ZYGLO® FLUORESCENT PENETRANT OPERATING INSTRUCTIONS FOR BULK APPLICATIONS

The ZYGLO® fluorescent penetrant process is a nondestructive testing (NDT) method that helps you locate and identify surface defects in order to screen out potential failure-producing defects, correct production problems and increase product uniformity.

It is a quick and accurate process for locating surface flaws such as shrinkage cracks, porosity, cold shuts, fatigue cracks, grinding cracks, heat treat cracks, seams, forging laps, forging bursts, through leaks, and lack of bond.

The ZYGLO® fluorescent penetrant process works effectively in a variety of porous and non-porous materials: aluminum, magnesium, brass, copper, titanium, bronze, stainless steel, sintered carbide, non-magnetic alloys, ceramics, plastic and glass. For magnetic (ferrous) materials, the Magnaglo magnetic particle testing method is recommended.

In general, the ZYGLO® fluorescent penetrant process consists of the several steps listed. However, the process steps for your specific application should be determined by the desired results, specification requirements, the penetrant materials being used and the parts being tested.

STEP 1—PRE-CLEAN PARTS

Successful penetrant testing depends largely on the ability of dye penetrant material to enter surface defects. To ensure that defects are open, parts must be thoroughly pre-cleaned *before* penetrant is applied.

Shot blasting, polishing and machining can peen over or smear cracks, so penetrant testing should be performed *prior to these finishing operations*.

Just because parts appear to be clean doesn't mean they are clean enough for penetrant testing. Parts must not only be free of gross contamination, but anything that can "clog" surface defects:

- **Rust**
- **Scale**
- **Paint**
- **Plating**
- **Grease**
- **Oil**
- **Wax**
- **Water**

Solvent degreasing or aqueous cleaners remove most oily contaminants. Caustic and acid cleaners remove most paints and plastic coatings. Ground-in metal can be loosened by oily cleaning compounds (emulsifiers.)

But remember, the cleaning agents you use to remove foreign materials must also be removed, usually with water, before applying a penetrant. The water can be removed by drying. ***In all cases, the part must be cleaned and completely dry before applying penetrant.***

STEP 2—APPLY PENETRANT

Once parts are clean and dry, Zyglo penetrant is applied by spray, immersion dip, or brushing. Complete coverage of the area to be inspected is essential, and a penetrant "dwell" time is required for the penetrant action to take place.

The length of dwell time depends on the material being inspected, the type of defect being sought, and specification requirements. Generally, 10 minutes to 30 minutes is adequate, but materials like titanium require a longer dwell period because of the tightness of typical discontinuities.

STEP 3—REMOVE PENETRANT

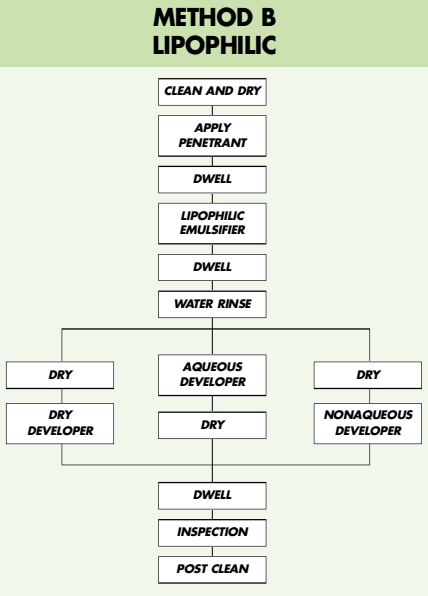
There are four primary methods for removing or cleaning surface penetrants.

1. Post Emulsifiers (PE)—Lipophilic Method

This method allows close control of penetrant removal, permitting more penetrant to remain in discontinuities and thus increasing the detectability of shallow cracks.

You can choose from a variety of products with different emulsifying rates, but the emulsifying speed will vary with different penetrants.

Emulsifiers are usually applied by dipping parts in a tank. Then, the emulsifier must be allowed to drain off for 2–5 minutes. After draining, the emulsifier/penetrant is washed off with water.



Post-emulsifiable, lipophilic penetrant inspection process flow chart

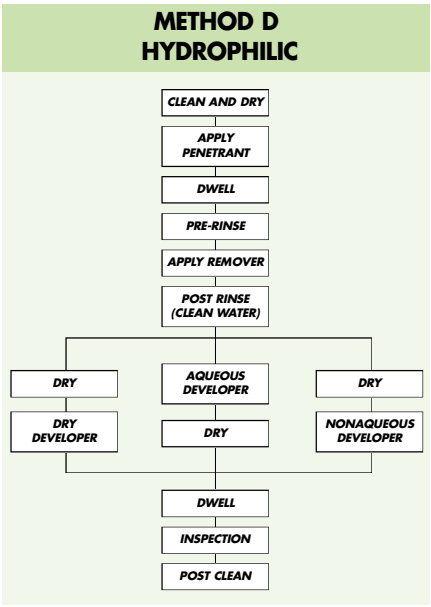
2. Post Remover (PR)—Hydrophilic Method
In this method the concentrates are fully miscible in water and are usually applied by immersing parts in a remover tank. The PR method prevents excessive penetrant removal because it only provides limited solvent action.

Because PR penetrants are not compatible with water, care must be taken to avoid excessive penetrant contamination of the remover bath.

A *water spray Pre-Rinse* removes excessive penetrant, leaving only a fine film when parts are immersed in the remover tank.

In the immersion tank, removal of penetrant relies largely on bath agitation. Immersion time varies from 20 seconds to 5 minutes, depending on the type of Zyglo penetrant, concentration, part surface texture, agitation rate, desired results and specification requirements. After immersion, a *water spray Post-Rinse* removes any remaining penetrant solution.

Post Removers can also be spray applied, using injectors or metering pumps for automatic concentration control and 20 PSI spray pressure. Pre-Rinsing and Post-Rinse are still recommended.

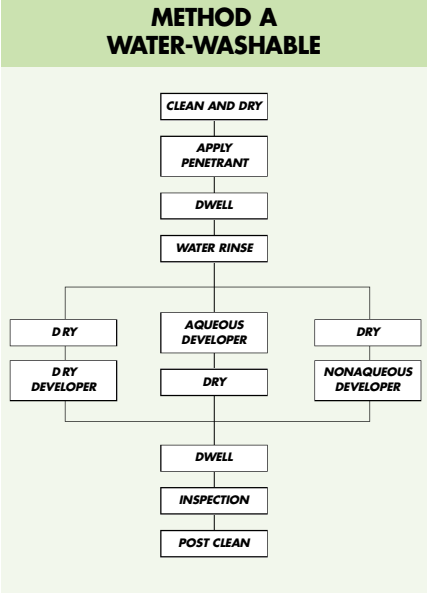


Post-emulsifiable, hydrophilic penetrant inspection process flow chart

3. The Water Washable (WW) method uses penetrants that include washing agents in their formulation, so they eliminate the emulsifier or remover process steps. However, be careful not to "overwash" parts.

Spray washing is generally employed, with water temperature of 50-100° F and black lights to visually determine the completeness of penetrant removal.

Water washable penetrant removability is affected by water temperature, pressure and wash time.



Water-washable penetrant inspection process flow chart

4. The Solvent Removable Method is used when water cannot be conveniently used. Refer to the Magnaflux Zyglo penetrant kit operating instructions for step-by-step procedures.

STEP 4—DRY PARTS

Drying is commonly done in a recirculating hot air dryer with part temperatures **not exceeding 160° F**. Parts should be taken from the drier as soon as surface moisture is gone. Overdrying can reduce inspection effectiveness. *Air blow-off* after final rinsing shortens the drying time for any application, but it's particularly helpful for large parts that don't fit into your dryer.

Refer to the flow charts shown above to determine the proper drying sequence for the developer being used.

THE ZYGLO FLUORESCENT PENETRANT PROCESS

STEP 5—APPLY DEVELOPER

Developers act as capillary systems to draw fluorescent penetrant out of cracks and to the surface of parts, thus making defect indications much more prominent. *There are three types of developers:*

1. Dry Powder Developers are free-flowing, lightweight, fluffy materials. They are applied *after parts are dry* by dusting, conventional spraying, or electrostatic spraying. (ZYGLO® ZP-4B)

2. Aqueous Developers are supplied as dry powders which are mixed with water. They are applied by immersion or spraying *before drying*. If the developer is sprayed on, be careful to avoid "foaming" because when foam bubbles break, they leave holes in the developer coating.

The recommended method for controlling aqueous developer concentration is regular hydrometer measurements of specific gravity. Magnaflux has two Aqueous Developers

- *Suspendible Aqueous Developers* (ZYGLO® ZP-5B) require bath agitation to prevent settling.
- *Soluble Aqueous Developers* (ZYGLO ZP-14A) are completely water soluble, thus eliminating the need for bath agitation.

3. Non-Aqueous Developers (ZYGLO® ZP-9F) are the most sensitive type of developer. They usually consist of developer particles suspended in a volatile solvent, they are always spray applied *after drying*, and agitation is required to maintain developer uniformity.

STEP 6—INSPECTION

Once the part is dry and the developer is applied, a 10-minute developer dwell allows time for the parts to cool and for the developer to do its job of drawing out the penetrant from surface defects.

Inspection must take place in a well darkened area. Inspectors should allow their eyes to become dark adapted before testing begins.

For fluorescent inspections, a black light must be used such as the MAGNAFLUX ZB-100F. They should be measured regularly to ensure proper output (1000 micro watts/cm^2 at part surface, 15 inches from 100-watt bulb). To avoid eye fatigue, black lights should be located so they don't shine directly into inspector's eyes.

After the inspection is complete, **Post Inspection Cleaning** is a good idea. This optional step, usually a water spray, removes most inspection materials.

Brushing is normally required to remove non-aqueous developers or to remove stubborn, baked-on aqueous developers.

SAFETY PRECAUTIONS*

Zyglo materials are intended for industrial use by qualified personnel only. Common sense must be used in handling, using and storing NDT materials.

Zyglo contains materials generally considered to be non-hazardous. However, Magnaflux recommends handling materials per the following guidelines:

- Wear protective gloves to avoid skin irritation
- Do not smoke or eat while using NDT materials
- Wash hands thoroughly after using NDT materials
- Avoid clothing contact with NDT materials
- Avoid breathing spray mists, airborne powders and solvent vapors
- Store all NDT materials in closed containers well apart from open flames or other heat sources

*Refer to Material Safety Data Sheets for complete health and safety information.

MAGNAFLUX®
A Division of Illinois Tool Works Inc
3624 WEST LAKE AVENUE ■ GLENVIEW, ILLINOIS 60026 ■ TEL 847.657.5300 ■ FAX 847.657.5388 ■ http://www.magnaflux.com
FARADAY ROAD, S. DORCAN INDUSTRIAL ESTATE ■ SWINDON, SN3 5HE, WILTSHIRE, ENGLAND ■ PHONE: 44-1793-524566 ■ FAX: 44-1793-619498

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