Activity D.
General maintenance guide for all equipment used in cotton testing laboratories

Project CFC/ICAC/33

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July 2010

General maintenance guide for all equipment used in cotton testing laboratories

This document was written as a sub-activity of D.2.1 (Basic evaluation of the different sources of cotton result variability and definition of a common approach to make the variability studies in Africa) as mentioned in DoA 2010.

However, it should better fit as a sub-activity of D.1 (Basic technical development studies), since it is complementary to:

- D.1.2 Development of a list of requirements for an integrated power supply system for laboratories, and

- D.1.3 Development of a list of requirements and basic principle drawings for a simple and efficient integrated climate control system.

Content

Bibliography: PAYET L., GOURLOT J-P., 2010, Rapport “General maintenance guide for all equipment used in cotton testing laboratories”, Project CFC/ICAC/33, 14 p.

Introduction

Cotton testing goes along with small cotton fibre fragments, as well as dust, seed-coat fragments, leaf and other trash that pollute the environment of the laboratory. Mainly for this reason, maintenance is known to be a factor that can influence test results, as well as the ambient conditions of the laboratory. It is therefore essential to plan a maintenance activity, both on all the Standardised Instruments for Testing of Cotton (SITC) of a laboratory and on its Air Management System equipment (AMS).

It is important not to confuse the term "maintenance" with "calibration". Especially for SITC, "calibration" is described as *a way of re-setting the level of testing by internal software adjustment and is not a substitute for maintaining the equipment in a good operating condition or constant attention to maintaining the specified standard atmospheric conditions* (HVI User Guide, ITMF, 2001, page 17). Therefore, SITC modules calibration should only be a part of the maintenance activities and should *be performed only when strictly necessary* (before the initial use, when calibration standards are changed and eventually when an important part of a measuring module has been repaired). However, "calibration check tests" should be performed periodically to ensure that the correct measurements are being collected. Additionally, for a complete qualification of SITC, the ASTM D7410-07 standard (Practice for qualification of cotton classification instruments for cotton marketing) can be followed on newly installed instrument, or for an annual verification.

As specified in ISO 17025:2005 (General requirements for the competence of testing and calibration laboratories), preventive and corrective actions are keywords for an improving system in a testing laboratory, associated with cause analysis, monitoring, control of records and traceability. In this context, preventive maintenance is generally conducted to keep the equipment working and even extend its life, whereas corrective maintenance aims at making it work again after failure. Preventive maintenance is highly recommended in the industry as well as in laboratories since its estimated cost is often lower than the estimated cost for corrective maintenance (waiting breakdown and repairing). Indeed, cost of failure takes into account many factors, such as: time spent at a cost of labor technicians, possible intervention of outside experts, stock of spare parts, loss of production during the shutdown, penalties related to any delay in delivery, loss of brand image…

1 - Preventive maintenance

Preventive maintenance aims at keeping the equipment in good operating conditions and reliable in order to avoid any breakdown or dysfunction. This action, which has to be planned regularly, consists in inspecting, controlling and preserving the equipment by cleaning, adjusting and also replacing pieces when estimated necessary.

Generally, a qualified service technician is assigned to be in charge of maintenance in the laboratory and to perform preventive maintenance periodically. Depending on its own activities and also on manufacturer's advices, the different tasks of preventive maintenance should be achieved daily, weekly, monthly or annually. The preventive maintenance can also be realized by a subcontracted company: in this case, its action has to be reported to the person in charge, who will only store the information. In both situations, the efficiency of the device should be checked in a routine way before concluding on its reliable status.

Preventive maintenance could be divided into two levels: periodic maintenance and predictive maintenance.

1.1 - Periodic maintenance

Both personnel using the equipment daily and the person in charge of maintenance are involved in condition-monitoring tasks in a routine way. In order to prevent the instruments from deterioration, a pre-requisite is that only appropriate people are authorized to use the machines. They should be well-trained and have easy access to documents related to instructions on maintenance of equipment, including manufacturer's manual.

Other actions retaining the healthy condition of devices are exclusively restricted to the person in charge during periodic inspections. He/she is assigned to methodically cleaning, adjusting, oiling and testing any equipment in the laboratory, with the help of pre-established follow-up forms and maintenance books for instance.

Possible method for periodic preventive maintenance

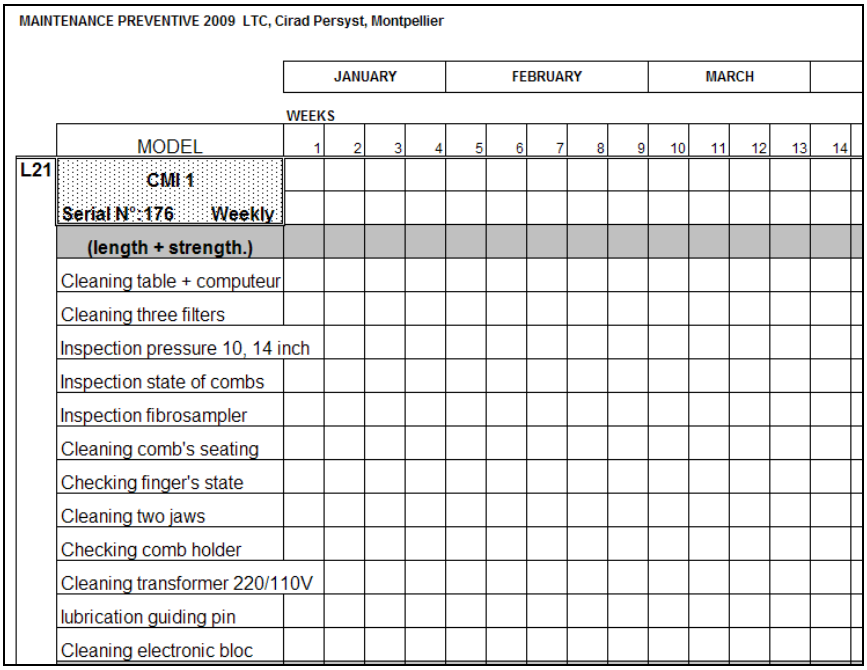
Documents such as follow-up forms have to be elaborated beforehand:

- For each laboratory room: the follow-up form enumerates all the testing instruments, including AMS elements to be checked.
- For each instrument: the follow-up form lists all the items to be checked.

The person in charge of maintenance completes periodically the follow-up forms:

- For each laboratory room: he/she performs the maintenance of listed instruments, ticks the boxes and affixes date and signature.
- For each instrument: he/she accomplishes the listed actions of cleaning and inspecting (using a vacuum cleaner, brushes, cleaning paper, lubricant, screwdrivers, measuring instruments…), ticks the boxes and affixes date and signature. Some tasks, such as internal cleaning, must be done while the equipment is shut down and others, such as checking cylinder rotation, must be done while the equipment is operating. See Figure 1 for an example of the type of actions to realize on a testing instrument. To conclude on the efficiency of the equipment, tests shall be done in a routine way when all actions are completed.

In complement to follow-up forms, any instrument should also be provided with its own maintenance book, where specific actions can be described precisely.



MAINTENANCE PREVENTIVE 2009 LTC, Cirad Persyst, Montpellier

		JANUARY				FEBRUARY					MARCH					
		WEEKS														
	MODEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
L21	CMI 1 Serial N°:176 Weekly															
	(length + strength.)															
	Cleaning table + computeur															
	Cleaning three filters															
	Inspection pressure 10, 14 inch															
	Inspection state of combs															
	Inspection fibrosampler															
	Cleaning comb's seating															
	Checking finger's state															
	Cleaning two jaws															
	Checking comb holder															
	Cleaning transformer 220/110V															
	lubrication guiding pin															
	Cleaning electronic bloc															

Figure 1. Example of a follow-up form for an instrument (extract: LS module)

1.1.1 - Specifications for SITC

The instrument system should be thoroughly checked according to the maintenance procedure prescribed by the manufacturer. Check lists should be prepared for maintenance items to be performed daily and/or at the end of each shift, week, month, and year. At the end of the test day (or shift) all loose cotton should be cleared from the work area and daily maintenance performed (Guidelines for HVI Testing, USDA 2005).

For details on daily maintenance from manufacturer, see Annex 2. Uster also provides troubleshooting actions for problems which can occur in routine (see Annex 3).

1.1.2 - Specifications for AMS

The controller for the atmospheric control system should be monitored regularly and the set points independently verified on a periodic schedule (Guidelines for HVI Testing, USDA 2005). As well, air vents and filters at return air ducts should be checked regularly and cleaned if necessary.

1.2 - Predictive maintenance

The person in charge of maintenance is also involved in life-extending tasks, which have to be scheduled regularly, even if less frequent than routine, in order to prevent faults from occurring in the long-term. The aim in this case is to identify imminent troubles and bring solutions to prevent equipment from failing, mainly by inspecting and then correcting, adjusting and/or replacing parts. Finally, check tests shall be done to conclude on the efficiency of the equipment after parts have been changed. A more advanced step of equipment diagnosis could also be done to measure deterioration and thus evaluate more accurately the end-of-life of parts in order to use them up to their limit. Moreover predictive actions shall be reported in appropriate maintenance books, where actions in addition to periodic maintenance tasks can also be described for a better traceability.

1.2.1 - Specifications for SITC

Information describing spare parts must be used and asked from manufacturer if any available. Additionally, calibration should be performed when important parts have been replaced.

Guidelines for HVI Testing, USDA, June 2005 provides troubleshooting tips for the three modules of a SITC (see Annex 4).

1.2.2 - Specifications for AMS

The chiller, heater, and humidifier units should be cleaned and checked on an established schedule (Guidelines for HVI Testing, USDA 2005).

1.3 - Importance of preventive maintenance

It could happen that suspect or outside specified limits results and also item dysfunction are only observed during preventive maintenance inspections. In such a case, the equipment cannot be considered as operational and the abnormality must be reported for traceability. An investigation should then be brought about in order to determine the impact of the erroneous deviation *from specified limits on previous tests and calibration*, as mentioned in ISO 17025:2005. Finally after only being reset/repaired and proved to be reliable by tests/calibration, the instrument can be considered as operational again.

Besides inspections, participating to CSITC Round Tests could be also a good opportunity to compare results with other laboratories results. When for example a significant difference in the level is observed, it could be considered as a clue for detecting a failure in the system (not well managed atmospheric conditions) or a calibration to be corrected (AMS or SITC). Likewise, Universal calibration standards (or internal standards) are used daily to check test levels. When SITC drifting is suspected, calibration check tests should be performed.

2 - Corrective maintenance

Whereas preventive maintenance attempts to schedule repairs prior to failure and/or further degradation, corrective maintenance is systematically done after a mechanical or electrical failure. It aims at quickly restoring the equipment and making it reliable again. This action consists in analysing the problem and solving it, generally by replacing pieces when possible by the laboratory, else by a subcontractor.

As soon as the failure is observed, the technician using the machine before the breakdown must report it to the chief of laboratory and provide information that will help finding the source of disruption (e.g. breakdown associated with noise? with/without signal? with burnt smell?). The person in charge of maintenance would then be able to proceed to a first analysis of the situation, using also information from technical files (mechanical plans, electronic diagram, instrument settings…). Employing measuring instruments such as a slide caliper, a multimeter, or an oscilloscope could also help in determining whether the instrument gives expected answers. When the issue is finally identified, the laboratory can decide its ability for repairing and use spare parts (mechanical parts, set of cards…). If the laboratory cannot handle the situation, outside experts can be called in. In such a case, the expert should provide the person in charge of maintenance with a detailed report of its action. In any situation, the efficiency of the device should be checked in a routine way before concluding on its effectual repaired and reliable status. Moreover corrective actions shall be reported and described in appropriate maintenance books for complete traceability.

2.1.1 - Specifications for SITC

Calibration should be performed when important parts of the system have been repaired or replaced.

2.1.2 - Specifications for AMS

Generally the Air Management System requires manufacturer intervention for corrective maintenance.

3 - Conclusion

In a well-managed maintenance system, all inspections done during preventive or corrective maintenance should be listed, recorded and archived every year in order to provide long term monitoring. In case additional disruptions would happen to the same device, gathered information should help evaluating and/or solving the situation. In a continuous improvement approach, information could also be used as a model for resolution when a similar failure occurs to another device.

Sources:

HVI User Guide, ITMF Standard Procedures for HVI Calibration and Operation for Testing Cotton / 2001, on line:
http://csitc.org/sitecontent//instrument_testing/public_documents_it/003_ITMF_HVI_User_Guide,_2001.pdf

Guidelines for HVI Testing, USDA, June 2005, on line:

http://csitc.org/sitecontent//instrument_testing/public_documents_it/002_USDA_HVI_User_Guide,_2005.pdf

Annex 1: Recapitulative table of different types of maintenance

Type	Preventive		Corrective
	Periodic: condition-monitoring tasks	**Predictive:** life-extending tasks	
Aim	Prevention from deterioration Maintain in satisfactory operating conditions	Prevent faults from occurring Prevent from failing Measure deterioration Identify problems	Repair Restore Replace
Who?	Personnel using the equipment daily + person in charge of maintenance	Person in charge of maintenance	Person in charge of maintenance / sub-contractor / manufacturer
When?	Periodic inspection, routine	Inspection to be scheduled regularly	After mechanical or electrical failure
What?	Care, servicing	Inspecting, diagnosis	Analysing and solving the problem
How?	Cleaning, adjusting, lubricating/oiling, testing	Inspecting, testing, and then correcting, adjusting and/or replacing parts	Parts replacement

Annex 2: Daily maintenance (Uster and Premier)

Source: USTER HVI, Application Manuals, 3-Testing-Calibration

3.5.2 Instrument Maintenance

It is the responsibility of the instrument user to ensure that the instrument is in good operating condition. In order to get repeatable results of any test instrument, it is important to keep it clean and well maintained. Proper equipment performance can be ensured if a Uster Technologies service technician regularly checks the instrument for maintenance purposes. However, regular cleaning does help as a preventive maintenance of the instrument as well. Cotton as a natural product is contaminated with dust, trash and leaf particles. Also, very small fiber fragments tend to build up as a fine layer of dust on and in the machine. Therefore, it is necessary that lab personnel follow a regular operating schedule

General guidelines that should be followed are listed in Table 3-9 below: Please, refer to the USTER® *HVI* Instruction Manual in this regard.

Daily	**Clean the instrument thoroughly after each shift.**
	This includes: • All cotton should be removed from the instrument surface area, especially from the sampling plate • Clean the color window with a soft, damp cloth (do not use abrasive or corrosive agents) • The vacuum switch on the top of the instrument should be turned OFF in order to clean the Lint Waste Box • Clean the filter inside the Lint Waste Box, removing all loose material * • Inspect the computer's cooling fan filters, and clean if necessary • The doors in front and in the back of the instrument should be opened and all excess dust, trash and remaining cotton fibers be removed *

Table 3-9 Cleaning Guidelines

* It is recommended using a small vacuum cleaner for this task.

Source: PREMIER ART, Operating Instructions (applicable for software version 1.1.7)

Premier ART Daily Maintenance

Daily maintenance required on the Premier ART system has been reduced to a minimum. However, there are a few tasks which need to be performed daily to keep the instrument in a good working condition.

Before starting up the instrument follow the cleaning maintenance given below:

1. Drain the water from the Air filter cum Regulator.
2. Using Vacuum cleaner, clean the fibre and other foreign matters adhered in the various instrument parts, inside and outside.
3. Clean the suction box every shift to maintain effective suction. This should be done only in the suction motor OFF condition.
4. Check whether the input air pressure in the main regulator shows 6 bar. If this is maintained, all other regulators provided for other operations will remain constant, as they are set at factory.
5. Clean the micronaire module cabinet using vacuum cleaner, to avoid accumulation of fibres or other foreign matters.
6. Drain off the water particles in the Air filter cum Regulator.
7. Check the micronaire chamber for accumulation of fibre or other foreign matters. This will affect the movement of piston during testing.
8. Clean the sample window of the colour & trash module using a soft cloth.

PREMIER ART, Operating Instructions (applicable for software version 1.1.7)

Premier ART Regular Maintenance

Greasing of LM guilde and Ball screw rod to be carried out at recommended intervals. The necessary details are given below:

i. Lubricant to be used : Grease

ii. Lubricant specification : AFB grease (THK make, standard package 400gm/70gm)

iii. Lubrication interval : Once in 25 shifts (1 shift = 8 hours)

iv. The above greasing to be done manually by using grease gun.(MG 70 - THK make)

v. Grease to be filled till it over flows from nut.

vi. Grease nipple location available in Fig.66.

Annex 3: Troubleshooting actions (Uster)

Extract from Uster HVI1000 Best operating practices for lab technicians/operators 2008

2.1.3 Micronaire Troubleshooting

The following actions can resolve frequently observed operation problems:

Problem	Action
Bad Start button for mic. Controller waiting for HVI ready.	• Wait until the HVI is ready for the Micronaire sample button. In general, the sample ID must be entered first.
No valid Mass.	• The HVI requires some time to ensure that the mass is stable and within the allowed mass range. Wait until the display on the balance agrees with the HVI monitor and the Micronaire air turns on.
Consistent lot limits	• Lot limits must be assigned to match the cotton being tested. Verify that the limits are consistent with the lot.
High variability	• Check the sample weight. Ensure that it is stable on the balance and that the display on the balance agrees with the HVI monitor. Ensure the entire sample mass is entered in the Micronaire chamber. • Use both hands to insert the sample. Do not poke the sample in with a single finger.
Door not closed	• Check that part of the sample is not fully inserted into the chamber and is holding the door open. • Very large sample mass near 11.5 grams may push the door open. Use a smaller mass.

2.3.4 Length/ Strength Troubleshooting

Learn to watch the data. Sudden changes in the data may warn of problems with the HVI. The following actions can resolve frequently observed operation problems:

Problem	Action
Consistent High Amounts	• The sample may be located deeper into the sample drum so that it covers fewer holes in the sample plate. The other option is to remove part of the sample from the drum.
Consistent Low Amounts	• Add some sample to the sample drum. Another option is to pull the sample and place it further up the sample plate in the sample drum so that it covers more holes in the sample plate. Finally, the sample can be manually opened more.
L/S Button Error	• Wait until the HVI is ready for the L/S sample button. In general, the sample ID must be entered first. The green LED will indicate that the HVI is ready.
Consistent lot limits	• Lot limits must be assigned to match the cotton being tested. Verify that the limits are consistent with the lot.
Unusually high (low) test results	• Test 4 combs of the each calibration cotton to verify calibration.
High variability	• Observe uniformity of fiber beard. Adjust sample placement if necessary (see high and low amounts above). • Verify that the comb is cleaning correctly. • Check 10 combs in module testing from extreme locations in the sample, to see if this is variability is due to the natural variation within the cotton.

2.5.6 Color/ Trash Troubleshooting

The following actions can resolve frequently observed operation problems:

Problem	Action
High trash readings	• Ensure that the entire sample window is covered and that the window is clean.
Color Button Error	• Wait until the HVI is ready for the color sample button. In general, the sample ID must be entered first. The green LED will indicate that the HVI is ready.
Consistent lot limits	• Lot limits must be assigned to match the cotton being tested. Verify that the limits are consistent with the lot.
High variability	• Check the thickness of the sample. Ensure that it is greater than 2 inches or 5 cm thick and uniform in thickness.

Annex 4: maintenance and troubleshooting tips

Extract from Guidelines for HVI Testing (USDA AMS Cotton Program), July 2005

MAINTENANCE

Maintenance should be performed on the HVI system according to the manufacturer's instruction manual. The instrument system should be thoroughly checked according to the maintenance procedure prescribed by the manufacturer. Check lists should be prepared for maintenance items to be performed daily and/or at the end of each shift, week, month, and year. At the end of the test day (or shift) all loose cotton should be cleared from the work area and daily maintenance performed.

In addition to the regular maintenance program for the HVI systems, a standard routine maintenance program should be performed on the atmospheric control system. The chiller, heater, and humidifier units should be cleaned and checked on an established schedule. The controller for the atmospheric control system should be monitored regularly and the set points independently verified on a periodic schedule.

TROUBLESHOOTING TIPS

Colorimeter/Trashmeter

Is the sample window glass clean?

How old are the lamps?

Are the lamps properly seated and lamp socket connections tight?

Are the calibration tiles clean?

Are there any cracks in the tiles?

Is the hand platen pressure properly adjusted?

Does the sample tray stop over the window at the correct position?

Micronaire

Does the micronaire chamber seal correctly?

Are the o-rings dirty or worn?

Are the air pressure levels for both the micronaire air chamber and the transducer manifold set correctly?

Is the chamber size correct?

Do the associated regulators stabilize quickly?

Is the balance level free of air turbulence and properly calibrated?

Does the balance respond by returning to zero every time the balance pan is empty?

Length & Uniformity Index Measurements

Is the brushing pressure even?

Do the combs open and close properly?

Are there missing or bent teeth in the combs?

Does the vacuum pressure ensure that fibers are being drawn into the optics window? Are the samples positioned for proper alignment in relation to the front of the optics window?

Is the fibrosampler card cloth thoroughly carding the cotton fibers?

Strength Measurements

Do both the front and rear jaws clamp correctly?

Is the jaw gap set correctly?

Are the air pressure levels for the clamping cylinders set to the proper settings?

Are all jaws clean?

Are electronic boards set up in accordance with manufacturer guidelines?