Air Leakage Test Conducted In Accordance with BS 476: Part 31, Section 31.1: 1983, on a Single-Leaf Doorset

Test Sponsor

Mann McGowan Fabrications Limited

Warrington FIRE research
CONSULTANCY • TESTING

The Professionals in Fire Safety

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Warrington FIRE research

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Test Sponsor

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Report	Name	Signature*
Responsible Officer	C. Johnson	
Approved	S. Hankey	

For and on behalf of Warrington Fire Research Centre.

Report Issued : 23rd January 2002

Air Leakage Test Conducted In Accordance with BS 476: Part 31, Section 31.1: 1983, on a Single-Leaf Doorset

Summary

One specimen of a single-acting, single-leaf, doorset and one specimen of double-acting, single-leaf doorset have been subjected to a series of air leakage tests conducted in accordance with BS 476: Part 31, Section 31.1: 1983.

The test incorporated additional requirements as detailed within the CERTIFIRE Performance Schedule, referenced P021.

The single-acting doorset had overall nominal dimensions of 2148 mm high by 990 mm wide and incorporated a door leaf of overall dimensions 2050 mm high by 900 mm wide by 44 mm thick.

The double-acting doorset had overall nominal dimensions of 2034 mm high by 934 mm wide and incorporated a door leaf of overall dimensions 1981 mm high by 838 mm wide by 44 mm thick.

Each doorset was tested with three different smoke seals referenced 'SS 5, 'Twinfin 5', and 'Flexifin 5'.

The specimens were fixed within a plywood faced, timber stud partition, to form the test construction.

Guidance with respect to the performance of fire doors required to resist the passage of smoke at ambient temperature conditions is given in Amendment 6160, October 1993 to BS 5588: Parts 2, 3, 6 and 10: 1983.

'A fire door required to resist the passage of smoke at ambient temperature conditions should, when tested in accordance with BS 476: Section 31.1 with the threshold taped and subjected to a pressure of 25 Pa, have a leakage not exceeding 3 $m^3/m/h$.'

In the absence of other criteria, this guidance has been adopted in reporting the results of this test. The leakage rates at other pressures are also included in this report.

The results obtained were as follows:

Seal and Configuration	Specimen Under Positive Pressure (+25Pa) Pre-Cycling	Specimen Under Negative Pressure (-25Pa) Pre-Cycling	Specimen Under Positive Pressure (+25Pa) Post Cycling	Specimen Under Negative Pressure (-25Pa) Post Cycling
SS 5 seal continuous around single-acting doorset	2.17 $m^3/m/h$	2.28 $m^3/m/h$	1.23 $m^3/m/h$	1.54 $m^3/m/h$
Twinfin 5 seal continuous around single-acting doorset	0.31 $m^3/m/h$	0.31 $m^3/m/h$	0.10 $m^3/m/h$	0.20 $m^3/m/h$
Twinfin 5 seal around single-acting doorset, interrupted at hinges and latch.	*	*	2.43 $m^3/m/h$	2.53 $m^3/m/h$
Flexifin 5 seal continuous around single-acting doorset	0.46 $m^3/m/h$	0.61 $m^3/m/h$	0.26 $m^3/m/h$	0.26 $m^3/m/h$
SS 5 seal continuous around double-acting doorset	2.96 $m^3/m/h$	2.66 $m^3/m/h$	2.50 $m^3/m/h$	2.21 $m^3/m/h$
Twinfin 5 seal continuous around double-acting doorset	0.98 $m^3/m/h$	1.13 $m^3/m/h$	0.95 $m^3/m/h$	0.60 $m^3/m/h$
Flexifin 5 seal continuous around double-acting doorset.	1.08 $m^3/m/h$	0.79 $m^3/m/h$	0.60 $m^3/m/h$	0.30 $m^3/m/h$

* Not performed

The doorset was installed such that it opened away from the test rig.

Date of Test: 17th September 2001 to 1st September 2001.

Contents

1 Purpose of the Test

1.1 To determine the air leakage through a constructions consisting of one single-acting and one double-acting, single-leaf doorset when tested in accordance with BS 476: Part 31, 'Methods for measuring smoke penetration through doorsets and shutter assemblies', Section 31.1: 1983, 'Method of measurement under ambient temperature conditions' in conjunction with the additional requirements as detailed within the CERTIFIRE Performance Schedule referenced P021.

2 Introduction

2.1 Guidance with respect to the performance of fire doors required to resist the passage of smoke at ambient temperature conditions is given in Amendment 6160, October 1993 to BS 5588: Parts 2, 3, 6 and 10: 1983.

2.2 Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group has identified a number of such areas and has agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Group. Where such Resolutions are applicable to this test they have been followed.

2.3 The series of tests were conducted from the 17th September 2001, at the request of Mann McGowan Fabrications Ltd, the sponsor of the test.

2.4 The tests were witnessed by Mr. R. Smith, a representative of the test sponsor.

3 Test Specimen Construction

3.1 A comprehensive description of the test construction is given in Annex A. The description is based on a detailed survey of the specimen and information supplied by the sponsor of the test.

3.2 The doorset and the seals were supplied by the test sponsor on the 17th September 2001. Warrington Fire Research Centre was not involved in any selection or sampling procedures of the specimen or any of the components.

3.3 The partition was supplied by Warrington Fire Research Centre on the 16th September 2001. The specimen doorset was installed within the partition on the 16th September 2001 by representatives Warrington Fire Research Centre.

4 Test Procedure

4.1 The tests were conducted in accordance with BS 476: Part 31: Section 31.1: 1983 in conjunction with the additional requirements as detailed within the CERTIFIRE Performance Schedule referenced P021.

4.2 The gaps between the leaf and the frame were measured and are shown in Figure 2. The door leaf was opened and closed 10 times. The door gaps were then sealed and the differential pressures were applied and the leakage measured, this being the designated rig leakage. The door gaps were then unsealed (except the threshold) and the leakage measured at the same differential pressures. The above procedure was then repeated with the air flow in the opposite direction.

4.3 The door seal was then subjected to a total of 100,000 opening and closing cycles of the leaf and the differential pressures were applied and associated net air leakages noted.

4.4 The readings were corrected for each leakage measurement to a reference temperature of 20°C and standard atmospheric pressure (1 atmosphere equals 101325 Pa) utilising the following formula:

$$Q = Qa \times \frac{(Pa + p)}{101325} \times \frac{293.15}{(Ta + 273.15)} \times 1 - 0.3795 \times \frac{Mw}{100} \times \frac{Es}{Pa + p}$$

Where Q = Adjusted rate of air flow (m^3/h)

Qa = Measured rate of airflow (m^3/h)

p = Pressure increase (Pa)

Pa = Barometric Pressure (Pa)

Ta = Air temperature (°C)

Mw = Relative Humidity (%)

Es = Saturated water vapour pressure (Pa)

5 Test Data and Information

5.1 The following data, which was recorded during the test, is given in Annex B:

5.1.1 Tables of the net leakages through the specimen at specified pressure differentials.

5.1.2 Graphs of the net leakages through the specimen at specified pressure differentials.

5.2 The ambient air temperature in the vicinity of the test construction was 20°C at the start of the first test with a maximum variation of -4°C during the testing.

5.3 The relative humidity in the vicinity of the test construction was 50% at the start of the first test with a maximum variation of -18% during the testing.

6 Evaluation Against the Performance Criteria

6.1 Guidance with respect to the performance of fire doors required to resist the passage of smoke at ambient temperature conditions is given in Amendment 6160, October 1993 to BS 5588: Parts 2, 3, 6 and 10: 1983.

'A fire door required to resist the passage of smoke at ambient temperature conditions should, when tested in accordance with BS 476: Section 31.1 with the threshold taped and subjected to a pressure of 25 Pa, have a leakage not exceeding 3 $m^3/m/h$.'

6.2 In the absence of other criteria, this guidance has been adopted in reporting the results of this test which are detailed below. The leakage rates at other pressures are also included in this report.

Seal and Configuration	Specimen Under Positive Pressure (+25Pa) Pre-Cycling	Specimen Under Negative Pressure (-25Pa) Pre-Cycling	Specimen Under Positive Pressure (+25Pa) Post Cycling	Specimen Under Negative Pressure (-25Pa) Post Cycling
SS 5 seal continuous around single-acting doorset	2.17 $m^3/m/h$	2.28 $m^3/m/h$	1.23 $m^3/m/h$	1.54 $m^3/m/h$
Twinfin 5 seal continuous around single-acting doorset	0.31 $m^3/m/h$	0.31 $m^3/m/h$	0.10 $m^3/m/h$	0.20 $m^3/m/h$
Twinfin 5 seal around single-acting doorset, interrupted at hinges and latch.	*	*	2.43 $m^3/m/h$	2.53 $m^3/m/h$
Flexifin 5 seal continuous around single-acting doorset	0.46 $m^3/m/h$	0.61 $m^3/m/h$	0.26 $m^3/m/h$	0.26 $m^3/m/h$
SS 5 seal continuous around double-acting doorset	2.96 $m^3/m/h$	2.66 $m^3/m/h$	2.50 $m^3/m/h$	2.21 $m^3/m/h$
Twinfin 5 seal continuous around double-acting doorset	0.98 $m^3/m/h$	1.13 $m^3/m/h$	0.95 $m^3/m/h$	0.60 $m^3/m/h$
Flexifin 5 seal continuous around double-acting doorset.	1.08 $m^3/m/h$	0.79 $m^3/m/h$	0.60 $m^3/m/h$	0.30 $m^3/m/h$

* Not performed

7 Conclusions

7.1 One specimen of a single-acting, single-leaf doorset and one specimen of double-acting, single-leaf doorset, have been subjected to a series of tests conducted in accordance with BS 476: Part 31, Section 31.1: 1983 in conjunction with the additional requirements as detailed within the CERTIFIRE Performance Schedule referenced P021.

7.2 The performance of the specimen was assessed against the criteria detailed within the Standard and the results obtained are detailed within Section 6.2 on the previous page.

8 Limitations

8.1 The results relate only to the behaviour of the specimen under the particular conditions of test.

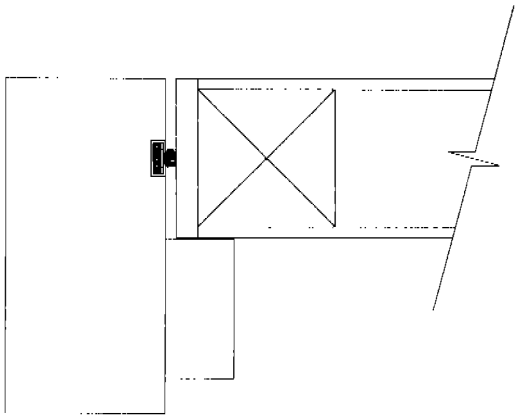
8.2 The test results relate only to the specimen tested. Application of the results to specimens of different dimensions or incorporating different components should be the subject of a design appraisal.

8.3 The dimensions of the gaps between the leaf and frame are shown in Figure 3 of Annex A. The results of this test are, therefore, limited to doorsets where the gap dimensions are similar to those which are detailed in this report.

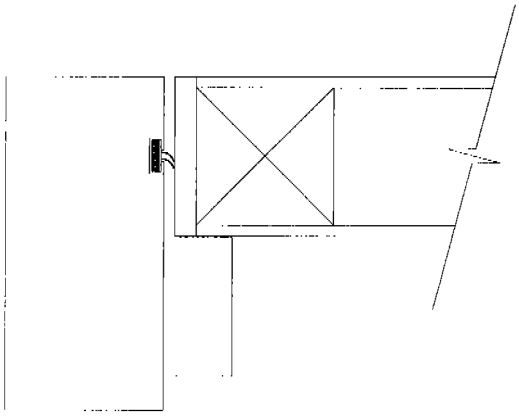
9 Review

9.1 The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

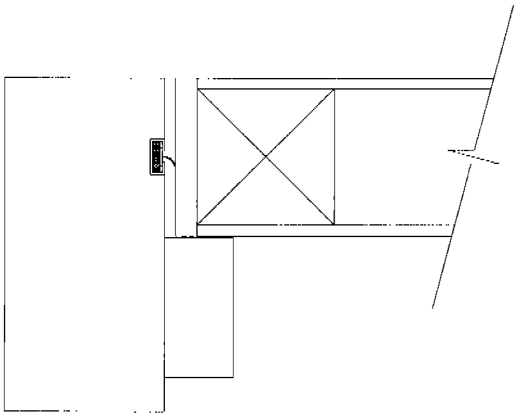
23rd January 2002



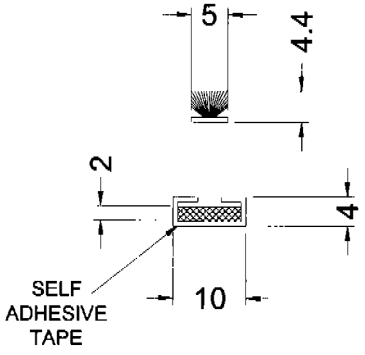
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 1 & 2



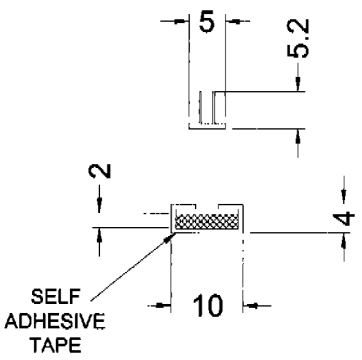
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 3, 4 & 5



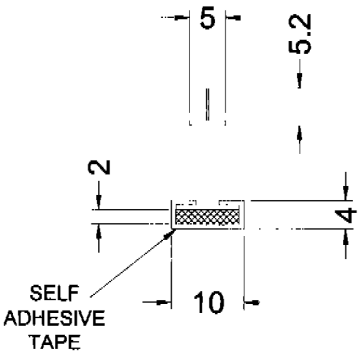
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 6 & 7



SECTION THROUGH SS5 SEAL
FITTED INTO DOOR FRAME
FOR TESTS 1 & 2



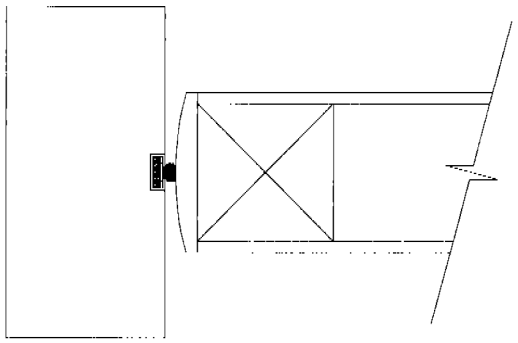
SECTION THROUGH TWINFIN SEAL
FITTED INTO DOOR FRAME
FOR TEST 3, 4 & 5



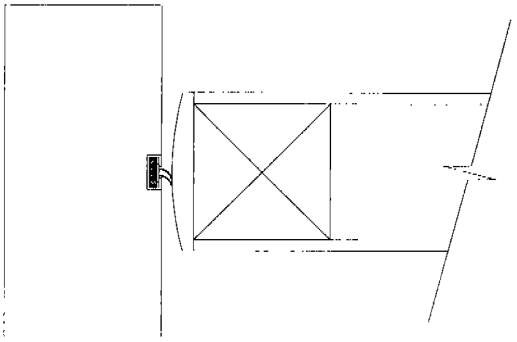
SECTION THROUGH FLEXIFIN SEAL
FITTED INTO DOOR FRAME
FOR TESTS 6 & 7

Do not scale

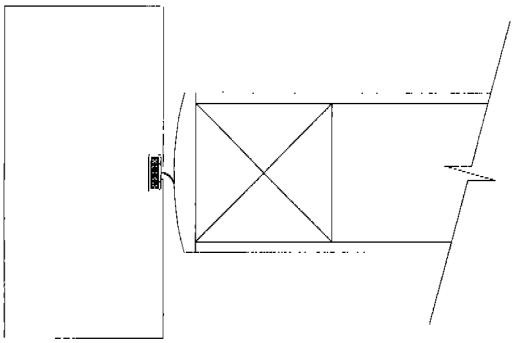
All dimensions are in mm.



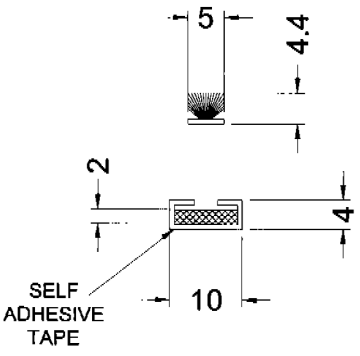
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 8 & 9



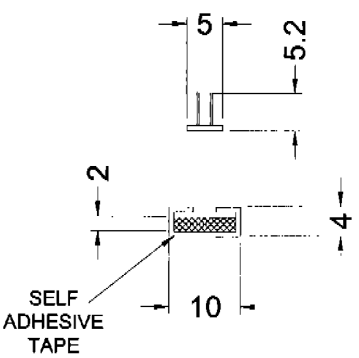
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 10 & 11



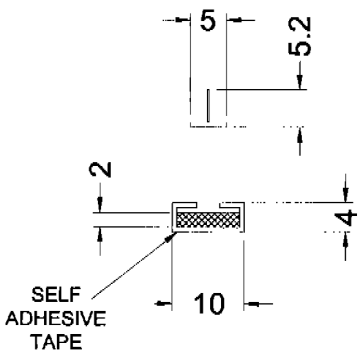
SECTION THROUGH
DOOR AND FRAME JAMB
FOR TESTS 12 & 13



SECTION THROUGH SS5 SEAL
FITTED INTO DOOR FRAME
FOR TESTS 8 & 9



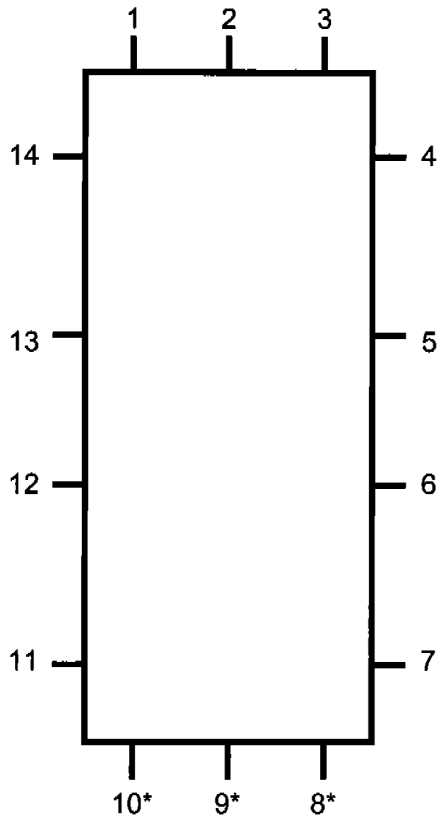
SECTION THROUGH TWINFIN SEAL
FITTED INTO DOOR FRAME
FOR TEST 10 & 11



SECTION THROUGH FLEXIFIN SEAL
FITTED INTO DOOR FRAME
FOR TESTS 12 & 13

Do not scale

All dimensions are in mm.



View from unexposed face

Gap Dimension in mm at Position													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
3.6	3.6	3.8	3.9	3.0	3.5	3.8	4.5	4.5	4.5	3.9	3.5	3.5	3.5
Mean			3.6		Maximum		4.5		Minimum		3.5		

* dimension not included in mean

DO NOT SCALE
ALL DIMENSIONS ARE IN mm

FIGURE 3

DOOR GAP DETAILS

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Annex B

Data Recorded During the Test

Table 1

Net Leakage's of Smoke Seal Referenced SS5 (Continuous, single acting) at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	*
-70	*
-50	*
-30	*
-25	**2.17**
-20	*
-10	*
-5	*
0	*
5	*
10	*
20	*
25	**2.28**
30	*
50	*
70	*
100	*

* Readings were taken but were lost due to data corruption.

Annex B (Continued)

Table 2

Net Leakage's of Smoke Seal Referenced SS5 (Continuous, single-acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	*
-70	*
-50	*
-30	*
-25	**1.23**
-20	*
-10	*
-5	*
0	*
5	*
10	*
20	*
25	**1.54**
30	*
50	*
70	*
100	*

* Readings were taken but were lost due to data corruption.

Annex B (Continued)

Table 3

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, single acting) at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	*
-70	*
-50	*
-30	*
-25	**0.31**
-20	*
-10	*
-5	*
0	*
5	*
10	*
20	*
25	**0.31**
30	*
50	*
70	*
100	*

* Readings were taken but were lost due to data corruption.

Annex B (Continued)

Table 4

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, single acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	0.41
-70	0.20
-50	0.35
-30	0.25
-25	**0.20**
-20	0.21
-10	0.20
-5	-0.10
0	0.00
5	0.05
10	0.10
20	0.10
25	**0.10**
30	0.25
50	0.35
70	0.31
100	0.36

* Readings were taken but were lost due to data corruption.

Annex B (Continued)

Table 5

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Interrupted at hinges & latch, single acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	5.64
-70	4.62
-50	4.16
-30	3.13
-25	**2.53**
-20	2.39
-10	2.03
-5	1.42
0	0.00
5	1.27
10	1.72
20	2.29
25	**2.43**
30	2.77
50	3.91
70	4.43
100	5.43

Annex B (Continued)

Table 6

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, single acting) at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	0.98
-70	0.71
-50	0.71
-30	0.51
-25	**0.61**
-20	0.46
-10	0.47
-5	0.55
0	0.00
5	0.35
10	0.25
20	0.51
25	**0.46**
30	0.51
50	0.91
70	1.02
100	1.19

Annex B (Continued)

Table 7

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, single acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	0.78
-70	0.51
-50	0.61
-30	0.41
-25	**0.26**
-20	0.26
-10	0.26
-5	0.45
0	0.00
5	0.35
10	0.25
20	0.36
25	**0.26**
30	0.36
50	0.61
70	0.36
100	0.63

Annex B (Continued)

Table 8

Net Leakage's of Smoke Seal Referenced SS5 (Continuous, double acting)
at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	*
-70	6.06
-50	4.68
-30	3.41
-25	**2.66**
-20	2.22
-10	1.19
-5	0.95
0	0.00
5	0.85
10	1.26
20	2.22
25	**2.96**
30	3.27
50	5.31
70	6.92
100	*

* Off scale

Annex B (Continued)

Table 9

Net Leakage's of Smoke Seal Referenced SS5 (Continuous, double acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	8.12
-70	5.98
-50	4.46
-30	2.94
-25	**2.21**
-20	1.92
-10	1.05
-5	0.78
0	0.00
5	0.58
10	1.25
20	2.17
25	**2.50**
30	3.04
50	5.07
70	6.94
100	-17.48

*Off scale

Annex B (Continued)

Table 10

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, double acting) at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	2.52
-70	1.95
-50	1.77
-30	1.42
-25	**1.13**
-20	0.94
-10	0.63
-5	0.19
0	0.00
5	0.15
10	0.74
20	0.84
25	**0.98**
30	1.32
50	1.92
70	2.60
100	3.58

Annex B (Continued)

Table 11

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, double acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	1.69
-70	1.17
-50	1.05
-30	0.85
-25	**0.60**
-20	0.81
-10	0.05
-5	0.10
0	0.00
5	0.49
10	1.04
20	1.01
25	**0.95**
30	1.30
50	1.81
70	2.55
100	3.39

Annex B (Continued)

Table 12

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, double acting) at Specified Pressure Differentials Before Cycling

Pa	m3/m/h
-100	2.28
-70	1.95
-50	1.48
-30	1.13
-25	**0.79**
-20	0.75
-10	0.39
-5	0.29
0	0.00
5	0.58
10	0.98
20	1.09
25	**1.08**
30	1.47
50	2.03
70	2.91
100	3.39

Annex B (Continued)

Table 13

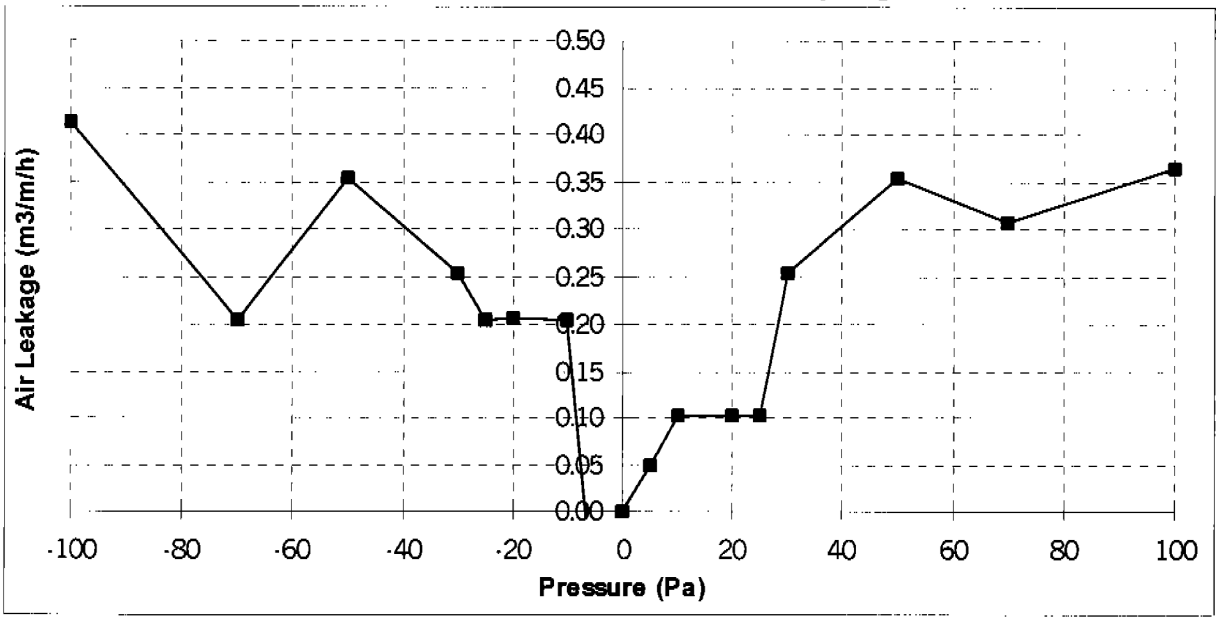
Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, double acting) at Specified Pressure Differentials After Cycling

Pa	m3/m/h
-100	1.12
-70	0.76
-50	0.60
-30	0.40
-25	**0.30**
-20	0.30
-10	0.25
-5	0.15
0	0.00
5	0.05
10	0.25
20	0.60
25	**0.60**
30	0.75
50	1.15
70	1.72
100	2.15

Annex B (Continued)

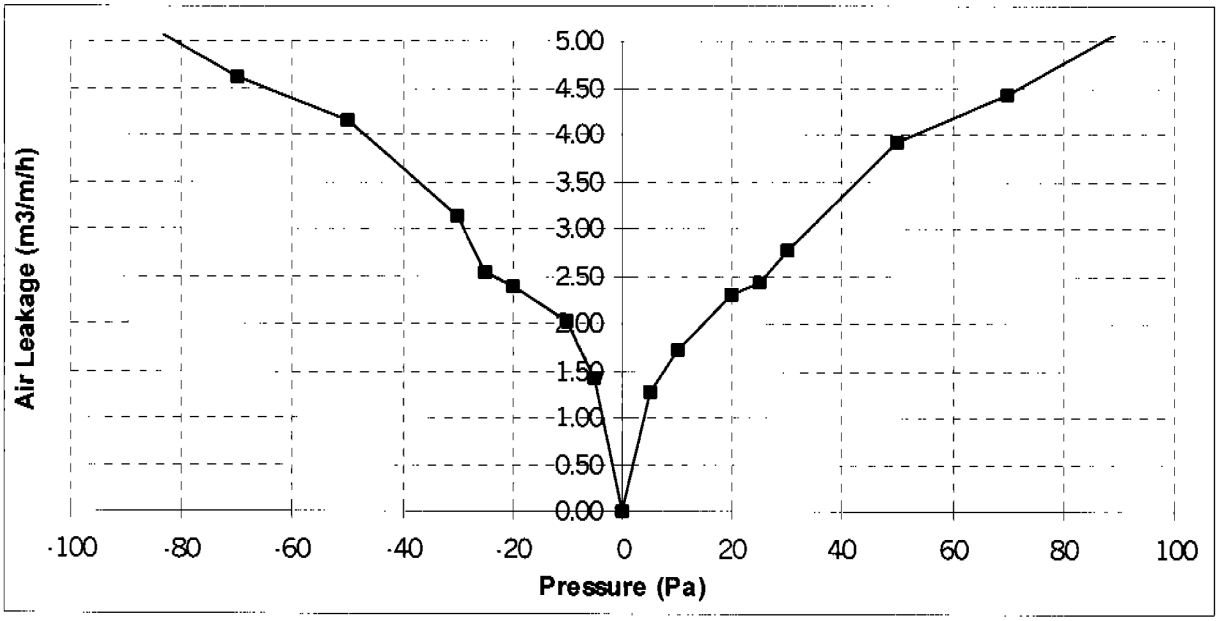
Graph 1

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, single acting)
at Specified Pressure Differentials After Cycling



Graph 2

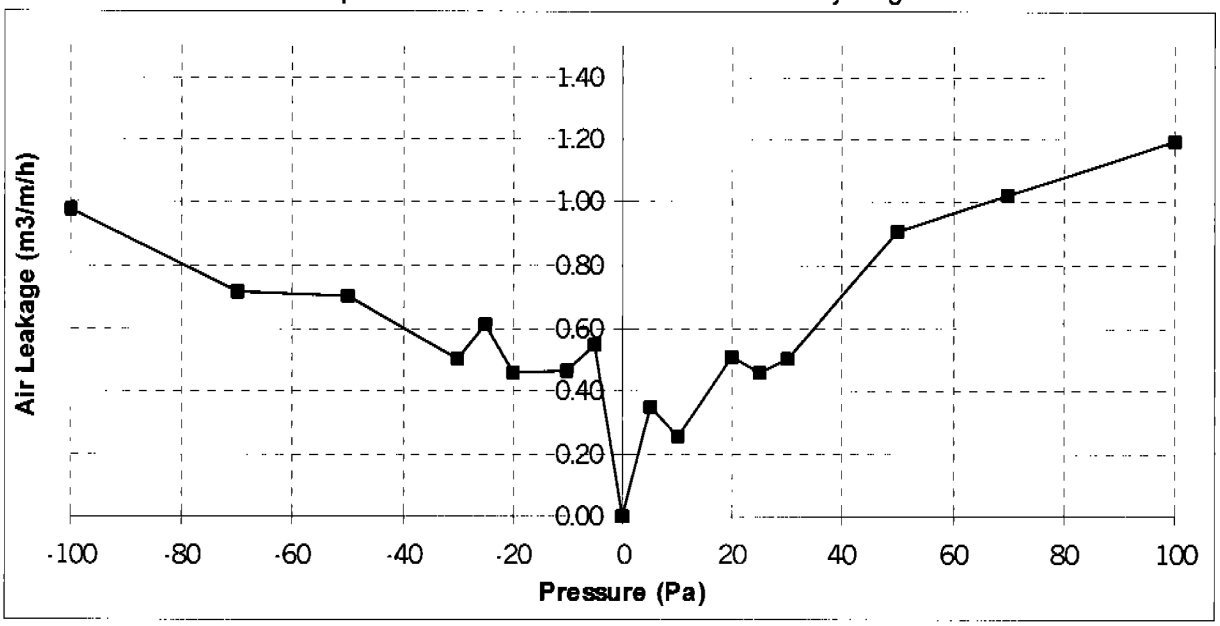
Net Leakage's of Smoke Seal Referenced Twinfin 5 (Interrupted at hinges & latch, single acting)
at Specified Pressure Differentials After Cycling



Annex B (Continued)

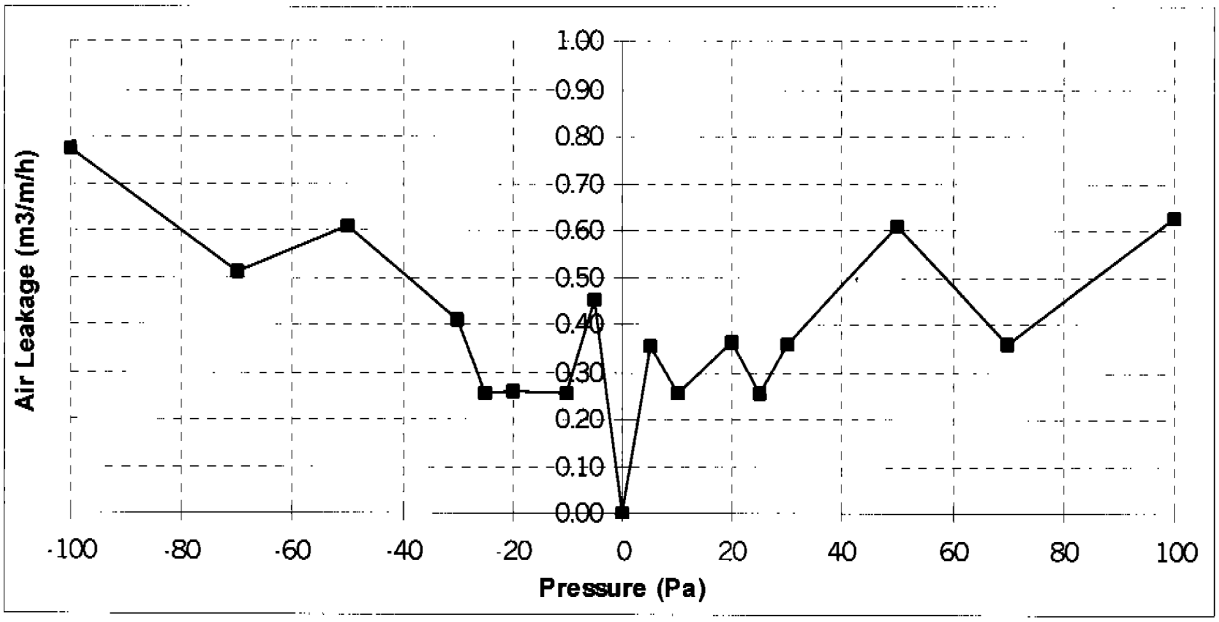
Graph 3

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, single acting) at Specified Pressure Differentials Before Cycling



Graph 4

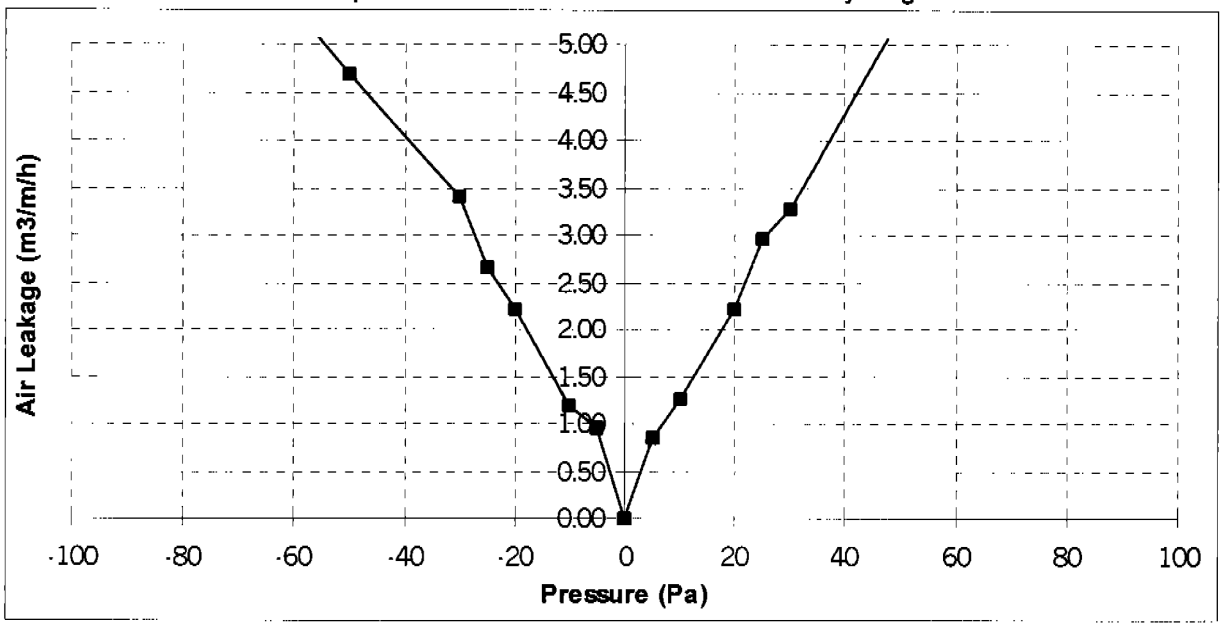
Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, single acting) at Specified Pressure Differentials After Cycling



Annex B (Continued)

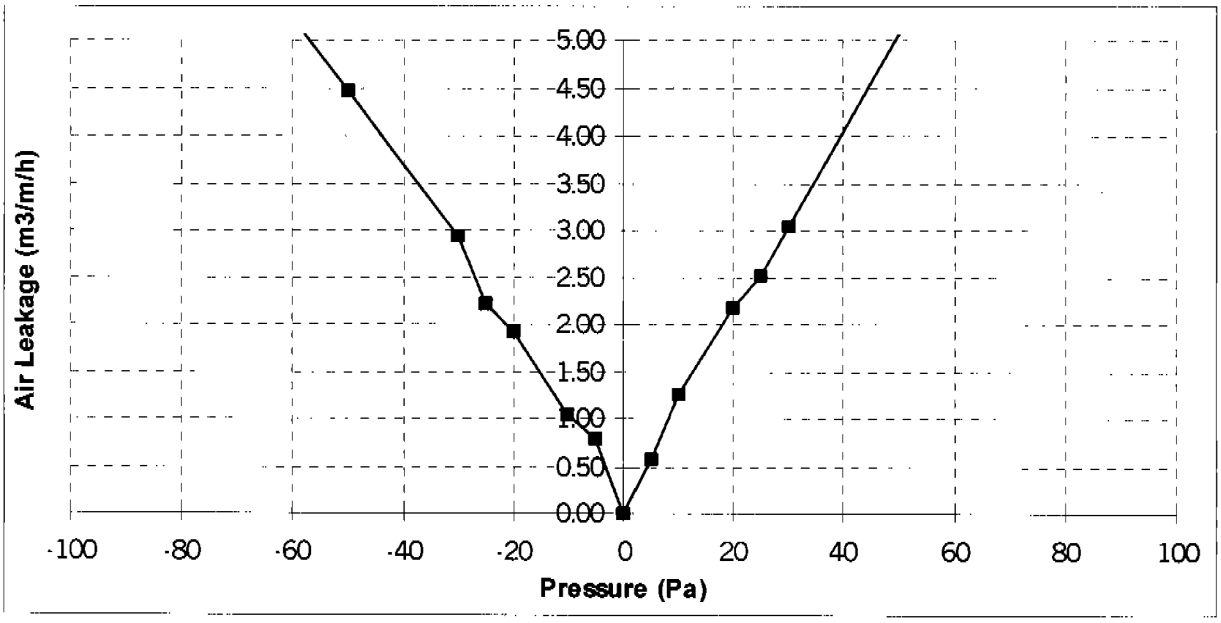
Graph 5

Net Leakage's of Smoke Seal Referenced SS5 (Continuous, double acting) at Specified Pressure Differentials Before Cycling



Graph 6

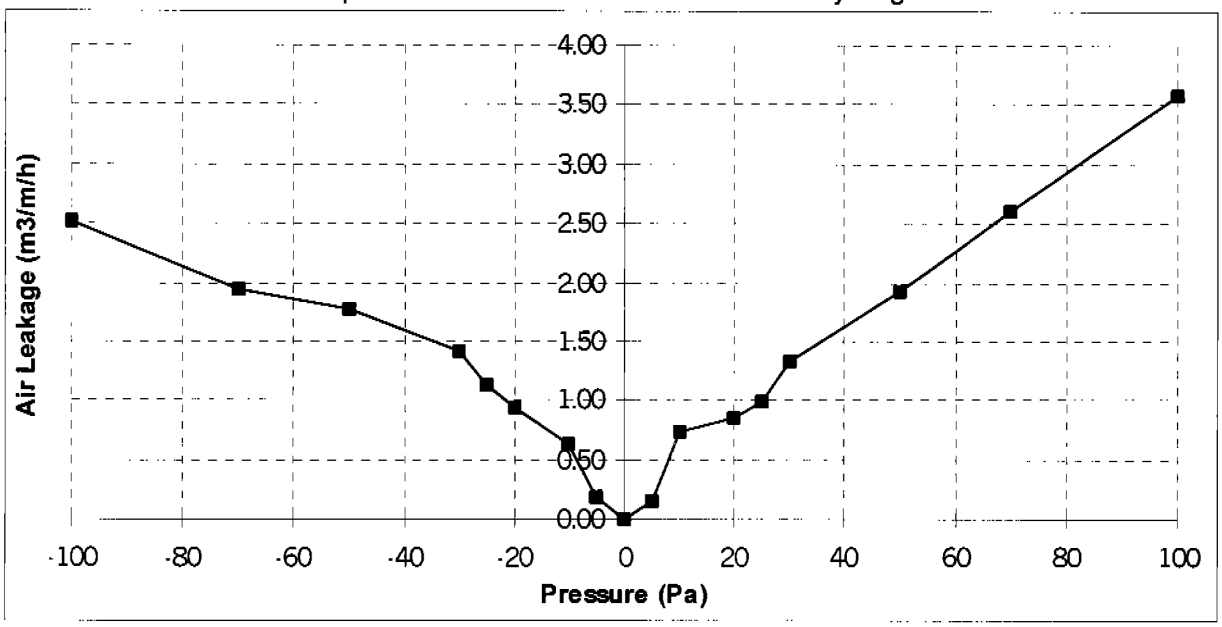
Net Leakage's of Smoke Seal Referenced SS5 (Continuous, double acting) at Specified Pressure Differentials After Cycling



Annex B (Continued)

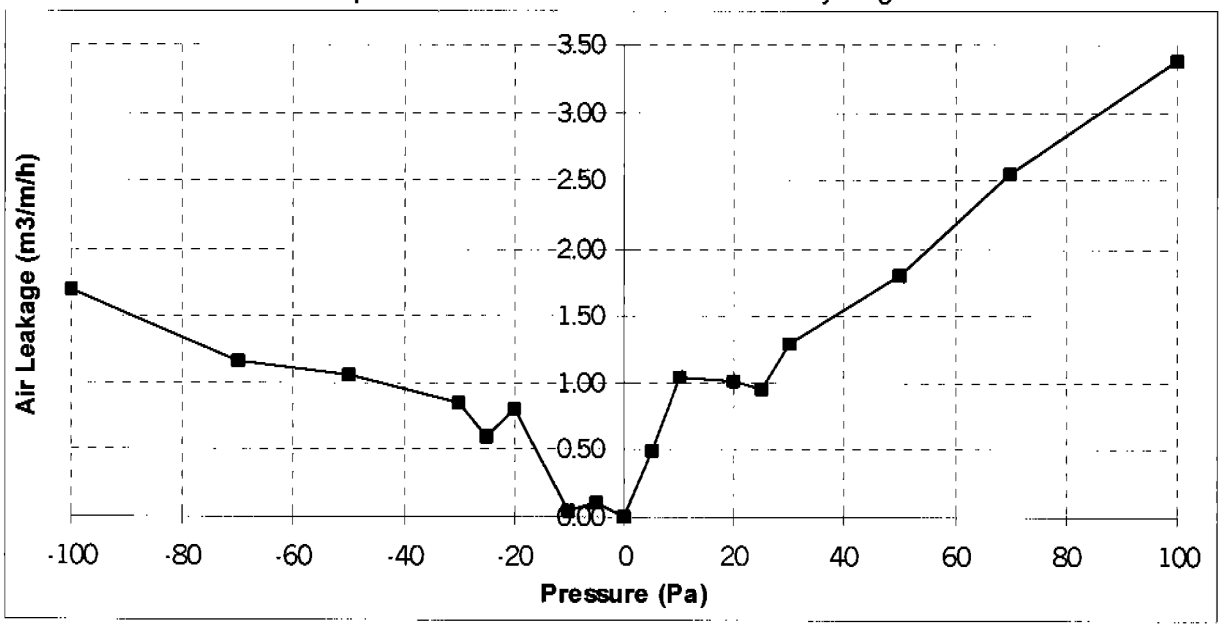
Graph 7

Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, double acting)
at Specified Pressure Differentials Before Cycling



Graph 8

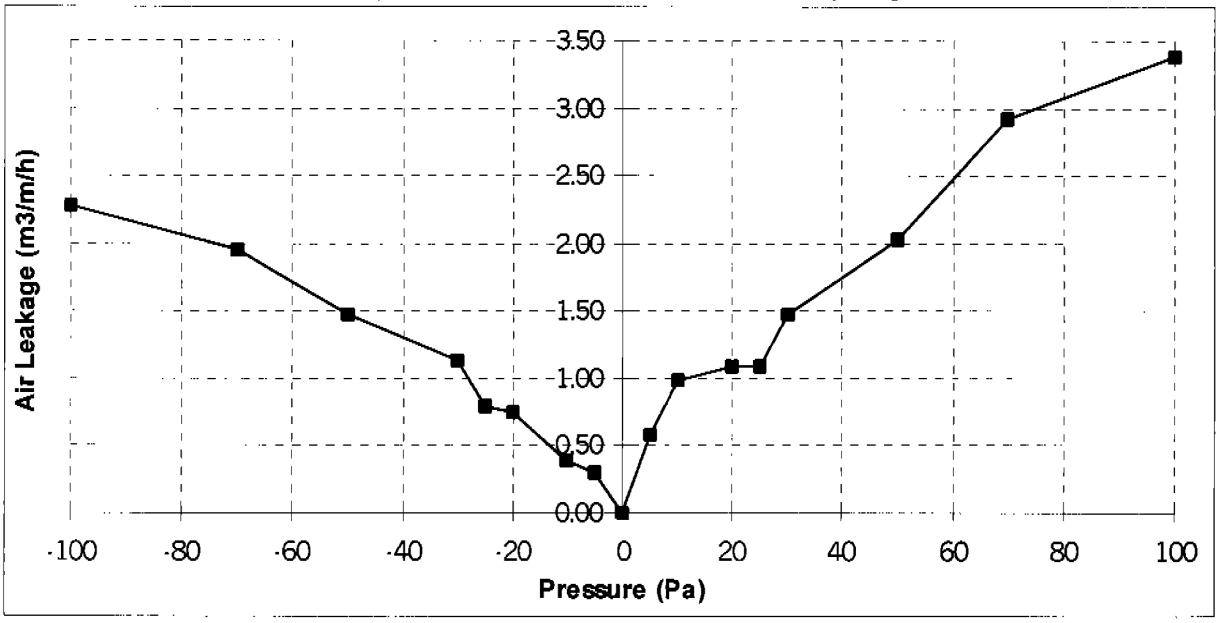
Net Leakage's of Smoke Seal Referenced Twinfin 5 (Continuous, double acting)
at Specified Pressure Differentials After Cycling



Annex B (Continued)

Graph 9

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, double acting)
at Specified Pressure Differentials Before Cycling



Graph 10

Net Leakage's of Smoke Seal Referenced Flexifin 5 (Continuous, double acting)
at Specified Pressure Differentials After Cycling