



TLD

HIGHLIGHTS



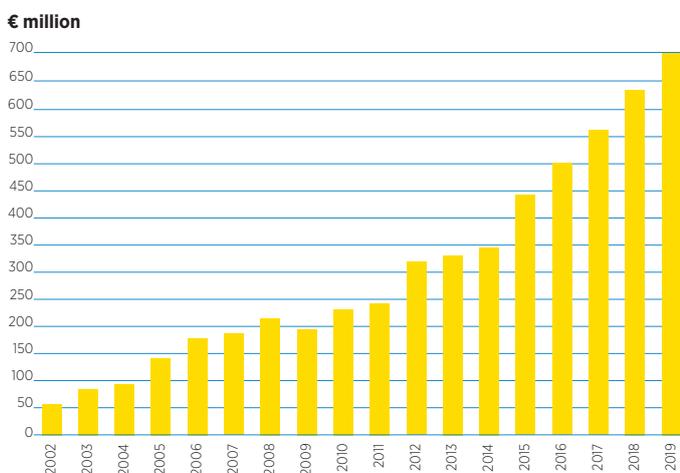
**LOCAL SUPPORT,
TOTAL COMMITMENT**

LEADERS IN INNOVATION IN GROUND SUPPORT EQUIPMENT

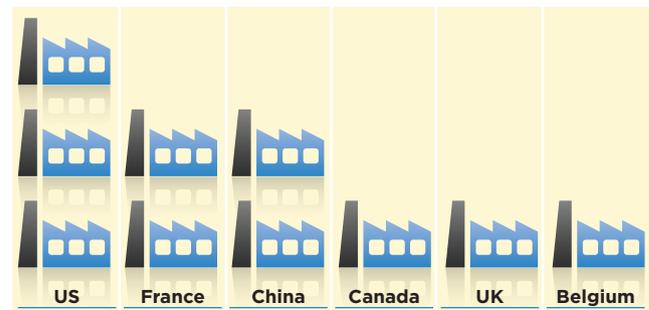
TLD is a group totally dedicated to the design, assembly, distribution and after-sales support of aviation Ground Support Equipment (GSE), with a history of more than 60 years in the industry.

- Almost **200** R&D engineers and **10** MUSD spent on R&D each year
- Over **400** employees dedicated to after sale support through Alvest spare part and field technical service
- Group spare parts inventory of **40** MUSD
- **6000** motorized units delivered in 2018

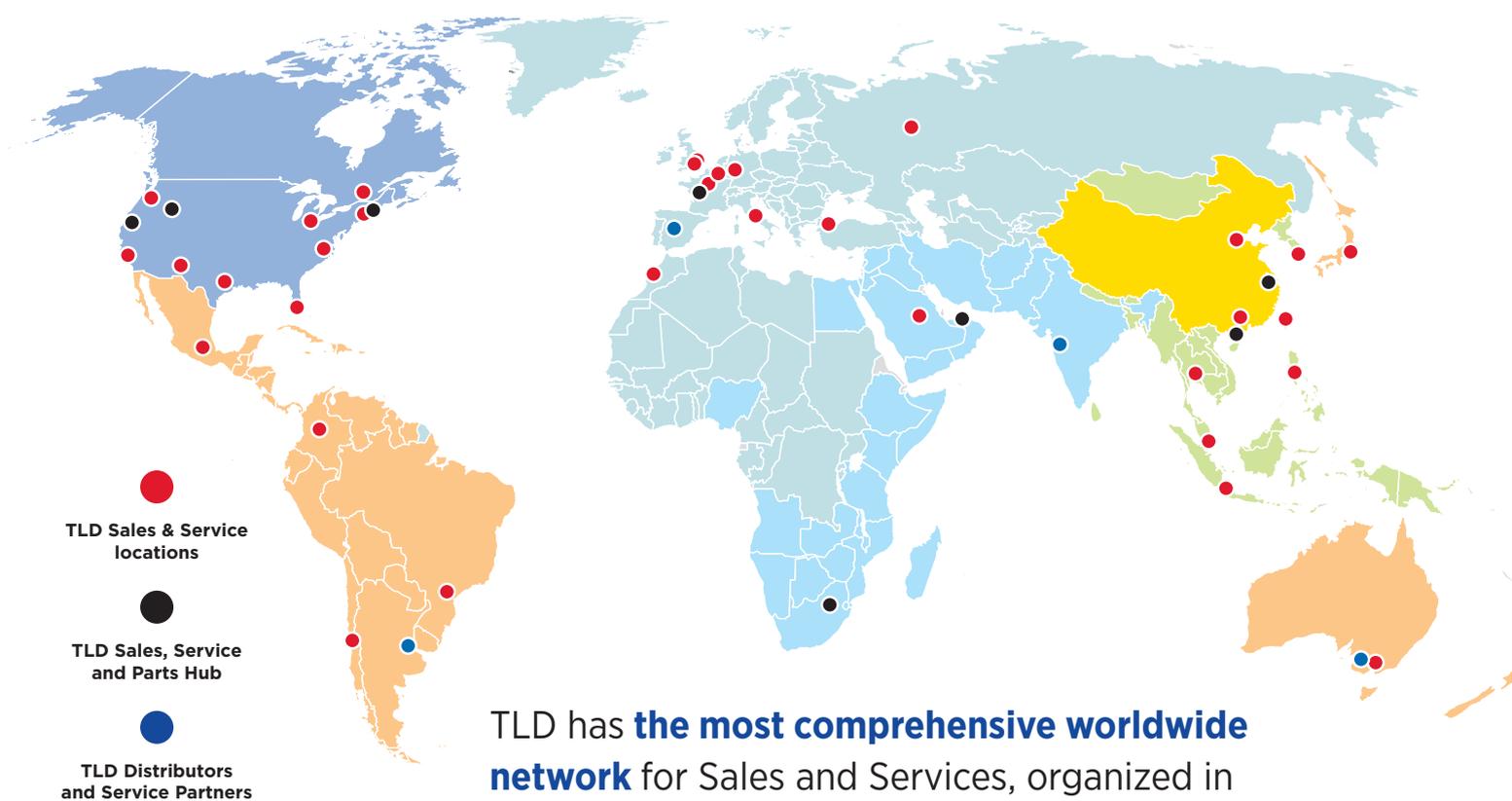
Revenues: Alvest Group, 2002-2019



OEM factories in charge of product lines development & production



SALES AND SERVICE NETWORK LOCAL CONTACTS IN A GLOBAL NETWORK



TLD has **the most comprehensive worldwide network** for Sales and Services, organized in 6 regional entities with over **45 TLD locations**



REGEN BATTERY-POWERED LOADER

SEES HUGE INCREASE IN POPULARITY

The GSE industry's move towards electric powered equipment has intensified greatly within the last year with airport and country initiatives being a contributing factor. Thanks to an innovative TLD design, the 838-reGen electric 7-ton loader has now become the most popular battery-powered loader in the world.

The energy regeneration system, or 'reGen' system as it's commonly known, is using super capacitors to prevent excessive battery heating during current peaks, which in turn will prolong battery longevity.

Adding an electric driveline has allowed the 838-reGen to achieve excellent performance and autonomy and it is now capable of a full day's operation in the harshest environment without any compromise - comparable to a diesel unit. The 80V system is also bringing a lot of commonality between TLD products, which will benefit the maintenance program due to the use of stock components.

The reGen family is continuing to expand as a new TLD 14 ton electric loader is now available and in operation - the '929-reGen'. This new loader is pushing the boundaries of battery-powered systems by using 80V Li-ion batteries. It also features the same innovative systems as the 838-reGen such as energy regeneration during the platform lowering process or decelerating, and a high hydraulic efficiency lift and convey system with electronic load sensing.

The first unit has already proven a technical success with its innovative features and the 929-reGen is currently supporting major cargo operations in North America. The drive system features an electric driveline and by using two electric motors and two pumps, the lift system is capable of lifting loads at speed comparable to a diesel unit.

The reGen family is *the* alternative to diesel loaders. Both the 838-reGen and 929-reGen are fully compatible with the new TLD iBS Li-ion battery and will offer impressive performance, reliable battery autonomy and low maintenance costs.



RAMPING UP RAMP SAFETY WITH INNOVATIVE

ASD AIRCRAFT SAFE DOCKING



For years, ground handling has focussed on addressing aircraft GSE collision damage. With the latest generations of aircraft fuselage, this is becoming a critical risk that has been recognized and addressed with new regulations to impose higher safety standards in order to eliminate any future collision damage risk, namely: AHM 910/913/920/931/932 (IATA) and ARP 1558 (SAE).

Our Aircraft Safe Docking (ASD) system has been a precursor to this evolution and to propose to our customers a retrofitable solution to reduce the human factor in this challenging process. More than 80% of our current production is equipped with ASD, and several thousands of those systems are in operation around the world today, making the ASD the benchmark in our industry.

As new systems become implemented, processes are adapted and we recognize the necessity to retrofit the installed base. TLD has therefore developed an effective retrofit solution of its proven ASD® system, which can easily be installed on TLD equipment or third-party equipment (belt loaders, cargo loaders, passenger steps).

On its journey to automation, and to increase the operation safety, TLD has also recently developed the ASD+® system, which allows for even safer cargo loader docking through automated steering to the aircraft doors. As per the ASD system, ASD+ is becoming available on new equipment as well as for retrofit.





INNOVATION IN ELECTRIC GSE WITH ENERGY EFFICIENT LI-ION TECHNOLOGY

GREEN, CLEAN and ENERGY EFFICIENCY have driven our engineering efforts for years at TLD, and the industry continues to invest and innovate in that field.

The iBS system was designed to be compatible with all current and future TLD electric GSE.

TLD has developed a complete range of Li-Io battery ready to address that growing electric challenge.

iBS is a modular concept that consists of 80V DC, 277Ah packs, rated at IP 67, that can be paralleled to increase capacity for more demanding applications. The iBS meets the highest safety requirements - each pack has an integrated monitoring system connected to the 'brain' that has active protection componentry to monitor the entire system. The Battery Management System (BMS) is located in the Power Distribution Units (PDUs). Up to 4 packs can be connected to the PDU and it constitutes a standalone lithium-ion battery that requires no additional current sensor or external relays.

The iBS system was designed to be compatible with all current and future TLD electric GSE including NBL-E belt loader, ABS-580-E passenger stair, JET-16 and JST-30-E baggage tractors, TPX-100-E, TPX-200-XE and TMX-

150-E aircraft tractors, TXL-838 reGen, TXL-929-renGen, and TXL 737-E aircraft loaders, TF-10-FTC-E transporter, LSP-900-E, WSP-900-E lavatory and water vehicles.

The modular concept allows an iBS pack to be swapped between any TLD product, allowing our customers to perform a battery fleet management, dedicating the newest packs to the most demanding applications (e.g. baggage tractors), giving them a second life in the less demanding ones (e.g. passenger steps).

iBS batteries are maintenance free, fast charging with no impact on life time and allow opportunity charging "lunch and charge". They do not require a dedicated charging room, and offer full usability down to 5% State of Charge (SoC). The iBS technology allows operation in conditions exceeding 55°C (131°F) and down to -20°C (-4°F).

TLD iBS
LI-ION TECHNOLOGY

iBS has been extensively tested on all TLD applications in various configurations. The iBS charger, 1 or 2 guns, 200A each, rated IP54 for outdoor application is also available. GB/T20234.3 charger plug or REMA 320 plug can be offered. iBS BMS charging protocol is also compatible with major high current charger brands available (PosiCharge, MinitCharge...). iBS can also be charged "blind" (no communication between BMS and charger), at 130A rate with regular lead acid battery charger.



AERO SPECIALTIES IS PREFERRED

SUPPLIER OF 21,000 ORGANIZATIONS

AERO Specialties provides complete aircraft ground support equipment (GSE) solutions to corporate, FBO, MRO, military, airline and general aviation customers worldwide. Our industry expertise and diverse product lines set us apart from the competition, making AERO the preferred GSE supplier for over 21,000 organizations globally.

Aviation Safety Equipment (ASE)

We have incorporated new safety features into most of our aircraft ground support equipment with our ASE line. Towing, ground power, lavatory service and more – we are dedicated to helping protect your staff, aircraft and bottom line.

Oxygen and Nitrogen Systems

Our oxygen and nitrogen systems provide the best value, quality and durability in the industry. We offer complete systems or individual components.

Towbars and Heads

AERO Specialties towbars and heads offer the highest quality and durability in the industry. Systems are available for business, regional, military and commercial airframes.

Lavatory and Water Carts

Business and regional aircraft, narrow-body and wide-body; we cover it all. We manufacture the finest lavatory and potable water carts. Our units are cost-effective, simple to use, and easy to maintain.

Solid State GPUs

AERO Specialties' new line of solid state power units have set the precedent for safety, precision, reliability and ease of use. Available in both 28.5V DC and 400Hz configurations.



Portable Power Units

AERO Specialties' line of portable aircraft starting units and continuous power units offer an affordable, durable and dependable solution for 12 to 28.5V DC aircraft power requirements.

Stairs and Stands

AERO offers a wide array of stairs and stands for any application, from passenger boarding and crew access to customized maintenance applications.

Hydraulic Power Units

Higher-quality, quieter and more efficient than what is otherwise available on the market, AERO's innovative HPUs are setting a new standard for hydraulic servicing. AERO custom-builds each unit specifically for the application.

TLD Ground Support Equipment

AERO is proud to be the primary general aviation and military distributor for TLD, the global leader in design, development, manufacturing and after-sales support of ground support equipment.



AERO SPECIALTIES NEW PRODUCTS

JetGo 900

This revolutionary GPU incorporates the highest continuous amperage in its class and performs in the most arduous environments. Overvolt protection systems and OptiTune™ fine voltage adjustment are standard on every unit, all part of manufacturing the safest GPUs on the market.



Narrow and Wide-Body Adjustable Fuel Stand

Allows easy servicing of all aircraft from 96 to 210 inches (243.8 to 533.4 cm) with one stand. The structural steel frame has stabilizer jacks and full bumpers on platform railings to protect the aircraft. Unlike many other fuel stands, the Adjustable Fuel Stand is OSHA-certified.



SYNCHRONISED ROLL-OUT OF RYANAIR SELF-HANDLING GSE

More than 600 motorized GSE units delivered to over 27 stations within a few weeks

In 2018, Europe's largest low-cost carrier Ryanair decided to adopt self-handling at 25 airports in Spain and at its biggest UK hub, London Stansted.

The startup was planned for 1st February 2019 at Stansted and 1st April 2019 at all Spanish airports. During this period, the company also started self-handling in its airports in Poland.

OPERATIONAL CHALLENGES

Ryanair's decision was motivated by a response to operational challenges that had been affecting its operations during the previous year, when disruptions on a daily basis disturbed the entire European schedule.

Once the overall strategy had been approved, Ryanair contacted TLD on a confidential basis early in the process in order to validate the overall GSE delivery plan. All equipment needed to be in place to guarantee the startup on the same single day at all the stations.

This ultimately resulted in the largest order of ground support equipment in history, involving multi-million-euro investments in more than 600 motorized GSE units to be delivered to over 27 stations within a few weeks.

TRUSTED PARTNER

TLD became sole partner of the program for all their available product range of motorized equipment – in particular baggage tractors, belt loaders, GPUs, pushback tractors, jetstarters and ACUs.

Most of the equipment was supplied in a mix of electric and diesel, depending on the airport infrastructure. Whenever possible, electrical chargers were delivered and installed in advance in order to ensure a smooth transition. For beltloaders, TLD's electric Regional Beltloader (RBL) was the obvious first choice.

All machines have been equipped with LINK telemetry for fleet management, including access control. All the beltloaders have TLD's Aircraft Safe Docking system (ASD) on board, in order to eliminate the risk of aircraft damage.

Logistics was one of the key challenges, so preparations were put in hand several months before. All specifications were validated and frozen early in the process, so that production could be launched well in advance. TLD's leveraged its industrial and technical capacity and its worldwide footprint to produce and store units in several factories in Europe, Asia and the US.

This enabled perfectly synchronized deliveries to all of the stations, involving hundreds of trucks, and commissioning through TLD's dense local service and support network. On top of that, some GSE was moved between countries using TLD Overhaul activities.

Another key factor in the success of the roll-out was training and deployment which TLD helped to support through several training sessions at the factory and on site where the equipment was to be delivered.

Following an extremely ambitious schedule, the startup itself was highly successful, with all GSE delivered on time, up and running from the very first minute. Ryanair was able to improve operational efficiency, achieve better on-time performance and keep its passengers happier.

In the long term the company will also be able to build up significant operational resilience at its biggest airports and operations.

TLD was able to harness its unique expertise in supporting customer startup operations on a very large scale. This same capability can be deployed to any other key market if our customers should require it.

LINK – THE LATEST IN INNOVATIVE

FLEET MANAGEMENT SYSTEM INTEGRATION

Telemetry is the new buzzword in the GSE industry. Yet in practice it is a long-established technology, and became popular in the 1990s in Formula 1 racing. Analysis of data captured from racing cars provided a real-time understanding of the performance of individual drivers.

The ground handling world took a while to adopt telemetry, but the systems available today offer far more than they did then, covering a much wider range of activities and services.

From fleet management (fleet localization) to operation management (scheduling and task management), including invoicing and maintenance management, these IoT (Internet of Things) solutions have relevance for the whole range of ground handling activities – driving new benefits, and at the same time raising new questions.

What is the appeal of a fleet management system?

The appeal may seem limited if you only consider fleet tracking. Watching units moving on a map is not really going to drive a worthwhile payback for an investment that is far from insignificant (it must cover telemetry boxes, SIM cards and software).

However, it can be very effective if you start to consider additional systems such as fleet support (remote diagnosis, troubleshooting assistance), operator tracking (access control and behavior monitoring) or operations management (task scheduling and automatic/assisted fleet optimization).

What is key in the selection of a fleet management system?

There are many services on offer, and will mostly be provided by specialist software, which may or may not exist in your company today. It is vitally important that

your service partner should provide an open platform, allowing highly streamlined connectivity to other enterprise resources.

The LINK software suite covers a vast range of services, and also allows very open and simple connection to any other software you may want to include in your operations, without modification to the hardware installed on the GSE. As a result, your IoT platforms become very flexible and can adapt to your future needs.

Why are OEMs playing a role in this field?

Not all OEMs are natural software specialists, yet they are the organizations creating and controlling the data generated on their machines.

As an OEM, we can access and understand each and every data stream available on our GSE. If the data is there, we know about it. It is therefore natural that we should manage data collection and data transmission.

With the LINK system, you have a fully integrated telematics system, accessing each and every data source available on the GSE, and making it available to the LINK Fleet Management System or any other software you may have selected. No need for post-installation, separate maintenance or technical evolution management.

The history of car radios offers a useful parallel. Once they were fitted as external aftermarket systems, yet now they are supplied by the OEM, thanks to smarter integration and a focus on greater convenience for the customer.

What are my immediate next steps?

Get the LINK system installed on your new GSE and maybe start with the LINK Fleet Management System. As your expertise increases, you may progress to other software, delivering yet more services. The LINK system will keep collecting the data for you!



TOWBARLESS TRACTORS

HIGHLIGHTS

The demand for eGSE is growing, and thanks to technical and technological evolutions, associated to the expertise developed over years for performance optimization, TLD is launching a full-electric push-back and inter-gate towing towbarless tractor: the TPX-200-XE.

What is one of the top current priorities?

The world is changing very fast and emission reduction is becoming a priority. The best way to promote the cleanest machine is to produce the highest efficiency.

That's why TLD offers its customers two ranges of tractors to cater for all operations.

TLD has manufactured towbarless tractors for more than 35 years, starting with internal combustion engines, and full-electric since 2004 with the launch of the TPX-100-E, gathering 15 years of experience in that technology.

Why a full electric tractor and not a hybrid solution?

TLD has developed a strong expertise in both full-electric towbarless (TPX-100-E) and hybrid machines (Taxibot or Power Pack), allowing us to select the best of the two technologies depending on the application.

Hybridisation is a performing solution when the load of the unit is highly variable and the hybrid system can leverage low load to balance high loads. In the case of towing, the load factor of the machine is very close to 100%, and the driveline efficiency is critical. The loss of efficiency associated to the power conversion of the hybrid solution will not be compensated by regeneration allowed in low load periods. As per the car industry, where hybrid cars are mainly dedicated to city application, hybrid GSE is mainly making sense for intermittent applications (such as belt-loaders or passenger steps with our Power Pack).

How to choose the most suitable tractor?

For push-back operations, where only a small amount of power is required, a pure electric unit, such as the TPX-200-XE is ideal.

Maintenance towing operations require a considerable amount of power. In this case, an IC engine powered unit such as the TPX-200-MTX would be recommended. Its efficiency is much higher (30%) than its hybrid competitor (22%).

TPX-200-XE and TPX-200-MTX – are they really two different machines?

The TPX-200-XE is the latest addition to the range and is based upon the TPX-200-MTX. This means that universal components are being used for both products, such as the driveline, human interface, cabin, chassis and cradle.

Finally, with the TPX-200-MTX and TPX-200-XE there is no need to train the operation team twice due to the commonality of both tractors – and the maintenance team will appreciate the familiarity when servicing either tractor too.

REMOTE CONTROL

What is the next challenge for vehicle manufacturers?

Autonomous vehicles are becoming an increasingly important part of TLD product development. It's anticipated that within the near future tractors will have the capability to drive completely autonomously, similar to the TractEasy.

What shouldn't we expect with autonomous vehicle now while we develop the TractEasy ?

Let's be honest, the full autonomous push-back operation is not the main priority today. Pushing autonomously an aircraft full of passengers and kerosene is a lot more than developing a system that works. It requires to have performed equivalent mission with less risks (TractEasy) for a long time before. Technology is here today at TLD, industry confidence in that technology is still to be built.

What is the next step for TLD then?

The next step is the launch of the remote control option for the towbarless tractors. It consists of implementing some of the autonomous steering technology within our existing product range, allowing remote control of the tractor. The TPX-100-E and TPX-200 series are already available.

What is the advantage of this solution?

Tractors fitted with the autonomous push-back technology have the option to be controlled remotely by a single person, or used in the traditional manner with a driver. Tractors will also have the ability to return to the gate at speeds in excess of 5km/h, unlike our competitors.



TLD PROCESS INNOVATION

WINNING THE INDUSTRY 4.0 AWARD

An international jury of "Smart Factory Experts" has awarded TLD the International Industry 4.0 prize. The award was presented during the Global Smart Factory Summit 2017 for the Best Horizontal Integration. A year later, in 2018, TLD was also awarded the IoT Innovation Award during the Internet of Things Congress in Shanghai for the best proof of concept.



well as gathering from the operations all measurements and controls required to ensure a perfect assembly.

The PIO System offers customers an increased level of quality control, the insurance of repeatable processes as well as a transparent online access to the entire machine manufacturing history.

Both juries, in recognition of the latest industrial performance developments, especially in the domain of integration of the whole value chain, have focused its evaluation on the Production & Inspection Online system (PIO).

This cyber-physical system links seamlessly information flow in two main directions: Vertically between customers, factories, and suppliers as well as horizontally between Engineering, Supply Chain, Planning, Production and Quality.

The system is making available in real-time all the required data to the workshop, via tablet computers. It is continuously pushing the latest engineering and assembly information to the assembly team, as

During the jury's inspection TLD factories showed on several live samples the perfectly aligned, controlled and integrated process to manage customer's expectations in terms of technical specifications, commercial terms and conditions and their online transfer from order intake to deliveries.

Direct internet links via TLD eVendor portals are made to suppliers in order for them to understand demand and delivery requirements and anticipate future needs.

Once a manufacturing order is released, the shop floor and all workers are guided by tablet computers, available to every employee, step-by-step through all sequences of production as well as material supply and quality checks.

400 Hz GROUND POWER AND AIR-CON

TEAM UP IN THE LATEST GF10 COMBO



The one and only GF10 Combo.

The happy marriage between LEBRUN's unique refrigeration technology and TLD's strong expertise in power electronics and 400 Hz ground power units. This unit is the combination of air-conditioning and 400Hz diesel ground power units.

It is the perfect substitute for the APU for regional and narrow-body aircraft in continental, tropical or even desert conditions built in one single piece of equipment. This unit will maintain adequate temperature in the cabin while providing the required electrical power during pre-flight operations, boarding and maintenance.

A single piece of equipment means only one tractor, only one operator, only one user license and subsequently a smaller carbon footprint. In one investment, the customer covers both ground services which makes the GF10 Combo a very cost-efficient piece of GSE.

The other big advantage of this unit is its very low fuel consumption. The diesel consumption for 400Hz & AC is maximum 5 gallons per hour.

This eco-friendly unit is particularly suitable for customers concerned with fuel savings and noise reductions. It reaches both targets with a limited and optimized TCO.

TLD's high standards of construction and component quality make the Combo a durable and reliable unit.



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