Vertiv™ Liebert® PDX-PAM Direct Expansion Perimeter Unit

High Efficiency Design, low-GWP
& Non-Flammable R513A Refrigerant
From 10 to 80 kW

Vertiv™ Liebert® PDX-PAM

High Efficiency Design, low-GWP & Non-Flammable Refrigerant

Vertiv™ Liebert® PDX-PAM is the Vertiv Thermal Management direct expansion range designed to operate with eco-friendly, non-flammable R513A refrigerant to deliver outstanding efficiency, reliability of operation and maximum flexibility of installation.

In today's interconnected world, the need for seamless global communication needs rapid access to data. Any minor delays or interruptions in the flow of communication can potentially result in adverse effects, ranging from financial losses to critical operational disruptions. To ensure maximum availability while minimizing expenses, it is imperative that air conditioning systems function seamlessly to maintain optimal conditions for data storage and processing.

In response to these demands, Liebert® PDX-PAM strives to provide comprehensive solutions that address the diverse needs of modern data centers.

Liebert PDX-PAM is available with a wide range of configurations, options and accessories, making the unit easily adaptable to various installation needs.
In conjunction with the Liebert PDX-PAM units, a wide choice of solutions is available for managing heat rejection to the outside, depending on the specific system configuration.

Vertiv™ Liebert® PDX-PAM is the right thermal management solution for rooms containing electronic equipment:

- Small to medium datacenters, from 10 kW to 700kW.
- Edge applications.
- UPS and battery rooms.

Vertiv™ Liebert® PDX-PAM at a glance

- Maximised cooling continuity, quiet operation and reliable continuous performance.
- **Low-GWP, non-flammable R513A refrigerant**, to reduce carbon footprint.
- Continuous modulation of the performance to achieve maximum efficiency in both full and part-load operations.
- Optimised cooling density: maximum cooling capacity with a minimal footprint.
- Compact design to facilitate transportation and installation.
- Wide range of airflow and system configurations, providing maximum flexibility and ease of implementation.
- Designed for a long service lifetime duration.

The Thermal Management Eco-Friendly answer

A mindful approach to environmentally friendly and sustainable cooling represents the latest challenge in the realm of IT cooling and Thermal Management.

Vertiv™ Liebert® PDX-PAM allows owners to comply with the F-Gas Regulation (EU) 2024/573 and achieve sustainability goals. Units are designed for use with R513A, a non-flammable refrigerant that allows a 70% reduction of the Global Warming Potential (GWP) when compared to the traditional R410A refrigerant, without any compromise from a safety and toxicity point of view.

The choice of this refrigerant contributes, along with the Liebert® PDX-PAM other distinctive features, to reduce installation costs (CAPEX): no additional safety devices are required, as is the case for indoor units using flammable refrigerants.

Liebert PDX-PAM is equipped with the most cutting-edge industry technology:

- Inverter-driven brushless motor compressors.
- Electronic expansion valve.
- Electronically commutated (EC) fans.

The Vertiv™ Liebert® iCOM™ controller ensures perfect synchronization of these components' operation, enabling complete modulation of performance. This way, the Liebert PDX-PAM unit can adapt to any operating condition and load in the most efficient and reliable manner possible. The full continuous modulation capability also permits precise monitoring of the machine's operation, facilitating performance tracking and allowing more timely and effective maintenance, thereby creating opportunities for predictive maintenance actions.

The perfect synchronization of the above-mentioned components, optimized heat exchangers selections together with an inhouse-developed control software, enable full continuous modulation, delivering higher efficiency throughout the whole year and precise supply air temperature control in compliance with ASHRAE recommendations.

Reduce Your Carbon Footprint!

Vertiv™ Liebert® PDX-PAM consents a true Total Equivalent Warming Impact (TEWI) optimization:

- **Direct** emissions reduction thanks to the eco-friendly low-GWP refrigerant.
- **Indirect** emissions reduction thanks to the innovative design that aims at maximizing the overall system efficiency.

Vertiv™ Liebert® PDX-PAM

At Vertiv we believe that being mindful of product design, development, use, and disposal are important to the longevity of our industry.

Checkout these environmentally conscious features of the Vertiv™ Liebert® PDX-PAM:

- **R513A refrigerant is totally compliant** to F-Gas Regulation (EU) 2024/573 and has a Low Global Warming Potential (GWP) of 631 as per IPCC AR4
- R513A is a **non-flammable refrigerant,** completely safe from fire injection and flame propagation risks, in case of leakage, with a lower toxicity compared to other refrigerants (class A1 as per ASHRAE 34 Standard)
- Inverter scroll compressor technology improves annual efficiency by up to 35% compared to a fixed speed compressor
- New generation of heat rejection condensers equipped with EC fans reduce even further power consumption and noise emissions

What are Indirect Emissions

Indirect emissions take into account the production of electricity used by the system during its operation.

There is, therefore, a direct correlation between efficiency and indirect emissions when carbon-based energy sources are used.

The more efficiently a unit operates, the less energy is required and the lower is its impact on indirect emissions.

What are Direct Emissions

Direct emissions measure the impact on the atmosphere linked to a direct release due to a leak of a refrigerant fluid that can have a significant greenhouse effect, thus increasing the world average temperature.

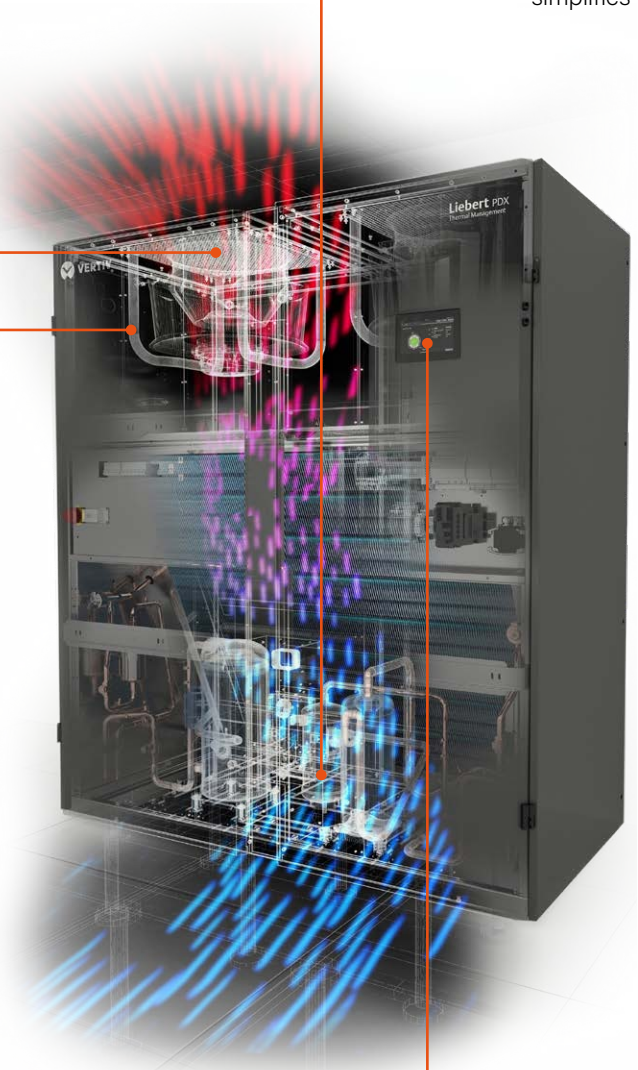
Global warming potential (GWP) is a measure of the contribution to the greenhouse effect of a gas relative to the effect of CO_2e which has a reference potential equal to one.

Higher Overall Efficiency

Vertiv™ Liebert® PDX-PAM allows a **continuous modulation of performance,** maximizing part load efficiency, significantly reducing running costs.

Eco-friendly without compromises

Vertiv™ Liebert® PDX-PAM is the ideal solution for the transition to a low carbon data center using a completely safe low-GWP refrigerant solution. The **absence of flammability risks** simplifies installation and limits costs increase.



Unique Flexibility

Vertiv™ Liebert® PDX-PAM offers a **wide range of airflow configurations** and delivery options that combined with easy and quick installation make it an extremely versatile unit that can satisfy any modern critical data center infrastructure.

Cooling Continuity

Vertiv™ Liebert® PDX-PAM design and safety control logics allow to **maximize reliability and continuity of operations.** Each unit cooperates with the others (teamwork operation) but is completely independent from cooling continuity perspective.

The state of the art in room cooling

Thanks to an innovative design with best-in-class components and to a leading edge state of the art in HVAC industry technologies, Vertiv™ Liebert® PDX-PAM is designed to maximise the part load efficiency. The continuous modulation of the cooling performance significantly reduces the annual power consumption resulting in more cost effective solutions.

Inverter-driven brushless motor compressors

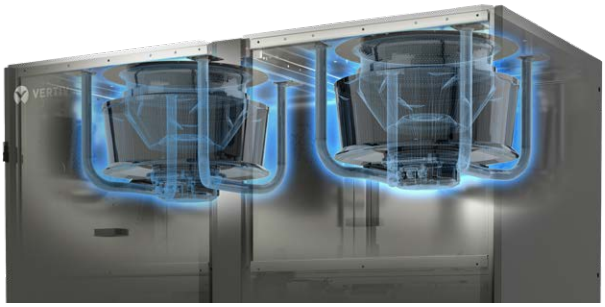
- Modulation capability down to 20% of maximum capacity.
- Optimum EER at part load conditions in which the unit operates most of the time.
- Less compressor on/off cycles: reduced starting current and improved power factor.
- Brushless motor design allows higher rotational speed and reduced mechanical wear.
- Permanent magnet motor turns into enhanced electrical efficiency.

Staged coil design with a cutting-edge and innovative patent pending filter solution

- Filter class ISO 16890: ePM10 50% as standard.
- Extended filter surface allows for greater air flow, less air pressure drops and reduced fan consumption.
- The innovative filter design significantly improve ease of maintenance.

Last generation centrifugal EC fans

- Speed modulation down to 30% of maximum value.
- Aerodynamically optimized vanes for minimum power consumption.
- Perfectly balanced fan wheel and self-lubricating bearings.
- Low noise design.



Electronic Expansion Valve

- Precise control of the evaporator feeding.
- Increased evaporator efficiency thanks to an optimal superheat control.

There is a system for your every need!

Vertiv™ Liebert® PDX-PAM units are available in different system configurations to best adapt to any specific installation needs.

The air cooled system

Liebert® PDX-PAM air cooled version dissipates the room heat through the evaporator direct expansion coil connected on site to the Vertiv™ Liebert® HPA OAC remote condensers, one for each circuit. With this solution no water is introduced in the white space.

Two different coil treatments (epoxy & electrofin coating) are available for remote condensers making their installation possible also in critical environments.

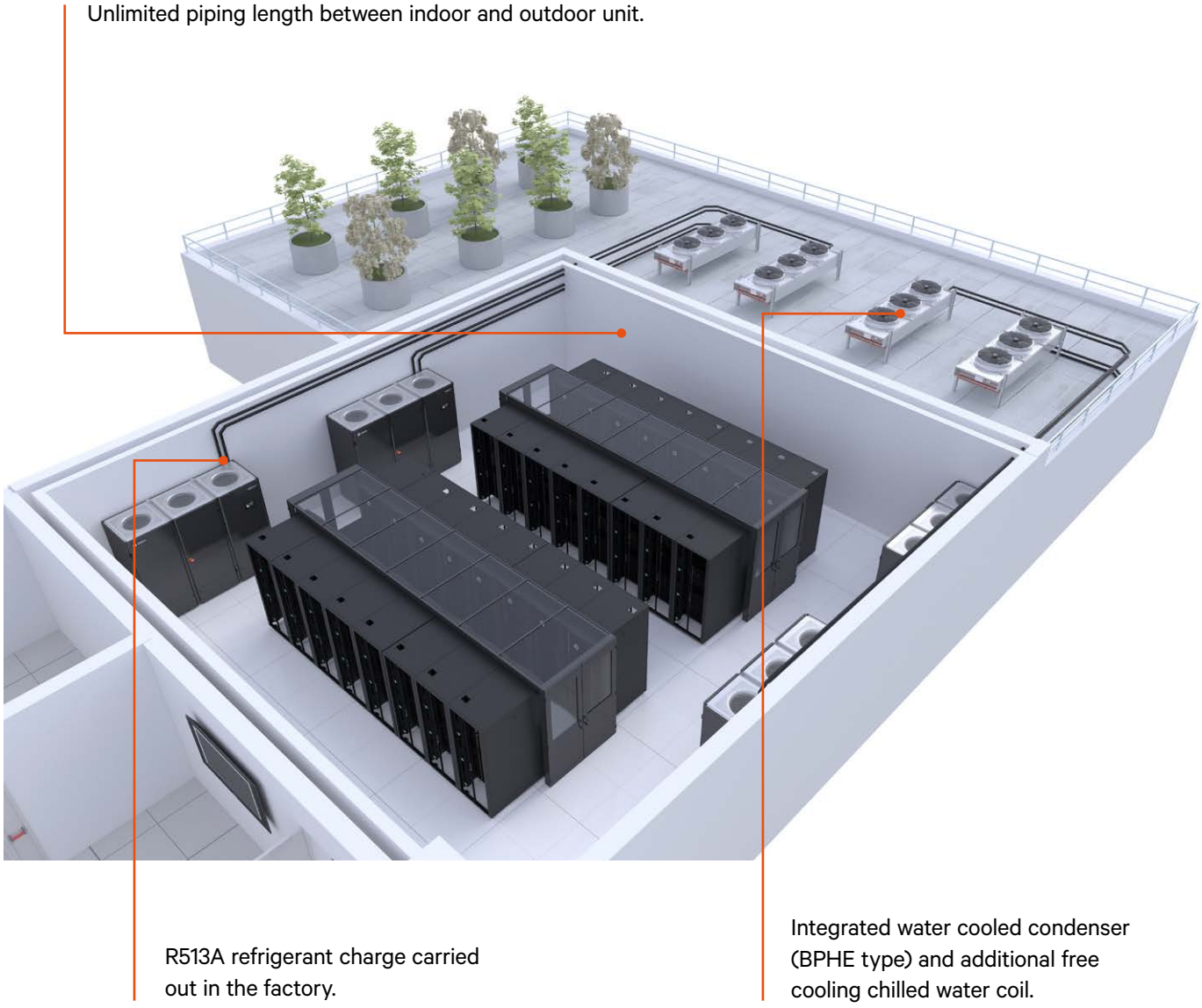
Equivalent pipe length between the indoor unit and the remote condenser up to 100m.

Low temperature version to operate also at low outdoor ambient temperatures (down to -20°C).

The water cooled system with and without indirect free cooling

In the Vertiv™ Liebert® PDX-PAM water-cooled range, room air is cooled down through the evaporator direct expansion coil and the refrigerant condensation is managed through a water-cooled plate heat exchanger integrated in the indoor unit. The heat rejection takes place in the outdoor Vertiv™ Liebert® HPD dry cooler.

Liebert® PDX-PAM free cooling units use an additional chilled water coil to provide free cooling capacity whenever the outdoor ambient conditions allow for it. When air ambient temperature is low enough, the compressor is stopped and water is recirculated between the dry cooler and the indoor chilled water coil to work in indirect free cooling mode.



Unique flexibility

Vertiv™ Liebert® PDX-PAM is available with these air flow configurations. For customized options, please reach out to Vertiv Technical Support.

Upflow

The unit is placed on the floor. Warm air goes inside the unit throught the front doors of the unit (red arrows) and cold air returns to the room (data center) from the top part of the unit, where the fan wheel is located (blue arrows).

Downflow Frontal

The unit is placed on the floor. Warm air goes inside the unit through the top (red arrows) and cold air returns to the room (data center) through the front grid in the bottom part of the unit. Fan wheel is located at bottom part of the unit.

Downflow Up

The unit is placed on the raised floor. Warm air goes inside the unit through the top (red arrows) and cold air returns to the room (data center) from the bottom grid through the raised floor. Fan wheel is located at the bottom part of the unit.

Main configurable features

- Refrigerant post-heating.
- Electrode humidifier.
- Clogged filter detection, sensors and alarm.
- Condensate pump.
- Dual power feed with automatic switchover.
- Harmonic filter.

Main options & accessories

- Motorized damper.
- Smoke and fire alarms.
- Leak detectors.
- Base frame.
- Antivibration dampers with adjustable height.
- Extension hood with different height.

Cooling continuity

Vertiv™ Liebert® PDX-PAM means enhanced availability of operations: downtime is minimized through prevention of alarms and failures and real-time optimization and adaptation of working parameters.

- **Dual power** feed option with automatic transfer switch option.
- **Embedded UPS (Ultracap)** feeds the control board at least for 60 seconds in case of power outage, permitting system supervision and the fastest unit restart.
- **Fast start logic:** the unit can recover from a power outage within 20-80s.
- **Guaranteed airflow continuity:** Each fan is controlled and powered independently, both in the indoor and the outdoor unit.
- **Tandem compressors** where applicable.
- **Multiple sensor logic** allows the unit to automatically adapt to grant cooling and airflow to the servers when a sensor fails.

Vertiv™ Liebert® iCOM™ Smart Control

Liebert® iCOM™ control is the heart of the direct expansion cooling system, managing not only Liebert® PDX-PAM units, but also outdoor heat rejection components. The Liebert® iCOM™ software embeds a comprehensive algorithm library developed and perfected over fifty years for perfectly adapting to the different requirements. The control set up can be done through a HD touch screen display which functions can be replicated even in a web browser (virtual display).

Ready for Teamwork of up to 32 Liebert PDX-PAM units connected together in a common network, sharing information with each other and managing critical operating situations: advanced control functionalities allow a single display to be used as a 'team display', synchronizing the parameters of all the units from the same access point. The unit can communicate with the user's BMS system with extended parameter availability, and it can also be connected to Vertiv remote diagnostic and preventive monitoring Services.

- More than 10 different strategies to control temperature/humidity and airflow.
- Auto-adaptive regulation PID algorithms.
- Automatic working envelope control.
- ESP Pressure monitoring and control.
- Extended parameters availability to BMS through the widest range of protocols.
- Outdoor unit safety logics: fan reversal mode for cleaning action, anti-freeze routines, etc.

Performance table

	PAM Model		PAM010	PAM020	PAM030	PAM060	PAM080	PAM088
Maximum capacity	Maximum air flow	m³/h	8508	9279	9130	20825	33572	28158
	Maximum net sensible cooling capacity	kW	15.7	20.2	30.6	60.1	76	92.9
Input conditions	Power supply	-	400V / 3ph / 50Hz					
	Refrigerant	-	R513A					
	Filter		ePM10 50%					
	Fans	Type	High Power					
	Unit inlet air temperature	°C	30					
	Unit inlet air relative humidity	%	35					
	Sea level	m	0					
	Condensing temperature	°C	45					
	External static pressure ESP	Pa	0					
	Air flow configuration	-	Downflow frontal					
	Supply air temperature	°C	18					
Performances at input conditions	Nominal air flow	m³/h	3043	3935	6138	11914	15579	22891
	Net Total cooling capacity	kW	12	15.6	24.3	47.1	61.6	91.3
	Net sensible cooling capacity	kW	12	15.6	24.3	47.1	61.6	91.3
	Unit power input	kW	3.26	4.04	6.8	11.42	14.58	25.91
	Net sensible EER	–	3.68	3.86	3.57	4.12	4.22	3.52
	Compressor modulation	%			80%			100%
	Fan modulation	%	39%	45%	70%	62%	51%	90%
	Room SPL (at 2m, free field)	dBA	49	53	64	63	63	78
Design features	Refrigerating circuits	n°	1	1	1	2	2	2
	Compressors	n°	1	1	1	1 / 1	1 / 2	2 / 2
	Fans	n°	1	1	2	2	3	3
	Compressor modulation capability	%			Continuous from 25 to 100%			4 steps
	Lenght (L)	mm	750	844	844	1750	2550	2550
	Width (W)	mm	750	890	890	890	890	890
	Height (H)	mm	1950	1970	1970	1970	1970	1970
	Weight	kg	285	354	363	730	937	1113
	Model							
System configurations	Air Cooled - Remote Condenser		•	•	•	•	•	
	Water cooled					•	•	
	Water cooled with freecooling					•	•	•
Airflow delivery available	Down Flow UP - Fans Over the Raised Floor		•	•	•	•	•	•
	Down Flow UP - Frontal air delivery		•	•	•	•	•	•
	Up Flow		•	•	•	•	•	•

Vertiv's Customer Experience Center located in Tognana (Padova - Italy)

The site includes 7 different laboratories and is specifically designed for customers to interact with Thermal Management data center technologies. Lab 3, the Floor Mount Validation Lab, and Lab 7, the Large Indoor Innovation Lab, are dedicated to test and validate Vertiv™ Liebert® PDX-PAM units.

1 R&D Validation Lab 1

The Research & Development Validation Lab 1 is specifically designed to test floor-mount units and can balance a thermal load of up to 150 kW with a chamber air temperature between 0°C and 60°C.

2 R&D Validation Lab 2

Designed for conditioners belonging to the Telecom sector, the Research & Development Validation Lab 2 includes two different testing chambers: one simulating internal ambient conditions from 0°C to 60°C and the other simulating external ambient conditions from -32°C to 60°C. This validation area can balance a thermal load of up to 100 kW (50 kW in each room).

3 Floor-Mount Validation Lab

The lab is equipped with a highly automated testing chamber, this validation area can balance a thermal load of up to 200 kW and can simulate a test environment within a temperature range of 0°C to 60°C.

4 Large Outdoor Packaged Innovation Lab

Dedicated area to test the state-of-the-art Liebert EFC - Vertiv's highly efficient indirect evaporative freecooling unit. Testing parameters include IT loads of up to 450 kW and an airflow of up to 120,000 m³ per hour at any external ambient temperature required to simulate typical peak conditions across the EMEA region.

5 Freecooling Chiller Validation Area

The Freecooling Chiller Validation Area is able to balance a thermal load of up to 1600 kW with a chamber air temperature between 20°C and 50°C and chiller water set point between 5°C and 20°C.

6 Adiabatic Freecooling Chiller Innovation Lab

This latest designed lab can test units with cooling capacities up to 1.5 MW with state-of-the-art accuracy in a broad range of working conditions, from -10°C to +55°C, also for adiabatic units.

7 Large Indoor Innovation Lab

This latest designed lab can test up to 400 kW and 100,000 m3/h, with operating conditions between +10°C and 50°C.

Rely on Integrated Project and Lifecycle Thermal Services for Superior Data Center Protection

Guarantee continuity to your business activities with a service partner who stands by you throughout your critical equipment lifecycle. From the project phase with start-up and testing, to lifecycle maintenance contracts and operational support, Vertiv ensures your solution performs optimally.

Global Presence & Local Resources

With the broadest, most comprehensive service presence in the industry and more than 650 engineers dedicated to servicing Europe, Middle East and Africa, Vertiv ensures that your business is always protected, and that service is available whenever needed 24 hours a day.

Premium Response

With Vertiv you can count on an extensive supply of critical parts plus crash-kits ready for deployment, and on service engineers that can respond to requests in record time. To do so, they can rely on a solid knowledge-base, and established escalation procedures valid across the entire region. In addition, they can also benefit from advanced incident management, and widespread presence of Service Centers all enabling them to deliver premium restoration capabilities.

Commissioning Phase	Technical Activities	Project Management	
Pre-Project activity	• Commissioning Spec & Plan • Engineering • Design Review • Schedule Integration • Submittal Review • Commissioning Procedure • Commissioning Kick-off	• Project Charter / Project Initiation Docs • Identify Stakeholder	
Level 0 **Program and Design**		• Work Breakdown Structure (WBS) • Supply Chain & Procurement Management Plan • Project Team Creation • Create Risk Management Plan • Create Communication Management Plan • Create Change Management Plan • Create Project Schedule • Health & Safety Assessment • Kick-Off meeting with Customer	
Level 1 **Factory Witness Test**	• Factory Witness Test		
Level 2 **Delivery, QA/QC, Installation Assembly, Field Supervision**	• Site Acceptance Inspection • Delivery & Assembly • Equipment Installation		• Manage Issues, Changes & Risks • Report Project Status • Contract, Financial & Quality Review • Health & Safety Review
Level 3 **Start-Up and Site Acceptance Test**	• Installation & Startup • Pre-Functional Equipment Verification • Site Acceptance Test	• Supply Chain & Procurement Management • Execute Project Plan • Schedule On-Site Resource Management • Facilitate Team Meetings & Distributes Minutes • Health & Safety Management	
Level 4 **Functional Performance Testing**	• Functional Performance Test		
Level 5 **Integrated System Test Support**	• Integrated System Test • Training & O&M Verification		
Level 6 **Close Out & Turn-over**	• System Manual • Seasonal Testing • Warranty Review & Supplemental Report • Commissioning Report	• Customer Acceptance • Handover to Operation & Maintenance • Lessons Learned • Financial Closure • Project Closure	

Expertise & Training

All service engineers are regularly certified according to country-specific regulations as well as wider European and international regulations and standards. Vertiv F-gas certifies all thermal service engineers. This enables them to operate with all refrigerants including the ones with low GWP (Global Warming Potential) such as R513A, used in Vertiv™ Liebert® PDX-PAM low GWP.

Vertiv service engineers are trained, experienced professionals who undergo an average of one week of intensive training each quarter, totalling one month of full-time training per year. Training includes both technology and safety, to ensure competent and safe field operations, reinforced by established procedures to follow and central technical support in case of need.

Project Services

From project planning and design, through to equipment procurement, installation, and commissioning, our project team offers comprehensive capabilities, ensuring speed of deployment and execution according to pre-defined and repeatable procedures. Low-GWP gases require the use of specific tooling. Vertiv engineers are endowed with the right tools and trained on how to use them, thus ensuring proper installation, start up, and maintenance of low-GWP units.

Supporting Your Business Around the Globe

Regular service of critical equipment supports maximum uptime and often reduces total cost of ownership. A service program ensures timely and proactive maintenance for avoiding unexpected, costly equipment downtime and enables optimal equipment operation. Vertiv service programs cover all technologies and can be tailored to suit individual business needs.

Preventing or minimizing refrigerant losses is key to every direct expansion circuit. Even more so with low-GWP refrigerants, where the aim is to use as least refrigerant as possible both in case of maintenance or repair. Advanced incident management procedures leveraging site data allow Vertiv to be extremely effective in fault management and root cause analysis should it happen. Vertiv extensive service offering includes installation, startup, commissioning, maintenance, replacements, 24x7 remote monitoring and diagnostics, and much more.

Warranty Contracts	After Warranty Contracts		
Preferred Warranty	**Basic**	**Essential**	**Preferred**
Preventive Maintenance	Preventive Maintenance	Preventive Maintenance	Preventive Maintenance
Response Time	Response Time	Response Time	Response Time
	-	Labour Included	Labour Included
	-	-	Parts Included

Global Presence

Manuf. and Assembly Locations **24**
Service Centers **220+**
Service Field Engineers **3,500+**
Technical Support/Response **220+**
Customer Experience Centers/Labs **19**

Americas

Manuf. and Assembly Locations **10**
Service Centers **80+**
Service Field Engineers **1,600+**
Technical Support/Response **90+**
Customer Experience Centers/Labs **5**

Europe, Middle East and Africa

Manuf. and Assembly Locations **10**
Service Centers **65+**
Service Field Engineers **650+**
Technical Support/Response **100+**
Customer Experience Centers/Labs **5**

Asia Pacific and India

Manuf. and Assembly Locations **4**
Service Centers **75+**
Service Field Engineers **1,250+**
Technical Support/Response **30+**
Customer Experience Centers/Labs **9**

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