

VALVE PERFORMANCE RESULTS FOR

GEARBOX OPERATED TOMOE TRICENTRIC BUTTERFLY VALVE

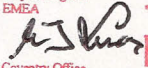
3" (80 MM NOM.), CLASS 150

FIRE TEST GENERALLY IN ACCORDANCE WITH ISO 10497 2ND EDITION

EXCEPTIONS – TEST TEMPERATURE LIMITED TO 540 °C

(TEST PROCEDURE TP003-REV2)

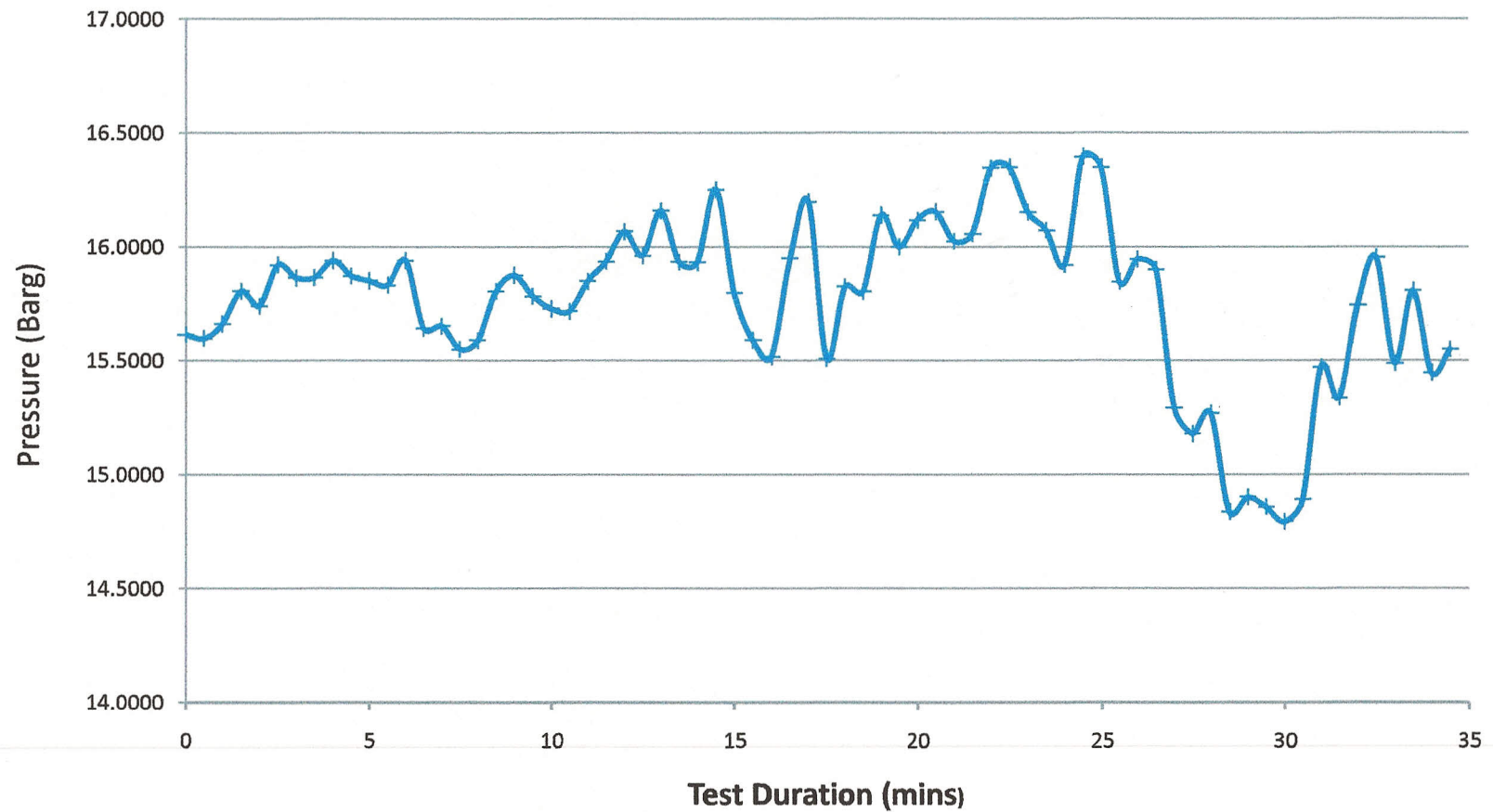
- The through seat leakage during the 34.5 minute burn period at the 15barg high pressure test condition, was 300ml. This is at a rate of 8.7ml/min and less than that allowed for the 80mm bore valve tested of 1280ml/min.
- The external leakage from the valve during the burn and cool down test periods was 0ml. The allowed is 320ml.
- The through seat leakage at the low test pressure condition after cool down was 0ml over the 5 minute test period. This is at a rate of 0ml/min and less than that allowed for the 80mm bore valve tested of 128ml/min.
- The opening torque to operate the valve under the high test pressure condition, following the cool-down was 33lb in (3.73 Nm). This was recorded at the input shaft to the gearbox. The Butterfly valve operated over the full 90 degree travel without any problems.
- There was no external leakage obtained after operational test. This was checked for over a 5min period with the valve at the high test pressure of 15 barg. The allowed is 320ml.

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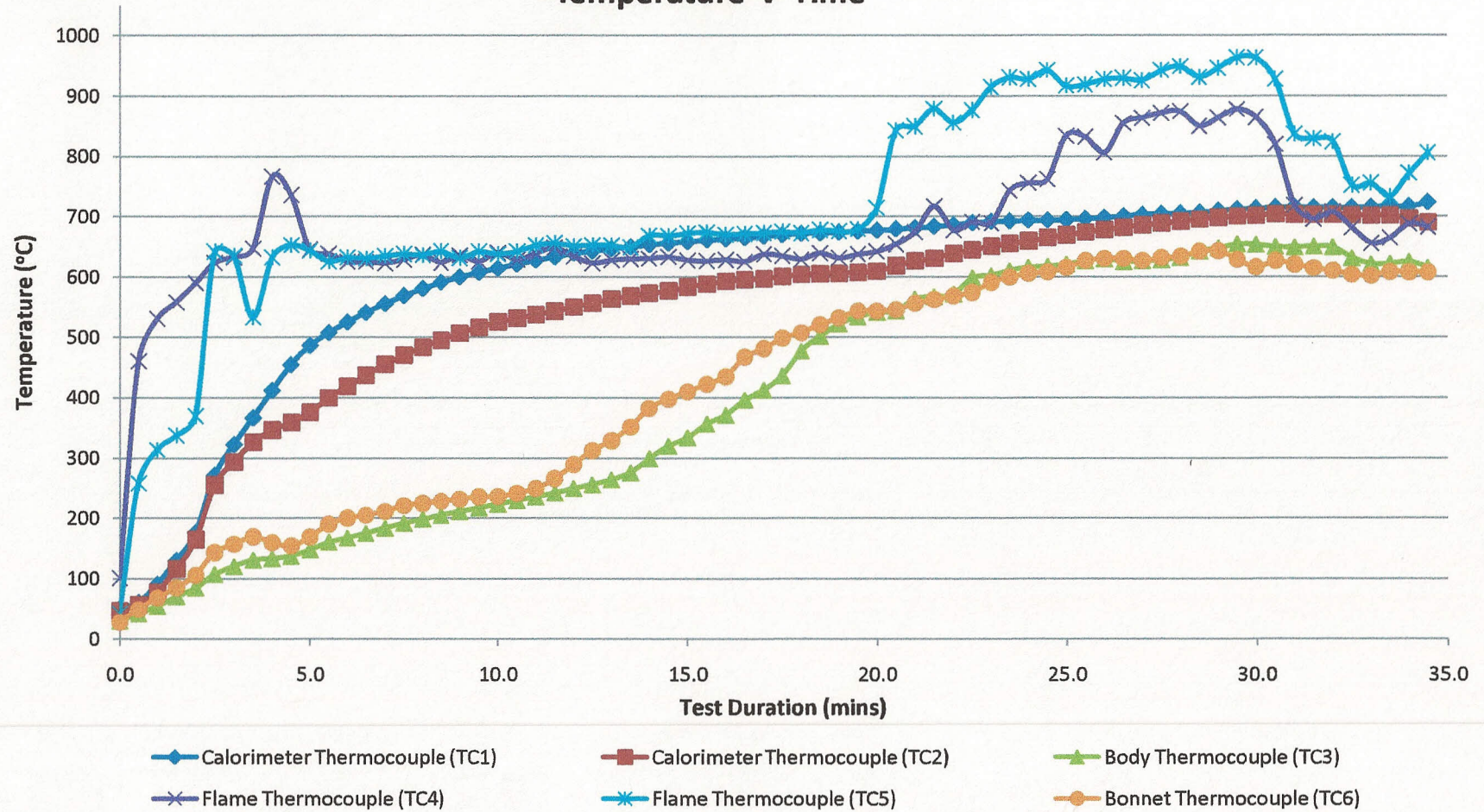
RECORDED TEST DATA



**Fire Test
Procedure TP003-Rev 2
Pressure v Time**



Fire Test **Procedure TP003-Rev 2** **Temperature v Time**



Test Duration (mins)	TC1	TC2	TC3	TC4	TC5	TC6	PTX1	Activity
0.0	49.782	46.490	29.833	101.507	41.797	27.836	15.616	Burn Period
0.5	60.157	56.368	42.168	460.482	258.379	49.401	15.598	
1.0	90.461	77.694	54.033	530.753	313.333	68.085	15.662	
1.5	129.920	116.162	70.124	558.599	336.872	84.997	15.807	
2.0	175.345	164.758	84.554	589.956	369.193	106.160	15.741	
2.5	270.823	255.223	107.525	623.708	641.967	143.543	15.921	
3.0	321.783	293.255	120.537	633.162	635.602	157.162	15.865	
3.5	366.214	326.030	131.308	647.359	533.028	169.302	15.866	
4.0	411.361	345.809	133.619	766.638	632.424	159.823	15.941	
4.5	454.662	358.580	137.607	736.935	653.181	154.247	15.874	
5.0	486.189	375.431	147.646	646.444	643.967	168.930	15.852	
5.5	507.671	399.557	160.500	639.023	626.102	190.191	15.833	
6.0	525.196	418.826	167.649	625.898	632.580	200.274	15.941	
6.5	541.148	437.043	175.060	625.593	631.264	205.541	15.642	
7.0	555.717	455.128	183.867	623.399	635.022	211.476	15.652	
7.5	568.991	470.004	191.951	629.501	638.492	221.123	15.550	
8.0	580.506	483.494	198.685	636.980	636.530	225.151	15.588	
8.5	591.046	495.421	205.141	624.373	642.521	228.019	15.805	
9.0	599.968	506.926	211.289	636.026	631.418	232.002	15.875	
9.5	607.432	516.846	217.180	625.765	642.341	235.733	15.784	
10.0	614.475	525.048	223.322	640.638	637.714	236.187	15.729	
10.5	621.437	531.482	229.653	629.519	642.558	241.841	15.718	
11.0	627.867	537.436	235.759	639.161	652.613	249.335	15.849	
11.5	633.608	543.534	241.946	648.626	656.401	266.000	15.936	
12.0	639.286	550.348	249.630	634.789	651.669	289.461	16.069	
12.5	643.404	556.557	256.248	623.234	653.258	312.522	15.962	
13.0	647.138	563.835	264.309	628.360	652.883	328.917	16.161	
13.5	650.391	568.905	275.887	630.594	649.772	351.844	15.935	
14.0	653.535	572.971	299.269	630.919	669.052	382.766	15.933	
14.5	656.511	577.206	320.292	633.380	668.193	397.971	16.252	
15.0	658.706	583.405	333.448	627.647	672.484	410.114	15.799	
15.5	661.226	588.697	356.268	626.786	674.388	422.502	15.590	
16.0	663.183	592.761	371.023	628.789	670.017	435.240	15.517	
16.5	665.072	595.640	396.233	625.896	672.021	467.530	15.950	
17.0	667.448	597.546	412.886	638.090	673.269	481.471	16.199	
17.5	670.053	600.686	436.649	635.173	675.198	498.999	15.509	
18.0	672.238	604.306	477.294	629.536	673.086	507.755	15.826	
18.5	673.168	605.170	501.864	640.013	678.372	521.208	15.804	
19.0	674.210	606.315	522.347	631.664	676.020	532.434	16.141	
19.5	676.257	608.117	534.329	637.855	679.426	543.667	16.000	
20.0	677.499	609.515	541.666	642.295	715.435	544.271	16.118	
20.5	679.433	618.997	543.719	654.460	843.138	545.942	16.156	
21.0	681.338	626.158	563.945	674.151	849.692	556.295	16.025	
21.5	683.513	631.234	567.653	717.842	879.731	562.399	16.058	
22.0	686.155	639.194	571.739	677.773	855.985	568.642	16.347	

22.5	689.869	645.017	598.526	691.231	877.136	574.611	16.351	
23.0	691.896	651.026	602.601	689.733	915.330	591.505	16.153	
23.5	692.510	655.412	611.109	743.658	931.295	600.151	16.074	
24.0	693.838	659.719	616.115	755.882	928.142	605.926	15.921	
24.5	694.372	665.161	618.242	762.279	942.991	608.578	16.397	
25.0	695.250	669.536	621.430	834.289	917.247	616.081	16.351	
25.5	696.859	674.473	627.082	832.377	919.478	627.069	15.848	
26.0	698.518	678.559	630.273	806.430	928.167	630.754	15.947	
26.5	701.213	682.489	625.615	855.591	930.350	631.066	15.901	
27.0	703.671	685.902	626.934	863.791	926.650	627.425	15.294	
27.5	704.779	689.161	628.363	872.614	942.940	631.552	15.180	
28.0	705.847	692.154	632.500	874.906	949.547	634.325	15.270	
28.5	707.210	695.557	643.139	850.619	932.055	642.148	14.836	
29.0	709.966	698.705	648.227	864.182	946.739	643.309	14.901	
29.5	712.486	700.878	654.980	878.431	964.491	629.271	14.857	
30.0	713.824	701.644	654.218	864.815	963.493	616.337	14.792	
30.5	715.776	704.445	650.344	820.076	928.423	626.958	14.891	
31.0	716.080	704.122	649.839	718.475	836.698	620.833	15.471	
31.5	715.722	703.652	651.024	696.208	829.834	614.809	15.338	
32.0	715.494	703.481	649.615	707.919	824.516	610.726	15.744	
32.5	715.613	702.804	631.678	681.412	752.467	604.175	15.956	
33.0	716.321	701.974	621.597	656.011	755.766	602.408	15.489	
33.5	717.593	701.594	622.288	664.491	733.759	608.980	15.810	
34.0	717.072	696.643	625.423	687.961	771.788	608.233	15.448	
34.5	723.672	690.381	615.588	682.842	805.537	607.930	15.551	
0.0	638.223	599.898	511.213	291.257	362.897	461.677	15.123	Cool Period
0.5	635.030	596.906	506.046	286.012	357.415	455.639	15.058	
1.0	606.576	568.218	401.795	218.052	267.360	355.924	15.056	
1.5	573.855	537.502	113.850	96.248	149.698	96.248	14.063	
2.0	493.994	491.609	102.014	53.861	54.551	99.192	14.134	
2.5	424.885	425.916	101.768	56.376	62.058	89.874	14.462	
3.0	332.249	352.051	96.870	49.402	52.746	91.358	14.543	
3.5	268.957	252.489	96.646	49.985	54.363	85.461	14.794	
4.0	150.754	159.094	78.488	47.741	53.450	79.975	14.977	
4.5	108.358	102.420	66.438	44.058	48.281	65.292	14.836	
5.0	79.488	77.819	61.050	42.200	43.013	54.618	14.690	
0.0	58.322	29.099	41.231	30.320	31.112	41.438	2.880	Low Pressure Seat Test
0.5	56.338	29.238	41.847	30.470	33.457	43.587	2.779	
1.0	52.240	29.342	42.646	29.166	33.970	42.530	2.175	
1.5	49.606	29.595	43.128	30.240	34.047	41.793	2.214	
2.0	47.851	29.690	43.395	29.924	33.088	41.248	2.527	
2.5	46.517	29.626	43.680	29.333	33.727	41.592	2.246	
3.0	45.682	29.953	43.945	30.305	34.111	41.915	2.061	
3.5	45.095	30.179	43.937	30.765	33.576	41.152	2.112	
4.0	44.721	30.328	43.910	31.090	31.969	40.951	2.417	
4.5	44.406	30.478	44.059	31.416	32.822	41.332	2.715	
5.0	44.329	30.635	43.924	32.685	32.393	40.732	2.707	

0.0	45.035	31.232	43.355	34.918	36.902	40.569	15.913	Break Out Test
0.5	45.177	31.435	42.280	34.536	37.978	40.538	15.639	
1.0	45.241	31.558	40.137	35.068	37.867	40.079	15.724	
1.5	45.360	31.678	36.880	36.005	37.579	39.384	15.562	
2.0	45.321	31.640	32.050	34.974	35.791	38.123	15.745	
0.0	44.018	36.403	33.950	35.294	41.698	33.365	17.786	External Leakage Test
0.5	43.836	37.269	33.942	35.111	41.574	33.124	17.780	
1.0	43.719	38.084	33.824	34.584	42.559	32.771	17.781	
1.5	43.685	38.864	33.848	34.608	42.409	32.620	17.748	
2.0	43.627	39.563	33.731	33.439	42.873	32.444	17.728	
2.5	43.465	40.098	33.568	35.321	43.175	32.163	17.703	
3.0	43.267	40.364	33.427	33.953	40.016	31.553	17.679	
3.5	43.183	40.688	33.226	34.746	40.107	31.352	17.661	
4.0	43.133	41.044	33.233	34.052	38.893	31.301	17.628	
4.5	42.971	41.230	33.245	34.648	39.312	31.372	17.598	
5.0	42.876	41.425	33.149	33.793	38.169	31.393	17.575	
5.5	42.687	41.642	33.017	34.421	38.794	31.085	17.557	
6.0	42.618	41.748	33.007	33.942	40.761	30.957	17.529	
6.5	42.477	41.955	32.981	32.279	41.607	30.931	17.503	
7.0	42.433	42.085	32.995	32.117	41.678	30.652	17.480	
7.5	42.373	42.373	32.994	32.174	41.387	30.592	17.450	
8.0	42.123	42.414	32.917	31.570	41.891	30.457	17.432	
8.5	41.979	42.559	32.830	32.538	42.327	30.369	17.407	
9.0	41.786	42.598	32.752	31.581	41.670	29.939	17.383	
9.5	41.609	42.653	32.691	31.929	41.667	29.877	17.360	
10.0	41.400	42.677	32.598	31.895	41.749	30.078	17.325	
10.5	41.235	42.686	32.607	31.260	41.699	30.028	17.310	
11.0	41.071	42.812	32.500	31.915	41.710	29.921	17.278	
11.5	41.024	42.881	32.511	31.515	41.140	29.932	17.261	

