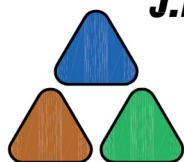
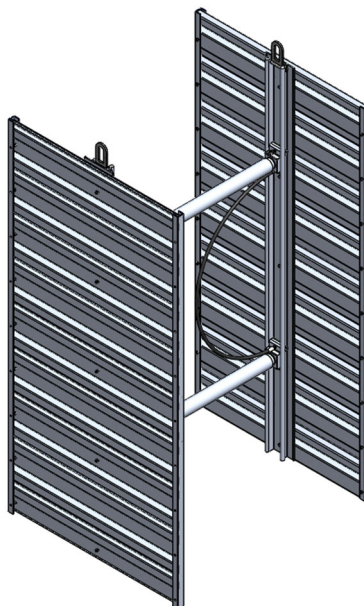


ALUMINUM SHEETING SHORE

TABULATED DATA
Effective April 22, 2020



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General Information for Use of Aluminum Sheeting Shores

1. The hydraulic aluminum sheeting shore system tabulated here is based on requirements of Federal OSHA 29CFR, Part 1926, Subpart P-Excavations, and Trenches

1926.652(c)(2)-Option (2) - Designs Using Manufacturer's Tabulated Data.

1926.652(c)(2)(i) -Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

All provisions of Subpart P apply when utilizing this tabulated data. The contractor's competent person shall use this data to select allowable trench depth, vertical and horizontal shore spacing, and plywood use requirements for Pacific Shoring Sheeting Shores. The competent person utilizing this tabulated data shall be experienced and knowledgeable of all requirements of Subpart P, and trained in the use and safety procedures for aluminum hydraulic shores.

2. Use of this tabulated data is dependent on first classifying the soil in accordance with OSHA Appendix A, Soil Classification. Classification shall be just prior to installing sheeting shores. Soil conditions may change at a later date and require sheeting shores to be reset at a different spacing.
3. Sheeting Shores are tabulated based on the effect of a 20,000 lbs surcharge load set back 2 ft from the edge of the trench and the equivalent weight effect of the OSHA soil type, see classification of soil types, 2.
4. The depth and spacing given in **Table 1** governs the use of Pacific Shoring sheeting shores and not tabulations given in OSHA Appendix C. This tabulated data applies exclusively to hydraulic shores manufactured by Pacific Shoring, LLC. Any alterations to the shores or variance from this tabulated data shall be indicated in a site-specific plan prepared and approved by a registered engineer.
5. Faces of excavations shall be vertical and there shall be contact with the soil at each cylinder, see **Figure 1**.
6. Shores shall be set near vertical; however, they may be set as much as 30 degrees from vertical provided that vertical and horizontal spacing is maintained.
7. Trenches 2 times the allowable horizontal shore spacing or less shall have a minimum of 2 shores set in accordance with spacing requirements. Trenches greater than 2 times the allowable trench spacing shall have a minimum of 3 shores set at required spacing. See **Figure 2**.

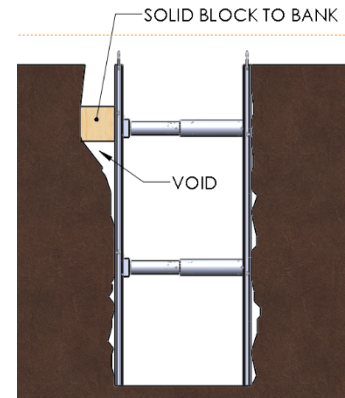


Figure 1: Voids in Excavation,
See Note 5

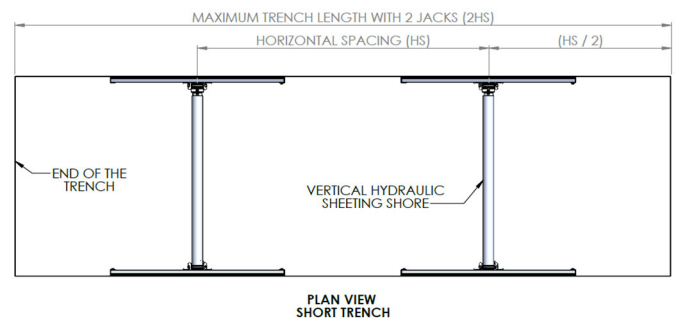


Figure 2: Short Trench, See Note 7.

8. Shores shall be installed and removed from outside the trench, see installation and removal procedure.
9. The competent person shall continually monitor the shored excavation for changed conditions such as water seepage, soil movement cracks at the surface, sloughing or raveling, proper surcharge load weight less than 20,000 lbs and setback a minimum of 2 ft, and damaged shores.
10. Workers shall always enter, exit, and work inside the shored area of the trench.

Description

Aluminum Sheeting Shores are constructed from aluminum sheet piles that are secured together with caps at the ends which are attached to heavy duty vertical rails attached to 2" hydraulic cylinders. The panel heights vary from 4 ft to 16 ft long. The cylinders can extend from 18" to 88". Cylinder extensions can be added to obtain lengths to 15ft. The hydraulic cylinder consists of a 2" OD piston, a 2" ID x 3/16" barrel, and a 3" OD x 3/16" oversleeve. The cylinders provide a 23,000 lb safe working load for cylinder bulging at a 1.5 factor of safety. At extensions longer than model 88-56, an additional 3" x 3" x 3/16" or 3.5" x 3.5" x 3/16" wall square oversleeve is required to prevent buckling. Based on the principal of soil arching Aluminum Sheeting Shores can be spaced horizontally as much as 8 ft apart without sheeting behind the panels. Plywood sheeting is used either attached or separate behind the panels to prevent the trench walls from sloughing or raveling.

Aluminum Sheeting Shores are installed from outside the excavation. The shores are hinged so that they can be folded when lowered into the trench and then opened up and pressurized with a hydraulic hand pump. The hydraulic fluid is water soluble, environmentally safe, and biodegradable. Panels are typically moved, set, and removed by a backhoe, loader, or boom truck.

Aluminum Sheeting Shores are typically used in linear trench applications in OSHA Type A, Type B, and Type C-60 soils at depths up to 20 ft and trench widths to 8 ft. Constraints such as the requirement that the bottom cylinder be set a maximum of 4 ft from the bottom of the excavation, bedding requirements, and pipe wall thicknesses limits the pipe diameter or duct height to approximately 36" maximum. The 8 ft maximum horizontal spacing limits pipe length to approximately 8 ft.

Classification of Soil Types

- Soil classification shall be in accordance with OSHA Appendix A and classified just prior to installing sheeting shores. Soil conditions may change at a later date and require sheeting shores to be reset at a different spacing.
- The equivalent weight of OSHA soil types* is assumed to be as follows:
 - OSHA Type "A" Soil 25 PSF per ft of depth
 - OSHA Type "B" Soil 45 PSF per ft of depth
 - Type "C-60" Soil 60 PSF per ft of depth**
 - OSHA Type "C" Soil 80 PSF per ft of depth

* These equivalent weights were adapted from OSHA 1926 Subpart P App C, Timber Shoring for Trenches, Tables C-1.1, C-1.2, and C-1.3

** Type C-60 soil is not identified or classified in OSHA Appendix A
- Type C-60 soil is soil that does not qualify as OSHA Type A, or Type B, can be cut with vertical walls and will stand up long enough to safely insert and pressurize the hydraulic shore.
- Sheeting shores shall not be used in OSHA Type C-80 Soil

Sheeting Shore Selection Guide

Table 1: Sheeting Shore Selection Guide ⁽¹⁾⁽²⁾					
Depth of Trench (ft)	Hydraulic Cylinder Requirements ⁽³⁾				
	Maximum Horizontal Spacing (ft)	Maximum Vertical Cylinder Spacing (ft)	Width of Excavation (ft)		
			to 8	8 to 12	12 to 15
OSHA Type "A" Soil					
to 10'	8'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
10' to 15'	8'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
15' to 20'	8'	4'	2" ID	2" ID ⁽⁴⁾	2" ID ⁽⁴⁾
20' to 25'	8'	4'	2" ID	2" ID ⁽⁴⁾	2" ID ⁽⁴⁾
OSHA Type "B" Soil					
to 10'	8'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
10' to 15'	7'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
15' to 20'	6'	4'	2" ID	2" ID ⁽⁴⁾	2" ID ⁽⁴⁾
20' to 25'	5'	4'	2" ID ⁽⁵⁾	2" ID ⁽⁴⁾⁽⁵⁾	2" ID ⁽⁴⁾⁽⁵⁾
Type "C-60" Soil					
to 10'	6'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
10' to 15'	5'	4'	2" ID	2" ID	2" ID ⁽⁴⁾
15' to 20'	4'	4'	2" ID	2" ID ⁽⁴⁾	2" ID ⁽⁴⁾

Table 1 Notes

1. Soil shall first be classified in accordance with OSHA Appendix A Soil Classification for use with this selection guide. Type C-60 soil is OSHA Appendix A Type C soil that will stand up long enough to install the hydraulic shores.
2. Sheeting between the panels is required at any depth whenever sloughing or raveling occur. Sheeting shall be equivalent to plywood described in **Table 2**. Steel plate and sheet piles with equivalent strength are also acceptable. Sheeting may be attached to panels or set into trench separately.
3. This tabulation includes lateral loading from equipment weighing 20,000 lbs or less and a maximum 2 ft high spoil pile set back a minimum of 2 ft. The competent person shall determine the effect of all other surcharge loads and reduce hydraulic shore spacing as required to resist those loads.
4. Use Pacific Shoring 2" inside diameter hydraulic cylinders with 3" aluminum oversleeves and standard extension system as required for trench width. Oversleeves larger than model 88-56 are steel 3.5"x3.5"x3/16" wall over 3" round standard aluminum pipe or steel 3"x3"x 3/16" full length.
5. Sheeting must be added behind the sheeting shores and extend to the bottom of the excavation.

Material	Grade Stress Level	Effective Section Modulus KS	Allowable Bending F_b
1-1/8"-2.4.1 int APA Plywood	S-2	0.840 in ³ /ft	1100 psi
Finland Form 3/4" All-Birch	S-1	0.4826	3600 psi

Table 2 Bending properties for OSHA Sheeting

Vertical Rail Specification Sheet

Section Properties	Heavy Duty Rail
Material	Aluminum
Alloy	6061-T6 or 6005A-T6
Area	3.47 in ²
Weight	4.17 plf
Section Modulus – Top (Leg Side)	1.25 in ³
Section Modulus – Bottom (Blade Side)	2.38 in ³
Equivalent Timber Size (Douglas Fir No. 2)	4x12 (Flat)

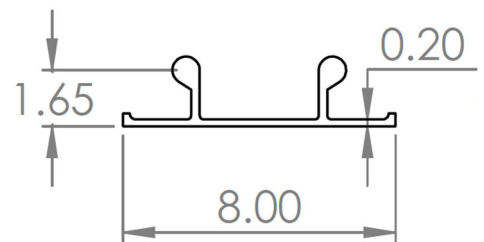


Figure 3: Vertical Rail Specifications

Interlocking Sheet Pile Specification Sheet

Section Properties	Interlocking Sheet Pile
Material	Aluminum
Alloy	6061-T6 or 6005A-T6
Area	3.03 in ²
Weight	3.64 plf
Section Modulus	0.97 in ³

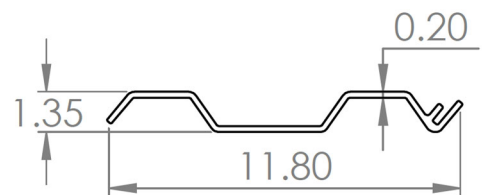


Figure 4: Interlocking Sheet Pile Specifications

Sheeting Shore Dimensions

Table 3: Sheeting Shore Dimensions

Rail Length (ft)	Sheeting Shore Dimensions	Assembly Weight (lbs)	Cylinder Locations (in)				
4'	4'x4'	175	11	37			
6'	6'x4'	260	18	44			
8'	8'x4'	342	24	72			
10'	10'x4'	429	22	58	94		
12'	12'x4'	512	24	72	95		
16'	16'x4'	688	24	72	120	145	168

Table 3 Notes:

1. Dimensions listed are measured from top of panel to approximate centerline of each cylinder.
2. Spacing between cylinders never exceeds 4ft.
3. Custom rail and cylinder spacing available upon request, however when using them with this tabulated data all spacing requirements of the data shall be met.

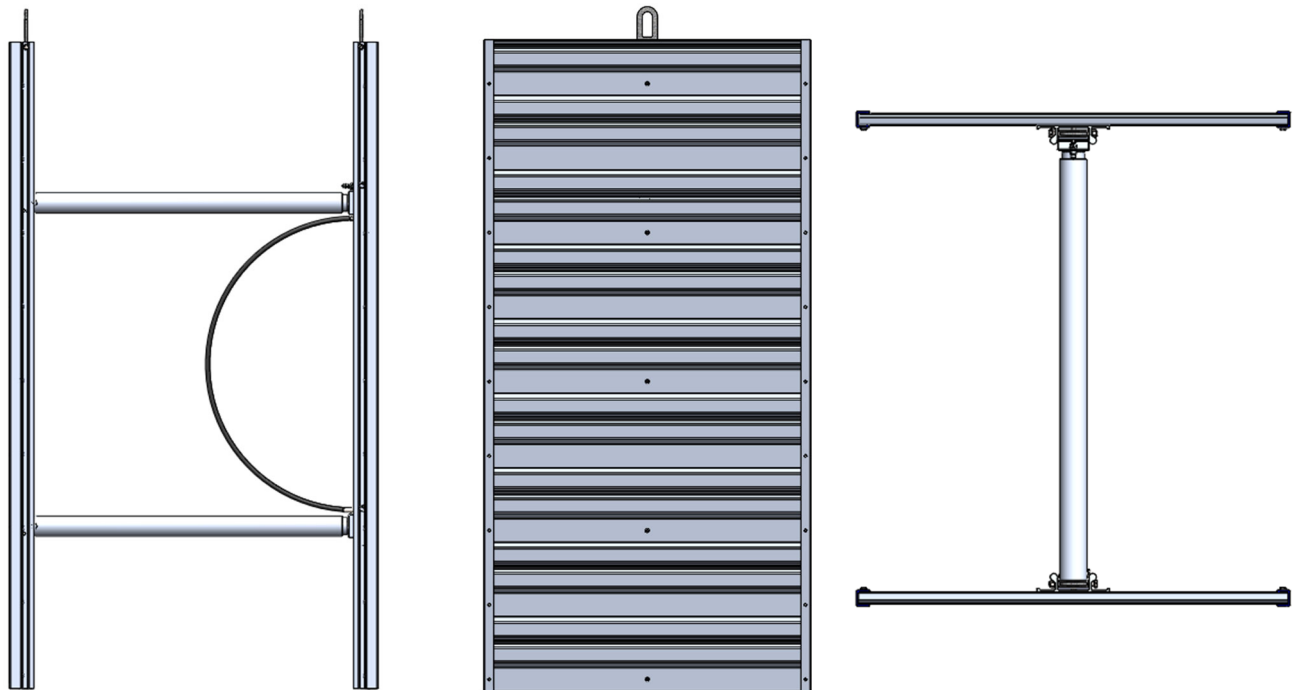


Figure 5: Sheeting Shore End View, Side View, and Top View

Sheeting Shore Installation and Removal Procedure

Required for installation

- Sheeting Shore
- Pump with fluid and operating pressure gauge
- Release tool

Installation Procedure

- Step 1 Attach hydraulic hose to hydraulic fitting on shore. Open the valve on the pump can so that the shore cannot be pressurized. Set plywood, if required.
- Step 2 Lower shore into trench with folded up blade toward opposite trench wall and hydraulic fitting toward adjacent wall. After the shore is set to elevation hold adjacent blade in place with release tool and let go of opposite blade allowing it to completely unfold and lock into position. In order for the shore to lock into position the cylinder must be 90 degrees from the blade. Shores should be set in with lifting equipment such as backhoe, boom truck, or crane.
- Step 3 Close the valve on the pump can and pressurize the hydraulic shore to between 750 and 1500 psi. Pressure gauge should hold at pressure and not indicate any loss of pressure.
- Step 4 Remove the hydraulic hose by prying off with release tool. Clip hose to top of pump to prevent contamination by dragging it in the dirt. Move to next shore location and repeat process.

While shores are in place

- Check at least at start of shift for loose shores. This can be done by tapping the top of the shore with a metal rod; it will sound loose, sort of like kicking a tire to see if it is flat. Remove and replace loose shores.
- Check for sloughing or raveling in between shores. If it is occurring sheeting must be used or shores should be placed closer together.
- Confirm that soil classification has not changed.

Required for Removal

- Sheeting Shore
- Release tool
- Removal tool or lifting equipment

Removal Procedure

- Step 1 Place release tool over hydraulic fitting and removal hook in handle on opposite blade.
- Step 2 Push release tool away to release fluid and pressure. Pull up on the removal hook to fold the shore up and then lift it out of trench.

Note - Depending on the length of the shore and width of the trench different installation procedures may be used. It is the responsibility of the contractor and his competent person to establish a safe installation and removal procedure for each application. All trench shore installers shall be instructed in the procedure prior to installing the shores.

Safe Handling and Use of Sheeting Shores

Sheeting shores have a huge impact on excavation safety since the shoring installer does not have to enter the unshored trench. Utilizing sheeting shores for shoring still has safety hazards that users should understand and protect workers from. These things happen rarely however it is still important that workers be informed of the risks they are taking before placing them at risk. The following are hazards and safety procedures associated with the use of sheeting shores

- Injury to back and muscles from lifting heavy objects; therefore, a backhoe or boom truck should be used to safely lift, set, and remove the sheeting shores from a trench.
- Overhead lifting hazard - When shores are being hoisted by sling from a tractor bucket or boom truck the swinging shore presents a hazard to workers guiding it. Rocks, debris, or other equipment can also fall off onto workers. Workers should stand clear and guide with a lead rope.
- Finger and hand protection - Sheeting shores have moving parts at the connection between the cylinder and the rail. When the jack swings open fingers can be crushed under the cylinder block and when it is swung closed fingers can easily be sheared off if they are between the block and the rail leg. When the hydraulic hose is being connected to the block fitting and when the shore is being lifted, shearing and crushing is most likely to happen. Awareness through safety instruction and hand placement a safe distance, 12", from the blocks is safe practice. Sheeting shores may have optional finger guards however it is still possible to get fingers under the block and wrists are cut and banged when the shore folds or unfolds.
- Bank collapse with worker standing on it - When the shore is being set it is still possible for the trench wall to collapse from the additional weight and activity going on around it. Sheeting shore installation should closely follow the excavation activity.

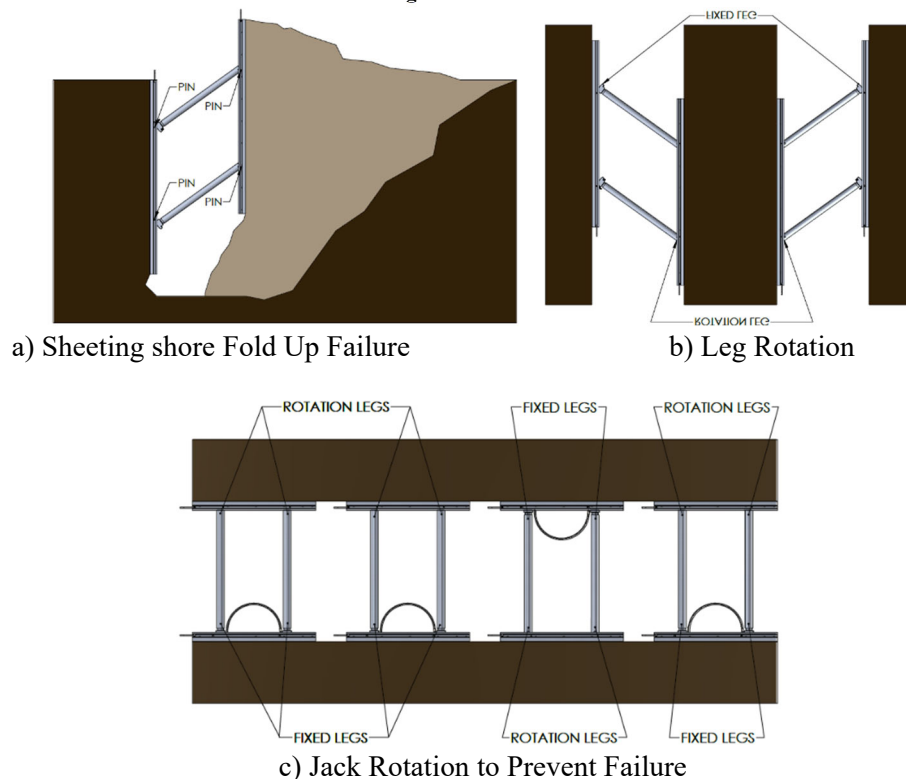
During shore removal the arch column is being literally removed with the load still on it. Pipe bedding and initial backfill cut the trench depth adding some stability prior to removing the shore. If backfill operations are closely following shore removal the length of unshored collapsible trench wall becomes short. Soil arching back to the backfilled area is likely and trench wall failure becomes less likely. Remote backfill operation such as excavator wheel or vibraplate, or remote operated compactors must always be used for compaction outside the shored area. When sheeting shores are being removed to allow pipe installation and then reset there is a greater likelihood of trench wall collapse. Equipment and personnel in close proximity are at risk of losing the ground under their feet. Keep equipment and personnel except those needed to remove the shore a safe distance away. This type of operation is not uncommon and most often works safely; however, if there is any evidence of trench wall collapse the operation should be discontinued and a different method of getting production materials into the trench or a different shoring system should be used. Several bad accidents have occurred in conjunction with this type of operation.

- Get the surcharge loads right - Equipment over 20,000 lbs and large spoil piles over 2 ft high quickly add additional surcharges, especially in the top 10 ft, that can easily overload the sheeting shore. If one cylinder fails, a progressive failure to the bottom of the trench and then down the length of the trench is possible. A boom truck or backhoe outrigger placed next to a sheeting shore can trigger this. The way to adjust for additional surcharge load is to move the load away from the trench, spread the load with timber pad or steel plate, or decrease the sheeting shore spacing. Centering the load on the jack places most of the load on that jack. The alternative, centering the load between the jacks distributes the load evenly between the jacks; however, it

increases the possibility of the arch void to fall out or arch shear failure at the shore. One alternative may not be any better than the other.

- Sheeting shore fold up failure - If all of the shores were unfolded into the trench from one side of the trench it is possible to get a bank failure that can lift the rotating jack leg. This type of failure is not common; however, the author has spoken with more than one worker that has fortunately from outside the trench witnessed this type of failure. No workers were inside the trench. The story goes that 40 ft of trench folded up the jacks and collapsed. The solution is to rotate the jack so that the rotation leg is on the other side of the trench. The problem is that the installers have to move to the other side of the trench to set and pressurize the jack. Two soil conditions that this would be most likely to happen are in medium dense to loose non-cohesive soils and soft clays with high surcharge loads.

Figure 6:



- Loose sheeting shores in the trench - Shores that are not pressurized in the trench are not setting up arching and preventing trench collapse. In this condition the shores can also fall down on workers below them. Shores should not leak at all. Pressure can change slightly up or down due to temperature changes or increase due to loading however it should never loosen up in the ditch. If jacks are left overnight they should be checked before entering the trench in the morning. Simply tap them with a hammer or bar of metal, they will sound loose if they are. Remove and replace shores that bleed off. If the trench wall has voids where the cylinder hits the wall, use wood blocking to extend the connection to the soil, see **Figure 7 (a)**
- Non-vertical trench walls - Trench walls that are not vertical, an inverted A shape, the sheeting shore is not stable see **Figure 7 (b)**. Assuming a coefficient of friction of 0.1 between the soil and the aluminum panel and applying a factor of safety of 1.5 calculations indicate that the slope

of the trench wall should not exceed 3 degrees or the jack will lift up and fail to provide an arching point.

- In trenches that are sloped above, extending the shore 18" above the hinge point only provides roll off protection for workers below if the shores are spaced 4' O.C. (no gaps between panels). For shores spaced more than 4' O.C. place fabric or boards behind the sheeting shores to stop objects at the surface and bank ravel from falling on workers, see **Figure 7 (c)**

