EUROPEAN ASSESSMENT DOCUMENT

EAD 330080-00-0602

June 2015

HIGH SLIP RESISTANCE CLAMP (HSR) ASSEMBLY

www.eota.eu

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

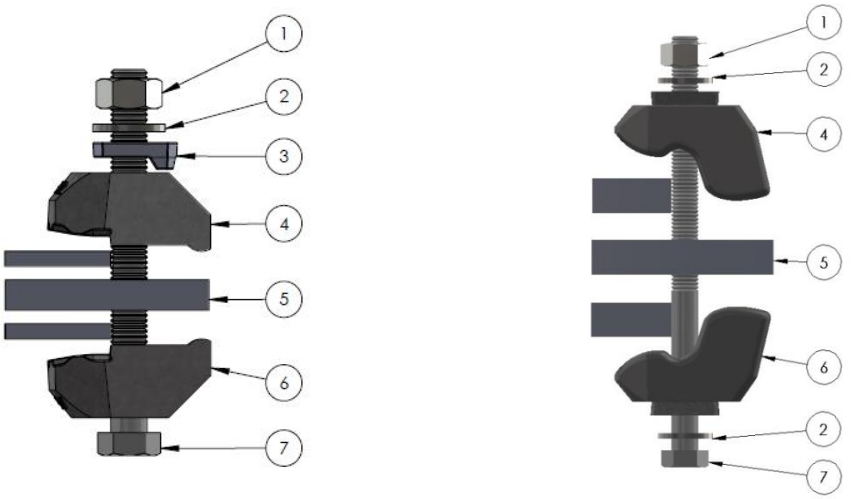
Contents

1. Scope of the EAD

1.1 Description of the Construction Product

The High Slip Resistance (HSR) Clamp Assembly is a fastener that clamps together steel components such as flanged beams without the need to drill holes in either connected component. The components of the construction product include the HSR clamps, a special washer, a fastener assembly (bolt, nut and washer or a bolt, nut and direct tension indicator (DTI)), a location plate and packing pieces where necessary. Additional proprietary locking devices may be used if required. A typical assembly of the types of HSR clamps are shown in *Figure 1*.

Figure 1: Typical Type 1 and Type 2 HSR Clamp Assembly



Type 1 HSR Clamp **Type 2 HSR Clamp**

1 Hexagonal Nut
2 Plain Washer
3 Special Washer (Type 1 only)
4 HSR Clamp
5 Location plate
6 HSR Clamp
7 Hexagon Bolt/setscrew

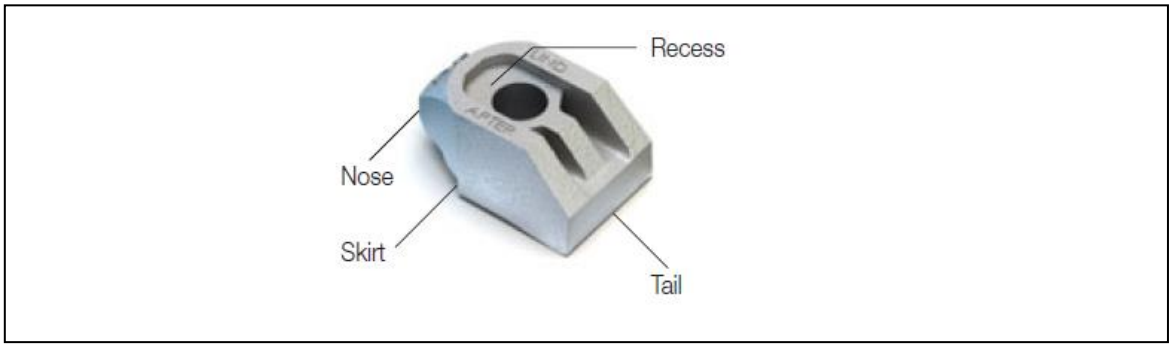
a) Type 1 HSR Clamp

The HSR clamp is a device with a recess and a through hole whereby a bolt is passed through. See *Figure 2*. The recess captivates a bolt head and prevents rotation of the bolt during tightening.

A typical HSR clamp has a vertical flat portion on the underside of the clamp, commonly known as a 'skirt' that butts up against the edge of the beam flange to prevent rotation of the clamp during installation.

At the back of the clamp is a 'tail' that spans along the full width of the clamp. The tail sits on top of the location plate and can span across slotted holes. The clamp has a profiled nose at the front to accommodate tapered beam flanges and teeth running from front to back on the underside of the nose to resist sideways movement. There are reinforcing ribs at the rear of the HSR clamp to increase strength.

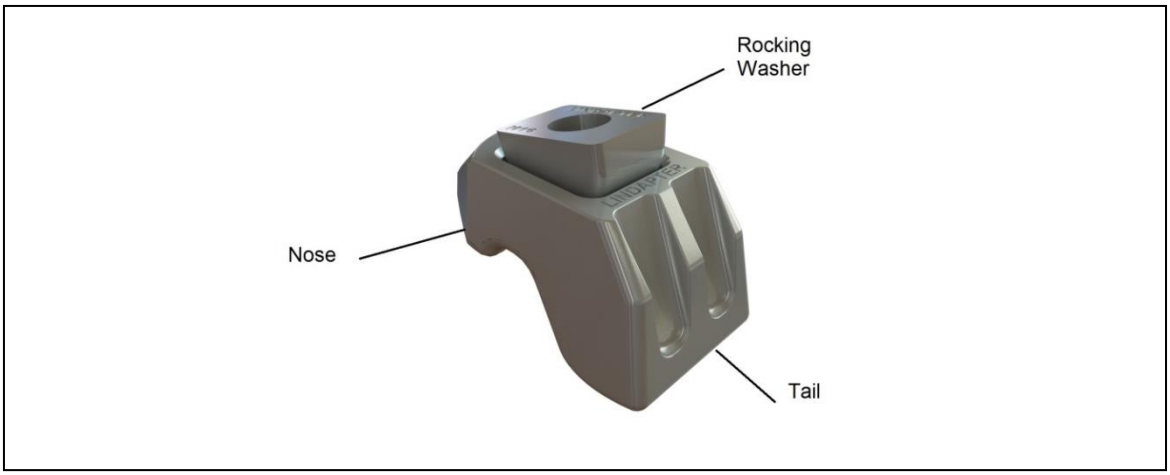
Figure 2: Type 1 HSR Clamp



b) Type 2 HSR Clamp

The HSR clamp is a fully adjustable clamp with a curved recess in the top that allows a mating rocking washer with a flat top to sit in the recess and articulate backwards and forwards to accommodate various flange thicknesses whilst allowing the bolt to remain in a vertical position. See *Figure 3*. At the back of the clamp is a curved 'tail' that spans along the full width of the clamp. The tail sits on top of the location plate and pivots to allow clamping of different thicknesses of flange and can span across slotted holes. The clamp has a profiled nose at the front to accommodate tapered beam flanges and teeth running from front to back on the underside of the nose to resist sideways movement. There are reinforcing ribs at the rear of the HSR clamp to increase strength.

Figure 3: Type 2 HSR Clamp



Special Washer (for use with Type 1 HSR Clamp only)

A special washer when positioned into the recess of the Type 1 HSR clamp converts it to a flat top clamp allowing a washer (or a DTI) and a nut to sit flush. On the underside of some sizes of special washer are two projections which when the special washer is inverted will captivate a larger bolt head (structural bolt assemblies to EN 14399-1).

Location Plate

The location plate is a square or rectangular piece of steel of calculated thickness, with pre-determined drilled holes. The plate is used to provide a connection between beams. The plate protrudes beyond the beam flanges with the bolt holes positioned on the overlaying edges. It is an essential part of the assembly and enables all of the components to be located in the correct position.

Packing Pieces

Packing pieces are square pieces of steel with a through hole at the edge for the bolt to pass through. They are positioned in between the clamp and the location plate and are used to adjust the tail length of the clamp to meet differing beam flange thicknesses. They can be used with either a Type 1 or Type 2 HSR clamp.

Fastener Assembly

The carbon and alloy steel fastener assembly comprises of a hexagonal bolt, nut and washer or a hexagon bolt, nut and DTI. Mechanical properties of the fasteners are specified in EN ISO 898-1:2013, enabling the use of fasteners of property classes 8.8 and 10.9.

The product is not covered by a harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the Intended Use(s) of the Construction Product

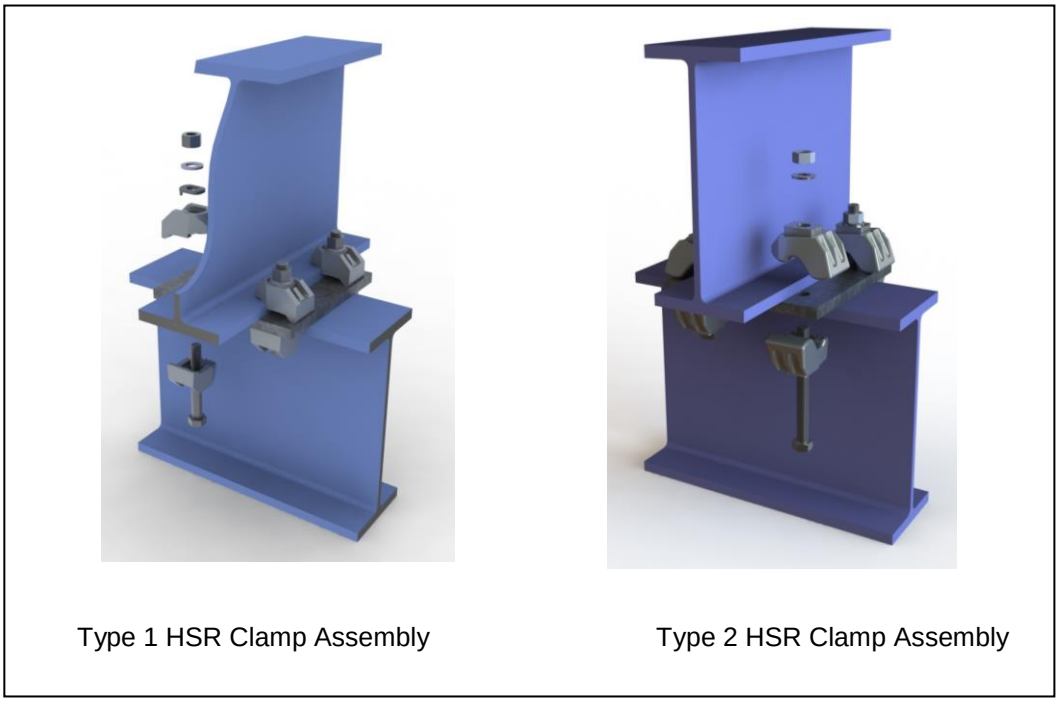
1.2.1 Intended Use(s)

The HSR Clamp Assembly is intended to secure steelwork fixtures to structural members (beams, columns using I sections, channels, etc.). The assembly may be required to resist tensile forces (i.e. forces tending to separate the structural components) or lateral forces, or a combination of the two. In some cases the assembly may also be required to resist dynamic forces.

The HSR Clamp Assembly is intended to be used for both temporary and permanent structures.

As a typical example, a connection is shown that clamps two I section beams using four Type 1 and Type 2 HSR Clamp Assembly. See *Figure 4*.

Figure 4: Beam to Beam Connection Utilizing Four HSR Clamp Assembly



Type 1 HSR Clamp Assembly Type 2 HSR Clamp Assembly

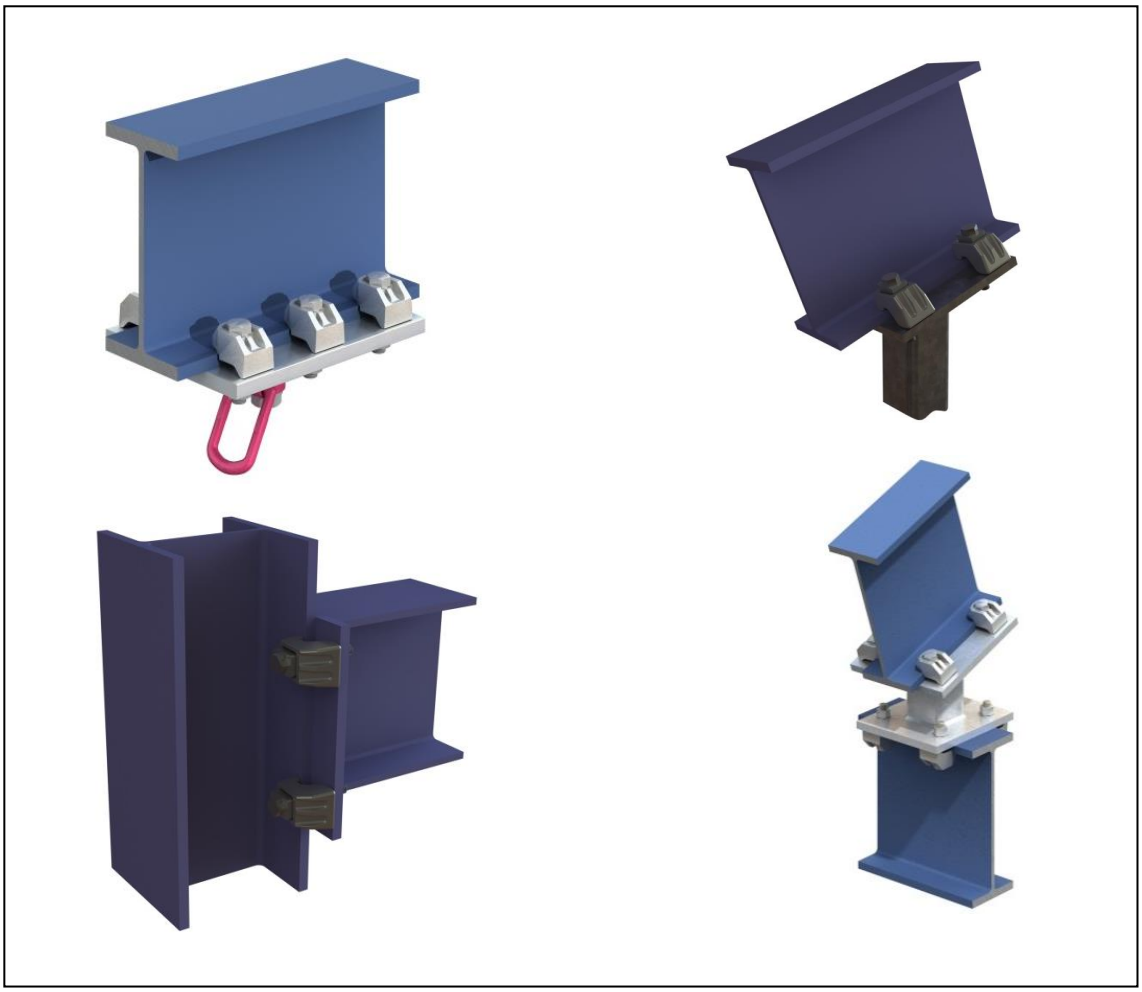
The location plate shown has four bolt holes on the overlaying edges. The clamps are positioned over the predrilled holes of the location plate with the nose of the clamp in contact with the beam flange and the tail in contact with the location plate. Bolts are passed through the holes in the bottom clamp (or top clamp depending on preference) and location plate. If using a Type 1 HSR clamp the bolt head sits in the recess of the clamp, preventing rotation of the bolt during tightening. A special washer may be located in the recess of the opposite clamp thus converting the recessed clamp into a flat top clamp. This allows a standard hardened washer and nut to be threaded onto the bolt and tightened. If required

packing pieces can be supplied in order to increase the clamping range. If using a Type 2 HSR clamp, the bolt head, nuts and washers will sit on top of the rocking washer. The bolt head will need to be restrained during tightening.

Tightening each assembly to a defined procedure will achieve preload in the bolts and the connection will possess tensile resistance and slip resistance (preventing relative movement between the connected components).

Other arrangements and combinations are possible. See *Figure 5*.

Figure 5: Other Typical Connections Using HSR Clamp Assembly



1.2.2 Working Life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the HSR Clamp Assembly for the intended use of 25 years when installed in the works (provided that the HSR Clamp Assembly is subject to appropriate installation. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting

1 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

1.3.1 $F_{t,Rk}$

Characteristic value of tension resistance as defined in section 2.2.1

1.3.2 $F_{t,Rd}$

Design value of tension resistance as defined in section 2.2.1.1

1.3.3 $F_{s,Rk}$

Characteristic value of slip resistance as defined in section 2.2.2

1.3.4 $F_{s,Rd}$

Design value of slip resistance as defined in section 2.2.2.1

2 Essential characteristics and relevant assessment methods and criteria

2.1 Essential characteristics of the product

Table 1 shows how the performance of the HSR Clamp Assembly is assessed in relation to the essential characteristics.

Table 1: Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No.	Essential Characteristic	Assessment Method	Type of Expression of Product Performance *(level, class, description)*
Basic Works Requirement 1: Mechanical Resistance and Stability			
1	Tensile Resistance of Assembly	2.2.1	$F_{t,Rk}$ [kN] $F_{t,Rd}$ [kN]
2	Slip Resistance of Assembly	2.2.2	$F_{s,Rk}$ [kN] $F_{s,Rd}$ [kN]
3	Design Resistance for Combined Tension and Shear Forces	2.2.3	Pass/fail
4	Design Resistance for Dynamic Loading	2.2.4	Pass/fail
5	Mechanical Properties of the Cast Iron Components	2.2.5	Pass/fail
6	External and Internal Soundness of the Cast Iron Components	2.2.6	Pass/fail
7	Mechanical Properties of the Carbon Steel Components	2.2.7	Pass/fail
8	Mechanical Properties of the Fastener	2.2.8	Pass/fail
Basic Works Requirement 2: Safety in Case of Fire			
9	Reaction to Fire	2.2.9	Class
Basic Works Requirement 4: Safety and Accessibility in Use			
10	Tensile Resistance of Assembly	2.2.1	$F_{t,Rk}$ [kN] $F_{t,Rd}$ [kN]
11	Slip Resistance of Assembly	2.2.2	$F_{s,Rk}$ [Kn] $F_{s,Rd}$ [Kn]
12	Design Resistance for Combined Tension and Shear Forces	2.2.3	Pass/fail
13	Design Resistance for Dynamic Loading	2.2.4	Pass/fail
14	Mechanical Properties of the Cast Iron Components	2.2.5	Pass/fail
15	External and Internal Soundness of the Cast Iron Components	2.2.6	Pass/fail
16	Mechanical Properties of the Carbon Steel Components	2.2.7	Pass/fail
17	Mechanical Properties of the Fastener	2.2.8	Pass/fail
Other requirement			
18	Durability	2.2.10	To EN ISO 9223

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

2.2.1 Tensile Resistance of the Assembly

At least four tests shall be carried out for each nominal bolt size as described in EN 1990 Annex D. The bolts shall be tightened with a torque moment specified for each bolt type and size or DTI washers may be used to determine bolt preload. The test load shall be increased until failure of at least one bolt or clamp occurs. The respective failure modes for each nominal size of bolt shall be documented in the test report.

The material properties are to be documented using inspection documents 3.1, according to EN 10204. The material properties shall correspond to the material specifications given by the manufacturer.

An example for the test principle is shown in Annex A1.

The results of the tests, according to 2.2.1.1 (failure loads), shall be evaluated statistically (determination of the 5% fractile, confidence level 75%). Generally a normal distribution can be assumed.

The corrected and statistically evaluated test results (5% fractile) of the tests according to 2.2.1 are the characteristic values of the tension resistance of the assembly, $F_{t,Rk.}$

2.2.1.1 Determination of Design Tension Resistance

The design values $F_{t.Rd}$ of the tension resistance are the characteristic values of the tension resistance according to 2.2.1 divided by the recommended partial safety factor γ_M given in the national regulations of the Member State where the HSR clamps are to be used. In cases where no value is given then γ_M = 1.33 should be used.

2.2.2 Slip Resistance of the Assembly

At least four slip tests shall be carried out for each nominal bolt size as described in EN 1990 Annex D. The bolts shall be tightened with a torque moment specified for each size or DTI washers may be used to determine bolt preload. The test load shall be increased until slipping of the assembly of > 0.1 mm, failure of at least one bolt or clamp occurs. The respective failure modes for each nominal size of bolt shall be documented in the test report.

The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties shall correspond to the material specifications given by the manufacturer.

The results of the test according to 2.2.2.1 (failure loads) shall be evaluated statistically (determination of 5% fractile, confidence level 75%). Generally, a normal distribution can be assumed.

The corrected and statistically evaluated test results (5% fractile) of the tests according to 2.2.2 are the characteristic values of slip resistance of the assembly, $F_{s,Rk.}$

2.2.2.1 Determination of Design Slip Resistance

The design values $F_{s.Rd}$ of the slip resistance are the characteristic values of the slip resistance according to 2.2.2 divided by the recommended partial safety factor γ_M given in the national regulations of the Member State where the HSR clamps are to be used. In cases where no value is given then γ_M = 1.33 should be used.

An example for the test principle is shown in Annex A2.

2.2.3 Design Resistance for Combined Tension and Shear Forces

The characteristic values of resistance under combined tensile and shear shall be calculated according to EN 1993-1-8.

2.2.4 Design Resistance for Dynamic Loading

Long term experience has shown that HSR clamp assemblies under dynamic loading fail due to failure of the bolts.

An appropriate fatigue assessment method, according to EN 1993-1-9, will be used to ascertain acceptable reliability of the clamp assembly, based on the specified design life of the product. A pass/fail outcome will be stated.

2.2.5 Mechanical Properties of the Cast Iron Parts

The mechanical properties of the cast iron parts shall be proved by an inspection certificate 3.1 according to EN 10204 and shall be in accordance with EN 1562 for malleable cast iron and EN 1563 for spheroidal graphite cast iron.

2.2.6 External Soundness of the Cast Iron Parts

The external and internal soundness of the cast iron parts shall be verified by visual inspection.

2.2.7 Mechanical Properties of the Carbon Steel Parts

The mechanical properties of the carbon steel parts shall be proved by an inspection certificate 3.1 according to EN 10204 and shall be in accordance with EN 10025-1.

2.2.8 Mechanical Properties of the Structural Fasteners

The mechanical properties of the fasteners shall be proved by an inspection certificate 3.1 according to EN 10204 and shall be in accordance with EN 14399-1, 15048-1 and EN ISO 898.

2.2.9 Reaction to Fire

The product shall be classified according to Commission Delegated Regulation (EU) 2016/364. The High Slip Resistance Clamp Assembly is considered to satisfy the requirements for performance Class A1 of the characteristic reaction to fire, in accordance with the Decision 1996/603/EC (as amended) without the need for further testing on the basis of its conformity with the specification of the product detailed in that Decision and its intended end use being covered by that Decision.

2.2.10 Durability

The product shall have a verified durability expressed as a Corrosivity Classification (C1 to C5) in accordance with EN ISO 9223. The durability of the product in relevant environmental conditions shall be stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European Legal Act is: Decision 1997/176/EC.

The System is: **2+**

3.2 Tasks of the Manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2: Control Plan for the Manufacturer; Cornerstones

No.	Subject/Type of Control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or Control Method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum Number of Samples	Minimum Frequency of Control
Factory Production Control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	Check of material properties stated in the ETA	Inspection document 3.1 according to EN 10204 (to be - furnished by the supplier)	as stated in the ETA	-	Inspection level criteria in accordance with EN ISO 2859-1
2	Geometry and dimensions	Check of geometry, dimensions and tolerances	as stated in the ETA	As per QMS	Inspection level criteria in accordance with EN ISO 2859-1
3	External and internal soundness of cast iron parts	Check according to test plan	as stated in the ETA	As per QMS	Inspection level criteria in accordance with EN ISO 2859-1
Initial Type Testing (ITT)					
4	Check of material properties stated in the ETA	Inspection document 3.1 according to EN 10204 (to be - furnished by the supplier)	as stated in the ETA	-	When starting the production or a new production line
5	Geometry and dimensions	Check of geometry, dimensions and tolerances	as stated in the ETA	4	When starting the production or a new production line
6	External and internal soundness of cast iron parts	Check according to test plan	as stated in the ETA	4	When starting the production or a new production line

3.4 Tasks of the Notified Body

The cornerstones of the actions to be undertaken by the Notified Body in the procedure of assessment and verification of constancy of performance for the HSR Clamp Assembly is laid down in Table 3.

Table 3: Control Plan for the Notified Body; Cornerstones

No.	Subject/Type of Control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or Control Method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum Number of Samples	Minimum Frequency of Control
Initial Inspection of the Manufacturing Plant and of Factory Production Control ***(for Systems 1+, 1 and 2+ only)***					
1.	Inspection of Factory and Factory Production Control	-	-	-	Before Certification
2.	Inspection of Manufacturers Test Facility	-	-	-	Before Certification
Continuous Surveillance, Assessment and Evaluation of Factory Production Control *(for systems 1+, 1 and 2+ only)*					
1.	Surveillance of Factory and Factory Production Control	-	-	-	2/Year
2.	Surveillance of Manufacturers Test Facility	-	-	-	2/Year

4. REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EN 1090-2	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
EN 1562	Founding - Malleable cast iron
EN 1563	Founding - Spheroidal graphite cast iron
EN 1993-1-8	Eurocode 3: Design of steel structures- Part 1-8: Design of Joints
EN 1993-1-9	Eurocode 3: Design of steel structures- Part 1-9: Fatigue
EN 10025-1	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10204	Metallic products - Types of inspection documents
EN 14399-1	High-strength structural bolting assemblies for preloading- Part 1: General requirements
EN 15048-1	Non preloaded structural bolting assemblies
EN ISO 898-1	Mechanical properties of fasteners made of carbon and alloy steel
EN ISO 1461	Hot Dip Galvanising and Chromate Passivate
EN ISO 2859-1	Part Sampling schemes indexed by AQL for Lot-by- Lot inspection
EN ISO 9223	Corrosion of metals and alloys
EN 1990	Basis of structural design

ANNEX A – SUITABILITY TEST FOR BLIND FASTENING

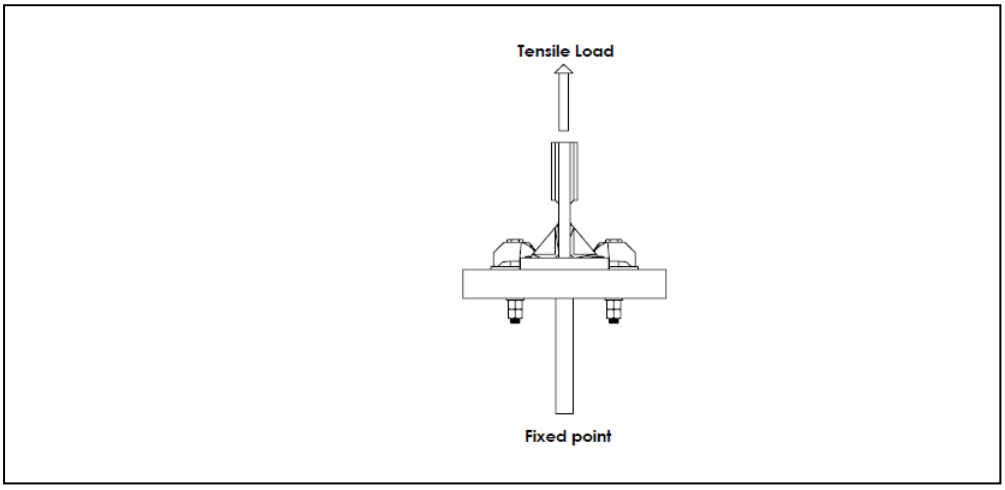
A.1: Tensile Test of the HSR Clamp Assembly

The intention of the design of the assembly is to provide a connection that would, after installation in accordance with a defined procedure, resist a tensile load that is at least equal to the characteristic tensile resistance of the HSR clamp determined in accordance with 2.2.1.

During initial type testing, the suitability test shall be carried out on the standard two bolt assembly, (with the result multiplied by two in order to simulate a four bolt assembly) and installed in accordance with the installation procedure that is to be specified in the ETA. At least four tests shall be carried out for each nominal size.

The results of the initial type testing shall be evaluated to demonstrate that the minimum tensile failure load of the installed assembly (the maximum load sustained during a test to failure) is at least the value specified in the ETA. The ETA shall specify the minimum information to be included in the test documentation.

Figure 6: Test Rig showing the Arrangement for a two Bolt Assembly



A.2: Slip Test of the HSR Clamp Assembly

The intention of the design of the assembly is to provide a connection that would, after installation in accordance with a defined procedure, resist a load that is at least equal to the characteristic slip resistance of the HSR clamp, determined in accordance with 2.2.2.

During initial type testing, the suitability test shall be carried out on a standard four bolt assembly and installed in accordance with the installation procedure that is to be specified in the ETA. A minimum of four tests should be carried out for each nominal size.

The results of the initial type test shall be evaluated to demonstrate that the minimum slip resistance load of the installed assembly is at least the value specified in the ETA.

Figure 7: Slip Test Arrangement