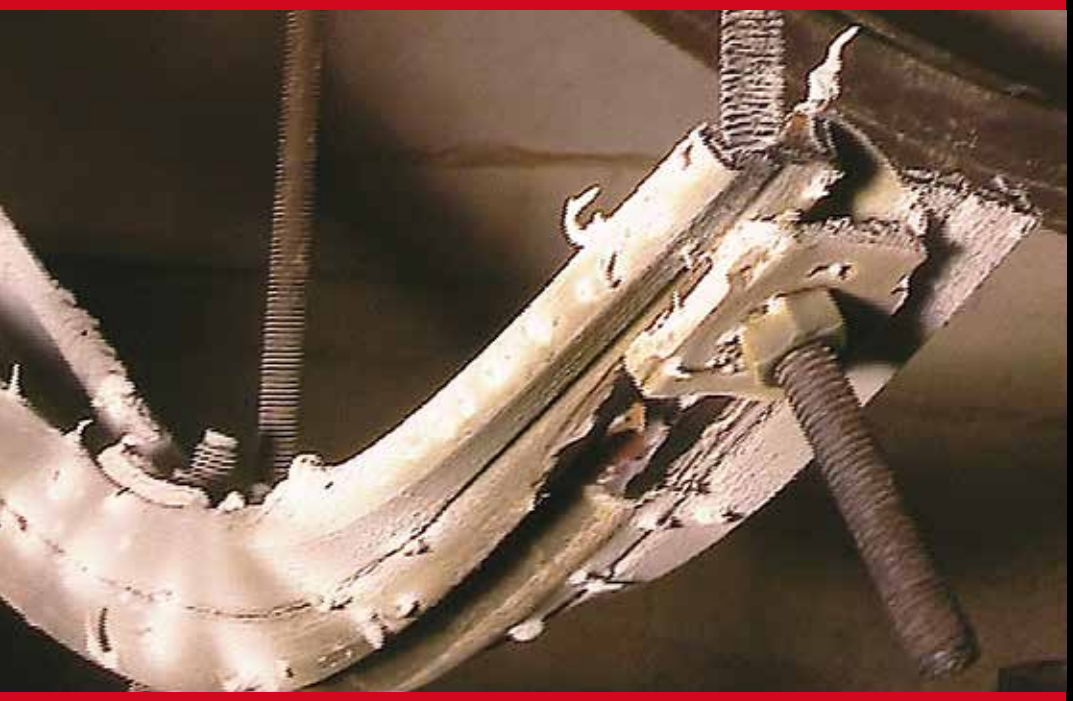
HILTI

Installation Technical Manual

Technical Challenges

Fire resistance



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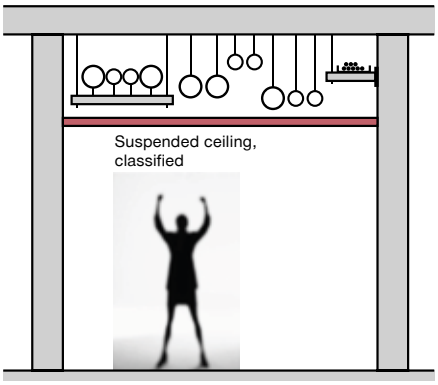
1.0 Introduction

Fire protection saves lives



Fires endanger human life, harm the environment and cause enormous economic losses. The overriding objective in terms of fire protection is to minimize the dangers from fires. Most importantly this involves protecting life and limb, followed by protecting the environment, buildings and technical equipment.
Technical and organizational safety measures for protecting building users are an integral part of the structure planning process and are the responsibility of the building owner or the persons acting on the building owner's behalf.
In this respect, the measures relating to fire protection are of the utmost importance.

In the construction industry there is a distinction between:

1. **Structural fire protection**
2. **System fire protection**
3. **Organizational fire protection**

Structural fire protection includes measures that do not prevent fires but can limit or slow down the spread of a fire. These measures include setting up fire compartments, arranging escape and emergency routes, fire walls, fire ceilings, self-closing fire protection doors and fire-resistant glazing etc.
System fire protection is implemented by means of mechanical and electrical installation measures including sprinkler systems, fire alarm systems, firestop shutters and smoke extraction systems etc.
Organizational fire protection primarily involves fire departments and other support and rescue teams that use suitable techniques and equipment to fight fires effectively.
Hilti offers a variety of fire-tested products in the areas of fire protection, fastening technology and installation technology, and therefore plays a major role in supporting structural and system fire protection to the effect that the people in the building can be evacuated, while ensuring safe access for the fire department and rescue teams. Protecting the escape and emergency routes is of paramount importance. For this reason, fire protection requirements are becoming increasingly important around the world.
Modern buildings house a variety of mechanical and electrical systems. Fire protection-related systems such as smoke extraction ducts, sprinkler piping and cable runs with functional integrity requirements (e.g. power supply for firestop shutters or ventilation and smoke extraction systems etc.) are crossed in many cases by pipes that are not related to fire protection, or the pipes are laid over a suspended fire protection ceiling due to lack of space. In the event of a fire, if the pipe supports fail or are severely deformed, this can seriously impact the required fire resistance time of the fire protection-related building components that are installed beneath. Therefore the installation positioned above the fire protection-related application (e.g. a suspended ceiling) must be guaranteed to have the same level of fire resistance as the structure below. This also applies in particular to escape and emergency routes where the suspended ceiling often is intended to protect the escape routes against flames and prevent the penetration of smoke and fumes.

A suspended ceiling with fire protection requirements must ensure the required fire resistance time in the event of fire exposure from both above and below. It must be noted that a fire can develop above the suspended ceiling due to the presence of flammable materials, e.g. as a result of retrofitting. Falling pipes and other installation components can damage a fire protection ceiling or cause it to collapse. Furthermore, severe deformations of the suspensions and support structures can result in partial damage to the suspended ceiling and thus impair the ceiling's fire-protection function.
In the event of a fire, if a suspended ceiling is damaged, the smoke that has collected in the ceiling cavity can spread into the areas within the building below. This can make it very difficult or even impossible for the people who are in the affected areas to orient themselves. Subsequently, for the people trying to escape there is a very high risk of fatality due to exposure to smoke and fumes. Therefore, it must be ensured that the function of escape and emergency routes is not affected during the entire required fire resistance time. Support systems installed above must under no circumstances affect the required fire resistance time of fire protection-related equipment or structures installed below, such as cable runs, ventilation, smoke extraction and electrical ducts as well as fire protection ceilings.

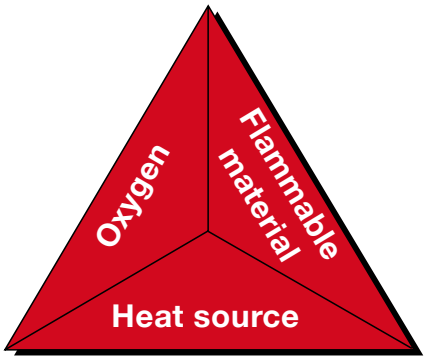
U-support with single and multiple load after the fire test

MQK bracket with central single load after the fire test

Suspended installation channels with multiple load after the fire test

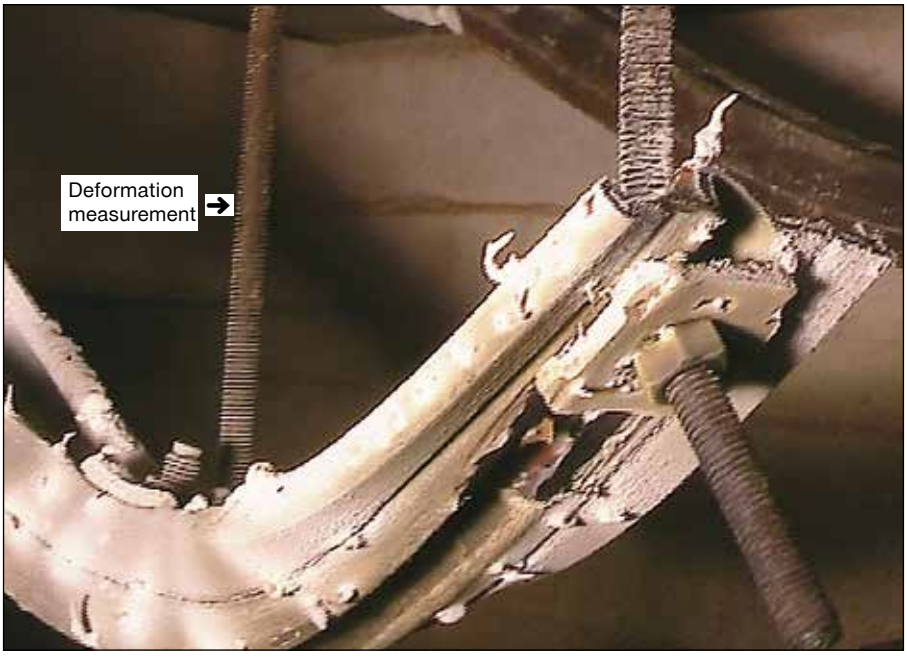
2.0 Outbreak and spread of fire

The following conditions lead to the outbreak of fire:



1. **Heat source**
2. **Flammable material**
3. **Oxygen**

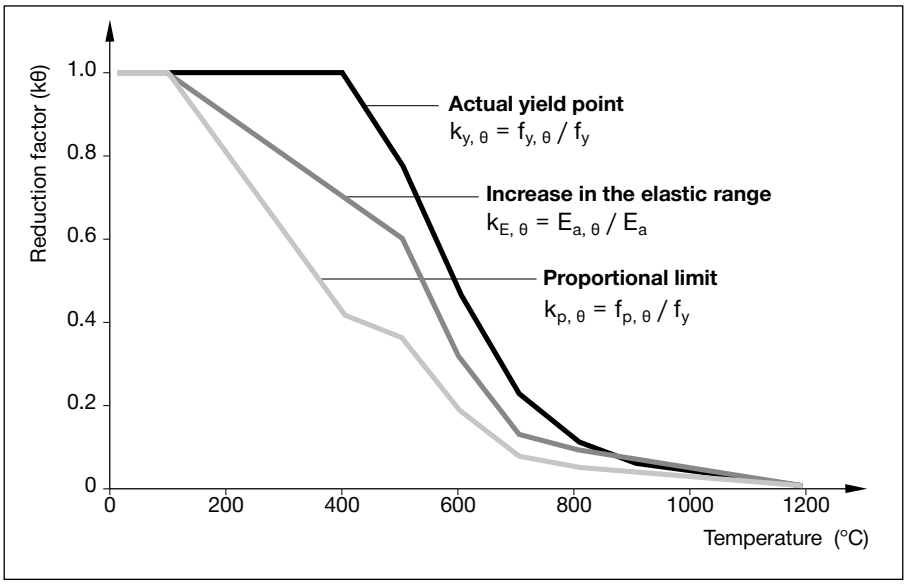
After the initial outbreak of fire, flames begin to spread and the ambient temperature rises. If the mixture of oxygen, smoke and fumes reaches the critical concentration level and if the ambient temperature is accordingly high, this causes flash-over. As a result, any flammable materials in the area will self-ignite.
This happens when the room temperature is between 600°C and 800°C. The fire spreads at a speed of approximately 10 m/min. The time when the flash-over occurs depends on the speed at which the fire spreads and can vary between 3 and 15 minutes. As the fire progresses, the temperature rises to over 1,000°C.



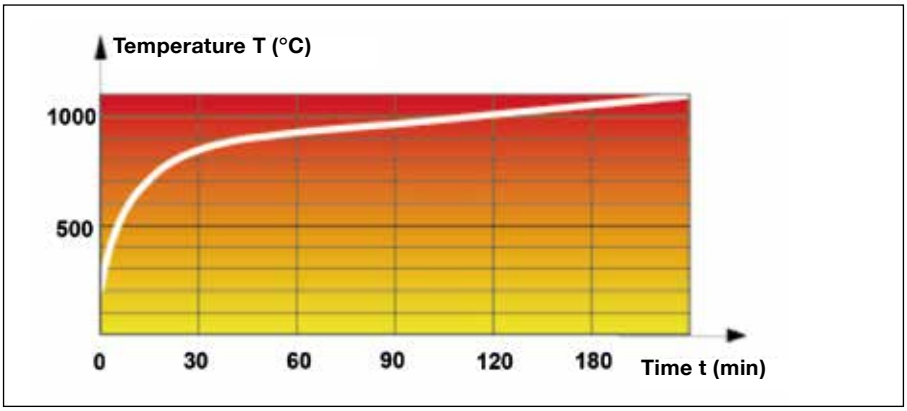
Suspended installation channel with central single load after the fire test

3.0 Behavior of steel in the event of fire

Steel is known to be a very good conductor of heat. Due to their low material thickness, installation channels and pipe rings reach their ambient temperature after just a very short time delay. In accordance with the uniform temperature time curve (UTTC) according to EN 1363-1 [1], the ambient temperature is 842°C after 30 minutes of fire and 1,006°C after 90 minutes of fire.
In a fire, the load-bearing capacity of steel decreases considerably the longer the fire continues. This is taken into account in EN 1993-1-2 (Eurocode 3) [2] by temperature-related reduction factors for yield strength, proportional limit and the modulus of elasticity of the material.
In particular, in the case of thin-walled, cold-formed, open-section installation channel profiles, buckling effects arise on account of the extremely high temperature, depending on the static system, the material thickness, the shape of the profile and the load. This results in a loss of rigidity and, as a consequence, severe deformation of the channel profile.
The reduction factors in accordance with EC3 are insufficient in this case and may be on the unsafe side (see section 5.0).



Reduction factors for the stress-strain correlation of carbon steel at high temperatures [2].



Uniform temperature time curve (UTTC) according to EN 1363-1:2012

4.0 Legal requirements

Around the world there are many different legal regulations and standards applicable to fire protection. The individual fire protection requirements, e.g. for fire walls, cable runs, ventilation ducts and smoke extraction ducts, suspended ceilings, hollow and double floors as well as anchors for fastening to supporting materials are similar to a great extent. There are no known comparable fire protection design requirements for the fastening of pipe supports.

As a result of more stringent safety requirements there is increasing demand for fire-resistant pipe supports in the commercial and industrial building construction sector. This applies, in particular, with regard to the safety of people and the functional integrity of the fire protection-related applications that are installed below the pipe support systems.

The fire resistance time that a suspended ceiling or a wall is required to have depends on the building type and building structure. Usually the buildings are divided into different building classes, varying from small residential buildings to high-rise buildings. The fire protection requirements can differ depending on the national construction regulations in each case.

4.1 European requirements

4.1.1 Escape and emergency routes

There are currently no European regulations, harmonized standards or guidelines for evaluating the fire resistance of pipe supports in escape and emergency routes. However, the national requirements as described in section 4.2 must be observed.

4.1.2 Ventilation pipes and smoke extraction systems

The highest harmonized design requirements for the planning of ventilation ducts and smoke extraction systems exist at a European level. This section provides an overview of some of the relevant content from the most important harmonized standards that apply in all EU member states, in the EFTA states (Iceland, Liechtenstein, Norway), Turkey, Switzerland, Andorra, San Marino and Monaco.

- EN 13501: Fire classification of construction products and building elements
  - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers.
  - Part 4: Classification using data from fire resistance tests on components of smoke control systems
- EN 1366-1:2014: Fire resistance tests for service installations
  Part 1: Ventilation ducts
  - Section 13.6 regulates suspension systems for horizontal pipes
  - Suspension systems must be made out of steel.
  - If the lateral spacing between the external vertical surface of the pipe and the axis of the suspension system is less than 50 mm, a test result of up to 50 mm applies. If the test result exceeds 50 mm, the result for spacings up to the tested value applies.
  - The suspension systems must be dimensioned in such a way that the calculated stress does not exceed the values specified in the following table:
  - The suspension system's load-bearing horizontal building component must have the same profile type as that used during testing. It must be designed in such a way that the bending stress does not exceed the stress applied to the corresponding building component during testing.

Type of stress	Maximum stress (N/mm^2)		
	t ≤ 60 min	60 min < t ≤ 120 min	120 min < t ≤ 240 min
Tensile stress in all vertically-positioned building components	9	6	3
Shear stress in screws of the strength class 4.6 in accordance with EN ISO 898-1	15	10	5

Source: EN 1366-1:2014, table 7

- EN 1366-5: Fire resistance tests for service installations Part 5: Service ducts and shafts
- EN 1366-8: Fire resistance tests for service installations Part 8: Smoke extraction ducts
- EN 1366-9: Fire resistance tests for service installations. Part 9: Single compartment smoke extraction ducts.
- EN 15871: Ventilation for buildings - Fire resisting duct sections
  - This standard defines the requirements for fire-resistant ducts and components to be installed in building ventilation systems, and refers to relevant testing procedures
- EN 15882 -1: Extended application of results from fire resistance tests for service installations. Part 1: Ducts
- EN 12101-7: Smoke and heat control systems – Part 7: Smoke duct sections; German version EN 12101-7:2011

4.2 German requirements

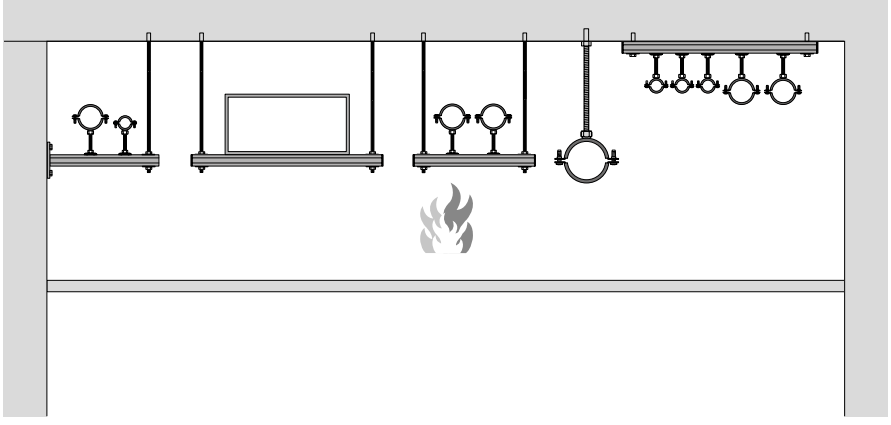
4.2.1 Escape and emergency routes (necessary corridors and staircases)

The initial step with regard to defining the requirements for the installation of pipes from a fire protection perspective was completed in Germany with the publication of the standard pipe/cable systems directive (MLAR) [3] by the expert committee for construction supervision at the Bauministerkonferenz (conference for ministers of construction) in 2000.
The MLAR (latest version 11/2005) illustrates the various possibilities that allow the escape and emergency routes (necessary corridors and stairwells) to be used for a sufficient length of time in the event of a fire.
The necessary corridors form the horizontal part of the escape and emergency routes incorporated in the building for the connecting section between the units in use and the vertical part of the escape and emergency routes (stairwell) that form part of the building design. The model construction regulations stipulate that the necessary corridors must be positioned and designed in such a way that they can be used for a sufficient length of time in the event of a fire.
The standard pipe/cable systems directive (MLAR 11/2005) regulates the following

- Pipe systems in necessary corridors and stairwells
- Pipe systems that are fed through room-enclosing building components (walls and ceilings)
- Electrical functional integrity in the event of a fire

Electrical cables and pipe systems made from flammable building materials or with flammable insulating materials in necessary corridors must be positioned above suspended ceilings. These suspended ceilings must consist of non-flammable building materials, and in the event of a fire breaking out they must be fire-resistant both above and below.
Important: All installations above an F30 suspended ceiling must be fastened in such a way that they will not fall down within 30 minutes in the event of a fire. During the classified fire resistance time, the suspended ceiling must not be subjected to additional loads presented by severely deformed or falling installations or building components. ⇨ All installations must be installed using fire protection-tested fasteners.

There are usually many installations running along the ceilings of corridors and the number may be increased by retrofitting, e.g. with additional cables (some of which may be flammable), at any point during subsequent use of the building. The suspended ceiling's sealing function must not be impaired in the event of a fire. This can have devastating consequences for life and limb, both for the people who are in the building as well as firefighting and rescue teams.



Fire load above a classified suspended ceiling

Regardless of whether legal regulations exist or not, or if there are no fire protection requirements, the general protection objective must always apply:

Protection of health and life

In particular, this must be observed when designing the installation runs in escape and emergency routes as unrestricted use of these areas of a building can be the deciding factor between life and death in serious situations.

Core statements from the MLAR in relation to our products are:

The required fire resistance time of suspended ceilings must be guaranteed in the event of fire exposure from above and below.

and

The special requirements with regard to the fire-resistant fastening of the pipes/cables positioned in the area between the structural ceilings and suspended ceilings must be observed.

The required fire resistance time for a suspended ceiling or a wall usually depends on the building type and building usage. Usually the buildings are divided into different building classes, from small residential units to high-rise buildings. Country-specific construction regulations must also be observed.

4.2.2 Ventilation ducts and smoke extraction systems

The standard pipe/cable systems directive for the fire-protection requirements of ventilation systems (standard ventilation systems directive M-LüAR [4] (version Dec. 2015) was passed by the German conference of construction ministers and it highlights the importance of fire protection for ventilation ducts.
Section 5.2.2 looks at pipe sections that must be fire resistant and indicates that these must be fastened to building components with the corresponding fire resistance.
Section 5.2.4 looks at ventilation ducts above suspended ceilings, which – as independent building components – must be fire resistant. In this case, these ventilation ducts must be fastened in such a way that they cannot fall down, even in the event of a fire (see DIN 4102-4, section 8.5.7.5 [5]).

4.3 Austrian requirements

4.3.1 Requirements and load-bearing capacity on exposure to fire

Guideline MA 37-15003-2015 applies to all health and social institutions that are operated under institutional control in accordance with the country-specific provisions.

There are a number of requirements for suspended ceilings that must be observed when designing pipe mounts, including the following:
Section 2.3
"In corridors, if the necessary installations made from flammable materials are different to those in adjoining occupied rooms, the suspended ceilings must be constructed out of EI 30 (a↔b) and A2."

OIB guideline 2.3 regulates fire protection for buildings with an escape level of higher than 22 m.
Section 2.1.2
"If, in the corridors outside of residential dwellings, pipes or cables are laid above suspended ceilings and are neither concealed in plaster nor protected by a casing, then the suspended ceilings must be tightly sealed and meet the fire load requirements of more than 25 MJ/m² and EI 30 (a→b)* that apply as a result of the pipes and cables. This is not the case if an appropriate fire-extinguishing system is installed."

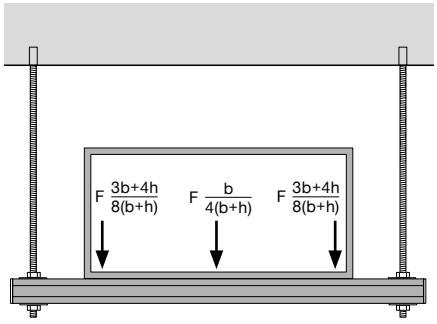
In terms of practical implementation, this means that checks must be carried out on an individual basis to determine whether the suspended ceiling constructions in question are loaded only with their own weight during fire exposure. Cables, cable bundles and cable runs as well as similar equipment such as pipes and other installations installed in the space between the ceilings must be fastened to the load-bearing ceiling structure (unfinished ceiling) in such a way that the suspended ceiling structure is not loaded during the classification period.

*) "E" (Étanchéité = sealing) stands for room partition and represents the ability of a building component with a room-dividing function to resist a fire that is attacking one side only. Fire penetration to the non-exposed side is prevented.
"I" (Insulation) stands for thermal insulation and represents the ability of a building component to restrict the transfer of fire and heat as much as possible so that nobody is injured on the side of the building component that is not exposed to the fire, nor that any of the materials located on that side are ignited. a↔b and a→b (above - below) specifies the orientation of the classified fire resistance time.

4.3.2 Ventilation ducts and smoke extraction systems

In addition to section 4.1.2, the following national standard applies
• ÖNORM H 6029: Ventilation and air-conditioning systems – smoke extraction systems

- The suitability of the suspension must be verified by an assessor from an accredited test center or a technical expert. The suitability must be verified in adherence with the following outset conditions:
  - The hangers must have a spacing of maximum 1.5 m and must be made out of steel.
  - They must be dimensioned in such a way that the calculated stress is no greater than 6 N/mm².
  - The hangers must be fastened with metal expansion anchors (at least M 8)
  - The anchors must be set twice as deep as is required in normal applications, to a depth of at least 6 cm. – The calculated tensile loading must not exceed 500 N for each anchor.
    Note: This requirement does not apply to approved anchors!



The duct weight can be split for the bending design of the channels, in accordance with the above sketch.

4.3.3 Additional relevant regulations for fastening pipe mounts

ÖNORM H 6031	Ventilation and air-conditioning systems – Installation and inspection of fire dampers and smoke control dampers
TRVB 110 B	Fire protection requirements for pipes and their feed-throughs.
TRVB 127	Sprinkler installations
TRVB 128	Fixed wet and dry fire extinguishing systems

4.4 Swiss requirements

The Association of Swiss Canton Fire Insurance Companies (VKF) regulates the obligatory fire protection regulations for Switzerland. The following provisions apply to pipe supports:

4.4.1 VKF fire protection standard, article 48 mechanical and electrical installations, paragraph 1

Mechanical and electrical installations (heating and cooling systems, air-conditioning systems, electrical systems) must be designed and installed so as to ensure safe operation, in the intended way, and that damage is limited in the event of an incident.
In individual cases, however, it is necessary to check whether pipe/duct systems can have a negative impact on other nearby installations in the event of a fire, and where necessary to determine whether suitable pipe determine whether need to be used.

Possible influence upon classified systems as a result of pipes installed above

4.4.2 VKF fire protection directive for building materials and building components / 13-15de

- 3.1.10 Non-supporting, space-enclosing components (VKF fire protection guideline)
  Paragraph 3. For suspended ceilings with a space-enclosing function and thermal insulation, which as suspended ceilings – as independent building components – guarantee fire resistance, the classifications are extended depending on whether the specified requirements for single or double-sided fire exposure ("a→b", "b→a", "a↔b") are met.

- 3.2.3 Suspended ceilings (VKF fire protection guideline)
  Paragraph 3. Suspended ceilings must not catch fire and must prevent the penetration of fire, heat and smoke. Such fire resistance classifications F 60 to F 180 must consist of RF1 building materials.
  This means that in individual cases checks must be carried out to see which requirements apply for suspended ceilings and whether piping systems could have a negative impact upon these suspended ceilings in the event of a fire.

4.4.3 Fire protection directive for ventilation systems / 25-15de

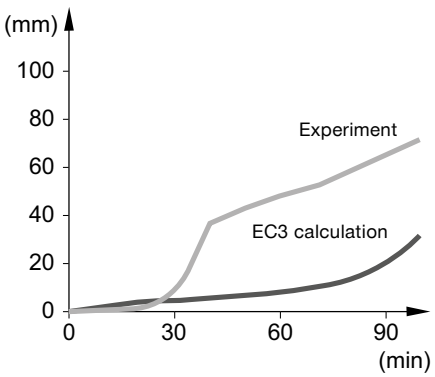
- 3.7.3 Suspensions and fasteners (VKF fire protection directive)
  Paragraph 2. Suspension systems and fasteners must be designed so that secure fastening of the ventilation ducts is guaranteed during the required fire resistance time.

5.0 Designing for fire resistance

EN 1993-1-2 (Eurocode 3) describes the rules and safety requirements for the load-bearing design of steel structures exposed to fire. This means that structures consisting of cold-rolled steel, thin-walled, open profile steels (e.g. installation channels and pipe rings) able to withstand temperatures of up to 1,200°C in the event of a fire can be designed.

The latest research results have demonstrated however, that this standard cannot be applied for thin-walled steel profiles, because deformations resulting from calculations in accordance with EN 1993-1-2 (Eurocode 3) significantly underestimate the actual deformations found to occur in fire tests (see section 13).

Research has shown that for temperatures above around 700°C, the building component deformations were considerably higher than indicated by the analytical calculations in accordance with table 3.1 from EN 1993-1-2 (Eurocode 3). In this table, the temperature-related reduction factors are specified for the modulus of elasticity, the effective yield point and the proportional (stress-strain). These factors are evidently unsuitable for describing the behavior of thin-walled, open profiles such as installation channels and pipe rings for installation systems exposed to fires that reach temperatures above 700°C.
The uniform temperature time curve (UTTC), based upon EN 1363-1, reaches 842°C after just 30 minutes. It is therefore easy to comprehend that the deformations of components or installation channels measured during the tests vary from the calculated values in accordance with EN 1993-1-2 (Eurocode 3). The measured deformations are already significantly higher than the deformations calculated in accordance with Eurocode 3 before 30 minutes have passed.



Source: MFPA Leipzig letter dated November 12 2015 – See annex 1

The comments from MFPA Leipzig (see annex 1) explain in greater detail that — for the purpose of verifying the limited deformations due to the current lack of a calculation basis — fire tests with fire exposure in accordance with DIN EN 1363-1 should be carried out.

It is relatively easy to design fire-resistant pipe rings in accordance with the table values from fire tests as per RAL-GZ 656 [6]. Depending on the required fire resistance time, the maximum vertical load and the associated deformation are specified. These tables are illustrated in section 11 "Hilti fire-tested pipe rings". By reducing the spacings between the pipe supports, the appropriate maximum load and/or the maximum permitted deformation for the intended application for the selected pipe ring can be achieved. In cases where the space between a fire-resistant suspended ceiling and the installation system positioned above it is restricted, it can be ensured that the maximum deformation remains within limits.

When pipe supports are designed to be fire-resistant, the load data from section 11 can only be used if the actual situation can be compared with the tested arrangement. It must be ensured that the same components are used, that the loading positions are identical and that the span width and suspension height are comparable or lower than those during the test.

When installation channels are combined with other components such as pipe rings, the overall deformation is the sum of the individual deformations depending on how the components are arranged.

6.0 Designing for high temperatures up to 600°C

Through extensive fire testing it was possible to verify that the standard EN 1993-1-2 (Eurocode 3) can be also applied for temperatures up to 600°C [7] for thin-walled steel sections.
This section includes a simple conversion of this procedure for the application up to 600°C. Table 3.1 from standard EN 1993-1-2:2010 (Eurocode 3) includes reduction factors for the modulus of elasticity, the effective yield point and the proportional limit. The reduction factors for the modulus of elasticity are lower than those for the effective yield point. The modulus of elasticity is incorporated linearly into the calculation of stability problems. By using these reduction factors (for the modulus of elasticity kE,θ) failure due to lack of rigidity can also be taken into account for the results at room temperature for Hilti PROFIS.

Loading safety factor / stress capacity utilization
The partial safety factor on the side of exposure is 1.0 in the event of a fire. The partial safety factor on the side of exposure at room temperature is 1.35 for ongoing exposure and 1.5 for varying exposure. These factors are automatically taken into account in PROFIS with the loads entered under "own weight" (dead weight) and "working load". However, a mean factor of 1.4 can be eliminated through division if PROFIS results based upon the cold case for the fire protection design up to 600°C are used.

The stress capacity utilization for the components specified in PROFIS can be multiplied by the following factors in order to determine the capacity utilization on exposure to heat at temperatures up to 600°C. Intermediate values can be linearly interpolated.

Factor stress capacity utilization at:
100°C: 1 / ($k_{E,100°C}$ x 1.4) = limited to 1.0 (corresponds to room temperature)
200°C: 1 / ($k_{E,200°C}$ x 1.4) = limited to 1.0 (corresponds to room temperature)
300°C: 1 / ($k_{E,300°C}$ x 1.4) = limited to 1.0 (corresponds to room temperature)
400°C: 1 / ($k_{E,400°C}$ x 1.4) = 1 / (0.70 x 1.4) = 1.02
500°C: 1 / ($k_{E,500°C}$ x 1.4) = 1 / (0.60 x 1.4) = 1.19
600°C: 1 / ($k_{E,600°C}$ x 1.4) = 1 / (0.31 x 1.4) = 2.30

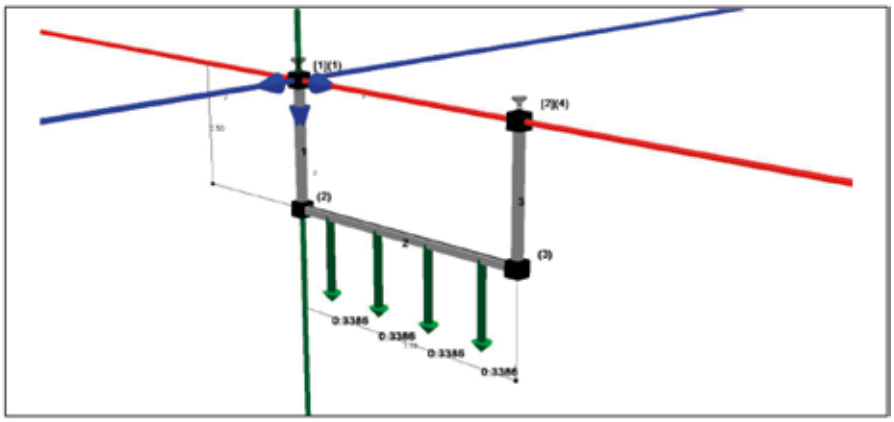
Serviceability / deformation:
In the event of serviceability (i.e. fitness for use), on exposure to fire and at room temperature, the partial safety factors are 1.0. Thus the factors below can be applied to the deformations specified in PROFIS. Intermediate values can be linearly interpolated.

Factor for deformation at:
100°C: 1 / $k_{E,100°C}$ = 1/1.0 = 1.0
200°C: 1 / $k_{E,200°C}$ = 1/0.9 = 1.11
300°C: 1 / $k_{E,300°C}$ = 1/0.8 = 1.25
400°C: 1 / $k_{E,400°C}$ = 1/0.7 = 1.43
500°C: 1 / $k_{E,500°C}$ = 1/0.6 = 1.67
600°C: 1 / $k_{E,600°C}$ = 1/0.31 = 3.23

Example from Hilti PROFIS Installation: In this case, stress capacity utilization and deformation of the MQ-41 installation channel at 500°C would be:

- Stress capacity utilization: 49.68 x 1.19 = 59.1%
- Deformation: 2.4 x 1.67 = 4.0 mm

Summary of the PROFIS calculation



1 Stäbe (1) Verbinder [1] Auflager

Stäbe

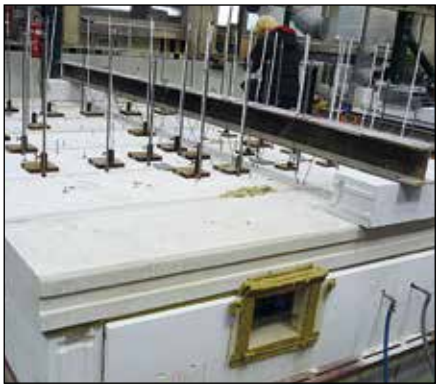
Stab/ Schie Nr.	LC	Bezeichnung	Verformung [mm]	Verformung [%]
1	LC1-SLS	AM 10x2m	0.0	1.25
2	LC1-SLS	MQ-41 3m	2.4	43.16
3	LC1-SLS	AM 10x2m	0.0	1.25

Stab/ Schie Nr.	LC	Bezeichnung	Spannung [%]	Torsion [°]	Torsion [%]
1	LC1-ULS	AM 10x2m	6.84		
1	LC1-SLS	AM 10x2m		0.0	0.00
2	LC1-ULS	MQ-41 3m	49.68		
2	LC1-SLS	MQ-41 3m		0.0	0.00
3	LC1-ULS	AM 10x2m	6.84		
3	LC1-SLS	AM 10x2m		0.0	0.00

With the above-described method, the entire range of Hilti installation channels can be used for designs suitable for exposure to high temperatures of up to 600°C.

7.0 Conditions for carrying out fire tests

- Fire tests on pipe rings carried out in accordance with the quality guideline RAL-GZ 656.
- In the absence of a specific test specification, installation channel systems are tested on the basis of previous test experience as well as following the standard EN 1363-1.
- Testing carried out at a certified test center, e.g. IBMB, MPA Braunschweig.
- The furnaces that are commonly used for these tests have a surface area of approx. 5 x 4 meters, of which a surface of 3 x 3 meters is used for positioning the test sample.
- Several oil or gas burners are positioned at both head ends of the furnace at a height of approx. 1.0 m.
- Temperature-controlled burner with sensors (plate sensors in accordance with EN 1363-1) arranged symmetrically in the furnace at the installation level height.
- Building components / systems to be tested are fastened to the furnace ceiling using threaded rods. The threaded rods are inserted through the holes in the ceiling and are fastened externally.
- Test specimen positioned with sufficient spacing above the burner.
- Building components / systems to be tested are loaded by way of dead loads, usually suspended below the test specimens using suitable coupling elements. In the case of pipe rings, the test load is attached via a solid dummy pipe made of steel.
- An area of approx. 0.5 m is kept clear between the burners and the test specimens in order to avoid reducing the radiating effect of the burner and also avoid unwanted turbulence.
- Equal loads are applied as an equally distributed load, by means of square plates (100 x 100 mm) that are positioned on the upper side of the channel. Threaded rods are fastened through holes in the center of the square plates. They are fed downwards through the rail hole and test loads are fastened to their ends. Compared with an equal load that is applied to a rigid building component, the equally distributed load that is applied in this way represents a far greater critical stress.
- As an alternative to application of the load by way of the square plates (equal load), the single loads and multiple loads are taken up by the channel using MQA-B pipe ring saddles, similarly to how this is done n practice.
- The deformation of the building components or systems is measured using threaded rods made of non-corrosive steel or alternatively using special ceramic rods or rods made from special glass. The measuring bars are fed through the furnace roof into the furnace and are attached to the building component or system that is to be measured. The respective deformation is recorded as a continual electronic measurement or is alternatively visually read and noted every five minutes using a scale.



Furnace: Roof made of gas concrete ceiling sections, observation window at the front

Furnace: The upper section is built for each test out of gas concrete blocks

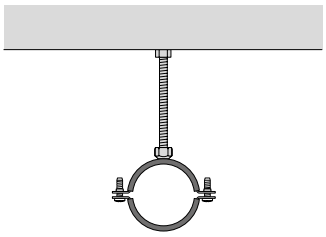
Electronic deformation measurement on the roof of the furnace

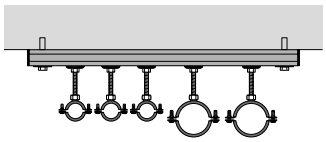
View of the furnace at the end of a fire test

8.0 Overview of Hilti fire-tested installation systems

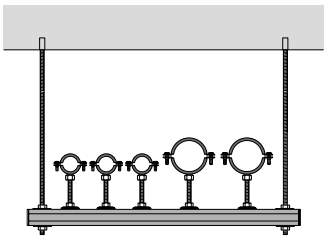
As there are no harmonized fastening design methods available to date, the Hilti range of fire-resistant installation channel systems has been developed on the basis of fire tests. The following illustrations provide an overview of the available solutions.

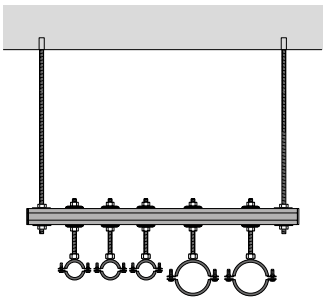
Single-point installation / installation channel on the ceiling



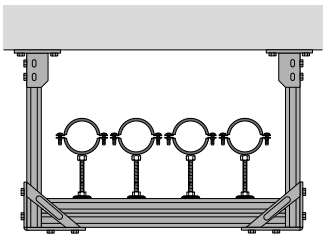


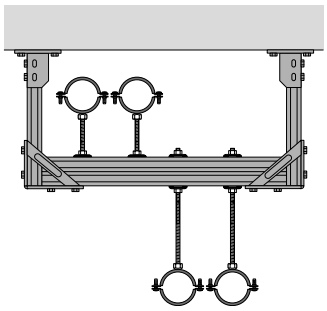
Suspended installation with threaded rods



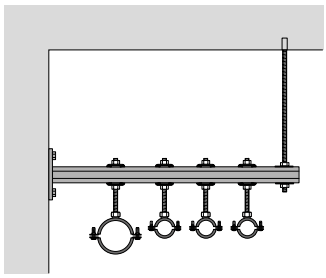


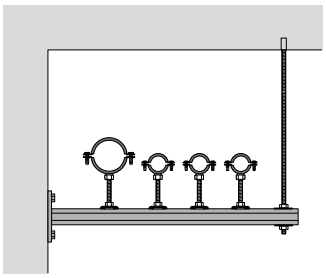
Suspended installation channel



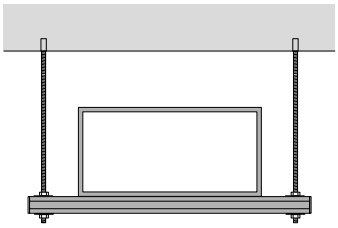


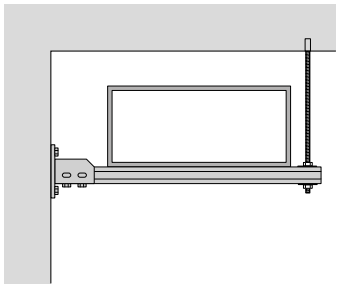
Suspended bracket

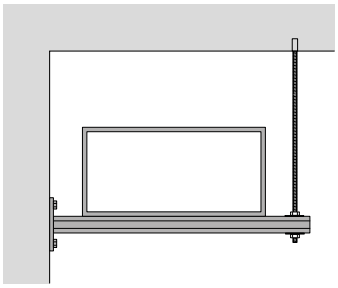




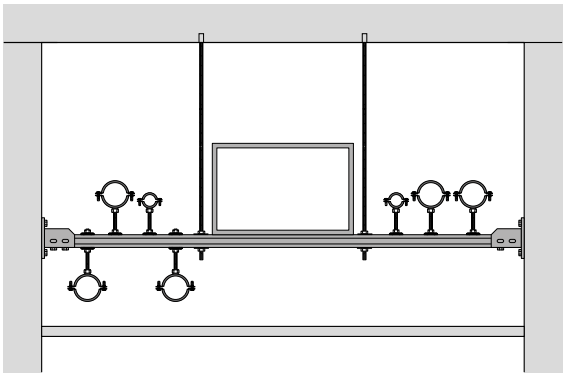
Rigid duct / flexible duct



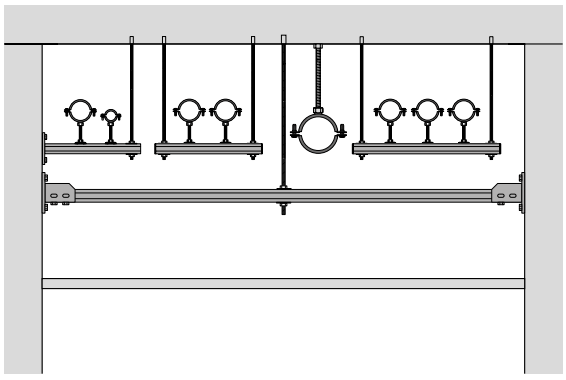




Continuous beam



Strengthening



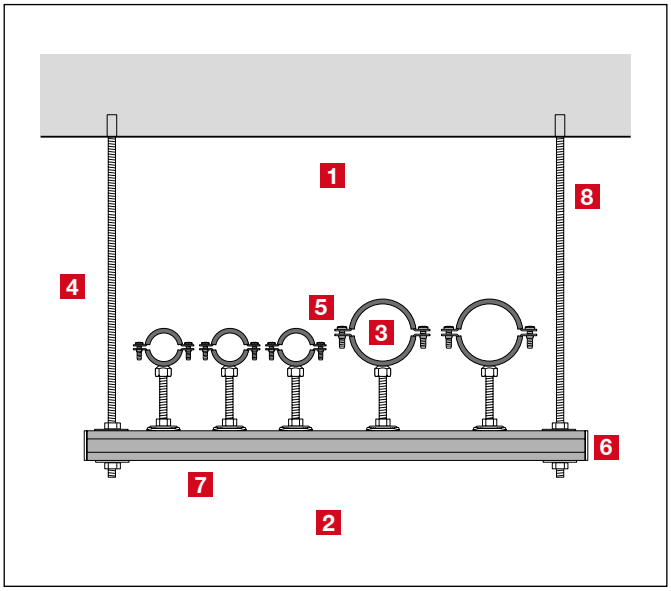
9.0 Fire protection design of installation systems

In the following is the summary of the eight process steps necessary for the fire protection design of pipe support systems. Design example see annex 2.

Fire-resistant installation systems

Important steps in the design process:

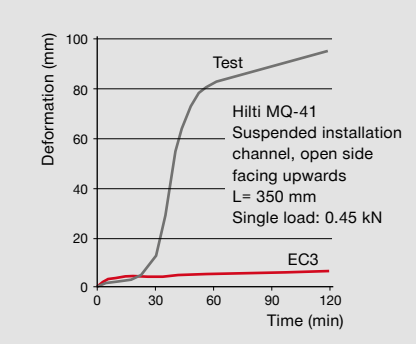
1. Collection of information about the application
2. Initial design of the supporting system
3. Calculation of the loads
4. Definition of the spacings between the supporting systems
5. Selection of pipe rings
6. Definition of the span width of the channels
7. Review of the deformation
8. Selection of suitable anchors



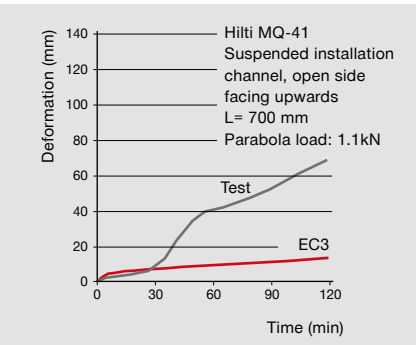
Important information:
The mathematical design of pipe support systems made of cold-formed, thin-walled, open channel profiles in accordance with EN 1993-1-2 [EC3] to be exposed to fire at temperatures of greater than 600°C is not suitable for realistically verifying building component deformations. For details on this see section 5.0.

How it should not be done

Research results indicate that the design approach according to EN 1993-1-2 [EC3] for calculating the deformation of channels leads to uncertain results.



- A significant discrepancy was observed between the designs according to EC3 and the actual test results for all the tested systems. The deviations occur between the 20th and 25th minute of the uniform temperature time curve (UTTC).
- Buckling often results in bending failure of the channel. This causes severe deformation. After formation of a polygon graph, deformation continues at a slow pace.

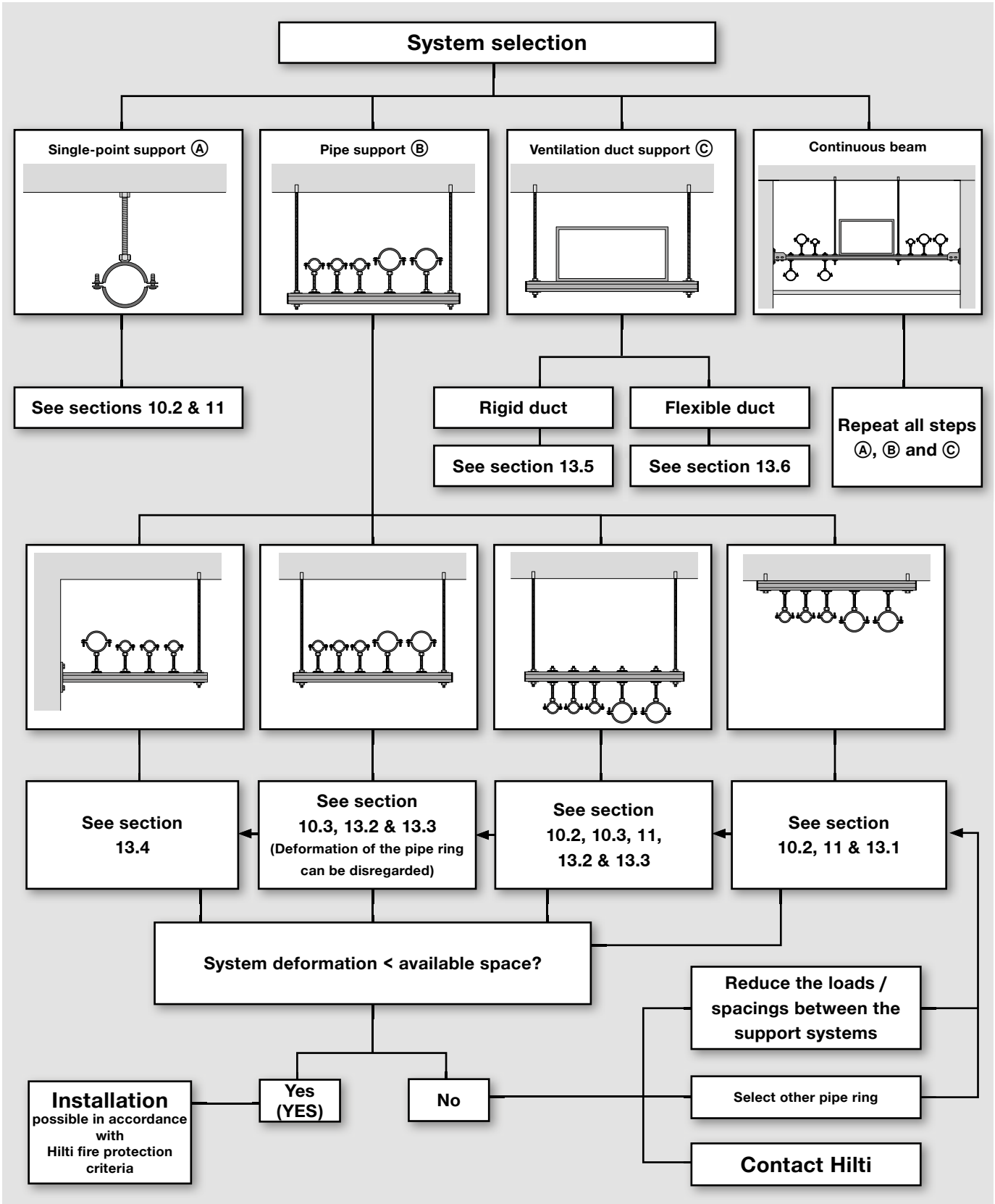


- Even in cases where there is no buckling, the actual deformations are far greater than the designs according to EC3.

10.0 Selection of fire-tested systems and products

10.1 System selection

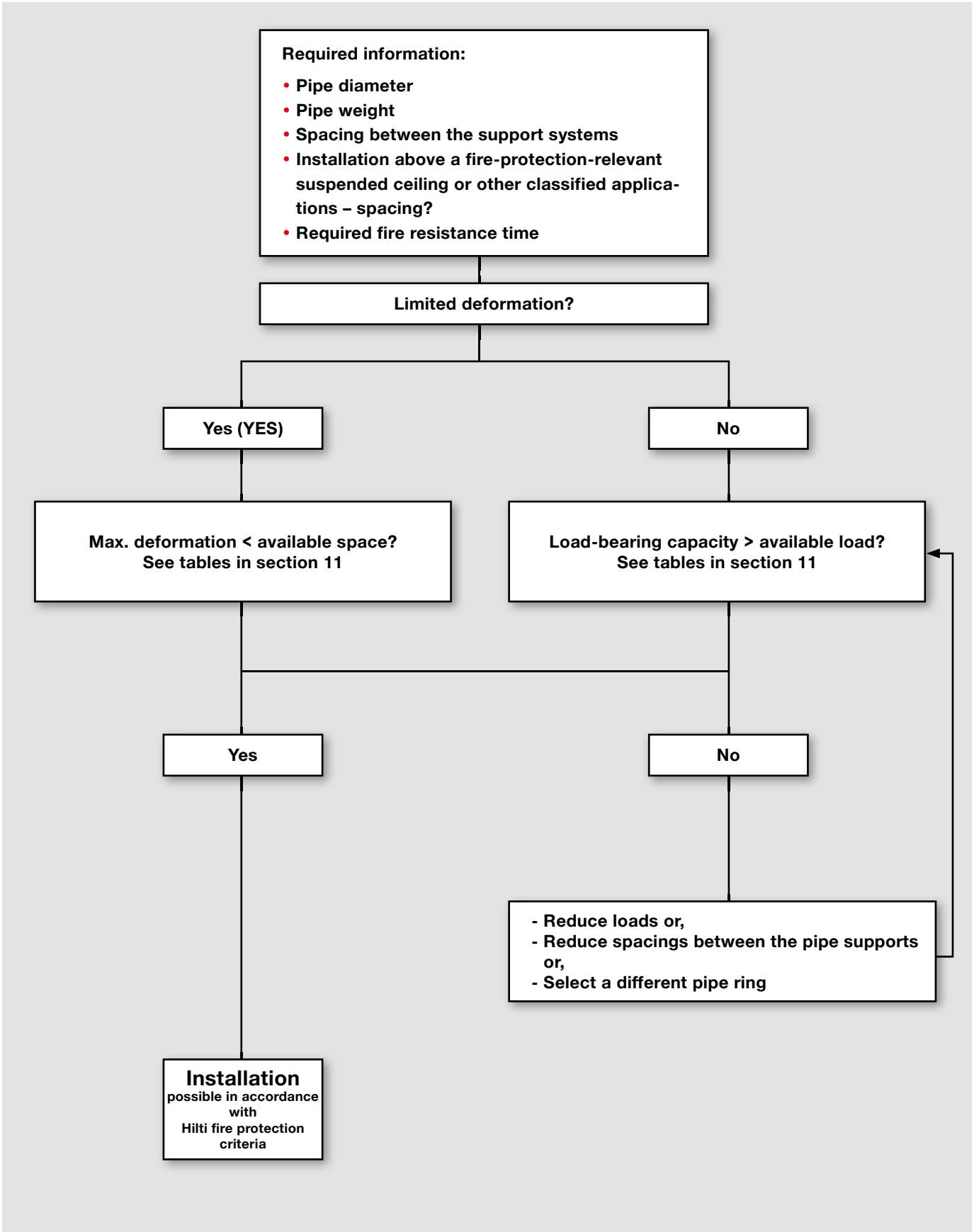
Selection procedure for fastening systems



Note: Use fire-tested Hilti anchors (annex 7)

10.2 Selection of pipe ring

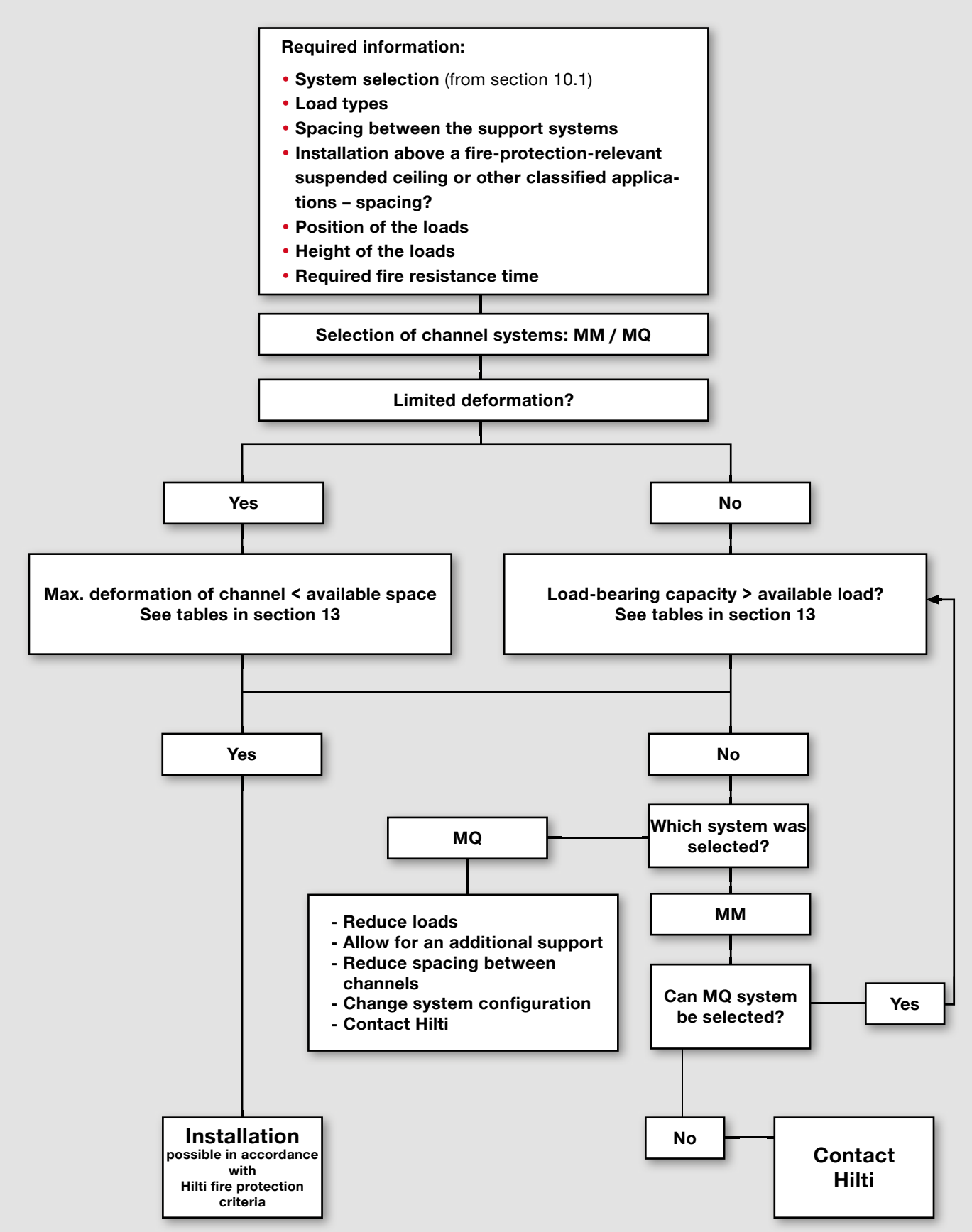
Selection procedure for fire-tested pipe rings



Note: Use fire-tested Hilti anchors (annex 7)

10.3 Selection of installation channel system

Selection procedure for fire-tested installation channel systems



Note: Use fire-tested Hilti anchors (annex 7)

11.0 Hilti fire-tested pipe rings

Hilti has tested various types of pipe ring over the last few years in accordance with the RAL quality guideline GZ-656 [6]. Furthermore, in the past other rings were fire-tested and evaluated by IBMB in Braunschweig. The corresponding RAL and IBMB test reports are summarized in annex 3.

Critical areas of suspended pipe rings when exposed to fire:

- Connection boss
  - Welded seam
  - Thread failure, internal thread on connection boss or threaded rod

- Closing mechanism
  - Joint
  - Screw
  - Quick-lock closure

MP-MXI pipe ring before and after the fire test

MP-MXI pipe ring with pipe dummy after the fire test

Overview of fire-tested pipe rings:

MPN-LI
RAL TD656.2011-17a.01

MPN-QRC
IBMB (3364/7036)-CM

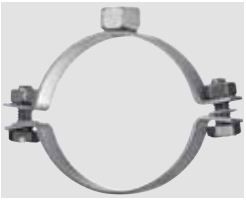
MP-HI M8/M10
RAL TD656.2011-18a.01

MPN-RC
IBMB (3712/787/09)-CM

MP-MI/MIS
RAL TD656.2013-04a.01

MP-MX/MXI
IBMB (3365/7046)-CM

MP-SRNI
RAL TD656.2011-16a.01



MP-SRN
RAL TD656.2011-16a.02

MPN-MR
IBMB (3366/7056)-CM

MP-MRXI
IBMB (3366/7056)-CM

Pipe ring after the fire test, no failure, severe deformation in at the closing mechanism

Pipe rings after the fire test, failure in the locking mechanism

11.1 Hilti fire-tested galvanized pipe rings

The following conditions must be clarified before a suitable pipe ring can be determined based upon the table:

1. The applicable pipe diameter.
2. Calculation of pipe weight per meter, taking the filling and possible insulation into account.
3. Definition of the available space between the pipe ring and relevant fire protection applications that are positioned below.
4. Clarification of the required fire resistance time.

The following table is used to clarify whether the pipe weight is lower than the maximum load capacity of the pipe ring with the specified spacing of the suspensions. Furthermore, it is possible to read whether the spacing is sufficient between the pipe ring and a classified building component or system that is installed below.

Pipe ring selection table

Pipe dimension		Clamping range	Load / Deformation			Clamping range	Load / Deformation			Clamping range	Load / Deformation			Clamping range	Load / Deformation			Clamping range	Load / Deformation		Max. weight steel pipe, filled
			FWD 30	FWD 90			FWD 30	FWD 90			FWD 30	FWD 90			FWD 30	FWD 90			FWD 30	FWD 90	
		[mm]	[N]/ [mm]	[N]/ [mm]		[mm]	[N]/ [mm]	[N]/ [mm]		[mm]	[N]/ [mm]	[N]/ [mm]		[mm]	[N]/ [mm]	[N]/ [mm]		[mm]	[N]/ [mm]	[N]/ [mm]	[N/m]
8/11	MPN-LI (M8)	8 - 61	120/ 10 320/ 23	70/31	MPN-QRC (M10)	8 - 41	300/ 50	130/ 55	MPN-RC (M8/M10)	8 - 61 (20 x 1 mm)	100/ 50 130/ >50		MP-HI (M8)	8-38	50/ 10 270/ 27	90/ 30	MP-MI / MIS (M10/M12/M16)								7
1"																		14-64	230/ 20 840/ 39	350/ 54					41
2"						40 - 93	450/ 50	190/ 75						38-66	150/ 15 280/ 39	140/ 39					MP-MX / MP-MXI (M10/M12/M16)	60-93	1050/ 50 1700/ 122	850/ 122	72
3"										40 - 93 (20 x 15 mm)	200/ 50 380/ >50			66-110	280/ 30 580/ 46	230/ 46		68-90	270/ 25 850/ 45	430/ 59					135
4"						99 - 118	500/ 50 750/ 82	360/ 82														108-166	1600/ 50 1700/ 148	850/ 148	209
5"										99 - 170 (20 x 2 mm)	450/ 30 590/ >50			110-172	590/ 50 640/ 54	310/ 54		97-168	390/ 30 1320/ 66	730/ 75					298
6"																									386
8"																		177.8-267	770/ 50 1780/ 69	790/ 78		163-508	2300/ 50 3000/ 218	1600/ 218	947
368																									1600
457																									2600
508																									3200

Note: Use fire-tested Hilti anchors (annex 7)

11.2 Hilti fire-tested pipe rings – stainless steel

The following conditions must be clarified before a suitable pipe ring can be determined based upon the table:

1. The applicable of pipe diameter.
2. Calculation of pipe weight per meter taking into account the filling and possible insulation.
3. Definition of the available space between the pipe ring and relevant fire protection applications that are positioned below.
4. 4. Clarification of the required fire resistance time

The following table is used to clarify the issue of whether the pipe weight (2) is lower than the maximum load capacity of the pipe ring with the specified spacing of the suspensions. Furthermore, it is possible to read whether the spacing (3) is sufficient between the pipe ring and a classified building component or system that is installed below.

Selection table for stainless steel pipe rings

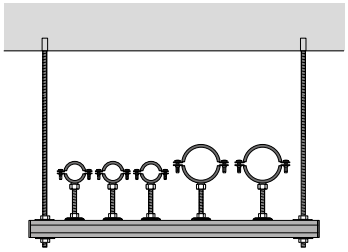
Pipe dimension		Clamping range	Load / Deformation			Clamping range	Load / Deformation		Max. weight steel pipe, filled
			FWD 30	FWD 90			FWD 30	FWD 90	
		[mm]	[N]/ **[mm]**	[N]/ **[mm]**		[mm]	[N]/ **[mm]**	[N]/ **[mm]**	[N/m]
8/11	**MP-SRNI** (M8/M10)	17 - 34	310/ **10** 1300/ **20**	410/ **41**	**MP-SRN** (M8/M10)	21 - 42	310/ **10** 1300/ **20**	410/ **41**	2
1"									32
2"		42 - 60	1040/ **10** 1600/ **12**	700/ **17**		42 - 60	1040/ **10** 1600/ **12**	700/ **17**	59
3"	**MP-MR** (M12/M16)	68 - 219.1	1500/ **50** 3600/ **128**	1300/ **128**					100
4"									166
5"									231
6"									338
8"									821
368	**MRXI** (M16)	244.5 - 508	1500/ **50** 3600/ **128**	1300/ **193**					1377
457									2619
508									3224

Note: Use fire-tested Hilti anchors (annex 7)

Pipe ring after the fire test, tearing of the connection boss

Pipe ring after the fire test, tearing of the ring band

MP-MXI pipe rings, view inside the furnace after the end of the fire test



11.3 Restriction of the threaded rod length for upright installation

To avoid sudden failure of the upright pipe rings due to lack of rigidity, it is recommended that the threaded rod lengths specified in the following tables are not exceeded.

Max. threaded rod length for upright installation of pipe rings

Threaded rod M8 (4.8)

	Recommended max. length of the threaded rod for upright installation			
Vertical load [N]	**FWD 30** [mm]	**FWD 60** [mm]	**FWD 90** [mm]	**FWD 120** [mm]
100	80	80	80	80
150			40	40
200		40		
250				
300	40			
400				
450				
500				

Threaded rod M10 (4.8)

	Recommended max. length of the threaded rod for upright installation			
Vertical load [N]	**FWD 30** [mm]	**FWD 60** [mm]	**FWD 90** [mm]	**FWD 120** [mm]
100	140	140	140	140
150			80	80
200		80		
250			40	40
300	80			
400		40		
450				
500				
600	40			
700				
750				

Threaded rod M12 (4.8)

	Recommended max. length of the threaded rod for upright installation			
Vertical load [N]	**FWD 30** [mm]	**FWD 60** [mm]	**FWD 90** [mm]	**FWD 120** [mm]
100	160	160	160	160
150				120
200			120	80
250				
300		120	80	60
400			60	40
450		80		
500			40	
600	120			
700		60		
750				
800	80	40		
900				
1000				
1050	60			
1250				
1300	40			
1500				

Threaded rod M16 (4.8)

	Recommended max. length of the threaded rod for upright installation			
Vertical load [N]	**FWD 30** [mm]	**FWD 60** [mm]	**FWD 90** [mm]	**FWD 120** [mm]
400	160	160	160	160
450				140
500				120
600			140	100
700		140	120	80
750				
800			100	60
900		120	80	40
1000				
1050	140	100	60	
1100				
1200		80	40	
1250				
1300	120			
1350		60		
1400				
1500		40		
1600	100			
1700				
2000				
2100	80			
2250				
2300	60			
2500				
2600	40			
2900				

12.0 Hilti fire-tested roller connectors

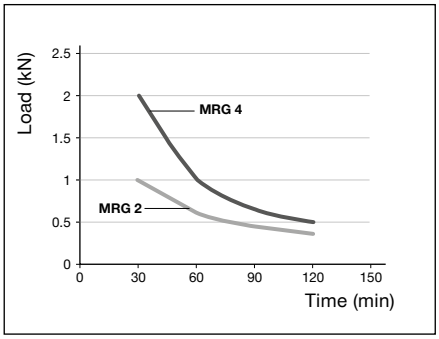
The MRG-2 and MRG-4 roller connectors allow thermal expansion of a pipe in the axial direction without the fastening to the base material being subjected to forces of constraint.

In order to avoid eccentric loading of suspended support channels in the event of a fire, MRG-2 and MRG-4 roller connectors are intended for use only in applications where the connectors are fastened directly to the base material (building structure). Use in connection with installation channels is not permitted.

Vertical deformation in the event of a fire is very low due to the solidity of the roller connectors and can therefore be disregarded.

Failure under tensile loading occurs either due to the threaded rod being pulled out of the connection boss or through failure of the rivet connection between the connection boss and the carriage.

The assessment includes the MRG-2 and MRG-4 roller connectors as well as the electrogalvanized, hot-dip galvanized and stainless steel types (see annex 4).



Fire design for roller connector MRG-2 / MRG-4

MRG-2 roller connector

Centric and eccentric loading of the roller connector

Mode of failure: threaded tubing pulled out of the carriage

13.0 Hilti fire-tested installation channel systems

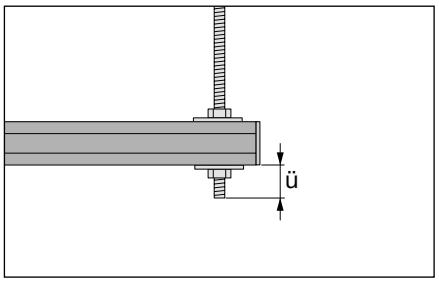
Over the last few years, Hilti has carried out many fire tests on different systems and products. The exposure to fire was consistent according to the uniform temperature time curve (UTTC) as per EN 1363-1.
In order to be able to offer a technically optimized and perfectly satisfactory solution that is also cost-effective, tests were carried out on different channels – **MM-C-36, MM-C-45, MQ-21, MQ-41, MQ-41 LL, MQ-41/3, MQ-41/3 LL and MQ-41 D and brackets MM-B-36, MQK-41 and MQK-41/3**.

The tested applications are listed below:
- Fastening directly to the ceiling
- Suspended installation – on threaded rods
- U-support (frame)
- Bracket – suspended at one end with a threaded rod
- Support system for duct made from calcium silicate sheet (rigid duct)
- Support system for sheet metal channel (flexible duct)
- Continuous beam
- Strengthening for existing installations

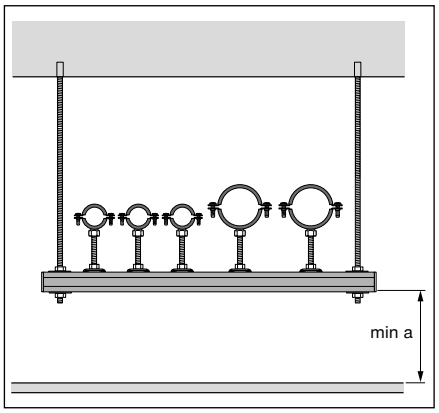
Fire-tested system configurations

System configuration	Channels and brackets					See section
	MM-C-36 MM-C-45 MM-B-36	MQ-21	MQ-41 MQ-41 LL MQK-41	MQ-41/3 MQ-41/3 LL MQK-41/3	MQ-41 D	
Channel installation on the ceiling	✓	✓	✓	✓		13.1
Suspended installation with threaded rods	✓		✓	✓		13.2
Suspended installation with installation channels				✓		13.3
Suspended bracket	✓		✓	✓		13.4
Rigid duct	✓		✓	✓		13.5
Flexible duct	✓		✓	✓		13.6
Continuous beam				✓		13.7
Strengthening of existing installation				✓		13.8

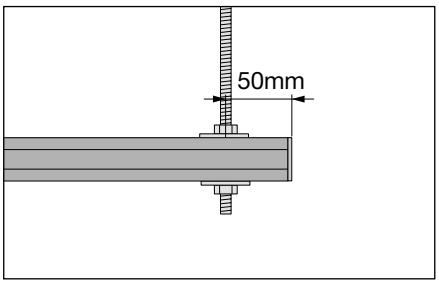
Each system configuration is explained in a separate section in the following. Each section includes detailed information about the application conditions and loads, depending on the required fire resistance time.
The load tables used are based upon the detailed tables from the official fire testing reports of IBMB Braunschweig.
These test reports are summarized in annex 5.



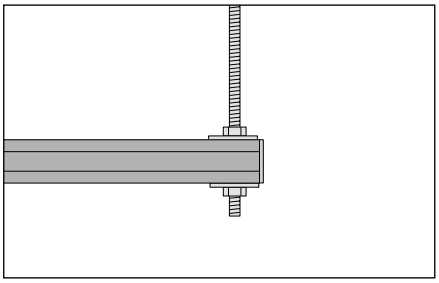
Maximum projection ü = 30 mm



Minimum spacing min a



a) Position of nodes > FWD 30

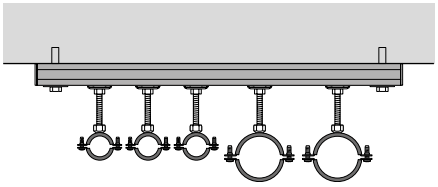


b) Position of nodes ≤ FWD 30

General stipulations and restrictions:

- Multiple loads must be distributed and arranged equally over the span width. If the total number of loads is reduced, it is not permissible to increase a single load beyond the value in the table. This ensures that the permissible stress of the threaded rods for the suspension does not exceed the maximum specified system deformation.
- The specified loads for several adjacent point loads are specified as the maximum total load for each channel system. This ensures that the total load (carrying load) of the channels is not exceeded if upright and suspended pipe rings are installed on the same channel.
- If Hilti installation channel systems are positioned above fire protection suspended ceilings, a minimum spacing "min a" between the top of the suspended ceiling and the bottom of the installation channel system must be observed.
  This is necessary in order to prevent damage to the fire-protected suspended ceiling as a result of deformation of the support system brought about through high temperatures.
- The specified minimum spacing "min a" takes into account the projection of the threaded rod below the load-bearing channel "ü", the thermal expansion of the threaded rods for the suspension as well as the maximum deflection, e.g. at the critical point on the channel in the center of the static span width of a beam.
- In addition to the minimum spacing "min a" that is required in the event of a fire, the deformation of the load-bearing channel as a result of the load at normal temperature must be added.
- The maximum projection of the threaded rod below the load-bearing channel should not exceed "ü" = 30 mm. If the 30 mm is exceeded, the total projection, minus the 30 mm must be added to the deformation of the support system "min a" specified in the table.
- All fire-tested Hilti installation channel systems must be fastened with Hilti fire-tested anchors.
- The threaded rods for suspending the installation channels must always be fastened in a complete (uncut) elongated hole.
- If pipe rings are fastened on the underside of the load-bearing channel, the deformation of the pipe ring must be taken into account in addition to the deflection of the load-bearing channel.
- If the installation is upright, deformation of the pipe ring can be disregarded.
- The evaluation for MQ installation channel systems made of galvanized steel (also applies to MQ-F and HDG-plus hot-dip galvanized systems) can be transferred to the same systems made of stainless steel.
- **MM system:** The nodes between MM-C channels and threaded rods must be created using MM-CW channel washers and corresponding nuts. If MM-C channels are suspended from the ceiling on threaded rods, MM-CW channel washers must be used on both sides of the channel. Alternatively if the channels are suspended, the lower MM-CW channel washer can be replaced with a washer (Ø 28 mm, thickness ≥ 2.0 mm). However, a MM-CW channel washer must be always be fitted on the open side of the channel.
- **MQ 41/3 system:** The installation of pipe rings or other building components below the installation channels is only permissible as a through-fastening, with MQZ plates and nuts permitted on both sides.
- **MQ system:** With suspended and directly-assembled MQ installation channels, a lateral channel projection of at least 50 mm from the central axis of the threaded rod must be observed. In the case of MLAR (FWD 30) applications with reduced load and limitation of the deflection to max. 50 mm, it is permissible for MQZ-L plates to be seated flush with the end of the channel (figure b).

13.1 Channel installation on the ceiling



Hilti offers fire-tested fastening solutions for installing pipes directly on ceilings with the following channel types:

- MM-C-36 and MM-C-45
- MQ-21, MQ-41 and MQ-41 LL
- MQ-41/3 and MQ-41/3 LL

The general stipulations and limitations for using installation channels are summarized in section 13.0.
If the channels are installed directly on the ceiling, failure occurs as a result of bending of the channel lips at the same time as deformation of the channel nuts (see figure).

Deformation of MQA-B and channel MQ-41, shortly before failure

Extreme deformation of the MQA channel nut with cold-formed sheet metal nut

Directly-installed channel with single load

Directly-installed channel MQ-21, span 350 mm, 3 single loads

Directly-installed channel MQ-21 and MQ-41, span 700 mm

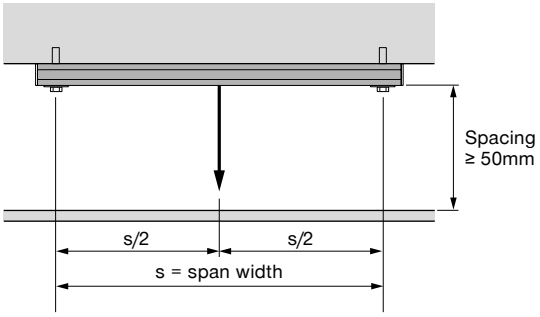
13.1.1 Fastening to the ceiling – MM-C-36 and MM-C-45 installation channels

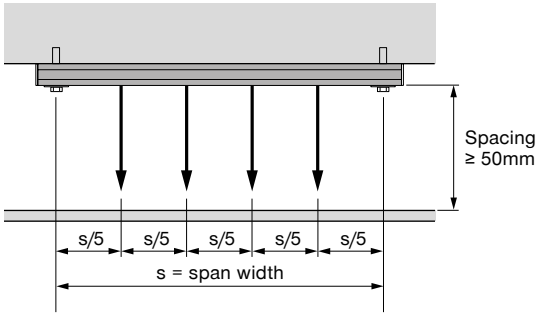
The following tables for the possible ultimate loads of the MM-C-36 and MM-C-45 fire-tested installation channels, depending on the required fire resistance time, are based upon IBMB test report no. 3074/068/12-CM, table 2-1 to 2-2 (annex 5a). The general stipulations and limitations for using installation channels are summarized in section 13.0.

Ceiling-mounted installation channel
Fire resistance time of 30 minutes
Deformation of the channel ≤ 50 mm

Installation channel		**MM-C-36**	**MM-C-45**
Span width		400mm	
Pipe ring saddle		MM-S and MM-ST (≥ M8)	
Single load	(kN)	0.15	0.15
Multiple load ≤ 4 loads	(kN)	4 x 0.113	4 x 0.113

Extract from the IBMB test report (3074/068/12)-CM, table 2-1 to 2-2





Note:

- MM-C installation channels can be fastened directly to concrete using Hilti HUS-P6 concrete screws as well as suitable Hilti fire-tested anchors, dimension M8 or M10, washers Ø ≥ 16 mm and corresponding hexagon nuts (strength class ≥ 8).


Preparation for fire test with MM-C-45


MM-S pipe ring saddle after the fire test


MM-C channel, with central single load, low partial deformation after failure of MM-S

Note: Use fire-tested Hilti anchors (annex 7)

13.1.1 Fastening to the ceiling – MQ-21 and MQ-41 installation channels

The following tables for the possible ultimate loads of the MQ-21 and MQ-41 (2 mm) fire-tested installation channels, depending on the required fire resistance time, are based upon IBMB test report no. 2100/580/15-CM, table 3-1 (annex 5b). The general stipulations and limitations for using installation channels are summarized in section 13.0.
Both the MQA and MQA-B pipe ring saddle can be used to fasten the loads.

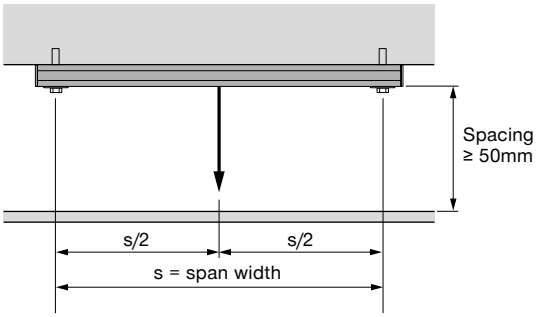
Ceiling-mounted installation channel MQ-21 or MQ-41
Fire resistance time of 30 minutes
Deformation of the channel ≤ 50 mm

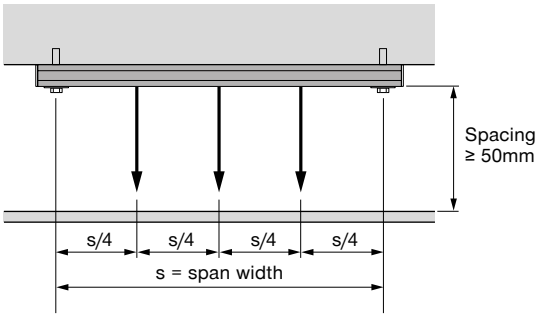
Span width		350mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.35	0.45
Multiple load	(kN)	3 x 0.25	3 x 0.30

Span width		500mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.30	0.40
Multiple load	(kN)	3 x 0.20	3 x 0.25

Span width		700mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.25	0.35
Multiple load	(kN)	3 x 0.15	3 x 0.20

Extract from IBMB test report no. 2100/580/15-CM





Note: Use fire-tested Hilti anchors (annex 7)

13.1.3 Fastening to the ceiling – MQ-41/3 and MQ-41/3 LL installation channels

The following tables for the possible ultimate loads of the MQ-41/3 fire-tested installation channel, depending on the required fire resistance time, are based upon IBMB test report no. 3054/048/12-CM, table C-1 to C-5 (annex 5c).
These tables can also be used for the MQ-41/3 LL ventilation channel.
Besides the shorter elongated holes, channel MQ-41/3LL is identical to installation channel MQ-41/3. The general stipulations and limitations for using installation channels are summarized in section 13.0. The MQA-B pipe ring saddle must be used to fasten the loads.

Ceiling-mounted installation channel MQ-41/3 and MQ-41/3 LL

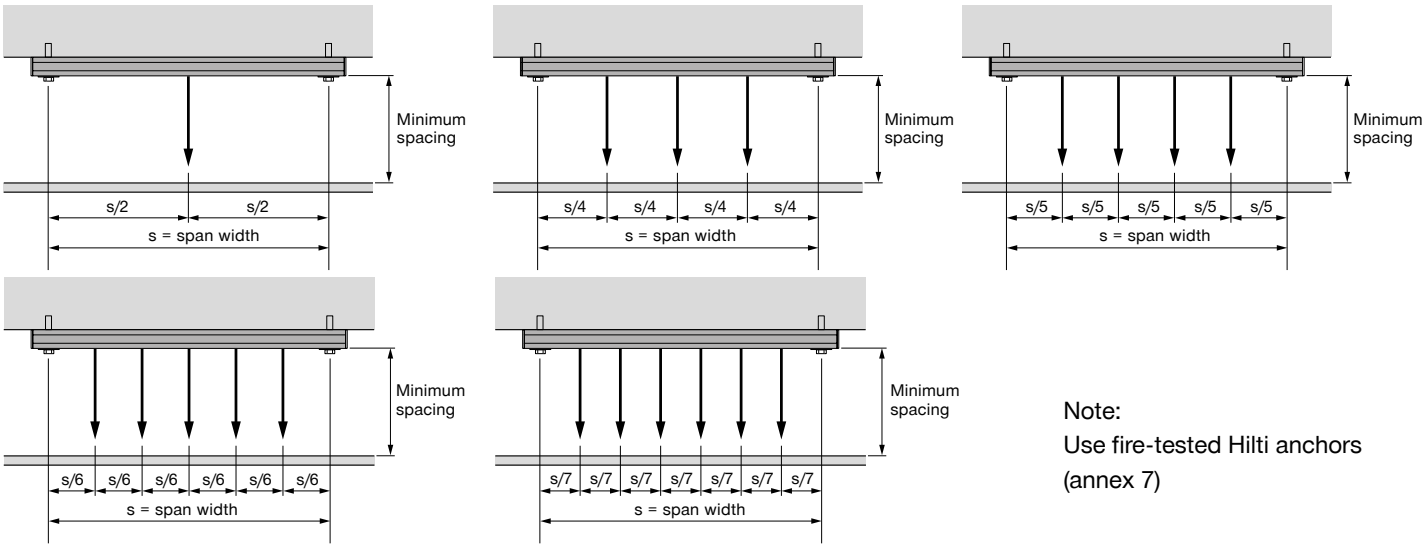
Span width		350mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.60	0.95	0.65	0.60
Multiple load	(kN)	3 x 0.90	3 x 0.45	3 x 0.30	3 x 0.28
Minimum spacing	(mm)	55	55	55	55

Span width		500mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.35	0.80	0.50	0.45
Multiple load	(kN)	4 x 0.58	4 x 0.31	4 x 0.19	4 x 0.17
Minimum spacing	(mm)	85	85	75	75

Span width		600mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.10	0.70	0.45	0.40
Multiple load	(kN)	5 x 0.42	5 x 0.22	5 x 0.14	5 x 0.12
Minimum spacing	(mm)	95	95	80	80

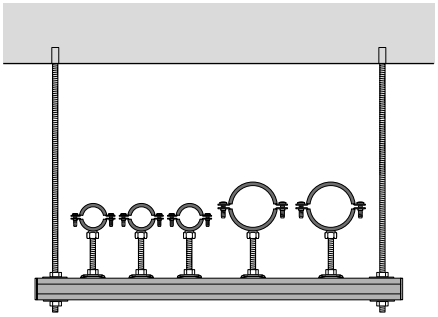
Span width		700mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.00	0.60	0.40	0.35
Multiple load	(kN)	6 x 0.30	6 x 0.16	6 x 0.11	6 x 0.10
Minimum spacing	(mm)	100	100	80	80

Extract from IBMB test report no. 2100/580/15-CM



Note:
Use fire-tested Hilti anchors (annex 7)

13.2 Suspended installation



Hilti offers fire-tested fastening solutions for suspended installations with the following channel types:

- MM-C-36 and MM-C-45
- MQ-41 and MQ-41 LL
- MQ-41/3 and MQ-41/3 LL

The general stipulations and limitations for using installation channels are summarized in section 13.0.

13.2.1 Suspended installation – MM-C-36 or MM-C-45 installation channel

The following tables for the possible ultimate loads of the MM-C-36 and MM-C-45 fire-tested installation channels, depending on the required fire resistance time, are based upon IBMB test report no. 3074/068/12-CM, table 2-1 to 2-2 (annex 5a).

Suspended MM-C channels must be installed with the channel opening facing upwards. MM-S and MM-ST pipe ring saddles may only be used in a channel that is facing upwards. The use of MM-S and MM-ST in one of the suspended MM-C channels facing downwards is not covered by the test report.

Pipes may only be fastened below suspended MM-C channels installed with the open side facing upwards, using a through-fastening with MM-CW channel washer and nuts on both sides and threaded rods ≥ M8 of the strength class ≥ 4.8.

Fire test of MM-C channels with single load

MM-C-45 channel, suspended, with single load after the fire test

Suspended MM-C installation channel with multiple load after the fire test

Stipulations and restrictions:

- Fire resistance time of 30 minutes.
- Table values are maximum loads for Hilti installation channel systems with MM-C-36 and MM-C-45 channel profiles.
- Deformation in the event of a fire with regard to the relevant fire protection applications ≤ 50 mm installed below.
- The specified spacing of ≤ 50 mm takes into account the deformation of the installation channels. If required, additional deformation must be taken into account separately, such as deformation of pipe rings and pipes.
- Suspension height ≤ 500 mm.
- If the suspension height is higher (up to 1,500 mm), the additional sagging of the system on account of the thermal expansion of the threaded rods must be taken into account.

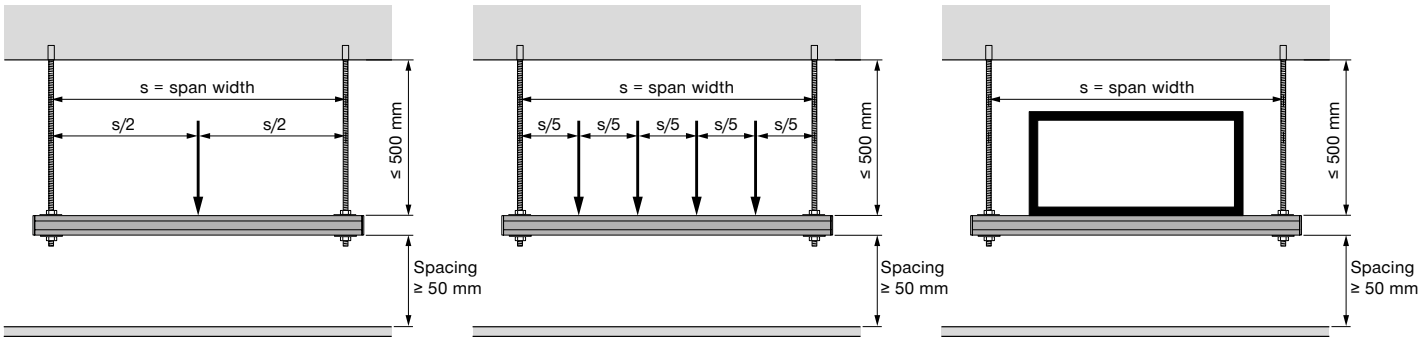
Fastening of pipe rings
Channel underside:
Through-fastening with
2 x MM-CW M8 or
2 x MM-CW M10

Channel upper side:
MM-S and MM-ST (≥ M8)

Suspended installation channel
Fire resistance time of 30 minutes
Deformation of the channel ≤ 50 mm

Installation channel		MM-C-36	MM-C-45
Span width		400mm	
Single load	(kN)	0.25	0.35
Multiple load ≤ 4 loads	(kN)	4 x 0.125	4 x 0.175
Equal load (Σ equally distributed load)	(kN)	0.50	1.00
Span width		700mm	
Equal load (Σ equally distributed load)	(kN)	0.35	0.50

Extract from IBMB test report no. (3074/068/12)-CM, table 2-1 to 2-2
Suspension height ≤ 500 mm



Note: Use fire-tested Hilti anchors (annex 7)

13.2.2 Suspended installation – MQ-41 or MQ-41 LL installation channel

The following tables for the possible ultimate loads of the MQ-41 and MQ-41 LL fire-tested installation channels, depending on the required fire resistance time, are based upon IBMB test report no. 2100/580/15-CM (annex 5b).

Stipulations and restrictions:
- The channel can be installed with the opening facing upwards or downwards.
- MQA and MQA-B pipe ring saddles can be used in both directions.
- MQZ-L (node) drilled plates can sit directly flush with the channel
- The fire resistance time is limited to 30 minutes.
- The loads are reduced compared with MQ-41/3.

MQ-41, suspended installation, MQA installed on the underside

MQ-41, suspended installation, 3 single loads, MQA installed on the underside

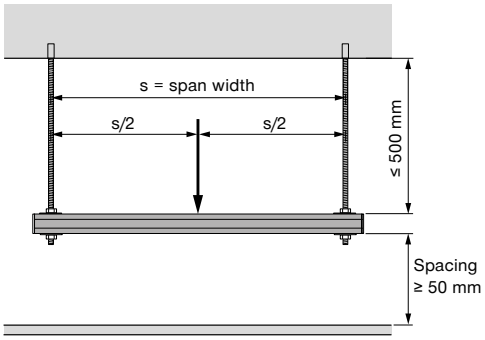
Suspended installation channel MQ-41
Fire resistance time of 30 minutes
Deformation of the channel ≤ 50 mm

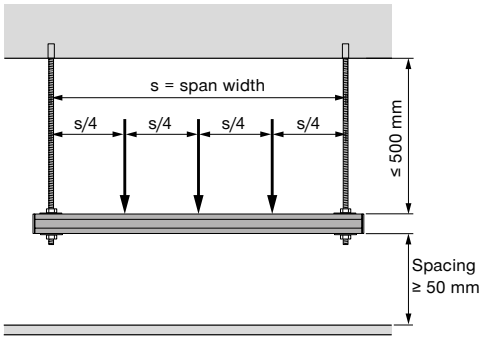
Span width		350mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.40	0.50
Multiple load	(kN)	3 x 0.30	3 x 0.35

Span width		500mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.30	0.40
Multiple load	(kN)	3 x 0.20	3 x 0.25

Span width		700mm	
Pipe ring saddle		≥ MQA M8	≥ MQA M10 B
Single load	(kN)	0.20	0.30
Multiple load	(kN)	3 x 0.12	3 x 0.15

Extract from IBMB test report no. 2100/580/15-CM
Suspension height ≤ 500 mm





Note: Use fire-tested Hilti anchors (annex 7)

13.2.3 Suspended installation – MQ-41/3 or MQ-41/3 LL installation channel

The following tables for the possible ultimate loads of the MQ-41/3 and MQ-41/3 LL fire-tested installation channels, depending on the required fire resistance time, are based upon IBMB test report no. 3054/048/12-CM (annex 5c). These tables can also be used for the MQ-41/3 LL ventilation systems channel. MQ-41/3LL channel is identical to MQ-41/3 installation channel, apart from the shorter elongated holes.

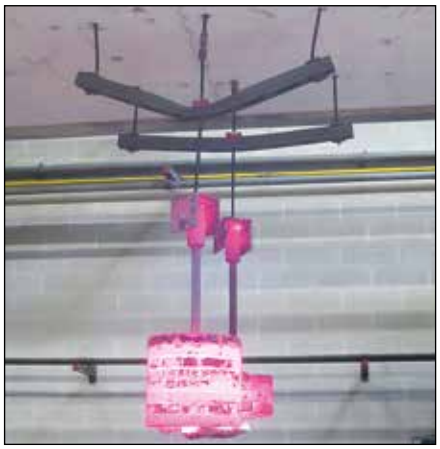
Stipulations and restrictions:

- The channel must be installed with the opening facing upwards.
- Pipe rings may only be fastened below suspended MQ-41/3 installation channels with the open side facing upwards, when a through-fastening is used with threaded rods ≥ M10 of the strength class ≥ 4.8, MQZ-L drilled plates and corresponding nuts on both sides of the channel.
- Underside installation with MQA-B is not covered by the test report.
- Hilti MQA M8 pipe ring saddles can be used alternatively in connection with fire-tested pipe rings with M8 connection thread with the required fire resistance time of 30 minutes. In doing so, the maximum single load of 0.40 kN must not be exceeded. If several pipe rings are positioned on the channel, none of these single loads must exceed 0.30 kN.

Suspended MQ installation channel with equal load immediately after the start of the fire test

Significant deformation of the channels when exposed to fire, depending on the applied load and the duration of the fire

Suspended MQ installation channel with central single load before the fire test



Suspended MQ installation channel with central single load. The central threaded rod is used for measuring the deformation

Suspended installation channel - Maximum load
MQ-41/3 and MQ-41/3 LL

Span width		350mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.70*	1.20	0.80	0.60
Minimum spacing	(mm)	185	170	155	175
Multiple load	(kN)	3 x 1.06	3 x 0.58	3 x 0.40	3 x 0.31
Minimum spacing	(mm)	55	60	70	65

Span width		700mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.70*	1.20	0.80	0.60
Minimum spacing	(mm)	380	305	295	290
Multiple load	(kN)	6 x 0.48	6 x 0.25	6 x 0.17	6 x 0.13
Minimum spacing	(mm)	240	225	200	195

Span width		1000mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.45	0.90	0.70	0.60
Minimum spacing	(mm)	440	395	390	395
Multiple load	(kN)	9 x 0.27	9 x 0.14	9 x 0.10	9 x 0.07
Minimum spacing	(mm)	95	370	345	330

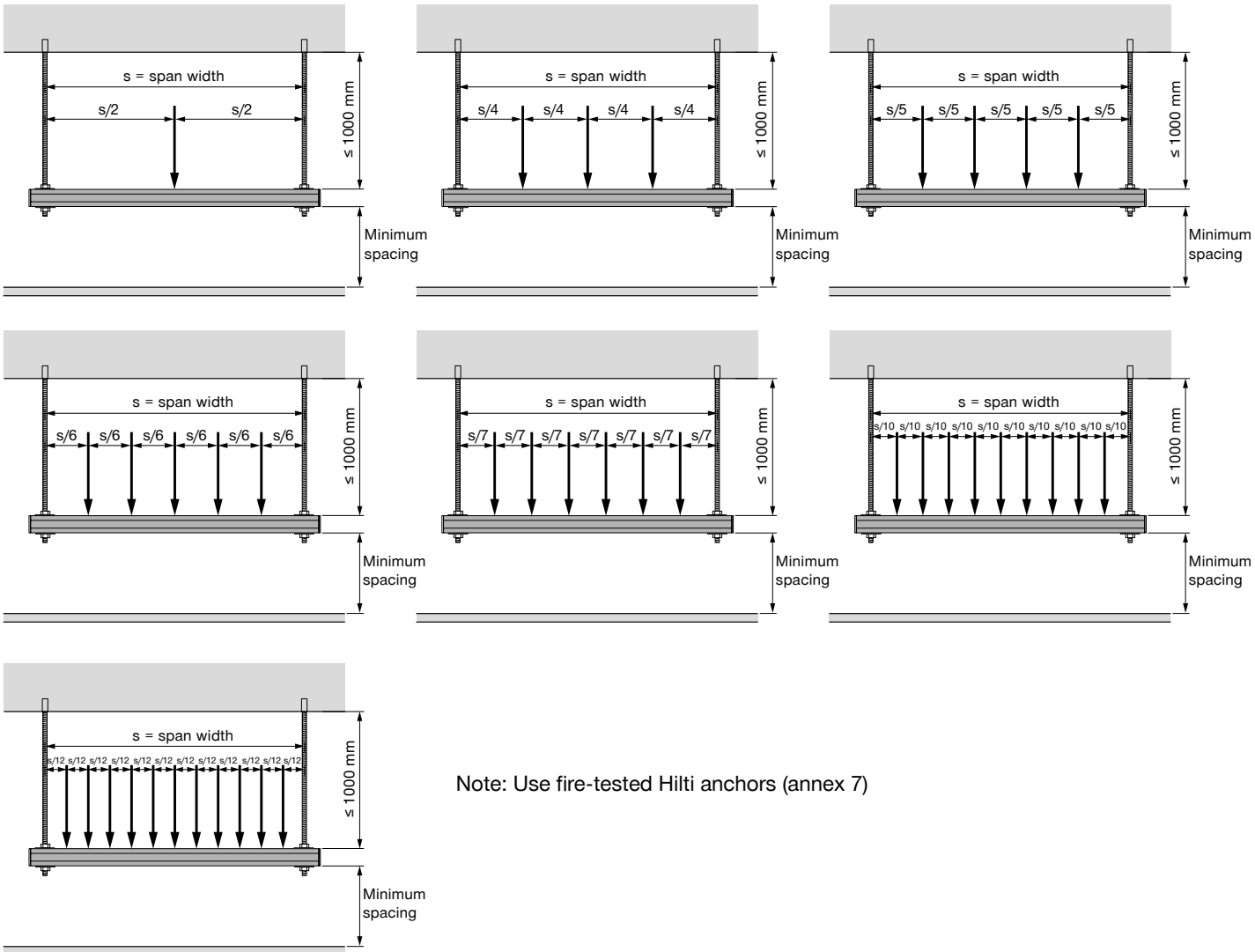
Span width		1250mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.20	0.85	0.70	0.60
Minimum spacing	(mm)	495	475	465	475
Multiple load	(kN)	11 x 0.21	11 x 0.10	11 x 0.07	11 x 0.05
Minimum spacing	(mm)	625	530	495	485

Extract from IBMB test report no. (3054/048/12)-CM, table D-6 to D25
The table takes a suspension height of 1,000 mm into account
* When using threaded rods ≥ M12 single loads can be increased to 2.4 kN

Note: Use fire-tested Hilti anchors (annex 7)

Suspended installation channel MQ-41/3 and MQ-41/3 LL Fire resistance time: 30 minutes					
Span width		350mm			
Single load	(kN)	1.10	1.05	1.00	0.95
Multiple load	(kN)	3 x 0.82	3 x 0.81	3 x 0.76	3 x 0.55
Minimum spacing	(mm)	100	80	60	40
Span width		500mm			
Single load	(kN)	0.70	0.65	0.60	0.55
Multiple load	(kN)	4 x 0.37	4 x 0.34	4 x 0.32	4 x 0.24
Minimum spacing	(mm)	100	80	60	40
Span width		600mm			
Single load	(kN)	0.55	0.50	0.45	0.40
Multiple load	(kN)	5 x 0.23	5 x 0.20	5 x 0.17	5 x 0.13
Minimum spacing	(mm)	100	80	60	40
Span width		700mm			
Single load	(kN)	0.45	0.40	0.35	0.30
Multiple load	(kN)	6 x 0.15	6 x 0.13	6 x 0.11	6 x 0.10
Minimum spacing	(mm)	100	80	60	40

Extract from IBMB test report no. (3054/048/12)-CM, table B-1 to B-4
The table takes a suspension height of 1,000 mm into account



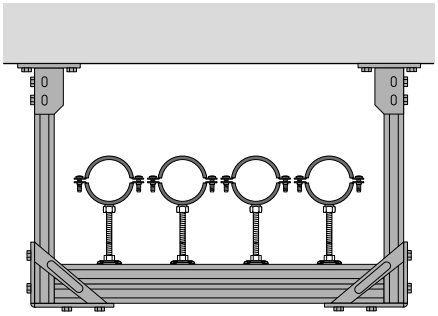
Note: Use fire-tested Hilti anchors (annex 7)

13.3 U-support

In addition to the general stipulations and limitations for using installation channels (section 13.0), the following points must be observed:

Stipulations and restrictions:

- Fastening of the MQP-21-72 channel support onto the ceiling exclusively using fire-protected Hilti anchors.
- The MQ-41/3 vertical channels must be fastened to the MQP-21-72 channel support using two MQN channel connectors in each case.
- The MQ-41 D horizontal load-bearing channel is connected to the vertical MQ-41/3 channels using the MQW-S/2 angle.
- Care must be taken to ensure that the MQP-41 D horizontal channel lies between the MQ-41/3 vertical channels on both sides and that the MQW-S/2 angle is positioned in such a way that two nodes are engaged in the vertical and horizontal channels.
- Use of the MQA-B pipe ring saddle is not permissible in the side of the MQ-41 double channel that faces downwards. In this case the fastening must comprise of a through-fastening with threaded rods ≥ M10 of the strength class ≥ 4.8, MQZ-L drilled plates and nuts on both sides.



U-support with single load or multiple load before the fire test

U-support with single load or multiple load after the fire test

13.3.1 U-support – MQ-41/3 (vertical) and MQ-41/D (horizontal) installation channel

The following tables for the possible ultimate loads of the fire-tested U-support systems, depending on the required fire resistance time, are based upon IBMB test report no. 3022/9626-CM, table A-1 to A-4 (annex 5d).

U-support - Maximum loads
Components used: MQ 41/3 (vertical), MQ 41D (horizontal), MQP 21-72, MQW-S/2, MQN

Span width		700mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	2.54	1.48	1.09	0.87
Minimum spacing	(mm)	284	239	148	161
Multiple load	(kN)	6 x 0.64	6 x 0.45	6 x 0.32	6 x 0.25
Minimum spacing	(mm)	50	90	110	84

Span width		1000mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	2.46	1.17	0.76	0.56
Minimum spacing	(mm)	424	234	266	248
Multiple load	(kN)	9 x 0.32	9 x 0.19	9 x 0.14	9 x 0.11
Minimum spacing	(mm)	124	103	116	122

Span width		1250mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Single load	(kN)	1.98	1.00	0.67	0.51
Minimum spacing	(mm)	458	470	355	394
Multiple load	(kN)	11 x 0.24	11 x 0.12	11 x 0.08	11 x 0.06
Minimum spacing	(mm)	139	97	136	205

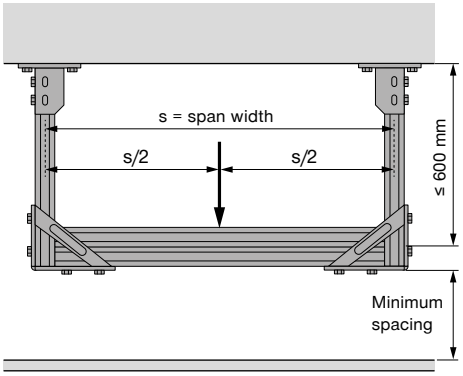
Extract from IBMB test report no. (3022/9626)-CM, table A-1 to A-4
Suspension height ≤ 600 mm

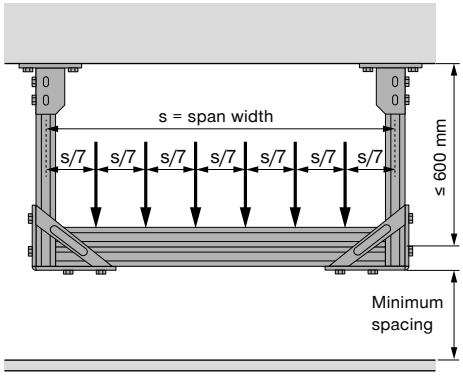
U-support
Components used: MQ 41/3 (vertical), MQ 41D (horizontal), MQP 21-72, MQW-S/2, MQN
Deformation ≤ 50 mm

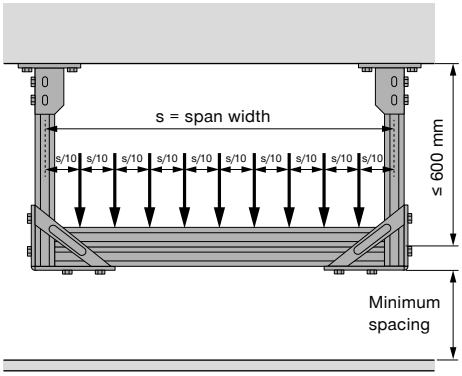
Span width		700mm	1000mm	1250mm
Fire resistance time		30 minutes		
Single load	(kN)	1.20	0.60	0.30
Multiple load	(kN)	6 x 0.64	9 x 0.15	11 x 0.07

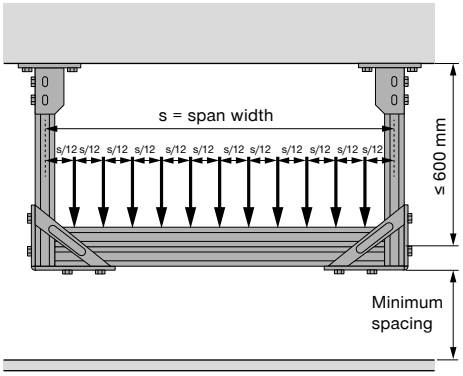
Extract from IBMB test report no. (3022/9626)-CM, table A-5
Suspension height ≤ 600 mm

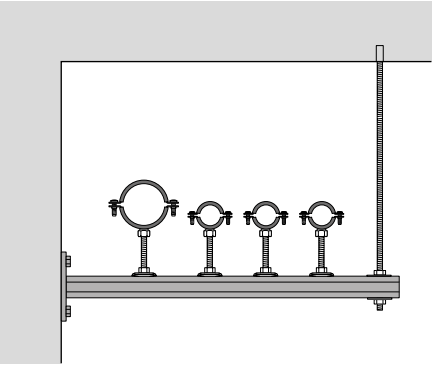
Note: Use fire-tested Hilti anchors (annex 7)











13.4 Bracket, suspended at one end

Hilti offers fire-tested fastening solutions for installing pipes on cantilever brackets suspended at one end, using MM and MQ channel systems:

- MM-B-36
- MQK-41
- MQK-41/3

13.4.1 MM-B-36 bracket, suspended at one end

Stipulations and restrictions:

- Length of the cantilever arm restricted to maximum 400 mm.
  The free end of the bracket must be held vertically using threaded rods ≥ M8 of the strength class ≥ 4.8.

- MM-B-36 brackets are designed for a fire resistance time of 30 minutes.

- The permissible load for the fire protection design, caused by the statically more favorable system, corresponds — on the safe side – to the load specification for the MM-C-36 channels suspended on threaded rods on both sides.

- With the permissible load stipulated for the event of a fire, it is ensured that with a spacing of 50 mm between the upper side of a classified suspended ceiling or another fire protection application and the underside of the bracket, the function of these building components is not impaired.

MQK bracket with central single load before the fire test

MM-B bracket with central single load after the fire test

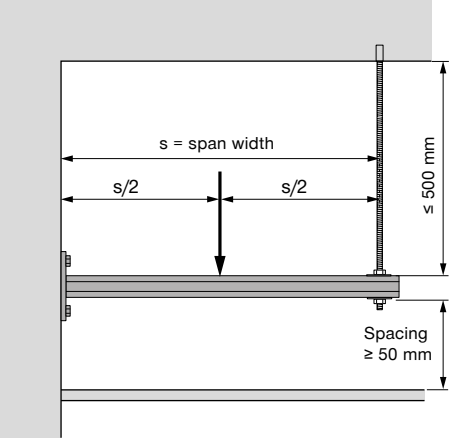
The following tables for the possible ultimate loads of the fire-tested MM-B-36 bracket, depending on the required fire resistance time, are based upon IBMB test report no. 3074/068/12-CM, table 2-1 to 2-2 (annex 5a).

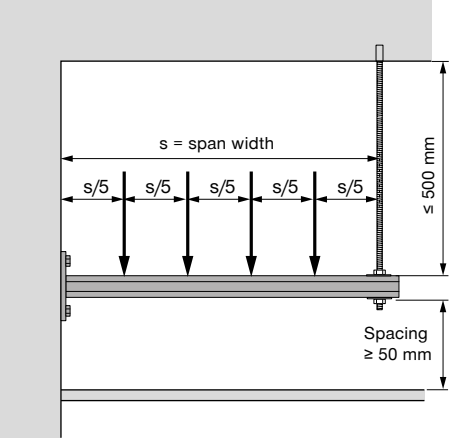
Suspended installation with bracket Fire resistance time of 30 minutes Deformation of the channel ≤ 50 mm		
Installation channel		**MM-B-36**
Span width		400mm
Single load	(kN)	0.25
Multiple load ≤ 4 loads	(kN)	4 x 0.125
Equal load (Σ equally distributed load)	(kN)	0.50

Extract from IBMB test report no. (3074/068/12)-CM, table 2-1 to 2-2
Suspension height ≤ 500 mm

Fastening of pipe rings
Channel underside:
Through-fastening
2 x MM-CW M8 or
2 x MM-CW M10

Channel upper side:
MM-S or MM-ST (≥ M8)





Note: Use fire-tested Hilti anchors (annex 7)

MQK bracket with multiple load before the fire test

Bracket composed of MQ-41/3 channel, MQP-21-72 channel support and MQN channel connectors, suspended at one end, after the fire test

MQK bracket with central single load, after the fire test

13.4.2 MQK-41 or MQK-41/3 brackets, suspended at one end

The fire protection design for MQK-41 and MQK-41/3 brackets suspended at one end is based upon the tables for the MQ-41 channels (section 13.2.2) or MQ-41/3 channels (section 13.2.3) suspended on both sides on threaded rods. This is based upon the fact that the prefabricated, welded bracket suspended at one end, represents the less critical system from a static point of view compared with the channel suspended on threaded rods ≥ M10 (≥ 4.8) on both sides.

In addition to the general stipulations and limitations for using installation channels (section 13.0), the following points must be observed for brackets suspended at one end:

Stipulations and restrictions:

- As a bracket suspended at one end is a more favorable system in structural terms compared with the installation channel suspended at both ends on threaded rods, the MQK-41 bracket with 2 mm material thickness may be used as an alternative to MQK-41/3 with 3 mm material thickness.
- The use of the MQK bracket is limited to a maximum span width of ls = 600 mm.

Two bracket applications:

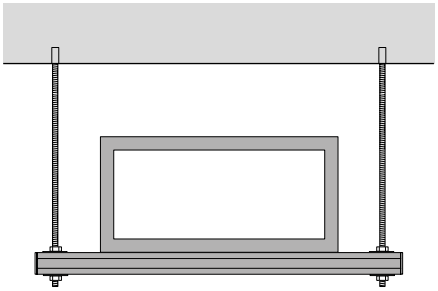
- Prefabricated welded bracket ≥ MQK-41 with a material thickness of ≥ 2.0 mm.
- Bracket assembled on the construction site, consisting of an MQP-21-72 channel support, with the open side facing upwards, fastened to the wall and a MQ-41/3 installation channel fastened to the MQP-21-72 channel support with two MQN channel connectors.

MQK bracket after the fire test, partial tearing away of the channel from the base plate

MQK bracket with central single load, after the fire test, MQA connector torn away from the channel

MQK bracket after the fire test, severely deformed

13.5 Rigid duct



Rigid ducts made of calcium silicate sheet are used as independent ventilation and smoke extraction ducts as well as cladding for sheet steel ventilation pipes.
A classification report is required as proof of usability in accordance with EN 13501-3 (ventilation) or EN 13501-4 (smoke extraction) from an accredited testing institute, in which the suitability is confirmed in accordance with the valid testing standards, e.g. EN 1366-1, EN1366-8. The support profiles used are specified explicitly in these classification reports. If this applies to a Hilti profile, the usability of this profile is proven.
However, there are many classification reports, test certificates and approvals from different manufacturers in relation to fire-resistant ventilation and smoke extraction ducts as well as fire-resistant dampers to prevent fire spread through ventilation ducts (firestop shutters and smoke extraction shutters) whereby different support profiles are used. The assessment (0190/2012, Dr. Nause, IBB) provides an indication of the possible use of equivalent Hilti profiles, see annex 6c. The use of alternative Hilti profiles should be approved by the client.
In situations where only the support function of the support profiles for the duct application needs to be verified for fire exposure, Hilti offers solutions with the following installation channels and brackets suspended at one end:

Rigid duct made from Promatect LS plates, before the fire test

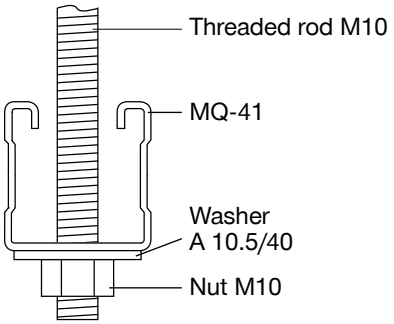
- MM-C-36 and MM-C-45
- MQ-41 and MQ–41 LL
- MQ-41/3 and MQ-41/3 LL
- MM-B-36 (bracket with cantilever ≤ 400 mm)
- MQK-41 MQK-41/3 (bracket with cantilever ≤ 600 mm)

Severe deformation of the mounting channel in the corner area, the threaded rods are in contact with the duct, hardly any deformation of the mounting channel

Rigid ducts are thick-walled ducts (maximum dimension W x H = 1,200 mm x 750 mm) made from calcium silicate sheet (e.g. PROMATECT-LS), material thickness ≥ 50 mm, which do not deform (or hardly deform) when exposed to fire as a result of their inherent rigidity.

13.5.1 Fastening of rigid duct with MM-C-36 and MM-C-45 channel

The loads in the tables in section 1.2.1 can be used for the fire protection design of suspensions for rigid ducts with MM-C-36 or MM-C-45.



13.5.2 Fastening of rigid duct with MM-C-36 and MM-C-45 channel

- In cases where the load takes the form of a rigid duct, the upwards-facing channel can be supported by a robust washer 10.5 / 40 (item no. 282857). Use of the MQZ-L drilled plate on the upper side of the channel is not required unless specified otherwise in the test reports for the ducts.

- For electric cables with functional integrity requirements, the specifications of the general building inspection test certificates must be observed.

- Distance of the horizontal threaded rods from the sides of the duct ≤ 50 mm.

The following tables for the possible ultimate loads of the fire-tested Hilti MQ installation channel for the use with rigid ducts, depending on the required fire resistance time, are based upon IBMB test report no. 3054/048/12-CM, table D-26 to D-27 (annex 5c).

Fastening of rigid duct
MQ-41 and MQ-41 LL

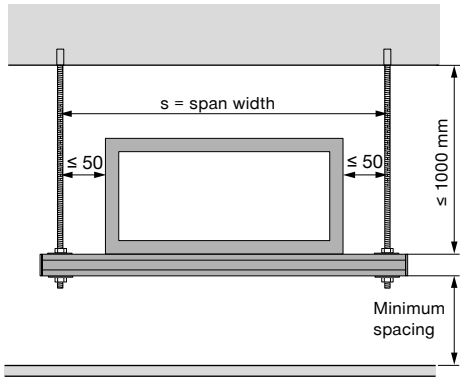
Span width				≤ 1,250 mm		
Fire resistance time				30 minutes	60 minutes	90 minutes
Equal load (Σ equally distributed load)	2.40 kN	Minimum spacing	(mm)	100	-	-
	1.70 kN		(mm)	65	105	-
	1.30 kN		(mm)	50	65	110
	1.00 kN		(mm)	50	50	80

Extract from IBMB test report no. (3054/048/12)-CM, table D-27
The table takes a suspension height of 1,000 mm into account

Rigid duct
MQ-41/3 and MQ-41/3 LL

Span width				≤ 1,250 mm		
Fire resistance time				30 minutes	60 minutes	90 minutes
Equal load (Σ equally distributed load)	3.20 kN	Minimum spacing	(mm)	100	-	-
	1.90 kN		(mm)	65	105	-
	1.40 kN		(mm)	50	65	110
	1.10 kN		(mm)	50	50	80

Extract from IBMB test report no. (3054/048/12)-CM, table D-26
The table takes a suspension height of 1,000 mm into account



Note: Use fire-tested Hilti anchors (annex 7)

13.5.3 Fastening a rigid duct with the MM-B-36 bracket

The fire protection fastening design for MM-B-36 brackets suspended at one end is based upon the tables for the MM-C-36 channel (section 13.2.1) suspended at both ends on threaded rods. This is based upon the fact that the prefabricated, welded bracket suspended at one end, represents the less critical system from a static point of view compared with the channel suspended on threaded rods ≥ M10 (≥ 4.8) at both ends.

Note: The bracket length is limited to 400 mm.

13.5.4 Fastening a rigid duct with the MQK-41 and MQK-41/3 bracket

The fire protection design for brackets MQK-41 and MQK-41/3 suspended at one end is based upon the tables for the MQ-41 channels (section 13.2.2) or MQ-41/3 channels (section 13.2.3) suspended at both ends on threaded rods. This is based upon the fact that the prefabricated, welded bracket suspended at one end, represents the less critical system from a static point of view compared with the channel suspended on threaded rods ≥ M10 (≥ 4.8) at both ends.

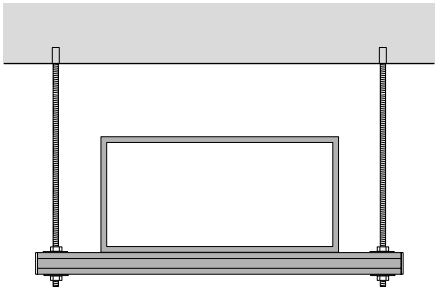
Note: The bracket length is limited to 600 mm.

13.5.5 Ventilation and smoke extraction duct applications with Hilti installation channels – test certificates / assessments

a) PROMAT offers classified fire-protected applications with Hilti MQ-41/3 and MQ-41/3 LL in accordance with EN13501-3 [9]

- Report no. 10030902-a: Classification report for Promatect system ventilation ducts – ventilation ducts in accordance with EN13501-3:2005+A1:2009, IBS Institute for fire protection technology and safety research, Austria
- Test certificate no. P-3096/090/12-MPA BS: General building inspection test certificate – ventilation ducts of the fire resistance class EI 90, EN13501-3:2006-03, IBMB Braunschweig, Germany

b) IBB (Dr. Nause) Assessment with regard to the equivalence of Hilti MQ and MM-C channel profiles for the tested profiles specified in the approvals and general building inspection test certificates of different manufacturers for ventilation and smoke extraction applications (annex 6, table 1a).



13.6 Flexible duct (sheet metal duct)

Sheet metal ducts are used for ventilation and smoke extraction. In order to meet the fire protection requirements, sheet metal ducts are designed with an accordingly higher sheet thickness or with an external insulation layer made from mineral fiber matting or sheets, or calcium silicate sheets. There are corresponding usability certificates for these applications, e.g. on the basis of tests according to EN 1366-1 and EN 1366-8. The classification takes place in accordance with EN 13501-3 and EN 13501-4.
To verify the support function of the support profiles in the duct application in the event of a fire, Hilti offers solutions with the following installation channels and brackets suspended at one end:

- MM-C-36 and MM-C-45
- MQ-41 and MQ–41 LL
- MQ-41/3 and MQ-41/3 LL
- MM-B-36 (bracket, cantilever ≤ 400 mm)
- MQK-41 and MQK-41/3 (bracket, cantilever ≤ 600 mm)

Test set-up for sheet metal ducts

Flexible ducts are thin-walled ventilation ducts made from sheet metal (max. 1,200 mm x 750 mm), they are not rigid and therefore influence the deformation of the load-bearing channel in the event of a fire. The assessment for this application can be calculated on the safe side based upon the load and deformation specifications for equal loading specified in the tables for suspended channels.

Stipulations and restrictions:
- Spacing of the horizontal threaded rods from the sides of the duct ≤ 50 mm.
- The maximum spacing between the suspensions is 1,500 mm (M-LüAR 09/2005, DIN 4102-4:1994-03, section 8.5.7.5).

Severe deformation of the load-bearing channel at the corner of the sheet metal duct, the length of channel below the duct follows the deformation of the duct

13.6.1 Fastening sheet metal duct with MM-C-36 or MM-C-45 channel

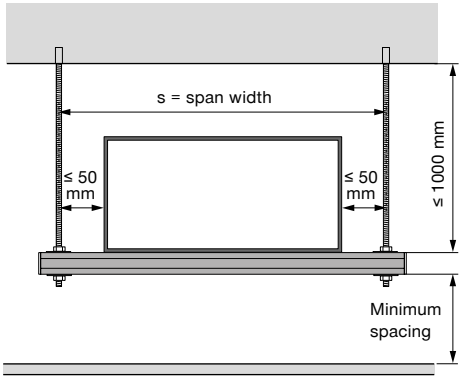
The loads in the tables in section 13.2.1 can be used for the fire protection design of suspensions for sheet metal ducts with MM-C-36 or MM-C-45.

13.6.2 Fastening sheet metal duct with MQ-41 or MQ-41 LL channel

The loads in the tables in section 13.2.2 can be used for the fire protection design of suspensions for sheet metal ducts with MQ-41 or MQ-41 LL.

13.6.3 Fastening sheet metal duct with MQ-41/3 or MQ-41/3 LL channel

The following table for the possible ultimate loads of the MQ-41/3 and MQ-41/3 LL fire-tested Hilti installation channels for use with sheet steel ducts, depending on the required fire resistance time, is based upon IBMB test report no. 3054/048/12-CM, tables D-6 to D-9 (annex 5c).



Fastening sheet metal duct MQ-41/3 and MQ-41/3 LL

Span width		≤ 350 mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Equal load (Σ equally distributed load)	(kN)	3.40	2.10	1.50	1.20
Span width		≤ 700 mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Equal load (Σ equally distributed load)	(kN)	3.00	1.60	1.10	0.85
Span width		≤ 1000 mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Equal load (Σ equally distributed load)	(kN)	2.65	1.35	0.95	0.70
Span width		≤ 1,250 mm			
Fire resistance time		30 minutes	60 minutes	90 minutes	120 minutes
Equal load (Σ equally distributed load)	(kN)	2.50	2.25	0.85	0.65

Extract from IBMB test report no. (3054/048/12)-CM, table D-6 to D9
The table takes into account a suspension height of 1,000 mm

13.6.4 Fastening sheet metal duct with MM-B-36 bracket

Note:
Use fire-tested Hilti anchors (annex 7)

The fire protection fastening design for MM-B-36 brackets suspended at one end is based upon the tables for the MM-C-36 channel (section 13.2.1) suspended at both ends on threaded rods. This is based upon the fact that the prefabricated, welded bracket suspended at one end, represents the less critical system from a static point of view compared with the channel suspended on threaded rods ≥ M8 (≥ 4.8) at both ends.

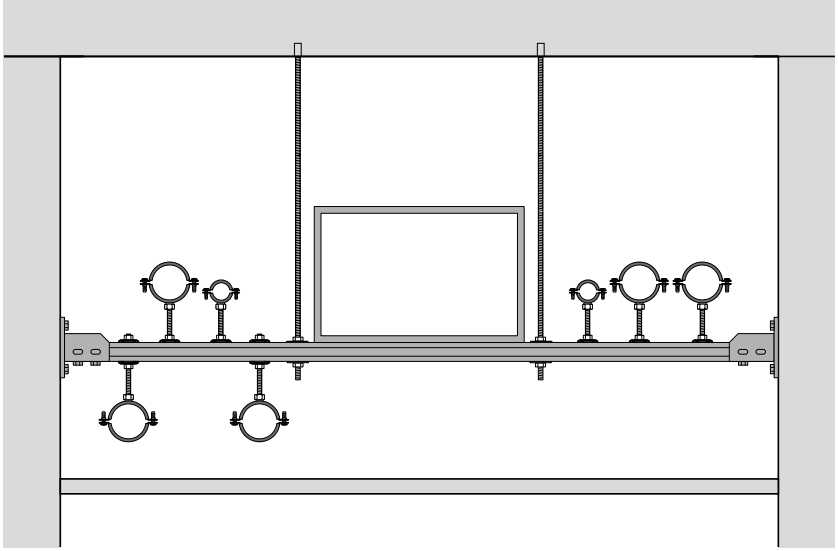
Note: The bracket length is limited to 400 mm.

13.6.5 Fastening sheet metal duct with bracket MQK-41 or MQK-41/3

The fire protection design of MQK-41 and MQK-41/3 brackets suspended at one end is based upon the tables for the MQ-41 channels (section 13.2.2) or MQ-41/3 channels (section 13.2.3) suspended at both ends on threaded rods. This is based upon the fact that the prefabricated, welded bracket suspended at one end, represents the less critical system from a static point of view compared with the channel suspended on threaded rods ≥ M10 (≥ 4.8) at both ends.

Note: The bracket length is limited to 600 mm.

13.7 Continuous beam

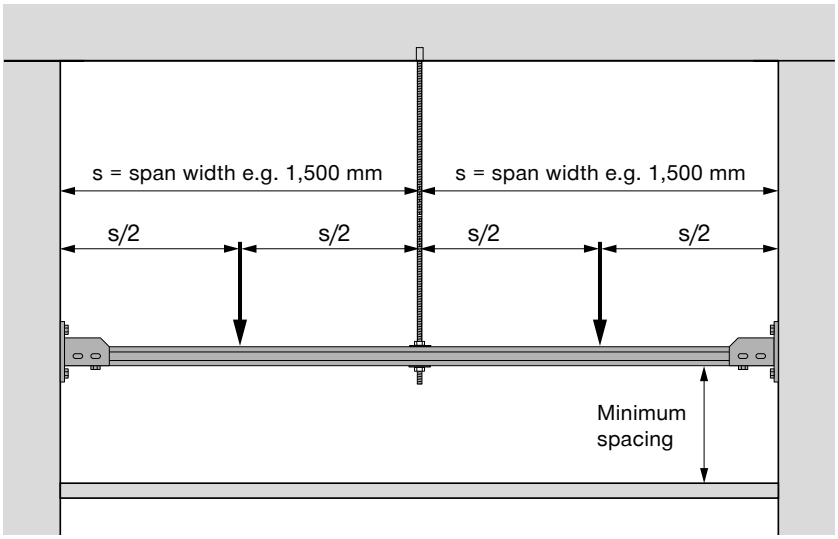


Hilti provides fire-tested solutions for continuous beam systems with MQ-41/3 and MQ-41/3 LL installation channels.
The fire protection design of continuous beams is based upon test report IBMB no. 3054/048/12-CM, table B-5 (annex 5c).
A summary of the fire protection data for continuous beam systems is included in the following table.

Continuous beam
MQ-41/3 and MQ-41/3 LL

Span width		4 x 750 mm	3 x 1000 mm	2 x 1,500 mm
Fire resistance time		30 minutes		
Single load / field	(kN)	1.00	1.00	1.00
Multiple load / field	(kN)	6 x 0.17	9 x 0.11	14 x 0.07
Minimum spacing	(mm)	120	130	170
Single load / field	(kN)	1.50	1.50	1.50
Multiple load / field	(kN)	6 x 0.25	9 x 0.17	14 x 0.11
Minimum spacing	(mm)	120	170	200

Extract from IBMB test report no. (3054/048/12)-CM, table B-5



Note:
Use fire-tested Hilti anchors (annex 7)

In addition to the general stipulations and limitations for using MQ installation channels as summarized in sections 13.0 and 13.2.3, the following points must be observed in the case of continuous beam systems:

Stipulations and restrictions

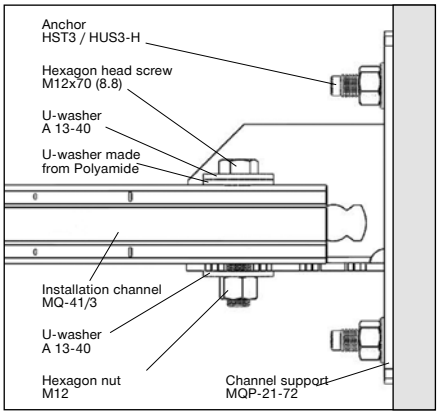
- Continuous beam systems made of MQ channels consist of horizontal and vertically aligned MQP-21-72 channel supports and a MQ-41/3 installation channel in association with MQN channel connectors.

- If additional intermediate supports are required, these must be consist of threaded rods ≥ M12 (4.8) and MQZ-L drilled plates with lock nuts on both sides.

- On exposure to fire, the continuous beam systems, which are supported using channel supports on opposite walls, exert a high force in the axial direction as a result of the temperature-related expansion of the material. Depending on the span width of the installation channel, the axial forces can be so high that the surrounding walls are damaged and as a result they can lose their fire protection properties. This can be prevented by design measures whereby one of the two supports is designed as a slide bearing, for example. The sliding bearing is designed to enable the channel to expand during the first 10-15 minutes after the start of exposure to fire. During the course of the fire, the vertical deformation of the installation begins in the respective spans, depending upon the applied loads and their position. The channels are deformed as a result of the tensile load at the support points.

- The MQP-21-72 channel support can also be installed horizontally (i.e. rotated through 90°).

Slide bearing



Detail floating bearing

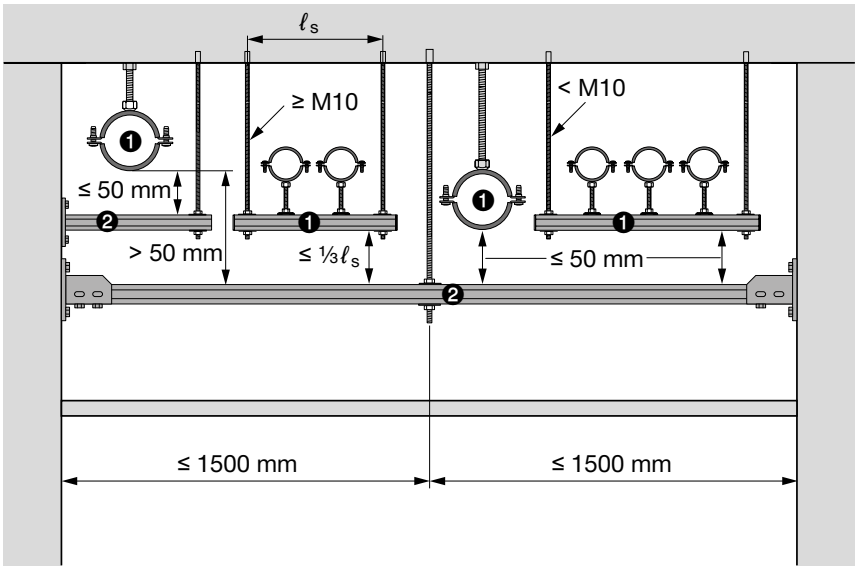
Multiple-span continuous beam with single loads, before the fire test

Multiple-span continuous beam with single loads, after the fire test
➔ = Deformation measurement

13.8 Strengthening of existing installations

❶ = Existing installation
❷ = Strengthening

Maximum permitted spacings between existing installation and strengthening



Hilti offers fire-tested solutions for continuous beam systems using MQ-41/3 and MQ-41/3 LL installation channels for strengthening existing installations:
The fire protection design of continuous beams for strengthening is based upon test report IBMB no. 3054/048/12-CM (annex 5c).

Continuous beam
MQ-41/3 and MQ-41/3 LL

Span width		4 x 750 mm	3 x 1000 mm	2 x 1,500 mm
Fire resistance time		30 minutes		
Single load / field	(kN)	1.00	1.00	1.00
Multiple load / field	(kN)	6 x 0.17	9 x 0.11	14 x 0.07
Minimum spacing	(mm)	120	130	170
Single load / field	(kN)	1.50	1.50	1.50
Multiple load / field	(kN)	6 x 0.25	9 x 0.17	14 x 0.11
Minimum spacing	(mm)	120	170	200

Extract from IBMB test report no. (3054/048/12)-CM, table B-5

Multiple-span continuous beam systems with single loads, after the fire test

Note:
Use fire-tested Hilti anchors (annex 7)

In addition to the general stipulations and limitations for using MQ installation channels as summarized in sections 13.0 and 13.2.3, the following must be observed in the case of continuous beam systems for strengthening existing installation systems:
Stipulations and restrictions:

- All the components to be used must be manufactured from steel or cast materials.
- As no previous experience has been gained of the impact of pulse loading caused by falling components in the event of a fire, it is important that the following conditions are observed.
  - Existing channels that are suspended with ≥ M10 (4.8) threaded rods can have a max. spacing of 1/3 of their span width from the upper side of the fire-tested load-bearing channel.
  - For installation channels with which the fastening does not meet the above-mentioned requirement, the distance from the fire-tested continuous beam must be no more than 50 mm.
  - In the case of individually fastened pipe rings, the distance from the continuous beam must not exceed 50 mm.

14.0 Literature references

[1] EN 1363-1: Fire resistance tests - Part 1: General requirements (page 9)

[2] EN 1993-1-2 (Eurocode 3): Design of steel structures – Part 1-2: General rules – Structural fire design (page 9)

[3] MLAR: Standard pipe / cable systems directive - last updated: 12/2015 (page 13)

[4] M-LüAR: Standard ventilation systems directive, last updated: 09/2005, last change as a result of the decision by the construction authority expert commission on 11 December 2015 (page 14)

[5] DIN 4102-4: Fire behavior of building materials and building components (page 14)

[6] RAL-GZ 656: Fire-tested pipe supports (page 17)

15.0 Annexes

General business conditions / legal information

Hilti continually endeavors to further develop and improve its products and services. As a result, this "Installation Technical Manual – Technical Challenges – Fire resistance" may also be subject to change from time to time. The customer is thus required to regularly check whether a new version of the manual has been made available on the Hilti websites. Only the version of the manual that is currently available on the Hilti websites is considered pertinent. Any and all information and data contained in the manual concern solely the use of Hilti products and are based on the principles, formulas and safety regulations in accordance with Hilti's technical directives and operating, mounting and installation instructions, etc., which must be strictly complied with. The building materials and base materials as well as the environmental conditions vary, all information and data are based upon standards and assumptions that were accepted at the time of their validity. The Hilti product portfolio referred to in the manual can vary from country to country. All the numbers included in the manual are average values. Therefore, application-specific tests must be carried out before using the corresponding Hilti product. The results of the calculations carried out with the help of the manual are essentially based upon the data used by the customer. Therefore the customer is solely responsible for making sure that the data it uses is free of errors, complete and relevant. The customer is also solely responsible for ensuring that the results of the calculation are checked and approved by an expert, in particular with regard to the adherence with the applicable standards and approvals, before the customer uses this for its specific systems/equipment. The manual is designed as an aid for interpreting standards and approvals. It does not guarantee that the results will be free of defects, accurate and relevant, nor does it guarantee the suitability for a specific application. The customer must implement all the required and appropriate measures in order to use the manual as a means of preventing or limiting damage. All the calculation results and construction drafts are recommendations and must be confirmed by a professional builder and/or structural engineer in order to ensure that the calculation results and drafts for the locally applicable legal and project-specific requirements for the customer or for its project are suitable and appropriate.

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