



AIRPORT MAINTENANCE

APRIL 14, 1963

Federal Aviation Agency



AC NO: AC 150/5380-1

AIRPORTS

EFFECTIVE :

4/14/63

SUBJECT : AIRPORT MAINTENANCE

1. PURPOSE. This guide provides a basic checklist and suggestions for an effective maintenance program on airports. It is not intended to be a complete maintenance manual but provides the fundamental information which airport authorities can use in developing, organizing, and managing airport maintenance activities. The material in this circular has been assembled specifically for use by overseas staffs to aid them in fostering the development of more effective airport maintenance procedures and practices.
2. DESCRIPTION OF THE CIRCULAR. The circular contains suggestions for organizing maintenance staffs and maintenance functions on civil airports. It defines the general scope of work required to assure essential maintenance accomplishment, suggests inspection schedules, and contains charts showing common maintenance problems, their probable causes and suggested corrective actions.
3. HOW TO GET THIS PUBLICATION. Copies of this advisory circular can be obtained free of charge from:

Federal Aviation Agency
Distribution Unit, MS-163
Washington 25, D. C.

Cole Morrow
Cole Morrow
Director, Airports Service

TABLE OF CONTENTS

	<u>Page No.</u>
CHAPTER 1. MAINTENANCE PRINCIPLES AND PROCEDURES	1
1. Why Maintenance?	1
2. Airport Management Attitude.	1
3. Maintenance and Design or Construction Deficiency.	1
4. Responsibility for Maintenance.	1
5. The Maintenance Inspection or Survey.	2
CHAPTER 2. MAINTENANCE GUIDELINES	5
6. Grading and Drainage Maintenance Procedures.	5
Figure 1. Trouble Shooting Guide - Grading and Drainage Maintenance.	7
7. Pavement or Surfacing Maintenance.	8
Figure 2. Trouble Shooting Guide - Pavements.	11
8. Maintenance of Marking, Lighting, and Related Electrical Facilities.	13
Figure 3. Trouble Shooting Guide - Marking and Lighting.	15
9. Maintenance of Buildings.	16
10. Landscaping and Grounds Maintenance.	18
11. Maintenance of Sewage Disposal Facilities.	19
APPENDIX 1. THE USE OF THE "MEGGER" IN MAINTAINING AIRPORT LIGHTING CIRCUITS	(2 pages)

CHAPTER 1. MAINTENANCE PRINCIPLES AND PROCEDURES

1. WHY MAINTENANCE? Any structure or facility which is subjected to usage or exposure to the elements is bound to deteriorate. While such deterioration cannot be completely prevented, it can be arrested to the point where the expected life of a facility can be realized, consistent with the durability which went into its original design and construction. Timely and effective maintenance is the one sure means by which this deterioration can be reduced to its least detrimental minimum.
2. AIRPORT MANAGEMENT ATTITUDE. Lack of adequate, timely maintenance is the greatest single cause of unnecessary deterioration of airport facilities. The attitude of the airport management towards maintenance responsibilities readily reveals itself upon examination of the functional reliability of airport components and even in the airport's overall appearance. Many cases are known where failure of an airport element - pavement, drainage feature, building facility or utility - was directly attributable to an indifferent maintenance attitude and the consequent absence of a vigorously followed maintenance program.
3. MAINTENANCE AND DESIGN OR CONSTRUCTION DEFICIENCY. Maintenance, no matter how effectively carried out, cannot overcome or compensate for a major design or construction inadequacy. It can prevent the total and possibly disastrous failure which may result from such deficiency. The maintenance inspection can reveal, at an early stage, where a problem exists (or may develop) and thus provide the time-warning to permit corrective action to be taken.
4. RESPONSIBILITY FOR MAINTENANCE. Maintenance is a continuous function and is the responsibility of every one who is employed on the airport. Nevertheless, this continuous "look-see" responsibility is only a small part of the job. A series of scheduled, periodic inspections or surveys, conducted by experienced engineers and technicians must be carried out in a truly effective maintenance program. The program of maintenance surveys must be controlled to assure that each element or feature being inspected is thoroughly checked, that potential problem areas are identified, and that corrective measures are recommended. The maintenance program must provide for adequate "follow-up" of the inspection to see that the corrective work is expeditiously accomplished and recorded. The many and varied demands of this work make it clear that the overall maintenance program must be entrusted to a competent and responsible individual on the airport's technical staff.

4/14/63

Although everyone who works on the airport is in effect a "maintenance reporter," the detailed maintenance surveys must be performed by persons possessing special skills and knowledge. Aside from a thorough familiarity with the various above and below ground installations, facilities, and appurtenances, they must be well aware of the distress warning signs which normally precede trouble and how to recognize them. They must know the corrective procedures which will arrest the observed potential problems and be thoroughly schooled in operation of the various tools or items of equipment which are available for their use.

It will probably not be possible to find one person gifted in the many skills and crafts which are essential to proper maintenance and repair of an airport complex. The maintenance supervisor or person charged with overall maintenance responsibility, should possess a general working knowledge of all such skills however, and in addition to having a profound respect for maintenance functions, must be a competent organizer and talented leader. Such a person will surround himself with the needed specialists and will see also that training of his staff is carried out to insure maximum benefit is realized from those who make up his organization.

5. THE MAINTENANCE INSPECTION OR SURVEY. The maintenance supervisor should establish a schedule of formal inspections for the variety of facilities and services installed at the airport. This does not mean that at other than scheduled inspection times the staff is indifferent to its maintenance responsibilities. Naturally, all are expected to be aware of the continuous need for advising on and reporting of potential or actual maintenance problems.

The formal inspection should be carefully scheduled to assure that all areas, particularly those which may not come under day-to-day observation, are thoroughly checked. In making the inspection, each problem or potential problem discovered should be recorded by identity, location, type of distress, and its apparent cause, and a suggested method of correction should be recommended. Maximum advantage should be made of the use of maps and charts to provide a historical log of the maintenance work and to aid in checking performance of facilities. The inspector should submit a report of his findings and recommendations, initiate action to get the work underway, and monitor progress on the rehabilitation work to assure its early completion and acceptability.

The organization for maintenance activities will vary from airport to airport, but the general types of maintenance are relatively the same regardless of airport size or extent of development. Whereas

the scope of maintenance work will vary in complexity and degree, maintenance of the facilities listed below generally is required at all airports:

Grading and drainage

Pavements (or surfaces)

Lighting and electrical facilities

Building and furnishings

Landscaping and grounds

Sewage disposal facilities

The balance of this report is broken down into subject headings as indicated above. Under each heading an outline of a maintenance procedure - the what, when, and how - is given. Many items which will require maintenance are listed but others may exist in specific instances or become evident as a result of local experience. At a risk of being repetitious, some elements of the outlines are repeated for each part. This is considered desirable to permit flexibility of report usage to meet any nature of organization which might be found in the wide spectrum of aviation organizations which these data are intended to reach.

CHAPTER 2. MAINTENANCE GUIDELINES

6. GRADING AND DRAINAGE MAINTENANCE PROCEDURES.

- a. What to do. A periodic, complete, on-the-ground inspection should be conducted by trained technicians and defective conditions of off-pavement surfaces, and surface and subsurface drainage facilities recorded. This inspection may be combined with inspections of other areas or facilities.
- b. When to do it. The period between inspections will vary with geography, topography, and climate but as a minimum should be conducted at six-month intervals with additional inspections during and immediately following unusual storms or other meteorological phenomena.
- c. What to Look for:
 - (1) Signs of wind, water, or blast erosion
 - (2) Ponding of water in undesired areas
 - (3) Buildup of soil at pavement edges preventing runoff
 - (4) Eroded ditches and spill basins
 - (5) Clogged and overgrown ditches
 - (6) Broken or displaced inlet grates or manhole covers
 - (7) Clogged or silted inlets
 - (8) Broken or deformed pipe
 - (9) Backfill settlement over pipes
 - (10) Erosion around inlets
 - (11) Generally poor shoulder shaping and random erosion

4/14/63

- d. What Work is Required? The Grading and Drainage Trouble Shooting Guide, Figure 1, indicates common problems found on airports and suggests possible cures for these problems.
- e. What Equipment is Needed? For general maintenance and repairs of drainage facilities and grading, a front-end loader is very versatile. It can be used as a dozer, loader, grader, and hoist for pipe laying. Some also are available with backhoe attachment which adds to their versatility. Other motorized equipments which are useful include a jeep with auger, trenching attachment and plow blade, and dump trucks. Naturally, a supply of hand tools - shovels, picks, brush axes, etc., should be available. A mowing attachment for the jeep or separate mower should be available for general vegetation control.
- f. How Many Men are Needed? The labor force for most day-to-day drainage and grading maintenance normally is not large. Depending on the scope of work, an equipment operator may or may not be required. For normal ditch dressing, several hand laborers can be expected to satisfy most requirements. A dump truck may be required in some cases. If pipe removal and replacement are required, the use of equipment usually will be desirable but may not be necessary unless large pipes are involved. Most normal drainage and grading maintenance work can be accomplished by hand labor but if time is a factor, it is usually advantageous to employ equipment. Even on a large airport, a maximum labor force of about four men should be able to handle most drainage and grading maintenance and repair work.

FIGURE 1. TROUBLE SHOOTING GUIDE - GRADING AND DRAINAGE MAINTENANCE

<u>Problem</u>	<u>Probable Cause</u>	<u>Cure</u>
Ditch erosion	Excessive flow velocity; absence of ditch lining	Reestablish lining (sod, riprap, etc.); install ditch checks
Erosion around structure	Poor backfill compaction; improperly designed inlet	Refill and compact; install apron; redesign inlet entrance
Settlement over pipes	Poor backfill compaction	Fill and recompact (removal and replacement of fill may be required if condition is recurring)
Crushed or broken pipe	Overload on pipe: (1) Insufficient cover (2) Excessive fill load	Replace pipe: (1) In concrete bedding or encasement (2) Use "elastic" cover (imperfect trench) in backfill
Surface erosion	Flowing water concentrating in wrong areas; poor ground cover; poorly designed grades	Remove cause (obstruction to intended flow), fill ruts and gullies; reestablish ground cover; reshape surfaces
Obstructed ditches or structures	Presence of foreign material; vegetation overgrowth	Remove obstructions and debris; trim vegetative growth; remove debris sources
Runoff trapped on pavement edges	Soil or turf accumulation at pavement edge	Reshape pavement shoulder
Blast erosion	Unprotected erosion-susceptible soil	Provide surface protection (turf, bituminous surfacing, etc.), consistent with operational requirements
Broken or displaced grates or manhole covers	Improper seating in frame; loose or broken fastening bolts or anchors	Clean cover recesses or grind cover to prevent rocking; replace broken units; anchor firmly

7. PAVEMENT OR SURFACING MAINTENANCE.

- a. What to do. The paving engineer should make a thorough condition and performance survey by conducting a detailed field inspection of all pavement areas (or surfaced areas subject to ground traffic).
- b. When to do it. Inspection of all paved or surfaced areas should be scheduled at least twice a year. In temperate climates, one inspection should be scheduled for spring and one for fall. Any unusual storms or other conditions which might have a generally adverse effect on the pavements would also necessitate a complete inspection. In areas of uniform temperature, the inspection should be conducted immediately following and immediately prior to the rainy season, if one exists.
- c. What to Look for:
 - (1) Unsealed old cracks and joints
 - (2) Random cracking (transverse, longitudinal, corner)
 - (3) Surface breakup (scaling, raveling)
 - (4) Joint faulting or spalling
 - (5) Pumping or rocking of slabs
 - (6) Surface irregularities (bird baths, washboard)
 - (7) Bleeding
 - (8) Pot-holing
 - (9) Bitumen oxidation
 - (10) Map cracking, alligator cracking, crazing
 - (11) Pop-outs or slab blowup
 - (12) Slipperiness
 - (13) Extruded joint material
 - (14) Bitumen erosion from solvents

- (15) Miscellaneous settlement
 - (16) Surface rutting or grooving
 - (17) Binder stripping
 - (18) Broken curbs and walks
- d. What Work is Required? For correcting minor pavement distress and failures, the Paving Trouble Shooting Chart, Figure 2, contains suggested cures which have been found effective over a long period of time.
- e. What Equipment is Needed? The normal day-to-day pavement maintenance requires only hand tools but certain specialized equipment is recommended for some jobs. Routing-out of joints in concrete pavements is best accomplished by a hand operated, motor-driven machine especially designed for that purpose. Expedient plow-type devices have been developed also to aid in removing old joint material. Joint sealing can be accomplished by hand pouring from kettles with narrow spouts, but some sealing materials require pressure application and must be applied with specialized equipment.

If concrete slabs must be broken, the use of mechanical hammers is recommended (air, gasoline, electric). These hammers can also be used for drilling slabs.

Patching and spot sealing can be expedited by use of trailer-type asphalt kettles. Those equipped with a powered handspray bar are valuable maintenance and repair items.

Compaction of patches can be accomplished with hand tampers but better and more uniform results can be assured if small vibrating compactors are employed. These vibrating compactors are easy to operate, transportable in small vehicles, can work in very confined areas, and do an excellent job.

A dump truck to transport materials, tools, and personnel is a necessity.

Large-scale work, for example seal coating of extensive areas, requires specialized equipment, such as pressure distributors for bitumens, aggregate spreaders, and rollers. As a general rule, work of this type is performed by contractors or others organized for such large-scale activities.

4/14/63

- f. How Many Men are Needed? Two to six men, trained in the various techniques of repairing and familiar with the tools available to them, can perform the routine maintenance required on the pavement surfaces. Work requiring more than such a crew would normally be considered as major repair and will require application of methods, materials, and equipment beyond the normal maintenance requirement.

FIGURE 2. TROUBLE SHOOTING GUIDE - PAVEMENTS

<u>Problem</u>	<u>Probable Cause</u>	<u>Cure</u>
Crack and joint sealer missing or not bonded to slabs	Faces of joints (cracks) not clean when filled; incorrect application temperature of sealer; wrong kind of seal material	Remove old material if extensive areas affected, clean joints and cracks, reseal properly
Random cracking	Uncontrolled shrinkage (poor joint spacing); overstressed slabs; slab support lost; subgrade settlement; bitumen too hard or overheated in mix	Seal newly formed cracks; replace subbase to establish support; if pavement being overloaded, probably will require overlay
Surface scaling or breakup	In <u>PCC</u> - Overworked finishing operation; inadequate curing; concentrations of de-icing salts In <u>Flexible Pavement</u> - Overheated binder; poor aggregate gradation; insufficient binder; incorrect binder or aggregate	In <u>PCC</u> - Remove and replace panel; resurface with thin bonded concrete; resurface area with bituminous concrete In <u>Flexible Pavement</u> - Apply seal coat; replace problem material; reinforce by overlay
Joint (1) faulting or (2) spalling	(1) Variable support for unbonded slabs; loss of load transfer capability; (2) incompressible matter in joint spaces; excessive joint finishing	(1) Remove problem slab, replace subbase, replace slab (tie to existing pavement); (2) clean joint, refill with bituminous-sand mix, reseal
Pumping or rocking slabs	Saturated pavement foundation; lack of subbase	Prevent entrance of water (correct the drainage problem); pump slurry under slabs to reseal; replace slabs and slab foundation
Surface irregularities: Rutting Washboarding Birdbaths Grooving Undulations	In <u>PCC</u> - Poor placing control; broken slabs, poor finishing In <u>Flexible Pavement</u> - Non-uniform settlement from inadequate compaction of pavement components or fill; unstable mix (poor aggregate gradation, too rich, etc.); poor laying control	In <u>PCC</u> - Patch local areas or overlay, if widespread In <u>Flexible Pavement</u> - Skin-patch local areas; apply leveling course; roll with kneading rollers

FIGURE 2. TROUBLE SHOOTING GUIDE - PAVEMENTS (CONT'D)

<u>Problem</u>	<u>Probable Cause</u>	<u>Cure</u>
Bleeding of bituminous binder	Too much binder in mix (overrich mix)	Scrape off excess material; blot with sand Note: Bleeding is usually an indication that other surface deformities (rutting, washboarding, etc.) will occur
Potholes	Water entering pavement structure; segregation in base course material	Remove and replace base (and subbase if required), replace surface and seal
Oxidation of bituminous binder	Lack of timely seal coat; binder overheated in mixing; wrong grade of asphalt for climate	Apply seal coat
Slap cracking; crazing; alligator cracking	In <u>PCC</u> - Excessive surface finishing; use of ice dissolving salts (scaling will usually follow) In <u>Flexible Pavement</u> - Overload; oxidized binder; underdesigned surface course (too thin)	In <u>PCC</u> - If surface deforms or breaks, resurface In <u>Flexible Pavement</u> - Overlay; apply seal coat
Pop-outs at joints	Dowels misaligned	Fill pop-out hole with bituminous concrete or bituminous-sand mix (if recurring may require replacement of joint assembly)
Slab "Blowup"	Incompressible material in joints preventing slab from expanding	Repair blown-up area; clean and reseal joints
Slipperiness	In <u>PCC</u> - Improper finish (too smooth); type of curing membrane; excessive curing In <u>Flexible Pavement</u> - Overrich mix; poorly designed mix; polished aggregate; improperly applied seal coat; wrong kind of seal coat	In <u>PCC</u> - If finish too smooth, resurfacing required to provide texture; wire broom to remove curing membrane In <u>Flexible Pavement</u> - Apply textured seal coat

8. MAINTENANCE OF MARKING, LIGHTING, AND RELATED ELECTRICAL FACILITIES.

- a. What to do. Visual inspection of the airfield lighting system should be made periodically, taking into account the recommendations of component manufacturers, weather, location of the airport, numbers and nature of operations, and system complexity. In addition, regular readings should be made on system resistance, and other circuit tests should be made as recommended by manufacturers. Standby units should be run at regular intervals to assure readiness if required.
- b. When to do it. Complete visual inspections of the lighting system should be made routinely at least once a week. If severe storms occur in intervening periods, resulting in excessive rainfall or lightning strikes, additional inspections should be conducted immediately thereafter. Operations of snow plows can be damaging to light fixtures, and inspections of light units should be made following plowing operations. Circuit resistance readings (megger readings) should be taken at least once each month.
- c. What to Look for:
 - (1) Burned-out bulbs and lamps
 - (2) Broken lenses or filters
 - (3) Dirty lenses
 - (4) Vegetation obscuring lights
 - (5) Fixtures knocked over or displaced
 - (6) Damaged or insecure cones
 - (7) Evidence of lightning strikes
 - (8) Decreasing circuit resistance
 - (9) Faulty ground connection
 - (10) Malfunctioning of regulators
 - (11) Water in belowgrade fixtures or components

4/14/63

- (12) Readiness of standby power source
 - (13) Torn or damaged wind indicator
 - (14) Faded or obscured markings
- d. What Work is Required? The Lighting and Marking Trouble Shooting Guide, Figure 3, contains a listing of normal lighting system problems, their probable causes and suggested cures.
- e. What Equipment is Needed? For routine upkeep and maintenance of airport lighting systems normally only small hand tools, associated with the electricians' trade, are required. Testing of circuits requires megohmmeters, ammeters, and voltmeters. And while not essential, a supply of cable splice kits can be a valuable addition to the maintenance stock. A small electrical shop is desirable to facilitate repair of units.
- f. How Many Men are Required? Routine maintenance of the airfield lighting system can be accomplished by one or two men.

FIGURE 3. TROUBLE SHOOTING GUIDE - MARKING AND LIGHTING

<u>Problem</u>	<u>Probable Cause</u>	<u>Cure</u>
Burned-out bulbs and lamps	Old age; abnormal power surge	Replace bulbs; check regulators for overload cut-off operation
Broken lenses or filters	Struck by blast-propelled stones; sudden temperature change (hot filter or lens chilled by sudden cold rain)	Replace; remove loose material that may be danger to lights
Dirty lenses	Jet exhaust residue; dust	Periodic cleaning
Vegetation obscuring lights	Lack of timely mowing	Sterilize area around light to prevent growth of weeds; better mowing program
Portions of lights in circuit dim or out	Low circuit ground resistance open circuit	Locate ground by megger (resistance) readings and correct; locate break and repair or replace cable <u>Note:</u> Some comments on use of "megger" (ohmmeter) are given in attachment 1 to this advisory circular.
Water in below-grade fixture	Broken lens or cover; improper lens seal; damaged gasket; clogged drain in certain type of units	Replace damaged element; clean out drain, if provided
Damaged fixtures or broken lamps in flush or semi-flush in-pavement lights	Pressure resulting from high, nonyielding force exerted on cover of unit (such as from snow plow blade); plow blade strikes	Raise plow blade slightly when removing snow

4/14/63

9. MAINTENANCE OF BUILDINGS.

- a. What to do. A schedule of periodic inspections of the airport buildings should be established and followed. Tenants and other occupants of the building should be made conscious of their responsibilities in maintaining the structure and facilities in good order and sound condition. All responsible occupants should be acquainted with means whereby maintenance or repair work can be reported to proper authorities. It may be desirable to designate a person in each building (or group of buildings) to perform the daily maintenance inspections and serve as a focal point for reported deficiencies.
- b. When to do it. Daily surveillance of building facilities should be an automatic function of airport personnel. The scheduled inspection should serve to formalize the maintenance survey and to cover those areas which may not come under daily scrutiny. As a general rule, a monthly scheduled inspection should be conducted. Local conditions may dictate a shorter or longer interval between such inspections. Inspections during or immediately after severe storms frequently can disclose or emphasize deficiencies and reveal otherwise unnoticed faults.
- c. What to Look for:
 - (1) Broken windows and window panes
 - (2) Paint deterioration (fading, scaling, peeling)
 - (3) Loose tiles (floor, wall, ceiling)
 - (4) Broken stairs or steps and guard rails
 - (5) Adequacy of trash and refuse depositories
 - (6) Leaks in roof or walls
 - (7) Defective appliances (driers, dispensers, fans, p. a., etc.) and fittings
 - (8) Torn or broken furniture
 - (9) Missing or mutilated signs
 - (10) Burned-out lamps and broken light fixtures

- (11) Vandalism "art and literature"
- (12) Available (and functional) fire extinguishers
Note: Periodic and thorough inspections by the Fire Marshall or trained fire fighting specialists should be performed on all aspects of the fire prevention systems and program.
- (13) Debris and trash accumulation
- (14) Blocked doors and passages; broken door closers
- (15) Defective plumbing (stopped drains, leaks, broken fixtures, etc.)
- (16) Apparent structural deficiencies, i.e., sagging beams and girders, floor or wall cracks, etc.
- (17) Hazardous sidewalks

Note: Heating and air-conditioning systems usually require attendance and care by specialists in these fields, and such persons should be made responsible for maintenance of these systems.

- d. What Equipment is Needed? Hand tools associated with the various building trades and crafts, such as carpentry, masonry, electrical, and plumbing, are needed. Larger airports may find a furniture repair shop is desirable. Shop space to facilitate repair of units should be provided.
- e. How Many Men are Required? Each of the building trades or crafts should be represented. In some places, it may be possible to utilize one person to cover more than one phase of the work and thus realize an economy of personnel for, except on all but the largest of airports, the routine maintenance will not fully occupy each specialist every day.

10. LANDSCAPING AND GROUNDS MAINTENANCE.

- a. What to do. Visual inspections of the "nonaircraft" areas of the airport should be accomplished. The inspections may be carried out simultaneously or concurrently with other maintenance inspections.
- b. When to do it. Grounds inspections should be made at least once each month.
- c. What to Look for:
 - (1) Surface erosion
 - (2) Dying trees and shrubs
 - (3) Broken tree limbs
 - (4) Weed overgrowth
 - (5) Adequacy of mowing, trimming and pruning
 - (6) Trash, rubbish and other undesirable deposits
 - (7) Pavement problems in roads, parking areas, etc.
(See also par. 7, Maintenance of Pavements)
 - (8) Lack of ground cover
 - (9) Damaged fences and gates
 - (10) Damaged or inoperative lighting
 - (11) Inadequate or damaged signs and markings
 - (12) Availability and adequacy of safety features
(traffic signals, emergency sand boxes, etc.)
- d. What Work is Required? Maintenance of airport grounds usually requires only hand labor. The work normally will comprise clean-up jobs, such as removal of trash, trimming of lawns, pruning of trees and shrubs, reseeding and similar tasks.
- e. What Equipment is Needed? Except in unusual cases only hand tools are required for general ground maintenance. Hand mowers (powered) are needed for grass and ground cover control.

f. How Many Men are Required? One full-time employee can handle most grounds maintenance, although for particular jobs some augmentation will be required.

11. MAINTENANCE OF SEWAGE DISPOSAL FACILITIES. The nature and extent of the sewage treatment and disposal facilities have a corresponding effect on the system's maintenance requirements. Where elaborate airport sewage treatment facilities are installed, there no doubt will be personnel trained in plant operations, and they should be made responsible for plant and system maintenance. Usually such plants are found on only the largest of airports.

Where less extensive or more primitive disposal systems are employed, such as septic tanks, primarily filters only, or where raw sewage is dumped into convenient water courses, maintenance problems will be less demanding technically but will impose other responsibilities on the airport management. The more primitive the installation the more acute are the requirements to prevent the system from becoming a hazard to health or a nuisance. It should be very evident that the disposal of untreated sewage into outfalls where there is even a remote possibility of contamination or pollution endangering human or animal life, should be discouraged vigorously.

The upkeep of sewerage (piping and ancillary facilities) will require very little maintenance effort. Occasional rodding and flushing may be required to remove blockages but this usually cannot be anticipated in a separate system. If a combined system is installed, i.e., one handling both sanitary sewage and storm water, some clogging may be anticipated after severe rains due to the introduction of foreign material (twigs and branches, silt, paper, etc.) flushed into the system by heavy surface runoff. Where kitchen waste is disposed of through the sewer system, it is sometimes the practice to install grease traps or separators. These will require frequent cleaning to perform effectively.

Recurring maintenance which will be required on some components of sewage treatment plants is listed below:

- a. Septic tanks - septic tanks require periodic pumping out. The frequency of this maintenance depends basically on the size of the septic tank in relation to the population served.
- b. Sand filters - the mat which accumulates on the surface of the filter bed must be removed periodically.
- c. Grit chambers - removal of accumulated grit must be accomplished at regular intervals unless automatic means are available for such removal.

4/14/63

- d. Contact beds - the ballast or filter material must be removed and cleaned periodically when clogging becomes evident.
- e. Trickling filters - these filters encourage development of filter flies (psychoda) which can become a nuisance. Flooding of the filter bed to drown the larvae is an effective means of control. Normally, flooding at 10- to 12-day intervals during the filter fly season is suggested.

ATTACHMENT 1. THE USE OF THE "MEGGER" IN MAINTAINING
AIRPORT LIGHTING CIRCUITS

Perhaps the handiest and most effective device available to the lighting technician for lighting system maintenance is the "500 volt megger." This instrument measures resistance in a series circuit. It is simple to operate, versatile, and relatively inexpensive.

Most airport lighting system problems result from circuit grounding. When tests of a circuit show steadily decreasing resistance, grounds in the field circuit are indicated. Trouble can be expected unless the ground is located and eliminated. Periodic "megger" readings of the system, therefore, provide a forecast of potential problems and permit correction of them before system failure occurs.

To check the circuit resistance with a megger, it is only necessary to:

1. Switch off the power to the regulator.
2. Disconnect the series cable leads at the regulator.
3. Connect one megger lead to the series cable.
4. Connect the other megger lead to ground.
5. Turn the megger crank and read resistance.

The megger can also be used to locate a fault or ground in the circuit. This may be accomplished as follows:

1. Disconnect the series cable leads at the regulator.
2. Open the primary on each side of an isolating transformer located at about the midpoint of the circuit and isolate these primary leads from ground.
3. Connect one megger lead to ground (the counterpoise, if installed),
4. Connect the other megger lead to one side of the series cable.
5. Take a megger reading.
6. Repeat steps 4 and 5 for the other side of the cable.

Comparison of the megger readings will reveal the side of the circuit in which the problem lies (assuming only one fault exists in the circuit).

By repeating the process described above, each time dividing the "problem side" of the circuit in half, the portion of the cable which is grounded can be easily isolated.