



2017 Herbicide Operations Manual

Maintenance Field Support Section
TxDOT, Maintenance Division

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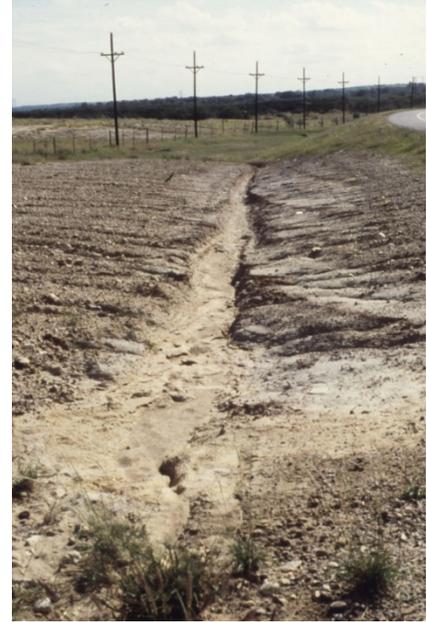
SECTION 1

1.0 INTRODUCTION TO HERBICIDES

Major reasons for highway right of way (ROW) vegetation management practices include:

- ◆ To maintain the integrity of the paved surface;
- ◆ To prevent or reduce erosion;
- ◆ To provide for the safety of the traveling public;
- ◆ To provide for efficient maintenance practices;
- ◆ To maintain drainage;
- ◆ To provide beauty, and;
- ◆ To provide wildlife habitat.

Vegetation management along the transportation system consists of propagation and control of vegetation. Control of



vegetative growth may be accomplished by a combination of physical and chemical methods. Physical methods of vegetation control include hand-pulling, hoeing, plowing, cultivating, trimming and mowing. Chemical methods include the application of approved herbicides to control specific vegetation problems. TxDOT's herbicide program is based upon extensive research for chemicals which will provide the desired control of the target species while presenting the minimum possibility of harm to the environment, the applicator, and to the traveling public. The use of herbicides is a key element to be used in combination with physical vegetation control methods to manage right of way vegetation.

There are numerous chemicals being registered by the Environmental Protection Agency (EPA) for both agricultural (crop) and right of way (non-crop) situations. Many of these chemicals have proven to provide excellent benefits to the vegetation manager in treating and/or controlling specific vegetation problems along the transportation system.



SECTION 2

2.0 VARIABLES AFFECTING HERBICIDES

Herbicide activity may be affected by many factors including:

- ◆ Species of Plant being Treated;
- ◆ Soil Type;
- ◆ Wind;
- ◆ Humidity;
- ◆ Rainfall;
- ◆ Temperature;
- ◆ Water Quality;
- ◆ Mixing and Application Procedures and Timing;
- ◆ Maintenance Supervisor; and
- ◆ *Individual Herbicide Applicator.*

2.1 Type and Species of Plants to be Controlled

The proper selection of herbicides, proper application rates and proper application method are dependent upon the type and species of vegetation to be controlled, as well as the condition of the plant itself. Some plant species are more resistant to certain herbicides than are other more sensitive plants. The plant may be in either an active growth or a dormant growth stage. The plant may be a seedling or may be a mature plant. The plant may be in the process of budding, leafing, flowering or fruiting. Each of these conditions is a component of how herbicides work and should be considered when deciding what herbicide(s) to use, where to use them and when to use herbicides.

For example, the best time to apply a foliar herbicide for the control of Johnsongrass is when there is good leaf area present before the boot stage. In general, seedling plants (immature plants just emerging), are much easier to control than established plants.

Plants are categorized as an annual, biennial or a perennial.

2.1.1 Annual, Biennial and Perennial Plants

Both annuals and biennials originate from seed (not from permanent rootstock). Annuals complete their entire life cycle in one growing season or year (seed to seed). Barnyard, Crabgrass and foxtail are examples of annual plants that are often seen on the TxDOT right-of-way. Biennial plants require two years to complete their life cycle. Musk thistles are biennial, producing a rosette in its first season and the tall flower readily recognized during its second season of life.

Perennial plants have extensive root systems and live for many years. Perennials produce seed as well to ensure survival of the species. Generally higher rates of herbicides will control perennial plant species. Johnsongrass is a common perennial on TxDOT ROW's.

2.1.2 Aquatic Plants

Aquatic plants, which may be annual, biennial or perennial, are associated with water and/or wetland areas, and typically have large, glossy, waxy leaves or a hairy surface. For aquatic plant control, TxDOT utilizes only ***Approved Aquatic Herbicides***. These herbicides have been approved by the EPA for the broad-spectrum control of vegetation within or adjacent to aquatic sites. An aquatically approved surfactant must be added to the ***Approved Aquatic Herbicide***. The surfactants stocked in the TxDOT Regional Warehouses ARE aquatically approved. ***Aquatic Herbicides*** used by TxDOT herbicide applicators to be considered approved by the Vegetation Management Section Staff will contain 54% Glyphosate and 46% Water (i.e. **Rodeo[®]**, **AquaMaster[®]** and **Roundup Custom[®]**). All products used by TxDOT herbicide applicators have been extensively tested and researched by the Vegetation Management Section Staff before being released for use.

2.2 Soil Type

Proper application rates as recommended within this document normally produce excellent results. Soil type, however, has an effect upon how well all herbicides work. Soil-active (residual) herbicides are more effective in soils that are low in clay or organic matter, such as sandy soils. In high clay soils, herbicide molecules attach (adsorb) to the clay particles and are not available for plant uptake. Therefore, in heavy clay soils, the application rates may need to be increased, within the limits of the product label for a soil-active (residual) herbicide.

The acidity or alkalinity of soils also has an effect upon the performance of herbicides. For example, in relatively acidic soils, often found within parts of East Texas, **Landmark[®] XP** and **Outrider[®]** decomposes at a faster rate (thus providing a shorter residual period), than it does in the more alkaline soils commonly associated with central and West Texas.

2.3 Wind Velocity

Wind will always disturb the spray pattern and blow herbicides away from the target area causing spray drift. High winds can blow an application several feet away from the target. The wider the pattern, the higher the nozzle from the ground, the smaller the droplet, the greater the effects of wind distortion. The best time to spray is before wind velocity rises (i.e. early in the morning). The addition of the proper drift control will help reduce drift. Drift Control WM and Droplex may reduce spray drift sufficiently for spraying to continue. However, if wind velocities rise to the point that the pattern cannot be kept on target, spraying should be discontinued. If wind velocities rise past the speed that a label directs, spraying should also be discontinued.

For purposes of deciding whether to spray and for record keeping, always carry a wind gauge in the spray unit. Document a single wind speed (i.e. 5 mph) instead of a range (i.e. 3-8 mph).

Winds over 5 mph may cause drift. Spraying operations should cease when winds are of such intensity that you cannot keep your spray on the target or if the label directs not to spray in winds of a certain velocity.

2.4 Humidity

Relative humidity is defined as the percent of moisture in the surrounding air relative to the maximum amount that the atmosphere could hold. Generally, the higher the relative humidity at the time of application, the more rapidly plants will absorb foliar-applied herbicides. However, when relative humidity approaches 100 percent, rainfall will likely occur and the chance that the herbicide will be washed from the foliage increases. Consequently, herbicides should not be applied when rainfall is threatening or is imminent or if there is moisture on the surface of vegetation.

2.5 Rainfall

Rainfall affects chemical control of vegetation in many ways. Rainfall acts as the vehicle that carries soil-active (residual) herbicides into the root zone of plants. Residual chemicals, in order to enter the root system of the target species, must be in solution. Excessive soil moisture may move (leach) the residual herbicide below the root zone and result in poor control. Moisture from rainfall, thawing cycles, and snow may prevent the herbicide from entering the soil in concentrations necessary to achieve the desired degree of control. Moreover, excessive rainfall may lead to serious herbicide damage to vegetation outside of the target area.

Do not spray herbicides during rainfall or when rainfall is predicted within 1–2 hours after application. Rain will wash herbicide off the foliage of target species before it can be absorbed by the plant. Conversely, after a rain, dust on the foliage will have been washed off and foliar-applied herbicides can be easily absorbed by the plant. Allow the foliage time to dry after a heavy dew or rain before conducting spraying operations as wet foliage may also yield poor results.

2.6 Temperature

Temperature affects the action of herbicides and the degree of control achieved as well. Do not apply herbicides when the soil is frozen, when rain or snow is falling, or when there is snow on the ground. High temperatures, typical during the hot-dry summer months, cause many plant species to become dormant. When these conditions occur, plants will not absorb herbicides and control will be reduced.

2.7 Water Quality

Water is an important factor affecting the action of all herbicides, especially when applying the herbicide Roundup PROMAX[®]. Always use the cleanest water available to mix herbicides, as impurities and soil particles in the water will bind or “tie up” the herbicide molecules and deactivate the chemical. Additionally, Landmark[®] XP and Outrider[®] herbicides, decompose faster in acidic water. For those instances where acidic water must be used, mix smaller batches to prevent Roundup PROMAX[®], Landmark[®] and Outrider[®] from becoming ineffective.

Impurities in the water, such as sand or clay particles, may also clog filters and damage centrifugal pumps, electric solenoids and nozzles.

2.8 Application Methods and Timing

Proper application methods and timing of your spray operations are essential to the success of any spraying program. Residual herbicides must be applied uniformly.

Herbicide Operations

Foliar-applied herbicides must be applied uniformly to the surface of the foliage of the target species.

Both residual and foliar-applied herbicides require proper timing for proper control and effective performance of the chemical.

SECTION 3

3.0 TYPES OF HERBICIDES

3.1 Soil-Active (RESIDUAL) Herbicides

Residual herbicides remain active within the soil for a period of time and prevent germination of seeds and/or growth of roots. Residual herbicides are moved into the root zone by water and rainfall. The herbicide is absorbed by the plant's root system and is distributed (translocated) throughout the plant. Plant growth processes are then affected. Toxic symptoms should begin to appear within several days.



The swiftness of how soon toxic symptoms begin to exhibit within the plant varies with the type of soil, rainfall rates, plant species, and the rate of herbicide actually applied. Residual herbicides can be applied to the soil in the winter months prior to or shortly after the initial emergence of new growth in the early spring.

Residual herbicides should **NEVER BE APPLIED TO BARE GROUND**. Vegetation should always be present before applying residual herbicides to avoid herbicide build-up and erosion.

3.2 Foliar-Applied Herbicides

Foliar-applied herbicides, as the name implies, must be applied to the green and growing foliage of the target species in order to be effective.

The herbicide is absorbed through the foliage and moved (translocated) throughout the plant and stored in the root system. Several days are typically required before the toxic effects of the herbicide appear. Repeat applications of foliar-applied herbicides may be necessary, as most foliar-applied herbicides used by TxDOT have a short soil residual activity or no soil activity at all.

Additionally, certain plant species may be harder to control with a herbicide, requiring either additional applications or the use of more than one herbicide in combination if broad-spectrum control is required.



SECTION 4

4.0 TYPES OF CONTROL

4.1 Bare Ground (COMPLETE) Vegetation Control

Bare ground situations may be appropriate where there is a specific reason for such a treatment. Treating the edge of pavement or vegetation encroachment within paved shoulders are good examples where bare-ground herbicide applications may be appropriate.

Continuous bare ground treatment, especially on sloped areas increase the potential for erosion and sediment loss. For those areas that receive bare-ground herbicide applications, additional spot-treatments may be necessary.

Applications to the edge of pavement should not be any wider than 6 inches from the edge of the paved surface and 12 inches behind the guardrail. Applications wider than 12 inches may result in erosion and soil sediment loss.

Application of an excessive quantity of herbicide is not economical and may result in damage to nearby desirable vegetation.

Complete control may be achieved by using a mixture of *Roundup PROMAX*[®] at 3 quarts per acre plus *EsplAnade*[®] 200 SC at 4 ounces per acre. *Roundup PROMAX*[®] at 3 quarts per acre plus *Landmark*[®] XP at 2-3 ounces per acre rate may also be used as long as the wind does not exceed 10 miles per hour. Bare ground is **not recommended under guardrails, or around signage, delineator posts, mailbox supports, etc.**

4.2 Selective Weeding

Selective weeding is the use of a herbicide or a combination of herbicides for the control of specific target plant species. Using herbicides selectively does not permanently harm desirable vegetation. Herbicides used for this type of control may be selective or low rates of non-selective herbicides. Examples would be *Roundup PROMAX*[®] plus *Outrider*[®] at 8 ounces plus 1.33 ounces per acre for the control of Johnsongrass, *Escort*[®] XP at a 1 ounce per acre rate for the control of Field Bindweed and Common Sunflower, *Transline*[®] at 10 ounces per acre rate for the control of weeds such as Musk Thistle and *Vista*[®] XRT at 10 ounces per acre plus surfactant at the rate of 2 quarts per 100 gallons of water for Giant Ragweed control.

4.3 Chemical Mowing

Chemical mowing is the practice of using *Roundup PROMAX*[®] to control undesirable vegetation which is in close proximity to desirable plants. This procedure may be utilized to control vegetation along fence lines, under guardrails, and within landscaped areas.

Chemical mowing is most often performed by using *Roundup PROMAX*[®] at the proper rate for the type of control desired.

SECTION 5

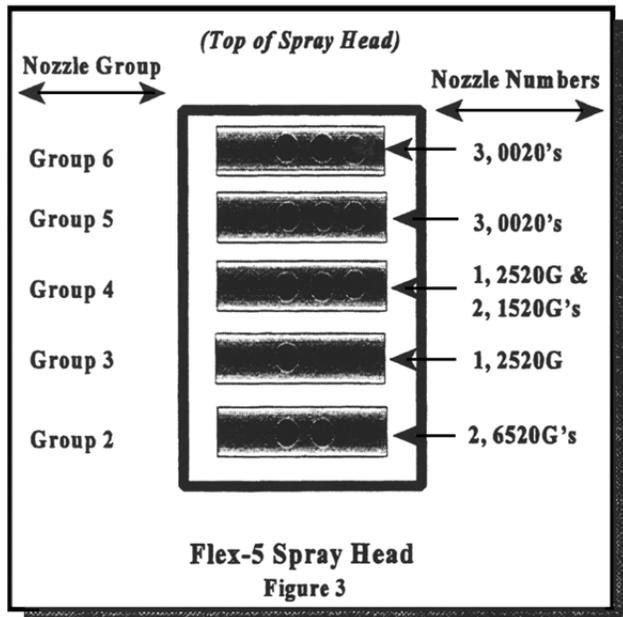
5.0 EQUIPMENT

5.1 Model 85 Spray Unit (FOD Issue)

The Model 85, which was initially produced within the General Services Division shops in 1985, is the spray unit that is currently used.

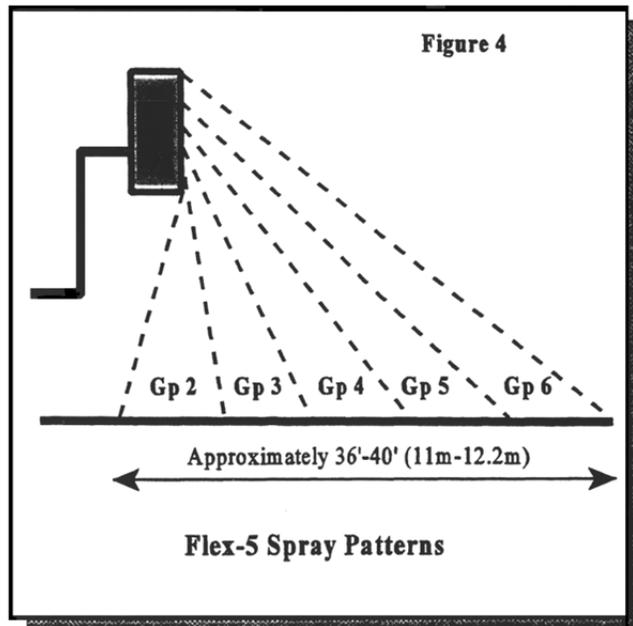
The Model 85 Spray Unit uses an electrically activated spray head called a Flex-Five spray head to spray wide areas of the right of way.

As shown in **Figure 3**, the Flex-Five spray head consists of five, independently operated nozzle groups.



Nozzle Group 2 includes two 6520G nozzles. Nozzle Group 3 has one 2520G nozzle. Nozzle Group 4 includes one 2520G nozzle and two 1520G nozzles. Nozzle Groups 5 and 6 both include three 0020 nozzles.

The spray pattern adjusts vertically by an electric cylinder operated from the control panel in the vehicle. This adjustment permits the applicator to maintain a constant spray width even on sloping terrain. Although wind affects all spray patterns, the flex-five spray head is designed to be able to spray wide areas (approximately 36-40 feet), as seen in **Figure 4**.

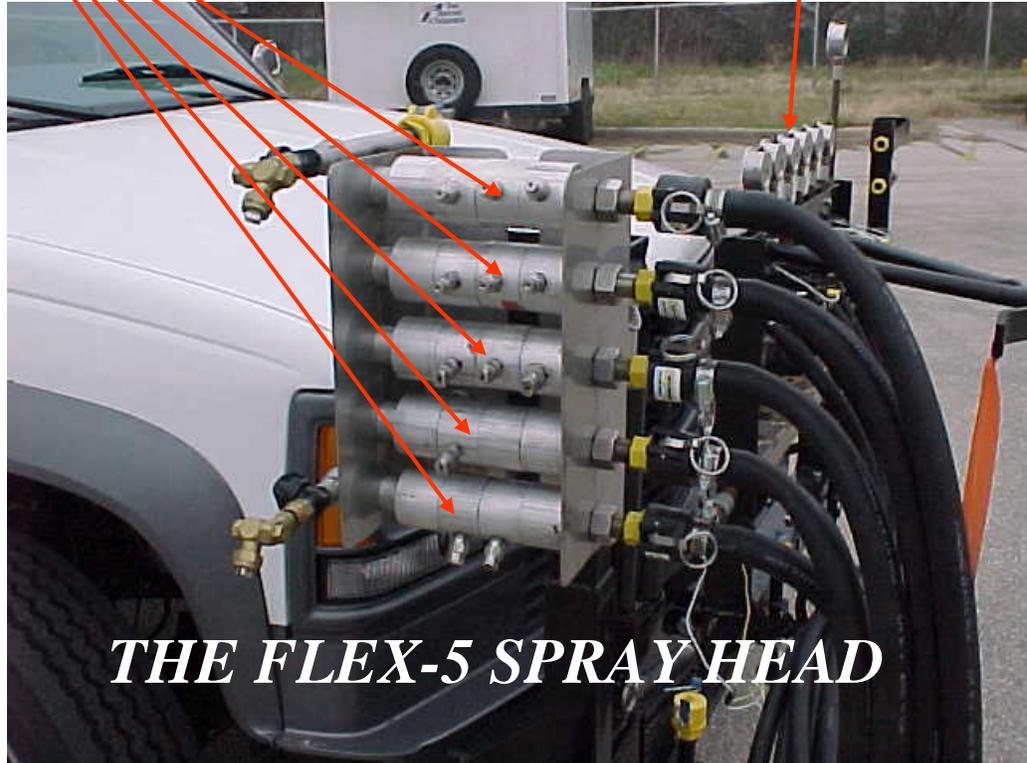


Example of nozzle sizes: Nozzle number 6520 directs the spray pattern at a 65 degree angle and distributes 2 gallons of solution per minute

Flex-5 Spray Head, Figure 5

5 Nozzle Banks

**Spray Pressure is
30 psi**



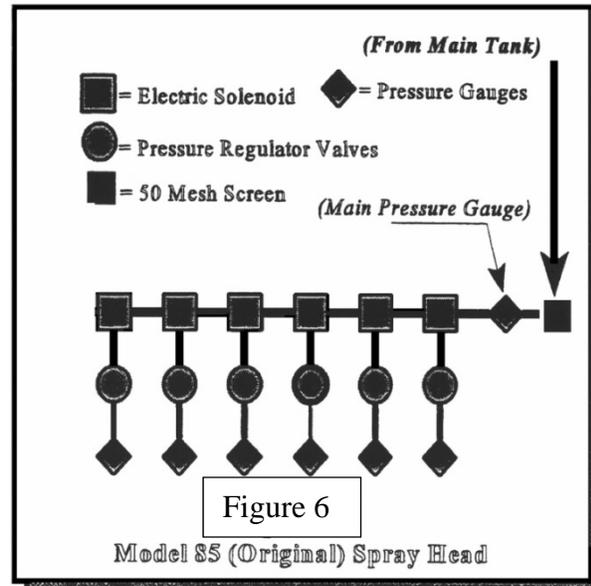
**Pre-Calibrated to
25 Gallons per Acre**

**Spray Speed is
11.4 Miles per Hour**

Herbicide Operations

As seen in **Figure 6**, this unit is distinguished by a spray head system, which includes a 50-mesh in-line filter, followed by the main pressure gauge and a series of six, in-line electric solenoids. On the downstream side of each of the electric solenoids, are flow regulators and pressure gauges.

At the downstream side of the last, in-line electric solenoid, is the by-pass pressure regulator, which permits return of excess fluid to the main tank during spraying operations.

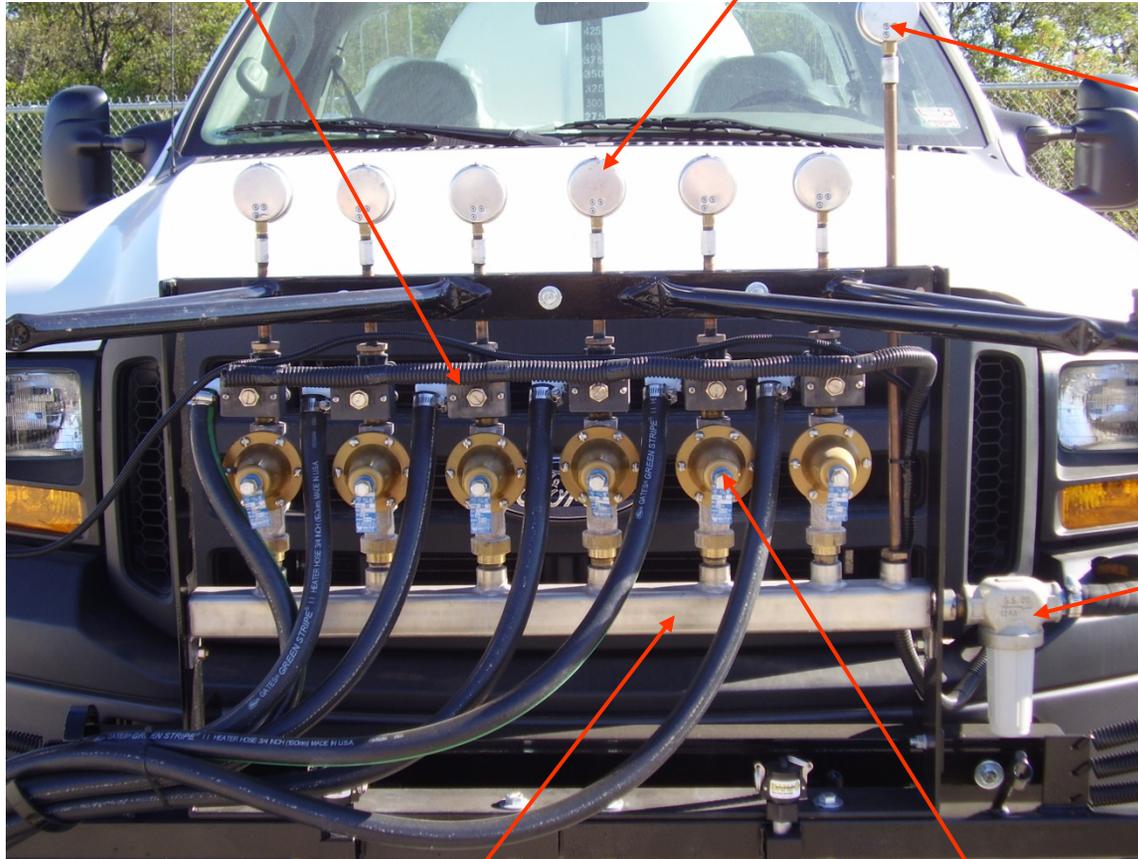


The main difference between the Modified, newer Model '85 unit and the older unit is that the solenoids and flow regulators have been “switched” around. This helps with the repair and replacement of solenoids, which need to be checked on a regular basis. Also on the newer Model '85 unit the return hose to the tank and pressure relief valve have been eliminated.

Model 85 (Modified) Spray Head-Figure 7

Electric Solenoids

Pressure Gauges



**Main
Pressure Gauge**

**Front In-Line
Filter**

Stainless Steel Manifold

Pressure Regulator Valves

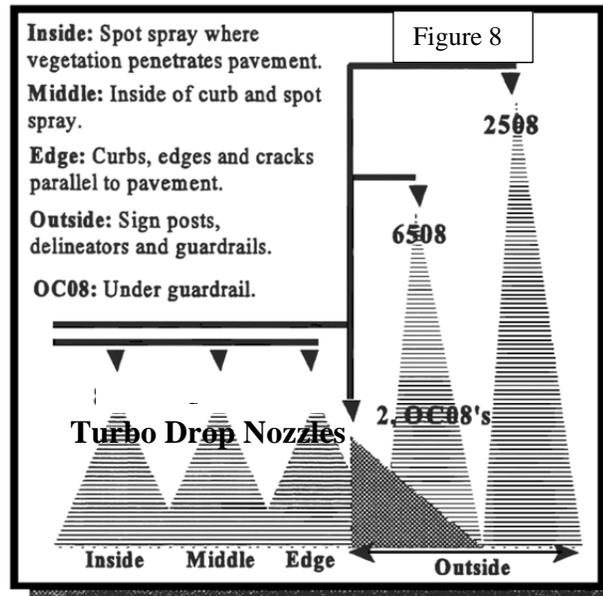
5.1.1 Fixture Operations

The fixture operation does not utilize an electrically or hydraulically operated boom system, but includes an arrangement of nozzles for spraying outside of the guardrails, under the guardrails, inside, middle and edge of pavement on the right or the left hand sides of the vehicle. These units were fabricated within the General Services Division shops.

As seen in **Figure 8**, the fixture spray operation is capable of spraying with the Inside, Middle, Edge and Outside nozzle depending on need. Use Turbo Drop nozzles for both the Inside and Middle of a pavement application, a Turbo Drop nozzle for edge work, two-OC08's for guardrail work, and a 6508 and 2508 for outside spraying around shoulders, guardrails, delineators, signs, etc.

The fixture nozzles are not used to spray wide areas of the right of way.

Each nozzle/set of nozzles on the Fixture boom, that has a brass nozzle should have a diaphragm check valve. The purpose of the diaphragm check valve is to eliminate drips when nozzles are not in use. Spray pressures should be set on **35 psi** if there is a 30-pound diaphragm check valve present or 30 psi if there is a 17-pound diaphragm check valve, to insure proper operation of the diaphragm check valves. See Figure 9.

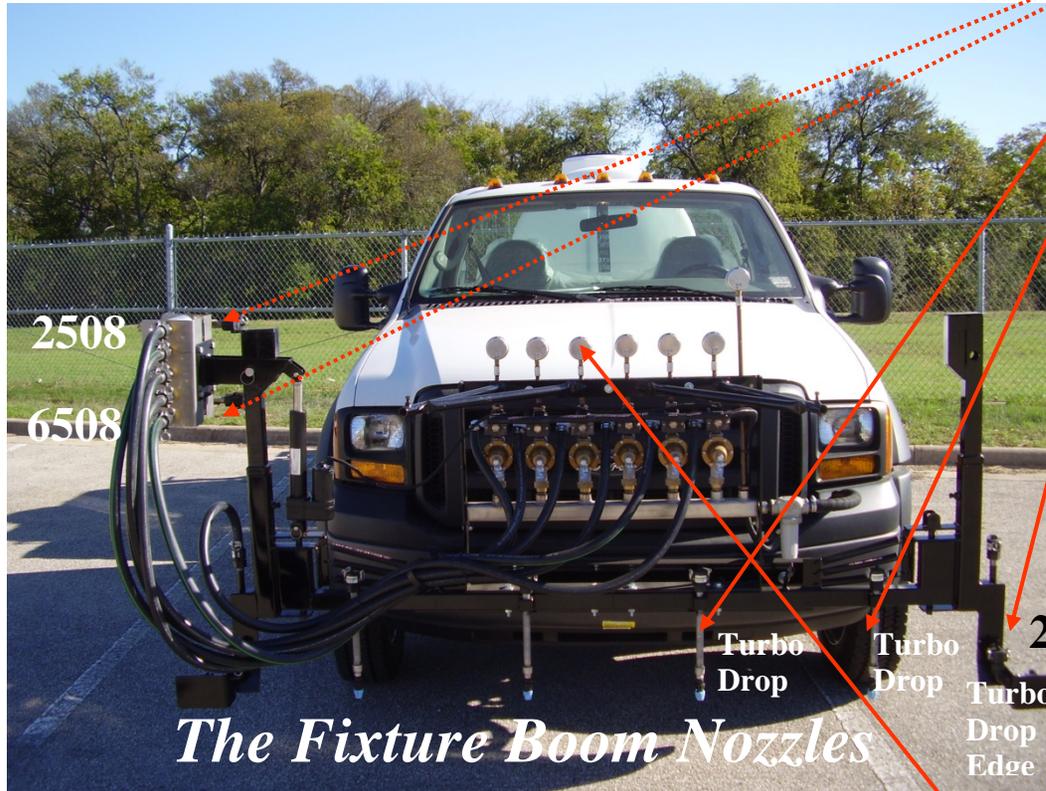
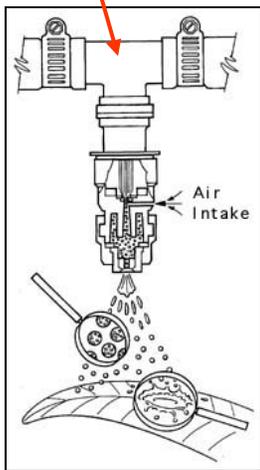


Fixture Boom Nozzles-Figure 9

6 Nozzles on Each Side



(Turbo-Drop Speed is 10 mph)



Must be Calibrated

ANNUALLY

Spray Speed is

5 mph

Spray Pressure is

**35 psi Standard (Brass Nozzles)
30 psi TurboDrop**

5.2 Turboprop Nozzles

Turbo drop nozzles have replaced the 8008 nozzles and are used for the edge of pavement, inside and middle nozzle positions for pavement treatments. These nozzles installed will change your driving speed from 5 MPH to 10 MPH, therefore cutting application time in half. Calibration for these nozzles is the same except speed should be calculated at 10 MPH instead of 5 MPH. These nozzles have NIGP codes and can be ordered through the TxDOT Regional Warehouses. Please call the Maintenance Field Support Section Staff for details concerning these nozzles.

5.3 Wick Applicator

Rope-wicks are generally used for thin stands of undesirable vegetation. When an undesirable stand of vegetation exceeds 35 percent of the ground surface, use the overspray operations of the herbicide spray unit. Before using the rope-wick check to make sure all of the ropes are wetting. Check possible sources of obstructions in the lines from tank to rope. The ropes used on the rope-wick should be polyester over acrylic ropes.

DO NOT wipe desirable vegetation with rope wick.

The herbicide mixture rate is two parts water to one part *Roundup PROMAX*[®].



SECTION 6

6.0 SURFACTANTS

6.1 General Characteristics of Surfactants

Surfactants are surface-active agents. They are useful as wetting or spreading agents. They act by increasing the contact between the liquid (i.e. herbicide/surfactant mixture) and the leaf surface of the pest plant, usually by reducing the surface tension of the spray droplets. Therefore, surfactants enhance the activity of the herbicide. An example of this can be seen when a drop of water is applied to a waxy leaf; it beads up. However, if detergent is added to the water first, then the droplets will spread out more readily. In this case the detergent is a surface-active agent, or a surfactant.



6.2 Mixing Rates for Department Stocked Surfactants

Applications using Roundup PROMAX® do not require the addition of a surfactant.

In Approved Aquatic Herbicide applications, always add 2 quarts of surfactant per 100 gallons of water. For applications of *Escort*® *XP* alone, always add 1 quart surfactant per 100 gallons of water. When using *Outrider*®, *Streamline*®, *Target*® 6.6, or *Vista*® *XRT* by itself always add 2 quarts of surfactant per 100 gallons of water. For *Transline*® applications on brush mix 2 quarts of surfactant per 100 gallons of water. Not using a surfactant can significantly reduce results. **Applications using Roundup PROMAX® do not require the addition of a surfactant.**

6.3 Surfactants Approved for Use with Department-Approved Herbicides

All surfactants received from the regional warehouses meet the approval of the Maintenance Field Support Section Staff in the Maintenance Division. These surfactants are safe for use with *Approved Aquatic Herbicide* applications sprayed directly in water and also for use with *Escort*® *XP*, *Transline*®, *Vista*® *XRT* and *Outrider*®, when applied alone.

6.4 Precautions Using Surfactants

Always wear goggles and gloves when adding and mixing surfactants. Surfactants can cause eye or skin irritation. Wash hands thoroughly with soap and water after handling surfactants.

Always read label directions prior to using any product, whether surfactant or herbicide.

Many surfactants are flammable and may burn with explosive violence. The liquid quickly evaporates and forms a vapor, which can catch fire. Keep away from heat, open flames, sparks and hot surfaces. Invisible vapor spreads easily and can be set on fire by such sources as pilot lights, welding equipment, electric motors and switches. The fire hazard is greater as the liquid temperature rises. Use only in well ventilated areas. Keep container closed when not in use. Clean up spills immediately. Do not weld heat or drill the container. Dispose of empty containers immediately according to label directions.

SECTION 7

7.0 DRIFT CONTROL AND ANTI-FOAMING AGENTS



7.1 Information About Drift Control and Anti-Foaming Agents

Drift control agents reduce drift; they do not eliminate drift. Winds above 5 mph may cause drift. Drift control agents reduce the fine particles created by the nozzle tip by increasing droplet size. Drift may still occur if the spray pressure is too high or the wind velocity is too great.

DO NOT SPRAY HERBICIDES WHEN WINDS ARE TOO STRONG AND SPRAY PATTERN CANNOT BE KEPT ON TARGET.

Control WM is injected from the drift control injector at the rate of 2 ounces per 100 gallons of water. **DO NOT pour Control WM in the top of the tank.**

Droplex is poured in the top of the tank or through the conical tank at a rate of 16 ounces per 100 gallons of water.

Prevent Anti-Foam **REDUCES** foam in the tank. **RoundUp ProMax**[®] has a tendency to get foamy when added to a tank filling with water. Shake Prevent well before adding to the top of your tank. Add the anti-foaming agent **SLOWLY** through the tank opening in a crisscross stream across the foam. **Prevent** is the Anti-Foam agent currently stocked in the TxDOT warehouses. **Prevent** Anti-Foam rate is 1 fluid ounce per 100 gallons of water.

7.2 Approved Drift Control and Anti-Foaming Agents

Control WM, **Droplex** and **Prevent** received from the regional warehouses all meet the approval of the Maintenance Field Support Section in the MNT Division for all herbicides.

7.3 Mixing Control WM/Droplex With Roundup PROMAX[®] and EsplAnade[®] 200 SC

Fill tank 1/2 full of the required amount of water. Add the required amounts of EsplAnade[®] 200 SC while maintaining agitation. With the agitators on, add another 1/4 amount of water. Add the recommended amount of **Roundup PROMAX**[®]. Add remaining 1/4 amount of water. Squeeze **Prevent** into the top of the tank and inject the proper amount of drift control through the drift control injector OR pour **Droplex** into the tank with the

agitators on and the bypass valve open. Inject the **Control WM** drift control (if not using Droplex), slowly to ensure adequate mixing. Leave the agitators on while operating the herbicide unit and making the application.

7.4 Mixing Control WM/Droplex With Roundup PROMAX[®] and Landmark[®] XP

Fill tank ½ full of the required amount of water. Add the required amounts of **Landmark[®] XP** while maintaining agitation. With the agitators on add ¼ amount of water. Add the recommended amount of **Roundup PROMAX[®]**. Add remaining ¼ amount of water. Squeeze **Prevent** into the top of the tank and inject the proper amount of drift control through the drift control injector OR pour **Droplex** into the tank with the agitators on and the bypass valve open. Inject the **Control WM** drift control slowly to ensure adequate mixing. Leave the agitators on while operating the herbicide unit.

7.5 Mixing Control WM/Droplex With Roundup PROMAX[®], Escort[®] XP and Outrider[®]

Fill tank ½ full of the required amount of water. Add the required amounts of **Outrider[®]** and **Escort[®] XP** while maintaining agitation. With the agitators on add ¼ amount of water. Add the recommended amount of **Roundup PROMAX[®]**. Add remaining ¼ amount of water. Squeeze **Prevent** into the top of the tank. Inject the proper amount of **Control WM** through the drift control injector OR pour **Droplex** into the tank with the agitators on and the bypass valve open. Leave the agitators on while operating the herbicide unit.

7.6 Mixing Control WM/Droplex With Roundup PROMAX[®] and Outrider[®]

Fill tank ½ full of the required amount of water. Add the required amount of **Outrider[®]** while maintaining agitation. With agitators on fill ¼ amount of water and the recommended amount of **Roundup PROMAX[®]**. Add remaining ¼ amount of water. Squeeze **Prevent** into the top of the tank and inject slowly through the drift control injector OR pour **Droplex** into the tank with agitators on and bypass valve open. Leave the agitators on while operating the unit.

7.7 Mixing Control WM/Droplex with Approved Aquatic Herbicide

Fill tank with the required amount of water. Add the recommended rate of **Approved Aquatic Herbicide**. Leave the agitators on while operating the herbicide unit. Squeeze **Prevent** into the top of the tank with the agitators on and the bypass valve open; inject the proper amount of drift control through the drift control injector OR pour **Droplex** into tank.

7.8 Mixing Control WM/Droplex with Vista[®] XRT and Capstone[®]

Fill tank ½ full of the required amount of water. Add the required amount of **Vista[®] XRT** or **Capstone[®]**. Fill the remaining ½ of batch. Squeeze **Prevent** into the top of the tank with the agitators on and the bypass valve open; inject the proper amount of drift control through the drift control injector OR pour **Droplex** into tank.

7.9 Mixing Control WM/Droplex with Transline[®]

Fill tank with the required amount of water and add the appropriate amount of **Transline[®]**. Squeeze **Prevent** into the top of the tank with the agitators on and the bypass valve open; inject the proper amount of drift control through the drift control injector OR pour **Droplex** into tank.

Herbicide Operations

7.10 Mixing Control WM/Droplex with Vista® XRT

Fill tank $\frac{3}{4}$ full of the required amount of water. Add the appropriate amount of **Vista® XRT**. Fill the remaining $\frac{1}{4}$ of batch. Squeeze **Prevent** into the top of the tank with the agitators on and the bypass valve open; inject the proper amount of drift control through the drift control injector OR pour **Droplex** into tank.

SPRAY HERBICIDES WHEN SPRAY PATTERN CAN BE KEPT ON TARGET.



SECTION 8

8.0 CALIBRATION

8.1 Reasons for Calibration

Poor results obtained after an herbicide application may be a result of inaccurate application methods. It is extremely important to calibrate the herbicide spray unit for the different spray operations. The pre-calibration phase involves the inspection of all parts of the spray system and equipment for proper operation and cleanliness. Leaks and drips are the first thing that a TDA inspector will notice.

To calibrate the herbicide spray unit use the following formulas to calculate the gallons per acre (GPA):

For additional examples of calibration procedures, see Section 17 pages 96-103.

$$GPA = \frac{5940 \times \text{Gallons Per Minute (GPM)}}{\text{Miles Per Hour} \times \text{Spray Width (inches)}}$$

Note: 5940 is a constant

To determine the amount of chemical to add to the herbicide tank. Find the number of acres a given batch will spray.

$$\text{Acres} = \frac{\text{Batch Size (gallons)}}{GPA}$$

To find the amount of herbicide to add to the tank, multiply the number of acres by the rate of herbicide.

$$\text{Amount of Herbicide} = \text{Acres} \times \text{Rate of Herbicide}$$



8.2 Calibration during Fixture Boom Operations

The nozzles used for fixture applications are located at different heights and spray different width patterns. This results in a variation in **GPA** from each nozzle. For this reason, an average GPA is sufficient for the required records and mixing procedures.

To determine the **GPA**, the following procedure should be used:

- ◆ Check operating fluids on both truck engine and independent engine.
- ◆ Inspect and clean filter screens.
- ◆ Add 100 gallons of water to the main tank.
- ◆ Open the main valve (from the bottom of the main tank) and bypass valve (located above the manifold on the outflow side of the pump). Also, open the tee-jet agitators located on the manifold.
- ◆ Turn independent engine switch on in the cab and after warm up increase throttle from inside of the cab.
- ◆ If using Control WM, add 2 ounces of drift control to the drift control injector and open ball valve to inject the drift control **VERY SLOWLY**. Do not allow air from drift control injector to enter the spray system. If using Droplex, add 16 ounces Droplex to the top of the tank. However, if air does enter and the pump loses prime, open bleeder valve at top of pump to bleed off air.
- ◆ To set spray pressure for fixture nozzles, increase the RPM of the independent engine to have 40-50 psi (or enough pressure to run the system properly) on the main pressure gauge with **all nozzles spraying**. Then loosen lock nuts on the pressure regulators and adjust the stem to achieve 35 psi on all spray pressure gauges while nozzles are spraying. Once spray pressure is set at the proper psi, turn solenoids on and off several times to check spray pressure setting. Then tighten lock nuts on the pressure regulators. Be sure diaphragm check valves are working when solenoids are turned on and off. The diaphragm check valves are located just above the spray nozzle and **Stops the Nozzle from Dripping**. The caps on the diaphragm check valves should only be tightened enough to prevent leakage. If they are too tight the valve will not open (you will read spray pressure even if the check valve does not open).
- ◆ To calibrate the GPA on the fixture nozzles, catch the fluid from the two upper nozzles (6508 and 2508), for one minute each. Measure the fluid to achieve GPM. Then adjust patterns of these two nozzles to achieve a good pattern with no gaps between the spray patterns. Spray these nozzles together at 5 mph to check the pattern and then measure the width of the spray pattern in inches. (In windy conditions, spray with the wind and measure and then spray against the wind and measure. Average the two spray widths and use this measurement in the calibration formula.)

After measuring GPM and spray width in inches, you are ready to calculate GPA using the following formula:

$$GPA = \frac{5940 \times GPM}{5\text{-mph} \times \text{Spray Width (inches)}}$$

Herbicide Operations

Once GPA is calculated, the amount of herbicide can be determined by dividing GPA into total gallons of mix desired which equals total number of acres to be sprayed. Then the number of acres multiplied by the rate of herbicide per acre equals the amount of herbicide to be added to the tank.

Mixing is accomplished by adding the appropriate amount of water to the tank. Then add the liquid herbicide to the 15 gallon chemical tank, if equipped (quantity based on calculations in step 9). Dry flowable herbicides need to be added to the top of the large spray tank or mixed in a smaller container with water to make a slurry. With the by-pass valve and the agitator valve open, slowly open the ball valve at the bottom of the 15 gallon tank to allow the herbicide to be pulled into the system and be mixed.

Once the chemical mixing tank is empty, close the valve to prevent air from being introduced into the pump. After the mixing is complete, close the by-pass valve to have spray pressure at the front of the spray unit.

8.2.1 Examples of Calibrating Fixture with Regular Nozzles

Catch the fluid from all three nozzles for one minute:

Drift control needs to be added in the proper sequence. Refer to Section 7.

Guardrail nozzle (6508)	112 ounces
Top nozzle (2508)	<u>93 ounces</u>
	205 ounces/minute

Divide 205 ounces per minute by 128 ounces per gallon to achieve 1.6 GPM

Measure the spray width of all the nozzles. 63 inches

The speed for fixture operations is 5 mph

Use the calibration formula.

$$GPA = \frac{5940 \times 1.6 \text{ GPM}}{5 \text{ mph} \times 63 \text{ inches}}$$

$$GPA = \frac{13543.2}{450}$$

$$GPA = 30.2 \text{ or } 30$$

Once the GPA has been calculated, the herbicide mixture can be made. The number of acres must be determined per batch size. Then the amount of herbicide can be calculated per batch size, depending on the type of treatment and rate of herbicide.

Example of Calibrating for SELECTIVE Vegetation Control:

Using Flex-5 Spray Head

$$\text{GPA} = 25$$

Rate of Roundup PROMAX[®] + Outrider[®] = 8 oz + 1.33 oz per acre

Batch size = 450 gallons of water

$$\text{Acres} = 450 \text{ gallons} \div 25 \text{ GPA}$$

$$\text{Acres} = 18$$

$$18 \text{ acre} \times 8 \text{ oz} + 1.33 \text{ oz per acre} = 4.5 \text{ quarts} + 24 \text{ oz}$$

To mix, the applicator adds 4.5 quarts of *Roundup PROMAX[®]* + 24 oz of *Outrider[®]* to 450 gallons of water in the tank.

Example of Calibrating for COMPLETE Vegetation Control:

Using Turbo Drop (11020) Nozzle for Edge of Pavement Application

$$\text{GPA} = 30$$

**Rate of Roundup PROMAX[®] = 3 quarts per acre plus
Landmark[®] XP = 3 ounces per acre**

Or Esplanade 200 SC = 4 ounces per acre

Batch size = 450 gallons of water

$$450 \text{ gallons of water} \div 30 \text{ GPA}$$

$$\text{Acres} = 15$$

$$15 \text{ acres} \times 3 \text{ quarts per acre} = 45 \text{ quarts plus}$$

$$15 \text{ acres} \times 3 \text{ ounces per acre} = 45 \text{ ounces}$$

To mix, the applicator adds 45 quarts (11.25 gallons) of *Roundup PROMAX[®]* plus 45 ounces of *Landmark[®] XP* to 450 gallons of water in the tank.

8.2.2 Examples of Calibrating Fixture with Nozzles

Catch the fluid from edge nozzle for one minute:

Drift control needs to be added in the proper sequence. Refer to Section 7.

Edge nozzle ()

128 ounces

128 ounces/minute

Divide 128 ounces per minute by 128 ounces per gallon to achieve 1 GPM

Herbicide Operations

Measure the spray width of all the nozzles. 24 inches

The speed for fixture operations with nozzles is 10 mph

Use the calibration formula.

$$GPA = \frac{5940 \times 1 \text{ GPM}}{10 \text{ mph} \times 24 \text{ inches}}$$

$$GPA = \frac{5940}{240}$$

$$GPA = 24.75 \text{ or } 25$$

Once the GPA has been calculated, herbicide mixture can be made. The number of acres must be determined per batch size. Then the amount of herbicide can be calculated per batch size, depending on the type of treatment and rate of herbicide.

Example of Calibrating for COMPLETE Vegetation Control:

$$GPA = 25$$

Rate of Roundup PROMAX[®] = 3 quarts per acre plus

Landmark[®] XP = 3 ounces per acre

Batch size = 500 gallons of water

$$500 \text{ gallons of water} \div 25 \text{ GPA}$$

$$\text{Acres} = 20$$

20 acres x 3 quarts per acre = 60 quarts plus

20 acres x 3 ounces per acre = 60 ounces

To mix, the applicator adds 60 quarts (15 gallons) of Roundup PROMAX[®] plus 60 ounces of Landmark[®] XP to 500 gallons of water in the tank.



8.3 Calibrating the Trailer Unit



8.3.1 Examples of Calibrating the Trailer Unit

Calibrating the Trailer Unit is very similar to calibrating the Herbicide Truck, but since this unit runs on the ROW it is operated at a slower speed usually 3 – 5 MPH.

The Trailer Unit consists of a single or tandem axle trailer with a 500 gallon low profile elliptical tank equipped with Tee Jet agitation, gasoline or diesel motor with centrifugal pump, Boom Buster or Boominator broadcast nozzles that spray up to 32 ft., Raven tractor mounted sprayer control with pressure regulator, electric ball valves, filters, hoses and valves.

Example: Boombuster nozzles running at 40 psi and 4 GPM. Ground application speed of tractor is 4 mph. Spray width 32 feet.

Note: 5940 is a constant

$$GPA = \frac{5940 \times \text{Gallons Per Minute (GPM)}}{\text{Miles Per Hour} \times \text{Spray Width (inches)}}$$

1st Catch the fluid from each nozzle for one minute and record in GPM:

Drift control needs to be added in the proper sequence. Refer to Section 7.

2nd Measure the spray width of all the nozzles and record in inches:

$$GPA = \frac{5940 \times 4 \text{ GPM}}{3 \text{ to } 5 \text{ mph} \times 384 \text{ inches}}$$

3rd Determine the application speed and record in miles per hour (Recommend 3 to 5 mph for most terrain):

4th Then, do the math:

$$GPA = \frac{5940 \times 4}{4 \times 384}$$

Herbicide Operations

5th Multiply top, then bottom and divide the bottom into the top:

$$GPA = \frac{23760}{1536}$$

Gallons per Acre (GPA) = 15.5

8.3.2 Optional Equipment for the Trailer Unit

Options include: Tandem Axles, Fenders, Hose Reel (CA32112L) with 200 ft. of ½ hose and Hudson or Green Garde handgun.

8.3.3 Trailer Unit Speed Calibration Tables

**Speed Calibration Table I
(Travel 88 feet)**

Time	MPH	Ft./Minute
20.0	3	264
17.1	3.5	308
15.0	4.0	352
13.3	4.5	396
12.0	5.0	440

**Speed Calibration Table II
(Travel 100 feet)**

Time	MPH	Ft./Minute
22.7	3	264
19.5	3.5	308
17.0	4.0	352
15.2	4.5	396
13.6	5.0	440

8.4 Calibrating the De-icing System



8.4.1 Fundamentals of the De-icing System

The De-icing System is an option to the Herbicide Truck when ordered by TxDOT, Fleet Operations Division (FOD). The System can also be ordered through purchasing and installed by the District/Region Equipment Shops.

The De-icing System uses a material when applied on the road surface in a pre-ice situation, prevents ice from forming and bonding to the pavement. A de-icing operation breaks down the bond between the ice and the pavement on roadways and bridge structures which allows for the thawing of ice. In most cases all of this depends upon the type of solution used and the climatic conditions encountered.

The solution is applied through the De-icing System. The de-icing system and its nozzles prevent damage to other fluid handling components of the herbicide truck except for the pump.

De-icing materials used by TxDOT:

FreezGard or M1000, Meltdown Apex, Calcium magnesium acetate (CMA), Brine solutions and any other liquid product deemed to be effective in thawing or breaking down ice in an environmental and safe way on the roadway surface. Other methods include sanding and pelletized de-icing products distributed by broadcasters on dump trucks.

Nozzles for use with the De-icing System when $MgCl_2$ is used:

- (Bottom) SS0030-G nozzle (Pre-icing) – 3 GPM
- (Top and Bottom) SS0015-G nozzle (De-icing) – 1.5 GPM
- (Discontinued Bottom) RA 60 nozzles – 6 GPM

Spray speed is to be determined at calibration

Spray pressure is to be determined at calibration

When using Brine solutions:

Pre-icing nozzle size (Center Boom) 0060-G

De-icing nozzle size (Center and Side Booms) 0030-G

Pretreatment for Brine @ 45 mph – 55 mph

Herbicide Operations

Standard guidelines for operating the herbicide truck with the De-icing System:

Spray pressure is be determined at calibration

Maximum Spray width: 12 feet x 12 feet x 12 feet = 36 feet

8.4.2 Calibrating the De-icing System

$$MPH = \frac{60 \times GPM}{GPLM}$$

MPH = Miles per Hour

GPM = Gallons per Minute

GPLM = Gallons per Lane Mile

- 1) Measure material from nozzles and convert to GPM
- 2) Recommended Gallons per Lane Mile as listed on label of material

Example of how to get MPH using material for De-icing:

Note: 60 is a constant

$$MPH = \frac{60 \times GPM}{GPLM}$$

- 1) Measured out one minute worth of material from the De-icing System nozzles at 70 psi and measured amount was 43.875 gallons or 43.875 Gallons per Minute,
- 2) Material label recommended application of 50 Gallons per Lane Mile,

BRINE CALIBRATION

Brine Pre-Icing MPH = $\frac{60 \times GPM}{GPLM}$ 60 is a constant

EXAMPLE: **GPLM**

Plug in what you know: MPH = $\frac{60 \times GPM}{\cancel{GPLM} \rightarrow 50}$

156 x 6 = 936 (Multiplied amount caught by 6 because it was caught for 10 sec.)

↓

Divide by 128 because there are 128 ounces in a gallon.

GPM = 936 x 6 = 5616 / 128 = 43.875

↙ ↘

Multiply by 6 because 6 nozzles will spray for Pre-Icing

Plug in: = $\frac{60 \times GPM}{50} = \frac{60 \times 43.875}{50} = \frac{2632.5}{50} = 52.65$ **MPH = 50**

Herbicide Operations



SECTION 9

Eye wash kits can be obtained from the regional warehouses

9.0 PRECAUTIONS

9.1 Precautionary Statements

All labels include precautionary statements. Always read the label for safety procedures before using chemicals. Most exposure to herbicides occurs during mixing operations, mainly to uncovered hands, forearms, and face. Exposure can be reduced significantly by wearing gloves, goggles and long sleeve shirts. Wash hands thoroughly after handling chemicals.

9.2 Do's and Don'ts While Applying Herbicides

- ◆ **Read label prior to opening the container. Follow instructions and pay attention to precautions and warnings.**
- ◆ Store products in original containers.
- ◆ With DRY herbicides, like *Outrider*[®], *Landmark*[®] *XP* and *Escort*[®] *XP*, hold the container inside the mouth of the tank and pour slowly. This will eliminate much of the dust blowing up from the tank. Or mix in smaller container with water to make a slurry.
- ◆ Do not use soil active products near desirable susceptible vegetation. In these areas use foliar applied products such as *Roundup PROMAX*[®].
- ◆ Dispose or recycle herbicide containers according to label recommendations. Disposal usually consists of triple rinsing the container and punching holes in it, rendering it useless.
- ◆ It is recommended that the herbicides not be left in the tank overnight, and should not be left for an extended period of time. The solution should be used up if an application is not scheduled for several weeks.
- ◆ *Outrider*[®], *Landmark*[®] *XP* and *Escort*[®] *XP* are unstable in acidic water and should not be left in the spray tank for long periods of time. These products will also break down in high temperatures.

9.3 Equipment

When cleaning spray equipment, make certain that the chemical solution does not drain into areas of desirable vegetation or into waterways.

Do not save worn out tips for later use. Throw them away. Keep spares of each type of tip and several diaphragm check valves in the spray unit.

Prior to equipment storage over the winter season, flush tanks, boom, and hoses with several changes of water. Clean all tips and screens. Antifreeze can be circulated through the system to prevent the pump from freezing or locking down if it is not used for a long period.

9.4 Application Knowledge

- ◆ Drive at the correct speed.
- ◆ Discontinue spraying if wind velocity rises or changes direction. **Winds above 5 mph may cause drift. All spraying must cease when patterns cannot be kept on target or if the label states that the application must stop at a certain wind velocity** The applicator may need to begin application early in the morning, in order to cover as much area as possible, before the wind velocity rises.
- ◆ Discontinue herbicide application if rainfall is threatening. **Most of our herbicides are rainfast within 1-2 hours.** Postpone treatment until favorable conditions are present. Wet soil and/or foliage may yield poor results.
- ◆ Do not apply herbicides when ground is frozen.
- ◆ Avoid contaminating water in lakes or streams with herbicides that are not labeled for use in water.
- ◆ Use only clean water in the tank. Sand or clay particles will damage the pump, solenoids, and nozzles, and will deactivate **Roundup PROMAX[®]**.
- ◆ Clean equipment when changing chemicals. Flush with water several times and spray rinsate on the right of way as a typical application.

9.5 Procedures to Follow for a Herbicide Spill

Emergency spill kits can be obtained from Regional Warehouses.

All herbicide units should have an emergency spill kit with the trucks. Small spills should be contained with the spill kits. Large spills need to be contained as much as possible and contact the District Vegetation Manager or the Maintenance Division, Maintenance Field Support Section Office at (512) 416-3093 for cleanup instructions.

9.6 Preventing Lateral Movement of Soil Residual Herbicides

Lateral movement is the outward or side movement of a herbicide (several inches or feet) from the target area where it was applied. This occurs with soil residual herbicides when the applicator applies too high of a rate of a soil residual herbicide, when the soil is sandy, when the area sprayed is on a slope, or when rainfall moves the herbicide. To prevent lateral movement of herbicides use the following precautions:

- ◆ Apply at the proper rate.
- ◆ Reduce rates applied to sandy soils.
- ◆ Avoid application to slopes with soil residual herbicides.
- ◆ Do not apply during rain or when a heavy rain is expected.
- ◆ Do not apply to water-saturated soils.

SECTION 10

10.0 TOXICITY

The objective of using herbicides is to control a particular vegetation problem without creating environmental or health hazards.

Signal words are required for all registered pesticide products, herbicides included, that TxDOT uses in the roadside vegetation management program. Signal words describe the short-term (acute) toxicity of the pesticide product. The signal words are either CAUTION, WARNING, or DANGER. Signal words are required to appear on the front panel of the pesticide label.

CAUTION indicates that the pesticide is slightly toxic or almost non-toxic if eaten, absorbed through the skin, inhaled, or it causes slight eye or skin irritation.

WARNING means the pesticide is mildly irritating or moderately toxic if eaten, absorbed through the skin, inhaled, or it causes moderate skin or eye irritation. **Vista® XRT** is the only herbicide in the TxDOT roadside management program labeled as WARNING. This is due to the fact that **Vista® XRT** can cause substantial but temporary eye injury.

DANGER indicates that the pesticide is highly toxic through at least one way of exposure.

Nevertheless, safety equipment (eye protection, gloves, long sleeve shirt and dust mask where appropriate) should always be worn when working with concentrated herbicides or spray additives and when using the handgun or a backpack sprayer.

All herbicides approved by the Texas Department of Transportation for use in roadside vegetation management are labeled as either CAUTION or WARNING and classified as either **slightly toxic (rating 3)** or **almost non-toxic (rating 4)** in terms of the acute oral toxicity. They are also classified as either **mildly irritating (rating 3)** or **non-irritating (rating 4)** to the skin.

Precautionary Statements

Hazards to Humans and Domestic Animals

WARNING

Causes Substantial But Temporary Eye Injury. Wear Protective Eyewear • Prolonged Or Frequently Repeated Skin Contact May Cause Allergic Reactions In Some Individuals

Do not get in eyes or on clothing. Avoid contact with skin.

Keep out of reach of children.

CAUTION!

CAUSES MODERATE EYE IRRITATION.

Avoid contact with eyes or clothing. Avoid breathing vapor or spray mist.

Herbicide Operations

The following table relates the relative toxicity of TxDOT-approved herbicides as compared to commonly used items:

Common Name	Common Trade Names	Oral LD-50 (mg/kg)	Oral Toxicity Rating	Dermal Toxicity Rating
Aspirin	for comparison	1,240	3	-----
Table Salt	for comparison	3,320	3	-----
Table Sugar	Sucrose	29,700	4	4
Glyphosate	Roundup PROMAX[®]	>5,000	4	4
Indaziflam	EsplAnade[®] 200 SC	>2,000	3	3
Sulfometuron methyl and Chlorsulfuron	Landmark[®] XP	>5,000	4	3
Sulfosulfuron	Outrider[®]	>5,000	4	4
Monosodium acid methanearsonate	Target[®] 6.6	2833	3	3
Metsulfuron methyl	Escort[®] XP	>5,000	4	3
Fluroxypyr-meptyl	Vista[®] XRT	>5,000	3	3
Triclopyr	Pathfinder II[®]	>4,464	3	3
Clopyralid	Transline[®]	>5,000	4	4
Aminocyclopyrachlor and Metsulfuron methyl	Streamline[®]	>5,000	4	4
Methoprene	Altosid[®] XR	34,600	4	4

An “Oral LD-50” is a measure of the concentration of a particular substance that is necessary to kill 50 percent of the test animals. Oral LD-50 is normally measured in milligrams of the product per kilogram (parts per million) of body weight of the test animal.

Toxicity Categories

Indicators	Category			
	I Poison	II Warning	III Caution	IV Caution
Oral LD50 (mg/kg)	<50	50-500	500-5,000	>5,000
Dermal LD50 (mg/kg)	<200	200-2,000	2,000-20,000	>20,000
Eye Effects	Corneal Opacity, Irreversible Eye Damage	Corneal Reversible	No Corneal Opacity	No irritation
Dermal Response Rating Class	Absorbed, poisonous, causes burns and blisters	Moderately irritating	Mildly irritating	Non-irritating
Probable Lethal Dose for 150 lb. Man	A taste (less than 7 drops) to 1 teaspoon	1 teaspoon – 1 ounce	1 ounce – 1 pint	1 pint – 1 quart
Toxicity Rating Class	Extremely Toxic	Moderately Toxic	Slightly Toxic	Almost Non-Toxic

The LD-50 is applicable whether the chemical enters the body by inhalation, absorption through the skin or swallowed by the mouth. Generally, the LD-50 value for a material ingested via the respiratory route is lower than the oral LD-50 and the LD-50 by the dermal route. The higher the LD-50 value, the lower the toxicity of the chemical.



SECTION 11

11.0 PROTECTED PLANT SPECIES

11.1 Management of Protected Plant Species

Currently there are 17 protected plant species on the highway right-of-way, which affords protection under the “Endangered Species Act”. This act is administered by the Texas Parks and Wildlife Department (TWPd) and enforced by the United States Fish and Wildlife Service (USFWS). Two plants are a “Candidate Species”, which means that there is an ongoing study to determine if the plant qualifies for future “Endangered” or “Threatened” protection. Two plants are not on any of the federal or state protection listing, but TxDOT is protecting these species because of their dwindling habitat.

All maintenance in these areas should be coordinated with the Maintenance Field Support Staff of the Maintenance Division and the Texas Parks and Wildlife Department. All maintenance in these areas must protect and preserve these protected plant species.

The following table lists these plant species, classification and county where they are located:

Species Name	Classification	County
Davis’ Green Pitaya	Endangered	Brewster
Nellie Cory Cactus	Endangered	Brewster
Tobush Fishhook Cactus	Endangered	Kimble, Kinney, Uvalde, Val Verde
Zapata Bladderpod	Endangered	Zapata
Ashy Dogweed	Endangered	Zapata
Texas Trailing Phlox	Endangered	Hardin
Slender Rush Pea	Endangered	Kleberg, Nueces
Texas Poppy Mallow	Endangered	Runnels
Texas Wild-rice	Endangered	Hays
Navasota Ladies-tresses	Endangered	Brazos, Grimes
South Texas Ragweed or Ambrosia	Endangered	Kleberg, Nueces
Walker’s Manioc	Endangered	Hidalgo
Texas Golden Glade Cress	Endangered	Sabine, Nacogdoches
Pecos or Puzzle Sunflower	Threatened	Pecos
Lloyd’s Mariposa Cactus	Threatened	Brewster
Neches River Rose Mallow	Threatened	Cherokee, Houston, Trinity
Johnston’s Frankenia	Endangered (Proposed to be Delisted)	Zapata, Starr
Rough-stem Aster	Protected by TxDOT	Anderson, Henderson, Smith, Van Zandt, Wood
Bailey’s Ballmoss	Protected by TxDOT	Kenedy

SECTION 12

12.0 LAWS AND REGULATIONS

12.1 Texas Department of Agriculture (TDA)

Application of all herbicides and spray additives will be made in a manner consistent with all current and pertinent laws and regulations.

The Texas Department of Agriculture (TDA) is the state agency responsible for regulating pesticide use. TDA does this by enforcing the Texas Pesticide Laws (Chapter 76, Pesticide and Herbicide Regulation of the Agriculture Code) and Rules (Title 4, Chapter 7, Pesticides of the Texas Administrative Code.)

TxDOT currently has a Memorandum of Agreement (MOA) with TDA that allows TxDOT to train and test TxDOT personnel.

- ◆ Texas Department of Transportation and Texas Department of Agriculture Memorandum of Agreement 1995 (See Pages 39 - 40)

MEMORANDUM OF AGREEMENT
BETWEEN
THE TEXAS DEPARTMENT OF TRANSPORTATION
AND
THE TEXAS DEPARTMENT OF AGRICULTURE

I. LEGAL AUTHORITY

This agreement is entered into under Section 76.101(c) of the Texas Pesticide Law.

II. PURPOSE

The purpose of this agreement is to promote thoroughness of preparation and testing, efficient use of agency personnel, and maximum economy in expenditure of funds for pesticide applicator certification of Texas Department of Transportation (TxDOT) personnel. Because of the statewide public right-of-way and roadside park pest control responsibilities of the TxDOT, that agency and the Texas Department of Agriculture (TDA) find that a cooperative agreement to provide specialized training and testing of TxDOT pesticide applicators will also promote public safety, environmental protection, and effective use of pesticides. The two agencies enter into this Memorandum of Agreement subject to the following conditions:

III. CONDITIONS

1. TxDOT will develop training and testing material for certification of TxDOT personnel in the right-of-way pest control category. All training and testing materials shall be subject to TDA review and approval. TxDOT will designate qualified instructors to direct training and testing.
2. TxDOT shall provide TDA with a schedule of testing dates and locations.
3. To be licensed under TxDOT testing, a person must pass a General Pesticide Applicator Exam, a Laws and Regulations Exam, and a Right-of-way Pest Control Exam. In no case will a score below 70% be approved as passing. All tests shall be written and may not be administered orally. TxDOT personnel may also be certified in the Research and Demonstration, the Predatory Animal Control Category and any additional categories by successfully completing the appropriate TDA exams in addition to the exams listed above.

4. A license issued to TxDOT personnel shall be a noncommercial license with no fee charged; however, such license shall be valid only for purchase and/or application of pesticides in the line of official TxDOT duties.

5. Licenses may be renewed on an annual basis subject to recertification regulation requirements and must be surrendered upon termination of employment with TxDOT. TxDOT shall notify TDA of surrendered licenses.

6. TxDOT will develop recertification courses approved by TDA for TxDOT personnel. On or before December 15 of each year, TxDOT will submit to TDA a record of TxDOT personnel who have successfully met the recertification requirements for licensing the following year.

7. TxDOT personnel may also receive recertification credits as otherwise provided by 4 TAC Section 7.10.

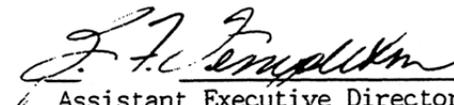
IV. NOTIFICATION OF VIOLATIONS

TxDOT and TDA each agrees to notify the other agency of any incident or complaints of pesticide misuse by TxDOT personnel. TDA shall notify TxDOT of any suspension or revocation of a license or certification of TxDOT personnel for pesticide misuse or other cause.

V. TENURE

This agreement shall remain effective until canceled by either of the signatory parties or their authorized agent and may be subject to review and amendment as deemed necessary or appropriate as mutually agreed.

SIGNATORY PARTIES



Assistant Executive Director
for Field Operations
Texas Department of Transportation

OCTOBER 25, 1995
Date



Deputy Commissioner,
Texas Department of Agriculture

10-9-95
Date

SECTION 13

13.0 HERBICIDE SPRAYING OPERATIONS

13.1 General Information

The purpose of the herbicide spraying operation is to control noxious and invasive plants that may cause a safety concern and compete with desirable vegetation on the right-of-way and are detrimental to the environment. An effective spraying program has been shown to reduce mowing cycles, mowing cost and improve the overall condition of the highway system.

It is very important that application timing guidelines are followed to ensure that spraying operations do not affect the emergence and growth of wildflowers.

Please refer to Sections 15.1.6, Section 15.3.1 and Section 15.4.3.

Herbicide spraying operations must be coordinated with mowing operations to be effective.

13.2 Bare ground Applications

Bare ground applications are herbicide treatments to the edge of pavement and vegetation encroachment within paved shoulders, retaining walls and paved and raised medians. The recommended application rate for these treatments is 3 quarts of Roundup PROMAX[®] plus *Esplanade*[®] 200 SC at 4 ounces per acre to provide for control of edges. Edge of pavement applications are generally made from March thru October. The most effective applications to control bermudagrass are generally made later in the recommended spray schedule.

Avoid using the herbicide combination of *Roundup PROMAX*[®] plus *Landmark*[®] XP on concrete structures and riprap due to the runoff of the herbicide *Landmark*[®] XP during rainy conditions onto desirable vegetation. **If** rainfall is **NOT** forecasted within 48 hours of the application, a handgun application of 3 quarts of *Roundup PROMAX*[®] plus *Esplanade*[®] 200 SC at 4 ounces per 100 gallons of water may be made to concrete structures and riprap.

These applications should be restricted to no more than 6 inches from to the edge of the paved surface and 12 inches behind the guardrail. Applications wider than 12 inches may result in erosion and soil sediment loss.

Reference: Section 4.1, Section 7.3, Section 14.7, Section 15.1.11, Section 15.2

13.3 Guardrail Applications

The recommended herbicides and application rates are 8 ounces of *Roundup PROMAX*[®] plus 1.33 ounces of *Outrider*[®] plus 1 ounce of *Escort*[®] XP (when Bahia grass is not desirable ROW vegetation) plus 10 ounces of *Vista*[®] XRT per acre. If Bahia grass is desirable, do not use *Escort*[®] XP on the ROW. These applications are generally made from May thru October, but **Escort XP applications should be discontinued after July 31st.**

Herbicide applications to control winter annuals (such as ryegrass, mustards and turnip weed) are recommended in the spring to improve visibility of guardrails. The application rate for these treatments is 1 quart of *Roundup PROMAX*[®] plus 2 ounces of *Landmark*[®] XP or 1 quart of *Roundup PROMAX*[®] plus 4 ounces of *Esplanade*[®] 200 SC per acre. These applications are made January thru April.

13.4 Noxious Weed Control

Broadcast herbicide applications are required to control noxious weeds on the right-of-way such as Johnsongrass, Switchgrass, Giant Ragweed, Sunflowers, Field Bindweed and other broadleaf weeds. The recommended herbicides and application rates are 8 ounces of Roundup PROMAX[®] plus 1.33 ounces of Outrider[®] plus 1 ounce of Escort[®] XP plus 10 ounces of Vista[®] XRT per acre. These treatments are also recommended to treat guardrails, signs and delineators when grasses are desired around and under these structures. Applications are generally made from May thru October; however, **Escort[®] XP should be discontinued after July 31.**

Reference: Section 4.2, Section 7.4, Section 7.5, Section 14, Section 15.3.1, Section 15.5.2, Section 15.8.3

Broadcast and spot applications of Transline[®] in the spring (January thru April) may be necessary to control Musk Thistle. Applications rates are 10 ounces per acre applied as a broadcast application and 10 ounces per 100 gallons of water for spot treatments. Spot applications are recommended in areas where large populations of wildflowers exist.

Reference: Section 7.8, Section 15.6.2

In some cases, it will be necessary to make herbicide applications with the handgun to noxious plants that cannot be sprayed with broadcast application equipment. To determine the proper herbicide application rate, find recommended rate per acre in this manual or in the manufacturer's chemical label. Add the recommended rate of the chemical to 100 gallons of water for handgun use. In instances when Roundup PROMAX[®] is not used, surfactant is also recommended.

Reference: Section 15

13.5 Brush and Tree Control and Chemical Pruning

Low volume foliar and basal bark herbicide applications will be necessary to control brush and trees such as Mesquite, Huisache, Retama, and Kudzu on the right-of-way.

Low volume foliar treatments are made using a solution of ½% Transline[®] plus 1/2% surfactant applied with a handgun equipped with a X-6 spray tip. The application should be made uniformly over the entire plant. These treatments are generally made in mid-summer thru fall.

Chemical prune (also known as side trimming) woody plants and tree limbs encroaching in the clear zone on the state's right-of-ways with the herbicide **Capstone[®]**. With the flex-5 spray head, woody plants can be controlled with **Capstone[®]** at 6 pints per acre plus surfactant at the rate of ½%. **Capstone[®]** can be applied at any time during the growing season when the woody plants are actively growing with adequate foliage. However, it's best to chemically prune vegetation in the Fall before trees and brush defoliate.

In areas where there are a lot of undergrowth around the trees that would otherwise need to be trimmed mechanically add **Vista[®] XRT**, at 10 ounces per acre to the **Capstone[®]** at 6 pints per acre plus the addition of surfactant at the rate of ½%.

Reference: Section 7.8, Section 14.8, Section 14.9, Section 14.10, Section 14.21, Section 15.6.4, Section 15.6.5, Section 15.6.6, section 15.6.7, Section 15.6.8.

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Basal bark herbicide applications can be made year-around using the ready-to-use herbicide (RTU), Pathfinder II[®]. Apply Pathfinder II[®] to the lower 12-15 inches of bark using an X-2 spray tip.

Reference: Section 15.7.2

13.6 Aquatic Weed Control

Handgun herbicide applications are often necessary to control aquatic vegetation. Aquamaster[®], Roundup Custom[®] or Rodeo[®] applied at 8 quart plus 2 quart of an aquatically approved surfactant per 100 gallons of water is recommended to control undesirable vegetation growing in standing or running water.

Reference: Section 7.6, Section 15.4

SECTION 14

14.0 NOXIOUS WEEDS ON THE RIGHT-OF-WAY

14.1 General Information

A variety of plants are considered pests along the highway right-of-way. Pest plants are generally those species that pose safety, maintenance, or public relation problems for the Department.

The predominant pest species in Texas include Johnsongrass, Giant Ragweed, Musk Thistle, Sunflower, Field Bindweed, Bermudagrass, Mesquite, Huisache, Retama, Georgia Cane, Kochia, Russian Thistle, Switchgrass, Turnip Weed, Morning Glory Vine, Western Bitterweed, African Rue, Cattails, Saltcedar, Wildoats, Jointed Goatgrass and Kudzu.

Some of these are native to Texas while others are introduced species that have become naturalized, taking advantage of environmental disturbance to invade and become established in the highway right-of-way. Minimizing disturbance caused by construction or maintenance activities is the best way to reduce the spread of such species. However, once these species become established in an area of the right of way which must be maintained, properly selected and applied herbicides may be used to control the weed and re-establish desirable vegetation.

This section addresses important characteristics of the major pest plants of concern to the Department, and the recommended methods for their control.

14.2 Johnsongrass

Johnsongrass (*Sorghum halepense*) is a perennial grass, which may grow to approximately six feet tall. It spreads vigorously by rhizomes (i.e. underground runners) and by seed. It flowers throughout the growing season under favorable growing conditions. Most Johnsongrass plants, however, mature and flower later in the growing season. Johnsongrass is commonly found growing along roadsides, in ditches, open areas, fields and waste places.

Johnsongrass is most effectively controlled in an overspray program either with **Roundup PROMAX[®] + Escort[®] XP+ Outrider[®]** until July 31st or with **Roundup PROMAX[®] + Outrider[®]** alone later in the growing season until October 15th. Johnsongrass around fixtures may be controlled by spraying the **Roundup PROMAX[®] + Escort[®] XP+ Outrider[®]** combination at any time during the growing season.



In areas where Johnsongrass and Bloodweed control are necessary, **Outrider[®]** and **Roundup PROMAX[®]** can be mixed with 10 oz/ac of **Vista[®] XRT**. The Bloodweed must be actively growing with adequate soil moisture to achieve the best results.

In instances where Johnsongrass has become hard to control with the above treatment recommendations, **Target[®] 6.6** can be used. However, **Target[®] 6.6** must be made in two

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applications, 30-60 days apart while the Johnsongrass is actively growing. And the temperature needs to be at least 70 degrees on the application day. **Target[®] 6.6** should be applied at a rate of 1.5 quarts per acre plus a ½% surfactant (2 quarts surfactant per 100 gallons of water.)

Also see Sections 15.1.5, 15.3.1.1, 15.3.1.2 and 15.3.2.1.

14.3 Giant Ragweed (Bloodweed)

Giant Ragweed (*Ambrosia trifida*) is an annual broadleaf weed that can obtain heights of over ten feet. The plant germinates in the spring and flowers in the fall. The flowers are small and inconspicuous. The plant is blamed for hay fever problems while it is blooming.



Normally growing in the eastern two-thirds of the State it generally prefers moist soil in and around ditch areas.

Giant Ragweed can be controlled with an application of **Vista[®] XRT** at 10 ounces per acre rate plus surfactant at the rate of 2 quarts per 100 gallons of water in late spring-early summer. **Spraying mature plants will yield poor results.**

In areas where Johnsongrass and Bloodweed control is necessary, **Outrider[®]** and **Roundup PROMAX[®]** can be mixed with **Vista[®] XRT** at the 10 oz/ac rate without surfactant. The Bloodweed must be actively growing with adequate soil moisture to achieve the best results. Also see Sections 15.3.1.2 and 15.8.3.

14.4 Musk Thistle

Musk Thistle (*Carduus nutans*) is a biennial plant, which can grow up to eight feet tall. Musk Thistle takes two years to mature and die. The first year the plant is a rosette, as illustrated in the photo, the second year the plant grows tall and blooms. The leaves are dark green, deeply lobed, hairless and have a light green mid-rib. A silver gray leaf margin is characteristic of each spine tipped lobe. The leaf base extends down the stem to give the plant a winged appearance. The terminal flower is large (one to three inches in diameter), solitary and usually nodding or bent over slightly. The flowers are purple and are "powder puff" shaped producing thousands of straw-colored seeds per plant. Seed dispersal begins seven to ten days after blooming. The seeds are attached to



parachute-like hairs (pappus) which allow for their dispersal by wind currents.

Musk thistle reproduces only by seed so it's very important to control this plant before it goes to seed. It grows from the Panhandle to Central Texas. It can become a serious agricultural pest as well as cause safety problems for the Department.

Control of Musk Thistle can be obtained with an application of **Transline**[®] at 10 ounces per acre rate applied early spring (March - April).

14.5 Sunflower

Sunflowers (*Helianthus annuus*) are a drought tolerant annual broadleaf weed, which may reach a height of eight to ten feet. Yellow daisy-like flowers with dark centers grow two inches across. Multi-stemmed plants grow irregularly and are common throughout the state on roadsides, but usually occur in disturbed areas.



Sunflowers are a common weed problem that quickly emerges after construction projects are over, especially when new topsoil is added to the right of way from outside sources when stockpiled topsoil is depleted.

Sunflowers can be controlled with an application of **Transline**[®] at 10 ounces per acre or with the herbicide **Escort**[®] **XP** at the rate of 1 ounce per acre plus surfactant at the rate of 1 quart per 100 gallons of water. Plants should be sprayed when they are 2-3 feet in height.

14.6 Field Bindweed

Field bindweed (*Convolvulus arvensis*) is a long-lived perennial which produces a dense ground cover. The twining stems vary from 1.5 to 6 feet or more in length. It produces white to pink flowers, from April through September, and seeds, which may lie dormant in the soil for 30 to 40 years.



Field Bindweed occurs from the Panhandle to Central and West Texas along roadsides, railroads, fields, gardens and waste places and is a serious agricultural pest. Field Bindweed invades and becomes rapidly established in disturbed areas; minimizing disturbance in the right of way will reduce the spread of this pest plant.

The most effective herbicide to control Field Bindweed is **Escort**[®] **XP** applied at a rate of 1 ounce per acre during the flowering period. Always add 1 quart of surfactant per 100 gallons of water.

14.7 Bermudagrass

Bermudagrass (*Cynodon dactylon*) is a low-growing, perennial grass, which spreads mostly by underground and above ground runners, although common Bermudagrass produces viable seed. This plant grows primarily in loamy, seasonally moist soils; it is commonly found on highway roadsides. Although, Bermudagrass is a valuable cover species, reducing erosion, it is a potential pest when it grows into the pavement. Bermudagrass often penetrates the pavement shoulder contributing to pavement breakdown.



Bermudagrass growing at the edge of pavement is generally best controlled by an early fall application of **Roundup PROMAX**[®] at 3 quarts plus **Esplanade**[®] 200 SC at 4 ounces per acre or **Roundup PROMAX**[®] at 3 quarts plus **Landmark**[®] XP at a 2-3 ounces per acre rate if the wind speed does not exceed 10 miles per hour during the application.

Bermudagrass growing in riprap and on concrete fixtures is generally best controlled with an application of **Roundup PROMAX**[®] at 3 quarts per acre rate. **Esplanade**[®] 200 SC and **Landmark**[®] XP are left out of this solution due to the possible runoff onto desirable vegetation and waterways after rainfall.

Applications should be restricted to no more than 6 inches from the edge of the paved surface and 12 inches behind the guardrail. Applications wider than 12 inches may result in erosion and sediment loss.

14.8 Mesquite

Mesquite (*Prosopis glandulosa*) grows either as a shrub or a tree and is abundantly armed with stiff spines. The plants usually flower in the spring. The flowers are very small and grouped together in conspicuous, yellowish bunches. Mesquite is widely distributed in the western half and southern Texas, generally in deep soils. It increases in abundance in disturbed grasslands.



Mesquite, where it occurs in areas of the right of way that must be maintained, may be mowed annually at the time of the fall full-width mowing. Alternatively, where the plants are large enough or the need of removal is necessary, the herbicide **Pathfinder II**[®] can be applied as a basal application or low volume application. Foliar applications can be performed with the herbicide **Tranline**[®], at 21 ounces per acre plus 2 quarts surfactant per 100 gallons of water, applied in mid-summer to early fall, or with the herbicide **Capstone**[®] at 6 pints per acre plus 2 quarts surfactant per 100 gallons of water, applied in summer and fall.

14.9 Huisache

Huisache (*Acacia farnesiana*) is a brushy species, which occurs as both shrubs and trees, usually with several trunks. The branches are numerous and armed with many paired, pin-like, pale spines. The fragrant yellow flowers are clustered in small spheres. The plants flower in the spring, but many produce flowers again after rain during periods of drought.



Huisache is primarily found in South Texas, extending north to Travis County and northwest to Brewster County.

Huisache, when it occurs in areas of the right of way that must be maintained, may be mowed annually at the time of the fall full-width mowing. Alternatively, where the plants are large enough or the need of removal is necessary, the herbicide **Pathfinder II**[®] can be applied as a low volume basal application at any time of the year. Foliar application with the herbicide **Transline**[®], at 21 ounces per acre plus 2 quarts surfactant per 100 gallons of water, applied in mid-summer to early fall, or with the herbicide **Capstone**[®] at 6 pints per acre plus 2 quarts surfactant per 100 gallons of water, applied in summer and fall.

Streamline[®] at 10 ounces per acre plus 2 quarts surfactant per 100 gallons of water, applied in mid-summer to early fall is also effective in treating huisache. However, do not apply **Streamline**[®] when wind speed is greater than 10 miles per hour.

14.10 Retama

Retama (*Parkinsonia aculeate*) generally occurs as a small, widely branching tree with sharp, slightly curved spines on green barked branches. The flowers are yellow, and are identifiable as distinct, individual flowers (unlike Mesquite and Huisache). The plant may flower Spring through fall, depending on location and climate.



Retama is distributed throughout the South Texas region, extending northward to at least Williamson County and east to Brazos County.

Retama, where it occurs in areas of the right of way that must be maintained, may be mowed annually at the time of the fall full-width mowing.

Alternatively, where the plants are large enough or the need of removal is necessary, the herbicide **Pathfinder II**[®] applied as a low volume basal application at any time of the year. Control can also be achieved with **Transline**[®] at 21 ounces per acre plus 2 quarts surfactant per 100 gallons of water, applied in mid-summer to early fall, or with a foliar application of the herbicide **Capstone**[®] at 6 pints per acre plus 2 quarts surfactant per 100 gallons of water, applied in summer and fall.

14.11 Georgia Cane or Giant Reed

Georgia Cane (*Arundo donax*), also known as Giant Reed and Wild Cane, is a tall, perennial grass that can grow to over twenty feet in height. Its fleshy, creeping rootstocks form compact masses from which tough, fibrous roots emerge that penetrate deeply into the soil. Leaves are elongate, one to two inches wide and a foot long. The flowers are borne in two foot long, dense, plume-like panicles during August and September. Georgia Cane is found throughout the state of Texas along ditches, streams and roadsides.



Georgia Cane was probably first introduced into the United States at Los Angeles, California in the early 1800's. Since then, it has become widely dispersed into all of the subtropical and warm temperate areas of the world, mostly through intentional human introductions along ditches for erosion control. Introduced from India.

Georgia Cane is controlled with an **Approved Aquatic Herbicide** at a 2 % or 8 quarts/100 gallons of water solution using a handgun. Always add 2 quarts of surfactant to each 100 gallons of water.

14.12 Kochia and Russian Thistle

Kochia (*Kochia scorparia*), a member of the Goosefoot family, was introduced from Europe and is an annual, reproducing by seed, which can grow up to six feet tall. Kochia can be found in cultivated fields, waste areas and roadsides.

Russian Thistle or Tumbleweed (*Salsola iberica*) is also a member of the Goosefoot family was introduced from Russia and is an annual, which reproduces by seed. Mature plants are spherical bushes up to five feet tall. After they turn grayish brown in the fall, the plants break away from the roots at the soil line becoming tumbleweeds that scatter their 250,000 seeds per plant in their path.



Kochia and Russian Thistle normally grow in the northern and western half part of the state.

Control of Kochia can be obtained with an application of **Vista[®] XRT** at 10 ounces per acre rate plus surfactant at the rate of 2 quarts per 100 gallons of water applied early spring or on actively growing plants.

Control of Russian Thistle can be obtained with an application of **Vista[®] XRT** at 10 ounces plus **Escort[®] XP** at 1 ounce per acre rate plus surfactant at the rate of 2 quarts per 100 gallons of water applied early spring or on actively growing plants.

14.13 Switchgrass

Switchgrass (*Panicum virgatum*) is a native, warm-season, perennial tall bunchgrass that grows from two to seven feet tall. Leaf blades are four to twenty-four inches long and .2 to .6 inches wide. Switchgrass flowers from August through September. Switchgrass roots can sometimes reach down ten to eleven feet deep. Very palatable by livestock.

Its large size and growing habit cause sight distance issues on the right-of-way.

Control of Switchgrass can be obtained by spot treating clumps using the herbicide **Roundup PROMAX**[®] in a 1.5 % solution with water and applying this solution with a handgun or pump-up sprayer. Another method would be to use a **Rotowiper**[®] application system with a 25 % **Roundup PROMAX**[®] solution in water.



14.14 Guinea Grass

Guinea Grass (*Panicum maximum*) is an introduced, warm-season bunchgrass from Africa. Deep, dense fibrous root system withstands drought conditions, but prefers south Texas. Guinea Grass can grow over 6 feet tall with long, narrow, fine, soft leaves.

Its large size and growing habit has become a pest on the right-of-way.

Control of Guinea Grass can be obtained by spot treating clumps using **Roundup PROMAX**[®] in a 1.5 % solution with water and applying this solution with a handgun or pump-up sprayer. Another method is by overspraying with the Flex-5 spray head the herbicide **Roundup PROMAX**[®] at a rate of 16 ounces per acre solution in water.



14.15 Chemical Pruning

Chemical Prune woody plants and tree limbs encroaching in the clear zone on the state's right of ways with the herbicide **Capstone**[®]. With the flex-5 spray head woody plants can be controlled with **Capstone**[®] at 6 pints per acre plus surfactant at the rate of ½%. **Capstone**[®] can be applied at any time during the growing season when the woody plants are actively growing with adequate foliage.



It is recommended that an early fall application of **Capstone**[®] be made before the trees defoliate. Position the flex-5 spray head to spray no higher than the cab of the herbicide truck prior to application.

In areas where there is a lot of undergrowth around the trees that would otherwise need to be trimmed mechanically add **Vista**[®] **XRT**, at 10 ounces per acre to the **Capstone**[®] at 6 pints per acre plus the addition of surfactant at the rate of ½%.

Note: The herbicide **Capstone**[®] at 9 pints per acre is the maximum rate per year.

14.16 Turnip Weed

Turnip Weed or Bastard Cabbage (*Rapistrum rugosum*) is an annual, many-branched, herbaceous plant that grows from one to five feet or more in height and has a taproot that can become quite large. Leaves are deep green, lobed and wrinkled, and sometimes have a reddish cast. The terminal lobe is larger than the lateral lobes, especially on the basal leaves. Younger leaves growing higher up on the plant are less lobed and more elongated. Turnip Weed typically flowers from early spring into summer, bearing clusters of small, showy yellow flowers at the tips of its branches, resembling those of broccoli and cabbage. Turnip Weed can be identified more easily and certainly by its unusually shaped fruit - a two-segmented seed capsule, called a silique. The seed capsule is stalked, with a long beak at the tip, and contains one to two seeds. The seeds are tiny, oval-shaped, dark brown and smooth.



Turnip Weed is one of the first plants to emerge in the spring and since it is faster growing than most spring wildflowers it grows alongside competing for moisture, nutrients and sunshine causing problems on the roadside where it exists.

Turnip Weed can be controlled by using the herbicide **Escort**[®] **XP** at a rate of 2 ounce per acre rate in the fall. Always add 1 quart of surfactant per 100 gallons of water.

14.17 Morning Glory Vine

Morning Glory Vine (*Ipomoea purpurea*), related to Field Bindweed (*Convolvulus arvensis*) and Sweet Potato, forms twining vines with bell-shaped flowers, and its varieties have also become intertwined botanically under the name "morning glory." The name comes from the flowers, which last a single day. Flowers are white, blue, pink, purple, red, and multicolored.



The vines grow quickly to ten feet or more only two months after seeds sprout. The leaves are heart-shaped, and the flowers are normally open from dawn to midmorning, then closing.

Morning Glory Vine has become a pest plant on the right of way twining up into signs, delineators, bridge structures, guard rails, barrier fences and landscaped shrubbery.

The most effective way to control Morning Glory Vine is with the herbicide *Escort*[®] *XP* applied at a rate of 1 ounce per acre during the flowering period. Always add 1 quart of surfactant per 100 gallons of water. Morning Glory Vine in cable barriers can be controlled with *Escort*[®] *XP* applied at a rate of 2 ounce per acre during the flowering period. Always add 1 quart of surfactant per 100 gallons of water.

14.18 Western Bitterweed

Western Bitterweed (*Hymenoxys odorata*) is an erect, annual, composite plant growing from three inches to two feet tall. Stems are purplish near the base. Leaves are alternate and usually woolly underneath. Bright yellow flowers bloom from April through June and occasionally in the fall. This plant has a bitter taste and a distinct odor. Bitterweed is toxic to sheep and is generally unpalatable.



Western Bitterweed is located throughout the western portion of the State in various counties and is concentrated in the Trans-Pecos region of Texas.

Western Bitterweed readily invades disturbed areas, but seems to be largely excluded from areas where native vegetation persists. Curtailing disturbances in the right of way will likely restrict the spread of this pest species.

Western Bitterweed can be controlled by using the herbicide *Escort*[®] *XP* at the 1 ounce per acre rate plus 1 quart of surfactant per 100 gallons of water. Control of Western Bitterweed can be accomplished by overspray application or by spot spraying small concentrations of Western Bitterweed with the handgun sprayer.

14.19 African Rue

African Rue (*Peganum harmala*) is a perennial plant with a rounded tuft of fleshy stems from a twisting, woody root. The flowers are white to pale yellow appearing from April through November. Each flower produces a small marble-sized capsule, which is filled with seeds.



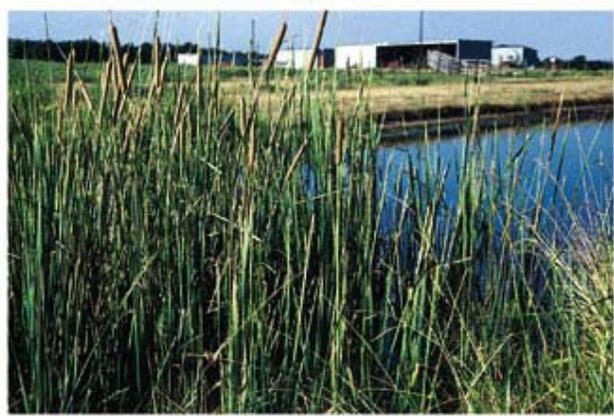
African Rue reportedly occurs in Edwards and Garza counties though it is most abundant in the Trans-Pecos region of Texas. This plant is reportedly poisonous to livestock.

African Rue is extremely aggressive and readily invades disturbed areas, but seems to be largely excluded from areas where native vegetation persists. Curtailing disturbances in the right of way will likely restrict the spread of this pest species.

Currently, the most effective means of controlling African Rue is with an application of the herbicide *Escort*[®] *XP* at a rate of 3 ounces per acre while the plant is flowering. Always add 1 quart of surfactant per 100 gallons of water.

14.20 Cattails

Cattails (*Typha latifolia*) are perennial aquatic plants, which may grow to ten feet tall from the creeping root to the tip of the flowering stem. The flowers are extremely small and are clustered together in a cylindrical, brown tuft. The flowers usually develop from March through May.



Cattails are scattered throughout Texas in roadside wetlands, drainage areas, marshes, streams and other shallow water areas impeding drainage.

Cattails and other associated aquatic vegetation are controlled with an *Approved Aquatic Herbicide* at 2 % or 8-quarts/100 gallons of water solution using a handgun. Always add 2 quarts of surfactant to each 100 gallons of water.

14.21 Saltcedar

Saltcedar (*Tamarix ramosissima*), grows five to twenty feet tall. Smooth, woody stems are reddish brown, turning gray and cracked as the tree ages. Leaves are small, scale-like, and give the slender stems a wispy green appearance. Flowers are pink to white, blooming from spring through late summer. They are very attractive and from a distance look like pink feathers at the end of the stems. Saltcedar is generally in the western part of the state of Texas along streams and rivers. Introduced from Eurasia.



Saltcedar is a small, shrubby tree and is often referred to as Tamarisk. It was introduced as an ornamental and was also used for stream bank erosion stabilization. Saltcedar has naturalized throughout the desert southwest, particularly along waterways and in wetlands. It is well adapted to salty, alkaline soils, to temperature extremes and to windy sites. Its aggressive root system uses much ground water (one plant draws and transpires 200 gallons of water per day from ground, stream or river), out competing native species.

Saltcedar is controlled with **Habitat[®] Herbicide** at 2-quarts per acre overspray or 2-quarts per 100 gallons of water solution using a handgun. Always add 2 quarts of surfactant to each 100 gallons of water.

Contact the Maintenance Field Support Section Staff of the Maintenance Division for specific recommendations for controlling Saltcedar.

14.22 Wildoats and Jointed Goatgrass

Wildoats (*Avena fatua*) and Jointed Goatgrass (*Triticum turgidum*) are two annual cool season grasses spread only by seed, which often occur on the right of way in North Texas. The seed germinate in the fall or winter. For this reason, an early application of **Roundup PROMAX[®]** (usually late March) at 10 ounces per acre as an overspray is effective in controlling these plants where it is necessary to do so.



14.23 Itchgrass

Itchgrass (*Rottboellia cochinchinensis*), is an annual, erect, up to 9 foot tall grass. Culms are supported by prop roots, nodes are smooth, leaf sheaths are smooth or with sparse tubercular-based hairs. Leaf blades are straight to broadly straight, apex slender, smooth or with sparse tubercular-based hairs. Flowers are 1-6 inches long, terminating with several reduced spikelets; directly attached spikelets and seed bearing spikelets. Native to the Philippines and introduced in the 1920's into Florida as a potential pasture grass. Later it spread into Texas by shipments of grass seed containing small amounts of this noxious weed in the bags. Itchgrass can be controlled by using a spot treatment of Roundup ProMax in a 1.5 % rate of water while actively growing. Another method is by overspray with the Fixture boom or Flex-5 spray head the herbicides **Roundup PROMAX[®]** at the rate of 12 ounces per acre plus **EsplAnade[®] 200 SC** at a rate of 4 ounces per acre or **Roundup PROMAX[®]** at the rate of 12 ounces per acre and plus **Landmark XP[®]** at a rate of 2 ounces per acre solution in water, if wind speed does not exceed 10 miles per hour.



14.24 Kudzu

Kudzu (*Pueraria lobata*) is an aggressive perennial, trailing and climbing vine member of the legume family. A dense stand of identically colored plants growing on and around everything in its path is a familiar field mark.

Rarely flowering, kudzu stems and roots spread out in all directions from starchy fibrous root crowns, with new plants beginning at stem nodes every one to two feet. This dense packing of Kudzu can result in tens of thousands of plants occupying a single acre of land. Leaves are dark green and hairy beneath, often tri-lobed, and in groups of three on the vine. The ½ to ¾ inch elongated purple flowers with a fragrance reminiscent of grapes are pea-like in shape and are produced on plants exposed to direct sunlight. Kudzu fruits, present in October and November, are hairy, bean-like pods which produce only a few viable seeds in each pod cluster. It is thought that some seeds can remain dormant for several years before they germinate.

During peak growing season in early summer, this prolific vine can grow at a rate of a foot a day, easily covering and choking trees and under story vegetation.

Kudzu populations consists of small pockets in the far eastern counties of the State with one infestation being eradicated by the Colorado River in south Austin. Introduced from Japan.

Kudzu is controlled with *Transline*[®] *Herbicide* at 21 ounces per 100 gallons of water solution using a handgun. Always add 2 quart of surfactant to each 100 gallons of water.



14.25 Other Right of Way Pests

Applications of all pesticides for the control of right of way pests including, but not limited to, burrowing rodents, fire ants, other destructive insects, etc. must be made in a manner consistent with all current and pertinent laws and regulations as established by the Texas Department of Agriculture and the Structural Pest Control Service. All label directions must be followed completely.

Contact the Maintenance Field Support Section Staff of the Maintenance Division for specific recommendations.

SECTION 15

15.0 APPROVED CHEMICALS FOR RIGHT OF WAY VEGETATION MANAGEMENT

15.1 General Characteristics of Roundup PROMAX[®] (Replaced Roundup[®] Pro)



Roundup PROMAX[®] is a herbicide which may be used effectively in many applications within TxDOT's maintenance activities. These applications include pavement edge treatment to prevent the destruction of pavement, treatments around signs, delineators and guardrails, and to control Johnsongrass. Packed in 2.5 gallon jugs, 2 per case, 1 Unit.

Roundup PROMAX[®] is a non-selective, foliar-applied, post-emergence herbicide which provides broad-spectrum control of many grasses and broadleaf plant species. Consequently, it is important to avoid application of this chemical onto the green portion of any desirable plant. The chemical is absorbed through the green leaf surface (or through green bark) and then translocated into the root system.

The best time to apply **Roundup PROMAX[®]** is when the plant species is green and actively growing. This will ensure maximum movement of the chemical into the root system.

Roundup PROMAX[®] has no soil residual activity, is non-volatile (does not form a gas), and is relatively low in toxicity to animals. As **Roundup PROMAX[®]** does not move within the soil, the likelihood of damage to nearby desirable plants due to root uptake of the chemical is slight. However care must be taken to prevent the drift of spray particles and to prevent accidental foliar application onto desirable vegetation.

15.1.1 Effects of Roundup PROMAX[®] Application during Dry Weather

High temperatures, prolonged periods of dry weather, and lack of soil moisture tend to force many plant species (e.g. Johnsongrass) into a state of semi-dormancy. When these conditions exist, plant growth slows in order to conserve available moisture and food reserves. With reduced energy production, movement of food within the plant is also reduced and very little food is moved into the plant's root system. Since **Roundup PROMAX[®]** acts directly upon the plant's root system, the application of the chemical during these conditions will yield poor results.

15.1.2 Effects of Roundup PROMAX® Applications

Applications of **Roundup PROMAX®** should generally be discontinued after the first killing frost. After this initial killing frost, warm-season plant species such as Johnsongrass become dormant for the winter and their leaves turn yellow or brown. Any application of chemical during this period will yield poor results since there is little or no movement of food from the foliage into the root system.

Do not apply **Roundup PROMAX®** if rainfall is imminent. Rainfall within 30 minutes after application will wash the chemical from the leaves and reduce the effectiveness of the application.

Roundup PROMAX® does not volatilize (form a gas or vapor) to drift onto non-target areas and cause damage. Because of this factor, the chemical may safely be utilized within urban areas. However care must be taken to prevent spray or drift onto the foliage of desirable plants. Drift normally occurs when the spray pressure is too high for the nozzle tips being used, or when spraying in windy conditions. Do not apply **Roundup PROMAX®** at higher than recommended spraying pressure or during windy conditions. Always use the correct nozzle tips (See Section 5), and always use the appropriate drift control agent (See Section 7).

Do not spray the bark of young trees when the bark is green. **Roundup PROMAX®** may enter the tree through the green bark and cause injury to the plant's root system. On older trees where the bark is no longer green, **Roundup PROMAX®** may be applied to the tree base without risk of injury.

Always mix **Roundup PROMAX®** with clean water. Canal, creek and pond water may contain soil particles that can reduce the effectiveness of the chemical and can damage spray equipment. Hard water may also reduce the effectiveness of **Roundup PROMAX®**.

Do not mix **Roundup PROMAX®** in galvanized containers. The chemical reacts with Zinc, forming a hydrogen gas, which may explode. Always use fiberglass or stainless steel backpack or hand-held sprayers. There is no danger when using the chemical in the TxDOT herbicide spray units.

15.1.3 Application Procedures for Roundup PROMAX® - Fall Application

- ◆ Johnsongrass should be actively growing and have adequate leaf area before application;
- ◆ Correct nozzle tips (See Section 5) must be used;
- ◆ Mix **Roundup PROMAX®** in water according to the quantities the spray unit actually dispenses (See Calibration Formula, Section 8);
- ◆ When using the herbicide spray unit, vehicle speed should be maintained at the speed used in the calibration procedure, and the proper spraying pressure must be maintained (See Section 8);
- ◆ Apply the spray uniformly to the foliage of the plant. Nozzles are spaced to cover plant foliage evenly. Plant foliage should appear wet and glistening after application; and
- ◆ Delay mowing the treated area until 10-14 days after application. This will permit adequate movement of the chemical into the root zone.

Herbicide Operations

15.1.4 Use of Roundup PROMAX® for Johnsongrass Control (Bermuda Release)

The Bermuda release program seeks to reduce infestation of Johnsongrass and to encourage the growth of desirable grasses including Bermuda grass.

To effectively control Johnsongrass, **Roundup PROMAX®** must be applied uniformly to the leaves of the plant. **Roundup PROMAX®** has no soil activity or residual, therefore direct foliar application is required for control.

Johnsongrass is most effectively controlled by an application of **Roundup PROMAX® + Escort® XP + Outrider®** during the summer before July 31st or a combination of **Roundup PROMAX® + Outrider®** can be applied later on before October 15th or in Bahiagrass areas. In the spring most of the growth activity is directed upwards away from the root zone. Food energy, stored in the roots during the previous fall, is being moved upward to produce new foliage and seed.

The plant will then move the chemical downward into the root system along with the food energy the plant is producing, thereby destroying the root system and the plant.

If **Roundup PROMAX®** is applied in the spring of the year, the results achieved will not be as successful as applications made during the late summer or early fall with the combination above.

Johnsongrass should be controlled when it is actively growing and there is adequate leaf area to spray before it gets exceedingly tall.

The ideal time to apply Roundup PROMAX® is when the plant is actively growing and is manufacturing food for storage in the plant's root system.

15.1.5 Flex 5 Spray Unit (FOD Issue)

The application procedure for effective Johnsongrass control with the Flex 5-spray unit:

Step	Action	Remarks
1.	Check equipment, nozzles and switches to ensure proper operation.	Adjust/repair as necessary.
2.	Calibrate Nozzles	At Standard Operating Pressure of 30 psi to apply 25 gallons per acre, at 11.4 mph. an electronic monitor on the control console will indicate Speed. The monitor is calibrated to the truck's transmission.
3.	Add appropriate amount of chemical	The Roundup PROMAX® , Escort® XP and Outrider® combination can be applied until July 31 st . Then after July 31 st use the Roundup PROMAX® and Outrider® combination until October 15 th or in Bahiagrass areas.
4.	Add proper drift control agent.	See Section 7.

Caution! Do not use the **Roundup PROMAX®**, **Escort® XP** and **Outrider®** combination until wildflowers have set mature seed.

Applying the three-way herbicide mix will prevent initial brownout of targeted weeds for a more aesthetic looking right-of-way. After 2 weeks following the application, dieback of targeted weeds will begin gradually in most cases and at this time the treated area may be mowed.

Herbicide Operations

15.1.6 Calibration Procedure for Roundup PROMAX[®], Water and Drift Control Agent for ALL HERBICIDE SPRAY UNITS WITHOUT COMPUTER INJECTION

It is difficult to determine a single mixture ratio that would satisfy the need of all spray units since there is wide variation in output from one unit to the next. Therefore, to determine the proper mixing ratios, follow the calibration procedure below:

Step	Action	Remarks
1.	Collect Spray emitted from the nozzles typically used, the two outside nozzles (2508 & 6508) and the edge nozzle (6508).	Add drift control agent. Collect the spray from each nozzle for a period of 60 seconds.
2.	Adjust spray patterns to insure adequate and uniform coverage.	Water and Drift Control only.
3.	Measure spray width of all nozzles and determine actual gallons per acre sprayed.	Use Calibration formula.
4.	Find Average Gallons Per Acre (GPA).	Divide GPA into the volume of water to find the number of acres to spray and then calculate the correct rate of Roundup PROMAX[®] to add per acre. Complete control (bare ground) rate = 3 quarts Roundup PROMAX[®] and 2-3 ounces of Landmark[®] XP per acre.

15.1.7 Roundup PROMAX[®] Applications in Chemical Mowing for TREATING AROUND DESIRABLE TREES AND SHRUBS

Roundup PROMAX[®] is not active in the soil and cannot be absorbed by the root system of desirable plants. Accordingly, the chemical may be applied to the foliage of weeds and unwanted grasses located underneath desirable trees and shrubs without harm to the desirable plant. This procedure may have benefit in landscaped areas and within picnic areas.

15.1.8 Roundup PROMAX[®] for Control of Switchgrass

Control of Switchgrass can be obtained by spot treating clumps using the herbicide **Roundup PROMAX[®]** in a 1.5 % solution with water applying this solution with a handgun or pump-up sprayer.

Another method would be to use a **Rotowiper[®]** application system with a 25 % **Roundup PROMAX[®]** solution in water.

15.1.9 Roundup PROMAX[®] for Control of Wildoats or Jointed Goatgrass

Control of Wildoats and Jointed Goatgrass on rights-of-way adjacent to wheat fields is best accomplished by using **Roundup PROMAX[®]** at the rate of 10 ounces per acre, and applied in the early spring. **Roundup PROMAX[®]** must be applied before the warm-season perennial grasses have begun to actively grow and broken their winter dormancy.

It is recommended that a program for control of Wildoats and Jointed Goatgrass be undertaken only where the adjacent landowner has expressed a need for control, and is trying to control the species within his crops as well.

Herbicide Operations

15.1.10 Roundup PROMAX® for Complete Control in Riprap, Raised Medians, Paved Medians and Retaining Walls

The recommended application rate for vegetation growing on Riprap, Paved Medians, Raised Medians and Retaining Walls is 3 quarts of **Roundup PROMAX®** per acre rate using the overspray method or a 1.5 % solution of **Roundup PROMAX®** using the Handgun method.

15.2 General Characteristics of EsplAnade® 200 SC

EsplAnade® 200 SC herbicide is a residual, broad-spectrum bareground herbicide for control of broadleaf weeds, sedges and grasses. **EsplAnade® 200 SC**'s active ingredient is Indaziflam. Applying **EsplAnade® 200 SC** in the spring controls spring and summer germinating weeds while a fall application will control winter weeds.

EsplAnade® 200 SC is formulated as white, liquid suspension. **Shake the EsplAnade® 200 SC container well before using.** Vigorous agitation is REQUIRED when mixing **EsplAnade® 200 SC**. Therefore **EsplAnade® 200 SC** must be used only within equipment which provides proper agitation.

Applications to the edge of pavement will be restricted to no more than 6 inches from the edge of the paved surface and 12 inches behind the guardrail. Applications wider than 12 inches may result in erosion and sediment loss.

The following precautions should always be observed when using **EsplAnade® 200 SC**:



PRECAUTION	Remark
Insure proper agitation.	To prevent chemical from settling out of suspension.
Leave buffer zone between agricultural crops, especially sorghum species.	Helps catch any spray drift and helps “tie-up” EsplAnade® 200 SC , which may otherwise move laterally from treated area.
Avoid treating edges adjacent to fields in which rows run perpendicular to the highway.	If lateral movement of EsplAnade® 200 SC was to occur, rows that run perpendicular to the highway are more likely to be affected.
Do not spray desirable vegetation.	EsplAnade® 200 SC can inhibit the emergence of seed and damage newly emerged seedlings.

The recommended application rate for vegetation growing at the edge of pavement is 3 quarts of **Roundup PROMAX®** plus **EsplAnade® 200 SC** at 4 ounces per acre rate to control of vegetation in Edge of Pavement.

If rainfall is **NOT** forecasted within 48 hours of the application, a handgun application of 3 quarts of **Roundup PROMAX®** plus **EsplAnade® 200 SC** at 4 ounces per 100 gallons of water may be made to concrete structures and riprap.

EsplAnade® 200 SC is **NEVER** used by itself in TxDOT’s herbicide spray program. This product is **ALWAYS** used in combination with **Roundup PROMAX®** to be applied on edge of pavement.

15.3 General Characteristics of Landmark® XP



Landmark® XP herbicide is a residual, broad-spectrum bareground herbicide for control of broadleaf weeds and grasses. **Landmark® XP** is a combination of two sulfonylurea herbicides, **Oust®** and **Telar®** and this residual combination controls broadleaf weeds better than **Oust® XP** alone. **Landmark® XP** is formulated as an extruded pellet (small, cylindrical granules) which eliminates most of the excessive dust created when mixing conventional powders. **DO NOT APPLY Landmark® XP IN WINDS GREATER THAN 10 MILES PER HOUR.**

EsplAnade® 200 SC is replacing Landmark® XP.

Vigorous agitation is REQUIRED when mixing **Landmark® XP**. Therefore **Landmark® XP** must be used only within equipment which provides proper agitation.

Applications to the edge of pavement will be restricted to no more than 6 inches from the edge of the paved surface and 12 inches behind the guardrail. Applications wider than 12 inches may result in erosion and sediment loss.

The following precautions should always be observed when using **Landmark® XP**:

PRECAUTION	Remark
Insure proper agitation.	To prevent chemical from settling in tank.
Leave buffer zone between agricultural crops, especially sorghum species.	Helps catch any spray drift and helps “tie-up” Landmark® XP , which may otherwise move laterally from treated area.
Avoid treating edges adjacent to fields in which rows run perpendicular to the highway.	If lateral movement of Landmark® XP was to occur, rows that run perpendicular to the highway are more likely to be affected.
Do not spray desirable vegetation.	Fruit trees are particularly susceptible to Landmark® XP .

The recommended application rate for vegetation growing at the edge of pavement is 3 quarts of **Roundup PROMAX®** plus **Landmark® XP** at 2 ounces per acre rate to provide for short term control of edges and 3 ounces of **Landmark® XP** for extended control of vegetation in Edge of Pavement.

Landmark® XP is NEVER used by itself in TxDOT’s herbicide spray program. This product is ALWAYS used in combination with **Roundup PROMAX®** to be applied on edge of pavement.

15.4 General Characteristics of *Outrider*[®]



Outrider[®] is a foliar applied herbicide with short soil residual half-life activity. The half-life (the time required for one-half of the chemical to lose its effectiveness) is approximately 16-32 days. *Outrider*[®] is formulated as a dispersible granule that eliminates most of the excessive dust created when mixing conventional powders.

Vigorous agitation is REQUIRED when mixing *Outrider*[®]. Therefore *Outrider*[®] must be used only within equipment which provides proper agitation.

The following precautions should always be observed when using *Outrider*[®]:

PRECAUTION	Remark
Insure proper agitation.	To prevent chemical from settling in tank.
Leave a buffer zone between agricultural crops, especially sorghum species.	Helps catch any spray drift and helps “tie-up” <i>Outrider</i> [®] in the soil, which may otherwise move laterally from treated area.
Avoid treating close to fields in which rows run perpendicular to the highway.	If lateral movement of <i>Outrider</i> [®] was to occur, rows that run perpendicular to the highway are more likely to be affected.
Do not spray desirable vegetation.	

15.4.1 Overspray Operations

15.4.1.1 Use of Roundup PROMAX[®] + *Outrider*[®] Combination for Johnsongrass Control

The *Roundup PROMAX*[®] + *Outrider*[®] combination is recommended for Johnsongrass control for the southern and eastern part of Texas where Bahiagrass is the predominate grass species on the right-of-way. This combination is also recommended for Johnsongrass control **when applications are made after July 31st in all areas due to wildflowers.**

However, applications of *Roundup PROMAX*[®] + *Outrider*[®] should be **discontinued October 15th** because it could cause wildflower damage.

The recommended herbicides to control Johnsongrass and broadleaf weeds are *Roundup PROMAX*[®] + *Outrider*[®] + *Vista*[®] XRT. Application rates are *Roundup PROMAX*[®] at 8 ounces plus *Outrider*[®] at 1.33 ounces plus *Vista*[®] XRT at 10 ounces per acre.

Herbicide Operations

If adjustments are needed in recommended application rates to accommodate changing vegetation control needs, consult with the Maintenance Field Support Section Staff of the Maintenance Division.

15.4.1.2 Use of Roundup PROMAX[®] + Escort[®] XP + Outrider[®] for Johnsongrass Control

Use of **Roundup PROMAX[®] + Escort[®] XP + Outrider[®]** combination in an overspray application that is used primarily for the control of Johnsongrass and broadleaf weed species. In the central and western parts of Texas. Precautions should be taken in those areas that have prolific wildflowers.

Overspray operations should begin in the spring after Bermudagrass has broken its winter-dormancy and is actively growing, and after wildflowers have produced mature seed. Usage of the **Roundup PROMAX[®] + Escort[®] XP + Outrider[®]** should be **DISCONTINUED BY JULY 31st**. Applications made after this date, have the potential to damage fall germinating wildflowers.

The recommended herbicides to control Johnsongrass and broadleaf weeds, especially bloodweed, ragweed and sunflower are **Roundup PROMAX[®] + Escort[®] XP + Outrider[®] + Vista[®] XRT**. Application rates are **Roundup PROMAX[®]** at 8 ounces plus **Escort[®] XP** at 1 ounce plus **Outrider[®]** at 1.33 ounces plus **Vista[®] XRT** at 10 ounces per acre.



15.4.2 Fixture Operations

15.4.2.1 Application with the Fixture Boom on All Herbicide Units

It is difficult to determine a single mixture ratio that would satisfy the need of all spray units since there is a wide variation in output from one unit to the next. Therefore, to determine the proper mixing ratios, follow the calibration procedure below:

Step	Action	Remarks
1.	Collect spray emitted from the two outside nozzles (2508 & 6508) and the edge nozzle (6508).	Use a suitable container. Add and mix suitable drift control agent. Collect the spray from each nozzle for a period of 60 seconds.
2.	Adjust spray patterns to insure adequate and uniform coverage.	Spray pattern on the pavement to check for any gaps.
3.	Measure spray width of nozzles collectively and determine actual gallons per acre sprayed.	Use calibration formula.
4.	Find average gallons per acre (GPA)	Use average GPA as the volume of water in which to add the desired rate of Roundup PROMAX[®] + Escort[®] XP + Outrider[®] per acre. Fixture operations rate = 8 ounces Roundup PROMAX[®] plus 1 ounces Escort[®] XP plus 1.33 ounces Outrider[®] per acre.
5.	Mix appropriate amount of chemical	
6.	Add appropriate amount of drift control agent.	See Section 7

15.5 General Characteristics of Target® 6.6



Target® 6.6 is a foliar applied, post-emergent selective herbicide used to control hard-to-kill Johnsongrass. The active ingredient in **Target® 6.6** is MSMA. **Target® 6.6** is formulated as an amber-colored liquid. It is important to apply **Target® 6.6** when the temperature is at least 70 degrees. It takes two applications, 30-60 days apart on growing Johnsongrass for an effective application to occur. **DO NOT MAKE MORE THAN 2 APPLICATIONS OF Target® 6.6 PER YEAR PER ACRE.**

Always agitate the tank mixture when mixing **Target® 6.6**. Therefore **Target® 6.6** must be used only within equipment which provides proper agitation. Once **Target® 6.6** is mixed, the entire batch should be sprayed and not left in solution.

The recommended use rate for **Target® 6.6** is 1.5 quarts per Acre plus a 1/2% surfactant (2 quarts of Surfactant per 100 gallons of water.)

The following precautions should always be observed when using **Target® 6.6**:

PRECAUTION	Remark
Insure proper agitation.	To prevent chemical from settling out of solution.
Leave a buffer zone between agricultural crops, especially sorghum and corn species.	Helps catch any spray drift.
Do not spray desirable vegetation.	Do not spray San Augustine or Bluestem grasses species.

15.6 Approved Aquatic Herbicide



There is a need for controlling unwanted aquatic vegetation in ditches, drainage areas near creeks and rivers and irrigated farmlands to insure proper drainage. The use of herbicides in these areas has been limited by the possible pollution of the water and the possibility of the herbicide moving off target.

All ***Approved Aquatic Herbicides*** will be compatible with the Department's desire to be environmentally sensitive and to maintain proper drainage on and through the highway system.

15.6.1 General Characteristics of Approved Aquatic Herbicide

All of the ***Approved Aquatic Herbicides*** stocked in the warehouses will contain the active ingredient Glyphosate, at 54% concentration, the same active ingredient that is found in ***Roundup PROMAX®***, but at a higher concentration. There is no surfactant found in the ***Approved Aquatic Herbicide***, so ***a surfactant approved for aquatic applications must be added.*** All ***Approved Aquatic Herbicides*** will be labeled for use in all bodies of fresh water and in all types of aquatic sites which may contain flowing and non-flowing water. All of the ***Approved Aquatic Herbicides*** will effectively control a wide variety of emerged (above water) aquatic weeds, and it exhibits the same toxicological and environmental benefits found in ***Roundup PROMAX®***.

15.6.2 Application Procedures for Approved Aquatic Herbicide

Applications of ***Approved Aquatic Herbicide*** can be done with all types of spray equipment, but a handgun application may be the most desirable since many areas are inaccessible to our spray units. When applying ***Approved Aquatic Herbicide*** with a handgun mix ***a 2 % or 8 quarts of Approved Aquatic Herbicide in 100 gallons of water.*** Application should be made on a "spray-to-wet" basis for uniform and complete coverage.

An aquatic surfactant must be added to *Approved Aquatic Herbicide*. The mixture rate is 2-quarts of surfactant per 100-gallons of water.

Although ***Approved Aquatic Herbicide*** is primarily for use in aquatic areas such as creeks and drainage ditches, it may happen that some ***Approved Aquatic Herbicide*** mixture may be left over after completing the spraying of the aquatic weeds. In this case the leftover ***Approved Aquatic***

Herbicide Operations

Herbicide mixture may be used for terrestrial (i.e. dry land) weed control in the right of way. This concentration of **Approved Aquatic Herbicide** will provide complete vegetation control.

15.6.3 Application Timing for Approved Aquatic Herbicide

Proper timing is important to achieve the best results. **Approved Aquatic Herbicide** is like **Roundup PROMAX[®]** in that it is most effective when applied late in the growing season to actively growing vegetation. Cattails should be sprayed when most plants are flowering, and willows should be sprayed when the plant has mature foliage in **late summer or fall**. The optimum treatment period for Georgia Cane or Giant Reed should be from September through October.

15.7 General Characteristics of Escort® XP



Escort® XP is a foliar herbicide that has a relatively short soil residual half-life. The residual effects of *Escort® XP* generally last for 3-4 weeks depending on soil type, rainfall, and temperature. *Escort® XP* is used for **selective broadleaf control** in the right of way. *Escort® XP* will affect Bahiagrass but will not damage other native grasses. *Escort® XP* is formulated as an extruded pellet (small, cylindrical granules) which eliminates most of the excessive dust created when mixing conventional powders.

Vigorous agitation is required when mixing Escort® XP. Therefore, *Escort® XP* must be used only within equipment that provides proper agitation.

Follow these precautions which using the herbicide *Escort® XP*:

PRECAUTION	REMARK
Insure proper agitation	Necessary to prevent chemical from settling in tank
Leave buffer zone between agricultural crops.	Helps catch any spray drift and helps “tie-up” <i>Escort® XP</i> , which may otherwise move laterally from treated area.
Avoid treating adjacent to fields in which rows run perpendicular to the highway.	If lateral movement of <i>Escort® XP</i> was to occur, rows that run perpendicular to the highway, are more likely to be affected.
Do not spray desirable vegetation.	Fruit trees are particularly susceptible to <i>Escort® XP</i> .
<i>Always read and follow label instructions for proper application and to determine plants which are susceptible to Escort® XP.</i>	

15.7.1 Application Procedures with Escort® XP

Application of *Escort® XP* can be made with all of the overspray equipment now being used by the Texas Department of Transportation (TxDOT). *Escort® XP* and the *Approved Aquatic Herbicide* both need the addition of a surfactant in the mixture. Without the addition of a surfactant results will be tremendously reduced.

A surfactant must be added to any *Escort® XP* application at a rate of 1 quart per 100 gallons of water.

Apply *Escort® XP* using the following table:

SPECIES OF PLANTS	RATE	TIME OF YEAR
Field Bindweed	1 ounce per acre	June -September
Common Sunflower	1 ounce per acre	Spray when 2-3 feet in height.
Western Bitterweed	1 ounce per acre	March - April
Turnip Weed	1 ounce per acre	very early Spring
Morning Glory Vine	1 ounce per acre	June -September
	2 ounce per acre	June –September, in Cable Fence
African Rue	3 ounces per acre	September
Other Broadleaf Weeds	1 ounces per acre	May - July 31 st

***Escort® XP* is primarily used for control of specific noxious weeds. Consult the Maintenance Field Support Section Staff in the Maintenance Division for further uses of this product.**

15.7.2 Use of Escort® XP with combination of Roundup PROMAX® + Outrider® for Johnsongrass and Broadleaf Weed Control

Escort® XP will be used in conjunction with *Roundup PROMAX® + Outrider®* in an overspray application used primarily for the control of Johnsongrass and broadleaf weed species. In the central and western parts of Texas precautions should be taken in those areas that have prolific wildflowers. *Escort® XP* only affects Bahiagrass and will not damage other native grasses.

Overspray operations should begin in the spring after Bermudagrass has broken its winter-dormancy and is actively growing, and after wildflowers have produced mature seed. Usage of the *Roundup PROMAX® + Escort® XP + Outrider®* should be **DISCONTINUED BY JULY 31st**. Applications made after this date have the potential to damage fall germinating wildflowers.

15.8 General Characteristics of Transline®



Transline® is an herbicide used effectively to kill certain broadleaf vegetation in the right of way. **Transline®** is a **selective, post-emergent herbicide that controls certain broadleaf weeds** and does not have any activity on grasses. **Transline®** has a short soil residual half-life of approximately 23 days. It is non-volatile and relatively low in toxicity to animals. However, care must be taken to prevent the drift of spray particles and to prevent accidental foliar application to desirable plants.

15.8.1 Application Procedures for Transline® on Musk Thistle

Musk Thistle is a biennial weed, which can cause serious safety and agricultural problems. It ranges throughout central Texas into the panhandle.

Control of Musk Thistle can be easily accomplished by using **Transline®** at the proper time. An application of **Transline®** at 10 ounces per acre applied early spring will provide effective control of Musk Thistle. The Musk Thistle should be actively growing and the application should be made prior to seed set on the plants.

15.8.2 Application Procedures for Transline® on Common Sunflower

Common Sunflowers are annual broadleaf weeds, which may reach a height of 8-10 feet. Sunflowers are common throughout the state, but usually occur in disturbed areas and cause a serious safety and drainage problem in the southern half of the state.

Sunflowers may be controlled with an application of **Transline®** at 10 ounces per acre, applied in late spring through early summer. Plants should be sprayed when they are 1-3 feet in height.

DO NOT SPRAY MATURE PLANTS. This will yield poor results.

15.8.3 Application Procedures for Transline® on Mesquite

Mesquite grows either as a shrub or a tree and is abundantly armed with stiff spines. The plants usually flower in the spring, but sometimes later. The flowers are very small and grouped together in conspicuous yellowish bunches. Mesquite is widely distributed in the western and southern parts of Texas, generally in deep soils. It increases in abundance in disturbed grasslands.

Mesquite, where it occurs in areas of the right of way that must be maintained, may be mowed annually at the time of the fall full-width mowing. Alternatively, where the plants are large enough or removal is necessary a foliar application with the herbicide **Transline**®, at 21 ounces per acre plus surfactant at the rate of ½%, applied in mid-summer through early fall, can be made.

15.8.4 Application Procedures for Transline® on Huisache

Huisache is a brushy species, which occurs as both shrubs and trees, usually with several trunks. The branches are numerous and armed with many paired, pin-like, pale spines. The fragrant yellow flowers are clustered in small spheres. The plants flower in the spring, but many produce flowers again after rain during periods of drought.

Huisache is primarily found in South Texas, extending north to Travis County and northwest to Brewster County.

Huisache can be controlled with a foliar application of the herbicide **Transline**®, at 21 ounces per acre plus surfactant at the rate of ½%, applied in mid-summer through early fall.

15.8.5 Application Procedures for Transline® on Retama

Retama is widely branching small tree with sharp, slightly curved spines on green barked branches. The flowers are yellow, and are identifiable as distinct, individual flowers. The plant may flower Spring through fall, depending on location and climate.

Retama can be controlled with a foliar application of the herbicide **Transline**® at 21 ounces per acre plus surfactant, at the rate of ½ %, applied in mid-summer to early fall.

15.8.6 Application Procedures for Transline® on Kudzu

Kudzu is a perennial, trailing or climbing vine of the legume family with a very aggressive behavior. Dark green leaves and rarely blooming purple elongated flowers that have a fragrance reminiscent of grapes. Kudzu is nicknamed “The Vine that Ate the South” for its aggressive covering and choking out of small trees and under story vegetation.

Range consists of small pockets in the eastern part of Texas with one infestation being eradicated by the Colorado River in south Austin.

Kudzu can be controlled with the herbicide **Transline**®, at 21 ounces per acre plus surfactant at the rate of ½%, applied during the growing season. One foliar application will not eradicate this aggressive vine and retreatments of **Transline**® along with Basal Bark and cut stump treatments will need to be scheduled into an ongoing program to eliminate this plant. Seed are viable for several years after dropping and pose a threat downstream of re-infestation of this noxious weed.

Note: The herbicide **Transline**® at 21 ounces per acre is the maximum rate per spraying season.

15.8.7 Low Volume Foliar Spray for Transline® on Mesquite and Huisache

Mesquite and Huisache are brushy species and a full description is stated above.

Low volume foliar spray can be accomplished using a X6 tip on a 25-gallon Poly Tank sprayer with 12-volt electric pump. Mesquite and Huisache can be controlled with the herbicide **Transline®**, at a rate of ½% plus surfactant at the rate of ½%, applied in mid-summer through fall.

Do not exceed 21 oz/acre labeled rate of Transline® per spraying season.

A four-wheel utility vehicle can be rigged to carry two 25-gallon tanks in the back to do a low-volume foliar application. Applicators don't have to leave the vehicle to make these applications in most situations.

15.8.8 Effects of Transline® Applications During Dry Weather

High temperatures, prolonged periods of dry weather and lack of soil moisture tend to force plants into a semi-dormant state. When these conditions exist, plants tend to slow down their growth in order to conserve moisture and energy. With this conservation of moisture and energy, the plant will not absorb an adequate amount of the herbicide and all spraying should cease at this time.

15.8.9 Precautions using Transline®

Do not make **Transline®** applications if rainfall is imminent. **Transline®** becomes rainfast in 1-2 hours.

Transline® does not volatilize (i.e. does not form a gas). It can be used safely in all areas except aquatic areas. However, care must be taken to prevent drift onto the foliage of desirable plants. Drift usually occurs when the operating pressure is too high for the nozzle tips being used, or when spraying in windy conditions. To aid in drift control always use the appropriate drift control agent (see Section 7).

Care must be taken while spraying **Transline®** in wildflower areas.

15.9 General Characteristics of Streamline®



Streamline® is an herbicide used effectively to kill difficult to control brush species, specifically Huisache for TxDOT. *Streamline*® is a **selective, post-emergent herbicide that controls certain brush and broadleaf species** with limited activity on native grasses. *Streamline*®'s active ingredients are Aminocyclopyrachlor and Metsulfuron methy (*Escort*® *XP*) and a dispersible granular (small, cylindrical granules) which eliminates most of the excessive dust created when mixing conventional powders.

The rate for *Streamline*® is 10 ounces per Acre plus a ½% Surfactant solution (2 quarts Surfactant per 100 gallons of water.) **DO NOT USE *Streamline*® IF THE WIND EXCEEDS 10 MILES PER HOUR.** The most effective applications to Huisache of *Streamline*® are during mid-summer through early-fall.

***Vigorous agitation is required when mixing Streamline*®.** Therefore, *Escort*® *XP* must be used only within equipment that provides proper agitation.

Follow these precautions which using the herbicide *Streamline*®:

PRECAUTION	REMARK
Insure proper agitation	Necessary to prevent chemical from settling in tank
Leave buffer zone between agricultural crops.	Helps catch any spray drift and helps “tie-up” <i>Streamline</i> ®, which may otherwise move laterally from treated area.
Avoid treating adjacent to fields in which rows run perpendicular to the highway.	If lateral movement of <i>Streamline</i> ® was to occur, rows that run perpendicular to the highway, are more likely to be affected.
Do not spray desirable vegetation.	Trees are particularly susceptible to <i>Streamline</i> ®.

15.10 General Characteristics of Pathfinder II®



For many years there has been a need for controlling brush in the right of way. The brush on the right of way has proven to be difficult to control due to the continuous mowing, removing the tops of the brush species while still allowing root systems to grow. Many herbicides have proven to be ineffective on this mowed brush. **Pathfinder II®** has proven to be very effective on this type of brush.

Pathfinder II® is a ready-to-use (RTU) herbicide mixture, which has Triclopyr as the active ingredient. It has a vegetable oil carrier that reduces environmental hazards by penetrating the brush species bark while carrying the active ingredient with it.

15.10.1 Application Procedures for Pathfinder II®

Applications of **Pathfinder II®** are limited to basal bark treatments from either backpack sprayers or small electric spray units. The basal bark treatment is a low volume treatment and the correct nozzle on the

The Maintenance Field Support Section has a videotape, which fully explains the product and recommended application techniques.

handgun is essential. The spray nozzle should be **Spray Systems Cone Jet Adjustable #5500-X2**. This allows the correct amount of herbicide to be dispensed. **All backpacks and spray units should have Viton® gaskets to prevent leakage.**

Using the wrong nozzle tip with Pathfinder II® will result in cost/acre increasing dramatically.

When applying **Pathfinder II®** the lower 12-15 inches of the bark should be sprayed. Complete coverage around the bark is essential for complete control of the brush species. Bark should be wet, but not to the point of runoff.

Complete coverage of the bark is necessary. If coverage is not achieved resprouting will occur.

15.11 General Characteristics of Vista® XRT



Vista® XRT is a selective postemergent product for control of annual and perennial broadleaf weeds. A dark brown liquid, non-volatile and rainfast in one hour after application. **Vista® XRT** is highly effective for the postemergent control of Giant Ragweed (Bloodweed), Kochia, the resistant/tolerate biotypes of Kochia and Russian Thistle.

15.11.1 Precautions using *Vista® XRT*

Kochia and Russian Thistles are annual weeds that can cause serious safety and agricultural problems. It ranges throughout the western region of Texas.

Control of Kochia can be easily accomplished by using **Vista® XRT** at the proper time. An application of **Vista® XRT** at 10 ounces per acre applied in late spring through summer will provide effective control. Kochia should be actively growing and the application should be made prior to seed set on the plant. **Vista® XRT** can be applied with either the handgun or overspray application method.

Control of Russian Thistle can be easily accomplished by using **Vista® XRT** and **Escort® XP** at the proper time. An application of **Vista® XRT** at 10 ounces per acre and **Escort® XP** at 1 oz per acre applied in late spring through summer will provide effective control. Russian Thistle should be actively growing and the application should be made prior to seed set on the plant. Application can be made with either the handgun or overspray application method.

Do not apply more than 22 ounces or 1 1/3 pints per acre of **Vista® XRT** annually.

15.11.2 Application Procedures for *Vista® XRT* on Giant Ragweed (Bloodweed)

Giant Ragweed (Bloodweed) is an annual weed, which can cause serious safety and drainage problems in the state. It can obtain heights up to 15 feet tall.

Vista® XRT can be utilized as a lower costing alternative to **Transline®** for controlling Giant Ragweed (Bloodweed) when applied in late spring and early summer. Apply **Vista® XRT** at 10 ounces per acre plus the addition of an approved surfactant at the rate of 2 quarts per 100 gallons of water in a broadcast application or 10 ounces of **Vista® XRT** plus 2 quarts of surfactant per 100 gallons of water with a handgun sprayer when the Giant Ragweed is 1-3 feet tall and actively growing. Early applications result in the most effective control and allow desirable vegetation to be established in the sprayed area. Always add surfactant at the rate of 2 quarts per 100 gallons of water.

Applications to mature plants usually result in poor control.

15.12 General Characteristics of Capstone®



Capstone® herbicide controls broadleaf weeds, including invasive and noxious weeds on non-cropland areas including right-of-ways and around these sites without injury to most grasses.

Capstone® will also chemically prune woody plants and tree limbs encroaching in the clear zone on the state's right-of-ways. With the flex-5 spray head woody plants can be controlled with the herbicide **Capstone**® at 6 pints per acre plus surfactant at the rate of ½%. **Capstone**® can be applied at any time during the growing season when the woody plants are actively growing with adequate foliage.

The addition of 10 ounces per acre of **Vista**® **XRT** can be added to 6 pints per acre of **Capstone**® for the control of Hackberries and strong underbrush plus surfactant at the rate of ½%.

Note: The herbicide **Capstone**® at 9 pints per acre is the maximum rate per year.



Chemical Pruning in Comanche County using Capstone®.

SECTION 16

16.0 RECORD KEEPING

16.1 Herbicide Records of Application Overview

- All applications contained in the record book are made for TxDOT purposes.
- Maintain records of ALL pesticide applications.
- Maintain records for 2 years.
- Furnish records to TDA if requested.
- Maintain records at principal place of business.
- Maintain copy of Direct Supervision Affidavit with records.

16.2 Records Must Contain:

- Applicator name and license number.
- Date and start time of the application.
- Location of the land/site treated. For example-the highway number, mile marker or GPS location. Guardrail, Edge of Pavement, ROW-Overspray.
- Name of the plant pest. Be as specific as possible. For example-Johnsongrass. NOT weeds. Field Bindweed is another name for Morning Glory.
- Application Method or Type of Equipment used to make the application. The following examples are to be used. Foliar-Edge, Foliar-Flex 5, Foliar-Fixed Boom, Foliar-Handgun, Foliar-Backpack, Basal Bark-Backpack, Cut Stump-Backpack, Painted-Backpack, Cut Stump-Handgun, Painted-Handgun, Basal Bark-Handgun.
- Product Name, taken from the label on the container poured.
- EPA Registration Number, taken from the label on the container poured.
- Rate of product per unit, can be found beginning on page 94 of this book and in the back of Herbicide Records books. Example: 8 ounces per acre.

Herbicide Operations

16.2 Records Must Contain (continued):

-Temperature, Wind Velocity and Wind Direction, taken at the application location site immediately before application begins.

-Total volume sprayed, recorded after the application is completed.

16.3 District Review Recommendations

-Districts should perform an independent review of herbicide mixing and application records (Herbicide Records,) corresponding DAR's, MMS, Compass, and ERP data entry monthly during the active herbicide season.

-Accurate recording of (I) Quantity Received from Supply and (K) Non-stock Material (Leftover) is recommended.

-End of the Month Operator reconciliation of Record Book (I) Quantity Received from Supply, (K) Non-stock Material (Leftover) and Daily Activity Report (DAR) or ERP equivalent.

-It is recommended that End of the Month Herbicide Inventory at MNT Sections be taken.

-End of the Month Section Herbicide Inventory reconciliation with District Herbicide Inventory.

-End of the Month Operator check of Record Book including that accurate documentation is present for (B) Herbicide and Additive, (C) EPA Registration Number, (H) Herbicide Application Rate and that calculations are correct.

-(K) Non-stock (Leftover) amounts should be documented on new record books, similar to how Calibration Rates are recorded on the front of Herbicide Records books.

16.4 Maintenance Field Support Section Vegetation Specialist

MNT FSS employees will perform Record Book checks during the Annual Herbicide Certification Trainings in each District each year.

SECTION 17

17.0 OTHER HELPFUL INFORMATION

- ◆ **Herbicide License and Operator Responsibilities**
- ◆ **Area Coverage at Different Speeds Chart**
- ◆ **Quick Rate Chart for Percentage Solutions**
- ◆ **Standard Rate Conversions**
- ◆ **(New) Calibrating the Calc-an-Acre II**
- ◆ **(Old) Calibrating the Calc-an-Acre _{LR}**
- ◆ **(Old) Digital Speed Indicator Calibration Chart - With “MPH/Distance Key”**
- ◆ **(Old) Digital Speed Indicator Calibration Chart - Without “MPH/Distance Key”**
- ◆ **Drift Minimization and Surfactant Recommendations**
- ◆ **Handgun/Backpack Calibration**
- ◆ **Fixture Boom Schematic**
- ◆ **How to Calibrate a Fixture Boom**
- ◆ **Timing of Herbicide Operations**
- ◆ **Quick Reference Table**
- ◆ **Herbicide Half-Life and Wait to Spray Times**
- ◆ **DHT Numbers for Selected Herbicide Truck Components**
- ◆ **Useful Conversion Factors**

HERBICIDE LICENSES & OPERATOR RESPONSIBILITIES

Through an agreement with the Texas Department of Agriculture (TDA), TxDOT personnel are issued a “Noncommercial Political Pesticide Applicators License” after receiving training and passing a 2-part exam given by personnel within the Maintenance Field Support Section in the Maintenance Division (MNT). Once you are licensed, **it is your individual responsibility to insure that your license remains current.**

LICENSE YEAR:

Your license is effective for a 12 month period which **starts from the date of issue.** In order to maintain your license, **you must meet TDA’s annual CEU requirements.**

SELF-CERTIFICATION:

Personnel within the Maintenance Field Support Staff of MNT provide annual training seminars, which will satisfy TDA’s current CEU (continuing education units) requirements.

These training sessions are provided by MNT between January and April of each year, and held at each district office. MNT personnel send an annual report to TDA with the names of each employee who attended the training, and who sat for examination. Correspondence DVD Training is available in the Fall of each year. However, correspondence training can only be attended every other year.

THE YEAR YOU PASS THE TEST:

After you receive your license it is necessary to obtain additional training within the year after testing for the required CEU’s to maintain your TDA license. This is normally done by viewing the **videotapes located at http://crossroads.org/mnt/VM/video_page.html or the DVD**, which are available through each district Vegetation Manager. These videos are normally shown during the fall of each year. Contact your Vegetation Manager to arrange for viewing the tapes.

EACH YEAR THEREAFTER:

As long as you remain in TxDOT’s program, you **must attend one of the training sessions offered by TxDOT or watch the videotapes** available through your Vegetation Manager. However, correspondence training can only be attended every other year. Furthermore, and probably most importantly, **you must sign and return the Application for Renewal form directly to the TDA.** If you do not receive your renewal form from TDA, you must contact TDA as soon as possible.

If you attend TxDOT training, but fail to return TDA’s Application for Renewal Form, your license will be canceled by TDA, and you will be required to retest in order to remain within TxDOT’s program.

WHO YA GONNA’ CALL?

If you are having licensing difficulties, or have questions about your Noncommercial Political Pesticide Applicators License, contact:

- 1) Your district Vegetation Manager; or
- 2) Travis Jez MNT FSS at (512) 913-7240

AREA COVERAGE AT DIFFERENT SPEEDS

Approximate ACRES Sprayed in One Hour			
Spray Width in Inches (Feet)	Speed of Application (Miles per Hour)		
	5 MPH	10 MPH	11.36 MPH
12" (1)	0.6	1.2	1.4
24" (2)	1.2	2.4	2.8
36" (3)	1.8	3.6	4.1
48" (4)	2.4	4.8	5.5
60" (5)	3.0	6.0	6.9
72" (6)	3.6	7.2	8.3
84" (7)	4.2	8.4	9.6
96" (8)	4.8	9.6	11.0
108" (9)	5.5	11.0	12.4
120" (10)	6.1	12.2	13.8
180" (15)	9.1	18.2	20.7
240" (20)	12.1	24.2	27.5
300" (25)	15.2	30.4	34.4
360" (30)	18.2	36.4	41.3
420" (35)	21.2	42.4	48.2

QUICK RATE CHARTS FOR PERCENTAGE (%) SOLUTIONS

Add the Following Ounces of Herbicide to Get...							
With This Volume of Water	¼ of 1%	½ of 1%	1%	1½%	2%	2½%	3%
1 Gal (128 Oz)	0.3	0.6	1.3	1.9	2.6	3.2	3.8
2 Gal (256 Oz)	0.6	1.3	2.6	3.8	5.1	6.4	7.5
3 Gal (384 Oz)	1	1.9	3.8	5.8	7.7	9.6	11.5
4 Gal (512 Oz)	1.3	2.6	5.1	7.7	10.2	12.8	15.4
5 Gal (640 Oz)	1.6	3.2	6.4	9.6	12.8	16 (1 Pint)	19.2
10 Gal (1,280 Oz)	3.2	6.4	12.8	19.2	25.6	32 (1 Quart)	96 (3 Quarts)
25 Gal (3,200 Oz)	8 (½ Pint)	16 (1 Pint)	32 (1 Quart)	48 (1½ Quarts)	64 (2 Quarts)	80 (2½ Quarts)	96 (3 Quarts)
50 Gal (6,400 Oz)	16 (1 Pint)	32 (1 Quart)	64 (2 Quarts)	96 (3 Quarts)	128 (4 Quarts)	160 (5 Quarts)	192 (6 Quarts)
100 Gal (12,800 Oz)	32 (1 Quart)	64 (2 Quarts)	128 (4 Quarts)	196 (6 Quarts)	256 (8 Quarts)	320 (10 Quarts)	384 (12 Quarts)

STANDARD RATE CONVERSION

1 Ounce (mass) per Acre =	70 Grams per Hectare (g/ha)
2 Ounces (mass) per Acre =	140 g/ha
3 Ounces (mass) per Acre =	210 g/ha
½ Quart per Acre =	1.2 Liters per Hectare (L/ha)
½ Quart plus 2 Ounce =	1.2 Liters plus 140 g/ha
1 Quart per Acre =	2.3 L/ha
3 Quarts per Acre =	7 L/ha
4 Quarts per Acre =	9.3 L/ha
5 Quarts per Acre =	11.5 L/ha
8 Ounces per 100 Gal Water =	250 Milliliters per 400 Liters
10 Ounces per 100 Gal Water =	312 Milliliters per 400 Liters
10 Ounces (fluid) per Acre =	730 Milliliters per Hectare (mL/ha)
1 Quart per 100 Gal Water =	1 Liter per 400 Liters
2 Quarts per 100 Gal Water =	2 Liters per 400 Liters
8 Quarts per 100 Gal Water =	8 Liters per 400 Liters
25 psi (Check Valves) =	172 Kilopascals (kPa)
30 psi (Spray Pressure) =	207 kPa
35 psi (Spray Pressure) =	241 kPa
1 Gallon = 128 Fluid Ounces =	3.78 Liters
25 Gallons per Acre (GPA) =	234 L/ha
5 Miles per Hour (MPH) =	8 Kilometers per Hour (km/h)
11.36 Miles per Hour (MPH) =	18 km/h

Calibrating the CALC-AN-ACRE® II

1. With power off - select "**Area**", press "**CAL/RESET**" and turn vehicle on.
2. Then put in "**HOLD**" mode and press "**CAL**" until the word CAL shows up on display.
3. Press "**CAL**" again until not displaying.
4. Put in "**HOLD**" mode and turn knob to "**Distance**" and be sure display shows "**0**".
5. If not, press "**RESET**" until display shows "**0**" and the word "**CLEAR**" will also be displayed when reset is pressed prior to showing "**0**".
6. Before driving "**500 feet**" use the "**RUN/HOLD**" button to start and stop the counting function.
7. Press "**RUN**" when passing the starting flag to activate the distance counting function.
8. Travel **500 feet** and at the end of **500 feet** press the "**HOLD**" button.
9. Press and hold the "**CAL**" button for one second.
10. Press "**CAL**" again and the word "**CAL**" will begin to flash and distance traveled will be displayed.
11. When "**CAL**" is flashing verify whether the number displayed is the exact distance (**500 feet**) that you drove. If not, press the "**+**" or "**-**" key to adjust the figure to "**500**" (or as close as possible to 500), which will match the distance you actually drove.
12. Read the new circumference number "" and record it.
13. Then select "**Speed**" on dial and check speed against speedometer.

CALC-AN-ACRE® II



Control Head & Digital Speed Indicator



Truck application speed should always be read from the **Digital Speed Indicator**

The cab-mounted control head powers up to 6 nozzle banks and raises the Flex-5 boom up and down

(Old) Calibrating the CALC-AN-ACRE[®] LR

1. With power off - select "**total area**", press "**cal/reset**" and turn vehicle on.
2. Select "**sub area / width**" and put in "**hold**" mode.
3. Press "**cal**" for three seconds.
4. Set width on **99**.
5. Press "**cal**" for 3 seconds and set in "**run mode**".
6. Turn knob to "**distance**" and put in "**hold**" mode.
7. Press "**cal**" for 3 seconds - (screen should flash).
8. Set **circumference** on **5.0** and put in "**run mode**".
9. Press "**cal**" for 3 seconds.
10. Press reset button and put in "**hold**" mode.
11. Press "**cal**" for 3 seconds and put in "**run**" mode.
12. Travel 500 feet.
13. Put in "**hold**" mode, and "**+ or -**" to 500 feet.
14. Press "**cal**" for 3 seconds.
15. Put in "**run**" mode and then put in "**hold**" mode.
16. Press "**cal**" for 3 seconds (take off calibration).
17. Read new circumference #, and press "**cal**" for 3 seconds.
18. Select speed on dial and check speed against speedometer.

(Old) CALC-AN-ACRE[®] LR

Entering Wheel Circumference Value

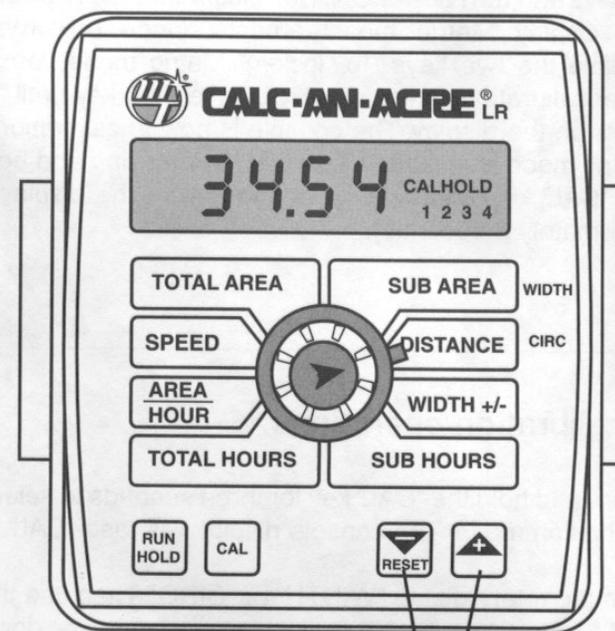
Having determined the correct wheel circumference (CIRC) value, turn ignition switch on to power up the console.

1. Place the console in HOLD.
2. Press and hold the “CAL” key for three seconds to enter the calibration mode and turn the dial to “CIRC” position. The display will alternate between the wheel circumference (CIRC) and distance values at about three-second intervals. (When the words “CAL” and “HOLD” and “1 2 3 4” appear, the number displayed is the wheel circumference (CIRC) value. When only the word “HOLD” and “1 2 3 4” appear, that is the distance value.)
3. When the display shows wheel circumference (“CAL”, “HOLD” and “1 2 3 4” are displayed), use the “+” and “-” keys to adjust the displayed value to the desired number. When the number shown on the display matches the desired value, you have arrived at the starting calibration value. Exit “CAL” by pressing and holding the “CAL” key for three seconds.

NOTE: If you let go of the “+” and “-” keys while you are adjusting the CIRC value, the console will wait to make sure you are finished. After 64 seconds, the display will start alternating between the wheel circumference (CIRC) and distance values again. Make sure you know which value you are adjusting.

NOTE: For fine-tuning the wheel circumference (CIRC) value, turn to page 16.

Illustration 14



Press to enter measured wheel circumference.

Digital Speed Indicator Calibration

For Older Units "With" a MPH/DIST Key

STEP	ACTION
1	Clear FIELD ACRES by pressing and hold key for approximately 3 seconds, and then release when readout displays 0.0 .
2	Clear TOTAL ACRES by pressing and holding key for approximately 3 seconds, then release when readout displays 0.0 .
3	Press and hold W (Width) key and at the same time, press the "+ or -" key the change circumference readout to display 1.0 , then release.
4	Press and hold C (Circumference) key and at the same time, press the "+ or -" key to change circumference readout to display 1.0, then release.
5	Press the MPH/DIST key to change readout to "speed" mode (readout will display S 0.0), then press MPH/DIST key to change readout to display distance.
6	Clear distance by pressing and holding the MPH/DIST key for approximately 3 seconds, then release when readout displays 0.0 .
7	Drive the vehicle for a distance of <u>exactly one-mile (5,280 feet)</u> , and then safely stop the vehicle.
8	Press and hold the MPH/DIST key and at the same time, press the "+ or _" key to change the distance readout to display 5280 , then release.
9a	If the readout displays the words " Help Calib ", return to Step 4 and enter a circumference of 5.0 ; Otherwise go to step 10.
9b	Repeat steps 5 through 9.
10	Record the Circumference number on the front cover of the Herbicide Record Book.

For Older Units "With" a MPH/DIST Key (contd.)

Daily Operation Checklist	
1	Turn the unit on by pressing the <i>C (Circumference)</i> key.
2	Compare the number shown on the digital display to the number recorded for Circumference on the front cover of the Herbicide Record Book.
3	If numbers are not identical, press and hold the <i>C (Circumference)</i> key and at the same time press the "+ or -" key and adjust the readout to the number determined in step 10 above and as shown on the front cover of the Herbicide Record Book.
4	If numbers are identical, press the <i>MPH/DIST</i> key to change the readout mode to speed (readout will display <i>S 0.0</i>).
5	Proceed with normal spraying operations <u>USING DIGITAL SPEED INDICATOR TO MONITOR VEHICLE SPEED.</u>
6	If unit reads speed inaccurately or erratically, <u>REPORT THE MALFUNCTION TO YOUR DISTRICT VEGETATION MANAGER.</u>

Note: This unit is to be used for measuring the speed of the vehicle only, and **should not be used to measure the number of acres sprayed.**

For Older Units "Without" a MPH/DIST Key

STEP	ACTION
1	Clear FIELD ACRES by pressing and holding key for approximately 3 seconds, then release when readout displays 0.0 .
2	Clear TOTAL ACRES by pressing and holding key for approximately 3 seconds, then release when readout displays 0.0 .
3	Press and hold W (Width) key and at the same time, press the "+ or -" key the change digital readout to display 99 , then release.
4	Press and hold C (Circumference) key and at the same time, press the "+ or -" key to change circumference readout to display 5.0 , then release.
5	Clear TOTAL ACRES by pressing and holding key for approximately 3 seconds, then release when readout displays 0.0 .
6	Drive the vehicle for a distance of <u>exactly one-mile (5,280 feet)</u> , then safely stop (the speed sensor will likely display a value between 0.4 or 0.6 Total Acres).
7	Press and hold the TOTAL ACRES key and at the same time, press the "+ or -" key to change digital readout to display 1.0 , then release.
8	Press and release C (Circumference) key to read Circumference.
9	If the digital display reads " Help Calib ", return to Step 4 and repeat steps 4 through 8; Otherwise go to step 10.
10	Record the Circumference number on the front cover of the Herbicide Record Book.

For Older Units "Without" a MPH/DIST Key (contd.)

Daily Operation Checklist	
1	Turn the unit on by pressing the <i>C (Circumference)</i> key.
2	Compare the number shown on the digital display to the number recorded for Circumference on the front cover of the Herbicide Record Book.
3	If numbers are not identical, press and hold the <i>C (Circumference)</i> key and at the same time press the "+ or -" key and adjust the readout to the number determined in step 10 above and as shown on the front cover of the Herbicide Record Book.
4	If numbers are identical, press the <i>MPH</i> key to change the readout mode to speed (readout will display <i>S 0.0</i>).
5	Proceed with normal spraying operations <u>USING DIGITAL SPEED INDICATOR TO MONITOR VEHICLE SPEED.</u>
6	If unit reads speed inaccurately or erratically, <u>REPORT THE MALFUNCTION TO YOUR DISTRICT VEGETATION MANAGER.</u>

Note: This unit is to be used for measuring the speed of the vehicle only, and **should not be used to measure the number of acres sprayed.**

DRIFT MINIMIZATION AND SURFACTANT RECOMMENDATIONS

DRIFT CONTROL:

Appropriate drift control must be used with all herbicides when using the truck handgun, fixture or Flex-5 booms. Drift control is not required when using backpack sprayers.

THE OPERATOR, HOWEVER, MUST ALWAYS INSURE THAT THE HERBICIDE IS BEING PLACED ON TARGET REGARDLESS OF THE METHOD OF APPLICATION. IF WIND CONDITIONS ARE SUCH THAT THE SPRAY CANNOT BE KEPT ON TARGET, THE OPERATOR MUST CEASE SPRAY OPERATIONS.

Control WM drift control should be shaken thoroughly, then slowly injected into the system, using the integral drift control injector. *Addition of Control WM Drift Control through the main tank lid is not recommended.*

The Control WM drift control rate is *2 fluid ounces per 100 Gallons of Water.*

Droplex drift control can be added through the main tank lid or the conical tank.

The Droplex drift control rate is *16 fluid ounces per 100 Gallons of Water.*

SURFACTANT:

A surfactant is required when using *Approved Aquatic Herbicide, Escort[®] XP, Capstone[®] and Transline[®]* when spraying Mesquite and Huisache.

The surfactant rate for *Escort[®] XP* is 1 quart per 100 gallons of water.

The surfactant rate for *Approved Aquatic Herbicide* is 2 quarts per 100 gallons of water.

The surfactant rate for *Transline[®]* is 2 quarts per 100 gallons of water or ½% when spraying Mesquite and Huisache.

The surfactant rate for *Vista[®] XRT* is 2 quart per 100 gallons of water when spraying Giant Ragweed.

The surfactant rate for *Outrider*[®] is 2 quarts per 100 gallons of water when spraying Johnsongrass by itself.

The surfactant rate for Target[®] 6.6 is 2 quarts per 100 gallons of water when spraying Johnsongrass.

The surfactant rate for Streamline[®] is 2 quarts per 100 gallons of water when spraying Huisache.

Handgun / Backpack Calibration

Method A:

Fill the handgun with clean water.

With a watch or stopwatch, time how long it takes to uniformly spray an area of 18½ feet by 18½ feet.

Using the recorded time, spray again into a measuring device. The fluid ounces collected will equal the Gallons Per Acre (GPA).

Method B:

Fill the handgun with clean water up to a specific marked level.

Uniformly spray an area of 18½ feet by 18½ feet.

Measure how many fluid ounces it takes to fill the sprayer back up to the marked level.

The fluid ounces sprayed out will equal the Gallons Per Acre (GPA).

*If the operator does not calibrate the handgun using either of these methods,
then use an estimated rate of 100 GPA.*

Inside 110-20 or Turbo-Drop - Sprays vegetation in shoulder

Middle 110-20 or Turbo-Drop - Sprays vegetation in shoulder

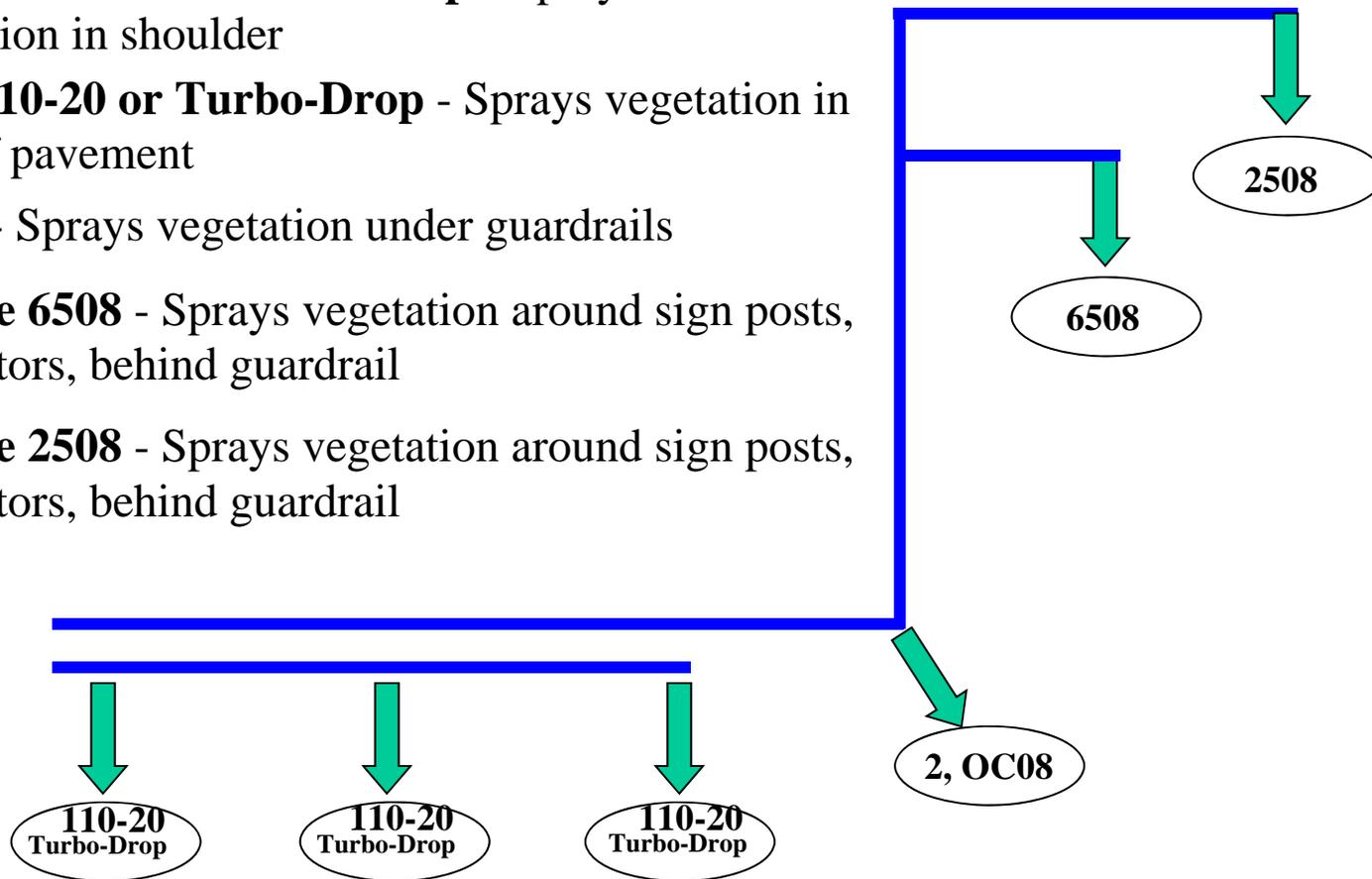
Edge 110-20 or Turbo-Drop - Sprays vegetation in edge of pavement

OC08 - Sprays vegetation under guardrails

Outside 6508 - Sprays vegetation around sign posts, delineators, behind guardrail

Outside 2508 - Sprays vegetation around sign posts, delineators, behind guardrail

Turbo-Drop & Fixture Boom Schematic



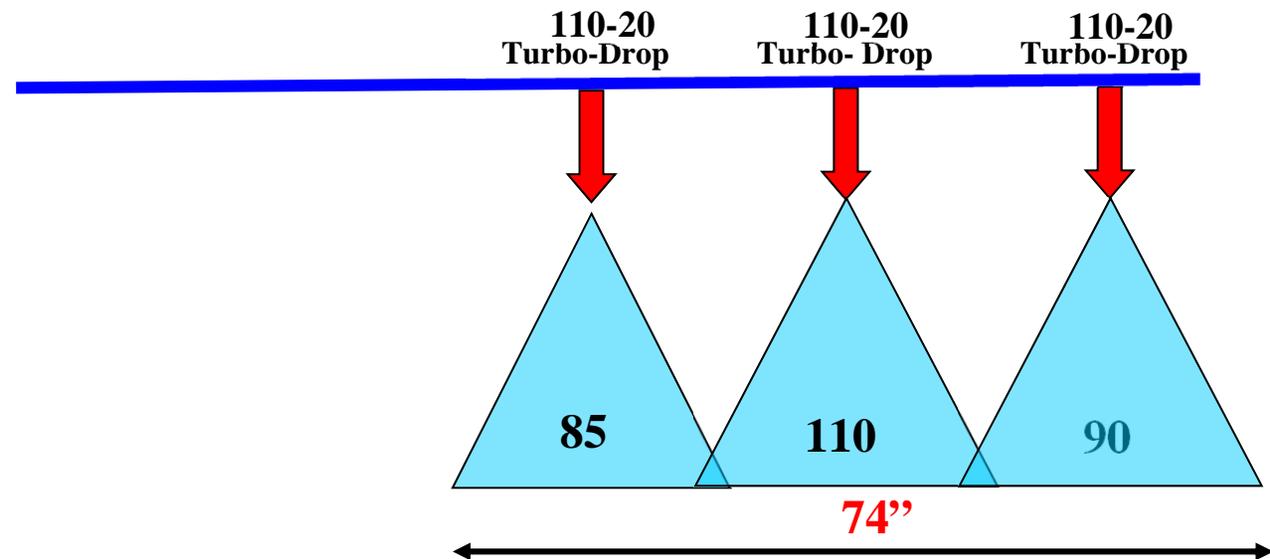
Calibrating your Turbo-Drop Nozzles on the Fixture Boom

Step 1: Select the nozzles you know you will be using for your application

Step 2: With drift control in the main tank, collect the fluid out of each nozzle selected for a period of 60 seconds and record the volume in fluid ounces

Step 3: Record the spray width of the selected nozzles.

Step 4: Do the math.



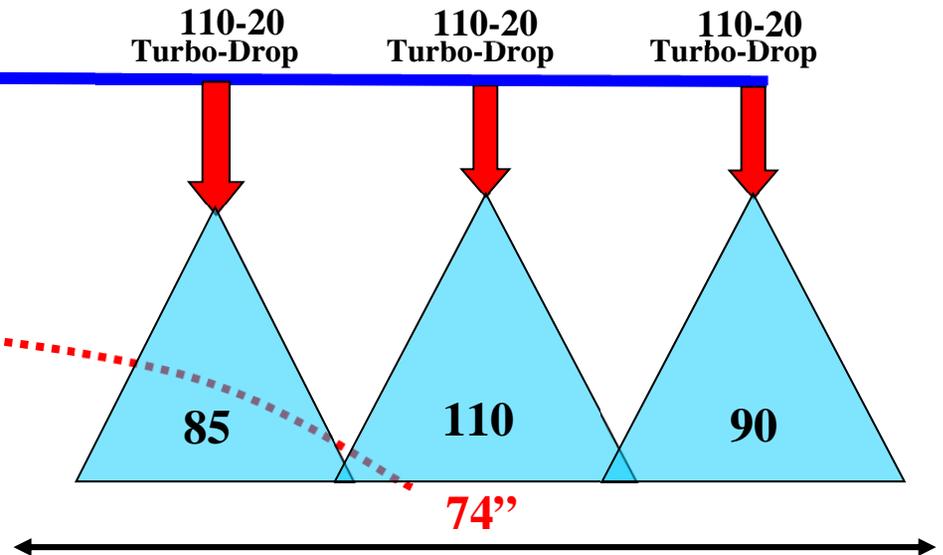
Calibrating your Turbo-Drop Nozzles on the Fixture Boom (cont.)

$$\begin{array}{r} 85 + \\ 110 + \\ \hline 90 = \\ \hline \end{array} \quad \mathbf{285 \text{ Fl Oz / Minute}}$$

285 divided by 128 fl oz per gallon = **2.2 GPM**

Now, plug these numbers into the Formula:

$$\text{GPA} = \frac{5940 \times \mathbf{2.2 \text{ GPM}}}{\text{MPH} \times \mathbf{74''}}$$



Calibrating your Turbo-Drop Nozzles on the Fixture Boom (cont.)

$$\text{GPA} = \frac{5940 \times \text{GPM}}{\text{MPH} \times \text{SW} \text{ "}}$$

$$\text{GPA} = \frac{5940 \times 2.2}{\text{Regular Nozzles or Turbo-Drop} \times 74}$$

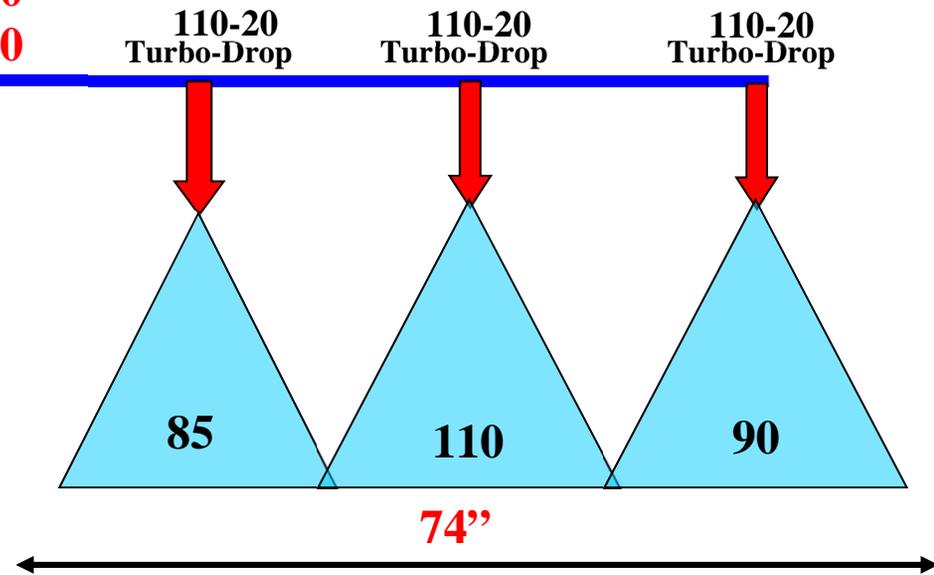
$$\text{GPA} = \frac{13,068}{\text{Regular Nozzles or Turbo-Drop} \times 74}$$

Regular Nozzles

GPA = 35

or Turbo-Drop

GPA = 18
(Turbo-Drop)



GPA = 18
(Turbo-Drop)

Example 1: Tank mix a 300-gallon load of *Roundup PROMAX*[®] and *Landmark*[®] XP for complete control (bare ground) along the edge of pavement with Turbo-Drop Nozzles.

Step 1: Determine the number of acres you can spray: $\frac{300 \text{ gal}}{18 \text{ GPA}} = 16.7 \text{ Ac}$

Step 2: Determine the proper amount of *Roundup PROMAX*[®] and *Landmark*[®] XP to add:

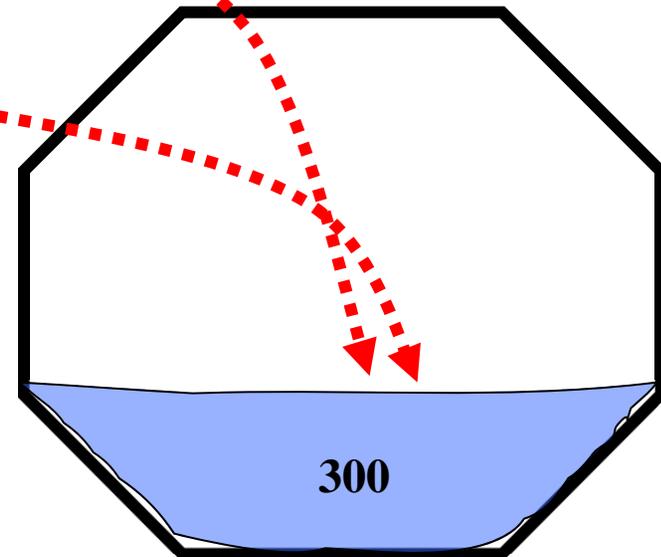
$$16.7 \text{ Ac} \times 3 \text{ Qt. / Ac} = 50.1 \text{ Qts.}$$

$$16.7 \text{ Ac} \times 3 \text{ Oz. / Ac} = 50.1 \text{ Ozs.}$$

Step 3: Determine the proper amount of drift control to add:

$$3 \times 2 \text{ Oz / 100 Gal} = 6 \text{ fl oz}$$

Drive the Proper Speed!
10 mph Turbo-Drop



GPA = 25

Example 2: Tank mix a 1,000 gallon solution of *Roundup PROMAX*[®] + *Escort*[®] *XP* + *Outrider*[®] for Johnsongrass control, using your Flex-5 Spray head:

Step 1: Determine the number of acres you can spray: $\frac{1,000 \text{ gal}}{25 \text{ GPA}} = 40 \text{ Ac}$

Step 2: Determine the proper amount of chemical to add:

$$40 \text{ Ac} \times 8 \text{ Oz} / \text{Ac} = 320 \text{ oz} / 32 = 10 \text{ Qts}$$

$$40 \text{ Ac} \times 1 \text{ Oz} / \text{Ac} = 40 \text{ Oz.}$$

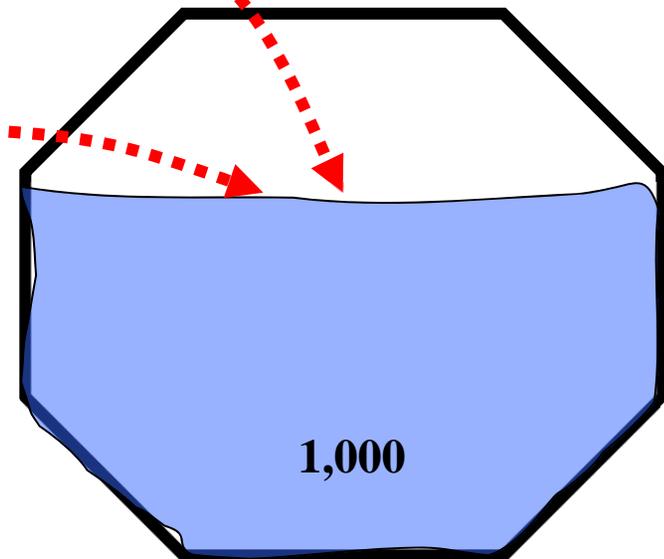
$$40 \text{ Ac} \times 1.33 \text{ Oz} / \text{Ac} = 53 \text{ Oz.}$$

Step 3: Determine the proper amount of drift control to add:

$$10 \times 2 \text{ Oz} / 100 \text{ Gal} = 20 \text{ fl Oz}$$

Drive the Proper Speed!

(11.36 mph)



Calibration Summary

- Calibrate your Turbo-Drop Nozzles at least **ANNUALLY**
- Record your Calibration Numbers on your **RECORD BOOK**
- Calibrate the Nozzle **Combinations you Normally Use** (could be more than one combination)
- If you're not sure what your Nozzles are Spraying, **CALIBRATE THEM before you spray any chemical**
- The FLEX - 5 Spray Boom has been Pre-Calibrated To **25 GPA**

TIMING OF HERBICIDE OPERATIONS

General Information

The time of the year that various herbicides are applied is very important. Herbicide application timing affects how well the treatment will control the weed problem for which it is directed without causing damage to desirable vegetation on the right-of-way. The herbicide application for weed control must also be applied at a time of the year so that it does not affect the establishment and propagation of wildflowers.

The following table outlines the recommended time of the year when herbicide operations should occur:

Herbicide Operations	Targeted Plants	Application Months
Edge of Pavement/Guardrails	Bermudagrass	March – October
Broadcast Applications	Johnsongrass and Broadleaf Weeds	June – October
Rip-rap, Medians, Gores and Retaining Walls	All Vegetation	Year Round
Other Noxious Weeds	Field Bindweed, Giant Ragweed, Sunflowers, Georgia Cane, Musk Thistle, African Rue, Broadleaf	June - October
Trees and Brush	Mesquite, Huisache, Retama	June – October
Aquatic Weeds	Cattails	April - October

QUICK REFERENCE TABLE

Target/Type of Control Desired	Herbicide	Application Rate	Optimum Treatment Period	Comments
Guardrails, delineators, mailboxes, signage (removal of tall weeds)	<i>Roundup PROMAX</i> [®] + <i>Escort</i> [®] XP + <i>Outrider</i> [®]	8 ounces + 1 ounce + 1.33 ounces per acre	Apply after wildflowers seed & before July 31 st .	Complete control (bare ground) beneath guardrails, under delineators and around sign supports is not recommended. <i>Vista</i> [®] XRT at the rate of 10 ounces per acre can be combined with the three way or two way mixtures for the control of Giant Ragweed without the need of a surfactant.
	<i>Roundup PROMAX</i> [®] + <i>Outrider</i> [®]	8 ounces + 1.33 ounces per acre	Can be applied until October 15 th .	
Edge of Pavement, (Bare Ground edge of pavement application, no more than 6 inches from edge of road surface)	<i>Roundup PROMAX</i> [®] with <i>EsplAnade</i> [®] 200 SC	3 quarts per acre + 4 ounces per acre	March through October	<i>EsplAnade</i> [®] 200 SC is replacing <i>Landmark</i> [®] XP Add 2 ounces of <i>Landmark</i> [®] XP with 3 quarts of <i>Roundup PROMAX</i> [®] to provide short term control of edges and 3 ounces for extended control of vegetation in Edge of Pavement. Do not use <i>Landmark</i> [®] XP if the wind is above 10 MPH.
	<i>Roundup PROMAX</i> [®] with <i>Landmark</i> [®] XP	3 quarts per acre + 2-3 ounces per acre		
Switchgrass	<i>Roundup PROMAX</i> [®]	1.5 % Solution	Apply while actively growing	Spot treatment during growing season.
		25 % Solution		Rotowiper [®] application.
Johnsongrass Control	<i>Roundup PROMAX</i> [®] + <i>Outrider</i> [®]	8 ounces + 1.33 ounces per acre	Early boot to early seedhead	Fixture or Flex-5. For use in Bahiagrass areas. Do not use <i>Outrider</i> [®] after October 15 th .
	<i>Roundup PROMAX</i> [®] + <i>Escort</i> [®] XP + <i>Outrider</i> [®]	8 ounces + 1 ounce + 1.33 ounces per acre		Fixture or Flex-5 booms. In areas of good wildflowers, do not continue use of <i>Escort</i> [®] XP in wide patterns (overspray) after July 31 st and <i>Outrider</i> [®] after October 15 th .
	<i>Outrider</i> [®]	1.33 ounces per acre + 2 qts. surfactant per 100 gallons of water		Fixture or Flex-5. Where <i>Roundup PROMAX</i> [®] brownout has been a problem. Do not use <i>Outrider</i> [®] after October 15 th .
	<i>Roundup PROMAX</i> [®]	2 parts water, 1 part chemical		Ropewick.

QUICK REFERENCE TABLE (cont.)

Target/Type of Control Desired	Herbicide	Application Rate	Optimum Treatment Period	Comments
Hard to Control Johnsongrass	<i>Target</i> [®] 6.6	1.5 quarts per acre + ½ % Surfactant	Apply while active growing	Temp needs to be at least 85°. Two applications, 30-60 days apart are needed.
Guinea Grass	<i>Roundup PROMAX</i> [®]	1.5 % Solution	Apply while actively growing	Spot treatment during growing season.
		16 ounces per acre		Fixture or Flex-5 booms.
Itchgrass	<i>Roundup PROMAX</i> [®]	1.5 % Solution	Apply while actively growing	Spot treatment during growing season.
	<i>Roundup PROMAX</i> [®] + <i>EsplAnade</i> [®] 200 SC	12 ounces plus 4 ounces per acre		Overspray with Roundup PROMAX [®] at 12 ounces plus EsplAnade [®] 200 SC at 2 ounces per acre. Flex-5 or Turbo-Drop.
Wildoats or Jointed Goatgrass	<i>Roundup PROMAX</i> [®]	10 ounces per acre	Late March	Spray before seed mature.
Riprap, Paved Medians, Raised Medians and Retaining Walls (Bare Ground)	<i>Roundup PROMAX</i> [®]	3 quarts per acre	Year Round	Overspray Operations.
		1.5 % Solution		Handgun Operations
	<i>EsplAnade</i> [®] 200 SC	4 oz per 100 plus 3 quarts Roundup PROMAX [®]		
Aquatic Vegetation (standing or running water present)	<i>Approved Aquatic Herbicide (54% Glyphosate)</i>	8 quarts per 100 gallons of water	When vegetation is actively growing	Handgun operations. Add surfactant at the rate of 2 quarts/100 gallons of water.
Sunflower	<i>Transline</i> [®]	10 fluid ounces per acre	Late Spring / Early Summer	Fixture or Flex-5 boom. Apply before plants mature. Do not use Transline [®] after July 31st.
		10 fl ounces per 100 gallons		Handgun operations.
Musk Thistle	<i>Transline</i> [®]	10 fluid ounces per acre.	Early Spring	Fixture or Flex-5 boom. Do not use Transline [®] after July 31st.
		10 fl ounces per 100 gallons.		Handgun operations.

QUICK REFERENCE TABLE (cont.)

Target/Type of Control Desired	Herbicide	Application Rate	Optimum Treatment Period	Comments
Giant Ragweed (Bloodweed)	<i>Vista® XRT</i>	10 fluid ounces per acre + 2 qts. surfactant per 100 gallons of water	Late Spring / Early Summer	Fixture or Flex-5 spray boom. Apply before plants mature. <i>Vista® XRT</i> can be combined with the three way or two way mixtures without the need of a surfactant. Do not use <i>Vista® XRT</i> in the ROW after July 31 st .
		10 fl ounces per 100 gallons + 2 qts. surfactant per 100 gallons of water		Handgun operations. Do not use <i>Vista® XRT</i> in the ROW after July 31 st .
Kochia	<i>Vista® XRT</i>	10 fluid ounces per acre Add surfactant at the rate of 2 qts. per 100 gallons of water.	When vegetation is actively growing	Fixture or Flex-5 boom. Do not use <i>Vista® XRT</i> in the ROW after July 31 st .
Russian Thistle	<i>Vista® XRT</i> + <i>Escort® XP</i>	10 fluid ounces per acre + 1 ounce per acre + 2 qts. of surfactant per 100 gallons of water.		
Mesquite & Huisache	<i>Transline®</i>	21 oz/ac + 2 qts. surfactant per 100 gallons of water	Mid-Summer / Early Fall	Overspray operations with Flex-5 boom. Do not use <i>Transline®</i> after October 15 th .
Mesquite & Huisache, Low Volume Foliar Spray	<i>Transline®</i>	<i>Transline®</i> - 1/2% + 2 qts. surfactant /100 gallons of water	Mid-Summer / Early Fall	Use low volume X6 tip. 25 gallon Poly Tank with 12 volt electric pump
Huisache	<i>Streamline®</i>	10 ounces per acre + 2 qts. surfactant per 100 gallons of water.	Mid-Summer / Early Fall	Do not use if wind exceeds 10 miles per hour
Field Bindweed	<i>Escort® XP</i>	1 ounce per acre	June-September	Add surfactant at the rate of 1/4% (1 quart per 100 gallons of water). Do not use <i>Escort® XP</i> after July 31 st .
Common Sunflower		1 ounce per acre	Spray when 2-3 feet in height	
Western Bitterweed		1 ounce per acre	March-April	
Turnip Weed		1 ounce per acre	February-March	
African Rue		3 ounce per acre	September	
Morning Glory Vine		1 ounce per acre	June-September	
		2 ounce per acre		

QUICK REFERENCE TABLE (cont.)

Target/Type of Control Desired	Herbicide	Application Rate	Optimum Treatment Period	Comments
Other Broadleaf Weeds	<i>Escort</i> [®] <i>XP</i>	1 ounce per acre	May-July 31 st	Rate to be added to two-way, three-way or four-way mixture. Overspray use.). Do not use <i>Escort</i> [®] <i>XP</i> after July 31 st .
Chemical Pruning (overhanging trees and brush encroaching on right-of-way or covering roadway signage)	<i>Capstone</i> [®]	6 pints per acre + 2 quarts surfactant per 100 gallons of water	When vegetation is actively growing	Overspray operations with Flex-5 boom. Used for chemically pruning overhanging trees and brush.
Chemical Pruning in areas where there are a lot of undergrowth and Hackberry trees	<i>Capstone</i> [®] + <i>Vista</i> [®] <i>XRT</i>	6 pints per acre + 10 ounces per acre + 2 quarts surfactant per 100 gallons of water	When vegetation is actively growing	Overspray operations with Flex-5 boom. Used for chemically pruning overhanging trees and brush.
Brush * (Mesquite, Huisache, etc)	<i>Pathfinder II</i> [®]	Basal Bark Treatment	Year Around (Fall least preferable-As long as ground is NOT frozen)	Cone Jet #5500 X2 nozzle required. Spray lower 12"-15" of stem. Complete coverage required. Do not spray to point of runoff.
*Optional Basal Bark and cut stump applications with <i>Pathfinder II</i> [®] can be used at any time during the year, as long as ground is not frozen.				
Kudzu ***	<i>Transline</i> [®]	21 fluid ounces per acre + 2 quarts surfactant per 100 gallons of water	When vegetation is actively growing	Handgun operations.
Georgia Cane or Giant Reed	<i>Approved Aquatic Herbicide (54% Glyphosate)</i>	8 quarts per 100 gallons + 2 quarts surfactant per 100 gallons of water	September - October	Handgun operations.
***Please Note: <i>Transline</i> [®] at 21 ounces per acre is the maximum use rate per year. Kudzu is a very aggressive vine and additional treatments will need to be planned and scheduled for future years to gain total eradication of this noxious weed.				

Herbicide Half-Life and Wait to Spray Times

	Half-Life of Herbicide in Contact with Soil	Half-Life of Herbicide in Water @ 105°F or Above	Annual not to Exceed Rates	Visual Effects of Wilting after Application	Time Required Prior to Rainfall after Application	Formulation
Monsanto Roundup PROMAX®	0 Days	Indefinite, if solution is mixed in clean, pure water. Very short life if water is high in pH or dirty.	7 qt./Ac	Annual Plants 2-4 Days and Perennial 7 Days or more	.5 Hours	Potassium Salt Glyphosate with Surfactant, Water Soluble Liquid
Monsanto Outrider®	28 Days	16 days if pH is at 7.	2.66 oz./Ac	2-3 Weeks & 4-6 Weeks	1-2 Hours	Sulfosulfuron Dispersible Granules
Approved Aquatic Herbicide, Aquamaster® or Rodeo®	0 Days	Indefinite, if solution is mixed in clean, pure water. Very short life if water is high in pH or dirty.	N/A	Annual Plants 2-4 Days and Perennial 7 Days or more	6 Hours	Glyphosate without Surfactant, Water Soluble Liquid
Bayer Escort® XP	20 Days	12-15 days if pH is at 7. More days if pH is higher and less days if pH is lower.	4 oz./Ac	2-4 Weeks & 4-6 Weeks	1-2 Hours	Metsulfuron Methyl, Dispersible Granules
Bayer Landmark® XP	40 Days	Tank Temperature = 110-115F pH5 = 80% at 10 hours pH7 = 95% at 4+ days pH9 = 80% at 3 days	9 oz./Ac	2-3 weeks & 4-6 Weeks	1-2 Hours	Sulfometuron Methyl and Chlorsulfuron, Dispersible Granules
Dow AgroSciences Transline®	23 Days	30 days at pH range of 5-9 at 77°F. Would not expect this to be significantly different at 105°F +	21 oz./Ac	1 Hour	.5 Hours	Clopyralid, Liquid Concentrate

Herbicide Half-Life and Wait to Spray Times (cont.)

	Half-Life of Herbicide in Contact with Soil	Half-Life of Herbicide in Water @ 105°F or Above	Annual not to Exceed Rates	Visual Effects of Wilting after Application	Time Required Prior to Rainfall after Application	Formulation
Dow AgroSciences Pathfinder II®	28 Days	Does not mix with water	N/A	2-3 Days or more	.5 Hours	Triclopyr, Ready to use Liquid
Dow AgroSciences Vista® XRT	14 Days	185 days @ 68° F. Would not expect this to be significantly different at 105°F +	22 oz/ac	1 Day	1 Hour	Fluroxypyr, Liquid Concentrate
Dow AgroSciences Capstone®	Aminopyralid 34.5 days, Triclopyr 30 days	(When in solution in spray tank) stable to hydrolysis, photodegrades in water in sunlight through UV (spray tanks have UV protection) Half-life of herbicide in water in sunlight. Aminopyralid 16 hours, triclopyr 8 hours	9 pt/ac	Varies with the species, can be from 6 to 48 hours, or on Russian knapweed can be as long as 3 months	No recommendation but 2-6 hours might be good	Aminopyralid and Triclopyr Liquid Concentrate
Bayer Esplanade® 200 SC	9-66 Days	Less than 5 days in clear, shallow water	10 oz/ac	3-5 Days after germination/emergence	2 Hours	Indaziflam Liquid Concentrate
Bayer Streamline®	Aminocyclopyrachlor 61 days, Metsulfuron methyl 20 days	12-15 days if pH is at 7. More days if pH is higher and less days if pH is lower.	11.5 oz/ac	5-7 Days	4 Hours	Aminocyclopyrachlor and Metsulfuron methyl Dispersible Granules
Luxembourg-Pamal Target® 6.6	245 Days	35 Days. Do not use near water.	12 pints/yr	2-3 Days	6-8 Hours	Monosodium methanearsonate-MSMA Liquid Concentrate

NIGP Codes for Selected Equipment/Chemicals/Components

(For an up to date NIGP listing with photos go to: <http://crossroads/org/mnt/VM/main.htm>)

Model 85 & 95 Herbicide Truck Part Description	NIGP Code
Components & Actuator	
Actuator, Mechanical; Linear, 12V-DC with 8 inch stroke length, Clevis Mount (See “Pin” Quick Release)	220-04-14-1226
Component, (Shop Built) Bumper, Small Truck	765-66-55-1305
Component, (Shop Built) Control Stand F/Cab	810-93-52-1037
Component, (Shop Built) De-Icer, Large and Small Truck (Complete)	765-66-55-1305
Component, (Shop Built) Front End Bracket, Small Truck	810-93-52-1045
Component, (Shop Built) Front End Bracket, Large Truck	810-93-52-1052
Component, (Shop Built) Front End, Right & Left	810-93-52-1003
Component, (Shop Built) Front End Manifold Tube	810-93-52-1029
Component, (Shop Built) Mirror Bracket (New right and left bracket)	810-93-52-1011
Mirror, Convex, 12”, Round, Acrylic Lens, Steel Back, Rubber Lens Retainer	055-64-06-1215
Pin, Quick Release, 1” Diameter x 2 ½ inches long, Type 303 Stainless Steel (For Actuator)	320-35-62-4009
Pin, Quick Release, ½” Diameter x 3 inches long, Type 303 Stainless Steel (For Actuator)	320-35-62-0502
Electrical & Digital Speed Indicator	
Alarm; Backup; Electric; 12Volt; 97DB(A); F/Automotive Use	055-79-21-3108
Component, (Shop Built) Lighted Control Panel, F/Cab	765-66-55-1313
Digital Speed Indicator; 12V Continuously Hot (.08 AMPS) for information storage.	020-10-25-2357
Lamp; Miniature; GEC 1815; Indicator; 14 Volt; Min. Bay.; T-3 ¼ (For Lighted Control Panel)	285-46-22-1806
Pulse Driver; Transmission, 12 Volt, Pulse Divider, Electronic (Chevy)	055-32-75-8454
Switch; Toggle, Green LED, Lighted, 30A/12V DC (Calterm Part number 40293) (For New Style Lighted Control Panel)	055-83-75-6282
Switch, Toggle, Heavy Duty, SPST, on-off, 15 Amp, 125 Volt, Solder (For Lighted Control Panel)	055-83-75-5763
Switch, 6 Position, 2 Pole, Momentary, 20 Amp, 28 Volt (For Lighted Control Panel)	287-72-80-8458
Engine, Filter, Drift Injection & Pump Assembly	
16-Mesh Screen Only	810-95-56-7509
50-Mesh Screen Only	810-95-56-7251
Cable Throttle; Veriner Locking Control; 20’	060-24-26-7889
Centrifugal Pump; 1-1/4” NPT inlet; Stainless Steel; 1” outlet; Pentair Hypro 9202S; 105 gpm	720-18-17-5660
Centrifugal Pump; 1-1/4” NPT inlet; Cast Iron; 1” outlet; Pentair Hypro 9202C; 105 gpm	720-18-17-5652
Centrifugal Pump; 1-1/2” NPT inlet; Cast Iron; 1 1/4” outlet; Pentair Hypro 9203C; 140 gpm	720-18-17-5669

Herbicide Operations

Drift Control Cap PVC, Slip; 3"; Schedule 40;	659-27-84-1950
Drift Control Tube; Clear Plastic; 3", Schedule 40, W/UL rating, order per foot	658-60-15-2910
Drift Control Tube Assembly, with all as shown with filter assembly	765-66-55-1321
Engine Diesel; 9 HP; 4 Cycle; Air Cooled; Single Cylinder	515-15-35-1503
Engine Gasoline; 8 HP; 4 Cycle; Air Cooled; One or more cylinders with horizontal shaft	515-15-40-3205
Line Strainer; 1 1/2" FPT; Aluminum; 5 3/8" x 8"; includes 16 mesh screen	810-95-77-2257
Line Strainer; 3/4" NPT; Female; Aluminum Head; Nylon Bowl; 150 psi; includes 50 mesh screen	810-95-77-1051
Motor Mount; Rubber; 2" DIA x 1-1/8" STUD; 3/8"-16 THD	060-40-48-4450
Petcock; Brass; 1/8" MPT x 5/32" PORT; 80 lb.; Tee Handle	815-06-39-0350
Pulley; V-Type; 3" DIA; 1/2"; 5/8" Bore; W/Hub & Bearing (Used for both pump and Diesel Engine Shafts) (New Style)	450-63-40-1165
Pulley; V-Type; Fixed Bore Cone Groove; OD 5.93 Inches (Used in problem situations)	450-63-40-3328
Relay, Automotive, 12 Volt DC, 45 Amp, 4 Circuit, Continuous Duty. (Engine Starter Relay)	060-36-67-0559
V-Belt; Automotive; Gates 9375 or DRA 17-377 (Engine to pump v-belt)	110-74-41-7855
Gauges, Solenoids, Pressure Regulator Valves	
Bushing, Brass, Reducing, 3/4 inch MPT x 1/4 inch FPT (Nipple pipe to solenoid bushing)	659-24-19-2605
Component, (Shop Built) Front End Manifold Tube	810-93-52-1029
Coupling, Stainless Steel, 1/4 inch internal pipe size (IPS), Type 304. (Nipple Pipe to Pressure Gauge)	659-33-87-0407
Electric solenoid 12 VDC; 3/4" x 3/4" x 1/2" IPS;	810-85-55-8807
Ell, Nylon, 3/4 inch MPT x 3/4 inch Hose x 90 Degrees	060-60-91-4451
Nipple, Pipe, Brass, 1/4 inch x 21 inches, MPT	659-50-38-2500
Pressure Gauge; Main; 0-160 psi; Liquid Filled; 1/4 BTM Connection	815-58-56-2005
Pressure Gauge; System; 0-60 psi; Liquid Filled; 1/4 BTM Connection	815-58-56-0603
Pressure Regulator Valve; 3/4" FPT; 25-75 PSI; Watts U5B (New Style)	815-81-57-1221
Pressure Regulator Valve; 3/4" FPT; 25-75 PSI; (Old Style, plastic bell)	815-81-57-1197
Herbicides, Additives, Surfactants, Wind & Safety	
Drift Control; Control WM, order by quarts, (1) quart container per unit	675-55-34-5221
Drift Control; Droplex deposition aid-drift retardant,; (1) gallon container per unit	675-55-35-1252
Anti-Foam/Defoamer – Additive; Prevent, order by quarts, (1) quart container per unit	675-55-10-0105
Herbicide; Approved Aquatic Herbicide (<i>Aquamaster</i>[®] <i>Roundup Custom</i>[®] or <i>Rodeo</i>[®]); (1)-2 1/2 gallon containers per unit	675-90-50-6704
Herbicide; <i>Escort</i>[®] <i>XP</i>; (6)-4 lb. containers per case, (1)-4 lb. container per unit	675-85-42-2388
Herbicide; <i>Landmark</i>[®] <i>XP</i>; (6)-4 lb. containers per case, (1)-4 lb. containers per unit	675-90-52-4004
Herbicide; <i>Capstone</i>[®]; (2)-2 1/2 gal containers per case, (1)-2 1/2 gal containers per unit	675-90-48-1619

Herbicide Operations

Herbicide; <i>Outrider</i> [®] ; (10)-20 oz containers per case, (1)-20 oz containers per unit	675-85-42-4954
Herbicide; <i>Pathfinder II</i> [®] ; (2)-2 ½ gal containers per case, (1)-2 ½ gal containers per unit	675-90-50-4964
Herbicide; <i>Round PROMAX</i> [®] (2)-2.5 gal containers per unit	675-55-35-8000
Herbicide; <i>Transline</i> [®] ; (2)-2 ½ gal containers per case, (1)-2 ½ gal containers per unit	675-90-50-8452
Herbicide; <i>Vista</i> [®] XRT; (2)-2 ½ gal containers per unit	675-90-50-9286
Herbicide; <i>Streamline</i> [®] ; (1)-3 lb. containers per unit	675-85-42-7833
Herbicide; <i>Target</i> [®] 6.6; (1)-2 ½ gal container per unit	675-90-50-8494
Herbicide; <i>EsplAnade</i> [®] 200 SC; (4)-1 quart containers per case, (1) 1 quart container per unit	675-90-48-2310
Surfactant; Approved, Non-ionic; spreader/activator, comes packed (1) gallon jug per unit	675-55-10-0105
Insecticide; Insecticide; Ant, Granular, 3.5 lb./Bag Kills Fire Ants	485-60-37-2111
Insecticide; Fire Ant Aerosol	485-60-15-1721
Insecticide; Rod for Fire Ant Aerosol	485-62-55-8006
Insecticide; Altosid XR [®] ; Mosquito Larvicide; 220 Briquets per case	675-40-45-0458
Eyewash Kit; Emergency; Sterile; 8 oz. Premixed	345-32-69-3107
Spill Kit; Herbicide, for sprayer truck, includes absorbent pads/coils, goggles, gloves.	485-74-04-2858
Thermometer; minimum/maximum, -30 to 120 degrees Fahrenheit with 2 degree increments	175-87-10-1050
Windmeter; Portable, Hand Held, measure wind speed from 2-66 mph. All Supply Centers.	220-87-47-3009
Nozzles & Fittings on Boom	
Adapter; brass; 3/8" FPT x 1/4" FPT	460-45-10-0651
Coupling, Reducing Bell, ½ inch x ¼ inch, FNPT, Stainless Steel	659-33-86-0606
Coupling, Stainless Steel, ¼ inch internal pipe size (IPS), Type 304.	659-33-87-0407
Diaphragm Check Valve; Nylon; 30# spring pressure;	810-95-43-8818
Double swivel brass nozzle assembly; male 1/4"; includes Spray Systems stainless steel OC08 Tips	810-95-51-0509
Double swivel brass nozzle assembly; 1/4"; without tips	810-57-55-7928
Nipple; Pipe, Brass, ¼" X Close, MPT	659-50-36-0258
Nozzle Cap; brass; 3/8" NPT	810-18-55-1150
Nozzle; Spray, Turbo Drop Style, Nozzle Only with Ceramic Inserted Air Injector, Attaches to Body 162529 & 162530	810-95-51-4063
Nozzle; Spray, Air Injection Body for 162528	810-95-51-5003
Nozzle; Single Swivel Quick Tee-Jet, ¼" FPT, Attaches to Air Injection Body-162529	810-95-51-4097
Single swivel brass nozzle assembly; male 1/4"; includes Spray Systems stainless steel 2508 Tip	810-95-51-0905
Single swivel brass nozzle assembly; male 1/4"; includes Spray Systems stainless steel 6508 Tip	810-95-51-1002
Spring, Extension, industrial, 1 inch diameter by 5 ½ inches long	060-84-80-4050
Stainless Steel Nozzle Tip; Spray Systems 2508	810-95-43-8651

Herbicide Operations

Stainless Steel Nozzle Tip; Spray Systems 6508	810-95-51-4105
Stainless Steel Nozzle Tip; Spray Systems 8008	810-95-43-8552
Stainless Steel Nozzle Tip; Spray Systems OC08	810-95-43-8529
Plastic Quick-off Fittings	
Adapter, Nylon, ¼ inch FPT x Male quick disconnect	060-60-91-0350
Adapter, Nylon, ½ inch FPT x Male quick disconnect	060-70-91-0400
Cap, Dust, ¾ inch Cam Lever Quick Disconnect	810-95-89-1008
Cap, Dust 1 inch Cam Lever Coupling, Fiberglass Reinforced	760-11-20-2108
Coupling; Hose; Nylon; ¾ inch; Hose Shank x Female Cam Lever, Quick Disconnect	060-60-91-2000
Coupling; Cam-Lock Poly; 1 inch Female x 1 inch Hose Shank	810-57-55-1400
Coupling; Cam-Lock Poly; 1 inch Male x 1 inch Hose Shank	810-57-55-1426
Coupling; Cam-Lock Poly; 1 inch Male x 1 inch MPT	810-57-55-1434
Coupling; Cam-Lock Poly; 1 ½ inch Female x 1 ½ inch Hose Shank	810-57-55-1418
Coupling; Cam-Lock Poly; 1 ½ inch Male x 1 ½ inch MPT	810-57-55-1442
Miscellaneous Truck Parts	
Agitator, plastic; FPT, heavy duty, on older models	020-46-16-0251
Agitator, plastic; MPT, heavy duty, on newer models	810-93-60-0500
Bibb, Hose ½ inch Rough Brass, Tee Handle for 30 gallon skid mount clean water tank	670-56-24-0509
Bushing; Brass, ½" FPT X ¾" MHT (Male Hose Thread), HEX	460-35-13-0759
Bushing; Brass, Reducing, ¾" MPT X ¼" FPT	659-24-19-2605
Bushing, Brass, Reducing, 1 inch MPT x ¼ inch FPT	810-57-55-0873
Bushing, Stainless Steel, Reducing, 1 inch MPT x 3/8 inch FPT	659-24-87-2602
Bushing, Stainless Steel, Reducing, 1 ½ inch MPT x 3/8 inch FPT	659-24-87-3857
Bushing, Stainless Steel, Reducing, 1 ½ inch FPT x 1 ¼ inch FPT	659-65-82-2904
Coupling, Stainless Steel, ¼ inch internal pipe size (IPS), Type 304	659-33-87-0407
Coupling, Stainless Steel, ½ inch internal pipe size (IPS), Type 304	659-33-87-0605
Coupling, Stainless Steel, ¾ inch internal pipe size (IPS), Type 304	659-33-87-0704
Coupling, Stainless Steel, 1 inch internal pipe size (IPS), Type 304	659-33-87-0803
Coupling, Stainless Steel, 1 ½ inch internal pipe size (IPS), Type 304	659-33-87-1108
ELL; Brass, 1" X 45 Degrees, FPT	659-42-17-2001
Ell, Stainless Steel, 1 inch x 45 Degrees	659-42-81-1657
Ell, Nylon, ½ inch MPT x ½ inch Hose x 90 Degrees	060-60-91-4105
Ell, Nylon, ½ inch MPT x ¾ inch Hose x 90 Degrees	460-36-46-0809
Ell, Nylon, ¾ inch MPT x ½ inch Hose x 90 Degrees	060-60-91-4360

Herbicide Operations

Ell, Nylon, 1 inch MPT x 1 inch Hose x 90 Degrees	460-36-46-1302
Ell, Stainless Steel, Street, ½ inch, 90 Degrees	659-42-81-0659
Ell, Stainless Steel, Street, 1 ½", 90 Degrees	659-42-81-2804
Flex-5 Assembly	765-99-50-0013
Handgun; pistol-grip; Green Guard	810-95-42-6508
Hose, Low Pressure, ½ inch ID x 0.75 inch OD, 300 lb. Working Pressure (Handgun Hose)	060-60-46-1008
Clamp, Hose, S.S., Size 8 (for ½ inch ID Hose)	060-33-08-0703
Hose, Low Pressure, ¾ inch ID x 1.04 inch OD, 300 lb. Working Pressure (Flex 5 and Agitator Hose)	060-60-40-4081
Clamp, Hose, S.S., Size 12 (for ¾ inch ID Hose)	060-33-20-0806
Hose, Low Pressure, 1 inch ID x 1.45 inch OD, 212 lb. Working Pressure (Pump to Manifold to Front of Truck)	060-50-46-1255
Clamp, Hose, S.S., Size 20 (for 1 inch ID Hose)	060-33-20-1408
Hose, Low Pressure, 1 ½ inch ID x 2.01 inch OD, 162 lb. Working Pressure (Pump to Manifold and Bypass Hose)	060-60-46-1800
Clamp, Hose, S.S., Size 32 (for 1 ½ inch ID Hose)	060-33-20-2307
Nipple, Pipe Brass, 3/8 inch x Close MPT	659-50-36-0357
Nipple, Pipe, Brass, ½ inch x Close, MPT	659-50-36-0456
Nipple, Pipe, Brass, ¾ inch x Close, MPT	659-50-36-0555
Nipple, Pipe, Brass, 1 ½ inch x Close, MPT	659-50-36-0902
Nipple, Hose Nylon, ½ inch MPT x ½ inch Hose	460-35-51-0604
Nipple, Hose Nylon, ¾ inch MPT x ¾ inch Hose	060-60-91-1150
Nipple, Hose Nylon, ¾ inch MPT x 1 inch Hose	460-36-46-1051
Nipple, Hose Nylon, 1 inch MPT x 1 inch Hose	060-60-91-4659
Nipple, Pipe, Stainless Steel, 1 ¼ inch x Close, MPT	659-50-69-0787
Nipple, Pipe, Stainless Steel, 1 ½ inch x Close, MPT	659-50-69-0886
Nipple, Pipe, Stainless Steel, 1 ½ inch x 1 ½ inch Hose	460-36-49-1556
Plug, Pipe, Square Head, Brass, ¾ inch MPT	659-54-30-1266
Reel Hose; W/50' x 1/2" Hose; 400 psi Working Pressure	075-46-76-0401
Reel Hose; Manual Crank, W/200 foot x ½ inch ID x 7/8 inch OD Hose (New Style)	075-57-80-5004
Tank Polyethylene; 15 Gal; Herbicide Fill Tank	830-44-58-0153
Tank Polyethylene; 25 Gal; Horizontal; Skid Mount	830-44-59-0251
Tank Polyethylene; 525 Gal; Horizontal Leg; Two Leg	830-44-60-5003
Tank Polyethylene; 1250 Gal; Horizontal Leg; Four Leg	830-44-58-1003
Tank Lid; 10-inch, Poly, Threaded for 15 Gallon Conical.	830-44-55-4653

Herbicide Operations

Tee, Nylon, 3/4 inch x 3/4 inch x 3/4 inch Hose	060-60-91-8155
Tee, Pipe, Brass, 1 inch FPT	659-85-15-1508
Tee, Pipe, Brass, 1 1/2 inch FPT	659-84-15-1301
Valve; Ball; 3/8 inch Bronze, 150 Lb.; SWP; 400 Lb.; WOG; Plastic (Drift Control)	670-70-24-0840
Valve; Ball; 1/2 inch; Bronze; 2-PC Construction; Brass Ball (Handgun Valve)	670-70-24-0279
Valve; Ball; 3/4 inch; Brass Ball; 2-PC Construction (Agitator)	670-70-24-0295
Valve; Ball; 1 1/2 inch; Bronze; Teflon Seat; 3-PC Construction	670-70-45-1405
Nozzles for Flex-5 Heads (Serviced by Veg Staff only)	
Nozzle, Spray, S.S., 0 Degree Stream Nozzle	810-95-51-1200
Nozzle, Spray, S.S., 15 Degree Spray Angle	810-95-51-4055
Nozzle, Spray, S.S., 25 Degree Spray Angle	810-95-51-1150
Nozzle, Spray, S.S., 65 Degree Spray Angle	810-95-51-0756
Vane, Guide, Fits 1/4 inch Spray Nozzle	460-35-55-8850
Parts for De-icer Units	
Adapter, Brass, 3/8 inch FPT x 1/4 inch FPT	460-45-10-0651
Adapter; PVC, Male, 1 inch MPT x Slip	659-06-78-0856
Adapter; PVC, Female, 1 1/2 inch Slip x 1 1/2 inch FPT	810-57-55-0907
Bushing; Reducing, Brass, 1 inch MPT x 1/4 inch FPT	810-57-55-0873
Bushing; Reducing, PVC, 1 1/2 inch Slip x 1 inch FPT	810-57-55-0899
Cable; Electrical, Battery End, 12 Feet	810-57-55-1152
Cable; Electrical, Harness Extension	810-57-55-1160
Cable; Electrical, Valve End, 15 Feet	810-57-55-1178
Cap; PVC, Slip 1 inch	659-27-84-0952
Component; Herbicide, (Shop Built) De-icer, (Small or Large Truck) (Complete Unit)	765-66-55-1305
Control Panel; Sprayer, For De-icer Bloom	810-57-55-5401
De-icer Kit, Consists of 8 Poly Electrical Connectors	810-57-55-1608
Hose, Low Pressure, 1 inch Green Stripe, 50 Feet in Length	060-60-40-4107
Clamp, Hose, S.S., Size 20 (for 1 inch ID Hose)	060-33-20-1408
Nipple, Hose Nylon, 1 inch MPT x 1 inch Hose	060-60-91-4659
Nipple, Pipe, Stainless Steel, 1 1/2 inch x 1 1/2 inch Hose	460-36-49-1556
Nipple, Pipe, Stainless Steel, 1 inch x Close, MPT	659-50-69-0696
Nozzle; Spray, Herbicide, 3/4 inch MPT, RA 60-140, 100 PSI	810-57-55-4909
Swivel; Double, Brass, 1/4 inch MPT Inlet x 1/4 inch MPT Outlet	810-57-55-7928
Tee, Pipe, Brass, 1 inch FPT	659-85-15-1508

Herbicide Operations

Tee; PVC, 1 inch x 1 inch x ¾ inch, Slip x Slip x FPT	659-85-80-1201
Tee; PVC, 1 inch x 1 inch x 1 inch, Slip x Slip x FPT	810-57-55-8306
Tip; Spray, Stainless Steel, ¼ inch, Solid Stream (0030G)	810-93-60-8438
Valve; Ball, 1 inch, Bronze, Teflon Seat	670-70-24-0311
Valve; Control, Directional	810-57-55-8918
Valve; Control, Pressure	810-57-55-8926
Vane; Guide, Fits ¼ inch Spray Nozzles	460-35-55-8850
Miscellaneous	
Spill Kit; Emergency	485-74-04-2858

Useful Conversion Factors

English To Metric

Multiply	By	To Get
Acres	0.404	Hectares (ha)
Acres	4046.9	Square Meters (m ²)
Cubic Yards	0.765	Cubic Meters (m ³)
Cubic Feet	28.317	Liters (L)
Cups	0.237	Liters (L)
Feet	0.305	Meters (m)
Feet per Second	1.097	Kilometers per Hour (km/h)
Gallons	3.785	Liters (L)
Gallons per Square Foot	41.132	Liters per Square Meter (L/m ²)
Gallons per Square Yard	4.527	Liters per Square Meter (L/m ²)
Gallons per Acre	9.369	Liters per Hectare (L/ha)
Inches	2.54	Centimeters (cm)
Inches	25.4	Millimeters (mm)
Miles	1.609	Kilometers (km)
Miles per Hour	1.609	Kilometers per Hour (km/h)
Ounces (mass)	28.35	Grams (g)
Ounces (fluid)	29.573	Milliliters (mL)

Useful Conversion Factors (cont.)

Metric to English

Multiply	By	To Get
Ounces (fluid) / Sq. Ft.	41.132	Liters per Square Meter (L/m ²)
Ounces (mass) / Acre	70.0	Grams per Hectare (g/ha)
Ounces (fluid) / Acre	73.0	Milliliters per Hectare (mL/ha)
Pints	0.473	Liters (L)
Pounds (mass)	0.454	Kilograms (kg)
Pounds (mass) / Gallon	0.12	Kilograms per Liter (kg/L)
Pounds (mass) / Cu. Ft.	16.018	Kilograms per Cu. Meter (kg/M ²)
Pounds (mass) / Acre	1.121	Kilograms per Hectare (kg/ha)
Pounds (mass) / Sq. Ft.	4.883	Kilograms per Sq. Meter (kg/M ²)
Pounds (force) / Sq. Inch	6.89	Kilopascals (kPa)
Pounds (force) / Sq. Ft.	47.88	Pascals (Pa)
Quarts per Acre	2.33	Liters per Hectare (L/ha)
Quarts	0.946	Liters (L)
Square Inches	6.452	Square Centimeters (cm ²)
Square Feet	0.093	Square Meters (m ²)
Square Yards	0.836	Square Meters (m ²)
Ton (2,000 Lbs.)	0.907	Megagrams (Mg)
Hectares (ha)	2.475	Acres
Square Meters (m ²)	0.000247	Acres
Cubic Meters (m ³)	1.307	Cubic Yards
Liters (L)	0.035	Cubic Feet
Liters (L)	4.219	Cups
Meters (m)	3.279	Feet
Kilometers per Hour (km/h)	0.912	Feet per Second
Liters (L)	0.264	Gallons
Liters per Square Meter (L/m ²)	0.024	Gallons per Square Foot
Liters per Square Meter (L/m ²)	0.221	Gallons per Square Yard
Liters per Hectare (L/ha)	0.107	Gallons per Acre
Centimeters (cm)	0.394	Inches
Millimeters (mm)	0.039	Inches

Herbicide Operations

Multiply	By	To Get
Kilometers (km)	0.622	Miles
Kilometers per Hour (km/h)	0.622	Miles per Hour
Grams (g)	0.035	Ounces (mass)
Milliliters (mL)	0.034	Ounces (fluid)
Grams per Square Meter (g/m²)	0.003	Ounces (mass) / Sq. Ft.
Liters per Square Meter (L/m²)	0.024	Ounces (fluid) / Sq. Ft.
Grams per Hectare (g/ha)	0.014	Ounces (mass) / Acre
Milliliters per Hectare (mL/ha)	0.014	Ounces (fluid) / Acre
Liters (L)	2.114	Pints
Kilograms (kg)	2.203	Pounds (mass)
Kilograms per Liter (kg/L)	8.333	Pounds (mass) / Gallon
Kilograms per Cu. Meter (kg/M³)	0.062	Pounds (mass) / Cu. Ft.
Kilograms per Hectare (kg/ha)	0.892	Pounds (mass) / Acre
Kilograms per Sq. Meter (kg/M²)	0.205	Pounds (mass) / Sq. Ft.
Kilopascals (kPa)	0.145	Pounds (force) / Sq. Inch
Pascals (Pa)	0.021	Pounds (force) / Sq. Ft.
Liters per Hectare (L/ha)	0.429	Quarts per Acre
Liters (L)	1.057	Quarts
Square Centimeters (cm²)	0.155	Square Inches
Square Meters (m²)	10.753	Square Feet
Square Meters (m²)	1.196	Square Yards
Megagrams (Mg)	1.103	Ton (2,000 Lbs.)

SECTION 18

18.0 RECORD BOOKS

Accurate records are vital during herbicide mixing and application activities. These records permit the monitoring of the purchase and use of herbicides.

Texas Department of Agriculture (TDA) regulations require that records be maintained for a **minimum period of 2 years from the date of application.**

IT IS VERY IMPORTANT AT THE START OF EVERY SPRAYING SEASON TO GET A NEW RECORD BOOK AND START THE YEAR OFF RIGHT.

Records also help determine the effectiveness and durability of a herbicide treatment and will help to determine when an area should be retreated. Specify any unusual conditions that may exist at the time of application, and maintain daily spray records.

Your district Vegetation Manager or the Maintenance Field Support Section Staff of the Maintenance Division can supply you with additional record books.

Examples of the record book are as follows:

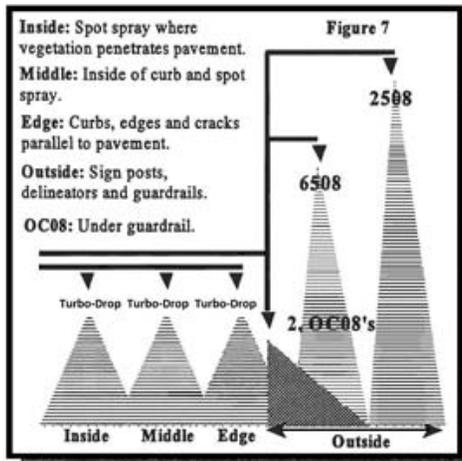


HERBICIDE RECORDS

(Revised December 2016)

State Law Requires Records be Kept for a Period of 2 Years From the Date of the Pesticide Application

Equipment Number:	
Starting Date:	
Ending Date:	
Speed Circumference Number:	



CALIBRATION HISTORY

(Turbo Drop Nozzles Should Be Calibrated Annually)
 (Flex-5 Booms are Pre-Calibrated to 25 Gallons per Acre)

Date	Nozzles Calibrated	Calibrated Rate (GPA)

MNT: _____

All applications contained in this record book are made for TxDOT AND TxDOT purposes.

Name of Applicator: Joe Snuffy

Applicator TDA License Number: 123456

Name of Licensee if Other than Applicator: _____

Mixing Records

(Revised 12/2016)

Date (MM/DD/YY)	A Herbicide (H) and Additive (A) Mixed	B E.P.A. Registration Number	C Volume From Previous Day Already Mixed in Tank (Gallons)	D Clean Water Added to Tank (Gallons)	E Calibrated Rate (GPA)	F New Sprayabl e Acres (D ÷ E)	G Herbicide Application Rate	H New Herbicide Added to Tank (F x G)	I Quantity Received from Supply	J Leftover (Non- Stock Material)
6/16/16	H: Roundup PROMAX	524-579	0	1,300	25	52	8 Oz/Ac	416 Oz.	1-U 640 Oz.	224 Oz.
	H: Escort XP	352-439					1 Oz/Ac	52 Oz.	1-U 64 Oz.	12 Oz.
	H: Outrider	524-500					1.33 Oz/Ac	69.2 Oz.	10-U 200 Oz.	130.8 Oz.
	H: Vista XRT	62719-586					10 Oz/Ac	520 Oz.	1-U 5 Gal	120 Oz.
	S:									
A: Control WM						2 Oz/100 Gal.	26 Oz.	32 Oz.	6 Oz.	
6/17/16	H: Roundup PROMAX	524-579	725	500	25	20	8 Oz/Ac	160 Oz.	224 Oz.	64 Oz.
	H: Escort XP	352-439					1 Oz/Ac	20 Oz.	1-U + 12 Oz.	56 Oz.
	H: Outrider	524-500					1.33 Oz/Ac	26.6 Oz.	130.8 Oz.	104.2 Oz.
	H: Vista XRT	62719-586					10 Oz/Ac	200 Oz.	1-U + 120 Oz.	560 Oz.
	S:									
A: Control WM						2 Oz/100 Gal.	10 Oz.	32 Oz.	22 Oz.	
6/18/16	H: Roundup PROMAX	524-579	0	500	34	14.7	3 Qts/Ac	1411 Oz.	3-U + 64 Oz	573 Oz.
	H: Landmark XP	352-645					3 Oz/Ac	44.1 Oz.	6 Lb (96 Oz)	51.9 Oz.
	H:									
	H:									
	S:									
A: Control WM						2 Oz/100 Gal.	10 Oz.	32 Oz.	22 Oz.	
6/19/16	H: Aquatic Herbicide	524-343	0	200	100	2	8 Qt/100 Gal.	4 Gal.(16Qt)	5 Gal. (20 Qt)	1 Gal.
	H:									
	H:									
	H:									
	S: Surfactant									
A: Control WM						2 Qt/100 Gal.	1 Gal. (4 Qt)	1 Gal. (4 Qt)	0	
						2 Oz/100 Gal.	4 Oz.	32 Oz.	28 Oz.	

SAMPLE

Mixing Notes: (1-U Roundup PROMAX = (2) 2.5 gal jugs, 1-U Escort XP or 640 Oz. = 4 lb. jug, 1-U Outrider = 20 Oz., 1-U Vista XRT = (2) 2 ½ Gal jugs or 640 Oz.)

Records Reviewed by: _____

Name of Applicator: Joe Snuffy

Applicator TDA License Number: 123456

Name of Licensee if Other than Applicator: _____

Application Records

(Revised 12/2016)

Date (MM/DD/YY)	K Highway Number	L Location and Time		M Target Plant Species/Site (ROW, Road, etc.)	N Weather Data			O Gal. Start of Appl.	P Total Volume Sprayed Gal.	Q Appl. Method/ Type of Equip. (See Notes Below)	R Calibrated Rate (GPA)	S Total Acres Sprayed (P ÷ R)	T Herbicide Application Rate	U Total Herbicide Sprayed (S x T)
		Start	End		Wind Direction	Wind Speed	Temp (°F)							
6/16/16	IH 100	Rt 66 10:30 am	MP 510 2:15 pm	Johnsongrass/ ROW	S	4	90	1300	575	F5	25	23	8 Oz/Ac 1 Oz/Ac 1.33 Oz/Ac 10 Oz/Ac	1.5 Gal 23 Oz. 30.6 Oz. 230 Oz.
6/17/16	IH 100	MP 510 8:30 am	RM 99 3:15 pm	Johnsongrass/ ROW	S	4	83	1225	1225	F5	25	49	8 Oz/Ac 1 Oz/Ac 1.33 Oz/Ac 10 Oz/Ac	3 Gal 49 Oz. 65.2 Oz. 490 Oz.
6/18/16	US 66	MP 103 9:15 am	MP 115 11:30 am	Bermudagrass (Complete Control)/ROAD	SE	6	85	500	500	E	34	14.7	3 Qt/Ac 3 Oz/Ac	44.1 Qts 44.1 Oz.
6/19/16	US 90	Brushy Ck 9:00 am	Brushy Ck 9:30 am	Willows & Cattails/ROW	S	8	85	200	50	H	100	.5	8 Qt/100 G 2 Qt/100 G	4 Qts. (1 Qt.)
6/19/16	SH 6	Navasota Ry 10:00 am	Navasota Ry 11:30 am	Willows & Cattails/ROW	S	9	90	150	150	H	100	1.5	8 Qt/100 G 2 Qt/100 G	12 Qts. (3 Qts.)

(Q) Application Method/Type of Equipment Used to Make the Application: Flex-5 Head/Broadcast-F5, Edge of Pavement/Turbo-Drop Nozzles: E, Handgun: H
Backpack: B, Cut Stump: CS

Application Notes:

6/16/16 At 2:15 pm, wind began gusting. Elected to stop spraying for the day.
6/17/16 Noticed what appeared to be herbicide application under TP&E transmission lines, performed by aerial applications which had drifted onto the right-of-way near MP 513. Fruit trees in nearby private property appeared to be affected as the foliage was yellowish and about 1/2 of the leaves had fallen off.
6/18/16 Sprayed the east side of US 66 in Big Sky County.



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6/20/16	H: Escort XP	352-439	0	1000	25	40	1 Oz/Ac	40 Oz (2.5 lb)	1-U 4 lb	24 Oz			
	H:												
	H:												
	H:												
	S: Surfactant												
A: Control WM						1 Qt/100 Gal	2.5 Gals	3 Gals	.5 Gals				
6/23/16	H: Pathfinder II	62719-176	Ready To Use	None used, (RTU)	2.5	1	2.5 Gal/Ac	2.5 Gals	1-U 2.5 Gal	0			
	H:												
	H:												
	H:												
	S:												
A:													
6/24/16	H: Capstone	62719-572	0	500	25	20	6 Pt/Ac	120 Pt = 15 Gal	6-U 15 Gal	0			
	H: Vista XRT	62719-586											
	H:												
	H:												
	S: Surfactant										2 Qt/100 Gal	10 Qt	3 Gal
A: Control WM						2 Oz/100 Gal	10 Oz	12 Oz	2 Oz				

SAMPLE

Mixing Notes: (1-U Pathfinder II = 2 ½ Gal jug, 1-U Capstone = 2 ½ Gal jug, 1-U Vista XRT = (2) 2 ½ Gal jugs)
 6/20/16 Drift Control was added at the rate of 2 fluid ounces per 100 gallons of water.
 6/23/16 Pathfinder II is a Ready-To-Use product and the application was made with a 3 gallon pump-up sprayer.
 6/24/16 Drift Control was added at the rate of 2 fluid ounces per 100 gallons of water.



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Application Records

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		Start	End		Wind Direction	Wind Speed	Temp (°F)							
6/20/16	IH 20	MP 150 9:00 am	MP 175 3:00 pm	Western Bitterweed/ROW	N	5	88	1000	1000	F5	25	40	1 Oz/Ac	40 Oz
													1 Qt/100 Gals	2.5 Gals
6/23/16	SH 83	MP 56 9:30 am	MP 67 2:30 pm	Mesquite/ROW	S	4	85	2.5	2.5 Gals	B	2.5	1	2.5 Gal/Ac	2.5 Gals
6/24/16	FM 555	MP 66 8:30 am	MP 134 4:00 pm	Liveoak, Hackberry (Chemical Pruning)/ROW	W	5	83	500	500	F5	25	20	6 Pt/Ac	15 Gal
													10 Oz	200 Oz
													2 Qt/100 Gal	10 Qt

SAMPLE

(Q) Application Method/Type of Equipment Used to Make the Application: Flex-5 Head/Broadcast-F5, Edge of Pavement/Turbo-Drop Nozzles: E, Handgun: H Backpack: B, Cut Stump: CS

Application Notes:
 6/20/16: Western Bitterweed was heavy in patches along the Interstate on flat areas lacking natural vegetation.
 6/23/16: Mesquite treated was from resprouts from prior treatments and areas treated measured about one acre.
 6/24/16: Trees being side trimmed along with hackberries and undergrowth were chemically pruned on the right-of-way using the herbicides Milestone VM Plus and Vista XRT.



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H: H: H: H: S: A:										
H: H: H: H: S: A:										
H: H: H: H: S: A:										

Mixing Notes:



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Application Records

(Revised 12/2016)

Date (MM/DD/YY)	K Highway Number	L Location and Time		M Target Plant Species/Site (ROW, Road, etc.)	N Weather Data			O Gal. Start of Appl.	P Total Volume Sprayed Gal.	Q Appl. Method/ Type of Equip. (See Notes Below)	R Calibrated Rate (GPA)	S Total Acres Sprayed (P ÷ R)	T Herbicide Application Rate	U Total Herbicide Sprayed (S x T)
		Start	End		Wind Direction	Wind Speed	Temp (°F)							

(Q) Application Method/Type of Equipment Used to Make the Application: Flex-5 Head/Broadcast-f5, Edge of Pavement/Turbo-Drop Nozzles: E, Handgun: H
 Backpack: B, Cut Stump: CS
 Application Notes:



Records Reviewed by: _____

Remember!

- Maintain Accurate Records for 2 Years from date of Application
- Do your Records As You Go (Don't Wait)
- Maintain Records on ALL Pesticide Applications including:
 - Stockpiles
 - Rest Areas
 - Signal Boxes
 - Maintenance Office



Records can be Your BEST FRIEND!