



zitrón

**TUNNEL AND METRO
VENTILATION**

ZITRON is a world-wide leading company in designing, manufacturing, testing, installing and commissioning complete ventilation systems for road tunnels, railway tunnels and metro.



Founded in 1963, the headquarters of the company remains at its original location in Gijón (Asturias region), on the north Atlantic coast of Spain.



During the last decades ZITRON Group has expanded internationally, with subsidiary companies all around the world and exclusive partnership agreements with local companies in over 30 countries.



VENTILATION EQUIPMENT

ZITRON designs and manufactures axial fans, jet fans and accessories for tunnel and metro ventilation. ZITRON's fans have a heavy duty construction providing high efficiency and reliable performance.

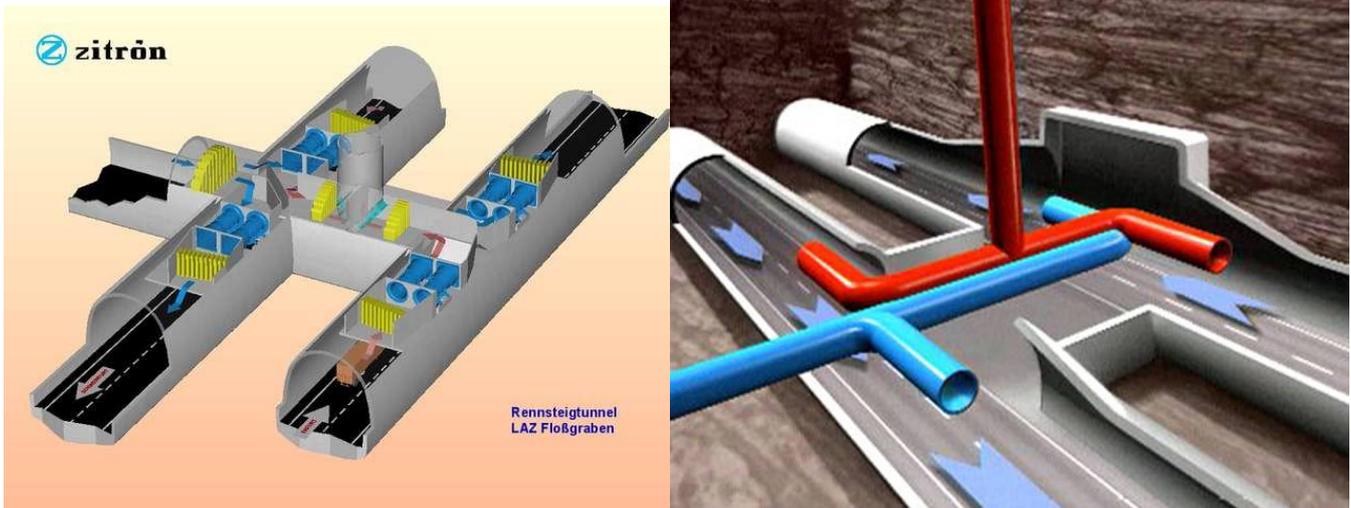


ZITRON's fans have been tested and certified to operate at high temperature conditions according to Standard EN 12102-3. The most typical high temperature rates used in tunnel ventilation are: 200°C during 2 hours, 250°C during 2 hours, 300°C during 1 hour and 400°C during 2 hours.



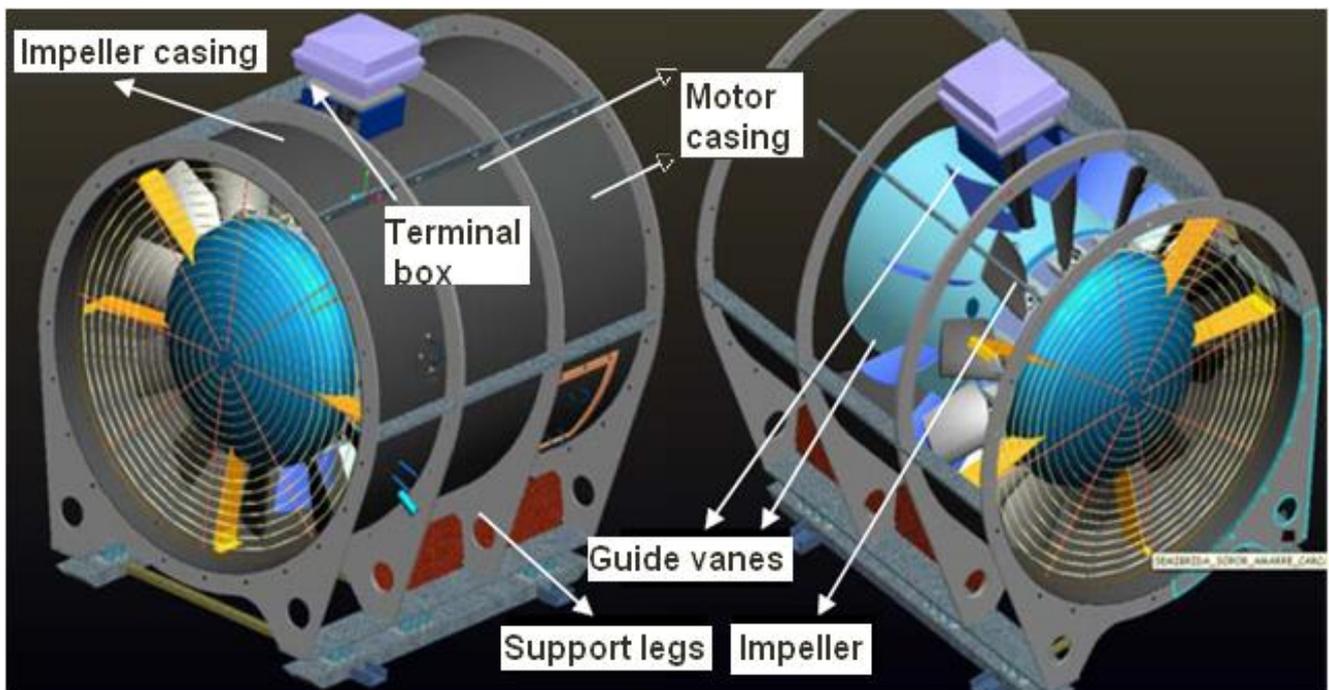
AXIAL FANS

According to the design of the tunnel ventilation system, axial fans are commonly used exhausting polluted air and fumes in case of a tunnel fire, but also blowing fresh air inside the tunnel.



Axial fans can be uni-directional type (our “ZVN” series) or fully reversible type (our “ZVR” series). The uni-directional fans are able to reach to 85 % efficiency, while the fully reversible fans can achieve up to 78 % efficiency. In case the uni-directional fans are requested to operate in reverse, their efficiency and performance will be lower than in the forward direction.

Although one stage axial fans are the most commonly used in tunnel and metro ventilation systems, when the pressure requirements are high, two stage fans could be needed.





Impellers of the axial fans have mostly fixed pitch blades, but in some tunnel ventilation projects impellers with variable pitch blades are requested. The fans with variable pitch blades can be either hydraulically or electro-mechanically adjusted during operation. Both types of fans, with fixed pitch blades or adjustable pitch blades, can be used in combination with motors suitable for operation over Inverter or with motors with one or more speeds.

According to the job site installation conditions the fans can be manufactured either with for horizontal or vertical configuration. Traditionally tunnel ventilation systems were using horizontal fans, installed in ventilation rooms; nowadays, to optimise the available underground space, there is an increasing tendency to use more vertical fans. ZITRON has a wide experience in vertical fans, which has been supplied in the most recent tunnel projects world-wide



ZITRON's axial fans are named using the following sequence:

Code:

A	B	C		D	-	E	-	F	/	G
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A: First Initial letter of manufacturer

- Z: ZITRON

B: type of machine

- V: Axial Ventilator (Axial Fan)

C: Reversibility

- N: Uni-directional axial fan
- R: 100 % Reversible axial fan

D: number of stages

- 1: single stage fan (1 impeller)
- 2: double stage fan (2 impellers)

E: Impeller diameter (in dm)

- From 4: 4 dm = 400 mm
- Up to 52: 52 dm = 5200 mm

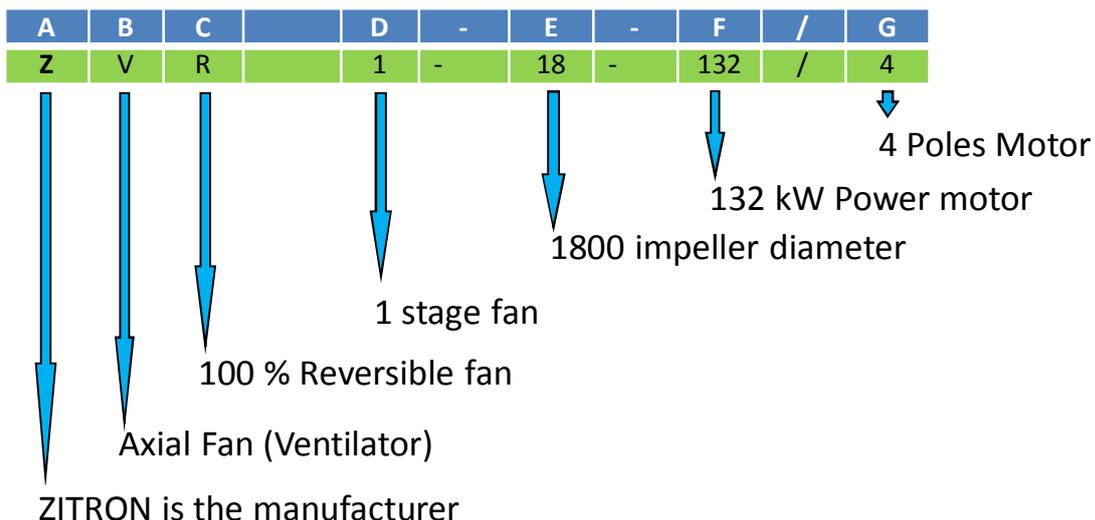
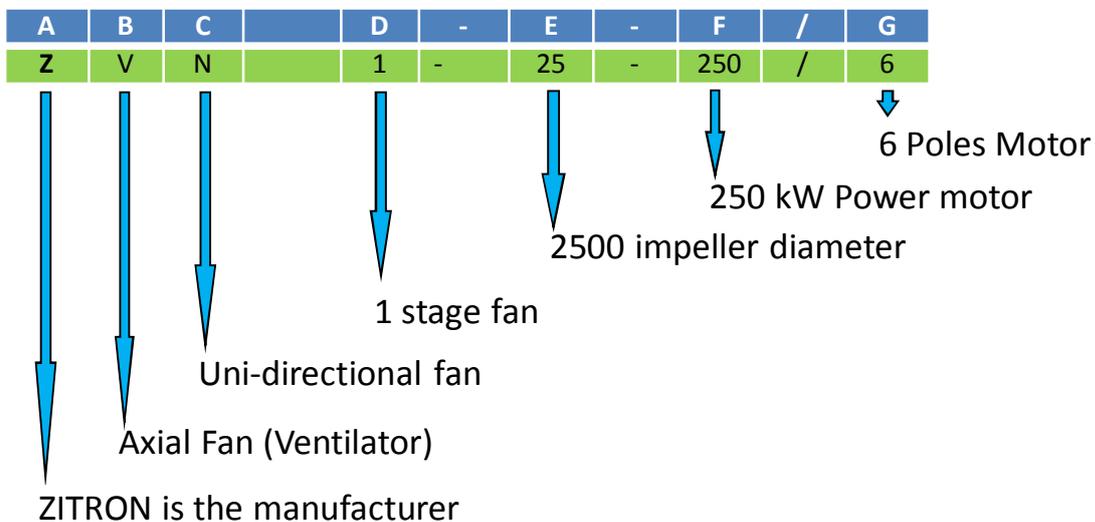
F: Motor Power (in kW)

- Power of the fan motor

G: Number of poles of the motor

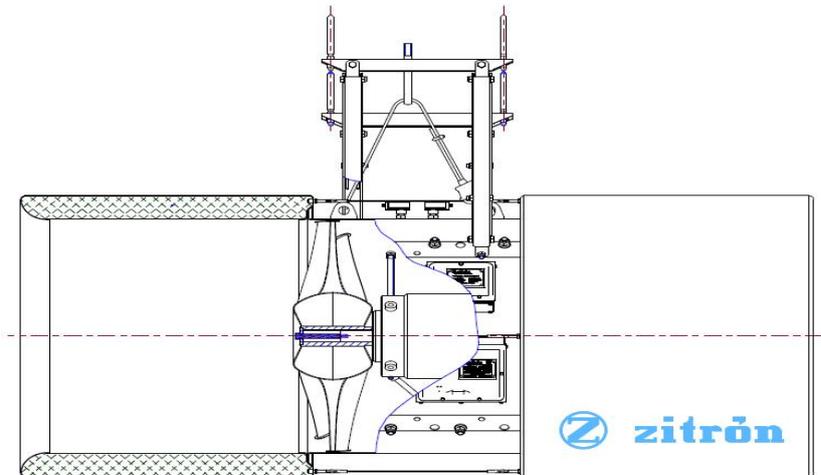
- 2 : 2 poles motor
- 4 : 4 poles motor
- 6 : 6 poles motor
- 8 : 8 poles motor
- ...

Examples:



JET FANS

Among all different tunnel ventilation systems, the longitudinal ventilation with jet fans is the most extended one, due to its flexibility and lower cost, compared with transverse and semi-transverse ventilation systems using axial fans.



Jet fans can be uni-directional type (our “JZ” series) or fully reversible type (our “JZR” series). The uni-directional jet fans, with asymmetrical blades, are designed to optimise their performance in one direction (forward), while the fully reversible jet fans, with symmetrical blades, are able to achieve the same performance in both directions (forward and reverse).

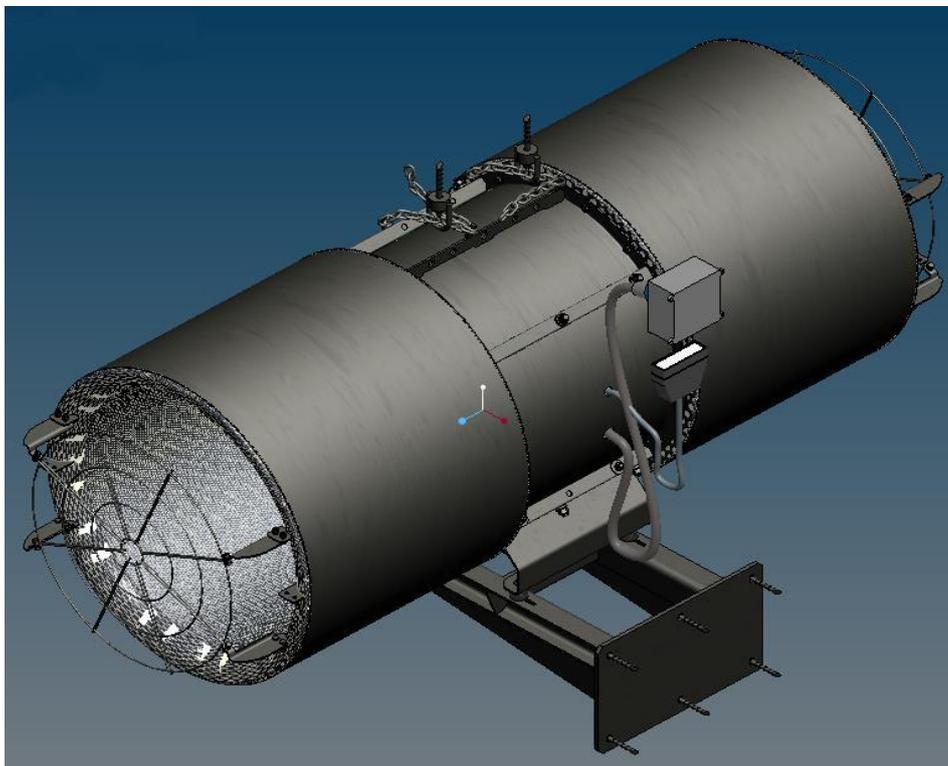
The jet fans are installed inside the tunnel, either hanging them from the ceiling by means of a suspensions system or placing them on top of small base frames fixed to the lateral walls of the tunnel. Normally suspension system or base frames are also included in ZITRON’s scope.



The standard configuration of jet fans includes two tubular silencers at both ends of the jet fan unit, so the noise level generated when the jet fans are in operation, especially at full speed, is reduced. In case of severe noise restrictions, the length of the tubular silencers can be enlarged. In addition to the tubular silencers, the following accessories can be also provided:

- Safety cables or chains to prevent jet fan is falling down
- Grids to avoid that operators and maintenance personnel could be injured accidentally by touching accidentally the impeller, which is the rotating part of the jet fan. Also to prevent that strange objects can go inside the jet fan, hitting and damaging the impeller blades while jet fan is in operation.
- Deflectors to lead the air flow in the required direction reducing frictional losses when the fan is installed very near to the tunnel walls
- Vibration sensors to control that vibration level are under the safety limit and alarm when it is exceeded.

(*) Grids and deflectors are assembled at the inlet side, in case of uni-directional jet fans, or at inlet and outlet sides, in case of fully reversible jet fans.



As the environmental conditions in some tunnels could be highly corrosive, jet fans have to be manufactured using the appropriate materials and anti-corrosive treatments to protect them against corrosion and enlarge their operative life.



The following types of mechanical construction are available:

Standard Construction

Casings of the jet fans and silencers in galvanised carbon steel

Impeller blades in aluminium alloy and impeller hub in galvanised steel plate

Improved Standard Construction

The standard construction can be improved by painting the casings and/or the impeller blades and hub. Different painting procedures can be applied.

Stainless Steel Construction

Casings of the jet fans and silencers in stainless steel plate AISI 316L

“Mono-block” type impeller with blades and hub in stainless steel plate AISI 316L

Hybrid Construction

A combination of above described different type materials and/or anti-corrosive treatments.

Consultants and tunnel operator should select the most adequate jet fan construction for their particular environmental conditions inside the tunnel.

ZITRON's jet fans are named using the following sequence:

Code:

A	B	C	D		E	-	F	/	G
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A: type of machine

- J: Jet fan

B: First Initial letter of manufacturer

- Z: ZITRON

C: Reversibility

- (No letter / number): Uni-directional
- R: 100 % Reversible

D: Type of impeller / mechanical construction

- (No letter / number): impeller with Aluminum alloy blades
- i: "monoblock" impeller with blades and hub manufactured in Stainless steel AISI 316L

E: Impeller diameter (in dm)

- From 5: 5 dm = 500 mm
- Up to 16: 16 dm = 1600 mm

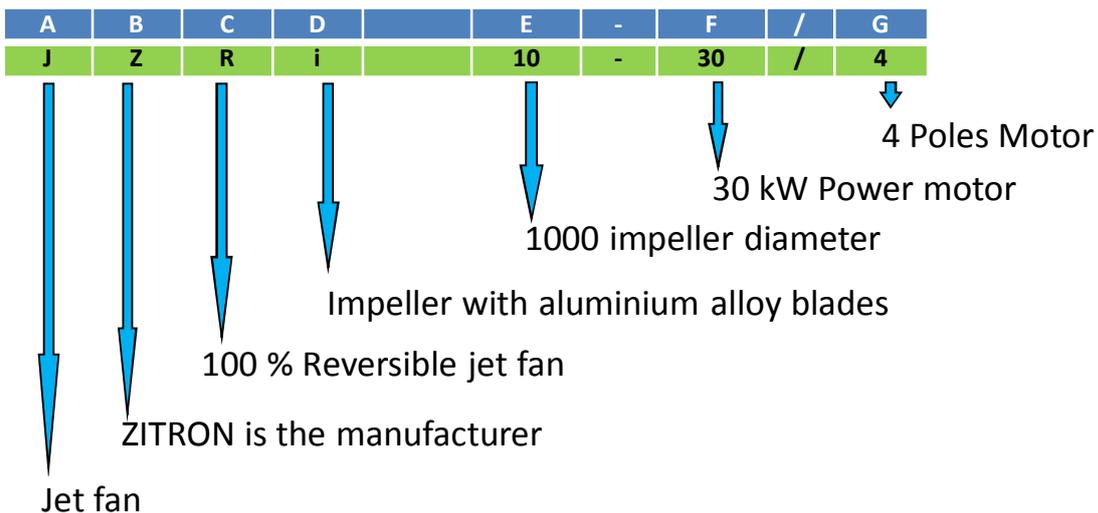
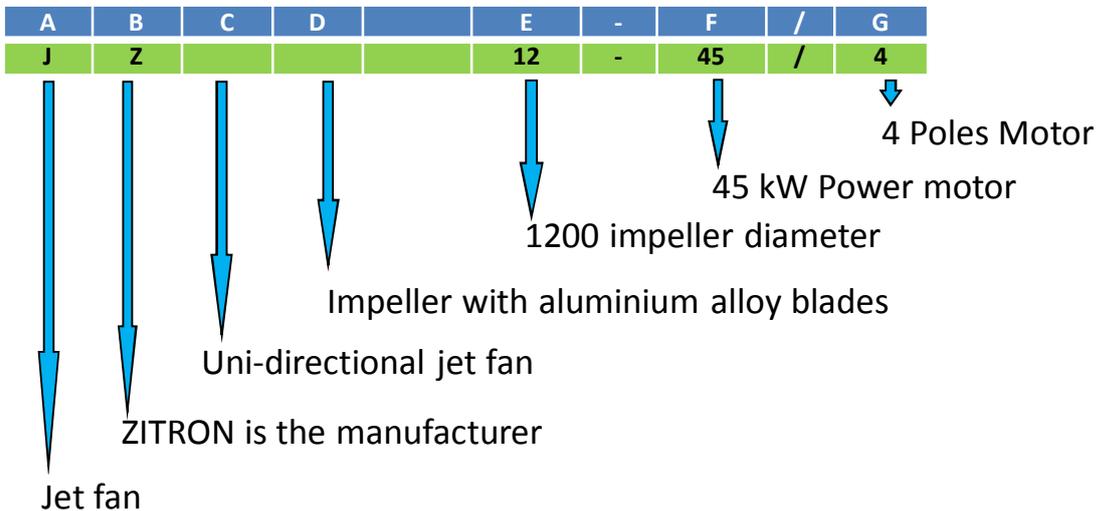
F: Motor Power (in kW)

- Power of the fan motor

G: Number of poles of the motor

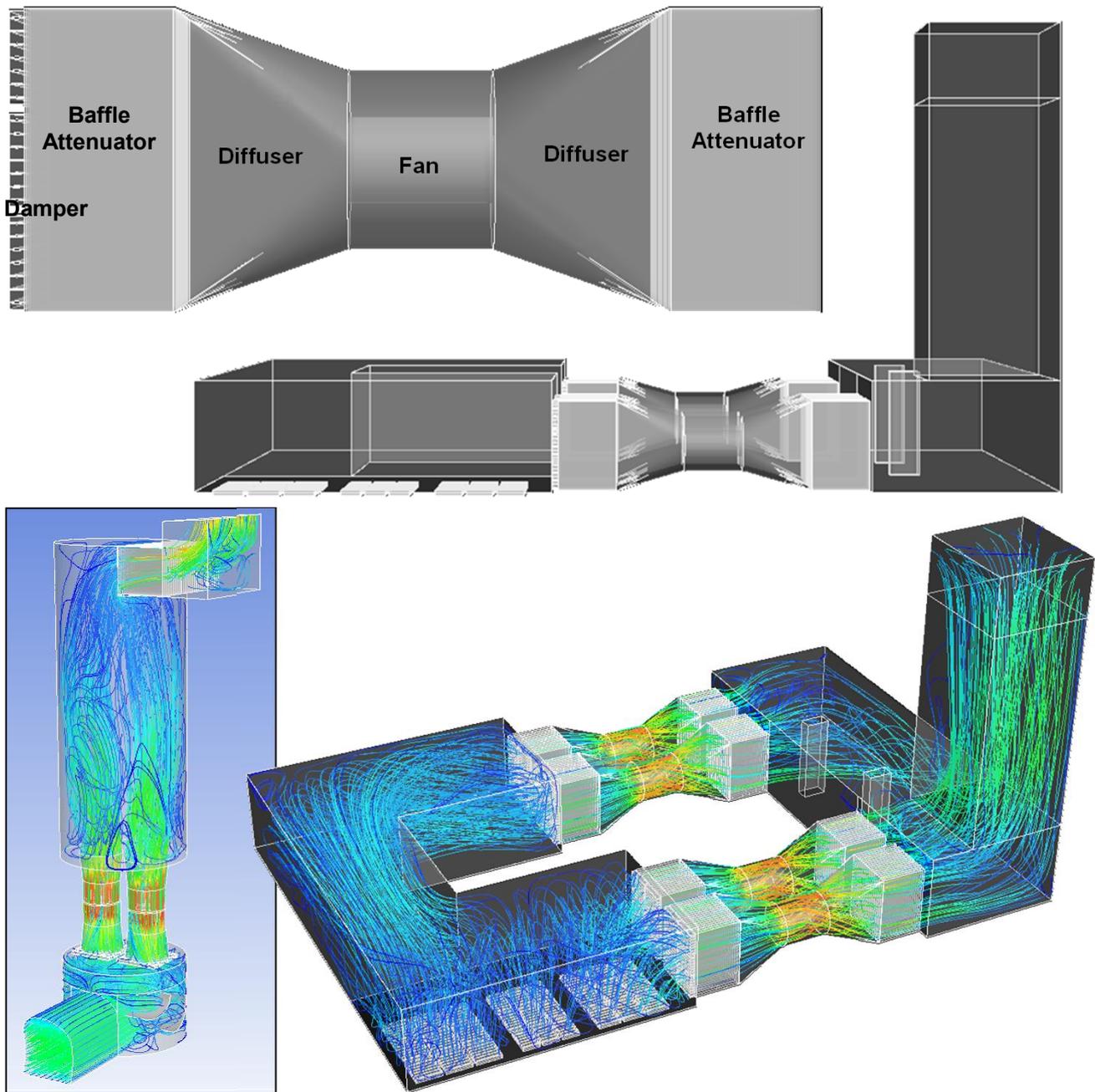
- 2 : 2 poles motor
- 4 : 4 poles motor
- 6 : 6 poles motor

Examples:



DESIGN AND ENGINEERING TOOLS

ZITRON technical department uses the latest available engineering tools for CAD (Computational Aided Design), CFD (Computational Fluid Dynamics) and 3-dimensional drawing programs.



By means of a 3D Computational Fluid Dynamic software, named as FLUENT[®], we can simulate and optimise the critical parts of the ventilation system, such as the connections between horizontal fan and vertical shaft, 90° bends, bifurcation areas,...

ZITRON also provides designing services and full technical support, including ventilation studies, optimization of the ventilation system, dimensional and installation drawings, foundation drawings, ...

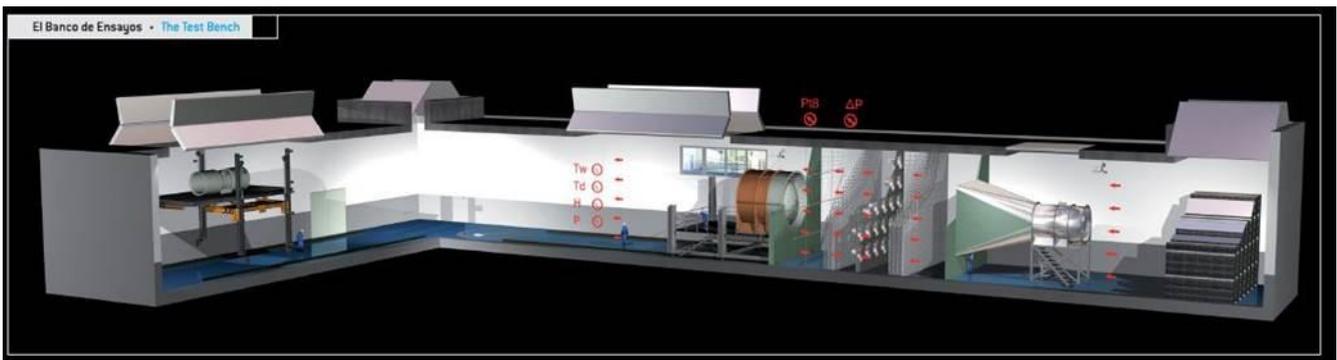


Further ZITRON has developed a fan selection and tendering software, required for adequate handling and limited response times. Development of design tools and software is an ongoing process in our company.

TEST BENCH

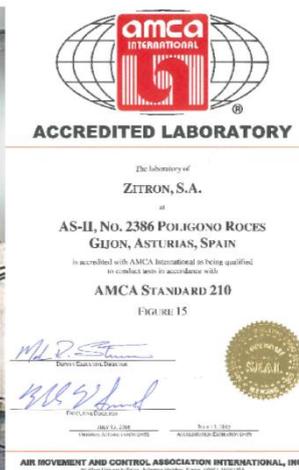
A complete FAT (Factory Acceptance Test) procedure is a key point to ensure a good performance and verify the right efficiency for axial fans and jet fans used in Tunnels and Metros.

ZITRON has the world's biggest aerodynamic test bench for Tunnel and Metro axial fans. The fans are not only tested for internal use but also to prove to our clients that they match the characteristic curve and other technical specifications.



ZITRON's testing procedure is certificated by AMCA (Air Movement and Control Association) and the test bench is considered to be the world's biggest AMCA laboratory.

During the test different aerodynamic conditions can be simulate to our clients, meaning that the fan is tested at different operational points (Air Flow Vs Pressure).



OUR SERVICE TEAM

ZITRON's team has the highest level of qualification and expertise to carry out mechanical and electrical installation for complete ventilation systems in road tunnels, railway tunnels and Metros.

Our after sales service includes engineers for supervision of installation, start up and commissioning. This is an important procedure that can only be successful with experienced and trained engineers to get the best out of our equipment.

Our engineers also provide training to the Customer's technical staff and maintenance services, upon request.



REFERENCES

ZITRON has an extensive reference list including the most important tunnel projects nowadays.



CROSSRAIL PROJECT (LONDON)



And over 500 different projects world-wide....

METRO MADRID LÍNEA 7 [ESPAÑA] / METRO DE MARSELLA [FRANCIA] / METRO DE ANKARA [TURQUÍA] / TÚNELES GEDO Y PEDREDO [CANTABRIA] / TÚNEL DE LAS ROZAS [MADRID] / TÚNEL DE EZCABA [NAVARRA] / TÚNEL AEROPUERTO DUBAI FASE II [EMIRATOS ÁRABES UNIDOS] / TÚNEL NANG PASS [VIETNAM] / TÚNEL SIAIX [FRANCIA] / TÚNEL DE LACABE [ESPAÑA] / TÚNEL CUATRO CAMINOS [MADRID, ESPAÑA] / TÚNEL FERROVIARIO AVE RENFE MADRID-LLEIDA [ESPAÑA] / TÚNEL DE PORTELA [PORTUGAL] / TÚNEL SAN JERONIMO [COLOMBIA] / TÚNEL CASTELL DE FERRO [ESPAÑA] / TÚNELES DE ISCA - POLLA, GALLERIE, D'AMBROSIO, LEONE [ITALIA] / TÚNELES DE ZALDIBAR [ESPAÑA] / TÚNELES DE SOZINA [MONTENEGRO] / ATHENS PIRAEUS ELECTRIC RAILWAYS [GRECIA] / VARIANTE DI VALICO, GALLERIE: MONTE MARIO, ALLOCO, VADO [ITALIA] / CHONGQING-CHANGSHOU EXPRESSWAY [CHINA] / TÚNEL SUR INTEROCEÁNICA [ECUADOR] / TÚNEL VANA [IRÁN] / TÚNEL DES TILLEULS [FRANCIA] / FASKRUDSFJARDARGÖNG [ISLANDIA] / TUNNEL DE L'EPINE, TUBE NORD [FRANCIA] / TÚNELES DE IKASTUNDI - ARISTI [ESPAÑA] / TUNNEL DES MONTS [FRANCIA] / LANE COVE TUNNEL [AUSTRALIA] / NEFISE AKÇELIK TUNNEL [TURQUÍA] / PORTE TUNNEL [ITALIA] / AUTOVIA DEL CAMINO [ESPAÑA] / TÚNEL CALLE COSTA RICA [ESPAÑA] / TÚNEL NOIRDRIFTSLEDEN [SUECIA] / TÚNEL PRIANES [ESPAÑA] / TÚNEL COLL DE FRARE [ESPAÑA] / TÚNEL AVENIDA PIO XII [ESPAÑA] / TÚNEL FLUGHAFEN [AUSTRIA] / TÚNEL KARSIYAKA [TURQUÍA] / TÚNEL DE LANTUENO [ESPAÑA] / TÚNEL PUERTO PIQUERAS [SORIA - ESPAÑA] / TÚNEL SXISTO [GRECIA] / TÚNEL DE LA BARROSA [ESPAÑA] / TÚNEL DE EL ESTRECHO [ESPAÑA] / TÚNEL DE EL COBAS [ESPAÑA] / TÚNEL METSOVO INTERCHANGE [GRECIA] / TÚNEL AMENAJEMENT DU CARREFOUR CHEVALLEY [ARGELIA] / METRO DE KIEV [RUSIA] / METRO DE MONTREAL [CANADÁ] / METRO DE TOULOUSE LIGNE B [FRANCIA] / METRO DE MADRID REMODELACION LÍNEA 3 [ESPAÑA] / E12 UMSKARDTUNNELN [NORUEGA] / METRO DE MUNICH [ALEMANIA] / METRO SÃO PAULO LINHA 2 [BRASIL] / METRO MADRID PROLONGACION LINEAS 1,4,5,10 Y 11 NORTE [ESPAÑA] / METRO CARACAS LÍNEA 4 [VENEZUELA] / METRO MADRID PROLONGACION L1 ENSANCHE VALLECAS [ESPAÑA] / TUNEL MONTE JARRIO AUTOVIA DEL CANTABRICO [ESPAÑA] / TUNEL DE ABOÑO MUSEL [ASTURIAS - ESPAÑA] / TUNNEL PORTE DES LILAS CIRCUNVALACION DE PARIS [FRANCIA] / T.C.S.P. SAINT OUENTIN [YVELINES PARIS - FRANCIA] / ULUBURUN TUNNELS GİRESUN BLACK SEA HIGHWAY [TURQUÍA] / PUNE - SATARA TUNNELS NH - 4 HIGHWAY [MAHARASHTRA - INDIA] / TUNNEL DU PAILLON A 8 [LA TRIMITE - FRANCIA] / HOGENHEIN TUNNEL [HOGENHEIN - NORUEGA] / METRO MADRID PROLONGACION L2 [ESPAÑA] / METRO LOS TEQUES [LOS TEQUES, CARACAS - VENEZUELA] / THE PALM JUMEIRAH TUNNEL [DUBAI - EMIRATOS ÁRABES] / METRO CARACAS LÍNEA 3 [VENEZUELA] / RESALAT TUNNEL [IRÁN] / METRO VALENCIA ESTACION MARITIMO SERRERIA, L5 [ESPAÑA] / METRO MADRID LÍNEA METRO NORTE [ESPAÑA] / TUNEL GUADARRAMA - VALLE DE LOS CAIDOS - S. RAFAEL AP 6 [MADRID - ESPAÑA] / SOTERRAMIENTO FERROVIARIO DE PALMA DE MALLORCA [PALMA DE MALLORCA - ESPAÑA] / TUNEL DE LA CIRCUNVALACION A SANTA CRUZ DE LA PALMA [LA PALMA - ESPAÑA] / CIUDAD DEPORTIVA PIO XII - SALIDA MONFORTE DE LEMOS [MADRID - ESPAÑA] / BOLU TUNNEL [TURQUÍA] / B 426a ORTUMGEHUNG NIEDER-RAMSTADT LÖHBERGTUNNEL [DARMSTADT HESSEN - ALEMANIA] / TUNEL TIMIJRAOUE [EL HIERRO - CANARIAS - ESPAÑA] / TUNNEL DU SCHIRMECK [SCHIRMECK - FRANCIA] / METRO MADRID PROLONGACION LÍNEA DE METRO DE MADRID ESTE [ESPAÑA] / METRO MADRID PROLONGACION LÍNEA METRO ESTE MADRID [ESPAÑA] / TUNEL N-I CONDADO DE TREVIÑO [BURGOS - ESPAÑA] / EXTENSION OF BRUNNEN TUNNEL [BRUNNEN - SUIZA] / TUNEL DE RAIMEX [BERN - SUIZA] / METRO LAUSANNE M 2 [SUIZA] / RASOUMI ROAD TUNNEL [RASOUMATI - GRECIA] / S4 TUNEL - SOUTH LANE [EGIPTO] / ODS - GRECIA] / TUNEL LA POLVORA [VALPARAISO - CHILE] / METRO MADRID LÍNEA 3 [ESPAÑA] / TUNEL DE EL MARCHANTE AUTOVIA MERJA - ALMUÑECAR [ESPAÑA] / ECHANGEUR DEFINITIF DE LA JUNCHERE [FRANCIA] / METRO TOULOUSE STATION JEAN JAURES [FRANCIA] / METRO LYON LOCALS LA SOIE ET R. SALENGRO [FRANCIA] / METRO LYON L. BONNEVAY [FRANCIA] / METRO MADRID PROLONGACION LÍNEA 4 [ESPAÑA] / TUNEL SA MOLA C-711 ACCESO AL PUERTO DE SOLLER [MALLORCA - ESPAÑA] / METRO MADRID PROLONGACION LÍNEA ESTE [ESPAÑA] / METRO ISTAMBUL [EDIRNEKAPI - SULTANCIFRUGI - TURQUÍA] / TUNNEL KINIMIDOS MOTORWAY ATHENS - THESSALONIKI [GRECIA] / DICHALORAMA TUNNEL MOTORWAY ATHENS - THESSALONIKI [GRECIA] / EPAD VOIE DES BATISSEURS [PARIS - FRANCIA]

The growing market of ZITRON's fans around the world, along with the high level of satisfaction of our clients is the best mark of our quality and services.



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