

Choosing a Nondestructive Test Method for Steel

The first question about a bar of tool steel is whether there is a crack inside it, and the answer starts from the flaw rather than from the instrument. The tables below set out which method finds which flaw, what each one needs from the material, and how thick and how complex a part each method can handle.

Reference only. This is a reference summary of published practice and it is not a specification of ours. The values are reproduced from the source tables, and tool material, machine rigidity, cutting fluid and workpiece condition will all move them. Final conditions are set on the job.

Start from the flaw, not from the instrument

Volumetric flaws and the methods that find them

Volumetric flaws	NDE detection methods
Porosity	Visual inspection (surface)
Inclusions	Replication microscopy (surface)
Slag	Liquid penetrant (surface)
Tungsten	Magnetic particle (surface and subsurface)
Other	Eddy current
Shrinkage	Microwave
Holes and voids	Ultrasonic
Corrosion thinning	Radiography
Corrosion pitting	X-ray computed tomography
	Neutron radiography
	Thermography
	Optical holography
	Speckle metrology
	Digital image enhancement (surface)

Volumetric flaw classification and the detection methods applied to it, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17. Entry methods marked surface react only to a flaw that reaches the surface, and the rest are stated against the depth they can reach where the source gives it.

Planar flaws need a different set of methods

Planar flaws	NDE detection methods
Seams	Visual inspection
Lamination	Replication microscopy
Lack of bonding	Magnetic particle
Forging or rolling lap	Magnetic field
Casting cold shut	Eddy current
Heat treatment cracks	Microwave
Grinding cracks	Electric current perturbation
Plating cracks	Magnabsorption
Fatigue cracks	Ultrasonic
Stress-corrosion cracks	Acoustic emission
Welding cracks	Thermography
Lack of fusion	
Incomplete penetration	
Brazing debond	

Planar flaw classification and the detection methods applied to it, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17. Heat treatment cracks, grinding cracks and fatigue cracks in this list are the ones a tool steel user meets most often.

Surface flaws and interior flaws

Choosing a Nondestructive Test Method for Steel

Methods for surface flaws	Methods for interior flaws
Visual inspection	Magnetic particle (limited use)
Replication microscopy	Magnetic field
Liquid penetrant	Electric current perturbation
Magnetic particle	Magabsorption
Magnetic field	Eddy current
Electric current perturbation	Microwave
Magabsorption	Ultrasonic
Eddy current	Acoustic emission
Ultrasonic	Radiography
Acoustic emission	X-ray computed tomography
Thermography	Neutron radiography
Optical holography	Thermography (possible)
Speckle metrology	Optical holography (possible)
Acoustic holography	Acoustic holography (possible)
Digital image enhancement	
Acoustic microscopy	

NDE methods for the detection of surface and interior flaws, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17. Magnetic particle is marked as limited use for interior flaws because its useful depth is small, and the entries marked possible are the borderline ones in the source.

How thick the part is, and how complex

Size of the object	Methods suited to it
Surface only, independent of size	Visual inspection, replication microscopy, digital image enhancement, liquid penetrant
Thin object, to about 1 mm or 0.04 in.	Magnetic particle, magnetic field, magabsorption, eddy current
Thicker, to about 3 mm or 0.12 in.	Microwave, optical holography, speckle metrology, acoustic holography, acoustic microscopy
Heavier, to about 100 mm or 4 in.	X-ray computed tomography
Heavy, to about 250 mm or 10 in.	Neutron radiography and X-ray radiography
Thickest, to about 10 m or 33 ft	Ultrasonic inspection

Comparison of NDE methods by size of the object to be evaluated, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17. A method that suits a thick object can also be used on a thin one, except neutron radiography.

Choosing a Nondestructive Test Method for Steel

NDE techniques by object shape, from simplest shape to most complex

Optical holography
Acoustic holography
Acoustic microscopy (simplest shapes)
Thermography
Microwave
Eddy current
Magnetic particle
Magnetic field
Magnetic absorption
Neutron radiography
X-ray radiography
Ultrasonic
Liquid penetrant
Digital image enhancement
Replication microscopy
Visual inspection
X-ray computed tomography (most complex shapes)

Comparison of NDE techniques by shape of the object to be evaluated, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17.

What the material itself allows

Method	Characteristic critical to the method
Liquid penetrant	The flaw must intercept the surface
Magnetic particle	The material must be magnetic
Eddy current	The material must be electrically conductive or magnetic
Microwave	Microwave transmission through the part
Radiography and X-ray computed tomography	A change in thickness, density or elemental composition
Neutron radiography	A change in thickness, density or elemental composition
Optical holography	The optical properties of the surface

NDE methods and the material characteristic each one depends on, reproduced from the Guide to Nondestructive Evaluation Techniques in ASM Handbook, Volume 17.

Grades and stock

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, DC53, A2, O1, H13, H11, H10, H21, S7, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.
Source, ASM Handbook, Volume 17, Nondestructive Evaluation and Quality Control, ASM International, 1989.

CONTACT

EMAIL
sales@aobosteel.com
WHATSAPP
[+86 180 6294 5370](https://api.whatsapp.com/send?phone=8618062945370)
WEB
aobosteel.com



Scan for the full reference page