

STARCON



Wire box system W60 to W140

Fixing insert systems for concrete elements.

User and design manual

1 Nomenclature

Symbol	Description	Unit
α	Diagonal pull angle between sling and axial direction	°
β	Tilting angle between element and axial direction	°
γ	Turning angle between element and horizontal direction	°
°C	Temperature Celsius	°C
ϕ_S	Diameter of the ribbed steel bar	mm
COG	Center of gravity	[–]
b	Thickness of the seam	mm
B	Width of wire box	mm
B_{min}	Min. total wall width	mm
C_{max}	Max. distance between wire rope loops at opposite sides of the joint	mm
d	Diameter of wire loop	mm
D_{min}	Min. distance of the wire rope loop to the upper and lower edge of the concrete element	mm
E_{min}	Min. distance between wire rope loops at the same side of the joint	mm
F_{Ed}	Tensile force	Ton
F_{Rd}	Resistance for tensile force	Ton
H	Height of wire box	mm
L	Length of wire box	mm
L₁	Length of wire loop	
h_{ef}	Embeement depth	mm
N_{Ed}	Transverse shear force	Ton
N_{Rd}	Resistance of transverse shear force	Ton
S	Load group symbol (STARCON)	–
S_L	Depth of wire loop	
V_{Ed}	Longitudinal shear force	Ton/m
V_{Rd}	Resistance of longitudinal shear force	Ton/m
WLL	Working Load limit	ton

Table 1 Nomenclature

Starcon Precast Concrete Design & Lifting Manual

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2 Identification

Table 2 provides insight into the revision number of this document. It facilitates tracking changes and ensuring version control for accurate referencing and updates.

Version	Responsible	Creator	Date	Comment
A	CERTEX Denmark	JLJ	03-09-2024	New documentation

Table 2 Revision table

3 Introduction Starcon Wire box system W60 to W140

Read this instruction manual before using the Starcon Wire boxes. Incorrect use can cause injury or danger!

Safety is paramount when using lifting devices and equipment. Only trained individuals should operate them as per national law. Familiarize yourself with the instruction manual before use to ensure safe operation. Adhering to these guidelines reduces the risk of accidents. Consult relevant national regulations as they may supersede these instructions. All individuals involved with the equipment must read and understand this manual. Contact Certex for assistance or clarification. Always keep the manual with the product. Contact information is provided on the last page.



General concept of the use Wire boxes:

The Starcon Wire box consists of a galvanized steel wire rope formed into a ring by pressing the rope ends together using a metal press sleeve and assembled into a steel box, shown on Figure 1.

To ensure proper placement of the Wire box in the finished concrete product, Wire boxes are always installed in concrete elements before casting. They can be positioned within the wall reinforcement and secured to the formwork using recess boxes, nails, magnets, or adhesives, depending on the shuttering type. Once the concrete has reached a minimum strength of 15 MPa, the formwork and protective tapes can be removed. The connection is considered load-bearing only after the grout has attained a minimum strength of 25 MPa. Contact CERTEX DK for lower strength values.

The Starcon Wire box is done according to the requirements of the European standards and according to CERTEX Danmark A/S (ISO9001 and ISO14001). This ensures the highest level of safety when using our products.

Material: Galvanized steel wire (GSW).
Surface treatment: White zinc plated (WZP)

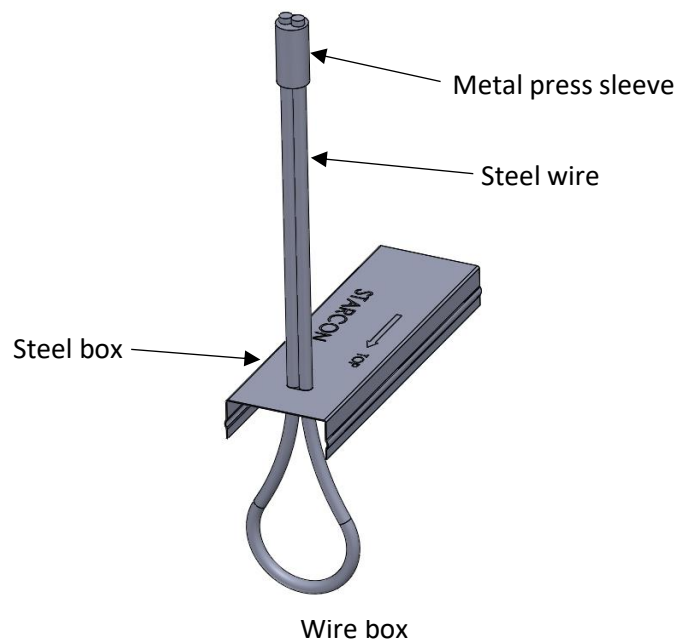


Figure 1 Starcon fixing system.

4 Safety instructions before use



- The Starcon Wire boxes that are exposed to corrosion, or damaged must not be used.
- The length of the steel wire and the recess dimensions of the Starcon Wire box must match to ensure suitable overlap of the steel wire and guarantee full carrying capacity.
- There should be sufficient space in the casting recess to accommodate the Wire box in its unfolded state without interference.
- The Starcon Wire box is not to be used for lifting or transporting precast concrete units.
- The Starcon fixing and handling system must not be used to fix more than the specified load.
- The Starcon fixing system must only be used by skilled, trained employees.
- The concrete safety factor assumes a factory production control complying with EN13369. If these requirements are not fulfilled, a safety factor of $\gamma = 2,5$ shall be used.
- All relevant concrete failure modes shall be verified by the pre casting manufacturer of the concrete elements; the different failure modes and verification methods are specified in EN13155 (Annex H).

5 Advantages of the Starcon system.

The Starcon system offers wire boxes. These wire boxes are used to transfer vertical shear forces, transverse shear forces, tensile forces, and combinations thereof in wall-to-wall or wall-to-column connections.

The Starcon system is available in groups W60 to W140. Typically embedded in concrete elements during the prefabrication stage, it is used for assembling precast concrete elements. These systems are employed for wall extensions, corner joints, or wall-ceiling joints, offering low-cost, easy, and safe joint formation.

The system's efficiency has been proven through many years of successful use and numerous laboratory tests. Components are regularly tested during production and are clearly marked with the maximum load. The Wire boxes are individually tested and come with a traceability batch code.

5.1 Note

The information in this manual is for guidance only, and the use of the manual does not in any way exempt the manufacturer from ensuring that the chosen fixing system is suitable for the intended purpose. The information and data listed in this manual only refer to original Starcon products supplied by *CERTEX DANMARK A/S*.

6 Using the Starcon system

The Starcon system includes a wide range of Wire boxes grouped from W60 to W80, each Wire box offers various lengths. The principle for using the system is the same for the entire range.

6.1 Starcon Wire box

Starcon wire boxes are devices embedded in concrete elements during the prefabrication stage and used for assembling precast concrete components. Typically made of steel wire, they come in various sizes to suit different applications. Starcon wire boxes undergo rigorous testing to ensure safety. Each wire box is marked with its article number, identification number, maximum working load, and a clear indication of a 3:1 safety factor. Additionally, a certificate is issued with every delivery for complete documentation.

7 Safety factors for Wire box systems

For the calculations of the Wire box system, the following safety factors shown Table 3 have been applied to ensure its reliability and safety. These factors, in accordance with the recommendation of EN13155, have been carefully selected as guidelines to ensure optimal safety during the system's operation.

Failure safety factors	
Steel failure of Wire box	$SF_{Steel} = 3$
Concrete pull out failure	$SF_{concrete} = 2,5$

Table 3 Failure safety factors

8 General information

This section provides essential details on the Starcon Wire box systems, offering clarity and guidance for safe and efficient usage.

8.1 Marking on the Wire box

Each Wire box is clearly labeled with its load-bearing capacity, length, and manufacturer's identification, ensuring easy and secure identification of the systems, even post-installation show on Figure 2.

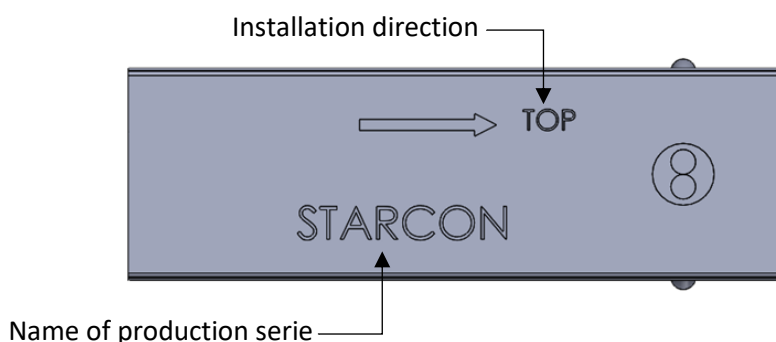


Figure 2 Marking on Wire box.

8.2 Guidelines for installation

When selecting Wire box, it's essential to consider various factors to ensure safety and effectiveness. The tables provided contain crucial information such as maximum load capacities, edge distances, and installation values for different Wire box types. Key points to consider:

- Wall thickness of the precast element.
- The number of Wire box.
- How the Wire boxes are arranged.
- The load-bearing capacity of the Wire box.
- Geometry of the joint
- Space in the casting recess.
- Environmental impact on the use.

8.3 Guidelines for installation

For the Starcon Wire box systems to be appropriately installed, it is imperative to ensure compliance with specific technical criteria and prerequisites:

- Adherence to load-bearing capacity specifications of the Wire box.
- Maintaining appropriate edge spacing.
- Ensuring the concrete grade is suitable.
- Verifying alignment with the load direction.
- Additional reinforcement requirements.

8.4 Guideline for load capacity

Load capacity of a Wire box relies on several factors:

- The strength of the concrete at the moment of lifting, as determined by a cube-test with dimensions of 15 × 15 × 15 cm.
- The length of the Wire box.
- The spacing between the Wire box and the edges, both axially and along the edge.
- The direction of the applied load.
- The arrangement of reinforcement within the concrete structure.

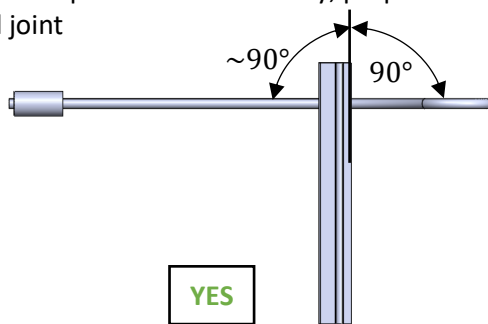
9 Design method

This section provides essential information for the correct and safe selection and use of the Wire box. To ensure the construction's durability and safety, it is crucial to carefully follow the manufacturer's technical specifications and guidelines during design and construction. Additionally, the casting process is discussed, including the transfer of load to the concrete, and the importance of correctly placing formwork and Wire box during casting to avoid errors and risks. Warnings are given regarding the correct size of formwork and the risk of errors with incorrect sizes, which can lead to potentially dangerous situations.

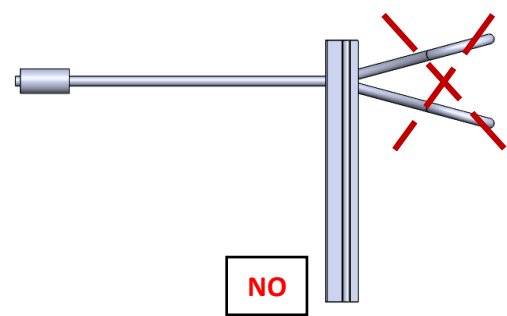
9.1 Correct placement Wire box during casting.

The Wire box system is designed to connect concrete components by embedding different sides of wire loops in concrete at separate times. Before concreting, the boxes are securely fastened to the formwork at the planned component joint. Figure 3 illustrates the correct placement of wire loops in concrete for optimal anchorage strength of the wire box.

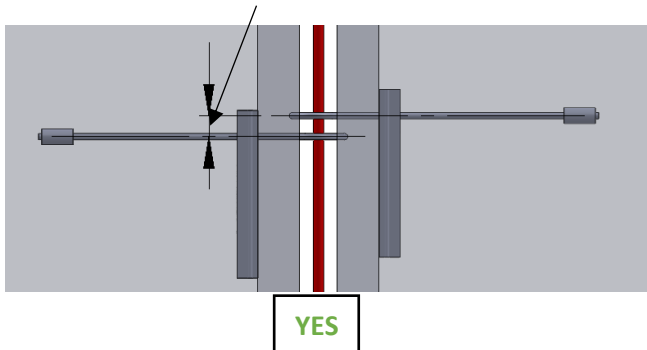
The wire loop is installed correctly, perpendicular to wall joint



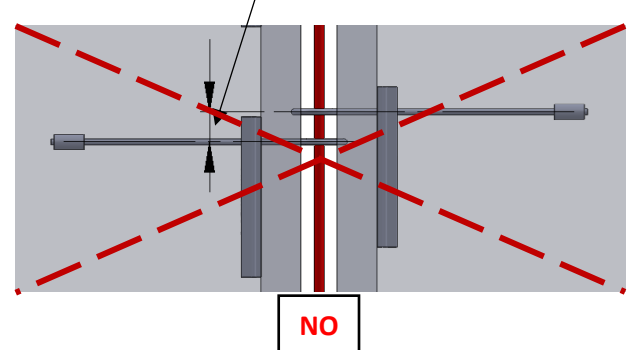
The wire loop is not installed correctly



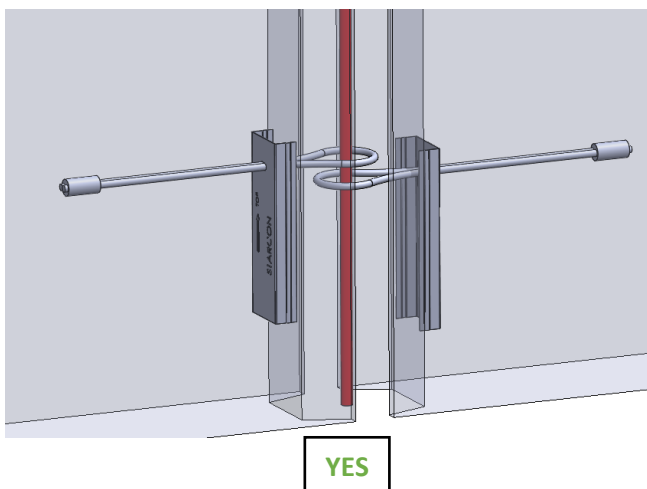
Spacing between loop is less than or equal to 20 mm



Spacing between loop is bigger than 20mm



Correct installation of wire loops.



Wrong position of the wire loop, outside ribbed steel bar

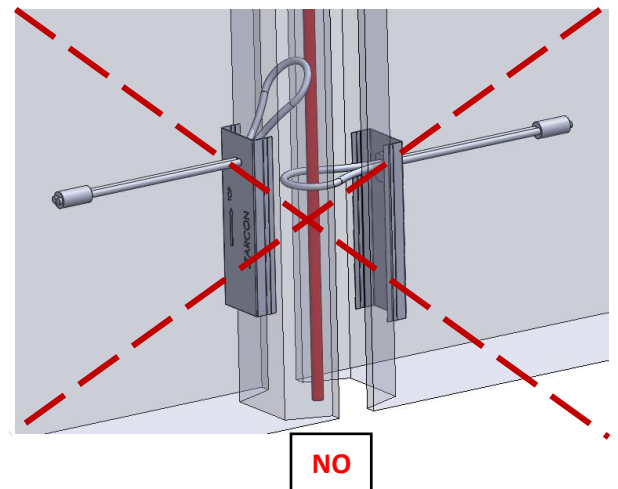


Figure 3 Correct placement of Wire box.

9.2 Installation dimensions for Wire box

The capacity of the wire rope loop is defined by the weakest concrete in the joint (element/joint concrete). The capacity calculations do not take into account cracks or deformations in the joint. The capacities of the wire rope loops are calculated for the joint width presented in Figure 4 and it is assumed that the steel boxes and the seam are fully filled with concrete.

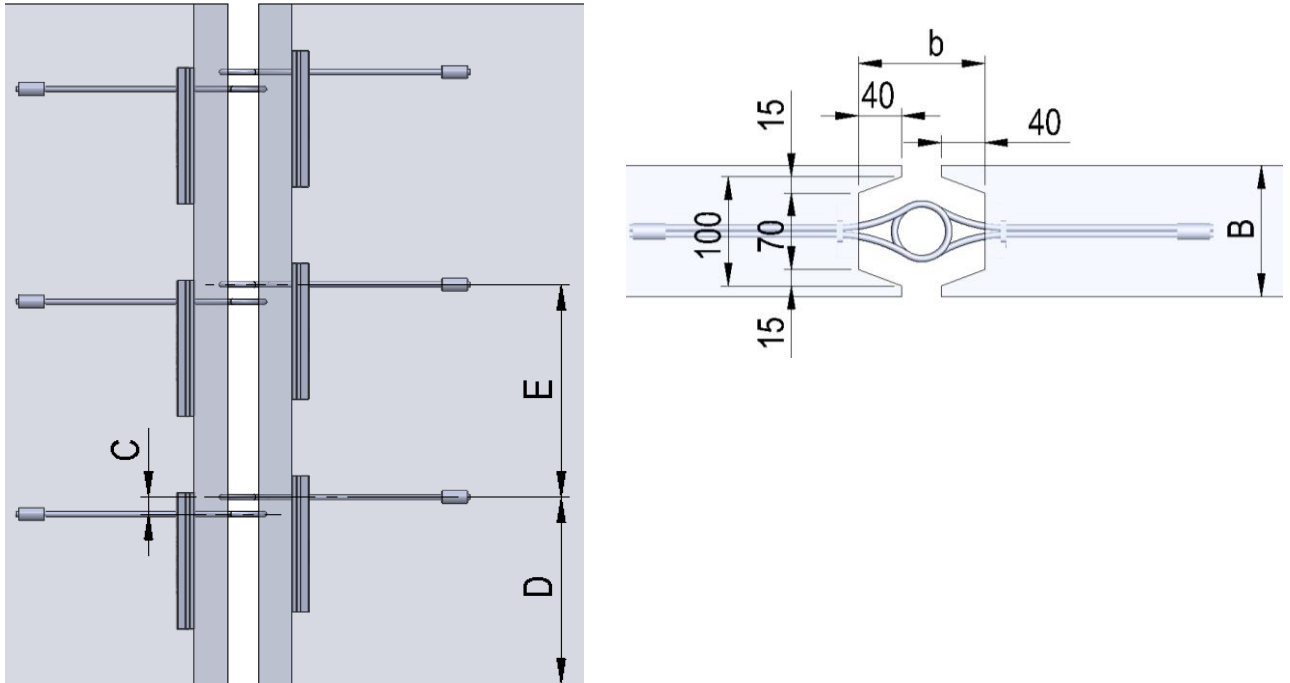


Figure 4 Installation dimensions of Wire box.

Table 4 shows the distances of the Wire box

Type	Thickness b mm	Min. width B_{min} mm	Center to center C_{max} mm	Edge distance D_{min} mm	Center to center E_{min} mm
650190W060	70-90	120	20	100	250
650190W080	90-110	120	20	100	250
650190W100	110-140	120	20	100	250
650190W120	140-190	120	20	100	250
650190W140	160-220	150	25	200	350

Thickness b : recommended thickness of the seam.

Min. width B_{min} : minimum total wall width.

Center to center C_{max} : maximum distance between wire rope loops at opposite sides of the joint.

Edge distance D_{min} : minimum distance of the wire rope loop to the upper and lower edge of the concrete element.

Center to center E_{min} : minimum distance between wire rope loops at the same side of the joint.

The size of the wire rope loops must be chosen according to the thickness of the joint to enable the vertical ribbed steel bar in the joint to pass through the wire rope loops on both sides of the joint.

The total wall width of the concrete wall element must be chosen taking into account the width of the indented joint Figure 4, the width of the steel box of the wire rope loop and the required concrete cover.

Table 4 Distances of the Wire box.

10 Recommend support for Wire box in concrete walls

When using the wire rope loops, a vertical ribbed steel bar must be installed to the joint according to Figure 5. This ribbed steel bar is installed through the wire rope loops

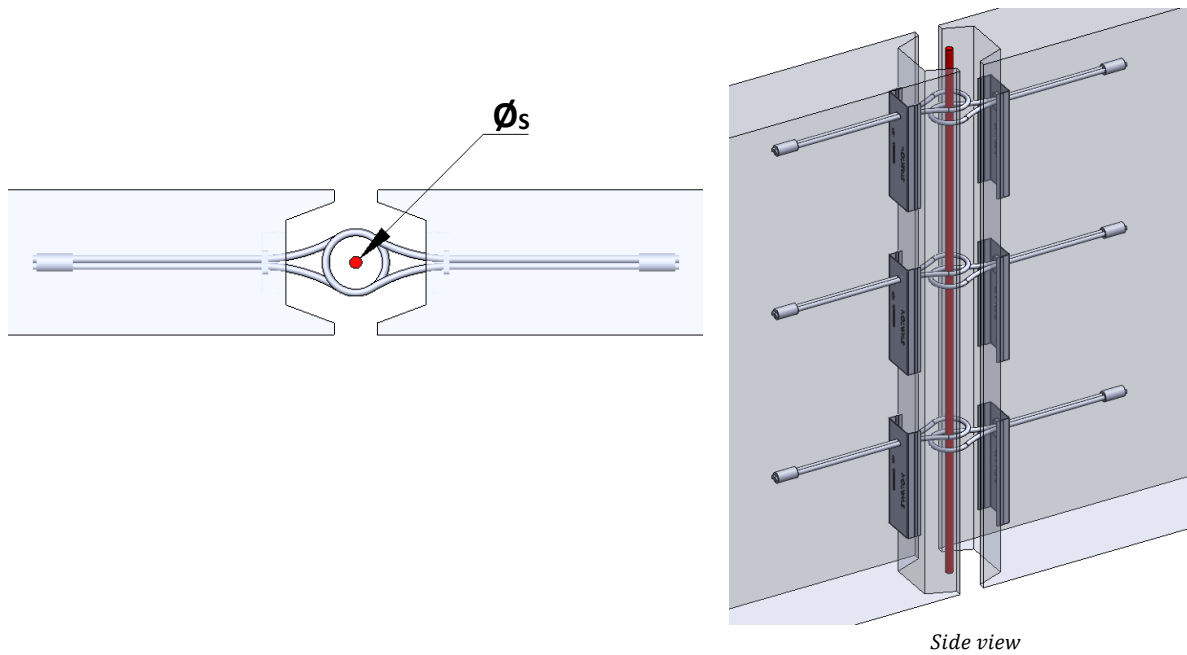


Figure 5 Ribbed steel bar in the joint.

Table 5 shows the size of the ribbed steel bar in the joint

Type	Dia. of the ribbed steel bar \varnothing_s mm
650190W060	Ø12
650190W080	Ø12
650190W100	Ø12
650190W120	Ø12
650190W140	Ø16

Table 5 Size of the ribbed steel bar

11 Starcon Wire Box capacities

This section covers the design method for the longitudinal shear capacities of wire rope loops. These capacities are calculated according to the wire rope loop joint calculation presented in Henrik Brøner Jørgensen's "Strength of loop connections between Precast concrete elements" (2014). Capacities are calculated for static loads with the joint width presented in Figure 4. The analysis does not consider joint cracks or deformations. Wire rope loops are not designed to be used for lifting or as lifting loops.

Capacities presented in the tables below are capacities in the ultimate limit state. The capacity is defined by the weakest concrete in the joint (element/joint concrete). Figure 6 show direction of longitudinal shear force in joint.

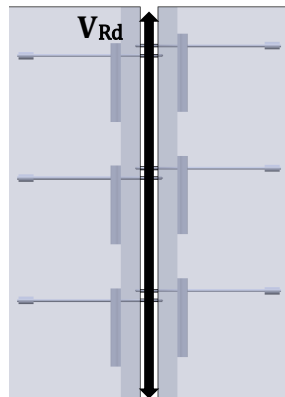


Figure 6 Direction of longitudinal shear force in joint.

Table 6 longitudinal shear force capacities of the STARCON WIREBOX 60, STARCON WIREBOX 80, STARCON WIREBOX 100 and STARCON WIREBOX 120

Distance c/c mm	Load capacity [Ton/m] with concrete strength			
	C25/30	C30/37	C35/45	C40/50
250	12,8	14,02	15,14	16,18
300	11,96	13,09	14,14	15,12
350	10,3	11,29	12,18	13,03
400	9,06	9,92	10,71	11,46
450	8,09	8,86	9,57	10,23
500	7,32	8,01	8,65	9,26
550	6,68	7,32	7,91	8,45
600	6,15	6,74	7,29	7,79
650	5,7	6,26	6,76	7,22
700	5,33	5,84	6,31	6,73
750	4,99	5,47	5,91	6,32

Distance c/c: represents the distance between two sets of installed wire boxes.

Table 6 Longitudinal shear force.

Table 7 longitudinal shear force capacities of the STARCON WIREBOX 140

Distance c/c mm	Load capacity [Ton/m] with concrete strength			
	C25/30	C30/37	C35/45	C40/50
350	18,55	20,33	21,95	23,47
400	16,66	18,26	19,71	21,07
450	14,86	16,28	17,57	18,79
500	13,41	14,68	15,86	16,96
550	12,22	13,39	14,46	15,46
600	11,23	12,31	13,3	14,21
650	10,4	11,39	12,31	13,15
750	9,68	10,61	11,46	12,24

Distance c/c: represents the distance between two sets of installed wire boxes.

Table 7 Longitudinal shear force of the STARCON WIREBOX 140.

12 Starcon Wire Box resistance for transversal shear and tensile force

Design values of resistance presented in the tables are resistance in ultimate limit state. The resistance is defined by the weakest concrete in the joint (element/joint concrete).

Design values for transversal shear force apply for one wire rope loops.

Figure 7 shows the direction of resistance for transversal shear and tensile force

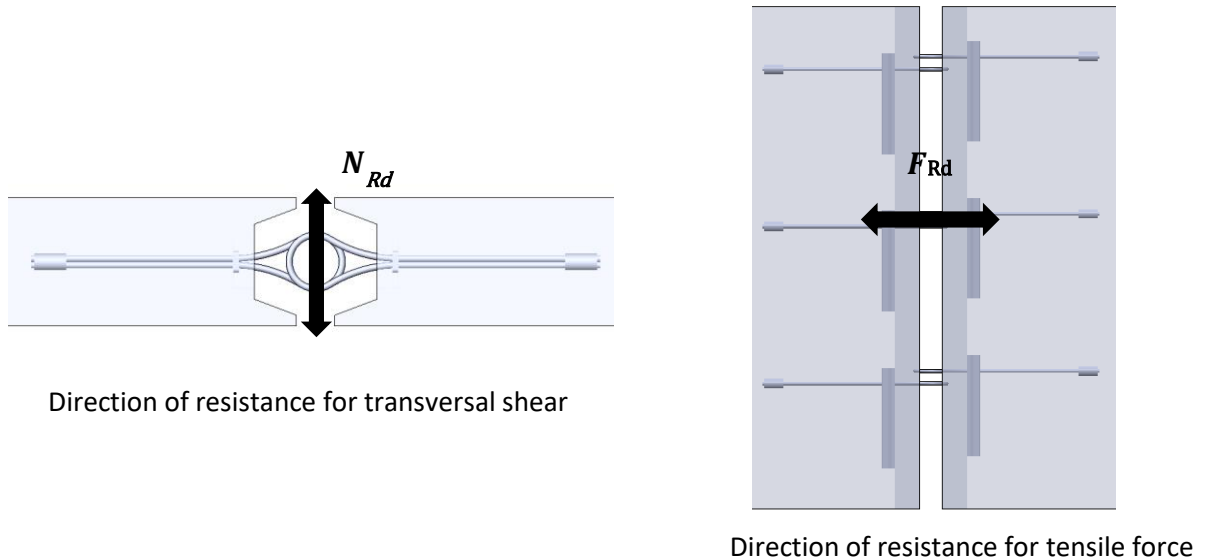


Figure 7 Direction of resistance for transversal shear and tensile force.

Table 8 resistance for transversal shear and tensile force of the STARCON WIREBOX

Type	Resistance of transversal shear force [Ton] N_{Rd}		Resistance of tensile shear force [Ton] F_{Rd}	
	C25/30	C40/50	C25/30	C40/50
650190W060	4,6	0,59	1,32	1,32
650190W080	0,84	1,05	1,32	1,32
650190W100	0,84	1,05	1,32	1,32
650190W120	0,84	1,05	1,32	1,32
650190W140	0,84	1,05	2,36	2,36

Resistance of STARCON WIREBOX joint for combined forces may be calculated according to equation:

$$\frac{V_{Ed}}{V_{Rd}} + \frac{N_{Ed}}{N_{Rd}} + \frac{F_{Ed}}{F_{Rd}} \leq 1$$

In which

- V_{Ed} = design value of longitudinal shear force.
- V_{Rd} = design value of resistance for longitudinal shear force.
- N_{Ed} = design value of transversal shear force.
- N_{Rd} = design value of resistance for transversal shear force.
- F_{Ed} = design value for tensile force.
- F_{Rd} = design value of resistance for tensile force.

Table 8 Resistance for transversal shear and tensile force of the STARCON WIREBOX.

13 General safety information when using the Starcon system.

General safety information when using the Starcon system.



- Ensure that the marking on the Starcon lifting unit always points in the direction of pull during lifting.
- The lifting machine must be approved to lift at least the maximum applied load + the weight of the Starcon lifting and handling system + any hoisting accessories.
- Lifting movements must be smooth; no sudden or abrupt changes in direction with the lifting machine should be made during a lifting operation, as this can lead to pendulum movements of the load, causing crushing hazards or dropping of the load.
- Where there is a risk of crushing between the load and objects, building parts, machinery, etc., the operator must not be in the danger zone.
- The operator's work area must be flat and free of obstacles that could pose a tripping hazard.
- When depositing the load, the operator must ensure this accepts on a flat and stable surface.
- Only when the load has been deposited and secured the Starcon lifting unit is completely unloaded may it be released and lifted free.
- Before each lift, ensure that both the Starcon lifting unit and the Starcon lifting anchor embedded in the concrete product are free from dirt that could reduce grip.
- Never insert arms or feet under a concrete product.
- Concrete products must never be dragged, only lifted.
- No modifications to the Starcon lifting and handling system may be made without written permission from the manufacturer.
- The operator must always ensure that the connection between the lifting machine and/or any hoisting accessories and the Starcon lifting unit is correct and secured against unintentional detachment.
- The operator must always ensure that the connection between the Starcon lifting unit and the Starcon lifting anchor is correct and secured against unintentional detachment.
- Keep a safe distance and never walk under a suspended load.
- Use gloves, safety shoes and other PPE when handling.
- Never use a Starcon lifting and handling system that has visible defects such as wear, deformations, rust damage, etc.
- Most anchors are designed to be easily handled during installation without the need for lifting equipment. However, some anchors may weigh more and should be handled using lifting equipment. Please refer to the order list for the accurate weight of each product.

13.1 Personal Protection

Always use gloves, a safety helmet, and safety shoes as a minimum requirement when operating the equipment. Keep hands and other body parts away from the lifting stand, lifting accessories, and the load during use.



13.2 Preparation of the product before use

13.2.1 Transport and Storage

Anchors should be transported and stored safely to prevent risks to personnel and nearby objects.

13.2.2 Unpacking

Remove the pallet and packaging protecting the anchors.

Cut the safety straps. The person unpacking should wear gloves, safety shoes, and safety glasses when cutting the straps.

13.2.3 Safe Disposal of Packaging Materials

All packaging used by Certex Denmark can be reused. Pallets and all wooden packaging can be reused or recycled.

All plastic, cardboard, and paper materials should be sent to the local recycling center.

If there are no local recycling facilities, the packaging should be returned to Certex Denmark for disposal at the customer's expense.

13.2.4 Preparatory Work Before Installation

After unpacking, visually inspect the anchors for any damage.

13.2.5 Installation and Assembly

The anchors are delivered ready for use.

13.2.6 Storage and Protection Between Periods of Normal Use

Inspect the anchors before each use and lift. Never use anchors or lifting accessories with visible defects such as wear, deformations, corrosion damage, etc.

Always store the lifting bar indoors, in a dry and ventilated area.

13.2.7 Provision of Information (Users, Operators, Service Experts)

All operators or individuals within the danger zone must receive information on operating the anchors and must be trained by the supervisor, familiarizing themselves with the product and its use before lifting operations commence.

Operators must be trained in the use of the lifting bar and all its functions and positioned to have a clear view of the entire lifting operation.

13.2.8 Placement of Instruction

All user manuals should always be stored together with the lifting bar.

14 Maintenance and inspection

- All maintenance must be performed when the Starcon lifting unit is unloaded.
- The Starcon lifting unit should be inspected and maintained to ensure it remains in proper condition during use.
- After each use, the Starcon lifting unit should be cleaned and inspected for any faults or deficiencies.
- If any faults are found, they must be rectified, or the Starcon lifting unit should be discarded.
- The Starcon lifting unit should always be stored in a dry and well-ventilated area.
- Any damaged, corroded, or worn-out Starcon lifting unit must be immediately taken out of service and marked not be used again.
- Equipment from Starcon should undergo at least one annual inspection by a qualified skilled person to inspect lifting equipment and cranes.

14.1 Maintenance Schedule



- Only original spare parts may be used, and they must be replaced by a trained individual.
- The annual inspection must be carried out by a qualified individual who has received the necessary training and certification for lifting equipment.
- All services must be documented, and the data must be stored.
- If there are any visual defects or if the labeling is not present on the lifting stand, the lifting stand must be marked as "out of service".

- B** Before use
- A** After use
- M** Monthly, or a maximum of 200 hours of usage.
- Y** Annually, or after a maximum of 2400 hours of use.

Inspection	B	A	M	Y
Perform a visual inspection to check for signs of overload, deformation, damage, wear, and corrosion.	X	X	X	X
The equipment must undergo inspection.			X	
Ensure that the equipment is ready and clearly labeled.			X	X
Inspection should be carried out by a qualified individual with a report prepared.				X

Table 9 Maintenance schedule

15 Disposal / Recycling

This section describes the end of use for the product.

- End of use / Disposal The lifting points shall be sorted / scrapped as general steel scrap.
- The Starcon lifting and handling system should be sorted and disposed of according to appropriate material categories, including metal, plastic, etc.
- Certex can assist you with disposal if required.

16 Product data of Wire box

Figure 8 shows a measurement sketch for the Wire box with labels for the respective dimensions.

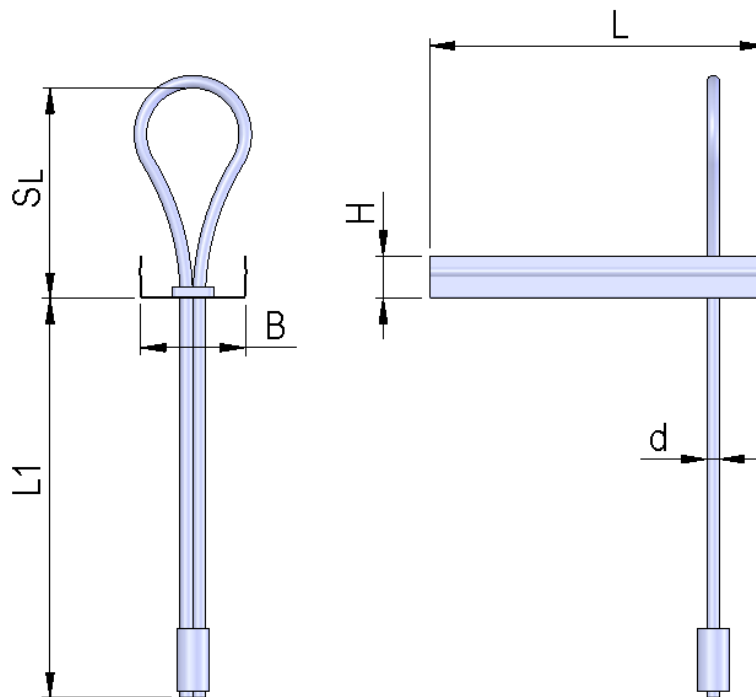


Figure 8 Wire box.

16.1 Technical data

Table 10 shows the dimensions of the various types of Wire box.

Type	Box length L mm	Box height H mm	Box width B mm	Wire length L1 mm	Wire depth S _L mm	Wire dia. d mm
650190W060	160	20	50	190	60	6
650190W080	160	20	50	190	80	6
650190W100	160	20	50	190	100	6
650190W120	160	20	50	190	120	6
650190W140	200	20	70	190	150	9

Table 10 Wire box dimension.

17 EC – Declaration of Conformity of the Machinery

This certificate meets the requirements of the Directive 2006/42/EC Annex II.

Manufacturer and responsible for compiling the technical documentation:

Company:	CERTEX Danmark A/S	Tel. No.:	+45 74 54 14 37
Address:	Trekanten 6-8 6500 Vojens Denmark	E-mail:	info@certex.dk

The undersigned hereby declares that the below specified tool comply with the current safety and health rules and legislation within the European Union. If any changes are made on the tool without approval from the manufacturer, this Declaration no longer applies.

Description:	Wire box
Drawing No.:	XXXXXXXXXXXXXXXX
Serial No.:	XXXXXX
Lifting Capacity:	WLL pr unit
Own Weight:	Kg pr unit

Is made in accordance with the following EC-directive;
2006/42/EC

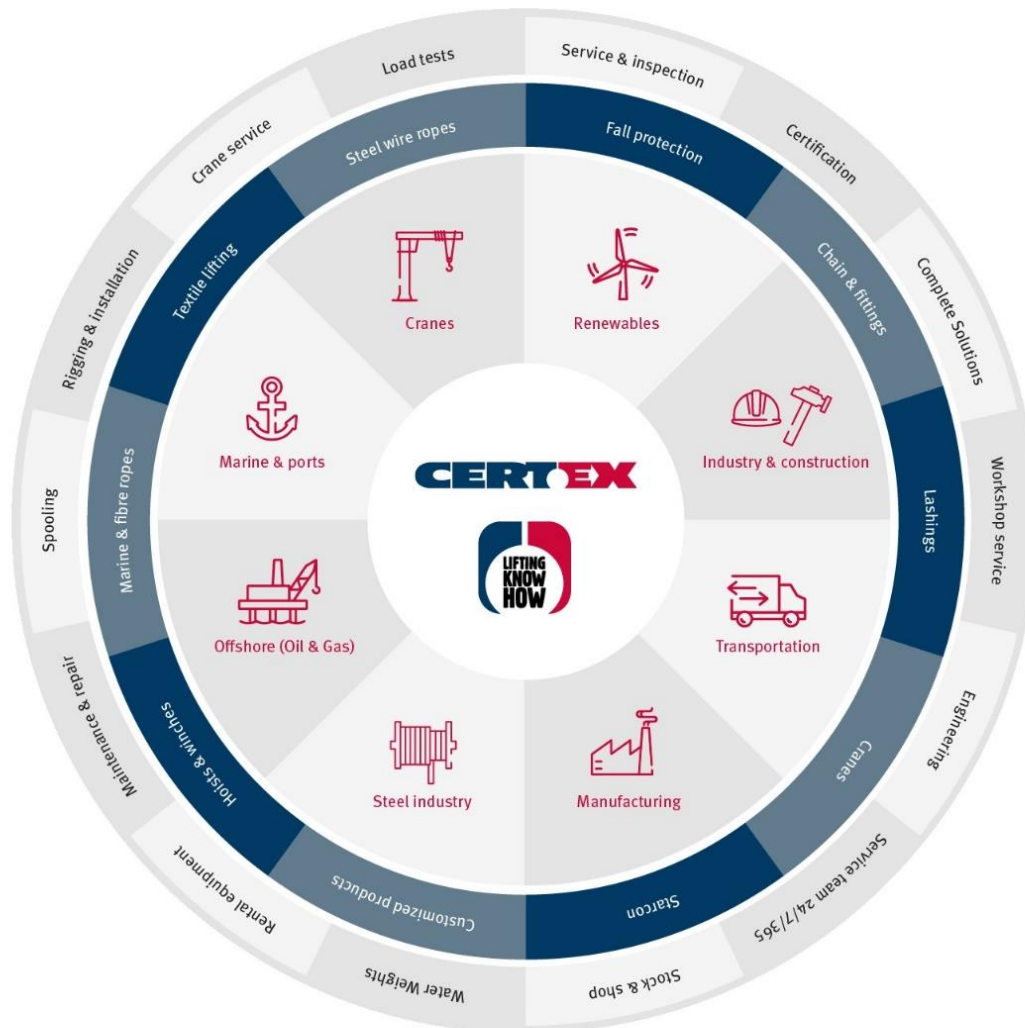
The following standards have been used:
EN 13155+A2 : 2009

Date:

For CERTEX Danmark A/S

Our industries, products & services

At CERTEX Denmark, we are a secure and reliable total supplier and partner within lifting equipment. Below is an overview of the industries we service, our product range, and the services we offer."



"

**Based on many years of experience
& know-how within lifting, load
tests & engineering, CERTEX
Denmark is your reliable partner &
supplier of steel wire, lifting
applications & related services."**