RLLD, LP

GRISSOM AFB – NEW LIGHTING SYSTEM

SUBMITTAL PACKAGE

12.10.09

Submitted by Dustin Smith – Specification Sales – RLLD, LP – 300 Shepherd Dr. STE B . Houston, TX 77007

phone: 713-867-7699 x105 / fax: 713-979-1429 / dustin@rlldesign.com

RLLD, LP
300 Shepherd Drive, Suite B, Houston, Texas 77007
international/local: 713-863-7699
fax: 713-979-1429
www.rlldesign.com

GRISSOM AFB – NEW LIGHTING SYSTEM
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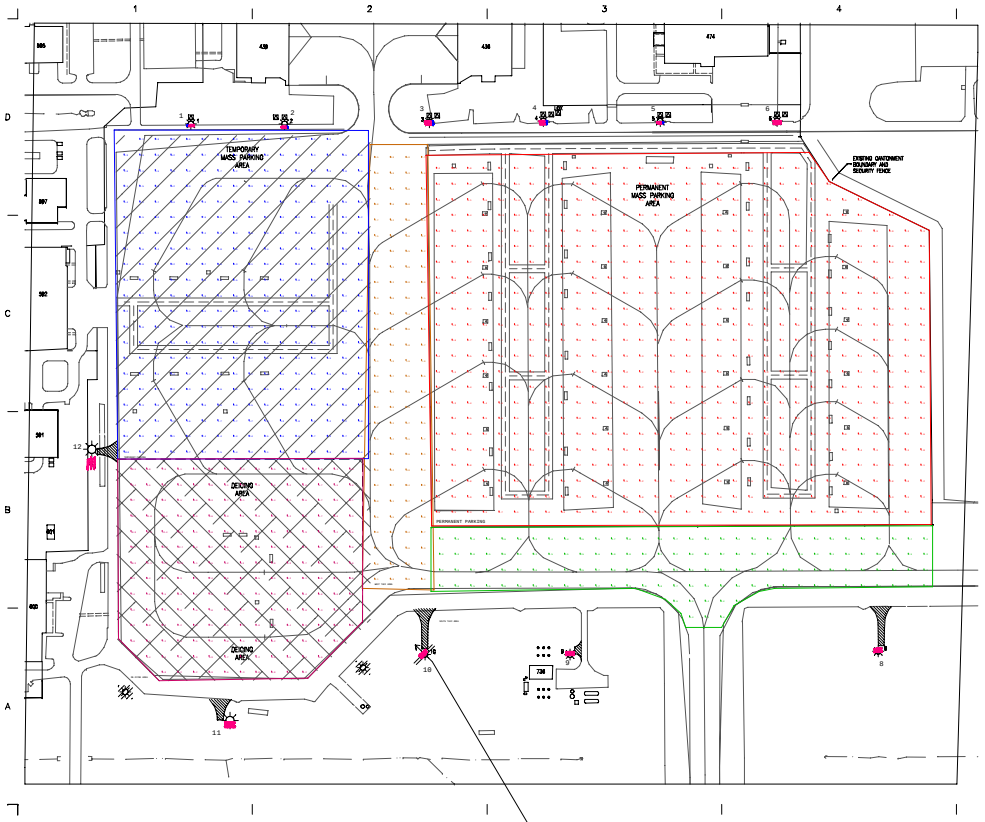
TABLE OF CONTENTS

PHOTOMETRIC ANALYSIS



LEGEND

PROPOSED SECURITY LIGHTING, POLES TO MATCH EXISTING POLES

EXISTING SECURITY LIGHTING, HIGH MAST POLES 80 FT.

REMOVE EXISTING TEMPORARY SECURITY LIGHTING

EXISTING TRANSFORMER

Luminaire Schedule

Symbol	Qty	Label	Arrangement	Lumens	LLF	Description
	9	TSL1500H-4	SINGLE	176000	0.700	POLE MOUNTED 80'
	121	TSL1500H-2	SINGLE	176000	0.700	POLE MOUNTED 80'

Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
WEST TAXI AREA	Illuminance	Fc	4.01	8.4	1.4	2.86	6.00
PERMANENT PARKING	Illuminance	Fc	3.09	12.3	1.0	3.09	12.30
TEMPORARY PARKING	Illuminance	Fc	3.08	10.0	1.2	2.57	8.33
SOUTH TAXI AREA	Illuminance	Fc	2.30	4.0	0.4	5.75	10.00
DE-ICING AREA	Illuminance	Fc	7.32	13.4	5.0	1.46	2.68

POWER REQUIREMENTS

POLE #	LOAD
1	9.66kW
2	9.66kW
3	19.32kW
4	19.32kW
5	9.66kW
6	19.32kW
7	19.32kW
9	19.32kW
10	19.32kW
11	28.98kW
12	32.2kW

SPECIAL NOTE:

CROSS-ARM FOR POLE 10 SHOULD BE RE-DIRECTED TOWARD THE NORTHWEST

RLLD
COMMERCIAL LIGHTING

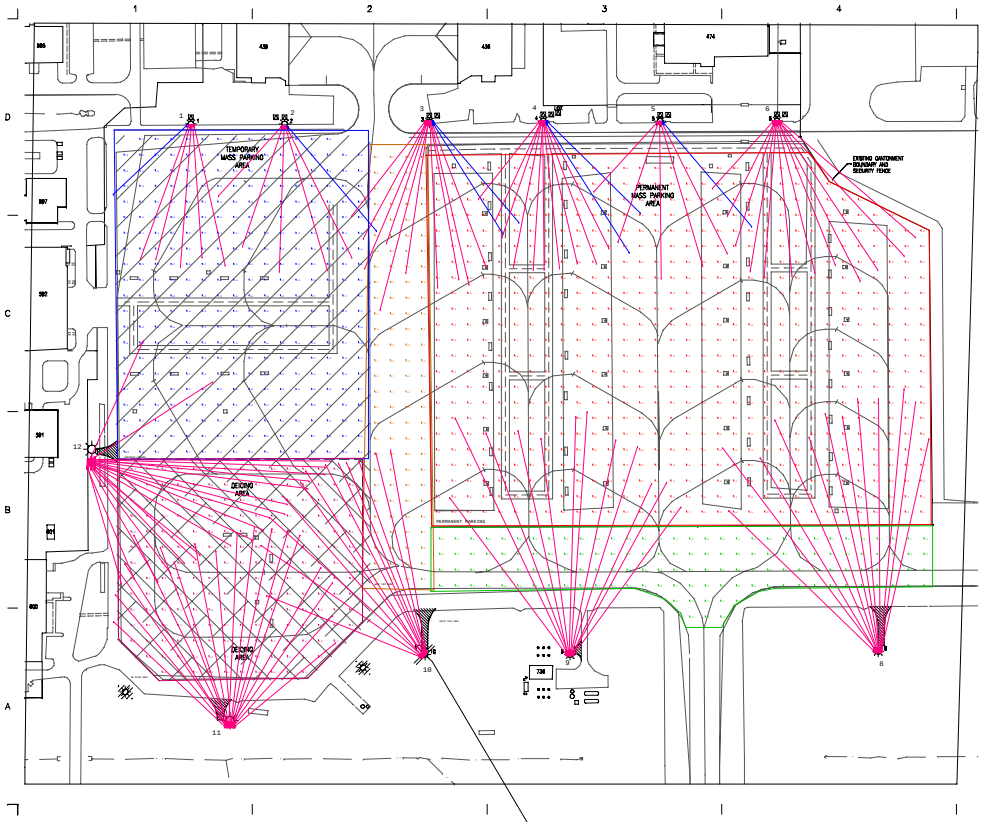
RLLD, LP
300 SHEPHERD DR STE B
HOUSTON, TX 77007
O. 713.867.7699
F. 713-979-1429
WWW.RLLDESIGN.COM

PROJECT: GRISSOM AFB - AREA LIGHTING
LOCATION: INDIANA
CONTACT: LARRY LAYTON - ITSI
DATE: 7-09-09

FOR PURCHASING INFORMATION OF APPROVED EQUIPMENT SPECIFIED ON THIS PLAN CONTACT:

Dustin Smith
RLL Design, LP
300 Shepherd Dr STE B
Houston, TX 77007
Voice Number : 713-863-7699 x 105
Fax Number : 713-979-1429
Email Address : dustin@rlldesign.com

PHOTOMETRIC ANALYSIS



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EXISTING TRANSFORMER

Luminaire Schedule

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	4	TSL1500H-4	SINGLE	176000	0.700	POLE MOUNTED 80'
	121	TSL1500H-2	SINGLE	176000	0.700	POLE MOUNTED 80'

Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
WEST TAXI AREA	Illuminance	Fc	4.01	8.4	1.4	2.86	6.00
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TEMPORARY PARKING	Illuminance	Fc	3.08	10.0	1.2	2.57	8.33
SOUTH TAXI AREA	Illuminance	Fc	2.30	4.0	0.4	5.75	10.00
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POWER REQUIREMENTS

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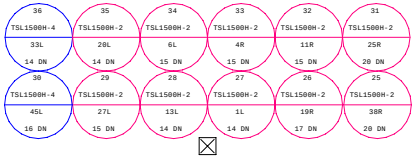
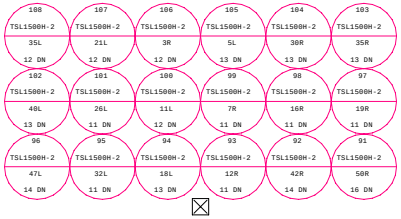
AIMING DIAGRAM - GRISSOM AFB

POLE 1



POLE 4

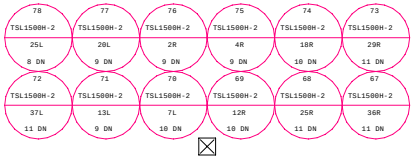
POLE 8



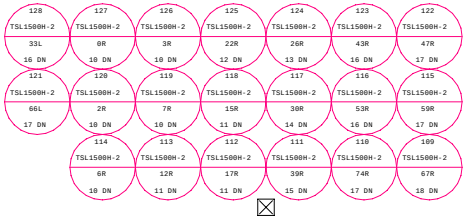
POLE 11

POLE 2

POLE 5



POLE 9



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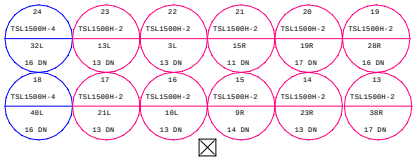
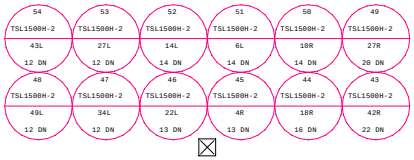
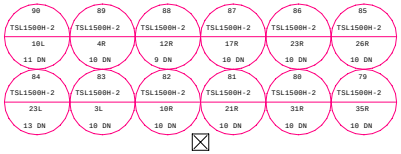


POLE 3



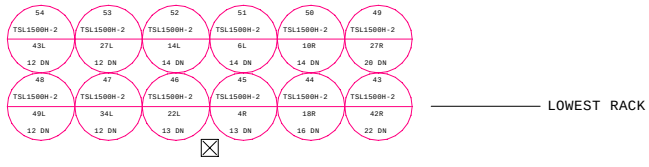
POLE 6



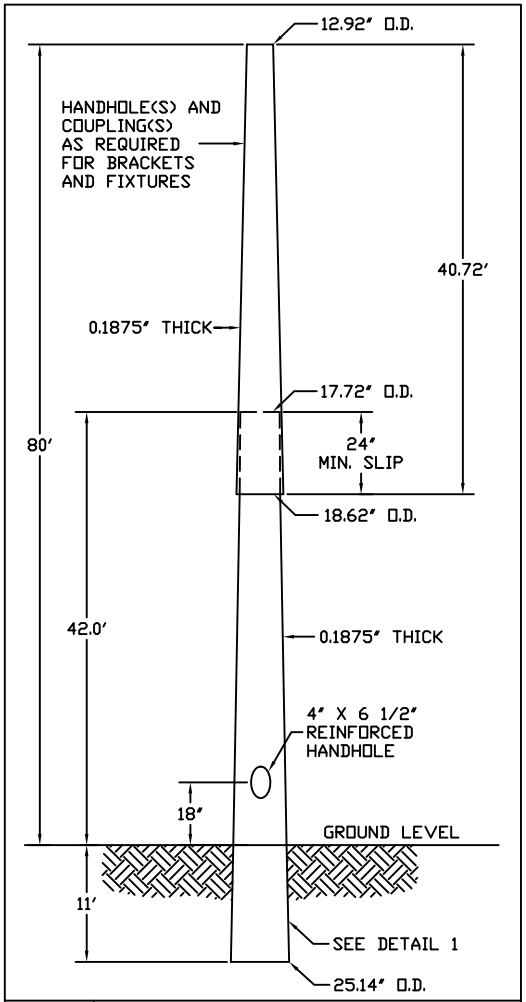
POLE 10

IMPORTANT NOTE FOR DEGREE AIMING

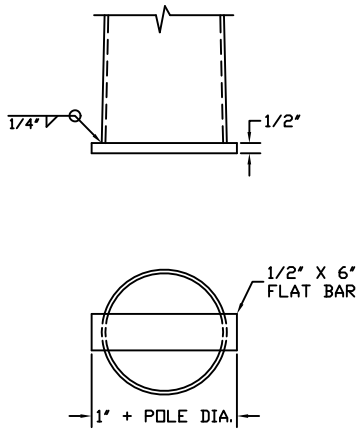
READINGS ARE TAKEN FROM BEHIND THE POLE LOOKING TOWARD THE SURFACE TO BE ILLUMINATED. PRE-AIMING LUMINAIRES USING THIS DEGREE AIMING CHART MAY SAVE SOME POLE TOP LABOR, HOWEVER, BECAUSE OF NUMEROUS MOUNTING VARIABLES, ACTUAL INSTALLATION MAY REQUIRE SOME FINAL TARGET AND/OR NIGHT AIMING ADJUSTMENT TO MEET THE CALCULATED RESULTS.



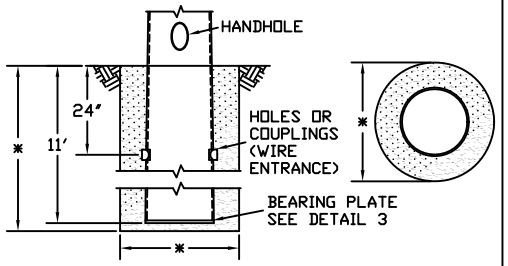
POLE 6



DETAIL | POLE ASSEMBLY



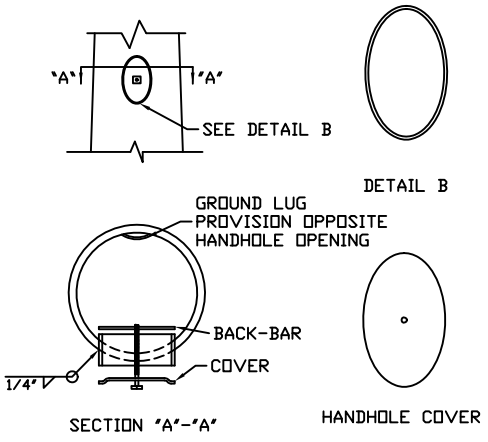
DETAIL 3 | BEARING PLATE



* DIMENSIONS TO BE DETERMINED BY ENGINEER.

NOTE:
EXTERIOR TOP COATED WITH COAL TAR MASTIC FOR EMBEDMENT DEPTH PLUS 6".

DETAIL 1 | FOUNDATION



DETAIL 4 | HANDHOLE

COMPONENT	SPECIFICATION
POLE TOP	ASTM A572 GR. 65
POLE BOTTOM	ASTM A572 GR. 65
MISC. STEEL	ASTM A36

GENERAL NOTES:

1. ALL HARDWARE TO BE GALVANIZED TO ASTM A153.
2. POLE ASSEMBLY TO BE GALVANIZED TO ASTM A123.
3. ALL WELDING TO CONFORM TO AWS D1.1 MOST RECENT EDITION.
4. DESIGN WIND SPEEDS INCLUDE 1.3 GUST FACTOR.
5. DESIGNS ARE BASED AGAINST COMMERCIAL GRADE STANDARDS.
6. REFER TO GENERAL INSTALLATION INSTRUCTIONS PRIOR TO ASSEMBLY.

MAXIMUM CAPACITY						
WIND	90	100	110	120	130	140
EPA	87.0	68.0	53.0	41.0	32.0	25.0
WEIGHT	2113	1638	1275	988	763	588

DETAIL 2 | MATERIAL SPECIFICATIONS

WHITCO POLES
2001 BEACH ST SUITE 800
FORT WORTH, TX 76103 www.whitcopoles.com
(800) 433-7753 FAX (817) 926-5003

REV.	DATE	BY	INIT.	DESCRIPTION

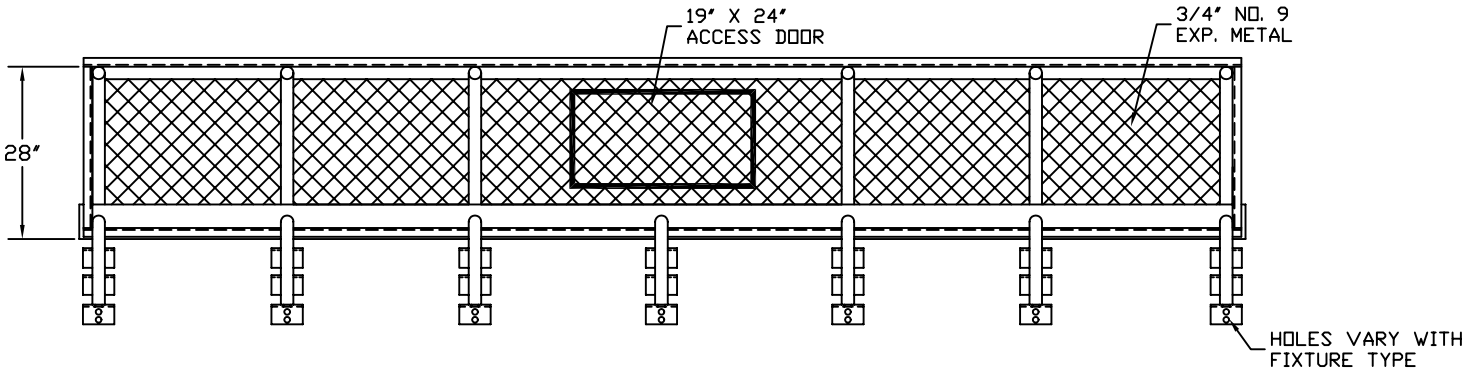
DRAWN BY: LBUI | CHECKED BY: – | CAD FILE: S:\ENGINEERING\AUTOCAD LIBRARY\SUBM...\RTSP-12-52-E2-AB.DWG|LJ|05-NOV-2007|08:38 | REV. –

SPECIFIC INFORMATION: –

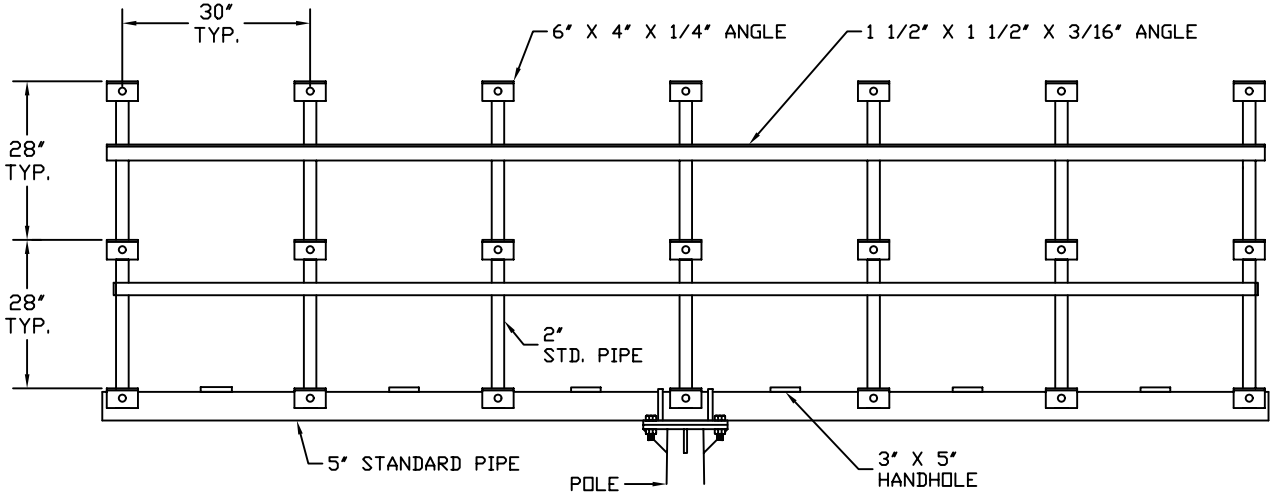
SCALE: NTS | DATE: 11-04-07 | SHEET NO. 1 OF 1

DRAWING TITLE: SPORTS LIGHTING POLE

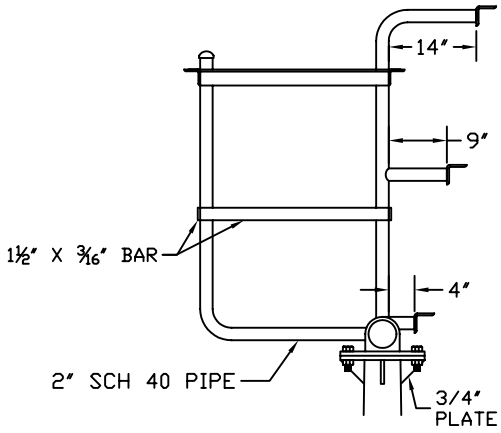
JOB NO. SLT– | DRAWING NO. 80-W11(SP)-EM-



TOP VIEW



FRONT VIEW



SIDE VIEW

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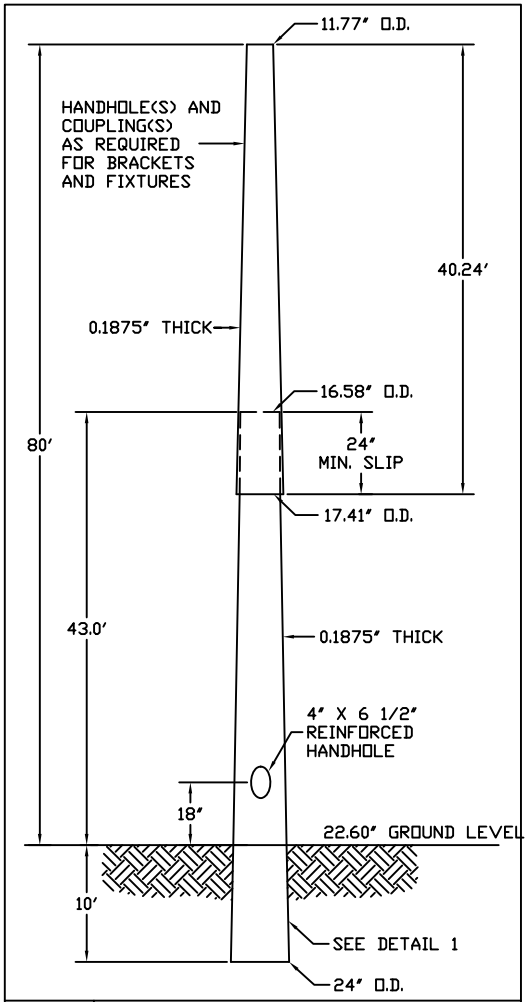
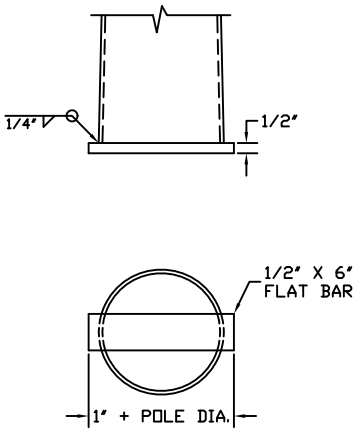
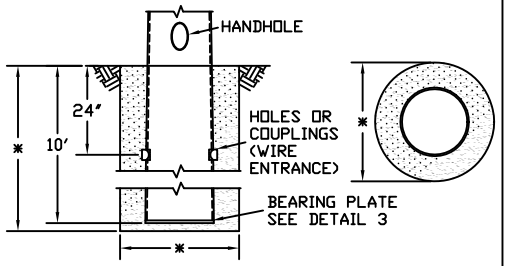


DETAIL | POLE ASSEMBLY



DETAIL 3 | BEARING PLATE



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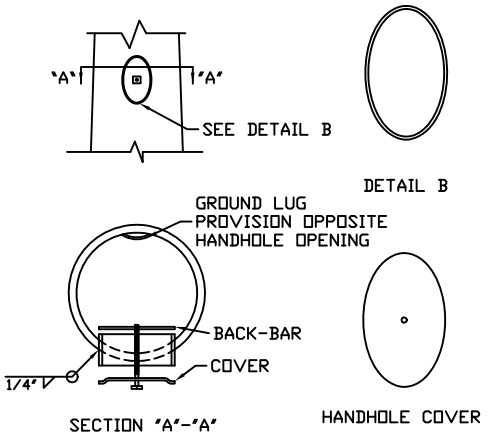

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4. DESIGN WIND SPEEDS INCLUDE 1.3 GUST FACTOR.
5. DESIGNS ARE BASED AGAINST COMMERCIAL GRADE STANDARDS.
6. REFER TO GENERAL INSTALLATION INSTRUCTIONS PRIOR TO ASSEMBLY.

MAXIMUM CAPACITY						
WIND	90	100	110	120	130	140
EPA	79.0	62.0	48.0	38.0	29.0	23.0
WEIGHT	1935	1488	1163	900	700	525

DETAIL 2 | MATERIAL SPECIFICATIONS

WHITCO POLES
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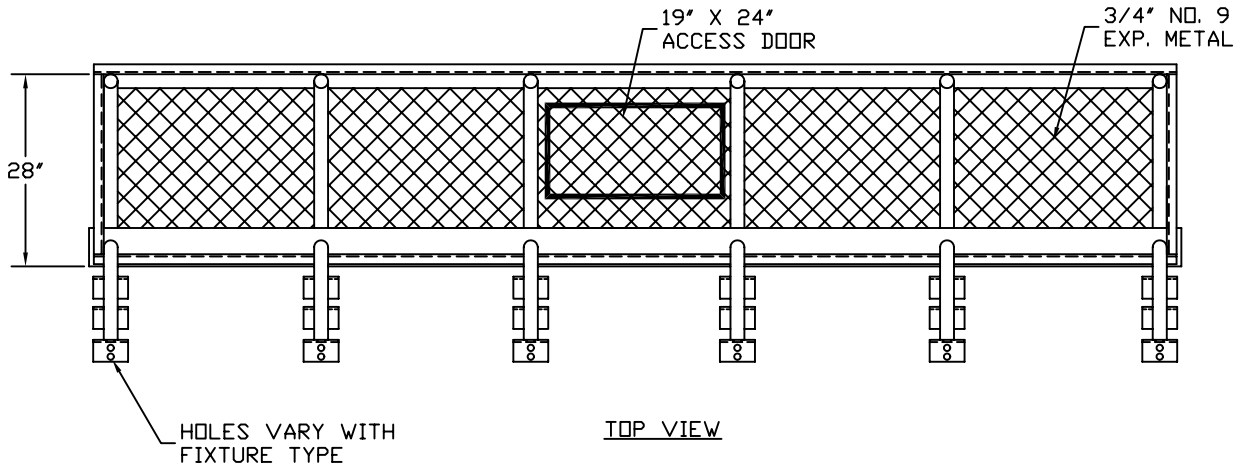
SPECIFIC INFORMATION: –

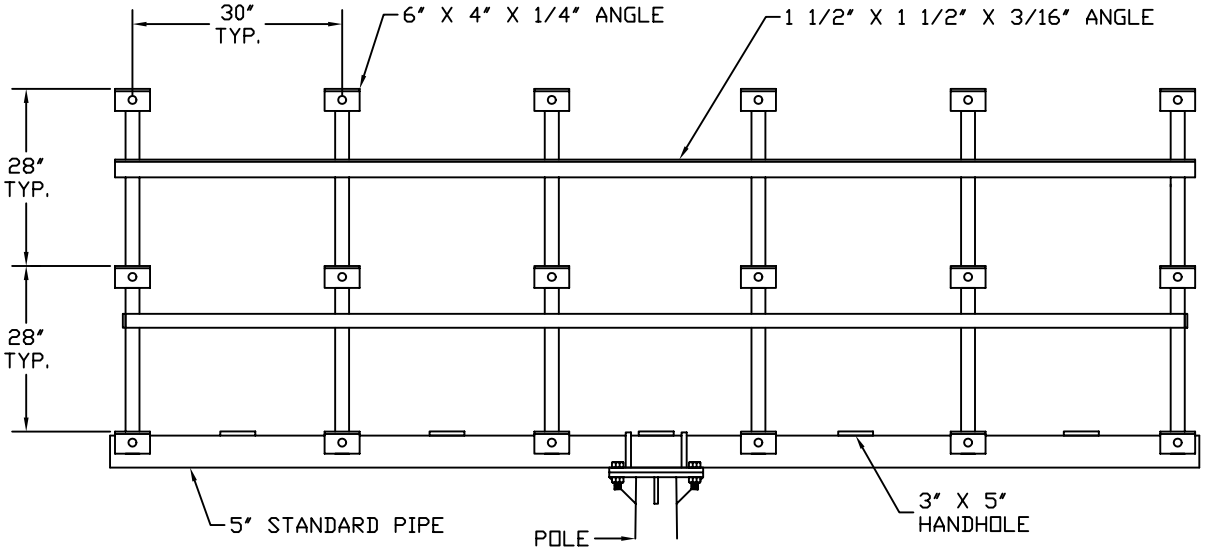
SCALE: NTS | DATE: 11-04-07 | SHEET NO.: 1 OF 1

DRAWING TITLE: SPORTS LIGHTING POLE

JOB NO.: – | DRAWING NO.: SLT-80-W10-EM



TOP VIEW



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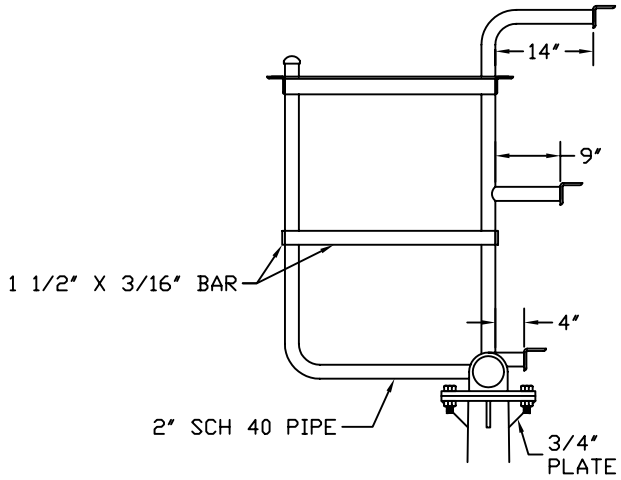

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DRAWING TITLE CAGES			JOB NO. –	DRAWING NO. CAG-TT-18	

American Sports Lighting
2001 Beach St, Suite 800
Fort Worth, TX 76103

1-800-433-7753 Fax 817-926-5003
www.americansportslighting.com

POLE SPECIFICATIONS

Structural Design
The pole standards designed by American Sports Lighting are designed to meet AASHTO 2001 (American Association of State Highway and Transportation Officials) design criteria.

The wind load effects have been analyzed with wind velocities ranging from 90 to 140mph plus a 1.3 gust factor. Due to varying wind effects, height correction factors and drag coefficients have been applied to the entire structure. The dead load effects have been determined by using a final deflected position analysis to account for secondary moments caused by eccentric dead loads. These combined loading effects have been used to determine the maximum allowable loading capabilities.

These maximum loading capabilities include an appropriate factor of safety which is based upon the nationally recognized AASHTO standard.

Pole Shaft
Each pole shaft is made from a single ply steel sheet. This steel sheet is formed into a tubular shape with one or more longitudinal welds. No circumferentially welded splices are permitted. This tubular shape has a cross section, which is either multi-sided, round, or square and is either tapered or non-tapered along it's length Standard taper rates include 0.11 inches per foot for square poles and 0.14 inches per foot for round. Multi-sided cross-sections do not utilize a bend radius of less than 2" and do not have a cross-section with less than 12 sides.

The material used for the pole sections meets the requirements of ASTM A500 Grade C, ASTM A595 Grade A, or ASTM A572 Grade 65.

Poles, which exceed 53 feet in length, are designed as two piece pole assemblies. These two piece assemblies are joined together by telescoping the upper "female" section over the lower "male" section by a minimum lap distance of 1.5 times the female inside diameter. The longitudinally welded seam on the female section is welded both inside and out to insure 100% weld penetration at the telescoped area.

Pole assemblies, which exceed 50 feet in height, or are specifically being used for sports applications, are also designed with an internal cable guide and strain relief mechanism, which is typically attached at the mid-height of the pole assembly. This cable guide assembly consists of an offset bar, steel pipe sleeve with internal PVC sheathing to reduce wear, and a hand hole opposite the offset bar for access.

Hinged Poles
All hinged poles are equipped with a shroud and an external hinge assembly to facilitate lowering the top of the pole for maintenance purposes. The shroud is made of a commercial quality carbon steel which meets the requirements of ASTM A572 Grade 50. The shroud is designed to conform to either a taper or non-tapered square pole and includes a locking devise which prevents unauthorized lowering of the pole. The external hinge assembly includes a stainless steel pin.

Base Plate
Base plates are used for either anchor base or stub base type pole assemblies. These plates are integrally welded to the bottom pole section with either a telescopic weld or a full penetration weld with a back-up bar. All bolt holes are circumferentially slotted to allow for +- 2.5 degrees rotation for field adjustment.

The material used for these plates will conform to either ASTM A36 or ASTM A572.

Anchor Bolts
All standard anchor bolts meet the requirements of ASTM F1554. Grade 55. The bolts have a minimum threaded length of at least 6 inches and are galvanized for a minimum of 12" on the threaded end to the requirements of A153. Each anchor bolt is supplied with two hex nuts and two flat washers. All standard anchor bolts have a hooked end on the embedded portion to assist in the development of pull out strength.

POLE SPECIFICATIONS continued

Stub Base
The stub base consists of a steel pipe with an integrally welded flange plate, which conforms to the requirements and dimensions of the aforementioned base plate. The flange plate is mechanically fastened to the base plate with hardware, which meets the requirements of ASTM A325. These bolts include two flat washers and one heavy hex nut. All bolt holes are circumferentially slotted to allow for a +- 2.5 degrees rotation for field adjustment. The steel pipe used for the stub base will either meet or exceed the requirements of ASTM A53 Grade B. The stub base will have a pair of wire entrances at 180 degrees apart located 24 inches below grade, dependent upon local electrical codes.

Embedded Poles
Embedded poles will be set directly into the ground by an embedment distance which is equal to 10% of the free pole height, plus 2 feet. The embedded pole will not utilze a stub base or base plates as an anchoring means, but will rest upon a bearing plate which is integrally welded to the bottom of the pole shaft. The embedded portion of the pole, plus 6 inches will be additionally protected with a mastic coating. Two 3" x 5" openings, located 24" below grade and oriented at 180 degrees apart will be provided for wire access.

Platforms
All service platforms or cages shall be constructed from either tubing or angle material, which meets the minimum requirements of ASTM A53 Grade B and ASTM A36 respectively.

Top mounted platforms shall be mechanically attached to the pole with plates meeting the requirements of ASTM A36 and connecting hardware meeting the requirements of ASTM A325.

Side mounted platforms should be mechanically fastened to the pole with plates conforming to ASTM A36 and ubolts fabricated from round stock conforming to ASTM A36. The floor of the platform shall consist of expanded metal grating and should incorporate a hinged door for access to the platform. The hinged door shall be capable of closing prior to unlatching any safety climbing devices.

Cross Arms
All cross arms shall be constructed from either tubing or angle material, which meets the minimum requirements of ASTM A53 Grade B and ASTM A36 respectively.

Top mounted cross arms shall be mechanically attached to the pole with plates meeting the requirements of ASTM A36 and connecting hardware meeting the requirements of ASTM A325.

Side mounted platforms should be mechanically fastened to the pole with plates conforming to ASTM A36 and ubolts fabricated from round stock conforming to ASTM A36.

Hand Holes
All hand holes are peripherally reinforced with flat bar which integrally welded to the plate shaft. Each pole will have a 4" x 6.5" reinforced hand hole located 18" above finished grade. Cover plates are included with all hand holes and are attached to the pole with a back bar and screw.

Protective Coatings
All pole shaft sections are either galvanized or powder coated or a combination of both. Stub base sections are galvanized in accordance with the requirements of ASTM A123. Each shaft assembly is completely coated both inside and out with a single dip. Double dipping will not be permitted in compliance with USGA recommended practices. Embedded portions of all pole shafts and stub bases will be additionally protected with a mastic coating which meets the performance requirements of TT-V-51F Varnish: Asphalt.

Powder coated poles are covered with a urethane polyester powder meeting the requirements of the project specifications and cured in a convection oven at 400 degrees Fahrenheit.

Welding
All welding is performed by AWS (American Welding Society) certified welders and all welds comply with the most recent edition of the AWS Structural Welding Code.

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American Sports Lighting
2001 Beach St, Suite 800
Fort Worth, TX 76103

1-800-433-7753 Fax 817-926-5003
www.americansportslighting.com

Galvanizing

Hot dip galvanizing is a process in which steel is coated with a layer of zinc by being submerged in a molten zinc bath. It's also the most effective corrosion protection for steel available today. The layer of zinc which is applied forms a metallurgical bond with the steel; actually becoming part of the surface. So it won't peel away, crumble, or crack even in the most adverse conditions. Hot dip galvanized steel also has the unique ability to protect itself. If surface scratches occur during shipment or assembly, zinc from the surrounding area will protect the damaged spot by natural electrochemical action. This prevents rust from forming and gaining a foothold. Zinc galvanizing provides steel with decades of protection, minimizing maintenance and replacement costs, and maximizing the steel's lifespan.

AMERICAN SPORTS LIGHTING

...we're more than just sports!

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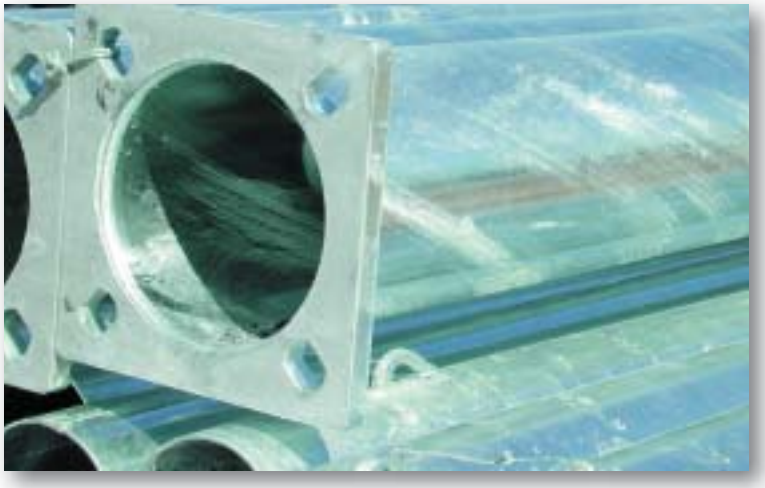
1-800-433-7753 • Fax 817-926-5003
www.americansportslighting.com

Galvanizing

The most widely used method of galvanizing is the hot dip process. The process consists of several steps:



Caustic Cleaning

The steel product is dipped into a hot alkali solution to remove most grease, paint and oil from the surface of the unprotected steel.

Rinse

The steel product is dipped into a rinse tank to remove any residual alkali solution.

Pickling

A dilute acid solution is used to remove mill scale and rust from the material's surface.

Rinse

A second rinse procedure removes residual acid solution from the steel.

Fluxing

Flux, a heated bath of zinc ammonium chloride solution removes oxides and prevents further oxidation of the material. This is also known as the dry method of galvanizing.

Drying

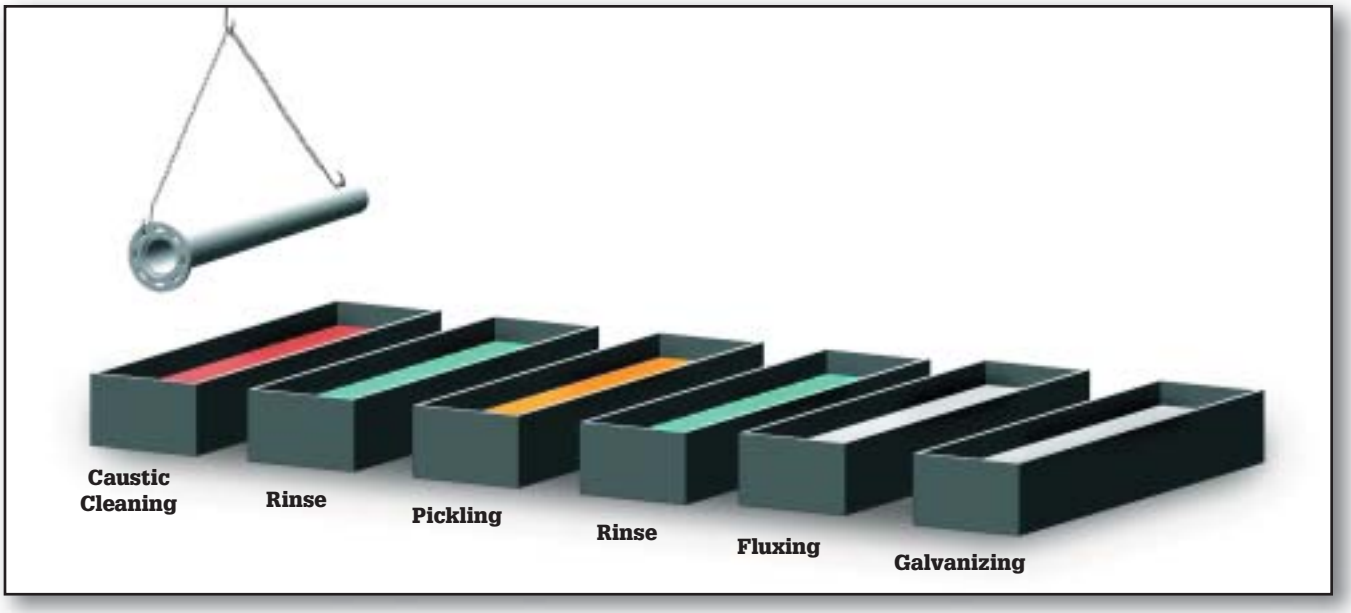
The material is thoroughly dried prior to immersion in the molten zinc.

Galvanizing

The prepared material is immersed in a molten bath a zinc heated to 835 degrees Fahrenheit and galvanized to the requirements of ASTM A123 (Steel hardware is galvanized to ASTM A153). The items remain in the bath long enough to reach the bath temperature. The steel reacts with the molten zinc to form a series of zinc-iron alloys which, together with the outer zinc layer, are metalurgically bonded to the steel surface.

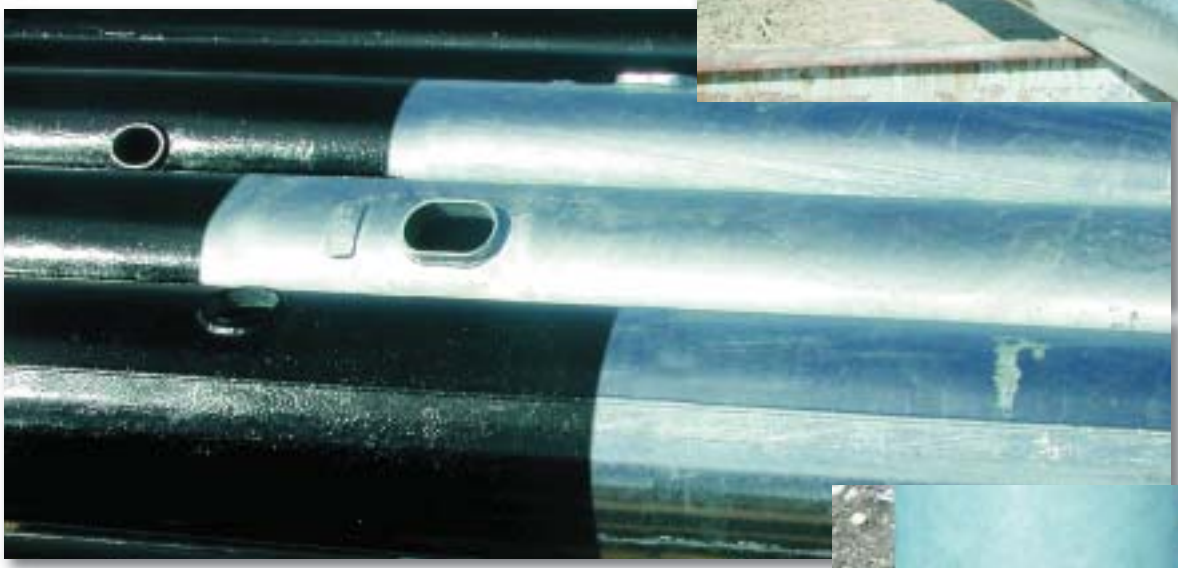
Cleaning and Inspection

The material is cleansed of any loose zinc material and tested for adherence, uniformity and thickness of the coating. Once passed through this step, the finished product is ready for shipping.



Black Asphaltum (Mastic Coating)

Black Asphaltum is an economical, highly protective, acid and alkali-resistant coating designed for general industrial use. This coating is used on commercial products such as rain gutters and by automakers for under coating frames, wheel fenders, chassis, etc. Company uses this product as a supplemental below-grade protective coating on direct embedded and stub-base pole structures. The advantages of Black Asphaltum are as follows:



- Superior resistance to acids and alkali.
- Excellent resistance to chemicals such as calcium chloride, sodium chloride and tri-sodium phosphates.
- Outstanding adhesion and wear resistance.
- Rust proofing properties.
- Meets performance requirements of TT-V-51F-Varnish: Asphalt.
- Free of lead and chromate hazards.

This protective coating is applied on either galvanized or powder-coated products to add a supplemental layer of corrosion protection. This combination of galvanizing and/or powder coating coupled with Black Asphaltum provides the best below-grade corrosion resistance in the industry.

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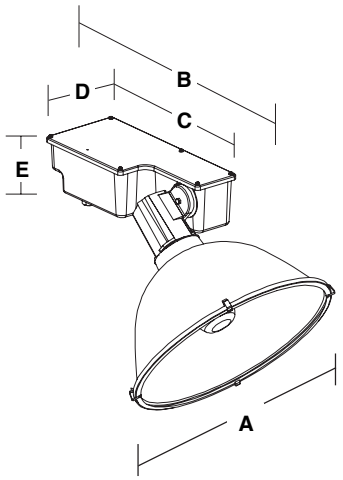
Job	Type
GRISSOM AFB - NEW LIGHTING EQUIPMENT	

Dimensions



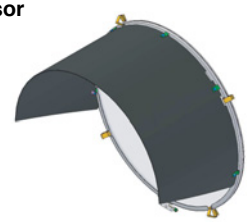
EPA
2.8 ft.^{2}
.03 m^2

Integral Ballasted System Axial Optics

A	B	C	D	E
22.87"	35.75"	20.13"	8.75"	5.5"
579 mm	907 mm	511 mm	223 mm	140 mm

Note: Aimed 40° below horizontal.

Optional Visor



Specifications

NRTL/C

Housing
Die cast aluminum housing. Isolated die cast aluminum socket housing. Isolated ballast compartment. Isolated capacitor compartment. Isolated wiring chamber (maximum 90° input cord.) Vertical aiming/repositioning memory. Horizontal aiming indicator, polyester powder paint finish (gray).

Optics
Spun Aluminum parabolic reflector. Four point latching. Stainless steel lens ring. Stainless steel door hinge. Silicone gasketing. Tempered clear glass lens. Filtered optics. Lamp support standard.

Installation
One captive mounting bolt (3/4" dia.) installed in fixture.
Aiming sight included. Modular shipment (ballast/optics).
Single ballast cover plate for easy access.

Special Features
1g, 100,000 cycle vibration tested. Wind tunnel tested to 120 m.p.h. Captive hardware. UL 1598 listed and CSA NRTL/C certified for 40°C ambient operation. Mogul socket, 4kv pulse rated, 600v rated. 100% factory electrically tested.

Ordering Information

Series	Watt	Optic Type	Voltage	Lamp	Options	Options
TSL	1500	2 / 4	MT	**L**	-	-

SERIES

TSL	**Techline Sports lighting**

WATT

1000	1000W
1500	1500W

OPTIC TYPE

2	NEMA type 2
3	NEMA type 3
4	NEMA type 4
5	NEMA type 5
6	NEMA type 6

VOLTAGE

5	480V
MT	Multi-TAP (120, 208, 240, 277V)

LAMP

L	**Lamp (shipped separately)**

OPTIONS

HD[1]	Outer Hull
V[2]	Visor

TSL SERIES ACCESSORY

TSLSLIP Slipfitter for 2" (2 3/8" OD) tenon TSLSLIP

1. Hull adds 4lbs. to total weight, shipped separately.
2. Shipped separately.

Comments (121) - NEMA TYPE 2 REFLECTOR TYPES / (7) - NEMA TYPE 4

For Retro-Fit or Customer-Supplied Pole Installations

INTEGRAL BALLAST LUMINAIRE

1. ***RUGGED ONE-PIECE ALUMINUM COVER*** allows for easy installation and maintenance.
2. ***ISOLATED BALLAST COMPARTMENT*** provides much cooler operation for prolonged life. (Maximum ballast temperature is 143°C any wattage at 40°C ambient.)
3. ***ISOLATED CAP/STARTER*** keeps components cooler for longer life. (Maximum capacitor case temperature is 65°C any wattage at 40°C ambient.)
4. ***VERTICAL AIMING/REPOSITIONING MEMORY*** provides accurate pre-aiming and repositioning stop when relamping. Reduces installation time. (FAST AIM)
5. ***FOUR-POINT LATCHING HUBBELL GARD®*** treated fasteners, provide tool-free entry and positive seal.
6. ***STAINLESS STEEL LENS RING*** is engineered for longer life.
7. ***SILICONE GASKET*** assures quality high temperature gasketing for a long life seal.
8. ***TEMPERED CLEAR GLASS LENS*** is thermal shock and impact resistant.
9. ***STAINLESS STEEL HINGE*** assures a long, service-free life.
10. ***FILTERED OPTICS*** significantly reduces optical contaminants while increasing lifetime optical efficiency.
11. ***LAMP SUPPORT*** provides lamp vibration resistance and positive alignment.
12. ***HEAVY-DUTY MOGEL SOCKET*** is nickel-plated with lamp grips to ensure proper lamp position. Optional position-oriented socket.
13. ***REFLECTOR*** of exclusive Anodal®-finished spun parabolic aluminum provides long life, and consistent lighting performance.
14. ***SOCKET HOUSING*** of durable die-cast aluminum allows for maximum heat dissipation and is painted in long-lasting Lektrocote® finish.
15. ***SINGLE BOLT MOUNTING*** (25,000 lb. strength and captive) makes installation easy. Ballast location centers ballast weight over crossarm/pole eliminating twisting moments as in yoke-mounted units. Mounting bolt (3/4"), nuts and washers included.
16. ***HORIZONTAL AIMING INDICATOR*** allows for precise preset aiming. Reduces installation time. (FAST AIM) Additional screw mounting required.
17. ***CABLE PROTECTED ENTRY*** accepts 16/3 thru optional 12/3 SO cord.
18. ***HOUSING*** of durable die-cast aluminum is painted in gray Lektrocote finish for long, trouble-free service.
19. ***ISOLATED WIRING*** utilizing 90°C wire, suitable for 40°C ambient, makes installation easy.
20. ***CAPTIVE HARDWARE*** Hubbell Gard® treated to prevent galvanic corrosion.
21. ***UL LISTED/CSA CERTIFIED*** to 40°C ambient operation.
22. ***INTERNAL SPILL/GLARE CONTROL*** with horizontal mounted lamps. Shipped completely assembled (ballast, optical, louver and lens).
23. ***FRONT LAMP SUPPORT*** (horizontal optic system) standard for vibration resistance and positive alignment.

ADDITIONAL FEATURES UL 1598 Wet Location listed; CSA certified for outdoor use; NRTL/C certified; built-in lamp support; shipped modularly – ballast optical; aiming sight included; external fusing (when required); FAST AIM system.

Hubbell Lighting, Inc.

Hubbell Lighting
Outdoor and Industrial

Hubbell Lighting
Outdoor & Industrial
701 Millennium Blvd.
Greenville, SC 29607
864-678-1000
www.hubbell-ltg.com

November 30, 2009

TO WHOM IT MAY CONCERN

Techline Sports Lighting luminaires are exclusively manufactured by Hubbell Lighting, Inc. at our production facility located in Christiansburg, VA

Please contact me if there are any questions.

Sincerely,

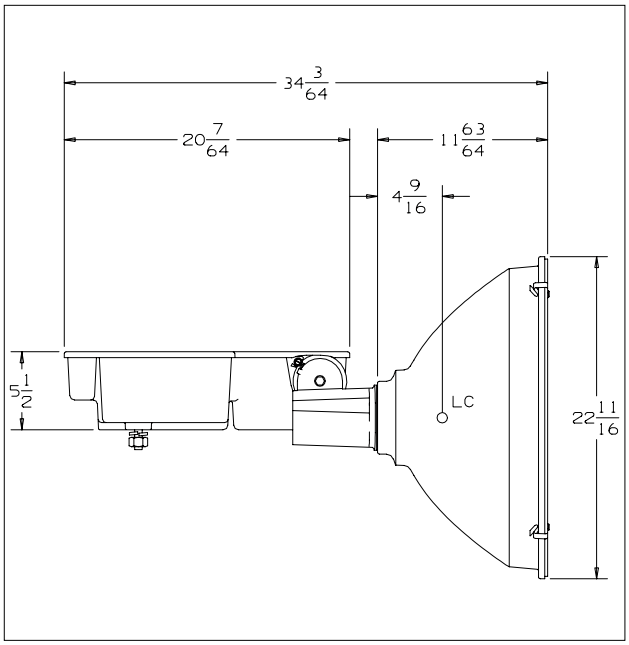
Ken Cornett
Director, Hubbell Lighting, Inc.

Lighting, Inc. Christiansburg, Virginia **Photometric Report**

NVLAP LAB CODE 200020-0

←

7-16-2004



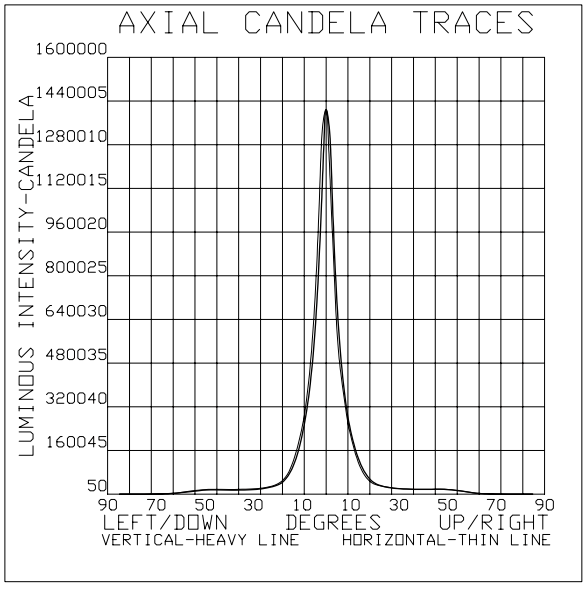
CAT NO.: SLS-1500Hx-x2x
TEST NUMBER: HP-09842

COVER GLASS: CLEAR,PLAIN,FLAT
REFLECTOR
SHAPE
FRONT: AS SPUN NEMA 2
REAR: AS SPUN NEMA 2
MATERIAL: ALUMINUM
ALLOY: 3002
FINISH: SPECULAR
REFLECTANCE
TOTAL: 81.0%
SPECULAR: 79.8%

* * * * LAMP DATA * * * *
DESIGNATION: MVR1500USPORTS
SOURCE: HALIDE ARC
LUMEN REFERENCE: 170000.
BULB: BT56, CLEAR
VOLTAGE: 288. volts
POWER: 1500. watts

LIGHT CENTER LENGTH: 9.5 INCHES
BASE: MOGUL SCREW
SOCKET SPACER: NONE

* * * * PERFORMANCE * * * *
TYPE: 2 H X 2 V
MAXIMUM CANDELA: 1428196
LOCUS OF MAX. CD -0.3H X 0.3V
AVERAGE OF 10 HIGHEST: 1051175
BEAM SPREAD (AT 50% MAX. CD)
DEG. HORIZONTAL: 8.6
DEG. VERTICAL: 8.4
BEAM LUMENS: 16592
BEAM EFFICIENCY: 9.8%
FIELD SPREAD (AT 10% MAX. CD)
DEG. HORIZONTAL: 25.1
DEG. VERTICAL: 25.0
FIELD LUMENS: 55211
FIELD EFFICIENCY: 32.5%
SPILL LIGHT LUMENS: 66107
TOTAL LUMENS: 121319
TOTAL EFFICIENCY: 71.4%
TEST DISTANCE: 60.0



SPECIAL CONDITIONS:
CURRENT PRODUCTION (7/2004) REFLECTOR

Tested By: R. E. Horan, M.I.E.S. **Approved By:** Mowen J. Rhodes

Lighting, Inc. Christiansburg, Virginia **Photometric Report**

NVLAP LAB CODE 200020-0

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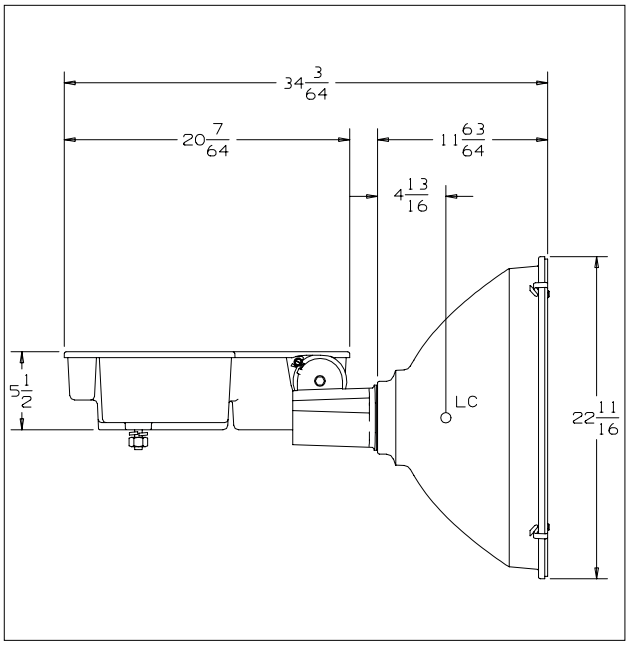
11-23-2004



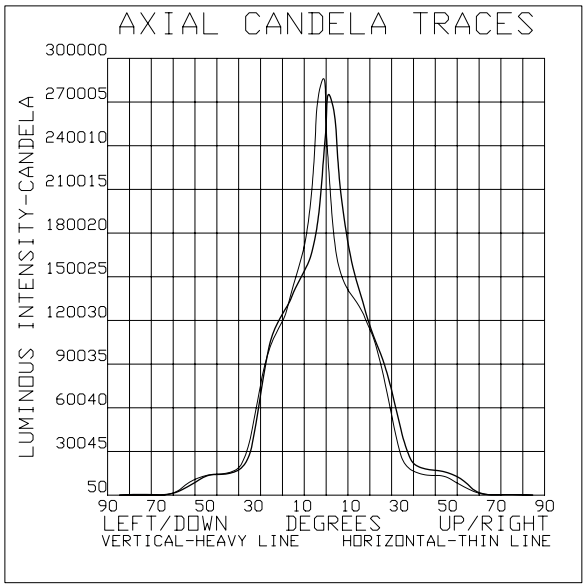
CAT NO.: SLS-1500Hx-x4x
TEST NUMBER: HP-10030

COVER GLASS: CLEAR,PLAIN,FLAT
REFLECTOR
SHAPE
FRONT: AS SPUN NEMA 4
REAR: AS SPUN NEMA 4
MATERIAL: ALUMINUM
ALLOY: 3002
FINISH: SPECULAR
REFLECTANCE
TOTAL: 81.1%
SPECULAR: 80.7%

* * * * LAMP DATA * * * *
DESIGNATION: MVR1500USPORTS
SOURCE: HALIDE ARC
LUMEN REFERENCE: 170000.
BULB: BT56, CLEAR
VOLTAGE: 290. volts
POWER: 1500. watts

LIGHT CENTER LENGTH: 9.5 INCHES
BASE: MOGUL SCREW
SOCKET SPACER: 0.25 INCH

* * * * PERFORMANCE * * * *
TYPE: 4 H X 4 V
MAXIMUM CANDELA: 355236
LOCUS OF MAX. CD -1.9H X 1.7V
AVERAGE OF 10 HIGHEST: 266370
BEAM SPREAD (AT 50% MAX. CD)
DEG. HORIZONTAL: 13.9
DEG. VERTICAL: 13.2
BEAM LUMENS: 8782
BEAM EFFICIENCY: 5.2%
FIELD SPREAD (AT 10% MAX. CD)
DEG. HORIZONTAL: 62.4
DEG. VERTICAL: 63.6
FIELD LUMENS: 95988
FIELD EFFICIENCY: 56.5%
SPILL LIGHT LUMENS: 33404
TOTAL LUMENS: 129392
TOTAL EFFICIENCY: 76.1%
TEST DISTANCE: 60.0



SPECIAL CONDITIONS:
CURRENT PRODUCTION (7/2004) REFLECTOR, 1/4" SOCKET SPACER; RETEST OF

Tested By: R. E. Horan, M.I.E.S. **Approved By:** Mowen J. Rhodes

HUBBELL'S LEKTROCOTE®
PAINT FINISH

Lighting fixtures and poles manufactured by Hubbell Lighting, Inc. have long been characterized as having excellent exterior durability. This durability represents the marriage of a superior quality polyester powder paint with specially pre-treated metal surfaces. What follows are discussions of Hubbell's paint and pre-treatment system; what we call our LEKTROCOTE.

The LEKTROCOTE Polyester Powder Paint

Representing the very latest in powder paint technologies, Hubbell uses a thermosetting, acid-functional polyester resin as the basis for its powder paint. Responsible for the excellent weatherability of the paint, this polyester resin is deposited onto metal surfaces using an electrostatic spray. The resin is then cured at 400°F to yield a tough, void free paint layer. Exact process controls are continuously enforced to assure paint thickness (0.003-inch minimum) and curing that is neither to fast nor too long.

One of the benefits of this powder paint over typical liquid paints and color anodization is its superior color uniformity. If you've ever had a car re-painted, you no doubt recall that the newly painted surface did not fade like the original paint! What is not generally recognized is that color anodization can share virtually the same problem. It is not uncommon to find anodized lighting fixtures and poles, in the same location, that have faded into two or more entirely different shades of the original color!!!

In contrast to these finishes, Hubbell's unique resin chemistry promotes uniform weathering of all painted surfaces! Although all paints are subject to a loss of gloss over time, this weathering is far less noticeable when all surfaces do so uniformly.

LEKTROCOTE Metal Pre-treatment

It is often said that the quality and durability of a paint finish is only as good as the quality of the underlying surface! In recognition of this, Hubbell takes great care to properly clean and passivate all metal surfaces prior to painting.

For our LIGHTING FIXTURES, this is accomplished using a five-step process during which the metal surface is thoroughly cleaned and rinsed. Both acid and alkaline based liquid cleaners are use to assure the removal of a brood spectrum of potential contaminants.

One of the last steps of the process deposits a thin layer of a proprietary corrosion resistant compound onto the metal surface. This layer provides maximum corrosion and paint adhesion! Only after all five steps have been complete are lighting fixtures and accessories painted.

Because of their size, METAL POLES require different processing. In lieu of liquid cleaning, each and every pole passes through a "Grit Blaster". While in this machine, clean cast iron grit is shot onto the metal's surface at speeds approaching 200mph. This cleans the metal surface and transforms it into its "white metal" state. The pole is now ready for painting – but not just yet!

LEKTROCOTE Zinc Primer

Before a steel pole is painted with its final color, a zinc-based primer is applied to the pole surface. Due to adhesion promoting compounds within the primer and the "anchor pattern" of the grit blasted surface, the primer forms a tenacious bond with the pole. So great is this bond that another trip trough the "Grit Blaster" will not remove the primer!!!

Once applied to the pole, the zinc primer is partially cured and inspected before the pole receives its final topcoat of polyester powder paint. To promote maximum bonding between the topcoat and primer, both are fully cured together. The result of this extra is an aesthetically pleasing galvanically protected steel pole.

TOTAL PERFORMANCE OF THE LEKTROCOTE® FINISH

PROPERTY	METHOD	RESULTS
Corrosion Resistance	ASTM B-117 (Salt Spray)	No creep more than 1/8 inch from scribe line after 1000 hours. No blisters
Exterior Durability	Florida Test	No peeling, blistering, or chalking after 12 months of continuous outdoor exposure. Slight loss in gloss. Uniform color.
Humidity Resistance	ASTM D-2247	No blistering after 1000 hours.
Impact Resistance	ASTM D-2794	Resistant to 160 inch-pounds - Direct and Indirect
Flexibility	ASTM D-522	Pass 1/8 inch radius bend
Film Hardness	ASTM D-3363	H –3H
Resistance to Construction Materials	AAMA 603	No blistering or adhesion loss, and only slight visual change after exposure to mortar and muriatic acid.
Chemical	Various	Generally resistant to dilute acids, salts, aliphatic and aromatic hydrocarbons, oils, petroleum solvents. Always consult factory for special applications.

CHEMICAL RESISTANCE OF POLYESTERS

Chemicals	Rating		Chemicals	Rating	
	Cold	Hot		Cold	Hot
Acids:			**Acid Salts:**		
Acetic, 10%	F	P	Aluminum Sulfate	E	E
Acetic, Glacial	P	P	Ammonium Chloride*	E	E
Benzene Sulfonic, 10%	E	E	Copper Chloride*	E	E
Benzoic	E	E	Iron Chloride	E	E
Boric	E	E	Nickel Chloride	E	E
Butyric, 100%	F	P	Zinc Chloride	E	E
Chloracetic, 10%	E	E	**Alkaline Salts:**		
Chromic. 5%	P	P	Barium Sulfide	E	E
Citric, 10%	E	E	Sodium Bicarbonate	E	E
Fatty Acids	E	E	Sodium Carbonate	E	F
Fluosilicic	P	P	Sodium Sulfide	E	F
Formic, 90%	P	P	Trisodium Phosphate	F	P
Hydrobromic, 20%	G	F	**Neutral Salts:**		
Hydrochloric, 20%	G	F	Calcium Chloride*	E	E
Hydrocyanic	E	E	Magnesium Chloride*	E	E
Hydrofluoric, 20%	P	P	Potassium Chloride*	E	E
Hypochlorous, 5%	G	F	Sodium Chloride*	E	E
Lactic, 5%	F	P	**Solvents:**		
Maleic, 25%	E	E	Alcohols	E	E
Nitric, 5%	F	F	Aliphatic Hydrocarbons	G	G
Nitric, 30%	P	P	Aromatic Hydrocarbons	G	F
Oleic	E	E	Chlorinated Hydrocarbons	P	N
Oxalic	E	E	Ketones	F	P
Phosphoric	G	F	Ethers	F	P
Picric	G	F	Esters	F	P
Stearic	E	E	Gasoline	E	E
Sulfuric, 50%	F	P	Carbon Tetrachloride	G	G
Sulfuric, 80%	P	N	**Organics:**		
Tannic	E	E	Aniline	P	P
Alkalies			Benzene	F	P
Ammonium Hydroxide	P	P	Formaldehyde, 37%	G	G
Calcium Hydroxide	P	P	Phenol, 5%	G	F
Potassium Hydroxide	P	P	Mineral Oils	E	E
Sodium Hydroxide	P	P	Vegetable Oils	E	E
			Chlorobenzene	G	F

KEY:

E = no attack

G = appreciably no attack

F = some attack, but useable in some instances

P = attacked, not recommended for use

N = rapidly attacked

C = cold, 70°F

H = hot, 180°F or boiling point of solvent

* = and nitrate and sulfate

HUBBELL GARD®
Product Specification

Why Hubbell Gard Fasteners

PROBLEM:
Corrosion resistant fasteners and support bolts used with aluminum lighting fixtures have historically been specified to be made of stainless steel. Due to electrochemical difference between the two metals, stainless steel fasteners can actually force aluminum fixtures to corrode. This phenomenon know as galvanic or dissimilar metal corrosion, can freeze fasteners into the fixtures, force wide spread formation of unsightly "white rust", cause paint blistering and flaking, and may even lead to fixture failure.

OBJECT:
Utilize a corrosion resistant material, which prevents aluminum structures from "sensing" the presence of dissimilar metal fasteners.

SOLUTION:
Hubbell Gard treatment on fasteners.

- Features include:
- Prevents fastener induced corrosion of aluminum lighting fixtures
- Promotes easy servicing of aluminum fixtures by preventing fastener freeze-up
- Resists over 70 corrosive agents commonly found in industrial, coastal, agricultural and commercial environments
- Resists abrasion and scuffing typically encountered during fixture manufacture, installation, and use
- Allows the use of fasteners that are up to 25% stronger than comparable stainless steel fasteners
- Prevents screw heads from breaking due to Hydrogen embrittlement
- Maintains fixture appearance by preventing "red" rust, "white" rust, and paint blistering / flaking
- Stops corrosion induced drift of aiming direction

Hubbell Gard treated fasteners have a true superiority over stainless steel.

CHEMICAL CORROSION RESISTANCE OF HUBBELL GARD COATING SYSTEMS

The following list is a guide to the corrosion resistance of Hubbell Gard. The Hubbell Gard coatings are not formulated for continuous immersion applications. However, the coatings can be used for splash zone and intermittent contact with many fluids. It is recommended that samples be tested in each specific environment before use since use temperature and chemical concentrations are also important.

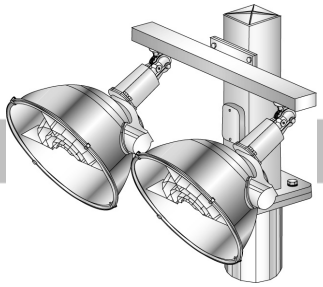
Chemical	Rating	Chemical	Rating
Acetate Solvents, crude	VG	Benzene	E
Acetate Solvents, pure	VG	Benzine	E
Acetic Acid, crude	F	Borax	VG
Acetic Acid, pure	F	Boric Acid	VG
Acetic Acid vapors	F	Butane, Butylene, Butadiene	E
Acetic Anhydride	U	Calcium Bisulfite	F
Acetone	E	Calcium Hypochlorite	F
Acetylene	E	Cane Sugar Liquors	U
Alcohols	E	Carbon Dioxide (dry)	E
Aluminum Sulfate	F	Carbon Dioxide (wet and Aqueous solution)	F
Alums	F	Carbon Disulfide	U
Ammonia Gas	U	Carbon Tetrachloride	VG
Ammonium Chloride	VG	Chlorine (dry)	U
Ammonium Hydroxide	VG	Chlorine (wet)	U
Ammonium Nitrate	VG	Chromic Acid	F
Ammonium Phosphate (Ammoniacal)	F	Citric Acid	G
Ammonium Phosphate (Neutral)	F	Coke Oven Gas	U
Ammonium Phosphate acid	F	Copper Sulfate	F
Ammonium Sulfate	F	Core Oils	U
Asphalt	E	Cottonseed Oil	E
Beer	VG	Creosote	U
Beet Sugar Liquors	U	Ethers	F
Ethylene Glycol	E	Rosin (dark)	VG
Ferric Chloride	F	Rosin (light)	VG
Ferric Sulfate	F	Shellac	E
Formaldehyde	VG	Soda Ash	F
Formic Acid	F	Sodium Bicarbonate	G
Freon	E	Sodium Bisulfate	F
Furfural	F	Sodium Chloride	E
Gasoline (sour)	E	Sodium Cyanide	NR
Gasoline (refined)	E	Sodium Hydroxide	NR
Gelatine	E	Sodium Hypochlorite	F
Glucose	E	Sodium Metaphosphate	F

Glue	E	Sodium Nitrate	E
Glycerol	E	Sodium Perborate	F
Hydrochloric Acid	NR	Sodium Peroxide	F
Hydrocyanic Acid	F	Sodium Phosphate (Alkaline)	F
Hydrofluoric Acid	F	Sodium Phosphate (Neutral)	E
Hydrogen Fluoride	F	Sodium Phosphate (Acid)	F
Hydrogen	E	Sodium Silicate	E
Hydrogen Peroxide	F	Sodium Sulfate	E
Hydrogen Sulfide (Dry)	VG	Sodium Sulfide	F
Hydrogen Sulfide (Wet and Aqueous Solution)	VG	Sodium Thisulfate	VG
Lacquers and Lacquer Solvents	E	Sludge Acid	E
Lime – Sulfur	U	Stearic Acid	E
Magnesium Chloride	F	Sulfate Liquors	NR
Magnesium Hydroxide	F	Sulfur	E
Magnesium Sulfate	VG	Sulfur Chloride	NR
Mercuric Chloride	VG	Sulfur Dioxide (dry)	E
Mercury	E	Sulfur Dioxide (wet)	F
Milk	E	Sulfuric Acid, 10%	F
Molasses	E	Sulfuric Acid, 10% – 75%	NR
Natural Gas	E	Sulfuric Acid, 75% - 95%	NR
Nickel Chloride	F	Sulfuric Acid, 95%	NR
Nickel Sulfate	F	Sulfurous Acid	F
Nitric Acid	NR	Tar	E
Oleic Acid	E	Tartaric Acid	F
Oxalic Acid	F	Toluneneroethylene	E
Oxygen	E	Trichloroethylene	VG
Plasmatic Acid	E	Turpentine	E
Petroleum Oils (sour)	VG	Varnish	E
Petroleum Oils (refined)	E	Vegetable Oil	E
Phosphoric Acid 25%	NR	Vinegar	F
Phosphoric Acid 25% - 50%	NR	Water (acid mine water)	F
Phosphoric Acid 50% - 75%	NR	Water (fresh)	E
Picric Acid	VG	Water (salt)	E
Potassium Chloride	E	Whiskey	E
Potassium Hydroxide	NR	Wines	VG
Potassium Sulfate	E	Xylene	E
Propane	E	Zince Chloride	F
		Zinc Sulfate	F

KEY:

E = Excellent
VG = Very Good
G = Good
F = Fair
NR = Not recommended*
U = Unknown*

* = Testing under the specific use conditions should be performed



SPORTSLITER SOLUTIONS MAINTENANCE MANUAL

Verify that the power is off.

The lens and reflector should be cleaned on a regular schedule (once a year or at more often intervals based on local conditions). Output efficiency will be retained only if properly maintained.

1. Clean the lens with a non-abrasive cloth and mild soap or detergent. Use care not to chip the glass.
2. The reflector, if needed, should only be cleaned with clear water and a clean cloth. **CAUTION**; do not apply any cleaning agent with strong alkaline or acid cleaners.
3. Lamp replacement should occur after 1500 hours of operation or as they burn out.
4. Ballast and capacitor replacement should occur as failures occur.

- **Annual tests**;
  - **Poles**;
  - Check to see that poles aren't leaning.
  - Check the pole for any signs of deterioration such as corrosion.
  - Check bolts and fittings for tightness.
    - Check all metal parts for signs of corrosion.
  - Check to see that pole wiring covers are in place.
  - Check all cables and conduits.
    - Pull on conduit to check for looseness.*
    - Check for loose fittings and damaged conduits.
  - **Luminaires**;
  - Check fixture housings for signs of water leakage or cracking.
  - Check lens ring assembly for tightness and any deterioration.
  - Replace broken lenses.
  - Replace burned out lamps.
  - **Remote ballast enclosures**;
  - Check ballast for signs of blackening.
  - Check capacitors for signs of bulging.
  - Check ground wire connections for secure fit.*
  - Check wiring for any signs of wire insulation deterioration.
  - Check aiming alignment of all fixtures.
  - Replace burned out fuses
  - **Three point Ground Rod Resistance Test***
    - Per the American electricians Handbook procedure.

*These tests and or repairs require the services of a qualified electrician. It is recommended that testing procedures for grounding be in accordance with local, state or national code.

High Output Multi-Vapor® Lamps
1500-Watt Universal Burn
SPORTSTAR

	Clear 1500-Watt
Ordering Code	47326
ANSI Code	M48
Description	MVR1500/U/Sports
	Physical Characteristics
Burning Position	Universal
Bulb Designation	BT-56
Bulb Material	Heat Restraint Glass
Bulb Nominal Diameter (mm)	177.8 (7”)
Base Type (Material)	Mogul Screw (High Nickel Copper Alloy)
Light Center Length (mm)	243.0 (9-1/2”)
Max. Overall Length (mm)	382.6 (15-1/16”)
Arc Length (mm)	88.9 (3-1/2”)
Max. Bulb Temp. (˚ C)**	430˚ C
Max. Base Temp. (˚ C)*	210˚ C
Max. Eccentricity: Bulb to Base	4˚
Bulb to Arc	3˚
	Luminaire Characteristics
	Enclosed Only
	Electrical Characteristics
Nominal Lamp Watts	1500
Nominal Lamp Volts	270
Nominal Lamp Amps - Starting	9.0
Nominal Lamp Amps - Operating	6.0
Max. Current Crest Factor	1.8
	Minimum Open Circuit Voltage for Starting & Sustaining to -30˚C
- RMS	530
- Peak	750
	Photometric Characteristics
Reference [1] - Initial Lumens (Vert/Hor 45˚)	178,000 Vert / 170,000 Horiz / 160,000 @ 45˚
- Mean Lumens (40% Rated Life)	160,000 Vert / 140,000 Horiz / 145,000 @ 45˚
Average Rated Life (Hrs.) - 5 Hrs./Start	3000
Color Rendering Index (Ra) CRI @ K[2]	65 @ 4000
Warm-Up Time (Minutes) to 90%	2 to 4
Hot Restart Time (Minutes) to 90%	10 to 15
CIE Chromaticity Coordinates: X	0.400
y	0.385

* For use only with metal halide ballasts. Can also be used on mercury lag ballast with 440-volt minimum OCV. This will provide reliable lamp starting above 50˚ F.

** Refers to a total bulb surface area not exceeding 4 square inches maximum. Permissable temperature for larger areas is 350˚ C.

WARNING - This lamp can cause serious skin burn and eye inflammation from short-wave ultraviolet radiation if outer envelope of the lamp is broken or punctured and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available from the General Electric Company. 21 CFR 1040.30

GE Lighting

70691 (6/01)
Printed in U.S.A.

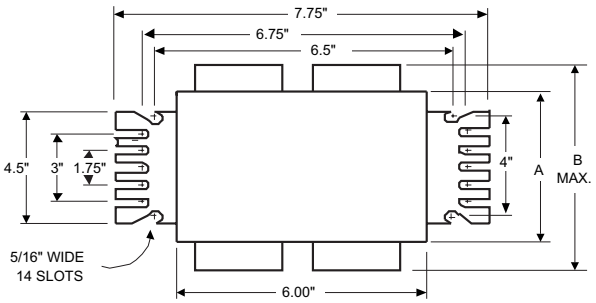
ADVANCE™

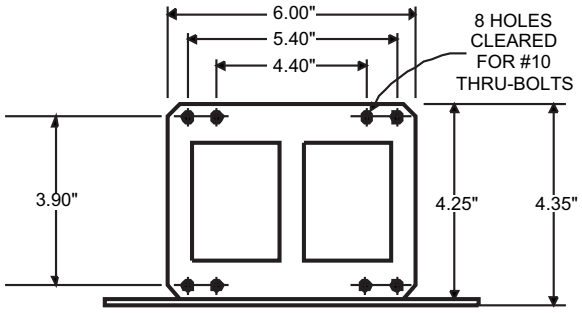
Metal Halide Lamp Ballast

Catalog Number 71A6792
For 1500W M48
60 Hz CWA
Status: Active

DIMENSIONS AND DATA

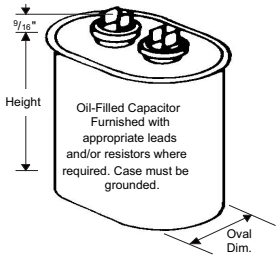
4 1/4 X 6 CORE - 2 COIL UNIT





INPUT VOLTS		120	208	240	277	
CIRCUIT TYPE	CWA					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±10%					
Lamp Watts	±12%					
LINE CURRENT (Amps)						
Operating		13.5	7.80	6.75	5.85	
Open Circuit		4.80	2.50	2.20	2.00	
Starting		13.4	7.70	6.70	5.70	
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	G	E	E	G	
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	450					
INPUT VOLTAGE AT LAMP DROPOUT		80	140	160	185	
INPUT WATTS	1605					
RECOMMENDED FUSE (Amps)		30	25	20	15	
CORE and COIL						
Dimension (A)	4.10					
Dimension (B)	6.10					
Weight (lbs.)	30					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	32.0					
Volts (min.)	525					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Advance Test Procedure for HID Ballasts - Form 1270)						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	405-495					
Short-Circuit Current Test (Amps)						
Secondary Current						
Input Current	7.40-9.00	9.80	5.60	5.20	4.40	-
		14.8	8.30	7.80	6.70	

Capacitor: MD3202-100



Capacitance: 32
Dia/Oval Dim: 1.75
Height: 5.3
Temp Rating: 90°C

Wiring Diagram:

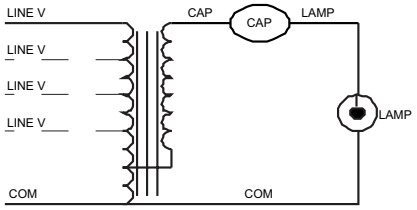


Fig. A

U.L. RECOGNIZED

Ignitor: NA

This ballast does not require the use of an ignitor.

Ordering Information

Order Suffix	Description
500	Ballast with Oil-Filled Capacitor
510	Ballast w/Welded Bracket and Oil-Filled Capacitor
600	Ballast Only, No Capacitor
610	Ballast with Welded Bracket, No Capacitor

Data is based upon tests performed by Advance Transformer in a controlled environment and representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

ADVANCE TRANSFORMER CO.
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

09/11/97

Lighting Analysts
illumination engineering software

10440 Bradford Road, Unit A Littleton, Colorado 80127 USA
info@agi32.com www.agi32.com t.303.972.8852 f.303.972.8851

December 7, 2009

Regarding AGi32 Software Validation and Verification

The development of the AGi32 software program is based upon twenty six years of experience in the design and implementation of illumination engineering software programs. Throughout this time Lighting Analysts, Inc., Littleton, Colorado, USA (LAI) has maintained a rigorous quality assurance plan for the development and maintenance of software and its related documentation. We believe the AGi32 software to represent the best possible practices for the computation and visualization of the lighted environment.

Since its initial release in 1999, the AGi32 software has undergone ten major upgrades and over 35 minor updates. Each product release, major or minor is processed through an internal test suite of lighting simulations designed to validate the consistency and integrity of calculated results.

The results of the test suite process are periodically compared with similar calculation programs by others as a benchmark of relative performance amongst industry tools. Observations have recorded consistent results within +/- 2% for direct illuminance computations and +/- 10% for interreflected environments.

Empirical benchmarks comparing calculated results with actual measured results have been performed for a variety of lighted environments. Due to the fact that Lighting Analysts does not have complete control over all of the possible variables in these simulations, results cannot be truly validated, however, the comparisons are extremely favorable.

AGi32 is the only illumination engineering software program to publicly publish the results of the CIE-171 benchmark for lighting software: "*Test Cases to Assess the Accuracy of Lighting Computer Programs*". The results can be found on our website at www.agi32.com, Please see the Technical Documents page under Support.

AGi32 and Calculation Methodology

The AGi32 software utilizes a variety of different calculation algorithms to arrive at predictions for the lighted environment. The methodology employed is dependent on the type of computation selected (e.g. roadway, direct, interreflected etc.), the desired result, the model complexity and user input.

Where appropriate, calculation methods are in accordance with techniques prescribed by the Illumination Engineering Society of North America (IESNA: www.ies.org) and the Commission International de Le'Eclairage (CIE: http://www.cie.co.at/cie/). This includes basic functionality such as:

- Zonal Cavity Method for interior estimation
- Direct illuminance calculation (illuminance at a point)
- Pavement luminance calculation (plus associated quantities)
- Unified Glare Rating (UGR), Glare Rating (GR)
- Sky luminance models
- Daylight Factor

By virtue, AGi32 also incorporates a number of proprietary calculation methods to handle complex illumination engineering tasks where standardized procedures either do not apply, are not suitable, or are not available. Calculations subject to proprietary methods follow:

- Interreflected light calculations are performed by radiosity techniques. The AGi32 calculation engine author, Ian Ashdown, has published similar procedures in: "*Radiosity a Programmers Perspective*", Copyright 1994 by John Wiley & Sons,.
- Daylight analysis radiosity, published in "*Fast Daylight Simulation and Analysis*", Ashdown, June, 2002.
- Propagation of light through glass
- Tunnel luminance calculation

Disclaimer

The AGi32 software is sold "as is", "without warranty" and its authors make no claim as to the final accuracy of calculated results.