KRUGER

# TUNNEL FAN

## KTF & KTF-R Series

# Company Profile

Established in Singapore since 1985, Kruger Ventilation is a full subsidiary company of Soler & Palau Ventilation Group. For decades, Kruger Ventilation continues to be a leading supplier of ventilation solutions for residential, commercial, industrial, and infrastructure applications; the last of which demands a high degree of specialization as in road and metro tunnel ventilation systems. The industry has grown to expect from us to deliver value in unmatched Quality, Delivery, and Service, which are made possible with our engineering expertise, world class manufacturing, and dedication towards innovative excellence. Meeting the needs of our customers is our success.

Kruger tunnel fans are precision engineered for superior performance and trouble-free operation for years to come. Advancements in technology have allowed our tunnel fans, manufactured and assembled in our state-of-the-art ISO 9001 certified factory to achieve world class performances in tunnel ventilation applications. Every Kruger tunnel fan is test run and quality recorded for performance assurance and quality compliance. Full F.A.T. in our AMCA certified test facility with third party certification further ensures our fans comply with the most demanding specifications.

With our continuous commitment towards excellence, and our localization of manufacturing capacity, technical support, testing & commissioning, and after-sales service & maintenance across Asia in seventeen locations, our customers' investments entrusted to us are in good hands, and our promises are always delivered.


Please refer to the AMCA certified Kruger catalogue CAT029-E2-ED1 for the AMCA certified performance curves.

## Application

Efficient underground space utilization is vital for sustainable urbanization for cities around the world. Consequently, more capitals are invested in underground infrastructure projects in transportation, storage caverns, utility pipelines, etc. Natural ventilation, although is the most economical, has few practical applications due to its limitations. Therefore it is necessary to mechanically ventilate these spaces properly in order to meet the design criteria for system functionality and safety. The applications of tunnel fans are many and to name a few:

### 1. Transportation Tunnel

Road and metro tunnels allow passenger vehicles or trains to go through and under terrains, significantly shorten the commute, making time and energy efficient travel possible. These tunnels also free up valuable land above for other uses. For road tunnel with its high level of contamination from vehicles, and metro tunnel characterized by design complexity for passenger comfort, the tunnel fans must work flawlessly in both cases to provide the necessary air circulation, and most importantly, control smoke pattern in case of fire to ensure the safety of the passengers.

### 2.Underground Construction

Underground constructions such as storage caverns and others require tunnel fans during construction as well as for permanent use. The environment demands the fans to efficiently provide fresh air while removing the pollutants, heat, humidity, and purge the environment of dusts from blasting during the construction phase.

### 3.Utility Tunnel

Utility tunnels are underground construction designed to carry utility lines including electrical power lines, communications cables and optics, water and sewer pipes, making the urban spaces above less obstructed and more aesthetically pleasing. The tunnel fans are required to removal heat, to provide fresh air for a working environment, and to maintain the proper ambient conditions for system operation.

### 4.Wind Tunnel

Wind tunnels are widely used, academically as well as commercially, in aerodynamic research to study the effect of air moving over solid objects such as automobiles, airplanes, building structures, etc. Large tunnel fans are used to create the desired airstream and pattern necessary to conduct the studies.

## Fan Features

- **Complete Range**

  -***Uni-directional***

  Range from diameter 1250 to 3150mm, static pressure up to 5000Pa, flow rate up to 450m³/s.

  -***Reversible***

  Range from diameter 1250 to 2240mm, static pressure up to 2500Pa, flow rate up to 160m³/s.

- **High Efficiency**

  Total efficiency as high as 85% for uni-directional fans and 75% for reversible fans.

- **Reliable Performance**

  Kruger tunnel fans are tested in AMCA accredited laboratory and rated in accordance with AMCA 210 for air performance and ISO 1940 and AMCA 204 for balancing quality.

- **Stall-Free Operation**

  Non-stall design or anti-stall ring ensures stall-free operation and protect the ventilation fans and upstream/downstream equipment from potential damage.

- **Truly Reversible**

  Reversibility of 97~100%.

- **Adjustable Blade Angle**

  Blade angle can be adjusted to suit tunnel development/control needs.

- **High Strength Blades**

  Specially designed aluminum alloy homogenous aerofoil blades with high yield strength cater for high pressure applications (up to 5000Pa) and thermal shock in case of fire.

- **Robust & Durable Design**

  Major components are made from high strength steel.

- **Reliable Corrosion Protection**

  Hot dipped galvanization as per ISO 1461 to enable fan operation in almost all adverse environments.

## Quality Assurance

- **High Temperature Test**

  Kruger tunnel fan KTF & KTF-R series are tested in accordance with EN 12101-3:2002 and comply with the high temperature resistance requirement for continuous operation at 250°C, 300°C and 400°C for a minimum of 2 hours. Other temperature ratings are available upon request.

  Certified by TUV SUD which is a leading international service organization focusing on consulting, testing, certification and training.

- **Pre-Assembly Examination**

  X-Ray examination for Aluminum alloy blades as per ASTM E-155 and dye penetration (non destructive) tests for welds on fan hubs as per ASME Section V, Art. 6 & 24 (identical with ASTM E-165) are available upon request to ensure the impellers are capable of withstanding the effect or all stress and load during staring, operation and reversal.

- **After-Assembly Examination**

  All Kruger tunnel fans are balanced in accordance with ISO 1940 and AMCA 204 standard and comply with G4.0 or G2.5 requirement.

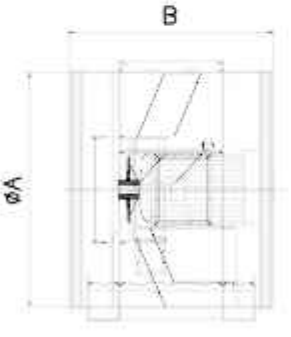
  Whirl test (over speed test) at 125% of full speed for a minimum of 15 minutes for the impeller is available upon request to ensure the fans are capable of withstanding the effect of all stress and load in case of emergency of malfunction .

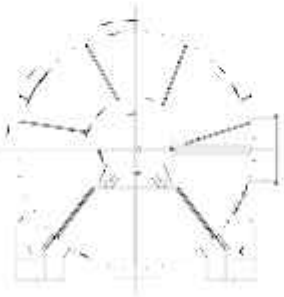
## Nomenclature

**MODEL : KTF 2000** Uni-Directional
- Nominal Fan Diameter
- Kruger Tunnel Axial Fan

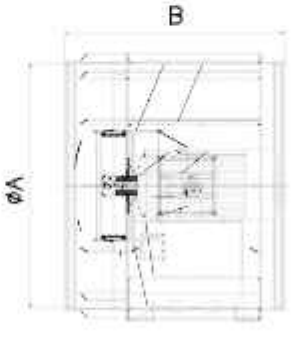
**KTF-R 2000** Reversible
- Nominal Fan Diameter
- Kruger Tunnel Axial Fan

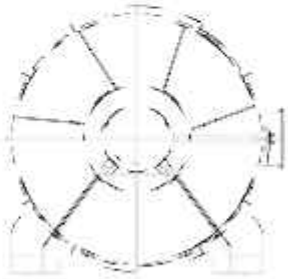
## Dimension



If dimension "B" is < 1750mm



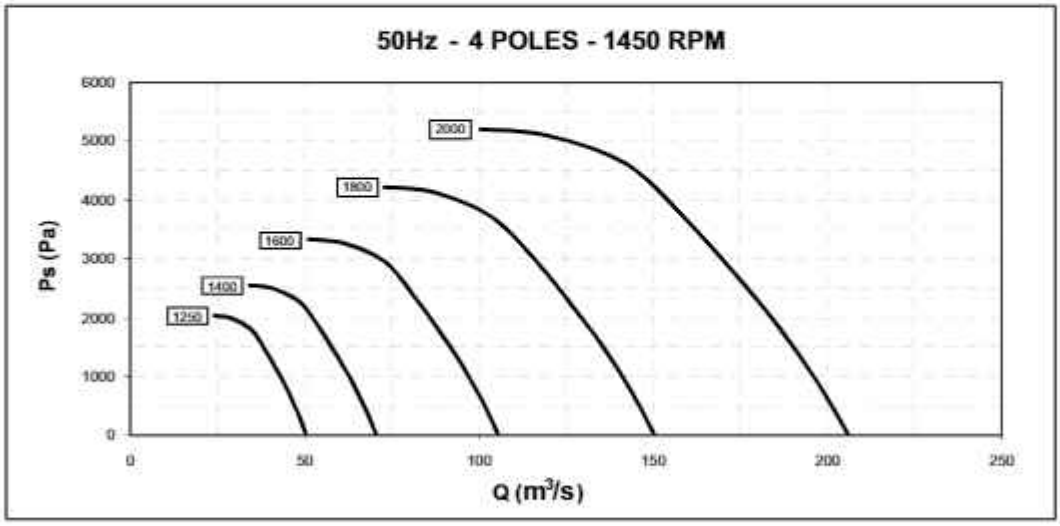
If dimension "B" is >= 1750mm

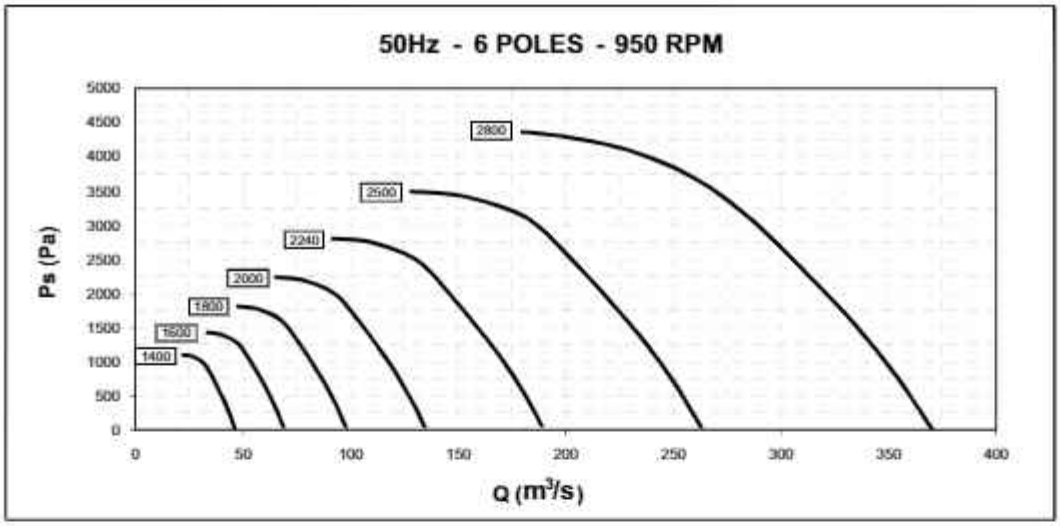
| Model | Motor Frame Size | A | B |
|---|---|---|---|
| 1250 | D160-200 | 1250 | 1150 |
| | D225-280 | | 1350 |
| | D315 | | 1650 |
| 1400 | D180-225 | 1400 | 1200 |
| | D250-280 | | 1450 |
| | D315 | | 1650 |
| 1600 | D200-225 | 1600 | 1250 |
| | D250-280 | | 1500 |
| | D315 | | 1750 |
| 1800 | D225 | 1800 | 1300 |
| | D250-280 | | 1550 |
| | D315 | | 1750 |
| 2000 | D250-280 | 2000 | 1600 |
| | D315 | | 1750 |
| | D355 | | 2000 |
| | D400 | | 2200 |
| | D450 | | 2350 |
| 2240 | D280 | 2240 | 1600 |
| | D315M/L | | 1900 |
| | D355 | | 2100 |
| | D400 | | 2300 |
| | D450 | | 2450 |
| 2500 | D280 | 2500 | 1700 |
| | D315 | | 2000 |
| | D355 | | 2250 |
| | D400 | | 2400 |
| | D450 | | 2500 |
| 2800 | D280 | 2800 | 1700 |
| | D315 | | 2050 |
| | D355 | | 2300 |
| | D400 | | 2450 |
| | D450 | | 2600 |
| 3150 | D280 | 3150 | 1750 |
| | D315 | | 2150 |
| | D355 | | 2350 |
| | D400 | | 2550 |
| | D450 | | 2650 |

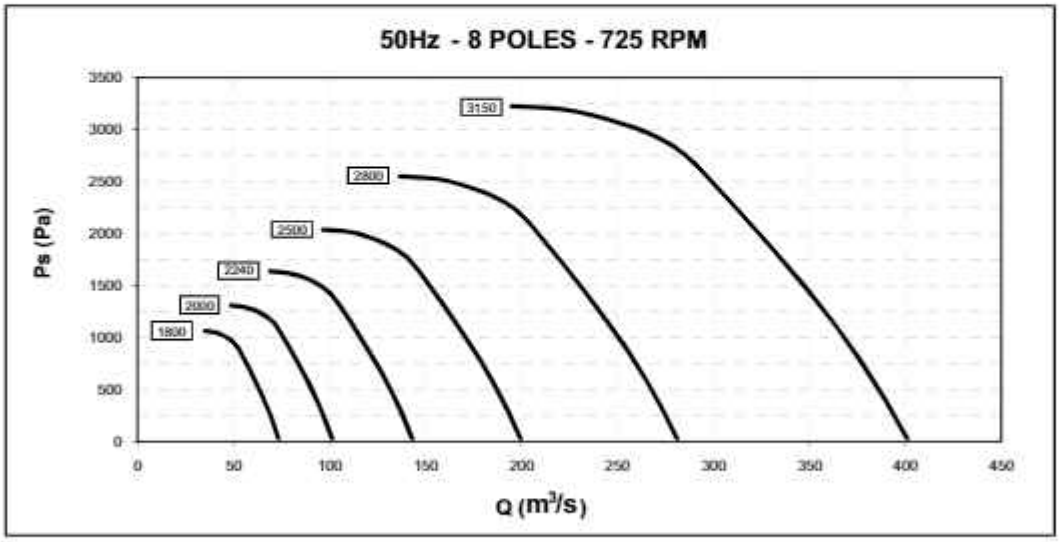
- Model sizes are nominal diameter

All dimensions in mm

# Quick Selection Chart - Fan KTF Series (Uni-Directional)

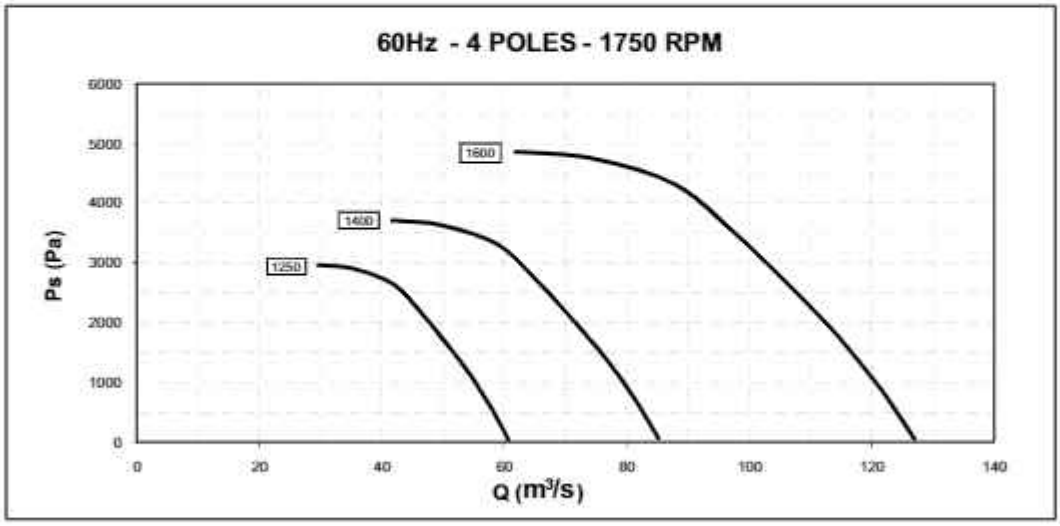


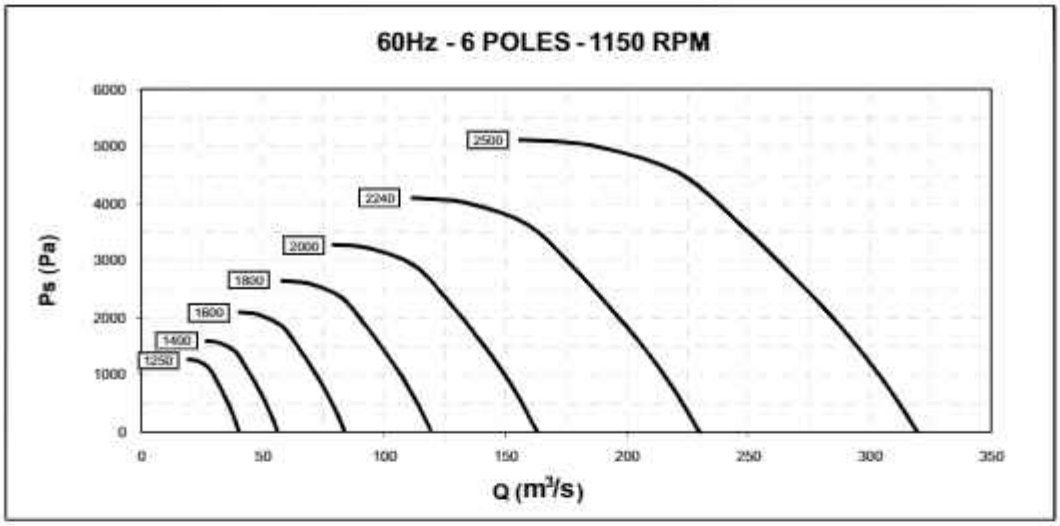



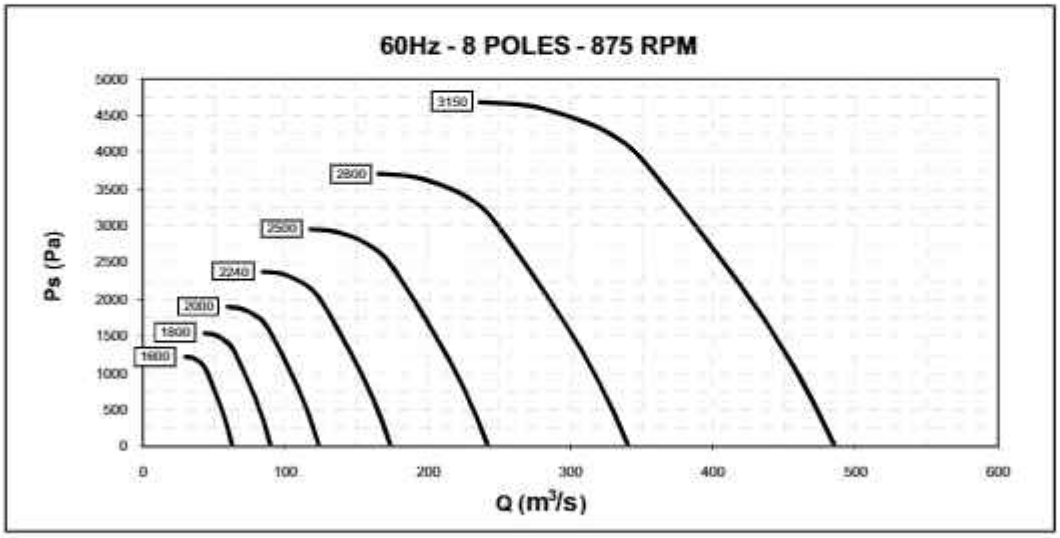




Please contact Kruger for fan selection beyond this range.

# Quick Selection Chart - Fan KTF Series (Uni-Directional)

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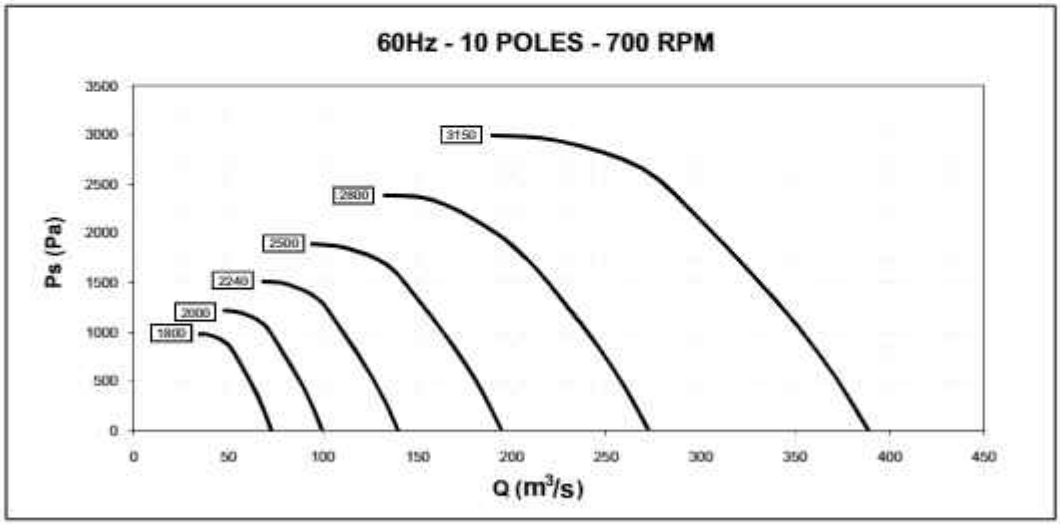
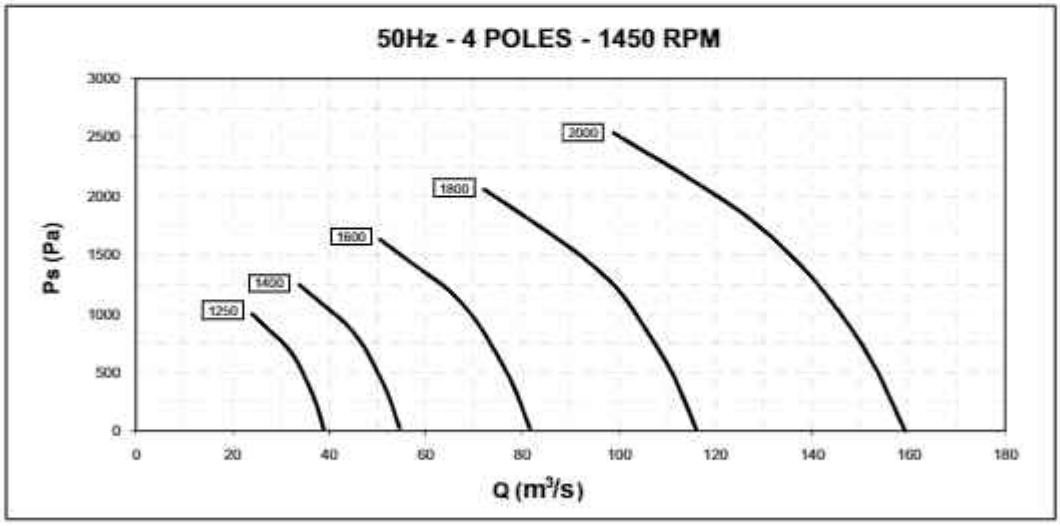
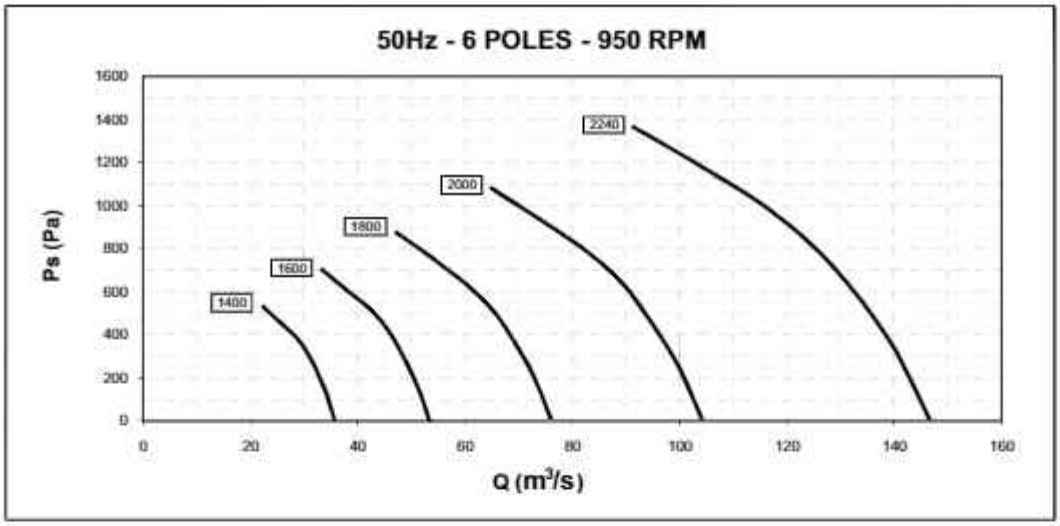
# Quick Selection Chart - Fan KTF Series (Uni-Directional)

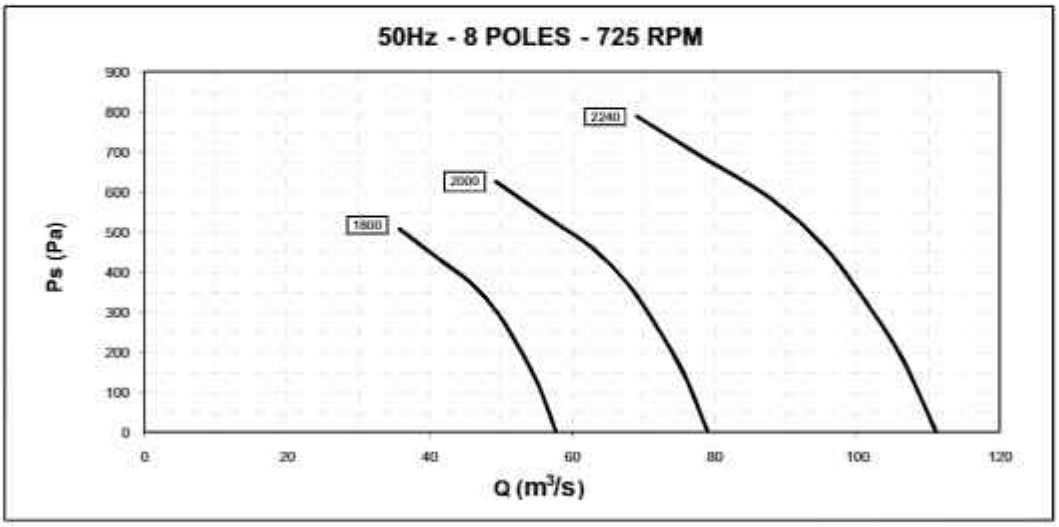



Please contact Kruger for fan selection beyond this range.

## Quick Selection Chart - Fan KTF-R Series (Reversible)

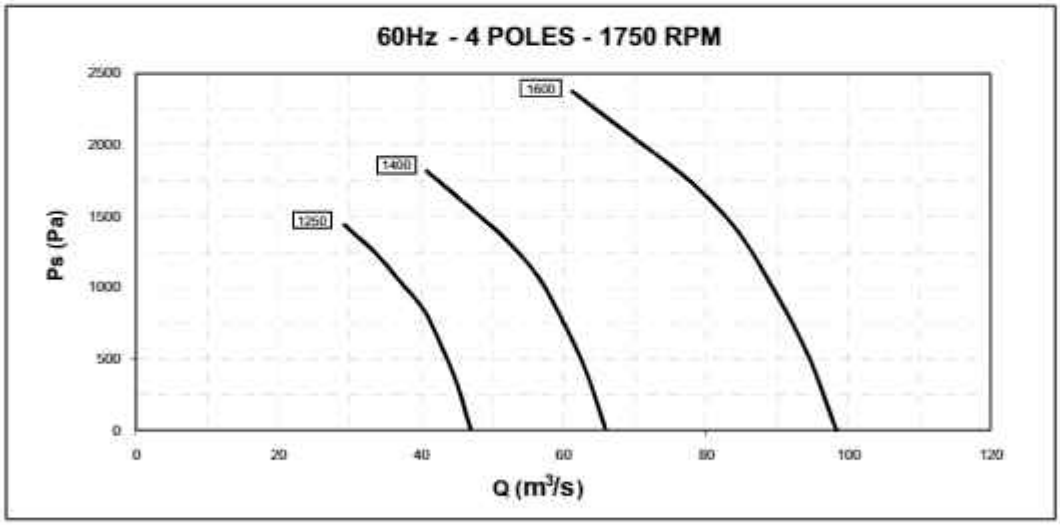


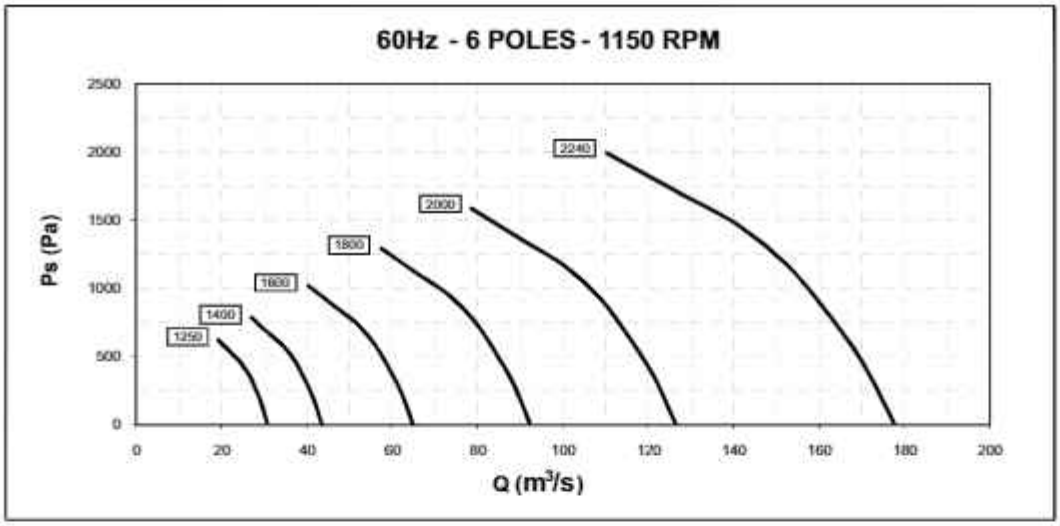



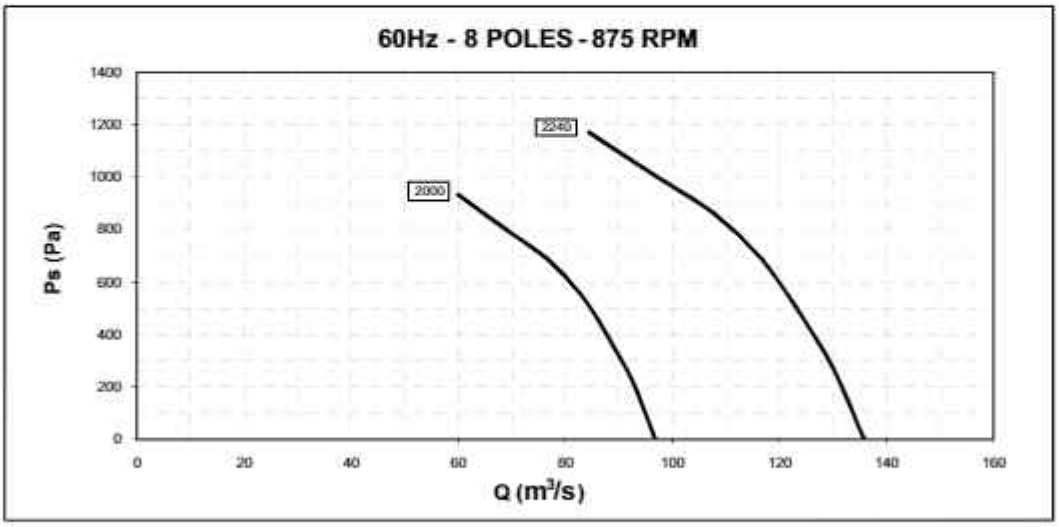




Please contact Kruger for fan selection beyond this range.

## Quick Selection Chart - Fan KTF-R Series (Reversible)

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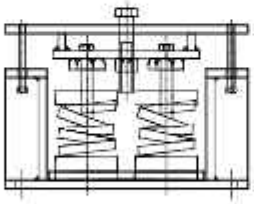
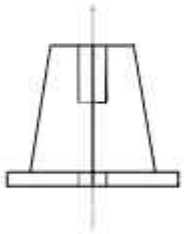
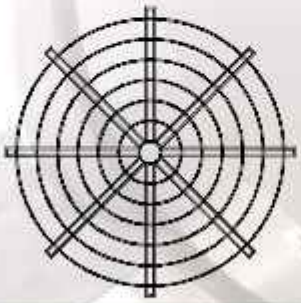
## Accessories

| | |
|---|---|
| Spring Isolator  | Rubber Isolator  |
| Inlet Bellmouth  | Counter Flange  |
| Saftey Wire  | Cable Pull Safety Switch  |
| Protection Net  | |

## Typical Project Reference

| Application | Project Name | Country & Region | Type | Fan Size |
|---|---|---|---|---|
| Metro | Metro Downtown Line – Stage 2 | Singapore | Axial Fan | 1800, 2000 |
| | | | Jet Fan | 630, 1250 |
| | Metro Xin Zhuang Line CK 378 A/B/D/H | Taiwan (Taipei) | Axial Fan | 1800 |
| | | | Jet Fan | 1120, 1400 |
| | Metro Xin Yi Line CR 388 A/B | | Axial Fan | 1600, 1800 |
| | | | Jet Fan | 1120 |
| | Metro Tao Yuan Airport CA 384 | | Axial Fan | 1250, 1800 |
| | Metro Project Mass Rapid Transit Lembah Kelang: Jajaran Sungai Buloh - Kajang | Malaysia | Axial Fan | 1800, 2000 |
| | | | Jet Fan | 1120 |
| | Chile Metro Line 3 and 6 | Chile | Axial Fan | 2500 |
| | Mexico Metro Line 3, 7 and 12 | Mexico | Axial Fan | 1600, 2000, 2240 |
| Road Tunnel | Xiang An Subsea Tunnel | China (Fujian) | Axial Fan | 2240, 2500, 2800 |
| | | | Jet Fan | 630, 1120 |
| | Ning Wu Expressway (Dong Gong Shan Tunnel & Fen Shui Guan Tunnel) | | Axial Fan | 2500, 2800 |
| | | | Jet Fan | 1120 |
| | Jian Tai Expressway (Tai Ning Tunnel) | | Axial Fan | 2500, 3150 |
| | | | Jet Fan | 1120 |
| | Zhang Yong Expressway (Guan Tian Tunnel) | | Axial Fan | 2500 |
| | | | Jet Fan | 1120 |
| | JingTai Expressway (Tian Long Shan Tunnel) | | Axial Fan | 2500, 3150 |
| | | | Jet Fan | 1120 |
| | JingTai Expressway (Huang Zhu Shan Tunnel) | | Axial Fan | 3150 |
| | | | Jet Fan | 1120 |
| | JingTai Expressway (Niu Yan Shan Tunnel) | | Axial Fan | 2500, 2800 |
| | JingTai Expressway (Yan Qian Tunnel) | | Axial Fan | 2500 |
| | Meiyu Expressway (Qi Shan Tunnel) | | Axial Fan | 2500, 2800,3150 |
| | Shen Hai Alternated Route Expressway (Ci Gan Yan Tunnel) | | Axial Fan | 2800 |
| | Shen Hai Alternated Route Expressway (You Che Ling Tunnel) | | Axial Fan | 3150 |
| | Wuhan East Lake Under Lake Tunnel | China (Hubei) | Axial Fan | 2240, 2500 |
| | | | Jet Fan | 630, 1000, 1250 |
| | Second Link Road Hankou Railway Station Road Tunnel | | Jet Fan | 560 |
| | Chang Ping Expressway (Hong Ti Guan Tunnel) | China (Shanxi) | Axial Fan | 2800 |
| | Xin Bao Expressway (Yun Zhong Shan Tunnel) | | Axial Fan | 2500 |
| | Tai Gu Expressway (Xi Shan Tunnel) | | Axial Fan | 2500 |
| | Hai He Cross River Tunnel | China (Tianjin) | Axial Fan | 1600, 2240 |
| | | | Jet Fan | 800 |
| | Yuewu Expressway (Ming Tang Shan Tunnel) | China (Anhui) | Axial Fan | 2240 |
| | Xin Zhong Zhou Tunnel | China (Tianjin) | Jet Fan | 630 |
| | Luntou-Shengwudao-HEMC Tunnel | | Jet Fan | 710 |
| | Hangzhou Xiao Shan Airport Tunnel | China (Zhejiang) | Jet Fan | 710 |
| | Hong Kong-Macau-Zhuhai Bridge Tunnel Project | China (Hong Kong-Macau-Zhuhai) | Axial Fan | 2500, 3150 |
| | | | Jet Fan | 630, 1120, 1250 |
| | Jurong Rock Cavern | Singapore | Axial Fan | 1600, 1800, 2000 |
| | Singapore Woodsville Tunnel | | Jet Fan | 1250 |
| | Ba Gua Shan Tunnel | Taiwan (Changhua) | Axial Fan | 2500 |
| Storage | Jurong Rock Cavern | Singapore | Axial Fan | 1800 |

## Tunnel Ventilation Methods

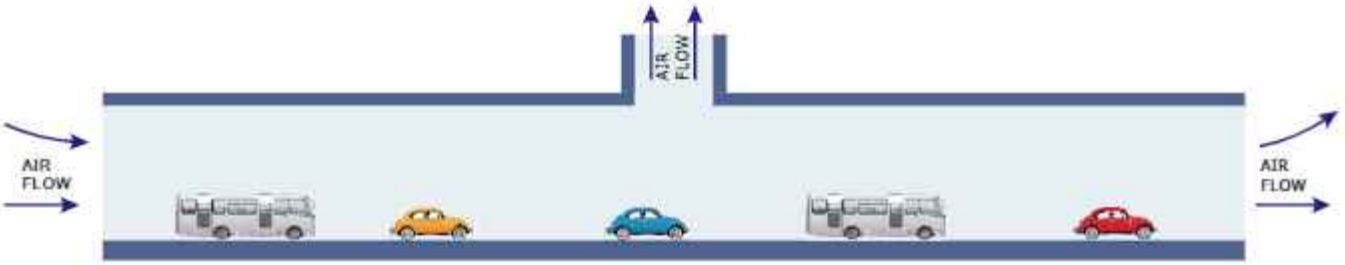
Different countries/regions may have different requirements/regulations on tunnel ventilation systems. There are many types of ventilation systems. However, only two types of fans are used: axial fans and jet fans. Axial fans are used to supply fresh air and extract contaminated air / smoke. Jet fans are used in longitudinal ventilation system to push the contaminated air / smoke to a place where it can then be extracted out by axial fans. The following are illustrations of different tunnel ventilation systems that are in common use.

### A. General Tunnel Ventilation

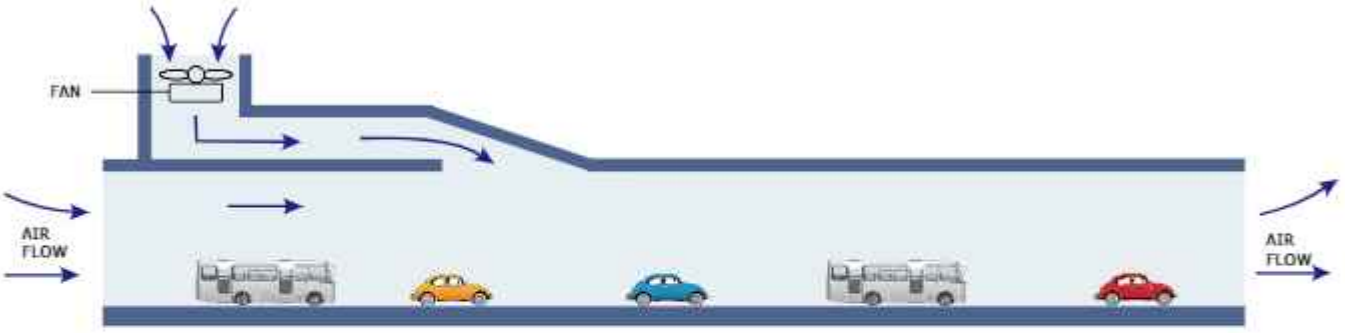
**This applies to both road tunnel and subway (metro) tunnel, road tunnel is used for illustration purpose.**

■ 1. Natural Ventilation

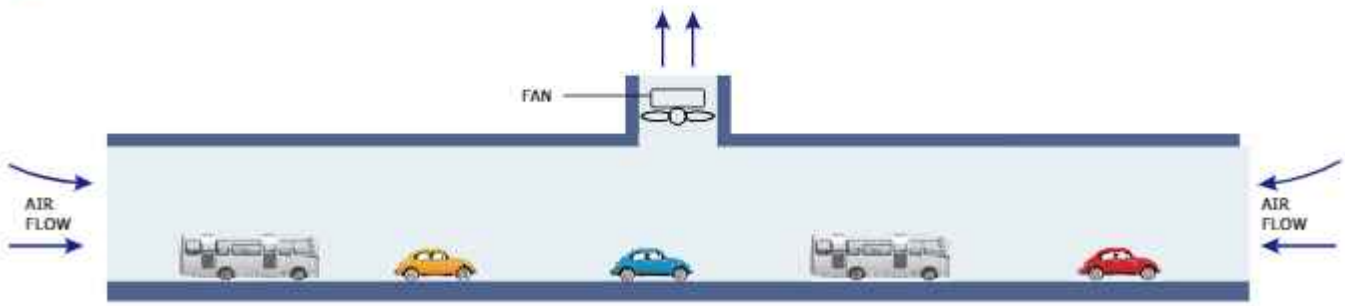

■ 2. Natural Ventilation with Central Shaft



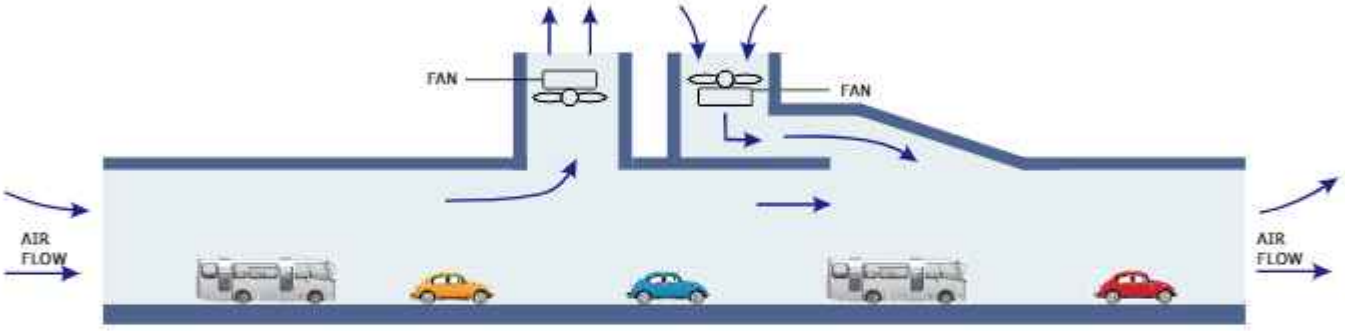

■ 3. Injection Type Longitudinal Ventilation



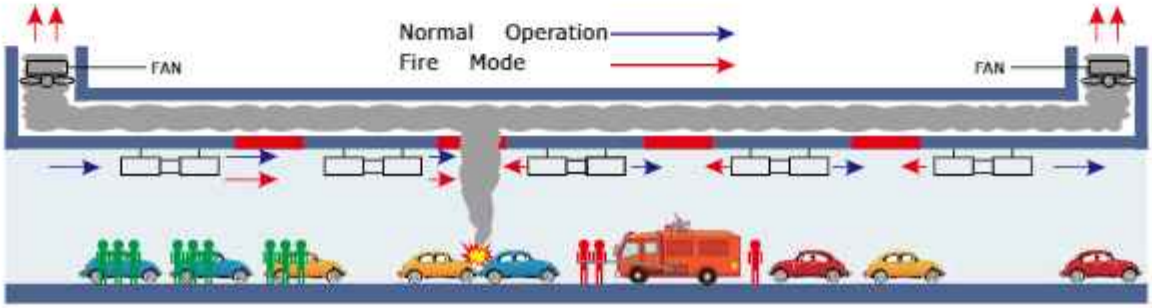

■ 4. Central Exhaust Shaft Type Longitudinal Ventilation



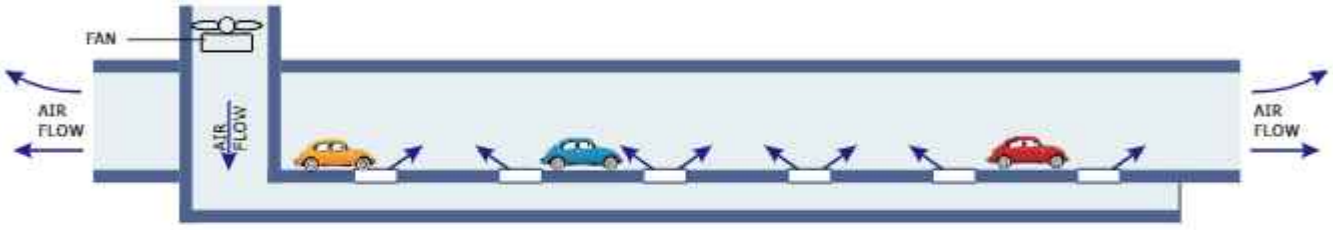
## 5. Central Supply & Exhaust Shaft Type Longitudinal Ventilation



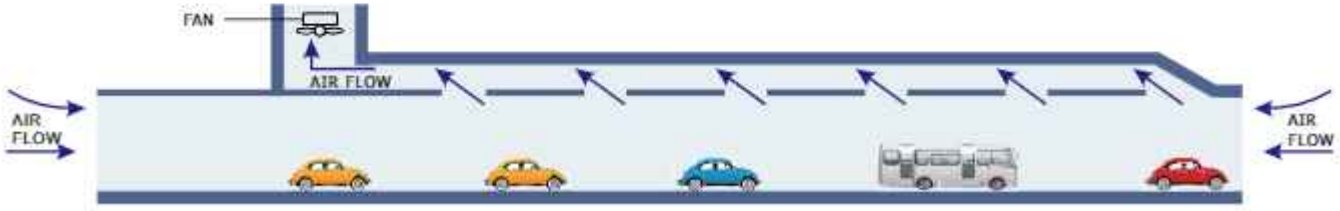

## 6. Point Extraction Type Longitudinal Ventilation (PEV)



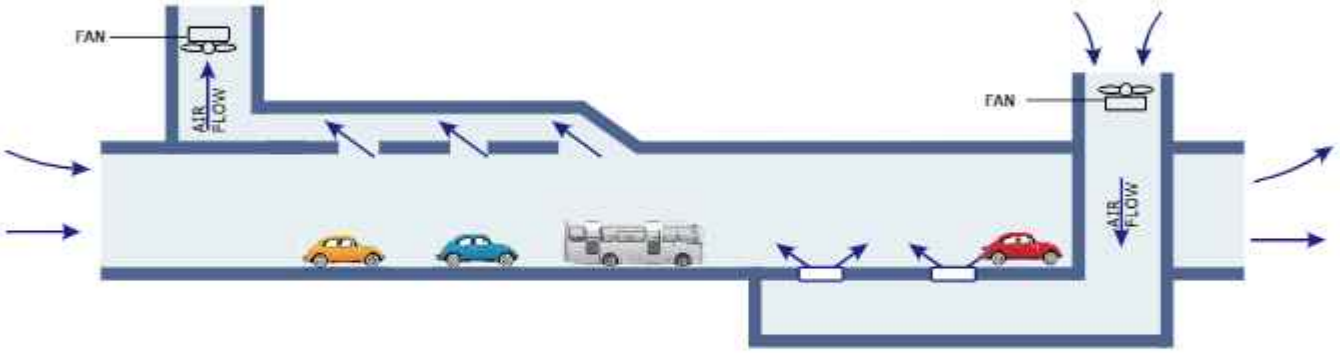

## 7. Semi-Transverse Supply Type



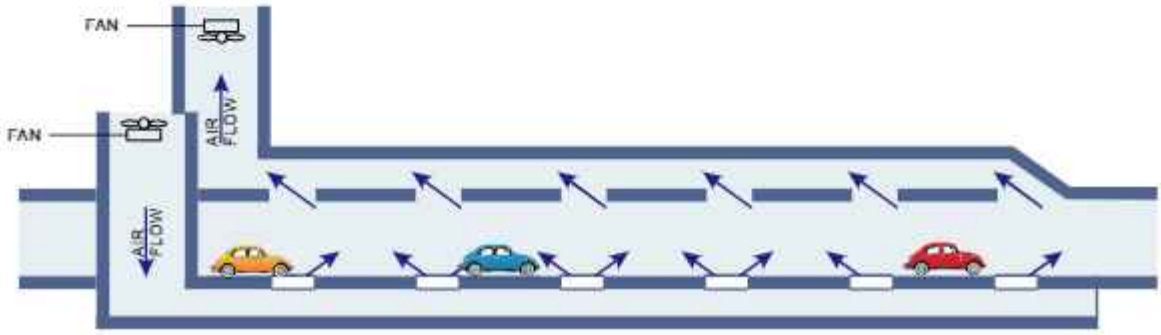

## 8. Semi-Transverse Exhaust Type



## 9. Semi-Transverse Half Supply Half Exhaust Type




## 10. Fully Transverse Type




## B. Metro Ventilation

**This applies to Trackway Exhaust**