Transportation Security Administration

Transportation Security Equipment (TSE)

Metrics Terms and Definitions
&
Reliability, Maintainability & Availability (RMA) Metrics

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1. Purpose

This document has three purposes:

- To define the process which the Transportation Security Administration (TSA) will use to identify, collect, record, and report each preventative and corrective maintenance activity conducted on Transportation Security Equipment (TSE).

- To establish the process for developing the Reliability, Maintainability, & Availability (RMA) metrics that TSA will use to evaluate the performance of TSE during the Operation and Maintenance (O&M) phase of its life cycle. An effective RMA metrics program for operational TSE provides TSA management with technical insight into the quality of the development and fielding of TSE.

- To support the process TSA uses to develop metrics to evaluate the performance of TSE contracted maintenance service providers (MSP) and Original Equipment Manufacturers (OEM). **Contractor performance metrics requirements are delineated in each applicable TSA Service Level Agreement (SLA) contract document. This document is <u>only</u> to provide guidance on how to collect and calculate the RMA metrics data. SLA metrics may be calculated differently than what is stated in this document.**

2. Scope

This document delineates the maintenance elements that TSA uses to document the corrective and preventative maintenance activities conducted on TSE. It identifies the requirements for recording these maintenance elements in the TSE Database, including time points and the low-level metrics from those time points associated with each corrective maintenance action. While individual TSA contracts will dictate the requirement for both types of maintenance, this document focuses on unscheduled corrective maintenance actions and the accurate recording of these actions in a TSE Database. It also provides the process that TSA uses to develop RMA metrics from the low-level metrics for evaluating and analyzing the operational performance of deployed TSE throughout its life cycle.

3. Maintenance Types

TSA identifies two types of maintenance activities to support TSE: preventative and corrective.

3.1 Preventive Maintenance (PM)

Preventive maintenance (PM) improves the reliability of TSE and is scheduled according to the Original Equipment Manufacturers (OEM) manual. All preventive maintenance documentation includes start and end times and a description of the preventative maintenance performed. Preventive maintenance records are used to demonstrate compliance with contract requirement but are not included in calculations for low-level or RMA metrics.

3.2 Corrective Maintenance (CM)

Corrective maintenance (CM) is unscheduled and is performed to repair and restore TSE to full mission capability status. Corrective maintenance can be performed either on site or at a depot facility. TSA defines three discrete levels of corrective maintenance as described below.

- Level I Corrective Maintenance – This is corrective maintenance that is performed as needed to effect minor repairs to TSE that do not require Field Service Technicians (FST) (e.g., some bag jams, reboots, etc.). These activities are normally performed by TSA personnel or their designees and are not addressed in this document.

- Level II Corrective Maintenance – This is unscheduled corrective maintenance activities performed as needed to effect repairs that always require FSTs. These activities are addressed in this document.

    - Field Service – These activities are performed on site by FSTs with the TSE in Level II CM status. Level II Corrective Maintenance – Field Service will be referred to as CM in this document.

    - Telephone Customer Support (TCS) – These activities are performed via telephone consultation with an FST. Level II Corrective Maintenance – Telephone Customer Support (TCS) will be referred to as TCS in this document.

- Level III Depot Maintenance (DM) – This is unscheduled corrective maintenance that requires shipping TSE to a depot facility for repair. Level III Depot Maintenance will be referred to as DM in this document. These activities are addressed in this document.

3.3 Security Technology Integrated Program (STIP)/Network Maintenance

Selected TSEs are connected to STIP network which can incur STIP/Network failures. When a network connection failure is detected by the STIP, then a ticket is autogenerated and sent to Single Point of Contact (SPOC). These failures are classified as STIP/Network related maintenance activities which do not require FST. These tickets are resolved by the STIP team via network.

4. Maintenance Activity Collation Process

Each TSE CM/DM activity must progress through a repair cycle from the initial notification of TSE failure to the return of the TSE to fill mission capability. The process identified in this document will ensure proper recording and reporting of the TSE maintenance activity required by TSA to successfully validate TSE and contractor performance.

4.1 Maintenance Elements

Each CM activity begins with the identification of a TSE maintenance requirement. It is important to identify the following maintenance elements in each repair cycle to properly document the corrective maintenance elements:

- TSE failure criticality
- TSE failure relevancy
- Maintenance action time points along the repair cycle
- Maintenance action low-level metrics derived from the maintenance action time points

All maintenance elements identified in this document, as well as other required maintenance activity information identified in Contract Data Requirements Lists (CDRL) and associated Data Item Descriptions (DID), must be collected and recorded for each corrective maintenance activity in the TSE Database. Other information would include, but is not limited to, failure mode indicators and parts replacement information as outlined in individual contracts.

4.2 TSE Failure Criticality

For each TSE failure, the criticality of a failure must be validated by the Contractor as soon as possible to ensure the prompt return of TSE to full mission capability and must be documented in the TSE Database. The definitions below are used to determine whether a TSE failure is identified as a critical failure or a non-critical failure.

- **Critical (Priority 1 (P1))** – Failures where TSE is unable to perform its required mission and requires immediate corrective maintenance to restore the TSE to full operational condition. Events that TSA Security Officers (TSO) can correct via system resets, simple removal of obstructions, etc., are not categorized as critical.
- **Non-Critical (Priority 2 (P2)) –** Failures where TSE needs corrective maintenance but still operates at full mission capability until the minor repair is completed.

CM, TCS and STIP related failures can be associated with either critical or non-critical failures. DM is always defined as critical failures.

4.3 TSE Failure Relevancy

For each TSE failure, the relevancy of the failure must be validated by the Contractor as soon as possible and must be documented in the TSE Database. The definitions below are used to determine whether a TSE failure is a relevant or non-relevant failure. Both relevant and non-relevant failures can be critical or non-critical.

- **Relevant –** Failures attributable to the TSE's inherent performance reliability. This could include such things as wear and tear or part failure. In this case, the inherent reliability of the TSE is directly related to the failure.
- **Non-Relevant** – Failures verified to be caused by an unintentional or intentional external occurrence in the operational environment not related to the inherent performance reliability of TSE. This could include baggage processing irregularities, operator mishaps that physically damage the TSE, or network connectivity. In this case, the inherent reliability of the TSE is unrelated to the failure.

CM, DM, and TCS maintenance activities can be either relevant or non-relevant depending on the cause of the failure.

4.4 Maintenance Action Time Points

TSA relies on the collection of specific maintenance action time points (T-Values) along a CM repair cycle to track its progress. Table 1 identifies and defines the 12 T-Values that must be recorded, as applicable, for each repair cycle to document CM, DM, and TCS maintenance actions. These T-Values must identify the date and time of each maintenance action and be provided in real clock times in the TSE location's local time based on a 24-hour day, seven-day week.

Table 1: Measurement Time Points (T-Values)

ID	Description
T1	Call Center Contacted: Time when the Dispatch Contact Facility is initially contacted after a TSE failure occurs.
T2	Technician Dispatched: Time when a FST is contacted to perform the repair.
T3	Technician Starts Diagnostics: Time when the FST begins to diagnose the TSE problem.
T4	Technician Diagnostics Complete: Time when the FST completes the diagnosis and is ready to request any part(s) from the supply chain or start the repair if parts are not required.
T5	Parts Begin Shipment: Time when the supply chain indicates that the part(s) are en route to the FST.
T6	Parts Delivered to Location: Time when the part(s) are delivered locally. Note that this is not necessarily when the part(s) are in the hands of the FST but rather when they are delivered from the supply chain locally; there may be additional time to get the part(s) to the FST to begin the repair.
T7	Technician Begins Repair: Time when the FST is at the TSE location and ready to begin the repair (has all necessary parts and tools).
T8	Technician Begins Testing: Time when the repair has been completed and the FST is ready to verify completion of the repair.
T9	TSE Ready for Signoff: Time when the FST has successfully completed the verification testing and the TSE is ready for the TSA signoff. For STIP/Network tickets, the STIP/Network issue have been resolved.
T10	TSA Signoff: Time when TSA signs off on the TSE repair and the TSE is ready to be returned to service.
T11	TSE Ready for Setup at the Location: Time when the TSE has returned from the depot or storage.
T12	Start of Telephone Customer Support: FST decides that phone support is sufficient to resolve the failure.
T13	The SPOC is notified for STIP/Network issues. STIP ticket is created.
T14	The ticket is assigned to STIP/Network team.
T15	The STIP ticket is assigned Information Technology (IT) Specialist.

4.5 Maintenance Action Low-Level Metrics

The T-Values provide the start and end times that are used to derive low-level metrics (M-Values) that measure the duration of discrete maintenance actions along the repair cycle. The M-Values are derived as the difference between two specific T-Values, resulting in M-Values that must be recorded as applicable for a repair cycle.

Table 2 shows the 13 M-Values that are derived from the T-Values in Table 1 in a straight linear progression. An explanation of each M-Value development process is identified below Table 2. Note that in Table 2, some T-Values and M-Values can be applicable when a TSE is in either a CM, DM, or TCS repair cycle. Section 4.6.2 explains deviations in the development of M-Values when a repair cycle is not in a straight linear progression.

Table 2: Low-Level Metrics Summary

Maintenance Path	Low-Level Metric		Start Time		End Time	
	ID	Description	ID	Description	ID	Description
CM & DM	M_1	Initial Call Center Interaction Time	T1	Call Center Contacted	T2	Technician Dispatched
CM & DM	M_2	Technician Dispatch Time	T2	Technician Dispatched	T3	Technician Starts Diagnostics
CM & DM	M_3	Technician Diagnosis Time	T3	Technician Starts Diagnostics	T4	Technician Diagnostics Complete
CM	M_4	Part(s) Request Time	T4	Technician Diagnostics Complete	T5	Parts Begin Shipment
CM	M_5	Part(s) Fulfillment Time	T5	Parts Begin Shipment	T6	Parts Delivered to Location
CM	M_6	Local Logistics Time	T6	Parts Delivered to Location	T7	Technician Begins Repair
CM	M_7	Technician Repair Time	T7	Technician Begins Repair	T8	Technician Begins Testing
CM & DM	M_8	Technician Testing Time	T8	Technician Begins Testing	T9	TSE Ready for Signoff
CM & DM	M_9	TSA Signoff Time	T9	TSE Ready for Signoff	T10	TSA Signoff
CM	M_{10}	Time to Repair	T3	Technician Starts Diagnostics	T4	Technician Diagnostics Complete
			T7	Technician Begins Repair	T9	TSE Ready for Signoff
DM	M_{11}	Depot Turn Around Time (DTAT)	T4	Technician Diagnostics Complete	T11	TSE Ready for Setup at the Location
DM	M_{12}	Uncrate/Setup at Location Time	T11	TSE Ready for Setup at the Location	T8	Technician Begins Testing
TCS	M_1	Initial Call Center Interaction Time	T1	Call Center Contacted	T12	Start of Telephone Customer Support
TCS	M_{13}	Telephone Customer Support	T12	Start of Telephone Customer Support	T9	TSE Ready for Signoff

Maintenance Path	Low-Level Metric		Start Time		End Time	
	ID	Description	ID	Description	ID	Description
STIP	M_{14}	STIP/Network Ticket Transfer Time	T13	STIP/Network Ticket is created	T14	Ticket is Assigned to STIP/Network
STIP	M_{15}	STIP/Network Ticket Resolved Time	T14	Ticket is Assigned to STIP/Network	T9	TSE Ready for Signoff
STIP	M_{16}	STIP/Network Ticket Resolved Time	T15	IT Specialist onsite	T9	TSE Ready for Signoff

- **M_1 – Initial Call Center Interaction Time.** This metric measures how long it takes the Dispatch Contact Facility to gather the initial information about the TSE problem(s) and assign a FST to conduct the repair. It is measured as the time between when the Dispatch Contact Facility is initially contacted after the failure occurs (T1) and the time the FST is contacted to perform the work (T2).

- **M_2 – Technician Dispatch Time.** This metric measures how long it takes for the FST to respond to the service call and arrive at the TSE ready to diagnose and repair the TSE. It is measured as the time between when the FST is initially contacted by the Dispatch Contact Facility to perform the work (T2) and the time that the FST arrives at the failed TSE and begins the diagnosis of the problem (T3).

- **M_3 – Technician Diagnosis Time.** This metric measures how long it takes the FST to diagnose the problem(s) with the TSE. It is measured as the time between when the FST begins the diagnosis of the problem (T3) and when the FST completes the diagnosis and is ready to request any part(s) from the supply chain (T4) or is ready to begin repair if no parts are required (T7). See Section 4.6.1 for this explanation.

- **M_4 – Part Request Time.** This metric measures how long it takes to request the part(s) from the supply chain required for the repair of the TSE. It is measured as the time between when the FST completes the diagnosis and is ready to request any part(s) from the supply chain when parts are required (T4) until the time the supply chain identifies that the part(s) are en route to the local delivery point (T5).

- **M_5 – Part Fulfillment Time.** This metric measures how long it takes the supply chain to deliver (or fulfill) the part(s) required for the repair of the TSE. It is measured as the time between when the supply chain identifies the part(s) are en route to the local delivery point (T5) until the time the part(s) are in fact delivered (T6). Note that this is not necessarily when the part(s) are in the hands of the FST but rather when they are delivered locally from the supply chain; there may be additional time to get the part(s) to the FST at the TSE location to start repairs that would be included in M_6.

- **M_6 – Local Logistics Time.** This metric measures any delays incurred where parts have been delivered locally but additional time is required to get the part(s) into the hands of the FST to start the repair of the TSE. It is measured as the time between when part(s) are delivered locally (T6) until they are in the hands of the FST at the TSE location and the FST is ready to begin the repair (T7).

- **M_7 – Technician Repair Time.** This metric measures the repair time for a TSE. This is defined as the time between when the FST has all necessary tools and parts and begins the disassembly of the TSE for repair to when the TSE is reassembled and is ready for verification testing of a successful repair. It is measured as the time between when the FST has all necessary part(s), if required, and tools at the TSE and is ready to begin the repair (T7) until the time the TSE is repaired and ready for verification tests (T8). See Section 4.6.3 for deviation to development of M_7.

- **M_8 - Technician Testing Time.** This metric measures the verification testing time for the TSE. It is measured as the time between when the TSE is ready for verification tests (T8) until the time the verification testing is successfully completed, and the TSE is ready for the TSA signoff process (T9).

- **M_9 – TSA Signoff Time.** This metric measures the TSA signoff time for the TSE and is the last step before the TSE is placed back into service. It is measured as the time between when the verification testing is successfully completed by the FST and the TSE is ready for the TSA signoff process (T9) until the TSE repair is signed off by TSA and the TSE is ready to be returned to service (T10).

- **M_{10} – Time to Repair.** This metric measures the actual repair time for a TSE, including the time required for diagnostics and testing. It is measured as the sum of M_3 (T3 to T4), M_7 (T7 to T8), and M_8 (T8 to T9) (i.e., $M_{10}=M_3+M_7+M_8$), which ends when the TSE is reassembled and is ready for TSA signoff (T9).

- **M_{11} – Depot Turn Around Time.** This metric measures how long a TSE remains away from its designated location for repair at the depot. It is computed as the time between when the diagnosis has been completed and DM decision (T4) has been made until the time the TSE is ready for setup at its designated location after the completion of depot repair (T11).

- **M_{12} – Uncrate/Setup at Location Time.** This metric measures how long it takes the TSE to be prepared for re-installation at the airport's designated location after it has returned from the depot or storage. It is measured as the time between when the TSE has returned from the depot or storage (T11) until the time the TSE is ready for testing after re-installation at the installed location (T8).

- **M_{13} – Telephone Customer Support Time.** This metric measures the time duration of diagnostics and maintenance where the FST directs the airport personnel over the phone (T12) to resolve the failure successfully without an FST visit to the TSE site. It is measured as the time between when TCS begins (T12) and the TSE is ready for TSA signoff (T9).

- **M_{14} – STIP/Network Ticket Transfer Time.** This metric measures the time duration of when the STIP/Network ticket is created and assign the tickets to either STIP and/or Network team. It is measured from when the ticket is created (T13) to when the ticket is assigned to STIP/Network team (T14)

- **M_{15} – STIP/Network Ticket Resolved Time.** This metric measures the time duration of when the STIP/Network ticket is resolved by the STIP/Network team. It is measured from when the ticket is assigned to STIP/Network (T14) and the TSE is ready for TSA Signoff (T9).

- **M_{16} – STIP/Network Ticket Resolved Time by IT Specialist.** This metric measures the time duration of when the STIP/Network ticket is resolved by the IT Specialist. It is measures from when the ticket is assigned to STIP/Network (T15) and the TSE is ready for TSA Signoff (T9).

4.6 Maintenance Action Repair Cycles

Each corrective maintenance activity involves a repair cycle that starts from initial notification (T1) until the repair is completed (T9) successfully. T-Values must be recorded, and these T-Values must also be accurately captured in the TSE Database for each corrective maintenance activity in accordance with the TSE CDRL and DID. Applicable low-level metrics (M-Values) are derived from the T-Values of each maintenance action.

The Contractor should identify any other deviations that would preclude the documentation of T-Values and M-Values as identified above and should make sure the TSE Database clearly identifies the T-Values used to derive an M-Value. As previously mentioned, it is also important that these T-Values and derived M-Values identify the actual date and time of each maintenance action and be provided in real clock times in the TSE location's local time based on a 24-hour day, seven-day week.

Some maintenance time points and associated low-level metrics will depend on whether the repair is being accomplished as a CM, DM or TCS repair. Figure 1 below shows an example of three paths (CM, DM or TCS) that TSE can progress through in a repair cycle in a straight linear progression. It identifies the maintenance time points (T-Values, i.e., T1, T2, etc.) and low-level metrics (M-Values, i.e., M_1, M_2, etc.) along a repair cycle, and illustrates the type of data points and low-level metrics that will be included in the TSE Database.

Figure 1: Repair Cycle Paths

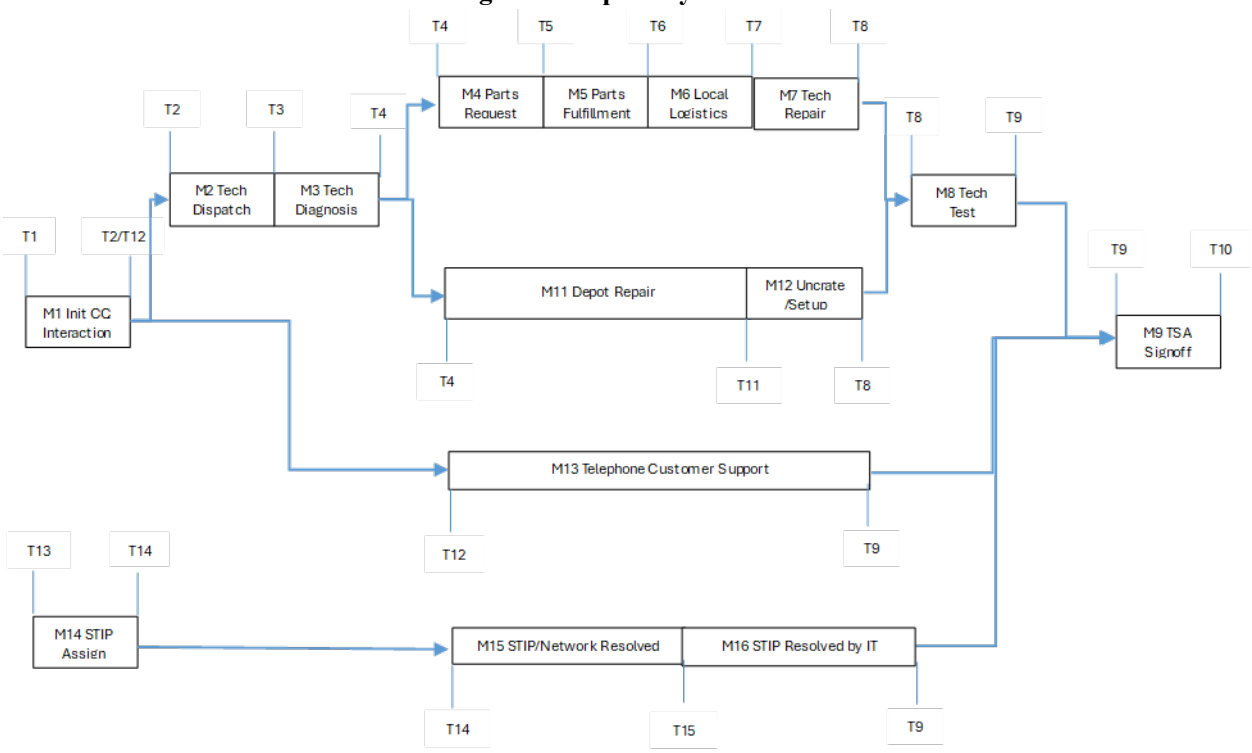


Table 3 shows the standard low-level metrics (M-Values) that will be measured from the T-Values for each failure type in a repair cycle's linear progression. The dark shaded blocks with no M-Values in the table indicate that the associated low-level metrics are not applicable to that failure type in its repair cycle.

Table 3: Failure Types and Associated Lower-Level Metrics

Failure Type			Low-Level Metrics										
Level	**Criticality**	**Relevancy**											
CM	Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
CM	Non-Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
CM	Critical	Non-Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
CM	Non-Critical	Non-Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
DM	Critical	Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9
DM	Critical	Non-Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9
TCS	Critical	Relevant	M_1									M_{13}	M_9
TCS	Non-Critical	Relevant	M_1									M_{13}	M_9
TCS	Critical	Non-Relevant	M_1									M_{13}	M_9
TCS	Non-Critical	Non-Relevant	M_1									M_{13}	M_9
STIP	Critical	Non-Relevant								M_{14}	M_{15}	M_{16}	M_9
STIP	Non-Critical	Non-Relevant								M_{14}	M_{15}	M_{16}	M_9

Normally, a repair is achieved by progressing through the T-Values and low-level metrics in a straight linear progression as shown in Table 3. However, below are known deviations from the normal linear progression that should be identified and measured accordingly.

4.6.1 No Parts Replacement

The repair cycle previously illustrated in Figure 1 assumes the need for spare parts to complete the repair. In a CM where parts are not required to complete the repair, the T-Values associated with parts replacement would not be recorded, some low-level metrics would not be derived, and other low-level metrics would be ended and started with different T-Values. Following is the progression of a repair cycles without a parts replacement requirement:

- T1 through T4 recorded, and M_1, M_2 and M_3 derived
- T5, T6 and T7 not recorded, and M_4, M_5 and M_6 not derived
- T8 and T9 recorded, M_7 derived (from T4 to T8), and M_8 and M_9 derived normally

4.6.2 Recursions

As a repair cycle progresses, there may be a need to repeat some T-Values or a need to change the type of repair cycle. This is referred to as recursion in the TSA maintenance collection

process and can occur in the forms identified below. Each recursion event and the applicable maintenance time points and derived low-level metrics must be captured in the TSE Database for a corrective maintenance activity.

4.6.2.1 The first form of recursion occurs when events result in the repetition of maintenance actions in a repair cycle and consequently the repetition of some T-Values and derived M-Values. An example would be the delivery of defective or incorrect parts, which would cause the repeat of M_4 and M_5, or failure of FST Testing (M_8), which would require the repeat of some portion of the repair cycle. A repair cycle that includes this type of recursion is represented in Figure 2, with the repair timeline path going back and forth, starting at M_1 and eventually ending at M_9. In this case the repair cycle would stay the same but repeat the necessary T-Values and derived M-Values and document them in the TSE Database.

Figure 2: Timeline Recursion - Repeated Maintenance Actions

Repair Activity	Low-Level Metrics										
CM	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9

4.6.2.2 The second form of recursion occurs when a repair starts as CM (repair in place) and is switched to DM because of the complexity of the needed repair. This is represented in Figure 3 with the repair timeline path starting in M_1 and eventually ending in the DM row at M_9 because the repair required depot maintenance. In this case the maintenance cycle would be changed to DM.

Figure 3: Timeline Recursion - CM Becomes DM

Repair Activity	Low-Level Metrics										
CM	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
DM	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9

4.6.2.3 The third form of recursion occurs when a repair starts as TCS and is switched to CM or DM because of the complexity of the needed repair. In this situation, the TCS was attempted but failed, and therefore a FST must travel to the location to diagnose the failure. In this case, there would be no M_{13} (Telephone Customer Support Time) measured. The repair follows the standard CM/DM repair cycle paths. These situations are represented by the TCS(1) and TCS(2) rows in Figure 4 with the repair timeline path starting with TCS repair but changing to CM or DM respectively.

Figure 4: Timeline Recursion - TCS Becomes CM or DM

Repair Activity	Low-Level Metrics										
TCS(1)	M_1										M_9
CM	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
TCS(2)	M_1										M_9
DM	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9

4.6.2.4 Another situation occurs when TCS is attempted and the FST determines which parts are needed for the repair during the phone conversation with the airport. This is when TCS fails but the Telephone Customer Support Diagnostic is accomplished. In this case, there would be no M_{13} (Telephone Customer Support Time) or M_2 (Technician Dispatch Time) since the ticket was forwarded to the Technician who was able to assist with the diagnosis over the phone to order parts without being physically dispatched. T4: Technician Diagnostics Complete is reported after T12: Start of Telephone Customer Support. The low-level metric created from T1: Call Center Contacted to T12: Start of Telephone Customer Support is M1: Initial Call Center Interaction time. The lower-level metric M_3: Technician Diagnosis Time is from T12: Start of Phone Triage to T4: Technician Diagnostics Complete. This type of maintenance activity with Telephone Customer Support Diagnostic results in no low-level metric of M_2: Technician Dispatch Time. Then repair follows the standard CM/DM repair cycle paths. This situation is represented in Figure 5 with the recursion from TCS to CM with Telephone Customer Support Diagnostic.

Figure 5: Timeline Recursion - TCS Identifies Parts Needed

Repair Activity	Low-Level Metrics									
TCS	M_1									M_9
CM	M_1	M_3	M_4	M_5	M_5	M_7			M_8	M_9

4.6.2.5 Another situation of Telephone Customer Support Diagnostic is when FST identifies that DM is required for the failure. Then the low-level metrics are created from T12: Start of Telephone Customer Support to T4: Technician Diagnostics Complete is M3: Technician Diagnosis time. The next T-value is T11: TSE Ready for Setup at the Location for the DM and follows the DM activity path. This situation is represented in Figure 6 with the recursion from TCS to DM with Telephone Customer Support.

Figure 6: Timeline Recursion – TCS Becomes DM

Repair Activity	Low-Level Metrics									
TCS	M_1									M_9
DM	M_1						M_{11}	M_{12}	M_8	M_9

4.6.2.6 The last recursion situation is where STIP ticket is attempt to resolve via STIP/Network team but failed and switched to CM or DM. In this situation, the STIP was attempted but failed, and therefore a FST must travel to the location to diagnose the failure. In this case, there would be no M15 (STIP/Network Ticket Resolved Time) measured. The repair follows the standard CM or DM repair cycle paths. These situations are represented by the STIP(1) and STIP(2) rows in Figure 7 with the repair timeline path starting with STIP repair but changing to CM or DM respectively.

Figure 7: Timeline Recursion – STIP Becomes CM or DM

Repair Activity	Low-Level Metrics										
STIP(1)	M_{13}										M_9
CM	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8	M_9
STIP(2)	M_{13}										M_9
DM	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9

4.6.3 Time to Repair (M_{10}) Development

As shown previously in Table 2 (Section 4.5), in a straight linear progression M_{10} consist of the sum of M_3 (from T3 to T4) and M_7 and M_8 (from T7 to T9). Time to Repair metrics includes time for FST to diagnoses the failure (M_3) and repair and test the TSE (M_7 and M_8). If parts are not required for the repair, the linear progression will go from T4 to T7. Therefore, for repairs with no parts replacement, the Time to Repair metrics is the sum of (from T3 to T4) and (from T4 to T9).

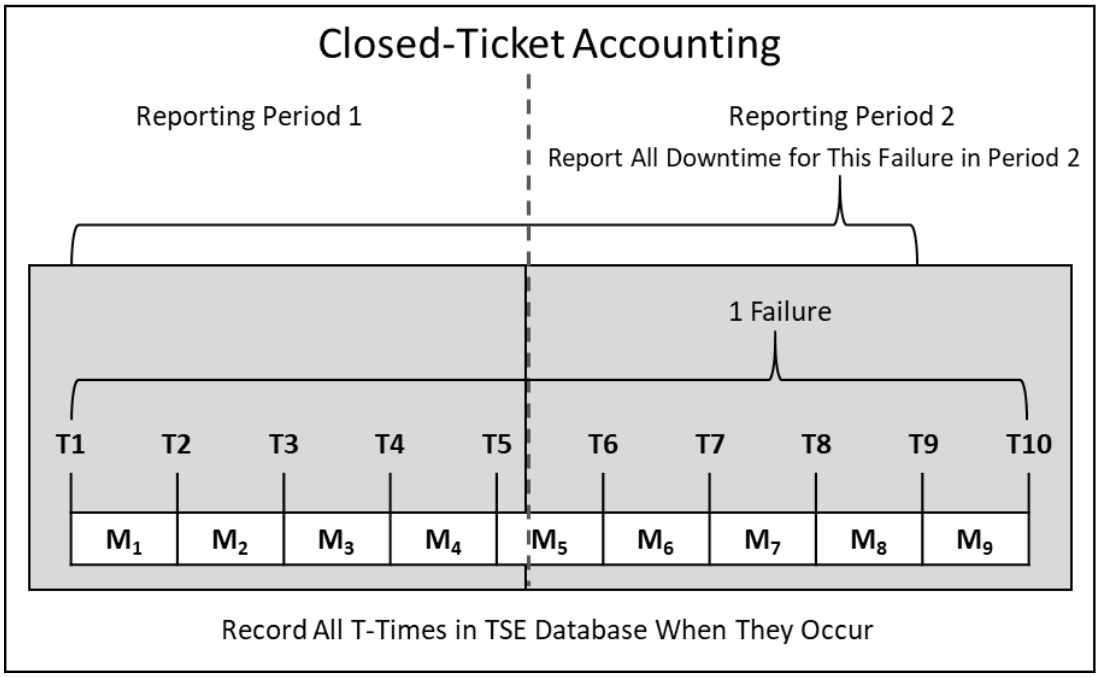
4.7 Accounting Methods

TSA uses two different types of accounting methods for the metrics calculations, Closed-Ticket and Open-Ticket Accounting.

4.7.1 Closed-Ticket Accounting

All high-level metrics will use a closed ticket accounting method except for Operational Availability (A_o) metrics. For example, if a ticket is open during two (or more) reporting periods, the entire downtime will be reported in the period when the ticket is closed and one failure counted in that period. Figure 8 shows an example of a maintenance cycle that started in one reporting period and continued into another reporting period.

Figure 8: Closed-Ticket Reporting Period Determination



- Times associated with M_1, M_2, M_3, M_4, and part of M_5 that were conducted during reporting period 1 will be counted as downtime for high-level metric calculations in reporting period 2.

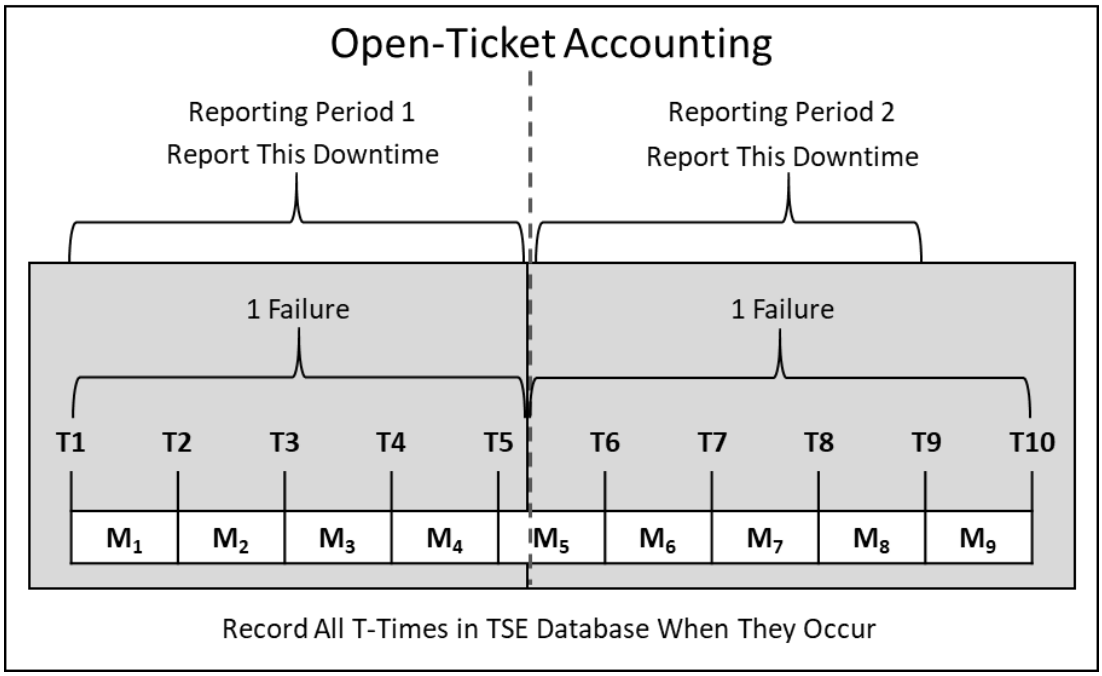
- Times associated with M_6, M_7, M_8, and the portion of M5 that were conducted during reporting period 2 will be counted as downtime for high-level metric calculation for reporting period 2.

- M_9 will not be included in any high-level metric calculations since the TSE should be operational at T9 awaiting TSA acceptance/signoff.

4.7.2 Open-Ticket Accounting

For **Operational Availability (A_o) metrics only**, the portion of the repair cycle time completed during a reporting period will be counted in the A_o metric calculations for that reporting period. See Figure 9 below as an example:

Figure 9: Open-Ticket Reporting Period Determination



- Times associated with M_1, M_2, M_3, M_4, and part of M_5 that were conducted during reporting period 1 will be counted as downtime for A_o metric calculations in reporting period 1.

- Times associated with M_6, M_7, M_8, and the portion of M5 that were conducted during reporting period 2 will be counted as downtime for A_o metric calculation for reporting period 2.

- M_9 will not be included in any high-level metric calculations since the TSE should be operational at T9 awaiting TSA acceptance/signoff.

5. Operational RMA Metrics

TSA will use the RMA metrics identified in this section to evaluate the operational performance of TSE during its operational life cycle.

Each TSE RMA metric in Sections 5.1 through 5.3 identifies the applicable low-level metrics to count in a particular failure type and repair cycle. Formulas and descriptions in Sections 5.1 through 5.3 are <u>generic</u> definitions of TSE RMA metrics. Each Maintenance Service Provider's Service Level Agreement (SLA) provides specific definitions and formulas for each contract's requirements.

5.1 TSE Reliability Metrics

5.1.1 Mean Time Between Critical Failures

Mean Time Between Critical Failure (MTBCF) will evaluate the reliability of TSE in relation to all critical relevant failures. MTBCF is the average uptime TSE is available to perform its mission between critical relevant failures. MTBCF will be calculated for a single TSE or grouping of TSE as follows:

1. Multiply daily uptime hours as defined in the contract by the number of TSE units in the TSE calculation population (one or more units) and the number of days in the reporting period;

2. Subtract the sum of the downtime associated with all critical relevant failures from the TSE calculation population (one or more units) during the reporting period;

3. Divide the difference by the total number of critical relevant failures.

MTBCF will be calculated for a specific reporting period (e.g., one month) and TSE combination (one or more units) based on the following formula:

One or more TSE units:

$$\textbf{MTBCF} = \frac{\textbf{(Uptime Hours x Number of TSE Units x Number of Days) – (Sum of TSE Critical Relevant Downtime)}}{\textbf{Total Number of Critical Relevant Failures}}$$

Where:

- **TSE Critical Relevant Downtime** = Period of time during which a TSE is not in a condition to perform its mission due to a critical relevant failure.

- **Uptime** = defined as the period of time TSE is available to perform its required mission.

For the failure types listed in Table 4, the low-level metrics (M-Values) identified are considered for the TSE downtime for MTBCF. As mentioned earlier in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirement.

Table 4: MTBCF Low-Level Metrics Count

Failure Type			Low-Level Metrics									
Level	**Criticality**	**Relevancy**										
CM	Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
DM	Critical	Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8
TCS	Critical	Relevant	M_1								M_{13}	

When a maintenance repair cycle continues into a new reporting period, the downtimes and failure count will be calculated in the new reporting period as defined in Section 4.7, Accounting Methods.

5.1.2 Mean Uptime

Mean Uptime (MUT) will evaluate the reliability of TSE in relation to all critical relevant and non-critical relevant failures. MUT is the average time TSE is available to perform its mission between all relevant failures (critical and non-critical). MUT is equivalent to Mean Time Between Failures (MTBF). MUT will be calculated for a single TSE or grouping of TSE as follows:

1. Multiply daily uptime hours as defined in contract by the number of TSE units in the TSE calculation population (one or more units) and the number of days in the reporting period;

2. Subtract the sum of all downtime associated with all critical relevant and non-critical relevant failures from the TSE calculation population (one or more units) during the reporting period;

3. Divide the difference by the total number of critical relevant and non-critical relevant failures with downtime.

MUT will be calculated for a specific reporting period (e.g., one month) and TSE combination (one or more units) based on the following formula:

One or more TSE units:

$$\textbf{MUT} = \frac{\textbf{(Uptime Hours x Number of TSE Units x Number of Days) – (Sum of all TSE Relevant Failures Downtime}}{\textbf{Total Number of Relevant Failures}}$$

Where:

- **TSE Relevant Failure Downtime** = The period of time during which TSE is not in a condition to perform its mission due to any relevant failure (critical and non-critical).

For the failure types listed in Table 5, the low-level metrics (M-Values) identified in the non-shaded blocks are considered for the TSE downtime for MUT. Lightly shaded blocks with M-Values, M_1, M_2, M_3, M_4, M_5, and M_6 for non-critical relevant CM and M_1 for non-critical relevant TCS failures are measured but not counted for MUT calculations. As mentioned earlier in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirements.

Table 5: MUT Low-Level Metrics Count

Failure Type			Low-Level Metrics									
Level	**Criticality**	**Relevancy**										
CM	Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
DM	Critical	Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8
CM	Non-Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
TCS	Critical	Relevant	M_1								M_{13}	
TCS	Non-Critical	Relevant	M_1								M_{13}	

When a maintenance repair cycle continues into a new reporting period, the downtimes and failure count will be calculated in the new reporting period as defined in Section 4.7, Accounting Methods.

5.2 TSE Maintainability Metrics

5.2.1 Mean Downtime

Mean Downtime (MDT) will evaluate the downtime of TSE in relation to all relevant failures. MDT is the average TSE downtime associated with all relevant failures. MDT will be calculated for a single TSE or grouping of TSE as follows:

1. Sum the TSE downtime associated with all relevant failures from the TSE calculation population (one or more units) during the reporting period;

2. Divide by the total number of relevant failures from the TSE calculation population (one or more units) during the reporting period.

MDT will be calculated for a specific reporting period (e.g., one month) and TSE combination (one or more units) based on the following formula:

One or more TSE units:

$$\textbf{MDT} = \frac{\textbf{Sum of TSE Relevant Failures Downtime}}{\textbf{Total Number of Relevant Failures}}$$

Where:

- **TSE Relevant Failure Downtime** = The period of time during which TSE is not in a condition to perform its mission due to any relevant failure (critical and non-critical).

For the failure types listed in Table 6, the low-level metrics (M-Values) identified in the non-shaded blocks are considered for the TSE downtime for MDT. Lightly shaded blocks with M-Values, M_1, M_2, M_3, M_4, M_5, and M_6 for non-critical relevant CM and M_1 for non-critical relevant TCS failures are measured but not counted for MDT calculations. As mentioned earlier

in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirements.

Table 6: MDT Low-Level Metrics Count

Failure Type			Low-Level Metrics									
Level	**Criticality**	**Relevancy**										
CM	Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
DM	Critical	Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8
CM	Non-Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
TCS	Critical	Relevant	M_1								M_{13}	
TCS	Non-Critical	Relevant	M_1								M_{13}	

When a maintenance repair cycle continues into a new reporting period, the downtimes and failure count will be calculated in the new reporting period as defined in Section 4.7, Accounting Methods.

5.2.2 Mean Time to Repair

Mean Time to Repair (MTTR) will evaluate the downtime required to diagnose and repair TSE due to all relevant failures. MTTR will be calculated for a single TSE or grouping of TSE as follows:

1. Sum the TSE downtime associated with Time to Repair (M_{10}) for all relevant failures from the TSE calculation population (one or more units) during the reporting period;

2. Divide by the total number of relevant failures from the TSE calculation population during the reporting period.

MTTR will be calculated for a specific reporting period (e.g., one month) and TSE combination (one or more units) based on the following formula:

One or more TSE units:

$$\textbf{MTTR} = \frac{\textbf{Sum of TSE Relevant Corrective Maintenance Downtime } (M_3 + M_7 + M_8 = M_{10})}{\textbf{Total Number of Relevant Failures}}$$

Where:

- **TSE Relevant Corrective Maintenance Downtime** = Duration of corrective maintenance actions associated with diagnosis, repair, and testing of TSE relevant failures.

For the failure types listed in Table 7, the low-level metrics (M-Values) identified in the non-shaded blocks are considered for the TSE downtime for MTTR. Lightly shaded blocks with M-Values, M_1, M_2, M_4, M_5, and M_6 for both critical and non-critical relevant CM failures are

measured but not counted for MTTR calculations. As mentioned earlier in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirements.

Table 7: MTTR Low-Level Metrics Count

Failure Type			Low-Level Metrics									
Level	**Criticality**	**Relevancy**										
CM	Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8
CM	Non-Critical	Relevant	M_1	M_2	M_3	M_4	M_5	M_6	M_7			M_8

When a maintenance repair cycle continues into a new reporting period, the downtimes and failure count will be calculated in the new reporting period as defined in Section 4.7, Accounting Methods.

Note that M_{11} (Depot Turn Around Time) and M_{13} (Telephone Customer Support Time) are not included in MTTR calculation. This is because MTTR measures the average on-site repair time. Thus, no DM or TCS failures' repairs will be included into the MTTR calculations.

5.3 TSE Availability Metrics

5.3.1 Operational Availability

Operational Availability (A_o) will evaluate the availability of TSE to perform its required mission in relation to failures of any type. It is the percentage of time during operational hours that TSE is available to perform its required mission during a specified reporting period.

If a maintenance repair cycle continues into two or more periods, the downtime within each airport operational period will be summed together. When a maintenance repair cycle continues into a new reporting period, the operational downtime occurring in the second reporting period will be calculated as defined in Section 4.7.2, Open-Ticket Accounting. As mentioned earlier in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirements.

6. Average Depot Turn Around Time

DTAT (M_{11}) measures the time TSE remains away from its designated location for repair at the depot or at its designated location in depot status while being repaired. The Average DTAT metric will evaluate the average time TSE remains away from its designated location for repair at the depot or in depot status for a reporting period. Average DTAT will include all DM from both relevant and non-relevant failures that have an M_{11} in their repair cycle. Each M_{11} is measured as the duration between the time when the diagnosis has been completed and the DM decision made (T4) until the TSE is ready for setup at its designated location after the completion of depot repair (T11). For Average DTAT metric calculations, a M_{11} time will be included in the reporting period when completed; the times will not be split between reporting periods. The Average DTAT metric will be calculated for a specific reporting period (e.g., one month) based on the following formula:

$$\textbf{Average DTAT} = \frac{\textbf{Sum of Depot Turn Around Time Hours (} M_{11}\textbf{)}}{\textbf{Number of DM Failures with } M_{11}}$$

Where:

- **Number of DM Failures** = Number of DM failures with M_{11} and counted in the metric calculations.

For the failure types listed in Table 8, the low-level metrics M_{11} times identified in the non-shaded blocks are counted toward the Average DTAT metric calculation. Lightly shaded blocks with M-Values, M_1, M_2, M_3, M_{12}, M_8, and M_9 are measured but not counted in DTAT calculations. As mentioned earlier in Section 5, each Maintenance Service Provider's Service Level Agreement provides specific definitions and formulas for each contract's requirements.

Table 8: DTAT Low-Level Metrics Metric Count

Failure Type			Low-Level Metrics										
Level	**Criticality**	**Relevancy**											
DM	Critical	Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9
DM	Critical	Non-Relevant	M_1	M_2	M_3					M_{11}	M_{12}	M_8	M_9

When a maintenance repair cycle continues into a new reporting period, the downtime occurring in the second reporting period will be calculated as defined in Section 4.7.1, Closed-Ticket Accounting.

Appendix A: List of Definitions

Corrective Maintenance. All repair cycle activities performed as a result of TSE failure by an FST to restore the TSE to a full operational condition.

Critical Failure. Failure that causes TSE to be non-operational and requires immediate action by the FST to restore the TSE to full operational capability.

Depot Maintenance. If the TSE cannot be repaired at the installed location, it will be sent to a depot for repair.

Downtime. The period of time during which TSE is not in a condition to perform its required mission.

Field Service Technician. A trained and certified technician authorized to service TSE.

Non-Critical Failure. Failure where the TSE is still able to perform its function until the FST begins the repair, at which time the downtime for the repair begins. This will be resolved by either CM or DM, although the DM resolution is less likely for this type of failure. The repair is completed by the usual testing and signoff process.

Non-Operational Hours. Non-operational hours are the periods of time within a 24-hour day that are outside of the airport's operational hours. TSE are not expected to be operational during non-operational hours. Downtimes incurred during non-operational hours do not count towards the overall operational downtime.

Operational Hours. Periods of time within a 24-hour day that an airport is operational. Airport operational hours are based on the airport category and will be specified in the maintenance contract. TSE is required to be available to perform its required mission during operational hours.

Preventive Maintenance. All actions scheduled and performed to maintain TSE in a specified operational condition by providing systematic inspection, detection, and prevention of incipient failures. PM is typically scheduled during non-operational hours, but can be performed during other operational downtime periods if advantageous to TSA given the circumstances.

Transportation Security Equipment. Equipment used at airports for security screening of passengers and baggage.

Uptime. The period of time TSE is available to perform its required mission.

Appendix B: Acronyms

Acronym	Meaning
A_O	Operational Availability
CDRL	Contract Data Requirements List
CM	Corrective Maintenance
DID	Data Item Description
DM	Depot Maintenance
DSD	Deployment and Sustainment Division
DTAT	Depot Turn Around Time
FST	Field Service Technician
ILS	Integrated Logistics Support
IT	Information Technology
MDT	Mean Downtime
MSP	Maintenance Service Provider
MTBCF	Mean Time Between Critical Failures
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
MUT	Mean Uptime
O&M	Operation & Maintenance
OEM	Original Equipment Manufacturer
PM	Preventive Maintenance
RMA	Reliability, Maintainability, and Availability
SLA	Service Level Agreement
SPOC	Single Point of Contact
STIP	Security Technology Integrated Program
TCS	Telephone Customer Support
TSA	Transportation Security Administration
TSE	Transportation Security Equipment
TSO	Transportation Security Officer