MAGNETIC BRAKE SYSTEMS

A DIVISION OF TECHNICAL FILM SYSTEMS, INC.

DYNAMOMETER DATA SHEET

(Version 1.1)

MODELS:

DB5B-8.7-BM DB5M-8.7-BM
DB5B-8.7-FM DB5M-8.7-FM

Maximum continuous power dissipation:	6.6 HP (4.9 kW)
Maximum power for 30 seconds:	15 HP (11.2 kW)
Maximum continuous brake torque:	212 in-lbs. (24 Nm)
Maximum Brake Torque:	250 in-lbs. (28.2 Nm)
Maximum Brake Speed:	6,000 RPM

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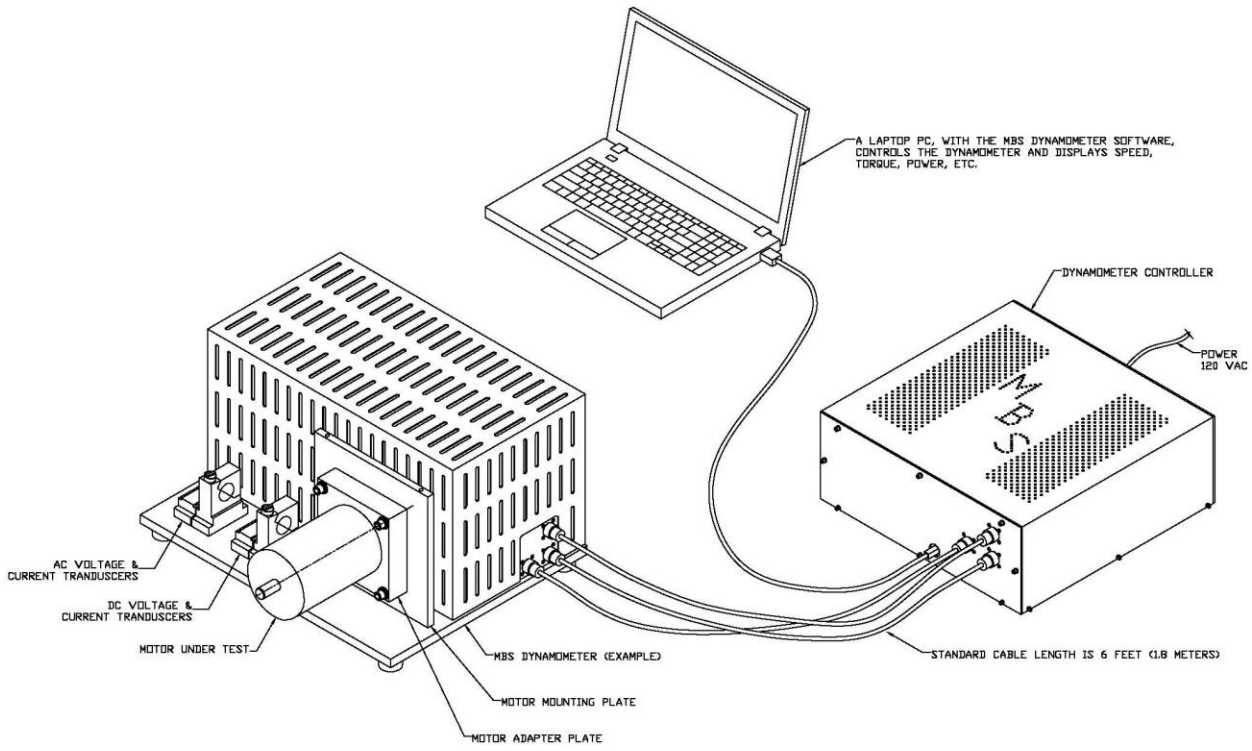
1. OVERVIEW

This data sheet is a reference for the performance specifications of the dynamometer models listed on the cover page.

The MBS dynamometers may be used to test just about any type of motor (i.e. electric, hydraulic, pneumatic, reciprocating). Types of testing include: endurance testing, speed versus torque curves, measure stall torque, efficiency, temperature rise, performance verification, etc. MBS dynamometers are sold as complete systems (shown in image below) that include: the dynamometer, controller, computer with software, calibration weight, manual and all cables. Our systems do not require annual fees, licenses or permits. The software is user friendly, is very configurable (i.e. changing units, display scale limits, data acquisition rate, etc.) and has some safety precautions build in to prevent damage to the motor under test and/or the system (i.e. brake temperature sensor, setting current limit, setting power limit, trigger input signals).



The nomenclature of the dynamometer part number is described at the end of this document. The power dissipation rating for this system is located on the bottom of the cover page. This data sheet may also be used to determine the best configuration for a system.

Dynamometers, or more specifically the size of the brakes for the dynamometers, are selected based on the required power dissipation and required torque.

A belt coupled system will provide a much broader range of torque supplied to the motor under test, which makes a dynamometer more cost effective and diverse than a direct drive system.

The location of the load cell is optional but must be decided prior to purchasing a dynamometer. Placing the load cell so that it measures the torque of the motor (i.e. Model DB5M-8.7-FM) may provide the most accurate torque readings; however, the range of torque that the system can measure is limited to the maximum load of the load cell and the accuracy at low loads; this can be seen in Section 3, Motor Torque and Speed, Section 5, Load Cell Accuracy Plots, and is cross-referenced with Table 7, Load Cell Reference.

Alternatively, placing the load cell so that it measures the torque of the brake (i.e. Model DB5B-8.7-FM) allows a much broader range of load torque to the motor; however, now the load cell will not measure belt friction, bearing friction and any other minor losses. Bearing friction is usually negligible and a properly aligned belt may have an efficiency as high as 98%. When measuring the brake torque, the air drag from the brake is not measured; however, the dynamometer software compensates for the air drag.

The motor torque, speed, voltage and current ranges (and types; i.e. DC, AC, AC-3ph) need to be specified when purchasing a dynamometer in order to select the limits for the instrumentation. The following performance specifications for load cells, transducers, etc., are based on vendor specifications.

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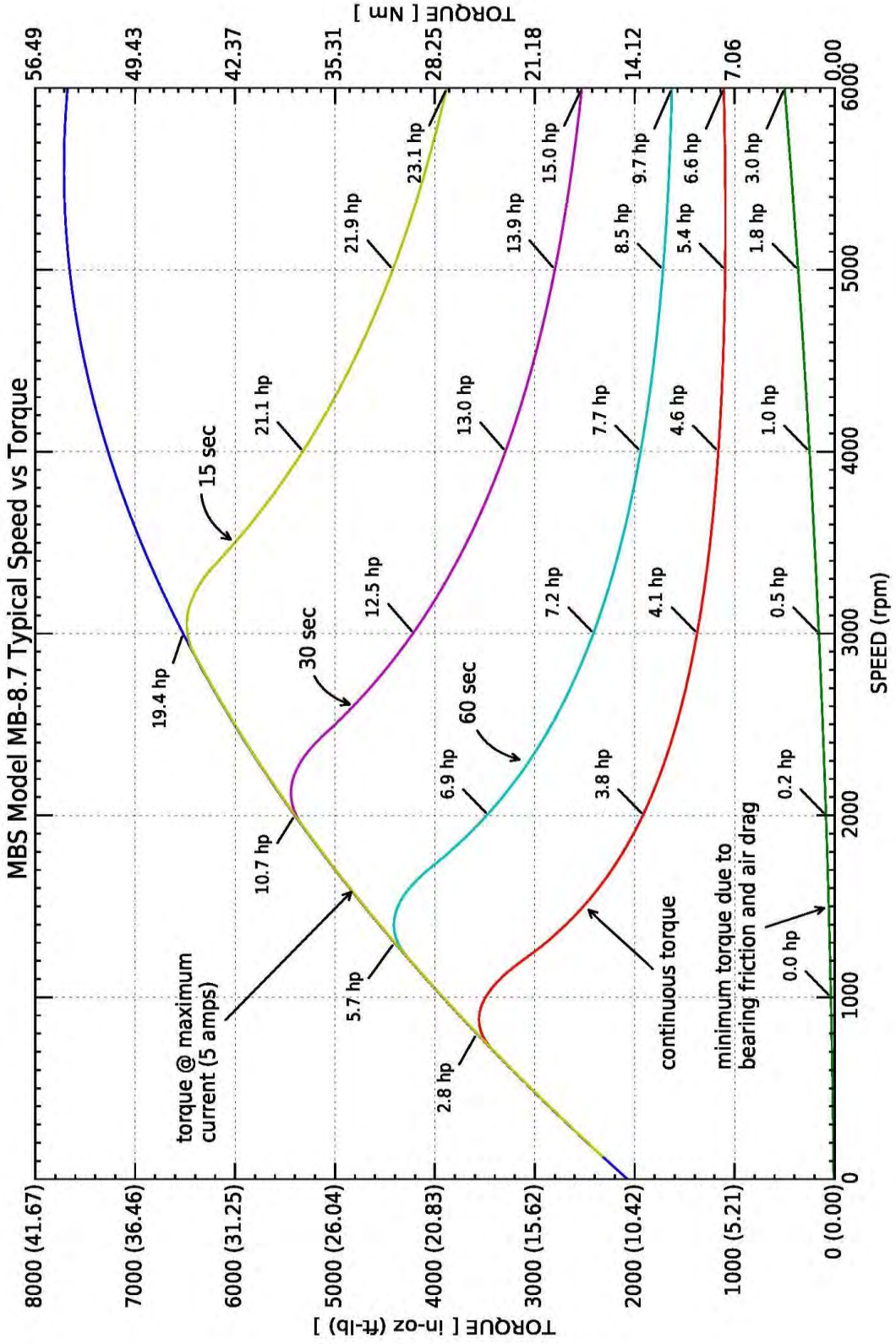
2. SPEED vs. TORQUE CURVE – FOR ONE MB-8.7 BRAKE



3. MOTOR TORQUE & SPEED

For a system measuring the motor torque (as opposed to the brake torque) Tables 1 through 6 may be referenced for helping select the pulley ratios based on the required torque to the motor and motor speed. The "L.C. Ref. #," represents the minimum rating of the load cell. Cross referencing this table with the Torque Accuracy Plots, section 5, will show the load cell accuracy for range of testing required.

3.1 Pulley Ratio's (English Units)

Motor_Spd (RPM)	Motor_Tq. (in-lbs.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-lbs.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	500	0	4:1	125	0	cont.	7
225	875	3.1	4:1	219	900	cont.	8
550	400	3.9	4:1	100	2,200	cont.	6
550	1,372	12.0	4:1	343	2,200	30	9
900	300	4.3	4:1	75	3,600	cont.	5
900	900	12.9	4:1	225	3,600	30	8
1,500	276	6.6	4:1	69	6,000	cont.	5
1,500	632	15	4:1	158	6,000	30	8

Table 1: Speed, Torque & Power (SI Units) 4:1 Pulley Ratio

Motor_Spd (RPM)	Motor_Tq (in-lbs.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-lbs.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	125	0	4:1	125	0	cont.	3
1,000	218	3.5	4:1	218	1,000	cont.	4
1,800	125	3.6	4:1	125	1,800	cont.	3
1,800	324	9.3	4:1	324	1,800	30	6
3,600	75	4.3	4:1	75	3,600	cont.	2
3,600	225	12.9	4:1	225	3,600	30	4
6,000	69	6.6	4:1	69	6,000	cont.	2
6,000	158	15	4:1	158	6,000	30	3

Table 2: Speed, Torque & Power (SI Units) 1:1 Pulley Ratio

Motor_Spd (RPM)	Motor_Tq (in-lbs.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-lbs.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	31.3	0	4:1	125	0	cont.	1
4,000	54.5	3.5	4:1	218	1,000	cont.	2
10,000	25.0	3.9	4:1	100	2,500	cont.	1
10,000	78.1	12.4	4:1	312	2,500	30	1
13,500*	20.3	4.3	4:1	81.25	3,375	cont.	1
13,500*	59.4	12.7	4:1	237.5	3,375	30	1
17,300*	18.3	5.03	4.091:1	75.0	4,229	cont.	1
17,300*	48.9	13.4	4.091:1	200	4,229	30	1

Table 3: Speed, Torque & Power (SI Units) 1:4 Pulley Ratio

The table is based on the performance graph for the MB-8.7 Brake, shown in Section 2.
* Maximum speed is limited to the physical speed limits of the pulleys and belt.
** See Table 7 for L.C. (Load Cell) specifications based on the number shown.

3.2 Pulley Ratio's (SI Units)

Motor_Spd (RPM)	Motor_Tq (Nm)	Power (kW)	Pulley Ratio (mtr/brk)	Brake_Tq (Nm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	56.48	0	4:1	14.12	0	cont.	7
225	98.8	2.3	4:1	24.7	900	cont.	8
550	45.2	2.9	4:1	11.3	2,200	cont.	6
550	155.2	8.95	4:1	38.8	2,200	30	9
900	33.9	3.2	4:1	24.63	1,000	cont.	5
900	101.7	9.6	4:1	14.12	1,800	cont.	8
1,500	31.2	4.9	4:1	36.61	1,800	30	5
1,500	71.4	11.2	4:1	8.47	3,600	cont.	8

Table 4: Speed, Torque & Power (SI Units) 4:1 Pulley Ratio

Motor_Spd (RPM)	Motor_Tq (Nm)	Power (Kw)	Pulley Ratio (mtr/brk)	Brake_Tq (Nm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. #**
0	14.12	0	1:1	14.12	0	cont.	3
1,000	24.63	2.6	1:1	24.63	1,000	cont.	4
1,800	14.12	2.7	1:1	14.12	1,800	cont.	3
1,800	36.61	6.9	1:1	36.61	1,800	30	6
3,600	8.47	3.2	1:1	8.47	3,600	cont.	2
3,600	25.42	9.6	1:1	25.42	3,600	30	4
6,000	7.79	5.8	1:1	7.79	6,000	cont.	2
6,000	17.85	11.2	1:1	17.85	6,000	30	3

Table 5: Speed, Torque & Power (SI Units) 1:1 Pulley Ratio

Motor_Spd (RPM)	Motor_Tq (Nm)	Power (kW)	Pulley Ratio (mtr/brk)	Brake_Tq (Nm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. #**
0	3.54	0	1:4	14.12	0	cont.	1
4,000	6.16	2.6	1:4	24.63	1,000	cont.	2
10,000	2.82	2.9	1:4	14.12	2,500	cont.	1
10,000	8.82	9.2	1:4	36.61	2,500	30	1
13,500*	2.29	3.2	1:4	8.47	3,375	cont.	1
13,500*	6.71	9.4	1:4	25.42	3,375	30	1
17,300*	2.07	3.75	4.091:1	8.47	4,229	cont.	1
17,300*	5.52	9.996	4.091:1	22.6	4,229	30	1

Table 6: Speed, Torque & Power (SI Units) 1:4 Pulley Ratio

The table is based on the performance graph for the MB-8.7 Brake, shown in Section 2.
* Maximum speed is limited to the physical speed limits of the pulleys and belt.
** See Table 7 for L.C. (Load Cell) specifications based on the number shown.

3.3 Load Cell Size

Table 7 is a reference for dynamometers that measure the motor torque. The load cell(s) for the system should be specified by their load rating (column 2 or 3).

Load Cell Ref. #	Load Rating (lbs.)	Load Rating (Kg.)	Arm (inches [cm])	Max Torque (in-lbs.)	Max Torque (Nm)
1	13	6	4 [10.16]	52.9	6
2	22	10	4 [10.16]	88.5	10
3	44	20	4 [10.16]	179	20
4	66	30	4 [10.16]	264	30
5	77	35	4 [10.16]	309	35
6	100	45	4 [10.16]	400	45
7	150	68	4 [10.16]	600	68
8	250	113	4 [10.16]	1,000	113
9	500	226	4 [10.16]	2,000	226

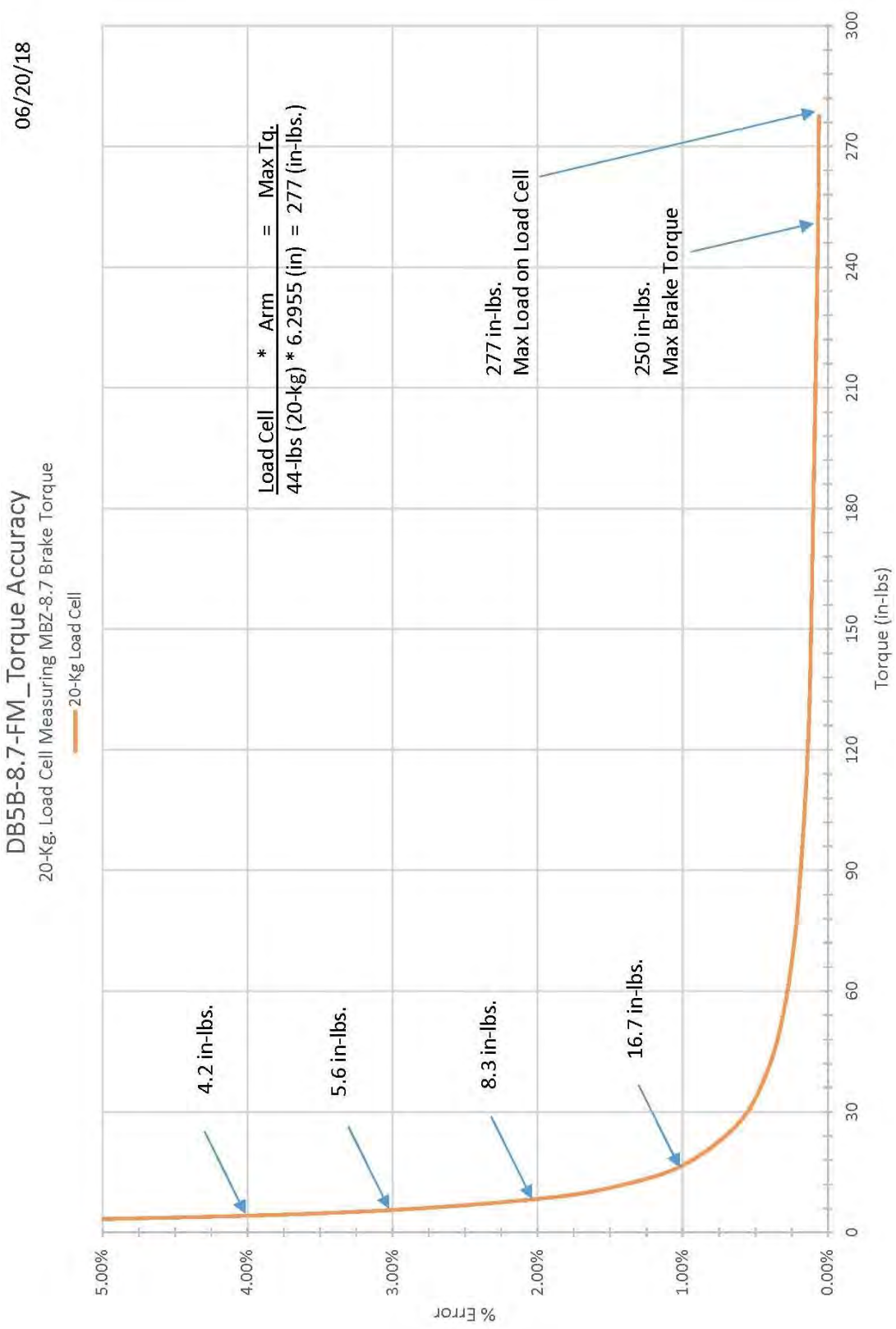
Table 7: Load Cell Reference

The following sections, 4 & 5, are the specifications for the different types of load cells.

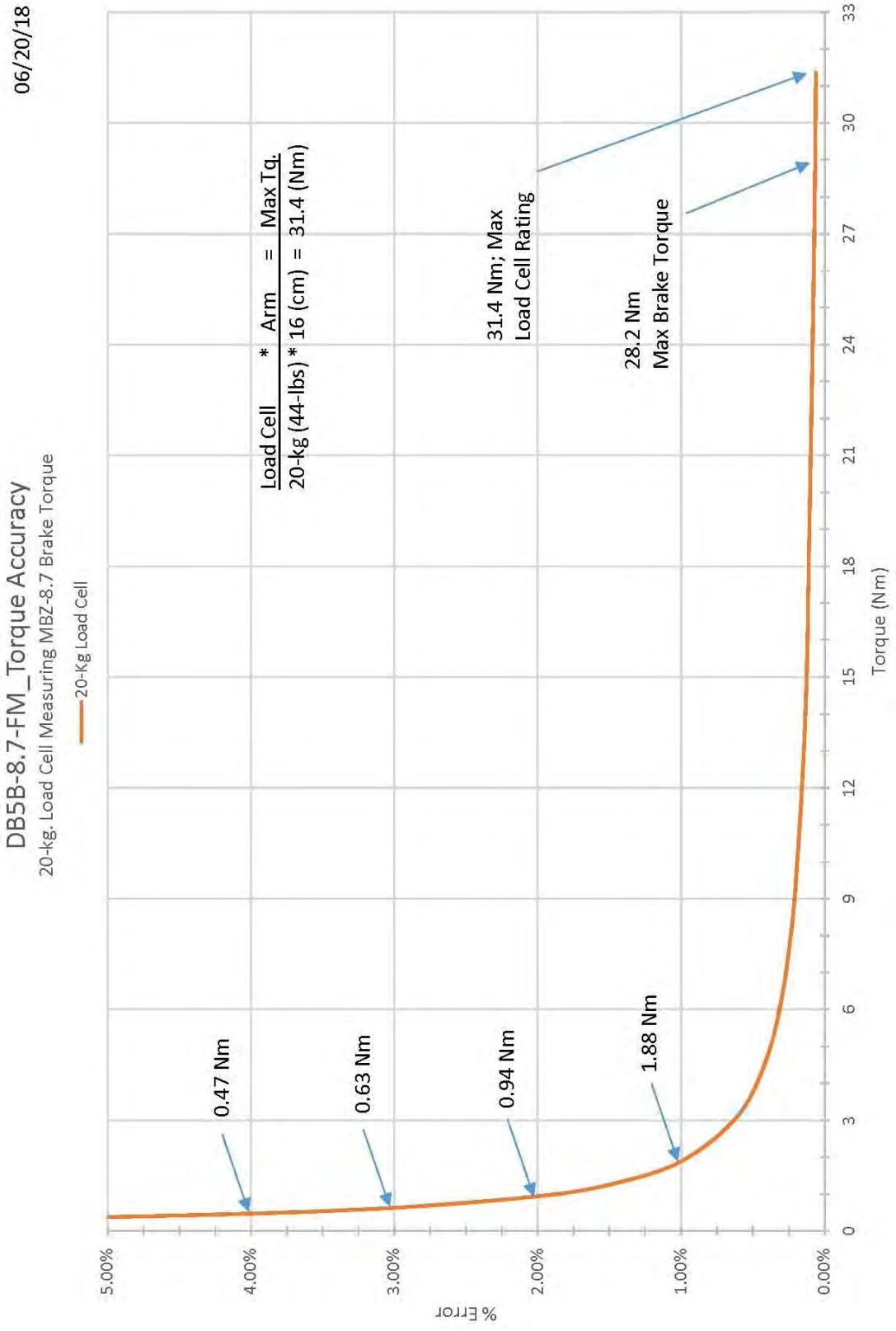
4. LOAD CELLS (Option 1: DB5B-8.7-FM, Measure Brake Torque)

Max Load Cell Rating ..... 44 lbs. (20-kg.)
Torque Arm 6.296-inches (16-cm)
Max Load Cell Rating ..... 277 in-lbs. (31-Nm)
Max Brake Torque ..... 250 in-lbs. (28-Nm)
Non-Linearity ..... 0.02% of Rated Output (R.O.)
Hysteresis ..... 0.02% of R.O.
Non-Repeatability ..... 0.02% of R.O.
Zero Balance ..... ±1% of R.O.
Compensated Temperature Range ..... 14°F to 104°F
Safe Temperature Range ..... 14°F to 140°F
Temperature Effect on Output ..... 0.002% of Load/°F
Temperature Effect on Zero ..... 0.002% of Load/°F
Safe Overload ..... 150% of R.O.*

4.1 Load Cell Accuracy Plot (in-lbs.) – DB5B-8.7-FM



4.2 Load Cell Accuracy Plot (Nm) – DB5B-8.7-FM



5. LOAD CELLS (Option 2: DB5M-8.7-FM, Measure Motor Torque)

5.1 Type I (Low Load)

Max Load Cell Load Rating (lbs.)	13, 22, 44, 66, 77
Max Load Cell Load Rating (kg.)	6, 10, 20, 30, 35
Torque Arm	4 inches (10.16 cm)
Torque Ratings (in-lbs.)	53, 88.5, 179, 264, 309
Torque Ratings (Nm)	6, 10, 15, 20, 25, 30, 35
Non-Linearity	0.02% of R.O.
Hysteresis	0.02% of R.O.
Non-Repeatability	0.02% of R.O.
Zero Balance	±1% of R.O.
Compensated Temperature Range	14°F to 104°F
Safe Temperature Range	14°F to 140°F
Temperature Effect on Output	0.002% of Load/°F
Temperature Effect on Zero	0.002% of Load/°F
Safe Overload	150% of R.O.*

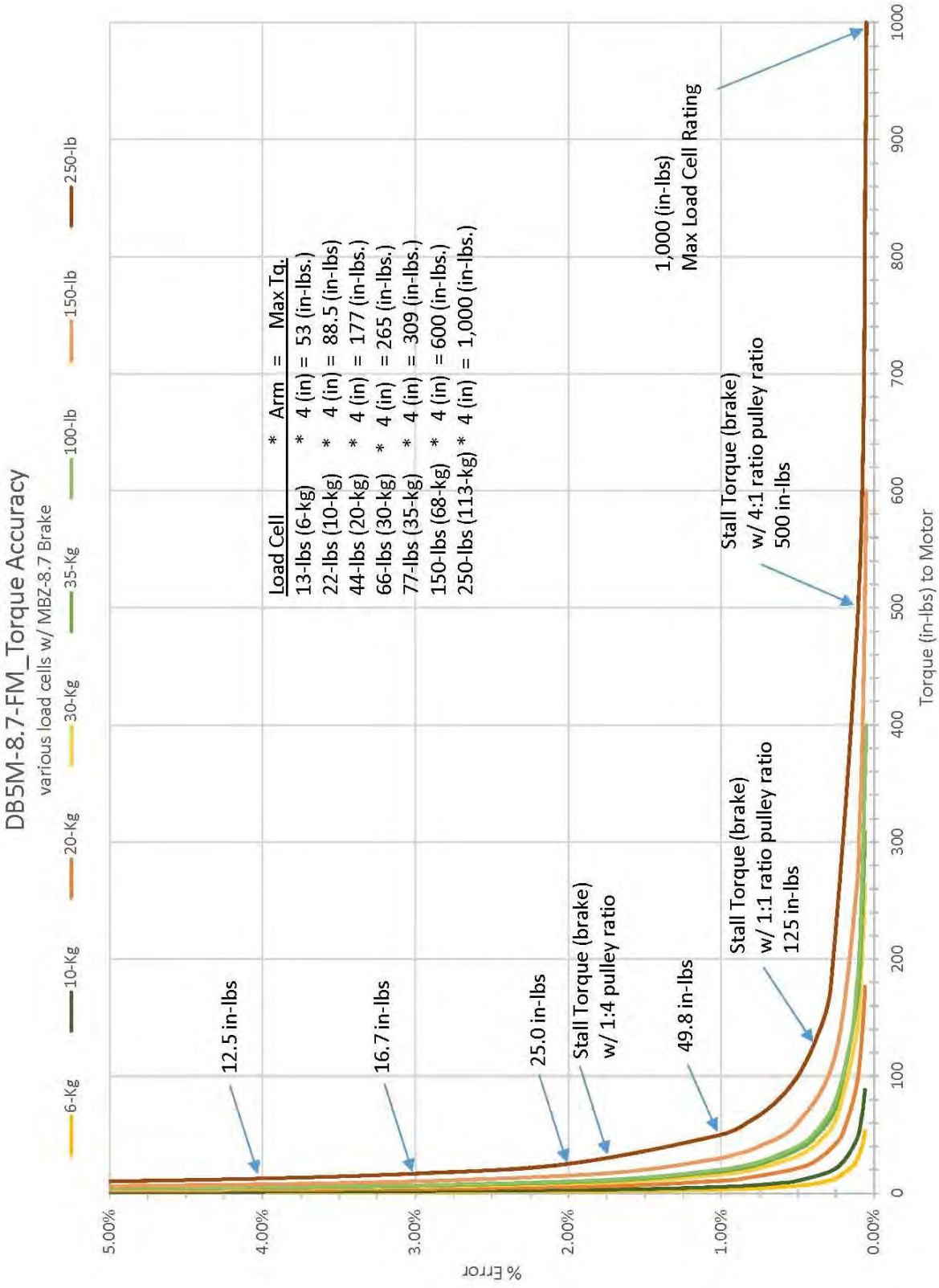
5.2 Type II (High Load)

Max Load Cell Load Rating (lbs.)	100, 150, 250, 500
Max Load Cell Load Rating (kg.)	45, 68, 113, 226
Torque Arm	4 inches (10.16 cm)
Torque Ratings (in-lbs.)	400, 600, 1,000, 2,000
Torque Ratings (Nm)	45, 68, 113, 226
Non-Linearity	0.03% of R.O.
Hysteresis	0.02% of R.O.
Zero Balance	±1% of R.O.
Operating Temperature Range	-40°F to 150°F / -40°C to 65°C
Temperature Effect on Output	0.002% of Load/°F
Temperature Effect on Zero	0.002% of Load/°F
Safe Overload	150% of R.O.*

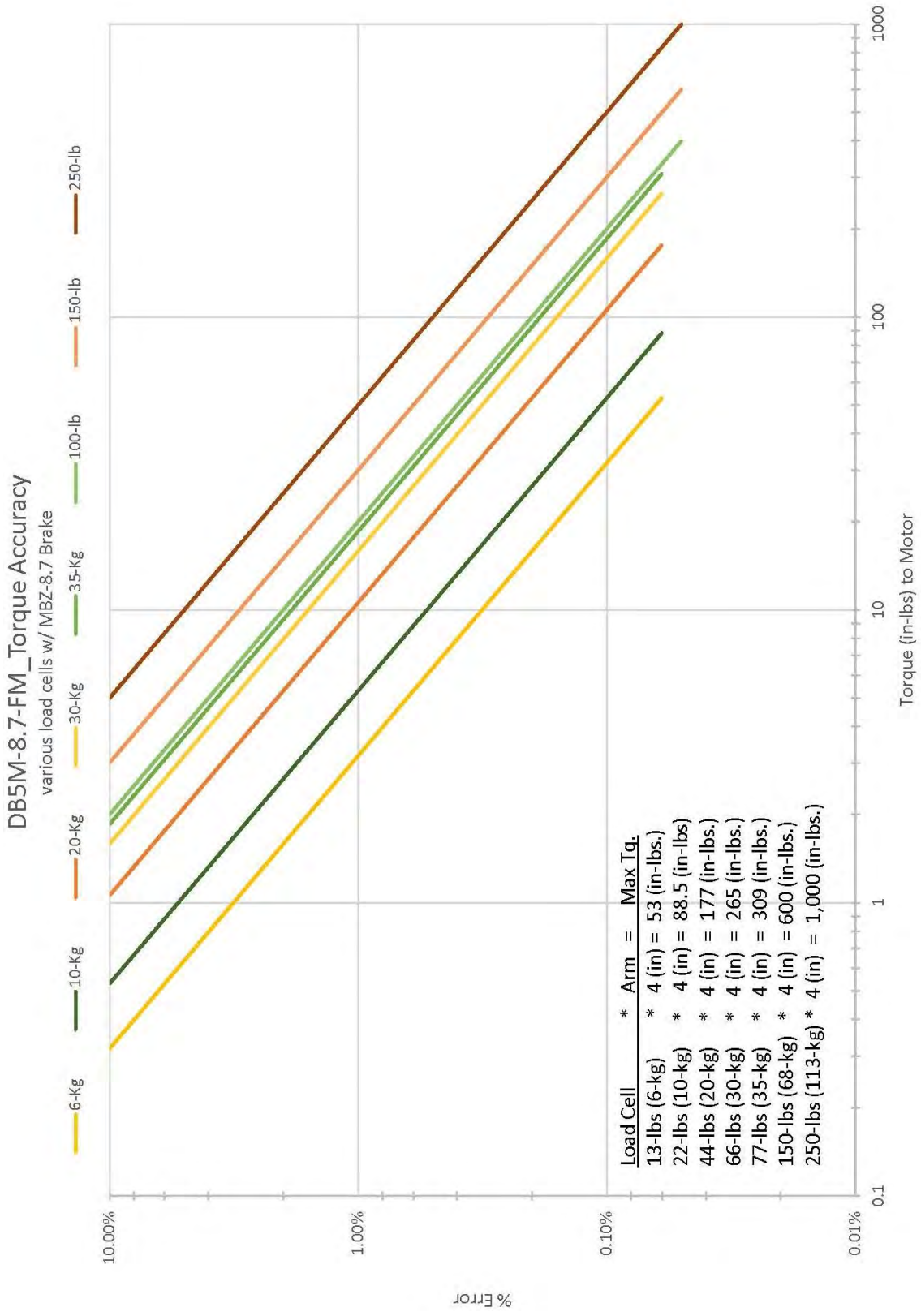
* Hard stops are in place to help prevent damage from over-load.

The Torque Accuracy plots, 5.3 through 5.6, show the percentage error as a function of measured torque. These plots show the range that a load cell will accurately measure. Plots are shown on a linear scale and, for clarity, on a logarithmic scale. The maximum torque to the motor is based on the pulley ratio selected for belt coupled systems. The error plot is based on published data from the vendor for the load cell.

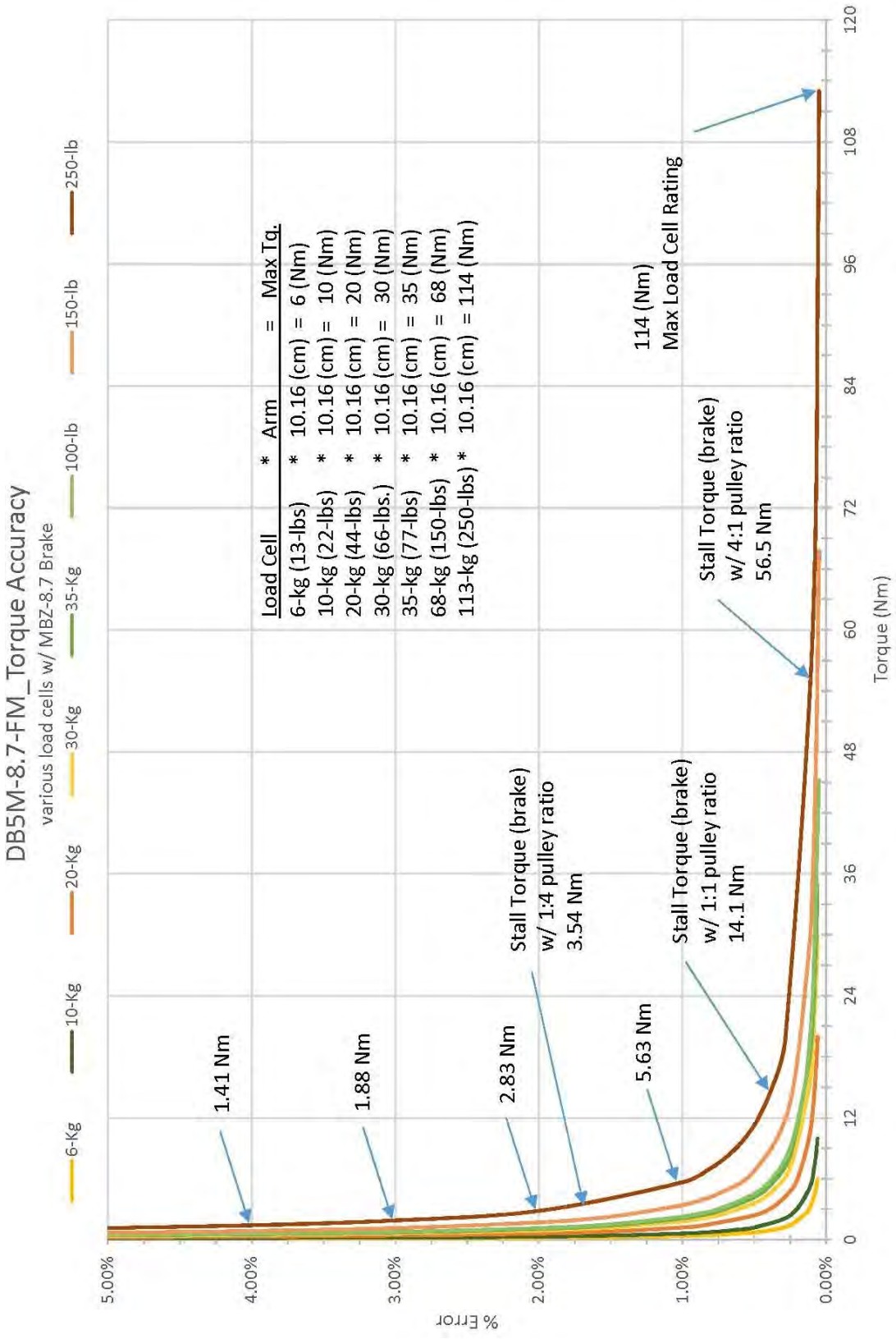
5.3 Load Cell Accuracy Plot – Motor (in-lbs.) – Linear



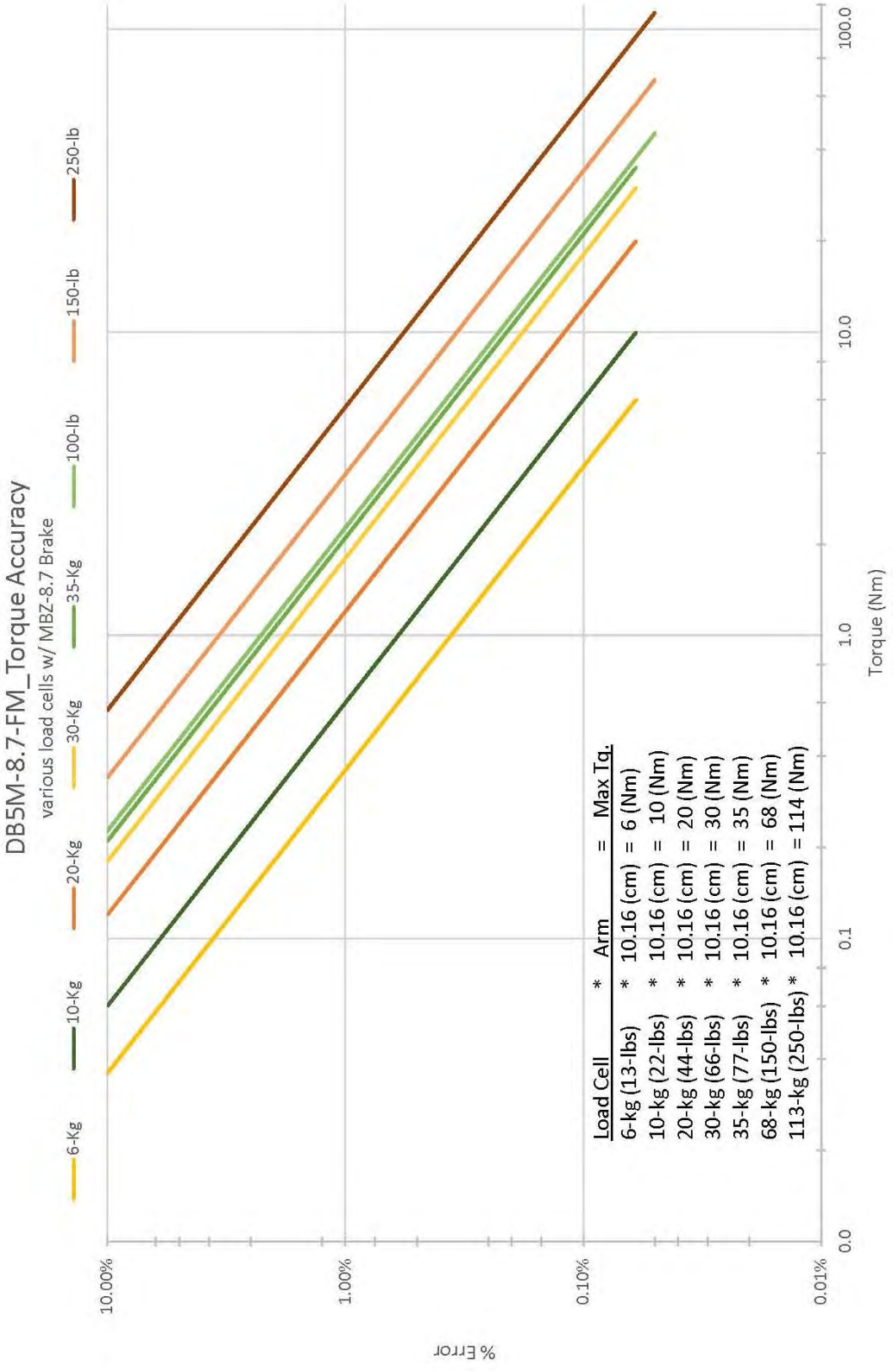
5.4 Load Cell Accuracy Plot - Motor (in-lbs.) – Logarithmic



5.5 Load Cell Accuracy Plot - Motor (Nm) – Linear



5.6 Load Cell Accuracy Plot – Motor (Nm) – Logarithmic



6. SPEED

A standard brake has five magnets (alternative quantity are optional) which trigger a hall effect sensor. The speed is averaged over one revolution of the brake. A 48-MHZ clock is used to measure the time between magnets.

Parameter	Conditions	Min.	Typ.	Max.	Units
Clock Error	~25°C		±30		PPM
	-10°C to 60°C		±50		PPM
	-40°C to 85°C		±100		PPM
Brake Speed	5 magnets	12		180*	KPM
	30 magnets	2		30*	KPM

* Theoretical speed; actual maximum speed is limited to the speed of the brake.

7. SAMPLING

Sampling is the frequency of measuring and recording data; this rate is adjustable by the operator.

Parameter	Conditions	Min.	Typ.	Max.	Units
Sampling Rate	2.3 GHz Proc.	20	50	-	ms

i.e. 50 ms = 20 samples (or readings) per second.

8. LAPTOP COMPUTER

Parameter	Conditions	Min.	Typ.	Max.	Units
Processor		2.3	GHz		
Memory		8	GB		
Display	LED LCD		15.6		inches

9. POWER REQUIREMENTS

The MBS Dynamometer requires two 115 or 230 VAC power outlets: one for the laptop computer and one for the controller. The brakes in the dynamometer structure receive power from the controller.

Item	Voltage	Type	Current (amps)	Freq. (Hz)	# Plugs
Controller	115/230	VAC	1.1/0.6	50/60	1
Laptop	110-240	VAC	1.2	50/60	1
Dynamometer	24	VDC	6.0	-	none

10. DC VOLTAGE TRANSDUCERS

10.1 Input

Range	0 VDC to: 1, 5, 10, 50, 150, 200 up to 600 VDC
Overload	2x voltage range selected
Frequency Range	DC only

10.2 Output

Basic Accuracy	1.0%
Linearity	10% to 100% F.S.
Thermal Drift	500 PPM/°C
Response Time	250 ms

10.3 Environmental and Physical Characteristics

Operating Temperature	0°C to +50°C
Insulation Category	CAT II
Vibration Tested to	IEC 60068-2-6, 1995
Pollution Degree	2
Altitude	2000-meter max.
Insulation Voltage	2500 VDC
MTBF	Greater than 100K hours
Relative Humidity	5% to 95%, non-condensing
Weight	0.5 lbs.

11. AC VOLTAGE TRANSDUCERS – SINGLE PHASE

11.1 Input

Range	0 VAC to: 50, 150, 250, 500, 600 VAC
Overload	2x voltage range selected
Frequency Range	20 Hz to 5 kHz

11.2 Output

Basic Accuracy	0.5%
Linearity	10% to 100% F.S.
Calibration	True RMS sensing
Thermal Drift	500 PPM/°C
Response Time	250 ms

11.3 Environmental and Physical Characteristics

Operating Temperature	0°C to +60°C
Insulation Category	CAT II
Vibration Tested to	IEC 60068-2-6, 1995
Pollution Degree	2
Altitude	2000-meter max.
Insulation Voltage	2500 VDC
MTBF	Greater than 100K hours
Relative Humidity	5% to 95%, non-condensing
Weight	0.5 lbs.

12. DC CURRENT TRANSDUCERS (Split Core)

12.1 Input

Range ..... 0 ADC to: 2, 5, 10, 20, 30, 50, 75, 100, 150, 300 up
..... to 600 ADC Overload 4x current range selected
Frequency Range ..... DC only

12.2 Output

Basic Accuracy 1.0%
Linearity ..... 10% to 100% F.S.
Thermal Drift ..... 500 PPM/°C
Response Time ..... 250 ms

12.3 Environmental and Physical Characteristics

Operating Temperature..... 0°C to +50°C
Insulation Category..... CAT II
Vibration Tested to ..... IEC 60068-2-6, 1995
Pollution Degree..... 2
Altitude..... 2000-meter max.
Insulation Voltage..... 2500 VDC
MTBF..... Greater than 100K hours
Relative Humidity..... 5% to 95%, non-condensing
Weight..... 0.5 lbs.

13. AC CURRENT TRANSDUCERS – SINGLE PHASE (Split Core)

13.1 Input

Range..... 0 AAC to: 5, 10, 15, 20, 25, 30, 40, 50, 75, 100, 150 up to 600 AAC
Overload..... 4x current range selected
Frequency Range..... 20 Hz to 5 kHz

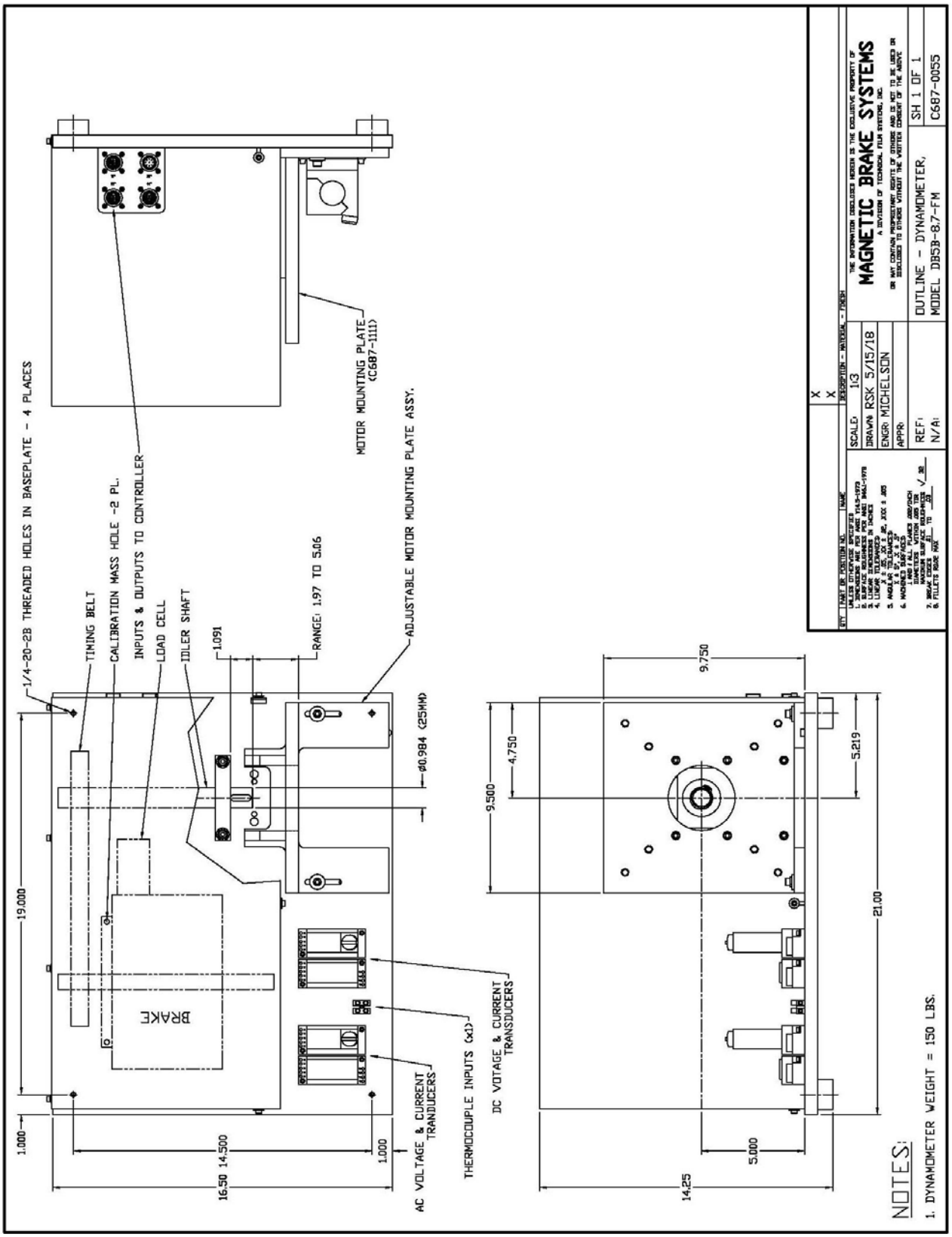
13.2 Output

Basic Accuracy..... 0.5%
Linearity..... 10% to 100% F.S.
Calibration..... True RMS sensing
Thermal Drift..... 500 PPM/°C
Response Time..... 250 ms

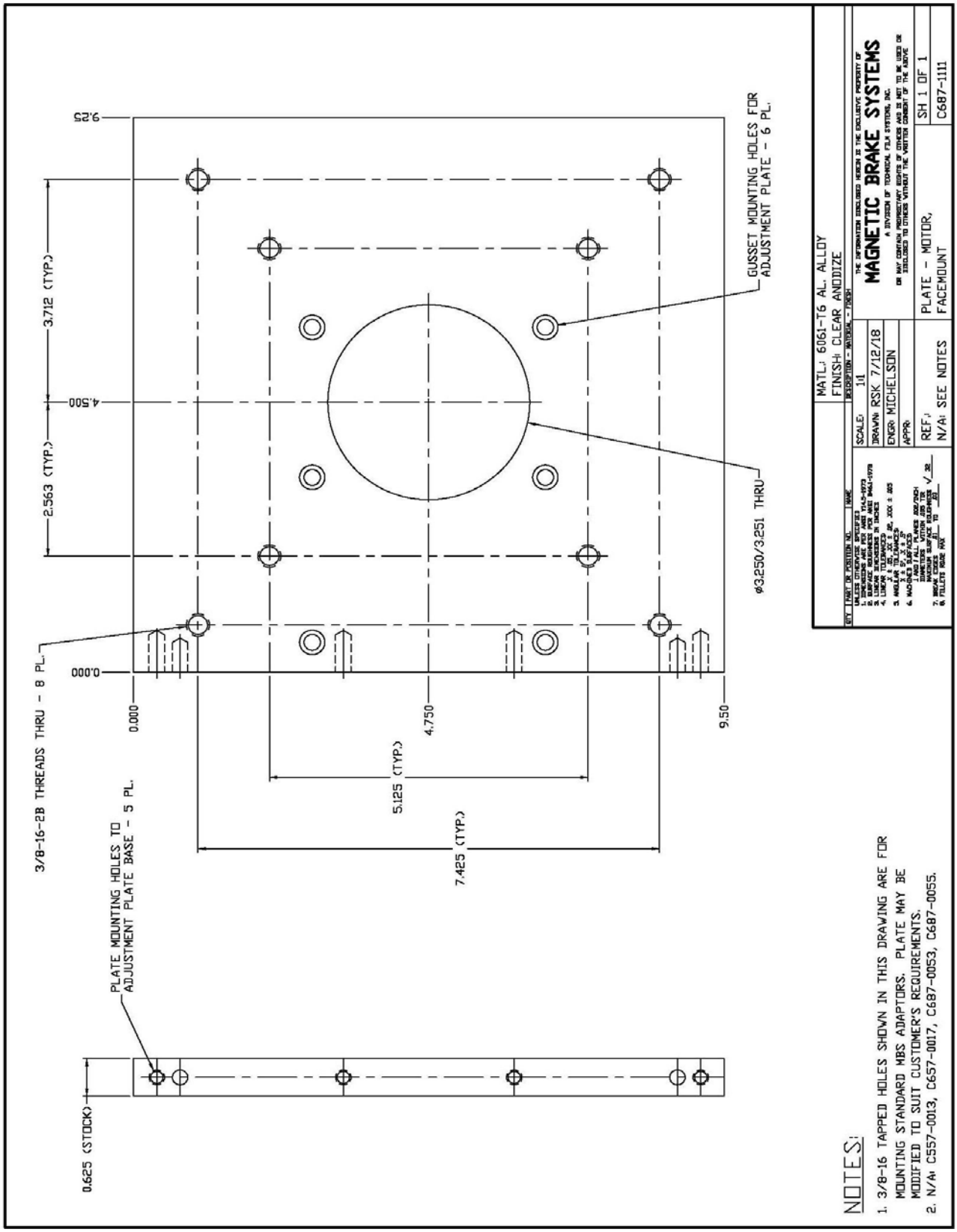
13.3 Environmental and Physical Characteristics

Operating Temperature..... 0°C to +60°C
Insulation Category..... CAT II
Vibration Tested to ..... IEC 60068-2-6, 1995
Pollution Degree..... 2
Altitude..... 2000-meter max.
Insulation Voltage..... 2500 VDC
MTBF..... Greater than 100K hours
Relative Humidity..... 5% to 95%, non-condensing
Weight..... 0.5 lbs.

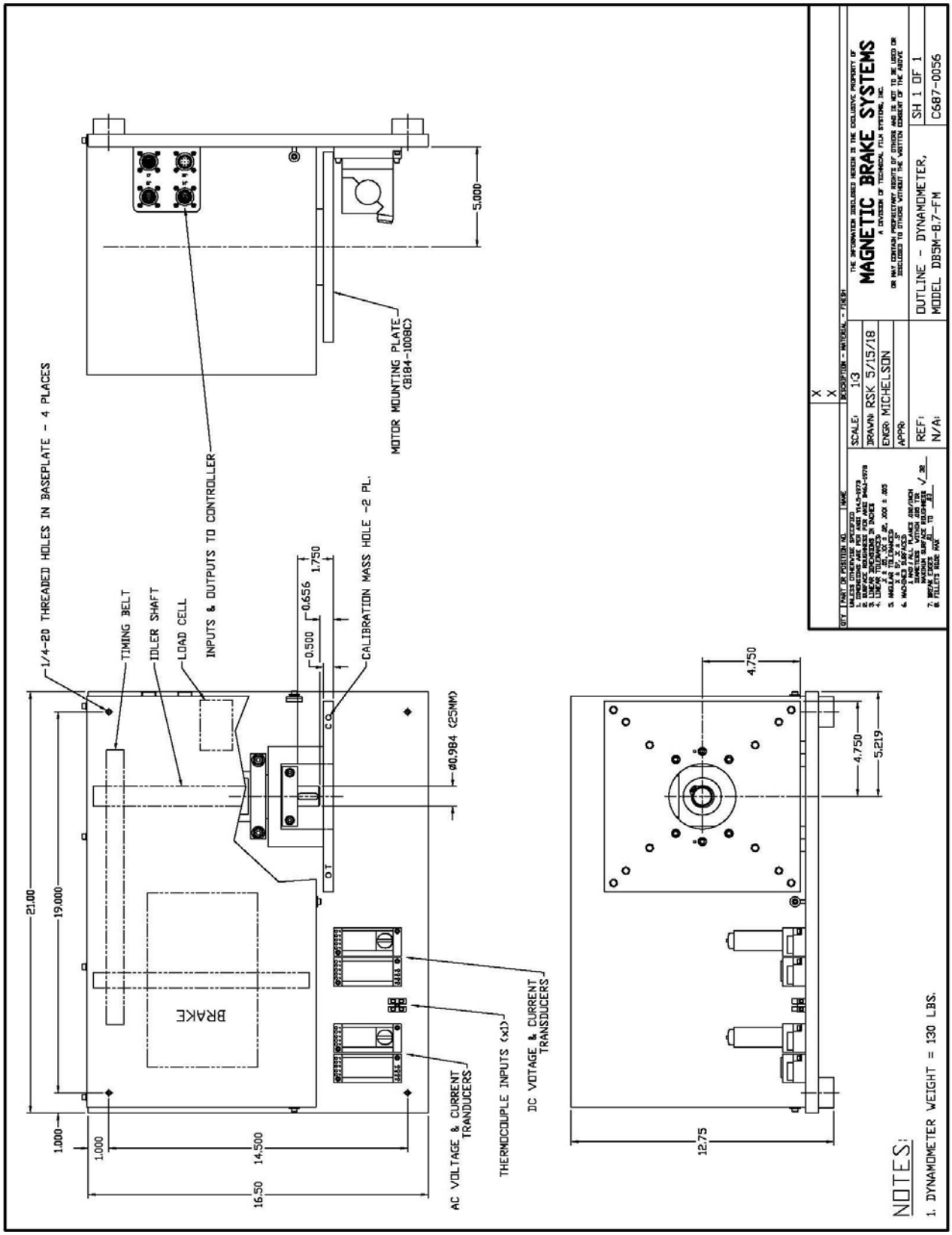
14. DYNAMOMETER LAYOUT – DB5B-8.7-FM, LOAD CELL ON BRAKE



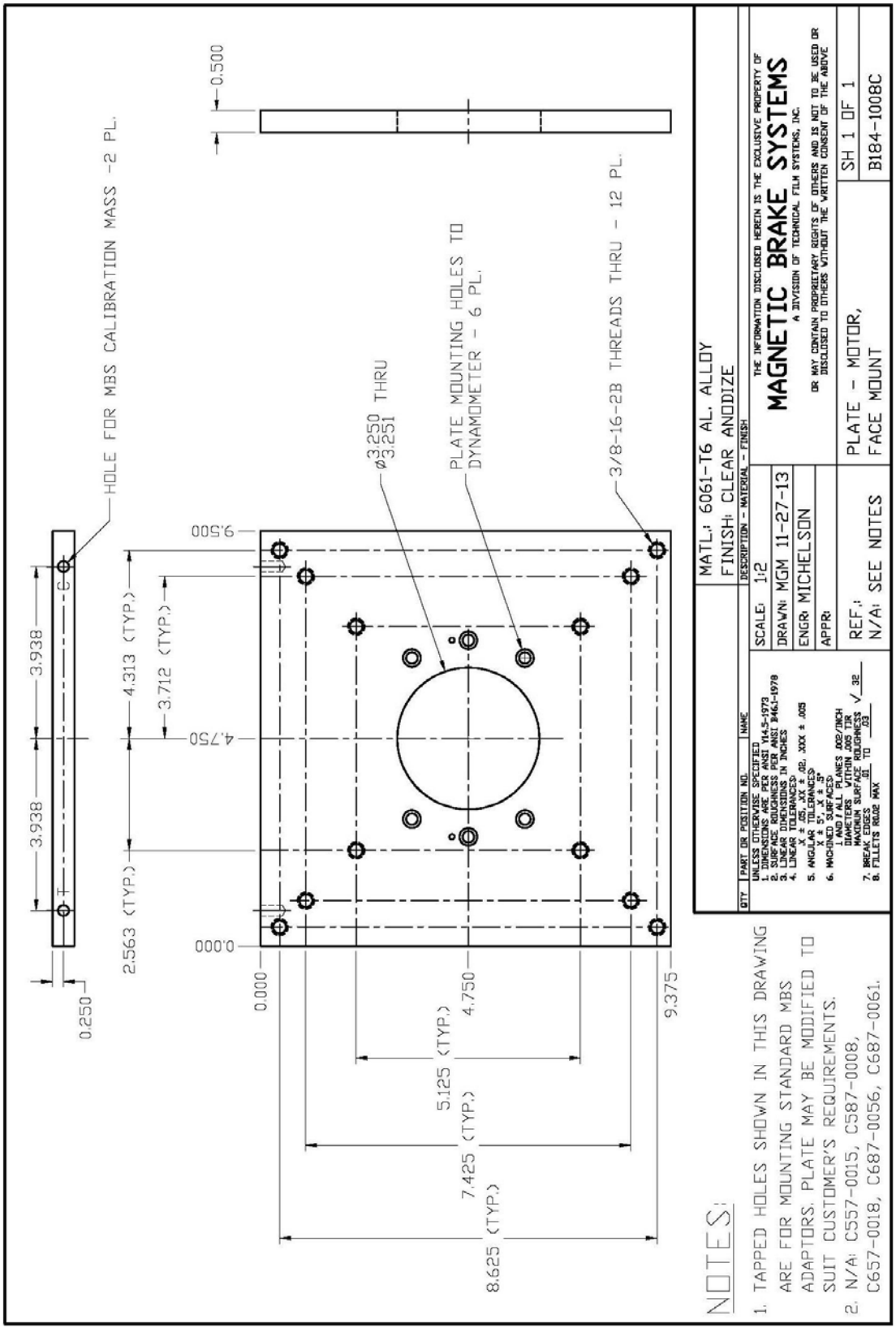
15. MOTOR MOUNTING PLATE – DB5B



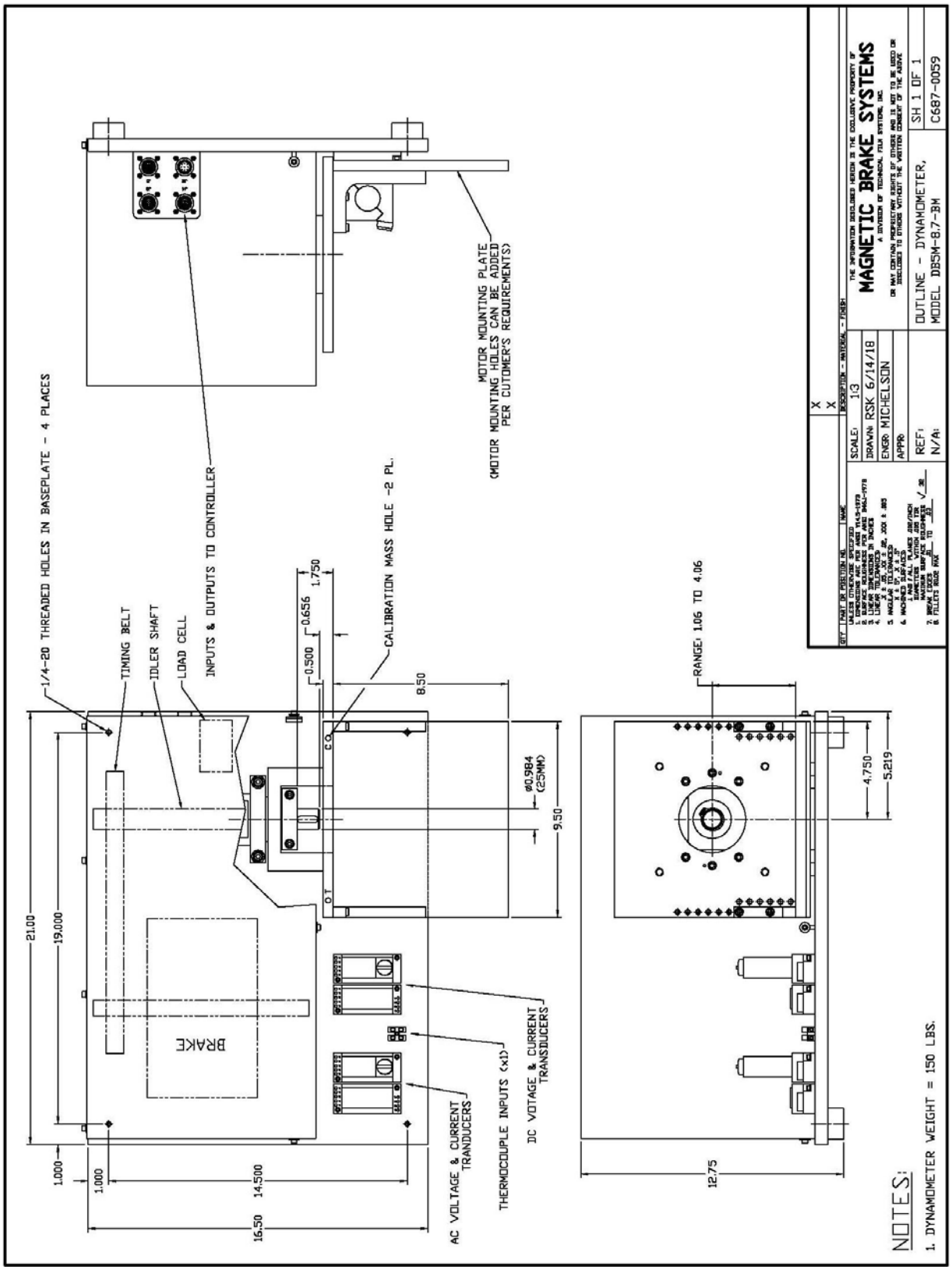
16. DYNAMOMETER LAYOUT – DB5M-8.7-FM, LOAD CELL ON MOTOR (OPTION 1)



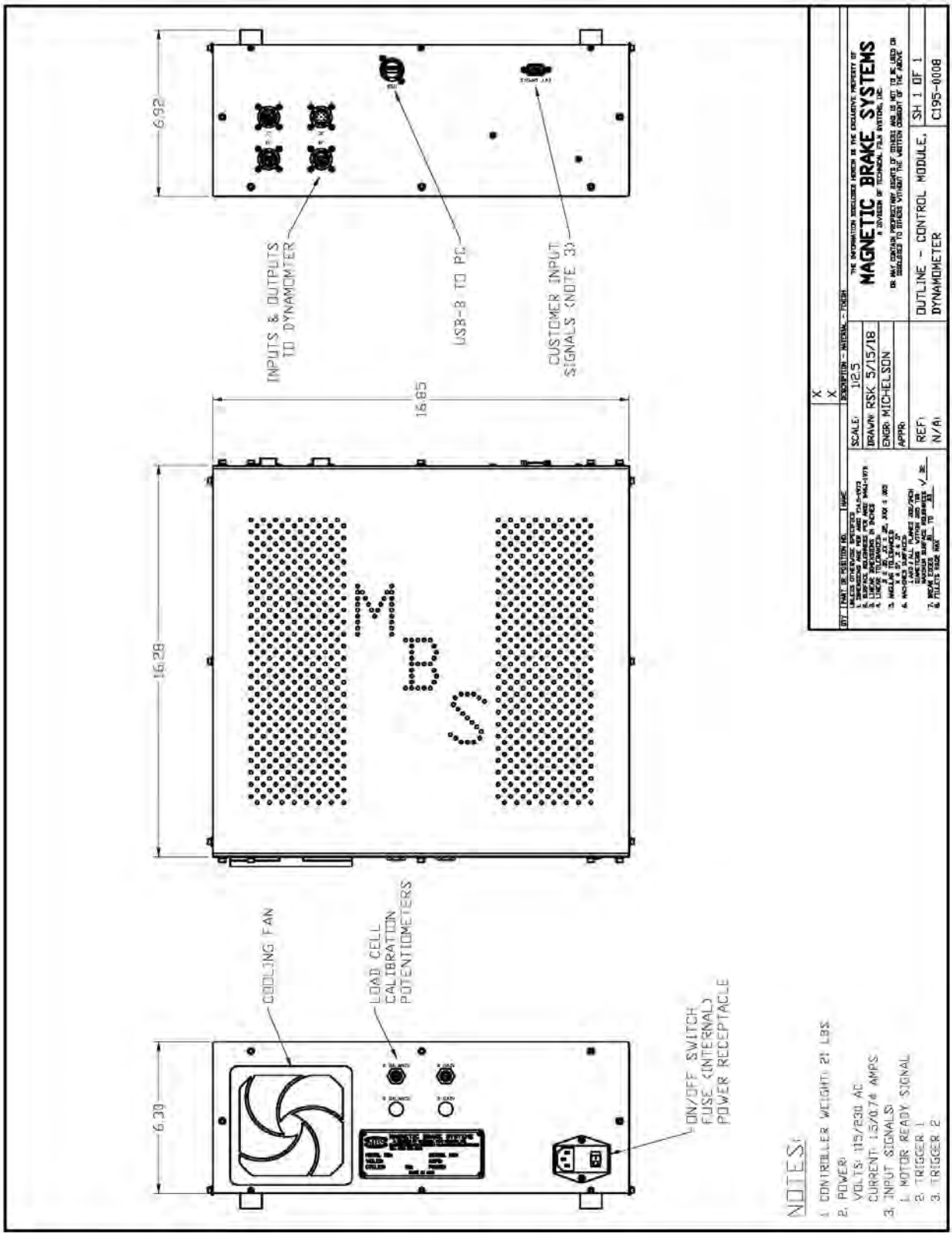
17. MOTOR MOUNTING PLATE – DB5M



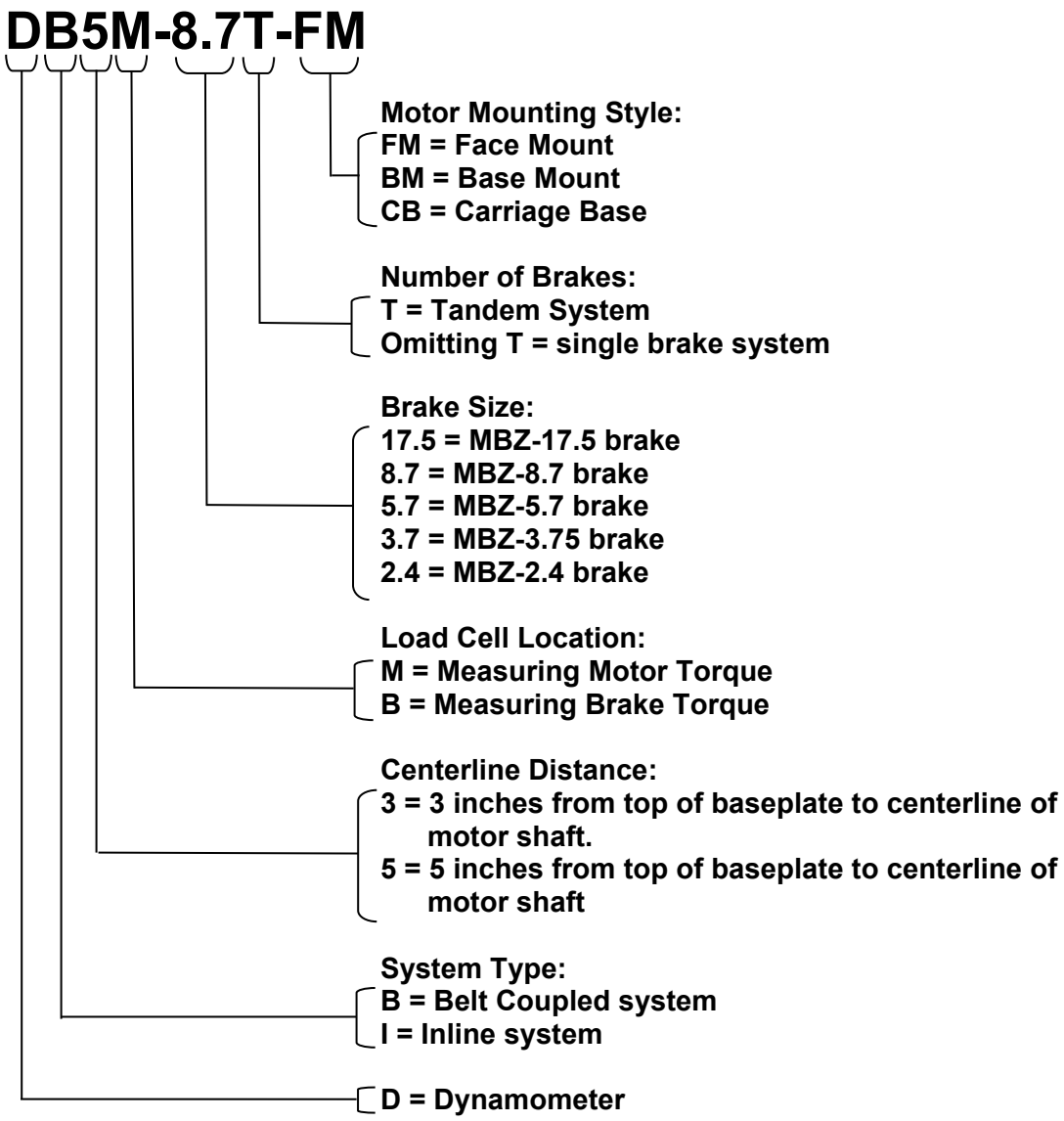
18. DYNAMOMETER LAYOUT – DB5M-8.7-BM, L. C. ON MOTOR (OPTION 2)



19. CONTROLLER - DYNAMOMETER



20. NOMENCLATURE OF DYNAMOMETER PART NUMBER



The load cell(s) size(s) and type(s) of voltage & Current transducers are to be specified individually.