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ASTM E119  
Fire Resistance Performance

TEST REPORT

Rendered to:

QUAIL SPRINGS

WALL ASSEMBLY:

*Mono-Density Cob Wall*

Report No.: QS032921-80  
Test Date(s): 12/07/2021  
Report Date: 01/11/2022  
39 pages

QS032921-80

01/11/2022

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## TEST REPORT

Rendered to:

QUAIL SPRINGS  
35070 California 33  
Maricopa, CA 93252

Report No.: QS032921-80  
Test Date: 12/07/2021  
Report Date: 01/11/2022

### **1.0 General Information**

#### **1.1 Product**

*Mono-Density Cob Wall*

#### **1.2 Project Summary**

ICC NTA, LLC was contracted by QUAIL SPRINGS to evaluate a wall assembly that includes earthen building practices within modern building codes to achieve sustainable and affordable living using earthen materials in accordance with ASTM E119. Testing was conducted at ICC NTA, LLC Southwest Test Facility in Bryan, Texas. Results obtained are tested values and were secured by using the designated test method(s). Test results and construction details are reported herein.

#### **1.3 Product Description**

Quail Springs constructed a wall assembly that uses earthen building materials such as monolithic adobe also known as cob. The wall consisted of a combination of clay, sand, and straw.

#### **1.4 Qualifications**

ICC NTA located in Bryan, TX has demonstrated compliance with ISO/IEC 17025 as an accredited as a Testing Laboratory and has performed all tests reported herein.

#### **1.5 Product Sampling**

No sampling information for the test specimen reported herein.

#### **1.6 Witnessing**

Representatives of Quail Springs were present for testing reported herein.

## 1.7 Conditions of Testing

Unless otherwise indicated, all testing reported herein was conducted in ambient laboratory conditions.

## 2.0 Referenced Standards

**ASTM E119-18c, Standard Test Methods for Fire Tests of Building Construction and Materials**

## 3.0 Summary of Results

**Fire Resistance Period: 120 minutes**

**Hose Stream Result: Pass**

**Loadbearing Assembly**

## 4.0 Test Method

The wall assembly was evaluated in accordance with the following:

- ASTM E119-18c, Standard Test Methods for Fire Tests of Building Construction and Materials. ASTM International, West Conshohocken, PA.

### 4.1 General

#### Fire Endurance Test

The fire exposure is continued on the specimen with its applied load, if applicable, until failure occurs, or until the specimen has withstood the test conditions for the desired fire endurance rating.

#### Test Furnace

The test furnace is designed to allow the test specimen to uniformly be exposed to the specified time-temperature conditions. It is fitted with six (6) premixed, natural gas/air burners positioned along the floor, on the left and right-side walls, designed to provide an even heat flux distribution across the face of the test specimen while inhibiting direct flame introduction. Each burner can produce a maximum of 1.5 MBtu/hr. The test engineer/technician has overall control of the furnace temperature by controlling the amount of gas air supplied to the burners thereby controlling the overall energy input into the furnace. The furnace opening is 14-ft. wide by 12-ft. tall but can be reduced to 10-ft. wide by 10-ft. tall using an adapter.

The temperature within the furnace is determined to be the mathematical average of thermocouples located symmetrically within the furnace and positioned twelve (12) inches away from the exposed face(s) of the test specimen. The construction of these thermocouples is per ASTM E119. During the test, the furnace temperatures are recorded and displayed every 15 seconds to allow for the test engineer to control the energy input and follow the specified time-temperature curve. The data is saved every minute for report purposes.

The furnace interior temperature during a test is controlled such that the corresponding area under the time-temperature curve is within 10% of the corresponding area under the standard time-temperature curve for one (1) hour or less tests, 7.5% for tests longer than 1 hour, but less than two (2) hours, and 5% for tests longer than two (2) hours.

The fire exposure is controlled in order to follow the standard time-temperature curve, see Figure No. 1 in Appendix B - Data.

### Temperatures of Unexposed Surfaces

Temperatures of the unexposed face are monitored using 18-gauge or lighter gauge, Type K thermocouples placed under 6-inch x 6-inch x 0.4-inch-thick, dry felted pads as described in the standard. Temperature readings are taken at not less than nine points on the surface, at intervals not exceeding one minute. The temperature on the unexposed surface is to be taken as the average value of all nine thermocouples.

### Hose Stream Test

If required, this practice is intended to standardize the apparatus and method used to represent a standard hose stream to building elements as part of the assessment and fire resistance of building products. This practice specifies the water pressure and duration of application of the hose stream to the test assembly. This practice is to be used only after a test assembly has completed a prescribed standard fire-resistance test. The practice exposes a test assembly to a standard hose stream under controlled laboratory conditions. The apparatus used to apply the hose stream is built per the standard with a 2-1/2-in. diameter hose to a playpipe with a 1-1/8-in. discharge tip that delivers a solid stream of water. Hose stream application time and water pressure varies based on the intended fire resistance period. The nozzle tip is located 20 feet away from the test assembly and verified prior to applying the hose stream to the test assembly. The hose stream starts at one corner of the test assembly and the stream is directed to the entire face of the test assembly. The hose stream follows the pattern provided in the standard. A fully developed hose stream shall not pass through the unexposed face of the test assembly.

## Applied Load

If required, this test method may be used to expose a test specimen to fire and hose stream tests while maintaining a compressive load on the wall. The load bearing wall is constructed within the top and bottom masonry/steel constraints. This is achieved in this laboratory using a load-bearing frame which has a movable base section. Hydraulic actuators press upwards on the bottom beam applying the prescribed load to the test specimen.

For the testing reported herein, load was intended to be applied to the wall assembly at a provided value of 1,875 plf. The load applied can be expressed as follows:

Load Calculation	
Hydraulic Pressure Applied for each Actuator (psig)	340
No. of Actuators	3
Actuator Effective Area (sq. inches)	11.04
<b>Applied Load by all Actuators (lbs.)</b>	<b>11,261</b>
Dead Load – Estimated Weight of Walls (lbs.)	8,408
Dead Load – Weight of Load Beam & Blocks (lbs.)	2,606
Weight of Top Beam (lbs.)	207
Superimposed Load (lbs.)	247
Wall Length (feet)	10
<b>Superimposed Load per Wall Length (plf)</b>	<b>25</b>
Client Specified Superimposed Load per Wall Length (plf)	1,875

**Eqn. 1:** Applied Load by all Actuators =  $(340 \text{ psig}) \times (3 \text{ Actuators}) \times (11.04 \text{ sq. in.}) = 11,261 \text{ lbs.}$

**Eqn. 2** = Superimposed Load (added to Wall) =  $\text{Actuator Load} - (\text{Dead Load of Wall} + \text{Dead Load of Beam & Bricks} + \text{Weight of Top Beam}) + \text{Weight of Top Beam}$

Or

Superimposed Load =  $11,261 \text{ lbs.} - (8,408 \text{ lbs.} + 2,606 \text{ lbs.} + 207 \text{ lbs.}) + 207 \text{ lbs.} = 247 \text{ lbs.}$

## 4.2 Test Specimens

All material for the wall assembly was provided by Quail Springs. A wall assembly was constructed by Quail Springs. ICC NTA, LLC personnel provided and constructed a steel frame to house the wall assembly during construction and drying of the material. The side pieces of the frame were removed from the wall prior to applying a load to the wall assembly.

### Cob Material

The 10-ft. x 10-ft. wall assembly consisted of Red Silty Clay with Sand locally sourced from a fill material company. Straw was added to the clay at a predetermined ratio per the client. Water was added to the clay/straw material for workability and formed within the steel frame. The only asymmetry was that the unexposed face of the wall assembly was constructed to include a taper in the face. The bottom of the wall was nominally 11-in. thick and tapered off to approximately 9-in. thick at the top of the wall assembly. Recorded density measurements of the material were an average of 100.9 lbs. /cu. Ft. The material was allowed 6 months to dry before moving. Prior to the fire exposure, material was taken from the bottom of the wall assembly to assess the moisture content of the center depth of the wall. The material pulled was weighed and subsequently dried in an oven. After approximately 6 hours in the oven, the material was weighed again and found to have lost 0.7% of its initial mass.

### Structural Wire Mesh

A structural wire mesh cage was constructed of 6-gauge., 6-in. x 6-in. steel reinforcing mesh. The cob material was placed in and around the wire mesh cage. The mesh cage matched the overall geometry of the wall assembly with one face having a taper. The wire mesh was used to provide rigidity to the cob material as the wall was being constructed. The mesh cage was imbedded within the cob material per the client's specifications.

#### 4.3 Test Setup and Procedure

The wall assembly was setup and evaluated in accordance with ASTM E119-18c. The loadbearing wall assembly was placed in front of the vertical furnace at ICC NTA, Inc.'s Laboratory on 12/06/2021 with the vertical face of the assembly directed towards the heat exposure and the tapered face away from the heat exposure. The thermocouple leads were connected to the data acquisition system in the control room and the connection was verified prior to ignition. The ambient air temperature within the lab was 61°F, with a relative humidity of 52%.

Deviations from the standard(s) include: None

#### 4.4 Test Results

At 10:10 AM, the burners were ignited, and the furnace temperature was controlled following the standard time-temperature curve for a period of 120 minutes.

**TEST OBSERVATIONS**

Pre-Test	Load applied – Initial difference between Deflection reference and center of wall : 3-1/4-in. at the center of the wall
0:00	Burners Ignited, Test Started
5:00	No deflection to report
10:00	No deflection to report
15:00	No deflection
20:00	Deflection: 1/4-in. at the center of the wall
25:00	No change to exposed face
30:00	No change in deflection since 20-minute mark
33:00	No change to unexposed face; couple of hot spots within cob material on exposed face
40:00	Deflection: 1/2-in. in center of wall, 1/4-in. at the quarter points
41:00	No changes to exposed face or unexposed face
50:00	Deflection: 3/4-in. in center of wall, 1/2 - 1/4-in. at quarter points
1:00:00	Deflection: 1-in. in center of wall, 3/4-in. at quarter points
1:13:00	Deflection: 1-1/8-in. at center of wall assembly
1:15:00	No changes to the exposed face or the unexposed face
1:20:00	No change to deflection

1:30:00	Deflection: 1-1/2-in. at the center of the wall
1:40:00	No changes to the exposed or unexposed faces
1:40:00	No change in deflection
1:45:00	Deflection: No changes
1:50:00	No changes to deflection
1:55:00	No changes to deflection, overall 1-1/2-in. at center of wall face
2:00:00	Burners extinguished, end of fire exposure period; No changes to report on unexposed face

#### Hose Stream Observations

2:03:15	Hose Stream test started
2:05:45	Hose stream test completed; No projection of hose stream through unexposed face; The wall assembly sustained the applied load throughout the hose stream test

\*Tabular and graphical data can be found in Appendix B

#### 4.5 Summary and Conclusions

The loadbearing, asymmetrical wall assembly described in this report did meet the Conditions of Acceptance of ASTM E119 when exposed to the standard time-temperature curve. The average temperature of the unexposed face of the wall assembly did not exceed the temperature threshold of 250°F average temperature and the 325°F single point. The Mono-Density Cob Wall Assembly with the flat face exposed to the furnace withstood the fire exposure of ASTM E119 for a period of **120 minutes**. The wall assembly did meet the Acceptance Criteria of ASTM E2226 when exposed to the hose stream test.

Additionally, after the Fire endurance period and Hose stream test was performed, the client requested compressive load testing to be performed on the sample to assess the structural integrity of the material after exposed to the erosional effects of the ASTM E119 fire endurance period and hose stream test. The wall assembly ultimately sustained a superimposed load of 66,818 pounds. At which time, spalling of material at the top of the wall was observed, intending imminent failure of the wall assembly, and subsequently the hydraulic pressure was released. For observations and procedure of the compressive loading test, see Appendix C.

#### 5.0 Closing Statement

This report contains only findings and results arrived at after employing the specific test procedures listed herein. It does not constitute a recommendation for, endorsement of, or certification of the product or material tested. Unless differently required, ICC NTA, LLC reports apply the "Simple Acceptance" rule, also called "Shared Risk approach", of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity. ICC NTA makes no warranty, expressed or implied, except that the test has been performed, and a report prepared, based upon the specimen specified by the client. Extrapolation of data, from the test data provided herein, to the batch or lot from which the specimens were obtained may not correlate and should be interpreted with extreme caution. ICC NTA assumes no responsibility for variations in quality, composition, appearance, performance, or other features of similar materials produced by the client, other persons, or under conditions over which ICC NTA has no control. ICC NTA has issued this report for the exclusive use of the client to whom it is addressed. Any use or duplication of this report shall not be made without their consent. This report shall only be reproduced in its entirety.

For ICC NTA, LLC:

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Joseph Briski  
Test Engineer

01/11/2022

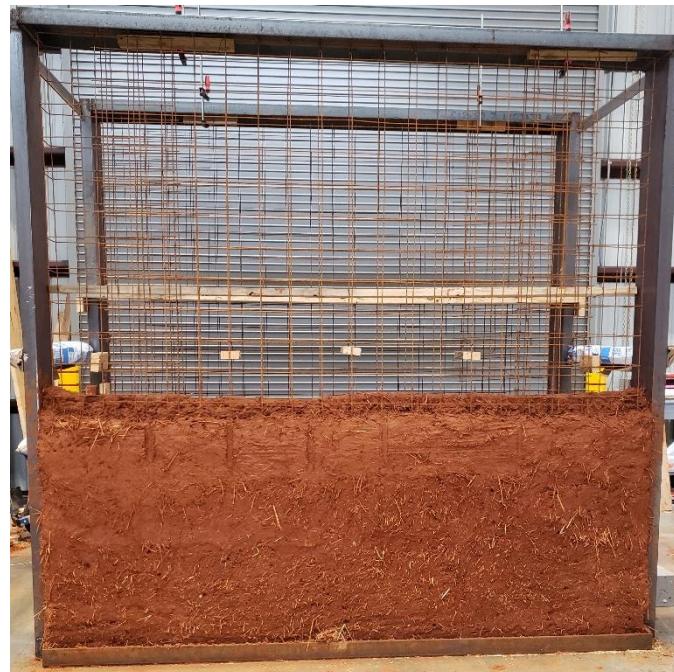
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Michael Luna  
Sr. Director

01/11/2022

## Appendix A - Photographs



**Photo No. 1**  
**Beginning stages of Mono-Density Cob wall construction**



**Photo No. 2**  
**Construction progress of Mono-Density Cob wall**



**Photo No. 3**  
**Completed construction of Mono-Density Cob Wall**



**Photo No. 4**  
**Completed Test-Setup**



Photo No. 5  
No changes to unexposed face

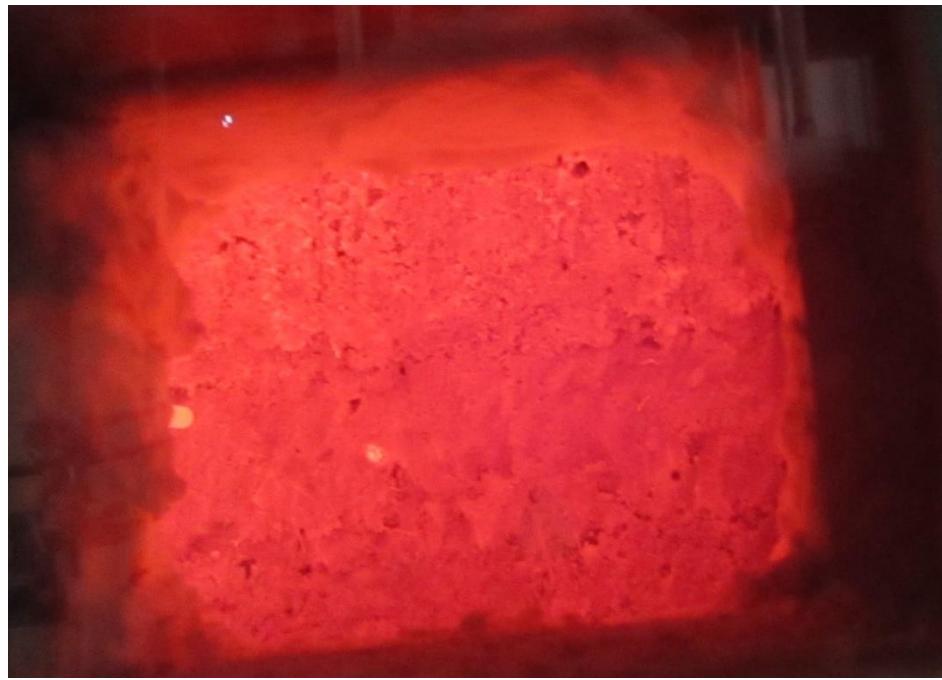
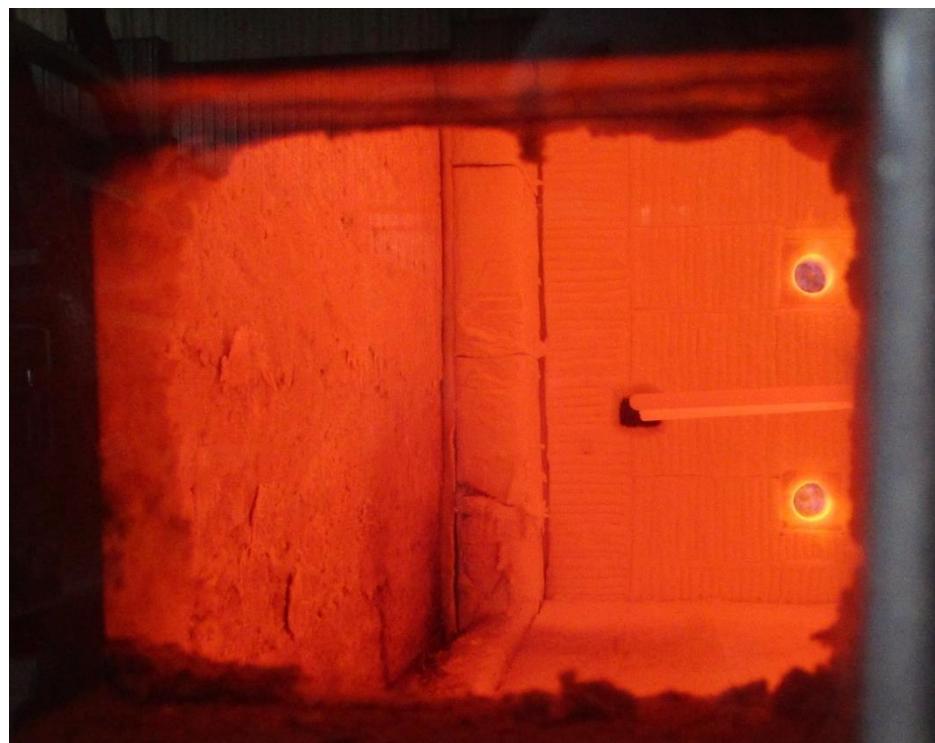


Photo No. 6  
Exposed face during test – (33:00 minutes into test)



**Photo No. 7**  
**Exposed face at 1-hr. into fire endurance portion of test**



**Photo No. 8**  
**Exposed face – (1:30:00)**



**Photo No. 9**  
**Unexposed face – (Post-Fire Endurance Period)**



**Photo No. 10**  
**Exposed face of wall assembly – (Post-Fire Endurance period)**



**Photo No. 11**  
**Exposed face – (Post-Hose Stream)**

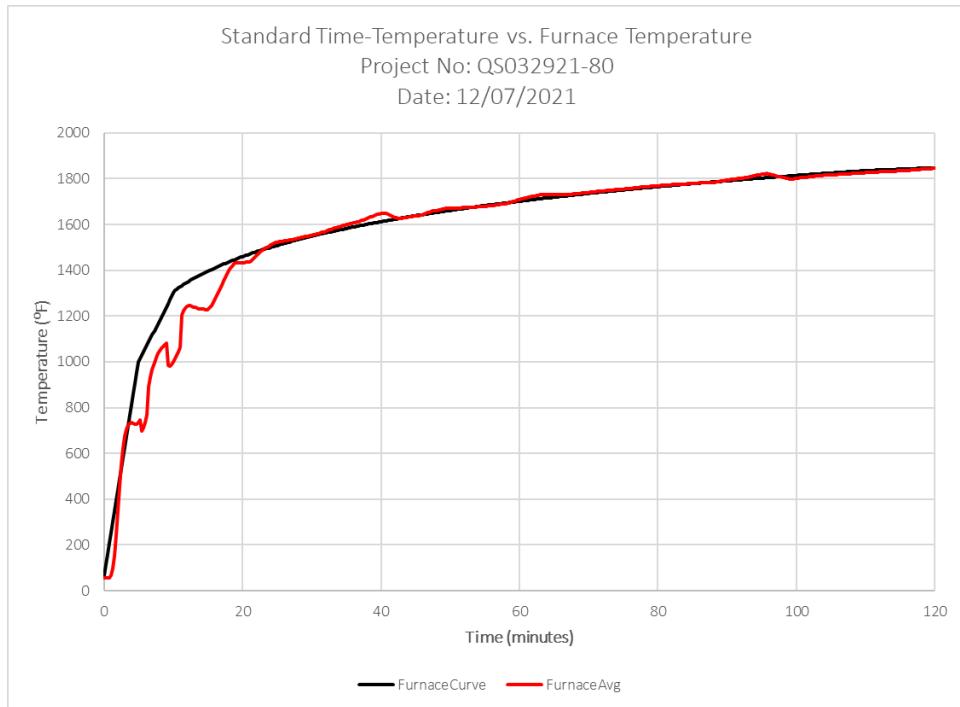


**Photo No. 12**  
**No changes to Unexposed face – (Post-Hose Stream)**

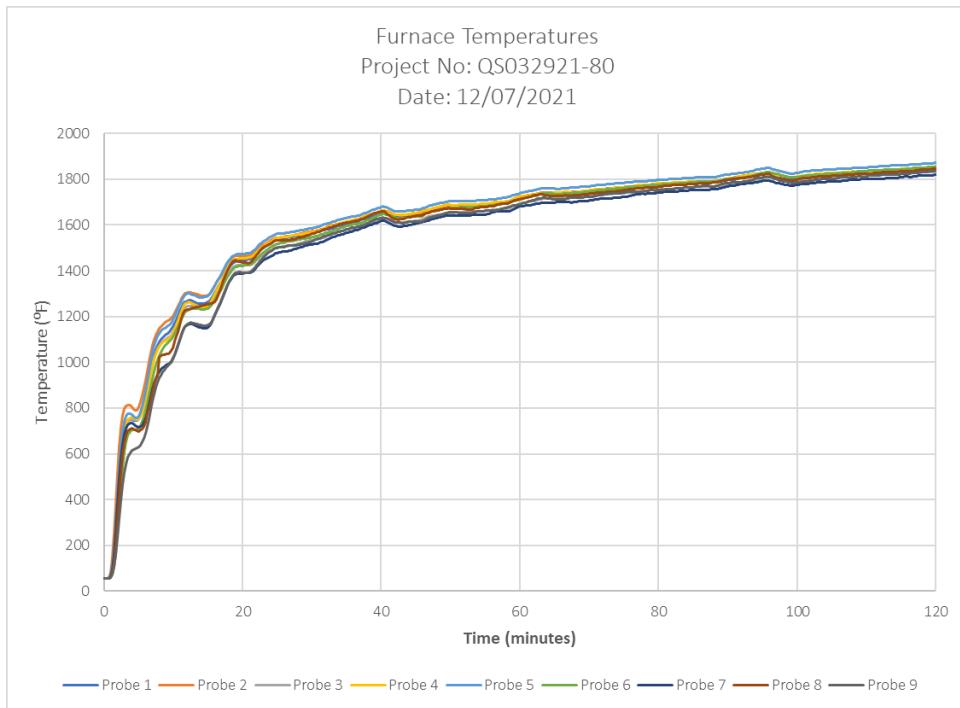


**Photo No. 13**  
**Wall assembly during additional compressive loading**

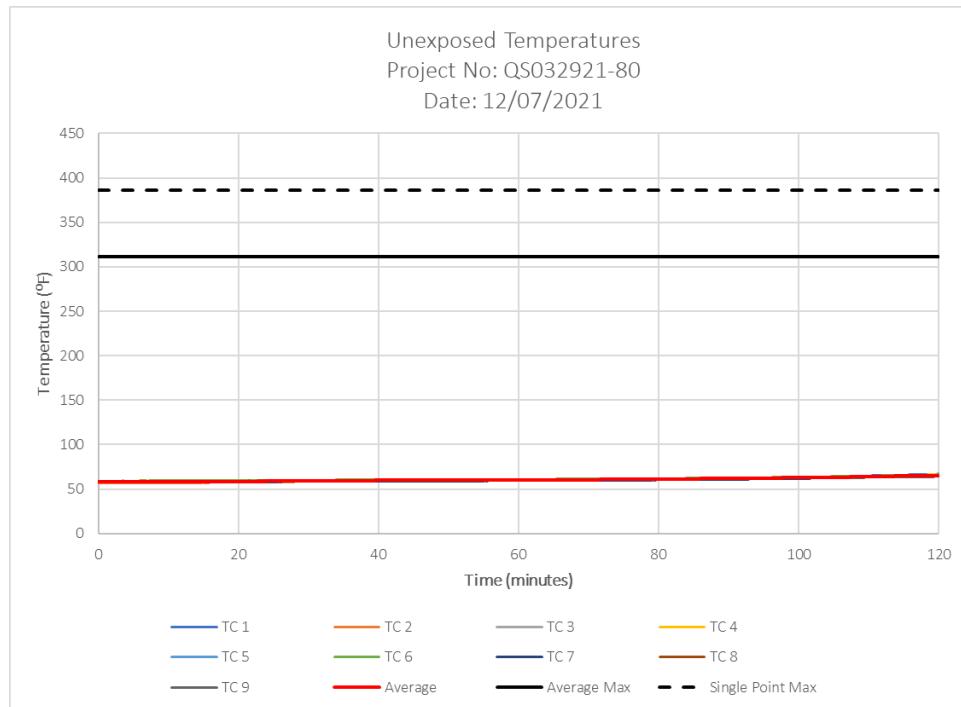
## Appendix B - Data



**Figure No. 1**



**Figure No. 2**



**Figure No. 3**

### TABULAR DATA

Time (minutes)	Furnace Temperatures								
	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
0	55	55	55	55	55	55	55	55	55
0.25	55	55	55	55	55	55	55	55	55
0.5	55	55	55	55	55	55	55	55	55
0.75	58	59	56	56	57	55	55	55	55
1	71	82	63	63	72	59	63	62	60
1.25	114	148	87	85	114	74	93	83	74
1.5	184	253	138	131	186	108	159	129	106
1.75	274	379	219	210	290	167	263	207	162
2	379	514	323	317	415	253	383	311	236
2.25	487	632	435	434	537	353	491	423	318
2.5	582	716	541	540	633	454	577	520	397
2.75	655	768	626	624	700	541	641	595	465
3	704	797	686	686	743	606	685	648	518
3.25	733	810	723	726	766	652	712	682	557
3.5	747	814	743	748	776	682	727	701	585
3.75	752	811	751	758	776	698	733	709	603
4	751	804	751	760	772	704	733	711	614
4.25	747	795	748	757	765	706	729	708	620
4.5	745	789	749	753	758	706	724	703	624
4.75	747	792	754	751	757	708	720	700	627
5	755	805	763	754	764	714	717	699	631
5.25	771	827	777	763	781	724	719	704	639
5.5	794	854	796	779	807	741	725	709	651
5.75	823	886	820	802	840	763	737	721	668
6	855	922	849	831	878	790	756	740	690
6.25	889	961	883	866	920	821	782	778	720
6.5	928	1002	921	905	963	856	815	801	755
6.75	967	1041	958	945	1005	892	850	836	792
7	1002	1074	992	983	1042	928	883	869	830
7.25	1032	1099	1020	1014	1072	960	909	906	863
7.5	1057	1119	1041	1038	1096	988	930	927	890
7.75	1075	1135	1058	1056	1113	1011	946	943	913
8	1089	1147	1071	1070	1126	1030	958	1022	931
8.25	1099	1157	1081	1080	1136	1046	968	1028	945
8.5	1108	1165	1088	1087	1143	1058	976	1032	957
8.75	1115	1171	1095	1093	1149	1069	982	1034	967
9	1121	1176	1101	1098	1153	1077	987	1035	975
9.25	1127	1180	1106	1102	1158	1085	992	1038	983
9.5	1134	1184	1111	1107	1163	1092	996	1042	990
9.75	1144	1191	1118	1115	1172	1100	1004	1050	1000
10	1156	1202	1130	1128	1185	1112	1017	1063	1013
10.25	1171	1214	1144	1145	1201	1125	1034	1094	1031
10.5	1187	1229	1160	1164	1218	1140	1055	1114	1052
10.75	1204	1245	1177	1183	1235	1156	1077	1134	1074
11	1222	1262	1194	1204	1251	1172	1100	1164	1097
11.25	1239	1278	1211	1224	1269	1189	1122	1194	1120
11.5	1255	1291	1227	1243	1284	1205	1142	1216	1141
11.75	1264	1300	1238	1255	1295	1218	1157	1228	1157
12	1269	1304	1245	1261	1299	1227	1165	1230	1168
12.25	1271	1305	1247	1262	1300	1232	1168	1232	1172
12.5	1270	1304	1246	1260	1298	1234	1168	1234	1173
12.75	1267	1302	1245	1257	1295	1235	1167	1236	1172
13	1264	1300	1243	1253	1292	1235	1164	1238	1170
13.25	1260	1298	1241	1248	1289	1234	1160	1240	1168
13.5	1257	1296	1238	1243	1285	1233	1157	1242	1166
13.75	1256	1293	1236	1240	1283	1232	1154	1244	1163
14	1256	1291	1234	1238	1282	1232	1151	1246	1162

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
14.25	1256	1290	1233	1239	1283	1231	1149	1248	1160
14.5	1257	1290	1233	1240	1285	1232	1149	1250	1160
14.75	1259	1290	1234	1243	1287	1233	1149	1252	1160
15	1262	1292	1237	1247	1291	1236	1151	1254	1162
15.25	1269	1298	1244	1255	1298	1241	1159	1256	1166
15.5	1278	1309	1256	1266	1309	1249	1173	1258	1175
15.75	1290	1321	1270	1281	1322	1260	1189	1260	1189
16	1304	1335	1284	1296	1336	1273	1207	1265	1206
16.25	1318	1348	1297	1312	1349	1285	1223	1275	1223
16.5	1331	1360	1308	1326	1361	1297	1238	1295	1241
16.75	1342	1371	1320	1340	1374	1309	1252	1314	1257
17	1355	1384	1332	1355	1387	1322	1270	1334	1275
17.25	1371	1399	1347	1372	1402	1337	1290	1356	1294
17.5	1386	1414	1362	1389	1417	1353	1310	1377	1314
17.75	1399	1427	1376	1404	1430	1368	1328	1396	1332
18	1411	1438	1388	1418	1442	1381	1345	1411	1348
18.25	1420	1448	1399	1429	1452	1392	1358	1424	1362
18.5	1428	1456	1409	1438	1460	1402	1369	1435	1373
18.75	1435	1463	1417	1446	1466	1410	1379	1443	1383
19	1439	1466	1421	1450	1470	1416	1384	1445	1389
19.25	1441	1467	1423	1452	1472	1419	1386	1443	1392
19.5	1443	1466	1423	1453	1473	1420	1387	1440	1393
19.75	1444	1465	1423	1454	1473	1421	1387	1438	1393
20	1445	1465	1423	1455	1474	1422	1388	1435	1392
20.25	1446	1466	1423	1456	1474	1423	1389	1434	1392
20.5	1447	1466	1424	1456	1475	1424	1389	1434	1392
20.75	1449	1466	1424	1456	1476	1425	1389	1434	1392
21	1450	1467	1424	1457	1477	1426	1390	1434	1393
21.25	1455	1470	1427	1460	1480	1429	1394	1439	1397
21.5	1460	1476	1433	1467	1486	1435	1399	1449	1404
21.75	1467	1483	1439	1474	1493	1442	1407	1459	1414
22	1474	1489	1445	1482	1500	1449	1415	1469	1424
22.25	1482	1497	1453	1489	1508	1457	1423	1478	1433
22.5	1489	1504	1460	1497	1516	1466	1432	1487	1442
22.75	1495	1510	1466	1503	1523	1474	1440	1495	1451
23	1500	1515	1471	1508	1528	1480	1446	1502	1458
23.25	1506	1519	1475	1513	1533	1486	1451	1507	1465
23.5	1511	1522	1478	1517	1538	1491	1455	1511	1472
23.75	1516	1527	1482	1522	1542	1497	1459	1515	1478
24	1520	1532	1487	1526	1547	1502	1462	1519	1484
24.25	1525	1536	1491	1530	1551	1506	1466	1523	1489
24.5	1529	1540	1495	1535	1555	1510	1471	1527	1493
24.75	1532	1543	1498	1539	1559	1514	1475	1532	1497
25	1535	1544	1501	1542	1561	1517	1478	1533	1500
25.25	1536	1544	1503	1544	1562	1519	1480	1533	1501
25.5	1537	1545	1504	1546	1563	1520	1481	1533	1502
25.75	1539	1546	1505	1547	1563	1521	1483	1533	1503
26	1540	1548	1506	1548	1564	1523	1484	1534	1504
26.25	1541	1549	1506	1548	1565	1525	1484	1534	1506
26.5	1543	1550	1507	1549	1566	1527	1485	1534	1508
26.75	1546	1551	1508	1551	1567	1528	1486	1534	1510
27	1547	1553	1510	1552	1568	1529	1488	1535	1510
27.25	1548	1554	1511	1553	1569	1530	1491	1536	1510
27.5	1549	1556	1513	1555	1571	1532	1494	1538	1510
27.75	1550	1557	1515	1556	1572	1533	1496	1540	1511
28	1552	1559	1518	1557	1574	1535	1499	1542	1513
28.25	1553	1561	1520	1558	1575	1537	1502	1544	1516
28.5	1555	1563	1522	1560	1577	1539	1504	1546	1517
28.75	1556	1565	1524	1562	1579	1540	1506	1548	1518
29	1557	1567	1527	1563	1580	1542	1508	1550	1519

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
29.25	1559	1568	1530	1565	1582	1543	1511	1553	1521
29.5	1560	1570	1531	1566	1584	1544	1512	1556	1524
29.75	1562	1571	1532	1567	1585	1545	1513	1559	1527
30	1564	1572	1533	1568	1586	1547	1514	1561	1530
30.25	1565	1573	1535	1570	1587	1548	1516	1564	1533
30.5	1566	1574	1536	1572	1589	1549	1517	1566	1536
30.75	1568	1576	1538	1574	1591	1551	1519	1568	1538
31	1571	1578	1539	1576	1594	1554	1521	1571	1542
31.25	1573	1580	1541	1579	1597	1557	1523	1574	1545
31.5	1575	1582	1543	1581	1599	1560	1525	1577	1547
31.75	1578	1584	1545	1583	1602	1563	1528	1579	1550
32	1580	1586	1549	1586	1604	1565	1531	1582	1553
32.25	1581	1590	1553	1589	1606	1567	1536	1585	1554
32.5	1582	1594	1558	1592	1608	1569	1539	1588	1556
32.75	1584	1597	1562	1594	1611	1571	1543	1590	1558
33	1586	1599	1564	1597	1613	1574	1546	1592	1561
33.25	1589	1601	1565	1599	1616	1576	1549	1595	1563
33.5	1592	1602	1567	1601	1618	1579	1551	1597	1566
33.75	1595	1604	1569	1603	1620	1582	1553	1600	1569
34	1597	1605	1571	1605	1622	1585	1555	1602	1571
34.25	1599	1608	1573	1608	1624	1587	1558	1605	1573
34.5	1601	1610	1575	1610	1626	1589	1560	1606	1575
34.75	1603	1612	1577	1612	1628	1592	1562	1608	1577
35	1605	1614	1579	1613	1630	1595	1564	1609	1580
35.25	1607	1615	1581	1615	1632	1598	1566	1611	1582
35.5	1609	1617	1582	1616	1634	1600	1568	1613	1585
35.75	1610	1619	1584	1618	1635	1601	1570	1614	1587
36	1612	1621	1586	1620	1637	1602	1573	1616	1588
36.25	1614	1623	1588	1622	1638	1602	1575	1618	1590
36.5	1616	1624	1591	1624	1640	1604	1578	1620	1591
36.75	1618	1626	1593	1626	1642	1606	1580	1621	1593
37	1620	1629	1596	1629	1644	1608	1583	1624	1595
37.25	1624	1632	1599	1632	1647	1611	1587	1627	1597
37.5	1627	1635	1602	1636	1650	1614	1589	1631	1601
37.75	1629	1639	1606	1639	1653	1617	1592	1634	1603
38	1631	1642	1609	1642	1656	1621	1595	1638	1607
38.25	1635	1644	1610	1645	1660	1624	1598	1642	1611
38.5	1638	1646	1612	1647	1663	1627	1601	1644	1614
38.75	1641	1648	1614	1649	1666	1631	1604	1647	1617
39	1644	1650	1616	1651	1669	1635	1606	1650	1621
39.25	1646	1653	1619	1653	1671	1638	1608	1653	1624
39.5	1648	1656	1622	1656	1673	1641	1610	1655	1627
39.75	1650	1659	1626	1659	1676	1643	1613	1656	1628
40	1651	1662	1630	1662	1678	1645	1617	1659	1629
40.25	1654	1663	1631	1664	1680	1647	1619	1661	1631
40.5	1655	1663	1631	1663	1679	1648	1618	1658	1631
40.75	1653	1661	1629	1660	1676	1646	1616	1652	1628
41	1651	1658	1627	1656	1673	1644	1611	1646	1625
41.25	1648	1655	1624	1652	1670	1642	1606	1640	1621
41.5	1645	1652	1621	1649	1666	1639	1602	1635	1618
41.75	1642	1648	1618	1646	1663	1637	1600	1630	1615
42	1641	1646	1615	1644	1660	1633	1597	1626	1612
42.25	1640	1644	1612	1643	1658	1631	1595	1624	1610
42.5	1640	1643	1611	1643	1658	1630	1594	1624	1609
42.75	1641	1642	1610	1643	1658	1630	1593	1624	1609
43	1641	1642	1610	1643	1658	1630	1593	1625	1609
43.25	1641	1643	1610	1644	1659	1631	1595	1627	1609
43.5	1642	1644	1612	1645	1660	1632	1596	1629	1610
43.75	1643	1646	1613	1646	1661	1634	1597	1632	1612
44	1644	1647	1614	1647	1662	1635	1598	1633	1613

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
44.25	1645	1648	1615	1649	1663	1636	1600	1635	1614
44.5	1646	1648	1616	1651	1664	1636	1602	1636	1615
44.75	1645	1650	1618	1652	1665	1636	1604	1638	1614
45	1646	1651	1619	1653	1666	1637	1606	1640	1614
45.25	1646	1651	1620	1655	1666	1637	1608	1640	1614
45.5	1646	1652	1621	1657	1667	1637	1610	1641	1614
45.75	1647	1654	1623	1659	1669	1639	1613	1641	1614
46	1650	1656	1625	1661	1672	1642	1614	1643	1617
46.25	1652	1659	1629	1662	1676	1646	1615	1647	1622
46.5	1655	1662	1633	1663	1679	1651	1617	1650	1627
46.75	1658	1664	1636	1665	1682	1654	1618	1653	1631
47	1660	1667	1638	1668	1684	1655	1621	1656	1633
47.25	1663	1670	1639	1670	1686	1657	1624	1658	1635
47.5	1666	1672	1640	1672	1688	1659	1627	1660	1636
47.75	1669	1673	1641	1675	1690	1660	1628	1662	1638
48	1672	1675	1643	1677	1691	1662	1630	1662	1640
48.25	1675	1676	1644	1679	1693	1664	1631	1664	1642
48.5	1676	1678	1645	1681	1695	1666	1633	1666	1643
48.75	1677	1680	1646	1682	1696	1667	1635	1668	1645
49	1678	1681	1648	1684	1698	1669	1637	1669	1648
49.25	1680	1682	1649	1686	1700	1671	1639	1671	1651
49.5	1682	1682	1651	1688	1702	1673	1640	1672	1653
49.75	1682	1683	1652	1688	1703	1673	1640	1673	1655
50	1682	1684	1653	1687	1704	1674	1640	1672	1655
50.25	1682	1684	1653	1687	1703	1674	1639	1672	1655
50.5	1682	1684	1653	1687	1703	1674	1639	1672	1654
50.75	1682	1685	1654	1687	1702	1675	1639	1671	1654
51	1682	1686	1655	1687	1702	1675	1639	1671	1654
51.25	1683	1687	1655	1688	1702	1675	1640	1670	1652
51.5	1683	1688	1656	1688	1702	1675	1641	1669	1651
51.75	1684	1688	1657	1689	1703	1675	1641	1669	1651
52	1685	1687	1658	1689	1704	1676	1642	1670	1652
52.25	1684	1688	1659	1689	1704	1677	1642	1670	1653
52.5	1684	1689	1659	1688	1704	1678	1642	1668	1653
52.75	1684	1689	1660	1689	1704	1678	1642	1668	1653
53	1684	1689	1660	1690	1704	1678	1642	1668	1653
53.25	1684	1690	1660	1690	1705	1678	1643	1670	1655
53.5	1684	1690	1660	1690	1705	1679	1643	1672	1656
53.75	1684	1691	1660	1690	1706	1680	1643	1675	1658
54	1685	1690	1660	1690	1706	1681	1644	1676	1659
54.25	1687	1690	1660	1691	1707	1681	1645	1676	1659
54.5	1687	1690	1660	1692	1707	1682	1646	1677	1660
54.75	1687	1690	1661	1692	1708	1682	1645	1678	1661
55	1688	1690	1661	1693	1708	1682	1646	1679	1661
55.25	1688	1690	1662	1694	1709	1682	1647	1679	1661
55.5	1689	1690	1663	1695	1710	1684	1649	1680	1662
55.75	1689	1691	1664	1696	1711	1685	1651	1681	1662
56	1690	1692	1666	1698	1711	1686	1654	1681	1661
56.25	1691	1694	1667	1699	1712	1686	1656	1682	1662
56.5	1691	1695	1667	1699	1713	1687	1658	1685	1663
56.75	1693	1696	1667	1700	1714	1688	1658	1687	1665
57	1694	1697	1668	1700	1716	1689	1659	1689	1668
57.25	1696	1698	1668	1701	1717	1691	1659	1691	1670
57.5	1696	1699	1669	1701	1718	1692	1659	1692	1672
57.75	1698	1700	1670	1702	1719	1693	1659	1693	1674
58	1699	1700	1671	1703	1720	1695	1660	1693	1676
58.25	1701	1702	1672	1704	1722	1696	1660	1694	1677
58.5	1703	1705	1674	1706	1724	1699	1660	1696	1679
58.75	1706	1709	1677	1708	1727	1701	1661	1699	1682
59	1708	1711	1680	1711	1729	1703	1665	1703	1683

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
59.25	1711	1714	1683	1714	1731	1705	1669	1706	1685
59.5	1714	1717	1686	1718	1733	1707	1673	1709	1686
59.75	1716	1719	1689	1721	1735	1709	1677	1711	1687
60	1717	1721	1691	1724	1737	1711	1680	1713	1689
60.25	1719	1723	1694	1725	1740	1713	1682	1714	1692
60.5	1721	1725	1695	1726	1742	1715	1683	1716	1695
60.75	1723	1727	1697	1727	1744	1718	1684	1717	1698
61	1724	1729	1699	1728	1746	1721	1684	1719	1701
61.25	1725	1731	1701	1728	1747	1723	1685	1721	1704
61.5	1727	1732	1703	1730	1748	1724	1686	1723	1706
61.75	1728	1733	1704	1732	1750	1725	1689	1725	1707
62	1729	1734	1705	1734	1751	1726	1690	1728	1709
62.25	1731	1735	1706	1734	1753	1728	1691	1730	1711
62.5	1732	1737	1708	1735	1754	1731	1692	1732	1713
62.75	1734	1739	1710	1736	1756	1734	1694	1733	1715
63	1736	1741	1712	1737	1759	1737	1695	1734	1717
63.25	1736	1743	1714	1737	1760	1739	1696	1733	1718
63.5	1736	1743	1714	1738	1760	1739	1696	1732	1718
63.75	1736	1743	1714	1738	1760	1739	1696	1730	1717
64	1737	1742	1714	1738	1759	1738	1696	1729	1716
64.25	1738	1742	1714	1739	1759	1737	1695	1727	1715
64.5	1738	1742	1714	1739	1759	1737	1696	1726	1714
64.75	1738	1741	1714	1740	1759	1736	1696	1726	1713
65	1738	1742	1714	1740	1758	1735	1697	1726	1712
65.25	1738	1742	1715	1741	1758	1734	1699	1727	1712
65.5	1738	1742	1715	1742	1758	1734	1699	1726	1712
65.75	1738	1742	1716	1742	1758	1734	1699	1726	1712
66	1738	1742	1717	1743	1758	1735	1700	1726	1712
66.25	1739	1742	1717	1743	1759	1736	1701	1728	1712
66.5	1739	1741	1717	1743	1760	1736	1701	1728	1713
66.75	1739	1742	1717	1743	1761	1737	1700	1728	1715
67	1739	1741	1718	1743	1762	1737	1699	1728	1717
67.25	1739	1743	1719	1742	1762	1738	1698	1728	1718
67.5	1739	1743	1719	1741	1763	1739	1698	1728	1720
67.75	1740	1744	1720	1742	1763	1740	1699	1729	1721
68	1740	1745	1721	1743	1764	1742	1700	1729	1720
68.25	1740	1746	1722	1744	1764	1742	1701	1729	1720
68.5	1741	1746	1722	1745	1765	1742	1703	1730	1720
68.75	1743	1747	1723	1747	1766	1742	1704	1731	1720
69	1744	1748	1723	1748	1766	1743	1704	1732	1720
69.25	1744	1749	1725	1748	1767	1744	1704	1734	1721
69.5	1745	1750	1725	1747	1768	1746	1704	1735	1723
69.75	1746	1750	1726	1749	1768	1746	1705	1735	1723
70	1748	1750	1726	1751	1769	1747	1707	1736	1723
70.25	1749	1751	1727	1753	1770	1748	1708	1737	1723
70.5	1750	1751	1727	1754	1771	1749	1709	1738	1724
70.75	1752	1751	1728	1756	1772	1749	1710	1739	1726
71	1753	1751	1728	1757	1773	1750	1711	1740	1728
71.25	1753	1753	1729	1757	1774	1751	1712	1740	1729
71.5	1753	1754	1730	1758	1774	1751	1714	1741	1730
71.75	1754	1755	1731	1757	1776	1752	1714	1742	1732
72	1754	1757	1731	1757	1776	1753	1715	1742	1733
72.25	1755	1758	1732	1757	1777	1754	1715	1743	1734
72.5	1755	1759	1733	1757	1777	1754	1715	1744	1735
72.75	1756	1759	1733	1757	1777	1755	1715	1744	1736
73	1757	1759	1734	1758	1778	1756	1715	1745	1737
73.25	1757	1761	1735	1760	1779	1756	1717	1746	1738
73.5	1758	1761	1736	1761	1780	1757	1718	1746	1738
73.75	1758	1762	1737	1762	1780	1758	1719	1747	1738
74	1759	1763	1738	1762	1781	1759	1719	1747	1738

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
74.25	1760	1763	1738	1763	1782	1759	1720	1748	1738
74.5	1761	1764	1739	1764	1783	1759	1720	1750	1739
74.75	1762	1764	1739	1765	1784	1760	1721	1750	1740
75	1761	1765	1739	1765	1784	1761	1722	1752	1741
75.25	1761	1766	1740	1765	1785	1763	1723	1753	1743
75.5	1762	1766	1740	1766	1785	1765	1724	1753	1744
75.75	1762	1767	1742	1766	1787	1766	1725	1754	1745
76	1763	1767	1742	1767	1787	1766	1727	1755	1745
76.25	1764	1768	1742	1768	1787	1766	1729	1756	1745
76.5	1766	1769	1743	1771	1788	1767	1730	1757	1745
76.75	1767	1770	1744	1773	1789	1767	1733	1758	1743
77	1768	1771	1746	1774	1789	1768	1734	1759	1743
77.25	1769	1772	1747	1775	1789	1768	1735	1760	1743
77.5	1769	1772	1748	1775	1790	1769	1736	1760	1744
77.75	1769	1773	1749	1776	1790	1770	1736	1761	1745
78	1770	1774	1750	1775	1791	1771	1736	1762	1747
78.25	1770	1775	1750	1776	1792	1771	1736	1763	1748
78.5	1770	1776	1751	1775	1793	1772	1736	1763	1749
78.75	1771	1776	1751	1776	1794	1773	1736	1764	1751
79	1772	1777	1751	1776	1794	1773	1736	1765	1751
79.25	1772	1777	1752	1778	1794	1773	1738	1765	1751
79.5	1773	1777	1753	1779	1795	1774	1739	1764	1750
79.75	1774	1777	1753	1781	1796	1775	1740	1765	1751
80	1775	1778	1754	1782	1796	1775	1741	1766	1751
80.25	1775	1779	1755	1782	1797	1776	1742	1767	1752
80.5	1776	1781	1756	1782	1798	1777	1743	1769	1753
80.75	1777	1782	1757	1782	1798	1778	1743	1770	1754
81	1777	1782	1757	1782	1799	1779	1744	1771	1756
81.25	1778	1782	1757	1783	1799	1779	1744	1771	1756
81.5	1778	1782	1758	1783	1799	1779	1745	1772	1756
81.75	1779	1783	1758	1784	1800	1779	1746	1773	1757
82	1780	1783	1758	1784	1800	1779	1746	1773	1757
82.25	1780	1783	1759	1784	1801	1780	1746	1774	1758
82.5	1781	1783	1760	1784	1801	1781	1746	1775	1758
82.75	1781	1784	1760	1784	1801	1780	1747	1775	1758
83	1782	1784	1761	1785	1802	1781	1747	1775	1759
83.25	1782	1784	1761	1786	1802	1782	1748	1775	1759
83.5	1782	1784	1762	1787	1803	1783	1748	1775	1761
83.75	1782	1785	1762	1787	1803	1783	1749	1776	1762
84	1783	1785	1762	1788	1804	1783	1749	1776	1762
84.25	1784	1785	1762	1788	1804	1784	1750	1777	1763
84.5	1784	1786	1763	1789	1805	1785	1751	1778	1763
84.75	1784	1787	1764	1789	1805	1785	1753	1778	1763
85	1783	1788	1765	1789	1806	1787	1753	1779	1764
85.25	1784	1788	1766	1789	1807	1788	1752	1779	1766
85.5	1784	1789	1766	1789	1807	1788	1752	1780	1768
85.75	1784	1789	1766	1789	1807	1788	1753	1781	1769
86	1785	1789	1766	1789	1808	1788	1753	1781	1769
86.25	1785	1789	1766	1790	1808	1788	1752	1781	1770
86.5	1786	1789	1766	1791	1808	1788	1753	1781	1769
86.75	1786	1790	1766	1791	1808	1788	1752	1781	1769
87	1787	1791	1766	1791	1808	1789	1752	1782	1770
87.25	1785	1791	1767	1791	1808	1789	1753	1783	1770
87.5	1785	1791	1768	1791	1808	1790	1755	1784	1769
87.75	1785	1791	1768	1791	1808	1790	1756	1785	1769
88	1786	1791	1769	1792	1809	1791	1756	1785	1768
88.25	1787	1791	1769	1793	1810	1791	1756	1785	1770
88.5	1789	1792	1770	1794	1811	1792	1757	1786	1772
88.75	1789	1794	1771	1794	1813	1794	1759	1789	1775
89	1791	1796	1773	1796	1815	1796	1761	1791	1778

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
89.25	1793	1797	1774	1797	1817	1798	1763	1793	1780
89.5	1795	1799	1775	1799	1818	1799	1764	1795	1781
89.75	1795	1800	1777	1800	1819	1800	1766	1796	1780
90	1795	1802	1778	1802	1820	1800	1768	1797	1780
90.25	1796	1804	1779	1803	1820	1801	1770	1799	1782
90.5	1797	1804	1780	1804	1822	1803	1770	1800	1784
90.75	1798	1806	1781	1804	1823	1803	1771	1802	1786
91	1799	1807	1782	1806	1823	1804	1773	1802	1786
91.25	1801	1808	1783	1808	1824	1804	1775	1802	1786
91.5	1802	1809	1784	1810	1825	1805	1776	1803	1786
91.75	1804	1809	1785	1812	1826	1806	1778	1804	1787
92	1805	1810	1786	1814	1827	1806	1779	1804	1788
92.25	1806	1811	1788	1814	1828	1807	1779	1805	1789
92.5	1807	1812	1789	1816	1830	1808	1780	1806	1790
92.75	1808	1813	1790	1817	1830	1809	1780	1807	1791
93	1809	1814	1791	1819	1832	1811	1782	1808	1792
93.25	1811	1815	1791	1821	1833	1813	1783	1810	1794
93.5	1813	1817	1793	1821	1836	1815	1784	1811	1797
93.75	1814	1819	1795	1822	1838	1817	1785	1812	1800
94	1816	1820	1797	1823	1840	1820	1786	1814	1803
94.25	1818	1823	1799	1823	1842	1823	1787	1816	1806
94.5	1819	1824	1801	1824	1843	1824	1789	1818	1807
94.75	1821	1825	1804	1826	1845	1826	1791	1819	1806
95	1822	1826	1806	1828	1846	1827	1793	1819	1807
95.25	1823	1828	1807	1829	1847	1829	1794	1821	1808
95.5	1824	1830	1808	1829	1848	1830	1794	1822	1810
95.75	1825	1830	1809	1830	1849	1831	1795	1824	1811
96	1824	1830	1808	1829	1848	1830	1794	1822	1810
96.25	1822	1828	1807	1827	1846	1828	1791	1817	1807
96.5	1819	1826	1806	1824	1844	1826	1788	1812	1804
96.75	1818	1824	1805	1821	1841	1825	1786	1808	1801
97	1816	1822	1803	1819	1839	1823	1784	1805	1799
97.25	1815	1820	1802	1818	1837	1822	1782	1803	1797
97.5	1813	1818	1800	1816	1836	1819	1781	1802	1795
97.75	1811	1817	1798	1814	1834	1817	1779	1802	1793
98	1810	1815	1796	1812	1832	1815	1777	1800	1792
98.25	1808	1813	1794	1811	1830	1814	1776	1798	1790
98.5	1807	1812	1793	1811	1828	1812	1774	1796	1788
98.75	1806	1810	1792	1810	1826	1810	1773	1796	1786
99	1804	1809	1790	1808	1825	1808	1772	1795	1784
99.25	1803	1807	1789	1807	1824	1807	1771	1794	1784
99.5	1804	1807	1789	1808	1824	1807	1772	1795	1784
99.75	1805	1808	1790	1810	1826	1808	1774	1797	1784
100	1806	1809	1791	1811	1827	1809	1775	1799	1786
100.25	1807	1811	1791	1812	1829	1810	1777	1800	1787
100.5	1807	1811	1791	1814	1830	1811	1778	1802	1788
100.75	1808	1812	1792	1815	1831	1812	1779	1803	1788
101	1809	1813	1793	1815	1833	1813	1779	1804	1789
101.25	1811	1814	1794	1817	1834	1814	1779	1804	1790
101.5	1812	1814	1794	1818	1835	1814	1780	1804	1791
101.75	1813	1815	1795	1819	1836	1815	1781	1805	1792
102	1813	1815	1796	1820	1836	1816	1782	1807	1794
102.25	1814	1816	1797	1821	1837	1817	1783	1808	1795
102.5	1815	1817	1798	1822	1838	1818	1784	1808	1796
102.75	1815	1818	1799	1822	1838	1819	1785	1809	1797
103	1816	1819	1800	1823	1839	1820	1785	1810	1798
103.25	1816	1820	1800	1823	1839	1820	1786	1811	1799
103.5	1817	1821	1801	1824	1840	1821	1786	1812	1799
103.75	1817	1822	1802	1825	1840	1821	1787	1813	1800
104	1817	1822	1802	1825	1841	1821	1788	1813	1801

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
104.25	1818	1823	1802	1826	1841	1822	1789	1813	1802
104.5	1819	1823	1802	1826	1841	1822	1790	1814	1802
104.75	1820	1824	1802	1827	1841	1822	1790	1814	1802
105	1820	1824	1803	1827	1842	1823	1790	1814	1801
105.25	1820	1824	1804	1828	1842	1824	1791	1815	1802
105.5	1821	1824	1805	1828	1843	1825	1791	1815	1802
105.75	1821	1825	1806	1828	1844	1826	1791	1816	1804
106	1822	1826	1807	1828	1845	1827	1791	1817	1806
106.25	1822	1826	1807	1828	1845	1828	1791	1817	1807
106.5	1823	1826	1807	1829	1845	1828	1792	1818	1807
106.75	1824	1827	1807	1830	1846	1828	1793	1818	1807
107	1825	1827	1807	1830	1846	1828	1793	1819	1807
107.25	1824	1828	1808	1831	1847	1828	1795	1820	1807
107.5	1825	1829	1809	1832	1847	1828	1795	1820	1806
107.75	1825	1829	1810	1832	1847	1829	1796	1820	1807
108	1825	1829	1810	1833	1848	1829	1796	1820	1807
108.25	1825	1829	1810	1833	1848	1830	1796	1820	1808
108.5	1825	1830	1810	1832	1848	1831	1796	1822	1809
108.75	1825	1831	1811	1831	1849	1833	1797	1822	1811
109	1826	1831	1812	1832	1849	1834	1798	1823	1811
109.25	1827	1832	1813	1833	1850	1834	1799	1824	1811
109.5	1828	1832	1814	1834	1850	1834	1800	1824	1810
109.75	1828	1833	1815	1835	1850	1834	1801	1825	1810
110	1828	1834	1815	1834	1851	1835	1800	1824	1812
110.25	1828	1834	1816	1833	1852	1837	1800	1825	1815
110.5	1828	1835	1817	1833	1852	1837	1800	1825	1815
110.75	1828	1835	1817	1834	1853	1838	1800	1825	1814
111	1828	1835	1817	1835	1854	1837	1801	1826	1814
111.25	1829	1835	1817	1836	1854	1837	1801	1827	1815
111.5	1830	1836	1817	1837	1855	1837	1801	1827	1816
111.75	1831	1837	1817	1837	1855	1838	1802	1827	1817
112	1832	1837	1817	1838	1856	1838	1802	1828	1818
112.25	1833	1838	1818	1838	1856	1839	1802	1829	1818
112.5	1834	1839	1819	1838	1857	1840	1803	1830	1818
112.75	1834	1839	1819	1838	1857	1840	1803	1830	1819
113	1834	1840	1820	1838	1858	1841	1803	1830	1819
113.25	1834	1839	1820	1839	1858	1841	1804	1830	1820
113.5	1835	1839	1820	1839	1859	1842	1804	1831	1820
113.75	1835	1839	1821	1840	1859	1842	1804	1831	1821
114	1835	1840	1821	1840	1860	1842	1804	1830	1821
114.25	1835	1840	1822	1841	1860	1842	1805	1831	1821
114.5	1836	1840	1822	1842	1860	1843	1806	1832	1821
114.75	1837	1840	1822	1843	1861	1843	1808	1833	1821
115	1838	1841	1823	1844	1861	1843	1809	1834	1822
115.25	1838	1841	1823	1845	1861	1843	1810	1835	1822
115.5	1839	1842	1824	1845	1861	1844	1810	1835	1823
115.75	1838	1843	1824	1845	1862	1845	1811	1835	1824
116	1839	1843	1825	1844	1862	1846	1811	1835	1824
116.25	1839	1844	1825	1844	1862	1846	1810	1835	1824
116.5	1839	1844	1826	1844	1863	1847	1810	1835	1826
116.75	1840	1844	1827	1845	1864	1848	1811	1836	1827
117	1840	1844	1827	1846	1864	1848	1812	1838	1827
117.25	1840	1845	1828	1846	1865	1848	1813	1839	1827
117.5	1839	1846	1828	1846	1865	1848	1814	1840	1828
117.75	1840	1847	1829	1846	1866	1849	1814	1840	1829
118	1840	1848	1829	1846	1866	1850	1815	1841	1831
118.25	1841	1848	1830	1846	1867	1851	1815	1841	1832
118.5	1842	1849	1831	1847	1867	1851	1815	1841	1832
118.75	1843	1849	1831	1849	1868	1852	1815	1842	1832
119	1844	1849	1831	1850	1869	1852	1815	1842	1833

Furnace Temperatures									
Time (minutes)	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9
119.25	1844	1849	1832	1851	1869	1853	1816	1843	1833
119.5	1845	1850	1832	1851	1869	1853	1817	1844	1833
119.75	1846	1850	1833	1853	1870	1854	1818	1845	1833
120	1847	1851	1834	1854	1871	1856	1820	1846	1834

Unexposed Temperatures										Average
Time (minutes)	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
0	57	57	57	58	59	59	57	59	59	58
0.25	57	57	57	58	59	59	57	59	59	58
0.5	57	57	57	58	59	59	58	59	59	58
0.75	57	57	57	58	59	59	57	59	58	58
1	57	57	58	58	59	59	58	59	58	58
1.25	57	57	58	58	59	59	58	59	59	58
1.5	57	57	58	58	59	59	58	59	59	58
1.75	57	57	58	58	59	59	58	59	59	58
2	57	57	58	58	59	59	58	59	59	58
2.25	57	57	58	58	59	59	58	59	59	58
2.5	57	57	58	58	59	59	58	59	59	58
2.75	57	57	58	58	59	59	58	59	59	58
3	57	57	58	58	59	59	58	59	59	58
3.25	57	57	58	58	59	59	58	59	59	58
3.5	57	57	58	58	59	59	58	59	59	58
3.75	57	57	58	58	59	59	58	59	59	58
4	57	57	58	58	59	59	58	59	59	58
4.25	57	57	58	58	59	59	58	59	59	58
4.5	57	57	58	58	59	59	58	59	59	58
4.75	57	57	58	58	59	59	58	59	59	58
5	57	57	58	58	59	59	58	59	59	58
5.25	57	57	58	58	59	59	58	59	58	58
5.5	57	57	58	58	59	59	58	59	59	58
5.75	57	57	58	58	59	59	58	59	59	58
6	57	57	58	58	59	59	58	59	59	58
6.25	57	57	58	58	59	59	58	59	59	58
6.5	57	57	58	58	59	59	58	59	59	58
6.75	57	57	58	58	59	59	58	59	59	58
7	57	57	58	58	59	59	58	59	59	58
7.25	57	57	58	58	59	59	58	59	59	58
7.5	57	57	58	58	59	59	58	59	59	58
7.75	57	57	58	58	59	59	58	59	59	58
8	57	57	58	58	59	59	58	59	59	58
8.25	57	57	58	58	59	59	58	59	59	58
8.5	57	57	58	58	59	59	58	59	59	58
8.75	57	57	58	58	59	59	58	59	59	58
9	57	57	58	58	59	59	58	59	59	58
9.25	57	57	58	58	59	59	58	59	59	58
9.5	57	57	58	58	59	59	58	59	59	58
9.75	57	57	58	58	59	59	58	59	59	58
10	57	57	58	58	59	59	58	59	59	58
10.25	57	57	58	58	59	59	58	59	59	58
10.5	57	57	58	59	59	59	58	59	59	58
10.75	57	57	58	59	59	59	58	59	59	58
11	57	57	58	58	59	59	58	59	59	58
11.25	57	57	58	59	59	59	58	59	59	58
11.5	57	57	58	59	59	59	58	59	59	58
11.75	57	57	58	59	59	59	58	59	59	58
12	57	57	58	59	59	59	58	59	59	58
12.25	57	57	58	59	59	59	58	59	59	58
12.5	57	57	58	59	59	59	58	59	59	58

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
12.75	57	57	58	59	59	59	58	59	59	58
13	57	57	58	59	59	59	58	59	59	58
13.25	57	57	58	59	59	59	58	59	59	58
13.5	57	57	58	59	59	59	58	59	59	58
13.75	57	57	58	59	59	59	58	59	59	58
14	57	57	58	58	59	59	58	59	59	58
14.25	57	57	58	59	59	59	58	59	59	58
14.5	57	57	58	59	59	59	58	59	59	58
14.75	57	57	58	59	59	59	58	59	59	58
15	57	57	58	59	59	59	58	59	59	58
15.25	57	57	58	59	59	59	58	59	59	58
15.5	57	57	58	59	59	59	58	59	59	58
15.75	57	57	58	59	59	59	58	59	59	58
16	57	57	58	59	59	59	58	59	59	58
16.25	57	57	58	59	59	59	58	59	59	58
16.5	57	57	58	59	59	59	58	59	59	58
16.75	57	57	58	59	59	59	58	59	59	58
17	57	57	58	59	59	59	58	59	59	58
17.25	57	57	58	59	59	59	58	59	59	58
17.5	57	57	58	59	59	59	58	59	59	58
17.75	57	57	58	59	59	59	58	59	59	58
18	58	57	58	59	59	59	58	59	59	58
18.25	57	57	58	59	59	59	58	59	59	58
18.5	58	57	58	59	59	59	58	59	59	58
18.75	58	57	58	59	59	59	58	59	59	58
19	58	57	58	59	59	59	58	59	59	58
19.25	58	57	58	59	59	59	58	59	59	58
19.5	58	57	58	59	59	59	58	59	59	58
19.75	58	57	58	59	59	59	58	59	59	58
20	58	57	58	59	59	59	58	59	59	58
20.25	58	57	58	59	59	59	58	59	59	59
20.5	58	57	58	59	59	59	58	59	59	59
20.75	58	57	58	59	59	59	58	59	59	59
21	58	57	58	59	59	59	58	59	59	59
21.25	58	57	58	59	59	59	58	59	59	59
21.5	58	57	58	59	59	59	58	59	59	59
21.75	58	57	58	59	59	59	58	59	59	59
22	58	57	58	59	59	59	58	59	59	59
22.25	58	57	58	59	59	59	58	59	59	59
22.5	58	58	58	59	59	59	58	59	59	59
22.75	58	58	58	59	59	59	58	59	59	59
23	58	58	58	59	59	59	58	59	59	59
23.25	58	58	58	59	59	59	58	59	59	59
23.5	58	58	58	59	59	59	58	59	59	59
23.75	58	58	58	59	59	59	58	59	59	59
24	58	58	59	59	59	60	58	59	59	59
24.25	58	58	59	59	59	60	58	59	59	59
24.5	58	58	59	59	59	60	58	59	59	59
24.75	58	58	59	59	59	60	58	59	59	59
25	58	58	59	59	59	60	58	59	59	59
25.25	58	58	59	59	59	60	58	59	59	59
25.5	58	58	59	59	59	60	58	59	59	59
25.75	58	58	59	59	59	60	58	59	59	59
26	58	58	59	59	60	60	58	59	59	59
26.25	58	58	59	59	60	60	58	59	59	59
26.5	58	58	59	59	60	60	58	59	59	59
26.75	58	58	59	59	60	60	58	59	59	59
27	58	58	59	59	60	60	58	59	59	59
27.25	58	58	59	59	60	60	58	59	59	59
27.5	58	58	59	59	60	60	58	59	59	59

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
27.75	58	58	59	59	60	60	58	59	59	59
28	58	58	59	59	60	60	58	59	59	59
28.25	58	58	59	59	60	60	58	60	59	59
28.5	58	58	59	59	60	60	58	60	59	59
28.75	58	58	59	59	60	60	58	60	59	59
29	58	58	59	59	60	60	58	60	59	59
29.25	58	58	59	59	60	60	58	60	59	59
29.5	58	58	59	59	60	60	58	60	59	59
29.75	58	58	59	59	60	60	58	60	59	59
30	58	58	59	59	60	60	58	60	59	59
30.25	58	58	59	59	60	60	58	60	59	59
30.5	58	58	59	59	60	60	58	60	59	59
30.75	58	58	59	59	60	60	58	60	59	59
31	58	58	59	59	60	60	58	60	59	59
31.25	58	58	59	59	60	60	58	60	60	59
31.5	58	58	59	59	60	60	58	60	60	59
31.75	58	58	59	59	60	60	58	60	60	59
32	58	58	59	59	60	60	58	60	60	59
32.25	58	58	59	59	60	60	59	60	60	59
32.5	59	58	59	59	60	60	59	60	60	59
32.75	58	58	59	59	60	60	59	60	60	59
33	59	58	59	59	60	60	58	60	60	59
33.25	59	58	59	59	60	60	58	60	60	59
33.5	59	59	59	59	60	60	59	60	60	59
33.75	59	58	59	59	60	60	59	60	60	59
34	59	59	59	59	60	60	59	60	60	59
34.25	59	59	59	59	60	60	59	60	60	59
34.5	59	59	59	60	60	60	59	60	60	59
34.75	59	59	59	60	60	60	59	60	60	59
35	59	59	59	60	60	60	59	60	60	59
35.25	59	59	59	60	60	60	59	60	60	59
35.5	59	59	59	60	60	60	59	60	60	59
35.75	59	59	59	60	60	60	59	60	60	59
36	59	59	59	60	60	60	59	60	60	59
36.25	59	59	59	60	60	60	59	60	60	59
36.5	59	59	59	60	60	60	59	60	60	59
36.75	59	59	59	60	60	60	59	60	60	59
37	59	59	59	60	60	60	59	60	60	59
37.25	59	59	60	60	60	60	59	60	60	59
37.5	59	59	60	60	60	60	59	60	60	60
37.75	59	59	60	60	60	60	59	60	60	60
38	59	59	60	60	60	60	59	60	60	60
38.25	59	59	60	60	60	60	59	60	60	60
38.5	59	59	60	60	60	60	59	60	60	60
38.75	59	59	60	60	60	60	59	60	60	60
39	59	59	60	60	60	60	59	60	60	60
39.25	59	59	60	60	60	60	59	60	60	60
39.5	59	59	60	60	60	60	59	60	60	60
39.75	59	59	60	60	60	60	59	60	60	60
40	59	59	60	60	60	60	59	60	60	60
40.25	59	59	60	60	60	60	59	60	60	60
40.5	59	59	60	60	60	60	59	60	60	60
40.75	59	59	60	60	60	60	59	60	60	60
41	59	59	60	60	60	60	59	60	60	60
41.25	59	59	60	60	60	60	59	60	60	60
41.5	59	59	60	60	60	61	59	60	60	60
41.75	59	59	60	60	60	61	59	60	60	60
42	59	59	60	60	60	60	59	60	60	60
42.25	59	59	60	60	60	60	59	60	60	60
42.5	59	59	60	60	60	60	59	60	60	60

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
42.75	59	59	60	60	60	60	59	60	60	60
43	59	59	60	60	60	60	59	60	60	60
43.25	59	59	60	60	60	60	59	60	60	60
43.5	59	59	60	60	60	61	59	60	60	60
43.75	59	59	60	60	60	60	59	60	60	60
44	59	59	60	60	60	61	59	60	60	60
44.25	59	59	60	60	60	61	59	60	60	60
44.5	59	59	60	60	60	61	59	60	60	60
44.75	59	59	60	60	60	61	59	60	60	60
45	59	59	60	60	60	61	59	60	60	60
45.25	59	59	60	60	60	61	59	60	60	60
45.5	59	59	60	60	60	61	59	60	60	60
45.75	59	59	60	60	60	60	59	60	60	60
46	59	59	60	60	60	60	59	60	60	60
46.25	59	59	60	60	60	60	59	60	60	60
46.5	59	59	60	60	60	60	59	60	60	60
46.75	59	59	60	60	60	60	59	60	60	60
47	59	59	60	60	60	60	59	60	60	60
47.25	59	59	60	60	60	60	59	60	60	60
47.5	59	59	60	60	60	60	59	60	60	60
47.75	59	59	60	60	60	60	59	60	60	60
48	59	59	60	60	60	60	59	60	60	60
48.25	59	59	60	60	60	60	59	60	60	60
48.5	59	59	60	60	60	60	59	60	60	60
48.75	59	59	60	60	60	60	59	60	60	60
49	59	59	60	60	60	60	59	60	60	60
49.25	59	59	60	60	60	60	59	60	60	60
49.5	59	59	60	60	60	60	59	60	60	60
49.75	59	59	60	60	60	60	59	60	60	60
50	59	59	60	60	60	60	59	60	60	60
50.25	59	59	60	60	60	60	59	60	60	60
50.5	59	59	60	60	60	60	59	60	60	60
50.75	59	59	60	60	60	60	59	60	60	60
51	59	59	60	60	60	60	59	60	60	60
51.25	59	59	60	60	60	60	59	60	60	60
51.5	59	59	60	60	60	61	59	60	60	60
51.75	59	59	60	60	60	61	59	60	60	60
52	59	59	60	60	60	61	59	60	60	60
52.25	59	59	60	60	60	61	59	60	60	60
52.5	59	59	60	60	60	61	59	60	60	60
52.75	59	59	60	60	60	61	59	60	60	60
53	59	59	60	60	60	61	59	60	60	60
53.25	59	59	60	60	60	61	59	60	60	60
53.5	59	59	60	60	60	61	59	60	60	60
53.75	60	60	60	60	60	61	59	60	60	60
54	60	60	60	60	60	61	59	60	60	60
54.25	60	60	60	60	60	61	59	60	60	60
54.5	60	60	60	60	60	61	59	60	60	60
54.75	60	60	60	60	60	61	59	60	60	60
55	60	60	60	60	60	61	59	60	60	60
55.25	60	60	60	60	60	61	59	60	60	60
55.5	60	60	60	60	60	61	59	60	60	60
55.75	60	60	60	60	60	61	59	60	60	60
56	60	60	60	60	60	61	59	60	60	60
56.25	60	60	60	60	60	61	59	60	60	60
56.5	60	60	60	60	60	61	59	60	60	60
56.75	60	60	60	60	60	61	59	60	60	60
57	60	60	60	60	60	61	59	60	60	60
57.25	60	60	60	60	60	61	59	60	60	60
57.5	60	60	60	60	60	61	59	60	60	60

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
57.75	60	60	60	60	60	61	59	60	60	60
58	60	60	60	60	60	61	59	60	60	60
58.25	60	60	60	60	60	61	59	60	60	60
58.5	60	60	60	60	60	61	59	60	60	60
58.75	60	60	60	60	60	61	59	60	60	60
59	60	60	60	60	60	61	59	60	60	60
59.25	60	60	60	60	60	61	59	60	60	60
59.5	60	60	60	60	60	61	59	60	60	60
59.75	60	60	60	60	60	61	59	60	60	60
60	60	60	60	60	60	61	59	60	60	60
60.25	60	60	60	60	60	61	59	60	60	60
60.5	60	60	60	60	60	61	59	60	60	60
60.75	60	60	60	60	60	61	59	60	60	60
61	60	60	60	60	60	61	59	60	60	60
61.25	60	60	60	60	60	61	59	60	60	60
61.5	60	60	60	60	60	61	59	60	60	60
61.75	60	60	60	60	60	61	59	60	60	60
62	60	60	60	60	60	61	59	60	60	60
62.25	60	60	60	60	61	61	59	60	60	60
62.5	60	60	60	60	61	61	59	60	60	60
62.75	60	60	60	60	61	61	59	60	60	60
63	60	60	60	60	60	61	59	60	60	60
63.25	60	60	60	60	60	61	59	60	60	60
63.5	60	60	60	60	60	61	59	60	60	60
63.75	60	60	60	60	60	61	59	61	60	60
64	60	60	60	60	60	61	59	61	60	60
64.25	60	60	60	60	61	61	59	61	60	60
64.5	60	60	60	60	61	61	59	61	60	60
64.75	60	60	60	61	61	61	59	61	60	60
65	60	60	60	61	61	61	59	61	60	60
65.25	60	60	60	61	61	61	59	61	60	60
65.5	60	60	60	61	61	61	59	61	60	60
65.75	60	60	60	61	61	61	59	61	60	60
66	60	60	60	61	61	61	60	61	61	60
66.25	60	60	61	61	61	61	60	61	61	60
66.5	60	60	61	61	61	61	60	61	61	60
66.75	60	60	61	61	61	61	60	61	61	60
67	60	60	61	61	61	61	60	61	61	60
67.25	60	60	61	61	61	61	60	61	61	60
67.5	60	60	61	61	61	61	60	61	61	60
67.75	60	60	61	61	61	61	60	61	61	60
68	60	60	61	61	61	61	60	61	61	60
68.25	60	60	61	61	61	61	60	61	61	60
68.5	60	60	61	61	61	61	60	61	61	60
68.75	60	60	61	61	61	61	60	61	61	60
69	60	60	61	61	61	61	60	61	61	60
69.25	60	60	61	61	61	61	60	61	61	60
69.5	60	60	61	61	61	61	60	61	61	60
69.75	60	60	61	61	61	61	60	61	61	60
70	60	60	61	61	61	61	60	61	61	60
70.25	60	60	61	61	61	61	60	61	61	61
70.5	60	60	61	61	61	61	60	61	61	61
70.75	60	60	61	61	61	61	60	61	61	61
71	60	60	61	61	61	61	60	61	61	61
71.25	60	60	61	61	61	61	60	61	61	61
71.5	60	60	61	61	61	61	60	61	61	61
71.75	60	60	61	61	61	61	60	61	61	61
72	60	60	61	61	61	61	60	61	61	61
72.25	60	60	61	61	61	61	60	61	61	61
72.5	60	60	61	61	61	61	60	61	61	61

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
72.75	60	60	61	61	61	61	60	61	61	61
73	60	60	61	61	61	61	60	61	61	61
73.25	60	60	61	61	61	61	60	61	61	61
73.5	61	61	61	61	61	61	60	61	61	61
73.75	61	61	61	61	61	61	60	61	61	61
74	61	61	61	61	61	61	60	61	61	61
74.25	61	61	61	61	61	61	60	61	61	61
74.5	61	61	61	61	61	61	60	61	61	61
74.75	61	61	61	61	61	61	60	61	61	61
75	61	61	61	61	61	61	60	61	61	61
75.25	61	61	61	61	61	61	60	61	61	61
75.5	61	61	61	61	61	61	60	61	61	61
75.75	61	61	61	61	61	61	60	61	61	61
76	61	61	61	61	61	61	60	61	61	61
76.25	61	61	61	61	61	61	60	61	61	61
76.5	61	61	61	61	61	61	60	61	61	61
76.75	61	61	61	61	61	62	60	61	61	61
77	61	61	61	61	61	61	60	61	61	61
77.25	61	61	61	61	61	62	60	61	61	61
77.5	61	61	61	61	61	62	60	61	61	61
77.75	61	61	61	61	61	62	60	61	61	61
78	61	61	61	61	61	62	60	61	61	61
78.25	61	61	61	61	61	62	60	61	61	61
78.5	61	61	61	61	61	62	60	61	61	61
78.75	61	61	61	61	61	62	60	61	61	61
79	61	61	61	61	61	62	60	61	61	61
79.25	61	61	61	61	61	62	60	61	61	61
79.5	61	61	61	61	61	62	60	61	61	61
79.75	61	61	61	61	61	62	60	61	61	61
80	61	61	61	61	61	62	60	61	61	61
80.25	61	61	61	61	61	62	60	61	61	61
80.5	61	61	61	61	61	62	60	61	61	61
80.75	61	61	61	61	61	62	60	61	61	61
81	61	61	61	61	61	62	60	61	61	61
81.25	61	61	61	61	61	62	60	61	61	61
81.5	61	61	61	61	61	62	60	61	61	61
81.75	61	61	61	62	61	62	60	61	61	61
82	61	61	61	62	61	62	60	61	61	61
82.25	61	61	61	62	61	62	60	61	61	61
82.5	61	61	61	62	61	62	60	61	61	61
82.75	61	61	61	62	61	62	60	61	61	61
83	61	61	61	62	61	62	60	61	61	61
83.25	61	61	61	62	61	62	60	61	61	61
83.5	61	61	61	62	61	62	60	61	61	61
83.75	61	61	61	62	61	62	60	61	61	61
84	61	61	61	62	61	62	60	61	61	61
84.25	61	61	61	62	62	62	60	61	61	61
84.5	61	61	61	62	62	62	60	61	61	61
84.75	61	61	61	62	62	62	60	61	61	61
85	61	61	61	62	62	62	60	61	61	61
85.25	61	61	61	62	62	62	60	61	61	61
85.5	62	61	61	62	62	62	61	62	61	61
85.75	62	62	61	62	62	62	61	62	61	62
86	62	62	61	62	62	62	61	62	61	62
86.25	62	62	61	62	62	62	61	62	61	62
86.5	62	62	61	62	62	62	61	62	61	62
86.75	62	62	61	62	62	62	61	62	61	62
87	62	62	61	62	62	62	61	62	61	62
87.25	62	62	61	62	62	62	61	62	61	62
87.5	62	62	62	62	62	62	61	62	61	62

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
87.75	62	62	62	62	62	62	61	62	61	62
88	62	62	62	62	62	62	61	62	61	62
88.25	62	62	62	62	62	62	61	62	61	62
88.5	62	62	62	62	62	62	61	62	61	62
88.75	62	62	62	62	62	62	61	62	61	62
89	62	62	61	62	62	62	61	62	61	62
89.25	62	62	62	62	62	62	61	62	61	62
89.5	62	62	62	62	62	62	61	62	61	62
89.75	62	62	62	62	62	62	61	62	61	62
90	62	62	62	62	62	62	61	62	61	62
90.25	62	62	62	62	62	62	61	62	61	62
90.5	62	62	62	62	62	62	61	62	61	62
90.75	62	62	62	62	62	62	61	62	61	62
91	62	62	62	62	62	62	61	62	62	62
91.25	62	62	62	62	62	62	61	62	61	62
91.5	62	62	62	62	62	62	61	62	62	62
91.75	62	62	62	62	62	62	61	62	62	62
92	62	62	62	62	62	63	61	62	62	62
92.25	62	62	62	62	62	63	61	62	62	62
92.5	62	62	62	62	62	63	61	62	62	62
92.75	62	62	62	62	62	63	61	62	62	62
93	62	62	62	62	62	63	61	62	62	62
93.25	62	62	62	62	62	63	61	62	62	62
93.5	62	62	62	63	62	63	61	62	62	62
93.75	62	62	62	63	62	63	61	62	62	62
94	62	62	62	63	62	63	61	62	62	62
94.25	62	62	62	63	62	63	61	62	62	62
94.5	62	62	62	63	62	63	61	62	62	62
94.75	62	62	62	63	62	63	61	62	62	62
95	63	62	62	63	62	63	61	62	62	62
95.25	63	62	62	63	62	63	61	62	62	62
95.5	63	62	62	63	62	63	61	62	62	62
95.75	63	62	62	63	62	63	61	62	62	62
96	63	63	62	63	62	63	61	62	62	62
96.25	63	63	62	63	62	63	61	62	62	62
96.5	63	63	62	63	62	63	61	62	62	62
96.75	63	63	62	63	62	63	61	62	62	62
97	63	63	62	63	62	63	62	62	62	62
97.25	63	63	62	63	62	63	62	62	62	62
97.5	63	63	62	63	62	63	62	62	62	62
97.75	63	63	62	63	62	63	62	62	62	62
98	63	63	62	63	63	63	62	62	62	63
98.25	63	63	62	63	62	63	62	62	62	63
98.5	63	63	62	63	62	63	62	62	62	63
98.75	63	63	62	63	63	63	62	62	62	63
99	63	63	62	63	63	63	62	62	62	63
99.25	63	63	62	63	63	63	62	62	62	63
99.5	63	63	62	63	63	63	62	62	62	63
99.75	63	63	62	63	63	63	62	62	62	63
100	63	63	62	63	63	63	62	62	62	63
100.25	63	63	62	63	63	63	62	62	62	63
100.5	63	63	62	63	63	63	62	62	62	63
100.75	63	63	62	63	63	64	62	62	62	63
101	63	63	62	63	63	64	62	63	62	63
101.25	63	63	62	63	63	64	62	63	62	63
101.5	63	63	62	63	63	64	62	63	62	63
101.75	63	63	62	63	63	64	62	63	62	63
102	63	63	62	63	63	64	62	63	62	63
102.25	63	63	62	63	63	64	62	63	62	63
102.5	64	63	62	63	63	64	62	63	62	63

Time (minutes)	Unexposed Temperatures									
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	Average
102.75	64	63	62	64	63	64	62	63	62	63
103	64	63	62	63	63	64	62	63	62	63
103.25	64	63	62	64	63	64	62	63	62	63
103.5	64	63	62	64	63	64	62	63	62	63
103.75	64	63	62	64	63	64	62	63	62	63
104	64	63	63	64	63	64	62	63	62	63
104.25	64	64	63	64	63	64	62	63	62	63
104.5	64	64	63	64	63	64	62	63	63	63
104.75	64	64	63	64	63	64	62	63	63	63
105	64	64	63	64	63	64	62	63	63	63
105.25	64	64	63	64	63	64	62	63	63	63
105.5	64	64	63	64	63	64	62	63	63	63
105.75	64	64	63	64	63	64	62	63	63	63
106	64	64	63	64	63	64	62	63	63	63
106.25	64	64	63	64	63	64	63	63	63	63
106.5	64	64	63	64	63	64	63	63	63	63
106.75	64	64	63	64	63	64	63	63	63	63
107	64	64	63	64	63	64	63	63	63	63
107.25	64	64	63	64	63	64	63	63	63	63
107.5	64	64	63	64	63	64	63	63	63	63
107.75	64	64	63	64	63	64	63	63	63	64
108	64	64	63	64	63	64	63	63	63	64
108.25	65	64	63	64	63	64	63	63	63	64
108.5	65	64	63	64	64	64	63	63	63	64
108.75	65	64	63	64	64	64	63	63	63	64
109	65	64	63	64	64	64	63	63	63	64
109.25	65	64	63	64	64	64	63	63	63	64
109.5	65	64	63	64	64	64	63	63	63	64
109.75	65	64	63	64	64	65	63	63	63	64
110	65	64	63	65	64	65	63	63	63	64
110.25	65	64	63	65	64	65	63	63	63	64
110.5	65	64	63	65	64	65	63	63	63	64
110.75	65	65	63	65	64	65	63	63	63	64
111	65	65	63	65	64	65	63	63	63	64
111.25	65	65	63	65	64	65	63	63	63	64
111.5	65	65	63	65	64	65	63	63	63	64
111.75	65	65	63	65	64	65	63	64	63	64
112	65	65	63	65	64	65	63	64	63	64
112.25	65	65	63	65	64	65	63	64	63	64
112.5	65	65	63	65	64	65	63	64	63	64
112.75	65	65	63	65	64	65	63	64	63	64
113	65	65	63	65	64	65	64	64	63	64
113.25	66	65	63	65	64	65	64	64	63	64
113.5	66	65	63	65	64	65	64	64	63	64
113.75	66	65	63	65	64	65	64	64	64	64
114	66	65	64	65	64	65	64	64	64	64
114.25	66	65	64	65	64	65	64	64	64	64
114.5	66	65	64	65	64	65	64	64	64	64
114.75	66	65	64	65	64	65	64	64	63	64
115	66	65	64	65	64	65	64	64	64	64
115.25	66	65	64	65	64	65	64	64	64	65
115.5	66	65	64	65	64	65	64	64	64	65
115.75	66	65	64	65	64	65	64	64	64	65
116	66	65	64	65	64	65	64	64	64	65
116.25	66	65	64	65	64	65	64	64	64	65
116.5	66	65	64	65	64	65	64	64	64	65
116.75	66	65	64	66	65	65	64	64	64	65
117	66	65	64	66	64	65	64	64	64	65
117.25	66	66	64	66	65	66	64	64	64	65
117.5	66	66	64	66	65	66	64	64	64	65

Time (minutes)	Unexposed Temperatures									Average
	TC 1	TC 2	TC 3	TC 4	TC 5	TC 6	TC 7	TC 8	TC 9	
117.75	66	66	64	66	65	66	64	64	64	65
118	66	66	64	66	65	66	64	64	64	65
118.25	66	66	64	66	65	66	64	64	64	65
118.5	67	66	64	66	65	66	64	64	64	65
118.75	67	66	64	66	65	66	64	64	64	65
119	67	66	64	66	65	66	64	64	64	65
119.25	67	66	64	66	65	66	64	64	64	65
119.5	67	66	64	66	65	66	64	64	64	65
119.75	67	66	64	66	65	66	64	64	64	65
120	67	66	64	66	65	66	65	64	64	65

## Appendix C – Post-ASTM E119 Fire Endurance and Hose Stream Compressive Load Testing

At the client's request, this assembly was subjected to increased superimposed load after cooling, approximately 3 hours after the hose stream. The superimposed load was increased gradually to 66,893 lbs., or 6,689 plf, at 2,350 psig hydraulic pressure, at which point the load was released. Nonmandatory Information in Appendix X5, Commentary subsection X5.8.3 states, "A former requirement that loadbearing walls and partitions also sustain twice the specified superimposed test load after cooling but within 72 h of the test period has been deleted from these test methods as being unrealistic."

### Procedure

In order to conduct the compressive load testing, the lab personnel and client discussed increasing the load in increments of 100 psig every minute. Increasing the load from one pressure reading to the next took place at approximately 60 seconds +/- 5 seconds.

During the compressive loading, at 3 minutes, pressure increment changed from 100 psig to 50 psig.

During the compressive loading, at 4 minutes and 10 seconds, the client suggested increasing the load every 30 seconds. Pressure increments increase took place at 30 seconds +/- 5 seconds to achieve new pressure reading.

The additional compressive load testing observations are as follows:

Time (minutes)	Observation
Pre- Compressive Test	Current pressure increment at 340 psig
0:00	Initial pressure increased to 500 psig, maintained for 60 seconds
1:00	Load increased to 600 psig
2:00	700 psig
3:00	750 psig
4:00	800 psig
4:10	Instructed to increase pressure every 30 seconds by client
4:30	850 psig
5:00	900 psig
5:30	950 psig
6:00	1,000 psig
6:30	1,050 psig
7:00	1,100 psig
7:30	1,150 psig
8:00	1,200 psig
8:30	1,250 psig
9:00	1,300 psig
9:30	1,350 psig
10:00	1,400 psig

	Lab personnel required to change pressure gauge to higher rated pressure gauge; pressure maintained during process
13:00	Pressure re-engaged at 1,400 psig
13:30	Pressure increased to 1,500 psig
14:00	1,550 psig
14:27	1,600 psig
15:00	1,650 psig
15:30	1,700 psig
16:03	1,750 psig
16:33	1,800 psig
17:00	1,850 psig
17:30	1,900 psig
18:00	1,950 psig
18:30	2,000 psig
19:00	2,050 psig
19:00	Small amount of material fell from face of specimen
19:30	2,100 psig
19:50	Technician noted some bowing in wall, client noted it could just be taper of wall
20:00	2,150 psig
20:20	More material falling from face of specimen
20:30	2,200 psig
21:00	2,300 psig
21:30	2,350 psig
21:33	Load reduced due to significant material falling from wall assembly. Lab personnel made decision to terminate compressive loading

Compressive Loading (Post-Fire Endurance & Hose Stream Test)	
Hydraulic Pressure Applied for each Actuator (psig)	2350
No. of Actuators	3
Actuator Effective Area (sq. inches)	11.04
<b>Ultimate Applied Load by all Actuators (lbs.)</b>	<b>77,832</b>
Dead Load – Estimated Weight of Walls (lbs.)	8,408
Dead Load – Weight of Load Beam & Blocks (lbs.)	2,606
Weight of Top Beam (lbs.)	207
Ultimate Superimposed Load (lbs.)	66,818

**Eqn. 1:** Ultimate Applied Load by all Actuators =  $(2350 \text{ psig}) \times (3 \text{ Actuators}) \times (11.04 \text{ sq. in.}) = 77,832 \text{ lbs.}$

**Eqn. 2** = Ultimate Superimposed Load (added to Wall) =  $\text{Actuator Load} - (\text{Dead Load of Wall} + \text{Dead Load of Beam & Bricks} + \text{Weight of Top Beam}) + \text{Weight of Top Beam}$

Or

Superimposed Load =  $77,832 \text{ lbs.} - (8,408 \text{ lbs.} + 2,606 \text{ lbs.} + 207 \text{ lbs.}) + 207 \text{ lbs.} = 66,818 \text{ lbs.}$

## Appendix D - Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	01/11/2022	N/A	Original report issue