GMW

USER'S MANUAL

MODEL: 5203

Projected Vertical Field Magnet

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Thermo Scientific Water Chemical Kit
Thermo Scientific Treated Water Instructions
ThermoFlex Preventative Maintenance

1. SAFETY

1.1 Symbols Used In This Manual

Important information. This label indicates important information that must be read and understood prior to operation.

Warning relating to the presence of magnetic field.

Warning relating to a trip hazard.

Warning relating to hot surfaces.

Warning relating to the potential for electrical shock.

Warning relating to the potential of injury due to lifting heavy weight.

1.2 Installation, Operation, and Service Precautions

During installation or servicing this magnet must be locked out following the Lockout/Tagout procedure defined in section 1.3.

Hazardous voltages are present within this product during normal operation. This equipment should never be operated with any covers removed or interlocks defeated.

When operated at peak direct current of 63A the surface temperature of the coils of the electromagnet can rise as high as 80°C. Care must be taken not to touch the coils for extended periods.

NEVER SERVICE ALONE. The output of this equipment and its DC Power Supply is capable of delivering high voltages at high currents, and is potentially lethal. Do not perform service to this equipment or its associated DC Power Supply unless another person is present who is capable of rendering first aid.

1.3 Lockout/Tagout Procedures

Purpose:

To protect personnel and ensure that machines and equipment are isolated from potentially hazardous electrical energy. Lockout or tagout must occur before employees perform service, maintenance, or renovation. This is important where unexpected start-up could cause personal injury, fire, or equipment damage.

Policy:

All equipment shall be locked out where possible. Where such control is not possible, equipment may be tagged out-of-service. In all instances, equipment shall be made inoperable to protect against possible operation where such operation may cause personal injury or damage. Employees must not attempt to operate any switch or source of energy which is locked out or tagged out.

Procedures:

1. When working on systems which could accidentally be activated, the system shall be locked out or tagged out by use of a safety lockout device and padlock. In addition, a tag shall be used to identify the purpose of the shutdown, the employee involved, the date the unit was removed from service, and when the system may operate again.

2. If more than one source of energy is present, all such sources must be locked out or tagged out. Special procedures must be followed to ensure that the equipment is disconnected from an energy management system or emergency generator system that may start or energize the equipment.

3. A lockout is required on all systems where possible. A tagout is an acceptable means of protection on systems which are less hazardous. An example of less hazardous is a device, if started accidentally, would not cause personal injury.

4. If more than one person is involved in the repair, each person shall install a lock and or tag to the equipment energy source. An employee may not use the tag or lock of another employee.

5. After servicing, renovation, or maintenance is complete, the area must be checked for tools, parts, removed guards, and assurance that no personnel are in the danger zone. Then the lockout or tagout will be removed by the same employee who initially locked it out so energy may be restored to the equipment.

6. If the employee who locked out or tagged out the equipment is unavailable, the supervisor may remove the lock or tag if the following conditions are met:
    1. Verification that the employee who applied the device has left for the duration of the shift and is not at the job site.
    2. Made reasonable efforts to reach the employee.
    3. Inform the employee that the lock or tag has been removed and the system is no longer de-energized, before the employee resumes work.

7. Employee's using lockout/tagout devices shall have training about this program, and shall have annual retraining to ensure that the employee understands and follows this program. The training and retraining shall be documented with the training records maintained by the training coordinator.

8. Outside contractors are required to follow this policy or provide a similar policy that is in compliance with Occupational Safety and Health Administration (OSHA) Standard 1910.147. Under no circumstances are outside contractors authorized to remove a lockout/tagout device nor are they allowed to energize a locked out/tagged out system.

Lockout/Tagout Procedures Checklist:

The following steps must be followed in sequence to properly lockout/tagout and re-establish energy:

I. Understand the hazard:

Electrical

Electrical Shock and or burn could result from contact with the exposed conductors line voltage or high voltage equipment. Flying parts or fire could result if this circuit were shorted. Electricity should be controlled at the circuit breaker, main switch, or fuse box.

Mechanical

Equipment or machinery can inflict tissue or skeletal injury through crushing, laceration or impalement. This can be controlled through the main electrical switch, plug, circuit breaker or anti-motion pin.

Thermal

May cause burns or fires. It can be controlled by the main electrical switch, electrical plug control, electrical circuit breaker, electrical fuse box, steam valve, fluid line valve or shielding.

II. Shutdown:

Know what type of energy the machine uses.
Identify its potential hazards.
Find the switches or other devices that control energy and need to be locked out.
Let employees know that you will be locking or tagging out the equipment and why.
Turn off the machine or equipment.

III. Isolate the source of energy

Electrical

- Locate the main switch box or circuit breaker.
- Open the breaker, open the switch or remove the plug.
- Attach a lockout enabling device if the circuit cannot otherwise accommodate a padlock.
- Place plug in a plug lock box.

Mechanical/Storage Potential Energy

- Lockout enabling device.
- Secure the energy controlling lockout by attaching a personal lock and completed tag to the lockout enabling device. If more than one person will be performing the work, each must apply their own lock to a multiple lock device.
- Release all stored energy.
- If there is a heat exposure, allow to cool.

Release from Lockout/Tagout

1. Inspect the surrounding area following completion of work for loose tools, parts, correct valve settings, system integrity, and exposed conductors.

2. Check that all machine guards are in place and reconnected if applicable.

3. Notify others in the area that the equipment is about to be made operational and returned to service.

4. Remove personal lock, tag, and lockout enabling device. This step must be performed by the same person who applied the tag and lock.

Lockout/Tagout Training

The lockout/tagout program is designed to train employees on disabling powered equipment from their power sources before beginning any servicing or maintenance work. Lockout/tagout training is required for all employees who may possibly need to lockout and tagout equipment.

Employees will receive annual training in the following areas:

1. Recognition of applicable hazardous energy sources.
2. Methods and Means necessary for energy isolation and control.
3. Restrictions and limitations of lockouts.

2. SPECIFICATIONS

2.1 General Specifications

Projected Field (X, Y, Z= 0, 0, 5mm)	
at:	
Max triangle wave current 100A, 945W	**Bz = ± 0.518T (5180G)**
Max sinusoidal current 85A, 945W	**Bz = ± 0.476T (4760G)**
Max DC current 63A, 945W	**Bz = ± 0.407T (4070G)**
Coils (series connection)	
Coil Resistance (20°C)	**0.173 Ohm**
Max Resistance (80°C)	**0.240 Ohm**
Max Power (water cooled @ 8 lpm)	**63A/15V (945W)**
Self Inductance (low field)	**3500µH at 1 Hz**
Self Inductance (high field)	**895µH at 1 Hz**
(The apparent inductance increases with frequency due to eddy currents in the solid poles)	
Water Cooling (18°C)	**4.0 bar (60 psid), 8 liters/min (2.1 US GPM)**
Over-temperature Interlock	**Selco UP62-080C thermostat**
	Contact rating 250VAC, 2.5A. Closed below 80°C
Water flow interlock	**GEMS FS-380. Closed above 1.5 US GPM**
Dimensions	**Drawing 11907-0224-0_F**
	74.0 mm W x 74.0 mm D x 123.5 mm H
	(2.91 inch W x 2.91 inch D x 4.86 inch H)
Mass	**2.5 kg (5.5 lb)Pole Diameter**

CAUTION The value of maximum coil resistance given should not be exceeded. At this resistance the coils are at maximum safe temperature for continuous operation.

2.2 5203 Electrical and Water Cooling Connections

DC Current

The 5203 electromagnet is shipped with the power and water connections between the junction box and the magnet head connected. In the event that these connections are broken, the correct reconnections can be made by referencing drawings 11907-0224-0_S2 and 11907-0233-0_S1.

Ground

The coil cooling plates, the magnet body and the base plate are all earthed through the power supply earth.

Interlocks
(refer Section 8)

The Model 5203 has a single thermostat, Selco part no UP62-080C. It is located between the base yoke plate and the lower cooling plate. The thermostat is normally closed, opening when the coil heatsink temperature exceeds 80°C, ± 5°C. In addition, a water flow switch is located in the junction box. This is normally open and will close once the flow rate rises above 1.5 US GPM.

Water

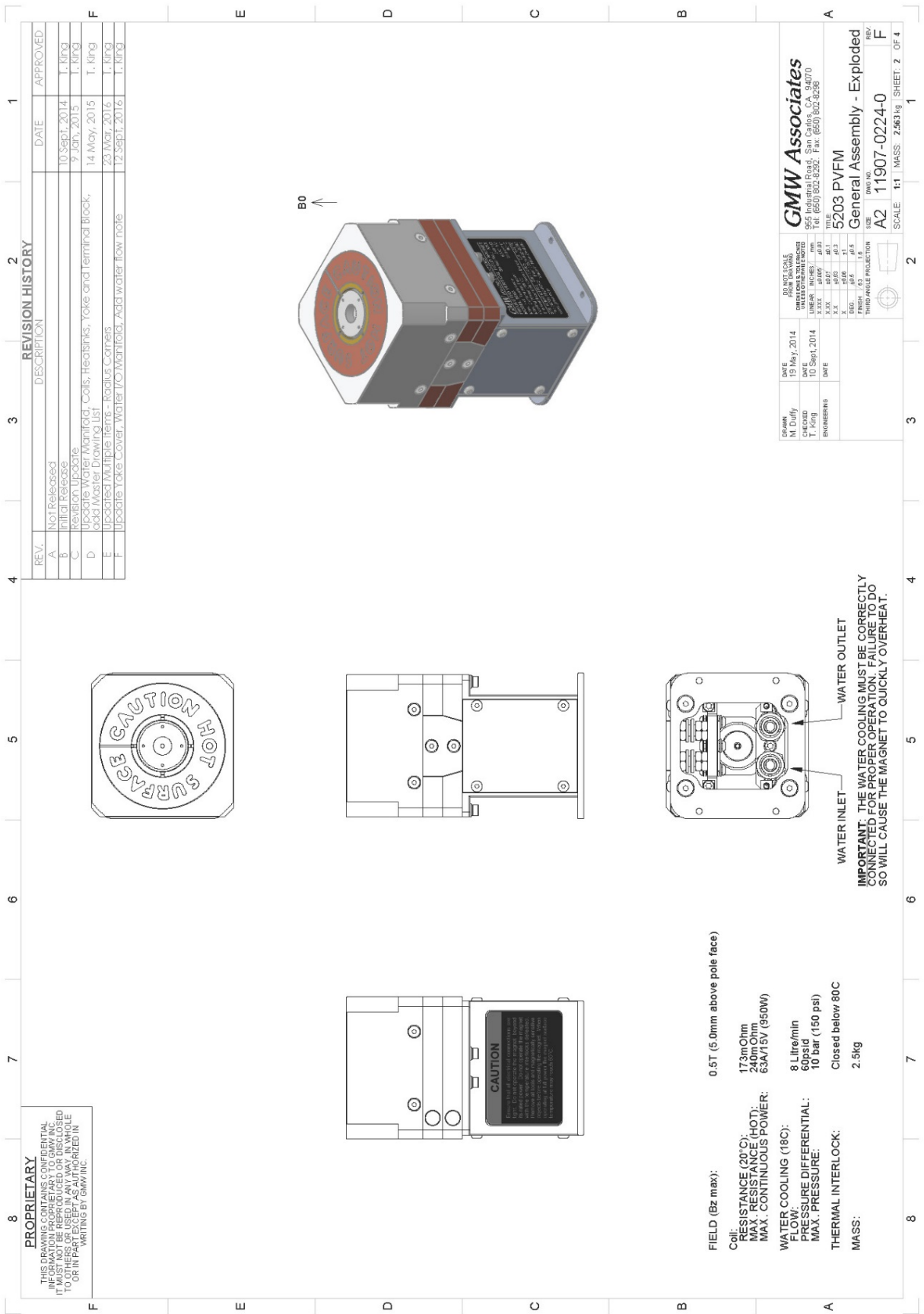
Clean, cool (16°C - 20°C) water at 8.0 lpm at 4.0 bar (60 psid) should be used to cool the 5203 magnet. This can be provided by house water supply or from a recirculating chiller. An appropriate recirculating chiller is the TF90 from Thermofisher. The magnet is shipped with a cable junction box connected, water connections should be made to the two connections on this junction box. The flow direction is indicated on the side of the flow switch. Refer to drawing 11907-0224-0_S2_F. If house water supply is used, an in-line 5 micron water filter should be used for the supply line to the magnet. Also, 10m of hose is provided to give two 5m lengths for connection between the magnet and the recirculating chiller (if ordered), brass fittings on the chiller are already provided. Note that 4 hose clamps have also been provided for fitting these water hoses. The power cable that connects the power supply to the magnet (16907-0116-1-S1_A) is also provided.

Outlet: 1/4 inch Swagelok
Inlet: 1/4 inch Swagelok

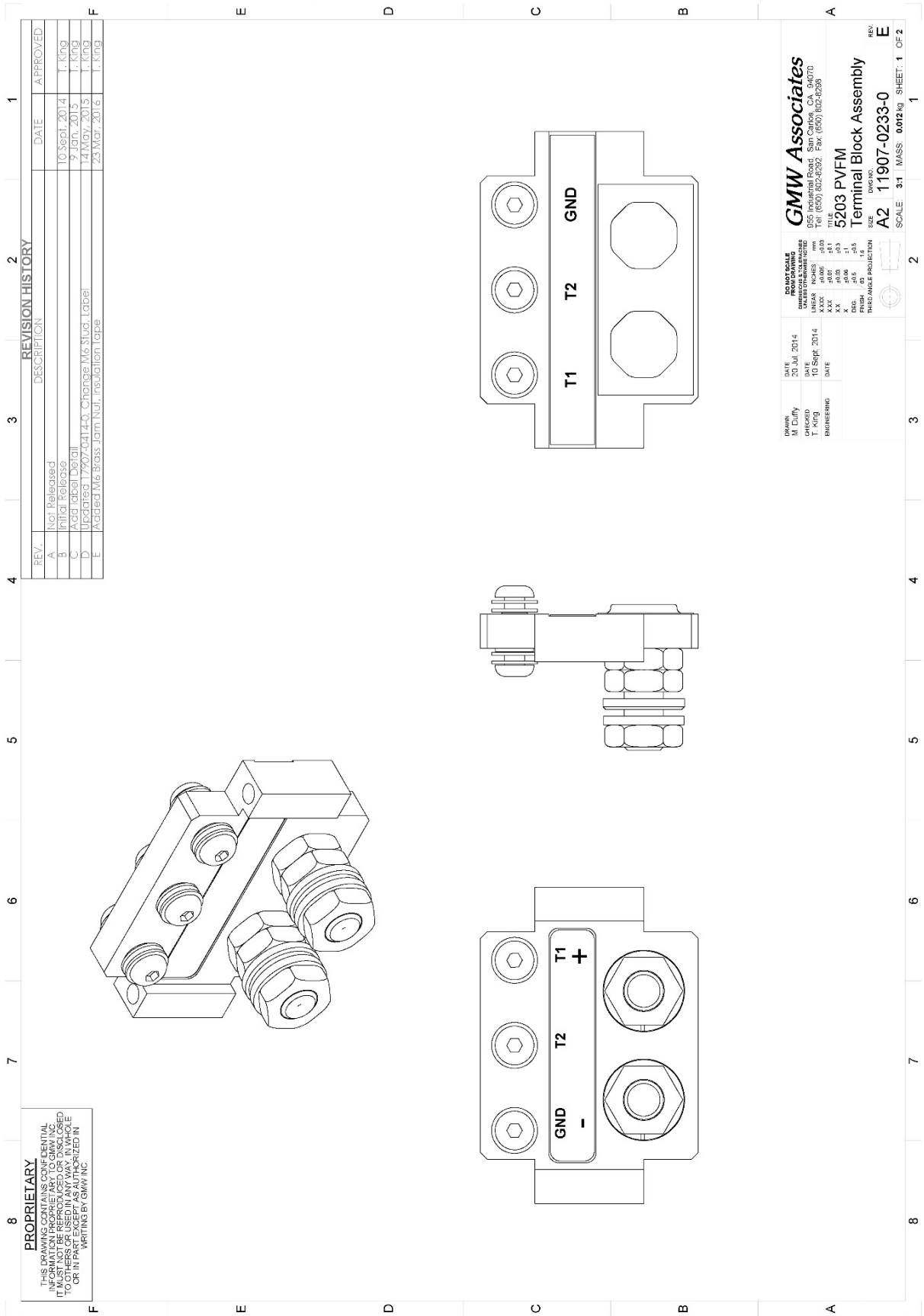
CAUTION

Ensure that the high current connections are tight. Loose connections may lead to oxidation and overheating. The field stability may be degraded and the current terminations damaged.

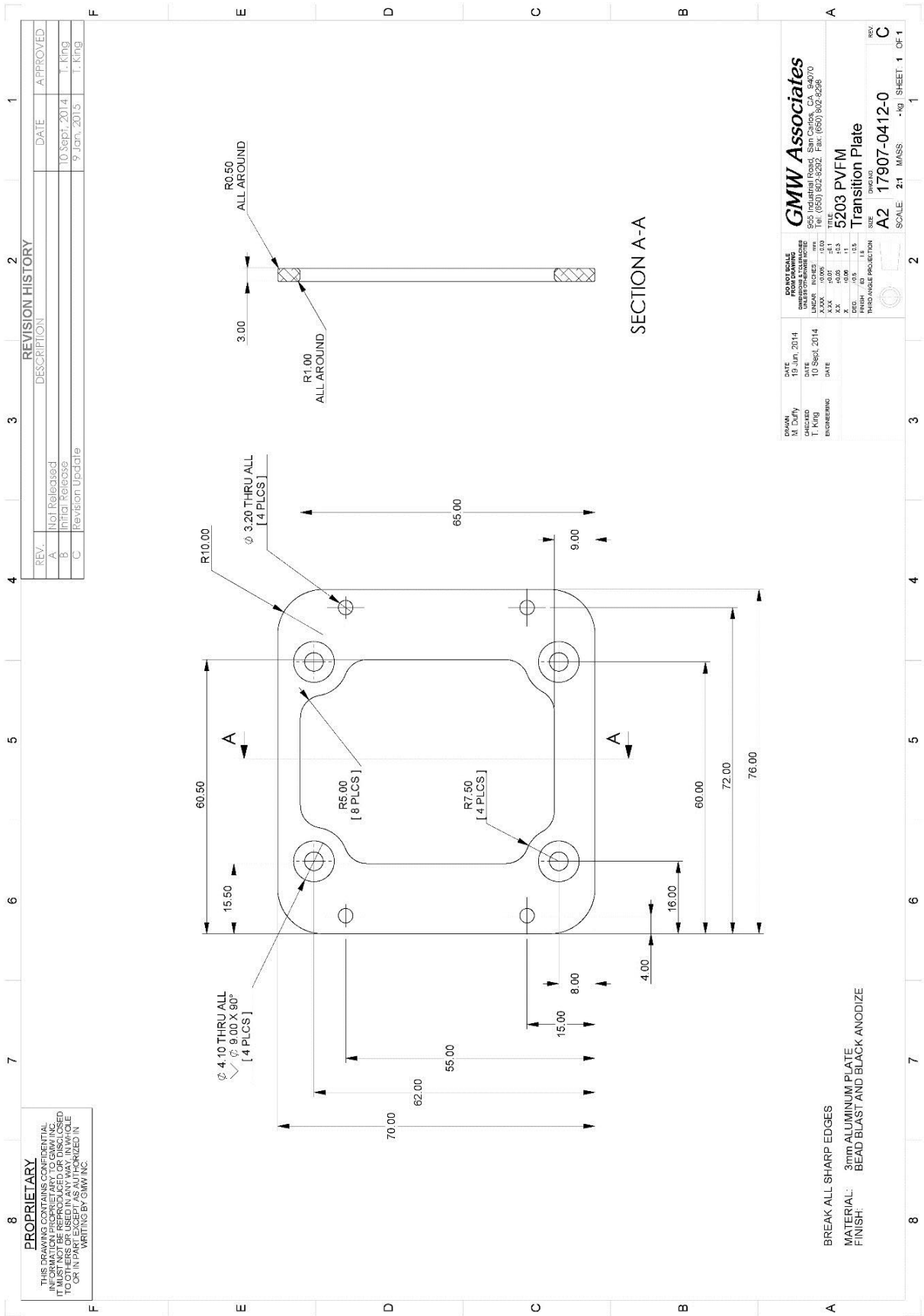
2.3 11907-0224-0 - 5203 General Assembly



2.4 11907-0233-0 - 5203 Terminal Block Assembly



2.5 17907-0412-0 - 5203 Mounting Plate



3. WARNINGS

PERSONNEL SAFETY	
	**The Model 5203 has a low level of fringe field. In operation the magnet fringing field can be in excess of 0.5mT (5G). This can cause malfunctioning of heart pacemakers and other medical implants. We recommend that the fringing field should be mapped and warning signs be placed outside the 0.5mT (5G) contour. Entry to this region of higher field should be restricted to qualified personnel.**

FERROMAGNETIC OBJECTS	
	**During operation the magnet exerts strong magnetic attraction towards ferromagnetic objects in the near vicinity. Loose objects can be accelerated to sufficient velocity to cause severe personnel injury or damage to the coils. Keep ferromagnetic tools clear.**

ARCING	
	**This magnet stores considerable energy in its field during operation. Do not disconnect any current lead while under load or the magnetic field energy will be discharged across the interruption causing hazardous arcing.**

HIGH VOLTAGES and CURRENTS	
	**Be aware that the AC mains input to the DC power supply and the output to the electromagnet are high voltage. Follow lock-out / tag-out procedures during all maintenance procedures. Verify that all electrical connections are secure and properly strain relieved. Loose connections may overheat and cause damage to equipment.**

HOT COIL RESISTANCE	
	**Do not exceed the maximum coil hot resistance given in the specifications or coil overheating and possible damage may occur.**

SYSTEM INTERLOCKS	
	**These should always be connected if the magnet is to be operated unattended to avoid the possibility of coil overheating caused by excessive power dissipation or inadequate cooling.**

WATCHES, CREDIT CARDS, and MAGNETIC DISCS	
	**Do not move magnetically sensitive items into the close vicinity of the magnet. Even some anti-magnetic watches can be damaged when placed in close proximity to the magnet during operation. Credit cards, hotel room keys, and magnetic disks are affected by magnetic fields as low as 0.5mT (5G).**

TRIP HAZARDS	
	**Caution must be taken when moving around the magnet as there are potentially cables and cooling hoses on the floor that will present a trip hazard. It is highly advised that floor conduit be purchased that will cover these items. This will also protect from potential damage.**

4. INSTALLATION

4.1 Site Considerations

The Model 5203 is not magnetically shielded. Ferro-magnetic material in the vicinity of the magnet will modify the magnitude and uniformity of the central region magnetic field. As a general rule avoid magnetic material closer than approximately 1 meter of the central region.

Background fields such as the geomagnetic field and alternating field from 60Hz power sources are not shielded by the magnet and will add to the field produced by the magnet. If possible these background fields should be measured and their effects evaluated before the Model 5203 magnet is installed. It may be necessary to orient the Model 5203 axis to minimize the effects of external fields, to relocate ac power sources or to install suitable magnetic shielding.

The 5203 Electromagnet features four M3 clearance holes in its base plate and should be securely mounted to a stable foundation. Refer Drawing 17907-0412-0_C in section 4.6

The width of the working space in front of control cabinets and compartments should be the width of the opening or 762mm (30 in.), whichever is greater. Where control equipment or devices are mounted on or through the fixed area around the opening into the control cabinet or compartment, the width of the working space in front of the control cabinet or compartment shall include the width of the fixed area containing the control equipment and devices.

The working space height shall be clear and extend from the grade, floor, or platform to a height of 2.0 m (6 ½ ft). Within the height requirements of Section 11.5, other equipment associated with the machine located above or below the control cabinet or compartment shall be permitted to extend not more than 150 mm (6 in.) beyond the front of the electrical control cabinet or compartment.

The working space shall permit at least 90-degree opening of control cabinet and compartment doors or hinged panels.

The main disconnect plug socket combination shall be marked “Main Disconnect. The Main Disconnect should be located within sight from the operator station and be readily accessible. The height of Main Disconnect must not be greater than 2m height from floor.

The switch rated plug/receptacle shall not be placed below 0.6m to be compliant with NFPA 79.

At least one entrance of sufficient area shall be provided to give access to the working space around control cabinets or compartments and working space should not be used for storage.

4.2 Unpacking and Damage Inspection

Caution: Take care when handling system. All movement, lifting and installation of the 5203 Electromagnet must be under the supervision of an experienced person to prevent the possibility of serious injury or damage to the electromagnet and associated equipment.

To unpack the electromagnet please use the following procedure.

1. First remove the wire clips and screws from the 'top crate cover' of the shipping crate.

2. Remove the top crate cover and set it aside. Remove the protective foam packaging material.

3. Inspect the magnet and junction box to ensure that no damage has occurred during shipment. If damage is evident report the damage in detail to the shipper for claim and simultaneously notify GMW in case assessment of the damage must be made. If no damage is found proceed with magnet unpacking and installation.

4. Carefully lift magnet, cables, hoses and junction box clear of the shipping crate.

5. All conductors of the same ac circuit routed to the same location shall be contained in the same raceway. Conductors external to the electrical equipment enclosure(s) shall be enclosed in raceways (ducts).

4.3 Magnet Power Supply

For full power operation, the 5203 Projected Vertical Field Electromagnet should have a power supply with an output current rating of up to 63A for a DC field and 100A for a triangle wave current. To provide a stable magnetic field the power supply should be operable in "current mode" to deliver a constant set current with overall stability of approximately 1% of full-scale current.

It is essential that the power supply to have an interlock input that will inhibit its output when the interlock circuit is in an OPEN state. This is referred to as a 'NORMALLY CLOSED' interlock. A normally closed interlock will ensure that the DC power supply will remain in an inhibited state should the interlock cable become disconnected.

4.5 AC Mains Connections

Never connect or remove the AC Mains cables from the power supply without first Locking-out and Tagging-out the AC Mains power source. In some cases, this power source may be a locking NEMA plug, and in systems with higher current draw, it should be direct wired into an appropriately fused, three phase disconnect box.

AC Mains connections should be made by a licensed electrician. Many facilities have such personnel on site.

Please refer to the Power Supply Operators Manual for complete details on AC Mains power connections.

4.6 Magnet Power Connections

Never connect or remove cables from the magnet with the power supply energized. The stored energy in the magnet can cause arcing resulting in severe injury or equipment damage.

Follow the lockout/tagout procedure as described in Section 1, Lockout/Tagout prior to connecting or removing the DC power cables.

The magnet is shipped with a power and interlock cable attached. The recommended current cable for the 5203 is shown in Drawing 16907-0116-1-S1_A (section 12). Because the magnet stores a significant amount of energy in its magnetic field, special care should be taken to ensure that the current terminations are secure and cannot work loose in operation. Local heating at the terminations can cause rapid oxidation leading to a high contact resistance and high power dissipation at the terminals. If left unattended this can cause enough local heating to damage the terminals and the coils.

4.7 5203 Interlocks

In the event of an interlock tripping it is strongly recommended that the root cause of the trip be determined. In the event that the root cause cannot be determined please contact Tom King (tom@gmw.com) for technical support.

The Model 5203 has one Selco UP62-080C thermostat. It is located between the base yoke plate and the lower cooling plate. The thermostat is normally closed, opening when the coil heatsink temperature exceeds 80°C, ± 5°C.

The interlock circuit also includes a flow switch (GEMS FS-380) located at the junction box. This flow switch is open for flow rates above 5.4 lpm (1.5 US gpm).

4.8 Interlock Testing

It is crucial that before general operation of the magnet system, that the interlock circuits be tested. This test requires that the terminal cover be removed from the magnet while energized and therefore must be completed by a qualified electrician.

This test should be done with the magnet operating with a LOW power setting, preferably less than 5 amps.

DO NOT AT ANY POINT TOUCH OR DISCONNECT THE MAGNET POWER CABLES.

Thermal Switches: Carefully remove one of the temperature switch connections from the interlock termination block. The power supply output MUST enter a disabled state. Reconnect the connection and the power supply output should return to normal.

Flow Switch: Shut off the water supply to the magnet. The power supply output MUST enter a disabled state. Restore the water supply and the power supply output should return to normal.

This interlock testing procedure should be carried out no less than every six months.

4.9 Magnet Cooling

The Model 5203 can be operated up to an average coil temperature of 80°C. Assuming an ambient laboratory temperature of 20°C and a temperature coefficient of resistivity for copper of 0.0039/°C, the hot resistance of the coil should not exceed 25% more than the ambient temperature "cold" resistance. The coil thermostat will open when any coil cooling plate temperature exceeds approximately 80°C . Clean, cool (16°C 20°C) water at 8 l/min and 4 bar (60 psid) must be used to cool the 5203 magnet.

The copper cooling tubes are electrically isolated from the coils to avoid electrochemical corrosion. A 50 micron filter should be placed before the input to the magnet to trap particulates.

Configuration Suggestion: For continuous operation of the magnet it may be appropriate to use a recirculating chiller to reduce water and drainage costs. The chiller capacity will depend on whether cooling is required for the magnet alone or magnet and power supply.

Do not use corrosion inhibitors in high quality electrical systems since the water conductivity is increased which can result in increased leakage currents and electrochemical corrosion.

Avoid cooling the magnet below the dew point of the ambient air. Condensation may cause electrical shorts and corrosion.

During operation the resistance can be checked using a voltmeter across each coil. The voltage will rise to a constant value once thermal equilibrium has been reached. If it is desired to save water, the water flow may be reduced until the hot resistance is approached. NOTE: This adjustment must be made slowly enough to allow for the thermal inertia of the coils.

5. OPERATION

The 5203 electromagnet is water cooled and should not be operated without water. Attempts to operate the magnet as an air cooled system will most likely result in irreversible damage to the magnet.

This product is an electromagnet and creates significant magnetic fields both within the magnet and in the surrounding area. Make sure that there are no ferromagnetic items, tools or components loose in a 1 meter radius surrounding the magnet.

The Model 5203 is not a shielded electromagnet. In operation the magnet fringing field can be in excess of 0.5mT (5G). This can cause malfunctioning of heart pacemakers and other medical implants. We recommend that the fringing field should be mapped and warning signs be placed outside the 0.5mT (5G) contour. Entry to this region of higher field should be restricted to qualified personnel.

Do not move magnetically sensitive items into the close vicinity of the magnet. Even some anti-magnetic watches can be damaged when placed in close proximity to the magnet during operation. Credit cards, and magnetic disks are affected by magnetic fields as low as 0.5mT (5G).

5.1 Initial Operation

The magnet system in its most basic configuration will consist of the electromagnet and a suitable DC power supply. Options are available to improve usability by providing better feedback of the magnet interlock status, computer control, and magnetic field monitoring and control.

1. Adjust the cooling water flow to approximately 8 liters/min (2.1 US gpm). For operation at less than maximum power the water flow may be correspondingly reduced. Note that the inlet water temperature will determine the actual flow rate required. The above specified flow rates were determined with a water inlet temperature of approximately 18°C.

2. Set the DC power supply voltage and current controls to zero and switch on the power supply. For maximum stability, the power supply should be operated in 'current mode', and most power supplies will automatically switch modes depending on which control is set LOWER as the lower control would be the limiting factor.

3. Switch on the DC power supply. To operate in the current mode, the voltage control must be set to a sufficiently high level to allow the desired current to be set: With the current control at its minimum, turn the voltage control up, and then adjust the current control to the desired output. Should the current control stop responding, it is likely that the system has switched to voltage mode. In that case, adjust the voltage control higher and then continue adjusting the current control.

   At this point the magnetic field should be checked to verify that the field being generated corresponds correctly with data given for the Excitation Curve. Refer to Section 7 - 'Excitation Curves' for excitation graphs that most closely resembles your magnet configuration.

4. Once the system operation has been checked to be satisfactory, the voltage control may be set to its maximum value. This will provide enough voltage for stable operation when running at high current settings.

5.2 Field Control Operation

The necessity to use calibration curves can be avoided by using a field controller to sense the magnetic field and provide a corresponding power supply control signal through the power supply programming inputs. Contact GMW for suitable instrumentation and software (Labview) (sales@gmw.com).

6. MAINTENANCE

Whenever performing maintenance on this magnet all electrical plug socket disconnects must be disconnected and a plug lockout device used to properly shut down the electrical system. Refer to the lockout/tagout procedure defined in section 1.3.

6.1 Cooling Circuit

Check the cooling water circuit to ensure the water is clean and free of debris and bacterial growth. If an in-line water filter is used, ensure that the filter is clean. If this magnet is used in conjunction with a closed cycle chiller please refer to the chillers' User Manual for details specific to that chiller for cleaning and maintenance.

For closed loop water chilling systems we recommend treating the water for algae and corrosion as required, but no less than every six months. Thermo Fisher provides a water treatment kit, part number 610000000005, which consists of a corrosion & scale inhibitor, and a biocide. This kit will treat 10 gallons of water, and multiple kits may be required depending on the cooling system capacity. Further information regarding water treatment can be found at the end of the 'Technical Reference' section of this manual.

6.2 Electrical Connections

Ensure that all electrical connections are tight. Check that the cable insulation is undamaged and that the cable assembly is properly strain relieved. Ensure that all electrical terminal covers are in place and are firmly secured.

6.3 Interlock Testing

Interlock functions should be verified no less than every three months. Use the procedure described in Section 4 - 'Interlock Testing' to test the interlock functions.

6.4 Spare Parts and Consumables

7. STANDARD OPTIONS

7.1 Standard Pole Options

The 5203 electromagnet is supplied with Pole A as standard. Standard Poles B, C and D can be ordered additionally to provide different performance characteristics. See Section 9 for performance characteristics of poles A, B, C and D.

Pole A - standard

Pole B

Pole C

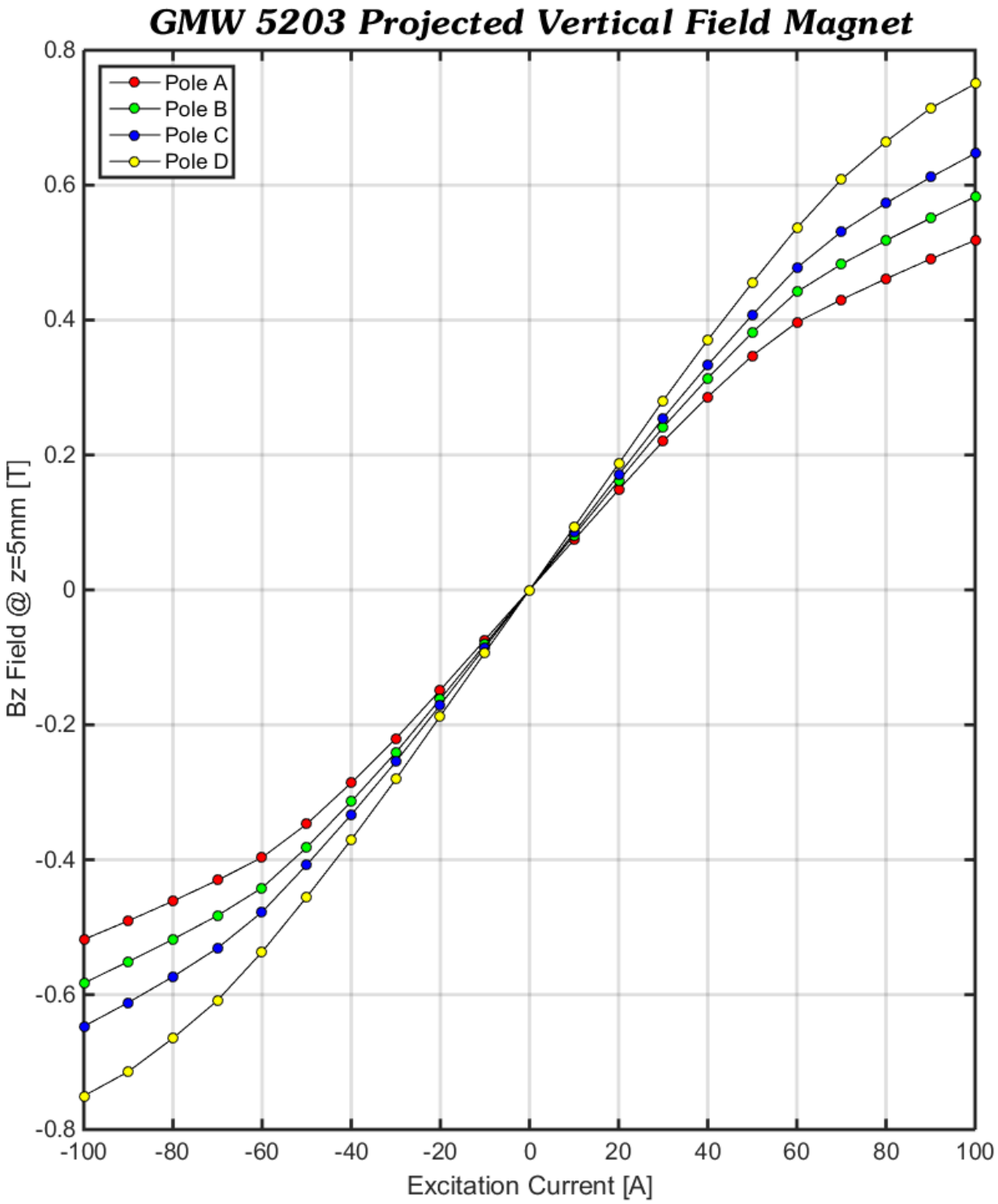
Pole D

8. CUSTOM OPTIONS

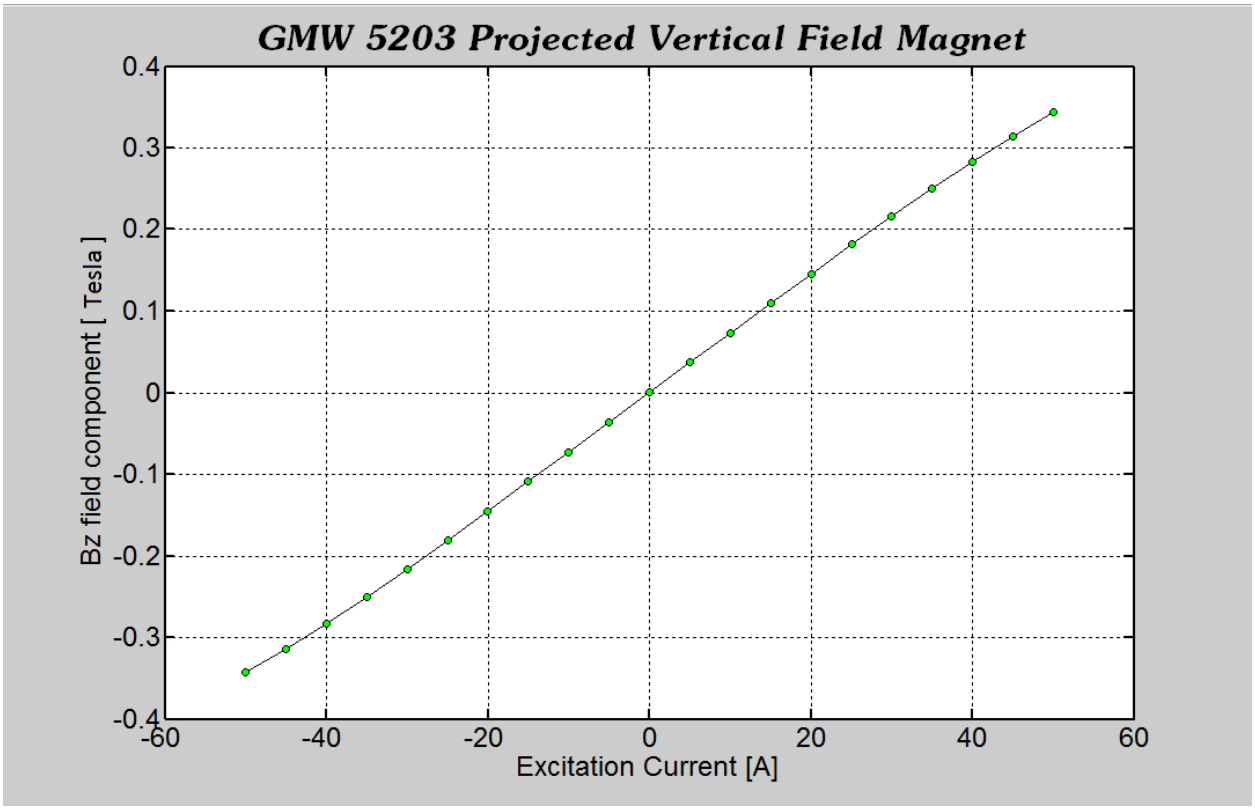
8.1 Custom Pole Options

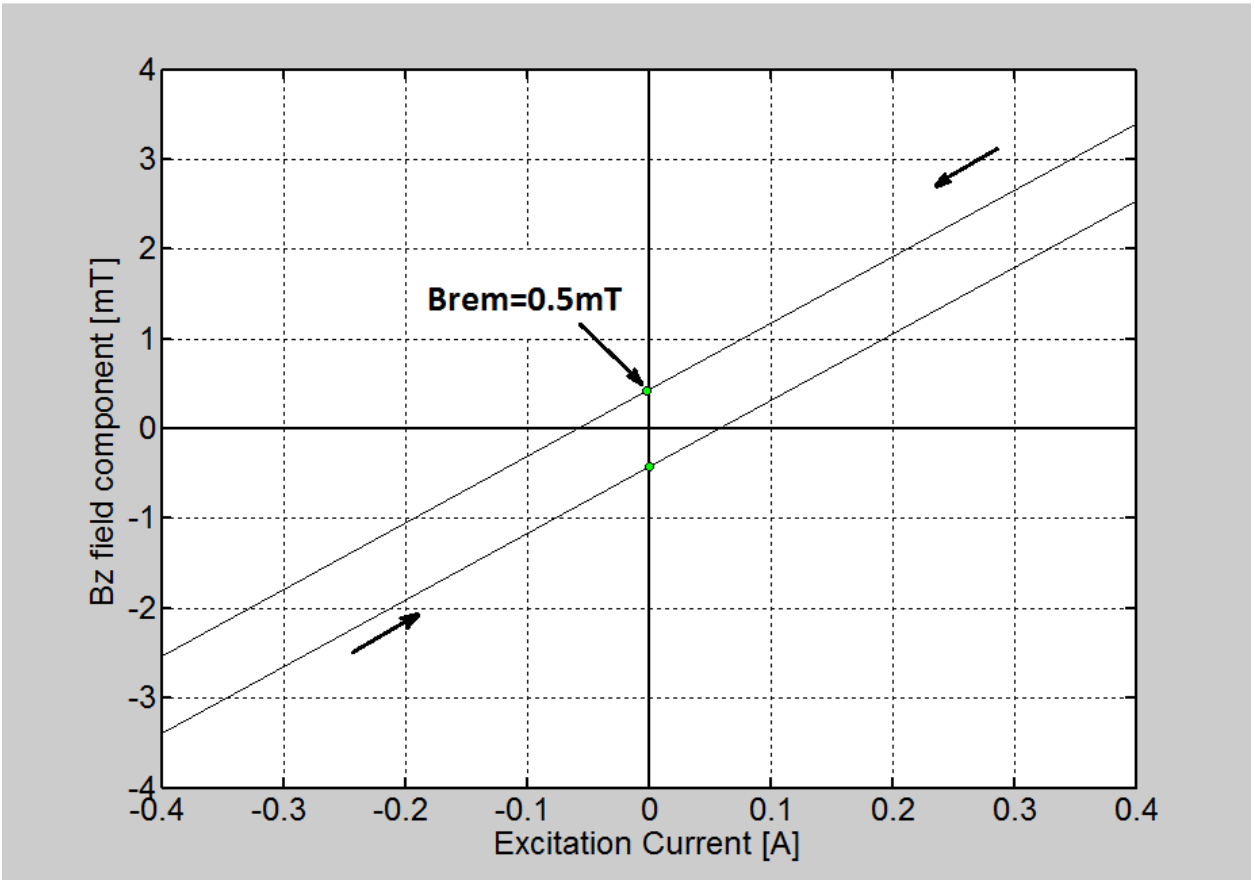
The model 5203 electromagnet can have customized performance by means of switching out the standard pole with a customized pole. GMW Associates will work with customers to provide the magnetic design of custom poles and will also manufacture such poles. Please direct inquiries to sales@gmw.com

9. EXCITATION CURVES AND FIELD UNIFORMITY

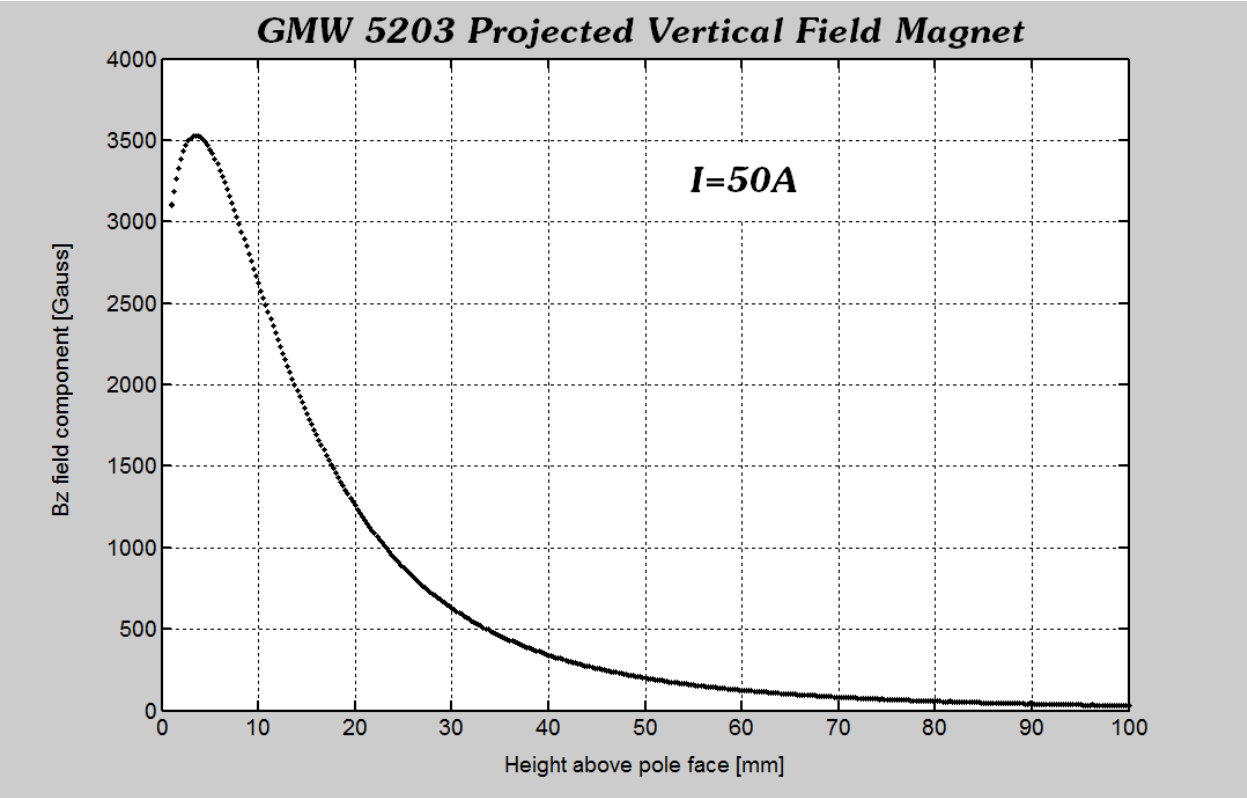


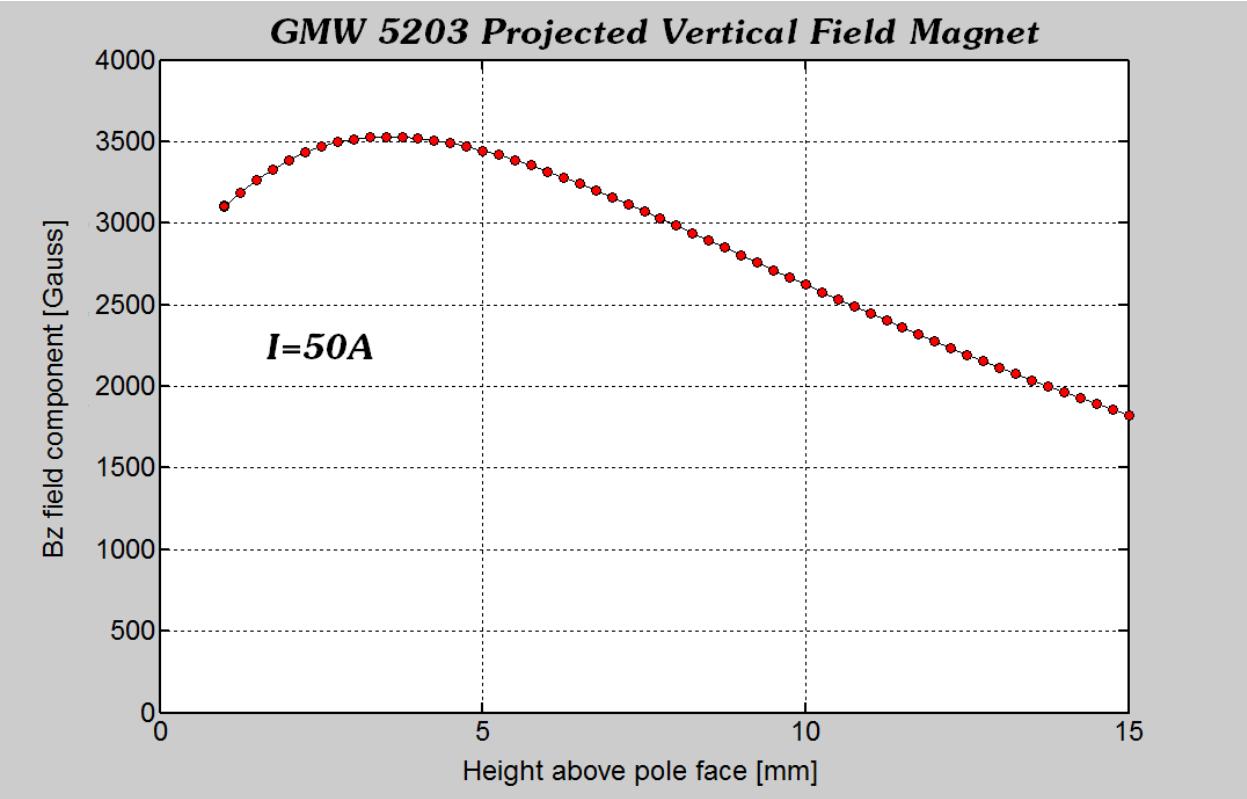
Excitation Curves for the various pole types



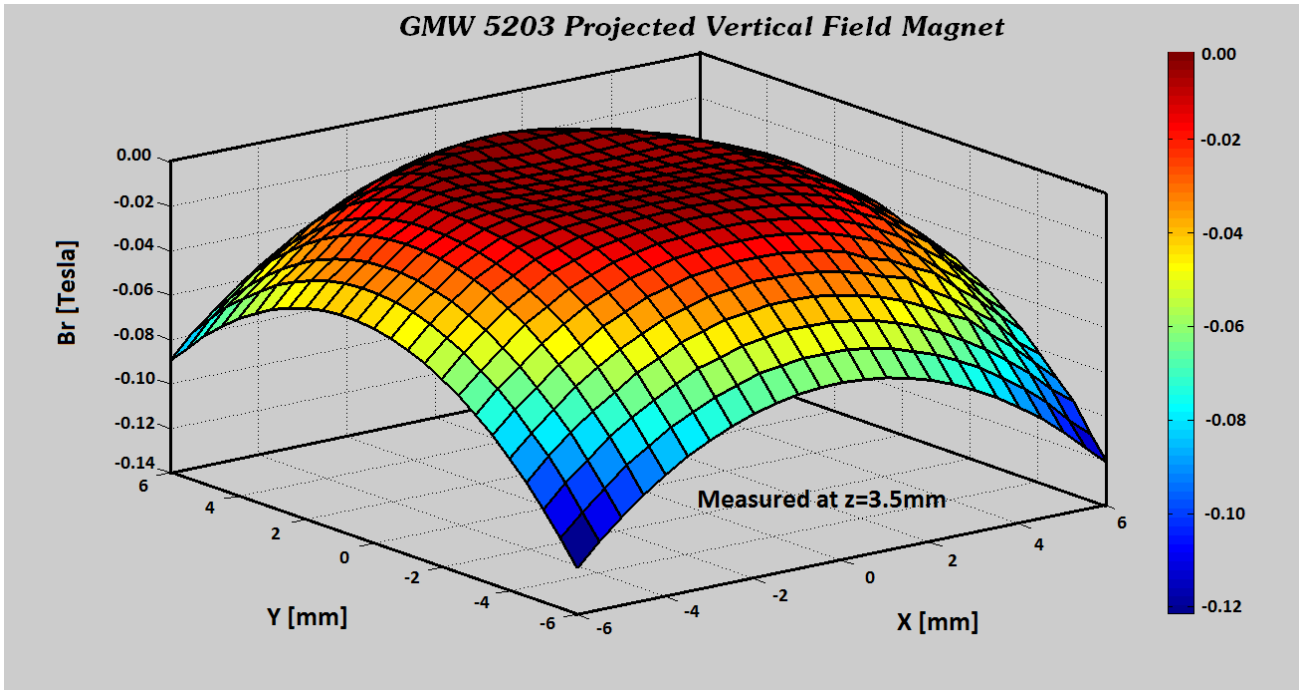


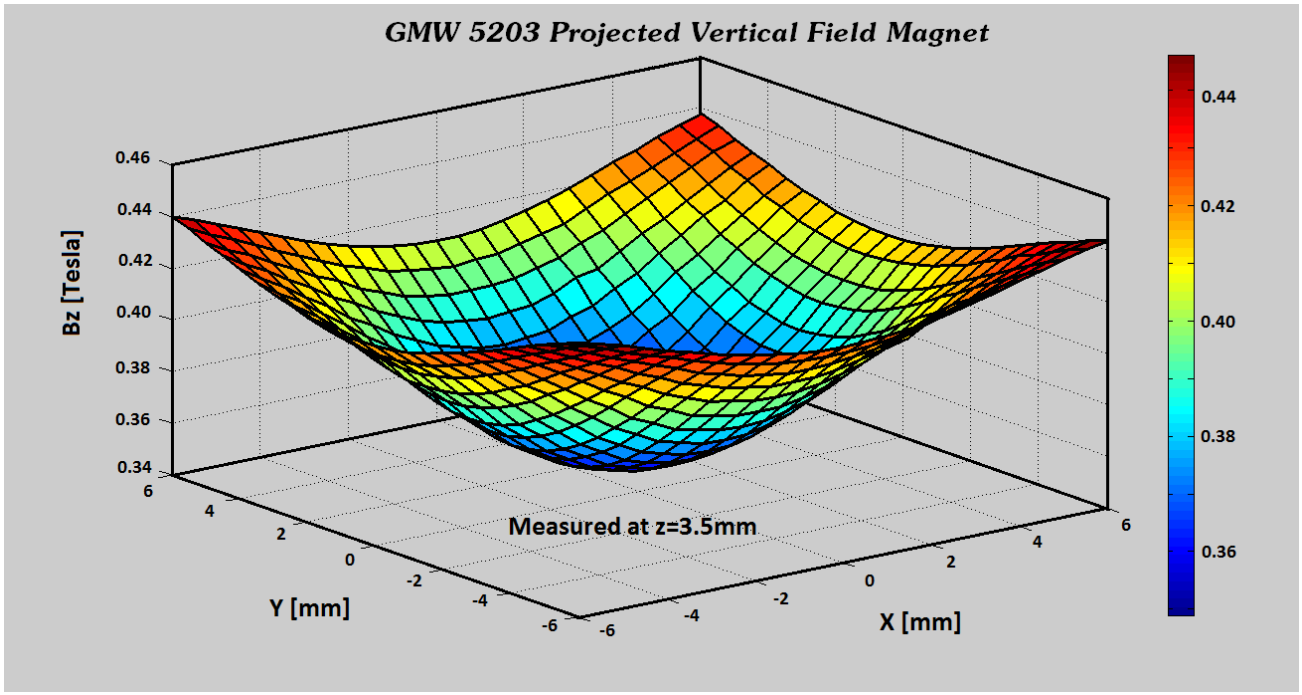
Excitation and Field Remanence for the standard pole Type A

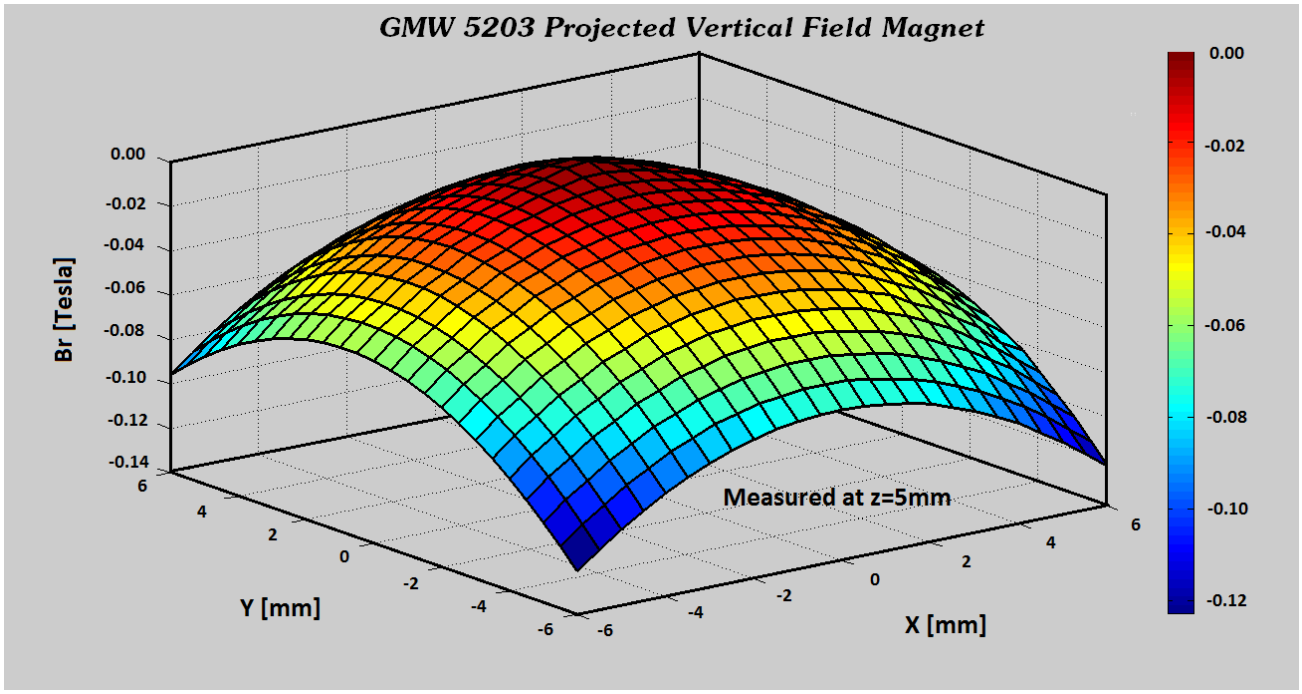


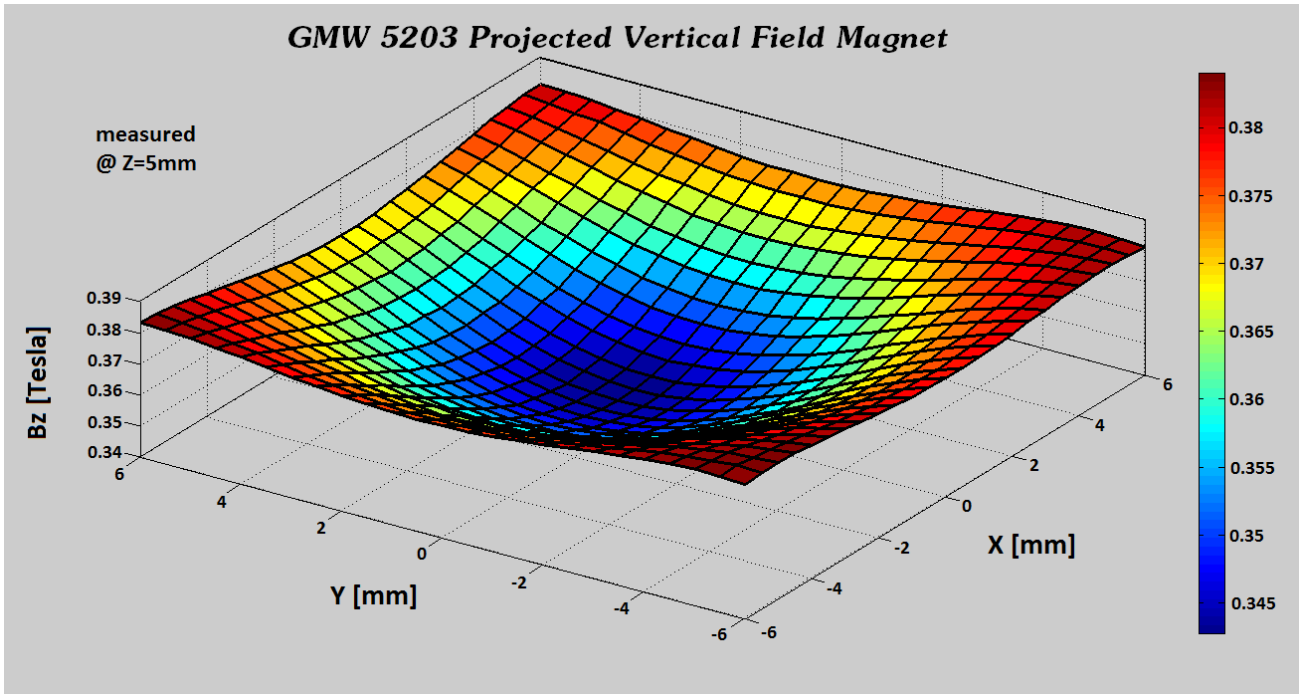


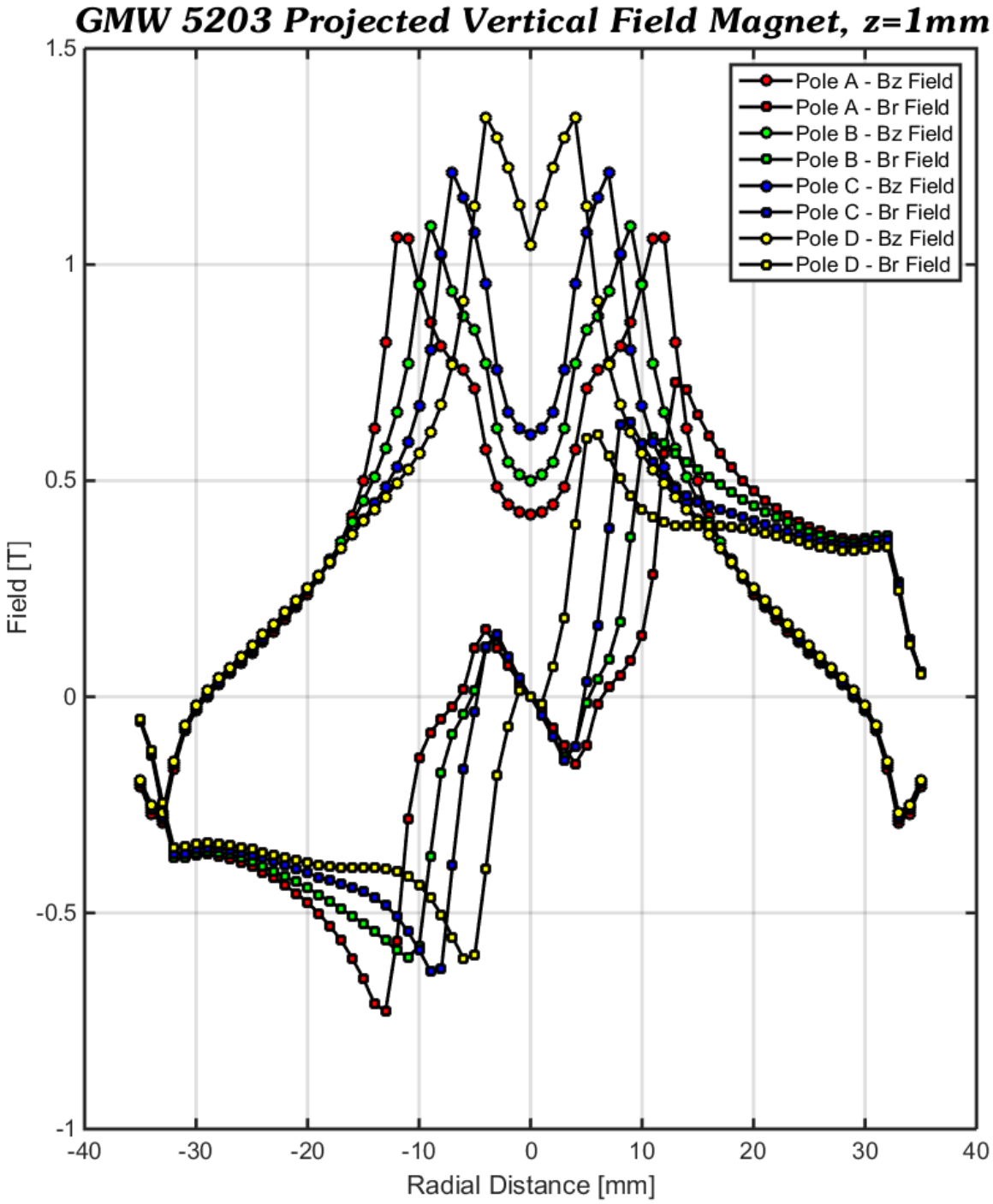
Near and far vertical field profiles for the standard pole Type A


GMW 5203 Projected Vertical Field Magnet
Br [Tesla]
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
Measured at z=3.5mm
Y [mm]
X [mm]
6
4
2
0
-2
-4
-6
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12

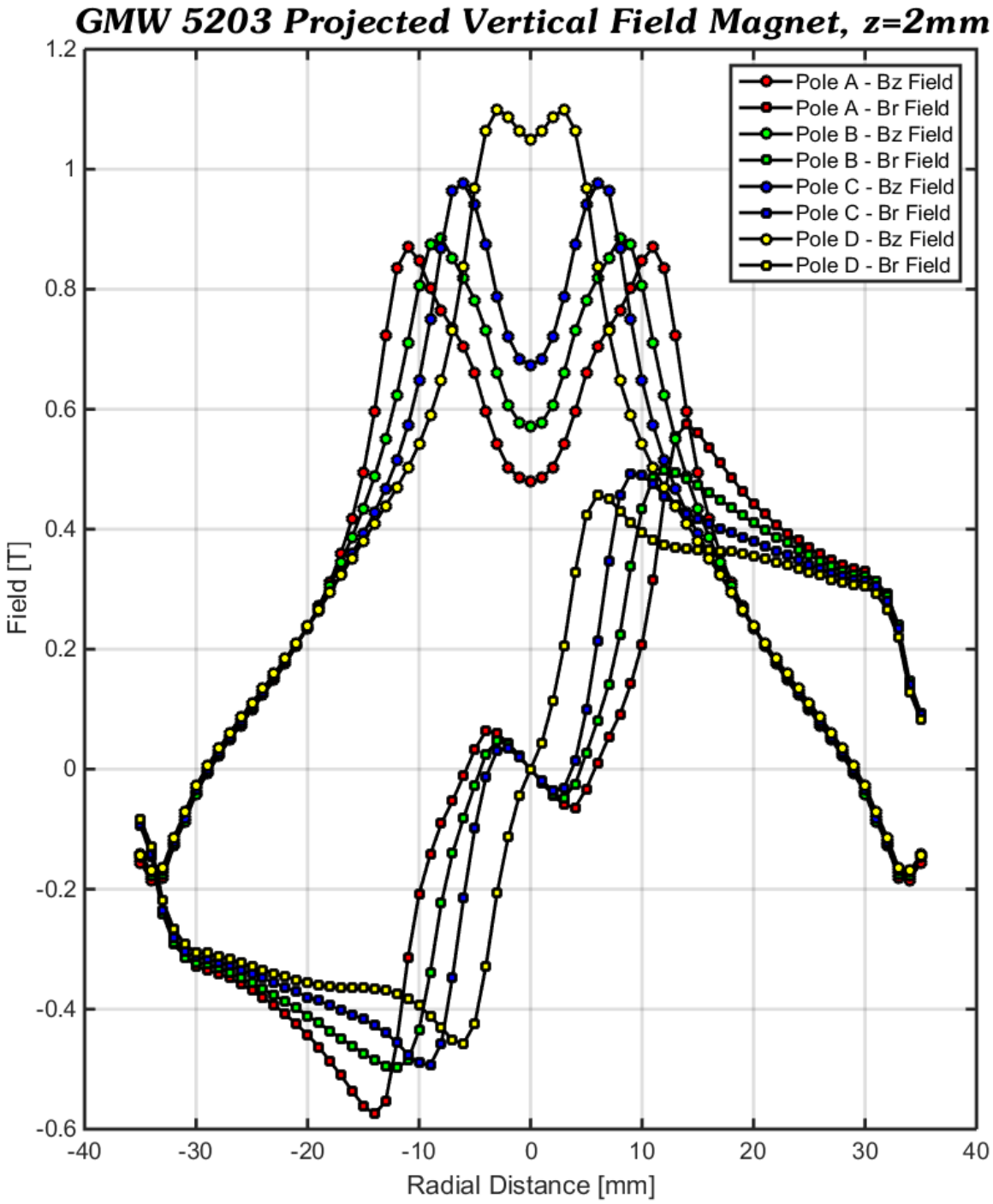

GMW 5203 Projected Vertical Field Magnet
Bz [Tesla]
0.46
0.44
0.42
0.40
0.38
0.36
0.34
Measured at z=3.5mm
Y [mm]
X [mm]
6
4
2
0
-2
-4
-6
0.44
0.42
0.40
0.38
0.36


GMW 5203 Projected Vertical Field Magnet
Br [Tesla]
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
Measured at z=5mm
Y [mm]
X [mm]
6
4
2
0
-2
-4
-6
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12

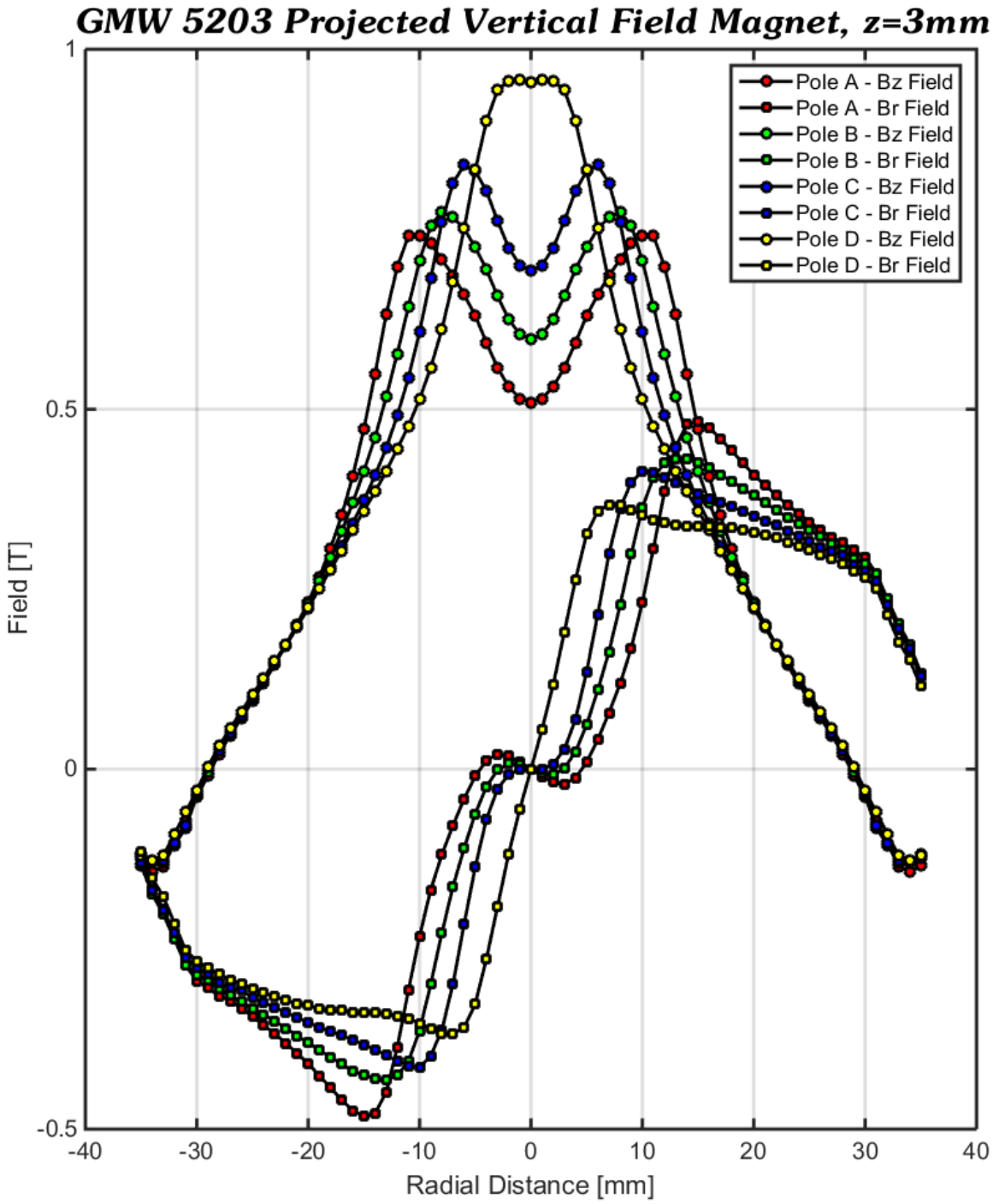

GMW 5203 Projected Vertical Field Magnet
measured
@ Z=5mm
Bz [Tesla]
0.39
0.38
0.37
0.36
0.35
0.34
Y [mm]
X [mm]
6
4
2
0
-2
-4
-6
0.38
0.375
0.37
0.365
0.36
0.355
0.35
0.345



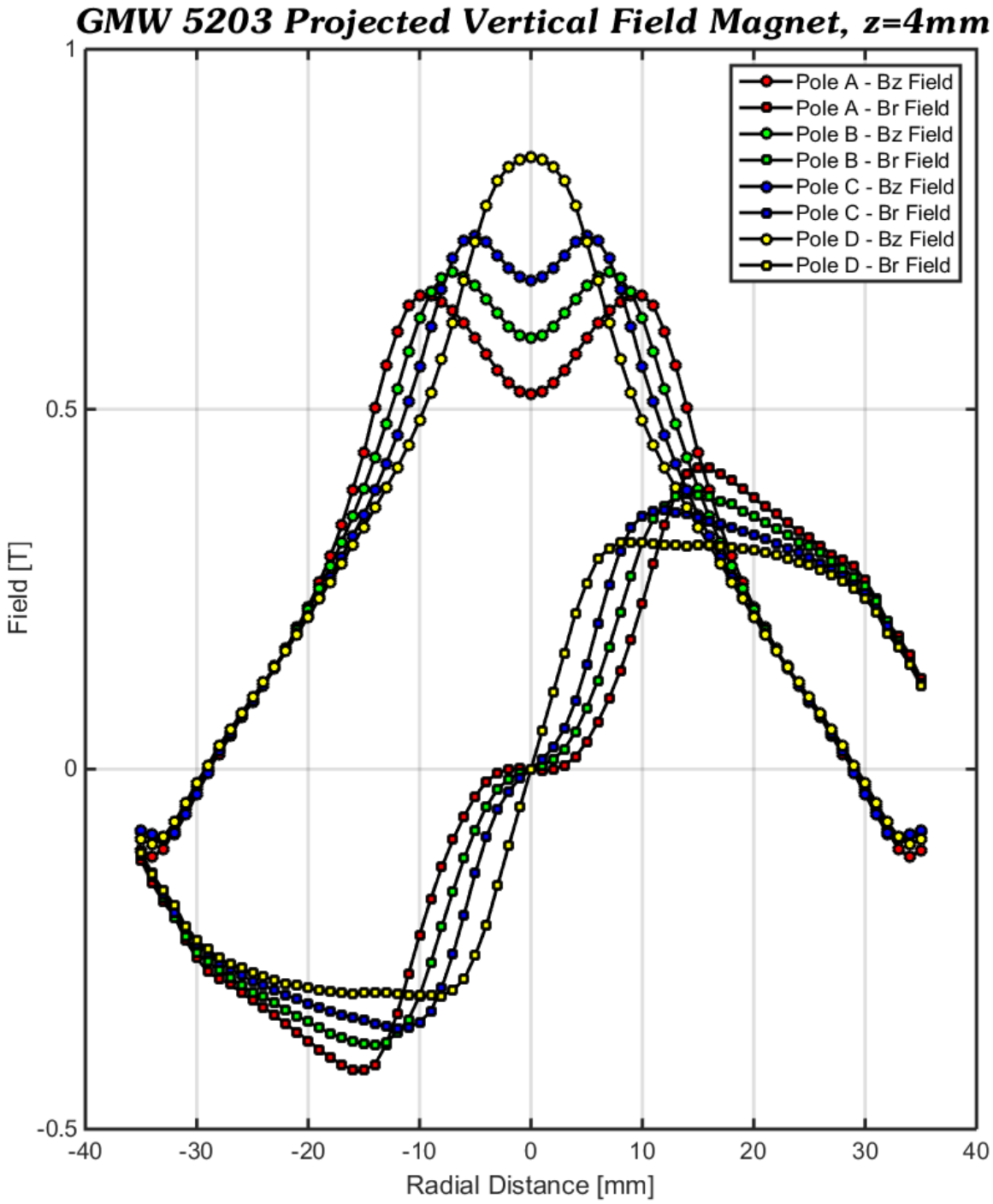
Z=1mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 7.54 %**	**± 2.36 %**	**0.42**
Pole B	**± 7.79 %**	**± 3.69 %**	**0.50**
Pole C	**± 6.72 %**	**± 3.76 %**	**0.61**
Pole D	**± 2.38 %**	**± 7.35 %**	**1.05**



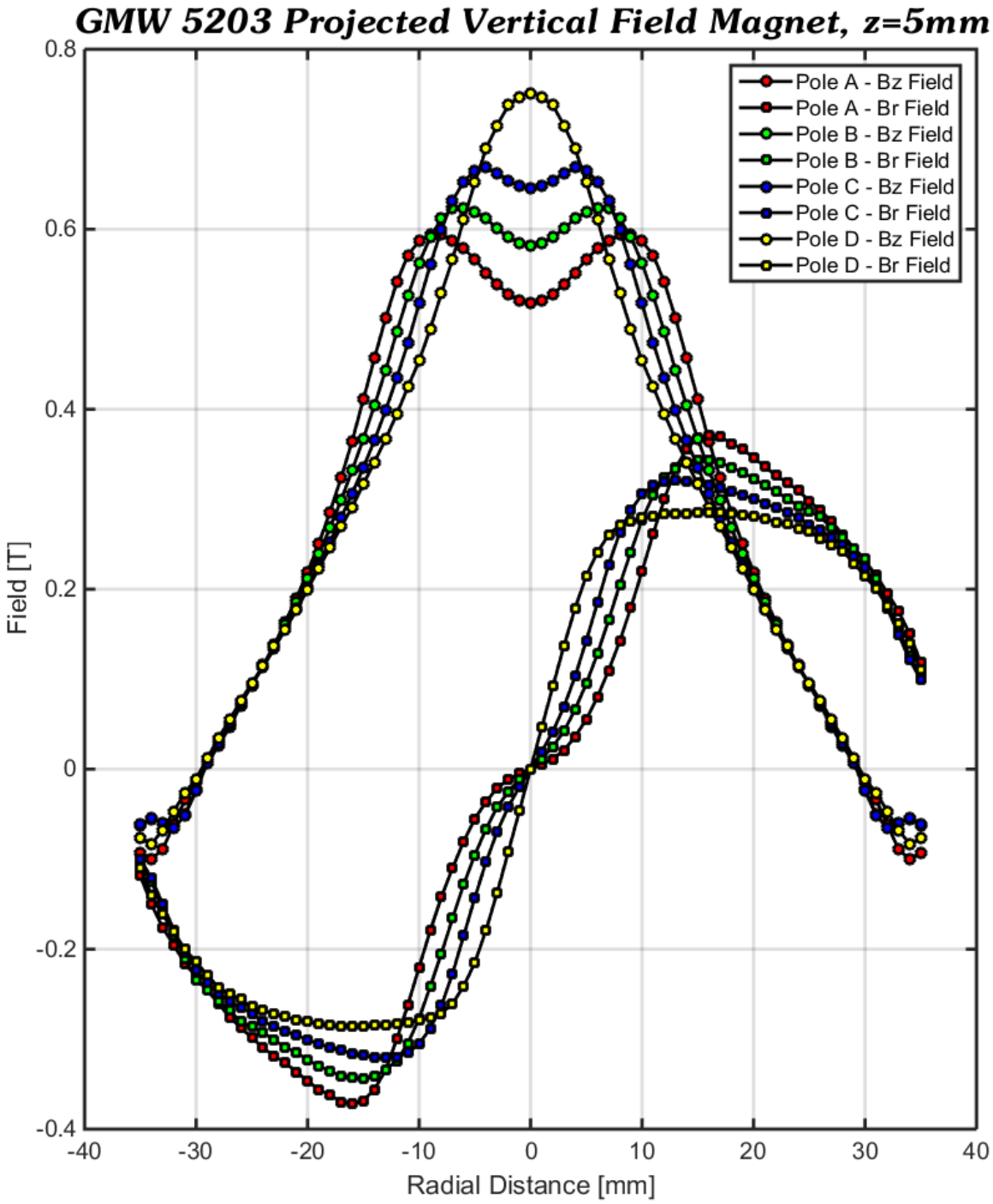
Z=2mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 4.12 %**	**± 2.29 %**	**0.48**
Pole B	**± 3.33 %**	**± 2.91 %**	**0.57**
Pole C	**± 2.36 %**	**± 3.07 %**	**0.67**
Pole D	**± 4.87 %**	**± 1.67 %**	**1.05**



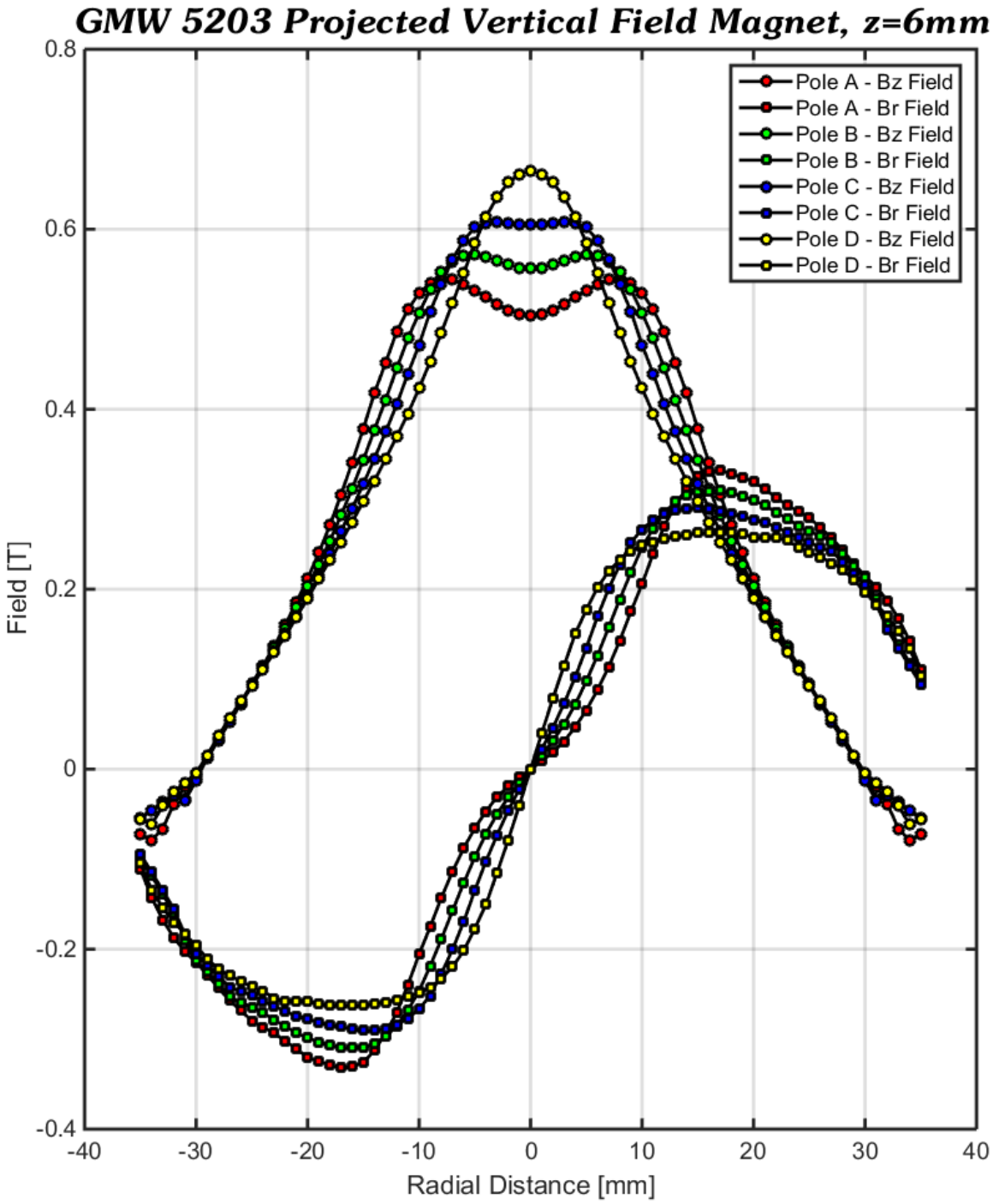
Z=3mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 1.68 %**	**± 1.82 %**	**0.51**
Pole B	**± 0.64 %**	**± 2.03 %**	**0.60**
Pole C	**± 0.42 %**	**± 2.06 %**	**0.69**
Pole D	**± 5.81 %**	**± 0.17 %**	**0.95**



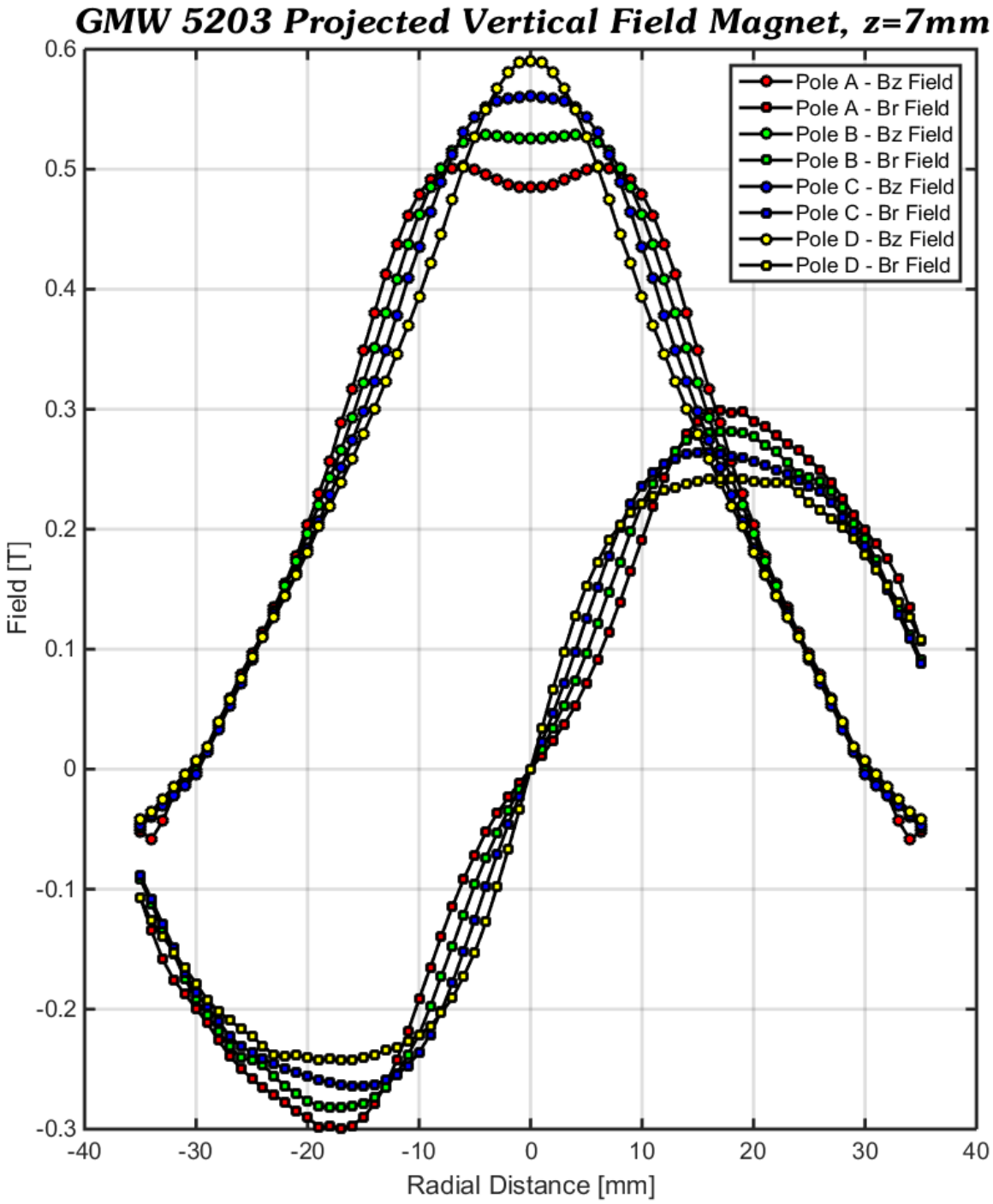
Z=4mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 0.13 %**	**± 1.28 %**	**0.52**
Pole B	**± 1.00 %**	**± 1.24 %**	**0.60**
Pole C	**± 2.07 %**	**± 1.17 %**	**0.68**
Pole D	**± 6.07 %**	**± 0.65 %**	**0.85**



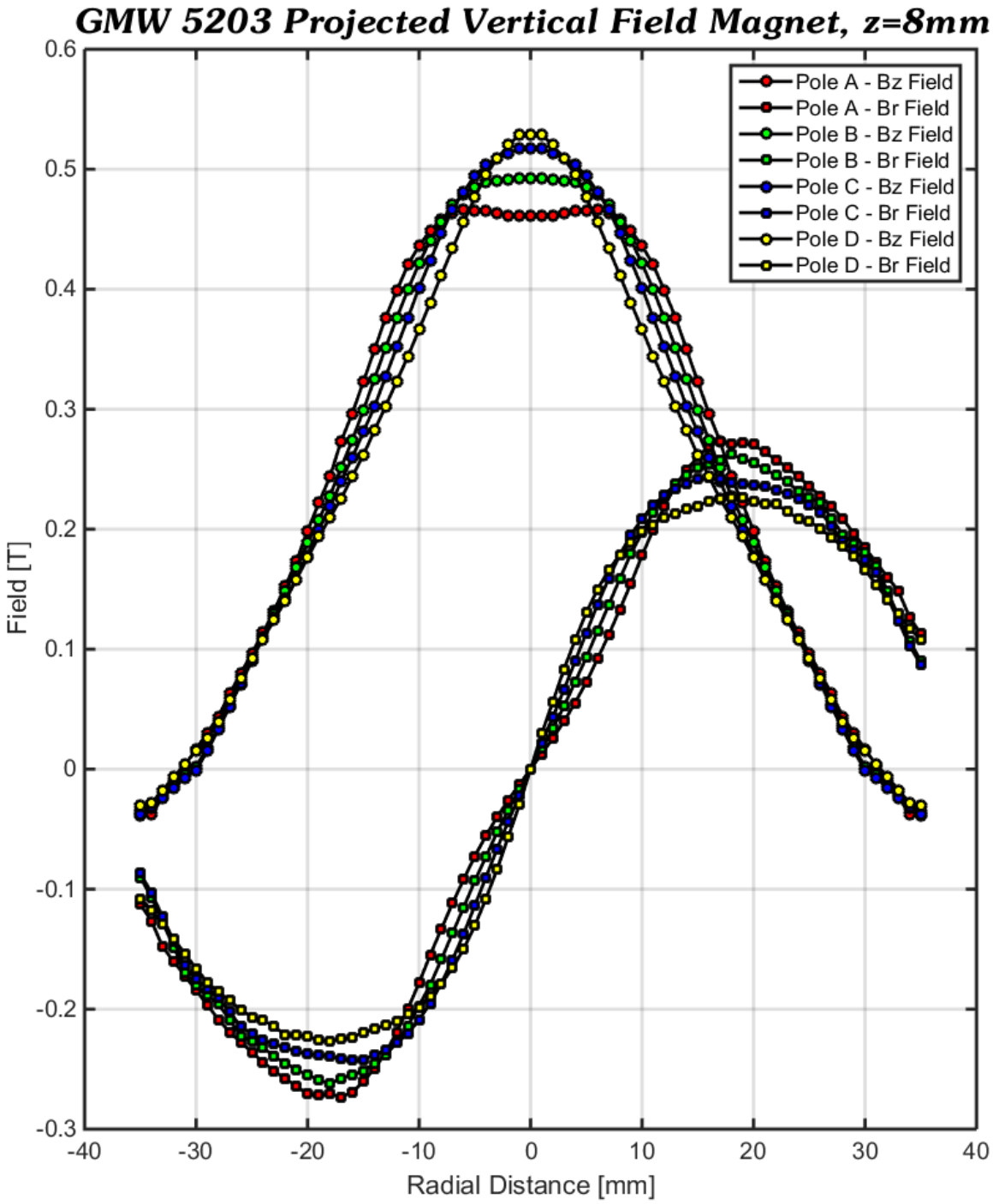
Z=5mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 1.00 %**	**± 0.83 %**	**0.52**
Pole B	**± 2.00 %**	**± 0.70 %**	**0.58**
Pole C	**± 3.00 %**	**± 0.51 %**	**0.65**
Pole D	**± 5.95 %**	**± 0.89 %**	**0.75**



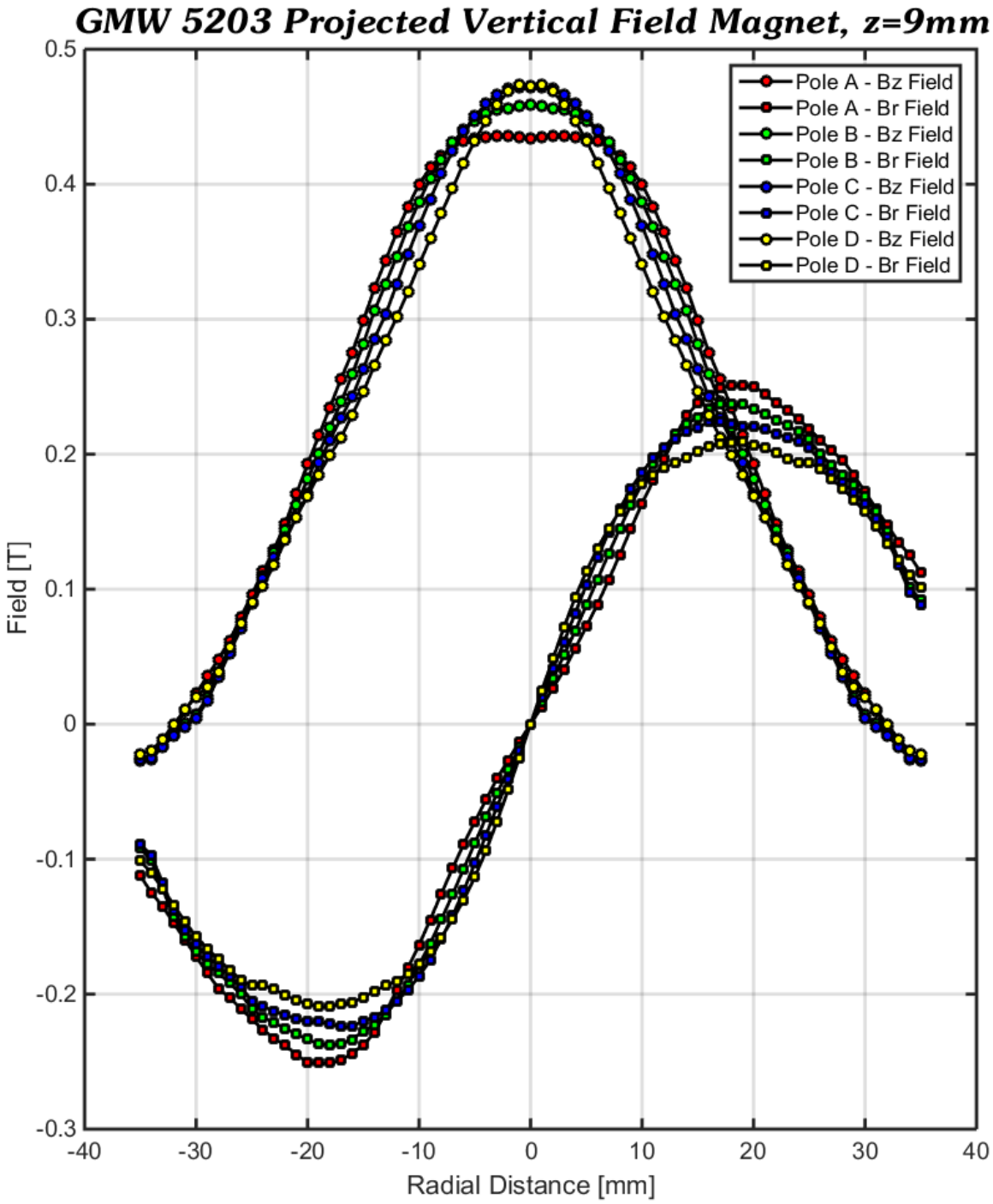
Z=6mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 1.74 %**	**± 0.55 %**	**0.50**
Pole B	**± 2.64 %**	**± 0.40 %**	**0.56**
Pole C	**± 3.57 %**	**± 0.21 %**	**0.60**
Pole D	**± 5.71 %**	**± 0.90 %**	**0.67**



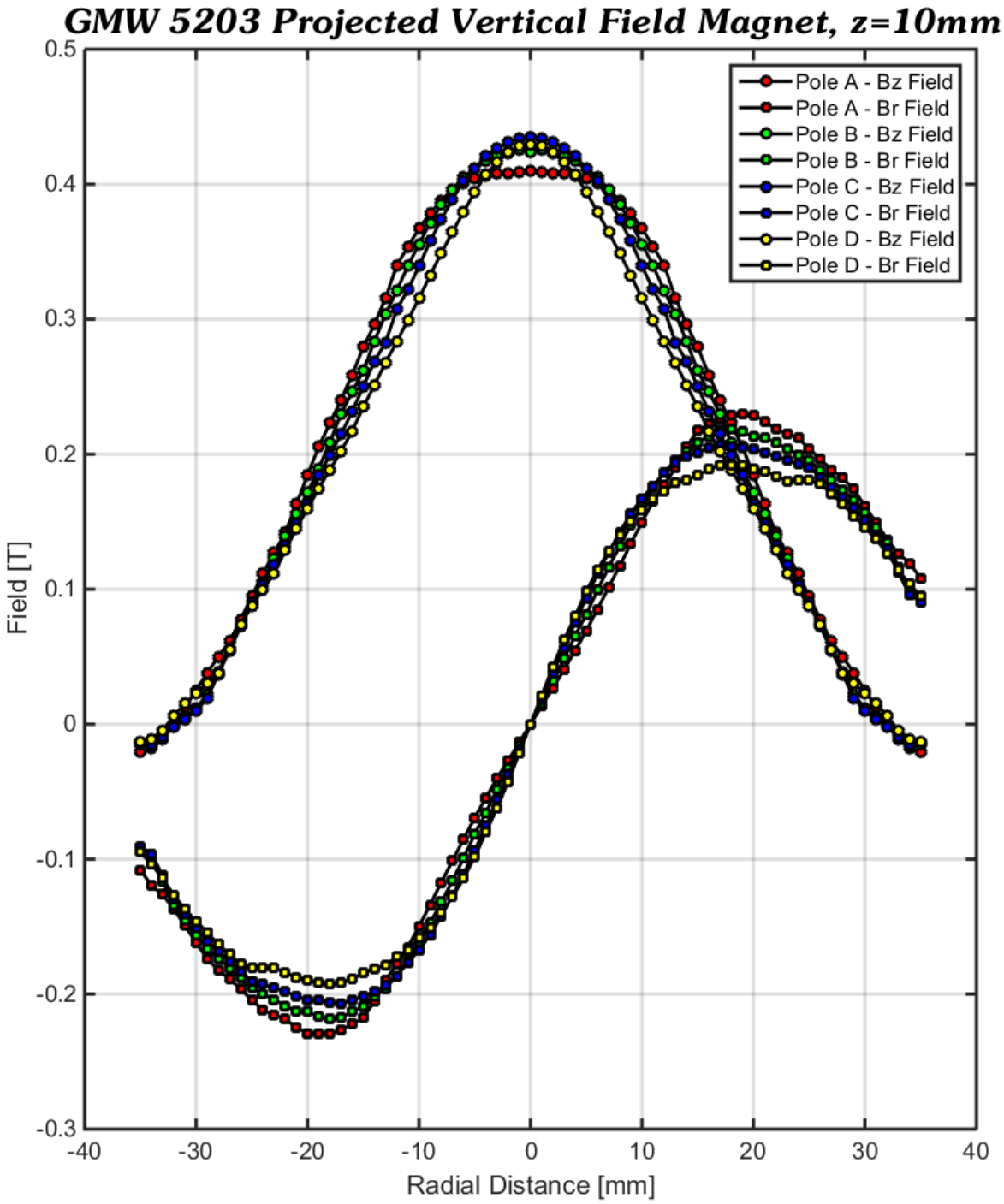
Z=7mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 2.28 %**	**± 0.35 %**	**0.48**
Pole B	**± 3.08 %**	**± 0.16 %**	**0.53**
Pole C	**± 3.91 %**	**± 0.08 %**	**0.56**
Pole D	**± 5.46 %**	**± 0.83 %**	**0.59**



Z=8mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 2.63 %**	**± 0.18 %**	**0.46**
Pole B	**± 3.28 %**	**± 0.27 %**	**0.49**
Pole C	**± 4.03 %**	**± 0.44 %**	**0.52**
Pole D	**± 5.16 %**	**± 1.01 %**	**0.53**



Z=9mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 2.89 %**	**± 0.15 %**	**0.43**
Pole B	**± 3.50 %**	**± 0.20 %**	**0.46**
Pole C	**± 4.14 %**	**± 0.41 %**	**0.47**
Pole D	**± 4.94 %**	**± 0.87 %**	**0.47**



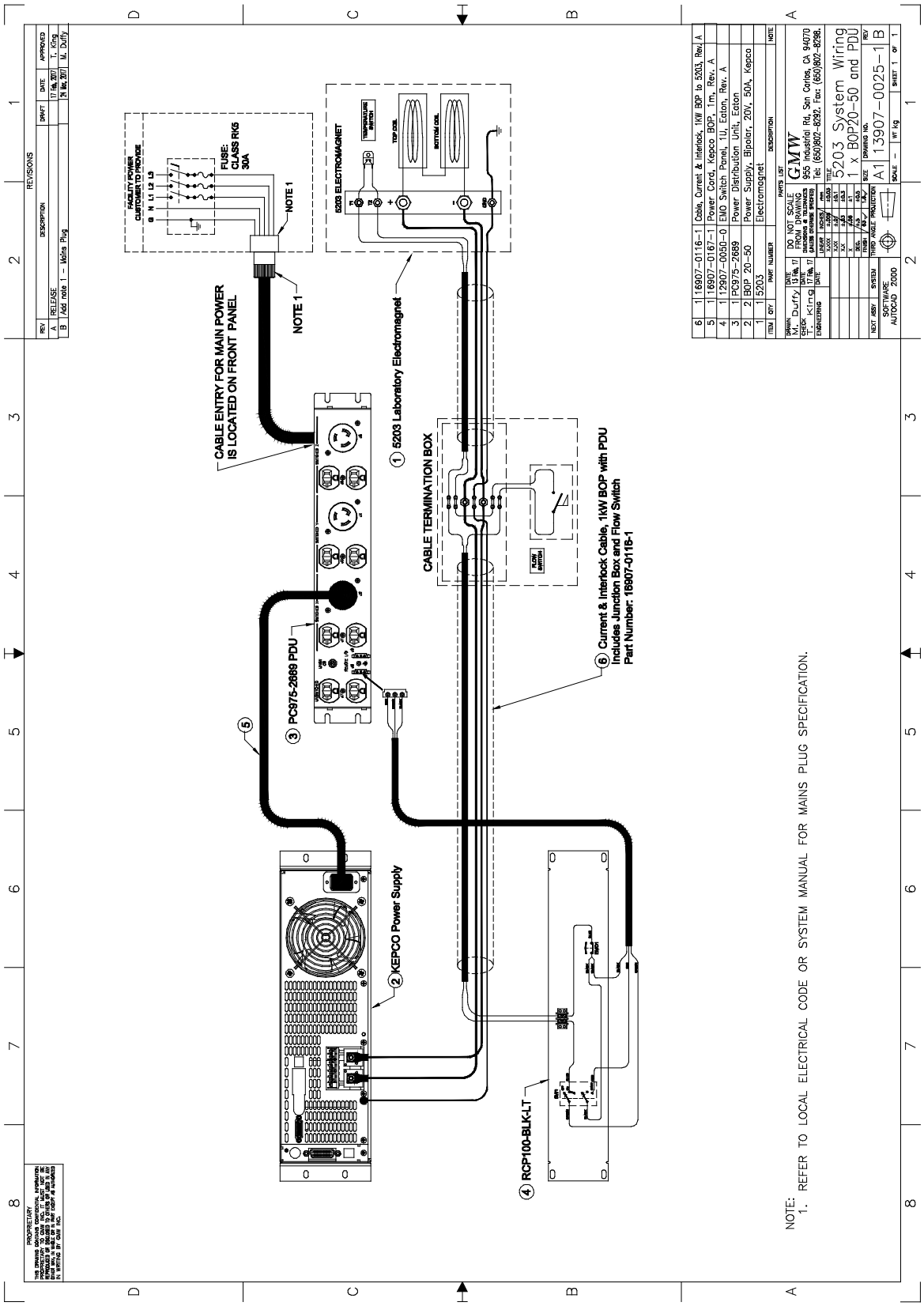
Z=10mm	Br/Bz Over Disc Ø4mm	Bz Over Disc Ø4mm	Peak Bz on axis [T]
Pole A	**± 3.14 %**	**± 0.18 %**	**0.41**
Pole B	**± 3.61 %**	**± 0.28 %**	**0.42**
Pole C	**± 4.11 %**	**± 0.41 %**	**0.43**
Pole D	**± 4.77 %**	**± 0.70 %**	**0.43**

10. TEST DATA

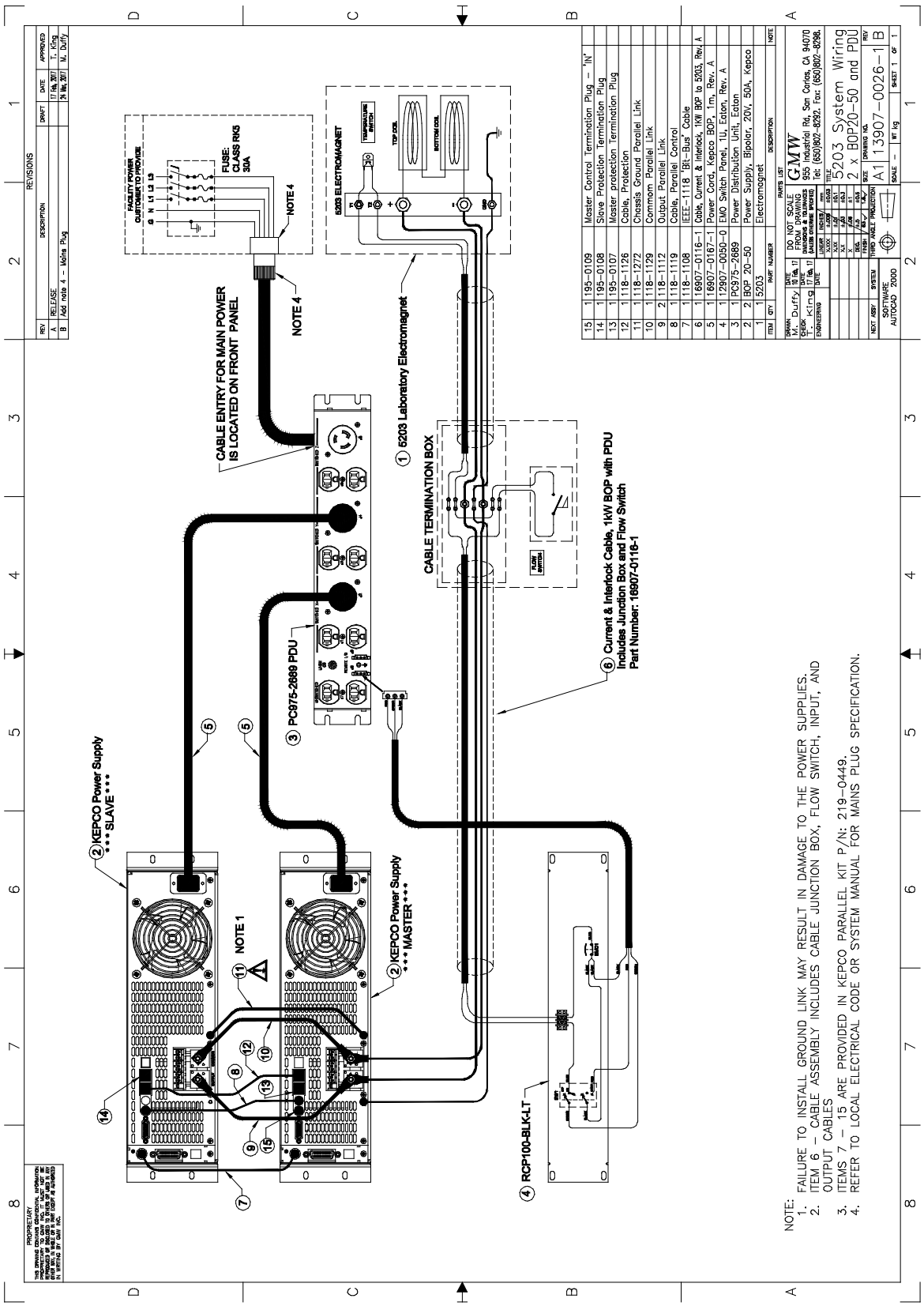
11. SYSTEM DRAWINGS

13907-0025-1 - System Wiring , 5203, 1x BOP20-50, and PDU 39
13907-0026-1 - System Wiring , 5203, 2x BOP20-50, and PDU 40
1C907-5203-08 - Electrical Assembly, 5203 and IECO BPS 41
1D907-5203-08 - Electrical Wiring, 5203 and IECO BPS 42
1C907-5203-09 - Electrical Assembly, 5203, IECO BPS, and 5972 43
1D907-5203-09 - Electrical Wiring, 5203, IECO BPS, and 5972 44

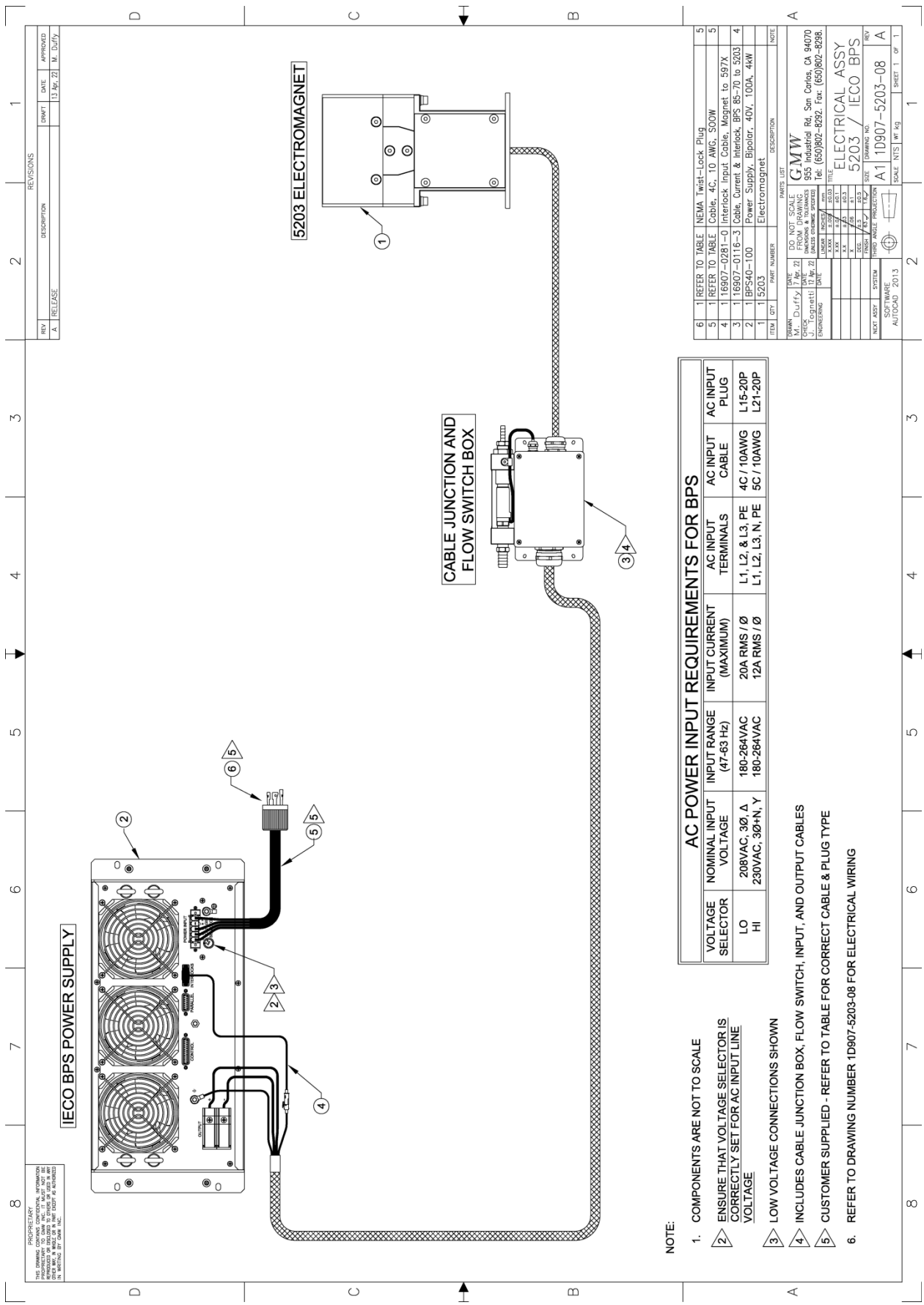
13907-0025-1 - System Wiring, 5203, 1x BOP20-50, and PDU



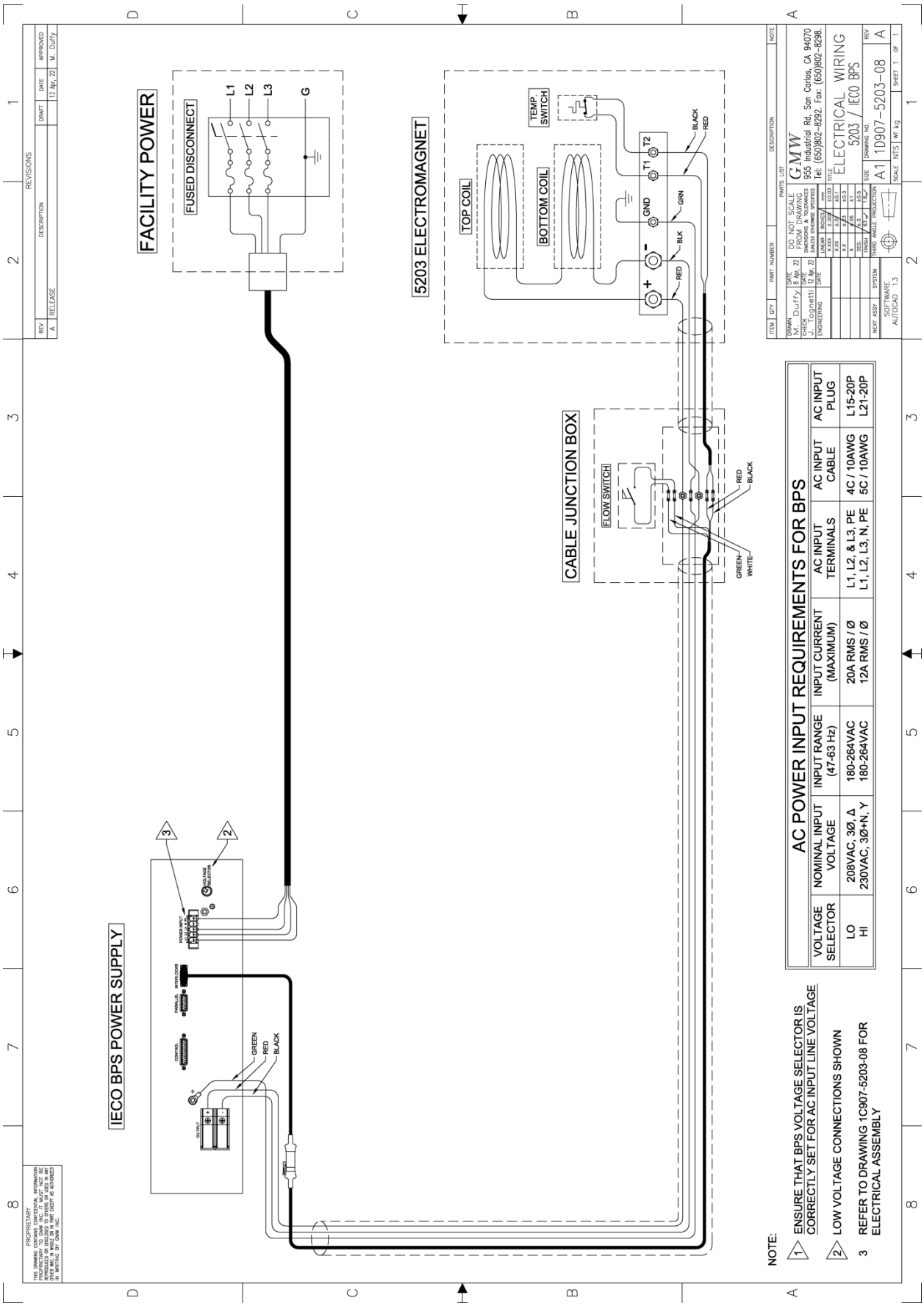
13907-0026-1 - System Wiring, 5203, 2x BOP20-50, and PDU



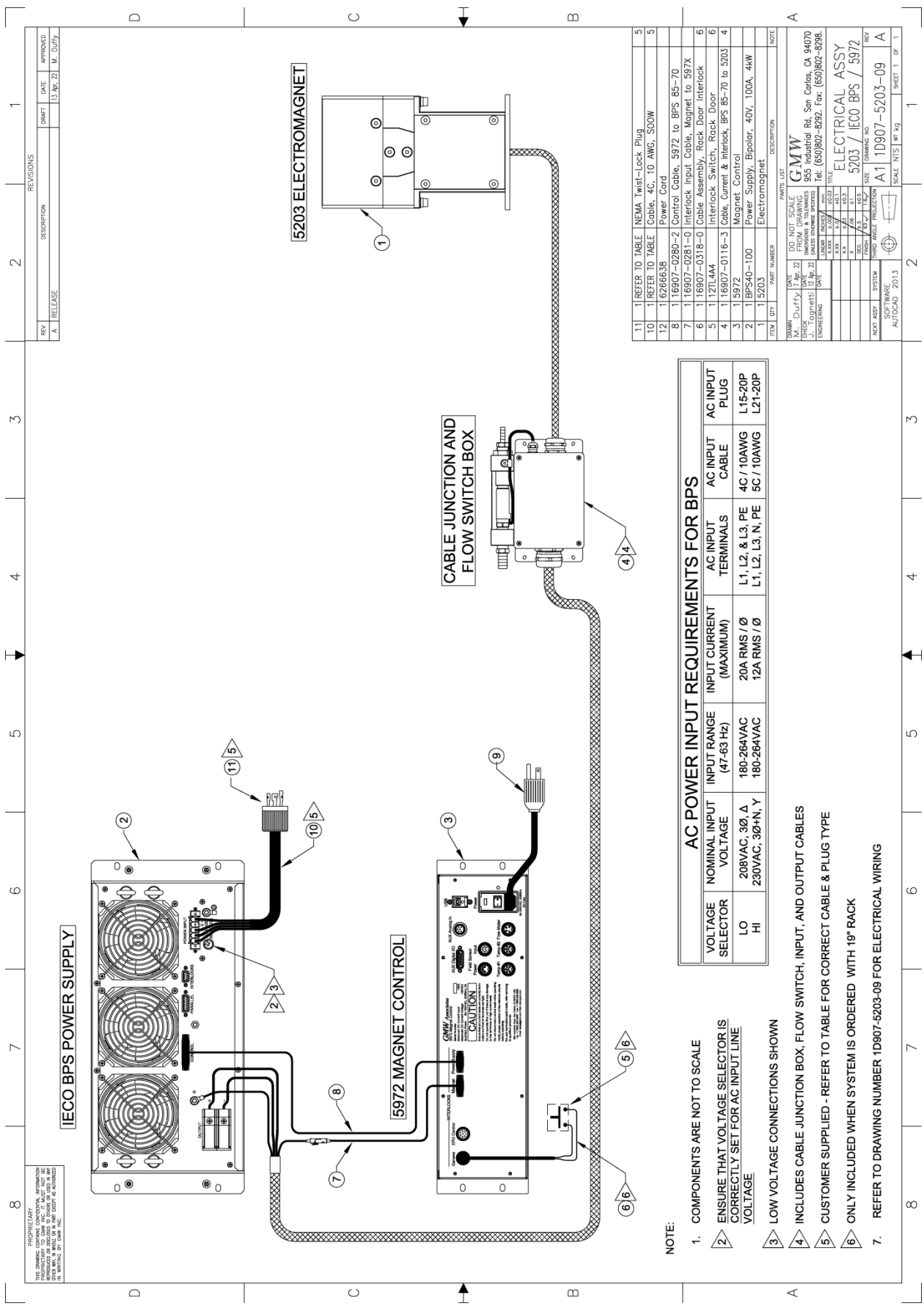
1C907-5203-08 - Electrical Assembly, 5203 and IECO BPS



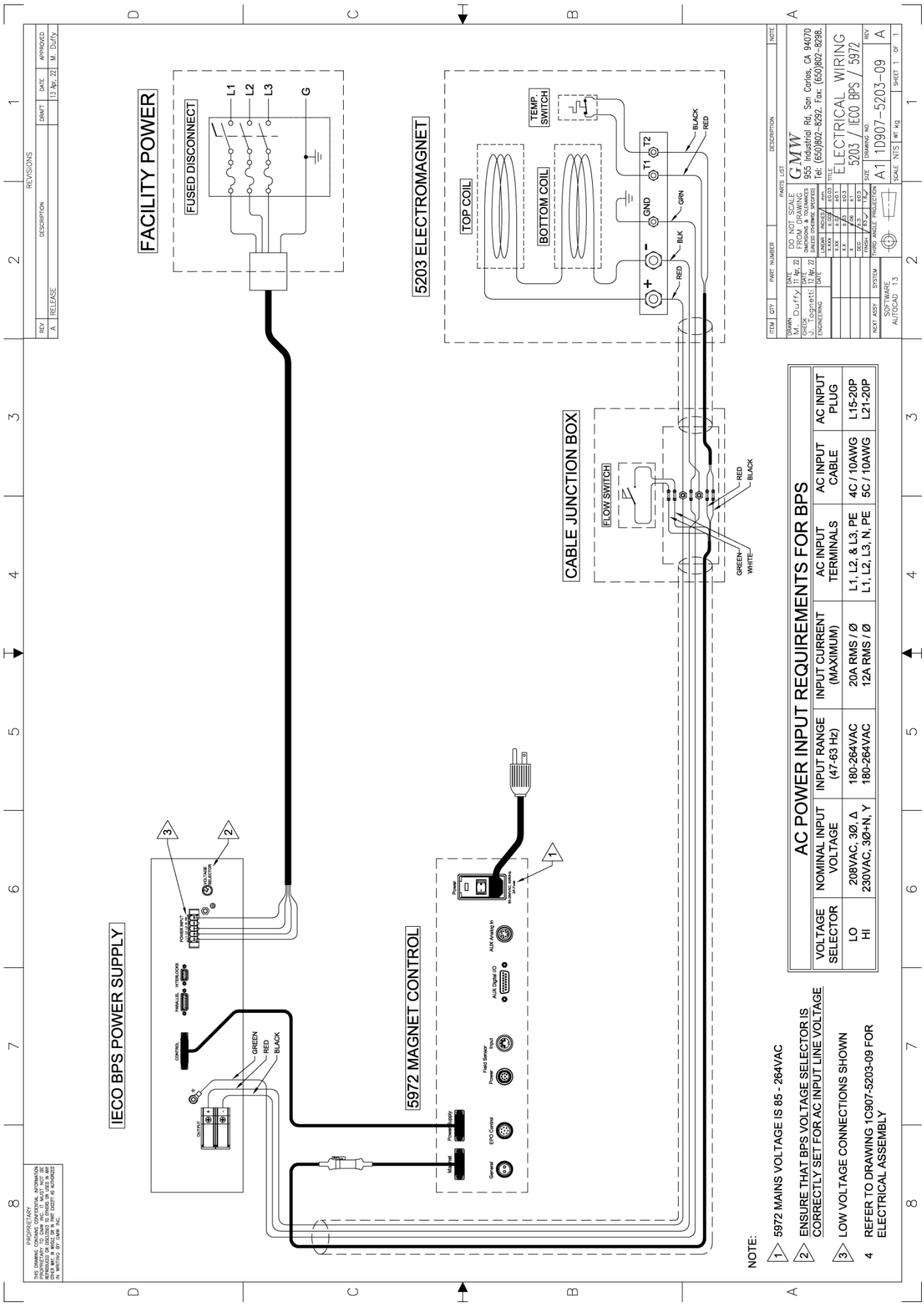
1D907-5203-08 - Electrical Wiring, 5203 and IECO BPS



1C907-5203-09 - Electrical Assembly, 5203, IECO BPS, and 5972



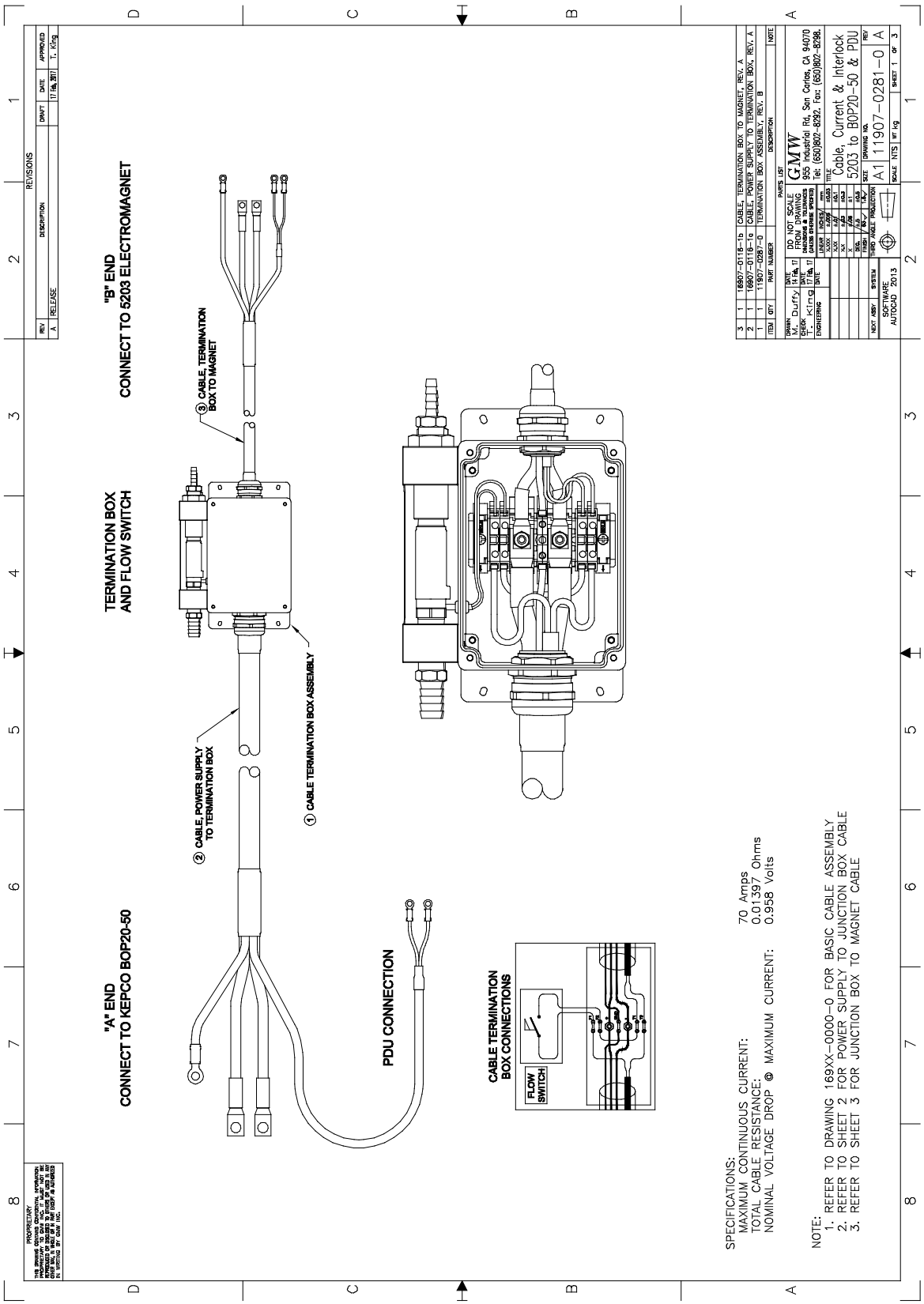
1D907-5203-09 - Electrical Wiring, 5203, IECO BPS, and 5972



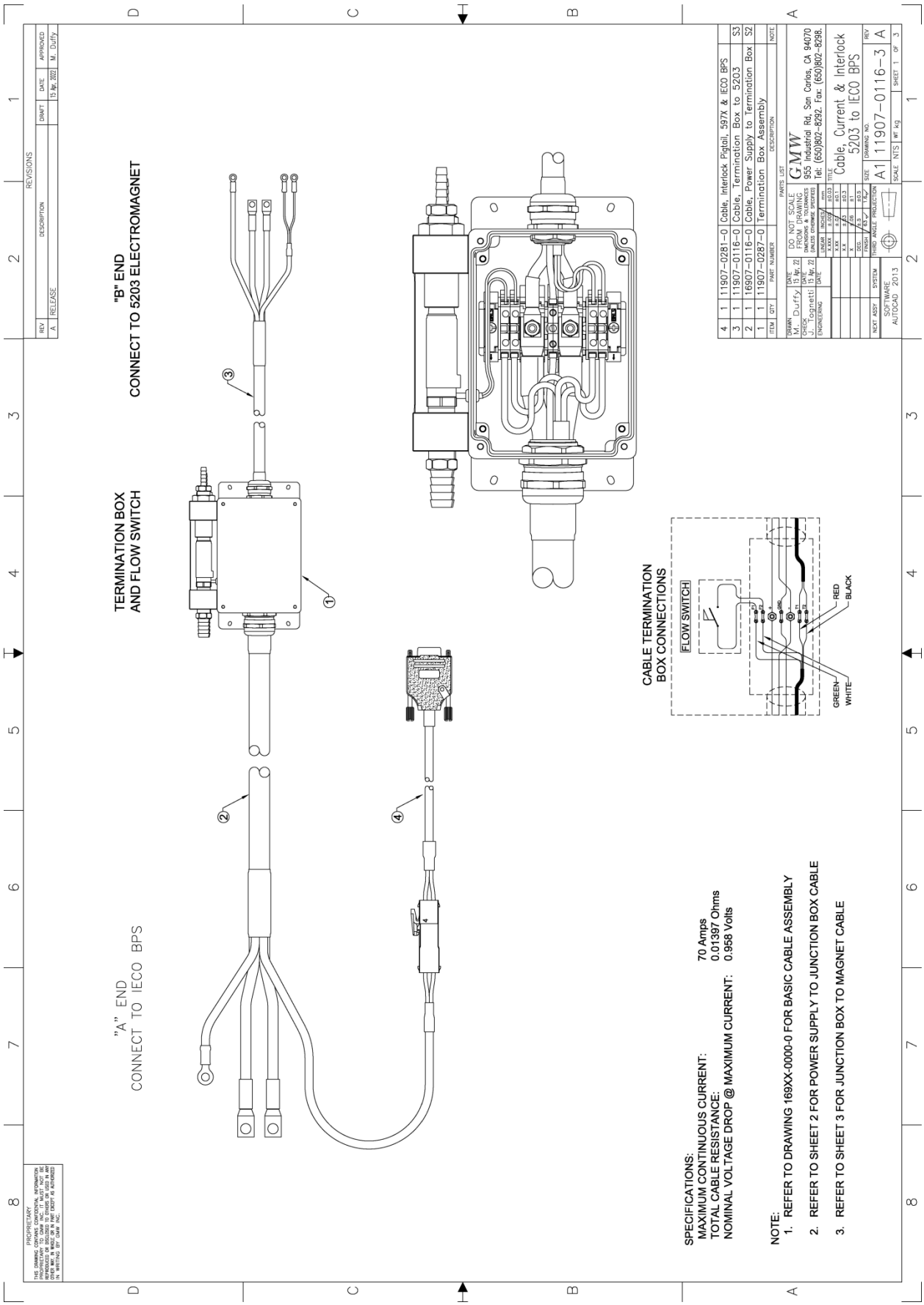
12. ACCESSORY AND OPTIONS DRAWINGS

16907-0116-1, S1 - DC Cable, 5203, BOP20-50, and PDU 46
16907-0116-3, S1 - DC Cable, 5203, IECO BPS, and 5972 47
16907-0281-0 - Cable Assembly, Interlock Pigtail, 5972 or IECO BPS 48
11907-0620-0 - GMW RC-1920 Equipment Rack 49

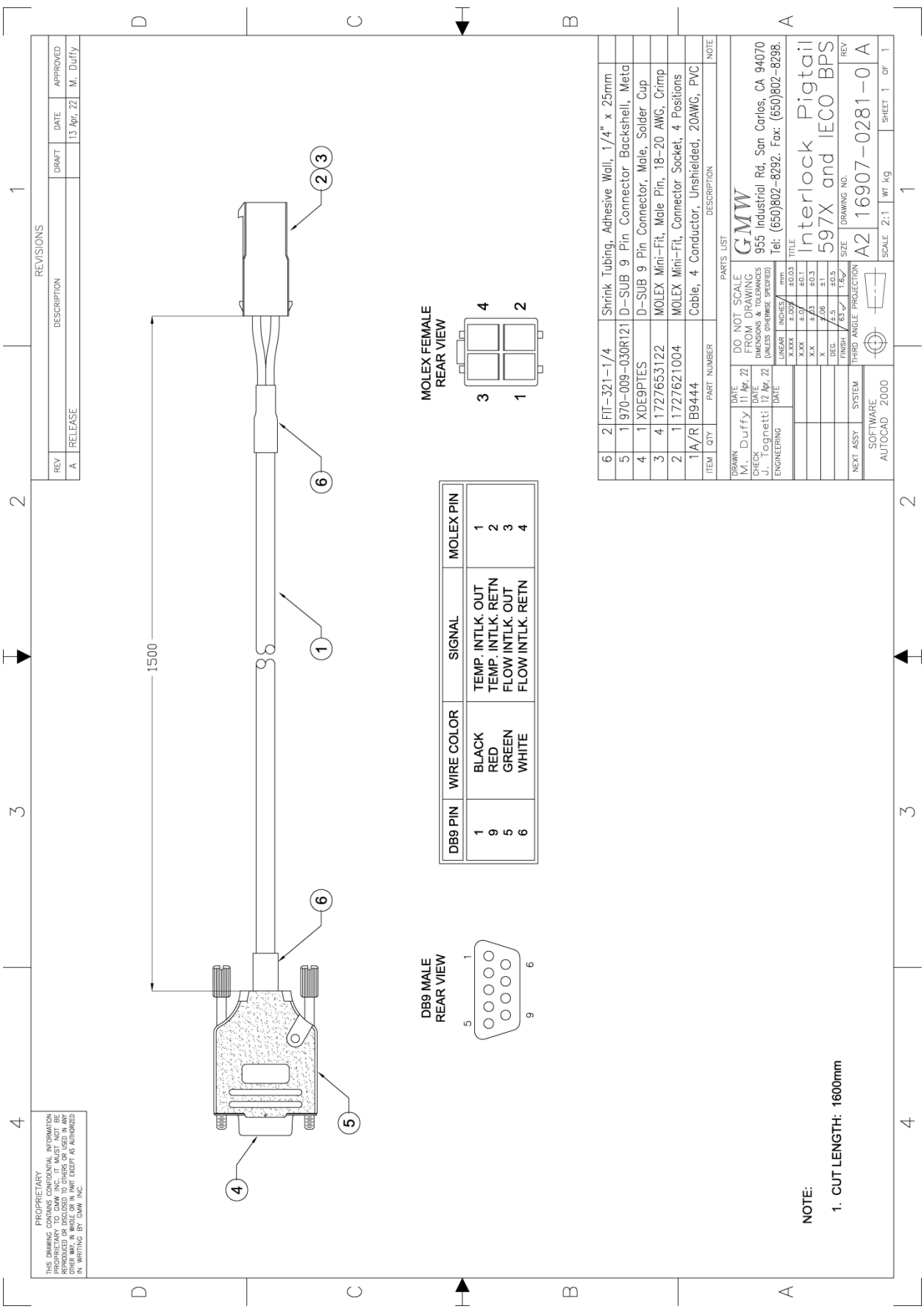
16907-0116-1, S1 - Cable, Current & Interlock, 5203, BOP20-50, and PDU



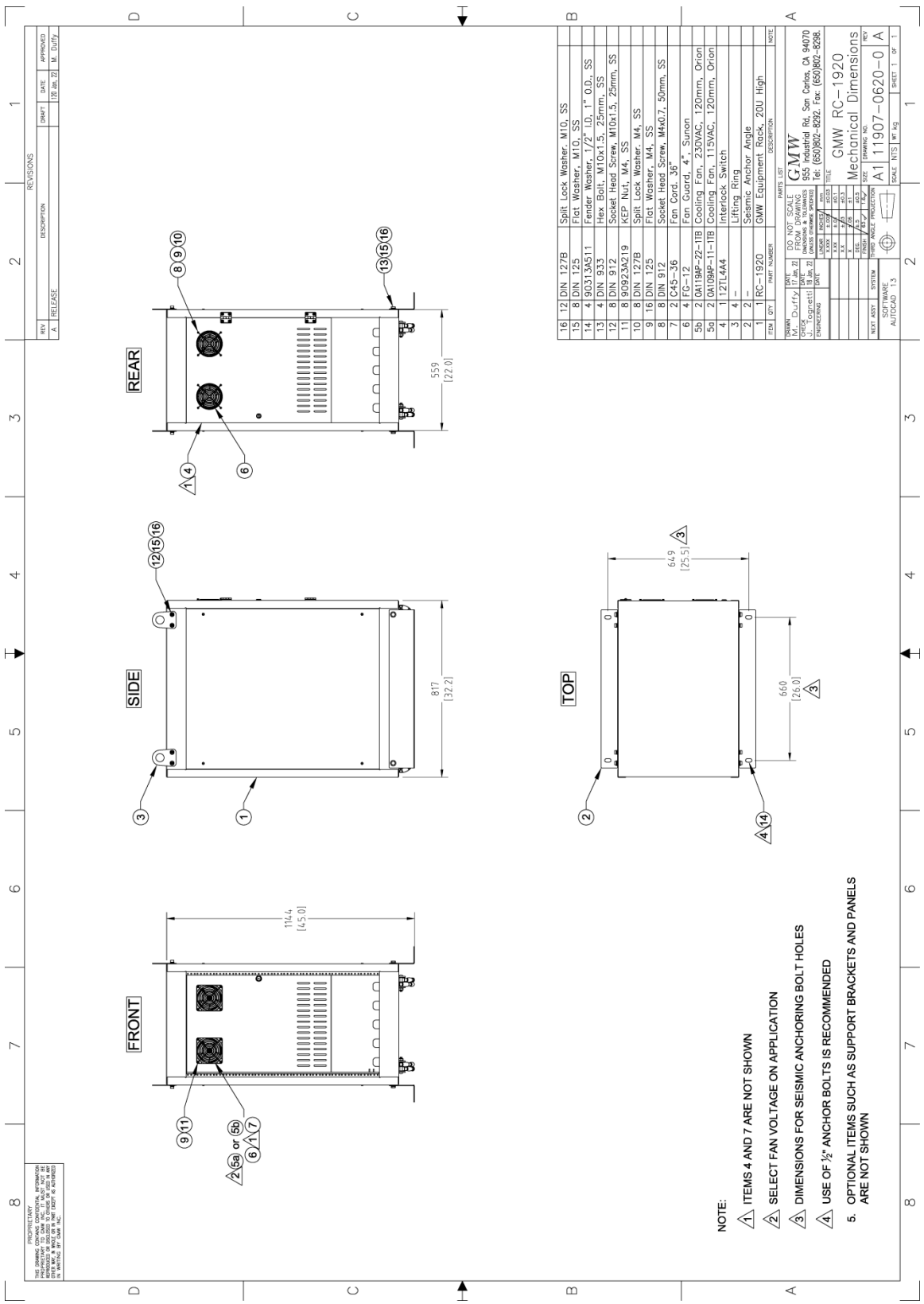
16907-0116-3, S1 - Cable, Current & Interlock, 5203, IECO BPS, and 5972



16907-0281-0 - Cable Assembly, Interlock Pigtail, 5972 or IECO BPS



11907-0620-0 - GMW RC-1920 Equipment Rack



13. MAGNET ACCESSORIES

13.1 5972 Magnet Control

The 5972 Magnet Control provides a convenient solution to magnet control and monitoring via a National Instrument USB DAQ integrated into a 3U rack mountable chassis. Field control is accomplished via the DAQs 16-bit analog output. Power and Field input connectors are provided for a Senis field hall effect sensor. Magnet and general interlock inputs provide protection for the magnet and personnel operating the equipment. Please refer to the 5972 Magnet Control brochure at the end of this manual for more details.

13.2 RC-1920 - 19" Equipment Rack

To help make system installation more simple, a 19", 20U tall equipment rack is available. This rack is fully enclosed and will accept any 19" rack mountable equipment up to 850mm [33.5"] deep. Our rack includes the following features:

- Interlock switch on the rear door
- Two cooling fans mounted on the rear door
- Key lock on the rear door
- Provision for cable strain relief
- Ground bonding rail
- Omni-directional castors
- Seismic anchoring brackets

Not included in the bare rack, but available are:

- Blanking panels in 1U, 2U, 3U, 4U, and 5U
- Equipment support brackets

When ordering a complete magnet system, GMW will pre-load the rack with all of the rack mountable components. The preloaded rack will include a power strip, support brackets for all pre-installed equipment, and blank panels to fill the unused rack space.

14. APPENDIX

13.1 Recommended Mains Connection

GMW recommends the following Mains Connection as per conformance with NFPA 79

- MELTRIC DS30 Receptacle (female): 33-34167
- MELTRIC DS30 Inlet (male): 33-38167
- Additional MELTRIC DS30 accessories as needed.

DECONTACTOR™ – 30A
Switch-Rated Plugs & Receptacles

Ratings

- Voltage
  600 VAC
- Switch-Rating (AC Only)
  Branch Circuit & Motor Circuit Disconnect Switching
- Horsepower Ratings
  120V 1ϕ 1 1/2 hp
  240V 1ϕ 3 hp
  208V 3ϕ 5 hp
  240V 3ϕ 5 hp
  480V 3ϕ 15 hp
  600V 3ϕ 15 hp
- Short Circuit Rating
  100kA Close & Withstand
  Testing was performed with RK1 current limiting fuses sized at 400% of the highest full load motor ampacity associated with the devices hp rating.
- Environmental Ratings
  Type 3R, IP54/IP55*
  * IP54 when the plug & receptacle are mated. IP55 on the receptacle alone when the lid is latched closed.
- Temperature Range
  Min -40°F/Max 140°F
  See pg 228 for temps below -15°F.
- Wiring Capacity
  Min 14 AWG Max 6 AWG
  Aux Contacts - Max 14 AWG
- Listings
  UL, CSA, IEC, CE*
  * Contact Customer Service

Receptacle (female)

Inlet (male)

Don't forget to add installation accessories to your order

Recommended Connector

For international configurations (CE) visit meltric.com/international-catalog or contact customer service at 800.433.7642.

Voltage	Polarity	Part # Poly	Voltage	Polarity	Part # Poly
120V	1P+N+G	33-34165	120V	1P+N+G	33-38165
120/208V	3P+N+G	33-34167	120/208V	3P+N+G	33-38167
125V	1P+N+G	33-34075	125V	1P+N+G	33-38075
125/250V	2P+N+G	33-34076	125/250V	2P+N+G	33-38076
208V	2P+G	33-34162	208V	2P+G	33-38162
208V	3P+G	33-34163	208V	3P+G	33-38163
250V	2P+G	33-34072	250V	2P+G	33-38072
250V	3P+G	33-34073	250V	3P+G	33-38073
277V	1P+N+G	33-34045	277V	1P+N+G	33-38045
277/480V	3P+N+G	33-34047	277/480V	3P+N+G	33-38047
347/600V	3P+N+G	33-34147	347/600V	3P+N+G	33-38147
480V	2P+G	33-34042	480V	2P+G	33-38042
480V	3P+G	33-34043	480V	3P+G	33-38043
600V	2P+G	33-34142	600V	2P+G	33-38142
600V	3P+G	33-34143	600V	3P+G	33-38143

Main Options


Auxiliary/Pilot Contacts


Mushroom Pawl

5/16" hole


Padlock Pawl


Closed Lid Configuration
Recommended for cord applications to keep lid tucked in to avoid damage.

See pgs 205-214 for detailed information on these options

Receptacle Options	Suffix #
With 2 Auxiliary/Pilot Contacts	Recept # - 972
With 3 Auxiliary/Pilot Contacts	Recept # - 973
With 4 Auxiliary/Pilot Contacts	Recept # - 974
Type 4X & closed lid configuration	Recept # - 4X
Straight Insertion	Recept # - 352
Self-Ejecting Connector Release	Recept # - 354
Mushroom Pawl	Recept # - 375
Padlock Pawl	Recept # - 843
Padlockable Mushroom Pawl	Recept # - 375-843
Locking Mushroom Pawl	Recept # - 845
Metal Pawl (on poly receptacle)	Recept # - 824
Closed Lid Configuration	Recept # - NC
With Auxiliary Switch	Recept # - 270*

Notes: * Not UL/CSA Listed.

Inlet Options	Suffix #
With 2 Auxiliary/Pilot Contacts	Inlet # - 972
With 3 Auxiliary/Pilot Contacts	Inlet # - 973
With 4 Auxiliary/Pilot Contacts	Inlet # - 974
Type 4X Watertightness	Inlet # - 4X
Self-Ejecting Plug Release	Inlet # - 338
With No Lockout Hole	Inlet # - A155
For Auxiliary Switch*	Inlet # - NNF

Notes: * Order inlet with P+N+G configuration and receptacle with P+G configuration

DS30 Order Example:
To order 2 auxiliary contacts on an inlet and receptacle add *-972* to the part numbers.
DS30 Poly inlet 3P+G=33-38043-*972*
DS30 Poly receptacle 3P+G=33-34043-*972*
Appropriate accessory part numbers must also be included on the order.

41 MELTRIC

15. WARRANTY INFORMATION

GMW Associates warrants that Laboratory Electromagnets and Laboratory Electromagnet Systems supplied by GMW Associates will be free of defects in materials or workmanship for a period of 12 months from the date of installation or 15 months from the date of shipment whichever is the shorter.

Within this period GMW Associates will repair or replace defective parts free of charge either at the end user's site or at GMW Associates location at GMWs choice.

GMW Associates will reimburse or pay the lowest two way freight charges on items returned to GMW Associates or our authorized agent provided prior authorization for shipment has been given by GMW Associates.

This warranty shall not apply to any equipment which our inspection shows to have become defective due to mishandling, misuse, improper maintenance or any other damage not generally acceptable for equipment of a similar type.

GMW Associates reserves the right to make changes in product or system design without incurring any obligation to modify previously delivered equipment.

The foregoing is the full extent of the GMW Associates warranty. No other warranty is expressed or implied. In no event shall GMW Associates be liable for damage arising from late delivery or misuse of the equipment. GMW Associates makes no warranty of the fitness of the equipment for the intended end-use other than the equipment meets the written specifications presented to the purchaser by GMW Associates.

If any defect or fault in the equipment is discovered the end-user should notify GMW Associates of the problem including details of Model numbers and serial numbers. GMW Associates will either make arrangements for service by the end-user or GMW Associates, or give authorization for return shipment to GMW Associates.

All return shipments must be made according to GMW Associates instructions with adequate packaging and documentation identifying the shipment including the GMW Associates Return Material Authorization (RMA) number. GMW Associates will not accept responsibility for equipment damaged in return shipment and thus all shipments should be properly packed and adequately insured by the customer.

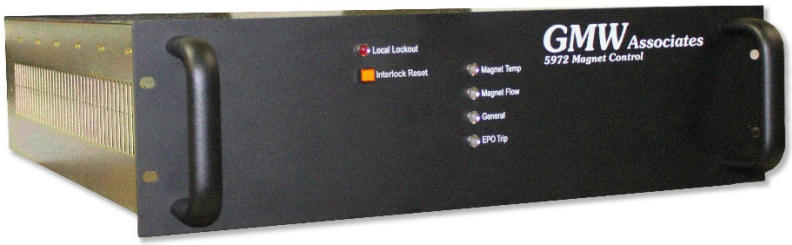
To request warranty service, please contact the GMW representative nearest you.

GMW Associates
Web: www.gmw.com/help/
Email: engineering@gmw.com

India: Transact.
Web: www.transact.co.in
Email: sales@transact.co.in

Japan: TOYO Corporation.
Web: www.toyo.co.jp/English/
Email: magne@toyo.co.jp

5972 Magnet Control



OVERVIEW

The GMW 5972 Magnet Control system acts as controller, interlock and DAQ for GMW Electromagnet Systems. A complete system typically consists of a DC magnet power supply, the 5972 Magnet Control, a Senis Magnetic Field Transducer, a GMW electromagnet, and computer with control software.

The DC magnet power supply provides current directly to the electromagnet. The Supply's output is enabled on a closed contact, providing protection should the interlock cable be disconnected. A failure in either the magnet temperature or water flow will cause the interlock relay to open, shutting down the DC Supply's output.

The 5972 Magnet Control is comprised of several sections: The display and interlock control electronics, a National Instruments USB-6351 Control with USB interface and an auxiliary power supply all integrated into a single 19" rack mounting chassis.

The NI USB-6351 DAQ interface provides computer control and monitoring of the system. It provides a 16-bit analog output (±10V) as a programming signal to the DC Supply. The output voltage and current are monitored by two 16-bit input channels. The magnet interlock status is also monitored via its digital input channels. When using an optional Senis Magnetic Field Transducer, the field is read back on a third 16-bit analog channel. An Auxiliary Analog Input connector allows for up to five additional analog inputs with user settable full-scale inputs from ±2V to ±10V.

Revised September, 2020

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5972 General Specifications

Electrical

Power Input	85-240VAC, 50/60Hz, 2A

Note: While the power input module has a 'selectable' voltage range, it is not necessary to select the range for any voltage between 85 - 240VAC.

Control Modes

Manual Control	Manual control of the DC current via the DC Power Supply's front panel controls Manual control of the current polarity via the Current Reversal Switch's front panel controls
Computer Control	National Instruments Multifunction DAQ, Model USB-6351 Current Control Resolution: 16 bits Current & Voltage Monitor Resolution:16 bits Digital read back of amplifier and magnet interlock status Magnetic field read back resolution:16 bits

Mechanical

5972 Current Magnet Control

Form Factor	3U rack mount fully enclosed chassis
Overall Dimensions	482mm (19")W x 132.0mm (5.20")H x 586.1mm (23.0")D
Weight	15.75 kg (35lbs)

5972 Magnet Control & SGA Power Supply in Optima Rack

Overall Dimensions	560.5 (22") W x 1,058 (41.6") H x 823 (32.4") D
Weight (with Sorensen SGA 60/83)	105.75kg (235lbs)
Weight (with Sorensen SGA 100/150)	115kg (250lbs)

BPS-40-100

Bipolar Power Supply

BPS-40-100

±40V, ±100A

Preliminary

International Electric Co.

Document: 200203PHa 3.2.2020.

BPS-40-100

Features

- High performance bipolar power supply with ± 40 V, ± 100 A output
- 4-quadrant output operation
- Operation with wide range of loads
- Voltage mode and current mode
- Very low ripple and noise
- Flux gate current transducer for excellent temperature and long term current stability
- Ramp response for different loads tuned from front panel
- Analogue voltage programming of output voltage or current
- Air cooled, 19 ” rack mountable package (5 U), 55 kg (121 lb)

Output performance

Output voltage max	± 40 V
Output current max	± 100 A
Output power	4 kW
Small signal bandwidth	> 10 kHz (-3dB)
Switching frequency	250 kHz

Voltage mode:

Line regulation	< 0.01 % (supply voltage min-max)
Load regulation	< 0.05 % (output current 0 – max)
Gain accuracy	< 0.02 %
Gain drift vs. time	< 0.01 % (any 8 hour period after 10 min warm up time)
Gain drift vs. temperature	< 0.005 % /ºC (10 ... 40ºC)
Initial offset	< 5 mV (adjustable to 0 mV)
Offset drift vs. time	< 5 mV (any 8 hour period after 10 min warm up time)
Offset drift vs. temperature	< 1 mV /ºC
Output noise voltage	< 0.2Vrms (0.1Hz...200kHz)
Switching ripple voltage	< 500 mVrms differential (>250kHz)

Current Mode:

Line regulation	< 0.01 % (supply voltage min – max)
Load regulation	< 0.05 % (output voltage 0 – max)
Gain accuracy	< 0.02 %
Gain drift vs. time	< 0.01 % (any 8 hour period after 10 min warm up time)
Gain drift vs. temperature	< 0.005 % /ºC (10 … 40ºC)
Initial offset	< 5 mA (adjustable to 0 mA)
Offset drift vs. time	< 5 mA (any 8 hour period after 10 min warm up time)
Offset drift vs. temperature	< 1 mA /ºC
Output noise current	< 1 mArms (0.1Hz...10kHz)
Switching ripple voltage	< 500 mVrms differential (>250kHz)

Control and monitoring

Local Mode, progamming via front panel:

Voltage mode	-40V to +40V. Setting resolution 10mV
Current mode	-100A to +100A. Setting resolution 10mA

Remote Mode:

Programming, voltage mode	TBD
Programming, current mode	TBD
Signal input impedance	40 kΩ

Fault protection:	Internal overtemperature
(Output shutdown due to)	AC input voltage out of tolerance
	Internal voltages out of tolerance
	Output crowbar protection for excess returned load energy
	Two external interlocks

Display	TFT 4.3” color display with large view angle
Local mode	Voltage or current mode selected via display Voltage or current output set by knob Enable button for activating the output
Remote mode	Remote mode connector on rear panel Remote mode enabled by logic signal Voltage or current mode selected by logic signal Voltage or current output set by analog programming signal
Tuning	Response for different loads can be fine-tuned at display
Voltage limit	Absolute max voltage limit set via display
Current limit	Absolute max current limit set via display

Bipolar Power Supply BPS-40-100

System specifications

Input voltage requirements	208V: 180-264VAC 47-63Hz 3-phase Delta, or 400V: 3 x 180-264VAC 47-63Hz L1, L2, L3, N Selected by switch at rear panel
Input current	typ. 15A/180VAC 12A/230VAC
Power factor	typ. 0.95/230VAC at full load
Efficiency	0.75 at 4kW output power
Inrush current	typ. 60A@230VAC at cold start
Leakage current	< 2mA/240 VAC
Environmental requirements:	
Ambient temperature	10 °C to 40 °C
Ambient humidity	30 to 70 % non-condensing
Storage temperature	-20 °C to +85 °C
Cooling	Forced air cooling (front in, rear out) Removable, washable dust filter with capability to replace
Unit dimensions:	
Mounting	19” rack. Provision for rack slides
Height	221,5 mm (5U, 8.75”)
Width	483 mm (19”)
Depth	740 mm (29.1”)
Weight	55 kg (121 lb)

Regulatory

Designed to meet	EN 61010, UL 61010 AC/DC section: UL60950-1, TUV 60950-1 approved
	CE marked

Company in brief

International Electric Company (IECO) designs and manufactures state-of-the-art electronics for medical, industrial, laboratory and military applications tailored to meet customer needs.

With over 40 years of experience in power electronics we are able to provide solutions for even the most challenging requirements. IECO's quality system is ISO 9001 and ISO 13485 certified.

Power amplifier technology

IECO introduced its first bipolar gradient amplifier in 1994. This revolutionary PWM amplifier enabled excellent image quality in open MRI systems. Simultaneously IECO also launched the first D-class magnet power supply delivering new efficiency levels with 0.1ppm accuracy. IECO's expertise has recently been utilized in the development of the industry's first High Temperature Superconductive MRI magnets.

IECO's power amplifiers are easily scalable for any type of load and any power level needed. Compact amplifier units can be connected in series or in parallel in Master/Slave operation to gain output voltages up to 1100V and output currents over 2000A. Thanks to low-noise, wide bandwidth and excellent step response, IECO has gained the reputation of a technology leader in bipolar gradient amplifiers.

Over 1000 amplifier and magnet power supply systems delivered worldwide.

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AP-134

Thermo Scientific Cooling Water System: Cleaning/Flushing Procedures

Analytical Procedure

The Thermo Scientific Chemical Kit (part #: 610000000005) consists of a corrosion/scale inhibitor (Product #: 460-Thermo100) and a biocide (Product #: 7330).

The Thermo Scientific Chemical Kit is designed to treat cooling water systems up to 10-gallons in volume.
Larger systems will require additional kits at 10-gallon intervals to maintain the chemical treatment program (for example, a 20-gallon system would require two kits).

DETERMINING THE CORRECT APPLICATION

Because the Thermo Scientific Chemical Kit can be used in different applications, determining which application you will need is critical to the success of the procedure. The guidelines for choosing the proper procedure for your needs are as follows:

If you are using the Thermo Scientific Chemical Kit in a new system that needs to be treated prior to normal operation, follow the procedure listed in the *End User Startup of a New System* section.

If you are using the Thermo Scientific Chemical Kit to conduct a routine maintenance flushing of an existing cooling water system, follow the procedure listed in the *Semiannual Water Change* section.

If you are using the Thermo Scientific Chemical Kit at the startup of an existing cooling water system that has had no previous treatment or a different chemical treatment, follow the procedure listed in the *Flushing and Startup for an Existing System* section.

If you are an original equipment manufacturer using the Thermo Scientific Chemical Kit in a new system that has not yet been shipped or stored, follow the procedure listed in the *Pre-ship Test/ Passivate* section.

END USER STARTUP OF NEW SYSTEM

Purpose

The cooling water systems in new units need to be treated before initiating normal operation and treatment. The following procedure will delineate the procedure for starting up the new cooling water system and improve system performance and reliability.

Procedure

1. Confirm the unit is ready for operation.
2. Fill the cooling water system with deionized (DI), distilled or Reverse Osmosis (RO) water and circulate for several minutes. Repair any leaks before proceeding.
3. Add the contents of the bottle labeled 460-Thermo100. Circulate for 10-15 minutes.
4. Add the contents of the bottle labeled NALCO 7330.
5. Attach the ***Fluid Replacement Reminder*** sticker to a prominent location on the unit. Sign and date the sticker noting when the system was treated and a scheduled date for the next treatment.
6. The system is now ready for use.

AP-134

Thermo Scientific Cooling Water System: Cleaning/Flushing Procedures

Analytical Procedure

SEMIANNUAL WATER CHANGE

Purpose

All cooling water systems require attention in order to minimize corrosion and fouling, especially biofouling. Since these systems are small, the simplest method is to change the treated cooling water on a regular schedule. Flushing the system will remove material that accumulated since the last water change. The following procedure will remove loose material, sanitize the cooling circuit, passivate metal surfaces, and improve system performance and reliability.

Procedure

1. Drain the system completely.
2. Refill the system with deionized (DI), distilled or Reverse Osmosis (RO) water and circulate for 10-15 minutes.
3. Drain the system completely.
4. Refill the system with DI water. Add the contents of the bottle labeled 460-Thermo100. Circulate for 10-15 minutes.
5. Add the contents of the bottle labeled NALCO 7330. Circulate for 3-4 hours.
6. Attach the ***Fluid Replacement Reminder*** sticker to a prominent location on the unit. Sign and date the sticker noting when the system was treated and a scheduled date for the next treatment.
7. The system is now ready for use.

FLUSHING AND STARTUP FOR EXISTING SYSTEM

Purpose

Existing cooling water systems might contain treatment chemicals that can be incompatible with 460-Thermo100. Additionally, existing systems might contain corrosion by-products and bacteria. These materials will increase system corrosion and impede performance of 460-Thermo100.

For best results, these materials must be removed from the system before starting the new treatment program. Additionally, metal surfaces should be passivated before starting any treatment program. Passivation helps to minimize corrosion and prepares the metal surface for the corrosion inhibitors in the treatment program. The following procedure will remove old treatment chemicals and bacteria, sanitize the cooling circuit, passivate metal surfaces, and improve system performance and reliability.

Procedure

1. Drain the system completely.
2. Refill the system with deionized (DI) water, and circulate for 10-15 minutes.
3. Add the contents of the bottle labeled 460-Thermo100. Circulate for 10-15 minutes.
4. Add the contents of the bottle labeled NALCO 7330. Circulate for 3-4 hours.
5. Drain the system completely.
6. Refill the system with deionized (DI), distilled or Reverse Osmosis (RO) water. Add the contents of the bottle labeled 460-Thermo100. Circulate for 10-15 minutes.
7. Add the contents of the bottle labeled NALCO 7330. Circulate for 10-15 minutes.
8. Attach the ***Fluid Replacement Reminder*** sticker to a prominent location on the unit. Sign and date the sticker noting when the system was treated and a scheduled date for the next treatment.
9. The system is now ready for use.

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Thermo Scientific Cooling Water System: Cleaning/Flushing Procedures

Analytical Procedure

PRE-SHIP TEST/PASSIVATE FOR ORIGINAL EQUIPMENT MANUFACTURERS

Purpose

If equipment testing is conducted prior to shipping or storage, new cooling water systems should be flushed and passivated. Passivation helps to minimize corrosion and prepares the metal surface for the corrosion inhibitors in the treatment program. The following procedure will passivate metal surfaces and improve system performance and reliability.

Procedure

1. Confirm the unit is ready for operation.
2. Fill the cooling water system with deionized (DI), distilled or Reverse Osmosis (RO) water and circulate for several minutes. Repair any leaks before proceeding.
3. Add the contents of the bottle labeled 460-Thermo100; circulate for 10-15 minutes.
4. Add the contents of the bottle labeled NALCO 7330; circulate until pre-ship testing is complete, but no less than a minimum of 4 hours.
5. Drain the system completely.
6. Attach the ***Fluid Replacement Reminder*** sticker to a prominent location on the unit. Sign and date the sticker noting when the system was treated and a scheduled date for the next treatment.
7. The unit is now ready for shipment or storage.

For more information, please contact the **Inside Sales Department at (800) 258-0830.**

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Thermo Scientific Cooling Water System: Initial Fill/Cleaning/Flushing Procedures

Analytical Procedure

The Thermo Scientific Treated Water (460-TFS200.11) consists of a 5-gallon package of pretreated water for prevention of corrosion, scaling and microbial growth.

The Thermo Scientific Treated Water is designed to treat cooling water systems of all volumes. Corrosion and Scale Inhibitors are pre-added to deionized (DI) quality water at proper dosages to ensure complete system protection. To use, directly fill the cooling water system to normal operating levels with the Thermo Scientific Treated Water. No additional water or additives are needed. Place system in normal operation.

Of important note, the treated water is made using deionized (DI) quality water. The DI process removes minerals normally found in tap and well waters that cause scaling and fouling on heat transfer surfaces. DI water by itself can be extremely corrosive to metal surfaces and should never be used alone in a cooling water system. However, the addition of the yellow metal, aluminum and carbon steel corrosion inhibitors to the DI water base make the solution non-corrosive. The Treated Water solution is no longer DI water after the addition of the inhibitors and meets all requirements of standard equipment specifications.

If additional system water makeup is needed during operation, add Thermo Scientific Treated Water only. Adding raw, untreated tap water will introduce contaminants and dilute Treated Water Inhibitors resulting in microbiological growth and/or system corrosion.

It is recommended to change the fluid after 6 months of operation (*see SEMIANNUAL WATER CHANGE*).

SEMIANNUAL WATER CHANGE

Purpose

All cooling water systems require attention in order to minimize corrosion and fouling, especially biofouling. The recommended method is to change the treated cooling water on a regular 6 month schedule to minimize the risk of corrosion and fouling.

When replacing fluid, it is recommended to flush the system to remove material that may have accumulated since the last water change and replenish active inhibitors that are consumed by metal surfaces over time. Changing the fluid will also introduce fresh preservatives that will ensure prevention of microbiological growth. The following procedure should be used every 6-months.

Procedure

1. Drain the system completely.
2. Refill the system to normal operating levels with Thermo Scientific Treated Water.
3. Record the time and date of the Treated Water change to serve as a reminder for the next water change date.
4. The system is now ready for use.

For more information, please contact the **Inside Sales Department at (800) 258-0830.**

ThermoFisher SCIENTIFIC

ThermoFlex

Preventative Maintenance

ThermoFlex Preventative Maintenance

- ThermoFlex chillers are equipped with preventative maintenance timers that will alert you to perform maintenance checks.

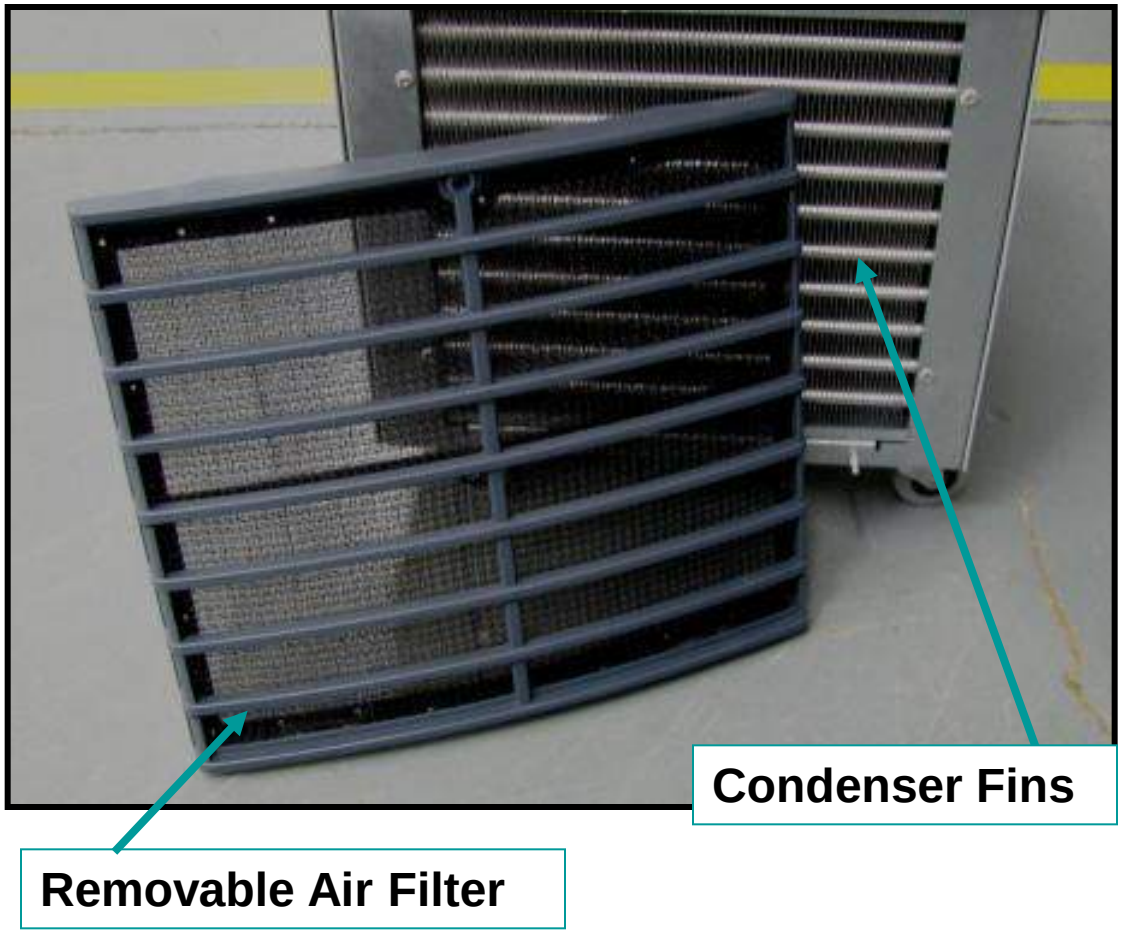
- Based on the environment you can choose 4 levels of PM timers
- Choose desired timer in the Setup Loop
  - L1 – 1000 hours (Default setting)
  - L2 – 2000 hours
  - L3 – 3000 hours
  - Off – Disables alert

When the unit's run time exceeds chosen limit display will flash "**Chng**" – **FltS**"

Press Enter button to clear message

ThermoFlex Preventative Maintenance

- To insure proper cooling, and extend the chiller life, the refrigeration air filter & condenser must be kept clean
- Remove front grill to inspect air filter & condenser fins

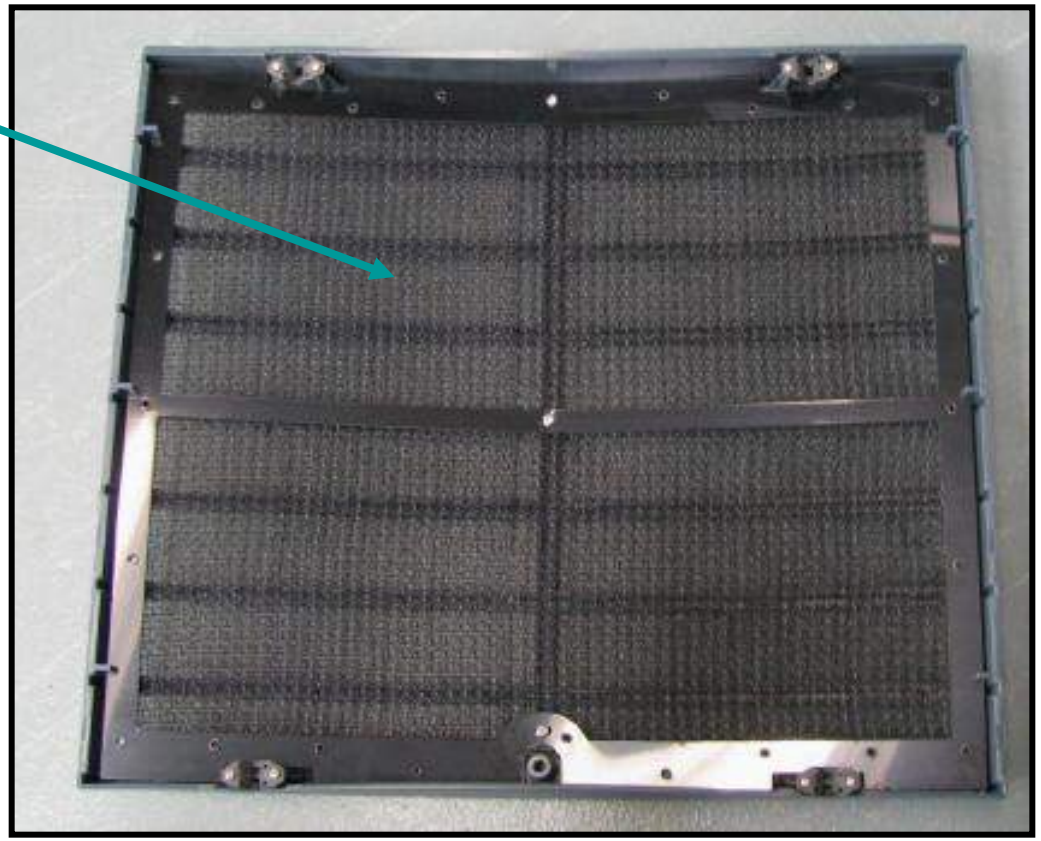


ThermoFlex Preventative Maintenance

Air Filter **Cleaning**

- Air Filter should be clean and free of dust or debris
- If necessary clean filter using a vacuum or blow off with compressed air. Filter can then be washed if needed.

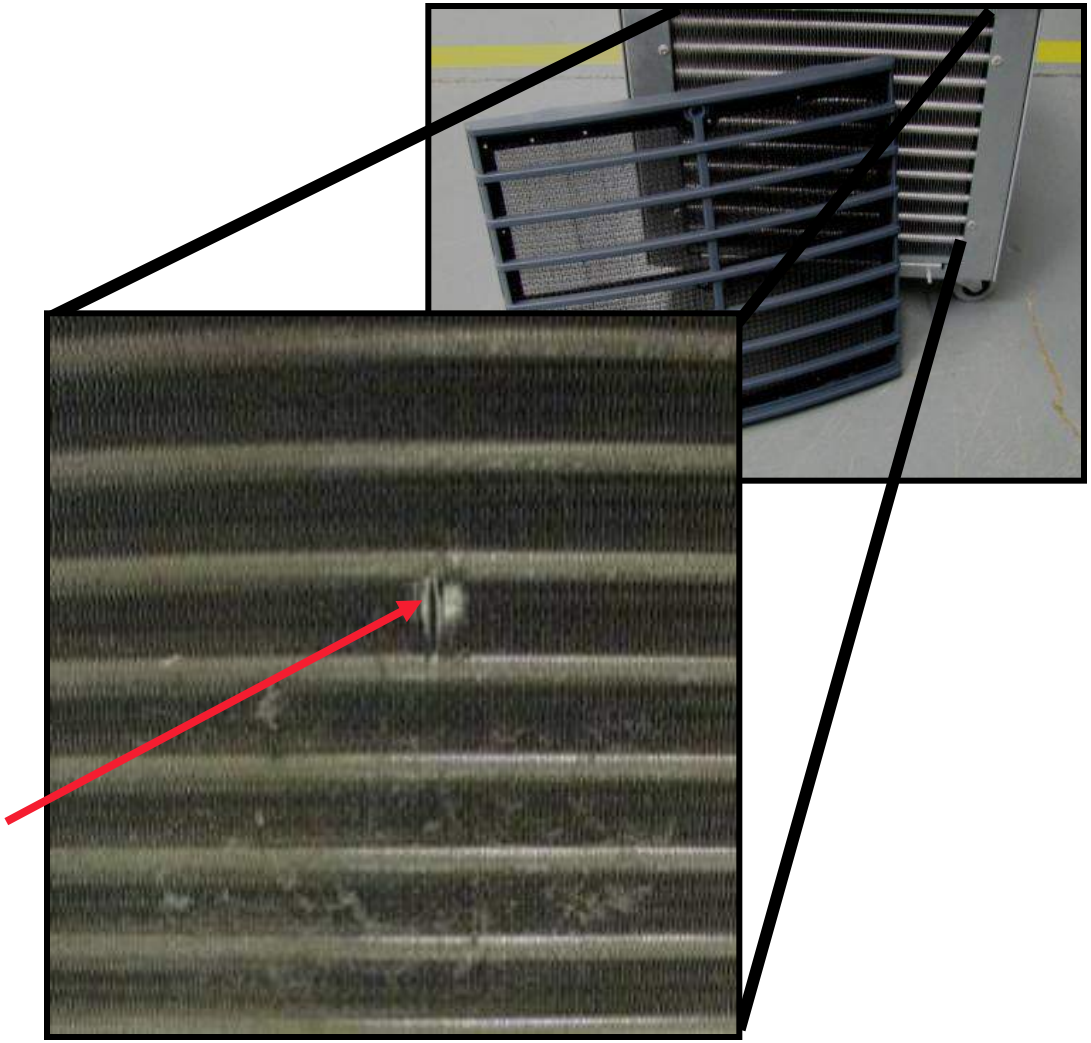
❖ Replacement Grill / Filter assembly is also available for sale



ThermoFlex Preventative Maintenance

Condenser Cleaning

- Gently vacuum or brush condenser fins to remove dust and debris.
- Take care not to cause damage to the fins



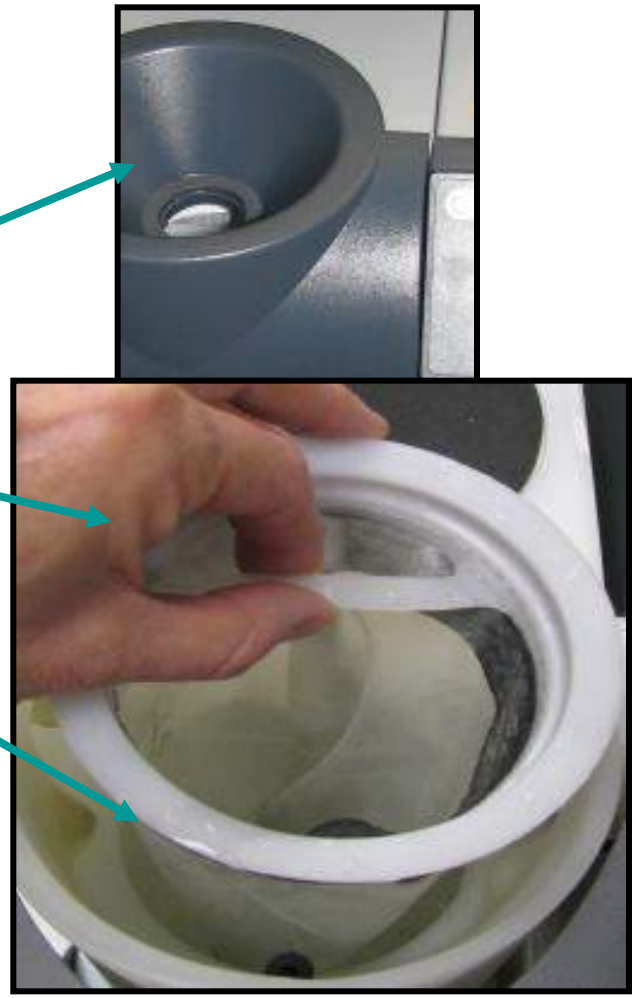
ThermoFlex Preventative Maintenance

Fluid filter cleaning & replacement

The ThermoFlex fluid bag filter can be easily removed for cleaning or replacement

1. Remove the funnel housing to access the filter bag by gently pulling it up
2. Lift the filter bag out as shown
3. Bag can then be cleaned by rinsing under running water
4. Insure that o-ring is installed on filter bag
5. When reinstalling, insure that the bag housing is fully in place before reinstalling funnel.

- If bag is excessively dirty replacement is recommended



ThermoFlex Preventative Maintenance

Insure that the "Fluid Diffuser" is in place at all times.

If diffuser is not installed fluid velocity will rapidly increase and fluid could splash out of the tank