

HC-Economical expansion joint

Technical fiche



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Description

The **HC-E expansion joint** is a patented day joint and expansion joint for industrial floors that is designed with a minimum of steel; yet, the unique concept and the sophisticated and efficient anchorage guarantee a rigid structure with some very durable benefits.

The **HC-E** day joint and expansion joint are constructed from various components in SJ235JRG grade steel. These sophisticated, well-developed components each have their specific function and assembled to the **HC-E expansion joint**, they offer extraordinary performance.

The upper side is constructed from 2 flat steel strips of either 6 or 10 mm, and protect the newly created concrete edges. These strips, with a height of 35 mm, are also available in electro-galvanized steel or stainless steel versions. If desired a corrugated upper side can be selected. The patented corrugated version is compatible with the straight version and can be applied as necessary.

The strips are welded onto 2 minutely welded and folded profiles of 1.5 mm thickness. These profiles give the HC-E joint its exceptional rigidity and also achieve the necessary load transfer. These profiles are equipped with oval ventilation perforations to allow the concrete to cure in the optimum compact composition. With their unique shape these profiles also function as extra anchorage.

To the bottom of these profiles, 4 stamped, 1.5 mm thick, cover plates are attached every 25 cm. They function as holders for the connecting pieces in flat steel of 50 x 12 mm. These connecting pieces allow for horizontal expansion in both directions, prevent vertical movement and achieve the load transfer.

Because of the continuous structure combined with the connecting pieces, the development of concentrations of stress is avoided during the load transfer. Compared to discontinued profiles where such concentrations of stress do appear, higher load transfers can be achieved and the likelihood of crack formation is reduced.

The entirety is anchored in the concrete with anchor rods $\varnothing 6$ mm in diameter that, with their sophisticated design and their connection to the welded and folded plates, ensure increased rigidity and optimum anchorage and reinforcement, meaning that fracturing or cracking of the concrete surrounding the joint is nearly impossible.

A partition plate is situated underneath, so that the profile can be adjusted to the height of the floor. The available heights of the profile vary from 100 to 240 mm.

The entirety is welded by robots so that a perfectly maintained level of quality can be guaranteed.

This profile is available in standard lengths of 3 metres. For container transport this profile is available in lengths of 2.1 or 2.6 metres.

The patented corrugated upper side in 5 mm thick steel is an option with many benefits.

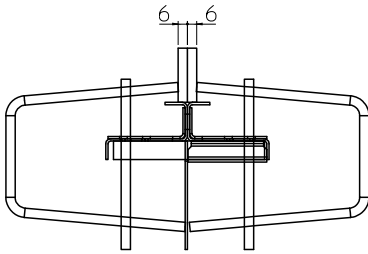
The corrugated version ensures continued support of the passing wheels, regardless of the direction, size and shape of the wheel, and this is achieved from the installation of the joint to its maximum opening of 20 mm. By neutralising the impact of the wheels, forklift drivers experience an unheard of level of **comfort. Maximum edge protection and load transfer** is also achieved, substantially reducing the chance of damage to the floor, the transport equipment or to the goods that are being transported. This corrugated upper side is highly recommended for passages and/or other areas in the floor that are subject to intense forklift traffic.

- **Free horizontal movement** of the industrial floor. The unavoidable shrinkage that is associated with drying of the poured concrete is compensated for by the horizontal expansion of the HC-E expansion joint. This prevents crack formation from occurring, which is a result of the drying process. Such crack formation could also result from **sawing** the floor too late, which would not be necessary when an expansion joint is installed.
- **Prevention of vertical movement.** The minuscule tolerance between the connecting pieces and the steel holder prevents vertical movement of the newly created floor plates.
- **Load transfer.** The unique anchorage combined with the connecting pieces in flat steel, and the folded profile plates, ensure that the HC-E expansion joint achieves an excellent load transfer from the one floor section to the other floor section in the event of forklift traffic. This means that the floor is less susceptible to wear and tear, the chances of damage are reduced and the service life of the industrial floor is increased considerably.
- **Maximum load tolerance.** The rigid steel structure and the connecting pieces in flat steel guarantee the maximum load tolerance without deformation. The anchorage ensures a strong bonding and bracing effect in the concrete and, also due to this, it achieves a high load tolerance value and prevents the concrete from cracking and fracturing.
- **Edge protection.** The 6 or 10 mm thick steel profiles on the upper side, and undoubtedly the corrugated version, provide maximum edge protection. This drastically reduces the chance that the edges of the floor sections will crumble.
- **Day joint profile.** The HC-E profiles are installed according to a layout with limited dimensions in order to separate the various floor sections. The sections can then be poured and processed according to daily planning.
- **Straightforward installation.** Installation of the HC-E expansion joint is simple and very quick to level, and if needed, can be performed without welding activities on the site (see installation instructions). Once installed, it affords a level finishing of the floor.
- **Shock free transition.** The corrugated version guarantees a shock free transition between two floor sections to a maximum opening of 20 mm, even for forklifts that have very small wheels.

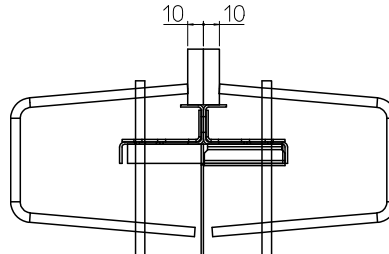
- **Rigid structure.** The HC-E profile is extremely rigid. This ensures that a straight line is maintained while installing and pouring the concrete, resulting in a functional and straight joint.



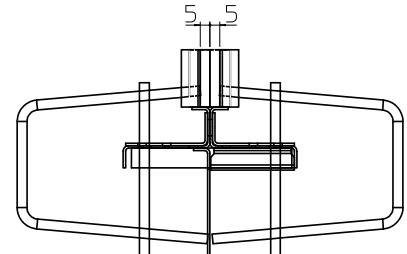
Product overview



1
Upper side 6 mm

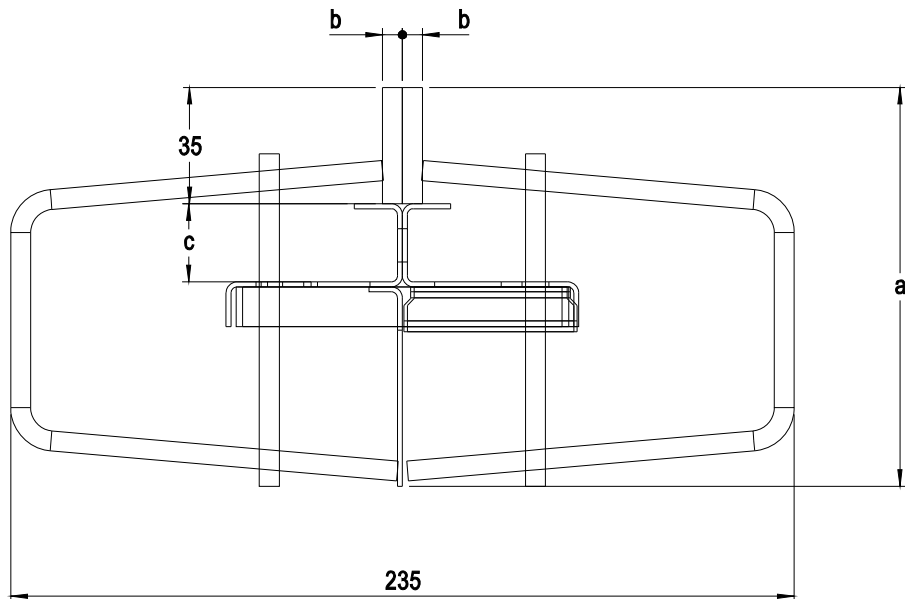


2
Upper side 10 mm

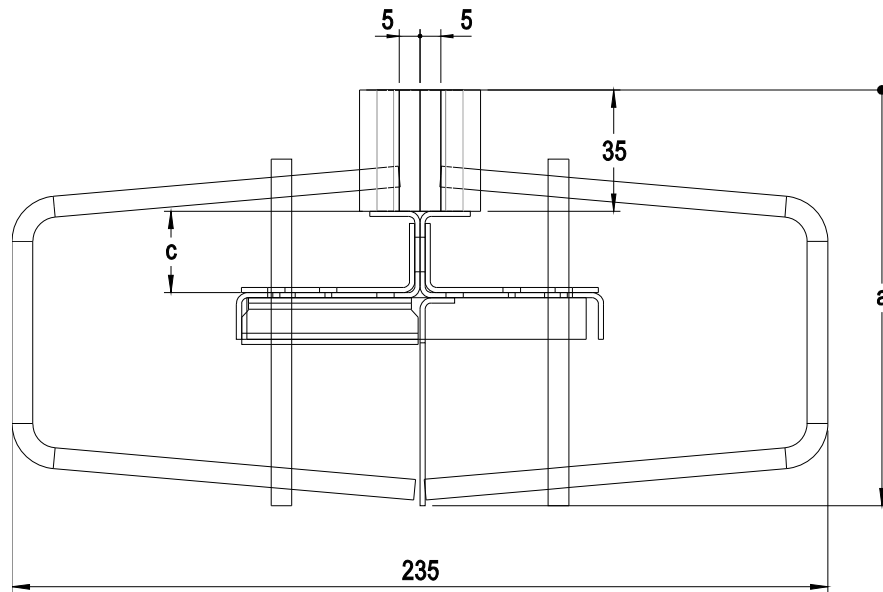


3
Corrugated
upper side 5 mm

| Technical characteristics of the HC-E expansion joint | | | |
|---|--|-----------|----------|
| | Type 1 | Type 2 | Type 3 |
| Thickness | 2 x 6 mm | 2 x 10 mm | 2 x 5 mm |
| Steel grade | SJ235JRG2 | | |
| Steel finish | Untreated Electro-galvanized Stainless steel on request | | |
| Length | 3m Standard, 2.6 m or 2.1 m on request | | |
| Type of anchor bolts | Ø6 Be500 26 parts per 3 metres. | | |
| Production | Fully-automatic welding | | |
| Height of profile | 100-220 mm Other dimensions on request | | |
| Fastening | Attached to the upper side with glue | | |
| Application | Suitable for all types of industrial floor Concrete with mesh reinforcement and fibre reinforced concrete | | |
| Accessories | Crossover points in T or X shape | | |
| Alignment of horizontal surface | 2 mm / 3 m | | |
| Alignment of vertical surface | 3 mm/3m | | |



| HC-E a x b | | | | | |
|--------------------------------|-------------------------|-----------|-----------|--------------------|--------------------------------|
| Height of profile a (mm) | Floor Thickness (mm) | b (mm) | c (mm) | Weight kg/metre | Number per pallet (m) |
| 100 | 105-125 | 6 | 25 | 9.18 | 144 |
| | | 10 | | 11.42 | |
| 120 | 125-140 | 6 | 25 | 9.43 | 144 |
| | | 10 | | 11.67 | |
| 130 | 135-150 | 6 | 25 | 9.54 | 144 |
| | | 10 | | 11.78 | |
| 140 | 145-160 | 6 | 40 | 9.88 | 144 |
| | | 10 | | 12.12 | |
| 150 | 155-170 | 6 | 40 | 10.04 | 144 |
| | | 10 | | 12.28 | |
| 160 | 165-180 | 6 | 40 | 10.26 | 120 |
| | | 10 | | 12.5 | |
| 180 | 185-200 | 6 | 65 | 10.83 | 120 |
| | | 10 | | 13.07 | |
| 200 | 205-220 | 6 | 65 | 11.12 | 120 |
| | | 10 | | 13.36 | |
| 220 | 225-240 | 6 | 65 | 11.45 | 108 |
| | | 10 | | 13.69 | |



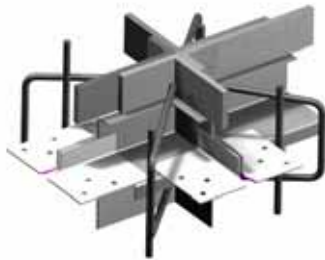
| HC-GE a | | | | |
|--------------------------------|-------------------------|-----------|--------------------|--------------------------------|
| Height of profile a (mm) | Floor Thickness (mm) | c (mm) | Weight kg/metre | Number per pallet (m) |
| 100 | 105-125 | 25 | 10.22 | 144 |
| 120 | 125-140 | 25 | 10.47 | 144 |
| 130 | 135-150 | 25 | 10.61 | 144 |
| 140 | 145-160 | 40 | 10.92 | 144 |
| 150 | 155-170 | 40 | 11.08 | 144 |
| 160 | 165-180 | 40 | 11.32 | 120 |
| 180 | 185-200 | 65 | 11.87 | 120 |
| 200 | 205-220 | 65 | 12.16 | 120 |
| 220 | 225-240 | 65 | 12.52 | 108 |

Accessories

Crossover points

These are available in all dimensions in relation to the profile used.

X-crossover points



T-crossover points



Connecting pieces

For the connection of cut off parts



Screw clamps



Feet for floors on insulation

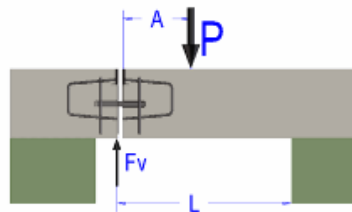


Self-drilling and tapping screws M4 x 20

Load transfer

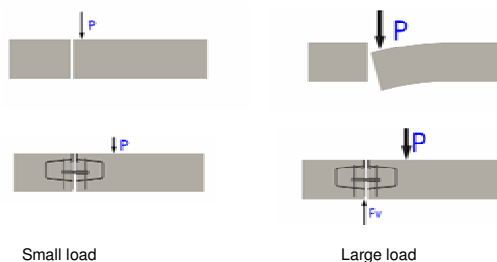
The load transfer by the profile is dependent on several factors

- The first factor is the positioning variable, which identifies the positioning of the load with regard to the joint and support.

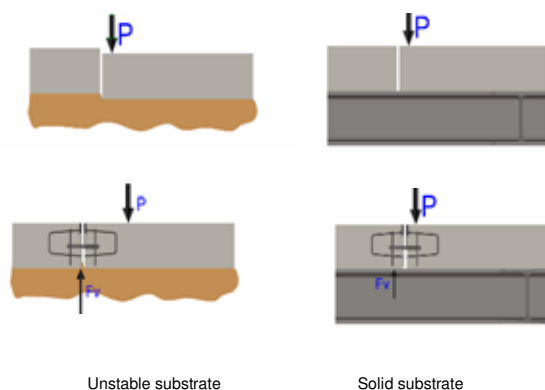


$$F_v = \frac{P \times (L-A)}{L}$$

- The second factor is the size of the load in relation to the thickness of the floor. Load transfer is only achieved from the moment that the load is large enough to move or to distort the floor section until possible separation between the parts has been eliminated.



- The third factor influencing the load transfer is the substrate. In the case of a solid substrate, the load will be carried by the substrate. In the case of a floor on poles, the profile will have to support the load completely.





If the load impact is on the edge of a plate then the concrete tension is 50% higher overall than when the load is in the middle of a plate. The expansion joint compensates for this increase and will, depending on the substrate, the position and the size of the load, shift up to 100% of this load to the adjacent plate.

Testing

The joints are subject to a test set-up commissioned by HCJ, developed by Magnel Laboratory at Ghent University. Testing is performed to the extreme, that is to say, until the concrete fractures.

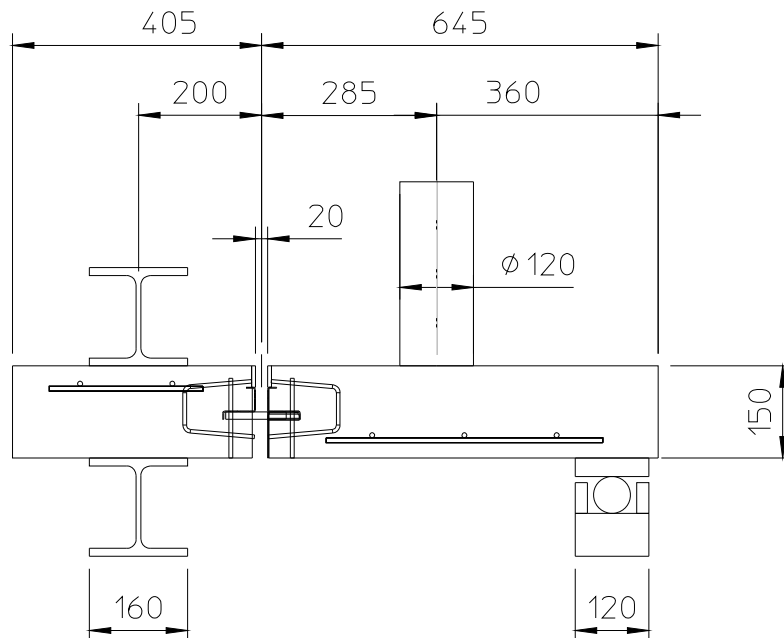
Test set-up

It was decided to test the joint without support, in such a way that the load transfer through the joint is at a maximum.

The joint is installed in a test specimen with dimensions of 1 m x 1.05m.

The joint opening amounts to 10 mm or 20 mm.

For the concrete a test is conducted with plain concrete (c30/37) and a test with fibre reinforced concrete 45 kg fibres/m³.



Test results

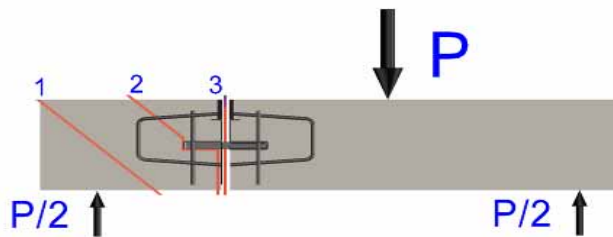
| Type | Opening (mm) | Height of concrete (mm) | Fibre reinforced concrete (y/n) | Breaking load kN |
|--------------|--------------|-------------------------|---------------------------------|------------------|
| Hc-E 140 x 6 | 10 | 150 | N | 90 |
| Hc-E 140 x 6 | 20 | 150 | N | 120 |
| Hc-E 180 x 6 | 10 | 200 | Y | 160 |
| Hc-E 180 x 6 | 20 | 200 | Y | 197 |



Concrete break at 197 kN per metre. Break appeared at 20 cm in the concrete which illustrates the efficiency of the anchorage.

Calculation example

Analysis of the various manners in which the joint breaks



Technical details

- Concrete thickness H: 160 mm
- Height of the profile: h= 140 mm.
- Break resistance of anchors: $\sigma_{anc} = 450 \text{ N/mm}^2$
- Break resistance of steel $\sigma_{st} = 350 \text{ N/mm}^2$
- Break resistance of connective slat $\sigma_c = 520 \text{ N/mm}^2$
- Characteristic compression strength of the concrete $f_{ck} = 25 \text{ N/mm}^2$
- Diameter of anchors $\phi 6 \text{ mm}$
- Load transfer 50%
- P = force per length-unit
- n_{anc} = Number of anchors per length-unit
- E= 21,000 MPa
- W_b = Section modulus against bending

Various manners of breaking

1. Breaking of the concrete through shifting:

$$P = 1/\text{Load transfer} * H * \sqrt{2} * \zeta \quad \text{where } \zeta = 0.05 * f_{ck} / 1.5$$

$$P = 1/0.5 * 160 * \sqrt{2} * 0.05 * 25 / 1.5 \\ = 377 \text{ kN}$$

2. Breaking of the anchors

$$P = 1/\text{load transfer} * (a * \sqrt{2} * \zeta + A_{\text{anc}} * n_{\text{anc}} * \zeta_{\text{anc}})$$

$$\text{where } \zeta_{\text{anc}} = 0.8 * \sigma_{\text{anc}}$$

$$P = 1/0.5 * (75 * \sqrt{2} * 0.05 * 25 / 1.5 + 6^2 * \pi/4 * 8.6 * 0.8 * 0.45)$$

$$P = 351.8 \text{ kN}$$

3. Breaking of the profile

$$P = 1/\text{load transfer} * A * \zeta_{\text{st}}$$

$$\text{where } \zeta_{\text{st}} = 0.8 * \sigma_{\text{st}}$$

$$P = 1/0.5 * (50 * 12 * 4 * 0.8 * 0.350)$$

$$P = 1,344 \text{ kN}$$

4. Maximum load-bearing capacity at 20 mm opening for plastic deformation of the connection plate

$$W_b = b h^2/6 = 50 * 12^2/6 = 1,200 \text{ mm}^3$$

$$M_{\text{max}} = W_b * \sigma_c = 1200 * 520 = 624000 \text{ Nmm}$$

$$F_{\text{max}} = 1/\text{load transfer factor} * n * M_{\text{max}} / 20 = 1/0.5 * 4 * 624,000/20$$

$$= 249.6 \text{ kN}$$

For this example the maximum load amounts to 249.6 kN, taking into account a load transfer factor of 50%.

The values indicated in this example are only guide values and must still be verified by a civil engineer.

The safety factors must be selected in function of the application.

Higher safety factors must be maintained for dynamic loads than for static loads.

Installation instructions

Preparation

The aim must be to divide the floor plate into square sections. If this is not possible, the ratio of 3/2 respectively for the width/length of the floor plate must be respected wherever possible.

The distances between the joints are determined as a function of the expected shrinkage of the concrete. The shrinkage of a floor plate is strongly dependent on several thermal variables, as well as the concrete quality. In any event, one must attempt to limit the opening of the joints to a maximum of 20 mm. An indication under normal circumstances is a floor section of 30 to 40 metres. The recommendation of a project leader or specialist is however still recommended, because the shrinkage can vary markedly from country to country due to the local environmental factors and concrete quality.

For intensely loaded floor sections, such as the floors in loading docks and passages, we recommend using the patented corrugated profile. The extra cost is low relative to the total project investment and it is recovered quickly considering the numerous benefits.

Fixed structures in the building, such as pillars and walls, must be insulated with compressible material.

Check whether there are any fixed equipment or fixtures being installed over 2 different floor plates which could hinder the movement of these floor plates, such as racks, conveyor belts, guard rails, etc.

In certain floors installed on a waterproof membrane or insulation for example, the use of anchorage in the substrate is not permitted. As an alternative our line offers adjustable installation feet whereby the substrate does not get perforated.

Check for the presence of utilities and underground lines when using anchorage by means of pickets in the ground.

Installation

1. Secure a cord on the spot where the profiles must be installed and position the joints along this cord.



2. Position the first joint parallel to the cord and bring it to the correct height by using wooden wedges. The joint can also be installed using adjustable feet. This installation technique is recommended when installing on insulation or when no pickets may be inserted in the ground.



3. Hammer or drill pickets into the ground vertically, along the end of the anchors. We recommend 4 pickets and 4 clamps per 3 metre length; 2 on each side, every side and end of the profile. A picket can also be placed in the centre if needed. If you weld the pickets to the anchorage, the clamps are not required.



4. Check the height level of the profile with a laser and also check whether it is parallel to the secured cord.
5. Check the levelness of the profile across and in the length using a spirit level.
6. Weld the pickets to the profile or use the special clamps.



7. Position the following profile with its overlapping in the first profile. With the overlapping, the beginning of the profile is already at the correct height. Screw both profiles together.



8. Bring the end of the second profile to the correct height with wedges or with the height setting.
9. Continue with the other profiles in this manner until you come to a crossover, pillar or wall.



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For crossover points

1. Position the crossover point on the relevant spot provided on the layout.
2. Measure the distance between the joint last installed and the crossover point. Cut the joint yet to be installed to the correct length with a grinder wheel.
3. Install the joint that has been cut to length as per the working method described above and screw it onto the previous profile using a mounting plate.
4. Join the crossover point to the correct level and screw or weld it onto the profile.

Maintenance and finishing

The HC-E expansion joint is, amongst other things, designed to protect the edges of concrete slabs that are automatically created when the joint opens due to shrinkage occurring in the drying process.

We recommend filling in the newly created openings with joint filler or sealing product in order to prevent the accumulation of dirt and dust in the joint.

Sealing the joint with hard material also reduces the impact of forklift traffic on the edges of the profile.

Final sealing may only take place when the expansion of the joint has stabilised.