

Prepared for:

**The Administration of the Union
Territory of Ladakh
PWD (R&B)**



Project:

Detailed Project Report (DPR) for preparation of various Road/Tunnel projects of Public Works (R&B) Department, UT of Ladakh - Highway tunnel across Fotu La Pass (1.7 Km approx.) along with its approaches on Zojila - Leh - Kargil Road

Subject:

**FOTULA TUNNEL
TECHNCIAL SPECIFICATIONS-
(TUNNEL VENTILATION)
VOLUME-4C**

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00	25.02.2025	Draft Issue	AAL	RSD	LK
Rev.	Date	Description	Originator	Checked	Approved
Document No: MITES_00081_FOTULA_TS-TV_VOL-4C_R0			Revision: 0		

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Revision History

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1 TECHNICAL SPECIFICATIONS

1.1 Jet Fans

1.1.1 General Requirements

The jet fans should be manufactured in a sturdy and robust manner. To avoid corrosion the jet fans and the mounting structure should be manufactured in Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm). The fans should be exchangeable.

The jet fans should be designed to run in both directions with same thrust in forward and reverse direction.

Under normal duties the jet fan has to be designed to run at temperatures between – 20 and +40°C. In the event of fire, the jet fan has to withstand a temperature up to 250°C for 120 minutes. In order to prove this, for the relevant parts like impeller, motor, terminal box and terminals a heat test of a complete unit has to be conducted. The test must be certified by an independent laboratory. Testing of single parts e.g. impeller blades is not valid or sufficient. If the manufacture could not provide a sufficient certificate the costs for a heat test has to be included in the quoted prices.

The jet fans are delivered with a vibration sensor mounted on the casing. The outlet signal is 4-20 mA.

1.1.2 Casing

The casing and the motor support should be manufactured from heavy construction 6 mm steel at minimum. To avoid corrosion in cracks the flanges have to be formed at the fan casing or welded construction. Welds must be continuous. The external terminal box in Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm) is heavy duty and corrosion resistant in IP55.

Outside on the fan housing a terminal box made of Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm) is installed.

1.1.3 Impeller

The impeller blades are made of corrosion-resistant, cast aluminium. To avoid corrosion the blade aluminium alloy must have less than 0.1% Cu. The nucleus of the hub is made of steel. The impeller is directly mounted onto the motor shaft. Strong steel bolts have to be cast in the aluminium blade to ensure the necessary stability in case of fire. To ensure a high efficiency the blades should be profiled. The blade angle is adjustable

at standstill. The impeller has to be carefully statically and dynamically balanced (min. G2.5).

1.1.4 Silencers

Due to corrosion protection, all components of the silencers are manufactured in Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm). At the inlet and the outlet side, an aerodynamically shaped cone has to be provided. All welds are continuous. Rivet on outer silencer casing are allowed. Corrosion in cracks must be avoided. The isolation material is non-flammable mineral wool, which is fitted between the outer casing and the perforated sheet. Fibre between perforated plate and mineral wool has to be included. The dimensioning of the silencers should be done according to specified sound power level. For silencer lengths above 1.5D, measures to prevent swing must be implemented.

1.1.5 Motor

For jet fans, 3 phase, fully enclosed, squirrel cage motors according to IEC standards in IP55 should be used. To reach a well-balanced cooling and air stream, the motor design is IMB5 or IMB14. The motor support with integrated guide vanes is welded on the fan casing. The electrical start will be via a frequency-converter or direct online in voltage operation 415 V +/- 10%. The isolation class is H. The motors are suitable to withstand 250°C for 120 minutes. The bearings are lubricated for life. The bearing life-time is min. 40,000 hours. The halogen free and flame-resistant power cables are connected to the external terminal box.

1.1.6 Specifications for reversible Jet Fan

Parameter	Jet Fan Specification	Unit
Outer Diameter	1570	m
Inlet Diameter	1120	m
Jet Fan Type	Reversible jet fan with silencer	-
Time for reversal	90	Sec
Stand-Thrust	2241	N
Discharge Velocity	44.7	m/s
Motor Rating	75	kW

1.1.7 Materials

Fan casing	Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm)
Impeller seawater resistant	Cast aluminium
Silencer casing	Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm)
Perforated sheet	Steel S235JR, galvanised in accordance with ISO 1462 (min. 50 µm) and powder coated RAL 7030 (100 µm)

1.1.8 Technical Data – Motor

Power	75 kW
Voltage	415 V
Frequency	50 Hz
Operation	FC or DOL
Efficiency	>91%
Power factor	>0.82
Protection	IP55
Isolation class	H
Bearing lifetime	min. 40,000 h
Winding protection	3xPT100 (3wire)
Corrosion protection	C5

1.2 Air Quality Monitor

Visibility sensor to measure the visibility (k-value) in the vicinity of its mounting point in the tunnel.

- Measurement of visibility by scattered light
- Laser diode with a wavelength of 650 nm (adapted to human night vision)
- Dual-beam method to compensate soiling of the optics
- Integrated purge air system to prevent optics from soiling
- Extraction of tunnel air by integrated fan either at the mounting location or through a suction system up to 10 m
- Probe air heater to eliminate fog from measurement

- IP rating IP69K
- Stainless steel housing 1.4404 (AISI 316L)
- Measuring range visibility $0 - 15 \times 10^{-3} \text{ m}^{-1}$
- Resolution visibility $0.001 \times 10^{-3} \text{ m}^{-1}$
- Temperature range $-40 - +60 \text{ }^{\circ}\text{C}$
- Relative humidity 0- 100 % (non-condensing)
- Measurement of gas concentration by electrochemical cells
- Delivered factory-calibrated
- Toolless quick exchange of electrochemical sensor cells with pre-calibrated sensor cells to avoid on-site calibration
- Measuring ranges / resolution / accuracy:
 - 0 -300 ppm CO / 0.3 ppm / ± 2 ppm or 2 % reading
 - 0 - 25 ppm NO / 0.05 ppm / ± 0.5 ppm or 2 % reading
 - 0 - 2 ppm NO₂ / 0.02 ppm / ± 0.05 ppm or 4 % reading
- Temperature-compensated measurement
- Connection to tunnel control system by
 - 4 x analogue 4-20 mA output (can be freely assigned, e.g. 1 visibility, 1 CO, 1 NO₂, 1 temperature)
 - 3 x relay output o MODBUS RTU (RS-485 port)
 - MODBUS/TCP (Ethernet port)
 - 3 x relay output
- Integrated web server for visualisation, configuration, data logging, remote maintenance
- Connection to tunnel control system by
 - 4 x analogue 4-20 mA output (can be freely assigned, e.g. 1 visibility, 1 CO, 1 NO₂, 1 temperature)
 - 3 x relay output

1.3 Air Flow Monitoring System

Air flow monitoring system to measure the longitudinal air flow in a tunnel.

- Ultrasonic air flow measuring system based on different transition times of ultrasonic pulses
- Measurement of average air flow over the whole tunnel cross section
- Two transceivers with mounting clamps mounted below the tunnel ceiling in an angle of 30° to 60° to the tunnel axis
- Sensor membranes made from corrosion-free material
- Stainless steel wall mounting brackets 1.4571 (AISI 316Ti) or 1.4404 (AISI 316L)
- IP rating IP67
- Measuring range -20 - +20 m/s
- Resolution 0.1 m/s
- Temperature range -40 - +70 °C
- 1 analogue output 4 - 20 mA, 2 relays
- RS-485 port
- MODBUS RTU protocol

-----End of Main Document-----