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PARKING REVENUE CONTROL

subject area
53 traffic control and operations

FOREWORD

Many parking development programs, both public and private, are planned and executed with the expectation that user fees, i.e., parking charges, will offset the construction and operations costs and perhaps accrue excess funds for profit or the support of other projects. Many such projects are also adjunct features of major business developments and often are treated as relatively unimportant but necessary subsystems. Failure to give careful attention to the selection, design and control of parking revenue systems, however, practically assures financial losses which can be of considerable magnitude.

As these facts repeatedly surfaced in deliberations of the Parking and Terminals Committee, it was decided that a subcommittee should be asked to develop material based on members' individual and collective experiences for publication in the hope that others could avoid costly mistakes.

The major portion of the work was done by subcommittee chairman James M. Hunnicutt, who acknowledges a substantial contribution by Norman Goldman and helpful suggestions from several A3E01 members who reviewed the text.

This Circular is designed as a supplement to Special Report 125, Parking Principles.

INTRODUCTION

Parking revenue control is a combination of procedures and equipment designed to guarantee that the total funds from a parking operation are accounted for and deposited in the bank. This simple task requires thoughtful consideration, good procedures, a reasonable amount of proper equipment and supervision on a daily basis to ensure that all procedures are carried out. Without such sound business practices, there is a likelihood that a substantial portion of the parking revenues can be lost.

Unlike many other retail service industries, parking deals mostly in cash and by its very nature doesn't particularly lend itself to highly accurate record keeping and personnel surveillance. Loopholes in operating systems and lack of proper equipment and supervision may tempt employees to pilfer. It has been estimated that 15 to 20% of the total annual parking income in the United States is stolen by employees.

This report describes some of the fundamentals of equipment and procedures which should be considered when planning a new parking facility or establishing a good system of control in an existing one. The report also covers parking meter revenue security and control. Nothing in the report is intended to be critical of any particular type of operation, although some will be observed to be better than others.

FUNDAMENTALS OF REVENUE CONTROL

History

Toll collection and the associated problems in revenue control are as old as history itself. It is said that the gates through the Walls of Jericho contained toll collection stations. Charges to cross bridges were also known in early Roman and Greek times. During the Middle Ages, toll roads were first established and problems of revenue control were evident. In twelfth and thirteenth century England, there are records which indicate that toll collectors were severely punished for stealing. Severing of hands was one of the more severe punishments meted out to dishonest toll collectors.

The problem increased in the 1920's. By this time, highway construction was booming. While few toll roads were being built, literally hundreds of toll bridges were. The majority of these bridges were financed with bonds to be retired from the charges assessed against users.

Initially there was no counting equipment or other system of registering the tolls, giving rise to an old adage, "One for the bridge, one for me." Some bridge toll collectors became wealthy men who refused to retire when their time came up. Some offered to stay on after retirement at no pay.

By the late 1920's and early 1930's, several U.S. firms began developing toll auditing equipment for toll roads and bridges. They tried to outwit the toll collector by anticipating every method of theft, in order to offset it with some type of monitoring and auditing equipment.

The parking industry is relatively new in the revenue control business. When facilities began to get larger and the amount of money increased, accounting for funds and tickets became essential. By the middle 1950's, the first specialized revenue control equipment began to appear. Today a number of companies produce many varieties of individual components and systems to accomplish almost any specific job.

Not only should the larger garages be considered candidates for control equipment, but also small parking lots should have at least a modest complement of control equipment designed to match their particular operation.

Why have revenue control?

Newspaper reports of parking revenue losses through employee thefts are not uncommon, and indicate a strong need for revenue control. In addition, there are undoubtedly other cases where employees are fired or transferred without attendant publicity.

Airports are the biggest parking revenue producers and some of the largest losses occur at these installations. A major airport found several years ago that one employec had stolen more than \$350,000 in a period of only a few months. Another airport estimates that their loss each year due to thefts approaches one-half to three-fourths of a million dollars. At one airport eight employees were indicted when they were apprehended stealing. The total loss was estimated to be about \$875,000.

While the large thefts which receive considerable notoriety are often detected, day-to-day pilferage is most difficult to detect in all sizes of operations. A complete audit surveillance was conducted on a downtown mid-western city parking lot several years ago. The manager had been with the parking firm more than fifteen years and was considered to be their best man. A tally of the day's receipts when compared against the amount that should have been received was off more than 25%.

Providing equipment to maintain employee honesty is a major consideration, but patron honesty is also a major problem. Some will try many methods to avoid payment of parking charges and if the system is lax in this respect, substantial funds can be lost. To some patrons, any system of control represents a challenging system to be defeated, if possible, and this is particularly true of electronic systems. Parkers will mutilate tickets, destroy or throw away tickets, swap tickets, alter tickets, vandalize equipment, exit through unauthorized points and work in collusion with other parkers and employees to "beat the system." Good operating procedures and record keeping can stop much of this type of loss. Procedures for handling lost tickets, patrons without funds and similar occurrences can catch repeaters and make it so difficult that it discourages others.

In addition to its anti-theft function, revenue control equipment is useful for administrative bookkeeping, employee records, payrolls for tax purposes, and other needed reports. These operations can become extremely costly and time consuming without some automatic record keeping equipment.

Basic Elements of Revenue Control

If an accurate record is to be made of parking operations, certain fundamental data and controls must be available. Without these, it is very difficult for the supervisory personnel to make any judgment as to what is wrong and who is responsible. One of the real challenges for a supervisor is the knowledge that money is disappearing, but it is not traceable to a specific employee. In any parking operation, the following is a list of elementary steps that must be taken:

1. There must be an accurate count made of all vehicles entering and leaving. There should be no way to get in or out of the parking facility without being counted, even for officials and employees.
2. No one should be allowed to enter the parking area without taking a ticket to be surrendered when he leaves. A hard copy record must be left in the cashier booth, or a positive vehicle registration count made with some type of recording equipment.
3. All clocks within the system must be operated accurately and in conjunction with each other; they must be designed in such a manner that no unauthorized person can reset them.
4. There must be some type of validating device, cash register or fee calculator to record all outbound transactions. The ticket must be stamped with all appropriate information so each cashier can be held responsible for his transactions.
5. The ticket issuing machines must be operated so that it is impossible for anyone to get more than one ticket. Future supplies of tickets must be kept in a safe place.
6. Parking gates or other devices must be used to prevent cars from entering through an exit or exiting through an entrance.
7. A display of the charge should be made visible to the parking patron.

General Security Concepts

There are a number of common ways parking thefts occur. The cashier disposing of a ticket and pocketing the money, resetting time clocks, ticket switching, lost tickets, quartering, ticket substitution, equipment vandalism and altered records are some of the more common ways parking losses occur.

In addition to relying on equipment, several general concepts can be helpful in the problem of revenue control. The biggest problem is the individual cashier in the booth and how to keep him honest.

In planning a parking garage or parking operation, definite and early thought must be given to how the revenue control system is to be installed and how it is to work. Architects seem generally to have little or no concern with this, and often physically design the building so that it is almost impossible to install a system to maintain cash security. Strange as it may seem, many owners hold the opinion that revenue control is the problem of the operator and they are unable to realize that it is their money and not his that they're trying to protect. The owner should insist on a good revenue control system designed specifically for his operation and made to protect his money!

The parking operator should not be allowed or required to install the equipment. The control equipment should be made part of the garage. Often the parking operator has been awarded a contract on a competitive low bid situation and he cannot be expected to install relatively expensive equipment in someone else's garage and take it with him when he leaves. The revenue control equipment should be made part of the original building just like the lighting or plumbing system and should be designed specifically to protect the owner and to assist the operator in doing a better job.

When equipment is installed by the owner of a garage and the operation is leased, there must be a definite provision in the agreement to assure that the operator will use the equipment in the way it was designed.

Agreements between owners and parking operators should be drawn to ensure hiring the best parking operator rather than the cheapest. The cheapest and the best are not synonymous. Owners who seek the highest dollar guarantee plus percentages should realize that such provisions may effectively reduce the incentive for the operator to provide an additional man or piece of equipment. Indeed, the parking operator can actually lose money by providing a better operation that will save the owner substantial money. This type of agreement is not in the owner's best interest and he should realize it.

Hiring good employees in a parking operation is not as difficult as it sounds. Retirees make excellent parking cashiers and their honesty record is usually higher than younger people. Some of the best employees are the physically handicapped. Sitting in a cashier's booth all day requires little or no physical exertion and these people make excellent employees and have good security records.

A good set of procedures for employees should be developed. Some of the better parking operations have employees manuals which explain, in detail, how each type of common occurrence is to be handled. This includes lost tickets, patrons without funds, emergency vehicle and similar incidents which occur occasionally. If proper procedures are spelled out in good, plain, common sense language, the employee has no excuse if he fails to carry out instructions.

Finally, a parking operation with the best designed control equipment and procedures can be worthless unless someone uses the data supplied by the equipment. The equipment only provides information which serves as a tool to assure honesty. If the output of the equipment is not used for checking, tabulation and cross checking against tickets and cash, then it serves no purpose.

REVENUE CONTROL EQUIPMENT

Parking equipment is primarily designed to reduce manpower, work more quickly than hand labor and handle large operations where there may be high volume with many entry and exit points. Some of the equipment is fundamental and may merely replace a function done in the past by a parking attendant. A good example is the ticket issuing machine (Figure 1). Other equipment provides security. These are barrier items such as parking gates. There is a complete family of equipment for monitoring employees and auditing.

In large garages, similar to those found at airports, convention centers, etc., thousands of parkers may come and go daily and the garage may have as many as 50 to 100 employees. It is simply not possible to keep a reasonably accurate audit of individual employees and funds by means of hand tallies, ticket counts, etc. with any degree of accuracy. High speed efficiency of operation is absolutely necessary, as is some way to automate bookkeeping and to supervise employee honesty.

The basic equipment normally used in parking operations varies from location to location, size of the facility and the individual job the owner wishes to have done. The advent of the computer and mini-computer is beginning to have a major effect on parking and its related equipment. Monthly billing for various customers based on the time used, validation, fee calculation, remote auditing and other jobs are now possible with the computer that before would have required several people.

Listed are some of the major components and how they operate. Many of the components are used in the most sophisticated systems and in some of the most elementary also (Figure 2).

Ticket Issue Machine

The ticket issue machine replaces the issuance of tickets by the parking attendant. This machine is placed on the driver's side of the entry lane into a lot or a garage. When a vehicle approaches, after actuation, the machine issues a parking ticket to the driver. The driver takes the ticket from the machine and proceeds into the parking facility (Figure 3).

A ticket machine normally holds 1,500 to 2,500 tickets.

Tickets issued by the machine vary widely in configuration and use. Most machines issue a paper ticket stamped with the time and date of entry and in the case of a large facility, possible entry lane of issue. Some machines issue plastic cards or plastic ticket stock.

In the case of computer operations, it is necessary to print the time and date on the ticket in a coded form for the computer to read. It is also necessary to have entry information printed visibly on all computer readable tickets to confirm entry time in case of question or computer malfunction. A variety of methods are now being utilized so the ticket can be machine readable. Some tickets are punched with holes which must be sensed by a card reader and the code transmitted to compute the parking charge (Figure 4). The computer reads the time of entry, subtracts from the time of departure and computes the elapsed time and fee. Some parking tickets are embossed with a bar code to indicate the time of arrival. This bar code is similar to those used on plastic credit cards. The sole purpose of the code is to record in computer readable terms the time of entry and possibly the location and parking rate.

Figure 1. Automatic issue machine. Many variations of this type of device are available to encode a variety of data required in a particular operation.



Figure 2. For a larger garage, these are the typical components for operation and audit. Usually a small room near the garage office is provided for the equipment.

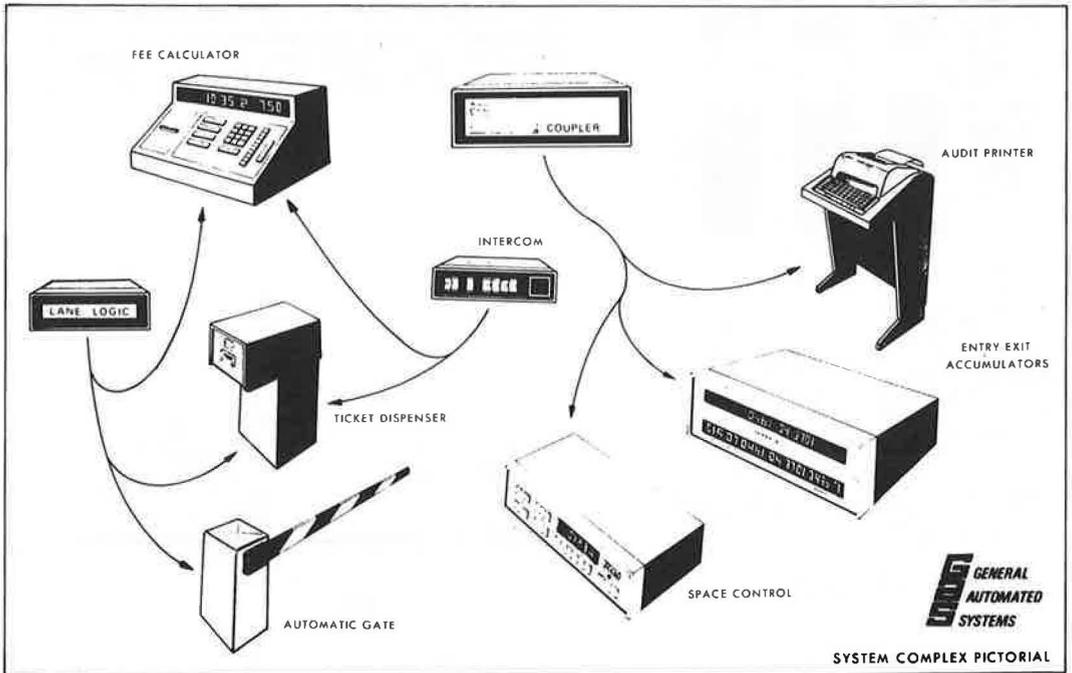


Figure 3. Automatic ticket issue machine and gate. The ticket machine is actuated by a loop detector to issue a time stamped or encoded ticket. The gate raises on removal of ticket from machine and the gate closes after vehicle leaves the entry lane.

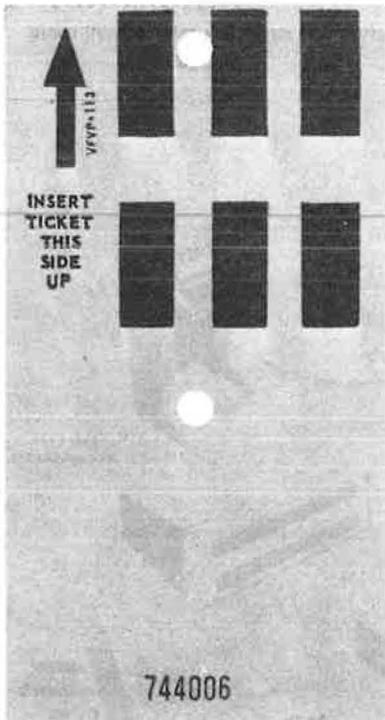
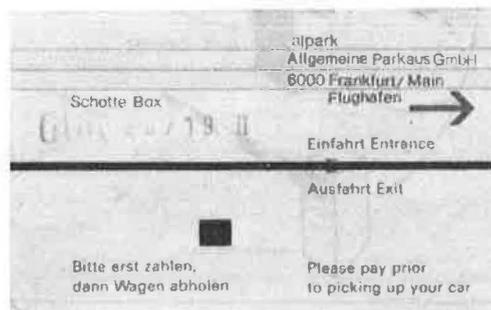


Figure 4. (a) Entry data are encoded in magnetic ink here. This ticket is primarily for patron use where the parker inserts it at the exit, the machine tells him the parking cost, and the money is inserted in the machine. Once satisfied, the gate raises to permit exit. (b) Automatic ticket used in Europe where entry time and date are encoded in the magnetic ink stripe. Time, date, and location of ticket machine are shown. This is used at the Frankfurt Airport.

(a)



(b)

The previous two types of tickets are less commonly used than the magnetic tickets. Since a ticket with punched holes can be mutilated or changed, and a bar coded ticket mashed, either can be made difficult to read. The magnetic ticket does not have this particular problem. Magnetic tickets come in several different styles. Some have the entire back covered in a magnetic substance which is encoded with the entry information. Others have a single strip of magnetic tape or ink in which the information is encoded (Figure 5). The width of the magnetic ink or tape varies from a sixteenth of an inch to one inch based on the design used. Encoding into the magnetic sensitive ticket is done by bar codes, binary and alpha-numeric depending on the type of equipment used.

VEHICLE DETECTORS

The purpose of a vehicle detector is to register the presence of a vehicle for the purpose of counting it and/or sending an impulse to another machine such as a ticket issue machine or a gate. Two major types of vehicle sensing devices are commonly used.

Induction Loop Detector

Probably the most commonly used detector is the loop detector because it is quite accurate and relatively inexpensive. As a car approaches in an entry lane, it passes over a loop of wire buried in the entry lane pavement. This loop is normally rectangular and approximately 3' x 8'. The wire itself is similar to ordinary lamp wire and it is coiled. Most commonly it is installed by sawing a slot in the pavement, placing the wire in the slot and covering it over with some type of sealer to keep it in place.

The loop wire is connected to a small amplifier which is connected to a power source. The loop carries a low voltage current. When a vehicle enters the loop area, it causes a measurable change in the inductance of the loop circuit. This change is amplified and produces the signal that is transmitted to the desired location.

Under most conditions, the loops are quite accurate for counting and impulse purposes. In some cases where two-way directional counting is required, two loops are buried together and placed in sequence. Logic within the amplifier can determine in which direction the two loops are actuated and transmit its impulse accordingly.

Treadles

Treadles are one of the oldest methods of counting and one of the most accurate. A rubber treadle plate is mounted in a metal frame placed in the approach roadway. Electrical contact points in the treadle are closed by the weight of the car as it passes over the treadle. Treadles can have directional or non-directional sensitivity.

It is difficult to make a properly installed and maintained treadle give an inaccurate count since it requires approximately 400 pounds of pressure to actuate it. Treadle accuracy is not changed in a bumper-to-bumper situation. As treadles can be extremely accurate, they are commonly used when large amounts of money and very accurate counts are necessary. Treadles cost more than loops and are more difficult to install.

When highly accurate counts are required, loops and treadles are used in a logic system. A loop on either side of a treadle can be designed to provide positive counts and detect cars that may back out of a lane, attempting to remove a ticket without entering the parking area, or any other non-standard vehicle behavior at an entry or exit lane. It is extremely difficult if not impossible to defeat this type of lane counting, while it is possible to do so with only a loop or a treadle alone.

Road Tubes

For secondary locations where revenue control is not critical, actuation of a rubber tube placed on the road surface can be used. It is anchored by brackets or metal frame. As the vehicle runs over the tube, air in the tube is forced against a small diaphragm. The force against the diaphragm generates an electrical signal which is transmitted to the control equipment. This type of detector cannot be used in low security areas since it is possible to actuate it by jumping on the tube. They can be ineffective if covered by snow and can be torn out by braking or accelerating vehicles.

Parking Gates

Along with the ticket issue machine, the parking gate is one of the most commonly used devices (Figure 3). It prevents movement into or out of a facility until a proper actuation opens it and lets the car pass. Basically the device is a metal cabinet containing an electric motor, necessary electrical connections, a belt or drive system and a gate arm. In an entry lane configuration, the removal of the ticket from the issue machine actuates the mechanism to raise the gate arm. As the vehicle passes over a detector placed beyond the gate, the second detector sends a signal back to the gate mechanism to close it.

For outside locations, 7 to 10 foot wooden gate arms are usually used. In garages, where restricted head room does not permit a long gate arm, folding arms are used. When the gate goes into its raised position, the gate arm folds. It returns to its normal extended position when retracted.

Time Clocks

The time clock is normally found at the exit booth. As a customer leaves the parking facility, the attendant places the ticket in a time clock which stamps the exit time and date on the ticket. The attendant determines the elapsed time between entering and leaving and computes the charges. Some clocks work on military or 24-hour time, some stamp a consecutive transaction number, most stamp only the outbound time.

Some time clocks are fitted with rate computing dials or clock faces which reduce the possibility of miscalculated tickets. The clock is fitted with a special face which, at a glance, determines the elapsed time and parking fee (Figure 6). For instance, if a parker leaves a facility at 1:00 in the afternoon and entered at 8:00 in the morning, the attendant would look at the arrival time on the clock face and next to 8:00 would be shown 5 hours and the fee for 5 hours would be under the time.

Master Clock

A master clock is an essential part of a system having a number of major components. Since the ticket issue machines, outbound clocks and auditing equipment are all based on time, it is imperative that all clocks within the system use the same time. Differentials in the time from one system component to another could mean revenue losses and inaccurate records.

Fee Indicator

The fee indicator is a device which displays to the parker at the cashier's booth a graphic picture confirming the parking fee (Figure 7). These are illuminated or mechanical signs with a phrase such as "The amount you paid was \$3" or whatever the parking charge actually was. The charge is displayed in a variable matrix configuration. The fee indicator is connected to some other device, usually a cash register in the cashier's booth. Whatever numbers are punched into the cash register or read by the computer are displayed as a confirmation of the fee charged.

The main purpose of the fee indicator is to reduce parking receipt thefts by the cashier. If the attendant were to inform the parker that his correct parking fee was \$3 but register only \$2 on the cash register, this would be evident to the parker. Such a procedure, if undetected, would leave the attendant free to pocket one dollar and deposit the remaining two dollars in the cash register.

Differential Counters

In almost any busy parking facility, for operational purposes, it is imperative to know at all times how many cars are parked. Once a parking facility begins to reach capacity it becomes necessary to close it rather than to let additional parkers enter when there is no place for them to park. In large garages with multiple floors or separate parking areas, it is also necessary to know how many cars are parked in each location. Illuminated signs can be actuated automatically to direct motorists to other locations within the garage where spaces are available. This reduces unnecessary internal driving and congestion.

Differential counters keep a count by adding one for each car that enters the facility and subtracting one when a car leaves. The differential count represents the total vacant spaces remaining. For a total facility net count, the impulses for the

Figure 5. Type of ticket now being used at several airports. Entry data encoded in magnetic ink and repeated in man readable form at lower left. After processing, at exit lane, audit data are printed at lower right.

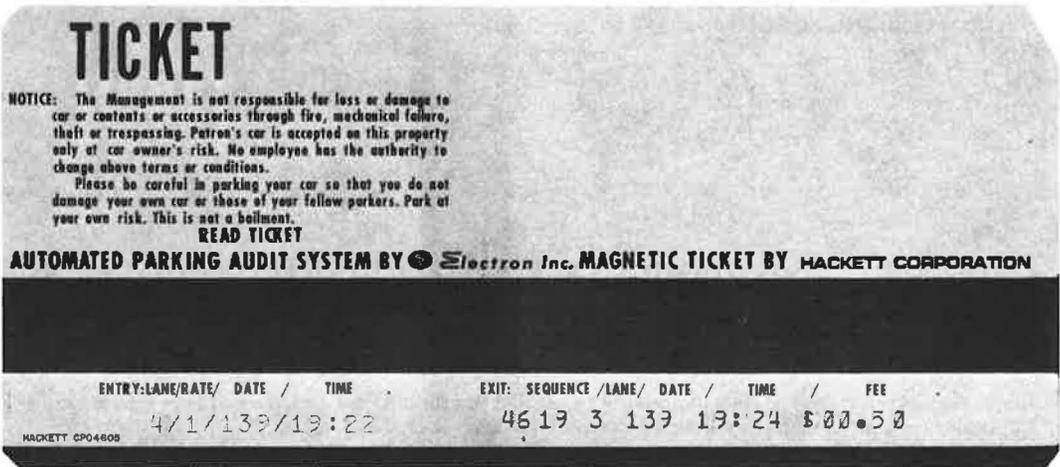


Figure 6. Clock used for calculating parking charges.

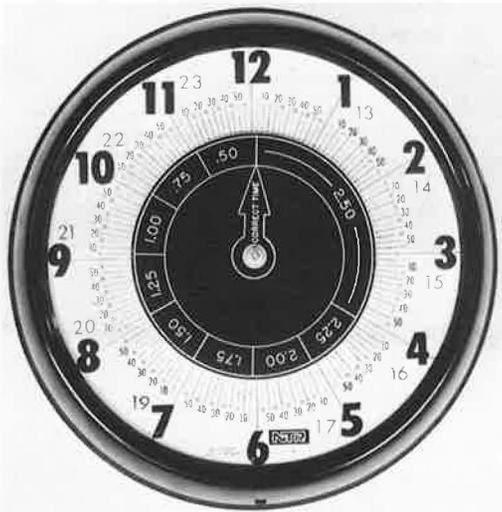


Figure 7. Automatic fee indicator. This device is connected to the fee calculator or cash register. In the case of the fee calculator, it informs the patron of the fee due. For a cash register, it represents a confirmation of the amount recorded.



Figure 8. Special ticket used where a patron may be without funds. It is very important to have a good record of exceptions since many thefts can occur by cashiers fabricating erroneous data.

EXCEPTION TICKET

LOST TICKET

INSUFFICIENT FUNDS

NON REVENUE, I.D. # _____

MUTILATED TICKEY

UNREADABLE TICKET

AUTHORIZED BY _____ CASHIER _____

AUTOMATED PARKING AUDIT SYSTEM BY  Electron Inc. MAGNETIC TICKET BY HACKETT CORPORATION

ENTRY: LANE/RATE/ DATE / TIME	EXIT: SEQUENCE /LANE/ DATE / TIME / AMOUNT
2 1 130 12:00	4621 3 139 22:03 \$22.00

HACKETT DPO4607

counters are normally from the detectors used to operate the ticket issue machines and count receipt transactions at the exit points.

Floor and differential counts require additional in and out floor detectors. When a differential counter determines that the parking facility is full, it can illuminate a FULL sign and simultaneously lock the entry lane ticket issue machines and gates to prevent additional parkers from entering.

AUDIT PROCEDURES

It is imperative that each cashier on duty be held completely responsible for his own operation. The cash register, validating equipment, cash drawer or whatever type of operation is used, should be locked and completely inoperable when not in use. Each cashier should be issued a coded key or identification card with his cashier number. When the cashier goes on duty, his key is inserted into the booth equipment switch, and turns it on. The audit recorder notes the time the equipment was turned on, the date, the lane number, the cashier number and any other program symbol or other actuating code for the computer or recorder. As the cashier begins operation, data are fed into the recorder or computer and held in memory or storage for a specified period, usually one hour. At the end of one hour, a summary of all data is printed out. The data can also be held in summary form within the memory and can be displayed on a cathode ray tube or handled in any other way desirable depending on the program used.

At the end of a time period, usually on the hour, the computer or equipment prints out a summary of all activities of the garage or parking operation. For each individual exit cashier, a print out is made of the time and date, each lane that is open, the total number of vehicle or vehicle axles going through each lane, the total number of transactions the cashier has recorded on the cash register or other devices and an accumulative total of the amount of money collected. This allows a supervisor to check the proper amount of money in the cash drawer. The number of vehicles counted in the exit lane must correspond to the total cashier transactions registered.

In any major parking operation, exceptions take place which are difficult to arrange for in advance. The more common problems are: patron without funds, lost ticket, mutilated or unreadable ticket, emergency vehicle, etc. When these incidents occur, usually a written form must be filled out and blank ticket stock is used to record the transaction which is then checked by the supervisor (Figure 8).

Since these exceptions are a source of possible loss, they should be entered immediately and recorded by the computer or audit control. When registered by the cashier, the audit control registers the time of the transaction, the cashier on duty, the lane, a coded number and letter for the type of exception noted, the amount of money received and the cumulative total of money in the cash drawer and the transaction number.

There are many other safeguards which can be installed in the cashier booths to prevent thefts. In a large office building complex, airport or similar facility, there can be many different types of parking transactions which must be recorded accurately not only for cashier security but possible billing of monthly accounts. In some cases provisions must be made for deliveries within the garage, short-term and long-term parkers, validations, prepaid parkers, employees and rate changes after certain hours. Each application should be designed specifically to meet the individual situation.

Equipment is now being used where all cashier, entry and exit information is recorded on punch paper tape or magnetic tape and transmitted by teleprinter to a central location for complete auditing and billing. If this procedure is followed, it is essential that accurate, up-to-date information be available at the facility. This is necessary so that the supervisor can make an evaluation at any time. When the information is transmitted to a central computer some distance away, it may be some time before it is printed out and returned. This information lag could make it difficult to keep an accurate check on employee honesty.

PLANNING A REVENUE CONTROL SYSTEM

Operating hardware such as gates, ticket issuers, detection systems and counting devices can be likened to the visible part of an iceberg. The data originated and transmitted by this equipment must be accumulated and organized into an accounting format for presentation to the "back office." It is as important to establish the "back office" needs and the system to serve those needs in the original planning process as it is the operating hardware. Without well designed forms and procedures it is possible to lose important information and therefore dilute the efficiency of the system.

Accounting and finance departments should be represented in preliminary systems design meetings to coordinate with operating departments for a well-rounded system. These departments ultimately inherit the responsibility of checking accounts, maintaining security and auditing the system output.

Statistical information derived from proper format is invaluable in planning present and future personnel requirements, structuring rate schedules and changes, and charting occupancy rates. This information can be derived as a by-product of the main system and planning for it should not be overlooked. The system should be designed as soon as parking characteristics are established and points of ingress and egress are determined. Planning should be a joint effort of the architect, engineer, parking consultant, financial and security office, and possibly an equipment system or component manufacturer.

Basic Requirements

Regardless of the type of facility to be controlled, one all-important principle must be observed: for every vehicular movement past a control point there must be a manual or machine verification of that movement. Speed and character of transaction will differ with specific types of operation.

This has been a general description of factors to consider when planning a revenue control system. To assure that the system is comprehensive in scope and within the proper operational criteria, and since elaborate systems are costly and difficult to maintain, the services of qualified consultants may prove beneficial.

Airports

Airports require a system which can rate tickets ranging from short-term to long-term with a minimum of delay. The loss or miscalculation of the rate on one long-term ticket results in a substantial loss of revenue from just that one car. No other facility processes single tickets with as high a value as airport parking. Speed of transaction and accuracy are extremely important. Therefore, the greatest use of computerized systems at these facilities is required.

Because of the number of exit lanes in operation at one time and the personnel required to operate airport parking facilities, the cashiers are usually identified by code as they open and close a lane. This identification combined with the computed rates and stored information provide airport authorities with detailed verified tour of duty information automatically. Additionally, through the utilization of the computer memory, traffic can be directed to available spaces by processing vehicle counts through a differential counter bank in the computer.

The high cost of central processing units coupled with the technical problems of data transmission, has resulted in installations designed around comparators or small individual lane units. While the memory capacity is reduced in these units, they are still functional and extremely economical. Larger data processors may share time with functions other than parking in order to be economically feasible.

Event Parking

Event parking characteristics of vehicular movement such as at sport stadiums, arenas and convention centers may make it impractical to collect revenues from exiting vehicles. Entering vehicles load the facility over a time span starting an hour or more prior to the event. When the event is over, drivers leave the facility in a much shorter time period. To attempt collection from the vehicles at exit would create a monumental traffic jam and cause severe operational problems. As there generally is a single rate for specific parking areas, collection points can be established at the entries to each area and personnel stationed there at the times of entry. All the lanes do not have to be opened to accommodate early arrivals, rather lanes can be opened as the traffic requires.

In event parking, the most important equipment function is accurate vehicle counting as one vehicle count corresponds to one flat fee collected. Recording of these counts by lane and by collector provides the required audit information. Collectors must recognize or validate each transaction by depressing a "fee collected" button which, in turn, activates a counter. The total of counts from this transaction counter is compared to the vehicle counts from the lane detection equipment for audit purposes.

Buses, taxi cabs and special vehicles should be directed to specific areas through special lanes if possible. If this is not possible, transactions must be made at collection points and refund tickets or passes issued to be re-collected when leaving. When the event has concluded, all lanes are opened for the exiting traffic. As there is no need to collect fees or conduct transactions, it is not necessary to have cashiers stationed at the lanes. Collection at entry enables personnel to be reassigned or dismissed after the event has begun as only a few lanes need to remain open for late comers.

This event parking procedure applies to locations where there is no overlap or conflict with normal daily parkers. If event parking is in a downtown area and daily parkers may still be in the facility, a modified procedure is used. This is called precashiering. As the event parker enters and pays his flat fee, he is given a receipt or other type of pass to present to an attendant when leaving. Other daily parkers in the garage do not have such a receipt and must pay their fee in the usual manner when leaving.

Retail and Business Parking Facilities

Downtown commercial facilities serving shoppers and workers are confronted with the greatest problem in controlling all types of parkers from short-term to long-term transients to monthlies and validation or discount parkers. Within the overall operating system there must be subsystems to account for each category of parker and the subsequent verification of transactions. Additionally, depending on the functional design of the facility, it might be desirable to have up to the minute capacity counts available for these categories. Unfortunately in commercial facilities, operating systems often are short changed by the designers or developers as the cost is usually the last to be allocated. Funds are applied to aesthetic considerations and taken from operations although the income from the parking facility will continue for the life of the building and a comprehensive system is the only way this income can be assured. Commercial systems must be built with accurate counting or detection devices regardless of the category of the parker. Accuracy in the space available or differential counting subsystem is extremely important as unfilled space or the lack of knowledge of vacant spaces translates to a loss of potential revenue.

Particular attention must be paid to the systems controlling revenue and non-revenue parkers. It should not be possible for a patron or cashier to switch tickets or classify a revenue vehicle for a nonrevenue transaction. A transaction that takes a few seconds longer to complete is certainly more desirable than a loss of revenue from a classification switch.

One method of assuring proper classification is by use of the ticket system. This means that every vehicle entering the facility is issued a ticket, however, the card holder or monthly parker must insert his card into a reader located in front of the ticket issuer. This will cause a ticket to be issued without a time and date stamp while transients are issued a ticket with the entry time and date stamped on the face. At the exit the cashier collects money for each time and date stamped ticket and validates the transaction in a cash register entering the appropriate classification type and fee collected. Non-time stamped tickets turned in by monthlies are accompanied by their credit cards. The cashier inserts the card into a reader to determine its validity and then validates the non-time stamped ticket in the cash register thereby removing it from circulation. A check of all monthly tickets will assure that no switches have taken place by looking for the entry time stamp.

An alternate method is to employ the cycling card system. This is a system which encodes on the card the fact that it has been used at an entry and must be used at an exit to neutralize the entry code. This eliminates the need for monthlies to take tickets and therefore, the only tickets turned in at the exit are cash transactions. To insure collection of monthly parking fees, the card readers are multi-period and the codes are changed periodically. Four period readers are usually used in the following manner: Cards are issued upon payment of the fee during the first two days of the month in the code period set in the reader. The following month, cards are available

the last three days of the previous month and the reader is set to accept cards coded with the first and second months code. The first month's code is removed from the card reader two days into the new month. When the fee is paid for the new card, the old one is returned. This cycle continues for four months. In the fifth month, the first month's codes and cards are reissued. A deposit in addition to the first month's fee is paid and forfeited if one card is not returned.

Parking facilities constructed for a single purpose such as employee parking, are relatively simple to control. The main point is to keep unauthorized personnel from entering and to eliminate employees from passing cards to one another. Again by using the cycling card system, the switching of cards can be eliminated as a card used at entry cannot be used for another entry until it has been used at exit. Visual inspection can be an additional control if all card holders are issued decals to place on their vehicle. Any vehicle not having a decal is cited and the employee is issued a warning.

Validations on parking tickets are sometimes given parkers who patronize certain stores, restaurants, etc. and the reduced rates or free parking is underwritten or paid for by the participating merchants. The patron's parking ticket is usually given an adhesive stamp, rubber stamped or impressed with a machine readable magnetic ink from a stamping device. The validations must be recorded manually on the cash register or tabulated in the ticket reader so an accurate count can be made of the validations. Good validation procedures are important since removal of adhesive stamps and placing them on other tickets to reduce the value of those tickets can be a source of lost revenue.

PARKING METER SECURITY

Introduction

The collection problems and security of parking meter revenues are different from other types of cash control because it is impossible to know for sure exactly how much money has been collected since it varies continuously. However, through good procedures and equipment, it is possible to keep the probability of revenue loss to a minimum.

The security of parking meters is broken down into two major areas. The first is external: keeping the money in the meter as secure as possible until it is collected. The second is internal: the security of the money from the time it is taken from the parking meter until it is deposited in the bank.

External Security

Parking meters have undergone great change since they were first placed into use during the middle 1930's. From the early days of light weight housings with simple clock mechanisms, progress in meter development has resulted in a variety of general and specialized designs to overcome particular problems.

Types of Vandalism

Parking meter vandalism may be malicious destruction for which the theft of funds is not the primary objective. Damage is inflicted on the meter or the standard. The most sturdy construction is probably the only defence against this kind of vandalism.

Another type of vandalism is the destruction or damage which occurs when the main intent is to steal the money. With parking rates increasing steadily, the amount of money in a meter can be substantial and tempting to a potential thief. With this situation it is desirable that meters be as vandal resistant as possible. Nearly every city has specific areas where the meters are more prone to theft and vandalism than others. Therefore, it is possible for the city to use several different types of meters, some more resistant to vandalism than others.

The Meter Housing

Most new meters on the market have been well engineered and meet the requirements for good design and operation. Yet, many cities have old meters that have been on the street for years and are quite easy to break into. A parking meter should have predominantly rounded surfaces with tight fitting doors and access points. It should be designed so it is almost impossible to insert items such as screw drivers to pry on the door against another part of the meter. There should be no exposed screws or pins that can be driven out or removed. The area around the lock should be hardened steel

construction which is resistant to drilling,

New improved vandal resistant meters have a standard meter mechanism combined with a vault-like device which holds the coins. The vaults are usually heavy malleable iron or similar construction. It is essential that heavy blows with a sledge hammer only dent the vault rather than shatter it. The design of the meter should be such that all monies going into the vault will be inaccessible if the meter mechanism is broken from the top of the vault. Vandals must not be able to "fish-hook" the money up from the vault if they destroy the top of the meter.

Keys and Locks

Good security requires a good lock with a key which is difficult to duplicate, and several different types of these keys and locks are available today. No key is immune from duplication. No large meter system should have all meters operated on the same lock and key combination. The lock should be designed so it can be quickly and easily changed in the field to a different key combination whenever desired. This type of action should be done periodically, but particularly when a parking meter is stolen or a key disappears.

Collection System

The coin collection system is critical. The system should be designed so coins go directly from the parking meter into the collection device with the collector never having access to them. In years past, meters had open-type coin containers which the collector removed from the meter and dumped into a cart. This type of system invites pilferage since a collector has unlimited access to the uncounted funds.

Several systems are available which provide a much higher degree of security. One system is a locked collection cart which is rolled to the meter. The meter coin box has a special top which, when inserted into the collection cart, releases the coins into the cart. The collection cart and the money container have matching male and female connections which release the money only when they are connected over the collection cart.

A similar system consists of a collection cart rolled to the meter and connected by a flexible hose to a similar fitting in the meter which, when turned, releases the coins into the collection cart. Another system has a long vacuum hose connected to a collection truck driving down the street.

Another system is one in which each meter has two coin containers. One container is in the meter with the money and the collector has a duplicate empty one. When the collection is made, the locked container with the coins is removed from the meter and an empty one is installed. The collector may carry a tray of 100 or more coin containers which are taken to the bank or other location for emptying and counting.

Separate Compartments

Most meters are designed with different compartments which separate the money from the timing mechanism. The separate compartment meter should be designed so it is almost impossible for the meter serviceman to get to the coins if he does not have a collection key. Normally the repairman is not given the key for collection of the coins. The track that directs the coins from the slot into the collection box should be such that it is very difficult for the repairman to block it and come back later to pilfer coins backed up in the slot.

Parking Meter Standard

Theft of an entire meter or meter and mounting pipe permits a thief to take the meter to another location and break into it at his leisure. Theft of an entire meter may also mean that a thief wants to get the lock so he can make a key.

Normally, parking meter pipes are inserted in sidewalks or the area between the sidewalk and curb and poured with grout or other materials to hold them fast. Pipe that has been restraightened or subjected to street vibration has a tendency to become loose and can be easy target for thieves. To prevent this, a metal rod or pin can be inserted through the pipe cast into the concrete to hold it securely.

Cutting off a parking meter standard with pipe cutters presents another problem. In locations where this happens, it is possible to use a pipe within a pipe technique. A slightly larger diameter pipe is slipped over the supporting standard and the outside

pipe is free-turning which makes it almost impossible to cut.

Internal Security

There are ways money can be diverted from the city or authority by internal personnel. This type of theft can be the most costly and difficult to detect. If undetected, it can go on for years and even though the amount may be small, it is continual and over the long run can be very expensive. There are a number of ways these thefts occur.

Maintenance or Servicemen

As mentioned earlier, some meters without locked coin compartments leave the coins available to the serviceman. He can remove a few coins at a time and hardly ever be detected. Some servicemen plug up the coin shutes and come back later to take out the coins before they drop into the locked coin compartments.

Key Security

Control of parking meter keys must be extremely tight. An operation that has lost or misplaced keys, keys left in the custody of collectors or given to other people for various reasons will probably have very weak cash security. A close record of every key should be kept and its location known at all times. The office should check out the keys and they should be brought in every night and locked up securely and reissued in the morning.

After many thousands of lock openings, keys wear out. These worn out keys should also be closely guarded until they can be disposed of safely. Disposal of keys by total destruction should be handled by a highly trusted employee or by the director himself.

Collection Procedures

A positive type collection system where money does not come in direct contact with the collector is a necessity for safe collection. It is best to have two men collecting together. This procedure makes it less probable a theft will occur since it is improbable for one employee to steal without the other one knowing it. An employee is less likely to steal if he knows he is being observed by a fellow employee.

In cases of large parking operations where there are a number of employees, it is best to rotate working partners. Theft becomes even more unlikely as the possibility increases that more people will know about it. Collectors routes should be changed periodically.

Accurate Records

Probably the most effective tool in detecting thefts is that of accurate records. Good records do not mean total meter collection receipts for an entire city on a monthly basis but detailed area by area weekly records. Meters should be collected on basically the same schedule so it is possible to compare one collection's receipts with another. Certain small zones of similar characteristics should be identified, collected and compared closely. By a series of sub-zones, zones and large areas, it is possible to go over the weekly receipts and any major variation can put the supervisory personnel on alert.

In addition to the total dollars and cents, it is a good idea to break down the collection into the number of coins by denomination. Another good comparison is the weight of coins by collection area.

Records should be kept on individual collectors so this can be compared with the receipts. A collector whose receipts over a period of time are less than other collectors, should be reason for concern.

Analyzing and comparing meter revenues requires knowledge and judgment of the specific areas. There are normal variations in revenue that must be considered. Bad weather may reduce meter use and revenue. Street construction or meters legally out of operation are normal, justified causes for reduction in funds. Other factors include holidays, special events and similar occurrences.

A supplement to any good collection system is a periodic check on meter space use from comparative studies of occupancy, revenue and enforcement. Individual meter income, that by block face and similar small collection areas can indicate any

fluctuation in revenue. Week by week comparison of collection receipts may give a clue to pilferage.

Surveillance

Surveillance is an absolute must if good security is to be maintained. This means police security for watching the meters at night to prevent theft and destruction as well as close supervision of employees who handle the money.

Employees should be reminded often that they are always under surveillance and should conduct themselves accordingly. One way to check collections to make sure each meter is collected is to insert a special coin-size token into each meter in a specified area. At the end of a collection cycle, the total number of special tokens can be counted to see that collectors have collected from each meter. Special, invisible dyes and marking powder are available to check the security of servicemen. Coins treated with the product can be placed in test meters and the suspected serviceman called to check the meter in question. A check of the meter can determine whether or not the coins are missing and if they are, the marking dye will stain the fingers and cannot be washed off, clear proof that coins have been removed. For this type of surveillance, it is wise to work with police officers.

Generally, it is best to have a minimum number of people involved with cash control. It is much easier to detect one thief out of five employees than one out of twenty employees.

If internal thefts are suspected, it can be desirable to talk with the police. They are specialists in detecting thefts and have ideas which may be helpful in apprehending and prosecuting an employee. It is always best to have the thief detected by the authorities rather than by some outside source. In case of petty theft by an employee some cities give the accused the choice of resigning or going to trial after being confronted by the evidence.

General Security Recommendations

Here are some helpful hints which apply generally and help get around specific problems:

1. Every meter serviceman and collector should be in uniform. The uniform should be readily recognizable and have large letters either on the back of the shirt or jacket or in some other readily visible location. Many thieves and vandals have been reported by citizens to the police for tampering with meters. Since the serviceman's uniform is known, the public knows anyone not in uniform has no business around the meter.
2. Certain types of meter losses are indicative of certain types of thefts. Continual thefts in an area may mean that someone has obtained a key and robs the meters periodically. This may be an employee or a local thief. These can normally be detected by a police stake out and stepped up surveillance.
3. A large loss at one time may indicate an area-wide theft ring that may strike occasionally. These are hit and run and difficult to detect. A change in locks is the best defence against this type of theft.
4. The specific charge filed against a meter thief can be most important. It is best to consult with the City Attorney, Prosecuting Attorney and the police to determine what methods for charging criminals will bring the best results.
5. The period before Christmas is usually the peak period of parking meter thefts. Additional care should be exercised at this time. If weekends are prime time for vandalism, meters should be collected on Friday. Accurate records should be kept of the location and type of entry of vandals. It may be possible to establish a pattern which can be most helpful in aiding police.
6. It is sometimes helpful to inform the news media of stiff sentences handed out by judges to meter thieves. This is one of the prime deterrents to meter vandalism. Some cities have offered special inducements such as cash rewards up to \$50.00 to officers who catch and convict meter vandals.

7. The best method of keeping parking losses at a minimum or preventing them is good supervision. Someone must continually check on all phases of the parking meter plant, procedures and personnel. Continued scrutiny of receipts can spot problems. Close supervision of employees in liaison with the police and the courts can assure a high return and a good, safe, overall operation.

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