

DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
ACTIVITY REPORT: On-site Inspection

A143062264

FACILITY: CALUMET ELECTRONICS CORP		SRN / ID: A1430
LOCATION: 25830 DEPOT STREET, CALUMET		DISTRICT: Marquette
CITY: CALUMET		COUNTY: HOUGHTON
CONTACT: Merideth LaBeau , Chief Technology Officer (CTO)		ACTIVITY DATE: 03/11/2022
STAFF: Joe Scanlan	COMPLIANCE STATUS: Compliance	SOURCE CLASS: MINOR
SUBJECT: Announced inspection to determine compliance with multiple PTIs (see activity report)		
RESOLVED COMPLAINTS:		

REGULATORY AUTHORITY

Under the Authority of Section 5526 of Part 55 of NREPA, the Department of Environment, Great Lakes, and Energy may upon the presentation of their card, and stating the authority and purpose of the investigation, enter and inspect any property at reasonable times for the purpose of investigating either an actual or suspected source of air pollution or ascertaining compliance or noncompliance with NREPA, Rules promulgated thereunder, and the federal Clean Air Act.

SOURCE DESCRIPTION

Calumet Electronics Corporation is in the city of Calumet, Houghton County, in a commercial/residential district adjacent to US-41. The company was founded in 1968 and designs, engineers, and manufactures printed circuit board (PCB) in a 160,000 square foot facility. The company has more than 300 employees and produces 3.5 to 4 million circuit boards annually.

PROCESS DESCRIPTION

The facility includes administrative offices, a clean room/laser imaging area, automated press lines (hot presses/cool presses/depinner/transport), drill/route/fabrication area, solder mask/legend printing area, optical inspection area, and a testing/shipping area.

Printed circuit board (PCB) fabrication is the process of transcribing a circuit board design onto the physical structure of the board, or substrate, using plating, etching, and stripping processes. The foundation of PCBs is the rigid board substrate with copper laminate bonded on either one or both sides.

The PCB etching process, also called a controlled horizontal process, is carried out to remove excess copper from the PCB substrate using a temporary mask. For a multi-layer PCB, laser direct imaging (LDI) is used on areas that will become the traces, pads, and metal ground of the PCB. During this process, a dry film is used as the temporary masking agent and applied to the copper laminate on the substrate. LDI exposes certain parts of the substrate to UV light in the shape of the desired PCB

pattern. Unexposed areas leave the dry film as an etch barrier that will be removed to expose the copper to form the copper circuitry. The etching process is completed using highly aggressive ammonia-based solutions. Emissions from these processes are controlled using a fume scrubber.

Once etching is completed, a chemical oxide treatment is applied to the inner layers of the PCB to improve the strength of the bond. Then, alternating layers of prepreg and copper foil are laminated together with heat and a hydraulic press. Prepreg is a fiberglass material containing an epoxy resin that melts from the heat and pressure of lamination, bonding the layers into a "PCB sandwich". Maintaining alignment of circuitry between each layer is crucial.

For a multi-layer printed circuit board to send signals from one layer to another, holes must be drilled or lasered in to form vias which connect them. A PCB via acts a bit like an elevator, passing signals from one floor to the next. Vias function as conductive pathways plated with copper to help send electrical signals and come in a variety of formats.

After holes are drilled into the surface, excess resin and debris are cleaned using chemical and mechanical processes. Once removed, a thin coating of copper is deposited on all exposed parts of a panel, creating a metallic base for the electroplating process. Like the develop/etch/strip process from before, dry film is applied to the outer layers of the copper panel and is exposed to laser direct imaging, leaving a conductive pattern.

With the conductive pattern and drilled holes exposed, the panel is placed into a copper plating bath containing sulfuric acid and copper sulfate. When an electrical current is added into this, copper is deposited onto the conductive surface of the board with a thickness of about 1 mil. The plate is then removed and placed into a tin plating bath to serve as an etch barrier. Emissions from this process are controlled by a fume scrubber.

As plating is completed, the dry film is removed and the exposed copper not covered by tin is etched away, leaving only the traces, pads, and other patterns on the plate. Nitric acid effectively removes the tin while maintaining the copper circuit map below the tin metal. Once the stripping process is complete, a clear distinct copper outline on the circuit board remains. Emissions from this process are controlled by a fume scrubber.

Next is the solder resist/masking process, which covers unsoldered areas on the circuit boards using solder resist material, a thin layer of polymer. This prevents the solder from forming traces, which can create shortcuts to adjacent component leads.

Once the solder mask has been applied, component reference designators and additional board markings are silkscreened onto the printed circuit board. The solder mask and silkscreened ink are cured by baking the circuit board in an oven.

Finally, a surface finish is applied to exposed metal surfaces not covered by the solder mask. This protects the metal and helps with soldering during the PCB assembly process.

Once fabrication is completed, the remaining processes involve final quality control assurance inspections, testing, assembly, and shipping.

INSPECTION

On March 11, 2022, EGLE AQD staff conducted a scheduled inspection of the Calumet Electronics Circuit Board (PCB) manufacturing plant. Meredith LaBeau, Chief Technology Officer (CTO), was the point of contact upon arrival. During a brief introductory conference, it was explained that the purpose of the visit was to conduct an inspection of the facility to determine compliance with issued PTIs. Ms. LaBeau proceeded to conduct a guided tour of the facility to observe each permitted emission unit. Following the inspection of the production area, Ms. LaBeau provided records the company is required to maintain to ensure compliance with each PTI issued to the facility, and also provided Rule 291 exemption verification documents for the electroless nickel and gold plating line as well as the copper and tin plating line.

PTI's and EMISSION UNITS

The company has the following active PTIs:

PTI 79-16 (EU-SES3)

EU-SES3 is a strip ammoniacal etching process line that is used primarily as a back-up to the SES2 line with a fume scrubber to control emissions. EU-SES3 was not in use at the time of inspection.

PTI 130-06 (EU-WDES & EU-MDES)

There are no emission limits for these emission units. Emissions are controlled via a fume scrubber. Only one line is used at a time. The reason for the redundancy is to have one line as a back-up. Records provided (SC 2.7) for the period of Feb 2021 through Jan 2022 show the average range of pressure drop was 0.25" H₂O, the liquid flow rate was 45 gal/min, and average Ph of 3.2 (SC 1.4, SC 1.5, SC 1.7, SC 2.4, and SC 2.5).

PTI 137-05 (EU-SES2)

EU-SES2 has two resist stripper tanks, a post strip tank, a cascade water rinse tank, two ammoniacal etch tanks, a replenisher tank, a cascade water rinse tank, a tin strip tank and a cascade water rinse tank. Emissions are controlled via a fume scrubber.

SC 1.1 has a 2.0 pph limit for free ammonia. Records provided showed the highest average pph of free ammonia was 0.23 for Jan 2022. This is well below the permitted limit.

Per SC 1.2, the permittee shall not use more than 480 lbs per calendar day of free ammonia contained in the ammoniacal etchant material in EU-SES2. Fresh etchant usage records from Feb 2021 through Jan 2022 were provided by the facility. During this time period, 166 lbs of free ammonia was the highest daily average used. This is well below the permitted limit.

SC 1.8 requires the permittee to keep the following information daily for EU-SES2: gallons of ammoniacal etchant used, free ammonia content (lbs/gallons) of ammoniacal etchant used and ammonia usage calculations determining the daily usage rate in pounds per calendar day. Records were provided and are on file.

SC 1.5, SC 1.6, and SC 1.9 EU-SES2 wet scrubber average range of pressure drop was 0.3" H₂O. Wet scrubber average liquid flow rate was 1.6 with an average pH of 7.5.

PTI 280-03 (EU-ENIG and EU-GOLDTAB)

EU-ENIG is an electroless nickel, gold and silver plating line. The permittee shall keep records of the bath make-up of each tank and the usage amounts for each tank in EU-GOLDTAB. Records were provided at the time of inspection. From February 2021 through January 2022, EU-ENIG 12-month rolling total annual emission rate was 5.093 lbs/hr and total monthly emission rates averaged 0.424 lbs/hr (SC 1.1, SC 1.2 and SC 1.3).

EU-GOLDTAB contains an electrolytic strip tank, an acid activator tank, a nickel electroplating tank and a gold electroplating line. SC 2.1a has an emission limit of 0.0004 lb/hr for Nickel. The permittee shall keep records of the bath make up of each solder strip and nickel sulfate tanks and the usage amounts for each tank in EU-GOLDTAB (SC 2.2 and SC 2.3). Records provided at the time of inspection showed nickel emissions well below the permitted limit.

EU-GOLDTAB For the period of February 2021 through January 2022, the company purchased 110 gallons of solder strip and the 12-month rolling average usage for solder strip was 14.31 gallons. For the same time period, the company purchased 4 gallons of nickel sulfate and the 12-month rolling average usage for nickel sulfate was 0.54 gallons (SC 2.2, SC 2.3 and SC 2.4).

PTI 290-01A (EU-LPI)

EU-LPI emission unit consists of solder mask ink line with two enclosed screen coaters, two electric tack cure ovens, a developer, a final electric bake oven and a UV oven. EU-SES has been removed and EU-DES 1 has replaced by EU-SVWDES (PTI 130-06)

EU-LPI has VOC emission limits of 12.4 tons per year (SC 1.1a) for EU-LPI and 5.5 tons per year (SC 1.1b) for EU-LPI (clean-up solvents). Based on records provided, the facility has emitted 9.82 tons of VOCs from EU-LPI and 2.90 tons of VOCs from EU-LPI (Clean-up solvents) during the period of Feb 2021 through Jan 2022 (SC1.6 & SC 1.7).

PTI 159-02 (EU-SOLDERLEVEL)

EU-SOLDERLEVEL emission unit has quicksilver and alchemy solder leveling lines. Both lines consist of a modular series of enclosed tanks, including: a micro-etch, sulfuric acid rinse, lightening process, leveler tank and flux cleaner. This emission unit is required to keep the VOC emission calculations to show compliance with the VOC emission limit of 1.0 tpy (SC 1.1). According to their records, VOC emissions were 0.211 tons from this unit for the period of Feb 2021 through Jan 2022. This is well below the permitted limit.

PTI 158-02 (EU-ELECTROLYTIC)

EU-ELECTROLYTIC is a copper and tin plating line consisting of an acid clean, micro-etch, copper pre-dip, copper plating bath, tinplating bath, and associated water rinses. This emission unit has no emission limits. The facility is required to keep records of the liquid flow rate and pressure drop for the wet scrubber portion of EU-ELECTROLYTIC (SC 1.5). Monthly flow rate and pressure drop data of the wet scrubber was sent via email (SC 1.1, 1.4 and 1.5). In the months of December 2021 and January 2022, the average flow rate and pressure drop was 2.2 GPM and 2.5" respectively.

PTI 157-02 (EU-ELECTROLESS)

EU-ELECTROLESS is an electroless copper plating line consisting of the following tanks: conditioner, micro-etch, pre-dip, activator, accelerator, and plating bath, followed by a sulfuric dip, and anti-tarnish. The permittee shall keep the monthly usage records of all formaldehyde containing materials (SC 1.2). Monthly usage data of formaldehyde was provided during the inspection. From Feb 2021 through Jan 2022, the facility used 10,175 gallons of Formaldehyde (3-8% by weight) and 1,925 gallons of M-Formaldehyde (30-40% by weight) in EU-ELECTROLESS. This satisfies the permit condition set forth in SC 1.2. SC 1.3 requires the facility to keep calculations of formaldehyde emission rates, however these were not addressed during the inspection and staff will follow up with the facility regarding these emission calculations.

PTI 166-95 (Permanganate)

This is a permanganate desmear line. Monthly usage records from Feb 2021 through Jan 2022 for potassium permanganate and N-methylpyrrolidone were received during the inspection. 12-month rolling averages for permanganate was 43.75 gallons and for M-treat Bio (N-methylpyrrolidone) 114.58 gallons. This satisfies the permit condition as specified in SC 17. Visible emissions were not observed during inspection.

COMPLIANCE

The facility provided detailed Rule 291 exemption analyses for the following emission units: IPS Plating Line, the IPS ENIG Line, the HASL/LFSL, and the Quick Etch Line. These are on file in the district office.

All air pollution control equipment appeared to be operated and maintained appropriately. Proper equipment operation, inspections, and preventative maintenance guidelines are being utilized. There were no signs of malfunctioning equipment.

Calumet Electronics Corporation appears to be in compliance with all current PTI's.

NAME 

DATE 7/5/2022

SUPERVISOR 