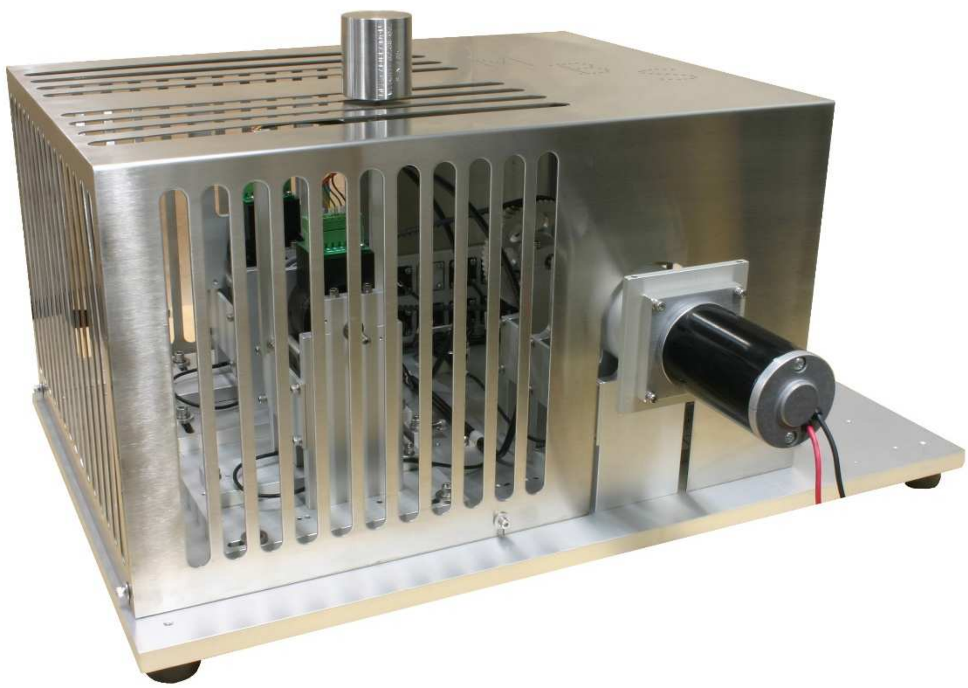
MAGNETIC BRAKE SYSTEMS
A DIVISION OF TECHNICAL FILM SYSTEMS, INC.

DYNAMOMETER DATA SHEET

(Version 1.1)



MODELS:

DB6B-3.75T-FM	**DB6M-3.75T-FM**
DB6B-3.75T-BM	**DB6M-3.75T-BM**

Max continuous power dissipation:	3.3 HP (2.46 kilowatts)
Max. Power for 30 seconds:	4.5 HP (3.37 kilowatts)
Max continuous brake torque:	540 in-oz. (381 N-cm)
Max brake speed:	12,000 RPM

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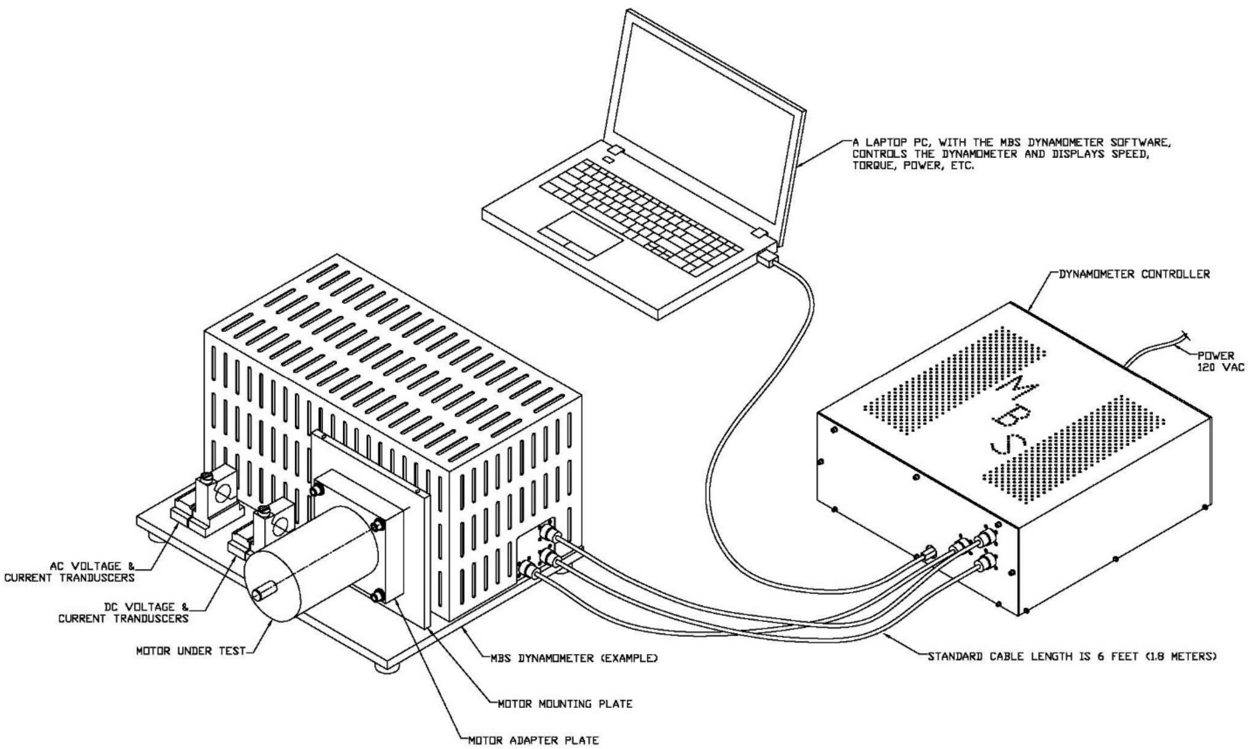
1. OVERVIEW

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. MBS systems do not require annual fees, licenses or permits. The software is user friendly, easily 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 model 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/speed supplied to the motor under test, which makes a dynamometer more cost-effective and diverse than a direct drive system. The pulleys are mounted to the brake and an idler shaft, which the motor couples to. The idler shaft strictly provides a torsional load to the motor.

There are two options in load cell configurations for this system.

First option: motor load cell is included (i.e. DB6M-3.75T-FM or DB6M-3.75T-BM). In this system, the operator may exchange the motor load cell as required in order to provide the highest accuracy of measurement for a specific torque range. Accuracy plots may be viewed in Section 3: Motor Torque and Speed. The brakes also have their own load cell, which the controller for the brake uses to control the torque of the brake.

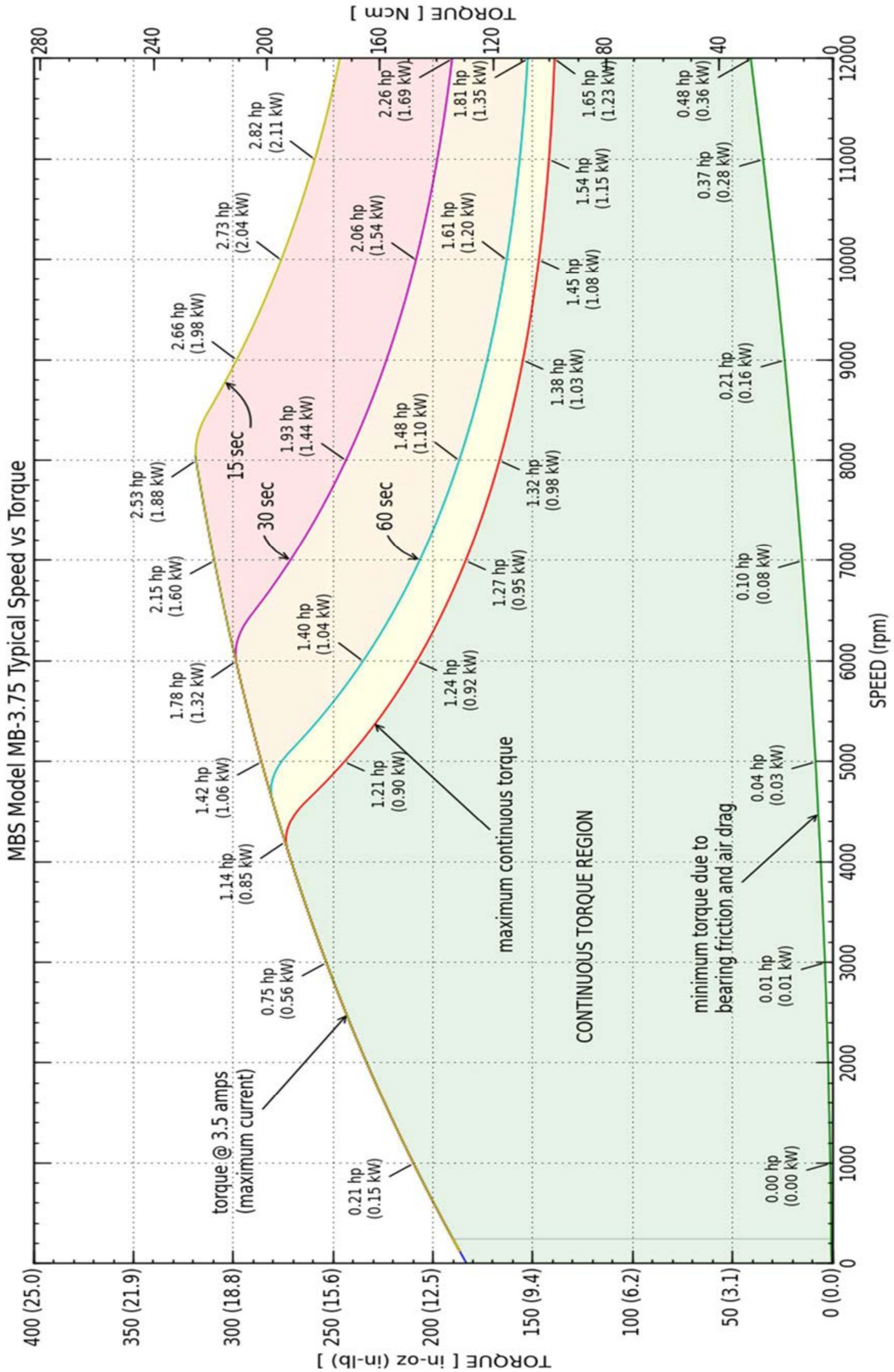
The software allows the operator to switch between reading/recording the motor torque and brake torque. In some cases, such as when a motor is placed in an environmental test chamber (the dynamometer remains outside the test chamber), it may not be possible to measure the motor torque.

Second option: motor load cell is not included (i.e. Model DB6B-3.75T-FM or DB6B-3.75T-BM). For this system, the motor torque is calculated by measuring the brake torque and multiplying by the transmission. Though belt friction, bearing friction and any other minor losses may not be accounted for in the measurements, the 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, motor speed, voltage range, current range and power type(s) (i.e. DC, AC, AC-3ph) need to be specified when purchasing a dynamometer in order to select the types and limits for the measurement instruments. The following performance specifications for load cells, transducers, etc., are based on vendor specifications.

A certified calibration weight comes with each system. The zero torque and gain are adjusted by the operator as part of the calibration procedure. Calibration takes a couple of minutes and may be performed as often as desired. Customers may use calibrated weights to simulate a specific load to check for torque accuracy.

2. SPEED vs. TORQUE CURVE – FOR ONE MB-3.75 BRAKE



3. MOTOR TORQUE & SPEED

Systems that measure motor torque allow for three options for the load cell arm length: 2-inches, 3-inches, & 4-inches. Below are tables that list possible speed/torque combinations based on different pulley ratios:

3.1 Pulley Ratio's (English Units)

Motor Speed (RPM)	Motor Torque (in-oz.)	Power (HP)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (in-oz.)	Brake Speed (RPM)	Time	Mtr. Arm (in.)	L.C. Ref. #**
0	90	0	1:4	2	180	0	Cont.	2	2
1,800	95	0.17	1:4	2	190	450	Cont.	2	2
3,600	105	0.37	1:4	2	210	900	Cont.	2	2
12,000*	62.5	0.74	1:4	1	250	3,000	Cont.	2	1
12,000*	0.84	0.1	1:4	1	3.4***	3,000	Cont.	2	1

Table 1: Speed, Torque & Power (English Units) 4:1 ratio

Motor Speed (RPM)	Motor Torque (in-oz.)	Power (HP)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (in-oz.)	Brake Speed (RPM)	Time	Mtr. Arm (in.)	L.C. Ref. #**
0	360	0	1:1	2	180	0	Cont.	3	3
1,800	450	0.8	1:1	2	225	1,800	Cont.	3	3
3,600	520	1.9	1:1	2	260	3,600	Cont.	3	3
12,000	260	3.3	1:1	2	130	12,000	Cont.	4	2
12,000	40	0.5	1:1	1	40***	12,000	Cont.	2	1

Table 2: Speed, Torque & Power (English Units) 1:1 ratio

Motor Speed (RPM)	Motor Torque (in-oz.)	Power (HP)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (in-oz.)	Brake Speed (RPM)	Time	Mtr. Arm (in.)	L.C. Ref. #**
0	1,440	0	4:1	2	180	0	Cont.	4	6
1,000	2,160	2.1	4:1	2	270	4,000	Cont.	4	7
2,000	1,360	2.7	4:1	2	170	8,000	Cont.	4	5
3,000	1,040	3.3	4:1	2	130	12,000	Cont.	4	5
3,000	160	0.5	4:1	1	40***	12,000	Cont.	2	3

Table 3: Speed, Torque & Power (English Units) 1:4 ratio

The table is based on the performance graph for the MB-3.75 Brake, shown in Section 2.
* Maximum speed is limited to the physical speed limits of the pulleys and belt.
** See Table 7 for load cell specifications based on the number shown.
*** Torque required to overcome the air drag of brake at speed; does not account for bearing friction or belt losses.

3.2 Pulley Ratio's (SI Units)

Motor Speed (RPM)	Motor Torque (Ncm)	Power (watts)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (Ncm)	Brake Speed (RPM)	Time	Mtr. Arm (cm)	L.C. Ref. #**
0	64	0	1:4	2	127	0	Cont.	5.08	2
1,800	67	127	1:4	2	134	450	Cont.	5.08	2
3,600	74	280	1:4	2	148	900	Cont.	5.08	2
12,000*	44	555	1:4	2	176	3,000	Cont.	5.08	2
12,000*	0.6	89	1:4	1	2.4***	3,000	Cont.	5.08	1

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

Motor Speed (RPM)	Motor Torque (Ncm)	Power (watts)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (Ncm)	Brake Speed (RPM)	Time	Arm (cm)	L.C. Ref. #**
0	254	0	1:1	2	127	0	Cont.	7.62	3
1,800	318	600	1:1	2	159	1,800	Cont.	7.62	3
3,600	367	1,385	1:1	2	184	3,600	Cont.	7.62	3
12,000	198	2,486	1:1	2	99	12,000	Cont.	10.2	2
12,000	28	355	1:1	1	28***	12,000	Cont.	5.08	1

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

Motor Speed (RPM)	Motor Torque (Ncm)	Power (watts)	Pulley Ratio (M/B)	Qty. Brks	Brake Torque (Ncm)	Brake Speed (RPM)	Time	Arm (cm)	L.C. Ref. #**
0	1,017	0	4:1	2	127	0	Cont.	10.2	6
1,000	1,525	1,600	4:1	2	191	4,000	Cont.	10.2	7
2,000	960	2,012	4:1	1	120	8,000	Cont.	10.2	5
3,000	790	2486	4:1	2	99	12,000	Cont.	10.2	5
3,000	113	355	4:1	1	28***	12,000	Cont.	10.2	3

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

The table is based on the performance graph for the MB-3.75 Brake, shown in Section 2.
* Maximum speed is limited to the physical speed limits of the pulleys and belt.
** See Table 7 for load cell specifications based on the number shown.
*** Torque required to overcome the air drag of brake at speed; does not account for bearing friction or belt losses.

3.3 Load Cell Size

The load cell(s) for the system should be specified by their load rating (column 2 or 3). Sections 5.1 & 5.2 has the data for the listed load cells.

Load Cell Ref. #	Load Rating (lbs.)	Load Rating (Kg.)	Arm (inches [cm])	Max Torque (in-lbs.)	Max Torque (in-oz.)	Max Torque (Ncm)
1	2.2	1	2 [5.08]	4.4	70.5	49.8
1	2.2	1	3 [7.62]	6.6	106	74.7
1	2.2	1	4 [10.16]	8.8	141	99.6
2	4.4	2	2 [5.08]	8.8	141	99.6
2	4.4	2	3 [7.62]	13.3	212	149
2	4.4	2	4 [10.16]	17.7	282	199
3	11	5	2 [5.08]	17.7	353	249
3	11	5	3 [7.62]	33.2	529	374
3	11	5	4 [10.16]	44	705	498
4	13	6	2 [5.08]	26.6	423	299
4	13	6	3 [7.62]	39.8	635	448
4	13	6	4 [10.16]	53.1	847	598
5	22	10	2 [5.08]	44.3	705	498
5	22	10	3 [7.62]	66.4	1058	747
5	22	10	4 [10.16]	88.5	1411	966
6	33	15	2 [5.08]	66.4	1058	747
6	33	15	3 [7.62]	100	1587	1121
6	33	15	4 [10.16]	133	2116	1495
7	44	20	2 [5.08]	88.5	1411	996
7	44	20	3 [7.62]	133	2116	1495
7	44	20	4 [10.16]	177	2822	1993

Table 7: Load Cell Reference

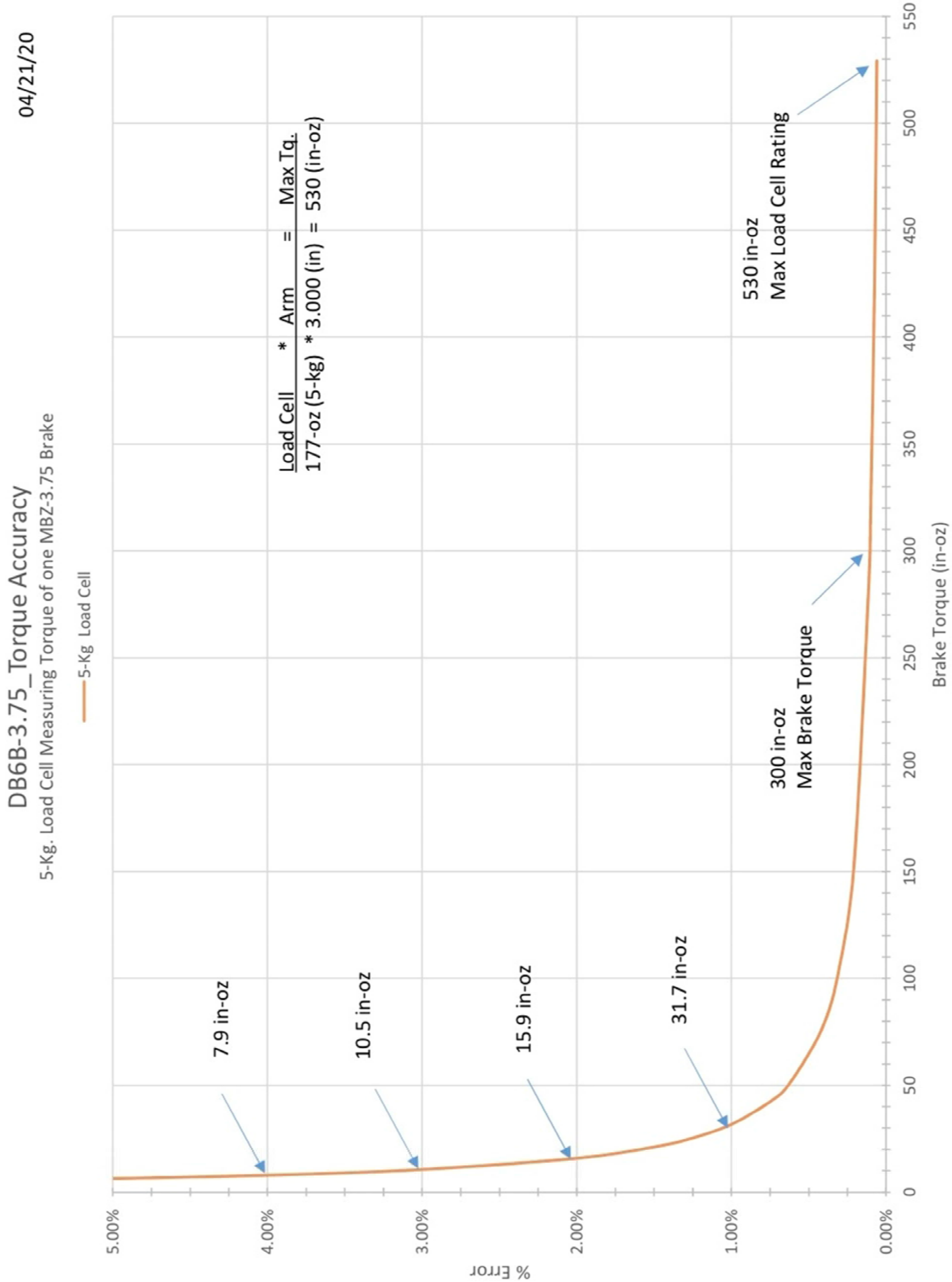
The following sections, 4 & 5, are the specifications for the different types of load cells.

4. LOAD CELLS (DB6B-3.75T-FM, Measuring Brake Torque)

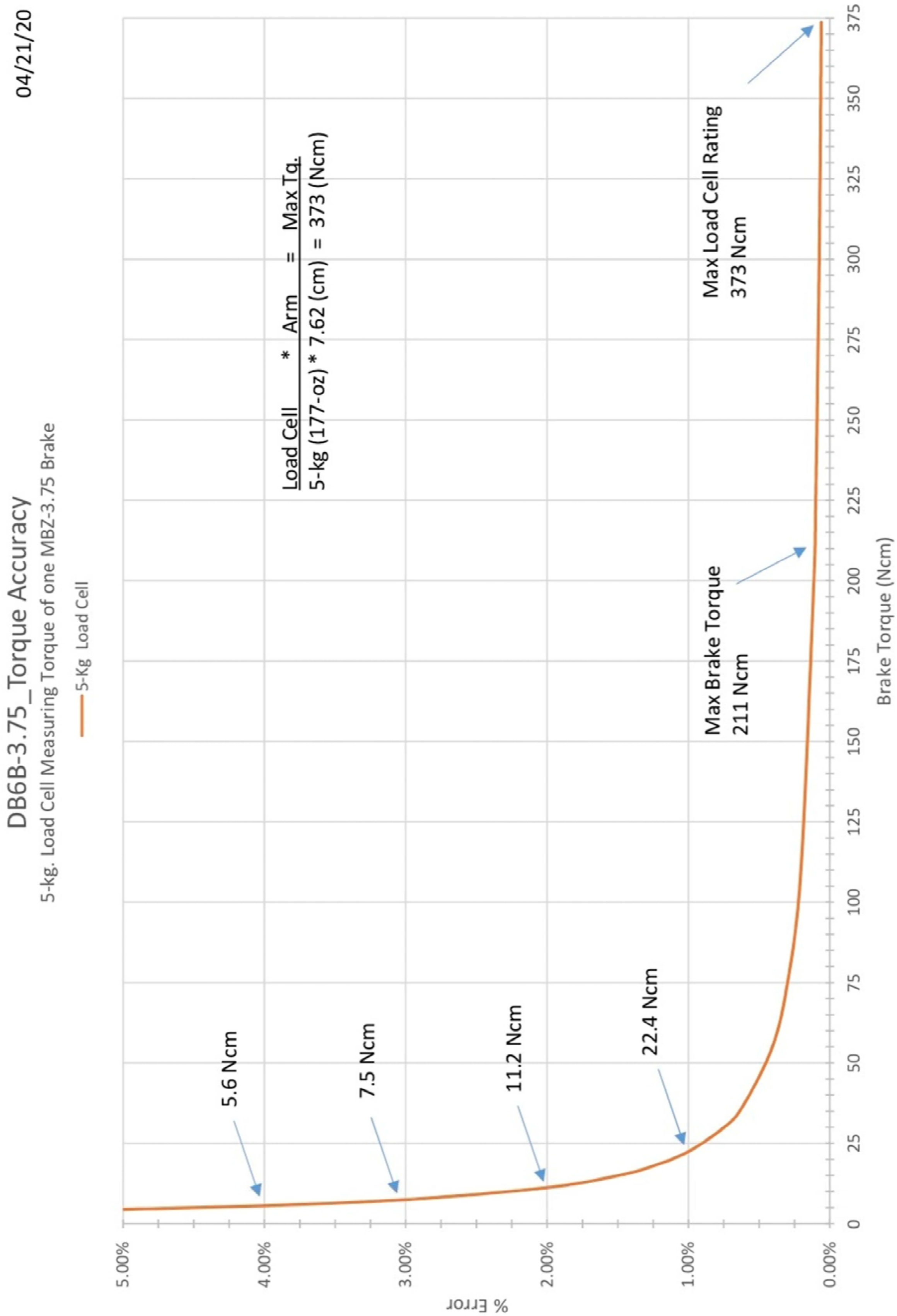
Load Cell Load Rating	176.4 oz. (5 kg)
Arm Length	3.00 inches (7.62 cm)
Rated torque of Load Cell	530 in-oz. (374 N-cm)
Safe Overload torque of Load Cell	795 in-oz. (562 N-cm)
Max Brake Torque	300 in-oz. (212 N-cm)
Non-Linearity	0.02% of Rated Output (R.O.)
Hysteresis	0.02% of R.O.
Non-Repeatability	0.02% of R.O.
Zero Balance	±5% of R.O.
Compensated Temperature Range	14℉ to 104℉
Safe Temperature Range	14℉ to 140℉
Temperature Effect on Output	0.002% of Load/℉
Temperature Effect on Zero	0.002% of Load/℉
Safe Overload	150% of R.O.*

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

4.1 Brake Load Cell Accuracy Plot (in-oz.) – Linear



4.2 Brake Load Cell Accuracy Plot (N-cm) – Linear



5. LOAD CELLS (DB6M-3.75T-FM, Measuring Motor Torque):

For section 5.1 & 5.2, reference Table 7, in section 3.3 Load Cell Sizes.

5.1 Load Cell #'s 1 through 3:

Safe Overload ....150% of R.O.*
Non-Linearity...0.02% of Rated Output (R.O.)
Hysteresis ....0.02% of R.O.
Non-Repeatability……………... ....0.02% of R.O.
Zero Balance..±5% 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

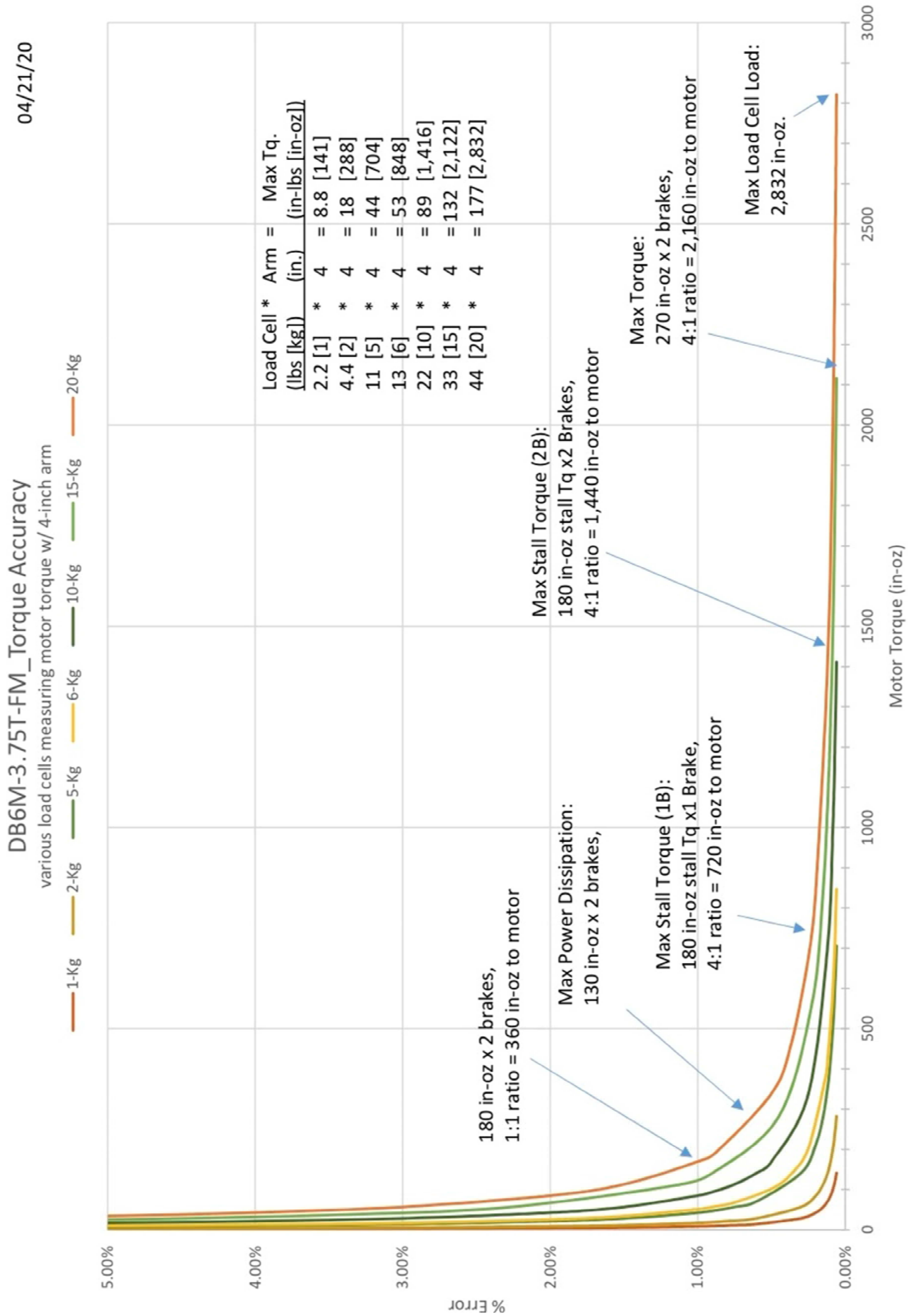
5.2 Load Cell #'s 4 through 7:

Safe Overload ....150% of R.O.*
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% mV/V
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

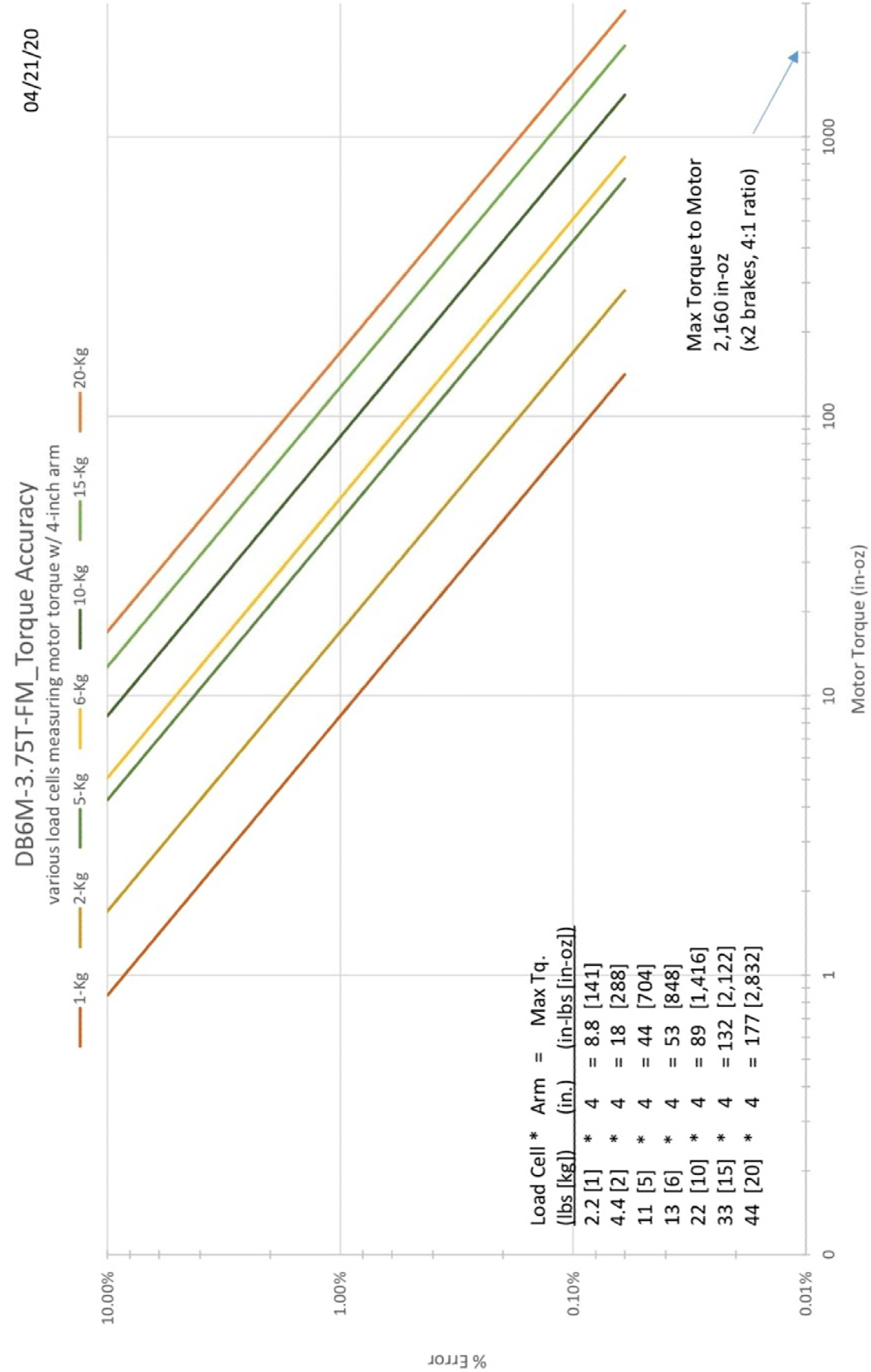
* Hard stops are in place to help prevent damage from over-load.

The Torque Accuracy plots to follow show the percentage error as a function of measured torque. These plots show the range that the load cell selected will accurately measure, based on published data from vendor. 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.

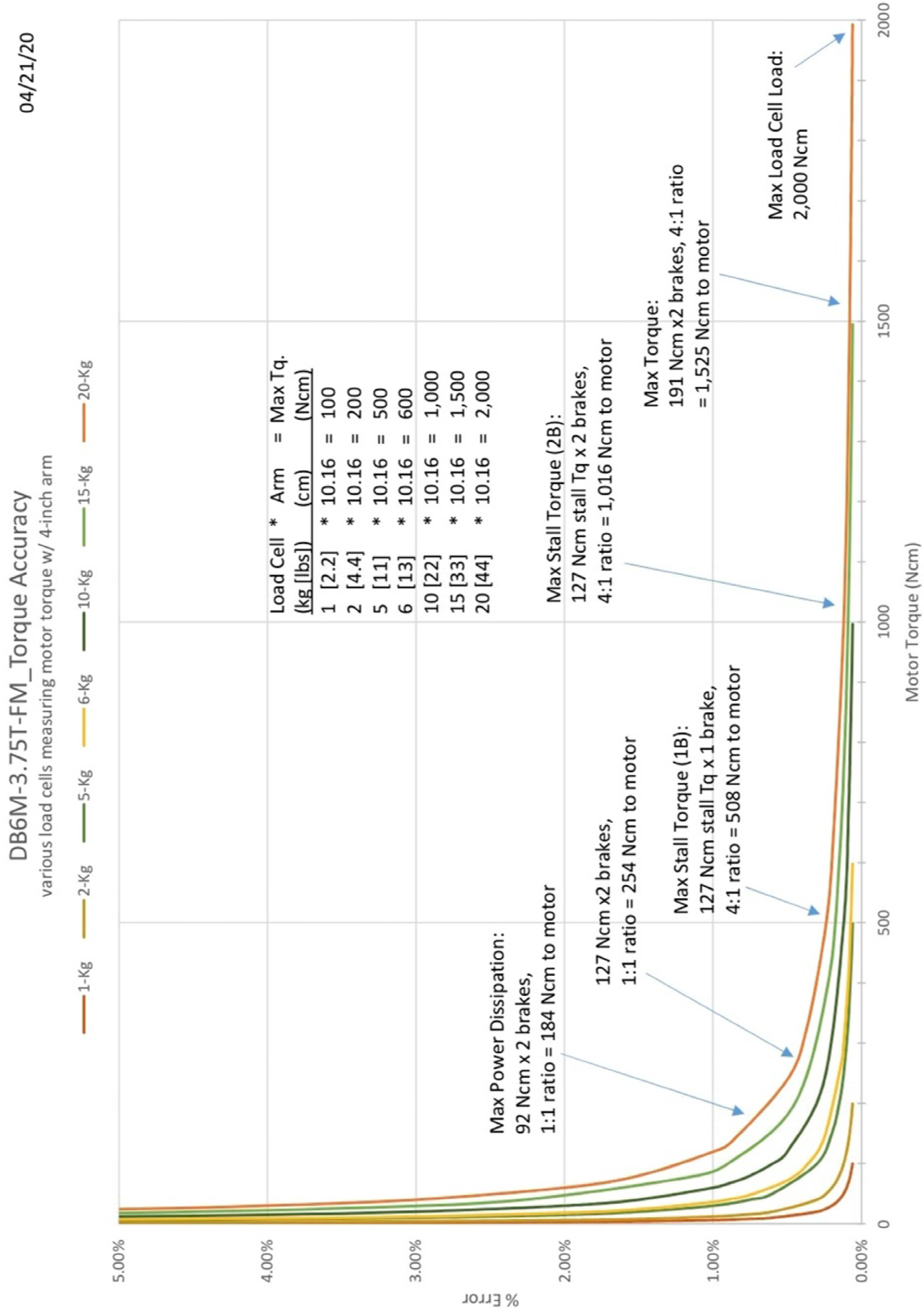
5.3 Motor Load Cell Accuracy Plots (in-oz., 4-inch arm) - Linear



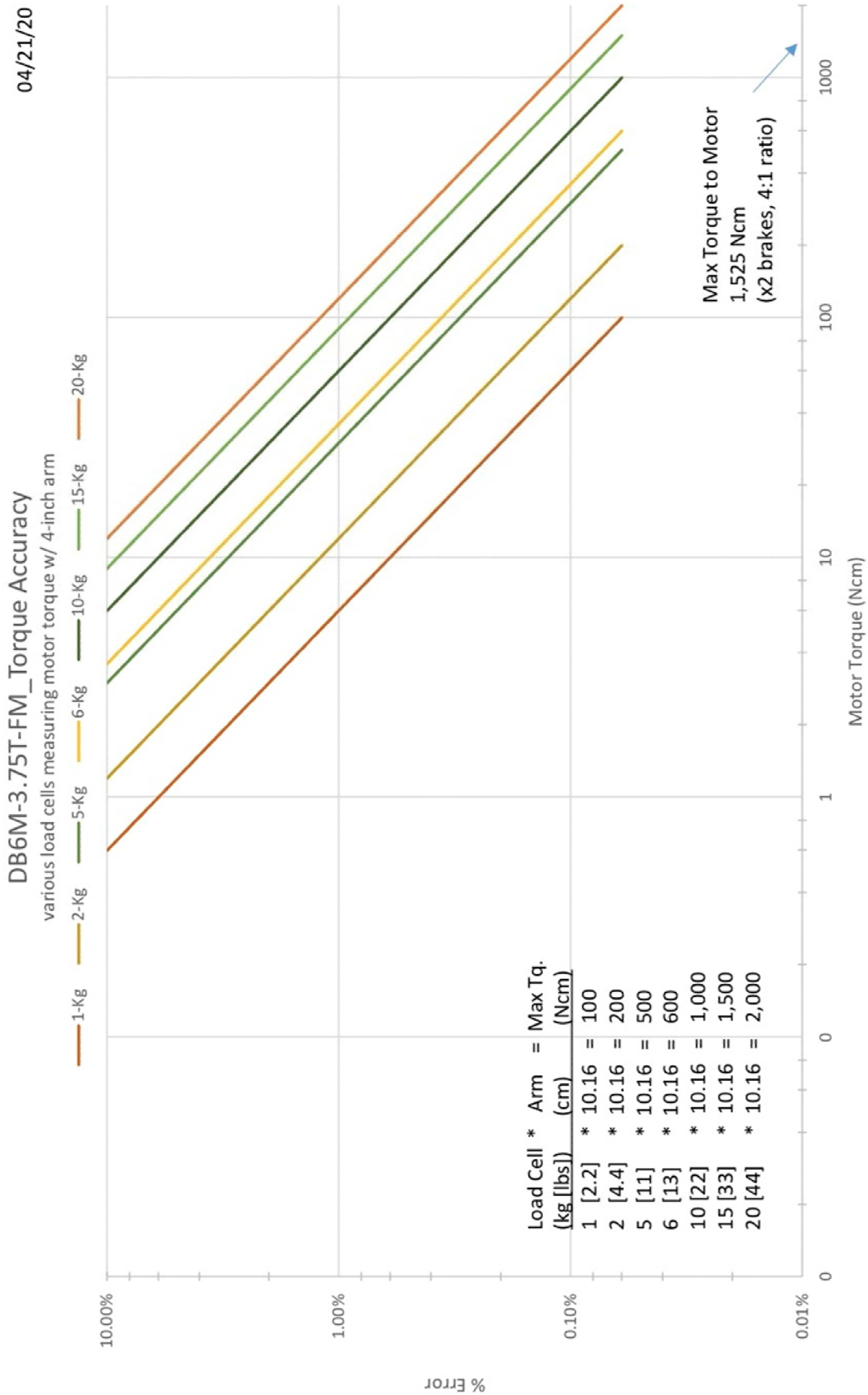
5.4 Motor Load Cell Accuracy Plots (in-oz., 4-in. arm) – Logarithmic



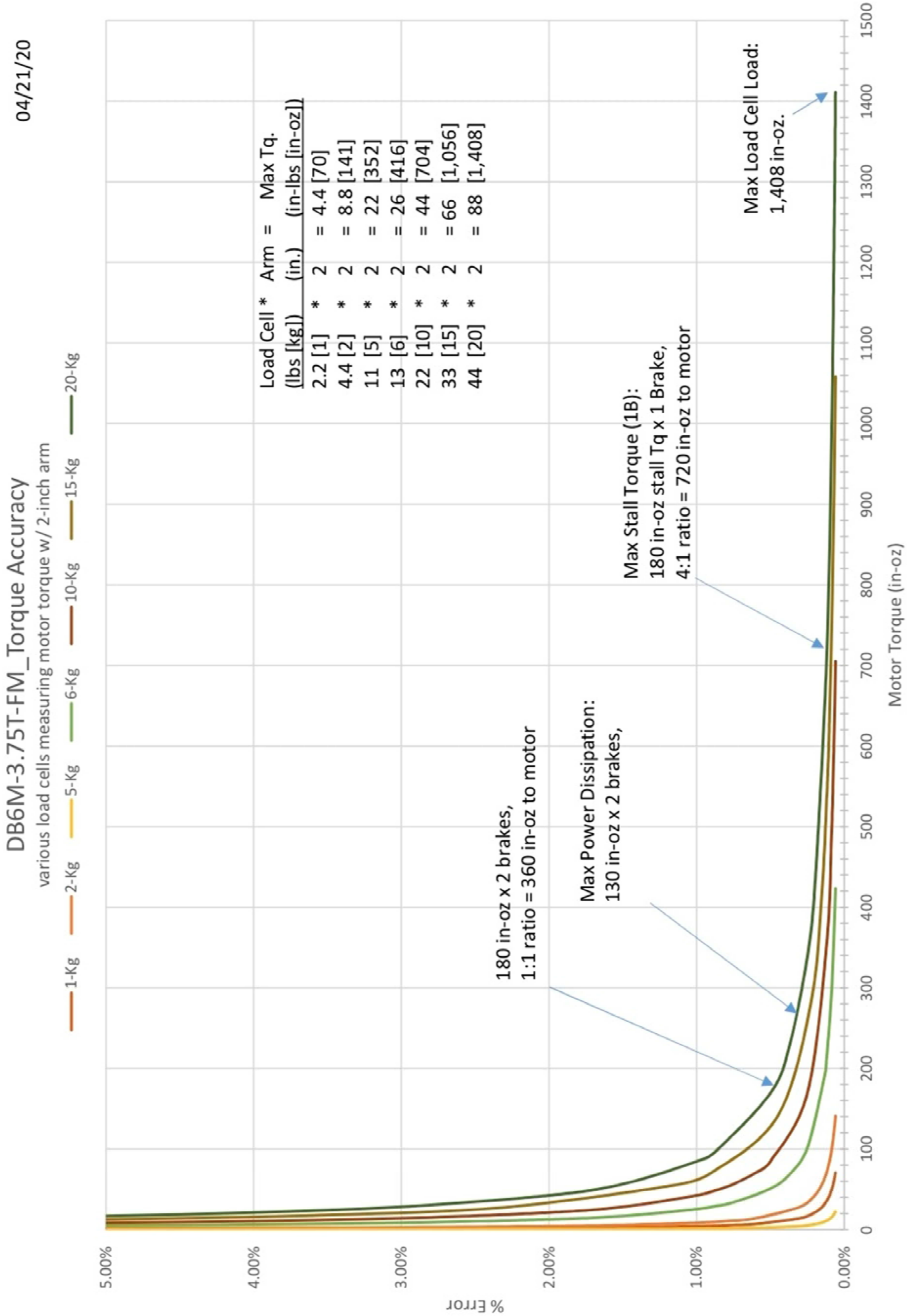
5.5 Motor Load Cell Accuracy Plots (N-cm, 10.16-cm arm) – Linear



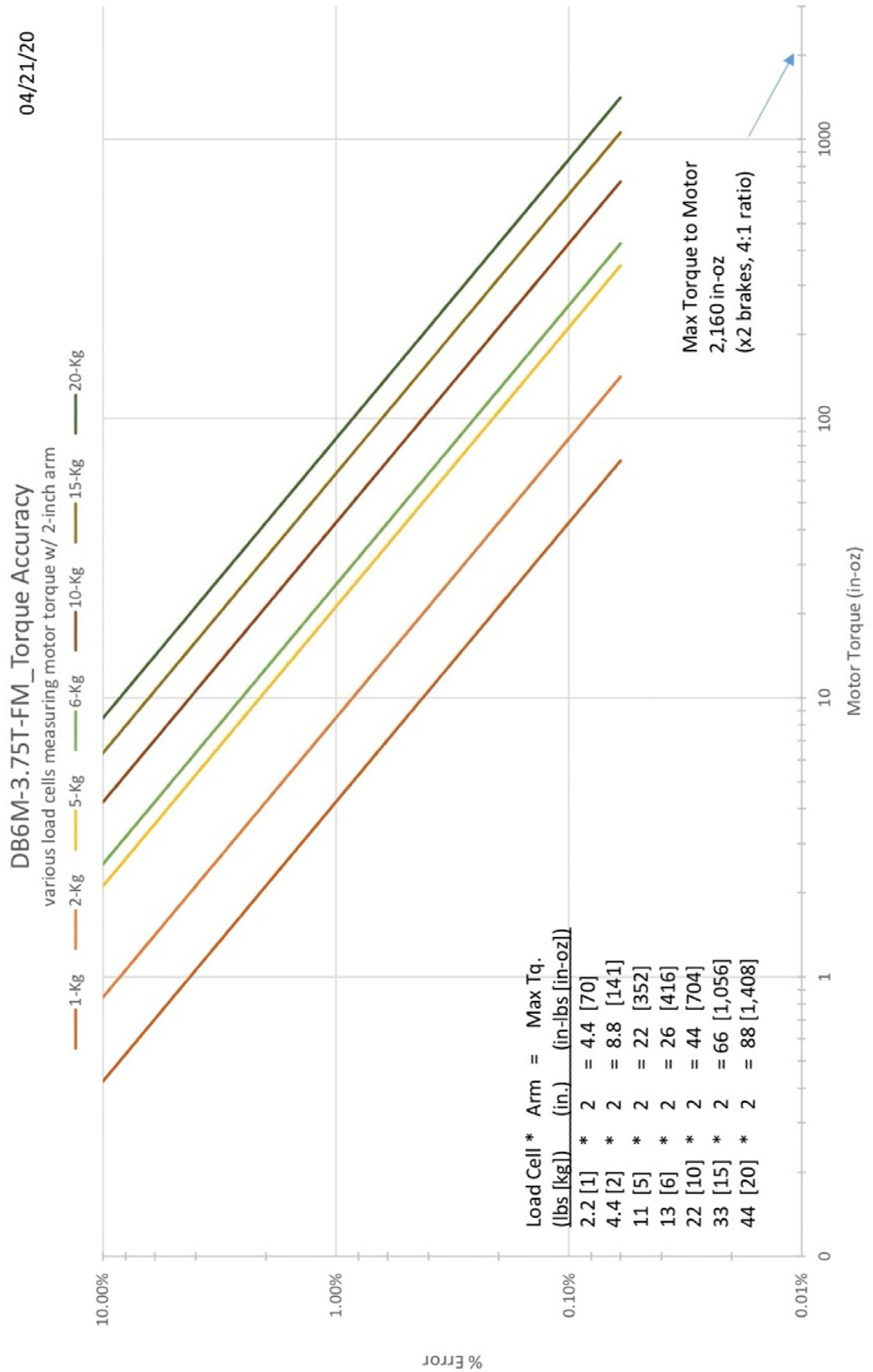
5.6 Motor Load Cell Accuracy Plots (N-cm, 10.16-cm arm) - Logarithmic



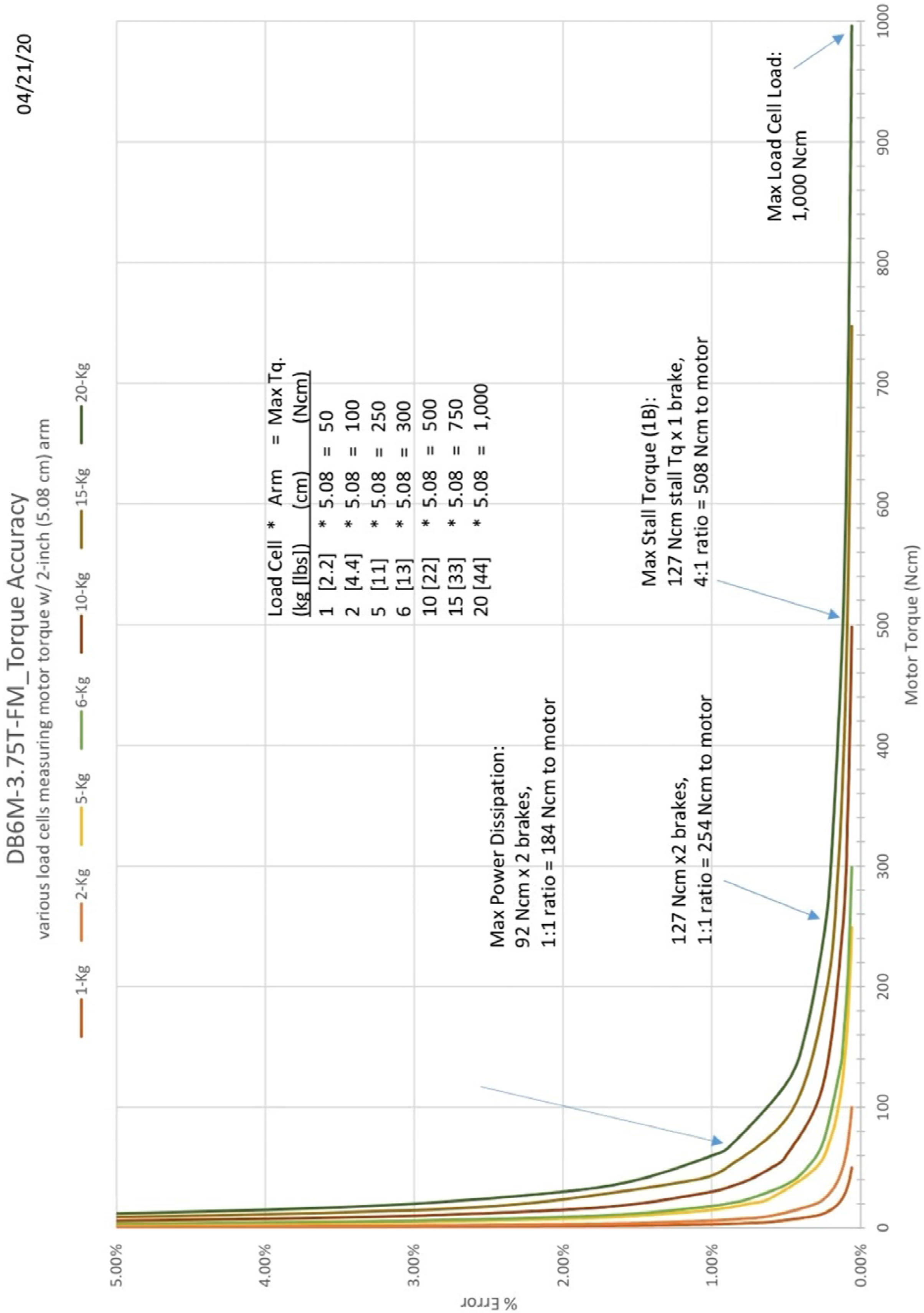
5.7 Motor Load Cell Accuracy Plots (in-oz, 2-inch arm) – Linear



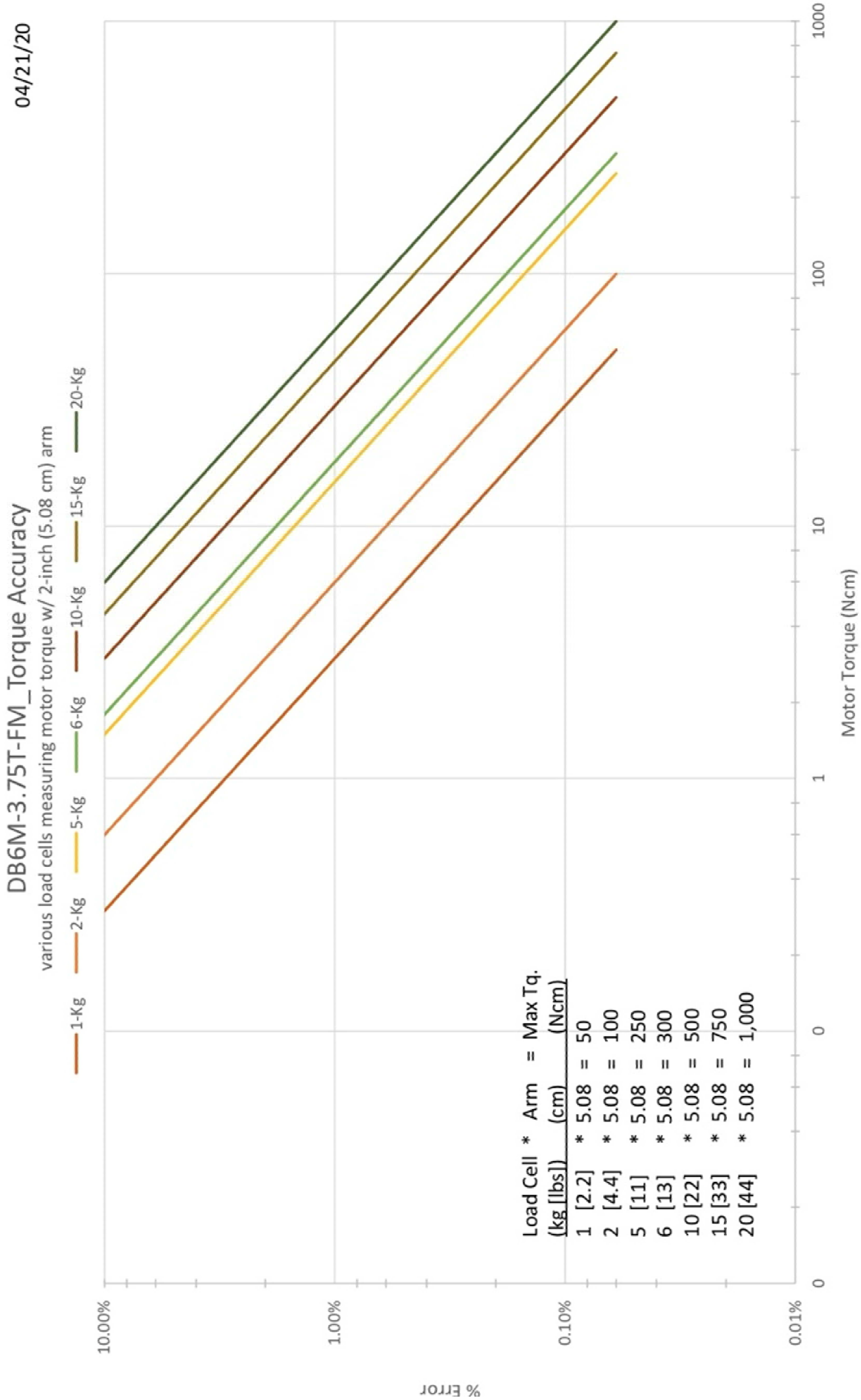
5.8 Motor Load Cell Accuracy Plots (in-oz, 2-inch arm) – Logarithmic



5.9 Motor Load Cell Accuracy Plots (N-cm, 5.08-cm arm) – Linear



5.10 Motor Load Cell Accuracy Plots (N-cm, 5.08-cm arm) – Logarithmic



6. SPEED MEASUREMENT

A standard brake has five magnets (alternative quantity or an external encoder is 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 (or pulses).

Parameter	Conditions	Min.	Typ.	Max.	Units
Clock Error	~25℃		±30		PPM
	-10℃ to 60℃		±50		PPM
	-40℃ to 85℃		±100		PPM
Brake Speed	5 magnets	12		180,000*	RPM
	30 magnets	2		30,000*	RPM
	1,000 PPR	0.066		5,000	RPM
	2,000 PPR	0.033		2,000	RPM

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

7. DATA 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

A computer with a more powerful processor may allow a higher sampling frequency.

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. The AC power supplies the power supplies and cooling fan in the controller; everything else is 24 VDC (or less) in the system.

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	4.5	-	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

The range represents transducers that measure from 0-1 VDC, 0-5 VDC, 0-10 VDC, etc.

10.2 Output

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

10.3 Environmental and Physical Characteristics

Operating Temperature .... 0℃ to +50℃
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/℃
Response Time .... 250 ms

11.3 Environmental and Physical Characteristics

Operating Temperature .... 0℃ to +60℃
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 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/℃
Response Time .... 250 ms

12.3 Environmental and Physical Characteristics

Operating Temperature .... 0℃ to +50℃
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 up to 600 AAC
Overload .... 4x current range selected
Frequency Range .... 20 Hz to 5 kHz

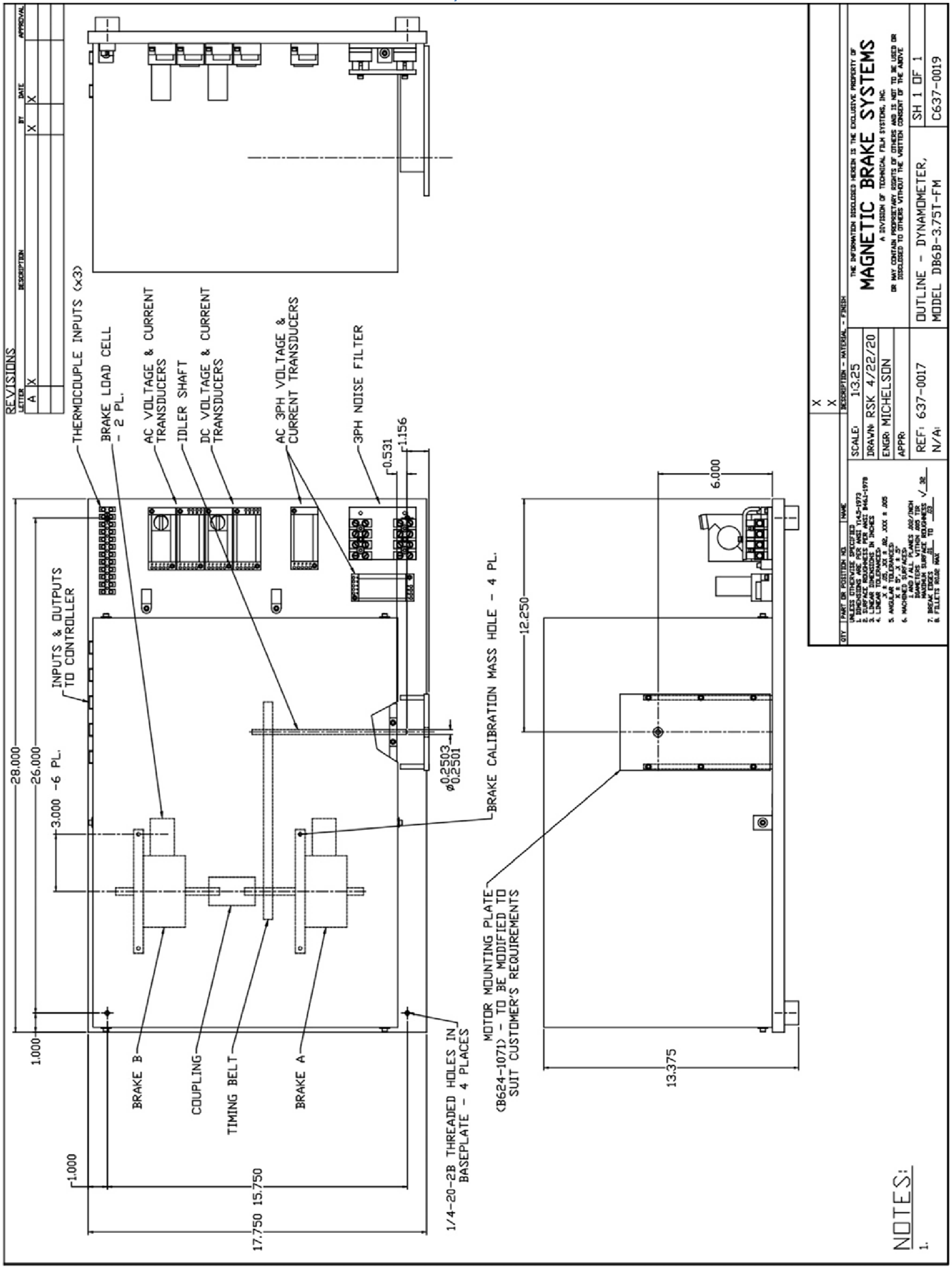
13.2 Output

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

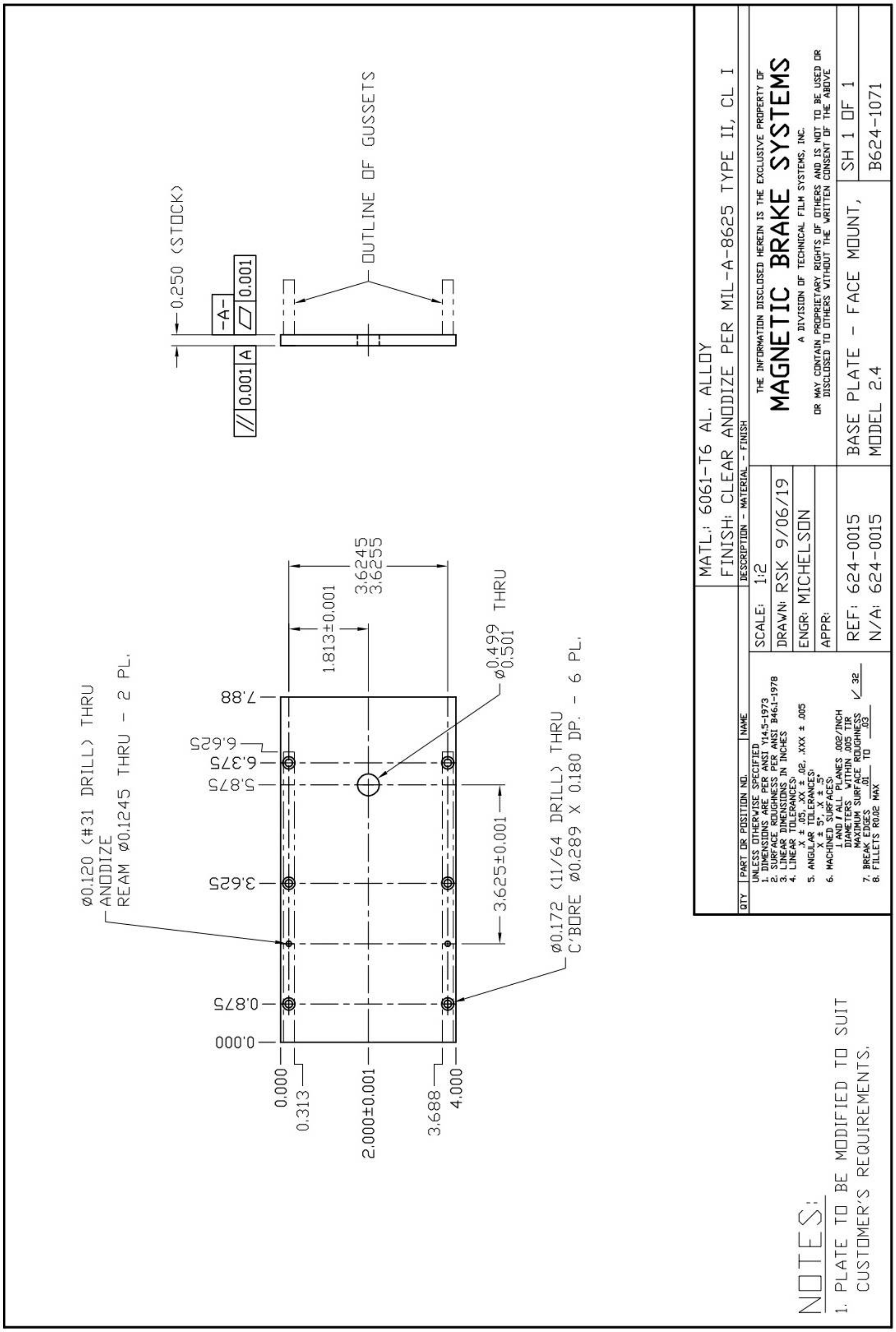
13.3 Environmental and Physical Characteristics

Operating Temperature .... 0℃ to +60℃
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.

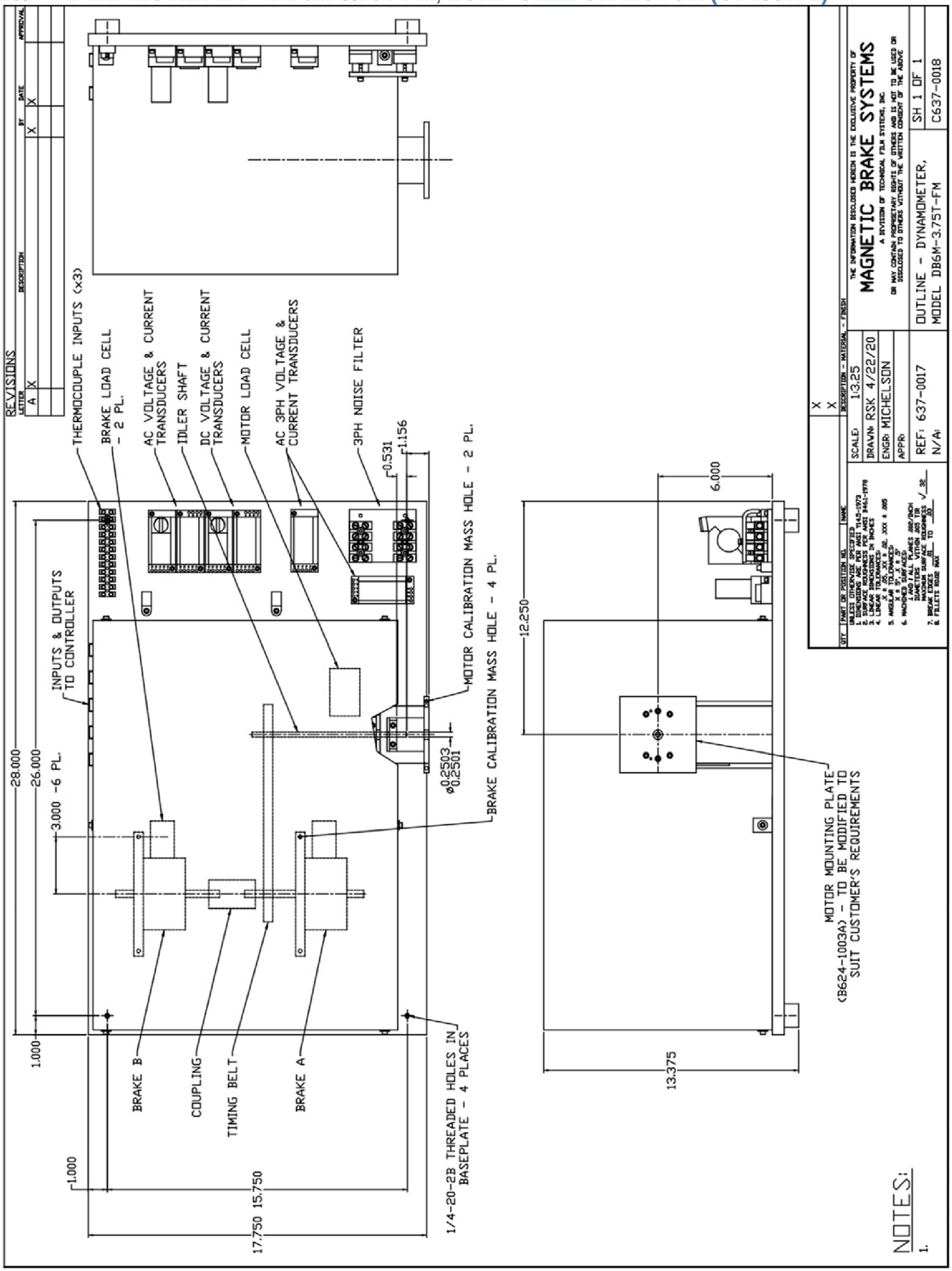
14. DYNAMOMETER – DB6B-3.75T-FM, LOAD CELL ON BRAKES



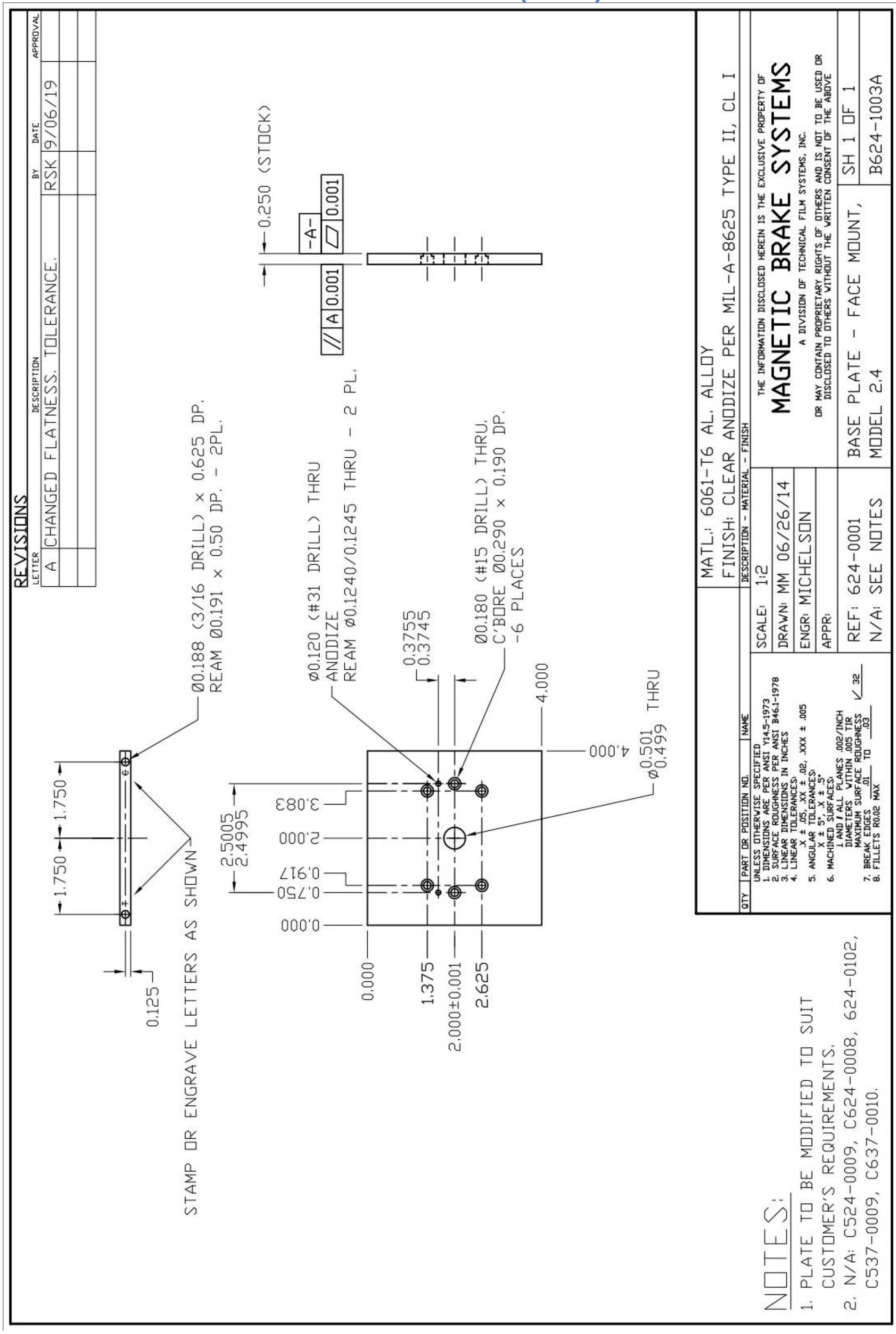
15. MOTOR MOUNTING PLATE – FACE MOUNT (DB6B)



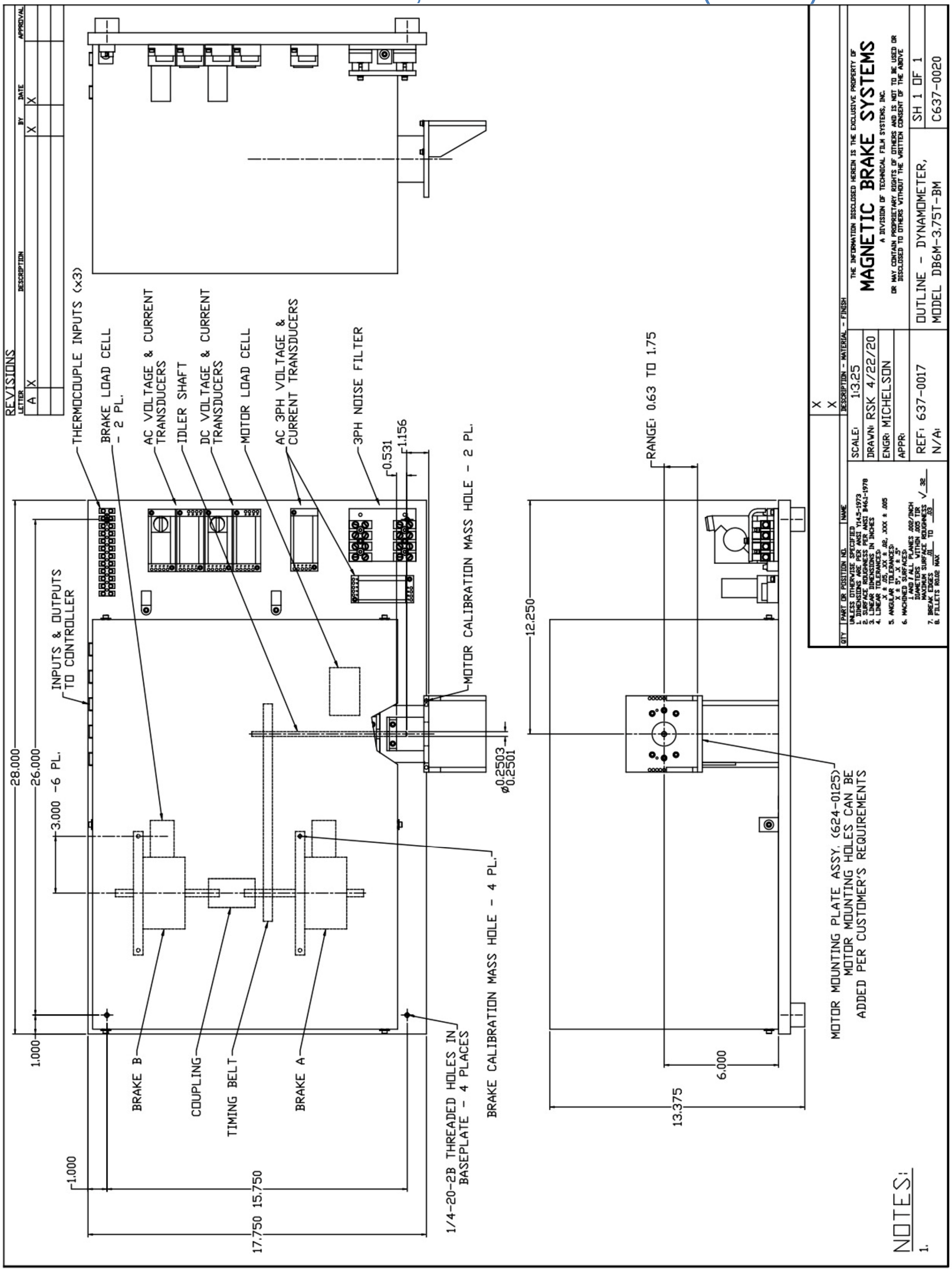
16. DYNAMOMETER – DB6M-3.75T-FM, LOAD CELL ON MOTOR (OPTION 1)



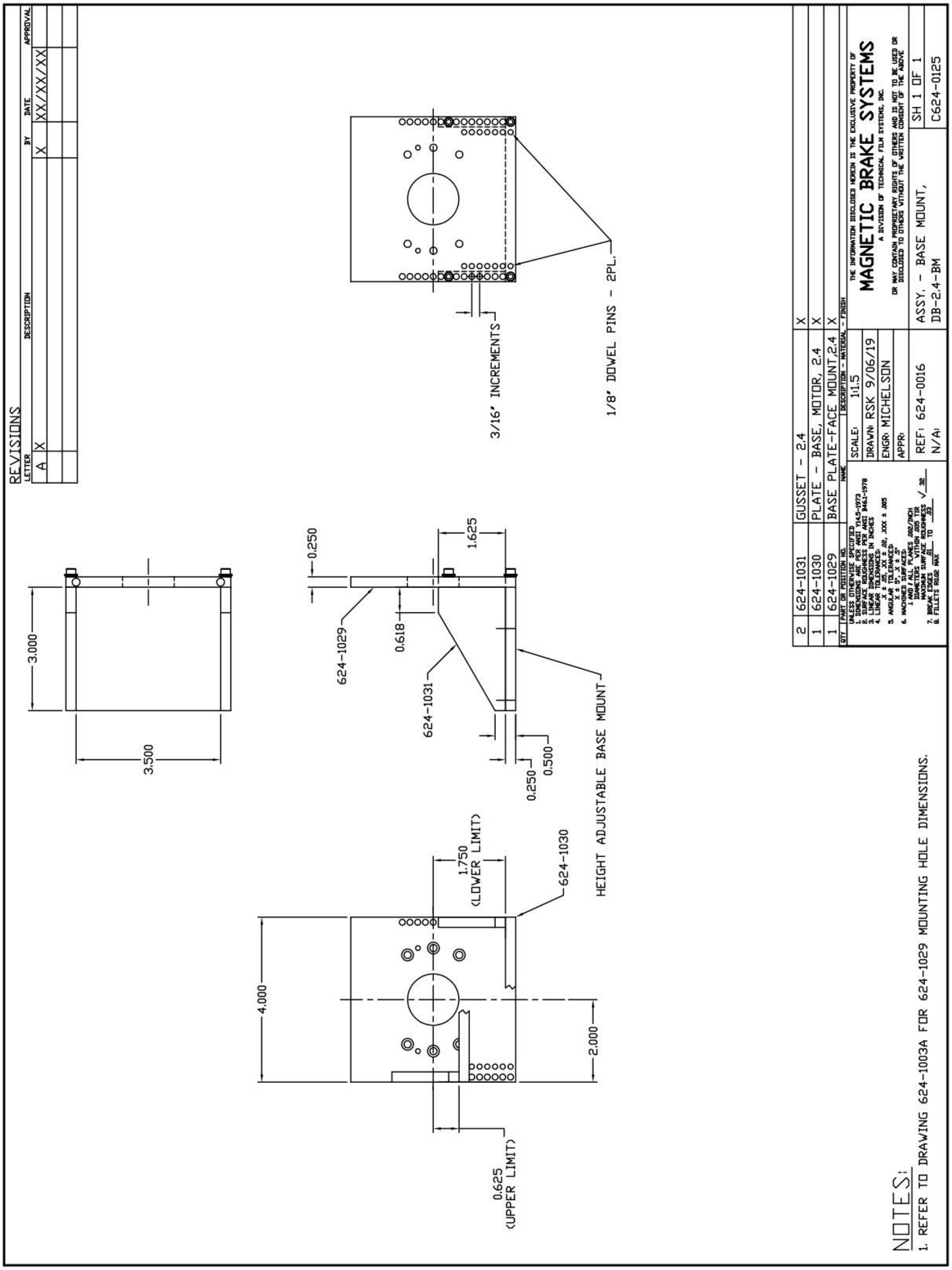
17. MOTOR MOUNTING PLATE – FACE MOUNT (DB6M)



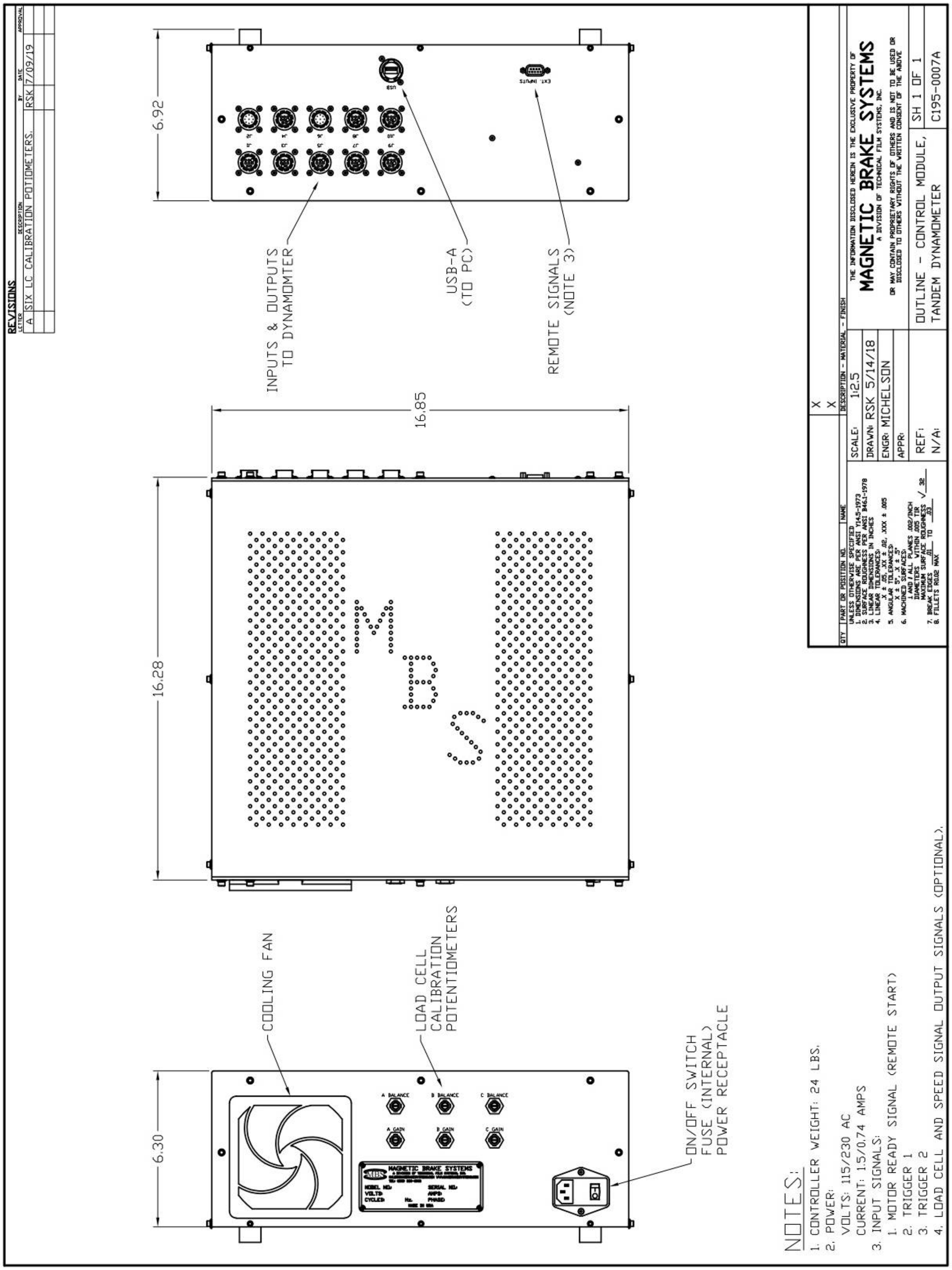
18. DYNAMOMETER– DB6M-3.75T-BM, LOAD CELL ON MOTOR (OPTION 2)



19. MOTOR MOUNTING PLATE – BASE MOUNT (DB6M)



20. CONTROLLER LAYOUT



21. NOMENCLATURE OF DYNAMOMETER MODEL NUMBER

DB6M-8.7T-FM

Motor Mounting Style:
- **FM = Face Mount**
- **BM = Base Mount**
- **CB = Carriage Base**

Number of Brakes:
- **T = Tandem System**
- **Omitting T = single brake system**

Brake Size:
- **17.5 = MBZ-17.5 brake**
- **8.7 = MBZ-8.7 brake**
- **5.7 = MBZ-5.7 brake**
- **3.7 = MBZ-3.75 brake**
- **2.4 = MBZ-2.4 brake**

Load Cell Location:
- **M = Measuring Motor Torque**
- **B = Measuring Brake Torque**

Centerline Distance:
- **3 = 3 inches from top of baseplate to centerline of motor shaft.**
- **6 = 6 inches from top of baseplate to centerline of motor shaft**

System Type:
- **B = Belt Coupled system**
- **I = Inline system**

D = Dynamometer

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