

NON-DESTRUCTIVE TESTING OF WELDS USING PENETRANTS

On 1 January 2006 Vecom became the exclusive distributor in the Benelux of Chemetall N.V. for the ARDROX® and OVERCHEK® industrial NDT programme. In this first edition of our Technical Bulletin you can read more about the hows and whys of non-destructive testing.

Crack investigation using penetrants is a fully proven technique that has been in use for many years for monitoring surface flaws in metals and non-porous materials. These penetrants were originally developed for use by the armed forces and for aircraft inspection. Meanwhile this technique has also been widely used in other industries for tracing cracks and flaws in countless types of metals and non-porous materials.

THE PROCESS

Non-destructive testing using penetrants involves the following steps: The penetrant is applied to the surface and penetrates surface cracks by means of capillary action. Then the excess penetrant on the surface is removed and the surface is dried. Next an absorbent powder developer is applied to the surface. This makes the dye visible in any cracks present. A visual inspection follows in order to determine the type and seriousness of the defect.

PERMEATION TEST

Penetrants can also be used for permeation testing as an alternative to hydrostatic testing of pressure vessels or to check if joints are fully watertight. In this case the penetrant is applied to the inside of the weld and the powder developer to the outside. Where defects run completely through the metal the penetrant will find its way through and appear on the other side.

Powder developers are applied electrostatically



Visual inspection determines the type and seriousness of the defect

There the dye colours the white developing power.

COLOURS

Red penetrant is the most frequently used type for locating surface cracking, but the human eye cannot always pick up the contrast between red and white effectively. Therefore yellow/green fluorescent penetrants are used for critical components. Using ultraviolet light makes defects much more visible to the naked eye. In addition they allow for various levels of sensitivity.

PENETRANTS USED FOR INSPECTING WELDS

Penetrants are a well-proven means of checking welded joints. It is a simple and cost-effective method that requires little or no specialist equipment. This method can be used on all metals and is particularly suitable for difficult / geometrically complex welded joints. It does not give

a true picture of the defect, however, rather an indication that then must be interpreted.

SUITABLE PENETRANT TYPES

It is important to choose the correct type of penetrant when carrying out an inspection. Test plates with various crack sizes and degrees of surface roughness are used to determine the sensitivity of the system. The type and dimensions of the material to be inspected, the desired accuracy and the available infrastructure are other factors that play a role. Penetrant in aerosol cans is ideally suited for on-site checks on components, but for larger series a modified NDT location is the most efficient. Fluorescent penetrants are more sensitive than red, making it easier to trace small defects. On the other hand they do require larger investments, since a separate inspection room with a UV lamp is required and the calibration costs are higher. This is because the

lamp used and the light meter must be calibrated. A penetrant that is too sensitive can indicate apparent 'defects' that are not really significant. This might result in a perfectly good component being rejected. Also the penetrant used must not react with the component being inspected and may only contain very small quantities of sulphur, chlorine and other sources of contamination.

THE PROCESS STEPS

In spite of the fact that penetrant inspection techniques are well known and have long been used for checking welds, the various process steps are not always correctly applied. Cleaning the surface to be inspected does not always receive the attention that it deserves due to time pressure during welding operations and insufficient knowledge of the complex interaction between the penetrant and the surface. If the surface is not clean, certain types of contamination such as grease, dust, soot and residuals from welding consumables can mask the defects or interfere with the effective action of the product. Therefore any cracks present may be difficult to see, or even invisible during the inspection. After thorough cleaning, the penetrant must be allowed sufficient time to fully penetrate into the cracks. Penetrant excess on the surface must not be removed too quickly before the developer is applied. Large defects become visible after a few seconds, but small cracks do not become visible until after a few minutes or longer. Fluorescent penetrants are faster than the red ones.

APPLICATION OF PENETRANT

As mentioned earlier, red penetrant in aerosol cans is generally used for checking weld seams. Applying penetrants using aerosol cans is convenient, but not very economical. There is also the risk that the penetrant will come into contact with a wider surface than the intended checking zone. Also the release of propellants and solvents (volatile organic compounds, VOC) is hazardous to workers and the environment. There are various alternatives on the market: Applying the penetrant (supplied in small-scale packaging) by brush or using a spray system under air pressure or with compressed air, and rinsing with water instead of cleaning with penetrant remover. These methods are often more time-consuming than the standard aerosol can. Therefore there are aerosol cans available that use inert propellants such as CO₂ or compressed air. These reduce the emission of volatile organic compounds (VOC).

INTERPRETATION OF THE RESULTS

The quality of a penetrant system also depends on the person who must interpret and assess the results. The interpretation of the type and the size of a defect is an important part of the inspection and the user must have sufficient expertise. Professional training is available from various NDT inspection organisations. The aim of these is to train personnel to become qualified inspectors.

NEW DEVELOPMENTS

Penetrant investigation is one of the most frequently used test methods and makes use of manual procedures during which the user comes into direct contact with the products being used. Long-term contact requires safe products. We are very conscious of this and are continually seeking a balance between reliable performance, safety in use and minimisation of any negative effects on the environment. Inspection using penetrants remains a good and reliable process for detecting surface defects. Each step in the process is important and requires adequate attention.

Source: Chemetall

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