

# CIRCOR DELIVERS ANTI-HEELING SYSTEM FOR CUSTOM-BUILT SUPERYACHT

In shipbuilding, most large vessels that are susceptible to heeling could benefit from an anti-heeling system (heeling is the term for when a ship tilts on any of its sides). The most common cause of heeling is uneven cargo loading/unloading in port, but high winds, waves, currents and turns can also cause it. Heeling can be dangerous to ships and to their passengers and cargo, so a good anti-heeling system can not only make port operations simpler, it can also make a ship safer in general.

## ANTI-HEELING SYSTEMS: AN OVERVIEW

Automatic anti-heeling systems operate by detecting the heeling angle of the ship and then compensating via heeling tanks to return the ship to its neutral, even position, or “even keel”. These heeling tanks are internally connected to each other by means of pipe lines, automatic valves and a control system. When the ship heels, the heeling sensor sends a signal to change the ship’s angle to the master control panel. This change in heeling angle is achieved by the anti-heeling system transferring the water in heeling tanks from the heeled side to the other side of the ship, which returns the vessel to an upright position.

There are two primary types of anti-heeling systems – pneumatic and water-pump systems. Pneumatic systems operate via an air purging arrangement and regulating valve system to force the air on the top of one heeling tank. The air is forced on one tank and purged from the other, making water rapidly flow from pressurized to purged tank. Water pump systems, on the other hand, consist of an electrical motor-driven water pump, which can be a reversible or non-reversible pump, connected with remote controlled valves that can direct ballast water flow in between the tanks.

Within the water-pump category of anti-heeling systems, there are two main types of available options. The most common is an anti-heeling system with a conventional propeller pump with a 90-degree bend. This kind of pump system is one of the most used solutions and a widely accepted concept, as it is generally more affordable and achieves acceptable efficiency. However, this kind of pump has a large footprint and inflexible installation requirements.

The second main variety of water-pump anti-heeling system is an in-line propeller pump, which features simple installation directly in piping.

For a superyacht shipyard working with one high-specification project, finding the right kind of anti-heeling system proved to be a challenge. CIRCOR was able to provide the solution they needed.



For illustrative purposes only; not the yacht referenced in this article

## THE CHALLENGE

### ELIMINATING UNWANTED VESSEL INCLINATION DURING CRANE-OPERATIONS

One fully customized yacht being built at a world-leading superyacht yard was equipped with a crane suitable for lifting tenders and other supporting equipment in and out of the water. To eliminate any unwanted heeling during crane operations, the customer was looking for a system providing dynamic counterweights – an anti-heeling system. Such a system must be designed to automatically shift ballast water from one side to the other in a continuous, dynamic operation. In addition to reducing heeling for the sake of comfort, the system can provide increased stability as a safety measure.

Different anti-heeling systems have different demands depending on the type of vessel they are used in. Onboard this superyacht, low levels of noise and vibration were extremely important for passenger comfort, so an anti-heeling system that was quiet and didn’t generate much residual vibration or structure-borne noise was needed. In addition, the superyacht had very limited installation space available. These two requirements both needed to be met, which meant that no standard solutions could meet the customer’s demands.

## THE SOLUTION

### A NEW ANTI-HEELING SYSTEM BASED ON WELL-PROVEN COMPONENTS FROM CIRCOR

The superyacht manufacturer building this challenging yacht had not worked with Allweiler, a CIRCOR brand, in the past. In the marine industry, trust is earned through years of cooperation and partners showing willingness to stretch themselves to reach a common target. Companies with the experience and know-how to develop new solutions and deliver these on time as specified earn the trust and respect to remain in the market. Thus, based on Allweiler’s reputation and history with other shipyards and designers in the past, and special

projects in general, the shipyard reached out and presented Allweiler with their particular requirements, and Allweiler designed a system accordingly.

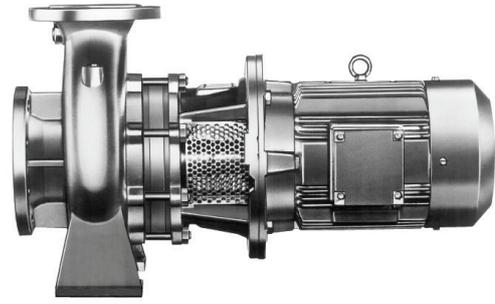
The solution to the difficult requirements on the superyacht was an Allweiler Anti-Heeling system based upon a centrifugal pump. To achieve this design, Allweiler transferred technology and know-how from other marine markets, such as Navy and Research vessels where extremely low levels of noise and vibration is crucial, and merchant marine markets where the level of accuracy is generally higher than for pleasure yachts, and the result was a system perfectly suited to the demands set by the shipyard. The pump operates at ultra-low speed and is controlled by a variable speed drive with prolonged ramp-up time.

Operating a centrifugal pump at lower than normal speed prevents wear on rotating parts such as impellers and bearings and enables the pump to operate with less noise and less vibration. Slower pump speed also creates better suction capabilities. This is achieved as water speed inside the pump casing is reduced. With reduced water speed, the risk of water hammering in the ship's piping (leading to noise, vibration and possibly damaging piping and valves) is reduced. The low pump speed also removes any risk of cavitation, another source of noise and vibration.

A pump with a reversible bi-flow is most commonly used in anti-heeling applications, but thanks to the smart valve set-up provided by CIRCOR, a single flow centrifugal pump could be used for the superyacht. A centrifugal pump is only capable of pumping water in one direction. In an anti-heeling system, it must be possible to pump the water in both directions as sometimes the water must be moved from starboard to port side, and vice versa.

However, with CIRCOR's valve set-up and the control system for these valves, it is possible to direct the water both ways. Additionally, the Allweiler anti-heeling system allows automatic emergency shut-down and automatic heeling monitoring and enables the heeling tank radars to be directly coupled to the Allweiler anti-heeling system. Normally, these signals are not allowed to go directly to the anti-heeling system, but CIRCOR managed to integrate a safe and certified solution to allow this, which is also the key for having the possibility for fully automatic, and safe, anti-heeling operation.

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The pump, drive and valves in the yacht's anti-heeling system are all controlled by the CIRCOR control system, which is also connected to an inclinometer that continuously monitors the yacht's inclination with a repeatable accuracy down to 0,04°. The system may be manually or automatically operated. In auto-mode, the system is pre-programmed to gently but quickly pump water between heeling tanks when the yacht reaches the default set-point listing of 2°. The list angle for starting the anti-heeling operation can be adjusted between 0,04-5°. To further ensure smooth movements onboard, the system is equipped with adjustable time delay.

For maximum safety, the system has a fail-safe arrangement including automatic shut-down and complies with DNV-GL Class Rules and Regulations.

The system and its components are scalable. Hence, the unique features and benefits of this Anti-heeling system can be applied to all types and sizes of vessels, such as cruise ships, heavy lift vessels, construction vessels, ferries, fishing vessels, Navy ships and research vessels to name a few.

## THE RESULTS

### GUESTS ONBOARD CAN ENJOY MAXIMUM COMFORT ONBOARD WITHOUT LISTING

The solution provided by CIRCOR ensures a stable, silent and vibration free anti-heeling operation. The yacht's guests can enjoy a noise and vibration free environment on the lower sun deck, located only an approximated three meters from the pumps and valves.

With its unique features based on well-proven Allweiler pump and components, the system is both efficient during operation and easy to maintain; an attribute well appreciated by the yacht's crew. After an Allweiler service technician successfully commissioned the system at the yard earlier this year, the yacht is ready to comfortably take its guests around the world.



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