REPORT RESUMES

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THROUGH CABLE TO CLASSROOM, A GUIDE TO ITV DISTRIBUTION SYSTEMS.

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NATIONAL EDUCATION ASSN., WASHINGTON, D.C.

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THE BENEFITS OF MASTER ANTENNA TELEVISION SYSTEMS (HAVING CENTRAL ANTENNA AND AMPLIFIERS WITH CABLE CONNECTIONS TO CLASSROOM) ARE DISCUSSED WITH RESPECT TO OTHER SYSTEMS OF CLASSROOM TELEVISION. INCLUDED ARE COST CONSIDERATIONS, NEED DETERMINATION, SCHOOL DESIGN, UTILIZATION OF EXISTING EQUIPMENT, AND FUTURE DEVELOPMENTS. AN EXTENSIVE ILLUSTRATED APPENDIX OF DETAILS AND SPECIFICATIONS FOR SUCH SYSTEMS IS PROVIDED. THIS DOCUMENT IS AVAILABLE FROM THE NATIONAL EDUCATION ASSOCIATION, 1201 SIXTEENTH STREET, N.W., WASHINGTON, D.C. 20036, FOR $1.00. DISCOUNTS ON QUANITY ORDERS--10 PERCENT ON 2-9 COPIES, 20 PERCENT ON 10 OR MORE COPIES. ALL ORDERS THAT AMOUNT TO $2.00 OR LESS MUST BE ACCOMPANIED BY FUNDS IN PAYMENT. ORDER BY STOCK NUMBER 071-02870. (JT)

A GUIDE TO ITV DISTRIBUTION SYSTEMS

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THROUGH CABLE TO CLASSROOM . . .

A GUIDE TO ITV DISTRIBUTION SYSTEMS

A Department of Audiovisual Instruction Publication

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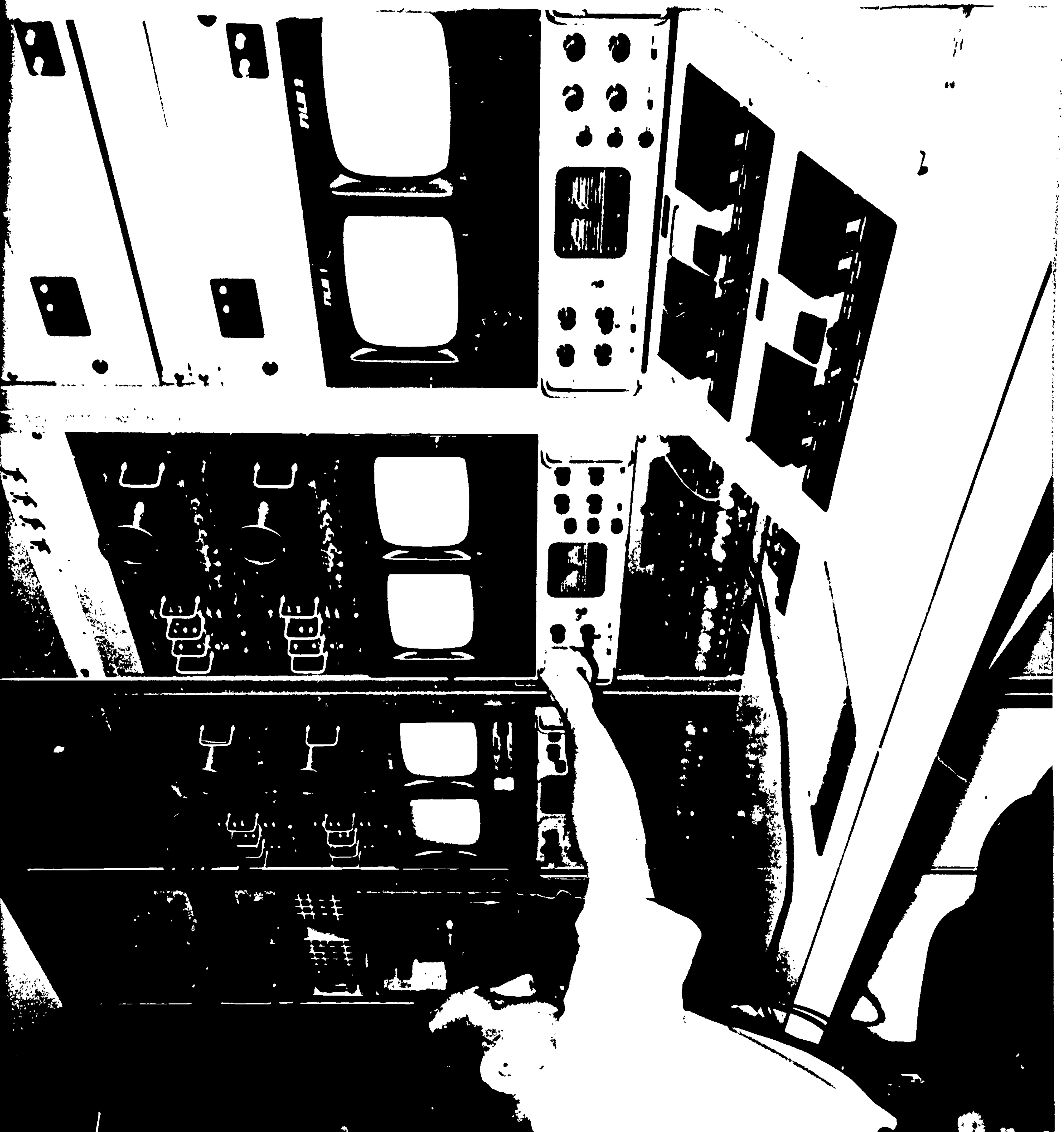

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Introduction

The use of television in the classroom has demonstrated that students can and do learn as well from television as from conventional modes of instruction. **How well** students learn from any mode of instruction, however, is highly dependent on the competency with which the particular instructional system is designed. An adequate and effective system of instruction should evolve from judgments based on information about the system as a whole. In the case of television, this means information about both its technical capabilities and its instructional applications.

The Division of Educational Technology of the National Education Association, recognizing the value of such a consideration, has to date focused attention on the programming and classroom utilization aspects of television through two publications: [1] *And TV too!* and [2] *Inquiry: Implications for Televised Instruction.* The technical complement to these two publications is this booklet, *Through Cable to Classroom . . . A Guide to ITV Distribution Systems,* a DAVI publication which serves to outline the necessary administrative planning for routing the television picture to the classroom receiver once it has been transmitted to the school. Its emphasis is on the concept of **Master Antenna Television systems.** *Through Cable to Classroom* is the connecting link which can make or break the impact of television on learning, for if the technical reception and distribution of the televised information are not maintained at their highest level, communication is disrupted and the value of television is either lessened or in fact destroyed.

Use of the approaches outlined in this booklet—regardless of whether the television signal utilized is from open-circuit boadcasts, closed-circuit cable systems, or 2500 MHz transmission systems—will assure the school administrator and media specialist that their schools' immediate and future needs for telecommunications will be met.

The properly designed Master Antenna Television system can carry a multiplicity of television channels, and it is conceivable that such a system may eventually make possible the organization, storage, and retrieval of a combination of instructional materials which can be instantaneously transmitted to the classroom.

Admittedly, *Through Cable to Classroom . . . A Guide to ITV Distribution Systems* deals with only one of the many facets of instructional telecommunications which are in need of discussion. The Department of Audiovisual Instruction will continue to report on new directions in the field of educational communications and technology in subsequent monographs. HTI

WIRING SCHOOLS FOR TELEVISION

DEFINING THE PROCESS

The use of a concept known as Master Antenna Television (MATV) system can provide schools with consistent quality reception in each classroom throughout the school as well as a degree of flexibility in television utilization not otherwise available. MATV systems can be used for transmission of school-originated television signals coming from video tape recorders (VTR), microscope cameras, film equipment, etc., as well as for distribution of signals received at the school from either VHF or UHF noncommercial and commercial television broadcast stations, the new 2500 megahertz (MHz) Instructional Television Fixed Service (ITFS) stations, closed-circuit television (CCTV), or other sources.

Simply stated, a Master Antenna Television system is a web of cable connected to a unit of electronic hardware which receives the desired television signal at one single point via an amplifying booster, or head-end. This amplifier helps to retain the same quality signal that was transmitted from the origination source. The diagram on the following page depicts how the varying alternatives for television signals can be distributed by MATV. A well-designed, well-installed MATV system will offer many benefits to teachers using television in the school. Not only will it provide ready access to all television signals in your area, but, more important, the quality of reception throughout the school will be consistent and uniform. Through the use of amplifiers, signals will be of like strength throughout the school, whether the television signal being received is close by or far away.

Today, there are many types of television transmission systems—RF cable, 2500 MHz, UHF television, VHF television, etc. However, at the point of reception (in this case the school), most signals are converted to a VHF television frequency which is then transmitted throughout the school by whatever distribution system is available. In other words, the VHF signal is used more or less as a common denominator for all distribution systems. It is at this point of conversion that a MATV system begins to offer maximum benefits.

For example, if access to the incoming network of cable is provided at a single point—the MATV system—television signals inserted at that point will be carried throughout the network of your own interconnection specification, and signals outside the cable will not interfere with your own cable signals. Thus, although there might be a channel 3 commercial station in your area, a single school can use a channel 3 signal for local instruction by keeping it in its own little closed-circuit world on the coaxial cable. Here, then, is one factor in favor of a MATV system.

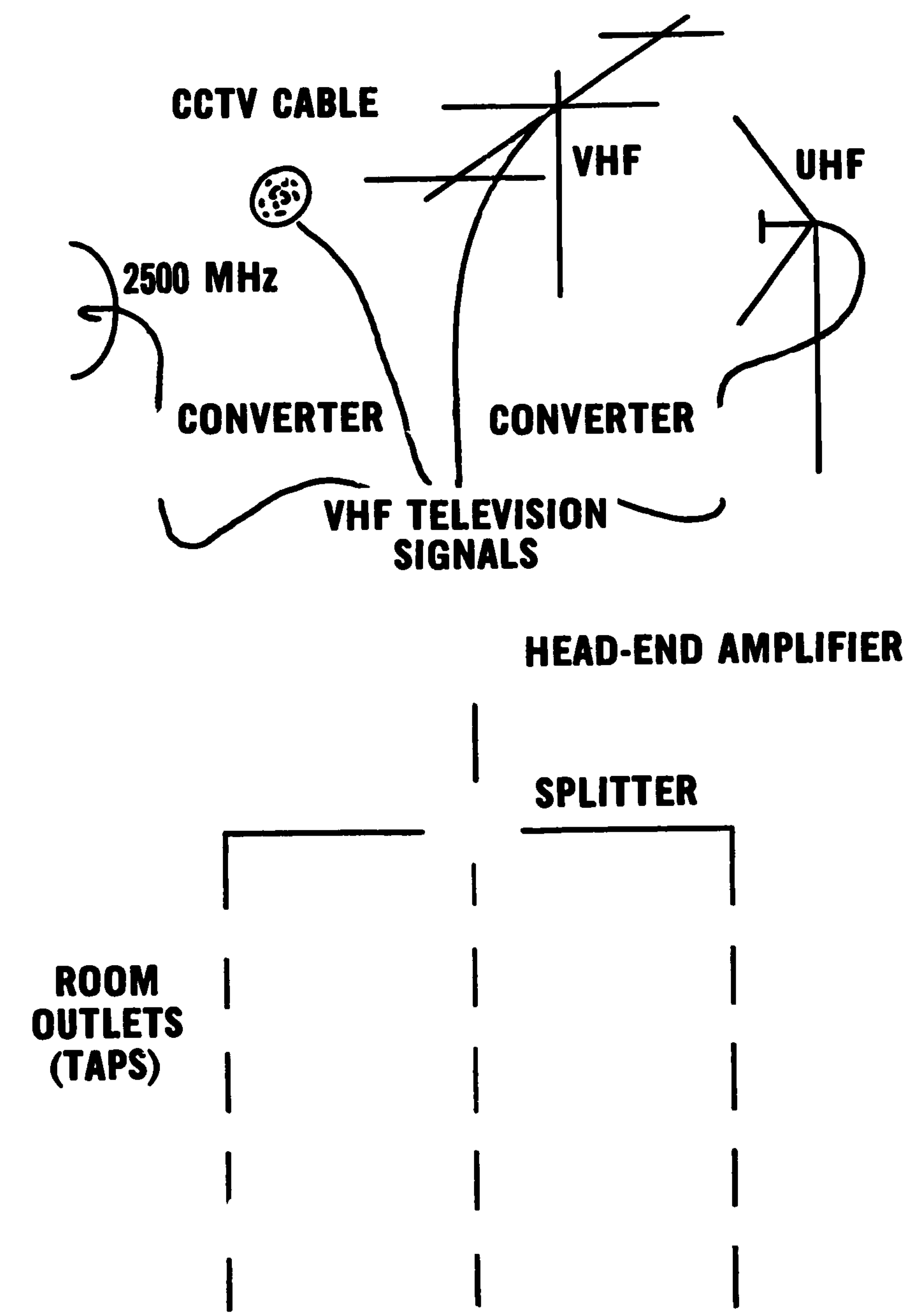
Another benefit of a MATV system is in the area of problems presented by cable connections. To maintain the characteristics of coaxial cable, special connection devices are used whenever the cable splits (is separated and routed to other designated areas) or wherever a receiver is attached. These special connection devices, called splitters and taps, contain electronic parts necessary to maintain the electrical characteristics of the cable just as if it were not divided. However, they present the main problem in the design of any system—loss of signal. Cable, splitters, and taps—all contribute to a reduction in the amount of signal available at any point. The amplifier provided, therefore, must be large enough to overcome all the losses between it and the farthest outlet. Here again is another instance where MATV can ensure that maximum benefits are felt at each viewing station.

A MATV system can also be an asset in providing the necessary modicum of flexibility that is increasingly desired in televised instruction. It can be so designed as to provide many channels for transmission of information at any single time.

With these factors in mind, the next logical question about a MATV system concerns costs. What about costs?

ESTIMATING THE SYSTEM COSTS

The most expensive single part of the system is the head-end installation. This includes the antenna, the amplifier, any UHF to VHF conversion equipment necessary, AC power wiring, if necessary, and any other accessories needed to feed the cable which serves the viewing areas. The cost of the head-end must be spread over the number of outlets in the system if one is to figure costs on a dollar-per-room or dollar-per-outlet basis. Obviously the per-outlet cost will be higher in a small school than it will be in a large one.



A TELEVISION DISTRIBUTION SYSTEM

A second factor affecting cost is the type and age of the building in which the system will be located. An old building with high ceilings, no television conduit, and thick masonry walls will require more man hours than a new building with a well-designed conduit system already within its walls. Type of construction has a definite bearing on cost.

A third factor in making a good estimate is the status of the labor market in the area. If budgetary matters are the prime concern, the school administrator might find that the financial savings in doing this type of work in the winter months will outweigh the nuisance of having workers in the building while school is in session. If tourism in a particular area is a major summer month industry, labor will probably be hard to find in the summer months. A contractor may have to pay a premium for summer labor (thus raising the cost of the system), and he may find that he is unable to complete the installation by fall. The list of "pros" and "cons" to be considered in the labor area is wide and varied. Consequently, it is advisable to discuss the labor situation with potential installers before beginning to negotiate for a system.

In Delaware, where 163 schools were wired during the 1965-66 fiscal year, the per-outlet cost was about $40. This was for some 5,200 outlets in schools located throughout the state.

Kentucky Authority for Educational Television set forth some rules for cost estimating in its *Reception and Distribution Systems* booklet. It advised schools as follows:

System costs may be estimated using the following approximate figures which include cable, labor, and equipment. The figures are based on the use of existing conduit or surface mounting of the cable where no conduit is available.

Building central receiving equipment which will receive off-the-air UHF or VHF signals and closed-circuit signals:

Each UHF channel—approximately $400 to $600
Each VHF channel—approximately $300 to $500
Each closed-circuit channel—approximately $300
Each classroom with one receiver outlet—approximately $40

Example:

School equips 5 classrooms to receive one UHF channel.

The cost would be:

For the central UHF receiving equipment:	$400 to $600
For the 5 classrooms at approx. $40 each:	$200
Total cost	$600 to $800

The reason for hesitance on the part of some wiring contractors to provide "top of the head" estimates for systems becomes obvious. The many variables which affect the overall operation and performance of the system also affect the cost of the system. **It is the instructional need and the instructional situation which will determine both technical capability and ultimate cost.** However, suppliers and technicians throughout the country will agree that the cost of a well-designed system providing high-quality reception over a 10-year period seldom exceeds the cost of a mediocre or poor system, which will have a shorter useful life and greater maintenance costs problems.

DETERMINING YOUR TELEVISION DISTRIBUTION NEEDS

Because the school faculty and the students are the ones the television system must serve, proper installation is essential if the system is to work efficiently without being a hindrance to the efforts of the educational community.

First, the school faculty must determine the areas which are to be served by the system. Usually all classrooms are served with at least one, but preferably two, television outlets. Areas where large-group instruction is carried on usually are equipped with many outlets to allow for use of a number of television receivers. Likewise, faculty areas and offices should be equipped if teachers are to preview material available via the television system. The decision to equip shops such as those used for teaching auto mechanics or woodworking should be based on the curriculum needs of students in these subjects. In other words, instead of having students in these classes viewing television in another classroom, away from the shop or laboratory areas, it may be better to equip such areas with their own television outlets. This would not only be conducive to better learning, but also eliminate the inconvenience and loss of time in transporting students to and from another classroom.

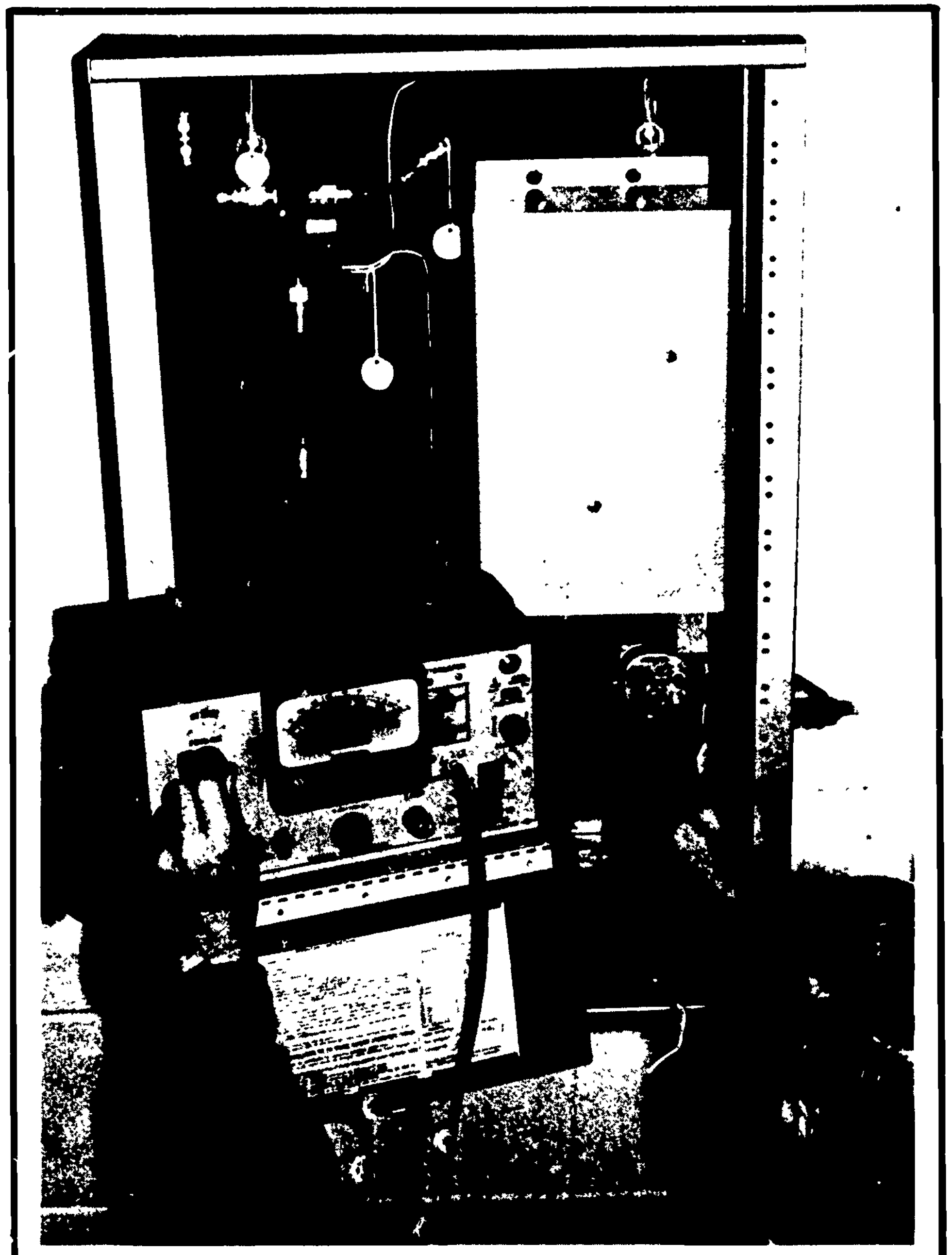
In general, a good rule of thumb is to provide a classroom receiver to serve a number of students not exceeding the picture tube diagonal measurement in inches. Thus, a 23-inch receiver would serve 23 students. Viewing of a single receiver by more than 30 students is definitely not recommended. In fact, for every student added over and above the aforementioned rule-of-thumb figure, the effectiveness of television on the learning process might be placed in serious jeopardy. Crowded viewing areas often generate an uncomfortable environment which may not be conducive to learning.

Once the locations to be served are determined, specifically locate the outlets in each area. Providing precise information about every room will ensure well-engineered proposals from your potential suppliers, as they can make definite determinations of cable requirements and can more precisely plan and estimate the performance of the system.

In most classrooms, the best location for a television receiver outlet is in the front of the classroom, adjacent to the window wall. Such a location minimizes reflection of the light from outdoors on the face of the picture tube. You may wish to locate outlets at different locations in particular rooms because of a number of factors, such as the following:

1. The location of available AC outlets
2. The layout of certain fixed furniture in the classroom
3. Whether the television set is permanently assigned to the room or is moved frequently
4. Lack of a window wall
5. Full control of both artificial and natural illumination in the classroom
6. The total number of television outlets in the room.

Once the outlet locations throughout the school are determined, locate potential areas where head-in distribution equipment might be installed (closets, utility areas, attics, boiler rooms, or finished areas such as the school office or even classrooms should be considered). Keep in mind that such equipment should be located as centrally within the school as possible and should also be easily accessible for maintenance. All pertinent locations should be detailed in writing **and** clearly marked on a simple diagram of the school.



A properly installed head-end amplifier has well-laid-out cables, properly labeled, and has been checked for performance with proper test instruments. This installation is in a cabinet that opens wide for easy maintenance.

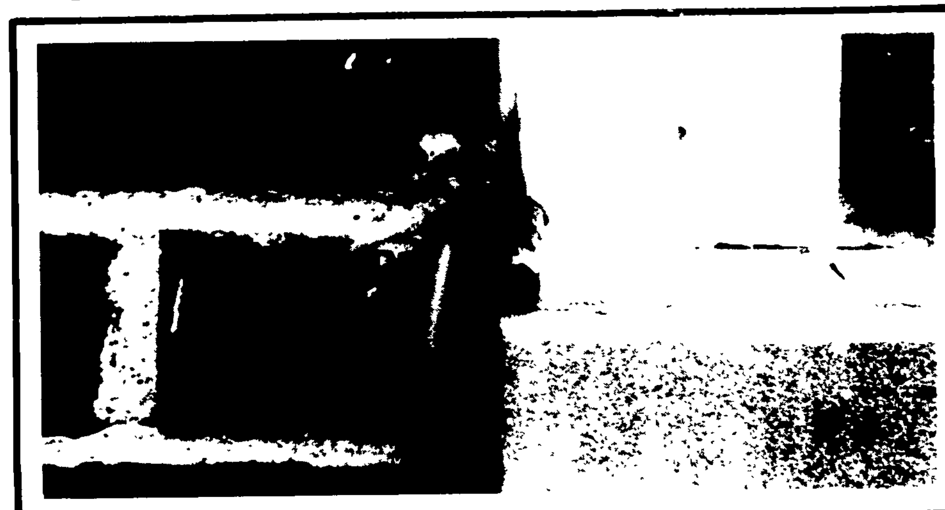
Failure to specify location of head-end equipment may result in the contractor locating it where it is difficult and indeed unsafe to service. In this type of installation, the head-end amplifier is in the mail box and leaves equipment open to vandals and the elements.

Having determined the viewing and equipment locations, review and specify allowable construction practices. If this is left to the installer's discretion, there is no end to the possible ways a cable might be run. There may be some limitations which school administrators, architects, or school boards wish to place on the contractor.

In existing buildings, the contractor may have to place all trunk and feeder wire on the outside of the building and allow the drops to each room to come through a window frame. Such a job **can** be neatly done. There are, however, instances where the feeder cable has been run around the circumference of the building between the first and second floor, with drops running up and down to rooms on both floors. As black cable was used, the appearance was that of a school wrapped like a package about to be mailed! In contrast, in many schools this type of wiring is done in a manner which blends the wiring unobtrusively into the outside of the building.

Many contractors who do outside wiring place cables on the school roof, which then drop off the roof and run down the side of the school into classrooms. In some areas, such practice affects the coverage of roofing contracts. It may also be a violation of some city or county code, be it a building, safety, fire, or insurance code. The administrator should check such factors before allowing cable to be installed which will make contact with the roof.

Outside wiring jobs can be done neatly. In this instance, a grommet is used to protect the cable where it passes through an aluminum window frame. The contractor left a drip loop to prevent water from entering the building along the cable and the cable is properly secured in the brick, not the mortar.



Outside wiring can be done neatly without marring the appearance of the building. In the example of what can happen when adequate supervision is not exercised, shingle nails were used rather than clamps and the lack of a drip loop necessitated later "gunking" of the window with tar.

DESIGNING THE SCHOOL PLANT FOR MATV

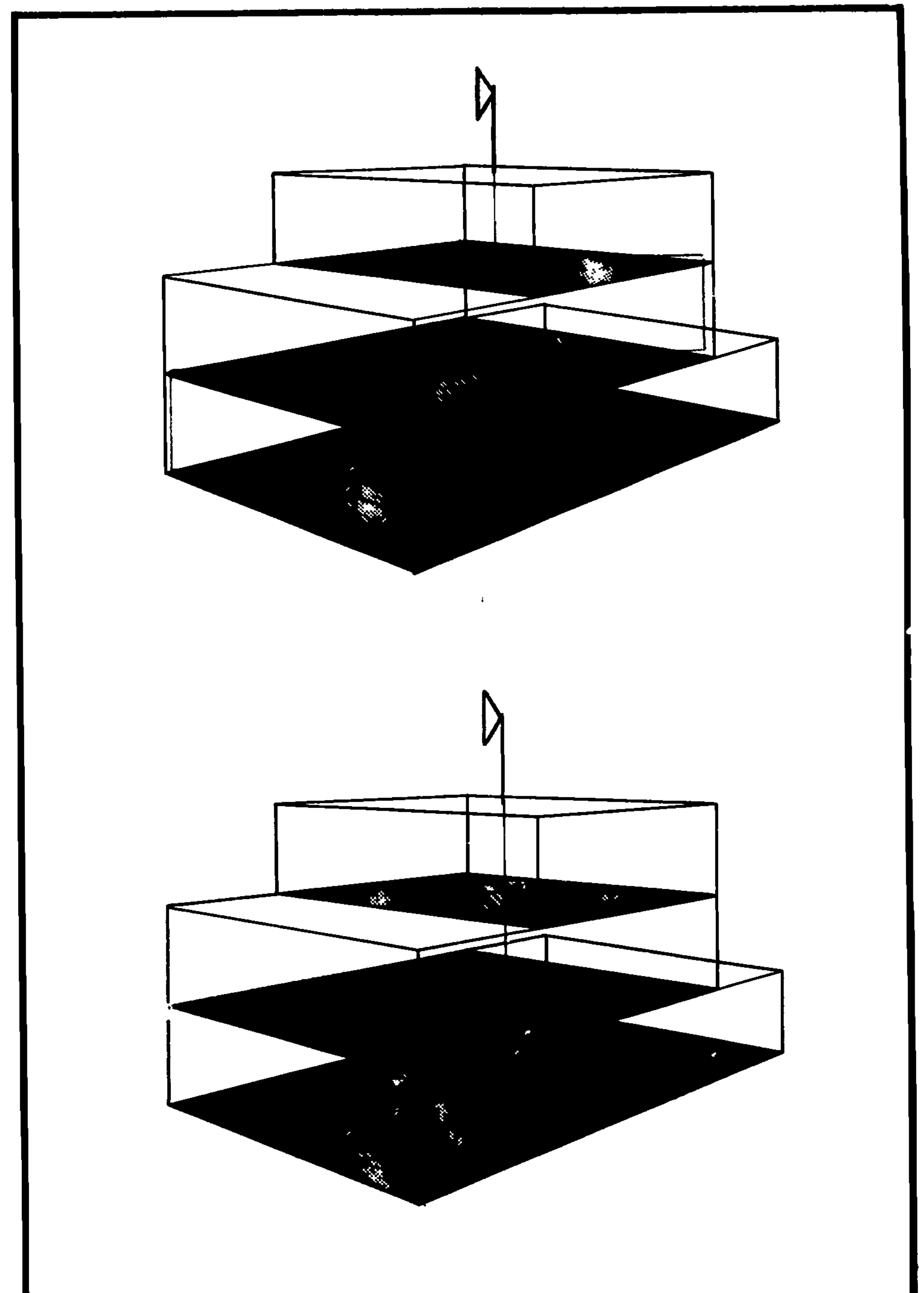
Wiring Partially Equipped Schools

So far, we have discussed wiring of existing schools having no television distribution system. Some schools partially wired in years past often need to update and expand the wiring to serve addition. classrooms. Use of the original system has probably taught the school faculty much about outlet placement and system performance, and this experience should certainly be incorporated into the expanded system.

If the system is four or five years old, investigate the possibility of total replacement. If the equipment is fairly new and the amplifier and taps are of modern design, these items may well be incorporated in a redesigned system. Provide potential contractors with as much pertinent data on the existing equipment as possible. The type and serial number of the amplifier, and data on taps, splitters, and type of cable used (as printed on most cable) will all be helpful to the contractor. Note existing outlets as well as equipment location and cable routing of existing systems on a simple floor plan or blueprint if possible.

Wiring Newly Constructed Buildings

Most schools being designed today make provision for the installation of conduits for television in every classroom. However, it may be impossible to use existing conduits and still obtain a **quality** television system without making a few technical compromises. The reason is simple enough: In many instances, when the school is designed, the architect tends to treat television in the same manner as he treats the school sound or clock system. This should not be the case. It is a bad practice to relate all television



The above diagrams display two common cable distribution patterns frequently used in newly constructed school buildings.

conduits to a head-end location in the office just as is the case with a public address or clock system. The wiring specifications for television are different, and they must be properly defined.

Once the new building schematic is complete, the school personnel should proceed as they would in an existing school and specifically locate the television outlets according to instructional need and situation. Generally speaking, the rules for outlet and equipment location are the same here as those previously mentioned for existing buildings.

The schematic floor plan showing outlets and suggested head-end equipment locations should be returned to the architect. The architect should take advantage of the services of a television consultant, a MATV system contractor, or a MATV system manufacturer to provide layout of conduit necessary for the installation of an optimum television system. This should be done whether the actual television system will be installed now or at some later date.

UTILIZING IN-SCHOOL CLOSED-CIRCUIT TELEVISION AND MATV

There are many schools that make use now, or will in the future, of closed-circuit television originated within the school. A properly designed MATV system can be used for distribution of these signals. All manufacturers can provide this capability, although in different ways.

More extensive systems provide fittings in each room that allow insertion of a television signal into the existing cable. Through the use of special devices known as directional couplers, this signal is channeled back to the head-end where it is converted to a VHF television signal and then routed through the head-end amplifier. From that point, it is distributed to all rooms, as is a VHF signal.

Building expansion should be done exclusive of the MATV system. Once the additional building construction is finished, special cables to carry locally originated television signals from key areas of the school to the head-end unit will usually be less expensive to install and will probably be more flexible and easier for school personnel to use and understand.

A consultant or service organization can advise on the best way to do the job, depending on the amount of local origination to be done, and especially on the number of rooms that would normally view such signals.

IMPLEMENTING AND OBTAINING A MATV SYSTEM

Once specific needs have been well defined, it is time to begin to procure a system. In most schools, such systems are purchased after the school administration has received competitive proposals from a number of system installers. To obtain complete, fair, meaningful proposals, a well-written set of **detailed** specifications is necessary.

Part II of this booklet contains a suggested set of specifications to serve as a system guideline which can be met competitively by many suppliers. Any manufacturer of MATV equipment can also provide specifications, although, in this writer's opinion, the use of specifications written by a manufacturer or his representative may place the buyer in a position of compromise.

Once the system specifications are complete, desired performance and parameters set forth, and all details of outlet and equipment location spelled out, this information should be forwarded to potential suppliers. These suppliers should be experienced MATV system sales and service companies, selling known equipment proven in school systems, and being able to display a record of their service.

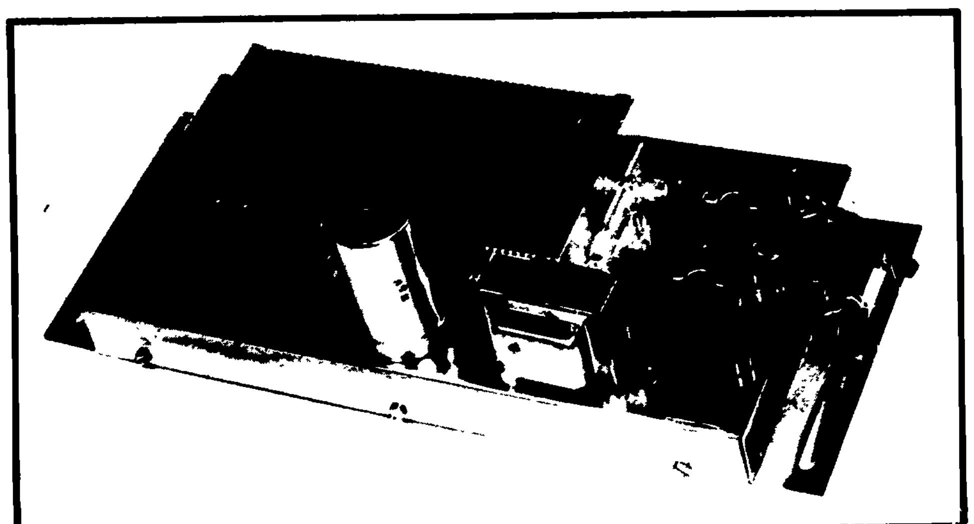
If the system is to be part of a new building, building addition, or remodeling project, be sure that your architect submits this part of the project to a subcontractor specializing in television. Many systems provided as a part of the electrical subcontracts in new buildings are not good systems in the final analysis. Although electricians might pull all television cable into the building conduit, be sure that the system design, hookup, balance, and checkout are done by a television systems organization. The value of this additional effort should not be underestimated.

Allow plenty of time for the return of proposals. Although many suppliers do allow bid proposals to lie around until the last minute, experienced, reliable, interested firms will make use of all available time to ascertain the soundness of the system they propose.

After proposals have been returned and accepted, be sure to look beyond the page indicating the price. If possible, have a consultant review the proposals to assure you that what is proposed is indeed what is asked for in the specifications. This same person later should also check your completed system for you, to ensure that it was completed as specified.

Bid evaluation and subsequent system checkout are important parts of buying such a system. Assurance that proposals will be fairly evaluated and systems checked in accordance with the specifications will motivate reliable bidders to provide fine systems at a reasonable cost. ETV station engineers might provide such a service in your area. Some state education departments now have technicians on their staff who can assist the local educator. The hiring of a consultant is an investment toward a more effective system, needing less maintenance over many years. Lessons lost because of an inoperative system or ideas lost because of a marginal system are difficult to price. In areas where ETV is widely used, teachers expressing dissatisfaction in ETV are many times expressing dissatisfaction in the technical reliability or picture quality of the system in their school.

Allow plenty of time to do the job. If monetary allocations for television become available in July, be careful about trying to complete the system by the start of the school year in September. Details overlooked and compromises made to beat the deadline will only cause future problems. In acquiring any electronic installation of any size, it would be well to allocate a minimum of 90 days to the project.



New transistorized equipment provides the user with added reliability, lower power requirements, and cooler operation. This broadband amplifier is an example of constant equipment development in the MATV field.

LOOKING AT FUTURE DEVELOPMENTS IN MATV

As in any technological field today, the MATV system manufacturers are constantly working on improvements to provide better service to the viewer. Until now, the high cable losses of UHF frequencies have prevented the direct distribution of UHF signals without first converting them to VHF signals. New low-loss cable has recently been developed so that UHF signals can be distributed throughout a school without conversion. In light of this development, manufacturers are now experimenting with amplifiers for use in UHF signal distribution. This breakthrough may well provide the forward-looking school administrator with many more television channels to meet his school's instructional objectives.

Transistorized or "solid state" equipment provides some definite advantage in size as well as reliability and maintenance when used in systems such as MATV. The trend today is toward replacing tube-type equipment with newer transistorized models.

As the school evolves, so too should the television system within the school structure. Educators concerned with the installation of television in school buildings should remain aware of new trends in this area. No system should be a carbon copy of another if improved equipment is available. On the other hand, no system should be purchased which is not of proven reliability. Above all, it should be emphasized that **the instructional need and the instructional situation should determine the operational nature of your television system.**

APPENDIX:

TELEVISION DISTRIBUTION SYSTEM GUIDELINES

GUIDELINES

The system specifications which follow have evolved over two years' experience in the wiring of nearly 200 schools. Supplemented to meet the needs of a specific educational situation, these basic performance specifications can apply to almost any MATV system. The ideas go beyond a representation of experience in that they have been reviewed by manufacturers' representatives, architects, engineers, and television consultants.

These are performance specifications. They set forth the way in which the final system is to perform and the manner in which it is to be installed. Most manufacturers of a line of Master Antenna Television equipment suitable to serve many locations can provide a system meeting these specifications. The system as specified will distribute any television signal in the VHF television band whether it be a converted 2500 MHz signal, a converted UHF signal, or a standard VHF signal off-the-air or from a closed-circuit cable.

Some administrators may not like this approach to system acquisition. It requires that they take an active, responsible, time-consuming part in obtaining the system. However, if the administrator exercises his responsibility, provides the additional necessary information regarding his school, and ascertains the necessary follow-up supervision as the system is installed, he will be assured of an excellent television system.

It should be remembered that there is no typical distribution system. As you read these specifications, you may well find that you will have to change some of the provisions. Hopefully, you will become aware of ways in which you can advise your installer of your special needs and your instructional situation which will enable him to provide a top-notch distribution system. Remember, these specifications are only provided as guidelines.

Explanations

INTRODUCTION 0.0

In simple terms, this section sets forth the desired product or service the buyer wishes to buy. Ground rules for purchasing, such as any regulations governing purchases by a school system, should be noted here. Important here, too, is information about the individual(s) in the school system who should be contacted regarding the specifications.

It is exceedingly important that there be a definite chain of communication set up for liaison between the school system and the television contractor. It should be set up through specific individuals, not on a departmental basis. Establishing this relationship initially will pay dividends to both the school system and installer as the project progresses.

DEFINITIONS 1.0

Before the supplier goes further into the specifications, some terms should be defined so that all potential suppliers are in agreement as to the precise description of the item that is up for bids. In the television business, different terms mean different things in different areas and in different suppliers' shops. Section 1 defines terms used in these specifications. Any administrator may have some other terms which should be defined as a part of a specification for his school. These would be placed in this section.

GENERAL CONDITIONS 2.0

Section O served to inform those who might provide a system as to just what kind of system is wanted. In this section, the television system salesman is informed more specifically of what will be required of him during the bidding procedures. This section also serves to qualify him as a contractor conforming to accepted standards, who will be able to supply parts and service and who has been in business long enough

0.1 INTRODUCTION

0.1 These specifications are issued to provide guidelines for the installation and performance of television distribution systems to be installed in (name of school system).

0.2 These specifications supersede all previous specifications for systems of this type issued by this office.

0.3 These specifications should not be interpreted as being completely rigid. Because of constantly changing methods, products, and standards for transmission systems of this kind, they will be periodically reviewed and updated.

0.4 These specifications apply to television distribution systems installed in existing buildings or installed as a part of new buildings, building additions, or remodeling projects.

DEFINITIONS

1.1 **Reference signal**—For the purpose of these specifications the standard reference signal of 0 dbm is understood to be 1 millivolt across 75 ohms.

1.2 **Head-end**—The system head-end consists of the main amplification system, associated antennas, and converters used to feed the overall building distribution system.

1.3 **Out of reach**—Equipment and cable will be recognized as being out of reach when in excess of 7 feet 8 inches from a location where a person might stand.

1.4 **Adjacent channel**—Two VHF television channels will be considered as adjacent channels when there is less than 6 megacycles of spectrum space between them. Example: Channel 4 and channel 5 are adjacent; channel 6 and channel 7 are not adjacent.

to be experienced in the MATV system business. A school administrator may also wish to set forth here rules about working in schools (working hours, smoking, etc.).

Subsection 2.5 sets forth the information the buyer needs as a part of a valid proposal. To supply the information and samples outlined in this section, the bidder will have to visit the school building and make a detailed "on-the-scene" inspection of the plant. Information provided in the diagram of the proposed system will enable his proposal to be compared in detail with competitive systems in terms of performance by a consultant or service organization. It will also provide a bill of materials from which it will be possible to determine later if corners were cut between the drawing board and the completed installation. The installer who unrolls cable at will, installs a system with relative abandon, turns the amplifier up full, and checks the system by merely looking at the picture will object to providing this material. Installers who actually "engineer" the systems they install and who install systems of utmost quality will have most of this information before they begin. The importance of sample connectors, completion dates, warranty details, and service manuals should be obvious.

Proposals returned with special technical notes [paragraph 2.5.7) should be carefully evaluated. Installers with extensive experience can bring many things to the attention of the buyer which could present problems in the final system. This, too, is a section where the vendor can take objection to any part of the specifications.

The school administration must provide sufficient information regarding channels to be viewed, outlet locations, school floor plans, conduit diagrams, and other information which will affect the contractor and how he goes about his work. **The more**

1.5 **Extraneous signals**—An extraneous signal is any RF signal or any television or random signal other than the signal the viewer wishes to view.

2.1 GENERAL CONDITIONS

The contractor agrees to install a new distribution system or to upgrade the existing distribution system to provide reception of open- and closed-circuit channels as specified by the system owners. The contractor agrees that the completed system, including portions of any existing system reused, will be installed, will perform, and will be warranted according to the specifications that follow.

2.2 The contractor agrees to conform with generally accepted standards of installation practice for systems of this kind. The final installation will conform to all applicable local and national codes (fire, electrical, etc.).

2.3 Labor and system components supplied new as a part of a contract issued as a result of this specification will be under warranty at least one year from the date of acceptance. (See paragraph 2.5.6.)

2.4 The contractor must have been in the business of installation and service of the type of system described for a reasonable period of time. The contractor shall show satisfactory evidence that he maintains a fully equipped service organization capable of furnishing installation and service of this type of system. The contractor shall also maintain a good stock of replacement parts.

2.5 To qualify for consideration, a bid proposal must contain the following information:

complete the invitation to bid, the more competitive the proposals will be. It may actually take as long to prepare specifications for presentation to potential contractors as it will for the contractor to provide a system.

This section also serves to set forth what other paperwork will be required. A reliable contractor should have this information at his fingertips; the less reliable will not. The information and diagrams asked for in subsection 2.7 are necessary to easy service of the system in years to come. Note that paragraph 2.7.4 asks that each and every outlet in the system be checked. Some 20 percent of the 5,000 outlets provided on the Delaware ETV Network were not operating when first full technical checks were made, because of individual problems. To ensure proper system balance as outlined in later sections, all outlets should be checked with proper test instruments. Checking them with a receiver to see if there is a picture present **is not adequate.** Where many schools obtain system service on a time and materials basis from local service organizations, having these data on hand will speed service and cut down on the cost of service calls. They also will be useful when the system must be extended to serve new additions to the school and other areas not initially served.

GENERAL INSTALLATION REQUIREMENTS 3.0

Subsections 3.1 and 3.2 again deal with factors that the school administration **must** dictate. Be specific about where the outlets are to go. Locate exact spots with an "X" on the wall if need be. Once they are located, do not allow change without approval by a specific person—one familiar with the reasons for the location in the first place. Do not let the contractor talk you into a location easy for him; locate the outlets where they will do the best job for your classrooms from the standpoint of the educational task to be performed.

A **simple** block diagram of the system to be installed must be drawn up indicating by catalog number the type of amplifier, type of splitters and taps, and type of cable to be used. 2.5.1

Estimated signal levels throughout the system are to be shown based on 0 dbm signal input to the amplifier on channels 2 and 13. The use of existing equipment, if any, should be shown on this diagram.

Where the system will make use of an existing television antenna and associated UHF to VHF converters, if any, signal strength of all normally viewed television signals will be read at the output of the antenna system at a point prior to any distribution equipment. 2.5.2

Where a television antenna system is to be provided as a part of this bid, the contractor must justify the type proposed. 2.5.3

In the case of a building addition, where the new portion of the system will take a signal from the existing system, the contractor must include the field strength of the normally used channels as specified at the tap-off point as a part of any proposal. The tap-off point must be specifically located in writing and as a part of paragraph 2.5.1 above. (See paragraph 7.3.3.) 2.5.4

A sample of the classroom receiver connection device to be supplied must be provided. 2.5.5

A statement of warranty covering the completed system as proposed must be provided. 2.5.6

Any special technical considerations which the vendor considers pertinent to better define the system to be provided should be included in the initial proposal. 2.5.7

A system completion date must accompany any bid. 2.5.8

Allowing cable to be installed at the discretion of the installer leads to situations such as this. The result was an unsightly installation in the hallway and permanent damage to a solid oak door frame. Note, too, the excess cable left by the installer inside the door. Adequate supervision as well as specification by the school will prevent this situation.

This picture shows the results of a neatly wired system, as defined in preplanning specifications agreed upon by the school administrator and the installer of the TV system.

Specific operation and service manuals on the equipment proposed as a part of any bid should be submitted with bid proposals. **2.5.9**

Where feasible, existing systems and equipment are to be used. (See paragraph 2.5.1.) Equipment deemed surplus by system redesign remains the property of the present owner and should be turned over to the owner's service organization or to any other designated person. **2.6**

Following a successful performance demonstration (section 10) and prior to checkout of the system by the owner's service organization, information in **triplicate** is to be provided. This information will consist of— **2.7**

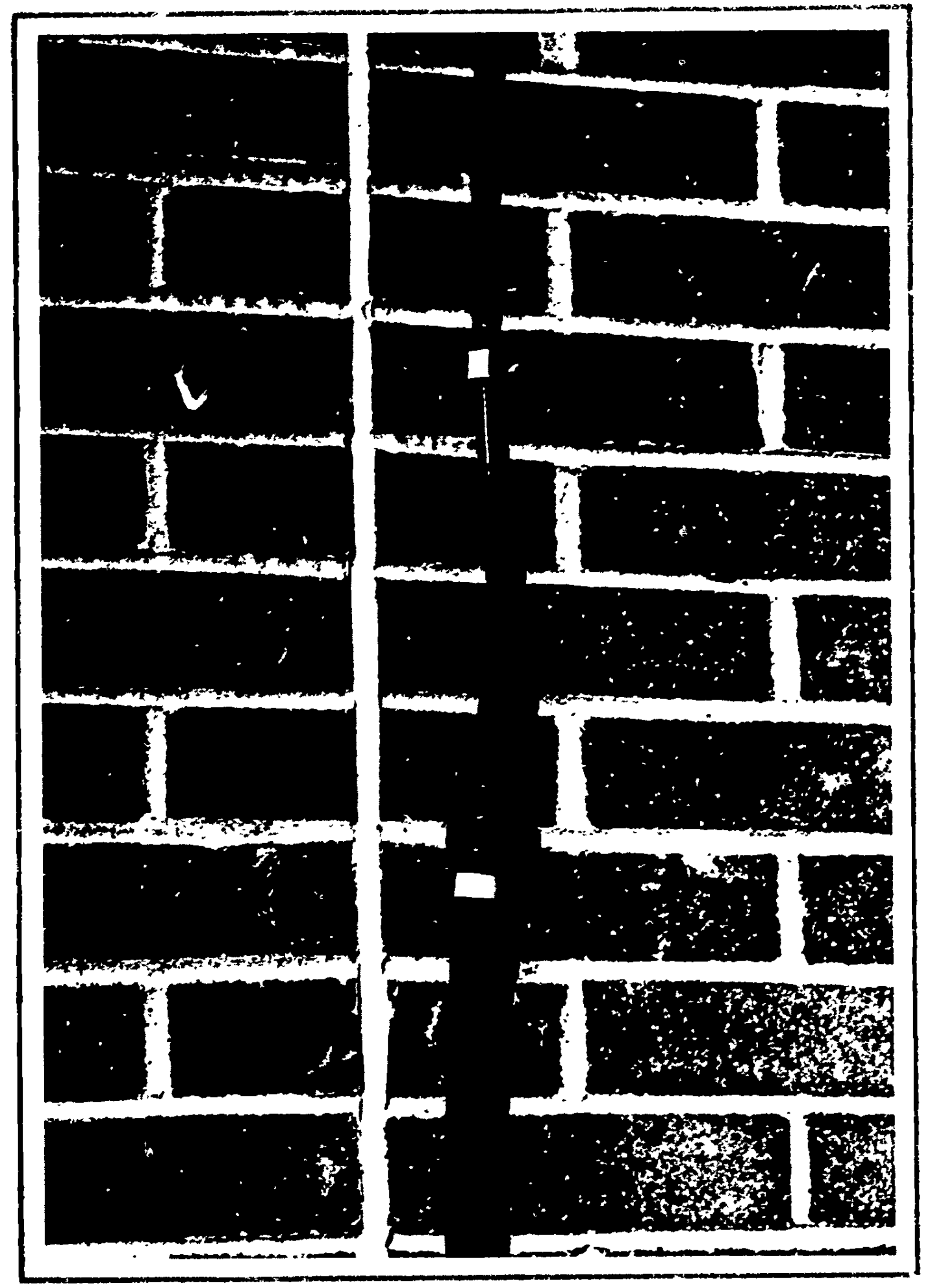
Complete service data including schematic diagrams and maintenance manuals of all new equipment supplied as a part of this contract. **2.7.1**

A complete system block diagram showing as accurately as possible all equipment, splitters, taps, and outlets as well as cable lengths. Notes relating this diagram to the diagram required in paragraph 2.7.3 should be included. **2.7.2**

A complete building floor plan on which the locations of all equipment, splitters, taps, and outlets are specifically located. Cable routing throughout the building is to be accurately shown. **2.7.3**

A complete list of signal strength readings taken on each channel used in the school and at the input of the head-end amplifier, the output of the head-end amplifier, the input and output of all subsequent reamplifiers, and all television outlets in the system. (Readings to be made with an approved field strength meter relative to 0 dbm.) **2.7.4**

Installation of cable clamps in mortar as shown here is poor practice, not only damaging to the cable but not a long-lasting installation. Specifications should define acceptable construction practice.



Cables installed on masonry walls should be carefully clamped, as in this case, to prevent pinching or breaking. Clamps should be installed in brick, not mortar.

2.8 Systems will not be deemed complete until they have been checked by the owner's service organization. Payment will not be made until such checks are complete and deficiencies as noted are corrected.

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment locations as specified by building personnel are indicated in the attached material. Should the contractor find these locations unsuitable, he is to so indicate clearly in writing as well as diagrammatically in his proposal, and he should provide a proposal for a system making use of alternate locations.

3.2 Television outlets are to be provided at designated points in each room. Departures from the designated locations must have the approval of building personnel and the owner's service organization.

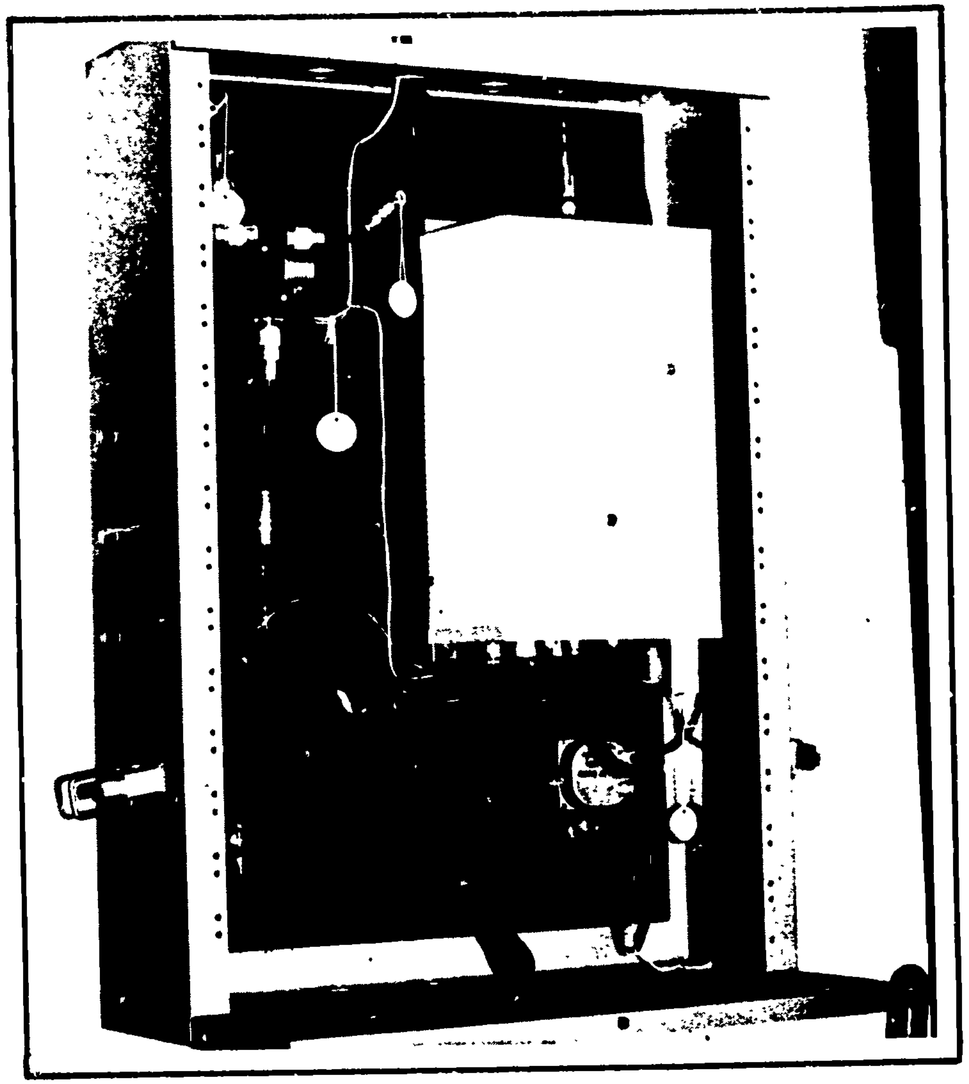
3.3 Cable runs should be as short as possible. A neat, well-protected installation is necessary. All cable installed on the surface of walls and not protected by conduit or molding of some type should be placed well out of reach. (See subsection 1.3.)

3.4 Cable within reach of students must be placed in molding or be otherwise concealed. Molding should be installed as neatly and unobtrusively as possible. Standard, readily available fittings should be used throughout.

3.5 All cable installed on the outside of buildings within reach of any normal traffic area or within reach of the ground or portions of the buildings on the ground outside the buildings generally accessible to any person must be in conduit properly installed with appropriate fittings, bushings, and clamps.

Being concise will allow you to receive bids based on educational need without a lot of "just in case they change their minds" thinking in them.

This writer agrees that the many stipulations of installation practice in section 3 appear to be unnecessary and that common sense should dictate these practices. Leaving installation practice wholly to the discretion of the contractors will provide you with a lower cost system, but maintenance needs will be greater and future growth will be limited. Warranties do not cover cable pulled loose by students; this is vandalism. Warranties on the system do not cover leaks due to poor calking with wrong material; this is building maintenance. Warranties do not cover loss of lesson material caused by a cable run too tightly around a bend breaking or cut where it enters a box without benefit of a grommet; this is poor specification planning.



Properly installed MATV amplifiers are neatly installed in protective cabinets with all connections labeled. The installation should be fully accessible for service.

All cable installed on the surface of walls within a building and not concealed (in conduit, wiremold, or other similar devices) will be secured at 24-inch intervals. **3.6**

All cable installed on the outside of any building will be clamped every 3 feet. Clamps will also be provided within 3 inches of the beginning and end of each bend in the cable. **3.7**

Cable clamps, screws, other hardware, and electronic devices subject to the effect of weather will be manufactured or treated in such a manner as to be impervious to rust and corrosion for at least two years. **3.8**

Outside cable clamps and other hardware secured to masonry walls, inside or outside, must be secured at points not within the building mortar except where brick or block is loose. **3.9**

The use of nail rings for securing cable is prohibited. **3.10**

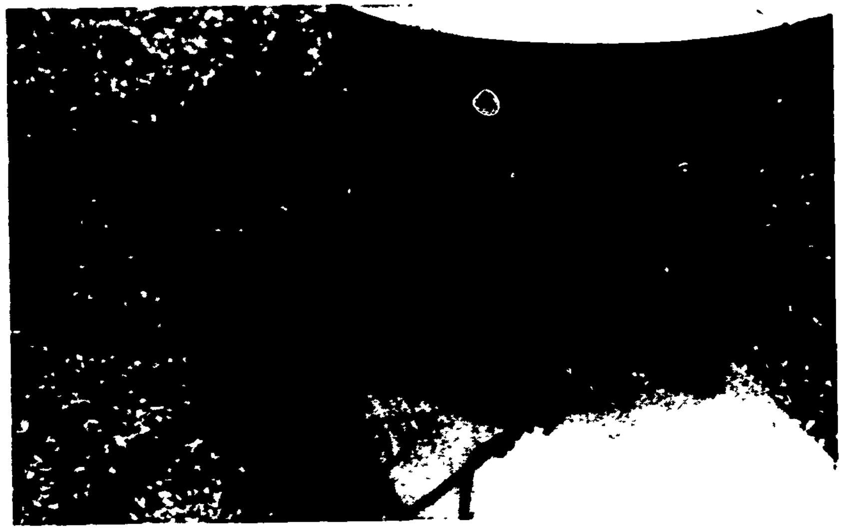
The use of plastic anchors out-of-doors or in walls subject to extremes of temperatures is prohibited. **3.11**

All cable bends will have a radius of not less than eight times the cable diameter. **3.12**

No more than 6 inches of free hanging cable will be allowed on the outside of any building. **3.13**

All cable which must run across roof areas, such as that which might run from the base of an antenna mast, will be run in weathertight conduit with provision for drainage of internal condensation for that distance where it is running parallel to the surface of the roof. **3.14**

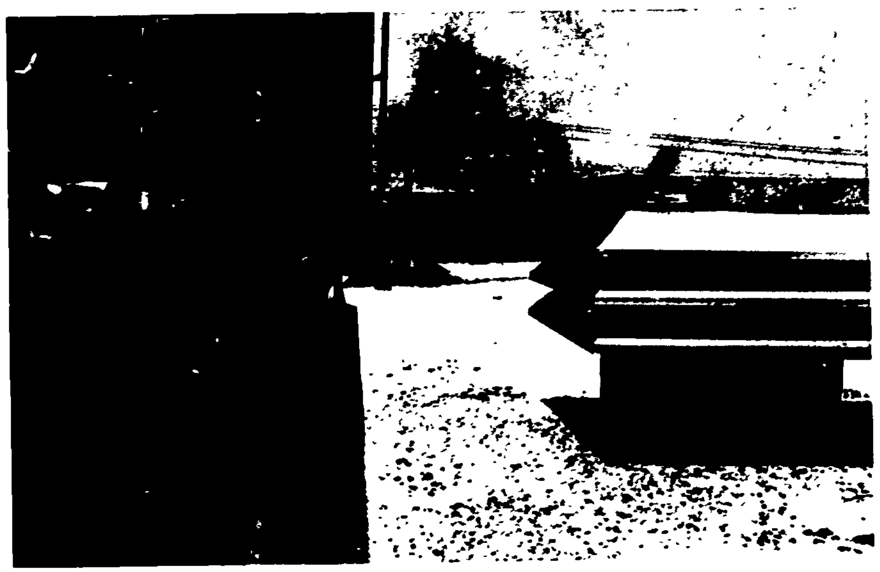
Conduit will be supported at 5-foot intervals. The conduit is to be above normal "puddle" level and will be of such a color that it will not present a hazard.



Cable should be secured with adequate messenger or clamped around the perimeter of rooftops. This poor arrangement leads to a hazard for maintenance workers, damage to ventilation, and possible voiding of bonds on roof and vent.

Although most wiring contractors have a fairly large work crew, few of these workers are really accomplished technical people. Because much of the work is mechanical in nature, many firms employ lower paid construction personnel. In many cases, these crews will run cable wherever necessary to spend the least amount of time in the school. The results can be appalling.

Section 3 serves to assure the educator that the cable is securely installed in such a manner that it will resist natural hazards which might cause it to droop and come loose or otherwise fail. Cable clamps that are impervious to rust will last many years, not just through the first warranty year. Where enough clamps are used, the cable will remain neat although temperature changes and students work on it throughout the year. Even if one clamp does fall out, there are enough left to keep the cable neatly in place.



Crew ran cable at their own discretion above; here, preplanned specifications prevailed, as shown by the clamped wiring around the perimeter of the rooftop.

Amplifier and other head-end equipment installed in finished areas of the school will be installed in equipment cabinets capable of being locked. Such cabinets will be of a neutral color, complimentary to the decor of the area in which they are installed. 3.15

All equipment will be installed so as not to interfere with school plant maintenance and in such a manner that it can be easily maintained. Equipment should be installed utilizing connectors on signal and power cables which allow for easy removal of equipment for bench service. 3.16

No electronic equipment subject to periodic maintenance is to be installed in any location necessitating use of a ladder to reach it (mast-mounted preamplifiers excluded). 3.17

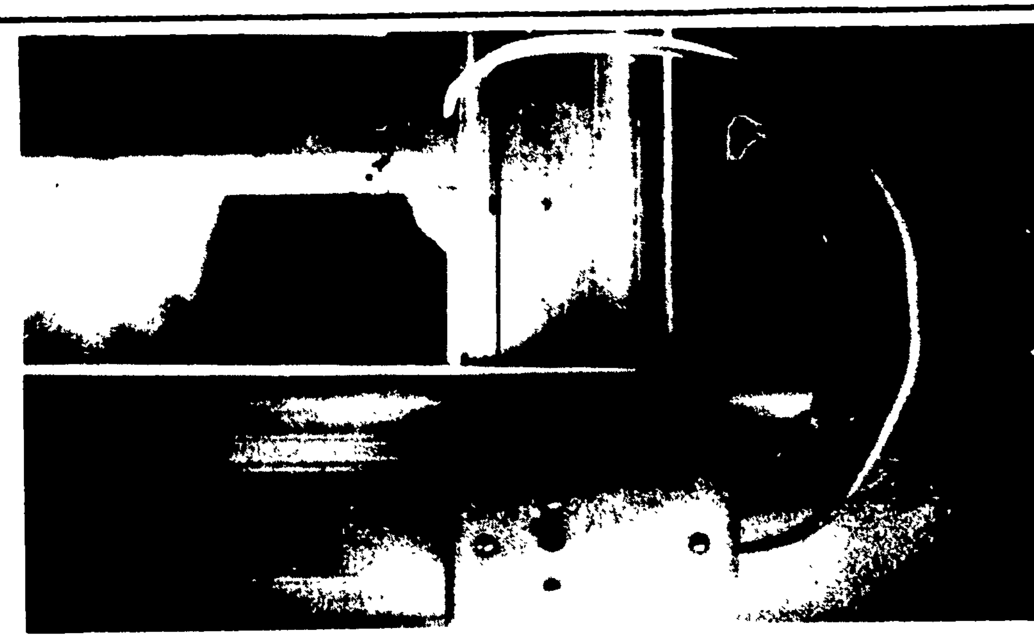
Cable access sleeves and conduits for signal cable are to be provided where directed. 3.18

All cable installed in close proximity to steam lines, water pipes, and other utilities which might adversely affect the operation of the system should be installed with suitable protection, using the utmost care. The cable should not be allowed to come in direct contact with such utility pipes and conduits. Maximum clearance possible should be maintained. Under no circumstances will the cable be run in pipe hangers provided for above pipes or taped to hangers or pipes themselves. 3.19

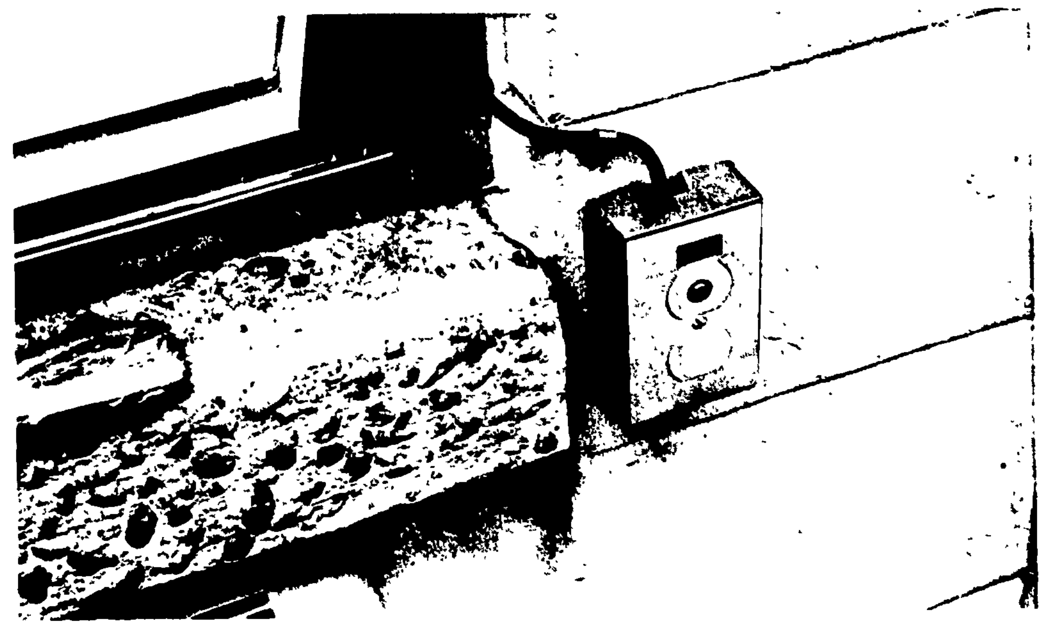
Wherever cable enters sheet metal boxes of any type, appropriate protective bushings or grommets are to be supplied. 3.20

All holes in walls, ceilings, or other parts of the building made by the contractor to provide for cable access will be appropriately calked and repaired. Calking designed for the particular 3.21

Cables should be placed in such a manner as to not interfere with normal building operation. Here is another obvious case of the MATV installer's using his own judgment without adequate supervision.



In a properly installed television system, television cables are run in spaces reserved for building services such as heating and telephone. The cable should not detract from the looks of the building or interfere with normal building operation.



environment will be used. In finished areas, damage to paint, plaster, and acoustical tile will be repaired by the contractor.

Drip loops will be provided where cable enters the school from the outside. 3.22

All airborne cable will be supported from a suitable messenger cable. 3.23

4.1 POWER REQUIREMENTS

The contractor is to install or arrange for the installation of permanent AC power outlets at all locations where AC power is needed for operation of system components. Cords between amplifier cabinets and nearby **available** AC power receptacles must not exceed 6 feet.

Where the contractor installed a new power outlet to provide power for amplifiers in the television system, such outlets should be on a separate circuit if at all possible. Where deficiencies in the existing electrical system make this impractical, a suitable AC overload device is to be provided as a part of cabinet wiring as described in subsection 4.3. 4.2

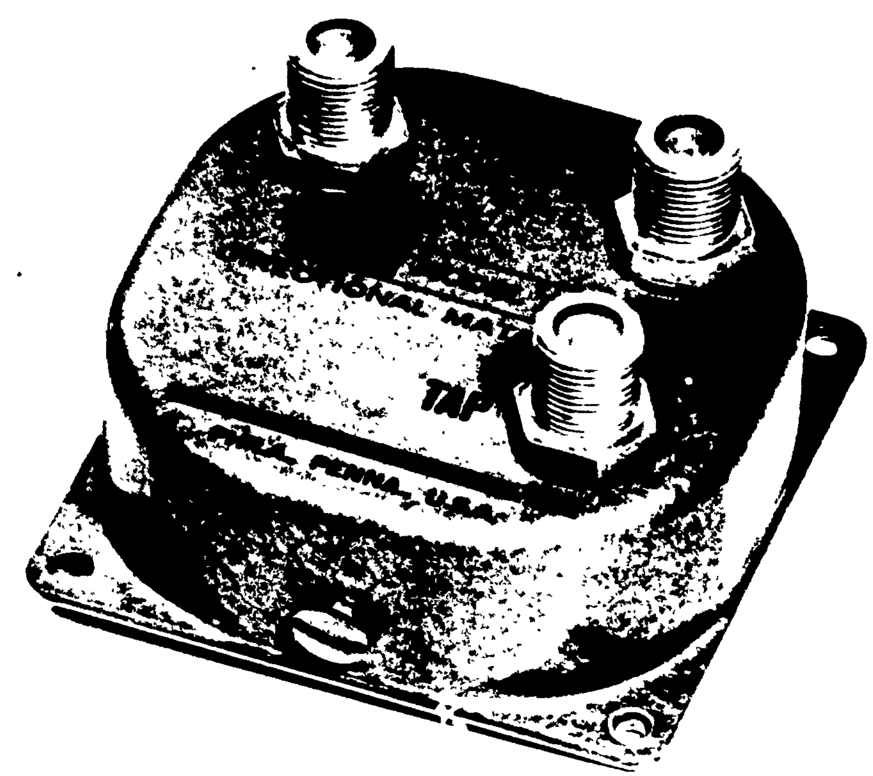
Sufficient AC power outlets are to be provided within equipment cabinets to supply power to all equipment installed within the cabinet as well as two additional outlets for use by maintenance personnel. 4.3

Power cords between AC power outlets and equipment cabinets will be 14/3 S cable. 4.4

Three-wire power circuitry and wiring devices will be used throughout. 4.5

Possibly the most important justification for this section is that it tells the contractor that the buyer is sensitive about the manner in which he installs the equipment, and that he is sensitive about the aesthetic qualities of the building and will be aware of degrading factors that a poor wiring job might present.

In terms of obtaining competitive proposals, section 3 serves to define the grade of workmanship required so that all bidders can take labor and material costs into consideration on a nearly equal basis. The contractor who does a high-quality construction job consistently has an equal opportunity to bid in competition with the contractor who may cut corners to keep his bid price down.



To distribute signals throughout a building, taps such as that shown in photograph are necessary to assure quality signals on all parts of the cable. These should be installed where they can be easily serviced.

4.6 If power is available at an amplifier location, three-wire grounding type outlets will be provided and installed in lieu of coro can adapters.

4.7 An earth or water pipe ground will be provided and all head-end equipment connected to it. (Earth ground is to be 3/4-inch, 10-foot ground rod with #6 copper wire to cabinet.) (See sub-section 6.10.)

5.1 DISTRIBUTION SYSTEM OPERATION AND PERFORMANCE CONSIDERATIONS

The system as installed will provide for distribution of properly balanced and adjusted adjacent channel television signals.

5.2 Equipment throughout the system is to be installed and operated as recommended by the equipment manufacturer.

5.3 All equipment is to be rated for continuous duty operations.

5.4 All equipment components making use of AC power are to be fused.

5.5 The system will be able to distribute N.T.S.C. color television signals without degradation.

5.6 The system will meet basic radiation limits as specified by the FCC.

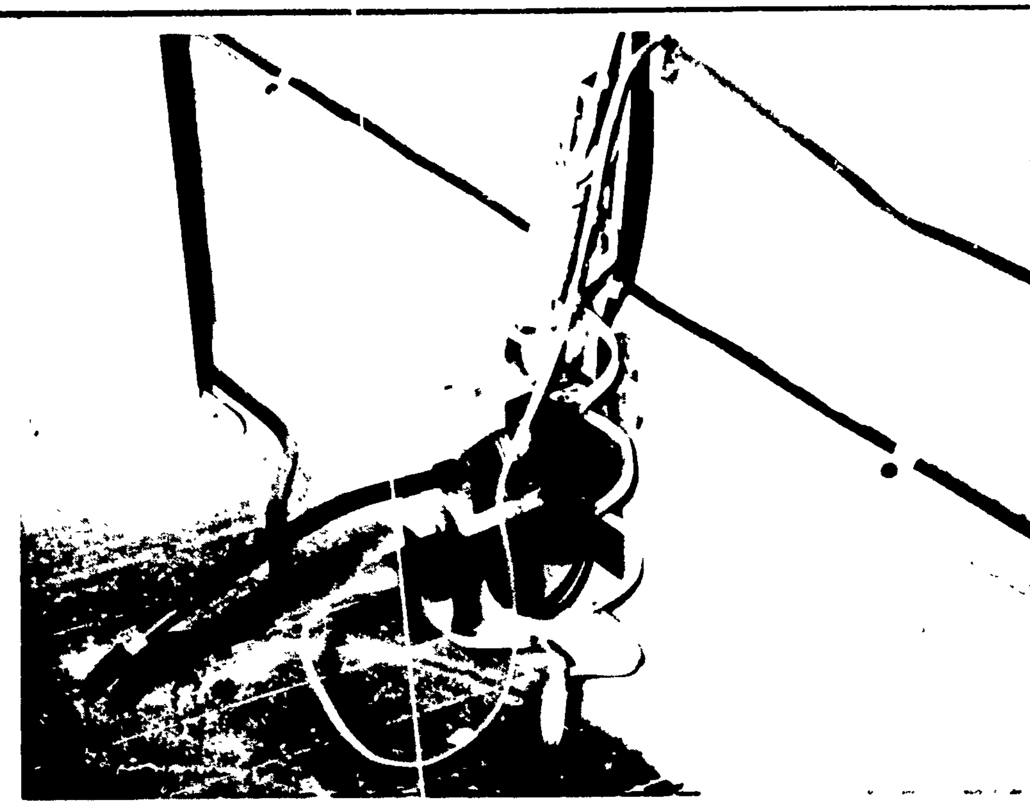
5.7 All devices installed in coaxial cable will be designed to match the characteristic impedance of the cable.

5.8 The overall distribution system will have a VSWR of 1.2 to 1 or better for VHF.

POWER REQUIREMENTS 4.0

Although the power drain is small for most television amplification equipment, the equipment does need power. The most ideal location for the equipment may not have the necessary power receptacles to do the job.

It is possible that unless specifications in this section are followed, a school could be equipped with a complete system that cannot be turned on. Providing power is indeed a cost factor in providing a system. The contractor knows the system needs and is the most logical one to arrange for such power installation. If the school maintenance personnel can provide AC outlets as necessary for the MATV installation, the specifications as issued should merely ask that a request for installation of the necessary receptacles be provided the school by the contractor as a part of his bid offering.



Without a wiring specification setting forth AC power requirements for the system and the responsibility for their installation, situations like the one pictured here will soon be prevalent.

The system bandwidth exclusive of the head-end amplifier will be from 10 MHz to 900 MHz, flat within 1.5 db P/V across the VHF portion and within 3.0 db across the UHF portion. **5.9**

Signal levels at all receiver outlets will be well balanced. System levels will be termed "well balanced" when the difference between any two adjacent low VHF band television signals (channels 2 through 6) does not exceed 2 dbm and the difference across the entire low VHF band does not exceed 6 dbm. In the high VHF band (channels 7 through 13), adjacent channels should not exceed 2 dbm in level difference, with the difference across the entire high VHF frequency range not exceeding 4 dbm. Where the supplier cannot supply a system in light of this requirement, he is to so state in his original proposal. (See subsection 1.4; also paragraph 2.5.7.) **5.10**

The minimum output at any outlet in the system is to be 0 dbm, the input being the signals, open or closed circuit, specified by the owner. **5.11**

The maximum signal available at any receptacle, making use of normally viewed open- and/or closed-circuit channels as specified by the owner, will not exceed 20 dbm. **5.12**

A signal on any specific channel, measured at any television receptacle in the system, will be within 15 dbm of the same signal measured at any other receptacle in the system. **5.13**

A channel 2 and/or channel 13 television signal inserted into the input of the head-end amplification system at a level of 0 dbm will be delivered at any receptacle in the system within the limits of subsections 5.11, 5.12, and 5.13 above. (See section 10.) **5.14**

Grounding is important not only from a fire and shock hazard standpoint, but from the standpoint of system operation as well. A well-grounded system will not radiate a signal outside the cable, and signals will be more efficiently transferred from one point to another.

If a school system has special electrical code requirements, these should be included in this section.

DISTRIBUTION SYSTEM OPERATION AND PERFORMANCE CONSIDERATIONS 5.0

Here is where a knowledgeable serviceman on the school system staff, or a consultant retained by the school system, will help the school to realize the benefit of such specifications.

Section 5 says simply that all outlets throughout the system will have a proper amount of signal. It says that one signal will be as strong as another at the same outlet, and it says that one signal will be about the same strength at every outlet in the system. It says that signals viewed will not be bothered by other unwanted signals. It sets forth some easily measured technical parameters. No matter what the system is to carry—CCTV, 2500 MHz converted TV, or open-circuit TV signals—if the performance considerations outlined here are followed, the result will be clean, clear signals that will not interfere with each other even when it becomes necessary to put signals on adjacent channels.

A word regarding television receivers! It is possible to negate all efforts of a fine distribution system installation by purchase and connection of low-quality television receivers. Older, ill-maintained receivers can introduce noise and interfering signals into the distribution system. Interference between channels (cross modulation) can occur in the receiver if the level feeding the receiver is high and the receiver selectivity is not limited. To provide optimum viewing on a multichannel system, receiver quality does become a factor.

5.15 There will be a minimum RF isolation between receiver and cable of 9 dbm throughout the system for VHF.

5.16 There will be a minimum RF isolation between receivers attached to the system of 18 dbm.

5.17 Extraneous signals present throughout the system will not exceed a level 50 dbm below any desired signal.

6.1 SPECIAL FUNCTIONS

If applicable, open/closed-circuit 2500 MHz switching will be provided in each school. A simple switch is to be provided to switch the entire distribution system from the antenna (off-the-air) to the closed-circuit cable or to the output of a 2500 MHz signal converter. The control switch is to be located in a central administrative point as directed; however, the switching may be accomplished by a remote relay.

6.2 As an alternative to subsection 6.1 above, the bidder may present a proposal providing for the simultaneous distribution and viewing of all signals specified as in normal use within the school complex on a single cable.

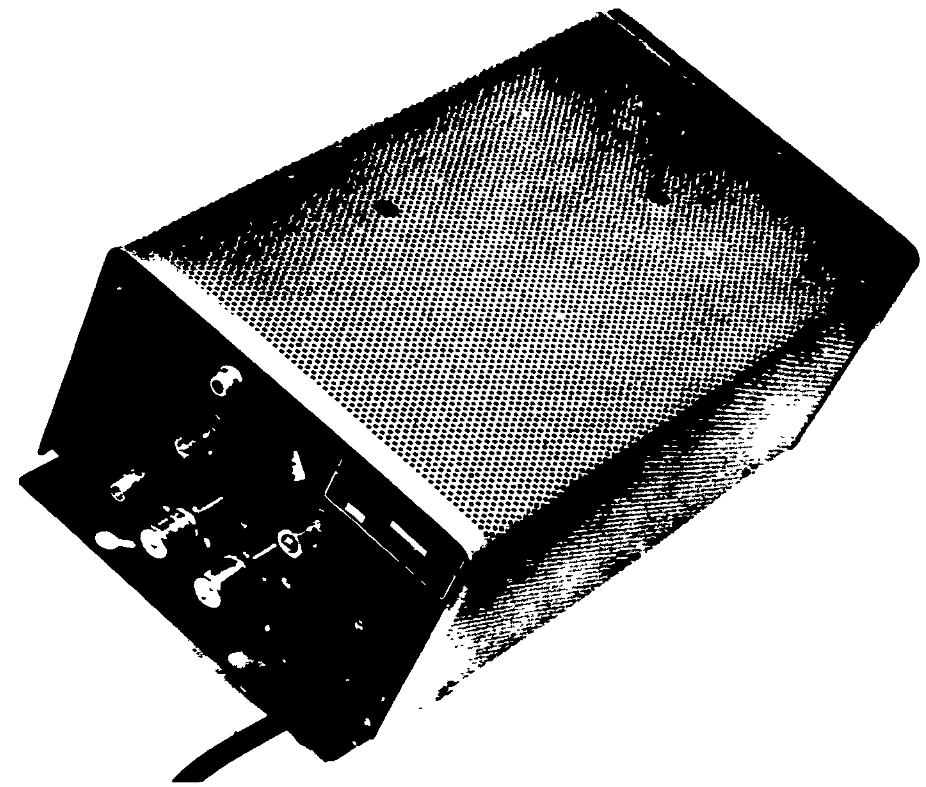
6.3 As a second alternative to subsection 6.1 above, the bidder may plan to provide for simultaneous distribution of all signals to be viewed in the school over a multi-cable system.

6.4 Provisions for local origination of television signals for distribution throughout the school will be provided as directed.

7.1 ELECTRONIC EQUIPMENT SPECIFICATIONS

Solid state or transistorized equipment is neither preferred nor prohibited. If a bidder wishes to base a proposal on the use of

MATV system amplifiers should be designed for 24-hour-a-day use. This amplifier is a tube type found in many systems throughout the country.



solid state equipment, he may do so, realizing that the proposal will be considered on the basis of economic considerations, guaranteed performance, and in light of the present state of the art of television signal distribution.

7.2 Head-End Amplifiers

7.2.1 Amplifiers supplied as part of a contract issued as a result of these specifications must be capable of providing at least 6 dbm more output than the actual loss of the system the amplifier feeds. (See section 10.)

7.2.2 Broadband amplifiers are acceptable in any system having an actual loss figure of 40 dbm or less. Where, because of a calculated figure, a system with a single broadband amplifier is contracted for and the actual loss figure exceeds 40 dbm, the contractor agrees to conform with paragraphs 7.2.3 and 7.2.4 of these specifications at no extra cost to the owner.

7.2.3 Should the system have a calculated loss figure in excess of 40 dbm and less than 60 dbm, a broadband amplification system will be acceptable. Where the use of more than one broadband amplifier in cascade is proposed, specific performance specifications of such an arrangement must be set forth. If the bidder prefers, he may set forth the merits of the use of strip amplifiers for a system with these losses and propose their use as an alternate. Should the actual losses of the system exceed 60 dbm once installed, the contractor agrees to conform to paragraph 7.2.4 at no additional charge to the owner.

7.2.4 For systems with actual loss figures of 60 dbm or higher, single channel amplifiers are required.

7.2.5 If single channel amplifiers are used, suitable mixing networks will be provided to combine the outputs of these amplifiers properly before the signals are fed into the cable system.

SPECIAL FUNCTIONS 6.0

This section is particularly important in that it points out some special capabilities which are available. Subsections 6.1, 6.2, and 6.3 deal with methods of providing for distribution of open-circuit and/or closed-circuit and/or 2500 MHz signals on the same system. Various suppliers have their own preferred way of doing the job. A key to your selection of method is the question, How easily does a teacher have access to a signal?

If the system is to be used for distribution of school-originated telecasts, here is the place to define locations and other factors relative to such origination that are pertinent. Again, the more information supplied, the better and more competitive the proposals will be.

ELECTRONIC EQUIPMENT SPECIFICATIONS 7.0

In this specification, performance is the criterion, and although all manufacturers can meet the performance set forth, they will each do it a little differently.

Subsection 7.2 is most important, as it ensures that the amplifier used will be big enough to do the job properly. The loss factors vs. amplifier types as listed here are generally accepted within the industry. Through measurement of actual losses as opposed to estimated losses, the contractor is again required to provide a system meeting performance as specified, and mistakes made in preliminary planning become his responsibility. This also provides incentive for the contractor to maintain adequate supervision on the job so that workmen do not take the long route with a cable, albeit the easy one, thus increasing losses throughout the system. Subsection 7.3 ensures that the signals at the head-end of the system will be balanced in relationship to each other so that all receivers attached to the cable will be receiving quality signals. Be sure that you supply your contractor with full information on the channels you wish to view. If you are installing a 2500 MHz system at the same time but under a separate contract, be sure that liaison exists between the contractor delivering the signal and the one distributing the signal.

Power for single channel amplifiers will be properly regulated. 7.2.6

The amplifier supplied must serve all outlets on the system without overload or distortion. 7.2.7

7.3 Preamplifiers, Reamplifiers, and Pads

Necessary preamplifiers or pads will be used to balance the input signals of the system before they are fed into the head-end amplifiers. 7.3.1

Reamplification is required in any system being provided in building additions where existing buildings are equipped with distribution systems, unless specifically waived by the owner. 7.3.2

The signal source for reamplification must be a directional coupler located in the system head-end or in a feeder running from the head-end but preceding any other tap. 7.3.3

The signal input to a reamplifier must not be less than 3 dbm. 7.3.4

The installation of taps for reamplification will not degrade service on the existing system. 7.3.5

System splitters will be provided where necessary. VSWR of splitters shall be less than 1.5 to 1. 7.4

8.1 COAXIAL CABLE

All coaxial cable supplied will be that of a known manufacturer with a **maximum** attenuation of 2.8 dbm per 100 feet on channel 2 and a **maximum** attenuation of 5.9 dbm per 100 feet on channel 13. The cable is to be sweep-tested and evidence of such test presented on completion of the system. 8.1

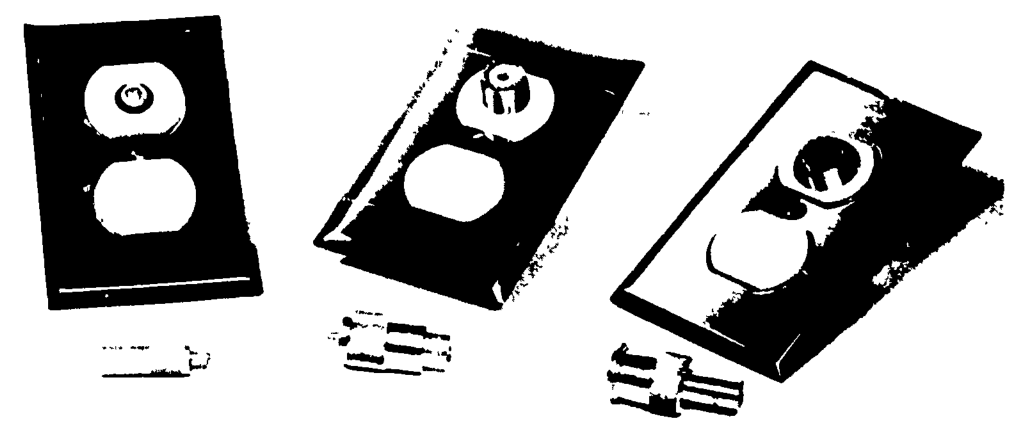
The cable is to be of new manufacture with noncontaminating jacket meeting JAN specifications. 8.2

COAXIAL CABLE 8.0

Although performance specifications in previous sections almost dictate the type of cable to be used in terms of overall performance, section 8 proceeds a bit further and again provides more information to bidders so they will be bidding on clearly defined terms. By specifying sweep-tested cable, the buyer is sure that the cable is of high quality and capable of properly transmitting the television signal. Tagging the equipment ends of cable is an indispensable help when additions are made to the systems or maintenance on cable sections is necessary.

In schools close to television signals, signals in the air may actually interfere with the signals on the cable. Double-shielded cable helps to prevent this and should be demanded in locations where local station field strengths are high. The use of double-shielded cable in industrial shop areas or in areas where other interference is present will also help guarantee better viewing.

Many types of television outlets are available. The school administrator should choose the type of outlet hardware which will best do the job in his situation. Easy access to the signal by classroom teachers is a must. If TV receivers are moved from room to room, push-on connectors are desired.



8.3 All cable attached to electronic equipment, active or passive, is to be labeled to show function and location of the other end of the cable. All labels will be typed, printed in black ink, or made with a suitable labeling device, and securely fastened to the cable.

8.4 Appropriate fittings are to be used when it is necessary to extend a length of cable. No splice is allowed within a conduit.

8.5 Where appropriate, bidders may use double-shielded cable. (See subsection 1.5; also subsection 5.16.)

9.1 THE TELEVISION RECEPTACLE

9.1 Receptacles provided for connection of television receivers are to be wall-mounted in or on standard electrical boxes.

9.2 Surface-mounted boxes provided by the contractor will be secured with no less than two suitable anchor devices.

9.3 Receptacles will provide 75 ohm access to the distribution system.

9.4 No part of the receptacle hardware will extend beyond the cover plate when not in use.

9.5 Receptacles using screw or screw-on type connections are not acceptable.

9.6 Receptacles or plugs using the center wire of the coaxial cable as the center pin of the connecting device are not acceptable.

9.7 The plug will be of the push-on, friction-held type.

9.8 If television receivers are to be permanently mounted in the classroom and permanently attached to the system, subsections 9.5, 9.6, and 9.7 above do not apply.

THE TELEVISION RECEPTACLE 9.0

There are many types of television receptacles, each just as suitable as any other as far as the television signal is concerned. The specifications listed are applicable in a school where television sets are moved about to a great degree. Here again, that which is easiest to use and requires minimum maintenance is best.

Where a receptacle is near the floor and unused for periods of the day, protruding portions can cut an ankle or shred a nylon stocking. Screw connectors, although not easy for some teachers to manage, do have a safety advantage in that they do not protrude. Quality connectors are a good investment in minimum maintenance service. Take the advice of your supplier or your consultant, but again be sure that all suppliers bid on a comparable item.

DEMONSTRATION OF PERFORMANCE 10.0

Once the system is completed, the contractor should be able to demonstrate that it does indeed work, and work right. This should be demonstrated with proper instruments that your serviceman or consultant can understand. The demonstration quickly serves to ascertain that the system is generally in shape, ready for your own serviceman to inspect in detail.

Comparing random readings here with those required in paragraph 2.7.4 may negate the necessity of a complete check by your service organization. Experience with the particular contractor, on-the-job supervision by school personnel, and other factors may also influence how and when to accept the system.

10.1 DEMONSTRATION OF PERFORMANCE

The contractor shall demonstrate compliance to the specification in general, prior to a complete check by the owner's service organization as follows:

10.1.1 A channel 13 television signal is to be inserted into the system head-end amplifier at 0 dbm. This signal will not be less than 0 dbm or more than 20 dbm at any outlet selected by the specifying engineer. (See subsection 5.13.)

10.1.2 With a channel 13 signal feeding the system as in 10.1.1, and after selected outlets have been checked, the contractor is to demonstrate the reserve gain capability of the amplifier. (See paragraph 7.2.1.)

10.1.3 Picture quality from the owner's closed-circuit source, if any, and/or the off-the-air signals will be observed on a television receiver (color, if applicable). A comparison of observed pictures should exhibit no degradation (noise, distortion, smearing, ghosting, cross modulation, etc.) of quality.

10.2 Equipment for this demonstration will be provided by the contractor.

10.3 Should such a demonstration of performance show that the contractor has not properly balanced the system and that picture degradation is present or that reserve or output gain is not as specified, a second performance demonstration will be arranged.

10.4 Should a second performance demonstration fail, the contractor agrees to correct the system deficiencies under the supervision of the owner's service organization or consultant. The contractor further agrees to pay the owner's service organization or consultant their usual fees for supervisory service.

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