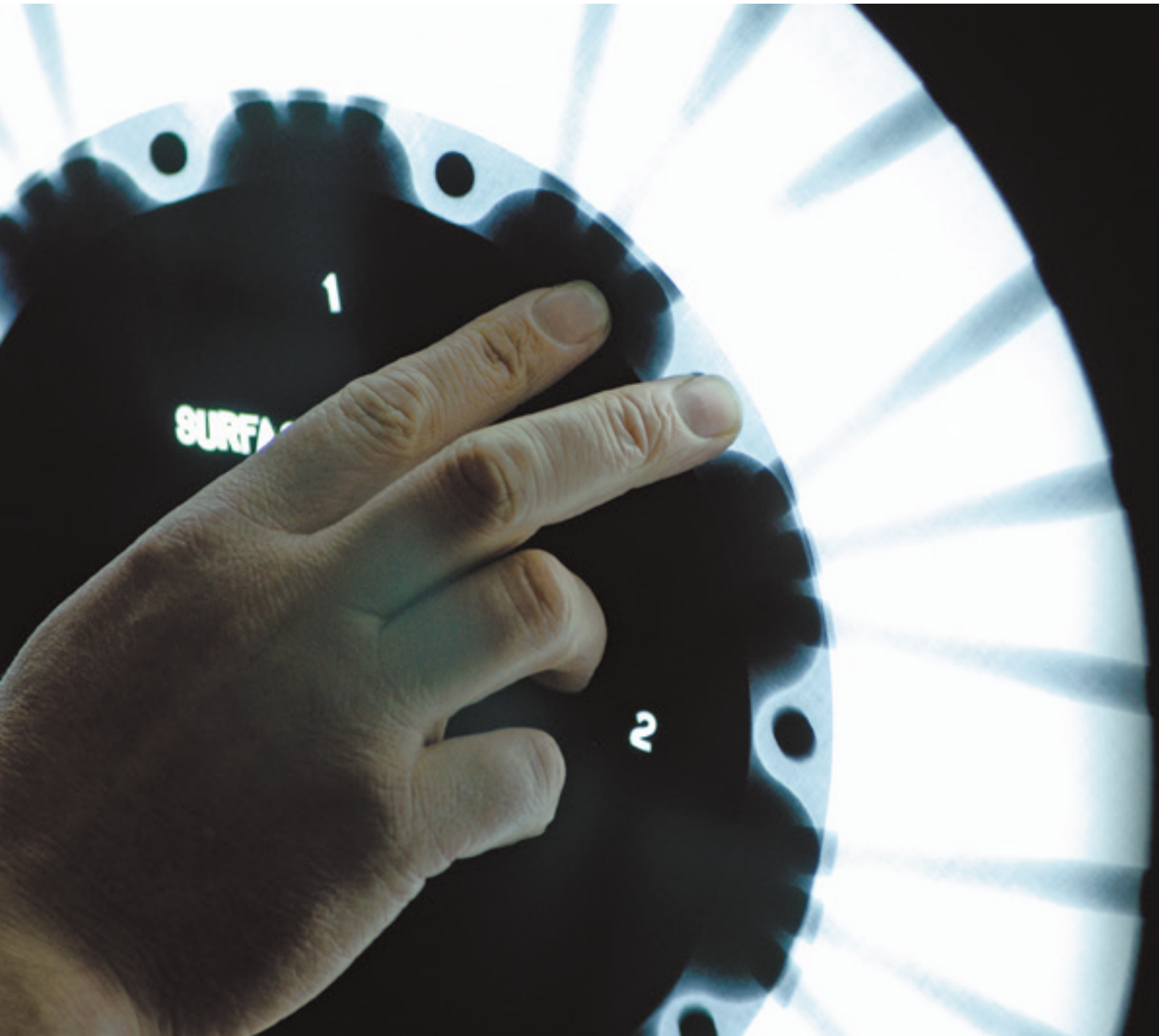
BRITISH
ENGINEERING
SERVICES

YOUR NON-DESTRUCTIVE TESTING METHODS GUIDE

Choosing the right method for your needs



CONTENTS

INTRODUCTION

With the wide variety and advancement of non-destructive testing (NDT) techniques, it can sometimes be difficult to ascertain which method should be used.

In the majority of instances, this issue is determined by the relevant regulations and applicable standards or codes. In others, there will be some flexibility as to which method can be used or engineers will need to determine the most suitable method based on what information they require.

We have, therefore, created an easy to read guide, outlining the following for each NDT method:

- **What they detect**
- **Common testing usages**
- **Advantages**
- **Disadvantages and issues to be aware of**
- **Common alternatives (where applicable)**
- **Advanced methods for each technique**

ULTRASONIC TESTING

The most commonly used NDT method for detecting internal planar defects on site

Detects internal defects and verifies material thickness

Includes:

- Planar defects
- Cracks, voids, inclusions and lack of fusion
- Corrosion or thinning (known as 'thickness gauging')

Common testing usages:

- Forgings/castings
- Welds in high pressure environments
- Structural steelwork welds
- Pressure vessels (although sometimes specifications require radiography)
- Storage tanks

Advantages:

- Able to penetrate various thicknesses without any damage to the product
- Battery operated, which means that it's portable and can be used on site
- Defects are accurately located
- More affordable than on-site radiography

Disadvantages:

- Needs a clean surface, clean of scale
- No permanent record apart from report

Common alternatives: **Radiography**

Advanced alternatives: **Phased Array**

X-RAY AND GAMMA RADIOGRAPHY

The most commonly used NDT method for detecting volumetric internal defects in welds and castings in radiography bays

Detects internal defects

Includes:

- Volumetric defects e.g. slag and porosity
- Voids, solid inclusions and gas pores
- Globular defects (more effective than ultrasonic testing)

Common testing usages:

- Pipework welds
- Castings
- Storage tanks
- Pressure vessels
- Small metal components

Advantages

- Permanent record in form of a radiograph image
- Ability to detect small defects
- Panoramic examination capability makes it an efficient testing method for large circumference items such as butt welds

Disadvantages/issues to be aware of

- Radiation dangers: area must be cordoned off and the HSE notified prior to attendance
- Initial outlay is expensive
- On-site radiography is expensive compared with ultrasonic testing
- Not very portable as it requires a power source and a lot of auxiliary equipment

Common alternatives: **Ultrasonic Testing**

Advanced alternatives: **Phased Array**

PHASED ARRAY

(AN ADVANCED ULTRASONIC TEST)

An alternative to ultrasonic testing and radiography, commonly used for multiple items

Detects internal defects and verifies material thickness

Includes:

- **Planar defects**
- **Cracks, voids, inclusions and lack of fusion**
- **Corrosion or thinning (known as 'thickness gauging')**

It cannot find any defects that would not be detected with conventional ultrasonic testing.

Common testing usages:

- **Forgings/castings**
- **Welds in high pressure environments**
- **Structural steelwork welds**
- **Pressure vessels (although sometimes specifications require radiography)**
- **Storage tanks**
- **Small metal components**

Advantages over ultrasonic testing:

- **Reduced scanning times, so quicker once set up**
- **Provides a permanent record**

Disadvantages over ultrasonic testing:

- **Increased set up time, so it's best reserved for multiple items**
- **Expensive**

Common alternatives: **Ultrasonic Testing** or, where permanent records are required, **Radiography**

MAGNETIC PARTICLE EXAMINATION

Most commonly used surface/subsurface examination

Detects surface/near-surface defects in ferromagnetic materials

Includes:

- Surface cracks
- Toe cracks
- Crater cracks
- Surface porosity

Common application:

- Castings
- Welds
- Shafts

Excludes: anything that is not ferromagnetic.

Advantages

- Very sensitive
- Instant results
- Transportable, so it can be used on-site and in-house
- Simple application

Disadvantages/issues to be aware of

- Flammable liquid dangers
- Requires ventilation and preferably a large space
- Need to remove paint prior to testing

Common alternatives: **Dye Penetrant** (also known as Liquid Penetrant Examination)

DYE PENETRANT

(ALSO KNOWN AS LIQUID PENETRANT EXAMINATION)

Detects surface defects in non-magnetic material

Includes:

- **Surface cracks**
- **Toe cracks**
- **Crater cracks**
- **Surface porosity**

Common application:

- **Castings**
- **Welds**
- **Shafts**

Excludes: anything that is ferromagnetic.

Advantages

- **Very sensitive**
- **Instant results**
- **Transportable, so it can be used on-site and in-house**

Disadvantages/issues to be aware of

- **Flammable liquid dangers**
- **Requires ventilation and preferably a large space**
- **Need to remove paint prior to testing**

Common alternatives: **Magnetic Particle Examination**

EDDY CURRENT TESTING

Can be used on painted surfaces

Detects surface and sub-surface defects on ferromagnetic materials

Includes:

- **Very shallow and tight surface fatigue cracks**
- **Stress corrosion cracks in pipes and tubes**
- **Pitting**

Common testing usages

- **Pipes and tubes**
- **Aircraft fuselage and wings**
- **Heat exchangers**
- **Welds**

Advantages

- **Can be used on painted surfaces**
- **Advanced sets can provide a permanent record of inspection data**
- **High inspection speeds possible**
- **Clean process, with no residue left**

Disadvantages

- **Can only be used on ferromagnetic material**

Common alternatives: **Magnetic Particle Examination**

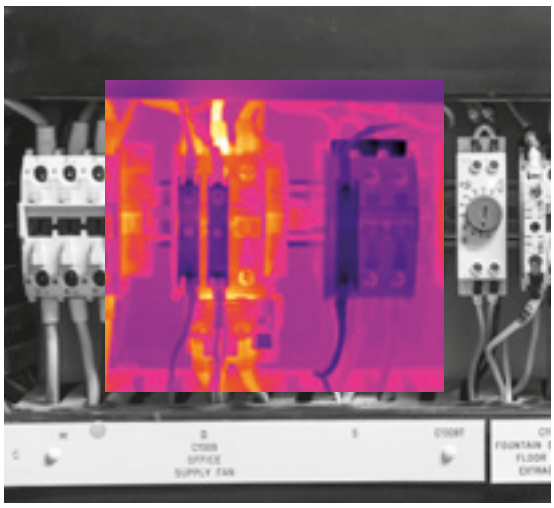
THERMOGRAPHY

Only NDT method to detect temperature variances at a distance with no contact

Detects temperature variances

Includes:

- Build-up of scale
- Breakdown in insulation
- Overloading of electrical circuit boards



Common application:

- Electrical systems
- Insulated steam pipes
- Cold stores
- Pumps

Advantages

- Can be used in inaccessible areas
- Can be used in areas too hazardous for other NDT methods
- Large areas can be inspected
- Does not affect the production process
- Detects problems in real time
- Initial part of the process can be undertaken by someone relatively inexperienced

Disadvantages/issues to be aware of

- Results must still be interpreted by an experienced operator
- The initial part of the process can be (unknowingly) undertaken incorrectly

POSITIVE MATERIAL IDENTIFICATION

Only testing method to confirm composition of material without a material sample

Detects the grade and chemical composition of metal and alloys

Includes:

- **Nickle and chrome content**
- **Carbon content (more specialised machines)**

Common testing usages:

- **Material verification after purchase**
- **Verification of suspected rogue material**
- **Post-purchase material certification**
- **Pre-purchase verification at steel stockists**

Advantages

- **Portable**
- **Instant results**
- **Can be used in confined spaces**

Disadvantages/issues to be aware of

- **It cannot detect the absolute composition of materials**

Common alternatives: **The Wet Method** (not a non-destructive method as it requires a sample)

CONCLUSION

We hope this guide has provided a helpful introduction on how to evaluate which NDT method is best for your needs. However, these are just some of the methods available and factors to consider.

In order to determine the most suitable method, consideration will need to be given to the relevant standard(s), the design & build, material composition and what information is required. It should also be noted that NDT methods can be complementary and should often be used in conjunction with each other to obtain maximum results.

All NDT methods should be carried out by an experienced operator with PCN certification. You can check an operator's credentials on the **British Institute of Non-Destructive Testing's PCN Verification Form** search.

To ensure that you are selecting the appropriate technique, why not speak to one of our skilled team of NDT experts? They are available to answer any queries you may have.

Our NDT team consists of highly qualified and experienced PCN Engineers and British Engineering Services is both UKAS accredited and a member of the British Institute of Non-Destructive Testing.

You can rely on us to devise and implement a NDT testing regime that will save you money and minimise disruption, utilising the latest cost-effective and time-saving techniques.

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British Engineering Services, 5 New York Street, Manchester M1 4JB
T 0345 678 2985 E info@briteng.co.uk W britishengineeringservices.co.uk