

Commonwealth of Massachusetts

Executive Office of Technology Services and Security (EOTSS)
Enterprise Risk Management Office



Secure System and Software Life Cycle Management Standard

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Table of contents

1	Purpose	2
2	AUTHORITY	2
3	Scope	2
4	Responsibility	2
5	Compliance	3
6	Standard Statements	3
6.1.	Security in System and Software Life Cycle	3
6.2.	Security in SDLC Support Processes	6
6.3.	System Hardening	8
7	Control Mapping	12
8	Related Documents	12
9	Document Change Control	12

1 PURPOSE

- 1.1. This **standard** establishes requirements for identifying **controls** that will be incorporated in system and **software** planning, design, building, testing and implementation, including:
- **Information** security activities that will occur during the system and **software** development life cycle.
 - Required **controls** for supporting system or **software** development **processes** such as segregation of environments, prevention and/or protection of **confidential** production **data** in test environments.
 - The use of version **control** for **software** development.
 - Requirements for security hardening when building and configuring systems and **applications**.

2 AUTHORITY

- 2.1. M.G.L. Ch. 7d provides that “Notwithstanding any general or special law, rule, regulation, executive order, policy or procedure to the contrary, all executive department agencies shall, and other state agencies may, adhere to the policies, procedures and objectives established by the executive office of technology services and security with respect to activities concerning information technology.”

3 SCOPE

- 3.1. This document applies to the use of **information, information systems**, electronic and computing devices, **applications**, and network resources used to conduct business on behalf of the Commonwealth. This document applies to the Executive Branch including all executive offices, and all boards, commissions, agencies, departments, divisions, councils, and bureaus, hereinafter referred to as Commonwealth Agencies and Offices. Other Commonwealth entities that voluntarily use or participate in services provided by the Executive Office of Technology Services and Security, (EOTSS), such as mass.gov, must agree to comply with this document as a condition of use. Commonwealth Agencies and Offices are required to implement **procedures** that ensure their **personnel** comply with the requirements herein to safeguard **information**.

4 RESPONSIBILITY

- 4.1. The Enterprise Risk Management Office is responsible for the development and ongoing maintenance of this **standard**.
- 4.2. The Enterprise Risk Management Office is responsible for compliance with this **standard** and may enlist other departments in maintaining and monitoring compliance with this **standard**.
- 4.3. Any inquiries or comments regarding this **standard** must be submitted to the Enterprise Risk Management Office by sending an email to ERM@mass.gov.
- 4.4. Additional **information** regarding this **standard** and its related **standards** may be found at <https://www.mass.gov/cybersecurity/policies>.

5 COMPLIANCE

- 5.1. Compliance with this document is mandatory for the Executive Branch including Commonwealth Agencies and Offices. Violations are subject to disciplinary action in accordance with applicable employment and collective bargaining agreements, up to and including the termination of their employment and/or assignment with the Commonwealth.

Exceptions to any part of this document must be requested online through ServiceNow, <https://www.mass.gov.service-now.com>. A policy **exception** may be granted only if the benefits of the **exception** outweigh the increased **risks**, as determined by the **Commonwealth CISO**, or his or her designee. Any and all **exceptions** will be for a specified time and will be narrow in scope.

6 STANDARD STATEMENTS

6.1. Security in System and Software Life Cycle

Commonwealth Agencies and Offices must define and oversee a **process** for addressing security and privacy **risks** throughout the systems development and acquisition life cycles. Commonwealth Agencies and Offices must follow a **risk**-based approach in determining the appropriate level of security based on the criticality or sensitivity of the system under consideration (see *IS.010 Information Security Risk Management Standard*).

Security considerations will be included in the plan, design, build, test and implementation phases of the system and **software** life cycle.

6.1.1. Plan and scope

6.1.1.1. Initial **risk** analysis

At the earliest opportunity during the design and development phase, a high-level **risk** assessment will be performed by the **Information Owner** or designee, with support from the Commonwealth agency's **information security personnel**, for all significant changes where security or privacy is applicable (e.g., new **software applications**, new **software** features, introduction of new system and **software** architecture or a significant modification to existing **software application** features or existing architecture), (see *IS.010 Information Security Risk Management Standard*). This initial **risk** assessment should determine whether or not the proposed system or **software** can operate within the agency's **risk** profile and identify the initial set of key **controls** that should be implemented to mitigate any major concerns.

6.1.1.2. Security requirements definition

Based on the initial **risk** assessment, security-related requirements for the proposed system and/or **software** will be identified, validated, and incorporated into the design, and approved by the **Information Owner**. Leading industry security standards and best practices will be used as a reference, such as NIST, OWASP Top 10 and CIS, to provide a comprehensive list of initial requirements for consideration. The security requirements will be refined and supplemented throughout the lifecycle of the system or **software**, based on follow-on detailed **risk** assessments.

6.1.2. Design

To ensure that security is incorporated in the system and **software** life cycle, the system design will include a “security-as-a-design” objective, and any security exceptions will be identified by the **Information Owner** or **Information Custodian**.

6.1.2.1. Security design

The **Information Owner** and **Information Custodian** will address all high-**risk** security-related requirements identified during project planning. In addressing these requirements, the following will be performed:

6.1.2.1.1 Architecture: Develop design specification and/or security architecture that describes the approach to protecting the confidentiality, integrity, and availability of the system. New architecture should integrate enterprise architecture standards.

6.1.2.1.2 Test plans: Test plans must be in place for validating security testing requirements. The following tests must be performed as applicable.

6.1.2.1.2.1 Threat assessments based on functional requirements

6.1.2.1.2.2 Classification of the **data** involved

6.1.2.1.2.3 Security requirements gathering and documentation

6.1.2.1.2.4 System design reviews for security

6.1.2.1.2.5 Secure code reviews

6.1.2.1.2.6 Penetration testing

6.1.2.1.2.7 **Vulnerability** scanning

6.1.2.1.2.8 Host and/or network configuration reviews

6.1.2.1.2.9 **Third-party** security reviews (design reviews, code reviews, testing, etc.)

6.1.2.1.3 Security design review: Security **personnel** will review the security design for all high-**risk** security requirements when conducting design reviews prior to build, test, and implementation.

6.1.3. Build

Depending on the methodology in use (e.g., waterfall, agile, scrum), security tollgates must be incorporated to ensure secure development.

6.1.4. Test

To ensure and validate that security is incorporated in the system and **software** life cycle, the following testing is required:

6.1.4.1. Identification and testing of security **controls**.

Information Owners and **Information Custodians** will test security requirements prior to implementation and use. For **software**, the following will be performed:

- 6.1.4.1.1. Automated source code scanning (static analysis) of all supported code should be performed using a Commonwealth-approved code analysis tool.
- 6.1.4.1.2. Manual source code analysis should be performed on all **information system** source code during testing and prior to deployment.

6.1.4.2. Documentation of change

Any changes to systems and **software** will be approved in line with change and release management **procedures**. Change records will be made available to security **personnel** for review when required.

6.1.5. Implementation

To ensure that security is incorporated in the system and **software** life cycle, the implementation will include **processes** for validation and change **control**.

6.1.5.1. Validation

Information Owners and **Information Custodians** will ensure that new or significantly changed systems and **software applications** are released to the production environment only after a pre-implementation security **risk** assessment and **information** security issues are addressed.

6.1.5.2. Change control

Changes related to Commonwealth **information systems** and **software** will be approved by the respective Change Advisory Board (see *Change Management in IS.012 Operations Management Standard*) prior to release to production environments (e.g., such as the completion of successful test simulations and resolution of identified issues where applicable).

- 6.1.5.2.1. Ensure appropriate security **controls** are in place before approving the change in level for the code.
- 6.1.5.2.2. Changes that alter the security **controls** in place at the **application**, system or network level will be reviewed prior to release to production.
- 6.1.5.2.3. All source code and configurations will be checked into an approved code repository.

6.1.6. Maintenance

Commonwealth Agencies and Offices must ensure that **Information Owners** coordinate with Security Officers and the Enterprise Security Office to deploy security patches/updates in a timely fashion to resolve **vulnerabilities** while ensuring the full functionality of the **information system** (see *IS.016 Vulnerability Management Standard*).

6.1.7. Decommissioning

Prior to decommissioning, the **Information Owner** will formalize plans describing the **processes** to securely remove, archive, or protect **sensitive data** from the systems to be decommissioned (see *Information Disposal in IS.004 Asset Management Standard*).

6.2. Security in SDLC Support Processes

Commonwealth Agencies and Offices must ensure that **controls** are implemented to ensure that the resources, materials, and **procedures** used in the development **process** are managed to minimize the introduction of security **vulnerabilities**. In the event of an **information** spill or **data breach**, the Incident Response Plan will be initiated.

6.2.1 Control **application software**

The following is required for maintaining **application software**:

6.2.1.1 Change control processes

All changes to system components must follow the change management process (see *IS.012 Operations Management Standard*).

6.2.1.2 Segregation of environments

Development, test, and production environments will be separated to reduce the **risks** of unauthorized access or changes to production systems and code repositories. Commonwealth Agencies and Offices will adhere to the following rules:

- 6.2.1.2.1 Rules for the transfer of **software** from development to production status will be logged through a formal recordkeeping system (see *IS.012 Operations Management Standard*).
- 6.2.1.2.2 Development, test, and production **software** will run on different systems or computer processors.
- 6.2.1.2.3 **Access controls** must be used to enforce access to the development, test, and production environments.
- 6.2.1.2.4 Test environments must emulate the operating system environment as closely as possible.
- 6.2.1.2.5 **Confidential** production **data** should not be copied into the test environment.
- 6.2.1.2.6 Test **data** must be removed from systems prior to going live in the production environment.

6.2.1.3 Secure coding practice

Applications must be developed using secure coding practices to prevent common coding **vulnerabilities** in **software** development **processes** (e.g., OWASP Top 10) to include, but not limited to, the following:

- 6.2.1.3.1 Injection flaws (e.g., SQL injection, OS Command Injection, LDAP, and XPath injection flaws as well as other injection flaws)
- 6.2.1.3.2 Broken authentication and session management
- 6.2.1.3.3 Cross-site scripting (XSS)
- 6.2.1.3.4 Broken access **control** (e.g., insecure direct object references, failure to restrict URL access and directory traversal)
- 6.2.1.3.5 Security misconfiguration
- 6.2.1.3.6 **Sensitive data** exposure
- 6.2.1.3.7 Insufficient attack protection (i.e., ability to detect, prevent and respond to both manual and automated attacks)
- 6.2.1.3.8 Cross-site request forgery (CSRF)
- 6.2.1.3.9 Using Components with known **vulnerabilities** (e.g., libraries, **software** modules)
- 6.2.1.3.10 Unprotected APIs (e.g., JavaScript in the browser and mobile apps that connect to an API of some kind (SOAP/XML, REST/JSON, RPC, GWT))
- 6.2.1.3.11 Others, including buffer overflow, insecure **cryptographic** storage, improper error handling

6.2.1.4 Custom **application** accounts, **user** IDs and passwords

Default or custom **application** accounts, **user** IDs and passwords will be removed before systems are moved into production (see *User Access Management in IS.003 Access Management Standard*).

6.2.1.5 Release management process

Releasing new systems and **application software** to the production environment must follow a defined process that ensures the integrity and accountability of all of the components released. Systems and **applications** will not be released to the production environment until use case testing is completed and recorded in source code or configuration change repositories.

6.2.1.6 Vendor **software** maintenance

Vendor-supplied **software** (e.g., product upgrades, updates, and patches; **software** developed by **third parties**) must be updated and maintained to ensure reduced **risk** of security **vulnerabilities**. Change **control procedures** will be documented according to the change and release management **procedures**.

6.2.2 Protection of **data** integrity

The **Information Custodian** is responsible for ensuring system inputs, outputs and processing functions are validated prior to production release in coordination with the development team.

6.2.3 Protection of system test **data**

The following is required for protecting system test **data**:

- 6.2.3.1 Authorization: The use of **confidential** production **data** in a non-production environment is prohibited unless required for a business purpose and explicitly approved by the **Information Security Team** (see *Release Management in IS.012 Operations Management Standard*).
- 6.2.3.2 **Data** masking: The use and copying of **confidential** production **data** is prohibited unless masking routines or other protective measures are applied to protect the **confidential** production **data** from unauthorized disclosure.
- 6.2.3.3 Secure **data** storage and removal: The storage of **confidential** production **data** used in the development environment will adhere to the *Information Protection* requirements of *IS.004 Asset Management Standard*. **Confidential** production **data** will be removed from test systems when it is no longer required.

6.2.4 Protection of **application** source library

The following is required for protecting **application** source libraries:

- 6.2.4.1 Version **control**: Old versions of production **application** source libraries will be archived using version **control**. Version controlled archives will contain summary **information**, including, but not limited to, version numbers and date of last use.
- 6.2.4.2 Protection from covert channels and malicious code: The creation of covert channels or administrative “back doors” in a system and/or **software** and its release into the production environment is strictly prohibited. A channel may be considered covert or an administrative “back door” if it allows remote access functionality that was not intended in the **software** design specifications.

6.3. System Hardening

Commonwealth Agencies and Offices must ensure that operating systems for email, **application**, web, database, network devices and file servers are hardened to protect from exploitation from non-authorized or malicious use. Adherence to hardening standards to protect and secure Commonwealth **information assets** prior to deployment into production environments is mandatory.

i. Technical security **standards**

Technical security **standards** will be developed for all critical and high-**risk information systems**. These **standards** will address known security **vulnerabilities** and must be consistent with industry-accepted system hardening standards.

It is the responsibility of **application** and platform owners in collaboration with the Enterprise Security Office to develop technical **standards** for critical and high-**risk** systems that they own or support.

1. **Risk** assessment: **Information Owners** will perform a regular **risk** assessment to determine if existing/planning **controls** adequately meet the

criticality and sensitivity of the **information asset**. More restrictive **controls** may be implemented as needed.

2. Review of technical **standards**: Systems will be reviewed periodically for compliance with technical **standards** by **Information Custodians**, **information security personnel** or the appropriate designee to ensure regular compliance:
 - a. **Information Custodians** are responsible for ensuring and maintaining compliance with technical **standards**.
 - b. **Information security teams** are responsible for monitoring and measuring compliance with technical **standards**.

ii. Primary system function

Implement only one primary function per server (or virtual server) to prevent functions that require different security levels from coexisting on the same server (e.g., web servers, database servers, DNS).

iii. Patch management

Apply most up-to-date vendor-supplied security patches or upgrades to correct for known **vulnerabilities**. Security patches should be deployed in a timely manner and consistent with the patch deployment schedule defined in *IS.016 Vulnerability Management Standard*. Any known **vulnerabilities** with the OS will be remediated (or a **risk exception** must be requested and approved) accordingly before using it to host a server.

iv. Disabling or removing unnecessary services

Disable or remove service, **applications** and network protocols that are not required when configuring the OS. Minimal OS configurations will be installed, and services, **applications** and network protocols will be added as needed for business purposes. Common types of services and **applications** that should be removed include but are not limited to:

1. File and printer sharing services (e.g., Windows Network Basic Input/Output System [NetBIOS] file and printer sharing, Network File System [NFS], FTP)
2. Wireless networking services
3. Remote control and remote access programs, particularly those that do not strongly **encrypt** their communications (e.g., Telnet)
4. Directory services (e.g., Lightweight Directory Access Protocol [LDAP], Network Information System [NIS])
5. Web servers and services
6. Unnecessary scripts and drivers
7. Unnecessary subsystems and file systems
8. Email services (e.g., SMTP)
9. Language compilers and libraries

10. System development tools
11. System and network management tools and utilities, including Simple Network Management Protocol (SNMP)

v. Disabling or removing default accounts

Operating system account defaults will be reviewed and updated by removing or disabling account default configurations (see *Account Management in IS.003 Access Management Standard*). **Controls** for **user** authentication include but are not limited to:

1. Disable or remove interactive default accounts. For default accounts that need to be retained, restrict access, and change the name (where possible) and default password.
2. Disable or remove non-interactive (e.g., system) accounts and their associated passwords.

vi. Configuring system security parameters

System security parameters will be configured to prevent misuse. System administrators and security resources should be knowledgeable of common security parameter settings for system components. Common system security parameters will be included in technical security **standards** and set appropriately on system components.

vii. Full disk **encryption**

Full disk **encryption** will be deployed for operating systems containing **confidential information** (see *Endpoint Security in IS.004 Asset Management Standard* and see *IS.008 Cryptographic Management Standard*).

viii. Other security hardening requirements

1. Reduce the attack surface presented by systems, platforms and **applications** comprising the **information system**. Secure resources according to least privilege.
2. **Information systems** that implement or connect to a directory containing non-public **information** must not permit anonymous binds.
3. **Information systems** that integrate with a directory used for authentication, authorization or identity **information** must connect over a secure connection.
4. File permissions on back-end configuration, system and **application** files must restrict access to authorized **personnel** and these files must not be accessible through the **application** or other non-administrative services.
5. All servers must be kept in sync with a time synchronization mechanism.
6. All vendor-supplied defaults must be changed to values appropriate to the environment (e.g., default passwords, SNMP permissions and community strings).
7. All services must run in the context of a non-privileged **user**.
8. Web servers must be configured to support only the HTTP methods required for **application** operation.

9. **Information systems** which implement HTML 5 must adhere to the HTML 5 Security Standard.
10. Network services must be configured to not allow low-grade TLS **encryption** and should adhere to *IS.008 Cryptographic Management Standard*.
11. Web servers must be configured to disallow directory listing.
12. Logging of detailed debugging **information** must be disabled on production systems.
13. Only the current non-debug-release of production code should be installed on production servers; non-production code and backup files must be removed.
14. Web servers must set folder permissions according to least privilege (e.g., disable unnecessary access, execute, and write permissions).
15. Malicious code protection must be in place.

7 CONTROL MAPPING

Section	NIST SP800-53 R5	CIS 18 v8	NIST CSF
6.1 Security in System and Software Lifecycle	PL-7	-	-
	PL-8	CSC 12	ID.AM-3
		-	-
	SA-1	-	
	SA-2	-	
	SA-3	CSC 4	PR.IP-2
		-	PR.IP-2
	SA-5	-	
	AU-10	-	PR.PT-1
	IA-8	CSC 6	PR.AC-1
	SC-7	CSC 4	PR.AC-5
	SC-8	CSC 3	PR.DS-2
	SC-3	-	-
6.2 Security in SDLC Support Processes	RA-3	CSC 16	ID.RA-1
	AC-3	CSC 3	PR.AC-4
	AC-6	CSC 3	PR.AC-4
	CM-2	CSC 4	
	CM-5	-	PR.IP-1
	CM-6	CSC 4	
	CM-7	CSC 2	
	CM-9	CSC 4	PR.IP-1
	MA-5	-	PR.MA-1
		-	-
		-	ID.GV-1
	CM-3	-	PR.IP-1
	CM-4	-	PR.IP-1
	SI-2	CSC 3	ID.RA-1
	IR-9	-	-
AC-4	CSC 3	ID.AM-3	
	-	PR.IP-3	
6.3 System Hardening	PE-19	-	PR.DS-5
	SI-2	CSC 7	ID.RA-1
		-	DE.CM-4
	SI-4	CSC 1	ID.RA-1
		-	-
	SI-1	-	ID.GV-1
	SI-6	-	-
	-	-	-

8 RELATED DOCUMENTS

Document	Effective date
Third Party Information Security Standard	

9 DOCUMENT CHANGE CONTROL

0.9	Jim Cusson	10/01/2017	Corrections and formatting
0.95	Sean Vinck	5/7/2018	Corrections and formatting
0.97	Andrew Rudder	5/31/2018	Corrections and formatting
0.98	Anthony O'Neill	05/31/2018	Corrections and Formatting
1.0	Dennis McDermitt	06/01/2018	Prepublication review
1.0	Andrew Rudder	10/4/2018	Approved for Publication by: John Merto
1.1	Megan Perkins	7/15/2020	Annual Review; Minor corrections and formatting
1.2	Sean M. Hughes	11/04/2021	Annual Review
1.3	Sean M. Hughes	08/29/2022	NIST 800-53R5 mapping and annual review
1.4	Thomas E. McDermott	12/01/2023	Corrections, formatting, updating and Annual Review

1.5	Anthony O'Neill	12/01/2023	Final Review

The owner of this document is the **Commonwealth CISO** (or his or her designee). It is the responsibility of the **document owner** to maintain, update and communicate the content of this document. Questions regarding this document must be submitted to the **document owner** by sending an email to ERM@mass.gov.

9.1 Annual Review

This document, the *Secure System and Software Life Cycle Management Standard*, should be reviewed and updated by the **document owner** on an annual basis or when significant **policy** or **procedure** changes necessitate an amendment.