

2019

# Fire safety of rectangular hollow section (RHS) truss members with local imperfections

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Bailey, L. (2019) 'Fire safety of rectangular hollow section (RHS) truss members with local imperfections', *The Plymouth Student Scientist*, 12(1), p. 187-206.

<http://hdl.handle.net/10026.1/14686>

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The Plymouth Student Scientist  
University of Plymouth

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# Appendix 1

## Fire Limit State Connection Loaded Model Results (Connection Loading = 22kN):

Room  
Temperature  
(RT)

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	6.38E-08	1.37E-06
4.00E-02	1.28E-07	2.75E-06
7.00E-02	2.23E-07	4.81E-06
0.115	3.67E-07	7.90E-06
0.1825	5.82E-07	1.25E-05
0.2825	9.00E-07	1.94E-05
0.3825	1.22E-06	2.63E-05
0.4825	1.54E-06	3.32E-05
0.5825	1.85E-06	4.01E-05
0.6825	2.17E-06	4.70E-05
0.7825	2.49E-06	5.38E-05
0.8825	2.81E-06	6.07E-05
0.9825	3.12E-06	6.77E-05
1.0825	8.17E-08	6.59E-05
1.1825	4.91E-06	6.76E-05
1.2825	9.46E-06	8.70E-05
1.3825	1.40E-05	1.19E-04
1.4825	1.85E-05	1.51E-04
1.5825	2.30E-05	1.84E-04
1.6825	2.75E-05	2.18E-04
1.7825	3.20E-05	2.52E-04
1.8825	3.64E-05	2.86E-04
1.9413	3.90E-05	3.07E-04
2	4.17E-05	3.27E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.22E-02	3.55E+06
4.00E-02	4.72E-02	7.09E+06
7.00E-02	9.12E-02	1.24E+07
0.115	1.75E-01	2.04E+07
0.1825	3.37E-01	3.24E+07
0.2825	6.60E-01	5.01E+07
0.3825	0.99905	6.79E+07
0.4825	1.3697	8.57E+07
0.5825	1.458	1.03E+08
0.6825	1.5007	1.21E+08
0.7825	1.7169	1.39E+08
0.8825	2.3766	1.57E+08
0.9825	3.5855	1.75E+08
1.0825	225.34	1.77E+08
1.1825	230.44	1.77E+08
1.2825	230.58	1.77E+08
1.3825	230.41	1.77E+08
1.4825	230.08	1.77E+08
1.5825	229.82	1.77E+08
1.6825	229.59	1.77E+08
1.7825	229.32	1.77E+08
1.8825	229.01	1.77E+08
1.9413	228.93	1.77E+08
2	228.83	1.77E+08

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.36E-13	1.77E-05
4.00E-02	2.95E-13	3.55E-05
7.00E-02	5.86E-13	6.21E-05
0.115	1.15E-12	1.02E-04
0.1825	2.27E-12	1.62E-04
0.2825	4.57E-12	2.51E-04
0.3825	7.80E-12	3.40E-04
0.4825	1.19E-11	4.29E-04
0.5825	1.74E-11	5.18E-04
0.6825	2.46E-11	6.07E-04
0.7825	3.39E-11	6.96E-04
0.8825	4.52E-11	7.85E-04
0.9825	6.02E-11	8.74E-04
1.0825	1.14E-09	8.88E-04
1.1825	1.16E-09	8.86E-04
1.2825	1.16E-09	8.86E-04
1.3825	1.16E-09	8.86E-04
1.4825	1.16E-09	8.85E-04
1.5825	1.16E-09	8.85E-04
1.6825	1.16E-09	8.85E-04
1.7825	1.16E-09	8.84E-04
1.8825	1.16E-09	8.84E-04
1.9413	1.16E-09	8.84E-04
2	1.16E-09	8.84E-04

300°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	7.98E-08	1.72E-06
4.00E-02	1.60E-07	3.43E-06
7.00E-02	2.79E-07	6.01E-06
0.115	4.58E-07	9.87E-06
0.1825	7.27E-07	1.57E-05
0.2825	1.13E-06	2.43E-05
0.3825	1.52E-06	3.29E-05
0.4825	1.92E-06	4.15E-05
0.5825	2.32E-06	5.01E-05
0.6825	2.71E-06	5.87E-05
0.7825	3.11E-06	6.73E-05
0.8825	3.51E-06	7.60E-05
0.9825	3.90E-06	8.46E-05
1.0825	1.97E-07	8.26E-05
1.1825	6.19E-06	8.55E-05
1.2825	1.18E-05	1.06E-04
1.3825	1.74E-05	1.45E-04
1.4825	2.30E-05	1.85E-04
1.5825	2.86E-05	2.26E-04
1.6825	3.42E-05	2.67E-04
1.7825	3.98E-05	3.10E-04
1.8825	4.54E-05	3.53E-04
1.9413	4.87E-05	3.79E-04
2	5.20E-05	4.05E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.25E-02	3.55E+06
4.00E-02	4.90E-02	7.09E+06
7.00E-02	9.72E-02	1.24E+07
0.115	1.92E-01	2.04E+07
0.1825	3.75E-01	3.24E+07
0.2825	7.13E-01	5.01E+07
0.3825	1.0852	6.79E+07
0.4825	1.1891	8.57E+07
0.5825	1.2539	1.03E+08
0.6825	1.6476	1.21E+08
0.7825	2.7062	1.39E+08
0.8825	3.8521	1.57E+08
0.9825	5.5199	1.75E+08
1.0825	280.8	1.78E+08
1.1825	288.3	1.78E+08
1.2825	288.12	1.78E+08
1.3825	287.81	1.78E+08
1.4825	287.29	1.77E+08
1.5825	286.69	1.77E+08
1.6825	286.13	1.77E+08
1.7825	285.59	1.77E+08
1.8825	285.01	1.77E+08
1.9413	284.83	1.77E+08
2	284.63	1.77E+08

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.73E-13	2.22E-05
4.00E-02	3.86E-13	4.44E-05
7.00E-02	7.88E-13	7.77E-05
0.115	1.60E-12	1.28E-04
0.1825	3.21E-12	2.03E-04
0.2825	6.76E-12	3.14E-04
0.3825	1.15E-11	4.25E-04
0.4825	1.84E-11	5.36E-04
0.5825	2.80E-11	6.47E-04
0.6825	4.08E-11	7.59E-04
0.7825	5.77E-11	8.70E-04
0.8825	8.07E-11	9.82E-04
0.9825	1.13E-10	1.09E-03
1.0825	1.77E-09	1.11E-03
1.1825	1.82E-09	1.11E-03
1.2825	1.82E-09	1.11E-03
1.3825	1.82E-09	1.11E-03
1.4825	1.81E-09	1.11E-03
1.5825	1.81E-09	1.11E-03
1.6825	1.81E-09	1.11E-03
1.7825	1.80E-09	1.11E-03
1.8825	1.80E-09	1.11E-03
1.9413	1.80E-09	1.11E-03
2	1.80E-09	1.11E-03

400°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	9.11E-08	1.96E-06
4.00E-02	1.82E-07	3.92E-06
7.00E-02	3.19E-07	6.87E-06
0.115	5.24E-07	1.13E-05
0.1825	8.31E-07	1.79E-05
0.2825	1.29E-06	2.77E-05
0.3825	1.74E-06	3.76E-05
0.4825	2.19E-06	4.74E-05
0.5825	2.65E-06	5.73E-05
0.6825	3.10E-06	6.71E-05
0.7825	3.55E-06	7.70E-05
0.8825	4.00E-06	8.69E-05
0.9825	4.46E-06	9.68E-05
1.0825	3.92E-07	9.48E-05
1.1825	7.08E-06	9.95E-05
1.2825	1.35E-05	1.17E-04
1.3825	2.00E-05	1.60E-04
1.4825	2.64E-05	2.03E-04
1.5825	3.28E-05	2.47E-04
1.6825	3.92E-05	2.93E-04
1.7825	4.56E-05	3.39E-04
1.8825	5.20E-05	3.86E-04
1.9413	5.57E-05	4.15E-04
2	5.94E-05	4.43E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.28E-02	3.55E+06
4.00E-02	4.99E-02	7.09E+06
7.00E-02	1.01E-01	1.24E+07
0.115	2.03E-01	2.04E+07
0.1825	4.05E-01	3.24E+07
0.2825	7.44E-01	5.01E+07
0.3825	1.0342	6.79E+07
0.4825	1.0744	8.57E+07
0.5825	1.3243	1.04E+08
0.6825	2.268	1.21E+08
0.7825	3.4246	1.39E+08
0.8825	5.1452	1.57E+08
0.9825	8.0708	1.75E+08
1.0825	319.26	1.78E+08
1.1825	329.85	1.78E+08
1.2825	328.89	1.78E+08
1.3825	327.88	1.78E+08
1.4825	326.83	1.78E+08
1.5825	325.75	1.78E+08
1.6825	324.65	1.78E+08
1.7825	323.55	1.78E+08
1.8825	322.45	1.78E+08
1.9413	322.09	1.78E+08
2	321.71	1.78E+08

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	2.01E-13	2.54E-05
4.00E-02	4.54E-13	5.07E-05
7.00E-02	9.45E-13	8.88E-05
0.115	1.94E-12	1.46E-04
0.1825	3.99E-12	2.32E-04
0.2825	8.44E-12	3.59E-04
0.3825	1.48E-11	4.86E-04
0.4825	2.43E-11	6.13E-04
0.5825	3.78E-11	7.40E-04
0.6825	5.61E-11	8.67E-04
0.7825	8.19E-11	9.95E-04
0.8825	1.19E-10	1.12E-03
0.9825	1.62E-10	1.25E-03
1.0825	2.31E-09	1.27E-03
1.1825	2.38E-09	1.27E-03
1.2825	2.38E-09	1.27E-03
1.3825	2.37E-09	1.27E-03
1.4825	2.37E-09	1.27E-03
1.5825	2.36E-09	1.27E-03
1.6825	2.35E-09	1.27E-03
1.7825	2.34E-09	1.27E-03
1.8825	2.34E-09	1.27E-03
1.9413	2.33E-09	1.27E-03
2	2.33E-09	1.27E-03

500°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	1.06E-07	2.29E-06
4.00E-02	2.13E-07	4.58E-06
7.00E-02	3.72E-07	8.01E-06
0.115	6.11E-07	1.32E-05
0.1825	9.69E-07	2.09E-05
0.2825	1.50E-06	3.24E-05
0.3825	2.03E-06	4.39E-05
0.4825	2.56E-06	5.53E-05
0.5825	3.09E-06	6.68E-05
0.6825	3.61E-06	7.84E-05
0.7825	4.14E-06	8.99E-05
0.8825	4.67E-06	1.01E-04
0.9825	5.19E-06	1.13E-04
1.0825	9.14E-07	1.12E-04
1.1825	7.99E-06	1.26E-04
1.2825	1.47E-05	1.76E-04
1.3825	2.10E-05	2.51E-04
1.4825	2.70E-05	3.36E-04
1.5825	3.29E-05	4.27E-04
1.6825	3.84E-05	5.28E-04
1.7825	4.38E-05	6.33E-04
1.8825	4.88E-05	7.49E-04
1.9413	5.16E-05	8.22E-04
2	5.42E-05	8.99E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.33E-02	3.55E+06
4.00E-02	5.18E-02	7.09E+06
7.00E-02	1.07E-01	1.24E+07
0.115	2.17E-01	2.04E+07
0.1825	4.41E-01	3.24E+07
0.2825	7.86E-01	5.01E+07
0.3825	0.9188	6.79E+07
0.4825	1.0467	8.57E+07
0.5825	1.8125	1.04E+08
0.6825	2.9931	1.21E+08
0.7825	4.7786	1.39E+08
0.8825	8.0206	1.57E+08
0.9825	12.535	1.75E+08
1.0825	367.77	1.78E+08
1.1825	379.49	1.79E+08
1.2825	381.64	1.79E+08
1.3825	374.05	1.79E+08
1.4825	366.56	1.79E+08
1.5825	358.77	1.80E+08
1.6825	349.06	1.80E+08
1.7825	340.59	1.81E+08
1.8825	328.19	1.81E+08
1.9413	325.13	1.81E+08
2	320.9	1.82E+08

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	2.41E-13	2.96E-05
4.00E-02	5.51E-13	5.92E-05
7.00E-02	1.18E-12	1.04E-04
0.115	2.44E-12	1.70E-04
0.1825	5.18E-12	2.70E-04
0.2825	1.10E-11	4.18E-04
0.3825	2.01E-11	5.67E-04
0.4825	3.40E-11	7.15E-04
0.5825	5.39E-11	8.64E-04
0.6825	8.33E-11	1.01E-03
0.7825	1.26E-10	1.16E-03
0.8825	1.83E-10	1.31E-03
0.9825	3.06E-10	1.46E-03
1.0825	3.12E-09	1.49E-03
1.1825	3.28E-09	1.49E-03
1.2825	3.21E-09	1.49E-03
1.3825	3.15E-09	1.49E-03
1.4825	3.09E-09	1.50E-03
1.5825	3.03E-09	1.50E-03
1.6825	2.95E-09	1.50E-03
1.7825	2.89E-09	1.51E-03
1.8825	2.79E-09	1.51E-03
1.9413	2.78E-09	1.51E-03
2	2.74E-09	1.51E-03

600°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	2.06E-07	4.43E-06
4.00E-02	4.12E-07	8.86E-06
7.00E-02	7.20E-07	1.55E-05
0.115	1.18E-06	2.55E-05
0.1825	1.87E-06	4.05E-05
0.2825	2.90E-06	6.27E-05
0.3825	3.92E-06	8.50E-05
0.4825	4.94E-06	1.07E-04
0.5825	5.96E-06	1.30E-04
0.6825	6.96E-06	1.52E-04
0.7825	7.90E-06	1.74E-04
0.8175	8.09E-06	4.35E-04
0.8525	8.82E-06	1.16E-03

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.59E-02	3.55E+06
4.00E-02	6.36E-02	7.09E+06
7.00E-02	1.42E-01	1.24E+07
0.115	2.92E-01	2.04E+07
0.1825	4.79E-01	3.24E+07
0.2825	6.43E-01	5.02E+07
0.3825	1.4094	6.80E+07
0.4825	3.5581	8.60E+07
0.5825	9.4138	1.04E+08
0.6825	27.986	1.23E+08
0.7825	108.49	1.45E+08
0.8175	451.77	1.48E+08
0.8525	1585.8	1.59E+08

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	5.30E-13	5.73E-05
4.00E-02	1.36E-12	1.15E-04
7.00E-02	3.14E-12	2.01E-04
0.115	7.25E-12	3.30E-04
0.1825	1.66E-11	5.23E-04
0.2825	4.13E-11	8.11E-04
0.3825	8.67E-11	1.10E-03
0.4825	1.64E-10	1.39E-03
0.5825	4.58E-10	1.68E-03
0.6825	1.43E-09	1.99E-03
0.7825	4.61E-09	2.34E-03
0.8175	1.49E-08	2.39E-03
0.8525	3.33E-08	2.57E-03

700°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	4.91E-07	1.06E-05
4.00E-02	9.81E-07	2.11E-05
7.00E-02	1.71E-06	3.70E-05
0.115	2.81E-06	6.09E-05
0.1825	4.46E-06	9.68E-05
0.2825	6.88E-06	1.50E-04
0.3825	9.20E-06	3.44E-04
0.38875	9.12E-06	2.98E-04
0.39187	8.89E-06	2.77E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	3.41E-02	3.55E+06
4.00E-02	9.28E-02	7.10E+06
7.00E-02	1.97E-01	1.24E+07
0.115	2.50E-01	2.04E+07
0.1825	8.61E-01	3.25E+07
0.2825	4.61E+00	5.09E+07
0.3825	47.789	7.16E+07
0.38875	163.93	7.23E+07
0.39187	484.36	7.27E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.74E-12	1.37E-04
4.00E-02	5.11E-12	2.73E-04
7.00E-02	1.36E-11	4.79E-04
0.115	3.74E-11	7.87E-04
0.1825	1.09E-10	1.25E-03
0.2825	5.50E-10	1.96E-03
0.3825	5.31E-09	2.76E-03
0.38875	1.47E-08	2.78E-03
0.39187	3.63E-08	2.80E-03

*Control Model Results (Same model as above but without connection force):*

Room  
Temperature  
(RT)

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	6.06E-18	6.53E-15
0.9825	3.23E-17	7.18E-15
1.0825	3.68E-06	2.64E-05
1.1825	8.13E-06	5.89E-05
1.2825	1.26E-05	9.18E-05
1.3825	1.70E-05	1.25E-04
1.4825	2.15E-05	1.59E-04
1.5825	2.60E-05	1.93E-04
1.6825	3.05E-05	2.28E-04
1.7825	3.49E-05	2.64E-04
1.8825	3.94E-05	2.99E-04
1.9413	4.21E-05	3.21E-04
2	4.47E-05	3.42E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.68E-06	9.79E-03
4.00E-02	8.48E-06	1.61E-02
7.00E-02	3.47E-06	1.93E-02
0.115	4.22E-06	2.02E-02
0.1825	1.00E-05	2.07E-02
0.2825	1.23E-05	2.29E-02
0.3825	6.58E-06	2.90E-02
0.4825	9.90E-06	3.39E-02
0.5825	1.45E-05	3.00E-02
0.6825	1.05E-05	3.38E-02
0.7825	7.49E-06	3.69E-02
0.8825	6.33E-06	3.99E-02
0.9825	1.05E-05	4.27E-02
1.0825	6.62E-02	2.97E+06
1.1825	1.40E-01	6.62E+06
1.2825	2.48E-01	1.03E+07
1.3825	3.57E-01	1.41E+07
1.4825	4.70E-01	1.79E+07
1.5825	5.83E-01	2.18E+07
1.6825	6.97E-01	2.57E+07
1.7825	8.14E-01	2.97E+07
1.8825	9.31E-01	3.37E+07
1.9413	9.71E-01	3.61E+07
2	1.01E+00	3.85E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.94E-16	3.28E-13
0.9825	7.64E-16	3.25E-13
1.0825	3.59E-13	1.57E-05
1.1825	7.23E-13	3.51E-05
1.2825	1.27E-12	5.46E-05
1.3825	1.81E-12	7.45E-05
1.4825	2.38E-12	9.47E-05
1.5825	2.95E-12	1.15E-04
1.6825	3.52E-12	1.36E-04
1.7825	4.12E-12	1.57E-04
1.8825	4.71E-12	1.78E-04
1.9413	4.91E-12	1.91E-04
2	5.12E-12	2.04E-04

300°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	2.50E-18	6.50E-15
0.9825	1.63E-17	8.24E-15
1.0825	4.59E-06	3.31E-05
1.1825	1.02E-05	7.38E-05
1.2825	1.57E-05	1.15E-04
1.3825	2.13E-05	1.57E-04
1.4825	2.69E-05	2.00E-04
1.5825	3.25E-05	2.44E-04
1.6825	3.81E-05	2.89E-04
1.7825	4.37E-05	3.34E-04
1.8825	4.94E-05	3.80E-04
1.9413	5.27E-05	4.08E-04
2	5.60E-05	4.36E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	2.14E-06	7.83E-03
4.00E-02	6.78E-06	1.29E-02
7.00E-02	2.77E-06	1.55E-02
0.115	3.37E-06	1.61E-02
0.1825	8.00E-06	1.65E-02
0.2825	9.86E-06	1.83E-02
0.3825	5.26E-06	2.32E-02
0.4825	7.92E-06	2.71E-02
0.5825	1.16E-05	2.40E-02
0.6825	8.41E-06	2.71E-02
0.7825	5.99E-06	2.95E-02
0.8825	1.12E-05	3.19E-02
0.9825	9.05E-06	3.32E-02
1.0825	8.36E-02	2.98E+06
1.1825	1.77E-01	6.65E+06
1.2825	3.11E-01	1.04E+07
1.3825	4.49E-01	1.42E+07
1.4825	5.92E-01	1.81E+07
1.5825	7.37E-01	2.20E+07
1.6825	8.88E-01	2.60E+07
1.7825	1.04E+00	3.01E+07
1.8825	1.19E+00	3.43E+07
1.9413	1.24E+00	3.68E+07
2	1.30E+00	3.93E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.78E-16	3.28E-13
0.9825	6.28E-16	3.50E-13
1.0825	5.45E-13	1.97E-05
1.1825	1.13E-12	4.40E-05
1.2825	1.97E-12	6.86E-05
1.3825	2.85E-12	9.38E-05
1.4825	3.75E-12	1.19E-04
1.5825	4.66E-12	1.45E-04
1.6825	5.62E-12	1.72E-04
1.7825	6.56E-12	1.99E-04
1.8825	7.53E-12	2.27E-04
1.9413	7.86E-12	2.43E-04
2	8.22E-12	2.60E-04



400°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	6.06E-18	6.53E-15
0.9825	3.23E-17	7.18E-15
1.0825	5.25E-06	3.78E-05
1.1825	1.16E-05	8.46E-05
1.2825	1.80E-05	1.32E-04
1.3825	2.44E-05	1.81E-04
1.4825	3.08E-05	2.31E-04
1.5825	3.72E-05	2.81E-04
1.6825	4.36E-05	3.33E-04
1.7825	5.00E-05	3.86E-04
1.8825	5.65E-05	4.40E-04
1.9413	6.03E-05	4.72E-04
2	6.42E-05	5.05E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	1.87E-06	6.86E-03
4.00E-02	5.93E-06	1.13E-02
7.00E-02	2.43E-06	1.35E-02
0.115	2.95E-06	1.41E-02
0.1825	7.00E-06	1.45E-02
0.2825	8.63E-06	1.60E-02
0.3825	4.60E-06	2.03E-02
0.4825	6.93E-06	2.37E-02
0.5825	1.02E-05	2.10E-02
0.6825	7.36E-06	2.37E-02
0.7825	5.24E-06	2.58E-02
0.8825	4.43E-06	2.79E-02
0.9825	7.36E-06	2.99E-02
1.0825	9.81E-02	2.98E+06
1.1825	2.06E-01	6.66E+06
1.2825	3.59E-01	1.04E+07
1.3825	5.18E-01	1.43E+07
1.4825	6.83E-01	1.82E+07
1.5825	8.54E-01	2.22E+07
1.6825	1.03E+00	2.63E+07
1.7825	1.20E+00	3.04E+07
1.8825	1.39E+00	3.47E+07
1.9413	1.45E+00	3.73E+07
2	1.51E+00	3.98E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.94E-16	3.28E-13
0.9825	7.64E-16	3.25E-13
1.0825	7.22E-13	2.25E-05
1.1825	1.50E-12	5.03E-05
1.2825	2.60E-12	7.87E-05
1.3825	3.75E-12	1.08E-04
1.4825	4.94E-12	1.37E-04
1.5825	6.17E-12	1.67E-04
1.6825	7.41E-12	1.98E-04
1.7825	8.71E-12	2.30E-04
1.8825	1.00E-11	2.62E-04
1.9413	1.05E-11	2.81E-04
2	1.09E-11	3.01E-04

500°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	6.06E-18	6.53E-15
0.9825	3.23E-17	7.18E-15
1.0825	6.13E-06	4.42E-05
1.1825	1.36E-05	9.90E-05
1.2825	2.10E-05	1.55E-04
1.3825	2.84E-05	2.12E-04
1.4825	3.59E-05	2.71E-04
1.5825	4.34E-05	3.32E-04
1.6825	5.09E-05	3.93E-04
1.7825	5.85E-05	4.57E-04
1.8825	6.61E-05	5.22E-04
1.9413	7.06E-05	5.61E-04
2	7.50E-05	6.01E-04

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	1.61E-06	5.88E-03
4.00E-02	5.09E-06	9.68E-03
7.00E-02	2.08E-06	1.16E-02
0.115	2.53E-06	1.21E-02
0.1825	6.00E-06	1.24E-02
0.2825	7.39E-06	1.37E-02
0.3825	3.95E-06	1.74E-02
0.4825	5.94E-06	2.03E-02
0.5825	8.71E-06	1.80E-02
0.6825	6.31E-06	2.03E-02
0.7825	4.49E-06	2.21E-02
0.8825	3.80E-06	2.39E-02
0.9825	6.31E-06	2.56E-02
1.0825	1.14E-01	2.99E+06
1.1825	2.40E-01	6.68E+06
1.2825	4.21E-01	1.05E+07
1.3825	6.11E-01	1.43E+07
1.4825	8.06E-01	1.83E+07
1.5825	1.01E+00	2.24E+07
1.6825	1.21E+00	2.66E+07
1.7825	1.43E+00	3.09E+07
1.8825	1.65E+00	3.53E+07
1.9413	1.72E+00	3.79E+07
2	1.80E+00	4.06E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.94E-16	3.28E-13
0.9825	7.64E-16	3.25E-13
1.0825	9.75E-13	2.63E-05
1.1825	2.03E-12	5.89E-05
1.2825	3.55E-12	9.23E-05
1.3825	5.15E-12	1.26E-04
1.4825	6.79E-12	1.62E-04
1.5825	8.48E-12	1.97E-04
1.6825	1.02E-11	2.34E-04
1.7825	1.20E-11	2.72E-04
1.8825	1.39E-11	3.11E-04
1.9413	1.45E-11	3.34E-04
2	1.52E-11	3.58E-04

600°C

Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	6.06E-18	6.53E-15
0.9825	3.23E-17	7.18E-15
1.0825	1.19E-05	8.63E-05
1.1825	2.63E-05	1.95E-04
1.2825	4.07E-05	3.10E-04
1.3825	5.53E-05	4.30E-04
1.4825	7.01E-05	5.56E-04
1.5825	8.44E-05	6.89E-04
1.6825	9.87E-05	8.30E-04
1.7825	1.13E-04	9.83E-04
1.8825	1.27E-04	1.15E-03
1.9413	1.36E-04	1.25E-03
2	1.44E-04	1.35E-03

Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	8.30E-07	3.04E-03
4.00E-02	2.63E-06	5.00E-03
7.00E-02	1.07E-06	5.99E-03
0.115	1.31E-06	6.25E-03
0.1825	3.10E-06	6.40E-03
0.2825	3.82E-06	7.10E-03
0.3825	2.04E-06	8.99E-03
0.4825	3.07E-06	1.05E-02
0.5825	4.50E-06	9.30E-03
0.6825	3.26E-06	1.05E-02
0.7825	2.32E-06	1.14E-02
0.8825	1.96E-06	1.24E-02
0.9825	3.26E-06	1.32E-02
1.0825	2.27E-01	3.01E+06
1.1825	4.74E-01	6.82E+06
1.2825	8.28E-01	1.08E+07
1.3825	1.20E+00	1.50E+07
1.4825	1.59E+00	1.94E+07
1.5825	2.00E+00	2.41E+07
1.6825	2.44E+00	2.90E+07
1.7825	2.90E+00	3.42E+07
1.8825	3.40E+00	3.97E+07
1.9413	3.65E+00	4.31E+07
2	3.86E+00	4.67E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.94E-16	3.28E-13
0.9825	7.64E-16	3.25E-13
1.0825	3.70E-12	5.14E-05
1.1825	7.73E-12	1.16E-04
1.2825	1.35E-11	1.84E-04
1.3825	1.95E-11	2.56E-04
1.4825	2.59E-11	3.31E-04
1.5825	3.26E-11	4.11E-04
1.6825	3.97E-11	4.95E-04
1.7825	4.73E-11	5.83E-04
1.8825	5.54E-11	6.77E-04
1.9413	5.95E-11	7.35E-04
2	6.30E-11	7.95E-04

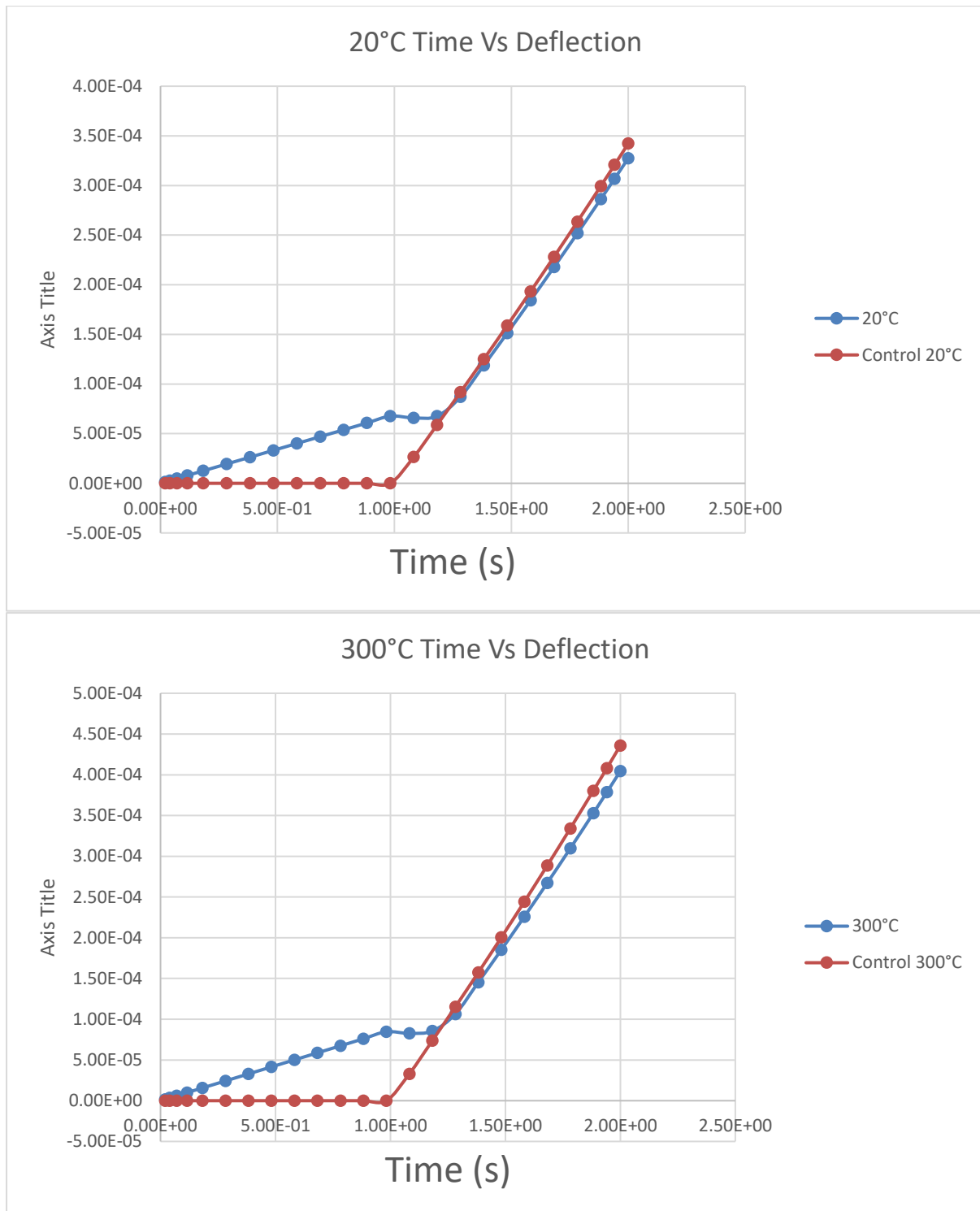
700°C

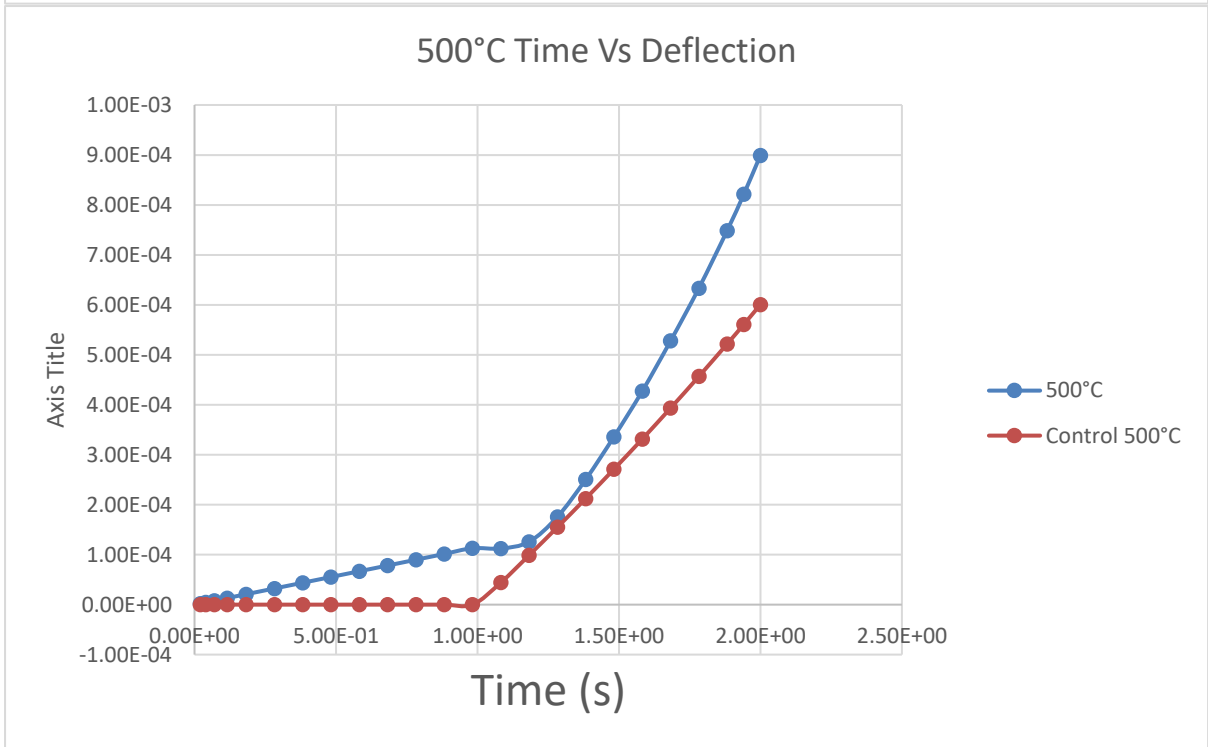
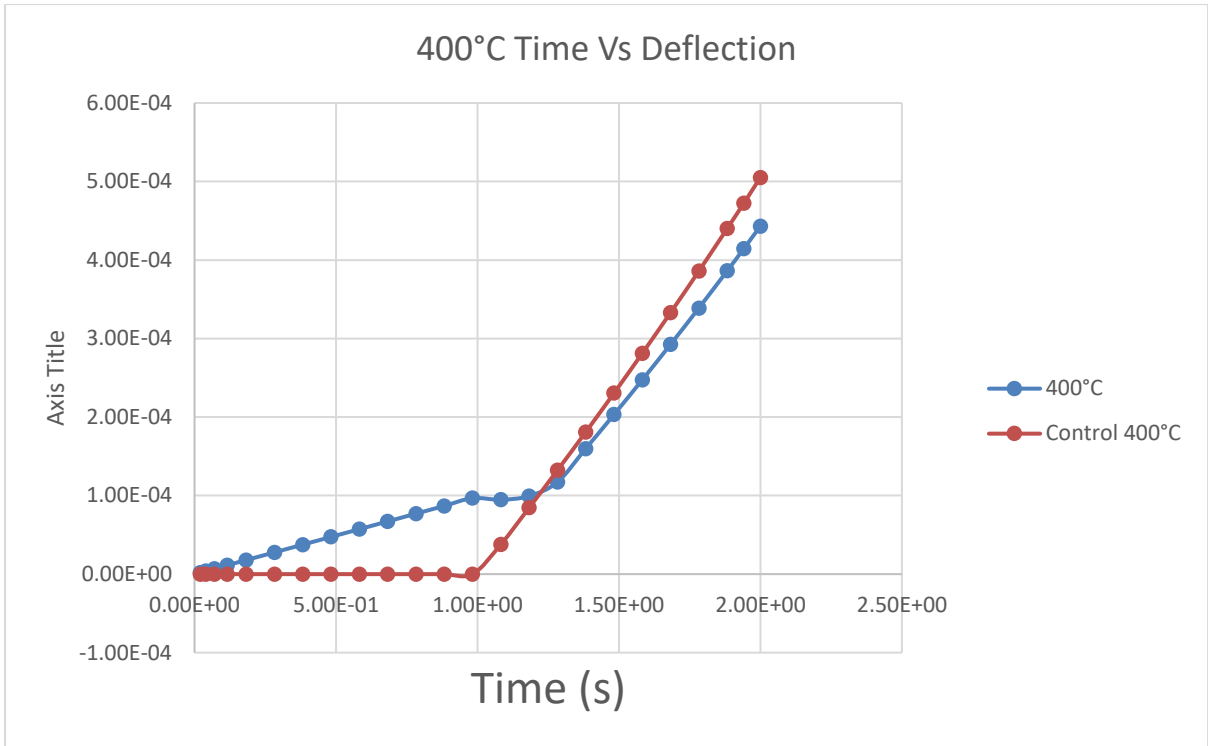
Time (s)	Deflection (m)	
	Min	Max
2.00E-02	3.16E-17	1.38E-15
4.00E-02	2.09E-17	4.47E-15
7.00E-02	6.44E-17	2.82E-15
0.115	6.77E-17	3.12E-15
0.1825	4.29E-17	2.89E-15
0.2825	7.44E-17	2.21E-15
0.3825	5.85E-17	2.58E-15
0.4825	2.29E-16	4.76E-15
0.5825	1.17E-16	5.00E-15
0.6825	9.44E-17	5.29E-15
0.7825	1.35E-16	6.45E-15
0.8825	6.06E-18	6.53E-15
0.9825	3.59E-17	7.19E-15
1.0825	2.83E-05	2.11E-04
1.1825	6.30E-05	4.96E-04
1.2825	9.75E-05	8.17E-04
1.3825	1.31E-04	1.20E-03
1.4825	1.66E-04	1.64E-03
1.5825	2.01E-04	2.16E-03
1.6825	2.34E-04	2.77E-03
1.7825	2.68E-04	3.48E-03
1.8825	2.98E-04	4.29E-03
1.9413	3.14E-04	4.80E-03
2	3.30E-04	5.38E-03

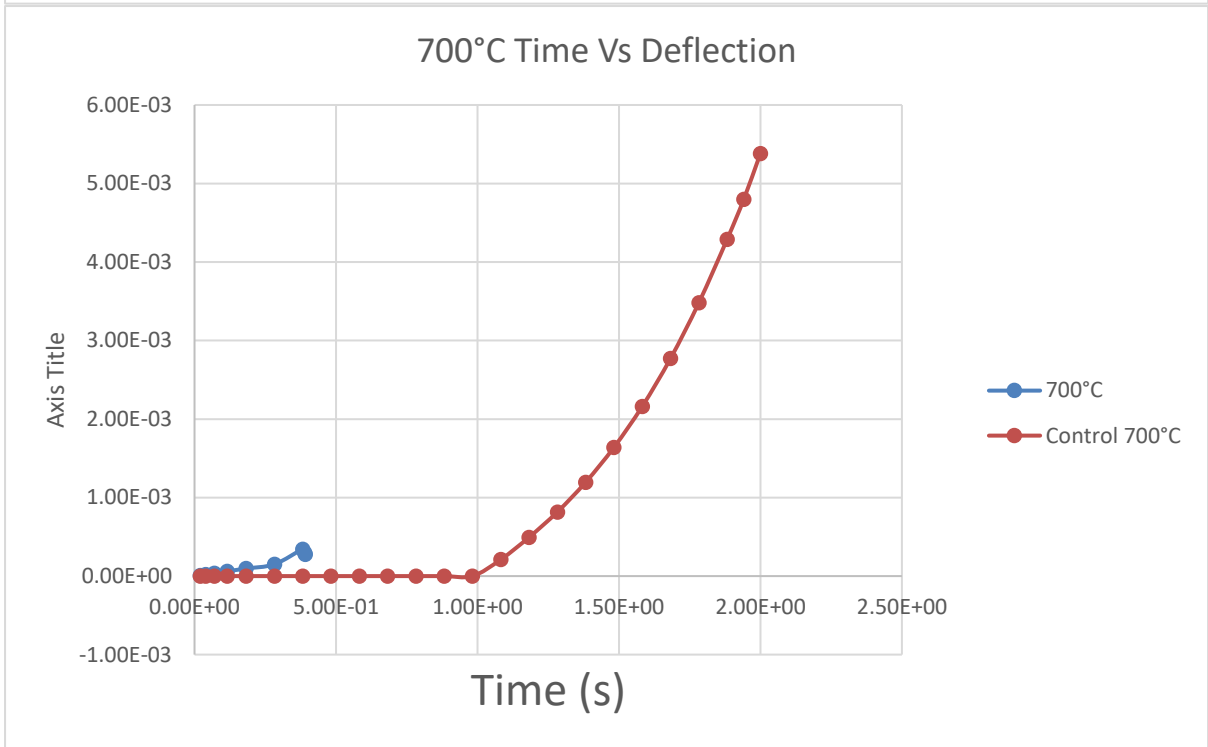
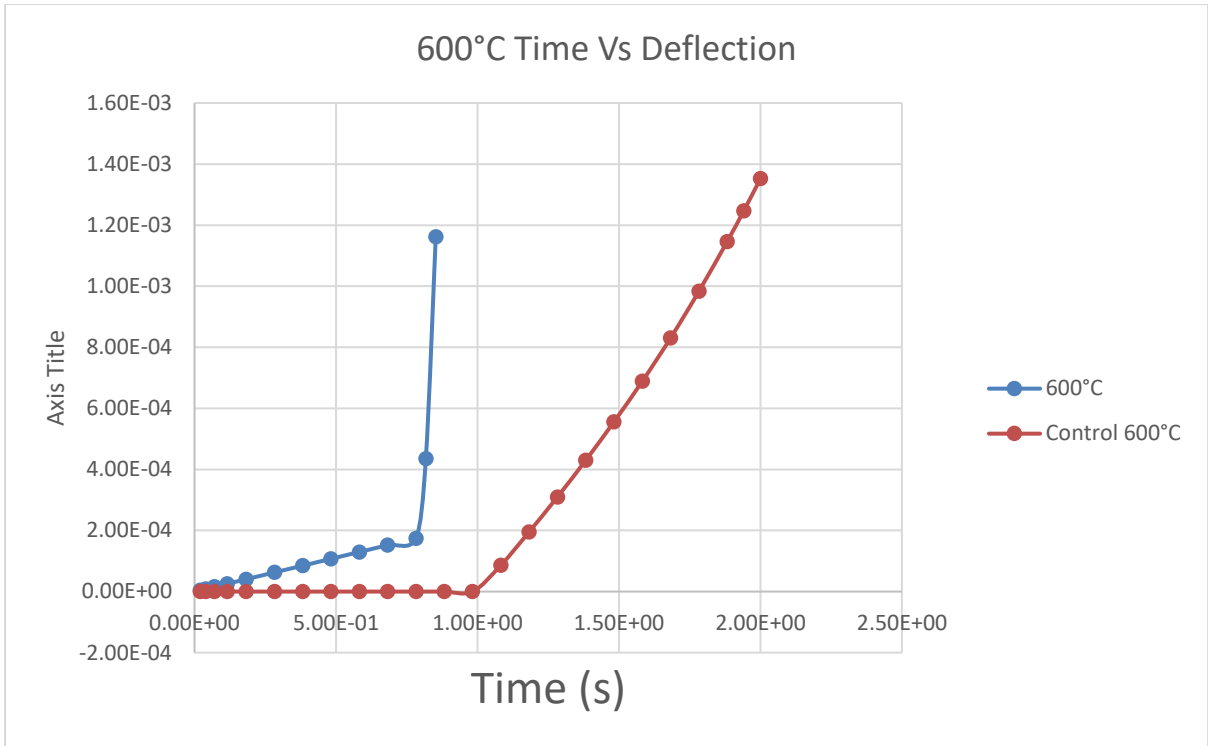
Time (s)	Stress (Pa)	
	Min	Max
2.00E-02	3.48E-07	1.27E-03
4.00E-02	1.10E-06	2.10E-03
7.00E-02	4.51E-07	2.51E-03
0.115	5.48E-07	2.62E-03
0.1825	1.30E-06	2.69E-03
0.2825	1.60E-06	2.98E-03
0.3825	8.55E-07	3.77E-03
0.4825	1.29E-06	4.41E-03
0.5825	1.89E-06	3.90E-03
0.6825	1.37E-06	4.40E-03
0.7825	9.73E-07	4.80E-03
0.8825	8.23E-07	5.19E-03
0.9825	1.47E-06	5.54E-03
1.0825	5.72E-01	3.09E+06
1.1825	1.19E+00	7.26E+06
1.2825	2.13E+00	1.20E+07
1.3825	3.21E+00	1.74E+07
1.4825	4.47E+00	2.37E+07
1.5825	6.02E+00	3.13E+07
1.6825	8.01E+00	4.06E+07
1.7825	1.07E+01	5.17E+07
1.8825	1.43E+01	6.49E+07
1.9413	1.65E+01	6.99E+07
2	1.67E+01	6.94E+07

Time (s)	Strain (m/m)	
	Min	Max
2.00E-02	1.22E-16	5.70E-14
4.00E-02	1.24E-16	8.30E-14
7.00E-02	2.54E-16	1.39E-13
0.115	2.00E-16	1.72E-13
0.1825	3.18E-16	1.77E-13
0.2825	2.75E-16	1.89E-13
0.3825	3.93E-16	2.20E-13
0.4825	5.04E-16	2.30E-13
0.5825	3.61E-16	2.82E-13
0.6825	5.97E-16	3.23E-13
0.7825	3.74E-16	3.36E-13
0.8825	5.94E-16	3.28E-13
0.9825	5.73E-16	3.25E-13
1.0825	2.24E-11	1.26E-04
1.1825	4.63E-11	2.95E-04
1.2825	8.28E-11	4.87E-04
1.3825	1.25E-10	7.06E-04
1.4825	1.74E-10	9.66E-04
1.5825	2.34E-10	1.28E-03
1.6825	3.12E-10	1.65E-03
1.7825	4.19E-10	2.11E-03
1.8825	5.73E-10	2.65E-03
1.9413	6.88E-10	2.84E-03
2	6.50E-10	2.86E-03

Graphical Representation of time Vs displacement at regular temperature intervals:







## Appendix 2

Engineering Data (For elevated temperatures):

Engineering Data: (S355 Steel)		
Steel Temperature	Reduction factors relative to room temperature. From Table 3.1 in BS EN 1993-1-2:2005	
	Yeild Strength	Youngs Modulus
20°C	1.000	1.000
100°C	1.000	1.000
200°C	1.000	0.900
300°C	1.000	0.800
400°C	1.000	0.700
500°C	0.780	0.600
600°C	0.470	0.310
700°C	0.230	0.130
800°C	0.110	0.090

Adjusted values due to increase in temperature relative to room temperature		
Yeild Strength (Mpa)	Youngs Modulus (MPa)	Tangent Modulus (MPa) (Assumed to be 1% of Young's Modulus)
355	200000	200
355	200000	200
355	180000	180
355	160000	160
355	140000	140
276.9	120000	120
166.85	62000	62
81.65	26000	26
39.05	18000	18