

# SOUTHWEST RESEARCH INSTITUTE

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION  
DEPARTMENT OF FIRE TECHNOLOGY  
FAX (210) 522-3377

February 2, 1999

Mr. Ed Golden  
Howred Corporation  
7887 San Felipe Suite 122  
Houston, TX 77063

Subject: SwRI Project No. 01-2305-306a

**FINAL REPORT**

“UL 1709 Fire Testing of Howred GoodTemp Pearlite Insulation”

Dear Mr. Golden:

A performance evaluation of Howred Corporation's GoodTemp, Pearlite insulation was conducted in accordance with Underwriter's Laboratories Standard 1709 "Rapid Rise Fire Tests of Protection Materials for Structural Steel," Sections 7-10. The test conducted is designed to evaluate the performance of a structural fire protection in the insulation of a steel member exposed to a rapid rise furnace environment.

A small-scale test was conducted in accordance with UL 1709, Sections 7-10. The results of the testing indicated that the pearlite material provided was capable of meeting the insulation performance criteria specified in UL 1709, Section 9, for a duration of 74 min 15 sec.

## 1 TEST PROCEDURE

The UL 1709 test exposes a representative column section to a temperature environment simulating a hydrocarbon pool fire. The sample is insulated as in standard practice, and instrumented so that heat transfer through the insulation can be monitored. The performance criteria of the test are that the insulation material shall limit the average internal temperature of the steel to below 1000°F, and limit any single point temperature to below 1200°F. The time period the insulation material can maintain these conditions is reported as the control period.

### 1.1 Sample Description

The program involved the construction of a test sample in accordance with Section 8 of the test standard. The sample was 6 x 6 x 3/4-in. structural tubing, and was capped with 8 x 8 x 1/4-in. steel plate. The column mock-up was 24 in. long, and was instrumented with four thermocouples. Thermocouples

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were placed at the mid-height of the specimen, and were welded to the inner walls of the rectangular section (one thermocouple at the mid-point of each wall, as detailed in UL 1709 Figure 8.1).

The column mock-up was insulated with two layers of 2-in. perlite boards. Each layer was held in place using stainless steel wire. Corner seams were staggered. Insulation was applied to the top and bottom of the column, as well as to each face, in an effort to model one-dimensional heat transfer.

The column section was finished with a stainless steel jacket having a thickness of 0.020 in. The jacket was applied in two pieces, and was fastened using No. 8 screws, 4 in. on center. Stainless steel top and bottom caps were also provided and attached in a similar manner.

## 2 TEST RESULTS

The sample was tested at Southwest Research Institute's (SwRI) Department of Fire Technology on January 15, 1999. The sample was placed in SwRI's small-horizontal furnace. The furnace is fired by three, pre-mixed, natural gas and air burners. The test was started at 1:30 p.m., with Messrs. Ed Golden, Fred Marquez, and H. Watson of Howred Corporation; and Mr. F. Keith Chustz of Exxon present to witness the testing.

Furnace and sample temperatures were monitored at 15-sec intervals for the duration of the test. Complete tabular and graphical data are provided as an attachment.

The average internal surface temperature of the steel column was 1011°F (in excess of the criteria for average surface temperature) at 74 min 30 sec into the test. At this time, the maximum single point temperature was 1111°F (recorded at the west thermocouple location). At 76 min 15 sec, the maximum single point surface temperature was 1206°F at the west thermocouple location (in excess of the 1200°F criteria), and the average internal temperature was 1101°F.

Post test documentation indicated the perlite boards remained intact, and were loosely attached to the column via stainless steel wire. The perlite material had undergone some degree of shrinkage, most evident on the exposed faces of the insulation material. The combined shrinkage of the perlite material and loosening of stainless steel wire, led to some openings at corners of the column. The predominant opening of the northwest seam was consistent with the temperature rise noted on the north and west faces of the test column. Pre- and post test documentary photographs are also provided as attachments to this report.

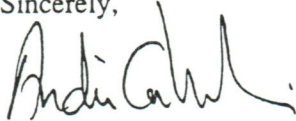
## 3 CONCLUSIONS

In conclusion, a 4-in. perlite system consisting of 2 layers of 2-in. panels, attached with stainless steel wire and encased in a stainless steel jacket was tested in accordance with UL 1709 Sections 7-10. The assembly tested met the requirements of UL 1709, Section 9 for a duration of 74 min 15 sec, after which time the average internal surface temperature was exceeded.

Howred Corporation  
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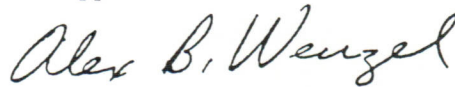
I look forward to working with you in the future in the further evaluation of your products. Should you have any questions or comments concerning the test program, please contact me at (210) 522-3376, or you can reach me by fax at (210) 522-3377.

Sincerely,



André Garabedian  
Research Engineer  
Fire Resistance Section

Approved:



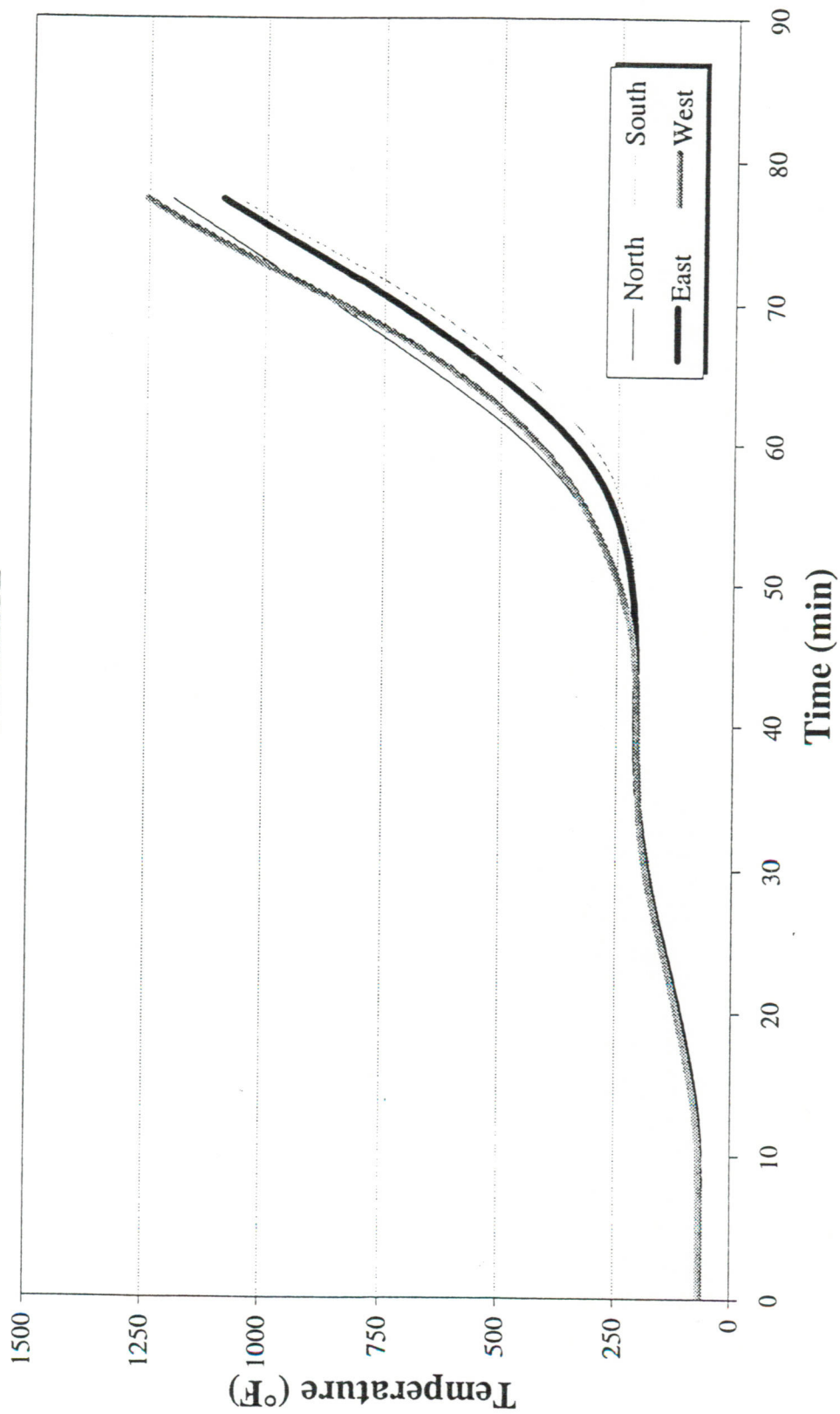
Alex B Wenzel  
Director  
Department of Fire Technology

ASG/llr  
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**ATTACHEMENT A**  
**(Consisting of 17 Pages)**

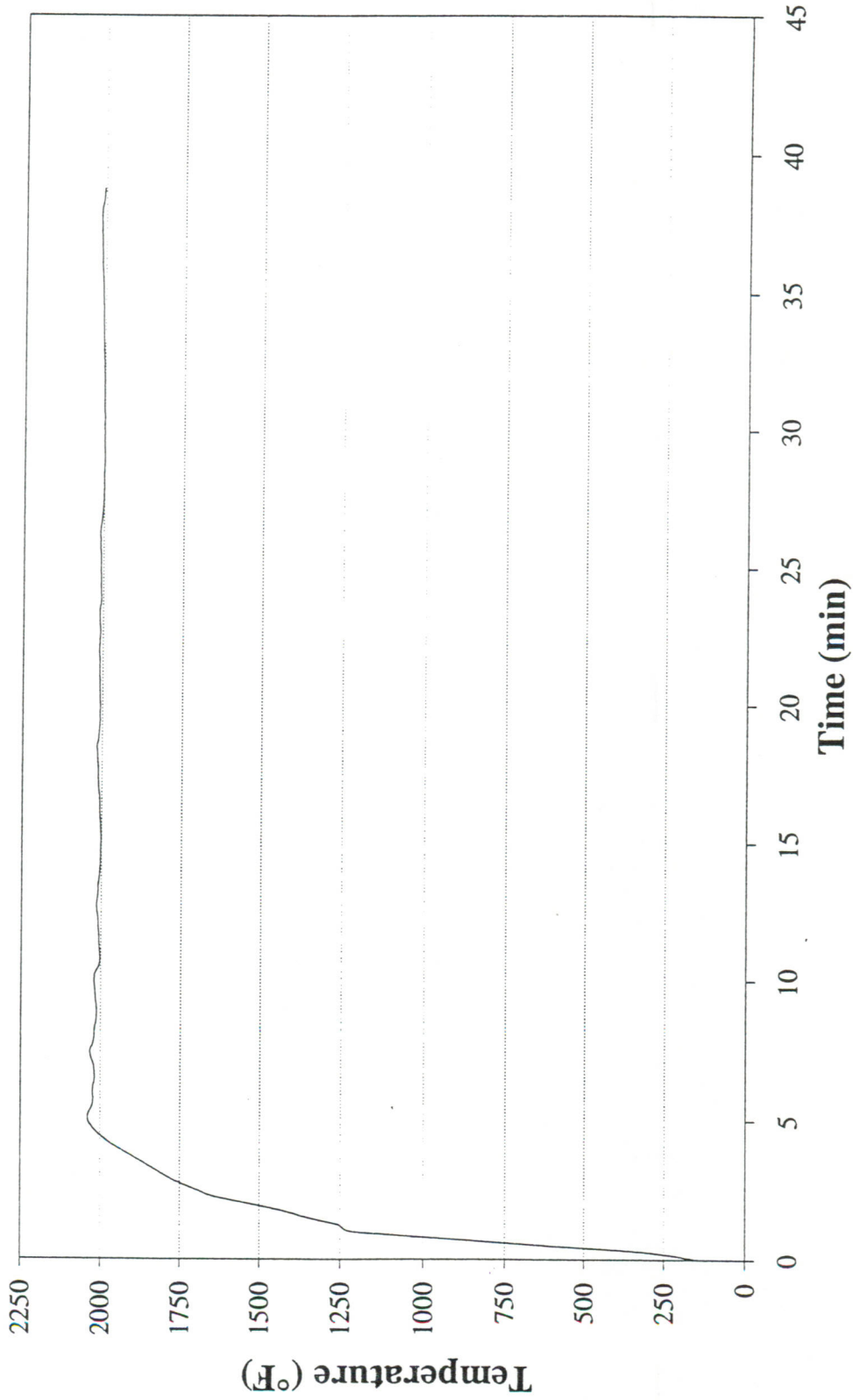
CLIENT: HOWRED CORPORATION  
SwRI PROJECT NO.: 01-2305-306a  
TEST DATE: 15 JANUARY 1999  
FILE ID: 15HOR2.DAT

### SPECIMEN THERMOCOUPLES PEARLITE



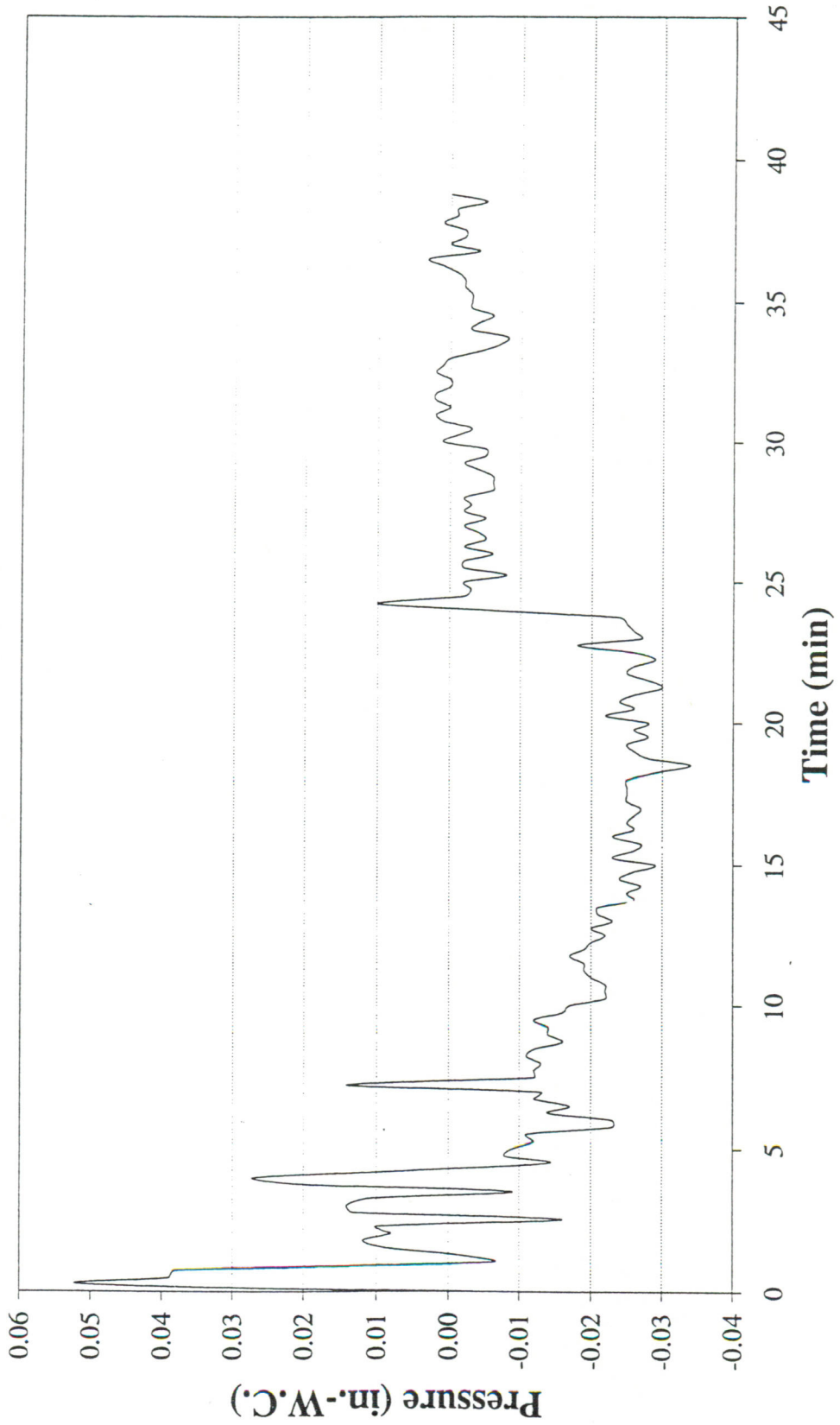
CLIENT: HOWRED CORPORATION  
SwRI PROJECT NO.: 01-2305-306a  
TEST DATE: 15 JANUARY 1999  
FILE ID: 15HOR2.DAT

**FURNACE AVERAGE  
PEARLITE**



CLIENT: HOWRED CORPORATION  
SwRI PROJECT NO.: 01-2305-306a  
TEST DATE: 15 JANUARY 1999  
FILE ID: 15HOR2.DAT

**FURNACE PRESSURE  
PEARLITE**



**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT**

**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>North</b>	<b>South</b>	<b>East</b>	<b>West</b>	<b>Spec. Avg.</b>
0:00	66	66	66	66	66
0:15	66	66	66	66	66
0:30	66	66	66	66	66
0:45	66	66	66	66	66
1:00	66	66	66	66	66
1:15	66	66	66	66	66
1:30	66	66	66	66	66
1:45	66	66	66	66	66
2:00	66	66	66	66	66
2:15	66	66	66	66	66
2:30	66	66	66	66	66
2:45	66	66	66	66	66
3:00	66	66	66	66	66
3:15	66	66	66	66	66
3:30	66	66	66	66	66
3:45	66	66	66	66	66
4:00	66	66	66	66	66
4:15	66	66	66	66	66
4:30	66	66	66	66	66
4:45	66	66	66	66	66
5:00	66	66	66	66	66
5:15	66	66	66	66	66
5:30	66	66	66	66	66
5:45	66	66	66	66	66
6:00	66	66	66	66	66
6:15	66	66	66	66	66
6:30	66	66	66	66	66
6:45	66	66	66	66	66
7:00	66	66	66	66	66
7:15	66	66	66	66	66
7:30	66	66	66	66	66
7:45	66	67	66	66	66
8:00	66	67	66	67	67
8:15	66	67	66	67	67
8:30	67	67	66	67	67
8:45	67	66	67	67	67
9:00	67	67	66	67	67
9:15	67	67	67	67	67
9:30	67	67	67	67	67
9:45	67	67	67	67	67
10:00	67	67	67	67	67
10:15	67	67	67	68	67
10:30	68	68	67	68	68
10:45	68	68	68	69	68
11:00	68	68	68	69	68



**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT

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TEST TYPE: UL 1709 SMALL-SCALE

TIME	North	South	East	West	Spec. Avg.
11:15	68	69	68	70	69
11:30	69	70	69	70	70
11:45	69	70	70	71	70
12:00	70	71	70	72	71
12:15	70	72	71	73	72
12:30	71	73	72	73	72
12:45	71	74	72	74	73
13:00	72	75	73	75	74
13:15	73	76	74	76	75
13:30	73	77	75	77	76
13:45	74	78	76	79	77
14:00	75	80	77	80	78
14:15	76	81	78	81	79
14:30	77	82	80	82	80
14:45	78	83	81	84	82
15:00	79	85	82	85	83
15:15	80	87	83	87	84
15:30	82	88	85	88	86
15:45	83	89	86	90	87
16:00	84	91	87	91	88
16:15	85	92	89	93	90
16:30	87	94	90	94	91
16:45	88	95	92	96	93
17:00	90	97	93	97	94
17:15	91	98	95	99	96
17:30	93	100	96	100	97
17:45	94	101	98	102	99
18:00	96	103	99	104	101
18:15	97	104	101	105	102
18:30	99	106	102	107	104
18:45	101	107	104	109	105
19:00	102	109	106	110	107
19:15	104	111	107	112	109
19:30	106	112	109	114	110
19:45	108	114	111	115	112
20:00	109	115	113	117	114
20:15	111	117	115	119	116
20:30	113	119	116	120	117
20:45	115	120	118	122	119
21:00	117	122	120	124	121
21:15	119	124	122	126	123
21:30	121	125	124	128	125
21:45	123	127	126	129	126
22:00	125	128	128	131	128
22:15	127	130	129	133	130

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
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**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>North</b>	<b>South</b>	<b>East</b>	<b>West</b>	<b>Spec. Avg.</b>
22:30	129	131	131	135	132
22:45	131	133	133	137	134
23:00	134	134	135	139	136
23:15	136	136	137	140	137
23:30	138	137	139	142	139
23:45	140	139	141	144	141
24:00	143	141	143	146	143
24:15	145	142	145	148	145
24:30	147	143	146	150	147
24:45	149	144	148	152	148
25:00	152	146	150	153	150
25:15	154	147	152	155	152
25:30	156	149	154	157	154
25:45	158	150	156	159	156
26:00	161	152	158	161	158
26:15	163	153	160	163	160
26:30	165	155	162	164	162
26:45	167	156	164	166	163
27:00	170	158	165	168	165
27:15	172	159	167	169	167
27:30	174	161	169	171	169
27:45	176	162	171	173	171
28:00	178	164	172	174	172
28:15	180	165	174	176	174
28:30	181	167	176	178	176
28:45	183	168	177	179	177
29:00	185	170	179	181	179
29:15	186	171	180	182	180
29:30	188	172	182	184	182
29:45	190	174	183	185	183
30:00	191	175	184	186	184
30:15	192	177	186	188	186
30:30	194	178	187	189	187
30:45	195	179	188	190	188
31:00	196	181	189	191	189
31:15	197	182	191	192	191
31:30	198	183	192	193	192
31:45	199	185	193	194	193
32:00	199	186	194	195	194
32:15	200	187	195	196	195
32:30	201	188	196	197	196
32:45	201	189	197	198	196
33:00	202	190	198	198	197
33:15	203	191	198	199	198
33:30	203	192	199	200	199

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**TEST DATE: JANUARY 15, 1999  
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TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>North</b>	<b>South</b>	<b>East</b>	<b>West</b>	<b>Spec. Avg.</b>
33:45	203	193	200	200	199
34:00	204	193	201	201	200
34:15	204	194	201	201	200
34:30	205	195	202	202	201
34:45	205	196	202	202	201
35:00	205	197	203	203	202
35:15	205	198	203	203	202
35:30	206	198	204	203	203
35:45	206	199	204	204	203
36:00	206	199	205	204	204
36:15	206	199	205	204	204
36:30	206	200	205	205	204
36:45	206	200	206	205	204
37:00	207	201	206	205	205
37:15	207	201	206	205	205
37:30	207	201	206	205	205
37:45	207	202	207	206	206
38:00	207	202	207	206	206
38:15	207	202	207	206	206
38:30	207	203	207	206	206
38:45	207	203	207	206	206
39:00	207	203	207	206	206
39:15	208	203	207	206	206
39:30	208	203	207	206	206
39:45	208	204	208	206	207
40:00	208	204	208	206	207
40:15	208	204	208	206	207
40:30	208	204	208	206	207
40:45	208	204	208	207	207
41:00	208	204	208	207	207
41:15	208	204	208	207	207
41:30	208	205	208	207	207
41:45	208	205	208	207	207
42:00	208	205	208	207	207
42:15	208	205	208	207	207
42:30	208	205	208	207	207
42:45	208	205	208	208	207
43:00	209	205	208	208	208
43:15	209	205	208	208	208
43:30	209	205	209	209	208
43:45	209	205	209	209	208
44:00	209	206	209	210	209
44:15	210	206	209	211	209
44:30	210	206	209	211	209
44:45	211	206	209	212	210

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
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TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>North</b>	<b>South</b>	<b>East</b>	<b>West</b>	<b>Spec. Avg.</b>
45:00	212	206	209	213	210
45:15	213	206	209	214	211
45:30	214	206	209	214	211
45:45	215	206	210	215	212
46:00	216	206	210	216	212
46:15	217	207	210	217	213
46:30	218	207	210	218	213
46:45	220	207	211	220	215
47:00	222	207	211	221	215
47:15	223	207	211	222	216
47:30	226	207	212	224	217
47:45	228	207	212	226	218
48:00	230	208	213	228	220
48:15	232	208	213	230	221
48:30	234	208	214	232	222
48:45	237	209	214	234	224
49:00	239	209	215	236	225
49:15	242	210	216	238	227
49:30	244	210	217	241	228
49:45	247	211	218	243	230
50:00	250	211	219	246	232
50:15	252	212	220	249	233
50:30	255	213	221	251	235
50:45	258	213	222	254	237
51:00	261	214	223	257	239
51:15	264	215	225	260	241
51:30	267	216	226	263	243
51:45	270	217	227	266	245
52:00	273	218	229	270	248
52:15	277	219	230	273	250
52:30	280	220	232	276	252
52:45	283	221	234	279	254
53:00	287	223	236	283	257
53:15	290	224	238	286	260
53:30	294	226	240	290	263
53:45	298	227	242	294	265
54:00	302	228	244	297	268
54:15	306	230	246	301	271
54:30	310	232	249	305	274
54:45	314	234	251	309	277
55:00	319	236	254	313	281
55:15	323	238	257	317	284
55:30	328	240	260	321	287
55:45	333	242	263	326	291
56:00	338	244	266	330	295

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT

SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE

TIME	North	South	East	West	Spec. Avg.
56:15	343	247	270	335	299
56:30	349	249	273	339	303
56:45	354	252	277	344	307
57:00	360	255	281	349	311
57:15	366	258	285	354	316
57:30	372	261	290	359	321
57:45	379	264	294	364	325
58:00	385	268	299	370	331
58:15	392	271	304	376	336
58:30	399	275	309	381	341
58:45	406	280	314	387	347
59:00	413	284	320	393	353
59:15	420	289	325	399	358
59:30	428	294	331	406	365
59:45	435	299	337	412	371
60:00	443	304	344	419	378
60:15	451	310	350	426	384
60:30	460	316	357	433	392
60:45	468	322	364	440	399
61:00	477	328	371	448	406
61:15	486	335	378	455	414
61:30	495	341	386	463	421
61:45	505	348	393	471	429
62:00	514	355	401	479	437
62:15	524	363	409	487	446
62:30	534	370	417	496	454
62:45	544	378	426	505	463
63:00	554	386	434	514	472
63:15	564	394	443	523	481
63:30	574	402	452	532	490
63:45	584	410	461	542	499
64:00	594	419	470	552	509
64:15	605	428	479	562	519
64:30	615	437	489	572	528
64:45	626	446	498	582	538
65:00	636	455	508	593	548
65:15	647	464	518	604	558
65:30	658	474	528	614	569
65:45	668	484	538	625	579
66:00	679	494	548	637	590
66:15	690	503	558	648	600
66:30	700	513	568	660	610
66:45	711	524	579	671	621
67:00	722	534	589	683	632
67:15	733	544	600	695	643

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
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<b>TIME</b>	<b>North</b>	<b>South</b>	<b>East</b>	<b>West</b>	<b>Spec. Avg.</b>
67:30	744	555	611	708	655
67:45	755	566	622	720	666
68:00	766	577	633	733	677
68:15	777	588	644	746	689
68:30	788	599	655	760	701
68:45	800	610	666	773	712
69:00	811	622	677	787	724
69:15	822	634	689	801	737
69:30	834	645	701	815	749
69:45	846	657	712	829	761
70:00	857	670	724	844	774
70:15	869	682	736	858	786
70:30	881	694	748	873	799
70:45	893	707	760	888	812
71:00	905	720	772	903	825
71:15	917	732	784	917	838
71:30	929	745	797	932	851
71:45	941	758	809	947	864
72:00	953	772	822	962	877
72:15	965	785	834	978	891
72:30	977	798	847	993	904
72:45	989	812	860	1008	917
73:00	1001	825	873	1023	931
73:15	1013	839	886	1038	944
73:30	1025	853	898	1053	957
73:45	1037	866	911	1067	970
74:00	1049	880	924	1082	984
74:15	1061	894	937	1097	997
74:30	1072	908	951	1111	1011
74:45	1084	922	964	1125	1024
75:00	1096	936	977	1139	1037
75:15	1108	950	990	1153	1050
75:30	1119	963	1003	1167	1063
75:45	1131	977	1016	1180	1076
76:00	1143	991	1028	1193	1089
76:15	1154	1004	1041	1206	1101
76:30	1166	1018	1054	1219	1114
76:45	1177	1031	1066	1231	1126
77:00	1189	1044	1079	1243	1139
77:15	1200	1057	1091	1254	1151

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT**

**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>FP 01</b>	<b>FP 02</b>	<b>FP 03</b>	<b>FP 04</b>	<b>Furn. Avg.</b>
0:00	136	151	145	147	145
0:15	308	337	244	314	301
0:30	676	689	492	644	625
0:45	989	1007	818	946	940
1:00	1266	1268	1156	1193	1221
1:15	1297	1282	1224	1221	1256
1:30	1394	1378	1318	1312	1351
1:45	1468	1450	1411	1392	1430
2:00	1582	1553	1494	1482	1528
2:15	1678	1684	1600	1602	1641
2:30	1728	1747	1660	1666	1700
2:45	1763	1797	1716	1735	1753
3:00	1814	1833	1758	1778	1796
3:15	1857	1861	1798	1818	1834
3:30	1897	1891	1835	1853	1869
3:45	1927	1927	1879	1893	1907
4:00	1968	1965	1914	1933	1945
4:15	1998	1996	1952	1967	1978
4:30	2045	2019	1974	1987	2006
4:45	2075	2034	1993	2005	2027
5:00	2090	2042	2009	2016	2039
5:15	2089	2034	2011	2015	2037
5:30	2075	2022	2004	2006	2027
5:45	2069	2017	2003	2003	2023
6:00	2070	2018	2006	2004	2025
6:15	2069	2014	2004	2003	2023
6:30	2063	2010	1999	2000	2018
6:45	2063	2013	2000	2002	2020
7:00	2066	2014	2003	2005	2022
7:15	2074	2022	2011	2014	2030
7:30	2076	2025	2017	2017	2034
7:45	2066	2018	2007	2008	2025
8:00	2063	2013	2002	2004	2021
8:15	2059	2013	2001	2004	2019
8:30	2057	2006	1997	1998	2015
8:45	2054	2005	1996	1998	2013
9:00	2054	2005	1995	1997	2013
9:15	2056	2009	1996	2001	2016
9:30	2057	2011	1999	2002	2017
9:45	2059	2013	2001	2004	2019
10:00	2061	2014	2003	2006	2021
10:15	2059	2010	2002	2004	2019
10:30	2047	2000	1991	1991	2007
10:45	2042	1997	1986	1988	2003
11:00	2043	1996	1987	1989	2004

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT

SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE

TIME	FP 01	FP 02	FP 03	FP 04	Furn. Avg.
11:15	2044	2000	1987	1991	2006
11:30	2045	2000	1989	1992	2007
11:45	2048	2000	1990	1993	2008
12:00	2049	2003	1991	1995	2010
12:15	2050	2005	1992	1996	2011
12:30	2053	2007	1995	1998	2013
12:45	2054	2009	1996	2000	2015
13:00	2052	2005	1995	1998	2013
13:15	2050	2004	1992	1996	2011
13:30	2049	2004	1993	1996	2011
13:45	2045	2001	1989	1992	2007
14:00	2043	2000	1986	1990	2005
14:15	2043	2000	1985	1989	2004
14:30	2041	1999	1985	1989	2004
14:45	2041	1998	1984	1989	2003
15:00	2041	1997	1985	1988	2003
15:15	2040	1998	1984	1989	2003
15:30	2040	1998	1985	1990	2003
15:45	2042	1998	1986	1990	2004
16:00	2044	2001	1987	1991	2006
16:15	2044	2002	1988	1992	2007
16:30	2044	2000	1989	1993	2007
16:45	2046	2003	1989	1994	2008
17:00	2048	2006	1992	1995	2010
17:15	2049	2007	1992	1996	2011
17:30	2049	2008	1993	1998	2012
17:45	2049	2007	1995	1999	2013
18:00	2051	2009	1995	2000	2014
18:15	2052	2012	1996	2001	2015
18:30	2053	2013	1997	2002	2016
18:45	2049	2009	1993	1997	2012
19:00	2046	2007	1992	1995	2010
19:15	2045	2004	1991	1994	2009
19:30	2045	2003	1989	1994	2008
19:45	2045	2005	1990	1994	2009
20:00	2045	2002	1988	1994	2007
20:15	2045	2004	1989	1995	2008
20:30	2045	2004	1990	1994	2008
20:45	2046	2005	1990	1996	2009
21:00	2047	2006	1991	1995	2010
21:15	2047	2008	1991	1996	2011
21:30	2048	2006	1991	1996	2010
21:45	2047	2008	1991	1997	2011
22:00	2048	2009	1992	1998	2012
22:15	2047	2008	1992	1996	2011



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PEARLITE INSULATION  
TEMPERATURE (°F)**

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FILE ID: 15HOR2.DAT**

**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>FP 01</b>	<b>FP 02</b>	<b>FP 03</b>	<b>FP 04</b>	<b>Furn. Avg.</b>
22:30	2045	2007	1990	1996	2010
22:45	2045	2004	1990	1996	2009
23:00	2046	2008	1992	1997	2011
23:15	2047	2008	1992	1997	2011
23:30	2047	2007	1992	1997	2011
23:45	2043	2004	1987	1993	2007
24:00	2042	2004	1987	1993	2007
24:15	2043	2006	1988	1994	2008
24:30	2045	2004	1988	1995	2008
24:45	2044	2005	1989	1994	2008
25:00	2045	2007	1989	1995	2009
25:15	2045	2005	1989	1995	2009
25:30	2046	2004	1990	1995	2009
25:45	2046	2008	1991	1996	2010
26:00	2046	2006	1990	1997	2010
26:15	2047	2009	1991	1998	2011
26:30	2044	2008	1990	1996	2010
26:45	2042	2003	1986	1992	2006
27:00	2040	2001	1984	1990	2004
27:15	2038	1999	1982	1989	2002
27:30	2037	2000	1981	1989	2002
27:45	2038	2000	1981	1988	2002
28:00	2036	1999	1979	1987	2000
28:15	2037	2000	1980	1988	2001
28:30	2036	1998	1980	1987	2000
28:45	2037	1997	1979	1987	2000
29:00	2035	1998	1979	1986	2000
29:15	2036	1998	1979	1987	2000
29:30	2036	2000	1980	1987	2001
29:45	2035	1998	1980	1988	2000
30:00	2035	1999	1979	1988	2000
30:15	2037	2000	1981	1989	2002
30:30	2035	1999	1980	1989	2001
30:45	2038	2000	1981	1989	2002
31:00	2037	2001	1981	1990	2002
31:15	2039	1998	1981	1990	2002
31:30	2039	1999	1982	1990	2003
31:45	2037	2001	1981	1991	2003
32:00	2038	2000	1981	1991	2003
32:15	2040	1999	1982	1991	2003
32:30	2039	2002	1982	1991	2004
32:45	2040	2002	1983	1993	2005
33:00	2041	2003	1983	1993	2005
33:15	2040	2005	1983	1993	2005
33:30	2040	2004	1984	1994	2006

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FILE ID: 15HOR2.DAT**

**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>FP 01</b>	<b>FP 02</b>	<b>FP 03</b>	<b>FP 04</b>	<b>Furn. Avg.</b>
33:45	2039	2007	1983	1994	2006
34:00	2042	2005	1985	1995	2007
34:15	2043	2005	1985	1995	2007
34:30	2042	2005	1985	1995	2007
34:45	2043	2007	1986	1996	2008
35:00	2044	2007	1986	1996	2008
35:15	2045	2006	1987	1997	2009
35:30	2046	2008	1988	1997	2010
35:45	2046	2008	1989	1999	2011
36:00	2048	2010	1990	2000	2012
36:15	2048	2011	1991	2000	2013
36:30	2048	2009	1990	2000	2012
36:45	2049	2010	1991	2001	2013
37:00	2050	2011	1992	2001	2014
37:15	2049	2012	1992	2002	2014
37:30	2050	2011	1992	2003	2014
37:45	2051	2013	1994	2003	2015
38:00	2048	2011	1992	2000	2013
38:15	2044	2008	1986	1995	2008
38:30	2042	2005	1985	1994	2007
38:45	2041	2003	1983	1992	2005
39:00	2040	2003	1982	1991	2004
39:15	2039	2001	1982	1990	2003
39:30	2038	1998	1982	1989	2002
39:45	2038	1999	1981	1989	2002
40:00	2038	2000	1980	1988	2002
40:15	2037	1999	1981	1988	2001
40:30	2037	1999	1980	1988	2001
40:45	2036	1999	1980	1988	2001
41:00	2037	1999	1980	1988	2001
41:15	2038	1999	1981	1988	2002
41:30	2040	2002	1983	1992	2004
41:45	2043	2003	1986	1993	2006
42:00	2042	2004	1986	1994	2007
42:15	2043	2005	1985	1994	2007
42:30	2042	2001	1985	1993	2005
42:45	2041	2000	1984	1992	2004
43:00	2041	2002	1983	1992	2005
43:15	2041	2003	1984	1992	2005
43:30	2041	2001	1984	1992	2005
43:45	2042	2002	1983	1992	2005
44:00	2040	2002	1983	1991	2004
44:15	2040	2000	1983	1990	2003
44:30	2039	2000	1982	1990	2003
44:45	2037	2000	1981	1989	2002

**HOWRED CORPORATION  
PEARLITE INSULATION  
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TEST DATE: JANUARY 15, 1999  
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SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE

TIME	FP 01	FP 02	FP 03	FP 04	Furn. Avg.
45:00	2036	1996	1980	1988	2000
45:15	2035	1997	1979	1987	2000
45:30	2037	1997	1979	1987	2000
45:45	2036	1996	1978	1986	1999
46:00	2036	1997	1977	1986	1999
46:15	2037	1997	1979	1987	2000
46:30	2036	2000	1978	1988	2001
46:45	2037	1995	1979	1988	2000
47:00	2037	1998	1980	1989	2001
47:15	2036	1997	1979	1988	2000
47:30	2036	1998	1979	1989	2001
47:45	2037	1998	1979	1989	2001
48:00	2039	1997	1981	1989	2002
48:15	2037	2000	1980	1990	2002
48:30	2037	2000	1981	1990	2002
48:45	2039	2001	1982	1992	2004
49:00	2038	2000	1981	1991	2003
49:15	2037	1998	1981	1991	2002
49:30	2038	1999	1982	1991	2003
49:45	2037	1999	1981	1991	2002
50:00	2038	1999	1981	1991	2002
50:15	2039	1999	1981	1991	2003
50:30	2038	1999	1981	1992	2003
50:45	2038	1998	1981	1991	2002
51:00	2038	2000	1981	1992	2003
51:15	2037	2001	1980	1991	2002
51:30	2038	1999	1981	1992	2003
51:45	2037	2002	1982	1992	2003
52:00	2038	2001	1981	1992	2003
52:15	2037	2001	1981	1993	2003
52:30	2038	2001	1981	1993	2003
52:45	2038	1998	1982	1993	2003
53:00	2038	2001	1981	1993	2003
53:15	2038	2000	1982	1993	2003
53:30	2036	2002	1981	1993	2003
53:45	2037	2001	1980	1992	2003
54:00	2036	2003	1980	1992	2003
54:15	2037	2001	1980	1992	2003
54:30	2035	2002	1980	1993	2003
54:45	2036	2001	1979	1993	2002
55:00	2035	2002	1979	1992	2002
55:15	2036	1998	1978	1991	2001
55:30	2035	1999	1978	1990	2001
55:45	2034	2000	1977	1991	2001
56:00	2035	2000	1978	1991	2001

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

**TEST DATE: JANUARY 15, 1999  
FILE ID: 15HOR2.DAT**

**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>FP 01</b>	<b>FP 02</b>	<b>FP 03</b>	<b>FP 04</b>	<b>Furn. Avg.</b>
56:15	2034	1999	1978	1991	2001
56:30	2033	1998	1978	1991	2000
56:45	2034	2001	1978	1991	2001
57:00	2033	2000	1977	1991	2000
57:15	2033	1999	1978	1992	2001
57:30	2034	2001	1978	1991	2001
57:45	2033	2000	1978	1992	2001
58:00	2034	1998	1977	1992	2000
58:15	2033	2002	1977	1992	2001
58:30	2033	2000	1977	1992	2001
58:45	2033	2002	1977	1992	2001
59:00	2033	2001	1977	1992	2001
59:15	2034	2000	1978	1993	2001
59:30	2034	2000	1979	1993	2002
59:45	2034	2001	1978	1993	2002
60:00	2033	2000	1977	1992	2001
60:15	2034	2001	1979	1993	2002
60:30	2034	2002	1978	1993	2002
60:45	2035	2000	1978	1992	2001
61:00	2033	2000	1978	1993	2001
61:15	2033	2002	1978	1993	2002
61:30	2033	2000	1977	1993	2001
61:45	2033	2002	1977	1993	2001
62:00	2033	2001	1977	1993	2001
62:15	2032	2001	1976	1993	2001
62:30	2033	2000	1977	1993	2001
62:45	2033	2002	1976	1993	2001
63:00	2032	2000	1976	1992	2000
63:15	2031	2000	1976	1992	2000
63:30	2032	2002	1976	1993	2001
63:45	2031	2001	1975	1993	2000
64:00	2031	2000	1976	1992	2000
64:15	2032	2002	1976	1993	2001
64:30	2031	2002	1975	1993	2000
64:45	2031	2000	1975	1992	2000
65:00	2032	2004	1975	1992	2001
65:15	2033	2001	1975	1993	2001
65:30	2031	2000	1975	1992	2000
65:45	2032	2002	1975	1992	2000
66:00	2032	1998	1975	1992	1999
66:15	2030	1999	1974	1991	1999
66:30	2029	2002	1973	1992	1999
66:45	2029	2002	1974	1991	1999
67:00	2029	1998	1974	1991	1998
67:15	2029	1999	1973	1991	1998

**HOWRED CORPORATION  
PEARLITE INSULATION  
TEMPERATURE (°F)**

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**SwRI PROJECT NO.: 01-2305-306a  
TEST TYPE: UL 1709 SMALL-SCALE**

<b>TIME</b>	<b>FP 01</b>	<b>FP 02</b>	<b>FP 03</b>	<b>FP 04</b>	<b>Furn. Avg.</b>
67:30	2031	2000	1974	1992	1999
67:45	2030	2001	1973	1992	1999
68:00	2030	2000	1973	1992	1999
68:15	2030	2002	1973	1992	1999
68:30	2030	2003	1973	1992	2000
68:45	2030	2003	1972	1993	2000
69:00	2030	2002	1973	1992	1999
69:15	2031	2000	1972	1992	1999
69:30	2031	2002	1973	1992	2000
69:45	2031	2002	1973	1992	2000
70:00	2029	2001	1972	1992	1999
70:15	2030	2000	1971	1991	1998
70:30	2031	2000	1973	1992	1999
70:45	2031	2002	1973	1992	2000
71:00	2031	2000	1972	1991	1999
71:15	2031	2001	1972	1992	1999
71:30	2031	2001	1972	1992	1999
71:45	2031	2001	1971	1992	1999
72:00	2032	2002	1972	1992	2000
72:15	2032	2003	1972	1993	2000
72:30	2031	2002	1973	1993	2000
72:45	2031	2001	1972	1992	1999
73:00	2032	2001	1972	1991	1999
73:15	2031	2001	1971	1992	1999
73:30	2032	2001	1970	1992	1999
73:45	2032	2003	1971	1992	2000
74:00	2032	2003	1972	1992	2000
74:15	2033	2004	1972	1993	2001
74:30	2032	2004	1972	1993	2000
74:45	2031	2001	1972	1992	1999
75:00	2032	2004	1972	1992	2000
75:15	2032	2002	1972	1993	2000
75:30	2032	2002	1972	1992	2000
75:45	2032	2002	1971	1991	1999
76:00	2033	2004	1972	1992	2000
76:15	2033	2003	1971	1992	2000
76:30	2033	2003	1971	1992	2000
76:45	2032	2004	1972	1992	2000
77:00	2033	2002	1971	1992	2000
77:15	1856	1797	1806	1758	1804