CERTIFICATE OF APPROVAL
No CF 5590

This is to certify that, in accordance with
TS00 General Requirements for Certification of Fire Protection Products
The undermentioned products of

CARBOLINE COMPANY

350 Hanley Industrial Ct, St Louis, MO 63144-1589
Tel: +1 314 644 1000

Have been assessed against the requirements of the Technical Schedule(s) denoted below and are approved for use subject to the conditions appended hereto:

CERTIFIED PRODUCT	TECHNICAL SCHEDULE
Firefilm A4	**TS15 Intumescent Coatings for Steelwork**

Signed and sealed for and on behalf of Exova (UK) Limited trading as Warrington Certification

Paul Duggan
Certification Manager

Issued: 19th October 2017
Valid to: 6th September 2020

CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

1. This approval relates to the use of Firefilm A4 for the fire protection of steel I-shaped beams and columns, circular and rectangular hollow column sections. The precise scope is given in Tables 1 to 24 which show the total dry film thickness of Firefilm A4 (excluding primer and topcoat) required to provide fire resistance periods in accordance with BS476: Part 21: 1987 of 15 minutes up to 120 minutes for differing sections, section factors and design temperatures.

2. This certification is designed to demonstrate compliance of the product or system specifically with Approved Document B (England and Wales), Section 2 of the Technical Standards (Scotland), Technical Booklet E (N. Ireland). If compliance is required to other regulatory or guidance documents there may be additional considerations or conflict to be taken into account.'

3. The products are approved on the basis of:

   i) Initial type testing.
   ii) A design appraisal against TS15.
   iii) Certification of quality management system to ISO 9001: 2008.
   iv) Inspection and surveillance of factory production control.
   v) Audit testing.

4. The data referring to three-sided fire exposure of beams relate to beams supporting concrete floor slabs. Separate consideration is required where this is not the case.

5. The data shown is applicable to steel sections blast cleaned to ISO 8501-1 SA $2^1/_2$ or equivalent and primed with a suitable and compatible primer. Specifications of surface preparations, primers and topcoats are available from the manufacturer whose responsibility is to ensure that Firefilm A4 is compatible for use in respect of both ambient and fire conditions. The total dry film thickness of primer and topcoat together should not exceed that tested.

6. Specific data given in the tables applies to horizontal, vertical, flexural and compression members supporting loads up to the maximum design loads specified in BS449: Part 2.

7. The approval relates to on going production. Product and/or its immediate packaging is identified with the manufacturers' name, the product name or number, the CERTIFIRE name or name and mark, together with the CERTIFIRE certificate number and application where appropriate.

8. The data shown in the tables is based on assessments which comply with the criteria for acceptability now incorporated within the CERTIFIRE scheme.

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CARBOLINE COMPANY

Firefilm A4

Table 1: I-Section Beams 15 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
90	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
95	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
100	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
105	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
110	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
115	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
120	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
125	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
130	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
135	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
140	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
145	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
150	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
155	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
160	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
165	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
170	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
175	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
180	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
185	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
190	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
195	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
200	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
205	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
210	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
215	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
220	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
225	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
230	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
235	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
240	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
245	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
250	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
255	0.457	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
260	0.468	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
265	0.479	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
270	0.490	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
275	0.501	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
280	0.513	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
285	0.524	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
290	0.535	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
295	0.546	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
300	0.557	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
305	0.568	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
310	0.580	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
315	0.591	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
320	0.602	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
325	0.613	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
330	0.624	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
335	0.636	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
340	0.647	0.458	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
345	0.658	0.467	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
350	0.669	0.477	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
355	0.680	0.486	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
360	0.692	0.496	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 2: I-Section Beams 30 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	0.455	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
90	0.475	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
95	0.495	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
100	0.515	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
105	0.536	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
110	0.556	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
115	0.576	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
120	0.596	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
125	0.617	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
130	0.637	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
135	0.657	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
140	0.678	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
145	0.698	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
150	0.718	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
155	0.738	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
160	0.759	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
165	0.779	0.472	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
170	0.799	0.492	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
175	0.819	0.512	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
180	0.840	0.532	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
185	0.860	0.552	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
190	0.880	0.572	0.461	0.454	0.454	0.454	0.454	0.454	0.454	0.454
195	0.901	0.592	0.478	0.454	0.454	0.454	0.454	0.454	0.454	0.454
200	0.921	0.612	0.496	0.454	0.454	0.454	0.454	0.454	0.454	0.454
205	0.941	0.632	0.513	0.454	0.454	0.454	0.454	0.454	0.454	0.454
210	0.961	0.652	0.530	0.454	0.454	0.454	0.454	0.454	0.454	0.454
215	0.982	0.672	0.547	0.454	0.454	0.454	0.454	0.454	0.454	0.454
220	1.002	0.692	0.564	0.457	0.454	0.454	0.454	0.454	0.454	0.454
225	1.022	0.712	0.581	0.472	0.454	0.454	0.454	0.454	0.454	0.454
230	1.042	0.732	0.598	0.487	0.454	0.454	0.454	0.454	0.454	0.454
235	1.063	0.752	0.615	0.502	0.454	0.454	0.454	0.454	0.454	0.454
240	1.083	0.772	0.632	0.517	0.454	0.454	0.454	0.454	0.454	0.454
245	1.103	0.792	0.650	0.531	0.454	0.454	0.454	0.454	0.454	0.454
250	1.124	0.812	0.667	0.546	0.454	0.454	0.454	0.454	0.454	0.454
255	1.144	0.832	0.684	0.561	0.459	0.454	0.454	0.454	0.454	0.454
260	1.164	0.852	0.701	0.576	0.472	0.454	0.454	0.454	0.454	0.454
265	1.184	0.872	0.718	0.591	0.485	0.454	0.454	0.454	0.454	0.454
270	1.205	0.892	0.735	0.606	0.498	0.454	0.454	0.454	0.454	0.454
275	1.225	0.912	0.752	0.620	0.510	0.454	0.454	0.454	0.454	0.454
280	1.245	0.932	0.769	0.635	0.523	0.454	0.454	0.454	0.454	0.454
285	1.265	0.952	0.786	0.650	0.536	0.454	0.454	0.454	0.454	0.454
290	1.286	0.972	0.804	0.665	0.549	0.454	0.454	0.454	0.454	0.454
295	1.306	0.992	0.821	0.680	0.561	0.454	0.454	0.454	0.454	0.454
300	1.326	1.012	0.838	0.695	0.574	0.465	0.454	0.454	0.454	0.454
305	1.346	1.032	0.855	0.709	0.587	0.476	0.454	0.454	0.454	0.454
310	1.367	1.052	0.872	0.724	0.600	0.486	0.454	0.454	0.454	0.454
315	1.387	1.072	0.889	0.739	0.612	0.497	0.454	0.454	0.454	0.454
320	1.407	1.092	0.906	0.754	0.625	0.508	0.464	0.454	0.454	0.454
325	1.428	1.112	0.923	0.769	0.638	0.519	0.474	0.454	0.454	0.454
330	1.448	1.131	0.940	0.784	0.651	0.530	0.484	0.454	0.454	0.454
335	1.468	1.151	0.958	0.798	0.663	0.540	0.494	0.454	0.454	0.454
340	1.488	1.171	0.975	0.813	0.676	0.551	0.504	0.454	0.454	0.454
345	1.509	1.191	0.992	0.828	0.689	0.562	0.514	0.454	0.454	0.454
350	1.529	1.211	1.009	0.843	0.702	0.573	0.524	0.456	0.454	0.454
355	1.549	1.231	1.026	0.858	0.714	0.583	0.534	0.465	0.454	0.454
360	1.569	1.251	1.043	0.873	0.727	0.594	0.544	0.474	0.454	0.454

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 3: I-Section Beams 45 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	1.055	0.707	0.484	0.454	0.454	0.454	0.454	0.454	0.454	0.454
90	1.077	0.721	0.507	0.454	0.454	0.454	0.454	0.454	0.454	0.454
95	1.100	0.744	0.529	0.454	0.454	0.454	0.454	0.454	0.454	0.454
100	1.123	0.767	0.551	0.454	0.454	0.454	0.454	0.454	0.454	0.454
105	1.145	0.790	0.573	0.454	0.454	0.454	0.454	0.454	0.454	0.454
110	1.168	0.813	0.595	0.454	0.454	0.454	0.454	0.454	0.454	0.454
115	1.190	0.836	0.617	0.473	0.454	0.454	0.454	0.454	0.454	0.454
120	1.213	0.859	0.639	0.494	0.454	0.454	0.454	0.454	0.454	0.454
125	1.236	0.882	0.661	0.514	0.454	0.454	0.454	0.454	0.454	0.454
130	1.258	0.905	0.683	0.535	0.454	0.454	0.454	0.454	0.454	0.454
135	1.281	0.928	0.706	0.556	0.454	0.454	0.454	0.454	0.454	0.454
140	1.303	0.951	0.728	0.576	0.454	0.454	0.454	0.454	0.454	0.454
145	1.326	0.974	0.750	0.597	0.454	0.454	0.454	0.454	0.454	0.454
150	1.349	0.997	0.772	0.618	0.454	0.454	0.454	0.454	0.454	0.454
155	1.371	1.020	0.794	0.639	0.462	0.454	0.454	0.454	0.454	0.454
160	1.394	1.043	0.816	0.659	0.482	0.454	0.454	0.454	0.454	0.454
165	1.416	1.066	0.838	0.680	0.501	0.454	0.454	0.454	0.454	0.454
170	1.439	1.089	0.860	0.701	0.521	0.454	0.454	0.454	0.454	0.454
175	1.462	1.112	0.882	0.721	0.540	0.454	0.454	0.454	0.454	0.454
180	1.484	1.135	0.905	0.742	0.560	0.454	0.454	0.454	0.454	0.454
185	1.507	1.158	0.927	0.763	0.580	0.463	0.454	0.454	0.454	0.454
190	1.529	1.181	0.949	0.784	0.599	0.480	0.454	0.454	0.454	0.454
195	1.552	1.204	0.971	0.804	0.619	0.498	0.465	0.454	0.454	0.454
200	1.575	1.227	0.993	0.825	0.639	0.515	0.481	0.454	0.454	0.454
205	1.597	1.250	1.015	0.846	0.658	0.533	0.498	0.454	0.454	0.454
210	1.620	1.273	1.037	0.867	0.678	0.550	0.514	0.466	0.454	0.454
215	1.642	1.296	1.059	0.887	0.697	0.567	0.531	0.480	0.454	0.454
220	1.665	1.319	1.081	0.908	0.717	0.585	0.547	0.495	0.454	0.454
225	1.691	1.342	1.104	0.929	0.737	0.602	0.564	0.510	0.454	0.454
230	1.729	1.365	1.126	0.949	0.756	0.620	0.581	0.525	0.454	0.454
235	1.767	1.388	1.148	0.970	0.776	0.637	0.597	0.540	0.456	0.454
240	1.805	1.411	1.170	0.991	0.796	0.655	0.614	0.555	0.469	0.454
245	1.844	1.434	1.192	1.012	0.815	0.672	0.630	0.570	0.482	0.454
250	1.882	1.457	1.214	1.032	0.835	0.690	0.647	0.585	0.495	0.454
255	1.920	1.480	1.236	1.053	0.855	0.707	0.663	0.600	0.507	0.454
260	1.958	1.503	1.258	1.074	0.874	0.725	0.680	0.615	0.520	0.454
265	1.996	1.527	1.281	1.094	0.894	0.742	0.696	0.630	0.533	0.454
270	2.035	1.550	1.303	1.115	0.913	0.760	0.713	0.645	0.546	0.454
275	2.073	1.573	1.325	1.136	0.933	0.777	0.729	0.659	0.559	0.454
280	2.111	1.596	1.347	1.157	0.953	0.795	0.746	0.674	0.572	0.454
285	2.149	1.619	1.369	1.177	0.972	0.812	0.762	0.689	0.585	0.455
290	2.188	1.642	1.391	1.198	0.992	0.830	0.779	0.704	0.597	0.466
295	2.226	1.665	1.413	1.219	1.012	0.847	0.795	0.719	0.610	0.476
300	2.264	1.691	1.435	1.240	1.031	0.865	0.812	0.734	0.623	0.486
305	2.302	1.731	1.457	1.260	1.051	0.882	0.828	0.749	0.636	0.496
310	2.341	1.771	1.480	1.281	1.070	0.900	0.845	0.764	0.649	0.507
315	2.379	1.811	1.502	1.302	1.090	0.917	0.861	0.779	0.662	0.517
320	2.417	1.851	1.524	1.322	1.110	0.935	0.878	0.794	0.675	0.527
325	2.455	1.890	1.546	1.343	1.129	0.952	0.894	0.809	0.687	0.537
330	2.493	1.930	1.568	1.364	1.149	0.970	0.911	0.824	0.700	0.548
335	2.532	1.970	1.590	1.385	1.169	0.987	0.927	0.839	0.713	0.558
340	2.570	2.010	1.612	1.405	1.188	1.005	0.944	0.853	0.726	0.568
345	2.608	2.050	1.634	1.426	1.208	1.022	0.960	0.868	0.739	0.578
350	2.646	2.090	1.656	1.447	1.228	1.040	0.977	0.883	0.752	0.589
355	2.685	2.130	1.679	1.467	1.247	1.057	0.993	0.898	0.765	0.599
360	2.723	2.170	1.714	1.488	1.267	1.075	1.010	0.913	0.778	0.609

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 4: I-Section Beams 60 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	1.683	1.270	0.955	0.702	0.494	0.454	0.454	0.454	0.454	0.454
90	1.716	1.293	0.979	0.715	0.518	0.454	0.454	0.454	0.454	0.454
95	1.749	1.316	1.002	0.739	0.541	0.454	0.454	0.454	0.454	0.454
100	1.782	1.339	1.025	0.763	0.564	0.466	0.454	0.454	0.454	0.454
105	1.815	1.362	1.049	0.787	0.587	0.487	0.454	0.454	0.454	0.454
110	1.848	1.386	1.072	0.811	0.610	0.509	0.465	0.454	0.454	0.454
115	1.881	1.409	1.095	0.835	0.634	0.530	0.486	0.454	0.454	0.454
120	1.914	1.432	1.119	0.859	0.657	0.551	0.506	0.454	0.454	0.454
125	1.947	1.455	1.142	0.883	0.680	0.573	0.527	0.454	0.454	0.454
130	1.980	1.479	1.165	0.908	0.703	0.594	0.548	0.470	0.454	0.454
135	2.013	1.502	1.189	0.932	0.727	0.615	0.568	0.489	0.454	0.454
140	2.046	1.525	1.212	0.956	0.750	0.636	0.589	0.509	0.454	0.454
145	2.079	1.548	1.235	0.980	0.773	0.658	0.609	0.529	0.454	0.454
150	2.112	1.572	1.259	1.004	0.796	0.679	0.630	0.548	0.454	0.454
155	2.144	1.595	1.282	1.028	0.819	0.700	0.650	0.568	0.454	0.454
160	2.177	1.618	1.305	1.052	0.843	0.721	0.671	0.588	0.454	0.454
165	2.210	1.641	1.329	1.076	0.866	0.743	0.692	0.607	0.471	0.454
170	2.243	1.664	1.352	1.100	0.889	0.764	0.712	0.627	0.490	0.454
175	2.276	1.690	1.375	1.124	0.912	0.785	0.733	0.646	0.508	0.454
180	2.309	1.727	1.398	1.148	0.935	0.807	0.753	0.666	0.527	0.454
185	2.342	1.764	1.422	1.172	0.959	0.828	0.774	0.686	0.545	0.454
190	2.375	1.800	1.445	1.197	0.982	0.849	0.794	0.705	0.564	0.461
195	2.408	1.837	1.468	1.221	1.005	0.870	0.815	0.725	0.583	0.477
200	2.441	1.874	1.492	1.245	1.028	0.892	0.836	0.745	0.601	0.492
205	2.474	1.911	1.515	1.269	1.052	0.913	0.856	0.764	0.620	0.508
210	2.507	1.947	1.538	1.293	1.075	0.934	0.877	0.784	0.638	0.523
215	2.540	1.984	1.562	1.317	1.098	0.955	0.897	0.804	0.657	0.539
220	2.573	2.021	1.585	1.341	1.121	0.977	0.918	0.823	0.675	0.555
225	2.606	2.057	1.608	1.365	1.144	0.998	0.938	0.843	0.694	0.570
230	2.639	2.094	1.632	1.389	1.168	1.019	0.959	0.862	0.712	0.586
235	2.672	2.131	1.655	1.413	1.191	1.041	0.980	0.882	0.731	0.601
240	2.705	2.167	1.678	1.437	1.214	1.062	1.000	0.902	0.749	0.617
245	2.738	2.204	1.717	1.461	1.237	1.083	1.021	0.921	0.768	0.633
250	2.771	2.241	1.759	1.486	1.260	1.104	1.041	0.941	0.786	0.648
255	2.808	2.278	1.802	1.510	1.284	1.126	1.062	0.961	0.805	0.664
260	2.848	2.314	1.844	1.534	1.307	1.147	1.082	0.980	0.823	0.679
265	2.888	2.351	1.886	1.558	1.330	1.168	1.103	1.000	0.842	0.695
270	2.927	2.388	1.929	1.582	1.353	1.189	1.124	1.019	0.860	0.710
275	2.967	2.424	1.971	1.606	1.377	1.211	1.144	1.039	0.879	0.726
280	3.007	2.461	2.013	1.630	1.400	1.232	1.165	1.059	0.897	0.742
285	3.047	2.498	2.056	1.654	1.423	1.253	1.185	1.078	0.916	0.757
290	3.087	2.534	2.098	1.678	1.446	1.275	1.206	1.098	0.935	0.773
295	3.127	2.571	2.140	1.718	1.469	1.296	1.226	1.118	0.953	0.788
300	3.167	2.608	2.183	1.761	1.493	1.317	1.247	1.137	0.972	0.804
305	3.206	2.645	2.225	1.804	1.516	1.338	1.267	1.157	0.990	0.820
310	3.246	2.681	2.267	1.848	1.539	1.360	1.288	1.177	1.009	0.835
315	3.286	2.718	2.310	1.891	1.562	1.381	1.309	1.196	1.027	0.851
320	3.326	2.755	2.352	1.934	1.585	1.402	1.329	1.216	1.046	0.866
325	3.366	2.795	2.394	1.978	1.609	1.423	1.350	1.235	1.064	0.882
330	3.406	2.852	2.437	2.021	1.632	1.445	1.370	1.255	1.083	0.898
335	3.446	2.908	2.479	2.064	1.655	1.466	1.391	1.275	1.101	0.913
340	3.485	2.965	2.521	2.108	1.678	1.487	1.411	1.294	1.120	0.929
345	3.525	3.021	2.564	2.151	1.718	1.509	1.432	1.314	1.138	0.944
350	3.565	3.078	2.606	2.194	1.762	1.530	1.453	1.334	1.157	0.960
355	3.605	3.134	2.648	2.238	1.805	1.551	1.473	1.353	1.175	0.975
360	3.645	3.191	2.691	2.281	1.849	1.572	1.494	1.373	1.194	0.991

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 5: I-Section Beams 75 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	2.423	1.879	1.446	1.156	0.895	0.676	0.549	0.504	0.454	0.454
90	2.474	1.910	1.477	1.178	0.918	0.700	0.574	0.527	0.454	0.454
95	2.526	1.941	1.507	1.199	0.942	0.724	0.599	0.550	0.474	0.454
100	2.578	1.972	1.537	1.220	0.966	0.748	0.623	0.573	0.495	0.454
105	2.629	2.003	1.568	1.242	0.990	0.772	0.648	0.596	0.517	0.454
110	2.681	2.035	1.598	1.263	1.013	0.796	0.673	0.619	0.538	0.454
115	2.732	2.066	1.628	1.285	1.037	0.820	0.698	0.642	0.560	0.454
120	2.784	2.097	1.659	1.306	1.061	0.844	0.722	0.665	0.581	0.471
125	2.824	2.128	1.690	1.327	1.085	0.868	0.747	0.688	0.603	0.491
130	2.865	2.160	1.725	1.349	1.108	0.892	0.772	0.711	0.624	0.510
135	2.905	2.191	1.759	1.370	1.132	0.916	0.797	0.734	0.646	0.529
140	2.946	2.222	1.794	1.392	1.156	0.940	0.821	0.757	0.667	0.549
145	2.986	2.253	1.828	1.413	1.180	0.964	0.846	0.780	0.689	0.568
150	3.027	2.284	1.863	1.435	1.203	0.988	0.871	0.803	0.710	0.587
155	3.067	2.316	1.898	1.456	1.227	1.012	0.896	0.826	0.732	0.606
160	3.108	2.347	1.932	1.477	1.251	1.036	0.920	0.850	0.753	0.626
165	3.148	2.378	1.967	1.499	1.275	1.060	0.945	0.873	0.775	0.645
170	3.188	2.409	2.002	1.520	1.298	1.084	0.970	0.896	0.796	0.664
175	3.229	2.441	2.036	1.542	1.322	1.108	0.995	0.919	0.818	0.684
180	3.269	2.472	2.071	1.563	1.346	1.132	1.020	0.942	0.839	0.703
185	3.310	2.503	2.105	1.584	1.370	1.156	1.044	0.965	0.861	0.722
190	3.350	2.534	2.140	1.606	1.393	1.180	1.069	0.988	0.882	0.741
195	3.391	2.565	2.175	1.627	1.417	1.204	1.094	1.011	0.904	0.761
200	3.431	2.597	2.209	1.649	1.441	1.227	1.119	1.034	0.926	0.780
205	3.471	2.628	2.244	1.670	1.465	1.251	1.143	1.057	0.947	0.799
210	3.512	2.659	2.279	1.701	1.488	1.275	1.168	1.080	0.969	0.819
215	3.552	2.690	2.313	1.746	1.512	1.299	1.193	1.103	0.990	0.838
220	3.593	2.722	2.348	1.790	1.536	1.323	1.218	1.126	1.012	0.857
225	3.633	2.753	2.382	1.835	1.560	1.347	1.242	1.149	1.033	0.877
230	3.674	2.784	2.417	1.880	1.583	1.371	1.267	1.172	1.055	0.896
235	3.714	2.836	2.452	1.925	1.607	1.395	1.292	1.195	1.076	0.915
240	3.755	2.889	2.486	1.969	1.631	1.419	1.317	1.218	1.098	0.934
245	3.795	2.941	2.521	2.014	1.655	1.443	1.341	1.241	1.119	0.954
250	3.835	2.993	2.555	2.059	1.678	1.467	1.366	1.264	1.141	0.973
255	3.876	3.045	2.590	2.104	1.721	1.491	1.391	1.287	1.162	0.992
260	3.916	3.098	2.625	2.148	1.768	1.515	1.416	1.310	1.184	1.012
265	3.957	3.150	2.659	2.193	1.815	1.539	1.440	1.333	1.205	1.031
270	-	3.202	2.694	2.238	1.862	1.563	1.465	1.356	1.227	1.050
275	-	3.254	2.729	2.283	1.909	1.587	1.490	1.379	1.248	1.069
280	-	3.307	2.763	2.327	1.956	1.611	1.515	1.402	1.270	1.089
285	-	3.359	2.812	2.372	2.003	1.635	1.539	1.425	1.291	1.108
290	-	3.411	2.883	2.417	2.050	1.659	1.564	1.448	1.313	1.127
295	-	3.463	2.954	2.462	2.097	1.683	1.589	1.471	1.334	1.147
300	-	3.516	3.025	2.507	2.144	1.731	1.614	1.494	1.356	1.166
305	-	3.568	3.097	2.551	2.191	1.779	1.638	1.517	1.377	1.185
310	-	3.620	3.168	2.596	2.238	1.827	1.663	1.540	1.399	1.205
315	-	3.672	3.239	2.641	2.285	1.874	1.693	1.563	1.420	1.224
320	-	3.725	3.310	2.686	2.332	1.922	1.741	1.586	1.442	1.243
325	-	3.777	3.381	2.730	2.379	1.970	1.789	1.609	1.464	1.262
330	-	3.829	3.452	2.775	2.426	2.018	1.838	1.632	1.485	1.282
335	-	3.882	3.523	2.860	2.473	2.066	1.886	1.655	1.507	1.301
340	-	3.934	3.594	2.956	2.521	2.114	1.934	1.678	1.528	1.320
345	-	3.986	3.665	3.051	2.568	2.162	1.982	1.722	1.550	1.340
350	-	-	3.736	3.147	2.615	2.210	2.031	1.770	1.571	1.359
355	-	-	3.807	3.242	2.662	2.257	2.079	1.818	1.593	1.378
360	-	-	3.878	3.338	2.709	2.305	2.127	1.867	1.614	1.397

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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Table 6: I-Section Beams 90 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	3.102	2.658	2.044	1.585	1.321	1.069	0.977	0.853	0.668	0.501
90	3.180	2.658	2.086	1.620	1.342	1.091	1.000	0.876	0.692	0.523
95	3.257	2.693	2.128	1.655	1.363	1.113	1.023	0.899	0.716	0.546
100	3.334	2.751	2.170	1.690	1.384	1.135	1.046	0.922	0.740	0.569
105	3.412	2.810	2.212	1.725	1.405	1.157	1.069	0.945	0.764	0.591
110	3.489	2.868	2.254	1.760	1.425	1.179	1.091	0.968	0.787	0.614
115	3.567	2.926	2.296	1.794	1.446	1.201	1.114	0.991	0.811	0.636
120	3.644	2.984	2.338	1.829	1.467	1.223	1.137	1.014	0.835	0.659
125	3.722	3.042	2.380	1.864	1.488	1.246	1.160	1.037	0.859	0.682
130	3.799	3.101	2.422	1.899	1.508	1.268	1.182	1.060	0.883	0.704
135	3.877	3.159	2.464	1.934	1.529	1.290	1.205	1.083	0.907	0.727
140	3.954	3.217	2.506	1.969	1.550	1.312	1.228	1.107	0.930	0.750
145	-	3.275	2.549	2.004	1.571	1.334	1.251	1.130	0.954	0.772
150	-	3.333	2.591	2.038	1.592	1.356	1.273	1.153	0.978	0.795
155	-	3.392	2.633	2.073	1.612	1.378	1.296	1.176	1.002	0.818
160	-	3.450	2.675	2.108	1.633	1.400	1.319	1.199	1.026	0.840
165	-	3.508	2.717	2.143	1.654	1.422	1.342	1.222	1.049	0.863
170	-	3.566	2.759	2.178	1.675	1.444	1.364	1.245	1.073	0.886
175	-	3.624	2.804	2.213	1.711	1.466	1.387	1.268	1.097	0.908
180	-	3.683	2.853	2.247	1.758	1.489	1.410	1.291	1.121	0.931
185	-	3.741	2.903	2.282	1.804	1.511	1.433	1.314	1.145	0.954
190	-	3.799	2.952	2.317	1.851	1.533	1.455	1.337	1.169	0.976
195	-	3.857	3.002	2.352	1.898	1.555	1.478	1.360	1.192	0.999
200	-	3.915	3.051	2.387	1.944	1.577	1.501	1.383	1.216	1.022
205	-	3.973	3.101	2.422	1.991	1.599	1.524	1.406	1.240	1.044
210	-	-	3.150	2.456	2.038	1.621	1.546	1.429	1.264	1.067
215	-	-	3.200	2.491	2.084	1.643	1.569	1.452	1.288	1.090
220	-	-	3.249	2.526	2.131	1.665	1.592	1.475	1.311	1.112
225	-	-	3.298	2.561	2.178	1.693	1.615	1.499	1.335	1.135
230	-	-	3.348	2.596	2.224	1.741	1.637	1.522	1.359	1.157
235	-	-	3.397	2.631	2.271	1.790	1.660	1.545	1.383	1.180
240	-	-	3.447	2.666	2.317	1.839	1.683	1.568	1.407	1.203
245	-	-	3.496	2.700	2.364	1.888	1.733	1.591	1.431	1.225
250	-	-	3.546	2.735	2.411	1.936	1.782	1.614	1.454	1.248
255	-	-	3.595	2.770	2.457	1.985	1.832	1.637	1.478	1.271
260	-	-	3.645	2.838	2.504	2.034	1.881	1.660	1.502	1.293
265	-	-	3.694	2.927	2.551	2.082	1.931	1.683	1.526	1.316
270	-	-	3.744	3.016	2.597	2.131	1.981	1.735	1.550	1.339
275	-	-	3.793	3.106	2.644	2.180	2.030	1.787	1.573	1.361
280	-	-	3.843	3.195	2.691	2.229	2.080	1.839	1.597	1.384
285	-	-	3.892	3.284	2.737	2.277	2.129	1.891	1.621	1.407
290	-	-	3.941	3.374	2.784	2.326	2.179	1.943	1.645	1.429
295	-	-	3.991	3.463	2.878	2.375	2.229	1.995	1.669	1.452
300	-	-	-	3.552	2.972	2.423	2.278	2.047	1.703	1.475
305	-	-	-	3.642	3.066	2.472	2.328	2.098	1.754	1.497
310	-	-	-	3.731	3.160	2.521	2.377	2.150	1.805	1.520
315	-	-	-	3.821	3.253	2.570	2.427	2.202	1.856	1.543
320	-	-	-	3.910	3.347	2.618	2.477	2.254	1.907	1.565
325	-	-	-	-	3.441	2.667	2.526	2.306	1.958	1.588
330	-	-	-	-	3.535	2.716	2.576	2.358	2.009	1.611
335	-	-	-	-	3.629	2.765	2.625	2.410	2.060	1.633
340	-	-	-	-	3.723	2.865	2.675	2.462	2.111	1.656
345	-	-	-	-	3.817	3.000	2.724	2.514	2.162	1.678
350	-	-	-	-	3.911	3.135	2.774	2.566	2.213	1.722
355	-	-	-	-	-	3.270	2.890	2.618	2.264	1.771
360	-	-	-	-	-	3.406	3.021	2.670	2.315	1.821

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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Table 7: I-Section Beams 105 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	3.892	3.128	2.670	2.210	1.700	1.452	1.361	1.222	1.017	0.806
90	3.892	3.224	2.741	2.258	1.741	1.477	1.381	1.241	1.039	0.829
95	-	3.319	2.812	2.307	1.782	1.502	1.400	1.260	1.061	0.852
100	-	3.415	2.883	2.356	1.824	1.527	1.419	1.279	1.083	0.875
105	-	3.510	2.954	2.404	1.865	1.552	1.439	1.298	1.105	0.898
110	-	3.606	3.025	2.453	1.907	1.577	1.458	1.318	1.128	0.920
115	-	3.701	3.097	2.502	1.948	1.603	1.478	1.337	1.150	0.943
120	-	3.797	3.168	2.550	1.989	1.628	1.497	1.356	1.172	0.966
125	-	3.892	3.239	2.599	2.031	1.653	1.516	1.375	1.194	0.989
130	-	3.988	3.310	2.648	2.072	1.678	1.536	1.395	1.217	1.012
135	-	-	3.381	2.696	2.113	1.717	1.555	1.414	1.239	1.035
140	-	-	3.452	2.745	2.155	1.759	1.574	1.433	1.261	1.057
145	-	-	3.523	2.794	2.196	1.802	1.594	1.452	1.283	1.080
150	-	-	3.594	2.842	2.238	1.844	1.613	1.472	1.305	1.103
155	-	-	3.665	2.891	2.279	1.886	1.633	1.491	1.328	1.126
160	-	-	3.736	2.940	2.320	1.929	1.652	1.510	1.350	1.149
165	-	-	3.807	2.988	2.362	1.971	1.671	1.529	1.372	1.172
170	-	-	3.878	3.037	2.403	2.013	1.703	1.548	1.394	1.194
175	-	-	3.949	3.085	2.445	2.056	1.754	1.568	1.416	1.217
180	-	-	-	3.134	2.486	2.098	1.804	1.587	1.439	1.240
185	-	-	-	3.182	2.527	2.140	1.855	1.606	1.461	1.263
190	-	-	-	3.231	2.569	2.183	1.905	1.625	1.483	1.286
195	-	-	-	3.280	2.610	2.225	1.956	1.645	1.505	1.309
200	-	-	-	3.328	2.652	2.267	2.006	1.664	1.528	1.331
205	-	-	-	3.377	2.693	2.310	2.057	1.683	1.550	1.354
210	-	-	-	3.425	2.734	2.352	2.107	1.739	1.572	1.377
215	-	-	-	3.474	2.776	2.394	2.158	1.795	1.594	1.400
220	-	-	-	3.523	2.845	2.437	2.208	1.852	1.616	1.423
225	-	-	-	3.571	2.921	2.479	2.259	1.908	1.639	1.446
230	-	-	-	3.620	2.996	2.521	2.309	1.964	1.661	1.468
235	-	-	-	3.668	3.072	2.564	2.360	2.020	1.683	1.491
240	-	-	-	3.717	3.148	2.606	2.410	2.076	1.735	1.514
245	-	-	-	3.766	3.224	2.648	2.461	2.132	1.787	1.537
250	-	-	-	3.814	3.300	2.691	2.511	2.189	1.839	1.560
255	-	-	-	3.863	3.376	2.733	2.562	2.245	1.891	1.583
260	-	-	-	3.911	3.452	2.776	2.612	2.301	1.943	1.605
265	-	-	-	3.960	3.528	2.859	2.663	2.357	1.995	1.628
270	-	-	-	-	3.604	2.953	2.713	2.413	2.047	1.651
275	-	-	-	-	3.680	3.047	2.764	2.469	2.098	1.674
280	-	-	-	-	3.755	3.141	2.843	2.526	2.150	1.715
285	-	-	-	-	3.831	3.235	2.942	2.582	2.202	1.768
290	-	-	-	-	3.907	3.329	3.041	2.638	2.254	1.821
295	-	-	-	-	3.983	3.423	3.140	2.694	2.306	1.874
300	-	-	-	-	-	3.516	3.239	2.750	2.358	1.926
305	-	-	-	-	-	3.610	3.338	2.833	2.410	1.979
310	-	-	-	-	-	3.704	3.437	2.956	2.462	2.032
315	-	-	-	-	-	3.798	3.536	3.079	2.514	2.085
320	-	-	-	-	-	3.892	3.635	3.203	2.566	2.138
325	-	-	-	-	-	3.986	3.734	3.326	2.618	2.191
330	-	-	-	-	-	-	3.833	3.449	2.670	2.244
335	-	-	-	-	-	-	3.932	3.572	2.722	2.297
340	-	-	-	-	-	-	-	3.695	2.774	2.350
345	-	-	-	-	-	-	-	3.818	2.927	2.403
350	-	-	-	-	-	-	-	3.941	3.106	2.456
355	-	-	-	-	-	-	-	-	3.284	2.509
360	-	-	-	-	-	-	-	-	3.463	2.562

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 8: I-Section Beams 120 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
85	-	3.892	3.212	2.800	2.362	1.934	1.700	1.516	1.371	1.139
90	-	3.892	3.312	2.879	2.419	1.971	1.742	1.558	1.388	1.158
95	-	-	3.412	2.958	2.476	2.008	1.784	1.600	1.405	1.178
100	-	-	3.512	3.037	2.533	2.045	1.826	1.641	1.422	1.198
105	-	-	3.612	3.116	2.590	2.082	1.868	1.683	1.439	1.217
110	-	-	3.712	3.196	2.647	2.119	1.910	1.725	1.456	1.237
115	-	-	3.812	3.275	2.704	2.156	1.952	1.766	1.473	1.256
120	-	-	3.912	3.354	2.761	2.193	1.994	1.808	1.490	1.276
125	-	-	-	3.433	2.818	2.230	2.036	1.850	1.507	1.295
130	-	-	-	3.512	2.874	2.267	2.078	1.892	1.524	1.315
135	-	-	-	3.591	2.931	2.304	2.120	1.933	1.541	1.335
140	-	-	-	3.670	2.988	2.341	2.162	1.975	1.558	1.354
145	-	-	-	3.750	3.044	2.378	2.204	2.017	1.575	1.374
150	-	-	-	3.829	3.101	2.414	2.246	2.058	1.591	1.393
155	-	-	-	3.908	3.157	2.451	2.288	2.100	1.608	1.413
160	-	-	-	3.987	3.214	2.488	2.330	2.142	1.625	1.432
165	-	-	-	-	3.270	2.525	2.372	2.183	1.642	1.452
170	-	-	-	-	3.327	2.562	2.414	2.225	1.659	1.472
175	-	-	-	-	3.383	2.599	2.456	2.267	1.676	1.491
180	-	-	-	-	3.440	2.636	2.498	2.309	1.721	1.511
185	-	-	-	-	3.496	2.673	2.540	2.350	1.784	1.530
190	-	-	-	-	3.553	2.710	2.582	2.392	1.848	1.550
195	-	-	-	-	3.609	2.747	2.624	2.434	1.911	1.569
200	-	-	-	-	3.666	2.784	2.666	2.475	1.974	1.589
205	-	-	-	-	3.722	2.863	2.708	2.517	2.037	1.609
210	-	-	-	-	3.779	2.942	2.750	2.559	2.101	1.628
215	-	-	-	-	3.835	3.021	2.800	2.601	2.164	1.648
220	-	-	-	-	3.892	3.101	2.882	2.642	2.227	1.667
225	-	-	-	-	3.949	3.180	2.963	2.684	2.290	1.694
230	-	-	-	-	-	3.259	3.045	2.726	2.354	1.750
235	-	-	-	-	-	3.338	3.126	2.767	2.417	1.807
240	-	-	-	-	-	3.417	3.208	2.838	2.480	1.863
245	-	-	-	-	-	3.496	3.289	2.929	2.544	1.919
250	-	-	-	-	-	3.575	3.371	3.020	2.607	1.975
255	-	-	-	-	-	3.655	3.452	3.111	2.670	2.031
260	-	-	-	-	-	3.734	3.534	3.202	2.733	2.087
265	-	-	-	-	-	3.813	3.615	3.293	2.804	2.144
270	-	-	-	-	-	3.892	3.696	3.383	2.903	2.200
275	-	-	-	-	-	3.971	3.778	3.474	3.002	2.256
280	-	-	-	-	-	-	3.859	3.565	3.101	2.312
285	-	-	-	-	-	-	3.941	3.656	3.200	2.368
290	-	-	-	-	-	-	-	3.747	3.298	2.424
295	-	-	-	-	-	-	-	3.838	3.397	2.481
300	-	-	-	-	-	-	-	3.928	3.496	2.537
305	-	-	-	-	-	-	-	-	3.595	2.593
310	-	-	-	-	-	-	-	-	3.694	2.649
315	-	-	-	-	-	-	-	-	3.793	2.705
320	-	-	-	-	-	-	-	-	3.892	2.762
325	-	-	-	-	-	-	-	-	3.991	2.929
330	-	-	-	-	-	-	-	-	-	3.169
335	-	-	-	-	-	-	-	-	-	3.410
340	-	-	-	-	-	-	-	-	-	3.651
345	-	-	-	-	-	-	-	-	-	3.892

Table applies to I-section beams with 3 sides fire exposure and a concrete slab on top. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 9: I-Section Columns 15 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
90	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
95	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
100	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
105	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
110	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
115	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
120	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
125	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
130	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
135	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
140	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
145	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
150	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
155	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
160	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
165	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
170	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
175	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
180	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
185	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
190	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
195	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
200	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
205	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
210	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
215	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
220	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
225	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
230	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
235	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
240	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
245	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
250	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
255	0.457	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
260	0.468	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
265	0.479	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
270	0.490	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
275	0.501	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
280	0.513	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
285	0.524	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
290	0.535	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
295	0.546	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
300	0.557	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
305	0.568	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
310	0.580	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
315	0.591	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
320	0.602	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
325	0.613	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
330	0.624	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
335	0.636	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
340	0.647	0.458	0.454	0.454	0.454	0.454	0.454	0.454	0.454
345	0.658	0.467	0.454	0.454	0.454	0.454	0.454	0.454	0.454
350	0.669	0.477	0.454	0.454	0.454	0.454	0.454	0.454	0.454
355	0.680	0.486	0.454	0.454	0.454	0.454	0.454	0.454	0.454
360	0.692	0.496	0.454	0.454	0.454	0.454	0.454	0.454	0.454

Table applies to I-section columns with protection to four sides. Thickness is intumescent only.
Table also applies to I-section beams protected on four sides.

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CARBOLINE COMPANY

Firefilm A4

Table 10: I-Section Columns 30 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	0.455	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
90	0.475	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
95	0.495	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
100	0.515	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
105	0.536	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
110	0.556	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
115	0.576	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
120	0.596	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
125	0.617	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
130	0.637	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
135	0.657	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
140	0.678	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
145	0.698	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
150	0.718	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
155	0.738	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
160	0.759	0.454	0.454	0.454	0.454	0.454	0.454	0.454	0.454
165	0.779	0.472	0.454	0.454	0.454	0.454	0.454	0.454	0.454
170	0.799	0.492	0.454	0.454	0.454	0.454	0.454	0.454	0.454
175	0.819	0.512	0.454	0.454	0.454	0.454	0.454	0.454	0.454
180	0.840	0.532	0.454	0.454	0.454	0.454	0.454	0.454	0.454
185	0.860	0.552	0.454	0.454	0.454	0.454	0.454	0.454	0.454
190	0.880	0.572	0.461	0.454	0.454	0.454	0.454	0.454	0.454
195	0.901	0.592	0.478	0.454	0.454	0.454	0.454	0.454	0.454
200	0.921	0.612	0.496	0.454	0.454	0.454	0.454	0.454	0.454
205	0.941	0.632	0.513	0.454	0.454	0.454	0.454	0.454	0.454
210	0.961	0.652	0.530	0.454	0.454	0.454	0.454	0.454	0.454
215	0.982	0.672	0.547	0.454	0.454	0.454	0.454	0.454	0.454
220	1.002	0.692	0.564	0.457	0.454	0.454	0.454	0.454	0.454
225	1.022	0.712	0.581	0.472	0.454	0.454	0.454	0.454	0.454
230	1.042	0.732	0.598	0.487	0.454	0.454	0.454	0.454	0.454
235	1.063	0.752	0.615	0.502	0.454	0.454	0.454	0.454	0.454
240	1.083	0.772	0.632	0.517	0.454	0.454	0.454	0.454	0.454
245	1.103	0.792	0.650	0.531	0.454	0.454	0.454	0.454	0.454
250	1.124	0.812	0.667	0.546	0.454	0.454	0.454	0.454	0.454
255	1.144	0.832	0.684	0.561	0.459	0.454	0.454	0.454	0.454
260	1.164	0.852	0.701	0.576	0.472	0.454	0.454	0.454	0.454
265	1.184	0.872	0.718	0.591	0.485	0.454	0.454	0.454	0.454
270	1.205	0.892	0.735	0.606	0.498	0.454	0.454	0.454	0.454
275	1.225	0.912	0.752	0.620	0.510	0.454	0.454	0.454	0.454
280	1.245	0.932	0.769	0.635	0.523	0.454	0.454	0.454	0.454
285	1.265	0.952	0.786	0.650	0.536	0.454	0.454	0.454	0.454
290	1.286	0.972	0.804	0.665	0.549	0.454	0.454	0.454	0.454
295	1.306	0.992	0.821	0.680	0.561	0.454	0.454	0.454	0.454
300	1.326	1.012	0.838	0.695	0.574	0.465	0.454	0.454	0.454
305	1.346	1.032	0.855	0.709	0.587	0.476	0.454	0.454	0.454
310	1.367	1.052	0.872	0.724	0.600	0.486	0.454	0.454	0.454
315	1.387	1.072	0.889	0.739	0.612	0.497	0.454	0.454	0.454
320	1.407	1.092	0.906	0.754	0.625	0.508	0.454	0.454	0.454
325	1.428	1.112	0.923	0.769	0.638	0.519	0.454	0.454	0.454
330	1.448	1.131	0.940	0.784	0.651	0.530	0.454	0.454	0.454
335	1.468	1.151	0.958	0.798	0.663	0.540	0.454	0.454	0.454
340	1.488	1.171	0.975	0.813	0.676	0.551	0.454	0.454	0.454
345	1.509	1.191	0.992	0.828	0.689	0.562	0.454	0.454	0.454
350	1.529	1.211	1.009	0.843	0.702	0.573	0.456	0.454	0.454
355	1.549	1.231	1.026	0.858	0.714	0.583	0.465	0.454	0.454
360	1.569	1.251	1.043	0.873	0.727	0.594	0.474	0.454	0.454

Table applies to I-section columns with protection to four sides. Thickness is intumescent only.
Table also applies to I-section beams protected on four sides.

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CARBOLINE COMPANY

Firefilm A4

Table 11: I-Section Columns 45 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	1.055	0.707	0.484	0.454	0.454	0.454	0.454	0.454	0.454
90	1.077	0.721	0.507	0.454	0.454	0.454	0.454	0.454	0.454
95	1.100	0.744	0.529	0.454	0.454	0.454	0.454	0.454	0.454
100	1.123	0.767	0.551	0.454	0.454	0.454	0.454	0.454	0.454
105	1.145	0.790	0.573	0.454	0.454	0.454	0.454	0.454	0.454
110	1.168	0.813	0.595	0.454	0.454	0.454	0.454	0.454	0.454
115	1.190	0.836	0.617	0.473	0.454	0.454	0.454	0.454	0.454
120	1.213	0.859	0.639	0.494	0.454	0.454	0.454	0.454	0.454
125	1.236	0.882	0.661	0.514	0.454	0.454	0.454	0.454	0.454
130	1.258	0.905	0.683	0.535	0.454	0.454	0.454	0.454	0.454
135	1.281	0.928	0.706	0.556	0.454	0.454	0.454	0.454	0.454
140	1.303	0.951	0.728	0.576	0.454	0.454	0.454	0.454	0.454
145	1.326	0.974	0.750	0.597	0.454	0.454	0.454	0.454	0.454
150	1.349	0.997	0.772	0.618	0.454	0.454	0.454	0.454	0.454
155	1.371	1.020	0.794	0.639	0.462	0.454	0.454	0.454	0.454
160	1.394	1.043	0.816	0.659	0.482	0.454	0.454	0.454	0.454
165	1.416	1.066	0.838	0.680	0.501	0.454	0.454	0.454	0.454
170	1.439	1.089	0.860	0.701	0.521	0.454	0.454	0.454	0.454
175	1.462	1.112	0.882	0.721	0.540	0.454	0.454	0.454	0.454
180	1.484	1.135	0.905	0.742	0.560	0.454	0.454	0.454	0.454
185	1.507	1.158	0.927	0.763	0.580	0.463	0.454	0.454	0.454
190	1.529	1.181	0.949	0.784	0.599	0.480	0.454	0.454	0.454
195	1.552	1.204	0.971	0.804	0.619	0.498	0.454	0.454	0.454
200	1.575	1.227	0.993	0.825	0.639	0.515	0.454	0.454	0.454
205	1.597	1.250	1.015	0.846	0.658	0.533	0.454	0.454	0.454
210	1.620	1.273	1.037	0.867	0.678	0.550	0.466	0.454	0.454
215	1.642	1.296	1.059	0.887	0.697	0.567	0.480	0.454	0.454
220	1.665	1.319	1.081	0.908	0.717	0.585	0.495	0.454	0.454
225	1.691	1.342	1.104	0.929	0.737	0.602	0.510	0.454	0.454
230	1.729	1.365	1.126	0.949	0.756	0.620	0.525	0.454	0.454
235	1.767	1.388	1.148	0.970	0.776	0.637	0.540	0.456	0.454
240	1.805	1.411	1.170	0.991	0.796	0.655	0.555	0.469	0.454
245	1.844	1.434	1.192	1.012	0.815	0.672	0.570	0.482	0.454
250	1.882	1.457	1.214	1.032	0.835	0.690	0.585	0.495	0.454
255	1.920	1.480	1.236	1.053	0.855	0.707	0.600	0.507	0.454
260	1.958	1.503	1.258	1.074	0.874	0.725	0.615	0.520	0.454
265	1.996	1.527	1.281	1.094	0.894	0.742	0.630	0.533	0.454
270	2.035	1.550	1.303	1.115	0.913	0.760	0.645	0.546	0.454
275	2.073	1.573	1.325	1.136	0.933	0.777	0.659	0.559	0.454
280	2.111	1.596	1.347	1.157	0.953	0.795	0.674	0.572	0.454
285	2.149	1.619	1.369	1.177	0.972	0.812	0.689	0.585	0.455
290	2.188	1.642	1.391	1.198	0.992	0.830	0.704	0.597	0.466
295	2.226	1.665	1.413	1.219	1.012	0.847	0.719	0.610	0.476
300	2.264	1.691	1.435	1.240	1.031	0.865	0.734	0.623	0.486
305	2.302	1.731	1.457	1.260	1.051	0.882	0.749	0.636	0.496
310	2.341	1.771	1.480	1.281	1.070	0.900	0.764	0.649	0.507
315	2.379	1.811	1.502	1.302	1.090	0.917	0.779	0.662	0.517
320	2.417	1.851	1.524	1.322	1.110	0.935	0.794	0.675	0.527
325	2.455	1.890	1.546	1.343	1.129	0.952	0.809	0.687	0.537
330	2.493	1.930	1.568	1.364	1.149	0.970	0.824	0.700	0.548
335	2.532	1.970	1.590	1.385	1.169	0.987	0.839	0.713	0.558
340	2.570	2.010	1.612	1.405	1.188	1.005	0.853	0.726	0.568
345	2.608	2.050	1.634	1.426	1.208	1.022	0.868	0.739	0.578
350	2.646	2.090	1.656	1.447	1.228	1.040	0.883	0.752	0.589
355	2.685	2.130	1.679	1.467	1.247	1.057	0.898	0.765	0.599
360	2.723	2.170	1.714	1.488	1.267	1.075	0.913	0.778	0.609

Table applies to I-section columns with protection to four sides. Thickness is intumescent only.
Table also applies to I-section beams protected on four sides.

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CARBOLINE COMPANY

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Table 12: I-Section Columns 60 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	1.683	1.270	0.955	0.702	0.494	0.454	0.454	0.454	0.454
90	1.716	1.293	0.979	0.715	0.518	0.454	0.454	0.454	0.454
95	1.749	1.316	1.002	0.739	0.541	0.454	0.454	0.454	0.454
100	1.782	1.339	1.025	0.763	0.564	0.466	0.454	0.454	0.454
105	1.815	1.362	1.049	0.787	0.587	0.487	0.454	0.454	0.454
110	1.848	1.386	1.072	0.811	0.610	0.509	0.454	0.454	0.454
115	1.881	1.409	1.095	0.835	0.634	0.530	0.454	0.454	0.454
120	1.914	1.432	1.119	0.859	0.657	0.551	0.454	0.454	0.454
125	1.947	1.455	1.142	0.883	0.680	0.573	0.454	0.454	0.454
130	1.980	1.479	1.165	0.908	0.703	0.594	0.470	0.454	0.454
135	2.013	1.502	1.189	0.932	0.727	0.615	0.489	0.454	0.454
140	2.046	1.525	1.212	0.956	0.750	0.636	0.509	0.454	0.454
145	2.079	1.548	1.235	0.980	0.773	0.658	0.529	0.454	0.454
150	2.112	1.572	1.259	1.004	0.796	0.679	0.548	0.454	0.454
155	2.144	1.595	1.282	1.028	0.819	0.700	0.568	0.454	0.454
160	2.177	1.618	1.305	1.052	0.843	0.721	0.588	0.454	0.454
165	2.210	1.641	1.329	1.076	0.866	0.743	0.607	0.471	0.454
170	2.243	1.664	1.352	1.100	0.889	0.764	0.627	0.490	0.454
175	2.276	1.690	1.375	1.124	0.912	0.785	0.646	0.508	0.454
180	2.309	1.727	1.398	1.148	0.935	0.807	0.666	0.527	0.454
185	2.342	1.764	1.422	1.172	0.959	0.828	0.686	0.545	0.454
190	2.375	1.800	1.445	1.197	0.982	0.849	0.705	0.564	0.461
195	2.408	1.837	1.468	1.221	1.005	0.870	0.725	0.583	0.477
200	2.441	1.874	1.492	1.245	1.028	0.892	0.745	0.601	0.492
205	2.474	1.911	1.515	1.269	1.052	0.913	0.764	0.620	0.508
210	2.507	1.947	1.538	1.293	1.075	0.934	0.784	0.638	0.523
215	2.540	1.984	1.562	1.317	1.098	0.955	0.804	0.657	0.539
220	2.573	2.021	1.585	1.341	1.121	0.977	0.823	0.675	0.555
225	2.606	2.057	1.608	1.365	1.144	0.998	0.843	0.694	0.570
230	2.639	2.094	1.632	1.389	1.168	1.019	0.862	0.712	0.586
235	2.672	2.131	1.655	1.413	1.191	1.041	0.882	0.731	0.601
240	2.705	2.167	1.678	1.437	1.214	1.062	0.902	0.749	0.617
245	2.738	2.204	1.717	1.461	1.237	1.083	0.921	0.768	0.633
250	2.771	2.241	1.759	1.486	1.260	1.104	0.941	0.786	0.648
255	2.808	2.278	1.802	1.510	1.284	1.126	0.961	0.805	0.664
260	2.848	2.314	1.844	1.534	1.307	1.147	0.980	0.823	0.679
265	2.888	2.351	1.886	1.558	1.330	1.168	1.000	0.842	0.695
270	2.927	2.388	1.929	1.582	1.353	1.189	1.019	0.860	0.710
275	2.967	2.424	1.971	1.606	1.377	1.211	1.039	0.879	0.726
280	3.007	2.461	2.013	1.630	1.400	1.232	1.059	0.897	0.742
285	3.047	2.498	2.056	1.654	1.423	1.253	1.078	0.916	0.757
290	3.087	2.534	2.098	1.678	1.446	1.275	1.098	0.935	0.773
295	3.127	2.571	2.140	1.718	1.469	1.296	1.118	0.953	0.788
300	3.167	2.608	2.183	1.761	1.493	1.317	1.137	0.972	0.804
305	3.206	2.645	2.225	1.804	1.516	1.338	1.157	0.990	0.820
310	3.246	2.681	2.267	1.848	1.539	1.360	1.177	1.009	0.835
315	3.286	2.718	2.310	1.891	1.562	1.381	1.196	1.027	0.851
320	3.326	2.755	2.352	1.934	1.585	1.402	1.216	1.046	0.866
325	3.366	2.795	2.394	1.978	1.609	1.423	1.235	1.064	0.882
330	3.406	2.852	2.437	2.021	1.632	1.445	1.255	1.083	0.898
335	3.446	2.908	2.479	2.064	1.655	1.466	1.275	1.101	0.913
340	3.485	2.965	2.521	2.108	1.678	1.487	1.294	1.120	0.929
345	3.525	3.021	2.564	2.151	1.718	1.509	1.314	1.138	0.944
350	3.565	3.078	2.606	2.194	1.762	1.530	1.334	1.157	0.960
355	3.605	3.134	2.648	2.238	1.805	1.551	1.353	1.175	0.975
360	3.645	3.191	2.691	2.281	1.849	1.572	1.373	1.194	0.991

Table applies to I-section columns with protection to four sides. Thickness is intumescent only.
Table also applies to I-section beams protected on four sides.

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Table 13: I-Section Columns 75 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	2.423	1.879	1.446	1.156	0.895	0.676	0.504	0.454	0.454
90	2.474	1.910	1.477	1.178	0.918	0.700	0.527	0.454	0.454
95	2.526	1.941	1.507	1.199	0.942	0.724	0.550	0.474	0.454
100	2.578	1.972	1.537	1.220	0.966	0.748	0.573	0.495	0.454
105	2.629	2.003	1.568	1.242	0.990	0.772	0.596	0.517	0.454
110	2.681	2.035	1.598	1.263	1.013	0.796	0.619	0.538	0.454
115	2.732	2.066	1.628	1.285	1.037	0.820	0.642	0.560	0.454
120	2.784	2.097	1.659	1.306	1.061	0.844	0.665	0.581	0.471
125	2.824	2.128	1.690	1.327	1.085	0.868	0.688	0.603	0.491
130	2.865	2.160	1.725	1.349	1.108	0.892	0.711	0.624	0.510
135	2.905	2.191	1.759	1.370	1.132	0.916	0.734	0.646	0.529
140	2.946	2.222	1.794	1.392	1.156	0.940	0.757	0.667	0.549
145	2.986	2.253	1.828	1.413	1.180	0.964	0.780	0.689	0.568
150	3.027	2.284	1.863	1.435	1.203	0.988	0.803	0.710	0.587
155	3.067	2.316	1.898	1.456	1.227	1.012	0.826	0.732	0.606
160	3.108	2.347	1.932	1.477	1.251	1.036	0.850	0.753	0.626
165	3.148	2.378	1.967	1.499	1.275	1.060	0.873	0.775	0.645
170	3.188	2.409	2.002	1.520	1.298	1.084	0.896	0.796	0.664
175	3.229	2.441	2.036	1.542	1.322	1.108	0.919	0.818	0.684
180	3.269	2.472	2.071	1.563	1.346	1.132	0.942	0.839	0.703
185	3.310	2.503	2.105	1.584	1.370	1.156	0.965	0.861	0.722
190	3.350	2.534	2.140	1.606	1.393	1.180	0.988	0.882	0.741
195	3.391	2.565	2.175	1.627	1.417	1.204	1.011	0.904	0.761
200	3.431	2.597	2.209	1.649	1.441	1.227	1.034	0.926	0.780
205	3.471	2.628	2.244	1.670	1.465	1.251	1.057	0.947	0.799
210	3.512	2.659	2.279	1.701	1.488	1.275	1.080	0.969	0.819
215	3.552	2.690	2.313	1.746	1.512	1.299	1.103	0.990	0.838
220	3.593	2.722	2.348	1.790	1.536	1.323	1.126	1.012	0.857
225	3.633	2.753	2.382	1.835	1.560	1.347	1.149	1.033	0.877
230	3.674	2.784	2.417	1.880	1.583	1.371	1.172	1.055	0.896
235	3.714	2.836	2.452	1.925	1.607	1.395	1.195	1.076	0.915
240	3.755	2.889	2.486	1.969	1.631	1.419	1.218	1.098	0.934
245	3.795	2.941	2.521	2.014	1.655	1.443	1.241	1.119	0.954
250	3.835	2.993	2.555	2.059	1.678	1.467	1.264	1.141	0.973
255	3.876	3.045	2.590	2.104	1.721	1.491	1.287	1.162	0.992
260	3.962	3.098	2.625	2.148	1.768	1.515	1.310	1.184	1.012
265	4.078	3.150	2.659	2.193	1.815	1.539	1.333	1.205	1.031
270	4.194	3.202	2.694	2.238	1.862	1.563	1.356	1.227	1.050
275	4.311	3.254	2.729	2.283	1.909	1.587	1.379	1.248	1.069
280	4.427	3.307	2.763	2.327	1.956	1.611	1.402	1.270	1.089
285	4.543	3.359	2.812	2.372	2.003	1.635	1.425	1.291	1.108
290	4.659	3.411	2.883	2.417	2.050	1.659	1.448	1.313	1.127
295	4.776	3.463	2.954	2.462	2.097	1.683	1.471	1.334	1.147
300	4.892	3.516	3.025	2.507	2.144	1.731	1.494	1.356	1.166
305	5.008	3.568	3.097	2.551	2.191	1.779	1.517	1.377	1.185
310	5.125	3.620	3.168	2.596	2.238	1.827	1.540	1.399	1.205
315	5.241	3.672	3.239	2.641	2.285	1.874	1.563	1.420	1.224
320	5.357	3.725	3.310	2.686	2.332	1.922	1.586	1.442	1.243
325	5.473	3.777	3.381	2.730	2.379	1.970	1.609	1.464	1.262
330	-	3.829	3.452	2.775	2.426	2.018	1.632	1.485	1.282
335	-	3.882	3.523	2.860	2.473	2.066	1.655	1.507	1.301
340	-	4.028	3.594	2.956	2.521	2.114	1.678	1.528	1.320
345	-	4.197	3.665	3.051	2.568	2.162	1.722	1.550	1.340
350	-	4.366	3.736	3.147	2.615	2.210	1.770	1.571	1.359
355	-	4.536	3.807	3.242	2.662	2.257	1.818	1.593	1.378
360	-	4.705	3.878	3.338	2.709	2.305	1.867	1.614	1.397

Table applies to I-section columns with protection to four sides. Thickness is intumescent only. Table also applies to I-section beams protected on four sides up to a limiting nominal protection thickness of 3.992mm.

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Table 14: I-Section Columns 90 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	3.102	2.658	2.044	1.585	1.321	1.069	0.853	0.668	0.501
90	3.180	2.658	2.086	1.620	1.342	1.091	0.876	0.692	0.523
95	3.257	2.693	2.128	1.655	1.363	1.113	0.899	0.716	0.546
100	3.334	2.751	2.170	1.690	1.384	1.135	0.922	0.740	0.569
105	3.412	2.810	2.212	1.725	1.405	1.157	0.945	0.764	0.591
110	3.489	2.868	2.254	1.760	1.425	1.179	0.968	0.787	0.614
115	3.567	2.926	2.296	1.794	1.446	1.201	0.991	0.811	0.636
120	3.644	2.984	2.338	1.829	1.467	1.223	1.014	0.835	0.659
125	3.722	3.042	2.380	1.864	1.488	1.246	1.037	0.859	0.682
130	3.799	3.101	2.422	1.899	1.508	1.268	1.060	0.883	0.704
135	3.877	3.159	2.464	1.934	1.529	1.290	1.083	0.907	0.727
140	4.074	3.217	2.506	1.969	1.550	1.312	1.107	0.930	0.750
145	4.303	3.275	2.549	2.004	1.571	1.334	1.130	0.954	0.772
150	4.531	3.333	2.591	2.038	1.592	1.356	1.153	0.978	0.795
155	4.759	3.392	2.633	2.073	1.612	1.378	1.176	1.002	0.818
160	4.987	3.450	2.675	2.108	1.633	1.400	1.199	1.026	0.840
165	5.215	3.508	2.717	2.143	1.654	1.422	1.222	1.049	0.863
170	5.443	3.566	2.759	2.178	1.675	1.444	1.245	1.073	0.886
175	-	3.624	2.804	2.213	1.711	1.466	1.268	1.097	0.908
180	-	3.683	2.853	2.247	1.758	1.489	1.291	1.121	0.931
185	-	3.741	2.903	2.282	1.804	1.511	1.314	1.145	0.954
190	-	3.799	2.952	2.317	1.851	1.533	1.337	1.169	0.976
195	-	3.857	3.002	2.352	1.898	1.555	1.360	1.192	0.999
200	-	3.919	3.051	2.387	1.944	1.577	1.383	1.216	1.022
205	-	3.985	3.101	2.422	1.991	1.599	1.406	1.240	1.044
210	-	4.052	3.150	2.456	2.038	1.621	1.429	1.264	1.067
215	-	4.119	3.200	2.491	2.084	1.643	1.452	1.288	1.090
220	-	4.185	3.249	2.526	2.131	1.665	1.475	1.311	1.112
225	-	4.252	3.298	2.561	2.178	1.693	1.499	1.335	1.135
230	-	4.318	3.348	2.596	2.224	1.741	1.522	1.359	1.157
235	-	4.385	3.397	2.631	2.271	1.790	1.545	1.383	1.180
240	-	4.452	3.447	2.666	2.317	1.839	1.568	1.407	1.203
245	-	4.518	3.496	2.700	2.364	1.888	1.591	1.431	1.225
250	-	4.585	3.546	2.735	2.411	1.936	1.614	1.454	1.248
255	-	4.652	3.595	2.770	2.457	1.985	1.637	1.478	1.271
260	-	4.718	3.645	2.838	2.504	2.034	1.660	1.502	1.293
265	-	4.785	3.694	2.927	2.551	2.082	1.683	1.526	1.316
270	-	4.851	3.744	3.016	2.597	2.131	1.735	1.550	1.339
275	-	4.918	3.793	3.106	2.644	2.180	1.787	1.573	1.361
280	-	4.985	3.843	3.195	2.691	2.229	1.839	1.597	1.384
285	-	5.051	3.892	3.284	2.737	2.277	1.891	1.621	1.407
290	-	5.118	3.988	3.374	2.784	2.326	1.943	1.645	1.429
295	-	5.185	4.083	3.463	2.878	2.375	1.995	1.669	1.452
300	-	5.251	4.179	3.552	2.972	2.423	2.047	1.703	1.475
305	-	5.318	4.275	3.642	3.066	2.472	2.098	1.754	1.497
310	-	5.384	4.370	3.731	3.160	2.521	2.150	1.805	1.520
315	-	5.451	4.466	3.821	3.253	2.570	2.202	1.856	1.543
320	-	5.518	4.562	3.911	3.347	2.618	2.254	1.907	1.565
325	-	-	4.657	4.007	3.441	2.667	2.306	1.958	1.588
330	-	-	4.753	4.102	3.535	2.716	2.358	2.009	1.611
335	-	-	4.848	4.198	3.629	2.765	2.410	2.060	1.633
340	-	-	4.944	4.294	3.723	2.865	2.462	2.111	1.656
345	-	-	5.040	4.389	3.817	3.000	2.514	2.162	1.678
350	-	-	5.135	4.485	3.910	3.135	2.566	2.213	1.722
355	-	-	5.231	4.581	4.001	3.270	2.618	2.264	1.771
360	-	-	5.327	4.676	4.093	3.406	2.670	2.315	1.821

Table applies to I-section columns with protection to four sides. Thickness is intumescent only. Table also applies to I-section beams protected on four sides up to a limiting nominal protection thickness of 3.992mm.

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CARBOLINE COMPANY

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Table 15: I-Section Columns 105 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	3.892	3.128	2.670	2.210	1.700	1.452	1.222	1.017	0.806
90	3.892	3.224	2.741	2.258	1.741	1.477	1.241	1.039	0.829
95	-	3.319	2.812	2.307	1.782	1.502	1.260	1.061	0.852
100	-	3.415	2.883	2.356	1.824	1.527	1.279	1.083	0.875
105	-	3.510	2.954	2.404	1.865	1.552	1.298	1.105	0.898
110	-	3.606	3.025	2.453	1.907	1.577	1.318	1.128	0.920
115	-	3.701	3.097	2.502	1.948	1.603	1.337	1.150	0.943
120	-	3.797	3.168	2.550	1.989	1.628	1.356	1.172	0.966
125	-	3.892	3.239	2.599	2.031	1.653	1.375	1.194	0.989
130	-	4.129	3.310	2.648	2.072	1.678	1.395	1.217	1.012
135	-	4.366	3.381	2.696	2.113	1.717	1.414	1.239	1.035
140	-	4.604	3.452	2.745	2.155	1.759	1.433	1.261	1.057
145	-	4.841	3.523	2.794	2.196	1.802	1.452	1.283	1.080
150	-	5.078	3.594	2.842	2.238	1.844	1.472	1.305	1.103
155	-	5.315	3.665	2.891	2.279	1.886	1.491	1.328	1.126
160	-	5.552	3.736	2.940	2.320	1.929	1.510	1.350	1.149
165	-	-	3.807	2.988	2.362	1.971	1.529	1.372	1.172
170	-	-	3.878	3.037	2.403	2.013	1.548	1.394	1.194
175	-	-	3.945	3.085	2.445	2.056	1.568	1.416	1.217
180	-	-	4.012	3.134	2.486	2.098	1.587	1.439	1.240
185	-	-	4.079	3.182	2.527	2.140	1.606	1.461	1.263
190	-	-	4.145	3.231	2.569	2.183	1.625	1.483	1.286
195	-	-	4.212	3.280	2.610	2.225	1.645	1.505	1.309
200	-	-	4.278	3.328	2.652	2.267	1.664	1.528	1.331
205	-	-	4.345	3.377	2.693	2.310	1.683	1.550	1.354
210	-	-	4.412	3.425	2.734	2.352	1.739	1.572	1.377
215	-	-	4.478	3.474	2.776	2.394	1.795	1.594	1.400
220	-	-	4.545	3.523	2.845	2.437	1.852	1.616	1.423
225	-	-	4.612	3.571	2.921	2.479	1.908	1.639	1.446
230	-	-	4.678	3.620	2.996	2.521	1.964	1.661	1.468
235	-	-	4.745	3.668	3.072	2.564	2.020	1.683	1.491
240	-	-	4.811	3.717	3.148	2.606	2.076	1.735	1.514
245	-	-	4.878	3.766	3.224	2.648	2.132	1.787	1.537
250	-	-	4.945	3.814	3.300	2.691	2.189	1.839	1.560
255	-	-	5.011	3.863	3.376	2.733	2.245	1.891	1.583
260	-	-	5.078	3.930	3.452	2.776	2.301	1.943	1.605
265	-	-	5.145	4.026	3.528	2.859	2.357	1.995	1.628
270	-	-	5.211	4.122	3.604	2.953	2.413	2.047	1.651
275	-	-	5.278	4.217	3.680	3.047	2.469	2.098	1.674
280	-	-	5.345	4.313	3.755	3.141	2.526	2.150	1.715
285	-	-	5.411	4.408	3.831	3.235	2.582	2.202	1.768
290	-	-	5.478	4.504	3.911	3.329	2.638	2.254	1.821
295	-	-	5.544	4.600	4.003	3.423	2.694	2.306	1.874
300	-	-	-	4.695	4.096	3.516	2.750	2.358	1.926
305	-	-	-	4.791	4.189	3.610	2.833	2.410	1.979
310	-	-	-	4.887	4.281	3.704	2.956	2.462	2.032
315	-	-	-	4.982	4.374	3.798	3.079	2.514	2.085
320	-	-	-	5.078	4.466	3.892	3.203	2.566	2.138
325	-	-	-	5.174	4.559	3.993	3.326	2.618	2.191
330	-	-	-	5.269	4.652	4.093	3.449	2.670	2.244
335	-	-	-	5.365	4.744	4.194	3.572	2.722	2.297
340	-	-	-	5.461	4.837	4.294	3.695	2.774	2.350
345	-	-	-	5.556	4.930	4.395	3.818	2.927	2.403
350	-	-	-	-	5.022	4.495	3.928	3.106	2.456
355	-	-	-	-	5.115	4.596	4.020	3.284	2.509
360	-	-	-	-	5.208	4.696	4.111	3.463	2.562

Table applies to I-section columns with protection to four sides. Thickness is intumescent only. Table also applies to I-section beams protected on four sides up to a limiting nominal protection thickness of 3.992mm.

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CARBOLINE COMPANY

Firefilm A4

Table 16: I-Section Columns 120 minutes									
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of								
	350°C	400°C	450°C	500°C	550°C	600°C	650°C	700°C	750°C
85	-	3.892	3.212	2.800	2.362	1.795	1.516	1.371	1.139
90	-	3.892	3.312	2.879	2.419	1.838	1.558	1.388	1.158
95	-	-	3.412	2.958	2.476	1.881	1.600	1.405	1.178
100	-	-	3.512	3.037	2.533	1.924	1.641	1.422	1.198
105	-	-	3.612	3.116	2.590	1.967	1.683	1.439	1.217
110	-	-	3.712	3.196	2.647	2.010	1.725	1.456	1.237
115	-	-	3.812	3.275	2.704	2.053	1.766	1.473	1.256
120	-	-	3.912	3.354	2.761	2.096	1.808	1.490	1.276
125	-	-	4.012	3.433	2.818	2.139	1.850	1.507	1.295
130	-	-	4.112	3.512	2.874	2.182	1.892	1.524	1.315
135	-	-	4.212	3.591	2.931	2.225	1.933	1.541	1.335
140	-	-	-	3.670	2.988	2.268	1.975	1.558	1.354
145	-	-	-	3.750	3.044	2.311	2.017	1.575	1.374
150	-	-	-	3.829	3.101	2.354	2.058	1.591	1.393
155	-	-	-	3.916	3.157	2.397	2.100	1.608	1.413
160	-	-	-	4.037	3.214	2.440	2.142	1.625	1.432
165	-	-	-	4.158	3.270	2.483	2.183	1.642	1.452
170	-	-	-	4.279	3.327	2.526	2.225	1.659	1.472
175	-	-	-	4.400	3.383	2.569	2.267	1.676	1.491
180	-	-	-	4.521	3.440	2.612	2.309	1.721	1.511
185	-	-	-	4.642	3.496	2.655	2.350	1.784	1.530
190	-	-	-	4.763	3.553	2.698	2.392	1.848	1.550
195	-	-	-	4.884	3.609	2.741	2.434	1.911	1.569
200	-	-	-	5.005	3.666	2.784	2.475	1.974	1.589
205	-	-	-	5.126	3.722	2.863	2.517	2.037	1.609
210	-	-	-	5.247	3.779	2.942	2.559	2.101	1.628
215	-	-	-	5.368	3.835	3.021	2.601	2.164	1.648
220	-	-	-	5.489	3.892	3.101	2.642	2.227	1.667
225	-	-	-	-	3.994	3.180	2.684	2.290	1.694
230	-	-	-	-	4.096	3.259	2.726	2.354	1.750
235	-	-	-	-	4.199	3.338	2.767	2.417	1.807
240	-	-	-	-	4.301	3.417	2.838	2.480	1.863
245	-	-	-	-	4.403	3.496	2.929	2.544	1.919
250	-	-	-	-	4.505	3.575	3.020	2.607	1.975
255	-	-	-	-	4.608	3.655	3.111	2.670	2.031
260	-	-	-	-	4.710	3.734	3.202	2.733	2.087
265	-	-	-	-	4.812	3.813	3.293	2.804	2.144
270	-	-	-	-	4.914	3.892	3.383	2.903	2.200
275	-	-	-	-	5.017	3.989	3.474	3.002	2.256
280	-	-	-	-	5.119	4.086	3.565	3.101	2.312
285	-	-	-	-	5.221	4.184	3.656	3.200	2.368
290	-	-	-	-	5.323	4.281	3.747	3.298	2.424
295	-	-	-	-	5.426	4.378	3.838	3.397	2.481
300	-	-	-	-	5.528	4.475	3.932	3.496	2.537
305	-	-	-	-	-	4.572	4.033	3.595	2.593
310	-	-	-	-	-	4.670	4.133	3.694	2.649
315	-	-	-	-	-	4.767	4.234	3.793	2.705
320	-	-	-	-	-	4.864	4.334	3.892	2.762
325	-	-	-	-	-	4.961	4.435	3.988	2.929
330	-	-	-	-	-	5.059	4.535	4.083	3.169
335	-	-	-	-	-	5.156	4.636	4.179	3.410
340	-	-	-	-	-	5.253	4.736	4.275	3.651
345	-	-	-	-	-	5.350	4.837	4.370	3.892
350	-	-	-	-	-	5.447	4.937	4.466	3.977
355	-	-	-	-	-	5.545	5.038	4.562	4.061
360	-	-	-	-	-	-	5.138	4.657	4.146

Table applies to I-section columns with protection to four sides. Thickness is intumescent only. Table also applies to I-section beams protected on four sides up to a limiting nominal protection thickness of 3.992mm.

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Table 17: Circular and Rectangular Hollow Section Columns 15 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
75	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
80	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
85	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
90	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
95	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
100	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
105	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
110	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
115	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
120	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
125	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
130	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
135	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
140	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
145	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
150	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
155	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
160	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
165	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
170	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
175	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
180	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
185	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
190	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
195	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
200	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
205	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
210	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
215	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
220	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
225	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
230	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
235	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
240	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
245	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
250	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
255	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
260	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
265	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
270	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
275	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
280	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
285	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
290	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
295	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
300	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
305	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
310	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
315	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781

Tabulated values continued overleaf

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 17: Circular and Rectangular Hollow Section Columns 15 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
325	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
330	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
335	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
340	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
345	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
350	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
355	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
360	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
365	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
370	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
375	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
380	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
385	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
390	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
395	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
400	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
405	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
410	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
415	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
420	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
425	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
430	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
435	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CARBOLINE COMPANY

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Table 18: Circular and Rectangular Hollow Section Columns 30 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
75	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
80	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
85	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
90	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
95	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
100	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
105	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
110	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
115	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
120	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
125	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
130	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
135	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
140	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
145	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
150	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
155	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
160	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
165	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
170	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
175	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
180	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
185	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
190	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
195	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
200	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
205	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
210	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
215	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
220	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
225	1.806	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
230	1.843	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
235	1.880	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
240	1.917	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
245	1.954	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
250	1.991	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
255	2.028	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
260	2.064	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
265	2.101	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
270	2.138	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
275	2.175	1.811	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
280	2.212	1.852	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
285	2.249	1.892	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
290	2.286	1.933	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
295	2.323	1.974	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
300	2.359	2.014	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
305	2.396	2.055	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
310	2.433	2.095	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
315	2.470	2.136	1.790	1.781	1.781	1.781	1.781	1.781	1.781	1.781

Tabulated values continued overleaf

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

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Table 18: Circular and Rectangular Hollow Section Columns 30 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	2.507	2.177	1.834	1.781	1.781	1.781	1.781	1.781	1.781	1.781
325	2.544	2.217	1.877	1.781	1.781	1.781	1.781	1.781	1.781	1.781
330	2.581	2.258	1.920	1.781	1.781	1.781	1.781	1.781	1.781	1.781
335	2.618	2.298	1.963	1.781	1.781	1.781	1.781	1.781	1.781	1.781
340	2.654	2.339	2.007	1.781	1.781	1.781	1.781	1.781	1.781	1.781
345	2.691	2.380	2.050	1.781	1.781	1.781	1.781	1.781	1.781	1.781
350	2.728	2.420	2.093	1.781	1.781	1.781	1.781	1.781	1.781	1.781
355	2.765	2.461	2.136	1.781	1.781	1.781	1.781	1.781	1.781	1.781
360	2.802	2.501	2.180	1.781	1.781	1.781	1.781	1.781	1.781	1.781
365	2.839	2.542	2.223	1.781	1.781	1.781	1.781	1.781	1.781	1.781
370	2.876	2.582	2.266	1.801	1.781	1.781	1.781	1.781	1.781	1.781
375	2.913	2.623	2.309	1.846	1.781	1.781	1.781	1.781	1.781	1.781
380	2.949	2.664	2.353	1.890	1.781	1.781	1.781	1.781	1.781	1.781
385	2.986	2.704	2.396	1.935	1.781	1.781	1.781	1.781	1.781	1.781
390	3.023	2.745	2.439	1.980	1.781	1.781	1.781	1.781	1.781	1.781
395	3.060	2.785	2.482	2.025	1.781	1.781	1.781	1.781	1.781	1.781
400	3.097	2.826	2.526	2.070	1.806	1.781	1.781	1.781	1.781	1.781
405	3.134	2.867	2.569	2.115	1.854	1.781	1.781	1.781	1.781	1.781
410	3.171	2.907	2.612	2.159	1.902	1.781	1.781	1.781	1.781	1.781
415	3.208	2.948	2.655	2.204	1.950	1.781	1.781	1.781	1.781	1.781
420	3.244	2.988	2.699	2.249	1.998	1.781	1.781	1.781	1.781	1.781
425	3.281	3.029	2.742	2.294	2.046	1.781	1.781	1.781	1.781	1.781
430	3.318	3.069	2.785	2.339	2.094	1.802	1.781	1.781	1.781	1.781
435	3.355	3.110	2.828	2.384	2.142	1.849	1.781	1.781	1.781	1.781

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 19: Circular and Rectangular Hollow Section Columns 45 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
75	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
80	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
85	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
90	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
95	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
100	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
105	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
110	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
115	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
120	1.868	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
125	1.961	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
130	2.054	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
135	2.147	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
140	2.240	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
145	2.333	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
150	2.426	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
155	2.520	1.820	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
160	2.613	1.947	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
165	2.706	2.074	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
170	2.799	2.202	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
175	2.892	2.329	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
180	2.985	2.457	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
185	3.078	2.584	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
190	3.172	2.712	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
195	3.265	2.839	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
200	3.358	2.967	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
205	3.451	3.094	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
210	3.488	3.222	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
215	3.525	3.349	1.808	1.781	1.781	1.781	1.781	1.781	1.781	1.781
220	3.562	3.458	1.966	1.781	1.781	1.781	1.781	1.781	1.781	1.781
225	3.599	3.491	2.124	1.781	1.781	1.781	1.781	1.781	1.781	1.781
230	3.636	3.524	2.282	1.781	1.781	1.781	1.781	1.781	1.781	1.781
235	3.673	3.557	2.440	1.781	1.781	1.781	1.781	1.781	1.781	1.781
240	3.710	3.591	2.598	1.781	1.781	1.781	1.781	1.781	1.781	1.781
245	3.747	3.624	2.756	1.832	1.781	1.781	1.781	1.781	1.781	1.781
250	3.784	3.657	2.914	1.936	1.781	1.781	1.781	1.781	1.781	1.781
255	3.821	3.691	3.072	2.040	1.781	1.781	1.781	1.781	1.781	1.781
260	3.858	3.724	3.230	2.143	1.816	1.781	1.781	1.781	1.781	1.781
265	3.895	3.757	3.388	2.247	1.917	1.781	1.781	1.781	1.781	1.781
270	3.932	3.790	3.472	2.351	2.018	1.781	1.781	1.781	1.781	1.781
275	3.969	3.824	3.507	2.455	2.119	1.818	1.781	1.781	1.781	1.781
280	4.006	3.857	3.542	2.558	2.220	1.900	1.781	1.781	1.781	1.781
285	4.043	3.890	3.577	2.662	2.321	1.982	1.781	1.781	1.781	1.781
290	4.080	3.923	3.612	2.766	2.422	2.063	1.781	1.781	1.781	1.781
295	4.117	3.957	3.647	2.870	2.523	2.145	1.781	1.781	1.781	1.781
300	4.154	3.990	3.682	2.974	2.624	2.227	1.781	1.781	1.781	1.781
305	4.192	4.023	3.717	3.077	2.725	2.308	1.781	1.781	1.781	1.781
310	4.229	4.057	3.752	3.181	2.825	2.390	1.781	1.781	1.781	1.781
315	4.266	4.090	3.787	3.285	2.926	2.471	1.801	1.781	1.781	1.781

Tabulated values continued overleaf

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 19: Circular and Rectangular Hollow Section Columns 45 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	4.303	4.123	3.823	3.389	3.027	2.553	1.877	1.781	1.781	1.781
325	4.340	4.156	3.858	3.466	3.128	2.635	1.953	1.781	1.781	1.781
330	4.377	4.190	3.893	3.502	3.229	2.716	2.028	1.781	1.781	1.781
335	4.414	4.223	3.928	3.539	3.330	2.798	2.104	1.781	1.781	1.781
340	4.451	4.256	3.963	3.575	3.431	2.880	2.180	1.781	1.781	1.781
345	4.488	4.289	3.998	3.611	3.480	2.961	2.255	1.781	1.781	1.781
350	4.525	4.323	4.033	3.648	3.516	3.043	2.331	1.781	1.781	1.781
355	4.562	4.356	4.068	3.684	3.552	3.124	2.407	1.781	1.781	1.781
360	4.599	4.389	4.103	3.721	3.588	3.206	2.482	1.781	1.781	1.781
365	4.636	4.423	4.138	3.757	3.624	3.288	2.558	1.781	1.781	1.781
370	4.673	4.456	4.173	3.794	3.660	3.369	2.634	1.781	1.781	1.781
375	4.710	4.489	4.208	3.830	3.696	3.451	2.709	1.781	1.781	1.781
380	4.747	4.522	4.243	3.867	3.733	3.490	2.785	1.853	1.781	1.781
385	4.784	4.556	4.278	3.903	3.769	3.528	2.861	1.933	1.781	1.781
390	4.821	4.589	4.313	3.940	3.805	3.567	2.936	2.014	1.781	1.781
395	4.858	4.622	4.348	3.976	3.841	3.605	3.012	2.095	1.781	1.781
400	4.895	4.655	4.383	4.013	3.877	3.644	3.088	2.176	1.781	1.781
405	4.950	4.689	4.418	4.049	3.913	3.683	3.163	2.256	1.781	1.781
410	5.005	4.722	4.453	4.085	3.949	3.721	3.239	2.337	1.781	1.781
415	5.060	4.755	4.488	4.122	3.985	3.760	3.315	2.418	1.781	1.781
420	5.115	4.789	4.523	4.158	4.021	3.798	3.390	2.498	1.781	1.781
425	5.169	4.822	4.559	4.195	4.057	3.837	3.458	2.579	1.781	1.781
430	5.224	4.855	4.594	4.231	4.094	3.876	3.495	2.660	1.781	1.781
435	5.279	4.888	4.629	4.268	4.130	3.914	3.532	2.741	1.781	1.781

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

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Table 20: Circular and Rectangular Hollow Section Columns 60 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	1.832	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
75	1.924	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
80	2.016	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
85	2.108	1.783	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
90	2.200	1.866	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
95	2.292	1.948	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
100	2.384	2.031	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
105	2.476	2.114	1.823	1.781	1.781	1.781	1.781	1.781	1.781	1.781
110	2.568	2.196	1.910	1.781	1.781	1.781	1.781	1.781	1.781	1.781
115	2.660	2.279	1.998	1.781	1.781	1.781	1.781	1.781	1.781	1.781
120	2.752	2.361	2.086	1.798	1.781	1.781	1.781	1.781	1.781	1.781
125	2.844	2.444	2.173	1.889	1.781	1.781	1.781	1.781	1.781	1.781
130	2.936	2.526	2.261	1.980	1.781	1.781	1.781	1.781	1.781	1.781
135	3.028	2.609	2.348	2.071	1.781	1.781	1.781	1.781	1.781	1.781
140	3.120	2.691	2.436	2.161	1.827	1.781	1.781	1.781	1.781	1.781
145	3.212	2.774	2.523	2.252	1.934	1.781	1.781	1.781	1.781	1.781
150	3.304	2.857	2.611	2.343	2.041	1.781	1.781	1.781	1.781	1.781
155	3.396	2.939	2.698	2.434	2.148	1.781	1.781	1.781	1.781	1.781
160	3.512	3.022	2.786	2.525	2.254	1.781	1.781	1.781	1.781	1.781
165	3.666	3.104	2.873	2.616	2.361	1.781	1.781	1.781	1.781	1.781
170	3.820	3.187	2.961	2.706	2.468	1.781	1.781	1.781	1.781	1.781
175	3.973	3.269	3.048	2.797	2.575	1.872	1.781	1.781	1.781	1.781
180	4.127	3.352	3.136	2.888	2.682	2.030	1.781	1.781	1.781	1.781
185	4.281	3.434	3.223	2.979	2.789	2.188	1.781	1.781	1.781	1.781
190	4.434	3.650	3.311	3.070	2.895	2.345	1.781	1.781	1.781	1.781
195	4.588	3.899	3.398	3.160	3.002	2.503	1.781	1.781	1.781	1.781
200	4.741	4.148	3.503	3.251	3.109	2.661	1.781	1.781	1.781	1.781
205	4.895	4.397	3.632	3.342	3.216	2.819	1.781	1.781	1.781	1.781
210	4.933	4.646	3.760	3.433	3.323	2.977	1.781	1.781	1.781	1.781
215	4.970	4.895	3.889	3.493	3.430	3.135	1.781	1.781	1.781	1.781
220	5.008	4.928	4.018	3.544	3.483	3.293	1.781	1.781	1.781	1.781
225	5.046	4.962	4.147	3.596	3.522	3.451	1.781	1.781	1.781	1.781
230	5.083	4.995	4.276	3.648	3.562	3.490	1.781	1.781	1.781	1.781
235	5.121	5.028	4.405	3.700	3.602	3.528	1.901	1.781	1.781	1.781
240	5.159	5.061	4.534	3.752	3.641	3.567	2.143	1.781	1.781	1.781
245	5.196	5.095	4.663	3.804	3.681	3.605	2.385	1.781	1.781	1.781
250	5.234	5.128	4.792	3.856	3.721	3.644	2.628	1.781	1.781	1.781
255	5.271	5.161	4.902	3.908	3.760	3.683	2.870	1.781	1.781	1.781
260	5.309	5.195	4.936	3.960	3.800	3.721	3.112	1.781	1.781	1.781
265	5.347	5.228	4.970	4.012	3.840	3.760	3.354	1.781	1.781	1.781
270	5.384	5.261	5.004	4.064	3.879	3.798	3.475	1.781	1.781	1.781
275	5.422	5.294	5.037	4.116	3.919	3.837	3.515	1.919	1.781	1.781
280	5.460	5.328	5.071	4.168	3.959	3.876	3.555	2.116	1.781	1.781
285	5.497	5.361	5.105	4.220	3.998	3.914	3.595	2.312	1.781	1.781
290	5.535	5.394	5.139	4.272	4.038	3.953	3.634	2.509	1.781	1.781
295	5.573	5.428	5.173	4.324	4.078	3.992	3.674	2.705	1.781	1.781
300	5.610	5.461	5.207	4.376	4.117	4.030	3.714	2.901	1.781	1.781
305	5.648	5.494	5.241	4.428	4.157	4.069	3.754	3.098	1.781	1.781
310	5.686	5.527	5.275	4.479	4.197	4.107	3.794	3.294	1.781	1.781
315	5.723	5.561	5.309	4.531	4.236	4.146	3.834	3.459	1.781	1.781

Tabulated values continued overleaf

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 20: Circular and Rectangular Hollow Section Columns 60 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	5.761	5.594	5.343	4.583	4.276	4.185	3.874	3.499	1.781	1.781
325	5.798	5.627	5.377	4.635	4.316	4.223	3.914	3.538	1.855	1.781
330	5.836	5.661	5.411	4.687	4.355	4.262	3.954	3.578	1.974	1.781
335	5.874	5.694	5.444	4.739	4.395	4.300	3.993	3.618	2.093	1.781
340	5.911	5.727	5.478	4.791	4.435	4.339	4.033	3.657	2.212	1.781
345	5.949	5.760	5.512	4.843	4.474	4.378	4.073	3.697	2.331	1.781
350	5.987	5.794	5.546	4.895	4.514	4.416	4.113	3.737	2.451	1.781
355	6.024	5.827	5.580	4.945	4.554	4.455	4.153	3.776	2.570	1.781
360	6.062	5.860	5.614	4.994	4.594	4.493	4.193	3.816	2.689	1.781
365	6.100	5.894	5.648	5.044	4.633	4.532	4.233	3.856	2.808	1.800
370	6.137	5.927	5.682	5.093	4.673	4.571	4.273	3.895	2.927	1.882
375	6.175	5.960	5.716	5.143	4.713	4.609	4.313	3.935	3.046	1.965
380	6.213	5.993	5.750	5.193	4.752	4.648	4.353	3.975	3.165	2.048
385	6.250	6.027	5.784	5.242	4.792	4.687	4.392	4.014	3.284	2.130
390	6.288	6.060	5.817	5.292	4.832	4.725	4.432	4.054	3.403	2.213
395	6.325	6.093	5.851	5.341	4.871	4.764	4.472	4.094	3.478	2.295
400	6.480	6.127	5.885	5.391	4.919	4.802	4.512	4.133	3.524	2.378
405	6.663	6.160	5.919	5.440	4.980	4.841	4.552	4.173	3.569	2.460
410	6.847	6.193	5.953	5.490	5.040	4.880	4.592	4.213	3.614	2.543
415	7.030	6.226	5.987	5.540	5.100	4.929	4.632	4.252	3.660	2.625
420	7.214	6.260	6.021	5.589	5.161	4.985	4.672	4.292	3.705	2.708
425	7.397	6.293	6.055	5.639	5.221	5.041	4.712	4.332	3.751	2.791
430	7.581	6.326	6.089	5.688	5.282	5.097	4.751	4.371	3.796	2.873
435	7.764	6.483	6.123	5.738	5.342	5.153	4.791	4.411	3.842	2.956

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 21: Circular and Rectangular Hollow Section Columns 75 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.894	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	2.024	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	2.154	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	2.283	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	2.413	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	2.543	1.845	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	2.673	1.973	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
75	2.802	2.100	1.821	1.781	1.781	1.781	1.781	1.781	1.781	1.781
80	2.932	2.227	1.919	1.781	1.781	1.781	1.781	1.781	1.781	1.781
85	3.062	2.355	2.018	1.800	1.781	1.781	1.781	1.781	1.781	1.781
90	3.192	2.482	2.116	1.882	1.781	1.781	1.781	1.781	1.781	1.781
95	3.321	2.610	2.214	1.965	1.863	1.781	1.781	1.781	1.781	1.781
100	3.451	2.737	2.312	2.048	1.947	1.827	1.781	1.781	1.781	1.781
105	3.540	2.865	2.410	2.130	2.032	1.913	1.781	1.781	1.781	1.781
110	3.629	2.992	2.509	2.213	2.116	1.998	1.781	1.781	1.781	1.781
115	3.718	3.120	2.607	2.295	2.201	2.083	1.821	1.781	1.781	1.781
120	3.808	3.247	2.705	2.378	2.285	2.169	1.909	1.781	1.781	1.781
125	3.897	3.375	2.803	2.460	2.370	2.254	1.998	1.781	1.781	1.781
130	3.986	3.497	2.901	2.543	2.454	2.340	2.087	1.781	1.781	1.781
135	4.075	3.611	2.999	2.625	2.539	2.425	2.175	1.781	1.781	1.781
140	4.164	3.726	3.098	2.708	2.623	2.511	2.264	1.781	1.781	1.781
145	4.253	3.841	3.196	2.791	2.708	2.596	2.352	1.781	1.781	1.781
150	4.342	3.955	3.294	2.873	2.792	2.682	2.441	1.781	1.781	1.781
155	4.431	4.070	3.392	2.956	2.877	2.767	2.530	1.781	1.781	1.781
160	4.521	4.184	3.518	3.038	2.961	2.853	2.618	1.781	1.781	1.781
165	4.610	4.299	3.686	3.121	3.046	2.938	2.707	1.914	1.781	1.781
170	4.699	4.414	3.854	3.203	3.130	3.024	2.795	2.054	1.781	1.781
175	4.788	4.528	4.022	3.286	3.214	3.109	2.884	2.194	1.781	1.781
180	4.877	4.643	4.190	3.368	3.299	3.195	2.973	2.333	1.781	1.781
185	5.145	4.757	4.358	3.451	3.383	3.280	3.061	2.473	1.781	1.781
190	5.458	4.872	4.526	3.729	3.509	3.366	3.150	2.613	1.781	1.781
195	5.770	5.116	4.694	4.006	3.798	3.451	3.238	2.752	1.781	1.781
200	6.083	5.393	4.861	4.284	4.086	3.740	3.327	2.892	1.781	1.781
205	6.351	5.669	4.970	4.562	4.375	4.029	3.416	3.032	1.781	1.781
210	6.438	5.946	5.063	4.839	4.664	4.317	3.512	3.172	1.781	1.781
215	6.526	6.222	5.156	4.930	4.902	4.606	3.614	3.311	1.781	1.781
220	6.614	6.369	5.250	4.974	4.939	4.895	3.715	3.451	1.781	1.781
225	6.701	6.429	5.343	5.018	4.976	4.930	3.817	3.502	1.781	1.781
230	6.789	6.488	5.437	5.062	5.013	4.965	3.919	3.553	1.781	1.781
235	6.877	6.548	5.530	5.105	5.050	5.000	4.020	3.604	1.781	1.781
240	6.964	6.608	5.623	5.149	5.087	5.035	4.122	3.654	1.781	1.781
245	7.052	6.668	5.717	5.193	5.124	5.070	4.224	3.705	1.781	1.781
250	7.140	6.728	5.810	5.237	5.160	5.104	4.326	3.756	1.781	1.781
255	7.227	6.787	5.903	5.281	5.197	5.139	4.427	3.807	2.361	1.781
260	7.315	6.847	5.997	5.325	5.234	5.174	4.529	3.858	2.967	1.781
265	7.403	6.907	6.090	5.368	5.271	5.209	4.631	3.909	3.460	1.781
270	7.490	6.967	6.184	5.412	5.308	5.244	4.732	3.959	3.506	1.781
275	7.578	7.026	6.277	5.456	5.345	5.279	4.834	4.010	3.552	1.808
280	7.666	7.086	6.359	5.500	5.382	5.314	4.911	4.061	3.598	1.966
285	7.753	7.146	6.425	5.544	5.419	5.349	4.952	4.112	3.644	2.124
290	7.841	7.206	6.491	5.588	5.455	5.384	4.992	4.163	3.690	2.282
295	7.929	7.265	6.557	5.632	5.492	5.419	5.032	4.214	3.736	2.440
300	8.016	7.325	6.622	5.675	5.529	5.453	5.073	4.265	3.782	2.598
305	8.104	7.385	6.688	5.719	5.566	5.488	5.113	4.315	3.828	2.756
310	8.192	7.445	6.754	5.763	5.603	5.523	5.154	4.366	3.874	2.914
315	8.279	7.505	6.820	5.807	5.640	5.558	5.194	4.417	3.920	3.072

Tabulated values continued overleaf

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CARBOLINE COMPANY

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Table 21: Circular and Rectangular Hollow Section Columns 75 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	8.367	7.564	6.885	5.851	5.677	5.593	5.234	4.468	3.966	3.230
325	8.455	7.624	6.951	5.895	5.714	5.628	5.275	4.519	4.012	3.388
330	8.542	7.684	7.017	5.938	5.750	5.663	5.315	4.570	4.058	3.480
335	8.630	7.744	7.083	5.982	5.787	5.698	5.355	4.620	4.104	3.529
340	-	7.803	7.148	6.026	5.824	5.733	5.396	4.671	4.150	3.577
345	-	7.863	7.214	6.070	5.861	5.768	5.436	4.722	4.196	3.625
350	-	7.923	7.280	6.114	5.898	5.802	5.477	4.773	4.242	3.674
355	-	7.983	7.346	6.158	5.935	5.837	5.517	4.824	4.288	3.722
360	-	8.043	7.411	6.201	5.972	5.872	5.557	4.875	4.334	3.771
365	-	8.102	7.477	6.245	6.009	5.907	5.598	4.928	4.380	3.819
370	-	8.162	7.543	6.289	6.045	5.942	5.638	4.982	4.426	3.868
375	-	8.222	7.609	6.333	6.082	5.977	5.679	5.037	4.472	3.916
380	-	8.282	7.674	6.508	6.119	6.012	5.719	5.091	4.518	3.965
385	-	8.341	7.740	6.684	6.156	6.047	5.759	5.146	4.564	4.013
390	-	8.401	7.806	6.859	6.193	6.082	5.800	5.200	4.610	4.062
395	-	8.461	7.872	7.034	6.230	6.117	5.840	5.255	4.656	4.110
400	-	8.521	7.937	7.210	6.267	6.152	5.881	5.309	4.702	4.158
405	-	8.580	8.003	7.385	6.304	6.186	5.921	5.363	4.748	4.207
410	-	8.640	8.069	7.560	6.405	6.221	5.961	5.418	4.794	4.255
415	-	8.700	8.135	7.736	6.763	6.256	6.002	5.472	4.840	4.304
420	-	-	8.200	7.911	7.122	6.291	6.042	5.527	4.886	4.352
425	-	-	8.266	8.086	7.481	6.326	6.083	5.581	4.942	4.401
430	-	-	8.332	8.262	7.839	6.620	6.123	5.636	5.000	4.449
435	-	-	8.398	8.398	8.198	6.979	6.163	5.690	5.059	4.498

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 22: Circular and Rectangular Hollow Section Columns 90 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	1.790	1.790	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	2.050	2.050	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	2.309	2.305	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
55	2.569	2.445	1.781	1.781	1.781	1.781	1.781	1.781	1.781	1.781
60	2.828	2.585	1.804	1.781	1.781	1.781	1.781	1.781	1.781	1.781
65	3.088	2.725	1.966	1.781	1.781	1.781	1.781	1.781	1.781	1.781
70	3.347	2.864	2.127	1.820	1.781	1.781	1.781	1.781	1.781	1.781
75	3.565	3.004	2.289	1.947	1.860	1.781	1.781	1.781	1.781	1.781
80	3.755	3.144	2.450	2.074	1.975	1.861	1.781	1.781	1.781	1.781
85	3.945	3.283	2.611	2.202	2.090	1.959	1.781	1.781	1.781	1.781
90	4.135	3.423	2.773	2.329	2.206	2.057	1.863	1.781	1.781	1.781
95	4.325	3.560	2.934	2.457	2.321	2.155	1.947	1.781	1.781	1.781
100	4.515	3.696	3.096	2.584	2.436	2.253	2.032	1.827	1.781	1.781
105	4.705	3.832	3.257	2.712	2.552	2.351	2.116	1.913	1.781	1.781
110	4.895	3.969	3.419	2.839	2.667	2.450	2.201	1.998	1.781	1.781
115	4.996	4.105	3.532	2.967	2.782	2.548	2.285	2.083	1.825	1.781
120	5.098	4.241	3.634	3.094	2.897	2.646	2.370	2.169	1.912	1.781
125	5.199	4.377	3.736	3.222	3.013	2.744	2.454	2.254	1.998	1.781
130	5.300	4.514	3.837	3.349	3.128	2.842	2.539	2.340	2.084	1.781
135	5.401	4.650	3.939	3.476	3.243	2.940	2.623	2.425	2.171	1.781
140	5.503	4.786	4.041	3.603	3.359	3.039	2.708	2.511	2.257	1.781
145	5.604	4.925	4.142	3.730	3.479	3.137	2.792	2.596	2.344	1.781
150	5.705	5.075	4.244	3.856	3.621	3.235	2.877	2.682	2.430	1.781
155	5.806	5.225	4.346	3.983	3.762	3.333	2.961	2.767	2.517	1.781
160	5.908	5.374	4.448	4.110	3.904	3.431	3.046	2.853	2.603	1.781
165	6.009	5.524	4.549	4.236	4.046	3.599	3.130	2.938	2.690	1.781
170	6.110	5.674	4.651	4.363	4.187	3.784	3.214	3.024	2.776	1.781
175	6.211	5.824	4.753	4.490	4.329	3.969	3.299	3.109	2.863	1.781
180	6.313	5.974	4.854	4.616	4.470	4.154	3.383	3.195	2.949	1.781
185	6.620	6.123	5.100	4.743	4.612	4.340	3.507	3.280	3.036	1.781
190	6.979	6.273	5.443	4.870	4.753	4.525	3.784	3.366	3.122	1.781
195	7.337	6.443	5.785	5.156	4.895	4.710	4.062	3.451	3.209	1.781
200	7.696	6.627	6.128	5.483	5.222	4.895	4.340	3.740	3.295	1.781
205	8.054	6.810	6.383	5.810	5.549	5.070	4.617	4.029	3.382	1.781
210	8.413	6.994	6.508	6.137	5.875	5.246	4.895	4.317	3.520	1.781
215	-	7.177	6.634	6.364	6.202	5.421	4.965	4.606	3.864	1.781
220	-	7.361	6.759	6.440	6.375	5.596	5.035	4.895	4.207	1.781
225	-	7.544	6.884	6.517	6.445	5.772	5.104	4.934	4.551	2.089
230	-	7.728	7.009	6.593	6.515	5.947	5.174	4.973	4.895	2.543
235	-	7.911	7.135	6.670	6.584	6.123	5.244	5.012	4.929	2.997
240	-	8.094	7.260	6.747	6.654	6.298	5.314	5.051	4.963	3.451
245	-	8.278	7.385	6.823	6.724	6.390	5.384	5.090	4.998	3.511
250	-	8.461	7.510	6.900	6.794	6.462	5.453	5.129	5.032	3.571
255	-	8.645	7.635	6.976	6.864	6.534	5.523	5.169	5.066	3.632
260	-	-	7.761	7.053	6.933	6.606	5.593	5.208	5.100	3.692
265	-	-	7.886	7.130	7.003	6.677	5.663	5.247	5.135	3.752
270	-	-	8.011	7.206	7.073	6.749	5.733	5.286	5.169	3.812
275	-	-	8.136	7.283	7.143	6.821	5.802	5.325	5.203	3.872
280	-	-	8.262	7.359	7.213	6.892	5.872	5.364	5.237	3.932
285	-	-	8.387	7.436	7.283	6.964	5.942	5.403	5.272	3.993
290	-	-	8.512	7.513	7.352	7.036	6.012	5.442	5.306	4.053
295	-	-	8.637	7.589	7.422	7.108	6.082	5.481	5.340	4.113
300	-	-	-	7.666	7.492	7.179	6.152	5.520	5.374	4.173
305	-	-	-	7.742	7.562	7.251	6.221	5.559	5.409	4.233
310	-	-	-	7.819	7.632	7.323	6.291	5.598	5.443	4.293
315	-	-	-	7.896	7.702	7.395	6.375	5.637	5.477	4.354

Tabulated values continued overleaf

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CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 22: Circular and Rectangular Hollow Section Columns 90 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	-	-	-	7.972	7.771	7.466	6.478	5.677	5.511	4.414
325	-	-	-	8.049	7.841	7.538	6.582	5.716	5.546	4.474
330	-	-	-	8.125	7.911	7.610	6.686	5.755	5.580	4.534
335	-	-	-	8.202	7.981	7.681	6.790	5.794	5.614	4.594
340	-	-	-	8.279	8.051	7.753	6.894	5.833	5.648	4.654
345	-	-	-	8.355	8.120	7.825	6.997	5.872	5.682	4.715
350	-	-	-	8.432	8.190	7.897	7.101	5.911	5.717	4.775
355	-	-	-	8.508	8.260	7.968	7.205	5.950	5.751	4.835
360	-	-	-	8.585	8.330	8.040	7.309	5.989	5.785	4.895
365	-	-	-	8.662	8.400	8.112	7.413	6.028	5.819	4.952
370	-	-	-	-	8.470	8.184	7.517	6.067	5.854	5.009
375	-	-	-	-	8.539	8.255	7.620	6.106	5.888	5.066
380	-	-	-	-	8.609	8.327	7.724	6.145	5.922	5.123
385	-	-	-	-	8.679	8.399	7.828	6.185	5.956	5.180
390	-	-	-	-	-	8.470	7.932	6.224	5.991	5.237
395	-	-	-	-	-	8.542	8.036	6.263	6.025	5.294
400	-	-	-	-	-	8.614	8.139	6.302	6.059	5.352
405	-	-	-	-	-	8.686	8.243	6.405	6.093	5.409
410	-	-	-	-	-	-	8.347	6.763	6.128	5.466
415	-	-	-	-	-	-	8.451	7.122	6.162	5.523
420	-	-	-	-	-	-	8.555	7.481	6.196	5.580
425	-	-	-	-	-	-	8.658	7.839	6.230	5.637
430	-	-	-	-	-	-	-	8.198	6.265	5.694
435	-	-	-	-	-	-	-	8.557	6.299	5.751

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CARBOLINE COMPANY

Firefilm A4

Table 23: Circular and Rectangular Hollow Section Columns 105 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	4.406	2.966	2.169	1.781	1.781	1.781	1.781	1.781	1.781	1.781
45	4.406	3.047	2.311	1.781	1.781	1.781	1.781	1.781	1.781	1.781
50	4.469	3.128	2.454	1.907	1.781	1.781	1.781	1.781	1.781	1.781
55	4.602	3.209	2.596	2.059	1.781	1.781	1.781	1.781	1.781	1.781
60	4.735	3.289	2.739	2.210	1.781	1.781	1.781	1.781	1.781	1.781
65	4.868	3.370	2.881	2.361	1.925	1.781	1.781	1.781	1.781	1.781
70	5.002	3.451	3.024	2.513	2.107	1.935	1.781	1.781	1.781	1.781
75	5.135	3.795	3.166	2.664	2.289	2.093	1.848	1.781	1.781	1.781
80	5.268	4.139	3.309	2.815	2.470	2.251	1.973	1.804	1.781	1.781
85	5.401	4.482	3.451	2.967	2.652	2.409	2.098	1.901	1.781	1.781
90	5.534	4.826	3.657	3.118	2.833	2.567	2.223	1.998	1.790	1.781
95	5.667	4.989	3.864	3.269	3.015	2.725	2.349	2.095	1.877	1.781
100	5.800	5.107	4.070	3.421	3.197	2.882	2.474	2.192	1.963	1.781
105	5.934	5.225	4.276	3.562	3.378	3.040	2.599	2.289	2.050	1.781
110	6.067	5.343	4.482	3.701	3.517	3.198	2.725	2.385	2.136	1.823
115	6.200	5.461	4.689	3.840	3.626	3.356	2.850	2.482	2.223	1.910
120	6.333	5.579	4.895	3.979	3.735	3.495	2.975	2.579	2.309	1.998
125	6.558	5.697	5.009	4.117	3.845	3.604	3.100	2.676	2.396	2.086
130	6.784	5.814	5.123	4.256	3.954	3.714	3.226	2.773	2.482	2.173
135	7.009	5.932	5.237	4.395	4.064	3.823	3.351	2.870	2.569	2.261
140	7.235	6.050	5.352	4.534	4.173	3.932	3.478	2.967	2.655	2.348
145	7.460	6.168	5.466	4.673	4.282	4.042	3.611	3.064	2.742	2.436
150	7.686	6.286	5.580	4.812	4.392	4.151	3.745	3.160	2.828	2.523
155	7.911	6.522	5.694	4.969	4.501	4.261	3.879	3.257	2.915	2.611
160	8.136	6.838	5.808	5.153	4.611	4.370	4.013	3.354	3.001	2.698
165	8.362	7.154	5.922	5.337	4.720	4.479	4.146	3.451	3.088	2.786
170	8.587	7.469	6.036	5.522	4.829	4.589	4.280	3.636	3.174	2.873
175	-	7.785	6.150	5.706	5.020	4.698	4.414	3.821	3.261	2.961
180	-	8.100	6.265	5.891	5.333	4.807	4.547	4.006	3.347	3.048
185	-	8.416	6.530	6.075	5.645	4.975	4.681	4.192	3.434	3.136
190	-	-	7.023	6.259	5.958	5.374	4.815	4.377	3.657	3.223
195	-	-	7.517	6.419	6.270	5.774	5.046	4.562	3.915	3.311
200	-	-	8.010	6.563	6.438	6.173	5.425	4.747	4.173	3.398
205	-	-	8.503	6.706	6.570	6.402	5.803	4.940	4.431	3.511
210	-	-	-	6.849	6.701	6.516	6.182	5.165	4.689	3.662
215	-	-	-	6.993	6.833	6.630	6.388	5.389	4.910	3.812
220	-	-	-	7.136	6.964	6.745	6.480	5.614	4.983	3.962
225	-	-	-	7.280	7.096	6.859	6.572	5.839	5.056	4.113
230	-	-	-	7.423	7.227	6.973	6.663	6.063	5.130	4.263
235	-	-	-	7.567	7.359	7.088	6.755	6.288	5.203	4.414
240	-	-	-	7.710	7.490	7.202	6.847	6.397	5.277	4.564
245	-	-	-	7.854	7.622	7.316	6.939	6.476	5.350	4.715
250	-	-	-	7.997	7.753	7.431	7.030	6.556	5.423	4.865
255	-	-	-	8.141	7.885	7.545	7.122	6.636	5.497	4.933
260	-	-	-	8.284	8.016	7.659	7.214	6.716	5.570	4.980
265	-	-	-	8.427	8.148	7.774	7.305	6.795	5.643	5.027
270	-	-	-	8.571	8.279	7.888	7.397	6.875	5.717	5.074
275	-	-	-	-	8.411	8.002	7.489	6.955	5.790	5.121
280	-	-	-	-	8.542	8.117	7.581	7.034	5.863	5.168
285	-	-	-	-	8.674	8.231	7.672	7.114	5.937	5.215
290	-	-	-	-	-	8.346	7.764	7.194	6.010	5.262
295	-	-	-	-	-	8.460	7.856	7.273	6.084	5.309
300	-	-	-	-	-	8.574	7.948	7.353	6.157	5.356
305	-	-	-	-	-	8.689	8.039	7.433	6.230	5.403
310	-	-	-	-	-	-	8.131	7.513	6.304	5.450
315	-	-	-	-	-	-	8.223	7.592	6.401	5.497

Tabulated values continued overleaf

CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 23: Circular and Rectangular Hollow Section Columns 105 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	-	-	-	-	-	-	8.315	7.672	6.513	5.544
325	-	-	-	-	-	-	8.406	7.752	6.626	5.591
330	-	-	-	-	-	-	8.498	7.831	6.739	5.637
335	-	-	-	-	-	-	8.590	7.911	6.851	5.684
340	-	-	-	-	-	-	8.682	7.991	6.964	5.731
345	-	-	-	-	-	-	-	8.070	7.077	5.778
350	-	-	-	-	-	-	-	8.150	7.190	5.825
355	-	-	-	-	-	-	-	8.230	7.302	5.872
360	-	-	-	-	-	-	-	8.309	7.415	5.919
365	-	-	-	-	-	-	-	8.389	7.528	5.966
370	-	-	-	-	-	-	-	8.469	7.640	6.013
375	-	-	-	-	-	-	-	8.549	7.753	6.060
380	-	-	-	-	-	-	-	8.628	7.866	6.107
385	-	-	-	-	-	-	-	8.708	7.979	6.154
390	-	-	-	-	-	-	-	-	8.091	6.201
395	-	-	-	-	-	-	-	-	8.204	6.248
400	-	-	-	-	-	-	-	-	8.317	6.295
405	-	-	-	-	-	-	-	-	8.429	6.446
410	-	-	-	-	-	-	-	-	8.542	7.009
415	-	-	-	-	-	-	-	-	8.655	7.573
420	-	-	-	-	-	-	-	-	-	8.136
425	-	-	-	-	-	-	-	-	-	8.700

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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CARBOLINE COMPANY

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Table 24: Circular and Rectangular Hollow Section Columns 120 minutes										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
40	5.700	3.961	3.030	2.393	2.153	1.813	1.781	1.781	1.781	1.781
45	5.700	4.173	3.103	2.525	2.297	1.967	1.781	1.781	1.781	1.781
50	5.819	4.385	3.175	2.658	2.441	2.122	1.781	1.781	1.781	1.781
55	6.003	4.598	3.248	2.790	2.585	2.276	1.781	1.781	1.781	1.781
60	6.186	4.810	3.320	2.922	2.730	2.431	1.781	1.781	1.781	1.781
65	6.370	4.993	3.393	3.054	2.874	2.585	1.849	1.781	1.781	1.781
70	6.553	5.156	3.582	3.187	3.018	2.740	2.035	1.790	1.781	1.781
75	6.737	5.320	4.239	3.319	3.162	2.895	2.222	1.939	1.781	1.781
80	6.920	5.483	4.895	3.451	3.307	3.049	2.408	2.087	1.837	1.781
85	7.104	5.647	5.031	3.779	3.451	3.204	2.594	2.235	1.952	1.781
90	7.287	5.810	5.166	4.107	3.718	3.358	2.780	2.383	2.067	1.821
95	7.471	5.974	5.302	4.436	3.986	3.531	2.967	2.532	2.183	1.909
100	7.654	6.137	5.438	4.764	4.253	3.732	3.153	2.680	2.298	1.998
105	7.838	6.300	5.573	4.967	4.521	3.932	3.339	2.828	2.413	2.087
110	8.021	6.567	5.709	5.087	4.788	4.133	3.493	2.977	2.528	2.175
115	8.205	6.859	5.845	5.207	4.965	4.333	3.600	3.125	2.644	2.264
120	8.388	7.151	5.980	5.326	5.081	4.534	3.706	3.273	2.759	2.352
125	8.572	7.443	6.116	5.446	5.197	4.735	3.812	3.421	2.874	2.441
130	-	7.736	6.252	5.566	5.312	4.921	3.918	3.541	2.990	2.530
135	-	8.028	6.454	5.686	5.428	5.052	4.024	3.654	3.105	2.618
140	-	8.320	6.758	5.806	5.544	5.183	4.131	3.767	3.220	2.707
145	-	8.612	7.061	5.926	5.660	5.313	4.237	3.880	3.336	2.795
150	-	-	7.365	6.045	5.776	5.444	4.343	3.993	3.451	2.884
155	-	-	7.668	6.165	5.892	5.575	4.449	4.105	3.595	2.973
160	-	-	7.972	6.285	6.008	5.706	4.555	4.218	3.740	3.061
165	-	-	8.275	6.448	6.124	5.836	4.661	4.331	3.884	3.150
170	-	-	8.579	6.641	6.240	5.967	4.768	4.444	4.029	3.238
175	-	-	-	6.833	6.378	6.098	4.874	4.557	4.173	3.327
180	-	-	-	7.026	6.604	6.228	5.233	4.669	4.317	3.416
185	-	-	-	7.218	6.829	6.376	5.656	4.782	4.462	3.600
190	-	-	-	7.411	7.054	6.589	6.079	4.895	4.606	3.849
195	-	-	-	7.603	7.280	6.802	6.399	5.409	4.751	4.098
200	-	-	-	7.796	7.505	7.015	6.563	5.922	4.895	4.347
205	-	-	-	7.988	7.731	7.229	6.728	6.358	5.318	4.596
210	-	-	-	8.180	7.956	7.442	6.892	6.483	5.741	4.845
215	-	-	-	8.373	8.182	7.655	7.056	6.609	6.164	4.986
220	-	-	-	8.565	8.407	7.868	7.221	6.734	6.391	5.100
225	-	-	-	-	8.632	8.082	7.385	6.859	6.489	5.215
230	-	-	-	-	-	8.295	7.549	6.984	6.586	5.329
235	-	-	-	-	-	8.508	7.714	7.109	6.684	5.443
240	-	-	-	-	-	-	7.878	7.235	6.781	5.557
245	-	-	-	-	-	-	8.043	7.360	6.878	5.671
250	-	-	-	-	-	-	8.207	7.485	6.976	5.785
255	-	-	-	-	-	-	8.371	7.610	7.073	5.899
260	-	-	-	-	-	-	8.536	7.736	7.171	6.013
265	-	-	-	-	-	-	8.700	7.861	7.268	6.128
270	-	-	-	-	-	-	-	7.986	7.366	6.242
275	-	-	-	-	-	-	-	8.111	7.463	6.360
280	-	-	-	-	-	-	-	8.237	7.560	6.493
285	-	-	-	-	-	-	-	8.362	7.658	6.627
290	-	-	-	-	-	-	-	8.487	7.755	6.761
295	-	-	-	-	-	-	-	8.612	7.853	6.895
300	-	-	-	-	-	-	-	-	7.950	7.028
305	-	-	-	-	-	-	-	-	8.047	7.162
310	-	-	-	-	-	-	-	-	8.145	7.296
315	-	-	-	-	-	-	-	-	8.242	7.430

Tabulated values continued overleaf

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Valid to: 6th September 2020

CERTIFICATE No CF 5590
CARBOLINE COMPANY

Firefilm A4

Table 24: Circular and Rectangular Hollow Section Columns 120 minutes (continued)										
Section Factor up to m^{-1}	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	520°C	550°C	600°C	650°C	700°C	750°C
320	-	-	-	-	-	-	-	-	8.340	7.563
325	-	-	-	-	-	-	-	-	8.437	7.697
330	-	-	-	-	-	-	-	-	8.534	7.831
335	-	-	-	-	-	-	-	-	8.632	7.964
340	-	-	-	-	-	-	-	-	-	8.098
345	-	-	-	-	-	-	-	-	-	8.232
350	-	-	-	-	-	-	-	-	-	8.366
355	-	-	-	-	-	-	-	-	-	8.499
360	-	-	-	-	-	-	-	-	-	8.633

Table applies to fully exposed circular and rectangular hollow columns with all round protection. Thickness is intumescent only.

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