



LCLS Engineering Specification Document #	1.3-101	Linac	Revision 1
LCLS Bend Magnet Specification			
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Brief Summary: This specification summarizes the engineering requirements for each LCLS bend magnet type.

Keywords: Bend Magnet

Key WBS#’s: 1.3.3.1; 1.3.3.2; 1.3.3.3; 1.3.3.4; 1.3.3.9; 1.3.3.11; 1.3.3.13



This document contains specification sheets that represent the engineering requirements for the different design models of LCLS Linac dipole magnets. Each sheet is a superset of requirements that will define the performance of identical magnets within a design model type. A unique WBS designation, identifying the model type, has been added to the individual specification chosen to represent the model type.

All LCLS magnets will be consistent with the latest version of the Electrical Safety Guidelines in the SLAC ES&H Manual. Particular attention must be paid to the section concerning Magnet Terminal Covers.

All LCLS magnets will conform to the LCLS Paint and Color Scheme.

All LCLS magnets will attempt to conform with, and will be reviewed against, the latest SLAC designs relating to improved magnet reliability.

All LCLS magnet design must file a SLAC DL design document in the Spires system.

All new LCLS magnet designs will have individual Magnetic Measurement Procedures that must be approved by the System Physicist.

LCLS MAGNET

4-Mar-2004

MAD Deck: LCLS02MAR04

Description:

WBS 1.3.3.13 Bend Magnet (BYW_LTU)

Magnet common name (MAD deck):	BYW1	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	3.40200
Magnet bends in X or Y:	Y	upper-limit bend-angle (mrad):	4.0
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	0.0
LCLS accelerator area:	DL2	nominal excitation current (A):	80.002
Z-location of cntr. w.r.t. cathode (m):	1252.812	upper-limit excitation current (A):	113.41
Nominal beam energy (GeV):	14.100	lower-limit excitation current (A):	0.00
Upper-limit beam energy (GeV):	17.000	nominal integrated field (kG-m):	1.60005
Lower-limit beam energy (GeV):	2.000	upper-limit integrated field (kG-m):	2.268
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	0.000
New, Relocated, or Existing magnet:	New	nominal pole-tip field (kG):	4.000
Magnet		nominal bend-angle (deg):	0.195
design designation type:	?	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	?
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	0.4000	horiz. half-width stay-clear (mm):	12
pole half-width (mm):	?	vert. half-height stay-clear (mm):	15
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.20
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	yes	y alignment tol. (mm):	1.00
trim-coil max. field fraction (%):	1.0	z alignment tol. (mm):	1.00
Power-supply		azimuthal roll tol. (mrad):	2.00
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.2
main supply "primary,micro,unit":	LGPS,LI??,?	sext field tol. (% @ r=10 mm):	2
Bipolar or Unipolar main supply:	Unipolar	N TC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.10	NA	?
approx. max. required current (A):	124.8	<i>I</i> vs <i>B</i> coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	ρ_0 (A):	0.000
total <i>N</i> magnets on main string (>0):	4	ρ_1 (A/kG):	50.000
names of other magnets on main:	BYW1, BYW2, BYW3, BYW4	ρ_2 (A/kG ²):	0.000
		ρ_3 (A/kG ³):	0.000
		ρ_4 (A/kG ⁴):	0.000
controller type:	?	ρ_5 (A/kG ⁵):	0.000
needs Shunt, Boost, or Trim supply:	Trim	ρ_6 (A/kG ⁶):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	ρ_7 (A/kG ⁷):	0.000
trim supply regulation tol. (%):	0.1	ρ_8 (A/kG ⁸):	0.000
trim supply primary,micro,unit:	?	ρ_9 (A/kG ⁹):	0.000
trim supply max. current (A):	?		

Comments:

LCLS MAGNET		3-Mar-2004	MAD Deck: LCLS02MAR04
Description:		WBS 1.3.3.9 Bend Magnet (BYD_LTU)	
Magnet common name (MAD deck):	BYD1	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	28.67200
Magnet bends in X or Y:	Y	upper-limit bend-angle (mrad):	28.7
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	28.7
LCLS accelerator area:	dump	nominal excitation current (A):	674.258
Z-location of cntr. w.r.t. cathode (m):	1651.781	upper-limit excitation current (A):	812.94
Nominal beam energy (GeV):	14.100	lower-limit excitation current (A):	95.64
Upper-limit beam energy (GeV):	17.000	nominal integrated field (kG-m):	13.48517
Lower-limit beam energy (GeV):	2.000	upper-limit integrated field (kG-m):	16.259
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	1.913
New, Relocated, or Existing magnet:	New	nominal pole-tip field (kG):	9.632
Magnet		nominal bend-angle (deg):	1.643
design designation type:	?	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	?
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	1.4000	horiz. half-width stay-clear (mm):	10
pole half-width (mm):	?	vert. half-height stay-clear (mm):	20
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.20
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	yes	y alignment tol. (mm):	1.00
trim-coil max. field fraction (%):	1.0	z alignment tol. (mm):	1.00
Power-supply		azimuthal roll tol. (mrad):	1.00
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.1
main supply "primary,micro,unit":	LGPS,LI??,?	sext field tol. (% @ r=10 mm):	1
Bipolar or Unipolar main supply:	Unipolar	N TC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.01	NA	?
approx. max. required current (A):	894.2	<i>I</i> vs <i>B</i> coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	p_0 (A):	0.000
total <i>N</i> magnets on main string (>0):	3	p_1 (A/kG):	50.000
names of other magnets on main:	BYD1, BYD2, BYD3	p_2 (A/kG ²):	0.000
		p_3 (A/kG ³):	0.000
		p_4 (A/kG ⁴):	0.000
controller type:	?	p_5 (A/kG ⁵):	0.000
needs Shunt, Boost, or Trim supply:	Trim	p_6 (A/kG ⁶):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	p_7 (A/kG ⁷):	0.000
trim supply regulation tol. (%):	0.1	p_8 (A/kG ⁸):	0.000
trim supply primary,micro,unit:	?	p_9 (A/kG ⁹):	0.000
trim supply max. current (A):	?		

LCLS MAGNET

1-Mar-2004

MAD Deck: LCLS26FEB04

Description:

WBS 1.3.3.1 Bend Magnet (BX1_BC1)

Magnet common name (MAD deck):	BX11	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	84.11600
Magnet bends in X or Y:	X	upper-limit bend-angle (mrad):	110.0
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	0.0
LCLS accelerator area:	BC1	nominal excitation current (A):	70.145
Z-location of cntr. w.r.t. cathode (m):	31.498	upper-limit excitation current (A):	110.08
Nominal beam energy (GeV):	0.250	lower-limit excitation current (A):	0.00
Upper-limit beam energy (GeV):	0.300	nominal integrated field (kG-m):	0.70145
Lower-limit beam energy (GeV):	0.210	upper-limit integrated field (kG-m):	1.101
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	0.000
New, Relocated, or Existing magnet:	New	nominal pole-tip field (kG):	3.448
Magnet		nominal bend-angle (deg):	4.819
design designation type:	?	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	0.000
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	0.2034	horiz. half-width stay-clear (mm):	50
pole half-height (mm):	?	vert. half-height stay-clear (mm):	15
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.10
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	yes	y alignment tol. (mm):	1.50
trim-coil max. field fraction (%):	1.0	z alignment tol. (mm):	2.50
Power-supply		azimuthal roll tol. (mrad):	1.00
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.01
main supply "primary,micro,unit":	LGPS,LI??,?	sext field tol. (% @ r=10 mm):	0.025
Bipolar or Unipolar main supply:	Unipolar	NTC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.02	NA	?
approx. max. required current (A):	121.1	I vs B coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	p_0 (A):	0.000
total N magnets on main string (>0):	4	p_1 (A/kG):	100.000
names of other magnets on main:	BX11, BX12, BX13, BX14	p_2 (A/kG^2):	0.000
controller type:	?	p_3 (A/kG^3):	0.000
needs Shunt, Boost, or Trim supply:	Trim	p_4 (A/kG^4):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	p_5 (A/kG^5):	0.000
trim supply regulation tol. (%):	0.02	p_6 (A/kG^6):	0.000
trim supply primary,micro,unit:	?	p_7 (A/kG^7):	0.000
trim supply max. current (A):	?	p_8 (A/kG^8):	0.000
		p_9 (A/kG^9):	0.000

LCLS MAGNET	11-Jan-2004	MAD Deck: LCLS26FEB04	
Description:	WBS 1.3.3.3 Bend Magnet (BX2_BC2)		
Magnet common name (MAD deck):	BX21	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	34.54700
Magnet bends in X or Y:	X	upper-limit bend-angle (mrad):	48.0
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	0.0
LCLS accelerator area:	BC2	nominal excitation current (A):	261.587
Z-location of cntr. w.r.t. cathode (m):	399.874	upper-limit excitation current (A):	472.33
Nominal beam energy (GeV):	4.540	lower-limit excitation current (A):	0.00
Upper-limit beam energy (GeV):	5.900	nominal integrated field (kG-m):	5.23173
Lower-limit beam energy (GeV):	3.200	upper-limit integrated field (kG-m):	9.447
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	0.000
New, Relocated, or Existing magnet:	New	nominal pole-tip field (kG):	10.461
Magnet		nominal bend-angle (deg):	1.979
design designation type:	?	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	?
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	0.5001	horiz. half-width stay-clear (mm):	40
pole half-height (mm):	?	vert. half-height stay-clear (mm):	12
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.10
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	yes	y alignment tol. (mm):	1.00
trim-coil max. field fraction (%):	1.0	z alignment tol. (mm):	2.00
Power-supply		azimuthal roll tol. (mrad):	1.00
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.01
main supply "primary,micro,unit":	LGPS,LI??,?	sext field tol. (% @ r=10 mm):	0.025
Bipolar or Unipolar main supply:	Unipolar	N TC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.05	NA	?
approx. max. required current (A):	519.6	I vs B coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	ρ_0 (A):	0.000
total N magnets on main string (>0):	4	ρ_1 (A/kG):	50.000
names of other magnets on main:	BX21, BX22, BX23, BX24	ρ_2 (A/kG ²):	0.000
		ρ_3 (A/kG ³):	0.000
controller type:	?	ρ_4 (A/kG ⁴):	0.000
needs Shunt, Boost, or Trim supply:	Trim	ρ_5 (A/kG ⁵):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	ρ_6 (A/kG ⁶):	0.000
trim supply regulation tol. (%):	0.02	ρ_7 (A/kG ⁷):	0.000
trim supply primary,micro,unit:	?	ρ_8 (A/kG ⁸):	0.000
trim supply max. current (A):	?	ρ_9 (A/kG ⁹):	0.000

LCLS MAGNET	11-Jan-2004	MAD Deck: LCLS26FEB04	
Description:	1.3.3.2 Bend Magnet (BX3_LTU)		
Magnet common name (MAD deck):	BX31	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	-8.72700
Magnet bends in X or Y:	X	upper-limit bend-angle (mrad):	-8.7
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	-8.7
LCLS accelerator area:	DL2	nominal excitation current (A):	-205.226
Z-location of cntr. w.r.t. cathode (m):	1241.940	upper-limit excitation current (A):	-29.11
Nominal beam energy (GeV):	14.100	lower-limit excitation current (A):	-247.44
Upper-limit beam energy (GeV):	17.000	nominal integrated field (kG-m):	-4.10453
Lower-limit beam energy (GeV):	2.000	upper-limit integrated field (kG-m):	-0.582
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	-4.949
New, Relocated, or Existing magnet:	Existing	nominal pole-tip field (kG):	-1.565
Magnet		nominal bend-angle (deg):	-0.500
design designation type:	4D102.36T	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	?
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	2.6230	horiz. half-width stay-clear (mm):	12
pole half-height (mm):	11.500	vert. half-height stay-clear (mm):	6
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.10
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	(unsure)	y alignment tol. (mm):	1.00
NA	?	z alignment tol. (mm):	2.00
Power-supply		azimuthal roll tol. (mrad):	1.00
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.1
main supply "primary,micro,unit":	LGPS,????,?	sext field tol. (% @ r=10 mm):	1
Bipolar or Unipolar main supply:	Unipolar	N TC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.005	NA	?
approx. max. required current (A):	272.2	I vs B coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	ρ_0 (A):	0.000
total N magnets on main string (>0):	4	ρ_1 (A/kG):	50.000
names of other magnets on main:	BX31, BX32, BX35, BX36	ρ_2 (A/kG ²):	0.000
		ρ_3 (A/kG ³):	0.000
controller type:	?	ρ_4 (A/kG ⁴):	0.000
needs Shunt, Boost, or Trim supply:	Trim	ρ_5 (A/kG ⁵):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	ρ_6 (A/kG ⁶):	0.000
trim supply regulation tol. (%):	0.01	ρ_7 (A/kG ⁷):	0.000
trim supply primary,micro,unit:	?	ρ_8 (A/kG ⁸):	0.000
trim supply max. current (A):	?	ρ_9 (A/kG ⁹):	0.000

LCLS MAGNET

3-Mar-2004

MAD Deck: LCLS02MAR04

Description:		WBS 1.3.3.11 Bend Magnet (BYPM_LTU)	
Magnet common name (MAD deck):	BYPM1	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	9.00000
Magnet bends in X or Y:	Y	upper-limit bend-angle (mrad):	9.0
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	9.0
LCLS accelerator area:	dump	nominal excitation current (A):	NA
Z-location of cntr. w.r.t. cathode (m):	1675.530	upper-limit excitation current (A):	NA
Nominal beam energy (GeV):	14.100	lower-limit excitation current (A):	NA
Upper-limit beam energy (GeV):	17.000	nominal integrated field (kG-m):	4.23293
Lower-limit beam energy (GeV):	2.000	upper-limit integrated field (kG-m):	NA
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	NA
New, Relocated, or Existing magnet:	Existing	nominal pole-tip field (kG):	4.484
Magnet		nominal bend-angle (deg):	0.516
design designation type:	?	nominal main coil voltage drop (V):	NA
magnet serial number:	?	NA	NA
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	0.9440	horiz. half-width stay-clear (mm):	15
pole half-width (mm):	?	vert. half-height stay-clear (mm):	100
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	1.00
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	no	y alignment tol. (mm):	1.00
NA	1.0	z alignment tol. (mm):	1.00
Power-supply		azimuthal roll tol. (mrad):	5.00
power-supply name or type:	none	quad field tol. (% @ r=10 mm):	0.1
main supply "primary,micro,unit":	none	sext field tol. (% @ r=10 mm):	1
Bipolar or Unipolar main supply:	Unipolar	N T/C's or klixons on magnet:	NA
rms regulation tol. of main (%):	NA	NA	NA
approx. max. required current (A):	NA	I vs B coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	NA	ρ_0 (A):	0.000
total N magnets on main string (>0):	3	ρ_1 (A/kG):	0.000
names of other magnets on main:	BYPM1, BYPM3 BYPM2,	ρ_2 (A/kG ²):	0.000
		ρ_3 (A/kG ³):	0.000
controller type:	?	ρ_4 (A/kG ⁴):	0.000
needs Shunt, Boost, or Trim supply:	none	ρ_5 (A/kG ⁵):	0.000
NA	NA	ρ_6 (A/kG ⁶):	0.000
NA		ρ_7 (A/kG ⁷):	0.000
NA		ρ_8 (A/kG ⁸):	0.000
NA		ρ_9 (A/kG ⁹):	0.000
Comments:	This is the permanent magnet safety bends (no power supply used)		

LCLS MAGNET	11-Jan-2004	MAD Deck: LCLS26FEB04	
Description:	WBS 1.3.3.4 Bend Magnet (BY_LTU)		
Magnet common name (MAD deck):	BY1	Operating point	
Magnetic type (dipole/quad):	dipole	nominal bend-angle (mrad):	2.33800
Magnet bends in X or Y:	Y	upper-limit bend-angle (mrad):	2.3
Used as corrector magnet (yes/no):	no	lower-limit bend-angle (mrad):	2.3
LCLS accelerator area:	VBSYS	nominal excitation current (A):	54.981
Z-location of cntr. w.r.t. cathode (m):	1212.224	upper-limit excitation current (A):	66.29
Nominal beam energy (GeV):	14.100	lower-limit excitation current (A):	7.80
Upper-limit beam energy (GeV):	17.000	nominal integrated field (kG-m):	1.09962
Lower-limit beam energy (GeV):	2.000	upper-limit integrated field (kG-m):	1.326
Magnet used for LCLS only (yes/no):	yes	lower-limit integrated field (kG-m):	0.156
New, Relocated, or Existing magnet:	New	nominal pole-tip field (kG):	2.749
Magnet		nominal bend-angle (deg):	0.134
design designation type:	?	nominal main coil voltage drop (V):	?
magnet serial number:	?	nominal trim setting (specify units):	?
magnet "primary,micro,unit":	BNDS,LI??,?	Installation	
effective magnetic length (m):	0.4000	horiz. half-width stay-clear (mm):	12
pole half-width (mm):	?	vert. half-height stay-clear (mm):	24
main coil resistance (ohms):	0	field accuracy w.r.t. string (%):	0.10
magnet is water-cooled (yes/no):	(unsure)	x alignment tol. (mm):	1.00
includes trim-coil (yes/no):	yes	y alignment tol. (mm):	1.00
trim-coil max. field fraction (%):	1.0	z alignment tol. (mm):	1.00
Power-supply		azimuthal roll tol. (mrad):	2.50
power-supply name or type:	?	quad field tol. (% @ r=10 mm):	0.75
main supply "primary,micro,unit":	LGPS,LI??,?	sext field tol. (% @ r=10 mm):	25
Bipolar or Unipolar main supply:	Unipolar	N TC's or klixons on magnet:	?
rms regulation tol. of main (%):	0.05	NA	?
approx. max. required current (A):	72.9	I vs B coeff's (below) Final or Temp:	Temporary
approx. max. voltage of main (V):	?	ρ_0 (A):	0.000
total N magnets on main string (>0):	2	ρ_1 (A/kG):	50.000
names of other magnets on main:	BY1, BY2	ρ_2 (A/kG ²):	0.000
		ρ_3 (A/kG ³):	0.000
controller type:	?	ρ_4 (A/kG ⁴):	0.000
needs Shunt, Boost, or Trim supply:	Trim	ρ_5 (A/kG ⁵):	0.000
trim supply is Bipolar or Unipolar:	Bipolar	ρ_6 (A/kG ⁶):	0.000
trim supply regulation tol. (%):	0.1	ρ_7 (A/kG ⁷):	0.000
trim supply primary,micro,unit:	?	ρ_8 (A/kG ⁸):	0.000
trim supply max. current (A):	?	ρ_9 (A/kG ⁹):	0.000