## Introduction

When unprotected steel elements are attached to main loadbearing elements (beams or columns) requiring fireproofing, the unprotected element ("attachment") transports the heat of the fire through the fire protection to the main element. This will create a local hot spot in the fire protected loadbearing element. In order to reduce this hot spot, the attachment is also fire protected over a certain length (coatback).

In practice a coatback distance of 450 mm is widely used. It is commonly accepted that this coatback distance is in many cases much more than necessary. Promat has performed a finite element study to define required coatback distances for Promat FENDOLITE® MII, dependent on relevant parameters such as the section factor ($H_p/A$) of the main element and the attachment and the thickness of Promat FENDOLITE® MII.

## Validity

The finite element study was carried out using thermal characteristics that have been validated and found to be conservative for Promat FENDOLITE® MII, as well as EN 1993-1-2:2005 for structural steel. The model calculates the additional heating (hot spot) of the main loadbearing element at the connection with the attachment, dependent on the coatback distance.

To determine the required coatback distance, it is necessary to determine a maximum local temperature limit at the connection. The UL1709 test standard considers the following criteria:

- The failure temperature of the undisturbed part of the main element is assumed to be 538°C (1000°F).
- If hot spots occur, they are considered as failure if their temperature exceeds 649°C (1200°F).

The maximum allowable local temperature at the attachment connection has been set at 593°C (1100°F). This is only half of the additional local temperature increase as allowed by UL1709 (100°F instead of 200°F). This is a conservative way to compensate for the fact that the model is two-dimensional and does not consider the exact cross-section geometry but only a uniform steel thickness representative of the section factor.

## Design tables

The values in the tables below are coatback distances in mm, measured from the steel surface of the main loadbearing element. The design tables are valid within the following limits:

- Promat FENDOLITE® MII thickness between 15 and 50 mm
- Application on steel structures with steel attachments, not being hollow sections
- Exposure to hydrocarbon-type fire curves

*NOTE: If the ratio $H_p/A_{attachment}$ / $H_p/A_{main\ element}$ is larger than 2.5, in all cases a coatback distance of 450 mm is required. This needs to be checked in cells marked with an asterisk (*).*

*Table 1: coatback distances for a Promat FENDOLITE® MII thickness of 15 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 250 | 310 | 370 | 450 | 450 | 450 |
| | **90-99** | 450 | 240 | 260 | 310 | 450 | 450 | 450 |
| | **100-119** | 450 | 220 | 240 | 260 | 340/450* | 450 | 450 |
| | **120-139** | 450 | 200 | 220 | 230 | 250 | 260/450* | 450 |
| | **140-159** | 450 | 180 | 200 | 210 | 230 | 230/450* | 450 |
| | **160-179** | 450 | 170 | 180 | 190 | 210 | 210 | 210/450* |
| | **180-199** | 450 | 150 | 170 | 180 | 190 | 190 | 190/450* |
| | **200-249** | 450 | 140 | 150 | 160 | 170 | 170 | 170/450* |
| | **250-299** | 450 | 130 | 140 | 140 | 140 | 140 | 140/450* |
| | **>=300** | 450 | 120 | 130 | 130 | 130 | 130 | 130/450* |

*Table 2: coatback distances for Promat FENDOLITE® MII thicknesses of 16-20 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 300 | 340 | 370 | 450 | 450 | 450 |
| | **90-99** | 450 | 270 | 300 | 330 | 350/450* | 450 | 450 |
| | **100-119** | 450 | 260 | 270 | 290 | 310/450* | 450 | 450 |
| | **120-139** | 450 | 240 | 250 | 250 | 260 | 260/450* | 450 |
| | **140-159** | 450 | 220 | 230 | 240 | 240 | 240/450* | 450 |
| | **160-179** | 450 | 200 | 210 | 220 | 220 | 220 | 220/450* |
| | **180-199** | 450 | 190 | 200 | 210 | 210 | 210 | 200/450* |
| | **200-249** | 450 | 180 | 190 | 200 | 200 | 200 | 190/450* |
| | **250-299** | 450 | 160 | 170 | 180 | 180 | 170 | 160/450* |
| | **>=300** | 450 | 150 | 150 | 160 | 160 | 150 | 150/450* |

*Table 3: coatback distances for Promat FENDOLITE® MII thicknesses of 21-25 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 340 | 360 | 370 | 410/450* | 450 | 450 |
| | **90-99** | 450 | 310 | 330 | 340 | 340/450* | 450 | 450 |
| | **100-119** | 450 | 290 | 300 | 310 | 310/450* | 450 | 450 |
| | **120-139** | 450 | 270 | 270 | 270 | 270 | 260/450* | 450 |
| | **140-159** | 450 | 240 | 250 | 250 | 250 | 250/450* | 450 |
| | **160-179** | 450 | 230 | 240 | 240 | 240 | 230 | 220/450* |
| | **180-199** | 450 | 220 | 230 | 230 | 230 | 220 | 210/450* |
| | **200-249** | 450 | 210 | 220 | 220 | 220 | 210 | 200/450* |
| | **250-299** | 450 | 190 | 200 | 200 | 200 | 190 | 180/450* |
| | **>=300** | 450 | 180 | 180 | 180 | 180 | 180 | 160/450* |

*Table 4: coatback distances for Promat FENDOLITE® MII thicknesses of 26-30 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 370 | 380 | 380 | 380/450* | 450 | 450 |
| | **90-99** | 450 | 350 | 360 | 360 | 360/450* | 450 | 450 |
| | **100-119** | 450 | 330 | 330 | 330 | 330/450* | 450 | 450 |
| | **120-139** | 450 | 300 | 300 | 300 | 290 | 270/450* | 450 |
| | **140-159** | 450 | 270 | 270 | 270 | 270 | 260/450* | 450 |
| | **160-179** | 450 | 260 | 260 | 260 | 260 | 240 | 230/450* |
| | **180-199** | 450 | 250 | 250 | 250 | 250 | 230 | 220/450* |
| | **200-249** | 450 | 240 | 240 | 240 | 240 | 230 | 210/450* |
| | **250-299** | 450 | 220 | 220 | 220 | 220 | 210 | 190/450* |
| | **>=300** | 450 | 210 | 210 | 210 | 210 | 200 | 180/450* |

*Table 5: coatback distances for Promat FENDOLITE® MII thicknesses of 31-35 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 400 | 400 | 400 | 390/450* | 450 | 450 |
| | **90-99** | 450 | 370 | 370 | 370 | 370/450* | 450 | 450 |
| | **100-119** | 450 | 350 | 350 | 350 | 350/450* | 450 | 450 |
| | **120-139** | 450 | 320 | 320 | 320 | 310 | 280/450* | 450 |
| | **140-159** | 450 | 300 | 300 | 300 | 290 | 260/450* | 450 |
| | **160-179** | 450 | 290 | 290 | 280 | 270 | 250 | 230/450* |
| | **180-199** | 450 | 270 | 270 | 270 | 260 | 240 | 220/450* |
| | **200-249** | 450 | 260 | 260 | 260 | 250 | 240 | 220/450* |
| | **250-299** | 450 | 250 | 250 | 240 | 240 | 220 | 200/450* |
| | **>=300** | 450 | 230 | 230 | 230 | 230 | 210 | 190/450* |

*Table 6: coatback distances for Promat FENDOLITE® MII thicknesses of 36-40 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 420 | 420 | 420 | 400/450* | 450 | 450 |
| | **90-99** | 450 | 400 | 400 | 390 | 380/450* | 450 | 450 |
| | **100-119** | 450 | 380 | 380 | 370 | 360/450* | 450 | 450 |
| | **120-139** | 450 | 350 | 350 | 340 | 330 | 280/450* | 450 |
| | **140-159** | 450 | 330 | 330 | 320 | 300 | 270/450* | 450 |
| | **160-179** | 450 | 310 | 310 | 300 | 290 | 260 | 240/450* |
| | **180-199** | 450 | 300 | 300 | 290 | 280 | 250 | 230/450* |
| | **200-249** | 450 | 290 | 290 | 280 | 270 | 250 | 220/450* |
| | **250-299** | 450 | 270 | 270 | 260 | 250 | 240 | 210/450* |
| | **>=300** | 450 | 260 | 260 | 250 | 240 | 220 | 200/450* |

*Table 7: coatback distances for Promat FENDOLITE® MII thicknesses of 41-45 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 440 | 440 | 430 | 400/450* | 450 | 450 |
| | **90-99** | 450 | 420 | 420 | 410 | 380/450* | 450 | 450 |
| | **100-119** | 450 | 400 | 400 | 390 | 370/450* | 450 | 450 |
| | **120-139** | 450 | 370 | 370 | 360 | 340 | 290/450* | 450 |
| | **140-159** | 450 | 350 | 350 | 340 | 320 | 280/450* | 450 |
| | **160-179** | 450 | 340 | 340 | 320 | 300 | 270 | 240/450* |
| | **180-199** | 450 | 330 | 320 | 310 | 290 | 260 | 240/450* |
| | **200-249** | 450 | 320 | 310 | 300 | 280 | 260 | 230/450* |
| | **250-299** | 450 | 300 | 290 | 280 | 270 | 250 | 220/450* |
| | **>=300** | 450 | 280 | 280 | 270 | 260 | 240 | 210/450* |

*Table 8: coatback distances for Promat FENDOLITE® MII thicknesses of 46-50 mm:*

| | | Hp/A_attachment [$m^{-1}$] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **<80** | **80-99** | **100-149** | **150-199** | **200-299** | **300-399** | **>=400** |
| **Hp/A_main [$m^{-1}$]** | **<80** | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | **80-89** | 450 | 450 | 450 | 450 | 410/450* | 450 | 450 |
| | **90-99** | 450 | 450 | 450 | 420 | 390/450* | 450 | 450 |
| | **100-119** | 450 | 430 | 420 | 400 | 380/450* | 450 | 450 |
| | **120-139** | 450 | 400 | 390 | 380 | 350 | 300/450* | 450 |
| | **140-159** | 450 | 380 | 380 | 360 | 340 | 290/450* | 450 |
| | **160-179** | 450 | 360 | 360 | 340 | 320 | 280 | 250/450* |
| | **180-199** | 450 | 350 | 350 | 330 | 310 | 270 | 240/450* |
| | **200-249** | 450 | 340 | 340 | 320 | 290 | 270 | 240/450* |
| | **250-299** | 450 | 320 | 320 | 300 | 280 | 260 | 230/450* |
| | **>=300** | 450 | 310 | 300 | 290 | 270 | 250 | 220/450* |

* first value is the coatback distance in case of $Hp/A_{attachment}$ / $Hp/A_{main\ element}$ <= *2.5*; second value (450 mm) in case of $Hp/A_{attachment}$ / $Hp/A_{main\ element}$ > *2.5.*

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*The information given in this Application Procedure is based on practical experience, independent and other tests and represents, in Promat's opinion, the best technical advice available. Since the products are applied under circumstances beyond our control, Promat can accept no direct or consequential liability, whether in contract or in tort, for the interpretation of such recommendations and reserves the right to modify the recommendations as necessary. Should it be unclear as to the meaning of any of the instructions given above, or if further information is required, please consult Promat.*