

## ***Background***

For the last 20 years polyurethane has been the leading topcoat technology used in corrosion protection systems for both marine and industrial structures. Performance, protection, appearance and total cost effectiveness are some of the factors customers have taken into consideration when selecting a product. Customers have a long list of demands, and polyurethane has become the preferred choice of technology in a wide range of coating situations.

The reason for the growing popularity is the versatility of these products for the end user as well as for the industry. To obtain special functionalities, polyurethane can be used in many different formulations in combination with a wide range of raw materials.

## ***Polyurethane technology and flexibility***

Polyurethane coatings are known for being flexible. Flexibility will, however, vary from product to product. Many types of polyurethane will resist low to medium stress like vibrations, temperature changes and steel deformation. Challenges related to high impact are well known, and the industry still experience many claims related to brittle paint film and hence cracking and flaking. A highly flexible coating has now been developed and will solve these problems for many customers.

## ***Practical experience with flexible polyurethane***

Hardtop Flexi polyurethane topcoat was formulated to give extreme flexibility in combination with good adhesion, UV resistance and good weathering properties. It was originally launched in 1997 on the Scandinavian market under the brand name Normadur 65 HS and has proved to work in real life.

## ***Flexibility***

Coating flexibility is measured in two main tests: ASTM D522 Elongation Conical Mandrel and ISO 1520 Cupping test.

In the Conical Mandrel test Hardtop Flexi has only up to 2 mm cracking. Hard topcoats use to have cracking up to 170 mm.

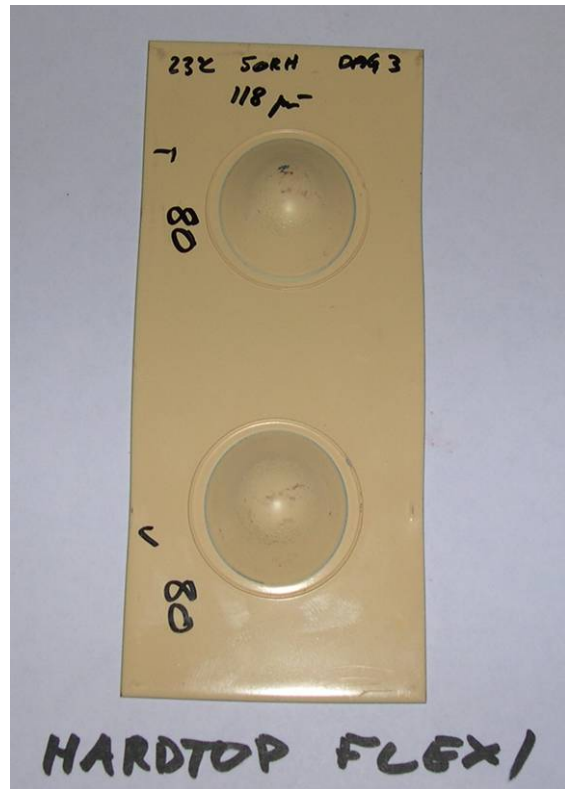
*Hardtop Flexi applied at 80 microns on aluminium plates, 21 days curing at 23°C.*



The Cupping test is used to measure the paint film's ability to resist heavy impact, which is crucial for areas like container decks, marine topsides, mining equipment etc. In this test a hydraulically steel bullet is pressed towards the back of the plate with high pressure until cracks are visible (values from 0 to 100, where 100 are most resistant). Typical value for a traditional polyurethane coating is 50-60, whilst Hardtop Flexi has a typical value of 80.



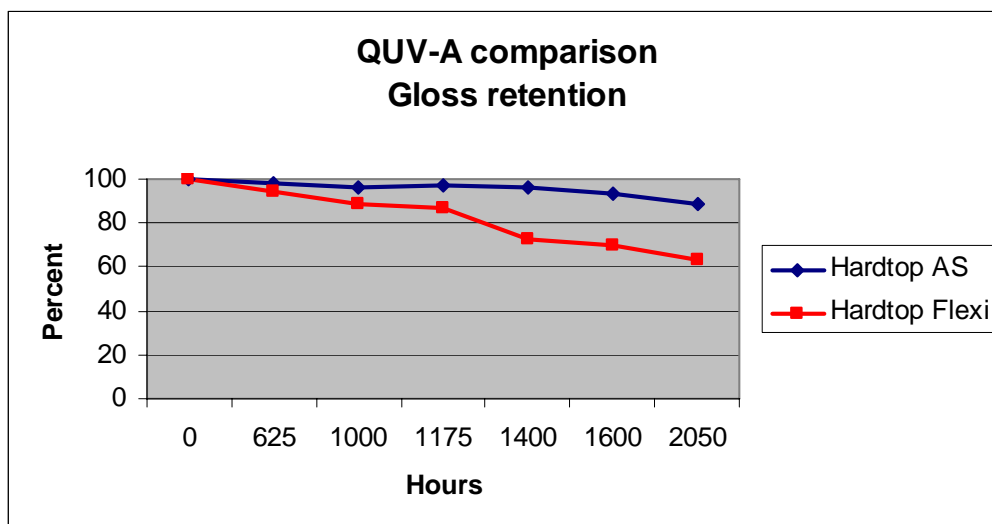
*Typical value for Hardtop Flexi in ISO 1520 Cupping test*



The excellent test results obtained for Hardtop Flexi are due to the combination of a flexible paint film and very good adhesion. Values will vary based on DFT (dry film thickness), temperature, humidity, curing and ageing. Experience show that many products loose flexibility dramatically over time (up to 24 months), and Hardtop Flexi is specially designed to maintain flexibility during the whole service life.

***Colour- and gloss stability***

Colour- and gloss retention for Hardtop Flexi is comparable with traditional polyurethanes. The initial gloss level is approx. 64 (100 = highest gloss), which is a benefit at later touch-up as this will be less "patchy" when applying a lower gloss level.



*Gloss retention Hardtop Flexi*

## Impact resistant polyurethane topcoat



### *Lower gloss level – and excellent imperfection hider*

The gloss level of approx. 60 will work as an imperfection hider on larger surfaces. This is an obvious advantage on for example cruise ships topsides.



*Typical example of the advantage of a lower gloss level.*

### *Impact resistant*

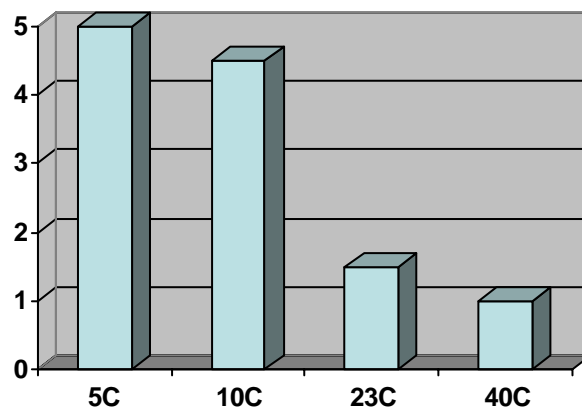
Hardtop Flexi has proven to have excellent impact resistant properties. This is due to two main performance parameters: excellent adhesion and excellent paint film flexibility/elastomarecy.

Adhesion has proven to be very good to all primers in a newbuilding situation.

Hardtop Flexi can also be applied direct to metal prepared to Sa 2½ for structures exposed to medium corrosivity (C3).

The binder composition provides excellent adhesion to existing coating systems, but we recommend using an anticorrosive primer for on-board maintenance as primers like Jotamastic Smart Pack includes anticorrosive pigments. Hardtop Flexi may be a very good alternative for direct to metal application for minor touch-up and maintenance of smaller areas. Using Hardtop Flexi as a single maintenance product will reduce stock and make training of staff easier.

The drying time for Hardtop Flexi is short even in cold weather, securing maximum convenience for cruise passengers.



*Drying times, Hardtop Flexi*

## **Practical example 1**

Container decks are normally exposed to extreme impact.



*Jotun was allowed to supply a test patch (stripe), seen two years after the application.*



*The deck was high pressure washed to prepare for new application.*



*After two years Hardtop Flexi was the only coating left on the deck.*

## **Practical example 2**

A container deck was painted with 50 microns Barrier + 150 microns Hardtop Flexi. One container dropped accidentally down on the deck from a crane and created damage to the steel structure.

The coating was still intact after the accident, which can be seen from the picture below where a pen is placed over the impact area to visualise the damage.



*Container deck exposed to extreme impact (see pen)*

## ***System flexibility***

The benefit of impact resistance will remain whatever primer is used. For high impact exposure in very high corrosive environment we recommend the following 200 microns system:

Minimum 1 x 50 microns Barrier

Minimum 1 x 150 microns Hardtop Flexi

This two-coat system has proven to work in practical life.

## ***Others***

Hardtop Flexi forms somewhat softer paint film and will never be as hard as conventional polyurethanes or epoxy based polysiloxanes. The product is therefore not suitable as floor coating or on other areas where an abrasion resistant coating is required.

## ***Conclusion***

Hardtop Flexi is a flexible and impact resistant polyurethane coating with excellent adhesion properties.

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