

Installation and Maintenance Manual

Forbes Marshall Deaerator Head

FMDH

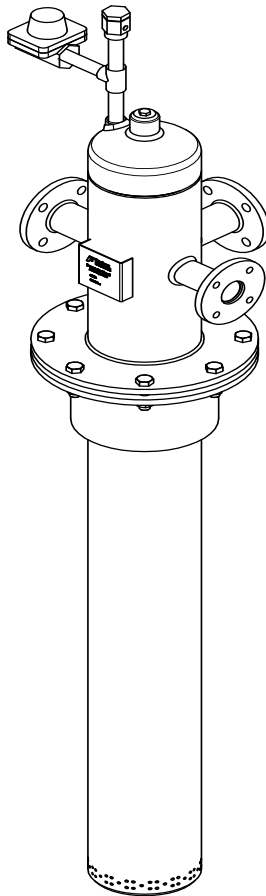


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PLEASE NOTE - Throughout this manual this cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked. This symbol denotes **CAUTION, WARNING** or **DANGER**.



1. Preface:

This manual is intended for anyone using, commissioning, servicing, or disposing the below mentioned products safely and efficiently.

Forbes Marshall Deaerator Head [FMDH]

Size: DN 150 (6"), DN 200 (8"), DN 250 (10"), DN 300 (12")

PLEASE NOTE:

Throughout this manual the following cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked.

2. Important Safety Notes:



Read this section carefully before installing/operating/maintaining the product. The precautions listed in this manual are provided for personnel and equipment safety. Furthermore, Forbes Marshall accepts no responsibility for accidents or damage occurring as a result of failure to observe these precautions. Note that the product is designed to perform for non-contaminated fluids only. A contamination in the form of chemical, foreign particle etc. can lead to problem with product performance and life of the product.

If these products in compliance with the operating instructions are, properly installed, commissioned, maintained and installed by qualified personnel (refer Section 2.7) the safety operations of these products can be guaranteed. General instructions for proper use of tools and safety of equipments, pipeline and plant construction must also be complied with.

2.1 Intended use:

Check if the product is suitable for intended use/ application by referring to the installation and maintenance instructions, name plates and technical information sheets.

- i) The product is suitable for use as defined in the technical information sheet. In case the need arises to use the product on any other fluid please contact Forbes Marshall for assistance.
- ii) Check for the suitability in conformance to the limiting conditions specified in technical information sheet of the product.
- iii) The correct installation and direction of fluid flow has to be determined.
- iv) Forbes Marshall products are not intended to resist external stresses, hence necessary precautions to be taken to minimize the same.

2.2 Accessibility and Lighting:

Safe accessibility and working conditions are to be ensured prior to working on the product.

2.3 Hazardous environment and media:

The product has to be protected from hazardous environment and check to ensure that no hazardous liquids or gases pass through the product.

2.4 Depressurizing of systems and normalizing of temperature:

Ensure isolation and safety venting of any pressure to the atmospheric pressure. Even if the pressure gauge indicates zero, do not make an assumption that the system has been depressurized. To avoid danger of burns allow temperature to normalize after isolation.

2.5 Tools and consumables:

Ensure you have appropriate tools and / or consumables available before starting the work. Use of original Forbes Marshall replacement parts is recommended.

2.6 Protective clothing:

Consider for the requirement of any protective clothing for you/ or others in the vicinity for protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects.

2.7 Permits to work:

All work to be carried out under supervision of a competent person. Training should be imparted to operating personnel on correct usage of product as per Installation and Maintenance instruction. "Permit to work" to be complied with (wherever applicable), in case of absence of this system a responsible person should have complete information and knowledge on what work is going on and where required, arrange to have an assistant with his primary goal and responsibility being safety. "Warning Notices" should be posted wherever necessary

2.8 Handling:

There is a risk of injury if heavy products are handled manually. Analyze the risk and use appropriate handling method by taking into consideration the task, individual, the working environment and the load.

2.9 Freezing:

Provision should be made to protect systems which are not self-draining, against frost damage (in environment where they may be exposed to temperatures below freezing point) to be made.

2.10 Product Disposal:

It is necessary to dispose this product only in accordance with local regulations at the authorized, qualified collecting point specified for equipment's and its parts—Please refer the part details mentioned in the material table of this manual. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities in India & abroad

2.11 Returning products:

Customers and Stockist are reminded that, when returning products to Forbes Marshall they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk.

This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

3. Brief Product Information:

3.1 Description:

The Forbes Marshall Deaerator Head, FMDH, is designed to mix incoming flows of cold make-up, condensate return and flash steam to the boiler feed tank. This mixing action is achieved by directing the downward flow through a baffle arrangement within the unit. This liberates dissolved gases from the cold make-up, which are vented to atmosphere. The cold make-up inlet is fitted with a spray screen which diffuses the flow, increasing its surface area to promote thorough mixing with the condensate and flash steam.

A FMDH consists of three parts,

- A mixing unit, which is bolted to the top of the tank and is supplied with connections to customer specifications for cold make-up, condensate return, flash steam from blowdown, etc.
- An immersion tube, which distributes the mixed fluids into the tank and has an integral plate flange which is sandwiched between the tank and mixing unit flanges.

The immersion tube is designed to distribute condensate return into the feedtank to ensure efficient distribution of hot condensate.

Gaskets : Two gaskets are required, one fitted each side on the immersion tube flange.

3.2 Available Types:

The mixing unit : DN 150, 200, 250 and 300 Flanged to ANSI class 150 / PN6

Immersion tubes are available in diameters to suit the deaerator heads and lengths of 1200, 1800 and 2400 mm to suit TM metric feed tanks. Since each deaerator head is built to suit specific plant requirements we recommend that you contact your local Forbes Marshall engineer for a connection layout sheet and to discuss your requirements.

3.3 Limiting Conditions:

Max. working pressure	1 bar g
Max. working temperature	120°C
Cold hydraulic test pressure	2 bar g

3.4 Selection Table:

Total Steam Generation Rate kg/h	Atmospheric Deaerator Head			
	Size- DN	Tank Depth mm(ft.)		
		1220(4)	1830(6)	2440(8)
5000	150	150FMDH3 150FMDH3.5 150FMDH4	150FMDH6	150FMDH8
10000	200	200FMDH4	200FMDH6	200FMDH8
20000	250	250FMDH4	250FMDH6	250FMDH7 250FMDH8
	-	-		
30000	300	-	300FMDH6	300FMDH8

Note: Size 150FMDH3 means DN 150 shell size with 3' immersion tube length.

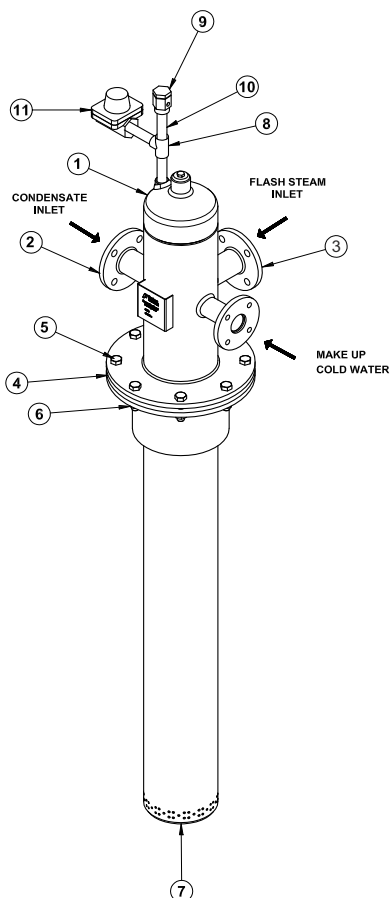


Figure 1: Forbes Marshall Deaerator Head

Material

Sr. No.	Part	Material
1	Mixing Unit Assembly	Stainless Steel, 304
2	Condensate Inlet Nozzle Assembly	Stainless Steel, 304
3	Flash Steam Inlet Nozzle Assembly	Stainless Steel, 304
4	Flange Gasket	AF 154
5	Hex Bolt	Stainless Steel, 304
6	Hex Nut	Stainless Steel, 304
7	Immersion Tube Assembly	Stainless Steel, 304
8	Dn15 BSPT Tee	Stainless Steel, 304
9	Vacuum Breaker	Stainless Steel, 304
10	DN15 Both Side BSPT Pipe 100mm Long	Stainless Steel, 304
11	Dn15 BSPT Airvent FMAV53	ASTM A105

Application:

FMDH is ideal for boiler feedtank applications. It is suitable for both new and retrofit applications. Each head is fitted with a connection for air vent and recirculating feedwater spray nozzle. The air vent is for the immediate venting of liberated gases.

Forbes Marshall immersion tubes are ideal for boiler feedtank applications. They are suitable for both new and retrofit applications. They offer a much neater and more convenient solution to distributing condensate return than traditional sparge pipes. Additionally, they reduce the common problem of waterhammer found in sparge pipes. This is achieved by slowing down the flow of the condensate return, in particular any flash steam, as it enters the immersion tube with its larger cross sectional area. This gives an opportunity for the flash steam to pass through the holes into the feedtank without creating sudden shocks.

When combined with a mixing unit they form an atmospheric deaerator head.

Air Vent / Vacuum Breaker:

The air vent / vacuum breaker can both be fitted to one connection by using a tee piece. The air vent should be installed horizontally and the vacuum breaker vertically. It is recommended that stainless steel or brass / bronze fittings are used. It is not necessary to pipe the discharge away.

Lagging:

The whole mixing unit should be lagged in order to conserve heat. When selecting a lagging material it is essential that one with a low or zero chloride content is selected. This is because leaching of the chloride from lagging on to moist / wet austenitic stainless steel surfaces has been known to cause stress corrosion cracking.

3.5 Product Dimension and Drawing:

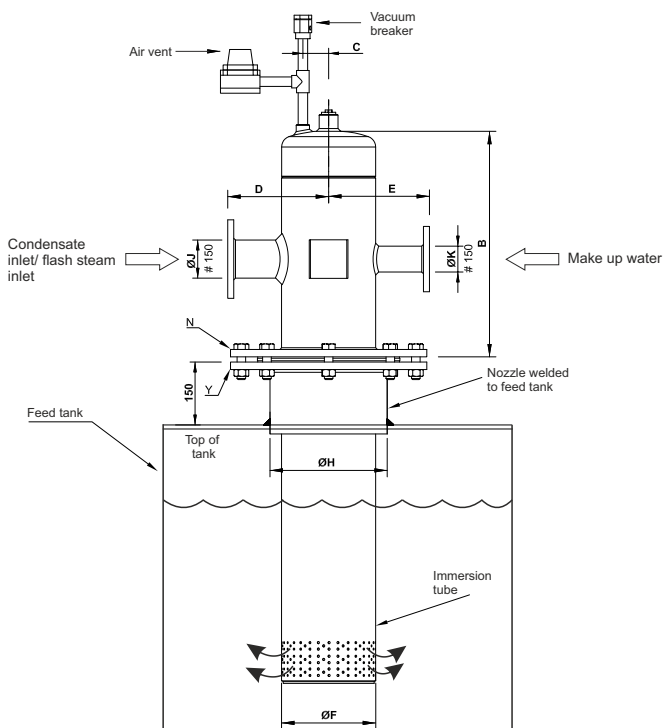


Figure 2: Dimensional Drawing of Forbes Marshall Deaerator Head

Dimensions (mm)

Type	A	B	C	D	E	F (# 150)	G	H(# 150)	K (# 150)	J(# 150)	N (# 150)	Y(# 150)
150FMDH3	210	495	60	185	185	DN150	915	DN200	DN40	DN50	DN200 BTSDN150	DN200
150FMDH3.5	210	495	60	185	185	DN150	1067	DN200	DN40	DN50	DN200 BTSDN150	DN200
150FMDH4	210	495	60	185	185	DN150	1229	DN200	DN40	DN50	DN200 BTSDN150	DN200
150FMDH8	210	495	60	185	185	DN150	2447	DN200	DN40	DN50	DN200 BTSDN150	DN200
200FMDH4	225	525	60	235	235	DN200	1220	DN250	DN50	DN80	DN250 BTSDN200	DN250
200FMDH6	225	525	60	235	235	DN200	1837	DN250	DN50	DN80	DN250 BTSDN200	DN250
250FMDH4	225	535	60	275	275	DN250	1229	DN300	DN80	DN100	DN300 BTSDN250	DN300
250FMDH6	225	535	60	275	275	DN250	1838	DN300	DN80	DN100	DN300 BTSDN250	DN300
250FMDH7	225	535	60	275	275	DN250	2100	DN300	DN80	DN100	DN300 BTSDN250	DN300
250FMDH8	225	535	60	275	275	DN250	2447	DN300	DN80	DN100	DN300 BTSDN250	DN300
300FMDH8	275	620	60	300	300	DN300	2447	DN350	DN100	DN125	DN350 BTSDN300	DN350

BTS : Bore To Suit Flange

4. **Product Working Principle:**

The Forbes Marshall Deaerator Head is a simple and effective solution for de-aerating boiler feed water at atmospheric pressure. The Forbes Marshall Deaerator Head has three inlets one each for flash steam, condensate and cold make-up water enter the mixing unit and are thoroughly mixed while the dissolved gases get released. The cold make-up water inlet connection has a spray screen which diffuses the flow, increasing its surface area to promote thorough mixing with the condensate and flash steam. The mixing action takes place in the mixing unit. The flow is diverted downwards through the baffle arrangement within the unit. An Forbes Marshall Air Vent fitted on top of the Forbes Marshall Deaerator Head allows the liberated gases from the cold water to be vented to atmosphere before entering the feed water tank. The mixed fluids enter the tank well below the water surface through a series of perforated holes in the immersion tube.

5. **Installation Guidelines: [Refer figure 1]**



Note: Before implementing any installations observe the 'Important Safety notes' in section 2. Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation.

1. Remove all packing and blanking plugs from the mixing unit (1) connections. Any connections which are not to be used must be properly blanked off or capped.
2. Place one flange gasket (4) on integral plate flange face, within the circle of studs.
3. Insert the immersion tube (7). Place second flange gasket (4) on face of the immersion tube (7).
4. Lower the mixing unit (7) onto the studs.
5. Ensure the connections are aligned correctly. Tighten all Hex nuts (6) uniformly.

Note: The whole mixing unit should be lagged (insulated) in order to conserve heat. When selecting a lagging material it is essential that one with a low or zero chloride content is selected. Leaching of the chloride from lagging on to moist / wet austenitic stainless steel surfaces has been known to cause stress corrosion cracking.

5.1. **Preparation to install Forbes Marshall Deaerator Head:**

5.1.1. **Pipework:**

1. Pipework should be the same nominal size as the connections.
2. Suitable expansion loops and supports should be incorporated.
3. A check valve is recommended in the cold make-up and condensate return pipelines only, as near to the mixing unit as possible.

5.1.2. Cold make-up water connection:

The cold make-up connection has a small bore connection as compared to condensate return and flash steam connection line; it is fitted with a spray screen which diffuses the flow, increasing its surface area thus promoting thorough mixing with the condensate and flash steam.

5.1.3. Recirculating feed water system:

In case the Forbes Marshall Deaerator Head is installed with a recirculating feed water system, fix the pipeline into the DN 25 central socket connection on the top of the mixing unit (1).

5.1.4. Forbes Marshall Air Vent and Vacuum Breaker:

The Forbes Marshall Air Vent(11) and Vacuum Breaker (9) is fitted to DN 15 connection using DN15 BSPT Tee (8). The Forbes Marshall Air Vent(11) should be installed horizontally and the Vacuum Breaker (8) vertically.

6. Maintenance Guidelines:



Note: Before undertaking any maintenance on the product it must be isolated from both supply line and return line and ensure pressure allowed to safely normalize to atmosphere. The product should then be allowed to cool. With suitable isolation repairs can be carried out with the product in the line. When re-assembling, make sure that all joint faces are clean. Once completed open isolation valves slowly and check for leaks.

6.1. Routine and Preventive Maintenance:

Please refer to the maintenance schedule mentioned in the table below to undertake routine maintenance of the Forbes Marshall Air Vent. **Note:** Forbes Marshall Deaerator Head does not need any routine maintenance.

Sr. No.	PARAMETER TO BE CHECKED	FREQUENCY FOR CHECKING VARIOUS PARAMETERS						
		Immediate	Daily	Weekly	Monthly	Quarterly	Half Yearly	Annually
1	Test Forbes Marshall Air Vent			Y				
2	Repair / Replace steam traps - when testing shows leaks	Y						
3	Clean internals of Forbes Marshall Air Vent						Y	
4	Visual Inspection for leakages		Y					
5	Arresting any other leaks	Y						

6.2. Tool Kit:

To carry out any maintenance on the Forbes Marshall Air Vent please use the tools mentioned below:

Size	Component	Tool used & size
DN 15	Fixture 86139	-
	0.8mm perforated screen in the body	-
	Rocol on threads of the seat	-
	Valve seat	Box spanner of 17mm (A/F)
	4 M8 bolts and nuts	Box spanner of 13mm (A/F)

6.3. Recommended tightening torques for Forbes Marshall Air Vent:

Item	Torque Range
Cover Bolts	25 -35 Nm

Table 1. Recommended tightening torques for Forbes Marshall Air Vent

6.4. Procedure to maintain the Forbes Marshall Deaerator Head:

1. The Forbes Marshall Deaerator Head does not need any routine maintenance.
2. Replace both flanged gaskets whenever the mixing unit is removed.
3. The spray screen present in the make-up water line should be cleaned during any major boiler inspection.

6.5. Procedure to fit or replace thermopod and seat assembly of Forbes Marshall Air Vent: [Refer figure 3]

1. Remove the cover from body by unscrewing the cover bolts and nuts using box spanner of 13mm.
2. Unscrew the thermopod and valve seat assembly set (A).
3. Remove the restraining clip from the thermopod and seat assembly (A) and lift the thermopod and spacer upwards and outwards.
4. Remove the gasket (C), and clean the internals using WD40 liquid spray and clean with lint free cloth.
5. After cleaning refit the thermopod and seat assembly (A) and insert new cover gasket (C) make sure that the strainer screen (B) is correctly located.
6. Ensure that the cover bolts are tightened evenly. The recommended torques for tightening as shown in Table 1.
7. When maintenance is complete, open isolation valves slowly until the normal pressure is obtained. Checks for leaks and correct operations.

6.6. Procedure to clean or replace the strainer screen of Forbes Marshall Air Vent: [Refer figure 3]

1. Remove the cover from body by unscrewing the cover bolts and nuts using a 13mm box spanner.
2. Clean the strainer screen (B) if rusted replace with new strainer screen (B).
3. Ensure that the cover bolts are tightened evenly. The recommended torques for tightening as shown in table 1.
4. When maintenance is complete, open isolation valves slowly until normal pressure is obtained. Checks for leaks and correct operation.

7. Troubleshooting:

If the expected performance is unachievable after installation of the Forbes Marshall Deaerator Head, check the following points for appropriate corrective measures.

Failure Mode	Possible Cause	Remedy`
Water hammer occurring in deaerator head.	Installation position of Forbes Marshall Air Vent and Vacuum Breaker.	The air vent should be installed horizontally and the vacuum breaker vertically
	Wrong connection of cold make-up water pipeline in mixing unit assembly	Check all fluid connection in mixing unit assembly is correct. As cold make-up connection has small nominal pipe size as compare to flash steam and condensate return line. Connection should be as shown in figure 1.
	The feed water level low in feed water tank.	Minimum 400mm distance should be maintained between immersion tube and bottom of feed water tank. The water level in the tank should be maintain 80 to 85%.
	Live steam coming to Deaerator Head	Check for leakage in process trap line, bypass line in closed loop is open and process trap health which is connected to condensate inlet line of de-aerator head.
	Visible live steam from tank vent.	
Fluid leakage From Deaerator Head.	Gasket deterioration or damage.	Replace both flange gaskets whenever the mixing unit is removed.
	Improper tighten torque in Hex nuts.	Tighten to proper torque to avoid leakage from mounting flanges.

Failure Mode	Possible Cause	Remedy`
No air discharge from Forbes Marshall Air Vent	Strainer Screen is choked with rust or scale.	Clean the Strainer Screen, if rusted replace with new one.
	Valve seat is blocked.	Clean the valve seat and thermopod ball surface then re-assemble the steam trap.
Flash steam leaking from Forbes Marshall Air Vent	Improper Installation.	Check installation i.e. end pipe of the Forbes Marshall Air Vents should be installed horizontally and Fluid flow direction to be same as arrow on the Forbes Marshall Air Vent body.
	Foreign material has between thermopod and valve seat.	Clean the valve seat and thermopod ball surface then re-assemble the trap check for further steam leak. If valve seat damage replace the seat assembly
	Valve seat and thermopod ball (valve head) does not shut – off tightly.	Clean both valve seat and thermopod ball after that seat stamping* must be done.
	Cover gasket deterioration or damage.	Replace with new cover gasket.
	Improper tightening torque on cover nut.	Tighten to the suitable torque.

Seat Stamping* Procedure:

Place valve seat on the fixture with thermopod on the valve seat (thermopod ball side resting on the valve seat orifice) and tap slightly on the center with a mallet. Due to stamping a seating surface is formed on the orifice.

Note: Never attempt to modify the product. When replacing old parts with new parts, use the spare parts listed in section 8.

8. Available Spares: [Refer figure 1 and figure 3]

Spare gaskets are available - two are needed per unit. State flange size and flange type when ordering spare.

Spares	Part No.	Spare Code
Thermopod & Seat assembly set (State thermopod filling) 'U' / STD fill	A	SPARE-1520FMTLT53-CTPKIT
Strainer Screen & Gasket kit (Pack of 5)	B,C	SPARE-1520FMTLT53-SGKIT

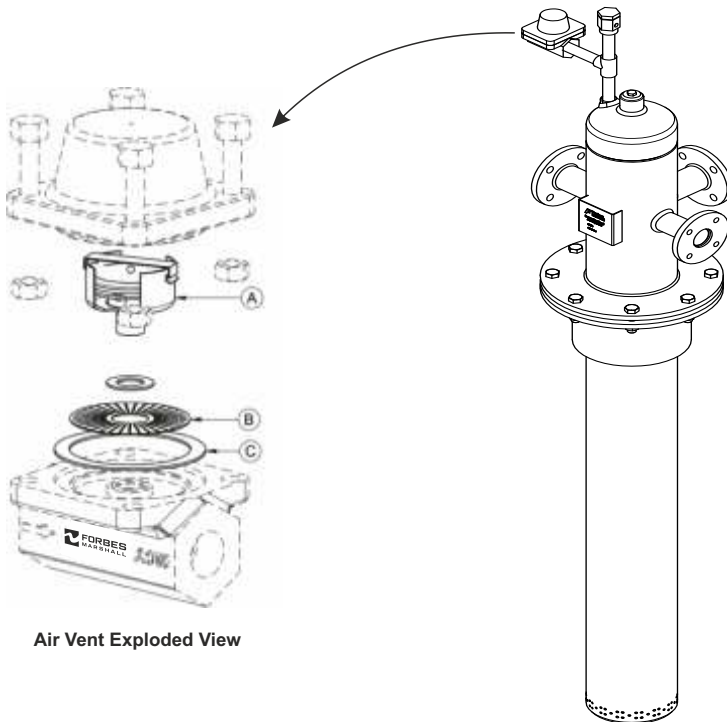


Figure 3: Parts available as spares (Heavy line) of Forbes Marshall Air Vent

How to Order:

Example : Forbes Marshall Deaerator Head FMDH, SS 304, DN150, immersion length 4 ft.

9. Warranty Period:

As per ordering information and agreements in the contract.



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