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BRE Global Test Report

Ad-hoc fire resistance test on a galvanised steel Tunnel Ventilation Damper employing procedures and criteria from BS 476: Part 20 : 1987.

Prepared for: **Betec Cad Industries**

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An ad-hoc fire resistance test, following the furnace heating conditions given in BS 476 : Part 20 : 1987, was carried out on a galvanised steel Tunnel Ventilation Damper, installed on the unexposed face of a concrete block wall, on 19th January 2015 for a duration of 240 minutes.

The test was conducted at the request of Betec Cad Industries, at the BRE Laboratories, Garston and employed procedures and criteria from BS 476: Part 20: 1987. The pressure conditions within the furnace were maintained to give 20Pa at the top of the specimen.

As the damper was uninsulated, no thermocouples were attached to the damper casing or spigot. However, the approximate insulation performance of the damper was assessed using a roving thermocouple.

The test specimen comprised one multi-blade damper, nominally 1015mm wide x 1215mm high x 501mm deep. The damper was installed on the face of a nominally 1000mm x 1200mm aperture created near the centre of a 3m x 3m block wall. The blocks around the opening in the wall (to which the damper was attached) were formed from dense concrete. The damper was held against the unexposed face of the wall using M12 studs, passing through the damper mounting flange, and passing through to the opposite face of the wall, with a nut on each end. A total of eleven studs passed through the wall, holding the damper in place. On the exposed face, the stud ends (and nuts) were protected with some insulation glued to the face of the wall.

The damper comprised six galvanised steel counter-rotating blades, each blade nominally 185mm high x 905mm long, contained within a galvanised steel frame. The blades were formed from a double skin of 2mm-thick galvanised steel, and included a thin stainless steel strip, protruding from each edge of the blade by approximately 6mm. Each blade was held together with 18 rivets, and was attached to an axle at each end. The third blade from the top of the damper was attached to a 24mm-diameter solid steel rod, which connected to the actuator. Further details of the damper are given in the drawings in the Figures section of this report, and are also kept on file.

The actuator was an electrically triggered, pneumatically operated type, observed to be a “Hytork 131” actuator. A data sheet for the actuator is attached in the Figures section of this report.

The damper and actuator are shown before and after the test in the attached Photo’s.

As there was no thermal fuse supplied with the damper and actuator, the damper was manually triggered to close after 30 seconds of the start of the test, by disconnecting the electrical supply to the actuator.

The following visual observations were made during the test.

Time minutes	Observation
0 : 00	Start test.
0 : 30	Damper triggered to close by disconnection of the electricity supply to the actuator.
13 : 00	A temperature of 205^{O}C was recorded using the roving thermocouple on the top of the damper casing.
15 : 00	Some distortion of the blades is occurring.
17 : 00	The galvanising on the blades if turning a light grey in colour.

Time minutes	Observation
20 : 00	A slight red glow is visible at the joints between the top four blades.
23 : 00	Some of the galvanising on the damper casing (on the exposed side of the blades) is now turning light grey in colour.
50 : 00	All the joints between blades are now glowing red hot. Additionally, most of the top and bottom blades are now glowing red hot.
60 : 00	The damper casing is starting to glow red hot adjacent to the wall.
110 : 00	The damper casing is now red hot for up to 100mm from the wall. Slight gaps of up to approximately 2mm have formed between the edges of the blades and the damper casing on the left hand side edge, with no gaps on the right hand side.
180 : 00	The damper blades and casing are now glowing more brightly red-hot.
240 : 00	Other than the damper glowing more brightly red hot, there are no other significant visual changes. Test stopped.

The mean furnace temperature recorded during the test is given in the attached Graph.

The information presented in this report should not be used to demonstrate performance against any standard nor compliance with a regulatory requirement.

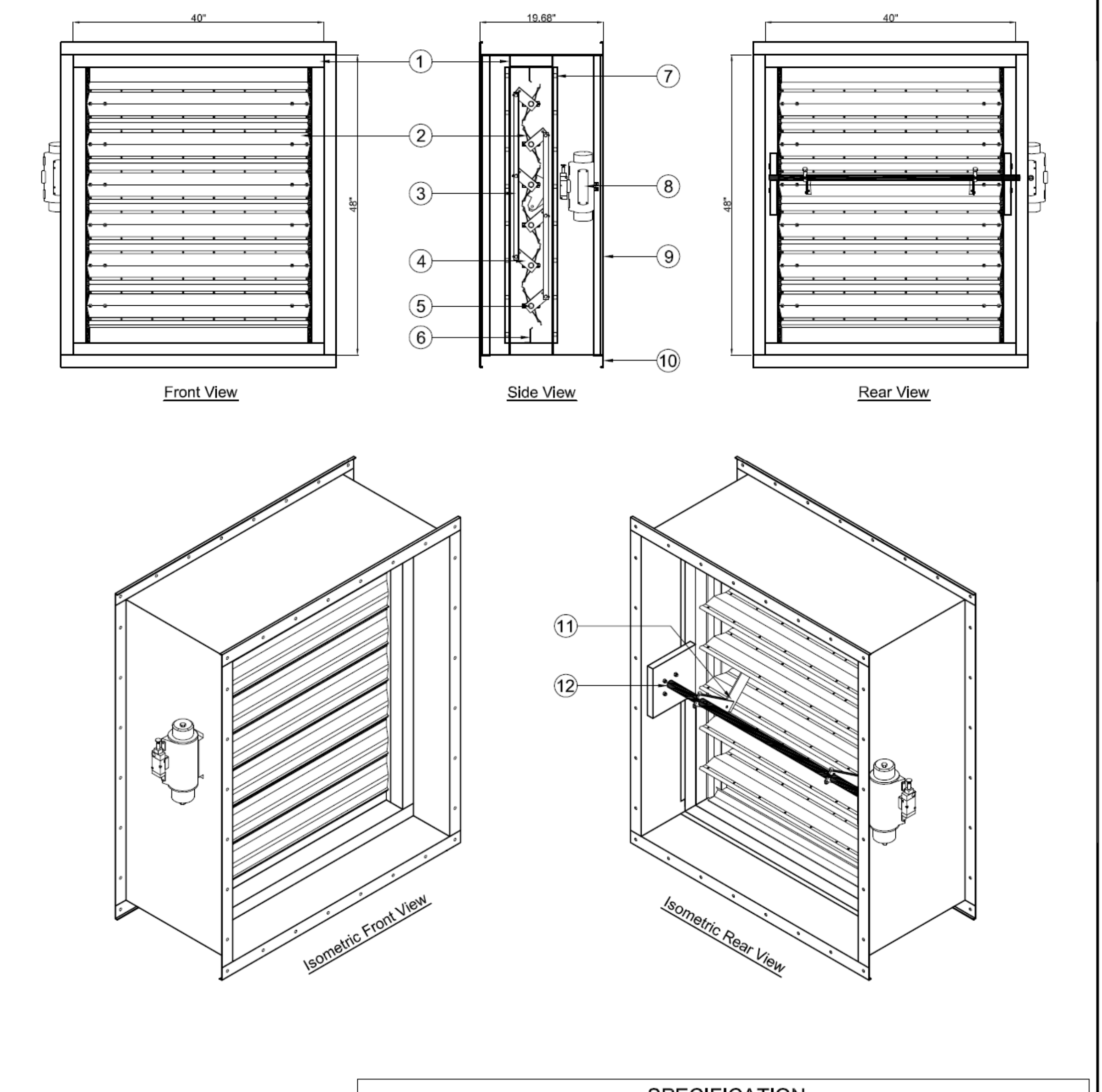
This report covers a test which was conducted to a procedure which is not the subject of any British Standard specification, but the test utilised the general principles of fire resistance testing given in B.S. 476 : Part 20. Since fire tests are the subject of a continuing Standardisation process, and because existing standards are the subject of review and possible amendment and new interpretations, it is recommended that the report be referred back to the test laboratory after a period of five years to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time.

The test was not conducted under the requirements of UKAS accreditation.

RESULT

There was no flaming from the damper during the test, and no gaps greater than 2mm-wide formed at any location. As such, the damper satisfied the integrity criteria given in BS : 476 : Part 20 for gaps and flaming throughout the 240 minute duration of the test.

FIGURES



SPECIFICATION			
1	Frame :- 2.0mm Thick G.I.	7	Nut & Bolts :- 10mm x 20mm G.I.
2	Blade :- 2.0mm Thick G.I. Double skin.	8	Actuator :- Pneumatic.
3	Flat Bar :- 6.0mm Thick G.I.	9	Sleeve :- 2.0mm Thick G.I.
4	Linkage :- 2.8mm Thick G.I.	10	Flange :- 50 X 2.0mm Thick G.I.
5	Blade Stopper :- 2.0mm Thick G.I.	11	Knee Lock :- 3.0mm Thick G.I.
6	Nut & Bolts :- 12mm x 20mm G.I.	12	Round Shaft :- Ø25 X 3mm Thick G.I.

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TITLE :- **TUNNEL VENTILATION DAMPER CONSTRUCTION DRAWING**

PROJECT :-		CLIENT :-	
DRAWN BY :-	NEYAZ AHMAD.		PROJECTION :-
CHECKED BY :-	ENGR SYED IFTEQUAR		SCALE :- NTS
APPROVED BY :-	ENGR RAHUL ZUTSHI		SHEET 1 OF 1 / Rev. 00
DATE :-	01/03/2015		

DRAWING NO:- BT/RZ/HVAC-016/275

Note :-
All Dimension are in MM, unless otherwise specified.

Hytork "TA" Tunnel Applications actuator

For use in conjunction with Tunnel Transit Damper which exceeds a test to operate safely at 250°/482°F for a minimum of two hours

"Tunnel Applications"

In modern traffic tunnels the venting system that removes or blocks toxic gasses and blinding smoke, is required to function in support of a safety window in time and operate for a number of cycles, both during and after a fire.

During such a fire, relative high temperatures may be reached around the venting system and systems must have the ability to continue operating during this critical safety window. These venting systems combine a louvred damper driven by a pneumatic actuator that vents or blocks the air flow in a tunnel and is constructed to operate safely at temperatures of up to 250°C ~ 482°F for a minimum of two hours.

The Hytork TA Solution

Emerson has developed a Hytork brand spring return actuator for these kinds of high demanding "Tunnel Applications" that can cope with these requirements. The actuator is equipped with special seals, bearings and grease to accommodate these temperatures.

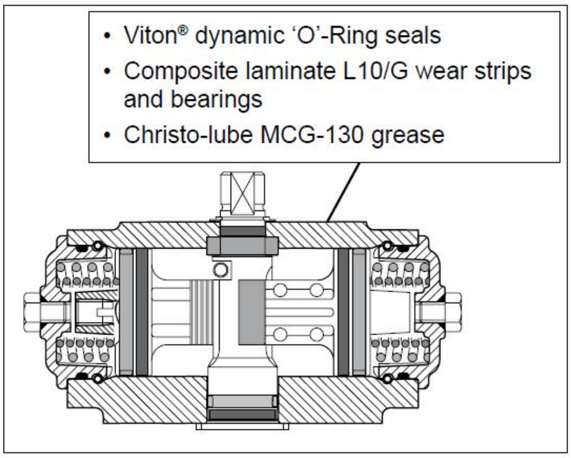
Under normal conditions the actuator functions as a normal Spring Return actuator, and in the case of a fire the actuator will be able to function a number of times under the below mentioned conditions.

Conformance Test Procedure:

Test actuators have been subjected to a specific high temperature / functional test as follows;

Step	Description
1.	Measure Torque output before test.
2.	Actuator put in oven, which is already at 250°C/ 482°F.
3.	Cycle Actuator at beginning of 2 hour period.
4.	Cycle Actuator every 15 minutes in oven at 250°C/ 482°F.
5.	Cycle Actuator several times at end of 2 hour period.
6.	Measure Torque output After test.

The test report is available on request.



Specifications:

Temperature range

Normal operation (No fire)	: -20°C to +120°C : -4°F to + 248°F
Tunnel Application (Under fire)	: -20°C to +250°C for 2 hours minimum : -4°F to / +482°F for 2 hours minimum
Dynamic O-ring seals	: Fluorocarbon Rubber 9775 (Viton®).
Static O-ring seals	: Nitrile Rubber (Buna-N)
Bearing material	: High temperature composite laminate L10/G
Grease	: Christo-lube MCG-130

High temperature effects on output torque.

Spring stroke

Due to the high temperatures occurring during a fire, the spring torque will reduce due to the annealing affect of the heat, causing a drop in output torque of about 10% on the spring stroke. The attached torque table reflects the torque output of a standard actuator with 10% torque loss on the spring stroke after a fire.

Air stroke

The table shows also the torque output of the air stroke. Note that these torque values are in some cases much higher (compared to a standard actuator) depending on the supply pressure and the chosen spring set.

Sizing instructions

To select the right size of the actuator for a tunnel application two things have to be checked:

1 Sizing

a Choose the smallest actuator size for **normal operation (no fire)**. Use the torque figures as per data sheet
Imperial data D67 (see web site).
Metric data D66 (see web site).

b Choose the smallest actuator size **operation under fire.** Use the attached output torque table on page 3 and 4.
Use normal sizing procedure to define smallest actuator. Note that the air stroke torque output values are always higher than the spring torque values.

c Select the largest actuator from “a” or “b”.

Note;

We recommend that the valve (or louver) manufacturer supplies the maximum required torque values, including any adjustments or suggested safety factors for valve or louver service conditions or application.

Additionally, the valve manufacturer must identify at which position(s) and direction(s) of rotation (Counter Clock Wise or Clock Wise) these maximum requirements occur.

2 Check the maximum valve stem torque

Check the maximum valve stem torque for the chosen smallest actuator size. The maximum valve stem torque should be lower than the output torque on the air stroke.

For venting louvres, the drive mechanism should be capable to cope with the maximum air stroke torque output torque of the chosen actuator.

Important: Use the maximum available plant pressure to define the maximum torque output on the air stroke of the actuator.

High temperature effects on actuator components

A high temperature operation as indicated under “Test Procedure” has influence on the:

- Springs; spring forces decreased.
- Grease; will dry out and might get hard.
- Soft parts; will lose their original shape and or strength.

Therefore we strongly recommend replacing the actuator after a high temperature operation as indicated under “Conformance Test Procedure”.

WARNING : Use only Spring Return (fail safe) models – Do not use Double Acting models, where the air needs to be driven in both directions.

At high temperatures of 250°C / 482°F, there is a risk that the plastic head and the rubber ‘o’ ring of the metal SafeKey could melt. This will cause complete torque loss on the inward stroke of double acting models.

We therefore advise to use only Spring Return models for these “Tunnel Applications”.

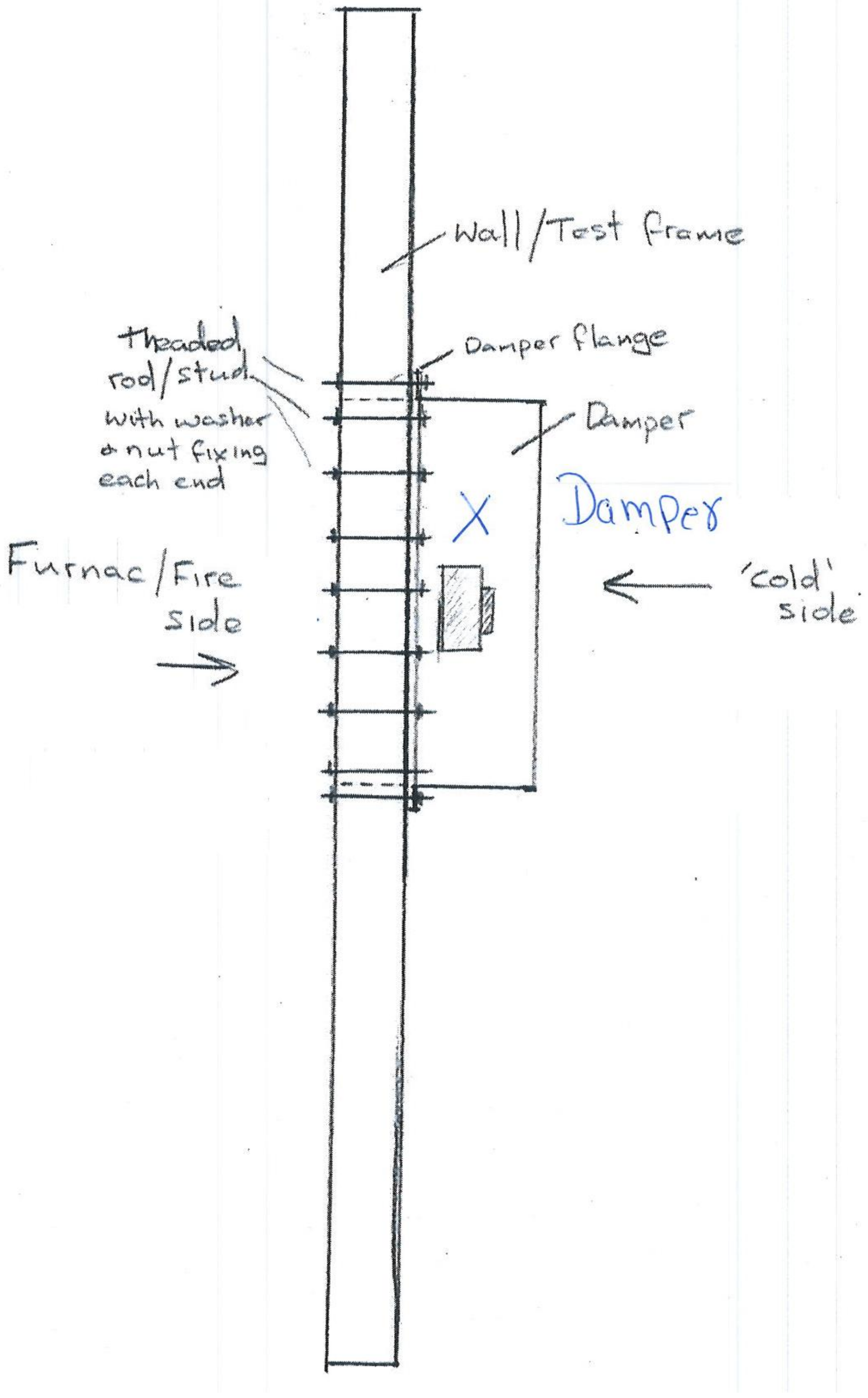
This problem does not occur on Spring Return models because the end cap chambers on Spring Return are normally not pressurized.

Torque output values for use on Tunnel applications Spring Return Actuators (Nm), XL26 to XL681

Model Number	Spring Rating	Torque from Springs		Torques from air stroke (Nm) at given operating air pressure (bar)													
				3.0 bar(g)		4.0 bar(g)		5.0 bar(g)		5.5 bar(g)		6.0 bar(g)		7.0 bar(g)		8.0 bar(g)	
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
XL26	S40	5	3	7	5	11	8	14	12	16	14	17	15	21	19	24	22
	S50	7	4	6	4	10	7	13	11	15	12	17	14	20	17	24	21
	S60	8	5	6	2	9	6	12	9	14	11	16	13	19	16	23	20
	S70	9	6	-	-	8	4	12	8	13	10	15	11	18	15	22	18
	S80	11	6	-	-	7	3	11	7	13	8	14	10	18	13	21	17
	S90	12	7	-	-	7	2	10	5	12	7	13	9	17	12	20	16
	S1C	13	8	-	-	-	-	9	4	11	6	13	7	16	11	20	14
XL71	S40	13	8	18	12	26	21	35	30	39	34	44	38	52	47	61	55
	S50	17	10	16	9	24	18	33	26	37	31	42	35	50	44	59	52
	S60	20	12	14	6	22	14	31	23	35	27	40	32	48	40	57	49
	S70	23	14	-	-	20	11	29	20	33	24	38	28	46	37	55	45
	S80	27	16	-	-	18	8	27	16	31	21	36	25	44	34	53	42
	S90	30	18	-	-	16	4	25	13	29	17	34	22	42	30	51	39
	S1C	33	20	-	-	-	-	23	10	27	14	32	18	40	27	49	35
XL131	S40	25	15	33	23	50	40	66	56	74	64	82	72	98	88	114	104
	S50	31	19	30	17	46	33	62	50	70	58	78	66	94	82	111	98
	S60	38	23	26	11	42	27	58	43	66	51	75	59	91	76	107	92
	S70	44	26	-	-	38	21	55	37	63	45	71	53	87	69	103	86
	S80	50	30	-	-	35	15	51	31	59	39	67	47	83	63	99	79
	S90	56	34	-	-	31	8	47	24	55	33	63	41	79	57	96	73
	S1C	63	38	-	-	-	-	43	18	51	26	59	34	76	51	92	67
XL186	S40	34	20	45	32	67	53	89	75	100	86	110	97	132	119	154	140
	S50	42	25	40	23	62	45	84	67	94	78	105	89	127	110	149	132
	S60	50	30	35	15	57	37	79	58	89	69	100	80	122	102	144	124
	S70	59	35	-	-	52	28	74	50	84	61	95	72	117	94	139	115
	S80	67	40	-	-	47	20	68	42	79	52	90	63	112	85	134	107
	S90	76	45	-	-	42	11	63	33	74	44	85	55	107	77	129	98
	S1C	84	50	-	-	-	-	58	25	69	36	80	47	102	68	124	90
XL221	S40	47	28	63	44	93	74	123	105	139	120	154	135	184	165	214	196
	S50	59	35	56	32	86	62	116	93	131	108	147	123	177	153	207	184
	S60	71	42	49	20	79	51	109	81	124	96	140	111	170	142	200	172
	S70	82	49	-	-	72	39	102	69	117	84	133	100	163	130	193	160
	S80	94	56	-	-	65	27	95	58	110	73	125	88	156	118	186	148
	S90	106	63	-	-	58	15	88	46	103	61	118	76	149	106	179	137
	S1C	118	71	-	-	-	-	81	34	96	49	111	64	142	95	172	125
XL281	S40	58	34	75	51	111	87	148	124	166	142	184	160	220	196	256	233
	S50	72	42	67	37	103	73	139	109	157	127	176	146	212	182	248	218
	S60	86	51	58	22	95	59	131	95	149	113	167	131	203	167	240	204
	S70	101	59	-	-	86	44	122	80	141	99	159	117	195	153	231	189
	S80	115	67	-	-	78	30	114	66	132	84	150	102	187	139	223	175
	S90	130	76	-	-	-	-	106	52	124	70	142	88	178	124	214	160
	S1C	144	84	-	-	-	-	97	37	115	55	133	74	170	110	206	146
XL426	S40	85	51	108	74	161	127	214	180	240	206	267	233	320	286	372	339
	S50	106	63	95	53	148	106	201	159	228	185	254	212	307	265	360	318
	S60	127	76	83	32	136	85	188	138	215	164	241	191	294	244	347	296
	S70	148	89	-	-	123	64	176	117	202	143	229	169	282	222	334	275
	S80	169	101	-	-	110	43	163	95	190	122	216	148	269	201	322	254
	S90	190	114	-	-	-	-	150	74	177	101	203	127	256	180	309	233
	S1C	211	127	-	-	-	-	138	53	164	80	191	106	244	159	296	212
XL681	S40	136	82	177	123	263	209	350	295	393	338	436	381	522	468	608	554
	S50	170	102	157	89	243	175	329	261	372	304	415	347	502	434	588	520
	S60	204	122	136	55	223	141	309	227	352	270	395	313	481	400	567	486
	S70	238	143	-	-	202	107	288	193	331	236	375	279	461	366	547	452
	S80	272	163	-	-	182	73	268	159	311	202	354	245	440	332	527	418
	S90	306	183	-	-	-	-	248	125	291	168	334	211	420	298	506	384
	S1C	340	204	-	-	-	-	227	91	270	134	313	178	400	264	486	350

Note;

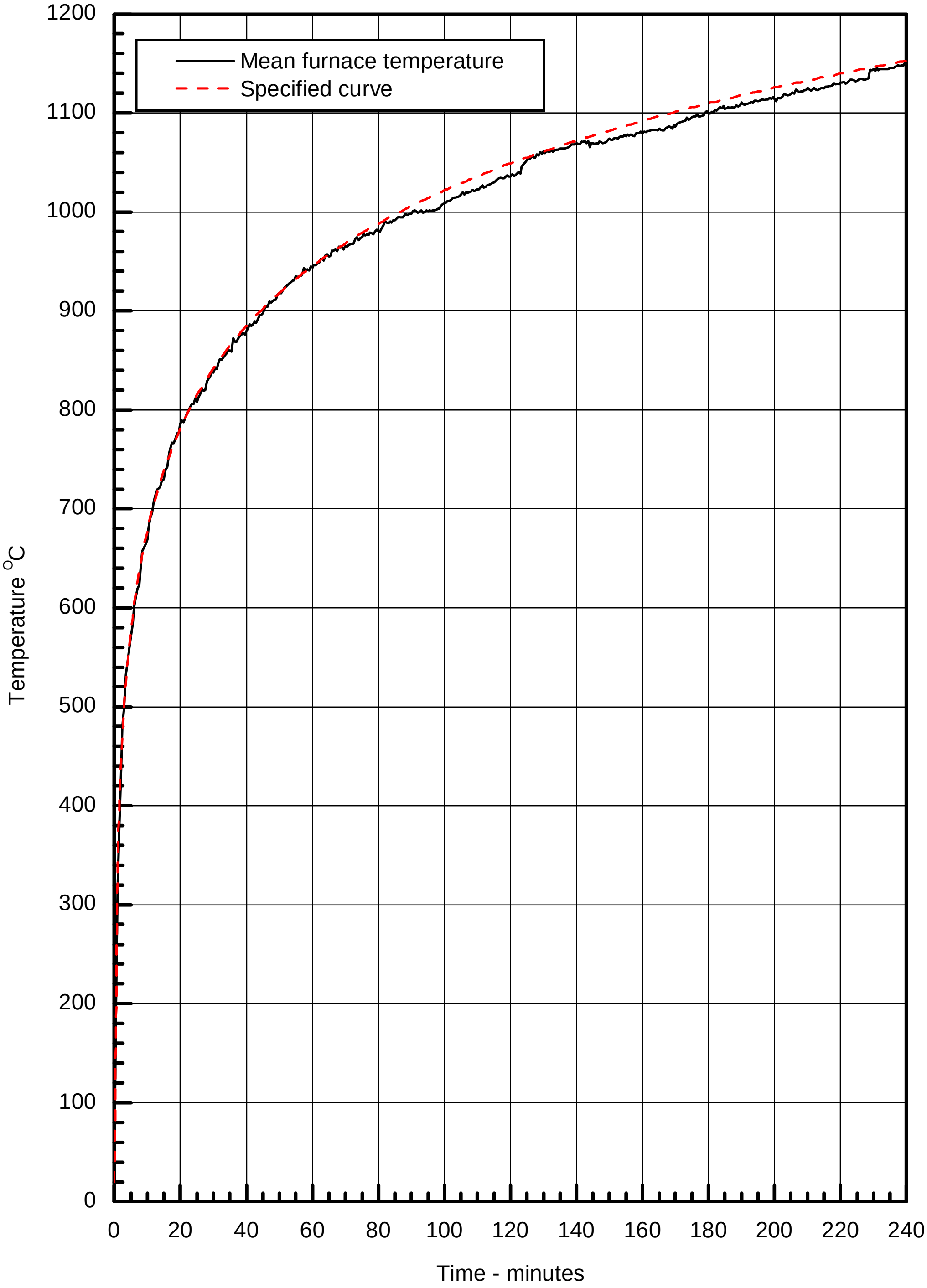
We recommend that the valve (or louvre) manufacturer supplies the maximum required torque values (Including any adjustments or suggested safety factors for valve or louvre service conditions or application). Additionally, the valve manufacturer must identify at which position(s) and direction(s) of rotation (Counter Clock Wise or Clock Wise) these maximum requirements occur.



The above sketch shows the general arrangement of the test.

(Not all the threaded studs shown in the sketch were actually used for the test).

GRAPH



Mean furnace temperature with specified curve for comparison.

PHOTOGRAPHS

Exposed face of damper before test.

Unexposed face of damper (in closed position) before test.

Unexposed face of damper (in open position) just prior to start of test.

Unexposed face of damper at end of test.

Exposed face of damper after test.

Report Ends