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# ***DRAFT REPORT***

## **Low Cost Automatic Gates for Irrigation Canals**

Prepared for the  
**Harlingen Irrigation District**



**Under a Texas Water Development Board Grant**

Innovative Technologies for  
Agricultural Water Management  
and Flow Measurement

September 27, 2010

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## TABLE OF CONTENTS

<b>1. Introduction and Overview .....</b>	<b>1</b>
<b>2. Gate description .....</b>	<b>4</b>
2.1 Gate .....	4
2.1.1 Gate frame.....	6
2.1.2 Actuator brackets .....	8
<b>3. Actuator and controls .....</b>	<b>10</b>
3.1 Actuator .....	10
3.1.1 Actuator position sensor .....	11
3.1.2 Control box .....	11
<b>4. Automation .....</b>	<b>14</b>

## APPENDICES

### **A Gate construction details**

- Elevations
- Sections
- Details
- Gate details

### **B Actuator**

- Basic dimensions and specifications
- Actuator arm parts breakdown
- Actuator motor/gear parts breakdown
- Parts list
- Wiring diagram
- Limit switch adjustment
- Part number code

### **C Automatic gate controller**

- Wiring schematic
- Parts list
- Test sheet

### **D NEMA enclosure vandal box**

- Elevations
- Sections
- Parts details

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## 1. Introduction and Overview

Flow in irrigation canal systems is controlled by gates that can be raised or lowered to change water levels and hence flow rate. Traditionally, gates have been raised or lowered manually and then left in position to achieve a target flow rate for a desired time period. This is a labor intensive and time consuming process, and is often done only at the beginning and end of the time period.



Figure 1. Various manual gates requiring an operator to raise and lower them.

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Automating canal gates enables them to be raised or lowered without visiting the site, and can also enable frequent adjustments to be made to maintain flow rates within a target range as water levels fluctuate within the system. Automatic gates are commercially available, but are often too expensive to be economically viable.

This project has resulted in the design of automatic gates that can be readily manufactured locally, assembled, and installed. All parts for the gates are available commercially off-the-shelf. The primary sub-assemblies of the system are:

1. The gate assembly itself
2. The actuator, including motor and controls for raising and lowering the gate

Optionally, water level sensors, telemetry and control hardware (such as SCADA) can be used for full automation, enabling the gate to be raised or lowered as required.

Figure 2 shows an example of a 3 ft wide by 4 ft tall canal sluice gate constructed of mild steel. This design is based on a USBR gate. The autogate modifies this design to:

- make the gate more reliable
- handle larger sizes with the associated greater forces needed for operation
- operate on solar power (DC)
- provide push-button up/down control

The primary difference between the system developed for this project and commercially available systems is cost.

Each of the primary components are described separately in the following sections, with parts lists, drawings and supporting information included in appendices. Figure 3 illustrates the individual components required for full automation and remote operation.

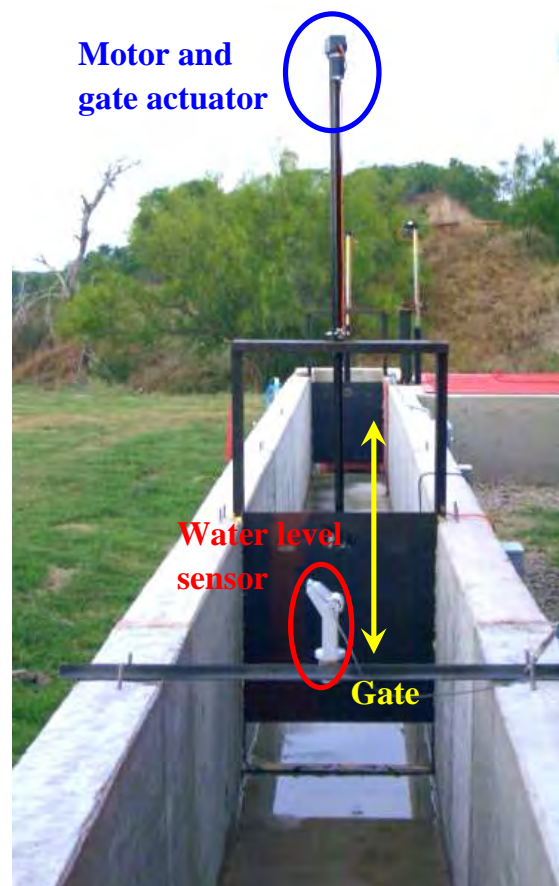


Figure 2. Typical sluice gate with actuator and water level sensor.



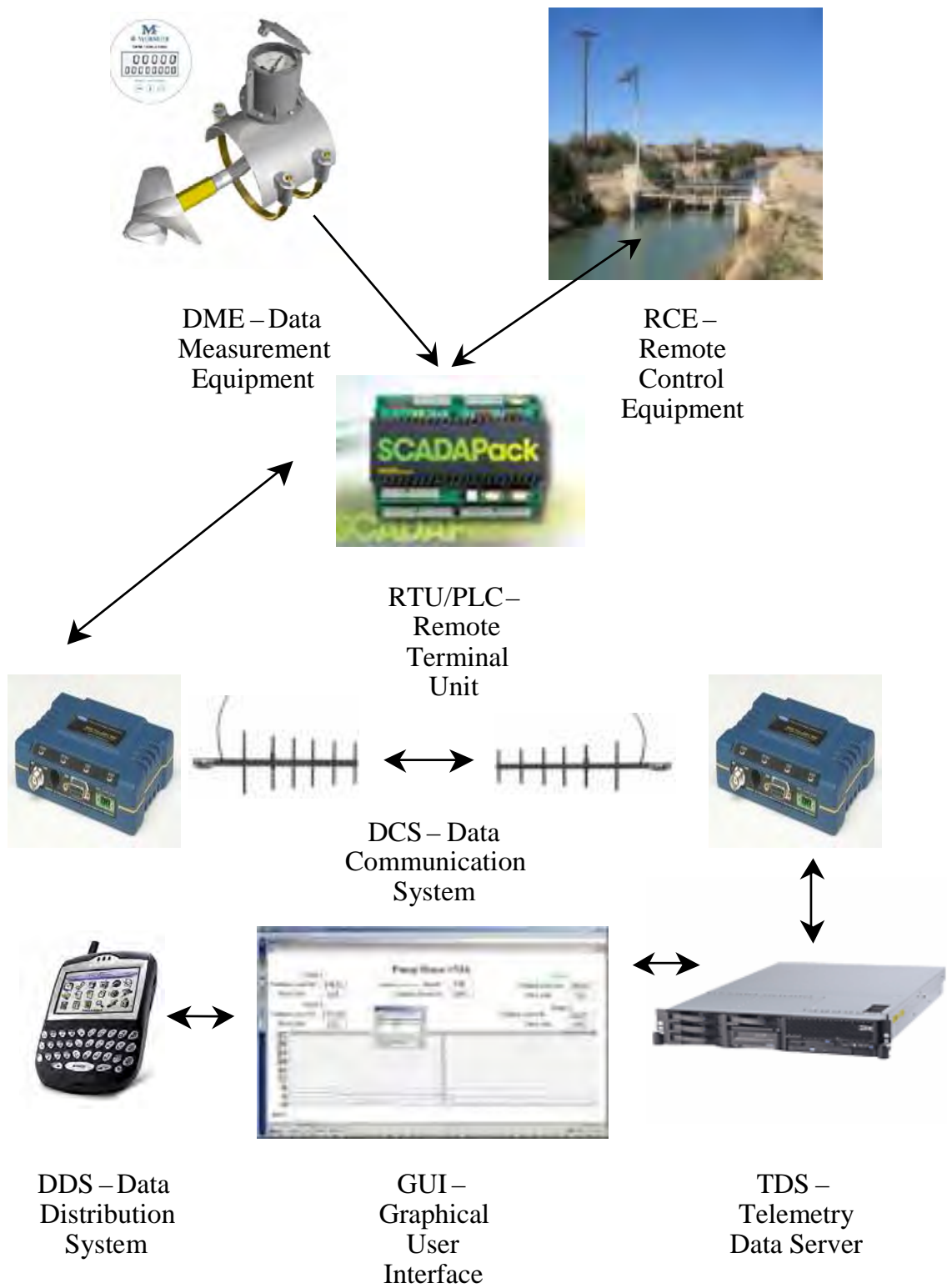


Figure 3. Major components of an automatic gate system.

## 2. Gate description

The gate assembly is fabricated of aluminum secured with welding or bolts, and can be made individually in custom sizes to fit existing canals.

### 2.1 Gate

The gate itself is constructed of 3/8 inch aluminum plate reinforced horizontally with 2 inch x 2 inch aluminum angle bolted to the plate with 1/2 inch stainless steel bolts. The gate can slide smoothly up and down within the aluminum frame using a bearing surface and seal provided by Ultra High Molecular Weight (UHMW) plastic strips.

([www.crownplastics.com](http://www.crownplastics.com))

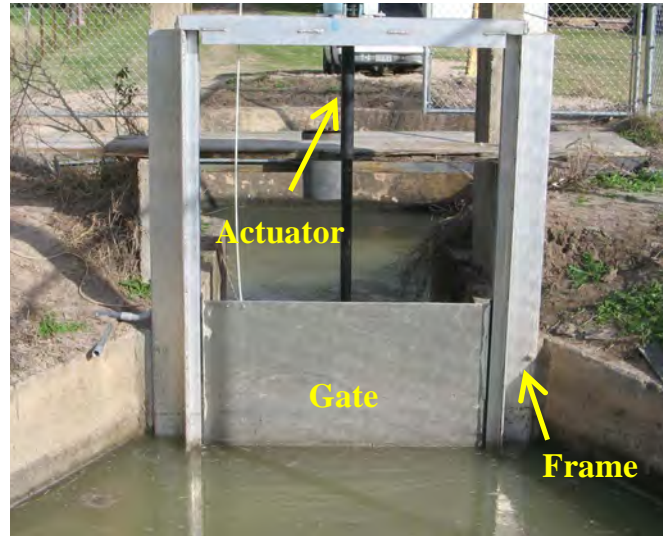
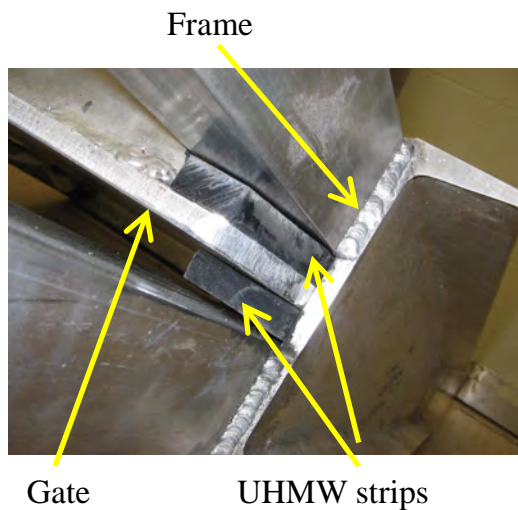


Figure 4

Right top and bottom: a gate assembly showing the gate itself and the frame in which the gate can slide up or down. Above: detail showing gate, frame and UHMW sealing/bearing strips.

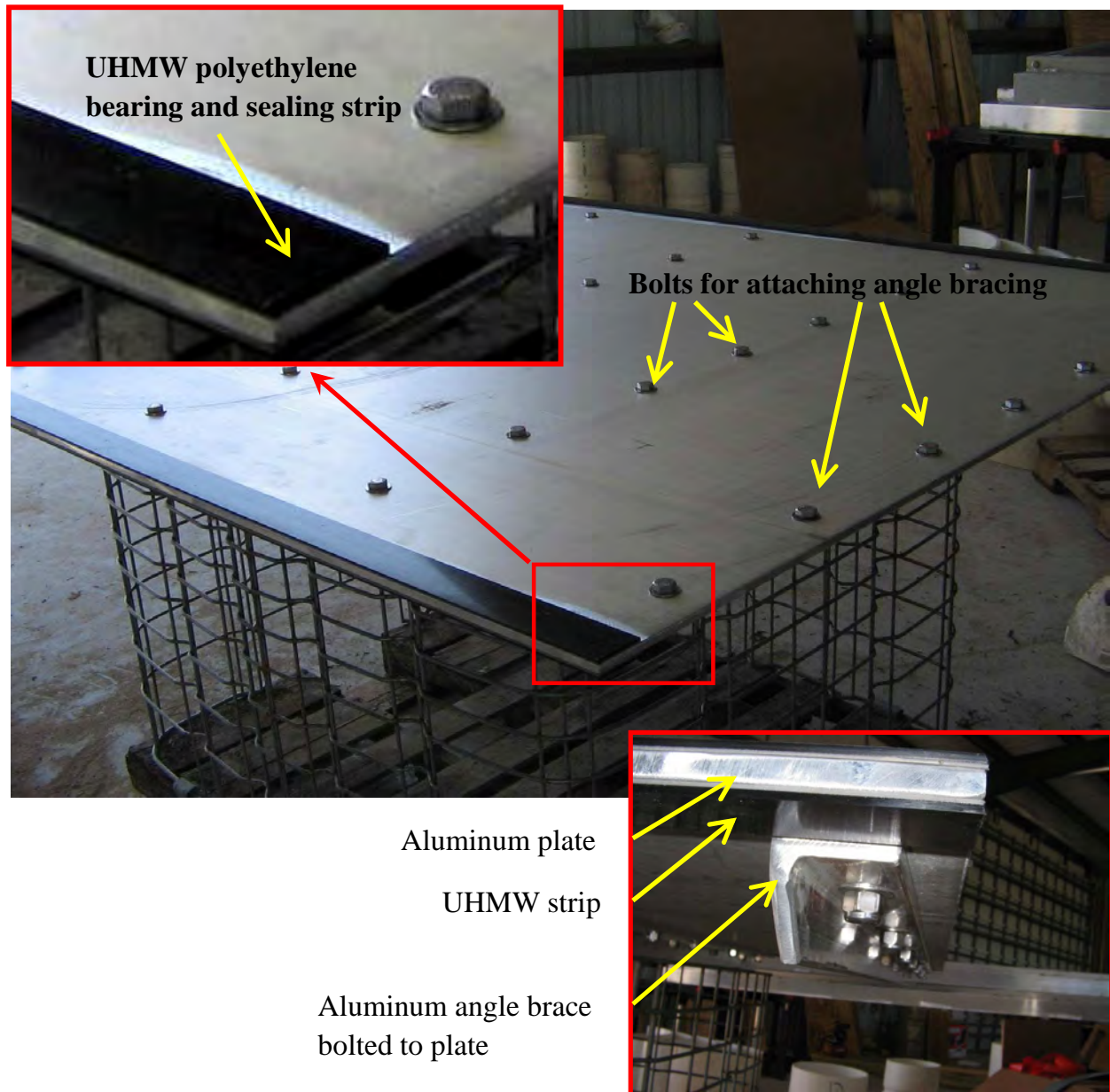


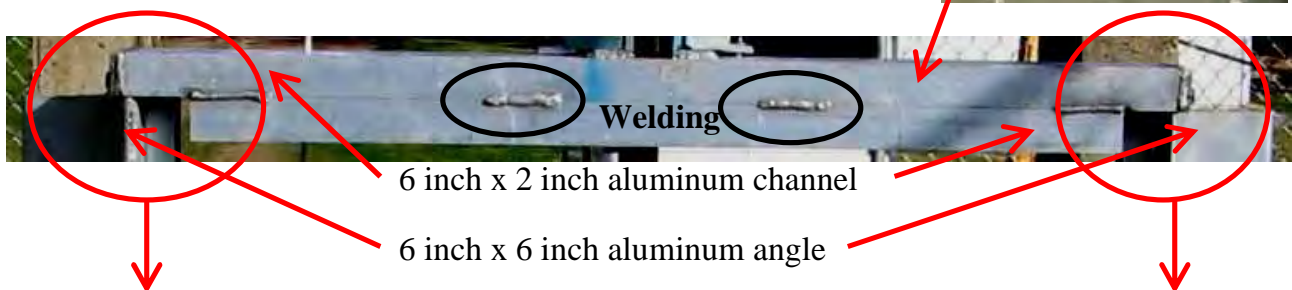
Figure 5. Fabrication of gate from aluminum plate. The inset at top left shows the UHMW bearing/sealing strip fixed to both sides (upstream and downstream) of the vertical edges that contact the frame. The inset at bottom right shows the underneath of the plate to which 2 inch x 2 inch aluminum angle bracing is bolted.



### 2.1.1 GATE FRAME

The frame in which the gate fits is constructed of 6 inch aluminum angle and channel welded and bolted together. The vertical path in which the gate slides is constructed of 2 inch aluminum angle.

Further details of the gate path are shown in figure 6. The bottom of the gate frame is constructed of 6 inch x 2 inch channel as shown in figure 7.



2 inch x 2 inch aluminum angle



6 inch x 2 inch aluminum end plate

Figure 6. Horizontal top of gate frame using 2 lengths of 6 inch x 2 inch aluminum channel welded together and supported on vertical 6 inch x 6 inch aluminum angle (top). Two lengths of 2 inch x 2 inch aluminum angle are welded to each vertical support to form the path in which the gate slides (bottom left). An end plate and bolts secure the top frame to the 6 inch x 6 inch vertical support channel and the two 2 inch x 2 inch channels forming the gate path (bottom right).



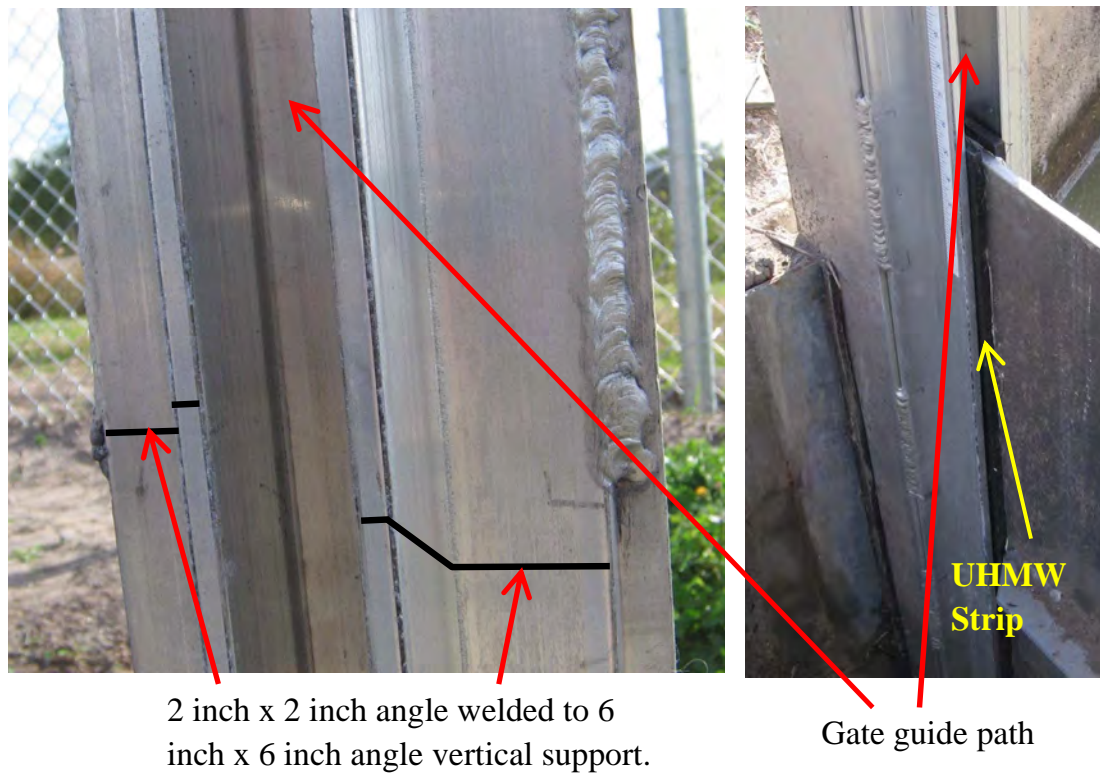


Figure 7. Construction of gate guide path using 2 inch x 2 inch aluminum angle



Figure 8. Construction of bottom of gate frame.

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### 2.1.2 ACTUATOR BRACKETS

There are two brackets to attach the linear actuator to the gate and to the frame. One bracket is welded to the top horizontal beam of the frame, and secures the non-moving part of the actuator. The other bracket is welded to the gate itself and is attached to the moving part of the actuator, enabling it to raise and lower the gate. Both brackets are made from 2 inch x 2 inch aluminum angle.

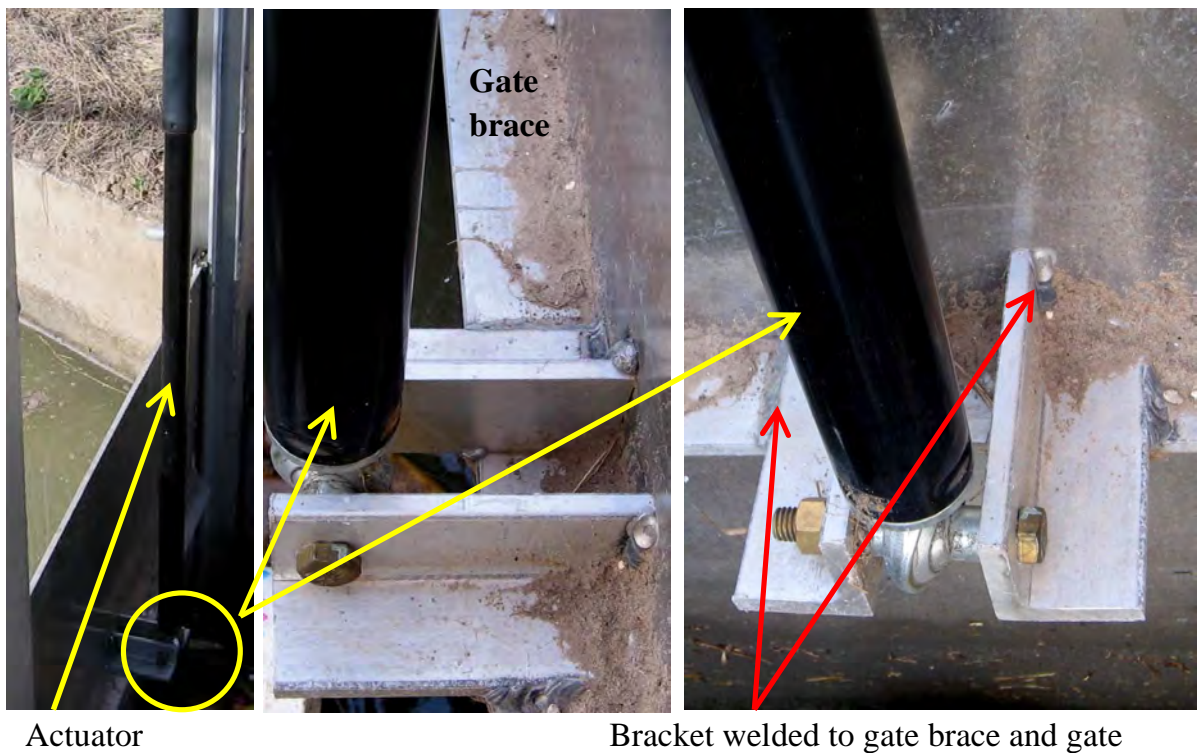


Figure 9. Bracket construction and attachment to the moving part of the actuator and the gate.



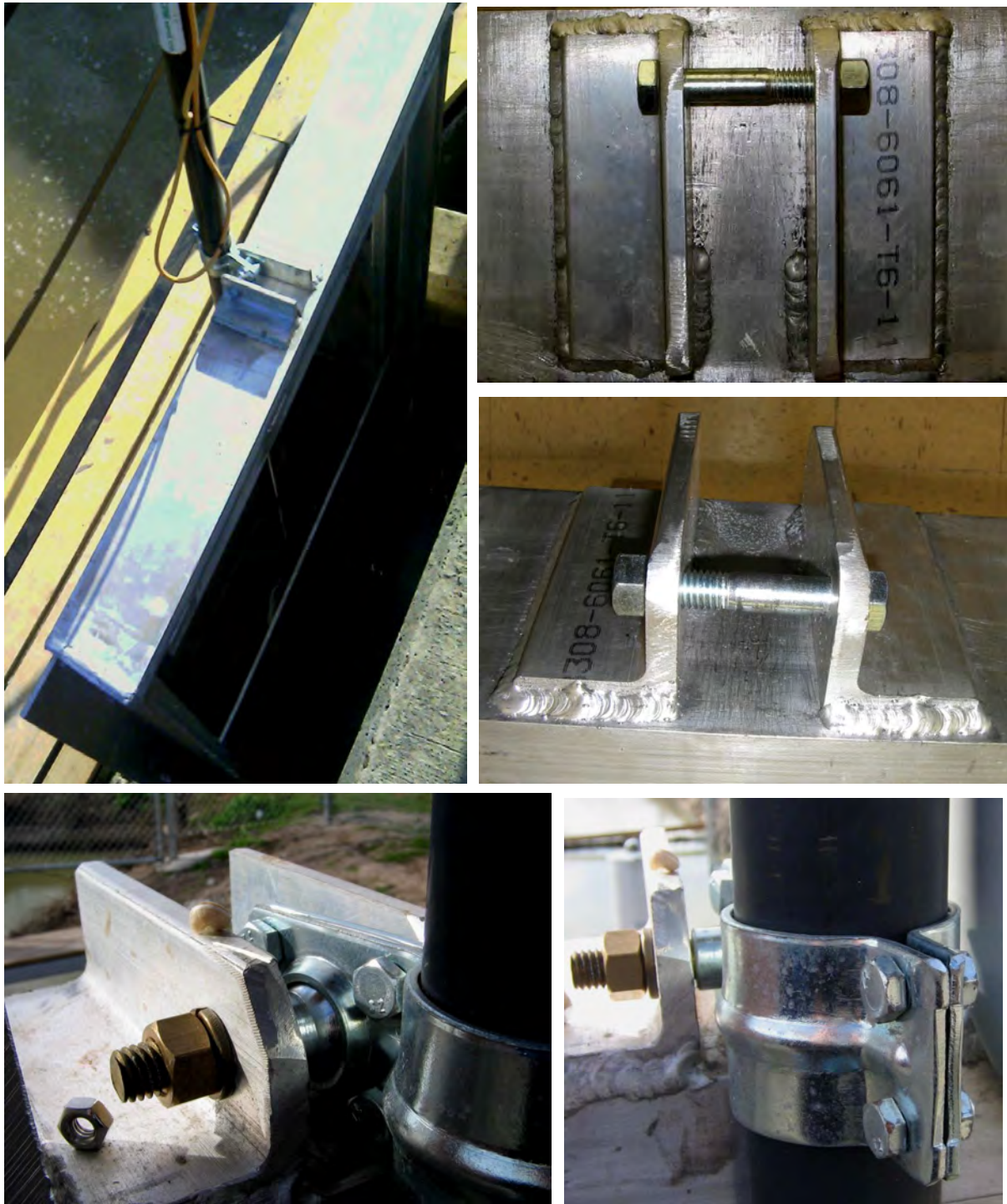


Figure 10. Bracket construction and attachment to the top of the gate frame and the non-moving part of the actuator.



### 3. Actuator and controls

The actuator is the mechanism that moves the gate up or down. The actuator used is a 12V DC off-the-shelf device found in applications such as “slide-out” room extensions on recreational vehicles. The motor operates a screw assembly that extends or retracts linearly. The mechanical advantage embodied in the screw mechanism enables the application of considerable force at a slow rate of linear movement, attributes that suit the movement of canal gates. The rated load for the actuators used is 1500 lbs force. There are adjustable positive limitations to the minimum and maximum travel, while an internal rheostat enables the position of the actuator between these limits to be determined. Power to operate the motor is supplied using a 12V battery recharged by a solar panel.

#### 3.1 Actuator



Figure 11. Gate actuator showing arm and motor (left), actuator arm position sensor (4-20 ma potentiometer) (Top right) and details of motor (bottom right).

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### 3.1.1 ACTUATOR POSITION SENSOR

As the threaded shaft of the actuator turns, a worm gear drives both a rheostat to determine linear position and a mechanical mechanism to shut off the motor when the limits of travel in either direction are reached. The rheostat outputs a 0-5V signal depending on relative position between the travel limits., but in order to use the signal for automatic control using SCADA, it must be converted to a 4-20 mA signal. This is accomplished with an external potentiometer mounted on top of the actuator enclosure and connected to the internal voltage output signal from the rheostat. The zero output position of the potentiometer as well as the span (range) have external screw adjustments.

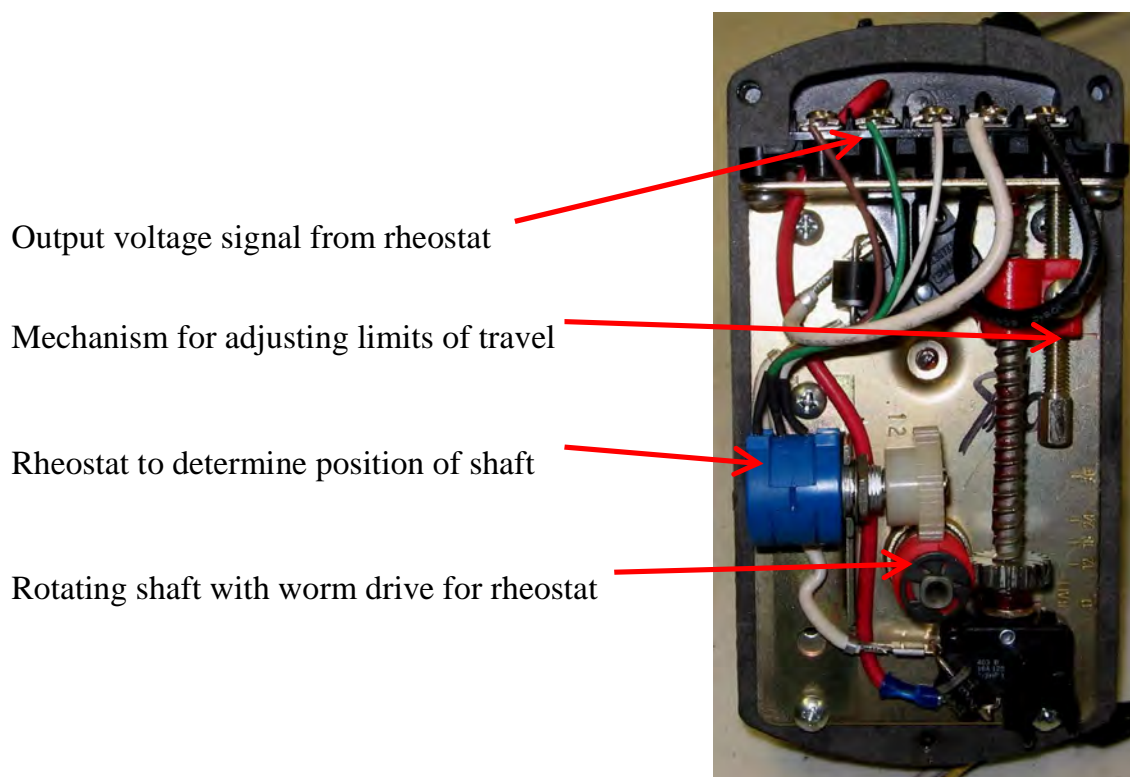


Figure 12. Position sensor and limit adjustment for actuator.

### 3.1.2 CONTROL BOX

The control box consists of a NEMA enclosure with internal circuitry to operate relays and external controls for manual operation of the gate. A three-position external switch enables selection of off/automatic/manual mode. Two external push-buttons, each with an indicator light, enable the gate to be either raised or lowered when in manual mode.

Each gate requires a set of controls, and more than one set of controls can be incorporated in each control box.

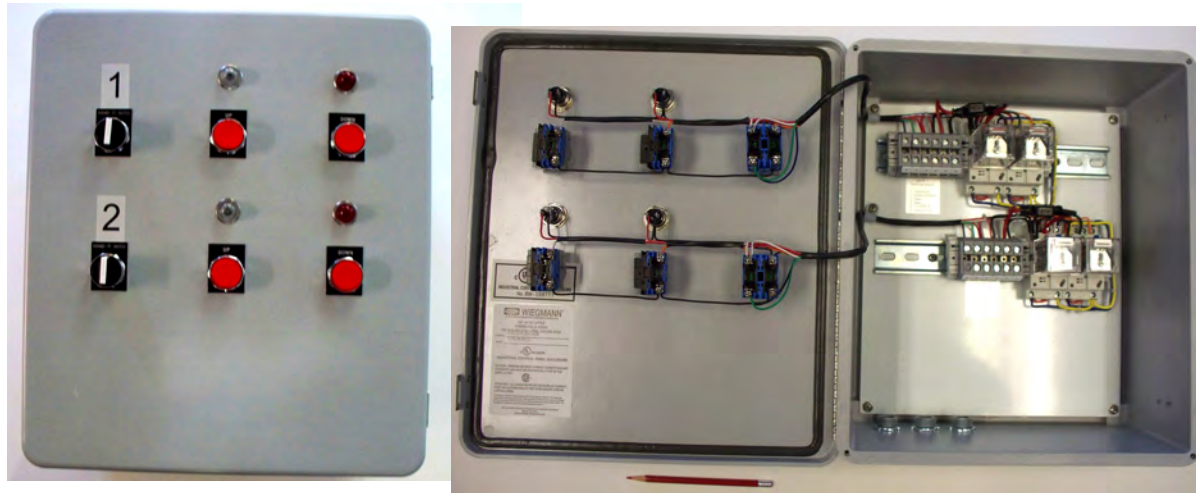


Figure 13. Closed (left) and open (right) gate control box for controlling 2 gates independently.

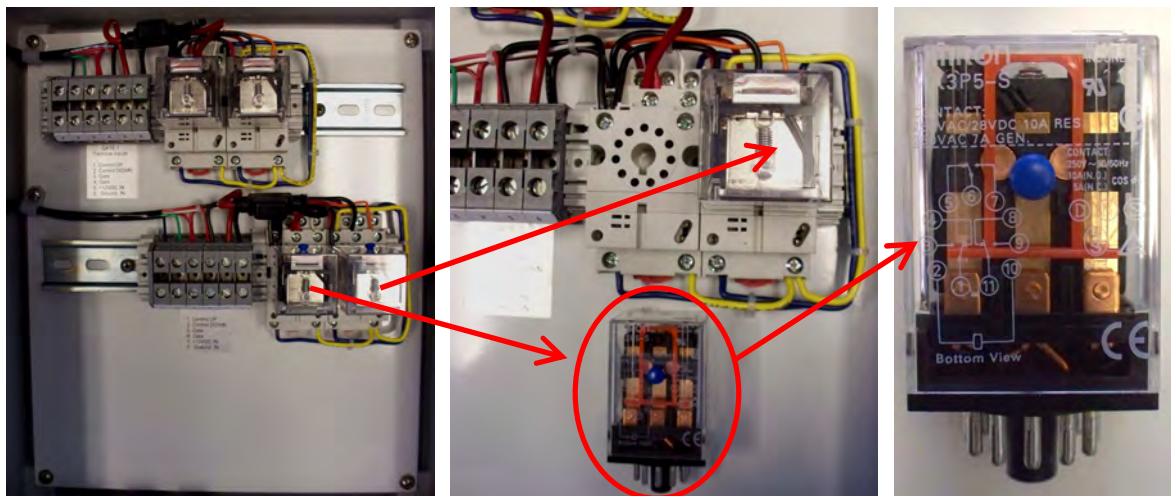


Figure 14. Control panel showing relay circuitry for two gates (left), the two relays required for each gate with one relay removed from the base (middle), and a relay (right).



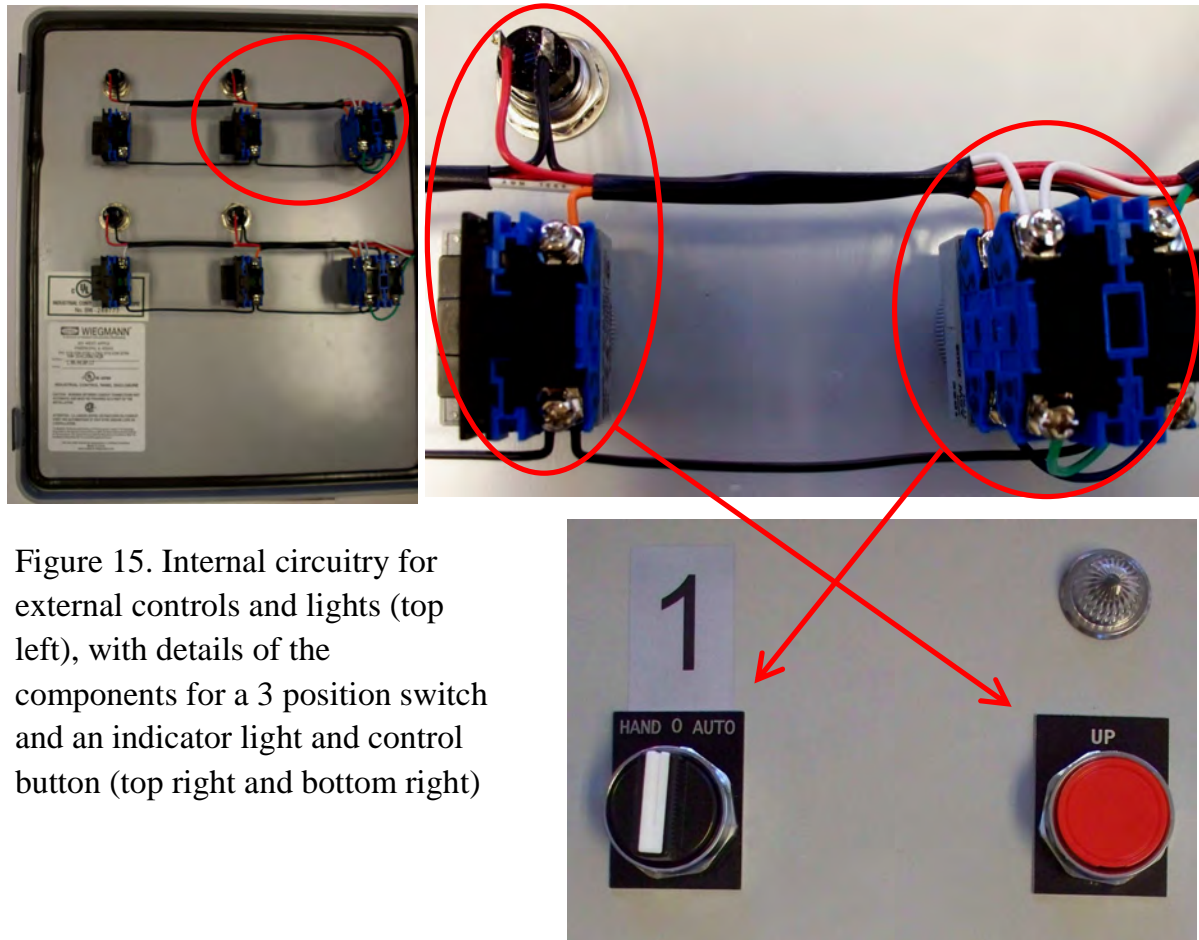


Figure 15. Internal circuitry for external controls and lights (top left), with details of the components for a 3 position switch and an indicator light and control button (top right and bottom right)

Power is supplied by a 12V deep cycle battery that is charged by a 20 Watt solar panel.

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#### **4. Automation**

The gate can be fully automated by using a sensor (such as for upstream waterlevel) together with a microprocessor based controller, such as SCADA. The incorporation of telemetry also enables remote operation.



Figure 16. A SCADA system capable of automating gate operation in response to input from a sensor such as water level.

## **APPENDIX A**

### **Gate construction details**

Elevations

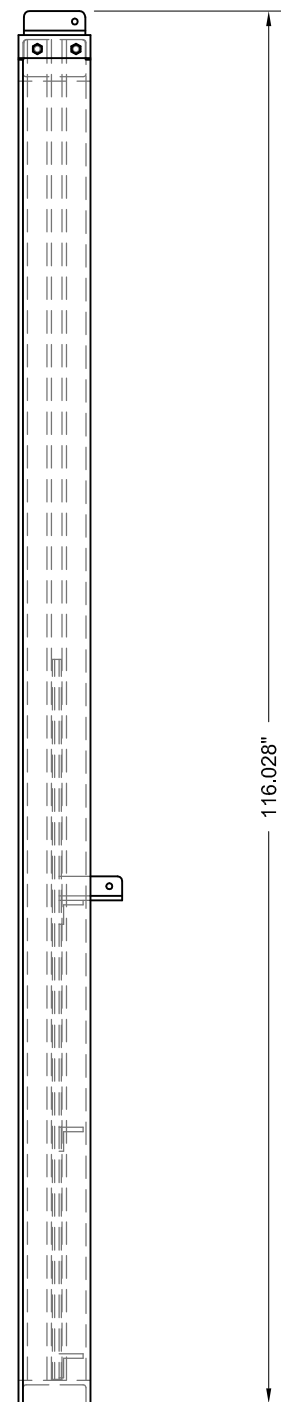
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Details

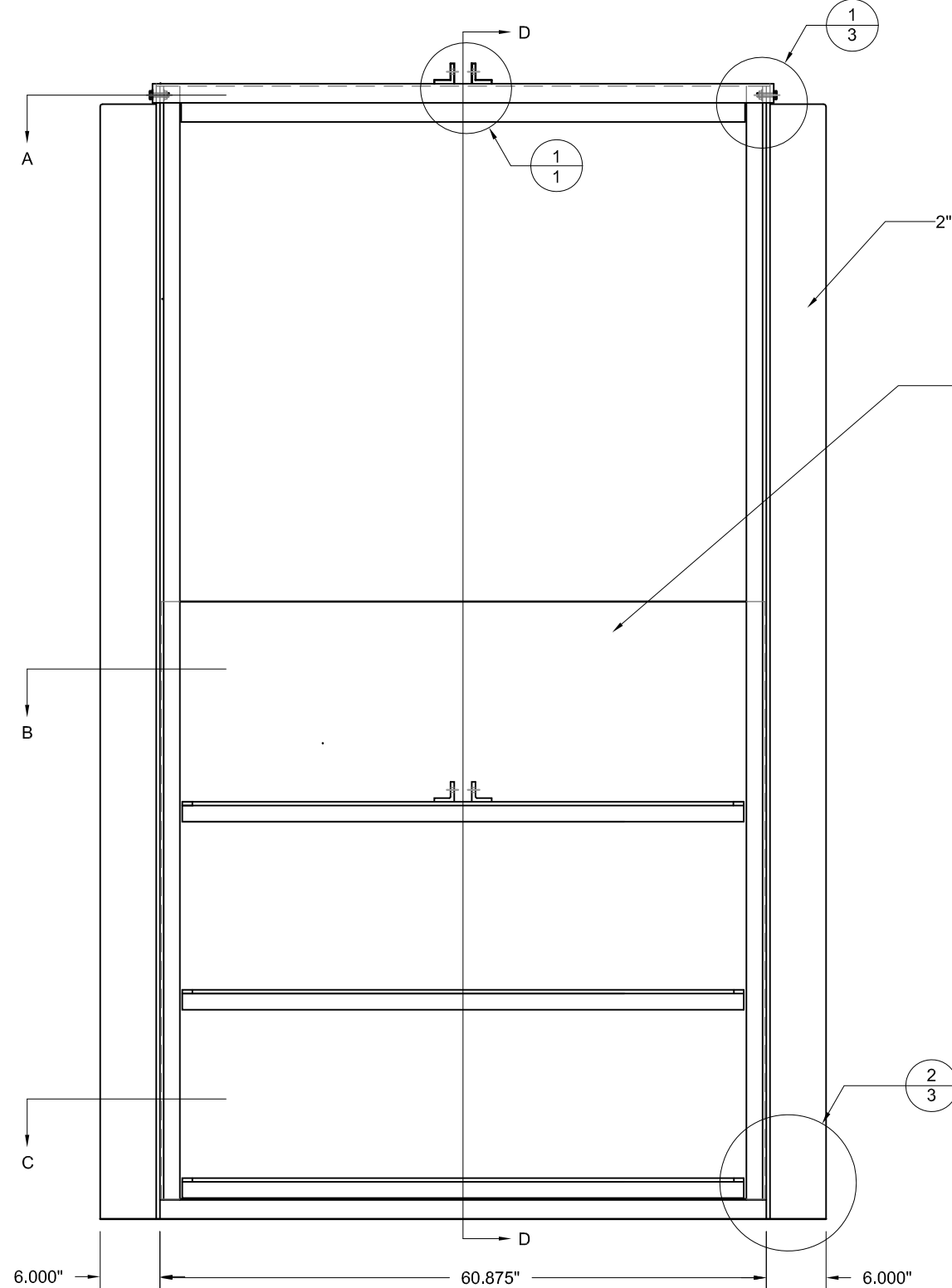
Gate details



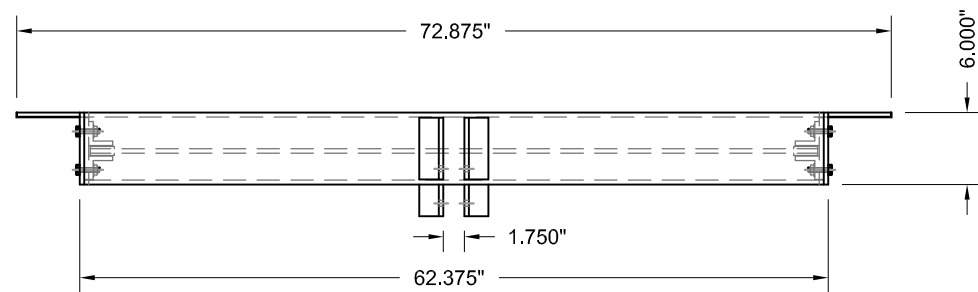
SIDE VIEW  
SCALE 3/4" = 1'



FRONT VIEW  
SCALE 3/4" = 1'



TOP VIEW  
SCALE 3/4" = 1'

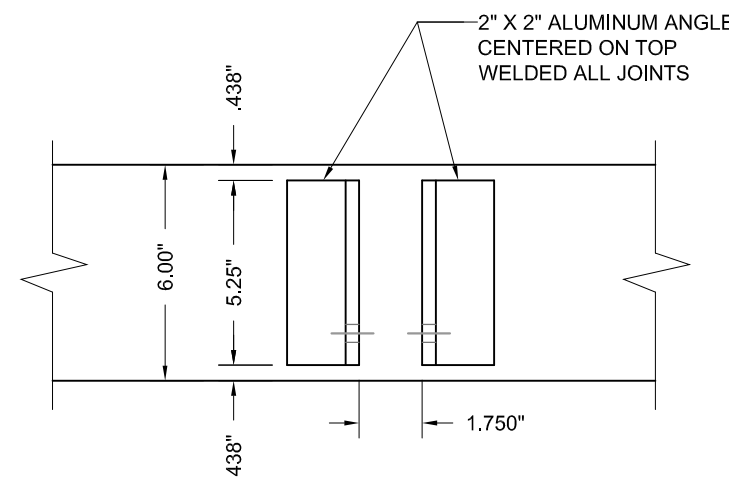


NOTES: GATE FRAME MADE FROM  
GRADE 6061 ALUMINUM  
2" X 2" ANGLE AND  
6" X 1.92' CHANNEL  
WELDED WHERE NOTED

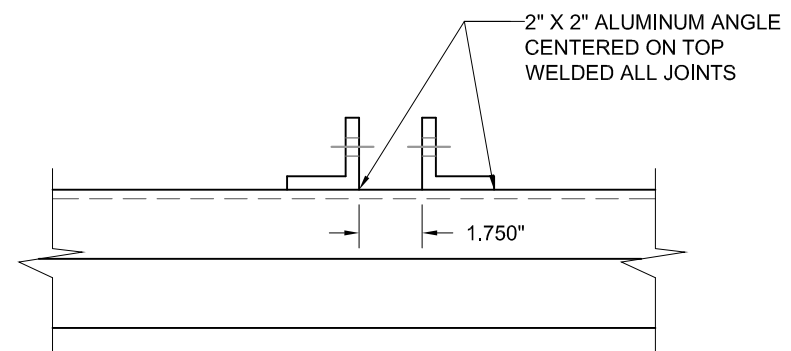
GATE MADE FROM 60" X 60.625" X 3/8"  
ALUMINUM PLATE WITH 1/8" GAP ON EACH SIDE

UHMW TO BE 2" X .125" BLACK 3M CVT  
LAM-N-HARD PRESSURE SENSITIVE

2" X 2" ANGLE GATE BRACES BOLTED TO GATE  
WITH 6 EACH - 1/2" SS BOLTS SPACED 8 1/2" APART



1  
1  
DETAIL TOP ACTUATOR MOUNT / TOP VIEW  
SCALE 1 1/2" = 1'



1  
1  
DETAIL TOP ACTUATOR MOUNT / FRONT VIEW  
SCALE 1 1/2" = 1'

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AW BLAIR  
ENGINEERING

P.O. Box 4615  
Austin, Texas 78765-4615  
Phone (512) 394-1011  
Fax (512) 394-1016

HIDCC#1  
TWB - ITA Automatic Gate Controller  
GATE CONSTRUCTION DETAILS  
ELEVATIONS

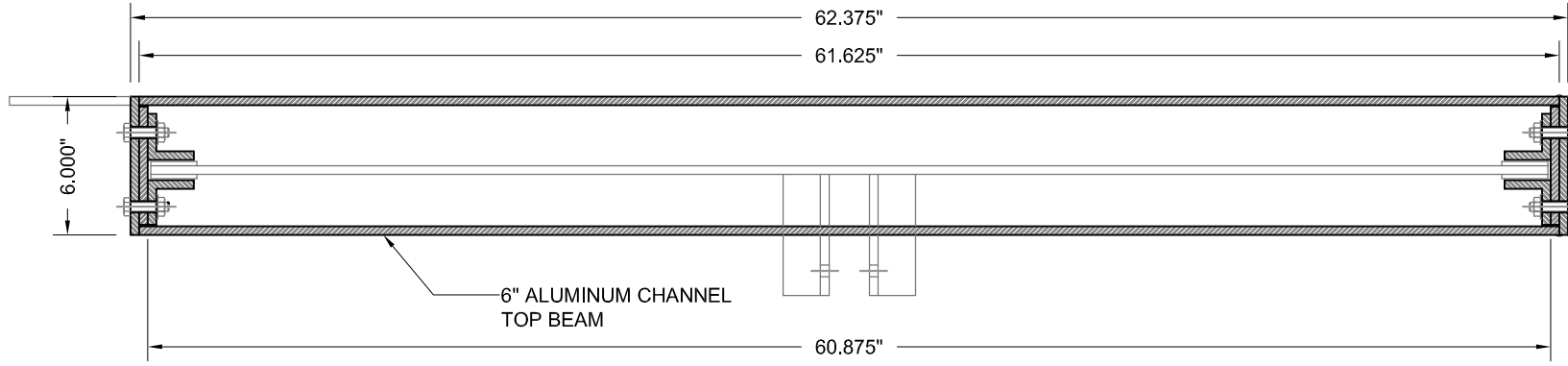
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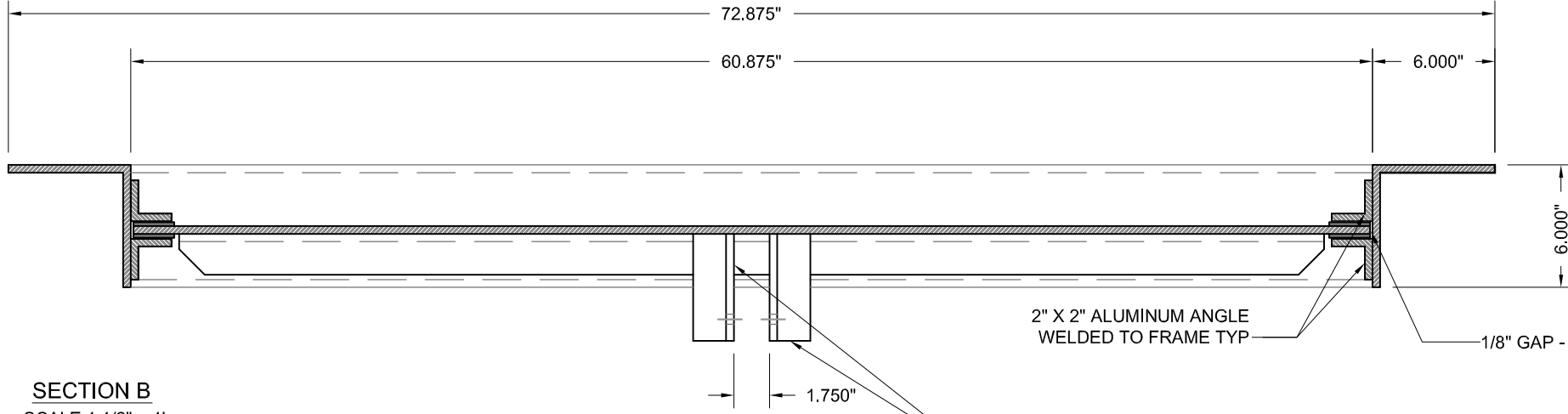
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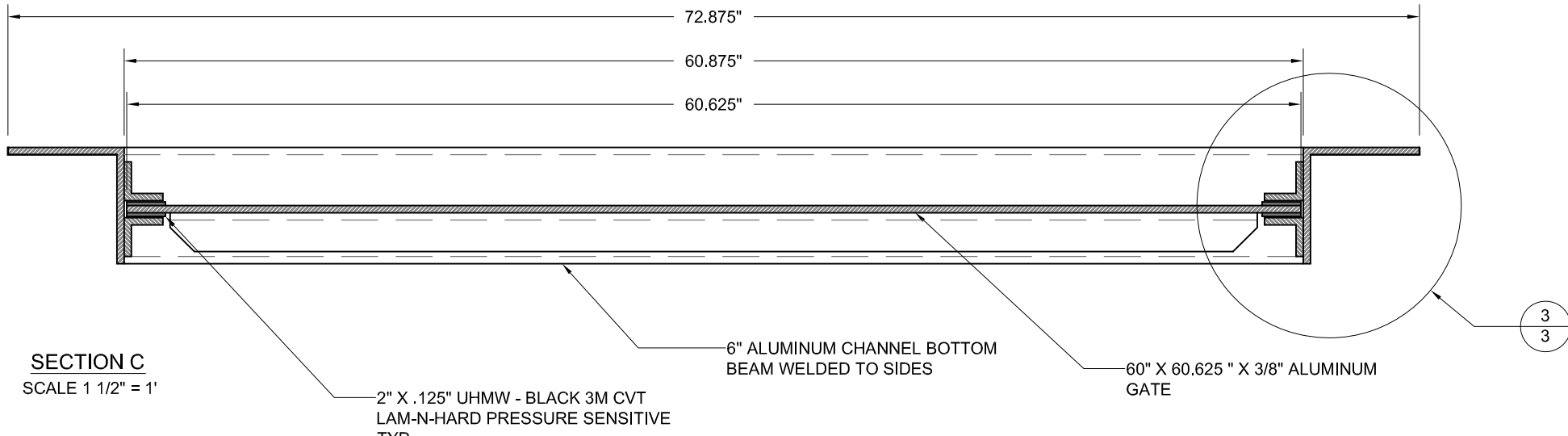
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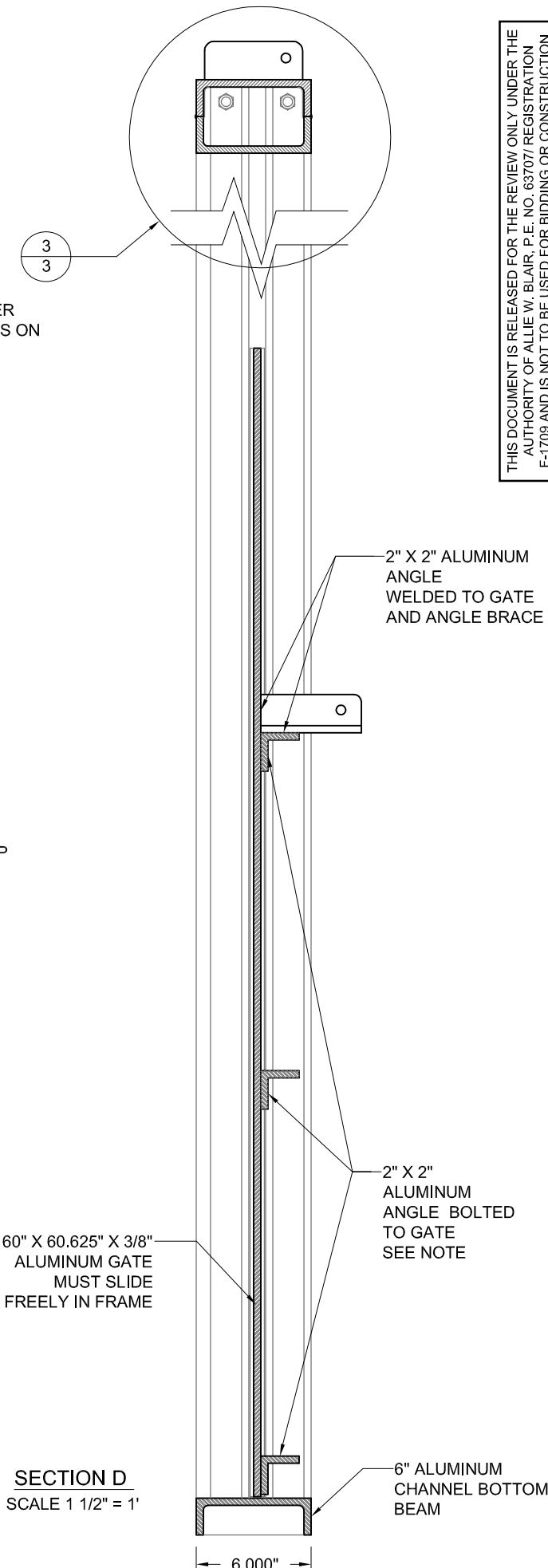
SECTION A  
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**SECTION B**  
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SECTION C  
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SECTION D  
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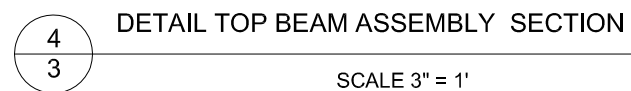
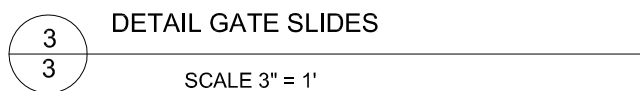
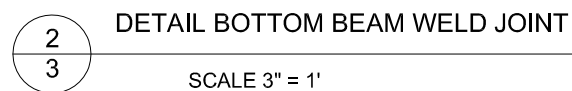
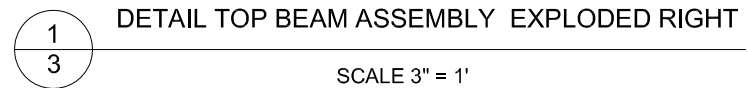
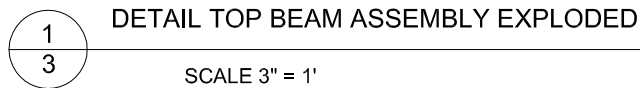
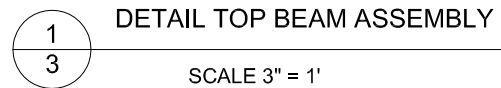
Austin, Texas 78765-4615  
Fax (512) 349-1016

P.O. Box 4615  
Phone (512) 394-1011

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TWB - ITA Automatic Gate Controller  
GATE CONSTRUCTION DETAILS  
SECTIONS

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SHEET	OF

2 OF 4

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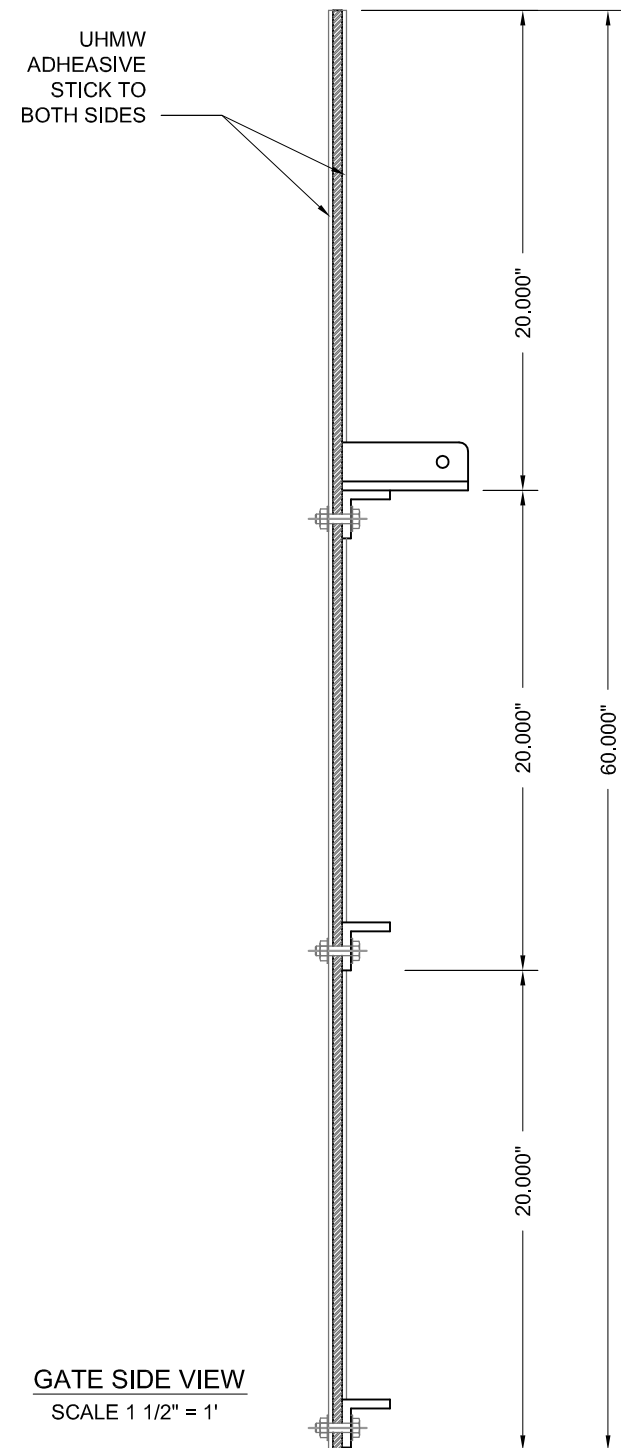
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Phone (512) 394-1011

# HIDCC#1 TWB - ITA Automatic Gate Controller GATE CONSTRUCTION DETAILS DETAILS

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SHEET	OF



Technical drawing of a gate assembly, showing side and front views with dimensions and annotations.

**Side View (Top):**

- Overall width: 60.625"
- Overall height: 2.250"
- Top flange width: 2.000"
- Gate body width: 56.125"
- Gate body height: 2.250"
- Gate body thickness: 0.125"
- Gate body material: 60" X 60.625" X 3/8" ALUMINUM GATE

**Front View (Bottom):**

- Overall width: 60.625"
- Overall height: 60.000"
- Gate body height: 20.000"
- Gate body thickness: 0.125"
- Gate body material: 60" X 60.625" X 3/8" ALUMINUM GATE
- Gate body width: 56.125" TYP
- Gate body height: 20.000"
- Gate body thickness: 0.125"
- Gate body material: 60" X 60.625" X 3/8" ALUMINUM GATE
- Gate body width: 56.125" TYP
- Gate body height: 20.000"
- Gate body thickness: 0.125"
- Gate body material: 60" X 60.625" X 3/8" ALUMINUM GATE

**Annotations:**

- 2" X 2" ANGLE WELDED TO GATE AND BRACE TYP
- 2" X 2" ANGLE BRACE BOLTED TO GATE WITH 1/2" STAINLESS STEEL BOLTS SPACED 8.5" APART TYPICAL
- 8.500" TYP
- 1.750"
- UP 1/8" FROM OF

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GATE CONSTRUCTION DETAILS

GATE DETAILS

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APPROVED:
FILE:
JOB NO.:
DATE:
SHEET                      OF



## **APPENDIX B**

### **Actuator**

Basic dimensions and specifications

Actuator arm parts breakdown

Actuator motor/gear parts breakdown

Parts list

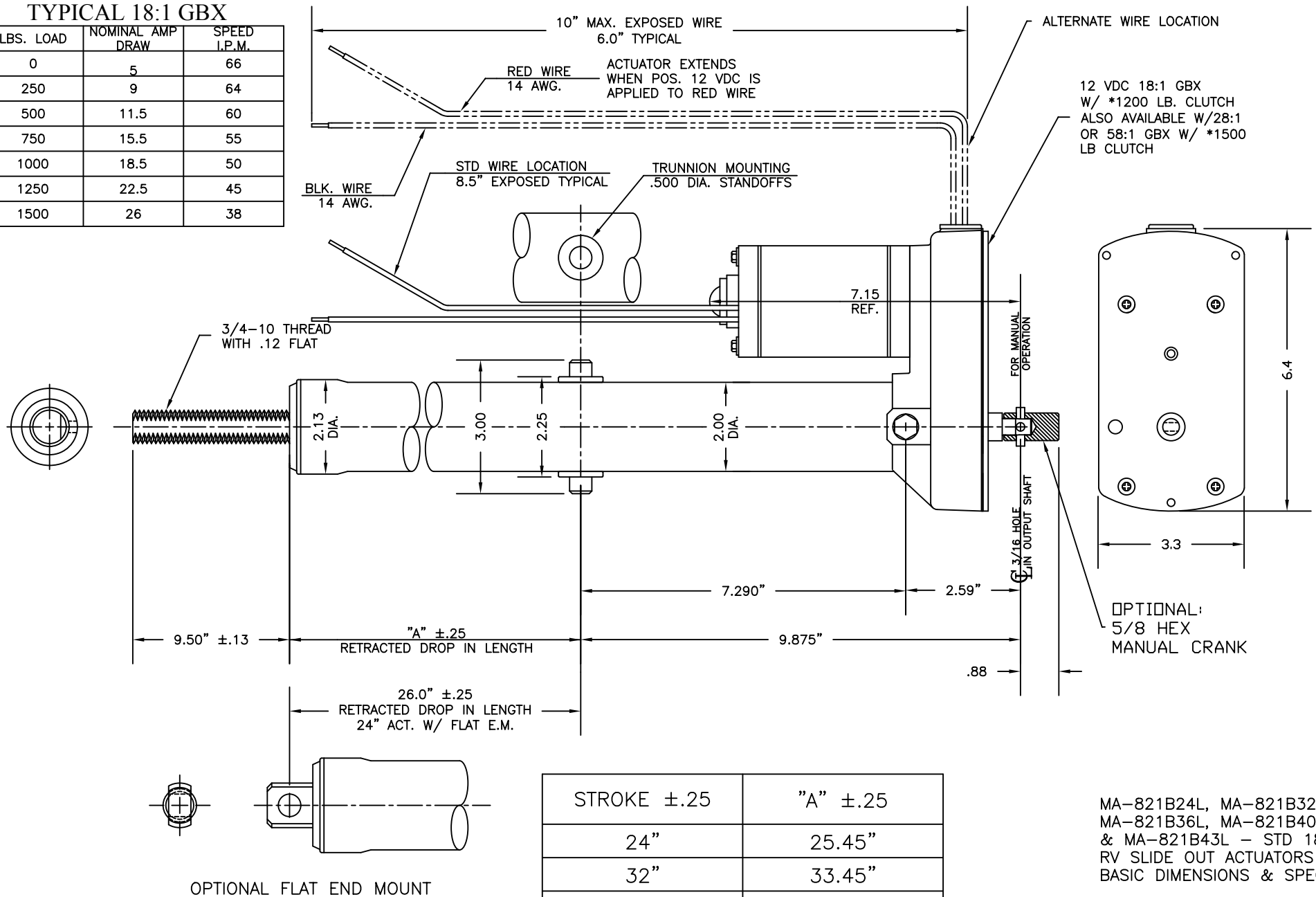
Wiring diagram

Limit switch adjustment

Part number code

# TYPICAL 18:1 GBX

LBS. LOAD	NOMINAL AMP DRAW	SPEED I.P.M.
0	5	66
250	9	64
500	11.5	60
750	15.5	55
1000	18.5	50
1250	22.5	45
1500	26	38



STROKE ±.25	"A" ±.25
24"	25.45"
32"	33.45"
36"	37.45"
40"	41.45"
43"	44.45"

MA-821B24L, MA-821B32L,  
MA-821B36L, MA-821B40L  
& MA-821B43L - STD 18:1  
RV SLIDE OUT ACTUATORS  
BASIC DIMENSIONS & SPECS

\*NOTE: NOMINAL CLUTCH SETTING SET TO  
NOT BE LESS THAN RATED LOAD  
THRU LIFE OF ACTUATOR

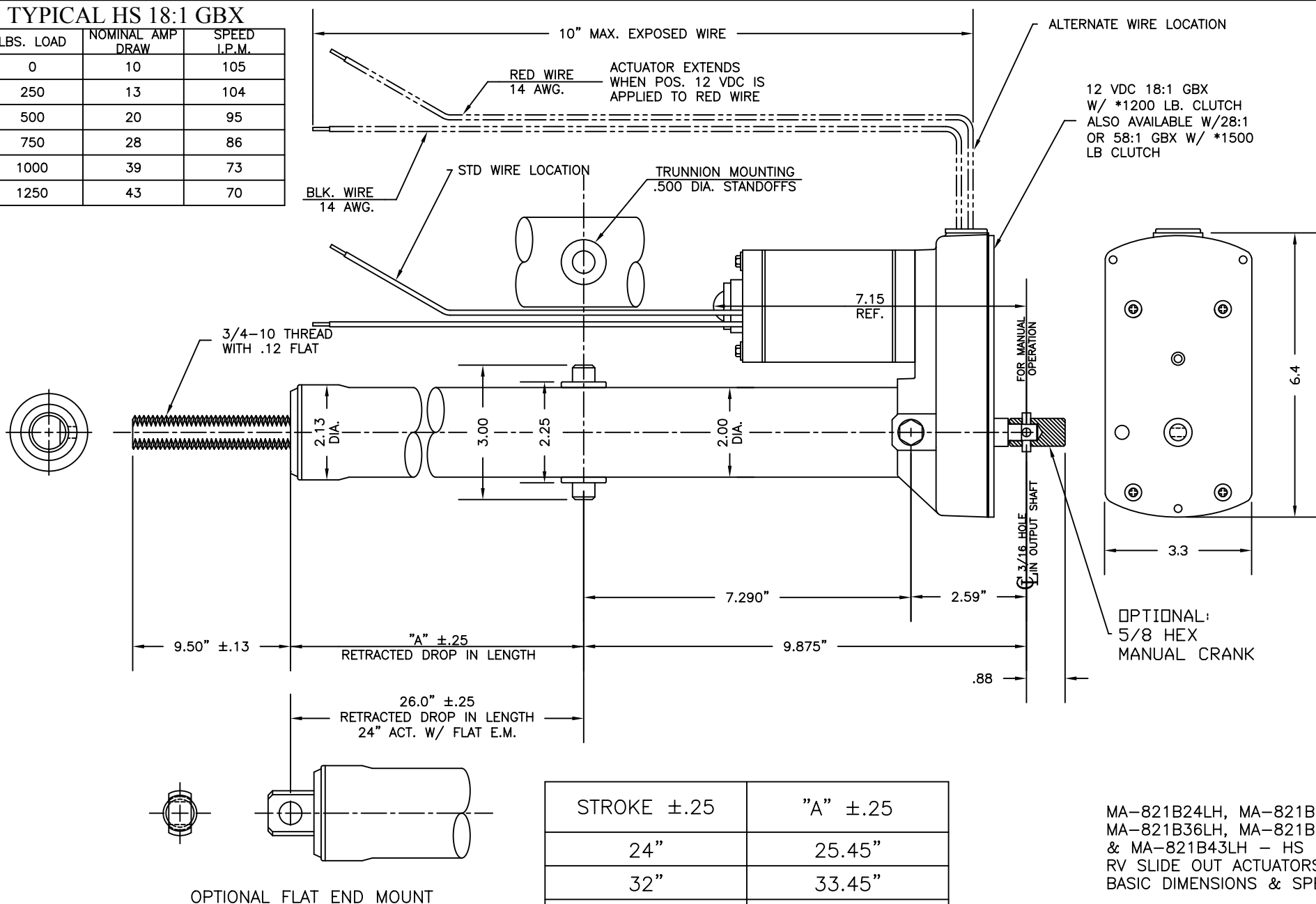
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VENTURE MFG. CO.

3636 DAYTON PARK DRIVE  
DAYTON OHIO 45414  
TEL: (937)233-6832  
FAX: (937)233-8485  
WEB PAGE: www.venturemfgco.com

# TYPICAL HS 18:1 GBX

LBS. LOAD	NOMINAL AMP DRAW	SPEED I.P.M.
0	10	105
250	13	104
500	20	95
750	28	86
1000	39	73
1250	43	70



STROKE ±.25	"A" ±.25
24"	25.45"
32"	33.45"
36"	37.45"
40"	41.45"
43"	44.45"

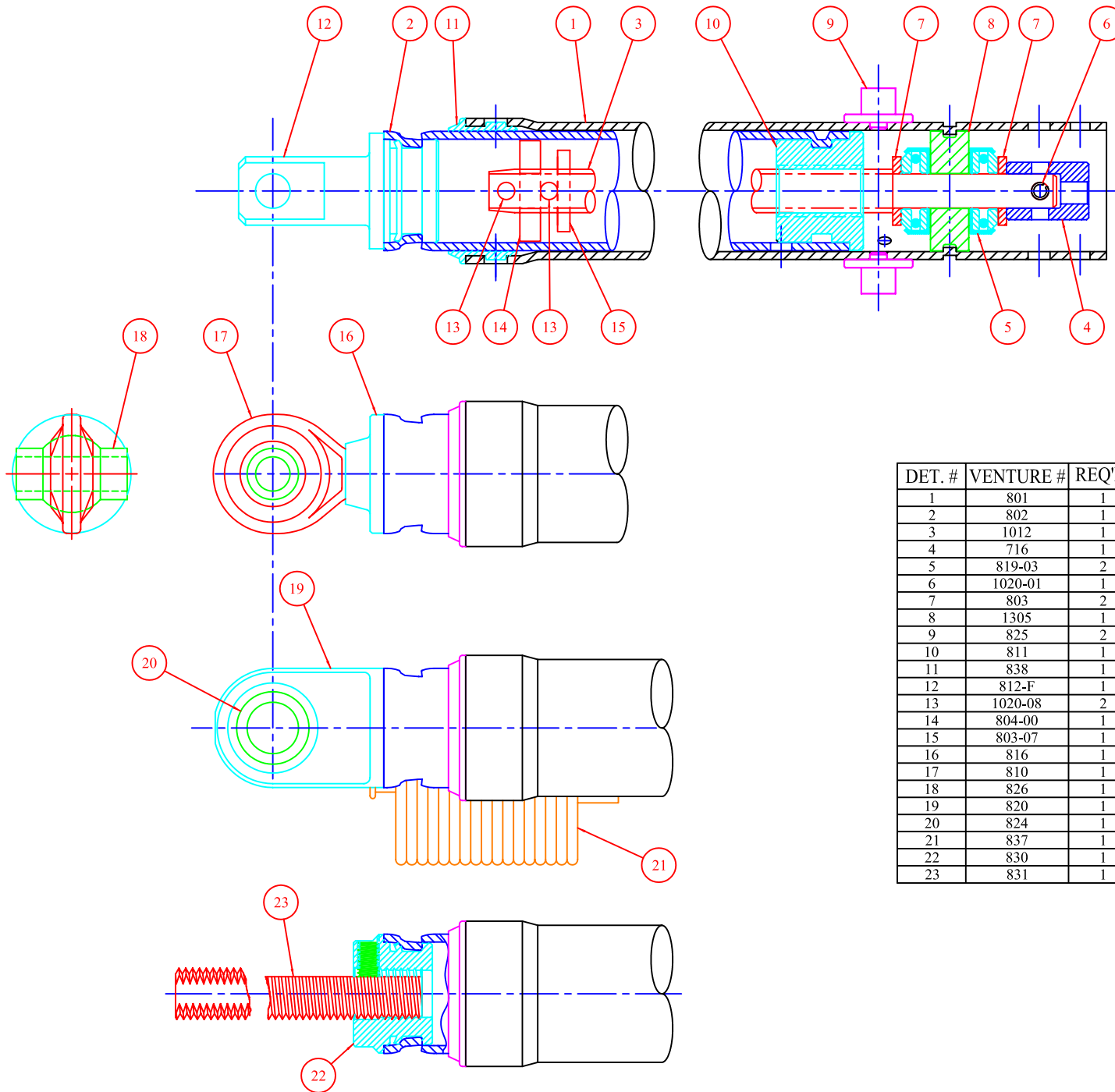
MA-821B24LH, MA-821B32LH,  
MA-821B36LH, MA-821B40LH  
& MA-821B43LH - HS 18:1  
RV SLIDE OUT ACTUATORS  
BASIC DIMENSIONS & SPECS

\*NOTE: NOMINAL CLUTCH SETTING SET TO  
NOT BE LESS THAN RATED LOAD  
THRU LIFE OF ACTUATOR

MAR 2007

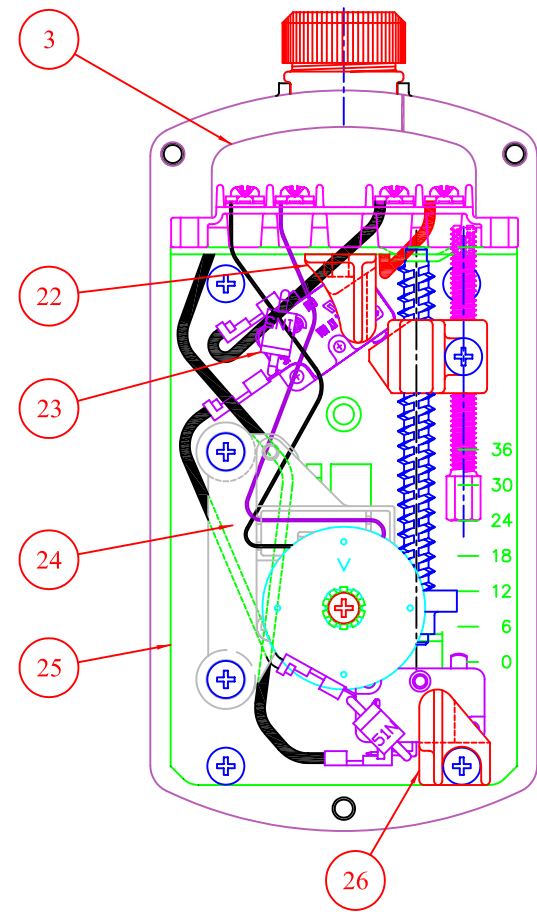
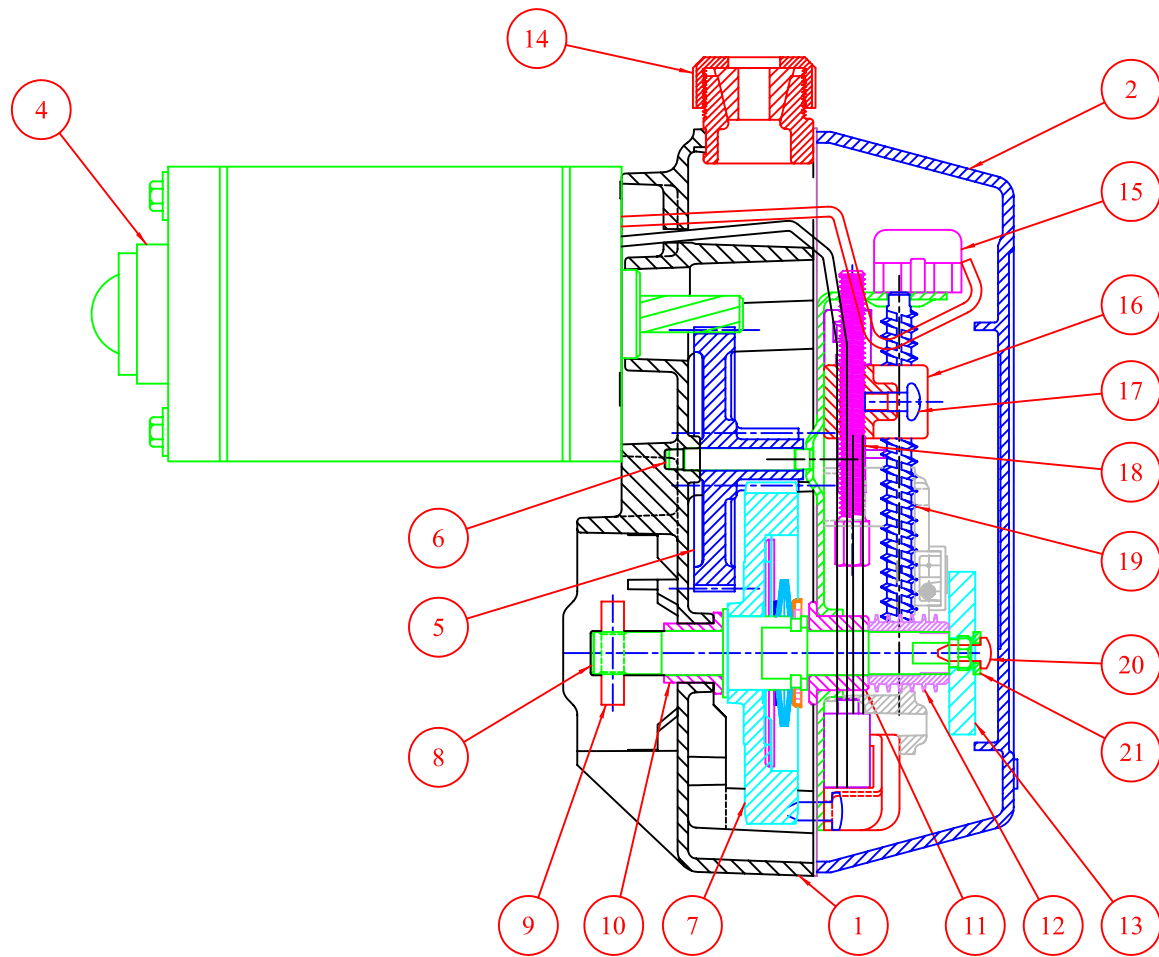
**VENTURE MFG. CO.**

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FAX: (937)233-8485  
WEB PAGE: [www.venturemfgco.com](http://www.venturemfgco.com)



DET. #	VENTURE #	REQ'D.	DESCRIPTION
1	801	1	OUTER TUBE
2	802	1	INNER TUBE
3	1012	1	ACME SCREW
4	716	1	DRIVE COUPLING
5	819-03	2	THRUST BEARING
6	1020-01	1	DRIVE PIN
7	803	2	WASHER
8	1305	1	SPACER
9	825	2	TRUNNION
10	811	1	JACK NUT
11	838	1	TUBE PILOT GUIDE
12	812-F	1	1/2" FLAT END MOUNT
13	1020-08	2	PIN
14	804-00	1	PILOT WASHER
15	803-07	1	WASHER
16	816	1	END MOUNT
17	810	1	1/2" BALL SWIVEL STUD
18	826	1	SWIVEL BALL
19	820	1	3/4" SWIVEL END MOUNT
20	824	1	3/4" BEARING SWIVEL
21	837	1	TUBE BOOT
22	830	1	END MOUNT (STUD TYPE)
23	831	1	THREADED STUD

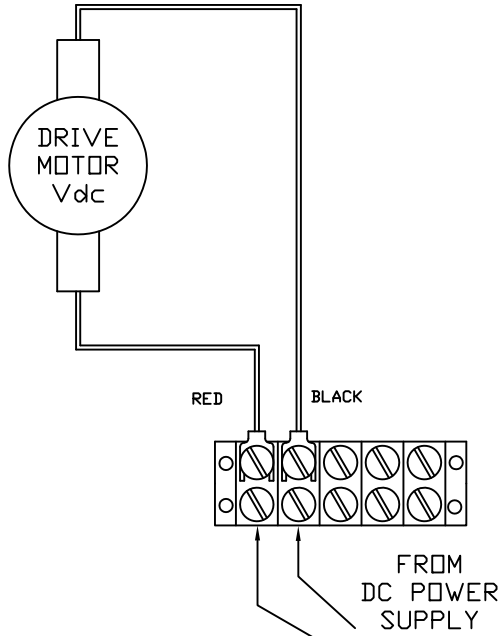




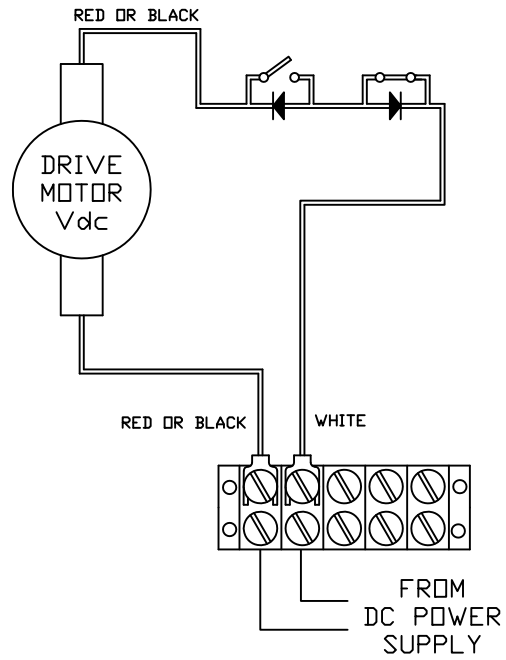
DET. #	VENTURE #	REQ'D.	DESCRIPTION
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2	8502	1	GEAR MOTOR LID
3	8520	1	GASKET
4	8532-08M	1	12 VDC MOTOR
	8532-09A	1	24 VDC MOTOR
	8532-01	1	36 VDC MOTOR
	8532-10A	1	90 VDC MOTOR
	8532-11A	1	110 VDC MOTOR
5	8504-01	1	REDUCTION GEAR FOR 18:1
	8504-02	1	REDUCTION GEAR FOR 28:1
	8504-03	1	REDUCTION GEAR (OVERMOLD) FOR 58:1
	8504-05	1	REDUCTION GEAR (METAL) FOR 58:1
6	8507	1	SHAFT, REDUCTION GEAR
7	8574-00	1	OUTPUT GEAR (PM, CLUTCH) FOR 18:1
	8574-02	1	OUTPUT GEAR (PM, CLUTCH) FOR 28:1
	8574-01	1	OUTPUT GEAR (PM, CLUTCH) FOR 58:1
	8503-04	1	OUTPUT GEAR (NO CLUTCH) FOR 58:1
8	8505-00	1	OUTPUT SHAFT W/OUT CLUTCH (B.S.)
	8505-01	1	OUTOUT SHAFT W/OUT CLUTCH (ACME)
	8575-00	1	OUTPUT SHAFT W/CLUTCH (ACME)
	8575-04	1	OUTPUT SHAFT W/CLUTCH (B.S.)
9	1020	1	SPIROL PIN
10	8514	1	FLANGE BUSHING
11	8514	1	FLANGE BUSHING
12	8509-00	1	DRIVE WORM, R.H. SINGLE START, BLACK
	8509-01	1	DRIVE WORM, L.H. SINGLE START, RED
	8509-02	1	DRIVE WORM, L.H. DOUBLE START, BRASS
13	8524-00	1	MAGNET WHEEL, 4 POLE
	8524-01	1	MAGNET WHEEL, 8 POLE
	8524-02	1	MAGNET WHEEL, 6 POLE
14	8530-00	1	STRAIN RELIEF ASSEMBLY (INCL. BUSHINGS)
15	8525	1	TERMINAL STRIP
16	8511-00	1	LEADSCREW NUT, BLACK
	8511-01	1	LEADSCREW NUT, RED
17	8518-02	1	#8 X .38 LONG P.P.H. SCREW
18	8512	1	ADJUSTING ROD
19	8510-01	1	LEADSCREW, 12 PITCH, ALUMINUM
	8510-02	1	LEADSCREW, 18 PITCH, STL. (BRITE ZINC)
	8510-03	1	LEADSCREW, 8 PITCH, ZINC (STANDARD)
20	8518-04	1	#6 X .38 LONG P.P.H. SCREW
21	803-05	1	#8 EXTERNAL STAR WASHER
22	8516-00	1	LIMIT SWITCH CLIP, RETRACT
23	8526	1	LIMIT SWITCH ASSEMBLY
24	8101-00	1	SUPER SENSOR II
	8102-00	1	HALL EFFECT SENSOR
	8529	1	POTENTIOMETER SENSOR KIT
25	8506	1	GEAR PLATE
26	8517-00	1	LIMIT SWITCH CLIP, EXTEND

# MOTOR DIAGRAM

W/O LIMIT SWITCH



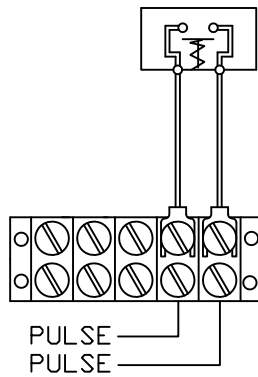
WITH LIMIT SWITCH



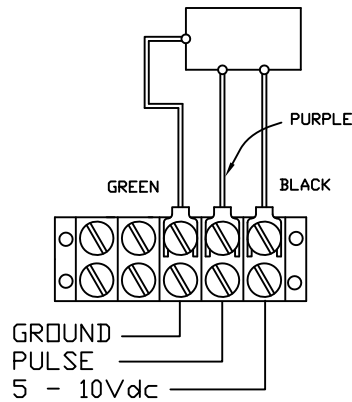
BALL SCREW ACTUATOR ~ RED MOTOR LEAD (+) = EXTEND  
ACME SCREW ACTUATOR ~ RED MOTOR LEAD (-) = EXTEND

## SENSOR OPTIONS

REED SWITCH

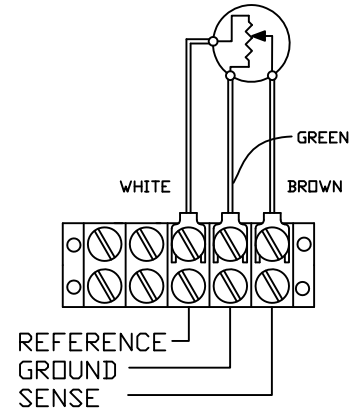


HALL EFFECT

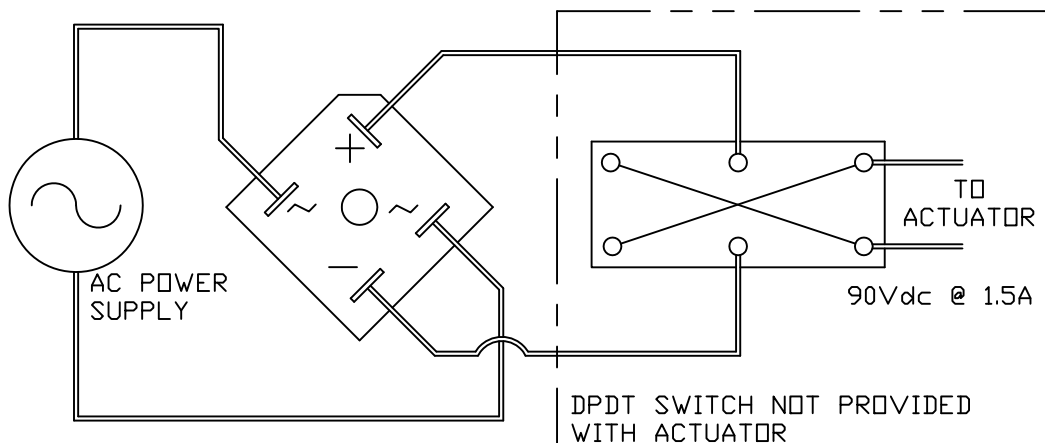


POT RESISTANCE WITH RETRACTION:  
BROWN TO GREEN - MINIMUM  
BROWN TO WHITE - MAXIMUM

10K POT



## 110V<sub>ac</sub> RECTIFIER







## **Limit Switch Adjustment**

*Follow directions below to adjust the limit switch settings to your Venture actuator. Your components and installation may vary slightly depending upon your original configuration, but concepts shown here should still apply. This procedure is meant to be performed on a fully-assembled actuator that is almost fully retracted.*

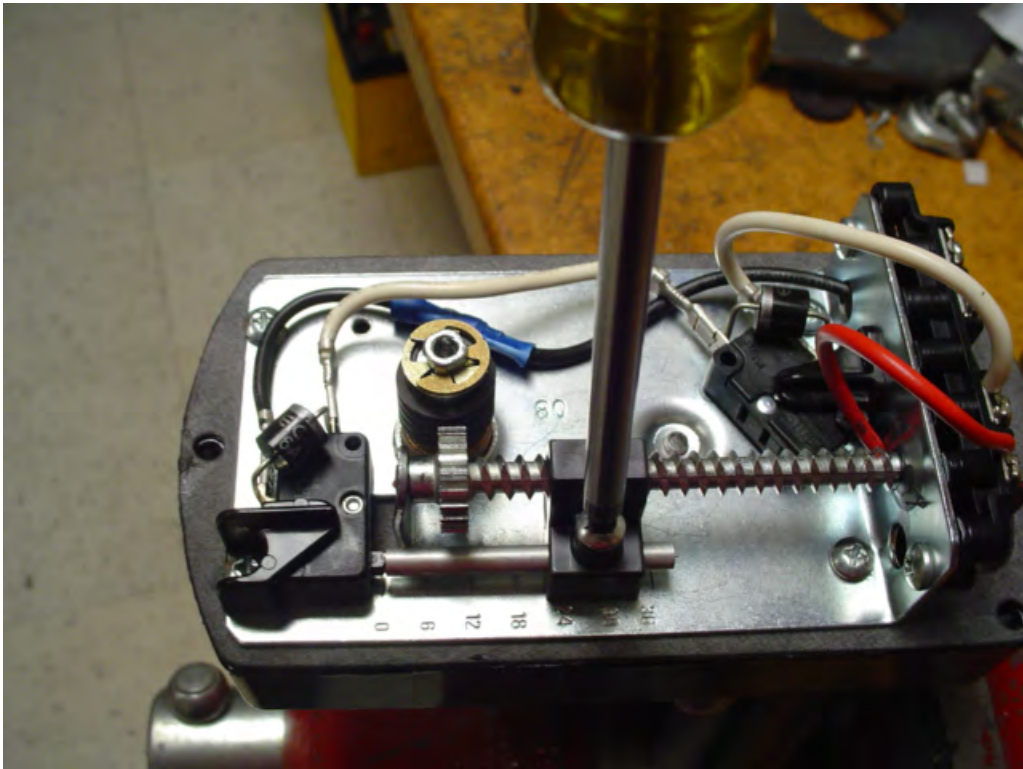
***\*\*Units are typically shipped from the factory with the retract switch activated and tube fully retracted, but power supplies vary, so it is always a good idea to reset the retract limit switch using the power supply that will be utilized in operation.\*\****

***Insure the inner tube does not rotate during this procedure when actuator is operated under power.***

***\*\*Warning\*\* Great care should be taken when adjusting the limit switches. If your actuator is supplied without a clutch it is possible to damage the gears if the actuator is over extended or retracted under power.***

### **Setting the stroke of your actuator**

1. If gearbox is not yet attached to actuator tube, do so now. Actuator tube should be almost fully retracted.
2. Extend actuator under power a short distance until Leadscrew Nut has come completely off of "retract" limit switch button.
3. Retract actuator under power until "retract" limit switch shuts off actuator.
  - a. If actuator "bottoms out" before limit switch shuts power off, immediately shut off power and manually extend (unscrew) Inner Tube a couple turns. Re-extend actuator under power, then re-retract under power until limit switch shuts it down (without bottoming it out).
4. After actuator shuts off, screw Inner Tube in manually until it bottoms out, then turn it back out 1 or 2 turns.
5. Now extend actuator under power, shutting it off manually when it reaches your desired stroke or extension point. ***\*\*units are typically set in the factory at less than full stroke... It may be necessary to loosen the screw which holds the adjusting rod in position in order to reach the desired extension.\*\****
6. Slide the adjusting rod to where it just activates (you should hear a click) the "extend" limit switch as shown in the photo below. Tighten screw onto the rod.
7. Retract actuator approximately 1 inch [25mm], then extend under power until "extend" limit switch turns the actuator off. Check the extension (stroke) of your actuator and adjust the Stroke Adjust Rod in or out if necessary until your proper setting is achieved.
  - a. Fully extended measurement minus fully retracted measurement is your full-stroke. Adjust rod away from "extend" limit switch to increase stroke, towards it to decrease stroke. ***Beware that it takes very little movement of the Stroke Adjusting Rod to make a large change to the stroke. Trial-and-error will be involved. A good hint is to rotate Stroke Adjust Rod to a new point before re-tightening screw, or screw will tend to find previous indentation. It is best to just lightly tighten screw onto rod until final setting is achieved.***
  - b. Numbers stamped onto gearplate may or may not coincide with a rough stroke measurement of your actuator, depending on your configuration. These numbers are for Venture internal use only.



**Actuator part number code.**

Part number: MA 81433851-48

The part number is composed of the following digits, in sequence:

8	Color (Black)
1	Motor RPM (6800)
4	Gear ratio (58:1)
3	Potentiometer
3	Dual limit switch (open/close)
8	Outer tube diameter (2 inches)
5	Screw size/type (5/8 inches RH Ball)
1	Tube mounting
-48	Stroke length (48 inches)

## **APPENDIX C**

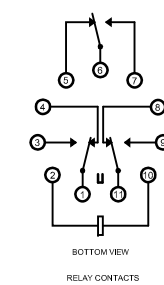
### **Automatic gate controller**

Wiring schematic

Parts list

Test sheet





**DRAFT**  
09/27/10

AUTOMATIC GATE CONTROLLER	
WIRING SCHEMATIC	
DESIGNED:   AWB	
APPROVED:	
FILE:   HIDCC_AUTOGATE	
JOB NO.:	
DATE:   JUNE 2010	
SHEET	OF
1	1

# AUTOGATE CONTROLER      PARTS LIST

Item #	Qty. per Unit	Item	Manufacturer / Model #	Description	Source / Part #	Price Each	Price Per Unit
1	1	Non - Metallic Enclosure, NEMA	Wiegmann / HW-J141206CHQR	NEMA 4 non metallic enclosure 14 x 12 x 6 Hinged	Automation Direct	\$89.00	\$89.00
2	1	Interior Panel	Wiegmann / HW-MP1412CS	White steel Interior mounting panel	Automation Direct	\$12.25	\$12.25
3	2	Relay, 11 pin	OMRON / MK3P5-S-DC12	Plug in Relay, 3PDT, 12 Coil Volts	Granger / 1YDH8	\$8.69	\$17.38
4	2	Relay Socket, 11 pin	Square D / 8501NR62	Din Mount 11 pin Relay Socket	Granger / 5B584	\$21.48	\$42.96
5	2	Down Legend Plate	Altech / 2LP06	Pushbutton Down Legend Plate	Allied / 767-0218	\$1.20	\$2.40
6	2	Up Legend Plate	Altech / 2LP05	Pushbutton Up Legend Plate	Allied / 767-0275	\$1.20	\$2.40
7	2	Hand / Off / Auto Legend Plate	Altech / 2LP36	Hand / Off / Auto Switch Legend Plate	Allied / 767-0229	\$1.20	\$2.40
8	2	Shrink Wrap Tubing 3/16"	3M / FP301 3/16 BK 48"	Black 3/16" Shrink Wrap 48" Length	Allied / 617-0431	\$1.46	\$2.91
9	2	3 pos Selector Switch	IDEC / ASW320	Manual / Off / Auto Switch	Allied / 814-0033	\$17.50	\$35.00
10	4	Push Putton Momentary Switch	IDEC / ABW110-B,G,R	Pushbutton Switch	Allied / 814-0010	\$9.35	\$37.40
11	4	Piggyback contacts	IDEC / HW-C10	Additional contacts for 3 Position Switch	Allied / 814-0201	\$5.57	\$22.28
12	2	Fuse Holder	Cooper Bussmann / HHM	Automotive Inline Fuse Holder	Allied / 740-0934	\$5.18	\$10.36
13	2	Fuse 10 Amp	Cooper Bussmann / ATM-10	Automotive Fast Acting 10 Amp Blade Fuse	Allied / 740-0889	\$1.28	\$2.56
14	4	Pilot Light	Sylvania / 12PSB	Incandescent Miniature Lamp, Slide Base 12V	Allied / 937-9630	\$1.55	\$6.20
15	4	Pilot Light Socket	Sylvania / 30099/32169	Indicator, Panel Mount, Socket	Allied / 937-6098	\$4.53	\$18.12
16	2	Pilot Light Lens / Red	Sylvania / 30120	Fluted, Dome, Lens Cap Red	Allied / 937-6245	\$0.68	\$1.36
17	2	Pilot Light Lens / Clear	Sylvania / 30125	Fluted, Dome, Lens Cap Clear	Allied / 937-6243	\$0.64	\$1.28
18	3	20 Gauge Hook Up Wire / Per Foot	Belden / 9919-009100	20 AWG Stranded Hook Up Wire, White / 100 Ft Roll	Allied / 214-0071	\$39.91	\$1.20
19	3	20 Gauge Hook Up Wire / Per Foot	Belden / 9919-005100	20 AWG Stranded Hook Up Wire, Green / 100 Ft Roll	Allied / 214-0074	\$39.91	\$1.20
20	3	20 Gauge Hook Up Wire / Per Foot	Belden / 9919-010100	20 AWG Stranded Hook Up Wire, Black / 100 Ft Roll	Allied / 214-0072	\$43.18	\$1.30
21	3	20 Gauge Hook Up Wire / Per Foot	Belden / 9919-003100	20 AWG Stranded Hook Up Wire, Orange / 100 Ft Roll	Allied / 214-0077	\$38.43	\$1.15
22	3	20 Gauge Hook Up Wire / Per Foot	Belden / 9919-002100	20 AWG Stranded Hook Up Wire, Red / 100 Ft Roll	Allied / 214-0073	\$39.91	\$1.20
23	2	18 Gauge Hook Up Wire / Per Foot	Belden / 8918-010100	18 AWG Stranded Hook Up Wiew Black / 100 Ft Roll	Allied / 214-0202	\$56.38	\$1.13
24	2	18 Gauge Hook Up Wire / Per Foot	Belden / 8918-002100	18 AWG Stranded Hook Up Wiew Red / 100 Ft Roll	Allied / 214-0203	\$56.38	\$1.13
25	1	Din Rail 35mm x 7.5 x 1m	Altech / 2511120/1m	Din Rail perforated steel zinc	Allied / 502-0156	\$3.75	\$3.75
26	3	Liquidtight Strain Relief 1/2"	Thomas & Betts / 2522	1/2" Hub, 9/16" Throat Strain Relief Connector	Allied / 534-9178	\$5.42	\$16.26
27	2	Cable Clamp	Panduit / CCH25-S10-C	Cable Clamp; .25 max bundle dia; #10 Screw mouint	Allied / 381-1063	\$0.16	\$0.32
28	6	Power Terminal	Entrelec / 11512017	Din Rail Mount Wiring Terminal Block	Gross Automation / 11512017	\$1.17	\$7.02
29	2	Terminal Stop	Entrelec / 39990302	Din Rail Mount Terminal Stop	Gross Automation / 39990302	\$0.69	\$1.38
30	1	Terminal End Cover	Entrelec / 11836816	Wiring Terminal End cover	Gross Automation / 11836816	\$0.24	\$0.24
31	1	Terminal Markers	Entrelec / 23800204	Wiring Terminal Marker Horz 1 - 8 / card of 10 rows	Gross Automation / 23800204	\$6.91	\$6.91
32	4	Stainless Steel Mounting Screws	UNC 18-8 Stainless	Machine Screw, Phillips Pan Head 10-24 x 3/8	Lawson / 91325	\$0.53	\$2.12
					Total Material Expense Per Unit		\$352.56

## TEST RESULTS

### Automatic Gate Controller

Controller Serial Number: \_\_\_\_\_

Gate 1 Relay  
Manual Mode:  
Input Voltage: \_\_\_\_\_

Gate UP Output Voltage: \_\_\_\_\_

Gate UP Indicator Light: \_\_\_\_\_

Gate Down Output Voltage: \_\_\_\_\_

Gate Down Indicator Light: \_\_\_\_\_

Gate 2 Relay  
Manual Mode:  
Input Voltage: \_\_\_\_\_

Gate UP Output Voltage: \_\_\_\_\_

Gate UP Indicator Light: \_\_\_\_\_

Gate Down Output Voltage: \_\_\_\_\_

Gate Down Indicator Light: \_\_\_\_\_

Automatic Mode:  
Input Voltage: \_\_\_\_\_

Gate UP Output Voltage: \_\_\_\_\_

Gate UP Indicator Light: \_\_\_\_\_

Gate Down Output Voltage: \_\_\_\_\_

Gate Down Indicator Light: \_\_\_\_\_

Automatic Mode:  
Input Voltage: \_\_\_\_\_

Gate UP Output Voltage: \_\_\_\_\_

Gate UP Indicator Light: \_\_\_\_\_

Gate Down Output Voltage: \_\_\_\_\_

Gate Down Indicator Light: \_\_\_\_\_

Test Date: \_\_\_\_\_

Test Initials: \_\_\_\_\_

## **APPENDIX D**

### **NEMA enclosure vandal box**

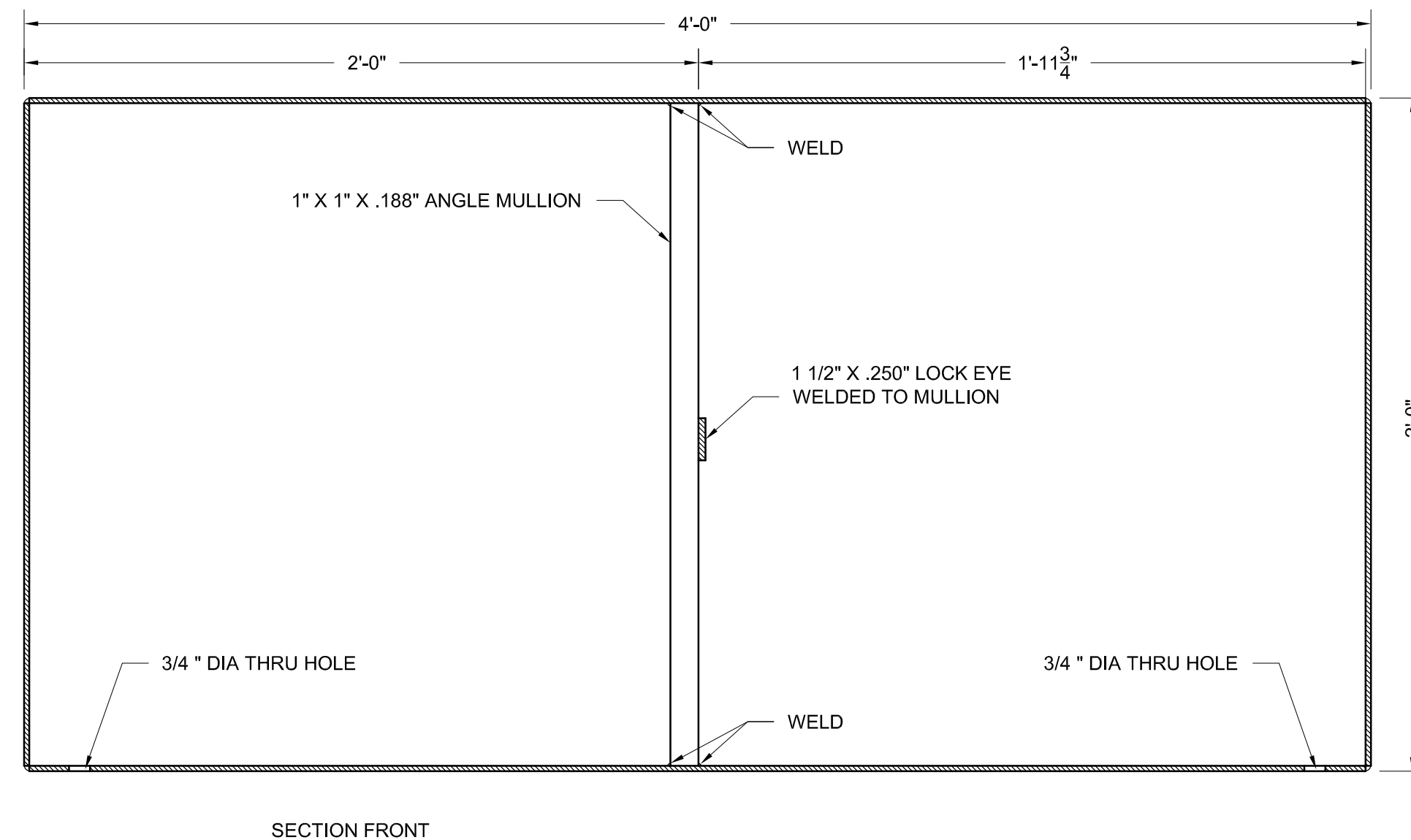
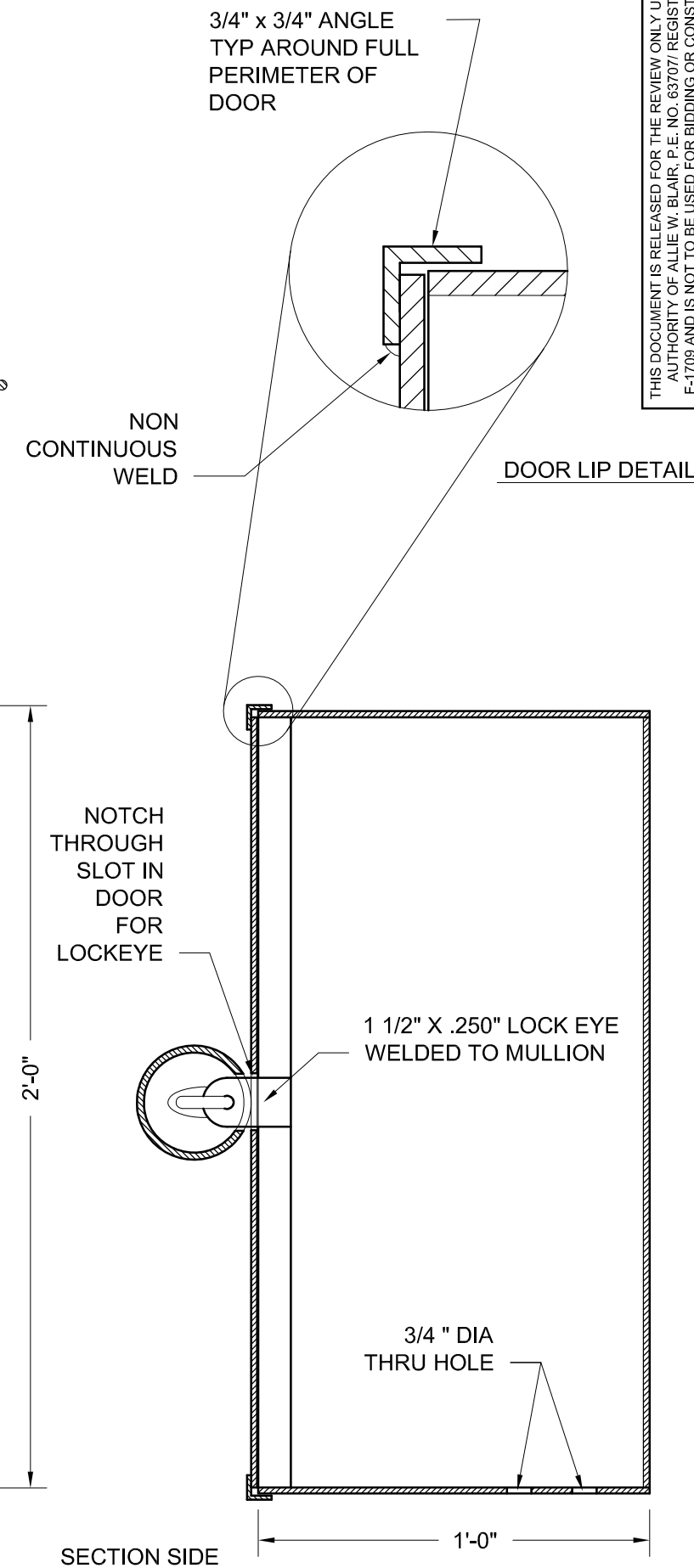
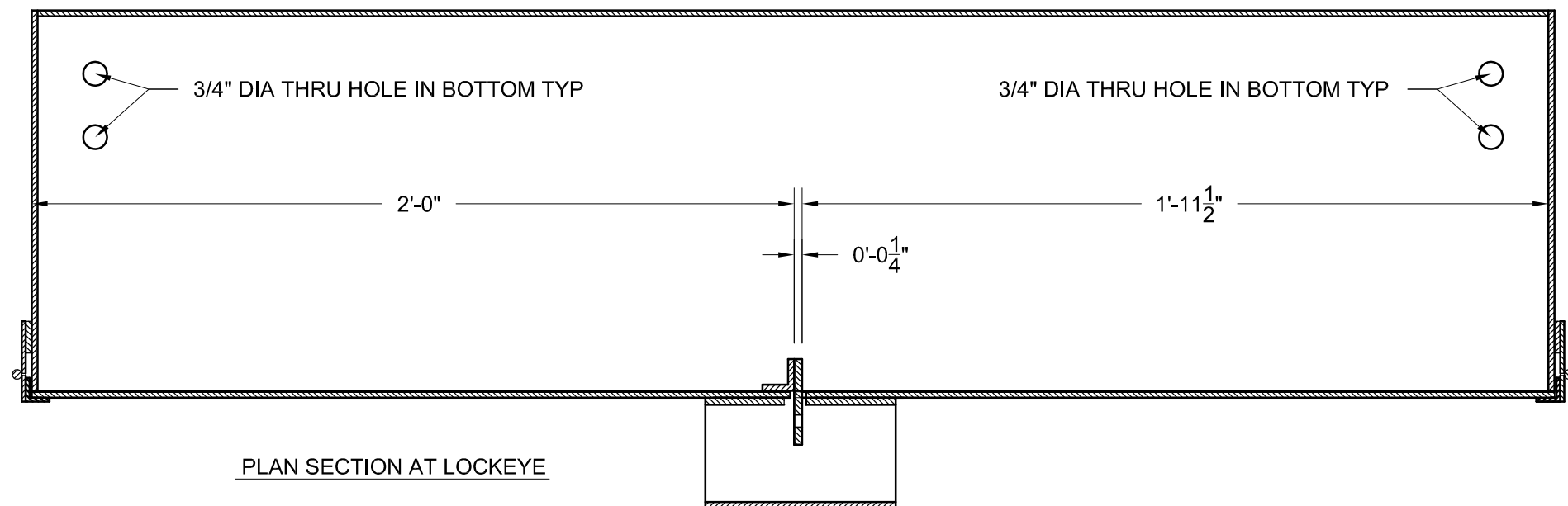
Elevations

Sections

Parts details







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DRAFT  
09.27.10



AW BLAIR  
ENGINEERING

P.O. Box 4615  
Austin, Texas 78765-4615  
Phone (512) 394-1011  
Fax (512) 349-1016

**HIDCC#1**  
**TWB - ITA Automatic Gate Controller**  
**NEMA ENCLOSURE VANDAL BOX**  
**SECTIONS**

DESIGNED:	
APPROVED:	
FILE:	
JOB NO.:	
DATE:	
SHEET	OF
2	3

