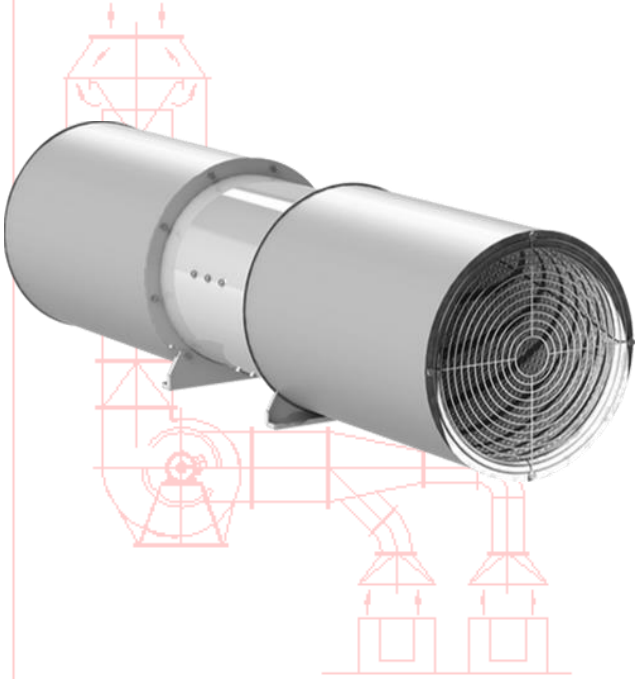
High Efficiency Underground Carpark Ventilation System



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Ductless Jet ventilation system:

Jet fans systems has been developed to ventilate underground cark parks for both CO removal during normal conditions & extracting smoke during emergency situations. These both requirements can be handled by single system more effectively & economically i.e. jet fan ductless car park ventilation systems.

The complete system is consisting of Jet fan, main axial fans for extract & fresh air. Normally fresh air fans are designed for the basements where there is not enough of natural cut-outs e.g. ventilation shafts or ramps. In addition to fans a unique control system i.e. designed to specific project, where the signals from CO / heat/smoke sensors operate the system at different speeds according to the need of situation & save energy.

To design an efficient system, we need to involve with the designers quite well in advance for suggesting the openings in the basement for an efficient fresh air intake & proper CO/ smoke removal. Fans are normally designed on the basis of air exchange rates for both normal & emergency applications. The local codes or building regulations plays vital role in designing the air flows, control systems & zones in the basement.

The jet fans work at different operating conditions pending on the signals from the CO sensors giving possibilities to save energy “working on demand” ventilation principle. Jet fans can be controlled individually or together as a group of fire zones. During fire operations complete system including main fresh air, extract air fans & jet fans run at full speed for cleaning the basement from smoke efficiently and quickly.

Advantages

The jet fan system has its own advantages over conventional ducted systems,

- As system doesn’t need ducts it allows the structure to have smaller heights appx 0.5m to 0.75m lesser than normal basements.
- Ductless system is easy to install in shorter time compare to conventional, expensive & complex ducted systems. It means saving on installation time & cost.
- Jet fan systems is easy to maintain & an ideal solution for renovations for the car parks.
- It is possible to operate systems in parts/zones as per signals given from CO/smoke sensors.
- As air is free to move in specified directions given by the jet fans, air mixer is proper in all the layers & provide better air quality in the basements compare to conventional ducted system.
- Jet fan systems allow CO & smoke extraction removal as one system with maximum level of automation & highly efficient. CO sensors ensure that only fans in the polluted zones to run. Smoke sensors decide that system should start in full swing once signal given to the controlling device.
- Elimination of ducts in systems give less resistance to the main fans resulting in lesser static pressure i.e. lower motor KW of the fans.
- Very flexible in positioning of jet fans in the car park.
- Low height of the jet fans allows the cark park to be neater& clean giving possibility to monitor the basement with help of CCTVs.

- Jet fan systems also prevents expensive structural damages in emergency fire conditions by providing proper mixing of fresh air & quick removal of smoke from the basement. This limits the heat exposure to ceilings/slabs.

System Requirements

Jet fans system design needs jet fans based on the area of the basement. Main fresh air fans (where cut outs are not sufficient)&extracts fans for both CO & smoke removal. The capacities of the main extract fans based on the air changes. International codes refer 4-6 ACH for CO removal & 8-10 ACH for smoke extraction.

Control system is the heart of the system & need to be designed carefully. The control system decides the response time for the speed of the jet fans after getting signals from CO sensors. This helps the complete system to optimize the energy at different parking loads of the day. Which means the control system will start/stop the fans individually or zone wise pending on the demand of the cark park.

When connected to the fire detection or in high CO levels, the controlling device need to switch on the fans on full speed after getting the signal from heat/smoke sensor or CO sensor. In addition to switching jet fans on high speed on fire floor, the control system is also responsible to switch off fans on other levels upper or lower than the fire floors. Control system will also regulate the main supply / extract fans on demand or signal from the respective sensors in addition to jet fans, quickly & effectively.

Building Codes

• International Mechanical Code - Section 403.5 Public garages - Mechanical ventilation systems for public garages are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide of 25 ppm by approved detection devices.

• Uniform Building Code - Section 705 - In all parking garages, automatic CO sensing devices may be employed to modulate the ventilation system to maintain a maximum average of CO of 50 ppm during any eight-hour period, with a maximum average concentration not greater 200 ppm for a period not exceeding one hour…

• State, municipal and other building codes - Most state, and local municipal building codes recognize and recommend using carbon monoxide monitors in enclosed parking garages. If the building code in your area does not have any provisions for CO monitoring, do not forget that carbon monoxide is still a very dangerous gas to personal health and safety. Therefore, the use of common sense by design engineers is still the best “building code” to use.

CO Alarm Level and Sequence of Operation:

First Alarm level:

1) Set at low concentration. (See Table for recommended low alarm level)

2) Gas monitoring system shall be able to actuate exhaust fans and outside air intake devices to bring the carbon monoxide level down to an acceptable level.

3) Optional: if the parking structure is equipped with either two-speed fans or with a second set of fans, only the first speed of fans or the first set of fans should be actuated.

Second Alarm level:

1) Set at high concentration. See Table for recommended high alarm level).

2) Ventilation equipment previously actuated at low level in the parking garage shall remain operational.

3) Optional: if the parking structure is equipped with either two-speed fans or with a second set of fans, they should be activated at full speed or all fans should be activated.

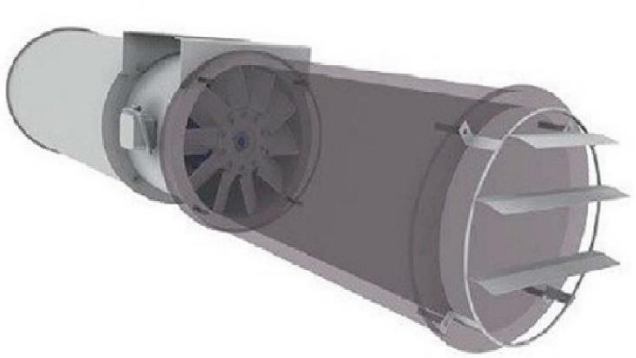
4) Activation of strobe light (red) and horn might be required.

5) People might be required to evacuate the parking garage.

Standards for CO exposure levels:

CO Level in Air	Standard & Regulation
200 ppm	NIOSH – National Institute for Occupational Safety & Health Short term exposure limit (15-minute maximum exposure level).
50 ppm	OSHA – Occupational Safety & Health Administration The maximum allowable concentration for worker's Continuous exposure in any eight-hour period.
50 ppm	UMC – Uniform Mechanical Code Recommends to activate the mechanical ventilation when CO is monitored in the parking structure.
35 ppm	EPA – Environmental Protection Agency Recommends 35 ppm or lower as an ambient air quality goal averaged over an hour.
35 ppm	NIOSH – National Institute for Occupational Safety & Health PEL – TWA – 35 ppm is maximum allowable concentration for a worker to be exposed to in any eight-hour period.
25 ppm	ACGH – American Conference of Governmental Industrial Hygienists TLW – TWA – 25 ppm is maximum allowable concentration for a worker's continuous exposure in any eight-hour period.
25 ppm	IMC – International Mechanical Code Recommend to actuate the mechanical ventilation when CO is monitored in a parking structure
9 ppm	EPA – Environmental Protection Agency Recommends 9 ppm or lower as an ambient air quality goal averaged over eight-hours.

Jet Fan



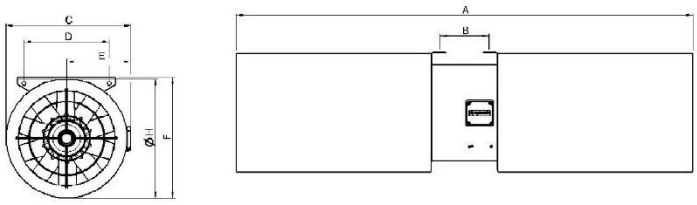
- For daily ventilation requirements and smoke extraction in case of fre F300 (300 °C/120 min.)
- Symmetrical impeller blades; 100% reversible with low noise emissions
- IP55 motors, insulation class H (smoke extraction version); IP55 motors, insulation class F (CO ventilation), according to EN 60034-5
- 50/60 Hz version available
- Tested maintenance switch optional
- Housing from Mild Steel & Galvanized sheet steel
- Application for Basement Ventilation & Tunnel Ventilation etc

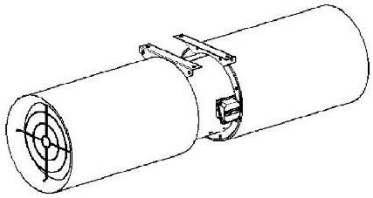
Technical data

JET FAN		55 °C			300 °C/120 min			
		Model 315	Model 355	Model 400	Model 315	Model 355	Model 400	Model 400
Voltage/Frequency	V/50 Hz	415	415	415	415	415	415	415
Phase	~	3	3	3	3	3	3	3
Fan impeller speed	1/min	2880/1440	2840/1380	2840/1380	2880/1440	2880/1440	2880/1440	2880/1440
Power	kW	0.80/0.16	1.4/0.3	1.5/0.4	0.8/0.16	1.5/0.2	1.5/0.2	1.7/0.34
Current	A	1.95/0.39	3.08/1.1	4.18/1.47	1.95/0.39	3.62/0.81	3.62/0.81	3.62/0.81
Thrust	N	22/6	37/9	55/14	22/6	37/9	55/14	66/17
Max. airfow	m³/s	1.22/0.61	1.78/0.89	2.42/1.21	1.22/0.61	1.78/0.89	2.42/1.21	2.62/1.32

Air volume related to air density 1.2 kg/m³.

Dimensions





Size	ØH	A	B	C	D	E	F
315	420	1535	211	433	265	223	425
355	460	1695	211	473	305	243	465
400	500	1875	211	516	350	266	505

Dimensions in mm.

Jet Fan

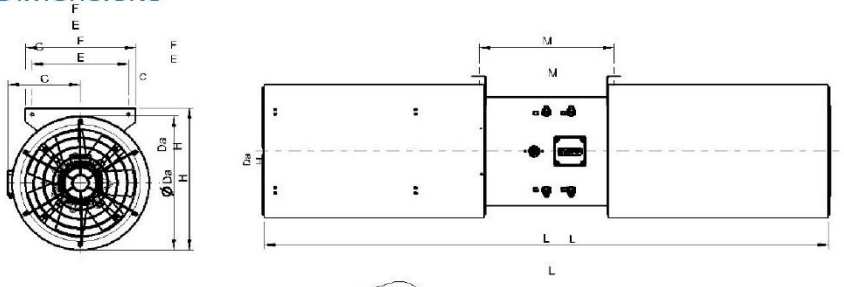
- For daily ventilation requirements and smoke extraction in case of fre F400 (400°C/120 min.)
- Symmetrical impeller blades; 100% reversible with low noise emissions
- IP55 motors, insulation class H (smoke extraction version), insulation class F (CO ventilation), according to EN60034-5
- Tested maintenance switch optional
- Housing from Mild Steel & Galvanized sheet steel
- Application for Basement Ventilation & Tunnel Ventilation etc

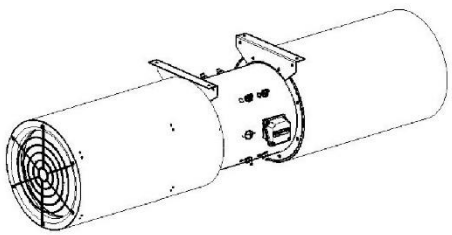
Technical data

JET FAN		400 °C/2 h		
		MODEL 315	MODEL 355	MODEL 400
Voltage/Frequency	V/50 Hz	415	415	415
Phase	~	3	3	3
Fan impeller speed	1/min	2860/1420	2880/1440	2885/1435
Power	kW	0.75/0.15	1.8/0.37	1.8/0.37
Current	A	1.61/0.85	3.5/1.54	3.5/1.54
Thrust	N	21/6	41/10	55/14
Max. airfow	m^3/s	1.94/0.60	1.83/0.92	2.42/1.21

Air volume related to air density 1.2 kg/m^3.

Dimensions





Size	ØDa	H	E	C	F	L	M
315	420	445	265	223	315	1635	425
355	460	480	305	243	355	1795	425
400	500	530	350	266	400	2050	500

Dimensions in mm.