14. Recommended Practice for Fiber Optic Multiplexer (FOM) Inspection, Testing and Maintenance

Approved June 25, 2002
APTA Rail Transit Standards Fixed Structures Inspection and Maintenance Committee

Approved January 10, 2003
APTA Rail Transit Standards Task Force

Authorized June 8, 2003
APTA Rail Transit Standards Policy Committee

Abstract: This recommended practice provides guidelines for inspecting, testing, and maintaining rail transit communication system fiber optic multiplexer (FOM) systems.

Keywords: communication, communication system, fiber optic multiplexer, FOM, inspection, maintenance

Introduction

(This introduction is not a part of APTA RT-SC-RP-014-03, *Recommended Practice for Fiber Optic Multiplexer [FOM] Inspection, Testing and Maintenance*.)

APTA rail transit safety standards and recommended practices represent an industry consensus on practices for rail transit systems to help achieve a high level of safety for passengers, employees, and the general public. This document was created by and for those parties concerned with its provisions; namely, rail transit systems (operating agencies), manufacturers, consultants, engineers, and general interest groups. This recommended practice provides guidelines for inspecting, testing, and maintaining rail transit fiber optic multiplexers.

APTA recommends this practice for:

- Individuals or organizations that inspect, maintain, and/or operate rail transit systems
- Individuals or organizations that contract with others for the inspection, maintenance, and/or operation of rail transit systems
- Individuals or organizations that influence how rail transit systems are inspected, maintained, and/or operated (including but not limited to consultants, designers, and contractors)

The application of any practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of how a rail transit system operates. In such cases, the government regulations override any conflicting practices this document recommends.

Participants

APTA greatly appreciates the contributions of the following members of the Signals and Communications Subcommittee who provided the primary effort in drafting the *Recommended Practice for Fiber Optic Multiplexer [FOM] Inspection, Testing and Maintenance:*

Carlton "Don" Allen, P.E.
Sal Arceo
Gabrielle Bayme
Paul Camera
Lenny De Meyer
Michael Esford
Patrick Lavin
Ruben Madrigal
Thomas Peacock
Stephen Roberts
Carey Vaughn

The following members of the Rail Transit Standards Fixed Structures Inspection and Maintenance Committee contributed to the review and approval process of the *Recommended Practice for Fiber Optic Multiplexer [FOM] Inspection, Testing, and Maintenance:*

James Dwyer, *Chair*
Frank Cihak, *Vice Chair*

Anthony Adams
Carlton "Don" Allen, P.E.
Sal Arceo
Roger Avery
Peter Bertozzi
Steven Bezner, P.E.
Raymond Borge
Michael Brown
John Bumanis
Clay Bunting
R. Sean Burgess
Paul Camera
David Cappa, P.E.
Gricelda Cespedes
Robert Chappell
Frank Cihak
Catherine Cronin
Lenny De Meyer
Tom Devenny
David Dunderdale
James Dunn
James Dwyer
William Early, P.E.
Percy Erves
Michael Esford
Richard Falcon
Ray Favetti
Peter Fedun, P.E.
Steve Feil
Robert Fiore
John Gaito
Ricky Green
Mohammad Irshad
Patrick Lavin
Harry Lupia
Frank Machara
Ruben Madrigal
Michael Monastero
Bill Petit
David Rankin
Pingali Rao, P.E.
Richard Raschke
James Redding
Stephen Roberts
Charles Slavis, P.E.
Frederick Smith, P.E.
Richard Spatz
Charles Stanford
F. Brian Steets
Paul Swanson, P.E.
Steven Thompson
Fred Tijan
Gary Touryan
Carey Vaughn
James Wang, P.E.

APTA Rail Transit Standards Fixed Structures Inspection and Maintenance Committee project consultants:

Peter Gentle, P.E., *STV Incorporated*
Carol Rose, *STV Incorporated*

APTA Rail Transit Standards project team:

Gabrielle Bayme, *Standards Development Program Specialist and Project Editor*
Saahir Brewington, *Administrative Assistant and Project Editor*
Antoinette Hankins, *Program Assistant*
Thomas Peacock, *Director-Operations & Technical Services*
David Phelps, *Senior Project Manager - Rail Programs*

Contents

Recommended Practice for Fiber Optic Multiplexer (FOM) Inspection, Testing and Maintenance

1. Overview

1.1 Scope

This document establishes recommended guidelines for inspecting, testing, and maintaining rail transit fiber optic multiplexers.

1.2 Purpose

The purpose of this recommended practice is to verify that fiber optic multiplexers are operating safely and as designed through periodic inspection, testing, and maintenance, thereby increasing reliability and reducing the risk of hazards and failures.

2. Definitions and acronyms

For the purposes of this recommended practice, the following definitions and acronyms apply:

2.1 Definitions

2.1.1 cartridge fuse: A device used to protect an electric circuit from the effect of excessive current draw enclosed in an insulating cartridge. *See also:* **fuse**.

2.1.2 electro-static discharge: The release of stored electrical energy.

2.1.3 external alarm: A visual message, light or audible tone produced by an electrical system that is either seen or heard when the system has failed or has generated an error.

2.1.4 failure message: A visual or audible indication produced by a system to report failure.

2.1.5 fiber optic multiplexer (FOM): A system used in the process of combining a number of individual channels into a common bit stream for transmission over fiber optic cable.

2.1.6 fuse: A device used to protect an electric circuit from the effect of excessive current draw. *See also:* **cartridge fuse**.

2.1.7 hazard: Any real or potential condition that can cause injury, death, or damage or loss of equipment or property.

2.1.8 internal logged error: An abnormal condition or communications error generated within a device, circuit or system that is displayed and stored in memory.

2.1.9 operations control center (OCC): A location or locations designed, equipped, and staffed for the purposes of monitoring and controlling RTS activities from a central location or locations. *Syn:* **rail control center, rail operations center, rail service control center.**

2.1.10 original equipment manufacturer (OEM): The enterprise that initially designs and builds a piece of equipment.

2.1.11 personal protective equipment (PPE): All clothing and other work accessories designed to create a barrier against workplace hazards. Examples include safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons, and work boots.

2.1.12 rail transit system (RTS): The organization or portion of an organization that operates rail transit service and related activities. *Syn:* **operating agency, operating authority, transit agency, transit authority, transit system**.

2.1.13 ribbon fuse: A cylindrical fuse consisting of a ribbon shaped fusible metal enclosed in a glass or transparent plastic cylinder with end caps.

2.1.14 warning message: A visual or audible message produced by a system to warn maintainers or monitors of the status of a device, circuit or system.

2.2 Acronyms

FOM	fiber optic multiplexer
OCC	operations control center
OEM	original equipment manufacturer
PPE	personal protective equipment
RTS	rail transit system

3. Inspection, testing, and maintenance provisions

3.1 Inspection, testing, and maintenance frequency

The inspection, testing, and maintenance procedures in this recommended practice should be performed

a) when FOM equipment is placed in service

b) when FOM equipment is modified, repaired, or disarranged

c) at the frequencies recommended in Table 1 below

d) as otherwise deemed necessary by the RTS

Table 1

Action	Recommended frequency (minimum)
Operational inspection	Bi-weekly
Mechanical inspection	Monthly
Electrical inspection	Monthly
Cleaning/Coating	As specified by the OEM and/or RTS
Lubrication	As specified by the OEM and/or RTS

The RTS should determine the need for additional inspection, testing, and maintenance frequencies for fiber optic multiplexers. A review of the following factors may be useful in making this assessment:

- OEM-recommended intervals
- Industry experience
- Operating environment/conditions
- Historical data
- Reliability-centered maintenance program development
- Failure analysis
- RTS testing and experience
- Regulatory requirements

The frequency of tasks should comply with applicable federal, state, and local regulations.

3.2 Training

The RTS and/or their maintenance contractors should develop and execute training programs that provide employees with the knowledge and skills necessary to safely and effectively perform the tasks outlined in this recommended practice.

3.3 Materials

The following materials are recommended for inspecting, testing, and maintaining fiber optic multiplexers:

- RTS-approved non-conducting cleaning solvents
- Additional materials as required by the OEM and/or RTS

3.4 Tools

The following tools are recommended for inspecting, testing, and maintaining fiber optic multiplexers:

- Multi-meter*
- Bit error rate tester
- Fiber optic power level meter*
- Electrostatic discharge protection equipment
- Laptop computer with network management software
- RTS-approved portable radio
- Standard tools carried by maintenance personnel
- Additional tools as required by the OEM and/or RTS

* Calibrate in accordance with OEM and/or RTS requirements.

3.5 Personal protective equipment

Personal protective equipment, as required by the RTS, should be worn at all times during inspection, testing, and maintenance.

3.6 Safety

RTS safety rules, procedures, and practices shall be followed at all times during inspection, testing, and maintenance.

3.7 Inspection, testing, and maintenance procedures

FOM inspection, testing, and maintenance may be modified for each rail transit system's requirements but should contain the steps listed in Sections 3.7.1-3.7.2 as a minimum.

Field maintenance personnel should make no changes to the internal software configuration or add, change, alter, or modify the interconnected input or serial connected wiring without proper engineering permission or authorized revision documentation.

3.7.1 Inspection

3.7.1.1 General inspection

3.7.1.1.1 Notify the operations control center (OCC) and/or other authorities of the inspection activities to be performed.

3.7.1.1.2 Follow RTS electro-static discharge protection procedures to prevent damage to the equipment.

3.7.1.1.3 Inspect each FOM system for proper condition and operation.

3.7.1.1.4 Check external alarms.

3.7.1.1.5 Check internal logged errors, warning and/or failure messages.

3.7.1.1.6 Inspect channel banks and associated equipment.

3.7.1.1.7 Inspect equipment for physical damage, signs of rust or corrosion, frayed or loose wiring and loose, missing or damaged hardware.

3.7.1.1.8 Ensure plugs and connectors are properly secured.

3.7.1.1.9 Inspect interconnected cabling and connectors and ensure they are tight and secure.

3.7.1.1.10 Notify the OCC and/or other authorities when inspection is complete.

3.7.1.2 Electrical inspection

3.7.1.2.1 Notify the OCC and/or other authorities of the inspection activities to be performed.

3.7.1.2.2 Inspect cabling and wiring to ensure it is not frayed, burned, broken, cut, or otherwise defective.

3.7.1.2.3 Inspect cables to ensure they do not exceed their normal bending radius and are positioned to prevent chafing or cutting.

3.7.1.2.4 Measure and record the values for optic light levels.

3.7.1.2.5 Measure and record the values for appropriate electrical voltages.

3.7.1.2.6 Inspect ribbon or cartridge type fuses and other electrical protection equipment for burned, separated or otherwise damaged elements and replace as required.

3.7.1.2.7 Notify the OCC and/or other authorities when inspection is complete.

3.7.2 Maintenance

3.7.2.1 Cleaning, coating, and lubrication

3.7.2.1.1 Perform cleaning procedures as required by the OEM and/or RTS.

3.7.2.1.2 Perform cleaning and/or filter replacement as required by the OEM and/or RTS.

3.7.2.1.3 Lubricate moving parts as required by the OEM and/or RTS.

3.7.2.2 Operational check

3.7.2.2.1 Check for proper operation of cooling fans.

3.7.2.2.2 Simulate failure of primary system and verify operation of back up systems.

3.7.2.2.3 Return system to normal mode of operation.

3.7.2.2.4 Notify the OCC and/or other authorities that maintenance activities are complete.

3.8 Correction of deficiencies

Deficiencies identified during FOM inspection, testing, and maintenance should be corrected and documented in accordance with OEM and/or RTS requirements.

3.9 Documentation

Inspection, testing, and maintenance activities should be documented, reviewed, and filed in accordance with RTS procedures.

Annex A

(informative)

Bibliography

[B1] Original equipment manufacturer (OEM) specifications for FOM system inspection, testing, and maintenance.

[B2] Rail transit system (RTS) procedures for FOM system inspection, testing, and maintenance.