grout has cured, the remaining lift(s) of grout is placed. Since the liner pipe is in a cradle after the first lift, and further deformation is limited, it may be possible to increase grout injection pressures, if needed, to ensure complete grouting of the annular space. Factory installed grout ports are optional and can simplify the grouting process (see figure 3).

Other grout placement methods include grouting from the surface through drilled holes and slick-line grouting from a tube, within the annulus, that is retracted while grout is pumped through it.

For all placement methods, the annular space should be uniformly and completely filled on both sides of the liner simultaneously. Unbalanced or uneven grouting can affect liner shape, line and grade (see figure 5).

ANNULAR SPACE GROUTING

Most sliplining installations require the annular space between the existing (host) pipe and the liner pipe to be grouted. Grouting of the annular space fixes the position of the new liner pipe, provides uniform support, increases allowable external hydrostatic pressure on the liner pipe and inhibits further failure of the host pipe. Introducing the grout into the annulus is accomplished by gravity flow or by pumping. Properly controlled grouting is essential to prevent liner pipe flotation, deformation or even collapse.

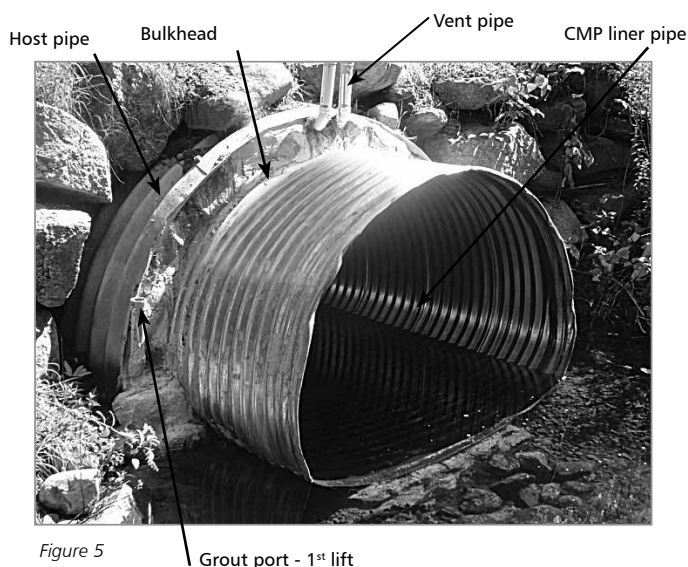


Figure 5

Grout port - 1st lift

MAXIMUM PRESSURE

The recommended maximum grouting pressure for ULTRA FLO and CMP is 5 psi. However, site conditions and pipe stiffness may allow slightly higher pressure. Appropriate gages should be used to monitor external pressures on the liner pipe. See Table 2 for more detail.

Table 2 – ULTRA FLO Grouting Pressure

Liner Diameter (in)	Steel – Max PSI Recommended* ¹		Aluminum – Max PSI Recommended* ¹	
	Round	5% Deflection	Round	5% Deflection
18	5 ²	5 ²	5 ²	5 ²
21	5 ²	5 ²	5 ²	5 ²
24	5 ²	5 ²	5 ²	5 ²
30	5 ²	5 ²	5 ²	5 ²
36	5 ²	5 ²	5 ²	5 ²
42	5 ²	5 ²	5 ²	5 ²
48	5 ²	5 ²	5 ²	5 ²
54	5 ²	5	5 ²	5
60	5	3	5	3
66	5	3	4	3
72	4	3	3	2
78	3	2	2	2
84	4	2	2	1
90	3	2	---	---
96	2	2	---	---
102	2	1	---	---

¹ Contact your local Contech representative for more information about recommended grout pressure and grout procedures.

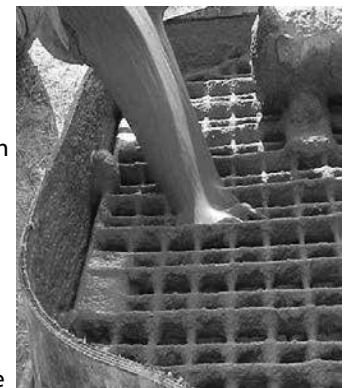
² Grout pressure limited to 5 psi maximum for practical, safe installation considerations. Higher grouting pressures may be possible and tolerable, depending upon the type of joint system used and other site-specific installation considerations.

* Includes a Factor of Safety (FS) = 3.0 for installed ULTRA FLO liner pipe that is perfectly round or a FS = 2.0 for liner pipe with 5% deflection.

Bulkhead designs should provide adequate venting and draining tubes. Hydrostatic head pressure resulting from the slope and/or diameter of the pipe, elevation change between the gage and the pipe, elevation difference between grout pump and the nozzle, etc. should be considered in addition to the grouting pressure on the gage. The hydrostatic head pressure combined with the pressure on the gage should not exceed the recommended maximum pressure. Contact your local Contech Sales Engineer for more information.

Typical Grouting Procedures

It is absolutely necessary to keep stray rocks out of the pump. Always use a screen on the pump hopper to sift out any larger aggregate that could inadvertently be mixed in the grout. The transport truck that delivers grout was likely carrying normal concrete as its prior load. A couple of 1-1/2" stones can clog a 2" grout line resulting in significant back pressure which can result in a sudden 'blow out' of the reline structure.



INSTALLATION TIPS

1. For curved sewers or severely misaligned sewers, using short ULTRA FLO or CMP liner pipe sections may reduce pushing or pulling forces and prevent hang ups. For large diameter sewers or tunnels, individual pipe lengths can be pulled through the line and joined within the line when necessary. When pulling individual pipe lengths, care should be taken to prevent damage to the re-rolled ends or alignment tabs.
2. When the annular space between the liner pipe and the exiting pipe is to be filled with grout, estimating the required grout volume before grout placement begins may be helpful. The estimate may include grout volume requirements for filling voids or sink holes outside the existing (host) pipe. Slope of the new structure must be taken into account when estimating volumes, buoyancy forces and bulkhead location.

REPAIRS

1. Should damage to the pipe occur at any point during installation, the Engineer should be contacted immediately.
2. For smaller abrasions or exposed steel after field cutting apply zinc-rich paint or cold galvanizing compound.
3. Contact your local Contech Sales Engineer if you have any questions or concerns and for recommendations.

TAPS AND LATERALS

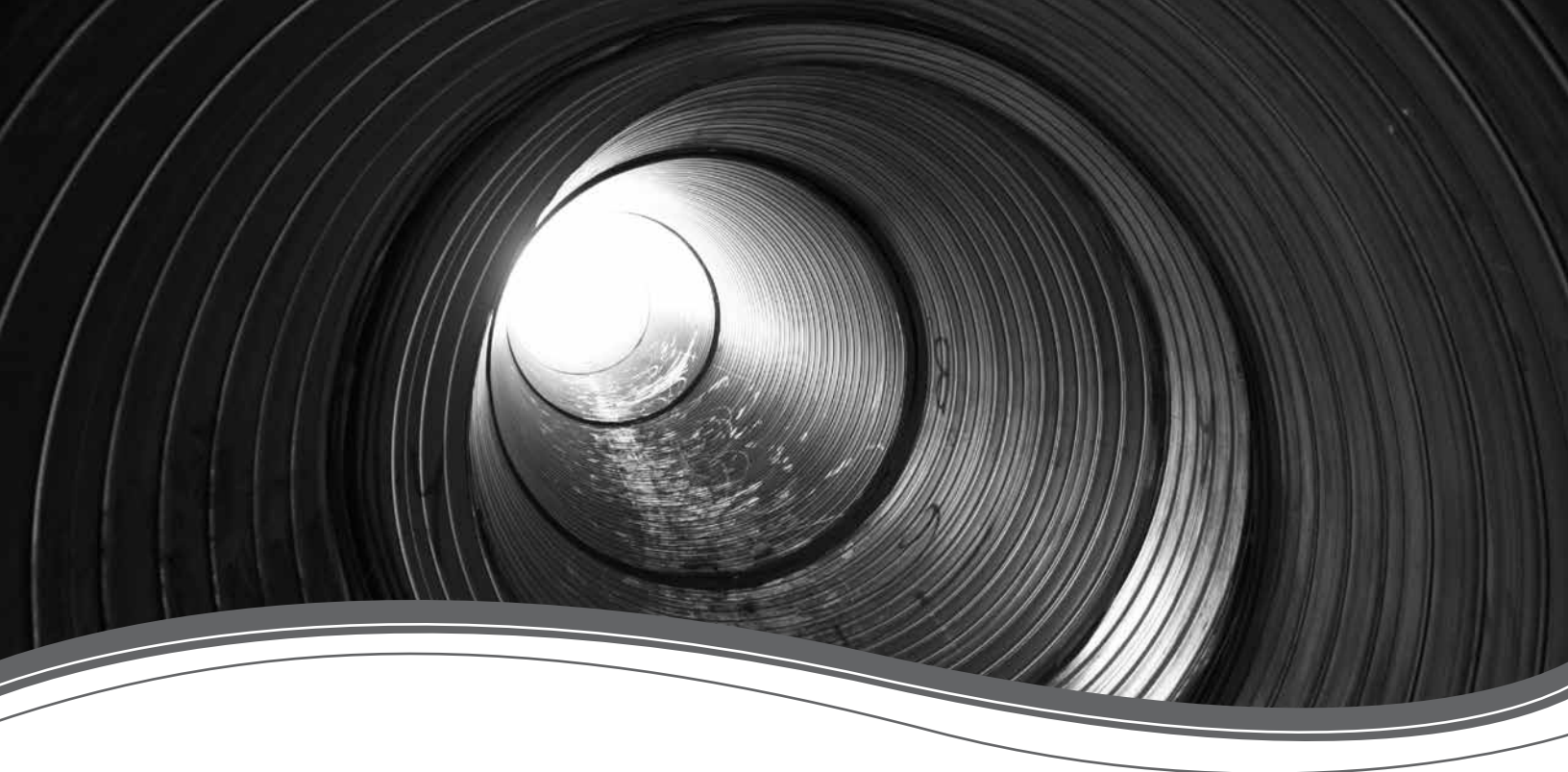
1. ULTRA FLO and CMP liner pipe can be supplied with standard prefabricated saddle stubs, fittings or components per job plans once prefabrication drawings are reviewed by Contech Engineering and approved by the Engineer. Overall clearance needs to be considered while choosing the appropriate details.
2. Consult the Engineer and your Contech Sales Engineer for further assistance.

Table 3 – ULTRA FLO Pipe Dimensions*

Pipe Diameter (in)	Max O.D. (in)	Steel Approx. Weight (lbs/ft)	Aluminum Approx. Weight (lbs/ft)
18	20.28	15	5
21	23.28	18	6
24	26.28	20	9
30	32.28	25	15
36	38.28	37	23
42	42.28	59	26
48	50.28	67	30
54	56.32	75	34
60	62.38	83	37
66	68.44	92	41
72	74.50	100	45
78	80.56	108	49
84	86.62	116	52
90	92.68	125	---
96	98.74	133	---
102	104.80	140	---

* Based on AASHTO M36 Specifications.
Custom diameters available upon request.





- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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