55 Waugh Drive, Suite 1250 | Houston, Texas 77007 | 281-558-7199 | jdfields-cp.com

HOESCH INTERLOCK SEALANT

The HOESCH interlock sealing system is factory-fitted in the sheet piling interlocks. It comprises a machine-profiled seal in the threading interlock and an injected seal adapted to the interlock slot in the pre-fabricated interlock. Treatment with an appropriate primer ensures excellent adhesion and prevents the formation of rust underneath the seal. Tips are pre-beveled, eliminating pile end preparation.

The seal in the threading interlock is such that restoring forces in the sealing material are activated during pile driving which then seal off the interlock slot in the required zones (compression sealing). The provision of two sealing lips in the interlock makes the sealing system doubly secure. The driving interlock, into which the next pile with profiled seal is threaded, is bevelled to facilitate the threading process. When continuously driving sealed piles it is therefore important for the driving direction to be set out in a driving plan prior to construction and for this plan to be observed on site.

Material Properties

The seal is made of a permanently elastic polyurethane material which is resistant to ageing, weathering, water, seawater, normal effluent, mineral oils and a variety of acids and caustic solutions. Hazardous materials differ greatly in composition and concentration from one landfill/contaminated site to another. For this reason, HSP Hoesch Spundwand und Profil GmbH has tests performed on the resistance of its seals for differing applications and the environmental compatibility of its sealing materials is documented in a number of test certificates.

Piledriving Instructions

Selecting the driving process: For preference, piles featuring the HOESCH interlock sealing system should be installed by percussive driving. If circumstances allow, it is also possible to use the vibration driving process. For this, the ground must have good vibrating properties; driving progress must be continuous and no slower than 10 seconds per meter. If it takes longer than this to install the pile, or progress is interrupted, it is better to continue using percussive equipment. Cooling the threading interlock seal with water during vibration has proved advantageous.

Product data

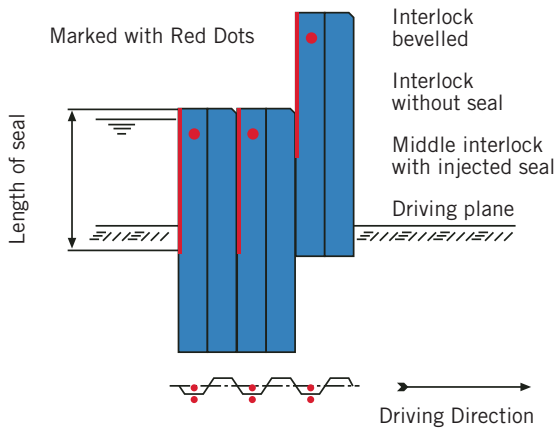
Base	polyurethane/epoxy resin
Solvents	none
Color	red/brown
Elongation at fracture	approx. 100 %
Flash point	100°C

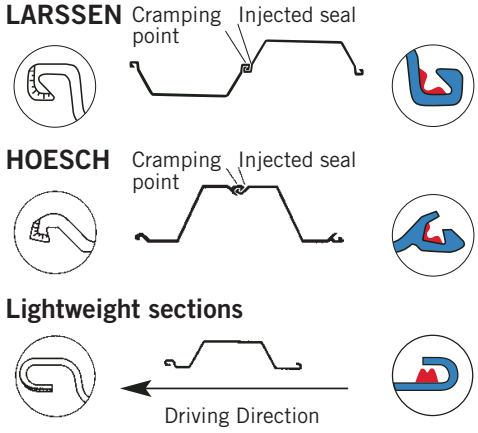
55 Waugh Drive, Suite 1250 | Houston, Texas 77007 | 281-558-7199 | jdfields-cp.com

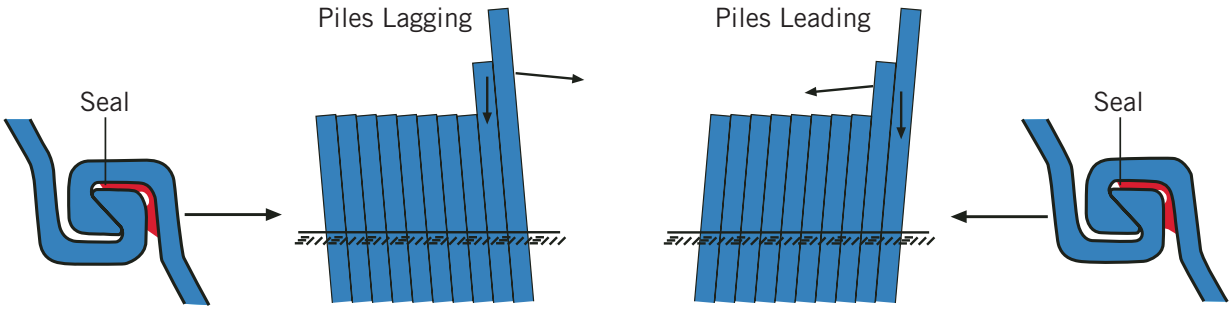
JD FIELDS CONSTRUCTION PRODUCTS

HOESCH INTERLOCK SEALING SYSTEM

The suitability of interlock sealing for pressing depends on the process selected. It is advisable to consult ThyssenKrupp GfT Bautechnik on this before-hand. During the winter it is important that the pile temperature does not drop below -5°C since the formation of ice crystals in the threading interlocks can cause damage to the profiled seal. The sealed interlocks should be kept free of snow and ice.







Seal lubrication

Regardless of the method used, HSP GM lubricant must be brushed evenly along the full length of the profiled interlock seal (approx. 100 g per meter) prior to driving. HSP GM is biodegradable and can thus be used in protected drinking water zones. The lubricant is water resistant, remains stable at low temperatures down to -5°C and displays good adhesive properties. Appropriate quantities of lubricant are included in the scope of supply.

Pile guiding

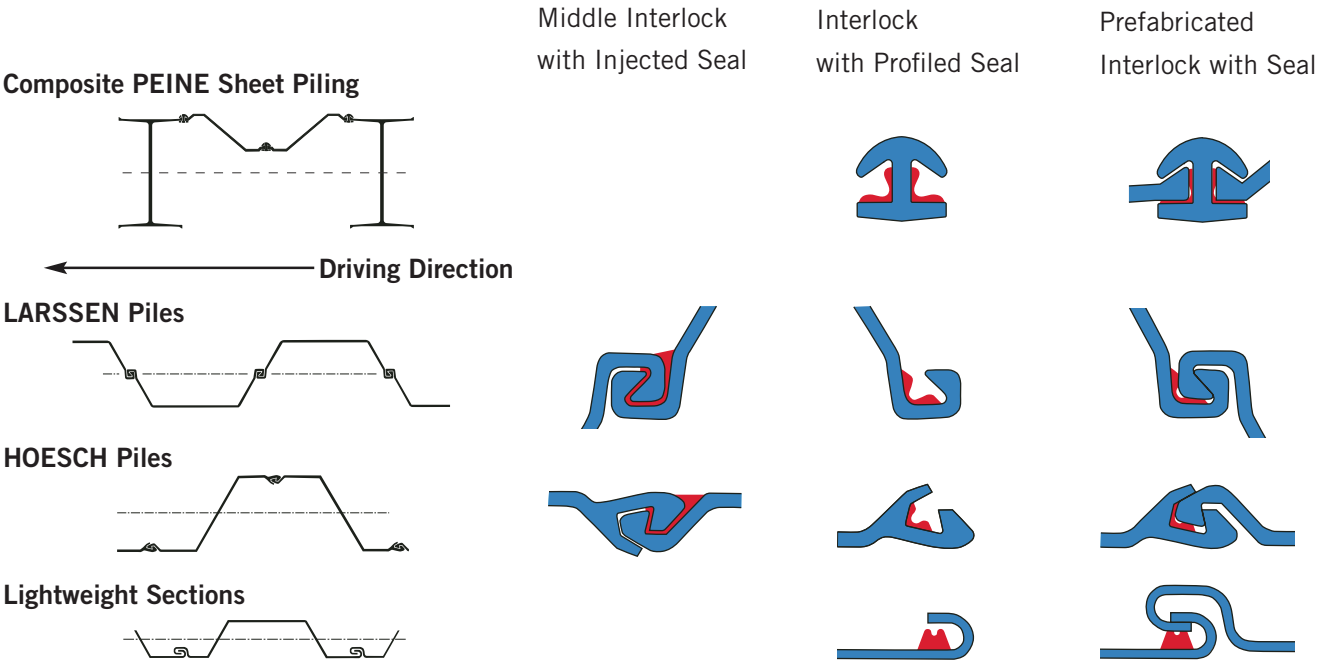
When driving sealed piles, special attention must be paid to guiding so as to avoid leading, lagging or inclining. Corrective measures must not cause any contraction of the interlock slot containing the profiled seal. For this you find comments in DIN EN 12063 and in EAU, E 118.

55 Waugh Drive, Suite 1250 | Houston, Texas 77007 | 281-558-7199 | jdfields-cp.com

JD FIELDS CONSTRUCTION PRODUCTS

HOESCH INTERLOCK SEALANT

HTK INTERLOCK SEALANT



HOESCH INTERLOCK SEALING SYSTEM

Driving direction

When using sealed piles, the driving direction must be stipulated prior to installation. When positioning the double piles on site, care must be taken to ensure:

- on LARSSEN piles that the free interlock is driven first and the interlock with the seal is threaded;
- on HOESCH piles that the finger is driven first and the sealed socket is threaded;
- on lightweight and sheet sections that the free interlock is driven first and the interlock with the seal is threaded.

For threading, the pile must therefore be turned in such a way that the unsealed interlock is pointing in the driving direction. The position of the seal is indicated by a colored dot on the pile head. Normally sheet piles should be driven continuously, but staggered installation is also a possibility. The result of the suitable method should take place on the basis of the whole installation conditions.

INTERLOCK FILLERS

Filling the site threading inter-locks with bituminous materials prior to driving greatly enhances the water impermeability of the interlocks.

Sheet piling interlocks can be provided with bitumen-based fillers in the factory or on the site. Interlock fillers work on the replacement principle, that means surplus material will be pressed out of the interlock by the following lock. Depending on the temperature, it is possible that a higher driving energy is needed. Differing materials are used depending on the pile driving process.

SIRO 88 is a hot bitumen sealant suitable for vibration driving. For percussion driving, a bituminous putty is recommended. When injected in the factory, both systems – SIRO 88 and the putty – consist of a pasty filler in the driving interlock and an injected compound in the prefabricated middle interlock.

The materials adhere well to the steel surface, eliminating the need to pretreat the interlocks with primers. Certificates have been obtained testifying the environmental compatibility of these fillers.

SIRO 88

Material properties

SIRO 88 is a bitumen/elastomer hot sealing compound. After application and cooling, this material may be anything from soft to tough (depending on the ambient temperature) and displays excellent adhesion with the steel surface. An investigation by the Gelsenkirchen Hygiene Institute has found that SIRO 88 can also be used in protected drinking water zones without reservation.

Product data

Base	bitumen
Color	black
Pouring temperature max.	180°C
Melting temperature max.	200°C
Flash point	250°C
Water solubility	none

Bitumen putty

Material properties

The sealant used by HSP is a synthetic-resin modified single component plastic bitumen putty which can be used to fill and seal interlocks on steel sheet piling. This bitumen putty displays good adhesion in the interlock slot and is able to withstand the forces of acceleration arising during the driving process. Its plastic properties remain even at low temperatures and the material can be used on site at temperatures down to -20°C. An investigation by the Gelsenkirchen Hygiene Institute has found that, as lubricant and sealant for sheet piling interlocks, this bitumen putty can be used without reservation in protected drinking water zones.

Product data

Base	bitumen
Color	black
Consistency	pasty
Density	approx. 1.0 kg/dm^3
Application	putty knife
	jointing iron
Flash point approx.	36°C
Temperature resistance	up to 90°C
Water solubility	none

55 Waugh Drive, Suite 1250 | Houston, Texas 77007 | 281-558-7199 | jdfields-cp.com

INTERLOCK FILLERS

Driving Direction →

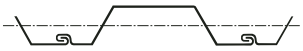
Middle Interlock

Interlock with factory or site applied bitumen filter

LARSSEN Piles

HOESCH Piles

Lightweight Sections



55 Waugh Drive, Suite 1250 | Houston, Texas 77007 | 281-558-7199 | jdfields-cp.com

SELECTION CRITERIA

Selection criteria for suitable interlock sealing

Example:
A vertical sealing wall with a depth of 10.5 m is to be set up to enclose a contaminated site. The ground has been contaminated with the following: chlorinated dioxins and furans, chlorobenzenes, chlorophenols, oils, mineral oils, polycyclic aromatics, aliphatic and aromatic solvents.

The wall selected must be resistant to all these hazardous substances. The requirement placed on permeability is k ≤ 1.0 x 10-9 m/s with a notional thickness of d = 60 cm. In view of the quality requirements, only factory sealed sheet piles should be permitted. The required section modulus is Wy ≥ 1100 cm^3/m. The suitable sealing system is selected on the basis of the following criteria:

Tightness

The requirement for interlock seepage resistance ρ is ρ req. ≤ k x b/d

Column 5 of the table on page 13 shows that to achieve equivalence with a 60 cm thick membrane wall with k ≤ 1.0-x 10-9 [m/s] the minimum requirement is for single piles with the HOESCH interlock sealing system in the threading interlock, the decisive element width being ≥ - 0.50 m. On static grounds, the section modulus required for this exam must be ≥ 1100-cm3/m.

The adjacent calculation models have been drawn up on the basis of DIN EN 12063:

Seepage resistance ρ

$$\rho = \frac{q(z) \times \gamma}{\Delta\rho(z)} \quad [m/s]$$

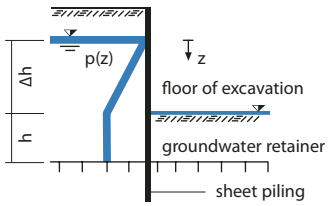
where:
q (z) = discharge rate over time related to interlock length [$m^3/m \times s$]
γ = specific gravity of fluid [kN/m^3]
Δp(z) = water pressure [kN/m^2]

Seepage rate Q

The seepage rate Q through an interlock can be calculated as follows:

$$Q = \int_0^{\Delta h+h} q(z) \times dz = (\rho/\gamma) \times \int_0^{\Delta h+h} \Delta p(z) \times dz$$

$$Q = \rho \times \Delta h \times (0{,}5 \times \Delta h + h) \; [m^3/s \times lock]$$



To allow tightness comparison with diaphragm walls of grouted curtain walls, it is possible to use the water permeability coefficient k in accordance with DIN EN 18130 part 1 for soils (porous media).

$$k = \frac{Q}{i \times A} \quad [m/s] \longrightarrow Q = \frac{k \times \Delta p(z)}{\gamma \times d} \times A[m^3/s]$$

where:
Q = measured water flow rate [m^3/s] A = cross sectional area, wall area [m^2]
i = hydraulic gradient [-]

By observing these basic correlations and taking into account the decisive quantity of sheet piling interlocks per m^2 of wall area, the following correlation results with a constant seepage rate Q:

$$\frac{k \times \Delta p(z)}{\gamma \times d} = \frac{\rho \times \Delta p(z)}{\gamma \times b}$$

$$\rightarrow \frac{k}{d} = \frac{\rho}{b}$$

where:
d = thickness of diaphragm wall [m]
b = pile width or element width [m]

ON SITE APPLICATIONS

Melting the SIRO 88 sealing compound

Unwrap the block of SIRO 88 and heat it in a double-walled, indirectly-heated receptacle with thermostat control. The melted sealing compound must be stirred constantly to prevent overheating. It is advisable only to melt the quantity required for that day, since repeated melting changes the properties of the compound.

Pouring temperature: approx. 180 °C
Melting temperature: approx. 200 °C

If outside temperatures are below 5°C, the enhancing agent SIRO 88 P should be added to the SIRO 88 compound. 3 kg of SIRO 88 P should be used for each block of SIRO 88, mixing with a mechanical stirrer until a homogenous compound has been formed. Minimum stirring time: 3 minutes. The interlocks and interlock joints must be dry, clean and free of oil and grease. Any contamination must be removed with a rotary wire brush; wet pile interlocks must be flame dried. Remove dust using condensate-free compressed air immediately prior to pouring.

Piles must be horizontal during pouring to ensure an even filling height, as shown on the adjacent drawing. At the first sign of rain, stop pouring. Piles are to be transported/ stored with the filled interlock opening facing upwards. If the piles are left in the sun for any period of time, they should be covered to prevent them from heating up.

Consumption

Approx. 250 to 450 g SIRO 88 per meter of interlock.

Packaging

SIRO 88 is supplied in 22 kg drums. SIRO 88 P is supplied in 30 kg drums.

Applying the bitumen putty

Interlocks and joints must be dry, clean and free of oil and grease. Any contamination is to be removed by mechanical brushing; wet pile interlocks must be flame dried. Remove dust using condensate-free compressed air immediately prior to filling.

The bitumen putty is filled into the interlock slot using an appropriate tool in accordance with the reference drawing. Piles are to be transported/stored with the injected interlock opening facing upwards.

Consumption

Approx. 400 to 500 g of bitumen putty per meter of interlock.

ON SITE APPLICATIONS

Packaging The bitumen putty is supplied in 30 kg drums.

Driving instructions

When using piles with interlock fillers, the driving direction must be stipulated prior to installation. Sheet piles with SIRO 88 filler should be vibrated into position for preference, whereas percussion driving is the better method for piles with bitumen putty. When positioning the double piles on site, care must be taken to ensure:

- on LARSSEN piles that the filled interlock is driven first and the free interlock is threaded;
- on HOESCH piles – contrary to normal practice – that the filled socket is driven first and the finger is threaded;
- on lightweight and panel sections that the filled interlock is driven first and the free interlock is threaded.

During threading, the pile must therefore be turned, so that the filled interlock is pointing in the direction of driving. On factory filled sheet piles, the position of the filler is marked by a colored bar on the pile head. It is important to ensure that piles are in vertical position and correctly aligned for installation.

During vibration driving, frictional heat in the threading interlock may cause the sealing compound to run out of the visible zone of the interlock or even burn. The following counter-measures are recommended:

- cool the interlocks with water
- use a more powerful vibrating driver.

ON SITE APPLICATIONS

Other sealing processes

For interlock joints which require sealing after the sheet piling has been installed, a number of processes are available. If sealing requirements are modest, it is possible to seal joints after installation with e.g. wooden wedges (swelling effect) or with rubber or plastic cords. However, if the interlocks need to be absolutely watertight, welding is the only answer. In general, this only affects the threading interlocks, since prefabricated interlocks can be welded tight before installation. Direct welding of the joint is only possible if the joint in question is clean and dry. Weld seams must be made on the side of the sheet piling facing the base of the structure to be built. If water is to run along the joints, they can be covered with a flat or sectional steel element which is fillet welded to the sheet piling.

Positioning the piles

Due to the increased interlock friction associated with sealed sheet piles, it cannot be assumed that the weight of the pile itself will be enough to sink it to the required depth. For this reason, suitable driving equipment must be kept on site to drive the piles further into the ground if necessary. To this end, HSP can supply a special starter weight, use of which requires a carrier with free fall equipment.

Effects of high temperatures

Welding work near seals or fillers will have an adverse localized effect on these sealing materials. If subsequent welding cannot be avoided, resealing will be necessary.

Flame cutting

If sheet piles with the HOESCH interlock sealing system have to be shortened or straightened on site using flame cutting apparatus, the interlock of the driven pile must be bevelled by grinding before attempting to install the next pile. If the appropriate interlock is not treated in this way, the seal may suffer damage during subsequent threading. If piles with filled interlocks have to be shortened or straightened on site using flame cutting apparatus, great care is required since the bituminous sealants are flammable and may require water-cooling. Appropriate extinguishers should be kept on site.

Coating

Coating is no problem when using the HOESCH interlock sealing system. Factory priming and on-site end coating is an ideal combination as it gets round the problem of damage in transit or during handling. However, full factory coating can also be provided. In order to avoid rust streaking on the coated piles, any interlock gaps should be filled on site. When using piles with bituminous interlock fillers, coating is not recommended, since any filling material which is pressed out of the interlock during installation would contaminate the coated sheet pile and subsequent cleaning is both time consuming and expensive.

ON SITE APPLICATIONS

Hot dip galvanizing

Hot dip galvanized steel sheet piles in conjunction with the HOESCH interlock sealing system can also be used without any problems. As with coated piles, it is recommended that hot dip galvanized piles should not be filled with bituminous materials for the reasons stated above.

Tightness

The coefficient of permeability k is frequently used to describe the tightness of a sealing wall, i. e. tightness is defined in terms of permeability. However, the actual discharge rate Q to be expected at a specified water pressure is more meaningful. Sheet piling is such that any possible material leakage, be it through convection or diffusion, is restricted to the interlock zones, since the rest of the wall is impermeable. It is difficult to determine exactly how the interlock may be breached, but it is highly unlikely that porosity will be a factor, so Darcy's law cannot be applied to the localized seepage through sheet piling joints. Therefore the only way of comparing the permeability of mineral sealing walls and sheet piling interlocks is via the actual amount of seepage Q. "Interlock seepage resistance" values have been calculated for the various interlock types on the basis of DIN EN 12063. The resultant value can be used both to calculate the quantity Q of seepage through an interlock and to make a comparison with a given k value for the calculation to DIN 12063. Always the integration of the sheet pile in a water tight soil layer is basically to avoid errors.