



QUALITY DEFINITION “DOUBLE TRAY SYSTEM”

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Quality Definition of the “Double Tray System” (DTS)

Description of the DTS

The DTS is a plastic double tray system made of Polystyrene (PS) raw material through thermoforming process. It consists of one flexible top tray for sowing or transplantation and one flexible bottom tray for support. Both trays of the system have drain holes. When the two trays are combined into the double tray system, the result is one unified and rigid object which is characterized by the fact that the bottom (supporting) tray has the reversed negative shape of the top tray of the system.



The design of the DTS is protected by international patent (**Patent No: WO 2014147250A1**) for the production or the use of the trays.



Advantages and Characteristics

The combination of these two trays makes an inflexible system. The outer shape of the system is compatible with all the sowing or transplanting automatic lines which are using expanded polystyrene trays. The surrounding wall keeps excess substrate away from the system during the filling stage and also provides a smooth surface for printing crop information that is essential for production management. Double tray system is impenetrable from roots, so no anchoring on cell walls occurs and plant extraction is easy with no root damage. Also plant extraction can be done through the drain holes with an extractor or by hand. Both parts of the plastic double tray system can be placed one inside the other respectively, thus keeping very low transport and storage volume (and cost). Plastic double tray system is made of PS (polystyrene) which are all recyclable.

Advantages of the DTS are: easy plant extraction with no injuries, very low transport and storage volume, made out of completely recyclable material. Plastic double tray system is also rigid, very durable and does not require any changes on the existing production systems.

Another important characteristic of the double tray system, not expected from trays made of solid polystyrene is the floating capabilities. The design of the DTS is such that traps air in the grooves of the bottom tray making the tray system to float carrying the weight of the soil and the growing plants on it.



The Double Tray System, whether floating or not, gives, proven in the field, 12% minimum premature growth, better and healthier plants provided that appropriate and good agricultural practices are being applied.

Design and dimensions

The design of the top tray is similar to the expanded polystyrene or injection trays in order to be compatible with all the sowing or transplanting automatic lines and greenhouse handling systems.

The cell design gives another advantage to the DTS trays. It has a groove on each side of the cell which forces the root system of the plant to be straight and prevents from curling



Typical Cell Design

The available Top Tray DTS sizes, according to the USA foot print, with their basic dimensions for the trays and cells and cell volume and typical packaging quantities are shown on the following table:

* Please note that every tray configuration below, comes with its equivalent base tray

PRODUCT USA SIZE	TRAY DIMENSION (cm)	No of CELLS	CELL DIMENSION (mm)	CELL VOLUME (ml)	PIECES PER PALLET*
1-ST4-01-BL-01	67X33	128	38X38X65	40	1665
1-ST4-03-BL-01	67X33	171	30.5X30.5X64	31	1665
1-ST4-02-BL-01	67X33	210	27X28X56	23	1665
1-ST4-04-BL-01	67X33	300	23X23X50,5	16	1665

* Pallet size 100X120 cm. Quantities per pallet refer to Top Trays. For complete DTS an equivalent quantity of Base Trays is required

Detailed dimensions and thicknesses of top and base trays analytically

Type of tray	Sheet Thickness microns	Length in mm	Width In mm	Thickness			Weight gr	Tolerance ES Norms
				Min' upper part mm	Min Cell walls mm	Min botto m mm		
Top tray 128 cells	670	673	335	0,058	0,032	0,028	170	5%
Base Tray 128 cells	750	675	335	0.064	0.035	0.031	180	5%
Top tray 171 cells	700	670	330	0.060	0.033	0.029	170	5%
Base Tray 171 cells	800	670	330	0.067	0.037	0.032	200	5%
Top tray 210 cells	730	669	330	0.062	0.034	0.030	175	5%
Base Tray 210 cells	800	671	332	0.067	0.037	0.032	200	5%
Top tray 300 cells	750	669	331	0.064	0.035	0.031	180	5%
Base Tray 300 cells	800	670	332	0.067	0.037	0.032	200	5%

The surrounding wall of the top tray is (14 to 15 mm) high

The detail design of the USA foot print (67X33) trays can be found in Appendix 1

Raw material

Both trays of DTS, top and bottom, are made from High Impact Polystyrene sheet material.

Production Process & Quality Milestones

1. Sheet production or Sheet purchase

Thickness verification with tolerance +/- 1%,

Pendulum Impact test per 500 kg roll to verify IZOD > 7

2. Thermoforming Process

The PS sheet is being heated up the material up to 180 degrees Celsius uniformly.

The next steps are forming, drain holes opening and peripheral cutting

The final step is the automatic stacking of the trays by the machine on batches of **10** pieces.

Every batch is visually checked for deficiencies and it is placed on the transportation pallet.

The **mechanical strength** of the DTS is tested and verified using the initial trays produced from each new roll fed in the machine

The **test** is carried out by placing the DTS on rails (30mm either side) and putting a flexible blanket weight of 20 kg evenly on the surface, simulating the real application conditions

3. Packaging for transportation

The trays are placed on pallets (1,00 m X1,20 m) in four columns at the height of 2,3 meters

Every pallet carries only top or bottom trays

The exact number of trays per pallet for every tray is noted on the table with the available DTS trays

The pallet is being wrapped up with white color stretch film for the stabilization of the trays on the pallet for transportation. Each pallet is covered with a cardboard top hat and PP straps are folding the pallet from top to bottom (including the pallet) from both sides.

Every pallet is marked with the type of tray, the quantity and the production date

When it is requested the trays can be packaged in carton boxes and the boxes on pallet. In this case each box contains 70 pcs and each pallet holds 21 boxes

Quality Standards and Tolerances

1. Dimensions

All dimensions as shown on the drawings of the molds on Appendix 1 can vary due to shrinkage up to 1%

2. Raw material

The PS sheet used is between 0,70 mm thick to 0,8 mm thick and the technical characteristics are HIPS (High Impact Polystyrene) with impact strength > 7

The material is a mixture of virgin and recycled PS keeping all the engineering values of the material.

In the case of the floating application the raw material is a special grade virgin HIPS with high melt flow index to secure 100% porous free material.

3. Thickness of the material on the DTS

The original thickness of the polystyrene sheet cannot be possible to be maintained on every point of the trays. This is a normal effect on thermoformed products. The thickness of the material at the bottom of the cells will be significantly less from the original thickness of the sheet material.

The thickness of polystyrene sheet for the top trays is between 700 to 750 microns and for the bottom trays between 750 to 800 microns.

The thickness of the side and the bottom of the cells and the side skirt of the top tray (all the "formed" in depth parts of the tray) can be medium 300 microns \pm 5%, with a minimum of 120 microns in particular deep corners according to design.

4. Weight of the tray

The actual weight of the tray is not of any importance for its application; more important is the actual minimum thickness of material on every part of the tray as mentioned before (Material Thickness).

The medium weight of the trays, top or bottom, can be from 170 to 200 gr according to application.

5. Drain Holes

The drain holes on the trays are offering the important drainage for the plants. The diameter of the drain holes of the trays, top and bottom, can be found between 6mm and 7mm. It is standard on each type of tray but can be different between the types. The alignment of the drain holes of the top with the bottom tray cannot always be absolute but it will always leave a minimum "operational" diameter of the hole (with the top and bottom tray combined) of 5 mm. The visual check of the drain holes' alignment is performed on every batch of 10 pieces of base tray production.

6. Surface finish

The finish of the surface it is even and glossy; free from perceptible projections, lumps, or indentations and adequately smooth passing the test of "cotton glove"

Instructions for handling

The trays are robust enough for the application were designed and engineered.

Removing the trays in batches from the pallet where they were being transported must be hold from two opposite sides and lifted up simultaneously preferably holding the trays from underneath.

The trays, top or bottom, on their own are flexible and must not be placed on uneven surfaces and put any weight on them because they can suffer damages.

When the two trays, top and bottom, are combined together become robust and strong enough to overcome all the usual loads and stress found in the green house or the field.