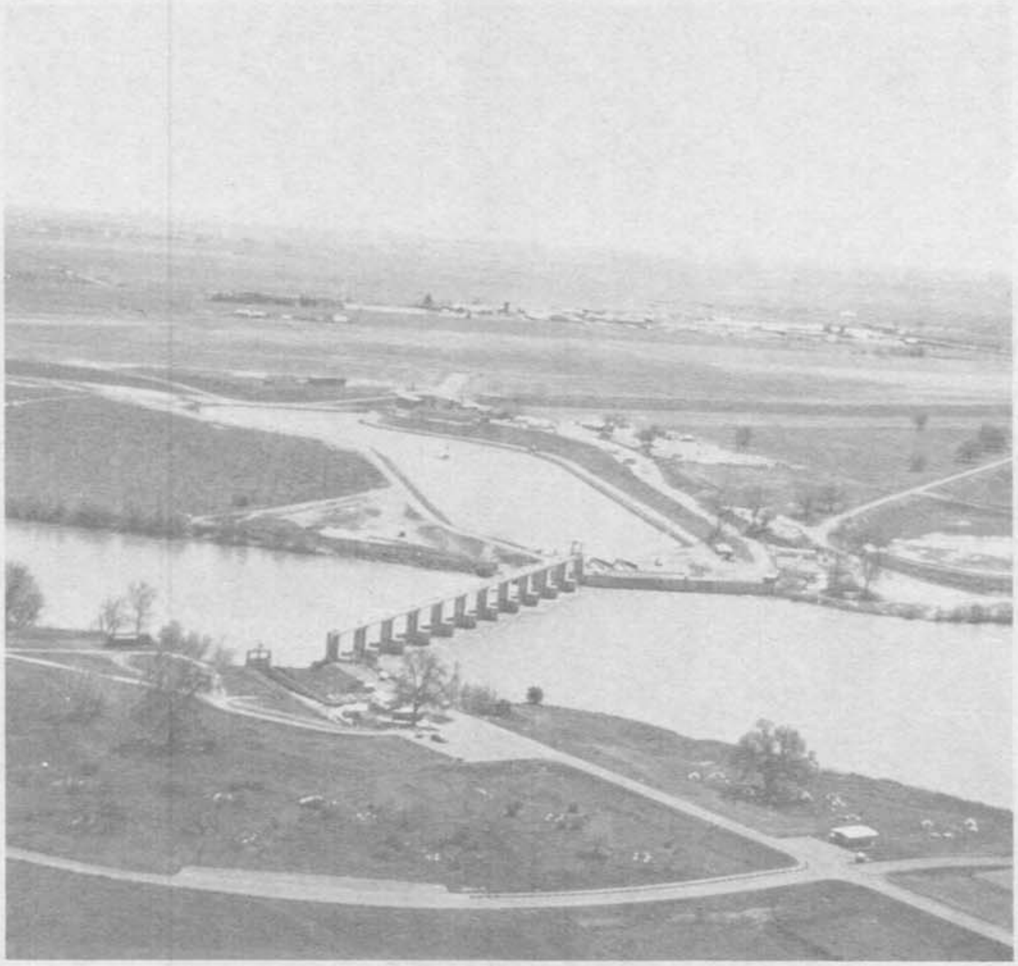
WATER OPERATION AND MAINTENANCE

BULLETIN NO. 102

DECEMBER 1977



IN THIS ISSUE

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

The Water Operation and Maintenance Bulletin is published quarterly for the benefit of those operating water supply systems. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning laborsaving devices and less costly equipment and procedures will result in improved efficiency and reduced costs of the systems for those operators adapting these ideas to their needs.

To assure proper recognition of those individuals whose suggestions are published in the bulletins, the suggestion number as well as the person's name is given. All Bureau offices are reminded to notify their Suggestions Award Committee when a suggestion is adopted.

Any information contained in this bulletin regarding commercial products may not be used for advertisement or promotional purposes and is not to be construed as an endorsement of any product by the Bureau of Reclamation.

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Division of Water Operation
and Maintenance
Engineering and Research Center
Denver, Colorado 80225

COVER PHOTOGRAPH:

Red Bluff Diversion Dam, in the foreground, diverts Sacramento River flow to the sedimentation basin (center) for delivery to service areas through the Tehama-Colusa and Corning Canals.

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

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INTRODUCTION

The article starting on page 1 entitled "How Are Your Roofs Doing?" describes the various types of roofs and what to look for when inspecting them.

Improving your water management program with the proper installation and care of your flow meter is described on page 7, in the article entitled "Flow Meters - First Step Towards Water Management."

The article starting on page 12 offers guidelines for precautionary measures for tank mixing pesticides.

The article "Safety Starts at the Top" on page 15, describes the value of a safety program when there is full participation from top management and labor.

The most damaging culprit in the well is iron bacteria. The article on page 16, "Chlorinate Your Well for Rust Control," deals with this problem.

Various situations of the effects of carbon monoxide on the heart are described on page 17.

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HOW ARE YOUR ROOFS DOING?[1]

What Kind of Roof Do You Have?

Up to the early 1960's, most Bureau roofs were "built-up" roofs using layers of hot-applied bitumen (either asphalt or coal-tar) alternated with layers of roofing felts to form an exterior waterproof membrane. Use of asphalt ("hot-mop") was more common starting in the late 1940's.

> Types of Roofs
>
> 1. Built-up roof
>   a. Coal-tar
>   b. Asphalt
> 2. Sheet rubber membrane
>   a. Fiberboard insulation
>   b. Polystyrene insulation
> 3. Sprayed urethane foam
>   a. Silicone coating
>   b. Other coatings
> 4. IRMA roof

New types of roofing systems became desirable due to the growing number of premature failures of built-up roofing experienced in the late 1950's. Increasing cost and decreasing quality of these conventional roofing materials made new synthetic products more attractive.

Selection of specific systems using new materials resulted from E&R Center laboratory studies, field experience, and observation of problems encountered by non-Bureau roof owners. From the many ideas encountered, the more promising were gradually introduced into Bureau construction.

Sheet rubber waterproofing was the first step, followed by substitution of water-resistant polystyrene insulating board for fiberboard insulation. Next, seamless, sprayed-in-place polyurethane foam coated with silicone rubber was used, especially where light roof weight was needed.

> Over 80 Bureau roofs have been constructed using either sheet rubber or sprayed urethane foam.

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[1] This article written especially for this publication by Bernard V. Jones, Materials Engineer, Materials Science Section, Division of General Research, Engineering and Research Center, Denver, Colorado.

The latest development is the protected membrane roof system, sometimes known as a ballasted roof. The IRMA roof system marketed by Dow Chemical Company (formerly AMSPEC) is a protected membrane roof. The system consists of a waterproof membrane installed directly on the roof deck; water-resistant polystyrene foam placed over the membrane to serve as protection from physical, thermal, and solar damage; and gravel or concrete block ballast placed on the insulation.

> USBR Laboratory Report No. REC-ERC-76-4 gives more details about these new type roofs. The report may be obtained from the E&R Center in Denver.

Inspection of Roofs - What to Look for

Although the goal of using new roofing systems is to obtain more durable roofs, problems can still develop that will shorten the life of these as well as conventional roofs. If caught and repaired in time, serious damage and need for replacement can be prevented.

The purpose of this article is to highlight defects to be recognized during an inspection. The most effective and economical remedy can then be selected.

> All roofs should be inspected once a year and after severe wind or hail storms.

Blisters - One of the most common problems is the formation of gas pockets (often water vapor) beneath rubber sheeting, or in or below built-up membrane layers. Blisters can also form between layers of urethane foam that are not well bonded in place.

Small blisters (up to approximately 150 millimeters (about 6 inches) in diameter) are generally of little concern in sheet rubber roofs, but may allow damage to occur more easily to sprayed foam or built-up roofs. Large blisters may indicate a more serious problem, such as entrapped moisture or lack of necessary adhesion to prevent wind uplift.

Flashing - Another common problem is either deterioration or disruption of the flashing. Look for unsound, disbonded, curled, or cracked felts in built-up roofs and protected membrane roofs at parapets, roof edges, and around all protrusions in the deck. Inspect for loose mastic at seams in the flashing and possible leakage at reglets or other flashing terminations.

Most sheet rubber roofs and sprayed urethane foam roofs are self-flashing, but some may have sheet rubber counterflashing or rubber expansion joints that should be inspected for possible leakage.

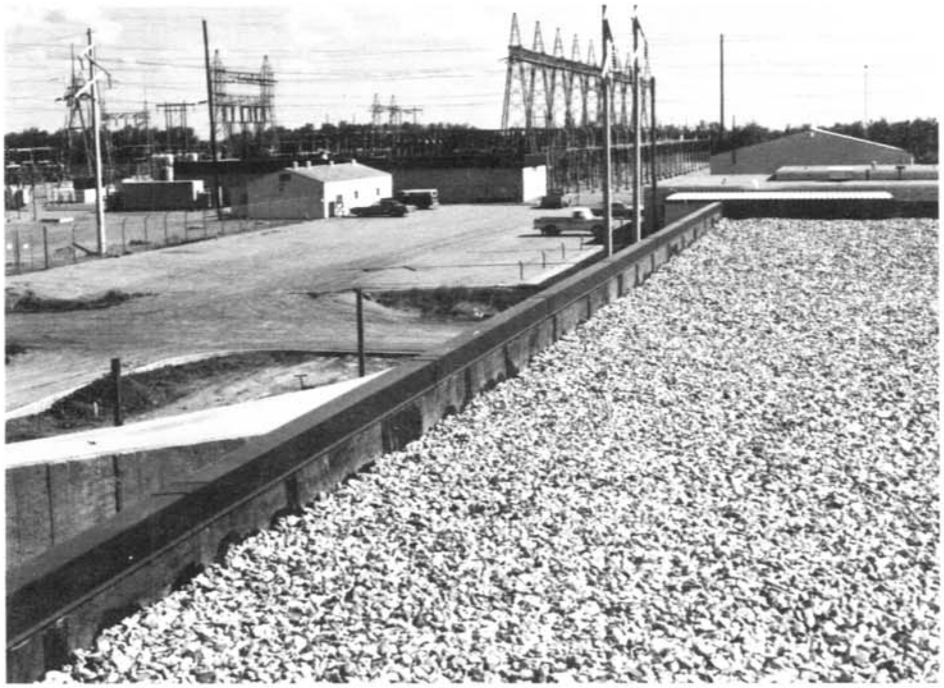

Figure 1. - Flashing at building perimeter. This should be inspected for loose seams and punctures.

Lack of Gravel - Most IRMA and conventional built-up roofs require continuous gravel surfacing for protection from sunlight. Make sure the gravel completely covers all areas so that no built-up membrane or polystyrene insulation (in the IRMA roof) is exposed. Figure 2, on the following page illustrates insufficient gravel cover exposing polystyrene foam on IRMA roof.

Loose Seams - Sheet rubber roofs should be inspected for seams that are not well adhered, especially where two seams (longitudinal and transverse) intersect. See figure 3 on following page.

Protective Coatings - Sheet rubber roofs, sprayed urethane foam, and some cast-in-place concrete roofs have a rubber paint coating. The silicone rubber coating used on most sprayed urethane foam roofs is extremely durable and is not expected to deteriorate from weathering. However, some silicone coatings are subject to damage from heavy foot traffic and large hailstones. Look for holes, tears, blisters, or breaks in the coating.

Figure 2. - Insufficient gravel cover exposing polystyrene foam on IRMA roof.

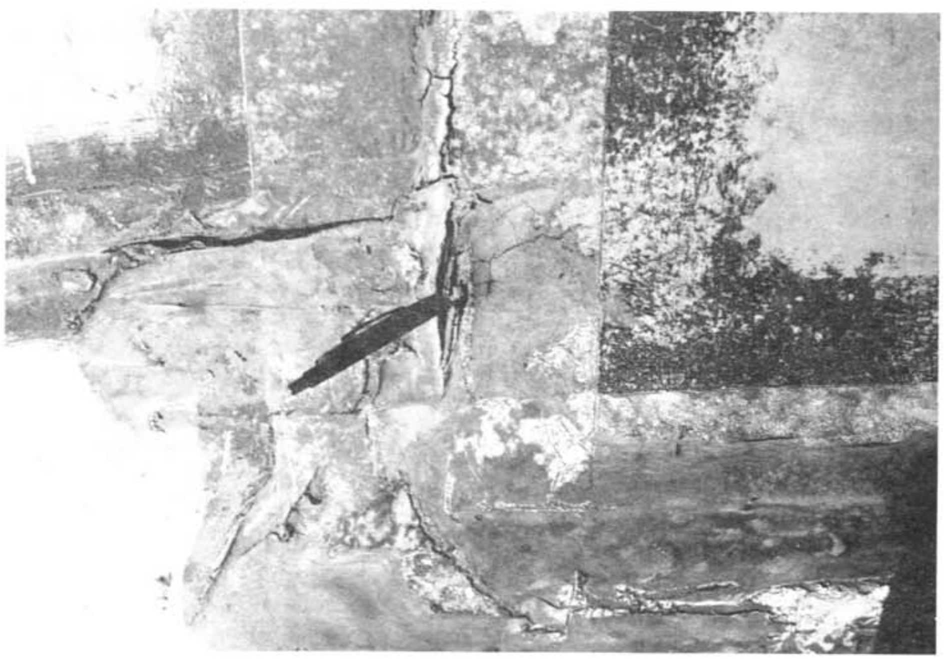

Figure 3. - Poor adhesion at intersection of two seams in rubber sheet roofing. Asphalt mastic repair cracked. Rubber calking should be used.

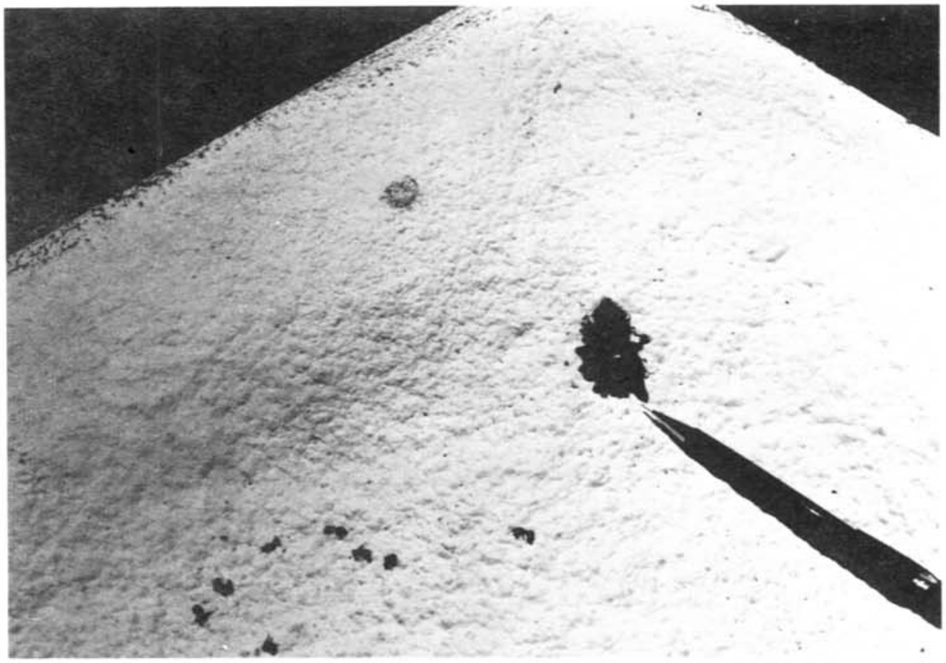

Figure 4. - Damage to coating on sprayed urethane foam.

On painted concrete decks or painted sheet rubber roofs, look for cracking, peeling, thinning from weather erosion, or other indications that recoating might be needed to restore reflectivity.

Wet Insulation - Any leakage through a built-up roof and sheet rubber membranes placed over fiber-type insulation is likely to have saturated the insulation. Sprayed urethane foam has also been found to absorb water under certain conditions even though the coating appears to be intact.

Look for soft, spongy areas, or places where water can be pressed out of the insulation through pinholes with foot or hand pressure. Some built-up roofs have absorbed enough water that ripples or waves can be caused by hitting the surface.

Figure 5 illustrates a plug cut in sprayed urethane foam to check for moisture in foam and suspected delamination. Plug must be replaced and sealed with sealant compatible with coating.

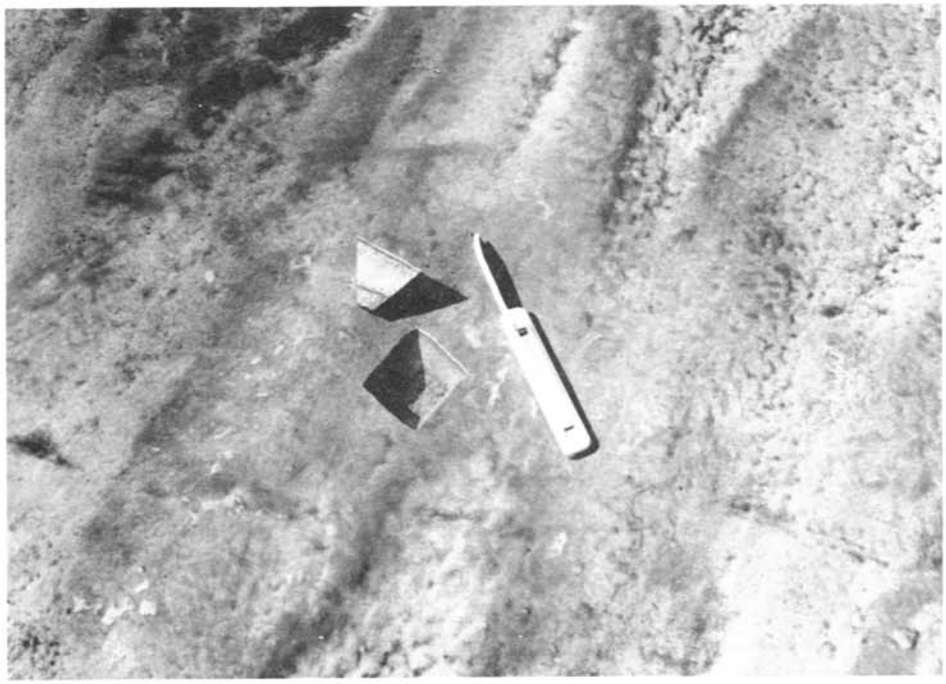

Figure 5

Repairs

Most of the new type roofs require special repair materials. Also, there are new developments continually in repair materials and methods for both new and conventional roofs. For these reasons, we have not made suggestions for repairs when you find problems during that inspection. (That is now at the top of your "things to do" list!)

For information on anything you think may be a problem and suggestions for making repairs, contact Code 1521 at the E&R Center or call (303) 234-3151 (FTS: 234-3151).

* * * * *

FLOW METERS -
FIRST STEP TOWARDS WATER MANAGEMENT

by Dean Eisenhauer[1]

How much "mileage" are you getting from your irrigation water? Unless you have a handle on the number of gallons you pump, it's pretty difficult to tell how many gallons of water you use to produce a bushel of grain or a ton of alfalfa.

One of the first steps towards improving your water management program should be the installation of a water flow meter. Once you know how much water you've used on a particular field, it's a simple matter to calculate the gallons you pumped per acre, or per unit of crop yield. Meters are also useful to help determine the efficiency of a pumping plant, or to detect potential well and pump problems before they mushroom out of proportion. They can even be used to help regulate the use of ground-water supplies - particularly important where such resources are limited.

There are two general classes of flow measuring devices available on the market today: those designed to measure open water flow, and those made for contained flow systems. Irrigators obtaining their water from ditches, rivers, canals, or laterals may use weirs, flumes, orifices, current meters, or floats to measure water flow.

Of more interest to many irrigators, however, are those meters made to measure water flow in a closed pipeline or discharge pipe. Again, there are a variety of devices available to do the job, including differential meters (orifice and venturi), electromagnetic meters, pitot tubes, propeller meters, and horizontal pipe arrangements.

Propeller meters - because they are generally reliable, simple to install and operate, and economical - are among the most practical of flow meters for on-the-farm use. Essentially all propeller meters register the total volume of water that passes through them, and many are available with optional devices to measure the rate of flow.

Propeller meters typically feature a multibladed propeller made of rubber, plastic, or metal. This propeller rotates a protruding indicator head (gage) that indicates the accumulated volume, the current flow rate, or both. Experience has shown that it is best to select a meter with a magnetic drive between the propeller and the indicating head.

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[1] Reprinted by special permission of the Editor from the March 1977 issue of Irrigation Age.

The diameter of the propeller is usually between 50 and 80 percent of the diameter of the pipe. The accuracy of a flow meter tends to drop off at low flow velocities. If your meter is used in a permanent installation, and will be measuring a narrow range of flow rates, then a relatively small propeller size should be acceptable. However, you should select a larger propeller size if you expect to be measuring a wide range of flow rates.

The rate at which the propeller turns depends on the rate of flow and the inside diameter of the pipe section where the meter is installed. It's important, therefore, that the gear ratios in the indicating head match the inside diameter of the pipe. For example, if a meter is geared for a 150-millimeter (6-inch), 1.5-millimeter (0.058-inch) wall aluminum pipe (149.45-millimeter (5.884-inch) I.D.), and was installed in a 150-millimeter (6-inch) seamless steel pipe with an I.D. of 154.05 millimeters (6.065 inches), a 6-percent error in measurement would result.

Most companies offer two kinds of indicating head dials - showing the rate of flow, the totalized volume of water, or both. These meter heads can be calibrated in just about any unit desired: volume, acre-inches, acre-feet, gallons, or cubic feet. The flow rate can be calibrated in gallons per minute, cubic feet per second, or other standard sizes.

What size meter should you buy? It depends on the size of pipe that the meter will be installed in, the range of water flows that will be measured, and the head loss characteristics of the meter. Since the accuracy of the meter will drop off at lower rates (as shown in figure 6 on the following page), the range of flow should be your first consideration. And when you do select a meter, make sure the lowest flow rate to be measured will be measured at or near 100 percent accuracy. Figure 7 (following page) lists the common flow ranges suggested by manufacturers for various sized meters.

Proper installation of flow meters also has an important bearing on their ultimate accuracy. Spiraling and turbulent flow in the meter section caused by valves, elbows, etc., will reduce the accuracy of the reading. For this reason, most manufacturers recommend a minimum of five straight pipe diameters ahead of the propeller, and at least one straight pipe diameter downstream from the meter.

As an example, if a 200-millimeter (8-inch) meter was installed, then 800 millimeters (40 inches) of straight pipe between the propeller and the fitting would be needed for an accurate reading. For even better results, eight to ten diameters or more are preferred upstream, and five downstream. If space does not allow for that much pipe, it's a good idea to install straightening vanes in the pipe section ahead of the meter.

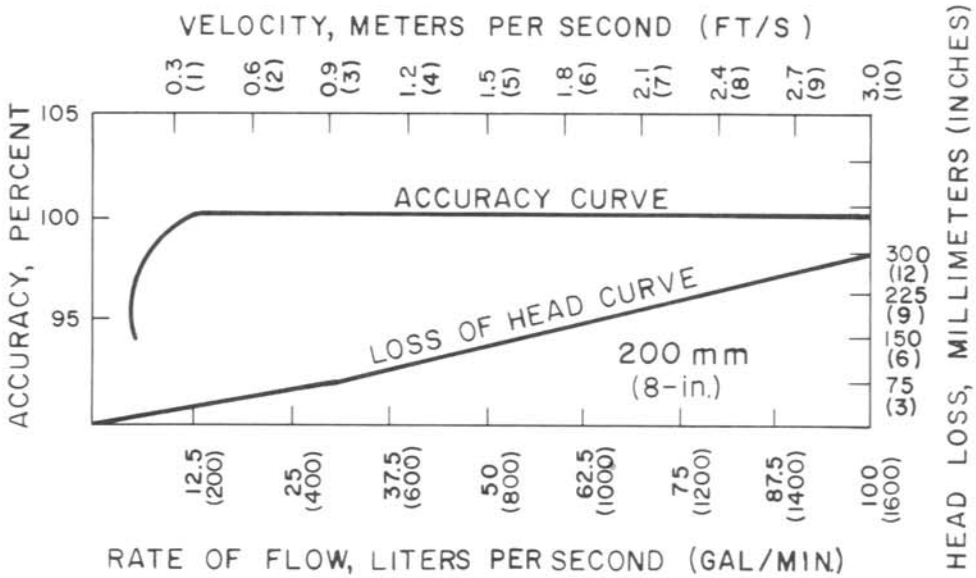

Figure 6. - Typical accuracy and head-loss curves for propeller meters.

Meter size (millimeter)	Minimum flow (liter per second)	Maximum flow (liter per second)
100 (4 in)	3.2 (50 gal/min)	25.2 (400 gal/min)
150 (6 in)	5.7 (90 gal/min)	56.8 (900 gal/min)
200 (8 in)	6.3 (100 gal/min)	75.7 (1200 gal/min)
250 (10 in)	7.9 (125 gal/min)	94.7 (1500 gal/min)
300 (12 in)	9.5 (150 gal/min)	126.2 (2000 gal/min)

Figure 7. - Common recommended flow ranges for propeller meters.

It is also vital that the propeller shaft be positioned exactly in the center of the pipe. The centerline of the shaft should not be at an angle to the centerline of the pipe. One study has shown that a 4-percent error in measurement resulted because the centerline of the shaft was off 11.5 degrees from the centerline of the pipe.

Like most other components of a water delivery system, it's usually easiest to install a meter when the irrigation system is first designed and assembled. This is especially true for center pivot and buried pipeline installations. When the meter installation is planned at the time the irrigation system is installed, enough room can be left for the required lengths of straight pipe.

Most meter manufacturers offer a wide range of fittings on their meter sections so that they can be installed in virtually any type of water conveyance. These fittings include flanges, aluminum couplings, Victaulic couplings, weld-on saddle meters, clamp-on saddle meters, or straight tubes which can be welded in or installed with dresser couplers.

Propeller meters can be installed in any position that is convenient - vertical, horizontal, or at an angle. They can even be installed in a buried pipeline with the indicating head extending aboveground. Wherever they are installed, however, always keep in mind that they can perform accurately only when the pipeline is flowing full.

Propeller meters are no different than any other piece of machinery in terms of maintenance and care. It's always wise to follow the manufacturer's maintenance recommendations. Some meters require periodic lubrication. Anything that causes the propeller to drag will cause inaccurate measurement. Therefore, the meter should be checked periodically to make sure the propeller spins easily. If if doesn't, you should check for obstructions which may cause the propeller to bind, or for a worn shaft, bearing, or gear.

Whenever possible, the meter should not be left in a pipe filled with water through the off-season. Meters that are installed in short lengths of portable pipe should be removed during the winter and stored on end with a board over the top.

You'll find a wide variety of prices when you shop for a water meter, due largely to differences in quality, the options selected for the indicator head, the type of meter section or method of fastening the meter to the pipeline, and the range of flow the meter is designed to measure. Generally, however, a small 100-millimeter (4-inch) meter will cost around $300, while a large 300-millimeter (12-inch) meter will average closer to $400 per unit.

What will it cost you to meter water on an annual or seasonal basis? Based on an average initial cost of \$325 for a 200-millimeter (8-inch) meter, and assuming that an average well will apply about 450 millimeters (18 inches) of water to 36 hectares (90 acres) each year, the annual costs could be calculated as shown below:

Average annual cost for 200-millimeter
(8-inch) propeller meter

Fixed costs:

\$325 x 0.1241 (capital recovery factor 9%, 15 years) = \$40.30

Repair and maintenance:

$0.45 \text{ m} \times 36 \times 10^4 \text{ m}^2 = 162 \times 10^3 \text{ m}^3/\text{a}$
(1.5 feet x 90 acres = 135 acre-feet per year)

$162 \times 10^3 \text{ m}^3 \times \$0.1135 \times 10^{-3}/\text{m}^3$
(135 acre-feet x \$0.14/acre-foot) = \$18.90

Total annual cost = \$59.20

The total annual cost of \$59.20 would be equivalent to \$0.66 per acre per year. If you paid \$0.38 for diesel fuel, and had a 30-meter (100-foot) lift, it would only take a water savings of about 35 millimeters (1.4 inches) per year to pay for the meter. And if you used a sprinkler system with the same well lift, the meter could pay for itself with an average water savings of only 18 millimeters (0.7 inch) per year.

* * * * *

BEFORE YOU TANKMIX PESTICIDES[1]

Tank mixing pesticides is a practice that has gained widespread acceptance in recent seasons. Time and labor savings are two of the obvious benefits, but certain precautions must be followed to insure proper control. Stauffer Chemical Company offers the following guidelines for safe and efficient tank mixing of pesticides.

Read the Label

The information contained on a product label may seem long and involved, but it's there for a purpose: to help you make the best use of the material. Follow directions carefully regarding mixing, method of application, dosage, soil characteristics, and other applicable information.

Recent EPA guidelines permit the use of nonregistered tank mixes until October 1977 if the dosages do not exceed label instructions for any product in the mix used singly for the same pests on the same crops, and if labels do not explicitly instruct against such a mixture.

Test for Compatibility

"Before you mix any pesticides, first do a test for material compatibility," recommends Dr. Douglas Murphy, Agronomist with Stauffer Chemical Company. "Many pesticides may not form a stable mixture, causing layering or formation of precipitates. Application of a mixture of noncompatible materials will cause excessive rates of each chemical in separate parts of the field, possibly resulting in crop injury, poor control, residue problems, or feed contamination."

You can complete a simple compatibility test as follows:

1. First place 0.5 liter (1 pint) of the carrier, usually water or liquid fertilizer, in a quart jar. Then add each pesticide to be mixed, one at a time, and shake well between each addition. When you add the pesticides, be sure to use the material in the same volume proportion as you'll be using it in the field, according to label recommended dosages and your soil conditions.

2. The usual order for pesticides to be added for proper mixing is: wettable powders first, followed in order by flowables, water solubles, surfactants, and emulsifiable concentrates. These are general recommendations, and you should refer to the label for more specific directions.

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[1] Reprinted by special permission of the Editor from the March 1977 issue of Irrigation Age.

3. After you've combined the materials and agitated them thoroughly, let the jar stand for approximately 1 hour while you inspect them for any separation by layer or precipitate formation. If you see any precipitates being formed, or if the materials separate out into layers relatively quickly, the mixture is incompatible and should not be used.

"The amount of separation permitted depends somewhat on the agitation capabilities of the field spray tank," says Dr. Murphy. "Generally, however, minor separating after 30 minutes is tolerable if field sprayer agitation is good."

Compatibility tests should be performed each time you fill the spray tank even if you use the same formulation. The same analysis of fertilizer may vary in mixing qualities from batch to batch and manufacturer to manufacturer, and untested mixes of the same materials may cause problems.

Provide Good Agitation

If you have good spray tank agitation, even somewhat unstable mixtures may be possible if the agitation is sufficient to keep them in suspension.

When you mix products in the field sprayer, put the carrier in before you add the pesticides, then allow time for thorough mixing between each material addition. Shortcuts in mixing may save you a few minutes, but the penalties can be exacted in yield and dollars.

Apply the fully agitated mixture as soon as possible after formulation to prevent possible separation, precipitation, or caking. Do not allow mixtures to stand overnight without constant agitation. Consult label information regarding temperature and humidity data which may apply before mixing or if the application is delayed.

Use All Information Available

If you're trying out an unknown combination, test it out first on a small scale at varying rates and under different conditions before you treat an entire field. Check with Extension specialists for information concerning university test data on new mixes, or for local water conditions which may affect mixtures.

Don't mix pesticides which require different application methods. For example, don't mix a foliar herbicide with a soil incorporated herbicide.

Don't hesitate to seek help from your farm chemical dealer or manufacturer's representative for advise if problems crop up.

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HOW ABOUT IT?

New ideas, original devices, ways to save water, use of material you have on hand to make a job easier or simpler, and methods devised to improve operation and maintenance of water systems, are what we are looking for.

You may not get a monetary award or a blue ribbon from us, but you will get credit for sharing your experiences and ideas with others with a publication in the Water Operation and Maintenance Bulletin.

We'd appreciate it! How about it?

SAFETY STARTS AT THE TOP[1]

Top management must be considered responsible for the establishment of a safety program and must be involved in its day-to-day operation. The implementation of such a program is a necessity at the worksite level, but direction and support starts at the top.

In 1972, a large company specializing in utility construction, including the installation of underground power and communications cable and conduit facilities, had an astronomical frequency rate of 387.9 disabling injuries per million man-hours worked. It was then that management realized the necessity of immediate and radical action to improve the disastrous safety position.

An experienced construction supervisor was reassigned as the safety director reporting direct to top management, and a series of safety meetings were organized to include all levels of the operation from senior to middle management personnel to foremen and laborers. An immediate evaluation and investigation of all injury records was initiated. All supervisory personnel were required to hold first-aid training certificates.

This company is highly labor oriented. Much of the emphasis was geared to that level with program direction retained by management. All supervisors and foremen were made aware of the human and financial costs of all accidents, with or without injuries, with emphasis on the contributory problems, and the action required to improve the situation. The union joins in the firm's accident prevention program and enthusiastically supports its. The firm's safety policy states, in part, "An accident prevention program can only be of value throughout our company if there is full participation from management and labor."

Day-to-day safe work practices are mandatory on each jobsite. Each accident is discussed at the weekly management meetings, and everyone at all levels is made aware of the causes of each accident and possible breach of regulations or company policy.

The results of this total involvement program have been dramatic. The disastrously high frequency rate in 1972 of 387.9 has dropped to a current rate of 21.7 disabling injuries per million man-hours worked. This remarkable drop in injuries, even with a considerable

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[1] Reprinted from Reclamation Safety News - First Quarter 1977.

work force and varying work schedule, indicates that it is possible to reduce accidents with good planning, safety education, union cooperation, and participation by top management. The net result is a safer work environment and a considerable dollar savings.

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CHLORINATE YOUR WELL FOR RUST CONTROL[1]

Your irrigation system is like any other piece of machinery. It should be cared for before putting away for the winter. Service of the sprinkler and aboveground equipment is often discussed. Let's consider maintenance of that portion that is not visible, the well. Even though you can't see what is going on doesn't mean it doesn't need attention and service.

The most damaging culprit in the well is iron bacteria. These bacteria are introduced into the well during the drilling process. They feed on the iron in the water and produce a slimy, black material that collects and hardens on the pump, pump column, screen, and casing. Material collecting on the screen reduces the screen opening, causing the well yield to decrease. As the screen opening decreases, the water velocity flowing through the screen increases. This causes mineral encrustation to increase and further reduces the screen opening.

Control of the iron bacteria should begin with chlorination of the well by the driller upon completion of the well. Regular annual chlorination will keep the bacteria under control. It is recommended this be done both in the fall and again in the spring before the well is needed for irrigation. However, chlorination only once a year may be sufficient in many cases.

Chlorination is accomplished by placing a specific amount of chlorine into the well. The amount needed depends on the well diameter and depth of water in the well. The 70-percent chlorine HTH tablets work the best. The 70-percent chlorine granules and 5-percent chlorine bleach will also work. However, they are more difficult to put into the well.

After being put into the well, the chlorine should stand for 4 hours. Then the well should be surged about 20 or more times to thoroughly mix with the water. Water should not flow from the well during surging. Add water equal to the volume in the well casing to force the chlorine solution out into the aquifer to kill the bacteria in this area. Let it stand for 24 hours, then surge again about 20 times and pump the water from the well until clear and the odor of chlorine is gone.

Annual chlorination will help maintain a healthy well and a healthy well is a productive well.

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[1] Reprinted by special permission of the Editor from the March 1977 issue of Irrigation Age.

CARBON MONOXIDE AGGRAVATES THE HEART[1]

In this country, carbon monoxide is found mainly in tobacco smoke and the exhaust of automobiles and trucks. There is no doubt that the gas aggravates angina pectoris by lessening the amount of exertion a victim can do before chest pain develops.

Normally, the hemoglobin in blood picks up its oxygen in the lungs and delivers it to the tissues of the body. But whenever hemoglobin has a choice between carbon monoxide and oxygen, it will select monoxide 200 to 1. Furthermore, CO (carbon monoxide) remains in the blood for several hours and the ill effects usually stem from the tissues being robbed of much needed oxygen.

The situation is somewhat similar to having a narrowed hardened artery that fails to deliver enough blood (and oxygen) to an organ. This oxygen deficiency is no different from blood containing too little oxygen (due to CO flowing through normal arteries). The trouble begins when the arteries are already narrowed and the individual inhales too much monoxide. This is why CO exposure aggravates angina pectoris.

[1] Reprinted from Reclamation Safety News - First Quarter 1977.

Air usually contains some carbon monoxide. A safe limit is 35 parts per million (p/m). When inhaled, this leads to levels up to 1 percent in the hemoglobin content of the blood. On Los Angeles freeways, the CO in the air reaches as high as 147 p/m.

Driving with the windows open leads to blood levels up to 5 percent - still low enough to prevent acute poisoning in a normal person.

Cigarette smoke has been called concentrated air pollution. Inhalers get about 475 p/m per cigarette. Pack-a-day smokers subject their systems to considerable monoxide. In fact, CO levels of up to 90 p/m have been measured passing across the faces of people seated next to smokers.

Breathing 50 p/m CO for 4 to 5 hours raises the CO content of hemoglobin from 1.3 to 2.9 percent, an amount that is enough to alter the exercise performance of a person with angina. And if this person is a smoker, the blood level may go up to 16 to 18 percent CO.

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T H I N K!!

GPO 843-740

The purpose of this Bulletin is to serve as a medium of exchanging operation and maintenance information. Its success depends upon your help in obtaining and submitting new and useful O&M ideas.

Advertise your district's or project's resourcefulness by having an article published in the bulletin! So let us hear from you soon.

Prospective material should be submitted through your Bureau of Reclamation Regional office.