OPERATION

MAINTENANCE

TROUBLESHOOTING

MANUAL

MODEL WAAW-15/25SB
ARROWMASTER V
SOLAR ASSISTED
ARROW BOARD SYSTEM

By

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REVISION 15

SOLAR ASSISTED ARROW BOARD

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INTRODUCTION

The SOLAR ASSISTED ARROW BOARD has been designed to eliminate fuel consumption and costly maintenance. The system is powered by a battery storage bank which is charged by photovoltaic solar modules and an optional onboard AC to DC solid-state charger. The specially designed control electronics and light board efficiently uses this stored energy to direct traffic in the same manner as other conventional Arrow Boards.

KEY FEATURES/ADVANTAGES

- Non-blinding, minimum glare electro-optical design to reduce nighttime blinding problems that exist on conventional Arrow Boards.

- The solar panel rises to a fixed position when the sign board is raised by a clutch winch. No solar panel positioning is required.

- The solar panel is out of the system's shadow. Shadows significantly reduce the panel's power output. This feature enables our system to use a lower wattage panel because our total daily power is accumulated without losses due to shadows. Common sense tells us that this concept is untrue when we place the unit where sunlight is restricted, such as under a bridge or tree.

- The solar panel, when in the travel position (folded down), is still shadow-free, providing a charge to the battery bank while not in use.

- The solar panel, when erected, is at a ninety degree (right) angle to the sign board, which protects the panel from a direct hit by a bottle, etc., thrown by a passing motorist. Also, the panel, being eleven feet high when in the erect position, is much less vulnerable to vandalism.

OTHER ADVANTAGES

- Eliminates diesel fuel.

- Reduces service trips to the job.

- Eliminates engine repair/overhaul.

- Servicing is greatly simplified.

OTHER ADVANTAGES (cont.)

- Eliminates diesel fuel spill damage to pavement.
- Reduces air and noise pollution.
- Increased lamp life/fewer replacements.
- Improved night vision for motorists.
- Optional onboard AC charger provides easy recharging and allows AC service operation.
- Commonly available deep cycle batteries.
- High efficiency solar panel.
- Thirty day, single arrow, no sun operation.
- High efficiency, high output LED 46 solid-state lamp.
- Automatic lamp intensity/brightness control.
- Charge regulation/over discharge protection.
- Sophisticated microprocessor circuit design.
- Two year warranty, materials workmanship, normal use on electronics; five year limited warranty on lamps.

SOLAR ASSISTED ARROW BOARD DESCRIPTION

POWER SOURCE

The SOLAR ASSISTED ARROW BOARD incorporates up to three 12-volt DC, group 27, deep cycle batteries that are wired in parallel. Group 4-D batteries are used with 25 light units. The batteries are housed in a ventilated, weatherproof, lockable enclosure that has been designed for easy access and removal of the batteries. The total capacity of the bank is 105 amp hours times the number of batteries at the 100 hour rate. The battery bank is regulated and protected by a solid state charge controller/low voltage disconnect. This prevents gassing and over discharging of the batteries, which can result in premature failure. The batteries carry a factory warranty as provided by the battery manufacturer.

The battery bank is charged by 12 volt DC, single crystal photovoltaic solar modules, which are mounted on an automatic/self-erecting/shadow free operation apparatus. The solar panels provide a charge to the battery bank while exposed to the sun. An onboard charger is optional for AC/DC charging and AC service operation.

LAMPS

The SOLAR ASSISTED ARROW BOARD uses a specially designed, amber, minimum glare, LED 46 solid-state high efficiency/high output, sealed beam lamp. This lamp meets or exceeds the M.U.T.C.D. one mile visibility specification for Type C Advance Warning Arrow Panels (Section 6E-9). The lamps are warranted for five years. The lamp may be repaired in most cases, as the components are replaceable. The lens is made from durable acrylic for protection and has been designed to spread the light being emitted. The specially designed optics reduces the nighttime blinding characteristics that are prevalent in conventional advance warners.

CONTROLLER/CHARGER

An onboard 110 volt AC/12 volt DC battery charger, with voltage regulator, is optional for in-house or remote charging. A male plug, which extends to the outside of the battery enclosure, accepts the female end of a standard AC extension cord. The optional charger may be used as an AC/DC converter allowing the AC service to power the system. The solid-state regulator regulates both the solar panel and the AC/DC charger, protecting the battery bank from overcharging.

CONTROLLER

GENERAL

The controller incorporates a state of the art microprocessor based controller for use in the 15 and 25 light Solar Assisted Arrow Boards. This new design will miniaturize the control package for the Arrow Boards, making the Arrow Board one of the most sophisticated on the market today.

MODES

15 LIGHT MODES:

Right Arrow	10 lamps flashing in unison, forming an arrow.
Left Arrow	10 lamps flashing in unison, forming an arrow.
Double Arrow	5 lamps in each arrow head and 3 lamps in a common shaft all flashing in unison.
Warning Bar or Caution Bar	7 horizontal lamps flashing in unison.
Four Point Caution	4 outermost corner lamps flashing in unison.
Sequencing Arrow Right	5 lamps in the arrow head and 5 lamps in the shaft sequencing right.
Sequencing Arrow Left	5 lamps in the arrow head and 5 lamps in the shaft sequencing left.

25 LIGHT MODES: (includes all 15 light modes plus the following)

Sequencing Chevron Right	3 chevrons of 5 lamps each, sequencing in a left to right direction.
Sequencing Chevron Left	3 chevrons of 5 lamps each, sequencing in a right to left direction.
Double Diamond	2 sets of 8 lamps forming two diamonds flashing alternately.

FEATURES:

1. Sophisticated microprocessor circuit design.
2. User friendly two-button operation.
3. Continuously active LED display showing mode of operation.
4. "Auto-Trak", which is a full-time ambient light monitoring system to monitor and adjust the Arrow Board's light output for maximum efficiency and consistent operation.
5. Continuous monitoring and adjustment of lamp intensity to compensate for changing battery voltages.
6. Continuous monitoring of battery bank voltage, with low voltage warning and shutdown to prevent deep discharge of batteries.
7. Upon detection of 11.2 volt battery bank, the controller will automatically change to the Four Point Caution Mode to continuously provide a caution indication to motorists and to give operators a warning that low battery conditions exist.
8. After a period of 48 hours and the battery voltage continues to decrease, the system will detect the second stage of low voltage shutdown and completely turn off all lamps and switch to a low power consumption mode to protect the battery bank from complete discharge.
9. Continuous monitoring of ambient temperature conditions and regulation of battery bank charge rates to prevent over or undercharging of the battery bank.
10. Full automatic test mode to test complete controller functionality and battery bank voltage with the Arrow Board running.
11. Solar panel charging indicator to continuously detect solar panel charge to battery bank.
12. Mode selection of lamp intensity levels:

Auto-Trak	Automatic 24-hour tracking, auto dimming for optimum efficiency and intensity reduction for night operation.
Manual Dim (optional)	Provides continuous night dimming operation of lamps.
Manual Bright (optional)	Provides continuous maximum intensity of lamps.

13. The controller is equipped with an automatic delay function to prevent false triggering of the Auto-Trak intensity control.

TEST/LOW BATTERY

The operator initiates a battery test by pressing/releasing the TEST BATTERY (Test Batt) membrane switch. Each indicator, starting with the top indictor (right arrow), is lit and then turned off. Each segment of the bar graph of BATTERY LEVEL is lit and then turned off. For 30 seconds the solar panel is electrically disconnected from the battery and the battery voltage displayed on the bar graph. The number of segments lit will indicate percentage of charge between 0 and 100 percent. When all ten segments of the bar graph are lit, the battery voltage is at least 13 volts (100%). If no segments are lit, the battery voltage is below 11.2 volts (0%). After 30 seconds, the bar graph display is turned off.

LOW BATTERY MODE

The controller continually monitors the voltage at the batteries for a Low Voltage Disconnect (LVD) condition. If the voltage drops below 11.2 volts for at least 30 seconds, an LVD condition will be declared. If the previous operating mode was any mode except OFF, the controller will go to Four Point Caution mode. It will remain in the Four Point Caution mode for 48 hours, at which time the controller will go to the OFF mode. If the controller was in the OFF mode, it will remain in the OFF mode during LVD.

TEMPERATURE COMPENSATION

The controller temperature compensates the maximum voltage that a battery is allowed to be charged to for a given ambient temperature.

TRAILER

The trailer and sign support system are fabricated from steel tubing and formed steel channel. The sign support/solar panel frame and lifting mechanism are designed for simplicity of operation. Setup and takedown time is minimal with one person. Sign board lock down/securing has been provided for both travel and erect positions. A braking winch is used to raise and lower the sign board/solar panel assembly. The trailer is equipped with a 2,000 pound rated leaf spring axle, roller bearings, and 14 inch automotive type wheels. The trailer has four adjustable jack stands, one mounted on each corner of the unit. The lockable battery box provides for easy access and removal of the batteries and controller/charger. The trailer is treated with primer and the final finish is Safety Orange Enamel. The unit is equipped with all necessary lights, reflectors, and safety chains, which meet all vehicle codes. The removable tongue has a two inch ball coupler. Pentile type hitch is optional.

POWER AND SYSTEM CONSUMPTION

The performance of the SOLAR ASSISTED ARROW BOARD is proportional to the weather. The system will run 15-30 days on a fully charged battery bank with no sun at all. For every hour/day of sunlight, the system's operating time will be increased. Winter conditions will affect system performance due to less sun and colder temperatures. Under ideal circumstances, every good day of sunlight will charge the battery bank back up to 100% charge.

SAFETY/WARNINGS/PRECAUTIONS

- A safe environment around the unit is encouraged. The following are recommendations to be noted, as the unit is typically being used within a construction area and with traffic congestion, the threat of accidents or injuries may be higher.
- Always tow the unit with the sign board down.
- Periodically inspect tires, wheels, tongue, pins and safety chains, which are used in towing.
- Always make sure that the taillights work before towing the unit.
- Traffic cones or barricades should first be set up around the trailer before the sign board is erected.
- The trailer should be properly set up with the jack stands, sandbags, etc., before leaving the unit deployed in the construction area.
- Periodically check all nuts, bolts, cable clamps, wiring, etc., and tighten/repair/replace when necessary.

USE IN A MOVING OPERATION

- Be sure unit is secured to towing vehicle at hitch and tow chains are secured.
- Sign panel should be fully erect and latch engaged.
- Towing vehicle should not exceed the maximum tow speed of 10 mph.

SAFETY NOTES/DISCLAIMER

We have taken precautions to insure that the SOLAR ASSISTED ARROW BOARD is safe and reliable. However, we cannot be held liable or responsible for any injuries, accidents, or other mishaps as a result of the use or misuse of this product. It is the user's responsibility to insure that the manner in which this unit is used is a safe one, and the user is to understand that they are the only liable party.

SETUP/OPERATING INSTRUCTIONS

The following is a step-by-step procedure for setup and operating instructions on the SOLAR ASSISTED ARROW BOARD.

1. Remove trailer from vehicle, blocking wheels first.
2. Using jack stands, set up unit for proper viewing angle making sure unit is level and the sign board is directed toward the traffic being controlled. NOTE: THE SOLAR ASSISTED ARROW BOARD REQUIRES A MORE PRECISE SETUP WHEN COMPARED TO A DIESEL UNIT. USE THE SIGHT TUBE MOUNTED ON THE HORIZONTAL CROSS BRACES OF THE TRAILER FRAME TO SIGHT IN THE SIGN BOARD. SEE ADDITIONAL INSTRUCTIONS UNDER "HOW TO USE THE SIGHT TUBE".
3. Remove tongue (if desired) by unplugging the wiring, and remove the bolt that secures the tongue to the trailer.
4. Disconnect sign board latches and erect board/solar panel by cranking braking winch.
5. Reset latch on board uprights to prevent wind shear.
6. Open battery enclosure and set the controller to the desired MODE.

HOW TO USE THE SIGHT TUBE

Position yourself at the draw bar end of the unit facing oncoming traffic. Pivot the right-hand screw jack only into the vertical use position.

Aim the unit as you normally would. To be more exacting with your setup, look through the peephole at the rear of the sight tube and find the desired target area. As you look through the sight tube, you may have to shift the drawbar to the right or left; or adjust the jacks up or down to properly align the unit until the bead at the front of the sight tube is centered on the lane of traffic to be influenced, at the greatest distance from the unit as practical, thus allowing as much motorist reaction time as possible. After you are satisfied with your setup, deploy the remaining three jacks and recheck yourself.

This sighting procedure is very effective and should be employed on every setup, whatever the sight distance may be. Remember, the sight tube is parallel to the lamp beams which, in turn, will align the lamps with the area in the sight tube.

SPECIFICATIONS FOR THE M-90 E SOLAR ASSIST ARROW BOARD

1. Sign panel consisting of 15 or 25 minimum glare, 5" Par 46 sealed beam lamps.

2. Control system of solid state design (microprocessor based) with automatic tracking, brightness adjustment and non-blinding optics.

3. Single sign/solar panel lifting mechanism.

4. Sign supporting frame.

5. Photovoltaic Solar Generator, DC voltage, 40 watt power supply (25 light units have 55 Watt power supply).

6. Meets the requirements of the Federal Manual on Uniform Traffic Control Devices.

FUNCTION (General)

The M-90 series, 15/25 Light Solar Assist Arrow Boards are all weather, self contained, battery/solar powered systems. The purpose is to signal, control, and direct high speed vehicular traffic both day and night for extended periods of time. This system incorporates a "non-blinding," minimum glare electro-optical design to reduce nighttime blinding problems which exist on conventional Advance Warners.

SPECIFICATIONS (General)

The 48" x 96" aluminum sign panel, which contains either 15 or 25 hooded lamps, is trailer mounted and will operate while being towed or while in a stationary position. It is capable of displaying the following mode configurations:

1. Right Arrow	**10 lamps flashing in unison forming an arrow.**
2. Left Arrow	**10 lamps flashing in unison forming an arrow.**
3. Double Arrow	**5 lamps in each arrow head and 3 lamps in a common shaft all flashing in unison.**
4. Warning Bar	**7 horizontal lamps flashing in unison.**
5. Four Point Caution	**4 outermost corner lamps flashing in unison.**
6. Sequencing Arrow Left	**5 lamps in the arrow head and 5 lamps in the shaft, sequencing left.**
7. Sequencing Arrow Right	**5 lamps in the arrow head and 5 lamps in the shaft, sequencing right.**

25 LIGHT MODES (includes all 15 light modes plus the following):

Sequencing Chevron Right – 3 Chevrons of 5 lamps each, sequencing in a left to right direction.
Sequencing Chevron Left – 3 Chevrons of 5 lamps each, sequencing in a right to left direction.
Double Diamond – 2 sets of 8 lamps forming 2 diamonds flashing alternately.

Sign Panel

1. The front and back panels of the sign shall be aluminum alloy, .063 thick x 48" x 96" long.

2. The perimeter frame and internal vertical members are manufactured from extruded aluminum channel 1/8" x 3" x 1". Corners and internal cross members are welded for maximum strength.

3. Access to the internal strip is provided through rear access panel.

4. The lamps are minimal glare, 5" amber, size Par 46
5. The lamp hoods/retainers are formed from high impact plastic, with four keyhole indexing mounting holes.

6. The wire harness is fabricated from insulated stranded wire with PVC jacket to resist moisture. Strain relief is provided using a 90 degree Squeeze Tight connector. The solar panel output wiring is incorporated into the sign panel wiring via insulated slip connectors.

7. The panel is primed and painted with a 2 coat system consisting of a polyurethane primer, flat black polyester top coat baked at 450 degrees.

Control System

1. The system operates on a 12V DC input to the controller. The system incorporates "Auto-Trak," a full-time tracking system designed to track ambient light 24 hours a day, providing maximum system efficiency.

2. The lamps shall be electronically operated by means of solid state microprocessor controlled circuitry. An automatic lamp intensity regulator holds the lamp output constant with varying battery voltage.

3. All wire harnesses shall be made up of weatherproof jacketed wire/cable and shall be routed to minimize chafing and interference with moving parts. Connectors shall be AMP CPC type for corrosion resistance.

4. The controller shall be in a weatherproof, ventilated, lockable enclosure.

5. The "Auto-Trak" feature tracks ambient light 24 hours a day, dimming for optimum system efficiency. Dimming occurs at 5 foot-candles to eliminate glare through the non-blinding optics.

6. Continuous monitoring of battery bank voltage with two stages of low voltage warning and shutdown to prevent deep discharge of batteries.

7. Upon detection of 11.2 volt battery bank, the controller will automatically change to the Four Point Caution Mode to continuously provide a caution indication to motorist and to give operators a warning that low battery conditions exist.

8. After a period of 48 hours and the battery voltage continues to decrease, the system will detect the second stage of low voltage shutdown and completely turn off all lamps and switch to a low power consumption mode.

9. A solid state low voltage disconnect electronically protects the battery bank from deep discharge. The system will automatically shut down at a preset discharge level, illuminating the low battery indicator.

10. The optional "on-board" 110V AC/12V DC battery charger is for in-house or remote charging. A male plug accepts the female end of a standard AC extension cord. The charger may be used as an AC to DC converter allowing AC service to power the system. The solid state regulator regulates the solar panel charge, protecting the battery bank from over charging.

11. Thermal compensation is provided to adjust the system's charge rate with variances in temperature.

12. Short circuit protection is provided for the lamps and the wiring harnesses.

13. A battery condition indicator and a test mode are provided to monitor the system's battery charge.

14. An indicator light(s) is provided to monitor the AC charge rates, when the optional AC/DC charger is installed.

15. Mode selection of lamp intensity level:

    - **Auto-Trak - Automatic 24 hour tracking, auto dimming for optimum efficiency and intensity reduction for night operation.**

16. The flash rate is 25-40 flashes per minute.

17. The "on time" is 50% of the cycle.

18. The controller employs a rotary switch for mode selection, and incorporates a built in LED mode display screen for night time viewing.

19. The system's controller/charger electronics carry a two year warranty against material defects and workmanship under normal use.

Sign/Solar Panel Lifting Mechanism

1. The panel lifting arm shall be fabricated from 11 GA x 2" square carbon steel tubing.

2. The lifting mechanism shall be a 1200 pound capacity hand operated braking winch using 3/16" wire cable and pulley mechanism (pulley mechanism only used on skid mount and other custom unit configurations).

3. Locking devices to secure the panel in a raised position shall be heavy duty steel spring loaded latches and a heavy duty rubber draw latch locking device for the lowered position.

Sign Supporting Frame

1. The sign supporting frame shall be fabricated from 1/8" wall x 2" x 2" square tubing. The frame is all welded construction.

2. The sign panel is secured to the sign support frame with (4) formed panel clamps.

3. The sign panel lifting assembly, while in the display position is locked in position by a spring loaded latch assembly.

Power Supply (DC Voltage)

1. The solar generator shall incorporate a 12V DC, 40 watt (15 light units), 55 watt (25 light units), single crystal photovoltaic solar panel array mounted on a self erecting, automatic positioning apparatus. The solar panel provides a maximum charge to the battery bank while exposed to the sun due to the shadow free top mount design.

2. The battery bank consists of up to three deep cycle series 27, 105 AMP hour 12V DC batteries, providing a total storage capacity of up to 315 AMP hours at the 100 hour rate. Group 4-D batteries are used with 25 light units.

3. The battery bank shall be of sufficient capacity to power the unit 30 days with no solar assist. **(No sun operation with 100% battery bank charge @ 78 degrees F, single arrow mode, 24 hours per day in "Auto-Trak").**

4. The batteries shall be regulated and protected by solid state microprocessor controlled electronics. A low voltage disconnect will protect the battery bank from over discharge. Upper end float regulation will prevent over charging by the solar panel and the on-board AC charger. Thermal compensation adjusts the system's charge rate with variances in temperature.

5. The batteries shall be housed in a ventilated, lockable, weatherproof housing.

Trailer

1. The trailer deck shall be fabricated from 11 gauge x 2” x 2” steel square tubing.

2. The trailer uprights and horizontal bracing shall be 11 GA x 2" x 2" steel square tubing.

3. The pivot support arms/lifting mechanism shall be 11 GA x 2" x 2" steel square tubing.

4. The battery box shall be constructed from 14 GA steel. The batteries are secured in position by a hold-down assembly. The battery enclosure lid is lockable using the single latch/locking device.

5. The axle shall be 2000 pound capacity rated and equipped with 1400 pound leaf springs, roller bearings and hubs.

6. The tires shall be P185/70R14.

7. The fenders shall be made from heavy duty plastic.

8. The hitch shall be a 2" ball. A 2 ½” or 3” pentle ring hitch is optional.

9. The trailer shall have 1/4" safety chains equipped with a 2600 pound slip safety hook.

10. The trailer shall be equipped with four (4) adjustable jackstands, one mounted on each corner of the unit. A fifth jack stand consisting of a top-wind, swing type shall be mounted to the unit’s tongue.

11. The trailer tongue shall be .250” thick x 2 ½” square tubing, 60” overall length. The tongue is removable to prevent theft.

12. The trailer shall have reflectors on each side, 2 amber at front. 2 red at rear. Combination marker light/stop taillight assemblies, one (1) with license bracket, are mounted at rear of trailer.

13. The trailer shall have the grease and wax removed prior to applying one coat of Primer and one coat of Safety Orange.

Capacities and Weights

15 LT Unit

* Shipping Weight: lbs.	940
* Tongue Weight Panel Down lbs.	65
* Tongue Weight Panel Up lbs.	125

25 LT Unit

* Shipping Weight: lbs.	1000
* Tongue Weight Panel Down lbs.	75
* Tongue Weight Panel Up lbs.	135

Trailer Dimensions

*Length Inches	110
*Width Inches	96
*Travel Height Inches	88
*Operating Height Inches	142

*** All weights and dimensions are approximate**

ALL SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

MAINTENANCE

The SOLAR ASSISTED ARROW BOARD has been designed to minimize maintenance. Following is a list of areas to check periodically.

TRAILER

Check wheels, tires, axle assembly, wheel bearings, taillights, tongue, safety chains, and all components related to safe towing. Check tightness of all nuts and bolts; replace worn parts when necessary.

ELECTRICAL SYSTEM CHECKOUT

(Refer to the Controller Features/Switch Functions section Solar Assisted Arrow Board face plate illustration. System Interconnect Wiring Diagram and the Lamp Layout & Terminal #'s Diagram).

WIRING/HARNESSES

Check all wiring for wear, damage, and proper connections. Check all connectors: P1, P4, and the solar panel connector behind the sign board.

CONTROLLER

Check for proper operation. Check LAMP functions/MODES. Clean photocell window located on the right side of battery box. (Clean acrylic window with damp cloth. DO NOT USE SOLVENTS.)

CHARGER (if equipped)

Plug in AC (female plug end) of an extension cord to the onboard AC male plug.

SOLAR PANEL

While exposing solar module to sunlight, observe the solar indicator light located on the controller face. The light should be on indicating that a solar panel charge is being applied to the battery bank. THIS CHECK SHOULD BE MADE WITH AC/DC CHARGER OFF. If no reading, check solar panel wiring (see System Interconnect Diagram). The solar panel also may be checked on pins 23 and 24 of the P1 wiring harness plug. Using a voltmeter, check open circuit voltage. The voltage reading should be 16-20 volt DC. Observing the current meter while the panel is exposed to full sun, a reading of five amps or more should be noted. MAKE SURE SOLAR PANEL CHECKS ARE PERFORMED WITH THE CONTROLLER IN THE OFF POSITION AND WITH PANEL EXPOSED TO THE SUN. Periodically CLEAN the solar panel, removing dust/dirt with a damp cloth.

BATTERIES

Check water level in each cell (six cells per battery). FILL ONLY WITH DISTILLED WATER. Check all terminals for proper connection, tightness and corrosion. Check BATTERY CONDITION and charge when necessary or not in use. A voltmeter or hydrometer may be used to more accurately determine the status of a battery. The batteries may be swapped out with freshly charged batteries. The battery enclosure has been designed to easily remove the batteries. WARNING: It is recommended that the batteries be charged every three to six months, regardless of weather conditions. If extremely deep discharges have occurred, a recharge should be done immediately to prevent sulfation, which will permanently damage the batteries.

The following data should be used in determining the battery bank charge status. By using a hydrometer to measure specific gravity, a corresponding approximate recharge time for the system can be determined.

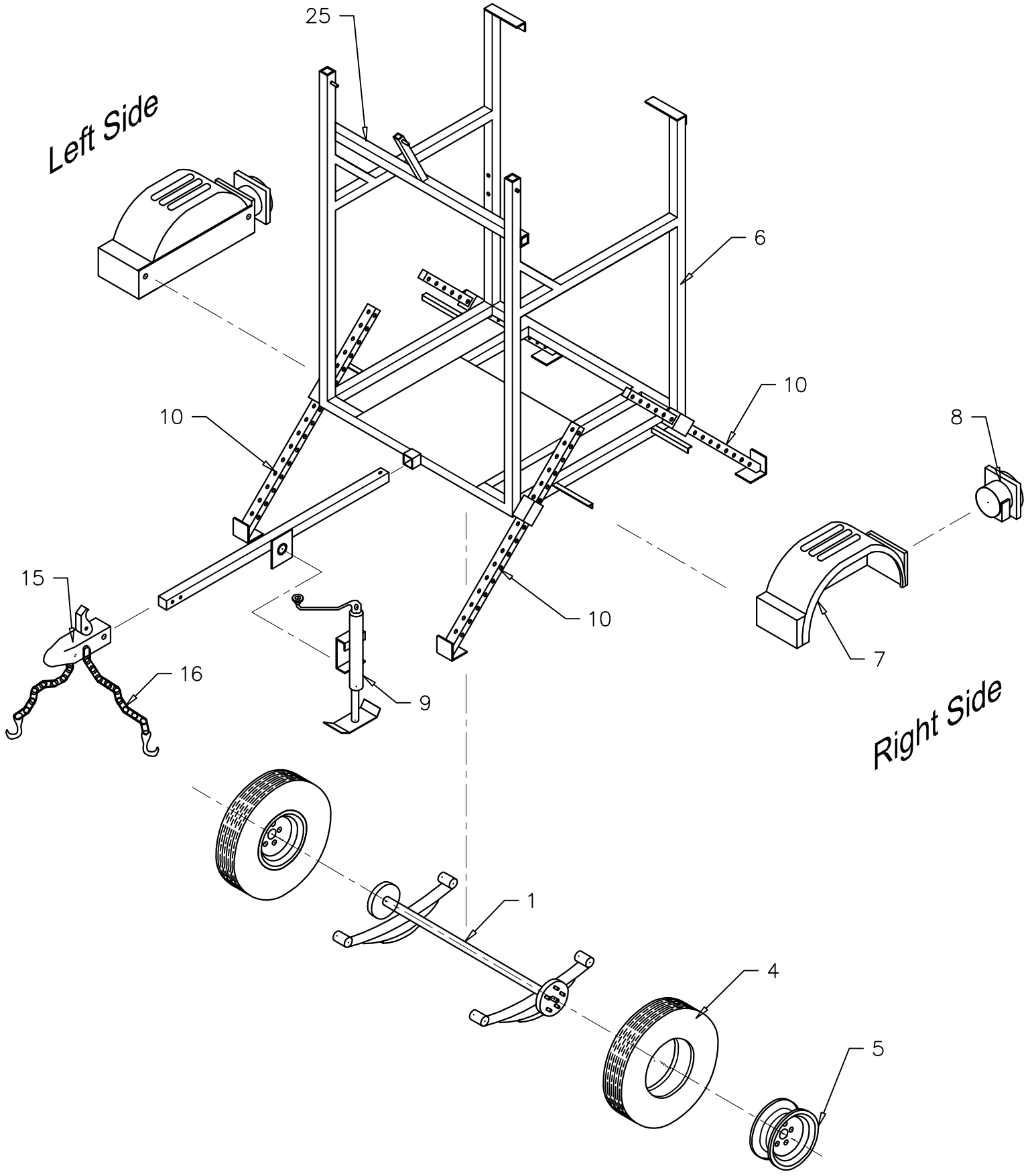
% State of Charge	Starting Specific Gravity
80	1230
60	1200
40	1170
30	1155
20	1140
10	1125
0	1110

TROUBLESHOOTING

The SOLAR ASSISTED ARROW BOARD is very simple to troubleshoot. All the control electronics/charger-regulator circuits are located at one, easily accessible area. Below is a list of electrical PROBLEMS/SOLUTIONS-ACTIONS.

PROBLEM	SOLUTION-ACTION
MODE not functioning properly or not operating.	Check wiring, related lamps, P1 connectors (see System Interconnect diagram). Replace Controller.
UNIT operational time marginal or shorter than specified.	Check BATTERY CONDITION. Charge system to 100%. Check battery status (see "BATTERIES" in the "MAINTENANCE" section). Check solar panel status. See "SOLAR PANEL" in the MAINTENANCE section. Replace Controller.
NO POWER to controller/system.	Check P1/P4 connectors. Check wiring (see System Interconnect diagram). Replace Controller.
LOW BATTERY LED illuminated; system is not operation.	System has shut down due to low voltage battery condition. Charge system with AC/DC charger to 100%.
BATTERY CHARGER (if equipped) Will not function	Check MDL 4 fuse. Check wiring (see System Interconnect diagram). Check P4 connectors and AC service/breaker. Replace Controller.
BATTERIES will not charge to 100% level.	Check battery status (see "BATTERIES" section).
LAMPS appear dim, but never brightens for "day" operation.	Clean photocell window (see "CONTROLLER" section).

CODE	ARROW BOARD PART NUMBERS	
2364	1	AXLE ASSEMBLY
2851	4	TIRE (14”)
2834	5	RIM (14”)
CALL	6	FRAME & DECK
5723	7	FENDER (RIGHT OR LEFT)
1763	9	TAILIGHT KIT
4034	10	TONGUE WITH BRACKET
0939	11	TRAILER JACK
1361	14	JACK TELSPAR
0500	15	TRAILER HITCH
0506	16	SAFETY CHAINS (EACH)
5404	17	BATTERY BOX WITH BASE
4221	19	CONTROLLER (25 LITE)
2190	20	BATTERY (27 DC – SMALL)
5403	21	CHARGER
2458	22	LATCH TRIP
4223	23	CONTROLLER (25 LITE)
5049	24	BATTERY (40 – BIG)
CALL	25	LIFTING ARM ASSEMBLY EZ
5435	26	SPRING KICKER
4350	27	WIRE HARNESS P-1 (9.33ft)
4140	28	PUSH ROD RUBE – ORDER 5ft
5411	29	SOLAR PANEL FRAME EZ
1004	30	LIGHT PANEL – 15 LIGHT
1858	34	SOLAR PANEL – 40 WATT FOR 15 LIGHTS
1876		SOLAR PANEL – 55 WATT FOR 25 LIGHTS
2300	35	HOOD LAMP
2591	36	SHACKLE SCREW PINS
5408	37	RUBBER HOLD-DOWN
2367	38	WINCH
5720	39	WINCH CABLE – ASSEMBLY #3
1311	40	BRACKET “F”
2755	41	LED LAMP 46A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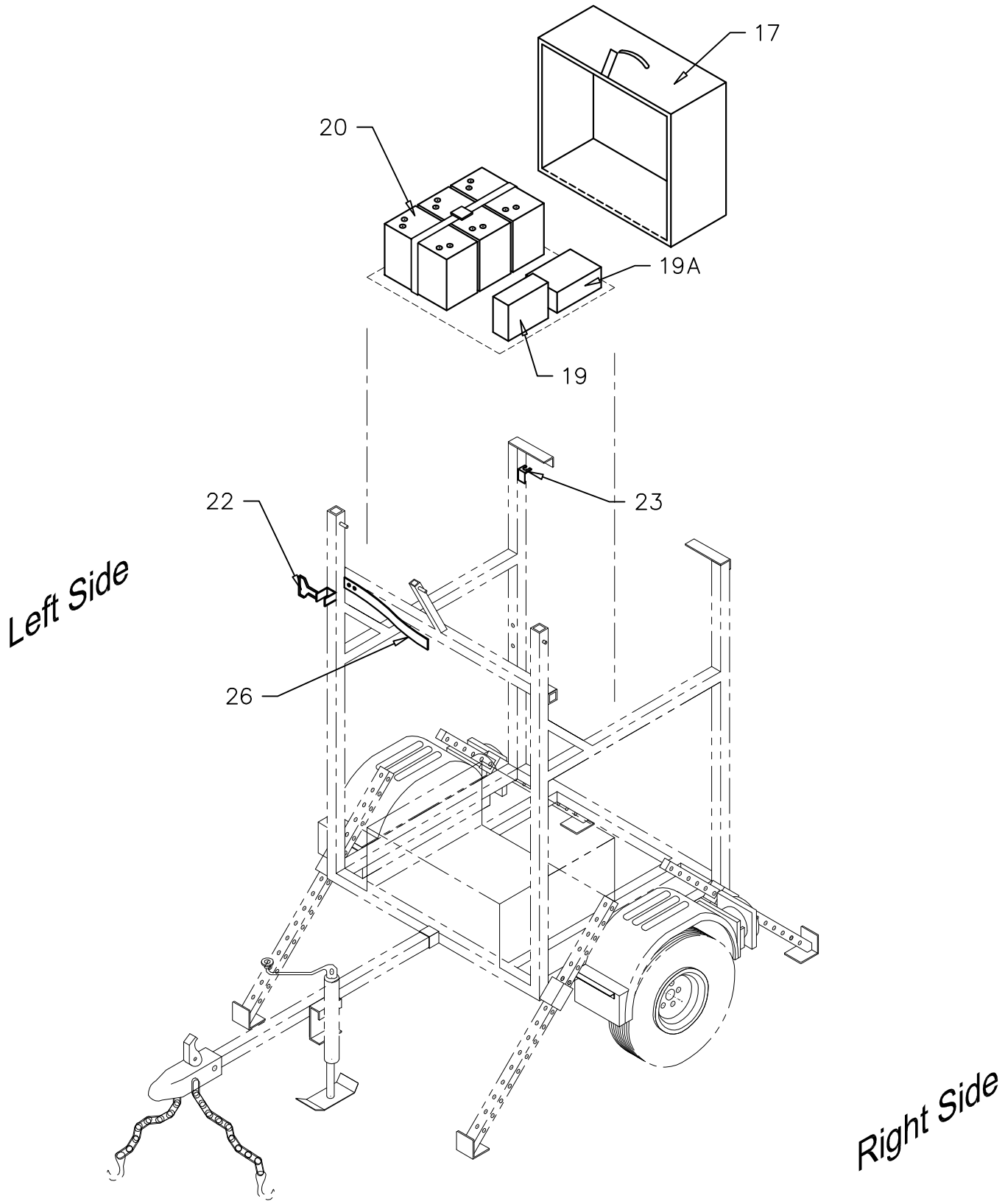
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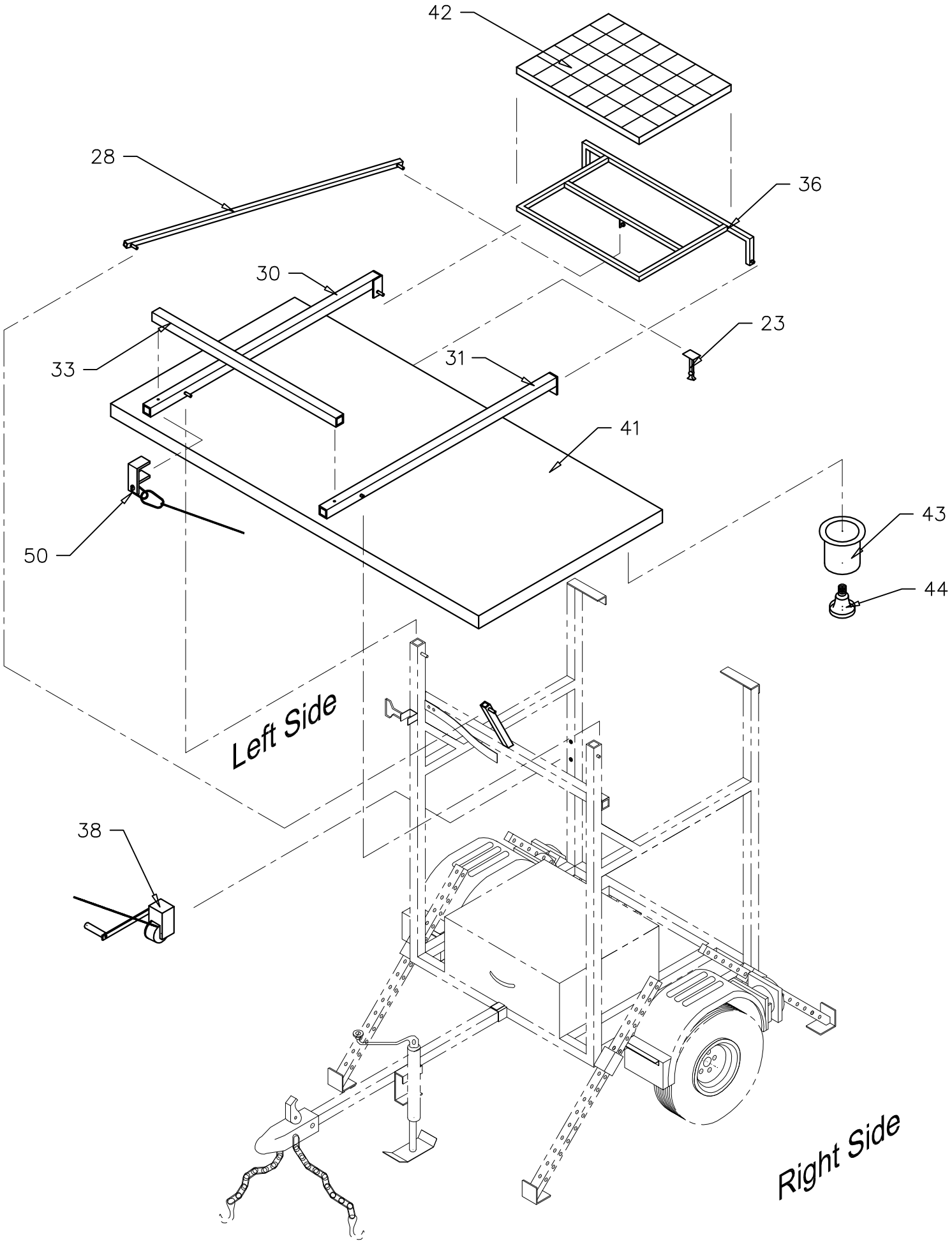
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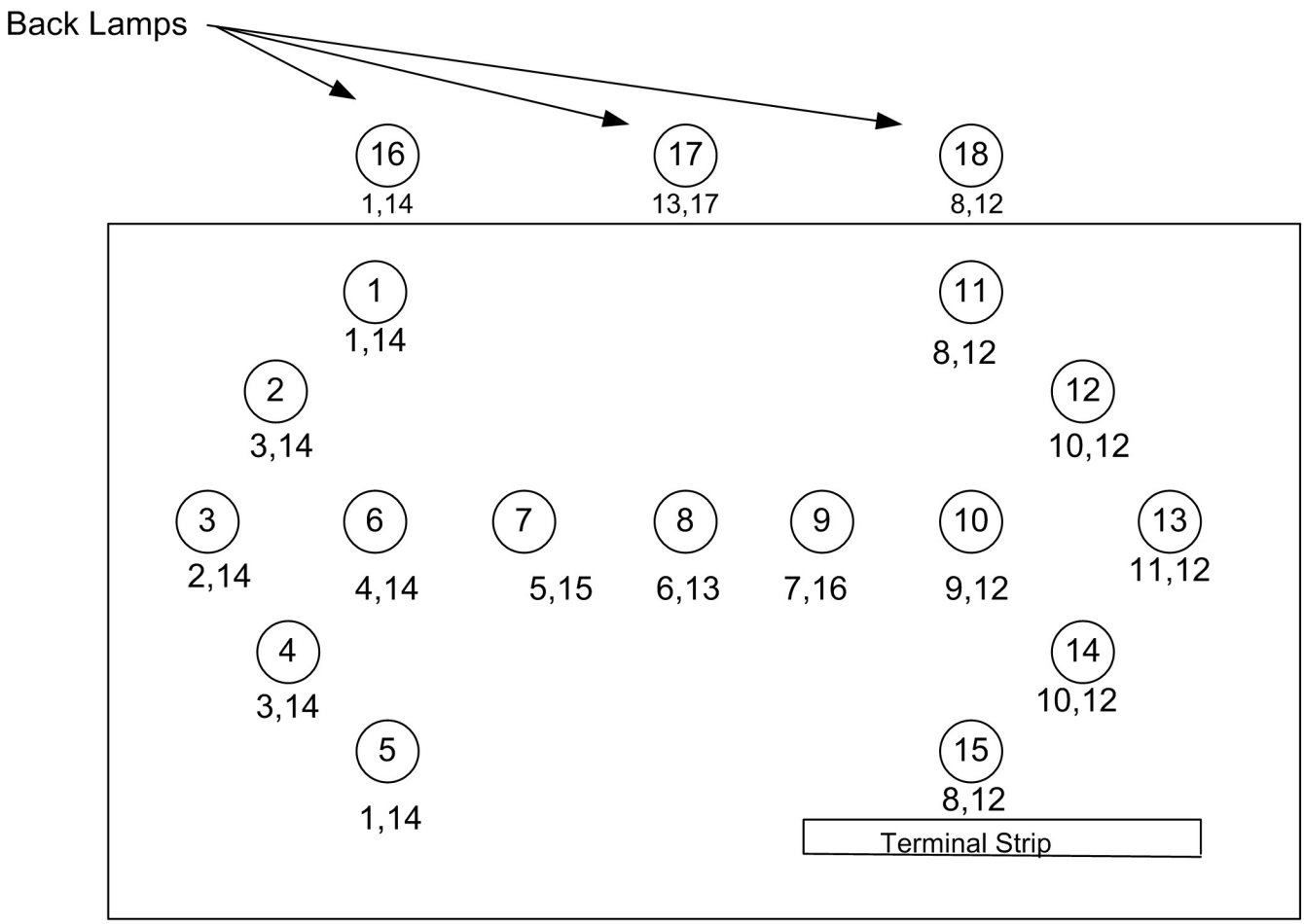


BACK VIEW

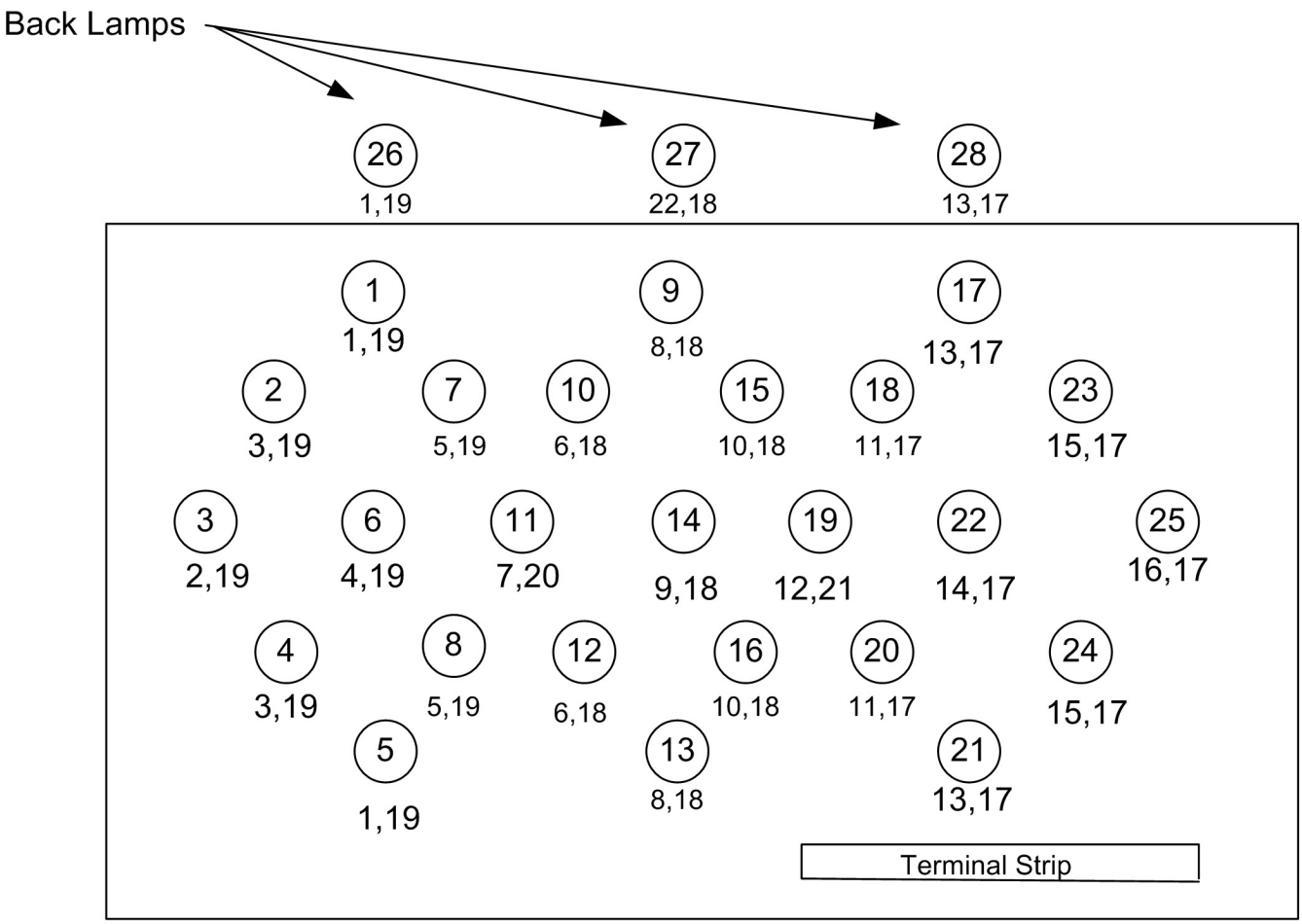
TERMINAL	LAMP
1	1,5,16
2	3
3	2,4
4	6
5	7
6	8
7	9
8	11,15,18
9	10
10	12,14
11	13
12	10,11,12,13,14,15,18
13	8,17
14	1,2,3,4,5,6,16
15	7
16	9
17	17
18	Solar panel (+)

Notes:
1. Terminals 12,13,14,15, 16 are the positive (+) wiring to the lamps. All others are negative (-) wiring.

2. Wiring Color Codes:
   Negative = Black Wires
   Positive = Red Wires

ARROWMASTER V CONTROLLER
15 LIGHT SIGNBOARD LAMP LAYOUT
AND TERMINAL NO.S DIAGRAM

Solar Panel (-) NOT Connected to Terminal Strip



BACK VIEW

TERMINAL	LAMP
1	1,5,26
2	3
3	2,4
4	6
5	7,8
6	10,12
7	11
8	9,13
9	14
10	15,16
11	18,20
12	19
13	17,21,28
14	22
15	23,24
16	25
17	17,18,20,21,22,23,24,25,28
18	9,10,12,13,14,15,16,27
19	1,2,3,4,5,6,7,8,26
20	11
21	19
22	27
23	Solar Panel (+)

Solar Panel (-) NOT Connected to Terminal Strip

Notes:
1. Terminals 17, 18, 19, 20, 21 are the positive (+) wiring to the lamps. All others are negative (-) wiring.

2. Wiring Color Codes:
   Negative = Black Wires
   Positive = Red Wires

ARROWMASTER V CONTROLLER
25 LIGHT SIGNBOARD LAMP LAYOUT
AND TERMINAL NO.S DIAGRAM

WARNING

Failure to follow instructions exactly can cause ball failure or loss of attachment, resulting in vehicle crash and/or personal injury. Installing dealers: Follow these instructions and give same to your consumer (suggestion: staple to invoice). Consumer: Follow these instructions and save same for reference.

- Use this hitch ball only for towing trailers or vehicles connected to the ball with a socket-type coupler.
- Ball diameter must match coupler socket size.
- Do not exceed gross trailer weight shown on ball or any other part of towing system, if lower.
- Attach to platform at least 3/8" thick. Mounting hole must not exceed ball threaded shank diameter by more than 1/16".
- Always use lock washer position next to nut.
- Tighten nut with torque wrench as follows:

3/4" dia. thread/160 lb.-ft.	1-1/4" dia. thread/450 lb.-ft.
1" dia. thread/250 lb.-ft.	1-3/8" dia. thread/600 lb.-ft.

Improper tightening can cause ball failure or loss of attachment.

- Threaded shank must protrude beyond bottom of nut when tightened. If it does not, ball shank is too short for the application and loss of attachment may occur.
- Check nut tightness every time you hook up the trailer and at the beginning of each towing day. Tow only if nut is tightened as specified.
- Replace any damaged or work part (except finish).
- Never attach a tow rope, chain, or stretch type elastic rope to hitch ball.
- Do not fasten trailer safety chain or any other type of attachment to or with the ball.
- Lubricate ball and coupler to minimize wear and friction; coupler must not bind on ball.

This product complies with V.E.S.C. Regulations V-5, C.S.A. Standard D-264 and the Safety Specifications and Requirement for Connection Devices and Towing Systems of the State of New York.

07/07 Printed in the U.S.A.

MANUFACTURER'S WARRANTY LED SOLAR ASSISTED ARROW BOARD

Warranty Statement

1. The manufacturer warrants that each new LED 46 Solar Assisted Arrow Board will be free from defects in material and workmanship for a period of one (1) year from date of shipment, subject to the conditions and restrictions contained herein.

2. The manufacturer further warrants parts furnished under this warranty, for a period that expires upon the termination of the warranty, applicable to the Arrow Board onto which these parts are installed. Parts furnished outside of this contract are warranted for a period of ninety (90) days from date of shipment and are subject to the conditions and restrictions applicable at shipment.

3. Exceptions to the general warranty statements above pertain to the following equipment installed at the factory:

    a. Provide only the original equipment manufacturer's warranty as it applies to solar panels, batteries, and tires.

    b. LED 46 lamps are warranted against defects in material and workmanship for a period of five (5) years from date of shipment, subject to the conditions and restrictions contained herein.

    c. Electronics are warranted against defects in material and workmanship for a period of two (2) years from the date of shipment, subject to the conditions and restrictions contained herein.

4. This warranty does not apply to a product that has not been installed or maintained in accordance with the manufacturer's instructions, has been subjected to damage in an accident, abused or neglected during operation, repaired or modified by persons other than the manufacturer, its employees or authorized agents, or failed to have normal maintenance.

MANUFACTURER'S WARRANTY LED SOLAR ASSISTED ARROW BOARD

Warranty Statement

(continued)

5. The buyer expressly agrees that the buyer's sole remedy and the manufacturer's sole responsibility, in respect to a warranty claim, is exclusively limited to repair or replacement at the manufacturer's option, of product or a portion thereof found by the manufacturer to be defective. The manufacturer is not responsible for labor or other expended charges by buyer, including transportation charges, and shall not be liable for any incidental or consequential damages connected with repair of a product deemed to be defective or with installation or replacement of repaired product. Further, the manufacturer disclaims any liability for any incidental or consequential damages, including lost or duplicated time or expense accruing for any reason, to the owner or user of any products sold by the manufacturer, whether claim is made in contract or in tort or under any theory of warranty, negligence or otherwise.

6. The manufacturer reserves the right to make changes in its products from time to time, without incurring any obligation to incorporate such improvements in any products previously sold or in service.

7. The terms and conditions of the warranty cannot be altered without the written consent of the manufacturer.

8. The foregoing warranty is exclusive and in lieu of all other express, statutory and implied warranties, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE. There are no warranties which extend beyond the language in the previous eight (8) paragraphs.