THERMOFORMING

Thermoforming is a moulding process which is becoming more important in many areas of industry. The high productivity sectors making thermoformed products are a large market for static control equipment.

For background in the thermoforming process please see (Courtesy of British Plastics Federation):

https://www.bpf.co.uk/plastipedia/processes/thermoforming

The thermoplastic material may be in a continuous web or in sheet form. These will be considered separately.

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1. CONTINUOUS WEB THERMOFORMING

The main markets for continuous web thermoforming are:

Food Packaging

- High volume food packaging containers and lids with thin wall plastics
- Disposable fast food cups, plates, bowls made in polystyrene
- In mould labelling is becoming used in thermoforming to decorate containers, in direct competition to injection moulding

Medical Packaging

- Blister packs, medical parts

Other

- Blisters, point of sale materials, trays

The material can be thin wall rigid plastics for food packaging and blister packs or polystyrene foam for fast food.

Static Control in Pre-Thermoforming Material Manufacture

The materials used include PVC, PE, PET and other normal thermoplastics. These are extruded in the conventional way, often by specialist extruders as well as by the thermoformer. Static elimination is often needed on the winders of these extrusion lines. See static control notes for winders.

High volume manufacturers of polystyrene bowls, cups and plates usually extrude the foam web on-site because transport of such a low density material is expensive.

There are 3 areas where static control may be needed in this polystyrene manufacturing process:

A) The Extrusion Process

Often extruded on a circular die and then slit to form a flat web. Hydrocarbon gases like propane are released at the slitting stage, which can be a fire risk.

Fraser has installed Ionised Air Blowers, such as Model 2010 at this point to neutralise the charge in the slit material and also to dilute the propane gas in the air. Typically the environment is not considered to be an EX area and therefore any anti-static device can be used. Customers include Linpac in UK.

B) The Extrusion Process

The foam is hot after extrusion and the static charge is not stable until it cools. Longer range static eliminators are needed here as web breaks are possible.

The photo on the right shows an Ionstorm Bar positioned high above a polystyrene web to neutralise the charge.

C) Neutralising the Winder

The winding is on large diameter centre winders and will need NEOS 20 or NEOS 30 to neutralise the charge.

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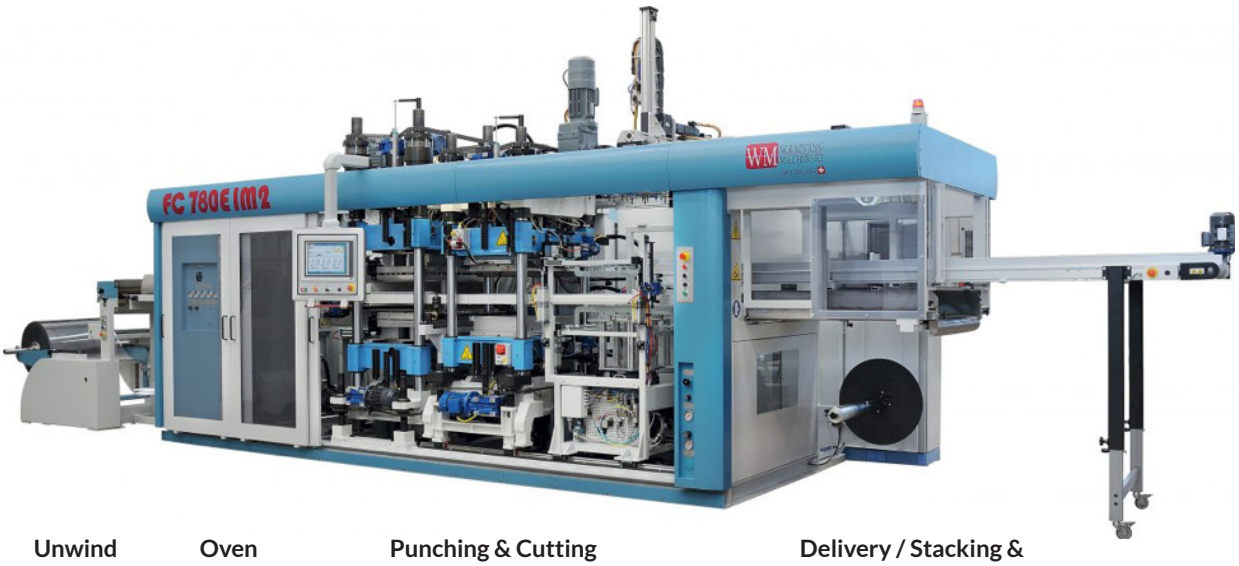
Static Control in the Web Thermoforming Process

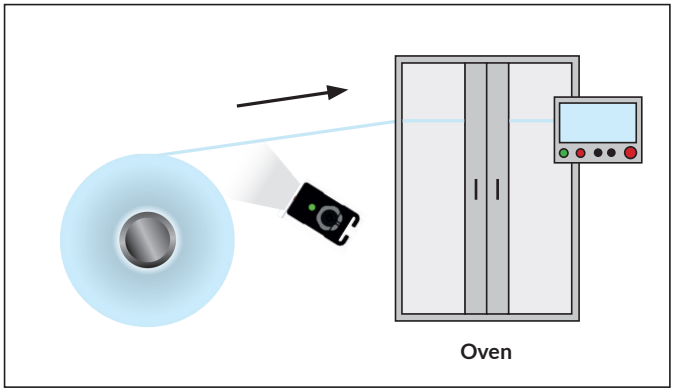
A typical continuous web thermoformer (WM Thermoforming Machinery, Switzerland) is shown below:



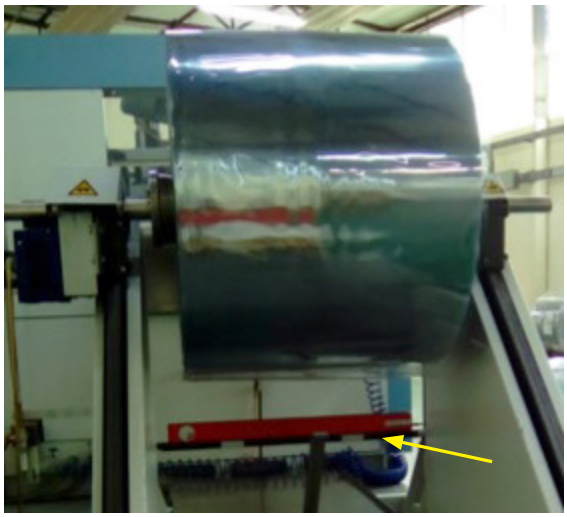
Unwind **Oven** **Punching & Cutting** **Delivery / Stacking & Waste Rewind**

A) Unwind: Neutralising, Cleaning the Material Entering the Process

The material must be clean when entering the oven. The unwinding of the material can create a large static charge which attracts airborne dust and contaminates the web.



A NEOS 20/30 Bar neutralises the charge in the material to prevent dust attraction onto the material before it enters the thermoformer.



This photos shows a NEOS 20 neutralising the unwinder of a thermoformer to stop dust being attracted to the material and prevent shocks.

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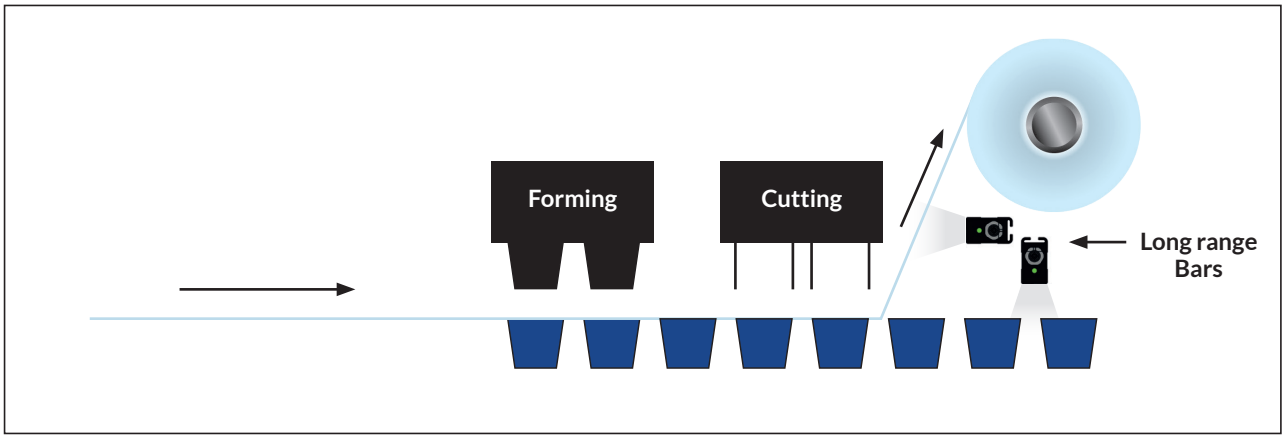
B) Punching and Cutting the Shapes

The heat, the action of the dies in forming and then the cutting out of the individual products can generate considerable levels of static charge. We have supplied many 3024L Bars to neutralise this charge. Typical application:

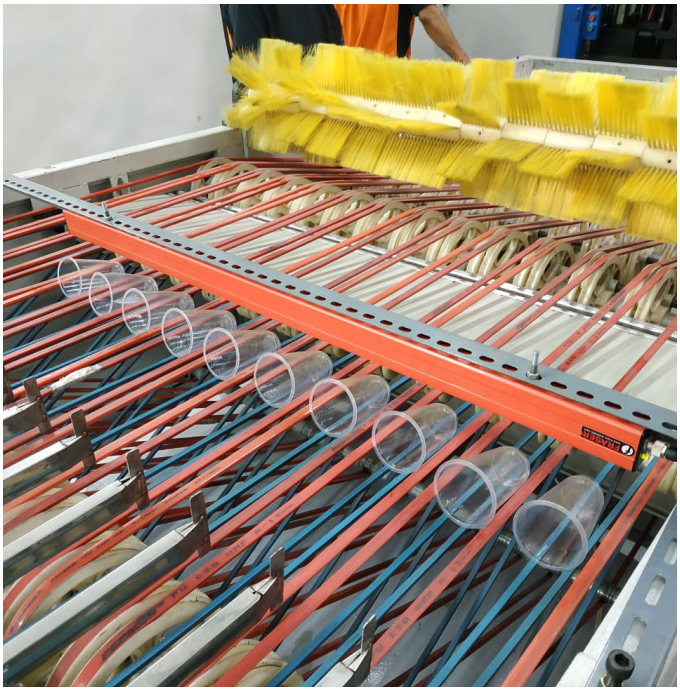


3024L Bars neutralising the skeletal / waste and the thermoformed product before robot handling / stacking.

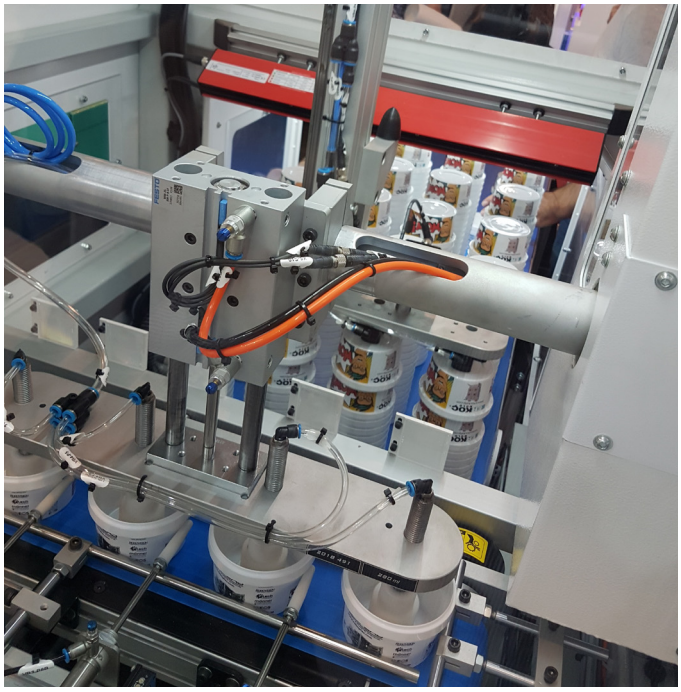
C) Delivery and Stacking the Thermoformed Products

If the products have a static charge they could misbehave in the stacking process and the charge will make it difficult to de-stack the products when they are to be used.

Longer range static eliminators are used to neutralise these products immediately before they are delivered onto the conveyor or stacks. Some customers use 3024L and NEOS Bars. Some customers also like airboost bars.



A NEOS 12F neutralising cups at the thermoformer output prior to stacking.



A NEOS 20 Bar neutralises the pots at stacking.

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1. CONTINUOUS WEB THERMOFORMING

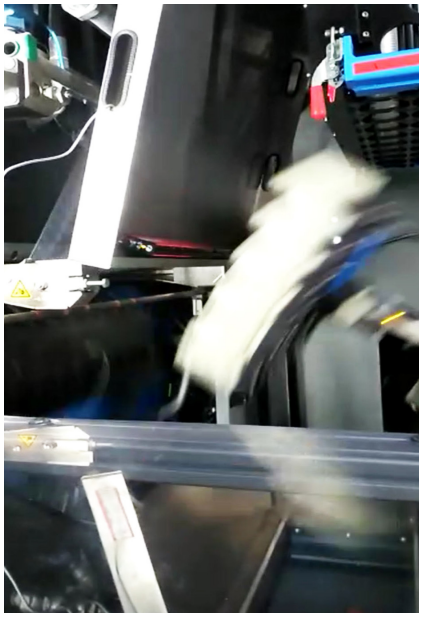
The photo on the left shows a 1250-Air Bar neutralising thermoformed trays as they are stacked on a conveyor.

In the photo on the right a NEOS 20 neutralises bowls as they are stacked.

These two screenshots show cups being removed from the mould by a robot head. 36 cups are moulded in each cycle. The second photo shows the robot head withdrawing. You can see the NEOS 20 Bar ready to neutralise the cups when they pass. In the top of the left hand photo you can also see the lattice of waste material after the cups have been cut out.

In these two photographs, you can see the cups passing quickly by the NEOS 20 Anti-static Bar. The movement is fast and this is why the photograph is blurred. Due to the way the robot collects the cups, some of the static will combine with the holders, however this is the only opportunity and will give a partial neutralisation. In the right hand photo the cups are being pushed into the bottom of individual tall tubes containing 10s of cups.

There is a problem with this installation. Although the bar is in a good position to neutralise the cups it is too close to the lip of the 'tray' that it is mounted to. This was insulated using some very thick plastic and we advised that the bar was used in Manual Mode.



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2. INDUSTRIAL SHEET THERMOFORMING

Some small scale sheet thermoforming is used in food packaging – this is not of interest to us here.

By industrial sheet thermoforming we mean the production of industrial 3-dimensional products. Generally the sheet material will be thicker and the life of the product will be much longer – these are not one-use disposable products.

The oldest thermoformed industrial product was the inner parts of refrigerators. These are still thermoformed and then machined to include holes and slots. Fraser has supplied many Bars and Ionised Airknives to international refrigerator manufacturers to neutralise the charge and clean these parts after machining.

Thermoforming of industrial products has increased in scope enormously in recent years. It is no longer just used for simple tray-like products.

Today thermoforming is used to make:

Automotive Parts

- Control panels
- Fascias
- Luggage trays
- Consoles
- Motor hoods
- Headrests
- Door linings
- Trunk luggage trays
- Air ducts
- Tractor hoods and cabs
- Caravan walls

Other Parts

- Industrial trays
- Door panels
- Refrigerator and freezer interior panels
- Point of sale displays

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2. INDUSTRIAL SHEET THERMOFORMING

A) Cleaning Industrial Products before Thermoforming

The sheet must be clean. If it has surface contaminants these will be included into the material when the material is heated and formed and it may be rejected for quality.

We have supplied a number of 4125 Ionised Airguns for cleaning sheets to remove dust and other contaminants. The tool cavities also need to be blown with ionised air to remove contaminants which could be pressed into the product.

The 4125 Ionised Airgun is used to clean sheets before thermoforming and also to clean the tool cavities.

5100 Ionised Airknives can be used for more automated sheet feeding.

B) Cleaning the Product after Thermoforming and Machining

If the thermoformed product goes into an automated machining process – such as with refrigerator interior panels – where holes and shapes are cut out of the product then the swarf will need to be blown off the product before it is delivered. We have supplied Ionised Airknives and Nozzles to many of the largest manufacturers of refrigerators and freezers for this purpose.

C) Neutralising the Product Before Delivery

A longer range static eliminator can be used to neutralise the product before it is delivered.

This is required to prevent shocks to operators, stop dust attraction and to stop the products sticking together if they are stacked.

Air-assisted static eliminators are used by some manufacturers because the air contributes to the cooling of the product. If there are already cooling airjets in use, these can be ionised with a short range static eliminator.

We have the widest choice of long range static eliminators available – from Air-assisted Bars and Blowers to the NEOS 30.

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1. CONTINUOUS WEB THERMOFORMING - SOLUTION SUMMARY

STAGE IN THE PROCESS	DESCRIPTION OF ISSUE	POSSIBLE RISKS	SUGGESTED FRASER SOLUTION
Material Extrusion (e.g. polystyrene)	Extrusion on a circular die then slit to form a flat web can generate a charge. Additionally the slitting process can release hydrocarbon gases.	- Shocks to operators - Fire - Attraction of contaminants	An **Ionised Air Blower** such as the **2010**. The ionised air flow will neutralise the static charge and dilute any released gases.
Neutralising the Web (after Extrusion)	When extruded, the material is hot and the electrical charge is unstable. A static charge can develop as the material cools.	- Shocks to operators - Attraction of contaminants	In the event of web breaks, clearance above the web is needed. A longer range solution such as the **Ionstorm Bar** is required.
Material Winding	Winding material using large diameter centre winders can generate a significant charge in the web.	- Uneven winding - Fire - Attraction of contaminants - Shocks to operators	**NEOS 20** or **NEOS 30**. The changing geometry of the material on the winder needs a high output, intelligent bar such as the NEOS.
Material Unwinding	Unwinding material using large diameter centre unwinders will generate a significant charge in the web.	- Fire - Attraction of contaminants - Shocks to operators	**NEOS 20** or **NEOS 30**. The changing geometry of the material on the unwinder needs a high output, intelligent bar such as the NEOS.
Transport to the Thermoformer - Cleaning the Web	Potential for contamination by airborne dust and other particulates.	- Attraction of contaminants	Compressed air solutions: - **4400** Ionised Air Nozzles - **5000** Compact Ionised Airknife - **5100** Ionised Airknife Fan driven solution: - **5500** Fan-driven Ionised Airknife
Forming/Punching and Cutting	Heat, the action of the dies and punching/ cutting out of the individual products and the winding of the skeletal waste can generate considerable levels of static charge.	- Attraction of contaminants - Product misbehaviour - Shocks to operators - Uneven winding	- **3024L** Bars - **NEOS** Bars
Delivery/Stacking of Thermoformed Products	Static charge on the products can cause misbehaviour in stacking and difficulty in de-stacking when the products are used. Smaller products can also cling to conveyor systems or even be repelled at their destinations.	- Attraction of contaminants - Product misbehaviour: unwanted cling or repulsion - Shocks to operators	- **3024L** Bars - **NEOS** Bars - Airboost bars can also be used to provide additional range, cleaning, cooling and help dislodge products from the end of conveyor lines

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2. INDUSTRIAL SHEET THERMOFORMING - SOLUTION SUMMARY

STAGE IN THE PROCESS	DESCRIPTION OF ISSUE	POSSIBLE RISKS	SUGGESTED FRASER SOLUTION
Manual Feed of Sheets	Separation and handling of sheets will generate a static charge.	- Attraction of contaminants - Shocks to operators	- **4125** Ionised Airgun
Automated Feed of Sheets	Separation and handling of sheets will generate a static charge.	- Attraction of contaminants - Shocks to operators	- **5100** Ionised Airknife
Cleaning Tool Cavities	Any contaminants left in the mould can be pressed into subsequent products	- Contaminants in the mould will give poor quality products and a high reject rate	Low volume/manual feed systems: - **4125** Ionised Airgun High volume/automated feed systems: - **4400** Ionised Air Nozzles - **5100** Ionised Airknife
Cleaning Products after Thermoforming and Machining	After thermoforming, the products can be trimmed, drilled or machined. Any of these processes can produce dust, swarf or other small plastic particulates.	- Poor finish. Products must be cleaned before stacking, delivery or application of finish such as paint or labels	Low volume/manual feed systems: - **4125** Ionised Airgun High volume/automated feed systems: - **5100** Ionised Airknife - **4900** Roto-Clean - **5500** Fan-driven Ionised Airknife
Neutralising the Product before Delivery	Cooling of the product and additional handling such as stacking and unstacking can generate further static charges.	- Attraction of contaminants - Shocks to operators - Product misbehaviour such as unwanted cling or repulsion	A longer range solution can be used such as: - **3024L** Bars - **NEOS** Bars Air-assisted static eliminators can also be used to provide additional cleaning and cooling. If airjets are already used, then they can be ionised with a short range static eliminator to improve contaminant removal and prevent re-attraction.

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