MFPA Leipzig GmbH

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Construction Products and Construction Types

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Object: Pipe clamps FRS-L M8/M10 Universal in span ranges 8-11 to 164-172
Advisory opinion on the load bearing and deformation behaviour under thermal exposure by the standard temperature-time curve (ETK) according to DIN EN 1363-1

Client: **fischerwerke GmbH & Co. KG**
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This document covers 23 pages, including 3 appendices.

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I Objective and request

MFPA Leipzig GmbH was ordered by fischerwerke GmbH & Co. KG at March 27th 2018 to prepare an advisory opinion regarding the load bearing behaviour and the deformation behaviour of pipe clamps FRS-L M8/M10 Universal in the span ranges 8-11 to 164-172 exposed to fire according to the standard temperature-time curve (ETK) [N1]. The aim is the identification of the characteristic load bearing capacity under tensile load in case of fire as well as the description of the occuring deformation behaviour.
The load bearing behaviour in case of fire was already described in [G2] basing on the test results in [G1] for the span ranges 8-11 to 111-119. The respective data from [G1] is considered in the framework of the document at hand. The analysis of the load bearing behaviour in case of fire for the span ranges 120-129 to 164-172 is carried out basing on the test results in [G3].

II Description of the construction

The pipe clamps FRS-L M8/M10 Universal are two-screw pipe clamps with a combination connection thread. They are produced of two metal strips of electrogalvanised steel according to [N2] (material number 1.0332), which possess a pre-assembled EPDM sound insulation lining. The terminal nut for thread dimensions M8/M10 is welded onto the top edge of the clamp. The two metal strips are connected on both sides with a locking screw, at which one of them is a floating single screw. An overview on the product line is given in Annex A1.
In coincidence with [N3], the division of the product line into sub-groups is carried out by means of the geometry of the clamp strip. Thus, 4 sub-groups may be defined:

- group 1: span range 8-11 to 31-37,
- group 2: span range 38-45 to 60-66,
- group 3: span range 67-75 to 111-119,
- group 4: span range 120-129 to 164-172.

According to [N3], at least the largest dimension has to be tested for each sub-group. The test results may be transferred to products of the same sub-group with smaller dimensions. Hence, tests were carried out for the pipe clamps with span range

- 31-37 (see [G1]),
- 60-66 (see [G1]),
- 111-119 (see [G1]),
- 164-172 (see [G3]).

For testing, threaded rods M8 with strength class 4.8 and suspension height 500mm are utilized. Regarding test arrangement and test procedure, please see [G1, G3].

III Fire protection assessment

The assessment of the pipe clamps FRS-L M8/M10 Universal with respect to fire protection includes the identification of the characteristic load bearing capacity under tensile load in case of fire, depending on the fire resistance period as well as the derivation of minimum distances between pipe clamps and structural members, relevant for fire protection. In addition, the maximum load is determined, so that a deformation of $a = 50mm$ is not exceeded after 30 minutes of fire loading.
The evaluation of the test results for the determination of the characteristics pointed out is done according to the requirements of [N3].
The minimum distances *min. a* refer to the deformation of the entire construction, consisting of pipe clamp and threaded rod, exposed to fire. Additional deformations effected by installations (e.g. pipes) have to be investigated seperately.
Since the elongation due to mechanical loading of the same quantity is smaller for threaded rods M10 compared to threaded rods M8 (larger cross section), the transfer of the determined values to constructions with threaded rods M10 is possible (safe side). The same holds true for threaded rods M8 and M10 with strength classes > 4.8.

1 Characteristic tensile strength

In Annex A2, a graphical analysis of the test results from [G1, G3] with respect to the time-dependent load bearing capacity as well as the fire resistance curve determined according to the requirements of [N3] is shown for each sub-group. The resulting values of characteristic tensile strength (centrical tension) depending on the fire resistance period are summarized in Table 1.

FRS-L M8/M10 Universal		Fire resistance period [*min*]			
Span range	Nominal size	30	60	90	120
[*mm*]	[*inch*]	F_{Rk} [*kN*]			
8-11		0,27	0,14	0,09	0,07
12-15	1/4"				
16-19	3/8"				
20-24	1/2"				
25-30	3/4"				
31-37	1"				
38-45	1 1/4"	0,29	0,14	0,09	0,06
46-52	1 1/2"				
53-59					
60-66	2"				
67-75		0,58	0,38	0,29	0,24
76-84	2 1/2"				
85-93	3"				
94-100					
101-110					
111-119	4"				
120-129		0,42	0,31	0,25	0,22
130-137					
138-145	5"				
146-155					
156-163					
164-172	6"				

Table 1: Pipe clamps FRS-L M8/M10 Universal: Characteristic tensile strength (centrical tension) F_{Rk} [*kN*] depending on the fire resistance period

The results indicated in Table 1, according to [N4], are limited by the tensile strength F_{zul} at ambient temperature (see [N3], paragraph B-3.2.2.1.4).

2 Minimum distances

For the application of the pipe clamps FRS-L M8/M10 Universal in the intermediate ceiling area of suspended ceiling constructions that are relevant with respect to fire protection, a minimum distance *min. a* between

the upper surface of the suspended ceiling and the bottom side of the pipe clamp is defined (see Figure 1). The aim is the preclusion of adverse effects on the suspended ceiling construction due to thermal vertical deformations of the pipe clamps and the threaded rods.

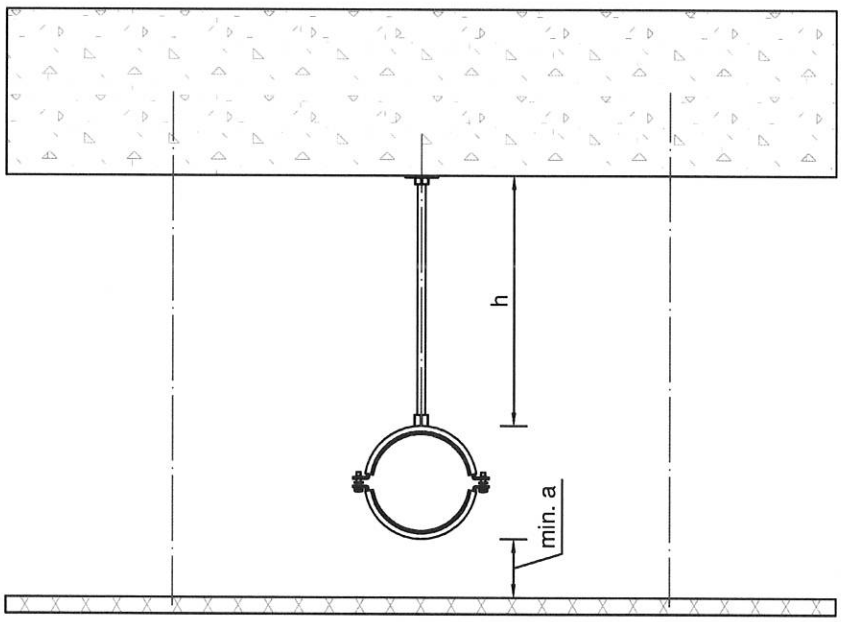

Figure 1: Application of pipe clamps FRS-L M8/M10 Universal in intermediate ceiling area: Schematic representation

The minimum distances *min. a* are determined under consideration of the maximum vertical deformations observed in the tests (independent from the time of failure, see [G1, G3]) and the temperature-dependent length change of the utilized threaded rods. Beeing on the safe side, the length change of threaded rods with $h \geq 500mm$ ($\geq$ tested length) is calculated under consideration of the thermal deformation $\frac{\Delta l}{l}$ according to [N5], chapter 3.4.1.1 for $t = 120min$ ($T(t)$ from ETK), since this point of time is the maximum fire resistance periode dealt with in the framework of the document at hand. For threaded rods with $h < 500mm$, the quantity of $\frac{\Delta l}{l}$ according to [N5], chapter 3.4.1.1 for $t = 30min$ is used.
The minimum distances specified in Table 2 are valid, provided that in case of fire the maximum loads according to Table 1 are not exceeded.

FRS-L M8/M10 Universal		Suspension height [mm]			
Spannbereich	Nenngröße	$h \leq 250$	$h \leq 500$	$h \leq 750$	$h \leq 1000$
[mm]	[$Zoll$]	$min.\ a$ [mm]			
8-11		54	57	61	64
12-15	1/4"				
16-19	3/8"				
20-24	1/2"				
25-30	3/4"				
31-37	1"				
38-45	1 1/4"	72	75	79	82
46-52	1 1/2"				
53-59					
60-66	2"				
67-75		75	78	82	85
76-84	2 1/2"				
85-93	3"				
94-100					
101-110					
111-119	4"				
120-129		65	68	72	75
130-137					
138-145	5"				
146-155					
156-163					
164-172	6"				

Table 2: Pipe clamps FRS-L M8/M10 Universal: Minimum distances $min.\ a$ [mm] to structural members relevant for fire protection

3 Maximum load for $a \leq 50mm$ at $t = 30min$

Since the usable height within the intermediate ceiling area is often limited, the minimum distances, specified in Table 2, cannot always be realised. Therefore, reduced loads are determined for the system at hand, to ensure that for a thermal loading according to ETK for a period of 30 minutes the minimum distance $min.\ a = 50mm$ according to the requirements of [N6] is not fallen below.
Basis for the determination of those values is the analysis of the experimental results of [G1, G3] with respect to the load deformation behaviour

for $0 < t \leq 30min$. In Annex A3, a graphical analysis of the test results as well as the load deformation curve determined according to the requirements of [N3] is shown for each sub-group. Regarding the specimens of group 4 with damaged deformation measuring device (tensile load $N_{fire} = 300N$ and $N_{fire} = 350N$, see [G3]), beeing on the safe side and in agreement with the client, the deformations of the specimen with tensile load $N_{fire} = 380N$ are applied for the analysis.
The resulting maximum loads under consideration of the thermal deformation $\frac{\Delta l}{l}$ of the threaded rods according to [N5], chapter 3.4.1.1 for $t = 30min$ are specified in Table 3.

FRS-L M8/M10 Universal		Suspension height $[mm]$			
Spannbereich	Nenngröße	$h \leq 250$	$h \leq 500$	$h \leq 750$	$h \leq 1000$
$[mm]$	$[Zoll]$	F_{max} $[kN]$			
8-11		0,27	0,26	0,24	0,22
12-15	1/4"				
16-19	3/8"				
20-24	1/2"				
25-30	3/4"				
31-37	1"				
38-45	1 1/4"	0,17	0,16	0,15	0,13
46-52	1 1/2"				
53-59					
60-66	2"				
67-75		0,45	0,45	0,45	0,45
76-84	2 1/2"				
85-93	3"				
94-100					
101-110					
111-119	4"				
120-129		0,40	0,40	0,38	0,36
130-137					
138-145	5"				
146-155					
156-163					
164-172	6"				

Table 3: Pipe clamps FRS-L M8/M10 Universal: Maximum load F_{max} $[kN]$ for $a \leq 50mm$ after 30 minutes of fire loading

IV Restrictions on use

The assessment at hand for pipe clamps FRS-L M8/M10 Universal excludes the utilization for cable systems with integrated functional integrity according to DIN 4102-12: 1998-11 [N7]. For such applications, further assessments and proofs for the overall system are required.
Pipe clamps FRS-L M8/M10 Universal may be used to fasten non-flammable pipes. In accordance with the comments on [N6], flammable pipes with an outer diameter of $d_a \leq 160mm$ may also be utilized if these are encapsulated with non-flammable, alu-foil-laminated insulation shells (melting point $> 1000°C$, thickness $> 30mm$, density approximately 80 - 120$\frac{kg}{m^3}$). The insulation has to be secured with the help of approximately 6 windings of binding wire per metre.

V Special notes

The assessment at hand is valid for pipe clamps FRS-L M8/M10 Universal made of electrogalvanised steel, which are installed in accordance with the mounting instructions in the technical data sheets of fischerwerke GmbH & Co. KG. The assessment becomes invalid, as soon as the basis of valuation changes due to substancial changes of the construction (e.g. material, geometry).

The type of galvanisation has no effect on the fire resistance. Thus, the characteristics pointed out in the framework of the document at hand also apply for pipe clamps FRS-L M8/M10 Universal made of hot-dip galvanised steel, provided that the dimensions of these pipe clamps are identical to those of the pipe clamps at hand.

The assessment at hand is valid in conjunction with threaded rods M8 and M10 with strength class $\geq$ 4.8 and in constructions, which feature at least the fire resistance class corresponding to the fire resistance class of the pipe clamps.

Due to the better high-temperature behaviour of stainless steels, the characteristics pointed out in the framework of the document at hand also apply for pipe clamps and bolts with the same dimensions made of stainless steel A2/A4.

The pipe clamps have to be fixed with fasteners that feature appropriate fire protection verifications.

This document does not replace a certificate of conformity or suitability according to national and European building codes.

Leipzig, den 29.06.2018

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VI References

1 Utilized guidelines, rules and standards

The analyses are based on the following guidelines, rules and standards:

[N1] DIN EN 1363-1:2012-10: Fire resistance tests - Part 1: General Requirements; German version EN 1363-1:2012

[N2] DIN EN 10111:2008-06: Continuously hot rolled low carbon steel sheet and strip for cold forming - Technical delivery conditions; German version EN 10111:2008

[N3] RAL-GZ 656: Fire-tested pipe supports - Quality assurance; RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V., Mai 2010

[N4] RAL-GZ 655: Pipe supports - Quality assurance; RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V., April 2008

[N5] DIN EN 1993-1-2:2010-12: Eurocode 3: Design of steel structures - Part 1-2: General rules - Structural fire design; German version EN 1993-1-2:2005 + AC:2009

[N6] Model guideline for technical fire protection requirements on conduit systems (Model Conduit Systems Guideline MLAR); Fachkommission Bauaufsicht der Bauministerkonferenz, as amended on 10.2.2015

[N7] DIN 4102-12:1998-11: Fire behaviour of building materials and building components - Part 12: Circuit integrity maintenance of electric cable systems; requirements and testing

2 Reference documents

The analyses are based on the following additional documents:

2.1 Assessment and test reports

[G1] Test report Nr. PB 3.2/15-141-1: Rohrschellen FRS-L M8/M10 Universal in den Größen 31-37, 60-66 und 111-119, Prüfung in Anlehnung an RAL-GZ 656 "Brandgeprüfte Rohrbefestigung" (Mai 2010) zur Ermittlung der Tragfähigkeit und des Verformungsverhaltens unter der thermischen Beanspruchung durch die Einheitstemperaturzeitkurve (ETK) nach DIN EN 1363-1 – MFPA Leipzig GmbH; 11.08.2016

[G2] Advisory Opinion Nr. GS 3.2/15-141-3: Pipe clamps FRS-L M8/M10 Universal in the sizes 1" (31-37), 2" (60-66) and 4" (111-119), Advisory opinion on the strength and deformation behaviour under thermal exposure with the standard temperature-time curve (ETK) according to DIN EN 1363-1 – MFPA Leipzig GmbH; 11.08.2016

[G3] Test report Nr. PB 3.2/18-120-1: Rohrschelle FRS-L M8/M10 Universal in der Größe 164-172, Prüfung in Anlehnung an RAL-GZ 656 Brandgeprüfte Rohrbefestigung: 2010-05 [1] zur Ermittlung der Tragfähigkeit und des Verformungsverhaltens unter der thermischen Beanspruchung durch die Einheitstemperaturzeitkurve (ETK) nach DIN EN 1363-1:2012-10 [2] – MFPA Leipzig GmbH; 28.06.2018

2.2 Miscellaneous

[S1] Technical data sheets for the pipe clamps FRS-L M8/M10 Universal of fischerwerke GmbH & Co. KG

VII Annex A1: Technical data of the product line FRS-L M8/M10 Universal

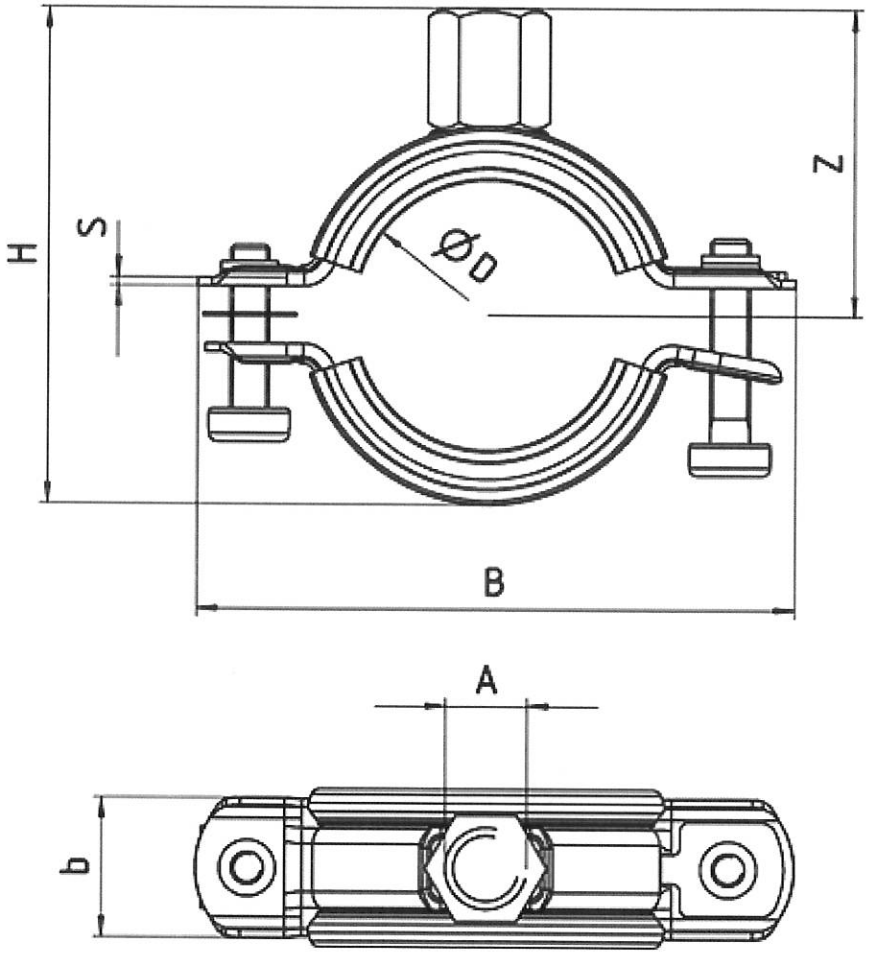

Figure 2: Technical data of the product line FRS-L M8/M10 Universal: Geometry, from [S1]

Span range	Nominal size	Connecting thread	Width and thickness of clamp strip	Width	Height	Height	Locking screw
D [*mm*]	[*inch*]	*A* [*mm*]	*b* x *s* [*mm*]	*B* [*mm*]	*H* [*mm*]	*Z* [*mm*]	
8-11		M8/M10	18 x 1,0	47	35	25	M5
12-15	1/4"			52	39	27	
16-19	3/8"			56	43	29	
20-24	1/2"			61	48	31	
25-30	3/4"			67	53	34	
31-37	1"			74	61	38	
38-45	1 1/4"		18 x 1,2	83	69	42	
46-52	1 1/2"			90	76	45	
53-59				97	83	49	
60-66	2"			104	90	52	
67-75			20 x 1,8	120	100	57	M6
76-84	2 1/2"			130	109	62	
85-93	3"			139	118	66	
94-100				146	125	70	
101-110				156	135	75	
111-119	4"			165	144	79	
120-129			25 x 2,0	180,6	148,9	82,9	
130-137				182,9	163,5	89,5	
138-145	5"			197,1	166	91,1	
146-155				205,3	173,8	95	
156-163				217,7	182,4	99,6	
164-172	6"			223,4	196	104,2	

Table 4: Technical data of the product line FRS-L M8/M10 Universal, from [S1]

Designation	Material
Clamp strip	Steel DD11 according to DIN EN 10111 [N2] (material number: 1.0332), electrogalvanised, 5 μm
Rubber profile/ sound insulation lining	SBR/EPDM, free from halogen and silicone, hardness: $55 \pm 5°$ Shore A
Locking screw	M5/M6 pan-head screw with cross recess shape H and additional slit, electrogalvanised $\geq$ 5 μm, strength class $\geq$ 4.8
Threaded rod	M8 or M10, electrogalvanised, strength class $\geq$ 4.8

Table 5: Technical data of the product line FRS-L M8/M10 Universal: Materials, from [S1]

VIII Annex A2: Fire resistance curves according to [N3]

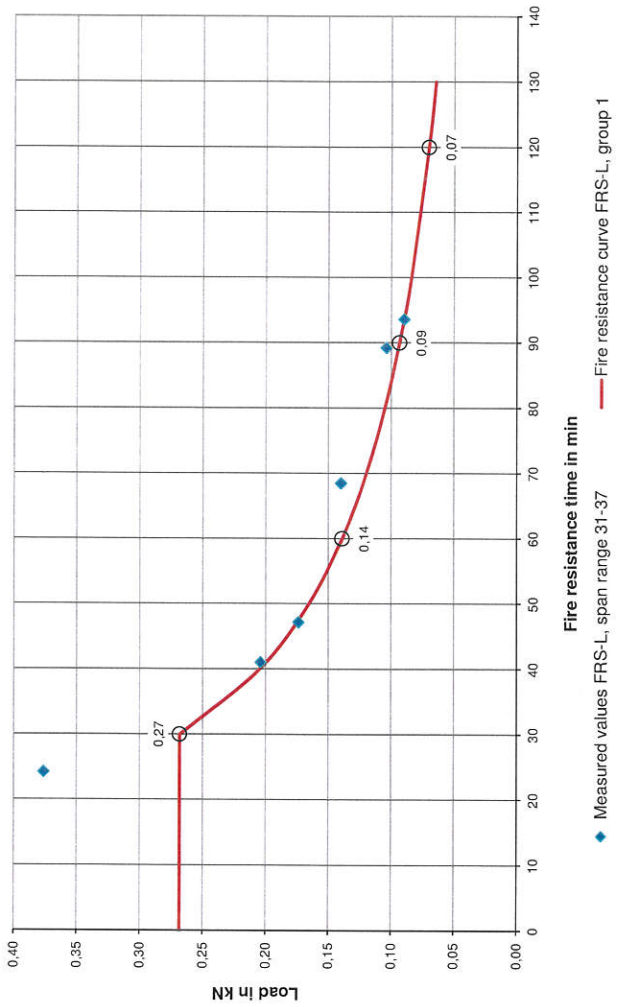

Figure 3: Fire resistance curve according to [N3] for pipe clamps FRS-L, group 1 basing on experimental results for the span range 31-37 (see [G1])

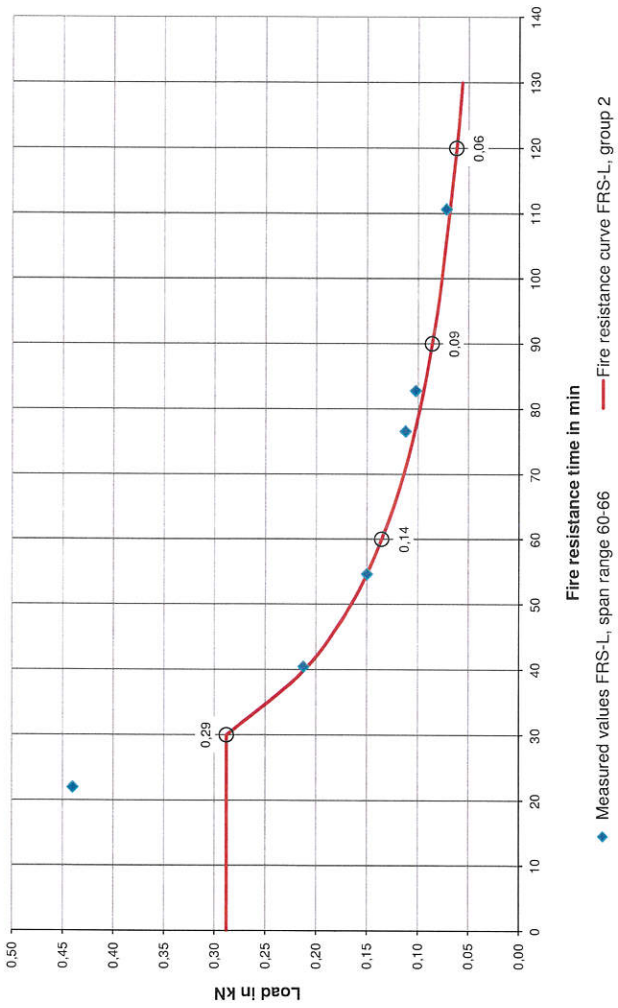

Figure 4: Fire resistance curve according to [N3] for pipe clamps FRS-L, group 2 basing on experimental results for the span range 60-66 (see [G1])

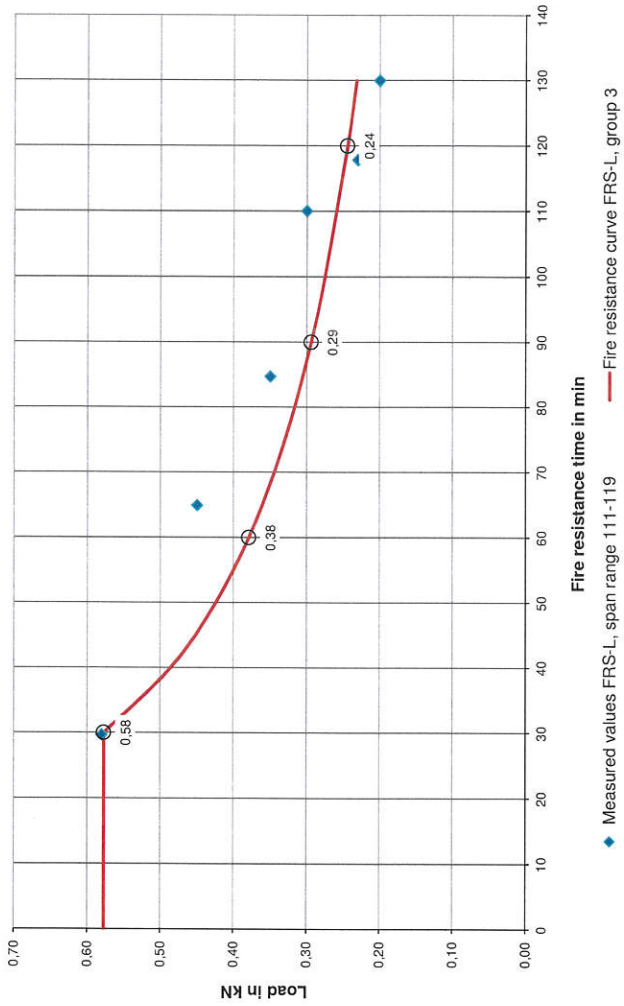

Figure 5: Fire resistance curve according to [N3] for pipe clamps FRS-L, group 3 basing on experimental results for the span range 111-119 (see [G1])

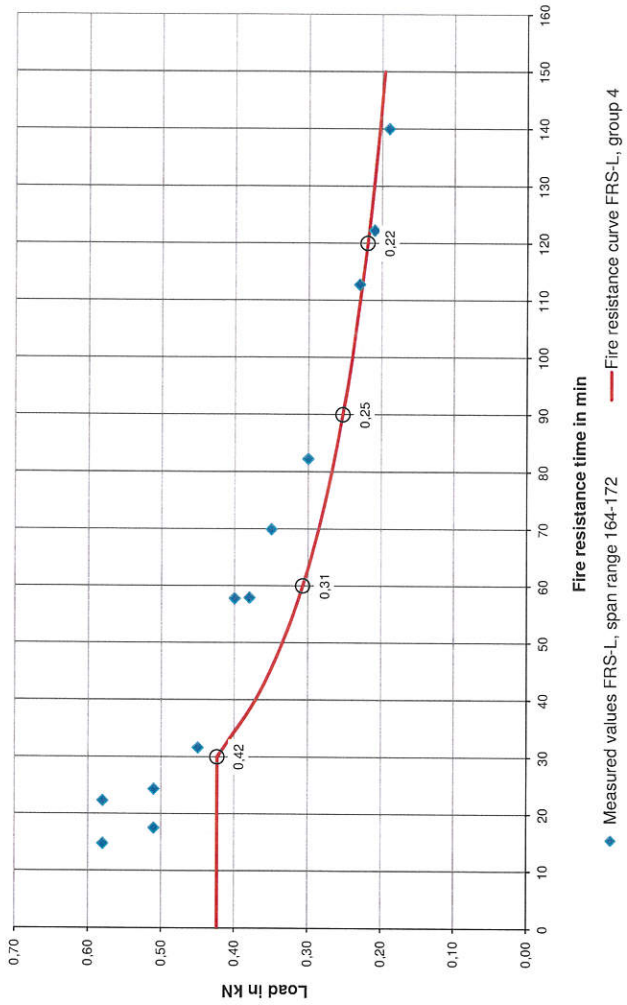

Figure 6: Fire resistance curve according to [N3] for pipe clamps FRS-L, group 4 basing on experimental results for the span range 164-172 (see [G3])

IX Annex A3: Load deformation curves according to [N3]

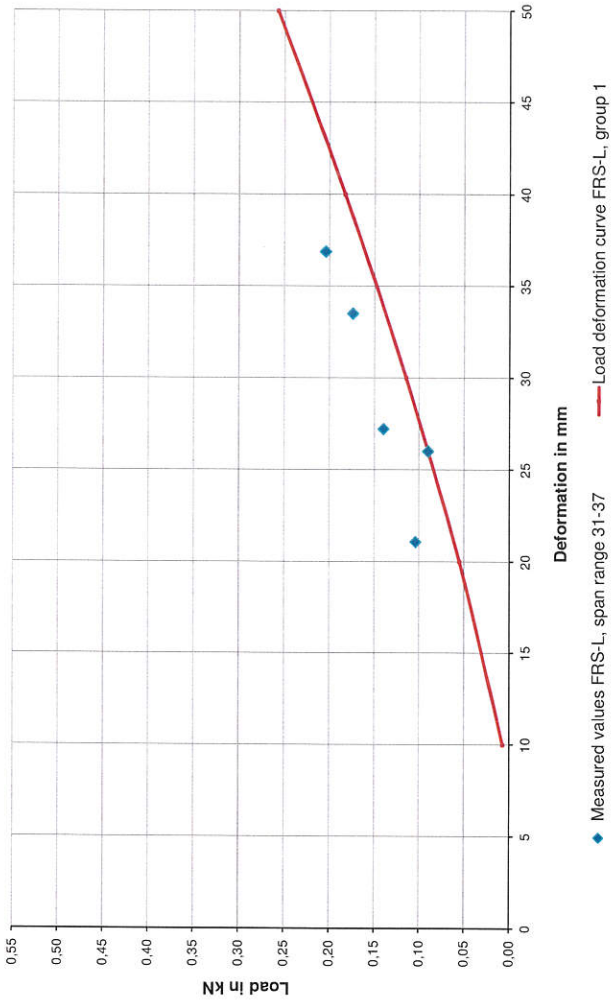

Figure 7: Load deformation curve for 30 minutes of fire loading according to [N3] for pipe clamps FRS-L, group 1 basing on experimental results for the span range 31-37 (see [G1])

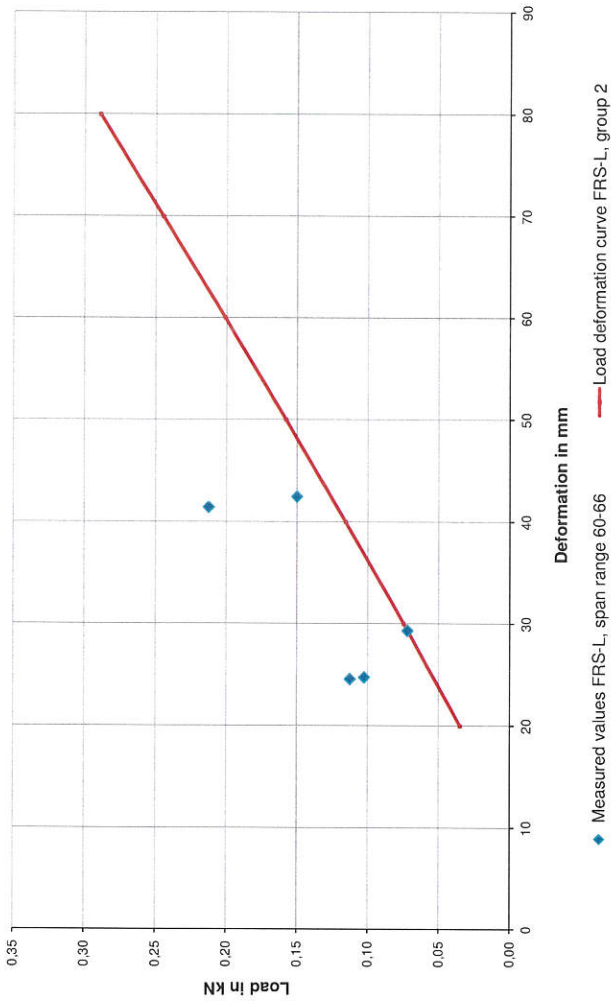

Figure 8: Load deformation curve for 30 minutes of fire loading according to [N3] for pipe clamps FRS-L, group 2 basing on experimental results for the span range 60-66 (see [G1])

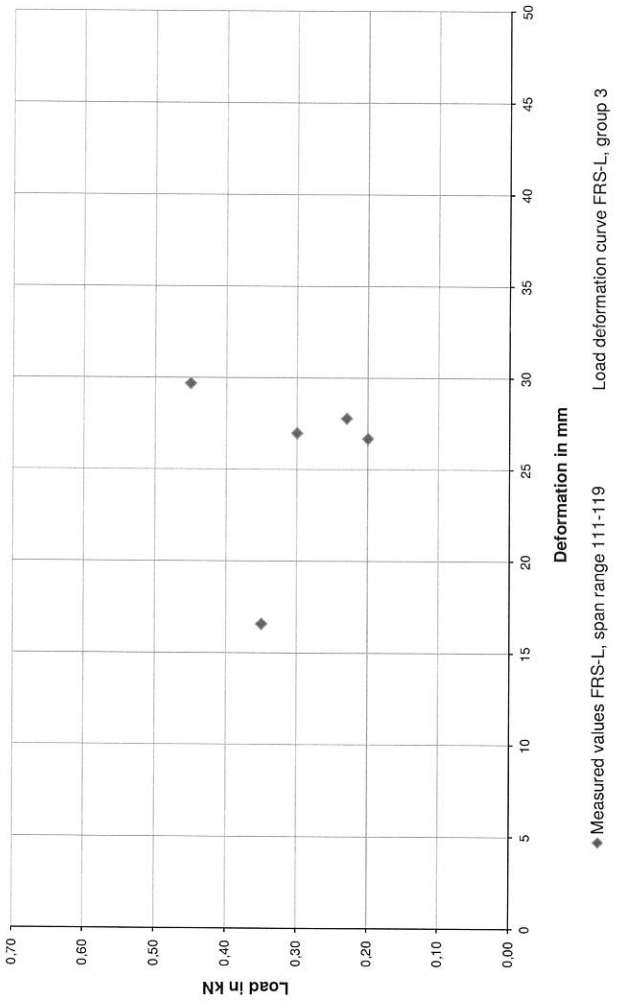

Figure 9: Load deformation curve for 30 minutes of fire loading according to [N3] for pipe clamps FRS-L, group 3 basing on experimental results for the span range 111-119 (see [G1])

The experimental results do not show a clear load deformation curve. However, even at the maximum test load of 0,45kN with failure time $t > 30min$, no deformations greater than 50mm are to be expected after 30 minutes of fire loading.

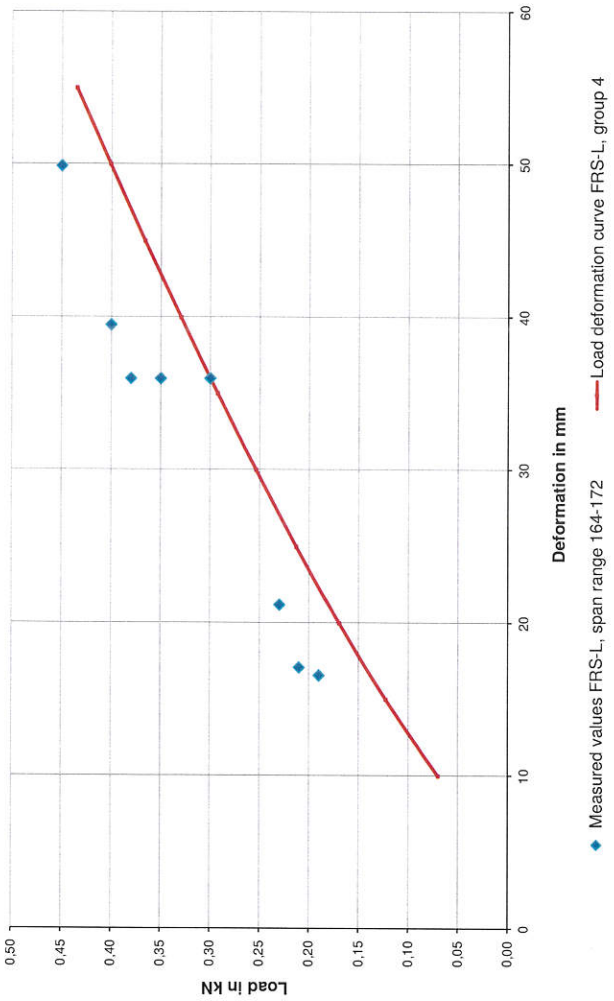

Figure 10: Load deformation curve for 30 minutes of fire loading according to [N3] for pipe clamps FRS-L, group 4 basing on experimental results for the span range 164-172 (see [G3])