CHAPTER J1

Tunnels, Tubes, Ferries and Pumping Plants

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J1.01 Introduction

J1.01.01 Chapter Content and Resources

This chapter contains information relevant to the maintenance of tunnels, tubes, ferries, and pumping plants. The repair and maintenance of tunnels, tubes, and ferries are included in the HM3 Program. The repair and maintenance of pumping plants are included in the HM-251 program, although more commonly included in the SHOPP 151 program due to higher associated cost and often longer time required to deliver such projects.

Tunnel or tube maintenance includes washing, cleaning, tile repair, and the maintenance of electro-mechanical equipment and other work as described in either the tunnel-specific inspection procedures or maintenance plans. Tunnel structural repairs will be performed under this program when covered by approved SM&I reports of work needed. Ferryboat maintenance includes all work to maintain ferryboats and related facilities such as slips, fenders, and docks. Pumping plant maintenance includes structural repairs, removal of material from the sumps, and periodic servicing, replacing, and/or repairs of electrical and/or mechanical equipment.

Refer to Volume 2 of the Maintenance Manual for administrative details and charging information regarding the HM3 and HM-251 Programs.

This chapter provides an overview of the policies, expectations, and strategies regarding tunnels, tubes, ferries, and pumping plants. For references found within this chapter, refer to the following resources:

Bridge Crew Resource Center (BIRIS and Bridge Level of Service): Bridge Crew Resource Center | Structure Maintenance And Investigations (ca.gov)

Cal/OSHA Title 8 of the California Code of Regulations (CCR): Title 8 Search (ca.gov)

Caltrans Electronic Forms System: CEFS - Forms (ca.gov)

Employee Safety Manual: Employee Safety Manual Online | Health and Safety (ca.gov)

Employee Safety Training and Educational Materials (Confined Space Training): Employee Safety Training and Educational Materials | Health and Safety

Structure Maintenance and Investigations (SM&I) Website: Structure Maintenance & Investigations | Structure Maintenance And Investigations (ca.gov)

California Code of Regulations: California Code of Regulations - California Code of Regulations (westlaw.com)

Winter Preparedness Memo and Checklist: Winter Operations Branch | Maintenance (ca.gov)

J1.01.02 Acronyms and Definitions

Acronyms

ABME	Area Bridge Maintenance Engineer
BIRIS	Bridge Inspection Records Information System
Cal/OSHA	Division of Occupational Safety and Health (DOSH), also referred to as Cal/OSHA
CEFS	Caltrans Electronic Forms System
CFR	Code of Federal Regulations
COI	Certificate of Inspection
DES	Division of Engineering Services
EMWW	Office of Electrical, Mechanical, Water and Wastewater Engineering
GIS	GIS Geographic Information System
HM	Highway Maintenance
HMI	Human Machine Interface
IR	Insulation Resistance
MOU	Memorandum of Understanding
NFPA	National Fire Protection Association
OMSWEC	Office of Maintenance Stormwater and Environmental Compliance
SAE	Society of Automotive Engineers
SHOPP	State Highway Operation and Protection Program
SM&I	Structure Maintenance and Investigations
USCG	United States Coast Guard

Definitions

Must – 1: an imperative need: REQUIREMENT
2: an indispensable item: ESSENTIAL

Should – indicating a desirable or expected state.

Tunnel (includes Tube) –an enclosed roadway for motor vehicle traffic with vehicle access limited to portals, regardless of type of structure or method of construction, and that involves special design considerations that may include lighting, ventilation, fire protection systems, and emergency egress capacity. Tunnels carry state highways which run underground; tubes carry state highways underwater.

See also Volume 1, Chapter H of the Maintenance Manual for additional definitions and illustrations of tunnels, tubes, and pumping plants, and for the responsibilities of the SM&I Tunnel Investigations team, ABMEs, and District Maintenance Engineers.

J1.01.03 References and Hyperlinks

There are hyperlinked resource materials identified within this chapter of the Maintenance Manual. If any hyperlink is not accessible, please notify the appropriate Division personnel to inquire about that resource or reference.

J1.01.04 Chapter Contact

This chapter of the Maintenance Manual is maintained by the Division of Maintenance, Structure Maintenance, and Investigations.

J1.02 Maintenance Levels

The general objective is to maintain all facilities in accordance with their initial construction or, if subsequently improved, in accordance with their subsequent improvement. This will help protect structural integrity, preserve Caltrans' capital investment and roadway aesthetics, and provide motorists with a safe and comfortable driving experience.

Correction of deficiencies that immediately affect safety and/or structural integrity should be given first priority.

Second priority should be given to the correction of deficiencies not having an immediate effect on safety, structural integrity, or capital investment.

J1.02.01 Tunnel, Tube, Ferry, and Pumping Plant Inspections

Frequent visual surveillance should be made by maintenance crews to detect deficiencies or conditions which may impair the structural integrity of tunnels, tubes, ferries, and/or pumping plants, or result in a hazard to traffic, pedestrians and/or adjacent property.

Tunnel/Tube Inspections
To comply with federal regulations, all tunnel and tube structures (as defined in section J1.01.02) must be inspected by the SM&I Tunnel Investigations Team, typically at a 24-month inspection interval and more frequently when the need is determined by the SM&I. The scope of the inspection encompasses all tunnel structural and civil 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. In addition, supporting tunnel structures such as ventilation buildings are included in the inspection. There are tunnel-specific inspection procedures for each tunnel and tube that list the systems included in the inspection. Copies of the tunnel-specific inspection procedures are available in BIRIS.

Ferry Boat Inspections
All ferries are inspected. Access to a ferry is done at the ferry terminals and during the dry dock period which is typically at a 5-year interval.

The superstructure, deck, vehicle aprons, equipment, and bilges can be inspected while the ferry is at the terminal or during the dry dock period. The exterior hull, keel coolers, and skid plate system can only be inspected during the dry dock period.

Code of Federal Regulation 46, Chapter I, Subpart T, requires the vessels undergo a drydock examination and an internal structural examination at least once every 5 years. The structural conditions must be acceptable to the Coast Guard Officer in Charge, Marine Inspection (OCMI), to be issued a new or renewed Certificate of Inspection.

Interim inspections between dry dockings are conducted periodically by SM&I in accordance with a MOU between SM&I, District 4, and the Division of Equipment. The purpose of these inspections is to determine conditions of the ramps and support facilities, and maintenance needs identified by the crew.

There is no frequency established for the interim inspections designated in the Code of Federal Regulations Code of Federal Regulations (CFR) or Memorandum of Understanding (MOU), but they have been historically conducted on a 24-month frequency.

The mechanical and electrical portions of the ferry are inspected by the Division of Equipment.

Pump Plant Inspections
The Caltrans DES' EMWW performs an engineering investigation and evaluation of all pump plants' mechanical and electrical equipment at least once a year, including Caltrans' drainage pump plants, pursuant to a Service Level Agreement with the Caltrans OMSWEC.

Reports
Written reports are made of all engineering evaluations on tunnels, tubes, ferries, and pumping plants. These reports are available in BIRIS. Work recommendations from the engineering evaluations are transmitted to the respective District, OMSWEC, and EMWW. For tunnels and tubes, the reports are also transmitted to FHWA.

Work recommendations noted as "Emergency" should be repaired immediately. If appropriate, mitigation measures should be taken to preserve the safety of the traveling public and maintenance personnel, and/or to preserve the structure or mechanical equipment.

Work recommendations noted as "Priority" should be repaired promptly, or temporary repairs should be made until permanent repairs can be scheduled.

Work recommendations noted as "Routine" should be coordinated with routine maintenance operations, but initiation or scheduling of corrective action should not be delayed more than 30 days beyond the recommended repair period.

J1.02.02 Tube and Tunnel Cleaning

Tiled and/or painted tunnels or tubes with reflective metal panels should be cleaned a minimum of once every 6 months. Localized conditions such as locations with high truck volumes may necessitate more frequent cleaning. Any loose tiles should be identified and repaired during these operations.

J1.03 Tunnels and Tubes

This section applies to all tunnels and tubes with mechanical and electrical systems. It should be the responsibility of the Superintendent to ensure that all Maintenance personnel are familiar with pertinent sections of Title 8 of the California Code of Regulations covering orders issued by Cal/OSHA.

(A) Fire Alarm System

Where the tunnel fire alarm system is connected into the fire alarm system of another agency, no work should be done upon the tunnel fire alarm system without notifying the other agency.

Annually, fire detection systems must be inspected and tested in accordance with the version of NFPA 72 “National Fire Alarm and Signaling Code” in effect at that time.

(B) Fire Protection Systems

For tunnels and tubes with fire protection systems, such as standpipes, sprinklers, and hydrants, fire protection systems must be inspected and tested annually, in accordance with the version of NFPA 25 “Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems” in effect at that time.

Fire extinguishers in the bore of the tunnel, in the operations and maintenance center, or in other supporting structures, must be inspected monthly and serviced annually by Maintenance personnel.

(C) Carbon Monoxide Analyzer Systems

The carbon monoxide analyzers should be maintained and calibrated in accordance with instructions issued by the manufacturers of the analyzers and as stated in the tunnel or tube-specific maintenance and inspection plans.

(D) Electrical and Lighting Systems

Tunnel Maintenance Workers should be familiar with the operation of all switches, breakers, and other safety or operating equipment.

Repair or adjustment of electrical equipment must be performed only by qualified electricians. Permanent changes in the circuitry of the tunnels/tubes should not be made without consulting SM&I. This is not intended to prevent electricians from making necessary emergency connections.

(E) Fans, Motors, and Drives

Lubrication of bearings and machinery must conform to the requirements of this chapter as well as the requirements of the equipment manufacturers and the tunnel and tube specific maintenance and tunnel-specific inspection procedures.

Belt drives should be adjusted in accordance with the recommendations of the belt manufacturers. When V-belt drives are replaced, they must be replaced only with matched sets of V-belts.

(F) Lubrication

Standard items of manufacture, such as electric motors, engines, compressors, gear reducers, and pillow blocks incorporating sealed ball or roller bearings, are usually furnished with Maintenance manuals that include recommended lubrication practices. These practices must be followed exactly unless overruled by "Specific Lubrication Instructions."

The manufacturer's manuals and the "Specific Lubrication Instructions" will be made a part of the "Special or Supplemental Orders" included in data posted in each control room.

(G) Maintenance Logs

Maintenance logs must be kept which document all maintenance performed on the tunnel/tube's mechanical and electrical systems. Maintenance intervals shall be established based on equipment manufacturer's recommendation or Caltrans' guidance.

(H) Functional System Test Logs

Functional system test logs must be kept which document all operational tests performed on the tunnel/tube mechanical and electrical systems. Functional system test intervals should be established based on equipment manufacturer's recommendation or Caltrans' guidance. At a minimum, the functional system test log should provide the date of the test, the system tested, who performed the test and the results of the test. Historical logs should be kept for a minimum of five (5) years.

J1.04 Ferryboats

Ferryboats should be maintained in a serviceable condition and should be the joint responsibility of District Maintenance, SM&I, and the Division of Equipment. Every effort should be made to keep ferries operational. Shutdowns for routine servicing and maintenance should be scheduled during shifts of minimum vehicular use of the ferries.

The USCG requires annual inspections of ferries, and a five (5) year dry-dock ferry inspection. This dry-dock inspection will allow for a complete hull inspection and repairs as required. Upon successfully passing the USCG Inspection, a COI will be issued by the USCG and is required to be posted in the ferry vessel's wheelhouse.

Every effort should be made by the District to provide service contracts for dry-docking ferries at least once every five (5) years, at minimum.

(A) Lubrication.

Standard items of manufacture, such as electric motors, engines, compressors, gear reducers and pillow blocks incorporating sealed ball or roller bearings, are usually furnished with maintenance manuals that include recommended lubrication practices.

These manuals should be made a part of the Maintenance Manual in the control room, and the recommended lubrication practices should be followed exactly unless

overruled by "Specific Lubrication Instructions."

Lubrication of open gears, wire ropes, and sleeve bearings must be varied to meet the conditions under which they operate. For example, open gears that are seldom used and subject to the accumulation of sand or dirt will be better protected and receive less wear if painted with State Specifications 8010-61J-45 paint with all oil or grease removed from the teeth.

Due to the great variation in proper lubrication requirements of somewhat similar facilities, the proper practice for each ferryboat will be covered in "Specific Lubrication Instructions."

The manufacturer's manuals and the "Specific Lubrication Instructions" for each ferryboat should be made a part of the Special or Supplemental Orders included with the data posted in each control room.

(B) Fire Protection.

Fire extinguishing equipment should be installed and maintained in accordance with the requirements of the USCG.

(C) Lifesaving Equipment.

Lifesaving equipment should be installed and maintained in accordance with the requirements of the USCG.

J1.05 Pumping Plants

Pumping plants should be maintained in a clean and serviceable condition. Pumping plants should be inspected, and the pumps manually operated, at intervals frequent enough to ensure that the pumping equipment is in proper operating condition. Every entry should be logged in the pump house maintenance logbook located in the pump house. A description of the work performed and the reason for the entry should be recorded in the log. The pump sump area is considered a confined space and proper confined space entry procedures must be followed.

The building should be kept swept out and generally cleaned up. Miscellaneous supplies and tools, other than those needed frequently for the pumping plant, should not be stored in the pump building.

During the rainy season, the pumping plants should be inspected and test operated at least once every two (2) weeks. During the off season, the pumping plants should be inspected and test operated at least monthly. For additional information, refer to the Winter Preparedness Memo and Checklist hyperlink provided in Section J1.01.01 of this chapter.

Test operation consists of operating each pump for approximately five (5) seconds by switching the pump selector switch to the "HAND" or "MANUAL" position. Care should be taken to ensure that the selector switches are reset to the "AUTO" position after each test so that the pump operation will be controlled by the water level in the storage box or pump sump.

During the rainy season, the sump screens should be inspected regularly and kept free of all debris that would impede free flow of water to the pumps.

When large amounts of dirt or debris enter the storage box or pump sump due to erosion of cut slopes or improperly screened catch basins, measures should be taken to stabilize the cut slopes and/or intercept the dirt or debris before it reaches the collection system.

Pump outfall facilities should be inspected and cleaned, if necessary, to ensure a free flow of water beyond the pumping system.

During an annual inspection, the main power or control disconnect should be opened and the electrodes removed from the stilling tube and cleaned if necessary. A brush and strong detergent solution are recommended for cleaning the electrodes. The connection of the suspender wires to the electrodes should also be checked at this time for any corrosion at the connection or of the suspender wire itself.

The float switches and bubbler system should be inspected and tested during the annual inspection. The exterior cable jacket of each float switch should be inspected for any damage. Manually raise or lower each float switch to test the pump start and stop operations and the low and high alarms. If applicable, use the HMI screen to simulate water levels and ensure proper pump operation. Use the purge function to clear the bubbler tube of any debris during every visit to the pump plant.

Measurements for the pump motors should also be taken during annual inspection. Open the disconnects for each motor and take an IR reading. After taking an IR measurement, return the disconnects back to the closed position. Run the motor and measure the current draw of each motor. The IR and current values should be documented annually to monitor the life of the motor.

If the plant is equipped with a source of emergency power, it should be exercised at least monthly. The most satisfactory method of testing the emergency power plant is to simulate water in the sump by grounding the electrodes or initiating the pumps to run as applicable, and then simulating a power failure by opening the main power switch. After a successful start and test run of the emergency power plant and its associated controls, close the main power switch. If the plant goes through its normal shutdown procedure, return the plant to normal utility power.

These operational tests and measurements should be made only by qualified personnel, either an electrician or one of the pump maintenance personnel.

Dikes and other facilities installed to prevent the encroachment of offsite drainage into the depressed area should also be inspected, replaced, and repaired if necessary.

J1.05.01 Lubrication

Pumping plants can be broken down into two (2) basic types: wet pit and dry pit. Each requires a different type of lubrication. In the wet pit, the pumps are submerged directly in the wet sump and are fitted with grease lubricated sleeve bearings. In the dry pit, the pumps are mounted in a dry sump with their suction lines connected to the wet sump through a dividing wall. These pumps are fitted with an anti-friction type ball or roller bearings.

(A) Wet Pit Style Pumps.

The older wet pit style pumps, with motors separate from the pumps, require the following lubrication requirements.

- The column bearings are oil lubricated from a solenoid operated oil lubricator. The reservoirs should be filled at all times with a non-detergent SAE 20 or SAE 30 weight oil.

- The lubricators should release oil to each column bearing at the rate of 8-12 drops per minute.

- During the rainy season, the pump bearings should be greased approximately every two (2) weeks or for every two (2) hours of running time, whichever occurs first. During the off season, the pumps should be greased every two months (unless the pump is subjected to ground water or landscape watering run-off, in which case it should be greased on the same basis as for the rainy season).

Modern submersible pumps have permanently sealed, lubricated bearings and don't require lubrication once installed.

(B) Dry Pit Style Pumps.

The dry pit pump is fitted with an anti-friction ball or roller bearings with grease retaining seals.

Because these bearings retain their grease supply and are not submerged in water, they do not require as frequent a greasing as the wet pit pump bearings. Greasing of ball or roller bearings should be limited to the small amount of grease that may leak out of the seals. If an abnormal amount of grease is observed leaking out of the seals, the grease seals should be replaced.

If a dry pit is accidentally flooded, the pumps should be shut down and the EMWW representative assigned to the district should be notified immediately.

(C) Motors.

The electric motors are fitted with ball or roller bearings, some of which are oil lubricated and some of which are grease lubricated. It is very important that these bearings are lubricated in exact accordance with the maintenance instructions furnished with the motor. Over lubrication can damage the pumps by injecting grease into the motor windings.

J1.05.02 Electrical Equipment

Repair or adjustment of the electrical equipment should be performed only by qualified

electricians.

Other Maintenance personnel charged with maintaining pumping plants should be knowledgeable of the switches and reset buttons that operate the plant but should not be permitted to attempt repairs of the electrical equipment.

Permanent changes in the circuitry of the pumping plants should not be made without consulting EMWW. This is not intended to prevent electricians from making necessary emergency connections.

Inspect pump station electrodes, float switches and other pump water-level control equipment to confirm they are operating the pumps normally.

J1.05.03 Data to be Posted

The following information should be posted in each drainage-pumping plant. This means attaching the information to one wall in the pumping plant in a noticeable location, or placing the information in a clearly labeled binder or file:

(A) Pump house Electrical Schematic.

(B) Maintenance Facility, address, and telephone number.

(C) Confined space entry forms.

In addition to the above, a Pumping Plant Log (DSD0030) and Generator Log Check List (DSD0031) which are available on CEFS, (See Appendix J1-1 of this chapter) should be mounted on a clipboard and hung on the wall where they will be noticeable to anyone entering or leaving the pump house. Each time a Maintenance worker enters a pumping plant, they should record the visit in the log along with any work they performed during the visit. Take pictures when doing any work. These photos are to be used by the Maintenance GIS Team for uploading to the Pump Plant GIS viewer. Most pumping plants have running time meters which record the accumulative running time of the pumps. It is very important that these times be recorded on every visit whether any work is performed or not.

J1.05.04 Safety Procedures

Work in drainage pumping plants should be done in accordance with all the following:

(A) Division 1, Chapter 4, Subchapter 4, Article 37, Title 8 of the California Code of Regulations.

(B) Division 1, Chapter 4, Subchapter 7, Article 108, Title 8 of the California Code of Regulations.

(C) Caltrans Safety Manual, Chapter 14: Confined Spaces.

(D) All other instructions posted at the pumping plant.

APPENDIX J1-1

Naming Conventions and Inspection Log Check Lists

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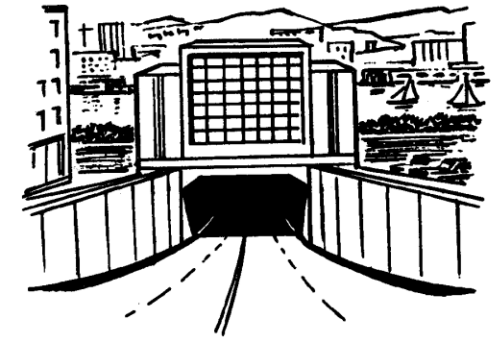
TUNNELS, TUBES, FERRIES, AND PUMPING PLANTS

TUNNEL

TUNNEL—This term is used in the name of a passageway which carries State Highway traffic underground such as through a hill or mountain.



TUBE

TUBE—This term is used in the name of a passageway which carries State Highway traffic below or under a body of water.

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

PUMPING PLANT LOG-CHECK LIST

DS-D0030 (REV. 01/1990)

Lock Data on Form

PUMPING PLANT NAME

STRUCTURE NUMBER

DATE	REASON		OPERATION		DEBRIS		WATER LEVEL SYSTEM CHECK	LUBRICATION				HOUR METER			POSTED ITEMS				LOG OF WORK DONE OR STATUS OF EQUIPMENT	NAME
	ROUTINE INSPECTION	EMERGENCY RESPONSE	MANUAL OPERATION CHECKED	AUTOMATIC STATUSVERIFIED	PIT & SUMP PUMP (CLEANEXCESSIVE)	STORAGE BOX (CLEAN \EXCESSIVE)		LUBRICATOR CRIP RATE (OK/ADJUSTED)	GREASE MOTOR (YES/NO)	GREASE PUMP (YES/NO)	PUMP PACKING (OK/ADJUSTED)	PUMP #1	PUMP #2	PUMP #3	RESCUE PLAN	CODE OF SAFETY PRACTICE	CONFINED SPACE ENTRY IF APPLICABLE	ELECTRICAL SCHEMATIC		

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DISTRIBUTION INSTRUCTIONS

When sheet is full; Route: Original to Region Office, Second Copy to Electrical Region Office, and Third Copy retain on clipboard with Pump House.
Check purpose of visit. for every entry into Pump House. If service needed beyond your ability, advise your supervisor.

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

GENERATOR LOG-CHECK LIST

DS-D0031 (REV. 8/94)

Lock Data on Form

HOME BASE | CHC NUMBER

	USE		WATER			OIL				FLUID CHANGES				GENERATOR				
DATE	ROUTINE	EMERGENCY	TEMPERATURE	LEVEL	FREEZE PROTECTION	PRESSURE	TEMPERATURE	HOUR METER	FULL LEVEL	ANTI-FREEZE CHANGE (ODD YEARS)	LUBE OIL (HOURS)		ROAD TEST (TWICE YEARLY) (DATE)	VOLTS	AMPS	FREQUENCY	REMARKS	NAME

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Check purpose of visit. If service needed beyond your ability, advise your supervisor. Place Yes, No, or check mark in each column as appropriate.