

**MICHIGAN STRUCTURE INSPECTION MANUAL
TUNNEL INSPECTION**

APPENDIX D

MICHIGAN TUNNEL INSPECTION REQUIREMENTS

D.01 Purpose

The [National Tunnel Inspection Standards \(NTIS\)](#) require each state transportation department to inspect, or cause to be inspected, all highway tunnels located on public roads, on and off Federal-aid highways, that are fully or partially located within the state’s boundaries. The purpose of this appendix is to briefly summarize the general requirements and procedures for the State of Michigan Tunnel Inspection Program to maintain compliance with the NTIS. Comprehensive reference information is contained in the [Specifications for the National Tunnel Inventory \(SNTI\)](#) and [Tunnel Operations, Maintenance, Inspection, and Evaluation \(TOMIE\) Manual](#).

D.02 Inventory

The NTIS define a tunnel as an enclosed roadway for motor vehicle traffic with vehicle access limited to portals, regardless of type of structure or method of construction, that requires, based on the owner’s determination, special design considerations that may include lighting, ventilation, fire protection systems, and emergency egress capacity. Tunnels do not include bridges or culverts inspected under the National Bridge Inspection Standards (NBIS). As of March 2021, the Michigan Tunnel Inventory consists of eleven structures owned by six agencies. The tunnel number, owner and name are provided in Table D.02.01

Table D.02.01 Michigan Tunnel Inventory

| Tunnel No. | Owner | Name |
|------------|----------------------------------|---------------------------|
| 50001 | Detroit Windsor Tunnel Authority | Detroit Windsor |
| 50002 | Wayne County Airport Authority | Taxiway F |
| 50003 | Wayne County Airport Authority | Runway 9, Taxiway J and T |
| 50004 | Wayne County Airport Authority | Runway 9, Taxiway V |
| 50005 | City of Detroit | Hart Plaza (Atwater) |
| 50006 | MDOT | Cobo Hall (TCF Center) |
| 50007 | MDOT | MDOT Larned Street |
| 50008 | City of Holland | Holland Airport |
| 50009 | City of Pontiac | Phoenix Center |
| 50010 | MDOT | Z01 |
| 50011 | MDOT | Z02 |

D.03 Laws and Regulations.

In 2012 The Moving Ahead for Progress in the 21st Century Act (MAP-21) stipulated the establishment of a tunnel inventory and inspection program. 23 CFR Part 650 was amended by the Federal Highway

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Administration (FHWA) on August 13, 2015 to incorporate the NTIS through the addition of Subpart E. The regulations serve as the national tunnel standards in accordance with 23 U.S. Code 144(h) and 23 U.S. Code 144(b).

D.04 NTIS Oversight

The FHWA developed and implemented the current review process to evaluate a state's bridge inspection program for compliance with the NBIS in 2011 as required by 23 U.S. Code 144(h). Each FHWA division office annually assesses the state's compliance with 23 individual metrics which are directly aligned with the existing NBIS regulation. The metrics, or measures, are designed to assess the quality and performance of each state's bridge inspection program and collectively, the national program that has been established to assure highway bridges are safe. Since the annual NBIS review process has been proven effective, FHWA developed 15 metrics to monitor NTIS compliance that were implemented during June 2019. The description and criteria for evaluating the tunnel inspection program are described in FHWA's National Tunnel Inspection Program [Compliance Review Manual](#).

D.05 Organization and Responsibilities

The NTIS specifies that each state must develop a tunnel inspection organization when one or more tunnels exist. The minimum requirements are defined in NTIS Section 650.507. The state's transportation department is responsible for ensuring general inspection procedures, tunnel-specific inspection procedures, quality control and quality assurance procedures, and preparing and maintaining the tunnel inventory. The transportation department is also required to ensure that timely tunnel inspections are performed, reports are submitted, load ratings are entered, critical findings are properly managed, and a registry of nationally certified tunnel inspectors is maintained. The provisions of the NTIS allow portions of these requirements to be delegated; however, delegation does not relieve the state's transportation department of the overall responsibility. All functions delegated to other agencies are required to be documented in a formal written agreement. The organization of MDOT's tunnel inspection program is shown in Figure D.05.01.

D.05.01 Tunnel Program Manager Responsibilities

In addition to performing the responsibilities identified in Chapter 1, the Bureau of Bridges and Structures is also tasked with ensuring NTIS compliance for all tunnels in the State of Michigan. The tunnel inspection program manager is responsible for working directly with FHWA's Michigan Division Assistant Structures Engineer for resolving potential NTIS compliance issues. Although the metric reviews are completed annually, coordination between MDOT and FHWA is a frequent activity.

On a statewide level, the tunnel inspection program manager develops a plan of corrective action (PCA) or improvement plan (IP) for any NTIS metric which did not receive a determination of compliance. A metric assessed at the substantial compliance level requires an IP, while a metric determined to be in non-compliance requires a PCA. Once the PCA is approved by FHWA the metric is categorized as being in

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conditional compliance. Performance reporting is completed on quarterly and annual frequencies. The tunnel inspection program manager may request individual tunnel owners to submit a PCA in order to mitigate outstanding deficiencies that require several intermediate tasks to solve.

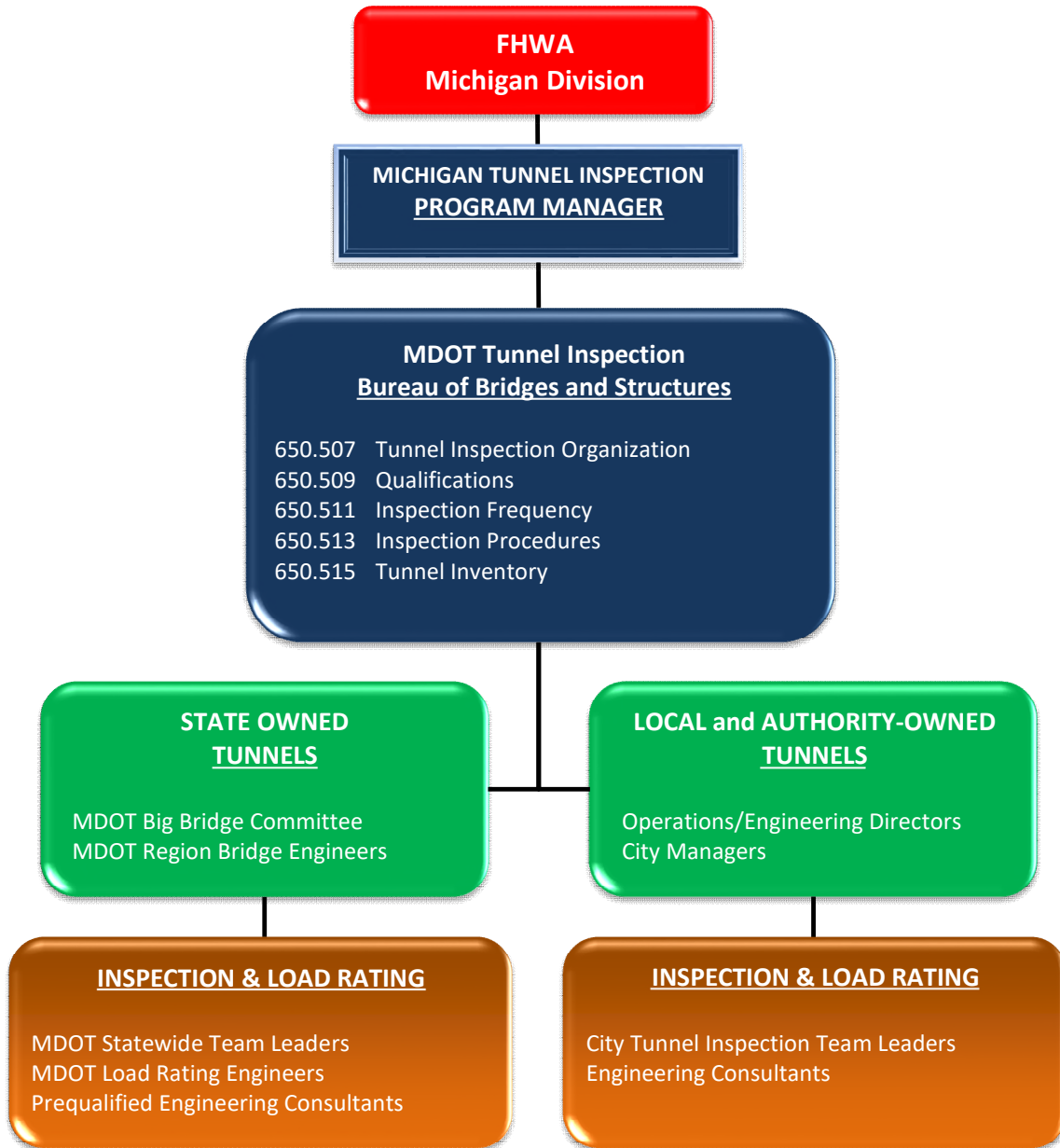


Figure D.05.01 MDOT Tunnel Inspection Organization

The Bridge Inspection Unit is responsible for reviewing and ensuring that the tunnel program manager and team leaders performing NTIS tasks meet the minimum qualifications. The unit maintains records of nationally certified tunnel inspectors performing work in Michigan. Requests for NHI-130110 Tunnel Safety Inspection certificates, professional licensure and/or work experience documentation are reviewed

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each month and submitted as-needed. The unit also requests existing team leaders to provide NHI-130125 Tunnel Safety Inspection Refresher or NHI-130125V Tunnel Safety Inspection Refresher (Virtual Delivery) certificates prior to their NTI recurrent training expiration date. An annual tunnel inspection team leader report is provided to FHWA.

The Bridge Load Rating Unit is responsible for ensuring that all load analyses are completed or reviewed by a licensed professional engineer. In addition, the Bridge Load Rating Unit is responsible for the coordination and scheduling of load rating workshops and training performed throughout the State of Michigan.

The Bridge Inspection Unit is responsible for developing methods and policies to ensure timely inspections. The unit notifies each tunnel owner 2 months prior to the routine inspection target date to ensure they are aware of the upcoming inspection. Subsequent correspondence and/or phone calls are provided by the unit until the agency acknowledges the inspection requirement. FHWA is included on the initial correspondence between MDOT and the tunnel owner.

The Bridge Inspection Unit is responsible for collecting all inspection reports from tunnel owners and/or team leaders within 60 days following the completion of field work. The unit will notify the tunnel owner and request a status update if the routine inspection report has not been submitted to MDOT within 60 days following the routine inspection target date. Failure to perform the inspection or provide the documentation may lead to funding restrictions and inability to obligate projects. FHWA is included on initial correspondence between MDOT, the tunnel owner and team leader.

The Bridge Inspection Unit is responsible for ensuring that accurate tunnel-specific inspection procedures exist for each structure. The unit will periodically request and review tunnel-specific inspection procedures for completeness. This action may be initiated as part of quality assurance activities, preparation for annual metric assessments, critical finding follow-up or tunnel inspection report review.

The Bridge Inspection Unit periodically reviews quality control procedures and the documented actions performed to ensure accuracy. The unit is also responsible for ensuring that quality assurance reviews are performed using standardized checklists and forms to verify element quantity calculations and adherence to inspection procedures. Quality control and quality assurance includes periodic field review of inspection teams as well as performing field and inventory data quality checks.

The Bridge Load Rating Unit is responsible for making sure all tunnels are load rated to verify safe load carrying capacity in accordance with the NTIS. The unit is also responsible for developing and maintaining load rating guidance for assessing structures within the State of Michigan for maximum legal loads.

The Bridge Management Systems Unit is responsible for maintaining the statewide database and organizing the data so it may be transmitted annually to FHWA Washington Headquarters. Throughout the year the unit also reviews the data for compliance deficiencies or errors and works to resolve them with the appropriate agency or individual. The unit also creates tunnel records, enters inspection reports

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into the database within 30 days of receiving them, and reviews plans to ensure the inventory coding is accurate.

D.05.02 Tunnel Owner Responsibilities

All tunnels within the inventory are delegated to a tunnel owner for responsibility, management and compliance with the NTIS. The tunnel owner should be familiar with all aspects of tunnel operation, inspection and documentation requirements. The tunnel owner must contact the tunnel inspection program manager for clarification or interpretation of any NTIS regulations that are poorly understood.

The tunnel owner is required to immediately take action to address critical findings and provide a corrective action plan to restore operational capacity. Critical findings are defined as any structural or safety related deficiency that requires immediate follow-up inspection or action. MDOT's definition of a critical finding for NTIS activities includes any instance where an unplanned full or partial tunnel closure is necessary to protect public safety. Additionally, critical findings also include improper functioning ventilation, fire safety, life safety or emergency generator systems. The tunnel owner or owner's representative must notify MDOT's tunnel inspection program manager at MDOT-MiBridge-Admin@michigan.gov within 24 hours of completing an immediate action. When detrimental damage or a system failure occurs between inspection periods the tunnel owner should also notify the team leader for purposes of emergency evaluation. This includes, but is not limited to, deficiencies related to detection, fire protection, emergency communications, operations and security systems. A detailed record of actions taken and supporting photographs to resolve critical findings must be available for review by MDOT or FHWA.

Unless a separate written agreement exists, tunnel owners must also ensure that timely and accurate tunnel safety inspections and load ratings are completed. Routine inspections should be facilitated by providing a point-of-contact for the team leader to coordinate access and maintenance of traffic during each routine inspection. Coordination with the team leader should begin 30 to 60 days prior to the inspection target date so tunnel file and preliminary field reviews may be scheduled. The tunnel owner must ensure that the routine inspection is performed two months before or two months after the routine inspection target date. Damage, in-depth, special, and post-construction inspections must be scheduled by the tunnel owner as needed.

Tunnel owners are required to ensure that inspection reports and procedures are submitted to MDOT within 60 days after the completion of field work. Tunnel owners must also contact MDOT within 60 days of load restriction or closure changes so that inventory coding may be updated.

The tunnel owner is solely responsible for all aspects of maintenance and preservation. To accomplish this, a readily accessible file must be maintained for each tunnel which provides historical and up-to-date information. The file must contain tunnel-specific inspection procedures, inventory data, current and previous inspection reports, critical finding documentation, maintenance and rehabilitation records, photos, and diagrams. If applicable, functional system testing results and load rating calculations shall be

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in the file. The file should also include pertinent construction documentation including plans, as-built drawings, shop drawings, specifications and material information. If tunnel file contents are in more than one physical location than a reference document shall include a description of where they are stored. MDOT strongly encourages the use of electronic files and will work with owners during quality assurance reviews to scan documents as required.

D.05.03 Team Leader Responsibilities

The team leader is responsible for leading the tunnel inspection team and planning, preparing, and performing structure inspections in accordance with the NTIS regulations. The team leader is ultimately responsible for preparing the inspection report and submitting the information to MDOT. The team leader shall be familiar with the Specifications for the National Tunnel Inventory (SNTI), Tunnel Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual, AASHTO Manual for Bridge Evaluation (MBE) and Michigan tunnel inspection requirements. Safety items may include ensuring each inspection team member complies with a safety plan including lockout tagout procedures, proper use of access equipment, communication protocols during functional system testing, and identifying nearby medical services.

The team leader should coordinate with the tunnel owner to identify personnel that can respond to proposed inspection schedules and unsecure all locked items including doors, mechanical, electrical or fire protection systems. The team leader should review the tunnel file and then perform a walk-through field review of the tunnel in advance of the planned inspection date. The purpose of the site visit is to confirm inspection equipment, maintenance of traffic, and all elements are accessible for the inspection. A list of structural, electrical, mechanical, fire protection, fire safety, security and any other operational components should be created to populate the required coding. Hazards should be identified and precautions to mitigate them included in the safety plan for use by the inspection team. Tunnel-specific inspection procedures and forms shall be documented or updated based on the review. Tunnel file deficiencies should be addressed as needed throughout the entire planning, inspection and reporting processes.

The team leader is required to be present during all phases of initial, routine and in-depth inspections. This includes being on site when functional tests are performed by mechanical or electrical specialists.

The team leader must finalize all inspection reports within 60 days of completing the inspection and facilitate document submittal to MDOT.

D.06 Qualifications

The minimum qualification requirements are defined in NTIS Section 650.509. MDOT is responsible for maintaining a list of nationally certified tunnel inspectors and copies of their certifications.

D.06.01 Tunnel Program Manager Qualifications

In Michigan the bridge inspection program manager also serves the role of tunnel inspection program manager. A tunnel inspection program manager shall:

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1. Be a registered professional engineer, or have 10 years of tunnel or bridge inspection experience;
2. Be a nationally certified tunnel inspector.

D.06.02 Team Leader Qualifications

An individual wanting to become a nationally certified tunnel inspector in accordance with the NTIS must complete an FHWA approved comprehensive tunnel inspection course such as NHI-130110 Tunnel Safety Inspection. A score of 70 percent or greater is required on the end-of-course assessment.

In addition to completing the comprehensive tunnel inspection training course, individuals must meet one of the following:

1. Be a registered professional engineer and have six months of tunnel or bridge inspection experience;
2. Have five years of tunnel or bridge inspection experience;
3. Have all of the following:
 - a. A bachelor's degree in engineering or engineering technology from a college or university accredited or determined as substantially equivalent by the Accredited Board for Engineering and Technology.
 - b. Successfully passed the National Council of Examiners for Engineering and Surveying Fundamentals of Engineering examination.
 - c. Two years of tunnel or bridge inspection experience.
4. Have all of the following:
 - a. An associate's degree in engineering or engineering technology from a college or university accredited or determined as substantially equivalent by the Accreditation Board of Engineering and Technology.
 - b. Four years of tunnel or bridge inspection experience.

In order to maintain status as a nationally certified tunnel inspector, recurrent training and successful completion of NHI-130125 or NHI-130125V is required every 60 months.

All complex tunnel inspections must be performed by a team leader registered as a professional engineer with 6 months tunnel and/or bridge inspection experience.

D.06.03 Mechanical and Electrical Staff Qualifications

Mechanical and electrical inspection staff should have professional registration or licensure to practice in their area of expertise. The specialists should also have recent documented tunnel or bridge inspection, design, or construction experience. All specialists need to be able to effectively communicate their inspection findings, test results, and repair recommendations to the team leader.

D.06.04 Competent Staff Qualifications

Tunnel owners, maintenance workers, and other competent staff may perform damage and special inspections as required. This work may be completed by any individual that has basic structural and load

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path knowledge, or experience working with tunnel functional systems.

D.07 Inspection Types and Frequencies

The minimum inspection frequency requirements are defined in NTIS Section 650.511. The NTIS establish a maximum tunnel inspection frequency of 24 months for routine inspections. The regulations require each state to establish criteria to determine the level and frequency of damage, in-depth, and special inspections.

D.07.01 Initial Inspections

The initial inspection is defined as the first inspection of a tunnel to provide all inventory, appraisal, and other data necessary to determine the baseline condition of the structural and functional systems. The importance of scheduling timely initial inspections cannot be understated. The NTIS requires an initial inspection to be performed after all construction has been completed, but prior to opening the structure to traffic. The timeframe imposed means that tunnel-specific inspection procedures must be developed during the design and/or construction phases. Federal law requires initial inspections to be performed for tunnels constructed after the August 13, 2015 NTIS effective date. Existing tunnels constructed prior to the effective date are to receive a routine inspection.

D.07.02 Routine Inspections

A routine inspection is defined as a regularly scheduled comprehensive inspection encompassing all tunnel structural elements and functional systems and consisting of observations and measurements needed to determine the physical and functional condition of the tunnel, to identify any changes from initial or previously recorded conditions, and to ensure that tunnel components continue to satisfy present service requirements. All elements of the tunnel must be visually inspected at a distance that is close enough to determine the overall condition and detect deficiencies. In addition to performing a structural evaluation, each routine inspection will require access and examination of any electrical, mechanical, fire safety, life safety, and security systems. The degree of inspection and testing frequency for these systems must be performed in accordance with the tunnel-specific inspection procedures.

A routine inspection target date is established during the first inspection a tunnel receives and cannot be modified without program manager approval. Unlike current NBIS processes, an early or late inspection does not adjust the inspection cycle or month that the next routine inspection is due. In order to adjust the date of future routine inspections please send a request to MDOT-MiBRIDGE-Admin@michigan.gov and provide justification that supports the change. MDOT will review the justification, request additional information if necessary, and seek concurrence with the Michigan FHWA office.

D.07.03 Damage Inspections

A damage inspection is defined as an unscheduled inspection to assess structural damage resulting from environmental factors or human actions. They should be completed as warranted by the tunnel owner

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or maintenance personnel. When detrimental damage occurs that causes a critical finding action must be taken immediately to protect public safety.

Examples of events initiating damage inspections include high load hits, fires, and flooding. Damage inspections require documenting changes to effected elements and updating condition state quantities appropriately. The inspection is recommended to be performed as soon as the area is safe and usually within 24 hours.

D.07.04 In-Depth Inspections

In-depth inspections are defined as a close-up inspection of one, several, or all tunnel structural elements or functional systems to identify any deficiencies not readily detectable using routine inspection procedures. They should be utilized to verify the accuracy of visual observations, to provide necessary information for a condition-based load analysis, and to ensure functional systems are not experiencing abnormal degradation. In-depth inspections should be conducted to quantify the extent of deterioration for elements with condition state quantities that warrant a structural review that has not been completed.

Examples of in-depth inspections include sounding tunnel liner for incipient spalls, measuring section loss on steel roof girders, vibration analysis of mechanical components, and load testing electrical systems. In-depth inspections must be performed according to the requirements and frequencies identified in the tunnel-specific inspection procedures. In-depth inspections require reviewing element condition state quantities and updating them as necessary.

D.07.05 Special Inspections

Special inspections are defined as an inspection scheduled at the discretion of the tunnel owner, used to monitor a known or suspected deficiency. Special inspections should be conducted at intervals not to exceed 12 months for all elements with condition state quantities that warrant a structural review that has not been completed or have unstable anchorage or connection hardware.

D.08 Tunnel-Specific Inspection Procedures

The minimum tunnel-specific requirements are defined in NTIS Section 650.513. Tunnel-specific procedures must be developed for every structure in the NTI regardless of type or classification. The procedures must be reviewed prior to each inspection and adhered to during field activities. They should be updated as additional information is gained through review of as-built drawings, visual observations and in-depth inspections. The procedures should also serve as a standalone living document to aid each subsequent inspection. All aspects of inspection and testing structural, civil, mechanical systems, electrical and lighting systems, fire/life safety/security systems, signs and protective systems need to be clearly described.

Pertinent instructions and recommended in-depth inspection frequencies based on manufacturer or specialized staff recommendations for functional systems need to be described. This shall include referencing any testing standards or methods provided by the National Electric Manufacturers Association

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(NEMA), National Electrical Testing Association (NETA), National Fire Protection Association (NFPA), or other applicable trade associations.

Access and coordination requirements shall be provided for all elements requiring inspection. This must include identifying individuals or agencies that can provide inspection personnel to secured or locked tunnel elements.

The procedures should be organized by general element type, material, and in accordance to their physical location in the tunnels. Diagrams or sketches of cross-sections, plan and elevation views must be included so locations of defects can be accurately determined. Specialized inspection procedures must be described for critical systems in complex tunnels.

D.09 Quality Control and Quality Assurance

The minimum quality control (QC) and quality assurance (QA) requirements are defined in NTIS Section 650.513.

QC consists of procedures that are intended to maintain the quality of a tunnel inspection and load rating at or above a specified level. QC procedures are developed by the organization employing the team leader. Each routine tunnel inspection needs to incorporate quality control measures to ensure accurate element condition state quantities are collected and reported. To accomplish this, QC should be performed throughout the entire inspection planning, collection and reporting process. QC must confirm accurate element quantity calculations, adherence to inspection procedures, and include field review of inspection teams.

QA is the use of sampling and other measures to ensure the adequacy of quality control procedures in order to verify or measure the quality of the entire tunnel inspection and load rating program. QA processes are implemented and performed by verifying that QC procedures are being properly instituted and randomly selecting tunnels for review. Tunnel file and field reviews are performed using standardized checklists and forms to identify missing or deficient data. A biennial QA report is provided to FHWA documenting the work completed and agencies reviewed.

D.10 Tunnel Files

The minimum tunnel file requirements are defined in NTIS Section 650.513. The file must contain tunnel-specific inspection procedures, inventory data, current and previous inspection reports, critical finding documentation, maintenance and rehabilitation records, photos, and diagrams. If applicable, functional system testing results and load rating calculations shall be in the file. The file should also include pertinent construction documentation including plans, as-built drawings, shop drawings, specifications and material information. If the contents of the file are in more than one location than reference shall be included in the file to ensure they are readily accessible. MDOT strongly encourages the use of electronic files and will work with owners during quality assurance reviews to scan important documents.

D.11 Reporting

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The minimum reporting requirements for inspection data entry, inventory coding, and critical findings are defined in NTIS Sections 650.513 and 650.515.

D.11.01 Inspection and Inventory

All initial, routine, damage, in-depth and special inspection reports must be submitted to MDOT-MiBridge-Admin@michigan.gov within 60 days after the completion of field work. Tunnel owners must also contact MDOT within 60 days of load restriction or closure changes so that inventory coding may be updated.

D.11.02 Critical Finding Reporting

MDOT will report critical findings to FHWA within 24 hours of being notified. Subsequent follow-up details describing the immediate action(s) taken, cause, and tentative repair plans will be provided as they are known. Refer to section D.05.02 for tunnel owner critical finding reporting.

In addition to as-needed notifications, an annual report summarizing the current status and resolution process of critical findings will be generated for review by FHWA.