BOOMLESS NOZZLES: AN INDUSTRY PERSPECTIVE

Richard D. Du Bey, Jr.* *

Accurate, effective and efficient application of pesticides, particularly for weed control, has always been and continues to be the fundamental goal of every pest management professional. The burden of steadily increasing costs for materials, equipment and labor, coupled with public demand for safety and accountability, is forcing everyone connected with vegetation management programs to focus more carefully on application equipment and technique.

In recent years, a number of specialized spraying appliances have been developed to assist applicators. Of particular interest is the evolution of tips and heads that facilitate spray patterns over wide areas and swath widths without resorting to the use of rigid booms. The benefit of these devices is obvious,- they eliminate the usual problems of hitting stationary objects such as road signs, bumper boards, trees, trellises, irrigation heads, etc. with the rigid boom member.

The appliances used in the "boomless" nozzle approach to spraying can be broken down into three broad categories or styles, namely:

1. Controlled Droplet Heads or Appliances

2. Single Nozzle Boomless Heads

3. Multiple Nozzle Boomless Heads

Controlled droplet applicator heads (CDA's) have become very popular and effective in both agricultural and roadside pest management. Commonly referred to as "herbie" heads, these appliances employ a common technology of variable speed distribution discs, whose revolutions per minute are easily increased or decreased by the operator by adjusting a rheostat or some other elctrical speed control. The head is driven with a 12VDC electric motor.

The operating principle is quite simple. As rim speed increases, average droplet size (also known as volume median diameter or VMD) decreases. (Please refer to the graph provided as Appendix "A".) As the discharge pressure of the sprayed material is increased at the disc, average droplet size (VMD) increases. By carefully monitoring pressure, hence flow, to the disc and by selecting an appropriate disc rim speed, the operator is assured of a spray pattern of excellent uniformity over a clearly predictable swath width.

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The following exhibit graphically demonstrates the relationship between increased pressures and target rates in gallons per acre:

ROTOJET ATOMIZER WITH ORIFICE PLATE NO.	CAPACITY oz/min (OUNCES PER MINUTE) AT PRESSURES P.S.I.(POUNDS PER SQ. INCH)						
	10 P.S.I.	15 P.S.I.	20 P.S.I.	25 P.S.I.	30 P.S.I.	40 P.S.I.	50 P.S.I.
4916-20	2.9	3.1	4.6	5.4	6.1	7.3	8.5
4916-24	3.8	4.9	6.0	6.9	7.8	9.5	11.0
4916-27	4.5	5.9	7.2	8.3	9.4	11.3	14.1
4916-29	5.4	7.0	8.5	9.7	11.2	13.3	15.6
4916-32	6.6	8.6	10.5	12.2	13.8	16.5	19.2
4916-35	7.8	10.0	12.2	14.1	16.0	19.3	22.5
4916-40	9.8	12.7	15.4	18.0	20.2	24.3	28.5
4916-46	13.0	17.0	20.7	23.7	27.0	32.2	37.6
4916-49	15.0	19.5	23.7	27.5	31.0	37.8	43.5
4916-55	18.5	24.0	29.0	33.7	38.0	45.9	53.0
4916-61	22.0	28.7	34.9	40.2	45.5	55.0	64.0
4916-68	26.0	34.3	41.7	48.0	59.0	65.8	75.7

DESCRIPTION

CAPACITY TABULATION FOR AA 900 ROTOJET ATOMIZER

SPRAYING SYSTEMS CO.

Spray Nozzles and Accessories

North Avenue and Schmale Road, Wheaton, Illinois 60187

Ref :

Revision No. 2

Data Sheet No. 900-1

Boomless spraying using CDA technology allows the operator to accurately distribute spray materials at very low volume rates, moving the droplets to the target with a minimum of drift. The swath width is generally limited to approximately seven feet, when a single head is used in a typical configuration that sprays to one side or the other of the prime mover. Despite this limitation, the CDA applicator is an excellent choice for berm spraying in vineyards, for weed control in orchards and for median or shoulder spraying in roadside vegetation management.

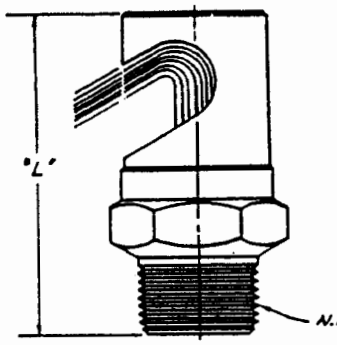
Perhaps the most common use of single "boomless" nozzles has always been in band spraying. Whether the application calls for weed control between the trellises in a vineyard, fire or fuel control along the shoulder of a paved road or pest control along a ditch bank, applicators have traditionally employed single nozzles to apply materials over predetermined swath widths. The inherent advantage to using single nozzles of the "boomless" variety is low cost. Unlike the CDA appliance or multiple nozzle arrays, which we will consider later, a boomless nozzle can be simply and easily mounted at almost any point on a prime mover. This type nozzle usually has a pattern that is designed to sheet or bathe a sprayed area with a relatively uniform swath width, but with a significantly diverse droplet pattern. Volume mediam diameter (VMD) of droplets produced by boomless nozzles tend to be very large at lower pressures, but tend to vary greatly as pressures are increased.

The very simplest approach to boomless spraying is the use of a fan pattern nozzle mounted or set at an angle other than vertical to the ground. Suppliers to the industry have also developed special purpose single orifice nozzles that produce specific patterns for uses other than field spraying.
A few examples of these are:

1. Flood Jets (Spraying Systems Company)
2. Flooding Spray Nozzle (Delevan)
3. Off-Center Nozzles (Spraying Systems Company)
4. LX Off-Center Tips (Delevan)

Typically, these nozzles are aerodynamically ground to produce patterns other than the tradional cone or fan shapes. The Flooding or Flood Jet style nozzle utilizes an angular ramp below the nozzle bore to create a cascade of material that moves away from the nozzle at right angles from its' axis. These nozzles are used to perform a variety of functions depending on how the nozzle is oriented to the prime mover.

NOZZLE DESCRIPTION				LIQUID PRESSURE IN p.s.i.	CAPACITY IN G.P.M.	"W" IN FEET	GALLONS PER ACRE					
NOZZLE NO.	PIPE CONN.	ORIFICE DIA.	"L"				2 M.P.H.	3 M.P.H.	4 M.P.H.	5 M.P.H.	7.5 M.P.H.	10 M.P.H.
¼ KLC-5	1/8"	.076"	1½"	10	.5	14	8.8	5.9	4.4	3.5	2.4	1.8
				20	.7	17	10.4	6.9	5.2	4.1	2.8	2.1
				30	.9	18	12.0	8.0	6.0	4.8	3.2	2.4
				40	1.0	21	11.8	7.9	5.9	4.7	3.1	2.3
¼ KLC-9	¼"	.100"	1½"	10	.9	16	13.9	9.3	7.0	5.6	3.7	2.8
				20	1.3	18	17.9	11.9	8.0	7.2	4.8	3.6
				30	1.6	19	20	13.6	10.1	8.1	5.4	4.1
				40	1.8	21	21	14.1	10.6	8.5	5.7	4.2
¼ KLC-18	¼"	.140"	1 11/16"	10	1.8	18	25	16.5	12.4	9.9	6.6	5.0
				20	2.5	20	31	21	15.5	12.4	8.2	6.2
				30	3.1	21	37	24	18.3	14.2	9.7	7.3
				40	3.6	22	41	27	20	16.2	10.8	8.1
¼ KLC-36	¼"	.199"	2"	10	3.6	19	47	31	23	19	12.5	9.4
				20	5.1	22	57	38	29	23	15.3	11.5
				30	6.3	24	65	43	32	26	17.3	13.0
				40	7.2	26	69	46	34	27	18.3	13.7
¾ KLC-50	¾"	15/64"	2 11/16"	10	5.0	20	62	41	31	25	16.5	12.4
				20	7.1	23	76	51	38	30	20	15.2
				30	8.7	26	82	55	41	33	22	16.5
				40	10	28	88	59	44	35	24	17.7



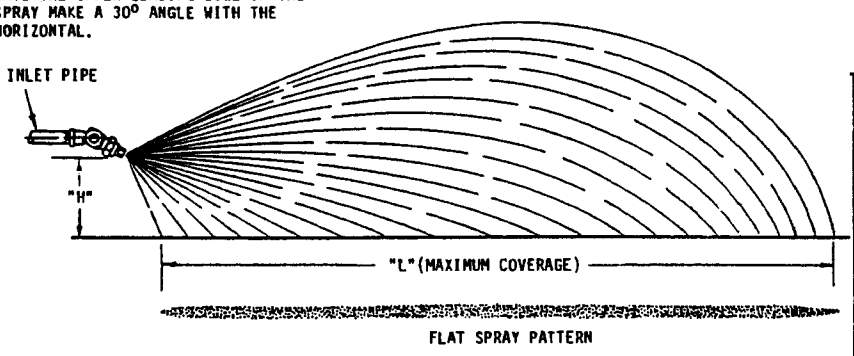
THE KLC NOZZLES ARE AVAILABLE IN BRASS AND STAINLESS STEEL.

SPRAYING SYSTEMS CO.
Engineers and Manufacturers
NORTH AVENUE AT SCHMALE ROAD • WHEATON, ILLINOIS 60187
DR. BY L.R. DWG. NO. 6797
DATE 1-23-64

The Off-Center nozzle is designed to produce a half rainbow shaped cascade of material that can be projected for some distance from the prime mover. With correct flow rates and nozzle orientation, spray swath widths of 18 to 30 feet are acheiveable with relatively uniform coverage. The table below graphically illustrates the coverages available with a typical "OC" set-up

NOZZLE NO.	LIQUID PRESSURE IN P.S.I.	CAPACITY IN G.P.M.	SPRAY HEIGHT "H" = 24"				SPRAY HEIGHT "H" = 36"				SPRAY HEIGHT "H" = 48"				SPRAY HEIGHT "H" = 60"			
			"L" IN FEET	GALLONS PER ACRE			"L" IN FEET	GALLONS PER ACRE			"L" IN FEET	GALLONS PER ACRE			"L" IN FEET	GALLONS PER ACRE		
				3 MPH	4 MPH	5 MPH		3 MPH	4 MPH	5 MPH		3 MPH	4 MPH	5 MPH		3 MPH	4 MPH	5 MPH
4629-3/4TOC10	10	.50	13-1/2	6.1	4.6	3.7	14	5.9	4.4	3.5	14-1/2	5.7	4.3	3.4	15	5.5	4.1	3.3
	15	.61	15	6.7	5.1	4.0	15-1/2	6.5	4.9	3.9	16	6.3	4.7	3.8	16-1/2	6.1	4.6	3.7
	20	.71	16-1/2	7.1	5.3	4.2	17	6.9	5.1	4.1	17-1/2	6.7	5.0	4.0	18	6.5	4.9	3.9
	30	.87	17-1/2	8.2	6.1	4.9	18	7.9	6.0	4.8	18-1/2	7.7	5.8	4.6	19	7.5	5.6	4.5
	40	1.0	18	9.2	6.9	5.5	18-1/2	8.9	6.7	5.3	19	8.7	6.5	5.2	19-1/2	8.5	6.3	5.1
	60	1.2	18	11.2	8.4	6.7	18-1/2	10.9	8.2	6.5	19	10.6	8.0	6.4	19-1/2	10.4	7.8	6.2
4629-3/4TOC20	10	1.0	16-1/2	10.1	7.6	6.1	17-1/2	9.5	7.1	5.7	18	9.3	6.9	5.6	18-1/2	9.0	6.8	5.4
	15	1.2	20	10.3	7.7	6.2	20-1/2	9.7	7.3	5.8	21	9.5	7.1	5.7	21-1/2	9.3	7.0	5.6
	20	1.4	22	10.6	7.9	6.4	22-1/2	10.4	7.8	6.2	23	10.1	7.6	6.1	23-1/2	9.9	7.4	6.0
	30	1.7	23	12.3	9.2	7.4	23-1/2	12.1	9.0	7.2	24	11.8	8.8	7.1	24-1/2	11.6	8.7	6.9
	40	2.0	24	13.9	10.4	8.3	24-1/2	13.6	10.2	8.2	25	13.3	10.0	8.0	25-1/2	13.1	9.8	7.8
	60	2.4	24	16.7	12.5	10.0	24-1/2	16.3	12.2	9.8	25	16.0	12.0	9.6	25-1/2	15.7	11.7	9.4
4629-3/4TOC30	10	1.5	18	13.8	10.3	8.2	18-1/2	13.4	10.0	8.0	19	13.0	9.8	7.8	19-1/2	12.7	9.5	7.6
	15	1.8	21	14.4	10.8	8.7	21-1/2	14.1	10.6	8.5	22	13.8	10.3	8.3	22-1/2	13.5	10.1	8.1
	20	2.1	23	15.1	11.3	9.0	23-1/2	14.7	11.1	8.8	24	14.4	10.8	8.7	24-1/2	14.1	10.6	8.5
	30	2.6	24-1/2	17.5	13.1	10.5	25	17.2	12.9	10.3	25-1/2	16.8	12.7	10.1	26	16.5	12.4	9.9
	40	3.0	25-1/2	19.4	14.6	11.6	26	19.0	14.3	11.4	26-1/2	18.7	14.0	11.2	27	18.3	13.8	11.0
	60	3.7	25-1/2	23.9	18.0	14.4	26	23.5	17.6	14.1	26-1/2	23.0	17.3	13.8	27	22.6	17.0	13.6
4629-3/4TOC40	10	2.0	19	17.5	13.2	10.5	19-1/2	17.1	12.8	10.3	20	16.7	12.5	10.0	20-1/2	16 2	12.2	9.8
	15	2.5	22	19.0	14.2	11.4	22-1/2	18.5	13.9	11.1	23	18.1	13.6	10.9	23-1/2	17.7	13.3	10.6
	20	2.8	24	19.4	14.6	11.7	24-1/2	19.0	14.3	11.4	25	18.7	14.0	11.2	25-1/2	18.3	13.7	10.9
	30	3.5	25-1/2	22.9	17.1	13.7	26	22.4	16.8	13.5	26-1/2	22.0	16.5	13.2	27	20.8	15.6	12.5
	40	4.0	26-1/2	25.2	18.9	15.1	27	24.7	18.5	14.8	27-1/2	24.2	18.2	14.5	28	23.8	17.9	14.3
	60	4.9	26-1/2	30.9	23.1	18.5	27	30.2	22.7	18.1	27-1/2	29.7	22.3	17.8	28	29.2	21.9	17.5
4629-3/4TOC60	10	3.0	20	24.8	18.6	14.9	20-1/2	24.1	18.1	14.5	21	23.6	17.7	14.1	21-1/2	23.0	17.3	13.8
	15	3.7	23	26.5	19.9	15.9	23-1/2	26.0	19.5	15.6	24	25.4	19.1	15.3	24-1/2	24.9	18.7	14.9
	20	4.2	25	27.7	20.8	16.6	25-1/2	27.2	20.4	16.3	26	26.7	20.0	16.0	26-1/2	26.1	19.6	15.7
	30	5.2	27	31.8	23.8	19.1	27-1/2	31.2	23.4	18.7	28	30.6	23.0	18.4	28-1/2	30.1	22.6	18.1
	40	6.0	28	35.4	26.5	21.2	28-1/2	34.7	26.1	20.8	29	34.1	25.6	20.5	29-1/2	33.6	25.2	20.1
	60	7.4	28	43.6	32.7	26.2	28-1/2	42.8	32.1	25.7	29	42.1	31.6	25.3	29-1/2	41.4	31.0	24.8
4629-3/4TOC80	10	4.0	21	31.8	23.8	19.1	21-1/2	31.0	23.3	18.6	22	30.3	22.7	18.2	22-1/2	29.6	22.2	17.8
	15	5.0	24	34.0	25.5	20.4	24-1/2	33.4	25.0	20.0	25	32.6	24.5	19.6	25-1/2	32.0	24.0	19.2
	20	5.6	26	35.9	26.9	21.6	26-1/2	35.2	26.4	21.1	27	34.6	26.0	20.8	27-1/2	33.9	25.4	20.4
	30	7.0	28-1/2	39.8	29.8	23.9	29	39.0	29.3	23.4	29-1/2	38.4	28.8	23.0	30	37.8	28.4	22.7
	40	8.0	29-1/2	45.2	33.9	27.2	30	44.4	33.3	26.6	30-1/2	43.7	32.8	26.2	31	43.0	32.2	25.8
	60	9.8	29-1/2	54.8	41.1	32.9	30	53.9	40.4	32.4	30-1/2	53.0	39.8	31.8	31	52.2	39.1	31.3

FOR MAXIMUM COVERAGE NOZZLE IS SET TO HAVE THE UPPER LEADING EDGE OF THE SPRAY MAKE A 30° ANGLE WITH THE HORIZONTAL.



NO. 4629-3/4T OC--
SINGLE SWIVEL NOZZLE

Spraying Systems Co.

Spray Nozzles and Accessories

North Avenue and Schmale Road
Wheaton, Illinois 60188

Ref :	Data Sheet No.
Revision No. 1	4629

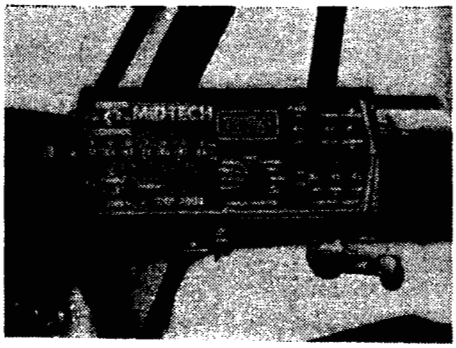
It is very important to note here that the nozzle performance and pattern of the "OC" nozzle is very pressure sensitive! Droplet size variations can be substantial. Streaking at the pattern edges, commonly referred to as a "rooster tail" can be a problem as well as some drifting off-target as the result of atomization.

With the advent of the microprocessor and its' inevitable marriage to spraying equipment, boomless spraying hardware has experienced a remarkable design evolution, particularly in the areas of roadside vegetation management, lawn and turf care, flood control and irrigation district channel maintenance. The professionals working in these areas have been continually challenged with the need to do high speed spraying, frequently under less than ideal conditions, with severe time constraints and difficult environmental requirements. In-cab microprocessing equipment is now available to provide on-the-go rate controlling as well as the "state-of-the-art" technique of computer controlled chemical injection spraying.

With these new technologies, the sprayer operator can now change flow rates and pressures automatically to achieve greater accuracy in applications. Chemical injection sprayers provide almost pinpoint accuracy in application and can rapidly react to major changes in spray width.

The NOVACHEM Five Nozzle Boomless Head is designed to replace the single nozzle, permanently mounted off-center ("OC") type nozzle that is characterized by its fan shaped pattern. The flow rate (measured in gallons per minute) and the pattern width (measured in feet) can be easily varied by the correct selection of the correct nozzle orifices. As a general rule, the larger the nozzle orifice, the higher the flow rate. Higher flow rates will produce consistently more uniform patterns, larger droplet rates (to reduce drift) and greater spray width capabilities. The five nozzle boomless head is capable of additional variations in spray pattern and width by changing the combinations of nozzles turned on (1 through 5, in any combination) from the control console in the cab. Because the sprayer injection controller is monitoring and injecting the exact amount of concentrated material required at any given time, the sprayer operator can choose any flow rate and pressure for the sprayed water as is appropriate to get the best coverage of the target area.

The multiple nozzle boomless head is designed primarily for these electronic technologies. Unlike the Off-Center nozzle's single cascade of material, the multiple nozzle head is designed to break the spray pattern up into many interrelated individual streams which are "aimed" or adjusted to provide uniform coverage over the desired swath width. The combinations of different nozzles determine the strike of the pattern on the target as well. Usually, the multiple hose circuits required to supply this style head are remotely controlled from the cab of the prime mover. Additionally, the head assembly is usually designed to articulate, or move on various planes to facilitate setting the correct spray nozzle angles needed to accurately project the sprayed streams to the target.



IN-CAB CONTROL

MID-TECH CCI-2000 In-cab control console provides single operator capability to spray either side or both sides of the vehicle with combinations variable width programable spray patterns at programmed application rates proportional to a speed range of .5-30 MPH. The computer console is "user friendly" allowing the operator/driver to concentrate on driving safely as the computer console monitors and operates the injection system while recording total acres and total volume being sprayed.

BOOMLESS SPRAYHEAD

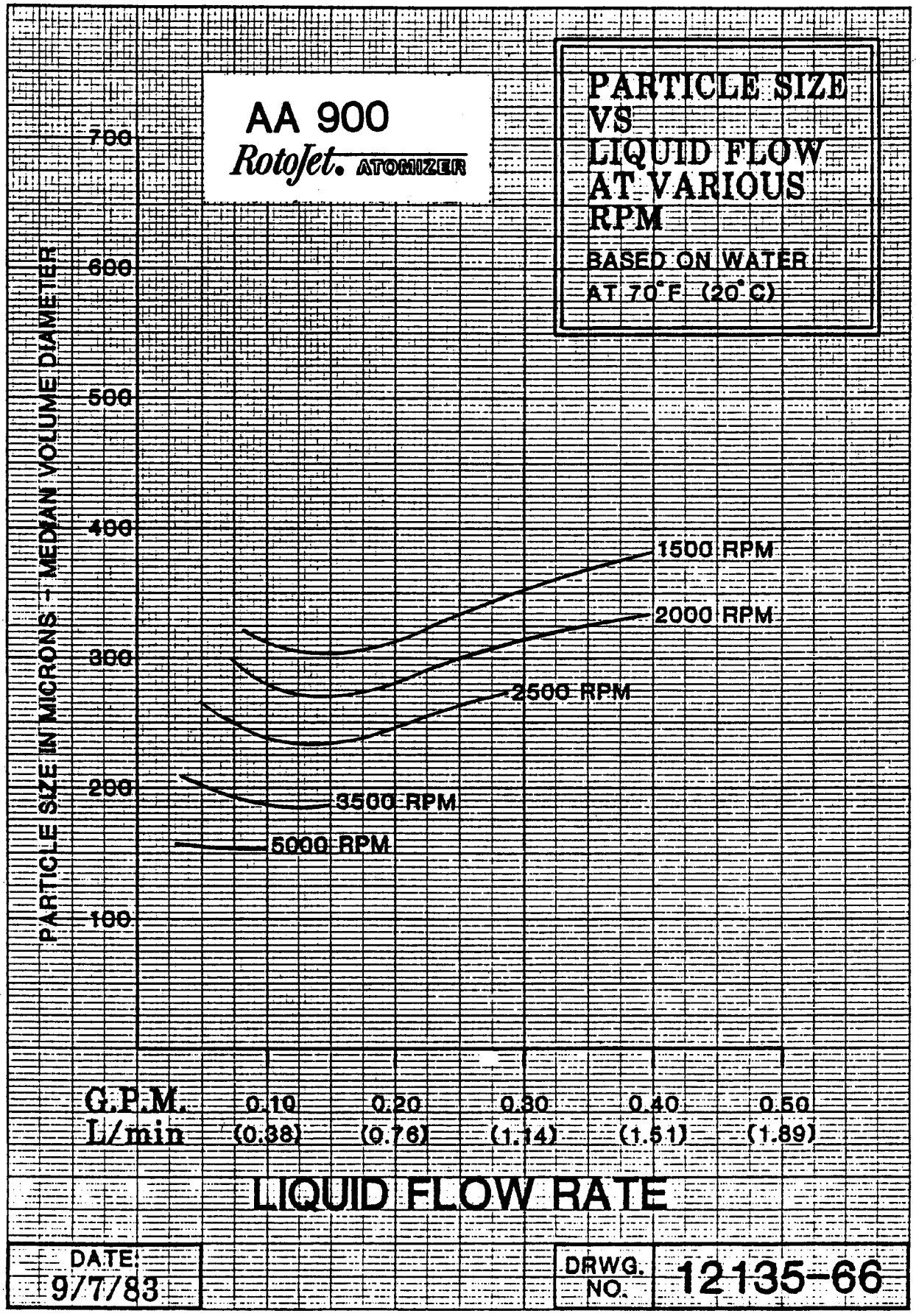
NOVACHEM's 5-section or dual 5-section boomless spray head can be mounted any where practical on the vehicle because the nozzle design minimizes drift even in windy condtions. In-cab controls provide height adjustment,head tilt and telescoping.boom control.Variable width nozzling allows you to tailor your spray patterns to suit any terrain and vegetation. The spray head is easily removed and relocated for any project.

With this type of versatile tool, spray widths and patterns can be quickly adjusted while "on-the-go". When this style head is coupled to an injection system, the on-board computer will instantly correct and adjust injection pump rates to comply with any rapid changes in swath width. Thus, the operator can select any range or combination of swath widths, by merely activating straight stream nozzle clusters from an electronic control panel in the cab. The concern for physical contact against stationary objects is eliminated. The coarse straight streams minimize particle drift "off-target". Chemical application rates can be held to very accurate levels. Variations in speed and spray swath widths are instantly sensed by the computer and injection rates are compensated to reflect those changes.

The multiple nozzle boomless spray head can also be used to spray tank mixtures as well. Properly configured, the boomless spray head affords an operator the flexibilty to ajust spray swath widths from 1 foot to 30 feet by merely flicking a series of toggle switches or turning a series of control valves.

When coupled to an flow based, pressure compensating electronic controller, the multiple nozzle spray head produces more accurate patterns than the single nozzle boomless head. Sprayer controllers that employ a downstream flow control valve to adjust application rates (adjusting nozzle pressure) severely degrade the pattern of a single nozzle head as the sprayer slows down. Conversely, a correctly adjusted single pattern arc may "blow out" in the center of the pattern as pressures rise relative to changes in speed. Straight stream nozzles tend to hold their trajectory and general shape through pressure modulations of as much as 20% or 25%.

To summarize, a whole new world of excellent tools await the professional applicator who is looking to upgrade equipment and techniques. Boomless nozzles, coupled with new sprayer electronics, can make the task of precision chemical application an affordable and acheiveable reality.



APPENDIX "A"