CHAPTER 11

INSPECTION EQUIPMENT

11.01 Purpose

A variety of equipment is necessary for the proper execution of bridge safety inspections. Access to hand tools or other aids during field inspection is vital for ensuring efficient and comprehensive results. The equipment should be well organized to limit the amount of time searching for particular items while parked near traffic. In addition, specialized access equipment is necessary to observe elements that cannot be viewed from adjacent surfaces, and when in-depth inspections are necessary. This chapter describes the minimum recommended equipment each team leader should have access to in the field during routine inspection, and other equipment that may be required periodically for in-depth inspection. Prior to performing field work the team leader should review Chapter 2 and Chapter 15 of the FHWA *Bridge Inspector's Reference Manual* (BIRM) for other beneficial and advanced inspection equipment.

11.02 Routine Inspection Equipment

The minimum recommended items that should be readily available during routine biennial inspection are described below. When exiting the confines of the vehicle, personal protective equipment should be used in accordance with MIOSHA and the employing agency's safety plan. During the bridge file review, the team leader should evaluate the bridge plans and previous inspection reports for consideration of special safety equipment. The team leader and assisting staff shall be responsible for wearing and maintaining the items identified in Table 11.02.01 at all times. In addition, life jackets shall be worn while working near water. Waders or hip boots are suggested to decrease the likelihood of contact with pollutants, organisms, and to provide a means for insulation while working in cold surface waters. Other personal protective equipment is necessary when working in confined spaces, at heights above 6', or where other vulnerabilities exist. Review Chapter 13 and applicable MIOSHA standards to ensure adequate precaution and preparedness have been taken prior to exposure to hazards at the bridge site.

Table 11.02.01 Minimum Personal Protective Equipment Required During Inspection

Personal Protective Equipment	Standard Required
Hard Hat	ANSI Standard Z89-1, Type 1 Class C or E
Safety Glasses	ANSI Z87.1
Safety Vest	ANSI 107 Class 2 or 3
Gloves	None
Steel or Composite Toe Boots	ASTM F2413 (previously ANSI Z41 Impact Rating I-75)

During the bridge file review, the team leader shall also review the previous inspection findings and determine whether specialized aerial access equipment or particular tools are required to adequately

assess the condition of the bridge. Specific information relating to platform bucket trucks or under-bridge inspection units is expressed in Section 11.03. The standard equipment that every team leader should have access to during field work may be categorized according to gear required for improving visual observation, diagnosing or identifying defects that are not visible, and accurate recording of the deficiencies identified. Failure to have access to these tools may result in repeated visits to the structure causing inefficient use of time and increased labor costs. A summary of the minimum equipment is provided Table 11.02.02.

Binoculars and a flashlight are two practical tools that allow enhanced visual observation of surfaces from a distance or those that are shielded from daylight. These items improve judgment for the need of additional investigation that is not associated with a routine inspection. Ladders should accompany the inspection team for cases where the inspection of beam ends, bearings, and other elements may not be viewed from ground level surfaces. Extension ladders should only be employed when there is adequate distance from traffic and a stable substrate is available that will support the personnel climbing on the equipment. Inexpensive hand tools that shall be used at locations accessible from the ground surface or ladder include putty knives, steel brushes, and other apparatuses that allow cleaning or removal of rust and debris.

Rock pick hammers, steel rods, or chains are necessary for detecting delamination or decay in horizontal and vertical surfaces. Generally, the surface areas that are sounded during a routine inspection are limited to distressed and accessible substructure or deck elements where closure of lanes is unnecessary. Rods used to probe for scour and feel for irregularities on submerged structural components are necessary for all crossings over water. A boat or raft is also essential when the water depth adjacent to submerged substructure elements is less than 10 feet but too deep for the individual to wade. The use of a fathometer is recommended for all underwater inspections that occur from the boat or raft. These relatively inexpensive devices allow for improved detection of active scour, but may not serve as a sole substitute for probing because scour holes filled with loose streambed materials may not be detected with the instruments.

Electronic cameras are necessary to record the condition of elements at the time of inspection. A transverse view of the deck, elevation of the structure, and any elements where the rating is modified from the previous inspection must be taken. Tools used to measure defects and provide a scale in photographs consist of tape measures and crack gauges. The inspection team leader should carry tape measures of adequate length that allow for accurate inventory, appraisal, and element condition state coding. Electronic distance meters may also be utilized at locations where measurements with a physical tape are inefficient or difficult. A level for determining the extent that items are out of plumb is necessary when settlement, displacement, or rotation is suspected. All inspection reports are required to be submitted using the web based Bridge Management and Inspection System. Smart phones are beneficial as they allow previous inspection findings to be viewed in MiB^{RIDG}E , immediate verbal contact or correspondence with the bridge owner, and verification of the value recorded for latitude and longitude.

Table 11.02.02 Routine Inspection Equipment and Tools

Visual Observation	Diagnosis or Identification of Unexposed Defects	Recording Equipment
Binoculars	Rock Pick Hammer, Sounding Rod, or Chain	Camera
Flashlight	Scour or Probing Rod	Measuring Tools
Extension Ladder	Boat or Raft	Level
Cleaning Tools	Fathometer	Smart Phone

11.03 Fracture Critical, Damage, and In-Depth Inspection Equipment

The fracture critical inspector or delegated authority responsible for performing the damage or in-depth inspection shall maintain and use the equipment identified in Section 11.02, and should also utilize the equipment identified in Table 11.03.01. Chapter 15 of the BIRM also provides additional information related to Non-Destructive Evaluation (NDE) that may be necessary during fracture critical, damage, or in-depth inspection.

One of the most significant factors for performing a fracture critical or Type II and Type III damage inspection is the condition that visual observations must be conducted from an arms-length distance. This prerequisite makes access equipment one of the first items that should be considered and coordinated for use. While few fracture critical element inspections may be conducted from a ladder, the majority requires use of a platform bucket truck or under-bridge inspection unit. Agencies who do not own platform bucket trucks may rent them on as-needed basis through several equipment vendors that are located throughout the state. However, under-bridge inspection unit rental or leasing is largely provided by companies located outside of the Midwest. MDOT provides the under-bridge inspection unit and it's operators for use by local agencies and their vendors free of charge due to the high rental fees and specialized training necessary to operate the under bridge units. Local agencies, and consultants performing services on their behalf, who are conducting NBI inspections may contact the Bureau of Bridges and Structures to inquire about availability. The gross weight and horizontal reach of both units operated by MDOT is 64,150 pounds and 62 feet which must be considered prior to requesting use of these resources. All personnel performing inspections from aerial equipment must wear a safety harness and lanyard that is secured to the devices at all times.

Other equipment that is often employed during a hands-on inspection includes apparatuses used to measure section loss. Grinders are frequently used to provide a clean surface free from scale for detailed thickness measurements or to remove protective coatings that inhibit identification of cracks. An ultrasonic thickness gauge, or caliper when the measurement will occur near an exposed edge, may be used to determine the amount of reduced section. These tools are necessary for providing accurate information to the engineer responsible for performing a load capacity analysis. Dye penetrant kits are an inexpensive and easy to use method for verifying suspected cracks from fatigue or impact. When impact damage causes distortion of the stringer, or immediate repairs are installed to stabilize the superstructure, the vertical under clearance must be measured to verify the posted clearance remains accurate. Although this may be performed using a measuring tape an efficient method includes the use of telescoping clearance rod. Paint markers are helpful for marking deficiencies that display well in

photographs and when repeated field evaluation is necessary to determine whether a change has occurred.

Table 11.03.01 Fracture Critical, Damage, and In-Depth Inspection Equipment

Specialized Equipment	Objective for Use
Platform Bucket Truck or Under-Bridge Inspection Unit	Majority of fracture critical inspections and as-needed for damage or in-depth inspection
Harness and Lanyard	Required for inspection from aerial equipment or unprotected edges
Grinder	Cleans corroded surfaces and removes protective coatings
Ultrasonic Thickness Gauge	Accurate and precise determination of remaining steel section
Calipers	Detailed measurement near an exposed edge
Dye Penetrant Kit	Verification of suspected cracking in steel elements
Telescoping Clearance Rod	Confirmation of posted vertical clearance
Paint Marker	Delineates information for use in photographs or follow-up evaluation

11.04 Confined Space and Underwater Diving Inspection Equipment

Confined spaces are those areas which allow access with restricted locations for exiting, and are not intended for long-term occupancy by workers. Examples of confined spaces that are encountered during NBI inspection include steel box girders, tie girders, and culverts. Specialized equipment is necessary to test the atmospheric conditions inside the space, provide suitable air for employees to perform the work, and provide a means for retrieving individuals that cannot exit the area under their own effort.

The kind of personal underwater diving inspection equipment utilized will depend on the conditions that will be encountered and individual preferences. There are several benefits and disadvantages amongst comparisons between Self Contained Underwater Breathing Apparatus (SCUBA) and surface-supplied diving equipment. Other equipment that must be worn or used while performing the underwater dive, among others, includes exposure suits, face mask, and a dive light.

Underwater diving and inspections that occur within a confined space require site specific equipment for monitoring conditions and providing a suitable environment during the inspection. These types of inspections require strict adherence to MIOSHA specifications due to the inherent risk involved. A certified trainer or occupational safety specialist should be consulted for the specific kind of equipment that is best suited and whenever uncertainties exist that may jeopardize safety or the quality of the work. Certifications and experience may also be necessary prior to proceeding with the work on MDOT or other agency owned bridges.

11.05 Equipment Procedures

Special equipment used during the inspection process should be noted so it can be used during subsequent inspections. The team leader should note special equipment that is required for an inspection and the specific areas where it is recommended to be employed. The inspector should also note the

special access equipment type, location, and frequency for use during each type of inspection. This information should be documented in the "General Notes" section of the Bridge or Culvert Safety Inspection Report, or in the "Inspection Procedures" section of the Fracture Critical, Fatigue Sensitive, Underwater, or Other Special Inspection reports.