technical specification 8

MULTI-STOREY PARKING

Waterproofing and Thermal Insulation of roofs covering car parks

Today, more than at any other time, parking in our towns and cities has become more difficult. The cost of land is extremely high and the increasing need for off street parking has made it impossible to provide sufficient space to meet demand. Multi-storey parking has therefore become a necessity in order to provide better and more economical use of the available space.

The kind of roof, which will have to withstand much higher physical and mechanical stresses than a normal roof, will require an extremely strong and flexible waterproofing protection. The choice of waterproofing and of the thermal insulation, should it be required, must be able to resist the stresses generated by compression, traction, cutting and chemical attack which are characteristics of roof parking.

The main structure and wearing surface should have dimensions compatible with the waterproofing and thermal insulation requirements. As the waterproofing is sandwiched between the main floor structure and the wearing surface, any maintenance work could prove extremely expensive. It is therefore vital that all forms of roof or terrace are carefully thought out and well planned.

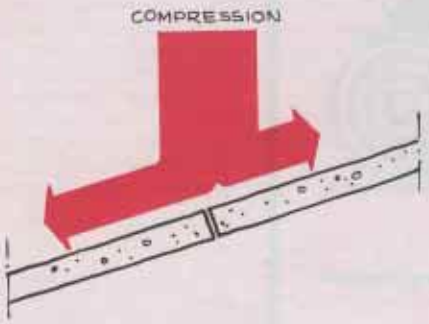
This publication deals with roof and terrace parking which have a concrete main structure and tarmac, cast concrete or block wearing surfaces. It gives information and suggestions on how to deal with the waterproofing system and roof details.

INDEX SpA manufactures waterproofing membranes based on polymer modified bitumen reinforced with non woven polyester fabric. They are TESTUDO SPUNBOND and HELASTA P. These types of materials do not rot, they resist traction, perforation and attack by anti-freeze solutions and are therefore suitable to be used in the waterproofing of roof and terrace parking.

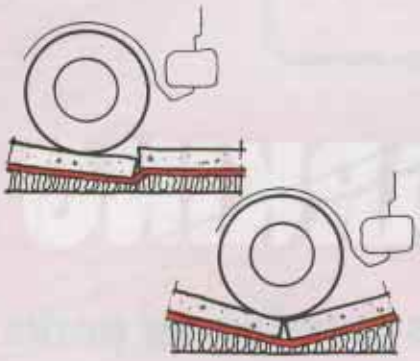
index complete systems

1 INTRODUCTION - PROBLE

At first sight, the waterproofing of the parking terrace and the flat roof with access may seem the same. In fact the stresses which affect parking terraces of roofs are much greater and of a very different nature. The waterproofing layer is subjected to much higher compression stress and horizontal traction.



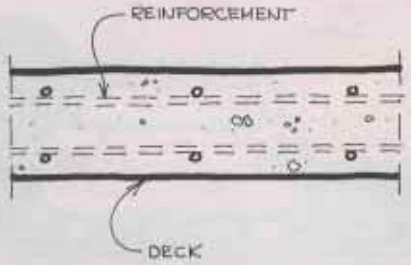
These horizontal stresses are characteristics associated with the access ramp but are also present on the flat surfaces where vehicles brake or accelerate harshly. When the waterproofing is applied on a thermal insulation with concrete slabs above, the stresses change, creating a cutting stress along the edge of the concrete slabs.



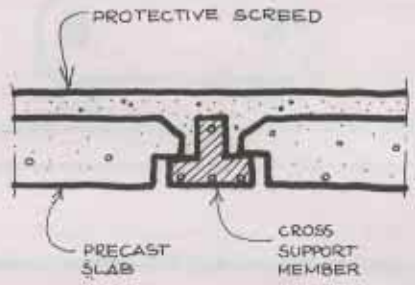
Chemical attack by anti-freeze salts, oil and petroleum creates further problems. It is therefore important that a good quality sealant which is not affected by oil, petrol, etc. is used between paving slabs. The roof area should have a 15° slope to accelerate the discharge of any harmful substances.
The waterproofing, when Tarmac is laid directly on top, will be subjected to thermal shock when the hot binder is applied, and to great puncture stress when the Tarmac is being rolled. It is important that the deck on which the waterproofing will be laid is sufficiently rigid to avoid great movement, particularly where the waterproofing covers adjacent prefabricated elements.

The main structure will be:

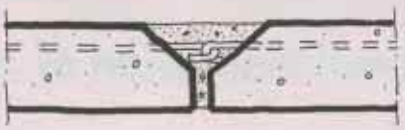
1 - Reinforced concrete site cast



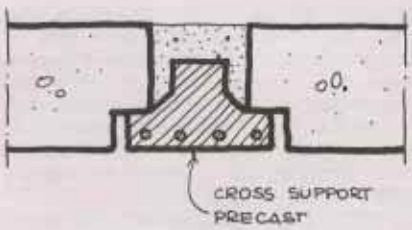
2 - Prefabricated concrete slab with screeded surface



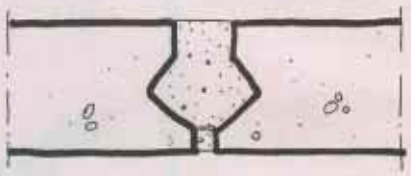
3 - Precast concrete slab with steel work tie and concrete infil at joint



4 - Precast concrete slab with concrete infil at joint



5 - Prefabricated concrete slabs tied with continuous "keys" of concrete



Movement between adjacent prefabricated elements of the main structure caused by the weight of vehicles should not exceed an opening of more than 1.5mm.
The waterproofing may only be used under Tarmac on structures depicted in diagrams 1, 2 & 3. The structure shown in diagram 5 can only be used for light weight vehicles (≤2t per axle) whilst for heavy weight vehicles (>2t per axle) the structure shown in diagrams 1, 2, 3 & 4 may be used.
The surface on which the waterproofing will be applied must be flat, in general using a 2 metre straight edge depressions should not exceed 10mm and with a 200mm straight edge they should not exceed 3mm.

LEGEND:

- WATERPROOFING MEMBRANE
- THIS IS NOT A WATERPROOFING LAYER BUT USED FOR ILLUSTRATION PURPOSES
- VAPOUR BARRIER
- THERMAL INSULATION

If thermal insulation panels are used they should be of a type which have a high resistance to compression. Generally preference should be given to those panels which have a minimum resistance of 2.5kg/cm² when compressed by 5%. The data sheet gives values of resistance with 10% compression for several types of insulation. For more detailed information regarding compression resistance in varying conditions of humidity, heat, etc. contact the relevant insulation manufacturer. Under all conditions, it is necessary to allow a safety coefficient of at least 3 from the calculation of load and overload expected on the insulation laid to the parking area. The thickness of the concrete paving must be in relation to the resistance of the insulating panels. However, the use of thermal insulation panels under paving should be restricted to those areas for light weight vehicles ≤2t per axle unless the manufacturer also specifically indicates suitability for heavy vehicles (>2t per axle).

Where insulation panels are used, Tarmac must never be applied directly onto the waterproof covering.

RESISTANCE TO COMPRESSION (WITH 10% COMPRESSION)	
Expanded polystyrene 20 - 25 kg/m³	1.9 kg/cm²
Expanded polystyrene 25 - 30 kg/m³	2.2 kg/cm²
Autoexpanded cork 80 - 100 kg/m³	1.5 kg/cm²
Tanned cork 140 - 200 kg/m³	2.5 kg/cm²
Expanded polyurethane continuously laminated 30 - 35 kg/m³	1.4 kg/cm²
Bulk expanded polyurethane 30 - 55 kg/m³	2.5 kg/cm²
Bulk expanded polyurethane 45 - 50 kg/m³	4.0 kg/cm²
Extruded expanded polyurethane 30 kg/m³	3.5 kg/cm²
Extruded expanded polyurethane 40 kg/m³	4.0 kg/cm²
Expanded phenolic resin 50 kg/m³	2.5 kg/cm²
Perlite & aggregate of cellular fibre 176 kg/m³	3.6 kg/cm²
Expanded glass foam 130 - 135 kg/m³	7 kg/cm²

INDEX MATERIALS

TESTUDO SPUNBOND POLYESTER

The membrane manufactured using polymer modified bitumen reinforced with a non woven, isotropic polyester fabric has excellent characteristics – IT IS FLEXIBLE – RESISTS PUNCTURING AND TEAR STRESS – DOES NOT ROT – IS STABLE AND HAS EXCELLENT RESISTANCE TO AGEING.

PRIMER

This bituminous compound contains quick drying solvents and adheres to all surfaces. It seals porous surfaces in preparation for the adhesion of a membrane. It also acts as a protection on metal surfaces. The primer is applied with a brush, mop or spray. For further information refer to specific technical data.

2 WATERPROOFING

PARKING FLOOR AREA WITH CONCRETE SURFACE - SITE CAST

Known conditions

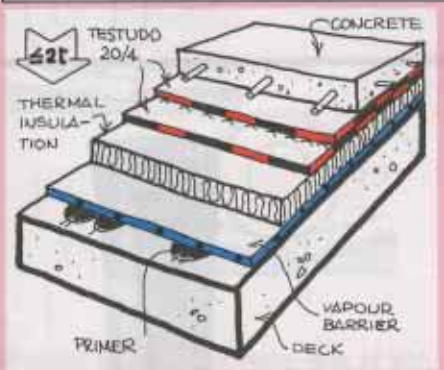
- **On support type 1-2-3-4 (light and heavy traffic)**
- **On support type 5 (light traffic ≤ 2t per axle)**
- **Slope 2%**

NON MOUNTAINOUS CLIMATE

technical specification

All elevations (joints, gullies, etc.) and the areas around them should be coated with a bituminous primer, **INDEVER**, comprising bitumen additives and solvents which have 50% solids and a FORD viscosity No. 4 at 25°C for 20 to 25 secs.

With Thermal Insulation (light traffic only ≤ 2t per axle)



VAPOUR BARRIER

A vapour barrier should be applied over the complete surface of the substrate. This will be a **DEFEND 3 FLAMINA** waterproofing membrane 3mm thick and manufactured using distilled bitumen modified with atactic polypropylene and other elastomers reinforced with a glass fibre mat.
The permeability to vapour of the membrane has been tested by using it to seal a payne cup containing a saturated solution of biacid ammonium phosphate (NH4 - H2P04). The test showed nil permeability.
The vapour barrier will be loose laid on the flat areas but on vertical sections, upstands, etc. it will be fully bonded to a height of at least 50mm above the insulation level. All laps will be 100mm and will be flame welded.
Using the same method, the roofing above any rooms which have a relative humidity in excess of 80% at 20°C should have a vapour barrier incorporating an aluminium foil. **DEFEND ALU** is manufactured using polymer modified bitumen and has a fibre glass carrier together with a vapour proof aluminium foil.

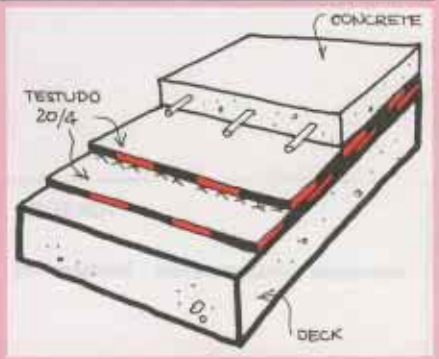
THERMAL INSULATION

(Refer to chapter 1 Introduction - Problems. Follow the manufacturers instructions).
Mineral cellular aggregates, glass foam, cork, foamed polyurethane, etc. In order to avoid cold bridging, insulation panels should be placed closely side by side, and the joints taped. If the total thickness is 60mm, two separate offset layers should be used.
(example: 60mm = 30mm + 30mm or 40mm + 20 mm)

WATERPROOFING MATERIALS

The waterproofing should consist of two 4mm layers of **TESTUDO SPUNBOND 20/4** which has been manufactured using atactic polypropylene modified bitumen reinforced with a non woven isotropic polyester fabric.
The Testudo will have an ultimate longitudinal and transverse tensile strength of 80 kg/5cm and 70 kg/5cm respectively. The ultimate elongation will be equal to 50% and the hydraulic pressure resistance to burst on free discs of 177 cm². will be 3 kg/cm². Testudo shows a high resistance to fatigue with over 1000 cycles across an active split, opening 3mm in both directions. When laid on a panel of expanded polystyrene of 30 kg/m³ it shows a resistance to static puncturing ≥ to 20 kg.
The first waterproofing layer should be loose laid onto the insulation and then turned at the vertical sections and flame bonded to a height of at least 200mm above the paving level. The second layer should be set parallel with and astride the laps of the previous layer and be fully flame bonded. For both layers the laps should be 100mm and these must always be flame welded using a propane gas torch.

Without Thermal Insulation



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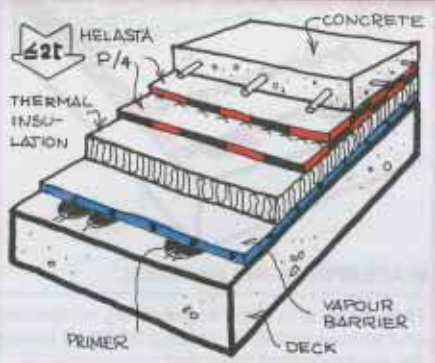
MOUNTAINOUS CLIMATE

technical specification

All elevations (joints, gullies, etc.) and the areas around them should be coated with a bituminous primer, **INDEVER**, comprising bitumen additives and solvents which have 50% solids and a FORD viscosity No. 4 at 25°C for 20 to 25 secs.

With Thermal Insulation (only light traffic ⩽ 2t per axle)



The first waterproofing layer should be loose laid onto the insulation and then be turned and flame bonded on vertical sections to a height of at least 200mm above the paving level. The second layer should be placed parallel with and astride the previous layer and be fully flame bonded.
For both layers the laps should be 10mm and these must always be flame welded using a propane gas torch.

VAPOUR BARRIER

(See previous specification).

THERMAL INSULATION

(See previous specification).

WATERPROOFING MATERIAL

The waterproofing system will consist of two layers of 4 mm thick **HELASTA P 4** (I.C.I.T.E. Agrement Certificate N. 400/93). This material si based on thermoplastic elastomers which have ultimate elongation properties equal to 2000%. The reinforcement is continuous single strand extruded non-woven isotropic polyester fabric. The membrane will have a longitudinal and transverse ultimate tensile strenght equal to 90 kg/5 cm and to 80 kg/5 cm respectively and ultimate elongation of over 50%. **HELASTA** will remain flexible at temperatures below -25 °C and be resistant to 10,000 fatique cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. When laid on a panel of expanded polystyrene of 30 kg/m^3 it shows resistance to static puncturing equal to ⩾ 20 kg.

PARKING FLOOR AREA WITH TARMAC LAID DIRECTLY ONTO THE WATERPROOFING LAYER

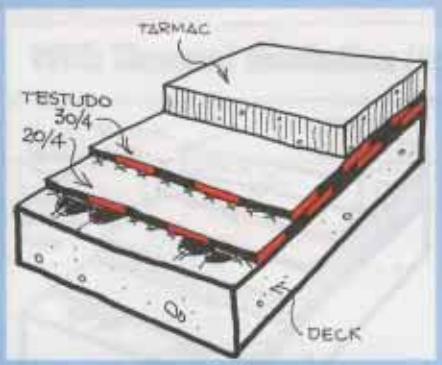
Known conditions

- **Without thermal insulation**
- **On support type 1-2-3-4 (light and heavy traffic**
- **On support type 5 (light traffic ⩽ 2 ton per axle)**

NON MOUNTAINOUS CLIMATE

technical specification

All elevations (joints, gullies, etc.) and the areas around them should be coated with a bituminous primer, **INDEVER**, comprising bitumen additives and solvents which have 50% solids and a FORD viscosity No. 4 at 25°C for 20 to 25 secs.



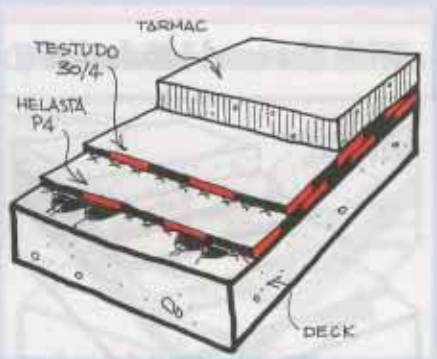
WATERPROOFING MATERIALS

The primer should be allowed to dry completely and should be left for at least 24 hours before the waterproofing is applied.
The waterproofing should consist of two 4mm layers of **TESTUDO**.
The first will be **SPUNBOND 20/4** and the second layer **SPUNBOND 30/4** which has been manufactured using atactic polypropylene modified bitumen reinforced with a continous single strand extruded, non woven isotropic polyester fabric. The Testudo will have an ultimate longitudinal and transverse tensile strenght of 80 kg/5cm and 70 kg/5cm respectively. The ultimate elongation will be equal to 50% and the hydraulic pressure resistance to burst on free discs of 177cm² will be 3 kg/cm². Testudo shows a high resistance to fatigue with over 1000 cycles across an active split opening 3mm in both directions and resistance to static puncturing on concrete equal to ⩾ 20 kg. The first layer will be fully bonded to the whole surface including upstands, etc. to a height of at least 200mm above the tarmac, using a propane gas torch. All laps should be at least 100mm and be fully flame welded.
A cap sheet of **TESTUDO SPUNBOND 30/4** should be set parallel with and astride the laps of the previous layer. **TESTUDO SPUNBOND 30/4** is manufactured using atactic polypropylene modified bitumen reinforced with a continuous single strand extruded non woven isotropic polyester fabric. The membrane will have an ultimate longitudinal and transverse tensile strength of 125 kg/5 cm and 110 kg/5cm respectively. The ultimate elongation will be equal to 60% and the hydraulic pressure resistance to burst on free discs of 177cm² will be 3 kg/cm². Testudo shows a high resistance to fatigue with over 1000 cycles across an active fissure opening 3mm in both directions and resistance to static puncturing on concrete equal to ⩾ 40 kg.
When fully bonding to the base layer allow overlaps if 100m and on vertical sections fully bond to a height of at least 200mm above the tarmac level.

MOUNTAINOUS CLIMATE

technical specification

All elevations (joints, gullies, etc.) and the surrounding areas should be coated with a bituminous primer, **INDEVER**, comprising bitumen, additives and solvents which have 50% solids and a FORD viscosity No. 4 at 25°C for 20 to 25 secs.



WATERPROOFING MATERIAL

The primer should be allowe to dry completely and should be left for at least 24 hours before the waterproofing is applied.
The waterproofing system should be of two layers of 4 mm thick **HELASTA P 4** (I.C.I.T.E. Agrement Certificate N. 400/93) membrane 4 mm thick based on termoplastic elastomers which have ultimate elongation equal to 2000%. The reinforcement is continuous single strand extruded non-woven isotropic polyester fabric. The membrane will have a longitudinal and transverse ultimate tensile strenght equal to 90 kg/5 cm and to 80 kg/5 cm respectively and ultimate elongation of over 50%. **HELASTA** will remain flexible at temperatures below -25 °C and be resistant to 10,000 fatique cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. Static puncturing resistance on concrete is ⩾ 20 kg.
The membrane will be fully bonded to the complete surface allowing 100mm overlaps and at the vertical sections taken to a height of at least 200mm above the tarmac level. A cap sheet of **TESTUDO 30/4** should be applied parallel with and astride the laps of the previous layer. **TESTUDO SPUNBOND 30/4** is manufactured using atactic polypropylene modified bitumen reinforced with a continuous single strand extruded non woven isotropic fabric. The membrane will have an ultimate

longitudinal and transverse tensile strength of 125 kg/5cm and 110 kg/5cm respectively. The ultimate elongation will be equal to 60% and the hydraulic pressure resistance to burst on free discs of 177cm². Testudo shows a high resistance to fatigue with over 1000 cycles across an active fissure opening 3mm in both directions and to static puncturing on concrete equal to ≥ 40 kg.
When fully bonding to the base layer allow 100mm overlaps and on vertical sections fully bond to a height of at least 200mm above the tarmac level.


1


2

1 - Fully bonding the waterproofing on the access ramp.

2 - Waterproofing the flat parking area.

3 - Completed ramp with tarmac surface.

4 - Completed parking area.

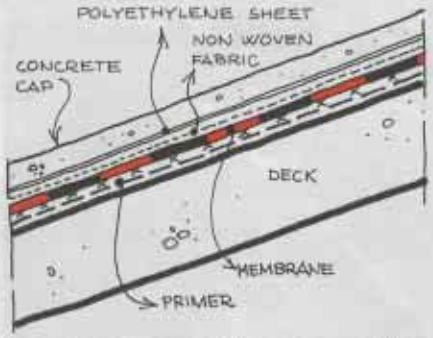

3


4

3 TECHNICAL DETAILS

RAMP

The ramp will be constructed as main structure type **1** or **2**.
The waterproofing should be protected by a concrete screed although in particular cases where small slopes (≤ 10%) are involved it is possible to lay a tarmac surface directly onto the waterproofing. In this case the membrane should always be a **TESTUDO SPUNBOND 30** with a thickness of 4mm or 5mm depending on the smoothness of the concrete. Prior to applying the membrane, all surfaces should be primed with **INDEVER**.
In general the procedures described on page 4 where membranes are used under concrete will apply although the sheets will be fully flame bonded when used on ramps. In all instances

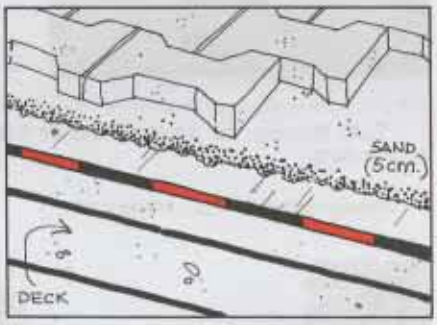


concrete surfaces should be primed (**INDEVER**) before the application of the waterproofing. To protect the waterproofing layer, a non woven polyester fabric 500gm/m² and a polyethelene sheet 0.15 to 0.20mm should be laid prior to the application of the concrete screed.

The ramp should be constructed in such a way as to prevent sliding of the top surface (paving) - see diagram.

CONCRETE PAVING - FLOOR SURFACE

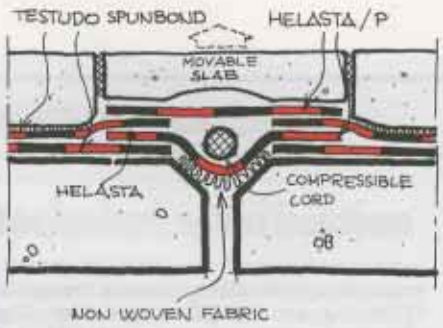
A protective layer consisting of a 0.15 or 0.20 mm thick polyethelene sheet should be loose laid allowing for 200 mm overlaps. Onto this loose laid surface a sand bed 3 - 4mm thick should be put down and a further polyethelene sheet 0.15/0.20mm thick should be loose laid or alternatively a 500gm/m² non woven polyester fabric protected by a polyethelene film as above.
To calculate the flooring thickness when thermal insulation is present follow DIN 1055 Blott 3 instructions and the insulation panel manufacturers directions. For other cases the French standard CSTB-DTU 43-1 1981 should apply and in this instance the thickness of floor surface will be at least 50mm and will be reinforced with an electrically welded metal mesh 150x150mm and 4mm rod.
Every 3 to 5 metres joints will be inserted in both directions, the width of the joint should be ≥ 20mm and will apply to all the paving thickness. The fissure should be filled with a solvent resistant filler which will withstand hydrocarbons, oil and anti freeze salts.
At the foot of every elevation or protrusion a joint should be inserted where flat areas meet the vertical. If the paving used is of the self locking type, it may be laid directly on the 5mm thick layer of sand which will in turn be applied directly onto the waterproofing.



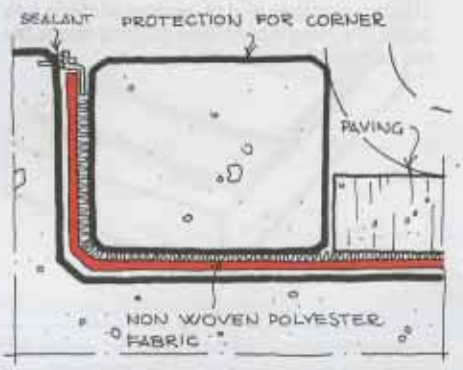
TARMAC SURFACE

The aggregate will preferably be rounded. It will be applied directly onto the waterproofing at a temperature of 140°C. The tarmac should be 40mm thick and be compressed using a hand roller.

STRUCTURAL JOINT (see picture)



RELIEF (see picture)



INDEX's production uses exclusive industrial patents covering secret processes employed during manufacturing.

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