



Forbes Marshall De-Superheaters
Fixed Nozzle, Minicooler Design & Variable Nozzle

Dynamic
Temperature
Control
for your
Entire System



Fixed Nozzle



Minicooler



Variable Nozzle

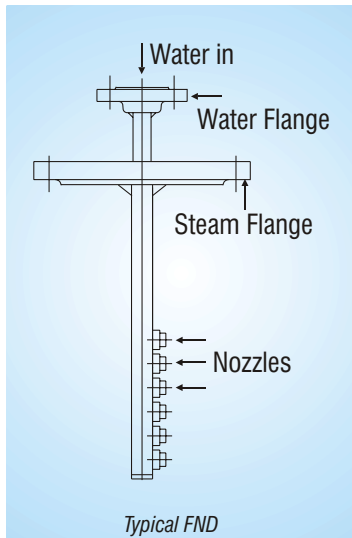
Specialists in Process Efficiency and Energy Conservation

Forbes Marshall ARCA, Ranks amongst the world's leading suppliers of steam desuperheaters. We specialize in designing and manufacturing such equipment for power, process and co-generation plants. FM ARCA has supplied more than 5000 desuperheater Since 1990 without a single claim against the guarantees we always give to over clients.

STEAM DESUPERHEATING :

The most practical way of reducing the superheat value of steam is by the direct addition of water. To achieve temperature stability of the conditioned steam and prevent thermal shock in downstream pipes, the cooling water must be atomized. It is also necessary to have a correct mix of superheated steam and cooling water.

Fixed Nozzle Desuperheater - FND



Standard Nozzle Kv's

Sr.	Kv per Nozzle
1	0.0162
2	0.0348
3	0.0714
4	0.106
5	0.138
6	0.175
7	0.204
8	0.233
9	0.273
10	0.312
12	0.864
13	1.6

Features

- Single Nozzle Kv as low as 0.0162 & as high as 1.6
- Number of Nozzles limited only by pipeline diameter
- For use on all pipe sizes 6" & above
- Ideal for use in conjunction with water control valve & control system
- Turndown ratio upto 4:1 (Depending on water quantity)

Notes

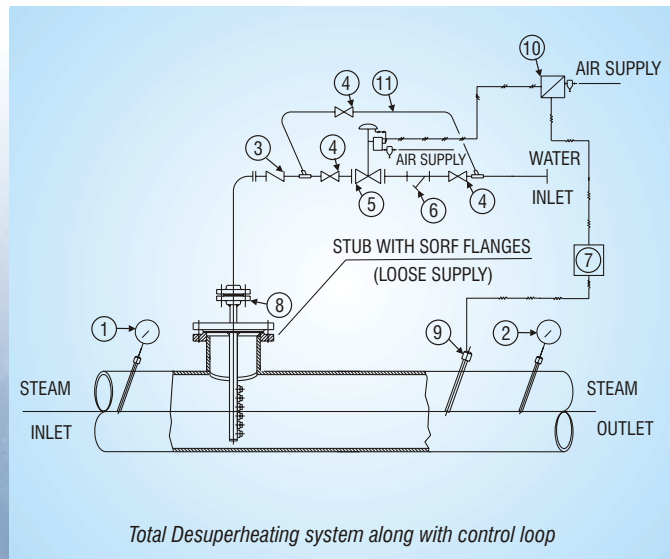
- Minimum pipe size required for installation of FND is 150mm.
- Water pressure should be minimum 7 bar more than the steam pressure.
- Maximum recommended pressure difference between steam and water is 45 bar. If it exceeds 45 bar, then install pressure control valve in waterline to reduce water pressure within limit.
- Spray water should be very clean (as clean as boiler feed water).
- IBR shall be provided for individual components.

Typical Sizes

- Steam side flange: 4" and water side flange 1" / 1 1/2" OR
Steam side flange: 6" and water side flange 2"
- Pressure rating: upto ANSI #2500
- Rangeability: 1:4

Advantages

- Custom made for any size, standard or range.
- Simple installation.
- Can be used for higher pipe sizes and low steam pressure.
- No moving parts.



Bill of Materials

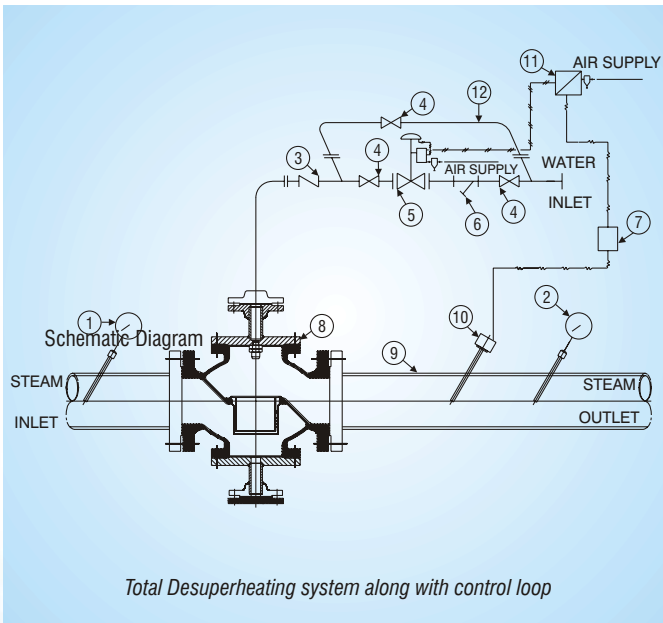
Sr.	DESCRIPTION	Sr.	DESCRIPTION
1	DIAL THERMOMETER	6	STRAINER
2	DIAL THERMOMETER	7	PID CONTROLLER
3	NON-RETURN VALVE	8	SPRAY NOZZLE INSERT
4	STOP VALVE	9	TEMPERATURE SENSOR
5	WATER FLOW CONTROL VALVE	10	I/P CONVERTOR
		11	PIPE WORK

Minicooler Desuperheater (MCD)



Standard Nozzle Kv's

Sr.	Kv per Nozzle
1	0.0162
2	0.0348
3	0.0714
4	0.106
5	0.138
6	0.175
7	0.204
8	0.233
9	0.273
10	0.312
12	0.864
13	1.6



Bill of Materials

Sr.	DESCRIPTION	Sr.	DESCRIPTION
1	DIAL THERMOMETER	7	TEMP. CONTROLLER
2	DIAL THERMOMETER	8	MINI COOLER DESUPERHEATER
3	NON-RETURN VALVE	9	STEAM PIPELINE
4	STOP VALVE	10	TEMPERATURE SENSOR
5	WATER CONTROL VALVE	11	I/P CONVERTOR
6	STRAINER	12	PIPE WORK

Notes

- For use with pipe sizes 1" to 4"
- Single nozzle Kv as low as 0.0162 & as high as 1.6
- Ideal for use with Forbes Marshall make water control valve & control system
- Turndown ratio upto 4:1 (Depending on water pressure)

Variable Nozzle Desuperheater - VND

Forbes Marshall has incorporated the latest technology in the spray nozzle design. The high quality surface finish minimises frictional losses, thereby ensuring that the total pressure difference between water and steam is available for atomisation of water.

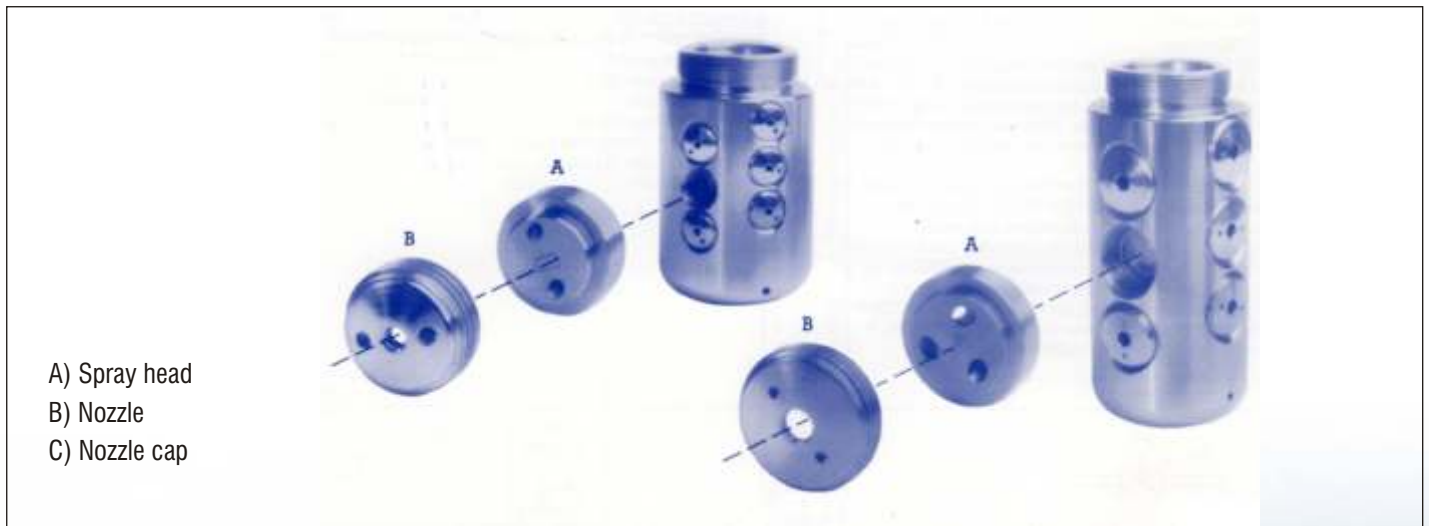
The nozzle assembly consists of three components:

A) Spray head B) Nozzle C) Nozzle cap

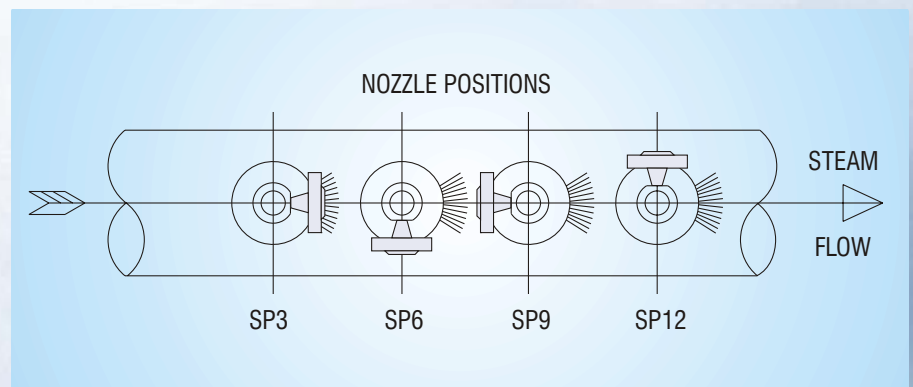
Each nozzle assembly is served by individual feedholes in the spray cylinder. Water enters the chamber through these openings. The relatively large volume of this chamber ensures that water is proportioned evenly through each orifice. The P across this spray cylinder head results in an increase in the fluid velocity. Water is subsequently rotated in the nozzle chamber before being emitted through the central hole.

The combination of splitting the feed flow, increasing velocity and rotating effect, ensures that the water is injected into the system in a fine symmetrical hollow cone spray. The nozzles are finally assembled with the spray cylinder and are sealed.

The Variable Nozzle Desuperheater may be equipped with a variety of spray heads. The uniform threading accepts spray cylinder heads with a wide range of Kv values. Standard configurations are with either 6 or 9 equally sized spray nozzles. Special combinations are available to suit customers' requirements. This feature enables the VND to be customized to specific system requirement. The commonly available Kv's are...



VND Standard Capacity Range			
6A	Kv = 0,065	9A	Kv = 0,097
6B	Kv = 0,137	9B	Kv = 0,205
6C	Kv = 0,263	9C	Kv = 0,395
6D	Kv = 0,505	9D	Kv = 0,758
6Dx	Kv = 1,000	9Dx	Kv = 1,500
6E	Kv = 1,640	9E	Kv = 2,460
6F	Kv = 2,450	9F	Kv = 3,680
6G	Kv = 5,200	9G	Kv = 7,800
6H	Kv = 8,100	9H	Kv = 12,150
6K	Kv = 11,570	9K	Kv = 17,440



- Spray water must be injected in the direction of the Steam flow.
- To facilitate installation of the water supply line, one of the following four positions have to be indicated before ordering:

SP3 - Along direction of flow

SP6 - Transverse right to direction of flow

SP9 - Opposite to direction of flow

SP12 - Transverse left to direction of flow

Features

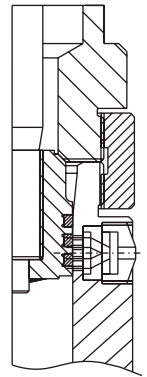
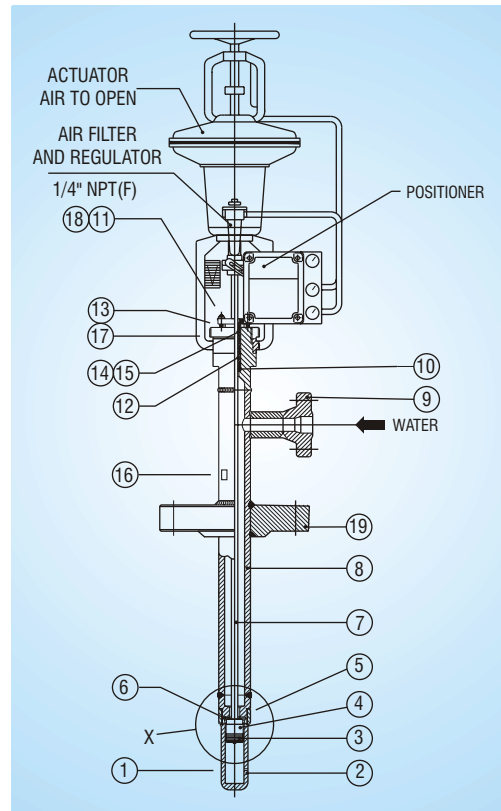
- Available in 6 & 9 nozzle design
- Compatible with both pneumatic & electric actuators.

Highlights

- Design as per ANSI B 16.34
- Graphite packing provided for optimal sealing with stem
- Suitable to fit a variety of yokes. (ideal with - Forbes Marshall make pneumatic diaphragm actuator).
- Fabricated body - available in Carbon Steel / Alloy Steel / Stainless Steel (other materials available on request).
- Stem - ground, hardened & roller burnished to a fine finish for optimum performance
- Ensures back-seat sealing due to fine machining & lapping of the seat after welding
- High performance spray head assembly. Gives fine atomisation of spray water
- Entire IBR assembly provided

Typical Sizes

- For Model 48:
 - Steam Side Flange: 3"
 - Water Side Flange: 1", 1 1/2"
- For Model 38:
 - Steam Side Flange: 4"
 - Water Side Flange: 1", 1 1/2", 2"
- Pressure Rating: Upto Ansi #2500
- Available Fm Arca Pneumatic Actuators For Mounting
 - A.'A' To 'Dx' Nozzles : UIII-60 n/v
 - B.'E' To 'H' Nozzles: UV-100 n/v
- Rangeability
 - For 6 Nozzle Head : 1:18
 - For 9 Nozzle Head : 1:27
 - For Mixed Nozzle Head: More Than 1:27
 - (as Per Customer's Specifications).

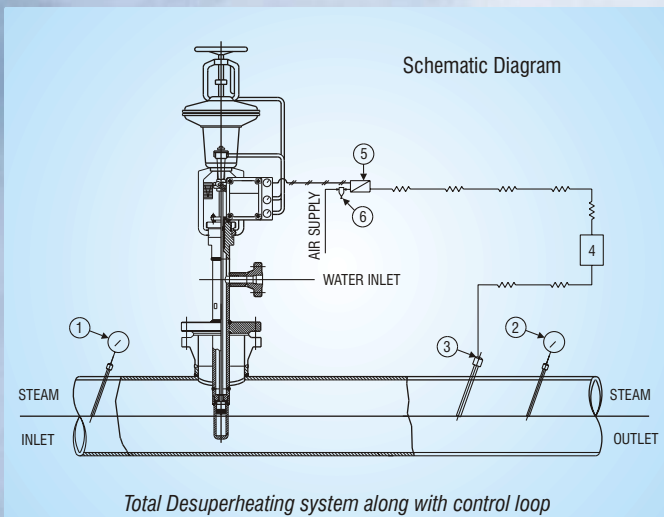


Detail 'X'

Sr.	DESCRIPTION
01	SPRAY CYLINDER
02	NOZZLE ASSY.
03	PISTON RING (3)
04	PISTON
05	FASTENER RING
06	SEAT
07	STEM
08	BODY
09	WATER FLANGE
10	SPACER

Sr.	DESCRIPTION
11	NUT
12	PACKING SET
13	STUD
14	GLAND
15	PLATE
16	NAME PLATE
17	NUT (FAG)
18	SECURING WASHER
19	BODY FLANGE

We supply entire temperature control loop



Sr.	DESCRIPTION
1	DIAL THERMOMETER
2	DIAL THERMOMETER
3	TEMPERATURE SENSOR
4	PID CONTROLLER
5	I/P CONVERTOR
6	AIR FILTER & REGULATOR

Notes

- Maximum recommended steam pipe size is 1200mm.
- Minimum pipe size required for installation of VND is 150mm.
- VND can be fitted in 100mm pipe size for nozzle upto 4Dx.
- Avoid vnd for steam having pressure less than 3 bar(g) and flowing through pipe size more than 400mm.
- Water pressure should be minimum 5 bar more than the steam pressure.
- Maximum recommended pressure difference between steam and water is 45 bar. If it exceeds 45 bar, then install pressure control valve in waterline to reduce water pressure within limit.
- Spray water should be very clean (as clean as boiler feed water).
- Model 38 with a maximum water flow capacity of 25 m³/hr. in continuous service
- Model 48 with a maximum water flow capacity of 50 m³/hr. in continuous service

Advantages

- Custom designing for any size, standard or range.
- Simple installation.
- VND ensures a fine conical spray that evaporates almost instantaneously, avoiding pipe impingement.
- Eliminates need of a separate coolant valve.
- More turn down ratio possible.
- Large desuperheating range because of number of available nozzles.

Applications

- Turbine Bypass.
- Turbine Exhaust.
- Turbine Bleed Steam.
- Auxillary Steam.
- Process Steam.
- Attemperator.
- Pressure Reducing Valve Outlet Steam.
- Boiler Superheaters.
- Boiler Re-heaters.

Reqd Sizing Parameters :

Steam Data

Inlet Pressure
Inlet Temperature
Outlet Temperature
Steam flow (Inlet)

Bar(g)
°C
°C

Water Data

Inlet Pressure
Inlet Temperature

Bar(g)
°C

Kg/hr/min/nor/max

General

Pipe Size
Pipe Schedule
Turndown Ratio

Water Flange Orientation : SP3 / SP6 / SP9 / SP12
(for detail refer to figure below)

Governing Formula for Desuperheater

$$M_w = M_{st} \times \frac{(h_1 - h_2)}{(h_2 - h_w)}$$

where

M_w = Water Injection mass in lbs/hr

M_{st} = Inlet Steam Mass in lbs/hr

h₁ = Enthalpy of Inlet Steam in BTU/lb

h₂ = Enthalpy of outlet steam in BTU/lb

h_w = Enthalpy of injection Water in BTU/lb

Good engineering practice for efficient Desuperheating

- Minimum inlet velocity should be 15mts/sec for FND & 7mts/sec for VND.
- Minimum straight length downstream beyond the Desuperheater should be 4 mts.
- Optimum distance between water injection point to the temperature sensor mounted downstream should be 10 mts.
- It is necessary to keep the steam flow rates (for max. & min conditions) as practical as possible else the turndown ratio increases unnecessarily which necessitates the selection & use of a combination of nozzles in the same spray cylinder
- Installation of a strainer with a mesh size of approximately 100 μ in the water supply line to prevent the nozzles from clogging is essential.

System Comparison

Conventional FND

Conventional injection water systems consist of:

- Fixed size spray nozzle
- Control valve
- Steam pipe section

The water injection quantity is regulated by the control valve. As a consequence of this flow regulation the downstream water pressure P2, varies as a function of the valve plug position. At reduced capacity the control valve starts to throttle, reducing P2 and hence the available water to steam "p", resulting in larger droplet size and poor atomization. The water evaporation rate slows down and temperature control becomes troublesome.

This typical system problem becomes compounded as nozzles and valves are usually sized for the design capacity but normally operate significantly below these design conditions. This oversizing results in a partially open control valve, even at normal operating conditions.

With reducing load, downstream water pressure P2 decays rapidly resulting in larger droplet size. Conventional systems therefore will work satisfactorily only at relatively steady load conditions.

Variable Nozzle

Desuperheater valve regulates the amount of injection water by varying the number of injection nozzles. This enables the water pressure to remain constant, independently of the number of injection nozzles in operation. This results in an excellent and near uniform spray quality over the entire operating range. Control of nozzle opening is achieved by the positioning of a piston which is operated directly by an actuator mounted onto the valve.

Through this simple design, there is no separate water control valve necessary.

Reference List

OEM's

BHEL -Hyderabad
Isgec John Thompson-Noida
Cethar Vessels -Trichy
Thermax -Pune
Siemens -Vadodara
BHPV- Visakhapatnam
TDPS Bangalore
Triveni Engineering -Bengalore
Ansaldo _Chennai
L&T -Vadodara

Actual Users

IOCL-Paniput
IOCL Mathura
HPCL-Mumbai
HPCL-Vizag
IOCL -Barauni
IPCL-Nagothane
Haldia petrochem
Mawana sugar
Maratha cement
Bhushan steel & Power
Aarti Steel Ind
Dwarikesh sugar
Renuka sugar
Ugar Sugar
Devipriya paper

CONSULTANTS.

Engineers India Ltd
Toyo
Avant Garde Engineers and consultants
Jacobs Engineering
Technimount -ICB

All India Sales and Service Network

Ahmedabad

Forbes Marshall
4 Shetoor Bungalows,
Opp. Drive in Petrol Pump,
Near Chandandwar Hospital
T V Tower,
Ahmedabad - 380 054
Tel : 079 - 26851738
Fax : 079 - 26854014

Alibag

Pent House No.1,
Bafna Baug Complex-B,
Behind Big Splash Hotel
Chendhare,
Alibag 404 201
Tel : 02141 - 223795(O)
Fax : 02141 - 223796 (O)
Tel : 02141 - 224699 (R)

Bangalore

21 Coles Road, Cleveland Town,
Bangalore - 560 005
Tel : 080 - 25483047
Fax : 080 - 25499971

Chandigarh

SCO # 77, Top Floor,
Sector 38-C, Chandigarh
Tel : 0172 - 5080285
Fax : 0172 - 2697861

Chennai

Plot # 59, Montieth Road,
Asha Mansion, Egmore
Chennai - 600 008.
Tel : 044 - 26611238
Fax : 044 - 26611236

Coimbatore

Flat No. 4C,
Classic Garden Apartment,
1552 Trichy Road,
Coimbatore - 641 018
Tel : 0422 - 2303679
Fax : 0422 - 2300072

Delhi

Anupama Arcade,
2nd Floor,
Opp. Samachar Apartments,
Mayur Vihar Extn., Phase I,
New Delhi - 110 091
Tel : 011 - 22713485
Fax: 011 - 22710484

Hyderabad

Plot No. A-19/2 & T-4/2
I.D.A. Nacharam,
Hyderabad - 500 076
Tel : 91 (0) 40 - 27153918
Fax : 91 (0) 40 - 27173235

Jamshedpur

59, Rajendra Nagar,
Jamshedpur - 831 001,
Jharkhand.
Tel : 0657 - 2437721
Telefax : 0657 - 2427983

Kolkata

5A Orient Row,
Kolkata - 700 017
Tel : 033 - 22407359
Fax : 033 - 22475280

Mumbai

107, Mahatma Gandhi Road,
Mumbai - 400 023
Tel : 022 - 2267 3821
Fax : 022 - 2267 2970

Nagpur

50, 'Asha' , 2nd floor,
Lendra Park, New Ramdaspath,
Nagpur - 440 010
Tel : 0712 - 2539386
Telefax : 0712 - 2549851

Navi Mumbai

"Ellora" Sector 14 /
Plot No. 45
Opp. Marathe Bhavan
Vashi,
Navi Mumbai - 400 705
Tel : 022 - 27666157

Fax: 022 - 27881533

Pune

P O Box No.29
Mumbai-Pune Road,
Kaswarwadi, Pune 411 034
Tel: 91-20-27145595
Fax: 91-20-27147413

Surat

7B Ground Floor,
Navchetan Society,
Opp. Krushimangal Hall,
Ring Road,
Surat - 395 007
Telefax : 0261 - 2651448

Vadodara

10, Shreeji Krupa Society,
Gotri Road,
B/H Kalpavruksha Complex,
Subhanpura P.O.,
Vadodara - 390 023
Tel : 0265 - 2343733
Direct : 0265 - 2342234
Fax : 0265 - 2337930

Visakhapatnam

403, Crescent Towers,
Opp. Enadu, Seethammadhara,
Visakhapatnam - 530 013
Tel : 0891 - 2552538
Fax: 0891 - 2535576

Area Representaives

Bhopal
Lucknow
Madurai
Pondicherry
Kanpur
Trichy

The data in the catalog may change based on various design parameters. Dimensions may change based on models selected. For more details contact your nearest branch office.

Manufactured & Marketed by:
Forbes Marshall Arca Pvt. Ltd.

A Forbes Marshall Company
A 34/35 MIDC Estate, H Block, Pimpri, Pune 411 018, India
Tel: 91-20-27442020 • Fax: 91-20-27442040 • Email: vsales@forbesmarshall.com
URL: <http://www.forbesmarshall.com>

