

## Read About

Aircraft handling systems

Track-based

Wire-based

Free-deck

Modelling and Simulation Tools

## How to Determine When a Free-Deck System Is the Right Choice for Safe, Fast, and Agile Operations at Sea

With personnel's lives, mission-critical equipment, and important military operations at stake, the ability to safely and securely maneuver aircraft on ships is a crucial requirement for every navy that is conducting airborne operations at sea. Today, that includes most navies around the world.

While airborne operations were once reserved for larger, "blue-water" navies, today there is an increased use of helicopters and unmanned aerial vehicles (UAVs) by navies that are focused on littoral operations. These navies find themselves evaluating naval aircraft handling systems for the first time.



Figure 1: Free-deck naval handling systems

An aircraft handling system needs to be considered in every case where shipboard aircraft operations are planned. While sea conditions may permit a safe landing, the subsequent pitch, roll, and associated deck accelerations that the ship experiences can result in undesired and dangerous aircraft movement on the deck. In extreme cases, lack of an effective handling system could lead to catastrophic loss of aircraft assets.

Moving aircraft by hand or using running lashings is time consuming, physically demanding, and a potential safety hazard for crew. To protect themselves and the aircraft and to maintain efficient and effective operations at sea, crews need a naval aircraft handling system that allows them to secure the aircraft and traverse it from the deck landing area to the hangar as safely, quickly, and easily as possible.

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For safety, speed, and maneuverability, the aircraft handling system must always match the size of the aircraft and the deck accelerations that result from the pitch and roll of the ship in the various sea state conditions that are likely to be encountered. A naval aircraft handling system that is designed specifically for these requirements gives deck crews complete confidence that all phases of shipboard aircraft management, from initial aircraft landing support to on-deck securing, maneuvering, and traversing operations, can safely be executed in the dark, in harsh weather conditions, and on rough seas.

## Evaluating Naval Aircraft Handling Systems

As navies embark on their evaluations of available naval aircraft handling systems, it's important to understand the advantages and disadvantages of the main options:

- Integrated systems
  - Track-based
  - Wire-based
- Free-deck systems

### Integrated Systems Are Ideal for Extreme Conditions

Integrated naval aircraft handling systems enable aircraft to be traversed quickly to the hangar when helicopter operations are required in higher sea states because they provide a physical coupling between the ship and the aircraft. These systems require structural, mechanical, hydraulic, and electrical installations and become part of the ship's baseline configuration.

Track-based integrated systems traverse aircraft along the ship's deck. These systems provide an extremely high level of security because the aircraft is mechanically attached to the deck track through a securing device. The securing device limits traverse movements to the constraints imposed by the track to ensure the ship structure does not interfere with the aircraft.

Sophisticated track-based naval aircraft handling systems may include advanced automation technology that continuously tracks and monitors the exact position of the aircraft relative to the landing area so the pilot can safely land the aircraft without assistance from

anyone on the deck. Once the aircraft lands, a single operator in the hangar can quickly align and traverse the aircraft along the track to the safety of the hangar. No other personnel are required on the flight deck for any handling operations and the ship is clear to move without restrictions once the aircraft is secure.

Wire-based integrated systems use hydraulically operated winches to secure the aircraft and a single-joystick control console to maneuver the aircraft. The steel wires from the winches are attached to the aircraft for traversing the helicopter between the landing area on the flight deck of the ship and the hangar. Running lashings are required to move the helicopter in severe weather conditions. An additional system, such as a landing grid, is needed to secure the helicopter.

The best integrated systems can secure, maneuver, and traverse the aircraft to the hangar, even in the worst conditions, in less than five minutes.

While there's no doubt that integrated systems increase safety for personnel and aircraft in harsh conditions, they are typically the most expensive option, costing millions of dollars. And they are not required in all situations.

### Free-Deck Systems Combine Flexibility, Precision, Affordability

Free-deck naval aircraft handling systems do not run on a track. They are free-moving systems that operate like a small vehicle, allowing deck crews to deftly and precisely maneuver aircraft anywhere on a flight deck or in a shipboard hangar. Free-deck handling systems can also be used to tow trailers, trolleys, and other large items on the ship deck. Because it is so versatile, a free-deck system can also be used for applications on the ground.

Free-deck systems fit completely within the aircraft footprint to enable extremely exact, high-density aircraft parking and fast, easy retrieval. They are operated by a single crew member using a chest-pack control unit.

The high degree of flexibility and precision provided by free-deck naval aircraft systems makes them ideal for quickly moving and maneuvering aircraft on ships with multi-level hangars and elevators, as well as in constrained spaces on the ship or on the ground. They can also be used as an agile alternative to integrated aircraft handling systems when sea conditions allow it.

Free-deck handling systems cost hundreds of thousands of dollars. While free-deck systems are relatively affordable and offer unmatched speed and maneuverability, they cannot be used in conditions where the ship's pitch, roll, or deck acceleration is high. In these conditions, a system that enables the aircraft to be secured is required.

### Modeling and Simulation Tools Enable Informed Decisions

When evaluating naval aircraft handling systems:

- Safety features must be the first priority.
- The roles that physical design, materials, and mechanical features play in enabling safety, speed, and maneuverability must be recognized and considered.
- The helicopter type and ship motion dynamics must be factored in.
- Capability and cost tradeoffs must be carefully considered.

Mathematical modeling and computer simulation helps navies determine which type of system is the best option for particular ships, aircraft, and sea states. Modeling and simulation software considers the pitch, roll, and inertial effects of the ship in various sea states, wind influences, and the highly nonlinear response characteristics of the aircraft to determine which type of aircraft handling system is required.

A modeling and simulation tool gives navies important insights into peak securing forces, operational envelopes, deck clearances, and fatigue spectra for the secured aircraft (Figure 2).

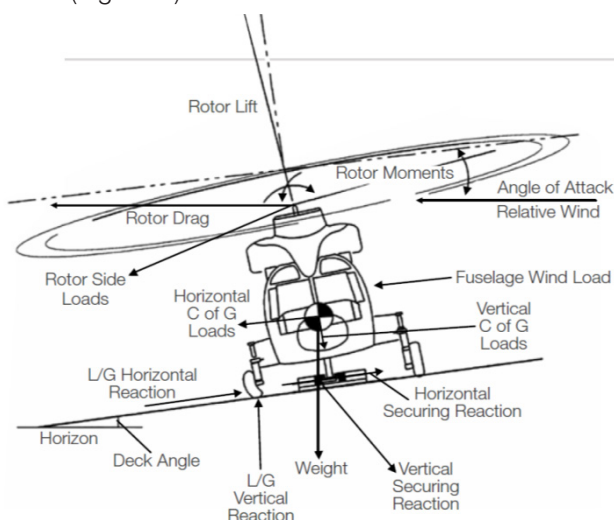


Figure 2: Modeling helps navies understand the many forces that affect aircraft movement

Understanding the full extent of aircraft responses on the ship deck in varying sea conditions gives navies the knowledge needed to decide whether a free-deck system alone is adequate or whether an integrated system is required to support operational requirements.

## Five Key Criteria for Free-Deck Naval Aircraft Handling Systems

The best free-deck naval aircraft handling system provides the required safety and operational capabilities for the aircraft, ship types, and typical sea states at an acceptable price.

Every vendor of free-deck naval aircraft handling systems will claim that their system offers the ideal combination of features and the best value. However, there are five key “must have” features for every navy that has determined a free-deck naval aircraft handling system is the right choice for their requirements.

### Fast and Precise Control Capabilities

The system should offer agile handling capabilities so that aircraft can be quickly and precisely maneuvered into position in the hangar or on the deck for takeoff. Systems that offer capture times of less than 12 seconds, variable traverse speeds up to 5 km/h, and on-the-spot turning circle abilities provide the optimal combination of speed and agility.

Capabilities such as four-wheel drive, four-wheel steering, computerized acceleration and deceleration, and traction management further increase safety, precision, and agility.

### Intuitive, Single-Person Operation

To simplify operations and mitigate risk, the free-deck naval aircraft handling system should allow a single on-deck operator to traverse the aircraft in and out of the hangar. The operator should be able to walk beside the aircraft while maneuvering it, maintaining full visibility of the entire aircraft and the surrounding area at all times.

A chest-pack portable control unit with dual joysticks — one to control drive speed and direction and another to control steering — lets operators control aircraft movements in a very natural way as they walk beside it.

## Compact, Low-Profile, Rugged Design

The design of the system affects its ease-of-use, flexibility, and durability.

For fast and easy attachment, the handling system should interface directly with the aircraft with no need for tow bars or airframe modifications. It should have a low profile to ensure it fits well beneath the fuselage on a wide range of helicopters, fixed-wing aircraft, and UAVs. And it should be able to maneuver aircraft with deflated tires, collapsed oleos, and nose-installed radomes.

To increase system strength, stability, and lifespan while decreasing weight, the system should be constructed with durable, corrosion-resistant materials, such as high-grade stainless steel, and include minimal welding detail.

Battery-powered electrical systems with solid polyurethane tires that are designed to increase traction and are deck-friendly will increase safety compared to systems powered by diesel, propane, or a combustion engine. The batteries should be long-lasting, able to continuously power a system that is moving a several-thousand-kilogram aircraft for several hours without recharging.

## Field-Proven on a Variety of Aircraft and Ships

Always look for a free-deck naval aircraft handling system that has been successfully used in a wide range of scenarios by a wide range of navies. This will help to ensure that the system is flexible, robust, and proven to perform. Questions to consider include:

- Which helicopters, fixed-wing aircraft, and UAVs has it been used with?
- What classes of ships has it been used on?
- What ground scenarios has it been used in?
- What specific tasks has it performed? Was it just moving aircraft, or was it used for towing tasks as well? Has it been used in shipboard elevators?

## Flexible Enough for Other Moving Tasks

The most flexible free-deck naval aircraft handling systems accommodate a tow bar so they can also be used for other tasks on the ship and on the ground. For the ultimate in flexibility, look for systems that can be customized for applications such as handling skid helicopters and scissor lift work platforms.

Systems that can be stacked and used in a stacked configuration offer an added advantage in situations where multiple systems are needed to meet requirements but storage space is at a premium.

## Work With a Leader in Free-Deck Naval Aircraft Handling Systems

Curtiss-Wright Defense Solution's INDAL business unit offers a range of naval aircraft handling systems that can meet the requirements of any aircraft and any ship in a variety of sea states. To help navies select the optimal naval aircraft handling system, or systems, for their requirements, we offer a unique modeling and simulation process to analyze ship motion and the associated aircraft reactions.

For navies that can take advantage of a free-deck naval aircraft handling system, the robust, flexible, and affordable Multi-Aircraft Nose Tail Interface System (MANTIS) aircraft tug is the ideal solution.

The MANTIS meets all of the key criteria for free-deck naval aircraft handling systems. It attaches directly to the aircraft, with no need for tow bars or airframe modifications, and is intuitively controlled by a single operator using joysticks on an umbilical-connected operator chest pack. Traction management, regenerative braking, and battery charging are all computer-managed and require no operator intervention. The MANTIS can maneuver aircraft with deflated tires, collapsed oleos, and nose-installed radomes.

MANTIS is available in a compact and lightweight Remote Aircraft Mover (RAM) version for aircraft up to 50,000 kg and a high-performance, four-wheel-drive, four-wheel-steering Extra Low Profile (ELP) version for aircraft up to 75,000 kg. With a rugged, low-profile design, it can be used for a variety of towing tasks, even when one unit is stacked on another. It can also be adapted for other applications, such as scissor lift work platforms.

## Deep Experience and Expertise

Navies that partner with the INDAL team at Curtiss-Wright get the benefits of our 60 years of experience designing and developing shipborne aircraft handling systems and managing the design and manufacture of complex defense solutions for the world's navies.

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We design our state-of-the-art naval aircraft handling systems using computer-aided design (CAD) software, computer simulation, solid modeling, and manufacturing resource planning (MRP) tools to ensure efficient and economical delivery of high-quality, custom systems. All of our naval aircraft handling systems are manufactured and tested following stringent practices that meet the most demanding requirements. In every project, we maintain a strong focus on:

- Safety of personnel and equipment
- Delivering high-performance systems at competitive prices
- Providing industry-leading life cycle support and services

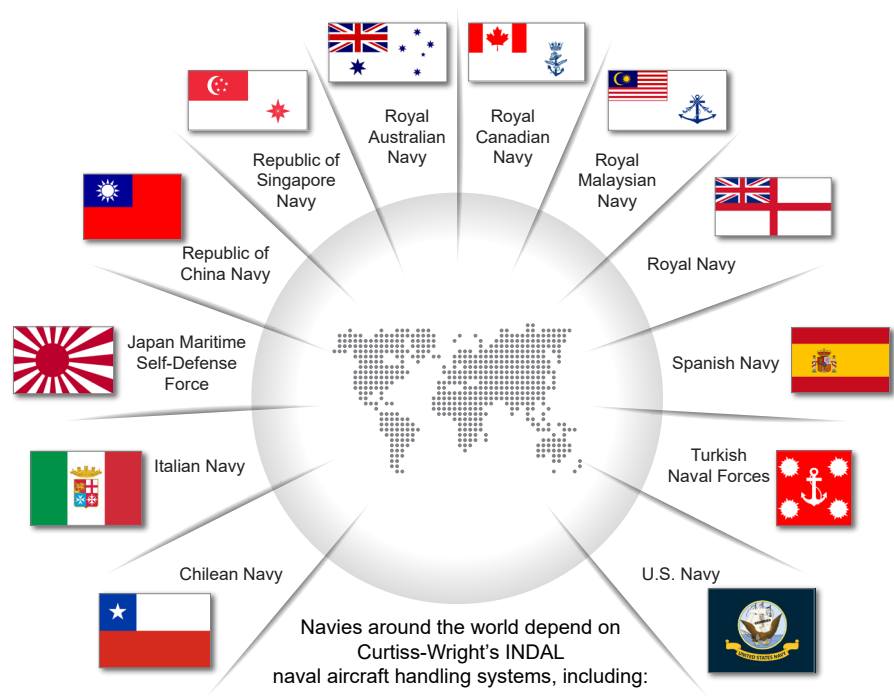


Figure 3: Leading Navies Depend on INDAL

## Learn More

- [Mantis Aircraft Tug](#)
- [Mantis ELP Aircraft Tug](#)
- [Mantis ELP Demo](#)