

VENT-O-MAT®

SERIES RBX

AIR RELEASE & VACUUM BREAK VALVES

OWNER'S MANUAL

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VENT	Air Valve Details:					MAT
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SERIES RBX "ANTI-SHOCK" AIR VALVE OWNER'S MANUAL

INTRODUCTION

Thank you for your purchase of the Vent-O-Mat series RBX "Anti-Shock" air valve. This air valve design is the culmination of years of intensive research, innovative design and leading edge technology.

The Vent-O-Mat series RBX air valve has transcended the line of being a mere air valve or surge alleviation mechanism as it represents more than just the combination of these functions. In fact, it is best described as a cost effective pipeline management system incorporating the features of a double acting air valve and surge alleviation device.

This manual is intended to provide the project engineer, contractor and end user with a useful guide on how best to install operate, maintain and maximise the performance of the Vent-O-Mat series RBX air valve. Included are comments on air valve sizing and positioning, Vent-O-Mat testing procedures and useful technical data.

Note this document is specifically directed at the use of Vent-O-Mat series RBX air valves and is not intended as a comprehensive pipeline design guide or system engineering manual.

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QUALITY CONTROL

Vent-O-Mat maintains stringent manufacturing and test procedures to ensure the best possible service and reliability is given by every valve produced. At Vent-O-Mat however, quality assurance is more than just a series of product inspections and tests it is in fact our approach to growth. Whilst it is true that each valve must pass a final test before it is cleared for dispatch, our basic belief is that quality cannot be inspected into a valve but must be designed and built into each valve. Total customer satisfaction is ensured through our employment of dedicated people, solid engineering and carefully monitored manufacturing procedures. We recognise the need for and encourage individual pride and self satisfaction which is gained in producing reliable, innovative and durable valves. This attitude to quality, permeates through our company, from the directors to the newest employees.

Vent-O-Mat Quality Control Programme

Vent-O-Mat has a well established and stringent standard Production Quality Programme. The general chain of material procurement, manufacturing and testing procedures are outlined below.

The general chain of events on receipt of an order are as follows:

Quality Requirements & Tests	Specification/Acceptance
1. Planning	
2. Procurement of materials and sundries	Standard materials spec.
3. Machining of flanges/body & floats	Drawings
4. Post machining dimensional inspection	Drawings
5. Assembly	Drawings
6. Hydrostatic test	7.3 psi - 1.5 times working pressure
7. Test Certificates	Standard
8. Final inspection prior to dispatch	Visual
9. Dispatch	Works

Enclosed below, is a more detailed description of some of the procedures carried out and checks put in place to ensure that each valve produced is of the highest standard.

1. Planning

On receipt, orders are reviewed initially by the Production Director before transcribing onto internal paper work. At this stage, any new or non - standard requirements are identified and actioned as appropriate.

This is then passed to the Planning Department who procure the relevant materials and sundries .

All correspondence relating to an order is held in the sales order file which also contains copies of all material and product test certification on completion of the order .

2. Work Instructions

The Planning Department issues to the Manufacturing Department , copies of the works order , detailed piece part drawings and manufacturing route cards which indicate both manufacturing and inspection operations . Detailed method sheets are compiled for each machining operation and issued as part of the full instruction package .

Any non - standard operations , such as specialised testing or marking are either detailed in the works order or the works order refers to a separately issued procedure.

3. Records

The records maintained against standard products are material test certification for pressure containing parts and final product certification.

In - house records are maintained in respect of components and final inspection

4. Design Control

All calculations and drawings are checked and signed - off by either the Production Director or the Technical Manager.

5. Documentation and Change Control

A drawing register is maintained which reflects current issue and date of drawings available. Change to the drawings is controlled by a change note system which maintains records of all changes.

Copies of modified drawings are issued to all relevant departments and are signed for on receipt . Copies of the superseded drawings are removed and destroyed . Control of process procedures, e.g. welding, is the responsibility of the Quality Assurance Manager and are issued as necessary against the specific works order.

6. Control of Inspection, Measuring and Test Equipment

Regular checks are carried out on equipment being used.

Pressure gauges used in product testing are tightly controlled. Each gauge is identified by a unique gauge or test stand number and the dates when calibration are due are clearly shown.

Calibration records of checks against a master standard pressure gauge are maintained.

7. Control of Purchased Materials and Services

Purchased supplies usually consist of raw materials, such as stainless steel and high density polyethylene, which are procured from well established suppliers who supply as standard, material test certificates.

Sub contracted processes are limited to plating operations, specialised welding and the machining of flanges.

Supplier performance is judged from an analysis of the Goods Received inspection reports.

All purchase orders are clearly drawn up and references are given to the required specifications.

All material received is first passed to Goods Receiving Inspection for checking and acceptance.

Visual inspection, verification of identification against test certification and dimensional inspection are carried out. Responsibility for the checking and signing - for the acceptance of materials test certification lies with Quality Assurance Manager. Materials are not passed to the stores until clearance has been obtained.

Material is cleared to the Stores by an inspection sign off or the stores receipt note .

Any reject material is segregated, marked and an inspection rejection note is raised.

8. Manufacturing Control

A work packet comprising the component drawings, method sheets and route card is prepared and issued for each item or batch of items to be manufactured. The route cards indicate the intermediate and final inspection operations.

A system of first off and patrol inspection is employed in addition to a 100% final inspection on all assembled products.

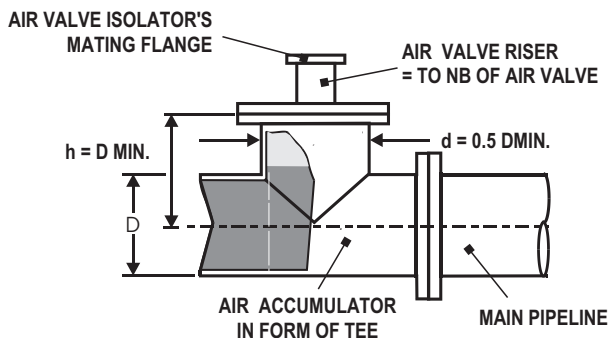
9. Completed Item Inspection Test

Assembly of the final product is carried out using the parts issued from the warehouse having identifiable inspection clearance, with reference to the general arrangement drawings.

RECOMMENDED INSTALLATION ARRANGEMENTS

Air Accumulators

It is common practice amongst some design engineers to place an air valve on a riser welded directly onto the main pipeline. This method however leads to inefficient air valve operation and restrictions in the main pipeline as air that is taken in under vacuum conditions will be swept away when the pumps are restarted. It is good pipeline design practice, to provide an accumulator, as indicated below for every air valve, to facilitate efficient air valve operation.

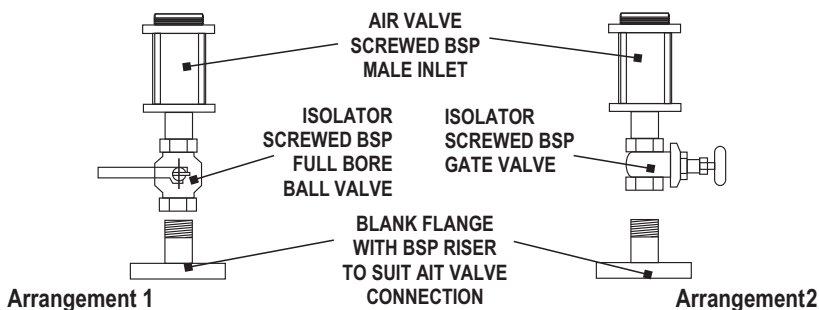


Isolator Arrangements

Every air valve installed, should have an isolator installed directly underneath it to allow the removal of the air valve in case of repairs. Indicated on the enclosed diagrams are Vent-O-Mat's recommended installation arrangements.

Arrangements 1 & 2

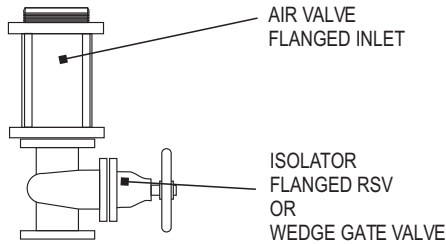
Specific to DN25 & DN50 Vent-O-Mat Series RBX valves.



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Arrangement 3

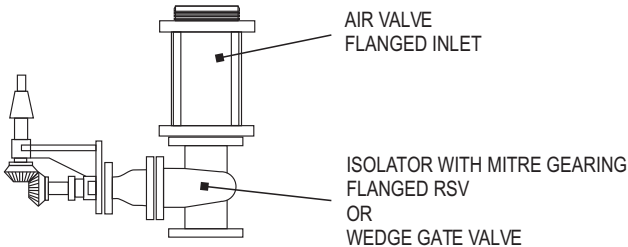
Specific to DN80(3"), 100(4"), 150(6") and 200(8") valves - Recommended for valves not installed in a valve chamber. Either a Wedge Gate or a Resilient Seal Valve can be utilised.



Arrangement 3

Arrangement 4

Specific to DN80, 100, 150 and 200 valves - Recommended for valves installed inside a valve chamber, to be operated by a Tee Key.

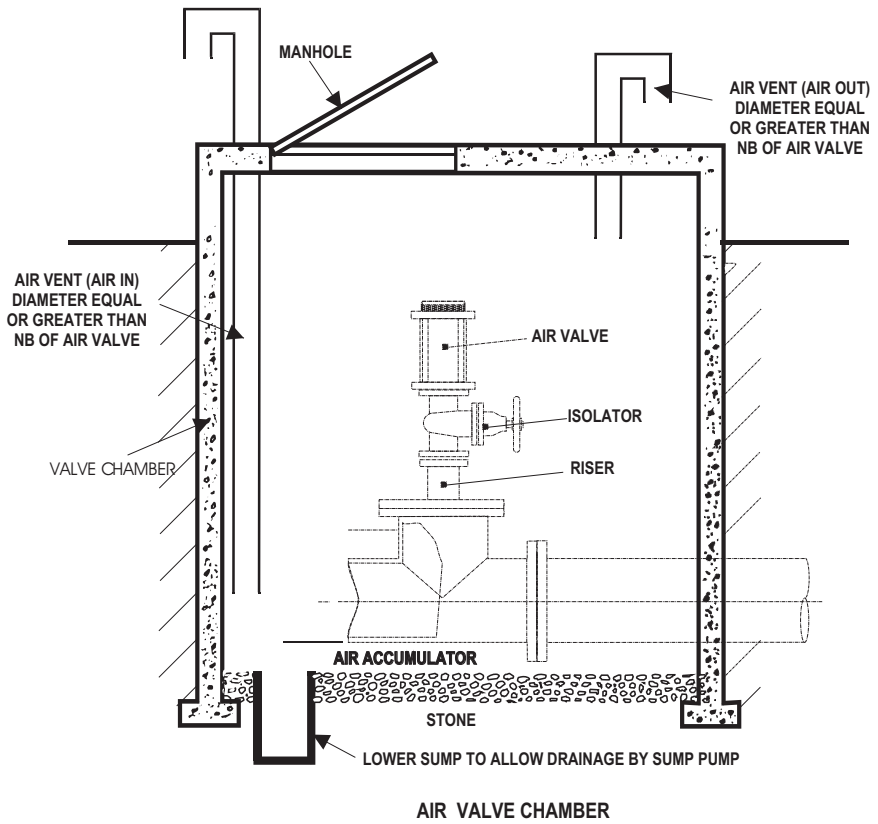


Arrangement 4

Air Valve Chamber Design

A well designed air valve chamber is important and should be designed with easy access to the valve for installation and subsequent maintenance. Good support is required in the case of chamber settling. It is a common practice to place a layer of stone underneath the pipe for drainage purposes. Two vents should also be installed, in the manner indicated on the opposite page to allow free and constant air circulation.

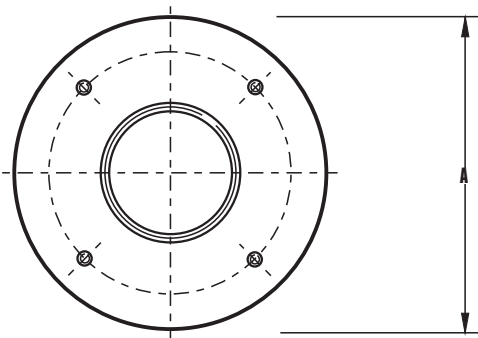
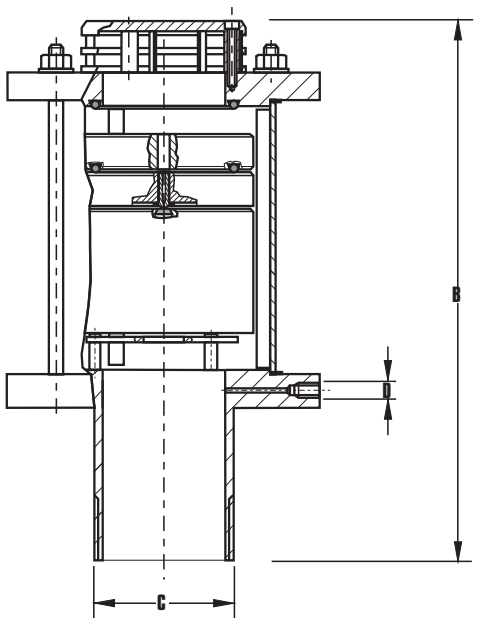
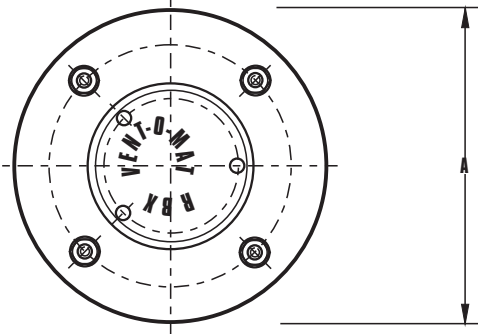
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GENERAL SPECIFICATIONS

FLANGED - DN25 (1") & DN50 (2")



Type:

Double Orifice (Small & Large Orifice) with Anti Shock Orifice mechanism.

End Connection:

Screwed BSP/ NPT male

Nominal Sizes:

DN25 (1") & DN50 (2")

Model No's:

RBX 2511 & 2521 _____ PN 25 (363 psi) ANSI #250
 RBX 4011 & 4021 _____ PN 40 (580 psi) ANSI #300

Pressure Ratings bar (psi)

Operating Pressure Range - bar (psi):

	Min		Max.
PN25 (363 psi) ANSI #250	0.5 (7.2)	—	25 (363)
PN40 (580 psi) ANSI #300	0.5 (7.2)	—	40 (580)

Operating Temperature Range:

4°C (40 F) to 80 C (180 F)

Acceptable Media:

Potable or strained raw water.

Function:

- i) High volume air discharge - pipeline filling.
- ii) High volume air intake - pipeline draining
- iii) Pressurized air discharge - pipeline filled.
- iv) Surge dampening - high velocity air discharge, water column separation & liquid oscillation.

Materials of Construction: - see page 10

Installation: - see page 6

Standard Factory Tests:

- i) Hydrostatic - 1.5 x max. rated working pressure
- ii) Low head leak - 0.5 bar (7.2 psi)
- iii) Small orifice function at max. rated working pressure (minimum 1 valve in 10).

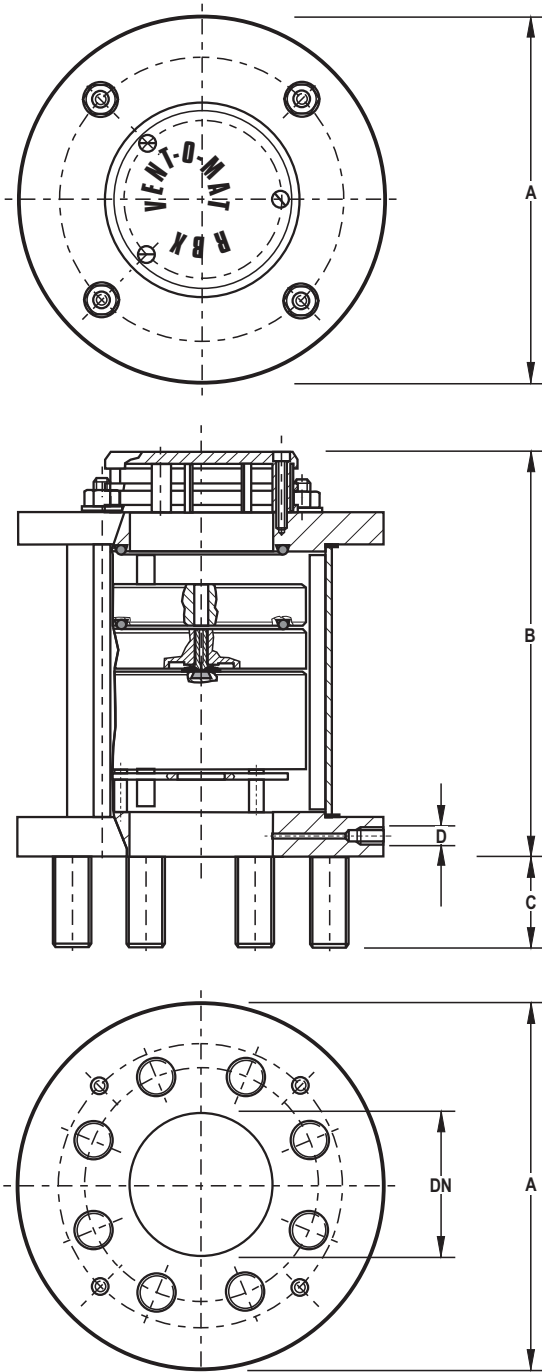
OVERALL DIMENSIONS & WEIGHTS

DN mm in.	MODEL No.	PRESSURE RATING	A		B		C	D	WEIGHT	
			mm	in.	mm	in.			kg.	lbs
25 1"	025RBX 2511 & 2521	PN25 (363 psi) ANSI #250	120	4 3/4	265	10 7/16	1" BSP/NPT		4.6	10.1
25 1"	025RBX 4011 & 4021	PN40 (580 psi) ANSI #300	120	4 3/4	317	12 1/2	1" BSP/ NPT	OPTIONAL 1/4 BSP/NPT BLEED PORT FOR TEST COCK	5.2	11.4
50 2"	050RBX 2511 & 2521	PN25 (363 psi) ANSI #250	165	6 1/2	320	12 3/5	2" BSP/ NPT		9.4	20.6
50 2"	050 RBX 4011 & 4021	PN40 (580 psi) ANSI #300	165	6 1/2	335	13 3/16	2" BSP/ NPT		9.7	21.3

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GENERAL SPECIFICATIONS

FLANGED - DN80 (3") & DN100 (4")



Type:

Double Orifice (Small & Large Orifice) with Anti Shock Orifice mechanism.

End Connection:

Flange with Screwed Studs for Alignment to:
 BS 4504 PN 10, PN16, PN25 & PN40
 SABS 1123 - Tables 1000/3, 1600/3, 2500/3 & 4000/3
 ANSI B16. 1 Class 125, Class 250 & ANSI B16. 5 Class 300

Nominal Sizes:

DN80 (3") & DN100 (4")

Model No's:

RBX 1601 & 1631 ————— PN 16 (232 psi) ANSI #125
 RBX 2501 & 2531 ————— PN 25 (363 psi) ANSI #250
 RBX 4001 & 4031 ————— PN 40 (580 psi) ANSI #300

Pressure Ratings bar (psi):

Operating Pressure Range - bar (psi):

	Min	Max.
PN25 (363 psi) ANSI #250	0.5 (7.2)	25 (363)
PN40 (580 psi) ANSI #300	0.5 (7.2)	40 (580)

Operating Temperature Range:

4 C (40 F) to 80 C (180 F)

Acceptable Media:

Potable or strained raw water.

Function:

- i) High volume air discharge - pipeline filling.
- ii) High volume air intake - pipeline draining
- iii) Pressurized air discharge - pipeline filled.
- iv) Surge dampening - high velocity air discharge, water column separation & liquid oscillation.

Materials of Construction: - see page 11

Installation: - see page 6

Standard Factory Tests:

- i) Hydrostatic - 1.5 x max. rated working pressure
- ii) Low head leak - 0.5 bar (7.2 psi)
- iii) Small orifice function at max. rated working pressure (minimum 1 valve in 10).

OVERALL DIMENSIONS & WEIGHTS

DN		MODEL No.	PRESSURE RATING	A		B		C		D	WEIGHT	
mm	in			mm	in	mm	in	mm	in		kg.	lbs
80	3	080 RBX 1601 & 1631	PN16 (232 psi) ANSI #125	235	9 1/4	305	12	50	2	OPTIONAL 1/4" BSP/NPT BLEED PORT FOR TEST COCK	23	50.6
80	3	080 RBX 2501 & 2531	PN25 (363 psi) ANSI #250	235	9 1/4	305	12	50	2		23	50.6
80	3	080 RBX 4001 & 4031	PN40 (580 psi) ANSI #300	235	9 1/4	320	12 3/5	50	2	25	55	
100	4	100 RBX 1601 & 1631	PN16 (232 psi) ANSI #125	235	9 1/4	320	12 3/5	50	2	22	48.5	
100	4	100 RBX 2501 & 2531	PN25 (363 psi) ANSI #250	235	9 1/4	320	12 3/5	50	2	22	48.5	
100	4	100 RBX 4001 & 4031	PN40 (580 psi) ANSI #300	235	9 1/4	353	13 7/8	50	2	26	57.2	

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GENERAL SPECIFICATIONS

FLANGED - DN150 (6") & DN200 (8")

Type:

Double Orifice (Small & Large Orifice) with Anti Shock Orifice mechanism.

End Connection:

Flange for Alignment to:
 BS 4504 PN 10, PN16, PN25 & PN40
 SABS 1123 - Tables 1000/3, 1600/3, 2500/3 & 4000/3
 ANSI B16. 1 Class 125, Class 250 & ANSI B16. 5 Class 300

Nominal Sizes:

DN150 (6") & DN200 (8")

Model No's:

Pressure Ratings bar (psi):

RBX 1601 & 1631 ————— PN 16 (232 psi) ANSI #125
 RBX 2501 & 2531 ————— PN 25 (363 psi) ANSI #250
 RBX 4001 & 4031 ————— PN 40 (580 psi) ANSI #300

Operating Pressure Range - bar (psi):

		Min		Max.
PN25 (363 psi) ANSI #250	—————	0.5 (7.2)	—————	25 (363)
PN40 (580 psi) ANSI #300	—————	0.5 (7.2)	—————	40 (580)

Operating Temperature Range:

4 C (40 F) to 80 C (180 F)

Acceptable Media:

Potable or strained raw water.

Function:

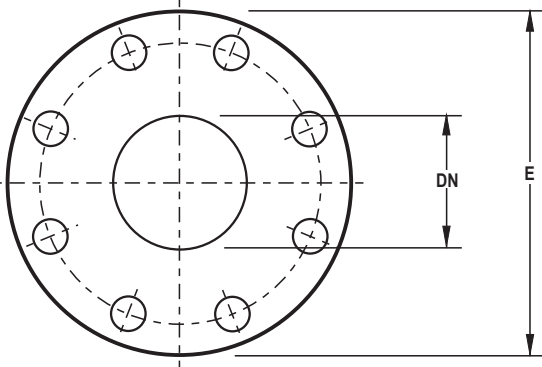
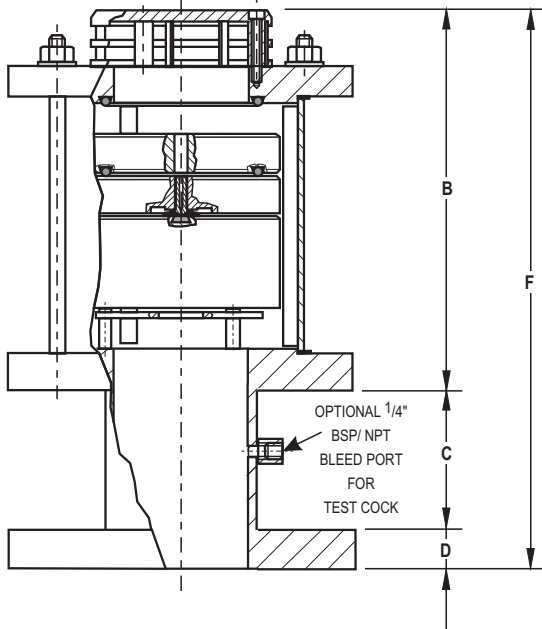
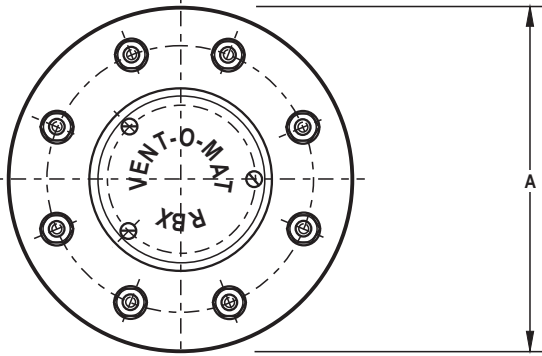
- i) High volume air discharge - pipeline filling.
- ii) High volume air intake - pipeline draining
- iii) Pressurized air discharge - pipeline filled.
- iv) Surge dampening - high velocity air discharge, water column separation & liquid oscillation.

Materials of Construction: - see page 12

Installation: - see page 6

Standard Factory Tests:

- i) Hydrostatic - 1.5 x max. rated working pressure
- ii) Low head leak - 0.5 bar (7.2 psi)
- iii) Small orifice function at max. rated working pressure (minimum 1 valve in 10).



OVERALL DIMENSIONS & WEIGHTS

DN	MODEL No.		PRESSURE RATING	A		B		C		D		E		F		WEIGHT	
	mm	in		mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	kg.	lbs
150	6	150 RBX 1601 & 1631	PN16 (232 psi) ANSI #125	340	13 3/8	440	17 5/16	120	4 3/4	22	7/8	285	11 1/4	582	22 7/8	70	154
150	6	150 RBX 2501 & 2531	PN25 (363 psi) ANSI #250	340	13 3/8	440	17 5/16	120	4 3/4	30	1 3/16	300	11 3/4	590	23 1/4	70	154
150	6	150 RBX 4001 & 4031	PN40 (580 psi) ANSI #300	340	13 3/8	440	17 5/16	120	4 3/4	30	1 3/16	300	11 3/4	590	23 1/4	78	171.6
200	8	200 RBX 1601 & 1631	PN16 (232 psi) ANSI #125	390	15 3/8	480	18 7/8	130	5 1/8	24	1 9/16	340	13 1/2	634	24 7/8	92	202.4
200	8	200 RBX 2501 & 2531	PN25 (363 psi) ANSI #250	390	15 3/8	480	18 7/8	130	5 1/8	28	1 1/8	360	14 1/8	638	25 1/8	92	202.4
200	8	200 RBX 4001 & 4031	PN40 (580 psi) ANSI #300	390	15 3/8	480	18 7/8	130	5 1/8	34	1 3/8	375	14 3/4	644	25 3/8	98	215.6

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COMPONENT DESCRIPTION & MATERIAL SPECIFICATION SCREWED DN25 (1") & DN50 (2")

Type:

Series RBX - Double Orifice (Small & Large Orifice) with Anti Shock Orifice Mechanism

End Connection:

Screwed BSP (ISO R7)/ NPT Male

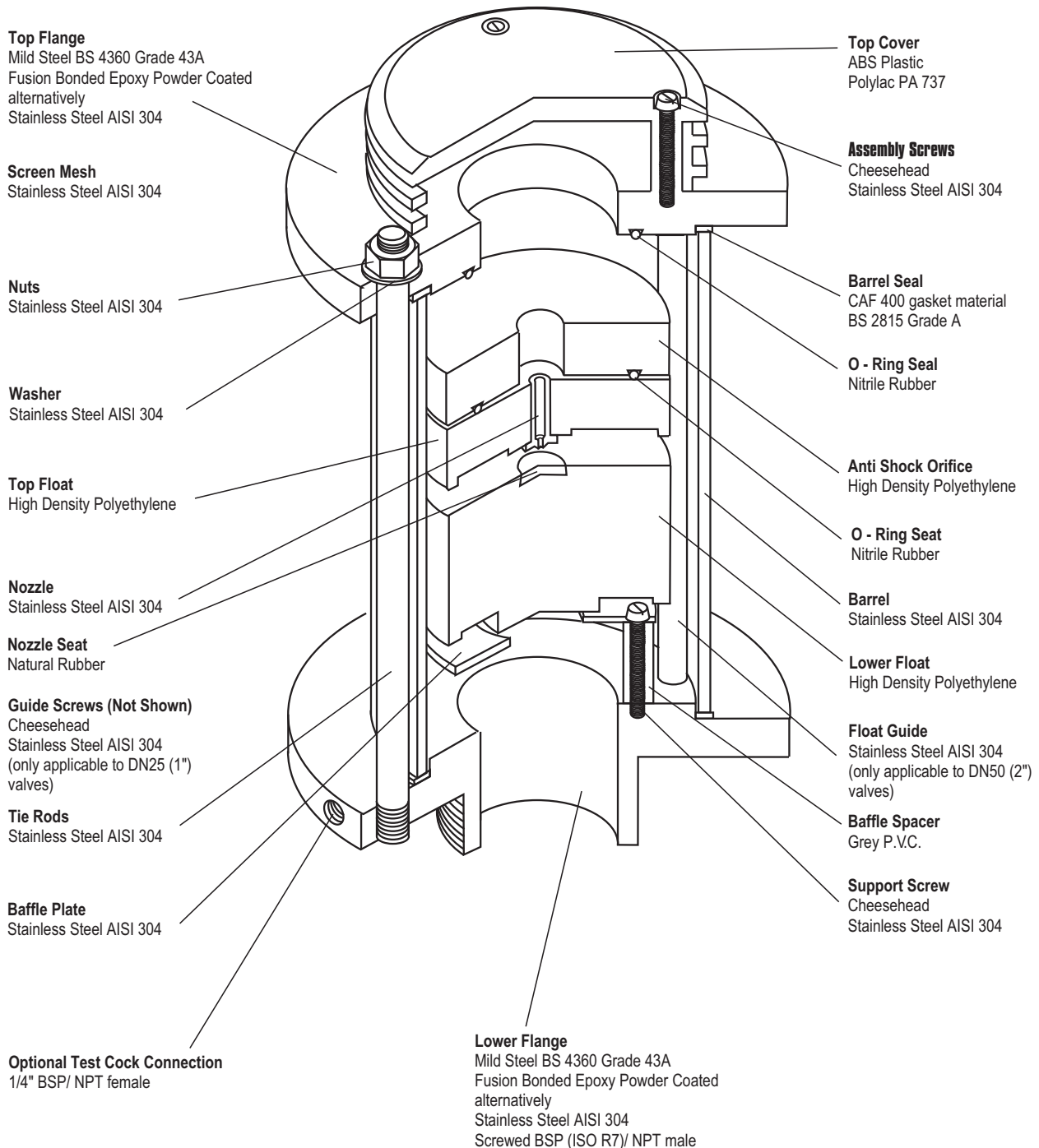
Nominal Sizes:

DN25 (1")
DN50 (2")

Model No's:

RBX 2511 & 2521 _____ PN25 (363 psi) ANSI #250
RBX 4011 & 4021 _____ PN40 (580 psi) ANSI #300

Pressure Ratings:



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COMPONENT DESCRIPTION & MATERIAL SPECIFICATION FLANGED DN80 (3") & DN100 (4")

Type:

Series RBX - Double Orifice (Small & Large Orifice) Flange with screwed studs.
With Anti Shock Orifice Mechanism.

End Connection:

Flange with screwed studs.

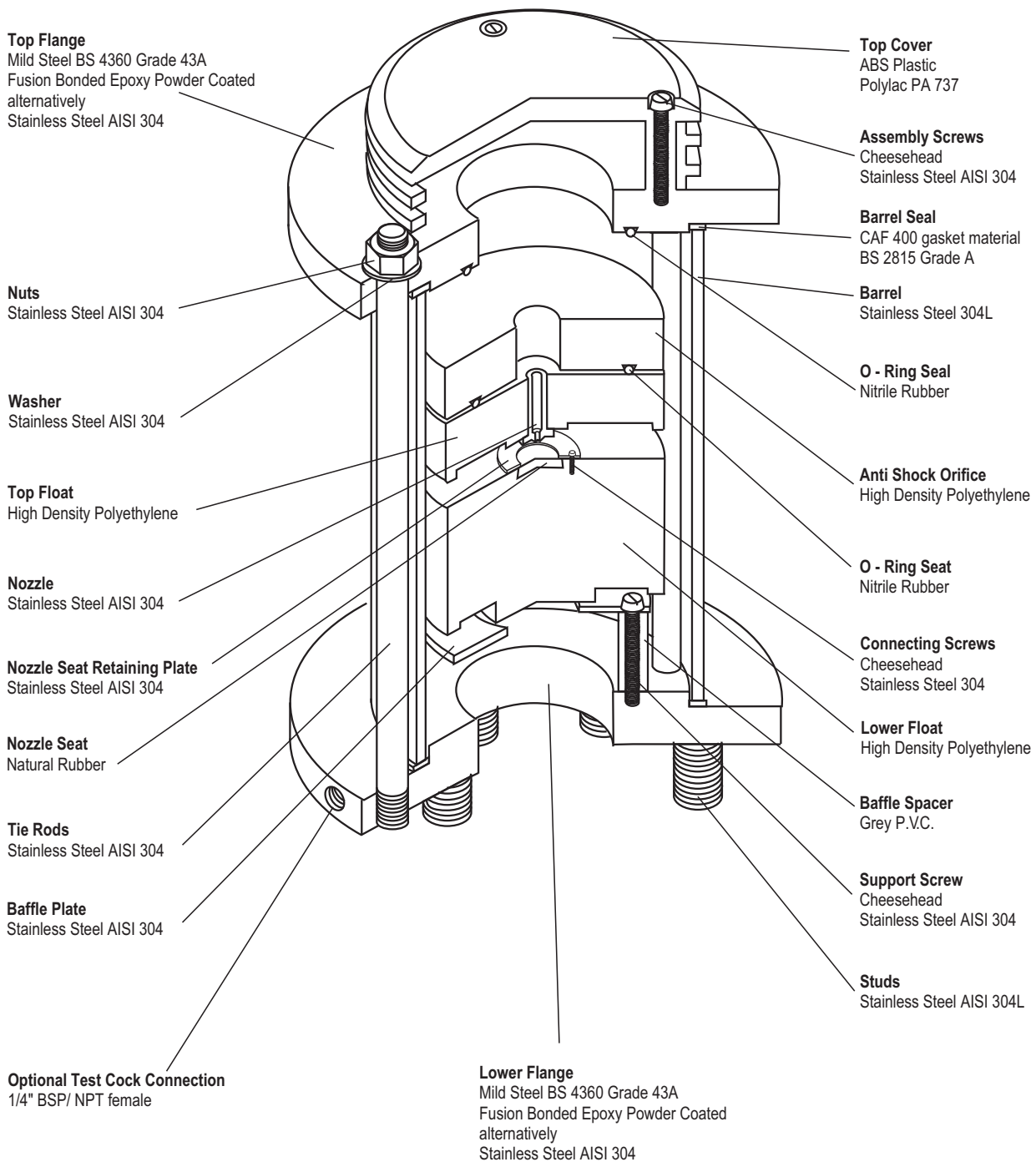
Nominal Sizes:

DN80 (3")
DN100 (4")

Model No's:

RBX 1601 & 1631 _____ PN16 (232 psi) ANSI #125
RBX 2501 & 2531 _____ PN25 (363 psi) ANSI #250
RBX 4001 & 4031 _____ PN40 (580 psi) ANSI #300

Pressure Ratings:



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COMPONENT DESCRIPTION & MATERIAL SPECIFICATION FLANGED DN150 (6") & DN200 (8")

Type:

Series RBX - Double Orifice (Small & Large Orifice) Flange with Anti Shock Orifice Mechanism.

End Connection:

Nominal Sizes:

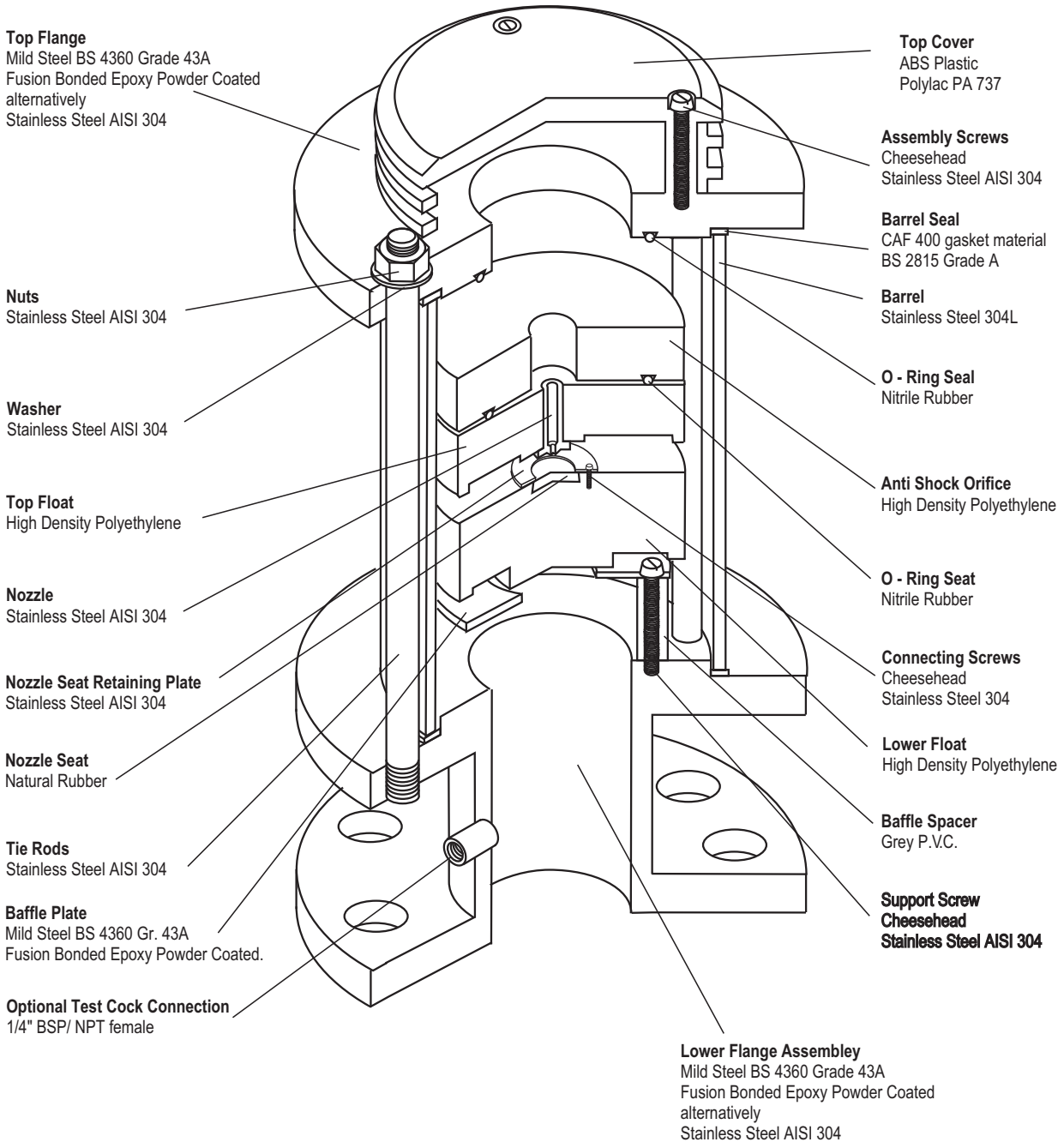
DN150 (6")
DN200 (8")

Model No's:

RBX 1601 & 1631
RBX 2501 & 2531
RBX 4001 & 4031

Pressure Ratings:

PN16 (232 psi) ANSI #125
PN25 (363 psi) ANSI #250
PN40 (580 psi) ANSI #300



MAINTENANCE

The Vent-O-Mat Series RBX valve is virtually maintenance free. There may however, on rare occasions, be the need to carry out maintenance on the valve. Enclosed is a guide providing possible reasons for maintenance requirements.

Problem	Reason	Course of Action
Valve Leaking through large orifice	Construction debris stuck in valve due to commissioning of new pipeline.	Follow enclosed Maintenance Instructions.
Valve Leaking around barrel seals.	Surge & Water Hammer problems in pipeline/ Severe undersizing of air valves	Notify manufacturer & Consulting Engineer/ Follow enclosed Maintenance Instructions.
Valve leaking through the large orifice despite no debris entrapped in valve.	Valve above the hydraulic gradeline.	Reposition valve 5 metres below hydraulic gradeline.
Small volumes of water evident on top flange during initial filling.	Normal operation of valve.	No course of action required

The RBX design facilitates ease of service and maintenance and all maintenance spares are replaceable without special tools or skills. A complete list of tools and spares required, as well as the maintenance procedures are enclosed below.

Tool & Spare Requirements

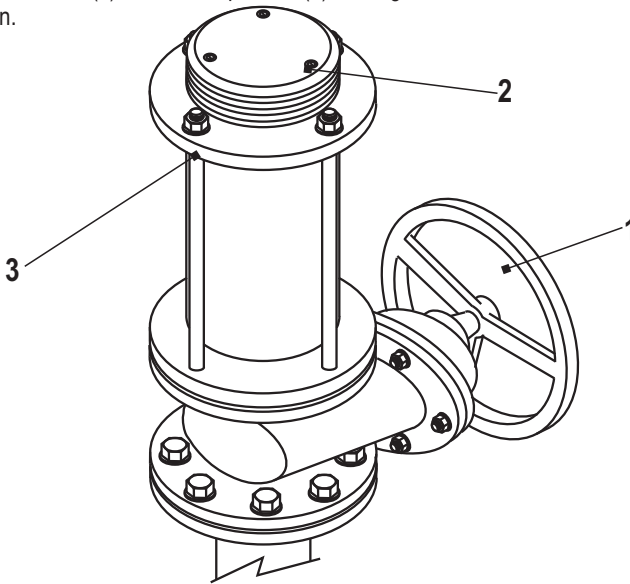
Valve Size	Tools Required	Spares Required
DN25(1")	M8 Spanner & Flat Screwdriver	2x Barrel Seals, 1x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat
DN50(2")	M8 & M12 Spanner & Flat Screwdriver	2 x Barrel Seals, 1 x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat
DN80(3")	M8 & M16 Spanner & Flat Screwdriver	2 x Barrel Seals, 1 x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat
DN100(4")	M8 & M16 Spanner & Flat Screwdriver	2 x Barrel Seals, 1 x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat
DN150(6")	M8 & M20 Spanner & Flat Screwdriver	2 x Barrel Seals, 1 x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat
DN200(8")	M8 & M20 Spanner & Flat Screwdriver	2 x Barrel Seals, 1 x Small Orifice Nozzle, 1 x O-Ring Seal, 2 x O-Ring Seats, 1 x Nozzle Seat

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Maintenance Procedures

Step 1

Close the Isolator Valve (1). Remove Top Cover (2) utilising a flat screwdriver. Loosen Nuts (3) in a circular fashion.



Step 2

Remove the Top Flange Assembly (4) and inspect the O-Ring Seal (5) for damage. Remove the Barrel Assembly (6).

Step 3

Remove all Floats (7,8 & 9) and check for any entrapped debris. Rinse Floats in clear water.

Step 4

Replace Lower Float (9) with Nozzle Seat (10) facing upwards as indicated. Inspect the Nozzle Seat (10) for damage. Use a flat screwdriver to remove the Seat Retainer Plate (11), should the Seat Retainer Plate (11) need replacing (for DN80 (3"), 100(4"), 150(6") and 200(8") only).

Step 5

Inspect the Small Orifice Nozzle (12) for any blockages or damage. Use a M8 spanner to remove the Small Orifice Nozzle (12) if necessary. Replace Upper Float (8) in the manner indicated. Ensure that the Small Orifice Nozzle (12) makes contact with the Nozzle Seat (10).

Step 6

Inspect the O-Ring Seat (13) for damage. Replace the "Anti-Shock" Float (7) in the manner indicated. Ensure that the O-Ring Seat (13) is facing down.

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Step 7

Inspect Upper and Lower Barrel Seals (14 & 15) for damage.

Step 8

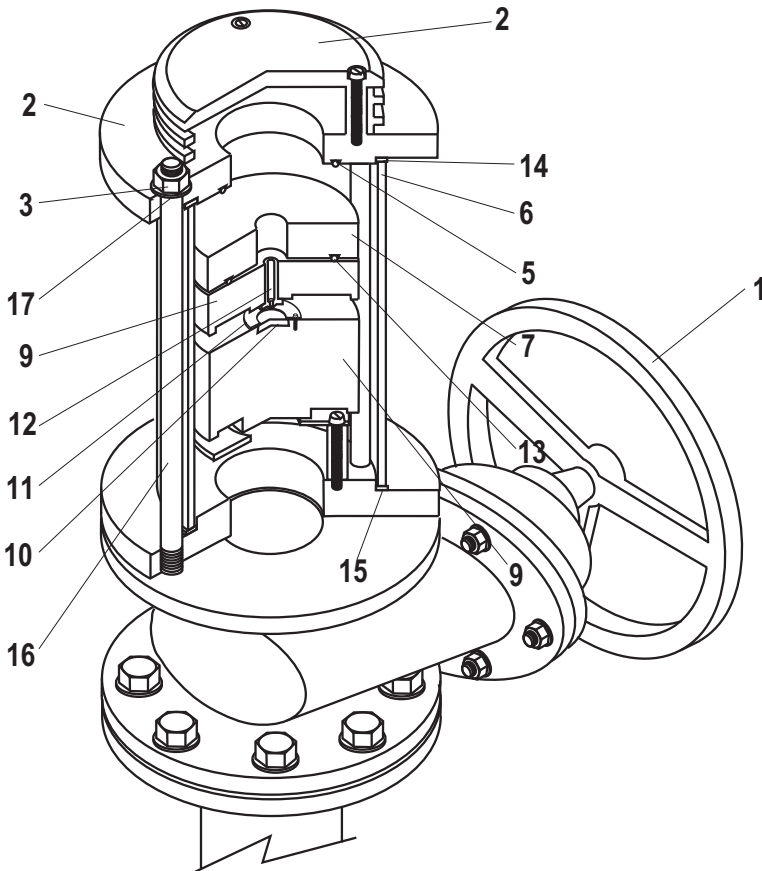
Replace the Barrel Assembly (6) ensuring that the Lower Barrel Seal (15) is in place.

Step 9

Replace the Top Flange Assembly (4), ensuring that the Upper Barrel Seal (14) is in place.

Step 10

Replace the Nuts (3) and Washers (17) ensuring that each Tie Rod (16) has a Washer (17) and that the Upper Barrel Seal (14) is correctly positioned. First hand tighten Nuts (3), then "cross" tighten. Torque to the correct specification as outlined on page 16. Replace Top Cover (2). Reopen Isolator (1).



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Vent-O-Mat Series RBX - Tie Rod Torque Settings

Valve Press. Rating	Model No.	Tie Rod No.	Nut Size	Torque in Nm	Torque in ft-lbs
PN25(363 psi)	025 RBX2521	4	M8	40	30
PN40(580 psi)	025 RBX4021	4	M8	40	30
PN64(928 psi)	025 RBX6471	8	M8	40	30
PN25(363 psi)	050 RBX2521	4	M12	55	41
PN40(580 psi)	050 RBX4021	4	M12	55	41
PN64(928 psi)	050 RBX6471	8	M12	100	74
PN19(276 psi)	080 RBX1931 & 1941	4	M16	100	74
PN25(363 psi)	080 RBX2551 & 2561	4	M16	100	74
PN40(580 psi)	080 RBX4051 & 4061	8	M16	110	82
PN64(928 psi)	080 RBX6471	8	M16	110	82
PN19(276 psi)	100 RBX1931 & 1941	4	M16	100	74
PN25(363 psi)	100 RBX2551 & 2561	4	M16	100	74
PN40(580 psi)	100 RBX4051 & 4061	8	M16	110	82
PN64(928 psi)	100 RBX6471	8	M16	110	82
PN19(276 psi)	150 RBX1931 & 1941	8	M20	480	354
PN25(363 psi)	150 RBX2551 & 2561	8	M20	480	354
PN40(580 psi)	150 RBX4051 & 4061	12	M20	480	354
PN64(928 psi)	150 RBX6471	12	M20	480	354
PN19(276 psi)	200 RBX1931 & 1941	8	M20	480	354
PN25(363 psi)	200 RBX2551 & 2561	8	M20	480	354
PN40(580 psi)	200 RBX4051 & 4061	12	M20	480	354
PN64(928 psi)	200 RBX6471	12	M20	480	354

Vent-O-Mat Identity Labels

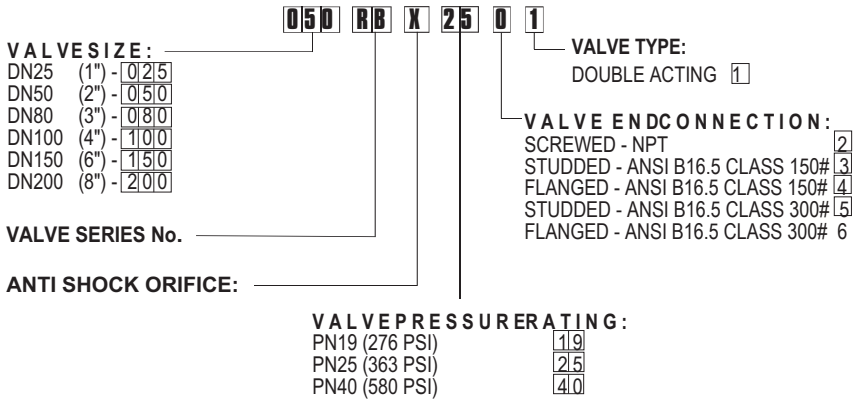
Each Vent-O-Mat valve sold has an identity label attached to the barrel, providing pertinent information on the valve. A sample of the label is provided below. For maintenance and technical assistance, kindly contact the agent that services your area (see page 17 for Vent-O-Mat's agent list), or the manufacturer (details on label), quoting the information on the label.

1. SEQ. No: Refers to sequential number of batch valves for specific orders/ contracts.
2. MODEL: Refer to page 18 for explanation of Model Numbers.
3. MAX WORKING PRESSURE: Indicates the valve's designed working pressure in kPa.
4. REF. No: Serial number that refers to Vent-O-Mat's internal paperwork, including test compliance that can be cross referenced to any test carried out on valve.

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EXPLANATION OF MODEL NUMBERS

Vent-O-Mat model numbers are a series of numbers providing information on valve size, valve type, valve pressure rating and valve end connection.



AIR VALVE SIZING AND POSITIONING

The presence of air in a water main in service or in the process of being filled is well known to be the cause of serious problems such as delay in filling, throttling and reduction in discharge capacities, risk of surge and water hammer and corrosion.

The indiscriminate selection and positioning of double acting air valves, without thorough evaluation of the system characteristics and dynamics will not solve the problem of air in the main but can and will lead to the aggravation of phenomena associated with it's presence as well as introduce other destructive phenomena.

Air valve selection and positioning is a complex exercise because of the unpredictable nature of air as it is influenced by many factors such as pressure, temperature, pipeline velocities etc., and it in turn influences the pipeline dynamics dramatically, making it difficult to quantify.

This section of the document provides the engineer with a guideline of where to position and how to size Vent-O-Mat air valves to ensure the maximum performance and protection is gained from every valve installation. Reference should also be made to Vent-O-Mat's other publications and Vent-O-Mat's computer sizing disc for a more comprehensive guide on air valve sizing and positioning.

Positioning of Air Valves

Air valves are positioned primarily on peak points to discharge air during initial filling and to draw air into the pipeline under drainage conditions. There are however, a number of other locations where air valves need to be installed to ensure effective pipeline operation and protection against phenomena such as surge and water hammer. The table below provides a quick check reference on where to position air valves.

Recommended Air Valve Locations
On apex points relative to the hydraulic gradeline. 5 metres below the apex points formed by the intersection of the hydraulic gradeline. Negative breaks - increase in downward slope or decrease in upward slope. Long horizontal sections - every 600 metres(2000 ft). Long ascending sections - every 600 metres(2000 ft). Long descending sections - every 600 metres(2000 ft). Pump discharge - subsequent to a pump non return valve. Prior to a pump non return valve - pump without positive suction head. Prior to a pump non return valve - deepwell application. Blank ends - where a pipeline is terminated by a blank flange or a valve.

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Sizing of Air Valves for air Intake (Vacuum Conditions)

Air valves are first and foremost sized for vacuum conditions (drainage) which may result from scouring of pipeline, pipeline rupture or instantaneous pump stoppage causing column separation.

The objective in sizing an air valve for vacuum conditions is to determine the smallest air release and vacuum break valve capable of admitting air into the pipeline whilst not exceeding a differential pressure that would put the pipeline and gasket joint at risk due to negative internal pressure.

Good pipeline design practice dictates that the following negative pressures not be exceeded for various pipe material to ensure that pipe collapse or seal failure does not occur.

Pipe Material	Recommended Negative Differential
Steel	35 kPa(5 psi)
Ductile Iron	35kPa(5 psi)
Fibre Cement	35 kPa(5 psi)
GRP	20 kPa(3 psi)
uPVC	15 kPa - 20 kPa(2-3 psi)
HDPE	15 kPa - 20 kPa(2-3 psi)
Concrete	35 kPa(5 psi)

Air valves are generally sized on scouring velocities or partial rupture to economise on the valve size selected. The following rupture rates (as a percentage of pipeline area), are generally used. Note all these factors are taken into consideration in the Vent-O-Mat Sizing Disc which is freely available to any interested party.

Pipeline Material	Rupture Rate on which to base Size of Air Valve
Steel	10 - 15 %
GRP	10 - 15 %
Fibre Cement	50 - 100 %
Ductile Iron	10- 15%
uPVC	10 - 20 %
HDPE	10 - 20 %

Scouring rates are generally 11 to 12% of pipeline area.

Sizing of Air Valves for Air Discharge (Initial Filling Conditions)

It is prudent to size an air valve for both filling and drainage for a particular point on the pipeline and always to select the larger valve.

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Sizing an air valve for filling is based on the velocity through the pipeline, the diameter of the pipeline and the pipeline material. Below is a quick check guide to determine if the valve on your pipeline is sized correctly. Vent-O-Mat recommends however, that air valve sizing should be done, utilising the Vent-O-Mat sizing programme, and with reference to Vent-O-Mat's document titled "Air Valve Technology Reviewed".

Pipeline Velocity	Pipeline Diameter	Recommended Valve Size
1 m/sec(3.3 ft/sec).	DN50 to DN200(2"-8")	DN25(1")
1 m/sec(3.3 ft/sec).	DN200 to DN400(8"-16")	DN50(2")
1 m/sec(3.3 ft/sec).	DN400 to DN600(16"-24")	DN80(3")
1 m/sec(3.3 ft/sec).	DN600 to DN700(24"-28")	DN100(4")
1 m/sec(3.3 ft/sec).	DN700 to DN900(28"-36")	DN150(6")
1 m/sec(3.3 ft/sec).	DN900 to DN1400(36"-55")	DN200(8")
2 m/sec(6.6 ft/sec).	DN100 to DN200(4"-8")	DN50(1")
2 m/sec(6.6 ft/sec).	DN200 to DN400(8"-16")	DN80(2")
2 m/sec(6.6 ft/sec).	DN400 to DN500(16"-20")	DN100(4")
2 m/sec(6.6 ft/sec).	DN500 to DN800(20"-75")	DN150(6")
2 m/sec(6.6 ft/sec).	DN800 to DN1000(75"-39")	DN200(8")

TECHNICAL FEATURES & FINANCIAL BENEFITS

The criteria for assessing the merits of any form of pipeline equipment are capital costs and operating and maintenance requirements. It is likely if all the below are taken into account, Vent-O-Mat valves will be seen as a cheap, reliable and efficient form of pipeline protection.

Vacuum Protection

All Vent-O-Mat valves have large orifice diameters equal to the nominal size of the valve i.e., a DN200(8") valve has a 200mm(8") orifice. This ensures the least possible resistance to the intake of air and consequently the least possible negative pressure within a draining pipeline.

Discharge Performance

The Vent-O-Mat valve design is not limited to the velocity within the pipeline and the differential across the large orifice as conventional air valves are. This ensures the effective removal of all air from a filling pipeline whilst eliminating the possibilities of surge and water hammer on closure of the large orifice.

Serviceability

The Vent-O-Mat valve is virtually maintenance free, but facilitates extreme ease of service and maintenance in the rare instances when required. Components are in corrosion free materials to allow problem free disassembly and reassembly even after years of operation. All maintenance spares are replaceable without special tools or skills.

Performance

Vent-O-Mat series RBX has been designed and developed to provide the optimum usable and safe performance relative to all functions. Selection data has been substantiated through the council of Scientific and Industrial Research - South Africa and other testing and can be confidently referenced.

Surge & Water Hammer Protection

Vent-O-Mat offers a cost effective and efficient solution to destructive phenomena such as surge and water hammer as all valves are supplied as standard, with an integral "Anti-Shock" surge alleviation mechanism. This device only operates in instances such as rapid filling or column separation to effectively and efficiently eliminate surge and water hammer, very much like an air bag in a motor vehicle in that it only operates in emergencies.

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Financial Benefits

The "" mechanism together with other features of the vent-o-mat design provides a number of financial benefits some of which are:

Reduction in Size or Total Elimination of Traditional Surge Protection Devices

The valve acts both as an effective double acting air valve and as a cost effective surge alleviation mechanism. Accommodating the vent-o-matseries RBX air valve in total surge protection strategy renders total protection to a pipeline at a fraction of the cost of any conventional method.

Shortening of Operational Procedures

Lengthy operational procedures can be dramatically shortened when utilising Vent-O-Mat air valves with out the risk of pipeline collapse, premature closure or water hammer. This allows for major time saving.

Cost Saving on Overspecified Pipe

Very many design engineers overspecify on pipe thickness to prevent unforeseen pipeline damage. This is unnecessary when utilising Vent-O-Mat air valves as it efficiently manages air within the pipeline therefore greatly minimising the possibility of unforeseen accidents.

Increase of Flow Through Existing Infrastructure

Many pipeline operate very inefficiently because of restriction created by air that is not released effectively by air valves. Vent-O-Mat valves are designed to discharge all air in a pipeline regardless of flow velocities, without the inducement of water hammer and other destructive phenomena associated with kinetic air valves. This feature allows for the increase of flow of up to 30% through existing infrastructure, by the mere replacement of conventional air valves with the Vent-O-Mat design.

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SHIPPING & STORAGE

Shipping

Vent-O-Mat valves are generally shipped by the factory or it's agents in well constructed wooden crates or cases, with the content, destination and factory (or agent's) details clearly marked by a label on at least two sides of the crate or case. Valves are carefully packed to ensure that no damage occurs during transit.

Storage

It is recommended that the valves be stored in a cool area if not to be used immediately.

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VENT-O-MAT SERIES RBX OPERATION

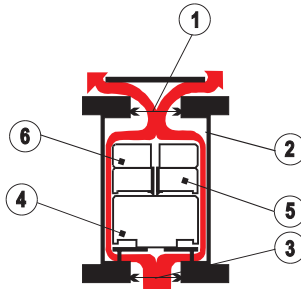
The Vent-O-Mat Series RBX valve, under normal conditions, operates as a standard air valve with the exception that it does not have the drawbacks such as: restricted large orifice diameters, is not affected by phenomena such as the "Venturi Effect" or "Dynamic Closure" and does not induce surge and water hammer on closure of the large orifice.

The valve reacts, in instances of rapid filling or column separation as an effective surge alleviation mechanism, in that it automatically controls the rate of air discharge, thereby effectively dissipating the energy of the surge whilst decelerating the approaching water column. The operation of the valve under these conditions can be compared to a safety air bag in a motor vehicle.

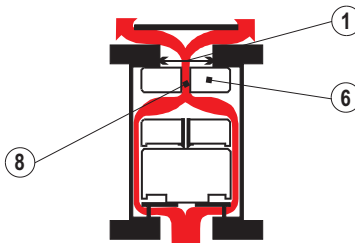
Venting of a Filling Pipeline (Sub Critical Water Approach Velocity)

Air enters Orifice (3), travels through the annular space between the cylindrical floats (4), (5) and (6) and the Valve Chamber Barrel (2) and discharges from the Large Orifice (1) into atmosphere.

Venting of a Filling Pipeline (Excessive Water Approach Velocity)

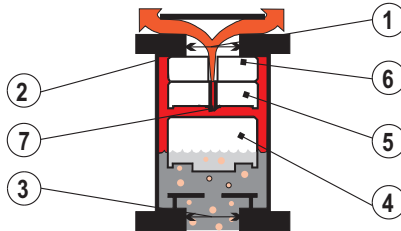


In reaction to the increased air flow, Float (6) closes the Large Orifice (1) and air is forced through the "Anti-Shock" Orifice (8) resulting in the deceleration of the approaching water due to the resistance of the rising air pressure in the valve.



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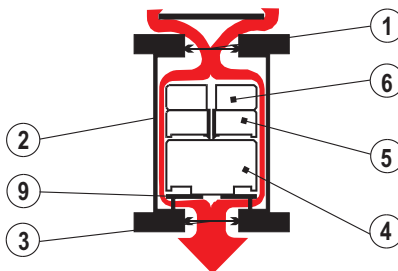
Pressurised Air Release from a Full Pipeline



Subsequent to the filling of a pipeline, liquid enters the valve Barrel Chamber (2) and the Float (4), (5) and (6) are buoyed so that the Large orifice (1) is closed by Float (6), the valve will then become internally pressurised. A minimal working pressure of < 0.5 bar acting on a relatively large area of the Orifice (1) will lock Floats (5) and (6) into a closed position across the Large Orifice (1).

Disentrained air rises through the liquid and accumulates in the valve chamber, when the volume of air is sufficient to displace the liquid, Float (4) will no longer be buoyant and will gravitate downwards thereby opening the Small Orifice (7) and allowing accumulated air to be discharged into atmosphere, as air is discharged the liquid raises Float (4) and reseals the Small Orifice (7) and prevents the escape of liquid.

Vacuum Relief (Air Intake) of a Draining Pipeline



Simultaneous drainage of liquid from Valve Chamber (2) causes Floats (4), (5) and (6) to gravitate downwards onto the Baffle Plate (9), thereby allowing atmospheric air through the valve to rapidly displace draining liquid in the pipeline and prevent potentially damaging internal negative pressure.

FLANGE ALIGNMENTS

The drilling of the connecting flanges of all Vent-O-Mat valves are done on computeresed CNC machines to the relevant ANSI or BS standards, ensuring the highest degree of accuracy at all times.

MULRIC HYDRO PROJECTS T/A VENT-O-MAT (hereinafter referred to as the 'COMPANY') STANDARD CONDITIONS OF TENDER AND SALE (Clauses 1 to 21)

1. ACCEPTANCE:

Except where specifically agreed to the contrary in writing by the 'Company', orders resulting from the 'Company's' written or verbal quotations or price lists are subject to the terms and conditions embodied herein.

2. CONTRACTUAL LIMITATIONS:

The 'Company's' supply is limited to such equipment, accessories, work and documentation as is specified in its quotations.

3. DRAWINGS AND DATA:

All drawings, illustrations, descriptive literature, technical data or particulars of mass and dimension accompanying the 'Company's' quotations must be considered approximate except when specifically certificated.

4. TESTS:

The goods will be tested in accordance with the specifications of the 'Company's' tender and/or the relevant standard specifications as stated therein.

5. AVAILABILITY:

(a) Offers for equipment available ex-stock are subject to such stock remaining unsold at time of order placement.

(b) Delivery periods quoted are based on the manufacturing position as at the time of quotation. Whilst every endeavour will be made to maintain such deliveries, no liability shall be accepted by the 'Company' for delay due to causes beyond its control.

(c) The 'Company' shall only accept liability for late delivery where the 'Company's' liability for such late delivery is not excluded in terms of the foregoing and where the 'Company' has specifically agreed in writing to the payment of a penalty or liquidated damages or damages for such late delivery, in which case the 'Company's' Liability shall be limited to the amount so agreed.

6. DELIVERY:

The 'Company' will deliver, where provided for, to a destination named in its quotation at which point the 'Company's' responsibility for the goods will cease.

7. PACKING:

Where the 'Company' deems goods vulnerable to damage during transit, the 'Company' reserves the right to pack such goods in suitable protective packaging or crates at the Purchaser's cost. Invoices for packing will be substantiated by a copy of relevant documentation from the packaging contractor.

8. PRICE BASIS:

Prices referenced from the 'Company's' valid lists or from the 'Company's' written or verbal quotation exclude packaging and delivery.

9. PAYMENT TERMS:

(a) Without exception, payment for all goods and services shall be received by the 'Company' not later than 30 (THIRTY) days subsequent to the date of statement Interest at prime lending rate + 2% will be charged on all overdue amounts.

(b) Where the 'Company' has quoted delivery point as **Ex-works**, delivery shall be deemed to have been effected when the goods are ready for collection, at which time, the Purchaser shall be advised and an invoice will be generated. Payment for **Ex-works** goods shall be due within the requisite period in accordance with the 'Company's' payment terms, starting from the date on which order completion advice was issued to the Purchaser. Failure or delay by the Purchaser or Purchaser's sub contractor to effect collection of completed goods shall not relieve the Purchaser from the contractual obligation to remit payment within 30 days from statement date.

10. DISCOUNT:

(a) It is the NONNEGOTIABLE policy of the 'Company' that, where provided for, discount is allowed only where full and final SETTLEMENT is received within 30 (THIRTY) days from date of statement.

(b) The 'Company's' delivery note/invoice reflects the date by which payment must be received to qualify for discount, therefore late receipt or non-receipt of statements will not constitute acceptable reason for payment delays.



(c) Late payments which reflect arbitrary discount deductions will be received without prejudice to the 'Company's' right to full and final payment.

11. TITLE:

Ownership of all goods supplied by the 'Company' will not pass to the purchaser or any other party until paid for in full and until such time, the 'Company' shall be entitled to repossess the goods whether affixed to immovable property or not. All such goods shall be deemed to be removable property and severable from immovable property.

12. TENDER/QUOTATION VALIDITY:

(a) Written or verbal quotations will be held valid for a maximum of 30 (THIRTY) days unless contradicted in writing by the 'Company'.

(b) Prices are quoted by the 'Company' in good faith based on the ruling costs of material, labour, transport and, if applicable, insurance, sureties and retention monies, as well as statutory government taxes, levies, duties and surcharges. Severely adverse changes and/or additions to any of these costs components which are contributory in the calculation of a price or prices quoted by the 'Company' will be for the purchaser's account.

13. PRICE VARIATION:

The Purchaser undertakes to refund to the 'Company' any extra costs incurred by the 'Company' as a result of the Purchaser's instruction or lack of instructions and for the purpose of this paragraph extra cost shall mean any amount which the 'Company' becomes liable to pay, whether in wages, for materials or otherwise howsoever in respect of the work which the 'Company' would not have been liable to pay but for the Purchaser's action or default. In the event of dispute on the amount of the extra cost, the decision of a mutually agreed upon arbitrator at Johannesburg, shall be final and binding.

14. CANCELLATION:

(a) Order cancellation or variation will not be considered without the written consent of the 'Company';
and

(b) In the case of equipment being or having been manufactured specifically for an order, the purchaser will be liable to pay proportion of the price according to the stage of completion of the equipment ordered.

15. RETURNS FOR CREDIT:

Acceptance of goods returned will be entirely at the discretion of the 'Company' and subject to a minimum restocking charge equal to 15% of the gross invoiced value of such returned goods.

16. ESCALATION:

Where the sum of the quotation validity period and delivery period is in excess of 90 (NINETY) days, prices for goods or services quoted by the 'Company' are subject to escalation in accordance with the relevant SEIFSA indices for material, labour and transport.

17. GUARANTEE:

(a) The 'Company' guarantees that the goods supplied will conform to specification and to any requirements specifically accepted by the 'Company' in writing in regard to each order but, except as aforesaid the 'Company's' gives no warranty, express or implied, of material workmanship or fitness of goods for any particular purpose whether such purpose be known to us or not. In the event of the goods proving to be not in accordance with the specifications or requirements aforesaid, or should defects under proper use appear in the goods within a period of 12 (TWELVE) calendar months after the goods have been delivered, caused solely by faulty design, materials or workmanship, we shall, if requested to do so within a reasonable time, but not later than 18 (EIGHTEEN) calendar months from date of delivery repair such goods, or at our option replace goods or the defective parts thereof, free of charge by supplying other goods or replacement parts at the initial place of delivery which do comply with the specifications or requirements aforesaid and/or which are free of the defects complained of.

(b) It is a condition of this guarantee:

(i) that any defective parts are returned to the 'Company's' works at the Purchaser's expense; and

(ii) in respect of parts or components not of the 'Company's' manufacture, the 'Company's' guarantee shall be limited to the guarantee, if any, which we may have received from the supplier of such parts or components in respect thereof so that the 'Company's' liability in terms of such guarantee shall be no greater than the 'Company's' liability in terms of the 'Company's' own guarantee as set out in this clause

(iii) the 'Company' shall be given reasonable time and opportunity to comply with the terms of the guarantee before you call upon the 'Company' to pay any sums in respect of liquidated damages;

and

(iv) save as provided in this clause, the 'Company' shall be under no liability, whether in contract, delict or otherwise in respect of defects in goods delivered, or for any injury, damage or loss resulting from defect or from any work done in connection therewith.

18. PATENTS:

The 'Company' will indemnify the Purchaser against any claim of infringement of Letters Patent or Registered Design (published at the date of the Contract) by the use or sale of any article or material supplied by the 'Company' to the Purchaser and against all costs and damages which the Purchaser may incur in any such action. Provided always that this indemnity shall apply to an infringement which is due to the 'Company' having followed a design or instruction furnished or given by the Purchaser or to the use of such articles or material in a manner or for a purpose or in a foreign country not specified by or disclosed to the 'Company', provided that this indemnity is conditional on the Purchaser giving the 'Company' the earliest possible notice in writing of any claim being made or action threatened or brought against the Purchaser and on the Purchaser permitting the 'Company' at the 'Company's' own expenses to conduct any litigation that may ensue and all negotiations for a settlement of the claim. The Purchaser on their part warrant that any design or instruction furnished or given by the Purchaser shall not be such as will cause the 'Company' to infringe any Lenders Patent, Registered Design or Trade Mark in the execution of the Purchaser's order.

19. LIMITED LIABILITY:

The 'Company' shall not be liable for any Incidental or consequential loss, damages or expense arising directly or indirectly from the use of any goods supplied, nor shall liability be accepted for any labour or other expenses incurred. The 'Company's' liability is limited solely to the terms of its guarantee.

20. LEGAL CONSTRUCTION:

Contracts entered into with the 'Company' shall be interpreted and construed in accordance with the laws of the Republic of South Africa whose courts shall have jurisdiction in respect of any dispute whatsoever.

21. LEGAL JURISDICTION:

In terms of Section 45 of the Magistrates Court Act of 1944 the Purchaser consents to the jurisdiction of any Magistrates Court by virtue of Section 20 of the said Act, notwithstanding that any Claim against the Purchaser may exceed the jurisdiction of such Magistrate s Court It is recorded that the 'Company' is not bound hereby and shall be entitled to institute any proceedings against the Purchaser out of any other Court of competent jurisdiction .

WARRANTY

(a) The 'Company' guarantees that the goods supplied will conform to specifications and to any requirements specifically accepted by the 'Company' in writing in regard to each order but, except as aforesaid, the 'Company' gives no warranty, express or implied, of the material workmanship or fitness of goods for any particular purpose whether such purpose is known to us or not. In accordance with the specifications or requirements aforesaid, or should defects under proper use appear in the goods within a period of 12 (TWELVE) calendar months after the goods have been delivered, caused solely by faulty design, materials or workmanship, we shall, if requested to do so within a reasonable time, but not later than 18 (EIGHTEEN) calendar months, from date of delivery, repair such goods or the defective parts thereof, free of charge by supplying other goods or replacement parts at the initial place of delivery which do comply with specifications or requirements aforesaid and/or which are free of the defects complained of.

(b) It is a condition of this guarantee:

- (i) that any defective parts are returned to the 'Company's' works at the purchaser's expenses and;
- (ii) in respect of parts or components not of the 'Company's' manufacture, the 'Company's' guarantee shall be limited to the guarantee, if any which we may have received from the supplier of such parts or components in respect thereof so that the 'Company's' liability in terms of such guarantee shall be no greater than the 'Company's' liability in terms of the 'Company's' own guarantee as set out in this clause;
- (iii) the 'Company' shall be given reasonable time and opportunity to comply with the terms of the guarantee before you call on the 'Company' to pay any sums in respect of the liquidated damages and;
- (iv) save as provided in the clause, the 'Company' shall be under no liability, whether in contract, delict or otherwise in respect of defects in goods delivered, or for any injury, damage or loss resulting from defect or from any work done in connection therewith.