SURE-LOCK®
CONCRETE PILE SPLICES

FOR TENSION, COMPRESSION AND MOMENT
ANY SIZE & SHAPE OF CONCRETE PILES
FAST, EASY & RELIABLE PILE SPLICING
USED FOR 25+ YEARS IN US & CANADA PROJECTS

SURE-LOCK SPLICES ARE INTERLOCKING STEEL CONNECTORS
PRECAST INTO PRESTRESSED CONCRETE PILES --
FAST, RELIABLE FIELD SPLICERS FOR SEGMENTED PILES

Each Section of the site is set up to print separately, approx. 14 pages total.
Last site update: April 26, 2004. Video of SPLICING - see DRIVING link.

NATIONAL VENTURES INC.
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Phone: 415-331-7260  Fax: 415-331-7261
OVERVIEW - SURE-LOCK® PILE SPLICES

HOW DO THEY WORK?

SURE-LOCK splices use a male-female connection with steel plates and attached rebar anchors precast into the ends of the pile segments.

When splicing, rectangular high-strength steel bars are driven into the matching annular grooves of the plates, forming a shear key joint.

Male/female splice halves are interchangeable. 24" & 30" sq units have 4 bars at 90°.

TYPICAL APPLICATIONS

- If pile lengths are too long for casting, hauling, or driving in one piece.
- Where low head-room or height restrictions requires short segments.
- Enables the use of smaller equipment for cheaper hauling or driving.
- Where it is in the public safety interest to loft and drive shorter segments.

SIZES AND SHAPES

Standard Shapes: Square, Octagonal, Hexagonal and Round.
Special shapes and sizes are made -- for cylindrical or composite piles, eg.
OVERVIEW - SURE-LOCK® PILE SPLICES

ADVANTAGES OF THE SURE-LOCK SPLICE

- Designed to meet or exceed any pile capacity or load requirement.
- Adaptable to virtually any pile size, shape, and strand pattern.
- Positive locking – cannot come apart during driving.
- Splicing time is minimal – no welding, grouting, or epoxy needed, minimizing field labor.
- Proven and reliable – tested, and extensively used for 25+ years in all types of projects.
- Design calculations satisfying the latest US and Canadian engineering and code standards for prestressed piles are provided.

PRICING

1. The SURE-LOCK is adaptable to virtually every pile design. However, since some designs have much higher strengths than others, even for the same pile size, it is necessary to match strength requirements. If the splice was standardized for the highest strength pile it would be too expensive for the standard commercial pile design of the region. Splice costs reflect strength requirements.
2. The SURE-LOCK is made in customer specified quantities to suit project requirements. There are some stocked standard QPL18" and 24" splices for FDOT projects at the present time.

TO OBTAIN A FIRM QUOTATION, we need to know as many of these factors as possible:

1) Pile design: concrete strength, strand size, number, and location.
2) Any particular bending and/or tension requirements on the drawing or in the specs, or epoxy dowel splice details if given as an option.
3) Possible quantities (minimum number, maximum, how many test piles). Will there be a small quantity of indicator/test piles needed before production piles are ordered?
4) Best approximation of schedule: when test pile splices and production pile splices would be needed at the casting yard.

We constantly work at improving prices by manufacturing efficiencies with no compromise to quality to keep world leadership in cost effectiveness, reliability, and engineering that the SURE-LOCK splice is known for with prestressed concrete piles.
MODULATION OF STANDARD CONFIGURATION

- Pile capacities change with strand quantity, diameter, location and concrete strength. A wide variety of pile designs are used throughout North America, even within one pile size.

- The SURE-LOCK splice load bearing elements are designed to meet strength requirements (see "Specs") using the standard configuration and modifying main plate thickness, size of locking bars, and size, number and length of rebar anchor/pile end reinforcement.

CALCULATIONS

- Calculations verifying the mechanical ability of the load-bearing components to meet specified capacities in tension, bending, and compression are submitted, with detailed shop drawings.

- Rebar anchor/pile end reinforcement is designed to ACI/AASHTO, DOT, and/or building code requirements, and calculations are included. The SURE-LOCK uses only Dayton/Richmond threaded Dowel Bars which give 100% strength of each rebar size, instead of cut threading rebar ends which reduces the effective tensile area by one rebar size.

TEST REPORTS

- There are no standard precast pile designs used throughout North America. Pile designs tend to be regional and vary with the customer. Therefore, it is not practical or economically feasible to have tests for every pile design, project, or have blanket certifications (such as ICBO) that are meaningful.

- SURE-LOCK test reports are representative and verify the design methodology:
  1) University of Illinois (Gamble) 14" sq. splices.
  2) Ecole Polytechnique (Houde & Roux) 14" sq. & 16" oct. splices.
  3) Gerwick Eng. (Ben Gerwick) 12" sq. splices.
  4) Hawaiian Dredge & Const. (Naaru Tower) 16" oct. splices.
  5) Haley & Aldrich (US Courthouse, Boston) 14" sq.
  6) Florida DOT Laboratory Tests of 24" sq. splices.

See "Contacts" for Test Report requests.
CORROSION

- Studies by the National Bureau of Standards (Materials Research, Metallurgy Div.) conclude that steel pilings are not significantly affected by corrosion in undisturbed (anaerobic) soils, regardless of soil types and properties. A copy of this report is available.

- CalTrans reports of extraction of earthquake collapsed Cypress Viaduct steel pipe piles in Oakland indicate that no significant corrosion occurred in 35+ years despite presence of high levels of chloride, sulfates, and low values of soil resistivities. A copy of this report is available.

- A steel splice can be safely located in the concrete pile zone that is in previously undisturbed (anaerobic) soil, and below ocean and river scour lines. (See "Projects" for some pier and bridge installations.)

INNOVATIVE USES

- The SURE-LOCK has been used to connect different pile sizes (20" sq. tops to 16" oct. bottoms -- Kehei Interchange, Honolulu; and 16" sq. tops to 14" sq. bottoms -- Mission Bay, San Francisco -- see "Photos" section) for higher pile moment at the top of the pile. This approach is an opportunity for pile designers working with seismic considerations to save client money, since pile design moment load is maximum in the top 10-30 ft. and it is unnecessary to keep the same moment capacity below that.

- The SURE-LOCK is a relatively ductile connection for seismic area 3 and 4 considerations. Kobe results indicate that concrete piles spliced with steel did not fail before non-spliced piles did.

- The SURE-LOCK has been used to make up thousands of 16" oct. 3 segment, 270 ft. long piles; 7 segment, 180 ft. long piles (Kehei Interchange 1981-5); and 8 segment, 64 ft. long piles (San Francisco Airport Expansion, 1997). No project has had a splice failure.

- SURE-LOCK splices can connect composite piles (www.necp.net), composite to concrete, and pipe to concrete (a yet undiscovered combination by designers that would save clients’ cost). Think of a problem and my team will work with you to solve it safely and cost-effectively.
SPECIFICATIONS - SURE-LOCK® PILE SPlice

Cost of the SURE-LOCK splice is generally governed by the moment capacity requirement. Please contact us for further discussion.

SAMPLE SPECIFICATIONS

"Piles with mechanical splices, such as the Sure-Lock Splice (National Ventures Inc. 415-331-7260) are allowed as an alternative to one piece piles provided that [ the splices are located at least ___ ft. from top cut-off and ___ ft. below scour elevation, and ]:

1. Splice capacity in tension, bending and compression is equal to the epoxy dowel splice as shown on the Contract Drawings/Standard Specifications. Calculations and shop drawings to be submitted for approval."
   or

2. Splice capacity in tension, bending and compression is at least _____K in tension, _____K-ft. in bending, and full pile capacity in compression. Also, the splice must have tension capacity greater than allowable driving stresses. Calculations and shop drawings to be submitted for approval."
   or

3. Splice capacity in tension, bending and compression is equal to ultimate pile capacity. Calculations and shop drawings to be submitted for approval."

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CASTING - SURE-LOCK® PILE SPLICE

Recommended Casting Instructions

A note to estimators - splice installation moderately increases pile casting cost, and this varies by pile size, labor rate and castingyard methods in a geographical region.

ASSEMBLY

1. Male and Female splice plates are shipped palletized and are interchangeable. Threaded rebar anchors are shipped separately.

2. Screw the bars into tapped holes in the back sides, making sure that the ends do not protrude through the plate face. The bent rebar is screwed into the Female splice half with the offset to the inside of the spiral per drawing.

3. The outside of the Male plate and inside of the Female plate groove edges must be protected from concrete spills. Run duct tape around edges before placing in forms.
CASTING - SURE-LOCK® PILE SPLICE

INSTALLATION

1. The Female half goes on the top of the bottom segment; the Male on the bottom of the top segment. Place the halves 1-2 ft. apart in the forms with vent hole in the skirts facing up. If there is spiral to go inside Female rebar offset bends and over strands, place the turns inside first, pull strands, do initial tensioning, spread spiral (and/or stirrups). Support the splice rebar weight from kicking the splice faces back.

2. Squaring:
   a) With sufficient quantity, it may be more efficient to have jigs made. Please consult with us about this.
   b) Otherwise, spacers can be made, or use a framing square against the splice face and form sides and bottom, and wedges at the splice sides. One man can check the square while another moves the rebar and ties it. Some precasters use strand clamps at the splice face without spacers.

AFTER CASTING

1. Remove duct tape before burning strands off flush with splice plates so it doesn’t melt.
2. Grind plate surfaces flush so that no strand element protrudes, not even 1/32".
3. Clean mating splice surfaces and grooves of all concrete before shipping.

It is important for successful splicing at the job site that the splice surfaces and grooves are free from concrete and strand ends are flush -- inspect! Site assistance by NVI personnel is available for initial casting by prior arrangement.

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Recommended Driving Instructions

**A note to estimators** -- SURE-LOCK splices can be attached in 30 seconds; the relevant time for splicing is dependant on how fast the top segment can be lofted into position and placed to splice -- say 7 minutes?

**EQUIPMENT**

- Two rectangular locking bars with rounded noses are supplied for each splice for the circular key splices.
- A drive plate -- see below -- is supplied for insertion in the female splice plate to provide a flat driving surface on the bottom pile segment. Normal hammer cushions and helmets are used.
- The locking bars are most effectively driven for large quantities of piles with an impact hammer, such as a Rivet Buster, with a "pin driver" or "ground rod driver" bit. A drive coupling will be supplied by NVI. For small quantities of splices or in close quarters, a 5 lb. sledge can be used without difficulty.
- No impact hammer is required for the FDOT 24" and 30" square splices.

**DRIVING & SPLICING**

1. Check to make sure all splice mating surfaces are clean of concrete and strands are ground flush when piles are delivered.
2. Insert filler plate into Female splice, loft, and drive bottom segment to waist height.
3. Remove filler plate and clean surfaces of debris manually or with compressed air.
4. After pick-up of top segment, clean off any dirt from Male splice surfaces and groove.
5. Align pile segments, and fit the top pile (Male) into the Female recess of the bottom segment.
6. Align top segment so splice faces meet evenly and grooves match (look through side slots to check). Insert both locking bars in a clockwise direction.

For 24" & 30" sq. Splices: Insert four locking bars manually through the 4 entry holes on the sides and secure with the plugs that come in the splice. Disregard 7 & 8 below.
Recommended Driving Instructions

Drive one locking bar about half way, then the other bar all the way, and come back and finish driving the first bar. The bars normally drive quickly and easily, but if high resistance is found at a certain point, the top pile segment needs to be realigned in the direction of locking bar tip location.

7. If using an impact hammer with recessed bit, the locking bars will still protrude a little after hammering – finish driving with a sledge. The locking bar length is calculated to have some protrusion when fully driven – the inside corner of the end of the bar should end up close to the outside edge of the splice plate.

It is important to have splice surfaces that are clean and flush, and that the top pile segment is aligned properly. *Initial driving site assistance by NVI personnel is available with 7-10 days notice.*
SOME MAJOR PROJECTS USING THE SURE-LOCK SPLICE:

- **Hawaii DOT**, Oahu – Keehi Interchange and H-3 Highway 1979-91, over 5000 splices 16 ½" octagonal and 20" sq. used in 3 segment 270 ft. and 5 segment 170 ft. piles (1981-84). *Second major project.*
- Naaru Tower, Honolulu – 800 – 16 ½" octagonal for high capacity 11 strand piles.
- Hawaii Convention Center – 16 ½" octagonal splices for tension piles.
- **Syracuse NY**, Sewage Treatment Plant – 10,000 – 14" sq. splices (1976-77). *First major project.*
- **City of San Francisco**, MUNI-Metro Turnback – 18" sq. high capacity splices.
- **City of San Francisco**, SFIA Expansion – Boarding Area G and Rental Car Garage, 14" sq. splices for high combined moment and tension seismic design loading.
- **San Francisco**, Mission Bay Project -- 65 ft. 16" sq. top segments to 100 ft. 14" sq. bottoms.
- **Port of Oakland**, Container Pier 57/58 -- 24" octagonal splices.
- New Chesapeake Bay Bridge – 14" sq. splices for batter piles.
- Florida DOT, numerous bridge widening projects -- 18" sq. splices.
- Florida DOT & OOCEA -- numerous bridge projects -- 24" sq. splices.
- City of Tallahassee, Blairstone -- 24" sq. splices.
- **Orlando Airport** -- 24" sq. splices for Cross-Field Taxiway Bridges.
- **Port Authority, Port Arthur, TX**: 140 – 16" sq. splices for new wharf.
- Boundary Health Center, Winnipeg, Canada: 500 – 16" oct. splices.
- **MassDOT (CA/T)**, S. Boston Bypass Road: 300 – 14” sq. splices.
- MassDOT (CA/T), Logan Airport Ramps/Viaducts: 650 – 16” sq. splices.
- MassDOT (CA/T), CO9A4, CO7D2 350 -- 16" & 60 -- 12" splices.
- **MBTA**, Boston, South Station: 75 -- 14" sq. splices.
- **Mass Port Authority**, Logan West Parking Garage: 150 -- 14” sq. splices.
- Mass Port Authority, Logan Airport Roadways: 260 -- 16” sq. splices.
- Logan Airport Hilton Hotel, Boston: 575 – 14” sq. splices.
- Constitution Square, Boston: 12" sq. for 8 strand piles.
- Biosquare II, & Stilling St. Garages, Boston: 470 – 14” sq. splices.
- **ALL PROJECTS SINCE INTRODUCTION -- NO SPLICE FAILURES & NO LITIGATION.**
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

24" octagonal Driving -- 4 pictures

Bottom pile segment of 80 ft. with Female splice half lofted.

24" oct. pile, Male and Female splice ends on 80 ft. pile segments
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

24" octagonal Driving -- 4 pictures

24" oct. Sure-Lock Pile Splice – inserting the top segment Male into bottom segment Female splice half.

Driving one of the two locking bars into the grooves of the Male & Female plates with an air hammer to form a circular shear key.
24” & 30” sq. pile splice Casting & Driving -- 5 pictures

30” sq. Sure-Lock Splice – Male & Female parts in casting bed, splice anchor rebar screwed into splice plates inside spiral.

Bottom Pile Segment – with Female Splice end, showing recess for square Male Plate.
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

24" & 30" sq. pile splice Casting & Driving -- 5 pictures

30” sq. Sure-Lock Splice – Top pile segment with Male main plate
Splices were for FDOT bridge project

Top pile segment lowered so splice plates fit together.
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

24” & 30” sq. pile splice Casting & Driving -- 5 pictures

24” sq. Sure-Lock Splice – when splice plates meet evenly, 4 high-strength steel locking bars are inserted through side holes into the groove space in the Male & Female plates.

The bars are shear keys, and after insertion, are held from backing out by plugs screwed into the holes in the main plate.

The main plate thickness, locking bars, rebar size are designed to conservatively meet strength requirements in compression, bending and tension. Calculations are provided for approval.
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

18" & 16" sq. pile splice Driving -- 4 pictures

18” sq. Sure-Lock Pile Splice – FDOT Bridge Project, Orlando Bottom segment showing Female splice half with circular ID.

Top pile segment with circular Male plate, lofted and ready for splicing.
PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

18" & 16" sq. pile splice Driving -- 4 pictures

18" sq. Sure-Lock Pile Splice – FDOT Bridge Project, Orlando
After mating the splice halves, 2 high-strength steel locking bars are inserted & driven into the matching Male & Female grooves.

16” sq. Texas DOT Project – 2 locking bars are driven between the splice plate grooves to form a circular shear key – 2 minutes.

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PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

16" to 14" sq. pile splice Driving -- 2 pictures

Use of 16" sq. top segment 65 ft. long with reinforcement for higher moment capacity, combined with 14" sq. 100 ft. long bottom segments saved on piling costs.

The Sure-Lock has also been used to splice 20" sq. top segments to 16" oct. bottoms.

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PHOTOGRAPHS - SURE-LOCK® PILE SPLICE

24" sq. pile splice FDOT -- Bend Test

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FOUNDATION CONSTRUCTION LINKS
SURE-LOCK® PILE SPLICE

TRADE ASSOCIATIONS:
- Deep Foundations Institute
- Precast/Prestressed Concrete Institute
- Pile Driving Contractors Association
- Florida Precast Concrete Association
- Florida Transportation Builders Assoc.

PILE MANUFACTURERS:
- Northeast Concrete Products, Plainville, MA, [www.necp.net](http://www.necp.net)
- Dura-Stress Inc., Leesburg, FL [www.durastress.com](http://www.durastress.com)
- Gate Concrete Products, Jacksonville, FL [www.gateconcrete.com](http://www.gateconcrete.com)
- Standard Concrete Products, Inc., Tampa, FL [www.standardconcrete.net/tampa.htm](http://www.standardconcrete.net/tampa.htm)
- Kie-Con, Div. of Kiewit Pacific Co., CA [www.kie-con.com](http://www.kie-con.com)

FDOT QPL:
- [http://www.dot.state.fl.us/specificationsoffice/QPLindex.htm](http://www.dot.state.fl.us/specificationsoffice/QPLindex.htm)
  Click on Pile Splice Systems.
- FDOT Specification of Pile Splices, Go to Section 455-7.8
CONTACT - SURE-LOCK® PILE SPLICE

SURE-LOCK PILE SPLICE TECHNICAL & SALES ASSISTANCE

Contact: Glenn Lockie, Splice Div. Manager, at

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Please see the last section in "Overview" for pricing information. A two page Brochure summarizing the web site info, a booklet of Photographs, and Test Reports are available on request. Comments and suggestions about the web site are very welcome, as are questions regarding engineering, casting and driving. Glenn