KEYS TO PROFESSIONAL ANNUAL DISPLAYS

SELECT, INSTALL AND MAINTAIN TO PRESERVE DESIGN IMPACT

By Richard Esmark King, Holliston, MA

Annuals are becoming more and more important in the groundskeeping industry. Industrial parks with limited outdoor space can use them to add color to the perimeter efficiently. If they have more space, they can work the annuals into patterns that are very eye catching.

Annuals are a disposable flower. Every year you can create a completely new garden with them. Every year you can develop a whole new motif. For instance, in 1976, gardeners all over the United States created designs that resembled flags, or banners. Red, white, and blue flowers were worked into many different designs, and some gardeners developed some very unique patterns.

Unlike the perennials, the annual flowers constantly all season. Of all our plants annuals have the greatest potential for a one hundred percent display of color. And there are annuals for virtually every color of the visible light spectrum. Some of the annuals have colors which are actually beyond our senses, but are visible to bees and butterflies.

A good annual bed can be made in almost any sunny location. A shaded area is going to limit the number of annuals you will be able to work with as most of them flower best in the bright sun.

Golden Celosia withstands full sun and wind and is an annual recommended for exposed locations. (Photo by T.A. Fretz)

Designs

You will find yourself working with three basic types of designs. The simplest is the zonal design, where your colors are clearly limited to specific areas of the bed. This may be a yellow marigold rectangle within a larger blue ageratum rectangle. Or it could be broad bands of flowers next to each other. For instance bands of red, white, and blue were often used in 1976.

The second, somewhat more advanced design, is linear. For this your background is a solid color and you draw your design in with lines of flowers. An example of this would be a background of red begonias with lines of white begonias. Or you could use a background of bronze coleus with an outline of green coleous.

The third, and by far the most complex pattern to work with is the combination of zonal and linear designs. In this you would have the color zones with linear drawings cutting through them. This last type of design takes careful planning on paper and a lot of attention to accuracy when planting. But if it is done right it can be very stunning.

Breaking designs down into area or line patterns can be done in most visual arts. You can see it in modern painting or renaissance architecture. The aesthitics involved are the same for you as for them and you will find that as you think in terms of area and line the pattern you make will be very artistic.

Setting

Look at your planting space in relation to it's surroundings, and try to see any factors that are going to influence the designs. In some cases the way the beds are situated will make a difference in their viewing. In one park where I was the head gardener we had raised annual beds set in concrete forms. The first year we planted the beds with flowers of about the same height. They all grew well but the flowers on the outside blocked the view to those on the inside. By midsummer the pattern was lost to anyone walking near the beds. The second year we used a little more height in the center of the flower beds.

Height is a very important factor in planning your designs. You have two methods to choose from when varying the height within the bed. First you can use flowers of the same height and simply raise the soil level where you want additional height. The major drawback with this is that in time erosion may alter the soil contour. If you pack the soil firmly, and the flowers are planted relatively close together, the hills and valleys you create will probably last the season. However, if there is an excess of rain, or the soil is loosely packed, you may find your display sagging or becoming distorted.

Continues on page 46

Design Impact *from page 44*

The second way to vary the height is to leave the soil level and choose plants which grow at varying heights. There are also drawbacks to this course of action. Most of these problems however, result from mistakes in plant care. For instance, if the initial fertilizing of the soil prior to planting is done unevenly you will have some plants shooting up taller than others in the same line. The same effect may also develop from uneven spread of lime.

You will almost always want the highest point to be at the back or the middle of the bed. If the bed is going to be seen from only one side you can have it sloping upwards from the front, the highest point being the back. If the bed is to be viewed from all sides, you obviously will have to slant it upwards from all angles toward the middle. Rarely will this vary. When the bed is viewed from above, the the bed can have a slight slope downwards toward the center. That is, the bed could be made concave rather than convex. This situation does not develop often. The obvious problem with a concave planting is that if the drainage is not adequate than a pool will develop at the bottom.

Symmetry

Now that we've considered the surrounding factors, let's look at the shape of the bed itself. The shape of the bed is going to be the first governing factor in your design. If the bed is symmetrical you may find it much simpler to work with. For example you can do a lot more with a square bed than one shaped like a horse shoe. If the asymmetrical bed is not extreme you may be able to fill in some of the odd corners with foliage plants or neutral colored flowers and create a symmetric shape within their borders in which you can develop a design.

On paper

Drawing the design out on paper is no problem when you are using a square or rectangular bed. Use graph paper and designate each little square as a space six inches by six inches square. This represents one plant. An eight by eight foot bed would be a square of graph paper sixteen spaces by sixteen spaces. Draw in your pattern and you have an accurate count of flowers. This works well only with the straight designs. Other than this try to keep to scale, using six inches as the space for each plant. By the way, most begonia sized plants spread easily to fill a space that size.

If you are new at annual beds stick to straight lines as opposed to curves and circles. They are easier to plan and plant. You can build squares within squares, or employ triangles. Remember to think ahead to what the beds are going to look like. Think in terms of line and area.

Continues on page 48

Begonia semperflorens (photo courtesy Agricultural Technical Institute, Wooster, OH).

Gazania (ATI)

Hemerocallis 'Bicolor' (ATI)

Achillea (ATI)

Design Impact *from page 46*

While planning, do not add plants that will cause weak lines. For instance pink begonias against red ones tend to be mute. Separating the two with a row of white begonias makes the colors stand out, and your design will stand out as well.

If you feel that you would like to work with curves and circles in your patterns remember to keep your drawings to scale. And order a few extra plants to compensate for any unforseen difficulties.

Soil Prep

Preparation of the soil prior to planting should include a thorough soil test. There are many test kits on the market that are self-explanatory, or you may choose to send samples to your local extension service. Many gardeners prefer to turn in the lime a week or two before the fertilizer. The proponents of this practice say that when the lime and fertilizer are added together the lime causes the fertilizer to release it's nutrients too quickly and they are leached from the soil within a few weeks.

Remember that a soil that tends to be alkaline, has excess lime, will often be a good base for weeds. So do not over lime your soil. On the other hand, when applying phosphorous or superphosphate, keep in mind that flower production requires alot of this mineral, don't cut yourself short.

Almost any soil needs additional organic material. While peat moss is most often used in parks, manure or leaf mould is often better as well as cheaper.

Once you have spread the soil additives evenly, turn them thoroughly into the soil. A thoroughly prepared soil mixture is extremely important to your flower production.

Ordering

When selecting plants for your beds specify to your grower that you want plants that are in, "bud and bloom". That is, they will not only have flowers when they are delivered, but they will have buds ready to burst as soon as the first flowers have gone by.

Many of the annuals will be in 3-½ inch pots or smaller. A few plants, such as geraniums may do better if you order them in the four inch pot size. Many growers will now deliver the flowers in peat moss cups or cubes. This eliminates the need for the flower pots which many of us have become accustomed.

Most plants that look unhealthy are unhealthy. Don't accept them. The most important part of your annual bed's appearance depends on how healthy your plants are.

Even the most experienced groundskeeper run into snags during the growing season. An animal running through your flower bed in July, a dog burying a bone in your display during August, will destroy plants. In the later part of the season it will be almost impossible to locate a source of plants that will be the same type, variety, and color as the others in your flower bed. So buy extras, and plant them where they will have about the same amount of sun as the main bed. Then if you need some extras later you will have them.

Planting

When it comes time to transfer the plans into the real thing organization is going to be a concern. The less experienced your staff is, the more exact you will have to be as supervisor. There are several ideas that I have seen used. One fellow cut a 2x4 board to the width of his flower bed and set half inch diameter dowels into the 2x4 every six inches. This looked like a giant grass rake. He would press the rake into the ground, and the holes left by the dowels would mark the location for each annual in the row. This seemed to be a successful method.

Another gardener I know simply sets each annual on the ground exactly where it is supposed to go. The laborers then are supposed to plant them exactly as they find them. If the help are inexperienced, this method could end in a disaster. I've seen many plants stepped on, and patterns dissolve into disarray, without seasoned gardeners trying to follow these steps.

The best way I've tried is to first plant the boundry, leaving one end open for the laborers to come in and out of. Then mark the second row with a string, running it from the boundry plants. Have your laborers plant along the string lining each flower up with the one in front of it. This method seems to cause the least confusion and at the same time the work progresses at a reasonable speed.

Care

After planting you will find it necessary to fertilize occasionally to keep the plants producing at a healthy rate. Many gardeners prefer to add fertilizer that can be dissolved in water and sprayed onto the plants. This is much safer than spreading granular fertilizer directly onto the plants. Granular fertilizer will burn the leaves and flowers of any plant it is dropped onto if it becomes all wet. If you followed the directions of the extension service carefully in the original soil preparation you should not have to add any fertilizer until thirty days after planting.

Watering should be done in the morning, as opposed to the afternoon or evening. When possible the ground should be watered, rather than the plants. These two precautions will keep the fungus growth at a minimum.

Frequency of watering is going to depend alot on the heat and wind and humidity of your local. Generally let the bed become dry on the surface, but not underneath, before you water.

Pinching back a few stems on each plant will cause the plant to grow in fuller. What happens is that the buds near the break each send out new shoots. Often as many as four at each break. Thus where you had one stem before pinching you will have several afterwards. Care should be taken that you do not take too much off a plant on each pinch. This would make it look "scalped". Also individual leaves and blossoms should be pinched off after they have passed their prime.

Annual beds can be colorful and full. They can add a unique touch to a shopping mall or park. With a little experimenting your designs can be extremely creative supplements to the total effect of your landscape. **WTT**

EXPOSED LOCATIONS REQUIRE HARDIER VARIETIES

By Gary A. Anderson, Chairman, Horticultural Industries Technologies Div., Agricultural Technical Institute, Ohio State University, Wooster, OH

The groundskeeper who desires to brighten the landscape with flowering plants often finds areas exposed to full sun and drying winds a special challenge. Newly constructed residential and public building sites are often without protection and shade. Bright sun and windy conditions work together to lower humidity around the plants and increase water loss from them. Windy conditions cause mechanical damage to delicate flower petals and foliage. However, selection and conditioning of annual and perennial plants can provide color for even these apparently harsh locations.

Planting in exposed locations

Select dwarf varieties which generally withstand windy conditions better than taller varieties of the same species.

Set out larger, more developed plants that have been grown in large cell packs or singly. Smaller plants may dry out before they become established.

Avoid setting out spindling plants that will be slow to establish and which may suffer from mechanical damage due to wind.

Condition plants to outside environment before planting. Withhold water to firm plant tissue and prepare for water stress conditions.

A number of annual and perennial plants will perform well in windy and dry conditions. One of the most tolerant plants for bedding work is *Vinca* or Periwinkle. The glossy green foliage grows eight to 16 in. tall and fills in rapidly. Five-petalled pink, white, or rose blossoms are produced throughout the summer and fall, even when temperatures become very hot.

Wax begonias are colorful, compact plants that withstand windy conditions well. Bright sun may cause some damage to the foliage but this is often covered with a profusion of red, white or pink blossoms and is therefore not conspicuous. There is very little maintenance with the plant and few insects and diseases attack it.

Gazanias grow well in hot, windy places. The brightly colored daisy-like flowers have distinctive dark around the center. Flowers rise six to 12 inches above the ground. Blossoms close in cloudy weather and at night.

Perennials

Perennials bloom over a shorter period of time than annuals, but once established, will persist for many years. *Asclepias* or butterfly weed is a showy, brilliant orange perennial that will tolerate dry windy locations and poor, dry soil. It has almost no insect or disease problems and once established requires little attention. The plant is two to three feet tall and blooms for about two weeks in midsummer. Another plant that sports a bright orange cluster of flowers two to three feet above the ground is Maltese Cross *(Lychnis).* Strong stems support flowers even during driving rains.

Achillea or yarrow will withstand drought in open, sunny locations. The flat golden heads are produced in midsummer, even if the plants are neglected. Wind passes through the fern-like foliage with little effect on the plant.

Other annuals and perennials listed in the chart have characteristics that make them good candidates for exposed planting. Nursery or seed catalogs and gardening books should be used to check out heights, blooming times and colors. When purchasing plants or seeds, pay attention to the attributes of the particular cultivar to make sure it is what you think you are getting. The introduction of many dwarf cultivars on the market has increased the choice of flowering plants for exposed locations. **WTT**

Plants Suitable for Exposed Locations

Annuals	Perennials
Arctotis (African Daisy)	*Achillea* (Yarrow)
Begonia (Wax Begonia)	*Armeria* (Sea-Pink)
Catharanthus (Vinca or Periwinkle)	*Artemisia*
Celosia	*Asclepias* (Butterfly Weed)
Coreopsis (Calliopsis)	*Aster* (Michaelmas Daisy)
Dimorphotheca (Cape Marigold)	*Coreopsis*
Eschscholzia (California Poppy)	*Echinops* (Globe Thistle)
Gaillardia	*Gaillardia*
Gazania	*Hemerocallis* (Day Lily)
Gomphrena (Globe Amaranth)	*Kniphofia* (Red-Hot-Poker)
Helichrysum (Strawflower)	*Liatris* (Gayfeather)
Mesembryanthemum (Livingston Daisy)	*Lychnis* (Maltese Cross)
Pelargonium (Geranium)	*Monarda* (Beebalm)
Portulacca (Moss Rose)	*Physostegia* (False Dragonhead)
Sanvitalia (Creeping Zinnia)	*Rudbeckia*
Tagetes (French Marigold)	*Sedum*
Verbena	*Veronica*

WEED AND GRASS CONTROL IS A PREPLANT CONSIDERATION

By Thomas A. Fretz, Professor and Head, Department of Horticulture, Kansas State University, Manhattan, KS

The control of annual grass and broadleaf weeds in and around annual bedding plant displays is a serious problem for those involved in landscape maintenance. The solution to this problem is most often accomplished by the laborious and costly process of manual weeding, however it should be remembered that several herbicides are available and labelled for use on annual bedding plants.

Prior to selecting one of the herbicides labelled for use on annuals, it is important to review a few of the principles of weed control. Initially, it must be remembered that in order to achieve success with a weed control program on annuals, it will be necessary to have a good idea of the weed species which are going to be present. While this is not always possible, it will be a great help in finally selecting the proper herbicide to do the job. In general, the herbicides which are are labelled for use on annuals will control annual grass and annual broadleaf weeds.

Secondly, the herbicides which are labelled for use on bedding plants are pre-emergent herbicides, thus they need to be applied prior to weed seed germination in order to be effective.

Thirdly, herbicides to be used on annual bedding plants can be applied at 2 times, prior to planting of the annuals (pre-plant) or prior to the emergence of the weeds but after transplanting of the annuals (pre-emergent). Except for an occasional spot treatment, the post emergent herbicides would rarely be used around annual bedding plants. In our research, we have generally applied the herbicides pre-emergent to weed seed germination, that is following transplanting and establishment of the annual flowers.

Also, it will generally be easier to use a granular formulation of the herbicide than either a wettable powder or emulsifiable concentrate. Our research observations have indicated that in general, less phytotoxicity occurs with granular when compared to the other formulations, however weed control is not always as satisfactory with the granules.

Well, what about specific herbicides for use on annual bedding plants? Of all of the materials labelled for this use, DCPA (Dacthal) which is available in either a 75% wettable powder or a 5% granular formulation has the broadest spectrum in terms of plant safety. Dacthal is labelled for use on alyss petunia, chrysanthem, coleus, dahlia, geranium, salvia, snapdragon, and zinnia to name a few. Applied after transplanting on clean, weed-free soil at a rate of 8-10 pounds of active ingredient per acre, Dacthal will control annual grass and broadleaf weeds including large crabgrass, annual bluegrass, speedwell, witchgrass, carpetweed, common chickweed, lambsquarter, purslane and others. Irrigation immediately after application with ½ inch of water will enhance and improve the weed control. Dacthal will cause injury to carnation, pansy, phlox, and sweet william and for this reason should not be used on these crops. A single application should control weed growth for approximately 6 weeks, after which there should be sufficient coverage of the area by the annuals to prevent or severely restrict further weed growth.

The second material which can be successfully used in annual plant beds in diphenamid (Enide). Available as a 50% wettable powder, this herbicide is recommended for use on a wide diversity of annual crops including aster, chrysanthemum, dahlia, marigold, petunia, phlox, salvia, shasta daisy, snapdragon, sweet william and zinnia at a rate of 5 pounds of active material per acre. Pre-emergent control of large crabgrass, annual bluegrass, yellow foxtail, goosegrass, ryegrass, pigweed, lambsquarter, smartweed, purslane, common chickweed, knotweed, pepperweed and shepherdspurse can be expected. As with Dacthal, irrigation immediately after application is recommended if maximum weed control is to be achieved. Also, if Enide is to be used on lighter, sandy soils, a lower application rate should be considered.

Trefluralin (Treflan) also has a broad, general purpose label which includes a great number of annuals and established flower crops. Available in either a 5% granular or a 4 pound emulsifiable concentrate formulation, Treflan in generally recommended for use as a pre-plant treatment at a rate of 1 pound of active ingredient per acre followed by mechanical incorporation to a depth of 1 inch. Treflan is safe for application on ageratum, allysum, aster, carnation, chrysanthemum, dahlia, marigold, periwinkle, petunia, phlox, portulaca, salvia, shasta daisy, snapdragon, sweet pea, sweet william and zinnia to cite a few of the more than 40 flower crops on the label.

At the 1 pound per acre rate, long lasting control of a wide variety of annual grass and broadleaf weeds including crabgrass, foxtail, goosegrass, annual bluegrass, pigweed, lambsquarter, purslane, chickweed and knotweed can be expected. In addition, if the annual beds have large amounts of organic matter present, it may be necessary to increase the rate of Treflan application in order to achieve the desired weed control.

Bensulide (Prefar or Betasan) is another pre-emergent herbicide registered for use on annual flowers, including alyssum, aster, dahlia, marigold, pansy, sweet pea, and zinnia. In addition, Betasan is labelled for use on several bulbous crops including daffodil, gladiolus, ranunculus, and tulip. Applied following transplanting and pre-emergent to weed seed germination, Betasan, in either the 12.5% granular or the 4% emulsifiable formulation, is used at the rate of 10 pounds of active ingredient per acre. Excellent control of annual grasses including, annual bluegrass, barnyardgrass, large crabgrass, foxtail, fall panicum and goosegrass can be achieved, however control of broadleaf weeds with Betasan is limited.

EPTC (Eptam) also has a label for use on several annual flowering crops, however it must be applied prior to transplanting and incorporated to a depth of 2-3 inches in the soil to be effective.

(Photo by T. A. Fretz)

Available as either a 7% emulsifiable concentrate, 5 or 10% granular, Eptam can be used safely on alyssum, ageratum, aster, begonia, chrysanthemum, dahlia, marigold, pansy, petunia and zinnia at a rate of 3 pounds of active material per acre. Control of a wide selection of annual and perennial grasses and broadleaf weeds including bermudagrass, ryegrass, purple and yellow nutsedge, quackgrass, foxtail, mugwort, purslane, lambsquarter and shepherdspurse.

Lastly Chloramben (Ornamental Weeder) can be used in annual beds, however it is not recommended for use on plantings unless they have been established a minimum of 6 weeks. Applications of 4% Ornamental Weeder at 4 pounds of active ingredient per acre will control a wide assortment of weeds including chickweed, crabgrass, foxtail, lambsquarter, pigweed, smartweed and velvetleaf. Crops tolerant to Ornamental Weeder include celosia, chrysanthemum, dahlia, marigold, snapdragon and zinnia. Because plants need to be fully established for a 6 week period prior to the application of Ornamental Weeder, it's usefulness is limited.

Lastly, one might consider a mulch in order to help reduce weed competition in annual plant beds. A 2 to 3 inch layer of organic mulch alone will help suppress weed growth, but it can also be applied after herbicide application. The mulch applied after herbicide application will help reduce herbicide losses due to volatility, but will also extend the period of useful weed control. **WTT**

IRRIGATION MAINTENANCE HOLDS PROMISE FOR CONTRACTORS

One possible stumbling block to an otherwise rosy future for irrigation systems is maintenance and the apparent fear of property maintenance personnel to tamper with a complex and carefully balanced network of pipes, wires and controls.

In an effort to dispel some of the fear and to point out very good potential for irrigation maintenance as a business for contractors, the Associated Landscape Contractors of America's Maintenance Committee organized and presented a program at ALCA's recent annual meeting in San Diego.

For three hours representatives from Rain Bird, Buckner and Toro provided basic instruction on controls, pipes and heads. Rod Bailey of Evergreen Services Corp., Bellevue, WA, chairman of the Maintenance Committee for 1979, suggested that irrigation installers don't want to do maintenance. Manufacturers try to help managers of large systems with training programs and do send representatives to diagnose problems where practical. But the owners or managers of medium- or small-size systems depend almost entirely on the installer at present. The maintenance contractor, especially if he already performs a service to the account, can provide irrigation maintenance service, according to Bailey.

Ron Smith, Evergreen Landscape and Maintenance of Lubbock, TX, moderated the session from a position of experience since he has made the move into the area of irrigation maintenance successfully. He outlined some of the problems of irrigation maintenance today as inexperienced personnel, lack of standard installation procedures, missing 'as built' plans to assist in location of components, and the need for alteration of landscapes to improve irrigation design, system efficiency and maintenance. Smith stressed the need to flush out a newly installed system before placing valves and heads.

Vincent Noletti of Buckner began the program with controller troubleshooting. He likened electricity to hydraulics, saying amps are similar to gallons per minute and volts are similar to pounds per square inch. Resistance relates to both systems and is measured in ohms for electricity. An understanding of electricity is necessary to figure out problems with controllers and to insure against shock hazards.

Trial and error is too time consuming and too costly Noletti stressed. There are key indicators which direct the maintenance technician to the real problem and make trial and error unnecessary.

There should be three wires to the controller: one hot wire, one common wire, and one ground. Controllers today are either electromechanical or solid state. They are interchangeable. The solid state controller requires more thoughtful programming. A record of the program should be kept in a secure but accessible place for reference. The solid state controller will be cheaper in the future, is more precise from a time standpoint, and is more difficult to change programs.

A maintenance technician should keep an extra control panel for each controller under his care. He should also have a wire cutter, wire stripper, amp meter, volt/ohm meter, water tight connectors, solenoid wrenches, valve wrenches, a fault locator, and a two-way radio.

Noletti presented three problem situations and what to check.

No valves operate by controller

1. check time of day on controller clock
2. check start wheel for times
3. check day wheel for right day
4. check start wheel adjustment
5. check on/off switch
6. check fuse or circuit breaker
7. check reset
8. check power supply with meter
9. check transformer, should reduce 120 volts to 24-30 volts
10. check fuse on transformer
11. check common wire connections
12. check common wires to valves
13. check wire splices by using as built plans
14. note any wire damage
15. check water pressure
16. check gate valve to system or back flow preventer
17. does controller cycle properly, if not replace panel

Continues on page 60

As-built plans are made after installation to record any variations from the original plans.

Irrigation *from page 59*

One valve doesn't operate

1. try to turn on valve manually at controller
2. check power at terminal, at bad valve, and at controller connection board. If output is at connection board in the controller, then the problem is probably in the valve or the hot wire to the valve.
3. check valve wire connection
4. check resistance of circuit; should be between 15 to 25 ohms depending upon the manufacturer.

Valve won't close

1. advance control to off
2. check output to see if it is off; if not, replace panel

The best advice is always good checkout following installation to see that all circuits have .25 to .4 amps depending upon the manufacturer.

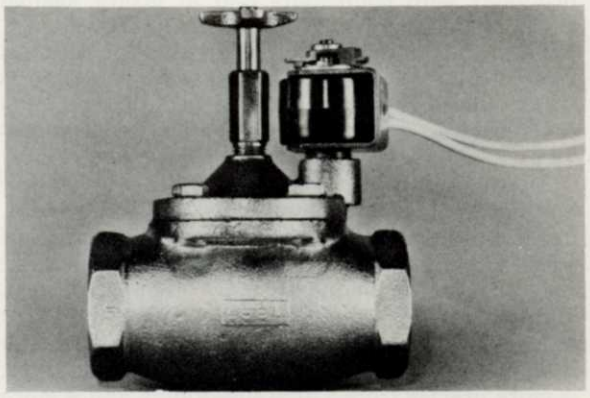
Rain Bird's Keith Kirby covered valve troubleshooting. He too stressed the need for as built plans, good water tight connection, and valve boxes.

Kirby narrowed valve problems down to four areas; no water in the system, low voltage, dirt clogging valve ports, and incorrect initial installation. There are basically two types of valves, electric or hydraulic. Hydraulic valves are usually found in warm climates only.

An electric valve is operated by current which causes the solenoid to open a port which bleeds water holding the diaphragm shut. It is a very delicate arrangement in which dirt can cause havoc. Any damage to the rubber diaphragm or blockage of ports hinders valve operation. A flow valve intended to regulate the flow of water through the valve can be closed by accident or by vandals. A closed flow valve would prevent the valve from opening even though current reached the valve as designed. A hole in the diaphragm or dirt in ports would keep the valve from shutting off. Solenoid failure would keep the valve from opening.

Kirby said there should be 40 to 50 psi in the main line for the valves to function properly. Flushing the lines twice before installing valves is recommended. When taking valves apart or putting back together care should be taken not to overtighten or strip threads.

Continues on page 62



Electric valve with solenoid and flow valve.

Irrigation *from page 60*

Extra steps during installation save in repair time later, such as this device which protects both heads and pipe from damage.

There are special electric valves for effluent water. Using effluent in a standard valve system is doomed to failure, Kirby said.

For finding electrical shorts, Kirby recommended fault finders made by Progressive Electronics Inc., or Hewlett Packard. The devices cost from $600 to $2,000 but perform reliably, he said. These devices not only tell you where a wire problem is, they will tell you how deep the wire is in the ground.

Chris Espinoza of Toro outlined the part of the irrigation system which takes the most beating, the heads. Espinoza said rotational heads (impact, ball drive, cam drive, and gear drive) wear even with proper use over time. Jamming from debris near the head, material in the water, or tampering by vandals should be carefully watched. Espinoza said replacement may be cheaper than repair due to labor costs in some instances.

Improper installation (not level with grade or lack of drainage for heads) and lack of safety devices invite head problems. The spray should clear surrounding grass without any special trimming around heads and puddling near heads should be corrected with use of gravel under and around the head. Correct water pressure is another major cause of malfunction for heads he said. Occasionally the problem will be traced to a backflow preventer which has its own gate valve. If this valve was tampered with, water flow will be incorrect for the design.

Espinoza suggested replacing shrub risers to pop ups for liability and maintenance reasons. He also suggested use of double swing joints during installation to prevent damage to lines underneath and to heads.

Overall, Espinoza proposed that the long term cost of a system should be considered as well as the short term. Using fewer heads, cheaper heads, less durable heads, and skimping on maintenance service could result in costs above those originally anticipated or desired. **WTT**