MAGNETIC BRAKE SYSTEMS

A DIVISION OF TECHNICAL FILM SYSTEMS, INC.

DYNAMOMETER DATA SHEET

(Version 1.0)

MODELS:

DB5B-5.7-FM **DB5M-5.7-FM**

DB5B-5.7-BM **DB5M-5.7-BM**

Max. Continuous Power Dissipation:	3.3 HP (2,460 watts)
Max. Power for 30 Seconds:	4.76 HP (3,550 watts)
Max Continuous Brake Torque:	800 in-oz. (5.65 N-m)
Max. Brake Torque:	1,000 in-oz. (7.06 N-m)
Max Brake Speed:	8,000 RPM

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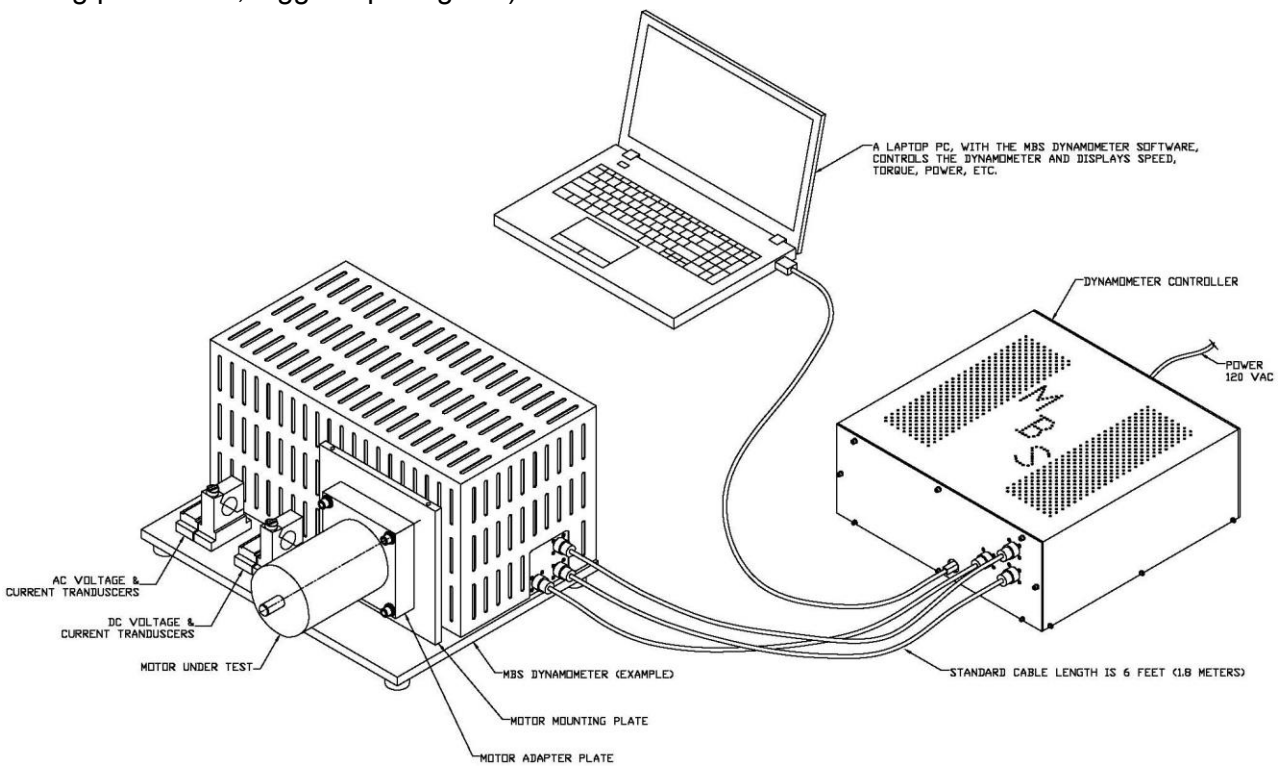
1. OVERVIEW

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.

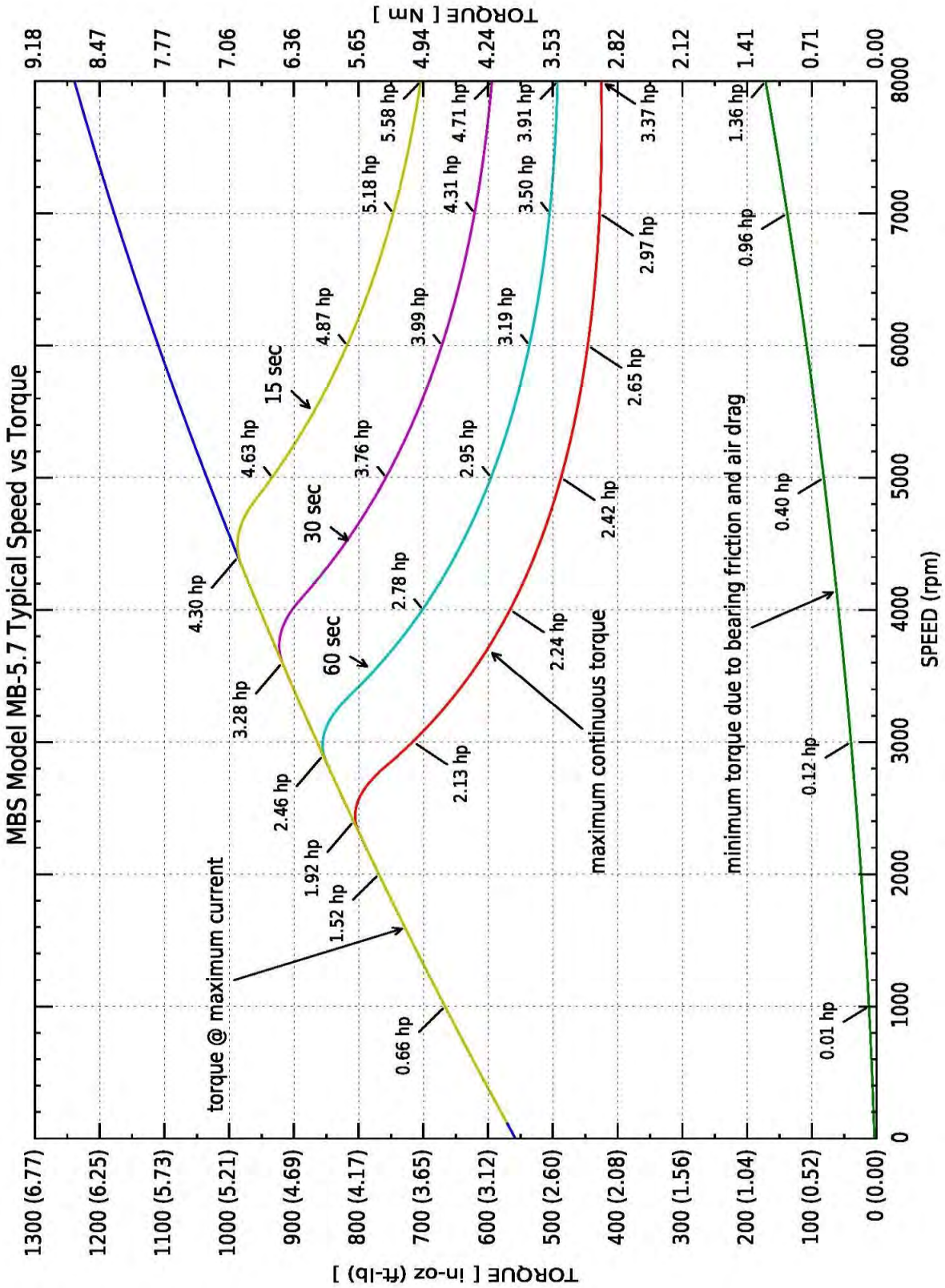
A belt coupled system will provide a much broader range of torque supplied to the motor under test, which makes a dynamometer more cost effective and diverse than a direct drive system.

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-5.7-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-5.7-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.

2. SPEED vs. TORQUE CURVE – MB-5.7 BRAKE



3. MOTOR TORQUE AND SPEED:

For a system measuring the motor torque (as opposed to the brake torque) Tables 1 through 6 may be referenced to help 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 will show the load cell accuracy for range of testing required.

3.1 Pulley Ratio's (English Units)

Motor_Spd (RPM)	Motor_Tq (in-oz.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-oz.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. #**
0	2,240	0	4:1	560	0	cont.	4
625	3,200	1.98	4:1	800	2,500	cont.	5
1,000	2,200	2.24	4:1	550	4,000	cont.	4
1,000	3,600	3.57	4:1	900	4,000	30	6
1,250	3,600	4.46	4:1	900	5,000	15	6
2,000	1,680	3.33	4:1	420	8,000	cont.	3
2,000	2,400	4.76	4:1	600	8,000	30	4

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

Motor_Spd (RPM)	Motor_Tq (in-oz.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-oz.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. #**
0	560	0	1:1	560	0	cont.	1
2,500	800	1.98	1:1	800	2,500	cont.	1
4,000	550	2.24	1:1	550	4,000	cont.	1
4,000	900	3.57	1:1	900	4,000	30	2
5,000	900	4.46	1:1	900	5,000	15	2
8,000	420	3.33	1:1	420	8,000	cont.	1
8,000	600	4.76	1:1	600	8,000	30	1

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

Motor_Spd (RPM)	Motor_Tq (in-oz.)	Power (HP)	Pulley Ratio (mtr/brk)	Brake_Tq (in-oz.)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. #**
0	140	0	1:4	560	0	cont.	1
10,000	200	1.98	1:4	800	2,500	cont.	1
17,000*	137	2.31	1:4	550	4,250	cont.	1
17,000*	212	3.7	1:4	850	4,250	30	1
20,000*	128	2.25	1:4.5	510	4,444	cont.	1
20,000*	205	3.61	1:4.5	820	4,444	30	1

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

The tables are based on the performance graph for the MBZ-5.7 Brake, shown in Section 2.

* Maximum motor speed is dependent upon limits of 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 (N-cm)	Power (Watts)	Pulley Ratio (mtr/brk)	Brake_Tq (N-cm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	1,582	0	4:1	395	0	cont.	4
625	2,260	1,477	4:1	565	2,500	cont.	5
1,000	1,552	1,671	4:1	388	4,000	cont.	4
1,000	2,544	2,663	4:1	636	4,000	30	6
1,250	2,542	3,327	4:1	636	5,000	15	6
2,000	1,186	2,484	4:1	297	8,000	cont.	3
2,000	1,695	3,551	4:1	424	8,000	30	4

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

Motor_Spd (RPM)	Motor_Tq (N-cm)	Power (Watts)	Pulley Ratio (mtr/brk)	Brake_Tq (N-cm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	395	0	1:1	395	0	cont.	1
2,500	565	1,477	1:1	565	2,500	cont.	1
4,000	388	1,671	1:1	388	4,000	cont.	1
4,000	636	2,663	1:1	636	4,000	30	2
5,000	636	3,327	1:1	636	5,000	15	2
8,000	297	2,484	1:1	297	8,000	cont.	1
8,000	424	3,551	1:1	424	8,000	30	1

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

Motor_Spd (RPM)	Motor_Tq (N-cm)	Power (Watts)	Pulley Ratio (mtr/brk)	Brake_Tq (N-cm)	Brake_Spd (RPM)	Time (sec)	L.C. Ref. # **
0	99	0	1:4	395	0	cont.	1
10,000	141	1,477	1:4	565	2,500	cont.	1
17,000*	97	1,723	1:4	388	4,250	cont.	1
17,000*	150	2,760	1:4	600	4,250	30	1
20,000*	90	1,679	1:4	360	4,444	cont.	1
20,000*	145	2,693	1:4	579	4,444	30	1

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

The tables are based on the performance graph for the MBZ-5.7 Brake, shown in Section 2.

* See Table 7 for L.C. (Load Cell) specifications based on the number shown.

** Maximum motor speed is dependent upon limits of pulleys and belt.

3.3 Load Cell Size

The load cell(s) for the system should be specified by their load rating (column 2 or 3).

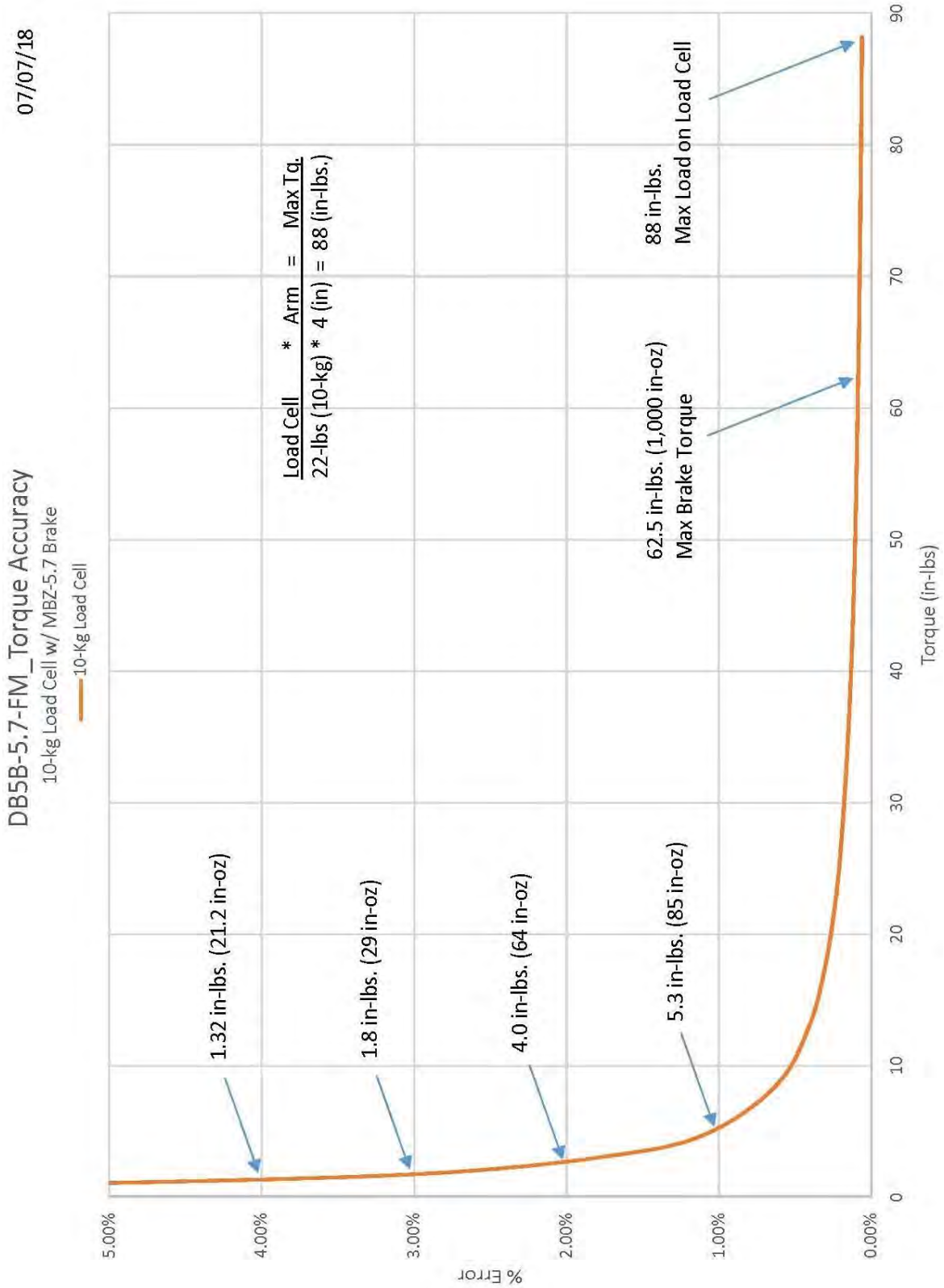
Load Cell Ref. #	Load Rating (lbs.)	Load Rating (Kg.)	Arm (inches [cm])	Max Torque (in-lbs.)	Max Torque (in-oz.)	Max Torque (Nm)	Max Torque (Ncm)
1	13	6	4 [10.16]	52.9	846	6	600
2	22	10	4 [10.16]	88.2	1,411	10	1,000
3	33	15	4 [10.16]	132.8	2,125	15	1,500
4	44	20	4 [10.16]	177	2,832	20	2,000
5	55	25	4 [10.16]	221.3	3,541	25	2,500
6	66	30	4 [10.16]	265.5	4,248	30	3,000

Table 7: Load Cell Reference

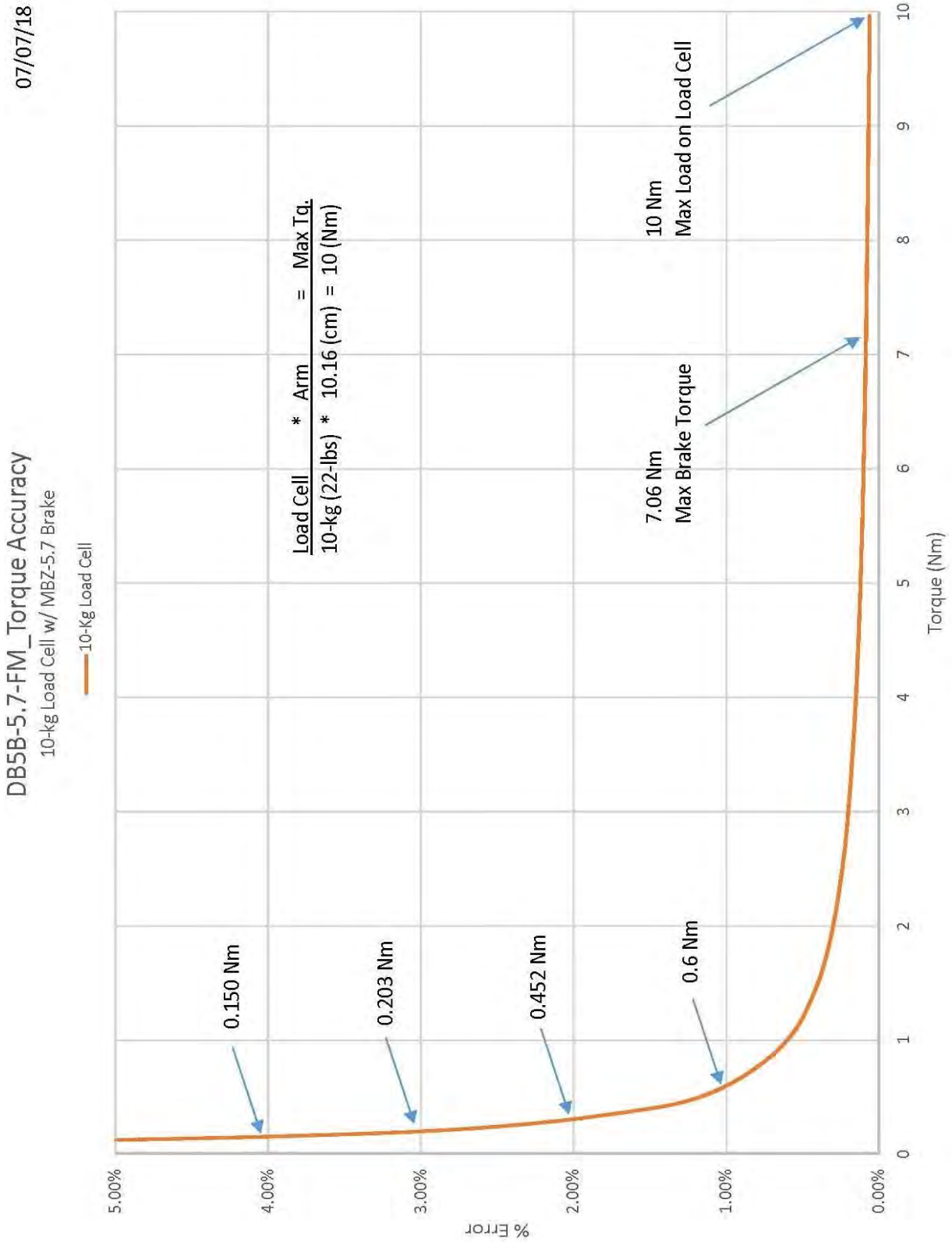
4. LOAD CELLS (Option 1: DB5B-5.7-FM, Measure Brake Torque)

Max Load Cell Load Rating ..... 22 lbs. (10 Kg.)
Torque Arm ..... 4 in. (10.16 cm)
Max Load Cell Torque Rating ..... 88 in-lbs. (
Max Brake Torque ..... 62.5 in-lbs. (7.1 Nm)
Max Torque to L.C ..... 88 in-lbs. (10 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 (Brake Torque) – Linear (in-lbs.)



4.2 Load Cell Accuracy Plot (Brake Torque) - Linear (Nm)



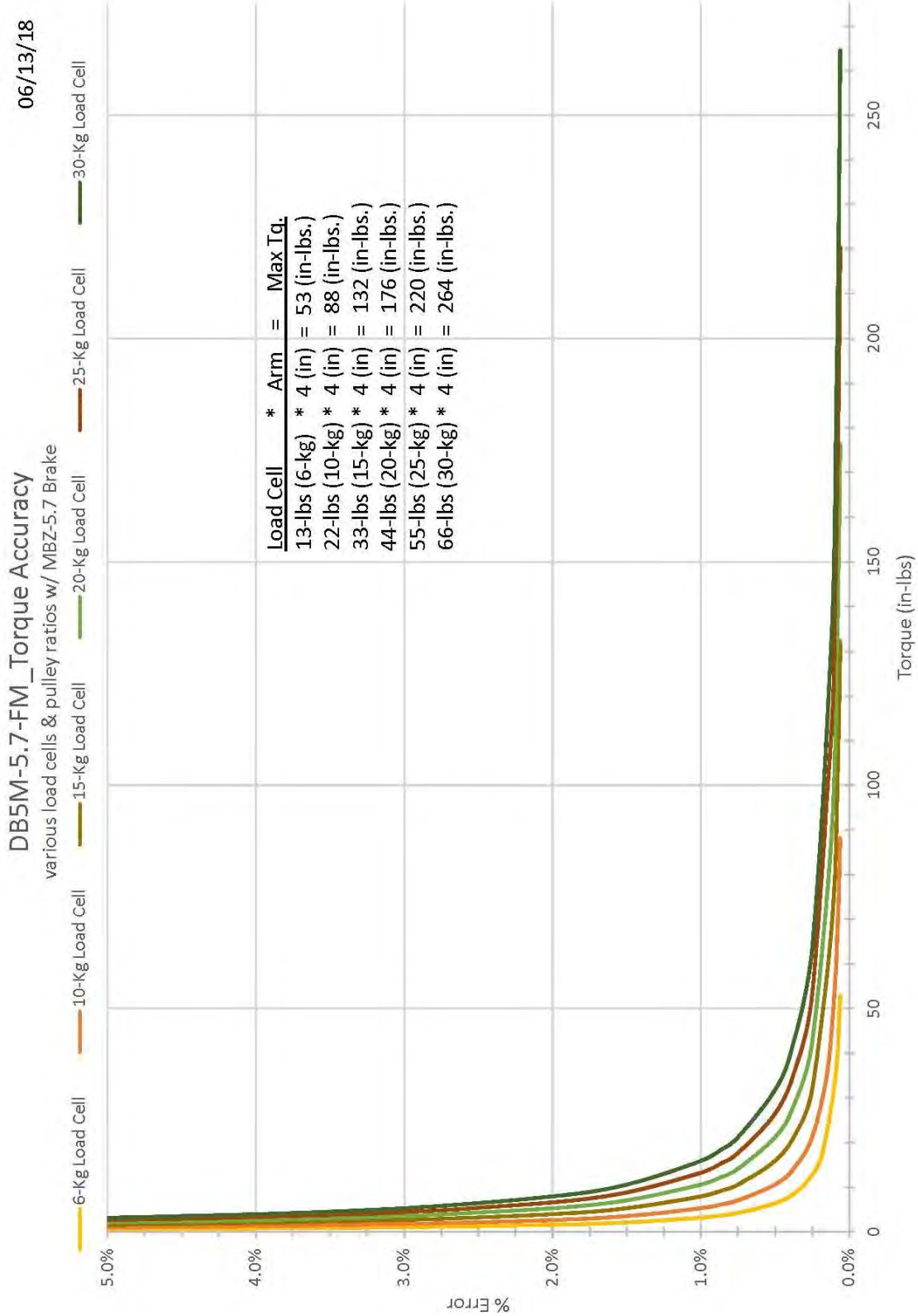
5. LOAD CELLS (Option 2: DB5M-5.7-FM, Measure Motor Torque)

Max Load Cell Rating (lbs.)	13, 22, 33, 44, 55, 66
Max Load Cell Rating (kg.)	6, 10, 15, 20, 25, 30
Torque Arm	4 in. (10.16 cm)
Torque Ratings (in-lbs.)	52, 88, 132, 176, 220, 264, 308
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.*

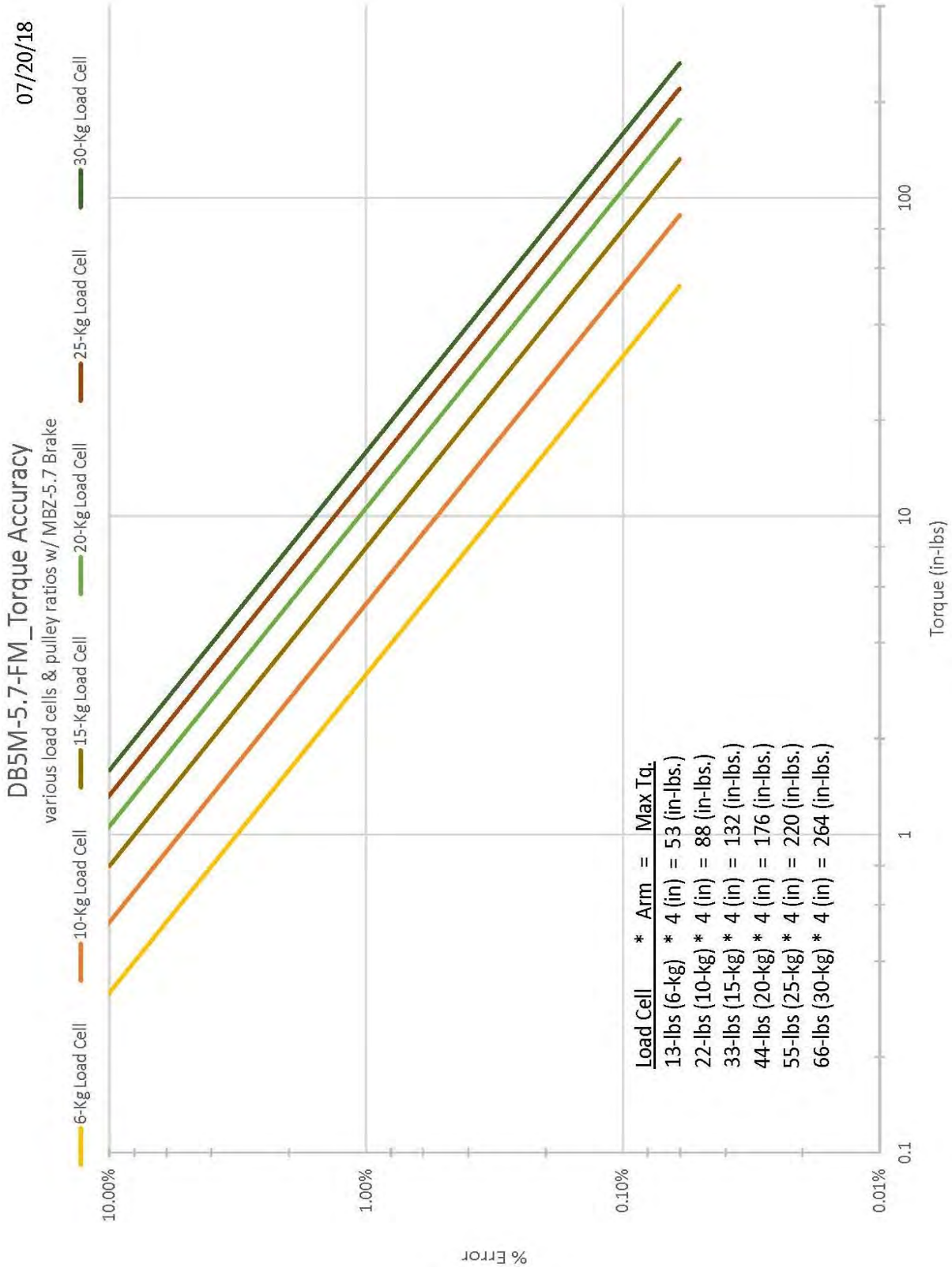
* Hard stops are in place to help prevent damage from over-load.

The Torque Error plots, 5.1 through 5.4, 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, the following plot is the same except 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.

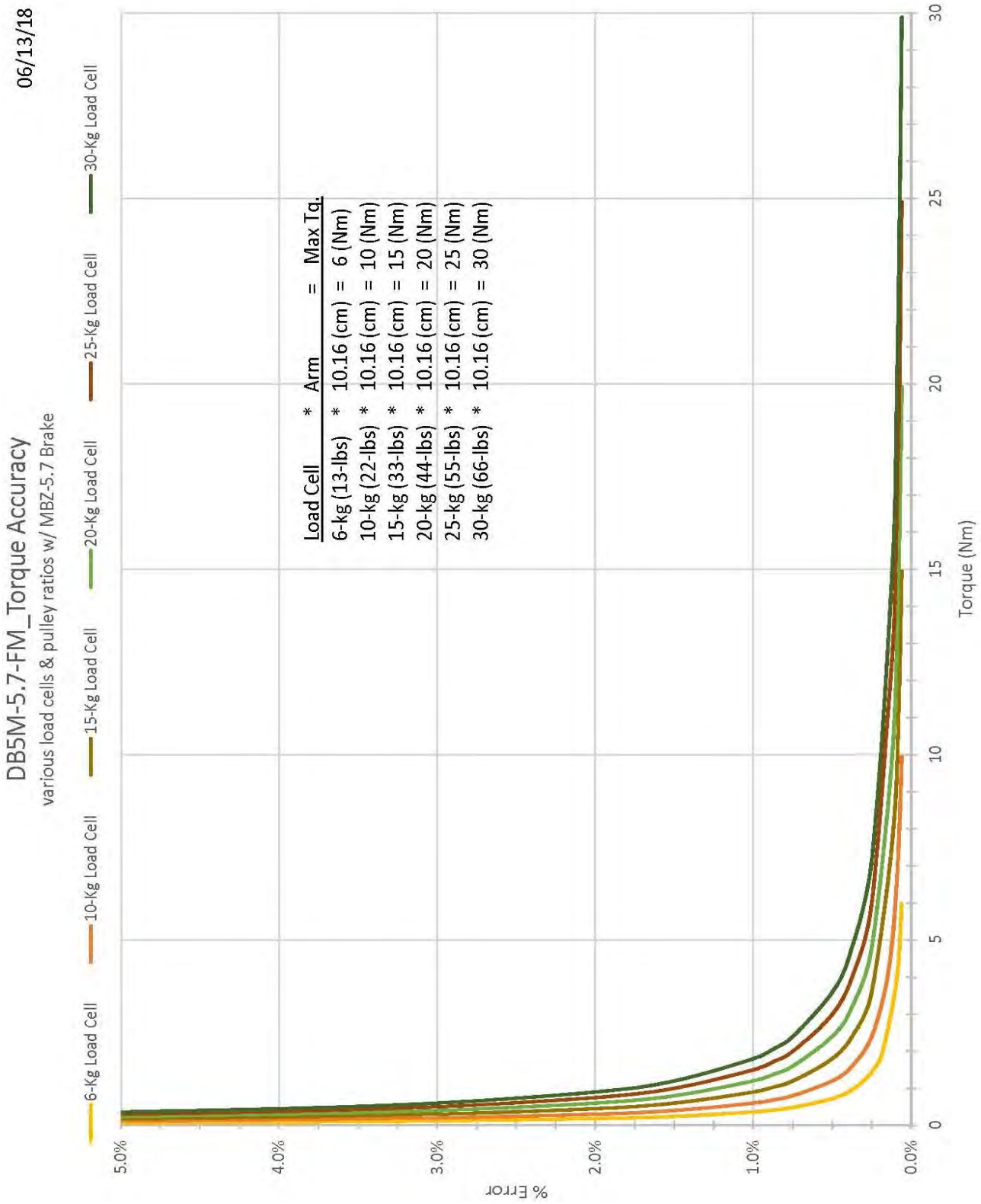
5.1 Load Cell Accuracy Plot - Motor Torque (in-lbs.) - Linear



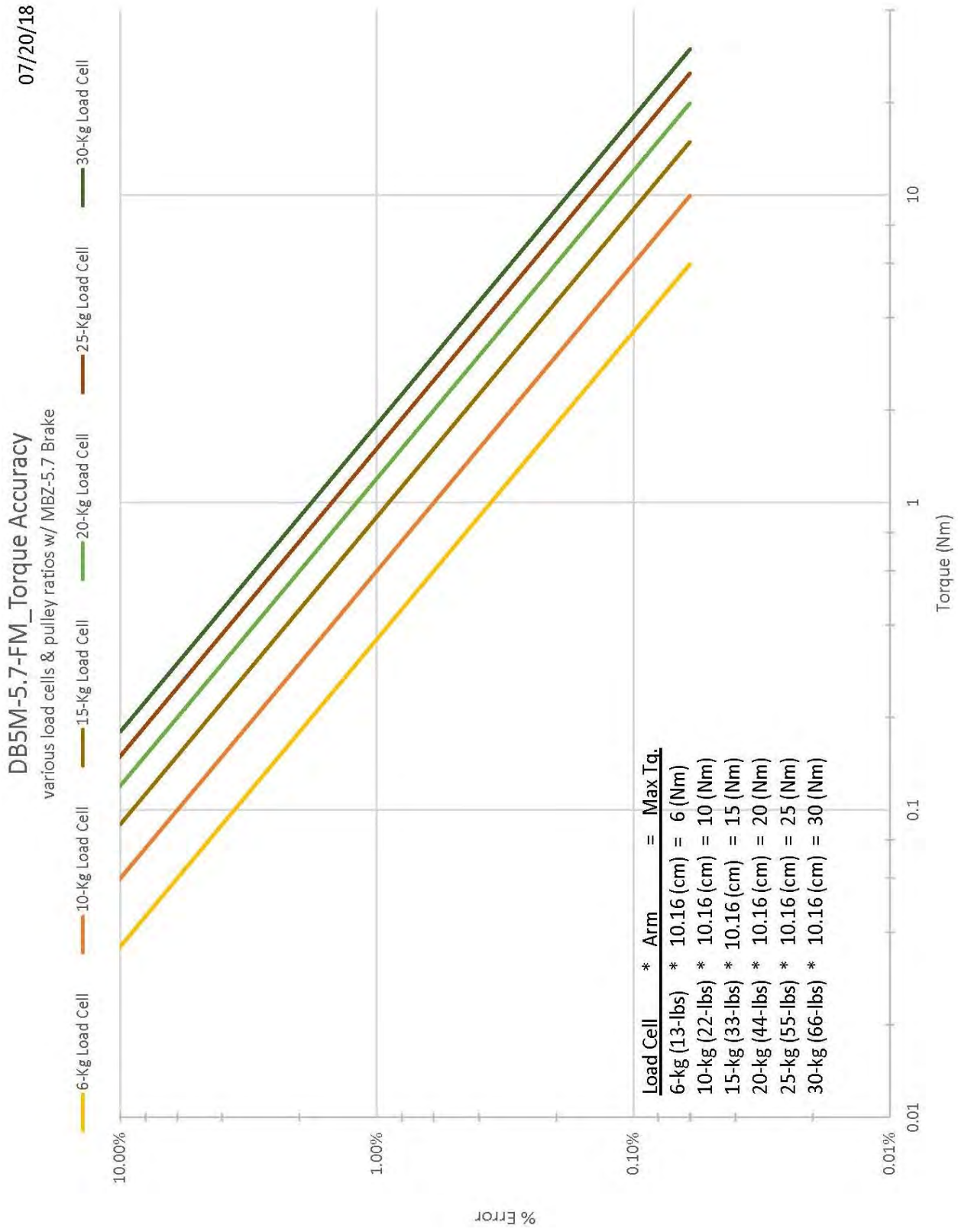
5.2 Load Cell Accuracy Plot - Motor Torque (in-lbs.) – Logarithmic



5.3 Load Cell Accuracy Plot - Motor Torque (Nm) - Linear



5.4 Load Cell Accuracy Plot - Motor Torque (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

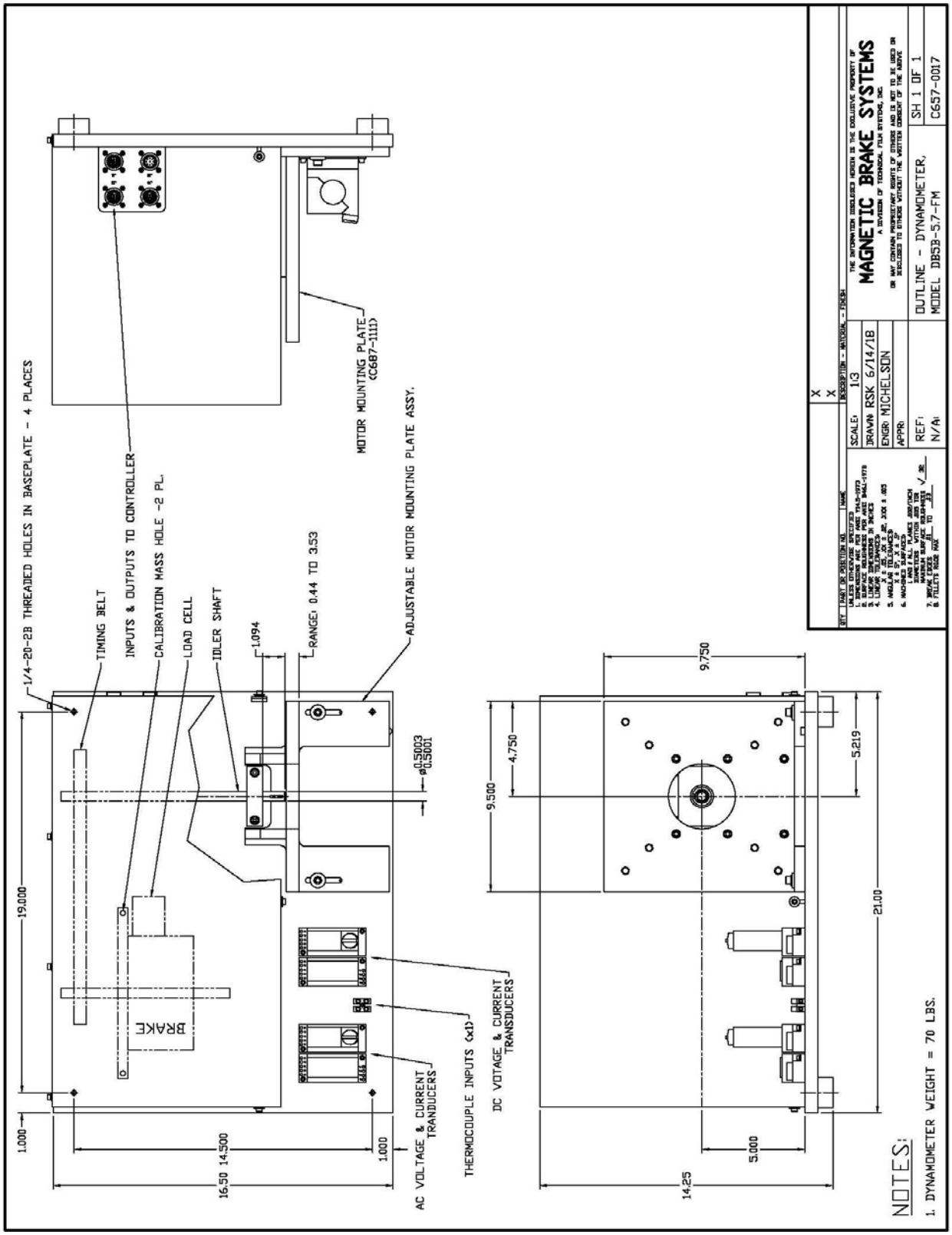
13.2 Output

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

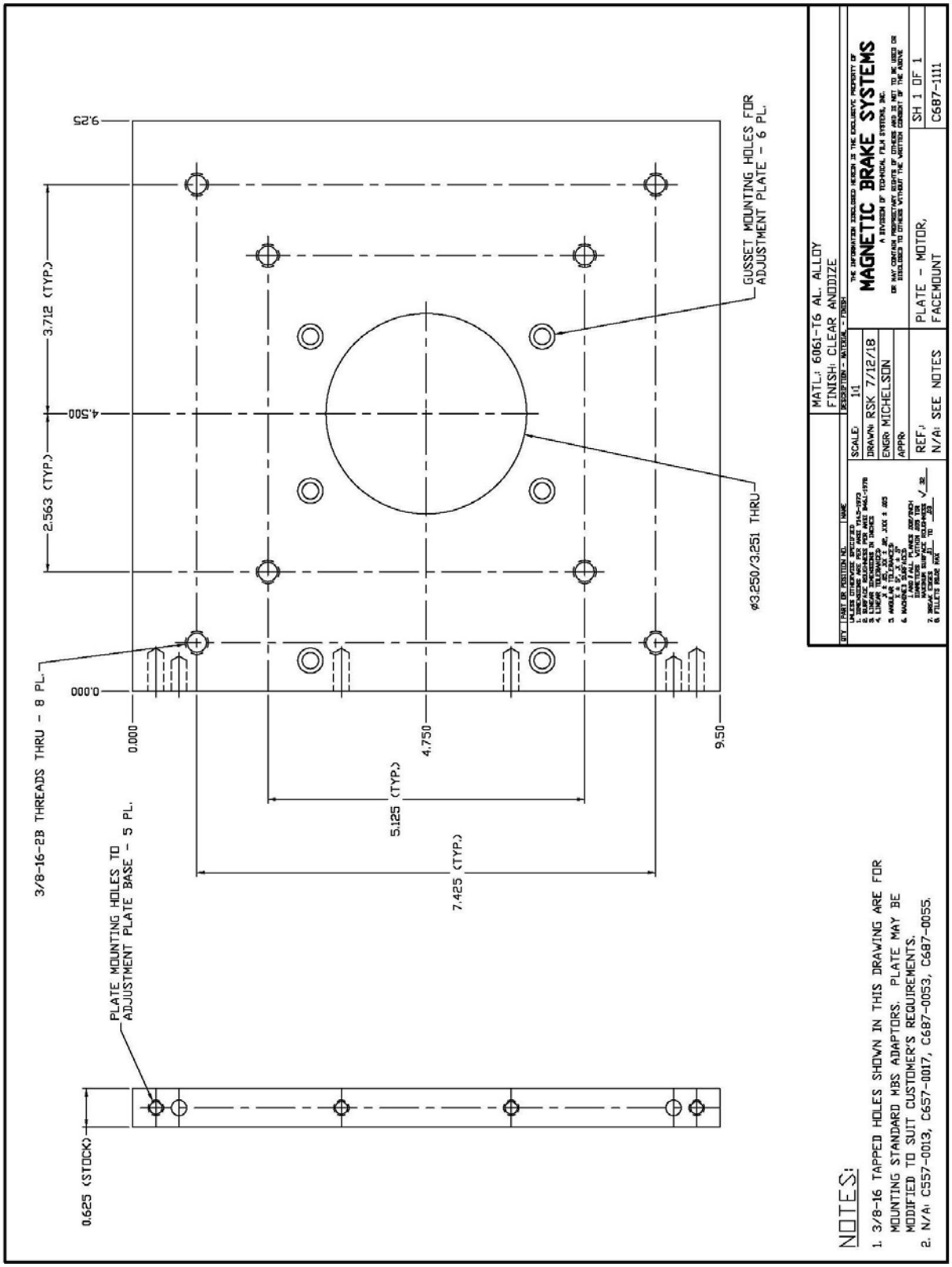
13.3 Environmental and Physical Characteristics

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.

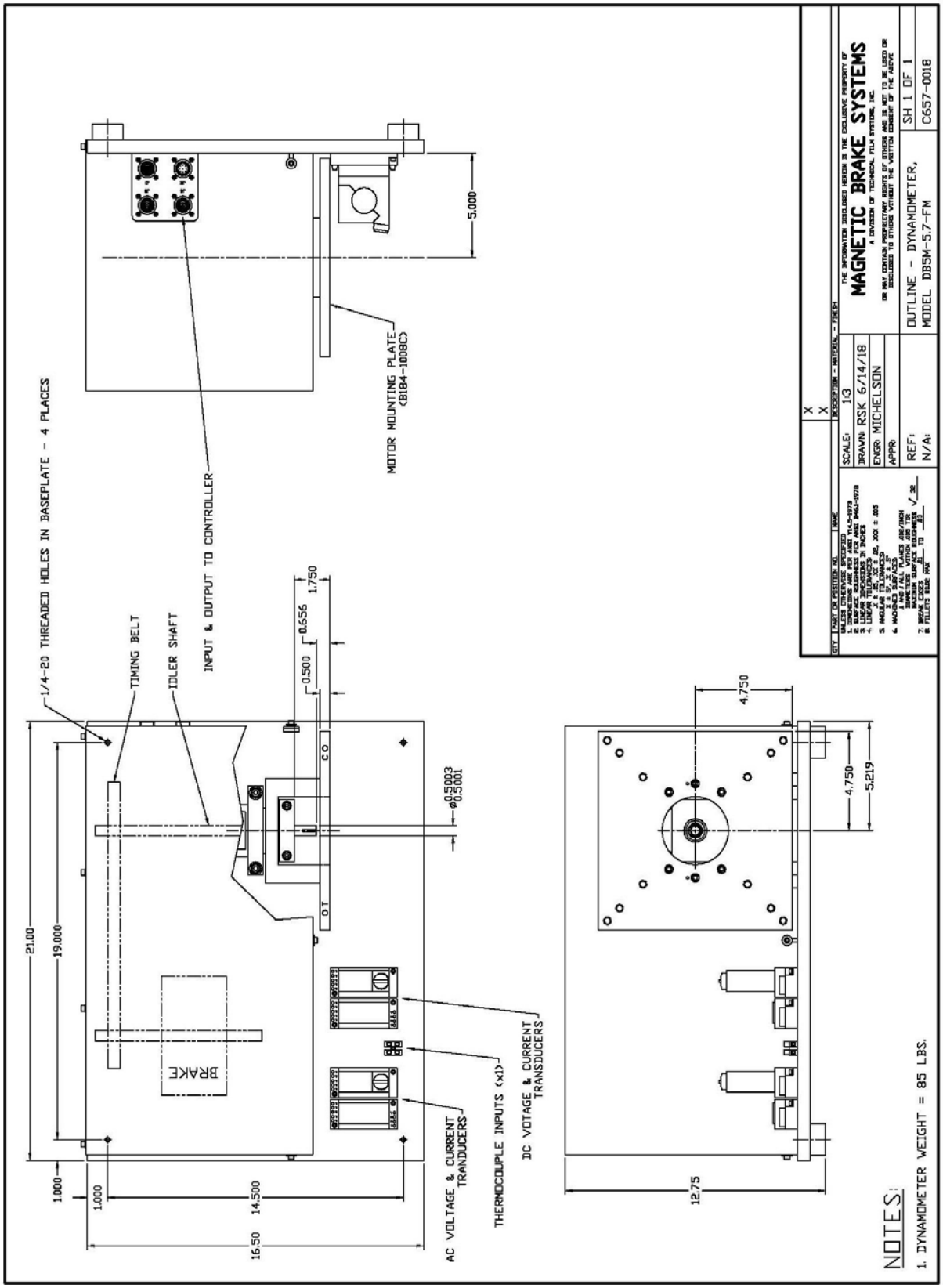
14. DYNAMOMETER LAYOUT – DB5B-5.7-FM, LOAD CELL ON BRAKE



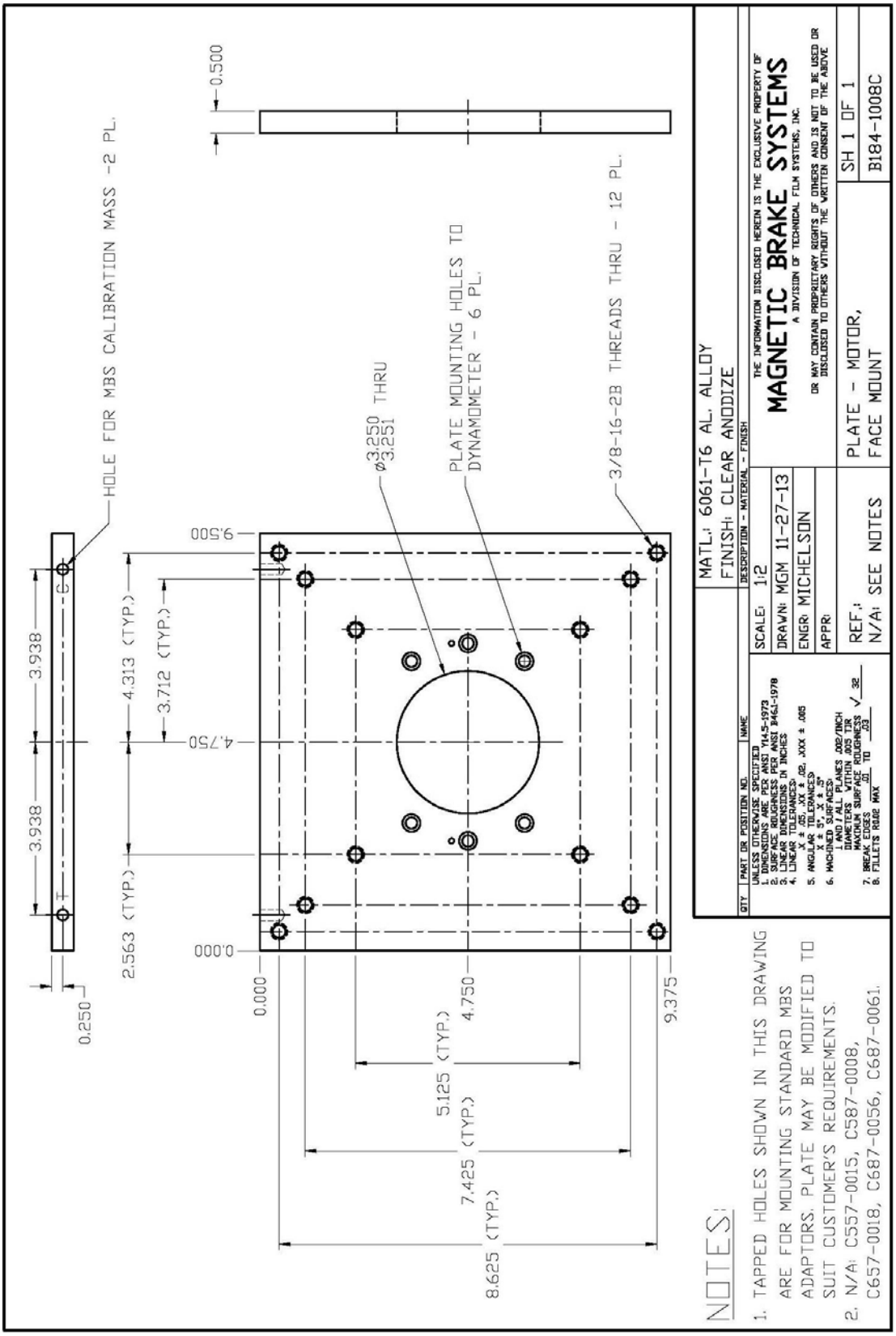
15. MOTOR MOUNTING PLATE – DB5B



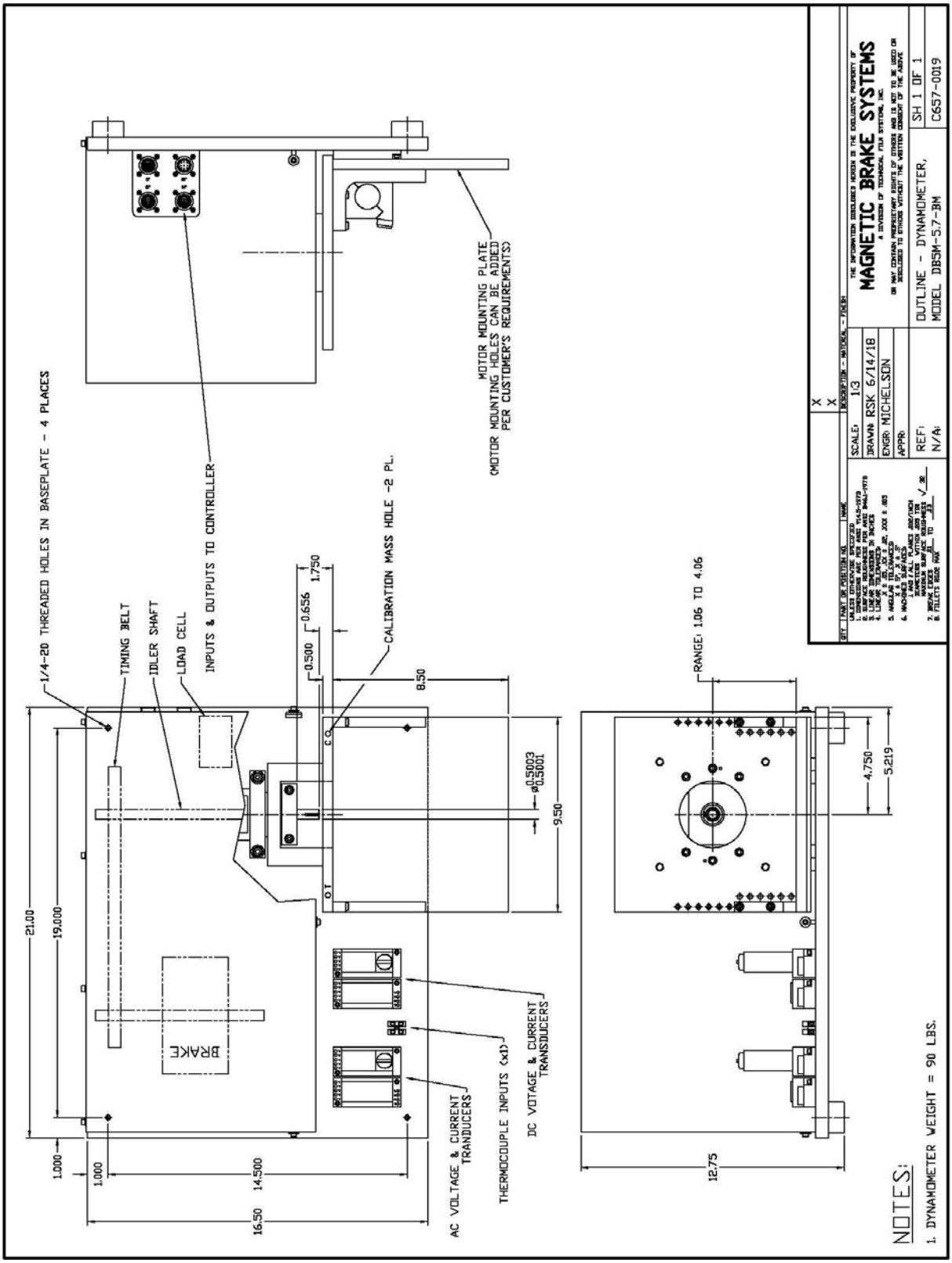
16. DYNAMOMETER LAYOUT – DB5M-5.7-FM, LOAD CELL ON MOTOR (OPTION 1)



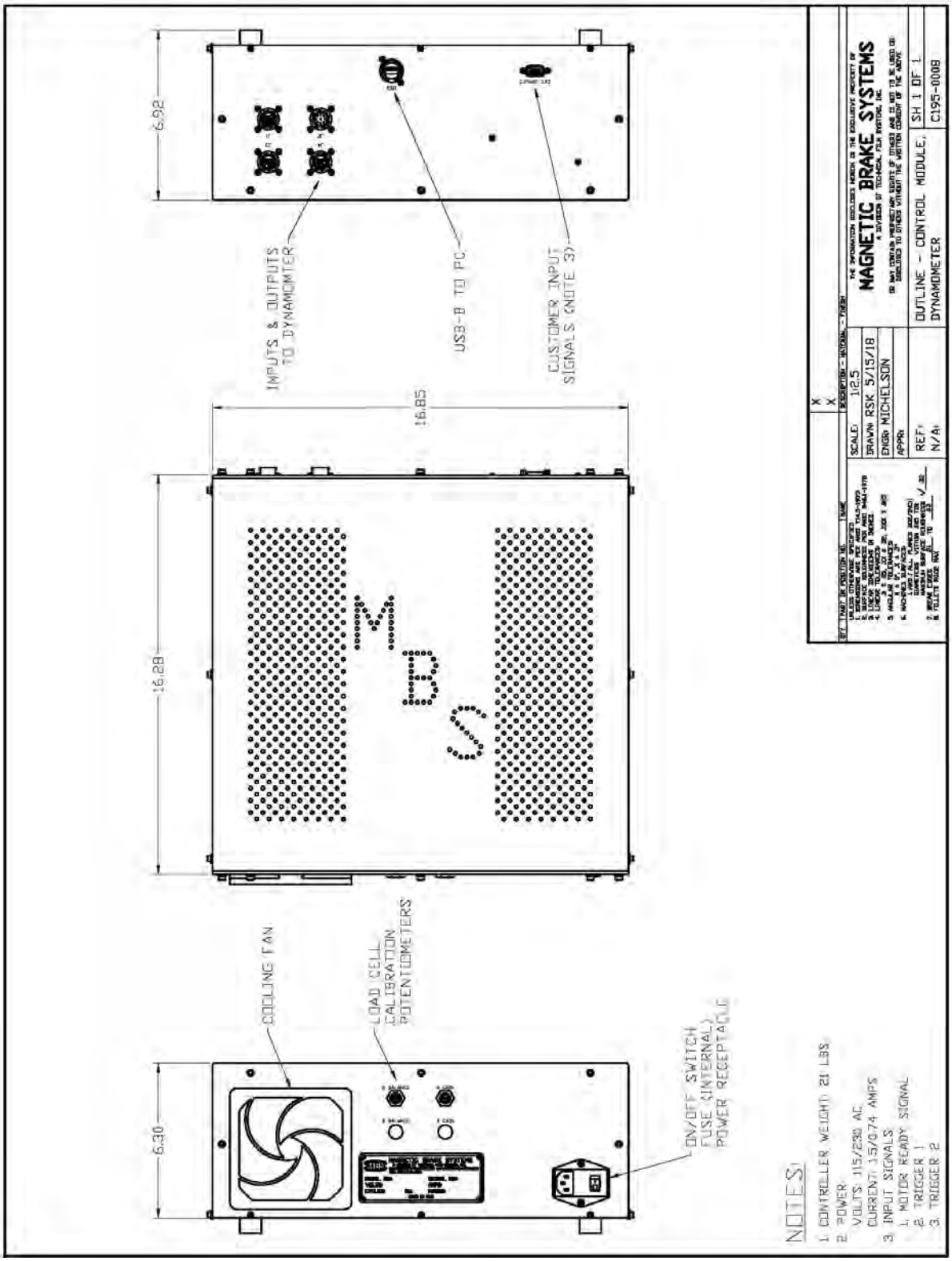
17. MOTOR MOUNTING PLATE – DB5M



18. DYNAMOMETER LAYOUT – DB5M-5.7-BM, L.C. ON MOTOR (OPTION 2)



19. DYNAMOMETER CONTROLLER



20. NOMENCLATURE OF DYNAMOMETER PART NUMBER

DB5M-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.**
- **5 = 5 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.