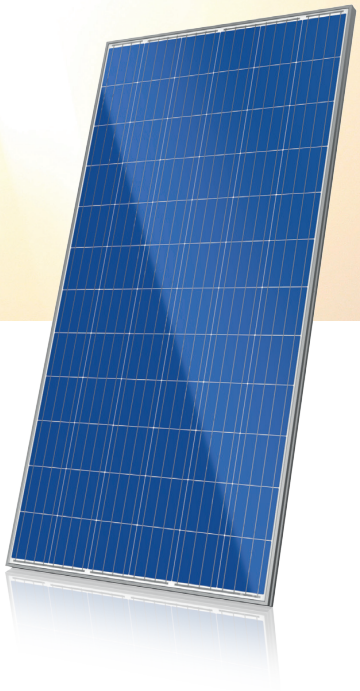
Attachment C

CanadianSolar



MAX POWER CS6X-300 | 305 | 310P

High quality and reliability in all Canadian Solar modules is ensured by 13 years' experience in module manufacturing, well-engineered module design, stringent BOM quality testing, an automated manufacturing process and 100 % EL testing.

KEY FEATURES

- Excellent module efficiency up to 16.16 %
- Outstanding low irradiance performance > 96.0 %
- +5Wp — Positive power tolerance up to 5 W
- No. 1 PTC — High PTC rating up to 91.94 %
- IP67 — IP67 junction box for long-term weather endurance
- Heavy snow load up to 5400 Pa wind load up to 2400 Pa
- Salt mist, ammonia and blown sand resistance, for seaside, farm and desert environments

25 years — insurance-backed warranty
non-cancellable, immediate warranty insurance
linear power output warranty

10 years — product warranty on materials and workmanship

MANAGEMENT SYSTEM CERTIFICATES

ISO 9001: 2008 / Quality management system
ISO/TS 16949: 2009 / The automotive industry quality management system
ISO 14001: 2004 / Standards for environmental management system
OHSAS 18001: 2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES

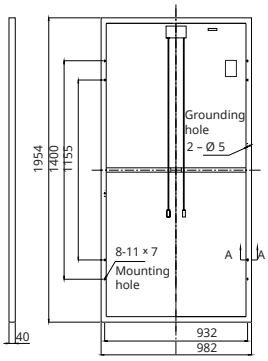
IEC 61215 / IEC 61730: VDE / MCS / CE / SII / KEMCO / CEC AU / CQC / INMETRO
UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)
UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: TUV / IEC 60068-2-68: SGS
PV CYCLE (EU) / UNI 9177 Reaction to Fire: Class 1

CANADIAN SOLAR INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading manufacturer of solar modules and PV project developer with about 8 GW of premium quality modules deployed around the world since 2001, Canadian Solar Inc. (NAS–DAQ: CSIQ) is one of the most bankable solar companies worldwide.

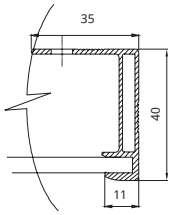
CANADIAN SOLAR INC.
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

MODULE / ENGINEERING DRAWING (mm)

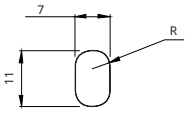
Rear View



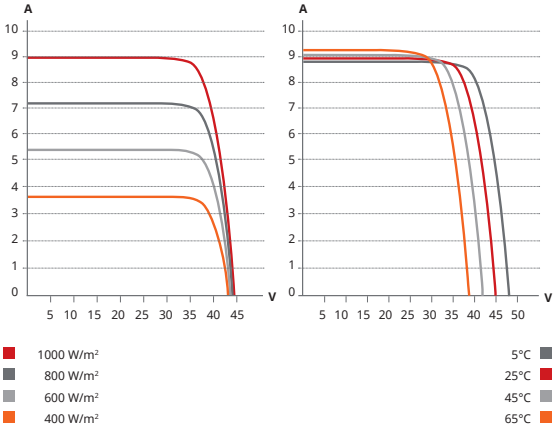
Frame Cross Section A-A



Mounting Hole



CS6X-305P / I-V CURVES



ELECTRICAL DATA / STC*

Electrical Data CS6X	300P	305P	310P
Nominal Max. Power (Pmax)	300 W	305 W	310 W
Opt. Operating Voltage (Vmp)	36.1 V	36.3 V	36.4 A
Opt. Operating Current (Imp)	8.30 A	8.41 A	8.52 A
Open Circuit Voltage (Voc)	44.6 V	44.8 V	44.9 V
Short Circuit Current (Isc)	8.87 A	8.97 A	9.08 A
Module Efficiency	15.63%	15.90%	16.16%
Operating Temperature	-40°C ~ +85°C		
Max. System Voltage	1000 V (IEC) or 1000 V (UL) or 600 V (UL)		
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC61730)		
Max. Series Fuse Rating	15 A		
Application Classification	Class A		
Power Tolerance	0 ~ + 5 W		

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C.

ELECTRICAL DATA / NOCT*

Electrical Data CS6X	300P	305P	310P
Nominal Max. Power (Pmax)	218 W	221 W	225 W
Opt. Operating Voltage (Vmp)	32.9 V	33.1 V	33.2 V
Opt. Operating Current (Imp)	6.61 A	6.68 A	6.77 A
Open Circuit Voltage (Voc)	41.0 V	41.2 V	41.3 V
Short Circuit Current (Isc)	7.19 A	7.27 A	7.36 A

* Under Nominal Operating Cell Temperature (NOCT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

PERFORMANCE AT LOW IRRADIANCE

Industry leading performance at low irradiation, +96.5 % module efficiency from an irradiance of 1000 W/m² to 200 W/m² (AM 1.5, 25°C).

As there are different certification requirements in different markets, please contact your sales representative for the specific certificates applicable to your products. The specification and key features described in this Datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, Canadian Solar Inc. reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.

MODULE / MECHANICAL DATA

Specification	Data
Cell Type	Poly-crystalline, 6 inch
Cell Arrangement	72 (6 × 12)
Dimensions	1954×982×40 mm (76.93×38.7×1.57 in)
Weight	22 kg (48.5 lbs)
Front Cover	3.2 mm tempered glass
Frame Material	Anodized aluminium alloy
J-BOX	IP67, 3 diodes
Cable	4 mm² (IEC) or 4 mm² & 12 AWG 1000 V (UL 1000 V) or 12 AWG (UL 600 V), 1150 mm or 1300 mm**
Connectors	MC4 or MC4 comparable
Stand. Packaging	24 pcs, 608 kg (quantity & weight per pallet)
Module Pieces per Container	528 pcs (40'HQ)

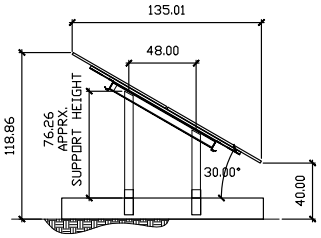
** The CS6X with cable of 1300 mm is only for Canadian market.

TEMPERATURE CHARACTERISTICS

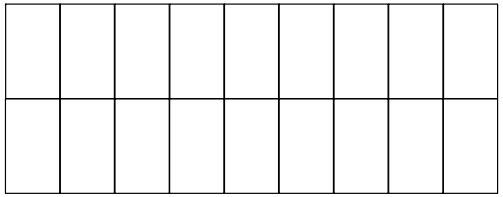
Specification	Data
Temperature Coefficient (Pmax)	-0.43 % / °C
Temperature Coefficient (Voc)	-0.34 % / °C
Temperature Coefficient (Isc)	0.065 % / °C
Nominal Operating Cell Temperature	45±2°C

PARTNER SECTION

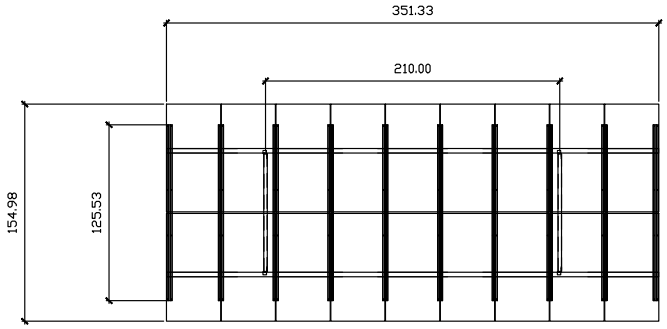
Caution: Please read safety and installation instructions before using the product.



ELEVATION VIEW



PLAN VIEW



PRELIMINARY DESIGN: NOT FOR CONSTRUCTION

PROJECTED VIEW

CUSTOMER: ADVANCED SOLAR PRODUCTS	QUOTE #: F150604A
ARRAY SIZE: 2x9 B3P-X	DRAWN BY: Wisjr
PANEL TYPE: CANADIAN SOLAR CS6X-315P	DATE: 06/11/2015

Economic

- Highest power density
- Market leading efficiency
- Provides ancillary services with Q-on-Demand
- Reduce installation and transportation costs with up to four inverters in a standard shipping container on a flat-bed truck

Robust

- Proven and intelligent precision air-cooling technology
- Durably built for outdoor installation in harsh environmental conditions
- Robust and redundant fiber optic communication network configurations

Flexible

- Operation up to 1,000 V DC
- Highest DC:AC design ratio in the industry
- Nominal power operation from -25°C to 50°C

Highly integrated

- Area for customer SCADA equipment
- Integrated zone monitoring
- LOTO DC and AC disconnects
- On-board 120V AC Power Outlet

SUNNY CENTRAL 1850-US

The new Sunny Central: maximum power density and integration

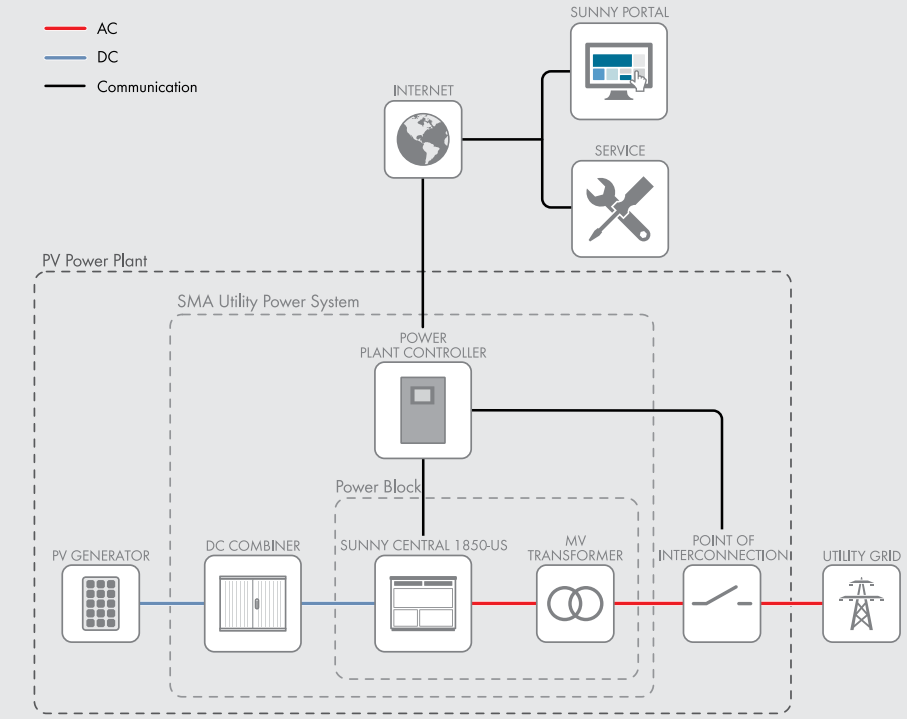
The Sunny Central 1850-US inverter (1,850 kVA and 1,666 kW of fixed active power across the entire temperature range) minimizes the total installed cost while maximizing the energy production of the photovoltaic power plant. This unique inverter is ideal for 5MW projects, providing full PV plant capacity with only three units, while still providing VAR support. Integrated control power, convenience power, network switch and optional NEC 2014 compliant DC recombiner and disconnect dramatically increase the speed to energization. The new Sunny Central can connect to virtually any grid in the harshest conditions. It is suitable for global outdoor installation with its proven OptiCool™ precision air cooling technology.

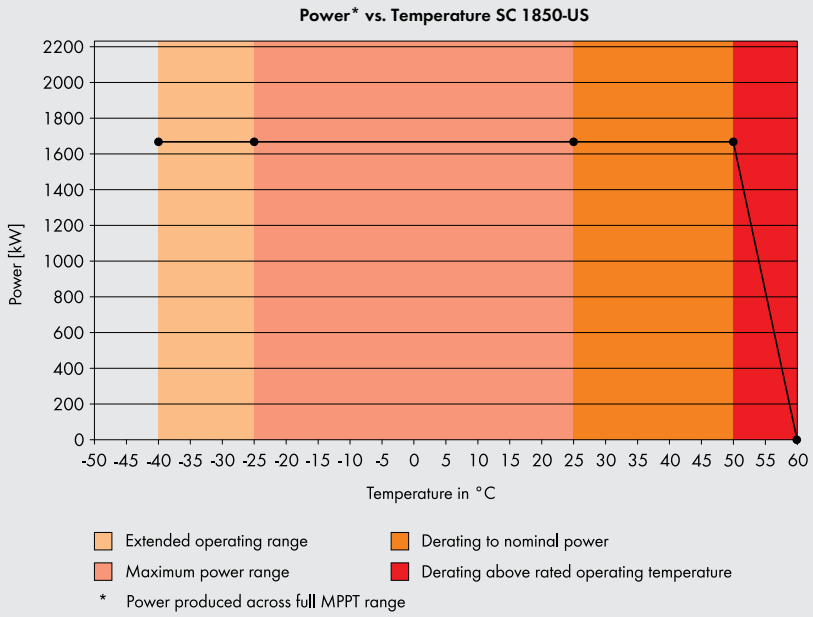
SUNNY CENTRAL 1850-US

Technical Data	SC 1850-US
Input (DC)	
MPP voltage range V_{DC} [2]	570 V to 950 V
Max. open circuit and operating voltage $V_{DC, max}$	1,000 V
Max operating DC current $I_{DC, max}$ (@ 25°C / @ 50°C)	4,110 A / 3,960 A
Number of DC inputs (24/28/32) [3]	● / ○ / ○
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm[4]
Integrated zone monitoring (shunt resistors)	○
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A
Output (AC)	
Nominal AC power (@ 25°C / @ 40°C / @ 50°C)	1,850 kVA / 1,850 kVA / 1,850 kVA
Nominal AC power at cos ϕ =0.9 (@ 25°C / @ 40°C / @ 50°C) [5]	1,666 kW / 1,666 kW / 1,666 kW
Max AC output current	3,300 A
Nominal AC current $I_{AC\ max}$ (1,850 kVA / 1,666 kW)	2,774 A / 2,498 A
Max. total harmonic distortion	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range (line-to-line)	385 V / 308 V to 462 V
AC power frequency	50 Hz, 60 Hz
Power factor at rated power / displacement power factor adjustable	1 / 0.8 leading to 0.8 lagging
Efficiency [1]	
Max. efficiency / European weighted efficiency / CEC weighted efficiency [4]	98.6% / 98.3% / 98%
Protection and Disconnection Devices	
Input-side disconnection point	DC load-break switch
Output-side disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type II
Ground-fault monitoring / remote ground-fault monitoring	○ / ○
Insulation monitoring	○
Degree of protection (as per IEC 60529)	IP54
Degree of protection (as per NEMA)	3R
General Data	
Dimensions (W / H / D)	2,780 / 2,318 / 1,588 mm (109.4 / 91.3 / 62.5 inch)
Weight	< 4,000 kg (8,819 lb)
Max. self-consumption (operation) / self-consumption (stand-by)	< 8,100 W / < 300 W
Internal control power supply	Integrated 8.4 kVA transformer
Operating temperature range [5]	-25°C to 60°C / -13°F to 140°F
Extended operating temperature range	○ (-40°C to 60°C / -40°F to 140°F)
Temperature range (stand-by)	-40°C to 60°C / -40°F to 140°F
Temperature range (storage)	-40°C to 70°C / -40°F to 158°F
Max. permissible value for relative humidity (condensing)	0% to 100%
Maximum operating altitude above MSL 2000m (6562 ft) / 4000m (13123 ft)	● / ○ (with temperature derating)
Fresh air consumption	3,826 cfm / 6,500 m³/h
Features	
DC connection	Terminal lug on each input with NEMA lug hole pattern
AC connection	With busbar system (three busbars, one per line conductor)
Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Enclosure / roof color	RAL 9016 / RAL 7004
Display	HMI touchscreen (10.1")
Convenience power supply transformer	○ (2.5 kVA)
Certificates and approvals	UL 1741, UL 1998, UL 840 Category IV, EMC FCC Part 15 Class A, IEEE 1547, CE
● Standard feature ○ Optional feature	
Type designation	SC-1850-US-10

1) Preliminary values
2) At unity power factor
3) Ungrounded systems available with 24 inputs only
4) CEC efficiency includes all control power
5) Power derated above 50 °C, 0 kVA above 60 °C

PLANT DIAGRAM





Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

Functional Specification for Three-Phase Pad-Mounted Distribution Transformers 45 – 10,000 kVA

1.0 Scope

1.1. This specification covers the electrical and mechanical characteristics of 45-10,000 kVA Three-Phase Step-Down Pad-Mounted Distribution Transformers. KVA ratings for transformers with secondary voltages not exceeding 700V are 45-3,750 kVA, while kVA ratings for transformers with secondary voltages greater than 700V are 1,000-10,000 kVA. Product is per Eaton's Cooper Power Systems catalog section 210-12.

2.0 Applicable Standards

2.1. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI®, IEEE®, NEMA®, and Department of Energy standards.

IEEE Std C57.12.00™-2010 standard – Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

IEEE Std C57.12.28™-2005 standard – Pad-Mounted Equipment - Enclosure Integrity.

IEEE Std C57.12.34™-2009 standard – Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVA and Smaller) - High Voltage: 34500GrdY/19920 Volts and Below; Low-Voltage: 480 Volt 2500 kVA and Smaller *(issued in March 2005 - combines IEEE Std C57.12.22 and IEEE Std C57.12.26 standards).*

IEEE Std C57.12.90™-2010 standard – Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.

IEEE Std C57.12.91™-2011 standard – Guide for Loading Mineral-Oil-Immersed Transformers.

NEMA TR 1-1993 (R2000) – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid-Immersed Power Transformers.

NEMA 260-1996 (2004) – Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.

10 CFR Part 431 – Department of Energy – Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.

3.0 Ratings

3.1. The transformer shall be designed in accordance with this specification and the kVA rating shall be:

45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10,000 (range may also be specified).

3.2. The primary voltage, configuration, and the basic lightning impulse insulation level (BIL) shall be _____, {make a selection from Table 1} Dual voltages are also available.

3.3. The secondary voltage, configuration, and the basic insulation level (BIL) of the secondary voltage shall be _____, {make a selection from Table 1}

Table 1
Ratings for Three-Phase Transformers
(Single Ratio)

Primary Voltage	BIL (kV)		Secondary Voltage	BIL (kV)
2400 Delta	60		208Y/120	All 30 kV
4160 Delta	60		480Y/277	
4800 Delta	60		575Y/332	
7200 Delta	75		600Y/347	
12000 Delta	95		690Y/398	
12470 Delta	95		240 Delta	
13200 Delta	95		480 Delta	
13800 Delta	95		240 Delta with 120 Mid-Tap	
14400 Delta	95		480 Delta with 240 Mid-Tap	
16430 Delta	125			
34500 Delta	150		See left column for voltages	
43800 Delta	250		over 700 V	
4160GrdY/2400	60			
8320GrdY/4800	75			
12470GrdY/7200	95			
13200GrdY/7620	95			
13800GrdY/7970	95			
22860GrdY/13200	125			
23900GrdY/13800	125			
24940GrdY/14400	125			
34500GrdY/19920	150			
43800GrdY/25300	250			

- For complete connector rating, see IEEE Std 386™-2006 standard.
- Transformers are suitable for connectors with phase-to-ground or phase-to-ground/phase-to-phase high-voltage ratings as listed.
- Arrester coordination may require higher BIL on multiple connections than indicated to achieve a minimum protection level of 20%.

3.4. The transformer may be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 4.3 of IEEE Std C57.12.34™-2009 standard. The tap changer shall be operable on the higher voltage only for transformers with dual voltage primaries. The unit shall have one of the following tap configurations:

No Taps
Two – 2 ½% taps above and below rated voltage (split taps)
Four – 2 ½% taps below rated voltage (four below)
NEMA taps (14400, 13800, 13200, 12470, 12540)
Non-standard tap configuration

The applicable tap configuration shall be specified on the inquiry.

3.5. The average winding temperature rise above ambient temperature, when tested at the transformer rating, shall not exceed 65 °C **OR** shall not exceed 55 °C **OR** at the base transformer rating, shall not exceed 55 °C, and when tested at 112% of the base rating, shall not exceed 65 °C.

3.6. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 2. For target impedances, the tolerance on the impedance shall be +/- 7.5% of nominal value for impedance values greater than 2.5%. The tolerance on the impedance shall be +/- 10.0% for impedance values less than or equal to 2.5%.

Table 2
Percent Impedance Voltage

KVA Rating (Low voltage < 700 V)	Impedance
75	1.10 - 5.75
112.5-300	1.40 - 5.75
500	1.70 - 5.75
750-3750	5.75 nominal

KVA Rating	Low voltage > 700 V (all nominal values)		
	≤150 kV BIL	200 kV BIL	250 kV BIL
1000 - 5000	5.75	7.00	7.50
7500 - 10000	6.50	7.00	7.50

4.0 Construction

4.1. The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper. Coils shall be either aluminum or copper (eliminate a metal if one is required over the other).

4.2. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE Std C2™-2002 standard), Section 15. The dielectric coolant shall be non-toxic*, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall result in zero mortality when tested on trout fry *. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements, and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved®, UL® Classified Dielectric Medium (UL-EOUV) and UL® Classified Transformer Fluid (UL-EOVK), Envirotemp™ FR3™ fluid.
*(Per OECD G.L. 203)

4.3. Tank and Cabinet Enclosure

4.3.1. The high-voltage and low-voltage compartments, separated by a metal barrier, shall be located side-by-side on one side of the transformer tank. When viewed from the front, the low-voltage compartment shall be on the right. Each compartment shall have a door that is constructed so as to provide access to the high-voltage compartment only after the door to the low-voltage compartment has been opened. There shall be one or more additional fastening devices that must be removed before the high-voltage door can be opened. Where the low-voltage compartment door is of a flat panel design, the compartment door shall have three-point latching with a handle provided for a locking device. Hinge pins and associated barrels shall be constructed of corrosion-resistant material, passivated ANSI® Type 304 or the equivalent.

4.3.2. A recessed, captive, penta-head or hex-head bolt that meets the dimensions per IEEE Std C57.12.28™-2005 standard shall secure all access doors.

4.3.3. The compartment depth shall be in accordance with IEEE Std C57.12.34™-2009 standard, unless additional depth is specified.

4.3.4. The tank base must be designed to allow skidding or rolling in any direction. Lifting provisions shall consist of four lifting lugs welded to the tank.

4.3.5. The tank shall be constructed to withstand 7 psi without permanent deformation, and 15 psi without rupture. The tank shall include a 15 psig pressure relief valve with a flow rate of minimum 35 SCFM.

4.3.6. The exterior of the unit shall be painted Munsell 7GY3.29/1.5 green (STD), ANSI® 70 gray, or ANSI® 61 gray in color. If a special paint color is specified, a federal spec number or paint chip must be provided at the time of order. The cabinet interior and front plate shall be painted gray for ease of viewing the inside compartment.

4.3.7. The tank shall be complete with an anodized aluminum laser engraved nameplate. This nameplate shall meet Nameplate B per IEEE Std C57.12.00™-2010 standard.

4.4. High Voltage Bushings and Terminals

4.4.1. High voltage bushings will be installed in the high voltage termination compartment located on the front left of the transformer and requiring access via the low voltage termination compartment on the front right.

4.4.2. Bushing Style

[ ] **15/25 KV DEADFRONT, CURRENTS BELOW 200 AMPS:** The high voltage bushings shall be 15/25 kV 200A bushing wells with bushing well inserts installed. The bushings shall be externally removable and be supplied with a removable stud (Re: Eaton's Cooper Power Systems catalog sections 800-32, 500-12, and 500-26).

[ ] **35 KV DEADFRONT, CURRENTS BELOW 200 AMPS:** The high voltage bushing shall be a one-piece, 150 kV, 200-amp large interface load-break bushing (Re: Eaton's Cooper Power Systems catalog section 800-39).

[ ] **15/25/35 KV DEADFRONT, CURRENTS ABOVE 200 AMPS:** The high voltage bushing shall be a 600A dead-break primary one-piece bushing externally removable, 3Ø rated, integral design. An optional 900 A bushing is available upon request (Re: Eaton's Cooper Power Systems catalog sections 800-45 and 800-47).

[ ] **36 KV TO 46 kV (250 KV BIL) DEADFRONT APPLICATIONS:** The high voltage bushing shall be a CONNEX® Plug-in Cable Termination System, size 3S. The male and female portions of the bushing shall be supplied with the transformer. Available in radial feed only.

[ ] **15/25/35 KV LIVEFRONT, 200 KV BIL MAX:** The high voltage bushing shall be a porcelain bushing with a two, four, or six-hole spade or an eyebolt connector.

4.4.3. Bushing Configuration

[ ] **15/25 KV RADIAL FEED DEADFRONT:** The transformer shall be provided with three (3) high voltage bushings in accordance with Figure 1 dimensions (Figure 4a dimensions may be specified when a larger termination compartment for greater working space is desired) from IEEE Std C57.12.34™-2009 standard for radial feed configurations. The bushing heights shall be in accordance with Figure 3 dimensions (Figure 6 dimensions may be specified for greater bushing height) of IEEE Std C57.12.34™-2009 standard.

[ ] **15/25 KV LOOP FEED DEADFRONT:** The transformer shall be provided with six (6) high voltage bushings in accordance Figure 2 dimensions (Figure 5a dimensions may be specified when a larger termination compartment for greater working space is desired) of IEEE Std C57.12.34™-2009 standard for loop feed configurations. The bushing heights shall be in accordance with Figure 3 minimum dimensions (Figure 6 dimensions may be specified for greater bushing height) of IEEE Std C57.12.34™-2009 standard.

[ ] **35 KV RADIAL FEED DEADFRONT:** The transformer shall be provided with three (3) high voltage bushings in accordance with Figure 4b dimensions of IEEE Std C57.12.34™-2009 standard for radial feed configurations. The bushing heights shall be in accordance with Figure 6 dimensions of IEEE Std C57.12.34™-2009 standard.

[ ] **35 KV LOOP FEED DEADFRONT:** The transformer shall be provided with six (6) high voltage bushings in accordance with Figure 5c dimensions of IEEE Std C57.12.34™-2009 standard for loop feed configurations. The bushing heights shall be in accordance with Figure 6 dimensions of IEEE Std C57.12.34™-2009 standard.

[ ] **46 KV / 250 KV BIL DEADFRONT:** The transformer shall be provided with three (3) bushings mounted 45° down from the horizontal, 60” from the ground, and 12” apart from each other.

[ ] **15/25/35 KV LIVEFRONT, 150 KV BIL MAX:** The transformer shall be provided with three (3) bushings in accordance with Figure 9 of IEEE Std C57.12.34™-2009 standard for radial feed configurations. The bushing heights shall be in accordance with Figure 10 of IEEE Std C57.12.34™-2009 standard.

[ ] **200 KV BIL LIVEFRONT:** The transformer shall be provided with three (3) bushings with phase-to-phase and phase-to-ground clearances adequate for 200 kV BIL.

4.5. Low Voltage Bushings and Terminals

4.5.1. Bushing Style

4.5.1.1. Voltages less than 700 Volts: The transformer shall be provided with tin-plated spade-type bushings for vertical takeoff. The spacing of the connection holes shall be 1.75” on center, per IEEE Std C57.12.34™-2009 standard Figure 13a. The quantity of connection holes shall be 4, 6, 8, 12, 16, or 20 holes.

4.5.1.2. Transformers 300 kVA and below, and 500 kVA with 480Y/277 secondary will have two-piece low voltage bushings with studs and screw on spades. Transformers 500 kVA with 208Y/120 secondary and all transformers above 500 kVA will have one-piece bushings.

Table 3
Standard / Maximum Bushing Hole Quantities

KVA	208Y/120	480Y/277 and higher
45-300	4 standard, 16 maximum	4 standard, 16 maximum
500	6 standard, 12 maximum	4 standard, 16 maximum
750-1500	12 standard, 20 maximum	6 standard, 12 maximum
2000-3750	N/A	12 standard, 20 maximum

(Re: Eaton’s Cooper Power Systems catalog sections 800-14, 800-16, and 800-21)

4.5.1.3. Bushing supports shall be provided for transformers requiring 10 or more connection holes. Bushing supports shall be affixed to the cabinet sidewalls; tank-mounted supports mountings are not acceptable.

4.5.2. Bushing Configuration

The transformer shall be provided with bushings in a staggered arrangement in accordance with Figure 11a dimensions (Figure 12a dimensions may be specified when a larger termination compartment for greater working space is desired) of IEEE Std C57.12.34™-2009 standard.

4.5.3. Voltages greater than 700 Volts: Refer to section 3.1 for the bushing type. Secondary arrangements shall be live-front or dead-front. Dead-front application with a required neutral shall have a porcelain X0 bushing. Dead-front application may be loop feed when specified. Provide additional front barrier for high voltage live front secondary, creating an additional barrier after the low voltage door has been opened.

4.6. Switching

[ ] **Primary Switching:** The primary switching scheme provided with the transformer shall be one *(only available option for radial feed)*, two, or three on-off under-oil load-break switch(s), or one four-position V or T-blade load-break sectionalizing switch. Refer to Appendix 1 for the schematics of these switching options (Re: Eaton's Cooper Power Systems catalog sections 800-64 and 800-65).

[ ] **Make-before-break option for four-position, sectionalizing switch:** This switch option provides improved system reliability by eliminating momentary interruptions during switching operations.

[ ] **External Visible Loadbreak On/Off switch:**
The external visible loadbreak switch allows customers to visibly confirm that the transformer is de-energized without having to expose themselves to dangerous arc flash in the transformer compartment.

[ ] **External Visible Loadbreak On/Off/Ground switch**
The external visible loadbreak switch allows customers to visibly confirm that the transformer is de-energized without having to expose themselves to dangerous arc flash in the transformer compartment. This feature also allows the end user to ground the transformer using the load break switch.

Note: The external load-break switch can also be supplied with external gauges mounted outside of the transformer cabinet. Refer to Section 9 for the gauges included with this option.

4.7. Overcurrent Protection

[ ] **BAY-O-NET WITH BACK-UP CURRENT LIMITING FUSES:** (available up to 130 amps of full-load transformer current, up to 34.5 kV grounded wye, or 23 kV delta). The high-voltage overcurrent protection scheme provided with the transformer shall be an externally removable loadbreak expulsion Bay-O-Net fuse assembly with a flapper valve to minimize oil spillage. The bayonet fuses shall be in series with ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 A. (Re: Eaton's Cooper Power Systems catalog sections 240-40, 240-45, 240-46, 240-47, 240-48, 240-49, and 240-98)
For voltages 23000Y or Delta and above (which must also take into account any higher tap settings), bayonet fuses are not available.

[ ] **Cartridge fusing, >23kV:** Under-oil cartridge fusing shall be utilized (available up to 208 amps of full-load transformer current, up to 34.5kV delta). The high-voltage overcurrent protection scheme provided with

the transformer shall be under-oil cartridge fusing. Cartridge fuses shall be in series with ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 A.

[ ] **Optional Accessory:** An interlock shall be required between the load-break switch scheme specified and the bayonet fuses, such that the fuses may not be removed unless the transformer has been de-energized via the load-break switch scheme.

[ ] **MAGNEX INTERRUPTER:** (available up to 42 amps of full-load transformer current, up to 35 KV grounded wye, or 17.1 KV delta), The high-voltage overcurrent protection scheme provided with the transformer shall be a three-phase trip MagneX interrupter. This externally resettable device may also be used as an on-off switch. The three-phase MagneX interrupter shall be in series with ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 A (Re: Eaton's Cooper Power Systems catalog sections 240-33 and 240-98).

[ ] **INTEGRAL VACCUUM, FAULT INTERRUPTER (VFI):** (available from 13 amps up to 900 amps of full-load transformer current, up to 34.5 kV, grounded wye or delta, maximum 150 KV BIL) The high-voltage or low-voltage overcurrent protection scheme provided with the transformer shall be an integral Vacuum Fault Interrupter (VFI). The VFI shall have a maximum interrupting rating of 12,000A RMS symmetrical (optional 16,000 A RMS symmetrical available at 15 KV) with resettable fault protection up through 35 kV. The VFI shall also include a Tri-Phase electronic breaker control with over 100 minimum trip settings and five (5) selectable time current curves. The minimum trip setting shall be XX amps, and curve profile shall be the EF, KF, TF, F, or H (Re: see Eaton's Cooper Power Systems bulletins 97055 and 02039 and catalog section S285-75-1 for the electronic control).

[ ] **Optional ELSP Accessory:** VFI shall be in series with ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 A.

[ ] **Optional VFI Accessories:** SCADA board; Ground fault detection; Motor operator assembly; Visible break window.

4.8. Overvoltage Protection

4.8.1. The overvoltage protection scheme provided with the transformer shall protect the high-voltage or low voltage winding.

[ ] **DEAD-FRONT BUSHINGS:** (maximum 150 kV BIL, for voltages up to 18 kV delta and 35 kV grounded wye). Externally mounted, Distribution Class M.O.V.E. Dead-front elbow arresters shall be supplied. (Re: Eaton's Cooper Power Systems catalog section 235-65.) M.O.V.E. arresters are for installation on 200 A rated dead-front bushing interfaces only. *If transformer bushings are rated 600 A or 900*

A, BT-TAP elbow connectors, T-OP II elbow connectors, or 600 A bushing adapters, each with a load-reducing tap plug for arrester connection, are required (Re: Eaton's Coo*per Power Systems* catalog sections 235-99 and 235-102).

[ ] **LIVEFRONT BUSHINGS:** (up to 200 KV BIL). Distribution- and Intermediate-Class arresters shall be supplied beneath the high-voltage bushings (Re: Eaton's Cooper Power Systems catalog sections 235-99.and 235-102).

[ ] **UNDER OIL:** (for voltages up to 27 kV delta and 35 KV grounded wye). Internally mounted, Distribution Class MOV under-oil surge arresters shall be supplied (Re: Eaton's Cooper Power Systems Catalog Section 235-95).

[ ] **Optional Accessory:** Three (3) disconnect switches shall be included to disconnect the under-oil arresters from ground for transformer testing (Re: Eaton's Cooper Power Systems catalog section 800-51).

5.0 Labeling

5.1. A temporary bar code label shall be attached to the exterior of the transformer in accordance with IEEE Std C57.12.34™-2009 standard**.**

6.0 Finish Performance Requirements

6.1. The tank coating shall meet all requirements in IEEE Std C57.12.28™-2005 standard including:

- Salt Spray
- Crosshatch adhesion
- Humidity
- Impact
- Oil resistance
- Ultraviolet accelerated weathering
- Abrasion resistance – taber abraser

6.2. The enclosure integrity of the tank and cabinet shall meet the requirements for tamper resistance set forth in IEEE Std C57.12.28™-2005 standard including but not limited to the pry test, pull test, and wire probe test.

7.0 Production Testing

7.1. All units shall be tested for the following:

- No-Load (85 °C or 20 °C) losses at rated current
- Total (85 °C) losses at rated current
- Percent Impedance (85 °C) at rated current
- Excitation current (100% voltage) test
- Winding resistance measurement tests

- Ratio tests using all tap settings
- Polarity and phase relation tests
- Induced potential tests
- Full wave and reduced wave impulse test

7.2. Minimally, transformers shall conform to efficiency levels for liquid immersed distribution transformers, as specified in Table I.1 of the Department of Energy ruling. “10 CFR Part 431 Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule; October 12, 2007.” Manufacturer shall comply with the intent of all regulations set forth in noted ruling. This efficiency standard does not apply to step-up transformers.

7.3. In addition, the manufacturer shall provide certification upon request for all design and other tests listed in IEEE Std C57.12.00™-2010 standard, including verification that the design has passed short circuit criteria per IEEE Std C57.12.00™-2010 standard and IEEE Std C57.12.90™-2010 standard.

7.4. In the event of proposal bid evaluated with guaranteed losses due to a loss evaluation (see section 10.0), manufacturer shall conform to guaranteed average losses as specified in IEEE Std C57.12.00™-2010 standard. The no-load losses of a transformer shall not exceed the specified no-load losses by more than 10%, and the total losses of a transformer shall not exceed the specified total losses by more than 6%.

8.0 Approved Manufacturers

8.1. Eaton’s Cooper Power Systems—Waukesha WI

9.0 Accessories

9.1. The following accessories and options shall be provided:

[ ] Bolted main tank cover (1000 kVA & below)
[ ] Welded main tank cover with bolted handhole (1500 kVA & above)
[ ] 1.0” upper fill plug
[ ] 1.0” drain plug in LV compartment (500 kVA & below)
[ ] 1.0” drain valve w/ sampling device in LV compartment (750 kVA & above)
[ ] Automatic pressure relief valve
[ ] Metal drip shield (when bayonets specified)
[ ] 20” deep cabinet (2500 kVA & below)
[ ] 24” deep cabinet (3000 kVA & above)
[ ] Ground provisions per IEEE Std C57.12.34™-2009 standard section 9.11.
[ ] Meet NEMA® TR-1 sound levels
[ ] Liquid level gauge
[ ] Dial-type thermometer gauge
[ ] Pressure vacuum gauge
[ ] 1.0” drain valve w/ sampling device in (LV or HV) compartment (500 kVA & below)

[ ] Upper fill valve
[ ] Pressure vacuum bleeder
[ ] 24” deep cabinet
[ ] 30” deep cabinet
[ ] 36” deep cabinet
[ ] 40” deep cabinet
[ ] Spare bayonet fuse links
[ ] Fault indicator provisions
[ ] Ground connectors
[ ] Mr. Ouch warning & danger signs
[ ] Danger high voltage warning signs
[ ] Miscellaneous stenciling
[ ] Non-PCB decal
[ ] Touch-up paint
[ ] Interphase barriers (for live front primary units only)
[ ] Seismic zone 3 and 4 tank anchoring
[ ] Complete 304L stainless steel tank and cabinet
[ ] 304L stainless steel tank base and cabinet sides & sill (partial)
[ ] Liquid level gauge with auxiliary contacts
[ ] Dial-type thermometer gauge with auxiliary contacts
[ ] Pressure vacuum gauge with auxiliary contacts
[ ] Current or potential transformers
[ ] Rapid rise relay with seal-in panel
[ ] Winding temperature indicator
[ ] Watt-hour meter package – includes GE kV2c Encompass™ Electronic Meter. Factory supplied wiring shall be internal to the cabinet, not in conduit. Communication connection shall be the OPTOCOM port.
[ ] Harmonic resistant K-factor design, K=4, 9, 13, or 20
[ ] Forced air ONAF (mineral oil) or KNAF (Envirotemp™ FR3™ fluid) rating. Forced air rating requires documentation from Eaton’s Cooper Power Systems customer that they are aware this transformer is no longer tamper resistant and is no longer in compliance with ANSI® standards.
[ ] Future forced air rating
[ ] *Forced Air Fan Control Package*
[ ] FM Global® (FM) Approved transformer (to comply with NEC® 450-23 listing restrictions for installations on, near, or inside of buildings)
[ ] Combination UL® Listed & Classified transformer (to comply with NEC® 450-23 listing restrictions for installations on, near, or inside of buildings) per UL XPLH
[ ] UL® Listed transformer (certifying compliance with ANSI® standards only) per UL® XPLH
[ ] External visible break with gauges: Gauges include liquid level, dial-type thermometer gauge, pressure/vacuum, pressure relief valve, and a 1.0” oil sampler valve, and fill plug.

10.0 **Optional Transformer Evaluation**

[ ] No unit evaluation, but include quote losses as reference only on bid.

[ ] Unit loss evaluation, guaranteed average losses. Criteria to properly evaluate quoted losses:

- Core loss evaluation (A-factor) ____ $/watt
- Winding loss evaluation (B-factor) ____ $/watt

(Eaton's Cooper Power Systems may be contacted for sample loss evaluation method)

11.0 Shipping

11.1. Transformers, 1000 kVA and below, shall be palletized. Transformers, 1500 kVA and larger, shall be loaded and unloaded with overhead cranes, so a pallet is not to be provided for these transformers.

12.0 Data With Proposal

12.1. The following data shall be submitted with the proposal:

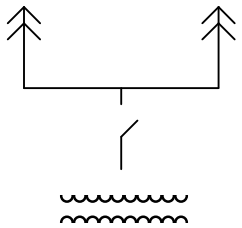
- Core losses (when requested per Sections 7.4 and 10.0).
- Winding losses (when requested per Sections 7.4 and 10.0).
- Percent Impedance
- Typical bid drawing
- Approval drawing – drawings shall show final dimensions and features. When requested, approval drawings shall be provided per quoted leadtime.
- Record Drawing – drawings shall show final dimensions and features. When requested, record drawings shall be provided.

13.0 Service

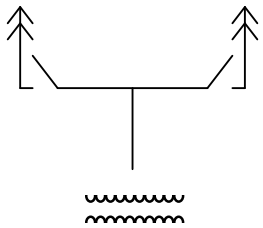
13.1. The manufacturer of the transformer shall have regional service centers located within two (2) hours flight time of all contiguous 48 states. Service personnel shall be factory trained in commissioning and routine service of quoted transformers.

APPENDIX 1: Switching Options and Schematics

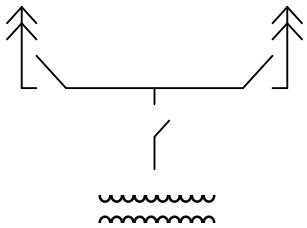
1 On/Off Switch



2 On/Off Switches

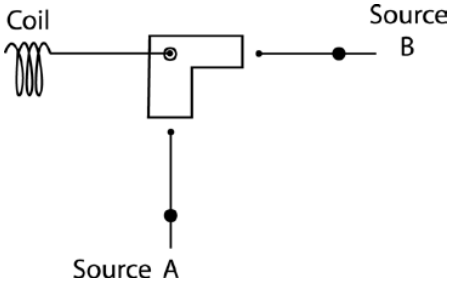


3 On/Off Switches



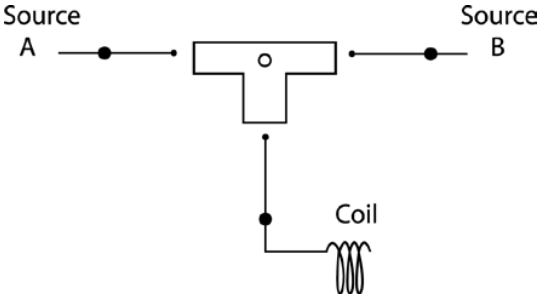
(Re: Eaton's Cooper Power Systems catalog section 800-65)

4-position sectionalizing switches:
V-blade switch



Description of positions:
Feed from A & B
Feed from A only
Feed from B only
Open — the loop is **open** and the transformer is de-energized

T-blade switch



Description of positions:
Feed from A & B
Feed from A only
Feed from B only
Open — the loop is **closed** and the transformer is de-energized

(Re: Eaton's Cooper Power Systems catalog section 800-64)

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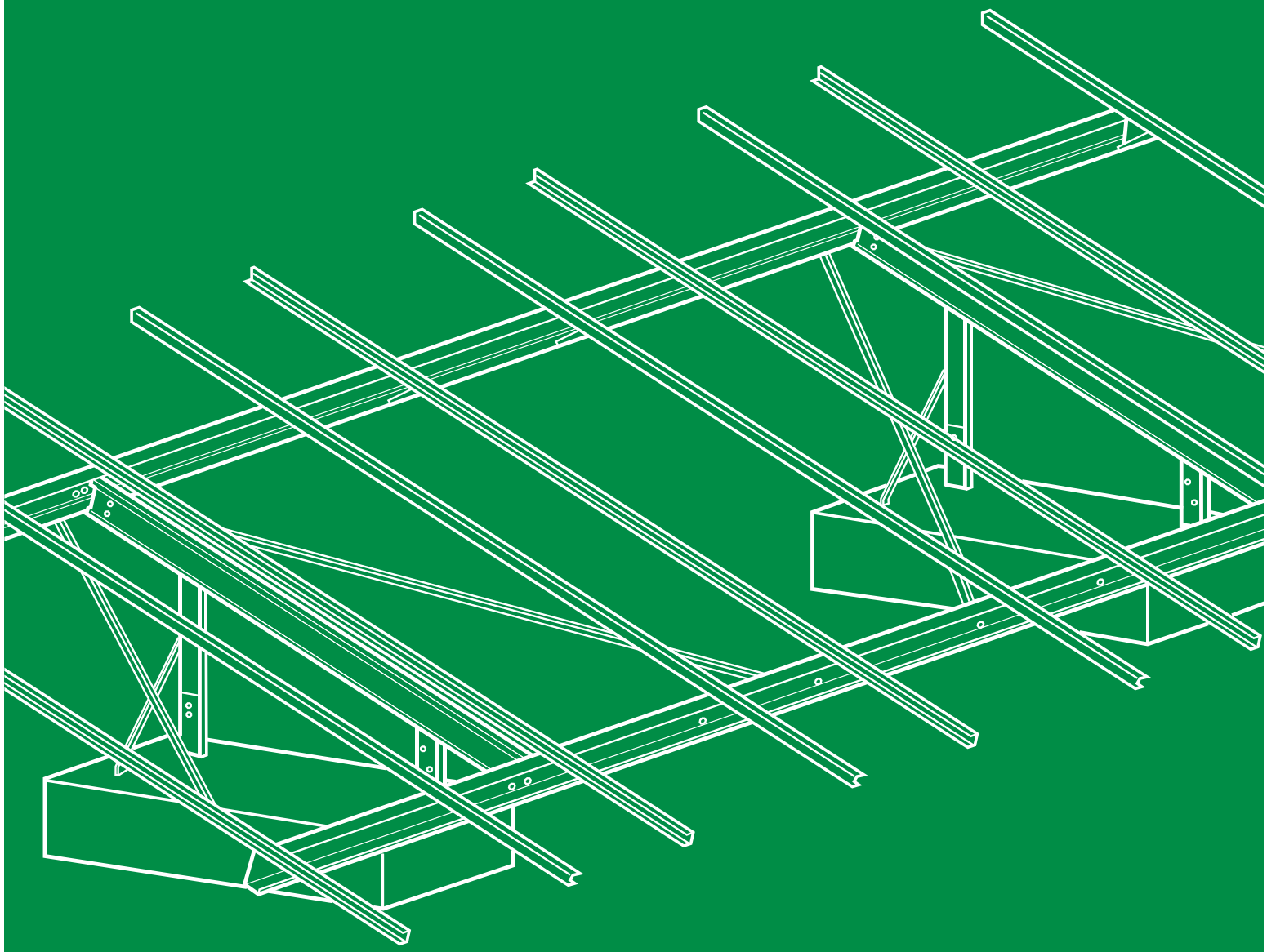
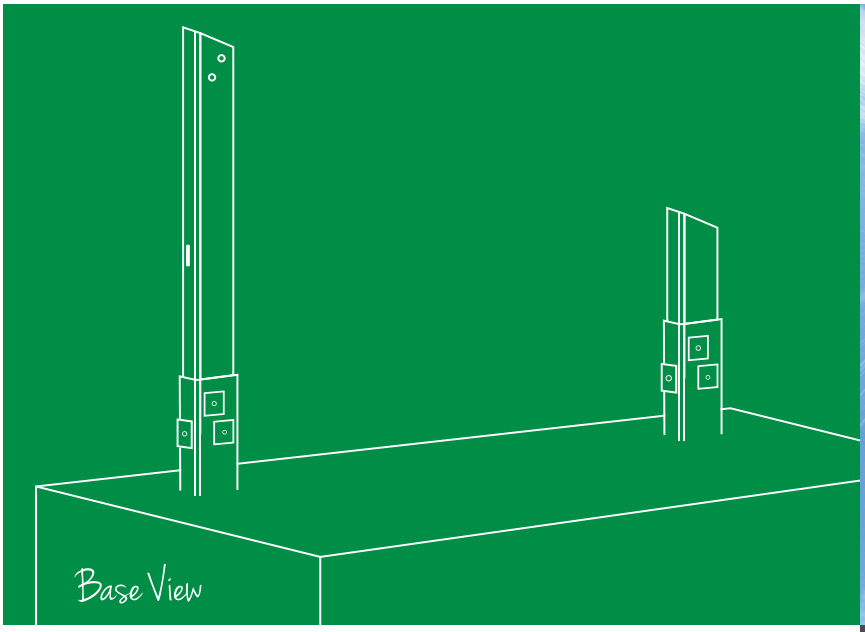
A Division of Northern States Metals



FlexRack Series B

A Ballasted Ground Mount System



Sturdier structure

The FlexRack Series B makes use of a two-support system, rather than the one-support system of its contemporaries; transferring loads into the block through two supports instead of one reduces ballast block thickness. This two-support system also enables the use of a split block system, which requires lighter lifting machinery to accommodate sites with low bearing pressure requirements.

Perfect for landfills

Converting landfills from unusable land to power generating solar fields is becoming more and more prevalent. In such cases, a geomembrane cap prevents ground penetrations and makes the use of ballasted systems, like the Series B, a must. Installed with our years of experience, the Series B is perfect for landfills, brownfields, superfund sites, and other areas where ground penetrations are not feasible.

Reduced costs

Our system uses steel and concrete more efficiently, reducing the overall cost of the unit and allowing for a lower array profile. It's also custom engineered to make installation a breeze—no matter the conditions, the Series B can be installed quickly and efficiently, saving you money on labor costs.

Complete compatibility

The FlexRack Series B offers compatibility with all of our ground systems, including the G1, G2, and G3. That means that all the innovative labor savings features and flexibility are still realized with the Series B. The cast-in channels allow for quick assembly and adjustability on the jobsite.

Services

- Engineering
- Pullout
- Layout
- Geotechnical
- Field
- Installation

A tougher foundation for a tougher job

The FlexRack Series B gives you the same features as our Series G systems, but with a more stabilizing ballast, making it a perfect fit for landfills, brownfields, and water-saturated terrain. With an all-steel framework and a design engineered to maximize cost savings on the jobsite, the Series B is everything you need in a ballasted PV ground mount.

LEADERSHIP IN SOLAR ENERGY
RACKING & MOUNTING
2013 Leadership Winner

The new Solar FlexRack ground mount [Series B] also has fewer components and fasteners, reducing material costs for steel. Designed for various ground clearances, the system also makes possible a lower profile for PV panel array layouts.

-Steve Daniel
Executive Vice President Sales and Marketing

Experience the Flex

CALL US TO FIND OUT HOW THIS GROUNDBREAKING TECHNOLOGY CAN IMPROVE HOW YOU DO SOLAR

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A Division of Northern States Metals

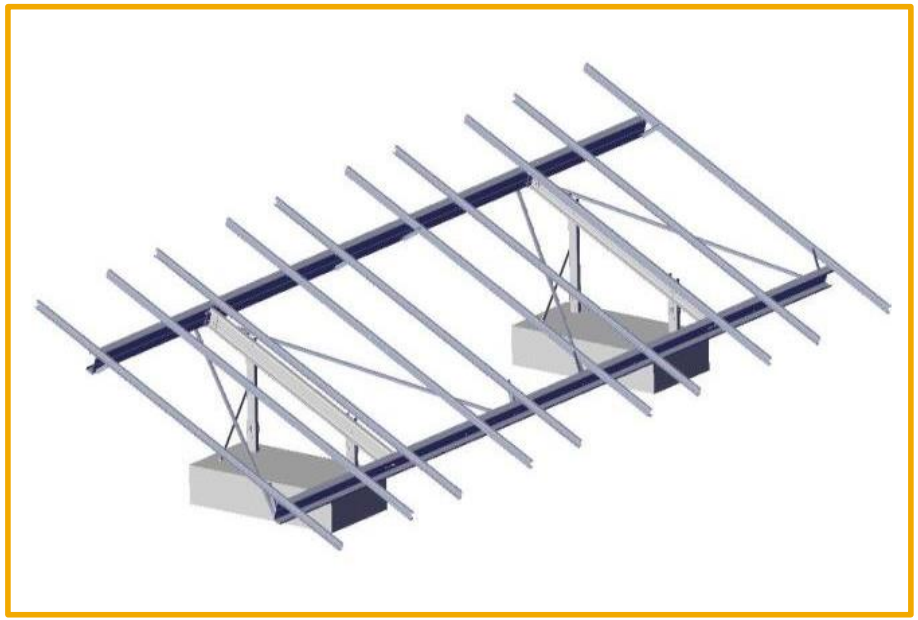
Solar FlexRack Ballasted Projects Overview

FlexRack Series B

- Solar FlexRack's innovative Ballast Ground Mount System, uniquely suited to Landfill and challenging terrain sites

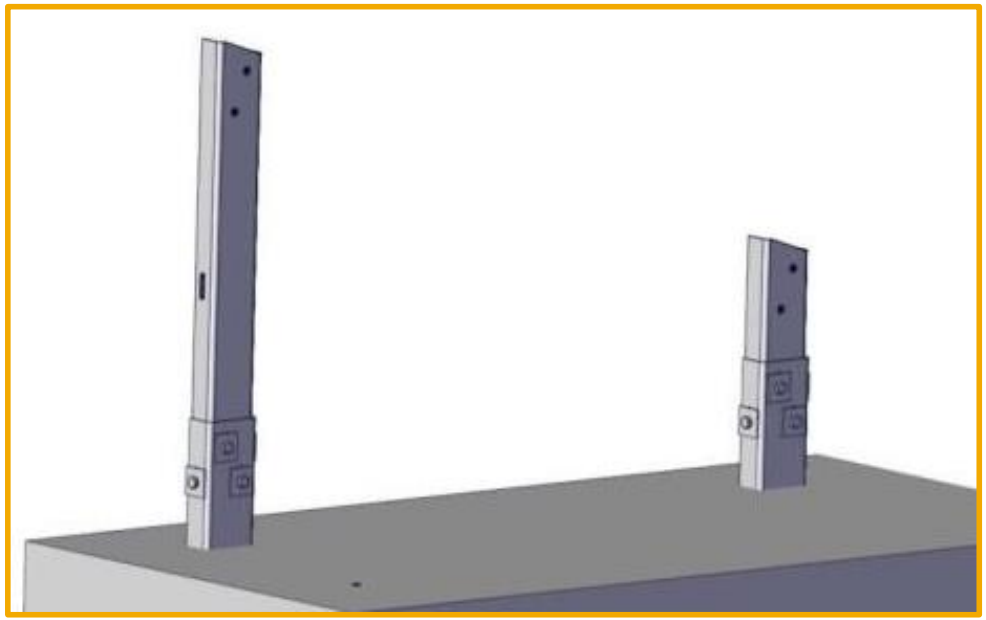
- Front and rear post design reduces ballast block sizes and creates flexibility of using one block or two depending on bearing pressure requirements.

- Reduces overall components and fasteners for lower overall material price.



FlexRack Series B

- Two-support system transfers loads into the block through two supports instead of one reducing ballast block thickness
- Cast-in channels allow for quick assembly and adjustability on the jobsite
- Eliminates post weldments
- Reduces block height requirements
- Adaptable for any ground clearance
- Reduces installation time



New Jersey Meadowland's Kearny Landfill

Project Location: NJ

Project Size: 3MW

Customer: SunDurance

Project Highlights:

- Capped landfill with settling of more than 20 feet in some areas.
- 2 x 13 Solar FlexRack Ground Mounts were used.
- Liberal East-West and North-South tolerances are built-in to each Solar FlexRack sub-array though slotted connections on the horizontal rail and also the tilt bracket.
- The tolerances allow for straight lines, providing a nice look for visitors, and some wiggle room when laying down ballast blocks.

The 2 x 13 system was able to accommodate 20% slope in the East - West direction

New Jersey Meadowland's Kearny Landfill

Project Location: NJ

Project Size: 3MW

Customer: SunDurance

Project Highlights:

- The racking was noncontinuous, a selling point on an irregular landscape because it allowed the flattened areas to be smaller, requiring less fill.
- Concrete ballast blocks, sized 2 feet by 8 feet.
- SFR engineers had to keep the total system under 200 lbs./sq. feet, but it needed to counteract a 105 lbs./sq. feet wind load, a number higher than average because the installation was on a hill not far from the ocean.

Oliver St Landfill, Easthampton, MA

Project Location: MA
Project Size: 2.3MW
Customer: Borrego Solar
Project Highlights:

- Three roads needed to be built for construction and maintenance access. 962 (3ft x 1ft x 11ft) concrete ballasts were installed on crushed rock material extending 1 ft. beyond the blocks at a maximum slope of 6 degrees.

- These foundations formed the support for 481 (4×5) Solar FlexRack Ground Racks attached on round posts to the footings.

- These racks stably support 9,620 Yingli 235 watt solar panels at a 30 degree tilt, to withstand 100 MPH winds and **55 psf** snow loads.

Sudbury and Acton Landfills

Project Location: MA

Project Size: 1.5MW each

Customer: Ameresco

Project Highlights:

- Solar FlexRack Ground Mounts with three posts (round pipe) attached to three ballast blocks. (8 feet-5 inches x 4 feet x 18 inches thick).
- These arrays were placed within the topsoil support layer i.e. the “erosion layer” of the final cover system on added gravel “leveling pads.”
- The Sudbury solar field consisted of just over 6,000 photovoltaic modules and covered about 5.3 acres of the total 28-acre landfill.
- These impressive systems were designed to withstand 100 MPH winds and **55 psf** snow loads at 25 degrees tilt angle.

Marshfield Landfill Solar Project

Project Location: MA
Project Size: 4 MW
Customer: SunDurance
Project Highlights:

- The ground-mounted solar array was built on a capped landfill and consisted of 13,518 panels covering 13 acres of land.

- The system is expected to produce more than 5,000,000-kilowatt hours of clean energy each year, which is equivalent to the total annual electrical usage of approximately 485 average single-family homes. The array will help power Marshfield municipal buildings and schools.

Barre Wool Solar Project

Project Location: MA
Project Size: 1.75 MW
Customer: Quabbin Solar
Project Highlights:

- The installation, developed and owned by Quabbin Solar, consisted of 6,292 PV modules.
- The racks were designed to withstand wind speeds of up to 100 mph and a snow load of up to **55 psf**.
- Barre Wool Ballast Install

Ford – Wayne Michigan Assembly Plant

Project Location: MI

Project Size: 500 kW

Customer: Nova Consultants

Project Highlights:

- 500kw of renewable energy supplied by the solar power generation system help power the production of the Ford Focus and Focus Electric, as well as next-generation hybrid and plug-in hybrid vehicles.

- A total of 84 (2×13) Solar FlexRack Ground Mounts, each holding 26 PV modules, were installed for the project.

Wastewater Treatment Facility Pueblo, CO

Project Location: CO

Project Size: 1 MW

Customer: MW Solar

Project Highlights:

- 83 Solar FlexRack Ground Racks supporting 1328 modules were supplied for this project.

- "Including unloading the truck and positioning the racks for installation, with a crew of four we were able to install 40 racks in three hours. The modules, 16 per rack, were able to be mounted in about 10 minutes." – Scott Steel , Construction Manager, MW Solar.

ON BEHALF OF EVERYONE AT SOLAR FLEXRACK

THANK YOU VERY MUCH

By: Greg Lewis

Have additional questions?

Drop me a line at: 410.715.4779
or email: glewis@solarflexrack.com

Versatile and Proven Secondary Containment Solutions

C.I.Agent® Polyvinyl and Barrier Boom Containment System

Laying out the polyvinyl sections.

Polyvinyl pit containment.

Wind farm - staking the C.I.Agent® Barrier Boom before applying stone for a 'to grade' finish.

Pre-fabricated corners.

PRODUCT DESCRIPTION:

The C.I.Agent® Polyvinyl and Barrier Boom Containment Systems for hydrocarbon filtration in sandy or undetermined subsoils, allows storm water to flow through the C.I.Agent Barrier Boom side walls while removing hydrocarbons. In the event of a large spill, the side walls completely solidify and contain the hydrocarbon, keeping it from escaping. The C.I.Agent Polyvinyl and Barrier Boom Containment System meets requirements SPCC 40CFR112.7, U.S.D.A. Bulletin 1724E-302, Chapter 3-3.2.2 and 3.2.3, and IEEE Std. 980.

PRODUCT APPLICATIONS:

The C.I.Agent® Polyvinyl Blankets install quickly and are perfect for secondary containment of substations, tank farming, and wind farms. It is recommend to have two to six inches of pea gravel or sand over excavated area prior to vinyl application.

PERFORMANCE SPECIFICATIONS:

- The base of the system is made of 22 oz. or 40 oz. polyvinyl with pre-formed corners. The side walls are made with C.I.Agent® Barrier Booms. The booms are constructed from non-woven geo-textile material filled with C.I.Agent® Granules, a proprietary blend of USDA food-grade polymers that encapsulate hydrocarbons
- Water flow rate: Minimum 3 GPM per square foot of material with one foot head pressure
- Hydrocarbon flow rate: 0 GPM (100%+ containment)
- Service life of installed product: Life of the equipment it protects

BENEFITS:

- A bury and forget application
- Cost-effective solution for Secondary Spill Containment
- Custom made for site specific application
- C.I.Agent Polyvinyl and Barrier Boom Containment Systems can be installed in one or two days (depending on size of install)
- The C.I.Agent Polyvinyl and Barrier Boom Containment Systems are made in the U.S.A., pre-fabricated at the factory, and assembled on site
- C.I.Agent Polyvinyl and Barrier Boom Containment Systems will not drip or leach out
- The C.I.Agent Polyvinyl and Barrier Boom Containment System comes complete with granular Bentonite, vinyl adhesive, vinyl cleaner, metal strips, wooden stakes, Reef tape, box of screws, Tap Cons, and roller.

NOTE:

C.I.Agent Solutions recommends a bed of washed pea stone or sand or geotextile fabric inwhich to lay the polyvinyl liner on. It is recommended that a geotextile fabric be laid over the vinyl before covering with clean, washed and screened stone, size 0.75" to 1.5", to prevent punctures in the vinyl.

AVAILABILITY:

Allow 4-5 weeks for delivery.

C.I.Agent® Polyvinyl and Barrier Boom Containment Systems carry a $4 Million Product and Environmental Insurance Policy when installed according to manufacturer's specifications and documented with photographs.

11760 Commonwealth Dr. • Louisville, KY 40299 **office** 502.267.0101 **toll free** 866.242.4368 **fax** 502.267.0181 **web** www.ciagent.com & www.ciagent-stormwater.com

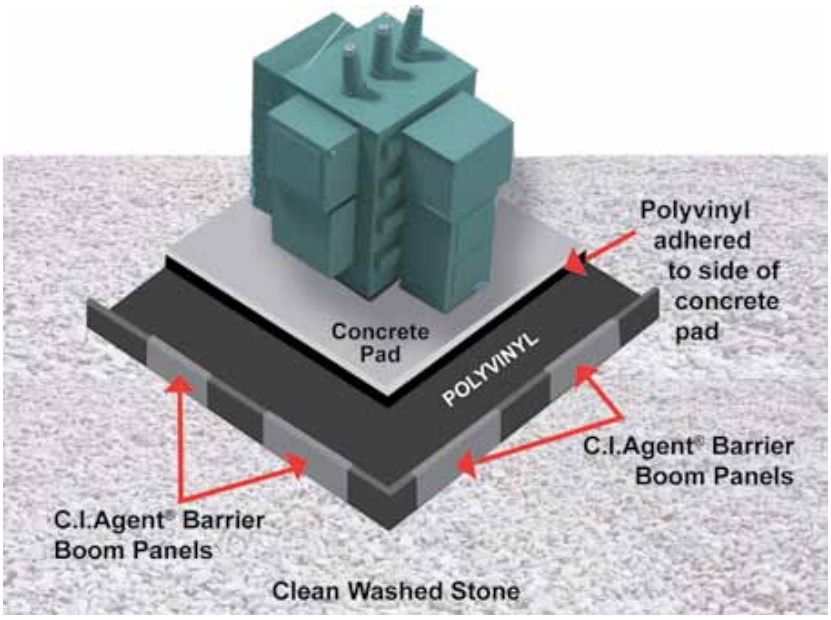
Versatile and Proven Secondary Containment Solutions

SIMPLE • COST EFFECTIVE SOLUTIONS

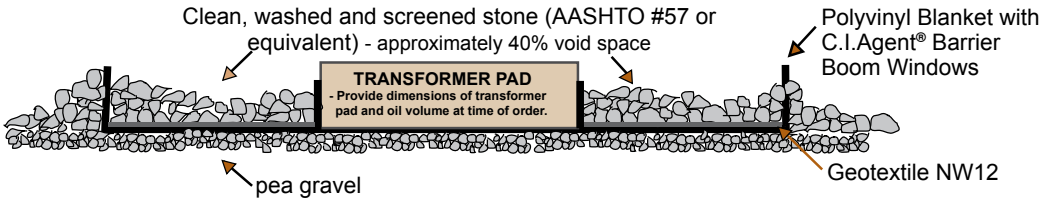
Description – C.I.Agent® 22 oz. or 40 oz. Polyvinyl and Barrier Boom Containment System
The C.I.Agent Polyvinyl and Barrier Boom Containment System ships in sections, each marked to correspond to a site map, for easy assembly in the field. It comes with pre-formed corners for height consistency and the C.I.Agent Barrier Boom walls are pre-bonded to the Polyvinyl Liner. Shipment includes the Polyvinyl Blanket, granular Bentonite® (for sealing around equipment pads, cables and conduits), polyvinyl adhesive, adhesive cleaner, roller, metal strips, wooden stakes, a roll of Reef tape, and a box of screws and Tap Cons. Quantities of supplies depend on the size of the installation.

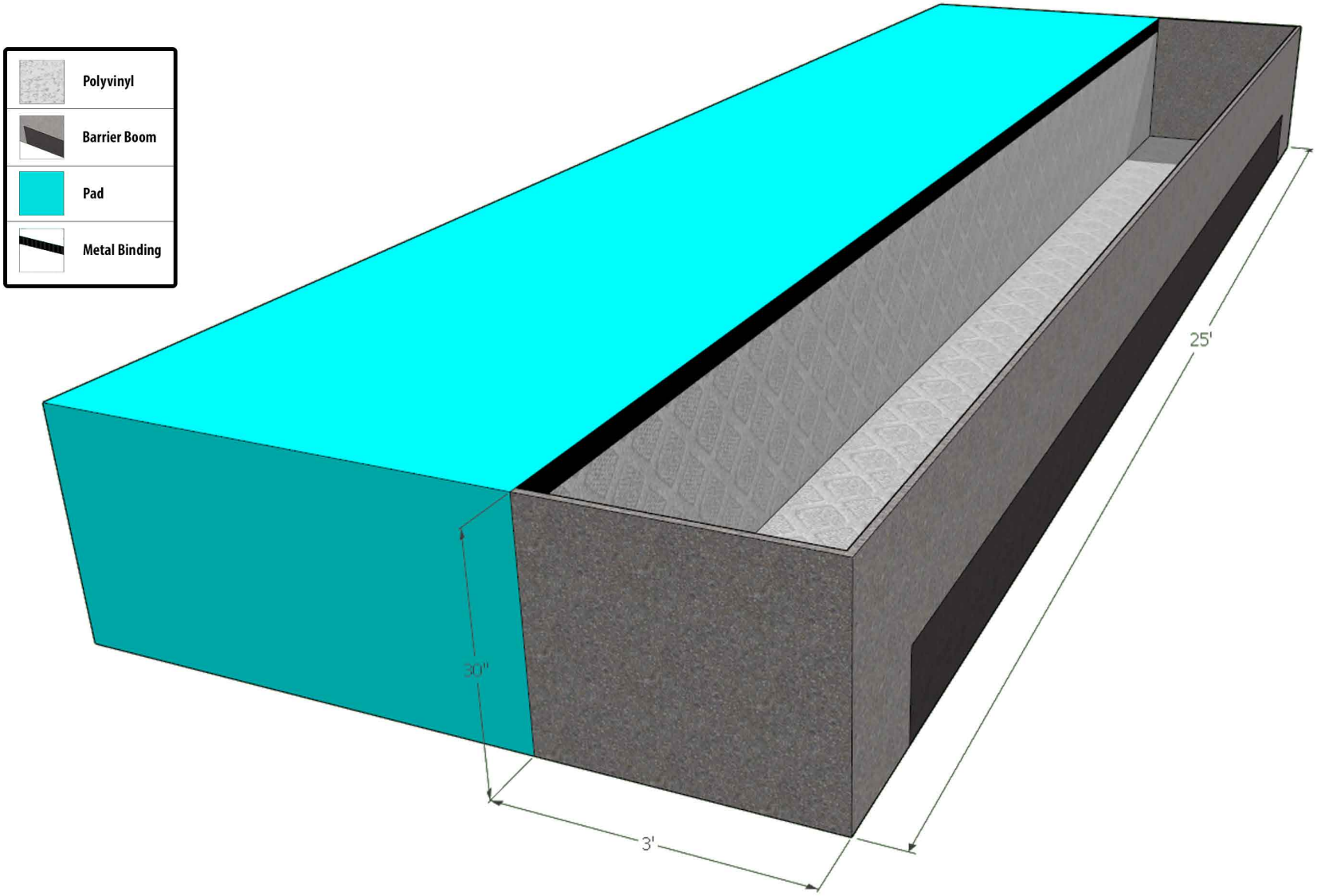
Information needed for a quote includes:
1. Drawing of the site and/or application with dimensions
2. The volume of oil being contained
3. The dimensions of the equipment pad; length and width
4. The direction of flow
5. If applicable, the depth of rock

TOP VIEW: Typical Example



SIDE VIEW: Typical Example





Legend

Utility: Northeast Remsco	Drawn by: Brent Warfield	Approved By: _____	Date: _____
Sub-name: MCUA USS400	Containment Dimensions: 25'x 3'x 30"	Northeast Remsco MCUA USS400	
Date: 10/1/2014	PVL: 22 (oz)		

RECTANGULAR SPREAD FOOTING ANALYSIS

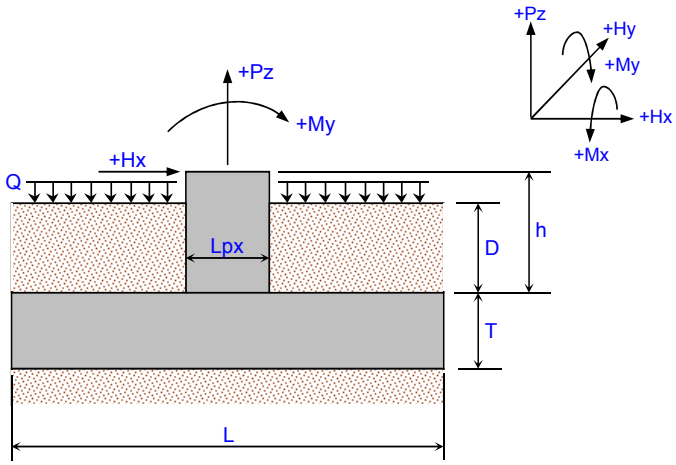
For Assumed Rigid Footing with from 1 To 8 Piers (Load Points)
Subjected to Uniaxial or Biaxial Eccentricity

Job Name:	Advanced Solar Products	Subject:	LC 6 (Controlling Downward Force)		
Job Number:	F150604A	Originator:	BMS	Checker:	

Input Data:

Footing Data:

Footing Length, L =	12.000	ft.
Footing Width, B =	4.000	ft.
Footing Thickness, T =	1.250	ft.
Concrete Unit Wt., γc =	0.150	kcf
Soil Depth, D =	0.000	ft.
Soil Unit Wt., γs =	0.000	kcf
Pass. Press. Coef., Kp =	0.000	
Coef. of Base Friction, μ =	0.570	
Uniform Surcharge, Q =	0.000	ksf

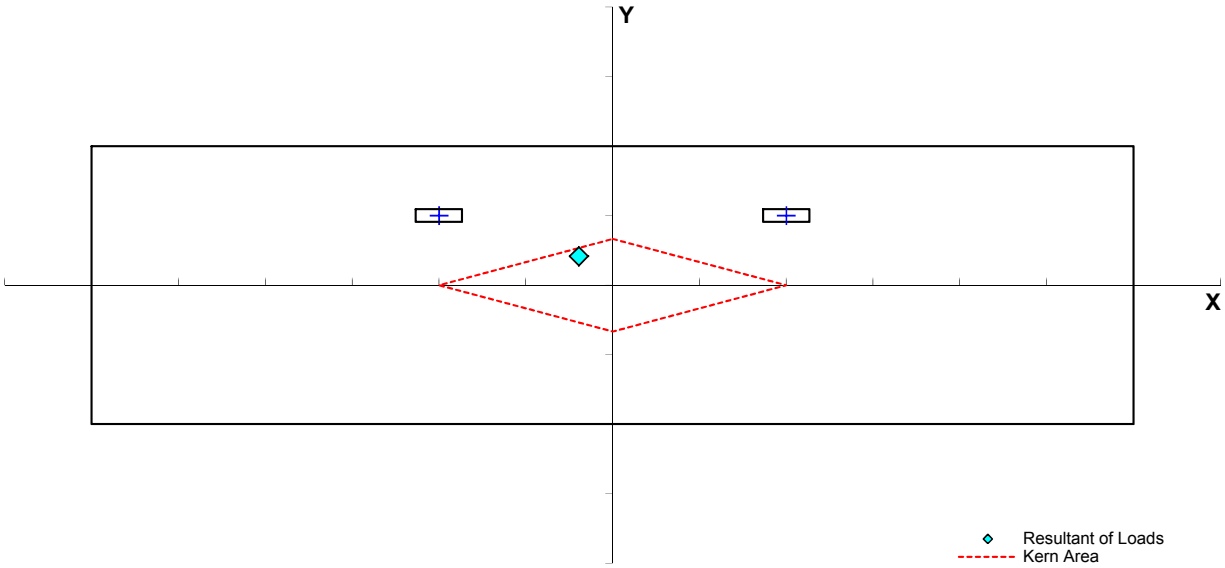


Nomenclature

Pier/Loading Data:

Number of Piers = 2

	Pier #1	Pier #2						
Xp (ft.) =	-2.000	2.000						
Yp (ft.) =	1.000	1.000						
Lpx (ft.) =	0.534	0.534						
Lpy (ft.) =	0.182	0.182						
h (ft.) =	0.000	0.000						
Pz (k) =	-3.22	-3.18						
Hx (k) =	-0.20	-0.85						
Hy (k) =	0.00	0.00						
Mx (ft-k) =	0.00	0.00						
My (ft-k) =	-1.28	-3.32						



FOOTING PLAN

(continued)

Results:

Total Resultant Load and Eccentricities:

ΣPz =	-15.40	kips
ex =	-0.39	ft. (<= L/6)
ey =	0.42	ft. (<= B/6)

Overturning Check:

ΣMrx =	N.A.	ft-kips
ΣMox =	N.A.	ft-kips
FS(ot)x =	N.A.	
ΣMry =	92.33	ft-kips
ΣMoy =	-5.91	ft-kips
FS(ot)y =	15.612	>= 1.5

Sliding Check:

Pass(x) =	0.00	kips
Frict(x) =	8.78	kips
FS(slid)x =	8.345	>= 1.5
Pass(y) =	0.00	kips
Frict(y) =	8.78	kips
FS(slid)y =	N.A.	

Uplift Check:

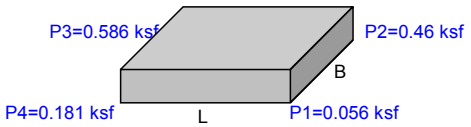
ΣPz(down) =	-15.40	kips
ΣPz(uplift) =	0.00	kips
FS(uplift) =	N.A.	

Bearing Length and % Bearing Area:

Dist. x =	N.A.	ft.
Dist. y =	N.A.	ft.
Brg. Lx =	12.000	ft.
Brg. Ly =	4.000	ft.
%Brg. Area =	100.00	%
Biaxial Case =	N.A.	6*ex/L + 6*ey/B = 0.825

Gross Soil Bearing Corner Pressures:

P_1 =	0.056	ksf
P_2 =	0.460	ksf
P_3 =	0.586	ksf
P_4 =	0.181	ksf



CORNER PRESSURES

Maximum Net Soil Pressure:

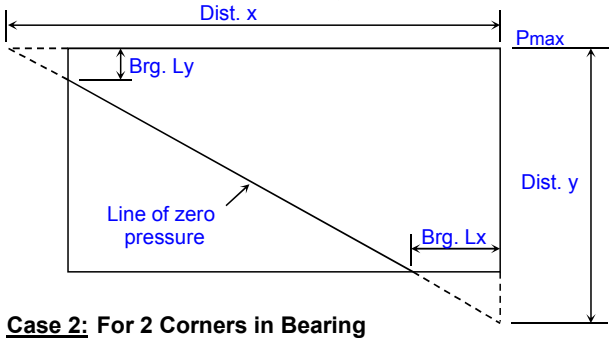
P_{max}(net) = P_{max}(gross)-(D+T)*γs

P_{max}(net) = 0.586 ksf

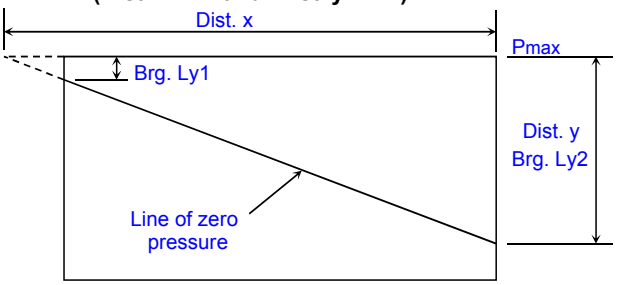
Comments:

Nomenclature for Biaxial Eccentricity:

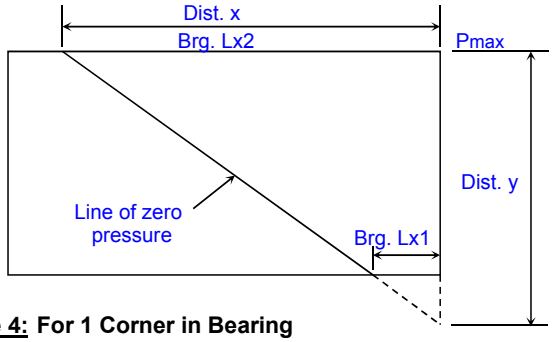
Case 1: For 3 Corners in Bearing (Dist. x > L and Dist. y > B)



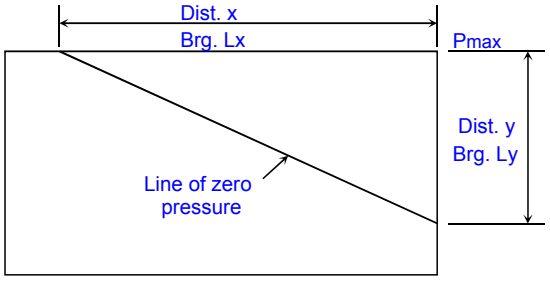
Case 2: For 2 Corners in Bearing (Dist. x > L and Dist. y <= B)



Case 3: For 2 Corners in Bearing (Dist. x <= L and Dist. y > B)



Case 4: For 1 Corner in Bearing (Dist. x <= L and Dist. y <= B)



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For Assumed Rigid Footing with from 1 To 8 Piers (Load Points)
Subjected to Uniaxial or Biaxial Eccentricity

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Job Number:	F150604A	Originator:	BMS	Checker:	

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Soil Depth, D =	0.000	ft.
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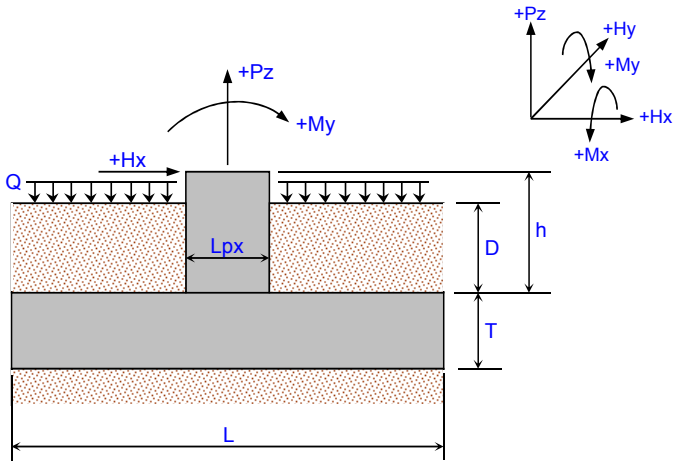
Coef. of Base Friction, μ =	0.570	
Uniform Surcharge, Q =	0.000	ksf



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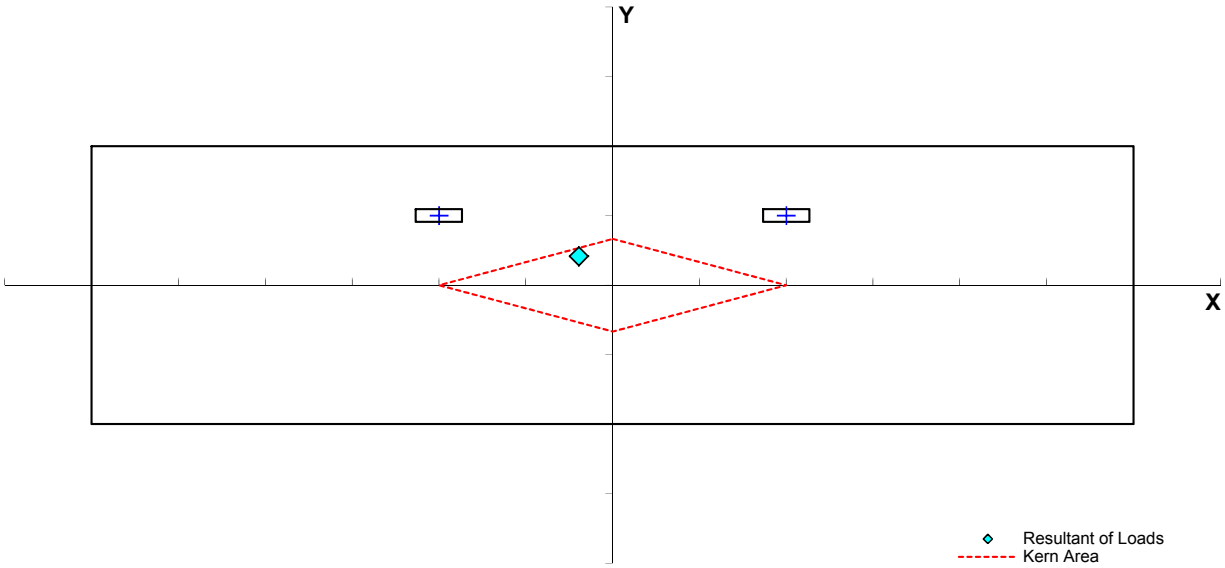

FOOTING PLAN

(continued)

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Frict(y) =	8.78	kips
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Uplift Check:

ΣPz(down) =	-15.40	kips
ΣPz(uplift) =	0.00	kips
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Dist. x =	N.A.	ft.
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Brg. Lx =	12.000	ft.
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%Brg. Area =	100.00	%
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P_3 =	0.586	ksf
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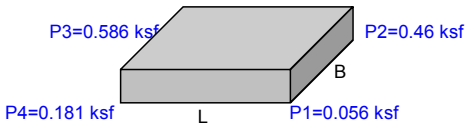

CORNER PRESSURES

Maximum Net Soil Pressure:

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P_{max}(net) = 0.586 ksf

Comments:

Nomenclature for Biaxial Eccentricity:

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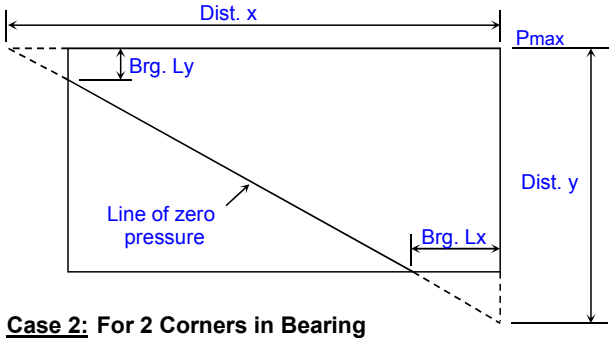
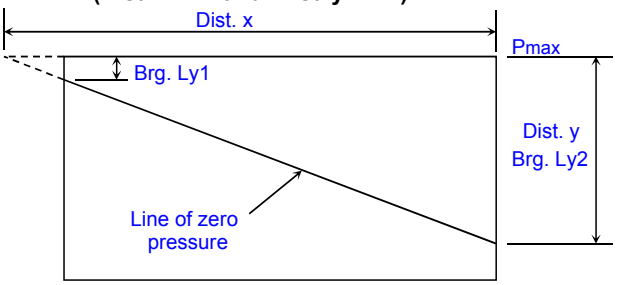
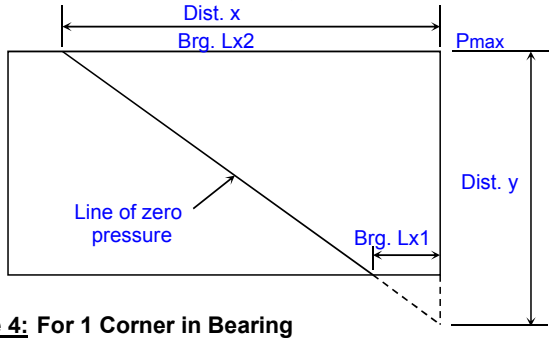


Case 2: For 2 Corners in Bearing (Dist. x > L and Dist. y <= B)



Case 3: For 2 Corners in Bearing (Dist. x <= L and Dist. y > B)



Case 4: For 1 Corner in Bearing (Dist. x <= L and Dist. y <= B)