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THE ART300 PRECISION ROTARY STAGE

USER'S MANUAL

P/N: EDA146 (V1.0)



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CHAPTER 1: OVERVIEW

In This Section:

- Introduction 1–1
- Description 1–2
- ART300 Model Numbers 1–3
- Safety Procedures and Warnings 1–5

1.1. Introduction

This manual describes technical information needed for typical applications of the ART300 series translation tables. Included are instructions detailing the entire installation from unpacking to start-up. Also included are concise explanations concerning applications, and the maintenance of the mechanical and electrical components. In addition, there is a section defining the specifications pertinent to the ART300 series stage from the package.

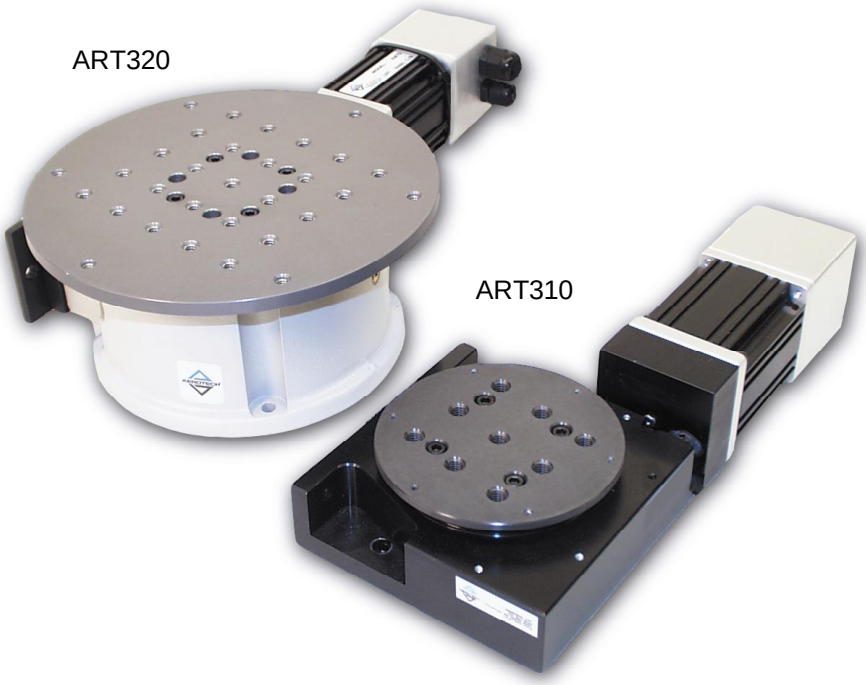


Figure 1-1. ART300 Rotary Stages

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1.2. Description

ART300 Series rotary stages are compact units providing precise positioning capability for lighter applications. The following is a list of some features:

- Maximum rotary speed of 27 rpm, and resolution of 1.5 arc second.
- Table mounted on dual large diameter pre-loaded angular contact bearings
- Anti-backlash gearing
- Base and table are machined from high strength aluminum plate
- Aluminum surfaces are either clear or black anodized
- Large aperture versions available
- Optional right angle brackets for orienting perpendicular to mounting surface
- Compatibility with a full line of Aerotech positioning and motion controls
- Standard stage and motor mounted optical home markers
- DC brushless torque motor comes standard
- Optional preparation for vacuum operation (10E-6 torr.)

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1.3. ART300 Model Numbers

The stage model number indicates the optional features on a particular stage. To determine the options on your stage, refer to Table 1-1. The example given is ART310-M-G54-BMS, which designates a 100 mm stage, a metric mounting and grid pattern, a 54:1 gear ratio, and a brushless servo motor.

Table 1-1. ART300 Model Numbering System (ART310-M-G54-BMS)

ART3	10		-M	-G54	-BMS	
Series	**Table Diameter**	**Stage Construction Options**	**Mounting and Grid Pattern**	**Gear Ratio**	**Motor**	**Options**
	10 15 20 30	/VAC3 /VAC6	-M -U -MA -UA	-G54 -G108 -G216	-BMS -BM -DC -SM -NM	-HC -RB310U -RB310M -RB310UA -RB310MA -RB315U -RB315M -RB315UA -RB315MA

Table 1-2. Model Options

ART300 Series Rotary Stage	
ART310	100 mm (4 in) diameter rotary stage
ART315	150 mm (6 in) diameter rotary stage
ART320	200 mm (8 in) diameter rotary stage
ART330	300 mm (12 in) diameter rotary stage
Stage Construction Options	
/VAC3	Vacuum preparation of stage to 10^{-3} torr.
/VAC6	Vacuum preparation of stage to 10^{-6} torr.
Mounting and Grid Pattern	
-M	Tabletop with metric-dimension mounting pattern and holes
-U	Tabletop with English-dimension mounting pattern and holes
-MA	Tabletop with aperture and metric-dimension mounting pattern and holes
-UA	Tabletop with aperture and English-dimension mounting pattern and holes
Gear Ratio	
-G54	54:1 gear ratio ART310, ART315 – Standard ART320 – Optional
-G108	108:1 gear ratio ART310, ART315 – Optional ART320, ART330 – Standard (only ratio available with ART330)
-G216	216:1 gear ratio ART310, ART315 – Optional

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Table 1-2. Model Options – Continued

Motor	
-BMS	Brushless servo motor with connectors and 1000-line encoder. Requires motor-to-controller cable. ART300, ART315, ART320 (BMS60-A-D25-E1000H/)
-BM	Brushless servo motor with connectors and 1000-line encoder. Requires motor-to-controller cable. ART330 (BM250-MS-E1000H/)
-DC	DC servo motor with connectors and 1000-line encoder. Requires motor-to-controller cable. ART310, ART315 (1035LT-MSOF-E1000LD/) ART320 (1050LT-MSOF-E1000LD/) ART330 (1135LT-MSOF-E1000LD/)
-SM	Stepping motor with 4.6 m (15 ft) integral cable and home marker pulse (one per rev). ART310, ART315 (50SMB2-HM/) ART320 (101SMB2-HM/) ART330 (310SMB3-HM/)
-NM	No motor or encoder
Options	
-HC	Home cam assembly establishes home reference accurate to one count. Requires home marker or encoder option on motor.
-RB310U	Raised tabletop for ART310, English
-RB310M	Raised tabletop for ART310, metric
-RB315U	Raised tabletop for ART315, English
-RB315M	Raised tabletop for ART315, metric
-RB310UA	Raised tabletop for ART310, English with aperture
-RB310MA	Raised tabletop for ART310, metric with aperture
-RB315UA	Raised tabletop for ART315, English with aperture
-RB315MA	Raised tabletop for ART315, metric with aperture
Accessories	
HDZ3	English right angle L-bracket for ART310, ART315
HDZ3M	Metric right angle L-bracket for ART310, ART315
HDZ4	English right angle bracket for ART320, ART330
HDZ4M	Metric right angle bracket for ART320, ART330



Listed options may be superseded at any time. Refer to the most recent addition of the Aerotech Motion Control Product Guide for the most current product information.

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1.4. Safety Procedures and Warnings

The following statements apply throughout this manual. Failure to observe these precautions could result in serious injury to those performing the procedures and/or damage to the equipment.

To minimize the possibility of electrical shock and bodily injury, make certain that all of the electrical power switches are in the off position prior to making any electrical connections.



To minimize the possibility of electrical shock and bodily injury when any electrical circuit is in use, ensure that no person comes in contact with the circuitry.



When this stage is connected to a mechanical system, mechanical motion will occur. Care must be exercised that all personnel remain clear of any moving parts.



To minimize the possibility of bodily injury, make certain that all electrical power switches are in the off position prior to making any mechanical adjustments.



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CHAPTER 2: SETUP

In This Section:

- Installation 2-1
- Stage Dimensions 2-2

2.1. Installation

This section covers the handling, mounting, and installation of the ART300 series stages. For added clarity, each step of the installation instructions has been broken down into component parts. The ART300 series stage should only be installed by those who read and thoroughly understand this manual. Each step appears below.

2.1.1. Read Instructions

When performing the installation instructions, do not continue to the next step until you have properly completed the previous step(s).

2.1.2. Unpack Stage

Carefully remove the stage from the protective shipping container. Place the stage on a smooth, flat, and clean surface. This is a simple, yet very important step in maintaining the integrity of the stage. You will notice a label that will include a system part number and serial number. Record these numbers for they contain all the information necessary to maintain or update system hardware and software. Also, find the enclosed customer service information and accuracy certification. If it is obvious that damage occurred during shipping, report it immediately. It is wise to save the shipping container for possible use in the future.

Improper handling of the stage could adversely affect the performance specifications. Therefore, use care when moving the stage. Do not allow the stage to drop onto the mounting surface. Set it down gently.



2.1.3. Prepare Mounting Surface

The mounting surface used with the ART300 series stage should be coplanar within 0.0001 in/in for valid accuracy. For example, if the longest distance between the base hole pattern is 8 inches, then the mounting surface should be coplanar within 0.0008 inches. This can be achieved by scraping or shimming the interface until no rocking occurs beneath the pads of the stage before tightening any of the mounting screws.

2.1.4. Bolt Down Stage

Install and tighten the mounting screws through the mounting holes. See Section 2.2. for outline drawings and dimensions.

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2.2. Stage Dimensions

2.2.1. ART310 Series Stage Dimensions

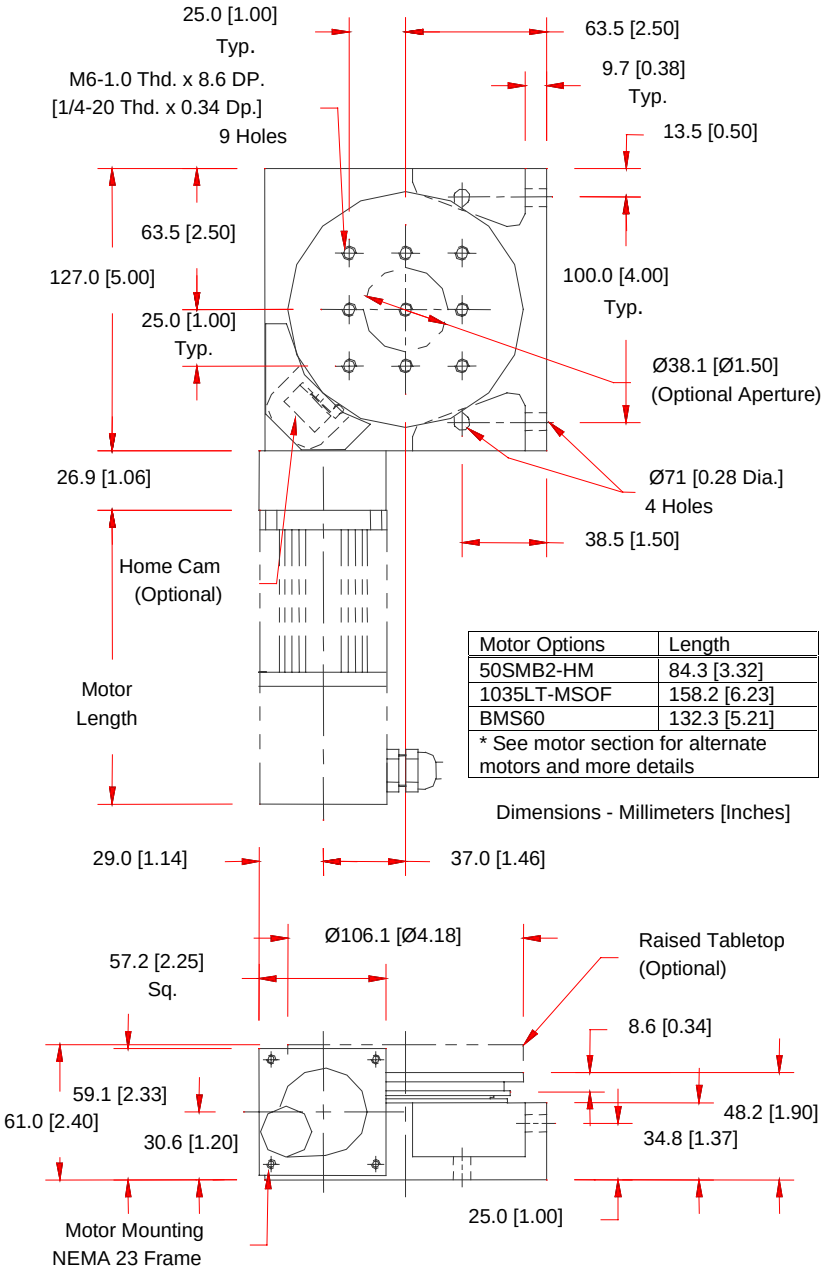
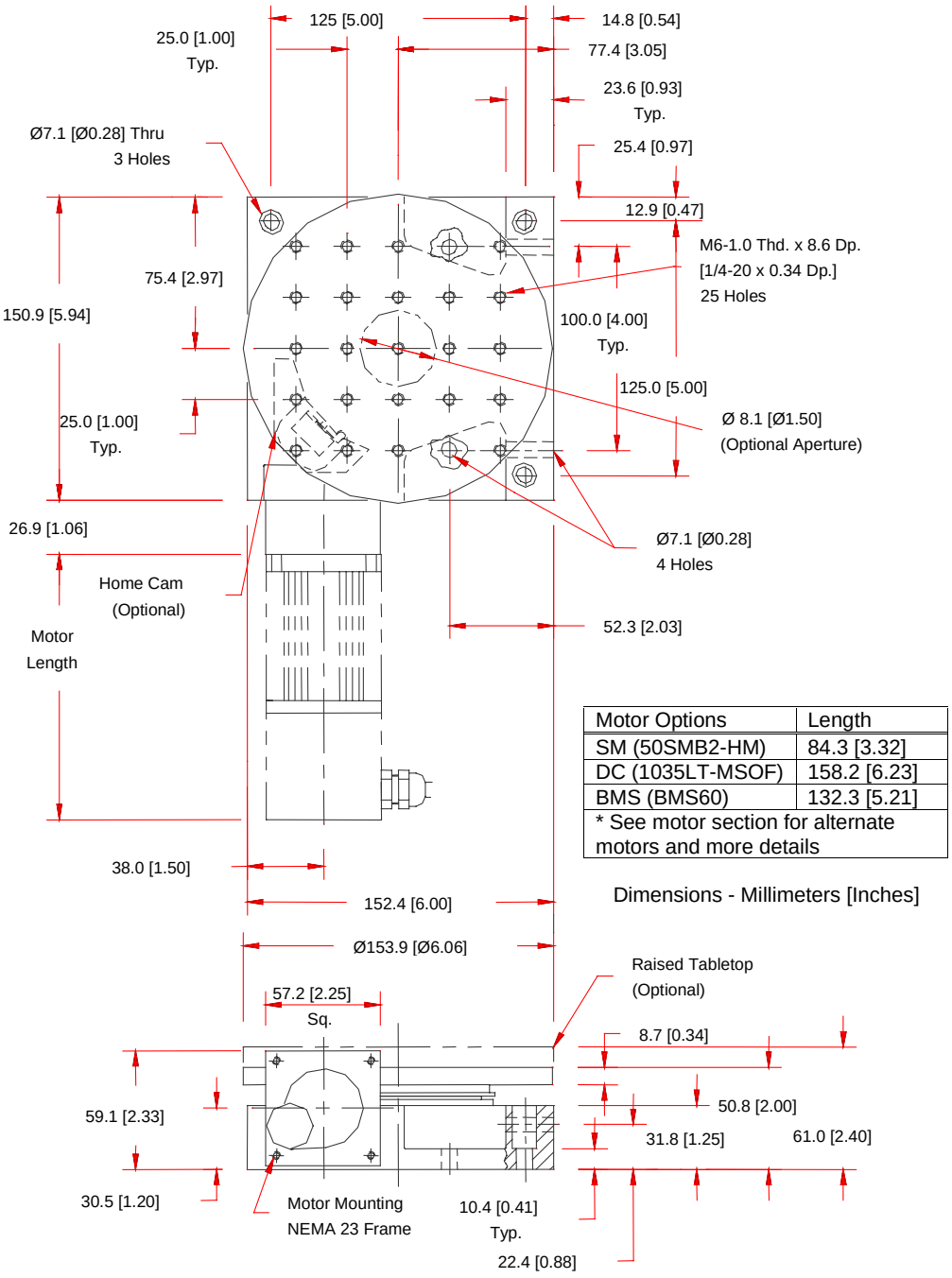


Figure 2-1. ART310 Series Stage Dimensions

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2.2.2. ART315 Series Stage Dimensions



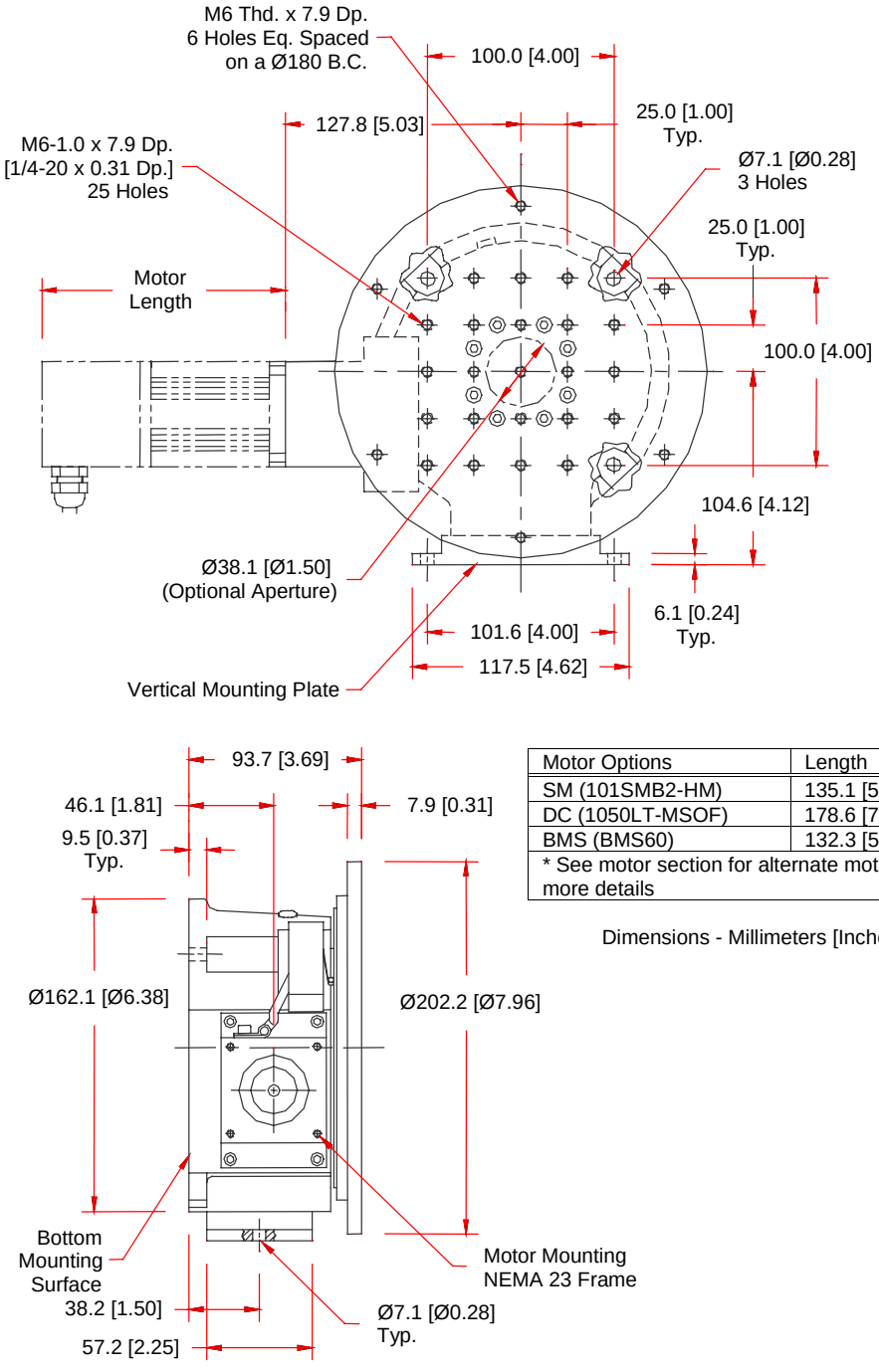
Motor Options	Length
SM (50SMB2-HM)	84.3 [3.32]
DC (1035LT-MSOF)	158.2 [6.23]
BMS (BMS60)	132.3 [5.21]
* See motor section for alternate motors and more details	

Dimensions - Millimeters [Inches]

Figure 2-2. ART315 Series Stage Dimensions

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2.2.3. ART320 Series Stage Dimensions



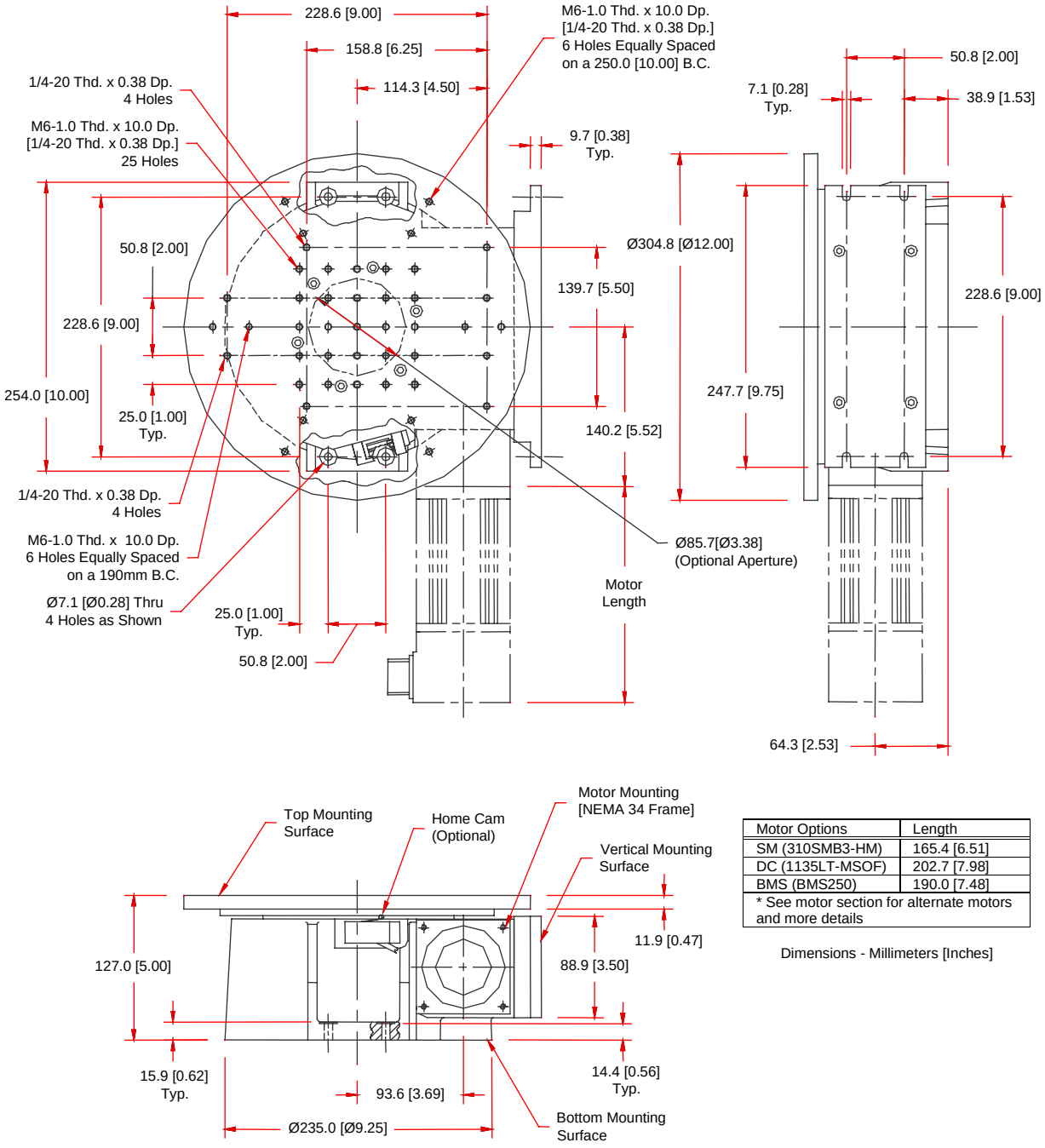
Motor Options	Length
SM (101SMB2-HM)	135.1 [5.32]
DC (1050LT-MSOF)	178.6 [7.03]
BMS (BMS60)	132.3 [5.21]
* See motor section for alternate motors and more details	

Dimensions - Millimeters [Inches]

Figure 2-3. ART320 Series Stage Dimensions

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2.2.4. ART330 Series Stage Dimensions



Motor Options	Length
SM (310SMB3-HM)	165.4 [6.51]
DC (1135LT-MSOF)	202.7 [7.98]
BMS (BMS250)	190.0 [7.48]
* See motor section for alternate motors and more details	

Dimensions - Millimeters [Inches]

Figure 2-4. ART330 Series Stage Dimensions

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CHAPTER 3: APPLICATION NOTES

In This Section:

- Introduction 3-1
- Fastening the Application 3-2
- Life Expectancy and Load Capability.....3-4

3.1. Introduction

When the stage is secure, the motor drive can be installed per the directions in Chapter 5.

After becoming comfortable with the drive electronics, verify that the maximum speed is obtainable without encountering any fault conditions (i.e., loss of steps with the stepper motor assembly). Do this before any delicate payloads are attached. Document all results.

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3.2. Fastening the Application

When fastening the payload to the upper mounting surface, the mounting interface should be coplanar within 0.00001 in/in for valid accuracies. It is recommended that feet or pads be used on the mounting surface to minimize the amount of surface needed to be coplanar.

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3.3. Temperature Effects

The permissible ambient temperature operating range of the stage assembly is 32°F to 140°F (in a non-condensing atmosphere). Due to thermal expansion or contraction, the geometry of the stage will vary slightly with temperature.

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3.4. Life Expectancy and Load Capability

The accuracy specification of ART300 series stages is measured at the center of travel 1.75 inches above the table with the stage in a horizontal position.

It is recommended that application loads be symmetrically distributed (i.e., the payload should be centered on the stage table and the entire stage should be centered on the support structure). If cantilevered loads are to be applied, consult the factory for the load capability.



Be sure to consider dynamic loading when using the stage for high-speed applications (especially with cantilever loading).

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CHAPTER 4: SPECIFICATIONS

In This Section:

- Specifications 4-1
- Motor Information..... 4-2

4.1. Specifications

Table 4-1. ART300 Series Rotary Stage Specifications

Basic Model		ART310	ART315	ART320	ART300
Table Diameter		100 mm (4 in)	150 mm (6 in)	200 mm (8 in)	300 mm (12 in)
Total Travel		360° continuous, both azimuth and elevation			
Drive System		Precision Worm Gear (54:1 motor-to-table ratio standard)		Precision Worm Gear in Oil Bath (108:1 motor-to-table ratio standard)	
Resolution	54:1	6 arc sec @ 4000 steps/rev motor resolution			N/A
	108:1	3 arc sec @ 4,000 steps/rev motor resolution			
	216:1	1.5 arc sec @ 4,000 steps/rev motor resolution			N/A
Maximum Speed	54:1	11 rpm		27 rpm	N/A
	108:1	5.5 rpm		27 rpm	32 rpm
	216:1	2.75 rpm		13.5 rpm	N/A
Accuracy		3 arc min		1.0 arc min	0.5 arc min
Repeatability (Unidirectional)		12 arc sec			6 arc sec
Axis Wobble		20 arc sec		10 arc sec	5 arc sec
Axis Runout (1)	Radial	15.0 µm (600 µin)			
	Axial	3.0 µm (120 µin)		2.0 µm (80 µin)	
Maximum Load	Axial	25.0 kg (55.1 lb)		45.0 kg (99.2 lb)	115.0 kg (253.5 lb)
	Radial	10.0 kg (22.0 lb)		25.0 kg (55.1 lb)	90.0 kg (198.4 lb)
	Output Torque (static)	0.3 kg-m (25 lb-in)		0.7 kg-m (60 lb-in)	4.6 kg-m (400 lb-in)
Nominal Stage Weight	w/o Motor	2.0 kg (4.46 lb)	2.9 kg (6.4 lb)	6.4 kg (14.1 lb)	14.3 kg (31.5 lb)
	w/ Motor	3.1 kg (6.8 lb)	4.0 kg (8.8 lb)	7.5 kg (16.5 lb)	17.9 kg (39.5 lb)
Material	Stage and Table	Aluminum		Stage: Cast aluminum; Table: Aluminum	
Finish	Stage	Black Anodize		Paint: Textured Epoxy (Polane-T); Pebble Gray Color	
	Table	Hard Coating (62 Rockwell Hardness Teflon Impregnated)			

1. Measured 75 mm (3 in) above table; includes wobble and eccentricity components.

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4.2. Motor Information

Table 4-2. ART310 / ART315 Series Standard Motor Information

Code	Type	Model	Bus	Amps	Cable	Driver
-BMS (Default)	Brushless Servo	BMS60-A-D25-E1000H	Up to 160 VDC	up to 1.8 A_{rms} Cont up to 7.3 A_{rms} Peak	BMCHPD/BFCD	U511/DR500/ DR600
					PMCHPD/BFCD	BB501 + BA
					PMCHPD/BFCD	BAI
					BMP2HPD/BFCD	U100Z
-DC	DC Servo	1035LT-MSOF-E1000LD	40 VDC	up to 4.1 A Cont up to 8.2 A Peak	DC-MSO	U511/DR500/ DR600
					BADC-MSO1	BB501 + BA
					BADC-MSO1	BAI
					DCC	U100S
-SM	Microstepping	50SMB2-HM	40 VDC	up to 1 A	SMS-O	U511/DR500/DR600
					SMC	U100M

Table 4-3. ART320 Series Standard Motor Information

Code	Type	Model	Bus	Amps	Cable	Driver
-BMS (Default)	Brushless Servo	BMS60-A-D25-E1000H	Up to 160 VDC	up to 1.8 A_{rms} Cont up to 7.3 A_{rms} Peak	BMCHPD/BFCD	U511/DR500/ DR600
					PMCHPD/BFCD	BB501 + BA
					PMCHPD/BFCD	BAI
					BMP2HPD/BFCD	U100Z
-DC	DC Servo	1050LT-MSOF-E1000LD	40 VDC	up to 5.4 A Cont up to 10.8 A Peak	DC-MSO	U511/DR500/ DR600
					BADC-MSO1	BB501 + BA
					BADC-MSO1	BAI
					DCC	U100S
-SM	Microstepping	101SMB2-HM	40 VDC	up to 5 A	SMS-O	U511/DR500/DR600
					SMC	U100M

Table 4-4. ART330 Series Standard Motor Information

Code	Type	Model	Bus	Amps	Cable	Driver
-BM (Default)	Brushless Servo	BM250E	Up to 320 VDC	up to 7.1 A_{rms} Cont up to 17.8 A_{rms} Peak	BMC2/BFC	U511/DR500/DR600
					PMC/BFC	BB501 + BA
					PMC/BFC	BAI
					BMP2/BFC	U100Z
-DC	DC Servo	1135LT-MSOF-E1000LD	80 VDC	up to 5.5 A Cont up to 11.0 A Peak	DC-MSO	U511/DR500/DR600
					BADC-MSO1	BB501 + BA
					BADC-MSO1	BAI
					DCC	U100S
-SM	Microstepping	310SMB3-HM	80 VDC	up to 6 A	SMS-O	U511/DR500/DR600
					SMC	U100M

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CHAPTER 5: ELECTRICAL

In This Section:

- Introduction 5-1
- Stepping Motor Wiring 5-2

5.1. Introduction

Aerotech ART300 series rotary translation stages can be supplied with a full line of Aerotech positioning and motion controls.

When the ART300series stage is part of an Aerotech system refer to the system manuals and documentation for additional installation and operation information. All systems are adjusted for optimum performance. The end user need only connect the interconnecting cable from the drive chassis to the stage, and apply power.

Never connect or disconnect any electrical component or interconnecting cable while power is applied. Serious damage will result.



WARNING

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5.2. Stepping Motor Wiring

For stages equipped with standard Aerotech stepping motor configurations, please refer to the following Figures.

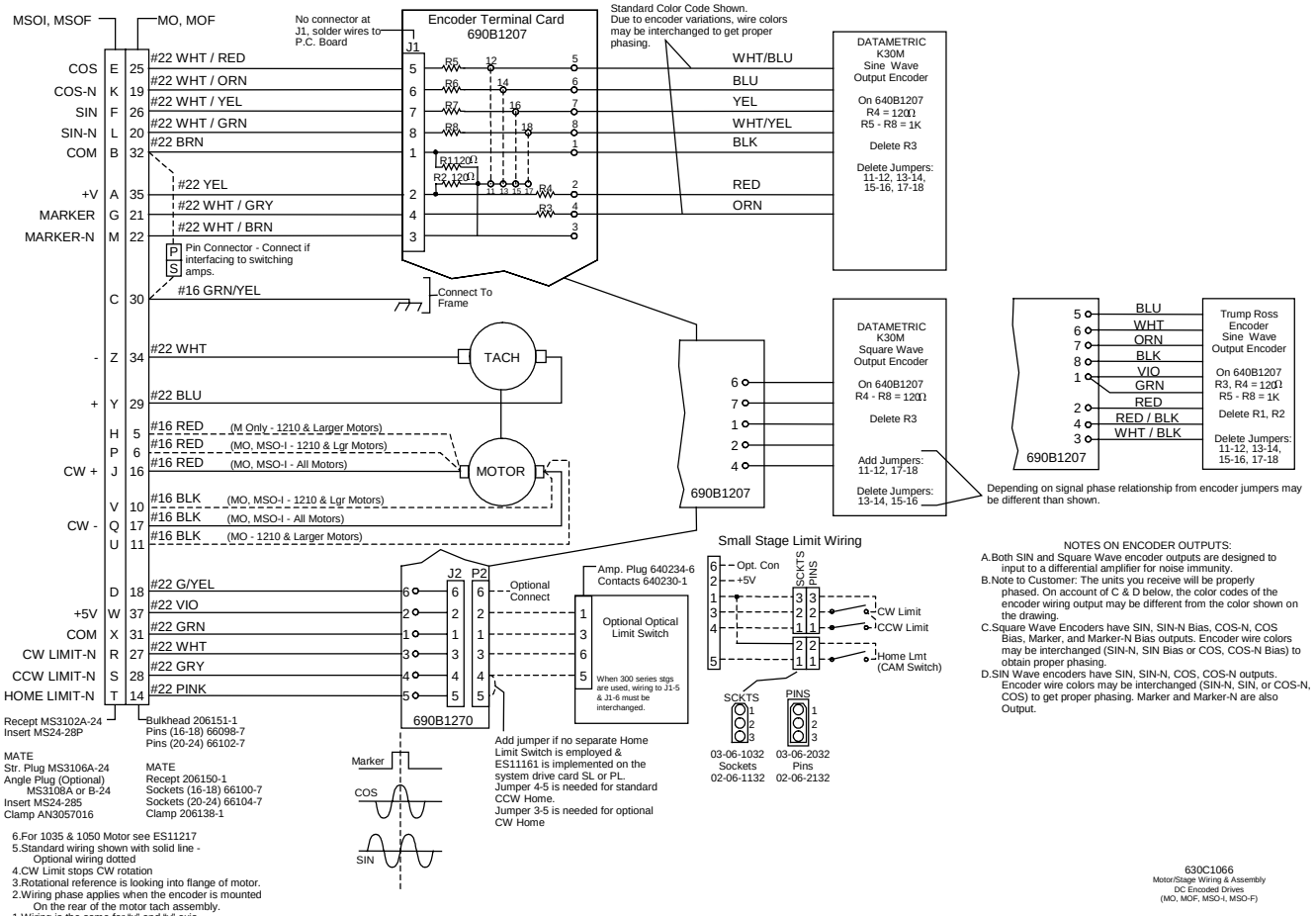


Figure 5-1. Motor/Stage Wiring

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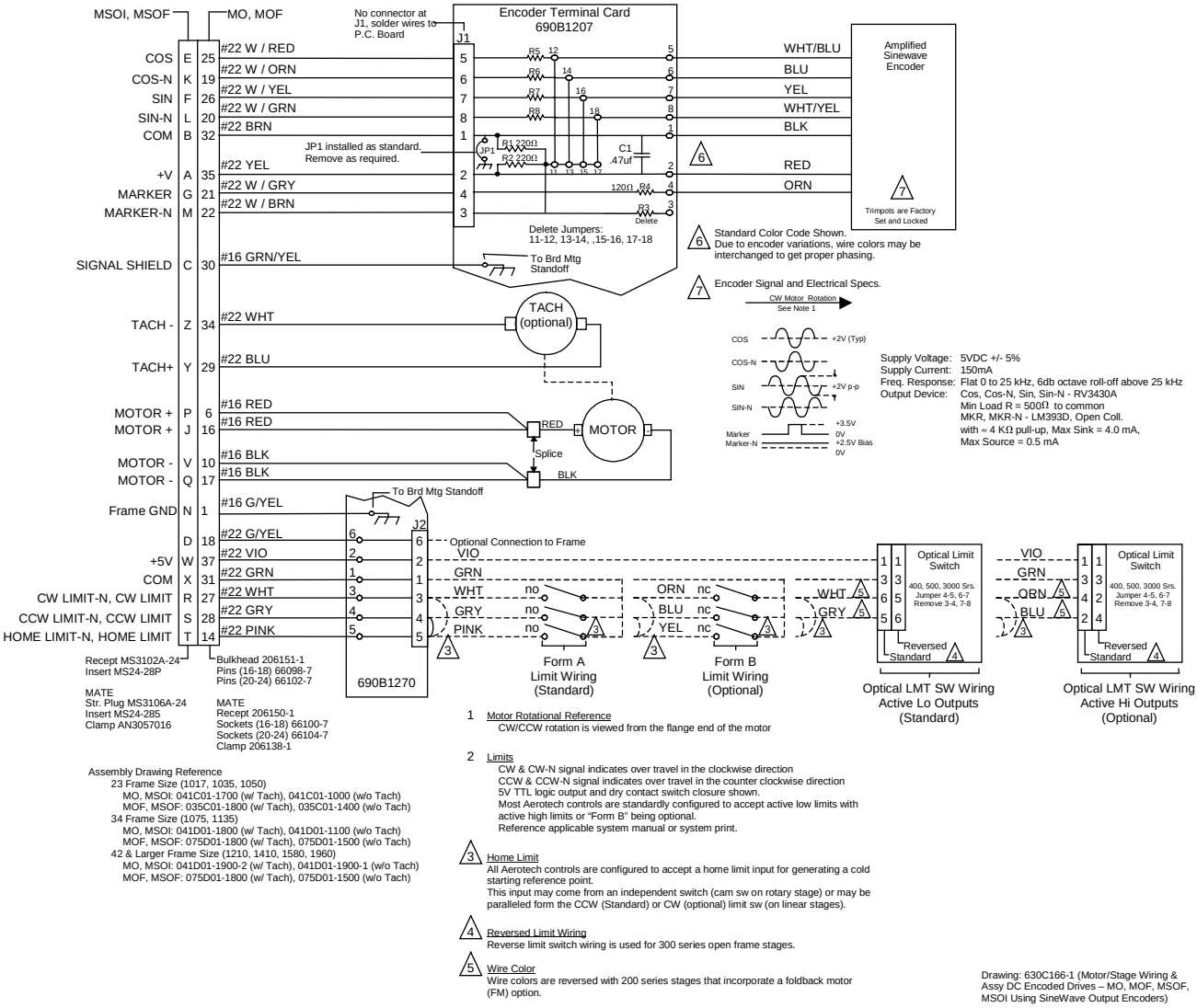


Figure 5-2. Motor/Stage Wiring

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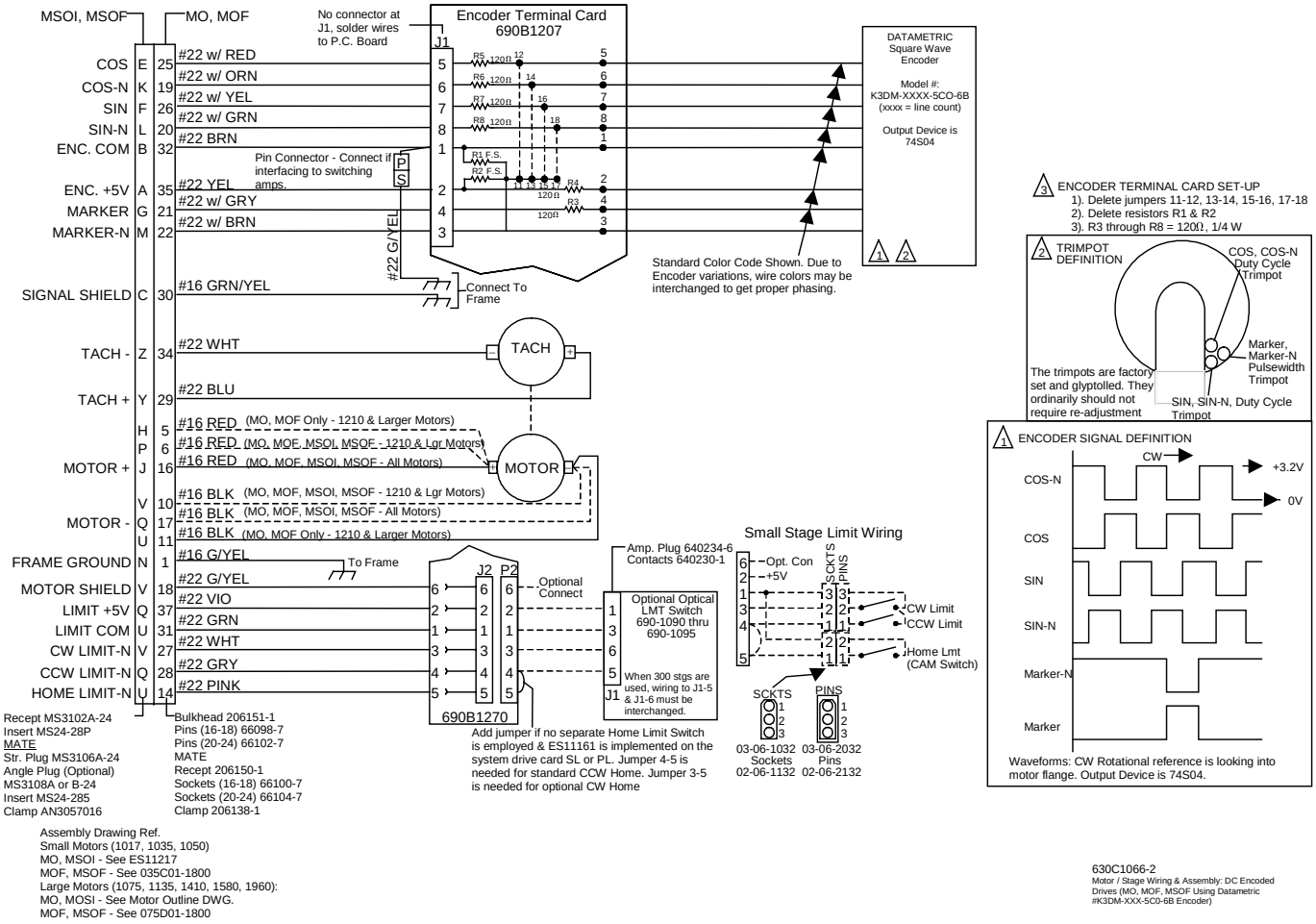


Figure 5-3. Motor/Stage Wiring

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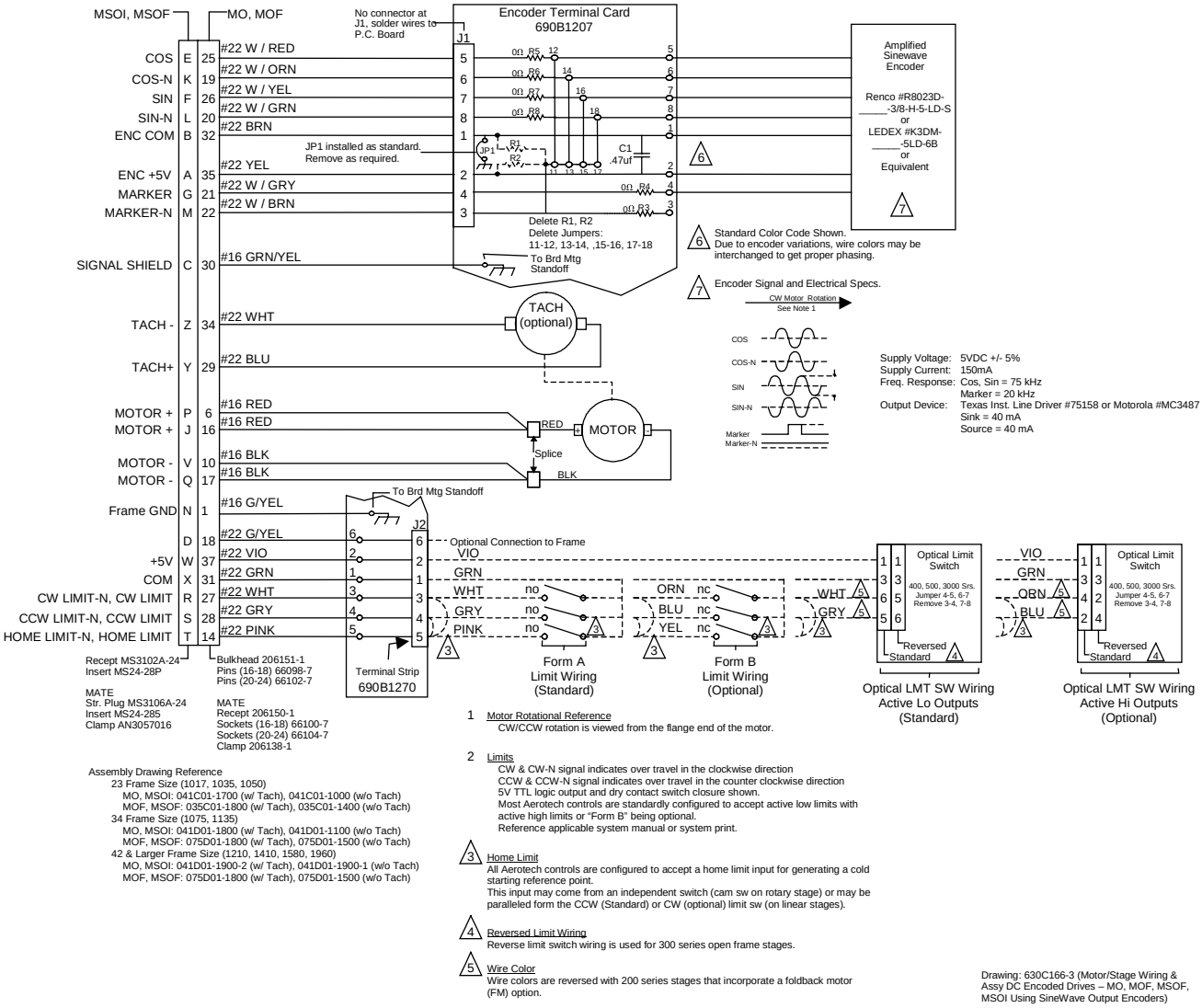
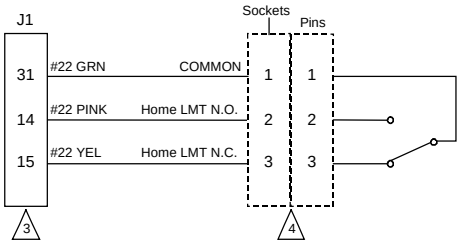


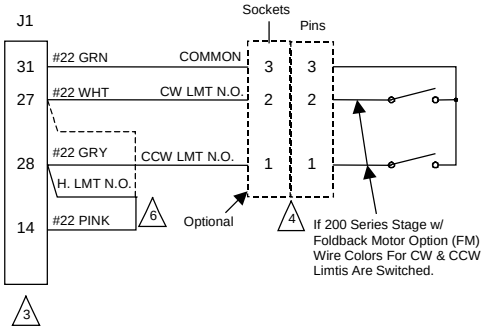
Figure 5-4. Motor/Stage Wiring

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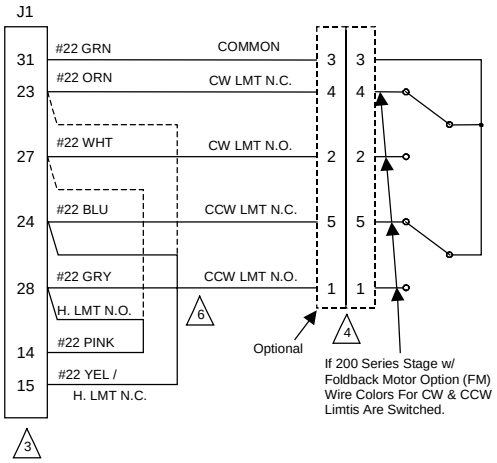
CAM SWITCH or MICRO SWITCH WIRING



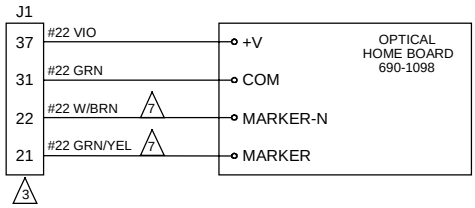
SMALL STAGE LIMIT WIRING (Optional)



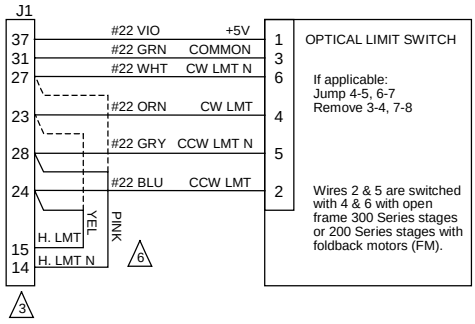
SMALL STAGE LIMIT WIRING (Standard)



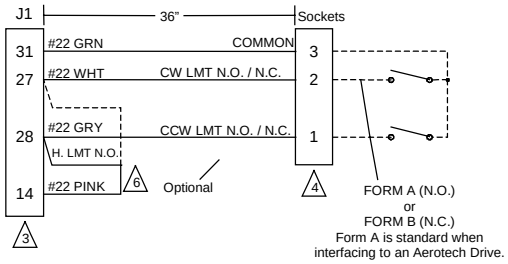
OPTICAL HOME WIRING



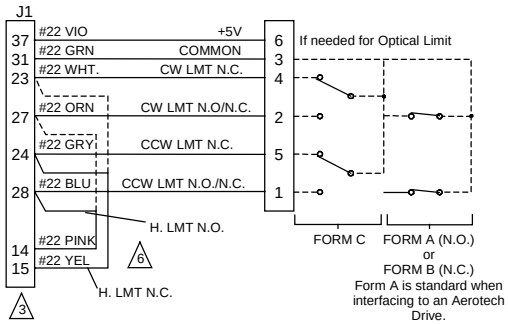
OPTICAL LIMIT WIRING (For stages using optical limit switch)



STEPPING MOTOR LIMIT WIRING (No Stage) (Optional)



STANDARD MOTOR LIMIT WIRING (No Stage) (Standard)

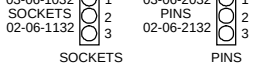


△2 IT IS STANDARD TO TIE THE MOTOR SHIELD CONNECTION TO THE MOTOR FRAME AND LEAVE THE SIGNAL SHIELD CONNECTION FLOATING. THIS PHILOSOPHY MAY BE VARIED AS REQUIRED.

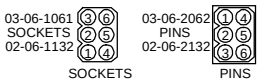
△3 J1 CONSISTS OF THE FOLLOWING:
- A) AMP PLUG #206151-2
- B) AMP EXTENDER #207055-1 (OPTIONAL)
- C) AMP CLAMP #206138-1
- D) AMP #16 PINS #66098-7
- E) AMP #22 PINS #66102-7

MATE TO J1 CONSISTS OF:
- A) AMP RECEPTACLE #206150-1
- B) AMP CLAMP #206138-1
- C) AMP #16 SOCKETS #66100-7
- D) AMP #22 SOCKETS #66104-7

△4 MOLEX CONNECTOR DEFINITION:



△5 MOLEX CONNECTOR DEFINITION:



△6 STANDARD ARRANGEMENT FOR HOME LIMIT WIRING IS TO PARALLEL THE CCW LIMITS. IF CW HOME IS REQUIRED, THE CW LIMITS SHOULD BE WIRED IN PARALLEL INSTEAD.

△7 ON STAGES/MOTORS SHIPPED PRIOR TO 5/20/86: MARKER WENT TO PIN 14, HOME LIMIT WENT TO PIN 21

ROTATIONAL REFERENCE IS LOOKING INTO THE FLANGE OF THE MOTOR. CW LIMIT STOPS CW ROTATION OF THE MOTOR. CCW LIMIT STOPS CCW ROTATION OF THE MOTOR.

Drawing Number:
630C1070 (Part 1)

Figure 5-5. Limit / Home Wiring Options

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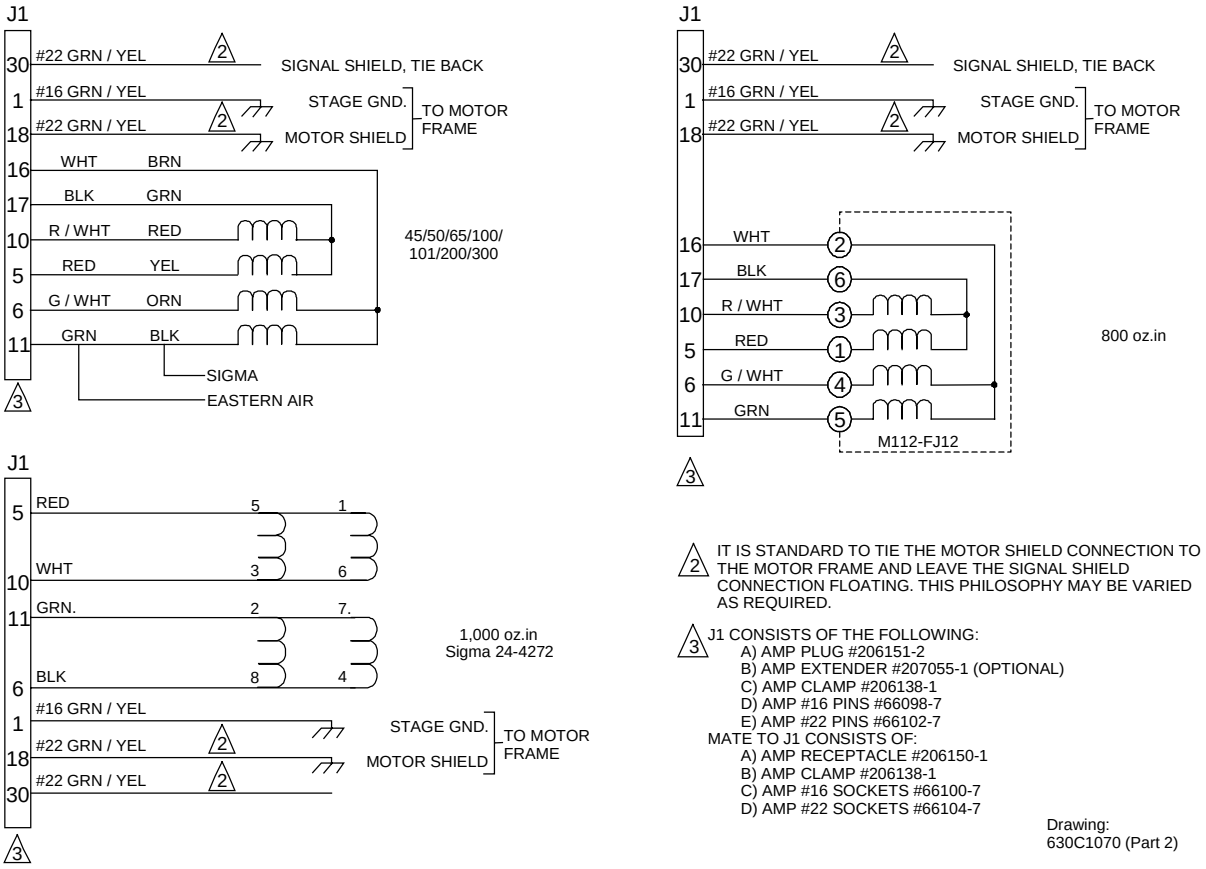


Figure 5-6. Stepping Motor Wiring Options

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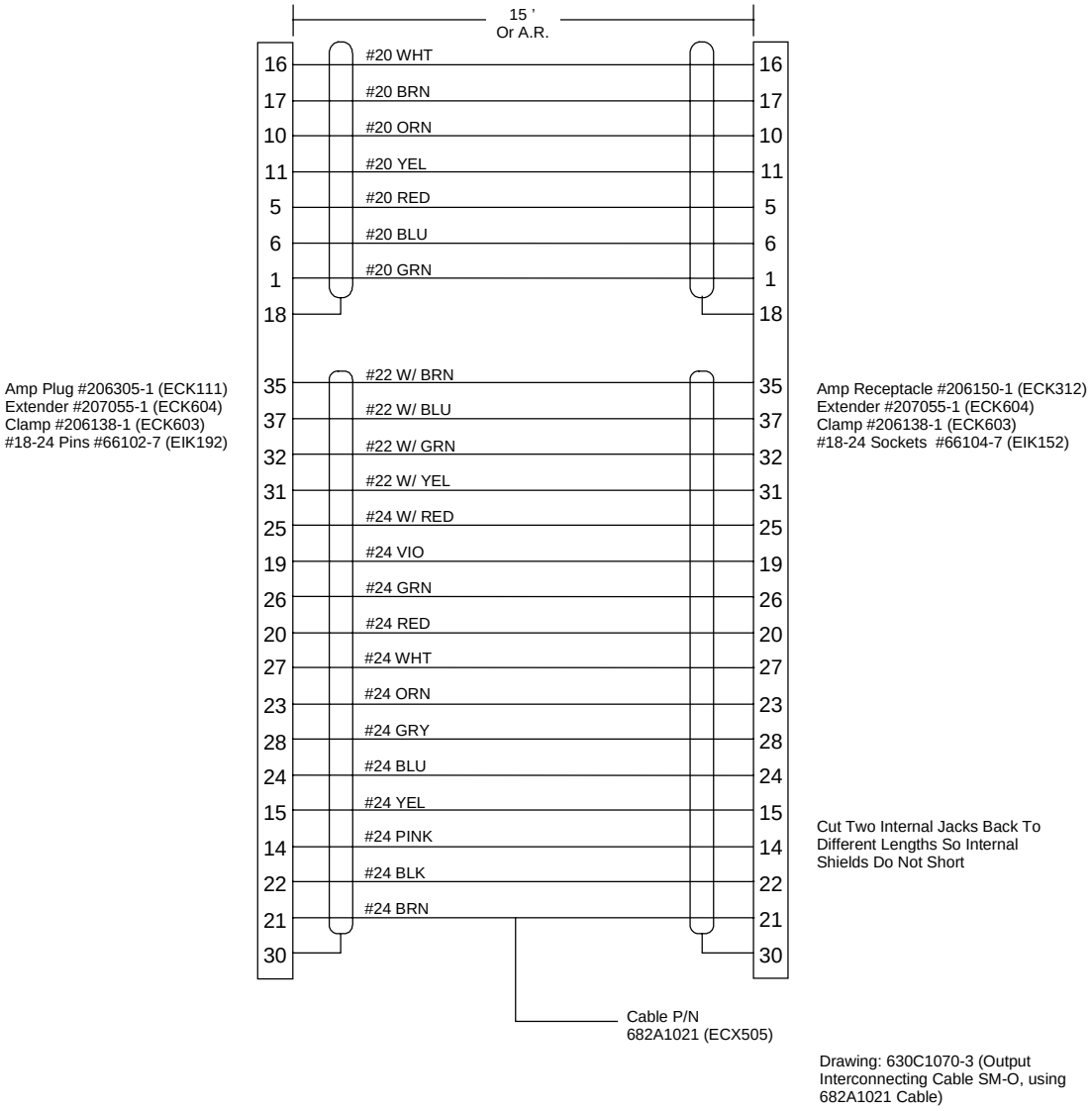


Figure 5-7. Output Interconnecting Cable (SM-O)

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CHAPTER 6: VACUUM OPERATION

In This Section:

- Introduction 6-1
- Prep for Vacuum Operation 6-2

6.1. Introduction

As an option, Aerotech will prepare the ART300 series stage for operation in a vacuum environment.

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6.2. Prep for Vacuum Operation

Meticulous attention to detail during modification, cleaning, and assembly has resulted in a stage with optimal performance in high vacuum applications (10^{-6} torr). Some of the features of this preparation are:

1. Lubrication with vacuum compatible lubricants.
2. Use of only materials with negligible outgassing under vacuum.
3. Elimination of situations that may allow gases to become temporarily trapped during pump-down.
4. Extensively cleaned and baked-out before being specially assembled in a clean environment and packed in a nitrogen filled bag.

To insure that the stage will continue to perform well in vacuum, follow the additional guidelines below:

1. **Handling** - Do not remove the stage from the sealed bag until ready for use. When handling, use teflon gloves in a clean environment to prevent any contaminants from adhering to the stage. When the stage is not in use for an extended duration, place it in a sealed container.
2. **Installation** - Use cleaned, vented, stainless steel fasteners when securing the stage.
3. **Applications** - In a vacuum environment, the lack of conductive heat transfer could result in excessive motor operating temperatures. This coupled with the viscous nature of vacuum compatible greases will make it necessary to derate performance specifications.

To reduce the amount of heat generated for low duty cycle applications, we offer special controllers that reduce the current supplied to the motor when idle. For applications that require additional performance, contact our applications engineers about implementing a cooling system.

4. **Lubrication** - Use only small quantities of Apiezon L grease or a substitute of equivalent quality.

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CHAPTER 7: MAINTENANCE

In This Section:

- Introduction 7-1
- Lubrication Schedule 7-2
- Lubrication and Cleaning Process 7-3
- Important Notes on Lubrication..... 7-4

7.1. Introduction

It is necessary to keep the bearing surfaces properly lubricated, otherwise, friction failure and deformation will occur at the contact areas. This will seriously affect the performance and life of the bearings.

Foreign matter or moisture entering the bearing is unacceptable. This will seriously affect gear set, bearing performance, and the life of the bearings.

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7.2. Lubrication Schedule

The interval for inspection and replenishment of lubricant is dependent on duty cycle, speed, and environment. An interval of one week is recommended for inspection until a trend develops for the application. Longer or shorter intervals of inspection may be required to maintain the film of lubricant on the gear teeth.

The worm end bearings and motor bearings are shielded and should not need to be relubricated. The table support ball bearings are unshielded, although they operate at a low speed, in a protected location and should not need to be relubricated under normal applications.

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7.3. Lubrication and Cleaning Process

The lubrication and cleaning process is outlined in the steps that follow.

1. Turn the power off.
2. Remove the socket head screws securing the motor cover and withdraw the motor.
3. Remove any accumulated dust or debris from the inside of the assembly.
4. Apply a thin continuous film of lubricant to the motor gear set through the access hole in the top of the housing. Rotate the assembly with the indexing knob to cover all of the teeth. A good quality, natural bristle artist's brush makes a good applicator.
5. Apply lubricant in the same manner to worm and worm gear through the access hole in the bottom of the stage with a hypodermic needle.
6. Replace the motor cover.

To minimize the possibility of bodily injury, make certain that all electrical power switches are in the off position prior to making any mechanical adjustments.



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7.4. Important Notes on Lubrication

When cleaning and/or lubricating components of the ART series stages:

1. Be sure to use a clean, dry, soft, lint–free cloth for cleaning.
2. Take the opportunity during the lubrication procedure to inspect the linear motion guides for any damage or signs of wear.
3. Dow Corning – BR2 is recommended as a lubricant
4. Further disassembly of the stage is not recommended because proper assembly and calibration can only be done at the factory. In addition, a laser interferometer is required for post assembly verification to maintain warranties.

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APPENDIX A: WARRANTY AND FIELD SERVICE

In This Section:

- Laser Product Warranty
- Return Products Procedure
- Returned Product Warranty Determination
- Returned Product Non-warranty Determination
- Rush Service
- On-site Warranty Repair
- On-site Non-warranty Repair

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products which are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, where or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability or any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Laser Products

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

Return Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than (30) days after the issuance of a return authorization number will be subject to review.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an air freight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

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Returned Product Non-warranty Determination

After Aerotech's examination, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special service rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-site Non-warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Company Address

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2897
USA

Phone: (412) 963-7470
Fax: (412) 963-7459
TWX: (710) 795-3125

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P/N EDA146, March, 2001

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