



650 Series Rotary Sprinkler

Installation and Service Instructions

Introduction

The 650 Series Rotary Sprinkler is designed for irrigation of large turf areas such as golf courses, parks, recreational fields and school grounds.

Manufactured from durable, high strength engineering plastic and stainless steel components, the 650 sprinkler incorporates many innovative and time proven features for lasting, maintenance-free operation. Some of these features are listed below:

Specifications

- Radius: 56 ft. – 86 ft. (17,1 m – 26,2 m)
- Flow Rate:
 - 13.0 – 43.7 GPM
 - 49,2 – 165,4 l/mn
 - 3,0 – 9,9 m³/hr
- Arc: See *Ordering Information* on page 2.
- Models:
 - Normally Open Valve-In-Head
 - Check-O-Matic
 - Electric Valve-In-Head
 - Normally Closed Valve-In-Head
- Maximum Pressure:
 - All Models - 150 PSI (10,5 kg/cm²) (1034,5 kPa)
- Body Height: 11 in. (279,0 mm)
- Pop-Up Height: 0.75 in. (19,1 mm)
- Pop-Up to Nozzle: 0.5 in. (12,7 mm)
- 1.5 in. NPT or BSP Female Thread Inlet
- Solenoid:
 - 24 VAC, 50/60 Hz
 - Inrush Current: 50 Hz, 0.47 Amps (11.3 VA)
60 Hz, 0.40 Amps (9.6 VA)
 - Holding Current: 50 Hz, 0.32 Amps (7.7 VA)
60 Hz, 0.30 Amps (7.2 VA)
- Manual Control: On-Off-Auto (Electric & Normally Closed Models)
- Check-O-Matic model checks up to 37 ft. (11,3 m) of elevation.

Features

- **Positive Spring Retraction** - Pulls nozzle and cap down out of the way of people and turf maintenance equipment.
- **Six Nozzle Sizes** - Multiple nozzle sizes provide 13.0 – 43.7 GPM (49,2 – 165,4 l/mn) flow and produce watering radii from 56 – 86 ft. (17,1 - 26,2 m).
- **Long Life Gear Drive** - Rotation drive gears are vacuum-packed with grease and isolated from water stream for long, trouble-free life.
- **Valve-In-Head Models** - Permits head-by-head control to customize turf watering for various topography and soil conditions. Multi-cycle for wind or runoff problems, frost control and dew removal without low-head drainage. Available for hydraulic normally open, normally closed or 24 Volt electric systems
- **Sprinkler Operating Mode** - Electric or normally closed valve-in-head models have three modes of operation; AUTO, ON and OFF. Mode is set using a selector tool inserted through the sprinkler body flange.
- **Built-in Check Valve** - Check-O-Matic sprinklers utilize a check valve in the sprinkler base to prevent seepage from low area heads after valve closure. Check valve will hold up to 37 ft. (11,3 m) of elevation differential.
- **Two-Speed/180° Models** - For more even precipitation where only a selected area is covered by an overlap, as is often found on greens. Runs at half speed on the half circle where there is no overlap.
- **Two-Speed/60-120° Models** - For more even precipitation over area covered by single-row fairway configuration. Runs at half speed where there is no overlap.



Model 654-06-XXX



Model 654-01-XX



Model 654-02-XX

Ordering Information

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Arc	Body	Nozzle	Pressure Regulation*
651 = 90°, Quarter Circle	01 = NPT, NO Valve-In-Head	54	5 = 50 PSI
652 = 180°, Half Circle	02 = NPT, Check-O-Matic	55	6 = 60 PSI
654 = 360°, Full Circle	06 = NPT, Electric Valve-In-Head	56	8 = 80 PSI
655 = Adj. Part Circle (45-315°)	08 = NPT, NC Valve-In-Head	57	1 = 100 PSI
656 = Full Circle, 2-Speed (60°-120°)	51 = BSP, NO Valve-In-Head	58	
658 = Full Circle, 2-Speed (180°-180°)	52 = BSP, Check-O-Matic	59	
	56 = BSP, Electric Valve-In-Head		
	58 = BSP, NC Valve-In-Head		

* Pressure Regulation available on Electric & NC VIH models only.

Conversion Information

- All gallons per minute shown are U.S.
- To convert to Imperial gallons per minute, multiply by .833.
- To convert to liters per minute, multiply by 3.78.
- To convert pounds per square inch (PSI) to atmospheres, divide by 14.7.
- To convert pounds per square inch (PSI) to kilograms per square centimeter (kg/cm²) divide by 14.22.
- To convert feet to meters, divide by 3.28.
- To convert inches to millimeters, multiply by 25.4.

Performance Chart

BASE PRES.	NOZZLE SET 54		NOZZLE SET 55		NOZZLE SET 56		NOZZLE SET 57		NOZZLE SET 58		NOZZLE SET 59	
PSI	Rad	GPM	Rad	GPM	Rad	GPM	Rad	GPM	Rad	GPM	Rad	GPM
50	56	13.0	61	16.4	64	17.8	65	22.4	66	24.7	67	28.7
55	56	13.6	62	17.2	65	18.7	67	23.6	68	25.8	71	30.7
60	57	14.2	62	18.0	67	19.6	70	25.1	71	26.9	76	33.7
65	57	14.8	63	18.7	68	20.4	71	26.1	73	28.1	78	34.9
70	58	15.4	64	19.4	69	21.1	72	27.0	75	29.7	80	36.5
75	58	15.9	64	20.0	70	21.9	74	27.9	76	30.5	81	37.5
80	59	16.4	65	20.7	71	22.6	75	28.8	78	31.7	82	38.8
85	60	17.0	66	21.3	72	23.6	76	29.6	79	32.6	83	40.0
90	60	17.5	68	21.9	74	24.5	77	30.6	80	33.5	84	41.7
95	61	18.1	69	22.5	75	25.5	78	31.3	81	34.4	85	42.5
100	61	18.6	70	23.1	76	26.4	79	32.1	82	35.3	86	43.7

Rad = feet GPM = gallons per minute = Pressure regulation = Nozzles not recommended at this pressure

Spacing

Wind Speed	% of Diameter
Square	
No Wind	55%
4 m.p.h.	50%
8 m.p.h.	45%
Triangular	
No Wind	60%
4 m.p.h.	55%
8 m.p.h.	50%
Single Row	
No Wind	50%
4 m.p.h.	50%
8 m.p.h.	45%

Installation Procedure

To assure maximum performance from your 650 Series Rotary Sprinklers, read these instructions completely prior to installing or servicing the sprinkler.

Construct Swing Joints

1. Construct or provide triple swing joints for each sprinkler as shown in Figure 1.

Note: On sites where the possibility of heavy equipment rolling over a sprinkler exists, the swing joint will flex preventing damage to the lateral or main lines. On a new installation in raw ground where the sprinklers are to be initially installed above the finished grade and lowered when new turf is established, the swing joint allows sprinkler repositioning without changing risers. This is a common and practical procedure which eliminates the problem of dirt being accidentally introduced into the lateral lines when a riser is changed.

2. Flush lines thoroughly prior to installing sprinkler.
3. Apply Teflon™ tape on riser threads. Install sprinkler to riser and tighten.

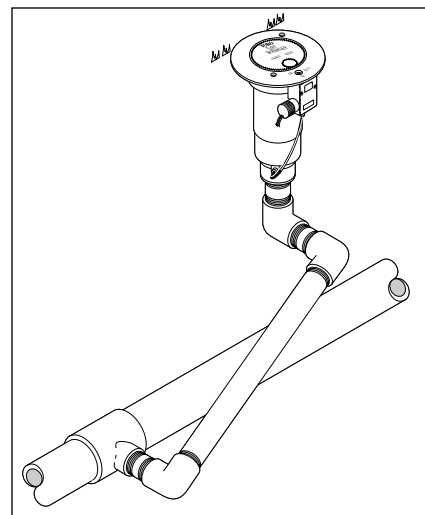


Figure 1
Triple Swing Joints

CAUTION

Use only Teflon tape on riser threads. Use of pipe dope or other types of sealing compounds can cause deterioration of sprinkler body threads.

Note: Part circle models (651 and 652) only – Lift nozzle cap to view green or blue dot on top of drive assembly. Adjust sprinkler body on riser to align colored dot with LEFT SIDE of watering area.

Note: See alignment information of two speed models (656 and 658) on page 5.

Connecting Electric Control Wires

1. Route control wires to sprinkler location(s). Provide enough extra wire at sprinkler to allow for movement of sprinkler without straining wire connections. One common wire and station wire is required for each sprinkler. See Wire Sizing Chart, **Table 1** for proper application.
2. Attach control wires to solenoid leads using an approved waterproof splicing method.

CAUTION

All wires must be waterproofed to prevent short circuit to ground and subsequent controller damage.

Connecting Hydraulic Control Tubing

1. Route control tubing from controller to sprinkler location(s).

Note: Leave an 18 inch (45,7 cm) service loop of tubing at each sprinkler to facilitate movement of sprinkler and service operations. Tubing runs in excess of 1,000 feet (304,8 m) are not advisable due to delayed response time. The controller for hydraulic valve-in-head systems should never be located more than 25 feet (7,6 m) below or more than 70 feet (21,3 m) higher than the valves. Although there is no limit to the amount of hydraulic valve-in-head sprinklers controlled by one control station, practical experience suggests the maximum number of heads normally used is five.

2. Flush tubing thoroughly to remove all air and debris.
3. Remove tube retainer and poly cap from tubing adapter at base of sprinkler.
4. Slide tube retainer over control tubing and attach tubing to adapter. Slide tube retainer over adapter area to secure tubing.

System Start-Up

The following is a recommended procedure that will protect system components during system start-up. The procedure is based on a velocity fill rate of less than 2 ft. (0,6 m) per second. See **Table 2** on page 4.



WARNING

TO PREVENT PERSONAL INJURY, DO NOT STAND DIRECTLY OVER ANY COMMERCIAL OR LARGE TURF HEAD DURING SYSTEM START-UP PROCEDURE.

1. Use jockey pump only to fill system at velocity fill rate of less than 2 ft. (0,6 m) per second.
2. Use quick coupler keys at all tees and greens with quick coupler valves to bleed air from system lines during filling process. Do not compress air and then relieve, bleed air while filling system.
3. After water has filled all lines and all air is removed, remove quick coupler keys.

CAUTION

Failure to comply with recommended fill rate will increase line pressure resulting in a water hammer effect that could damage sprinklers.

Table 1 - Wire Sizing Chart

Maximum Allowable Length in Feet From Controller to VIH Sprinklers.

VOLTAGE AT CONTROLLER	WIRE SIZE		NUMBER OF VALVES			
	CONTROL	COMMON	1	2	3	4
110 V.A.C.	14	14	2348	1012	549	353
110 V.A.C.	14	12	2890	1239	673	433
110 V.A.C.	14	10	3378	1448	786	505
110 V.A.C.	12	12	3759	1604	873	561
110 V.A.C.	12	10	4591	1973	1071	688
110 V.A.C.	12	8	5411	2328	1263	812
110 V.A.C.	10	10	5945	2555	1387	892
115 V.A.C.	14	14	2765	1309	846	549
115 V.A.C.	14	12	3393	1608	1039	673
115 V.A.C.	14	10	3962	1877	1213	783
115 V.A.C.	12	12	4394	2082	1346	872
115 V.A.C.	12	10	5397	2557	1652	1071
115 V.A.C.	12	8	6364	3018	1949	1263
115 V.A.C.	10	10	6986	3311	2140	1387


Chart based on the following: Transformer - 115 V.A.C. - 124 V.A.C., 45 VA
Coil Assy. - 24 V.A.C., 60 Hz
Holding - .21 Amps
In Rush - .42 Amps

Table 2. Recommended System Fill Rate

Pipe Size		Flow		Velocity		Pipe Size		Flow		Velocity	
in.	mm	GPM	LPM	ft/sec	m/sec	in.	mm	GPM	LPM	ft/sec	m/sec
1/2	12,7	2	7,6	1.60	0,49	3	76,2	45	170,3	1.86	0,57
3/4	19,1	3	11,4	1.92	0,59	4	101,6	75	283,9	1.87	0,57
1	25,4	5	18,9	1.50	0,46	6	152,4	150	567,8	1.73	0,53
1-1/4	31,3	10	37,9	1.86	0,57	8	203,2	250	946,3	1.70	0,52
1-1/2	38,1	10	37,9	1.41	0,43	10	254,0	450	1703,0	1.97	0,60
2	50,8	20	75,7	1.80	0,55	12	304,8	500	1893,0	1.55	0,47

Arc Adjusting - Model 655

The 655 Part Circle Sprinkler can be adjusted to produce a watering arc of 45° minimum to 315° maximum. For best results, the arc of the part circle 655 head should be adjusted while the sprinkler is in operation. Arc adjustments, whether increasing or decreasing, always result in a change to the right travel limit. Looking down on top of sprinkler from behind nozzles, the left travel is stationary and will change only if the drive assembly is rotated in the body or if the sprinkler is rotated on the riser.



WARNING

DUE TO HIGH OPERATING PRESSURE, NEVER STAND OR LEAN DIRECTLY OVER SPRINKLER OR COME IN CONTACT WITH SPRAY WHEN ACTUATING SPRINKLER MANUALLY OR AUTOMATICALLY. PRIOR TO ACTUATION OF SPRINKLER, USE A SLOT HEAD SCREWDRIVER TO LIFT CAP TO OBSERVE DIRECTION OF NOZZLE. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY.

- Grasp the cap with nozzle assembly and rotate it counterclockwise to left travel limit.
NOTE: Cap and nozzle assembly should rotate with little resistance. If resistance is felt, rotate nozzle assembly clockwise to right travel limit first and then back to the left (this will trip the reversing mechanism).
- Check alignment of nozzle with left edge of desired watering area. If an alignment correction is required rotate drive assembly in body or rotate body on riser.
- To increase arc, see **Figure 2**. To decrease arc, see **Figure 3**.

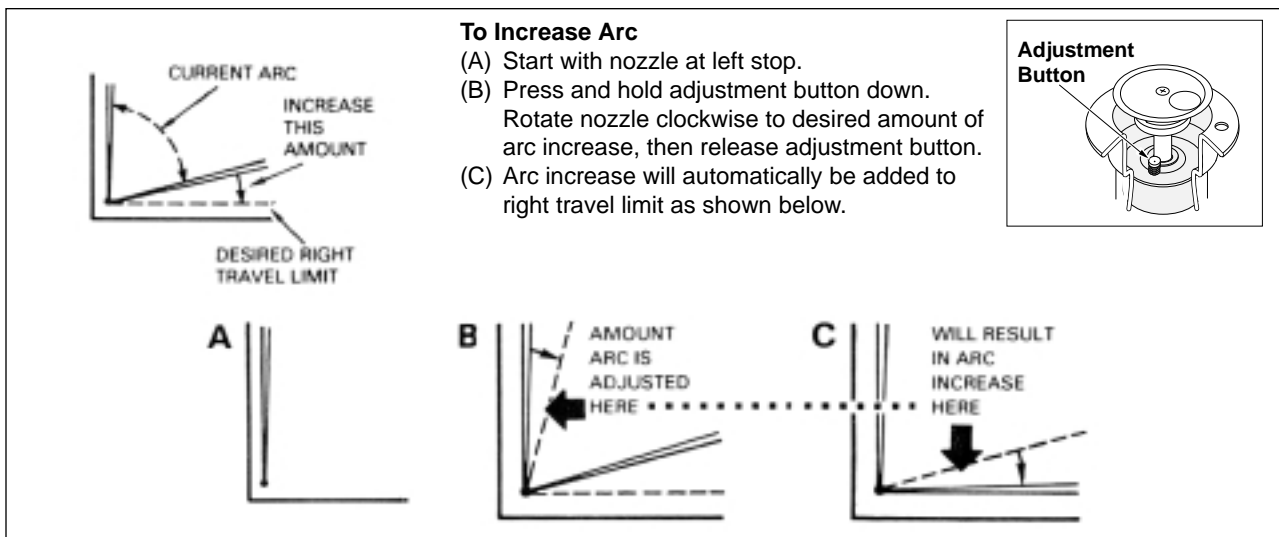


Figure 2 - Increase Sprinkler Arc

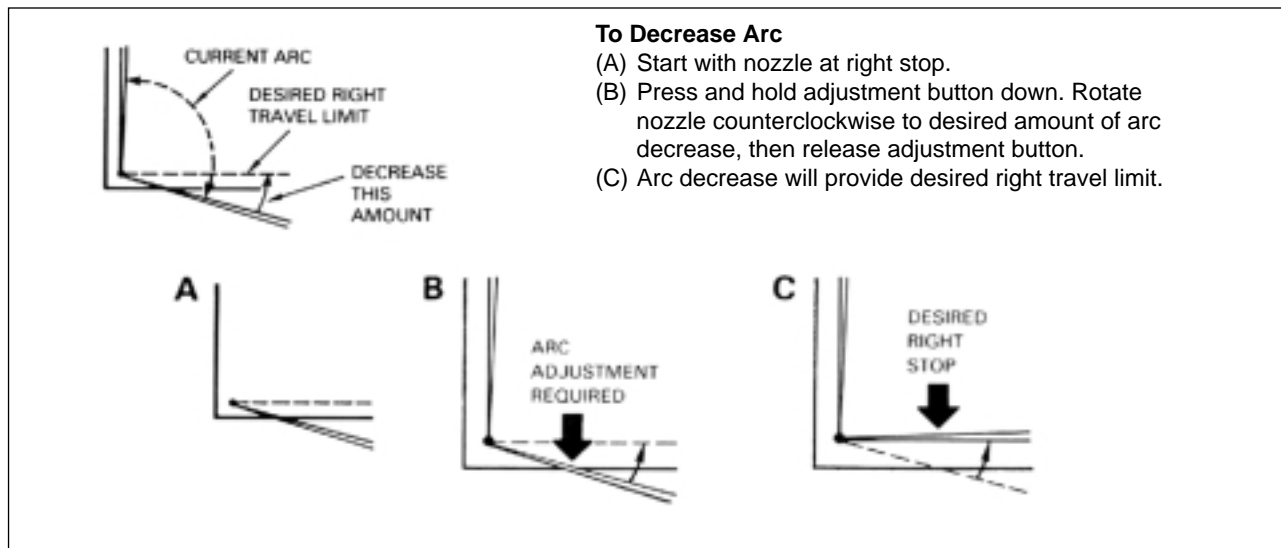


Figure 3 - Decrease Sprinkler Arc

Two-Speed Sprinkler Alignment (Models 656 & 658)

The 656 sprinkler nozzle rotates alternately between 120° of arc at regular speed and 60° of arc at half speed. The 658 sprinkler rotates for 180° of arc at regular speed and 180° of arc at half speed. These sprinkler models are used primarily on golf course fairways and greens and utilize a two-speed drive assembly to provide balanced water distribution throughout a coverage area which has some non-overlap segments. For proper results, the half speed arc portion(s) of the sprinkler pattern must be oriented with the non-overlap watering areas. Therefore, correct alignment of these models is essential during installation. See Figure 4 below for alignment procedure.

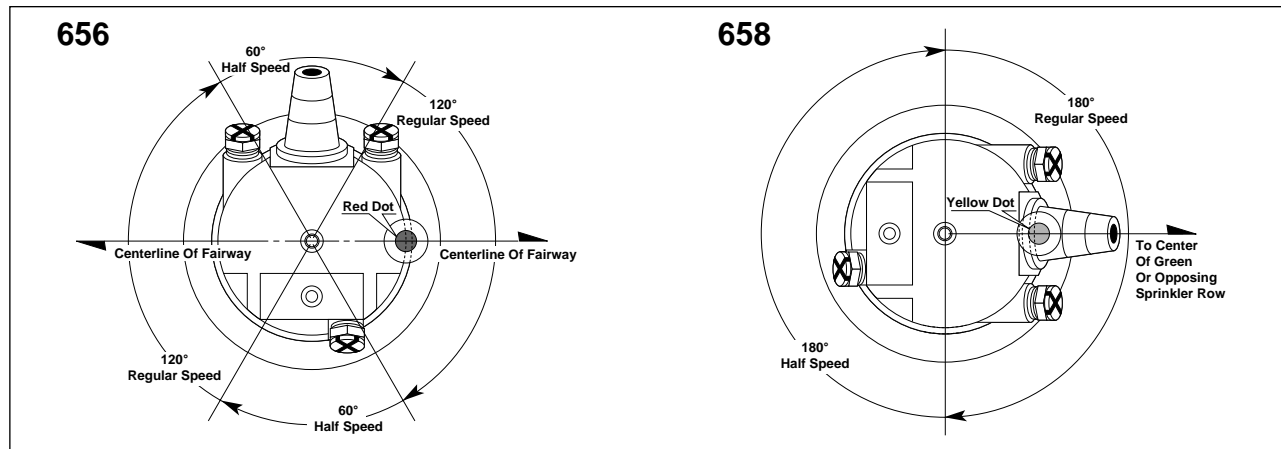


Figure 4 - Alignment of Drive Assembly to Turf Coverage

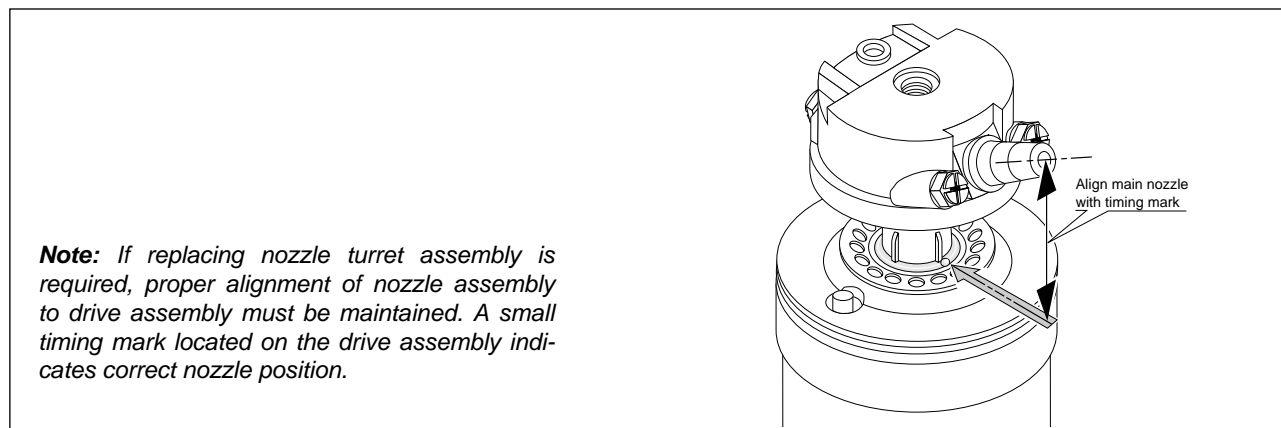


Figure 5 - Nozzle Alignment

Rotation Speed Adjustment

The rotation speed of the 650 head can be adjusted to compensate for system variables such as: water pressure, temperature or possible drive assembly variations. Changing rotation speed is accomplished by changing stators.

NOTE: Changing stators will directly affect the spray pattern radius. Changing to a smaller number stator will increase the rotation speed and decrease the spray pattern radius. Likewise, changing to a larger number stator will decrease the rotation speed and increase the spray pattern radius. A stator change is not available to decrease rotation speed of Model 65X-XX-58.

Table 3 below indicates the nozzle size and the stator used for standard rotation speed and the stator used to increase or decrease rotation.

Table 3 - Rotation Speed/Stator Change

Nozzle Number	Standard Stator and Part No.		To Increase Rotation Speed Use Stator #	To Decrease Rotation Speed Use Stator #
32	32	9-5185	—	33
33	33	35-8909	32	34
54	54	9-5188	32	55
55	56/55	9-5186	54	57
56	55/56	9-5186	54	57
57	57	9-5190	56	58
58	58	9-5192	57	59
59	59	9-5187	58	—

CAUTION

Any stator changes other than indicated in Table 3 may produce unsatisfactory performance and are not recommended.

Pilot Valve Operation

The main function of the pilot valve is to control the operation of the main valve located in the base of the sprinkler body. The main valve is operated by the release of water metered through the pilot valve when it is activated either manually or automatically by the 24 VAC coil assembly.

Another important function of the pilot valve is to regulate the water pressure to the sprinkler nozzle. Pressure regulation compensates for large variations within the system and maintains a constant pressure for optimum sprinkler operation. The 650 series pilot valve is factory set to regulate one of four pressure levels ranging from 50–100 PSI (3,5 – 7,0 kg/cm²).

Note: Prior to August 1988, an adjustable pilot valve assembly (PN 35-7547) was used. Although factory set at 50, 80 or 100 PSI regulating pressure, the pilot valve is adjustable from 40 to 120 PSI (2,81 – 8,44 kg/cm²) to compensate for various field conditions. See Adjusting Pressure Regulation page 13 for more information.

Sprinkler operation mode is set using a Toro Selector Tool (P/N 995-15) inserted through the body flange onto the pilot valve D-shaped selector-cam. The "AUTO" mode permits automatic operation from the system controller. The "ON" mode opens the main valve for manual operation and "OFF" mode prevents the main valve from opening.

WARNING



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System Troubleshooting

Pilot Valve

Possible equipment failures with causes and corrective action are listed below.

PROBLEM	POSSIBLE CAUSE – CORRECTIVE ACTION
1. Sprinkler will not turn on	<p>(a) No 24 VAC to coil assembly. – <i>Measure voltage with Digital Volt Meter (DVM). Check wiring and controller program. – Refer to Controller Operating Instructions.</i></p> <p>(b) Selector cam in "OFF" position. – <i>Set to "AUTO" position.</i></p> <p>(c) Debris in pilot valve assembly. – <i>Disassemble and remove all debris. (See Servicing Pilot Valve pages 12-13.)</i></p>
2. Sprinkler will not shut off	<p>(a) Constant 24 VAC from controller. – <i>Check for voltage using a DVM. If voltage is present, disconnect wire. If sprinkler closes, service controller. Refer to Controller Service Manual.</i></p> <p>(b) Selector cam in manual "ON" position. – <i>Set to "AUTO" or "OFF" position.</i></p> <p>(c) Debris in pilot valve assembly. – <i>Disassemble and remove all debris. (See Servicing Pilot Valve pages 12-13.)</i></p>

Sprinklers

PROBLEM	POSSIBLE CAUSE – CORRECTIVE ACTION
1. Sprinkler won't rotate	<p>(a) Stator too large for nozzle. – <i>Use proper stator.</i></p> <p>(b) Debris wedged between stator and turbine. – <i>Remove obstruction.</i></p> <p>(c) Gear box assembly defective. – <i>Replace gear box assembly.</i></p>
2. Head sticks up	<p>(a) Dirt in riser assembly. – <i>Flush out. (See Flushing Procedure page 12.)</i></p> <p>(b) Damaged riser. – <i>Replace drive assembly.</i></p>
3. Poor distribution pattern	<p>(a) Nozzle plugged with debris. – <i>Clean or replace nozzle.</i></p> <p>(b) Nozzle orifice/stream straightener damaged. – <i>Replace nozzle.</i></p> <p>(c) Low operating pressure. – <i>Determine why system overloaded and correct.</i></p> <p>(d) Head misaligned during installation (2-speed only). – <i>Realign head properly, see Alignment Procedures page 5.</i></p>

System Troubleshooting

Sprinklers (continued)

PROBLEM	POSSIBLE CAUSE – CORRECTIVE ACTION
4. Valve won't close (Hyd. Normally Open 65X-01-XX)	<ul style="list-style-type: none">(a) Leak in control tubing. – <i>Isolate and repair.</i>(b) Pilot valve leak in controller – <i>Confirm by observing constant dripping from discharge line of controller. Refer to Controller Service Manual.</i>(c) Foreign object keeping valve from seating. – <i>Remove, clean and check valve for damage. Replace if necessary.</i>(d) Damaged piston seal or piston assembly. – <i>Replace valve assembly.</i>(e) Valve not properly communicated to tube in body. – <i>Reassemble if necessary.</i>
Valve won't close (Electric 65X-06-XXX)	<ul style="list-style-type: none">(a) Leak in pilot valve assembly. – <i>Replace pilot valve assembly.</i>(b) Bent push rod. – <i>Replace push rod.</i>(c) Plugged supply screen on piston. – <i>Clean or replace screen.</i>(d) Manual control selector on pilot valve assembly turned to "ON" position. – <i>Turn to "AUTO" position.</i>(e) Pilot Valve solenoid inoperative. – <i>Remove and replace.</i>
Valve won't close (Hyd. Normally Closed 65X-08-XXX)	<ul style="list-style-type: none">(a) Debris in or around valve assembly preventing complete closure. – <i>Remove and clean valve assembly and valve seat.</i>(b) Damaged valve piston assembly and/or cylinder. – <i>Remove and replace parts as necessary.</i>(c) Valve cylinder misaligned with sprinkler body communication tube. – <i>Remove valve assembly and install correctly.</i>(d) Elevation differential between sprinkler and controller exceeds tolerance. – <i>Check elevation differential. Tolerance specification: 0 – 75 ft. (23 m).</i>(e) Restriction in controller discharge line. – <i>Inspect and clean.</i>
5. Valve won't open	<ul style="list-style-type: none">(a) Plugged controller discharge line or discharge port in pilot valve. – <i>Verify by checking for discharge at discharge line when station is activated - If no discharge, refer to Controller Service Manual.</i>(b) Water supply to head closed off. – <i>Determine if closure is shut-off valve or blockage and correct.</i>
Valve won't open (Hyd. Normally Closed 65X-08-XXX)	<ul style="list-style-type: none">(a) Insufficient pressure in controller supply line and/or sprinkler control tube. – <i>Check pressure. Tolerance specification: 40 – 150 PSI (2,8 – 10,5 kg/cm²)</i>(b) Restriction in sprinkler body communication tube. – <i>Remove valve assembly.</i> – <i>Inspect and clean communication tube.</i>(c) Pilot valve hydraulic adapter inoperative. – <i>Remove and replace.</i>

System Troubleshooting

Sprinklers (continued)

PROBLEM	POSSIBLE CAUSE – CORRECTIVE ACTION
6. Valve won't open (Electric 65X-06-XXX) and (Hyd. Normally Closed 65X-08-XXX)	<ul style="list-style-type: none">(a) Control (field) wires severed. – <i>Isolate and repair.</i>(b) Defective solenoid. – <i>Replace solenoid.</i>(c) No power to controller. – <i>Establish controller power.</i>(d) No power from controller to solenoid. – <i>Check for blown fuse and replace.</i>(e) Bent push rod. – <i>Replace push rod (P/N 9-1668).</i>(f) Manual control selector on pilot valve assembly turned to "OFF" position. – <i>Turn to "AUTO" position.</i>(g) No supply from main valve and piston. – <i>Remove supply tube from supply port. If no supply, repair valve and piston assembly.</i>(h) Pilot Valve solenoid inoperative. – <i>Remove and replace.</i>
7. Sprinkler Weeping (Slow leak in valve)	<ul style="list-style-type: none">(a) Damaged or blocked valve seat. – <i>Remove blockage and, if necessary, replace valve assembly.</i>(b) Damaged piston seal or piston assembly. – <i>Replace valve assembly.</i>(c) Low pressure on supply line on hydraulic Normally Open sprinklers. – <i>Check for low pressure reason and correct.</i>(d) Elevation of Normally Closed sprinklers exceeds 75 ft. (23 m) differential.
8. Several valves on different stations fail to close (Hydraulic 65X-01-XX)	<ul style="list-style-type: none">(a) Control tubing leak which lowers supply pressure to other stations. – <i>Turn controller from station to station until a station is reached where only valves on that station stay open. The leak would be in the tubing on that station - Isolate and repair.</i>(b) Leak in supply line to controller. – <i>Verify by checking pressure in all control lines</i> – <i>Place pressure gauge on discharge tube to check for station with low PSI.</i>(c) Leak in controller pilot valve. – <i>Verify by constant discharge on controller. Refer to Controller Service Manual.</i>(d) Plugged supply line filter. – <i>Replace filter if more than 3 PSI (0,21 kg/cm²) differential exists.</i>
9. Head adjusts backward	<ul style="list-style-type: none">(a) Head improperly adjusted. – <i>Turn nozzle base as far right as it will go, depress plunger and move nozzle base as far to the left as possible to correct alignment of adjustment tabs.</i>
10. Head loses alignment	<ul style="list-style-type: none">(a) Debris holding adjustment plunger down. – <i>Clear debris from bowl of head.</i>(b) Defective drive assembly. – <i>Replace drive assembly.</i>
11. Head stalls while adjustment is made	<ul style="list-style-type: none">(a) Improper nozzle/stator match. – <i>Correct by replacing nozzle or stator with proper size.</i>(b) Water pressure sub-standard. – <i>Correct deficiency.</i>

Servicing Procedures

Introduction

The 650 Series rotary sprinkler is designed to provide the user trouble-free operation for many years without scheduled maintenance. Should it become necessary to disassemble the sprinkler to correct a malfunction or replace a component, all internal parts of the sprinkler are accessible from the top. Refer to the Troubleshooting Procedure in this manual in the event of a malfunction. Some special tools are required for disassembly and/or maintenance of the sprinkler and are available from your Toro dealer. See **Table 4** below.

Table 4

Tool Part Number	Nomenclature	Tool Part Number	Nomenclature
995-06	Drive Extraction Tool	995-16	Riser Pliers
995-07	Snap Ring Pliers	995-31	Hose Adapter
995-09	Valve Removal Tool	995-49	Pressure Gauge
995-10	Valve Insertion Tool	995-50	Pitot Tube
995-15	Selector Tool (Flag Key)		

WARNING



TO PREVENT POSSIBLE INJURY DURING SPRINKLER SERVICING PROCEDURES, CONFIRM THE FOLLOWING CONDITIONS EXIST PRIOR TO STARTING.

- A. WATER SUPPLY TO SPRINKLER IS SHUT OFF AT SOURCE.**
- B. SYSTEM PRESSURE IS BLED FROM SYSTEM, INCLUDING CONTROL TUBES.**
- C. A.C. POWER IS DISCONNECTED AT SOURCE**

Servicing Nozzles and Drive Assembly

Note: Refer to the Parts Breakout, **Figure 12** during service procedures.

1. Remove cap plug (1) (if rubber cover is installed) using small screwdriver.
2. Remove cap screw (4) and cap (5).
3. Remove snap ring (6) from body (20). Use snap ring pliers (P/N 995-07) to pull snap ring out of body groove.
4. Screw drive extraction tool (P/N 995-06) into nozzle assembly (7). Applying even force, pull nozzle/drive assembly out of body (20).

Note: O-ring (16) will cause resistance when removing drive assembly

5. To remove nozzle assembly from drive assembly (17):
 - a. Disconnect nozzle retraction spring (9) from spring collar (14).
 - b. Using Riser Pliers (P/N 995-16), hold riser and turn nozzle assembly counterclockwise to remove from riser.
 - c. Remove main nozzle (10) from nozzle assembly by inserting thin blade screwdriver behind nozzle to loosen nozzle, then pull nozzle straight out.

Note: If difficulty is encountered removing nozzle, use needle nose pliers, grasp outer flange of nozzle and pull nozzle from nozzle assembly. Use care not to mar or distort nozzle.

6. Carefully separate screen (19) from stator (18).
7. To remove stator, insert a slot head screwdriver or knife blade between stator and base of drive assembly and pry off.
8. Remove o-ring seal (16) from drive assembly if necessary.

Valve Removal and Replacement



WARNING

POSITIVELY SHUT OFF WATER SUPPLY AT SOURCE PRIOR TO DISASSEMBLING SPRINKLER. BLEED ALL PRESSURE FROM SYSTEM INCLUDING CONTROL TUBES. FAILURE TO DEPRESSURIZE SYSTEM PRIOR TO SNAP RING REMOVAL COULD CAUSE VALVE MECHANISM TO EJECT FROM SPRINKLER BODY UNDER PRESSURE RESULTING IN POSSIBLE SERIOUS INJURY TO PERSONNEL.

1. To remove valve assembly, squeeze ears of snap ring together with snap ring pliers and remove snap ring from sprinkler body. (See **Figure 6**).

CAUTION

If snap ring is difficult to remove, there may be residual water pressure in the system. Recheck the water supply to insure it is turned off and all pressure has been totally eliminated before removing the snap ring and valve.

2. Use valve removal tool (P/N 995-09) to remove valve assembly from base of sprinkler body. Valve Removal Tool is inserted into sprinkler body and pushed through valve ribs to the underside of valve. A slight twist will lock tool to valve enabling removal by pulling straight up and out. (See **Figure 7**).

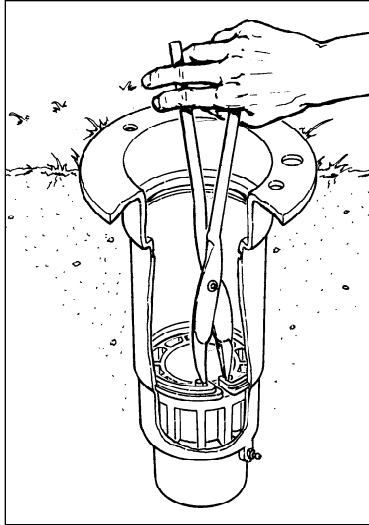


Figure 6

Using Snap Ring Pliers to Remove Snap Ring

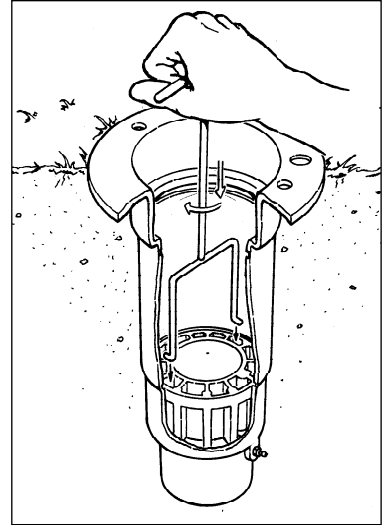


Figure 7

Using Valve Removal Tool to Remove Valve Assembly

NOTE: If valve removal tool is unavailable use snap ring pliers to grasp rib of valve cylinder assembly and pull up and out of sprinkler body (see **Figure 8**).

3. To reinstall valve assembly with snap ring and to prevent damage to the communication tube in sprinkler body, use valve insertion tool (P/N 995-10). Valve insertion tool will automatically line up valve assembly with sprinkler body communication tube and correctly seat the snap ring. (See **Figure 9**).

NOTE: It is possible to install the snap ring backwards (upside down). See inset in **Figure 9** to insure that snap ring is placed on the insertion tool in the correct manner.

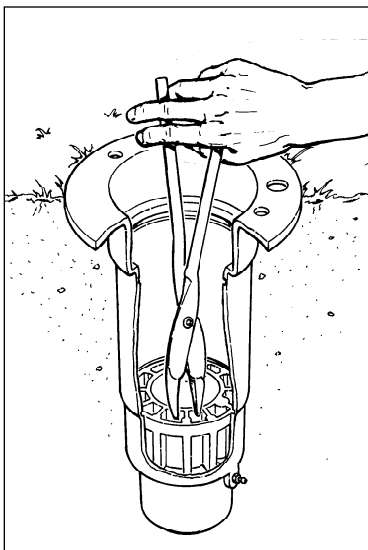


Figure 8

Using Snap Ring Pliers to Remove Valve Assembly

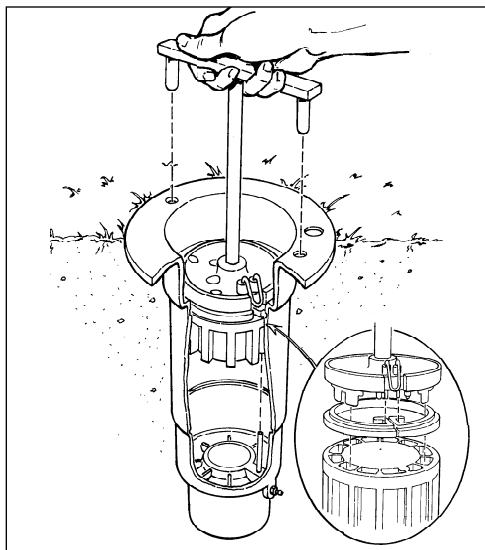


Figure 9

Using Valve Insertion Tool to Install Valve Assembly with Snap Ring

Sprinkler Assembly (See Figure 12 & 13)

1. Clean all sprinkler parts before assembly. Inspect stator for clogged ports and clean as required.
2. Flush screen thoroughly to remove all dirt and debris.
3. Flush sprinkler body thoroughly prior to assembly.
4. Assembly of sprinkler is the reverse of disassembly. Assemble sprinkler components as required to restore operation.
5. Restore electric power and water supply to sprinkler, check sprinkler for leaks and proper operation.

Flushing Sprinkler Heads



WARNING

DUE TO HIGH OPERATING PRESSURE, NEVER STAND OR LEAN DIRECTLY OVER SPRINKLER OR COME IN CONTACT WITH SPRAY WHEN ACTUATING SPRINKLER MANUALLY OR AUTOMATICALLY. PRIOR TO ACTUATION OF SPRINKLER, USE A SLOT HEAD SCREWDRIVER TO LIFT CAP TO OBSERVE DIRECTION OF NOZZLE. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY.

1. With sprinkler operating, carefully step down on center of cap several times. Water will flow around riser and flush out debris.
2. Cycle sprinkler on and off several times to check for proper retraction. Cap should be even with top of body flange when fully retracted. If riser sticks in up position, check for damaged retraction spring and retainer. Replace as necessary.

Servicing Adjustable Pilot Valve Assembly

(P/N 35-6045, 35-6048 and 35-7547 - Used 1986 to 1988) (See **Figure 15**)

1. Turn off electric power and water supply to sprinkler being serviced.
2. Remove two pilot valve screws holding pilot valve to body.
3. Disconnect control tubing from pilot valve at base of sprinkler body.
4. Remove two screws (16) holding solenoid assembly to pilot valve.
5. Pull solenoid assembly from pilot valve using care not to lose push rod (15).
6. Remove D-cam retainer (1) and D-cam (2) from valve.
7. Remove shuttle plug (8), shuttle spring (7) and shuttle assembly (5 and 6) from valve .
8. Remove dust cover (11) and remove regulator assembly (9) with o-rings (10).
9. Insure that all parts of pilot valve and solenoid are thoroughly cleaned. Inspect all parts for damage and replace as necessary.
10. Assemble valve parts in reverse order of disassembly.

CAUTION

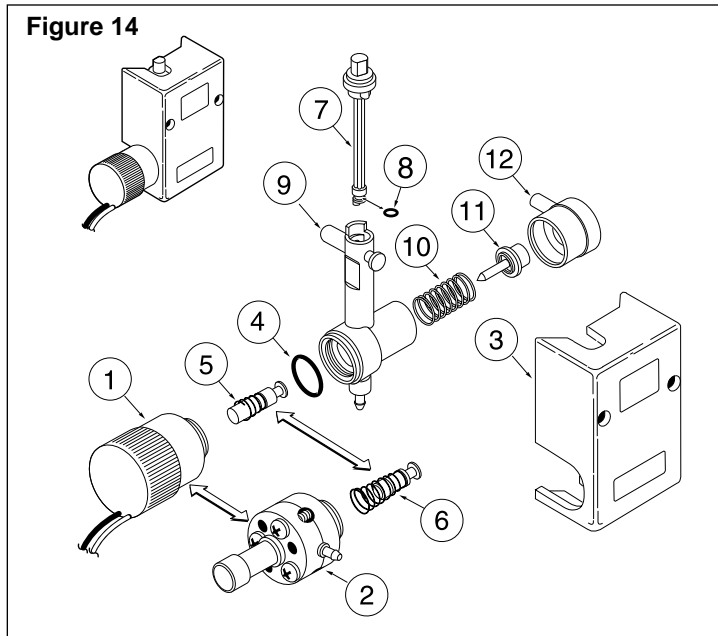
When replacing solenoid, leave wire service loop for future servicing of sprinkler assembly. Waterproof all wire splices with approved method to prevent shorting to ground.

Servicing Pilot Valve Assembly

(P/N 89-0009, 89-0011 & 89-0012 - Current Production) (See **Figure 14**)

1. Prior to servicing pilot valve, shut off 24 V a.c. or hydraulic control source. Isolate sprinkler from irrigation water source and completely depressurize connecting sprinkler line.
2. Remove control tube from pilot valve at sprinkler base connection.
3. Remove two phillips screws securing pilot valve housing (3) to sprinkler body.
4. If hydraulic NC, remove control tube from NC pilot valve adapter (2). (If electric, disconnecting solenoid wires is not necessary unless solenoid replacement is required.)
5. Turn solenoid (1) or NC adapter counter-clockwise to remove.
6. With diaphragm assembly (12) held in position with valve body assembly (9), carefully remove complete valve assembly from housing keeping all pieces assembled.
7. Remove diaphragm assembly, piston (11) and spring (10) from valve body.
8. Pull selector shaft (7) out of valve body. Plunger assembly (5 or 6) is retained by selector shaft and can now be removed from valve body.
9. Thoroughly clean and inspect all pilot valve components for damage or corrosion. Replace parts as necessary. Reassemble in reverse order.

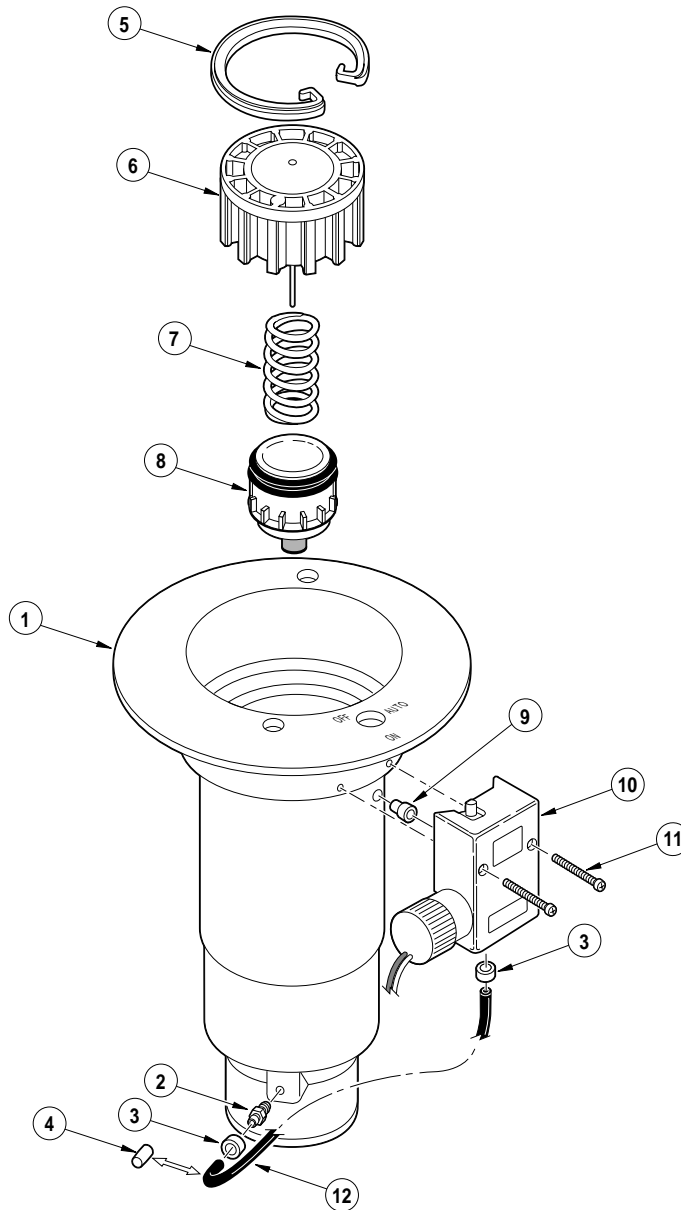
Figure 14



Item No.	Part No.	Nomenclature	Qty. Per Assy.
1	89-1905	Solenoid, Pilot Valve & Valve	1
2	89-6005	Adapter, Pilot Valve, NC	1
3	89-0001	Housing, Pilot Valve	1
4	360-0220	O-Ring, .070 in. x .551 in. x .691 in.	1
5	35-9993	Plunger Assy., Elec.	1
6	89-6003	Plunger Assy., NC	1
7	-----	Selector	1
8	1-2035	O-Ring, .070 in. x .114 in. x .254 in.	1
9	89-6004	Body Assy., Pilot Valve	1
10	35-9970	Spring, 50 lbs., Black	1
10	35-9971	Spring, 65 lbs., Green	1
10	35-9972	Spring, 80 lbs., Red	1
10	35-9973	Spring, 100 lbs., Blue	1
11	89-0029	Piston	1
12	89-0005	Diaphragm Assembly	1
		SERVICE PARTS AND ASSEMBLIES	
	89-0009	Pilot Valve Assy., 50 lbs., Elec.	
	89-0010	Pilot Valve Assy., 65 lbs., Elec.	
	89-0011	Pilot Valve Assy., 80 lbs., Elec.	
	89-0012	Pilot Valve Assy., 100 lbs., Elec.	
	89-3918	Pilot Valve Assy., 50 lbs., NC	
	89-3919	Pilot Valve Assy., 65 lbs., NC	
	89-3920	Pilot Valve Assy., 80 lbs., NC	
	89-3921	Pilot Valve Assy., 100 lbs., NC	
	89-0998	Pilot Valve less Solenoid, 50 lbs., Elec.	
	89-0999	Pilot Valve less Solenoid, 65 lbs., Elec.	
	89-1000	Pilot Valve less Solenoid, 80 lbs., Elec.	
	89-1001	Pilot Valve less Solenoid, 100 lbs., Elec.	
	89-0008	Selector Cam Assy. (Includes Items 7-8)	1

Item No.	Part No.	Nomenclature	Quantity Per Assy.
1	3-2095	Plug, Cap (See Service Item 650-02)	1
2	35-8563	Cap Assy., Cover (See Service Item 650-02)	
3	9-5355	Cover, Rubber (Rounded Flange, See Service Item 650-02)	
4	3-2510	Screw, Machine, 5/16-18 x 11/16 in.	1
5	89-4855	Cap, Molded	1
6	3-3308	Ring, Snap, Drive Assembly	1
7	89-4850	Nozzle Base Assy., 658	1
8	35-5846	Retainer, Spring	1
9	35-6289	Spring, Nozzle	1
10	35-7658	Nozzle, Main, #54 (Includes Item 11)	1
10	35-7659	Nozzle, Main, #55 (Includes Item 11)	1
10	35-7660	Nozzle, Main, #56 (Includes Item 11)	1
10	35-7661	Nozzle, Main, #57 (Includes Item 11)	1
10	35-7662	Nozzle, Main, #58 (Includes Item 11)	1
10	35-9839	Nozzle, Main, #59	1
11	89-5819	Insert, Nozzle (Not used with #59 Nozzle)	1
12	89-3942	Nozzle, Inner, Blue	1
12	89-4738	Nozzle, Inner, Red	1
13	89-4785	Nozzle, Back, Green	1
14	9-2735	Collar, Spring	1
15	3-2093	Plate, Retainer	1
16	363-3208	O-Ring, 1/8 in. x 3 in. x 3-1/4 in.	1
17	89-4772	Drive Assy., 651, 54-57 Nozzles, 90° (Coded Green) (Includes Items 14-15)	1
17	89-4782	Drive Assy., 651, 58-59 Nozzles, 90° (Coded Green) (Includes Items 14-15)	1
17	89-4773	Drive Assy., 652, 54-57 Nozzles, 180° (Coded Blue) (Includes Items 14-15)	1
17	89-4783	Drive Assy., 652, 58-59 Nozzles, 180° (Coded Blue) (Includes Items 14-15)	1
17	89-4774	Drive Assy., 654, 54-57 Nozzles, FC (Includes Items 14-15)	1
17	89-1294	Drive Assy., 654, 58-59 Nozzles, FC (Includes Items 14-15)	1
17	89-4775	Drive Assy., 655, 54-57 Nozzles, PC 45–315° (Includes Items 14-15)	1
17	89-0645	Drive Assy., 655, 58-59 Nozzles, PC 45–315° (Includes Items 14-15)	1
17	89-4842	Drive Assy., 656, 54-57 Nozzles, 2-Speed 60–120° (Coded Red) (Includes Items 14-15)	1
17	89-1295	Drive Assy., 656, 58-59 Nozzles, 2-Speed 60–120° (Coded Red) (Includes Items 14-15)	1
17	89-4843	Drive Assy., 658, 54-57 Nozzles, 2-Speed 180–180° (Coded Yellow) (Includes Items 14-15)	1
17	89-1296	Drive Assy., 658, 58-59 Nozzles, 2-Speed 180–180° (Coded Yellow) (Includes Items 14-15)	1
18	9-5188	Stator, 54 (used with 651-54, 652-54, 654-54, 655-54, 656-54 & 658-54)	1
18	9-5186	Stator, 55/56 (used with 651-55, 652-55, 654-55, 655-55, 656-55, 658-55, 651-56, 652-56, 654-56, 655-56, 656-56, & 658-56)	1
18	9-5190	Stator, 57 (used with 651-57, 652-57, 654-57, 655-57, 656-57, & 658-57)	1
18	9-5192	Stator, 58 (used with 651-58, 652-58, 654-58, 655-58, 656-58 & 658-58)	1
18	9-5187	Stator, 34/59 (used with 651-59, 652-59, 654-59, 655-59, 656-59, & 658-59)	1
19	35-1106	Screen, Molded	1
20	See pp. 16-17	1.5 in. Body Assy.	1
21	See pp. 18-19	Pilot Valve Assy.	1
		SERVICE PARTS AND ASSEMBLIES	
	650-02	Kit, Cover, Rubber (Includes Items 1-3)	
	35-3598	Straightener, Stream, Debris Resistant	
	* 89-0644	Conversion Assy., 654-59 (Includes Items 4-16 and 18-19)	
	* 89-1068	Conversion Assy., 656-59 (Includes Items 4-16 and 18-19)	
	* 89-0643	Conversion Assy., 658-59 (Includes Items 4-16 and 18-19)	
	* 89-0835	Conversion Assy., 655-59 (Includes Items 4-16 and 18-19)	
	35-7638	Nozzle Assy., less Main, 650 (Includes Items 4, 5, 7, 8, 9 and 12)	
	89-4795	Nozzle Assy., less Main and Cap, 650 (Includes Items 7, 8, 9 and 12)	
	89-4852	Nozzle Assy., less Main, 658 (Includes Items 4, 5, 7, 8, 9 and 12)	
	89-4853	Nozzle Assy., less Main and Cap, 658 (Includes Items 7, 8, 9 and 12)	
		SERVICE TOOLS	
		See p. 17	
		* Order through Finished Goods Distribution System – Minneapolis	

Figure 13 Golf Sprinkler Body — 1.5 Inch



Item No.	Part No.	Nomenclature	Quantity Per Assy.
1	See p. 17	Body Assy.	1
2	9-6002	Adapter, Tubing, Threaded, 1/4 in.	1
3	900-40	Retainer, Tube	2
4	740-07	Cap, Poly	1
5	3-3304	Ring, Snap, Valve	1
6	9-1479	Cylinder Assy., NO and COM	1
6	9-1486	Cylinder Assy., EL and NC	1
7	3-3323	Spring, Valve, NO, EL and NC	1
7	3-3311	Spring, Valve, COM	1
8	89-1201	Piston Assy., NO and COM	1
8	89-0937	Piston Assy., EL and NC	1
9	35-7663	Adapter, Pilot Valve to Body	1
10	See page 18	Pilot Valve Assy.	1
11	3-2696	Screw, Tap #8	2
12	9-2623	Tubing, Poly, 1/4 in., Pilot Valve, 8 in.	1
12	9-1876	Tubing, Poly, 1/4 in., COM, 11.5 in.	1
N/I	3-2606	Adapter, Poly 1/4 in. (Used on 02 and 52 models only)	1

Item No.	Part No.	Nomenclature	Quantity Per Assy.
		1.5 INCH NPT BODY STYLE	
1	3-3389	ELEC wo/VIH (Includes Items 1-4)	1
1	89-1011	ELEC w/VIH (Includes Items 1-8)	1
1	89-4864	ELEC w/VIH, 50 lb. PV (Includes Items 1-12)	1
1	89-1018	ELEC w/VIH, 65 lb. PV (Includes Items 1-12)	1
1	89-1016	ELEC w/VIH, 80 lb. PV (Includes Items 1-12)	1
1	89-1017	ELEC w/VIH, 100 lb. PV (Includes Items 1-12)	1
1	3-3343	HYD NO wo/VIH (Includes Items 1-4)	1
1	89-1040	HYD NO w/VIH (Includes Items 1-8)	1
1	9-1257	COM wo/VIH (Includes Items 1-4)	1
1	89-1043	COM w/VIH (Includes Items 1-8)	1
1	3-3389	HYD NC wo/VIH (Includes Items 1-4)	1
1	89-1011	HYD NC w/VIH (Includes Items 1-8)	1
1	89-5760	HYD NC w/VIH, 50 lb. PV (Includes Items 1-12)	1
1	89-5764	HYD NC w/VIH, 65 lb. PV (Includes Items 1-12)	1
1	89-5768	HYD NC w/VIH, 80 lb. PV (Includes Items 1-12)	1
1	89-5773	HYD NC w/VIH, 100 lb. PV (Includes Items 1-12)	1
		1.5 INCH BSP BODY STYLE	
1	35-5362	ELEC wo/VIH (Includes Items 1-4)	1
1	89-4860	ELEC w/VIH (Includes Items 1-8)	1
1	89-4865	ELEC w/VIH, 50 lb. PV (Includes Items 1-12)	1
1	89-4869	ELEC w/VIH, 65 lb. PV (Includes Items 1-12)	1
1	89-1014	ELEC w/VIH, 80 lb. PV (Includes Items 1-12)	1
1	89-1015	ELEC w/VIH, 100 lb. PV (Includes Items 1-12)	1
1	35-5245	HYD NO wo/VIH (Includes Items 1-4)	1
1	89-1039	HYD NO w/VIH (Includes Items 1-8)	1
1	35-5322	COM wo/VIH (Includes Items 1-4)	1
1	89-1042	COM w/VIH (Includes Items 1-8)	1
1	35-5362	HYD NC wo/VIH (Includes Items 1-4)	1
1	89-4860	HYD NC w/VIH (Includes Items 1-8)	1
1	89-5761	HYD NC w/VIH, 50 lb. PV (Includes Items 1-12)	1
1	89-5765	HYD NC w/VIH, 65 lb. PV (Includes Items 1-12)	1
1	89-5769	HYD NC w/VIH, 80 lb. PV (Includes Items 1-12)	1
1	89-5774	HYD NC w/VIH, 100 lb. PV (Includes Items 1-12)	1
		SERVICE PARTS AND ASSEMBLIES	
	89-1036	Valve Assy., NO	
	89-1010	Valve Assy., EL and NC	
	9-1249	Valve Assy., NO with Drain	
	89-1037	Valve Assy., COM	
	35-9645	Filter Assy., Metering, EL and NC	
	9-7271	Adapter, Oversized Thread	
		SERVICE TOOLS	
	995-07	Pliers, Snap Ring (650, 670 and 680)	
	995-09	Tool, Removal, Valve (650, 670, 680 and 750)	
	995-10	Tool, Insertion, Valve (650, 670, 680 and 750)	
	995-15	Tool, Selector (Flag Key) (650, 670, 680 and 750)	
	995-16	Pliers, Riser (650)	
	995-31	Adapter, Hose (650)	
	995-49	Gauge, Pressure (650, 670, 680 and 750)	
	995-50	Tube, Pitot (650, 670, 680 and 750)	
	995-52	Nut Driver, 1/4" (680)	
	995-53	Nut Driver, 3/8" (680)	
	995-55	Tool, Insertion, Crown (680)	
	996-06	Tool, Removal, Snap Ring (680 and 750)	

Notes:

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