SEVENBIT

Long-term hydrostatic strength

ISO 9080:2012 — standard extrapolation method (SEM)

DEMO — NOT VALID FOR CERTIFICATION

DATA SET PE 100 — 20 · 60 · 80 °C	OBSERVATIONS 120	TEMPERATURES 20 · 60 · 80 °C
REPORT DATE 2026-11-15 12:09 UTC	PREPARED BY —	MATERIAL / TYPE PE 100
PIPE DIMENSIONS d32 × e3.0		

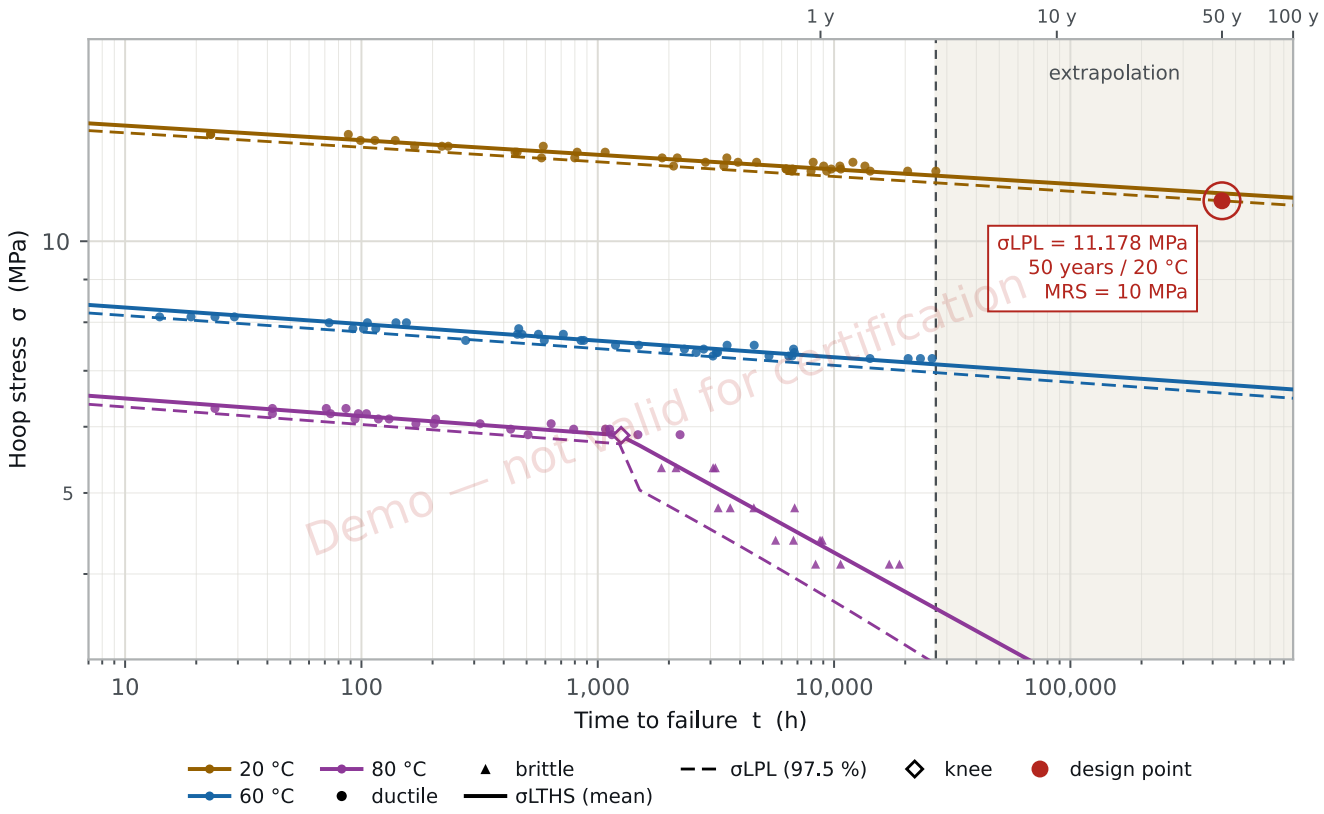
ISO 9080 Clause 7 asks the test report for a full identification of the material and the specimens (7 b), the dimensions of the test pipes (7 c) and the outside environment and internal pressure medium (7 d). Missing fields can be filled in on the data set page.

Design point — 50 years

Temperature	σ_{LTHS} (MPa)	σ_{LPL} (MPa)	Extrapolation limit
20 °C	11.411	11.178	93.8 years
60 °C	6.741	6.582	0.9 years · 50 years not covered
80 °C	2.356	1.868	–

MRS = 10 MPa · classification number 100 (ISO 12162). σLPL at 20 °C and 50 years, 11.178 MPa, rounded down to the R20 series (ISO 12162 Table 1). The material is designated by its ISO 1043-1 symbol followed by 100.

σLPL is the 97.5 % one-sided lower prediction limit and the value ISO 9080 classification rests on. σLTHS is the mean curve. The extrapolation limit t_e is the longest time higher test temperatures grant to this one under 5.1.5; it is undefined for the highest test temperature.



PE 100 · d32 × e3.0 · ISO 9080:2012, 3-parameter model · R² 0.927 (A) / 0.852 (B). Stress–time to failure curves. Dashed lines are the 97.5 % lower prediction limit; the shaded region shows the extrapolation beyond the longest test (26,960 h).

Model

$$\log_{10} t = c_1 + c_2/T + c_4 \cdot \log_{10} \sigma/T$$

t time to failure (h), T absolute temperature (K), σ hoop stress (MPa). The data contain a knee per ISO 9080 Annex B; the type A (ductile) and type B (brittle) regions were evaluated separately.

COEFFICIENTS — TYPE A

Term	Value	Standard error	t	p
c_1	-90.380	2.757	-32.78	$2.81 \cdot 10^{-54}$
c_2	45,914.161	1,374.163	33.41	$5.12 \cdot 10^{-55}$
c_4	-16,802.448	516.801	-32.51	$5.84 \cdot 10^{-54}$

STATISTICS

Observations used	100
Censored — included (> 1,000 h)	0
Censored — excluded	0
Degrees of freedom	97
Residual variance s^2	0.057453
R^2 ($\log_{10} t$)	0.927
Adjusted R^2	0.926
Condition number	61,233.004
Test of fit (Annex A.4)	Pr[F(21;76) > 1.527] = 0.094 — model accepted

c_3 not significant at 5 % (t = -1.57, p = 0.119 in the 4-parameter fit) → 3-parameter model (c_3 = 0)

COEFFICIENTS — TYPE B (BELOW THE KNEE)

Term	Value	Standard error	t	p	Obs.	d.o.f.	s^2	R^2	R^2 adj.
c_1	8.034	0.435	18.46	$3.83 \cdot 10^{-13}$	20	18	0.025210	0.852	0.844
c_3	-6.427	0.631	-10.18	$6.79 \cdot 10^{-9}$					

Test of fit (Annex A.4): Pr[F(3;15) > 0.241] = 0.867 — model accepted · single temperature: c_2 and c_4 not identifiable → 2-parameter model

Knee analysis — ISO 9080 Annex B

Temperature	Result	F	p	Knee stress (MPa)	Knee time (h)
20 °C	no knee	0.911	0.411	–	–
60 °C	no knee	1.647	0.207	–	–
80 °C	knee	64.099	$1.37 \cdot 10^{-12}$	5.883	1,224

F test at the 5 % level; p < 0.05 accepts a knee. Knee stress and time: Annex B's hinge at that temperature alone, not where the fitted surfaces cross.

Extrapolation table

Time	20 °C		60 °C		80 °C	
	σ_{LTHS}	σ_{LPL}	σ_{LTHS}	σ_{LPL}	σ_{LTHS}	σ_{LPL}
10 h	13.750	13.480	8.332	8.150	6.486	6.335
100 h	13.208	12.954	7.960	7.788	6.180	6.037
1,000 h	12.688	12.445	7.605	7.440	5.888	5.751
0.14 years (t_{max} 80 °C)	12.638	12.396	7.571	7.406	5.860	5.181
0.5 years	12.365	12.127	7.386	7.223	–	–
1 year	12.217	11.980	7.285	7.124	–	–
1.88 years (t_{max} 60 °C)	12.083	11.848	7.194	7.034	–	–
5 years	11.879	11.645	–	–	–	–
10 years	11.736	11.503	–	–	–	–
25 years	11.550	11.317	–	–	–	–
50 years	11.411	11.178	–	–	–	–
93.77 years (t_e 20 °C)	11.286	11.054	–	–	–	–

Values in MPa. Year = 365 days = 8,760 h (ISO 9080 Annex D). A dash: beyond what 5.1.5 allows at that temperature. Its limit is a row: t_e granted by a higher test temperature, or its own t_{max} where longer.

Data sufficiency — ISO 9080 Clauses 4.2 and 5.1

OBSERVATIONS PER TEMPERATURE

Temperature	Recorded	Failed	Censored	Used	> 7,000 h	> 9,000 h	Type B	Pressure levels	Excluded	Longest failure (h)	Longest test (h)
20 °C	40	40	0	40	12	10	0	9	0	26,960	26,960
60 °C	40	40	0	40	4	4	0	10	0	25,995	25,995
80 °C	40	40	0	40	6	3	20	10	0	18,909	18,909
Required (4.2.1)				≥ 30	≥ 4	≥ 1	≥ 5	–	–	–	–

Used and the counts after it are of the observations the fit uses (censored per 4.2.4, degradation failures left out), on which 4.2.1 is judged; a shortfall is marked. Type B: at least 5 at each temperature the second branch reaches, 20 in all. Pressure levels: pressures with at least two observations, for information; ISO 9080:2012 sets no minimum.

The data meet all 17 requirements the tool can check (observations per temperature, long-term tests, temperature spacing).

Not checked: the highest test temperature against the Vicat softening or melting point (5.1.2 c) — the tool holds no material data — and whether the test range includes the service temperature (5.1.2 e).

Extrapolation time — ISO 9080 5.1.5

Test temperature T_t	t_{max} (h)	T	ΔT	k_e	t_e (h)	t_e (years)
60 °C	16,427.8	20 °C	40	50.0	821,392	93.77
80 °C	1,255.7 †	20 °C	60	100.0	125,569	14.33
		60 °C	20	6.0	7,534	0.86

t_{max}: the log-mean of the five longest times to failure at the same temperature (3.7). † marks the time of the knee point (the intersection of the two branches), used when a knee was detected at the highest test temperature only (5.1.5 NOTE, Figure 2). k_e: Table 1 — polyolefins (5.2); per 5.4 also for polymers outside its scope. $t_e = k_e \cdot t_{max}$; reported as 100 years (876,000 h) at most (Annex D, Tables D.8–D.10).

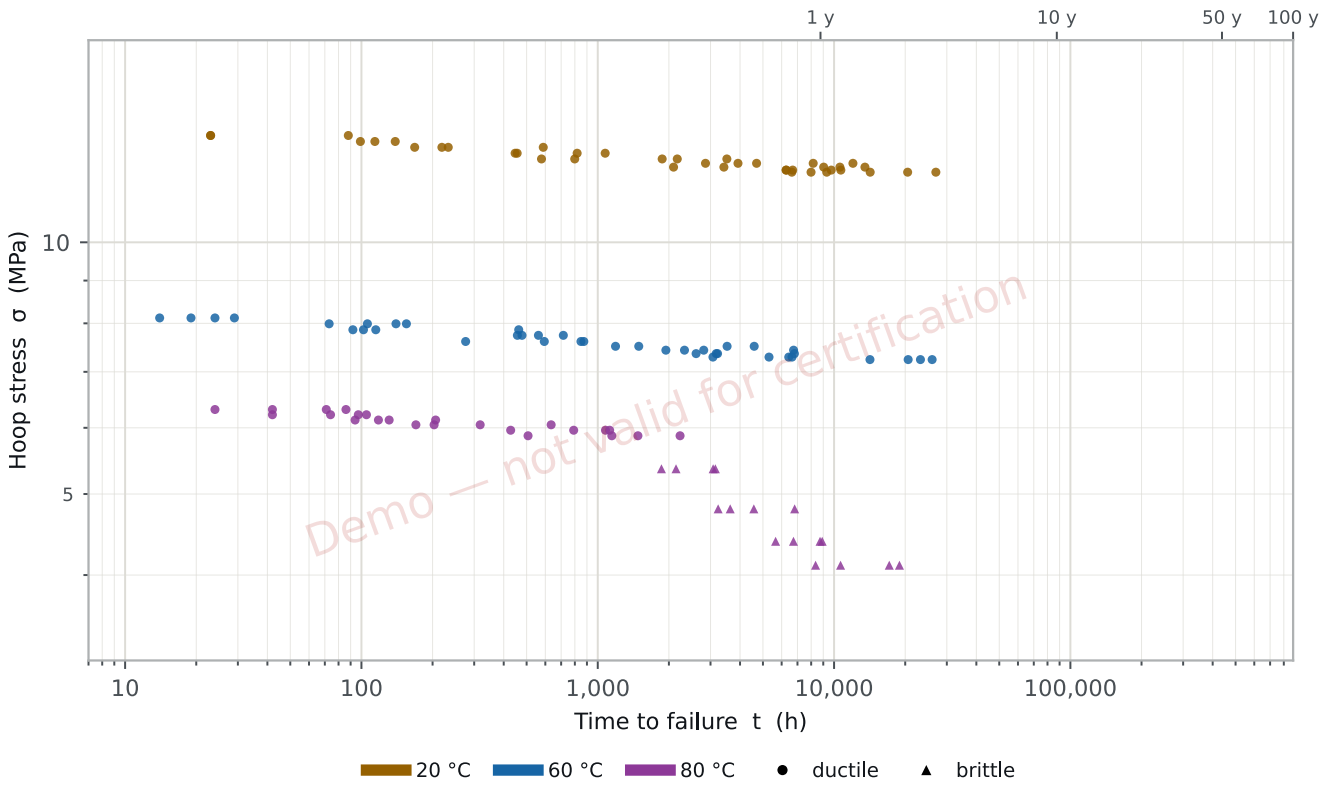
Traceability

Calculation engine	`creepfit-engine 0.7.1`
Application	`creepfit-api 0.1.0`
Input hash (SHA-256)	`2b8e1083389ada50be038bd7e5c85ac30397175355e2635a1c54b04e1c9234f7`
Workspace	Trial workspace

This document was produced from a stored result; reprinting gives the same numbers. With the same input hash and engine version the calculation reproduces exactly. A knee was detected; the data are split into type A and type B (ISO 9080 Annex B).

Appendix — observation list (ISO 9080 Clause 7 e)

OBSERVATIONS



PE 100 · d32 × e3.0. The observations as recorded, before any fit: colour is the test temperature, shape the failure mode.

120 observations, in the data set's canonical order. All are included in the fit. The A/B data type is this analysis's classification (Annex B).

#	Specimen	Temperature (°C)	Pressure (bar)	d_{em} (mm)	e_{min} (mm)	σ (MPa)	Time (h)	Failure	Type	Start	End	Included
1	SC-20-39	20	25.1	32.00	3.00	12.13	6,626	ductile	A	2024-05-11	2025-02-11	yes
2	SC-20-36	20	25.1	32.00	3.00	12.13	7,990	ductile	A	2024-05-02	2025-03-30	yes
3	SC-20-38	20	25.1	32.00	3.00	12.13	9,309	ductile	A	2024-05-08	2025-05-30	yes
4	SC-20-35	20	25.1	32.00	3.00	12.13	14,217	ductile	A	2024-04-29	2025-12-12	yes
5	SC-20-40	20	25.1	32.00	3.00	12.13	20,480	ductile	A	2024-05-14	2026-09-14	yes
6	SC-20-37	20	25.1	32.00	3.00	12.13	26,960	ductile	A	2024-05-05	2027-06-02	yes
7	SC-20-30	20	25.2	32.00	3.00	12.20	6,263	ductile	A	2024-04-14	2024-12-30	yes
8	SC-20-32	20	25.2	32.00	3.00	12.20	6,279	ductile	A	2024-04-20	2025-01-06	yes
9	SC-20-33	20	25.2	32.00	3.00	12.20	6,680	ductile	A	2024-04-23	2025-01-26	yes
10	SC-20-34	20	25.2	32.00	3.00	12.20	9,728	ductile	A	2024-04-26	2025-06-05	yes
11	SC-20-31	20	25.2	32.00	3.00	12.20	10,681	ductile	A	2024-04-17	2025-07-06	yes
12	SC-20-27	20	25.4	32.00	3.00	12.30	2,093	ductile	A	2024-04-05	2024-07-01	yes
13	SC-20-26	20	25.4	32.00	3.00	12.30	3,418	ductile	A	2024-04-02	2024-08-22	yes
14	SC-20-25	20	25.4	32.00	3.00	12.30	9,037	ductile	A	2024-03-30	2025-04-10	yes
15	SC-20-29	20	25.4	32.00	3.00	12.30	10,584	ductile	A	2024-04-11	2025-06-26	yes

#	Specimen	Temperature (°C)	Pressure (bar)	d_{em} (mm)	e_{min} (mm)	σ (MPa)	Time (h)	Failure	Type	Start	End	Included
16	SC-20-28	20	25.4	32.00	3.00	12.30	13,508	ductile	A	2024-04-08	2025-10-22	yes
17	SC-20-21	20	25.7	32.00	3.00	12.43	2,857	ductile	A	2024-03-18	2024-07-15	yes
18	SC-20-23	20	25.7	32.00	3.00	12.43	3,921	ductile	A	2024-03-24	2024-09-03	yes
19	SC-20-20	20	25.7	32.00	3.00	12.43	4,700	ductile	A	2024-03-15	2024-09-26	yes
20	SC-20-22	20	25.7	32.00	3.00	12.43	8,159	ductile	A	2024-03-21	2025-02-23	yes
21	SC-20-24	20	25.7	32.00	3.00	12.43	12,017	ductile	A	2024-03-27	2025-08-09	yes
22	SC-20-15	20	26.0	32.00	3.00	12.58	578	ductile	A	2024-02-29	2024-03-24	yes
23	SC-20-19	20	26.0	32.00	3.00	12.58	799	ductile	A	2024-03-12	2024-04-14	yes
24	SC-20-17	20	26.0	32.00	3.00	12.58	1,873	ductile	A	2024-03-06	2024-05-23	yes
25	SC-20-16	20	26.0	32.00	3.00	12.58	2,170	ductile	A	2024-03-03	2024-06-01	yes
26	SC-20-18	20	26.0	32.00	3.00	12.58	3,518	ductile	A	2024-03-09	2024-08-02	yes
27	SC-20-12	20	26.4	32.00	3.00	12.78	447	ductile	A	2024-02-20	2024-03-09	yes
28	SC-20-13	20	26.4	32.00	3.00	12.78	456	ductile	A	2024-02-23	2024-03-13	yes
29	SC-20-11	20	26.4	32.00	3.00	12.78	818	ductile	A	2024-02-17	2024-03-22	yes
30	SC-20-14	20	26.4	32.00	3.00	12.78	1,075	ductile	A	2024-02-26	2024-04-10	yes
31	SC-20-09	20	26.9	32.00	3.00	12.99	168	ductile	A	2024-02-11	2024-02-18	yes
32	SC-20-08	20	26.9	32.00	3.00	12.99	219	ductile	A	2024-02-08	2024-02-17	yes
33	SC-20-10	20	26.9	32.00	3.00	12.99	233	ductile	A	2024-02-14	2024-02-23	yes
34	SC-20-07	20	26.9	32.00	3.00	12.99	588	ductile	A	2024-02-05	2024-02-29	yes
35	SC-20-05	20	27.3	32.00	3.00	13.20	99	ductile	A	2024-01-30	2024-02-03	yes
36	SC-20-06	20	27.3	32.00	3.00	13.20	114	ductile	A	2024-02-02	2024-02-06	yes
37	SC-20-04	20	27.3	32.00	3.00	13.20	139	ductile	A	2024-01-27	2024-02-01	yes
38	SC-20-01	20	27.8	32.00	3.00	13.42	23	ductile	A	2024-01-18	2024-01-18	yes
39	SC-20-02	20	27.8	32.00	3.00	13.42	23	ductile	A	2024-01-21	2024-01-21	yes
40	SC-20-03	20	27.8	32.00	3.00	13.42	88	ductile	A	2024-01-24	2024-01-27	yes
41	SC-60-39	60	15.0	32.00	3.00	7.24	14,187	ductile	A	2024-05-31	2026-01-12	yes
42	SC-60-37	60	15.0	32.00	3.00	7.24	20,583	ductile	A	2024-05-25	2026-09-29	yes
43	SC-60-38	60	15.0	32.00	3.00	7.24	23,200	ductile	A	2024-05-28	2027-01-19	yes
44	SC-60-40	60	15.0	32.00	3.00	7.24	25,995	ductile	A	2024-06-03	2027-05-22	yes
45	SC-60-36	60	15.1	32.00	3.00	7.29	3,072	ductile	A	2024-05-22	2024-09-27	yes
46	SC-60-34	60	15.1	32.00	3.00	7.29	5,305	ductile	A	2024-05-16	2024-12-23	yes
47	SC-60-35	60	15.1	32.00	3.00	7.29	6,430	ductile	A	2024-05-19	2025-02-10	yes
48	SC-60-33	60	15.1	32.00	3.00	7.29	6,637	ductile	A	2024-05-13	2025-02-13	yes
49	SC-60-30	60	15.2	32.00	3.00	7.36	2,607	ductile	A	2024-05-04	2024-08-20	yes
50	SC-60-29	60	15.2	32.00	3.00	7.36	3,170	ductile	A	2024-05-01	2024-09-10	yes
51	SC-60-31	60	15.2	32.00	3.00	7.36	3,213	ductile	A	2024-05-07	2024-09-17	yes

#	Specimen	Temperature (°C)	Pressure (bar)	d_{em} (mm)	e_{min} (mm)	σ (MPa)	Time (h)	Failure	Type	Start	End	Included
52	SC-60-32	60	15.2	32.00	3.00	7.36	6,794	ductile	A	2024-05-10	2025-02-17	yes
53	SC-60-28	60	15.4	32.00	3.00	7.43	1,942	ductile	A	2024-04-28	2024-07-17	yes
54	SC-60-26	60	15.4	32.00	3.00	7.43	2,328	ductile	A	2024-04-22	2024-07-28	yes
55	SC-60-27	60	15.4	32.00	3.00	7.43	2,808	ductile	A	2024-04-25	2024-08-20	yes
56	SC-60-25	60	15.4	32.00	3.00	7.43	6,740	ductile	A	2024-04-19	2025-01-24	yes
57	SC-60-22	60	15.5	32.00	3.00	7.51	1,189	ductile	A	2024-04-10	2024-05-29	yes
58	SC-60-24	60	15.5	32.00	3.00	7.51	1,491	ductile	A	2024-04-16	2024-06-17	yes
59	SC-60-21	60	15.5	32.00	3.00	7.51	3,526	ductile	A	2024-04-07	2024-08-31	yes
60	SC-60-23	60	15.5	32.00	3.00	7.51	4,592	ductile	A	2024-04-13	2024-10-21	yes
61	SC-60-17	60	15.7	32.00	3.00	7.61	276	ductile	A	2024-03-26	2024-04-06	yes
62	SC-60-19	60	15.7	32.00	3.00	7.61	594	ductile	A	2024-04-01	2024-04-25	yes
63	SC-60-18	60	15.7	32.00	3.00	7.61	849	ductile	A	2024-03-29	2024-05-03	yes
64	SC-60-20	60	15.7	32.00	3.00	7.61	873	ductile	A	2024-04-04	2024-05-10	yes
65	SC-60-15	60	16.0	32.00	3.00	7.74	457	ductile	A	2024-03-20	2024-04-08	yes
66	SC-60-16	60	16.0	32.00	3.00	7.74	478	ductile	A	2024-03-23	2024-04-11	yes
67	SC-60-14	60	16.0	32.00	3.00	7.74	561	ductile	A	2024-03-17	2024-04-09	yes
68	SC-60-13	60	16.0	32.00	3.00	7.74	715	ductile	A	2024-03-14	2024-04-12	yes
69	SC-60-11	60	16.3	32.00	3.00	7.86	92	ductile	A	2024-03-08	2024-03-11	yes
70	SC-60-09	60	16.3	32.00	3.00	7.86	102	ductile	A	2024-03-02	2024-03-06	yes
71	SC-60-10	60	16.3	32.00	3.00	7.86	115	ductile	A	2024-03-05	2024-03-09	yes
72	SC-60-12	60	16.3	32.00	3.00	7.86	463	ductile	A	2024-03-11	2024-03-30	yes
73	SC-60-06	60	16.5	32.00	3.00	7.99	73	ductile	A	2024-02-22	2024-02-25	yes
74	SC-60-05	60	16.5	32.00	3.00	7.99	106	ductile	A	2024-02-19	2024-02-23	yes
75	SC-60-07	60	16.5	32.00	3.00	7.99	140	ductile	A	2024-02-25	2024-03-01	yes
76	SC-60-08	60	16.5	32.00	3.00	7.99	155	ductile	A	2024-02-28	2024-03-05	yes
77	SC-60-02	60	16.8	32.00	3.00	8.12	14	ductile	A	2024-02-10	2024-02-10	yes
78	SC-60-04	60	16.8	32.00	3.00	8.12	19	ductile	A	2024-02-16	2024-02-16	yes
79	SC-60-03	60	16.8	32.00	3.00	8.12	24	ductile	A	2024-02-13	2024-02-14	yes
80	SC-60-01	60	16.8	32.00	3.00	8.12	29	ductile	A	2024-02-07	2024-02-08	yes
81	SC-80-37	80	8.5	32.00	3.00	4.11	8,351	brittle	B	2024-06-04	2025-05-17	yes
82	SC-80-38	80	8.5	32.00	3.00	4.11	10,654	brittle	B	2024-06-07	2025-08-24	yes
83	SC-80-39	80	8.5	32.00	3.00	4.11	17,121	brittle	B	2024-06-10	2026-05-24	yes
84	SC-80-40	80	8.5	32.00	3.00	4.11	18,909	brittle	B	2024-06-13	2026-08-09	yes
85	SC-80-34	80	9.1	32.00	3.00	4.39	5,657	brittle	B	2024-05-26	2025-01-16	yes
86	SC-80-35	80	9.1	32.00	3.00	4.39	6,733	brittle	B	2024-05-29	2025-03-05	yes
87	SC-80-36	80	9.1	32.00	3.00	4.39	8,723	brittle	B	2024-06-01	2025-05-30	yes

#	Specimen	Temperature (°C)	Pressure (bar)	d_{em} (mm)	e_{min} (mm)	σ (MPa)	Time (h)	Failure	Type	Start	End	Included
88	SC-80-33	80	9.1	32.00	3.00	4.39	8,907	brittle	B	2024-05-23	2025-05-29	yes
89	SC-80-29	80	9.9	32.00	3.00	4.80	3,232	brittle	B	2024-05-11	2024-09-22	yes
90	SC-80-32	80	9.9	32.00	3.00	4.80	3,635	brittle	B	2024-05-20	2024-10-18	yes
91	SC-80-31	80	9.9	32.00	3.00	4.80	4,576	brittle	B	2024-05-17	2024-11-23	yes
92	SC-80-30	80	9.9	32.00	3.00	4.80	6,810	brittle	B	2024-05-14	2025-02-21	yes
93	SC-80-27	80	11.1	32.00	3.00	5.36	1,860	brittle	B	2024-05-05	2024-07-21	yes
94	SC-80-26	80	11.1	32.00	3.00	5.36	2,144	brittle	B	2024-05-02	2024-07-30	yes
95	SC-80-28	80	11.1	32.00	3.00	5.36	3,078	brittle	B	2024-05-08	2024-09-13	yes
96	SC-80-25	80	11.1	32.00	3.00	5.36	3,145	brittle	B	2024-04-29	2024-09-07	yes
97	SC-80-24	80	12.1	32.00	3.00	5.87	507	ductile	B	2024-04-26	2024-05-17	yes
98	SC-80-23	80	12.1	32.00	3.00	5.87	1,147	ductile	B	2024-04-23	2024-06-09	yes
99	SC-80-21	80	12.1	32.00	3.00	5.87	1,479	ductile	B	2024-04-17	2024-06-17	yes
100	SC-80-22	80	12.1	32.00	3.00	5.87	2,230	ductile	B	2024-04-20	2024-07-21	yes
101	SC-80-19	80	12.3	32.00	3.00	5.96	428	ductile	A	2024-04-11	2024-04-28	yes
102	SC-80-17	80	12.3	32.00	3.00	5.96	791	ductile	A	2024-04-05	2024-05-07	yes
103	SC-80-18	80	12.3	32.00	3.00	5.96	1,078	ductile	A	2024-04-08	2024-05-22	yes
104	SC-80-20	80	12.3	32.00	3.00	5.96	1,123	ductile	A	2024-04-14	2024-05-30	yes
105	SC-80-14	80	12.5	32.00	3.00	6.05	170	ductile	A	2024-03-27	2024-04-03	yes
106	SC-80-13	80	12.5	32.00	3.00	6.05	203	ductile	A	2024-03-24	2024-04-01	yes
107	SC-80-16	80	12.5	32.00	3.00	6.05	318	ductile	A	2024-04-02	2024-04-15	yes
108	SC-80-15	80	12.5	32.00	3.00	6.05	635	ductile	A	2024-03-30	2024-04-25	yes
109	SC-80-11	80	12.7	32.00	3.00	6.13	94	ductile	A	2024-03-18	2024-03-21	yes
110	SC-80-09	80	12.7	32.00	3.00	6.13	118	ductile	A	2024-03-12	2024-03-16	yes
111	SC-80-12	80	12.7	32.00	3.00	6.13	131	ductile	A	2024-03-21	2024-03-26	yes
112	SC-80-10	80	12.7	32.00	3.00	6.13	206	ductile	A	2024-03-15	2024-03-23	yes
113	SC-80-07	80	12.9	32.00	3.00	6.22	42	ductile	A	2024-03-06	2024-03-07	yes
114	SC-80-05	80	12.9	32.00	3.00	6.22	74	ductile	A	2024-02-29	2024-03-03	yes
115	SC-80-06	80	12.9	32.00	3.00	6.22	97	ductile	A	2024-03-03	2024-03-07	yes
116	SC-80-08	80	12.9	32.00	3.00	6.22	105	ductile	A	2024-03-09	2024-03-13	yes
117	SC-80-02	80	13.1	32.00	3.00	6.31	24	ductile	A	2024-02-20	2024-02-21	yes
118	SC-80-03	80	13.1	32.00	3.00	6.31	42	ductile	A	2024-02-23	2024-02-24	yes
119	SC-80-01	80	13.1	32.00	3.00	6.31	71	ductile	A	2024-02-17	2024-02-19	yes
120	SC-80-04	80	13.1	32.00	3.00	6.31	86	ductile	A	2024-02-26	2024-02-29	yes