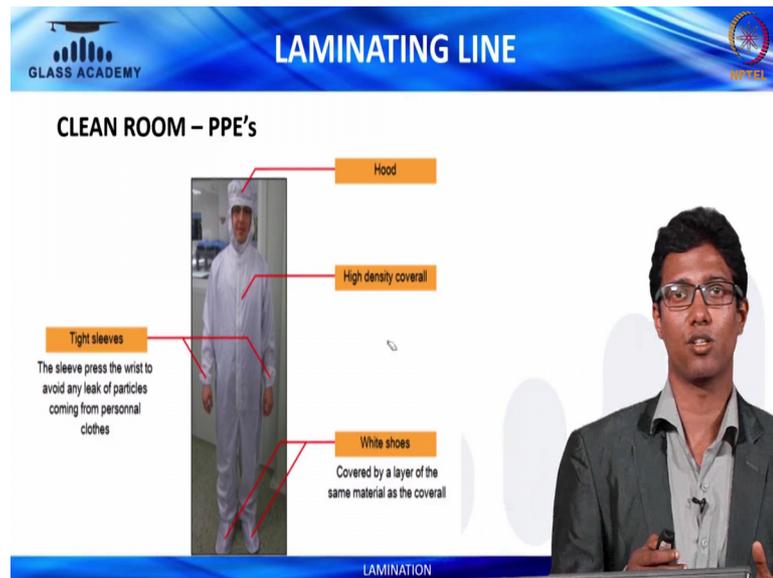


Glass Processing Technology
Prof. Mr. Srivats
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture- 32
Lamination Part- II

(Refer Slide Time: 00:21)



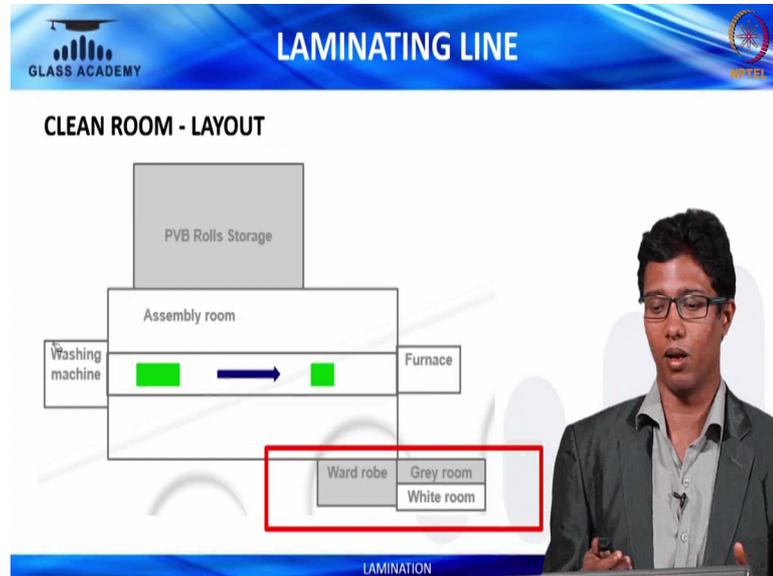
Coming to clean room; clean room can also be referred to as assembly room and it can also be referred to as layup rooms. So, since we are saying clean room, it has to be ideally clean. To maintain the cleanliness the person who is entering and working inside a clean room has to have following PPEs.

Now the PPEs should have an hood, it should have high density coverall, which covers the entire portion of the body. It should have white shoes, which are dedicated for the clean room and it should also have tight sleeves around the hand. The sleeves press the wrist to avoid any leak of particles coming from personal clothes. So, just to ensure that there is no wear and tear of the cloth and that is contaminating the clean room.

So, this PPE is very mandatory inside the clean room and it is our duty to ensure that all the person who are inside the clean room are wearing and not entering without these PPEs. And the PPEs have to be used dedicatedly inside the clean room only. It should not be kept outside the clean room and because again outside you have dust

particles which might come in contact and again contaminate. So, all the PPEs and material that you use inside clean room has to be dedicatedly used only for clean rooms.

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Coming to the layout of clean room there you can see you have a washing machine. Basically this is through which the glasses being conveyed inside the clean room and you also have inter layers storage basically which is the PVB from the rolls are stored inside and then you have the furnace. And then between the person the entry of the person is controlled through Grey room, White room and Ward robe. Basically what we are trying to convey is, we all wear I mean our clothes and there should be a room when where the PPEs are kept and the person goes there and no changes I mean wears that PPE and then it goes inside.

Basically it is just the medium, before the entry of the clean room. Just trying to ensure that we do not contaminate the clean room as we have the atmosphere has lot of dust. So, this is basically just in arrangement to ensure that you have double protection against contamination of the clean room.

(Refer Slide Time: 02:37)

LAMINATING LINE

CLEAN ROOM – STANDARD (HANDHELD 3013)

Classe ISO	Concentration maximale autorisée (particules/m ³ d'air) de particules de taille identique ou supérieure à celles mentionnées						US Federal Standard 209E
	Nombre de particules						
	> 0.1 µm	> 0.2 µm	> 0.3 µm	> 0.5 µm	> 1 µm	> 5 µm	
ISO Classe 1	10	2					
ISO Classe 2	100	24	10	4			
ISO Classe 3	1 000	237	102	35	8		Classe 1
ISO Classe 4	10 000	2 370	1 020	352	83		Classe 10
ISO Classe 5	100 000	23 700	10 200	3 520	832	29	Classe 100
ISO Classe 6	1 000 000	237 000	102 000	35 200	8 320	293	Classe 1 000
ISO Classe 7				352 000	83 200	2 930	Classe 10 000
ISO Classe 8				3 520 000	832 000	29 300	Classe 100 000
ISO Classe 9				35 200 000	8 320 000	293 000	Classe 1 000 000



LAMINATION

So, for clean room dust control, we have a standard which is basically the us federal 209e standard that we follow and ideal condition of a clean room we have normally is ISO Classe 7 or Classe 10000 wherein we have a this meter basically handheld 3013 which is shown on the right side. This you can keep it on to the atmosphere and know when you start it, it will start to measure the particles of size 0.5 micron, 1 micron and 5 micron. And normally we recommend to have a 20 run the meter for 20 minutes and this meter the it takes reading for every 1 minute or can also take for 30 seconds depends on what you set.

Normally we keep 20 minute readings and every one minute the reading is taken and the average of all those reading the 0.5 micron particle should not exceed 3.52 lakhs. 1 micron particle size the particle greater than 9 micron should not exceed 83,200 numbers and particles which are of size greater than 5 micron should not exceed 2930. This is standard for maintaining clean room and this is standard also maintained in hospitals and you know from a manufacturing setup ISO Classe 9 7 and Classe 10000 and this is very significant for the quality of lamination.

(Refer Slide Time: 04:09)

LAMINATING LINE

GLASS ACADEMY NPTEL

CLEAN ROOM - CONDITIONS

- Double door entrance (sash)
- Over pressure in the room
- Air filtration (dust free)
- Special adhesive door mats to remove dust from shoe soles.
- Temperature : 18 to 22° C
- Relative Humidity: 25 to 30 %
- Limited passage
- Special clothing : lint free + gloves and hair caps
- Floor: tiles or special coating to allow easy cleaning

LAMINATION

Coming through the conditions that are required for clean room those are basically you should have a double door entrance. This double entrance as we know is basically just we trying to protect the clean room from contamination and inside this double door we have also have basically a fan which know blows on to your body and all the impurities that are settled on to the surface. Or let us say your cloth, those get removed and you then enter inside the clean room. Then you have over pressure in the room normally it is recommended to have a pressure of 15 Pascal in the clean room.

So, that all the dust from outside do not penetrate inside the clean room and you have air filtration system as we mentioned, it is just to ensure that the clean room remains dust free. You have special adhesive door mats to remove dust from shoe soles. Basically it is ideal to have a dedicated white shoes for the clean room and those are only confined within the periphery of the clean room. Those will also be subjected to some dust. It is always dust is I mean everywhere.

So, you have the adhesive door mats which is kept at the entrance of the clean room. So, where you step in the dust from the shoe soles could be transferred to the door mats and you can over a period of time as and when you see the door mats are dirty you can just remove a layer of it and you can do it out. And those door mats comes in let say 15 numbers and you can keep removing as and when it gets dirty.

So, the maintenance of the temperature of the clean room should be around 18 to 22 degrees. Humidity is somewhere around 25 to 30 percent. It is again critical to ensure that the inter layer does not have absorb too much of moisture. Limited passage, what we mean by limited passage is basically you have to restrict the entry and exit of people in and out of clean room.

So, only limited amount of entry and exit should be permitted. That is that is how you can maintain the dust control parameter. Those are required and also the temperature and humidity will you will have fluctuations in it. If you have repeated in and out people moving in and out of clean room.

So, it is important to ensure that you do not allow a permit too many people and you have a clear cut sop standard operating procedure for people who are entering the clean room. And for visitors there should be some form of a approval letters or authorisation permissions which are to be allotted, if at all they have to enter the clean room. They should not be permitted for the clean room. As we saw that there is PPE which was demonstrated earlier.

So, it is the PPEs basically it should be lint free and you normally people wearing gloves and hair caps to ensure that hair or any impurity does not come in contact of the inter layer of the time of assembly and I mean again you will have defects. The tiles or special coating basically those are for the construction of the clean room those and those are required for ease of cleaning. So, tiles or special coating those are for the construction of base of the clean room those are for ease of cleaning

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GLASS ACADEMY **LAMINATING LINE** **NPTEL**

CLEAN ROOM – Maintenance BASICS

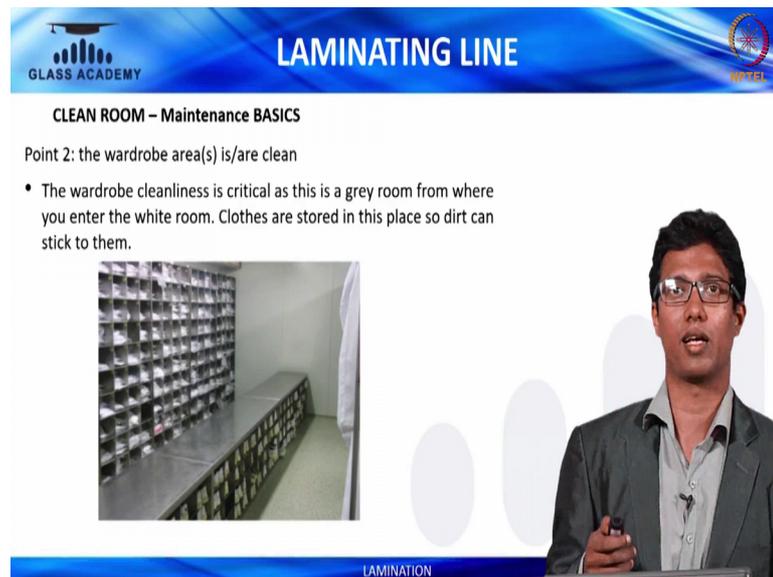
Point No 1: At least disposable suits for guest are available. Everyone that enter the cleanroom should wear the cleanroom suits. It is not allow to enter without any protection.

LAMINATION

Coming to the basics of a clean room; so, we normally recommend to follow this thirty two points which are basically required for the maintenance of cleanliness of the clean room and also to ensure that your product comes out of a very high quality. So, the point number 1 is basically should have disposable suits for guests. Basically as we mentioned the PPE is are to be used dedicatedly inside the clean room and for guests we should have disposable suits. So, that whenever they are entering in out it is it should be a onetime use or something.

So, everyone that enter the clean room should wear the clean room suits. It is not allowed to enter without any protection. So, this again it could be you can have a PPE again for the guest or you can have a disposable suit, which are used for onetime use and throw kind of suits.

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LAMINATING LINE

GLASS ACADEMY NPTEL

CLEAN ROOM – Maintenance BASICS

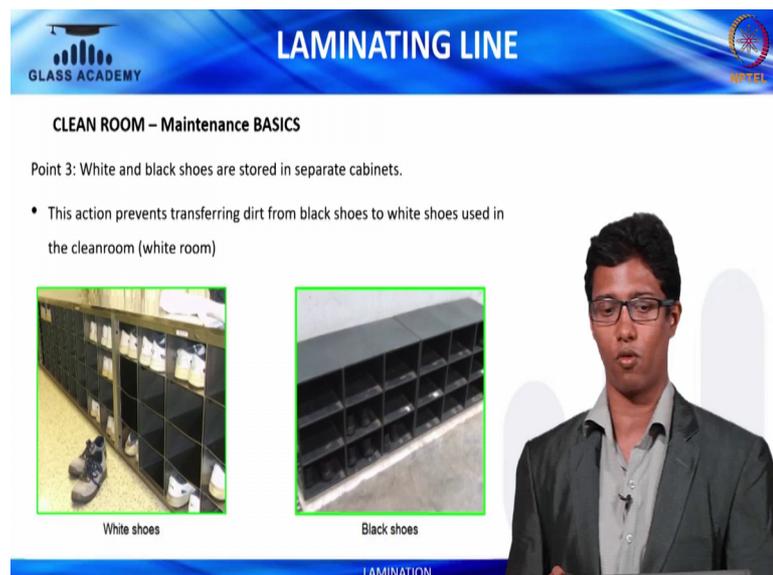
Point 2: the wardrobe area(s) is/are clean

- The wardrobe cleanliness is critical as this is a grey room from where you enter the white room. Clothes are stored in this place so dirt can stick to them.

LAMINATION

Point number 2: the wardrobe area should be clean. Wardrobe cleanliness is critical as this is a grey room from where you enter the white room. Clothes are stored in this place are dirty. So, the again the cleanliness of wardrobe place a very important role as you can see there is a picture which demonstrates how the wardrobes are stored and we can see a very good level of fibre system demonstrated here. It is all identified and everything is a kept it is in its own place.

(Refer Slide Time: 08:51)



LAMINATING LINE

GLASS ACADEMY NPTEL

CLEAN ROOM – Maintenance BASICS

Point 3: White and black shoes are stored in separate cabinets.

- This action prevents transferring dirt from black shoes to white shoes used in the cleanroom (white room)

White shoes

Black shoes

LAMINATION

Coming to point number 3, white and black shoes are stored in separate cabinets. The black shoes are the safety shoes that are used in the line and when you enter you normally, we recommend white canvas shoes for the operation of clean room and the people who are working there. So, those are basically segregated and kept and that is important because we recommend that the shoes are used dedicatedly inside the clean room.

So, that is how we can ensure that that happens. This action prevents transferring dirt from black shoes to the white shoes used in the clean room. You can see again picture demonstrating how white and black shoes are segregated and different racks again very good demonstration of 5 s. And these are very critical when you have to maintain the dust conditions that are required for maintaining clean room.

(Refer Slide Time: 09:43)

GLASS ACADEMY **LAMINATING LINE** **LPTCL**

CLEAN ROOM – Maintenance BASICS

Point 4: Instruction of “How to wear the clothes” is available

It is not so easy to correctly wear the cleanroom clothes, especially for both new workers and guests. It is therefore important to have an instruction in place to explain how to put them on

LAMINATION

Coming to point number 4: instructions of how to wear clothes that should be available you should have SOP or let us say you can have an instruction. It says how the cloth has to be weared and how the how at the condition has to be added. It is not easy to correctly wear the clean room cloth especially for new workers and guest. That is why the manual or the SOP for wearing clothe becomes mandatory. Therefore, it is therefore, important to have an instruction in place to explain them as to how to wear the clothes. So, this is a demonstration of how a PPE is worn and this is for visitors or people who are coming in and who are new to the system.

(Refer Slide Time: 10:29)

LAMINATING LINE

GLASS ACADEMY

CLEAN ROOM – Maintenance BASICS

Point 5: Mirror at the entrance is available to assess good wearing conditions

- This is a really good practice, it helps assess if you have correctly put on the cleanroom clothes



LAMINATION

Coming to point number 5 mirror at the entrance should be available. It just basically to ensure that whether you have to person who has just finished the wearing PPE he has worn it properly or not. So, basically it is just the good practice and it ensures the person can see himself in a mirror and can he can be satisfied that he has worn it properly or if something is to be corrected those can be corrected the sticky.

(Refer Slide Time: 10:55)

LAMINATING LINE

GLASS ACADEMY

CLEAN ROOM – Maintenance BASICS

Point 6: sticky mats on the floor at the entrances are existing

- Sticky mats collect the dirt from the shoes, and dirt falling down from the clean room clothes.



LAMINATION

Mats on the floor at the entrances are existing as we mention that the shoe soles gets dirty over a period. So, it is a to ensure that the dirt from the soles are not contaminating

the clean room you have sticky mats at the entry of the clean room wherein people can step in on the mats and then enter the clean room. So, this sticky mats basically collects the dirt from the shoes and the dirt falling from the clean room clothes. So, this is how sticky mat you can see the one on the left hand side of the picture where is the blue colour ones are the sticky mats which basically takes the dirt from the shoes and the body.

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LAMINATING LINE

GLASS ACADEMY

NPTI

CLEAN ROOM - Maintenance BASICS

Point 7: sticky mats are clean and replaced regularly.

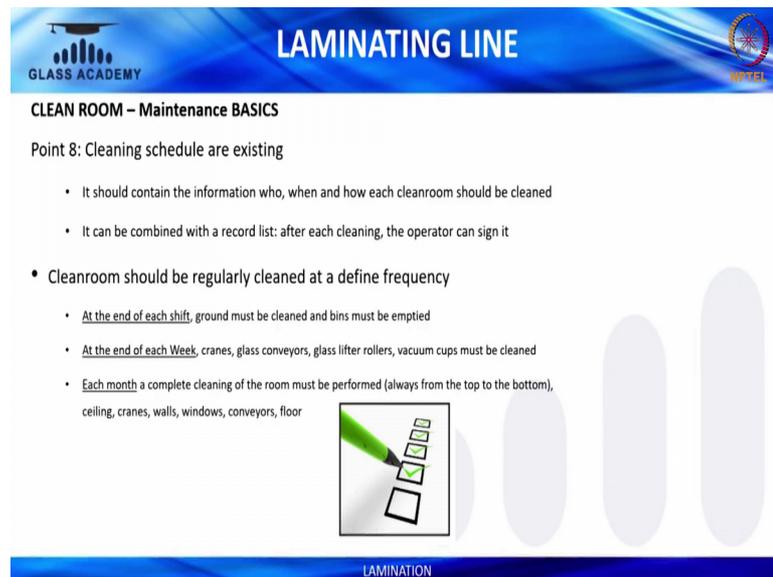
- This is a key point. Only clean sticky mats with unpolluted surface will clean properly and thus help us bring down the inclusions rate

LAMINATION

Coming to point number 7; sticky mats, again over a period of time it keeps collecting the dirt from the soles it will get dirty. So, it is important to have an SOP which clearly states as to are what frequency the sticky mats has to be replaced. So, only clean sticky mats with unpolluted surface will properly will clean properly and thus help us bring down the inclusion weight. So, it is important that we at a regular interval based on the dirt collection of the mats and the based on the frequency at which the mats get dirty.

We have to make an SOP and ensure that the mats are replaced. So, pictures again demonstrates the dirt collected by the sticky mats, you can see the one on the right hand side are dirty And as soon as you see lot of dirt on the sticky mats, it is important that you take off the layer of it and replace it with the new layer which is clean which again starts collecting the dirt.

(Refer Slide Time: 12:33)



GLASS ACADEMY **LAMINATING LINE** **NPTEL**

CLEAN ROOM – Maintenance BASICS

Point 8: Cleaning schedule are existing

- It should contain the information who, when and how each cleanroom should be cleaned
- It can be combined with a record list: after each cleaning, the operator can sign it
- Cleanroom should be regularly cleaned at a define frequency
 - At the end of each shift, ground must be cleaned and bins must be emptied
 - At the end of each Week, cranes, glass conveyors, glass lifter rollers, vacuum cups must be cleaned
 - Each month a complete cleaning of the room must be performed (always from the top to the bottom), ceiling, cranes, walls, windows, conveyors, floor

LAMINATION

Point number 8 is there should be a cleaning schedule. Basically its again a part of 5 s as well as 2 maintain the standards of clean room. It is important that you have a cleaning schedule. So, it should that is cleaning schedule should contain information of who, when and how room is to be cleaned. Basically it will give a person responsibility, it also gives you the time frame or the frequency as to the when the clean rooms will be clean and it will also tell you a procedure, a standard operating procedure of what is to be used and how it is to be used.

So, it can be combined with a record list or may be a check list after each cleaning and the operator know to ensure that it has it has happened properly and there is a proper monitoring of it. You can have a check list and let us be operator is signing. So, operator can sign it clean room should be cleaned regularly at a defined frequency may be you can have for different parts of cleaning.

You can have a different frequency like we see if the end of each shift ground must be clean and mis bins must be emptied at the end of each week cranes, glass conveyors, rollers, vacuum cups must be cleaned. At the end of each month a complete cleaning of the room must be performed always from top to bottom as the dust settles at the bottom sealing, cranes, walls, windows, conveyers and floors.

So, as you see we have three different frequencies defined for different, we have every shift frequency. We have week frequency and month frequency for let say the bins the

conveyers and also the walls and other parts of the clean room and the checklist which is maintained for you know ensuring that a the cleaning has happened and just for documentation also for making it happen.

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GLASS ACADEMY **LAMINATING LINE**

CLEAN ROOM – Maintenance BASICS

Point 9: Cleaning instructions are prepared and available

- It is not clear on “How to clean the process line or walls” with the proper tool (mops, tissue, sticky rolls, water, etc.). That’s why clear instruction must be available

Point 10: cleaning records are available and duly completed

- This practice helps maintain the cleanliness in cleanroom

Item	Frequency	Status
Process line	Daily	Completed
Walls	Weekly	Completed
Floors	Daily	Completed
Equipment	Monthly	Completed
Tools	Weekly	Completed
Waste disposal	Daily	Completed
Water supply	Daily	Completed
Air filtration	Monthly	Completed
Temperature control	Daily	Completed
Humidity control	Daily	Completed
Lighting	Daily	Completed
Security	Daily	Completed
Documentation	Daily	Completed

LAMINATION

Coming to point number 9 by cleaning instructions are prepared and available. So, it is not clear on how to clean the process lines or walls with proper tools that is why this instructions are mandatory. So, basically have different tools for cleaning; your mops, tissues, sticky rolls, water etcetera. So, it is important that a there is a procedure which tells you how those are to be used and what are they dos and do nots in it talk about clean room cleanliness.

And then you have a point number 10 which strucks cleaning records are available and duly completed. This basically is we are trying to ensure that the cleanliness of the room is maintained properly. So, the we have a proper check sheet and ensure that you following everything as per the sequent frequency that you have defined.

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LAMINATING LINE

GLASS ACADEMY IITEL

CLEAN ROOM – Maintenance BASICS

Point 11: Windows are clean

- On clean windows, you can easily see the particles collected inside the cleanroom.
- Windows are on the points easy to control. It is equally important to maintain cleanliness on windows as walls

Point 12: Walls are clean

- This is the main area where hair inclusions are stacked. Walls must be therefore cleaned properly with sticky rolls. Us the UV light to check the wall after cleaning

LAMINATION

So, windows are clean ah; this is again a point which is to be ensured. On clean windows, you can normally see the particles collected inside the clean room. Windows are on the point points easy to control is equally to important to maintain cleanliness on windows as walls. Walls point number 12, walls are clean it is important that we ensure that. So, this is main area where hair inclusions are stacked.

So, basically the inclusions coming from the hair and again stacked on to the walls, this the walls must. Therefore, be cleaned properly with sticky rolls, we have sticky rolls which is basically applied on to the walls of the clean room and the sticky roll what it does is basically it catches the hair and other inclusion which has stuck on to the body

And basically we will also use UV light to check the wall after cleaning just to ensure that there are no other foreign material and if there are any, again we use a sticky roll on to the surface and try to collect those on to the sticky roll. Just to ensure that the entire body of the room as well as everything is properly maintained. You can see that some of the impurities that are there on to the walls. So, those can be removed.

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LAMINATING LINE

CLEAN ROOM – Maintenance BASICS

Point 13: Conveyors belts are clean

- Conveyors got contact to the glasses but also create electrostatic discharges which will collect dirt. Thus, conveyors must be clean to get rid of dirt

Point 14: No glass cullet on the floor

- Cullet is a place where the dirt will be collected. Cullet glasses must be removed from the floor at every shift changeover

LAMINATION

Coming to point number 13, it is important to ensure that conveyor belts are clean. Conveyor basically the glasses are in contact of this conveyor and they also create electrostatic discharges which will collect dirt. Thus conveyors must be clean as you can see the picture of conveyor..

Point number 14, no glass cullet on the floor; cullet is basically you talking about glass particles which are there on the floor. Cullet is a place where the dirt will be collected. Cullet glasses must be removed from the floor at every shift changeover. Again we are trying to ensure that repeatedly at a frequency of every shift all the cullet and impurities that are collected on to the floor are removed.

(Refer Slide Time: 16:57)

GLASS ACADEMY **LAMINATING LINE** **NPTEL**

Point 15: No PVB sheets or PVB foil on the floor / No PVB roll unprotected

- PVB sheets got electrostatic discharges so they will accumulate dirt. They must be discarded to the dedicated waste bins

Point 16: The floors are in good conditions and free from dusts

- Floor in good condition will allow easy cleaning. Contact between walls and floor are critical for cleanliness. Damaged floor might cause the pollution itself

LAMINATION

Point number 15, no PVB sheets or PVB foil on the floor; no PVB roll have unprotected. What we mean by PVB on the floor is floor can have a little bit of dust and when PVB comes in contact of the floor, it can absorb the dust particle and those will not be visible to the naked eye and you do the layup and you do the further processing and you further over a period of time, it might lead to some kind of issues with respect with regards to addition. And later subsequently it can also lead to delamination.

And again PVB sheets got elect electrostatic discharges. So, they will accumulate dirt. They must be discarded to the dedicated waste bins. Those PVB sheets which are basically which have accumulated dusts; it is important that you do not use those and you discarded to the waste bins. You can see that most of the rolls are protected using aluminium foil. The protection is also important because you are trying to ensure that the moisture which are absorbed since PVB is hygroscopic, the moisture levels are maintain and you do not expose it to be improper conditions.

Point number 16, the floors are in good conditions and free form dust. Floor in good condition will allow easy cleaning contact between floors and walls are critical for cleanliness. Damage floors might cause pollution itself. You can see picture of floors which are damaged. These will again contaminate the periphery or the clean room (Refer Time: 18:25) What will happen is again, you will have issues with regards to quality and for durability point of view also the clean room has to be ideally clean.

(Refer Slide Time: 18:33)

LAMINATING LINE

CLEAN ROOM – Maintenance BASICS

Point 17: No oil leakage in the clean areas.

- Oil can strongly affect the PVB and thus determines the cleanliness

Point 18: Chain drives are protected to avoid pollution

- Open chains and belts can release pollution which can go to the PVB

LAMINATION

Point number 17: there should not be any oil leakage in the clean room or the clean areas oil can strongly affect the PVB and thus the cleanliness is very important. Again it is form of contamination and when PVB comes in contact of oil, the addition is deeply affected. The chain drives are protected to avoid pollution. Open chains and belts can release pollution which can go and contact come in contact of the PVB. Again it is important that all those chains and belts are protected and there is no nothing coming in contact of PVB.

(Refer Slide Time: 19:07)

LAMINATING LINE

CLEAN ROOM – Maintenance BASICS

Point 19: Cleanroom doors with interlocks are well working

- This will prevent opening two doors at the same time (protect the cleanroom from undesired air stream) that might spread pollution (non-laminar flows)

Point 20: The air flow and the air-distribution in the cleanroom is good

- The rule is: "The highest pressure in the cleanest area (Assembly room); the lowest pressure in the dirt area of the cleanroom (grey rooms: PVB storage, wardrobe).

Diagram illustrating air flow and pressure distribution:

- Gray rooms: (Wardrobe, PVB storage,...) +0 Pa (compared to the pressure reference)
- White rooms: (Assembly, plotter,...) +15 Pa (compared to the pressure reference)
- Pressure reference: Shop floor
- The particles do not enter the white rooms thanks to the overpressure

Footer

Point number 19: clean room doors with interlocks as well working. So, basically this will prevent opening two doors of the same time, talked about double door entry. So, when the door which is inside or entering the clean room is the main door which where from where you enter the clean room is open, the other door should be closed.

So, that you are not allowing any dust or impurity from outside of the clean room to enter. So, there should be an interlock as to if one door is open the other door does not open. That is what we are talking about just to ensure that there is no contamination happening in the clean room. This will prevent opening two doors of the same time protect the clean room from undesired air stream that might spread pollution. So, interlocks are very important.

Point number 20: the air flow and the air distribution in the clean room is good. It is important the rule is the higher pressure highest pressure in the cleanest area a. Assembly and the lowest pressure in the dirt area which is grey room and subsequently outside. So, normally we maintain a positive pressure of 15 Pascal compared to the pressure reference and this is important so, that the air undesired air stream from outside causing contamination does not enter the clean room where we are doing the assembly.

(Refer Slide Time: 20:25)

GLASS ACADEMY **LAMINATING LINE** **NPTL**

CLEAN ROOM - Maintenance BASICS

Point 21: The absolute filters are not damaged or broken

- Absolute filters clean the ambient air. If they are broken or damaged, the system stops working

→ Filter covered by equipments

LAMINATION

Point number 21: the absolute filters are not damaged or broken. It is important that the absolute filters are clean since they clean the ambient air if they are broken or damaged. They are the system stops working and the air flow is effected and again we will have

issues. So, it is important than from time and again we keep checking whether the absolute filters are in good conditions. If they are dirty, they are they are clean; if they are broken, they are replaced.

(Refer Slide Time: 20:52)

GLASS ACADEMY **LAMINATING LINE**

CLEAN ROOM - Maintenance BASICS

Point 22: Central vacuum cleaner system is installed or dedicated vacuum cleaner

- Vacuum cleaning is the best method of cleaning the cleanroom. A good system well maintained will ensure good cleaning and thus good cleanliness of the cleanroom

Point 23: Tolerance for humidity, temperature and pressure are displayed

- There must be under electronic display the tolerances of humidity and temperature. Everybody should know instantly if the standard conditions are respected or not.

Tolerances are displayed
Tolerances are not displayed

LAMINATION

Central vacuum cleaner system is installed and dedicated vacuum cleaner you have. The importance of having a dedicated is when you take it outside; again it comes in contact of the ambience air which might be polluted which might be dusty. So, vacuum cleaning is the best method of cleaning the clean room. A good system well maintained will ensure good cleaning and thus good cleanliness of the clean room. You can see a person I mean picture which is demonstrating the cleaning of clean room using vacuum cleaners.

Point number 23 a tolerance for humidity, temperature and pressures are displayed. So, those are the three controls for maintaining the clean room and those are very critical from the point of view of processing quality. And there should be some indicator which is displayed which gives you the tolerance and also everybody should know instantly. If the standard conditions are respected or not if they are respected you go ahead and process if they are not respected you raise an alarm and stop and know ensure that those are rectified before you continue.

So, you can see picture which is giving you the tolerance, it is a 19 degrees plus or minus. So, just an example do not have to take it literally. But what we are trying to show is basically, there is just display which gives you tolerance as well as there is an indicator

which is indicating the actual. So, we can from the actuals and the display you can see that whether those are respected and you can go ahead with the process.

(Refer Slide Time: 22:23)

The slide features a blue header with 'GLASS ACADEMY' on the left and 'LAMINATING LINE' in the center, accompanied by a logo on the right. The main content is titled 'CLEAN ROOM - Maintenance BASICS' and includes two points: Point 24 regarding unnecessary equipment and Point 25 regarding waste bin placement and design. Two photographs show cleanroom environments with equipment and waste bins. A decorative graphic of four vertical bars of increasing height is on the right, and a 'LAMINATION' bar is at the bottom.

GLASS ACADEMY **LAMINATING LINE**

CLEAN ROOM - Maintenance BASICS

Point 24: there is no "unnecessary equipment" in the cleanroom area

- General 5S: Unnecessary material will accumulate dirt that can be easily released in case of air streams (air blows).

Point 25: Waste bins are at the intended place for disposal

- General 5S: Design of the waste bin itself should be easy to clean

LAMINATION

Point number 24: there is no unnecessary equipment in the clean room area. General 5 s unnecessary material will accumulate dirt than can be a easily released in the cause of air streams. So, the 5S again is very important. So, you should ensure that the one s which is basically seri, which talks about unnecessary unwanted items segregation and being removed subsequently. Those are maintained properly.

Point number of 25: waste bins are at the intended place for disposal. As you have lost of waste accumulating and you are segregating and you should have a bin where we are trying to no dispose of the waste. So, bin are necessary. Design of the waste bin itself should be easy to clean in all the material that are used in a within the periphery of the clean room are to be designed in such a way that the their cleaning is also a very easy.

(Refer Slide Time: 23:22)

LAMINATING LINE

GLASS ACADEMY

CLEAN ROOM – Maintenance BASICS

Point 26: Bins are at the intended place for disposal

- There should be dedicated places to storage PVB trims

Point 27: No food somewhere in the cleanroom

- Food is one of the root cause of pollution/dirt in the cleanroom. It is not allowed to bring or eat food in the cleanroom or wardrobe.



LAMINATION

Point number 26: bins are at the intended place for disposal. There should be dedicated place for storage of PVB trims. So, when you when you are doing the trimming of the PVB, there is I mean you would always get small trims of the PV as the yield will never be 100 percent. So, those trims you should have a place also to dispose of those trims or may be can be either dispose up to scrap or whether you are recycling, but those are to be collected in a separate bin.

Point number 27: no food items should be used inside the clean room. Food is one of the root cause of pollution or dirt in the clean room. It is allowed not allowed to bring or eat any food inside the clean room or I mean you should not be even keeping any of the food items in your wardrobe. Those will end up contaminating the clean room.

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LAMINATING LINE

CLEAN ROOM – Maintenance BASICS

Point 28: No private stuff in the cleanroom

- Private stuff can bring pollution into the cleanroom

Point 29: Cleanroom hoods are duly worn

- Hoods well worn will protect the worker hairs from falling down to the PVB product

LAMINATION

Point number 28: no private stuff in the clean room. Private stuff again can bring in pollution and contaminate the clean room. Point number 29: clean room hoods are duly one. As we saw in the initial PP drawing hoods are basically protecting the hair. They ensuring to be hair particles are not coming in contact of the PVB. Thus hoods well worn will protect the working hair workers hairs from falling down to the PVB product and coming in contact of them. You can have skull caps as well if it is I mean the hoods are not. There you can ensure that the workers are wearing skull caps and ensuring that the hair is not following.

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LAMINATING LINE

CLEAN ROOM – Maintenance BASICS

Point 30: Instruction of “not opening suits in the cleanroom” will be followed

- Suit is mandatory to protect the cleanroom against hairs stacked to the undergarments.
Opening the cleanroom suit bring a lot of pollution

Point 31: The cleaning tools are suitable for the usage in the cleanroom

- Cleaning tool should be cleaner than the area that are cleaned up. There should be a cleaning equipment especially dedicated and designed for cleanrooms

LAMINATION

Point number 30: instructions of not opening suits in the clean room will be followed. Suit is mandatory to protect clean room against hair stack to the undergarments. Opening the clean room suits will bring again lot of pollution. So, again it is in we have to ensure that the suits are fully covered and you do not open any of the know do not give any openings for the clothes that you wear to contaminate

Point number 31: the cleaning tools are suitable for the usage of the clean room. Cleaning tool should be cleaner than the area that are cleaned up there should be a cleaning equipment especially dedicated and designed for clean rooms. It is important the those tools are not being used outside of the clean room and they are only dedicatedly used within the periphery of clean room. You can see the tools and how they are being kept very good demonstration of 5S. And those are to be dedicatedly either kept in the grey room or inside the clean I mean within the periphery. Those are to be used within the periphery of clean room.

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LAMINATING LINE

GLASS ACADEMY NPTL

CLEAN ROOM – Maintenance BASICS

Point 32: A break (minimum 2 hours), after a big cleaning to reduce the “noise”, is established

- After big cleaning of the cleanroom, a lot of pollution (coming from equipment, floors, etc.) can fly in the air. Air flows and absolute filters will clean the cleanroom itself but it will take some time

After big cleaning → 2 hours after big cleaning

Too much particles, a break must be established to let air conditioning unit evacuate the particles

After a certain time, the level of particles is returned to normal concentration (class)

LAMINATION

That is very important. Point 32: a break of minimum 2 hours after a big cleaning which normally is recommended on a monthly basis to reduces the noises as established. After big cleaning of the clean room a lot of pollution coming from equipment floors can fly in the air. Air flows and absolute filters will clean the clean room itself, but it will take a little bit of time that is why we recommend a break period of two hours before you resume the production after any big cleaning of the clean room.

You can see pictures which are demonstrating the effect of cleaning. You can see after the big cleaning, you can see lot of dust particle which are flying around the clean room. Those will not be visible to our naked eye, but you have filter absolute filters and which will automatically be ensuring that those are absorbed and or a period of time you will not have those. But then ideally we should give some time for the ambience to know not have pollution and before you resume the production.