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SAFETY ALERT 01/24

## SAFETY GUIDE: CRITICAL RISKS OF CAM CLUTCH UNITS IN LIFEBOAT LAUNCHING APPLIANCES

This safety guide addresses the risks associated with Cam Clutch units in lifeboat launching appliances on ships.

### 1. Introduction

Cam clutches (also known as one-way bearings or overrunning clutches) are critical components in winch units used for lifeboat and rescueboat davits. These clutches allow rotational movement in one direction (hoisting) while preventing motion in the opposite direction (lowering), allowing controlled lowering and secure holding of the lifeboat or rescue boat.

### Key Awareness Issue

Through extensive discussions with shipowners, operators, and maintenance personnel, we have found that:

- Many crew members are unaware of the existence of cam clutches inside the winch, or even their function.
- It is often assumed that the main holding (static) brake serves as the primary safety mechanism.
- If a cam clutch fails, the lifeboat can descend uncontrollably, even if the holding brake is applied.
- In cases of slipping loads, although the brakes are often blamed, when in fact, the cam clutch may actually be the root cause.

To address these gaps, it is essential that all personnel involved in maintenance or operation of lifeboat launching appliances receive proper training. This training should cover the function of cam clutches, their maintenance, and the steps to take in the event of failure. A well-informed crew is key to preventing accidents and ensuring the safety of lifeboat operations.

### 2. Consequences of Cam Clutch Failure

The consequences of cam clutch failure can be severe, leading to uncontrolled descent and posing significant risks to both the crew and the lifeboat itself. **Such a failure could result in catastrophic damage or injury**, highlighting the importance of understanding and maintaining this critical component.

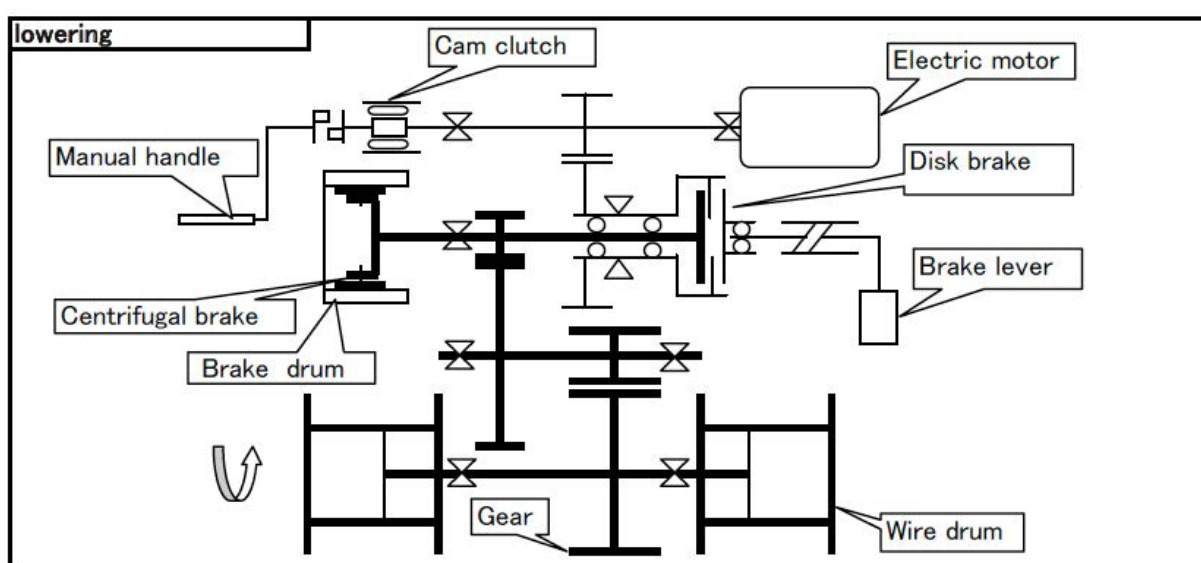
### 3. Recommendations

- It is recommended that regular inspections and maintenance of cam clutches be incorporated into safety protocols to ensure their proper functioning. Specific focus should be placed on the condition of the clutch and its operation in both hoisting and lowering directions.
- Preventive measures, including early identification of wear and tear or mechanical failure, will significantly reduce the risk of sudden clutch failure.
- Implementing regular inspections and crew training will significantly mitigate the risk of lifeboat accidents caused by cam clutch failure.

#### 4. How Cam Clutches Work in Winch Systems

In a lifeboat winch system, the cam clutch is installed between the motor shaft and the gear mechanism. It controls the directional torque transfer between the motor, drum shaft, brake shaft, and gears.

- **During Hoisting:** The cam clutch freewheels, bypassing the brake shaft so the motor directly drives the drum even with the holding brake applied.
- **When the Motor Stops:** The cam clutch instantly locks to prevent back-driving of the winch drum.
- **During Lowering:** The holding brake releases, allowing the drum to rotate. The cam clutch remains engaged to prevent the motor from reversing, while the centrifugal governor brake controls descent speed.
- **If the cam clutch fails:** The winch drum may rotate freely, leading to an uncontrolled descent of the lifeboat.



Typical diagram of the layout of a winch and the interaction of key components

#### 5. Risks & Failure Modes of Cam Clutches

##### Critical Failure Risks

- **Backlash and Wear:** Excessive movement before locking indicates internal wear.
- **Lubrication Breakdown:** Grease or oil degradation can cause slippage.
- **Incorrect Lubrication:** Wrong oil viscosity can cause slippage.
- **Corrosion and Rust:** Common in marine environments, leading to jamming.
- **False Engagement:** Appears to lock but slips under load.
- **Dormancy Related Seizure:** Long periods of inactivity lead to internal sticking.

##### Early Warning Signs of Failure

- Excessive free movement before engagement.
- Grinding, clicking, or inconsistent locking during operation.
- Lifeboat movement before the clutch locks when hoisting.
- Slipping under load, even when the brake is applied.

*If any of these signs appear, the cam clutch requires immediate inspection and possible replacement.*



## 6. Cam Clutches vs. Brake Systems

It is fair to say that the cam clutch is arguably the most critical component of a lifeboat winch because its failure can result in an uncontrolled descent of the lifeboat, even if the holding brake is applied. Yet many crew, service providers and surveyors fail to recognise this point and wrongly believe that the holding brake is the most critical aspect of the winch in securing a load.

### Why the Cam Clutch is the Most Critical Component

- It directly controls load holding: If the cam clutch fails, the winch cannot hold the load, regardless of brake condition.
- It engages automatically: Unlike brakes, which rely on manual or mechanical activation, the cam clutch must engage instantly when power is removed.
- Even slight backlash can be catastrophic: Unlike brakes, where wear can be tolerated to a certain extent, any noticeable backlash in a cam clutch indicates potential failure.
- Brakes have wear tolerances, but cam clutches do not: Brakes can still function, to a certain degree, with worn pads or discs, but a worn cam clutch can suddenly slip completely, leading to a freefalling lifeboat.

*Failure of the cam clutch = immediate loss of lifeboat control.*

### Cam Clutch vs. Brake System: Failure Consequences

Component	Function	Wear Tolerance	Failure Consequence
<b>Cam Clutch</b>	Prevents back-driving of the drum; engages automatically when power is removed.	<b>Minimal</b> (Even slight backlash is critical).	<b>Catastrophic</b> – Load may descend uncontrollably.
<b>Holding Brake</b>	Locks the brake shaft when applied to hold the load in place.	Moderate (Pads/discs can wear but still provide resistance).	Reduced braking performance, but system may still resist movement.
<b>Centrifugal Brake</b>	Regulates descent speed to meet SOLAS requirements.	Moderate (Components can wear but still regulate speed).	Over-speeding risk if worn beyond tolerance.

### Why Brake Wear is Less Critical than Cam Clutch Wear

- Brakes are designed to wear gradually. They have thickness tolerances, and even when worn, they still provide some resistance.
- Brakes operate manually or automatically, meaning their function is actively controlled by the operator.
- A brake failure usually does not result in immediate lifeboat freefall, as other stopping mechanisms may provide resistance.
- The cam clutch, on the other hand, is a passive safety device that must work 100% of the time, without operator intervention. If it fails, there is no backup mechanism.

### Improper Use of The Holding Brake During Lowering

Many crew members attempt to control the descent speed of the lifeboat using the holding brake instead of the centrifugal brake. This is incorrect and causes premature wear while also potentially affecting the cam clutch.



If the operator does not fully release the holding brake and tries to "feather" the descent speed:

- Accelerated wear on the brake system: The holding brake is designed to hold static loads, not regulate speed.
- Increased heat generation: Partial engagement creates high friction, possibly leading to brake fade.
- Possible torque variations on the cam clutch: This is where it can indirectly affect clutch performance.

While the primary damage occurs to the brake system, improper brake use can also impact the cam clutch in certain ways

### Effects on the Cam Clutch

- Torque Variations: Improper brake modulation causes fluctuating torque, increasing wear on clutch internals.
- Backlash Development: Inconsistent load transfer can accelerate wear on sprags or rollers.
- Heat Transfer Issues: Excessive braking generates heat that can degrade cam clutch lubrication over time.
- Delayed Locking: Oscillations in shaft motion may cause engagement issues when stopping.

*Best Practice: Always fully disengage the holding brake before lowering and allow the centrifugal brake to control descent speed as designed.*

### Why Over-Appling the Brake Can Disengage the Cam Clutch

It has been observed that once lowering of a lifeboat has been completed and the holding brake has been applied many crew force the brake lever beyond its intended limit or firmly against the brake lever holding bracket. It is assumed that they believe that the firmer the brake is applied the more secure the load is. This bad practice of forcing the brake lever beyond its limit can:

- Push the brake shaft too hard, affecting the alignment of the cam clutch.
- Cause excessive axial force, which may momentarily unlock the clutch.
- Release the load unexpectedly, as the clutch fails to hold.

*This is why some manufacturers warn against over tightening the brake, it can unintentionally disengage the cam clutch and create a hazardous situation.*



*Example of incorrectly applied brake lever, forced closed against the holding bracket*



*Example of correctly applied brake lever in a natural closed position*





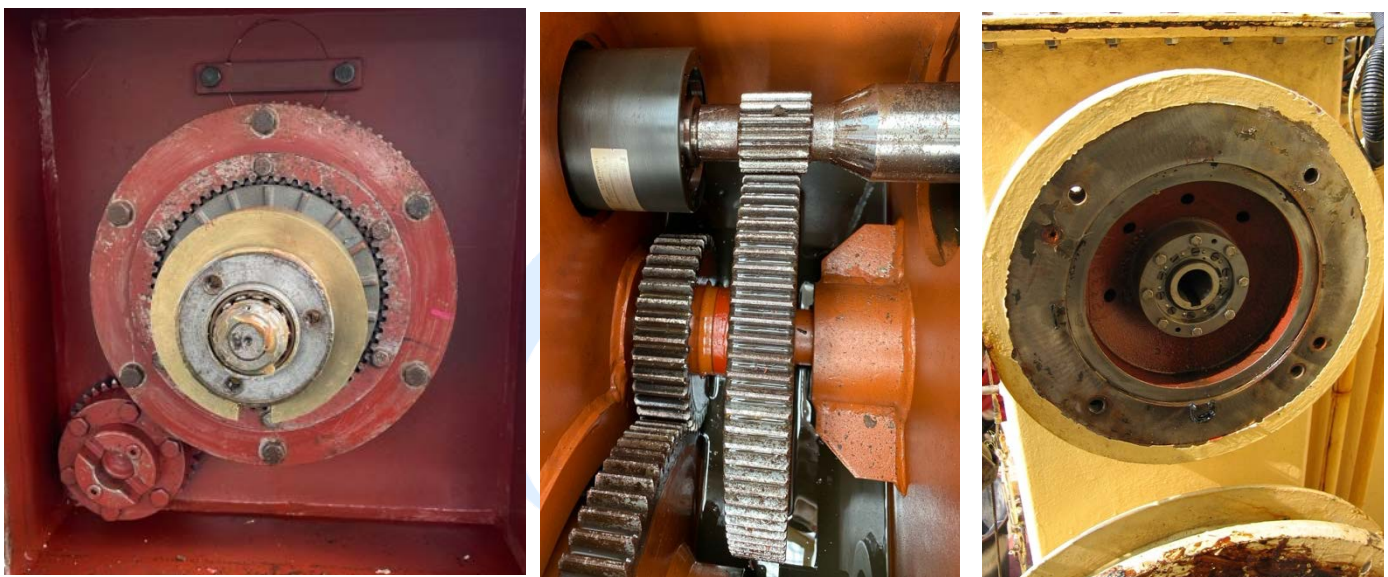
## 7. Inspection & Maintenance Guidelines

While these winches are safety-critical systems, their low usage frequency can lead to dormancy-related failures that may not be immediately noticeable until the system is needed in an emergency. Proactive and correct maintenance is critical to ensuring the clutch and winch remain reliable when needed.

### Different Cam Clutch Applications

Different manufacturers place cam clutches in different locations on their winches, affecting lubrication and maintenance needs so its imperative that you familiarise yourself with the specific application being used:

a) **Internally Mounted Cam Clutches** - Located inside the gearbox and lubricated via a splash lubrication system.



Examples of internally located cam clutches

b) **Externally Mounted Cam Clutches** - Located outside the gearbox, requiring manual lubrication.



Examples of externally mounted cam clutches





*Crew members often paint over oil inlet grub screws, blocking access and preventing proper lubrication.*



*Examples where crew had painted over lubrication inlets*

*Result of a lack of lubrication*

### **Maintenance Guidelines**

<b>Frequency</b>	<b>Action</b>
Weekly	Visual check in accordance with SOLAS III/20.6
Monthly	In accordance with SOLAS III/20.7 during the required turning out of the launching appliance the drum should be rotated to check smooth clutch engagement.
Quarterly	Function test under light load. Verify that the clutch locks immediately.
Annually (Certified Service)	Conducted by certified third-party service providers in accordance with SOLAS III Regulation 20 and MSC.402(96). Backlash to be verified and externally mounted cam clutches to be manually lubricated
5 Yearly (Certified Service)	Conducted by certified third-party service providers in accordance with SOLAS III Regulation 20 and MSC.402(96). Recommended to replace externally mounted cam clutches due to potential lack of regular lubrication

*Although lifeboats must be lowered every three months as part of abandon ship drills, this is generally alternated between boats. What is recommended here as quarterly maintenance should not be mistaken for, or combined with, a drill activity.*

### **6. Training & Awareness for Crew Members**

All crew members involved in lifeboat operations should be trained to:

- Understand the role of the cam clutch in the winch system.
- Recognise early failure symptoms of a faulty cam clutch.
- Differentiate between brake issues and cam clutch failures.
- Conduct pre-use checks to confirm the clutch is operational.
- Operate winch systems correctly and not feather the lowering speed through the holding brake.



## **7. Action Required:**

Immediate action is necessary to prevent potential failure. The following steps should be taken without delay:

- Shipowners, operators, and crew should prioritise regular testing and maintenance of cam clutches.
- Any signs of clutch failure must be addressed immediately to prevent potential accidents.
- During annual statutory servicing, ensure certified personnel inspect and lubricate cam clutches.
- Follow manufacturer requirements on the type of lubrication to be used. Sprag type cam clutches have been known to fail due to the incorrect lubricant viscosity. Ratchet type cam clutches should never be packed with grease.
- Recommended to keep spares onboard as cam clutches have no tolerance for wear and can fail suddenly.
- Follow manufacturer suggestions on replacement intervals whilst bearing in mind if on-board maintenance practices are lacking the replacement intervals will be accelerated.
- Keep a record of when cam clutches are replaced.

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## **Conclusion**

The incidents detailed in this safety alert underscore the critical importance of proper inspection, maintenance, and operation of cam clutch units in lifeboat launching appliances. Cam clutch failures can lead to uncontrolled lowering, serious injuries, or operational downtime. Addressing root causes through routine inspections, proper maintenance, crew training, and the use of high-quality components ensures safe and reliable lifeboat operations while maintaining compliance with safety regulations.

For further guidance or technical assistance, contact Watercraft Marine where our lifeboat safety experts are available to provide support and ensure your vessels meet the highest safety standards.

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