Tech II

The Sterling and Francine Clark Art Museum

225 South Street, Williamstown, MA 01267-2878

26 October 2011

Table of Contents

Power Distribution Systems

Executive Summary

The following report describes and analyses the electric, fire alarm, telecom, and security systems for the Phase IIA and Phase IIB additions to The Sterling and Francine Clark Art Institute (The Clark). The Clark Art Institute is an art museum and research facility located in Williamstown, Massachusetts. The Phase IIA addition to The Clark consists of a utility plant that will service the original museum and the Manton research center. Phase IIB of the project is a Visitor, Exhibition and Conference Center (VECC) that will adjoin the plant building. The Clark campus is planning for a large water feature as part of the Phase IIB addition. The reflecting pools, which will be located on the north side of the VECC, will be used as a skating rink in the winter.

The descriptions and analysis documented in this report include: a summary of electrical systems in the addition, utility company information, information on emergency and standby systems, properties of all major electrical equipment, summaries of the communications systems in the building, and calculations for service entrance sizing. The report also includes information on specific HID lighting equipment used in the facility as well as two sets of single line diagrams, one of which was prepared for the actual project and one of which was prepared for this report.

Summary Description of Distribution System

The power distribution system for The Sterling and Francine Clark art Museum addition is a simple radial system. The campus has medium voltage service, with The Clark owning and servicing all of the transformers. The facility operates on 480Y/277V, 3Ph power with a backup generator to provide emergency power for the building. The electrical room, PB23, houses a unit substation and the main power distribution panels. The electrical room is located centrally in the plant section of the addition, with the large equipment loads, such as those from the HVAC system, kitchen, and woodshop are located completely in the plant. Power for the Visitor, Exhibition and Conference Center (VECC) is distributed from the plant.

Utility Company Information

National Grid, an international utility company, supplies power to The Clark.

National Grid
52 2nd Avenue, Waltham, MA 02451-1127
(781) 466-5000
www.nationalgrid.com

For large commercial and industrial facilities, such as The Clark, with demands greater than 200 kW, National Grid offers Time of Use (G-3) service. G-3 service is outlined below. Peak hours are from 8:00 a.m. to 9:00 p.m. daily on Monday through Friday, excluding holidays.

Customer Charge	$200.00/month
Distribution Demand Charge	$3.92/kW
Distribution Charge Peak Hours Off-Peak Hours	 1.117¢/kWh 0.364¢/kWh
Transmission Charge	1.552¢/kWh
Transition Energy Charge	0.009¢/kWh
Energy Efficiency Charge	0.780¢/kWh
Renewables Charge	0.050¢/kWh
Cable Facilities Surcharge	
Summer (June-Sept.)	2.857¢/kWh
Winter (Oct.-May)	2.469¢/kWh

National Grid offers discounts to facilities that have high voltage metering and own their own transformer.

Service Entrance

The Clark campus is serviced and metered at a utility pole on South Street. The power is distributed underground using a campus system operated at 13.8kV, which services the original museum building, the Manton Research center, and the Plant/VECC addition. The voltage is then transformed down for each building. From the utility pole, the power flows to Manhole 1 where it is distributed using a G&W

15kV Puffer Vacuum Interrupter switch. The service enters the addition through room PB20, which is the chiller room. The owner meters the power usage at 480Y/277V in Electrical Room PB23 inside the unit substation. The electrical contractor will provide the unit substation for the project.

Voltage Systems

The unit substation will reduce the voltage from the service voltage of 13.8kV to 480Y/277V, 3Ph, 4W voltage system, which is used for the majority of the building. There is a 225kVa transformer that transforms the power to a 208Y/120V, 3Ph, 4W voltage system. The equipment that runs on the lower voltage includes portions of the kitchen and woodshop loads, a portion of the lighting load (mostly in the VECC), and receptacle loads. The rest of the load operates on a 480Y/277V, 3Ph, 4W voltage system. This includes: HVAC loads, the remainder of the kitchen and woodshop loads, lighting loads, plant emergency, and plant standby loads.

Emergency Power Systems

The emergency power for this project and previous additions to The Clark will be supplied by a 1500kW/1875kVA, 1800 RPM diesel generator. Emergency power will be supplied using a 480Y/277V, 3Ph, 4W voltage system. The emergency system will service emergency lighting and power in addition to elevators and an air compressor used for dry and preaction systems. One of the emergency lighting panels will operate on a 208Y/120V, 3Ph, 4W system via a 30kVa transformer.

In addition to the emergency power system, the project will also include a standby system. This 480Y/277V, 3Ph, 4W system will also receive power from the generator. The standby power system will provide power for non-critical elements such as kitchen refrigerators, motors for HVAC equipment, motors for gray-water pumps, and several receptacle circuits. Most kitchen equipment and receptacle loads will use a 208Y/120V, 3Ph, 4W voltage system via a 75kVa transformer.

Locations of Switchgear

The major service electrical equipment, the unit substation, is located in Electrical room PB23. Distribution panels are also found in the generator room, PB22 and in the boiler room, PB25.

Major Electrical Equipment						
Equipment Tag	**Equipment Type**	**Floor Level**	**Room Number**	**Room Name**	**1/8" scale drawing**	**Additional Drawings**
PHMB	Unit Substation	Basement	P B23	Eletcrical Room	P E2.B01A	none
PRDB	Distribution Panel	Basement	P B23	Electrical Room	P E2.B01A	none
GDB	Distribution Panel	Basement	P B22	Generator Room	P E2.B01A	none
PSDB	Distribution Panel	Basement	P B20	Chiller Room	P E2.B01A	none
PEDB	Distribution Panel	Basement	P B23	Electrical Room	P E2.B01A	none
VDB1	Distribution Panel	Basement	V B05	Mechanical Room	V E2.B01A	none
VDB2	Distribution Panel	Basement	V B36	Mechanical	V E2.B01B	none
VLD1	Distribution Panel	Basement	V B05	Mechanical Room	V E2.B01A	none
VLD2	Distribution Panel	Basement	V B36	Mechanical	V E2.B01B	none

Lighting and Appliance Panelboards								
Equipment Tag	**Voltage System**	**Main Type**	**Main Size**	**Bus Size**	**Floor Level**	**Room Number**	**Room Name**	**Additional Notes**
PEL1	480Y/277V, 3Ph, 4W	MLO		100A	B	P B24	Emergency Power	
PL1	480Y/277V, 3Ph, 4W	MLO		100A	B	P B23	Electrical Room	
PP1	480Y/277V, 3Ph, 4W	MLO		225A	B	P B20	Chiller Room	
PP2	480Y/277V, 3Ph, 4W	MLO		100A	B	P B26	Machine Room	
PRS1	208Y/120V, 3Ph, 4W	MCB	225A	225A	B	P B20	Chiller Room	
PRS2	208Y/120V, 3Ph, 4W	MCB	225A	225A	B	P B25	Boiler Room	
PPS2	480Y/277V, 3Ph, 4W	MLO		225A	B	P B25	Boiler Room	
PWS	208Y/120V, 3Ph, 4W	MCB	100A	100A	-	-	-	
PER1	208Y/120V, 3Ph, 4W	MCB	100A	100A	B	P B24	Emergency Power	
PR1	208Y/120V, 3Ph, 4W	MLO		100A	B	P B20	Chiller Room	
PR2	208Y/120V, 3Ph, 4W	MLO		100A	B	P B26	Machine Room	
PPK	480Y/120V, 3Ph, 4W	MCB	225A	225A	B	P B30	Kitchen	
PRK	480Y/277V, 3Ph, 4W	MCB	225A	225A	B	P B30	Kitchen	
MRS1	208Y/120V, 3Ph, 4W	MLO		100A	-	-	-	
RELB	208Y/120V, 3Ph, 4W	MLO		100A	-	-	-	
VR1	480Y/277V, 3Ph, 4W	MLO		225A	B	V B05	Mechanical Room	
VR2	208Y/120V, 3Ph, 4W	MLO		100A	B	V B36	Mechanical	
VR3	208Y/120V, 3Ph, 4W	MLO		100A	-	-	-	
VK1	208Y/120V, 3Ph, 4W	MCB	225A	225A	B	V B28	Warming Pantry	
VP1	480Y/277V, 3Ph, 4W	MCB	100A	100A	B	V B05	Mechanical Room	
VPWF	480Y/277V, 3Ph, 4W	MCB	225A	225A	B	V B06	Pump Room	
VD2	208Y/120V, 3Ph, 4W	MLO			B	V B05	Mechanical Room	Dimmer Panel
VD4	208Y/120V, 3Ph, 4W	MLO			B	V B36	Mechanical	Dimmer Panel
VD3A	208Y/120V, 3Ph, 4W	MLO			B	V B05	Mechanical Room	Dimmer Panel
VD3B	208Y/120V, 3Ph, 4W	MLO			B	V B05	Mechanical Room	Dimmer Panel
VD5	208Y/120V, 3Ph, 4W	MLO			B	V B36	Mechanical	Dimmer Panel
VD6	208Y/120V, 3Ph, 4W	MLO			B	V B05	Mechanical Room	Dimmer Panel
VEDB	480Y/277V, 3Ph, 4W	MCB	225A	225A	B	V B09	Electrical Room	
VER1	208Y/120V, 3Ph, 4W	MCB	100A	100A	B	V B09	Electrical Room	
VS1	208Y/120V, 3Ph, 4W	MLO		225A	B	V B05	Mechanical Room	
VER2	208Y/120V, 3Ph, 4W	MCB	100A	100A	B	V B36	Mechanical	
VPS1	480Y/277V, 3Ph, 4W	MCB	225A	225A	B	V B05	Mechanical Room	
VRS1	208Y/120V, 3Ph, 4W	MCB	100A	100A	B	V B05	Mechanical Room	
VPS2	480Y/277V, 3Ph, 4W	MCB	100A	100A	B	V B36	Mechanical	
VEV1	208Y/120V, 3Ph, 4W	MLO		100A	B	V B38	Elevator Machine Room	
VEV2	208Y/120V, 3Ph, 4W	MLO		100A	B	V B04	Elevator Machine Room	
VED2	208Y/120V, 3Ph, 4W	MLO		-	-	-	-	Dimmer Panel
VED4	208Y/120V, 3Ph, 4W	MLO			B	V B36	Mechanical	Dimmer Panel

Over-current Devices

Circuit breakers are the primary over-current device used in The Clark plant and VECC. Fuses are used in addition with circuit breakers to protect the building main service entrance as well as several of the large motors used for the mechanical systems. The unit substation is protected by a fused air interrupter switch as well as one set of three fuses. The interrupter switch is rated at 600A continuous load, 40kA RMS asymmetrical, and 25kA symmetrical. A set of three 125A Type E fuses will also protect the service entrance. Additionally, one set of distribution class 18kV surge arrestors will be installed in

the main terminal cabinet. After the power has been transformed to low voltage inside the unit substation, it is protected by a 3000A MCB GFI and is rated for 100,000 AIC.

The plant's other main distribution panel board, which operates with a 208Y/120V, 3Ph, 4W voltage system, is rated at 65,000 AIC and is protected by an 800A MCB. In the VECC, there are two distribution panel boards, both of which are protected by an 800A MCB and rated for 65,000 AIC.

The emergency distribution panel board in the plant is rated for 65,000 AIC and is protected by a 225A MCB. The standby power distribution panel board is rated for 65,000 AIC and is protected by a 1200A MCB. The emergency distribution panel board in the VECC is rated for 42,000 AIC and is protected by a 225A MCB.

A typical branch panel board is protected by a 100A to 225A breaker and generally do not have mains.

Transformers

All of the transformers used in The Clark are dry type and are either floor or suspension mounted. In addition to the unit substation transformer, there are three transformers in the plant. One of these is dedicated to the standby system and one is dedicated to the emergency system. In the VECC, there are five transformers, with two of these being dedicated to the emergency system and one being dedicated to the standby system.

Individual Transformer Schedule								
Tag	**Primary Voltage**	**Secondary Voltage**	**Size**	**Type**	**Temp. Rise**	**Taps**	**Mounting**	**Remarks**
PHMB unit substation	13.8kV	480Y/277V	2000kVA	Dry	80˚C rise over 40˚C	(4) 2.5% taps	Floor	
PXF1	480Y/277V	208Y/120V	225kVA	Dry	150˚ rise	(6) 2.5% taps	Floor	
PSXF1	480Y/277V	208Y/120V	75kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	
PEXF1	480Y/277V	208Y/120V	30kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	
VFX1	480Y/277V	208Y/120V	225kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	
VFX4	480Y/277V	208Y/120V	112.5kVA	Dry	150˚ rise	(6) 2.5% taps	Floor	
VSFX1	480Y/277V	208Y/120V	30kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	
VEXF1	480Y/277V	208Y/120V	30kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	
VEXF2	480Y/277V	208Y/120V	30kVA	Dry	150˚ rise	(6) 2.5% taps	Ceiling	

Grounding

On the main plan electrical drawings, grounding is noted at the main building entrance transformers but not at the smaller transformers. Grounding details for the service entrance are provided on drawing P E5.01.

Special Equipment

Surge protectors and electronic monitoring devices are installed with the automatic transfer switches. A lightening arrestor is also located at the building service entrance.

Lighting Loads

The lighting system in The Sterling and Francine Clark Art Institute (The Clark) is composed of halogen, fluorescent, and LED sources for the major spaces. Halogen MR-16 sources are used for the gallery and guest spaces. Linear fluorescent sources are used for the plant and non-guest areas. Exterior lighting is accomplished primarily with LEDs and HID. Dimmable track lighting systems are present in all gallery spaces and a daylight control system is used to regulate exterior fixtures. A large portion of the building enclosure is composed of a glazed aluminum curtain wall system necessitating photo sensor dimming and an automated shade control system. The guest areas are designed with flexibility and aesthetics in mind, while the non-guest areas are designed primarily for functionality.

The luminaire table provides a comprehensive list of equipment used in The Clark's lighting design system. Information is given for both the lamp and the luminaire, such as source type, lamp, wattage, and electrical operating characteristics. Several pieces of lighting equipment are specified in linear feet, meaning that the wattage changes depending on the length needed for a particular application. This is noted by listing wattage or volt-amps in linear feet and by the remark "length varies."

Luminaire Table											
	Lamp				Luminaire						
Tag	Source	Lamp	Wattage	Quantity	Ballast	Voltage	Watts or VA	B.F.	Current (S/O)	P.F. (S/O)	Remarks
ASW1	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
ASW2	FLUOR	F40TBX/SPX35	40	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
ASW3	FLUOR	F32TBX/SPX35	32	1	GEC226-MVPS-3W	277	29	1.1	0.11	0.98	
ASW4	FLUOR	F32TBX/SPX35	32	3	GE432-MVPS-N	277	92	0.96	0.34	0.95	
ASW5	FLUOR	F32TBX/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AD6	FLUOR	32W CFL	32	1	GEC226-MVPS-BES	277	36	0.98	0.13	0.98	
AD14	INCAN	50WT4	50	1	N/A	120	50	N/A	0.42	1	
AE15	MH	CMH70U830MED/O	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AL7	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL8	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL9	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL10	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL11	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL12	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AL13	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
AP1	MH	MVR/70C/U/MED	70	1	GEMH70-MSF-120	120	77	1	0.68	0.99	
AP2	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP2A	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP3	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AT2	-	-	-	-	-	120	-	-	-	-	TRACK SYSTEM
ATH1	INCAN	75W PAR38	75	1	N/A	120	75	N/A	0.63	1	
ATH2	INCAN	75W PAR38	75	1	N/A	120	75	N/A	0.63	1	
AW2	LED	LED	18	1	N/A	120	18VA	-	0.15	0.95	
AW3	MH	CMH70U830MED/O	70	1	72C5281	120	94	1	1.00/0.85	0.9	
ASW1	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
ASW2	FLUOR	F32T8/SPX35	32	2	GE232-MVPS-N	277	58	0.89	0.21	0.96	
ASW3	FLUOR	F32T8/SPX35	32	1	GE132-MVPS-N	277	30	0.89	0.12	0.95	
AA1	INCAN	A	60	1	N/A	120	60	N/A	0.5	1	
AA2	LED	LED	7.62W/FT	1	N/A	24	8VA/FT	N/A	VARIES	0.95	LENGTH VARIES
AA3	LED	LED	7.62W/FT	1	N/A	24	8VA/FT	N/A	VARIES	0.95	LENGTH VARIES
AC1	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	MAX BF 1.0
AC2	QUAR	575W HPL	575	1	N/A	120	575	N/A	4.79	1	
AC2A	QUAR	300W FKW	300	1	N/A	120	300	N/A	2.5	1	
AC28	LED	LED	100W/FT	1	N/A	120	103VA/FT				LENGTH VARIES
AC3	FLUOR	28WT5	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	

Luminaire Table (Continued)

	Lamp				Luminaire						
Tag	**Source**	**Lamp**	**Wattage**	**No.**	**Ballast**	**Voltage**	**Watts (VA)**	**B.F.**	**Current (S/O)**	**P.F. (S/O)**	**Remarks**
AD1	INCAN	Q50MR16/HIR/CG25	50	1	N/A	120	50	N/A	0.42	1	
AD2	INCAN	Q50MR16/HIR/CG40	50	1	N/A	120	50	N/A	0.42	1	
AD3	INCAN	Q37MR16/HIR/CG40	37	1	N/A	120	37	N/A	0.31	1	
AD4	INCAN	Q37MR16/HIR/CG40	37	1	N/A	120	37	N/A	0.31	1	
AD5	INCAN	Q71MR16/C/NFL25	71	1	N/A	120	71	N/A	0.59	1	
AD6	INCAN	Q20MR16/HIR/CG35	20	1	N/A	120	20	N/A	0.17	1	
AD7	INCAN	Q37MR16/HIR/CG40	37	1	N/A	120	37	N/A	0.31	1	
AD8	INCAN	Q37MR16/HIR/CG25	37	1	N/A	120	37	N/A	0.31	1	
AD9	FLUOR	F32TBX/835/A/ECO	32	1	GE132-MVPS-N	120	30	0.89	0.28	0.99	
AD10	INCAN	Q37MR16/HIR/CG10	37	1	N/A	120	37	N/A	0.31	1	
AD11	INCAN	Q37MR16/HIR/CG10	37	1	N/A	120	37	N/A	0.31	1	
AD12	INCAN	Q37MR16/HIR/CG10	37	2	N/A	120	37	N/A	0.31	1	
AD13	INCAN	Q37MR16/HIR/CG10	37	1	N/A	120	37	N/A	0.31	1	
AD14	MH	CMH20T/U/830/G12	20	1	GEMH20-MSJ-MV	120	23	1	0.21	0.95	NOT USED
AD15	MH	CMH20T/U/830/G12	20	1	GEMH20-MSJ-MV	120	23	1	0.21	0.95	
AF1/AF2	LED	3W LED	1.25W/FT	1	N/A	120	96	N/A	VARIES	0.95	LENGTH VARIES
AG1	LED	LED	7	1	N/A	120	7VA	N/A	0.06	0.95	
AG2	INCAN	Q50T4/12V	50	1	N/A	120	55VA	N/A	0.46	1	
AG3	MH	CDM35/TC/830	39	1	71A5005P	120	55	1	(0.45/0.5)	0.95	
AG4	FLUOR	Q50T4/12V	50	1	N/A	12	55VA	N/A	4.58	1	
AG5	MH	CDM Elite 70/T6/930	70	1	72C5281	120	79	1	0.67	0.95	
AL1	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AL1A	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AL2	FLUOR	F54WT5HO/835/ECO	54	1	GE254MVPS90-F	120	71	1.11	0.61	0.99	
AL3	FLUOR	F28T5/8XX/HL/ECO	28	2	GE228MVPS-A	120	60	0.96	0.5	0.99	
AL3a	FLUOR	F28T5/8XX/HL/ECO	28	2	GE228MVPS-A	120	60	0.96	0.5	0.99	
AL4	LED	LED	11.1W/FT	1	N/A	120	12VA/FT	N/A	VARIES	0.95	LENGTH VARIES
AL5	FLUOR	28WT5	28	2	GE228MVPS-A	120	60	0.96	0.5	0.99	
AL6	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AL14	FLUOR	F32T8/TL930	32	1	GE132-MVPS-N	120	30	0.89	0.28	0.99	
AL15	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AR1	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AR2	FLUOR	F28T5/835/WM/ECO	28	2	GE228MVPS-A	120	60VA	0.95	0.48	0.99	
AT1, AT1E, AT2, AT3, ATA, ATB1, ATB2, ATB3, ATC, ATM	-	-	-	-	-	120	40VA/FT	-	-	1	2 CIRCUIT TRACK SYSTEM
ATH1	INCAN	VARIES	VARIES	1	N/A	120	VARIES	-	VARIES	1	TRACK FIXTURE
ATH2	INCAN	VARIES	VARIES	1	N/A	120	VARIES	-	VARIES	1	TRACK FIXTURE
ATH3	INCAN	VARIES	VARIES	1	N/A	120	VARIES	-	VARIES	1	TRACK FIXTURE
ATH4	INCAN	Q50MR16/HIR/CG10	50	1	N/A	120	50	-	0.42	1	TRACK FIXTURE
ATH5	INCAN	VARIES	VARIES	1	N/A	120	VARIES	-	VARIES	1	TRACK FIXTURE
AT6	INCAN	VARIES	VARIES	1	N/A	120	VARIES	-	VARIES	1	TRACK FIXTURE

Luminaire Table (Continued)											
	Lamp				Luminaire						
Tag	Source	Lamp	Wattage	No.	Ballast	Voltage	Watts (VA)	B.F.	Current (S/O)	P.F. (S/O)	Remarks
AU1	LED	LED	4W/FT	1	N/A	24	5VA/FT	-		0.95	LENGTH VARIES
AU2	-	-	-	-	-	-	-	-	-	-	NOT USED
AU3	FLUOR	F28T5/835/WM/ECO	28	1	GE132-MVPS-N	120	30	0.89	0.28	0.99	
AU4	FLUOR	F96T8	96	1	SLYVANIA 49590	120	67	1.02	0.56	0.95	
AW1	LED	LED	12	1	N/A	120	24VA	-	0.2	0.95	
AW2	-	-	-	-	-	-	-	-	-	-	NOT USED
AW3	MH	CMH70/U/830/MED	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AW4	-	-	-	-	-	-	-	-	-	-	NOT USED
AW5	MH	CMH70/U/830/MED	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AW6	MH	CMH70/U/830/MED	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AW7A	LED	LED	8W/LF	1	N/A	24	8VA/FT	-	VARIES	0.95	LENGTH VARIES
AW7B	LED	LED	8W/LF	1	N/A	24	8VA/FT	-	VARIES	0.95	LENGTH VARIES
AW8	MH	20W BT5 PGJ5 3000K	20	1	GEMH20-MSJ-MV	120	23	1	0.21	0.95	
AE1	LED	LED	15.8W/FT	1	N/A	24	16VA/FT	-	VARIES	0.95	LENGTH VARIES
AE2	-	-	-	-	-	-	-	-	-	-	NOT USED
AE3	MH	CDM Elite 35/T6/930	39	1	71A5005P	120	55	1	(0.45/0.5)	0.95	
AE4	-	-	-	-	-	-	-	-	-	-	NOT USED
AE5	MH	CDM Elite 35/T6/930	39	1	71A5005P	120	55	1	(0.45/0.5)	0.95	
AE6	LED	LED	4	1	N/A	24	5	-	0.21	0.95	
AE7	-	-	-	-	-	-	-	-	-	-	NOT USED
AE8	LED	LED	8	1	N/A	12	10VA		0.83	0.95	
AE9	MH	CDM Elite 35/T6/930	39	1	71A5005P	120	55	1	(0.45/0.5)	0.95	
AE10	LED	LED	2.16W/FT	1	N/A	24	2.16VA/FT		VARIES	0.95	LENGTH VARIES
AE11	-	-	-	-	-	-	-	-	-	-	NOT USED
AE12	MH	CDM Elite 70/T6/930	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AE12A	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AE13	-	-	-	-	-	-	-	-	-	-	NOT USED
AE14	MH	CDM Elite 35/T6/930	39	1	71A5005P	120	55	1	(0.45/0.5)	0.95	
AP1	MH	CMH70U830MED/O	70	1	72C5281	120	94	1	1.00/0.85	0.9	
AP2	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP2A	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP3	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP3A	MH	CMH39TUVCU830G12	39	1	GEMH39-MSJ-MV	120	44	1	0.17	0.95	
AP4	MH	CDM150/T6/830	150	1	71A54A3	120	189	1	(0.95/1.75)	0.95	
AP5	MH	MVR/70C/U/MED	70	1	GEMH70-MSF-120	120	77	1	0.68	0.99	
AS1	LED	LED	3W/FT	1	N/A	24	4VA/FT	-	VARIES	0.95	
AS2	LED	LED	3W/FT	1	N/A	24	4VA/FT	-	VARIES	0.95	

Lighting Control

Occupancy sensors automatically switch off lighting within 30 minutes of occupants leaving, satisfying ASHRAE 90.1 sections 9.4.1.1 and 9.4.1.2. A photosensor-based control system dims interior lighting and controls the light reduction shading system. For exterior and site lighting, a photosensor and time switch automatically turns off exterior lighting when appropriate to satisfy ASHRAE 90.1, section 9.4.1.3.

Mechanical and other Loads

The Mechanical system for The Clark contains six AHU's, most of which use variable frequency drive motors. Three chillers with a combined total of 705 tons cooling capacity service the campus in combination with a geothermal heat rejection. Four boilers serve the facility with a total of 10,838 MBH and provide heat for the snow melting system. Six heat exchangers service the various mechanical systems, such as the geothermal heat rejection, condenser economizer, cooler freeze protection, snow melting and humidification boiler systems. The facilities wood shop contains several large tools, such as a table saw and dust removal system. Two elevators service the additions to The Clark, and six water pumps are used for the two exterior water features. The kitchen facility contains several large pieces of equipment, such as a large walk in cooler/freezer, a dumbwaiter system, and commercial dishwasher with conveyor system.

The tables on the following pages list the mechanical, plumbing, architectural, kitchen, and other loads for The Clark. The loads for the mechanical system are typical of a modern HVAC system that has economizers and heat exchangers. One unique addition, however, is the added load for the snow melting system. The plumbing electrical loads for the facility consist of sump and sewage pumps as well as an extensive system of pumps that service The Clark's water feature. Architectural loads consist of the two elevator motors. The kitchen loads listed are the major connected loads of the space. In addition to the typical large equipment loads, there are additional loads due to Ozone generators that are used to sanitize the water feature. For the mechanical and plumbing tables, there is only one of each piece of equipment. For the tables showing architectural, kitchen and other loads, quantities are noted.

Mechanical Equipment Table									
Load				Characteristics					
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW
AHU-2E	AIR HANDLING UNIT	25	HP	34	480	3	0.95	28.3	26.85
AHU-5E	AIR HANDLING UNIT	5	HP	7.6	480	3	0.95	6.3	6.003
AHU-8E	AIR HANDLING UNIT	5	HP	7.6	480	3	0.95	6.3	6.003
AAHU-8E	AIR HANDLING UNIT	10	HP	14	480	3	0.95	11.6	11.06
AHU-10E	AIR HANDLING UNIT	5	HP	7.6	480	3	0.95	6.3	6.003
AHU-11E	AIR HANDLING UNIT	20	HP	27	480	3	0.95	22.4	21.33
CCC-1	CLOSED CIRCUIT COOLER	20	HP	27	480	3	0.95	22.4	21.33
CCC-2	CLOSED CIRCUIT COOLER	20	HP	27	480	3	0.95	22.4	21.33
CH-1	CHILLER	196.3	kW	N/A	480	3	0.95	206.6	196.3
CH-2	CHILLER	196.3	kW	N/A	480	3	0.95	206.6	196.3
CH-3	CHILLER	155.2	kW	N/A	480	3	0.95	163.4	155.2
P-1,2,3	PUMP	20	HP	27	480	3	0.95	22.4	21.33
P-4,5,6	PUMP	15	HP	21	480	3	0.95	17.5	16.59
P-7,8,9	PUMP	15	HP	21	480	3	0.95	17.5	16.59
P-10,11	PUMP	5	HP	7.6	480	3	0.95	6.3	6.003
P-12,13	PUMP	7.5	HP	11	480	3	0.95	9.1	8.688
P-14,15	PUMP	10	HP	14	480	3	0.95	11.6	11.06
P-16,17	PUMP	10	HP	14	480	3	0.95	11.6	11.06
P-18,19	PUMP	5	HP	7.6	480	3	0.95	6.3	6.003
P-20,21	PUMP	0.08	HP	-	480	1	0.75	0.1	0.08
P-22,23	PUMP	0.75	HP	1.2	480	1	0.85	0.6	0.49
FOP-1	PUMP	0.50	HP	1	480	1	0.85	0.5	0.408
FOP-2	PUMP	0.75	HP	1.6	480	3	0.85	1.3	1.131
AD-1	AIR DOOR	1.5	HP	6.6	208	3	0.85	2.4	2.021
AD-2	AIR DOOR	1.5	HP	6.6	208	3	0.85	2.4	2.021
UH-1	CABINET/UNIT HEATER	0.08	HP	-	120	1	0.75	0.11	0.08
UH-2	CABINET/UNIT HEATER	0.05	HP	-	120	1	0.75	0.07	0.05
B-1	BOILER	10	HP	14	480	3	0.95	11.64	11.06
B-2	BOILER	10	HP	14	480	3	0.95	11.64	11.06
B-3	BOILER	0.75	HP	1.6	480	3	0.85	1.33	1.13
B-4	BOILER	0.75	HP	1.6	480	3	0.85	1.33	1.13
FC-1P	FAN COIL UNIT	0.5	HP	1.1	480	3	0.85	0.91	0.78
FC-2P	FAN COIL UNIT	1	HP	16	120	1	0.85	1.92	1.63
FC-3P	FAN COIL UNIT	0.166	HP	4.4	120	1	0.75	0.53	0.40
FC-4P	FAN COIL UNIT	0.05	kW	N/A	208	1	0.95	0.05	0.05
FC-5P	FAN COIL UNIT	0.089	kW	N/A	208	1	0.95	0.09	0.09

Mechanical Equipment Table (Continued)									
Load				Characteristics					
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW
RF-2E	FAN	0.5	HP	1.1	480	3	0.85	0.91	0.78
RF-11E	FAN	0.75	HP	1.6	480	3	0.85	1.33	1.13
KEF-1	FAN	2	HP	3.4	480	3	0.85	2.83	2.40
DWEF-1	FAN	0.33	HP	-	480	3	0.75	0.45	0.33
EF-1	FAN	0.75	HP	1.6	480	3	0.85	1.33	1.13
EF-2	FAN	1	HP	2.1	480	3	0.85	1.75	1.48
EF-3	FAN	0.8	HP	1.6	480	3	0.85	1.33	1.13
EF-4	FAN	0.5	HP	1.1	480	3	0.85	0.91	0.78
EF-5	FAN	0.33	HP	7.2	120	1	0.75	0.86	0.65
EF-6	FAN	0.75	HP	1.6	480	3	0.85	1.33	1.13
SF-1	FAN	3	HP	4.8	480	3	0.85	3.99	3.39
SF-2	FAN	0.75	HP	1.6	480	3	0.85	1.33	1.13
DIF-1	FAN	3	HP	4.8	480	3	0.85	3.99	3.39
DIF-2	FAN	0.5	HP	9.8	120	1	0.85	1.18	1.00
							Total	865.7	818.5

Plumbing Equipment Table									
Load				Characteristics					
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW
SE-1	Sewage ejector	1.5	HP	6.6	208	3	0.85	2.38	2.02
SE-2	Sewage ejector	0.33	HP	7.2	120	1	0.75	0.86	0.65
SP-1	Sump pump	2	HP	7.5	208	3	0.85	2.70	2.30
SP-2	Sump pump	3	HP	10.6	208	3	0.85	3.82	3.25
N/A	Pool Weir Supply Pump #1	25	HP	34	480	3	0.95	28.27	26.85
N/A	Pool Weir Supply Pump #2	15	HP	21	480	3	0.95	17.46	16.59
N/A	Filtration Pump	60	HP	77	480	3	0.95	64.02	60.82
N/A	Overflow pump	4.6	HP	7.6	480	3	0.85	6.32	5.37
N/A	Upper Pool Pump	1	HP	2.1	480	3	0.85	1.75	1.48
N/A	Lower Pool Pump	1	HP	2.1	480	3	0.85	1.75	1.48
N/A	Duplex Sump Pump	1.5	HP	3	480	3	0.85	2.49	2.12
							Total	131.8	122.9

Architectural Equipment Table												
Load				Characteristics								
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW	Quantity	Itemized kVA Total	Itemized kW Total
V PEV-1	Passenger Elevator	40	HP	114	208	3	0.95	23.71	22.53	1	23.71	22.53
V PEV-2	Passenger/Service Elevator	50	HP	143	208	3	0.95	29.74	28.26	1	29.74	28.26
N/A	Hydraulic Platform	9.15	kVA	11	480	3	0.95	9.15	8.69	1	9.15	8.69
N/A	Exterior Overhead Door	2	HP	3.4	480	3	0.85	1.63	1.39	1	1.63	1.39
N/A	Interior Overhead Door	1	HP	2.1	480	3	0.85	1.75	1.48	2	3.49	2.97
N/A	Dock Leveler	1.5	HP	3	480	3	0.85	1.44	1.22	1	1.44	1.22
N/A	Automatic Daylight Shades	0.44	kVA	N/A	120		0.75	0.44	0.33	101	44.44	33.33
										Total	113.61	98.38

Kitchen Equipment Table												
Load				Characteristics								
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW	Quantity	Itemized kVA Total	Itemized kW Total
E-113	CONDENSING UNIT	1	HP	4.6	208	3	0.85	1.66	1.41	1	1.66	1.41
E-115	CONDENSING UNIT	1.5	HP	6.6	208	3	0.85	2.38	2.02	1	2.38	2.02
E-117	CONDENSING UNIT	1.5	HP	6.6	208	3	0.85	2.38	2.02	1	2.38	2.02
E-143	ICE MAKER	1	HP	16	120	1	0.85	1.92	1.63	1	1.92	1.63
E-154	BLAST CHILLER	1.2	HP	20	120	1	0.85	2.40	2.04	1	2.40	2.04
E-189	HEAT LAMP	2.4	kW	N/A	208	1	0.95	2.53	2.40	1	2.53	2.40
E-206	DISHWASHER/CONVEYOR	27	kW	N/A	480	3	0.95	28.42	27.00	1	28.42	27.00
										Total	41.68	38.52

Other Equipment Table												
Load				Characteristics								
Tag	Description	Magnitude	Units	NEC Motor Amps	Voltage	Phase(s)	Assumed P.F.	kVA	kW	Quantity	Itemized kVA Total	Itemized kW Total
N/A	DelOzone #CD-45GV generator			N/A		1	0.95	2.00	1.90	2	4	3.80
N/A	DelOzone #CD-25GV generator			N/A		1	0.95	1.40	1.33	5	7	6.65
										Total	11	10.45

Service Entrance Size

The following is a summary of the service entrance sizing using three different methods. The first method, used in the conceptual and schematic design phase, uses an assumption of VA/Sq.Ft. based on building type. The second method, used in the design development phase, segregates loads based on type and uses assumptions for VA/Sq.Ft. and demand factor to more accurately estimate the service entrance size. The third method used is for actual conditions, not assumed conditions, and takes into account the loads that are being designed into the actual facility.

Conceptual/Schematic Phase - Load per Square Foot		
Building Type	**Building Area (sq. ft.)**	**Demand Loading (Museum, VA/Sq.Ft)**
Museum	78800	14
Total kVA	1103.2	
Current at 480Y/277V, 3Ph, 4W (Amps)	1326.9	
Switchboard size (Amps)	1600	

Design Development - NEC Loading				
Load Type	**Load (VA/Sq.Ft.)**	**Demand Factor**	**Area (Sq.Ft.)**	**kVA**
Lighting	3.5	1	78800	275.8
Receptacle	0.5	1	78800	39.4
HVAC cooling	8	1	78800	630.4
HVAC fans	2	1	78800	157.6
Kitchen (full service)	20	0.65	1500	19.5
Shop Equipment	25	1	1900	47.5
Elevators	50 kw per	1	2 (quantity)	100
Total kVA	1270.2			
Current at 480Y/277V, 3Ph, 4W (Amps)	1527.8			
Switchboard Size (Amps)	1600			

Working Drawings - Actual Loading			
Load Type	**Connected Load (kVA)**	**Demand Factor**	**Demand Load (kVA)**
Lighting	218.38	1	218.38
Receptacles	149.41	1.0 (<10000), 0.5 (REST)	79.71
Mechanical Equipment	865.66	0.8	692.52
Plumbing Equipment	131.81	1	131.81
Architectural Equipment	113.61	0.8	90.89
Kitchen Equipment	41.68	0.75	31.26
Other Equipment	11.00	1	11.00
Audio, Video and Security System	17.49	1	17.49
Total kVA	1273.06		
Total kVA (With 25% spare capacity)	1591.32		
Current at 480Y/277V, 3Ph, 4W (Amps)	1914.06		
Switchboard Size (Amps)	2000		

Summary Tables				
Table A: Service Entrance Sizing Summary				
Phase	**Load (kVA)**	**Voltage System**	**Load (Amps)**	**Switchboard Size**
Conceptual/Schematic Design	1103.2	13.8 kV, 3Ph, 3W	1326.9	1600
Design Development	0	13.8 kV, 3Ph, 3W	1527.8	1600
Working Drawings	1273.057432	13.8 kV, 3Ph, 3W	1914.1	2000
Table B: Service Entrance Actual Conditions				
Service Entrance	**Size (Amps)**	**Voltage System**	**Capacity (kVA)**	
Actual Conditions	3000	480Δ/277V, 3Ph, 3W	2000	
Summary: VA/Sq.Ft.				
NOTE: Unit Substation includes provisions for fans to increase capacity to 2660 kVA				

The difference between the load per square foot, NEC loading, and actual loading methods used for sizing the service entrance likely come from the building's split purpose. About 50% of the space is designated as a Visitor, Exhibition, and Conference Center (VECC), and 50% is a utility plant facility. The plant is not only serving the VECC, but also previous additions to The Clark campus, such as the Manton and the original museum building. Because of this, VA/Sq.Ft. assumptions were very inaccurate in this case. Either a higher VA/Sq.Ft. needed to be used, or the area entered into these calculations would have to take into account the other spaces being serviced from the plant. There is also a large difference between actual building service entrance conditions and the service entrance calculated using the actual loading method. This can be accounted for by the large quantities of spare circuits throughout the distribution system. These circuits would be included for designing for future additions to The Clark, but would not show up in the actual service size calculated for this report.

Environmental Stewardship Design

The building is scheduled for minimum LEED silver certification. The project will receive LEED credit for controllability of lighting systems. The exterior lighting system uses energy efficient HID and LED sources resulting in an exterior lighting power density that is significantly below the ANSI 90.1 recommendations. Additionally, a portion of the interior lighting system is energy efficient linear

fluorescent sources. To reduce electrical loads from HVAC motors, variable frequency motor controllers are used in The Clark.

Design Issues

The utility plant portion of the additions to The Clark provides power to the surrounding campus. Voltage drop is a potential issue due to the distances between the facilities on the campus. The service to the lighting systems for the new parking lot, Manton and original building are where voltage drop would need to be considered.

Single-Line Diagrams

Appendix A includes several sets of single-line diagrams. On set is provided by the electrical engineer for the project and one was generated for this report. Each set of single-line diagrams is broken up into two drawings; one shows the plant's power distribution system, and the other shows the VECC's power distribution system.

Communication Systems

Fire Alarm and Protection System

Fire data gathering panels (DGPs) are located throughout the facility. The fire command station functions as the interface between the fire alarm network, the DGP's, and the building management system (BMS). The components that are used for The Clark's fire alarm system are intelligent addressable fire alarm control panels manual pull stations, heat detectors, analog smoke detectors, alarm monitoring modules, and supervised control modules. Additionally, the facility is broken down into voice evacuation zones, each of which is on two independent audio circuits with independent amplifiers. The fire protection system includes equipment such as Magnetic door holder releases, operation of automatic smoke vents, elevator recall and shutdown, and voltage monitoring of elevator disconnect switches.

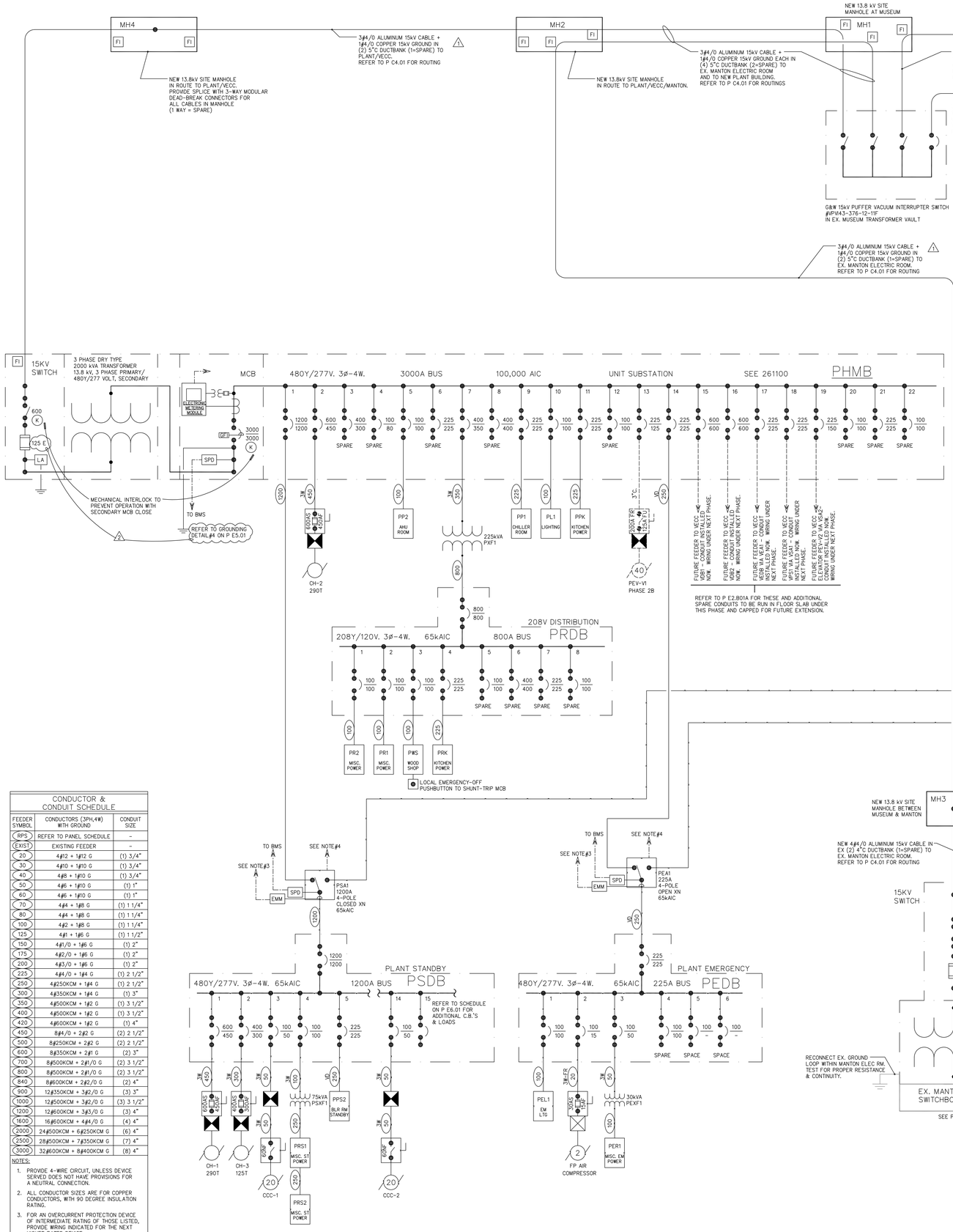
Telecom System

The Telecom system for The Clark is composed of a fiber optic backbone system with UTP horizontal service. The networking is organized into four zones; TZ-P-TR, TZ-V-TR, TZ-V-TE1, and TZ-V-TE2, each of which span both floors. Zone TZ-P-TR contains a telecom rack housed in the Plant Telecom Room, and zone TZ-V-TR contains a telecom rack housed in the VECC Telecom Room. Zones TZ-V-TE1 and TZ-VE2 do not have a dedicated telecom room but instead are mounted inside a metal rack enclosure.

Security System

The security system for The Clark is composed of intelligent field panels, electric card readers, motion detectors, controllable magnetic door contacts, cameras, and duress buttons at staffed locations. A CAT 6 video network works with a dedicated security local area network to provide the security infrastructure for The Clark. The hub of the security system, which is the security equipment panel, is located on the basement floor (room number withheld due to sensitive nature of topic).

Appendix A: Single Line Diagrams



SINGLE LINE LEGEND

- FI — FAULT INDICATOR
- LA — LIGHTNING ARRESTOR
- TRANSFORMER
- CIRCUIT BREAKER — FRAME/TRIP ST = SHUNT TRIP UNIT GFI = GROUND FAULT UNIT
- FUSED SWITCH — SWITCH SIZE/FUSE RATING
- CT (METERING)
- SPD — SURGE PROTECTION DEVICE
- MOTOR STARTER OR CONTROLLER
- MOTOR (HORSEPOWER)
- LIGHTING/POWER PANEL
- LIGHTING PANEL WITH INTERNAL CONTACTOR
- GROUND PER N.E.C.
- NETWORKED CUSTOMER METERING EQUIPMENT SEE 262413
- EMM — ELECTRONIC METERING MODULE SEE 263200
- ENCLOSED FUSED SWITCH
- ENCLOSED CIRCUIT BREAKER
- 400/350 — CIRCUIT BREAKER WITH NETWORKED CUSTOMER METERING EQUIPMENT SEE 262413

CONDUCTOR & CONDUIT SCHEDULE

FEEDER SYMBOL	CONDUCTORS (3PH,4W) WITH GROUND	CONDUIT SIZE
RPS	REFER TO PANEL SCHEDULE	-
EXIST	EXISTING FEEDER	-
20	4#12 + 1#12 G	(1) 3/4"
30	4#10 + 1#10 G	(1) 3/4"
40	4#8 + 1#10 G	(1) 3/4"
50	4#6 + 1#10 G	(1) 1"
60	4#6 + 1#10 G	(1) 1"
70	4#4 + 1#8 G	(1) 1 1/4"
80	4#4 + 1#8 G	(1) 1 1/4"
100	4#2 + 1#8 G	(1) 1 1/4"
125	4#1 + 1#6 G	(1) 1 1/2"
150	4#1/0 + 1#6 G	(1) 2"
175	4#2/0 + 1#6 G	(1) 2"
200	4#3/0 + 1#6 G	(1) 2"
225	4#4/0 + 1#4 G	(1) 2 1/2"
250	4#250KCM + 1#4 G	(1) 2 1/2"
300	4#350KCM + 1#4 G	(1) 3"
350	4#500KCM + 1#2 G	(1) 3 1/2"
400	4#500KCM + 1#2 G	(1) 3 1/2"
420	4#600KCM + 1#2 G	(1) 4"
450	8#4/0 + 2#2 G	(2) 2 1/2"
500	8#250KCM + 2#2 G	(2) 2 1/2"
600	8#350KCM + 2#1 G	(2) 3"
700	8#500KCM + 2#1/0 G	(2) 3 1/2"
800	8#500KCM + 2#1/0 G	(2) 3 1/2"
840	8#600KCM + 2#2/0 G	(2) 4"
900	12#350KCM + 3#2/0 G	(3) 3"
1000	12#500KCM + 3#2/0 G	(3) 3 1/2"
1200	12#600KCM + 3#3/0 G	(3) 4"
1600	16#600KCM + 4#4/0 G	(4) 4"
2000	24#500KCM + 6#250KCM G	(6) 4"
2500	28#500KCM + 7#350KCM G	(7) 4"
3000	32#600KCM + 8#400KCM G	(8) 4"

NOTES:

1. PROVIDE 4-WIRE CIRCUIT, UNLESS DEVICE SERVED DOES NOT HAVE PROVISIONS FOR A NEUTRAL CONNECTION.
2. ALL CONDUCTOR SIZES ARE FOR COPPER CONDUCTORS, WITH 90 DEGREE INSULATION RATING.
3. FOR AN OVERCURRENT PROTECTION DEVICE OF INTERMEDIATE RATING OF THOSE LISTED, PROVIDE WIRING INDICATED FOR THE NEXT HIGHER RATED DEVICE.
4. VD=FEEDER UPSIZED DUE TO VOLTAGE DROP 3W=3WIRE FEEDER (NO NEUTRAL) REQUIRED 5W=5WIRE FEEDER (2X NEUTRAL) REQUIRED FR=FIRE-RATED CABLE IN CONDUIT (260500)
5. FEEDERS ON TRANSFORMER SECONDARY SIDE SHALL CONTAIN SYSTEM BONDING JUMPER SIZED PER NEC 250-30(A)(1), & NEC TABLE 250-66.

NOTES:

1. LINETYPE ———— INDICATES EXISTING EQUIPMENT TO REMAIN.
2. ALL TRANSFORMERS SHALL BE 480V DELTA – 208Y/120V UNLESS OTHERWISE NOTED.
3. PROVIDE LOW VOLTAGE WIRING IN 1"C. FOR ATS METERING NETWORK COMMUNICATIONS SYSTEM – SEE 263200.
4. PROVIDE LOW VOLTAGE FIRE-RATED WIRING IN 1"C. FOR GENERATOR START CIRCUIT – SEE 260500 AND 263200.
5. LIFE SAFETY AND STANDBY POWER CIRCUIT BREAKERS IN GDB SHALL BE PROVIDED IN SEPARATE VERTICAL SWITCHBOARD SECTIONS PER NEC ARTICLE 700.

1 SINGLE LINE DIAGRAM
P E1.01 SCALE: NONE

THE CLARK

Design Architect
TADAO ANDO ARCHITECTS AND ASSOCIATES
5-23 Toyosaki 2-Chome, Kita-Ku
Osaka, JAPAN 531-0072
Telephone (011) 81 (6) 6375-1148
Facsimile (011) 81 (6) 6374-6240

Architect of Record
GENSLER
1230 Avenue of the Americas, Suite 1500
New York, NY 10020
Telephone (212) 492-1400
Facsimile (212) 492-1472

Landscape Architect
REED HILDERBRAND ASSOCIATES, INC
741 Mt. Auburn Street
Watertown, MA 02472
Telephone (617) 923-2422
Facsimile (617) 923-3740

Consulting Architect
SKY DESIGN, INC
9520 Jefferson Blvd., Studio C
Culver City, CA 90232
Telephone (310) 839-5106
Facsimile (310) 839-5107

MEP Engineer
Altieri SeborWieber, LLC
31 Knight Street
Norwalk, CT 06851
Telephone (203) 866-5538
Facsimile (203) 866-5243

Structural Engineer
BURO HAPPOLD CONSULTING ENGINEERS, PC
100 Broadway, 23rd Floor
New York, NY 10005
Telephone (212) 334-2025
Facsimile (212) 334-5528

Consulting Engineers
ARUP
155 Avenue of the Americas
New York, NY 10013
Telephone (212) 229-2669
Facsimile (212) 229-1057

Civil Engineer
GUNTLOW & ASSOCIATES, INC
55 North Street
Williamstown, MA 01267
Telephone (413) 458-2198
Facsimile (413) 458-2712

Code Consultant
TECHNICAL SOLUTIONS ASSOCIATES, INC
14 Hunter Circle
Jefferson, MA 01522
Telephone (508) 829-2208
Facsimile (508) 829-2208

Food Service Consultant
ARTHUR M. MANASK & ASSOCIATES, INC
209 West Alameda Avenue, Suite 103
Burbank, CA 91502
Telephone (818) 557-0635
Facsimile (818) 563-3552

Food Service Consultant
CLEVENGER FRABLE LAVALLEE
39 Westmoreland Avenue
White Plains, NY 10606
Telephone (914) 997-9660
Facsimile (914) 997-9671

Waterproofing Consultant
JAMES R. GAINFORT AIA CONSULTING ARCHITECTS PC
121 West 27th Street, Suite 803
New York, NY 10001
Telephone (212) 736-3344
Facsimile (212) 736-4466

Security Consultant
LAYNE CONSULTANTS INTERNATIONAL
1305 Krameria Street, Suite H-129
Denver, CO 80220
Telephone (303) 377-2176

Project Manager
RISE/ZUBATKIN
120 South LaSalle, Suite 1750 — *Chicago, IL 60603*
Telephone (312) 917-1000
Facsimile (312) 917-1572
333 West 52nd Street, 6th Floor — **and** *New York, NY 10019*
Telephone (212) 271-4850
Facsimile (212) 271-4707

Issue	Date & Issue Description	By	Check
1	12/11/2009 FOR CONSTRUCTION		
1	1/11/2010 ADDENDUM 1		
2	3/5/2010 ADDENDUM 3		

Seal/Signature

Project Name
PLANT
STERLING & FRANCINE CLARK ART INSTITUTE
WILLIAMSTOWN, MASSACHUSETTS

Project Number
06.6714.999

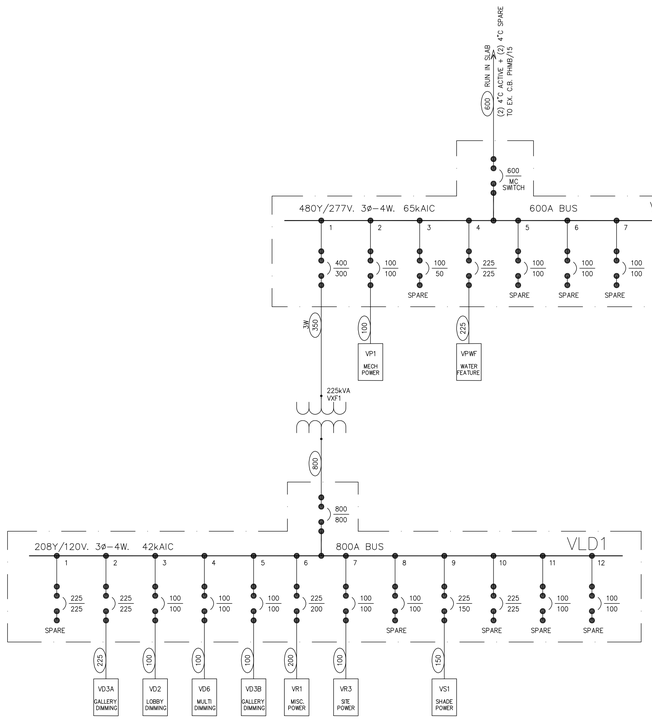
CAD File Name
0652.1EOPP

Description
SINGLE LINE DIAGRAM
PLANT

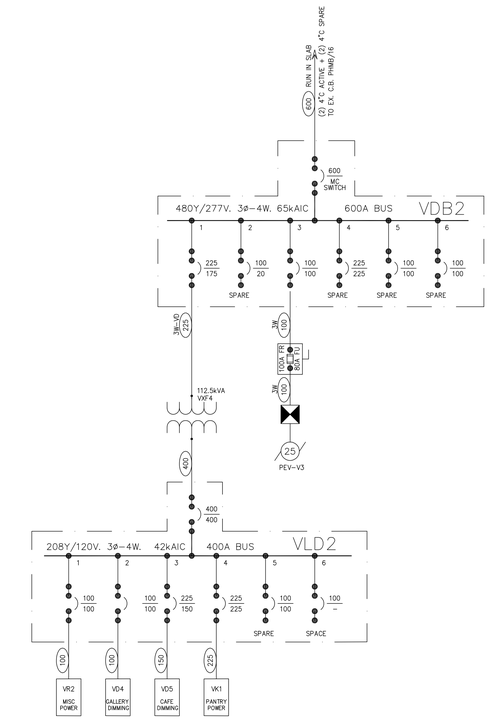
Scale
NONE

P E1.01

FILE:0652.1tb REV11/18/2009 10:03
FILE:0652.1EOPP REV: 03/05/10 14:41
FILE:0652EOPREV 12/09/02 20:15



1 VECC WEST SINGLE LINE DIAGRAM
V E1.01 SCALE: NONE



2 VECC EAST SINGLE LINE DIAGRAM
V E1.01 SCALE: NONE

SINGLE LINE LEGEND

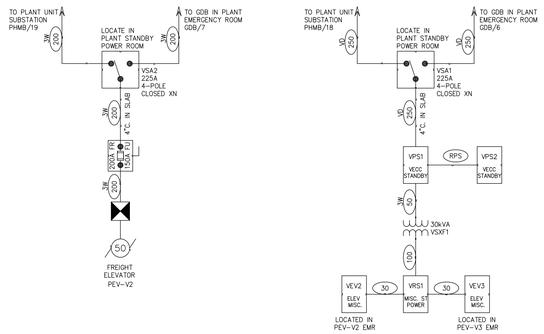
- TRANSFORMER
- CIRCUIT BREAKER — FRAME/TRIP; ST = SHUNT TRIP UNIT; GFI = GROUND FAULT UNIT
- FUSED SWITCH — SWITCH SIZE/FUSE RATING
- CT (METERING)
- SURGE PROTECTION DEVICE
- MOTOR STARTER OR CONTROLLER
- MOTOR (HORSEPOWER)
- LIGHTING/POWER PANEL
- LIGHTING PANEL WITH INTERNAL CONTACTOR
- GROUND PER N.E.C.
- UTILITY COMPANY REVENUE METER PAN AND METER
- ENCLOSED FUSED SWITCH
- ENCLOSED CIRCUIT BREAKER
- NETWORKED CUSTOMER METERING EQUIPMENT SEE 16410

CONDUCTOR & CONDUIT SCHEDULE

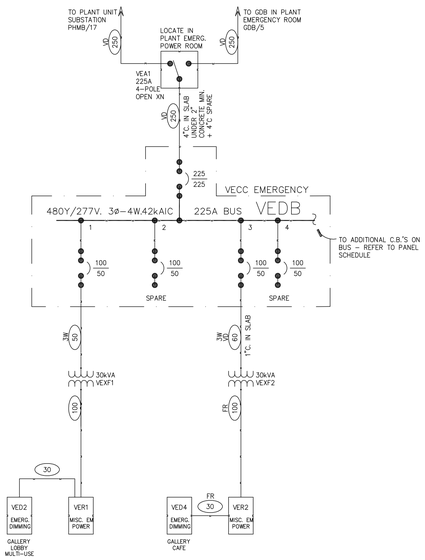
FEEDER SYMBOL	CONDUCTORS (3PH,4W) WITH GROUND	CONDUIT SIZE
RPS	REFER TO PANEL SCHEDULE	–
EXIST	EXISTING FEEDER	–
20	4#12 + 1#12 G	(1) 3/4"
30	4#10 + 1#10 G	(1) 3/4"
40	4#8 + 1#10 G	(1) 3/4"
50	4#6 + 1#10 G	(1) 1"
60	4#6 + 1#10 G	(1) 1"
70	4#4 + 1#8 G	(1) 1 1/4"
80	4#4 + 1#8 G	(1) 1 1/4"
100	4#2 + 1#8 G	(1) 1 1/4"
125	4#1 + 1#6 G	(1) 1 1/2"
150	4#1/0 + 1#6 G	(1) 2"
175	4#2/0 + 1#6 G	(1) 2"
200	4#3/0 + 1#6 G	(1) 2"
225	4#4/0 + 1#4 G	(1) 2 1/2"
250	4#250KCM + 1#4 G	(1) 2 1/2"
300	4#350KCM + 1#4 G	(1) 3"
350	4#500KCM + 1#2 G	(1) 3 1/2"
400	4#500KCM + 1#2 G	(1) 3 1/2"
420	4#600KCM + 1#2 G	(1) 4"
450	8#4/0 + 2#2 G	(2) 2 1/2"
500	8#250KCM + 2#2 G	(2) 2 1/2"
600	8#350KCM + 2#1 G	(2) 3"
700	8#500KCM + 2#1/0 G	(2) 3 1/2"
800	8#500KCM + 2#1/0 G	(2) 3 1/2"
840	8#600KCM + 2#2/0 G	(2) 4"
900	12#350KCM + 3#2/0 G	(3) 3"
1000	12#500KCM + 3#2/0 G	(3) 3 1/2"
1200	12#600KCM + 3#3/0 G	(3) 4"
1600	16#600KCM + 4#4/0 G	(4) 4"
2000	20#600KCM + 5#250KCM G	(5) 4"
3000	32#600KCM + 8#400KCM G	(8) 4"

NOTES:

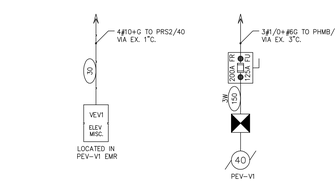
1. PROVIDE 4-WIRE CIRCUIT, UNLESS DEVICE SERVED DOES NOT HAVE PROVISIONS FOR A NEUTRAL CONNECTION.
2. ALL CONDUCTOR SIZES ARE FOR COPPER CONDUCTORS, WITH 90 DEGREE INSULATION RATING.
3. FOR AN OVERCURRENT PROTECTION DEVICE OF INTERMEDIATE RATING OF THOSE LISTED, PROVIDE WIRING INDICATED FOR THE NEXT HIGHER RATED DEVICE.
4. VD=FEEDER UPSIZED DUE TO VOLTAGE DROP 3W=3WIRE FEEDER (NO NEUTRAL) REQUIRED 5W=5WIRE FEEDER (2X NEUTRAL) REQUIRED FR=FIRE-RATED CABLE IN CONDUIT (260500)
5. FEEDERS ON TRANSFORMER SECONDARY SIDE SHALL CONTAIN SYSTEM BONDING JUMPER SIZED PER NEC 250-30(A)(1), & NEC TABLE 250-66.



3 VECC STANDBY POWER SINGLE LINE DIAGRAMS
V E1.01 SCALE: NONE



4 VECC EMERGENCY POWER SINGLE LINE DIAGRAM
V E1.01 SCALE: NONE



5 ELEVATOR PEV-V1 SINGLE LINE DIAGRAMS
V E1.01 SCALE: NONE

THE CLARK

Design Architect
TADAO ANDO ARCHITECTS AND ASSOCIATES
5-23 Toyosaki 2-Chome, Kita-Ku
Osaka, JAPAN 531-0072
Telephone (011) 81 (6) 6375-1148
Facsimile (011) 81 (6) 6374-6240

Architect of Record
GENSLER
1230 Avenue of the Americas, Suite 1500
New York, NY 10020
Telephone (212) 492-1400
Facsimile (212) 492-1472

Landscape Architect
REED HILDERBRAND ASSOCIATES, INC
741 Mt. Auburn Street
Watertown, MA 02472
Telephone (617) 923-2422
Facsimile (617) 923-3740

Consulting Architect
SKY DESIGN, INC
9520 Jefferson Blvd., Studio C
Culver City, CA 90232
Telephone (310) 839-5106
Facsimile (310) 839-5107

MEP Engineer
ALTIERI SEBOR WIEBER, LLC
31 Knight Street
Norwalk, CT 06851
Telephone (203) 866-5538
Facsimile (203) 866-5243

Structural Engineer
BURO HAPPOLD CONSULTING ENGINEERS, PC
100 Broadway, 23rd Floor
New York, NY 10005
Telephone (212) 334-2025
Facsimile (212) 334-5528

Consulting Engineers
ARUP
155 Avenue of the Americas
New York, NY 10013
Telephone (212) 229-2669
Facsimile (212) 229-1057

Civil Engineer
GUNTLOW & ASSOCIATES, INC
55 North Street
Williamstown, MA 01267
Telephone (413) 458-2198
Facsimile (413) 458-2712

Food Service Consultants
CLEVENGER FRABLE LAVALLEE
39 Westmoreland Avenue
White Plains, NY 10606
Telephone (914) 997-9660
Facsimile (914) 997-9671

Waterproofing Consultant
JAMES R. GAINFORT AIA CONSULTING ARCHITECTS PC
121 West 27th Street, Suite 803
New York, NY 10001
Telephone (212) 736-3344
Facsimile (212) 736-4466

Security Consultant
LAYNE CONSULTANTS INTERNATIONAL
1305 Krameria Street, Suite H-129
Denver, CO 80220
Telephone (303) 377-2176
Facsimile (303) 321-4988

Water Feature Consultant
DAN EUSER WATERARCHITECTURE, INC.
58 Major Mackenzie Dr. W.
Richmond Hill, Ontario L4C 3S2, CANADA
Telephone (905) 884-4176
Facsimile (905) 884-4079

Project Manager
RISE/ZUBATKIN
120 South LaSalle, Suite 1750
Chicago, IL 60603
Telephone (312) 917-1000
Facsimile (312) 917-1572

333 West 52nd Street, 6th Floor
and *New York, NY 10019*
Telephone (212) 271-4850
Facsimile (212) 271-4707

Issue	Date & Issue Description	By	Check
3/17/11	Bid Package 3		

Seal/Signature

Project Name
PHASE 2B: VISITOR, EXHIBITION, & CONFERENCE CENTER
STERLING & FRANCINE CLARK ART INSTITUTE
WILLIAMSTOWN, MASSACHUSETTS

Project Number
06.6714.000

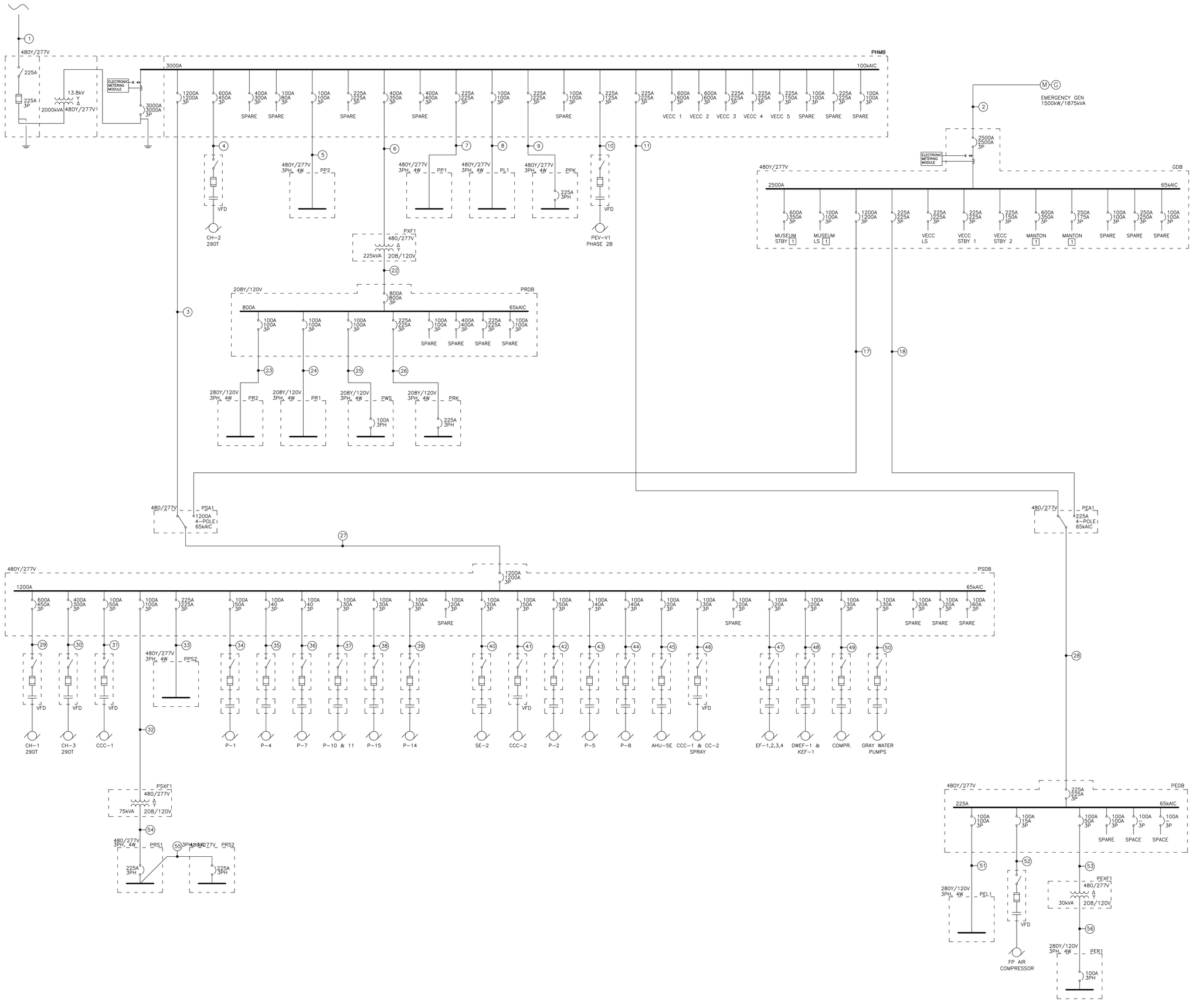
CAD File Name
0652.2EOPV

Description
SINGLE LINE DIAGRAMS

Scale
NONE

V E1.01

FILE:0652.1b REVISED7/2009 11:15
FILE:0652.2EOPV REVISED7/11 16:29
FILE:0652.1EOPV REVISED7/02 20:15



THE CLARK

Notes

1. The Plant serves the entire Clark campus. These portions of electrical power distribution system are outside the scope of this study

Revision	Date

Project

STERLING & FRANCINE CLARK ART INSTITUTE, 255 SOUTH STREET WILLIAMSTOWN MA

CAD File Name

single-line.dwg

Author

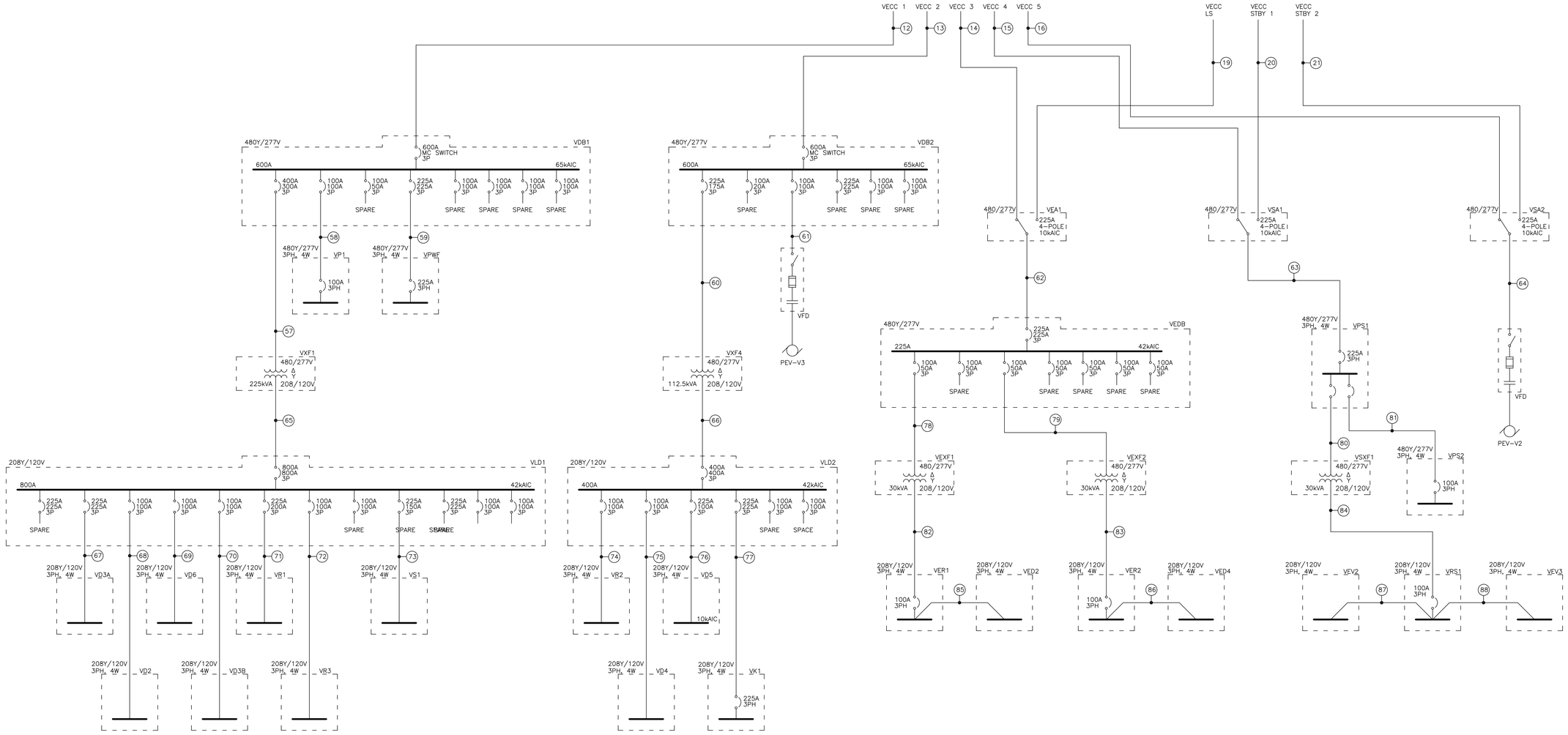
Asher Harder

Description

SINGLE-LINE DIAGRAM - PLANT

Scale

NONE



Feeder Schedule

Tag	From	To	No. of Sets	Conduit (Per Set) Size	Conduit (Per Set) Type	Conductors (Per Set) Phase Conductors No.	Phase Conductors Size	Phase Conductors Type	Neutral Conductors No.	Neutral Conductors Size	Neutral Conductors Type	Ground Conductors No.	Ground Conductors Size	Ground Conductors Type	Size of Overcurrent Protection	Frame or Switch Size	Remarks
1	CAMPUS	PHMB	2	5"	EMT	3	#4/0 AWG	AL-THWN	0	-		1	#4/0 AWG	CU-THWN	600	600	
2	GENERATOR	GDB	7	4"	EMT	21	500 KCM	CU-THWN	7	500 KCM	CU-THWN	7	350 KCM	CU-THWN	3000	3000	
3	PHMB	PSA1	3	4"	EMT	9	600 KCM	CU-THWN	3	600 KCM	CU-THWN	3	#3/0 AWG	CU-THWN	1200	1200	
4	PHMB	CH-2	2	2.5"	EMT	6	#4/0 AWG	CU-THWN	2	#4/0 AWG	CU-THWN	2	#2 AWG	CU-THWN	450	600	
5	PHMB	PP2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
6	PHMB	PXF1	1	3.5"	EMT	3	500 KCM	CU-THWN	0	-		1	#2 AWG	CU-THWN	350	400	
7	PHMB	PP1	1	2.5"	EMT	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
8	PHMB	PL1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
9	PHMB	PPK	1	2.5"	EMT	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
10	PHMB	PEV-V1	1	1.5"	EMT	3	#1 AWG	CU-THWN	1	#1 AWG	CU-THWN	1	#6 AWG	CU-THWN	125	225	
11	PHMB	PEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
12	PHMB	VEDB1	2	3"	EMT	6	350 KCM	CU-THWN	2	350 KCM	CU-THWN	2	#1 AWG	CU-THWN	600	600	
13	PHMB	VEDB2	2	3"	EMT	6	350 KCM	CU-THWN	2	350 KCM	CU-THWN	2	#1 AWG	CU-THWN	600	600	
14	PHMB	VEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
15	PHMB	VSA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
16	PHMB	VSA2	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	225	225	
17	GDB	PSA1	3	4"	EMT	9	600 KCM	CU-THWN	3	600 KCM	CU-THWN	3	#3/0 AWG	CU-THWN	1200	1200	
18	GDB	PEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
19	GDB	VEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
20	GDB	VSA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
21	GDB	VSA2	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	150	225	
22	PXF1	PRDB	2	3.5"	EMT	6	500 KCM	CU-THWN	2	500 KCM	CU-THWN	2	#1/0 AWG	CU-THWN	800	800	
23	PRDB	PR2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
24	PRDB	PR1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
25	PRDB	PWS	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
26	PRDB	PRK	1	2.5"	EMT	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
27	PSA1	PSDB	3	4"	EMT	9	600 KCM	CU-THWN	3	600 KCM	CU-THWN	3	#3/0 AWG	CU-THWN	1200	1200	
28	PEA1	PEDB	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
29	PSDB	CH-1	2	2.5"	EMT	6	#4/0 AWG	CU-THWN	0	-		2	#2 AWG	CU-THWN	450	600	
30	PSDB	CH-3	1	3"	EMT	3	350 KCM	CU-THWN	0	-		1	#4 AWG	CU-THWN	300	400	
31	PSDB	CCC-1	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	50	100	
32	PSDB	PSXF1	1	1.25"	EMT	3	#2 AWG	CU-THWN	0			1	#8 AWG	CU-THWN	100	100	
33	PSDB	PPS2	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
34	PSDB	P-1	1	1"	EMT	3	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#10 AWG	CU-THWN	50	100	
35	PSDB	P-4	1	0.75"	EMT	3	#8 AWG	CU-THWN	1	#8 AWG	CU-THWN	1	#10 AWG	CU-THWN	40	100	
36	PSDB	P-7	1	0.75"	EMT	3	#8 AWG	CU-THWN	1	#8 AWG	CU-THWN	1	#10 AWG	CU-THWN	40	100	
37	PSDB	P-10 & 11	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
38	PSDB	P-15	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
39	PSDB	P-14	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
40	PSDB	SE-2	1	0.75"	EMT	3	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	20	100	
41	PSDB	CCC-2	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	50	100	
42	PSDB	P-2	1	1"	EMT	3	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#10 AWG	CU-THWN	50	100	
43	PSDB	P-5	1	0.75"	EMT	3	#8 AWG	CU-THWN	1	#8 AWG	CU-THWN	1	#10 AWG	CU-THWN	40	100	
44	PSDB	P-8	1	0.75"	EMT	3	#8 AWG	CU-THWN	1	#8 AWG	CU-THWN	1	#10 AWG	CU-THWN	40	100	
45	PSDB	AHU-5E	1	0.75"	EMT	3	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	20	100	
46	PSDB	CCC-1 &CC-2 SPRAY	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
47	PSDB	EF-1,2,3,4	1	0.75"	EMT	3	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	20	100	
48	PSDB	DWEF-1 & KEF-1	1	0.75"	EMT	3	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	1	#12 AWG	CU-THWN	20	100	
49	PSDB	COMPR.	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
50	PSDB	GRAY WATER PUMP	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
51	PEDB	PEL1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
52	PEDB	FP AIR COMPR.	1	0.75"	EMT	3	#12 AWG	CU-THWN	0	-		1	#12 AWG	CU-THWN	15	100	
53	PEDB	PEXF1	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	50	100	
54	PSXF1	PRS1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
55	PRS1	PRS2	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
56	PEXF1	PER1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	

Notes:
1. Refer to single line diagram for feeder tags

AL=Aluminum
CU=Copper

Feeder Schedule

Tag	From	To	No. of Sets	Conduit (Per Set) Size	Conduit (Per Set) Type	Conductors (Per Set) Phase Conductors No.	Phase Conductors Size	Phase Conductors Type	Neutral Conductors No.	Neutral Conductors Size	Neutral Conductors Type	Ground Conductors No.	Ground Conductors Size	Ground Conductors Type	Size of Overcurrent Protection	Frame or Switch Size	Remarks
57	PHMB	VDB1	2	3"	EMT	6	350 KCM	CU-THWN	2	350 KCM	CU-THWN	2	#1 AWG	CU-THWN	600	600	
58	PHMB	VDB2	2	3"	EMT	6	350 KCM	CU-THWN	2	350 KCM	CU-THWN	2	#1 AWG	CU-THWN	600	600	
59	PHMB	VEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
60	PHMB	VSA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
61	PHMB	VSA2	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	200	225	
62	GDB	VEA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
63	GDB	VSA1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
64	GDB	VSA2	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	200	225	
65	VDB1	VXF1	1	3.5"	EMT	3	500 KCM	CU-THWN	0	-		1	#2 AWG	CU-THWN	350	400	
66	VDB1	VP1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
67	VDB1	VPWF	1	2.5"	EMT	3	#4/0 AWG	CU-THWN	1	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
68	VDB2	VXF4	1	2.5"	EMT	3	#4/0 AWG	CU-THWN	0	-			#4 AWG	CU-THWN	175	225	
69	VDB2	PEV-V3	1	1.25"	EMT	3	#2 AWG	CU-THWN	0	-		1	#8 AWG	CU-THWN	100	100	
70	VEA1	VED8	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
71	VSA1	VPS1	1	2.5"	EMT	3	250 KCM	CU-THWN	1	250 KCM	CU-THWN	1	#4 AWG	CU-THWN	225	225	
72	VSA2	PEV-V2	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	200	225	
73	VXF1	VLD1	2	3.5"	EMT	6	500 KCM	CU-THWN	2	500 KCM	CU-THWN	2	#1/0 AWG	CU-THWN	800	800	
74	VXF4	VLD2	1	3.5"	EMT	3	500 KCM	CU-THWN	1	500 KCM	CU-THWN	1	#2 AWG	CU-THWN	400	400	
75	VLD1	VD3A	1	2.5"	EMT	3	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
76	VLD1	VD2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
77	VLD1	VD6	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
78	VLD1	VD3B	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
79	VLD1	VR1	1	2"	EMT	3	#3/0 AWG	CU-THWN	1	#3/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	200	225	
80	VLD1	VR3	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
81	VLD1	VS1	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	150	225	
82	VLD2	VR2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
83	VLD2	VD4	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
84	VLD2	VD5	1	2"	EMT	3	#1/0 AWG	CU-THWN	1	#6 AWG	CU-THWN	1	#6 AWG	CU-THWN	150	225	
85	VLD2	VK1	1	2.5"	EMT	3	#4/0 AWG	CU-THWN		#4 AWG	CU-THWN		#4 AWG	CU-THWN	225	225	
86	VEDB	VEXF1	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	50	100	
87	VEDB	VEXF2	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	60	100	
88	VPS1	VSXF1	1	1"	EMT	3	#6 AWG	CU-THWN	0	-		1	#10 AWG	CU-THWN	50	100	
89	VPS1	VPS2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	50	100	
90	VEXF1	VER1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
91	VEXF2	VER2	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
92	VSXF1	VRS1	1	1.25"	EMT	3	#2 AWG	CU-THWN	1	#2 AWG	CU-THWN	1	#8 AWG	CU-THWN	100	100	
93	VER1	VED2	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
94	VER2	VED4	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
95	VRS1	VEV2	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	
96	VRS1	VEV3	1	0.75"	EMT	3	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	1	#10 AWG	CU-THWN	30	100	

Notes:
1. Refer to single-line diagram for feeder tags

AL=Aluminum
CU=Copper

THE CLARK

Notes

Revision	Date

Project
STERLING & FRANCINE CLARK ART INSTITUTE, 255 SOUTH STREET WILLIAMSTOWN MA

CAD File Name
single-line.dwg

Author
Asher Harder

Description
SINGLE-LINE DIAGRAM - VECC

Scale
NONE

Appendix B: HID catalog cuts

MASTERColour CDM-Tm Mini

MASTERColour CDM-Tm Mini 20W/830 PGJ5 1CT

Miniature, single-ended ceramic metal halide lampPGJ5 twist-lock lamp base

Product data

• General Characteristics

Cap-Base	PGJ5
Bulb	T3.5
Bulb Finish	Clear
Operating Position	any [Any or Universal (U)]
Life to 5% failures	9000 hr
Life to 10% failures	10000 hr
Life to 20% failures	11000 hr
Life to 50% failures	12000 hr

• Electrical Characteristics

System Power EL	24 W
Lamp Wattage	20 W
Lamp Wattage EL	22 W
Lamp Voltage	100 V
Lamp Current EL	0.220 A
Ignition Time	30 (max) s
Run-up time 90%	3 (max) min
Re-ignition Time [min]	15 (max) min
Dimmable	No

• Environmental Characteristics

Mercury (Hg) Content	2.4 mg

• Light Technical Characteristics

Color Code	830 [CCT of 3000K]
Color Rendering Index	82 (min), 85 (nom) Ra8
Color Designation (text)	Warm White
Color Temperature	3000 K
Color Temperature Technical	3020 K
Chromaticity Coordinate X	0.432 -
Chromaticity Coordinate Y	0.396 -
Luminous Flux Lamp EL	1650 Lm
Luminous Efficacy Lamp EL	75 Lm/W
Lumen Maintenance 2000h	75 %
Lumen Maintenance 5000h	65 %
Lumen Maintenance 10000h	60 %
Lumen Maintenance 1000h	80 %

• UV-related Characteristics

PET (NIOSH)	34 h.klx
Damage Factor D/fc	0.51 -

• Product Dimensions

Overall Length C	52 (max) mm
Diameter D	11.2 (max) mm
Light Center Length L	22.3 (min), 22.6 (nom), 22.9 (max) mm
Arc Length O	3 mm
Light Center Length L [inch]	0.87 in
Overall Length C [inch]	1.75 (max) in
Diameter D [inch]	0.44 in

MASTERColour CDM-Tm Mini

- Luminaire Design Requirements

Cap-Base Temperature	250 (max) C
Bulb Temperature	380 (max) C

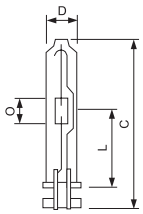
- Product Data

Order code	928087905130
Full product code	928087905130
Full product name	MASTERColour CDM-Tm Mini 20W/830 PGJ5 1CT
Order product name	MASTERC CDM-Tm Mini 20W/830 PGJ5 1CT/12
Pieces per pack	1
Packing configuration	12
Packs per outerbox	12
Bar code on pack - EAN1	8711500207517
Bar code on outerbox - EAN3	8711500207524
Logistic code(s) - 12NC	928087905130
ILCOS code	MC-20/30/1B-H-PGJ5
Net weight per piece	0.005 kg

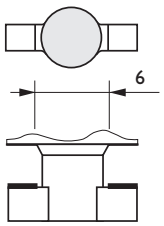
Warnings and Safety

- Use only in totally enclosed luminaire, even during testing (IEC61167, IEC 62035, IEC60598)
- The luminaire must be able to contain hot lamp parts if the lamp ruptures
- Use only with electronic control gear
- Control gear must include end-of-life protection (IEC61167, IEC 62035)
- For 20W PGJ5 lamp, use only Philips electronic control gear HID PV mini PGJ5 22W
- For 35W PGJ5 lamp, use only Philips electronic control gear HID PV mini 35W

Dimensional drawing

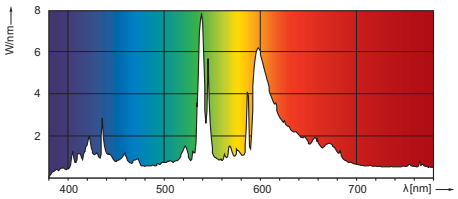


Product	C (Max)	D (Max)	L (Min)	L (Norm)	L (Max)	O (Min)	O (Norm)	O (Max)
CDM-Tm 20W/830 PGJ5	52	11.2	22.3	22.6	22.9	-	3	-



MASTERColour CDM-Tm Mini

Photometric data



MASTERColour CDM-Tm Mini /830 & /930

www.philips.com/lighting

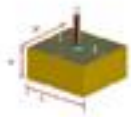
2011, August 31
data subject to change

GE Lighting

63042 - GEMH20-MSJ-MV

GE HID UltraMax™ eHID Electronic Low Frequency Ballast

- Superior low frequency square wave frequency design maximizes performance and life of ceramic metal halide lamps.
- Multi-Voltage Technology handles voltage from 120 to 277V
- Improves lumen maintenance vs magnetic
- Suitable for recessed use
- Lamp life 4x the life of halogen: 12K vs 3K
- 2% line regulation minimizes lamp to lamp color variation
- 15% Energy savings vs magnetic HID ballasts in retrofits
- Excellent color control with GE CMH & tight line regulation
- End-of-Lamp-Life Protection



GENERAL CHARACTERISTICS

Application	1-20W M156/C156 120/277V Low frequency Junction Box Mounting Bottom lead with studs Electronic HID
Category	High Intensity Discharge
Ballast Type	Electronic - Low Frequency
Line Voltage Regulation (+/-)	10.0 %
Ambient Temperature (MIN)	-20.0 °C
Ambient Temperature (MAX)	55.0 °C(13 °C)
Ballast Factor	Normal
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal Can
Primary Application	Indoor Floodlight

PRODUCT INFORMATION

Product Code	63042
Description	GEMH20-MSJ-MV
ANSI Code	C156/M156
Standard Package	Standard Pack
Standard Package GTIN	10043168630426
Sales Unit	Standard Pack
No Of Items Per Sales Unit	10
No Of Items Per Standard Package	10
UPC	043168630429

DIMENSIONS

Case dimensions	
Length (L)	3.3 in(83.06 mm)
Width (W)	3.0 in(75.95 mm)
Height (H)	1.6 in(39.62 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	NaN in(NaN mm)
Mount Width (X or F)	NaN in(NaN mm)
Mount Slots (MS)	NaN in(NaN mm)
Weight	1.1 lb
Exit Type	Bottom Leads with Studs
Remote Mounting Distance	2.0 m
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Bottom	6 (152mm)
Brown	1	Bottom	6 (152mm)
Green	1	Bottom	6 (152mm)
Red	1	Bottom	6 (152mm)
White	1	Bottom	6 (152mm)

ELECTRICAL CHARACTERISTICS

Lamp Operating Frequency	130.0 Hz
Supply Current Frequency	50.0 Hz/60.0 Hz

SAFETY & PERFORMANCE

- UL Type 1 Outdoor
- Inherent Thermal Protection
- Short Circuit Protection
- FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits
- ANSI - C82.14-2006
- UL 1029 Listed
- cUL Listed
- RoHs Compliant
- Suitable for recessed use

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
C156	1	120	23.0	0.21 AA	1.0	0.87	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	
C156	1	277	23.0	0.09 AA	1.0	0.87	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

MasterColor® CDM-T T6 Elite

MasterColor CDM-T Elite 35W/930 T6 1CT

The Elite family is at the very top of the MasterColor CDM range, and gives a unique combination of unbeatable light quality and consistent performance over lifetime, while keeping running costs low. MasterColor metal halide lamps deliver consistent white light and higher color rendering than any standard metal halide source for architectural lighting.

Product data

• General Characteristics

Base	G12
Bulb	T6 [Diameter: 6/8 inch /19mm]
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Avg. Hrs. Life	15000 hr
Life to 5% failures EL	9000 hr
Life to 20% failures EL	12000 hr
Life to 10% failures EL	10000 hr

• Light Technical Characteristics

Color Code	930 [CCT of 3000K]
Color Rendering Index	87 (min), 90 (nom) Ra8
Color Designation	Warm White
Color Temperature	3000 K
Color Temperature technical	2970 K
Chromaticity Coordinate X	0.435 -
Chromaticity Coordinate Y	0.395 -
Initial Lumens	3700 Lm
Initial Lumens	4000 Lm
Luminous Efficacy Lamp EM	98 Lm/W
Luminous Efficacy Lamp EL	102 Lm/W
Lumen Maintenance EL 2000h	94 %
Lumen Maintenance EL 5000h	88 %
Lumen Maintenance EL 10000h	83 %
Design Mean Lumens	3390 Lm
Lumen Maintenance EL 12000h	82 %

• Electrical Characteristics

System Power EL	43 W
Watts	35 W
Lamp Wattage	38 W
Lamp Wattage EL	39 W
Lamp Voltage	84 V
Lamp Current EM	0.500 A
Lamp Current EL	0.470 A
Ignition Time	30 (max) s
Run-up time 90%	3 (max) min
Re-ignition Time [min]	15 (max) min
Dimmable	No

• Environmental Characteristics

Mercury (Hg) Content	4.7 mg

• UV-related Characteristics

Damage Factor D/fc PET (NIOSH)	0.2 (nom), 0.3 (max) - 8 (min), 64 (nom) h500lx

• Luminaire Design Requirements

Cap-Base Temperature	250 (max) C
Pinch Temperature	350 (max) C
Bulb Temperature	500 (max) C

PHILIPS

sense and simplicity

MasterColor® CDM-T T6 Elite

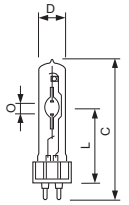
• Product Dimensions

Reference Length A	90 (max) mm
Overall Length C	103 (max) mm
Diameter D	20 (max) mm
Light Center Length L	55 (min), 56 (nom), 57 (max) mm
Arc Length O	4.8 mm
Light Center Length L	2.16 (min), 2.20 (nom), 2.24 (max) in
Max Overall Length (MOL) - C	4 (max) in
Diameter D	0.79 (max) in

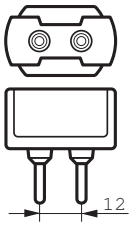
• Product Data

Product number	409144
Full product name	MasterColor CDM-T Elite 35W/930 T6 1CT
Short product name	CDM35/T6/930 ELITE 12PK
Pieces per Sku	1
eop_pck_cfg	12
Skus/Case	12
Bar code on pack	46677409142
Bar code on case	50046677409147
Logistics code(s)	928185205117
eop_net_weight_pp	0.028 kg

Dimensional drawing

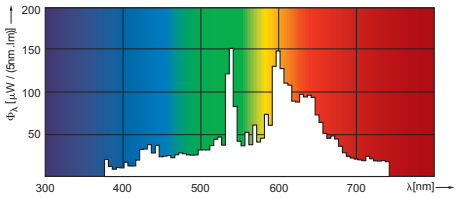


Product	C (Max)	D (Max)	L (Min)	L (Norm)	L (Max)	O (Norm)
CDM-T ACCENT 35W/930 G12	103	20	55	56	57	4.8



MasterColor® CDM-T T6 Elite

Photometric data



CDM-T Elite 35W /930

www.philips.com/lighting

2011, October 6
data subject to change

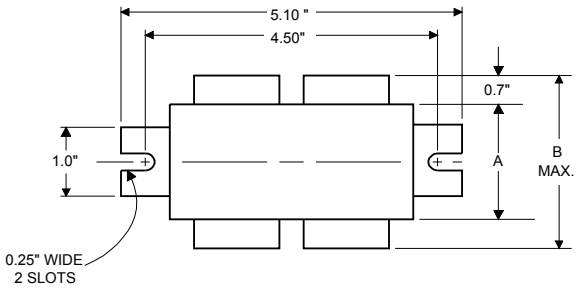
PHILIPS ADVANCE

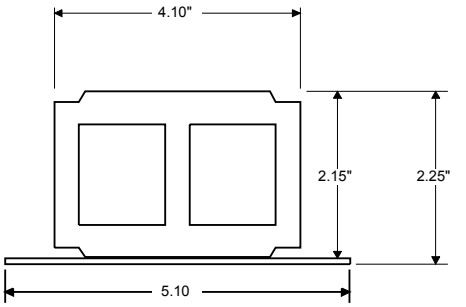
Metal Halide Lamp Ballast

Catalog Number 71A5005P
For 35/39W M130
60 Hz HX-HPF
Status: Active

DIMENSIONS AND DATA

2 X 4 CORE





INPUT VOLTS		120				
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.50				
Open Circuit		1.10				
Starting		0.45				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	230					
INPUT VOLTAGE AT LAMP DROPOUT		100				
INPUT WATTS	55					
RECOMMENDED FUSE (Amps)		3				
CORE and COIL						
Dimension (A)	0.83					
Dimension (B)	1.70					
Weight (lbs.)	2					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	28.0					
Volts (min.)	120					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	205-255					
Short-Circuit Current Test (Amps)	0.60-0.75					
Secondary Current						
Input Current		0.30-0.50	-	-	-	-

Capacitor: 7C280M12RA

Capacitance: 28
Dia/Oval Dim: 1.65
Height: 2.75
Temp Rating: 105°C

RoHS COMPLIANT

U.L. RECOGNIZED

Wiring Diagram:

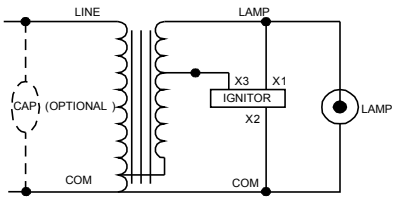


Fig. F

Ignitor: LI533-H4

Ballast to Lamp Distance (BTL) = 15 feet
Temp Rating: 105°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 07/31/09

MasterColor® CDM-T T6 Elite

MasterColor CDM-T Elite 70W/930 T6 1CT

The Elite family is at the very top of the MasterColor CDM range, and gives a unique combination of unbeatable light quality and consistent performance over lifetime, while keeping running costs low. MasterColor metal halide lamps deliver consistent white light and higher color rendering than any standard metal halide source for architectural lighting.

Product data

• General Characteristics

Base	G12
Bulb	T6 [Diameter: 6/8 inch /19mm]
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Avg. Hrs. Life	15000 hr
Life to 5% failures EL	9000 hr
Life to 20% failures EL	12000 hr
Life to 10% failures EL	10000 hr

• Light Technical Characteristics

Color Code	930 [CCT of 3000K]
Color Rendering Index	87 (min), 90 (nom) Ra8
Color Designation	Warm White
Color Temperature	3000 K
Color Temperature technical	2970 K
Chromaticity Coordinate X	0.435 -
Chromaticity Coordinate Y	0.396 -
Initial Lumens	7500 Lm
Initial Lumens	7750 Lm
Luminous Efficacy Lamp EM	103 Lm/W
Luminous Efficacy Lamp EL	106 Lm/W
Lumen Maintenance EL 2000h	94 %
Lumen Maintenance EL 5000h	88 %
Lumen Maintenance EL 10000h	83 %
Design Mean Lumens	6730 Lm
Lumen Maintenance EL 12000h	82 %

• Electrical Characteristics

System Power EL	80 W
Watts	70 W
Lamp Wattage	72 W
Lamp Wattage EL	73 W
Lamp Voltage	84 V
Lamp Current EM	1 A
Lamp Current EL	0.89 A
Ignition Time	30 (max) s
Run-up time 90%	3 (max) min
Re-ignition Time [min]	15 (max) min
Dimmable	No

• Environmental Characteristics

Mercury (Hg) Content	6.6 mg

• UV-related Characteristics

Damage Factor D/fc PET (NIOSH)	0.2 (nom), 0.3 (max) - 8 (min), 64 (nom) h500lx

• Luminaire Design Requirements

Cap-Base Temperature	250 (max) C
Pinch Temperature	350 (max) C
Bulb Temperature	500 (max) C

PHILIPS

sense and simplicity

MasterColor® CDM-T T6 Elite

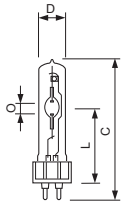
• Product Dimensions

Reference Length A	90 (max) mm
Overall Length C	103 (max) mm
Diameter D	20 (max) mm
Light Center Length L	55 (min), 56 (nom), 57 (max) mm
Arc Length O	7.15 mm
Light Center Length L	2.16 (min), 2.20 (nom), 2.24 (max) in
Max Overall Length (MOL) - C	4 (max) in
Diameter D	0.79 (max) in

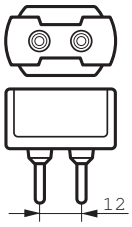
• Product Data

Product number	409151
Full product name	MasterColor CDM-T Elite 70W/930 T6 1CT
Short product name	CDM70/T6/930 ELITE 12PK
Pieces per Sku	1
eop_pck_cfg	12
Skus/Case	12
Bar code on pack	46677409159
Bar code on case	50046677409154
Logistics code(s)	928185305117
eop_net_weight_pp	0.029 kg

Dimensional drawing

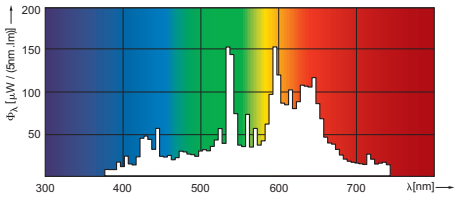


Product	C (Max)	D (Max)	L (Min)	L (Norm)	L (Max)	O (Norm)
CDM-T ACCENT 70W/930 G12	103	20	55	56	57	7.15



MasterColor® CDM-T T6 Elite

Photometric data



CDM-T Elite 70W /930

www.philips.com/lighting

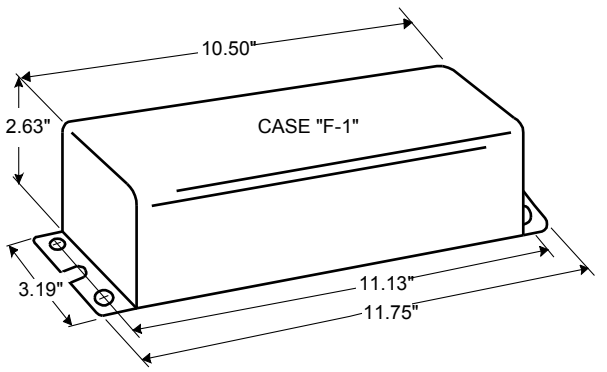
2011, October 6
data subject to change

PHILIPS ADVANCE

Metal Halide Lamp Ballast

Catalog Number 72C5281
For 70W M139
60 Hz HX-HPF
Status: Active

DIMENSIONS AND DATA



INPUT VOLTS		120	277			
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.85	0.37			
Open Circuit		1.70	0.75			
Starting		1.00	0.45			
UL TEMPERATURE RATINGS						
Insulation Class	A (105°C)					
Coil Temperature Code	1029	A	A			
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	240					
INPUT VOLTAGE AT LAMP DROPOUT		100	225			
INPUT WATTS	94					
RECOMMENDED FUSE (Amps)		5	2			
CORE and COIL						
Dimension (A)						
Dimension (B)	8.5					
Weight (lbs.)	12"					
Lead Lengths						
CAPACITOR REQUIREMENT						
Microfarads						
Volts (min.)						
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	1500					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	215-265					
Short-Circuit Current Test (Amps)	1.05-1.35					
Secondary Current						
Input Current		0.60-1.10	0.25-0.50	-	-	-

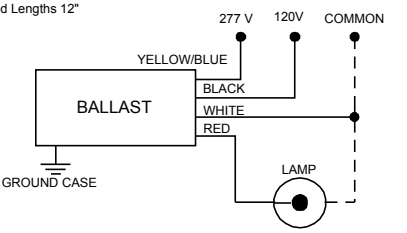
Capacitor:

The capacitor is included as part of the potted assembly.

RoHS COMPLIANT

Wiring Diagram:

All Lead Lengths 12"



F-Can Wiring Diagram

Ignitor: IN CAN

The ignitor is included as part of the potted assembly.

Ballast to Lamp Distance (BTL) = 5 feet
Temp Rating: 90°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 10/11/99

Philips MasterColor®
Ceramic Metal Halide
3000K Tubular
Single-Ended T4 Lamps

Ideal for retail display lighting, and accent lighting

MasterColor CDM

A compact solution for retail displays

Philips MasterColor® 3000K Tubular Single-Ended T4 Lamps are compact, energy efficient, ceramic metal halide lamps that provide crisp, sparkling light.

Excellent color
- 81–85 CRI (color rendering index)
- Color stability over life within ± 200K
- Lamp to lamp color consistency over life

Total cost of ownership benefits
- High lamp efficacy (up to 92 LPW)
- Energy-efficient alternative to incandescent/halogen
- Improved lumen maintenance over standard metal halide

Application versatility
- Universal operating position
- Compact lamp dimensions for high beam intensities

FadeBlock™
- Lamps feature integrated UV blocking medium for reduced fading of fabrics and paintings

PHILIPS
sense and simplicity

Philips MasterColor® Ceramic Metal Halide 3000K Tubular Single-Ended T4 Lamps

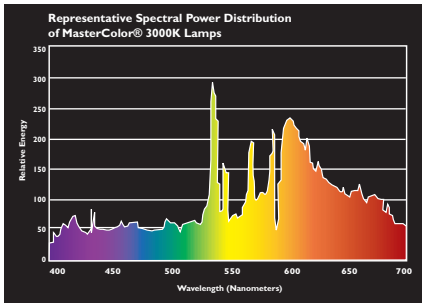
MasterColor CDM

Ordering Data (Subject to change without notice)

Product Number	Ordering Code	Pkg. Qty.	Nom. Watts	ANSI Ballast Code	Approx. Initial Lumens[1]	Approx. Mean Lumens[2]	CRI
40493-9	CDM20/TC/830	12	22	C156/C175/E	1650	1175	85
37372-0	CDM35/TC/830	12	39	C130/E	3300	2300	81
37373-8	CDM70/TC/830	12	70	C139/E	6400	4500	83

Electrical and Technical Data

Lamp Operating Voltage (rms)(Nominal)[3] —100 (22W)
—88 (39W)
—83 (70W)
Initial Lamp Voltage Range (rms)[4] —80-100
Lamp Operating
Current (Amps) Nominal (rms) —0.22 (22W)
—0.53 (39W)
—0.98 (70W)
Lamp Current Crest Factor (Maximum)—1.8
Warm-up to 80% Full Brightness —3 minutes
Restrike Time for Hot Lamps — 4–8 minutes
Ballast Open Circuit Voltage —250 RMS Min.(22W)
—209 RMS Min.(39W)
—198 RMS Min.(70W)
Pulse Peak Volts —3000-4000
Pulse Width @ 90% Peak —2 Micro Sec. Minimum
Pulse Repetition Rate (Minimum)[5]—1 per Half Cycle
Minimum Operating Temp. — -30°C (-22°F)



Physical Characteristics

Bulb Size —T-4
Bulb Finish —Clear
Base —G-8.5 Bi-Pin
Max. Overall Length (MOL) —3.35" (85mm)
Light Center Length (LCL)—2.0" (52mm)
Arc Length —0.1" (3mm)(22W)
—0.2" (5mm)(39W)
—0.28" (7mm)(70W)
Arc Tube Material —Polycrystalline Alumina
Max. Bulb Temp. —320°C (608°F)(22W)
—500°C (932°F)(39W)
—550°C (1022°F)(70W)
Max. Pinch Temp. —300°C (572°F)
Max. Arc Tube to Base Eccentricity—3°

Operating Characteristics

Rated Average Life, Hours.[6] —12,000
Correlated Color Temp. (CCT)[2] —3000K
CIE Chromaticity Approx.[2] —x-.430, y-.385 (22W)
—x-.432, y-.394 (39W)
—x-.434, y-.398 (70W)
Efficacy (lpw)—75 (22W)
—85 (39W)
—92 (70W)

Operating Position

Universal-Enclosed Luminaires Only

Note: Use on thermally protected electronic ballast only.

1) Measured at 100 hrs. life. Approximate lumen values listed are for vertical operation of the lamp.
2) Approximate lumen output at 40% of lamp rated average life.
3) Measured at rated lamp watts on a linear reactor. LPW does not include ballast losses.
4) Measured with the lamp operating at rated watts.
5) Option-Pulse Width @ 90% Peak, 1 micro second minimum with 2 pulses per half cycle.
6) Rated average life is the life obtained, on the average, from large representative groups of lamps in laboratory tests under controlled conditions at 10 or more operating hours per start. It is based on survival of at least 50% of the lamps and allows for individual lamps or groups of lamps to vary considerably from the average.

WARNINGS, CAUTIONS AND OPERATING INSTRUCTIONS for MasterColor® Ceramic Metal Halide Lamps: Single-Ended CDM-T G12, CDM-TCG8.5 (Universal); Double-Ended CDM-TD RX7 (Horizontal ± 45°, Enclosed Fixtures Only)

R "**WARNING:** These lamps can cause serious skin burn and eye inflammation from short wave ultraviolet radiation if outer envelope of the lamp is broken or punctured. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available." This lamp complies with FDA radiation performance standard 21 CFR subchapter J. (USA:21CFR 1040.30 Canada:SOR/DORS/80-381)

If the outer bulb is broken or punctured, turn off at once and replace the lamp to avoid possible injury from hazardous short wave ultraviolet radiation. Do not scratch the outer bulb or subject it to pressure as this could cause the outer bulb to crack or shatter. A partial vacuum in the outer bulb may cause glass to fly if the envelope is struck.

WARNING: The arc-tube of metal halide lamps are designed to operate under high pressure and at temperatures up to 1000° C and can unexpectedly rupture due to internal or external factors such as a ballast failure or misapplication If the arc-tube ruptures for any reason, the outer bulb may break and pieces of extremely hot glass might be discharged into the surrounding environment. If such a rupture were to happen, **THERE IS A RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE.**

Certain lamps that will retain all the glass particles should inner arc-tube rupture occur are commercially available from Philips Lighting Company.

RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.

This lamp contains an arc tube with a filling gas containing less than 10 nCi of Kr-85 and is distributed by Philips Lighting Company, a division of Philips Electronics North America Corporation, Somerset, New Jersey, 08875.

CAUTION: TO REDUCE THE RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE RESULTING FROM AN ARC-TUBE RUPTURE THE FOLLOWING **LAMP OPERATING INSTRUCTIONS** MUST BE FOLLOWED:

LAMP OPERATING INSTRUCTIONS:

1. RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.
2. Use only in fully enclosed fixtures capable of withstanding particles of glass having temperatures up to 1000° C. Lens/diffuser material must be heat resistant. Consult fixture manufacturer regarding the suitability of the fixture for this lamp.
3. Do not operate a fixture with a missing or broken lens/diffuser.
4. Operate lamp only within specified limits of operating position.
5. Before lamp installation/replacement, shut power off and allow lamp and fixture to cool to avoid electrical shock and potential burn hazards.
6. Use only auxiliary equipment meeting Philips and/or ANSI standards. Use within voltage limits recommended by ballast manufacturer.
   A. Operate lamp only within specified limits of operation.
   B. For total supply load refer to ballast manufacturers electrical data.
   C. Operate CDM-T (G12 base) lamps only on thermally protected ballasts.
   D. Operate CDM-TC lamps (G8.5 base)only on thermally protected electronic ballasts
   E. Operate CDM-T (G12 base) 39W/842 lamps only on thermallly protected electronic ballasts
7. Periodically inspect the outer envelope. Replace any lamps that show scratches, cracks or damage.
8. If a lamp bulb support is used, be sure to insulate the support electrically to avoid possible decomposition of the bulb glass.
9. Protect lamp base, socket and wiring against moisture, corrosive atmospheres and excessive heat.
10. Time should be allowed for lamps to stabilize in color when turned on for the first time. This may require several hours of operation, with more than one start. Lamp color is also subject to change under conditions of excess vibration or shock and color appearance may vary between individual lamps.
11. Lamps may require 4 to 8 minutes to re-light if there is a power interruption.
12. Take care in handling and disposing of lamps. If an arc tube is broken, avoid skin contact with any of the contents or fragments.

Printed in USA 2/09

P-5575-E

www. philips.com

Philips Lighting Company
200 Franklin Square Drive
P.O. Box 6800
Somerset, NJ 08875-6800
1-800-555-0050
A Division of Philips Electronics North America Corporation

Philips Lighting
281 Hillmount Road
Markham, Ontario
Canada L6C 2S3
1-800-555-0050
A Division of Philips Electronics Ltd.

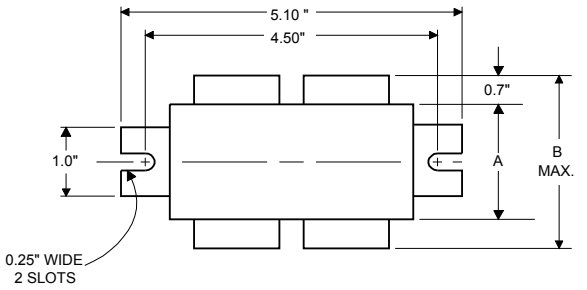
PHILIPS ADVANCE

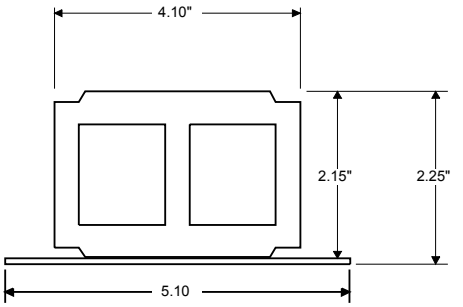
Metal Halide Lamp Ballast

Catalog Number 71A5005P
For 35/39W M130
60 Hz HX-HPF
Status: Active

DIMENSIONS AND DATA

2 X 4 CORE





INPUT VOLTS		120				
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.50				
Open Circuit		1.10				
Starting		0.45				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	230					
INPUT VOLTAGE AT LAMP DROPOUT		100				
INPUT WATTS	55					
RECOMMENDED FUSE (Amps)		3				
CORE and COIL						
Dimension (A)	0.83					
Dimension (B)	1.70					
Weight (lbs.)	2					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	28.0					
Volts (min.)	120					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	205-255					
Short-Circuit Current Test (Amps)						
Secondary Current	0.60-0.75					
Input Current		0.30-0.50	-	-	-	-

Capacitor: 7C280M12RA

Capacitance: 28
Dia/Oval Dim: 1.65
Height: 2.75
Temp Rating: 105°C

RoHS COMPLIANT

U.L. RECOGNIZED

Wiring Diagram:

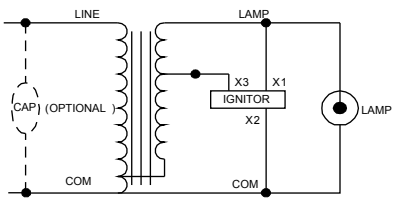


Fig. F

Ignitor: LI533-H4

Red (X1)
White (X2)
Blue (X3)

Ballast to Lamp Distance (BTL) = 15 feet
Temp Rating: 105°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

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

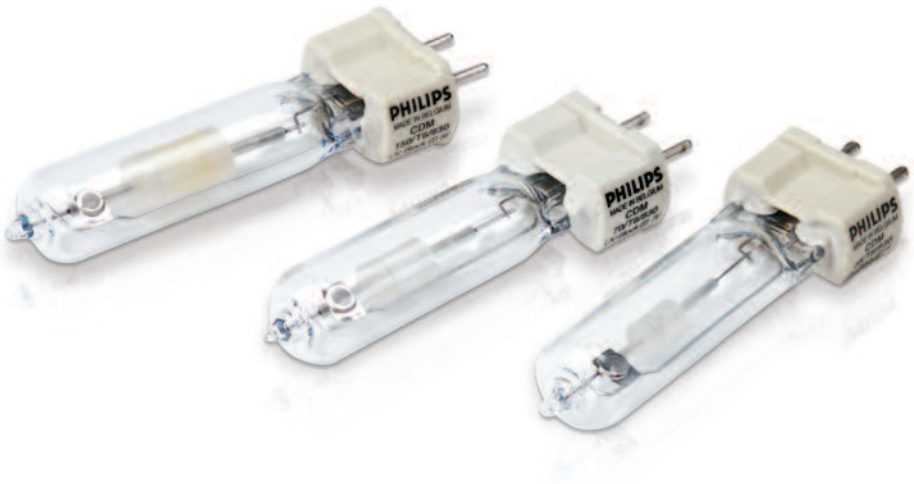
PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 07/31/09

Philips MasterColor®
Ceramic Metal Halide
3000K Tubular
Single-Ended T6 Lamps

Ideal for retail display lighting, general and indirect lighting, wall washing and fiberoptic systems

MasterColor® CDM



A compact solution for retail displays

The Philips MasterColor® 3000K Tubular Single-Ended T6 lamp is a compact, energy efficient, ceramic metal halide lamp that provides crisp, sparkling light.

Excellent color
- 81-85 CRI (color rendering index)
- Color stability over life within ± 200K
- Lamp to lamp color consistency over life

Total cost of ownership benefits
- High lamp efficacy (up to 94 LPW)
- Energy-efficient alternative to incandescent/halogen
- Improved lumen maintenance over standard metal halide

Application versatility
- Universal burning position
- Compact lamp dimensions for high beam intensities

FadeBlock™
- Lamps feature integrated UV blocking medium for reduced fading of fabrics and paintings

PHILIPS
sense and simplicity

Philips MasterColor® Elite Ceramic Metal Halide 3000K Tubular Single-Ended T6 Lamps

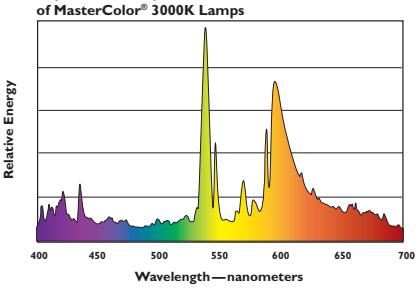
Ordering Data (Subject to change without notice)

Product Number	Ordering Code	Pkg. Qty.	Nom. Watt.	ANSI Ballast Code	Approx. Initial Lumens[1]	Approx. Mean Lumens[2]	CRI
40642-1	CDM20/T6/830	12	22	M156/175/E	1650	1175	85
22328-9	CDM35/T6/830	12	39	M130/E	3300	2600	81
22337-0	CDM70/T6/830	12	70	M139/E	6600	4950	81
23272-8	CDM150/T6/830	12	150	M142, M102/E	14,000	9800	85

Electrical and Technical Data

Lamp Operating Volt. (rms)(Nom.)[3] ——— 100 (22W)
88 (39W/70W)
96 (150W)
Initial Lamp Volt. Range (rms)[4] ——— 95-108 (22W)
85-105 (39W/150W)
80-100 (70W)
Lamp Operating
Current (Amps) Nominal (rms) ——— 0.22 (22W)
0.53 (39W)
0.98 (70W)
1.8 (150W)
Lamp Current Crest Factor (Maximum) ——— 1.8
Warm-up to 80% Full Brightness ——— 2 minutes
Restrike Time for Hot Lamps ——— 4–8 minutes
Ballast Open Circuit Voltage ——— 198 RMS Min.
Pulse Peak Volts ——— 3000-4000
Pulse Width @ 90% Peak ——— 2 Micro Sec. Minimum
Pulse Repetition Rate (Minimum)[5] ——— 2 per Half Cycle
Minimum Operating Temp. ——— -30˚C (-22˚F)

Representative Spectral Power Distribution of MasterColor® 3000K Lamps



Physical Characteristics

Bulb Size ——— T-6
Bulb Finish ——— Clear
Base ——— G-12 Bi-Pin
Max. Overall Length (MOL) –3 15/16" (22W/39W/70W)
4 1/32" (150W)
Light Center Length (LCL) ——— 2 7/32"
Arc Length ——— 0.2" (5mm)(22W/39W)
0.275" (7mm) (70W)
0.354" (9mm) (150W)
Max. Bulb Temp. —— 500˚C (932˚F) (22W/39W/70W)
650˚C (1202˚F) (150W)
Max. Base Temp. —— 280˚C (536˚F) (22W/39W/70W)
250˚C (482˚F) (150W)
Arc Tube Material ——— Poly Crystalline Alumina
Max Bulb to Base Eccentricity ——— 3˚
Max. Arc Tube to Base Eccentricity ——— 3˚

Operating Characteristics

Rated Average Life, Hours.[6] ——— 12,000
Correlated Color Temp. (CCT)[2] ——— 3000K
CIE Chromaticity Approx.[2] ——— x-.431 y-.388 (22W)
x-.428 y-.397 (39W)
x-.428 y-.394 (70W)
x-.435 y-.400 (150W)
Efficacy (lpw) ——— 75 (22W)
87 (39W)
94 (70W)
93 (150W)

Operating Position

Universal-Enclosed Luminaires Only

1) Measured at 100 hrs. life. Approximate lumen values listed are for vertical operation of the lamp.
2) Approximate lumen output at 40% of lamp rated average life.
3) Measured at rated lamp watts on a linear reactor. LPW does not include ballast losses.
4) Measured with the lamp operating at rated watts.
5) Option-Pulse Width @ 90% Peak, 1 micro second minimum with 2 pulses per half cycle.
6) Rated average life is the life obtained, on the average, from large representative groups of lamps in laboratory tests under controlled conditions at 10 or more operating hours per start. It is based on survival of at least 50% of the lamps and allows for individual lamps or groups of lamps to vary considerably from the average.

MasterColor® CDM

WARNINGS, CAUTIONS AND OPERATING INSTRUCTIONS for MasterColor® Ceramic Metal Halide Lamps: Single-Ended CDM-T G12, CDM-TC G8.5 (Universal); Double-Ended CDM-TD RX7 (Horizontal ± 45°, Enclosed Fixtures Only)

R "**WARNING:** These lamps can cause serious skin burn and eye inflammation from short wave ultraviolet radiation if outer envelope of the lamp is broken or punctured. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available." This lamp complies with FDA radiation performance standard 21 CFR subchapter J. (USA:21CFR 1040.30 Canada:SOR/DORS/80-381)

If the outer bulb is broken or punctured, turn off at once and replace the lamp to avoid possible injury from hazardous short wave ultraviolet radiation. Do not scratch the outer bulb or subject it to pressure as this could cause the outer bulb to crack or shatter. A partial vacuum in the outer bulb may cause glass to fly if the envelope is struck.

WARNING: The arc-tube of metal halide lamps are designed to operate under high pressure and at temperatures up to 1000° C and can unexpectedly rupture due to internal or external factors such as a ballast failure or misapplication If the arc-tube ruptures for any reason, the outer bulb may break and pieces of extremely hot glass might be discharged into the surrounding environment. If such a rupture were to happen, **THERE IS A RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE. Certain lamps that will retain all the glass particles should inner arc-tube rupture occur are commercially available from Philips Lighting Company.**

RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.

This lamp contains an arc tube with a filling gas containing less than 10 nCi of Kr-85 and is distributed by Philips Lighting Company, a division of Philips Electronics North America Corporation, Somerset, New Jersey, 08875.

CAUTION: TO REDUCE THE RISK OF PERSONAL INJURY, PROPERTY DAMAGE, BURNS AND FIRE RESULTING FROM AN ARC-TUBE RUPTURE THE FOLLOWING **LAMP OPERATING INSTRUCTIONS** MUST BE FOLLOWED:

LAMP OPERATING INSTRUCTIONS:

1. RELAMP FIXTURES AT OR BEFORE THE END OF RATED LIFE. Allowing lamps to operate until they fail is not advised and may increase the possibility of inner arc tube rupture.
2. Use only in fully enclosed fixtures capable of withstanding particles of glass having temperatures up to 1000° C. Lens/diffuser material must be heat resistant. Consult fixture manufacturer regarding the suitability of the fixture for this lamp.
3. Do not operate a fixture with a missing or broken lens/diffuser.
4. Operate lamp only within specified limits of operating position.
5. Before lamp installation/replacement, shut power off and allow lamp and fixture to cool to avoid electrical shock and potential burn hazards.
6. Use only auxiliary equipment meeting Philips and/or ANSI standards. Use within voltage limits recommended by ballast manufacturer.
   A. Operate lamp only within specified limits of operation.
   B. For total supply load refer to ballast manufacturers electrical data.
   C. Operate CDM-T (G12 base) lamps only on thermally protected ballasts.
   D. Operate CDM-TC lamps (G8.5 base) only on thermally protected electronic ballasts.
   E. Operate CDM-T (G12 base) 39W/842 lamps only on thermally protected electronic ballasts.
7. Periodically inspect the outer envelope. Replace any lamps that show scratches, cracks or damage.
8. If a lamp bulb support is used, be sure to insulate the support electrically to avoid possible decomposition of the bulb glass.
9. Protect lamp base, socket and wiring against moisture, corrosive atmospheres and excessive heat.
10. Time should be allowed for lamps to stabilize in color when turned on for the first time. This may require several hours of operation, with more than one start. Lamp color is also subject to change under conditions of excess vibration or shock and color appearance may vary between individual lamps.
11. Lamps may require 4 to 8 minutes to re-light if there is a power interruption.
12. Take care in handling and disposing of lamps. If an arc tube is broken, avoid skin contact with any of the contents or fragments.

PHILIPS

Printed in USA 06/09

P-5434-D

www.philips.com

Philips Lighting Company
200 Franklin Square Drive
P.O. Box 6800
Somerset, NJ 08875-6800
1-800-555-0050
A Division of Philips Electronics North America Corporation

Philips Lighting
281 Hillmount Road
Markham, Ontario
Canada L6C 2S3
1-800-555-0050
A Division of Philips Electronics Ltd.

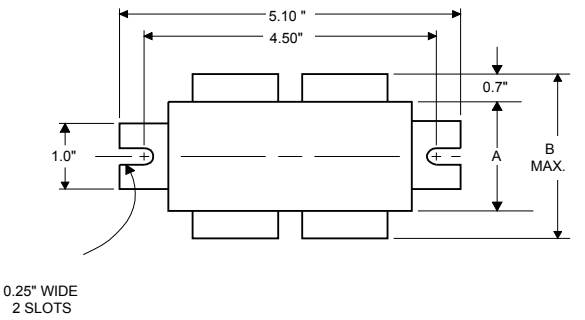
PHILIPS ADVANCE

Metal Halide Lamp Ballast

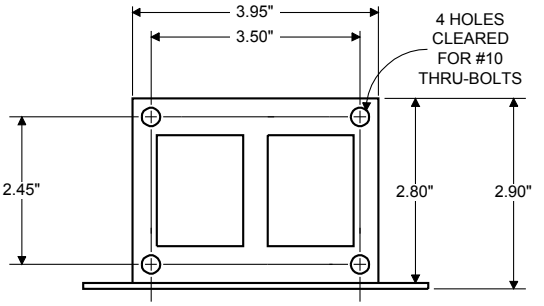
Catalog Number 71A54A3
For 150W M102
60 Hz SUPER-CWA
Status: Active

DIMENSIONS AND DATA

3 X 4 CORE - 2 COIL UNIT



0.25" WIDE
2 SLOTS



INPUT VOLTS		120	277	347		
CIRCUIT TYPE	SUPER-CWA					
POWER FACTOR (min)	85%					
REGULATION						
Line Volts	±10%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		1.75	0.76	0.62		
Open Circuit		1.40	0.60	0.48		
Starting		0.95	0.40	0.30		
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	C	B	A		
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	187					
INPUT VOLTAGE AT LAMP DROPOUT		90	210	260		
INPUT WATTS	189					
RECOMMENDED FUSE (Amps)		5	2	2		
CORE and COIL						
Dimension (A)	2.65					
Dimension (B)	3.95					
Weight (lbs.)	8.5					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	22.0					
Volts (min.)	240					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	175-205					
Short-Circuit Current Test (Amps)						
Secondary Current	2.40-2.90					
Input Current		0.45-0.75	0.20-0.40	0.15-0.35	-	-

Capacitor: 7C220M24RA

Capacitance: 22
Dia/Oval Dim: 1.65
Height: 2.75
Temp Rating: 105°C

RoHS COMPLIANT

U.L. RECOGNIZED

Wiring Diagram:

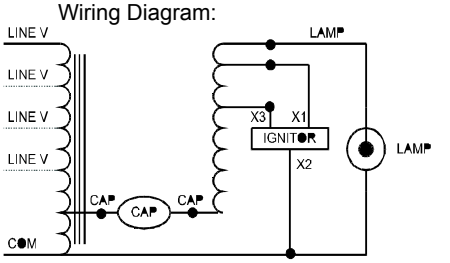


Fig. L1

Ignitor: LI501-J4

Red (X1)
White (X2)
Blue (X3)

Ballast to Lamp Distance (BTL) = 15 feet
Temp Rating: 105°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

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

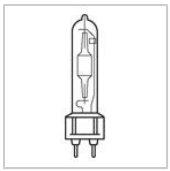
PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

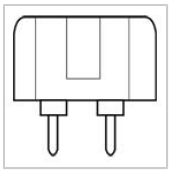
Revised: 07/31/09

GE Lighting

29703 - CMH20T/U/830/G12

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4.5





GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4.5
Base	Bi-Pin (G12)
Rated Life	12000.0 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	184 picograms Hg per mean lumen hour
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1650.0
Mean Lumens	1090.0
Nominal Initial Lumens per Watt	82
Color Temperature	3000.0 K
Color Rendering Index (CRI)	81.0

ELECTRICAL CHARACTERISTICS

Wattage	20.0
Burn Position	Universal burning position
Warm Up Time to 90% (MAX)	2.0 min
Hot Restart Time to 90% (MIN)	10.0 min
Hot Restart Time to 90% (MAX)	15.0 min

DIMENSIONS

Maximum Overall Length (MOL)	3.5600 in(90.4 mm)
Light Center Length (LCL)	2.180 in(55.4 mm)

PRODUCT INFORMATION

Product Code	29703
Description	CMH20T/U/830/G12
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168297032
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168297035

CAUTIONS & WARNINGS

Caution

- Lamp may shatter and cause injury if broken
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use fused or thermally protected ballast - see instructions.
  - Use in fixture rated for this product.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.

NOTES

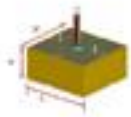
- Use only with low frequency square wave (LFSW) electronic ballast.

GE Lighting

63042 - GEMH20-MSJ-MV

GE HID UltraMax™ eHID Electronic Low Frequency Ballast

- Superior low frequency square wave frequency design maximizes performance and life of ceramic metal halide lamps.
- Multi-Voltage Technology handles voltage from 120 to 277V
- Improves lumen maintenance vs magnetic
- Suitable for recessed use
- Lamp life 4x the life of halogen: 12K vs 3K
- 2% line regulation minimizes lamp to lamp color variation
- 15% Energy savings vs magnetic HID ballasts in retrofits
- Excellent color control with GE CMH & tight line regulation
- End-of-Lamp-Life Protection



GENERAL CHARACTERISTICS

Application	1-20W M156/C156 120/277V Low frequency Junction Box Mounting Bottom lead with studs Electronic HID
Category	High Intensity Discharge
Ballast Type	Electronic - Low Frequency
Line Voltage Regulation (+/-)	10.0 %
Ambient Temperature (MIN)	-20.0 °C
Ambient Temperature (MAX)	55.0 °C(13 °C)
Ballast Factor	Normal
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal Can
Primary Application	Indoor Floodlight

PRODUCT INFORMATION

Product Code	63042
Description	GEMH20-MSJ-MV
ANSI Code	C156/M156
Standard Package	Standard Pack
Standard Package GTIN	10043168630426
Sales Unit	Standard Pack
No Of Items Per Sales Unit	10
No Of Items Per Standard Package	10
UPC	043168630429

DIMENSIONS

Case dimensions	
Length (L)	3.3 in(83.06 mm)
Width (W)	3.0 in(75.95 mm)
Height (H)	1.6 in(39.62 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	NaN in(NaN mm)
Mount Width (X or F)	NaN in(NaN mm)
Mount Slots (MS)	NaN in(NaN mm)
Weight	1.1 lb
Exit Type	Bottom Leads with Studs
Remote Mounting Distance	2.0 m
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Bottom	6 (152mm)
Brown	1	Bottom	6 (152mm)
Green	1	Bottom	6 (152mm)
Red	1	Bottom	6 (152mm)
White	1	Bottom	6 (152mm)

ELECTRICAL CHARACTERISTICS

Lamp Operating Frequency	130.0 Hz
Supply Current Frequency	50.0 Hz/60.0 Hz

SAFETY & PERFORMANCE

- UL Type 1 Outdoor
- Inherent Thermal Protection
- Short Circuit Protection
- FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits
- ANSI - C82.14-2006
- UL 1029 Listed
- cUL Listed
- RoHs Compliant
- Suitable for recessed use

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
C156	1	120	23.0	0.21 AA	1.0	0.87	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	
C156	1	277	23.0	0.09 AA	1.0	0.87	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	

WARRANTY INFORMATION

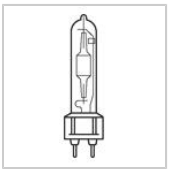
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

GE Lighting

20153 - CMH39TUVCU830G12

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4.5

Photo Not Available



GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4.5
Base	Bi-Pin (G12)
Rated Life	16500.0 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	127 picograms Hg per mean lumen hour
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3400.0
Mean Lumens	2300.0
Nominal Initial Lumens per Watt	87
Color Temperature	3000.0 K
Color Rendering Index (CRI)	84.0

ELECTRICAL CHARACTERISTICS

Wattage	39.0
Burn Position	Universal burning position
Warm Up Time to 90% (MAX)	2.0 min
Warm Up Time to 90%	2.0 min
Hot Restart Time to 90% (MIN)	10.0 min
Hot Restart Time to 90% (MAX)	15.0 min

DIMENSIONS

Maximum Overall Length (MOL)	3.5600 in(90.4 mm)
Light Center Length (LCL)	2.180 in(55.4 mm)

PRODUCT INFORMATION

Product Code	20153
Description	CMH39TUVCU830G12
ANSI Code	C130/M130
Standard Package	Case
Standard Package GTIN	10043168201534
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168201537

CAUTIONS & WARNINGS

Caution

- Lamp may shatter and cause injury if broken
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use fused or thermally protected ballast - see instructions.
  - Use in fixture rated for this product.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.

NOTES

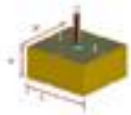
- Rated life is 15,000 hours on magnetic ballasts.

GE Lighting

63044 - GEMH39-MSJ-MV

GE HID UltraMax™ eHID Electronic Low Frequency Ballast

- Superior low frequency square wave frequency design maximizes performance and life of ceramic metal halide lamps.
- 15% Energy savings vs magnetic HID ballasts in retrofits
- Lamp life 4x the life of halogen: 12K vs 3K
- Improves lumen maintenance vs magnetic
- Excellent color control with GE CMH & tight line regulation
- 2% line regulation minimizes lamp to lamp color variation
- End-of-Lamp-Life Protection
- Multi-Voltage Technology handles voltage from 120 to 277V



GENERAL CHARACTERISTICS

Application	1-39W M130/C130 120/277V Low Frequency Junction Box Mounting Bottom Lead with Studs Electronic HID
Category	High Intensity Discharge
Ballast Type	Electronic - Low Frequency
Line Voltage Regulation (+/-)	10.0 %
Ambient Temperature (MIN)	-20.0 °C
Ambient Temperature (MAX)	55.0 °C(13 °C)
Ballast Factor	Normal
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal Can
Primary Application	Indoor Floodlight

PRODUCT INFORMATION

Product Code	63044
Description	GEMH39-MSJ-MV
ANSI Code	M130/C130
Standard Package	Standard Pack
Standard Package GTIN	10043168630440
Sales Unit	Standard Pack
No Of Items Per Sales Unit	10
No Of Items Per Standard Package	10
UPC	043168630443

DIMENSIONS

Case dimensions	
Length (L)	3.3 in(83.06 mm)
Width (W)	3.0 in(75.95 mm)
Height (H)	1.6 in(39.62 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	NaN in(NaN mm)
Mount Width (X or F)	NaN in(NaN mm)
Mount Slots (MS)	NaN in(NaN mm)
Weight	1.1 lb
Exit Type	Bottom Leads with Studs
Remote Mounting Distance	2.0 m
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Bottom	6 (152mm)
Brown	1	Bottom	6 (152mm)
Green	1	Bottom	6 (152mm)
Red	1	Bottom	6 (152mm)
White	1	Bottom	6 (152mm)

ELECTRICAL CHARACTERISTICS

Lamp Operating Frequency	130.0 Hz
Supply Current Frequency	50.0 Hz/60.0 Hz

SAFETY & PERFORMANCE

- UL Type 1 Outdoor
- cUL Listed
- RoHs Compliant
- UL 1029 Listed
- Suitable for recessed use
- FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits
- ANSI - C82.14-2006
- Short Circuit Protection
- Inherent Thermal Protection

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
M130	1	120	44.0	0.17 AA	1.0	0.886	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	
M130	1	277	45.0	0.39 AA	1.0	0.867	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	
C130	1	120	44.0	0.17 AA	1.0	0.886	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	
C130	1	277	45.0	0.39 AA	1.0	0.867	NaNA		NaNV	NaNV	0.95	-20.0 °C°F	1.25	

WARRANTY INFORMATION

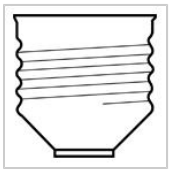
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

GE Lighting

31069 - CMH70U830MED/O

GE Protected ConstantColor® PulseArc® CMH® Ceramic Metal Halide ED17

Photo Not Available



CAUTIONS & WARNINGS

Caution

- Lamp may shatter and cause injury if broken
  - Dispose of lamp in a closed container.
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not store flammable materials near/below lamp.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use only properly rated ballast.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use in fixture rated for this product.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	ED17
Base	Medium Screw (E26)
Bulb Finish	Clear
Rated Life	15000.0 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Open or enclosed fixtures
LEED-EB MR Credit	94 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	5700.0
Mean Lumens	4100.0
Nominal Initial Lumens per Watt	81
Color Temperature	3000.0 K
Color Rendering Index (CRI)	80.0
Effective Arc Length	0.28125 cm

ELECTRICAL CHARACTERISTICS

Wattage	70.0
Burn Position	Universal burning position
Warm Up Time to 90% (MIN)	2.0 min
Warm Up Time to 90% (MAX)	5.0 min
Hot Restart Time to 90%	15.0 min

DIMENSIONS

Maximum Overall Length (MOL)	5.4300 in(137.9 mm)
Nominal Length	5.430 in(137.9 mm)
Bulb Diameter (DIA)	2.125 in(54.0 mm)
Light Center Length (LCL)	3.370 in(85.6 mm)

PRODUCT INFORMATION

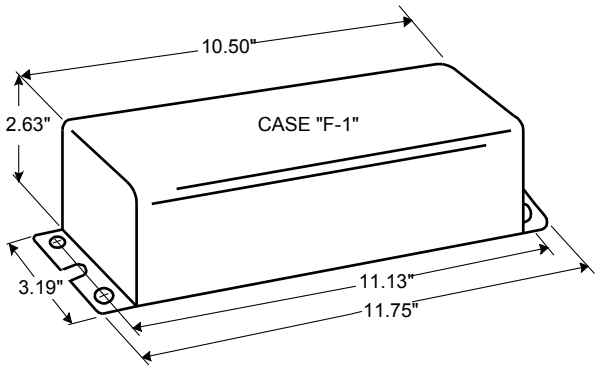
Product Code	31069
Description	CMH70U830MED/O
ANSI Code	C98/M143/M98
Standard Package	Case
Standard Package GTIN	10043168310694
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168310697

PHILIPS ADVANCE

Metal Halide Lamp Ballast

Catalog Number 72C5281
For 70W M139
60 Hz HX-HPF
Status: Active

DIMENSIONS AND DATA



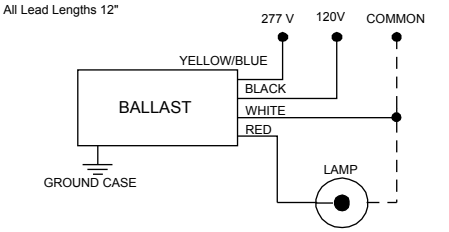
INPUT VOLTS		120	277			
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.85	0.37			
Open Circuit		1.70	0.75			
Starting		1.00	0.45			
UL TEMPERATURE RATINGS						
Insulation Class	A (105°C)					
Coil Temperature Code	1029	A	A			
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	240					
INPUT VOLTAGE AT LAMP DROPOUT		100	225			
INPUT WATTS	94					
RECOMMENDED FUSE (Amps)		5	2			
CORE and COIL						
Dimension (A)						
Dimension (B)						
Weight (lbs.)	8.5					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads						
Volts (min.)						
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	1500					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	215-265					
Short-Circuit Current Test (Amps)						
Secondary Current	1.05-1.35					
Input Current		0.60-1.10	0.25-0.50	-	-	-

Capacitor:

The capacitor is included as part of the potted assembly.

RoHS COMPLIANT

Wiring Diagram:



F-Can Wiring Diagram

Ignitor: IN CAN

The ignitor is included as part of the potted assembly.

Ballast to Lamp Distance (BTL) = 5 feet
Temp Rating: 90°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

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

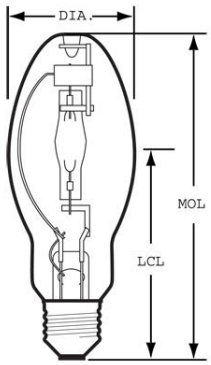
PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

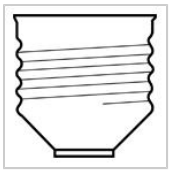
Revised: 10/11/99

GE Lighting

12594 - MVR70/C/U/MED

GE Multi-Vapor® PulseArc® Quartz Metal Halide BD17





CAUTIONS & WARNINGS

Caution

- Lamp may shatter and cause injury if broken
  - Dispose of lamp in a closed container.
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn lamp off at least once for 15 minutes per week.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use in fixture rated for this product.

GRAPHS & CHARTS

Graphs_Spectral Power Distribution

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Quartz Metal Halide
Bulb	BD17
Base	Medium Screw (E26)
Bulb Finish	Coated
Rated Life	12000.0 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	146 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	5250.0
Mean Lumens	2800.0
Nominal Initial Lumens per Watt	75
Color Temperature	4000.0 K
Color Rendering Index (CRI)	70.0

ELECTRICAL CHARACTERISTICS

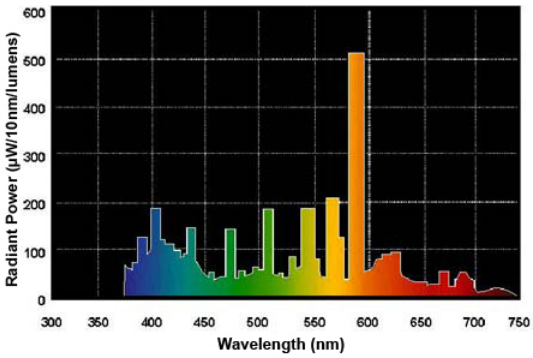
Wattage	70.0
Voltage	85.0
Burn Position	Universal burning position
Open Circuit Voltage (peak lead ballast) (MIN)	332.0 V
Open Circuit Voltage (RMS lag ballast) (MIN)	235.0 V
Warm Up Time to 90% (MIN)	2.0 min
Warm Up Time to 90% (MAX)	5.0 min
Hot Restart Time to 90% (MIN)	10.0 min
Hot Restart Time to 90% (MAX)	15.0 min

DIMENSIONS

Maximum Overall Length (MOL)	5.43 cm
Nominal Length	5.43 cm
Bulb Diameter (DIA)	2.125 cm
Light Center Length (LCL)	3.43 cm

PRODUCT INFORMATION

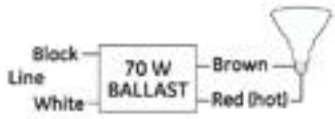
Product Code	12594
Description	MVR70/C/U/MED
ANSI Code	M98
Standard Package	Case
Standard Package GTIN	10043168125946
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168125949


Radiant Power (µW/10nm/lumens)
600
500
400
300
200
100
0
300
350
400
450
500
550
600
650
700
750
Wavelength (nm)

GE Lighting

87531 - GEMH70-MSF-120

GE HID UltraMax™ eHID Electronic Low Frequency Ballast



GENERAL CHARACTERISTICS

Category	High Intensity Discharge
Ballast Type	Electronic - Low Frequency
Line Voltage Regulation (+/-)	10.0 %
Ambient Temperature (MAX)	55.0 °C(13 °C)
Case Temperature (MAX)	90.0 °C
Ballast Factor	Normal
Sound Rating	A (20-24 decibels)
Enclosure Type	Plastic
Distance to Lamp (MAX)	8.0 ft
Additional Info	End of Life Protection (EOL)/ Thermally protected

PRODUCT INFORMATION

Product Code	87531
Description	GEMH70-MSF-120
Standard Package	Case
Standard Package GTIN	10043168875315
Standard Package Quantity	10
Sales Unit	Case
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168875318

DIMENSIONS

Case dimensions	
Length (L)	3.7 in(95.00 mm)
Width (W)	3.0 in(75.69 mm)
Height (H)	1.2 in(30.73 mm)
Mounting dimensions	
Bracket Length (BL)	NaN in(NaN mm)
Mount Length (M)	3.4 in(86.11 mm)
Mount Width (X or F)	2.5 in(63.75 mm)
Mount Slots (MS)	0.2 in(4.32 mm)
Weight	0.38 lb
Exit Type	Side
Remote Mounting Distance	8.0 ft
Remote Mounting Wire Gauge	18.0 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left	10.0 (254mm)
Red	1	Right	10.0 (254mm)
White	1	Left	10.0 (254mm)
Brown	1	Right	10.0 (254mm)

ELECTRICAL CHARACTERISTICS

Lamp Operating Frequency	130.0 Hz

SAFETY & PERFORMANCE

- ANSI - C62.41
- cUL Listed
- FCC - CLASS A Non-Consumer
- UL Listed
- UL Type 1 Outdoor
- RoHs Compliant
- Housing meets UL94V0 flame retardant
- UL 1029 Listed
- Suitable for recessed use

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
M98	1	120	77.0	0.68 AA	1.0	0.909					0.99	0.0 °F°F	3.0	
M143	1	120	77.0	0.68 AA	1.0	0.909					0.99	0.0 °F°F	3.0	

NOTES

- 200C rated lead wires
- Do not connect brown or red wires to ground

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.