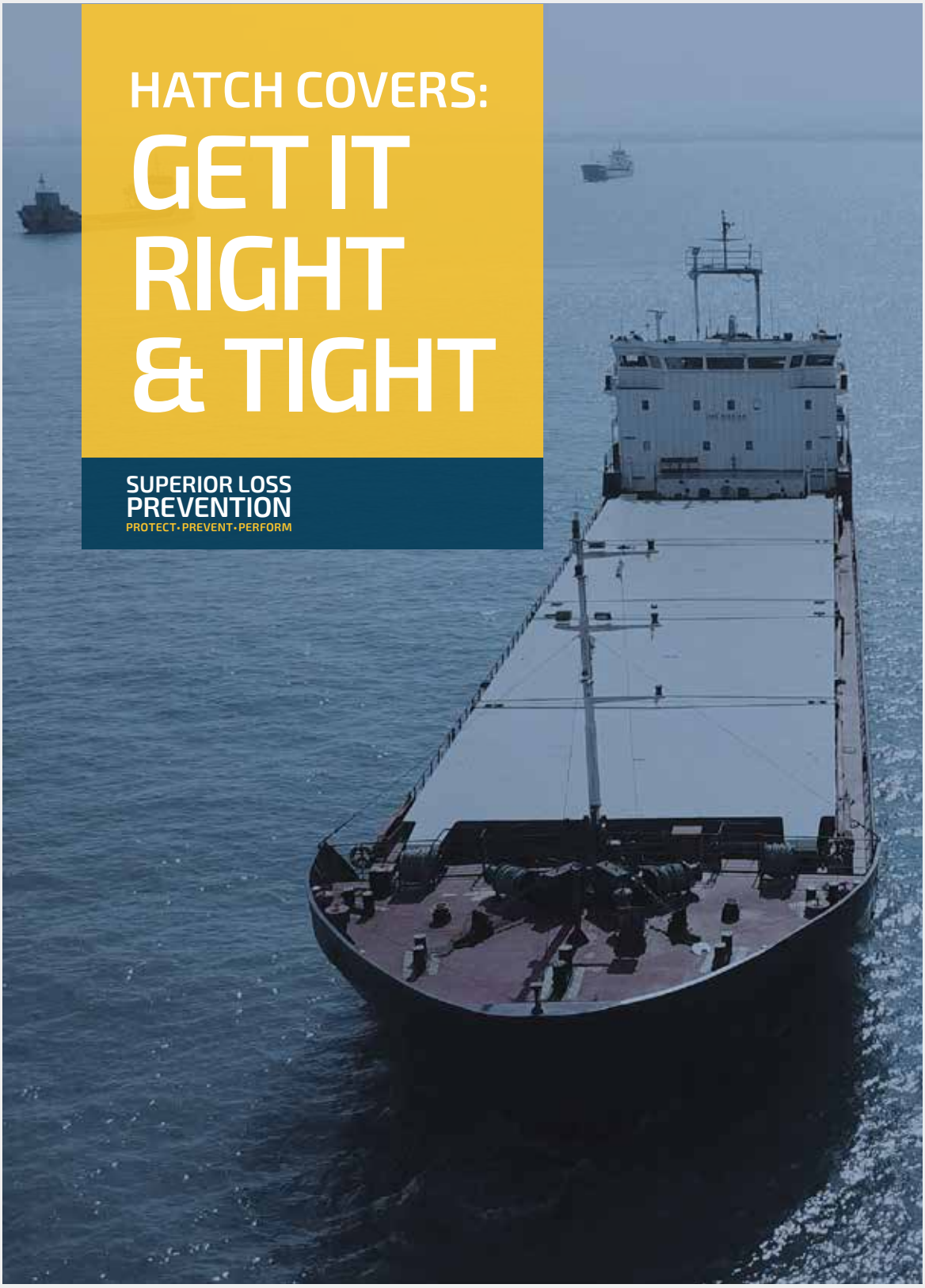
HATCH COVERS: GET IT RIGHT & TIGHT

SUPERIOR LOSS PREVENTION

PROTECT • PREVENT • PERFORM



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INTRODUCTION

Each year, insurers face significant costs as a result of losses caused by wetting damage to water-sensitive cargoes.

The business model of shipping is to transport cargo for a freight that will be paid for when the goods are delivered in time and in good condition. Only when ships are seaworthy, cargoworthy and operated in a safe manner and environmentally friendly way will it be possible to meet with the expectations of customers and generate a profit. Within the scope of cargoworthiness, hatch covers are key equipment for dry cargo ships.

Whilst in many cases wetting damage to cargo is caused by leaking hatch covers, problems with hatch cover operation systems are also responsible for delays, claims, accidents and injuries.

Hatch covers are generally referred to as heavy-duty shipboard equipment and, as the wording suggests, this is generally material that can withstand rough handling and does not need consistent maintenance. However, this loss prevention bulletin will hopefully eradicate this way of thinking, as hatch covers are fine pieces of engineering that need professional handling and proper maintenance in order to function properly.

Within the legal framework, the International Convention on Load Lines is one of the most important conventions related to hatch covers, and requires them to be strong, tight and well secured in order to remain weathertight and withstand the rigours of an ocean voyage.

Finally, and even when engineered, installed, handled and operated with great care and professionalism, the continuous exposure to the elements and rigours of ocean voyages means that hatch covers must be maintained whilst the ship is in service as well as during docking periods. The continuous trend in cutting costs often results in requesting crew members to carry out repairs that are beyond their capacity, often with inappropriate materials and spare parts. Such an approach, together with mediocre documenting and poor maintenance systems, will limit or even nullify the

FIGURE 1 SHOWING WETTING DAMAGE TO BULK CARGO – COURTESY FRANS VOOGT

owners', manager's and legal personnel's chances of proving that due diligence was exercised to provide shippers or charterers with a sea- and cargoworthy ship in case a claim for wetting damage is filed against the ship.

If we want hatch covers to do what they are designed for and meet expectations, then the designing, engineering and installation processes, as well as training, operation and maintenance, all deserve the same attention.

As the transport of goods by sea is crucial for the world economy, this brochure was created to raise awareness of the importance of hatch covers and their role in keeping ships and crew safe and cargo dry. Proper inspection, correct operation and regular maintenance will ensure that the goods loaded onboard ships can be transported in a safe, responsible and environmentally-friendly manner and be delivered in time and in good condition.

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IMCS bvba
Chairman, IMCS Group

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HATCH COVERS & LEGISLATION: A PRACTICAL APPROACH

Most people will associate hatch covers with the hatch cover tests that are carried out at the shippers' or charterer's request prior to giving the green light for loading operations or accepting the ship as being on-hire. This is not an unusual request, as the shippers' and charterers' main concern is that the hatch covers will not leak during the forthcoming voyage as this would ruin the quality of the products shipped and scuttle the profit-making part of the sea venture.

Although profit may be the driver of transporting goods by sea, it should not be overlooked that the safety of the ship and crew prevails. What is paramount in any sea venture is the safety of the ship and crew. After all, cargo is replaceable, but human life is not.

The ship's load lines are generally used to establish the quantity of cargo that has been loaded, which, economically or commercially speaking, is important from a freight (revenue) and contract point of view. However, from a safety point of view, not the quantity loaded (and the part of the ship that is under water), but the remaining freeboard (the part of the ship that is above the water) after the ship has been loaded is paramount, as freeboard means reserve buoyancy, which in turn means extra safety.

This is clearly addressed by the International Convention on Load Lines (ICLL), which states that its main goal is to "*Establish uniform principles and rules with respect to the limits to which ships on international voyages may be loaded, having regard to the need for safeguarding life and property at sea*".

FIGURE 2 INTERNATIONAL CONVENTION ON LOAD LINES

The ICLL further states that "*The load line shall never be submerged at any time when the ship puts to sea, during the voyage or on arrival*" (Art. 12). As such, the ICLL not only addresses the fact that overloading is not allowed because it would reduce the freeboard (reserve buoyancy of the ship), but also because overloading would have an effect on the ship's stability and create excessive stresses on the ship's hull.

With hatch covers covering up large openings in the ship's weatherdeck, the ingress of water through the hatch covers (but also any other openings such as vents, accesses and portholes that would give access to the interior of the ship), will add weight to the vessel ($1m^3$ of water weighs one tonne). When this happens to a vessel that is fully loaded to its marks when at sea, the vessel will quickly become heavier, the load line will become submerged and the freeboard reduced, and together with increased stresses on the ship's hull this results in the vessel's safety being impaired.

It is therefore necessary that hatch covers are always weathertight in order to prevent the ingress of water.

Tightness depends on different parameters, of which the sealing (rubber packing and compression bar) is the most well-known. However, it should not be overlooked that hatch covers, once closed and battened down, should remain in place throughout the voyage and as such they need to be efficiently secured to the ship's hatch coaming as well. Finally, the ship's hatch covers should be able to withstand the rigours of an ocean voyage. Therefore, it should be ensured that water that crashes on the hatch covers cannot cause structural damage, as this would most probably result in catastrophic failure, with possible loss of the vessel as a result.

From the aforementioned it becomes clear that, from a safety point of view, not only must overloading be avoided, but the strength, tightness and securing of hatch covers are important issues that will have to be considered during any inspection. This is also mentioned in the ICLL, which states that "*The means of securing weathertightness shall be to the satisfaction of the administration*" and "*The arrangements shall ensure that the tightness can be maintained in any sea condition and for this purpose tests for tightness shall be required at the initial survey and may be required at periodical surveys and at annual inspections or at more frequent intervals*" (Reg. 16-4).

FIGURE 3 INCORRECTLY MARKED LOAD LINE MARKS

It is important to note that the ICLL is a convention, which means that it is a statutory requirement for the signatory parties to the convention. In simple terms, it should be considered as a law, imposed by the flag state and as such it is important that shipowners, managers and crew are aware of the fact that not complying with the ICLL requirements (when ratified by their flag state) is an infringement of the law.

As such, construction, installation, testing, maintenance and repairs should not be taken lightly. Surveys for assigning the freeboard will include mentioning the type of openings on board the ship as well as the required degree of tightness. In some cases, the ICLL certificate will also impose trading limitations, which should always be observed and considered when making the ship's passage plan for the upcoming voyage.

Considering that hatch covers must be inspected and tested regularly, it is good to be able to document that inspections, maintenance and repairs have been carried out as required and therefore it is recommended that all hatch cover-related inspections and tests are properly filed and readily available on board.

Although it is quite common to refer to watertightness to indicate that hatch covers should not allow water to enter the hold, it can be seen from the ICLL that hatch covers do not have to be watertight, but weathertight.

This means that in any sea conditions, water (that comes from the "weather" side such as green seas, spray, rain, etc.) should not enter the ship's hold. Typical locations where you will find weathertight closures are situated above the waterline.
On the other hand, "watertight" means that "water will not pass through the sealing arrangements from both directions across the seal under a head of water". Therefore, a closure between two compartments below the waterline will typically be watertight. Watertight compartments are resistant to great water pressure, as is the case during a major water leakage. Thanks to the "watertight" closure, the leakage will not spread, and the vessel will stay afloat.

From a practical point of view, hatch covers should be weathertight but, in some cases, (e.g. container vessels), the administration may approve so-called partly (reduced) weathertight or non-weathertight hatch cover designs, subject to strict conditions. Partly weathertight designs will only have compression packing rubbers on the perimeter, and wipe or lap seals at the cross joints.

Non-weathertight hatch covers have no sealing arrangements and usually rely on a water retarding Labyrinth-type system to prevent major ingress. To compensate for the lack of tightness, such sealing arrangements are usually only approved on the condition that extra bilge pumping capacity and CO^2 (for firefighting) is provided on board.

When complying with the requirements as laid down in the ICLL, the ship's load line certificate will be issued by the administration, or by the classification society that acts as Recognised Organisation.

What is not well known is that the "Record of Conditions of Assignment of Load Lines" should also be attached to the load line certificate. This record includes details of the disposition and dimensions of the superstructure, trunks, deckhouses, machinery casings, bulwarks, etc., and also about the position and sealing requirements of the hatchways.

A perusal of this document during surveys is interesting, as it provides details about the tightness requirements (weathertight, partly- or non-weathertight) of the hatch covers as approved by the Administration.

Whilst the ICLL is by far the most important hatch cover-related convention, it should be emphasised that hatch covers are also subject to compliance with other important conventions (SOLAS, MARPOL) and codes (IMDG). Furthermore, useful guidance about safety aspects as well as the safe handling and operation of hatch covers can be found in the Code of Safe Working Practice for Merchant Seamen (CSWP).

Whilst hatch covers will be inspected by surveyors of the administration or classification societies to ensure compliance with the

FIGURE 4 CREW SHOULD BE TRAINED IN UNSAFE PRACTICES WHEN OPERATING HATCH COVERS - HERE SHOWING CREWMEMBER PUTTING HIS HAND ON THE HATCH COVER TRACKWAY WHILST CLOSING

ICLL requirements, hatch covers are also frequently inspected by surveyors acting on behalf of shippers, charterers and P&I providers.

In many cases, shippers and charterers will only require a hatch cover test (usually a hose or ultrasonic test) to ensure that the hatch covers are fit and tight for the upcoming voyage.

However, it should be noted that a test is not a substitute for a careful visual inspection of the hatch covers. To conclude that hatch covers are weathertight, and will remain weathertight throughout the voyage, both a test and a visual inspection are necessary.

In addition to the above, and when acting on behalf of P&I providers, surveyors will also check if due diligence has been exercised. Proving due diligence is necessary in case a claim for wetting damage is filed against the ship, as in such cases owners will have to prove that the wetting damage is not the result of improper (or lack of) maintenance, but is to be attributed to the perils of the sea (force majeure). To do so, the ship will have to prove and document that the hatch covers are in good condition, are well maintained, are regularly inspected and are tested in line with good industry practice and standards.

HATCH COVERS: DESIGN ISSUES

In order to comply with the ICLL requirements, it is important to ensure that "*weathertightness can be maintained in any sea condition*" (reg. 16(4)).

From a manufacturing point of view, this is quite a challenge as "any" sea condition means that even in the harshest conditions, water should not penetrate the ship's holds (see "overloading") so as not to endanger the ship and crew.

In the design stage, it is important to consider several important design issues and to combine these with safeguards that will prevent water ingress. The design issues include the client's information and desired data, such as:

- **Type of vessel (bulk carrier, multipurpose, reefer, etc.)**
- **Hatch dimensions/required extent of opening**
- **Required opening/closing time (depending on trading pattern)**
- **Degree of automation (available crew, etc.)**
- **Repair possibilities (availability of shore specialists/ship's crew repair skills, spare parts, etc.)**
- **Carriage of cargo on hatch covers**
- **Required degree of tightness (weathertight/reduced weathertight and non-weathertight)**
- **Budget (min – max scantling, steel price, etc.)**
- **Trading pattern (warm or cold climate, tropical rain showers and speed of closing hatch covers)**

These criteria must then be married up to the ICLL requirements, which means that the following issues should also be considered by the manufacturers:

- **Available deck space for stowing the panels**
- **Available stowage height for panels**
- **Required coaming height**
- **Type of sealing (rubber packing and compression bars)**
- **Type of operation (opening and actuating mechanisms)**
- **Availability of deck cranes/winches for opening hatch covers**
- **Required/maximum panel weight (ship's gear, shore gear, etc.)**
- **Available power on board**
- **Construction type (open web, double skin) and required fittings (cleats, packing)**

Finally, once the design is complete, the plans will be submitted to the administration for approval.

HATCH COVERS: ACHIEVING TIGHTNESS

A well-designed ship with approved hatch covers will meet the ICLL requirements that state the hatch covers must be weather-tight. In the first place, it is important to know that whilst a ship is at sea, it will be subject to deformations such as flexing, hogging, sagging, twisting and a combination thereof as a result of wave action, load, ballast or empty condition and sometimes ice pressure.

As hatch covers must be strongly built, they will be heavy and rigid pieces of equipment. On the other hand, the ship is flexible, partly because the deck has large openings in it (hatchways). The size of the hatchway openings will be one of the parameters that will determine the flexibility of the ship (e.g. open hatch ships). The flexibility of the ship and the rigidity of the hatch covers will mean that the panels will not move in unison with the ship. This will result in relative movement between the panels and the ship and also between the panels in a hatch cover set.

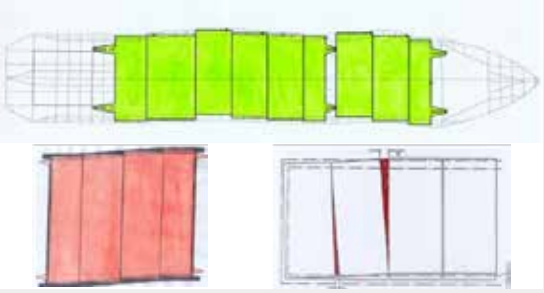

FIGURE 5 ILLUSTRATING RELATIVE MOVEMENTS BETWEEN PANELS. (COURTESY MACGREGOR)

The impact of these relative movements can be controlled and minimised by the design of sealing arrangements, steel structure, bearing pads and stoppers.

Whilst it is commonly believed that the hatch covers are made weathertight by means of the packing rubbers, is should be noted that weathertightness is not achieved by packing rubbers alone. The first barrier to water ingress will be the hatch plating itself. Indeed, most of the overcoming water will be kept out by the hatch cover plating, which is why this plating needs to be strong and well-supported by the hatch panel stiffeners.

Although it may theoretically be possible to make a single hatch panel/pontoon, the weight and size of such a pontoon would make it practically impossible to handle it and stow it away. Therefore, most designs consist of a series of loose pontoons or sets of linked or hinged panels that will eventually cover the hatch opening.

FIGURE 6 TYPICAL LEAKAGE PATTERN IN WAY OF PANEL INTERSECTIONS/CROSS JOINTS

This creates intersections between adjacent panels, and these intersections are a vulnerable part in the hatch cover system. This is proven by the many wetting damage claims that show a clear and typical pattern of water ingress via the cross joints.

As we will see later, the hatch cover packing rubbers will only be able to compensate for a given range of deflections, meaning that in extremely heavy weather conditions the compression range of the rubber will no longer be able to compensate for the relative movement between the panels. As this will generally happen at a moment where tightness is needed most (i.e. in heavy weather) it is necessary to include a third safety barrier in the design, which is the drainage system.

Therefore, it is recognised that rubbers alone may not be able to keep all the water out and that some water may pass through the packing rubber/compression bar interface in the case of extremely heavy weather. As the ICLL does not allow water to run into the hold, the incoming water will be collected in the drainage channel and will be drained away out on deck.

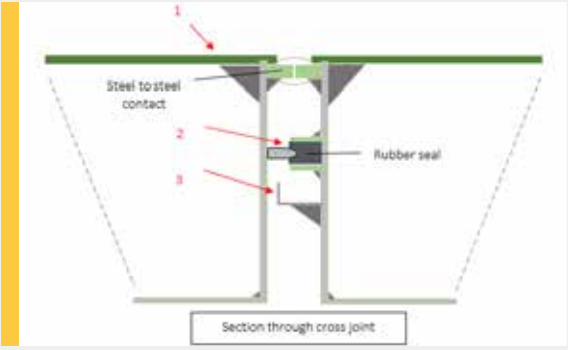

FIGURE 7 SHOWING THE 3 SAFETY BARRIERS IN HATCH COVER DESIGN, I.E. THE STEEL HATCH PLATING (1), THE SEALING SYSTEM (2) AND THE DRAIN CHANNEL (3)

As this will happen in heavy weather, the ship will be rolling and pitching heavily. Under these circumstances, it is not unusual for some water that accumulates in the drainage channel to pass over the drainage channel and fall onto the cargo stowed below, causing wetting damage and therefore claims. The fact that with well-maintained hatch covers this will only happen in extremely heavy weather means that from an insurance point of view, ship owners are entitled to call in the "perils of the sea" clause. Under this clause, the claim resulting from water ingress during extremely heavy weather ("force majeure") will be absorbed by the cargo insurance (on condition that the owners can prove that they exercised due diligence).

From a risk management point of view, a sea voyage is considered as a venture. To make the transport of goods by sea less risky, and by knowing that wetting damage accounts for a large portion of overall claims paid by insurance companies year on year, the three-tier safety barrier concept allows the risk to be mitigated to an acceptable level.

To reduce the risk, it should be clear that the vessel's hatch covers must be of a trustworthy design, installed by specialists, and properly operated and maintained by the ship's crew.

HATCH COVERS: KEY PARTS

As mentioned above, and in line with ICLL requirements, hatch covers must be tested at regular intervals. Even when no leaks are found, such a test reflects a tightness condition at the time of the test only. According to the ICLL, it is not only important that hatch covers pass a test at a certain moment (snapshot), but also that they can maintain tightness throughout their in-service life.

Therefore, it is necessary to carry out a visual inspection of the key items. Once the hatch covers have been visually inspected and based on the test results and details of the visual inspection, it will be possible to determine if the hatch covers are and will remain weathertight.

Visual inspections should not be limited to key items only, but should include all necessary items and hatch cover fittings. However, as there is a big variety of hatch cover designs on the market, it is up to the inspector or surveyor to familiarise themselves with the hatch cover type and operation system prior to inspection. The key parts described in this brochure are generally found on every type of hatch cover and can be considered the most important ones. When inspection reveals that these key parts are in order and fit for duty, the chances of water ingress will be remote.

With regard to the visual inspection, and although there is a perception that hatch covers are heavy, robust pieces of equipment, hatch covers are, in fact, fine pieces of engineering that work against very small tolerances and clearances. As such, we are talking about millimetres and it is recommended that during inspections, checks are carried out against the manual specs and drawings. Using the right tools for taking measurements of clearances and imprints is recommended.



FIGURE 8 SHOWING THE USE OF DEDICATED TOOLS FOR MEASURING CLEARANCES AND PERMANENT SET IN PACKING RUBBER

From a practical point of view, consulting the manual prior to the commencement of the inspection will provide you with useful details and information, as will a quick review of the last inspection results, tests reports and maintenance files.

Nowadays, we see that in several cases, hatch cover maintenance is included in the ship's Planned Maintenance System (PMS). However, the checks or tests to be carried out according to the PMS are often quite superficial and do not provide the necessary info to conclude that all is in order. Even though ISM focuses on the prevention of accidents, pollution and damage to third-party property (a.o. the cargo loaded), few safety management systems seen on board so far include appropriate information about the inspection, maintenance and correct operation of the ship's hatch covers.

In order to facilitate preparation for the visual hatch cover inspection, the main key parts of a hatch cover system are listed below:

- **Packing rubbers**
- **Bearing pads (steel-to-steel contact)**
- **Locators**
- **Stoppers**
- **Operation mechanisms**
- **Drainage system**
- **Hatch panels**
- **Compression bar**
- **Securing mechanisms**

PACKING RUBBERS

As pointed out earlier, hatch covers are rigid pieces of equipment, and as the ship is more flexible, there will be relative movement between the panels and the ship's hatch coaming whilst the ship is at sea.

Due to these relative movements, and without a proper sealing arrangement, it would be easy for water to infiltrate into the ship's holds, which is not permitted. Therefore, it is necessary to fit a compression seal (packing rubber) into the panel's retaining channels.

Due to continuous interaction between the packing rubber and the compression bar (or flat mating surface on the coaming), packing rubbers will suffer and age at a steady pace. Furthermore, exposure of the packing rubbers to heat, cold, sunlight, cargo (abrasive/chemicals, ...), chlorides, etc. during their service life will accelerate the deterioration and ageing process. As such, packing rubbers also require high-end engineering to ensure that the rubbers retain their resilience throughout their service life. When hatch covers are well maintained and taken care of, rubber packing should normally have a service life of approximately five years (two surveys) but there are cases on record where packing rubber can last even longer.

Different types of packing rubber are available on the market, and the right seal for the ship will depend on a wide variety of factors. Hatch cover manufacturers are the right people to advise on which rubber packing will perform best for a specific type of ship and hatch.

The compression seal referred to earlier is designed to be compressed up to a specific depth, which is referred to as the rubber's "design compression" and which will allow the rubber to compress and relax and, as such, absorb relative movements between the hatch covers and the coaming compression bar.

Depending on the type of rubber packing (box type or CAT/sliding profile seals), the design compression will generally be in the range of 8–20mm. Exact information about the packing rubber's design compression should normally be available from the maker's manual or drawings.

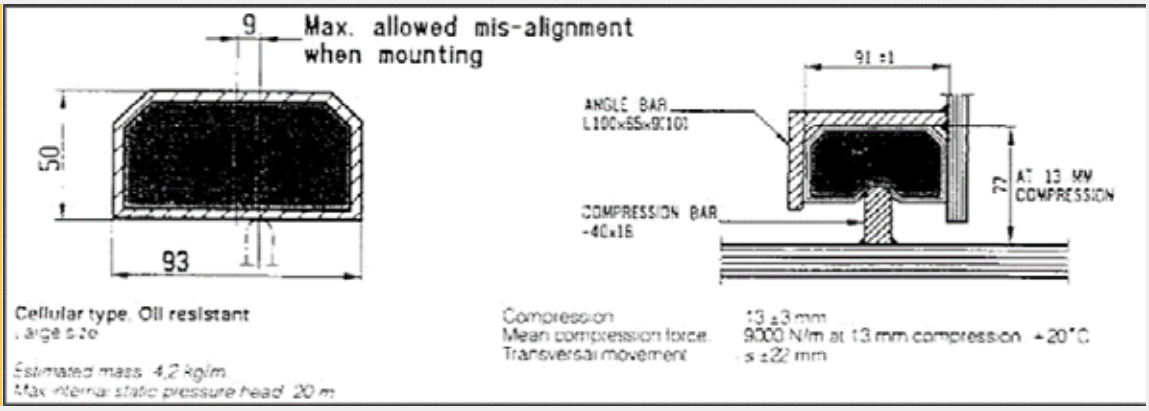

FIGURE 9 KEY INFORMATION ON PACKING RUBBERS AS SHOWN IN THE MAKER'S MANUAL

In the absence of manufacturer details, the design compression of ordinary box-type rubber packing can be estimated using the following rule of thumb:

Design compression = 25% of the nominal thickness of the packing rubber

Packing rubbers will age over time and slowly a permanent set will become visible. Together with the permanent set, the rubber will lose some of its resilience and in order to ensure that a minimum compensating capacity and resilience can be guaranteed (necessary to prevent water ingress and assure the vessel's safety), discard criteria are applicable and will also be mentioned in the manual. However, when not available, inspectors may use another rule of thumb to calculate the discard criteria of ordinary box-type rubber packing as a result of a permanent set as follows:

Discard criteria = 50% of the design compression.

This is further illustrated by the below sketch:

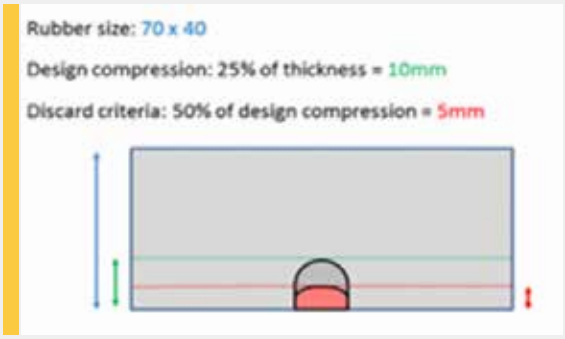

FIGURE 10 ILLUSTRATING THE DISCARD CRITERION OF AN ORDINARY BOX-TYPE PACKING RUBBER

FIGURE 11 MEASURING THE PERMANENT SET OF AN ORDINARY BOX-TYPE PACKING RUBBER

When the hatch covers are well maintained, the steel-to-steel contact (see "Bearing pads") will keep the panel in its correct sealing position, i.e. at design compression level. This prevents the packing rubbers from becoming over-compressed.

Over-compression of the packing rubber should always be avoided, as it will destroy the structure of the rubber and cause premature development of the permanent set (i.e. in the case of a box seal, this will be a groove in the packing rubber in the contact area between the packing rubber and compression bar, whilst for a CAT or sliding seal this will be the moment when the triangular-shaped part of the rubber becomes round shaped) with loss of resilience as a result (see figure 11) .

Over-compression in a packing rubber is like "overstretching" an elastic band. Once overstretched, the elastic band will never regain its initial length (plastic deformation (ref. Hook's Law)) and the time needed to return to its original stage will be longer.

FIGURE 12 NORMAL CAT SEAL IN GOOD CONDITION (LEFT) AND A CAT SEAL WITH EXCESSIVE PERMANENT SET (RIGHT)

This brings us to another important issue, i.e. the reaction capacity (or reaction time) of a packing rubber. If a rubber packing is over-compressed, it will become "slow" or "lazy" and will no longer be able to respond instantaneously to the relative movements between the adjacent panels as well as between the panels and coaming, thereby leaving some time for water to penetrate through the seal.

To allow the packing rubber to regain its original shape quickly, packing rubber will need to have a certain compression force (as can be seen from the above drawing, the compression force of a normal 90x50 packing rubber can be in the range of 9000N/m). Based on the mean compression force of a packing rubber, it will be seen that a considerable force is required to bring the panel up to its design compression. While some may think that it is the duty of the quick-acting cleats to pull the panels down, it is generally the weight of the panel that will ensure that the packing rubber is compressed to its design compression when the hatch is closed.

Once closed, the panel will rest on the bearing pad system, which will prevent over-compression of the packing rubber.

Once a permanent set starts to develop, which is inevitable, it is important to monitor the evolution closely. If the permanent set develops rapidly, the reason for this abnormally accelerated/rapid decay should be investigated. Frequently seen causes are the use of low-quality rubber or improperly adjusted bearing pads (or both). In the latter case (improperly adjusted bearing pads), replacing the rubber packing with a new one will not solve the problem, as the newly fitted packing rubber will become over-compressed from its installation and quickly develop a permanent set again.

An important lesson to be learnt here is that packing rubber should only be renewed after the height of the bearing pads is checked and properly adjusted.

It should now be clear that the proper performance of a packing rubber is a matter of millimetres. Both the design compression and corresponding discard criteria are very accurately determined, and the range of allowable deviation is limited. Furthermore, packing rubbers will only function well if the correct dimensions and compression force are observed. Whilst it may be tempting to look for cheap alternatives to the original rubber, it should be noted that the right packing rubber is the result of advanced research and engineering, and that cheaper alternatives might not be able to live up to expectations.

BEARING PADS

Bearing pads (also called resting pads, landing pads, vertical (Fz stoppers) are a key element in the design of hatch covers. Bearing pads provide steel-to-steel contact between the hatch covers and the ship's hatch coaming. A bearing pad system consists of two mating halves, one of which is mounted on the hatch cover panel and another that is positioned on the coaming table. Due to the relative movements between the panels and the coaming, the mating half mounted on the panel's side plating is referred to as the moving part, whilst the half on the coaming table is referred to as the fixed part.
As there is movement between the two parts, wear can be expected during the in-service life of the ship. Usually wear will be in the range of 1mm per year and this can be considered as a rule of thumb. Bearing pad wear depends not only on the age of the ship/pads, but also on loads acting on the pads and the position where the pads are installed.

Bearing pads are important for many reasons, but the four items listed below are probably amongst the most important ones that should be considered:

FIGURE 13 GENERAL VIEW OF A BEARING PAD SYSTEM

- **When at sea, panels will be subjected to weather and cargo loads. Overcoming seas and the weight of cargo loaded on the hatch covers, as well as the weight of the panel itself, will tend to push the panels down. Bearing pads will absorb these forces and transfer them to the ship's deck structure.**

- **As bearing pads provide a "hard" resting surface for the panel, they prevent compression of the packing rubber beyond the design compression (over-compression). In other words, if the design compression of the packing rubber is 13mm, bearing pads will prevent the packing rubber from further compression due to the weight of the panel, weather and/or cargo loads.**

- **As there is relative movement between the panels and coaming, it is necessary that both mating halves are allowed to move/slide. Irregularities in the mating surfaces (e.g. rust or scale) or excessive wear (e.g. due to incompatible steel) will prevent free movement, as a result of which loads and forces would be transferred to the panel or coaming and cause damage.**

FIGURE 14 CRACKED PANEL SIDE PLATING AS A RESULT FROM WEAR ON BEARING PAD

FIGURE 15 WORN OUT MATING SURFACE OF A BEARING PAD

- **In the early days of steel hatch covers, the steel-to-steel contact was realised through contact between the cover's side plating and hatch coaming. As the interaction between the hatch panel and coaming interface caused grooving of the hatch coaming plating and wear on the side plating (a deadly combination for packing rubber over-compression as well as difficult and expensive repairs to fix), bearing pads are a solution for this problem and allow for relatively easy maintenance, repairs, adjustment or renewal.**

FIGURE 16 SHOWING DEEP GROOVING IN THE COAMING TABLE AS A RESULT FROM CONTACT WIH THE PANEL SIDE PLATING

Whilst initially bearing pads were made of steel, we now see that there are different types of material used for the mating halves. This is done to alleviate friction, reduce the disturbing sound of steel on steel, enhance resistance to dirt etc. Some designs include wear indicators (lines or rings), which is handy as they show when it is necessary to replace the pads.

FIGURE 17 SHOWING WEAR LINES IN THE MATING SURFACE OF THE BEARING PAD

It is often seen that bearing pads are greased by the ship's crew and that sometimes greasing is a task that is included in the ship's maintenance plan. It should be borne in mind that high loads are acting on the bearing pads and therefore normal grease will not perform well and will be squeezed out, leaving the pad dry

FIGURE 18 CREW MEMBER GREASING A BEARING PAD WITH A ROLLER BRUSH ON A CELLULAR CONTAINER VESSEL

Another disadvantage of greasing the bearing pads is that when the ship is carrying granulated/abrasive cargoes, such as ore, coal, fertilizer, etc., the dust from the cargo will fall and settle on the greased surface of the bearing pads, and the mixture of grease and cargo dust will act as a grinding paste. Therefore, and before deciding to grease the bearing pads, it is recommended to consult manufacturers for advice.

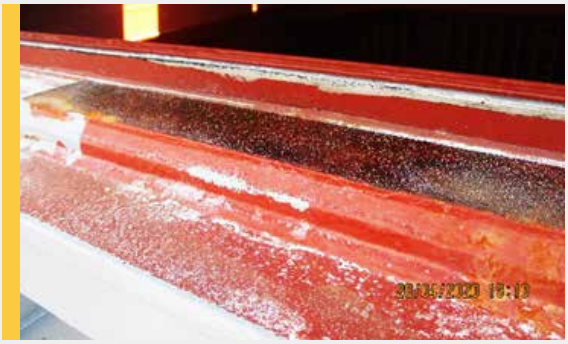

FIGURE 19 SHOWING FINE DUST FROM THE CARGO (WHITE FERTILIZER) STICKING TO THE GREASED BEARING PAD SURFACE

As wear on the bearing pads will result in over-compression of the packing rubber, it is important to monitor wear at regular intervals. A quick and easy way to do this is to verify the skirt clearance, i.e. the clearance between the lower edge of the panel and the coaming table. This is normally one of the standard measures that can be found in the ship's drawings and indicates the level of wear. In the case of newbuilds, this is also a good reference measure that should be checked, recorded and included in the ship's manual for further use and reference when repairs or adjustments are to be made. Beware that this measure is not "absolute" and that tolerances may apply, but more considerable deviations are an indication of the onset of wear.

FIGURE 20 MEASURING SKIRT CLEARANCE BETWEEN PANEL AND COAMING TABLE

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If bearing pad wear is noted, it may be tempting to have this "quickly" repaired by the ship's crew. Although maintenance or repair is recommended, the adjustment of steel-to-steel contact is specialist work. In good designs, manufacturers will recognise the wear problem and counter this by using different types of steel (hard steel like Hardox for the "moving" part and softer steel for the "fixed" part) or other proven and tested materials. Very often, improper or quick "welding-up" or shim plate repairs are the basis of serious problems afterwards.

In addition to over-compression of the packing rubber, panel or coaming damage, bearing pad wear may also affect other hatch cover component parts, such as wheels, hinges, cylinders and securing devices.

Bearing pads are one of the most important items in a hatch cover design and their number, size, design and location are carefully determined and considered during the design and approval process. Getting the steel-to-steel contact right is of crucial importance and repairs or adjustments should be done in dialogue with and/or by manufacturers or specialist servicing teams.

LOCATORS

FIGURE 21 SHOWING LOCATOR ASSEMBLY ON THE HATCH COAMING

FIGURE 22 MEASURING CLEARANCE IN WAY OF THE LOCATOR

Hatch cover panels must be opened and closed, and when closed they must be correctly positioned (located) so that there is no discontinuity in the weathertight seal along the perimeter of the hatch and in the cross joints between the panels.

Locators are designed to ensure that, with the panels closed, the rubbers in the cross joints and corner areas are compressed up to their design compression and as such are able to compensate for the relative movements that result from the flexing of the ship whilst at sea.

As locators determine the design compression in the seal with the panels closed, locators require very careful installation and adjustment. Locator tolerances will generally not be more than a few millimetres, and it is important that clearances are regularly monitored and compared with manual specs, as wear on the locators will directly affect design compression and tightness.

From a positioning point of view, not only is the longitudinal position important (compression in corner/end piece area and cross joints), but also transversally, panels must be correctly positioned. Misalignment can have many causes, but centreline locators do help in ensuring that the panel is properly centred when closing. Checking of clearances is also important here. In case the packing rubber were to show an offset imprint, panel alignment should be checked.

FIGURE 23 SHOWING CENTRELINE LOCATOR

As tightness depends on the design compression and as this compression is a matter of millimetres, it will be understood that excessive locator clearances result in a lack of compression to such an extent that the allowed variation of seal compression is exceeded, which enhances the risk of water ingress.

FIGURE 24 THE OFF-CENTRE IMPRINT ON THE PACKING RUBBER INDICATES IMPROPER ALIGNMENT

Whilst it is not the purpose of this brochure to highlight each specific type of hatch cover, it is worthwhile noting that mini-bulkers (multi-purpose coastal vessels that often trade in the NW and Mediterranean areas) are frequently equipped with stacking pontoons that are lifted away and moved forward or aft to their stowage location on the coaming by the ship's own gantry crane or motorised panels.

In several designs, panels are positioned by so-called "positioners", i.e. large and strong pins fitted at the side of the hatch panel which fit into relatively large slots in the hatch coaming table. Sometimes, there is confusion as to whether these pins are acting as locators or not. Further inspection may reveal that apart from these pins, the hatch covers are equipped with genuine locators or junction pieces (on older designs) to achieve tightness at the corners and cross joints. However, in some designs, these pin-like positioners may also be acting as locators. A useful indicator as to whether the side pins are acting as a positioner or a locator is to check the clearance in way of the slots in the coaming. If this clearance is relatively small (2–4mm) then the pins will most probably act as a locator (relating to the rubber packing's design compression). If the clearance is more substantial, then the pins are most probably positioners.

It should be noted that coaming retraction as a result of hydrostatic pressure acting on the hull may result in the panels not being able to be positioned. To avoid this problem, good designs will include king beams.

FIGURE 25 SHOWING REPLACEABLE LOCATORS

It is of utmost importance that buyers of 2nd hand tonnage insist that the hatch cover manual and drawings are part of the set of documents that need to be provided at the time of handover. Missing info may prevent proper maintenance or repairs and may have a serious impact on future employment and P&I cover. As locators are also prone to wear and wastage, new designs Include replaceable locator pads which are easy to adjust and replace.

FIGURE 26 TYPICAL MINI-BULKER WITH OWN GANTRY CRANE

FIGURE 27 CLOSE-UP OF GANTRY CRANE WHILST SHIFTING PANELS

FIGURE 28 SHOWING A KING BEAM POSITIONED IN THE MIDDLE OF THE HATCH TO LIMIT COAMING RETRACTION

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STOPPERS

Whilst locators ensure that the correct design compression is achieved when the panels are closed, it will be necessary to maintain this sealing condition throughout the ship's in-service life.

During a voyage, the ship's hull and deck will be subject to deflections (hogging, sagging, twisting, warping) and deformations (hydrostatic pressure due to draft, ice pressure, etc.). Furthermore, the effects of rolling and pitching when in a seaway will try to push or pull the panels away from their correct sealing position. As hatch covers are fine pieces of engineering, and with tightness depending on a few mm, excessive movements of the panels may result in damage, water ingress and significant maintenance or repair costs. To prevent this from happening, stoppers are installed. Under no circumstances should the stoppers be a tight fit, as this would cause the loads and stresses to be passed on directly into the hatch structure and cause damage. So, in line with the sealing system, bearing pads and locators, the stoppers (sometimes also referred to as restraints) will be allowed some movement, but within very strict and controlled margins.

Also stopper clearances must be closely checked and compared with the specs as mentioned in the hatch cover manual.

Whilst the stopper function is described here as a separate function, it should be noted that from a design point of view, bearing pads, locators and stoppers may be combined or integrated in one piece, which may sometimes be a bit confusing. Therefore, it is important to study the manual and drawings to familiarise yourself with the system.

Intermediate summary

Whilst most of the water is kept out by the hatch cover panel plating (first safety barrier), water ingress into the hold as a result from relative movements between the panels and between the panels and coaming is prevented by the sealing system. It is important to ensure that there are no discontinuities in the sealing system (openings, gaps, damages, etc.) and that the correct packing rubber design compression is maintained. Bearing pads (also called Fz-stoppers) will prevent over-compression, while locators will ensure correct compression in the longitudinal direction (or transversal direction on side rolling hatch covers) and proper alignment of the panels. Stoppers or restraints will maintain this condition whilst at sea and prevent excessive movements that could dislocate the panels from their correct sealing position and cause damage or water ingress. As such, hatch cover tightness can only be achieved when all parts work in unison and through carefully balancing forces and loads.

FIGURE 29 MEASURING EXCESSIVE CLEARANCE IN WAY OF A TRANSVERSAL (FY) STOPPER

FIGURE 30 SHOWING STOPPER ON THE PANEL SIDE PLATING

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SECURING SYSTEMS

As per the ICLL, it is required to secure the hatch panels so that they remain in position throughout the voyage. If panels were to be pushed off by overcoming waves or lost overboard, the ship's holds would be open to the elements, which could have disastrous consequences. Therefore, where stoppers restrict movements of the panels, cleats will secure the panels to the hatch coaming.

Different types of cleats are available on the market and the right cleating system is selected in terms of the time available to prepare the ship for sea after loading or discharging, the number of crew members on board, required strength, maintenance issues, and so on. The most common type are manually-operated quick-acting cleats, whereas automated and auto cleat systems, as well as holding down devices (mainly on container carriers) are also in use. Cleats are fitted to hold the panel down when at Sea and not to obtain a tighter seal. Furthermore, cleats are flexibly mounted (hence the rubber washer) so that they will allow for some limited movement of the panel.

Quite often, securing is considered a synonym for pulling or screwing down hard and tight, but this is not so for hatch covers and their securing devices.

FIGURE 31 SHOWING PARTS OF A MANUALLY OPERATED QUICK ACTING CLEAT

Rigid securing of the hatch cover panels to the coaming, in combination with the relative movements between the hatch covers and the ship, would lead to damage of the securing system (failing of the cleats) and deformations or damage to the hatch coaming or panel plating.

Like any lashing and securing system, cleats must be strong and fit for duty. So, all parts of the securing system should be commensurate in strength and in good condition (pay attention to this when ordering spare parts).

During inspection of the cleats, it is important to check that they are all in place, structurally sound and free of damage.

Wear on cleats is often the result of corrosion and subsequent maintenance (i.e. chipping/descaling etc) which results in loss of steel, diminution of the cross-sectional thickness which affects the strength and holding capacity of the cleats.

FIGURE 32 SHOWING CORRODED CRUTCH OF A QUICK ACTING CLEAT, AFFECTING THE OVERALL STRENGTH OF THE CLEAT SYSTEM

Also, sandblasting of the panels and coaming has the same effect on the strength of the securing system. Especially on older tonnage, it is recommended to check that cleats are in place and that they are not suffering from wastage or corrosion.

Quite often, when a hatch cover test reveals leaks the crew will decide to tighten up the cleats more and in such cases it is common to use cheater bars or spanners to tighten up the cleats tightly, hoping that the leakage will stop due to extra compression on the seal. This is dangerous practice because cleats should never be over-tightened. Furthermore, it also shows that there is a lack of basic understanding of hatch covers, as the steel-to-steel contact provided by the bearing pads will prevent the panel from being pulled down further. If leakages were reduced after tightening up, this would indicate that either the panel, coaming or both are deformed as a result from the additional tightening action.

FIGURE 33 SHIP'S CREW TIGHTENING UP THE CLEATS WITH A CHEATER BAR

It should be noted that quality cleats will usually have a spacer ring in the rubber washer, which will prevent overtightening as well.

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There are cases on record where the crew had removed these spacer rings to tighten up the cleat further and squeeze the rubber till it was down to the size of a pancake!

In several designs, it is possible that cross-joint wedges are used. With the typical cross joint wedges, it is also often seen that the striker plates are welded up so that extra force is needed when driving the wedges home, believing that the harder it is to close them, the better they will secure the panel, which is not true.

FIGURE 34 SHOWING A STRIKER PLATE OF A CROSS JOINT CLEAT THAT HAS BEEN WELDED UP, WHICH MAKES IT DIFFICULT TO DRIVE THE WEDGE HOME AND WILL RESULT IN DAMAGE

The cross wedges are fitted in order to ensure that the panels are all on the same plane and level with the adjacent panels. Cross wedges are not to be used to push the panel down and obtain a tighter seal in the cross joint (also in the cross joint there will be a form of steel to steel contact to prevent over-compression).

Also, the tightening bolts on the sides of the panels in the cross joint (meeting) section on some designs are only fitted to join the forward and aft sections of the hatch cover set and should not be screwed tight in the hope of obtaining a tighter seal at the meeting joint.

FIGURE 35 NOTE THE USE OF SEVERAL RUBBER WASHERS ON THE PANEL'S QUICK ACTING CLEATS. ALSO THE RUBBER WASHERS HAVE BEEN OVERPAINTED WHICH WILL RESULT IN RAPID DECAY OF THE RUBBER

In some cases, crew will fit double rubber washers to the cleats. This practice should be discouraged as in most cases it will be a deviation from the originally approved design.

With regard to the positioning of cleats, it should be noted that cleats are always in a vertical position and never crooked, as any deviation from the vertical direction would result in a loss of holding power and improper engaging of the hinged head in the snug.

FIGURE 36 SHOWING CROOKED CLEAT

For cleats, the most important thing to remember is that they should be tightened gently so that they will secure the panel to the coaming, by still allowing for some relative movement. Cross joint wedges should be easy to drive home, protected from travelling back (as a result from vibrations), and striker plates should never be welded up.

DRAINAGE SYSTEMS

In order to consider a hatch type as "weathertight", it is necessary to have a drainage system installed.

When relative movements exceed the design compression of the rubber packing, which will generally happen during extremely heavy weather, there is a possibility that the seal/compression bar interface will open up, allowing water to pass and run into the hold, which is not permitted according to the ICLL.

When waves crash over the deck and hatches, any water that would pass through the cross joint or perimeter sealing arrangement will be collected in the drainage channels and run out on deck via the drainage hole, drainpipe and the non-return drain valve. To allow evacuation of water, the drainage system should always be free and unobstructed.

It should not be overlooked that a drain valve is an open connection between the hold and the deck and as such, drain openings should be closed and plugged in case of fire in the ship's hold (in order to keep the CO^2 inside the hold and to prevent air from entering). This is made possible by screwing the fire cap on the discharge mouth of the drain valve. This is also a requirement in case the cargo carried is under fumigation, as closing the drain valve with the fire cap will prevent loss of the fumigant (which can be dangerous and would make fumigation less efficient).

FIGURE 37 SHOWING A COAMING DRAIN VALVE WITH THE FIRE CAP PROPERLY CONNECTED TO THE VALVE WITH A LANYARD

Sometimes, crew members may decide to plug the drainage hole in the coaming whilst loading or discharging bulk cargo with a wooden bung or rags to avoid clogging the drainage hole, drainpipe and drain valve. This is good practice, as long as the plug is removed prior to the ship sailing out.

Sometimes, when the drain valve is damaged, a piece of used firehose may be used as a temporary repair, on condition that the hose is long enough to bend back on itself to prevent water on deck from entering the drainage system. However, hoses are not a substitute for a proper repair of the drain valve and a genuine type should be ordered or installed as soon as possible.

FIGURE 38 FIREHOSES (OF SUFFICIENT LENGTH) CAN ONLY BE CONSIDERED AS A TEMPORARY REPAIR FOR A DAMAGED DRAIN VALVE

COMPRESSION BARS

Packing rubbers act against a mating surface in order to become compressed until they reach their design compression.
The type of mating surface depends on the type of packing rubber that is selected. It can either be a raised compression bar (for the normal traditional box seals) or a flat steel mating surface (for CAT or C- gaskets (sliding seals). In case of CAT or C-gasket seals, the sealing surface will either consist of the coaming table or a stainless-steel plate welded on the coaming table. The latter is preferred since it is resistant to rust/corrosion and will provide a smooth contact surface. The advantage of flat steel mating surfaces is also that they can be easily installed and kept clean whilst there are no restrictions in movement.

FIGURE 39 RAISED COMPRESSION BAR WITH ROUNDED CONTACT EDGE

FIGURE 40 FLAT STEEL MATING SURFACE

For compression bars, three issues must be considered:

First of all, compression bars have to be straight, as an irregular sealing edge would cause uneven compression, which should be avoided. Over-compression will damage the seal whilst under-compression will result in premature opening of the seal and allow water ingress, even under less harsh conditions. Normally, some slight tolerances for unevenness will be allowed during newbuilding, but tolerances are limited to a few millimetres.

FIGURE 41 SHOWING INDENT IN COMPRESSION BAR WHICH RESULTS IN UNEVEN COMPRESSION

Secondly, the sealing edge of the compression bar should be smooth and round-shaped to avoid abrasion damage to the rubber packing.

FIGURE 42 HEAVILY CORRODED AND DAMAGED COMPRESSION BAR

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Nowadays, most compression bars are made of stainless steel, but older designs used mild steel, which was prone to corrosion. Corrosion and scale made the sealing surface of the compression bar rough, uneven, and caused damage to the packing rubber.

Furthermore, corrosion results in thinning down and reduced strength of the compression bar, whereas knife edges on the mild steel compression bars would cut into the packing rubber and cause damage to the seal.

Finally, compression bars should be strong to withstand the compression force (in combination with the relative movements) of the packing rubber (see "Packing rubbers").

OPERATING SYSTEMS

Whilst the basic single pull panels were still rather small and light, more modern panels are heavy pieces of equipment. Hatch cover panels can be opened/closed with different systems, ranging from wires or chains, rack and pinion, hydraulic cylinders, roll-up-roll systems and over the last five years also with electrically driven systems.

In view of the weight of hatch cover panels, hydraulically operated systems were the preferred method for opening and closing hatch covers for a long time. However, with the development of powerful electric motors, the use of electrically driven systems for hatch cover operations was made possible. The advantages of electric systems include that they are easy to install and that they do away with the need for hydraulic cylinders, hydraulic piping on deck and hydraulic powerpacks, as well as time consuming maintenance issues and the cost of hydraulic oil. Also, the risk of pollution and contamination of cargo in case of hydraulic hose failure no longer exists when electric systems are used. However, its use is not yet widespread and most ships that are in service today still use hydraulic systems.

The improper operation of hatch covers can have serious safety and operational consequences and personnel in charge of operating the hatch covers should be trained in their use as part of onboard or ship-specific training. During hatch cover operations, and from a safety point of view, it is recommended to have one operator for opening and closing the hatch covers with another crew member standing by to ensure that hatch covers are ready to be opened and closed and to observe a safety perimeter around the hatch covers during operation.

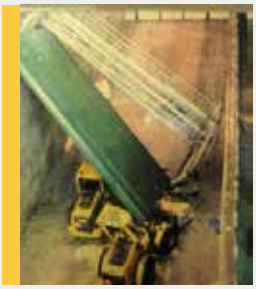

FIGURE 43 IMPROPER OPERATION OF HATCH COVERS CAN RESULT IN ACCIDENTS

The operator stands should be safe, provide a good overview of the hatch cover operating area, and controls should be clearly marked and indicated. Never should the controls be lashed back with a rope to operate them from a distance or keep them running whilst the stand is unmanned!

During the operation of well-maintained hatch covers and operating systems there will normally not be any abnormal noises, deviating sounds or vibrations. Also, operating times, which are mentioned in the hatch cover manual, should be regularly checked and deviations, if any, investigated.

Hydraulic systems operate at very high pressures (up to 250 bar). If oil is leaking, this also means that dirt can enter the system. In view of the pressures involved, any dirt or particles that find their way into the system will have high damage potential. Therefore, the hydraulic system, as well as power pack should be carefully inspected for leaks or damage and cleanliness of the oil is key to trouble-free operation. Oil coming straight out of the barrel does not have the required degree of cleanliness and filtering is always recommended.

When hatch covers are open, hydraulic cylinders are exposed to the environment and cargo dust or remnants might stick on the cylinder surface and be drawn into the cylinder during operations, resulting in leakage and damage to seals. In order to protect the cylinders from becoming dirt-stained, protection sleeves are available, and their use is recommended.

FIGURE 44 HATCH COVER CYLINDER SLEEVES HELP IN KEEPING CYLINDERS AND SEALS IN GOOD CONDITION

Finally, it should be remembered that operating systems can fail. If they do so whilst water sensitive cargo is being loaded or

discharged, there is a risk that the cargo will suffer wetting damage. Therefore, the availability of suitable emergency protective equipment that can protect the cargo and rigged up quickly should be considered.

For hydraulic power failures, manufacturers will provide emergency hydraulic packs. In an unplanned failure scenario, setting up the system may take some time, but when on board, the crew in charge of hatch cover operations should be made familiar with its use.

Although it may be necessary to carry out hold cleaning operations or repairs in the cargo holds or to hatch covers whilst at sea, opening the hatch covers whilst on passage is not allowed. If a problem occurs and if panels cannot be closed in time, both the ship and crew may be in danger.

FIGURE 45 EMERGENCY HATCH COVER OPERATION POWER PACK

Most hatch cover systems have dedicated operating systems (e.g. rack and pinion, hydraulic cylinders, roll-up-roll, …) or can be operated with on-board equipment such as dedicated winches, ship's gantry or cradle cranes. However, pontoon-type hatch covers, generally seen on board container vessels, rely on shore gantry cranes to be lifted away. It should always be checked that the crane is able to lift the pontoons in question (crane weight and SWL should be checked) and that the lifting sockets on the panels (usually painted in a contrasting colour) are in good structural condition.

In the NW Europe-Mediterranean trading area, there are a lot of small vessels (mini-bulkers, coastal vessels, etc.) that are equipped with stacking-type pontoons operated by the ship's own hatch Cradle or gantry crane. Whilst the panel design is quite simple and straightforward, the hatch cradle is an important piece of equipment and should be properly maintained.

FIGURE 46 HATCH PANEL SAFETY DEVICES SHOULD ALWAYS BE PROPERLY ENGAGED

From a safety and operational point of view, uncontrolled closing should be prevented. Always ensure that the panel safety latches or locking systems are structurally sound and properly engaged when the panels are in an open position.

Moving parts such as hinges and wheels should be operating freely without abnormal noise, and greasing should be carried out with the appropriate grease at the required intervals.

FIGURE 47 ALWAYS ENSURE THAT MOVING PARTS ARE PROPERLY GREASED

FIGURE 48 MARKING THE GREASING POINTS IS GOOD PRACTICE

Remember that for wheeled panel systems, the wheels should be turning freely when the hatch covers are closed and battened down. If this is not the case, it means that the panel wheels are taking up the loads that are acting on the panels (instead of the bearing pads) with damage to the wheels and bearings or bushings as a result.

HATCH PANELS

Whilst hatch cover tightness is often associated with rubber packing and drains, it is the hatch top and side plating that will mainly prevent water from gaining access to the hold. It is therefore crucial to inspect the hatch covers and hatch structure to ensure that the initial strength requirements are complied with and that both plating and structure scantlings are able to withstand the rigours of an ocean voyage, including large or standing waves crashing onto the deck and hatch covers.

FIGURE 49 ADVANCED CORROSION WILL AFFECT THE INTEGRITY OF THE PANEL PLATING AND STRUCTURE

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FIGURE 50 CRACK IN PANEL GIRDER DUE TO EXCESSIVE STRESSES (COURTESY MACGREGOR)

Painting hatch covers is not merely a cosmetic issue, but necessary because hatch covers are exposed to abrasive cargo, sea- and rainwater and physical damage during cargo operations. Unprotected steel may quickly deteriorate and succumb due to corrosive action. Cracks and deformations can be the result of improper maintenance or panel adjustment, worn bearing pads, overloading or heavy weather damage and should be identified. In case repairs are necessary, the same should be brought to the attention of the classification society.

FIGURE 51 SHOWING DEFORMED HATCH COVER PLATING AS A RESULT FROM LOADING HEAVY CARGO WITHOUT PROPER LOAD SPREADING ARRANGEMENTS

As hatch covers are used more and more as a platform for loading cargo on deck, overloading and damage as a result from improper load spreading should also be considered. If stevedores damage the hatch covers during loading, protest letters should be drafted and proper repairs should be carried out as necessary in order to ensure that the hatch covers are fit for duty before sailing from the port in question.

FIGURE 52 DOUBLERS WELDED ON TOP OF THE HATCH TOP PLATING

Doubler repairs, often seen as a remedy for holes and cracks in the panel top plating, should never be considered as a substitute for proper and permanent repair. Also, the assistance of classification society should be called in as improper repair methods (especially with regard to welding and heat treatment) may cause significant and sometimes permanent damage to the hatch covers.

FIGURE 53 PREPARING AND WELDING D-RINGS ON HATCH TOP PLATING FOR LASHING PURPOSES

Also welding of stoppers or D-rings onto the hatch top plating for lashing and securing purposes or cutting of the same after discharge of the deck cargo, should be properly planned and carried out by professionals.

COAMING PLATING

Just like the panel plating the hatch coaming plating, which surrounds the hatchway, prevents the entry of water and as such its structural condition is important.

Whenever cargo has suffered wetting damage, large rusty streaks on the coaming plating may be the first indicator that water has entered the ship's holds.

FIGURE 54 RUST STREAKS ON THE HATCH COAMING PLATING AS A RESULT FROM WATER INGRESS

From a structural point of view, the hatch coaming is welded to the deck and as such is part of the ship's structure. The coaming is also home to the many hatch cover-related parts such as the wheel track, bearing pads, locators, cleats, and so on.

With many of these essential parts being load-bearing, the structural integrity of the coaming plating and coaming table needs to be inspected at regular intervals.

FIGURE 55 ADVANCED CORROSION TO COAMING TABLE

The hatch coaming stays have a double function in that they add to the rigidity of the coaming plating and transfer the loads acting on the panels into the deck structure. Stays should be inspected for cracks and deformations as well. Cracks found in the toes of the brackets are often an indication of excessive stresses that can be related to a design issue (improper tapering of the bracket). Even though it is frequently seen during inspections, crew members should never try to "redesign" the hatch covers by making repairs to the coaming without the consent of classification society or the flag state.

FIGURE 56 IMPRESSION OF HATCH COAMING STAYS

FIGURE 57 SHOWING STARTING CRACK IN TOE OF HATCH COAMING BRACKET

Ships with large hatches (especially mini-bulkers) like the one depicted below may suffer from coaming deflection and some designs incorporate the use of a kingbeam to avoid inward or outward bending of the coaming as a result from draft changes or ice pressure. Without a kingbeam, coaming deflection may prevent the opening or closing of the hatch covers.

Just like the panel plating, the coaming plating, which surrounds the hatchway, prevents the entry of water and as such, its structural condition is important.

FIGURE 58 SHOWING A KINGBEAM, USED TO PREVENT COAMING DEFLECTION

INSPECTION & MAINTENANCE: PROVING DUE DILIGENCE

To sail from A to B, propulsion and power-generating machinery is important. However, in order to make a profit from transporting goods by sea, hatch covers are necessary for the safety of the ship and crew as well as for keeping the cargo dry so that it arrives at its destination in good condition.

Whilst the main and auxiliary engines in most cases receive the attention and maintenance they deserve, hatch cover maintenance is often overlooked. Also, engine maintenance will generally be done using the manufacturer's guidelines, recommendations and spare parts, whilst hatch cover maintenance will, in many cases, be limited to the minimum that is necessary, with the cheapest possible spare parts and very often without proper guidance, as the manual and drawings may have been lost over time.

With a view to proper inspection and maintenance during the in-service life of the ship, it is important that hatch covers are designed with great care, in line with the ship's trading pattern requirements and with the owner's desired data in mind. Then it should be verified that the hatch covers are installed in a proper manner, so supervision by a knowledgeable person during the building process is necessary as well.

During installation and prior to commissioning, it should be verified that all clearances and tolerances are in line with the hatch cover manual and drawings, a copy of which should be left on board. Finally, it is also recommended to include ultrasonic hatch cover testing in the building contract, as this will be the best method to verify that the sealing arrangements are in order prior to taking delivery of the ship.

Right from the start of the ship's in-service life, it is recommended to include hatch cover maintenance in the ships PMS and to work out the necessary hatch cover-specific checklists. Best practice would be to link repairs to spare part management as well. Doing so will have the benefit that any arrears on hatch cover maintenance will clearly show up so that proper action can be taken to avoid items from becoming overdue.

Those in charge of hatch cover operations, their maintenance and inspection should be familiar with the ship's hatch cover system and both general as well as hatch cover-specific training is worth considering. In many cases, hatch cover training is not part of the curriculum offered by maritime training centres and as such, training will have to be obtained from other (external) sources. While the most economical way to carry out maintenance and

repairs during the in-service life of the ship would be to use the ship's crew, this approach should be considered with some caution. Whilst day-to-day maintenance and small repairs can indeed be carried out by the ship's crew (provided they are properly instructed and trained), some parts that require enhanced maintenance and more delicate repairs like adjustment and alignment, should be done by specialists. Whilst this may seem expensive, this approach will allow things to be done right first time and in time. Experience has shown that when crew members try to tackle the more specialist issues, the outcome of their efforts (often under stress in view of upcoming cargo operation deadlines) might not meet expectations and more time will be needed by experts to get things right again. Another advantage of involving specialists is that when a claim should be filed, it can be shown that no shortcuts were taken and that due diligence was exercised by calling in advice and assistance from experts.

"Things to be done right first time and in time."

Whilst well-maintained hatch covers will normally pass an ultrasonic test without problems, reality shows that approximately 75% of the ships tested do not pass an ultrasonic test the first time. In approximately 50% of cases, the reasons for leakage can be attributed to maintenance issues that can be resolved quickly whilst the remainder of the ships tested have more serious problems for which specialist assistance is recommended.

As passing an ultrasonic test is often a prerequisite for starting loading or being taken on-hire, and with many ships failing the first test, the ship's crew will be urged to carry out repairs with the sole purpose of passing the ultrasonic test as quickly as possible.

This is generally the moment whereby quick and temporary repairs are carried out and where everyone is relieved when the test is passed. Unfortunately, and despite efforts made by the crew (usually under pressure, during night-time and with limited spare parts and equipment being available) these repairs are generally poorly executed and in most cases not of such a quality that the hatch covers will remain weathertight during the forthcoming voyage and certainly not for several months afterwards.

Moreover, root cause analysis is rarely conducted and therefore repairs are often more focused on cosmetics rather than on making the hatch covers weathertight.¨A typical example of such a situation would be where the hatch covers fail an ultrasonic test due to over-compressed packing rubbers. In such cases, the crew will generally be ordered to replace the packing rubber to restore the sealing so that it looks like new again. However, as over-compression is generally the result of wear from steel-to-steel contact, the root cause, which is bearing pad wear, will not be addressed. Whilst money is saved by carrying out the repairs by the ship's crew and subsequent passing of the ultrasonic test, the result of this repair will be that in a very short period the newly fitted packing rubber will be over-compressed again.

Normally, a qualified surveyor and ultrasonic operator should identify the fact that, when the test is passed after the above rubber renewal repairs have been carried out, the steel-to-steel contact is still lacking and he should therefore fail the test on this basis. However, in most cases this will not be done and in general, once the ultrasonic test is passed, the false belief that all is in order will prevail.

What can make things even worse is that the crew, in order to pull the panels further down in an attempt to achieve steel-to-steel contact, will overtighten the cleats and make the system too rigid so that the chance of structural damage to coaming, panels and cleats as well as loss of weathertightness during the upcoming voyage is inevitable, with huge costs and claims as a result.

Furthermore, the temporary repairs will not always be successful, and with deadlines for cargo operations becoming an issue, the last resort may be to apply abundant quantities of Vaseline or grease in order to block the passage of ultrasound and pass the test anyway. Whilst this may help a little in passing the ultrasonic test (but certainly not in all cases and definitely not for areas with more significant lack of compression), this gives a false sense of security as the Vaseline will damage the rubber (see "Packing rubbers") and will be washed off when in heavy weather whilst at sea, leaving the sealing system open to the passage of water with expensive claims as a result.

Finally, it is not unusual that, in cases of persistent leakage and after several attempts to pass the test, sealants, such as RAMNEK tape and expansion foam, will be applied by the ship prior to sailing. These sealants may not always be as effective as hoped, and in case a claim for wetting damage would be filed against the ship, the application of such sealants will be considered as evidence that the master and crew were aware of the fact that hatch

covers were leaking and eventually decided to use sealants rather than carrying out proper repairs prior to going to sea.

FIGURE 59 SHOWING RAM-NEK TAPE APPLIED TO THE HATCH COVERS IN WAY OF THE CROSS JOINTS

FIGURE 60 EXPANSION FOAM USED IN WAY OF THE HATCH COVER PANEL PERIMETER

There are cases where, as a standard rule, charterers or shippers ask the master to apply RAM-NEK as extra precaution. This is not an unreasonable request and most masters will do so in order not to jeopardize the relation and cooperation with the charterers. However, in case the cargo would become wet damaged, claimants will generally consider the use of sealants as prima facie evidence that hatch cover weathertightness was compromised at the outset of the voyage and that the master and owners failed to provide a sea- and cargoworthy ship.

Generally, owners or masters might say that the sealants were applied as "extra security", but this can only be accepted on condition that the hatch covers successfully pass a thorough visual inspection and a tightness test which, in most cases, will be very difficult if not impossible.

Therefore, masters should be aware that applying sealants should only be done on condition that the hatch covers are in good condition and are proven to be weathertight. Having hatch covers inspected and tested by a third party and making a proper entry in the logbook before sealants are applied will help the master to prove that the sealants were indeed used as extra security only.

Finally, it should not be overlooked that sealants will have to be removed once the voyage is completed, which is often a time-consuming exercise. Removing the RAM-NEK tape or expansion foam from the vessel's hatch covers might even cause damage to panel coating, which will then need reconditioning. Also, and when not properly removed it may prevent proper closing of the hatches afterwards.

As hatch covers are designed, made and approved to withstand heavy weather (without using sealants), they will not leak under "normal" heavy weather. Therefore, if hatch covers are in good condition and well maintained, and if goods are found to be wet-damaged upon arrival at the discharge port, this would automatically mean that the ship encountered exceptional weather conditions (causing relative movements that are beyond the packing rubber's design compression) whilst en-route. Whenever it can be proven that hatch covers are in order and that the ship ran into extreme heavy weather, cargo interests will have no other option than to accept that the damage sustained by the cargo is the result of force majeure and pay for the loss incurred.

Under the Hague Visby rules, it is the owners and master's obligation to exercise due diligence, which means that all possible and reasonable steps have been taken in preparing the ship for sea. In simple terms, this would mean that the master or officer in charge should inspect the hatch covers to check that there are no obvious and visible defects or damages and that, if anomalies were to be found, they are repaired in a proper way before the commencement of the voyage.

As proper maintenance is crucial, and In order to set up a maintenance strategy, it may be handy to divide the hatch cover's critical components into four categories as follows:

- **Bearing pads/stoppers/locators**
- **Sealing & drainage**
- **Mechanical items (parts used to move the panels, wheels, wheel tracks, hinges, chains, etc.)**
- **Hydraulics (piping, pack, valves, cylinders, controls, motors)**

From a practical point of view, it should be considered that not all of the above items can be maintained during one drydock and as such it is up to the owners, master and superintendent to decide what can reasonably be done by the ship's crew and what needs to be done by a specialist company (in drydock) so that upon renewal of the class and load line certificate (every five years), all the required items have received a thorough inspection and that repairs have been carried out as necessary.

In the unfortunate event that a claim were to be filed against the ship, and in order to help the P&I providers and legal people to defend the owner's interests, it will be up to the master and owners to prove that they have done whatever is necessary in

order to make the hatch covers weathertight. This can be done by providing relevant documents such as:

- **Work schedules**
- **Maintenance logs & test reports**
- **Work specifications**
- **Accounts**
- **Standing instructions**
- **Reports and correspondence**
- **Logbook entries**
- **Hatch patentee manual**
- **Holding valid (relevant) certificates**
- **Evidence of planning voyage & weather reports**
- **Proof of operating the ship in a good/seamanlike manner during the voyage (C/C, RPM, etc.)**

Of course, and when appropriate, a sea protest should also be prepared, and a local P&I correspondent should be called in to assist the ship's staff with further survey and test requirements (including compiling of evidence).

To avoid claim situations, and as already emphasised before, regular inspection and proper maintenance of the hatch covers will avoid such problems and allow for trouble-free trading. Ultimately, and when a claim is filed against the ship, the costs associated with damaged cargo and claims handling, delays and emergency repairs may nullify any profit from many months of successful and claim-free trading. Therefore, whenever it might be tempting to carry out hatch cover repairs quickly with cheap alternative spare parts by unqualified people, it should always be remembered that "the bitterness of poor quality remains long after the sweetness of low price is forgotten"

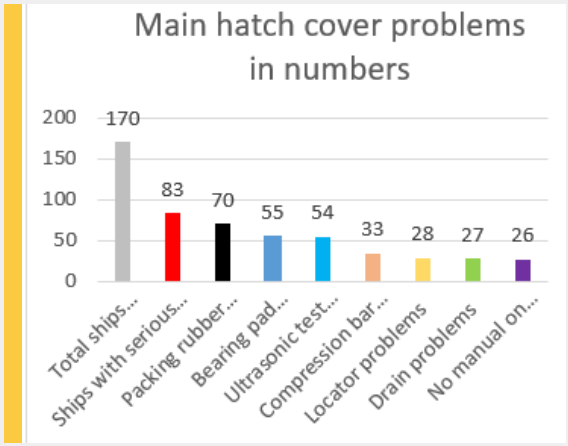
TESTING

With regards to hatch cover testing, the ICLL (Reg. 16.4 – "Means for Securing Weathertightness") states:
"The arrangements shall ensure that the tightness can be maintained in any sea conditions, and for this purpose tests for tightness shall be required at the initial survey, and may be required at periodical surveys and at annual inspections or at more frequent intervals".

Apart from the statutory requirement for tightness, aimed at safeguarding the ship and crew, weathertightness of hatch covers is also important for the cargo itself as well as cargo interests. This is proven by the fact that many shippers or charterers will require (and even state in the charter party), that hatch covers must be tested prior to commencement of loading operations and that the ship can be rejected in case test results are not satisfactory.

There are different methods for testing tightness (e.g. light infiltration, chalk/grease test (for normal or sliding-type rubbers), smoke test, pressure decay) but hose testing and ultrasonic tightness tests are the most used and appropriate tests for checking the weathertight integrity of hatch covers.
Whilst hose tests can be carried out by the ship's crew, not all ships have ultrasonic test equipment on board and as such independent surveyors (who are qualified and certified and use classification society-type approved equipment) are appointed to carry out an ultrasonic test.

Unfortunately, most instructions for testing (ultrasonic or hose test) only require carrying out a tightness test on the hatch covers, which is not correct. By carrying out a test, the surveyor is only able to test the sealing system. Although this is very important, the test will only reflect that at the moment of the test no leaky areas (i.e. water infiltration or areas where readings > 10% OHV are measured) were found. Whilst passing an ultrasonic or hose test is a good sign, the conclusion that hatch covers are weathertight can only be made when the other critical parts as mentioned in this brochure have been visually inspected, checked and found to be in order. Only when this is the case can it be concluded that the hatch covers are tight, and that tightness will be maintained during the forthcoming voyage. Saying that hatch covers are weathertight, that loading operations can start or the vessel taken on-hire when no leaks are found during a hose or ultrasonic test alone would be dangerous and might well lead to cargo claims.



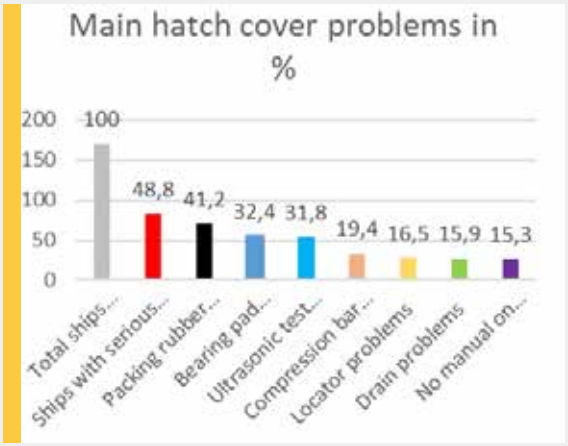


FIGURE 61 THE ABOVE GRAPHS SHOW THAT ALMOST 50% OF THE 170 SHIPS INSPECTED OVER A THREE-MONTH PERIOD HAD SERIOUS HATCH COVER-RELATED PROBLEMS THAT WOULD AFFECT WEATHERTIGHTNESS.

HOSE TESTS

When carrying out hose tests for class and statutory purposes, it is necessary to check compliance with the ICLL criteria which require that in any sea condition, water will not enter into the hold and that, at any stage of the voyage, the load line mark will not be exceeded.

This is the reason why classification society surveyors will carry out a test with two people, i.e. one surveyor on deck to ensure that the test is carried out correctly, and another surveyor who is in the hold to check that no water enters the hold. When considering the three safety barriers of a weathertight hatch cover system, we know that when water enters the hold during the hose test in port, there is a problem with the sealing arrangement (lack of contact that allows water to pass) and that water ingress is so significant that it can no longer be contained by the drainage channel, which is the last safety barrier to water entry in the hold. If hatch covers leak whilst in port, they will certainly leak when at sea when the ship is in a dynamic condition. So water leakage into the hold during a hose test in port indicates a significant safety problem. As this may put the ship and crew at risk it will not be possible for the classification society or Flag state surveyor to issue the load line certificate and proper repairs will have to be carried out in order to restore weathertightness.

Water that passes through the sealing arrangements in extremely heavy weather conditions will be collected in the drainage channel and evacuated through the drainpipe and drain valve.
However, when the vessel is rolling and pitching in a seaway, part of the water that accumulates in the drainage channel will be spilled over the drainage channel rim and fall on the cargo stowed underneath, causing a claim for wetting damage.

Typically this would happen in heavy weather and in cases where the packing rubber compression is not sufficient to compensate for the serious distortions caused by the relative movements and/or when the mean compression force of the packing rubber is such that a rapid response to those relative movements is delayed. In such a situation, and for rather short periods, there would be a gap between the compression bar and packing rubber (as there would be no contact or compression any more) so that water can pass through the sealing arrangements and accumulate in the drain from where it will be evacuated out on deck. Also, minor damages to the sealing arrangements, such as gaps or missing sections of rubber, could cause similar problems. The amount of water that would enter the hold in this way (i.e. by spillage over the drainage channel rim) is such that it will not put the safety of the ship and crew at risk but it might be sufficient to generate a serious cargo claim.

Only in cases where the hatch covers are well maintained and extreme heavy weather was encountered, will the wetting damage be considered as the result of force majeure, and any claims for cargo damage would then be compensated by the cargo underwriters.

FIGURE 62 SHOWING HEAVILY DAMAGED COILS AS A RESULT FROM WATER INGRESS

However, in case water were to enter the hold under normal weather conditions that are likely to be expected when at sea (and which do not create extreme deflections), and especially when investigation would reveal that hatch covers are not well maintained, the damage sustained will not be considered to have been the result of extremely heavy weather, but rather as the result of failing to exercise due diligence. This would put the owners in a difficult position when trying to defend themselves and playing the card of extremely heavy weather.

Whilst physical damage to a sealing system is relatively easy to detect during a visual inspection (cuts/missing lengths of packing rubber, gouged compression bars, etc.), a lack of compression in the sealing system is more difficult to observe and may not always be detected with hose tests.

As long as there is physical contact between the packing rubber and the compression bar, the physical barrier that is created will prevent water from passing through. However, areas with light contact may, even with small relative movements, open up on passage and allow water entry with consequent damage to the cargo as a result.

Another issue to keep in mind is that a jet of water generated by a fire hose that is equipped with a nozzle may actually prevent the testing water from reaching the rubber/compression bar interface at the cross joints. This is because the space left between the top plating of the adjacent hatch panels is very small and will cause the jet of water to break apart on top of the panels instead of entering the interpanel void space where the cross join sealing system is located. In such a case, the absence of water in the hold would not be an indication that the sealing arrangements are in order, but merely the result of lack of water and hydrostatic pressure acting on the seal during the test.

FIGURE 63 WATER BREAKING APART ON THE HATCH TOP PLATING DURING HOSE TESTING OF THE CROSS JOINTS.

An improved testing method when carrying out hose tests with a view to assessing the integrity of a weathertight system (especially when delicate cargo is to be loaded) would be to close the panel's side guttering and fill up the cross joint interpanel void spaces with water (with a fire hose without a nozzle and thus without applying a high pressure jet). This will allow hydrostatic pressure to build up on top of the packing rubber/compression bar interface and in case of leakage, water that passes through a leaky area would be collected in the drainage channel and be evacuated out on deck through the drain valve. (Note: perimeter joints would still require a water jet for testing). Therefore, water that is seen leaking out of the drain valve during a hose test is an indication of problems in the packing rubber/compression bar interface.

FIGURE 64 HOSE TESTING WITHOUT NOZZLE IN ORDER TO FILL UP THE INTERPANEL VOID SPACE DURING HOSE TESTING OF THE CROSS JOINTS.

As a lot of water is generated during hose tests, it may not always be easy to see if water is leaking out of the drain; therefore, it is recommended that a plastic bag is placed at the discharge end of the drain valve. This bag will, in case of leakage, fill up with water and provide evidence that there is a problem with the sealing arrangements.

FIGURE 65 WATER COLLECTED IN PLASTIC BAG ATTACHED TO DRAIN VALVE DURING HOSE TEST

FIGURE 66 WATER LEAKING FROM DRAIN VALVE DURING HOSE TEST

However, as already stated above, lack of compression may not be easy to detect with a hose test. In this context it should be understood that when there is lack of compression in the sealing arrangement, the seal in question will open up prematurely and will already allow water entry during more clement weather conditions.

As heavy weather conditions are encountered frequently when at sea, the risk exposure for wetting damage to cargo is higher in cases where the hatch cover packing rubber compression force is impaired (more chance of it opening up), which would increase the claim potential significantly. In view of the above, hose tests may not be the ideal testing method to ensure that the hatch cover's sealing system is fit for service, especially when considering cargo safety, as hose tests do not provide information on the packing rubber compression. When it comes to checking sealing systems for compression, ultrasound testing may provide additional information and evidence.

FIGURE 67 ULTRASONIC TRANSMITTER POSITIONED IN THE SHIP'S HOLD

FIGURE 68 ULTRASONIC TEST IN WAY OF THE CROSS JOINTS

FIGURE 69 ULTRASONIC TESTING ALLOWS TO FIND LEAKS WITH PINPOINT ACCURACY

ULTRASONIC TESTS

It is beyond the scope of this article to provide a scientific contribution to ultrasound technology, but the basics of ultrasound will, in simple terms, be explained below.

Ultrasound testing is based on the characteristics of a piezo electrical crystal which vibrates when subject to an electrical current and which, when squeezed, discharges an electrical current.

In the transmitter, which is positioned in the ship's hold, a piezo electrical crystal is installed which, when subjected to an electrical current, starts to vibrate (actually, the transmitter contains several sensors which all contain piezo electrical crystals). This vibration will create an ultrasonic signal that travels through the hold until it reaches the hatch covers. Being high frequency waves, ultrasound signals do not have a good penetrating capacity and as a result they remain stuck in the hold where they will start to build up a sound pressure. In case there is discontinuity in the sealing system, and assisted by the sound pressure, ultrasounds will be "pushed" through any opening or gap in the sealing system. On deck, the operator will be scanning the sealing area with a receiver unit. When ultrasound signals are passing through the sealing arrangement, they will be picked up by the receiver as they cause an impact on the piezo electrical crystal inside the receiver, thereby creating an electrical current that can easily be measured. As such, it is possible to measure a signal that would normally not be detected by the human ear.

Following the above logic, a small leaky spot will only allow a small amount of ultrasounds to pass through and "hit" the receiver's sensor, which will generate a small electrical current, resulting in a low measurement that is an indication for a small leak.

In case of a big leak, a "bundle" or "beam" of ultrasounds will hit the receiver's sensor and cause a significant impact and electrical discharge, resulting in a high measurement that indicates a big leak.

Even though ultrasound cannot be heard, a technique called "heterodynage" allows to convert an ultrasonic signal into an audible signal. By listening to this audible signal, the operator will easily find leaky areas in the sealing system. Furthermore, and with ultrasound being high frequency waves, the sound will travel in a directional way (like a laser beam) which helps the operator in finding the leaky spot with pin-point accuracy. This would not be possible with a hose test.

In fact, the word "leakage" may not be fully correct and it would be more appropriate to use "lack of compression" instead. This is because, with ultrasound, we are not only finding areas where the packing rubber is physically damaged (gaps, cracks, etc…) and which would allow water to penetrate during a hose test, but also areas where the packing rubber lacks compression and would therefore no longer be able to compensate for relative movements when the ship is at sea. So actually, and by using ultrasonic testing equipment for making a test when the ship is in port, and when no areas with lack of compression are found, we also know that when the ship will be at sea, the packing rubber will be able to compensate for the relative movements and maintain a tight seal, even in heavy weather.

In order to obtain an idea of the importance of a leak, and to decide if the sealing condition is still acceptable or not, a reference value should be set. This reference value is found in the form of an "open hatch value" (OHV), which is the ultrasound signal that is measured at an open hatch, i.e. a hatch where the hatch covers are open and which can, therefore, be considered as a "big hole". The value measured at the open hatch will be quite significant and represents the maximum value or biggest measure that one will be able to find when carrying out a test on a particular hatch (the measurements recorded during the test will not and cannot normally be more than the OHV). During the test, the readings obtained will be compared with this Open Hatch Value. To decide if the hatch cover sealing condition is still acceptable, the fail/pass criteria for ultrasonic testing has been set at 10% of the OHV. Whatever is below 10% means that the compression status of the packing rubber is acceptable, and readings above 10% indicate that too much compression has been lost and therefore weathertightness is impaired.

The biggest advantage of ultrasound testing is that the test results give an indication of the compression status of the packing rubber. If compression is good, the packing rubber will have sufficient compression force, which means that the rubber packing will be able to compensate for relative movements/flexible deformations at the sealing interface and as such provide a tight seal. The fact that we can identify whether the rubber will perform well at sea whilst the ship is still in port provides extra safety.

Other advantages offered by ultrasound tightness testing include:

- **One-man operation (observe safety!)**
- **No pollution risks**
- **No limitations by temperature/weather**
- **Possible during day/night**
- **Pinpoint accuracy**
- **Quick & easy to use**
- **Holds can be loaded/empty**
- **Compression measured/fail pass criteria can be set (enhanced safety)**
- **Professional test report can be generated in a few seconds (see photo)**
- **The test is (or should preferably be) carried out by a qualified operator so that results can be considered reliable and correct**

Although ultrasound testing has many advantages, several points should be observed and considered:
The author has, since the late 1980s, been heavily involved in

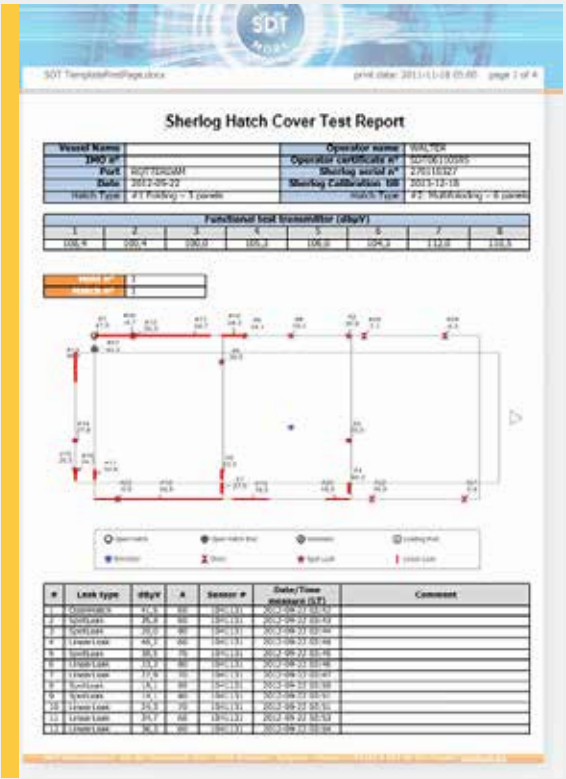


FIGURE 70 TYPICAL EXAMPLE OF AN AUTOMATICALLY GENERATED HATCH TEST REPORT. RED STARS ON THE SKETCH REPRESENT SPOT LEAKS, WHILE LINEAR LEAKS ARE DEPICTED AS RED LINES.

pioneering and developing ultrasound tightness testing of hatch covers. In the early days of ultrasound testing, the perception was that many ships passed a hose test but failed an ultrasonic test. This made people believe that if hatch covers passed an ultrasonic test they must be in perfect condition. This perception then started to lead its own life and has led to many principals appointing a surveyor to carry out an ultrasonic test and to advise them if hatch covers are weathertight and if the ship can start loading or being taken on-hire, etc.

However, as seen before, it is impossible to say that hatch covers are weathertight on the basis of an ultrasonic test alone. This is because, with ultrasound testing, only the sealing arrangement is tested. Whilst this is indeed a very important part of the hatch cover arrangement, the sealing arrangement alone does not make a hatch cover weathertight.

Weathertightness also depends on the other key parts that are installed and help the hatch covers and sealing system to be and remain weathertight (and safely secured) during the voyage. Therefore, the condition of these key parts also needs to be assessed and this can only be done by means of a visual inspection. This is also clearly explained in the DNV 403 ultrasonic tightness testing procedure which states that, in case measurements taken during an ultrasound test are < 10% OHV, the hatch covers can only be considered to be weathertight "subject to a visual inspection". So in order to advise on whether or not a hatch cover is weathertight, both tightness test results and visual inspection details should be considered.

Of course, carrying out a visual inspection of the hatch covers, in addition to an ultrasonic test, will take more time, as will the drafting of a test and inspection report with photographs. Both time pressure and costs result in the fact that many principals will only ask an ultrasound inspection to be carried out, as they are convinced that this will be sufficient. This is definitely not the case and is dangerous practice.

"Hatch covers can only be considered weathertight when they pass an ultrasonic test as well as a visual inspection."

Whilst operating ultrasonic test equipment is not difficult, it requires some skills and experience to use the equipment in the correct way. Operators should familiarise themselves with the operation of the equipment and learn how to evaluate measurements obtained during a test onboard a ship.

Another practical problem is that there are many surveyors and inspectors who have an ultrasound testing kit and who are familiar with its use, but there are not so many operators who are also able to carry out a good visual inspection as well. Therefore, it may not always be easy for principals to obtain the necessary and correct information to evaluate whether the ship's hatch covers are indeed weathertight and will remain so during a voyage.

The fact that the importance of a visual inspection should not be underestimated is also made clear by the IACS UR Z17 procedures for service suppliers, which require operators using ultrasound equipment for tightness testing of hatch covers to be familiar with hatch designs, hatch cover operation, maintenance and repairs, etc.

Another reason why operators of ultrasound equipment should have a good understanding of hatch covers is that, prior to the test being carried out, they should be able to confirm that the hatch covers are ready for testing. Evidence such as crooked/misaligned cleats, improper steel-to-steel contact, misaligned or mismatching panels and so on are indicators that the panels may not be properly closed and battened down, which might result in a lack of compression and affect the test results.

Operators should also be aware of the effects of snow, grease or Vaseline on the packing rubbers, effects of over-compression on test results, false echoes, etc. to ensure that the readings taken during the test are correct.

Once the test is completed, the biggest challenge is to evaluate the test results and find out if the hatch covers are fit for duty. In this context, readers should know that ultrasonic tests are carried out to provide information on the possible risk of water ingress (and damage to the cargo).

As such, it is important to understand the meaning of the readings obtained during the test (not only the figures) and their impact on the weathertight integrity of the hatch covers and to link this data to the possibility of water ingress and cargo damage during the forthcoming voyage(s).

The most dangerous conclusion that one can make is to say that, if during an ultrasonic test no measurements more than 10% OHV are found, the hatch covers are weathertight and that there is, therefore, no risk of water ingress and cargo damage.

As stated earlier, hatch covers can only be considered weathertight when they pass an ultrasonic test as well as a visual inspection that indicates that all parts that contribute to achieving and maintaining weathertightness are in good condition.

Another example is that many decision-makers will be concerned when they receive a report that indicates some red dots/stars (spot leaks) that are in range of 50% or more of the OHV. On the other hand, they will feel quite relaxed to see a measurement that is slightly above the 10% OHV fail-pass criteria over a longer length in a cross joint (because this is just a little over the acceptable value).

What is important and necessary to understand in order to come to a correct conclusion is that ultrasound measurements reflect a certain degree of compression (or lack thereof) and of course, the higher the measurement, the more compression has been lost. However, the real question that needs to be answered is how much water will infiltrate the hold as a result of the leaky spot that is found. In the case of spot leaks with a high value, water can indeed infiltrate, but the overall amount that will infiltrate is most likely not so much that it cannot be safely evacuated by the drainage system. However, in the case of the leaky cross joint, the main issue is that even a reading that is slightly above the fail pass criteria indicates that there is lack of compression in the sealing arrangement over a longer length. This is generally a more dangerous situation as the readings in this case indicate that there is loss of compression over several metres, and this means that the seal will open up prematurely (i.e. during more clement weather conditions where distortions between the panels and the panel/coaming are not excessive as would be the case in "normal" heavy weather situations. In case a cross joint opens up over a longer length, the amount of water that can infiltrate will be significant and this will normally be more than can be safely accommodated by the drainage channel. As a result, a more significant amount of water will be spilled over the inboard drainage channel rim which will cause wetting damage to the cargo.

The above example makes it clear that a few spot leaks with high values might not always present a big risk or result in a significant claim; therefore, it may well be that from an ingress and claim potential point of view there is no need to overreact or panic. After all, and as long as the water can reasonably safely be evacuated by means of the drainage system, there is no risk of being non-compliant with the ICLL requirements and the overall risk exposure for cargo damage will be remote.

REPORTING

No job is completed until the paperwork is done. This is also true for hatch cover tests and inspections and in many cases, surveyors will be asked to provide a test report which is a time-consuming exercise.

To help the surveyor with this difficult task it may be useful to know that free software that generates a professional test report quickly and easily is available. Moreover, it is now also possible to create comprehensive hatch cover test reports and share them with principals in real time by using Apps

FIGURE 71 SHOWING THE FREE SDT SHERLOG REPORTER APP.
HTTPS://WWW.SDTULTRASOUND.COM/SHERLOGREPORTER

Using the right testing tools and appropriate software is important, as it facilitates the reporting work, enables professional reports to be provided quickly and easily, helps readers in visualizing and understanding the test results and make the correct decisions.

Also, for ship owners and managers, it may be important to use these software tools as it would allow them to document inspections and tests made by the crew (even when no ultrasonic equipment is on board) and prove due diligence whenever this is should be required.

TRAINING

Hatch cover training is generally not a part of the curriculum offered by the maritime training centres. Furthermore, with hatch cover maintenance often being reduced to the bare minimum, missing manuals and poor practices not being recognised, there is a risk that poor practices will start to lead their own life and for wrong practices being considered standard.

With hatch covers being heavy pieces of moving equipment that are mechanically operated (with high pressure equipment) and having the potential to cause injury, pollution and cargo damage, hatch cover training should be considered and promoted.

In view of the risks involved, one would expect to see relevant procedures in the ship's SMS, but in practice this is rarely the case and owners/managers should be encouraged to include procedures about key hatch cover operations in their SMS.

Basically, we can divide hatch cover training into three categories: occupational training, operational training and inspection training.

For crew on board, a further distinction can be made in terms of general familiarisation training and a hatch cover- specific training.

OCCUPATIONAL/SAFETY TRAINING

Year-on-year accidents and injuries related to hatch cover operations are reported, often with loss of life or limb.
Chapter 16 of the CSWP (2015 edition) addresses a wide variety of hatch cover-related issues and in Ch. 16.2.8 it is stated that "All personnel involved with the handling and/or operation of hatch covers should be properly instructed in their handling and operation. All stages of opening or closing hatches should be supervised by a responsible person". In practice, however, it is often seen that no proper hatch cover familiarisation programme is available on board.

For people involved in hatch cover operation, not only should a general familiarisation training be given, but also hatch cover-specific training that highlights the specific risks related to the hatch type installed on board. Depending on the prevailing conditions, carrying out a risk assessment that takes specific risks into consideration when different operations are carried out simultaneously in the proximity of the hatch covers might even be considered.

Training should not only be focused on good practice for the crew, but should also highlight dangerous practices by stevedores, servicing staff, visitors, etc.

Bad and dangerous practices (sitting/walking on coaming, putting hands on trackways, etc.). Crew members should be familiarised with hatch covers, their operation and safety issues

FIGURE 72 SHOWING BAD AND DANGEROUS PRACTICES (SITTING/WALKING ON COAMING, PUTTING HAND ON TRACKWAY,.) CREW SHOULD BE PROPERLY FAMILIARIZED WITH HATCH COVERS, THEIR OPERATION AND SAFETY ISSUES

OPERATIONAL TRAINING

During the commissioning process, it is not uncommon for hatch cover manufacturers to provide the crew on board at that time with information and training about the correct use of the hatch cover system. However, due to crew rotation, this useful and practical info gets fragmented and lost over time and things will start to take on their own lives very quickly.

Apart from the dangers linked to this situation, erroneous operation is often the basis for problems, claims and warranty disputes.

To avoid the above problems, and even if a manual is available, it may be worthwhile recording additional useful information related to the correct and safe operation of hatch covers.

Not only are the correct opening and closing procedures important, but also the conditions under which the hatch covers can be operated should be well known. There are operational limitations that pertain to specific ship conditions, such as trim, heel, transversal and longitudinal coaming deflection, that can be found in the manuals of reputable manufacturers.

A typical example of operational conditions is listed below:

Maximum operating conditions:

- **Heel ± 3°**
- **Bow Trim 0.25°**
- **Aft Trim 1.0°**

Maximum coaming deflections on weather deck level:

Transversally:	**Longitudinally:**
• Inwards 2 x 25 mm	**• Warping over the ship's breadth 40 mm**
• Outwards 2 x 15 mm	**• Hogging/sagging 0.6 mm/m**

Failure to observe these limitations whilst working out the loading/discharge plans as well as during the act of loading/discharging (uneven distribution of cargo, ballasting operations and effects of squat on river berths) might cause hatch covers to derail or result in hatch covers not being opened/closed in time. The OOW/cargo officer should be advised to be vigilant and monitor such operational limitations closely.

During the design stage, owners should be critical and try to provide manufacturers with the maximum amount of operational and trading information which, in their opinion, might have an influence on safe and efficient hatch cover operation (such as loaded draft, whether the vessel will be trading high density cargo or light cargo, etc.), so that possible difficulties or problems related to hatch cover operations can already be identified and tackled in the design stage. If deemed necessary, calling in the advice of external experts might be of help in identifying specific trade/hatch type-related details that might assist manufacturers in designing hatch cover systems and arrangements that meet the expectations of the client and are in line with applicable rules and regulations.

INSPECTION TRAINING

On board, there will be teams assigned to the operation of the hatch covers whilst others will be in charge of the inspection of the hatch covers. Most probably the C/O will be in charge of hatch cover inspections, but they might decide to delegate this task to the second or third officer after proper familiarisation and hatch-specific training.

To ensure that onboard inspections are correctly carried out and can support servicing teams in case repairs are to be carried out, necessary and useful information about key parts, clearances and tolerances, etc. should be available on board.

Once an inspection is carried out, it is recommended that an entry is made in this respect in the ship's logbook. This will allow an inspection history to build up which is something that can come in handy when due diligence needs to be demonstrated.

For superintendents, port captains and surveyors, more enhanced training should be considered. Such training should not only deal with the obvious mishaps, but should provide a more profound understanding of hatch cover problems, inspections and planning for drydock, repairs, discussing repairs with shipyards, etc. such advanced courses are organised by the IMCS Training Academy (see "Hatch cover level 2" training course and workshop on www.imcs-training.eu).

Also, a better understanding of hatch covers and their operation will allow for proper root cause investigation and contribute to more professional and efficient repairs.

MAIN PROBLEMS FOUND

Experience has revealed that, when testing and inspecting hatch covers, the following typical or frequently seen issues are identified below.

Common issues

- **Insufficient knowledge about hatch covers, not allowing for good inspections and proper, understandable reporting**
- **Overestimating the capability of the ship's crew for repairs (maintenance & adjustment)**
- **Overlooking the importance of involving class when shipboard repairs are carried out on hatch covers**
- **Improper/temporary repairs by crew**
- **Missing manual/drawings**
- **No on-board instructions for maintenance**
- **No maintenance files on board (PMS)**
- **Hatch covers not included in SMS**
- **No understanding of due diligence principle/issues**

Weather tightness

- **Ignoring discard/replacement criteria (over-compression)**
- **Replace rubber and not fix the pads**
- **Installation of backstrip rubber everywhere, even on top of rubber packing**
- **Mix of new and old rubber**
- **Using old rubber (from shipboard stock and ignoring shelf life)**
- **Use of small pieces and filling-in of gaps**
- **Unpainted or lightly painted rubber channel**

Mechanical

- **Abnormal sounds/vibration during operation ignored**
- **No greasing, no greasing plan**
- **Onboard repairs instead of ashore**
- **Ignoring safety issues (heavy and moving equipment)**

Hydraulic

- **Cleaning filter instead of changing**
- **Improper filtering**
- **Closed covers without pump**
- **Changing of pipes without flushing**
- **Valve positions during voyage**
- **Ignoring leaks & pollution risk**
- **Ignoring high pressure risk**

CONCLUSIONS

Improperly maintained or wrongly operated hatch covers are vehicles for disasters and will have an impact on the successful outcome of the voyage.

Whist taking care of hatch covers should not be difficult, it is often the case that hatch cover maintenance is neglected and that hatch covers do not get the attention they deserve.

With this publication, we have tried to highlight the most important and practical hatch cover-related issues so that anyone involved in hatch cover work will be able to recognise the challenges of hatch cover maintenance and operation.

Remember, if you take care of your hatch covers, your hatch covers will take care of you!

The author wishes all readers fair winds and smooth seas and hopes that the information disclosed will help all involved with hatch covers in the execution of their day-to-day work.

PROTECT · PREVENT · PERFORM

IMCS GROUP OF COMPANIES

The history of the IMCS Group of Companies goes back to 1990 when IMCS-Belgium was founded in Antwerp. From 1993, IMCS branch offices were set up in strategic locations throughout Europe and in the Baltic and Black Sea areas.

In 2001, under the Chairmanship of Walter Vervloesem (FNI), the "IMCS Group of Companies" was set-up with a view to strengthening ties between the different IMCS entities, streamlining survey and reporting standards, and enhancing professionalism through an in-house quality system, training programs, seminars and Group meetings.

After 2005, further expansion included representation in overseas areas such as China and Brazil and in 2016, offices in Chile and India were set-up.

The worldwide IMCS Group network presently comprises 20 offices, and our surveyors carry out 5000+ surveys per year. More than 1000 hatch cover and cargo worthiness surveys (part of which are within the scope of dedicated ship inspection programs) are carried out annually by a team of highly trained surveyors.

The recent economic downturn brought several challenges, which were turned into opportunities by recognising our principal's needs and working out tailor-made solutions, developing dedicated ship vetting platforms and setting-up the IMCS Training Academy as well as by embracing modern techniques such as 3D scanning and the use of drones.

Throughout the years, IMCS has worked hard to make quality its hallmark, and significant efforts are made every day to ensure high standards of performance and customersatisfaction.

The Author

After leaving the sea in 1988, Walter Vervloesem (FNI) redirected his career and became a marine surveyor and consultant. He joined IMCS Belgium in 1995, and became Chairman of the IMCS Group in 2001. He pioneered the use of ultrasonic tightness testing back in the late eighties and early nineties, and is the training instructor for the SDT-IMCS worldwide training program for operators using ultrasonic tightness testing equipment for testing the weathertight integrity of hatch covers. In 2011, he founded the IMCS Training Academy. Walter is the author of several major reference works published by the Nautical Institute, such as "The Ship Survey and Audit Companion" (2000), "Hatch Covers Inspections" (2004), "Mooring and Anchoring Ships" (2009) and has contributed to many books and articles for leading maritime organisations.

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