TRIPLE5 Lifeboat Release Mechanism - A Design Centered Approach to Lifeboat Hooks

Introduction

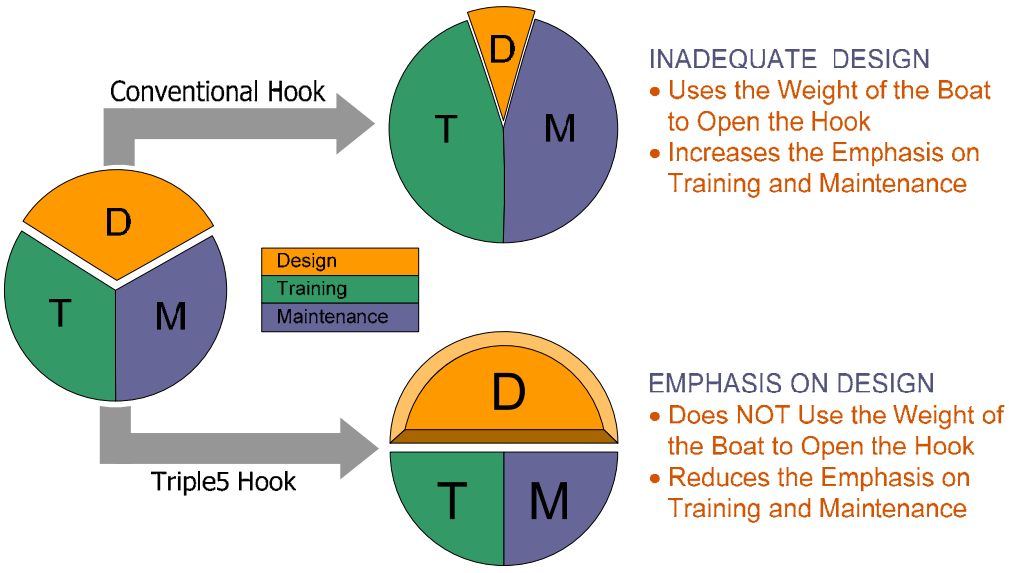
Over the past 25 years there have been a significant number of accidents and fatalities related to lifeboats. Numerous studies have looked into the cause of these accidents. It has become clear that the primary cause of fatalities has been related to the release mechanisms (hook systems). The most recent study commissioned by the UK MCA (MCA 555 Report) specifically looked at the relationship between lifeboat hooks and lifeboat accidents.

MCA 555 Report Findings

The central finding of the MCA 555 report was that there were three key elements for a successful lifeboat hook. These three elements are:

- Design
- Training
- Maintenance

All three of these elements are important as shown in the pie chart on the left below. The report found that the design of conventional twin-fall lifeboat hooks was inadequate. This inadequate design created a greater reliance on both training and maintenance as shown below in the top right pie chart.



Triple5 – A Design Centered Approach

In the development of a hook system for twin-fall lifeboats the developers of the Triple5 hook took a design-centered approach. As shown above in the bottom pie chart a significant emphasis was placed on design. While training and maintenance remain important, the emphasis on design reduces the emphasis on both training and maintenance when compared to conventional hook systems.

Triple5 – Design Requirements

The development of the Triple5 hook began with a set of fourteen design requirements and one key primary design feature.

Primary Design Requirements

1. Off-Load Safety with On-Load Functionality
2. Based on SSI's Current Hook (25 Year Safe History)
3. The Weight of the Boat Holds the Hook Closed
4. The Weight of Boat is Not Used to Open the Hook in On-load Release
5. Inherently Stable Hook: meets "Fail to Safe" Criteria

Primary Design Feature – Load Over Center

Secondary Design Requirements

6. No Critical "Wear Areas" that Lead to Inadvertent Hook Release or Reduce Component Life
7. No Coils or Springs to Fail or Loose Tension
8. No Fine Tolerances

Operator Interface Requirements

9. Regular Operation Release Handle Cannot Release Under Load
10. Distinctly Different Release Method for On-Load Release
11. Multiple Deliberate Actions to Release On-Load
12. Hook is either Open Or Closed, Cannot be Partly Open or Closed

Maintenance Interface Requirements

13. Incorrect Cable Adjustment Cannot Lead to Catastrophic Failure
14. Cannot be Assembled Incorrectly after Maintenance

Primary Design Requirements

In developing the Triple5 hook there were a central set of Primary requirements, these are outline below.

1 Off-Load Safety with On-Load Functionality

Off-load release hooks were used in lifeboats for many years. These were replaced when a requirement for On-load was deemed desirable.

Off-load hooks are less likely to fall from their davits due to operator or equipment error as they will not release when the weight of the boat is on the hooks. However off-load hooks do not provide an ability to release under load on the occasions when that may be necessary.

On-load hooks have the ability to release under load using the weight of the boat to open the hooks. However conventional twin-fall on-load hooks have been prone to accidents due to accidental release when the boat is in the air.

Both off-load and on-load capabilities are desirable. The design goals were to design an Off-load hook (less prone to accidental release) which has On-load functionality when required.

2 Based on SSI's Current Hook (25 Year Safe History)

SSI developed their own On-load/Off-load release mechanism for use in its single cable capsule equipment. This release mechanism has been in operation since 1982 without a single incident or injury. The twin-fall hook solution was developed based on this proven design.

3 The Weight of the Boat Holds the Hook Closed

To ensure that the boat does not release in the air the design should be such that the weight of the boat will keep the hooks closed.

4 Weight of Boat Not Used to Open Hook in On-load Release

Related to the previous requirement the weight of the boat should not be used to open the hooks, therefore limiting the chance of accidental release in the air.

5 Inherently Stable Hook: meets "Fail to Safe" Criteria

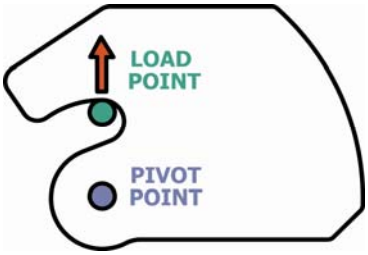
Should something go wrong with the operation of the hook system it will "Fail to Safe" i.e. it will remain in a safe position and will not drop the lifeboat.

Primary Design Feature

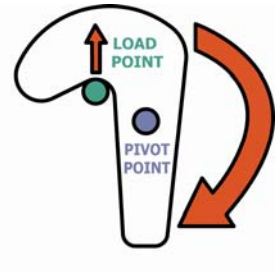
Load Over Center is the central design feature of the hook that enables the achievement of the primary design requirements. Load Over Center is defined as the load point of the hook being directly above the center of the pivot point of the hook. Such a design ensures that the weight of the boat keeps the hook closed when it is in the air.

A Load Over Center design is shown in the two diagrams on the left below. The first shows SSI's single cable hook and the second shows the Triple5 hook derived from that design. The diagram right below shows a conventional unstable twin-fall hook that does not have a Load Over Center design and uses the weight of the boat to open the hook.

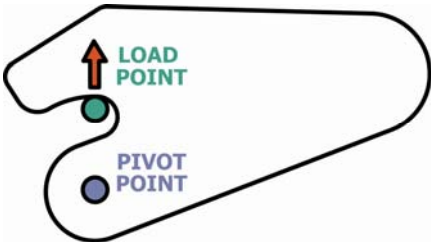
SSI SINGLE CABLE INHERENTLY STABLE HOOK
LOAD OVER PIVOT CENTER
NO ROTATIONAL FORCE



UNSTABLE HOOK
LOAD **NOT** OVER PIVOT CENTER
ROTATIONAL FORCE
(Opens the Hook)



TRIPLE5 INHERENTLY STABLE HOOK
LOAD OVER PIVOT CENTER
NO ROTATIONAL FORCE



The Triple5 hook has the same Load Over Center characteristics as the SSI single cable hook.

In addition the Triple5 hook has the identical hook profile (left side) of the SSI single cable hook.

No Hydrostatic Valve Required: A hydrostatic valve is used in conventional twin-fall hook designs in an attempt to prevent premature hook release, and is required due to the unstable design. As the Triple5 hook is a stable Load Over Center design, a hydrostatic valve is not required.

No Locking Pin Required: The stable Load Over Center design will not allow premature release of the lifeboat using the same release handle as used for regular waterborne operation. This is not the case with other hook designs. As such other hook designs require added levels of security (such as a locking pin).

Secondary Design Requirements

Following on from the Primary design requirements which focused on the central concept of the hook there were additional Secondary design requirements. These focused on design issues that had proved problematic with many conventional twin-fall hook designs.

⑥ No Critical "Wear Areas" that Lead to Inadvertent Hook Release or Reduce Component Life

Many twin-fall hook designs have critical "wear areas" (in particular, and most dangerously, on the tail of the actual hook). These can and have led to inadvertent hook release, leading to the dropping of a lifeboat which has resulted in injuries and fatalities. In other cases these wear areas may not have dropped a lifeboat but they significantly reduced component and hook life expectancy.

⑦ No Coils or Springs to Fail or Lose Tension

Previous twin-fall release mechanism designs have included coils and springs which can loose tension and impact the functionality of the release mechanism. A design requirement for the Triple5 hook was that there were are no coils or springs.

⑧ No Fine Tolerances

Fine tolerances have been employed in the design of many twin-fall hooks. These fine tolerances require precision measurements when performing a service on the hook. Such fine tolerances can lead to a hook getting out of tolerance with use. When a hook slips out of this fine tolerance there is a danger of premature release.

Operator Interface Requirements

The following are design requirements focused on the operator (seaman) to ensure that the operator cannot release or hook up incorrectly.

⑨ Regular Operation Release Handle Cannot Release Under Load

In conventional hook systems the regular release handle can be used to open the hooks under load and therefore potentially drop the boat. A requirement for the Triple5 hook was that when the hooks are under load it is physically impossible to use the regular operation release handle.

⑩ Distinctly Different Release Method for On-Load Release

Related to the requirement above is that there needs to be a distinctly different method of releasing the hooks in an on-load condition. This further reduces the possibility of an accidental mid-air release.

11 Multiple Deliberate Actions to Release On-Load

To further ensure that on-load release cannot accidentally occur through operator error, there was a requirement for multiple deliberate actions to release the boat under load.

12 Hook is either Open Or Closed, Cannot be Partly Open or Partly Closed

Many conventional hooks allow for the hooks to remain in a partially open or partially closed state. This has resulted in operators hooking up to an incorrectly set hook. This then leads to catastrophic consequences when the boat falls from the hooks. A requirement for the Triple5 hook was that the hooks are either open or closed, they cannot remain partially open or partly closed. The operator will then not be able to hook up to an incorrectly set hook.

Maintenance Interface Requirements

The following are design requirements focused on maintenance issues. These requirements reduce the possibility that maintenance related errors can lead to catastrophic consequences.

13 Incorrect Cable Adjustment Cannot Lead to Catastrophic Failure

Certain accidents with conventional release mechanisms resulted from incorrect cable adjustments after the inspection or servicing of the hooks. A requirement for the Triple5 hook was that this could not occur.

14 Cannot be Assembled Incorrectly after Maintenance

Certain conventional release mechanisms have parts that can be assembled incorrectly after a release mechanism has been stripped down and serviced. It was required that the Triple5 release mechanism be designed in such a way that it can only be reassembled one way – correctly.

Conclusion

The Triple5 Hook Mechanism Provides the Following:

- An Inherently Stable hook using a Load Over Center design.
- A design that uses the weight of the boat to hold the hook closed and not to open the hook.
- A design based on SSI's current hook that has a 25 year accident free history.
- Off-load safety with on-load functionality.
