

# Weight & Balance

Autoload module - Automates and optimizes air cargo load planning

With the Weight & Balance software and its key Autoload feature, CHAMP Cargosystems has enhanced its new generation of automated cargo solutions. This unique decision-support system allows automating and optimizing one of the most complex, critical and sensitive freighter operations, leveraging on a deeply applied research and development work conducted on mathematical optimization.

## Benefits

- Reduced planning time – load planning is completed in a few seconds
- Flight safety – compliance with all the aircraft structural weight limitations
- Center of gravity target – optimizes fuel consumption and aircraft maneuverability
- Dangerous goods segregation – in line with IATA regulatory requirements
- Multi-leg flights – allows for convenient unloading by planning for multiple legs

Focusing on flight safety, the solution also manages to consistently reduce costs related to fuel consumption and unloading operations. Autoload targets an optimal center of gravity and supports multi-leg flights.

## Allows significant cost savings due to reduced planning time and fuel economies

With a single key stroke or click of a mouse, Autoload will position most of the load of a freighter within a few seconds. All load limits, compatibility rules, and dangerous goods restrictions are fully checked and respected, and the planning will be optimized to a target center of gravity set by the airline for the aircraft type or specific tail number. Multi-leg flights are fully supported, and the load will also be optimized for ease of unloading at transit points. Taking less time to create a load plan already has obvious cost savings, and consistent planning to an optimal center of gravity for the aircraft can lead to vital fuel efficiency. The load planner can also have full confidence in an efficient and safe plan produced quickly in a time-sensitive environment.

## A complex planning problem

Loading an aircraft is a complex and difficult planning task. Counter-intuitively, even if the problem size seems to be small or medium – it can go up to roughly 50 pallets to be assigned to 50 positions – the number of possible solutions is incredibly huge. Indeed, it is enumerated by doing simple math:

$$50! = 50 \times 49 \times 48 \times \dots \times 2 \times 1 \approx 3 \times 10^{64}$$

To get the best solution, we could evaluate all the possibilities and pick up the most advantageous. However, even the most powerful computer in the world, browsing around one billion solutions per second would still take  $10^{48}$  years to check every possible solution. That would be far more than the estimated age of the universe, which is around  $10^{10}$  years! So brute-forcing is excluded.

## Advanced optimization techniques

CHAMP Cargosystems has taken advantage of recent and innovative optimization algorithms to hopefully, solve this kind of problem in the most efficient way possible. A delicate balance had to be struck between the quality of the solution and the solving time. Given the complexity of the problem and all the constraints to be checked, exact methods which find the optimal solution take too long. Instead, search algorithms called meta-heuristics have been chosen thanks to their ability to find a good solution in a reasonable time. Tailor-made parameterization of these algorithms allows Autoload to propose an extremely accurate load planning in a few seconds.



# Autoload in practice

## A one-time aircraft set-up

The Autoload functionality requires a one-time set-up in the aircraft parameters. The aircraft's center of gravity target has to be set and the location of the doors at the aircraft positions level has to be indicated.

## Some preparation beforehand

For some operations, manual intervention is still required. Before using Autoload, the Loadmaster needs to configure the aircraft positions and overlays in line with the load, and position any non-standard pallets. These include pallets that need to be placed in multiple positions, pallets with overhangs and/or indents, and associated or linked pallets.

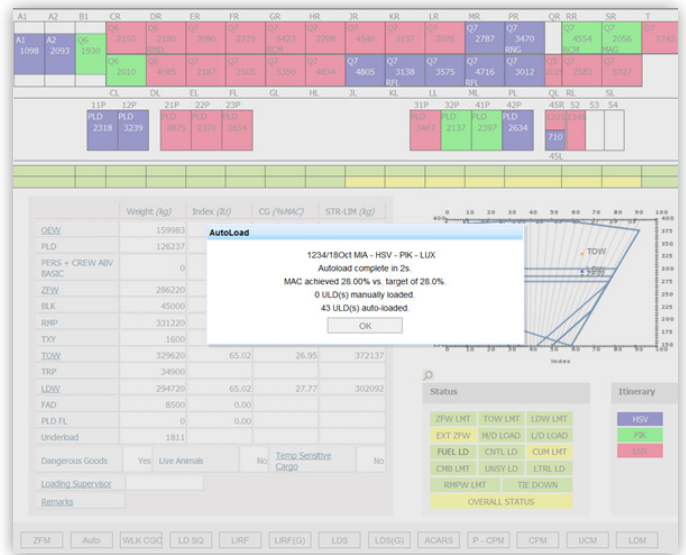
These limitations are in place due to certain problems that become mathematically intractable when other operations are automated. Also, the Loadmaster has to have full control on some operations.

## Autoload is achieved by a single click and is accomplished in seconds

Autoload automatically assigns standard pallets to single positions in a few seconds by a single click. Absolute priority is given to flight safety: the pallets are assigned to compatible positions and the solution will always comply with all the aircraft structural weight limitations. With Autoload, center of gravity target is achieved with surgical precision, pallets are positioned according to destination for convenient unloading, and dangerous goods are segregated according to standards. Autoload can be seen as a tool that helps the decision-making process, designed to facilitate the Loadmaster's

work. Most of the time, it proposes a very satisfying load plan that does not need any change. The Loadmaster however, still has the last word and is able to modify the planning configuration as needed.

## A 3-leg flight on a 747-400F



By a single click on the Auto button, the load plan is completed and a pop-up window summarizes the results. This 3-leg flight has been planned in an elapsed time of two seconds, and the target center of gravity of 28% is accomplished. The flight safety is granted as the overall status is almost fully green.

Each destination has been allocated with direct access to the doors for ease of unloading. Doors are located at positions A1 and PL on the main deck, and 12P and 42P on the lower deck. Blue pallets have to be unloaded at Huntsville (HSV), the green pallets at Prestwick (PIK) and the red pallets at Luxembourg (LUX), and it is clear that there is no obstacle for unloading at each transit point.

**About us:** CHAMP Cargosystems was founded in Luxembourg in 2003 as a 100% subsidiary of Cargolux Airlines. In January 2005, CHAMP was merged with SITA Cargo (UK) Ltd. Only three years later, we acquired Softair AG and the acclaimed Cargospot portfolio. The company expanded rapidly and in 2010 opened a development center and operational office in the Philippines. In November 2011, we took over Traxon Europe, a provider of leading edge electronic communication solutions. Some 450 people are now working for CHAMP all over the world. We provide global solutions delivered locally to you. For further information see: [www.champ.aero](http://www.champ.aero) **CONNECTED THINKING FOR THE AIR CARGO COMMUNITY**



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