1.0 Purpose

The purpose of this procedure is to document the key administrative and technical requirements of the ESD Control Program used by Top Technology, Inc. (TTI). This ESD program has been developed to comply with the requirements of ANSI/ESD S20.20-2021.

2.0 Scope

This procedure applies to all manufacturing areas and the associated manufacturing operations where unprotected ESD sensitive products are handled.

3.0 Responsibilities

TTI have assigned an ESD Coordinator to implement the requirements listed in this internal ESD Control procedure. Once implemented the ESD Coordinator shall be responsible for ensuring the on-going compliance with this procedure.

4.0 Referenced Documents

ANSI/ESD S6.1
ANSI/ESD S20.20
ANSI/ESD S541
ANSI/ESD STM 9.1
ANSI/ESD STM 97.1
ANSI/ESD STM 97.2
ESD TR-53
ESD ADV1.0 - Glossary of Terms

5.0 Definitions

ESD Protected Area (EPA)
A designated environment provided with materials and equipment to limit electrostatic potentials.

6.0 ESD Control Program Plan

This procedure meets the requirements of ANSI/ESD S20.20-2021. The controls referenced in this document have been selected to ensure that ESD sensitive devices (ESDS) that are susceptible to discharges of greater than or equal to 100 volts Human Body Model, 200 volts Charged Device Model and 35 volts on isolated conductors will not be damaged. Since Top Technology, Inc. does not have the actual ESD sensitivity data for the devices that are being handled, it is assumed that all ESDS have an ESD sensitivity of greater than or equal to the

above values for each ESD sensitivity model. ESDS devices that are more sensitive may require additional control measures.

7.0 Training Plan

7.1 *Initial Training*

All TTI employees who handle ESD sensitive products (whether on a continual or intermittent basis) must attend initial ESD orientation training before they handle any ESD sensitive device.

The initial training class is delivered by training department personnel. The initial ESD class covers ESD basics as well as a description of the TTI ESD controls. At the conclusion of the ESD training class each employee shall write an ESD comprehension test. The TTI Training department will mark the test and in order to pass the employee must obtain a score of 80%.

If an employee passes the test a training record will be set up in the training database that is controlled by the Training Department. If the employee fails to obtain a score of 80% the employee will have to attend a supplemental class held by the Training Department. The employee will be required to write a second test and obtain a score of 80% in order to pass. If the employee passes the second test a record will be set up in the training database. If the employee fails to obtain a score of 80% on the second test the Human Resources manager will need to make a determination on whether or not the employee will continue their employment with TTI.

7.2 *Refresher Training*

All TTI employees who handle ESD Sensitive products must receive refresher training once every 24 months. On a monthly basis, the Training department shall prepare a list of employees who require re-training in the next two months. The employees on the list as well as their immediate supervisor will be notified that re-training is required and the affected employee will be invited to attend a re-training session held by the training department.

At the conclusion of the re-training session the employee must pass a written test and obtain a score of at least 80%. The training department will update the records for the employees who pass the test. If the employee fails to obtain a score of 80% or higher the trainer will meet with the employees to discuss the incorrect answers. After the meeting the trainer will consider the retraining complete if the employee understands why they answered the question(s) incorrectly.

If an employee fails to attend a re-training session before their certification period expires, the employee will not be allowed to have access to the manufacturing areas until the re-training session has been successfully completed.

8.0 Product Qualification

The ESD Coordinator is responsible for ensuring that all of the ESD control items used in the facility (see Table 1 of this procedure) have been qualified per the requirements of tables 2 and 3 in ANSI/ESD S20.20. Product qualification data, to the required test methods and standards, is compiled and maintained by the ESD Coordinator.

Evidence of qualification will be any one of the following:

a. Product Specification Sheet
b. Third party lab report
c. Internal test report

Note: Each of the above methods must reference the ESD Association test method for that technical item and the limits must comply with the limits listed in ANSI/ESD S20.20-2021.

The ESD floor used by TTI was installed before ANSI/ESD S20.20 was adopted by TTI and specification sheets are no longer available for the installed product. Product qualification of the floor was done by measuring the resistance to ground and point to point resistance at the lowest Rh level at the site.

9.0 Compliance Verification Plan

The ESD control program compliance verification requirements established by TTI can be found in **Table 1**.

The ESD Coordinator is responsible for defining the ESD control items that require periodic verification. The ESD Coordinator is also responsible for the development of the audit procedures as well as the training of any person performing ESD audits.

The ESD Coordinator will ensure that all non-conformances found during the audits have been closed prior to publishing the quarterly audit report to management.

Note: The audit test methods not covered by the ESD Association Technical Report (TR) 53 can be found in Annex 1 of this document.

Technical Control Item	Limits	Test Procedure	Test Frequency	Checked By
Wrist strap (system test)	Rs < $1.0x10^7$ Ohms	ESD Association publication TR53: Wrist strap section	Daily (before use)	Operator
Footwear	Rs < $1.0x10^7$ Ohms	ESD Association publication TR53: Footwear Section	Daily (before use)	Operator
ESD Flooring	Rg<$1.0x10^6$ ohms	ESD Association publication TR53: Flooring Section	Once every 3 months	Site Facilities maintenance
Work surface	Rg < $1x10^9$ Ohms	ESD Association publication TR53	Once every 3 months	ESD Coordinator
Wrist strap connection point	Rg < 2 Ohm	Annex A.1 of this procedure	Once every 3 months	ESD Coordinator
Process Required Insulators	Within 2.5 cm less than 125 volts Greater than 2.5 cm but less than 30 cm, 2000 volts	ESD Association publication TR53	Random samples every six months	ESD Coordinator
- EPA (General)	≤ 2,000 Volts/inch	Annex A.2 of this procedure	Once every 3 months	ESD Coordinator
- Direct contact	≤ 125 Volts/inch	Annex A.2 of this procedure	Once every 3 months	ESD Coordinator
Shielding bags	< $1x10^{11}$ Ohms, internal and external surface	Six random samples	Once every 3 months	ESD Coordinator
Rs refers to system resistance including person, the wrist band and the grounding cord or ESD footwear Rg refers to resistance to ground				

Table 1 – Compliance Verification Requirements

10.0 ESD Protected Area Requirements

For the purposes of the ESD control program at TTI the ESD Protected Area (EPA) is defined by yellow floor tape that outlines the borders of the EPA.

The ESD protected work stations within the EPA are identified with a sign indicating that the workstation is ESD protected.

Visitors to the EPA as well as untrained employees shall be escorted by ESD certified employees.

Non-essential insulators (insulative items not required in the manufacturing process), including packaging materials, shall be removed from all ESD protected workstations.

Process required insulators are permitted at an ESD protective workstation as

long as the measured electrostatic field does not exceed the limits in table 1 (see the measurement procedure in ANNEX 1).

Before a new production process is introduced the ESD coordinator shall measure all conductors (that cannot be grounded) that may come into contact ESD sensitive devices. The voltage on these conductors must be less than 35 volts. If greater than 35 volts an air ionizer must be added to this process step. The measurements of isolated conductors will only be performed during process qualification.

10.1 Grounding Plan

Equipment (AC) ground shall be used as the ground reference for all ESD control items used by TTI. All wrist strap connection points, and work surfaces shall be connected to ground via a common point ground as defined in ANSI/ESD S6.1. All newly installed work surfaces and wrist strap connection points shall be tested before use to ensure that they are connected to ground.

The ESD floor shall be connected directly to AC ground.

10.2 Personnel Grounding Plan

Personnel shall be connected to ground with either a wrist strap system or, for standing operations, through the ESD floor when wearing approved ESD footwear.

Wrist strap system:
The wrist band must be worn such that there is 360 degrees of contact with the employee's skin. The wrist cord must be plugged into the wrist strap receptacle that is located at every ESD protected work station.

Footwear System:
Employees working at standup operations while handling ESDS must wear ESD footwear that has been qualified by the ESD coordinator per the requirements in ANSI/ESD STM 9.1 and ANSI/ESD STM 97.1.

Note: Product qualification data has shown that the total system resistance of the employee, ESD footwear and flooring is less than $3.5x10^7$ ohms when tested per the requirements of ANSI/ESD STM 97.1. In addition, the walking test peak voltage is less than 100 volts when tested using ANSI/ESD STM 97.2

Testing:
Employees shall test their wrist strap and footwear at least once per day (before use) using the testers located at the entrance to the manufacturing area. If the tester gives a “pass” indication the employee shall initial the log sheet located next to the tester. If the tester gives a “fail” indication the employee shall contact their supervisor or the ESD coordinator. The ESD coordinator or the supervisor will help to determine the cause of the failure. Employees must not handle ESDS until both the wrist strap and footwear have passed the daily test.

Employees who only visit the manufacturing lines periodically must test their wrist strap and footwear on the days when they handle ESD sensitive devices. The testing must be done before ESD sensitive devices are handled. The test log sheet must be initialed (if pass indication is achieved) before the employee handles ESD sensitive devices.

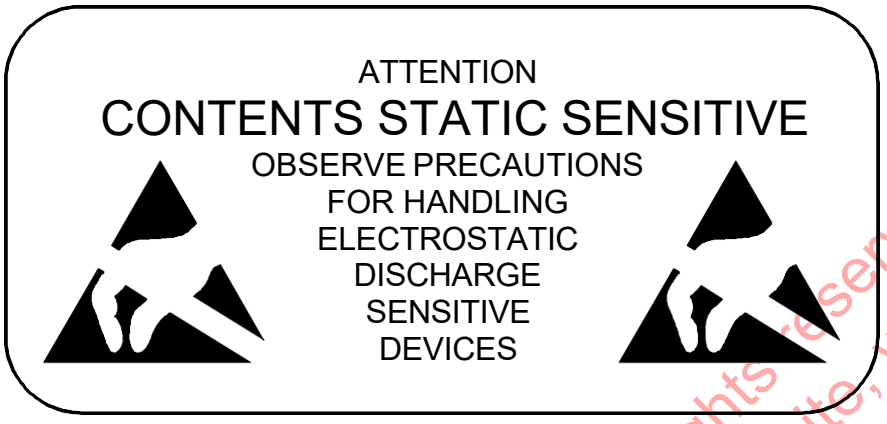
10.3 Packaging

Metallized shielding bags (qualified per ANSI/ESD S541) shall be used to transport ESD sensitive products from one ESD protected workstation to another. ESD sensitive products must be completely enclosed by the shielding bag. ESD sensitive products are to be removed from the packaging only at an ESD protected work surface by grounded employees.

Once the ESD sensitive product has been tested and is ready for shipment to the customer it will be returned to the shielding bag and sealed with an ESD label. The sealed shielding bag will then be placed in a protective container for shipment to the customer.

10.4 Marking

TTI have not received any specific marking requirements from its customers. However, in order to ensure that the customer is aware that the product is ESD sensitive the following label will be used to seal the metallized shielding bags that are used to ship all products to the customer.



ANNEX 1
Audit Procedures not covered by ESD Association Technical Report TR53.

Annex A.1 – Testing of wrist strap connection point
Equipment: Calibrated multi-meter

1. Connect one lead of the multi-meter to ground.
2. Connect the second lead to the wrist strap connection point.
3. Turn on the multi-meter and read the resistance.
4. If less than 2 Ohms then the reading is acceptable.
5. If greater than 2 Ohms have the wiring connection checked and fixed if necessary.

Annex A.2 – Checking for Static Generators
Equipment: Calibrated electrostatic field meter

1. Turn on, ground and zero the electrostatic field meter.
2. Measure all the items the work area (where the ESD sensitive devices are handled) with the field meter. If the reading exceeds the process required insulator limits in table 1 of this procedure action must be taken to correct the non-conformance.