



B15.en

The Firewin systems

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B15.en Reactive coating systems for fire protection

Knauf Firepaint Steel



Contents



page

B15.en

Reactive coating systems for fire protection

Product description	3
Technical details	2
Protection of steel beams and columns	į
Section factor U/A for steel beams and columns	(
Protection thickness required	
Steel beams, 3-sided open H- or I-sections	8
Steel columns, 4-sided open H- or I-sections	10
Steel columns, 4-sided circular hollow sections	12
Steel columns, 4-sided rectangular hollow sections	14
Application instructions	16

Product description



Product description

Knauf Firepaint Steel

Knuf Firepaint Steel is a one component, solventborne, physically drying intumescent coating for passive fire protection of structural steel against cellulosic fires. It is suitable for in-shop and on-site applications. Knuf Firepaint Steel received European Technical Approval.

Primers:

For carbon steel surfaces:

Knauf Firepaint Primer K1

Knauf Firepaint Primer K1 is a very quick-drying anticorrosive primer/finish pigmented with zinc phosphate as anticorrosive inhibiting pigment.

Knauf Firepaint Primer is used as a single/double coat anticorrosive primer (or finish - to put directly) for steel structures, general steel work and a multitude of applications for heavy and light steel industry, where quick drying properties are required. It is for general use, in exterior and interior steel surfaces. Suitable for protection of steel in mild to medium atmospheric corrosive environments.

For galvanized surfaces:

Knauf Firepaint Primer K2

Knauf Firepaint Primer K2 is a two-component epoxy paint. It cures to a flexible, well adhering coating with good abrasion and impact resistance. Contains zinc phosphate.

As a primer for on hot dipped galvanized surfaces, aluminium and stainless steel in moderately corrosive environments. Knauf Firepaint Primer K2 is also suited when roughening of the surface is not

Top coat:

Knauf Firepaint Finish

Knauf Firepaint Finish s a finishing coat based on acrylic resin and nonchlorinated plasticizer for optimum gloss and colour retention. Physically drying. Resistant to salt water, splashes of aliphatic hydrocarbons and animal and vegetable oils.

Knauf Firepaint Finish is used as an interior and exterior finishing coat in Knauf Firepaint systems in moderately to severely corrosive environment.

Knauf Firepaint Finish Thinner AL Knauf Firepaint Finish Thinner EP

Knauf Paint is produced and supplied in such a way that thinning is normally not necessary provided the paint is properly mixed/stirred.

However, if the paint is to be applied in a low film thickness (for instance as a "sealer coat") or if the paint has become too thick, e.g. in cold weather, the Knauf Thinners indicated on the product data sheet may be added to obtain a consistency most suitable for application. As a general rule, thinning should be kept at a minimum as the quality of the paint work will suffer from too liberal thinning.

Scope of application, properties, storage, method of delivery

Scope of application

Knuf Firepaint Steel is used as reactive coating system to fire protect beams and columns made of structural steel to achieve a fire resistance duration in accordance with EN 13501-2.

The product is approved on the basis of Approval testing in accordance with EN 13381-8:2010 and ETAG 018.

Knuf Firepaint Steel is intended to fire protect various sizes of open sections (H and I) and square and circular hollow columns for up to a fire resistance classification, in the design temperatures range of 350°C to 750°C.

Knauf Firepaint Steel is intended for the following applications:

- · As intumescent fire protection for internal and external structural steel. Suitable for open beams and columns and hollow sections
- As a repair and touch-up coating for damaged areas of freshly applied Knauf Firepaint Steel.
- Applied in up to 1500 micron dry film thickness per coat (equivalent to 2000 micron wet film
- Knuf Firepaint Steel in accordance with ETA for the protection of steel beams and columns: open H- or I-sections - up to R 240 circular hollow sections - up to R240 rectangular hollow sections - up to R300

Properties:

- Easy application Easy to work with
- Cost effective high volume solids and quick drying
- Off-site and on-site application by airless spray
- Suitable for indoor and outdoor use
- Matt white finish
- Wide range of primers and topcoats

Storage

Knuf Firepaint Steel shall be stored in dry, shaded areas. The recommended storage conditions are between 5°C and 40°C. The shelf life of Knauf Firepaint Steel may vary depending on the storage conditions. At 25°C the shelf life is 12 months from date of manufacture. The shelf life may be reduced if the products are stored outside Knauf's recommended storage conditions. The products must be re-inspected before use in case the shelf life is exceeded.

Method of delivery

bucket 5 I

Knauf Firepaint Steel bucket 20 I article no. 528431 Knauf Firepaint Primer K1 bucket 20 I article no. 528433 Knauf Firepaint Primer K2 bucket 5 I article no. 528434 Knauf Firepaint Finish white bucket 20 I article no. 528435 Knauf Firepaint Finish colour bucket 20 I article no. 528436 Knauf Firepaint Thinner AL bucket 5 I article no. 528824 Knauf Firepaint Thinner EP

article no. 528825

Technical details



Knauf Firepaint Steel	
Reaction to fire	D-s2,d0
Shade nos/Colours	10000 / White
Finish	flat
Volume solids, %	75 ± 3
Theoretical spreading rate	1 m²/l to 750 micron
Flash point	23 °C
Specific gravity	1.3 kg/litre
Surface dry	30 minutes, 20°C and 750 micron
Dry to touch	35 minutes, 20°C and 750 micron
Dry to handle	1 day 20°C and 750 micron
VOC content	320 g/l
Shelf life	12 months

Knauf Firepaint primer K1	
Shade nos/Colours	11150*/ Grey
Finish	flat
Volume solids, %	49 ± 1
Theoretical spreading rate	7 m ² /I - 70 micron
Flash point	25 °C
Specific gravity	1.4 kg/litre
Dry to touch	15 minutes (proper ventilation is required)
Dry to handle	1 hour (proper ventilation is required)
VOC content	442 g/l

Knauf Firepaint primer K2	
Shade nos/Colours	11630 / Off-white
Finish	flat
Volume solids, %	55 ± 1
Theoretical spreading rate	11 m²/l - 50 micron
Flash point	30 °C
Specific gravity	1.5 kg/litre
Dry to touch	3 approx. hours 20°C
Dry to handle	7 days 20°C
VOC content	389 g/l

Technical details



Knauf Firepaint Finish					
Shade nos/Colours	10000*/ White				
Finish	glossy				
Volume solids, %	32 ± 1				
Theoretical spreading rate	9.1 m ² /l - 50 micron				
Flash point	25 °C				
Specific gravity	1.1 kg/litre				
Dry to touch	1 approx. hour 20°C				
Dry to handle	3-4 hours 20°C				
VOC content	597 g/l				

Knauf Firepaint Finish Thinner A	NL
Shade nos/Colours	00000/ Colourless
Flash point	23 °C
Specific gravity	0.9 kg/litre
VOC content	870 g/l

Knauf Firepaint Finish Thinner EP	
Shade nos/Colours	00000/ Colourless
Flash point	23 °C
Specific gravity	0.9 kg/litre
VOC content	857 g/l

Protection of steel beams and columns



Primer (irrespective of the use environmental category	Reactive coating	Topcoat (depending on the environmental use category)
Primer for carbon steel surfaces: Knauf Firepaint Primer K1	Knowlet Charles	Category Type X (including Types Y, Z ₁ and Z ₂ Knauf Firepaint Finish
Primer for galvanized surfaces:	Knauf Firepaint Steel	Category Type Y (including Types Z ₁ and Z ₂)
Knauf Firepaint Primer K2		Without topcoat or with the topcoats Type X approved

The environmental use categories are specified in ETAG 018 Part 2, section 2.2.2:

- Type X: external use
- Type Y: internal use and semi-exposed conditions
- Type Z₁: internal use with high humidity conditions
- Type Z₂:internal use

Protection of steel beams and columns



Determination of the U/A section factor for steel beams and columns

Type of section	Exposure to fire	U/A
values of: b, h, t - in cm, are	ea A - in cm²	m ⁻¹
—	4 sides	100 t
CA) ac	4 sides	2πR A• 100

Type of section	Exposure to fire	U/A
values of: b, h, t - in cm, area A	- in cm²	m ⁻¹
A L	4 sides	4b - 2t + 2h A • 100
A t b	3 sides	3b - 2t + 2h A • 100

all dimensions in mm

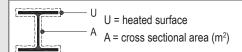
Minimum thickness of Knauf Firepaint Steel

The thickness of the plaster Knauf Firepaint Steel depends on the U/A section factor of steel beams and columns, critical temperature of steel and the fire resistance class required.

Section factor U/A for steel beams and columns



Steel beams and columns



The spray thickness required is calculated based on the U/A section factor and the section shape. The values given are approximations. They may be slightly different depending on the rolled beam manufacturer.

Section factor U/A for steel beams and columns(m ⁻¹)									
IPN pro	IPN profile IPE profile						HEA profile		
	I	I		I	I		I	I	
	3-sided	4-sided		3-sided	4-sided		3-sided	4-sided	
80	346	401	80	370	431	100	218	265	
100	302	349	100	336	389	120	220	268	
120	268	309	120	311	360	140	208	253	
140	238	274	140	291	336	160	190	234	
160	220	252	160	269	310	180	185	225	
180	200	229	180	254	292	200	175	212	
200	185	212	200	234	270	220	162	196	
220	171	196	220	221	254	240	147	178	
240	160	183	240	205	236	260	141	171	
260	149	170	270	197	227	280	136	164	
280	139	158	300	188	216	300	126	153	
300	131	149	330	175	200	320	117	142	
320	123	140	360	162	186	340	112	134	
340	117	133	400	153	174	360	107	128	
360	110	125	450	144	163	400	101	120	
380	105	119	500	133	150	450	96	113	
400	100	113	550	125	141	500	92	107	
425	95	107	600	115	130	550	90	104	
450	89	101				600	89	102	
475	84	95				650	87	100	
500	80	91				700	84	96	
550	75	85				800	84	94	
600	67	76				900	81	90	
						1000	81	89	

Section factor U/A for steel beams and columns



			Sect	ion factor U/	A for Steel Deallis	and columns(m ⁻¹)			
нев р	orofile		HEM p	orofile		Hollow sections			
		_			_		_	1	
	I	I		I	I				O
	3-sided	4-sided		3-sided	4-sided		4-sided		4-sided
100	180	218	100	96	116	40 x 40 x 4	268	51 x 4	270
120	167	202	120	92	111	50 x 50 x 4	264	70 x 5	216
140	155	187	140	86	104	60 x 60 x 3	344	101,6 x 4	260
160	140	169	160	83	100	70 x 70 x 3	343	101,6 x 8	136
180	130	158	180	80	96	80 x 80 x 3	341	139,7 x 4	257
200	122	147	200	76	91	90 x 90 x 4	257	139,7 x 8	133
220	115	140	220	73	88	100 x 100 x 4	257	168,3 x 5	206
240	108	130	240	61	73	120 x 120 x 5	206	168,3 x 10	106
260	105	127	260	59	71	140 x 140 x 5	205	193,7 x 5	206
280	102	123	280	58	70	150 x 150 x 5	205	193,7 x 10	106
300	96	116	300	50	60	160 x 160 x 5	204	244,5 x 6	171
320	91	110	320	50	60	180 x 180 x 5	204	244,5 x 12	88
340	88	106	340	50	60	200 x 200 x 5	203	273 x 6	171
360	86	102	360	51	61	220 x 200 x 6	170	273 x 12	87
400	82	98	400	52	61	250 x 250 x 6	169	323,9 x 6	170
450	78	91	450	53	63	260 x 260 x 6	168	323,9 x 12	86
500	76	89	500	54	63	300 x 300 x 6	168	355,6 x 8	128
550	76	87	550	56	64	350 x 350 x 8	127	355,6 x 20	53
600	75	86	600	57	65	400 x 400 x 10	101	406,4 x 8	128
650	74	85	650	58	66			406,4 x 20	53
700	72	82	700	59	67			457 x 10	103
800	72	81	800	61	68			508 x 10	103
900	70	78	900	62	69			508 x 20	52
1000	70	78	1000	64	70			610 x 10	102
								610 x 20	52

Steel beams, 3-sided open H- or I-sections - protection thickness required



					Thicknes	s (mm) r	equired	for the R	F period -	only int	tumesce	nt coatin	g			
T		R	15			R	30			R	45			R	60	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
58	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,307	0,246	0,220	0,220
60	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,319	0,254	0,220	0,220
65	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,349	0,276	0,233	0,220
70	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,234	0,220	0,220	0,220	0,379	0,297	0,252	0,220
75	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,253	0,220	0,220	0,220	0,408	0,318	0,270	0,220
80	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,271	0,220	0,220	0,220	0,438	0,339	0,288	0,231
85	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,290	0,225	0,220	0,220	0,468	0,361	0,306	0,249
90	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,308	0,243	0,220	0,220	0,497	0,382	0,325	0,267
95	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,327	0,261	0,220	0,220	0,527	0,403	0,343	0,286
100	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,345	0,278	0,220	0,220	0,557	0,424	0,361	0,304
105	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,364	0,296	0,220	0,220	0,587	0,446	0,379	0,323
110	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,382	0,314	0,236	0,220	0,616	0,467	0,398	0,341
115 120	0,220	0,220	0,220 0,220	0,220	0,220	0,220 0,220	0,220	0,220	0,401	0,332	0,254 0,273	0,220	0,646	0,488 0,509	0,416	0,359 0,378
125	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,419	0,349	0,273	0,220	0,676	0,509	0,454	0,376
130	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,456	0,385	0,309	0,220	0,700	0,552	0,432	0,390
135	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,475	0,402	0,303	0,220	0,765	0,573	0,489	0,433
140	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,220	0,493	0,420	0,346	0,220	0,795	0,594	0,507	0,451
145	0,220	0,220	0,220	0,220	0,227	0,220	0,220	0,220	0,512	0,438	0,364	0,220	0,825	0,616	0,525	0,470
150	0,220	0,220	0,220	0,220	0,247	0,220	0,220	0,220	0,530	0,456	0,382	0,228	0,854	0,637	0,544	0,488
155	0,220	0,220	0,220	0,220	0,267	0,220	0,220	0,220	0,549	0,473	0,401	0,250	0,884	0,658	0,562	0,507
160	0,220	0,220	0,220	0,220	0,288	0,220	0,220	0,220	0,567	0,491	0,419	0,272	0,914	0,679	0,580	0,525
165	0,220	0,220	0,220	0,220	0,308	0,220	0,220	0,220	0,586	0,509	0,437	0,294	0,944	0,701	0,598	0,543
170	0,220	0,220	0,220	0,220	0,328	0,220	0,220	0,220	0,604	0,526	0,456	0,316	0,978	0,722	0,617	0,562
175	0,220	0,220	0,220	0,220	0,348	0,220	0,220	0,220	0,623	0,544	0,474	0,338	1,012	0,743	0,635	0,580
180	0,220	0,220	0,220	0,220	0,369	0,220	0,220	0,220	0,641	0,562	0,492	0,360	1,046	0,764	0,653	0,599
185	0,220	0,220	0,220	0,220	0,389	0,220	0,220	0,220	0,660	0,580	0,511	0,382	1,080	0,786	0,671	0,617
190	0,220	0,220	0,220	0,220	0,409	0,220	0,220	0,220	0,678	0,597	0,529	0,404	1,115	0,807	0,690	0,635
195	0,220	0,220	0,220	0,220	0,430	0,220	0,220	0,220	0,697	0,615	0,547	0,426	1,149	0,828	0,708	0,654
200	0,220	0,220	0,220	0,220	0,450	0,220	0,220	0,220	0,715	0,633	0,566	0,448	1,183	0,849	0,726	0,672
205	0,220	0,220	0,220	0,220	0,470	0,220	0,220	0,220	0,734	0,650	0,584	0,470	1,217	0,871	0,744	0,691
210	0,220	0,220	0,220	0,220	0,491	(0,221)	0,220	0,220	0,752	0,668	0,602	0,493	1,251	0,892	0,763	0,709
215	0,220	0,220	0,220	0,220	0,511	0,284	0,220	0,220	0,771	0,686	0,620	0,515	1,286	0,913	0,781	0,727
220 225	0,220	0,220	0,220	0,220	0,531	0,276 0,303	0,220	0,220	0,789	0,704 0,721	0,639 0,657	0,537 0,559	1,320	0,934 0,961	0,799 0,817	0,746 0,764
230	0,220	0,220	0,220	0,220	0,532	0,330	0,220	0,220	0,826	0,721	0,675	0,539	1,388	0,993	0,817	0,783
235	0,220	0,220	0,220	0,220	0,572	0,357	0,220	0,220	0,845	0,757	0,694	0,603	1,422	1,025	0,854	0,703
240	0,220	0,220	0,220	0,220	0,613	0,385	0,220	0,220	0,863	0,774	0,712	0,625	1,457	1,023	0,872	0,819
245	0,220	0,220	0,220	0,220	0,633	0,412	0,220	0,220	0,882	0,792	0,730	0,647	1,491	1,089	0,890	0,838
250	0,220	0,220	0,220	0,220	0,653	0,439	0,220	0,220	0,900	0,810	0,749	0,669	1,525	1,121	0,909	0,856
255	0,220	0,220	0,220	0,220	0,673	0,467	0,220	0,220	0,919	0,828	0,767	0,691	1,559	1,153	0,927	0,875
260	0,220	0,220	0,220	0,220	0,694	0,494	0,220	0,220	0,937	0,845	0,785	0,713	1,593	1,185	0,945	0,893
265	0,220	0,220	0,220	0,220	0,714	0,521	0,249	0,220	0,962	0,863	0,803	0,735	1,628	1,217	0,976	0,911
270	0,220	0,220	0,220	0,220	0,734	0,549	0,287	0,220	0,989	0,881	0,822	0,757	1,662	1,249	1,007	0,930
275	0,220	0,220	0,220	0,220	0,755	0,576	0,326	0,220	1,017	0,898	0,840	0,779	1,696	1,282	1,038	0,950
280	0,220	0,220	0,220	0,220	0,775	0,603	0,364	0,220	1,045	0,916	0,858	0,801	1,730	1,314	1,069	0,978
285	0,220	0,220	0,220	0,220	0,795	0,631	0,402	0,232	1,072	0,934	0,877	0,823	1,764	1,346	1,100	1,007
290	0,220	0,220	0,220	0,220	0,816	0,658	0,440	0,277	1,100	0,953	0,895	0,845	1,799	1,378	1,131	1,035
295	0,220	0,220	0,220	0,220	0,836	0,685	0,478	0,322	1,128	0,976	0,913	0,867	1,833	1,410	1,162	1,063
300	0,220	0,220	0,220	0,220	0,856	0,713	0,517	0,368	1,156	0,998	0,932	0,889	1,864	1,442	1,193	1,091
305	0,220	0,220	0,220	0,220	0,877	0,740	0,555	0,413	1,183	1,020	0,950	0,911	1,893	1,474	1,224	1,119
310	0,220	0,220	0,220	0,220	0,897	0,767	0,593	0,458	1,211	1,042	0,970	0,933	1,992	1,506	1,254	1,148
315	0,220	0,220	0,220	0,220	0,917	0,795	0,631	0,503	1,239	1,064	0,990	0,954	1,951	1,538	1,285	1,176
320	0,220	0,220	0,220	0,220	0,938	0,822	0,670	0,549	1,266	1,087	1,010	0,974	1,980	1,570	1,316	1,204
325 330	0,220	0,220	0,220	0,220	0,958	0,849	0,708	0,594	1,294	1,109	1,030	0,993	2,009	1,602	1,347	1,232
330	0,234	0,220	0,220	0,220	0,978	0,876	0,746	0,639	1,332	1,131	1,050	1,013	2,038	1,634	1,378	1,260

Steel beams, 3-sided open H- or I-sections - protection thickness required

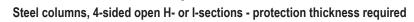


					Thicknes	s (mm) r	equired	for the RI	period -	only int	umescei	nt coating	9			
T		R	90			R	120			R	180			R	240	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
58	0,946	0,592	0,444	0,343	1,467	1,222	1,057	0,804	-	-	-	1,779	-	-	-	-
60	0,966	0,619	0,462	0,356	1,500	1,249	1,082	0,842	-	-	-	1,823		-	-	
65	1,018	0,686	0,509	0,390	1,584	1,318	1,144	0,936	-	-	-	2,142	-	-	-	-
70	1,069	0,753	0,555	0,423	1,667	1,386	1,206	0,998	-	-	-	2,530	-	-	-	-
75	1,121	0,820	0,602	0,457	1,750	1,454	1,268	1,057	-	-	-	2,917	-	-	-	-
80	1,173	0,887	0,649	0,490	1,834	1,523	1,330	1,116	-	-	-	-		-	-	-
85	1,224	0,951	0,695	0,524	2,019	1,591	1,392	1,175	-	-	-			-	-	-
90	1,276	0,996	0,742	0,557	2,230	1,659	1,454	1,234		-	-	-	-	-	-	-
95	1,327	1,040	0,788	0,591	2,441	1,728	1,516	1,292		-	-	-	-	-	-	-
100	1,379	1,085	0,835	0,624	2,652	1,796	1,578	1,351		-	-			-	-	-
105	1,431	1,129	0,882	0,658	2,863	1,882	1,640	1,410	<u> </u>				<u></u>			-
110	1,482	1,174	0,928	0,691	3,074	2,045	1,702	1,469	<u> </u>	-	-	<u> </u>	<u> </u>			-
115	1,534	1,219	0,973	0,725		2,207	1,764	1,528		-	-			-	-	-
120	1,585	1,263	1,017	0,758		2,369	1,826	1,587	┝			<u> </u>	<u> </u>	-	-	-
125	1,637	1,308	1,060	0,792		2,531	1,921	1,645	Ŀ	-	-	<u> </u>	<u> </u>	-	-	-
130	1,689	1,353	1,104	0,825	<u> </u>	2,693	2,040	1,704	┈	-	-	╙╌╢	┝┷	<u> </u>	<u> </u>	-
135	1,740	1,397	1,148	0,859	┝┷	2,855	2,158	1,763	⊢∸	-	-	<u> </u>	<u> </u>	<u> </u>	-	-
140	1,792	1,442	1,191	0,892	-	3,017	2,276	1,822	<u> </u>	-	-		<u> </u>	-	-	-
145	1,843	1,486	1,235	0,926	<u> </u>	3,180	2,394	1,899	<u> </u>	-	-		<u>⊢-</u>	-	-	-
150	1,923	1,531	1,279	0,965	<u> </u>	-	2,512	1,993	<u>⊢-</u>	-	-	<u> </u>	<u>⊢-</u>	-	-	-
155	2,007	1,576	1,322	1,012	<u> </u>	-	2,630	2,087	<u>⊢-</u>	-	-	<u> </u>	<u> </u>	-	-	-
160	2,092	1,620	1,366	1,059		<u> </u>	2,748	2,182	⊢	<u> </u>	-	<u> </u>	<u> </u>	-	-	-
165	2,176	1,665	1,410	1,106	<u>⊢-</u>	-	2,867	2,276	⊢∸	-	-	<u> </u>	⊢∸	-	-	-
170	2,261	1,709	1,453	1,152	<u> </u>	-	2,985	2,370	⊢∸	-	-	-	<u> </u>	-	-	-
175 180	2,345 2,430	1,754 1,799	1,497 1,541	1,199 1,246	H	-	3,103 3,221	2,465 2,559	⊢∸	-		\vdash	H	-	-	-
185	2,430	1,843	1,584	1,246	H-			2,653	<u>⊢-</u>	-		-				-
190	2,514	1,905	1,628	1,339	<u> </u>		-	2,748	H		-	-	-	_	- -	-
195	2,683	1,903	1,672	1,386		_	Ė	2,842	H-			H	H-			-
200	2,767	2,037	1,715	1,433				2,936	<u> </u>	<u> </u>		H	\vdash		<u> </u>	
205	2,852	2,103	1,759	1,480				3,031					<u> </u>		<u> </u>	
210	2,936	2,169	1,803	1,526				3,125					_			
215	3,021	2,234	1,846	1,573	<u> </u>	_	_	3,219	<u> </u>	_	-		<u> </u>	_	_	
220	3,105	2,300	1,896	1,620	<u> </u>	-	_	0,210	<u> </u>	-	-				-	
225	3,190	2,366	1,945	1,666		-	_			-	-				-	-
230	-	2,432	1,995	1,713	<u> </u>	-	_		<u> </u>	-	-		<u> </u>		_	-
235	<u> </u>	2,497	2,045	1,760	<u> </u>	-	_		-	-	-		-	-	-	-
240	-	2,563	2,095	1,807	-	-	-		-	-	-	<u> </u>	-	-	-	-
245	-	2,629	2,145	1,853	-	-	-		<u> </u>	-	-		<u> </u>	-	-	-
250		2,695	2,194	1,891	-	-	-		-	-	-			-	-	-
255	-	2,760	2,244	1,929	-	-	-		-	-	-		-	-	-	-
260	-	2,826	2,294	1,967	-		-	- 1	-	-	-		-	-	-	-
265	-	2,892	2,344	2,005	-	-	-		-	-	-	- 1	-	-	-	-
270	-	2,958	2,394	2,044	-	-	-		-	-	-	- 1	-	-	-	-
275	-	3,083	2,443	2,082	-	-	-	-	-	-	-	- 1	-	-	-	-
280	-	3,288	2,493	2,120	-	-			<u> </u>		-		<u> </u>			-
285		3,492	2,543	2,158		-	-	-	<u> </u>	-		-		-	-	-
290		3,697	2,593	2,196	-	-	-	-	-	-	-	-		-	-	-
295		3,901	2,643	2,234	-	-	-	-	-	-	-	-	-	-	-	-
300		-	2,692	2,272	-	-	-	-	-	-	-		-	-	-	-
305		-	2,742	2,310	-	-	-	-	-	-	-	-	-	-	-	-
310	-	-	0,792	2,349	-	-	-	-	-	-	-	-	-	-	-	-
315		-	2,842	2,387		-	-	-		-		-		-	-	-
320		-	2,892	2,425	-	-	-	-	-	-	-			-	-	-
325		-	2,941	2,463	-	-				_	-				-	-
330			2,991	2,501		-		-			-			-		-

Steel columns, 4-sided open H- or I-sections - protection thickness required



					Thicknes	s (mm) r	equired t	for the RI	F period -	only int	umescer	nt coating	9			
T		0,212 0,212 0,212 0,21				R	30			R	45			R	60	
U/A	500°C			650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
71			_	0,212	0,212	0,212	0,212	0,212	0,250	0,212	0,212	0,212	0,390	0,322	0,275	0,248
75		0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,271	0,226	0,212	0,212	0,420	0,346	0,296	0,268
80	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,296	0,249	0,212	0,212	0,458	0,377	0,322	0,293
85	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,322	0,272	0,229	0,212	0,496	0,407	0,348	0,317
90	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,348	0,295	0,251	0,220	0,534	0,438	0,374	0,342
95	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,212	0,374	0,318	0,272	0,241	0,572	0,468	0,400	0,366
100	0,212	0,212	0,212	0,212	0,222	0,212	0,212	0,212	0,399	0,341	0,294	0,262	0,610	0,499	0,426	0,391
105	0,212	0,212	0,212	0,212	0,243	0,212	0,212	0,212	0,425	0,364	0,315	0,284	0,648	0,529	0,452	0,415
110	0,212	0,212	0,212	0,212	0,265	0,212	0,212	0,212	0,451	0,387	0,337	0,305	0,686	0,559	0,477	0,440
115	0,212	0,212	0,212	0,212	0,286	0,219	0,212	0,212	0,476	0,410	0,359	0,327	0,724	0,590	0,503	0,464
120 125	0,212	0,212	0,212	0,212	0,308	0,240 0,261	0,212	0,212	0,502	0,433	0,380	0,348	0,762	0,620 0,651	0,529 0,555	0,489 0,513
130	0,212	0,212 0,212	0,212 0,212	0,212	0,329	0,281	0,212 0,212	0,212 0,212	0,526	0,456 0,479	0,402 0,423	0,370	0,800	0,681	0,555	0,513
135	0,212	0,212	0,212	0,212	0,372	0,303	0,212	0,212	0,579	0,501	0,425	0,391	0,875	0,711	0,607	0,563
140	0,212	0,212	0,212	0,212	0,393	0,325	0,255	0,212	0,605	0,524	0,466	0,434	0,913	0,742	0,633	0,587
145	0,212	0,212	0,212	0,212	0,415	0,346	0,276	0,212	0,631	0,547	0,488	0,455	0,951	0,772	0,659	0,612
150	0,212	0,212	0,212	0,212	0,436	0,367	0,297	0,240	0,656	0,570	0,509	0,477	0,989	0,803	0,685	0,636
155	0,212	0,212	0,212	0,212	0,458	0,388	0,318	0,261	0,682	0,593	0,531	0,498	1,027	0,833	0,711	0,661
160	0,212	0,212	0,212	0,212	0,479	0,409	0,339	0,283	0,708	0,616	0,552	0,520	1,065	0,864	0,737	0,685
165	0,212	0,212	0,212	0,212	0,500	0,430	0,360	0,305	0,733	0,639	0,574	0,541	1,103	0,894	0,763	0,710
170	0,212	0,212	0,212	0,212	0,522	0,451	0,381	0,327	0,759	0,662	0,595	0,563	1,155	0,924	0,789	0,734
175	0,212	0,212	0,212	0,212	0,543	0,473	0,402	0,348	0,785	0,685	0,617	0,584	1,244	0,955	0,815	0,759
180	0,212	0,212	0,212	0,212	0,565	0,494	0,423	0,370	0,811	0,708	0,639	0,606	1,334	0,985	0,841	0,784
185	0,212	0,212	0,212	0,212	0,586	0,515	0,444	0,392	0,836	0,731	0,660	0,627	1,423	1,016	0,867	0,808
190	0,212	0,212	0,212	0,212	0,608	0,536	0,465	0,413	0,862	0,754	0,682	0,648	1,512	1,046	0,893	0,833
195	0,212	0,212	0,212	0,212	0,629	0,557	0,486	0,435	0,888	0,777	0,703	0,670	1,601	1,076	0,919	0,857
200	0,212	0,212	0,212	0,212	0,650	0,578	0,507	0,457	0,913	0,800	0,725	0,691	1,690	1,107	0,945	0,882
205 210	0,212	0,212	0,212	0,212	0,672	0,599 0,621	0,528 0,550	0,479 0,500	0,939	0,823 0,845	0,746 0,768	0,713 0,734	1,779	1,148 1,223	0,971	0,906 0,931
215	0,219	0,212	0,212 0,212	0,212	0,093	0,642	0,550	0,500	0,965	0,868	0,789	0,756	1,957	1,223	1,023	0,951
220	0,243	0,212	0,212	0,212	0,736	0,663	0,592	0,522	1,016	0,891	0,703	0,777	2,046	1,373	1,049	0,980
225	0,290	0,212	0,212	0,212	0,758	0,684	0,613	0,565	1,042	0,914	0,832	0,799	2,135	1,448	1,075	1,004
230	0,314	0,212	0,212	0,212	0,779	0,705	0,634	0,587	1,068	0,937	0,854	0,820	2,224	1,523	1,101	1,029
235	0,337	0,212	0,212	0,212	0,800	0,726	0,655	0,609	1,093	0,960	0,876	0,841	2,313	1,598	1,127	1,054
240	0,361	0,212	0,212	0,212	0,822	0,747	0,676	0,631	1,119	0,983	0,897	0,863	2,402	1,673	1,191	1,078
245	0,385	0,212	0,212	0,212	0,843	0,769	0,697	0,652	1,165	1,006	0,919	0,884	2,490	1,748	1,261	1,103
250	0,408	0,226	0,212	0,212	0,865	0,790	0,718	0,674	1,226	1,029	0,940	0,906	2,574	1,823	1,330	1,127
255	0,432	0,253	0,212	0,212	0,886	0,811	0,739	0,696	1,287	1,052	0,962	0,927	2,659	1,898	1,399	1,194
260	0,455	0,281	0,212	0,212	0,908	0,832	0,760	0,718	1,348	1,075	0,983	0,949	2,744	1,973	1,469	1,266
265	0,479	0,308	0,212	0,212	0,929	0,853	0,781	0,739	1,408	1,098	1,005	0,970	2,829	2,048	1,538	1,338
270	0,503	0,336	0,212	0,212	0,950	0,874	0,802	0,761	1,469	1,121	1,026	0,992	2,914	2,123	1,607	1,410
275	0,526	0,363	0,236	0,212	0,972	0,896	0,823	0,783	1,530	1,172	1,048	1,013	2,998	2,197	1,677	1,481
280 285	0,550	0,390	0,266	0,212	0,993	0,917	0,844	0,804	1,591	1,242	1,069	1,034	3,083	2,272	1,746	1,553
290	0,574 0,597	0,418 0,445	0,296 0,325	0,212	1,015	0,938 0,959	0,865 0,887	0,826 0,848	1,651 1,712	1,313 1,383	1,091 1,112	1,056 1,077	3,168	2,347 2,422	1,815 1,885	1,625 1,697
295	0,621	0,443	0,355	0,234	1,058	0,939	0,887	0,870	1,773	1,453	1,112	1,077	3,337	2,536	1,954	1,769
300	0,644	0,500	0,385	0,200	1,079	1,001	0,929	0,891	1,834	1,524	1,228	1,120	3,422	2,686	2,023	1,840
305	0,668	0,528	0,303	0,330	1,100	1,022	0,950	0,031	1,894	1,594	1,310	1,120	3,507	2,836	2,023	1,912
310	0,692	0,555	0,444	0,362	1,122	1,044	0,971	0,935	1,955	1,664	1,392	1,270	3,592	2,986	2,162	1,984
315	0,715	0,582	0,474	0,394	1,178	1,065	0,992	0,957	2,016	1,735	1,474	1,360	3,676	3,137	2,231	2,056
320	0,739	0,610	0,504	0,426	1,254	1,086	1,013	0,978	2,077	1,805	1,556	1,451	3,761	3,287	2,301	2,128
325	0,762	0,637	0,533	0,458	1,330	1,107	1,034	1,000	2,138	1,875	1,638	1,541	3,846	3,437	2,370	2,200
330	0,786	0,665	0,563	0,490	1,406	1,128	1,055	1,022	2,198	1,946	1,720	1,632	4,099	3,587	2,439	2,271
335	0,810	0,692	0,593	0,523	1,482	1,209	1,076	1,043	2,259	2,016	1,803	1,722	4,419	3,737	2,741	2,343
340	0,833	0,719	0,622	0,555	1,558	1,296	1,097	1,065	2,320	2,086	1,885	1,812	4,738	3,919	3,134	2,415
344	0,852	0,741	0,646	0,580	1,619	1,365	1,114	1,083	2,386	2,142	1,950	1,885	4,994	4,257	3,448	2,547





				1	Thickness	s (mm) re	equired f	or the RF	period -	only int	umescer	nt coating				
T		R	90			R	120			R	180			R	240	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
71	0,942	0,696	0,553	0,493	2,911	2,604	1,315	1,016	-	-	3,701	3,447	-	-	-	-
75	1,016	0,750	0,595	0,531	2,980	2,663	1,809	1,097		-	3,817	3,553		-	-	
80	1,110	0,817	0,648	0,578	3,067	2,737	2,427	1,351			3,969	3,685			_	
85	1,510	0,884	0,701	0,626	3,154	2,811	2,521	1,680	<u> </u>	-	4,123	3,817	<u> </u>	-	-	
90	1,997	0,952	0,754	0,673	3,241	2,885	2,587	2,009	<u> </u>	-	4,277	3,995	<u> </u>	-	-	
95	2,461	1,019	0,807	0,721	3,328	2,959	2,652	2,338	┝	- -	4,432	4,205	⊢∸	-	-	╙
100 105	2,517 2,572	1,086 1,227	0,860 0,912	0,768 0,816	3,415	3,032 3,106	2,718 2,784	2,499 2,562	<u> </u>	-	4,586 4,741	4,414 4,624	⊢∸	-	-	
110	2,627	1,502	0,912	0,863	3,589	3,180	2,764	2,626	\vdash	-	4,741	4,833	<u> </u>	-		H
115	2,683	1,778	1,018	0,003	3,676	3,254	2,915	2,689		-	5,050	5,043	<u> </u>	-	<u> </u>	\vdash
120	2,738	2,053	1,071	0,958	3,763	3,327	2,981	2,753			- -	-		-		
125	2,793	2,328	1,124	1,006	3,850	3,401	3,047	2,816	-	-	-		-	-	-	<u> </u>
130	2,848	2,487	1,277	1,053	4,020	3,475	3,112	2,880		-	-		<u> </u>	-	-	
135	2,904	2,542	1,443	1,100	4,214	3,549	3,178	2,943	-	-	-	- 1	-	-	-	
140	2,959	2,596	1,610	1,174	4,408	3,623	3,244	3,007	-	-	-	-	-	-	-	-
145	3,014	2,651	1,776	1,289	4,602	3,696	3,309	3,070		-	-	-		-	-	-
150	3,070	2,705	1,942	1,405	4,796	3,770	3,375	3,133		-	-			-	-	
155	3,125	2,759	2,108	1,520	4,990	3,844	3,441	3,197		-	-	-		-		
160	3,180	2,814	2,275	1,635		4,059	3,507	3,260		-	-	-		-	-	 -
165	3,236	2,868	2,441	1,751	┝	4,350	3,572	3,324	┝	<u> </u>	-	<u> </u>	╙	-	-	<u> </u>
170	3,291	2,923	2,511	1,866	<u> </u>	4,642	3,638	3,387	<u> </u>	-	-		<u> </u>	-	-	
175	3,346	2,977	2,570	1,982	<u> </u>	4,934	3,704	3,451	<u>⊢-</u>	<u> </u>	-	<u> </u>	⊢∸	-	-	╙
180	3,401	3,031	2,629	2,097	<u> </u>	-	3,769	3,514	<u> </u>	-	-	<u> </u>	<u> </u>	<u> </u>	-	
185	3,457	3,086	2,688	2,212	<u> </u>	-	3,835	3,578	<u> </u>	-	-		<u> </u>	-	-	┝╧┩
190 195	3,512	3,140 3,195	2,747 2,806	2,382 2,443	Ŀ	-	4,162 4,779	3,641 3,705	Ŀ	-	-		<u> </u>	-	-	
200	3,623	3,249	2,865	2,443	<u> </u>	-	4,119	3,768	<u> </u>	-	-	-	H	-	-	H
205	3,678	3,303	2,924	2,582		<u> </u>		3,831		-	-	\vdash	H	-	<u> </u>	\vdash
210	3,733	3,358	2,982	2,648				-							_	
215	3,789	3,412	3,041	2,714	-	-	-		-	-	-	-	<u> </u>	-	-	
220	3,844	3,467	3,100	2,780	-	-	-		-	-	-	-	-	-	-	<u> </u>
225	4,032	3,521	3,159	2,846	-	-	-		-	-	-	- 1	-	-	-	
230	4,339	3,576	3,218	2,912	-	-	-	-	-	-	-	-	-	-	-	-
235	4,645	3,630	3,277	2,978		-	-		-	-	-	-		-	-	-
240	4,951	3,684	3,336	3,044	-	-	-	-	-	-	-	-		-	-	-
245		3,739	3,395	3,110			-				-			-		
250		3,793	3,454	3,176		-	-	<u> </u>		-	-			-	-	
255	<u> </u>	3,848	3,513	3,242	┝	-	-	<u> </u>	<u> </u>	-	-	<u> </u>	╙	-	-	
260	<u> </u>	4,030	3,571	3,308	-	-	-		<u> </u>	-	-		<u> </u>	-	<u> </u>	
265	<u>⊢-</u>	4,300	3,630	3,374	<u> </u>	<u> </u>	-	┝╧┦	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	-	<u> </u>	╙
270 275	<u> </u>	4,571	3,689	3,440	<u> </u>	<u> </u>	-	\vdash	<u> </u>	-	-		<u> </u>	-	<u> </u>	╓
280	<u> </u>	4,841 5,111	3,748 3,807	3,506 3,572	<u> </u>	-	<u>-</u>		<u> </u>	-	-		<u> </u>	-	-	
285	<u> </u>	5,111	3,866	3,638	H	-	-	\vdash	<u> </u>	-	-		H	-	-	H
290		Ė	4,045	3,704				$\vdash\vdash\vdash$		-		\vdash		-		\vdash
295		-	4,232	3,770		-	-	\vdash		-		\vdash	_	-	-	<u> </u>
300	-	-	4,419	3,836	<u> </u>	-	-		-	-	-	-	- -	-	-	-
305	<u> </u>	-	4,606	4,044	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	
310	-	-	4,793	4,405	-	-	-		-	-	-		-	-	-	
315	-	-	4,981	4,766	-	-		-	-	-	-	-		-	-	-
320	-	-	5,168	5,127	-	-	-	- 1	-	-	-	-	-	-	-	-
325		-	-			-	-	-		-	-	-		-	-	-
330		-	-		-		-		-	-	-	-	_	-	_	-
335		-	-			-	-		-	-	-			-	-	
340			-			-	-			-	-	-		-	-	-
344		<u> </u>		<u></u> _		<u> </u>	-	╚		-	-			-	<u> </u>	

Steel columns, 4-sided circular hollow sections - protection thickness required



					Thicknes	s (mm) ı	required	for the R	F period	only in	tumesce	nt coatir	ıg			
T		R	15			R	30			R	45			R	60	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
45	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,360	0,256	0,256	0,256	0,905	0,709	0,545	0,365
50	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,508	0,328	0,256	0,256	1,102	0,897	0,726	0,537
55	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,651	0,464	0,308	0,256	1,291	1,078	0,901	0,702
60	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,256	0,788	0,595	0,434	0,258	1,473	1,252	1,069	0,862
35 70	0,256 0,256	0,256 0,256	0,256 0,256	0,256 0,256	0,256	0,256	0,256	0,256	0,920 1,046	0,721 0,843	0,555 0,673	0,374 0,485	1,648 1,816	1,420 1,582	1,230 1,386	1,016 1,164
5	0,256	0,256	0,256	0,256	0,277	0,256 0,256	0,256 0,256	0,256 0,256	1,169	0,043	0,673	0,465	1,978	1,737	1,537	1,307
30	0,256	0,256	0,256	0,256	0,439	0,259	0,256	0,256	1,103	1,073	0,895	0,696	2,135	1,888	1,682	1,445
85	0,256	0,256	0,256	0,256	0,515	0,332	0,256	0,256	1,401	1,182	1,000	0,796	2,286	2,033	1,822	1,578
90	0,256	0,256	0,256	0,256	0,589	0,403	0,256	0,256	1,510	1,288	1,102	0,892	2,432	2,174	1,958	1,707
95	0,256	0,256	0,256	0,256	0,661	0,471	0,312	0,256	1,616	1,390	1,200	0,986	2,572	2,308	2,089	1,832
00	0,256	0,256	0,256	0,256	0,730	0,538	0,376	0,256	1,719	1,488	1,295	1,076	2,708	2,439	2,215	1,953
05 10	0,256 0,256	0,256 0,256	0,256 0,256	0,256 0,256	0,796	0,602 0,663	0,437 0,497	0,258	1,818 1,914	1,584 1,676	1,388 1,477	1,164 1,249	2,840 2,967	2,566 2,688	2,338 2,457	2,070 2,183
15	0,256	0,256	0,256	0,256	0,001	0,003	0,497	0,315 0,370	2,007	1,765	1,563	1,331	3,091	2,807	2,457	2,103
20	0,256	0,256	0,256	0,256	0,984	0,723	0,611	0,370	2,007	1,852	1,647	1,411	3,210	2,922	2,684	2,399
25	0,256	0,256	0,256	0,256	1,043	0,838	0,665	0,475	2,184	1,936	1,729	1,489	3,326	3,034	2,792	2,502
30	0,256	0,256	0,256	0,256	1,100	0,893	0,718	0,525	2,269	2,017	1,807	1,564	3,438	3,142	2,897	2,603
35	0,256	0,256	0,256	0,256	1,155	0,946	0,769	0,574	2,351	2,097	1,884	1,637	3,547	3,247	2,999	2,700
40	0,256	0,256	0,256	0,256	1,209	0,997	0,819	0,621	2,431	2,173	1,958	1,708	3,653	3,349	3,098	2,794
145	0,256	0,256	0,256	0,256	1,261	1,047	0,867	0,667	2,508	2,248	2,031	1,777	3,755	3,448	3,194	2,886
50 55	0,256 0,256	0,256 0,256	0,256 0,256	0,256 0,256	1,312 1,361	1,096 1,143	0,914 0,960	0,711 0,755	2,583 2,656	2,320 2,391	2,101 2,169	1,844 1,909	3,855	3,545 3,638	3,288 3,379	2,976 3,063
160	0,256	0,256	0,256	0,256	1,409	1,189	1,004	0,797	2,727	2,459	2,103	1,972	4,046	3,729	3,467	3,147
165	0,256	0,256	0,256	0,256	1,455	1,234	1,048	0,838	2,796	2,526	2,300	2,034	4,137	3,818	3,553	3,230
170	0,256	0,256	0,256	0,256	1,500	1,277	1,090	0,878	2,863	2,591	2,363	2,094	4,226	3,904	3,637	3,310
75	0,256	0,256	0,256	0,256	1,544	1,320	1,131	0,917	2,929	2,654	2,425	2,153	4,313	3,988	3,719	3,388
180	0,256	0,256	0,256	0,256	1,587	1,361	1,171	0,955	2,992	2,715	2,484	2,210	4,397	4,070	3,798	3,464
85 90	0,256 0,256	0,256 0,256	0,256 0,256	0,256 0,256	1,629 1,670	1,401 1,440	1,210 1,248	0,992 1,029	3,054 3,115	2,775 2,834	2,543 2,599	2,265 2,319	4,480 4,560	4,149 4,227	3,876 3,951	3,538 3,610
195	0,256	0,256	0,256	0,256	1,709	1,440	1,245	1,029	3,173	2,891	2,655	2,372	4,638	4,302	4,025	3,681
200	0,265	0,256	0,256	0,256	1,748	1,516	1,321	1,098	3,231	2,946	2,709	2,424	4,714	4,376	4,097	3,750
205	0,284	0,256	0,256	0,256	1,785	1,552	1,356	1,132	3,287	3,000	2,761	2,474	4,788	4,448	4,167	3,817
10	0,303	0,256	0,256	0,256	1,822	1,588	1,390	1,165	3,341	3,053	2,813	2,523	4,861	4,518	4,235	3,882
15	0,322	0,256	0,256	0,256	1,858	1,622	1,424	1,197	3,395	3,105	2,863	2,571	4,931	4,587	4,302	3,946
220 225	0,340 0,357	0,256 0,256	0,256 0,256	0,256 0,256	1,893 1,927	1,656 1,689	1,457 1,489	1,228 1,258	3,447 3,497	3,155 3,204	2,912 2,960	2,618 2,664	5,000 5,068	4,654 4,719	4,367 4,431	4,009 4,070
230	0,374	0,256	0,256	0,256	1,961	1,721	1,520	1,288	3,547	3,252	3,007	2,709	5,133	4,783	4,493	4,130
235	0,391	0,256	0,256	0,256	1,993	1,753	1,551	1,371	3,596	3,299	3,052	2,753	5,198	4,845	4,554	4,188
240	0,408	0,256	0,256	0,256	2,025	1,784	1,580	1,346	3,643	3,345	3,097	2,795	-	4,906	4,614	4,245
45	0,424	0,256	0,256	0,256	2,056	1,814	1,610	1,374	3,689	3,390	3,141	2,837	-	4,966	4,672	4,301
250	0,439	0,256	0,256	0,256	2,087	1,843	1,638	1,401	3,734	3,434	3,184	2,878	<u> </u>	5,024	4,729	4,355
255 260	0,455 0,470	0,267 0,282	0,256 0,256	0,256 0,256	2,117	1,872	1,666	1,428	3,779	3,477 3,519	3,225 3,266	2,918 2,958	<u> </u>	5,081 5,137	4,784 4,839	4,409 4,461
265	0,470	0,282	0,256	0,256	2,146	1,900 1,928	1,694 1,720	1,454 1,479	3,822	3,519	3,200	2,958	<u> </u>	5,137	4,839	4,461
270	0,499	0,230	0,256	0,256	2,174	1,955	1,747	1,504	3,906	3,600	3,346	3,033		5,245	4,944	4,562
275	0,513	0,323	0,256	0,256	2,230	1,981	1,772	1,529	3,946	3,639	3,384	3,070	-	-	4,996	4,612
280	0,527	0,336	0,256	0,256	2,256	2,007	1,798	1,553	3,986	3,678	3,422	3,106	-	-	5,046	4,660
285	0,540	0,349	0,256	0,256	2,283	2,032	1,822	1,577	4,025	3,716	3,458	3,142	-	-	5,095	4,707
290	0,553	0,362	0,256	0,256	2,308	2,057	1,846	1,600	4,063	3,753	3,495	3,176	<u> </u>	-	5,143	4,753
295 300	0,566 0,579	0,374 0,386	0,256 0,256	0,256 0,256	2,333	2,082 2,106	1,870 1,893	1,622 1,645	4,100 4,137	3,789 3,825	3,530 3,565	3,210 3,244	<u> </u>	-	5,190 5,236	4,798 4,843
305	0,579	0,398	0,256	0,256	2,382	2,129	1,916	1,666	4,173	3,859	3,599	3,276		-	J,230 -	4,886
10	0,604	0,410	0,256	0,256	2,406	2,152	1,938	1,688	4,208	3,894	3,632	3,308	-	-	-	4,929
315	0,616	0,422	0,256	0,256	2,429	2,174	1,960	1,709	4,243	3,927	3,665	3,340	-	-	-	4,971
320	0,627	0,433	0,266	0,256	2,452	2,196	1,982	1,729	4,276	3,960	3,697	3,370	-	-	-	5,012
325	0,639	0,444	0,277	0,256	2,474	2,218	2,003	1,749	4,310	3,992	3,728	3,401	-	-	-	5,052
30	0,650	0,455	0,287	0,256	2,496	2,239	2,023	1,769	4,342	4,024	3,759	3,430	<u> </u>	-	-	5,092
1.33	0,661 0,672	0,465 0,476	0,298 0,308	0,256 0,256	2,518 2,539	2,260 2,281	2,044 2,064	1,788 1,807	4,374 4,405	4,055 4,086	3,790 3,819	3,459 3,488	<u> </u>	-	-	5,130 5,169
		U.T/U	0,000	U, Z U U	■ ∠, ∪∪∪	١ ٢٠٠٠	۷,00		■ 7,700	7,000	0,010	0,700	mi =	-	-	0,100
340						2.301	2.083	1.826	4.436	4,115	3,849	3,516	-	-	-	5.206
340 345 350	0,683 0,693	0,486 0,496	0,318 0,327	0,256 0,256	2,559 2,580	2,301 2,320	2,083 2,102	1,826 1,845	4,436 4,486	4,115 4,145	3,849 3,877	3,516 3,544		-	-	5,206 5,243

Steel columns, 4-sided circular hollow sections - protection thickness required



					Thicknes	s (mm) r	equired	for the R	F period -	only int	umescei	nt coating	<u> </u>			
						, ,			Former				,			
T		R					120				180				240	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
45 50	1,996	1,754	1,553	1,323	3,087	2,799	2,562	2,282	<u> </u>	-	4,579	4,199	<u> </u>	-	-	-
55	2,290 2,572	2,036 2,306	1,825 2,086	1,581 1,830	3,478 3,853	3,174 3,534	2,924 3,272	2,626 2,957	\vdash	-	5,121 -	4,715 5,212	<u> </u>	-	-	-
60	2,843	2,567	2,000	2,069	4,214	3,881	3,607	3,276		-	-	5,212		-	-	-
65	3,104	2,817	2,580	2,299	4,561	4,214	3,930	3,583		-	-	\vdash			-	
70	3,356	3,059	2,814	2,522	4,895	4,536	4,241	3,880	-	-	-		<u> </u>	-	-	-
75	3,598	3,292	3,039	2,736	5,217	4,846	4,541	4,166	<u> </u>	-	-		-	-	-	-
80	3,831	3,516	3,256	2,943	-	5,145	4,831	4,442		-	-		-	-	-	-
85	4,057	3,733	3,466	3,144	-	-	5,111	4,709	-	-	-		-	-	-	-
90	4,274	3,942	3,669	3,337	-	-	-	4,967	-	-	-	-	-	-	-	-
95	4,484	4,145	3,865	3,524	-	-	_	5,216	-	-	-	-		-	-	-
100	4,687	4,341	4,055	3,705		-	-	-	-	-	-	-	-	-	-	-
105	4,883	4,530	4,239	3,881		-					-				-	-
110	5,074	4,713	4,417	4,051	-	-				-	-			-	-	-
115		4,891	4,589	4,215	-	-	-		-	-	-			-	-	-
120	<u> </u>	5,063	4,757	4,375	<u> </u>	-	-		<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-
125	<u> </u>	5,230	4,919	4,530	<u> </u>	-	<u> </u>		<u> </u>	-	-	\vdash	<u> </u>	-	-	-
130	<u> </u>	-	5,076	4,680	<u> </u>	-	-	-	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-
135	<u> </u>	-	5,229	4,826	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-
140 145	Ŀ	-	-	4,968	<u> </u>	-	-		<u> </u>	-	-	\vdash	<u> </u>	-	-	-
150	<u> </u>	<u> </u>	-	5,106	-	-	<u> </u>	\vdash	<u> </u>	<u> </u>	<u>-</u>	-	<u> </u>	<u> </u>	-	-
155	<u> </u>	-	-	5,240 -	H	-	-	\vdash	-	-	-	\vdash	H	-	-	-
160			<u> </u>			-			_	-		\vdash			-	
165		-				-				-		\vdash		-		
170	<u> </u>	-	-			_			<u> </u>	-	-		-	-	-	-
175	-	-	-		-	-	-		-	-	-		-	-	-	-
180	-	-	-	-	-	-	-	-	<u> </u>	-	-		-	-	-	-
185	-	-	-		-	-	-			-	-		-	-	-	-
190	-	-	-	- 1	-	-	-	- 1	-	-	-		-	-	-	-
195	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
205		-	-			-				-	-			-	-	-
210		-	-			-	-			-	-			-	-	-
215	<u> </u>	-	-	<u> </u>	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-
220	╙	-	-	<u> </u>	╙	-	-	<u> </u>	╙	-	-	<u> </u>	<u> </u>	-	-	-
225	<u> </u>	-	-	<u> </u>	<u> </u>	-	-		<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-
230	<u>⊢-</u>	<u> </u>	<u> </u>	<u>-</u>	<u> </u>	-	<u> </u>		<u> </u>	-	-		<u> </u>	<u> </u>	-	-
235	<u> </u>	-	-	<u> </u>	H	-	<u> </u>		<u> </u>	-	-	\vdash	<u> </u>	-	-	-
240 245	H-	<u> </u>	-	H	-	-	<u> </u>		<u> </u>	<u> </u>	<u>-</u>	-	<u> </u>	<u> </u>	-	
250	H	<u> </u>	-	\vdash	H	-	-		<u> </u>	-	-		<u> </u>	<u> </u>	-	-
255			-	\vdash		-	<u> </u>	\vdash	<u> </u>	-	-	\vdash	<u> </u>	-	-	-
260		<u> </u>	<u> </u>			-	<u> </u>	\vdash				\vdash		<u> </u>	-	
265	<u> </u>	-	-			-	-			-	-	\vdash	<u> </u>	-	-	
270	-	-	-		-	-	-	-	-	-	-		-	-	-	-
275	<u> </u>	-	-		<u> </u>	-	-		-	-	-		-	-	-	-
280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
285	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
290	-	-	-	-		-	-	-		-	-	-	-	-	-	-
295		_	-			-				-	-	-		_	-	-
300		-	-	-		-				-	-			-	-	-
305			-			-						\Box			-	-
310		-	-		-	-	-		-	-	-			-	-	-
315	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-
320	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-
325	<u> </u>	-	-	<u> </u>	-	-	-		-	-	-		<u> </u>	-	-	-
330	<u> </u>	-	-	<u> </u>	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-
335	⊢∸	-	<u> </u>	<u> </u>	<u> </u>	-	-		<u> </u>	-	-	\vdash	<u> </u>	-	-	-
340	<u> </u>	-	-	H	H	-	<u> </u>		<u>⊢-</u>	-	-	\vdash	<u>⊢-</u>	-	-	-
345	<u> </u>	-	-	H	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-
350 355	⊢ <u>·</u>	-	-	H	<u> </u>	-	- -		<u> </u>	-	-	\vdash	<u> </u>	-	-	-
333		-				-				-	-					

Steel columns, 4-sided rectangular hollow sections - protection thickness required



					Thicknes	s (mm) r	equired	for the RI	F period ·	only in	tumesce	nt coatin	g			
T		R	15			R	30			R	45			R	60	
U/A	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C
50	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,316	0,230	0,230	0,230
55	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,478	0,278	0,230	0,230
60	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,635	0,424	0,230	0,230
65	0,230	0,230	0,230	0,230	0,230	0,230 0,230	0,230	0,230	0,232	0,230	0,230	0,230	0,789	0,567	0,355	0,230 0,278
70 75	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,346	0,230	0,230	0,230	0,938	0,706 0,842	0,464	0,276
80	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,566	0,352	0,230	0,230	1,227	0,975	0,734	0,508
85	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,672	0,451	0,239	0,230	1,366	1,106	0,855	0,619
90	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,776	0,547	0,328	0,230	1,502	1,233	0,973	0,729
95	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,230	0,877	0,641	0,415	0,230	1,635	1,357	1,089	0,836
100 105	0,230	0,230	0,230	0,230	0,230	0,230 0,230	0,230	0,230	0,976 1,073	0,733	0,501 0,584	0,283	1,764	1,479 1,598	1,202 1,313	0,941 1,044
110	0,230	0,230	0,230	0,230	0,233	0,230	0,230	0,230	1,168	0,824	0,564	0,300	2,015	1,715	1,422	1,145
115	0,230	0,230	0,230	0,230	0,384	0,230	0,230	0,230	1,260	0,999	0,746	0,509	2,136	1,829	1,529	1,244
120	0,230	0,230	0,230	0,230	0,446	0,230	0,230	0,230	1,350	1,083	0,825	0,582	2,254	1,941	1,633	1,342
125	0,230	0,230	0,230	0,230	0,507	0,282	0,230	0,230	1,439	1,166	0,902	0,653	2,370	2,050	1,736	1,437
130	0,230	0,230	0,230	0,230	0,567	0,337	0,230	0,230	1,525	1,247	0,978	0,723	2,483	2,158	1,837	1,531
135	0,230	0,230	0,230	0,230	0,626	0,391	0,230	0,230	1,610	1,327	1,052	0,791	2,594	2,263	1,935	1,623
140 145	0,230	0,230	0,230	0,230	0,683	0,445 0,497	0,230 0,265	0,230	1,693 1,774	1,405 1,482	1,125 1,196	0,859 0,925	2,703	2,366 2,467	2,032	1,714 1,803
150	0,230	0,230	0,230	0,230	0,794	0,548	0,311	0,230	1,853	1,557	1,266	0,990	2,913	2,566	2,221	1,890
155	0,230	0,230	0,230	0,230	0,847	0,598	0,358	0,230	1,931	1,630	1,335	1,054	3,015	2,663	2,312	1,976
160	0,230	0,230	0,230	0,230	0,900	0,647	0,403	0,230	2,007	1,702	1,402	1,117	3,115	2,758	2,402	2,060
165	0,230	0,230	0,230	0,230	0,951	0,695	0,447	0,230	2,082	1,773	1,469	1,178	3,213	2,851	2,490	2,143
170	0,230	0,230	0,230	0,230	1,002	0,742	0,491	0,254	2,155	1,843	1,534	1,239	3,309	2,943	2,577	2,224
175 180	0,230	0,230	0,230	0,230 0,230	1,052	0,788 0,834	0,534 0,576	0,293	2,227	1,911 1,978	1,598 1,661	1,229 1,357	3,403	3,033	2,662 2,746	2,304 2,383
185	0,230	0,230	0,230	0,230	1,148	0,878	0,576	0,332	2,367	2,043	1,722	1,415	3,585	3,208	2,828	2,460
190	0,230	0,230	0,230	0,230	1,195	0,922	0,658	0,407	2,434	2,108	1,783	1,472	3,674	3,293	2,909	2,536
195	0,230	0,230	0,230	0,230	1,240	0,965	0,698	0,444	2,501	2,171	1,843	1,527	3,761	3,377	2,988	2,611
200	0,230	0,230	0,230	0,230	1,285	1,008	0,737	0,480	2,566	2,233	1,901	1,582	3,847	3,459	3,066	2,684
205	0,230	0,230	0,230	0,230	1,330	1,049	0,775	0,515	2,630	2,294	1,959	1,636	3,930	3,539	3,143	2,757
210 215	0,230	0,230	0,230 0,230	0,230	1,373 1,415	1,090 1,130	0,813 0,851	0,550 0,585	2,693 2,754	2,354 2,413	2,016 2,071	1,689 1,741	4,013	3,619 3,696	3,218 3,292	2,828 2,898
220	0,230	0,230	0,230	0,230	1,417	1,169	0,887	0,619	2,815	2,471	2,126	1,793	4,173	3,773	3,365	2,967
225	0,230	0,230	0,230	0,230	1,498	1,208	0,923	0,652	2,874	2,528	2,180	1,843	4,251	3,848	3,437	
230	0,230	0,230	0,230	0,230	1,539	1,246	0,959	0,685	2,933	2,584	2,233	1,893	4,327	3,922	3,507	3,102
235	0,230	0,230	0,230	0,230	1,578	1,284	0,994	0,717	2,990	2,639	2,285	1,942	4,402	3,995	3,577	3,168
240	0,230	0,230	0,230	0,230	1,617	1,320	1,028	0,749	3,047	2,693	2,337	1,991	4,476	4,066	3,645	3,233
245 250	0,230	0,230	0,230	0,230	1,655 1,693	1,357 1,392	1,062 1,096	0,780 0,811	3,102 3,157	2,747 2,799	2,387 2,437	2,038 2,085	4,549 4,620	4,137 4,206	3,713 3,779	3,296 3,359
255	0,250	0,230	0,230	0,230	1,730	1,427	1,128	0,841	3,210	2,851	2,486	2,131	4,690	4,274	3,844	3,421
260	0,270	0,230	0,230	0,230	1,766	1,462	1,161	0,871	3,263	2,901	2,534	2,177	4,759	4,341	3,908	3,482
265	0,289	0,230	0,230	0,230	1,802	1,496	1,192	0,901	3,314	2,951	2,582	2,222	4,827	4,407	3,971	3,542
270	0,309	0,230	0,230	0,230	1,837	1,539	1,224	0,930	3,365	3,000	2,629	2,266	4,894	4,471	4,034	3,602
275	0,328	0,230	0,230	0,230	1,872	1,562	1,255	0,959	3,415	3,049	2,675	2,309	4,959	4,535	4,095	3,660
280 285	0,346	0,230	0,230 0,230	0,230	1,906 1,939	1,594 1,626	1,285 1,315	0,987 1,015	3,465	3,096 3,143	2,720 2,765	2,352 2,395	5,024 5,087	4,598 4,660	4,155 4,215	3,718 3,774
290	0,383	0,230	0,230	0,230	1,972	1,658	1,344	1,013	3,561	3,189	2,703	2,436	5,150	4,721	4,273	3,830
295	0,401	0,230	0,230	0,230	2,004	1,688	1,373	1,069	3,608	3,235	2,852	2,477	5,211	4,781	4,331	3,885
300	0,418	0,230	0,230	0,230	2,036	1,719	1,402	1,096	3,654	3,279	2,895	2,518	5,272	4,840	4,388	3,940
305	0,436	0,230	0,230	0,230	2,067	1,749	1,430	1,122	3,699	3,323	2,937	2,558	5,331	4,898	4,444	3,993
310	0,453	0,230	0,230	0,230	2,098	1,778	1,458	1,148	3,744	3,367	2,979	2,597	┝┷	4,955	4,499	4,046
315	0,469	0,230	0,230	0,230	2,129	1,807	1,486	1,174	3,788	3,410	3,020	2,636	Ŀ	5,021	4,554	4,098
320 325	0,486	0,230 0,235	0,230	0,230	2,159 2,188	1,836 1,864	1,513 1,539	1,199 1,224	3,831	3,452 3,493	3,060 3,100	2,674 2,712	<u> </u>	5,067 5,122	4,608 4,661	4,150 4,201
330	0,502	0,250	0,230	0,230	2,100	1,892	1,566	1,248	3,916	3,534	3,139	2,712	<u> </u>	5,176	4,713	4,251
335	0,534	0,265	0,230	0,230	2,246	1,920	1,592	1,273	3,958	3,574	3,178	2,786	_	5,229	4,764	4,300
340	0,549	0,279	0,230	0,230	2,274	1,947	1,617	1,297	3,999	3,614	3,216	2,823	<u> </u>	5,282	4,815	4,349
345	0,565	0,293	0,230	0,230	2,302	1,973	1,642	1,320	4,039	3,653	3,254	2,859		5,334	4,865	4,397
350	0,580	0,307	0,230	0,230	2,329	2,000	1,667	1,343	4,078	3,692	3,291	2,894	<u> </u>	-	4,915	4,444
355 360	0,595	0,321	0,230	0,230 0,230	2,356	2,025 2,051	1,692 1,716	1,366 1,389	4,117 4,156	3,730 3,768	3,328 3,364	2,929 2,963	<u> </u>		4,964 5,012	4,491 4,537
300	0,009	U,JJ4	<u></u> ∪,∠3∪	U,ZJU	۷,505	_ ∠,UJ I	1,110	1,508	-1 ,100	J,100	₽ 0,00 4	∠,505			■ ∪,∪ I ∠	₩ ,∪∪1

Steel columns, 4-sided rectangular hollow sections - protection thickness required



					Thicknes	s (mm) r	equired t	for the RI	F period -	only int	umescer	nt coating					
			00				400		_		400				0.40		
T U/A	50000	R		05000	50000		120	05000	50000		180	05000	50000		240	05000	
	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	500°C	550°C	600°C	650°C	
50 55	1,207 1,445	0,965 1,187	0,733 0,939	0,517 0,708	2,097 2,412	1,801 2,096	1,514 1,789	1,246 1,501	3,879 4,346	3,474 3,914	3,077 3,489	2,704 3,088	H-	5,146 -	4,641 5,189	4,162 4,675	
60	1,677	1,404	1,141	0,708	2,719	2,384	2,058	1,751	4,802	4,343	3,891	3,464	\vdash	-	3,109	5,177	
65	1,903	1,616	1,338	1,077	3,017	2,665	2,320	1,731	5,246	4,763	4,285	3,832	<u> </u>	-	-	-	
70	2,124	1,823	1,531	1,256	3,309	2,939	2,577	2,235	-	5,172	4,670	4,192	<u> </u>	-	-	-	
75	2,339	2,025	1,719	1,432	3,593	3,208	2,829	2,469	-	-	5,047	4,545	-	-	-	-	
80	2,549	2,223	1,904	1,603	3,871	3,470	3,075	2,699	-	-	-	4,891	-	-	-	-	
85	2,754	2,416	2,085	1,772	4,141	3,726	3,315	2,924		-	-	5,230		-	-	-	
90	2,954	2,605	2,262	1,937	4,406	3,977	3,551	3,145		-	-		<u> </u>	-	-	-	
95	3,149	2,790	2,435	2,099	4,664	4,222	3,782	3,362	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-	
100	3,340	2,970	2,605	2,257	4,916	4,462	4,008	3,574	<u> </u>	-	-	<u>-</u>	<u> </u>	<u> </u>	-	-	
105 110	3,527	3,147	2,771	2,413	5,163	4,697 4,926	4,230 4,447	3,782 3,986	<u> </u>	-	-		<u> </u>	-	-	-	
115	3,888	3,321 3,490	2,934 3,094	2,566 2,716		5,151	4,660	4,187			-	\vdash	<u> </u>			-	
120	4,062	3,656	3,251	2,862		5, 15 1 -	4,868	4,383				\vdash	<u> </u>				
125	4,233	3,819	3,404	3,007	-	_	5,073	4,576	-		-		<u> </u>	-	-		
130	4,400	3,978	3,555	3,148		-	5,273	4,765	<u> </u>	-	-			-	-	-	
135	4,563	4,134	3,703	3,287		-	-	4,951	-	-	-	-	-	-	-	-	
140	4,723	4,287	3,848	3,424	-	-		5,134		-					-		
145	4,879	4,437	3,990	3,558		-		5,313							-	-	
150	5,033	4,584	4,130	3,690	-	-	-		<u> </u>	-	-		<u> </u>	-	-	-	
155	5,183	4,728	4,267	3,819	-	-	-	-	-	-	-		<u> </u>	-	-	-	
160	5,330	4,870	4,401	3,946	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-	
165 170	<u> </u>	5,008 5,144	4,533 4,663	4,071 4,194	<u> </u>	-	<u> </u>	<u> </u>	<u> </u>	-	-	H	<u> </u>	-	-	-	
175	-	5,278	4,790	4,194	-	-	-	\vdash	H	-	-	\vdash	H	-	-	-	
180		3,270	7,916	4,433		-				-	-		_	-		-	
185	-	-	5,039	4,550	-	-	-		-	-	-		<u> </u>	-	-	-	
190	-	-	5,159	4,665		-	-		-	-	-			-	-	-	
195	-	-	5,278	4,778	-	-	-		-	-	-	-	-	-	-	-	
200				4,889											-		
205	<u> </u>	-	-	4,998	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-	
210	<u> </u>	-	-	5,106	<u> </u>	-	<u> </u>		<u> </u>	-	-	<u> </u>	┝┷	-	-	-	
215	<u> </u>	-	-	5,211	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	<u>-</u>	<u> </u>	-	-	-	
220 225	<u> </u>	-	-	5,316	<u> </u>	-	-		<u> </u>	-	-	\vdash	-	<u> </u>	-	-	
230		-	-			-	-		H	-	-	\vdash	H		-	-	
235			-								-			-	-	-	
240	-	-	-	-	-	-	-		-	-	-		<u> </u>	-	-	-	
245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
250	-	-	-	-		-	Ŀ			-	-	-		-	-	-	
255		-	-	-		-	-			-	-			-	-	-	
260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
265	<u> </u>	-	-	\vdash	<u> </u>	-	-	<u> </u>	<u> </u>	-	-	<u> </u>	<u> </u>	<u> </u>	-	-	
270	<u> </u>	-	-		<u> </u>	-	<u> </u>		<u> </u>	-	-	-	<u> </u>	-	-	<u> </u>	
275 280	H	-	-	-		-	-		<u> </u>	-	-	H	<u> </u>	-	-	-	
285	<u> </u>	-	-			-	-		<u> </u>	-	-		H	-	-	-	
290								\vdash				\vdash	\vdash				
295	-			-	-			-	-	_		-	-				
300	-	-	-	-		-	-		<u> </u>	-	-		<u> </u>	-	-	-	
305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
310		-	-	-		-	-			-	-	-		-	-	-	
315		-	-		-	-	-			-	-			-	-	-	
320	-		-	<u> </u>		-	-		-	-	-			-	-		
325		-	-			-	-		<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-	
330	<u> </u>	-	-		<u> </u>	-	<u> </u>		<u> </u>	-	-	<u> </u>	<u> </u>	-	-	-	
335	<u> </u>	-	-	-	<u> </u>	-	<u> </u>		<u> </u>	-	-	-	<u> </u>	-	-	<u> </u>	
340 345	<u> </u>	-	-	-	<u> </u>	-	-		<u> </u>	-	-		<u> </u>	-	-	-	
350	-		-		-	-	-		<u> </u>	-	-		<u> </u>	-	-	-	
355						-	H						<u> </u>				
360		-	-			-	<u> </u>			-	-			-	-	-	
500																	

Surface preparation, application



Preparation

Substrates and surface preparation

<u>Carbon stee</u>

Cleaning and degreasing. Entire area to be (high pressure) fresh water cleaned in order to remove salts and other contaminants. When the surface is dry, perform abrasive blasting to minimum Sa 2½ according to ISO 8501-1. In case oxidation has occurred between blasting and application of the primer, then the surface should be reblasted and primed.

Under restrictions St3 steel can be accepted. Degrease and high pressure water wash the substrate, prior to the St3 cleaning. Special care shall be taken to avoid polishing of the surface. Power tools such as chipping hammers, needle guns and power rotary wire brushes will provide acceptable roughness for proper adhesion of the primer. It is not acceptable that any mill scale is present on the cleaned surface. For steel prepared to St3, use primer Knauf Firepaint primer K1. Afterwards apply Knauf Firepaint Steel and the

possible topcoat as per the normal instructions. The St3 preparation is generally only recommended for repair of small areas.

Galvanised steel

Cleaning and degreasing. Entire area to be (high pressure) fresh water cleaned in order to remove salts and other contaminants. When surface is dry, perform either light abrasive sweep blasting to a uniform rough surface or roughen the surface by mechanical means. Afterwards, apply one coat of primer Knauf Firepaint Primer K2 at maximum DFT of 100 micron.

After priming and before application of Knauf Firepaint Steel, remove oil and grease etc. with suitable detergent. Salt and other contaminants shall be removed by (high pressure) fresh water cleaning. Leave the surface drying for sufficient time to ensure full evaporation of water, prior to application of Knauf Firepaint Steel.

Knauf must be consulted in all cases of doubt about the suitability for overcoating of the primer. Cases where Knauf should be consulted include (but not limited to): surface contamination, damages and defects, unknown primer preapplied, non-approved primer and exceeded dry film thickness of primer.

Primers

Only Knauf-approved primers can be used in combination with Knauf Firepaint Steel.

Knauf Firepaint Steel must under no circumstances be applied directly to the steel surface.

Knauf Firepaint Steel shall be applied within the minimum and maximum overcoating intervals of the primer specified. Please consult the datasheet of the relevant primer.

The maximum dry film thickness of the primer recommended by Knauf shall not be exceeded as this could influence the performance during a fire.

Application

Application conditions

Knauf Firepaint Steel can be applied on steel temperatures between +5°C and + 50°C.

The surface temperature must always be 3°C above dew point and the maximum relative humidity should not exceed 85% during the application.

The area where Knauf Firepaint Steel is applied must be well ventilated and proper air circulation shall be secured for optimal drying.

For applications under warm conditions special attention shall be given to avoid solvent entrapment due to application of high dry film thicknesses per coat. For optimum drying in these conditions it is generally recommended to apply several thinner coats to obtain the specified dry film thickness (e.g. apply 2 coats of 750µm each instead of 1500µm in a single coat). For applications outdoors at warm conditions, direct sunlight exposure can be avoided to prevent skinning of the paint that will result in longer overall drying times due to solvent entrapment; if direct sunlight cannot be avoided a lower DFT per coat may be beneficial for the drying time of the complete coating system.

It is recommended that the products in all situations are protected from condensation and water during application and drying.

Knauf Firepaint Steel are relatively high viscosity materials and normally they are supplied showing a false body effect. Prior to application the material has to be stirred shortly in order to homogenise the material and break the false body effect to ensure good flow during the application. Excessive stirring should be avoided as this may cause increased solvent evaporation.

Application equipment

Recommended airless spray equipment: (Airless spray data are indicative and subject to adjustment)

Pump ratio: min. 45:1 Nozzle size: .017" - .023"

Nozzle pressure: 200 bar/2800 psi

Fan angle: 30-50°.

After finishing the application, clean the equipment immediately with Knauf Firepaint Finish Thinner AL. It is recommended to remove the gun filter. Note: Increasing spray hose diameter may ease paint flow, thereby improving the spray fan. If longer hoses are necessary, it may be necessary to raise the pump ratio to 60:1 maintaining the high output capacity of the pump.

Thinning

Thinning of Knauf Firepaint Steel is normally not required. Only for areas where low DFTs (<225µm DFT, 300µm WFT) is to be applied 5% (vol) thinner can be used. Use Knauf Firepaint finish thinner Al

When thinned down, the sag resistance of the coating is reduced so 1500µm DFT for Knauf Firepaint Steel cannot be achieved anymore.

Application

Spray application

During application it is recommended to put the steel sections on support trestles such that the area of contact is minimum. Best practice is "sharp" contact. This minimises the area of damages and therefore limits the to-be-repaired surfaces after the applications. With Knauf Firepaint products applied in one/few coat(s) at low dry film thicknesses, it is of special importance that a continuous, pinhole-free paint film is obtained at application of each coat. An application technique which will ensure good film formation on all faces of the profiles must be adopted. It is very important to use nozzles of the correct, not too big, size and to have a proper, uniform distance of the spray gun to the surface; 30-50 cm should be aimed at. Furthermore, great care must be taken to cover edges, openings, rear sides of stiffeners etc. Thus, on these areas application of a stripe coat will therefore be good painting practice.

The finished coating must appear as a homogeneous film with a smooth surface; irregularities such as dust, dry spray, abrasives, should be remedied.

Brush and roller application

Application with hand tools, brush or roller is possible but it results in a more uneven paint film by these methods compared to airless spray paints and many additional coats may be necessary to obtain the specified dry film thickness.

Application by hand tools, brush, or roller is generally only recommended for small areas, repairs and touch-up; although, repairs can often be made easily by putty knife or plastering trowel.

Thickness



Thickness

Wet/dry film thickness

It is important that the specified dry film thickness is achieved as a minimum in order to make sure that the coating system is performing as specified.

The required dry film thickness of Knauf Firepaint products vary depending on the section size of the steel profile and the configuration that the steel profile is used in. It is the responsibility of the applicator to ensure that the specified dry film thickness is applied on all areas. The applicator should therefore be in possession of a full list of steel sections and dry film thicknesses according to the configuration, including information about the number of sides to be coated.

It is recommended that all steel sections are marked according to the list of steel sections and dry film thicknesses specified to secure that application is done according to the specification.

It is recommended that the wet film thickness is measured frequently during the application using a wet film gauge to ensure that the specified thickness is achieved. This will allow the applicator to adjust the thickness if necessary. Avoid the gauge from sinking into the underlying coat to prevent incorrect wet film thickness measurements.

Measurements of the dry film thickness should be conducted on the fully dry Knauf Firepaint coats. It is important that dry film measurements are done on fully dried paint as measurements on not fully dried paint may give incorrect results. Normally electronic dry film thickness-gauges are used for this. The applicator must confirm that the specified dry film thickness has been achieved according to the specification. If insufficient dry film thickness is measured then an additional coat or touch-up should be applied.

When indicative measurements have to be made prior to complete drying of the coating, indicative dry film thickness measurements may be done with an electronic DFT-gauge in combination with a shim. The shim must be held in between the coating and the gauge in order to minimise the sinking in of the gauge into the soft coating. Drying checks made on areas that are in direct sunlight exposure may not represent the state of drying for the rest of the project. An intumescent coating is a thermoplastic product and (once dry) exposure to heat will soften the product. Softening will happen above approximately 40°C. Select areas at cooler conditions for making drying checks or check the state during the morning, when the steel sections will be the coolest. It is important that no topcoat is applied before dry film thickness of Knauf Firepaint Steel has been measured and confirmed to be correct. If a topcoat has been applied on an area with insufficient Knauf Firepaint dry film thickness then the topcoat must be removed before repair/touch-up

can be conducted.

The paint layer must be applied homogeneously and as close to the specification as possible. Avoid excessive film thickness due to the risk of sagging, cracks and solvent retention and extended drying/overcoating times.

The maximum dry film thickness that can be applied with Knauf Firepaint Steel in a single coat is 1500µm.

A differentiation shall be made between on-site applications (after erection of the steel structure) and off-site (in shop) applications. For on-site applications it is beneficial to spray in high DFTs in order to achieve the coating thickness required for the demanded fire protection in minimum number of coats. In this case the steel elements do not have to be handled after the coating application; hence the speed of drying to hard dry is generally of low importance, as long as the dry to touch time is short. Therefore it is beneficial that Knauf Firepaint can be applied at the maximum DFTs per coat.

For applications off-site (in shop) and on-site preerection, it is generally important that the drying of the applied coating is fast for quick throughput of the steel. When the required total thickness exceeds 3000 µm DFT, evaporation of solvents will take longer time and therefore it is necessary to apply multiple coats of 750 µm DFT per coat (1000 µm WFT) with an overcoating interval of minimum 24 hours for optimal drying. It is good practice to determine the state of drying of the coating by pressing firm with thumb. When it is not easy to make a mark in the coating, it is ready to accept a next coat. (It is technically possible to apply the next coat sooner, but it will affect the drying of the entire coating system). If this advice is ignored, it will take drastically more time to dry the complete coating system.

Film thickness acceptance

It is required that as a minimum the specified dry film thickness of Knauf Firepaint Steel is achieved. Excessive thicknesses shall be prevented as well as it will increase drying times and increase paint consumption.

Weathering exposure

Knauf Firepaint Steel can be exposed to mild exterior conditions up to 6 month before being top coated. For longer or permanent exterior exposure (C3 or C4 exposure according to ISO12944) the Knauf products shall be topcoated with a suitable topcoat. Pooling/standing water affects the coating system, hence pooling water must be prevented at all times.

For C1 and C2 conditions (ISO12944) Knauf Firepaint Steel can be used without topcoat, but for aesthetic reasons a topcoat is possible.

Topcoats

Depending on the end use of the coating system, a topcoat may be required. A selection of approved topcoats are compatible with nauf Firepaint Steel. Only Knauf-approved topcoats can be used in combination with nauf Firepaint Steel. It must be ensured by the applicator that the total specified dry film thickness of Knauf Firepaint Steel is achieved prior to the start of the topcoat application. Dry film thickness measurements must be done on a fully dry Knauf Firepaint coating in order to measure an accurate result.

Before application of a topcoat (or additional coat of Knauf Firepaint Steel) the applicator must ensure that the coating surface of the Knauf Firepaint product is clean of salts, oil, grease or other contaminants.

Topcoats may prolong the drying of Knauf Firepaint Steel. Special attention should be given to areas where the total specified dry film thickness of the Knauf Firepaint Steel product exceeds 2 mm. It is good practice to measure the state of drying of the intumescent coating prior to the application of the next coat. Press firm with a thumb on the coating. It should not be easy to make an indent in the coating. Once this state is achieved the coating is ready to accept its topcoat. Acrylic topcoats could be applied faster, but for fastest drying of the entire system it is still recommendable to use the before mentioned "thumbtest". It is not necessary to achieve the so called "nail hard" stage.

Handling, Repair & Maintenance



Handling, Repair & Maintenance

Handling

In off-site applications, the steel sections will need to be handled after drying of the coating system. It is important to note that due to the thermoplastic nature of acrylic intumescent coatings, they are sensitive to damage, also after full drying. Generally it is more of a matter to minimise the damage than to prevent damage. Therefore special care should be taken to smartly handle the coated steel sections. If the steel sections have areas that are not sprayed with intumescent paint (e.g. areas left blank as welding/bolting area), the lifting straps should be installed in those places when possible. This reduces the amount of damage, and therefore also the repair work required. The amount of supporting beams, normally of wood, shall be limited to the minimum required, in order to minimise the damaged areas. Areas where the sections lean on the supporting beams are likely to be damaged. Maintain sufficient ventilation, also when the product is considered dry. Therefore, do not cover up the sections as this will affect the final drying proper-

Repair & Maintenance

Knauf Firepaint Steel can be used as repair and touch-up coating for damaged areas of freshly applied Knauf Firepaint Steel. Prior to repair, make sure that the surface is clean and free of contamination. Loose parts are to be removed completely.

When film damages are deep and bare steel is visible, then clean the area to St 3 (spot-repairs) or by abrasive blasting to minimum Sa 2½ or high pressure water jetting to Wa 2½ prior to application of the new coating system. Application of the damaged areas can be done by airless spray, brush cladding or roller. Conditions during these applications shall fulfil the requirements as during normal application conditions.

When damages occur when the intumescent paint is still soft, it may be possible to remove the intumescent paint using a clean putty knife. It is recommended to remove the complete soft intumescent layer and after the drying of the (undamaged part of the) coating the spot repair can be made by brush, roller of airless spray.

For repairs of older systems, the full coating sys-

tem shall be removed and the damaged areas shall be cleaned thoroughly by power tool cleaning to St 3 (spot-repairs) or by abrasive blasting to minimum Sa 2½ prior to application of the new coating system.

Feather edges to sound and intact areas. Brush off loose material. Touch up to full film thickness.

Maintenance of Knauf Firepaint coating systems must be done with Knauf approved topcoats or with the same Knauf Firepaint products if no topcoat has been used before. Knauf Firepaint products cannot be directly applied over an already topcoated coating system.

Areas of damaged topcoats must be repaired immediately, as the underlying intumescent in these areas may be exposed to unacceptable weathering.

Maintenance of a Knauf Firepaint coating system without consulting Knauf for approval may influence the performance of the Knauf Firepaint product. All maintenance of any Knauf Firepaint coating system must therefore be done in consultation with Knauf.









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