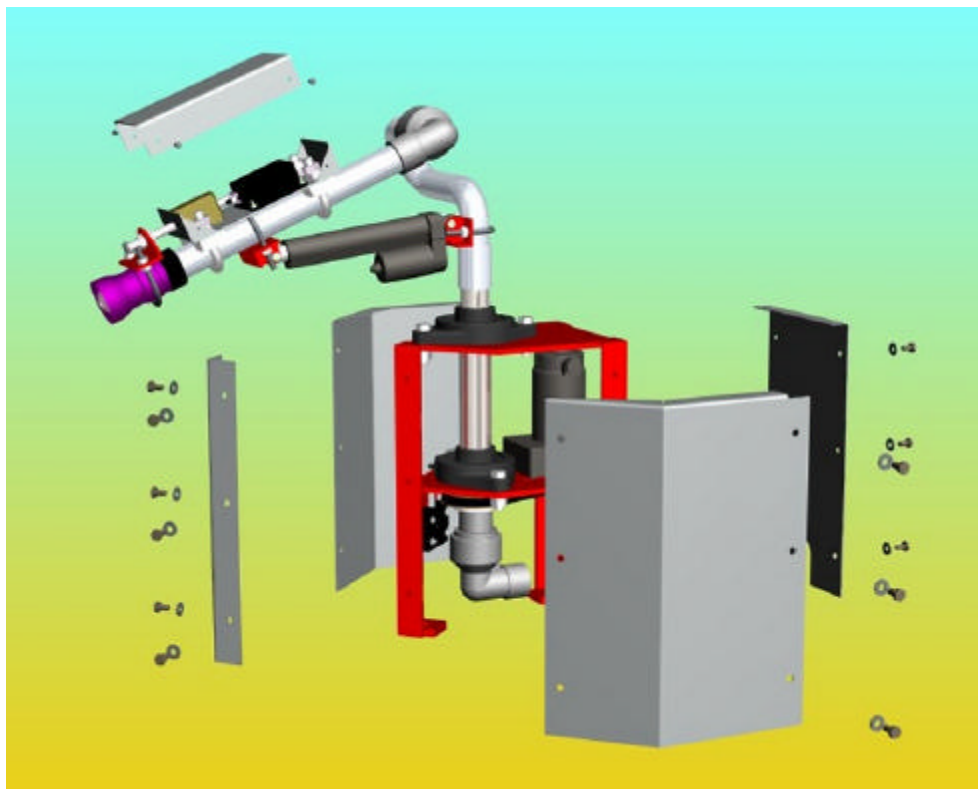


ROSCOMMON EQUIPMENT CENTER

Project Number 58

March 2000



Low Cost Remote Controlled Water Turret

Updated With a Nozzle Pattern Control

REC Project No. 58

Low Cost Remote Controlled Water Turret

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This project was started during REC's cooperative effort with the Northeast Forest Fire Supervisors. The completion was done during National Association of State Foresters funding.

Acknowledgements

The Roscommon Equipment Center would like to thank the Indiana Department of Natural Resources and the Texas A & M Engineering School for their involvement.

The Indiana Department of Natural Resources initiated the REC project, tested the design, and provided much information.

Kirk Bradley of the Michigan Department of Natural Resources, Forest Fire Experiment Station, designed the nozzle pattern control system and streamlined the overall system design.

Inquiries, comments and suggestions regarding this project may be directed to:

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Email: info@RoscommonEquipmentCenter.com

Disclaimer

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Introduction

One frequently used wildland fire suppression tactic is “pump and roll.” During a pump and roll operation, the wildland engine moves slowly along while the crew suppresses the fire. Often agency personnel rode on the engine spraying water (with a hose line) as the operator drove. Firefighter safety concerns have severely reduced this practice. Additionally, smaller budgets have made it more likely that an engine dispatches with a lone operator. These factors have increased the need for water discharge systems controlled from within the cab.

Monitor or turret water discharge devices can provide remote directional control. They are not new; however, most have been developed for high flows well past the needs of wildland fire. These systems have also carried a large price tag. Searching for a less costly solution, the Texas Engineering Extension Service approached Texas A & M’s Engineering School in the early 90’s, to develop a low cost monitor. The “Aggie Roll ‘N Squirt” was the result. In this project we refine the Roll ‘N Squirt to meet additional requirements of some member agencies.

The Roll ‘N Squirt

The Roll ‘N Squirt was a cab-top mounted design created by a senior mechanical engineering class at Texas A & M. The system consisted of a shaft through the cab roof. On top of the cab, the shaft was connected to a pipe nipple via a pivot pin; one end had a fire nozzle attached, the other end the hose line from the pump. A motorized linear actuator was used to raise and lower the nozzle. Electric controls in the cab operate the linear actuator allowing one to change the angle of elevation. The shaft revolved by means of a handle in the cab. This allowed the operator to manually direct the spray by rotation. The amount of rotation available was restricted to that allowed by the wind up of hose or electric wire. For this reason, the total rotation was substantially less than 360 degrees.

The Roll ‘N Squirt met its design criteria. It was relatively inexpensive; about \$675, although it is unclear if this figure takes all the labor into account. It provided directional control of the water discharge from within the cab. It met the general requirements for “pump and roll” at grass fires.

In 1993, the Indiana Division of Forestry purchased from Texas A & M a redesigned version of the Roll ‘N Squirt for trial. This unit utilized an additional motor and electrical control to rotate the turret rather than use the manual method. Also, Indiana preferred not to mount the unit on the cab top, thus requiring a remote rotational control. A quick connect mount was developed by Indiana which allowed the operator to move the system between a “high” mount on top of the hose reel or a “low” mount on the tank. The first position allowed operator greater range and coverage. The second better protected the system in dense cover because of its below the cab top location. The cost increased slightly but came in at about \$735. This cost included machining but not assembly labor.

Indiana found that the unit worked well in grass fuels, but that its wires, drives, and controls were vulnerable in brush and timber fuels. They submitted a proposal to REC for solutions.



Figure 1 - High mount location of turret on top of Indiana slip-on unit.

The REC Project

In 1994 the project proposal was approved and REC began a redesign. The criteria included:

- Protect vulnerable parts from brush.
- Provide for flexible mounting points, like the Indiana quick mount.
- Keep the cost low; target less than \$1000.
- Enhance features within cost parameter; continuous rotation, swivel joint hose connection and remote spray pattern control were considered.

In 1995, REC delivered a test unit to Indiana where it was field tested through 1996. The final product cost, including all labor, was just under

\$1000 and features 360 degree noncontinuous rotation, significant improvement in electrical and drive components protection and wiring design. Additionally a swivel water connection eliminated the rotation of the water supply hose with the turret.

In 1997, REC designed a simple nozzle pattern control to allow remote changes from straight stream to fog. This adds optional components to the 1995 version and also adds to the cost. In this report, the pattern control is treated as an option with the drawings showing how to build the turret with or without that option.

REC Design

The drawings for the original REC turret without the nozzle pattern control are contained in Appendix A. Appendix B is a parts list, including the parts source for purchased parts and their cost, for the original version without pattern control. Appendix C contains the drawings for the optional nozzle pattern control. Appendix D is a parts list for adding the pattern control option. The completed assembly of the original version weighs approximately 48 pounds. The pattern control adds a few more pounds.

To keep costs low and make fabrication easy, most parts are made from mild steel. An exception is the mast tube which is made from stainless steel. This part requires machining. We chose stainless because of the widespread use of class A foam. This chemical's corrosive nature makes it prudent to protect higher cost parts such as the mast tube. If you use these foam chemicals sparingly, lower cost carbon steel could be used.

The cover was made from aluminum to reduce weight. This requires TIG welding skills and equipment.

The lower plate is the other part requiring machining. Two slots must be made in this part. The other parts can be made with simple cutting and drilling methods. Assembly is done by welding and common fasteners.

Drawings 90-5807C through 90-5809C show the electrical control boxes and wiring diagrams for

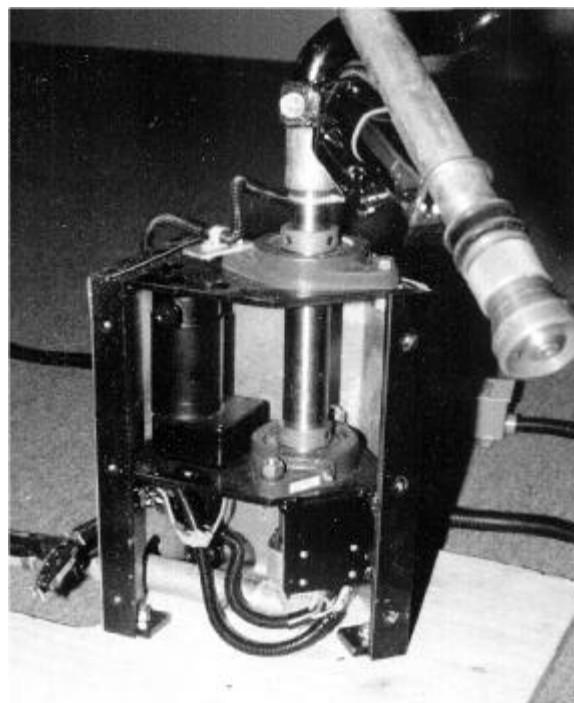


Figure 2 - Turret without nozzle pattern control. The cover is removed to show internal components.

the non-pattern control option. Drawings 90-5810C through 90-5812C should be used if the pattern control will be added. The design calls for a harness covered by automotive loom

to help protect the wires. Utilizing the harness makes connections easy and reduces the chance for improper connection after unit has been removed or relocated.

The rotation of the turret is done with a small electric motor. REC looked at designing a collector ring to allow full continuous rotation. A collector ring is a rotating electrical junction; the electrical equivalent of a plumbing swivel joint. The cost of such a device would push the total cost above that of the criteria. Instead, the unit was designed for 360 degrees noncontinuous rotation controlled by limit switches. Hence, it will rotate one full revolution but rotation must be reversed at the end of one revolution. This creates what can be called a “dead spot” in the pattern.

The design allows this “dead spot” to be adjusted to an area of minimal user ease, i.e., where the operator has limited visibility already. To adjust the “dead spot”:

- First rotate the turret using the control switch until it contacts one of the rotational limit switches and stops. Remove the side covers.
- Loosen the set screws (4) in the drive collar (see drawing 90-5806C).
- Rotate the turret by hand to the desired location for the “dead spot.”
- Tighten set screws and install side covers.

Nozzle Pattern Adjustment Option

The remote nozzle pattern operation requires a third electric switch, its accompanying wiring, a modified nozzle and an additional linear actuator. This is an option that is not required. It is not necessary for those planning to use straight nozzle tips or aerated foam nozzles on the turret.

It will cost approximately \$250.00 to add this option, of which \$185.00 will be for parts and material. We used a 1 inch aluminum variable pattern nozzle for delivering the water. The NFES #1081 aluminum barrel 1 inch by 11-1/2 inch NPSH nozzle works well when modified as shown in drawing no. 26-0068B. These nozzles also are identified as National Stock Number 4210-01-165-6603, if purchasing through Federal Supply Service. They can also be purchased direct from:

Teems, Inc.,
1281 D. Logan Avenue
Costa Mesa, CA 92620

The nozzle barrel threads onto the nozzle’s hose connection body. These threads are machined off allowing the barrel to “trombone” on the body. The movement changes the pattern. The linear actuator, when assembled as shown in the drawings, slides the barrel back and forth along the nozzle body, changing the spray pattern.

The additional hardware needed for the nozzle pattern control can be mounted without modifying the original turret design. The electric wiring and control box will be slightly different. Because of this, we provide separate electric diagrams for the pattern control option. Installing the additional switch reduces the room inside the control box. Because of this, the fuse must be located outside the control box.

We looked at having a remote, electric operated shutoff for the turret. This would be very useful. Unfortunately, we could not find a relatively inexpensive water control valve that could handle high pressures. If you use a low pressure pump (under 100 psi), you might find a suitable valve.

We also looked at having the pattern control’s linear actuator shut the water flow by closing the nozzle completely. The actuator did not have enough force to open the nozzle at pressures above 125 psi. Hence, the design requires that the actuator stroke be adjusted so that the nozzle does not close all the way. Drawing 26-0069B shows how to make that adjustment so that the pattern control works properly.

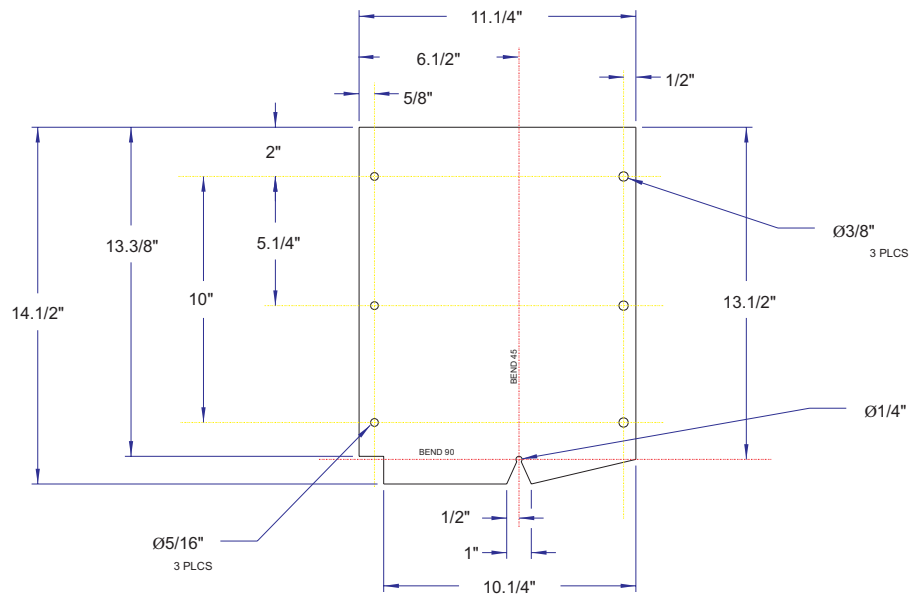
Simple, In Cab Water System Controls

The remote control nozzle system described in this report provides an alternative to past pump and roll techniques where firemen rode with a nozzle on the truck outside of the operator's compartment. It is by no means the only method nor the least expensive. Several other concepts have been used in the past.

- Pulling the booster line into the cab. You cannot get simpler than this! We have not seen this method documented in print, but know that many engine crews have pulled line off the reel and into the cab with them so they can deliver water as they drive. A few have found that a sliding rear cab window makes it easier to get the hose in the cab.
- High pressure spray gun. Industrial and agricultural trigger-type spray guns work great from inside the cab. They are low volume, easy to control and turn on or off with one hand. The Michigan Department of Natural Resources (MDNR) has used these successfully for 20 years. They can be plumbed directly into the cab with a short ½ inch ID hose and a swivel connection. Flows are about 10 gpm, depending on the size of the orifice disk. The pattern changes from mist to straight stream controlled by the trigger squeeze. Spraying Systems Company, North Avenue & Schmale Road, Wheaton, Illinois 60188, Model 43HA-AL-12 with 11990-19 swivel fitting is a good example. It is rated at 800 psi and costs about \$75.00.
- Fender nozzle system. Low flow "V" jet-type nozzles mounted at the front corners of an engine are ideal for hands free fireline control. REC's Project #39, Tanker Handbook: Military 5-Ton 6x6, 1500 Gallon Low Profile Tanker, shows such a system. A pipe fitting manifold can be plumbed under the operator's seat with valves to control each nozzle. The spray distance for this type of system is limited and the spray direction can be controlled only by maneuvering the vehicle.

Appendix A
Drawings: REC Turret Without Nozzle Pattern Control

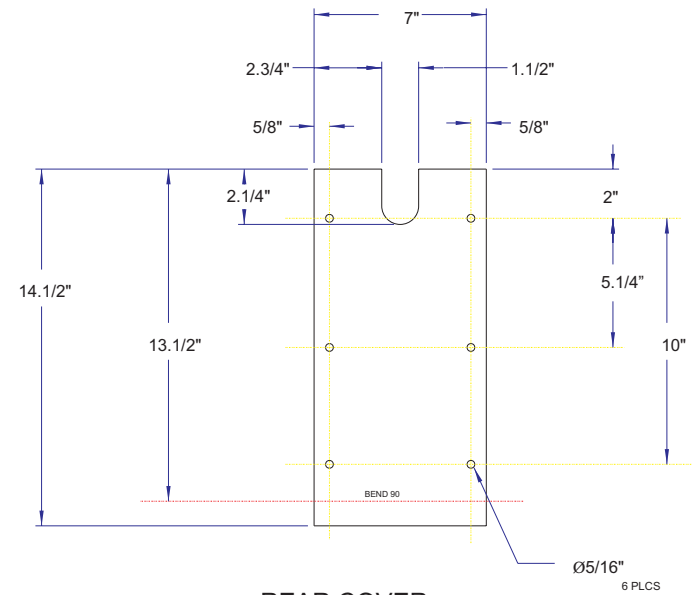
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90-5802C	Cover Assembly	Includes front, side, rear covers and their installation.
90-5803C	Mast Frame	Includes mast parts and welding instructions.
90-5804C	Monitor Details	Parts for turret construction.
90-5805C	Remote Control Monitor	Turret hardware overview.
90-5806C	Monitor Assembly	Parts and assembly information for turret hardware.
90-5807C	Monitor Control Wiring	Wiring diagram for control box.
90-5808C	Monitor Harness	Electrical harness between monitor and controls.
90-5809C	Monitor Wiring	Electrical diagram within turret hardware.



SIDE COVER

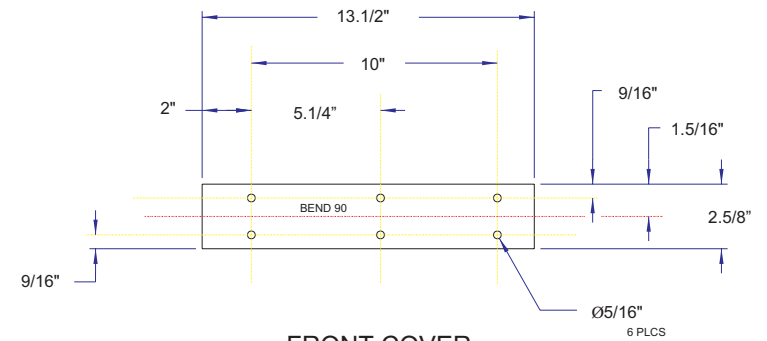
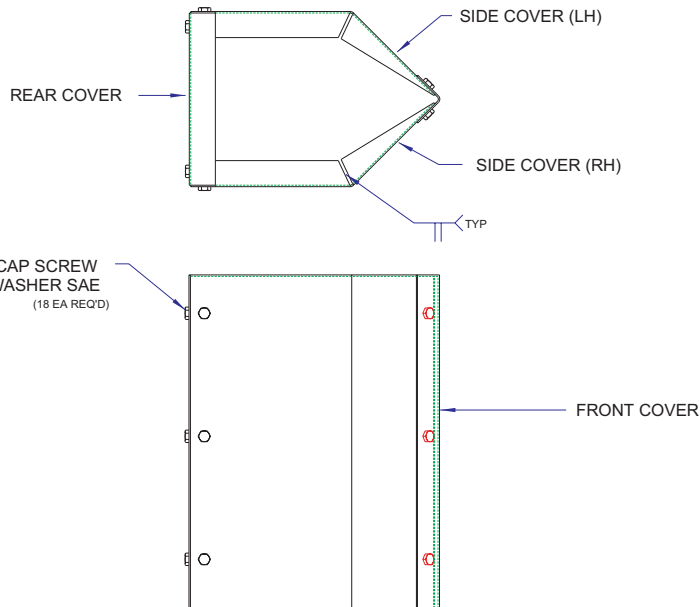
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LEFT HAND-BEND DOWN
RIGHT HAND-BEND UP



REAR COVER

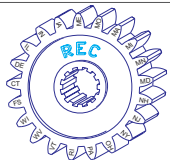
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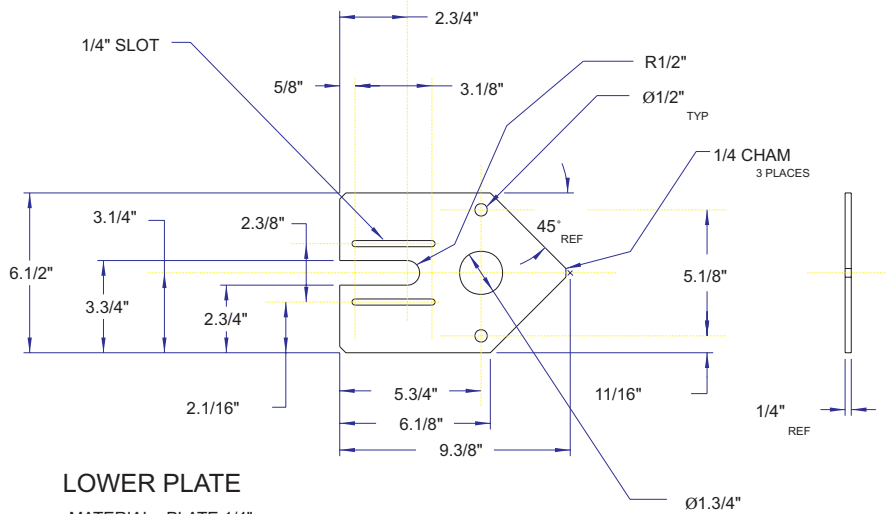


FRONT COVER

MATERIAL: SHEET .063"
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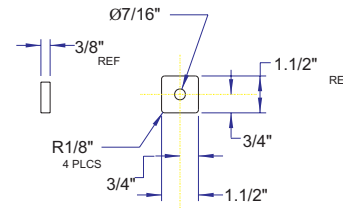
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REVISION			
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P.O. BOX 68 ROSCOMMON, MICHIGAN 48653			
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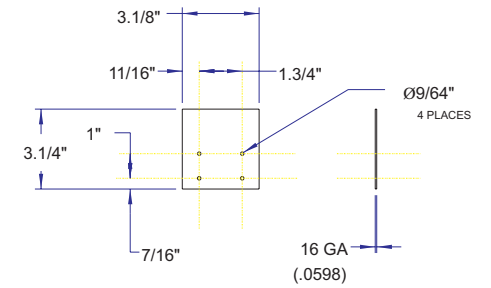
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MATERIAL: PLATE 1/4"



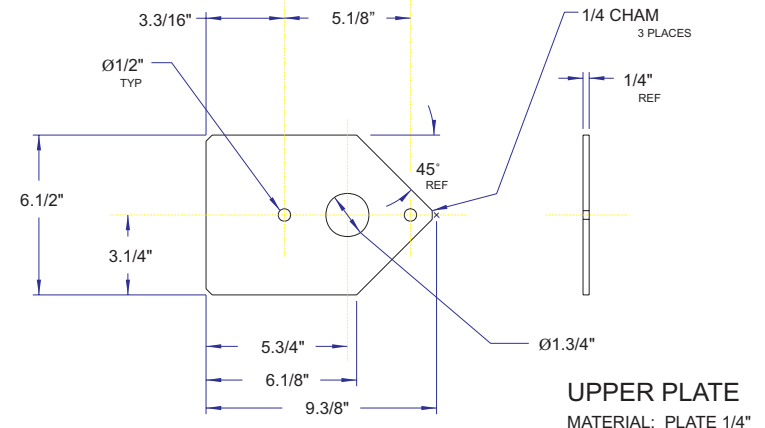
FOOT

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 3/8 X 1.1/2 HR
 (3 REQ'D)



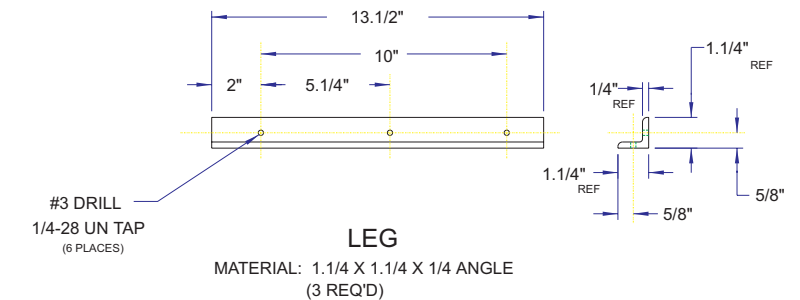
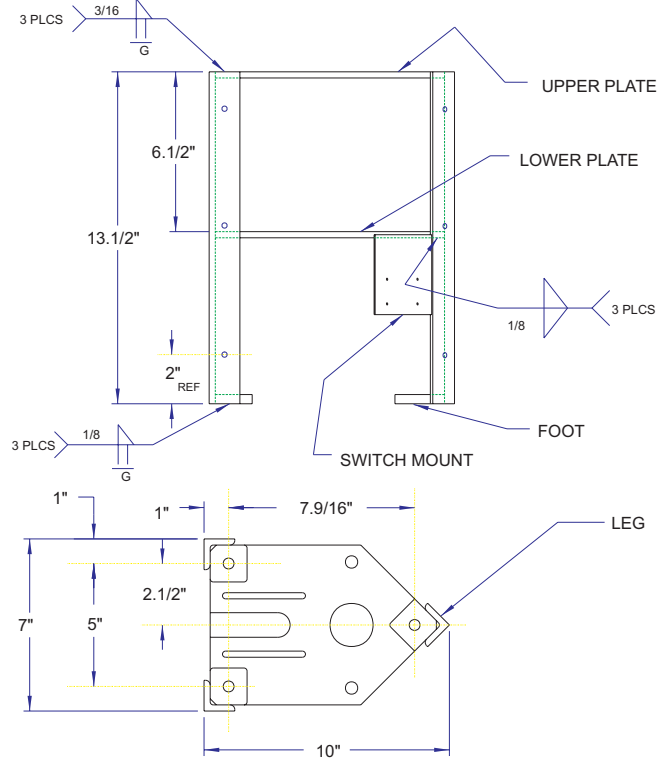
SWITCH MOUNT

MATERIAL: SHEET 16 GA



UPPER PLATE

MATERIAL: PLATE 1/4"



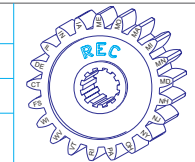
LEG

MATERIAL: 1.1/4 X 1.1/4 X 1/4 ANGLE
 (3 REQ'D)

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	REVISION		

FOREST FIRE EXPERIMENT STATION

P.O. BOX 68 ROSCOMMON, MICHIGAN 48653



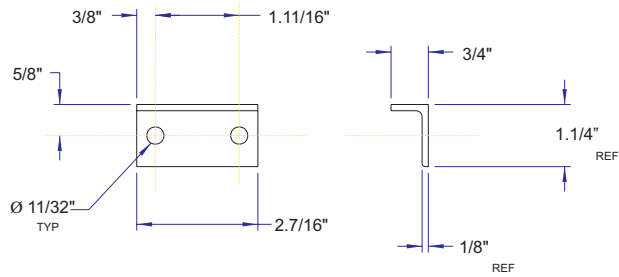
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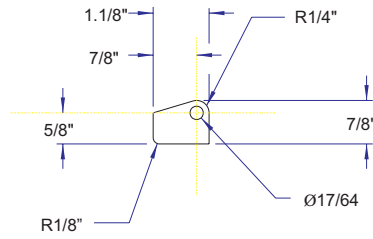
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DATE: 9/15/96

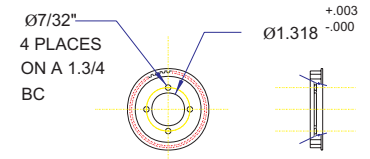
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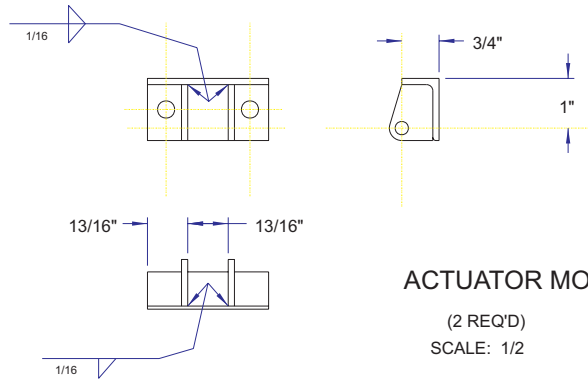


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(2 REQD PER ACTUATOR MOUNT)
SCALE: 1/2



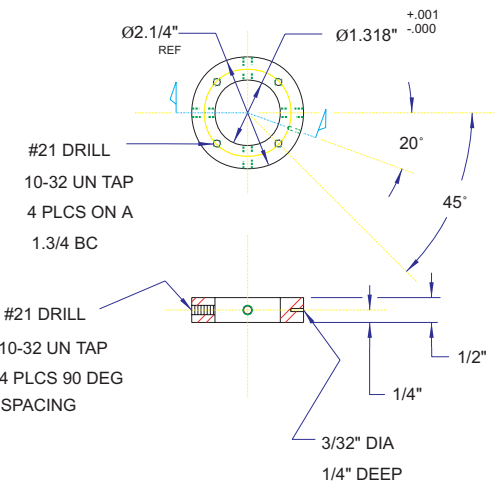
PULLEY

MAKE FROM 5mm X 50 TOOTH PULLEY



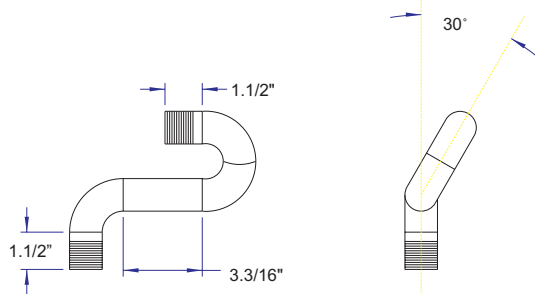
ACTUATOR MOUNT

(2 REQ'D)
SCALE: 1/2



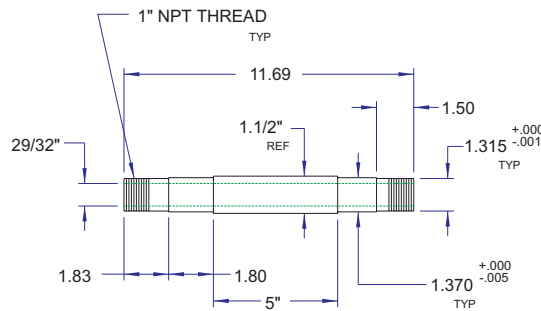
DRIVE COLLAR

MATERIAL: BAR, RD 2.1/4" DIA CD



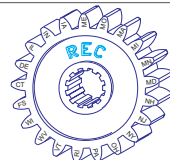
TURRET FITTING

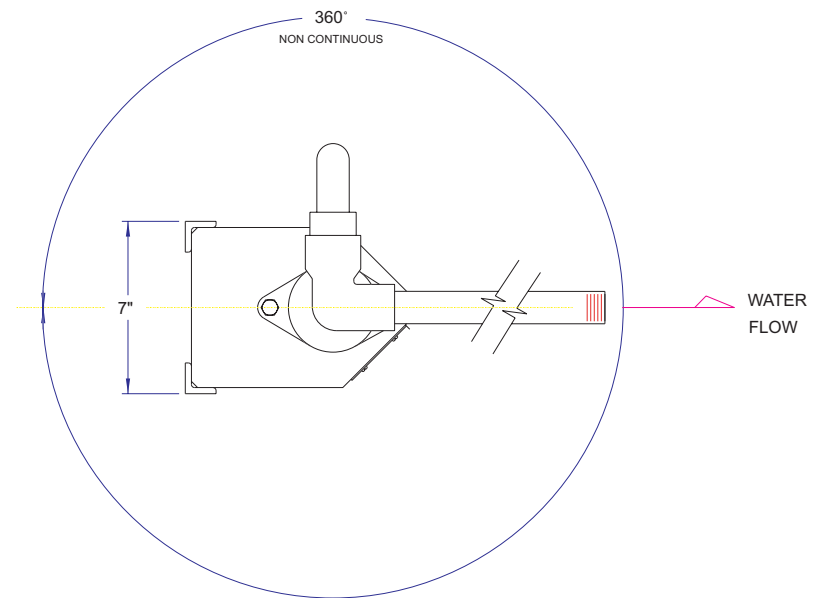
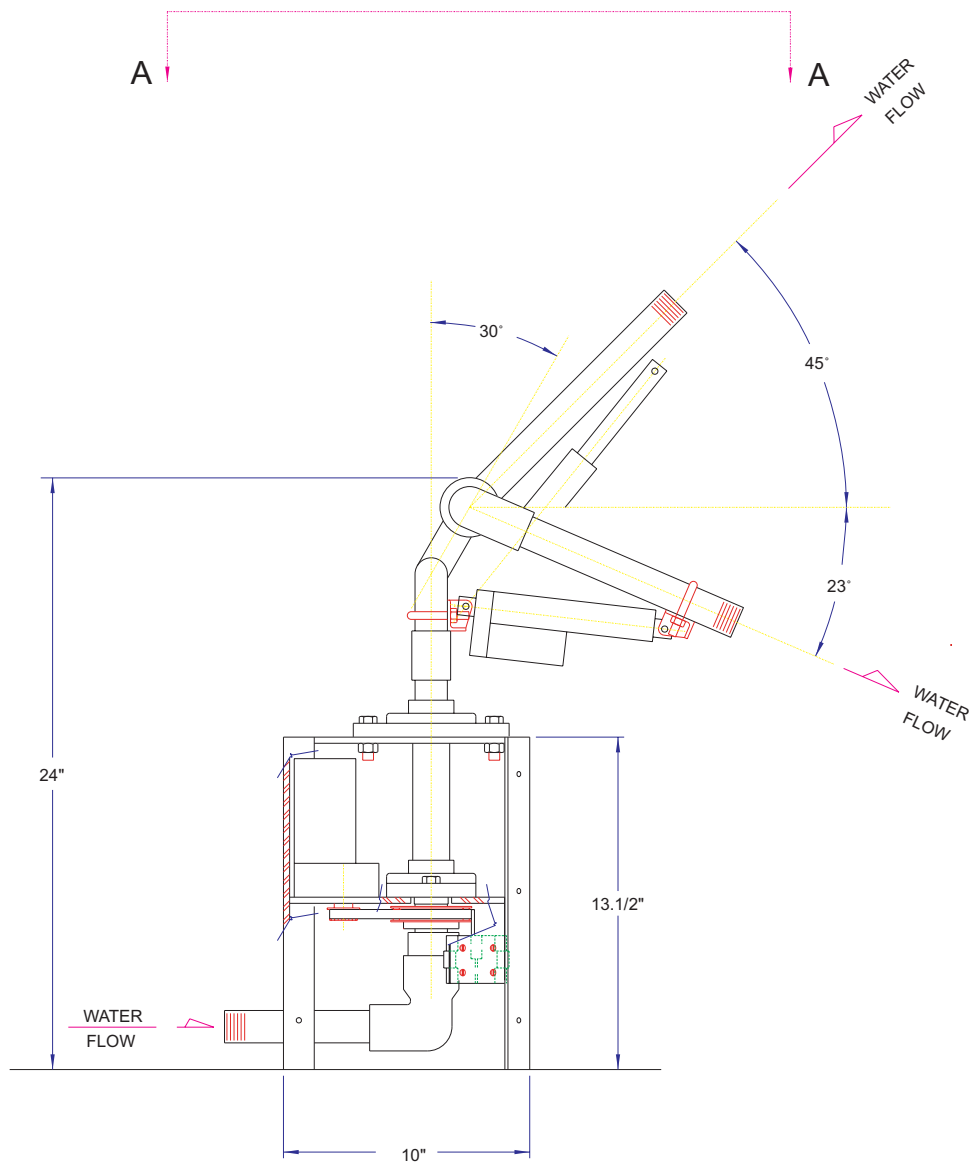
MATERIAL: PIPE NIPPLE, 1" X 6.1/2" LONG
SCHEDULE 40 BLACK (QTY 1)
ELBOW, BUTT WELD 90
1" LONG RADIUS (QTY 2)



MAST TUBE

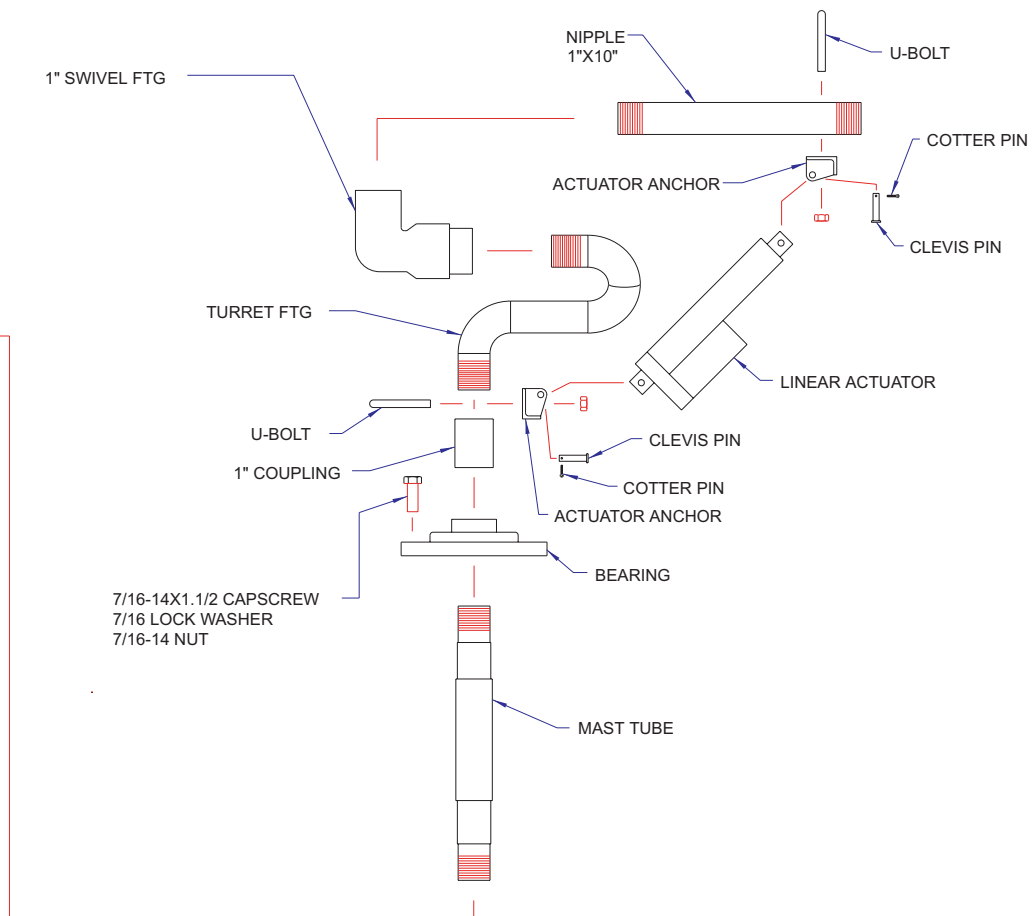
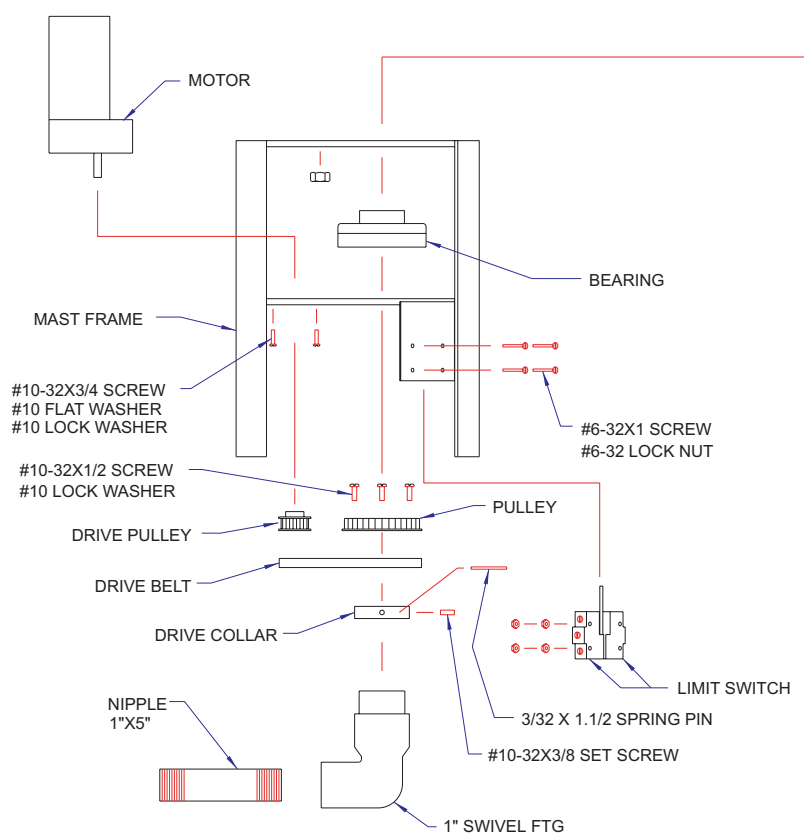
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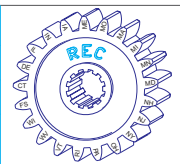


VIEW A-A

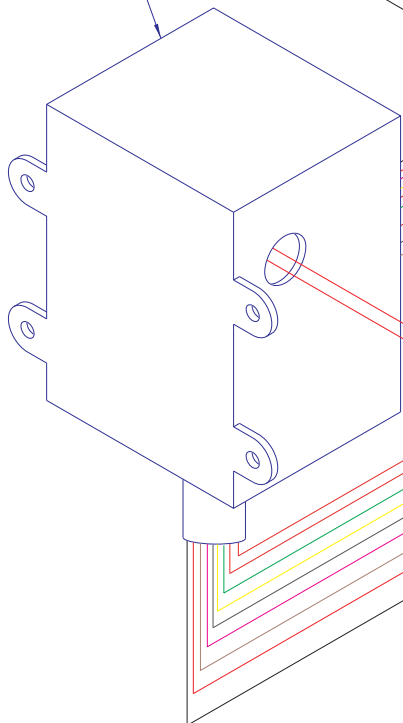
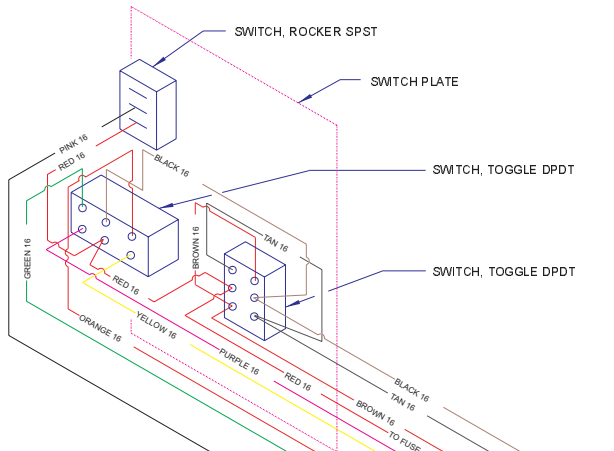
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NO. BY DATE REVISION		PROJECT NO.: REC 58	
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LESS COVERS	SCALE: 1/4	DATE: 9/15/96	DWG. NO. 90-5805C



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2 PLACE +.001					
3 PLACE +.0005					
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BOX, RECEPTICAL SINGLE GANG
PLASTIC, WEATHERPROOF



FUSE HOLDER PANEL MOUNT
FUSE 10 AMP AGC TYPE

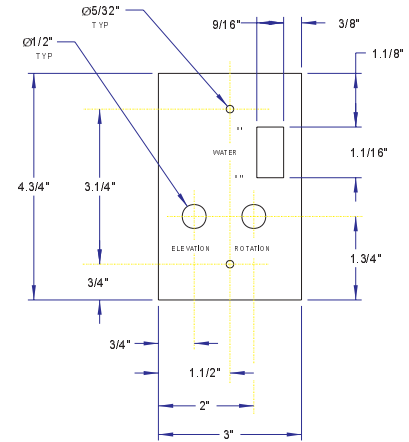
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CONNECTOR, PIN 20-14 GA WIRE

CONNECTOR, 2 WIRE PIN HSG
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CONNECTOR, 2 WIRE PIN HSG
CONNECTOR, PIN 20-14 GA WIRE

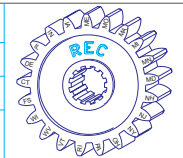
TO CHASSIS GROUND
TO 12 V DC POWER



SWITCH PLATE
LABEL AS SHOWN
SCALE 1/2

MATERIAL: SHEET .063" THICK
3003 ALUMINUM

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BEYOND 6/32 ± .118		KDB	
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2 PLACE ± .001			
3 PLACE ± .0005			
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FOREST FIRE EXPERIMENT STATION

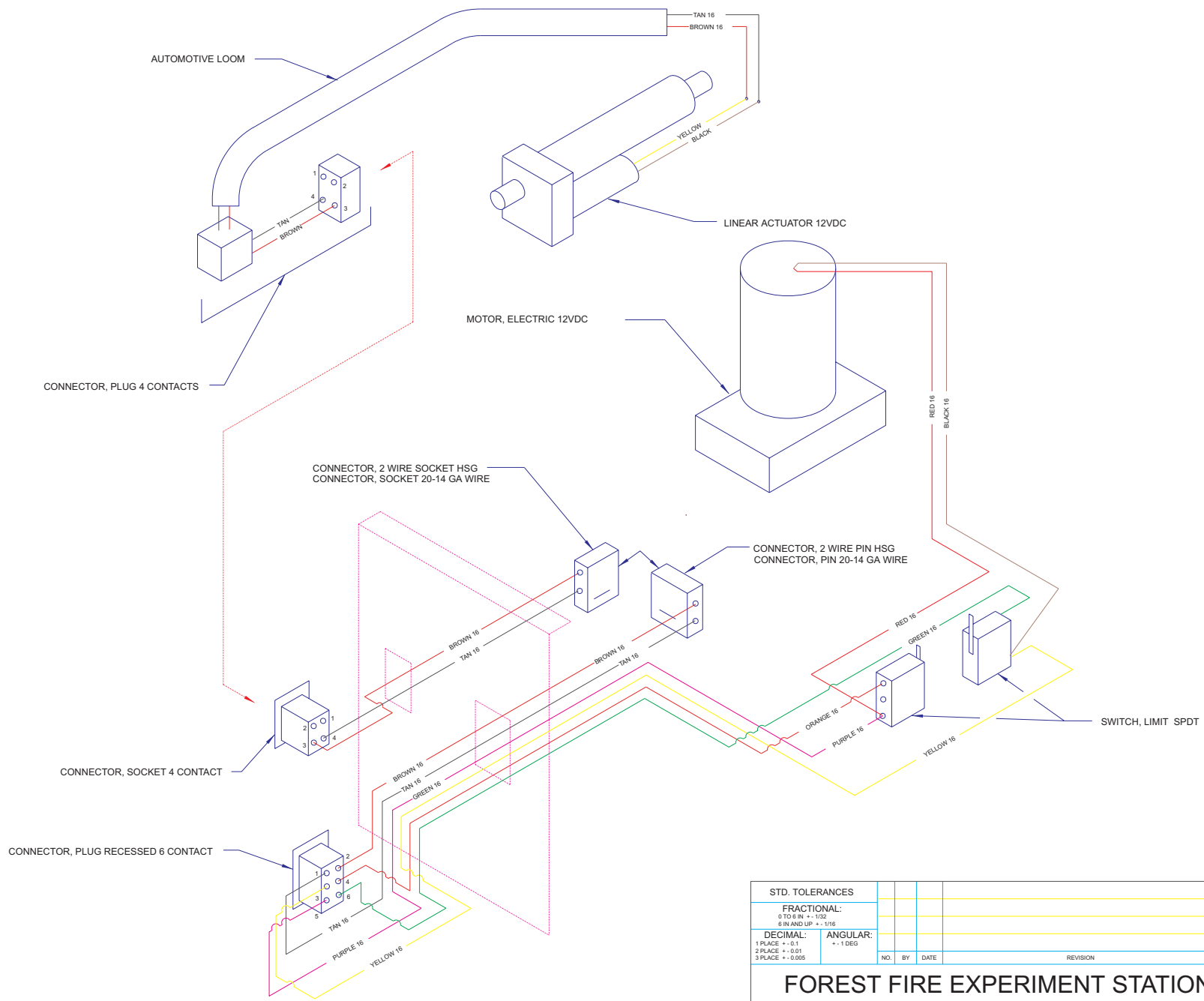
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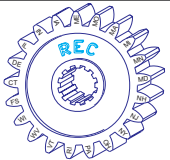
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DWG. NO. 90-5807C



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NO.	BY	DATE	REVISION												

DRAWN:
LLP
CHECKED:
KDB
APPROVED:



FOREST FIRE EXPERIMENT STATION

P.O. BOX 68 ROSCOMMON, MICHIGAN 48653

PROJECT NO.: REC 58

TITLE: MONITOR WIRING

SCALE: NONE

DATE: 9/25/96

DWG. NO. 90-5809C

Appendix B - Parts List for REC Turret Without Nozzle Pattern Control

Item	Qty	Units	Cost				Material	Manufacturer	Part Number	Information Location		
			Labor Hours	Each		Total				Detail	Assembly	Electric
				Labor	Mat'l							
Actuator Mount	2	EA	0.7	14.00	1.50	31.00	Steel Angle/Bar		90-5804C	90-5806C	90-5809C	
Actuator, Linear 12VDC	1	EA			122.00	122.00	Purchased	Warner Electric	Electrak 1 w/Limit switches		90-5806C	
Automotive Loom 3/4	10	FT			1.01	10.10	Purchased	McMaster Carr	7609K4		90-5807C, 90-5808C & 90-5809C	
Automotive Loom 3/8	5	FT			0.75	3.75	Purchased	McMaster Carr	7609K2		90-5807C, 90-5808C & 90-5809C	
Bearings, Flanged	2	EA			20.75	41.50	Purchased	Fafnir	SCJT 1 3/8		90-5806C	
Belt, Timing	1	EA			6.88	6.88	Purchased	Stock Drive Products	A 6R25M072090		90-5806C	
Box, Switch	1	EA	0.1	2.00	4.57	6.57	Purchased	Local Hardware			90-5807C	
Connector, 2 Wire Pin Housing	3	EA			0.21	0.63	Purchased	Allied Electronics	512-1455		90-5807C & 90-5809C	
Connector, 2 Wire Socket Housing	3	EA			0.20	0.60	Purchased	Allied Electronics	512-1405		90-5807C, 90-5808C & 90-5809C	
Connector, 6 Wire Pin Housing	1	EA			0.37	0.37	Purchased	Allied Electronics	512-1470		90-5807C	
Connector, 6 Wire Socket Housing	1	EA			0.44	0.44	Purchased	Allied Electronics	512-1420		90-5808C	
Connector, Pin 20-14 Ga Wire	11	EA			0.12	1.31	Purchased	Allied Electronics	512-1401		90-5807C & 90-5809C	
Connector, Plug 2 Contact	1	EA			3.68	3.68	Purchased	Allied Electronics	750-3300		90-5808C	
Connector, Plug 4 Contact	1	EA			2.61	2.61	Purchased	Allied Electronics	750-3104		90-5809C	
Connector, Plug 6 Contact Recessed	1	EA			3.09	3.09	Purchased	Allied Electronics	750-3107		90-5809C	
Connector, Socket 2 Contact	1	EA			3.76	3.76	Purchased	Allied Electronics	750-3301		90-5808C	
Connector, Socket 20-14 Ga Wire	11	EA			0.12	1.31	Purchased	Allied Electronics	512-1402		90-5807C, 90-5808C & 90-5809C	
Connector, Socket 4 Contact Recessed	1	EA			3.39	3.39	Purchased	Allied Electronics	750-3401		90-5809C	
Connector, Socket 6 Contact	1	EA			3.28	3.28	Purchased	Allied Electronics	750-3402		90-5808C	
Coupling 1" Galvanized	1	EA			1.75	1.75	Purchased	McMaster Carr	4638K166		90-5806C	
Cover, Front	1	EA	0.2	4.00	4.56	8.56	3003 Aluminum .063"			90-5802C	90-5802C	
Cover, Rear	1	EA	0.3	6.00	4.56	10.56	3003 Aluminum .063"			90-5802C	90-5802C	
Cover, Side (LH)	1	EA	0.5	10.00	4.56	14.56	3003 Aluminum .063"			90-5802C	90-5802C	
Cover, Side (RH)	1	EA	0.5	10.00	4.56	14.56	3003 Aluminum .063"			90-5802C	90-5802C	
Drive Collar	1	EA	1.5	30.00	2.00	32.00	Steel Plate			90-5804C	90-5806C	
Elbow, Swivel 1"	2	EA			57.1	114.20	Purchased	Aeroquip	FS590000-1616-01		90-5806C	
Fuse Holder, Panel Mount	1	EA					Purchased	McMaster Carr	7087K17		90-5807C	
Fuse, AGC 10A	1	EA			0.33	0.33	Purchased	McMaster Carr	7085K79 15 AMP		90-5807C	
Mast Frame	1	EA	1.8	36.00	10.00	46.00	Steel Plate/Angle/Bar			90-5803C	90-5806C	
Mast Tube	1	EA	2.5	50.00	18.32	68.32	316 Stainless Stl 1 1/2" Dia			90-5804C	90-5806C	
Misc Fasteners					5.00	5.00	Purchased					
Motor, Electric 12VDC	1	EA			84.90	84.90	Purchased	W. W. Grainger	1L478		90-5806C	
Nipple 1" x 10" Galvanized	1	EA			4.10	4.10	Purchased	McMaster Carr	4549K624		90-5806C	
Nipple 1" x 5" Galvanized	1	EA			2.12	2.12	Purchased	McMaster Carr	4549K618		90-5806C	
Pin, Clevis	2	EA			0.15	0.30	Purchased	McMaster Carr	98340A120		90-5806C	
Pin, Cotter	2	EA			0.04	0.09	Purchased	McMaster Carr	98355A010		90-5806C	
Pin, Spring 3/32 Dia x 11/2 Long	1	EA			0.05	0.05	Purchased	McMaster Carr	92383A216		90-5806C	
Pulley 18 tooth	1	EA			8.27	8.27	Purchased	Stock Drive Products	A 6A25M018DF0908		90-5806C	
Pulley 50 tooth	1	EA	0.4	8.00	7.62	15.62	Purchased & Modified	Stock Drive Products	A 6Z25M050SF0912	90-5804C	90-5806C	
Switch Plate	1	EA	0.3	6.00		6.00	3003 Aluminum .063"				90-5807C	
Switch Plate	1	EA	0.2	4.00	1.50	5.50	3003 Aluminum .063"			90-5807C	90-5807C	
Switch, Limit SPDT ON-ON	2	EA			5.64	11.28	Purchased	W. W. Grainger	6X289		90-5806C	
Switch, Rocker SPST ON-OFF	1	EA			2.95	2.95	Purchased	Allied Electronics	683-0117		90-5807C	
Switch, Toggle DPDT (ON)OFF(OFF)	2	EA			13.94	27.88	Purchased	Allied Electronics	826-8904		90-5807C	
Terminal, Quick Slide 1/4" 16-14 Ga	2	EA			0.30	0.60	Purchased				90-5807C	
Terminal, Ring #8 16-14 Ga	18	EA			0.10	1.80	Purchased	Allied Electronics	512-5288		90-5807C & 90-5809C	
Turret fitting	1	EA	0.75	15.00	10.00	25.00	Purchased			90-5804C	90-5806C	
U-Bolt for 1" pipe	2	EA			0.59	1.18	Purchased	McMaster Carr	3043T24		90-5806C	
Wire 16Ga (Various Colors)	75	FT			0.09	6.75	Purchased				90-5807C, 90-5808C & 90-5809C	
Assembly Labor			10	200.00		200.00						

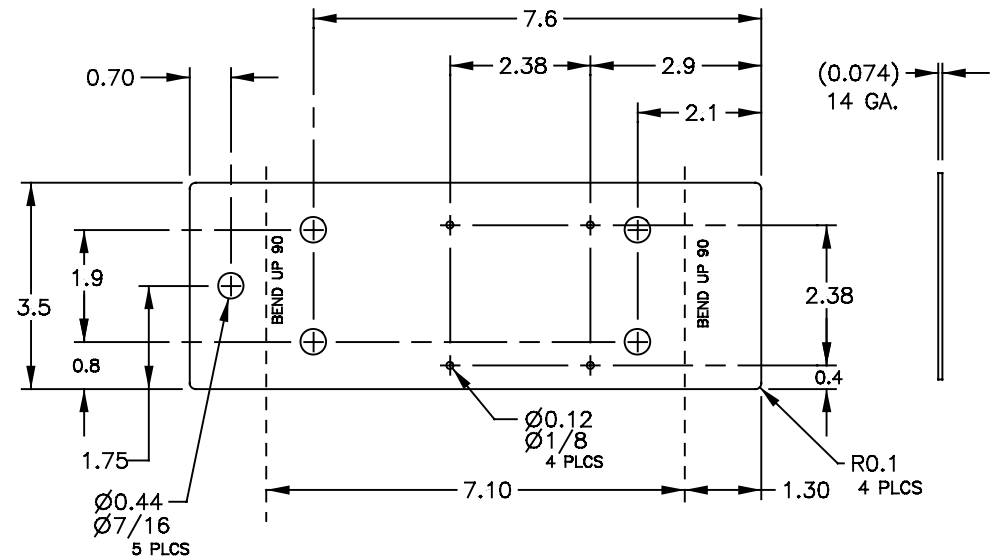
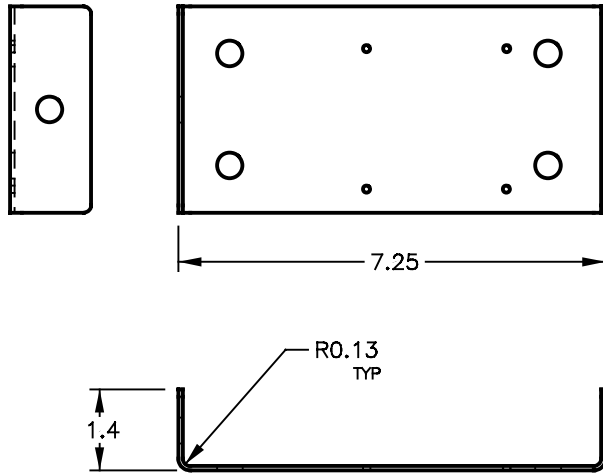
Labor	Parts	Total
Total	395.00	571.48
		966.48

Appendix C

Drawings: Optional Nozzle Pattern Control

Drawing	Drawing Name	Description
26-9808B	Nozzle Assembly	Overall hardware assembly for pattern control option.
00-1292B	Mount Base	
00-1310A	Mount Gusset	
00-1309A	Rod Guide	
00-1289A	Connector Tab	
00-1288A	Rod	
26-0043B	Nozzle 1" Aluminum	Purchasing specification for nozzle.
26-0063A	Rod W/C	
26-0064B	Actuator Mount W/C	
26-0065B	Actuator Mount Cover	
26-0066A	Spacer	
26-0067A	Nozzle Angle	
26-0068B	Nozzle 1 IN w/Thread Modifications	Instructions for modifying part 26-0043.
26-0069B	Nozzle Adjustment	Instructions for proper nozzle adjustment.
28-3101B	Actuator	
33-0070B	U-Bolt W/Base 1" Pipe	
90-5810C	Monitor Control Wiring	Wiring diagram for control box.
90-5811C	Monitor Harness	Electrical harness between monitor and controls.
90-5812C	Monitor Wiring	Electrical diagram within turret hardware.

NOTE: 90-5810C, 90-5811C, and 90-5812C, are wiring diagrams for the turret with nozzle pattern control and replace 90-5807C, 90-5008C, and 90-5009C, listed in Appendix A, when the pattern control option is desired.

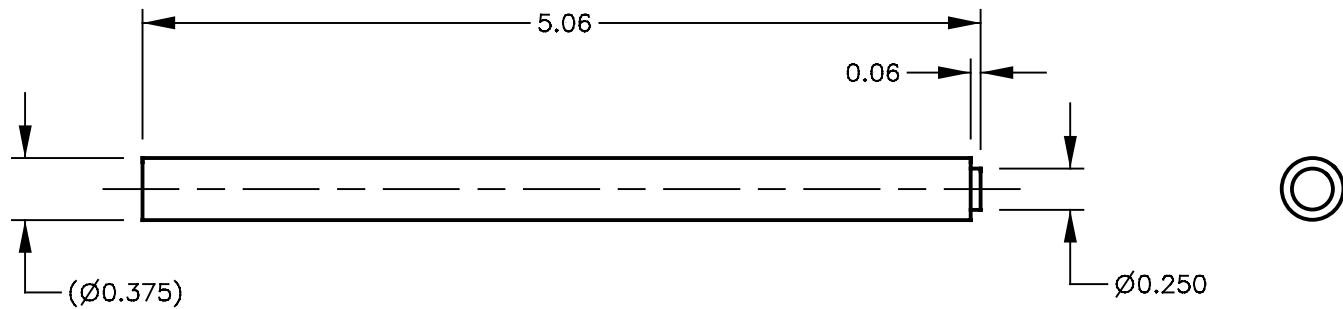


FLAT LAYOUT


PART NO: 00-1292
 MAT'L: SHEET, 14 GA 4 X 8 HR P&O
 ASTM A569
 FFES SPEC NO: AA-G1448AP
 EST WT: 0.70 LBS

STD. TOL.						DRAWN: DGP
DECIMAL:						CHECKED: KDB
1 PLACE + - 0.06						APPROVED:
2 PLACE + - 0.03						
3 PLACE + - 0.005						
ANGULAR:	NO.	BY	DATE	REVISION		
+ - 1 DEG.						
DATE: 12/08/99	FOREST FIRE EXPERIMENT STATION					
SCALE: 1/2	P.O. BOX 68 ROSCOMMON, MICHIGAN 48653					
PROJECT NO.: REC 58	TITLE: MOUNT BASE					
	DWG. NO. 00-1292B					



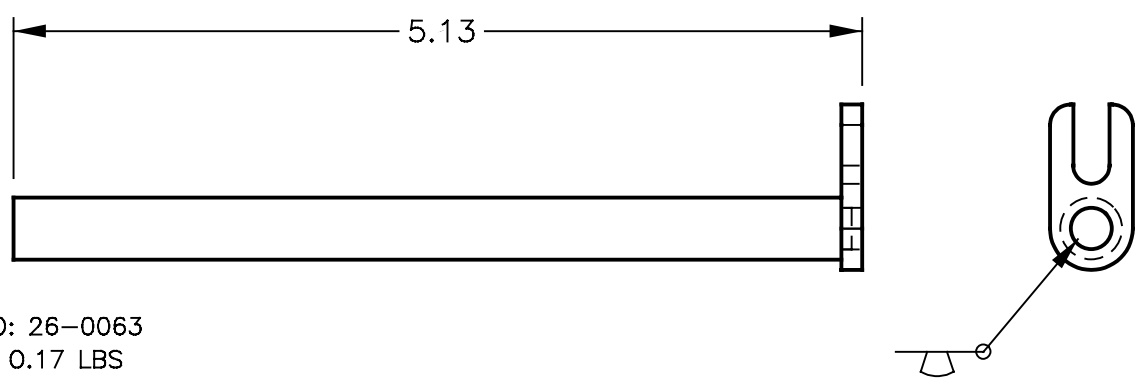


PART NO: 00-1288
 MAT'L: BAR, RD 3/8 DIA CD
 G10200
 FFES SPEC NO: AC-00375AW
 EST WT: 0.16 LBS


STD. TOL.						DRAWN: DGP	 DNR FOREST MANAGEMENT DIVISION
DECIMAL: 1 PLACE + - 0.06 2 PLACE + - 0.03 3 PLACE + - 0.005						CHECKED: KDB	
ANGULAR: + - 1 DEG.						APPROVED:	
DATE: 12/09/99	NO.	BY	DATE	REVISION			
SCALE: 1/2	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653						
PROJECT NO.: REC-58	TITLE: ROD						DWG. NO. 00-1288A

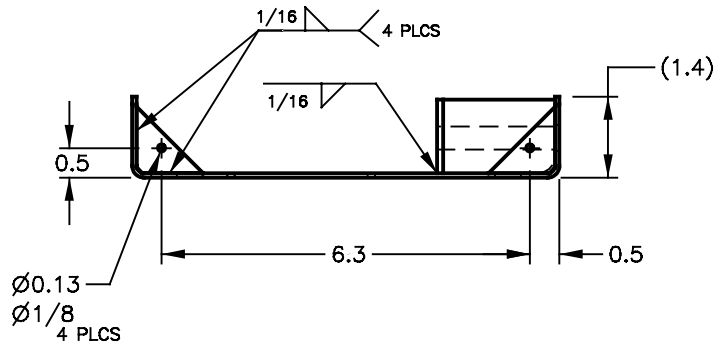
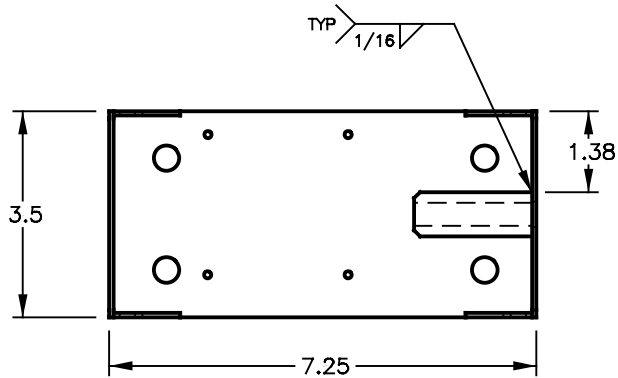
COMPONENT LIST

ITEM	PART NO	DWG	DESCRIPTION	QTY
1	00-1288	B	ROD	1
2	00-1289	A	CONNECTOR TAB	1



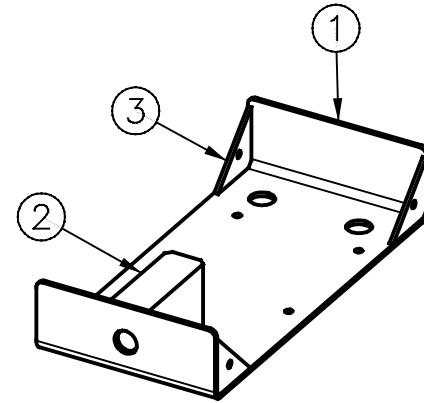
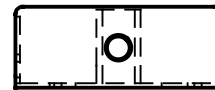
PART NO: 26-0063
EST WT: 0.17 LBS


STD. TOL.						DRAWN: DGP	 DNR FOREST MANAGEMENT DIVISION
DECIMAL: 1 PLACE + - 0.06 2 PLACE + - 0.03 3 PLACE + - 0.005						CHECKED: KDB	
ANGULAR: + - 1 DEG.	NO.	BY	DATE	REVISION		APPROVED:	
DATE: 12/09/99	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653						
SCALE: FULL							
PROJECT NO.: REC 58	TITLE: ROD W/C					DWG. NO. 26-0063A	

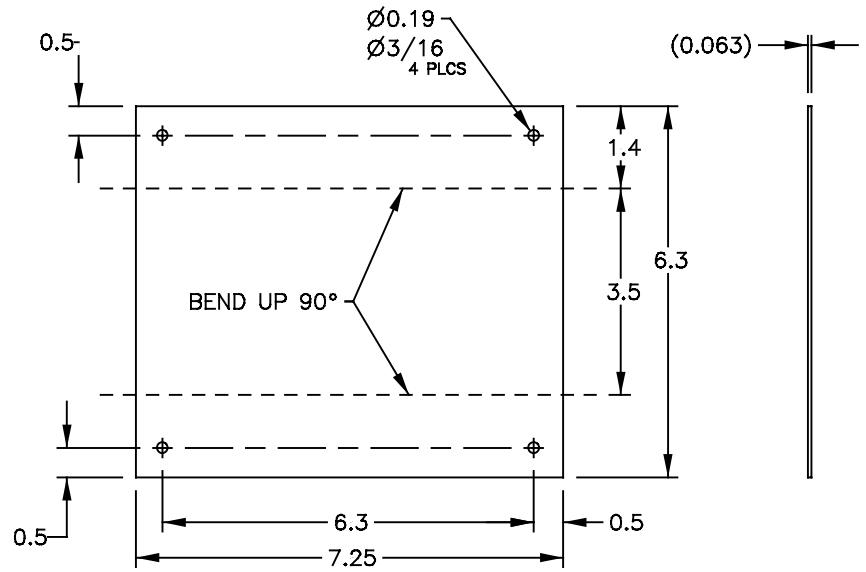
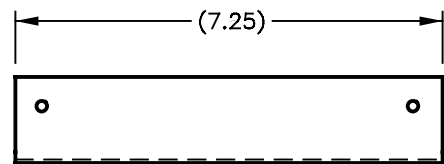
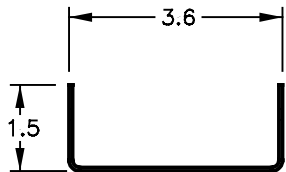


PART NO: 26-0064
EST WT: 1.30 LBS

COMPONENT LIST				
ITEM	PART NO	DWG	DESCRIPTION	QTY
1	00-1292	B	MOUNT BASE	1
2	00-1309	A	ROD GUIDE	1
3	00-1310	A	MOUNT GUSSET	4




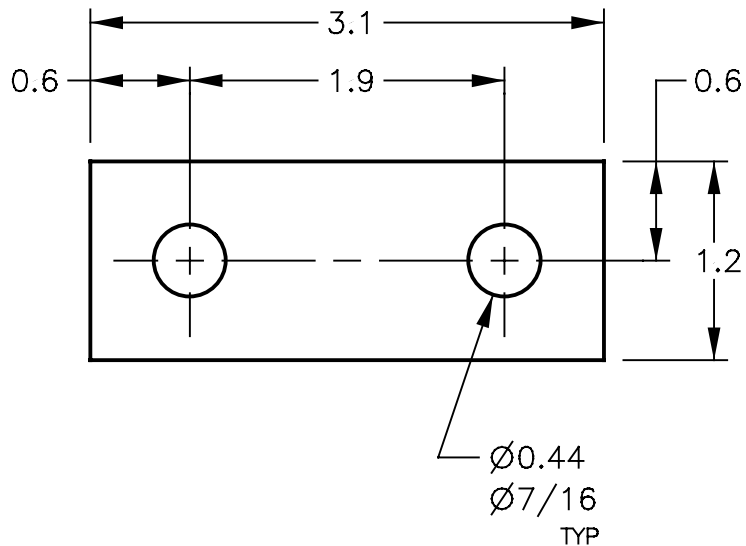
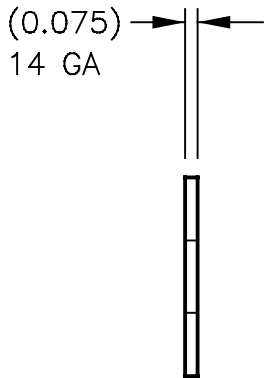
STD. TOL.						DRAWN: DGP	 DNR FOREST MANAGMENT DIVISION
DECIMAL:						CHECKED: KDB	
1 PLACE + - 0.06 2 PLACE + - 0.03 3 PLACE + - 0.005						APPROVED:	
ANGULAR: + - 1 DEG.	NO.	BY	DATE	REVISION			
DATE: 12/09/99	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653						
SCALE: 1/2							
PROJECT NO.: REC-58	TITLE: ACTUATOR MOUNT W/C						DWG. NO. 26-0064B




FLAT LAYOUT

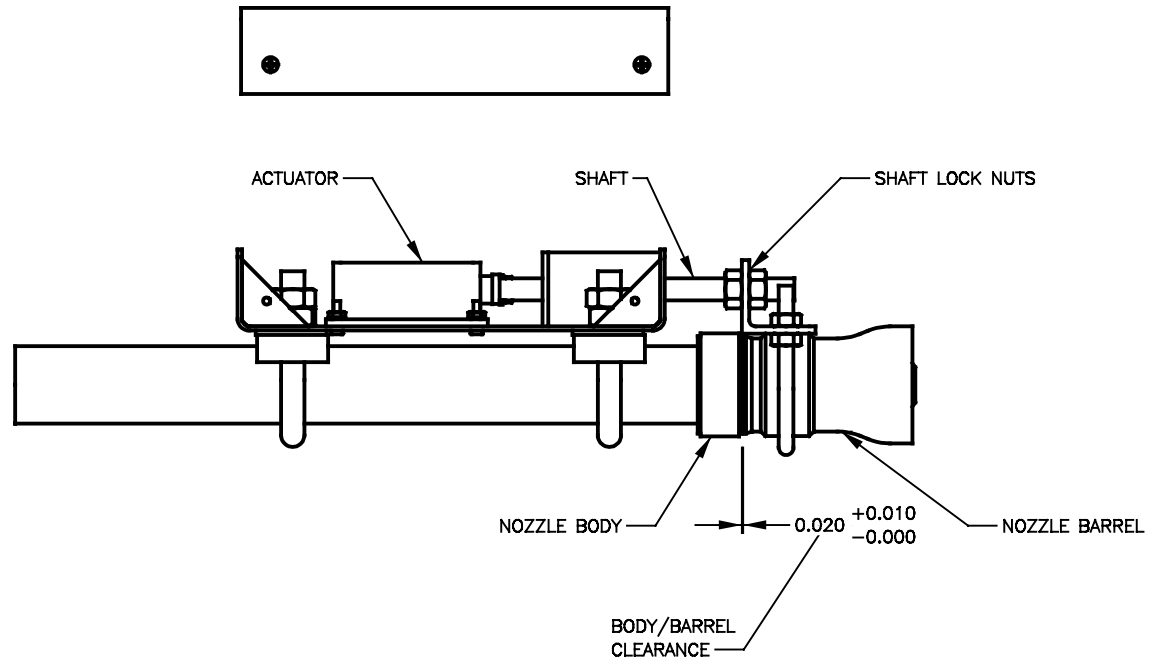
PART NO: 26-0065
 MAT'L: SHEET, 1/16" ALUMINUM
 USN A93003
 FFES SPEC NO: AA 06238AT
 EST WT: 0.29 LBS

STD. TOL.						DRAWN: DGP	 DNR FOREST MANAGEMENT DIVISION	
DECIMAL: 1 PLACE +- 0.06 2 PLACE +- 0.03 3 PLACE +- 0.005						CHECKED:		
ANGULAR: +- 1 DEG.						APPROVED:		
DATE: 12/09/99	NO.	BY	DATE	REVISION			FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653	
SCALE: 1/2	PROJECT NO.: REC-58						TITLE: ACTUATOR MOUNT COVER	DWG. NO. 26-0065B



PART NO: 26-0066
 MAT'L: SHEET, 14 GA 4 X 8 HR P&O
 ASTM A569
 FFES SPEC NO: AA-G1448AP
 EST WT: 0.08 LBS

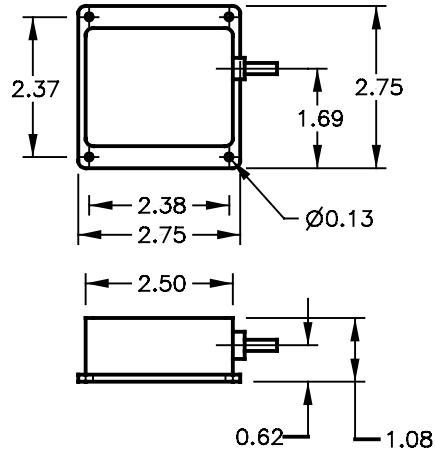
STD. TOL.						DRAWN: DGP	 DNR FOREST MANAGEMENT DIVISION
DECIMAL: 1 PLACE + - 0.06 2 PLACE + - 0.03 3 PLACE + - 0.005						CHECKED: KDB	
ANGULAR: + - 1 DEG.						APPROVED:	
DATE: 12/09/99	NO.	BY	DATE	REVISION			
SCALE: FULL	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653						
PROJECT NO.: REC 58	TITLE: SPACER					DWG. NO. 26-0066A	



NOTE: WITH ACTUATOR FULLY RETRACTED, ADJUST SHAFT LOCK NUTS TO ACHIEVE PROPER BODY/BARREL CLEARANCE.

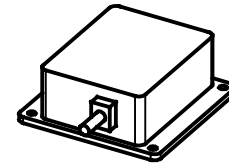
STD. TOL.						DRAWN: DGP
DECIMAL:						CHECKED: KDB
1 PLACE + - 0.06						APPROVED:
2 PLACE + - 0.03						
3 PLACE + - 0.005						
ANGULAR:	NO.	BY	DATE	REVISION		
+ - 1 DEG.						
DATE: 12/09/99	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653					
SCALE: 1/2						
PROJECT NO.: REC-58	TITLE: NOZZLE ADJUSTMENT					
						DWG. NO. 26-0069B





ACTUATOR

OPERATING VOLTAGE: 10-14 VDC
NO LOAD CURRENT: 150 mA @ 14V
MAX THRUST: 40 LBS
OUTPUT MOVEMENT: 0.2 INCH
OUTPUT SHAFT: 10/32 THD. ROD



APPROVED MANUFACTURER


PART NO

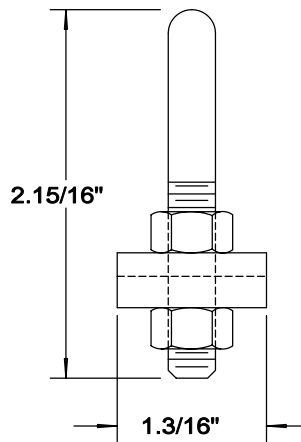
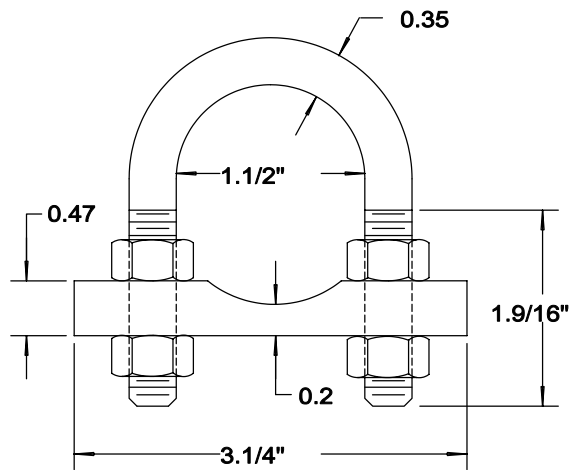
APPROVED MANUFACTURER

PART NO

MENZIMMER AIRCRAFT COMPONENTS
 2525-8 PIONEER AVENUE
 VISTA, CA 92083

S1-50X STROKE 0.2"

STD. TOL. DECIMAL: 1 PLACE + - 0.06 2 PLACE + - 0.03 3 PLACE + - 0.005 ANGULAR: + - 1 DEG.	<table border="1"> <tr> <th>NO.</th> <th>BY</th> <th>DATE</th> <th>REVISION</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	NO.	BY	DATE	REVISION					DRAWN: DGP CHECKED: APPROVED:	 DNR FOREST MANAGEMENT DIVISION
NO.	BY	DATE	REVISION								
DATE: 03/29/00 SCALE: FULL	FOREST FIRE EXPERIMENT STATION P.O. BOX 68 ROSCOMMON, MICHIGAN 48653										
PROJECT NO.:	TITLE: ACTUATOR										
FFES PART NO: 28-3101	DWG. NO. 28-3101B										



U-BOLT

SIZE: 1" PIPE NOMINAL
 THREAD: M10-1.5
 MATERIAL: U-BOLT: STEEL, ZINC
 BASE: POLYPROPYLENE
 TEMPERATURE RANGE: -30 DEGREES F
 EST WT: 0.31 LBS

APPROVED MANUFACTURERS

McMASTER-CARR
 SUPPLY COMPANY
 P.O. BOX 4355
 CHICAGO, IL 60680-4355

PART NO.

3066T32

APPROVED MANUFACTURERS

STD. TOLERANCES				
FRACTIONAL:				
0 TO 6 IN +1/32				
6 IN AND UP +1/16				
DECIMAL:				
1 PLACE +- 0.1				
2 PLACE +- 0.01				
3 PLACE +- 0.005				
ANGULAR:				
+/- 1 DEG				
NO.	BY	DATE	REVISION	

DRAWN:
 CHECKED:
 APPROVED:

MICHIGAN
 DNR
 FOREST MANAGEMENT
 DIVISION

FOREST FIRE EXPERIMENT STATION

P.O. BOX 68 ROSCOMMON, MICHIGAN 48653

PROJECT NO.:

FFES PART NO: 33-0070

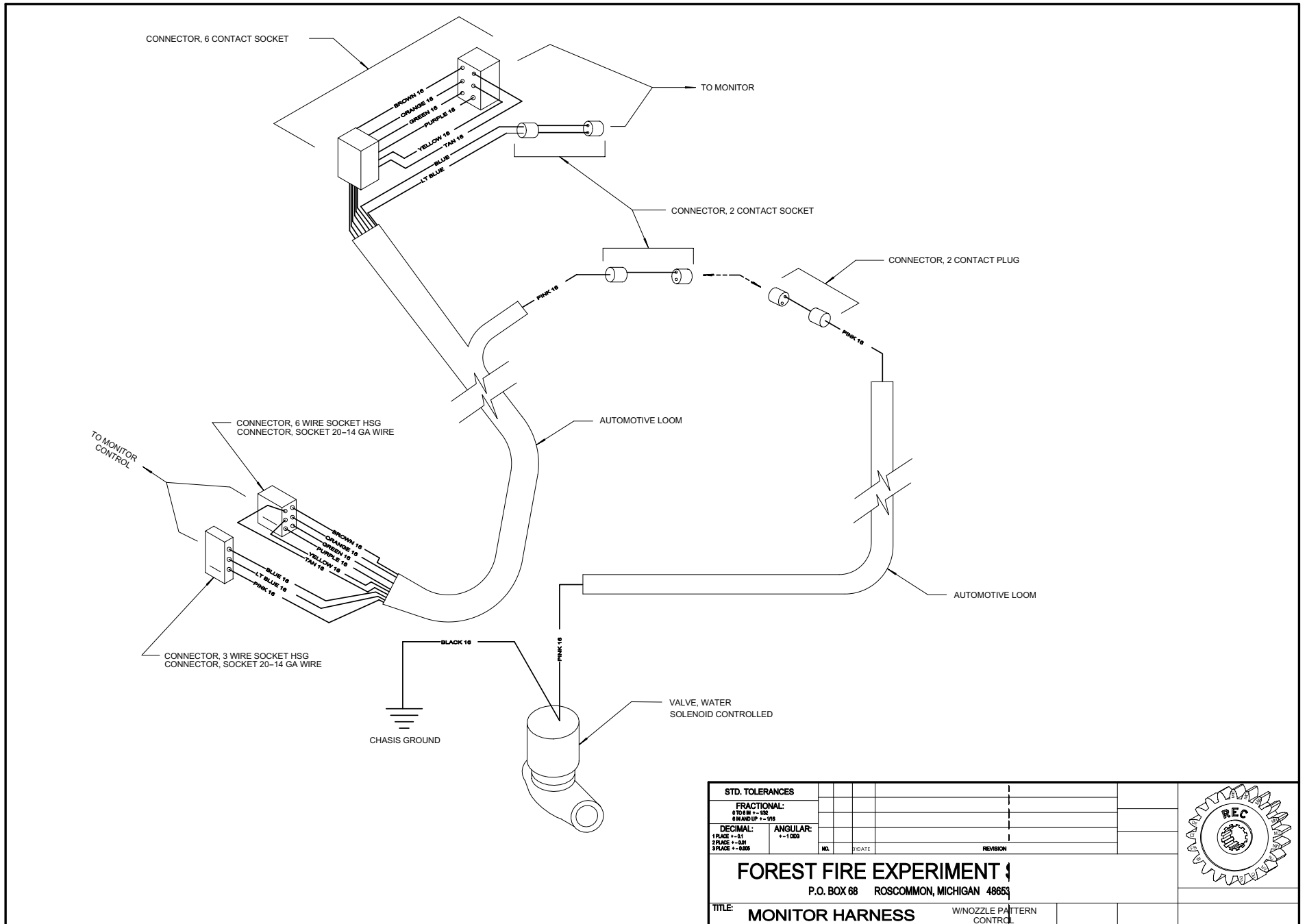
TITLE: **U-BOLT W/BASE**

1" PIPE

SCALE: **FULL**

DATE:

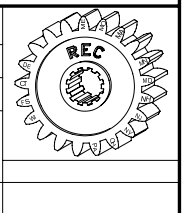
DWG. NO.



STD. TOLERANCES									
FRACTIONAL:									
1 TO 24 IN ±.002									
2 TO 48 IN ±.003									
DECIMAL:									
1 PLACE ±.01									
2 PLACE ±.001									
3 PLACE ±.0005									
ANGULAR:									
±.1 DEG									
NO.									
DATE									
REVISION									

FOREST FIRE EXPERIMENT
P.O. BOX 68 ROSCOMMON, MICHIGAN 48863

TITLE: **MONITOR HARNESS** W/NOZZLE PATTERN CONTROL



Appendix D Parts List – Optional Nozzle Pattern Control

Item	Qty	Unit	Labor Hours	Est. Cost			Material	Manufacturer	Part Number	Information Location			Comments
				Each		Total				Detail	Assembly	Electric	
				Labor	Mat'l								
Actuator Mount Cover	1	EA	0.3	6.00	2.50	8.50	3003 Aluminum .063"			26-0065B	26-9808B		
Actuator Mount Spacer	2	EA	0.2	4.00	1.50	11.00	Steel Sheet			26-0066A	26-9808B		
Actuator Mount W/C	1	EA	1	20.00	1.50	21.50	Steel Sheet/Bar			26-0064B	26-9808B		
Actuator, Linear 12VDC, 0.2" Stroke, 40#	1	EA		0.00	108.00	108.00	Purchased	Menzimer Aircraft Components	S1-50X 0.2 Stroke			90-5812C	
Connector, 3 Wire Pin Housing	1	EA		0.00	0.25	0.25	Purchased	Allied Electronics	512-1350			90-5810C	Replaces one Connector, 2 wire Pin Housing listed in Appendix B.
Connector, 3 Wire Socket Housing	1	EA		0.00	0.22	0.22	Purchased	Allied Electronics	512-1410			90-5811C	Replaces one Connector, 2 wire Socket Housing.
Connector, Pin 20-14 Ga Wire	3	EA		0.00	0.12	0.36	Purchased	Allied Electronics	512-1401			90-5810C	Replace one Connector, Pin 20-14 Ga Wire.
Connector, Plug 2 Contact	1	EA		0.00	3.68	3.68	Purchased	Allied Electronics	750-3300			90-5812C	
Connector, Socket 2 Contact	1	EA		0.00	3.76	3.76	Purchased	Allied Electronics	750-3301			90-5811C	
Connector, Socket 20-14 Ga Wire	3	EA		0.00	0.12	0.36	Purchased	Allied Electronics	512-1402			90-5811C	Replace one Connector, Socket 20-14 Ga Wire.
Fuse Holder, Inline	1	EA		0.00	1.77	1.77	Purchased	McMaster Carr	7696K33			90-5810C	
Fuse, AGC 1A - 32VDC	1	EA		0.00	0.32	0.32	Purchased	McMaster Carr	7085K75 1 AMP			90-5810C	
Misc Fasteners				0.00	2.00	2.00	Purchased						
Nipple 1" x 12" Galvanized	1	EA		0.00	3.65	3.65	Purchased	McMaster Carr	4549K624				
Nozzle Angle	1	EA	0.3	6.00	0.50	6.50	Steel Angle			26-0067A			
Nozzle, 1" w/Thread Modification	1	EA	0.5	10.00	22.37	32.37	Purchased/Modified	GSA	4210-01-165-6603	26-0068B	26-9808B		
Rod W/C	1	EA	0.4	8.00	1.50	9.50	Steel Bar Flat & Round			26-0063A			
Switch, Toggle DPDT (ON)OFF(ON)	1	EA		0.00	13.94	13.94	Purchased	Allied Electronics	826-8904			90-5810C	In order to install this switch in the control, the panel mount fuse holder and fuse must be installed in another location.
Terminal, Quick Slide 1/4" 16-14 Ga	2	EA		0.00	0.30	0.60	Purchased	Allied Electronics					
Terminal, Ring #8 16-14 Ga	6	EA		0.00	0.10	0.60	Purchased	Allied Electronics	512-5288				
U-Bolt For 1 1/4" pipe	1	EA	0	0.00	0.47	0.47	Purchased	McMaster Carr	3043T19				
U-Bolt w/Base for 1" pipe	2	EA		0.00	3.79	7.58	Purchased	McMaster Carr	3066T32	33-0070	26-9808B		
Wire 16Ga (Various Colors)	20	FT		0.00	0.09	1.80	Purchased						
Assembly Labor			0.5	10.00		10.00							
			Total	Labor	Parts	Total							
				64.00	184.72	248.72							