

HATCH COVERS

CLAIMS v/s MAINTENANCE

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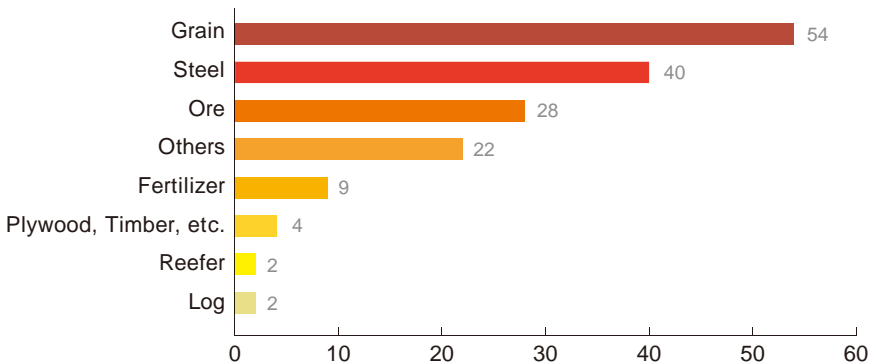
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INTRODUCTION

A recent study and claims analysis carried out by the Japan P&I club over a 5 year period between 2016PY and 2020PY shows that out of the 161 claims that were reported, 76% consisted of wetting damage to grain, steel and ore cargoes.

In 74 cases (46%), the sea water damage was caused by leaking hatch covers. This once again shows that hatch covers continue to generate seawater induced claims and that improperly maintained and leaky hatch covers have a high claim potential.



Graph 1 Number of Sea Water Damage on Bulk Carrier,General Cargo Vessel 2016PY-2020PY

When water susceptible cargo comes in contact with seawater during an ocean passage, it is most likely that a claim for wetting damage will be filed against the ship by the cargo owners/receivers.

These claims generally consist of a financial compensation for the damaged cargo, but indirect consequences associated with wetting damage claims, such as extra work for

legal staff, survey costs, delays, sorting and reconditioning of the damaged cargo, unscheduled repairs to hatch covers, reputation damage, disruption of the ship's operational schedule, travel costs for superintendents, ... can be significant as well.

Whenever a claim for damage to 3rd party property is introduced, it is incumbent on the club to defend the owners' interests and successful settling will mainly depend on proving that the hatch covers were well maintained and that the shipowner and Master exercised due diligence to ensure that the hatch covers were in good condition at the outset of the voyage. It is sad to see that many of the claims filed for wetting damage could have been successfully defended and settled if only the owners and crew would have carried out basic hatch cover maintenance in line with good industry practice. The seas and oceans are a hostile environment and rigours of an ocean voyage should never be underestimated. Hatch covers are designed to withstand the perils of the sea but only when they are well maintained, they will be able to keep water out and cargoes dry.

Despite awareness campaigns in the past, hatch covers remain a major driver for wetting damage claims. Water infiltration may not only be a safety issue for the vessel and crew on board, but it also scuttles the business model of carrying goods by sea and should be avoided at all times.

The importance of correct hatch cover operation, maintenance and repairs cannot be emphasized enough. This loss prevention article, written by industry leading expert Mr. Walter Vervloesem (FNI) of IMCS bv (Belgium), will highlight key issues that should be well understood and observed in order to reduce exposure to ingress, wetting damage claims and to allow the club to defend your interest with success.

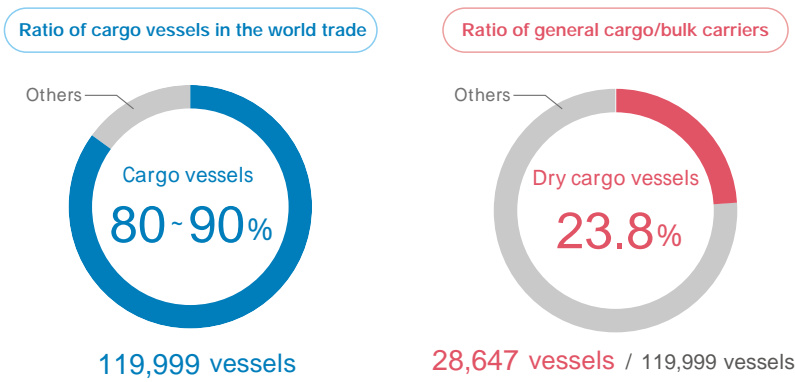
HISTORY OF HATCH COVERS

Since ancient times, different kinds of floating objects have been used for transporting goods over water. Initially trees, rafts and canoes were used, but gradually, and with the industrial revolutions over the last centuries, we have seen an evolution and transition from floating objects to wooden ships and more recently to steel vessels.

Over the last decades a wide variety of specialized and sophisticated ships appeared on the maritime scene in order to satisfy demand of world trade or to carry out specific marine tasks and operations.

The most commonly seen ships nowadays can be categorized as follows: container ships, bulk carriers, tankers, roll-on roll-off vessels, passenger/cruise vessels, offshore vessels, fishing vessels, speciality vessels, high-speed craft and dredgers.

Roughly 80-90% of the world trade is being done by a total of 119,999 cargo ships of which 28,647 ships (23.8%) consist of dry cargo vessels, i.e. general cargo ships and bulk carriers, which represent 38.2% of the gross tonnage of the worlds' fleet.



Graph 2 Type of vessels

Typically water sensitive cargoes like grain, steel, fertilizer, ores etc are transported on dry cargo vessels. In order to allow a swift intake and facilitate easy discharge of the above commodities, these vessels are equipped with hatch covers.

In case large amounts of water should penetrate the ship's hatch covers, both ship and crew could be in danger but limited water ingress would normally not cause a safety problem for the ship.

However, from a cargo quality point of view, even small amounts of water can ruin a cargo and cause commercial havoc. In general, one can say that the Class and statutory rules and associated inspections will mainly look to the safety of the vessel and crew. The industry (charterers, shippers, receivers, underwriters,...) will take statutory and class compliance for granted and will focus more on the commercial aspects of carrying goods by sea.

Whilst decades ago, only a few types of hatch covers were made, a wide variety of hatch covers were being developed to accommodate the requirements of specific ships, trades and cargoes. Nowadays, the most commonly seen types of hatch covers for general cargo ships, handysize, panamax and capesize bulk carriers consist of folding hatch covers (general cargo & handysize) and side rolling hatch covers (panamax & capesize). For container vessels we generally see that lift-away type pontoons are installed.



Ultimately it will be the shipowner who will decide, in concertation and dialogue with the shipyard, classification society, flag administration, customers,... which hatch cover type will suit the client's business model best and eventually hatch covers that are right for the ship, trade and cargo will be developed around a number of key parameters. Items that may influence the design are amongst others size of hatches, carriage of deck cargoes, strength requirements, available crew for preparing hatches to go to sea, opening/closing methods,.....

Hatch cover designs have evolved from vary basic and relatively lightweight designs to huge, heavy and moving pieces of equipment. Hatch covers are generally referred to as heavy-duty shipboard equipment and this is generally associated with material that can withstand rough handling and does not need constant care and maintenance. However, this is not true as modern hatch covers are high-tech equipment for which very small tolerances should be observed. Their maintenance is type-specific and their operation should be

considered a risk. Therefore, having a good understanding of how hatch covers work, and how to maintain and operate them is very important.

Cargo should not only be carried and delivered in time and in good condition but should also be transported in an environmental friendly manner. In view of the size and weight of hatch covers, many types are still operated by hydraulic systems which, in case of failure and associated spillage, have a pollution potential.

Only the combination of proper inspection, correct operation and regular maintenance of hatch covers will ensure that the goods loaded onboard ships can be transported in line with good industry standards.

In view of their impact on the safety of the ship and crew, hatch covers should comply with different rules and regulations imposed by Class, Flagstate (statutory) and Industry. As already pointed out in Chapter 2, Class will be working together with owners and shipyards during the development, design and manufacturing process and supervise installation of the hatch covers on board. Furthermore, the vast experience and knowledge from Class, reflected by the Class rules, will generally ensure that hatch covers can be type approved and, once installed, be in compliance with ruling regulations.

Throughout the in-service life of the ship, Class will carry out regular inspections to ensure that the approved design of the hatch covers has not been altered, modified or changed and that the hatch covers are still fit for duty. This could be the case when (temporary) repairs to the hatch covers were carried out by the crew after they suffered damage or when the crew thinks that so-called “improvements” should be made to facilitate or enhance operations, closing, sealing or securing.

Most shipboard staff are not aware of the fact that such modifications cannot be made without the consent of Class (and/or flag state) who previously approved the hatch cover design. Failing to bring repairs or modifications to the attention of the Classification society might result in Class being withdrawn (even post-factum in case of an incident).

In many cases, flag states will delegate their responsibility for inspections to Classification societies which will then be allowed to act as a “recognised organisation” and carry out tests and inspections required by the conventions to which the flag state is signatory party.

Conventions that are ratified by the flag state have to be included in the flag state's maritime law and as such they will become statutory instruments. Finally, and besides the Class and statutory requirements, which are both aimed to guarantee the ship's seaworthiness, there are also requirements that are imposed by industry players such as charterers, P&I clubs, transport insurers, vetting organisations,....

Industry requirements are based on the fact that a ship, once inspected and certified by the Class and flag state, will be compliant with Class and statutory rules and therefore technically fit and able to sail.

Extra requirements imposed by the industry will be focussing more on the commercial and quality aspects of the trade and might include requirements related to fumigation, ventilation, ultrasonic testing of hatch covers, cargo, cleanliness,

Whilst safety of the ship is paramount, claims will seldom be introduced on grounds of unseaworthiness of the vessel but rather on non-compliance with the industry requirements or commercial related issues (cargoworthiness) such as leaking hatch covers (and wetting damage to cargo), condensation damage, delays for opening/closing hatch covers, stevedore damages,.....



Photograph 1
Hatch pontoon, fallen into
cargo hold on bulldozer

Under the terms and conditions of a charter party, owners will be required to provide a seaworthy ship. A seaworthy ship is a ship that is technically fit (re-structure, certification, performance,...), cargoworthy (suitable to lift and transport the intended cargo) and fit to undertake the forthcoming voyage (incl. bunkers, crew, provisions, spare parts,...).

Practically speaking, and in case of cargo damage as a result from water ingress via

improperly maintained hatch covers, it will be concluded that the hatch covers were not such that the cargo could be transported without risk for damage and that therefore the ship was not seaworthy from a cargo carrying point of view. Such a verdict will usually be made after inspection and testing of the hatch covers and when it is proven that the hatch covers were indeed not in good condition at the outset of the voyage. In such a case, owners will be blamed of not having exercised due diligence.

International convention on loadlines (ICLL):

With regards to the ship's hatch covers, the ICLL is first and foremost the most important convention. Loadlines and draft marks are normally used to determine how much cargo has been loaded which, from a commercial point of view (charter party and freight) is very important.

However, from a Loadline convention point of view, not the cargo loaded, but the freeboard (the part of the ship that is out of the water for a specific draft) is of paramount importance as it determines the ship's reserve buoyancy and safety. The more freeboard, the more reserve buoyancy the ship will have and the safer the ship will be. This is why the Loadline convention clearly 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).

Under the Loadline convention, openings that are above the waterline are required to be weathertight. This actually means that water that is coming from the weatherside (such as green seas, sprays, rain,...) should not penetrate into the ship via these openings. If this should happen, water, and therefore weight (each m³ of sea water weighs 1.025 ton), would be added to the ship which will cause the ship to be deeper in the water with less freeboard as a result. In order to prevent wateringress and be considered weathertight, the ICLL requires the closures of these weathertight openings to be structurally sound and strong, tight and well secured.



“Weathertight means that in any sea conditions water will not penetrate into the ship”
(Reg. 3-12). (from the weatherside)

As the ship’s hatches are huge openings, which, in case of failure or leakage can admit substantial amounts of water to the ship’s holds, it is clear that every effort should be made to ensure that hatch covers are tight and will remain tight during the voyage.

Weathertight should not be confused with “watertight” as watertight means that “water will not pass through the sealing arrangements from both directions across the seal under a head of water” (in both directions). Therefore, a closure between two compartments below the waterline should normally be watertight. Watertight compartments are resistant to water pressure, as is the case during a major water ingress. Thanks to the “watertight” closure, the leakage will not spread, and the vessel will stay afloat.

As the Loadline convention is a statutory instrument, overloading the ship (and therefore willingly reducing the ship’s freeboard and reserve buoyancy), is not allowed and constitutes an infringement against the maritime law of the flagstate.

Finally, the Loadline convention requires 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)

As ICLL compliant hatch covers should prevent water entry, they have to be strong, tight and well secured. Whilst tests are merely carried out to ensure that the sealing arrangements are in order, it is clear that apart from testing, a visual inspection should be carried out as well in order to determine that the hatch cover related structure and securing arrangements are in order. A satisfactory test alone is not a substitute for a careful visual inspection of the hatch covers and in order to confirm that hatch covers are weathertight, and will remain weathertight throughout the voyage, both a test and a visual inspection are necessary.

Other conventions and regulations

Whilst the ICLL is the most important hatch cover related convention, other important conventions apply to hatch covers as well. It is beyond the scope of this article to highlight all possible hatch cover related rules and regulations but some important hatch cover related conventional issues are listed below:

| SOLAS |

Owners responsibility of maintaining the ship, exemption for fixed fire fighting, carriage of dangerous cargoes (IMDG – dangerous when wet), pesticides (fumigation), ISM (risk, accidents, damage to property), specific safety measures for bulk carriers.

| MARPOL |

Pollution from hydraulic oil, grease,...

| MLC |

Safe working, familiarization & training

| The Code of Safe Working Practice for Merchant Seafarers (COSWP) |

Hatch cover safety guidance.

Hatch cover type approval

It should be noted that hatch covers are designed and type approved by the classification society. Such a type approval confirms that the hatch covers, when properly maintained, are in conformity with the ICLL, applicable rules and regulations and therefore able to withstand the rigours of an ocean voyage.

In case of damage, any repairs, other than day-to-day maintenance, that might have an impact on the hatch cover design and approval criteria, should be brought to the attention of the Classification society and/or flag state as this will allow studying of the intended repairs or modifications and determine if the earlier given type approval is not affected. Also Class will be able to advise on correct repair requirements, welding methods and techniques. In case lashing terminal points (stoppers, D-rings,...) are welded on the hatch covers or coaming, it is best to call in the advice of Class. Not doing so may jeopardize the vessel's Classification status.

Commercial and charter party issues

Under the Hague-Visby rules, Article III, the carrier shall comply with the below 3 main issues when signing a contract of carriage:

The carrier shall be bound before and at the beginning of the voyage to exercise due diligence to:

- a) Make the ship seaworthy;
- b) Properly man, equip and supply the ship;
- c) Make the holds, refrigerating and cool chambers, and all other parts of the ship in which goods are carried, fit and safe for their reception, carriage and preservation.

From a hatch cover point of view, it is considered evident (and required) that hatch covers are in a good condition and in compliance with Class and statutory requirements (see item a)) whenever a charter party or contract of affreightment is signed. However, with regards to supplies (item b)), necessary spare parts for the hatch covers (which can be considered as critical equipment) should be placed on board. This is important to maintain weathertightness during the voyage in case hatch cover parts should become damaged. Furthermore, under part c), hatch covers will have to be inspected and maintained so that the cargo loaded in the holds will not suffer wetting damage.

In order to prove that due diligence was exercised (i.e. by doing everything that is practically possible and reasonable to ensure that the hatch covers are fit and in order for the forthcoming voyage) owners will have to document actions taken to ensure that hatch covers are in good condition.

Quite often a satisfactory ultrasonic or hose test will be considered as sufficient proof that the hatch covers are in order. However, the main issue is not if hatch covers can pass a test (there are plenty ways or “tricks” to pass a test, even if the hatch covers are not in good condition), but if the hatch covers are weathertight and will remain weathertight during the voyage in order to preserve the cargo and avoid water ingress. As pointed out above, this also requires a thorough visual inspection to confirm that the sealing capacity of the hatch covers, as proven by a satisfactory test, can be maintained throughout the voyage. During such a visual inspection, all parts that contribute in maintaining a tight

seal (e.g. bearing pads, locators, stoppers, cleats, drains,...) should be inspected in accordance with manufacturer's instructions and good industry practice.

Unfortunately, till today, and despite of what is mentioned above, we often see that charterers, shippers etc are requesting surveyors to carry out ultrasonic (or hose) tests in order to confirm that the hatch covers are in order (to start loading operations, take a vessel "on-hire",...). Such an instruction – carrying out a hose or ultrasonic test alone – will indicate that the hatch covers are not leaking at time of the test, but will not give information on whether or not due diligence has been carried out and if the necessary hatch cover parts are in a good condition to ensure that tightness can and will be maintained during the voyage. Considering a satisfactory hatch cover test in port alone as sufficient proof that hatch covers are weathertight and will remain weathertight during the voyage is dangerous and might give a false sense of security.

It should be noted that hatch covers are designed and type approved to withstand the rigours of an ocean voyage and face the ordinary perils of the sea. Only when conditions that are beyond the design (approval) criteria are met with, i. e. extreme heavy weather, freak waves etc, it is accepted that some water might enter into the ship, but not to such an extent that the safety of the ship and crew would be at stake. However, as stated before, even small amounts of incoming water may ruin a cargo and so it is possible that water susceptible cargo might suffer wetting damage.

In case of a claim being filed for wetting damage, owners and ship's crew should ensure that the hatch covers are able to withstand detailed scrutiny (visual inspection) and pass a hose or ultrasonic test. This will make it clear that the wetting damage claimed is not the result from improperly maintained hatch covers and can therefore only be the result of extreme weather conditions being met with during the voyage. In such a case, the wetting damage can be referred to as "Act of God"/"Perils of the sea", which will allow redirecting of the claim towards the cargo underwriters.

HATCH COVERS

4 - 1 DESIGN ISSUES

Designing hatch covers that are in compliance with the required rules and regulations and at the same time meet with the shipowners expectations (type and size of vessel, maintenance requirements and repair possibilities, carriage of cargo on hatch covers, budget, ...) is a difficult and challenging task and in many cases compromises will have to be made, however, always by keeping in mind that “weathertightness can be maintained in any sea condition” (ICLL (reg. 16(4))), so that the safety of the ship and crew is not at stake.

With owners’ requirements in mind, designers and manufacturers will then consider issues like type and construction (open web type, double skin, corrugated, flat topped/peak topped), required stowage space, sealing type and systems, type of operation, weight, securing mechanisms, ...

Once a suitable design has been defined, the plans will be submitted to the Classification society and/or administration who will study and eventually approve the design.

4 - 2 RELATIVE MOVEMENTS & ACHIEVING TIGHTNESS

A ship is often compared with a steel box. Although a steel box is quite rigid, the box becomes flexible once the cover (deck) is removed or when large openings are cut into the deck (hatchways).

In order to prevent water ingress in the holds, and to keep the cargo dry, holds have to be covered up with hatch covers which are required to be weathertight. Furthermore, and in order to withstand the forces acting on the hatch covers due to weather conditions (weatherload) and twisting and flexing of the hull whilst the ship is on passage, and by taking into consideration that carriage of deck cargoes may be required, hatch covers need to be strong.

Whilst at sea, the strong and rigid hatch covers will not move in unison with the flexible hull of the ship and hence relative movements will occur which will enhance the risk for water ingress.

Typically, these relative movements, which are the result from weatherloads, ice pressure, flexing, hogging, sagging, twisting and a combination thereof when the ship is at sea, will take place in way of the packing rubber and compression bar interface (hatch cover & coaming and between adjacent panels).

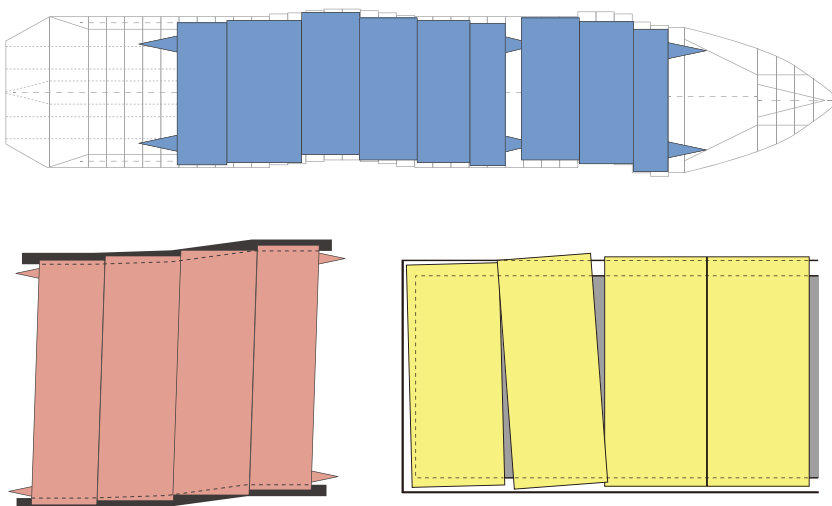


Figure.1 Illustrating relative movements between panels. (Courtesy MacGregor)

It is therefore important to identify/determine the relative movements and to install counter measures that will prevent ingress. By installing a soft and flexible packing rub-

ber in the hatch covers, the resilience of the rubber will compensate for these relative movements and preclude water ingress. However, there may be situations where the packing rubber alone will not be able to keep water out. This would be the case when the packing rubber's design compression (see later in this article) would not be sufficient to compensate for excessive relative movements at a given moment as might be the case during hurricanes or impact of freak waves etc..

Even in such extreme cases, and according to the ICLL, the weathertight integrity should not be impaired and water should not enter into the ship's hold. Therefore, and in order to achieve compliance, manufacturers will install drain systems i.e. drain channel above the packing rubber/compression bar interface in cross joints to evacuate water from the interpanel void space ("A" - Figure 2) as soon as possible and a drain channel ("B" - Figure 2) underneath the packing rubber/compression bar interface which will evacuate incoming water that passes through the rubber/compression bar interface and prevent water from falling into the hold.

Obviously, and when the ship is facing heavy weather, it cannot be avoided that some of the water that collects in the drain channels is spilled over the edge of the drain channel and falls in the hold on the cargo stowed underneath, leading to wetting damage to the cargo with subsequent claims as a result.



Photograph 2

Water spilled over the edge of the drain channel and fell on the cargo stowed underneath.

Whilst the rubber packing and drains are of key importance in keeping water out, it is the hatch cover steel plating that will keep most of the water out and therefore assessing the condition and structural integrity of the panel (and coaming) plating is very important as well.

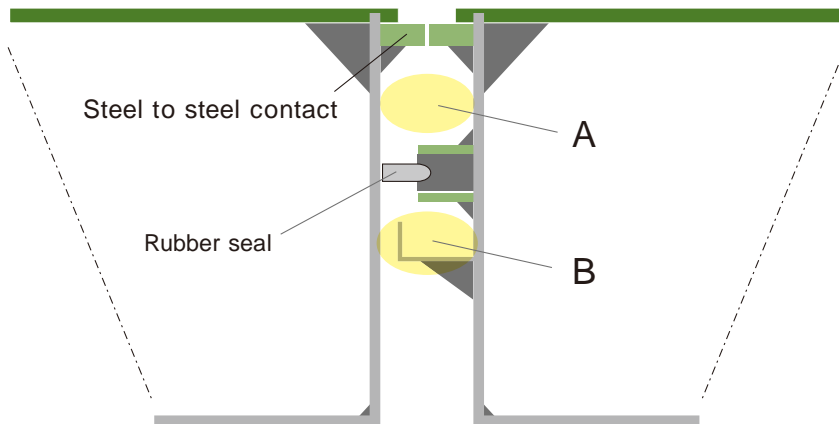


Figure.2 Showing the 3 safety barriers in hatch cover design, i.e. the steel hatch plating, the sealing system and the drain channel

In summary, we can now say that designers and manufacturers will install 3 safety barriers in order to reduce the risk of water ingress to acceptable level (see Figure 2).

4-3 KEY PARTS

With hatch covers being equipment that can weigh up to 100 MT or even more and span very large openings, it is clear that hatch covers will only meet with expectations and work well when they are correctly made, installed, maintained and operated.

Apart from the fact that the hatch panel (and coaming) plating, packing rubbers and drain systems will keep the water out, relative movements during the voyage will require

additional equipment and key parts that will keep the panels in place, prevent the distortion of the panel geometry and secure the panels to the ship. As per the ICLL requirements, “*The arrangements shall ensure that the tightness can be maintained in any sea condition*” and “*The load line shall never be submerged at any time when the ship puts to sea, during the voyage or on arrival*” (Art. 12). In other words, no water shall enter into the holds. This means that during an inspection in port (where it is usual for inspections to be carried out), one should not only be focussing on whether or not the hatch covers are able to pass a tightness test, but also on judging if the condition of the hatch cover parts as found during the inspection will allow to maintain tightness (and keep the panels in the required sealing position) when the ship is at sea. This further clarifies that carrying out a test of the hatch cover sealing arrangements alone is not sufficient and why a visual inspection is paramount when weathertightness has to be confirmed.

Hatch covers are complex and delicate pieces of engineering which work against very small tolerances and clearances which are all in the range of millimeters. In view of the size and shape of hatch covers, such small tolerances are difficult to check or confirm with the naked eye and therefore measuring equipment such as tapered feeler gauges,



Photograph 3 Using feeler gauges, yardsticks and depth gauges during an inspection

depth gauges, calipers, piano wire (or laser), yardstick etc.... should be in the inspector's toolbox.

Hatch panels & Coaming plating

Hatch panels (panels and stiffeners) and coaming plating (side plating, coaming table and coaming stays) keep most of the water out and have to be able to withstand the impact of waves, weather and cargo loads and as such their structural integrity needs to be assessed at regular intervals. Furthermore, many load bearing parts such as bearing pads, stoppers, locators, cleats, trackways etc... welded onto the hatch panel and coaming table make assessment of the structural integrity of the panels and coaming table a priority item. Inspection should focus on the following items:

Advanced corrosion

Advanced corrosion will affect the strength of the structural members and plating. Preventing the effects from corrosion starts with good maintenance and proper (and timely) painting. Besides being a cosmetic issue, painting is an efficient way to counter the devastating effect of exposure to weather conditions and abrasive cargoes. Visual inspection and thickness measurements will confirm that the plating is still sufficiently thick and strong.



Photograph 4
Advanced corrosion to hatch panels

Physical damage

Physical damage (cracks, holes, deformations) as a result from stresses (caused by twisting, hogging/sagging, coaming deflection, overloading/improper weight spreading, improper adjustment/alignment of the panels) but also stevedore damages may affect the hatch covers structural integrity. Therefore, hatch covers should be inspected for damage after loading and discharge operations and the cause of cracks and deformations should be investigated.



Photograph 5
Stevedore damage to hatch panels

Temporary repairs

Temporary repairs on shipboard made lashing terminal points such as stoppers and D-rings. Exposure of hatch cover and coaming structure to heat may cause thermal deflections and improperly made repairs may affect type approval and not be in accordance with requirements or good industry practice.



Photograph 6
Welding D-rings on hatch covers

Presence of rust streaks and leakage traces.

Whilst the external hatch coaming plating is prone to the same damages as the hatch top plating (corrosion, cracks, deformations...), the inner hatch coaming may show the which is prima facie evidence that water has been infiltrating through the hatch covers.



Photograph 7
Evidence of leakage traces on inner
hatch coaming plating

Packing rubbers

Packing rubbers are fitted in retaining channels that are part of the hatch panel and constitute importance reference material when it comes to hatch panel adjustment. Packing rubbers should be flexible part and provide sufficient resilience to compensate for the relative movements between the panels and panels and coaming.

Whilst often considered to be just “a piece of rubber” packing rubbers have to remain flexible and be able to withstand exposure to heat, cold, sunlight, cargo (abrasive/chemicals, ...), chlorides, etc. as long as possible during their in-service life. On condition that the hatch covers and packing rubbers are well maintained, rubbers will normally age slowly and at a steady pace and easily remain in good shape for a 5 year period.

Various types and designs of rubber packing are available. Part of these designs are the so-called ordinary/box type rubber packings which act on a raised steel compression bar, whilst the other type is the “sliding profile” seal which act on a flat steel mating surface.

Types of rubber packings



Photograph 8 Flex seal, CAT seal and sponge seal

Packing rubbers are designed with a certain design compression (see photographs below) which is generally in the range of 8-20mm. This design compression corresponds with a certain reaction force (line compression) which allows the packing rubber to respond properly and quickly to relative movements in order to keep and maintain a tight seal.

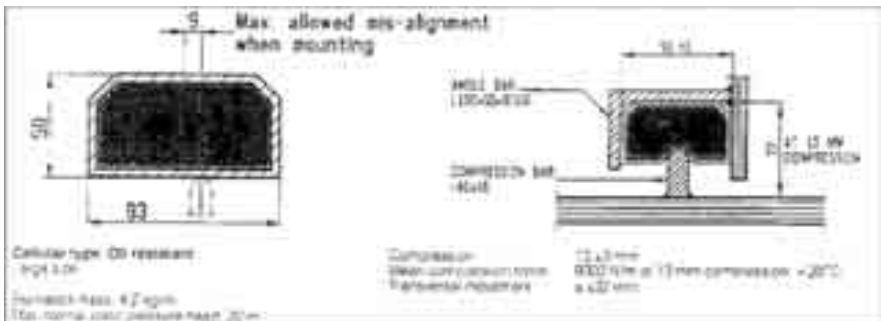


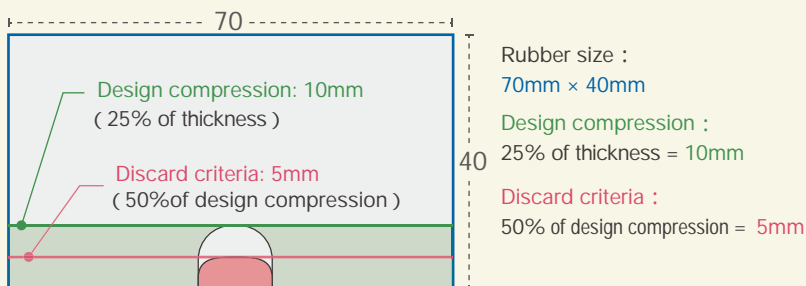
Figure 3 Showing packing rubber specs as per the manufacturer s manual

It is important that the packing rubber is compressed to its correct design compression since over compression will lead to damage and permanent set of the rubber, whilst insufficient compression will cause the seal to lose contact with the compression bar in less severe weather conditions and allow for water entry.

In order to check if a box-type packing rubber is overcompressed and permanent set excessive, and without a manual being available, the following rule of thumb can be used.

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

Discard criteria = 50% of the design compression



So for a 70x40mm packing rubber with a design compression of 10mm, 5mm of permanent set will be the limit for replacement. In case of the normal type of CAT seal, a round shaped profile, instead of the triangular one, indicates that the packing rubber is nearing the end of its in-service life.

Packing rubbers are normally correctly compressed up to their design by the weight of the panel and not by overtightening the cleats!



Photograph 9 Overcompressed CAT seal

Although often considered to be good practice, crew should refrain from “lubricating” packing rubber with grease like substances such as petroleum jelly, ordinary grease etc