MACGREGOR

Weatherdeck Hatch Covers

Hydraulic Folding Types

TECHNICAL INFORMATION H2

Weatherdeck Hatch Covers

Hydraulic Folding Types

The weatherdeck hatch cover on a dry cargo ship has the following basic functions: in the open position it provides access to the hold for loading and discharging cargo, and in the closed position it seals the hatchway in a weathertight manner for transit in heavy seas. With the progress of containerisation, the ability to carry substantial deck loads has emerged as a new, essential function for weather deck hatch covers.

Introduction

It goes without saying that the hatch cover must be safe to operate, and it must be cost effective, both as an initial investment and in service, i.e. the maintenance cost has to be low and the service life long.

Furthermore, the design of the hatch cover must suit the various general arrangements of dry cargo vessels. This calls for a range of different designs in respect of size, loading, operating systems and sealing arrangements.

There are numerous criteria relating to the design of a weatherdeck hatch cover. Many contradictory criteria must be applied simultaneously to the design. The balancing of the various require-ments calls for a wealth of experience. In this respect Cargotec's MacGregor solutions are second to none.

Co-operation

To achieve the best vessel for both the owner and the shipyard, Cargotec's MacGregor experts are happy to join in technical discussions regarding the hatch cover arrangement, and its implications on the vessel's design, at a very early stage of the project. Items which should be addressed in these discussions include:

GA of the vessel

- Main particulars of the vessel
- Cargo specifications
- Number of holds
- Tweendeck covers
- Grain bulkheads / combination of tweendeck & bulkhead
- Cranes, location of the cranes
- Stowage space (length and height restrictions)
- Class, national authorities, applicable rules

Flexible deformations of the hull

- Stiffness of the hull / size of the hatchways in relation to the deck area
- Deformations in port due to variable loading (draught)
- Deformations at sea

Loads on the covers

- Container arrangement
- Stack weights
- Project load
- Transmitting of forces to the hull / necessary reinforcements in the hull
- Lashing arrangement
- Need for partial/non-sequential opening of covers
- Need for sliding container foundations
- Handling of hatch cover panels by the container crane
- Timber load

- Proven cargo access solutions for general cargo ships
  - container feeder vessels
  - open vessels for long cargoes
  - paper/steel carriers
  - project cargo carriers
  - river vessels
- Non-sequential/partial opening of container loaded covers
- Smooth control by proportional hydraulic components
- Long service life due to well selected materials
- Worldwide after sales service

Consult us at the early stage of the project.

Folding hatch covers in operation

Operating requirements

- Necessary power
- Location of hydraulic power pack and control stands
- Running the hydraulic pipelines
- Operating forces
- Arrangement of securing and cleating devices

Main types of hatch covers

State-of-the-art hatch covers can be divided into three basic types: lift-away covers on container carriers, side-rolling covers on bulk carriers, and folding covers on general cargo ships. However, folding covers can also be installed on geared bulk carriers and lift-away panels on general cargo ships. If stowage space is not available, rolling covers (mostly in the longitudinal direction) can also be built as stacking covers, i.e. two or more panels are stacked hydraulically on top of each other and the stack is rolled along the coaming as the cargo work requires.

There are dedicated MacGregor leaflets for each type of hatch covers.

General

The objective of this document is to give a general idea about the range of MacGregor standard folding covers available today, and to describe the options available to the shipowner.

With ever more efficient cargo working in port being the objective, modern dry cargo vessels are tending to develop to a more 'open' trend, i.e. the size of the hatches compared with the deck area is growing. This implies that there is less stowage space available for the hatch covers, which has made the high-stowing hydraulic folding covers very popular. Hydraulic operation results in smooth and positive control of the big panels during opening and closing of the cover. A major advantage with the hydraulic folding covers is the low number of panels. Fewer big panels are advantageous when designing the covers for container loads.

Relative movements between the hull and the hatch cover

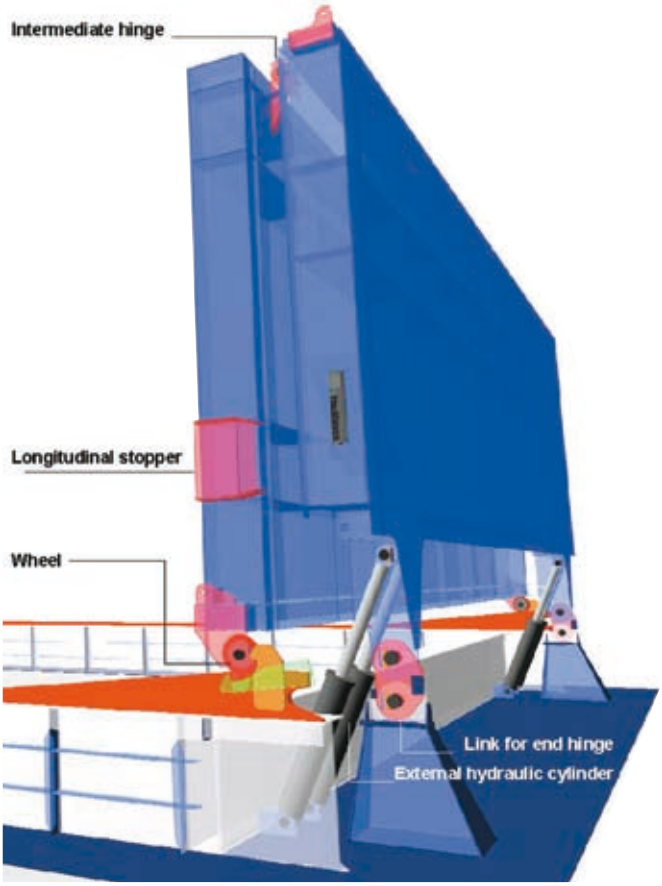
The hull of a vessel always experiences flexible deformations in rough seas. The bigger the size of the hatches in relation to the deck area, the more significant are the flexible deformations, as well as their implications, on the hatch cover design.

The large size of the hatches reduces the torsional stiffness of the hull and causes twisting and diagonal changes in the hatchway, as well as warping of the deck plane in rough seas. The longitudinal bending of the hull or hogging/sagging causes considerable changes in the hatch length. The third major type of flexible deformation is bending of the sides inwards and outwards. This not only occurs at sea but also in port when the draught changes due to variations in loading. In winter conditions the pressure of ice contributes to the flexible deformations of the hull. See sketch below.

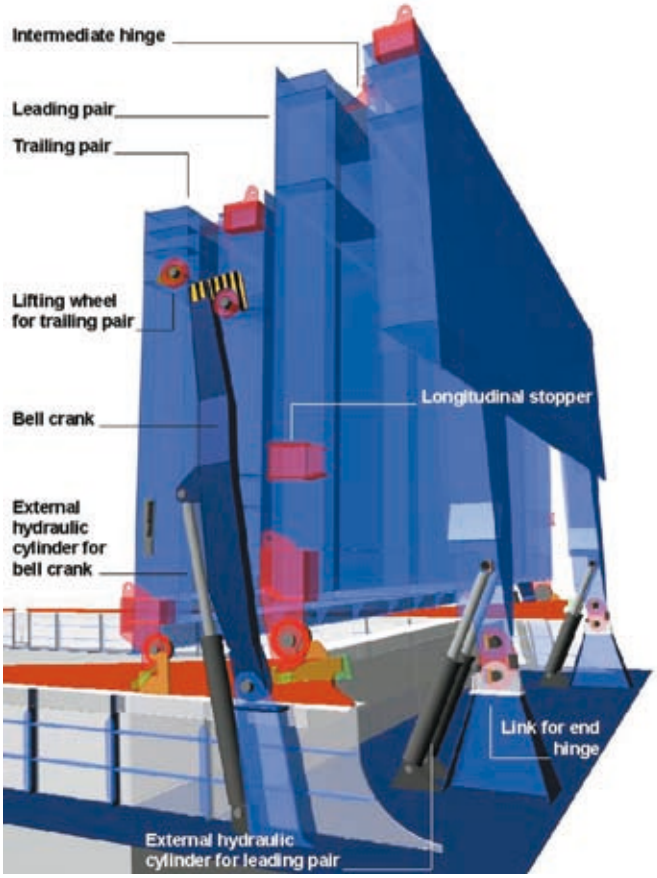
The above flexible deformations of the hull result in relative movements between the hatch cover and the coaming, calling for special design solutions for maintaining the weathertight integrity of the vessel in all conditions, and keeping the maintenance costs under control. The high deck loads on modern vessels further accentuate the situation. The implications of the design for relative movements can be seen in the sealing arrangements, steel structure, and bearing pads/stoppers, as well as in operating-related components such as cleats, wheels, intermediate hinges and end hinges. With a suitable stopper arrangement, the longitudinal and athwartships relative movements can be controlled and divided so that the weathertightness can be maintained in all circumstances. This implies that the magnitude of the displacement does not exceed the allowed variation of compression at the water seal at any location.

To ensure the most favourable hatch covers for a projected vessel, the shipyard must be able to provide information relating to calculated flexible deformations of the hull under different conditions as a basis for MacGregor cargo access system basic design work.

Hull deformation at sea



Two-panel folding hatch cover



Multi-folding hatch cover

Special adjustable and replaceable stoppers can be provided in order to help installation and make wear and tear repairs easier.

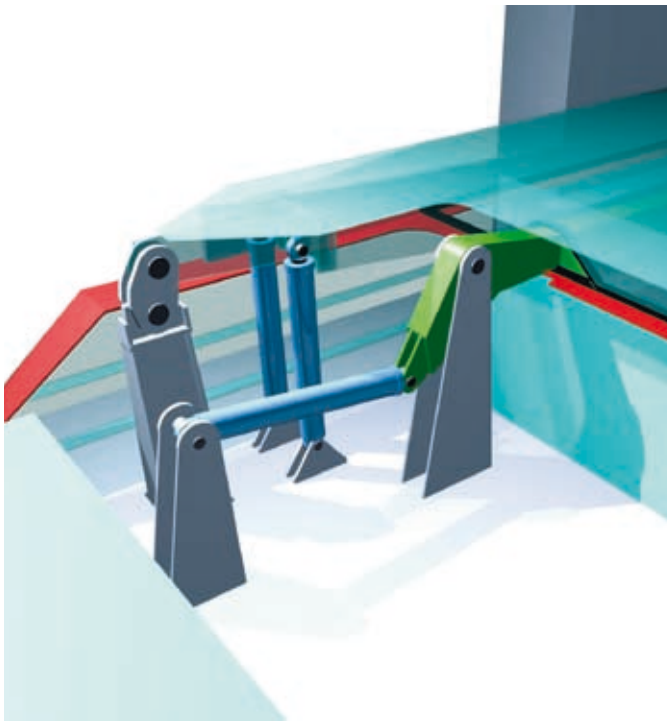
Operating arrangements

The name 'hydraulic folding cover' refers, in MacGregor product range, to a cover consisting of two panels which are connected by hinges to form a folding pair. In many cases the cover consists of two folding pairs. One pair is stowed at the aft end of the hatch and the other forward. The folding pair is operated by hydraulic cylinders acting directly on the end hinge arms which are connected at stools on the deck. When the cylinders push the end panel up from the closed position, the cover is folded and the second panel, fitted with wheels, rolls on the rails to the stowage position. The panels are usually secured in the open position by semi-automatic hooks interacting with the wheel arms.

If the size of the targeted cargo calls for longer hatches, a selection of 'multi-folding' MacGregor designs suited to the various cargo-working needs is available. The number of folding panels forming a functioning unit can be 2, 3, 4 or 6. By combining two units (stowing forward and aft) the total number of folding panels can be up to 12. The panels are connected by hinges to form pairs of panels. The pair connected to the end hinges is called the leading pair. The additional pairs of panels are called trailing pairs. They are connected by intermediate hinges to the leading pair to form one unit.

There are several methods of operating the hydraulic multi-folding cover. The leading pair is most often operated as the folding cover, i.e. by hydraulic cylinders acting directly on the end hinge arms. The trailing pairs are often operated by hydraulic bell crank arms. They are long and strong arms connected pivotally outside the longitudinal coamings. The bell crank arms interact with respective wheels on the first panel of the trailing pair, when being pushed up by hydraulic cylinders. In the six-panel units there are two sets of bell crank arms. In the case of an extremely wide hatch, the first bell crank arms can also be built into the hatchway under the leading pair in narrow ships.

As an alternative to the above external hydraulic operating arrangement on the multi-folding covers, the cylinders can, in addition, be built into the hatch cover panels. This type of operating system is called a 'link'. The main advantages with link operation are that the stowage space is shorter than when using external hydraulics, the coaming can be built lower, and the function of the cover is tested in the workshop, thus reducing the installation time and cost on board.



Bell crank located at transversal coaming

Flush foundation

Raised socket dovetail

Dovetail foundation in channel

Raised socket 110

Raised socket in channel

It is, of course, possible to combine the two systems, i.e. external cylinders on the leading pair and internal cylinders on the trailing pairs. Another opportunity to increase the length of the hatch is to insert rolling panels between the folding pairs. They can be towed by the folding cover, thus opening the desired section of the hatch for cargo working. They can also be designed for lifting ashore by container cranes.

Steel structure

The steel structure of a hatch cover is a compromise between optimal stiffness and weight. Keeping the structure simple, i.e. the number of components low, helps in keeping production costs in check, as well as facilitating the production of high quality surface treatment of the cover.

Keeping the deadweight of the vessel under control and maintaining the stability calls for the use of high tensile steels in the main members of hatch covers. The size of the containers dictates the arrangement of the main girders carrying the loads and conveying the forces from the hatch cover to the coaming and hull structures. The bearing pads transmitting the forces from the hatch cover to the hull, in the predetermined locations, must be designed to allow flexible deformation of the hull to take place, while simultaneously maintaining the correct shape and position of the hatch cover for weathertightness at sea. Depending on the magnitude of the relative movements, there is a range of different bearing pad designs available, i.e. ordinary steel/steel pad, replaceable steel pad or Flexipad (see separate datasheets).

For stable and smooth operation of the cover, the panels should be stiff, but to maintain weathertightness at sea, the steel structure of a hatch cover must adapt to the varying shape of the coaming top while the hull is working.

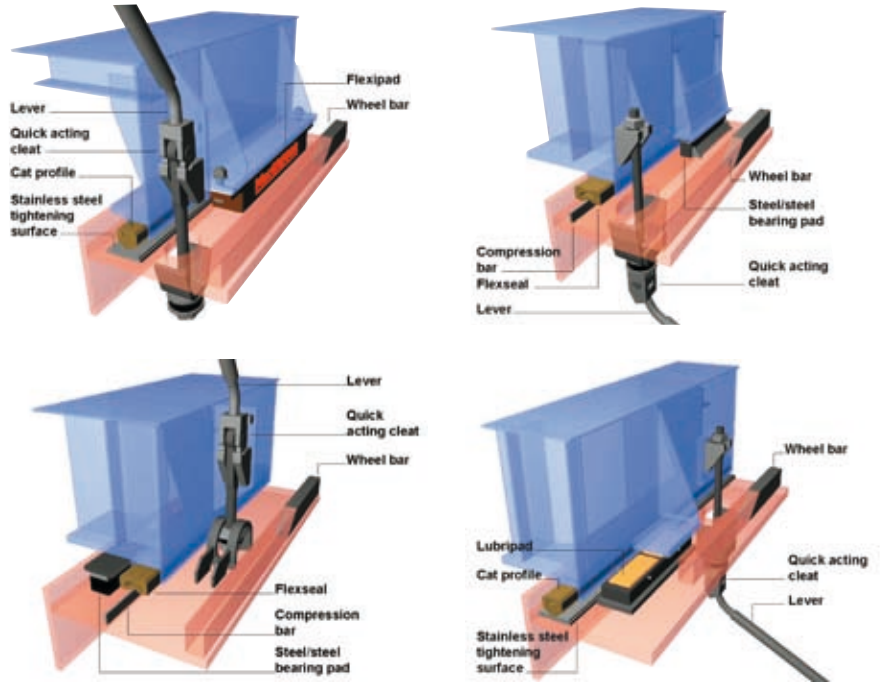
The optimal stiffness of the steel structure of a hatch cover panel is a compromise between the above issues. The correct stiffness is achieved by selecting the optimal proportion between the open web and box construction, the double skin construction being the stiffest design.

Fixed container fittings

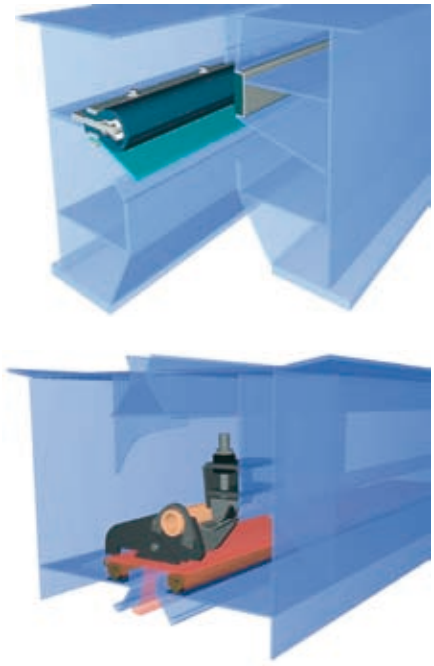
The fixed container fittings can be located on hatch covers, recess or flush.

Weathertight sealing arrangement

The traditional sealing arrangement is made up of a water seal, which is pressed against the edge of a compression bar. For the arrangement to function correctly, there must be a suitable sealing force and the



Battening, sealing and bearing pad solutions



Cross joint sealing with Omega Sealing and a Swing-seal

compression bar must be in the correct position in relation to the seal. The above implies that the compression of the seal shall be within the specified limits and the seal must be intact. The position of the compression bar changes while the coaming sides are flexing, which also causes dynamic wear and tear on the seal. Hogging/sagging of the hull and warping of the coaming plane at sea causes an additional challenge for the sealing arrangement, i.e. the variation of the deflection at the cross-joints.

We have dealt with the issues relating to flexible deformations in the hull and the relative movements between the hull and hatch cover by introducing the sliding seal concept. The sealing arrangement is made up of a ridged seal section, the so-called 'Cat-profile', which is pressed against a flat surface. The seal is made of solid rubber material with a cross section of various cavities for producing the desired sealing force over a wide range of deflections. The rubber composition is designed to meet a number of criteria applied simultaneously, e.g. low friction for sliding, good wearing resistance, resistance to UV radiation, as well as a wide temperature range. There are two sizes of the MacGregor sliding Cat-seal which can be used depending on the magnitude of the expected variation of the compression in service. Reference is made to the datasheet H20.

Partial/non-sequential opening

On container feeder vessels shipowners often want to open part of the hatch while the remaining part of the cover is loaded. Partial opening can be achieved by retractable hinge pins and a suitable operating sequence following the 40ft container arrangement in hold. Non-sequential opening for the panel joints may be asked for where lift-away operation is requested (either rolling panels or one trailing pair). This calls for the elimination of contact between the water seal and the counter surface prior to operating the cover, which can be achieved by adopting the MacGregor Omega Sealing arrangement.

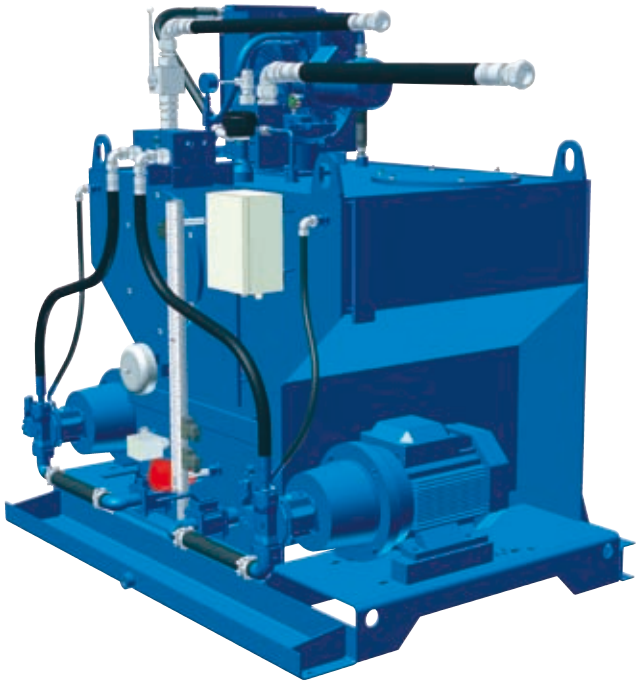
Another alternative for non-sequential opening is the MacGregor Swing-seal arrangement. Reference is made to the datasheet H1. If the multi-folding cover is operated by internal hydraulics ('link'), the trailing pairs can be designed to allow partial opening at the meeting joint.

Wheels, hinges and bearings

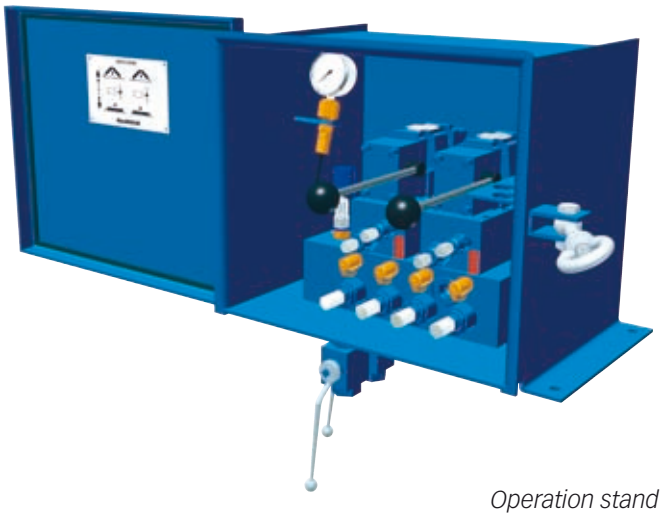
All wheels are fitted with roller bearings for reduced friction and easy maintenance. Bronze is the material for all other bearings (plain or spherical). The bearings are fitted with grease nipples and a remote lubrication facility, where necessary.

Hydraulics

Aggressive weather conditions on deck call for specially designed hydraulic components used in the hatch cover



The MacGregor standard pump unit



Operation stand

operating systems. Also, operational requirements, e.g. smooth accelerating/braking of the cover, dictate that the use of conventional components does not result in the best hydraulic system.

The effects of weather on hydraulic components appear to be mainly corrosion on the cylinder piston rods and seizing of bearings. We have dealt with these piston rod problems by using stainless material on the whole rods, or in way of the top seal and wiper ring on big cylinders. For additional protection of the piston rod surface, the space between the top seal and wiper ring is fitted with grease nipples. The top of the cylinder is bolted to facilitate dismantling for maintenance purposes.

The bearings on both ends of the MacGregor cylinder are spherical and made of bronze. This dramatically extends the service life of the bearings/pins compared with any other design.

Good control of the operating speed is essential for safe operation of high stowing folding hatch covers. This applies particularly in the open position, where, due to geometry, the speed increases. We have dealt with this problem by developing special control valves for hatch covers.

The manually operated valves are modular, with cartridge type pressure and flow control valves. This results in swift spare parts deliveries from stock and low maintenance cost. The block design of the control valve cuts down possible leakage and corrosion damage. The superior flow control feature is based on valve spools, which have been designed so that the stroke is long and the control lever makes a large angle at the opening/closing stage. This makes it easy to control the speed at the critical stage. The valve is fitted with connections for the pressure gauges to allow the setting of the system.

The MacGregor pump units come with twin pumps installed below the oil tank for redundancy and easy maintenance. The pump units are fitted with return filters. An air cooler and a cooling/filtering pump option is also available as a retrofit. The pump units are designed to keep noise levels down, e.g. the motor/pump unit is installed on vibration dampers and connected by flexible hoses to the pipelines.

There is a range of standard sizes to suit different capacity needs. Optionally a portable pump unit is available for situations when the standard pump unit cannot be used.

Electrical equipment

The motor winding is used for the standstill heating of the motors, which drive the pumps, i.e. the motors are of standard type. The MacGregor starter units are supplied as complete units. The starter units of protection class of IP 54 are fitted with running time limiter, running indication, high/low level alarm, low level stop, high temperature stop and electric filter clogging indication.

Lloyd's Register Quality Assurance certifies that the Quality Management System for Cargotec Corporation's business area MacGregor is ISO 9001 compliant.

Cargotec improves the efficiency of cargo flows on land and at sea – wherever cargo is on the move. Cargotec's daughter brands, Hiab, Kalmar and MacGregor are recognised leaders in cargo and load handling solutions around the world.

MacGregor is the global market-leading brand in marine cargo handling and offshore load-handling solutions. Customer-driven MacGregor engineering and service solutions for the maritime transportation industry, and the offshore load-handling and naval logistics markets are used onboard merchant ships, offshore support vessels, and in ports and terminals.

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