

UBC 26-2 Test Method for the Evaluation of Thermal Barriers

Contego International 7/16" OSB with Fire Barrier Latex

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November 27, 2002

Prepared for:

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Abstract

A piece of 7/16" thick oriented strand board (OSB) containing a surface spline over a board joint was coated with 0,02" (20 mils) dft of Contego International's Fire Barrier Latex Paint and evaluated as a thermal barrier by utilizing UBC 26-2 Test Method for the Evaluation of Thermal Barriers. The test specimen achieved an index of 15 minutes, then the test was continued until the upper limiting temperature was reached, which occurred at 23 minutes, 12 seconds.

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TABLE OF CONTENTS

ITEM	PAGE
Introduction	1
Test Procedure	1
Test Specimen Construction	4
Test Results and Observations	4
Conclusions	5
Appendices	
Appendix A: Thermocouple Data	6
Appendix B: Photographs	28
Last page of document	35



INTRODUCTION

The use of foam plastics in buildings is permitted by most building codes provided the foam is protected by a thermal barrier. A thermal barrier is a material which will keep the surface of the foam plastic nearest the fire sufficiently low, for a specified time, that it will not ignite and cause the rapid spread of the fire.

This test method is intended to evaluate the thermal transmission performance of thermal barrier materials when the material is subjected to a standard fire test exposure condition. The method does not evaluate the ability of the material to remain in place under all actual fire exposure conditions.

TEST PROCEDURE

The 7' x 7' test furnace is fitted with 25 uniformly located diffuse-flame natural gas burners providing an even heat flux distribution across the face of the test specimen. Furnace pressures are maintained at +0.04" W. C. to -0.20" W. C.

The temperature within the furnace is determined to be the mathematical average of thermocouples located symmetrically within the furnace and positioned twelve inches below the under, horizontal surface of the test specimen. The materials used in the construction of these thermocouples are those suggested in the test standard. During the performance of a fire exposure test, the furnace temperatures are monitored at least every 30 seconds and displayed to maintain control of the temperature along the specified temperature curve.

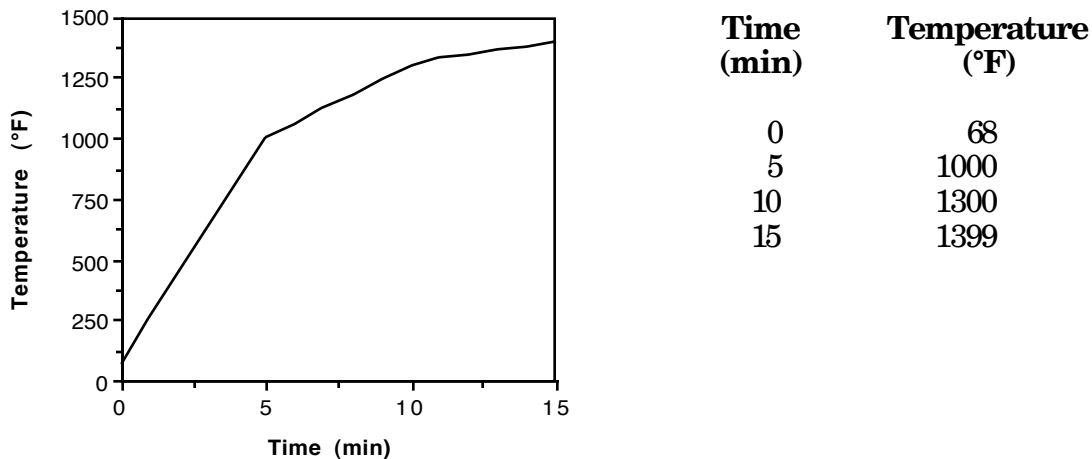


Figure 1

The fire exposure is controlled to conform with the standard time-temperature curve shown in Figure 1 above. The furnace interior temperature during a test is



controlled such that the area under the time-temperature curve is within 10% of the corresponding area under the standard time-temperature curve.

The fire exposure is continued on the specimen until failure occurs, or until the specimen has withstood the test conditions for the desired thermal barrier rating. The thermal barrier Index is the number of minutes at which the temperature rise, above the initial temperature, at the interface of the thermal barrier and the calcium silicate board has not exceeded 250°F average or 325°F at any one of the thermocouples.

The test specimen consists of a wood frame constructed of nom. 2" x 4" wood surfaced on each side with 1/2" thick calcium silicate board. The thermal barrier material is applied to one side. If the test material is typically installed with joints, a representative joint shall be placed in the center of the specimen. Nine thermocouples are located between the calcium silicate board and the test material as shown in Figure 2.

Temperatures of the interface between the test specimen and the calcium silicate are monitored using 24 GA., Type K thermocouples. Temperature readings are taken at not less than nine points on the surface, at intervals not exceeding 1.0 minute.



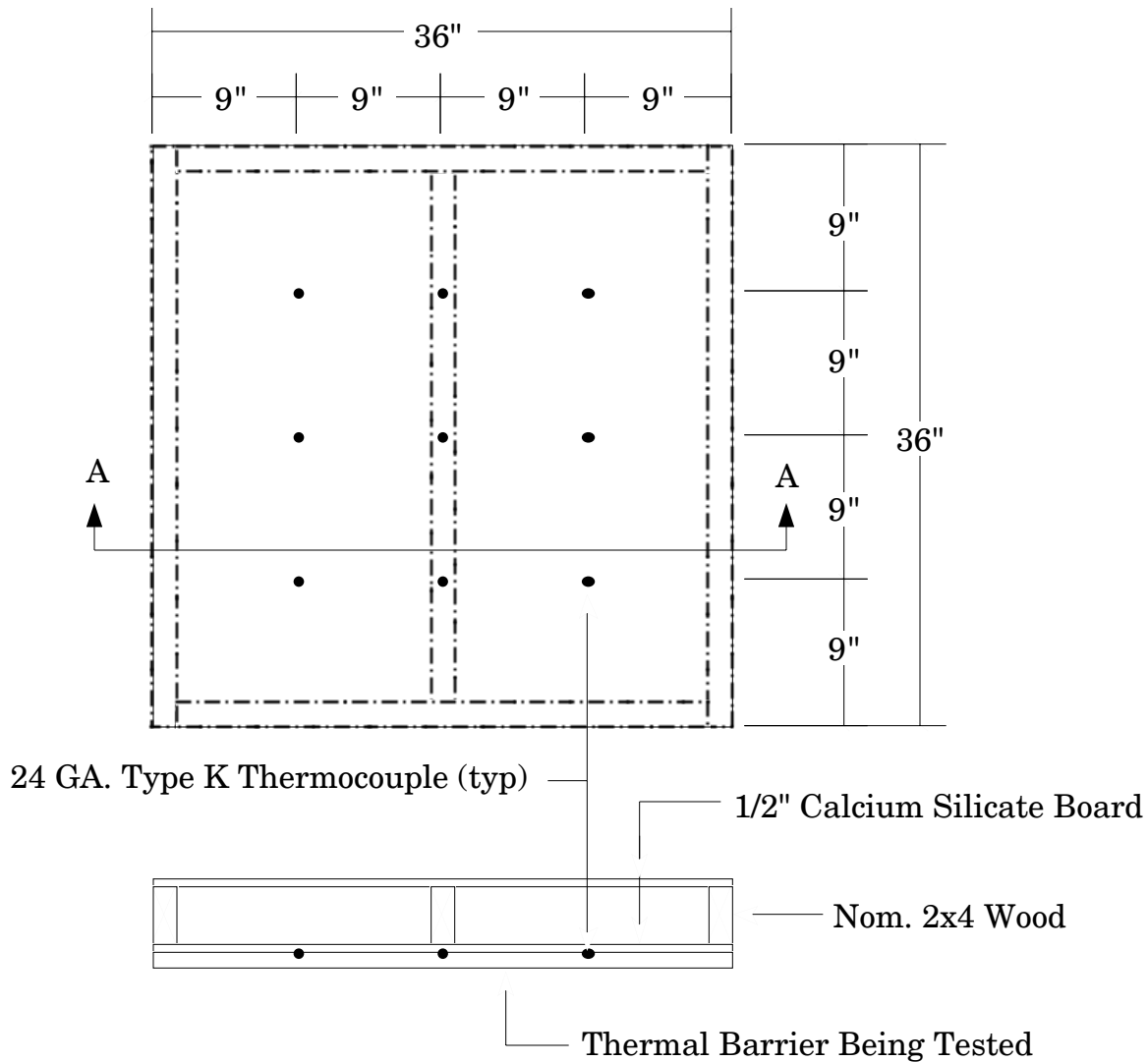


Figure 2: THERMOCOUPLE PLACEMENT

Once assembled, the test article is placed into a frame and the exposed surface of the frame is clad with a double layer of 5/8" thick Type X gypsum drywall, leaving a 30" x 30" area of the test specimen exposed. The entire frame is then lifted into position on a horizontal fire resistance furnace, with the thermal barrier down (exposed to flame).



TEST SPECIMEN CONSTRUCTION

The test specimen identification is as provided by the client and Omega Point Laboratories, Inc. accepts no responsibility for any inaccuracies therein. Omega Point did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

The test specimen was prepared by representatives of Contego International and shipped to the laboratory for testing. It consisted of a 36" x 36" piece of 7/16" thick oriented strand board with a joint down the centerline. The joint was covered on the unexposed face with a surface spline consisting of a 3" wide, 36" long, 7/16" thick piece of OSB, fastened to the face board on each side of the joint with 3/4" screws spaced nominally 8" o.c. The perimeter of the test specimen was covered with two layers of 5/8" Type X gypsum wallboard, leaving a 30" x 30" section to be exposed to the fire.

TEST RESULTS AND OBSERVATIONS

On November 27, 2002, the test assembly was placed atop the Laboratory's horizontal fire resistance furnace. After connecting the thermocouples to the data acquisition system and verifying their outputs, the furnace was fired and the standard UBC Standard 7-1 time-temperature curve was followed for 24 minutes. The furnace was then extinguished and the specimen removed from the furnace and allowed to cool.

Observations made during the test are as follows:

Time (min:sec)	Observation
0:00	Start of test
0:24	Surface turned dark and beginning to bubble
0:44	Char layer forming
6:30	The char at the board joint location is opening slightly
8:00	Uniform char with no cracks other than at the joint location
15:00	15-minute thermal barrier index achieved, test continued
24:00	Furnace extinguished

At the conclusion of the fire exposure period, the test specimen was removed from the furnace and allowed to cool. The exposed face was completely gray with light flaming at the board joint location.



The temperature values registered on each of the nine interface thermocouples at the end of the fire exposure are presented in the table below:

Thermocouple Position	Temperature @ 15 Min. (°F)	Max Allowable (°F)
1	244	391
2	133	388
3	230	390
4	238	391
5	204	388
6	250	391
7	228	390
8	143	388
9	249	390
Average	213	315

Listings and plots of the furnace control temperatures and specimen surface temperatures may be found in Appendix A. A photo documentation is contained in Appendix B.

CONCLUSIONS

The test specimen identification is as provided by the client and Omega Point Laboratories, Inc. accepts no responsibility for any inaccuracies therein. Omega Point did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

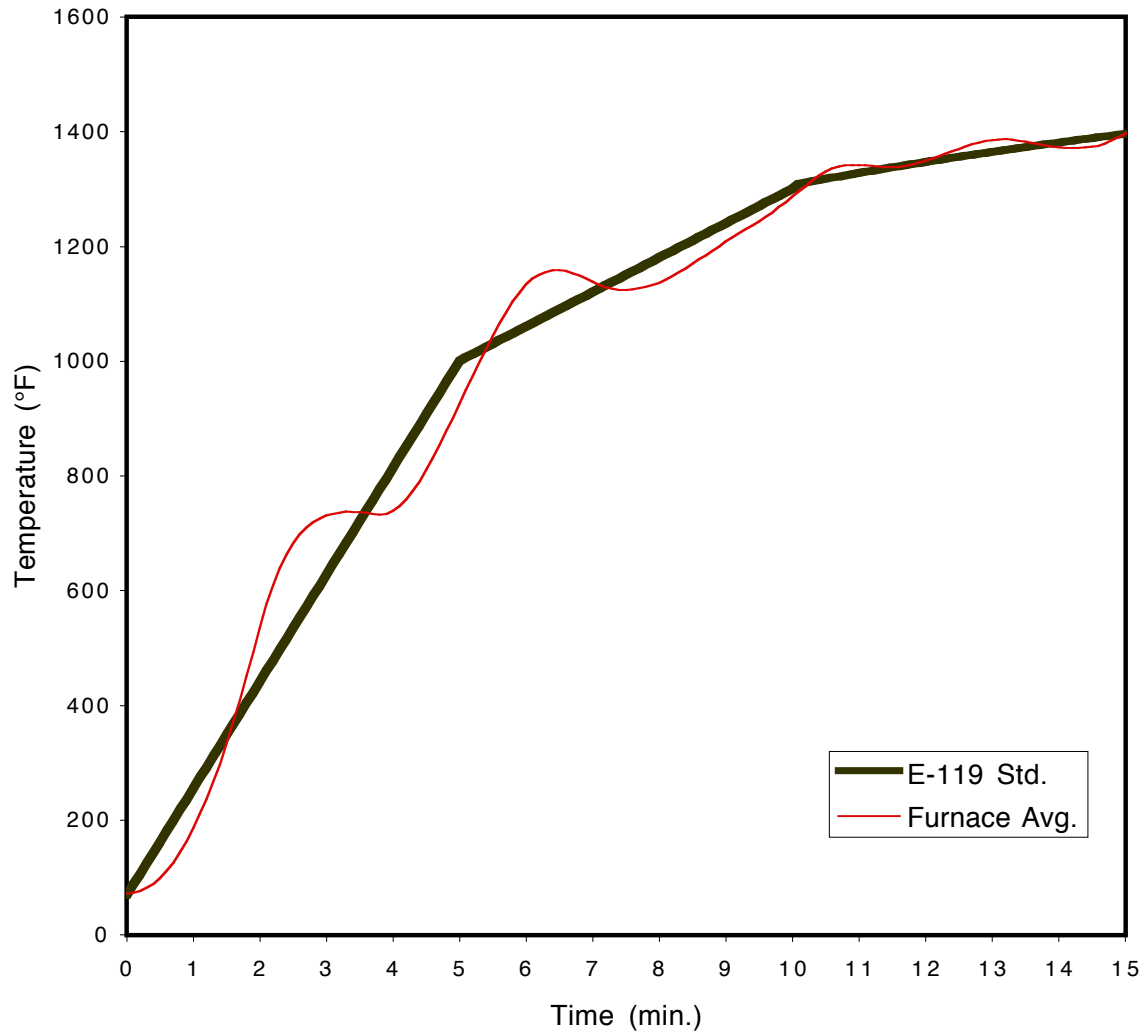
The test specimen described in this report achieved a thermal barrier rating of 23 minutes.



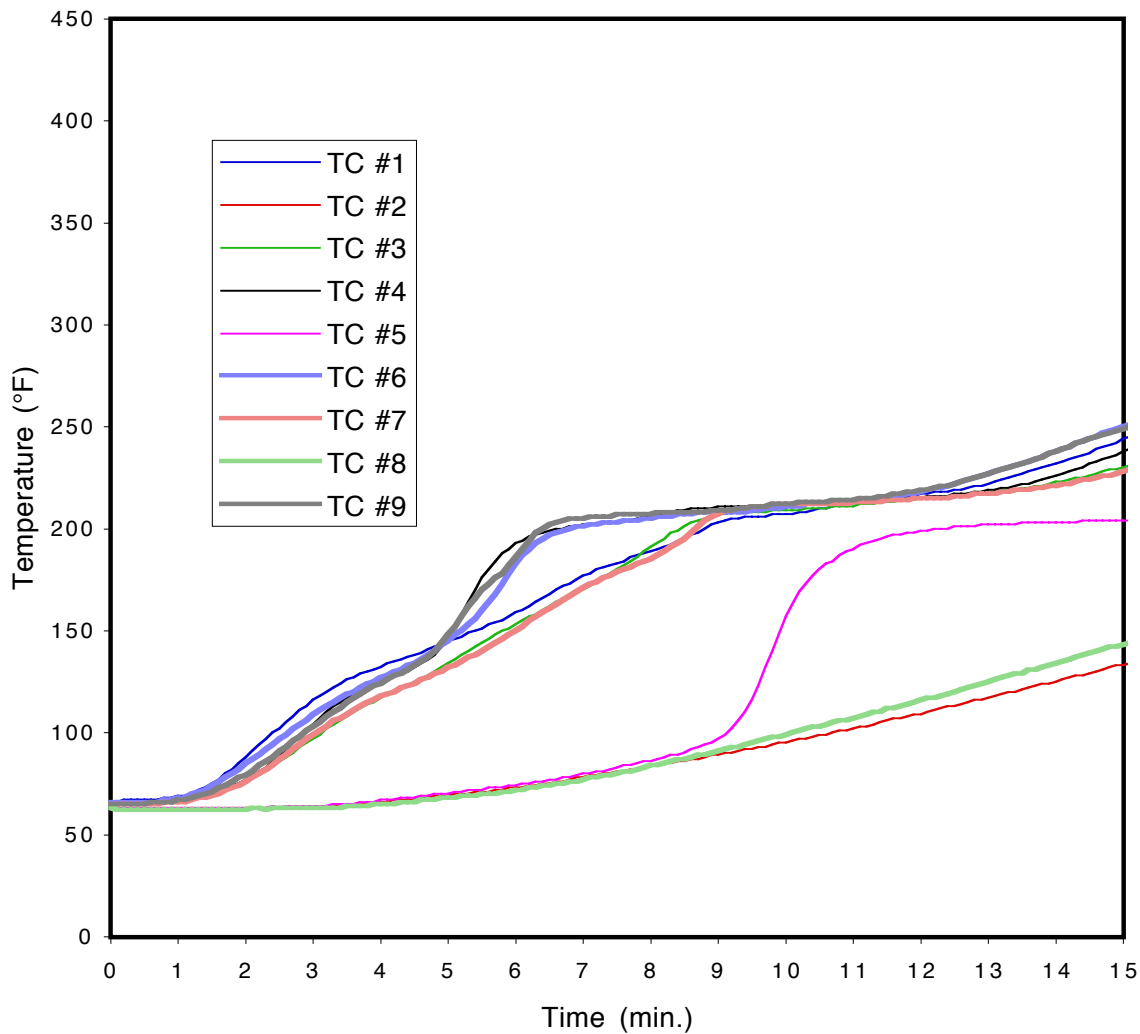
APPENDIX A
THERMOCOUPLE DATA



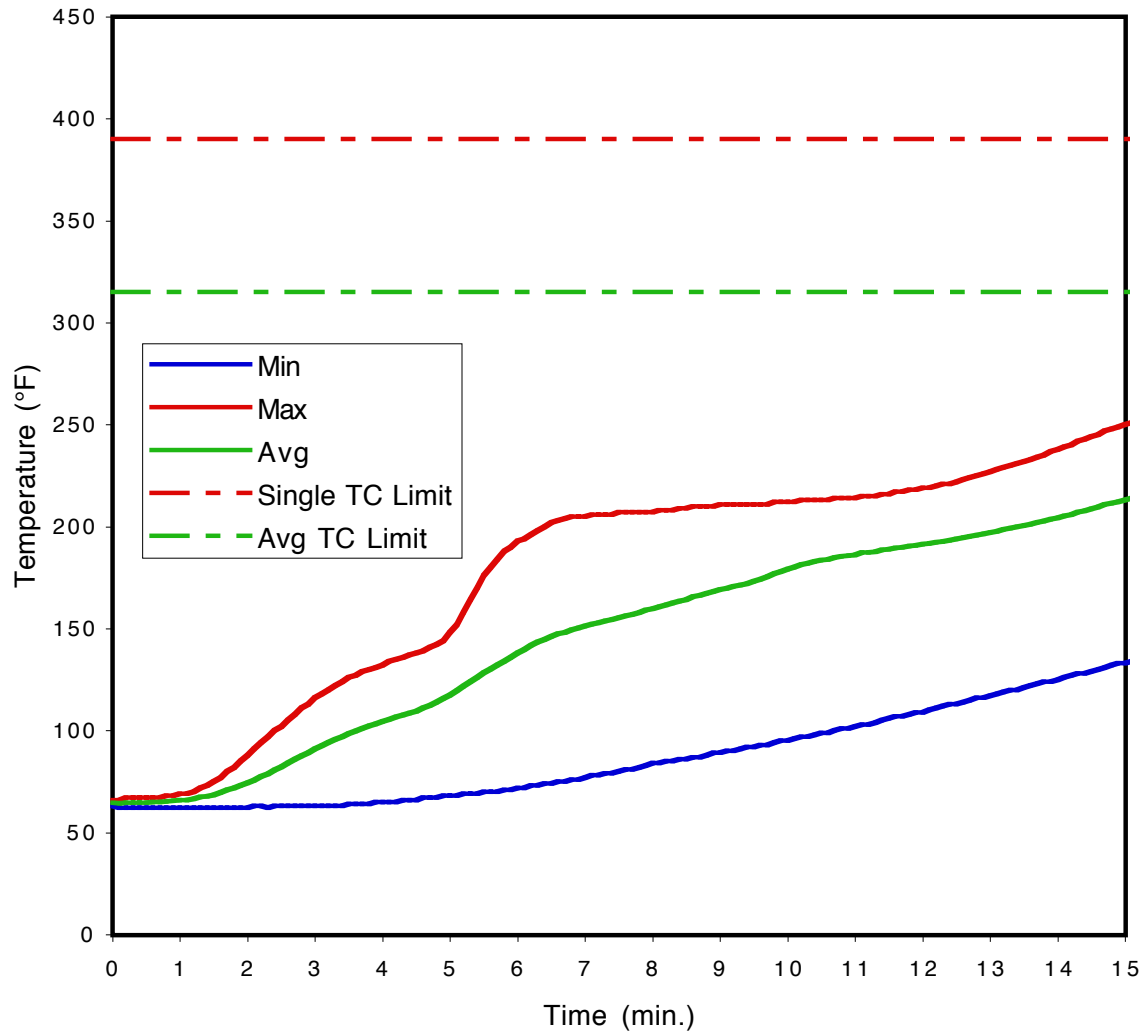
**Contego International
Project No. 16539-112809
Furnace Interior Temperatures**



Contego International
Project No. 16539-112809
Individual Cold Side Temperatures



Contego International
Project No. 16539-112809
Min, Avg, Max Cold Side Temperatures



Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
0	68	72	0	0	0.00	74
0.1	87	72	0	0	0.00	75
0.2	105	76	4	9	-58.42	78
0.3	124	81	10	37	-73.51	83
0.4	143	88	20	84	-75.86	90
0.5	161	98	37	149	-75.27	101
0.6	180	110	62	233	-73.39	115
0.7	198	125	98	336	-70.75	132
0.8	217	143	148	457	-67.65	153
0.9	236	163	214	596	-64.19	178
1	254	185	299	755	-60.46	206
1.1	273	210	405	932	-56.60	237
1.2	292	236	534	1128	-52.67	271
1.3	310	265	689	1342	-48.69	307
1.4	329	297	871	1575	-44.68	347
1.5	348	332	1085	1827	-40.62	390
1.6	366	370	1331	2097	-36.51	434
1.7	385	409	1614	2386	-32.34	478
1.8	404	449	1936	2693	-28.14	521
1.9	422	492	2296	3020	-23.95	564
2	441	535	2699	3365	-19.78	606
2.1	459	575	3144	3728	-15.67	646
2.2	478	609	3631	4110	-11.67	681
2.3	497	639	4155	4511	-7.90	711
2.4	515	663	4710	4930	-4.46	735
2.5	534	682	5293	5368	-1.41	754
2.6	553	697	5897	5825	1.24	768
2.7	571	710	6519	6300	3.46	779
2.8	590	719	7154	6794	5.29	785
2.9	609	726	7800	7307	6.75	790
3	627	731	8454	7838	7.85	792
3.1	646	734	9114	8388	8.65	792
3.2	664	736	9778	8957	9.17	791
3.3	683	737	10444	9544	9.44	789
3.4	702	737	11113	10149	9.49	786
3.5	720	736	11782	10774	9.35	783
3.6	739	735	12450	11417	9.05	779
3.7	758	733	13118	12079	8.60	774
3.8	776	732	13784	12759	8.03	770
3.9	795	734	14448	13458	7.36	769
4	814	739	15113	14176	6.61	772
4.1	832	747	15781	14912	5.82	779
4.2	851	759	16455	15667	5.03	789
4.3	870	773	17140	16440	4.26	802

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
4.4	888	790	17838	17233	3.51	819
4.5	907	810	18552	18044	2.82	838
4.6	925	831	19284	18873	2.18	859
4.7	944	853	20036	19721	1.59	882
4.8	963	877	20809	20588	1.08	905
4.9	981	900	21606	21473	0.62	928
5	1000	925	22427	22377	0.22	953
5.1	1006	950	23271	23300	-0.12	978
5.2	1012	974	24141	24235	-0.39	1003
5.3	1018	998	25034	25176	-0.56	1027
5.4	1024	1021	25952	26123	-0.65	1049
5.5	1030	1043	26894	27076	-0.67	1070
5.6	1036	1065	27858	28035	-0.63	1090
5.7	1042	1085	28844	29000	-0.54	1108
5.8	1048	1103	29850	29971	-0.40	1124
5.9	1054	1120	30876	30948	-0.23	1140
6	1060	1134	31919	31931	-0.04	1154
6.1	1066	1143	32978	32920	0.18	1164
6.2	1072	1151	34048	33915	0.39	1172
6.3	1078	1155	35127	34916	0.60	1176
6.4	1084	1158	36212	35923	0.80	1178
6.5	1090	1158	37300	36936	0.99	1178
6.6	1096	1157	38390	37955	1.15	1176
6.7	1102	1153	39479	38980	1.28	1172
6.8	1108	1149	40566	40011	1.39	1167
6.9	1114	1143	41649	41048	1.46	1161
7	1120	1138	42727	42091	1.51	1154
7.1	1126	1132	43800	43140	1.53	1147
7.2	1132	1128	44867	44195	1.52	1142
7.3	1138	1126	45929	45256	1.49	1139
7.4	1144	1124	46988	46323	1.44	1137
7.5	1150	1124	48044	47396	1.37	1137
7.6	1156	1125	49100	48475	1.29	1138
7.7	1162	1127	50157	49560	1.20	1139
7.8	1168	1130	51214	50651	1.11	1142
7.9	1174	1133	52275	51748	1.02	1146
8	1180	1136	53338	52851	0.92	1150
8.1	1186	1142	54404	53960	0.82	1156
8.2	1192	1148	55475	55075	0.73	1163
8.3	1198	1155	56552	56196	0.63	1171
8.4	1204	1162	57635	57323	0.54	1180
8.5	1210	1170	58725	58456	0.46	1190
8.6	1216	1177	59823	59595	0.38	1199
8.7	1222	1184	60928	60740	0.31	1208

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
8.8	1228	1192	62040	61891	0.24	1218
8.9	1234	1200	63160	63048	0.18	1228
9	1240	1208	64288	64211	0.12	1239
9.1	1246	1215	65424	65380	0.07	1248
9.2	1252	1223	66568	66555	0.02	1257
9.3	1258	1230	67719	67736	-0.03	1265
9.4	1264	1236	68877	68923	-0.07	1273
9.5	1270	1243	70042	70116	-0.11	1281
9.6	1276	1251	71214	71315	-0.14	1290
9.7	1282	1259	72393	72520	-0.18	1298
9.8	1288	1268	73580	73731	-0.21	1306
9.9	1294	1277	74775	74948	-0.23	1313
10	1300	1286	75980	76171	-0.25	1321
10.1	1309	1295	77193	77400	-0.27	1329
10.2	1311	1304	78415	78636	-0.28	1336
10.3	1313	1314	79647	79878	-0.29	1342
10.4	1315	1323	80888	81122	-0.29	1349
10.5	1317	1330	82139	82368	-0.28	1356
10.6	1319	1336	83397	83617	-0.26	1362
10.7	1322	1339	84662	84867	-0.24	1366
10.8	1324	1341	85931	86120	-0.22	1368
10.9	1326	1342	87202	87374	-0.20	1368
11	1328	1342	88476	88631	-0.18	1367
11.1	1330	1341	89749	89889	-0.16	1366
11.2	1332	1340	91022	91150	-0.14	1364
11.3	1334	1339	92295	92413	-0.13	1362
11.4	1335	1338	93566	93677	-0.12	1360
11.5	1337	1338	94837	94944	-0.11	1360
11.6	1339	1338	96106	96212	-0.11	1360
11.7	1341	1340	97376	97482	-0.11	1362
11.8	1343	1342	98647	98755	-0.11	1365
11.9	1345	1345	99920	100029	-0.11	1369
12	1347	1349	101196	101305	-0.11	1373
12.1	1349	1353	102475	102583	-0.11	1378
12.2	1350	1357	103758	103862	-0.10	1384
12.3	1352	1361	105044	105144	-0.09	1390
12.4	1354	1365	106335	106427	-0.09	1396
12.5	1356	1370	107630	107712	-0.08	1402
12.6	1358	1374	108929	108999	-0.06	1409
12.7	1359	1378	110233	110288	-0.05	1415
12.8	1361	1381	111541	111578	-0.03	1418
12.9	1363	1383	112852	112870	-0.02	1420
13	1364	1385	114166	114164	0.00	1421
13.1	1366	1386	115482	115460	0.02	1421

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
13.2	1368	1387	116799	116757	0.04	1420
13.3	1369	1385	118118	118056	0.05	1417
13.4	1371	1384	119435	119356	0.07	1414
13.5	1373	1382	120752	120659	0.08	1410
13.6	1374	1380	122067	121963	0.09	1406
13.7	1376	1378	123380	123268	0.09	1402
13.8	1378	1375	124691	124575	0.09	1398
13.9	1379	1373	125999	125884	0.09	1394
14	1381	1372	127305	127194	0.09	1391
14.1	1382	1371	128610	128506	0.08	1389
14.2	1384	1372	129914	129820	0.07	1388
14.3	1385	1372	131217	131135	0.06	1387
14.4	1387	1372	132521	132452	0.05	1387
14.5	1388	1374	133824	133770	0.04	1388
14.6	1390	1375	135129	135090	0.03	1389
14.7	1391	1379	136436	136411	0.02	1392
14.8	1393	1385	137745	137733	0.01	1396
14.9	1394	1390	139058	139058	0.00	1400
15	1396	1396	140378	140383	0.00	1405
15.1	1397	1402	141702	141711	-0.01	1412
15.2	1399	1408	143033	143039	0.00	1419
15.3	1400	1413	144369	144369	0.00	1426
15.4	1402	1418	145711	145701	0.01	1432
15.5	1403	1422	147059	147034	0.02	1437
15.6	1405	1426	148410	148368	0.03	1442
15.7	1406	1430	149766	149704	0.04	1447
15.8	1407	1434	151126	151042	0.06	1452
15.9	1409	1438	152489	152380	0.07	1457
16	1410	1440	153857	153720	0.09	1460
16.1	1412	1438	155227	155062	0.11	1458
16.2	1413	1436	156598	156405	0.12	1455
16.3	1414	1432	157967	157749	0.14	1450
16.4	1416	1428	159333	159094	0.15	1444
16.5	1417	1423	160694	160441	0.16	1438
16.6	1418	1419	162052	161790	0.16	1432
16.7	1420	1413	163404	163139	0.16	1425
16.8	1421	1409	164752	164490	0.16	1419
16.9	1422	1405	166095	165842	0.15	1413
17	1424	1402	167434	167196	0.14	1409
17.1	1425	1401	168769	168551	0.13	1407
17.2	1426	1402	170103	169907	0.12	1407
17.3	1427	1404	171436	171265	0.10	1409
17.4	1429	1407	172771	172623	0.09	1413
17.5	1430	1411	174108	173983	0.07	1419

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
17.6	1431	1416	175449	175345	0.06	1425
17.7	1432	1421	176795	176707	0.05	1432
17.8	1434	1427	178145	178071	0.04	1438
17.9	1435	1432	179501	179436	0.04	1445
18	1436	1438	180862	180802	0.03	1451
18.1	1437	1443	182229	182170	0.03	1457
18.2	1439	1446	183601	183538	0.03	1461
18.3	1440	1448	184978	184908	0.04	1463
18.4	1441	1450	186357	186279	0.04	1464
18.5	1442	1450	187738	187652	0.05	1463
18.6	1443	1450	189119	189025	0.05	1462
18.7	1445	1451	190501	190400	0.05	1461
18.8	1446	1451	191884	191776	0.06	1460
18.9	1447	1451	193266	193153	0.06	1458
19	1448	1451	194649	194531	0.06	1457
19.1	1449	1450	196031	195911	0.06	1455
19.2	1450	1450	197414	197291	0.06	1454
19.3	1451	1451	198796	198673	0.06	1454
19.4	1453	1451	200178	200056	0.06	1454
19.5	1454	1452	201561	201440	0.06	1455
19.6	1455	1452	202945	202825	0.06	1454
19.7	1456	1452	204329	204212	0.06	1454
19.8	1457	1452	205713	205599	0.06	1453
19.9	1458	1452	207097	206988	0.05	1453
20	1459	1451	208480	208377	0.05	1452
20.1	1460	1452	209864	209768	0.05	1452
20.2	1462	1453	211247	211160	0.04	1453
20.3	1463	1454	212631	212553	0.04	1454
20.4	1464	1456	214016	213947	0.03	1456
20.5	1465	1459	215403	215342	0.03	1460
20.6	1466	1462	216793	216738	0.03	1463
20.7	1467	1465	218186	218136	0.02	1466
20.8	1468	1467	219581	219534	0.02	1469
20.9	1469	1470	220979	220933	0.02	1472
21	1470	1473	222379	222334	0.02	1475
21.1	1471	1475	223782	223735	0.02	1478
21.2	1472	1478	225188	225138	0.02	1480
21.3	1473	1480	226596	226542	0.02	1483
21.4	1474	1483	228007	227946	0.03	1486
21.5	1475	1485	229420	229352	0.03	1488
21.6	1476	1487	230836	230759	0.03	1490
21.7	1477	1489	232253	232167	0.04	1492
21.8	1478	1489	233673	233575	0.04	1492
21.9	1479	1487	235093	234985	0.05	1491

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F·min)	Integration of E119 Std Average (°F·min)	Error (%)	Furnace Probe # 1 (°F)
22	1480	1485	236513	236396	0.05	1488
22.1	1481	1483	237931	237808	0.05	1485
22.2	1482	1481	239347	239221	0.05	1482
22.3	1483	1480	240761	240634	0.05	1481
22.4	1484	1479	242173	242049	0.05	1479
22.5	1485	1480	243585	243465	0.05	1479
22.6	1486	1480	244996	244882	0.05	1479
22.7	1487	1481	246408	246300	0.04	1479
22.8	1488	1482	247821	247718	0.04	1479
22.9	1489	1483	249234	249138	0.04	1480
23	1490	1484	250649	250559	0.04	1480
23.1	1491	1484	252064	251980	0.03	1481
23.2	1492	1484	253480	253403	0.03	1481
23.3	1493	1485	254896	254827	0.03	1482
23.4	1494	1486	256313	256251	0.02	1483
23.5	1495	1487	257730	257677	0.02	1484
23.6	1496	1490	259149	259103	0.02	1487
23.7	1497	1493	260570	260530	0.02	1491
23.8	1498	1497	261993	261958	0.01	1496
23.9	1499	1502	263420	263388	0.01	1501
24	1499	1508	264851	264818	0.01	1507

**Max Temp @ 15 min.
Max Allowed**

Time (min)	Furnace Probe # 2 (°F)	Furnace Probe # 3 (°F)	Furnace Probe # 4 (°F)	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
0	72	71	69	63	65	66	66	63
0.1	73	72	69	62	64	66	66	62
0.2	76	77	72	62	65	67	67	63
0.3	80	83	78	62	65	67	67	63
0.4	86	91	86	62	65	67	67	63
0.5	93	101	97	62	65	67	67	63
0.6	103	112	111	62	65	67	67	63
0.7	114	125	129	62	65	67	67	63
0.8	128	140	150	62	65	68	68	63
0.9	144	157	173	62	65	68	68	63
1	162	175	197	62	66	69	69	63
1.1	182	195	224	62	66	69	69	63
1.2	205	217	252	62	67	70	70	63
1.3	230	242	282	62	67	72	72	63
1.4	258	269	315	62	68	73	73	63
1.5	288	299	352	62	69	75	75	63
1.6	320	331	394	62	70	77	77	63
1.7	354	364	438	62	71	80	80	63
1.8	390	401	485	62	72	82	82	63
1.9	430	439	534	62	73	85	85	63
2	470	479	583	62	74	88	88	63
2.1	509	516	628	63	76	91	91	63
2.2	543	546	666	63	77	94	94	63
2.3	573	572	698	62	79	97	97	63
2.4	599	593	723	63	81	100	100	63
2.5	621	611	742	63	82	102	102	63
2.6	639	625	756	63	84	105	105	63
2.7	655	637	767	63	86	108	108	63
2.8	668	647	774	63	88	111	111	63
2.9	678	655	779	63	89	113	113	63
3	687	661	782	63	91	116	116	64
3.1	693	666	783	63	92	118	118	64
3.2	699	670	783	63	94	120	120	64
3.3	703	673	783	63	96	122	122	64
3.4	705	676	780	63	97	124	124	64
3.5	707	677	778	64	99	126	126	64
3.6	708	678	775	64	100	127	127	65
3.7	709	678	771	64	101	129	129	65
3.8	709	679	768	64	102	130	130	65
3.9	713	683	769	65	103	131	131	66
4	719	690	773	65	105	132	132	66
4.1	727	700	782	65	106	134	134	66
4.2	738	714	795	65	107	135	135	67
4.3	750	729	811	66	108	136	136	67

Time (min)	Furnace Probe # 2 (°F)	Furnace Probe # 3 (°F)	Furnace Probe # 4 (°F)	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
4.4	764	748	829	66	109	137	137	67
4.5	781	769	850	66	110	138	138	67
4.6	800	791	872	67	111	139	139	68
4.7	820	815	896	67	112	141	141	68
4.8	841	840	920	67	114	142	142	69
4.9	862	867	944	68	116	144	143	69
5	885	893	969	68	117	148	145	69
5.1	908	919	993	68	120	152	146	70
5.2	931	944	1018	69	122	158	147	70
5.3	953	969	1043	69	124	164	149	70
5.4	975	993	1067	69	126	170	150	71
5.5	996	1017	1090	70	128	176	151	71
5.6	1017	1039	1112	70	130	180	153	71
5.7	1038	1060	1132	70	132	184	154	72
5.8	1057	1080	1151	71	134	188	155	72
5.9	1074	1097	1167	71	136	190	157	73
6	1089	1111	1180	72	138	193	159	73
6.1	1101	1120	1188	72	140	194	160	73
6.2	1111	1126	1193	73	142	196	162	74
6.3	1118	1130	1195	73	143	198	164	74
6.4	1124	1133	1196	74	145	200	166	75
6.5	1127	1133	1195	74	146	202	168	75
6.6	1128	1131	1192	75	147	203	170	76
6.7	1126	1127	1187	75	148	204	172	76
6.8	1124	1123	1181	76	149	205	173	77
6.9	1120	1118	1174	76	150	205	175	78
7	1117	1113	1168	77	151	205	177	78
7.1	1113	1108	1161	78	152	206	178	79
7.2	1110	1104	1156	78	153	206	180	79
7.3	1108	1103	1152	79	154	206	181	80
7.4	1107	1102	1149	79	154	206	182	80
7.5	1107	1103	1148	80	155	207	183	81
7.6	1107	1106	1149	81	156	207	184	81
7.7	1108	1111	1149	81	157	207	186	82
7.8	1110	1116	1150	82	158	207	187	82
7.9	1112	1121	1152	83	159	207	188	83
8	1114	1126	1155	84	160	207	189	84
8.1	1119	1132	1159	84	161	208	190	84
8.2	1126	1139	1164	85	162	208	191	85
8.3	1132	1145	1170	85	163	208	192	85
8.4	1140	1151	1176	86	164	209	194	86
8.5	1148	1158	1182	86	164	209	195	86
8.6	1156	1164	1188	87	166	210	197	87
8.7	1164	1170	1194	87	166	210	198	87

Time (min)	Furnace Probe # 2 (°F)	Furnace Probe # 3 (°F)	Furnace Probe # 4 (°F)	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
8.8	1172	1177	1201	88	167	210	200	88
8.9	1181	1183	1207	89	168	210	202	89
9	1190	1190	1213	89	169	211	203	89
9.1	1198	1196	1219	90	170	211	204	90
9.2	1207	1202	1225	90	171	211	205	90
9.3	1215	1208	1231	91	171	211	205	91
9.4	1222	1213	1237	92	172	211	206	92
9.5	1231	1219	1242	92	173	211	206	92
9.6	1240	1225	1248	93	174	211	206	93
9.7	1250	1233	1255	93	175	211	206	93
9.8	1260	1243	1264	94	177	212	207	94
9.9	1267	1252	1274	95	178	212	207	95
10	1276	1263	1284	95	179	212	207	95
10.1	1283	1274	1294	96	180	212	207	96
10.2	1291	1285	1305	97	181	213	208	97
10.3	1300	1298	1317	97	182	213	208	97
10.4	1307	1308	1327	98	183	213	209	98
10.5	1313	1315	1335	99	184	213	210	99
10.6	1319	1321	1340	99	184	213	210	99
10.7	1323	1324	1342	100	185	214	211	100
10.8	1326	1325	1344	101	185	214	212	101
10.9	1328	1326	1344	101	186	214	213	101
11	1330	1325	1344	102	186	214	213	102
11.1	1331	1325	1343	103	187	215	214	103
11.2	1331	1324	1341	103	187	215	214	103
11.3	1332	1322	1339	104	188	215	214	104
11.4	1333	1321	1337	105	188	216	215	105
11.5	1334	1321	1336	106	189	216	215	106
11.6	1335	1322	1335	107	190	217	216	107
11.7	1337	1324	1336	107	190	217	216	107
11.8	1339	1326	1338	108	190	218	216	108
11.9	1342	1330	1340	109	191	218	216	109
12	1345	1335	1343	109	191	219	217	109
12.1	1347	1339	1346	110	192	219	217	110
12.2	1350	1344	1349	111	192	220	218	111
12.3	1352	1349	1352	112	193	221	218	112
12.4	1355	1354	1356	113	193	221	218	113
12.5	1357	1359	1360	113	194	222	219	113
12.6	1360	1363	1364	114	194	223	219	114
12.7	1362	1367	1368	115	195	224	220	115
12.8	1364	1371	1370	116	196	225	221	116
12.9	1366	1373	1373	116	196	226	221	116
13	1368	1375	1375	117	197	227	222	117
13.1	1369	1376	1377	118	198	228	223	118

Time (min)	Furnace	Furnace	Furnace	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
	Probe # 2 (°F)	Probe # 3 (°F)	Probe # 4 (°F)					
13.2	1371	1377	1378	119	199	229	224	119
13.3	1371	1376	1377	120	199	230	225	120
13.4	1372	1375	1375	120	200	231	226	120
13.5	1371	1374	1373	121	201	232	227	121
13.6	1371	1372	1371	122	201	233	228	122
13.7	1370	1370	1368	123	202	234	229	123
13.8	1369	1368	1366	124	203	235	230	124
13.9	1368	1367	1364	124	204	237	231	124
14	1369	1366	1362	125	204	238	232	125
14.1	1369	1365	1362	126	205	239	233	126
14.2	1370	1366	1362	127	206	240	234	127
14.3	1371	1366	1362	128	207	242	235	128
14.4	1373	1367	1362	128	208	243	236	128
14.5	1375	1368	1363	129	209	244	237	129
14.6	1377	1369	1365	130	210	245	239	130
14.7	1381	1373	1370	131	211	247	240	131
14.8	1386	1378	1378	132	212	248	241	132
14.9	1390	1383	1387	133	212	249	242	133
15	1394	1388	1395	133	213	250	244	133
15.1	1397	1395	1402	134	214	251	245	134
15.2	1400	1401	1410	135	215	253	247	135
15.3	1403	1407	1415	136	216	254	248	136
15.4	1407	1413	1419	137	217	255	249	137
15.5	1410	1417	1423	138	218	256	251	138
15.6	1414	1421	1425	138	218	257	252	138
15.7	1418	1425	1428	139	219	258	254	139
15.8	1422	1429	1432	140	220	260	255	140
15.9	1426	1432	1435	141	221	261	257	141
16	1428	1434	1436	142	222	262	258	142
16.1	1429	1432	1434	143	223	264	260	143
16.2	1427	1430	1430	144	224	265	261	144
16.3	1425	1426	1426	145	226	267	263	145
16.4	1423	1423	1420	146	227	269	265	146
16.5	1420	1419	1415	147	228	270	266	147
16.6	1417	1415	1410	148	229	272	268	148
16.7	1413	1410	1405	148	230	273	269	148
16.8	1410	1407	1399	149	231	275	271	149
16.9	1407	1404	1394	150	232	277	272	150
17	1406	1402	1392	151	233	278	274	151
17.1	1405	1401	1391	152	234	280	275	152
17.2	1406	1402	1391	153	236	282	277	153
17.3	1408	1404	1393	153	236	283	278	153
17.4	1412	1407	1396	154	238	285	280	154
17.5	1415	1411	1400	155	239	287	282	155

Time (min)	Furnace Probe # 2 (°F)	Furnace Probe # 3 (°F)	Furnace Probe # 4 (°F)	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
17.6	1420	1415	1404	156	240	288	283	156
17.7	1424	1420	1409	157	241	290	285	157
17.8	1429	1426	1413	158	242	292	286	158
17.9	1434	1431	1419	159	244	294	288	159
18	1439	1436	1424	160	245	295	290	160
18.1	1443	1441	1429	161	246	297	291	161
18.2	1447	1444	1432	162	248	299	293	162
18.3	1450	1446	1434	162	249	301	294	162
18.4	1452	1447	1435	164	250	303	296	164
18.5	1453	1448	1436	165	252	305	297	165
18.6	1454	1448	1436	166	253	306	299	166
18.7	1455	1449	1437	167	254	308	300	167
18.8	1456	1450	1437	168	256	310	302	168
18.9	1457	1450	1437	169	257	312	304	169
19	1458	1451	1437	170	259	314	305	170
19.1	1458	1451	1436	171	260	315	307	171
19.2	1458	1452	1436	172	261	317	308	172
19.3	1460	1453	1436	174	263	319	310	174
19.4	1461	1454	1436	175	264	320	312	175
19.5	1462	1455	1436	176	265	322	314	176
19.6	1463	1455	1436	177	267	324	315	177
19.7	1464	1455	1436	179	268	326	317	179
19.8	1463	1455	1435	180	269	327	319	180
19.9	1463	1455	1435	182	271	329	321	182
20	1463	1455	1434	183	272	330	322	183
20.1	1464	1456	1434	185	274	332	324	185
20.2	1465	1457	1435	186	275	333	326	186
20.3	1467	1459	1437	187	276	335	328	187
20.4	1469	1461	1439	189	277	337	330	189
20.5	1473	1464	1440	190	279	339	331	190
20.6	1476	1466	1442	192	280	341	333	192
20.7	1479	1469	1445	193	282	343	335	193
20.8	1481	1471	1447	194	283	345	337	194
20.9	1483	1474	1450	195	284	347	338	195
21	1486	1477	1452	196	286	348	340	196
21.1	1488	1479	1455	197	287	351	342	197
21.2	1491	1482	1457	198	289	353	343	198
21.3	1494	1484	1459	199	290	354	345	199
21.4	1496	1487	1461	200	291	356	347	200
21.5	1498	1489	1463	201	293	358	348	201
21.6	1500	1491	1465	201	294	360	350	201
21.7	1502	1493	1467	202	295	362	353	202
21.8	1502	1493	1467	203	297	364	355	203
21.9	1501	1491	1466	203	298	366	356	203

Time (min)	Furnace Probe # 2 (°F)	Furnace Probe # 3 (°F)	Furnace Probe # 4 (°F)	Sample Min (°F)	Sample Avg (°F)	Sample Max (°F)	Sample TC #1 (°F)	Sample TC #2 (°F)
22	1499	1489	1464	204	299	367	358	204
22.1	1497	1487	1462	204	300	369	360	204
22.2	1495	1486	1460	205	302	371	362	205
22.3	1493	1485	1460	205	303	373	364	205
22.4	1493	1485	1460	206	304	375	366	206
22.5	1494	1486	1460	206	305	376	367	206
22.6	1495	1486	1461	206	306	378	370	206
22.7	1497	1487	1461	207	307	380	371	207
22.8	1499	1488	1462	207	308	382	373	207
22.9	1500	1489	1463	207	310	384	375	208
23	1500	1490	1464	207	310	385	371	208
23.1	1500	1491	1464	208	311	387	369	208
23.2	1500	1491	1465	208	312	389	370	209
23.3	1501	1492	1466	209	314	391	371	209
23.4	1502	1493	1467	209	315	393	373	209
23.5	1503	1494	1468	209	316	395	375	209
23.6	1505	1496	1470	209	317	397	376	209
23.7	1508	1500	1473	209	319	399	378	210
23.8	1511	1504	1477	209	320	401	380	210
23.9	1515	1510	1482	209	321	403	382	211
24	1519	1516	1488	209	323	405	383	212
Max Temp @ 15 min.				133	213	250	244	133
Max Allowed				388	315	391	391	388

Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
0	65	66	63	66	65	63	65	69
0.1	65	65	63	66	65	62	65	69
0.2	65	66	63	66	65	62	65	69
0.3	65	66	63	66	65	62	65	69
0.4	66	66	63	66	65	62	65	69
0.5	66	66	63	66	65	62	65	69
0.6	66	66	63	66	65	62	66	69
0.7	66	66	63	66	65	62	66	69
0.8	66	67	63	67	66	62	66	69
0.9	67	67	63	67	66	62	66	69
1	67	67	63	68	66	62	67	69
1.1	67	68	63	68	66	62	67	69
1.2	68	68	63	70	67	62	68	69
1.3	69	69	63	71	68	62	69	69
1.4	70	70	63	72	68	62	70	69
1.5	70	70	63	74	69	62	71	69
1.6	72	71	63	76	70	62	73	69
1.7	73	72	63	78	72	62	74	69
1.8	74	74	63	80	73	62	76	69
1.9	75	75	63	82	74	62	78	69
2	77	77	63	85	76	62	79	69
2.1	78	78	63	87	78	63	81	69
2.2	80	81	63	89	80	63	84	69
2.3	82	83	63	92	82	62	86	69
2.4	84	86	64	94	84	63	88	69
2.5	86	88	63	97	87	63	91	69
2.6	88	92	64	99	89	63	93	69
2.7	90	95	64	102	92	63	96	69
2.8	93	98	64	104	94	63	98	69
2.9	95	101	64	106	97	63	101	69
3	97	104	64	109	99	63	103	69
3.1	99	107	64	111	101	63	105	69
3.2	102	110	64	113	103	63	108	69
3.3	104	113	65	115	106	63	110	69
3.4	106	115	65	117	107	63	112	69
3.5	108	117	65	119	109	64	115	69
3.6	110	119	65	120	111	64	117	69
3.7	112	120	66	122	113	64	119	69
3.8	114	122	66	124	115	64	121	69
3.9	115	123	66	125	116	65	123	69
4	117	125	67	127	118	65	124	69
4.1	119	126	67	128	119	65	126	69
4.2	120	128	67	130	120	65	128	69
4.3	122	129	68	131	122	66	129	69

Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
4.4	123	130	68	133	123	66	131	69
4.5	125	132	68	134	124	66	133	69
4.6	126	134	69	136	126	67	135	69
4.7	128	136	69	138	127	67	137	69
4.8	130	138	70	140	129	67	140	69
4.9	132	142	70	143	130	68	144	69
5	134	146	70	145	132	68	148	69
5.1	136	152	71	148	133	68	152	69
5.2	138	158	71	150	135	69	157	69
5.3	140	164	72	153	137	69	162	69
5.4	142	170	72	156	138	69	166	69
5.5	144	176	72	160	140	70	170	69
5.6	146	180	73	164	142	70	173	69
5.7	148	184	73	168	144	70	176	69
5.8	150	188	73	173	146	71	178	69
5.9	151	190	74	178	148	71	182	69
6	153	193	74	183	150	72	186	69
6.1	155	194	75	187	152	72	190	69
6.2	157	196	75	190	155	73	194	69
6.3	158	197	76	193	157	73	198	69
6.4	160	198	76	195	159	74	200	69
6.5	162	199	77	197	161	74	202	69
6.6	164	200	77	198	163	75	203	70
6.7	165	200	78	199	165	75	204	69
6.8	167	201	78	200	167	76	205	69
6.9	169	201	79	201	169	76	205	70
7	170	202	80	201	171	77	205	69
7.1	172	202	80	202	173	78	206	69
7.2	174	202	81	202	174	78	206	69
7.3	176	203	81	203	176	79	206	69
7.4	178	203	82	203	177	79	206	69
7.5	180	203	83	203	179	80	207	69
7.6	182	204	84	204	180	81	207	69
7.7	184	204	84	204	181	81	207	69
7.8	186	205	85	204	183	82	207	70
7.9	189	206	86	205	184	83	207	70
8	191	206	86	205	185	84	207	70
8.1	193	207	87	206	187	84	208	70
8.2	195	207	88	206	189	85	208	70
8.3	198	208	89	206	191	86	208	70
8.4	199	209	89	207	193	87	208	70
8.5	201	209	90	207	195	87	208	70
8.6	203	210	92	207	198	88	208	70
8.7	204	210	93	208	201	89	208	70

Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
8.8	205	210	94	208	204	89	208	70
8.9	206	210	95	208	206	90	209	70
9	207	211	97	208	207	91	209	70
9.1	207	211	99	208	209	92	209	70
9.2	208	211	102	208	209	93	209	70
9.3	208	211	106	208	210	93	210	70
9.4	208	211	110	208	210	94	210	70
9.5	208	211	116	209	211	95	211	70
9.6	208	211	123	209	211	96	211	70
9.7	208	211	132	210	211	97	211	70
9.8	209	211	140	210	212	98	212	70
9.9	209	211	148	210	212	98	212	70
10	209	211	157	211	212	99	212	70
10.1	209	211	163	211	212	100	212	70
10.2	209	212	169	211	212	101	213	70
10.3	210	212	173	212	212	102	213	70
10.4	210	212	177	212	212	103	213	70
10.5	210	213	180	212	212	103	213	70
10.6	210	213	183	212	212	104	213	70
10.7	211	213	184	213	212	105	214	70
10.8	211	213	187	213	212	106	214	70
10.9	211	213	189	213	212	106	214	70
11	211	213	190	213	213	107	214	70
11.1	212	214	192	214	213	108	215	70
11.2	212	214	193	214	213	109	215	70
11.3	212	214	194	214	213	110	215	70
11.4	213	214	195	215	213	110	216	70
11.5	213	214	196	215	214	112	216	70
11.6	213	215	197	216	214	112	217	70
11.7	214	215	197	216	214	113	217	70
11.8	214	215	198	217	214	114	218	70
11.9	214	215	198	217	215	115	218	70
12	215	215	199	218	215	116	219	70
12.1	215	216	199	219	215	117	219	70
12.2	215	216	200	220	215	117	220	70
12.3	215	216	200	220	215	118	221	70
12.4	216	216	200	221	215	119	221	70
12.5	216	217	201	222	216	120	222	70
12.6	216	217	201	223	216	121	223	70
12.7	217	217	201	224	216	122	224	70
12.8	217	218	201	225	217	123	225	70
12.9	217	218	202	226	217	124	226	70
13	218	219	202	227	217	125	227	70
13.1	218	219	202	228	217	126	228	70

Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
13.2	219	220	202	229	218	127	229	70
13.3	219	220	202	230	218	128	230	70
13.4	219	221	202	231	219	129	231	70
13.5	220	222	203	232	219	129	232	70
13.6	220	222	203	233	219	131	233	70
13.7	221	223	203	234	220	131	234	70
13.8	221	224	203	235	220	132	235	70
13.9	222	225	203	237	221	133	237	70
14	223	226	203	238	221	134	238	70
14.1	223	227	203	239	222	135	239	70
14.2	224	228	203	240	222	136	240	70
14.3	225	229	203	242	223	137	242	70
14.4	225	230	204	243	224	138	243	70
14.5	226	232	204	244	224	139	244	70
14.6	227	233	204	245	225	140	245	70
14.7	228	234	204	247	226	141	246	70
14.8	229	235	204	248	226	142	247	70
14.9	229	236	204	249	227	142	248	70
15	230	238	204	250	228	143	249	70
15.1	231	239	204	251	229	144	250	70
15.2	232	240	204	253	229	145	251	70
15.3	232	241	204	254	230	146	251	70
15.4	233	243	205	255	231	147	252	70
15.5	234	244	205	256	232	148	252	70
15.6	234	245	205	257	233	149	251	70
15.7	235	246	205	258	234	150	252	70
15.8	237	247	205	260	235	151	254	70
15.9	238	248	205	261	236	151	255	70
16	239	249	205	262	237	152	256	71
16.1	240	250	206	264	238	153	257	71
16.2	241	251	206	265	239	154	258	70
16.3	242	253	206	267	240	155	260	70
16.4	243	254	206	269	241	156	261	70
16.5	244	255	206	270	242	157	264	70
16.6	245	256	206	272	243	158	265	70
16.7	246	257	206	273	244	159	266	70
16.8	247	258	207	275	245	160	267	70
16.9	249	260	206	277	246	160	268	70
17	250	261	207	278	248	161	269	70
17.1	252	262	207	280	249	162	271	70
17.2	253	264	207	282	250	163	272	70
17.3	254	265	207	283	251	164	273	70
17.4	256	266	207	285	253	165	274	70
17.5	257	267	207	287	254	166	275	70

Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
17.6	259	269	208	288	255	167	277	70
17.7	260	270	207	290	256	168	278	70
17.8	261	271	208	292	258	169	279	70
17.9	263	272	208	294	259	170	281	70
18	265	273	208	295	261	171	282	70
18.1	266	274	208	297	262	173	284	70
18.2	268	276	208	299	263	175	285	70
18.3	270	277	208	301	265	176	287	70
18.4	271	278	209	303	266	178	288	70
18.5	273	279	209	305	268	180	290	70
18.6	275	280	209	306	269	181	291	70
18.7	277	282	209	308	271	183	293	70
18.8	278	283	209	310	272	184	294	70
18.9	280	284	209	312	273	186	296	70
19	282	285	210	314	275	188	298	71
19.1	284	286	210	315	277	189	299	70
19.2	286	288	210	317	278	191	301	70
19.3	288	289	210	319	280	192	303	70
19.4	289	291	210	320	281	193	304	70
19.5	291	292	211	322	283	194	306	70
19.6	293	294	210	324	284	195	308	70
19.7	295	295	211	326	286	196	310	70
19.8	296	296	211	327	288	196	311	70
19.9	298	298	211	329	289	197	313	70
20	300	299	210	330	291	197	315	70
20.1	302	301	211	332	293	198	316	70
20.2	303	302	212	333	294	198	318	70
20.3	305	303	212	335	296	199	319	71
20.4	307	305	212	337	297	199	321	71
20.5	309	306	213	339	299	200	322	71
20.6	310	308	214	341	301	200	324	71
20.7	312	309	215	343	302	200	325	71
20.8	314	311	216	345	304	201	327	71
20.9	315	312	217	347	306	202	328	71
21	317	314	218	348	307	203	330	71
21.1	319	315	219	351	309	204	331	70
21.2	320	317	220	353	310	204	333	71
21.3	322	318	221	354	312	205	334	70
21.4	323	319	222	356	313	205	336	70
21.5	325	321	223	358	315	205	337	70
21.6	327	322	224	360	316	205	338	71
21.7	329	324	226	362	318	205	340	71
21.8	330	326	227	364	320	206	341	71
21.9	332	327	228	366	321	206	343	71

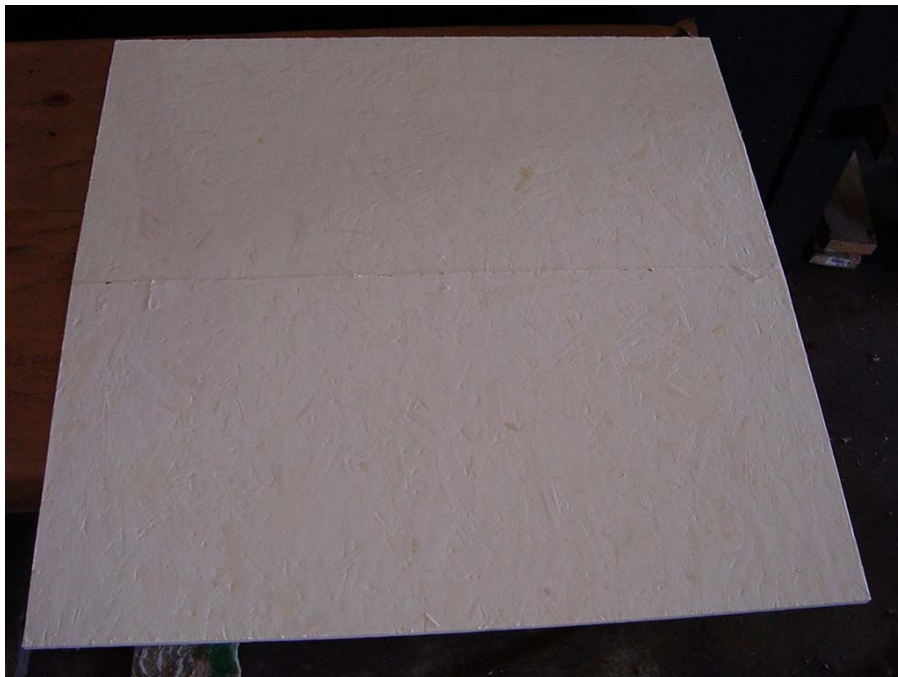
Time (min)	Sample TC #3 (°F)	Sample TC #4 (°F)	Sample TC #5 (°F)	Sample TC #6 (°F)	Sample TC #7 (°F)	Sample TC #8 (°F)	Sample TC #9 (°F)	Lab Ambient (°F)
22	334	329	228	367	323	206	344	71
22.1	335	330	229	369	324	206	345	71
22.2	337	332	229	371	326	206	347	71
22.3	339	334	229	373	327	206	348	71
22.4	340	335	229	375	329	206	349	71
22.5	342	337	228	376	331	206	351	71
22.6	343	339	227	378	332	206	353	71
22.7	345	341	227	380	334	207	354	71
22.8	347	342	227	382	335	207	356	71
22.9	348	344	227	384	337	207	357	71
23	350	346	227	385	339	207	359	71
23.1	352	347	228	387	340	208	361	71
23.2	353	349	229	389	342	208	362	71
23.3	355	351	230	391	343	209	364	71
23.4	356	352	231	393	345	209	365	71
23.5	358	354	232	395	347	210	367	71
23.6	360	355	234	397	348	209	368	71
23.7	362	357	234	399	350	209	370	71
23.8	363	359	235	401	351	209	372	71
23.9	365	361	236	403	353	209	373	71
24	366	362	238	405	354	209	375	71
Max Temp @ 15 min.	230	238	204	250	228	143	249	
Max Allowed	390	391	388	391	390	388	390	

APPENDIX B
PHOTOGRAPHS





Sample as received at the laboratory



Sample as received at the laboratory





Unexposed surface



End view showing surface spline





Sample mounted in the test frame prior to mounting on the furnace



Sample mounted in the test frame prior to mounting on the furnace



Start of test



Furnace interior (sample at bottom)





Exposed surface

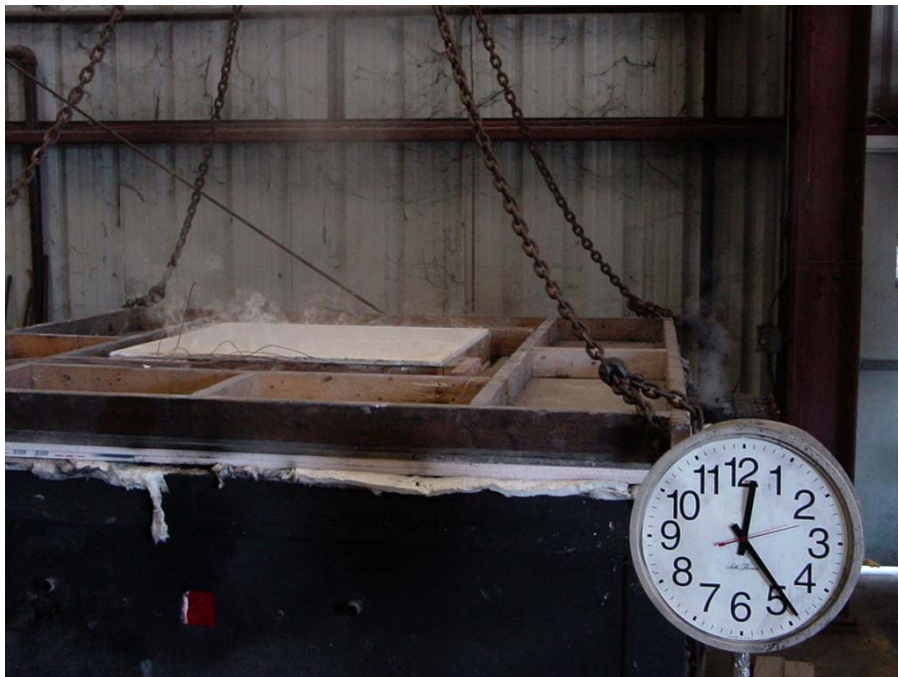


15 minutes





Furnace interior



Furnace extinguished after 24 minutes





Sample after the test



Sample after the test

