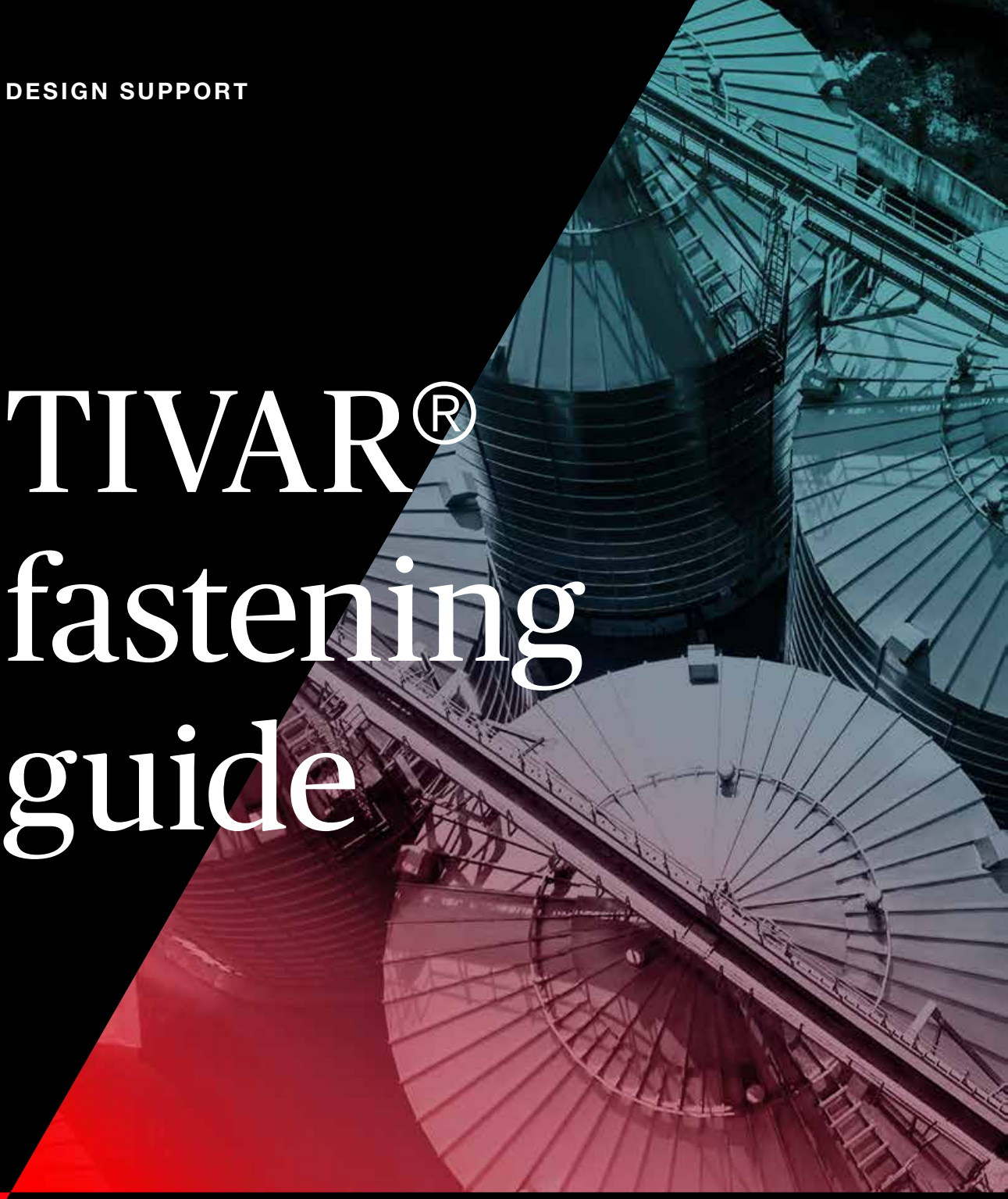
DESIGN SUPPORT



TIVAR® fastening guide

Benefits, ideal applications, limitations, tools required, and installation procedures to assist your design process

MITSUBISHI CHEMICAL GROUP

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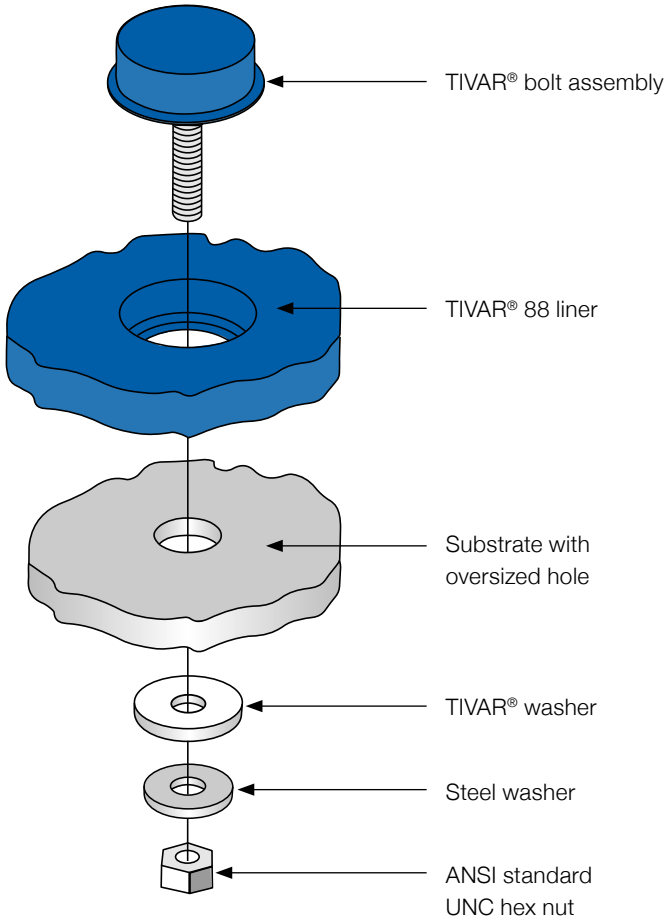


Benefits

- Provides a smooth surface
- Eliminates bolt head wear, material turbulence and material hang-up
- Eliminates corrosion caused by seepage around fastener
- Available in 1/4"-20 or 3/8"-16 bolt shank diameters
- Available in carbon steel or stainless steel

Ideal applications

- Where corrosive materials are handled
- In high velocity areas
- In sticking areas
- When TIVAR® is fastened to steel, aluminum, etc.

Examples

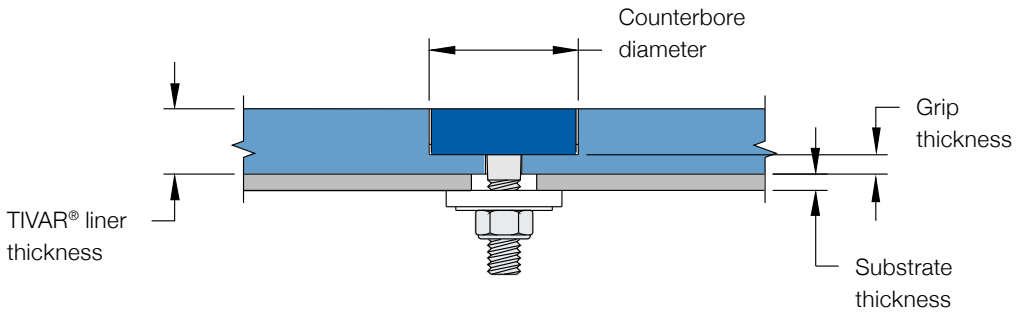
- Drag conveyors
- Vibrating feeders
- Floatation tanks
- Chutes and hoppers
- Machinery bearing pads
- Under chain wear strips

Limitations

- Where one-sided fastening is necessary
- Where drilling the substrate is not possible
- Where TIVAR® is fastened to concrete
- Where TIVAR® material thicknesses are less than 1/4"

1/4”-20 TIVAR® Capped bolt fastening system

Specification chart



TIVAR® LINER THICKNESS	GRIP THICKNESS	COUNTERBORE DIAMETER	ITEM #03760307 - XXX				
			BOLT SIZES (BOLT SHANK X LENGTH)				
			1/4”-20 x 1”	1/4”-20 x 1 1/4”	1/4”-20 x 1 1/2”	1/4”-20 x 1 3/4”	1/4”-20 x 2”
1/4”	.100”	Ø1.145”	-001	-005	-007	-008	-009
3/8”	.125”	Ø1.145”	-010	-013	-015	-016	-017
1/2”	.150”	Ø1.145”	-019	-020	-021	-025	-026
5/8”	.175”	Ø1.145”	-030	-031	-032	-033	-034
3/4”	.220”	Ø1.145”	-106	-036	-038	-039	-040
1”	.250”	Ø1.145”	-041	-077	-042	-043	-044

1/4”-20 TIVAR® Capped bolt length determination equation

Add: Grip thickness of TIVAR® liner
Substrate thickness
+ 3/4”

To obtain: Theoretical bolt length

“What length of TIVAR® capped bolt do I need? "

Example: Using 1/2” thick TIVAR® 88 and 1/4” steel substrate

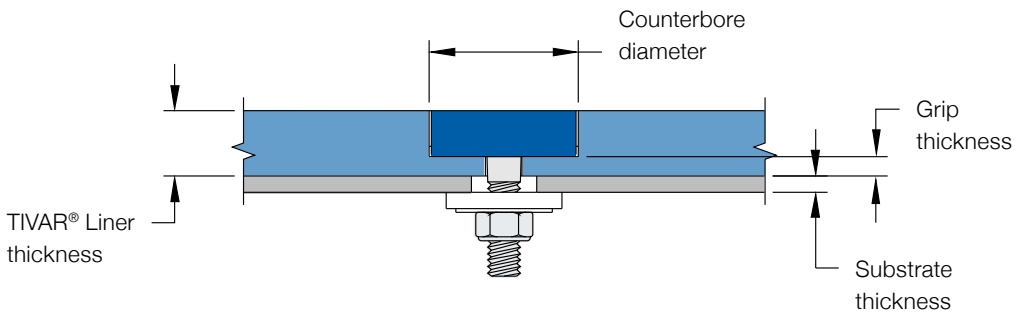
Add:	Grip thickness	.150”
	Substrate thickness	.250”
		+ .750”
To obtain:	Theoretical bolt length	1.15”

Select next longest TCB length, which is the 1-1/4” long TIVAR® capped bolt

	ITEM #
TIVAR® washers for 1/4”-20 TCB	06010007132
Steel washers for 1/4”-20 TCB	06010000442
Lock washers 1/4”-20 TCB	06010000449
Lock nuts 1/4”-20 TCB	06010000443
Regular nuts 1/4”-20 TCB	06010000441

3/8”-16 TIVAR® Capped bolt fastening system

Specification chart



TIVAR® LINER THICKNESS	GRIP THICKNESS	COUNTERBORE DIAMETER	ITEM #03760307 - XXX			
			BOLT SIZES (BOLT SHANK X LENGTH)			
			3/8”-16 x 1 1/4”	3/8”-16 x 1 1/2”	3/8”-16 x 1 3/4”	3/8”-16 x 2”
1/4”	N/A	N/A	N/A	N/A	N/A	N/A
3/8”	.125”	Ø1.500”	-131	-045	-046	-058
1/2”	.150”	Ø1.500”	-076	-048	-094	-050
5/8”	.175”	Ø1.500”	-165	-164	-163	-085
3/4”	.220”	Ø1.500”	-147	-051	-142	-052
1”	.250”	Ø1.500”	-093	-053	-109	-054

3/8”-16 TIVAR® Capped bolt length determination equation

Add: Grip thickness of TIVAR® liner
Substrate thickness
+ 1.0”

To obtain: Theoretical bolt length

	ITEM #
TIVAR® washers for 3/8”-16 TCB	06010000446
Steel washers for 3/8”-16 TCB	06010000445
Lock washers 3/8”-16 TCB	06010000455
Lock nuts 3/8”-16 TCB	06010000447
Regular nuts 3/8”-16 TCB	06010000444

“What length of TIVAR® capped bolt do I need? "

Example: Using 1/2” thick TIVAR® 88 and 1/4” steel substrate

Add:	Grip thickness	.150”
	Substrate thickness	.250”
		+ .750”
To obtain:	Theoretical bolt length	1.15”

TIVAR® Capped bolt fastening system

TIVAR® Capped bolt counterbore tools

The TIVAR® capped bolt counterbore tool simply consists of an all-in-one tool, and makes drilling TIVAR® capped bolt holes a breeze. The counterbore tool will drill both the thru hole & counterbore in one step. MCAM offers counterbore tools for both $1/4^{-20}$ & $3/8^{-16}$ TIVAR® capped bolts.

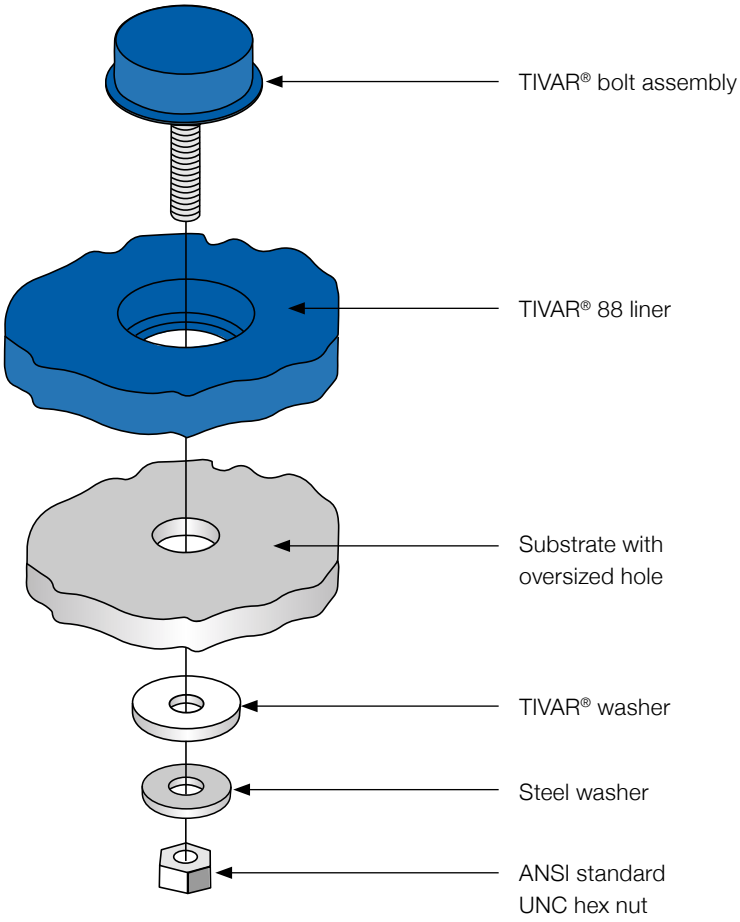
The correct TIVAR® capped bolt counterbore tool required is dependant on the diameter of TIVAR® capped bolt being used and thickness of the TIVAR® material.

$1/4^{-20}$ TIVAR® CAPPED BOLT COUNTERBORE TOOL	
ITEM #040000 - XXXXX	
TIVAR® LINER THICKNESS	ITEM #
1/4"	-02900
3/8"	-02204
1/2"	-02205
5/8"	-06156
3/4"	-02206
1"	-02725

$3/8^{-16}$ TIVAR® CAPPED BOLT COUNTERBORE TOOL	
ITEM #040000 - XXXXX	
TIVAR® LINER THICKNESS	ITEM #
1/4"	N/A
3/8"	-05294
1/2"	-03415
5/8"	-51245
3/4"	-07550
1"	-03702

TIVAR® capped bolt fastening system

General installation information



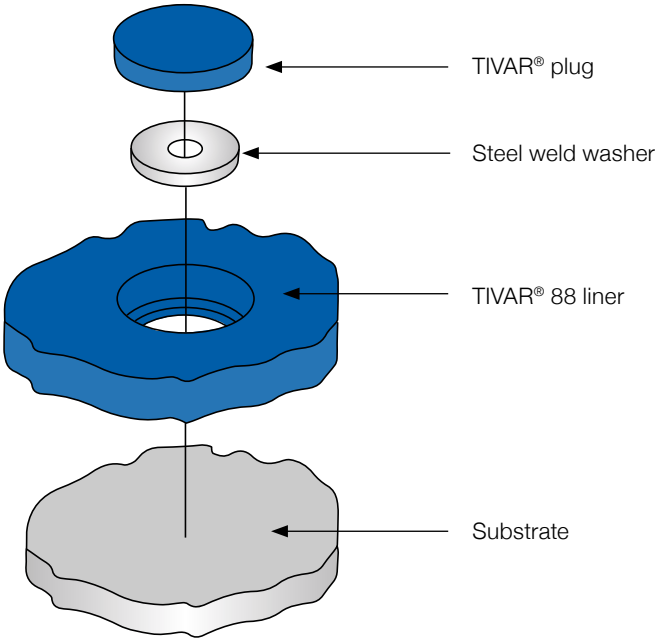
Tools required

- Hand held drill
- 7/16” wrench
- Hammer or mallet
- 1/2” drill bit
- TIVAR® capped bolt bounterbore tool

Installation procedure

1. Drill and counterbore the TIVAR® sheet, using the appropriate TIVAR® capped bolt counterbore tool from MCAM.
2. Place the drilled TIVAR® sheet into position as a template and mark the substrate at all fastener locations, with a china marker. Then remove the TIVAR® sheet.
3. Drill the substrate at the marked locations with the 1/2” drill bit.
4. Reposition the sheet. Insert at least two TIVAR® capped bolts, and assemble the TIVAR® washers, steel washers, and lock nuts, to hold the sheet in place.
5. Insert the remaining bolts and assemble with the washers and nuts.

Weld washer fastening system



Benefits

- No substrate drilling is required
- Quick and easy installation
- Eliminates turbulence and minimizes sticking when a TIVAR® plug is used
- Eliminates vibrational loosening
- Available in carbon steel, stainless steel, or aluminum

Ideal applications

- When TIVAR® is used to protect steel or aluminum
- When drill holes in the substrate are not desirable
- When one side fastening is necessary

Examples

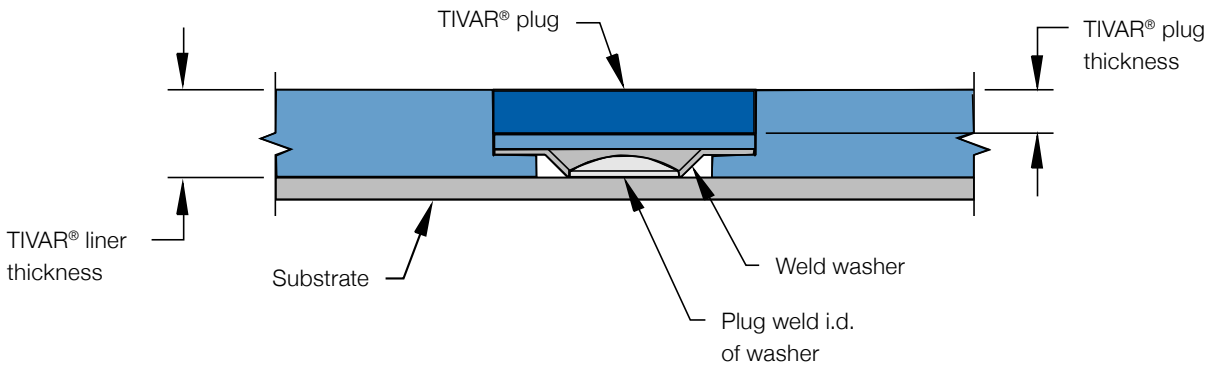
- Dragline buckets
- Trailer and dump bodies
- Tanks and containers
- Silos, hoppers, and bins
- Chutes

Limitations

- Cannot be used where TIVAR® liners are used over non-weldable substrates
- Where TIVAR® material thicknesses are less than 1/4”

Weld washer fastening system

Specification chart



TIVAR® LINER THICKNESS	TIVAR® PLUG THICKNESS	WASHER / PLUG ITEM #
1/4”	N/A	N/A
3/8”	*.125”	03770297002
1/2”	.250”	03770297006
5/8”	.375”	03770297012
3/4”	.500”	03770297015
1”	.750”	03770297019

*Note: The use of TIVAR® plugs in 3/8” liners may not be recommended. Please consult MCAM for application information.

	ITEM #
Weld washer - mild steel	06010000393
Weld washer - stainless steel	06010000395
Weld washer - aluminum	06010000394

Weld washer fastening system

Welt washer counterbore tool kit

The weld washer counterbore tool kit consists a 1” spade bit and flat bottom counterbore tool.

Drilling a weld washer hole is a two stage process:
Step 1 - Drill the thru hole using the spade bit
Step 2 - Drill the counterbore using the flat bottom counterbore tool

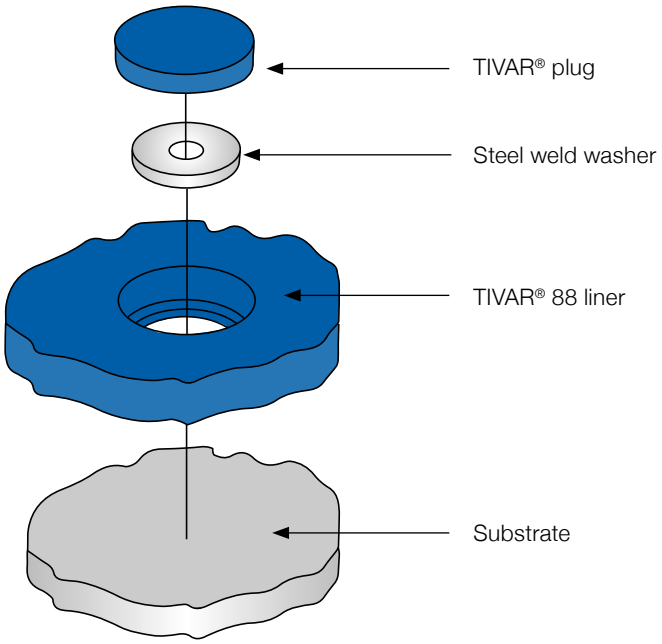
The weld washer counterbore tool kit works with any thickness of TIVAR® material.

WELD WASHER COUNTERBORE TOOL KIT

ITEM# 04000001101

Weld washer fastening system

General installation information



Tools required

- Portable 3/8” drive drill
- Hammer
- Welding equipment
- 2 Stage weld washer counterbore tool kit
- Hand held grinder or wire wheel

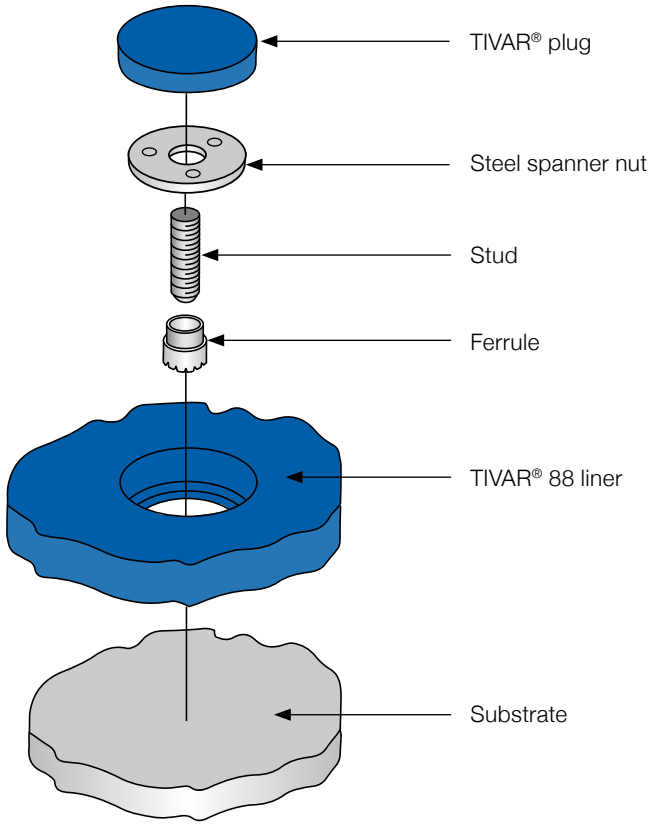
Installation procedure

1. Drill and counterbore the TIVAR® sheet, using a 2 stage weld washer counterbore tool kit from MCAM.
2. Place the sheet into position as a template and mark the substrate at all fastener locations, with a china marker.
3. Remove the liner and clean the substrate for welding at the marked locations.
4. Reposition the sheet and insert the weld washer, making sure the washer contacts the substrate.
5. Plug weld the washer to the substrate. (Special techniques may be required when welding)
6. *Drive the TIVAR® plugs into the holes with a hammer until flush.

*Optional

Stud weld fastening system

General installation information



Benefits

- Quick and easy installation
- One sided fastening
- Substrate drilling is not required
- Can be used with a TIVAR® plug to eliminate sticking and corrosive leakage (Minimum of 3/4” TIVAR® material required to use TIVAR® plugs)
- Available in carbon steel or stainless steel

Ideal applications

- When TIVAR® liners are placed over weldable substrates
- When drilling the substrate is not desirable
- When a one side fastening is necessary

Examples

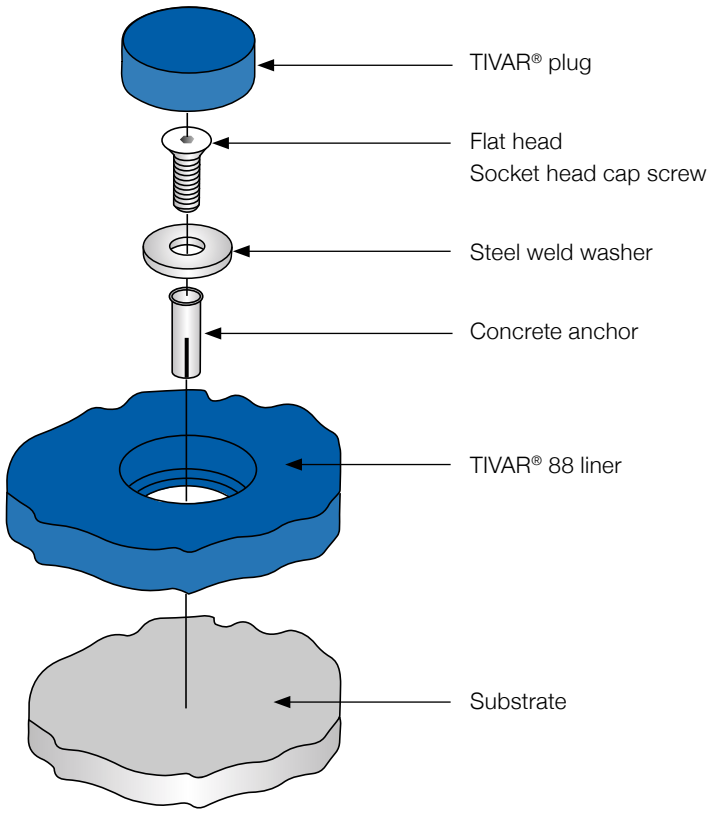
- Dragline buckets
- Hoppers, bins, and silos
- Chutes

Limitations

- Can only be used with a weldable substrate
- Can only be used with 3/8” liners or thicker
- Special stud welding equipment is needed for installation

Concrete expansion anchor fastening system

General installation information



Benefits

- One sided fastening
- Provides excellent strength
- Available in carbon steel or stainless steel

Ideal applications

- When TIVAR® liners are fastened to concrete or masonry substrates

Examples

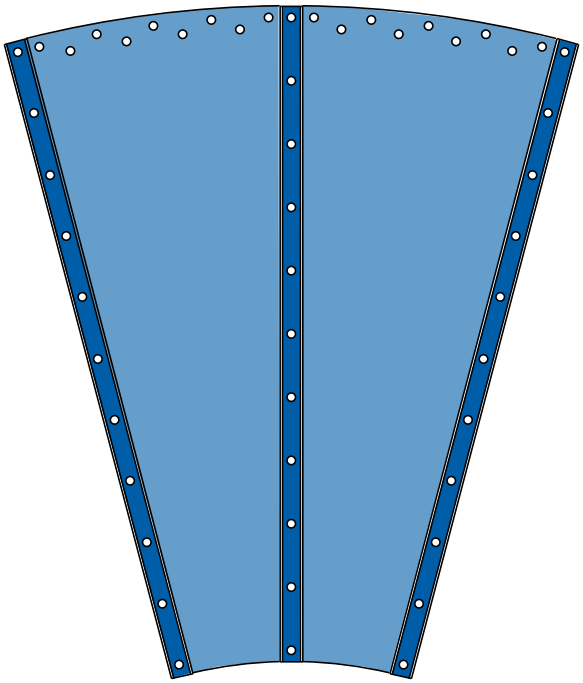
- Bunkers
- Hoppers, bins, and silos
- Flumes

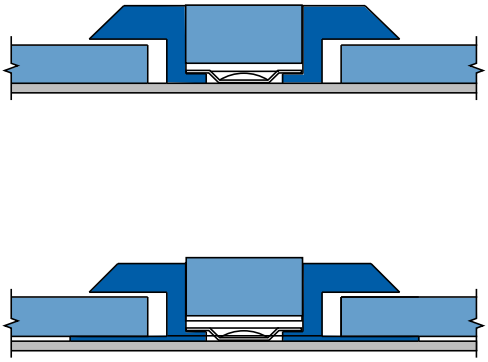
Limitations

- When the substrate to be lined is deteriorated or structurally unsound, this fastener will not hold

TIVAR® Vertical seam profiles

T-profiles & H-profiles





Benefits

- Fast Installation
- Versatile
- Provides excellent surface continuity
- Allows free movement of the sheets due to thermal expansion and contraction
- Minimizes fines from filtering behind the sheets

Ideal applications

- When surface continuity is critical
- When temperature fluctuations are large
- When installing liners up to 1/2” thick
- When handling fine or very sticky materials

Examples

- Bunkers
- Hoppers, bins, and silos
- Chutes
- Extra space

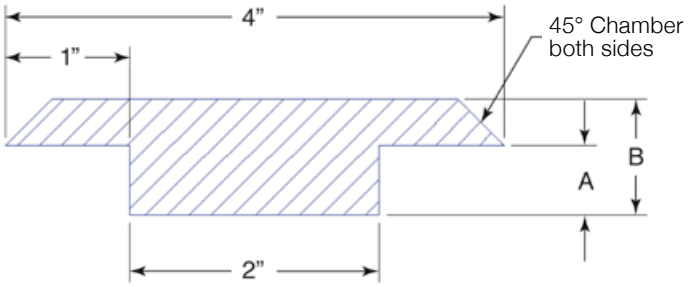
Limitations

- Cannot be used on joints or seams perpendicular to bulk material flow

TIVAR® Vertical seam profiles

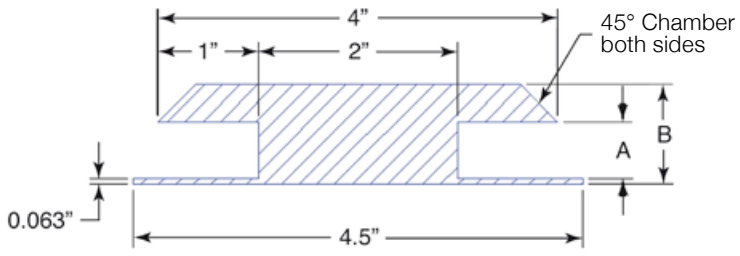
Specification chart

T-profile



TIVAR® T-PROFILE		
TIVAR® LINER THICKNESS	DIMENSION “A”	DIMENSION “B”
1/4"	0.275”	0.625”
3/8"	0.412”	0.75”
1/2"	0.562”	1.00”
5/8"	0.650”	1.25”
3/4"	0.812”	1.25”
1"	1.063”	1.375”

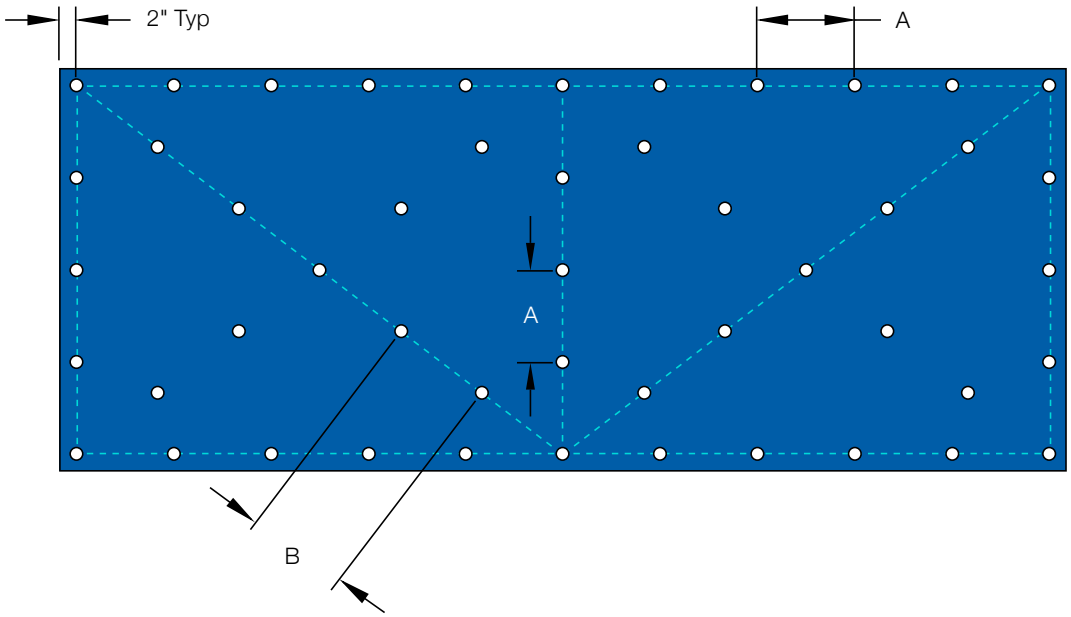
H-profile



TIVAR® H-PROFILE		
TIVAR® LINER THICKNESS	DIMENSION “A”	DIMENSION “B”
1/4"	0.275”	0.625”
3/8"	0.412”	0.75”
1/2"	0.562”	1.00”
5/8"	0.650”	1.25”
3/4"	0.812”	1.50”
1"	1.063”	2.00”

Typical TIVAR® fastener pattern & spacing

For (4’x10’) sheets



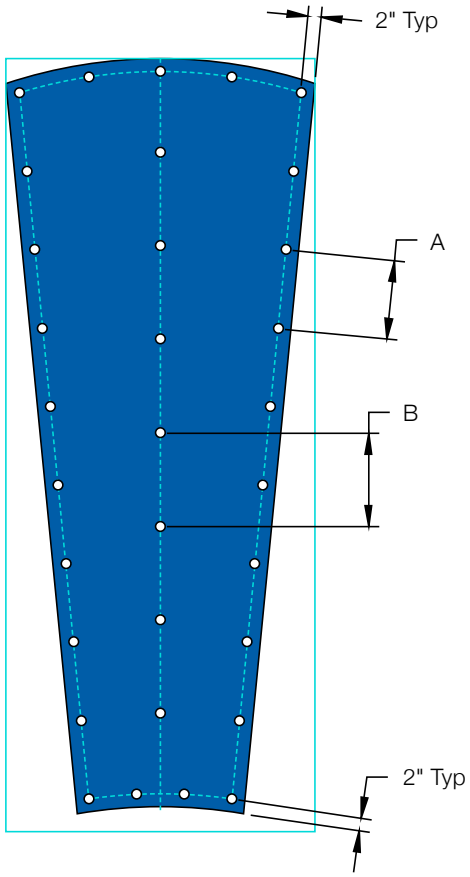
TIVAR® LINER THICKNESS	A*	B*
1/4”	6” - 8”	10” - 12”
3/8”	8” - 10”	12” - 14”
1/2”	10” - 12”	14” - 16”
5/8” - 3/4”	11” - 13”	15” - 17”
1” - 1 1/2”	13” - 15”	17” - 19”
2”	15” - 20”	17” - 22”

A = Perimeter & center spacing
B = Fastener spacing on diagonals

The listed dimensions are generally appropriate for most installations; spacing may vary depending on the severity of the application or when the material is subject to severe temperature fluctuation.

TIVAR® Fastener pattern

For conical hopper layout



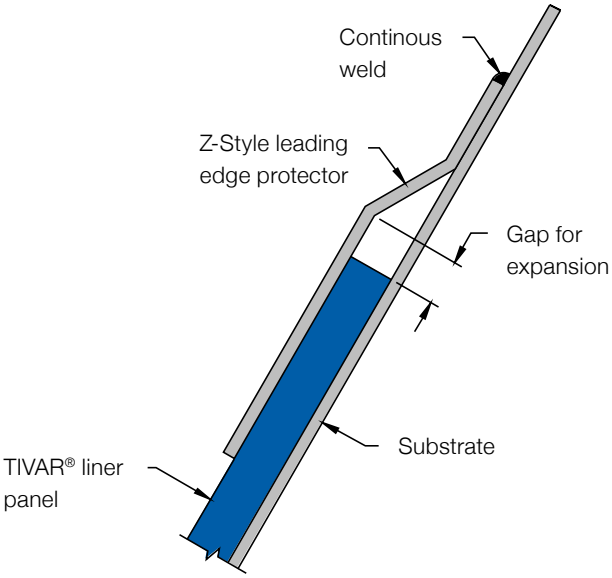
TIVAR® LINER THICKNESS	A*	B*
1/4”	6” - 8”	10” - 12”
3/8”	8” - 10”	12” - 14”
1/2”	10” - 12”	14” - 16”
5/8” - 3/4”	11” - 13”	15” - 17”
1” - 1 1/2”	13” - 15”	17” - 19”
2”	15” - 20”	17” - 22”

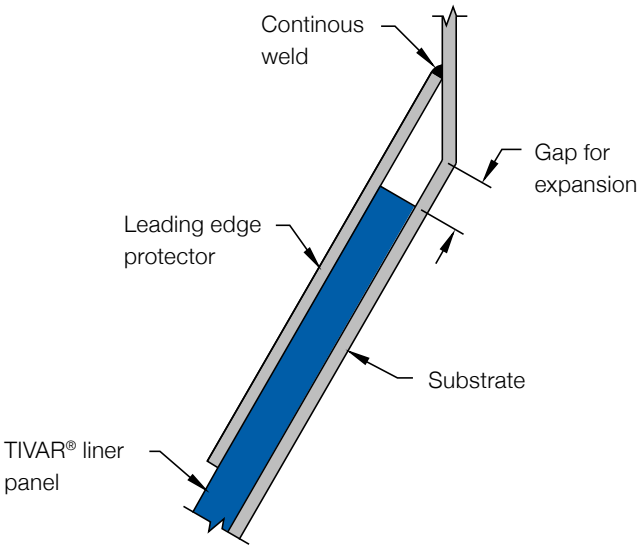
A = Perimeter & center spacing
B = Fastener spacing on diagonals

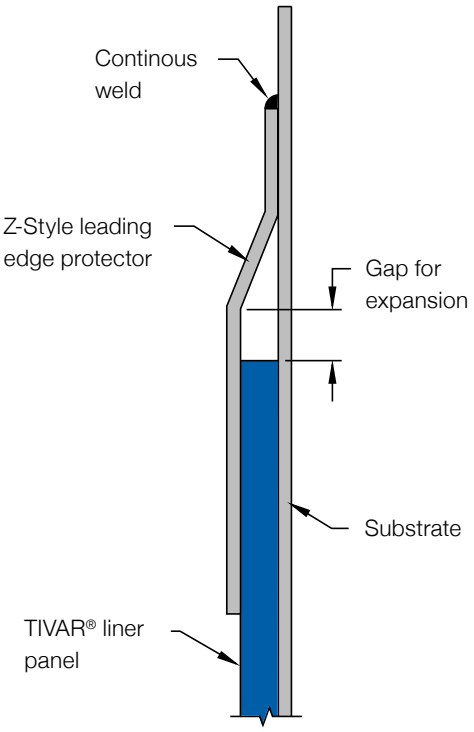
The listed dimensions are generally appropriate for most installations; spacing may vary depending on the severity of the application or when the material is subject to severe temperature fluctuation.

Leading edge protectors

General information







ITEM # 0601000 - XXXX	
Z-STYLE LEADING EDGE PROTECTORS (8' LENGTHS)	
1/4" & 3/8" Liners - Mild steel	-0437
1/4" & 3/8" Liners - 304 S.S.	-7021
1/2" Liner - Mild steel	-0438
1/2" Liner - 304 S.S.	-0484

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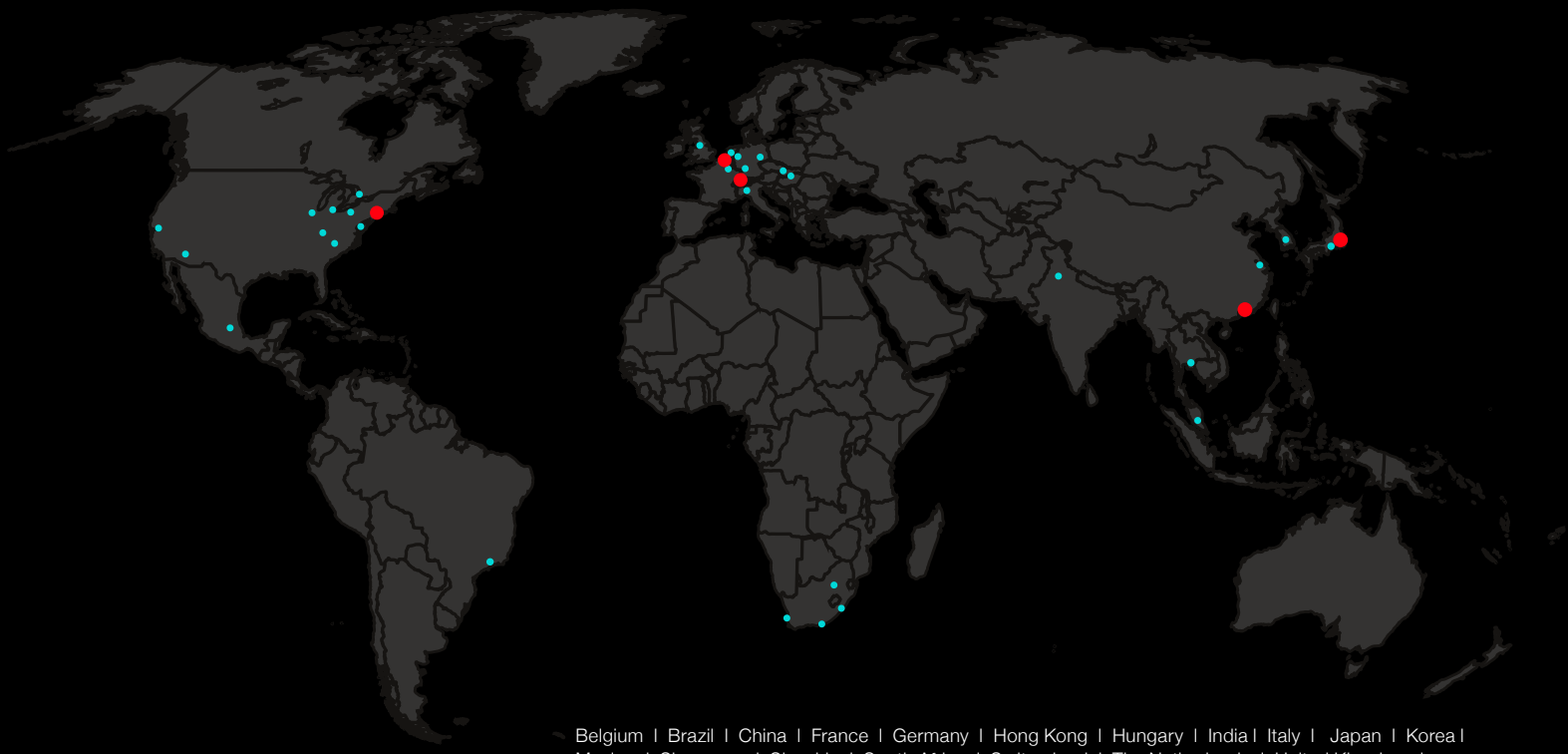

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