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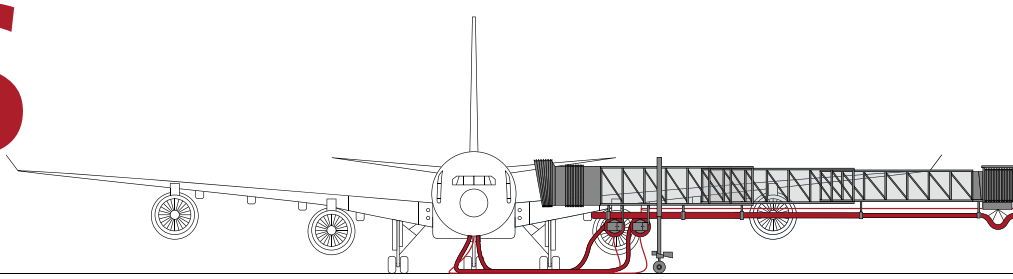
Airport Systems

AIRCRAFT GROUND ENERGY SYSTEM AGES



AIRPORTS FOR AGES FOR AIRPORTS

Stationary Aircraft require electrical power (400 Hz) during their stay on the ground. Depending on the ambient environmental conditions, they also require pre-conditioned air (PCA) for the heating and cooling of the cabin. Traditionally, these ground energy needs are provided by an Auxiliary Power Unit (APU) located at the rear of the aircraft. As a result of the poor efficiency of this unit (8-14%), the APU is a major contributor to pollutant emissions and noise at airports and their environment.

Through the use of stationary systems providing power and pre-conditioned air, typical fuel savings of up to 90% (excluding grey energy) can be achieved when compared to the fuel consuption by the APU. The emissions of CO_2 and other pollutants are reduced respectively by 90% while the ramp noise level drops considerably.

IST–Edelstahl-Anlagebau AG (IST) offers the first complete system for the power and pre-conditioned air needs of aircrafts on ground: the Aircraft Ground Energy System AGES.

Rising fuel prices and a greater need to protect the environment demand a greater awareness and fundamental review of energy efficiency. The implementation of AGES allows airports to invest in the future as well as the environment.

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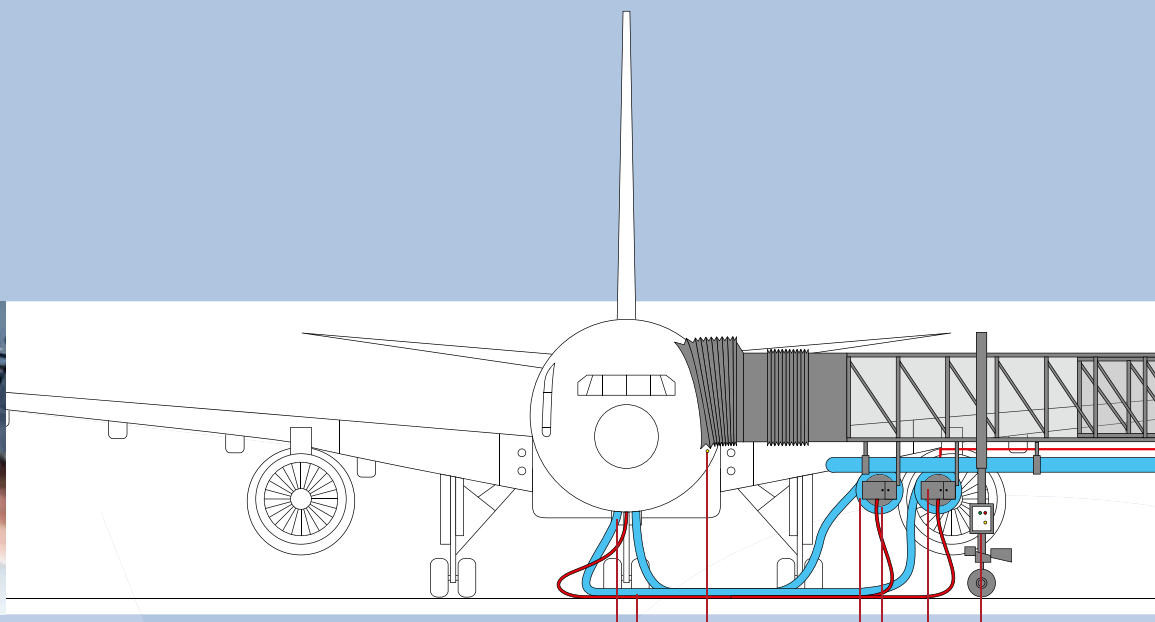
Aircraft Ground Energy System – AGES

The Auxiliary Power Units (APUs) are supplementary engines located at the rear of the aircraft. They provide electrical power and pre-conditioned air to the aircraft while on ground and are also used to start the engines. With an efficiency of between 8% and 14%, they are one of the main sources of CO_2 emissions and other air polluting agents at airports. In addition to this, they substantially contribute to the noise level on the apron. The operation of APUs costs the airlines millions annually. Thanks to the availability of 400 Hz power and pre-conditioned air (PCA) as provided by the Aircraft Ground Energy System (AGES), the APU, for these services, remains off.

"Kerosene is for flying, not for ground services."

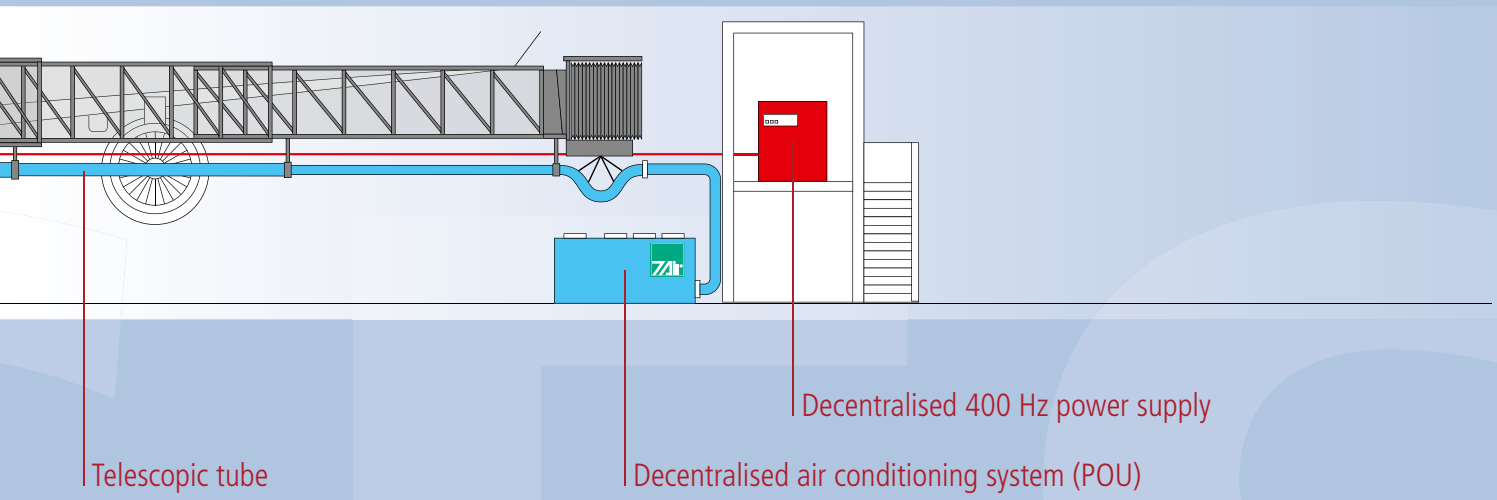


AGES replaces the APU's energy provisions on the ground

After the energy crisis of 1972, former Swissair, in cooperation with Zurich Airport, initiated the concept of providing energy to stationary aircraft on the ground. The company IST- Edelstahl-Anlagenbau AG was mandated to develop and implement components for this system – and as a result, the first stainless steel telescopic tube and the first stainless steel hose reel were launched onto the market and were patented throughout Europe.

Consequently, and in recognition of benefits achieved after the implementation of the first two stationary systems, the (Swiss) Federal Office of Civil Aviation (FOCA) established rules that restrict the use of the APUs. All pier positions at Zurich Airport were subsequently equipped with stationary power systems. In line with this upgrade, IST continued to develop its components for this system. Today, as a result of its many years of experience and 'know-how', IST is in a position to deliver a complete AGES package.

To this date, AGES represents the world's only high-quality, complete and highly efficient system. 400 Hz generators provide uninterrupted power supply to the aircraft on the ground prior to their safe shut down of engines after docking. The provision of conditioned air, available from either a central or a stationary so called Point-of-Use (POU) air handling unit, assures the conditioning of the aircraft's air, enhanced hygiene and increased passenger comfort.



IST- Edelstahl-Anlagenbau AG
Supported by a network of specialists and market-leading subcontractors, IST offers tailor-made solutions for any airport and any aircraft, while consistently ensuring the highest quality in the industry. Thanks to years of experience and specialised technical knowledge, IST supports the airport from planning to implementation, making significant contributions to a successful implementation of the AGES system.

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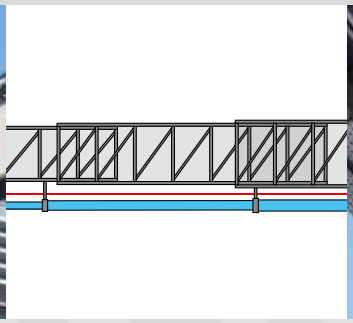
AGES - Telescopic Tube

The telescopic tube is mounted directly under the passenger bridge and channels conditioned air over a hose reel to the aircraft. Manufactured entirely of stainless steel, the doubly insulated, two or three stage telescopic tube provides high quality and durability; with low maintenance and minimal pressure and temperature losses.

Telescopic tube manufactured of stainless steel

The IST-manufactured and initially patented telescopic tube is the only PCA tube worldwide that consistently demonstrates a well above average service life. Manufactured entirely out of stainless steel, it is extremely stable, robust and basically maintenance free. Therefore, the maintenance costs are very low and high operational availability is assured. Furthermore, as a result of the exceptionally smooth surfaces that can be achieved through the use of stainless steel, pressure losses are reduced to a minimum. Due to its special sandwiched insulation, the telescopic tube achieves a very high K value with low temperature losses. Its simple design allows the telescopic tube to be adapted to almost every type of passenger boarding bridge. It is furthermore self-supporting over long spans.



Why stainless steel?

Quality	Stainless steel components are easy to clean, virtually maintenance free and durable.
Safety	Stainless steel is strong, corrosion resistant, wear resistant and resilient.
Design	Stainless steel is aesthetically pleasing.
Environment	Stainless steel has better energy and resource-use balance and is 100% recyclable.
Cost	Technically and economically, stainless steel is the best solution.

TÜV HESSEN

Technical specifications

Two or three stage telescopic tube made up entirely of 1.4301 stainless steel
Maximum temperature loss 0.017 K/m for a pipe diameter of 400 mm
Maximum pressure drop of 20 Pa/m with flow at 10,000 m^3/h
TÜV certified (TÜV Hessen)

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AGES-Hose Reel

The IST provided hose reel replaces the manual winding and unwinding of the 40 kg air hoses. Thanks to easy handling and a freely programmable control capability, the operator can adapt the operation of the reel to meet his own needs. The stainless steel hose reel ensures very stable, durable and virtually maintenance free operation.

HANDLING

Hose reel made of stainless steel

The formerly patented stainless steel hose reel provides easy handling of the air hoses. Through the use of a remote control device located at the connection to the aircraft, the reel can be operated easily and safely by one person, thus minimizing wear to the air hose. The use of high quality materials ensures minimal maintenance costs and guarantees optimal function.

The axially arranged rotary seal at the hose reel permits the air to flow to the aircraft with a minimum of pressure loss. Siemens provided Logo controls allow the operator to program in line with his individual needs.




Innovative aircraft coupling

- Rotatable 360 degrees with end stop
- Coupling provided with spring activated pressure mechanism and protected flange gasket
- Robust
- Developed in accordance with the specifications of a diversity of airports
- Allows for simple docking with all aircraft types
- Fitted with integrated temperature and pressure sensors (subfreezing)

Technical Specifications

Electrically powered hose reel manufactured completely out of stainless steel
Remote control with 870.00 or 433.00 MHz
High quality hose for the supply of conditioned air
Frequency transformer for the setting of roll up and discharge speeds
Freely programmable Siemens Logo controls
TÜV certified (TÜV Hessen)

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AGES - Decentralised Air Conditioning System

Seven-Air Gebr. Meyer AG, in cooperation with IST and a team of former Swissair specialists, developed a Point-of-Use (POU) air conditioning unit (ACU) designed to satisfy the individual heating and cooling requirements for all aircraft types. This innovative POU provides subfreezing temperatures in the range from plus 2 to minus 25 degrees Celsius and, thereby, optimises cooling in hot and humid weather conditions.

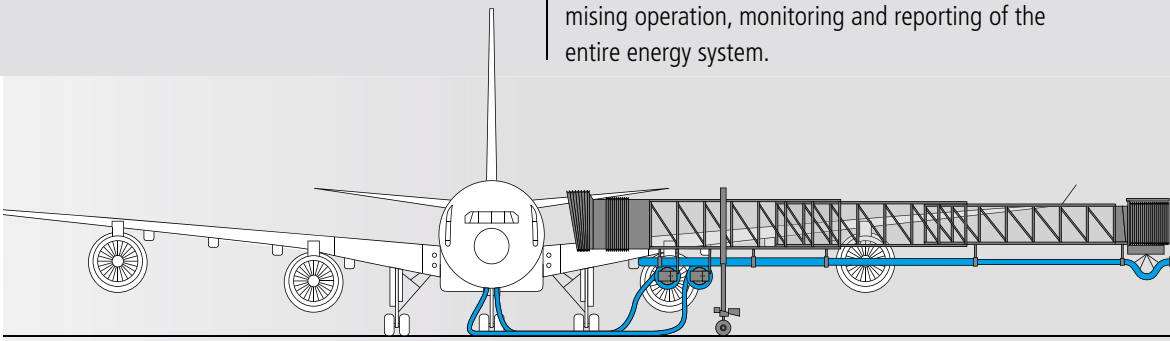
DECENTRAL

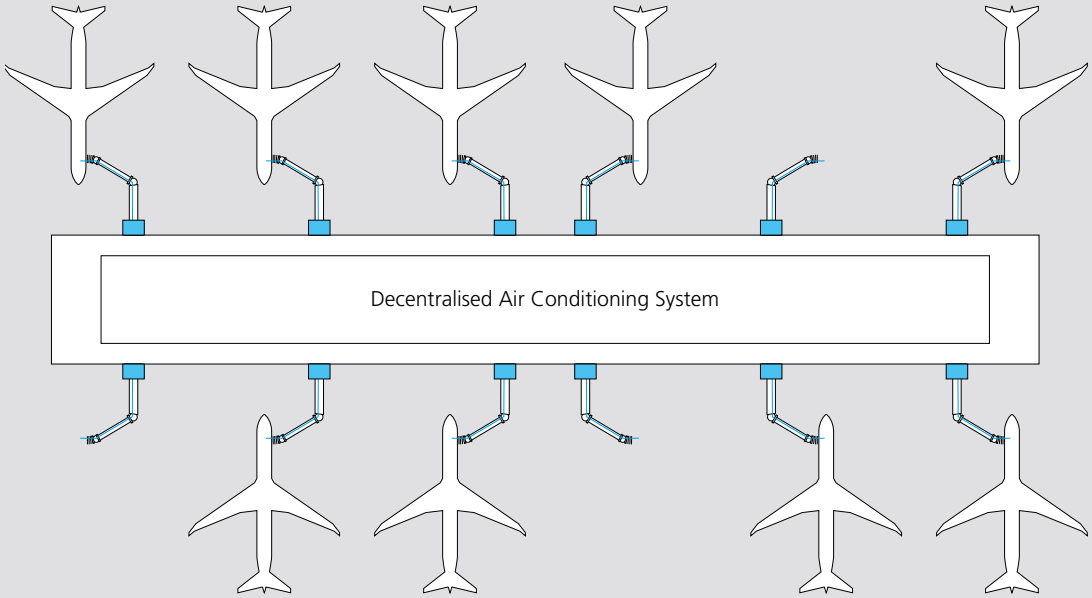
Suitable for all aircraft types

The POU supplied by Seven-Air is a complete, self-contained unit that ensures the effective cooling, heating and air flow to all types of aircraft while on the ground. Extremely high pressure and temperature differences place high demands on such equipment. To suit the air conditioning requirements of all aircraft types, two different units are available. These are specifically designed to meet local climatic conditions and individual needs of the airport.

When local climatic conditions require heating of the aircraft cabin, the required heat is then either obtained from the heating system of the airport itself or produced on site by an electrical air heater. POUs are available in a full range of RAL colours.

All POUs are individually equipped with dedicated process controls. In addition to this, the possible use of a standard facility based bus protocol (e.g. Bacnet) can provide an overriding control function, optimising operation, monitoring and reporting of the entire energy system.





POU Specifications

Since the founding of the company in 1971, Seven-Air Gebr. Meyer AG has been paving new ground in the production and supply of air handling equipment. Technical competence, convincing innovations, high quality and environmental awareness combined with continuity and reliability have led Seven-Air to become the market leader in Switzerland. During the last 25 years, Seven-Air has continually equipped all terminals at Zurich Airport with Air Handling Units (AHUs).

Technical POU-ACU data sheet for the climate in central Europe *

Aircraft category		**C**	**C/D/E**	**C/D/E/F**
Aircraft manufacturer: A Airbus, B = Boeing, MD = McDonnell Douglas		A319/320/321	A319/A320/A321/A330	A319/A320/A321/A330
			A340/A350	A340/A350/A380
		B737	B747/B757/B767/B777/B787	B747/B757/B767/B777/B787
		MD9	MD9/MD11	MD9/MD11
Unit type		POU-ACU C	POU-ACU C/D/E	2 x POU-ACU C/D/E
Air cooled DX refrigeration component				
Refrigerant	Freon	407c	407c	407c
Type of compressor		Screw/Reciprocating	Screw/Reciprocating	Screw/Reciprocating
Number of refrigeration circuits		1/2	3	3
Air handling component				
Air flow minimum/maximum at -2°C (Boeing, McDonell Douglas)	kg/h	2500-6500	2500-12600	2x2500-12600
Air flow minimum/maximum at -14°C (Airbus, subfreezing)	kg/h	2500-5700	2500-10400	2x2500-10400
Static pressure (at air handling unit outlet)	Pa	8500	10500	10500
Outside air temperature /relative humidity	Summer °C/% r.F.	36/40	36/40	36/40
	Winter °C/% r.F.	-16/95	-16/95	-16/95
Supply air temperature/relative humidity	Summer °C/% r.F.	-6/100	-14/100	-14/100
	Winter °C	50	50	50
Air outlet connection	diameter mm	355	450	2x450
Cooling capacity	kW	156	336	2x336
Heating coil capacity (glycol/water mixture 35/65%)	kW	80	150	2x150
Heating capacity electrical strip heaters	kW	(optional)	(optional)	(optional)
Electrical power requirements				
Fan motor (nominal)	kW	22	55	2x55
Cooling plant (nominal)	kW	90	258	2x258
Miscellaneous equipment (nominal)	kW	3	3	2x3
Total power (nominal)	kW	115	316	2x316
Total Amps (simultaneously)	A	155	386	2x386
Noise level				
Sound level at a distance of 3 meters	dB A	83	85	89
Dimensions / Weights				
Size	Length mm	4600	5800	1x5800
	Width mm	2500	2900	2x2900
	Height bridge mounted unit mm	1350	-	-
	Height tarmac placed unit mm	1500	3380	3380
Weight	Bridge mounted unit kg	3900	-	-
	Tarmac placed unit kg	4200	9000	2x9000

*Technical data for POU devices in countries with hot and humid climate zones (>36°C, > 45% RH) are adapted to local climate conditions.

AGES - Central Air Conditioning System

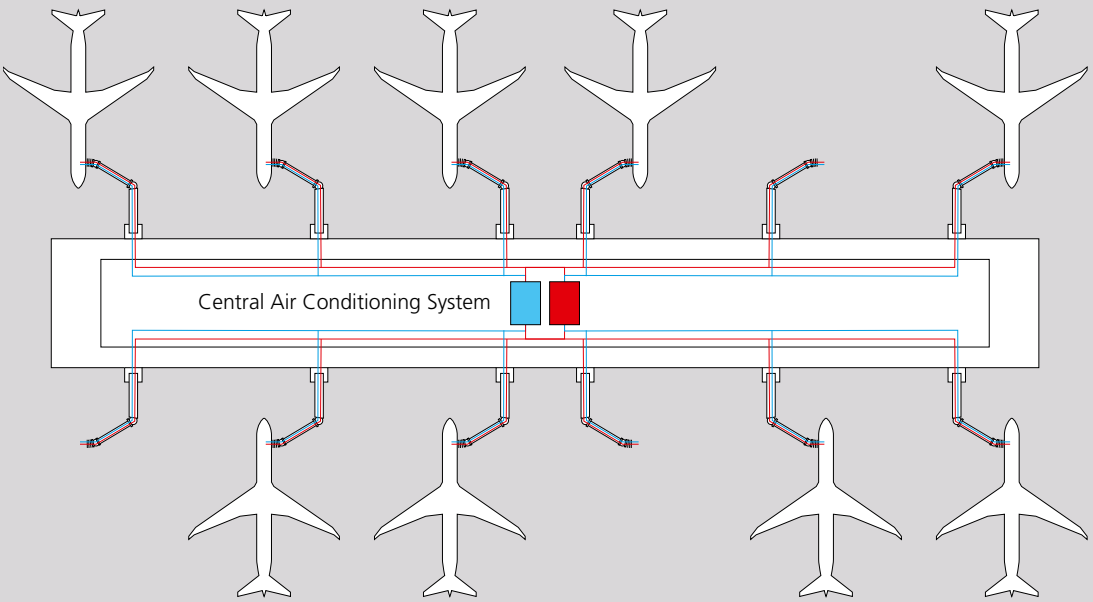
The central air conditioning system concept represents an alternative to the decentralised Point-of-Use approach where devices (POUs) are located at the piers. It provides the needed cold and warm water from a central location and then sends it via a circularly routed distribution system to compact air handling units (AHUs) located at the passenger bridges where the conditioned air is then produced.

Central chiller for better energy efficiency

The AHUs at the pier positions are supplied with heated and chilled water from a central system. The heat supplied is obtained from the building's heating system. The cold is produced by the central system during the night and stored in chiller plants for later use. Because this cold is being produced during non-peak or reduced rate hours, the energy costs are substantially lower for this 'central' concept when compared to a 'de-centralised' one.

Each gate is provided with an integrated control system that monitors cold and hot water consumption of different aircraft types. These individual controls are then controlled by a supplementary overriding system that monitors and assures optimal operation of all components of the energy supply system. Where the existing infrastructure permits, as for example in new terminals, the integration of a centralised system is recommended. The decentralised system, adapted to an existing infrastructure, is seen as an alternative solution.



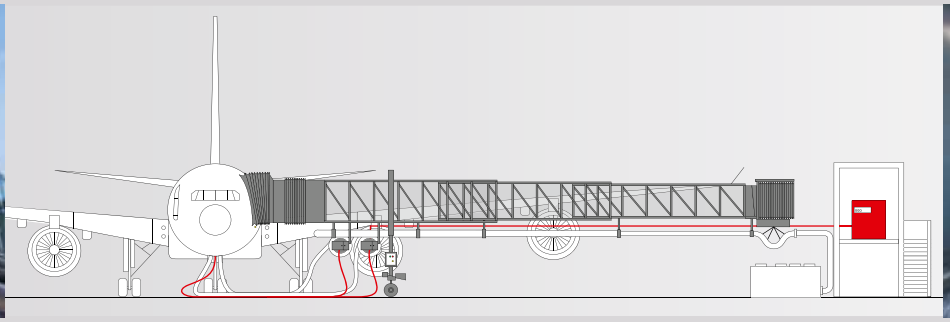
AGES-400 Hz Power Supply

A 400 Hz system essentially replaces the aircraft's APU and provides the electrical power needs of an aircraft while on the ground. In order to make sense from an economical as well as ecological standpoint, the power supply and air conditioning of the aircraft on the ground must be considered as a single, unified entity. IST satisfies this requirement with AGES and assumes the respective responsibility.

Fewer interfaces for efficient project progress

Ground power supply alone without a complimentary PCA supply system is generally inefficient. This is because ground power alone cannot fully replace the APU – not as long as the aircraft cabin needs to be heated or cooled due to varying outside temperatures. As a result, the power supply and air conditioning for the aircraft on the ground must be considered as a unified whole.

By implementing AGES as a complete system under one contractor, interfaces are reduced and the entire coordination is passed onto IST. Correspondingly, the customer benefits by having a single point of contact whose responsibility is to coordinate the implementation of all individual components and their relevant manufacturers within the overall system.



In order to guarantee that the airport receives the best possible system on the market, IST employs the same standards of quality in the selection of subcontractors for the 400 Hz systems as it does for its own products.

IST suspension systems for the hose reels and 400 Hz cable coils
Thanks to consideration of all passenger bridge requirements, IST's specifically designed suspension systems can easily accommodate and accept the 400 Hz cable coils and hose reels under the bridge without affecting the bridge's operational capability.

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AGES-Engineering

Equipping the passenger boarding bridge with telescopic tube, hose reels and 400 Hz cable coils, requires comprehensive and professional engineering services. Demanding standards of flexibility, functionality and safety are placed on the bridge. IST is in a position to assume the coordination of technical issues in cooperation with the client and passenger bridge manufacturer.

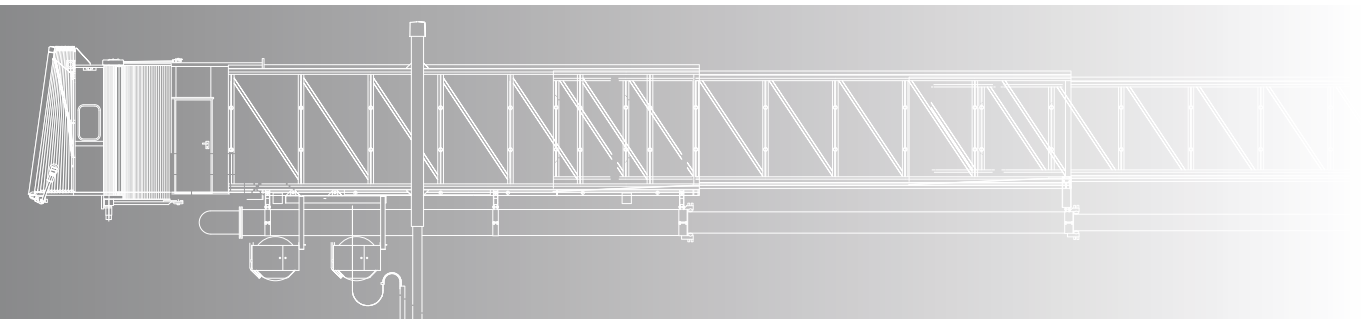
Profit from years of experience

A passenger boarding bridge must be able to service any aircraft type, including new large aircraft such as the A380 or the B747-8. Its mobility cannot be limited and structural integrity, as well as its safety, cannot be compromised.

"Your passenger bridge – our engineering"

In accordance with the new Machinery Directive 2006/42/EC, the airport, as a manufacturer and operator of the entire system, bears the responsibility for compliance with safety and health requirements as well as the CE conformity assessment.

Thanks to many years of experience, IST can optimally equip all types of passenger bridges and assist the airport in the technical planning to assure that such standards are continued to be met in the future.



CE certification – compliance with Machinery Directive 2006/42/EC

CE certification indicates compliance of requirements for ensuring health, safety and environmental protection. The conformity assessment procedure of passenger boarding bridges fitted with an integrated AGES can be very complex. As a TÜV certified CE coordinator, IST provides support in this effort.

CONFORMITY

AGES-Project Team

The key to success lies in a comprehensive approach executed by a team of independent, experienced professionals. In cooperation with consultants, engineers and other specialists involved with the implementation of AGES, IST offers advice and provides support in all aspects of planning, implementation and monitoring of the project.

EXPERIENCE

An integrated project team is the key to success

The goal of the AGES project team is to generate solutions that meet the interests and needs of all parties and recognise the key aspects of the environment, the economics and socio-political system.

Equipping pier positions with 400 Hz and PCA systems involves a substantial investment. IST ensures that this investment is also a worthwhile investment. It has the benefit of over 30 years of AGES experience in all areas of development, planning, implementation and operation of ground energy support systems. IST offers comprehensive and integrated solutions for the successful execution of such complex projects.

"Our advice – your success"

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AGES-Implementation at Zurich Airport

The AGES system was recently installed at Terminal A's new passenger bridges. Within the short period of 11 months after signing the contracts, 17 passenger bridges were equipped with 400 Hz and PCA systems. The successful implementation and use of AGES requires a combination of different factors in the planning as well as in the implementation of the project.

Zurich Airport as an example of a successful implementation

Expert advice pays for itself
Comprehensive and professional planning guarantees problem free and on-time implementation.

Power and conditioned air supply as a unified system
The 400 Hz electrical power system alone does not replace the APU. The needed stationary energy supply must be integrated into one holistic unit, analogous to the overall APU system.

Quality pays for itself
An investment in a quality system ensures a long life, low maintenance costs and 100% reliability. IST components at Terminal E have operated for over 10 years, practically maintenance free, and have never needed replacement.

Integration of all decision makers into the project team
A holistic approach, precisely defined interfaces, a close cooperation between all parties and a competent project management team are all of key importance to the successful implementation of AGES.

Fair system of fees
Through a fair system of fees, the airport can recover its investment and on-going operating and maintenance costs. The airlines benefit from the savings gained as a result of reduced fuel consumption and lower APU operating costs.

ZURICH

High technical availability
Thanks to the exceptional technical quality and an efficient handling and maintenance concept, the AGES system at Zurich Airport maintains an availability of 99.96%[1]. This exceedingly high reliability is the key to the system's acceptance by pilots.

Simple operation and training
Thanks to its easy handling, the system is also well accepted by the handling agents who use it to its full extent. Handling personnel are trained accordingly.

Efficient and dependable operation
The pilot of an incoming aircraft at Zurich airport can depend on the handling crews to have the ground energy support system ready and efficiently available. The APU, for these services, remains off.

Trouble-free operation thanks to high quality
Servicing and replacing of ground equipment components may result in the blocking of aircraft stands which, in turn, leads to costly aircraft schedule changes.

Implementation and enforcement of regulations
Airport issued APU regulations restrict the use of APUs by the airlines while on the ground. Such regulations maximise the use of AGES.

AIRPORT

"In the end, the cheapest systems are often the most expensive"




Quality means

- Reduced need for servicing and lower maintenance costs
- High operational availability and subsequent reliability
- Efficient aircraft ground movements due to problem-free operation
- Safety
- Durability
- Economy

[1] Zurich Airport AG: Aircraft Ground Energy System at Zurich Airport", Zurich, 2013

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Benefits for Airports, Airlines and Environment

Many ground power supply systems no longer correspond to the current state of technology and generate avoidable environmental emissions – not unlike those of APU operation. By implementing AGES, 90% of APU emissions can be avoided. The airport, the airlines and the environment benefit from the use of AGES. APU fuel consumption is significantly reduced as are CO_2 and NO_X emissions. The noise level on the apron and its surroundings drops significantly.

Less Noise

- The noise level of an APU, depending on the aircraft type, operates in the range of 95 to 105 dB A.[1]
- The noise level of AGES operates in the range of 70 to 75 dB A (between 80 – 85 dB A with POUs).[1]

Using AGES significantly reduces the continuous noise level locally and, correspondingly, the negative impact on the surroundings.

Less CO_2 and NO_X

- For every 1 kg of kerosene burned, 3.16 kg of CO_2 and 0.00727 kg of NO_X are produced.[1]
- APU operation produces about 85% of all airport area emissions (excluding takeoff and landing).[1]
- In the future, airlines will have to compensate the airport for their CO_2 and NO_X emissions.

By using AGES, these emissions produced by APU operation can be reduced by around 90%.[1]

Less fuel

- The APU consumes between 107 and 240 kg of kerosene per hour of operation.[2]
- Since the year 2000, the price of oil has risen from 39.49 EUR (20.09.2000) to 87.87 EUR (09.09.2013) per barrel. The rising trend continues.

By using AGES, the fuel consumption required by APU operation can be reduced by around 90%.[1]

Conclusion Zurich Airport

- The airlines consume about 20'700 t less fuel per year, which corresponds to an energy value of 230'000 MWh (828'000 GJ).[2]
- The operating costs for the energy supply with AGES are significantly lower than the costs of using the APU. An Airbus A330 on the ground drawing 3 hours of 400 Hz and 1 hour of PCA pays 370 Euro (EUR/CHF 1.22) for this service. Using the APU for the same period results in a cost of 820 Euro (EUR/CHF 1.22).[2]
- As a result of the reduced fuel consumption, a total of 65'500 t of CO_2 and 173.3 t of NO_X can be saved at the airport annually.[2]
- The noise level on the apron can be reduced from a level of 95-105 dB A to a level of 70-75 dB A.[1]

Cost effectiveness

- In order to assure optimum cost effectiveness of AGES, power supply and conditioned air should be considered as a holistic, unified system.
- The fees for the use of the system should be at least 20% lower than the cost of APU operation.
- An hourly rate should be set for the use of passenger bridges equipped with AGES.
- The airports should aspire to reach a Return-on-Investment (ROI) of between 8 and 15%.
- The airport operator can maximise the use of AGES by implementing appropriate rules and regulations

"Less fuel, less CO_2 and NO_X, less noise – greater energy efficiency"

[1] Calculations of former Swissair engineering teams, the new AGES team and airport operating data from 2001 to 2004, revised 2012

[2] Zurich Airport AG; ‚Aircraft Ground Energy System at Zurich Airport', Zurich 2013.

*excl. grey energy

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"Swiss Made" stands for top quality, precision, reliability and exclusivity. Since 1975 IST has committed itself to bringing this concept to the market through the production of its high quality systems. In order to ensure that Swiss standards of quality are met in every sense, IST's products are exclusively produced by its qualified staff at its location in Switzerland. From concept to engineering, from fabrication to installation and commissioning, IST covers all technical aspects in process engineering such as manufacting of specialised equipment, plants and piping systems.

Swiss quality since 1975

Since 1975, IST has developed processing plants, manufactured equipment and piping systems in stainless steel, including BAS equipment intended for the food, machinery, printing, pharmaceutical and chemical industries, as well as for water distribution plants, municipal facilities and airports.

The IST brand maintains the highest of standards and continually strives to improve its quality and quality assurance. Close cooperation between design, development and manufacturing enables IST to respond quickly and flexibly to customer needs, delivering orders on-time to an outstanding standard.




Thanks to many years of experience, qualified staff and modern production facilities, customers can be assured of working with a experienced player in this field who can deliver comprehensive and innovative solutions of the highest quality – tailored to their needs.

swiss

References Airport Systems

Zurich Airport (ZRH)

- **Terminal A, 18 Gates, 1983-1984**
  - First central PCA system on the basis of compressed air

- **Terminal A, 18 Gates, 1999-2000**
  - Replacement of the central PCA system (central heating and cooling)
  - AHUs by Seven-Air
  - IST develops and patents its PCA distribution system (telescopic tube and hose reel)

- **Terminal E, 27 Gates, 2000-2003**
  - Central PCA heating and cooling plant
  - AHUs by Seven-Air
  - Further development of telescopic tube and hose reel
  - Supply and installation of 400 Hz cable coils

- **Terminal A, 17 Gates, 2012-2013**
  - PCA distribution in conjunction with new passenger boarding bridges
  - Supply and installation of 400 Hz cable coils

- **Terminal E, 27 Gates, 2013-2014**
  - Conversion of hose reels to remote control
  - Adaptation of Gate E52 to accommodate Airbus A380

Geneva Airport (GVA)

- **Satellite Terminal, 8 Gates plus 5 Aircraft Stands, 1996-1998**
  - Central heating and cooling plant
  - AHUs by Seven-Air




Frankfurt Airport (FRA)

- **Terminal 2, 1 Sample Gate, 2012**
  - Prototype PCA distribution system, including engineering
  - TÜV (authority) approval

Munich Airport (MUC)

- **Terminal 1, 20 Gates, 2013-2015**
- **Terminal 2, 24 Gates, 2013-2015**
- **Satellite (new), 28 Gates, 2013-2015**
  - PCA distribution system, including engineering

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Zertifikate

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