



## BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI3425	P052 LRRNCHJRDNMT2006	CORS ARP	N472229.026 W1070107.185	166878.8
DI2257	P049 ARMINGTON_MT2006	CORS ARP	N472059.850 W1105422.382	169571.2
DG9749	MTMS MONTANA STATE UNI	CORS ARP	N483227.426 W1094111.858	72011.9

## NEAREST NGS PUBLISHED CONTROL POINT

TK0470	MARTEN	N480917.660	W1090141.197	7017.6
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## BASE STATION INFORMATION

STATION NAME: p052 a 2 (LRRnchJrdnMT2006; Jordan, MT United States)

MONUMENT: NO DOMES NUMBER

XYZ	-1266648.1846	-4138194.5676	4670709.5484	MON @ 2005.0000 (M)
XYZ	-0.0158	0.0003	-0.0057	VEL (M/YR)
NEU	-0.0000	0.0000	0.0083	MON TO ARP (M)
NEU	0.0012	0.0008	0.0860	ARP TO L1 PHASE CENTER (M)
NEU	0.0006	-0.0006	0.1184	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1518	0.0031	-0.0550	VEL TIMES 9.6013 YRS
XYZ	-0.0016	-0.0054	0.0061	MON TO ARP
XYZ	-0.0161	-0.0551	0.0641	ARP TO L1 PHASE CENTER
XYZ	-1266648.3541	-4138194.6249	4670709.5636	L1 PHS CEN @ 2014.6022
XYZ	0.0000	-0.0000	-0.0000	+ XYZ ADJUSTMENTS
XYZ	-1266648.3541	-4138194.6249	4670709.5636	NEW L1 PHS CEN @ 2014.6022
XYZ	-1266648.3381	-4138194.5698	4670709.4995	NEW ARP @ 2014.6022
XYZ	-1266648.3364	-4138194.5645	4670709.4934	NEW MON @ 2014.6022
LLH	47 22 29.04864	252 58 52.75788	858.7208	NEW L1 PHS CEN @ 2014.6022
LLH	47 22 29.04860	252 58 52.75785	858.6348	NEW ARP @ 2014.6022
LLH	47 22 29.04860	252 58 52.75785	858.6265	NEW MON @ 2014.6022

STATION NAME: p049 a 1 (Armington\_MT2006; Belt, MT United States)

MONUMENT: NO DOMES NUMBER

XYZ	-1545099.6822	-4044895.8653	4669084.6330	MON @ 2005.0000 (M)
XYZ	-0.0157	-0.0002	-0.0067	VEL (M/YR)
NEU	-0.0000	0.0000	0.0083	MON TO ARP (M)
NEU	0.0012	0.0008	0.0860	ARP TO L1 PHASE CENTER (M)
NEU	0.0006	-0.0006	0.1184	ARP TO L2 PHASE CENTER (M)
XYZ	-0.1512	-0.0017	-0.0646	VEL TIMES 9.6013 YRS
XYZ	-0.0020	-0.0053	0.0061	MON TO ARP
XYZ	-0.0198	-0.0539	0.0640	ARP TO L1 PHASE CENTER
XYZ	-1545099.8552	-4044895.9261	4669084.6385	L1 PHS CEN @ 2014.6022
XYZ	0.0000	0.0000	0.0000	+ XYZ ADJUSTMENTS
XYZ	-1545099.8552	-4044895.9261	4669084.6385	NEW L1 PHS CEN @ 2014.6022
XYZ	-1545099.8354	-4044895.8722	4669084.5745	NEW ARP @ 2014.6022
XYZ	-1545099.8334	-4044895.8669	4669084.5684	NEW MON @ 2014.6022
LLH	47 20 59.87006	249 5 37.55750	1186.1535	NEW L1 PHS CEN @ 2014.6022
LLH	47 20 59.87002	249 5 37.55746	1186.0675	NEW ARP @ 2014.6022
LLH	47 20 59.87002	249 5 37.55746	1186.0592	NEW MON @ 2014.6022

STATION NAME: mtms a 1 (MONTANA STATE UNIVERSI; Havre, Montana, U.S.A.)

## MONUMENT: NO DOMES NUMBER

XYZ -1425435.4171 -3984013.1973 4757493.9413 MON @ 2005.0000 (M)  
 XYZ -0.0165 -0.0009 -0.0066 VEL (M/YR)  
 NEU 0.0000 0.0000 0.0000 MON TO ARP (M)  
 NEU 0.0003 0.0005 0.0559 ARP TO L1 PHASE CENTER (M)  
 NEU 0.0001 0.0005 0.0580 ARP TO L2 PHASE CENTER (M)  
 XYZ -0.1580 -0.0082 -0.0635 VEL TIMES 9.6013 YRS  
 XYZ 0.0000 0.0000 0.0000 MON TO ARP  
 XYZ -0.0119 -0.0348 0.0421 ARP TO L1 PHASE CENTER  
 XYZ -1425435.5870 -3984013.2404 4757493.9199 L1 PHS CEN @ 2014.6022  
 XYZ 0.0000 -0.0000 -0.0000 + XYZ ADJUSTMENTS  
 XYZ -1425435.5870 -3984013.2404 4757493.9199 NEW L1 PHS CEN @ 2014.6022  
 XYZ -1425435.5751 -3984013.2055 4757493.8778 NEW ARP @ 2014.6022  
 XYZ -1425435.5751 -3984013.2055 4757493.8778 NEW MON @ 2014.6022  
 LLH 48 32 27.44705 250 18 48.08174 773.4072 NEW L1 PHS CEN @ 2014.6022  
 LLH 48 32 27.44705 250 18 48.08172 773.3513 NEW ARP @ 2014.6022  
 LLH 48 32 27.44705 250 18 48.08172 773.3513 NEW MON @ 2014.6022

## REMOTE STATION INFORMATION

STATION NAME: 0187 1

## MONUMENT: NO DOMES NUMBER

XYZ -1385755.3923 -4035374.0149 4726295.6468 MON @ 2014.6020 (M)  
 NEU -0.0011 0.0007 2.0000 MON TO ARP (M)  
 NEU 0.0011 -0.0007 0.0892 ARP TO L1 PHASE CENTER (M)  
 NEU 0.0007 -0.0031 0.1016 ARP TO L2 PHASE CENTER (M)  
 XYZ -0.4333 -1.2638 1.4883 MON TO ARP  
 XYZ -0.0197 -0.0554 0.0672 ARP TO L1 PHASE CENTER  
 XYZ -1385755.8453 -4035375.3341 4726297.2022 L1 PHS CEN @ 2014.6022

BASELINE NAME: p052 0187

XYZ -0.3104 0.0357 0.5466 + XYZ ADJUSTMENTS  
 XYZ -1385756.1557 -4035375.2983 4726297.7488 NEW L1 PHS CEN @ 2014.6022  
 XYZ -1385756.1360 -4035375.2430 4726297.6817 NEW ARP @ 2014.6022  
 XYZ -1385755.7027 -4035373.9792 4726296.1934 NEW MON @ 2014.6022  
 LLH 48 7 1.45315 251 2 50.72392 968.5394 NEW L1 PHS CEN @ 2014.6022  
 LLH 48 7 1.45311 251 2 50.72395 968.4501 NEW ARP @ 2014.6022  
 LLH 48 7 1.45315 251 2 50.72392 966.4502 NEW MON @ 2014.6022

BASELINE NAME: p049 0187

XYZ -0.3119 0.0419 0.5366 + XYZ ADJUSTMENTS  
 XYZ -1385756.1572 -4035375.2922 4726297.7388 NEW L1 PHS CEN @ 2014.6022  
 XYZ -1385756.1375 -4035375.2368 4726297.6716 NEW ARP @ 2014.6022  
 XYZ -1385755.7042 -4035373.9730 4726296.1834 NEW MON @ 2014.6022  
 LLH 48 7 1.45306 251 2 50.72375 968.5283 NEW L1 PHS CEN @ 2014.6022  
 LLH 48 7 1.45302 251 2 50.72379 968.4391 NEW ARP @ 2014.6022  
 LLH 48 7 1.45306 251 2 50.72375 966.4391 NEW MON @ 2014.6022

BASELINE NAME: mtms 0187

XYZ -0.3220 0.0278 0.5463 + XYZ ADJUSTMENTS  
 XYZ -1385756.1673 -4035375.3063 4726297.7485 NEW L1 PHS CEN @ 2014.6022  
 XYZ -1385756.1476 -4035375.2509 4726297.6814 NEW ARP @ 2014.6022  
 XYZ -1385755.7143 -4035373.9871 4726296.1931 NEW MON @ 2014.6022

LLH 48 7 1.45287 251 2 50.72351 968.5467 NEW L1 PHS CEN @ 2014.6022  
 LLH 48 7 1.45283 251 2 50.72355 968.4574 NEW ARP @ 2014.6022  
 LLH 48 7 1.45287 251 2 50.72351 966.4575 NEW MON @ 2014.6022

G-FILES

Axx2014 8 8 14 8 8

B2014 8 81712 14 8 82128 1 page5 v1209.04IGS 126 1 2 27NGS 2014 811IFDDPX  
 IIGS08\_1804 IGS 20140803  
 C00090005 1191073663 9-1028205853 23 -555867000 26 X2204A0187X2204AP052  
 D 1 2 6213334 1 3 -7748236 2 3 -8945925

Axx2014 8 8 14 8 8

B2014 8 81712 14 8 82128 1 page5 v1209.04IGS 126 1 2 27NGS 2014 811IFDDPX  
 IIGS08\_1804 IGS 20140803  
 C00090001-1593441292 10 -95218939 18 -572116150 21 X2204A0187X2204AP049  
 D 1 2 6412605 1 3 -5430848 2 3 -9113943

Axx2014 8 8 14 8 8

B2014 8 81712 14 8 82128 1 page5 v1209.04IGS 126 1 2 27NGS 2014 811IFDDPX  
 IIGS08\_1804 IGS 20140803  
 C00090002 -396798608 13 513607816 32 311976847 36 X2204A0187X2204AMTMS  
 D 1 2 6663801 1 3 -8517095 2 3 -8653596

POST-FIT RMS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 06 07 08 10 11  
 p052-0187| 0.020 0.016 0.030 0.011 0.023 0.013 0.014 0.023 0.013  
 12 15 17 19 20 24 25 26 28  
 p052-0187| 0.025 0.017 ... .. 0.036 0.018 0.026 0.015 0.014  
 30  
 p052-0187| 0.011

OVERALL 01 02 04 06 07 08 10 11  
 p049-0187| 0.017 0.012 0.022 0.012 0.024 0.018 0.017 0.024 0.013  
 12 15 17 19 20 24 25 26 28  
 p049-0187| 0.020 0.018 ... .. 0.028 0.017 0.024 0.009 0.015  
 30  
 p049-0187| 0.011

OVERALL 01 02 04 06 07 08 10 11  
 mtms-0187| 0.021 0.021 0.023 0.016 0.023 0.018 0.016 ... 0.022  
 12 15 17 19 20 24 25 26 28  
 mtms-0187| 0.025 0.020 ... .. 0.032 0.018 0.028 0.021 0.015  
 30  
 mtms-0187| 0.017

OBS BY SATELLITE VS. BASELINE

OVERALL 01 02 04 06 07 08 10 11  
 p052-0187| 3548 325 166 455 301 70 140 59 180  
 12 15 17 19 20 24 25 26 28  
 p052-0187| 208 211 ... .. 224 382 59 167 399

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30
p052-0187| 202
  OVERALL  01  02  04  06  07  08  10  11
p049-0187| 3487  300  143  466  308  80  143  59  179
  12  15  17  19  20  24  25  26  28
p049-0187| 210  221  ...  ...  210  380  59  138  391
30
p049-0187| 200
  OVERALL  01  02  04  06  07  08  10  11
mtms-0187| 2921  273  147  342  286  30  84  ...  140
  12  15  17  19  20  24  25  26  28
mtms-0187| 164  199  ...  ...  162  366  34  176  346
30
mtms-0187| 172

```

Covariance Matrix for the xyz OPUS Position (meters^2).

```

0.0000007778  0.0000001248  -0.0000001491
0.0000001248  0.0000041711  -0.0000004251
-0.0000001491 -0.0000004251  0.0000058600

```

Covariance Matrix for the enu OPUS Position (meters^2).

```

0.0000010591 -0.0000007027  0.0000006303
-0.0000007027  0.0000043264  0.0000009340
0.0000006303  0.0000009340  0.0000054234

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Horizontal network accuracy = 0.00427 meters.

Vertical network accuracy = 0.00457 meters.

#### Derivation of NAD 83 vector components

Position of reference station ARP in NAD\_83(2011)(EPOCH:2010.0000).

	Xa(m)	Ya(m)	Za(m)	
P052	-1266647.47169	-4138195.81057	4670709.52375	2010.00
P049	-1545098.96458	-4044897.09606	4669084.59181	2010.00
MTMS	-1425434.69795	-3984014.42122	4757493.88638	2010.00

Position of reference station monument in NAD\_83(2011)(EPOCH:2010.0000).

	Xr(m)	Yr(m)	Zr(m)	
P052	-1266647.47009	-4138195.80517	4670709.51765	2010.00
P049	-1545098.96258	-4044897.09076	4669084.58571	2010.00
MTMS	-1425434.69795	-3984014.42122	4757493.88638	2010.00

Velocity of reference station monument in NAD\_83(2011)(EPOCH:2010.0000).

	Vx (m/yr)	Vy (m/yr)	Vz (m/yr)
P052	-0.01580	0.00030	-0.00570
P049	-0.01570	-0.00020	-0.00670
MTMS	-0.01650	-0.00090	-0.00660

Vectors from unknown station monument to reference station monument in NAD\_83(2011)(EPOCH:2010.0000).

	Xr-X= DX(m)	Yr-Y= DY(m)	Zr-Z= DZ(m)	
P052	119107.36191	-102820.60217	-55586.68135	2010.00
P049	-159344.13058	-9521.88776	-57211.61329	2010.00
MTMS	-39679.86595	51360.78178	31197.68738	2010.00

## STATE PLANE COORDINATES - International Foot

SPC (2500 MT )	
Northing (Y) [feet]	1410266.191
Easting (X) [feet]	2102174.816
Convergence [degrees]	0.40045445
Point Scale	0.99957906
Combined Factor	0.99942758

\*\* Orthometric Heights Above Future Geopotential Datum.

Prototype orthometric heights are now being made available as a precursor to the completion of GRAV-D and the replacement of NAVD 88 with a new geopotential reference system. The following height reflects the current best estimate of the true orthometric height, based on the existing gravimetric geoid model. This height is subject to change as data and modeling for the gravimetric geoid change throughout the lifetime of the GRAV-D project, or as new realizations of the ITRF are adopted. However, at the completion of GRAV-D, these heights will supersede the NAVD 88 heights

APPROX ORTHO HGT: 981.375 (m) [PROTOTYPE (Computed using USGG2012,GRS80,IGS08)]

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.