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Testing, calibrating, advising.



Title:

The fire resistance performance of two horizontal ventilated cavity barrier fire seals, when tested to the general principles of BSEN 1363-1: 2012, using the test method stated in ASFP TGD 19: 2014 (fire resistance tests for 'Open-State' cavity barriers).

WF Report No:

376150 A



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1 Introduction

Two horizontal ventilated cavity barrier fire seals were tested installed within a reinforced AAC floor slab built on top of a 1.5m x 1.5m furnace.

A further two horizontal and four vertical cavity fire barriers were also tested, but are not subject to this report.

2 Specimen verification

The specimens were delivered to Exova Warringtonfire during November 2016. Exova Warringtonfire fabricated the supporting constructions and subsequently installed the cavity barrier sealing systems into the supporting constructions in line with the sponsor's instructions.

2.1 Conditioning

Exova Warringtonfire stored the specimens in climatic conditions approximate to those in normal service.

2.2 Sampling

Exova Warringtonfire was not involved in factory sampling of the components used for the specimens subject to this report.

3 Description of supporting constructions

Supporting construction

The horizontal supporting construction comprised a 1800mm x 1800mm x 150mm thick reinforced AAC floor slab, built on top of a 1.5m x 1.5m furnace aperture. The supporting construction included 1 No. aperture, 104mm wide x 1000mm long x 600mm high labelled as Seal A and 1 No. aperture 113mm wide x 1000mm long x 600mm high labelled as Seal C to accept the cavity closer specimens. Both apertures were lined to one side with 45mm thick x 95mm high softwood timber, which was faced with 9mm thick OSB. Both apertures had Monarperm 500 breather membrane fitted onto the OSB. Seal C only was lined with 9mm OSB on the second face of the aperture.

4 Description of specimens

Details of the specimens are shown overleaf. All measurements are in mm and the descriptions are written viewing the specimens from the unexposed face unless stated otherwise.

4.1 Horizontal ventilated cavity fire sealing systems

Ventilated cavity seal A

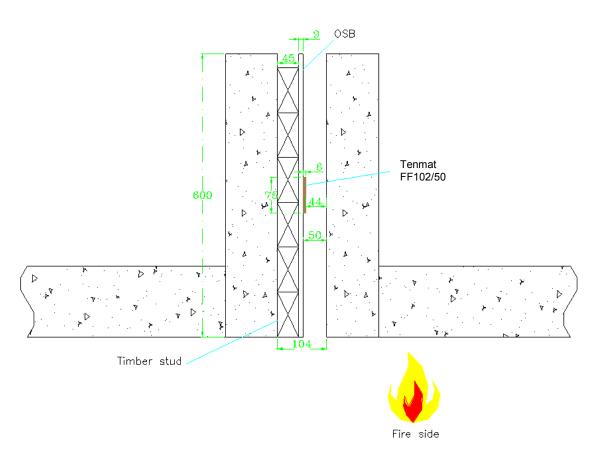
The cavity seal barrier comprised 75mm wide x 6mm thick Tenmat FF102/50 intumescent, aluminium foil wrapped with the join along the front face of the seal along the centre line, fitted at mid height within the cavity, fixed to the timber stud / OSB with 40mm long wood screws fitted at 250mm centres along the centre line of the seal, leaving a 44mm wide free air space. There was a straight splice butt join in the seal 250mm from one end of the seal.

Seal length	Seal width	Seal depth
1000mm	6mm	75mm

Cavity size

Length	Block to Block aperture Width	Block to OSB cavity width	Height
1000mm	104mm	50mm	600mm

Cross section through ventilated cavity barrier fire seal



Ventilated cavity seal C

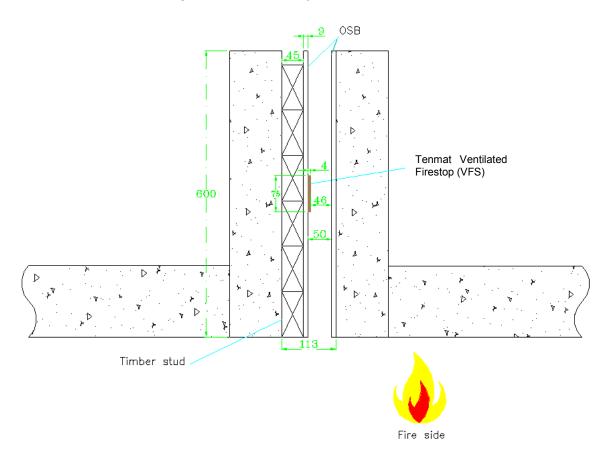
The cavity seal barrier comprised 75mm wide x 4mm thick Tenmat Ventilated Firestop (VFS), polythene encased seal system (full details held in confidence by Exova Warringtonfire), fitted at mid height within the cavity, fixed to the timber stud / OSB with 14mm long steel staples fitted at 250mm centres along the centre line of the seal, leaving a 46mm wide free air space. There was a straight splice butt join in the seal 250mm from one end of the seal.

Seal length	Seal width	Seal depth
1000mm	4mm	75mm

Cavity size

Length	Block to Block aperture Width	OSB to OSB cavity width	Height
1000mm	113mm	50mm	600mm

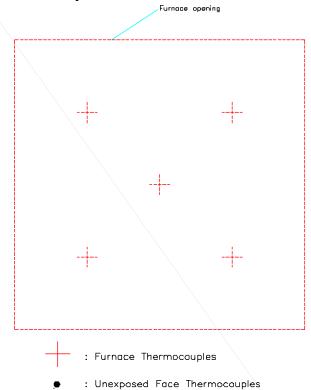
Cross section through ventilated cavity barrier fire seal



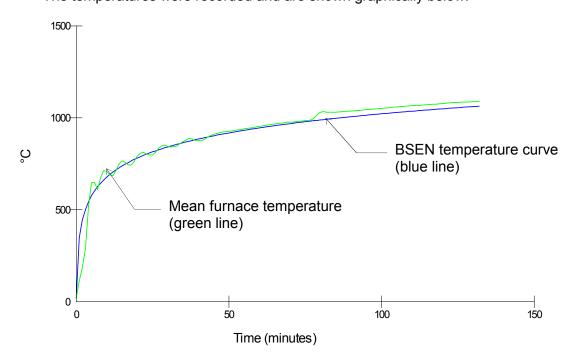
5 Test Conditions

5.1 Furnace temperature

The furnace was controlled to follow the temperature/time relationship specified in BS EN 1363: Part 1: 2012 Section 5.1.1 as closely as possible, using the average of five plate thermometers suitably distributed within the furnace.

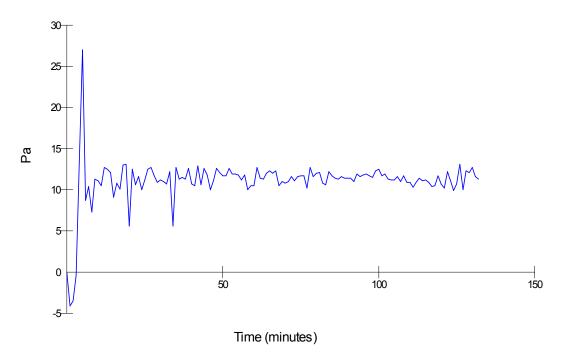


The temperatures were recorded and are shown graphically below:



5.2 Pressure readings

After the first 5 minutes of the test, the furnace pressure was maintained at 11.5 ± 5 Pa and after 10 minutes was maintained at 11.5 ± 3 Pa with respect to atmosphere, equating to 20Pa 100mm below the underside of the cavity seal. The pressure readings were recorded and are shown graphically below:



5.3 Ambient temperature

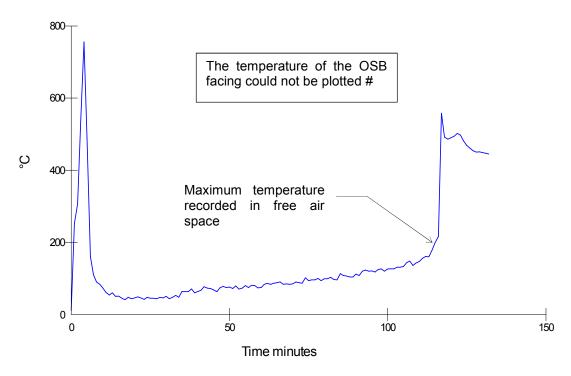
The ambient temperature of the test area at commencement of the test was 10°C.

5.4 Unexposed face thermocouple positions and test equipment

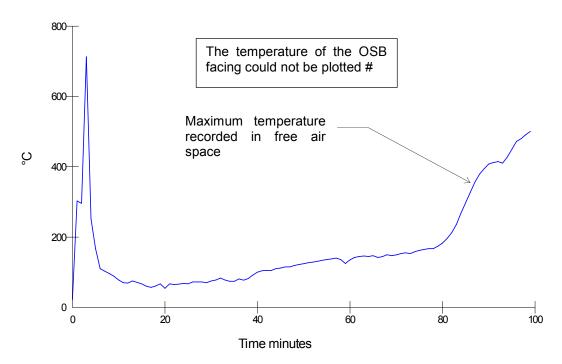
- 5.4.1 The temperature of the unexposed face of each specimen was monitored by means of thermocouples positioned in accordance with the test standard to determine the maximum unexposed face temperature rise.
- 5.4.2 A roving thermocouple was available to monitor any positions suspected of being at a greater temperature than indicated by fixed position thermocouples.
- 5.4.3 The thermocouple positions are shown on each specimen are tabulated in section 5.6.
- 5.4.4 The temperatures recorded have been tabulated in the Appendix
- 5.4.5 Cotton pads were available to assess integrity of the specimens.

5.5 Unexposed face temperatures

Ventilated cavity barrier fire seal A



Ventilated cavity barrier fire seal C



Due to the nature of the specimens under evaluation, the thermocouples could not be adequetly fixed to the OSB facing after construction, and a roving thermocouple could not be employed without the danger of possible mechanical damage being caused to the test specimen.

5.6 Thermocouple positions

The temperature of the unexposed face was monitored by means of the following thermocouples.

Thermocouple Number	Type (location)					
1	Furnace					
2	Furnace					
3	Furnace					
4	Furnace					
5	Furnace					
6	Laboratory ambient					
	Cavity seal A					
10	In free air space, 25mm above the cavity fire seal, $\frac{1}{4}$ from the end of the aperture					
11	In free air space, 25mm above the cavity fire seal, $\frac{1}{2}$ from the end of the aperture					
12	In free air space, 25mm above the cavity fire seal, 3/4 from the end of the aperture					
13	On OSB 25mm above cavity fire seal, ½ from the end of the seal					
14	On OSB 25mm above cavity fire seal, ½ from the end of the seal					
15	On OSB 25mm above cavity fire seal, ¾ from the end of the seal					
	Cavity seal C					
25	In free air space, 25mm above the cavity fire seal, $\frac{1}{4}$ from the end of the aperture					
26	In free air space, 25mm above the cavity fire seal, $\frac{1}{2}$ from the end of the aperture					
27	In free air space, 25mm above the cavity fire seal, 3/4 from the end of the aperture					
28	On OSB 25mm above cavity fire seal, 1/4 from the end of the seal					
29	On OSB 25mm above cavity fire seal, ½ from the end of the seal					
30	On OSB 25mm above cavity fire seal, 3/4 from the end of the seal					

The temperatures recorded have been tabulated in the Appendix.

6 Observations

All comments refer to the unexposed face unless stated otherwise.

Time	Comments
(minutes) 00.00	Test started.
00.43	Seal C, damp proofing liner beginning to melt.
04.19	Seal C, has reacted and sealed off the void.
05.00	Seal A was noted to have already sealed off the void.
07.04	Seal C, there is smoke issuing from the perimeter of the sealed void.
07.30	Both seals, there is discoloration on the supporting construction above the sealed void.
12.58	Seal A, there is smoke issuing from the perimeter of the sealed void.
23.12	Seal A, there is further discoloration along the supporting construction above the sealed void.
33.58	Seal C, there is an increase of smoke issuing at the perimeter of the sealed void.
67.32	Seal C, there is an increase of smoke issuing at the perimeter of the sealed void.
79.51	Seal C, there is an increase of smoke issuing at the perimeter of the sealed void.
80.00	Seal A, there is an increase of smoke issuing at the perimeter of the sealed void.
92.32	Seal C, there is glow at the perimeter of the sealed void.
100.10	Seal C there is a further glow at the perimeter of the sealed void.
105.27	No visual change recorded.
115.19	Seal A, there is glow at the perimeter of the sealed void.
117.32	Seal A there is continuous flaming at the perimeter of the sealed void, thereby constituting to integrity failure .
120.26	Seal C, there is continuous flaming at the perimeter of the sealed void, thereby constituting to integrity failure .
132.00	Test terminated.

7 Expression of results

Horizontal ventilated cavity barrier fire seals overall performance

Specimen	Integ	rity (minutes)	Insulation (mins)	'Air gap' Insulation (mins)
·	Cotton pad	Continuous flaming	Fixed thermocouples	Suspended thermocouples
Seal A	*	117 (one hundred and seventeen) minutes	**	108 (one hundred and eight) minutes #
Seal C	*	120 (one hundred and twenty) minutes	**	80 (eighty) minutes #

^{*} No failure of test criteria at termination of the test at 132 minutes

^{**} Due to the nature of the specimens under evaluation, the thermocouples could not be adequetly fixed to the OSB facing after construction, and a roving thermocouple could not be employed without the danger of possible mechanical damage being caused to the test specimen

[#] The initial spike in temperature rise in the free air space exceeding 180°C above ambient is discounted until the effective closure of the cavity barrier and the furnace and temperature and pressure conditions are achieved

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedures outlined in EN 1363-1, using the test method stated in ASFP TGD 19: 2014 (fire resistance tests for 'Open-State' cavity barriers).

Any significant deviation with respect to size, construction details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

The results only relate to the behaviour of the element of construction under the particular conditions of test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires.

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. Exova Warringtonfire will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result. This test was not conducted under the requirements of UKAS accreditation.

	Written and checked by:	Authorised by:			
Signature:	AdriBallo	Bempell			
Name:	Ashley Babb	Callum Sempill			
Title:	Lead Technical Officer	Lead Technical Officer			
Date of issue:	27 January 2017	27 January 2017			

9 Photographs

Unexposed face at start of test



After 15 minutes



After 30 minutes



After 45 minutes



Appendix – raw test data

Time		, .pp	Ciluix -	- iaw t		-							
0 11 - 11 10 10 9 10 23 11 10 10 9 1 247 - 252 70 78 59 258 23 303 240 89 157 2 280 - 367 99 118 84 275 23 296 301 115 230 3 609 - 542 475 303 208 171 546 713 283 289 402 4 744 - 756 781 757 687 126 16 252 202 301 408 5 447 - 161 260 309 305 84 20 110 144 251 202 6 167 - 161 260 309 305 84 20 110 144 251 29 78 150 181	Time												
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27 40 - 44 58 51 60 72 13 48 172 139 94 28 43 - 47 55 53 61 72 17 52 157 139 95 29 45 - 46 55 53 60 70 20 54 157 142 98 30 46 - 50 54 52 56 75 22 56 175 141 100 31 51 - 44 56 52 54 78 26 49 178 142 100 32 47 - 48 56 54 55 83 27 55 170 145 98 33 50 - 53 56 53 57 78 27 50 164 145 100 34 51 - 48 57 54 50 74 27 48 130 144 100 35 55 - 64 59 53 50 74 28 55 131 146 105 36	25	47	-	45	54	51	65	67	10	51	167	140	93
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33 50 - 53 56 53 57 78 27 50 164 145 100 34 51 - 48 57 54 50 74 27 48 130 144 100 35 55 - 64 59 53 50 74 28 55 131 146 102 36 53 - 63 58 52 50 81 29 52 142 146 105 37 59 - 64 61 52 50 77 29 53 159 145 109 38 58 - 71 60 53 51 82 29 54 159 150 111	31	51	-	44	56	52	54	78	26	49	178	142	100
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35 55 - 64 59 53 50 74 28 55 131 146 102 36 53 - 63 58 52 50 81 29 52 142 146 105 37 59 - 64 61 52 50 77 29 53 159 145 109 38 58 - 71 60 53 51 82 29 54 159 150 111	33	50	-	53	56	53	57	78	27	50	164	145	100
36 53 - 63 58 52 50 81 29 52 142 146 105 37 59 - 64 61 52 50 77 29 53 159 145 109 38 58 - 71 60 53 51 82 29 54 159 150 111	34	51	-	48	57	54	50	74	27	48	130	144	100
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30 30 71 00 33 31 02 23 34 133 130 111	37	59	-	64	61	52	50	77	29	53	159	145	109
39 60 - 60 61 55 50 92 30 68 159 154 114	38	58	-	71	60	53	51	82	29	54	159	150	111
	39	60	-	60	61	55	50	92	30	68	159	154	114

10	Time	Chan	-	Chan									
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Heat	min	°C	-	°C									
42 59 - 77 61 54 52 105 32 70 192 166 119 43 555 - 73 59 56 52 105 32 68 184 173 121 44 62 - 72 59 57 51 110 32 61 184 179 121 45 61 - 68 61 58 53 112 32 69 197 186 122 46 63 - 63 63 59 51 115 33 67 192 194 195 124 48 55 - 78 61 59 56 119 33 59 194 199 126 49 61 - 75 61 61 53 122 36 58 203 203 127 50 62	40	56	-	64	61	55	49	100	31	57	186	155	116
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48 55 - 78 61 59 56 119 33 59 194 199 126 49 61 - 75 61 61 53 122 36 58 203 203 125 50 62 - 76 63 61 53 124 35 61 197 207 125 51 67 - 72 64 62 50 127 37 67 196 209 127 52 68 - 79 65 61 52 131 35 56 202 217 127 53 67 - 70 67 62 52 131 35 56 120 217 127 54 70 - 73 67 62 52 131 35 51 214 222 125 56 68 -	46	63	-	63	63	59	51	115	33	67	192	191	122
49 61 - 75 61 61 53 122 36 58 203 203 125 50 62 - 76 63 61 53 124 35 61 197 207 125 51 67 - 72 64 62 50 127 37 67 196 209 127 52 68 - 79 65 61 52 129 36 62 199 214 126 53 67 - 70 67 62 52 134 35 61 204 219 127 54 70 - 73 67 62 52 134 35 61 204 219 127 55 67 - 80 68 63 53 136 35 73 217 224 220 125 54 140 35 <td>47</td> <td>61</td> <td>-</td> <td>74</td> <td>61</td> <td>58</td> <td>54</td> <td>115</td> <td>34</td> <td>62</td> <td>194</td> <td>195</td> <td>124</td>	47	61	-	74	61	58	54	115	34	62	194	195	124
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54 70 7 73 67 62 52 134 35 61 204 219 127 55 67 - 80 68 63 53 136 35 73 214 222 125 56 68 - 75 67 65 53 138 36 73 214 222 125 56 68 - 75 67 65 54 140 35 60 221 228 127 58 66 - 80 67 65 54 136 35 57 224 230 131 59 71 - 74 66 66 56 125 34 64 224 232 130 60 66 - 75 67 66 54 135 35 68 227 234 131 61 70 284	52	68	-	79	65	61	52	129	36	62	199	214	126
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61 70 - 84 66 67 56 142 34 64 232 237 129 62 67 - 86 63 68 57 145 36 70 236 241 132 63 71 - 84 64 68 58 146 33 77 238 244 131 64 74 - 87 69 69 58 145 34 80 242 247 131 65 71 - 88 66 67 58 147 16 65 245 249 130 66 68 - 90 68 69 59 142 17 72 244 251 133 67 72 - 84 68 70 58 150 17 72 249 255 105 68 74 -	59	71	-	74	66	66	56	125	34	64	224	232	130
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67 72 - 84 68 70 58 144 17 89 248 253 105 68 74 - 85 70 70 58 150 17 72 249 255 105 69 74 - 84 70 71 56 147 18 78 255 257 151 70 70 - 85 72 73 58 149 18 83 252 260 155 71 76 - 90 70 72 59 153 18 95 260 263 156 72 75 - 88 73 73 58 155 18 96 267 266 160 73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 -	65	71	-	88	66	67	58	147	16	65	245	249	130
68 74 - 85 70 70 58 150 17 72 249 255 105 69 74 - 84 70 71 56 147 18 78 255 257 151 70 70 - 85 72 73 58 149 18 83 252 260 155 71 76 - 90 70 72 59 153 18 95 260 263 156 72 75 - 88 73 73 58 155 18 96 267 266 160 73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 - 102 72 74 61 158 20 122 277 274 165 75 80 -	66	68	-	90	68	69	59	142	17	72	244	251	133
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70 70 - 85 72 73 58 149 18 83 252 260 155 71 76 - 90 70 72 59 153 18 95 260 263 156 72 75 - 88 73 73 58 155 18 96 267 266 160 73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 - 102 72 74 61 158 20 122 277 274 165 75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 78 76 - <td>68</td> <td>74</td> <td>-</td> <td>85</td> <td>70</td> <td>70</td> <td>58</td> <td>150</td> <td>17</td> <td>72</td> <td>249</td> <td>255</td> <td>105</td>	68	74	-	85	70	70	58	150	17	72	249	255	105
70 70 72 73 50 145 16 33 232 260 153 71 76 - 90 70 72 59 153 18 95 260 263 156 72 75 - 88 73 73 58 155 18 96 267 266 160 73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 - 102 72 74 61 158 20 122 277 274 165 75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 78 76 - 96 72 </td <td>69</td> <td>74</td> <td>-</td> <td>84</td> <td>70</td> <td>71</td> <td>56</td> <td>147</td> <td>18</td> <td>78</td> <td>255</td> <td>257</td> <td>151</td>	69	74	-	84	70	71	56	147	18	78	255	257	151
72 75 - 88 73 73 58 155 18 96 267 266 160 73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 - 102 72 74 61 158 20 122 277 274 165 75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298	70	70	-	85	72	73	58	149	18	83	252	260	155
73 75 - 87 73 75 59 153 19 118 271 269 164 74 73 - 102 72 74 61 158 20 122 277 274 165 75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	71	76	-	90	70	72	59	153	18	95	260	263	156
73 - 102 72 74 61 158 20 122 277 274 165 75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	72	75	-	88	73	73	58	155	18	96	267	266	160
75 80 - 94 73 75 60 162 19 126 282 279 166 76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	73	75	-	87	73	75	59	153	19	118	271	269	164
76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	74	73	-	102	72	74	61	158	20	122	277	274	165
76 77 - 96 72 76 61 165 20 138 293 284 170 77 76 - 96 72 76 60 167 21 146 300 290 171 78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	75	80	-	94	73	75	60	162	19	126	282	279	166
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78 76 - 100 72 76 61 167 21 152 307 292 174 79 72 - 94 71 79 61 174 22 160 316 298 175	77	76	-	96	72	76	60	167	21	146		290	171
79 72 - 94 71 79 61 174 22 160 316 298 175	78	76	-	100		76	61	167	21	152			174
	79	72	-	94		79	61	174	22	160	316	298	175
	80		-	99	70	80	61	183	23	181	333	307	185

	Time	Chan	-	Chan									
81 81	Time	10		12	13		15	25	26	27	28	29	30
82 83 - 103 76 82 60 213 31 201 378 331 185 83 84 - 97 78 83 60 236 33 214 407 347 186 84 84 - 96 79 84 61 269 36 225 434 368 195 85 91 - 113 77 84 64 297 38 255 459 389 200 86 94 - 108 80 86 64 227 38 279 482 409 203 87 98 - 104 83 91 60 379 43 324 525 451 220 88 98 - 104 83 91 60 379 43 324 525 451 220 89 97 <	min	°C	-	°C									
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90 102	88	98	-	104	83	91	60	379	43	324	525	451	220
91 111 - 108 95 95 68 412 67 371 563 486 252 92 103 - 120 92 98 71 415 93 384 575 494 267 93 102 - 123 94 101 73 410 119 405 581 500 284 94 107 - 120 96 101 74 410 126 428 589 507 308 95 109 - 121 95 104 72 408 152 450 597 511 334 96 111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 <t< td=""><td>89</td><td>97</td><td>-</td><td>104</td><td>88</td><td>92</td><td>61</td><td>394</td><td>45</td><td>344</td><td>538</td><td>465</td><td>230</td></t<>	89	97	-	104	88	92	61	394	45	344	538	465	230
92 103 - 120 92 98 71 415 93 384 575 494 267 93 102 - 123 94 101 73 410 119 405 581 500 284 94 107 - 120 96 101 74 410 126 428 589 507 308 95 109 - 121 95 104 72 408 152 450 597 511 334 96 111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99	90	102	-	112	88	94	65	408	47	361	551	477	245
93 102 - 123 94 101 73 410 119 405 581 500 284 94 107 - 120 96 101 74 410 126 428 589 507 308 95 109 - 121 95 104 72 408 152 450 597 511 334 96 1111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520 111 262 - 156 189 301 83 547 338 616 713 654 588 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	91	111	-	108	95	95	68	412	67	371	563	486	252
94 107 - 120 96 101 74 410 126 428 589 507 308 95 109 - 121 95 104 72 408 152 450 597 511 334 96 111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101	92	103	-	120	92	98	71	415	93	384	575	494	267
95 109 - 121 95 104 72 408 152 450 597 511 334 96 111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102	93	102	-	123	94	101	73	410	119	405	581	500	284
96 111 - 118 94 104 71 406 164 472 603 515 366 97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 <td>94</td> <td>107</td> <td>-</td> <td>120</td> <td>96</td> <td>101</td> <td>74</td> <td>410</td> <td>126</td> <td>428</td> <td>589</td> <td>507</td> <td>308</td>	94	107	-	120	96	101	74	410	126	428	589	507	308
97 117 - 125 98 106 68 401 182 480 610 521 391 98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 118 139 75 468 231 556 560 600 497 105<	95	109	-	121	95	104	72	408	152	450	597	511	334
98 119 - 126 101 109 74 398 148 491 617 527 413 99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 10	96	111	-	118	94	104	71	406	164	472	603	515	366
99 116 - 120 100 114 73 410 164 501 625 535 434 100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 502 262 578 688 619 517 1	97	117	-	125	98	106	68	401	182	480	610	521	391
100 118 - 126 100 117 71 418 194 511 630 542 458 101 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517	98	119	-	126	101	109	74	398	148	491	617	527	413
100 110 123 - 127 104 122 75 426 202 521 274 549 474 102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517	99	116	-	120	100	114	73	410	164	501	625	535	434
102 121 - 127 104 128 75 439 224 529 411 564 480 103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517	100	118	-	126	100	117	71	418	194	511	630	542	458
103 131 - 131 111 131 75 455 231 542 559 582 489 104 137 - 131 118 139 75 468 231 556 560 600 497 105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520	101	123	-	127	104	122	75	426	202	521	274	549	474
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105 145 - 133 130 151 77 484 255 570 678 611 513 106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520 110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528	103	131	-	131	111	131	75	455	231	542	559	582	489
106 156 - 144 136 155 77 502 262 578 688 619 517 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520 110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535	104	137	-	131	118	139	75	468	231	556	560	600	497
100 130 144 130 133 77 302 202 378 688 619 317 107 155 - 148 142 164 77 513 266 584 693 624 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520 110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535 113 <t< td=""><td>105</td><td>145</td><td>-</td><td>133</td><td>130</td><td>151</td><td>77</td><td>484</td><td>255</td><td>570</td><td>678</td><td>611</td><td>513</td></t<>	105	145	-	133	130	151	77	484	255	570	678	611	513
107 155 140 142 104 77 513 266 584 537 517 108 171 - 136 149 183 77 522 267 595 701 628 517 109 198 - 143 163 211 78 524 266 603 708 635 520 110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 <td>106</td> <td>156</td> <td>-</td> <td>144</td> <td>136</td> <td>155</td> <td>77</td> <td>502</td> <td>262</td> <td>578</td> <td>688</td> <td>619</td> <td>517</td>	106	156	-	144	136	155	77	502	262	578	688	619	517
109 198 - 143 163 211 78 524 266 603 708 635 520 110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659	107	155	-	148	142	164	77	513	266	584	693	624	517
110 223 - 147 172 251 80 532 281 611 697 648 520 111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	108	171	-	136	149	183	77	522	267	595	701	628	517
111 262 - 156 189 301 83 547 338 616 713 654 528 112 321 - 161 210 414 88 566 553 625 729 671 535 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	109	198	-	143	163	211	78	524	266	603	708	635	520
112 321 - 161 210 414 88 566 553 625 729 671 535 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	110	223	-	147	172	251	80	532	281	611	697	648	520
112 321 161 216 414 36 366 353 623 723 671 533 113 355 - 160 222 477 89 579 787 634 736 681 543 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	111	262	-	156	189	301	83	547	338	616	713	654	528
113 353 166 222 477 63 575 767 634 736 661 548 114 367 - 178 247 490 95 635 - 641 744 686 548 115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	112	321	-	161	210	414	88	566	553	625	729	671	535
115 413 - 199 313 509 104 677 - 651 768 694 559 116 425 - 216 403 515 109 722 - 659 779 696 557	113	355	-	160	222	477	89	579	787	634	736	681	543
115 413 116 425 - 216 403 515 109 722 - 659 779 696 557	114	367	-	178	247	490	95	635	-	641	744	686	548
110 425 210 403 313 103 722 033 773 030 337	115	413	-	199	313	509	104	677	-	651	768	694	559
117 590 - 558 534 548 269 772 - 673 791 709 565	116	425	-	216	403	515	109	722	-	659	779	696	557
	117	590	-	558	534	548	269	772	-	673	791	709	565
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Time	Chan	-	Chan	Chan	Chan	Chan	Chan	-	Chan	Chan	Chan	Chan
Time	10		12	13	14	15	25		27	28	29	30
min	°C	-	°C	°C	°C	°C	°C	-	°C	°C	°C	°C
122	484	=	502	425	444	416	653	-	598	637	632	484
123	479	-	497	437	438	418	621	-	565	593	593	467
124	467	-	481	436	420	413	600	-	544	563	567	454
125	456	=	469	430	406	405	587	-	528	541	549	442
126	447	-	461	425	397	399	581	-	517	526	536	435
127	438	-	454	419	389	393	561	-	510	510	527	426
128	438	-	450	424	384	392	546	-	505	515	522	354
129	440	-	451	430	384	398	538	-	499	510	517	345
130	439	=	449	431	382	400	533	-	493	505	513	337
131	437	-	447	431	383	399	527	-	488	501	509	330
132	437	-	445	430	382	399	524	-	485	448	508	325