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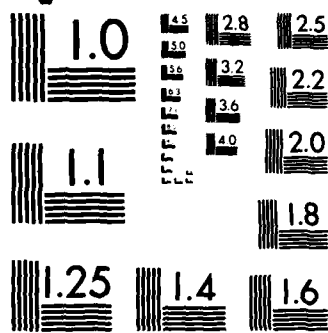
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Timer Rinse Control Systems

1LT JAMES R. ALDRICH
CHARLES G. ROBERTS

USAF ENGINEERING AND SERVICES
LABORATORY (AFESC/RDVW)

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JANUARY 1985 - JUNE 1985

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Timer rinse control systems were installed on eight rinse tanks at the San Antonio Air Logistics Center (SA-ALC) electroplating shop to evaluate their use for reducing water consumption at military metal finishing facilities. The controllers achieved a 71 percent reduction in water consumption for the eight tanks tested. The economics of applying the controllers, installed cost approximately \$1000 per unit, is site-specific and dependent upon factors such as initial water use rates. Although SA-ALC does not use enough water to justify a complete change over to the new system, most military metal-finishing facilities would benefit from the system. Included in the report is a predictive model for system application.					
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PREFACE

This report was prepared by the Air Force Engineering and Services Center, Engineering and Services Laboratory, Tyndall Air Force Base, Florida, under Job Order Number IESC 0008, Timer Rinse Control Evaluation. Data from project resulted in a generic model for determining the applicability of timer rinse control systems to military plating shops.

This report covers work performed between January 1985 and June 1985. The work was done via a research and development contract with L. I. Dimmick Corporation, Reston, Virginia. The AFESC Project Officer was 1Lt James R. Aldrich.

This report discusses the results of testing a particular timer rinse control system for reducing the volume of water used at Air Force electroplating facilities. The report does not constitute an indorsement or rejection of any specific piece of equipment for Air Force use nor can it be used for advertising a product.

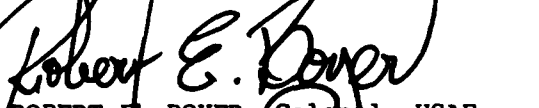
This report has been reviewed by the Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public including foreign nationals.

This technical report has been reviewed and is approved for publication.


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SECTION I

INTRODUCTION

OBJECTIVE

The objective of this project was to evaluate a manually activated, timed flow controller for reducing the volume of rinse water used in metal finishing operations.

BACKGROUND

As part of aircraft maintenance, the Air Force operates five major electroplating facilities at its Air Logistic Centers (ALCs). These facilities generate over 1 billion gallons of wastewater which must be treated at an industrial waste treatment plant (IWTP) at an annual cost of over \$3 million (Reference 1).

Nearly 90 percent of this wastewater comes from the rinse systems in the plating shops due to a constant flow of approximately 3 to 15 gallons per minute to each tank. However, the plating workload at the ALCs is highly variable with most process tanks only being used intermittently. As a result, the continuously flowing rinse tanks pour clean water into the waste stream which increases treatment costs, lowers the pollutant concentrations in the wastewater, and requires unnecessarily large treatment plants.

SCOPE

This project shall evaluate timed, rinse control systems at the San Antonio Air Logistics Center (SA-ALC). Water use data on the tanks selected for the demonstration shall form the basis for a predictive model for applying this technology.

SECTION II

PRESENT RINSE CONTROL TECHNOLOGY

THEORY

Factors effecting rinse efficiency include agitation within the rinse tank, the concentration of metal in the rinse water, and the amount of time the part is immersed. These three variables must all be considered if effective rinsing is to be maintained. The first is the variable under consideration, the time the part is in the tank is largely a function of the production rate of the shop, and the concentration of metals a quality control item. In turn, the water flow can be minimized by optimizing these variables.

The relationship between the concentration of metals in a plating bath and it's associated rinse tank is referred to as the rinsing criterion, "R." Assuming the rinse tank is completely mixed (i.e., air-agitated), "R" is defined as:

$$R = C_p/C_n \quad (1)$$

where C_p = metal concentration in the plating bath and
 C_n = maximum allowable metal concentration in the rinse water.

If solution dragout on the part being rinsed (D) is included, the amount of water needed to keep the rinse tank free of metals (Q) can be calculated:

$$Q = D (C_p/C_n). \quad (2)$$

For example, if a part and its rack drags out .05 gallons (D) from a plating bath with 18 ounces/gallon of solution (C_p) and is rinsed in a finishing rinse tank with a maximum allowable metal concentration of .01 ounces/gallon (C_n) the required rinse water flow (Q) can be calculated:

$$Q = .05 \times (18/.01) = 90 \text{ gallons per part.}$$

If the average rinse water flow to this example tank was average, 10 gallons per minute, this tank could rinse 6 parts per hour. However, given the intermittent nature of the operation at the ALCs (approximately 1 to 2 parts per hour), up to 3 million gallons of water could be needlessly added to the wastewater flow.

CURRENT TECHNOLOGY

Countercurrent Rinsing.

Countercurrent rinsing uses multiple-rinse tanks with the water flowing opposite to the flow of the workpieces. By reusing the water from the last tank to the first, even a two-stage system can reduce water consumption by as much as 90 percent (Reference 2).

Although the capital investment for countercurrent rinsing is relatively high, this is a common technique in private industry where the workload is constant. However, due to the intermittent workload and the space requirement for extra rinse tanks, the ALCs would not benefit from this technology.

Rinsewater Reuse.

This technique involves reusing water from one rinse tank for another that either has a less stringent contaminant requirement or a complimentary use (e.g., reuse alkaline rinse water as feed for an acid rinse). This technique is effective at reducing water flow, but has major drawbacks. First, great care must be taken to not mix acidic rinse water with cyanide processes. Second, it requires a great deal of complex plumbing to incorporate. Finally, once the system is installed, it restricts plating/rinse tank use if changes are required.

Flow Restrictors.

These devices reduce the flow to the rinse tank by reducing the diameter of the inlet water pipe. Although these devices are widely used by both military and private industries, they are designed to benefit operations requiring continuous flowing rinse tanks. Again, the intermittent workload limits their benefit to military operations.

Conductivity Cells.

A conductivity cell measures the concentration of dissolved solids in the rinsewater. When the concentration gets to a preset maximum, the freshwater flow is started and continues until the solids concentration is diluted to a preset minimum. Theoretically, these devices are ideal for both the military and private industries because they are dependent only upon the concentration of the contaminants in the rinsewater; however, there are inherent problems. First, the controllers are frequently packaged in a metal box which is subject to corrosion problems. Second, since the probes are located in the rinse water, they are subject to damage by the workpieces as they are rinsed. Finally, the platers can easily override the systems by placing the probes in the plating tank causing a continuous flow.

SECTION III

TIMER RINSE CONTROL

TECHNOLOGY DESCRIPTION

Timer rinse controls are manually activated to deliver a preset quantity of water. The flow is determined by using Equation (2). These systems can be activated by either pushbutton or contact switch in the case of automatic plating lines. A typical system is shown in Figure 1.

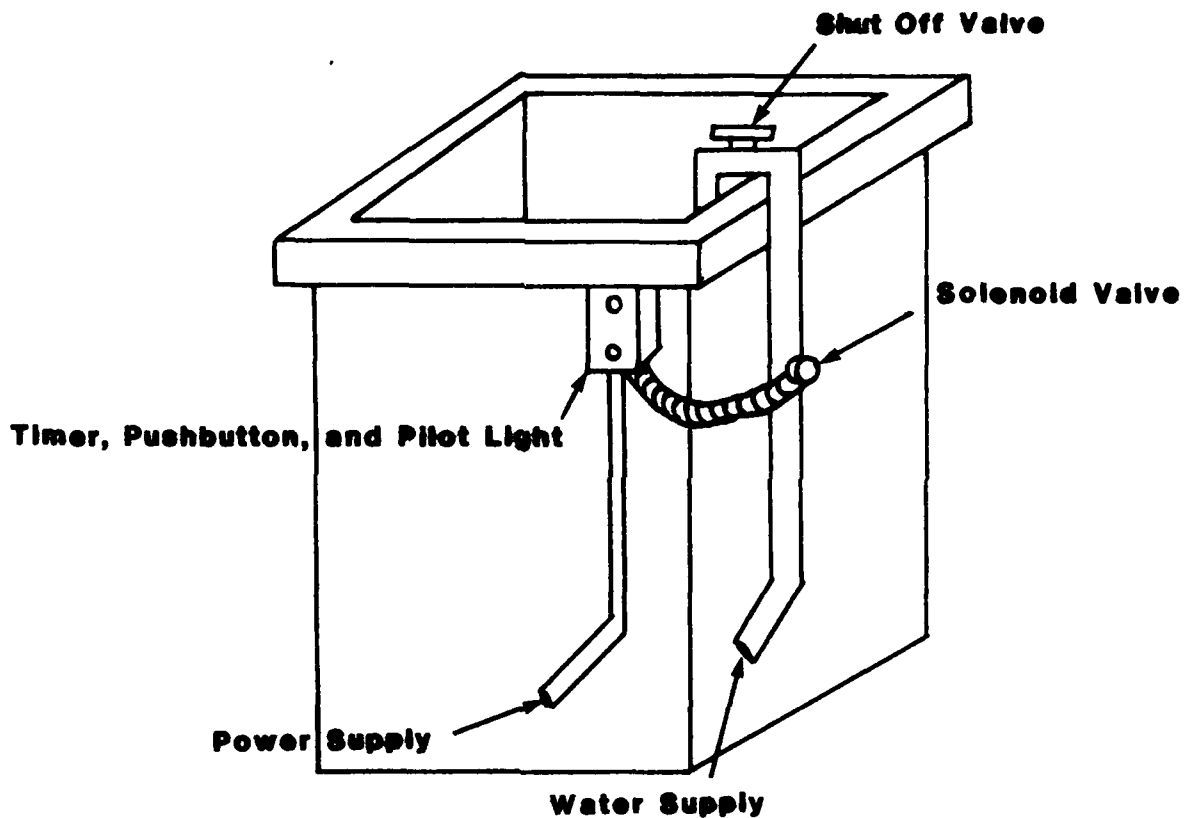


Figure 1. Timer Rinse Control System.

The biggest advantage of this system to the military is that it is tailored to intermittent use. The flow is activated only when a part is rinsed and because the control box must be disassembled to change the timer setting, it is very difficult to override.

EQUIPMENT DESCRIPTION

The system designed for the SA-ALC is manually activated consisting of two major components:

- (1) A 1/2-inch nominal pipe thread solenoid valve with brass body; 120 volt ac, 60 Hz service.
- (2) A multirange timer mounted in a corrosion resistant fiberglass reinforced plastic enclosure with a momentary contact pushbutton and pilot light.

Solenoid valves were installed on the waterlines and the fiberglass enclosures mounted directly on the rinse tanks. The existing manual ball valves between the solenoid valves and the tank were left in place to provide for emergency shutoff if the overflow becomes plugged. The process flow is shown in Figure 2.

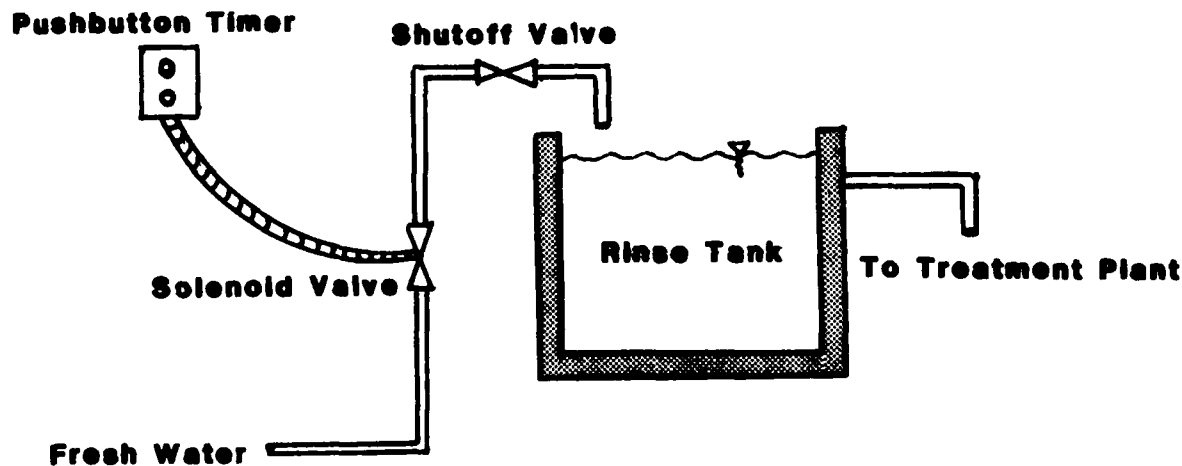


Figure 2. Process Flow Diagram.

FLOW CALCULATION

Measuring actual dragout volume is practical only when large numbers of similar parts are plated. The intermittent nature of the military shops, however, lead to a wide variety of pieces. As a result, the minimum flowrates for the controllers were determined by calculating a "worst-case" dragout rate.

It is generally accepted that good rinsing can be achieved if the contaminant level is kept at or below 150 ppm (0.02 ounces/gallon). Using this number for the maximum acceptable concentration, and the assumed dragout rate, the required flow could be easily computed for any given plating solution. The timer setting can then be computed by dividing the

SECTION IV

TECHNICAL APPROACH

SITE SURVEY

Although the SA-ALC plating shop is large, over 200 tanks, only 91 rinse tanks were being used during the survey (a full description of the tanks is contained in Appendix A). Although the shop operates 24 hours per day, the majority of the plating occurs during the day shift with only skeleton crews on the swing and night shifts.

Cyanide wastewater is collected separately from the other wastewaters in two 5000-gallon sumps. Any time these sumps fill, incoming water is shut off until the sumps can be emptied and taken to the IWTP for treatment. This limited capacity for cyanide waste, and resulting flow interruption, would have to be considered in the data evaluation from the project.

Rather than install 91 devices, only the 10 most frequently used tanks were evaluated for the demonstration. Flows to these tanks were measured to establish baseline data and eight were selected for installation of rinse controllers. The tank numbers, descriptions, and base flows are presented in Table 1.

TABLE 1. RINSE TANKS SELECTED FOR THE DEMONSTRATION

Tank Number	Description	Flow Rate (gpm)
128	Cyanide Rinse	7.9
133	Cyanide Rinse	4.7
419*	Acid Rinse	4.2
425	Acid Rinse	8.5
526	Cyanide Rinse	9.6
616	Cyanide Rinse	11.2
634	Cyanide Rinse	6.3
638*	Acid Rinse	9.4
640	Acid Rinse	14.4
711	Cyanide Rinse	2.1
Total flow for the eight tanks:		64.7
Average flow for the eight tanks:		8.1

*Not selected for testing. Tank 419 had a conductivity cell installed.

TABLE 3. MAXIMUM RINSE WATER CONDUCTIVITIES

Tank Number	Process Solution	Allowable Conductivity (in mho)
128	Cleaner, light duty	230
133	Cleaner, heavy duty	450
425	Sodium Hydroxide	690
526	Cadmium (Cyanide)	260
616	Chromic Acid	450
634	Copper Cyanide Strike	320
640	Nickel	128
711	Zinc (Cyanide)	280

These tanks were selected because of their frequency of use vs. their flow rates. Hence, the 8.1 gpm flow rate does not represent the average flow for the 91 rinse tanks in use during the demonstration. Given the total flow from the plating shop, 325,000 gallons per day, these tanks are below the tank average for the shop which makes the estimate of water savings from this demonstration more conservative.

Because the demonstration involved only a fraction of the total rinse tanks and the intermittent shutdown of the water because of the cyanide wastewater sumps, flow rates on the selected tanks were used as criteria to evaluate the system performance instead of total wastewater generation. In addition, electric clocks were installed at each rinse station to record how long the flows were activated. These times, along with the timer settings, made it possible to determine the frequency of use for each tank. The final flowrates, timer settings, and frequency of tank use are shown in Table 2.

TABLE 2. POSTINSTALLATION FLOW RATES AND TIMER SETTINGS

Tank Number	Flow Rate (gpm)	Timer Setting (min)	Times Used/Day
128	5.6	4.5	22
133	2.7	20	20
425	13.6	4.6	2
526	8.5	7.1	29
616	7.5	8.0	3
634	7.5	8.7	9
640	8.1	4.0	3
711	1.2	23	n/a*
Average Flow		6.8 gpm	

*Data not available due to clock malfunction.

DATA COLLECTION

During testing there were times when the water was turned off due to the cyanide sumps being full. To allow for this water interruption rinsewater conductivity measurements were taken to verify the accuracy of the clock readings. If the timer indicated the rinse controller had been activated and there was a rise in conductivity, meant the water had been shut off and the recorded times would be valid. Conversely, if the clock showed the system had not been activated, and there was an increase in conductivity, it meant that the operator had failed to activate the system.

The conductivity measurements also were used to monitor rinse tank contaminant levels. These limits, presented in Table 3, were exceeded only once during the demonstration when the system had not been for an entire shift.

SECTION V

CONCLUSIONS

FEASIBILITY

Manually activated timer rinse controllers are capable of reducing the water consumption at military plating shops. They are simple to operate and maintain, require little maintenance, and are applicable to any running rinse tank. Interviews with the platers indicated a very favorable response to the controllers and many stated they felt they were doing more to save money (water) for the shop. Although the demonstration was successful from an operational standpoint, the periodic shutdowns of feedwater and relative low baseline water use at SA-ALC made the projections for water savings artificially low. In general, the savings at other facilities would probably be much higher.

COST/PAYBACK

The controllers for SA-ALC cost \$467 each and were installed by contract for \$546 each. These costs were relatively high because the eight tanks selected for the demonstration were spread throughout the shop, thus, increasing installation cost. In addition, had military electricians and plumbers been used to install the controllers, the costs would have been cut considerably.

The controllers reduced the water consumption on the demonstration tanks by 71 percent. Assuming approximately 20 percent of the tanks would not be used enough to warrant installation, this leads to a potential water savings of nearly 2 million gallons per year. Again, due to the installation cost, the payback period, 6.6 years, would not be economical for SA-ALC; however, this shop is the exception rather than the rule. Most plating shops use many times that much water; 200,000 gallons per day is not uncommon. In these cases, or if an IWTP is approaching its maximum flow, this rinse control system could be applicable.

RECOMMENDATIONS

Although the application is site-specific, the timer rinse controllers are a viable, economical method for reducing water consumption in plating operations. Figure 3 illustrates the annual water cost savings for a facility using 2.4 million gallons of water per year (i.e., \$5.50/1000 gallons=\$13,200 per year). The potential savings from a timed rinse controller system is \$9,400.

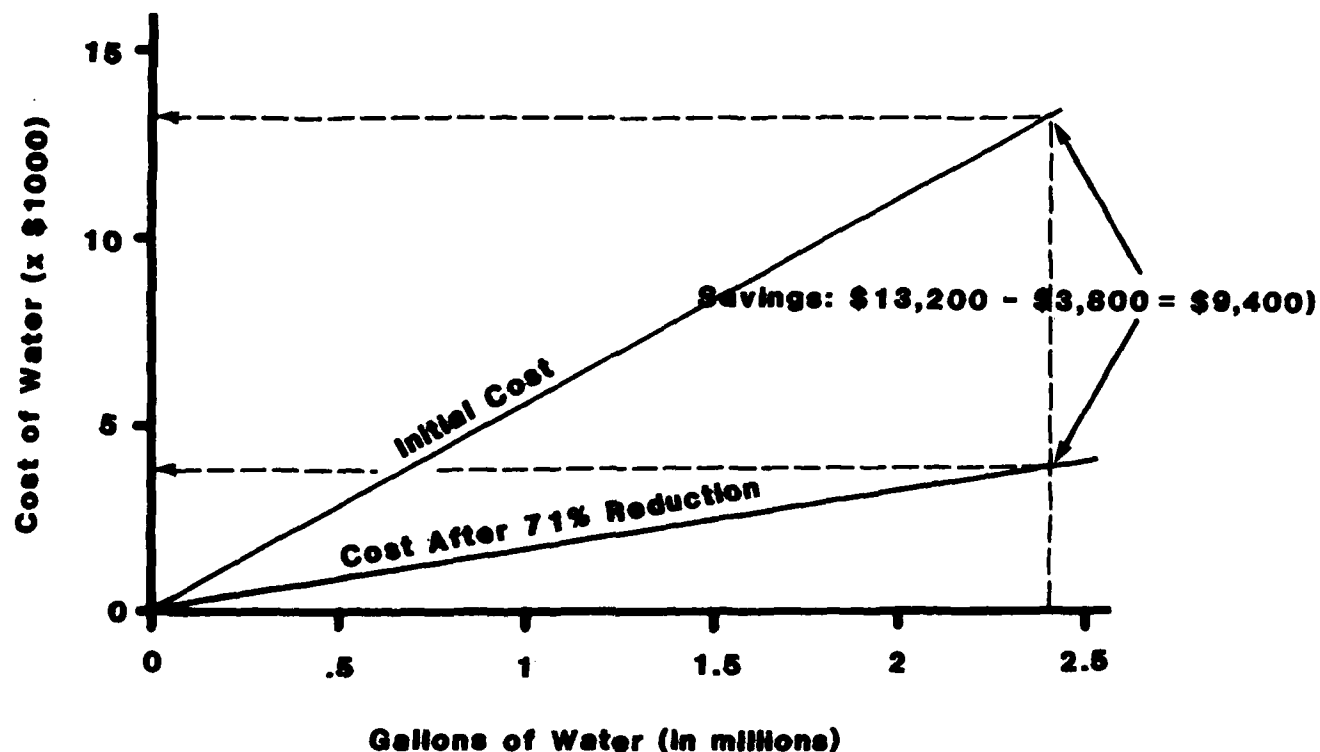


Figure 3. Potential Savings from Timer Rinse Controllers

This analysis can be taken one step further and turned into a predictive model. Using the installed cost from this project, \$1000 per tank, and the 71 percent water savings (\$5.50 per 1000 gallons) of water, the plot shown in Figure 4 can be generated.

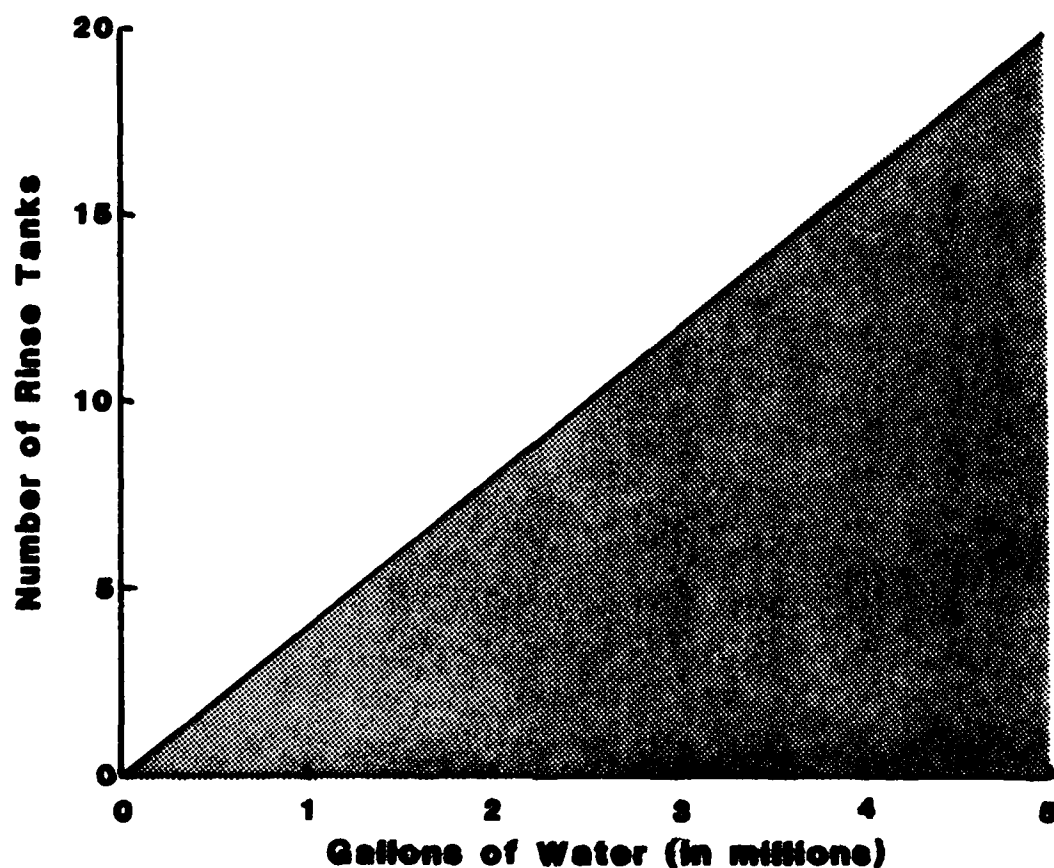


Figure 4. Feasibility Model for Applying Timed-Rinse Controllers

To use the graph in Figure 4 you need only three figures. First, the number of running rinse tanks in the shop; second, the annual water consumption of the shop; and finally, a target payback period for the investment in rinse controllers. For example, a shop operating 8 hours a day, 300 days a year, with 5 rinse tanks using 3 gpm would use 4.3 million gallons of water per year. If a target payback period of 1 year is selected, enter the graph at 4.3 million on the X axis and 10 tanks on the Y axis. The intersection of the line is in the shaded area of the curve which indicates that the system could potentially payoff and warrants consideration. Likewise, if a 2-year payback was selected, then the X coordinate would be 8.6 million gallons. Figure 5 shows the same plot (i.e., $y = 4x$) for use by a larger shop.

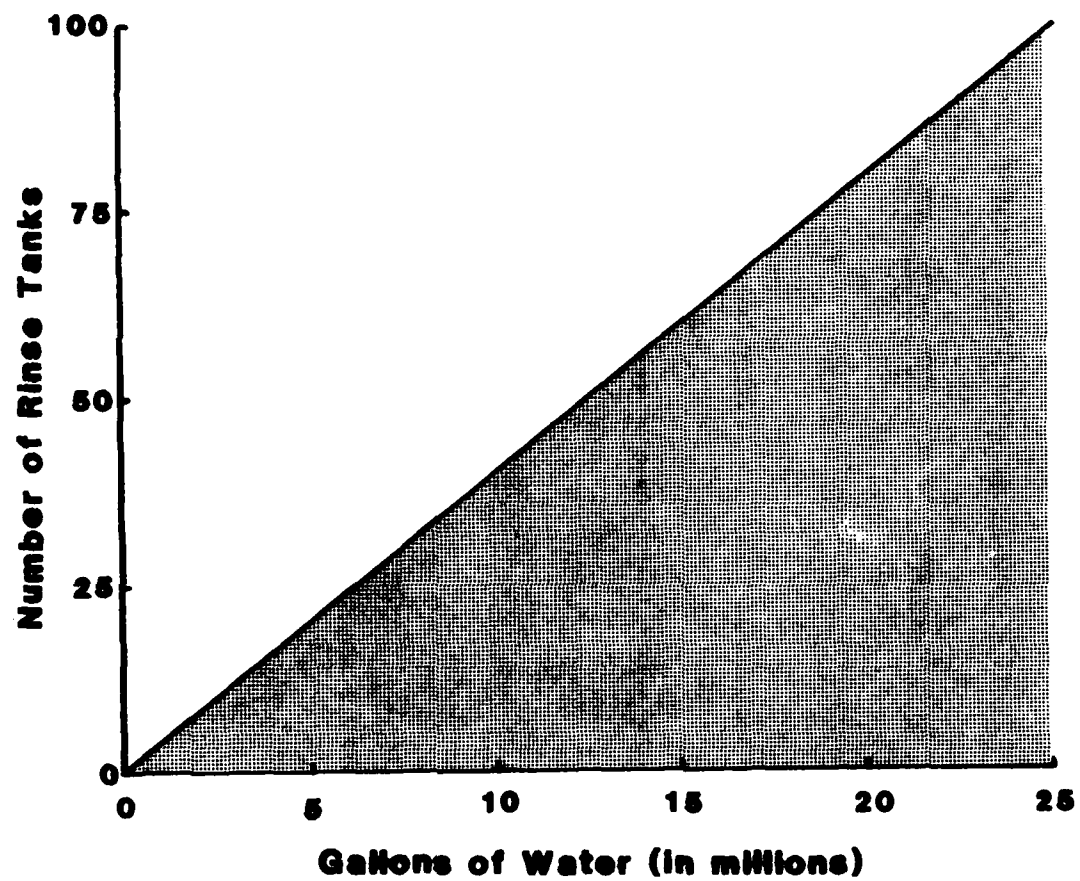


Figure 5. Feasibility Model for Applying Timed-Rinse Controllers for Larger Plating Shops

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APPENDIX A

SA-ALC PLATING SHOP TANK SCHEDULE

TABLE A1. KELLY AFB PLATING SHOP TANK SCHEDULE

<u>Tank Number</u>	<u>Description</u>	<u>Tank Number</u>	<u>Description</u>
101	Cyanide waste holding	211	Nital etch
102	Cold rinse (CN)	212	Hot rinse
103	Amonium Nitrate	301	Alkaline rust remover
104	Cold rinse	302	Hot rinse
105	Anodize strip	303	Non etch cleaner
106	Cold rinse	304	Cold rinse
107	Hot rinse	305	Chrome pickle
108	Chrome strip	306	Cold rinse
109	Cold rinse	307	Ammonium biflouride
110	NiCd strip	308	HF
111	Cold rinse (CN)	309	Cold rinse
112	Anode cleaner	310	Deoxidizer
113	Cold rinse (Cr)	311	Cold rinse
114	Lead strip	312	Dow 19
115	Alpac strip (lead strip)	313	Cold rinse
116	Cold rinse (acid)	314	Chrome recovery evap
117	Cyanide rinse	315	Cold rinse
118	Paint strip	316	Dichromate Dow 7
119	Nitric acid in barrels	317	Cr acid anodize
120	Cold rinse	318	Cold rinse
121	Ni strip (nitric acid)	319	Hot rinse
122	Acid cold rinse	320	Perc/tet degreaser
123	Cu strip	320-A	Nitric acid
124	Cold rinse	321	Cold rinse
125	Hot rinse	322	Alodine
126	Ni strip (CN)	323	Cold rinse
127	Ni strip (CN)	324	Sulfuric acid anodize
128	Cold rinse (CN)	325	Hardcoat anodize
129	Ag strip (CN)	326	Cold rinse
130	Cold rinse (CN)	327	Dichromate sealer
131	Alkaline Cr strip	328	Cold rinse
132	Alkaline Cr strip	329	Black dye bath
133	Cold rinse (CN)	401	Alkaline cleaner
134	Hot rinse (CN)		
201	Non etch cleaner (alkaline)		
202	Cold rinse		
203	Deoxidizer		
204	Cold rinse		
205	Alodine coat		
206	Cold rinse		
207	Empty		
208	Chrome holding		
209	Cr acid holding		
210	Cold rinse		

TABLE A1(Continued)

<u>Tank Number</u>	<u>Description</u>	<u>Tank Number</u>	<u>Description</u>
402	Cold rinse	520	Nitric acid leach. solu.
403	Cr acid hold	521	Cold rinse
404	Cold rinse	522	Nitric acid pass. solu.
405	Cr acid etch	523	Electroless Ni
406	Cr plate	524	Cold rinse
407	Cr plate	525	Cd plate (CN)
408	Cr plate	526	Cold rinse
409	Cr plate	527	Conversion coat
410-A	Ammonium biflouride sulfuric acid	528	Hot rinse
410-B	Cr plate stainless	601	Cold rinse
411	Ammonium biflouride	602	Phosphate type 2
412	Cold rinse	603	Cr acid
413	Cr plate	604	Cold rinse
414	Cr plate	605	Black oxide
415	Cr plate	606-A	Black oxide
416	Cr plate	606-B	Black oxide
417	Cr plate	607	Hot rinse
418	Cr still rinse	608	Alkaline cleaner
419	Cold rinse	609	Cold rinse
420	Sodium hydroxide	610	HCl
421	HCl solu.	611	Cold rinse
422	Cr plate	612	Ni strike
423	Cr plate	613	Cold rinse
424	Cr plate	614	Cd plate (CN)
425-A	Still rinse	615	Cd plate (CN)
425-B	Cr rinse	616	Cold rinse (CN)
501	Cold rinse	617	Chromate conversion
502	Alkaline cleaner	618	Cold rinse (acid)
503	Cold rinse	619	Hot rinse
504	HCl	620	Chem. milling solu.- NaOH
505	Cold rinse	621	Cold rinse
506	Sulfuric acid	622	Nitric acid
507	Cold rinse	623	Cold rinse (acid)
508	Ni strike	624-A	Removed
509	Cold rinse	624-B	Removed
510	Electroless Ni Series	625	Acid cold
511	Electroless Ni	626	Zincate
512	Electroless Ni		
513	Electroless Ni		
514	Electroless Ni		
515	Electroless Ni		
516	Electroless Ni		
517	Cold rinse		
518	Hot Rinse		

TABLE A1 (Concluded)

<u>Tank Number</u>	<u>Description</u>	<u>Tank Number</u>	<u>Description</u>
627	Cold rinse	720	Empty
628	LTA plate	722	Empty
629	Cold rinse	723	Hi speed Ag plate
630	Bronze plate	724	Hi speed Ag plate
631	Cold rinse (CN)	725	Empty
632	Hot rinse	726	Cold rinse(CN)
633-A	50% Nitric acid	727	Cold rinse(CN)
634	Cyanide rinse	728	Cold rinse(CN)
635	HCl etch	729	Hot rinse(CN)
636	Cold rinse	730	Au plate
637	Ni strike	731	Cold rinse(CN)
638	Cold rinse	801	Cold rinse
639	Ni plate	802	Scale Condition
640	Cold rinse (acid)	803	Cold rinse
641	Ni plate	804	Nitric etch
642	Cold rinse	805	Cold rinse
643	Covered w/ plastic	806	HCL etch
644	Cold rinse	807	Rochelle salt
645	Lead plate	808	Cu strike
646	Empty	809	Cold rinse
647	Rinse (acid)	810	Electroless Ni
702	Alkaline cleaner	811	Cold rinse
703	Cold rinse (acid)	818	Cold rinse
704	Sulfuric acid	819	Vitro cleaner
705	Cold rinse (acid)	900	Area of plant permanently shut down
706	Cold rinse (acid)		
707	Cold rinse (acid)		
708	Ni		
709	Cold rinse (acid)		
710	Cu strike		
711	Cold rinse (CN)		
712	Ag strike		
719	Cold rinse		

APPENDIX B
MISCELLANEOUS DATA/CALCULATIONS

TABLE B-1. ANALYTICAL DATA

Grab Samples from the Two Acid Rinse Tanks

Tank Number	Date	Time	Sample ID Number	Metal	Conc., mg/l
425	2/26/85	3:30 PM	K-022685-1	Cr	1.24
640	2/26/85	3:30 PM	K-022685-2	Ni	37.04
425	2/27/85	3:30 PM	K-022785-1	Cr	1.15
640	2/27/85	3:30 PM	K-022785-2	Ni	31.96
425	2/28/85	3:00 PM	K-022885-1	Cr	1.10
640	2/28/85	3:00 PM	K-022885-2	Ni	33.98

Table B-2. CONDUCTIVITY MEASUREMENTS, mho

Tank Number	2/25/85 10:30 AM	2/26/85 7:30 AM	2/26/85 3:30 AM	2/27/85 7:30 AM	2/27/85 3:45 PM	2/28/85 7:30 AM	2/28/85 12:15 PM
128	15	95	245	238	272	205	220
133	tank empty	18	20	92	88	91	85
425	15	18	20	18	19	19	20
526	212	122	375	500	720 *	1180 *	1000 *
616	165	235	255	270	300	260	300
634	155	165	185	175	205	170	180
640	71	75	98	88	98	103	110
711	35	82	90	90	123	103	115

* Clock readings indicated that the operator was failing to activate the timer on the night shift. High tank usage, low timer setting, and shutdown of COT water system contributed to rapid rise in contaminant level.

TABLE B-3. CALCULATION OF WATER SAVINGS

Tank Number	A Original Flow Rate gal/min	B Adjusted Flow Rate gal/min(a)	C C=Bx8 h/d Flow/day gal(b)	D New Flow Rate(c) gal/min	E Frequency of Use, no. Times/day	F Timer Setting min/times	G G = D x E x F Total Flow gal/day
128	7.8	4.0	1920	5.6	22	4.5	554
133	4.7	2.4	1152	2.7	20	20	1080
425	8.5	4.3	2064	13.6	2	2	125
526	9.6	4.8	2304	8.5	29	29	1750
616	11.2	5.6	2688	7.5	3	3	180
634	6.3	3.2	1536	7.5	9	9	587
640	14.4	7.2	3456	8.1	3	3	97
711(d)	-	-	-	-	-	-	-
TOTALS			15,120				4373

Percent reduction = $15,120 \text{ gal/d} - 4373 \text{ gal/day}$ x 100 = 71%

 15,120 gal/day

a Original flow rates were measured with valves wide open and adjusted by multiplying by 0.50 to account for some values being throttled part way.

b Flow per day calculated on 8 hour water system operation per day.

c After installation of solenoid valves

d Tank 711 eliminated from test due to malfunction of electric clock used to collect data.

APPENDIX C
OPERATING MANUAL

APPENDIX C

RISON RINSE CONTROLLER

INSTALLATION AND OPERATING
INSTRUCTION MANUAL

Supplied by:
Rison, Inc.
P.O. Box 1916
Leesburg, VA 22075

(Note: This manual was supplied by Rison, Inc., and is printed as submitted. Reference to the manufacturer does not suggest endorsement.)

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Principle of Operation

The cost of water has risen rapidly over the past ten years. In most areas a sewage surcharge several times the water cost is added to the water bill to cover the expense of treating the contaminated wastewater. In the electroplating industry, the entire wastewater flow must be treated prior to discharge to remove undesirable chemicals. In order to keep these cost factors at a minimum, the water used for rinsing in a plating shop must be kept at a minimum.

Several devices, such as flow restrictors and conductivity controllers, have been developed to control the quantity of rinse water used. Each has proven to be effective in reducing flows but have produced maintenance problems. Flow restrictors change flow characteristics with time, tend to trap particles in the water lines, and waste water when production is interrupted. Conductivity controllers are susceptible to deterioration of the sensor probe and the mineral content of the water supply.

The Rison Rinse Controller provides rinsewater very close to the minimum required to produce an acceptable product. The quantity of water used is BASED UPON THE PRODUCTION RATE. The flow of water is stopped during production interruptions, coffee breaks, lunch periods, etc.

The components of the Rinse Controller are a timer, a solenoid valve, and an actuating device (pushbutton, limit switch, etc.). All these components have been proven reliable and trouble free in millions of applications. The components are housed in corrosion-proof enclosures to withstand the plating shop environment.

RINSING REQUIREMENTS

Many studies have been conducted to determine just what quantity of water is required in the various rinsing operations in a plating shop. These rinsing steps follow cleaning and surface preparation, plating, and postplating treatment (e.g. chromating). The dragout from each of these operations must be diluted with fresh water to avoid contaminating the following bath or avoid staining the parts being plated.

The allowable rinse tank concentrations consistent with good quality work have been determined as follows:

TABLE A-1
ALLOWABLE RINSE WATER CONCENTRATIONS

Type of Rinse	Application	Average g/l	Concentration oz/gal
Intermediate	metal preparation	3	.33
Final	functional	0.7	0.09
Final	bright	0.03	0.004

If the dragout per rack is known, the amount of rinse water required to dilute that dragout to the allowable rinse tank concentration can be calculated:

$$\text{Rinse Water Required} = \frac{\text{Process tank Conc} \times \text{Dragout Rate/Rack}}{\text{Allowable Rinse Tank Concentration}}$$

The rinse water required divided by the water flow rate in the rinse tank gives the time the water must be turned on per rack. The pushbutton/timer/solenoid combination provides the means for controlling this flow.

INSTALLATION

1. Install the solenoid valve in the inlet water line supplying the rinse tank. Be sure to note the direction of flow indicated on the valve.
2. Mount the Rinse Controller control box in a location convenient to the operator.
3. Connect the 120 volt supply to the control box and the wiring to the solenoid valve according to the wiring diagram.

SETTING THE TIMER

1. Determine the maximum drag-out per rack (piece, barrel, etc.). Procedures for determining the dragout are given in these instructions.
2. Measure the water flow rate into the rinse tank by following the procedure given in these instructions.
3. Select the allowable rinse concentration from Table 1 if not otherwise mandated by procedural manuals, etc.
4. Determine the timer setting using the following example as a guide.

EXAMPLE: The dragout from a bright zinc cyanide plating bath with a concentration of 4.0 oz/gal is 1 quart (.25 gal) per hour at a production rate of 20 racks/hour. The water flow into the following rinse tank is 5 gal/min. What is the proper timer setting?

Solution: The dragout rate/racks is 0.25 gallon divided by 20 racks/hr or 0.0125 gal/rack. Using the above formula, the rinse water required is:

Rinse Water Required =

$$\frac{4 \text{ oz/gal} \times 0.0125 \text{ gal/rack}}{0.004 \text{ oz/gal}} = 12.5 \text{ gal/rack}$$

Therefore the timer setting is:

$$\frac{12.5 \text{ gal/rack}}{5 \text{ gal/min}} = 2.5 \text{ min/rack}$$

5. Set the timer for the approximate time calculated in Step 4.

Note: The timers supplied with the Rison Rinse Controller can be set for one of three time ranges: 0-1 minutes, 0-10 minutes, and 0-100 minutes by moving a jumper plug on the back of the timer. The range is factory set at 0-10 minutes unless otherwise specified. Refer to the timer instruction manual supplied with this manual to change the timer range.

DETERMINING DRAGOUT RATE

The dragout rate from a plating tank can be determined by first draining and thoroughly cleaning the first rinse tank following the bath. The tank is then filled with fresh water to the overflow line and the water is turned off. Then a fixed number of racks are plated and passed through the rinse. The rinse is thoroughly mixed to assure uniformity. A sample is taken of the rinse water and the plating tank and is analyzed for the metal being plated. The dragout is then calculated as follows:

$$\text{Volume of dragout} = \frac{\text{Conc. rinse tank} \times \text{Volume rinse tank}}{\text{Conc. plating tank} \times \text{Number of racks}}$$

per rack

DETERMINING RINSE WATER FLOW

Note that the solenoid valve should be installed on the water line before the flow is measured.

If the inlet water line to the rinse tank is conveniently placed, the water flow can be determined by setting the timer at a high value so that it does not interrupt the flow measurement. Hold a 5 gallon pail under the inlet line and push the rinse controller pushbutton. With a stopwatch, record the time required to fill the pail.

A more accurate method is to drain some of the water from the rinse tank and measure the distance from the water surface to the overflow. The volume required to fill the tank is then calculated. By timing the flow until the water just reaches the overflow line, the flow rate can be calculated.

RINSE CONTROLLER

MODEL RC1-1

PARTS LIST

<u>Item</u>	<u>Description</u>
Enclosure	Crouse Hinds # HJB050905
Timer	ATC # 344A360020X
Solenoid Valve	Asco # 8211D2
Pilot Bulbs # 120PSB	General Electric or Sylvania

The above items can be ordered from the manufacturers listed
or from:

RISON, INC.
P.O. Box 1916
Leesburg, VA 22075

Please state model and serial number when ordering.

344 BR1X TDR



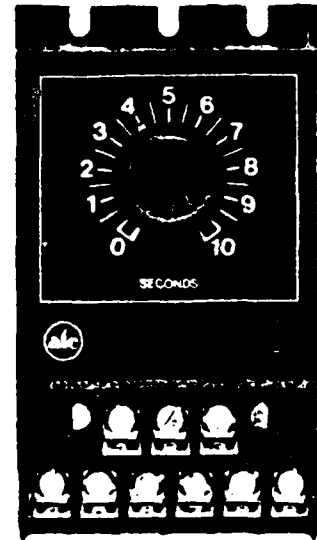
INSTALLATION
INSTRUCTIONS
JANUARY 1984

DESCRIPTION:

The ATC 344 is available in an off-delay (delay-on-break) model and a programmable on-delay/interval model. The off-delay model employs a 3 wire start circuit (L1, L2 and start) to allow start on break of a contact. The unit does not provide memory retention on power failure.

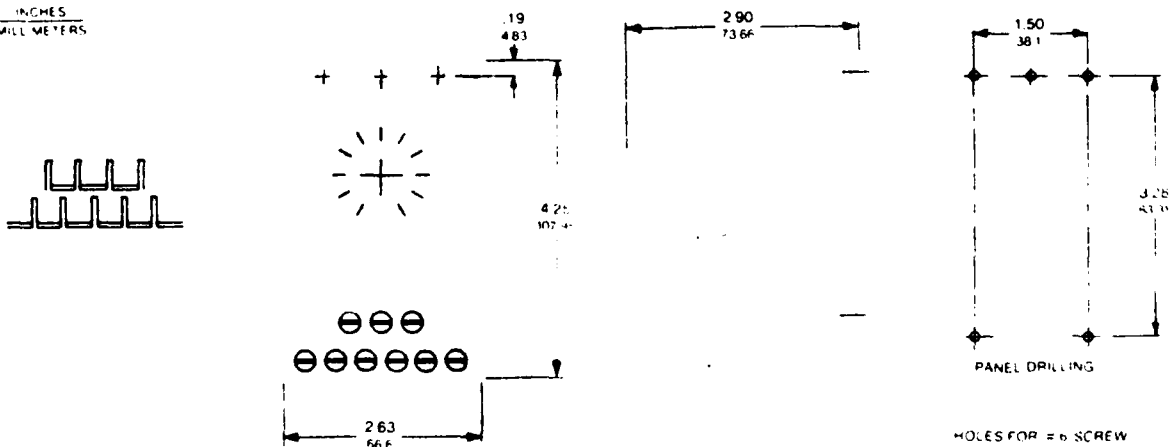
The on-delay/interval model is normally used in the on-delay mode; programming to interval mode would allow use in a momentary start circuit. The interval mode also allows duplication of some circuits normally employing an instantaneous contact when used in series (XOX or OXO) with a delayed contact.

Both are fully adjustable multi-range timers, available in a choice of 1/10/100 seconds or minutes.



DIMENSIONS:

INCHES
MILL METERS



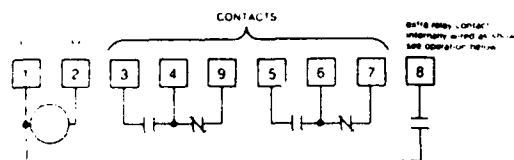
MOUNTING:

The unit is designed for surface mounting only; it does not panel mount.

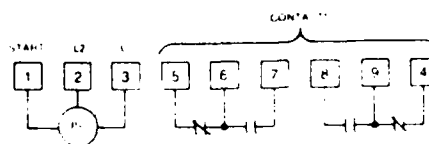
It is not position sensitive and can be mounted on any flat surface. Using the unit as a template, mark, drill and tap for #6 screws

WIRING:

ON DELAY/INTERVAL

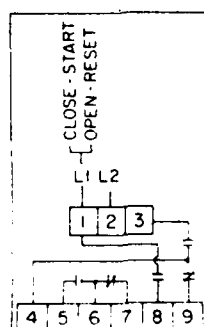


OFF DELAY

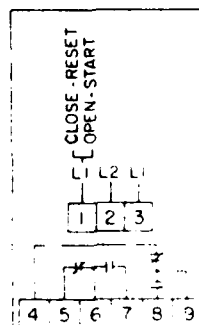


TERMINAL WIRING:

ON DELAY/INTERVAL



OFF DELAY



OPERATION:

On Delay/Interval Model

Timing begins when the start switch is closed. In **on-delay** operation, the relay is energized at end of timing. In **interval** mode the relay energizes at start of timing and releases at timeout. In either mode, reset is accomplished when the start switch is open. The pilot light is on during timing.

Note that an extra relay contact (SPST) is wired between terminal 1 and 8 on the on delay/interval unit. In the **interval** mode, use this contact as a lockup for a momentary start. Or, it can be used as another output in either mode. In **interval** mode contact action is OXO. In **on-delay** mode contact action is OOX.

Off Delay Model

With power applied and the start switch closed, the timer is in the reset condition with the relay energized. Timing begins when the start switch is open. At timeout, the relay deenergizes, reclosing the start switch resets the timer. Pilot light is on during timing.

CHANGING THE RANGE:

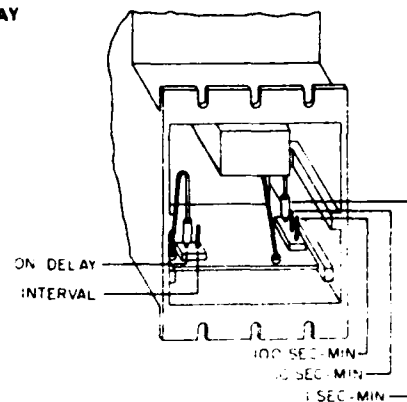
The 1, 10 and 100 second range model will come factory set in the 10 second range.

The 1, 10 and 100 minute range model will come factory set in the 1 minute range.

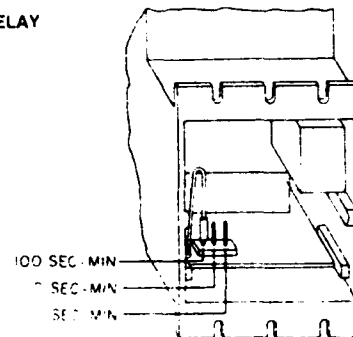
To change range:

- Remove the knob with a small .50" Allen wrench
- Remove the retaining nut, then the exposed scale and replace with proper scale for range intended.
- Position pot shaft at minimum (ccw) setting; replace knob, aiming pointer at the heavy reference line at zero mark. Tighten Allen screw.
- Set range programming jumper per Figure #1.

ON DELAY



OFF DELAY



PROGRAMMING ON DELAY/INTERVAL:

Position the jumper (shown also on the nameplate label) per Figure 1

Figure 1

SPECIFICATIONS:

MODELS

Choice of two
On-Delay/Interval (programmable)
Off-Delay (delay-on-break)

RANGES

Choice of two programmable multi-range models

- 1, 10 and 100 sec
- 1, 10 and 100 min

All ranges are fully dial-adjustable

REPEAT ACCURACY

Varies as a function of line voltage and temperature but not of reset time**
± 1% of setting or 2.0 msec when temperature is constant and line voltage is constant but within limits**
± 1% of setting or 2 ms when temperature is constant and voltage varies within limits (on delay mode interval and off delay ± 3%)
± 8% of setting or 2.0 msec when line voltage is constant and temperature varies within limits**
± 8% of setting or 2.0 msec when line voltage and temperature vary within limits**

**Reset time must be at least 100 ms for on delay or off delay modes 275 ms for interval mode

**Line voltage must be within +10% -15% of 120V nominal (NEMA standard) and temperature between 0°-65°C (32°-150°F)

SETTING ACCURACY

± 10% at full scale

EFFECTS OF

RESET DURING TIMING AND POWER INTERRUPTION DURING TIMING

ON DELAY: Power interruptions during timing greater than 100 ms cause a new timing cycle to be initiated.

OFF DELAY: Power interruptions during timing between 2.5 ms and 100 ms will cause the relay to deenergize for the duration of the interruption, but will not abort the cycle. Interruptions longer than 100 ms will cause immediate time-out

Reset pulses (start contact closings) applied during timing shorter than 200 ms will be ignored. Pulses longer than 500 ms will cause a new cycle to be initiated. Results of pulses between 200 ms and 500 ms is indeterminate

INTERVAL: Power interruptions between 2.5 ms and 10 ms will cause the relay to deenergize for the duration of the interruption. Interruptions between 10 ms and 150 ms will cause immediate time-out in the 1 sec range and shortened cycle time in the longer ranges. Power interruptions longer than 150 ms will cause a new timing cycle to be initiated

LOAD RELAY

TYPE: DPDT, hard-wired
LIFE: 50,000,000 operations (no load)
CONTACT RATING: 7A resistive at 120 or 240V
1/6 HP at 120V

POWER REQUIREMENTS

120V AC: 95 to 132V, 50/60 Hz, 0.02A
240V AC: 190 to 264V, 50/60 Hz, 0.02A
24V AC: 21 to 28V, 50/60 Hz, 0.015A

TEMPERATURE RATING

0 to 70°C (32 to 158°F)

TERMINALS

9 front-facing saddle clamp screw terminals

HOUSING

Impact-resistant molded plastic case for surface mounting

WEIGHT

NET: 7 oz 196 gm
SHIPPING: 10 oz 280 gm

ORDERING CODE	344A	358	O	13	X
BASIC TYPE					
RANGE					
358		Programmable multi-range 1.10 100 sec			
360		Programmable multi-range 1.10 100 min			
VOLTAGE AND FREQUENCY					
O			120/50/60		
R			240/50/60		
T			24/50-Hz		
ARRANGEMENT					
13				On delay Interval (programmable)	
20				Off delay	
FEATURES					
X					Standard
K					Special



AUTOMATIC TIMING & CONTROLS CO.

KING OF PRUSSIA, PENNSYLVANIA 19406

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