

# Acrylic Plastic Viewports



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### **IMCA D 047**

This document – an update of the earlier AODC 030 – *Acrylic plastic viewports* – has been produced for IMCA under the direction of its Diving Division Management Committee.

The update provides additional guidance on the deterioration of viewports and identifies a reference providing more detailed technical guidance.

AODC 030 is now withdrawn, superseded by this document.

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# Acrylic Plastic Viewports

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## **I Introduction**

Acrylic plastic viewports had been in satisfactory use for a number of years. However, the development of testing them by polarised light showed that there are various misconceptions about them. The guidance note on acrylic plastic viewports was initially prepared as AODC 030 in 1986, following advice from Det Norske Veritas (DNV), which sought to correct these misconceptions.

This revised document has been produced by IMCA through the Safety, Medical, Technical & Training (SMTT) Committee of the Diving Division Management Committee as part of the phased review of AODC guidance notes and subsequent re-issue as IMCA guidance. It provides additional guidance on deterioration of viewports as well as identifying a reference document which provides technical criteria and guidelines on the inspection, care, testing and recertification of acrylic viewports.

Acrylic viewports are used in many pressurised systems under a variety of conditions world-wide and this document has been produced to provide general guidance. For a more detailed guidance reference should be made to ASME *Safety Standard for Pressure Vessels for Human Occupancy: In-Service PVHO Acrylic Windows Guidelines*, PVHO-2: 2003, which provides technical criteria and guidelines for the in-service inspection, care, repair or replacement, testing, and recertification of pressure vessels for human occupancy (PVHO) acrylic windows.

## **2 Certification**

The date of examination, serial number and the certifying surveyor's identification should always be marked indelibly on the viewport. This can be achieved by the use of indelible ink, but it should not be by the use of metal stamps or engraving, as this may cause cracking.

The marking preferably should be visible on the viewport so that it can be viewed under normal operations without the need to remove the viewport to verify the details.

Viewports should be subjected to proof stress testing and relevant certification provided before installation.

All viewports in a pressure system need to be rated to the design pressure of the system.

Viewports which are not marked or properly documented should not be used.

## **3 Deterioration**

After a certain period, acrylic plastic will start to decompose. As it decomposes, it gradually turns yellow (this can be demonstrated by holding a white sheet of paper behind it). Slight yellowness is, however, acceptable.

Acrylic plastic exposed to direct sunlight decomposes more quickly and should be examined at least annually for signs of deterioration. Additionally, acrylic viewports exposed to direct external lighting or heating such as from a TV projector system may also be affected. However, experience has shown that 10 years is normally a safe working life for an acrylic plastic viewport, after which a viewport should be replaced, even if it appears not to have deteriorated. PVHO-2: 2003 provides additional guidance when determining the length of service.

It is very important that regular visual inspections are carried out to determine if there has been any mechanical damage as evidenced by chips, deep scratches or crazing. The frequency of these inspections will be dependent upon any environmental factors due to the chamber location. The chamber planned maintenance system (PMS) should be used to record the frequency of inspections and the inspection results. If any significant damage is seen, then expert advice should be sought from a manufacturer, for example, to establish whether a replacement is needed.

Deterioration can also occur through the incorrect use of cleaning materials, therefore care should be taken to ensure the correct cleaning material is used. Diving systems could be located in areas which may be indirectly exposed to other cleaning materials; consideration of this should be taken into account in determining the inspection frequency and cleaning regime of the exposed viewports.

## **4 Yielding**

All acrylic plastics yield continuously even when not under pressure. The effect of pressure is to increase the rate of yield.

Any acrylic plastic viewport which has been subjected to pressure will have a slight permanent deformation and will, therefore, contain a certain level of inbuilt stress.

## **5 Polarised Light Testing**

Polarised light will show up areas of different stress as different colours. However, since the viewport will show areas of stress when examined by polarised light, this does not necessarily indicate a fault.

It takes a skilled and experienced specialist to interpret stress levels shown by polarised light.

The removal of inbuilt stress in a viewport is a complex process involving removal of the viewport and specialised heat treatment, which should only be undertaken by a company specialising in such work. Viewports will almost certainly need recertification after such treatment.

## **6 Conclusions**

Acrylic plastic viewports should be properly certified and marked prior to use.

It is generally agreed that acrylic viewports should be replaced after 10 years of service. PVHO-2: 2003 provides additional guidance when determining the length of service.

Examination of an acrylic plastic viewport by polarised light after the viewport has been in service is of very limited use, as all such viewports will show evidence of inbuilt stress.

The use of polarised light to check that acrylic plastic viewports are correctly mounted and evenly pre-stressed is not a simple matter and should not be used as a principal test.

When mounting an acrylic plastic viewport, it is critical, especially when installing new ports in old pressure vessels, to check that the housing is the correct dimension and that the viewport and any sealing gaskets or O-rings are properly seated and of the correct size. A torque wrench should be used to correctly tension fixings diametrically to the manufacturer's specification when replacing retainers.