

MAINTENANCE GUIDE

A GUIDE TO AXTER WATERPROOFING
SYSTEM MAINTENANCE



FLAT ROOF

Flat roof maintenance

Flat roof guide

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FLAT ROOF MAINTENANCE

All flat roofs require regular and proper care and maintenance if they are to function reliably over the long term. The maintenance of flat roofs should be well-thought-out during the building design process and a comprehensive maintenance programme and budget should be compiled for the entire building. The provision of regular maintenance is considered to be general good practice, but is also a condition of the waterproofing system guarantee or warranty, and full attention should be paid to the system specific requirements within the building maintenance plan to ensure compliance.

PLANNED MAINTENANCE

The flat roof is considered to be one of the largest depreciating elements of the building fabric and a planned structured maintenance programme completed by qualified personnel is essential to safeguard its maximum service life. Planned maintenance will also give a clear indication of the most economic time to refurbish and/or upgrade the roof to ensure compliance with modern building regulations, such as improved thermal performance in relation to energy conservation.

A well designed, installed and maintained flat roof will exceed anticipated performance-in-use expectations over a building's life and should be undertaken. The implementation of a pro-active (preventative) maintenance plan will likely be more cost effective and cause less long term prolonged disruption to the building owner and/or its occupants than reactive (problem solving) maintenance post occurrence of a defect.

However, there will be occasions during the life of even the most well maintained building when an unexpected problem will arise and reactive maintenance will be required. For this reason, both forms of maintenance should be covered within the building maintenance plan.

MAINTENANCE INSPECTION

The first requirement of a planned maintenance programme is inspection. A flat roof should be routinely inspected every spring and autumn. The spring inspection may detect winter related roof damage. The autumn inspection is to ensure the roof is clear of leaves, debris and dirt before the approach of winter.

Areas of the roof considered to be high-risk locations, those areas subjected to high dust or pollution or in close proximity to trees, should be inspected more frequently. All inspections should include all associated construction, such as brick parapets, rooflights, and rainwater drainage, as well as the building interior, and any defects should be recorded and rectified. A permanent record of inspection and any associated repair works should be held and be available for review at any time.

HEALTH AND SAFETY

The starting point of any maintenance inspection must be the completion of a detailed risk assessment and method statement taking into account site specific requirements. All maintenance inspections must be carried out strictly in accordance with the relevant Health and Safety regulations. Please refer to Health and Safety Executive (HSE) publications, such as Working at Height Regulations (WAHR) and Health and Safety in Roof Work HSG33, for further guidance.

INSPECTION PROCEDURE

Following the completion of risk assessment and method statements, the inspection should commence with the interior of the building, where internal walls and ceilings should be checked for leaks and signs of water staining. A floor plan corresponding to the roof plan should be developed to identify roof level problems manifesting internally.

The exterior walls, rainwater goods (hoppers & downpipes), eaves and soffits should also be included in the inspection procedure, where all signs of defect, such as movement and cracks to exterior walls, blocked hoppers and damaged eaves and soffits, should be noted.

The roof should then be safely accessed and inspected by checking the following roof components:

- » Cap flashings - metal or other rigid or semi-rigid coverings of membrane terminations, including counter flashings, expansion joint covers and copings.
- » Edge details - metal or other rigid or semi-rigid components used to terminate, waterproof and provide wind uplift protection at the perimeter of the roofing system.
- » Membrane flashings - roof membrane termination at walls, water checks, kerbs and gutters.
- » Penetrations and protrusions - pipes, drains, rooflights and all other items that penetrate the roofing membranes.
- » Main waterproofing - the main membrane roofing system.

MAINTENANCE MANUALS

A maintenance manual should be prepared for each building preferably at the time of construction, although this can be completed retrospectively. Maintenance manuals should include the following information:

- » A complete set of 'as built' roof drawings.
- » A dated schedule of roof works covering the life of the building, detailing repairs and any alterations that have taken place.
- » Project specific roofing specifications and design calculations (thermal & drainage).

- » Reference to controlling documentation, such as Building Regulations, British Standards and relevant trade association guidance.
- » Copy records of quality assurance (QA) reports during construction, final QA reports issued upon completion and any supporting test information, such as waterproofing integrity test (WIT) reports.
- » A comprehensive list of manufacturers, designers, suppliers, contractors and accredited installers involved in the roof element of the works.
- » Copies of roof system Guarantees/Warranties combined with specific maintenance requirements and clear guidance of who to contact in the event of a reported defect.
- » Maintenance checklists and timetables of required maintenance tasks, such as clarification of items to be checked bi-annually, annually every 3 years, 5 years and so on.
- » Standard documents that will help keep maintenance record keeping in order, including provision for photographic and video footage record keeping.
- » Records of any reported or discovered defects and any following actions.
- » General building use information and any special requirements and observations.
- » Detailed guidance to assist with all aspects of planned (preventative) and reactive maintenance.
- » Details of any term maintenance contracts and/or repairing lease agreements.

PREVENTATIVE MAINTENANCE GUIDELINES

The following preventative maintenance guidelines should be followed to minimise the effect of disruption to the building owner and/or its occupants.



FLAT ROOF GUIDE

MAINTENANCE GUIDELINES

- » Remove debris such as nails, bottles, cans, balls, boards and bricks.
- » Leaves, paper, dirt etc., which may collect at roof drains, gutters and gullies, should be cleared and removed from the roof.
- » Cut back tree limbs which overhang the roof to give a metre clearance outside the roof edge. This will significantly reduce leaves continually blocking drainage ways.
- » Remove or repair roof mounted equipment which has fallen into disuse or become redundant - it may have the potential to cause damage to the roof membranes.
- » Ensure chippings and other materials designed to protect the roof membranes from UV degradation are in place and evenly spread. Redistribute any surfacing that has been displaced by the action of wind or water flow.
- » Ensure flashings to supporting plinths and cradles of ductwork are checked and maintained in good condition, that they are not penetrating the membranes or restricting drainage.
- » Surface coatings, if applied, will generally require at least one re-application during the life of the waterproofing system to maintain effectiveness against UV degradation. Re-coating is an integral part of the maintenance schedule of any roof system that employs a surface coating material.
- » Regularly ponded surfaces and other areas of self-finished membranes, where there is a build up of moss or algae, should be treated with an appropriate fungicide to reduce the risk of 'mud curling'.
- » Ensure sealants / mastics at counter flashings, termination strips and other locations are in good condition and effective.
- » Ventilation of the roof spaces, if any, and the building or rooms under the roof should be checked. Corrective measures should be taken to improve ventilation of the roof construction in cases of excessive condensation.

INSPECTION - EXCEPTIONAL

An inspection should also be carried out if one or more of the following situations has occurred:

- » Recent construction on or adjacent to the roof
- » New equipment is installed on the roof
- » Unusual weather conditions, such as very high winds or unusually heavy snow
- » Following fire, vandalism or other known damage to an adjacent roof area

TRAFFIC - WARM ROOF CONSTRUCTION WITH SELF PROTECTED MEMBRANE CAP SHEET

Routine foot traffic for inspection purposes is permitted. Concentrated occasional loads such as ladders must not be allowed, except when a load spreading plate is used below the point. Specialist walkway membranes are available if more regular access is required to maintain roof top plant.

In periods of hot weather care must be taken not to disturb the surface of the membrane, which will become soft in the heat. Suitable footwear must be worn and maintenance personnel instructed to minimise their visits to the exposed roof areas. Similarly, in periods of cold weather, it is probable that frost and ice will be present on the roof and all concerned must exercise the utmost care.

PROTECTED MEMBRANE ROOFS

Protected membrane roofs, properly designed and installed, should last for many years without failure. It is often extremely difficult to inspect the waterproofing membranes; in such cases it is only when water enters a building that failure can be detected.

PAVING SLABS

Where paving slabs on proprietary supports cover the waterproofing membrane, then periodic inspection of the membrane, by removing some of the slabs, is recommended. Any debris that has accumulated beneath the paving slabs must be removed.

GREEN ROOFS

It is not practicable to remove the plants and growing medium to inspect the waterproofing, and the system should have been designed to eliminate the risk of mechanical damage. If mechanical damage does occur then it will be necessary to remove the coverings so that inspection and/or repair can take place.

MASTIC ASPHALT, MACADAM ETC.

The membrane in such cases cannot be inspected, but the wearing surface should be periodically inspected for signs of cracks, blisters or other indicators. The underside of the structure should also be inspected for signs of water ingress.



INFORM

If a leak is discovered then inform:

- » The roofing contractor who installed the Axter roofing system that a fault has been discovered.
- » Axter Ltd, if the matter is subject to a warranty claim or if further discussion is required.

RECOMMENDATIONS - SUMMARY

In order to care properly for the roof, the following should be implemented:

- » Maintain historical records
- » Control roof access
- » Conduct 6 monthly inspection and special inspections
- » Report leaks or roof damage immediately
- » Ensure routine maintenance is carried out
- » Use competent persons for major maintenance, emergency repairs and permanent repairs.

GUARANTEE

Failure to follow these guidelines could affect Axter Ltd's and the roofing contractor's liability under the terms of any issued Guarantee or Warranty.

This guide should be read in conjunction with the following:

BS 6229 : 2018 Flat roofs with continuously supported flexible waterproofing coverings - Code of Practice

BS 8217 : 2005 Reinforced bitumen membranes for roofing - Code of Practice

SPRA Single Ply Design Guide 2018 Edition (for PVC-p roofs)



ROOFLIGHT MAINTENANCE GUIDE

MAINTENANCE AND PERIODIC CHECKS

Axter rooflight units are not guaranteed against changes to the characteristics or functions of the unit or any of its constituent parts.

Periodic function checks and maintenance procedures should be carried out in accordance with current regulations. In particular, Axter stipulates a minimum of two tests per year to check the opening/closing in security position of the unit.

Special attention should be paid to the hinges and lock (which must be kept lubricated) and to the struts.

Check that screwed parts are fastened tightly.

Check that the locking system is working properly.

Gas struts should be replaced if they become scratched, distorted or if there is any sign of a leak.

Do not clean the struts with a solvent; this could damage the joints.

Do not paint the struts.

Units should be checked at least once a year.



HYDOME ROOFLIGHT OPERATION AND MAINTENANCE

Hydome rooflights and accessories require no specific maintenance, however the following general guidelines should be followed in strict compliance with relevant Health and Safety regulations.

	OPERATION	MAINTENANCE
HYDOME ROOFLIGHTS	Hydomes are fixed at installation stage to the relevant upstand, and are a means of allowing natural light into the area below.	Wash only with warm soapy water.
	<p>Acrylic rooflights are fragile and should be treated as such.</p> <p>Polycarbonate rooflights are non-fragile, but should not be trafficked.</p>	DO NOT USE strong detergents or abrasives.
HYDOME KERB	Normally manufactured in extruded PVCu, or GRP, Hydome kerbs provide a proprietary upstand detail for Hydome rooflights.	<p>Maintenance free.</p> <p>GRP Hydome kerbs may be decorated internally if required.</p>
PASSIVE VENTILATION	Normally by means of 'Trickle', 'Louvre' or 'Rotating' vents, to provide background ventilation. Trickle vents are adjusted by hand. Louvre and Rotating vents are adjusted by a proprietary operating rod – available in 1.5, 2 or 3m lengths. Louvre vents require a sharp upwards push to fully close.	Maintenance free.
OPENING FRAME	Operated electrically by means of 24V electric actuators. Electric actuators must be connected by a qualified electrician.	Physically check fixing brackets to ensure fixings are secure.
OPENING VENTILATION	Operated manually by spindle and proprietary winding rod, or electrically by means of 24V or 240V electric box motors. Manual operation opens to 300mm. Electric motors must be installed by a qualified electrician.	Test annually by an Approved Electrical Installations Testing Company.
ACCESS UNITS	<p>For means of access onto roof area. Only to be used by authorised personnel.</p> <p>Unit is opened by opening the locking cockspur handle and pushing the unit into the open position. The two frictional struts should be adjusted to ensure unit is safely held in the open position.</p> <p>DO NOT use as a means of ventilation.</p> <p>DO NOT USE in windy conditions.</p> <p>ONLY USE in accordance with relevant Health and Safety Regulations.</p>	Check brackets, struts, locking handle, etc., to ensure operation is correct and fixings are secure.
EXTRACT FANS	<p>These are factory fitted to the relevant rooflight component and connected to an unswitched fused-spur.</p> <p>A switched electrical supply should be connected by a qualified electrician.</p>	Test annually by an Approved Electrical Installations Testing Company.
ELECTRIC ACTUATOR	The actuator drives the opening frame to 160 degrees within 60 seconds.	Test weekly and test at 6 month intervals by an Approved Servicing Company.



LIVING ROOF MAINTENANCE GUIDE

Maintenance, conducted by qualified personnel, will ensure the initial establishment and continued health of the green roof system. It is strongly recommended that the installing contractor remains responsible for the maintenance of the green roof during this establishment stage (between 12 - 15 months) and prior to the assignation of maintenance duties to the building owner's representative. Maintenance contractors with specialist training in green roof care should be used where possible.

All maintenance actions carried out at roof level must be in full compliance with the appropriate Health and Safety regulations, and particularly those specifically dealing with working at height. BS 4428:1989 – Code of practice for general landscape operations (excluding hard surfaces) and BS 7370-4:1993 Grounds maintenance - Part 4: Recommendations for maintenance of soft landscape (other than amenity turf) provide guidelines for maintenance actions.

IRRIGATION

Irrigation will be required for the initial establishment of the green roof. Take care not to over water. Once the plants are established, irrigation on extensive and bio-diverse roofs can be reduced or eliminated altogether.

FERTILISER

On extensive roofs with low nutrient growing medium, regular fertilising will be required to provide additional nutrients to enhance germination, flowering and resistance to extremes of weather.

PLANTING REGIME

Unless the object of the green roof is to replicate the ecology of the site prior to the development, as could be the case with a bio-diverse green roof, undesirable plant species can be avoided by ensuring full coverage of the desired plant species at the outset. Alien plants should be removed before they have an opportunity to take root.

PLANT MANAGEMENT

Dead plant material should be removed to allow greater coverage. This improves the appearance of the roof as well as reducing the spread of fungal diseases. On bio-diverse roofs this material could be left to create habitat for wildlife.

MAINTENANCE PROGRAMME

After installation of vegetation on an Axter extensive or bio-diverse green roof, two visits should be made:

- » The first a month later to ensure that the vegetation is in a good condition and to observe any anomalies,
- » The second three to six months later to verify the root growth and to effect any reinstatement that may be necessary.

After this initial maintenance, it is recommended that at least two maintenance visits are made to the roof each year, the first in early spring and the second in late autumn, to ensure that leaf fall is not adversely affecting drainage performance.

The following table gives an indicative work plan during installation and for each subsequent visit.

GENERAL MAINTENANCE FOR ALL GREEN ROOFS	DURING INSTALLATION	STANDARD MAINTENANCE
Remove all vegetation and debris from rainwater outlets, walkways and on sterile areas. Additional pebbles or gravel should be added to the vegetation barrier if movement or settlement has occurred.	✓	✓
Manually remove any herbaceous material that may be detrimental to waterproofing.	✓	✓
Remove leaves that may stifle vegetation and block rainwater outlets, although some leaf litter may be beneficial to a bio-diverse environment.	✓	✓
Manually remove any aesthetically displeasing vegetation which may affect waterproofing membranes (e.g. grass).		Optional
Minimum number of maintenance visits per year		2
In addition the following procedures should be followed for specific Axter green roof systems:		
Axter Hydropack pre-planted modular tray extensive green roof (sedum):		
» Dead head the sedum.	Optional	Optional
» Re-plant any missing sedum fragments.	As required	As required
» Use of fertiliser: it is recommended that a slow release fertiliser is applied to the Hydropack at the start of spring (25gm/m ²). A product such as Osmocote Exact (produced by Scotts) with a formula NPK 15-9-9 should be applied by a hand spreader to ensure even coverage.		As required
» Water after installation and during prolonged dry periods or periods of high temperatures. Take care not to over water.		
Axter Sedum Vegetation Blanket:		
» Light hand weeding once or twice a year to keep out wind blown seeds.	As required	As required
» Dead head the sedum.	Optional	Optional
» Re-plant any missing sedum fragments.		As required
» Use of fertiliser: use of fertiliser: It is recommended that a slow release fertiliser is applied to the sedum mat twice a year in March and September (25gm/m ²). A product such as Osmocote Exact (produced by Scotts) with a formula NPK 15-9-9 should be applied by a hand spreader to ensure even coverage.		
» Water after installation and during prolonged dry periods or periods of high temperatures. Take care not to over water.		
Axter Wildflower Blanket:		
» One main cut in late autumn, removing all cuttings.		✓
» A spring cut may be advisable if the grasses become too dominant.		✓
» Water after installation and during prolonged dry periods or periods of high temperatures. Take care not to over water.	✓	✓

	DURING INSTALLATION	STANDARD MAINTENANCE
Axter Bio-diverse Green Roofs:		
» One light cut in late autumn removing all cuttings.		✓
» Bio-diverse roofs usually require minimal maintenance with no fertilisation or artificial watering. However this may be needed if vegetation other than naturally colonising plants is introduced into the roof. Consult Axter for further advice.		✓
Axter Hydroseed:		
» The Axter seed mix for green roofs should be applied evenly onto the prepared Axter brown roof substrate by hand-broadcasting, seed fiddle, or seed/fertilizer distributor. Rake after sowing, particularly in dry weather and with freshly worked loose soil; this will press the seed into contact with the soil and bring moisture to the surface by capillary action. In wet weather a good rain after sowing will wash the seed in and settle the soil surface.	✓	
» Regular light watering is important once seeds are sown, particularly in prolonged dry periods, to provide optimum conditions for seed establishment with sufficient water at the critical time. Weeds should be removed as soon as possible.		✓
» It is important to remember that some seeds are slower to germinate than others and some may not germinate until the following year. In addition, some seeds will not flower in the first year.		
The seed mix may take two growing seasons to become fully established and produce a full floral display. During this time other wind-blown seeds may also establish themselves and should be removed.		

Separate information sheets are available from Axter for the different types of green roof mentioned above. Contact Axter Ltd for further details.

ROOF MAINTENANCE PROCEDURES

- » Ensure safe access can be gained to the roof and that, when working at roof level, safety harness attachment points and man safe systems are used where provided and that Health and Safety Procedures are respected.
- » Rainwater outlets, chutes, gutters and inspection chambers to be kept free from debris and leaves. All downpipes should be kept unblocked so that water can flow freely.
- » Check mastic sealant and mortar pointing for degradation and repair or renew as required.
- » Check that protective metal flashing or termination bars remain securely fixed in place.
- » Paving slab walkways and promenade tiles should remain securely fixed and in good condition.
- » Plant or equipment on the roof should be positioned on suitable supports and fixings not allowed to penetrate the waterproofing. In addition, maintenance to adjoining areas should be carried out without causing damage to the roof waterproofing.
- » Any signs of damage or deterioration to the roof waterproofing should be reported to Axter Ltd immediately.
- » Contact Axter Ltd for advice on works or alterations that may affect the integrity of the waterproofing and the validity of the Axter Guarantee.

Further information on Axter green roofs is available from Axter, tel: 01473 724056, email: info@axterltd.co.uk. For more general advice go to www.nfrc.co.uk/green-roof-installations



PHOTOVOLTAIC (SOLAR PV) MEMBRANE LAMINATES MAINTENANCE GUIDE

The following inspection and routine maintenance instructions are in addition to and must be read in conjunction with Axter's standard maintenance instructions for waterproof membranes.

A grid connected General Solar PV system is a potentially dangerous, high voltage electrical generator and should be inspected at least every six months to ensure that all system components are working correctly.

Appropriate maintenance should occur at least before the onset of both summer and winter. Axter recommend that all General Solar PV systems are fitted with monitoring software as this can give advance warning of potential problems and can provide the opportunity to perform corrective action before a problem becomes serious.

CAUTION

General Solar PV photovoltaic modules produce electrical energy when exposed to the sun, including under cloud, or other light sources. The power of an individual module is not considered dangerous but when connected in series and / or parallel the danger of an electric shock will increase.

The DC voltage produced by General Solar PV modules can reach up to 1000V during the day even if the inverter is not switched on. The module surface can become slippery when wet and operatives must follow appropriate safe working practices when accessing General Solar PV systems.

GENERAL ADVICE

- » Ensure that appropriate safety signs are in place at each access point to the installation.
- » When working on a roof, ensure you are properly tethered and that your safety equipment is in safe operating condition.
- » Avoid walking on photovoltaic modules and utilise access routes where provided.
- » Do not cut or fold the photovoltaic modules for any reason.
- » Do not apply screws, nails etc. and avoid letting pointed or heavy objects fall onto any part of the module. Such action could cause shock, generate flame, and invalidate any warranty.
- » Do not place any device on top of the photovoltaic modules.
- » Do not work on a Solar PV array when it is under standing water.

INSPECTION & MAINTENANCE GUIDANCE

- » Visually check that each laminate is bonded perfectly to the waterproof membrane. If any areas of the laminate are NOT perfectly bonded, mark the product with a permanent marker or crayon. If this de-bonding gets worse over subsequent maintenance visits, carry out the following repair advice:
- » Re-establish the adhesion by a combination of hot air and pressure from a Teflon coated roller or by applying Axter Solar fill glue and pressing the two elements together until they adhere.
- » Check the top surface of each laminate for any scratches or surface damage. Patch any surface damage in accordance with module manufacturer repair guidelines (contact your Axter representative) without delay. If the PTFE top surface becomes damaged and is not repaired quickly, system performance can be degraded and the laminate could fail.

- » Visually inspect cables and cable ducting, verifying that adequate strain relief is provided and the connections are tight, secure and free from corrosion. Ponding water on laminate surface should be avoided, laminates should not be subjected to ponding water and cables should be housed off the membrane surface in an appropriate free-draining cable tray. The most appropriate time to carry out this inspection is just before and/or just after the winter (or rainy) season.
- » Cable trays should be secured to the roof membrane with an Axter approved attachment system. Consult Axter for further information..
- » Clean laminates which are particularly dirty or have localised shading (bird droppings, leaves, etc.).
- » During the pre-summer visit, check the extent of dirt on the module surface and perform cleaning if this is warranted (refer to the Cleaning Procedure for cleaning instructions).
- » Verify that all laminates are located in areas that have no shading, and remove temporary objects that may be shading the array and reducing system performance. For example, prune trees that may be shading the array during the summer months.
- » Ensure that the drainage system is not blocked and that there is no potential for water pooling on the laminates.

SYSTEM COMMISSIONING & TROUBLESHOOTING FOR ELECTRICIANS & MAINTENANCE STAFF

- » The following tests should only be performed by trained and qualified personnel. The best weather conditions that will provide the most accurate system tests are cloudless days with strong sun conditions.



- » Before starting PV system maintenance, check that metal parts (array frames, junction box enclosures, DC disconnect switch enclosures, inverter enclosures) are earthed properly.
- » When working on the PV Laminates, always wear electrical gloves and shoes and use only insulated tools rated for the maximum rated system voltage (i.e. 600 VDC), disconnect all energy source (i.e. battery and/or utility) and short-circuit the output of the PV Laminates.
- » If more than one ground rod is being used, verify that all ground rods are bonded together with appropriately sized conductors.
- » Measure and record the open circuit voltage of each series string, verifying that all strings that are feeding the same inverter have the same polarity and a similar open circuit voltage (within + 5V of each other). If the variation in string voltages is greater than 5V, check the individual connections to that string of laminates.
- » Measure and record the operating current of each series string and verify that all strings with the same number of laminates have a similar operating current (within + 1A of each other). A variation in operating current can indicate areas of the array which are shaded or are particularly dirty and should be investigated further.
- » Check the alarm status of each inverter and also the historical alarm log if this is available (refer to inverter manufacturer's manual). Any alarm which indicates either a low resistance or an earth leakage fault should be investigated as soon as weather conditions permit, by suitably qualified personnel.
- » Record DC and AC power (at the input and output of the inverter) and determine inverter operating efficiency.
- » Perform and record insulation resistance (Riso) on the input to each inverter.
- » Check that system fuses and DC disconnect switches are operational.
- » Check for loose wires or connections at all solar system array controllers (voltage regulators), Combiner Boxes, and/or other Junction Boxes within the system.
- » Perform maintenance on the inverter(s) as stipulated by the manufacturer (clean filters, etc.).
- » Confirm that no new loads have been added to the system and that loads are operating for the specified number of hours per day.



CLEANING PV LAMINATES

Generally, a good rain is sufficient to clean the PV Laminates. However, in dusty arid locations the PV Laminates can be cleaned with water or mild soap and water in accordance with the following procedure. However, avoid cleaning the panels in the middle of the day and do not use abrasive soaps or solvents.

GENERAL RECOMMENDATIONS

- » Wear rubber soled boots and cut resistant gloves when cleaning laminates.
- » Survey the roof for any loose wires, damaged modules and tough stains that will require special attention.
- » While surveying, remove all large debris from the roof surface.
- » Use a leaf blower to remove all small sized debris from the roof surface.
- » Use a garden hose to get the entire PV laminate wet, making sure not to spray water on electrical wires.

WHEN TO CLEAN

The amount of electricity generated by a solar cell is proportional to the amount of light falling on it. A shaded cell will produce less energy. The non-stick PTFE top surface of Axter General Solar PV modules promotes automatic self-cleaning. It is normally NOT necessary to perform an all-encompassing cleaning of dirt from the solar array, provided that the array is installed on more than a 5% slope.

Cleaning should be performed on any modules that are excessively affected by a collection of bird droppings, dirt, or miscellaneous debris, such as fallen leaves. This cleaning should be performed at each maintenance visit. The monetary value of cleaning dirt and debris from the array is a trade-off between the cost of the cleaning, increased energy production as a result of the cleaning, and the inevitable re-soiling of the laminates over time once they have been cleaned.

To help determine the performance benefit of cleaning, perform the following steps to measure the short circuit current of individual laminates before and after cleaning:

- » Measure and record the operating voltage of each series string and verify that all strings feeding the same inverter have a similar operating voltage (within $\pm 5V$ of each other). Any difference greater than 5V between strings requires investigation.
- » Isolate a single string, making sure all the DC isolation switches are open (OFF) and all the string fuses have been removed.
- » Disconnect the laminates that will be used for the test by opening connections via an MC4 disconnect tool.
- » Verify that the current sunlight is effectively constant (clear sky, strong sunshine, no clouds)
- » Connect a DC multimeter across the terminals (10A or greater) to measure and record short circuit current.
- » Clean the laminate as described in the Cleaning Procedure below.
- » Measure and record the current and verify the percentage difference between the two readings. This percentage difference is the potential gain that will be derived from cleaning the product.

CLEANING PROCEDURE

Clothing: anti-slip rubber shoes and gloves.

Tools: soft brush, dry cotton mop or clean broom; low pressure water or portable pressurised water tank; biodegradable, non-abrasive mild detergent; clean water source.

- » Check earth connection of PV modules and inverter.
- » Examine the roof for damaged modules or persistent staining.
- » Remove all waste matter lying on the modules.
- » Wet the area avoiding the electrical cables.
- » Using a soft brush remove excess dirt.
- » Pressurised power washers should NOT be used directly on the laminates. If these devices are being used to clean the roof around a solar array, ensure that the nozzle of the power washer remains at least two feet away from the surface of the laminates at all times while cleaning.
- » When spraying a module, do NOT spray water directly on the electrical connections or at the leading edge of the PV laminate.
- » Use caution when cleaning PV modules, as the combination of water and electricity may present a shock hazard.
- » Use a soft brush to scrub stubborn stains, be careful not to scratch the surface.
- » Rinse with water to remove all traces of detergent.
- » Dry any puddles left on the roof post cleaning.



FLAT ROOF MAINTENANCE CHECK LIST

WATERTIGHTNESS	COMPLETE	ACTION REQUIRED
Visual check of membrane for watertightness		
Repairing identified defects and damages		
Checking the watertightness of distressed areas		
Check existing permanent and emergency repairs		
Cleaning the roof area from incrustation, vegetation and foreign matter		
Check and, if needed, repair laps		
Check mechanical fastening elements		
Movement joints, stresses, deformations to be repaired if required		
FLASHINGS IN ROOF AREA		
Visual check for stress cracks, splits		
Check existing permanent and emergency repairs		
Check and, if needed, repair laps		
Check the mechanical fastening system and flashings, repair if needed		
ROOF PERIMETER		
Visual check for stress cracks, splits		
Check existing permanent and emergency repairs		
Check laps and repair if needed		
Check the mechanical fastening system and flashings, repair if needed		
Check roof edge trims and repair if required		
Check roof edge trims, corrosion, apply protective coating if required		
Check integrity of wall connection profile and repair if required		
Check integrity of fascia boards and repair if required		
DRAINAGE		
Visual check of outlets to be cleaned from obvious debris, if required		
Performance test, check with water if required		
Visual check of water spouts or emergency outlets, to be cleaned if required		
Performance test, check with water if required		
Visual check of gutters and performance test, to be cleaned if required		
Down pipe, check fastening and integrity		
Corrosion, protective coating if applicable		
SURFACE PROTECTION LAYER		
Removal of debris and vegetation growth		
Paving slabs, to be aligned if required		
Inverted roof, checking position stability of thermal insulation		
Inverted roof, condition of thermal insulation		
Other protective layers, status check, to be replaced if needed		
Vegetation layer, removal of unwanted vegetation		
VENT PIPES		
Check vent pipes, to be cleaned if needed		
KERBS AND PENETRATIONS		
Check condition and integrity of rooflights and other kerbs		
Check roof anchor's watertightness		

OTHER	COMPLETE	ACTION REQUIRED



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