HATCH COVERS

Thomas Miller P & I Ltd. wrote as follows in their Carefully to Carry published in May, 1996:

"Since time immemorial it would seem that P & I clubs have been encouraging their members to ensure that the cargo hatch covers on their ships are watertight. It is a sad fact that the need for this encouragement continues".

A feature of hatch covers is that every part has a vital role to perform. All, ultimately, contribute to the effectiveness of the covers and weathertightness.

Lack of maintenance leads to general deterioration. Steel becomes wasted and distorted. Spindles, wheels, cleats and other fittings wear. Packing is affected by undue distortion of the steel structure.

Covers in worn condition continue to deteriorate at a faster rate than previously. Rubber is insufficiently protected within wasted steel channels. The laboured progress of panels on worn wheels across uneven coamings aggravates wear and tear.

Where there has been general deterioration, a significant improvement requires widespread repairs. Those have to be carefully planned and are, in any event, particularly difficult to carry out effectively. That is because the accurate fit of metal parts has to be restored. If virtually all metal parts are worn, there is no reliable datum and measuring becomes impractical.

Repairs carried out in haste, perhaps following leakage and cargo damage, will often be particularly costly and are unlikely to be effective.

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WEATHERTIGHT OR WATERTIGHT?

The 1966 Load Line Rules are often quoted in support of the view that hatch covers must always remain watertight in any sea conditions. I consider that would be a misinterpretation of the Load Line Rules.

Recent P & I club publications have suggested that watertightness means that water cannot pass in either direction across a seal, whereas weathertightness means preventing water from entering the ship. I do not doubt that is correct so far as it goes. I believe, however, that in terms of the Load Line rules, weathertightness is a lower than standard watertightness.

A conference was arranged jointly by the Royal Institute of Naval Architects, the Institute of Marine Engineers and the Nautical Institute in January, 1977. In opening the conference the Chairman, Mr. F.N. Boylan, said the following:

"The 1966 International Conference on Load Lines took steel covers into formal consideration. It stipulated standards for stress, deflection and minimum thickness plating in conjunction with spacing stiffeners. The means of securing and maintaining "weathertightness" (please note not "watertightness") was left to the satisfaction of the authority which assigned the loading, but it was required that the arrangements approved be such as to ensure that "tightness can be maintained in any sea condition" and also that tests for tightness should be required at the initial survey and could be required an annual inspections, or at more frequent intervals".

The underlining was included in the transcript of the papers.

An example of the practical difference between watertightness and weathertightness was given in a paper by Mr. R.G. Lockhard of Lloyd's Register as follows:

"It is sometimes said that hose testing is inadequate for the purpose of ascertaining cross-joint tightness and that the drain holes in the ends of the troughs in way of the transverse joints should be blocked off and the troughs filled with water. However, the international requirement for hatch covers is that they should be weathertight, not watertight."

I consider that the above quotations show clearly that the Load Line requirement is for hatch covers to be weathertight and that is a lower standard than watertight.

The difference between weathertightness and watertightness may readily be understood by comparing a manhole cover sealing an access to a ballast tank on a weather deck, with a cover protecting a cargo hatch. Normally, of course, the hatch cover would be located a few metres above the manhole.

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Sealing of a manhole is achieved by the use of closely pitched bolts which cause the hard compression of a gasket. The manhole cover is fairly small, and a very effective seal can readily be obtained. The nearby hatch cover has an entirely different type of seal. It has widely spaced cleats, and compression of the rubber seal varies considerably along its length. It is, I believe, a much less effective seal than the manhole cover.

An indication of the standard expected in practice is that hatch covers should be able to withstand a hose test which involves water being directed near to the joints. A more rigorous test involving a small hydraulic head of water, of a few centimetres, being placed on the seals is not appropriate and is not the standard.

THE PRIMARY SEAL

Whenever there is leakage there must either be a breach in the panel or coaming or, more commonly, a failure of the primary seal. The latter, therefore, is of obvious importance.

The primary seal is provided by the mating of packing on seal.

A good seal requires:

1. Accurate fit of steel parts.
2. Packing satisfactory condition.
3. Compression bars fair and smooth.

The seal is maintained in the seaway by the use of cleats.

Design Compression

When all components of a hatch cover and coamings are new and in correct position, the packing compresses by a pre-determined distance known as design compression. The force of packing acting on steel prevents the passage of water. Insufficient elastic compression allows leakage. Too much force damages the parts. I show below a common arrangement, with steel and packing unworn, and the hatch open in Sketch 1, and closed in Sketch 2.

Given wear within proper limits and shipbuilding tolerances, the compression will be fairly high at some places and only a few millimetres elsewhere. That may appear to be surprising but follows from the design of hatch covers, normal wear and shipbuilding tolerances.
Hatch Covers

**Sketch 1**

**Sketch 2**
Hatch Covers

Normal design compression is altered by:

1. Shipbuilding tolerances, i.e. the permanent distortion of nominally level surfaces such as the coamings.

2. Ship motion when the ship works in the seaway, affecting coamings and panels differently.

Design compression for a particular set of hatch covers is not generally easy for ship's personnel or surveyors to determine. Occasionally, this is written on a drawing or in a manufacturers' handbook. The value can be estimated by reference to drawings of hatch covers on board.

A very common type of hatch cover uses packing of rectangular section about 71 mm wide and 32 mm deep. This has a design compression of 8 mm.

**Permanent Set**

As packing ages and is worn, permanent set develops. That is the permanent distortion of the original flat surface of the packing. A groove develops in the packing, the depth of which can be measured.

Ageing also causes packing to become less resilient and therefore, less effective.

When permanent set becomes excessive, weathertightness is compromised. I show below, in Sketch 3, the common arrangement, where packing has developed permanent set.

**Sketch 3**
Hatch Covers

**The Effect of Permanent Set**

Consider hatch covers with seals of 71 mm x 32 mm material and design compression of 8 mm. Assume that the steel components were perfectly constructed and had suffered neither distortion nor wear.

In the above situation, every 1 mm of permanent set would reduce compression by the same value. Permanent set of 8 mm would result in contact between the compression bar and rubber, but no elastic compression of the packing and thus water ingress would occur.

A wide range of values has been put forward as maximum permissible limits for permanent set. These include:

**North of England and David Byrne**

The following was included in the book "Hatch Cover Maintenance and Operation" by the North of England and David Byrne, published in 1997:

> "WHEN PERMANENT SET REACHES HALF THE DESIGN COMPRESSION REPLACE THE SEAL."

Using the criterion given by Mr. Byrne, packing which is 32 mm deep, having a design compression of 8 mm, should be replaced when permanent set reaches only 4 mm.

**International MacGregor Organisation**

Maintenance books produced by this organisation in previous years included advice that permanent set in excess of half of design compression may be a cause of leakage.

That advice corresponds with the recommendation given by Mr. Byrne.

**MacGregor Navire (GBR) Ltd.**

A number of papers by MacGregor Navire include no specific guidance concerning an acceptable level of permanent set.

In a paper in October, 1993, Mr. K.J. Taylor advised as follows:

> "A good guide to the "point of renewal" is when the permanent set reaches 1/3rd of the depth of the rubber packing."

Using that criterion, packing of section 71 mm x 32 mm and covers with a design compression of 8 mm, should be discarded only when permanent set reaches about 11 mm.
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**Classification Societies**

Classification Societies appear to have no specific criteria for the acceptable level of permanent set. In practice they allow high levels without requiring replacement of the packing. I commonly see ships which have recently passed their statutory and classification surveys with hatch cover packing affected by 20 mm or so of permanent set.

**When to renew?**

In practice, steel corrodes and wears while permanent set of rubber develops. The change of the steel structure normally counteracts permanent set. I show that situation in **Sketch 4**.

**Sketch 4**

In the situation shown by **Sketch 4**, there is only contact between the mating surfaces, with no compression. Further, the relationship between wear of steel and development of permanent set is not controlled.

I consider that when permanent set of packing exceeds half of design compression the packing should be replaced. When that is done the fit of steel components should be checked and returned to original values.

Until recently, reliable guidance concerning the maximum level of permanent set was comparatively hard to find. Now that David Byrne and the North of England have published their book that is no longer the case. Conflicting information is still to be found, but I have no doubt that the value of 50% of design compression is appropriate.

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**Designs without a compression bar**

Some designs of hatch cover allow the packing to protrude out of the retaining channel and bear upon the hatch rest bar or the flat bar of the cross joint. Over time, the packing distorts and protrudes less out of the steel channel. That causes a loss of compression. The discussion concerning when to change the packing is similar to that involving a conventional seal. Sufficient elastic compression must be retained.

**DRAINAGE**

Most hatch covers incorporate drain channels which carry away slight leakage through the primary seal. These have to be kept in good condition. Non return valves allow leakage to pass harmlessly onto the weather deck while preventing water from passing in the other direction. These should also be kept in good order.

**CLEATS**

Commonly, hatches are secured for sea by adjusting the nuts of the spindles of the quick acting perimeter cleats. In fact, those nuts are intended for occasional adjustment and not operation.

All of the quick acting perimeter cleats of a hatch panel should be adjusted at the same time. That is because the adjustment of one can affect others. However, such adjustment should only need to be comparatively infrequent. Cleats should be tensioned when securing the hatch for sea by operation of the eccentric cam, and not by adjustment of the nut on the spindle.

I have surveyed ships on which hatch cover cleats were considered redundant and were not used. One of those ships was a large bulk carrier fitted with two types of cleats, large and small. The large ones kept the panels in place, the smaller ones assisted. The large cleats were heavy so only the smaller ones were used.

Cleats were also considered to be redundant by the officers of several ships carrying containers on deck which I have surveyed. The theory is that the weight of containers holds the hatches in place. That may well be correct for much of the time, until a combination of heavy weather and the distribution of containers which causes separation forces to develop at the base. In any event, lack of use causes cleats to seize and become inoperative.
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**POSITIONING**

The design of hatch covers incorporates the means of accurately positioning the panels, both horizontally and vertically, one to the next and on the coamings. It is essential that these are kept in good order. Ill fitting panels leak.

The means of achieving weathertightness should be known for a particular set of covers, so that repairs can be correctly planned. This may involve wedges acting in recess, junction pieces at the sides of the panels or hinges.

**MANUALS AND DRAWINGS**

A good quality manual and drawings should be available to superintendents and ship’s officers. These should be used so that personnel understand the systems, and to plan necessary maintenance.

Many years ago I surveyed a ship which suffered the complete flooding of number one hold during severe weather conditions. Investigation revealed that the crew did not understand how the cross joint cleats operated. They believed that rotation of cleats by 90° was sufficient. In fact, the cleats had to be fully rotated several times. The ship was carrying containers which imposed additional loads on alternate panels. At some places the extra loads caused the cross joints, which were virtually uncleated, to separate. If the officers had consulted the hatch cover manual they would have learned the correct manner of operation of the cleats.

A well written manual would give specific guidance as to when to replace packing, and upon other maintenance aspects.

Too often, in my experience, hatch cover manuals give vague and non specific advice on matters such as replacement of packing.

**TESTING**

Hatch covers are commonly tested in port, either routinely prior to carriage of a sensitive cargo or for statutory purposes.

Testing may be carried out by water, light, chalk or ultrasonic means. The different methods have their advantages. Unfortunately, all share the limitation of testing under static conditions which differ substantially from those likely to be encountered at sea.

I have often tested hatch covers in port with heavily worn seals, using hose, light and approved ultrasonic equipment, finding no leakage.

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When components are in apparently good order, testing is a useful means of detecting the unexpected. There is a common practice in the shipping industry to test hatch covers in visually unsatisfactory condition. Commonly, no leakage is detected. I consider those tests are of no value in determining the efficiency of the covers.

**SEALING TAPE**

Sealing tape is used on many ships. This is applied to form a bridge between panels above cross joints, as shown in the sketch below:
Hatch Covers

It is also applied at the perimeter, between panel skirts and the coamings as shown below:

![Diagram showing sealing tape application at the perimeter]

When used over time, sealing tape damages paintwork and thus encourages corrosion. It may be washed off during heavy weather. In general, I believe that money spent on hatch sealing tape would be more usefully expended on conventional maintenance.

Notwithstanding the above, hatch tape above cross joints will keep water away from the seals and, I believe, is therefore likely, in practice, to reduce the possibility of leakage.

I believe that hatch sealing tape at the perimeter may well interfere with the draining of water away from the seal. I therefore consider that tape should not be used at the perimeter.
Hatch Covers

RISK

I have known a few ships with hatch covers which leaked in their maiden voyages or shortly afterwards. Generally, however, that does not happen. Indeed, many ships trade for long periods with hatch covers in poor condition without experiencing leakage. I believe that because major leakage often occurs when a variety of factors coincide. Those include:

1. Very heavy weather conditions.
2. Incautious navigation of the vessel.
3. Carriage of a high density cargo such as steel.

I believe that leakage also occurs on occasion but results in no action, being insufficient to cause complaint from receivers of cargo. A few cargoes are not water sensitive.

In addition to the above, many modern ships have high coamings. Thus the covers seldom have to deal with anything heavier than spray.

In my experience, a reported history of satisfactory performance of covers and coamings is of limited interest when determining their efficiency.

COMMENT

If packing should be changed when permanent set exceeds 50% of design compression, as others and I believe, advice that the point of renewal may be much higher is incorrect.

The classification societies commonly allow ships to trade with 20 mm of permanent set, much more than that which others consider to be the correct level.

I often see ships about seven years old with the steel of coamings and covers in moderately good condition and packing very heavily worn. Such a vessel would have passed her first special survey a few years previously with minimal attention to hatch covers. That would have been a missed opportunity. Steel parts could have been restored and protected and rubber changed in a satisfactory manner. Those measures would have been much more cost effective than less satisfactory work on covers which had been allowed to deteriorate further.

The various P & I Clubs continue to issue circulars to their members concerning maintenance of hatch covers. While the standards applied by various parties differ so radically as I discuss above, and in the absence of clear and correct guidance from manufacturers, I believe the situation is unlikely to improve.
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**SUMMARY**

1. Leakage of hatch covers which have been properly maintained is not common.
2. Weathertightness is a lower standard than watertightness.
3. Hatch covers and coamings must fit together accurately in order to operate efficiently.
4. Packing must be sufficiently compressed to prevent ingress.
5. Design and building tolerances are such that compression of packing, in the best circumstances, is fairly small. Permanent set decreases that value.
6. The implicit assumption that steel will wear away at the same rate as permanent set develops is common by incorrect. Leakage is likely when that is permitted.
7. Neglect of steel results in covers and coamings becoming virtually impossible to repair to original specifications.
8. Over tension of cleats should not be necessary but is often done when parts are worn. When cleats are over tensioned while steel is worn or wasted, so that panels come closer to the coamings, the deterioration of rubber is greatly increased.
9. Perimeter cleats should be operated and adjusted by the correct means.
10. Replacing packing without restoring steel to correct dimensions is likely to lead to accelerated wear.
11. There is presently no common standard for the maximum level of permanent set. Different criteria are put forward by various respected parties. The classification societies appear to have no real interest in this aspect. Ships commonly trade with high levels of permanent set with the apparent compliance of Classification Societies.
12. Leakage can be expected during heavy weather conditions when permanent set has been allowed to exceed half of design compression.
13. Hatch sealing tape should not be used to compensate for a lack of maintenance. It may be washed off and promotes rusting of the edges of panels. When used above the cross joints of well maintained covers, it may reduce the likelihood of ingress. It may hinder effective drainage at the perimeters.
14. Manuals published by manufacturers should be regarded as essential guides by those operating ships and controlling the maintenance of the covers.

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15. Manuals are often vague and unspecific upon vital aspects of maintenance of covers, particularly in determining when to replace packing.

16. Hatch tests in port are of value in revealing the unexpected. They should not be used to allow excessively worn or damaged parts, which are readily detectable by visual inspection, to remain in service.

17. Neglect of maintenance results in risk to cargo and the disproportionate cost of work subsequently carried out.

John C. Fairclough