Met-L-Chek®

PENETRANT PROFESSOR APPROVED

FLUORESCENT (TYPE I) & VISIBLE (TYPE II)

PENETRANT INSPECTION MATERIALS per AMS-2644 & ASTM E-1417

REMOVAL METHODS: A - Water washable.
B - Post emulsifiable, lipophilic emulsifier.
C - Solvent wipe removal.
D - Post emulsifiable, hydrophilic emulsifier (17-20% dip or < 5% spray, concentrations).

SENSITIVITY LEVEL: 1/2 - very low; 1 - low; 2 - medium; 3 - high; 4 - ultra high; for Type I penetrants only.

DEVELOPER FORMS: a- Dry powder developer; use with all Type I penetrants, Methods A, B, C, & D.
b - Water soluble developer; use with Type I penetrants Methods B, C, & D.
c - Water suspendible developer; use with all penetrants, Methods A, B, C, & D.
d - Nonaqueous developer; use with Type I penetrants, Methods A, B, C, & D.
e - Nonaqueous developer; use with Type II penetrants, Methods A, B, C, & D.
f - Special application material.

SOLVENT CLASS: 1 - Halogenated solvent remover, use with all penetrants, Method C.
2 - Nonhalogenated solvent remover, use with all penetrants, Method C.
3 - Special application material used with special application penetrants, Method C.

NAME	TYPE	METHOD class/form	SENSITIVITY LEVEL	AMS-2644 QPL4	GENERAL DESCRIPTION
FP-900	I	A & C	1/2	YES	Very low sensitivity, general metal working.
FP-901	I	A & C	1	YES	Low sensitivity, general metal working.
FBP-911	I	A & C	1	YES	Low sensitivity, oil & solvent free.
FP-921	I	A & C	1	YES	Low sensitivity, aerospace applications.
FP-902	I	A & C	2	YES	Medium sensitivity, general metal working.
FBP-912	I	A & C	2	YES	Medium sensitivity, oil & solvent free.
FP-922	I	A & C	2	YES	Medium sensitivity, aerospace applications.
FP-903	I	A & C	3	YES	High sensitivity, all applications.
FBP-913	I	A & C	3	YES	High sensitivity, solvent & oil free.
FP-923	I	A & C	3	YES	High sensitivity, aerospace applications.
FBP-914	I	A & C	4	YES	Ultra High sensitivity, oil & solvent free.
FP-93A(M)	I	B, C, & D	2	YES	Medium sensitivity, all applications.
FP-95A(M)	I	B, C, & D	3	YES	High sensitivity, all applications.
FP-97A(M)	I	B, C, & D	4	YES	Ultra High sensitivity, all applications.
VP-30	II	A & C	NA	YES	Welding, nuclearand general metal work.
VBP-300	II	A & C	NA	YES	Oil & solvent free, general metal working.
VP-31A	II	B & C	NA	YES	Welding, nuclearand general metal work.
VP-302*	II	C	NA	NA	Special high temperaure penetrant.
E-50	II	B	NA	YES	Lipophilic emulsifier for VP-31A.
E-57	I	B	NA	YES	Lipophilic emulsifier for FP-93/95/97A(M).
E-58D	I	D	NA	YES	Hydrophilic remover for FP-93/95/97A(M).
E-59	I & II	C, class 2	NA	YES	Solvent remover for all penetrants.
E-59A	I & II	C, class 2	NA	YES	Solvent cleaner/remover for all penetrants.
R-502*	II	C, class 3	NA	NA	Special high temperature remover for VP-302.
R-503	I & II	C, class 2	NA	YES	Petroleum solvent free cleaner/remover.
R-504	I & II	C, class 2	NA	YES	Flash dry solvent cleaner/remover, phenol free.
D-70	I & II	forms d & e	NA	YES	Nonaqueous developer, all penetrants.
D-72A	I	form a	NA	YES	Dry powder developer, all Type I penetrants.
D-76B	I	form b	NA	YES	Aqueous soluble developer.
D-78B	I & II	form c	NA	YES	Aqueous suspendable developer.
D-702*	II	form f	NA	NA	Special high temperature developer for VP-302.
FLP-1	I	A	NA	NA	Water based, leak detector, water dilutable.
RLP-1	II	A	NA	NA	Water based, leak detector, water dilutable.
#210	NA	NA	NA	NA	Aqueous alkaline cleaner; immersion or spray.
300LF	NA	NA	NA	NA	Aqueous alkaline cleaner; immersion or spray.

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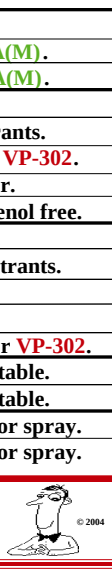

Met-L-Chek®

PENETRANT PROFESSOR APPROVED

PENETRANT INSPECTION SEQUENCE per AMS-2644 & ASTM E-1417

PRE-CLEAN SURFACE

Part must be clean, dry, and at a temperature of 40˚-125˚F (4.4˚-52˚C) before penetrant application.
Use Met-L-Chek® # 210 or 300LF aqueous alkaline degreaser; immersion or spray application.
Use Met-L-Chek® E-59A, R-503 or R-504 solvent cleaners for spot inspection cleaning applications.

APPLY Met-L-Chek® TYPE I or TYPE II PENETRANTS (Methods A, B, C, & D)

Use spray, immersion, or wipe on application.

DWELL

Wait a minimum of 10 minutes; 20 minutes if temperature is 40-50˚F (4.4˚-10˚C).
Reapply penetrant if dwell is over 2 hours to prevent drying out prior to removal..

Method A Penetrant Water Wash Process

Method B Penetrant Lipophilic Process

METHOD B EMULSIFIER

Immerse part in or flow on emulsifier. Drain.
Time < 3 minutes Type I;
< 30 seconds Type II
Met-L-Chek® E-57; Type I
Met-L-Chek® E-50; Type II

Method D Penetrant Hydrophilic Process

PRE-RINSE

Water temperature 50-100 ˚F (10-38˚C).
Pressure < 40 psi (<275kPa).
Time- only long enough to remove bulk of surface penetrant.

METHOD D EMULSIFIER

Agitated Dip :
17-20% concentration; < 2 minutes
or
Spray: 2- 5% concentration; < 2 minutes
Met-L-Chek® E-58D

Method C Penetrant Solvent Wipe Process

WIPE REMOVAL of SURFACE PENETRANT

Moisten cloth with remover and wipe penetrant from surface. *Do not* spray remover on surface to remove penetrant, as sensitivity will be impaired. Water may be used with Method A penetrants but surface will need to be dried before developer application.
Met-L-Chek® E-59, E-59A, R-503, R-504, R-502*

WASH

Water temperature 50-100 ˚F(10-38˚C). Water pressure < 40 psi (<275kPa); hydro-air nozzle use limited to < 25 psi(172kPa). Distance >12 inches (>30cm). Time- only long enough to remove surface fluorescence under UV-A or color under bright visible light.

DRY

Temperature <160 ˚F(<71 ˚C)
Time- only long enough to dry surface

APPLY AQUEOUS DEVELOPER

Immersion, flow on, or spray.
D-76B (Methods B, C, & D; Type I only)
D-78B (Methods A, B, C, & D)

APPLY NONAQUEOUS DEVELOPER

Spray thin even film.
Met-L-Chek® D-70
or
D-702*

APPLY NONAQUEOUS or DRY DEVELOPER (Type I only)

Met-L-Chek® D-70 or D-72A (Type I only)

DRY

Temperature <160 ˚F(<71 ˚C)
Time- only long enough to dry surface

DWELL

Wait a minimum of 10 minutes before inspection. Maximum time is 1 hour for forms "d & e" (nonaqueous), maximum 2 hours for forms "b & c" (aqueous), and maximum 4 hours for form "a" (dry powder).
If times are exceeded, clean part and reprocess.

INSPECT

For fluorescent Type I penetrants use UV-A illumination of >1000 µw/cm² @ 15inches (38.1 cm) in a darkened area of < 2 footcandles visible light (21 lux).
For visible Type II penetrants use lighting of 100 footcandles(1100 lux/m²) minimum.

* Special high temperature application materials 150˚F-350˚F(˚65C-177˚C)

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PENETRANT PROFESSOR APPROVED

PENETRANT INSPECTION PRACTICE and PROCESS MONITORING

PRE-CLEAN SURFACE

1. Procedures should define cleaning method, cleaning materials, concentrations, temperatures and times.
2. Remove all coatings, corrosion, machining fluids and soils.
3. Etch part following mechanical surface treatments such as shot peening, bead blasting or wire brushing of soft materials.
4. Part must be clean, dry, and at a temperature of **40˚-125˚F (4.4˚-52˚C)** before penetrant application.

PENETRANT PROCESS (Methods A, B, C, & D)

1. Use **AMS-2644** approved and QPL listed inspection materials. Keep copy of manufacturers certification.
2. Procedures should define penetrant Type, Method and Sensitivity Level (for **Type I**), as well as process parameters for each step; including application technique, time, temperature and pressures.
3. Retain a sample of each batch of material, as a standard to monitor in use materials performance against.
4. Label each tank or container with product, batch number, start of use date, if not in manufacturers original labeled container.
5. Establish base line performance by running a known defect standard with fresh materials. Record results and use to compare daily runs against.
6. **Daily/Shift:** Verify processing parameters; times, temperatures, and pressures.
7. **Daily:** Check that the UV-A lights have an intensity of at least **1000 µw/cm² (10 W/m²) @ 15 inches (38.1 cm)** for **Type I**.
8. **Daily:** Check that the inspection area is clean; should be free of fluorescence and dark to < **2 footcandles (21 lux)** visible light for **Type I**. Light intensity for **Type II** inspection should be at least **100 footcandles (1100 lux)**.
9. **Daily:** Monitor in use materials for signs of visible contamination such as color or consistency changes.
10. **Daily:** Run system check with known defect standard to verify process consistency to prior base line run. Increased background or loss of indications may be a sign of poor cleaning, contaminated materials, or processing parameter changes. Verify by recleaning standard and rerunning with retained fresh materials, or run two similar defect standards, one with in use materials and the other with the retained fresh materials. Results must be similar. Some OEM's may require the individual materials be tested regularly if recycled or used in immersion applications. **Materials in closed, unexposed containers and used expendably do not require individual tests unless the system check is inconsistent to prior results.**
11. Material problems can be isolated by the following checks or by sending samples to **Met-L-Chek®** for the monthly **Pen-Chek® Program**.

Penetrant Removability: Perform if system check is inconsistent. Pour a strip of fresh and a strip of in use penetrant on a sand blasted panel, and allow to dwell 5 minutes. Process according to appropriate Method below.

- **Method A Penetrants**: Wash panel per process procedure and observe removal rates for differences between the fresh and used penetrant. Dry panel and apply developer. Wait 10 minutes and then look at panel under appropriate lighting to evaluate backgrounds, which should be similar. A noticeably different background between the two would indicate the penetrant should be changed or adjusted by adding fresh penetrant until the performance is the same.
- **Method B penetrants**: Pour fresh emulsifier over strips of penetrant, allow procedural dwell time and then wash and process panel as described for Method A penetrant. Test may also be performed using two separate panels, one for each sample set, but they must be processed identically.
- **Method D Penetrants**: Pre rinse panel with water for 10-15 seconds and then pour fresh emulsifier bath over panel or immerse panel in fresh emulsifier bath for procedural time. Wash and process as defined for Method A penetrant. Test may also be performed using two separate panels, one for each sample set, but they must be processed identically.

Method A Penetrant Water Content: **Monthly:** Measure water content per **ASTM D-95** or **Karl Fischer Method (annex A1 ASTM E-1417)**; water content < **5 %**. If high, replace penetrant or add new material to lower water content.
Method A (water based) Penetrant Concentration: **Weekly:** Use a refractometer to verify concentration per manufacturers guide.

Fluorescent Penetrants: **Quarterly:** Measure fluorescent brightness per **ASTM E-1135**; brightness > **90 %** of original. Change if low.

Emulsifier Removability: Perform if system check is inconsistent. Pour two strips of fresh penetrant on a sand blasted panel, and allow to dwell 5 minutes. Process according to appropriate Method below.

- **Method B Emulsifier**: Simultaneously pour fresh emulsifier over one strip of penetrant and in use emulsifier over other strip of penetrant and allow to drain and wash per process defined times. Observe removal rates for difference between the fresh and used emulsifier. Dry panel and apply developer. Wait 10 minutes and then look at panel under appropriate lighting to evaluate backgrounds. They should be similar. A noticeably different background between the two would indicate the emulsifier should be changed or adjusted by adding fresh emulsifier until the performance is the same as fresh material. Test may also be performed using two separate panels, one for each sample set, but must be processed identically.
- **Method D Emulsifier**: Pre-rinse the panel with water for 10-15 seconds and then follow procedure for Emulsifier B above. In the event of a noticeable difference the bath should be replaced. Test may also be performed using two separate panels, one for each sample set, but they must be processed identically.

Emulsifier-B- Water Content: **Monthly:** Measure emulsifier water content per **ASTM D-95** or **Karl Fischer Method (annex A1 ASTM E-1417)**. Water content < **5 %**. If high, replace emulsifier or add new material to lower water content.

Emulsifier-D- Concentration: **Weekly:** Use a refractometer to verify concentration per manufacturers guide; range is 3 percentage points. Range for **E-58D** immersion applications is **17-20 %** or a **refractive Index** of **12-14** on the Brix scale, or **2-5 %**; **RI 1-3.5** for spray. Adjust concentration by adding water to lower concentration or emulsifier to raise concentration.

Dry Developer Condition: **Daily:** Check for clumping & fluorescent specs; < **10 in a 4" (10 cm) circle** under UV-A. Replace if dirty.

Aqueous Developer Condition: **Daily:** Check by immersing a clean aluminum panel into the bath and then drying the panel. Developer film should be uniform and free of fluorescence under UV-A. Replace if it fails test.

Aqueous Developer Concentration: **Weekly:** Check the concentration using a hydrometer per manufacturers guide.

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