

SECTION 12 - FARE COLLECTION EQUIPMENT

12.0.0	GENERAL	2
12.1.0	AUTOMATED FARE COLLECTION	2
12.2.0	TICKET VENDING MACHINES	2
12.3.0	MODULARITY	3
12.4.0	CODE REQUIREMENTS	3
12.5.0	DESIGN LIFE	3
12.6.0	OPERATING ENVIRONMENT REQUIREMENTS	3
12.7.0	ELECTRICAL	4
12.8.0	PASSENGER ACCESS	4
12.9.0	CONSTRUCTION/EQUIPMENT ENCLOSURE	4
12.10.0	MAINTAINABILITY AND ACCESSIBILITY	5
12.11.0	SAFETY	5
12.12.0	SECURITY	5
12.13.0	AESTHETIC REQUIREMENTS	6
12.14.0	PROTECTION AGAINST VANDALISM AND BURGLARY	6
12.15.0	CENTRAL DATA SYSTEM	6
12.15.1	Data Networking	7
12.15.2	Central Computer	7
12.15.3	Application Software	7
12.15.4	Database Software	8
12.15.5	Report Generation	8
12.15.6	System Status and Security Monitoring	8
12.15.7	Configuration Management	9
12.16.0	SCADA INTERFACE	9

SECTION 12 - FARE COLLECTION EQUIPMENT

12.0.0 GENERAL

The Fare Collection System shall consist of Ticket Vending Machines (TVMs), a Central Data Collection & Information System (CDCIS), Stand Alone Validators (SAVs), spare parts, special tools, test equipment, documentation, training, technical assistance and warranty as part of the System. The TVMs and SAVs shall be designed for outdoor installation in an un-sheltered environment, including precipitation, sun glare, heat and solar loading. Any equipment supplied and/or installed, that is not housed in an environmentally controlled enclosure shall be rated to operate in the environmental conditions of the Denver Metro area.

It is required that the TVMs and SAVs (Fare Collection Equipment) shall be service proven. The System shall be of materials that are new and free of defects and which conform to the requirements of the Technical Specification.

12.1.0 AUTOMATED FARE COLLECTION

- All platforms shall have provisions for free-standing Ticket Vending Machines (TVMs) and future Ticket Validators.
- RTD shall determine the number of initial machines and future provisions.
- Weather protection shall be provided for each machine unless otherwise approved by RTD.
- All TVMs shall be protected from direct sunlight onto the screen.

12.2.0 TICKET VENDING MACHINES

In general, TVMs shall be designed to sell tickets and passes to RTD's customers by coins, bills or credit/debit cards. TVMs shall be capable of printing and issuing different tickets, passes, mag cards, smart cards, RFID cards or combination thereof from within the same housing. The design of the TVMs shall be based on simple, clear and reliable construction, and modular components to make them easy to use and maintain.

Each TVM shall be equipped to:

- Accept U.S. nickel (\$.05), dime (\$.10), quarter (\$.25), and post-1978 dollar (\$1.00) coins; RTD 0.0650 Token; U.S. one dollar, five dollar, ten dollar, twenty dollar, and fifty dollar bills; and provide for future acceptance of credit/debit cards as payment;
- Provide change in the fewest number of coins as required;
- Respond to customer's choice of action;
- Issue tickets and passes;
- Register the number of media of each type and price range issued and total value of fare media sold;
- Indicate malfunctions of the unit; and

- Include complete on-line TVM network capability with remote TVM status monitoring, automatic polling for sales information, a complete audit and accounting system, ability to remotely command TVMs to reset and self-diagnose, ability to remotely modify operating parameters such as fare tables and ticket print layouts, and optionally process all credit/debit card authorizations.

12.3.0 MODULARITY

Each TVM shall be a self-contained machine, complete with its own cabinet and mounting stand or base, and having integral light fixtures to illuminate the control face. Each TVM shall consist of a bill processing unit, coin processing unit, credit card processing unit (optional), debit card PIN pad (optional), display and information unit, change maker, ticket and pass issuing unit, key pad and function keys, power supply, and processing and control unit, all located within a self-contained unit. Each of the basic functions within the machine shall be performed by modular components which readily permit field replacement of inoperative modules to return the machine to service in minimal time. Control and power connections shall be made via plug-in connections. Modules shall not be directly hard wired together and/or into the TVMs. The individual module shall be fixed in the unitized frame with fast latching devices and be secured by locks against unauthorized removal, where required.

12.4.0 CODE REQUIREMENTS

TVMs shall be designed to comply with all applicable local or national design codes, ordinances, and standards existing at the time of procurement. Listed below are the principal applicable codes:

- National Electric Safety Code, American National Standard C2, latest edition
- National Electric Code, National Fire Protection Association ANSI/NFPA 70, latest edition
- Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG), latest edition
- Underwriters Laboratories UL-751, "Vending Machines," latest edition
- International Electrotechnical Commission standard 529 (IEC529)

12.5.0 DESIGN LIFE

The entire TVM shall be designed for a minimum service life of 10 years of normal operation in the Denver metropolitan area. All equipment shall be designed to operate seven days per week, twenty-four hours per day.

12.6.0 OPERATING ENVIRONMENT REQUIREMENTS

The TVMs shall be capable of operating without shelter over an ambient temperature range of -15°F to 110°F. In the summer, direct sunlight conditions will cause cabinet temperature to rise considerably above ambient, in excess of 155°F. All equipment shall be capable of operating in relative humidity from 30% to 70% over the ambient

temperature range given above. This shall include periods of condensation and wind-driven rain, freezing rain and snow. Equipment enclosures shall comply with International Electrotechnical Commission standard 529 (IEC529) level IP34 or equivalent.

12.7.0 ELECTRICAL

The TVMs shall be designed to accept standard 3-wire, 115 volt, single phase, 60 Hz power. Each machine shall be powered by a separate 20-amp circuit protected by circuit breaker. In addition, each TVM shall provide its own circuit protection.

All equipment shall be designed to tolerate 10% fluctuation in line voltage without any damage or service interruption. Breaks in the voltage (below 10% of the source voltage) or supply interruptions shall cause an orderly shutdown of the TVM.

Voltage transient suppression shall be provided where necessary. Each TVM shall include a protection system capable of withstanding transients of 3.0 kV peak pulse with a total energy of 1000 joules without damage, improper operation or shutdown. The functional status of any such surge and transient suppressor circuitry must be visible at all times when the outer door is open.

12.8.0 PASSENGER ACCESS

All functional controls, coin slots, bill slots, ticket slots and ticket and coin return bins shall be compliant with current Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

The TVM display shall use dark characters on a light background. Characters shall be at least 0.75 inches tall and be of sufficient contrast to make them easily readable in all ambient light conditions, including total darkness and direct sunlight. The TVM display shall utilize technology suitable for the environment and shall provide a viewing angle of least 45° from perpendicular in all directions. High-contrast raised lettering at least 0.625 inches high shall be used to label all controls, pushbuttons, coin and bill slots, and the ticket/coin return bin. All such labels shall also utilize standard Braille characters.

The TVM shall, on demand of the patron, provide audible voice instructions. The voice system shall utilize either stored human speech or synthesized speech using AT&T Natural Voices Software or approved equal. The messages shall be stored in digital form for operation and be modifiable by RTD. Context-sensitive voice messages shall provide, in audio form, the information shown on the TVM display or otherwise conveyed by the TVM. RTD will have final say in how the TVM looks and operates.

12.9.0 CONSTRUCTION/EQUIPMENT ENCLOSURE

The TVMs shall be designed to operate in unsheltered locations.

The overall dimension of an installed TVM shall not exceed 80 inches (height) by 38 inches (width) by 25 inches (depth). The equipment enclosure for the TVMs shall be of stainless steel with an unpainted random-orbital finish. The cabinet shall have a leveling

base which shall accommodate the station platform surface slope. Mounting shall be by means of stainless steel bolts imbedded in concrete.

Frames shall be provided for graphic panels on the front of the TVM as required for explaining the operation of the TVM. The top of the TVM shall slant at least 5° downward and to the rear of the TVM to prevent any accumulation of rain. The interior of the equipment shall be designed to allow easy and safe access to service equipment and sub-assemblies.

12.10.0 MAINTAINABILITY AND ACCESSIBILITY

In the design of the TVMs, greatest emphasis shall be put on reliable operation of all components and equipment over their economic life, and to the minimization and simplification of scheduled and unscheduled maintenance tasks.

Equipment shall be modular in design to permit rapid field replacement of malfunctioning modules.

These units shall combine the advantages of relatively simple mounting and accessibility for maintenance. Adequate space shall be available to fit keys; to grasp, lift and turn internal components; and to remove and replace units, components, connections, and ticket stock. The weight of the units that must be lifted during servicing, except coin and bill vaults, and coin storage units when full, shall not exceed 37 pounds. Guide rails shall be provided to facilitate the removal of the modules. Adequate space for the use of tools shall be available as required. For ease of service, all electrical connections between components and sub-assemblies shall be established by means of coupling to allow rapid removal of a component and/or sub-assembly from the TVM.

12.11.0 SAFETY

The interior of the TVM shall be similarly free of sharp edges or other hazards that may cause injury to maintenance personnel. Particular attention shall be given to protecting blind persons who may explore the exterior surface with their fingers.

The exterior panels and control shall be grounded to prevent electrical leakage or static charge.

12.12.0 SECURITY

Access to the interior of the equipment enclosures and to the cash vaults shall be restricted on a "need to gain access" basis as approved by RTD.

The arrangement of modular mechanical and electrical components and money containers shall be such that normal maintenance, including change-out of defective modules, shall neither require removal of, nor access into, the coin and bill containers.

TVM location shall be coordinated with CCTV camera angles to ensure the TVM is viewed by a camera.

12.13.0 AESTHETIC REQUIREMENTS

TVMs shall be designed with all controls and customer interface display and inputs on a common front face of the enclosure. Suitable graphics shall be provided explaining the operation of the TVM.

12.14.0 PROTECTION AGAINST VANDALISM AND BURGLARY

For protecting against vandalism and burglary for each TVM, the following requirements shall be met:

- All latches shall be secure and robust
- All external screws and hinges must be covered
- Security locks with profile catches must be used
- Locks must be drill resistant, mounted flush with the outside surface of the door
- The door must be locked with at least a three-point latching device with a bascule bolt and hook bar, or equivalent tools
- Overlapping doors must be constructed with a joining gap equal to or less than 2 mm
- Reinforcement must be provided at positions where there is danger of burglary
- The display screen must be protected by a fixed, transparent shield

Each TVM shall be equipped with a signaling and alarm system. TVMs shall be capable of surviving a kick or punch from a large adult acting in an irrational manner (acceleration pulses of 5 gravities peak value with approximate duration of 10 milliseconds along each of three mutually perpendicular axes) while the equipment is operating.

The signaling and alarm system shall be equipped with an electronic or mechanical siren capable of emitting a sound level of at least 110 dB(A) measured at a distance of three feet with the door open. This siren shall sound whenever unauthorized entry is detected or when severe impacts to the front door are detected.

An internal momentary contact switch, hidden inside the TVM but readily accessible, shall permit an authorized technician to trigger a "silent" alarm. When activated, this switch shall cause the TVM to notify the central computer system and/or SCADA, but not activate the siren.

12.15.0 CENTRAL DATA SYSTEM

All TVMs shall communicate over the most efficient communications medium available to a centrally located data system. The fare collection equipment shall report status, events, alarms, and other information when necessary. All fare collection equipment shall also be able to receive information from the central computer to update fare structures, ticket print layouts, patron display information, operating parameters, and to be remotely commanded to perform certain diagnostic exercises.

While the central data system will be installed in the revenue shops, remote workstations shall provide users access to the data for queries, report generation and status information.

One or more such workstations shall be at the maintenance facility.

12.15.1 Data Networking

Data communications shall be provided in a hierarchical network, with a central control computer at the top level, an Ethernet switch at the middle level, and the TVMs at the lowest level.

All TVMs shall be networked back to the central computer via Ethernet. RTD will make available one 10/100 Mbps Ethernet port at each station for communications over RTD's IP-based network between the station and the revenue shop.

Ethernet switches, cabling and connectors shall be provided by the Contractor to communicate between the TVMs and the RTD provided communications network. An SNMP capable, managed Ethernet switch shall be provided at the station with enough ports to accommodate twice the original number of TVMs.

All outdoor cabling shall be suitable for outdoor/wet installations. For cable runs greater than 75 meters fiber optic cabling and transceivers (suitable for the environmental conditions it is installed in) shall be provided. For shorter distances CAT 5 or 5e cabling is sufficient.

Five RU of rack space will be provided by RTD in the communications room for installation of the fare collection communications equipment.

12.15.2 Central Computer

The central computer shall be an IBM-compatible PC, suitably configured for the intended application. The computer shall be of a dual-server architecture, with the second server in a "hot" spare configuration.

To facilitate reduced maintenance costs the central computer shall be of the same manufacturer as used by RTD's corporate IT group.

12.15.3 Application Software

Application software shall permit the computer to simultaneously communicate with several stations, two or more users (on remote computers), and up to two financial clearing houses for credit/debit card authorizations should such an option be exercised. Application software shall utilize menu or icon-driven user interfaces. All access to application software shall be under strict password control.

12.15.4 Database Software

All transaction, event, sales, accounting, maintenance and other records shall be maintained in a commercially available relational database manager such as Ingress, Informix or Oracle. The database manager software shall be of the most recent version available at the time the system enters factory system testing.

12.15.5 Report Generation

The central computer system shall generate reports that shall enable RTD to analyze the fare collection system, revenues, trends, maintenance activities, security status and so on. All reports shall be available on demand, spanning any range of data stored (such as by date, station, TVM, ticket type, event type, etc.). Based on user selection, the computer system shall also generate reports automatically at programmed intervals (such as daily, weekly, monthly and quarterly).

In addition to those reports to be provided with the system, the computer system shall enable RTD to customize existing reports and create new reports using Structured Query Language (SQL) commands available from the relational database manager.

All reports shall be available locally on the computer screen, printed to any available printer, or on any other workstation networked to the central computer.

The system shall also provide line graphs, bar charts, pie charts and other common data presentation methods to represent summarized data.

12.15.6 System Status and Security Monitoring

The central computer system shall receive status information from the TVMs when by the unit. All event information shall be stored on the central computer and depending on the priority of the event, displayed on the central computer screen.

Alarm information, such as intrusion alarms, out of service conditions and other high priority events shall be displayed without delay regardless of other activities in progress on the computer system.

The central computer shall also periodically poll all stations for status, to insure that all station network interfaces (master TVM or station computer) are functioning properly.

The central control computer system shall maintain a current understanding of the complete system status and permit authorized workstation operators to view the status of all equipment by station and by individual component.

The abilities to place an individual TVM in service and out of service, cause a TVM to perform self-diagnostics, and reset the TVM shall also be provided from the central computer system.

The central computer system shall also monitor the status of connections to the clearinghouses for credit/debit card authorizations should such an option be exercised. In the event that all communication with the clearing house(s) is lost, the central computer shall inform the TVMs that credit card transactions are temporarily unavailable, and the TVMs shall act accordingly. Upon restoration of communication with the clearing house(s), the central computer shall so inform the TVMs.

12.15.7 Configuration Management

All configuration parameters of the TVMs shall be alterable remotely from the central computer system, including date and time, fare tables, security access codes, ticket printing formats, passenger display messages, in-service/out-of-service times, accepted types of credit/debit cards, etc.

12.16.0 SCADA INTERFACE

The TVMs shall report simple status and alarms conditions to RTD's SCADA system via dry contacts. The conditions and the responses are:

- TVM Intrusion Alarm (unauthorized entry) & (impact sensor activated)
- TVM/SAV Maintenance Alarm (inclusive of all maintenance alarms)
- TVM Revenue Service Alarm (inclusive of all revenue service)
- Silent Alarm. Activated (opened) whenever the silent alarm is initiated

The SCADA circuits shall be wired to the TVM relays so that any cable fault (such as intentional cutting the wire, forcible removal of the TVM or just a simple break in the cable) would be detected as an alarm. The TVM/SAV Maintenance Alarm should also be constantly powered (in the closed position) so that any loss of power will open the relay and trigger the alarm. In cases where there are multiple TVMs at a station, one TVM shall be designated as the Master TVM. The other TVMs shall have their SCADA contacts terminated in the Master TVM. The Master TVM will report to the SCADA system one master alarm per location.