



# TLT-Turbo



## Important reference projects for tunnel ventilation

### Road tunnel ventilation systems

- Tunnel Craptaig / Switzerland (2170 m)
- Tunnel Roveredo / Switzerland (2300 m)
- Tunnel Leifers / Italy (2860 m)
- Tunnel Lungern / Switzerland (3550 m)
- Elbtunnel / Germany (2950 m)
- Zürich Western Ring / Switzerland (2175 m)
- Tunnel Seelisberg / Switzerland (9200 m)
- Tunnel Roppener / Austria (5100 m)
- Tunnel Arlberg / Austria (13930 m)

### Railway tunnel ventilation systems

- Gotthard Base Tunnel / Switzerland (57 km)
- Furka Tunnel / Switzerland (15,4 km)
- Oresund Tunnel / Denmark – Sweden (4 km)

### Metro tunnel ventilation systems

- London Heathrow Terminal 5 / Great Britain (19 km)
- Metro Almaty / Kazakhstan (8,5 km)
- Metro Baku / Azerbaijan (3,5 km)



## TLT's metro references worldwide





## Reference 1

**Longest railway tunnel worldwide  
Gotthard Base Tunnel, Switzerland**





## TLT's newest reference project for tunnel ventilation systems (TVS)

### Longest railway tunnel worldwide

### Gotthard Base Tunnel, Switzerland

Scope: "TVS" Tunnel Ventilation System

- Construction time: 17 years  
TLT-Part: 5 years
- Investment: 21,5 Billion EUR  
TLT-Part: 48 Million EUR

Customer's decision for TLT because a full range integrated solution was requested





## TLT's newest reference project for tunnel ventilation systems (TVS)

**Longest railway tunnel worldwide**

**Gotthard Base Tunnel, Switzerland**

Scope: "TVS" Tunnel Ventilation System

400 fans with drive systems, cabling, station control system, fire detection device system, medium/low voltage system, installations, commissioning and testing

**... for health & safety**



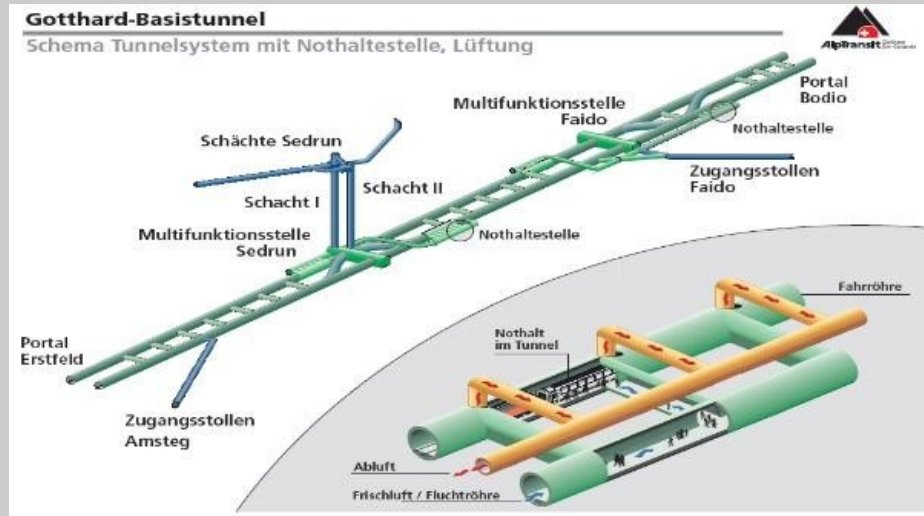


## Fresh Air for the World's longest Railway Tunnel



### Longest railway tunnel worldwide 2x57 Km Gotthard Base Tunnel, Switzerland

Scope: "TVS" Tunnel Ventilation System with fans, drive system, cabling, station control system, fire detection device system, medium/low voltage system, installations, commissioning and testing







## Fresh Air for the World's longest Railway Tunnel

152



TLT-Turbo GmbH



152 km of tunnel system  
incl. 2 x 57 km main tunnel  
with 180 cross passage tubes

TLT as consortium leader  
for tunnel ventilation system

High availability system

- High speed test with 275 km/h
- Fulfillment of Swiss customers high availability targets of > 99,8%
- Energy saving upto 18% due to TLT's optimization compared to design
- Integrated system for high complexity with from one source
- 30 years life time requirement for ventilation equipment



## Fan System and installation for the World's longest Railway Tunnel

**Longest railway tunnel worldwide  
2x57 Km Gotthard Base Tunnel,  
Switzerland**

- 4 supply fans each 28 t
- 4 smoke exhaust fans each 28 t
- 24 exhaust dampers
- 360 overpressure fans
- 24 special jet fans

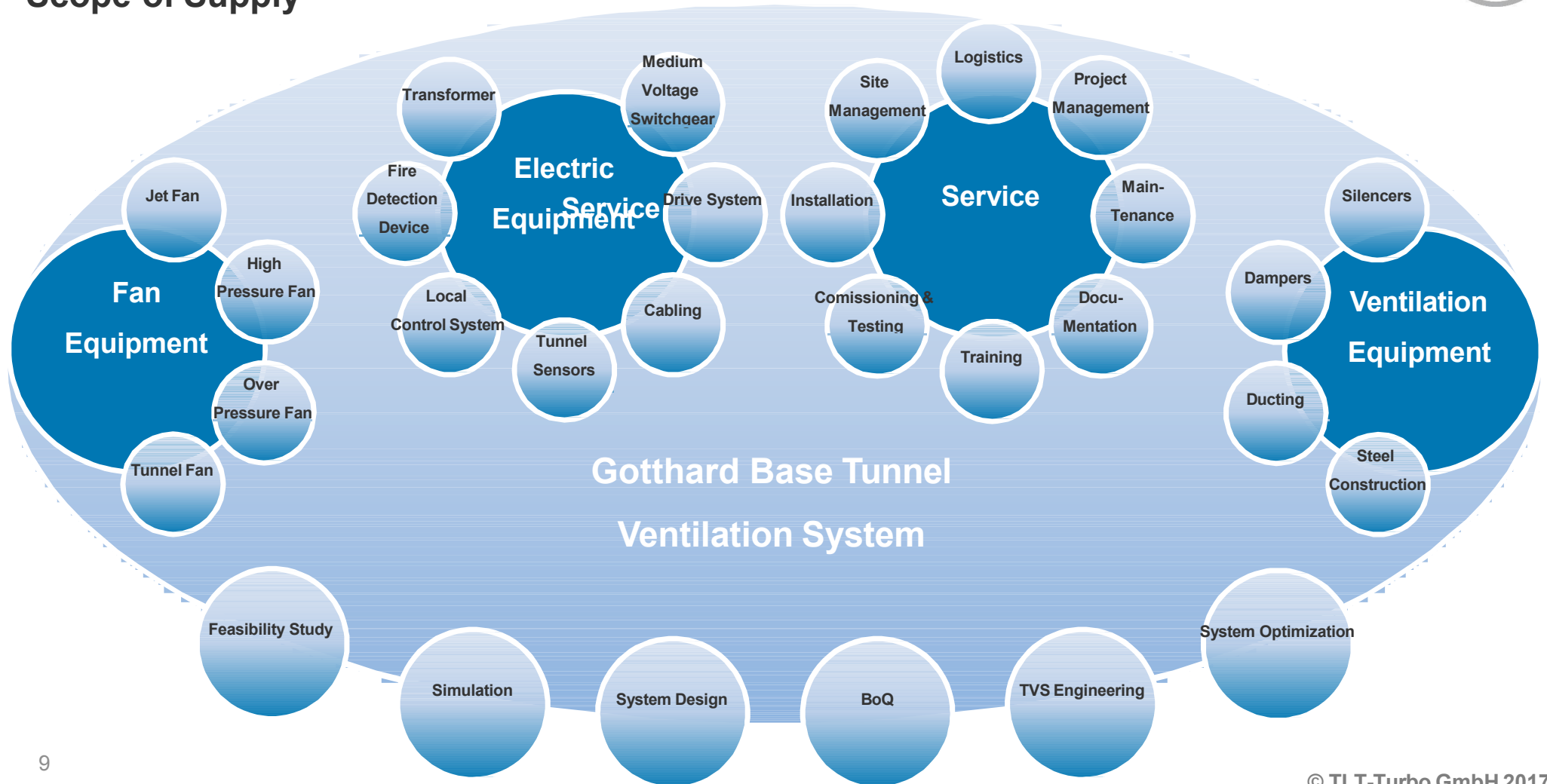
Number of trucks: 32

Total equipment weight: approx. 550t





## Scope of Supply



## Scope of Supply

### Fan Equipment

- 4 Tunnel Fans for fresh air
- 4 Tunnel Fans for exhaust air (temp. res. 400 C)



*Pictures of Tunnel Fans*



## Scope of Supply

### Fan Equipment

- 24 Jet Fans



Picture of Jet Fan installation



## Scope of Supply

### Fan Equipment

- 1 High pressure fan with two stages



*Picture of high pressure fan*



## Scope of Supply

### Fan Equipment

- 360 Over pressure fans



*Picture of over pressure fans*



## Scope of Supply

### Ventilation Equipment

- 28 Exhaust air hatches (4,3 m x 5 m)
- 1 Hydraulic fresh air hatch (2 m x 2,5 m, temp. res. 1000 C)
- 2 Air hatches per axial fan

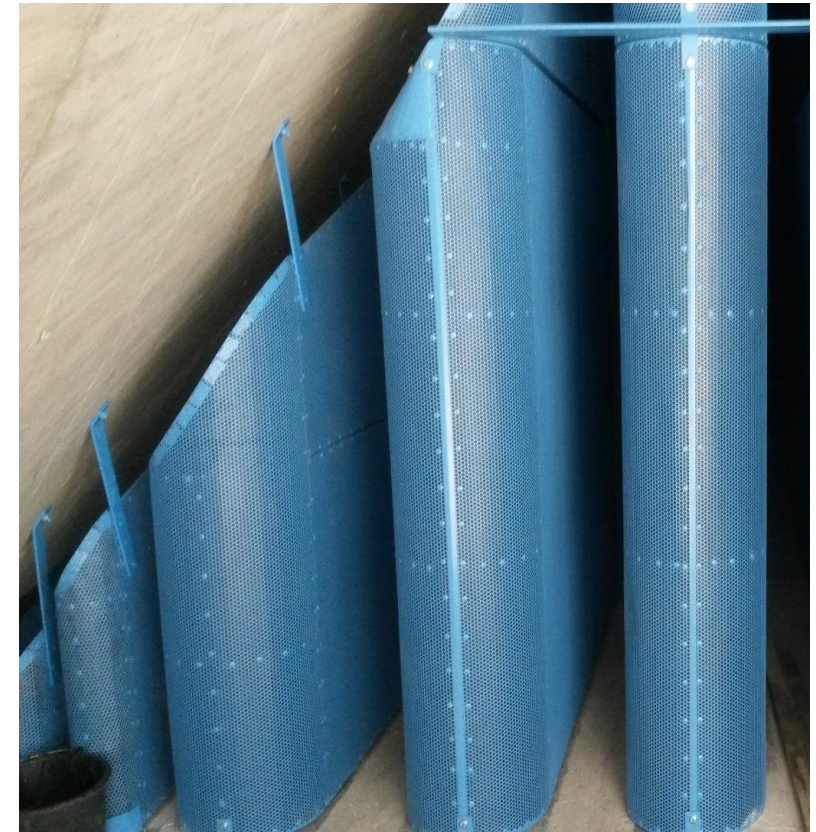
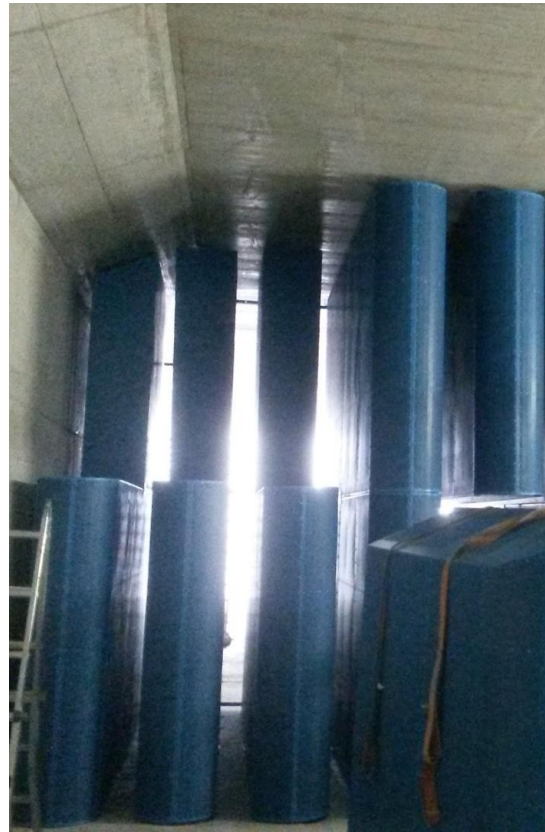


*Picture of exhaust air hatch*

## Scope of Supply

### Ventilation Equipment

- Silencers
- Steel construction parts
- Ducting



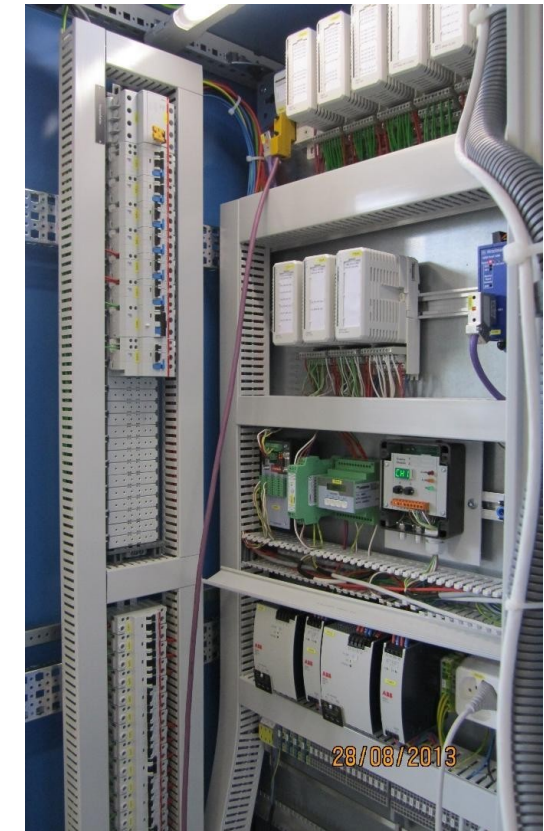
*Pictures of silencers*



## Scope of Supply

### Electric Equipment

- Drive Systems
- Cabling
- Station Control System
- Fire Detection Device System
- Medium/low Voltage System



*Pictures of control system and fan monitoring cabinet*



## Scope of Supply

### Service

- Logistics
- Site management
- Installation
- Commissioning & Testing



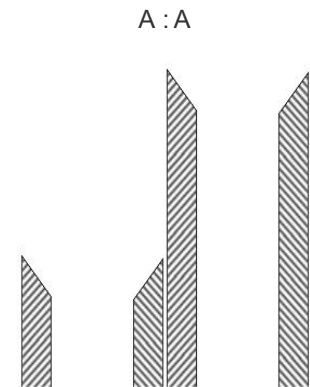
*Pictures of fan installation*



## Scope of Supply

### System Design

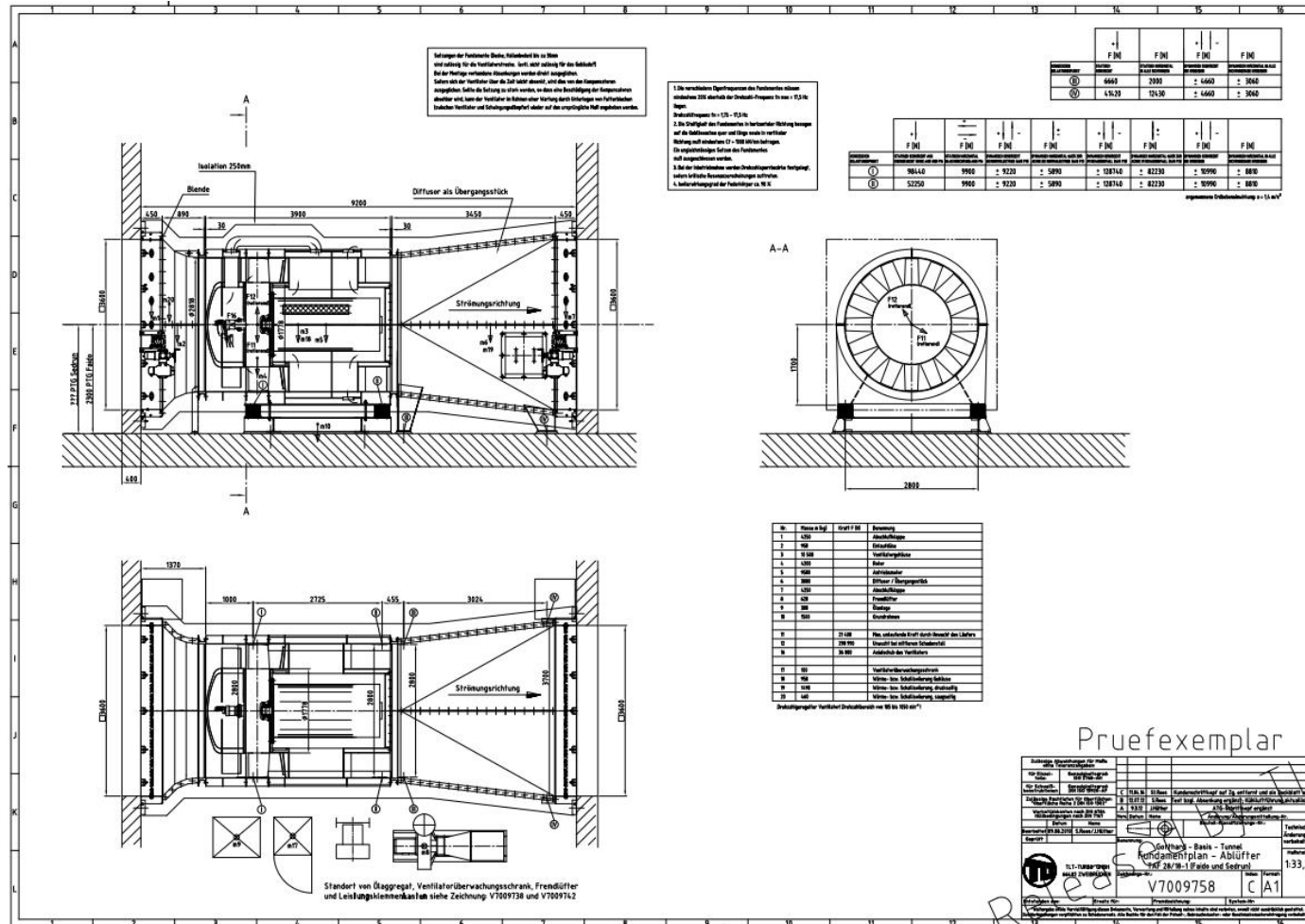
- Development and improvement of aerodynamic design to reduce pressure drop
- Prevention of smoke recirculation from exhaust to fresh air inlet



Erstfeld Portal



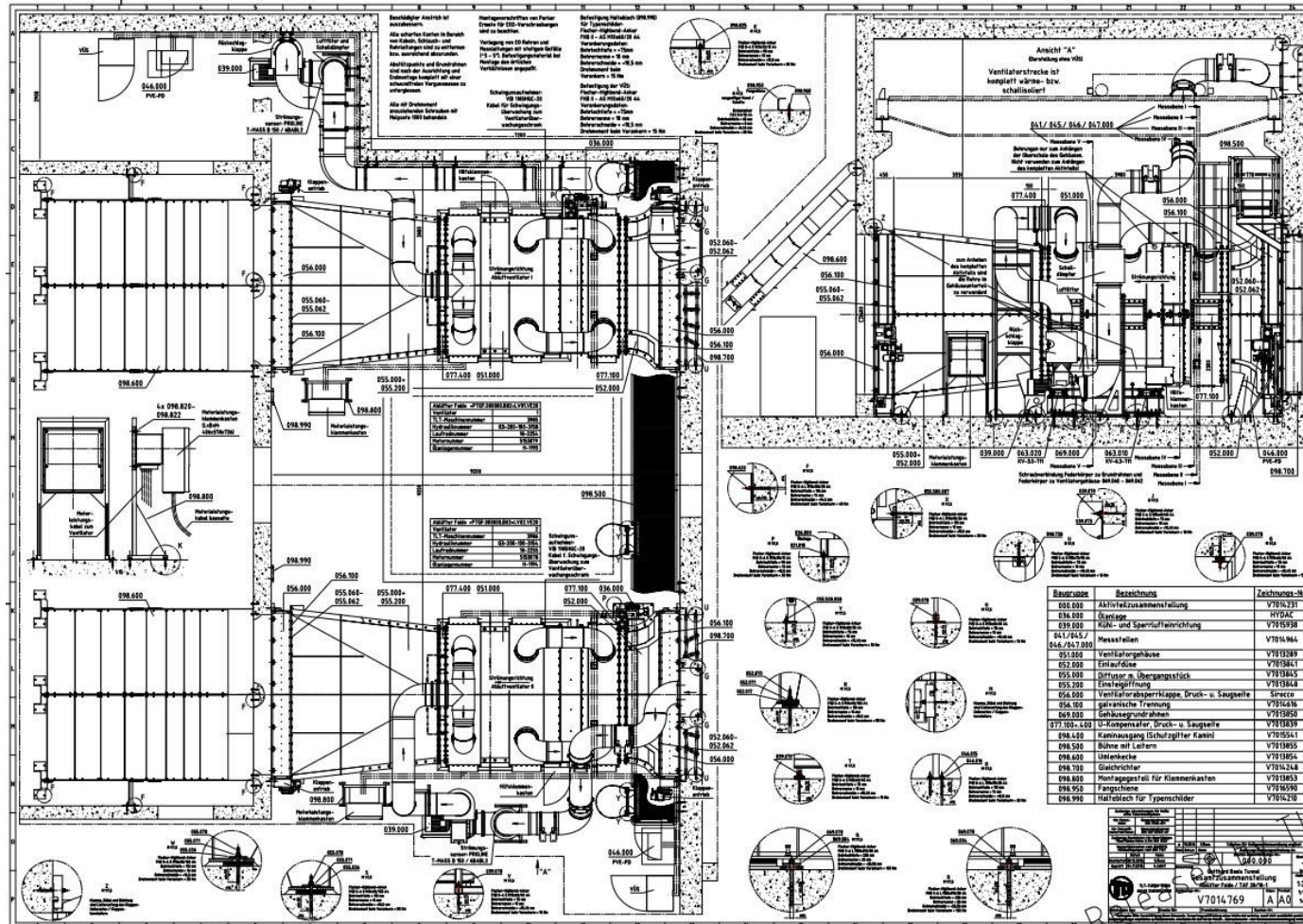
# Drawings (extract)







# Drawings (extract)





## Customer Benefits

### Summary

- Reduction of total fan electricity consumption by 1.303 kW (~10 %)
  - 32.000 MWh over life time
  - 30.500 t CO2 substitution over life time
  - 4,5 Mio € savings in operating costs over life time

Project life time	Operating hours per year [h/a]	Electricity consumption [kWh]
Construction & Test	5.200	6.760.000
1	650	845.000
2	650	845.000
...	...	
30	650	845.000
<b>Σ</b>	<b>24.700</b>	<b>32.110.000</b>

## Technical Reliability & Safety

### TLT-Project

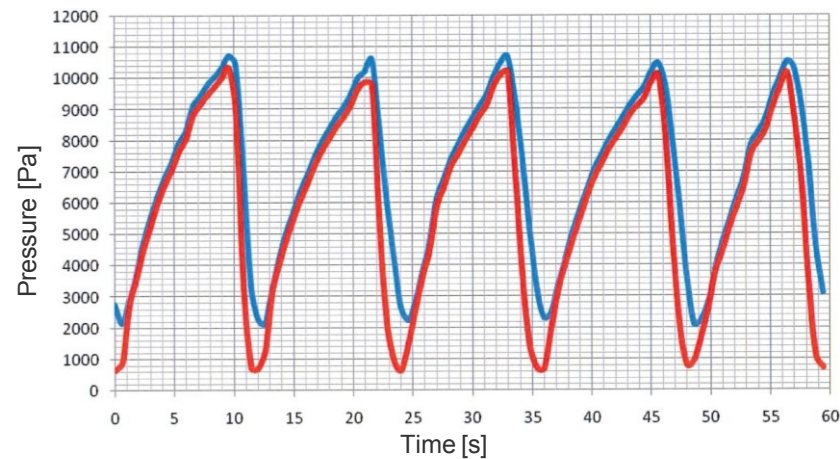
#### „Gotthard Base Tunnel“

#### Technological Challenge

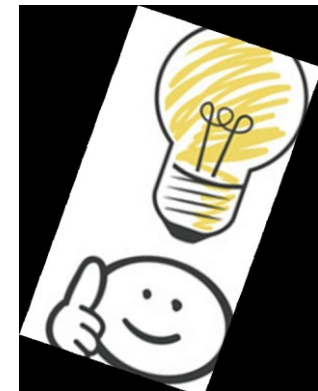
- High train speed of 250 km/h and interaction between train and tunnel cause exceptionally high pressure waves
- **TLT had to proof to customer that ventilation equipment will withstand the resulting mechanical stress**

#### Customer demand:

- Full size test under real conditions
- 510.000 cycles without interruptions or breaks
- $\pm 10.000$  Pa pressure waves



*Detail of measuring record for pressure wave tests in TLT test bench  
[blue: pressure in chamber, red: pressure in outlet]*



# Preference Letter for worlds longest railway tunnel for TLT's excellent project management



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 CHE-104 360 449 MWST  
 ISO 9001 / ISO 14001  
 ISO 18001 / ISO 27001

AlpTransit Gotthard AG

Seite 2 von 3  
 October, 1st 2014

TLT-Turbo GmbH  
 Herr Andreas Kuhn  
 Gleiwitzstrasse 7  
 D - 66482 Zweibrücken

Bearbeitet durch: Andreas Hüber, Telefon: +41 226 06 62  
 E-Mail: andreas.huber@alptransit.ch  
 L201-454627-v1/16a

Luzern, 01. Oktober 2014

**Los C. vorläufiges Referenzschreiben / preliminary reference**

Sehr geehrter Herr Kuhn

Hiermit übersenden wir Ihnen das gewünschte Referenzschreiben betreffend Los C , Betriebslüftung Gotthard Basistunnel.

**Project Name:** Gotthard Base Tunnel – Switzerland  
 Contract Lot C: Operational Ventilation

**Owner:** AlpTransit Gotthard AG  
 Zentralstrasse 5,  
 CH - 6003 Luzern, Switzerland  
 Tel. / Fax +41-41-226 06 06 / +41-41-226 06 00  
 E-mail: info@alptransit.ch

**Engineer:** Ingenieurgemeinschaft Gotthard-Basistunnel Süd – IG GBTS  
 c/o Arnberg Engineering AG  
 Trockenlostrasse 21  
 Postfach 27  
 CH – 8105 Regensdorf-Watt, Switzerland

**Contractor:** Consortium ABB/ TLT formed by:  
 TLT Turbo GmbH, Zweibrücken (GER) – Lead Partner  
 ABB Schweiz, Baden (CH)

**Contract signature:** 30 April 2011

**Starting date:** May 2011  
**Completion date:** May 2016

**Total Contract Price at signature:** CHF 38,803,572.20  
 (Excluding V.A.T.)

**Physical performance:** 85% (September 2014)

**Project Description**

The Gotthard Base Tunnel consists of two 57-kilometres-long single-track tubes. These are connected together every 325 metres by cross passages. Including all cross-passages, access tunnels and shafts, the total length of the tunnel system is over 152 km. It joins the north portal at Erstfeld to the south portal at Bodio. With a rock overburden of up to 2300 metres, the Gotthard Base Tunnel is also the world's deepest railway tunnel constructed to date. Two multifunction stations at Faido and Sedrun divide the two tubes into three approximately equally long sections. The multifunction stations each contain emergency stop stations and two track cross-overs. In case of an incident such as a fire in the train or a fault in the Gotthard Base Tunnel (GBT), whenever possible the affected train travels out of the tunnel into the open air. If this is not possible, the driver stops the train at an emergency stop.

**Work Description**

Development, manufacture, delivery and installation of all the elements of the operational ventilation GBT (including 8 Axial fans, 24 jet fans, 28 smoke and heat vents incl. energy supply and control).

Development (design), manufacture, supply and installation of fire detection system in the multifunction stations

All tests / certificates from receiving material, workshop and factory tests, tests on the site (including delivery and installation tests) to the commissioning of the components and the acceptance during the commissioning phase A of the GBT as well as various special tests and verifications obtained through the unique operating conditions in the GBT

Delivery of the required materials and accessories for all necessary installation, maintenance and repair work.

Project- and construction management (participation in meetings, coordination with the client and the site management, etc.)

Provision of technical personnel for the maintenance of the equipment after the technical inspection (following assembly) and the revision / Repair of the equipment prior to commissioning phase A of the GBT.

Provision of technical personnel and measurement equipment for commissioning, integration into the overall system and the acceptance during the commissioning phase A of the GBT

Provision of technical personnel and appropriate documentation for the instruction of operating and maintenance personnel

Development of a user's manual for the maintenance personnel in German and Italian



*In 2016 a 5-years maintenance contract was signed for 5 Million €*

## Reference 2

**Metro Almaty, Kazakhstan**







## Reference project for tunnel ventilation systems (TVS)



### Metro Almaty Line 1 (Kazakhstan)

Scope: "TVS" Tunnel Ventilation System with fans, drive system, local control system, silencers, dampers, installation, commissioning and testing

TVS (fans)

- 36 TA Metro supply / exhaust fans
- 250°C / 1h temperature resistant

Cooling equipment for electrical rooms



## Scope of Supply

### Fan Equipment

- 36 Metro Fans  
(temp. res. 250 C° )



*Picture of Metro Fan for Metro Almaty*



## Scope of Supply

### Fan Equipment

- 36 round dampers  
(temp. res. 250 C° )



*Picture of damper for Metro Almaty*



## Scope of Supply

### Frequency converter & control panels

- 36 VSDs
- 36 control panels



Picture of VSD & control panel for Metro Almaty



## Scope of Supply

### Service

- Testing (FAT)



*Picture of metro fan testing*



## Scope of Supply

### Service

- Onsite commissioning



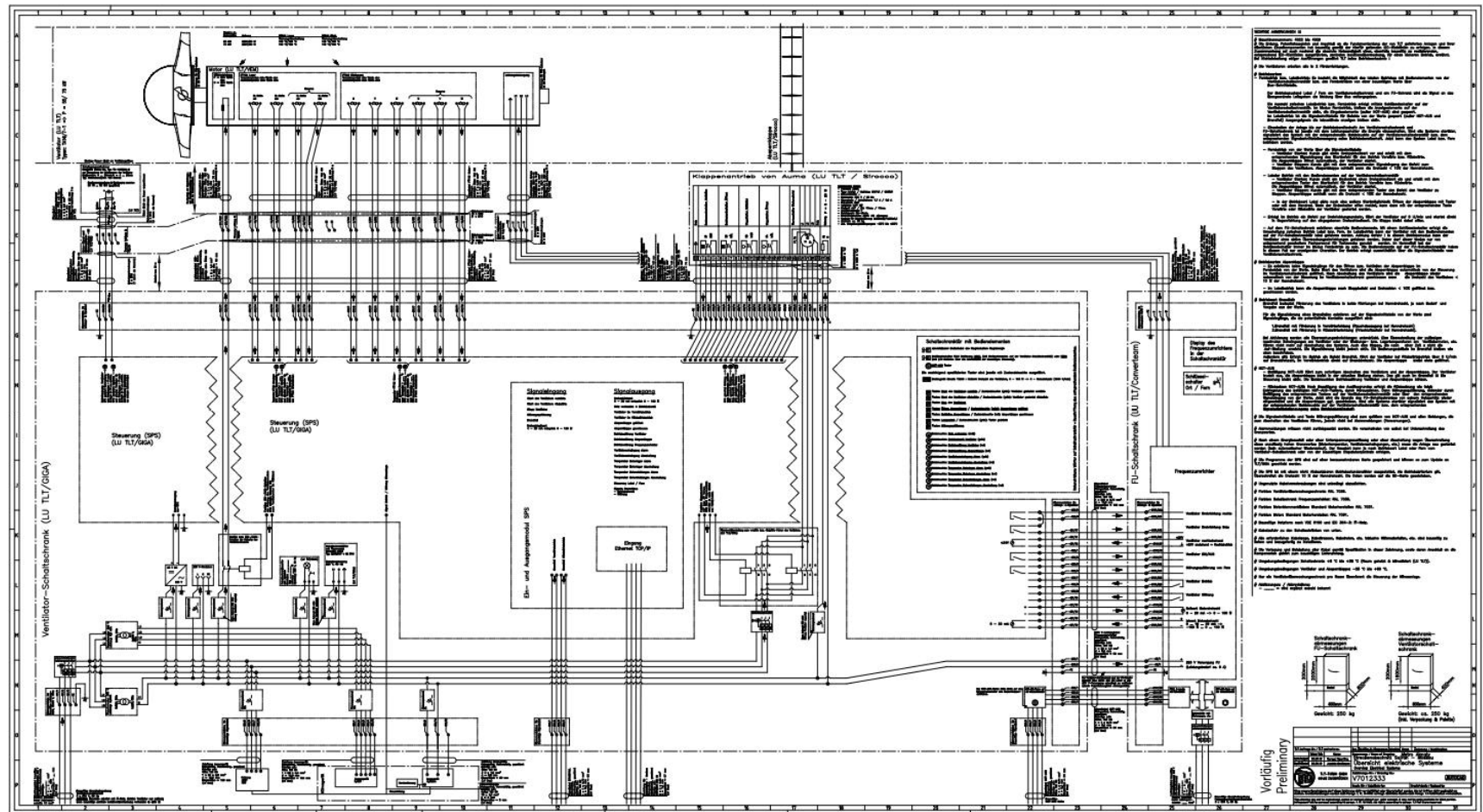
*Picture of metro fan commissioning*







# Drawings (extract)





# Customer Benefits

## Summary

- Reduction of total fan types
  - 28 operating points for 36 fans
  - Result only in 3 fan types
  - savings in spare parts
  - Less variation in spare parts
  - Less storage costs
  - Less costs



Teilrierterios	Teilrios 1: Rajymbek					Teilrios 2: ShibeK Sholy				Teilrios 3: Almay				Teilrios 4: Abaja			
	3801	3802	3803	3804	3805	3806	3807	3808	3809	3810	3811	3812	3813	3814	3815	3816	3817
Maschinennummer	R		L		R		L		R		L		R		L		
Bedienselle (Blick auf Laufrad)	LV7000.0061		LV7000.0061		LV7000.0140		LV7000.0105		LV7000.0105		LV7000.0105		LV7000.0105		LV7000.0140		
Frequenzrichterart	341285		341286		341287		341288		341279		341274		341270		341277		
Schwingungsaufnehmer	341285		341286		341287		341288		341279		341274		341270		341277		
Standort der Ventilatoren	Ventilationskammer PK 2x7.300		Station Rajymbek		Ventilationskammer PK 10x16.000		Station ShibeK Sholy		Ventilationskammer PK 22x43.741		Station Almay		Ventilationskammer PK 31x43.000		Station Abaja		
Ventilatorart	TA 14.7-1		TA 14.7-1		TA 16.7-1		TA 16.7-1		TA 14.7-1		TA 14.7-1		TA 14.7-1		TA 16.7-1		
Anzahl der Ventilatoren	1		2		2		2		2		2		2		2		
Volumenstrom	15,28		12,02		22,92		18,19		38,89		37,22		37,50		30,56		
Dichte	1,2		1,2		1,2		1,2		1,2		1,2		1,2		1,2		
Druckverlust Ventilator	600		620		680		710		690		680		660		560		
Druckverlust Ventilator-gesamteinheit	78		50		175		110		312		280		290		193		
Totdruckverlust	678		670		650		620		1002		980		960		872		
Stufenwirkungsgrad	65,5		58		72		67,5		73		73,5		73		74		
Kraftbedarf an der Ventilatorwelle	15,8		13,9		27,2		22,1		53,4		43,9		50,4		37,0		
Gewählte Motorenleistung	18,5		30		70		70		95		95		45		55		
Motorbetriebsdrehzahl	1189		1135		1480		1395		1451		1374		1420		1255		
zulässige Maximaldrehzahl	1200		1480		1480		1460		1420		1490		1460		1480		
Motorart	Y1R 225 S4		Y11R 225 S4		Y21R 280 M4		Y21R 280 M4		Y21R 280 S4		Y21R 280 S4		Y21R 280 S4		Y21R 280 M4		
Kenntnis	45D00781		45D00782		45D00783		45D00784		45D00785		45D00786		45D00787		45D00788		
Schaltenspektrum	45S00348		45S00350		45S00351		45S00352		45S00353		45S00354		45S00355		45S00356		
Schauwinkel	+15,5		+19,5		+18		+18		+18		+22,5		+22,5		+18		
Betriebspunkt	W		K		W		K		W		K		W		K		

Teilrierterios	Teilrios 5: Bajkonur			Teilrios 6: Tulpar			Teilrios 7: Alatau					
	3818	3819	3820	3821	3822	3823	3824	3825	3826	3827	3828	3829
Maschinennummer	R		L		R		L		R		L	
Bedienselle (Blick auf Laufrad)	LV7000.0140		LV7000.0105		LV7000.0140		LV7000.0168		LV7000.0168		LV7000.0105	
Frequenzrichterart	341282		341283		341284		341285		341290		341291	
Schwingungsaufnehmer	341282		341283		341284		341285		341290		341291	
Standort der Ventilatoren	Station Bajkonur		Ventilationskammer PK 62-67.100		Station Tulpar		Ventilationskammer PK 74x90.000		Ventilationskammer PK 72x70.900		Station Alatau	
Ventilatorart	TA 16.7-1		TA 14.7-1		TA 16.7-1		TA 16.7-1		TA 16.7-1		BVAKD10/50/10000	
Anzahl der Ventilatoren	1		2		2		2		2		1	
Volumenstrom	40,28		32,22		33,33		26,07		40,28		31,99	
Dichte	1,2		1,2		1,2		1,2		1,2		1,2	
Druckverlust Ventilator	670		680		660		580		670		700	
Druckverlust Ventilator-gesamteinheit	330		214		370		237		335		203	
Totdruckverlust	1005		894		1030		817		1005		883	
Stufenwirkungsgrad	73,5		72		74		73		73,5		72	
Kraftbedarf an der Ventilatorwelle	65,1		40,0		46,4		29,8		55,1		38,5	
Gewählte Motorenleistung	75		55		75		75		90		90	
Motorbetriebsdrehzahl	1480		1287		1480		1369		1480		1376	
zulässige Maximaldrehzahl	1480		1480		1480		1470		1480		1376	
Motorart	Y21R 280 M4		Y21R 280 S4		Y21R 280 M4		Y10R 280 S4		Y10R 280 S4		Y21R 280 S4	
Kenntnis	45D00790		45D00791		45D00792		45D00793		45D00794		45D00795	
Schaltenspektrum	45S00358		45S00359		45S00360		45S00361		45S00362		45S00363	
Schauwinkel	+18		+22,5		+18		+18		+23,5		+23,5	
Betriebspunkt	W		K		W		K		W		K	

W ... Warme Jahreszeit  
K ... Kalte Jahreszeit



## Preference Letter for Metro Almaty

<p>Қазақстан Республикасы Алматы қаласы әкімдігінің шаруашылық жүргізу құқығындағы «Метрополитен» коммуналдық мемлекеттік қасіпоры</p>		<p>Republik of Kazakhstan Communal state own company Subway of Almaty</p>
<p>050000, Алматы қаласы, Пойызқона көшесі, 84 Тел: 8 (727) 271-82-77, факс: 8 (727) 271-49-11 http: www.metroalmaty.kz</p>		<p>050000, город Алматы, ул. Пойызқона, 84 Тел: 8 (727) 271-82-77, факс: 8 (727) 271-49-11 http: www.metroalmaty.kz</p>
<p><i>Id. of. 2016. № 17-06/1122</i></p>		
<p><b>REVIEW</b></p>		
<p>Ventilation systems delivered by TLT-Turbo GmbH have been installed in Subway of Almaty. In particular there are fresh air and smoke exhaust fans for Subway stations and connecting railway tunnel hauls.</p>		
<p>Delivery, installation and startup operations are been fulfilled in determined terms. All fan units are operated with frequency converter, monitoring and controlling (local and remote) is been fulfilled by means of fan control cabinet also delivered by TLT-Turbo GmbH. Till the present moment of time the fans run corresponding the current operation schedule of the subway.</p>		
<p>The product of TLT makes a positive impression by its high quality level. Technical experience and service quality also indicate a highly professional approach of TLT-Turbo GmbH specialists. High operating availability of the fans, their integrity and low maintenance costs assure the efficiency and safety of subway systems.</p>		
<p>Chief engineer</p>		<p>N.Usenov</p>

**Other references**

**Metro & Railway**







## London Heathrow Terminal 5 City Link

3100



3100 mm rotor diameter -  
TLT's largest metro fan

TLT as consortium leader  
for tunnel ventilation system

High availability system

- 19 km-link between airport and city station Paddington (TLT work period 2005-2007)
- Train speed 160 km/h
- Fulfillment of British health and safety standards
- Integrated system for high complexity with from one source
- 30 years life time requirement for ventilation equipment



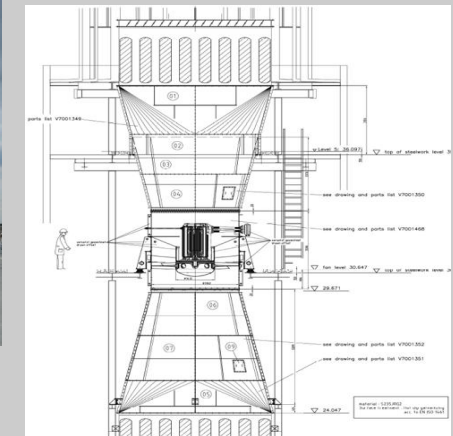
## Reference project - Design for tunnel ventilation systems (TVS)



### London Heathrow Terminal 5 City Link

Realization: 2005 – 2006 完成：2005 – 2006 年

TLT's largest installed Metro Fan with 3100mm rotor diameter motor power: 600kW, volume flow: 280 m<sup>3</sup>/s (100% reversible)





## Preference Letter for London Heathrow Terminal 5 City Link from Balfour Beatty

### “Scope of Supply:

- 4 TLT Metro-Exhaust-Axial Fans TA 31,5/14-1

Total power 2400 kW (approx. 3120kVA)

- 2 TLT Metro-Exhaust-Axial Fans TA 22,4/14-1

Total power 500 kW (approx. 650kVA)

- 2 TLT Metro-Exhaust-Axial Fans TA 22,4/14-1

Total power 220 kW (approx. 285kVA)

*We herewith confirm that TLT-Turbo GmbH has successfully carried out the work as described above, fulfilling its contractual obligations.”*

*BBRP – Balfour Beatty Rail Projects  
(Contractor)*

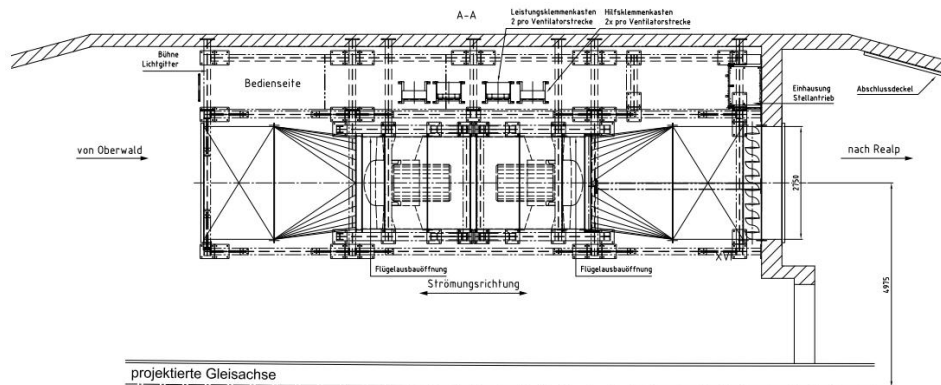
## Important Reference project for tunnel ventilation systems (TVS)



### Railway Tunnel Furka, Switzerland

Scope: "TVS" Tunnel Ventilation System for fresh air supply for civil works and smoke exhaust in case of fire and air drying with all installations, commissioning and testing

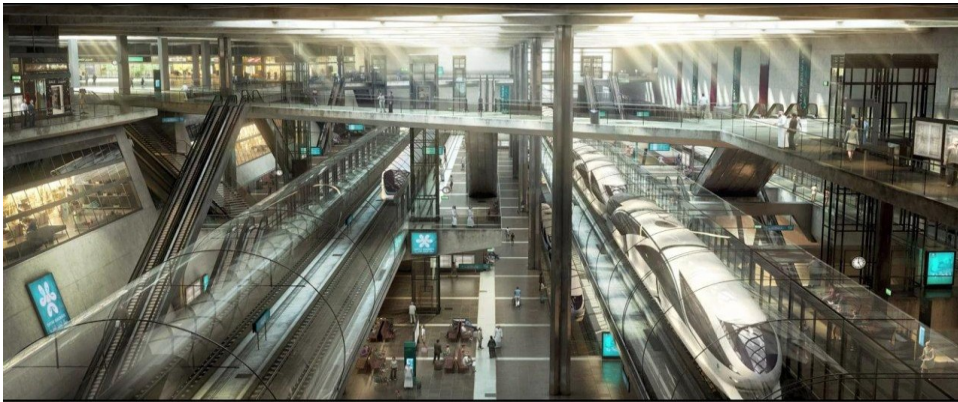
- 2 x 2-stage reversible axial fans for 6000 Pa (300°C / 2h temperature resistant)
- Motor drive power: 2 x 630 kW/fan
- Dampers
- Silencers







## Reference project - Design for tunnel ventilation systems (TVS)



### Metro Doha (Qatar)

#### As nominated sub-contractor of Siemens

Design work 2013-2015 together with Pöyry

- Definition & analysis of ventilation modes
- Definition of ventilation system
- Definition & analysis of tunnel cooling system
- Compliance with NFPA 130
- Final Design
- Improved design for efficiency
- Efficient operating modes for comfort and safety



## Preliminary Design for Qatar's vision

35

35 underground stations  
130 km network with  
59 km tunnel



TLT-Turbo GmbH



SIEMENS

TLT as consortium leader  
for tunnel ventilation system



High availability system

- Train speed 90 km/h at headway of 90s with underground airport link to city
- Fulfillment of high international standards (e.g. NFPA 130)
- High complexity with tunnel cooling
- 30 years life time requirement for ventilation equipment



## Reference project for tunnel ventilation systems (TVS)



### Metro Baku (Azerbaijan)

Scope: "TVS" Tunnel Ventilation System with fans, drive system, local control system, silencer, dampers, installation, commissioning and testing

TVS (fans)

- 23 TA Metro supply / exhaust fans
- 250°C / 1h temperature resistant