enthone

Technical Data Sheet

ENTHONE® M-Series

Permanent Epoxy Marking Ink

M-Series inks are permanent, two component, epoxy-based marking inks. They may be used with a selection of catalysts which cure at elevated and/or room temperatures. When properly applied and cured, M-Series inks have excellent adhesion to glass, metal and thermosetting plastics. They have excellent chemical and thermal resistance properties. READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT.

M-Series marking inks are used in the electronic, aerospace, automotive, appliance and decorative packaging industries. Uses include the permanent marking of semiconductor components, printed circuit boards, connectors, dials, nameplates, panels, chassis, glass and thermoplastics.

COLOR NUMBERS AND MIX RATIOS

Ink Number	Color	Recommended Catalyst	Mix Ratios Catalyst Additions Parts by Weight per 100 Parts Ink	
			All Catalysts (except Catalyst 5)	Catalyst 5 Only
M-1-N	Brown (Cadmium/Chromium)	*	5.0	7.5
M-2-N	Red (Cadmium)	*	4.0	6.5
M-3-N	Orange (Cadmium)	*	5.0	7.5
M-4-N	Yellow (Cadmium)	*	5.0	7.5
M-5-N	Green (Cadmium)	*	5.0	7.5
M-6-N	Blue	*	5.0	7.5
M-7-N	Violet	*	4.0	6.5
M-8-N	Gray	*	5.0	6.5
M-9-N	White	*	5.0	7.5
M-0-N	Black [1]	*	5.0	7.5
M-0-NC	Inorganic Black	B-13/28	5.0	NR

* Use any catalyst listed in Catalyst Description Section

[1] Not intended for electrical applications

Issued: 30 Jan 08
Spsds: August 2000

CATALYST DESCRIPTION

Catalyst	Description	Cure	Average Pot Life (hours)
20/A	Basic air cure catalyst. Cures at room temperature in 5-7 days. Tack free after 1-2 hours. May also be heat cured.	R.T. or Heat	2
B-3	Basic heat cure only catalyst. Higher cure temperatures decrease cure time.	Heat	4
5	Long pot life. Excellent adhesion properties. Special mix ratios are required for this heat cure only catalyst (refer to Color Numbers and Mix Ratios Section).	Heat	24 Max*
B-13/28	Accelerated air cure catalyst. Cures at room temperature in 3 days. Shorter pot life.	R.T. or Heat	1
45	Long pot life. This heat cure only catalyst contains adhesion promoters. Provides excellent adhesion to glass and metals with good water resistance. Slightly decreases solvent resistance.	Heat	12
77	Adhesion promoting catalyst. Cures at room temperature in 5-7 days. Provides similar characteristics as Catalyst 45. Maximum adhesion is achieved by heat cure @ 65.6-93.3 ^{o}C (150-200^{o}F).	R.T. or Heat	1

* Note: When using Catalyst #5 discard ink after 24 hours

MIXING INSTRUCTIONS

Measure ink and catalyst at the proper mix ratio (refer to Color Numbers and Mix Ratios Section). Both the ink and catalyst should be weighed accurately. Excessive and insufficient amounts of catalyst are detrimental to cured ink film properties. Mix thoroughly without introducing excessive amounts of air. Avoid the use of paper or wax coated cups. Stir from bottom of the container.

OBSERVE INDUCTION PERIOD
All catalysts: 30 minutes
Catalysts 45 and 5: 60 minutes
Allow ink/catalyst mixture to stand for at least 30 minutes prior to application. This provides an induction period ensuring a homogenous mix of resin and catalyst and allows any entrapped air to escape from the mixture. The average pot life begins after the induction period.

APPLICATION
M-Series inks may be applied by hand stamping, machine marking, screen printing, spraying, and roller printing. To ensure optimum adhesion, it is imperative that the surface to be printed is clean and free of any residues or particulates.

OPTIONAL ADDITIONS

Additions of thinner or flow agents should always follow the induction period. If the induction period is not observed, the thinner or flow agent may interfere with the catalyzation process and could effect the final cured properties.

POT LIFE

Pot life will vary with the catalyst used (refer to Catalyst Description Section). To avoid waste, mix only an amount which can be consumed before the end of the pot life. High ambient temperatures will shorten the pot life. Solvent additions will increase the pot life. Catalyst 45 and 5 have the longest pot life (12 hr and 24 hr max respectively), however cure temperature requirements must be observed (see Recommended Cure Section). Catalyst # 5 has special pricing (Contact your local distributor for pricing information).

SHELF LIFE

M-Series Inks: 3 years from date of manufacture
All Catalysts: 2 years from date of manufacture

NOTE**:** Catalysts are hygroscopic. Containers should be kept tightly closed after each use to prevent moisture contamination.

METHODS OF APPLICATION

MACHINE MARKING
Minimum pressure is recommended for transfer-pad or flat-bed printers. Adjust rollers to 0.5 mils (0.0125mm) clearance prior to the addition of ink. Increase the depth of the ink on the roll feeds until ink is transferred. Additions of AD2003 retarder may be used during the print run.

HAND STAMPING
Use a brayer to roll out a thin film of ink onto a glass or metal plate. Transfer the ink from plate to the part with a rubber, neoprene, or urethane stamp. Minimum pressure provides a sharp image definition. Disposable stamp pads made of finely textured polyurethane foam or foam rubber may also be used. Because the ink begins to solidify at the end of its pot life, stamp pads cannot be reused.

SCREEN PRINTING
Monofilament polyester fabrics with a mesh count of 180-330 may be used. Mesh tension should be to the fabric manufacturer's recommendations. Stencils may be applied by direct, indirect, or direct/indirect methods. Squeegee material should be 70-80 durometer, sharp and free of nicks. Squeegee durometer, pressure, angle and print speed should be adjusted according to overall printing parameters to ensure high quality print definition.

SPRAYING
Following the induction period, thin with AD2002 or a blend of 80% PM glycol ether and 20% methyl isobutyl ketone at 25-40% by volume, depending on air pressure and orifice of spray unit. Thinner additions will extend the pot life considerably.

THINNING
If thinning is required, add small amounts of AD2001 thinner. Additions should be made after the induction period. Thinner additions extend the pot life.

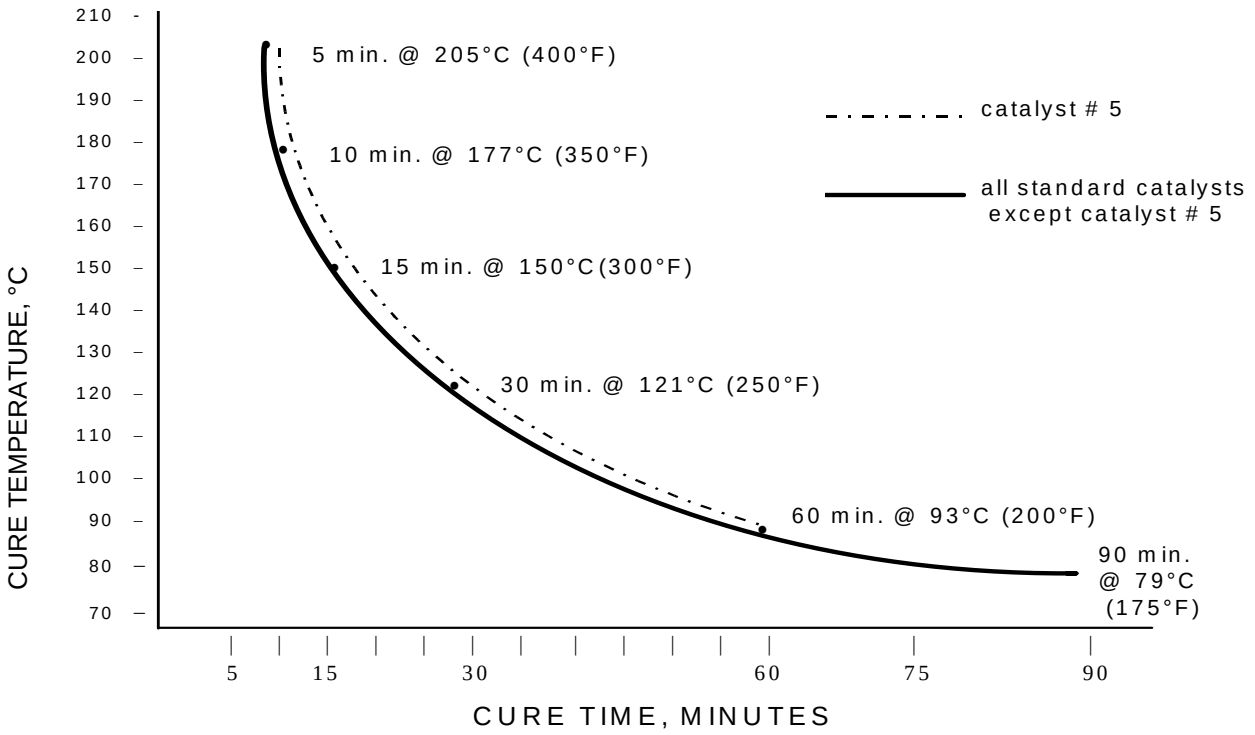
RETARDING
Small amounts of AD2003 or carbitol acetate are recommended. Additions should only be made after the induction period has been observed.

CLEANING / REMOVAL

Clean equipment before the ink dries and partially cures. Use Enthone Screen Cleaners SC1710, PC7804, or PC7886. Requires post water rinsing to remove surfactants.
Localized Equipment Cleaning: Use AD2001, AD2002, AD2003, or other strong oxygenated solvents without surfactants that require post water rinsing.

RECOMMENDED CURE

CURE SCHEDULE



ADDITIONAL CURE INFORMATION

Cure schedules denote times/temperatures for curing ink film only. Allow additional time for the substrate to reach the actual cure temperature. Convection ovens should have sufficient exhaust and air movement to ensure solvent removal.
Cure temperatures above 79 °C (175 °F) are required for Catalysts B-3 or 45.
Cure temperatures above 93°C (200°F) are required for Catalyst 5.

Air cure Catalysts 20/A, B-13/28 and 77 provide a tack-free ink surface after 1-1.5 hours, depending on the ink film thickness. A tack-free surface is not an indication of cure. When using an ambient cure, articles should be racked and/or spaced to allow air circulation for the designated cure schedule. Do not box, bag, or package until the recommended cure time has been observed. Hot air blasts can be used to expedite handling. These catalysts may be fully or partially heat cured. Heat cure enhances the final cured properties. M-Series marking inks may also be cured by infrared radiation.

Recommended cured ink film thickness should be between 0.7-1.4 mils (0.017-0.035mm).
An extended cure of 30 min. @ 150°C (300°F) will result in low outgassing properties.

CURED ELECTRICAL PROPERTIES

Property	Value **	Test Method
Insulation resistance, ohms		Mil-I-43553A
@ 25°C, initial reading		¶ 3.10 4.5.2.5
M-0-N	$>1.0 \times 10^{12}$	
M-0-NC	$>1.0 \times 10^{12}$	
All Other Colors	$>1.0 \times 10^{12}$	
Insulation resistance, ohms		Mil-I-43553A
after humidity conditioning		¶ 3.10 4.5.2.5
@ 77 ±10 °F and 95% RH for 48 hours		
M-0-N	1.5×10^{9}	
M-0-NC	$>1.0 \times 10^{10}$	
All Other Colors	$>1.0 \times 10^{10}$	

** All test samples were cured at 121°C (250°F) for 30 minutes. Variations in the cure schedule will affect electrical properties.

QUALIFICATIONS

Qualification information to Mil-I-43553 & replacement C.I.D. A-A-56032 available upon request. Please contact your local representative.

ELECTROLESS NICKEL IMMERSION GOLD (ENIG) PROCESSING

In printed wiring board applications with electroless nickel immersion gold (ENIG) as the final surface finish ink application must occur after the ENIG process. Processing the M-Series inks through ENIG will hold up to the ENIG process, however during high heat assembly operations color change effects will occur with the white ink. Other colors can also be effected to a lesser extent. Please contact your local representative for additional information.

ACCESSORY PRODUCTS

AD2001	Thinner for nominal adjustments in viscosity. Incrementally add 3-6% by weight.
AD2002	Thinner for spray applications. Add 25-40% by volume.
AD2003	Retarder to extend open time. Incrementally add 3-6% by weight.
AD3002	Flow agent to eliminate crawling, pin-holing and bubbling. Incrementally add 2-4% by weight. Mix gently to avoid over mixing.

PACKAGING

M-Series marking inks are available in 6 fl. oz. ratio pack kits. These kits consist of the ink packaged in ½ pint metal containers with ratio packaged catalyst in glass vials. White and black inks are also available in quart, non-ratio packaged units. Quarts are sold with ¼ pint catalyst units. Catalyst 5 is available as a special order and is not included in the price of the ink, as are the other catalysts. Catalyst 5 is available individually for quarts units only.

M-0-N black, M-0-NC nonconductive black, and M-9-N white are also available in premeasured 10cc “bi-packs” with selected catalysts. M-0-N and M-9-N are available with either Catalyst 20/A or Catalyst B-3. M-0-NC is available with either Catalyst B-13/28 or Catalyst B-3.

STORAGE AND HANDLING

M-Series inks and catalysts should be stored at or below room temperature (27°C/80°F maximum) and out of direct sunlight.

PRECAUTIONARY INFORMATION-HEALTH AND SAFETY

Enthone provides customers with product specific Material Safety Data Sheets (MSDS) detailing potential acute and chronic health effects, first aid, safe handling and storage conditions. Copies of the MSDS are available upon request. **Always refer to the product specific Material Safety Data Sheet (MSDS) prior to its use.**

When handling any of the Enthone M Series Inks or Catalyst, avoid contact with eyes, skin and clothing. Avoid breathing vapors or mists. Do not take internally. Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure. Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates that this is necessary. Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates that this is necessary.

Keep containers of the Enthone M Series Inks or Catalyst tightly closed when not in use. Store indoors in a cool, well-ventilated area. Keep away from oxidizing agents. Loosen containers cautiously when opening. Do not reuse containers, wash thoroughly before disposal.

TROUBLESHOOTING

Problem	Cause	Cure
Bleed/Smear	Various	1. Verify uniform screen mesh tension and off contact distance 2. Check sharpness of squeegee 3. Decrease off contact distance 4. Increase squeegee durometer 5. Reduce flood pressure 6. Increase print stroke speed 7. Reduce stencil thickness
Bubbling	1. Screen mesh too coarse 2. Over aggressive mixing 3. Ink settling	1. Use finer screen mesh 2. Gently hand mix 3. Stir ink from bottom of can 4. Add AD3002 flow agent
Under Cure	1. Incorrect ink catalyst mix ratio 2. Insufficient cure schedule 3. Insufficient air movement in oven 4. Expired catalyst	1. Verify mix ratio 2. Confirm cure schedule time and temperature 3. Increase air circulation/ventilation 4. Check/clean exhaust duct(s) 5. Confirm expiration date on label
Poor Adhesion	1. Surface contamination 2. Insufficient cure schedule 3. Incorrect ink:catalyst mix ratio	1. Remove all surface residue and debris 2. Confirm cure schedule time and temperature 3. Verify mix ratio
Ink Drying in Screen	1. Screen left unattended 2. High shop temperature 3. End of pot life	1. Keep screen flooded with ink when not in use 2. Replenish ink supply frequently 3. Reduce room temperature 4. Mix fresh batch of ink 5. Retard with AD2003 or carbitol acetate
Ink Thickens Prematurely	1. Over catalyzed 2. Evaporation of solvent 3. High shop temperature	1. Verify mix ratio and mix fresh ink 2. Keep catalyzed ink covered 3. Reduce room temperature 4. Retard with AD2003 or carbitol acetate

MATERIAL SAFETY DATA SHEETS

For more detailed information on the toxicological properties of the products described herein, reference can be made to the Material Safety Data Sheet (MSDS) for each product. If you do not have the proper MSDS, it can be requested from: Enthone Inc., attention: Regulatory Affairs Department, 350 Frontage Road, West Haven, CT 06516. For emergency assistance call CHEMTREC (800) 424-9300.

WARRANTY AND DISCLAIMER

The information presented herein is to the best of our knowledge true and accurate and all recommendations and suggestions appearing in this bulletin covering the use of our products are based upon information believed to be reliable. However, since the conditions of use are beyond our control, this information is given on the express condition and agreement that Enthone Inc. will not be liable to any person in contract, tort (including negligence), strict liability or otherwise for any claims, damages or losses whatsoever. Nothing herein shall be deemed a recommendation to use any product or process in violation of any existing patent rights and no warranties, expressed or implied, are made regarding the information, product, processes, recommendations, description and safety notations contained herein. The above includes proprietary information of Enthone Inc. and is furnished to you for your use solely on products or processes supplied by us to you.

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