

ENTERPRISE

Endload Cartoner

OPERATION / MAINTENANCE PARTS MANUAL

SCHWANS - ATLANTA
HS5160

REPLACEMENT MANUALS CAN BE ORDERED

AT A NOMINAL CHARGE. PURCHASES ORDER MUST INCLUDE
MACHINE MODEL _____ AND SERIAL NUMBER

(AND MANUAL NUMBER (S) IF AVAILABLE).

You can get additional information by contacting
Kliklok-Woodman at the address below:

Kliklok-Woodman

5224 Snapfinger Woods Drive
Decatur, Georgia 30035
E-Mail:service@kliklok-woodman.com
Telephone: 770/981-5200
Fax: 770/987-7160

To Order Spare Parts,

Ask for the Parts Sales Department.

If you want troubleshooting, maintenance,
or other advice, ask for the
Service Department.

Parts Sales are staffed daily
Monday-Thursday from
7 AM until 7 PM eastern time and
Friday 7AM until 5PM.

OPERATION / MAINTENANCE

ELECTRICAL DRAWINGS

REPLACEMENT PARTS

SPARE PARTS LIST

CUSTOM PARTS LIST

SETUP SHEETS

MANUAL

ELECTRICAL

PARTS

SPARES

CUSTOM

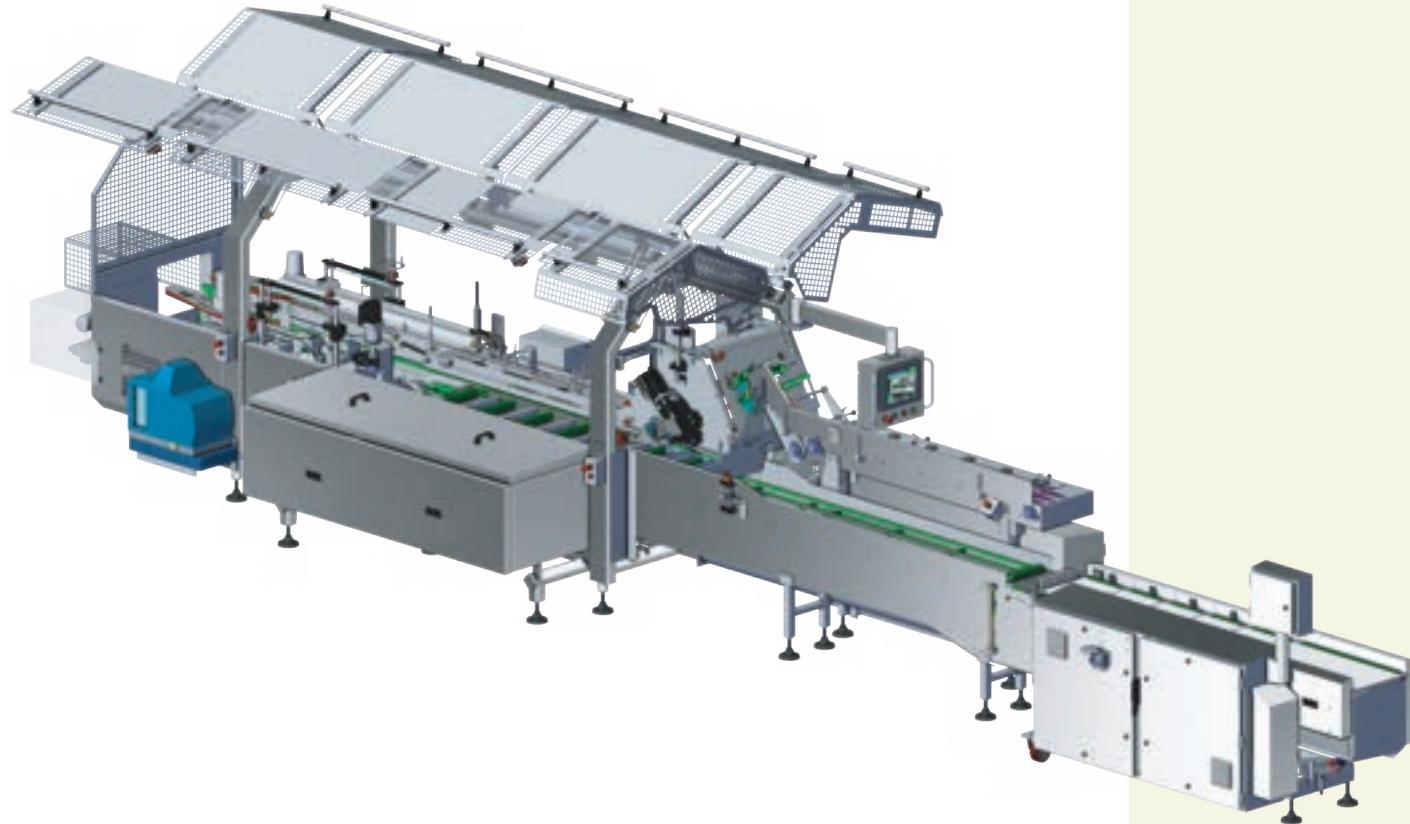
SETUP

SERVICE
BULLETINS

SERVICE BULLETINS

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EXIT



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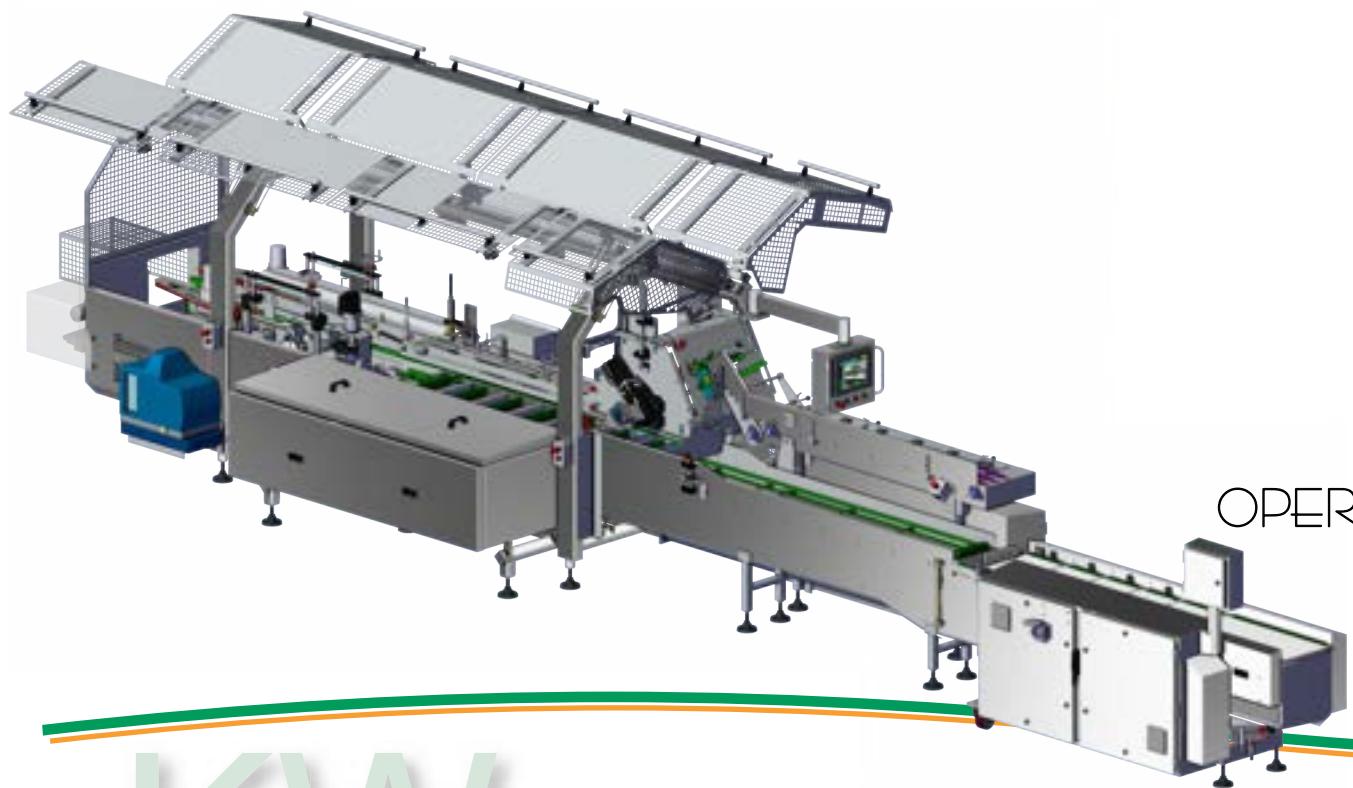
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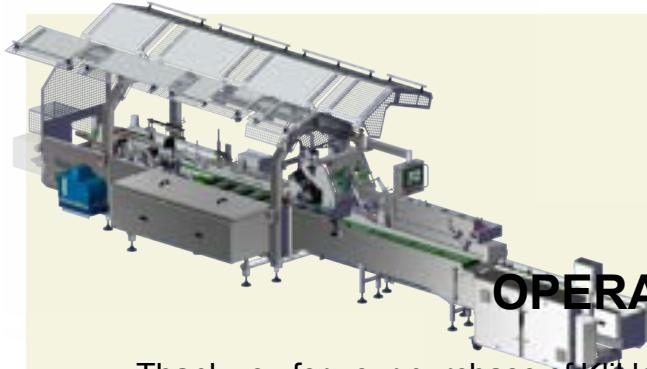
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⚠ WARNING

DO NOT OPERATE OR PERFORM
ANY MAINTENANCE / REPAIRS ON
THIS MACHINE UNLESS YOU HAVE
A FULL UNDERSTANDING OF THE
CONTENTS IN THIS MANUAL



5224 SNAPFINGER WOODS DRIVE, DECATUR GA 30035 USA
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email: publications@kliklokwoodman.com



KLIKLOK
ENTERPRISE
Endload Cartoner

OPERATORS AND MAINTENANCE MANUAL

Thank you for your purchase of Kliklok-Woodman packaging machines. We hope this comprehensive Operators, Maintenance and Parts manual will help you get the best possible performance and reliability from your Enterprise packaging system. Kliklok-Woodman stands behind every machine we make and we are ready to provide any additional assistance you may require.

The operator's sections give step by step procedures on machine operations and set ups. The maintenance sections give brief descriptions of each machine system along with a preventive maintenance schedule and troubleshooting guides.

Should service or assistance in troubleshooting and repair be required, please contact the Kliklok-Woodman Customer Service Department with the following information:

1. Machine Serial Number
2. Software Version

Your machine may differ slightly from those illustrated in this manual due to engineering changes or the addition of optional equipment.

MACHINE SERIAL NUMBERS SOFTWARE VERSIONS

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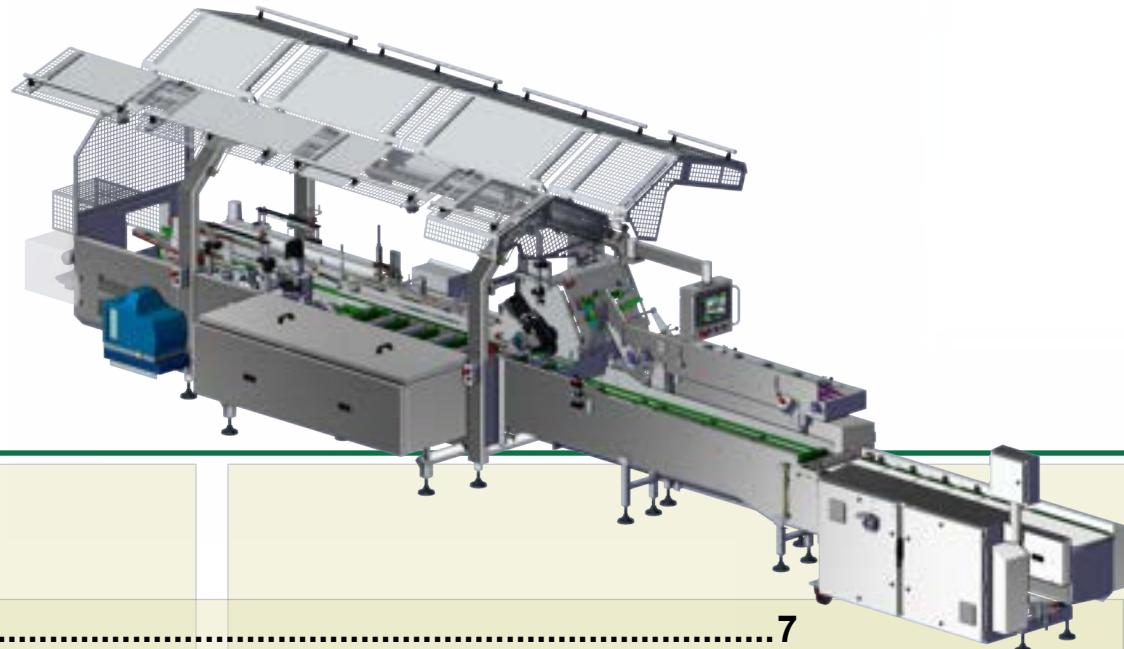


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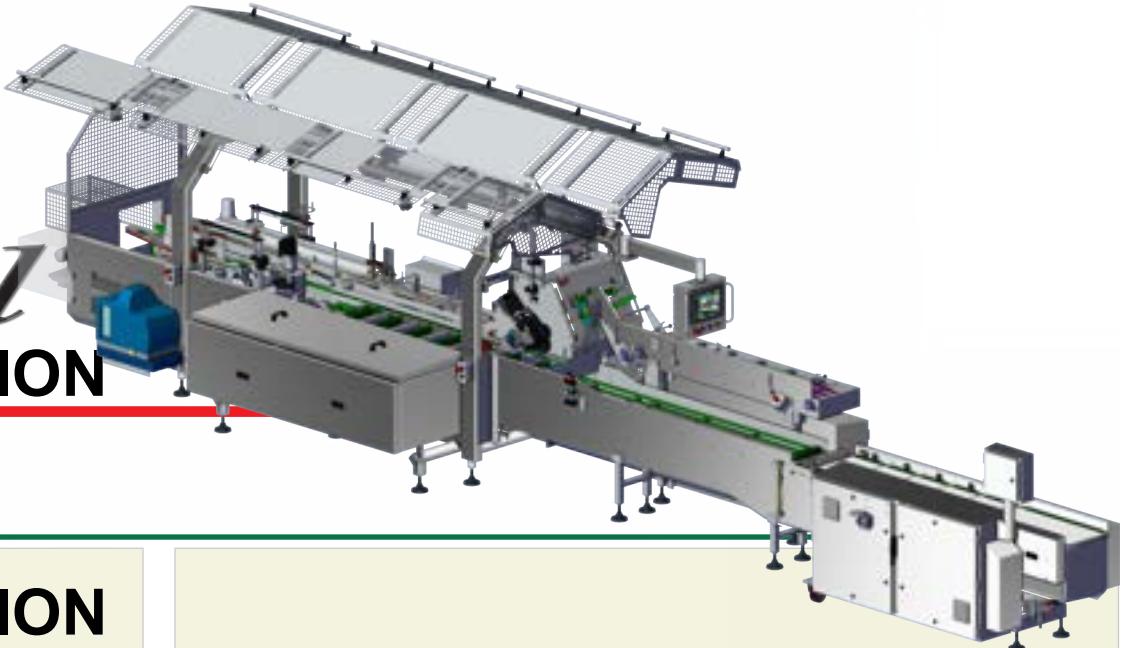
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ENTERPRISE

Endload Cartoner

Operation Maintenance
Manual

1.0 GENERAL INFORMATION



1.0 GENERAL INFORMATION

1.0 INTRODUCTION

Kliklok-Woodman would like to thank you for choosing our product to fill your packaging needs. We can assure you that you have chosen a prestigious product which offers the latest motion control technology and exceptional reliability, which derives from computer aided design and the high quality materials used in its construction.

The Enterprise 12" Cartoner has been designed to meet your specific needs both in terms of yield and versatility.

Please read this manual carefully. It will help you maintain the machine in prime operating condition and will enable you to maximize its production capacity.

1.1 HOW TO USE THIS MANUAL

The following information describes the content and use of each section of this manual.

SECTION 1- INTRODUCTION

This section provides general overview of the layout of information in this manual and Kliklok-Woodman Parts and Service contact information.

SECTION 2- SAFETY

Information about machine and operator safety and Lockout/ Tagout practices. Safety symbols and their meanings are described here as well as installation/reassembly procedure.

SECTION 3- SYSTEM OVERVIEW

This section provides a description of carton process flow, mechanical/ electrical systems, and subsystems descriptions. You will also find machine specifications, machine options, and various system options available.

SECTION 4- OPERATOR INTERFACE

Description of the various screens utilized to operate the Enterprise Cartoner, control button identification, and machine state description.

SECTION 5- OPERATOR INSTRUCTIONS

Controls and procedures such as start/stop, clearing faults, and performing a size change.

SECTION 6- MAINTENANCE

Identification description of maintenance level screens, homing the Enterprise Cartoner, preventative maintenance, lubrication schedules, and troubleshooting.

SECTION 7- PRODUCT SETUP & ADJUSTMENTS

This section displays the product and component parameter lists in detail. This can be used for fine tuning a product and assist in troubleshooting.

1.2 PERSONNEL SKILL LEVEL

Proper operation and production can be achieved provided the personnel who operate, maintain, and repair this machine have the required skills. The following is a brief description of skill level requirements.

1.2.1 OPERATOR SKILL LEVEL

Any persons that are assigned the task of operating this equipment should have a basic knowledge of machine operation and have completed some form of safety training applicable to his/her job description. The operator should also have basic reading and math skills.

1.2.2 MAINTENANCE SKILL LEVEL

Maintenance personnel assigned to this equipment should have successfully completed a certified mechanical apprentice program or have attained the equivalent maintenance experience. Qualified candidates also must have successfully completed any safety programs or policies that are in effect.

1.2.3 REPAIR PERSONNEL

Repairing and troubleshooting areas on the equipment can be divided into two categories: Mechanical and Electrical

1.2.3.1 MECHANICAL REPAIR

Personnel performing mechanical repairs are to have completed a certified mechanical apprentice program or have the equivalent experience and have knowledge of mechanical assembly techniques and common practices. In addition, he/she must have successfully completed any applicable safety programs or procedures.

1.2.3.2 ELECTRICAL REPAIR

Persons performing basic electrical repair and troubleshooting should be qualified in accordance with the requirements stated in the National Electric Safety Code or equivalent rating. In addition, he/she must have successfully completed any applicable safety programs or procedures.

1.3 PARTS AND SERVICE CONTACT INFORMATION

For replacement parts, emergency service, training, or a qualified service engineer, please contact the Kliklok-Woodman Service Desk.



PERFORMANCE

SPEED: Variable to 200 cpm (9" pitch) / 150 cpm (12" pitch)

Actual speed depends upon machine configuration and carton size and style. *Ask KW about meeting higher speed requirements.

CARTON SIZE RANGE

	MIN.	MAX.
Length	2 $\frac{1}{8}$ " (54 mm)	7 $\frac{1}{2}$ " (190 mm) 9" Pitch
Width	1.0" (25 mm)	10 $\frac{3}{8}$ " (264 mm) 12" Pitch
Depth	4 $\frac{1}{2}$ " (114 mm)	3 $\frac{5}{16}$ " (100 mm) 13 $\frac{1}{2}$ " (343 mm)*

*(Mods can add $\frac{5}{8}$ " on a 12" pitch machine)

OPERATING REQUIREMENTS

ELECTRICAL:

460 VAC $\pm 5\%$, 3-Phase with earth ground (PE), 50/60 Hz standard
380–420 VAC, 3-Phase Wye with Neutral and PE, 50/60 Hz available

NORMAL POWER CONSUMPTION: 28 kVA

SERVICE REQUIRED: 40 Amps @ 460 VAC

AIR: 8 cfm (226 L/min) @ 80 psi (5.5 bar)

CONSTRUCTION

Fully welded stainless steel frame. Stainless steel shafts. Clear polycarbonate guards. Chains, pulleys and sprockets are nickel-plated.
Stainless Steel Guards (Optional)
Approximate shipping weight: 8500 lb (3855 kg)

STANDARD FEATURES

- Heavy-duty, fully-welded, stainless steel, angled-surface washdown frame (IP-65 standards)
- Ergonomic design for outstanding operator access
- Modular design for easy custom configuration
- Powered 60" carton hopper
- Patented servo-driven rotary carton feeder
- Independently-servo-driven flight chains
- Barrel-cam product inserter with jam protection
- Digital Proportional Glue Regulator
- Corrosion-resistant nickel-plated chains
- Insight® color touch screen icon-based operator interface
- Allen-Bradley ControlLogix control system
- Sanitary washdown wiring
- Network connectivity and data acquisition
- 1-D servo-driven semi-automatic carton size adjustment
- CE Mark
- OMAC PackML compatible

OPTIONAL FEATURES

- Caustic washdown
- Trailing minor flap kicker
- Open Flap Reject
- Carton graphic recognition system (visual)
- Cluster and central lubrication systems
- Laser-cut "mesh" guarding
- MPF food-grade servo motors
- Aborted Product Conveyor

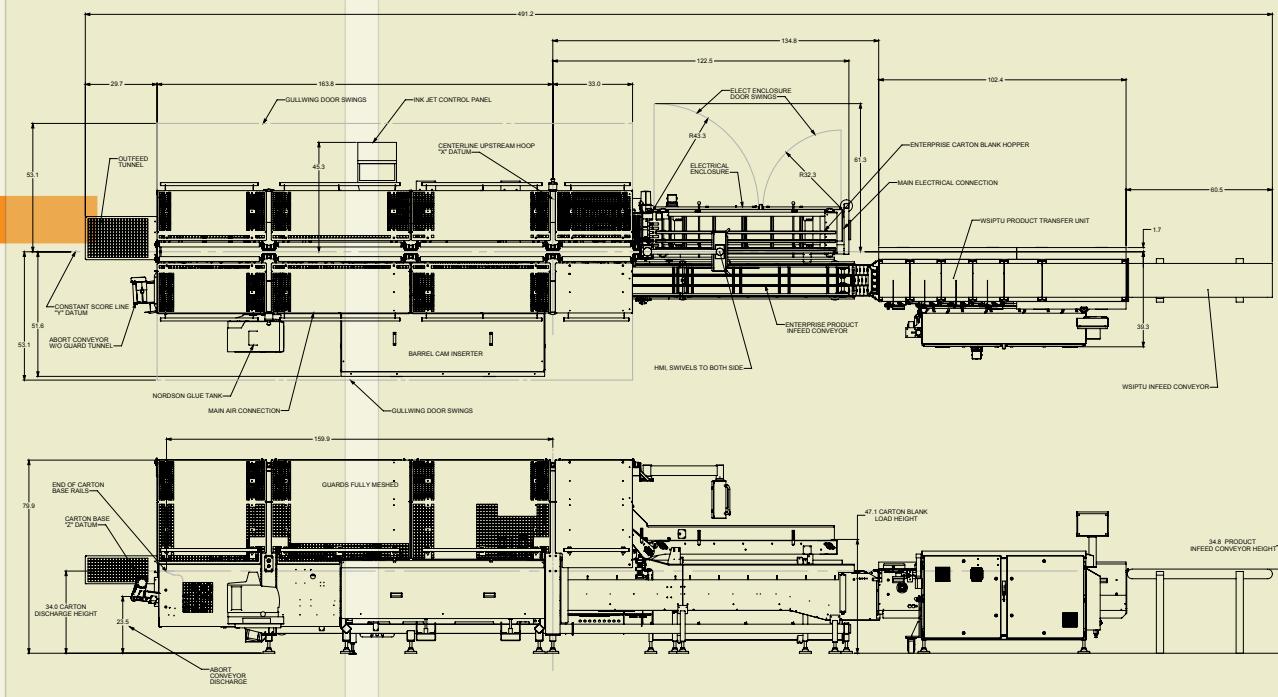


Kliklok-Woodman

Maintains a policy of constant machine improvement. Individual machines, designs and illustrations may vary from this publication, which does not constitute any part of a contract.

As such, it is imperative that you review all information in its entirety. Individual systems may incorporate modifications or added features which are only reflected in attached supplements, drawings or parts lists.

1.4 MACHINE LAYOUT

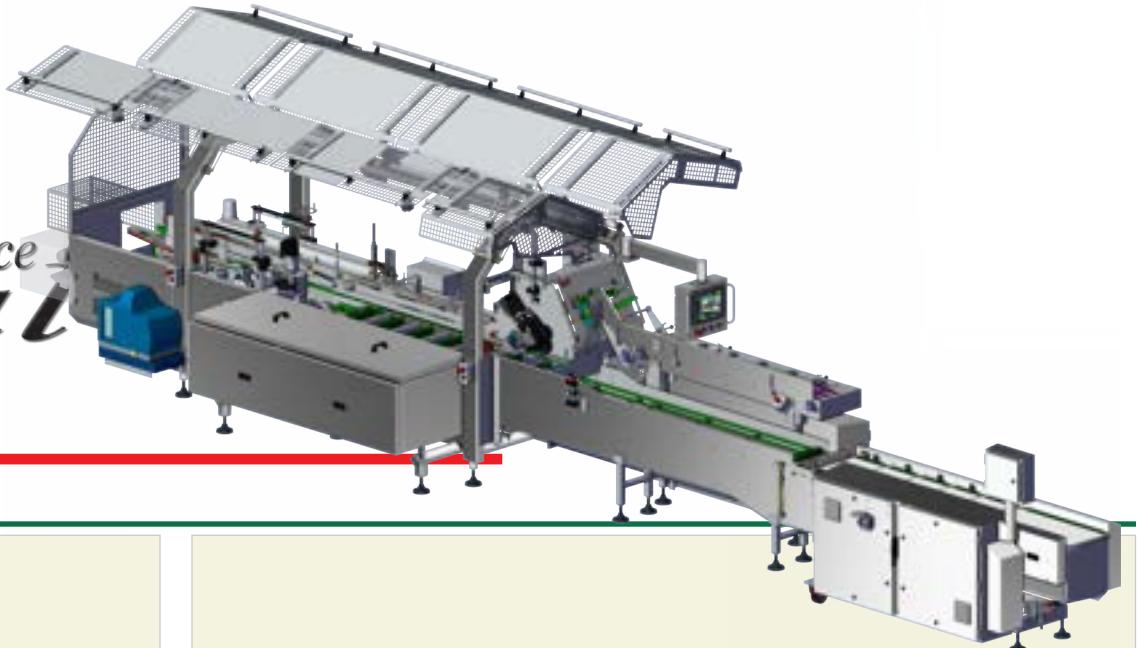


ENTERPRISE

Endload Cartoner

Operation Maintenance Manual

2.0 SAFETY



2.0 SAFETY

This section will describe the various safety standards and general safety practices that should be followed when operating or working on the equipment. Make sure you have a clear understanding of the material in this section before attempting to operate or work on this machine.

2.1 SAFETY STANDARDS

Applicable safety standards are located in the front of your manual. Make sure that all personnel assigned to this equipment read and understand these standards.

2.2 LOCK-OUT/TAG-OUT PROCEDURES

In accordance with the Occupational Safety and Health (OSHA) Bulletin 1910 of the Code of Federal Regulations (CFR), identification of hazardous energy which may be present on this machine and a documented procedure for its removal shall be implemented. Personnel, who are as-

signed to operate, maintain/repair or support the equipment in any way must follow a written safety procedure for locking out hazardous energy sources when any procedures might endanger them or others. This document must describe methods required to disconnect, lock-out, and de-energize any potential energy sources before performing any services necessitating this procedure.

Some potential energy sources that might be present on this equipment are:

- A. Electrical energy
- B. Compressed air for pneumatic devices
- C. Hydraulic energy (gas struts on guarding)



2.3 SAFETY SYMBOLS

Listed below are the safety symbols that are used throughout this manual.



NOTE!! Important Information To Be Aware Of!!



CAUTION!! Describes a process that could damage the machine.



WARNING!!! Risk of Injury or Death!!!



LOCKOUT SYMBOL- When this is at the beginning or next to a procedure, implement lock-out/tag-out procedures before continuing the procedure.



2.3.1 MACHINE SAFETY LABELS



WARNING

Avoid injury.
Do NOT operate with guard removed.
Replace guard before operating machine.



DANGER

Severe Shock Hazard:
Only authorized personnel may service this equipment.
Turn power OFF before entry.



WARNING

Entanglement hazard
Do not operate with guard removed.
Lockout/tagout before servicing.



CAUTION

Hot surface.
Do not touch.
To avoid possible skin burns, disconnect and lockout power and allow surface to cool before servicing.



DANGER

Moving parts can crush and cut.
Keep hands clear while operating machine.



CAUTION

DO NOT OPERATE SERVICE OR ADJUST THIS MACHINE BEFORE RECEIVING PROPER SAFETY AND OPERATING INSTRUCTIONS.
DO NOT PERFORM ANY TYPE OF MAINTENANCE OR CLEAN-UP ON "MACHINE" BEFORE DISCONNECTING ELECTRICAL POWER AND AIR SUPPLY.
DO NOT CLIMB ON OR UNDER, REACH IN OR LEAN AGAINST MACHINE OR PACKAGING LINE WHILE IT IS RUNNING.
DO NOT ATTEMPT TO RETRIEVE OR REMOVE CARTONS, PRODUCT OR ANY OBJECT FROM MACHINE WHILE IT IS RUNNING.
DO NOT START MACHINE UNTIL ALL GUARDS ARE IN PLACE AND ALL ATTENDANTS ARE ALERTED AND SEEN TO BE CLEAR.
DO NOT WEAR JEWELRY OR LOOSE CLOTHING. ALWAYS WEAR PROPER EYE, HAIR AND HEAD PROTECTION.
KEEP CLEAR AT ALL TIMES WHEN MACHINE HAS AUTOMATIC START.
USE CAUTION WHEN ADJUSTING ADHESIVE TO HOT MELT POTS, ADJUSTING APPlicATORS OR ATTENDING HEATED ELEMENTS.

These safety instructions are an extension of the machine operating manual.



WARNING

Any electrical wiring or other hardware modifications altering the electrical system provided with this equipment may impair important safety features, cause operational problems, or both.

Before altering this equipment in any way, please refer carefully to the equipment manual to ensure that neither control nor safety features will be compromised or defeated.

Additionally, contact Kliklok/Woodman Engineering for consultation and approval before attempting to interface with, or modify, the electrical system of this machine.

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WARNING

Hazardous voltage.
Follow lockout procedure before servicing.

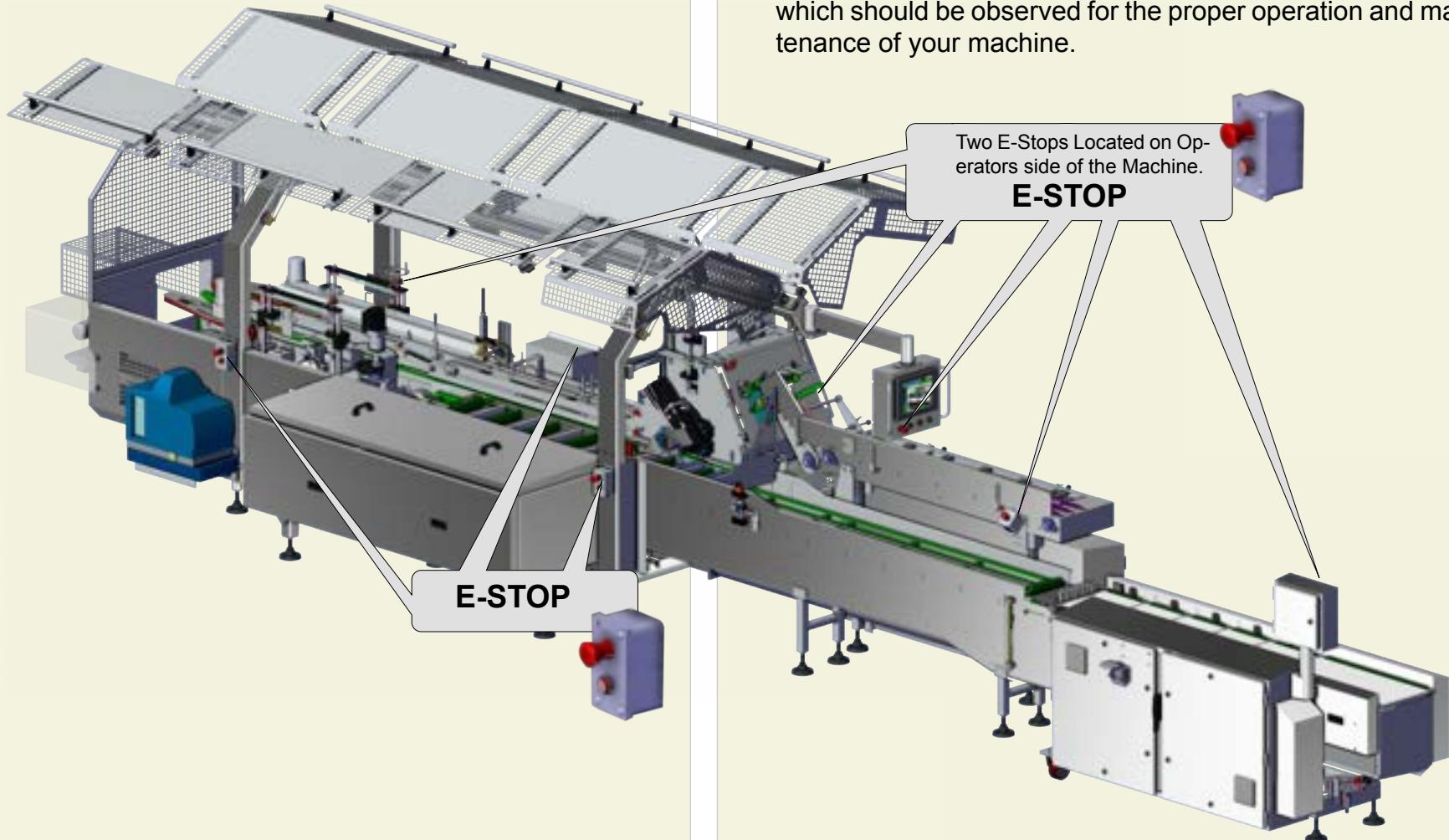


WARNING

Hydraulic, pneumatic and electric power sources present.
Lockout ALL energy sources before servicing.

2.4 LOCATION OF EMERGENCY STOP BUTTONS

There are six (6) Emergency stop Push Buttons located on the Enterprise Cartoner. One on each of the four (4) corners of the machine, one on the HMI control panel and one just over the PIC Infeed to the machine.



2.5 SAFETY GUIDELINES FOR PERSONNEL

The Enterprise Cartoner was designed for safe operation. Carelessness or inattention to safety guidelines could result in accidental injury and/or damage to the machine or components.

The following sections cover important safety precautions which should be observed for the proper operation and maintenance of your machine.

2.5.1 OPERATOR / ATTENDANT SAFETY

1. All personnel know the location of all emergency stop push buttons. All personnel must be trained in the procedure for using these emergency stop push buttons. This will include any and all used to control ancillary equipment on the line.
2. Keep arms and hands clear of moving parts at all times.
3. Do not start the machine if there are any damaged or missing parts.
4. Do not start the machine unless all guards and covers are in place and securely fastened.
5. Never reach around or crawl under any safety guards or guard doors. This includes any that might be attached to other equipment.
6. Remove any tools/obstructions/product jams from the machine prior to start-up.
7. Do not operate machinery with known defective or bypassed safety interlocks.
8. Before starting, restarting, or applying electrical power or compressed air to the machine:
 - A. Make a visual observation that all personnel are clear of moving components.
 - B. Make an audible warning to all personnel in the vicinity of the machine before pressing the START button.

9. Prior to clearing a jam, making some minor adjustments, or performing a size change press the nearest emergency stop push button.
10. Make sure heated components have cooled to a safe temperature before making adjustments to them (i.e. glue guns, heated hoses, etc...)
11. Observe plant safety rules concerning clothing, jewelry, etc. Do not wear any loose clothing that could become entangled within the machine.
12. Never climb, lean, or step on the machine. Serious injury could result.
13. Follow all safety guidelines set in place by your employer.

2.5.2 MAINTENANCE PERSONNEL SAFETY GUIDELINES

Due to the job requirements of maintenance and repair personnel, there are a few additional guidelines that must be adhered to.

1. Follow all safety guidelines, when applicable, from Operator & Attendant Safety Guidelines (section 2.5.1).
2. When performing a task that requires intrusion beyond safety features or barrier guarding, perform the LOCK/OUT/TAG/OUT procedure to remove any harmful energy sources.

3. Replace any broken or defective safety devices. Failure to do so voids machine warranty(s) and injuries and/or damage to the equipment becomes the responsibility of the user.
4. Use only approved Kliklok-Woodman replacement parts when replacing damaged or worn components. Failure to do so voids all expressed warranty(s) and damage to the machine and/or injuries to personnel caused either directly or indirectly from using non-approved components is the responsibility of the user.
5. When replacing fuses, circuit breakers, overloads, or any other circuit protection components, replace only with components of the same rating.

2.6 MACHINE GUARDS AND SAFETY SWITCHES

The operators and attendants are protected from contact with the moving parts of the machine by barrier guarding. This machine is equipped with stainless steel guards on the lower half of the machine and gull wing doors on the upper half of the machine.

All doors are interlocked with the machine control for safety. If any door is opened during production, the machine will stop and air pressure for all pneumatic systems will be released.



⚠ WARNING

NEVER REACH AROUND OR CRAWL UNDER SAFETY DOORS OR GUARDS. DISREGARDING THE SAFETY ASPECTS OF MACHINE GUARDS MAY RESULT IN SERIOUS PERSONAL INJURIES.

SAFETY INTERLOCK SWITCHES ARE NOT TO BE TAMPERED WITH OR BYPASSED. KLIKLOK-WOODMAN NEVER ALLOWS GUARD DOORS OR SAFETY SWITCHES TO BE BYPASSED.

The correct operation of these switches is required at all times to provide the proper guarding. An interlock switch that is not functioning properly should be reported to a supervisor immediately and the machine should be shut down until the switch is repaired or replaced.

2.6.1 MAIN ELECTRICAL DISCONNECT

The electrical cabinet of the machine is equipped with an Electrical Disconnect Switch. This switch is linked to the main circuit breaker inside the cabinet which connects or disconnects the factory supplied power to the machine.

⚠ CAUTION

CAUTION! Be aware that the Electrical Disconnect Switch only removes power AFTER the switch; all incoming power cables will still be live.

During maintenance, services, or repair operations, always use the appropriate Lockout/Tag-out procedure accepted in your plant.

2.7 INSTALLATION SAFETY

The following are important safety guidelines and information for the authorized installer of the equipment.

2.7.1 GENERAL INSTALLATION INFORMATION

1. Operating & Maintenance Manual must be read and understood by installation personnel.
2. Verify all drawing and floor plans are current and correct and that all utility supplies match the requirements of the machine's specifications.
3. Whenever possible, complete all overhead work (conveying systems, conduit, etc...) before placing the machine in line. Minimize construction work over the machine.
4. Do not connect machine to any utility supply unless all welding or other types of electrical arc producing equipment is on an isolated circuit different than the machine's supply line.
5. Make no modifications to the guarding, electrical system devices, or programming unless you have written authorization from Kliklok-Woodman's Engineering Department.

2.7.2 PERSONNEL REQUIREMENTS

1. Make sure personnel who will be installing or testing installed equipment are properly trained and have read the Operation & Maintenance Manual.
2. Only qualified personnel are to be used when connecting electrical supplies.
3. If safety interlocks must be temporarily removed for installation, qualified personnel must note the action and make sure the interlocks are reinstalled and in good working order prior to powering up the machine.

2.8 INSTALLATION

2.8.1 RECEIVING & UNPACKING THE MACHINE

The machine will arrive at your facility mounted to a wooden shipping skid and may be enclosed within a shipping crate. Personnel responsible for unpacking the machine should use caution to avoid damaging the machine or misplacing any loose items that may accompany the machine.

Listed are the steps to observe when unpacking the Enterprise Cartoner.

1. Make sure all motor leads, wires, and air lines are free of obstructions before removing the machine from its shipping skid.
2. Remove all packing straps and tie downs.

3. Collect all loose items contained within the shipping crate (leveling bolts or casters, machine manuals, etc...)
4. Unpack hot melt applicator.
5. Make a thorough visual inspection of the machine and all the components. You must note any damage at this time BEFORE removing the machine from the shipping skid. Report any discrepancies to the shipping company and to Kliklok-Woodman Service Department.

2.8.2 MOVING THE MACHINE

After the unpacking steps are complete, the machine is ready to be moved into position.

During this installation process, be sure to obey all safety instructions outlined in this manual.

1. This process may require two forklift trucks.
2. A firm, level foundation should be provided for the machine.
3. Adjust the forks as wide as possible.
4. Move the main section to the required position, using a forklift truck with sufficient lifting capacity. Study the machine lifting points to ascertain its center of gravity.
5. From the non-load side of the machine, insert the forks of the truck underneath the machine frame and lift the machine.
6. Locate the machine so that the center of the carton out-feed is in line with any downstream equipment.



2.8.3 LEVELING THE MACHINE

The Enterprise Cartoner is equipped with several adjustable feet to aid in leveling the equipment. The product infeed Conveyor has leveling feet and the Electrical Enclosure has leveling feet for aiding in leveling the machine.

During this leveling process, be sure to obey all safety instructions outlined in this manual.

1. The Enterprise Cartoner is equipped with eight (8) adjustable feet to aid in leveling the equipment. The Product Infeed Conveyor has an additional eight (8) feet conveyor extension.
2. Adjust the machine feet until the machine is just below the required height.
3. Adjust the feet at the in-feed and the out-feed ends of the machine to level.
4. Check the level in two directions at right angles, at or near each corner and at one intermediate point on each side of the machine.
5. When the machine is level, check that the Product Inserter is level.



NOTE: For proper machine operation the Inserter Chain Rails MUST sit 190 thousandths of an inch higher than the Carton Rails.

6. When satisfied, adjust the remaining mounting feet to rest firmly on the floor.
7. Re-check the machine and tighten the lock nuts on the mounting feet.

2.8.4 REASSEMBLY

This machine has been strengthened so that it can be moved in and out of position very quickly.

Raise the leveling feet so the wheels are touching the floor. Un-lock the wheels, disconnect the power to the machine by the quick dis-connect and push the machine to the required location. CAUTION: This machine is very heavy care must be used when moving it around.

CAUTION

BEFORE REASSEMBLY, SECTION 2, SAFETY AND SECTION 5, OPERATION, MUST BE READ AND UNDERSTOOD.

2.8.5 REMOVING THE SHIPPING TIE BAR

The SHIPPING TIE BAR is utilized to support the electrical cabinet and powered carton hopper during transport.

Prior to removing the Shipping Tie Bar it is imperative that the machine be positioned, leveled, and that all feet be securely positioned on the floor.

To remove the Shipping Tie Bar:

1. Utilizing a suitable wrench locate and remove the mounting hardware attaching the Tie Bar to the machine.
2. With assistance, remove the Tie Bar from its mounting location.

NOTE:

Retain the Shipping Tie Bar for any future movement of the machine using a forklift, failure to utilize the Tie Bar during machine movement can cause machine damage.

2.8.6 INSTALLING THE PRODUCT INFEED CONVEYOR (P.I.C.)

1. When the Enterprise Cartoner is correctly positioned and leveled, fit Product Infeed Conveyor, and any additional conveyors / equipment.
2. Check that the center lines of extensions are accurately aligned with the center line of the integral infeed conveyor within the main machine
3. Level the extensions by adjusting the support legs. Extensions must be level with integral length of the conveyor.
4. Align the infeed conveyor and connect using the supplied fixing bolts, inserted through the splice plates.

5. Reassemble the P.I.C. chain by joining the sections together with the supplied chain master links (pins). Be sure to install any master links so that the retaining clips face the direction of chain travel.
6. Tension the chain assembly by adjusting the two jacking shafts located at the tail end of the conveyor.
7. Complete the wiring to the product sensors.
8. Fit all remaining guard panels.

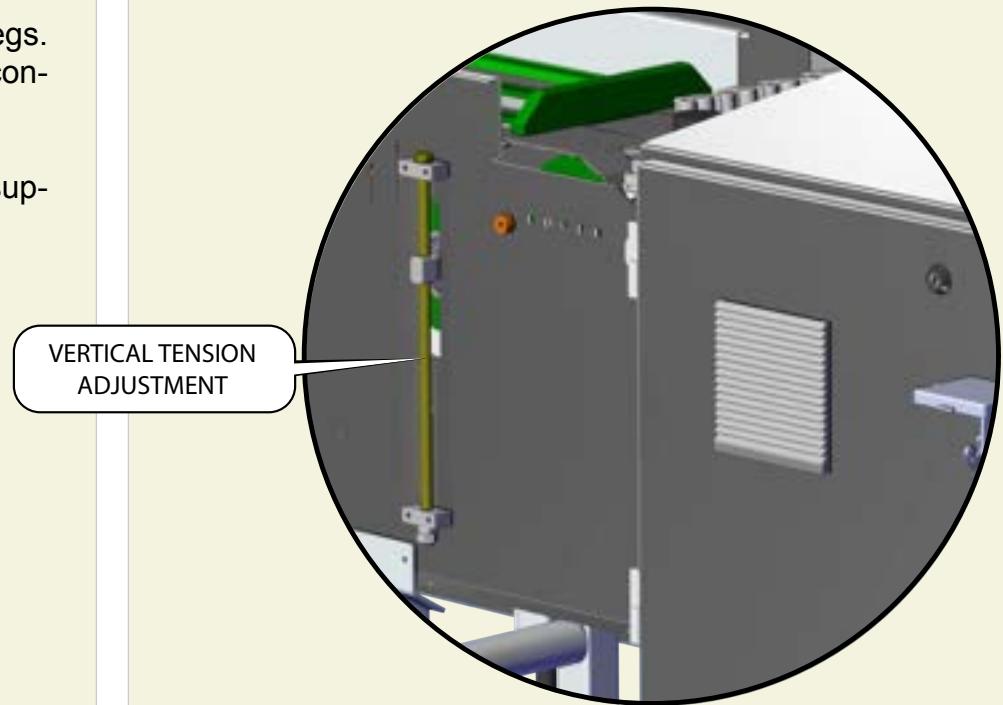


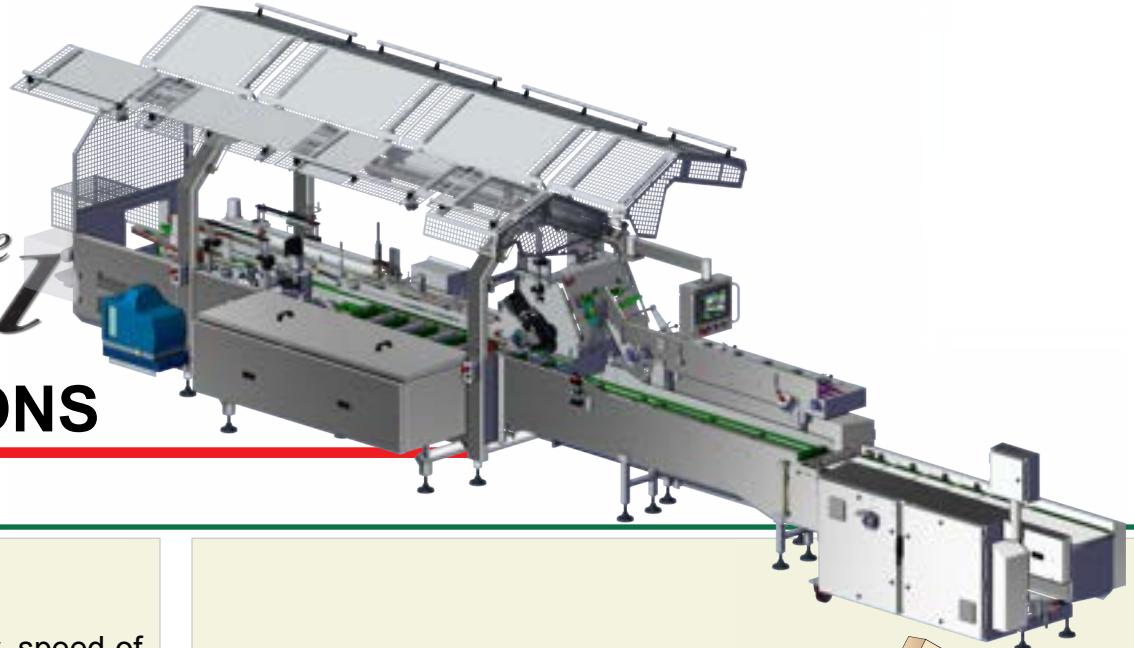
FIGURE 2.8.6
Tensioning Chain Adjustment Assembly

ENTERPRISE

Endload Cartoner

Operation Maintenance Manual

3.0 PARTS AND FUNCTIONS



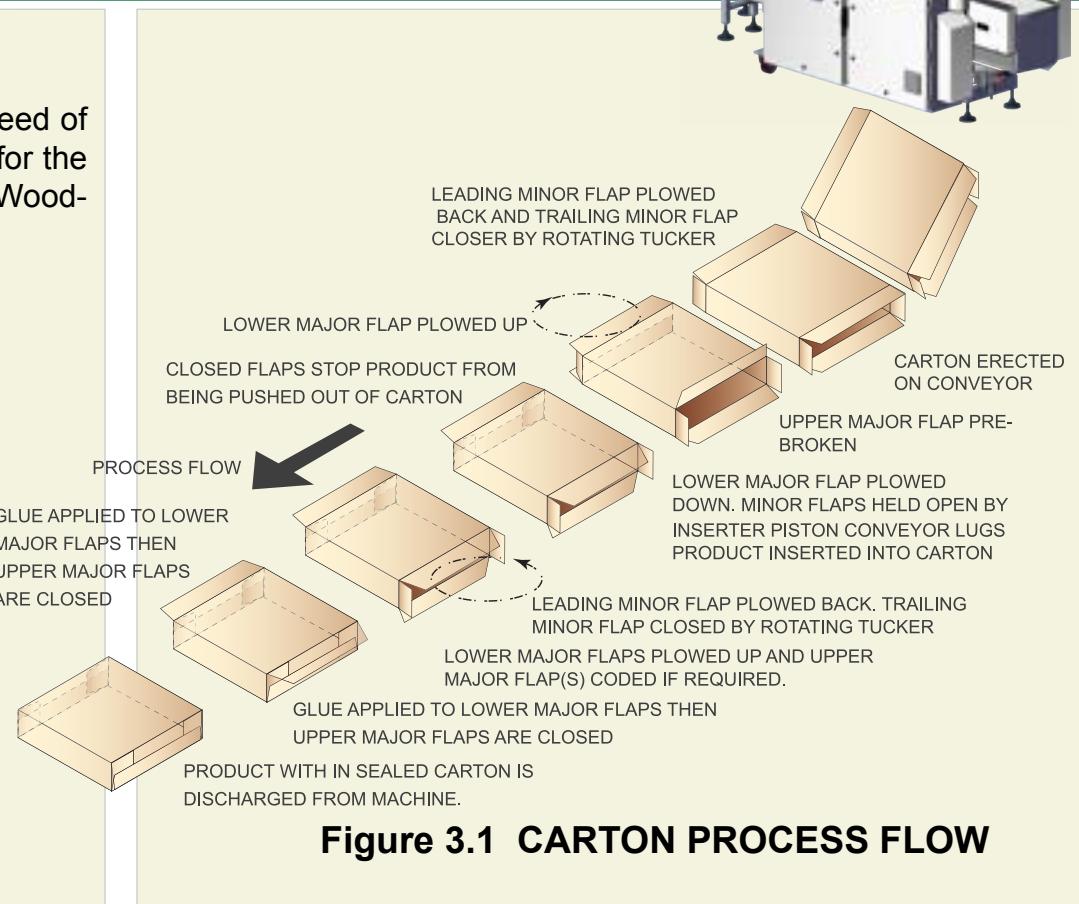
3.0 OVERVIEW

This section will describe the carton process flow, speed of operation, carton size range, and give specifications for the electrical and mechanical components of the Kliklok-Woodman Enterprise cartoner.

3.1 CARTON PROCESS FLOW

Product loading is achieved by utilizing a Barrel Cam Piston Inserter, which is fed with product via a Product Infeed Conveyor or labeled as PIC. The infeed conveyor is auto-phase adjustable to suit products of different sizes. When a new recipe is selected from the HMI screen menu, the pusher panel of the conveyor will automatically move, (phase) to accommodate the new carton length dimension.

Product is placed onto the infeed conveyor, between the two panels of the lugged chain. As the product is carried into the machine, the



product detect sensor detects the product and triggers the feeding of a carton. If the product is sitting too high on the conveyor, the product over height Sensor will cause the product to be aborted out of the machine and no carton will be pulled.

When enabled through the recipe settings there are 2 sensors.

- 1) There are 2 sensors on the infeed, the lower one is for detecting a product, and the 2nd is for Over Height product.
- 2) The over height product sensor has a count to stop the machine if 5 (this number is selectable) consecutive products are detected.

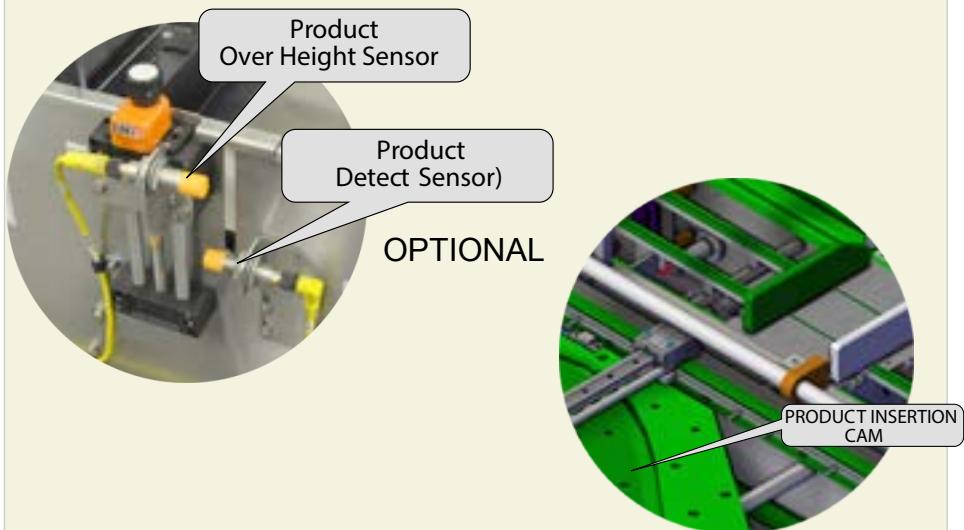


Figure 3.1 A SENSORS

The Inserter Pistons are driven across the Infeed Conveyor, by means of a Linear Cam, pushing the Product toward the open carton.

With the product inserted, the open carton continues downstream passing the non-load side upper major flap beneath (if equipped) a laser date coder. The carton is coded just prior to it entering the closing area of the machine.

Following the coding of the carton, all remaining open flaps are closed in sequence, with the upper major flaps tucked after adhesive is applied. The carton then passes through compression rollers and out the machine.

3.1.1 CARTON / PRODUCT SENSORS

A carton sensor is positioned between the static carton "Ski" guides near the Rotary Feeder. If a corresponding carton is not present to receive the incoming product, the sensor signals the PLC, which triggers the load/abort diverter cam on the Piston Inserter. The piston cam follower then runs into the Abort Cam Track. When a cam follower is in this track, the associated piston arm/plunger does not outstroke/extend and the product remains on the product conveyor until it is delivered outside the machine.

A product sensor is positioned on the load side of the product infeed conveyor. If no product is detected within the conveyor pocket, a signal is sent to the PLC, which disables the vacuum at the Rotary Feeder and no carton is pulled for that corresponding conveyor pocket.



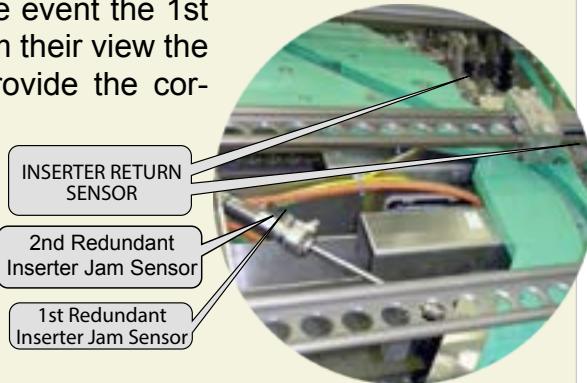
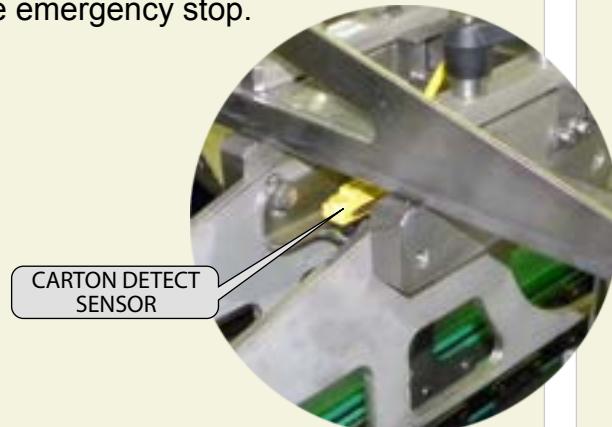
Note! The pistons will stay in their last position until told to change, for example if they are in abort they will stay in abort until told to load and visa versa.

The inserter jam sensor is positioned on the air cylinder. This sensor detects undue pressure on the air cylinder caused by a jam during product insertion. This cylinder can move easily (depending on air pressure) so that, when a jam is detected the internal trigger inside the cylinder moves away from the cylinder sensor. The sensor signals the PLC which immediately triggers a software emergency stop.

The carton detect sensor detects that a carton is present and fully formed, if its not fully formed the product will be aborted and the carton will exit out of the machine.

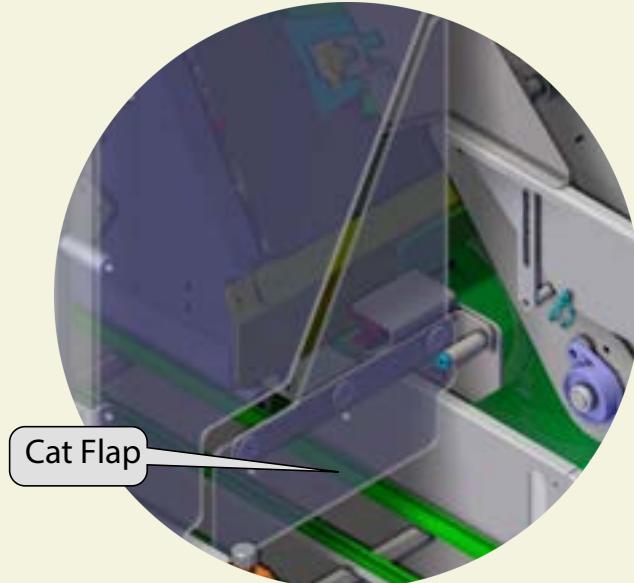
There are three additional jam sensors located on the Piston Inserter. These sensors detect any undue resistance on the Inserter Pistons as they are withdrawing from the push position. Should resistance be met, the sensors will signal the PLC which will immediately trigger a software emergency stop. These sensors are backed up with a secondary set of sensors so that in the event the 1st set were blocked from their view the second set would provide the correct action.

The 2nd redundant jam sensor is a check sensor so the machine is protected if the 1st jam sensor fails.



Over height product is detected by an adjustable sensor located on the load side of the infeed conveyor. Should this sensor be triggered a signal is sent to the PLC and no carton will be pulled and the inserter will be aborted causing the product to remain on the conveyor until it is delivered outside the machine. This sensor is equipped with an adjustment hand knob and digital counter and will need to be adjusted for product changes

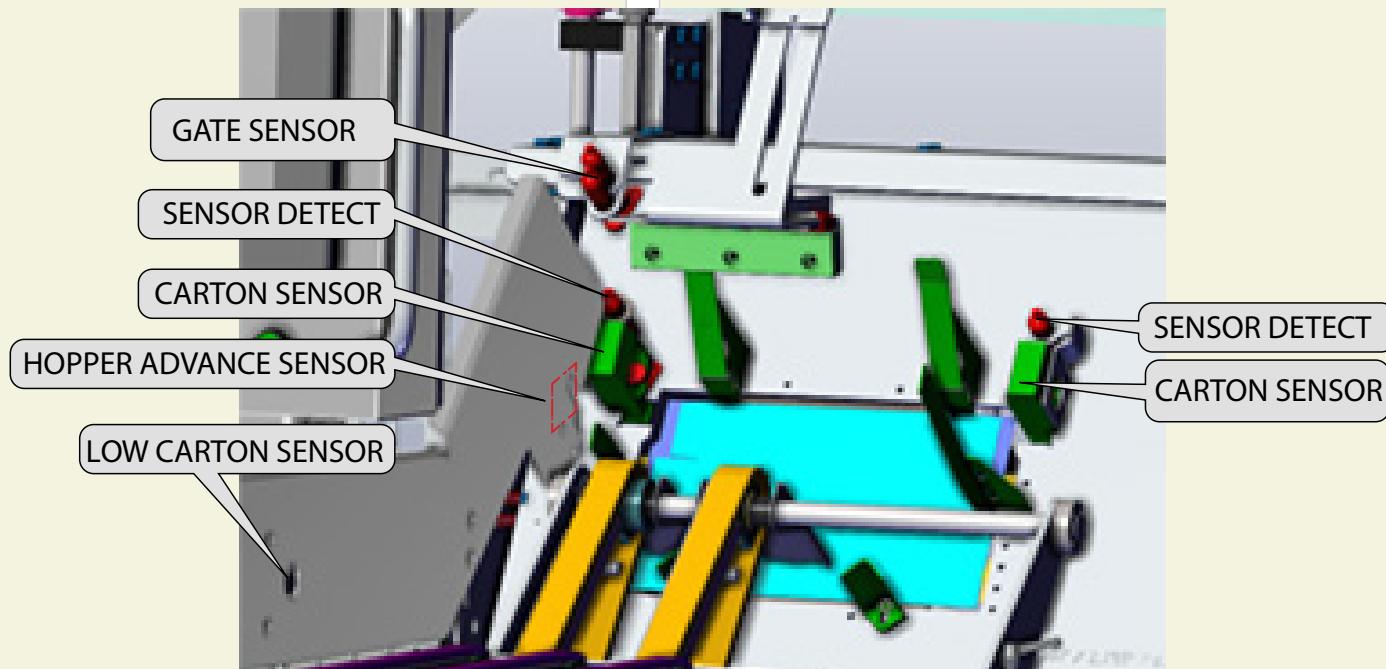
A Cat Flap Guard Switch located on the Infeed Conveyor, just prior to the Rotary Feeder, will cause the machine to stop when it is triggered. This component is designed to protect the operator from injury and the machinery from being damaged and is not to be used for stopping the machine on overheight product, that is what the overheight sensor is for.

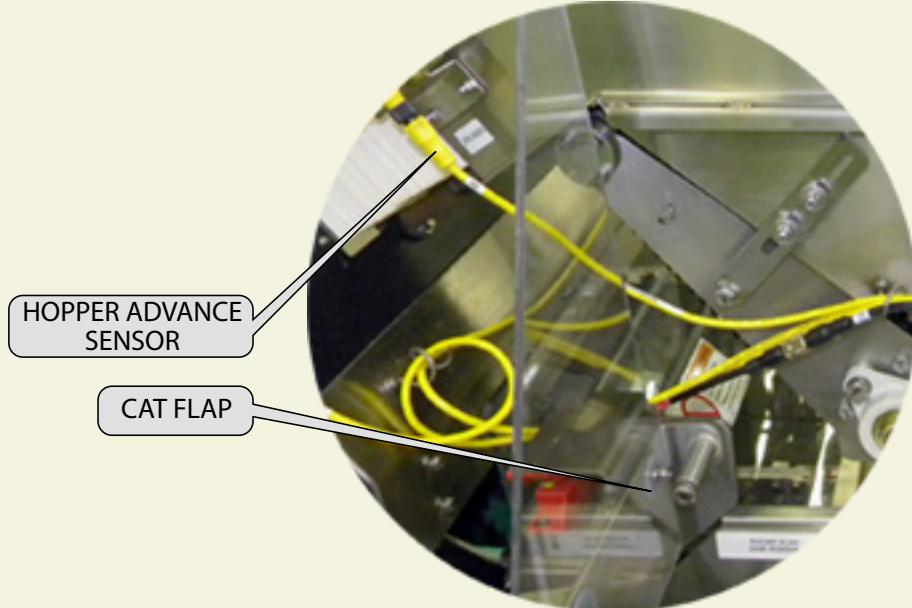


3.2 CARTON HOPPER AND GATE

The gate is equipped with multiple sensors to detect the presence of the gate as well as the cartons being in place. If the Gate is not inserted the machine will not function and will stay in an E-Stop condition. Once the gate is inserted into it's position two(2) Sensors detect it's presence, for the machine to achieve the reset status the carton sensors must be inserted and the carton stack must be present with the carton sensors detecting the presence of the cartons themselves. Once this is all in place the machine is ready to be reset.

Sleeve style cartons are hand loaded on edge onto the horizontal surface of a VFD powered hopper. The stack of cartons is advanced toward the gate for feeding when signaled by the Hopper Advance Sensor that detects a lack of cartons at the gate. Once this has been detected the VFD operates and advances the hopper belts and cartons forward, toward the gate. Once the spacing has been closed the cycle stops, thus keeping an even pressure on the gate.





3.3 CARTON FEEDING AND ERECTION

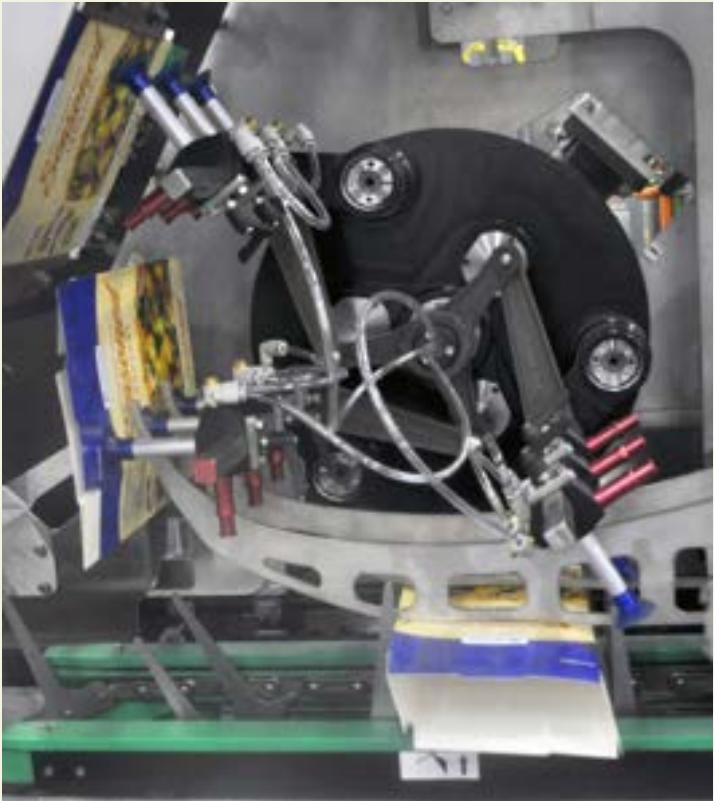
Cartons are pulled from the hopper by vacuum cups mounted on three (3) rotating arms. Each arm plucks a carton from the gate and carries it beneath static overhead carton erector ski guides. The carton leading edge (lower edge) is forced against the retarding lugs on the carton conveyor.

The vacuum cups move faster than the conveyor, while the carton gets into position, then they match the speed of the flight chain, which causes the upper side (top) of the carton to overtake the lower side, (bottom) which is restrained by the retarding lugs. As the top of the carton catches up with the bottom, the carton is opened and erected. At the same

time the vacuum cups move down toward the conveyor, forcing the carton down between the retarding lugs and the following set of pusher lugs. Soon after the carton is fully erected, the vacuum is released while the carton is still just above the conveyor. As the carton moves along the conveyor, the carton erector ski guides drive the carton into contact with the conveyor rails. The carton is then held in position and in shape between the retarding and pushing lugs and between the conveyor rails and the overhead guides.



Vacuum is “switched” on and off (distributed to the vacuum arms) by valves connected to a pneumatic supply and is controlled from the HMI.

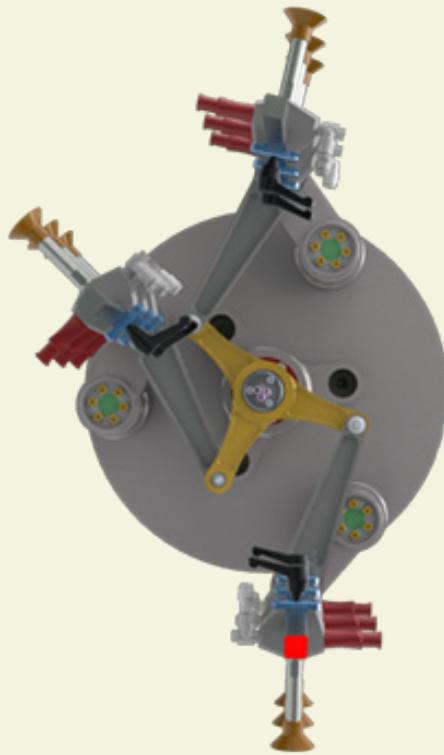


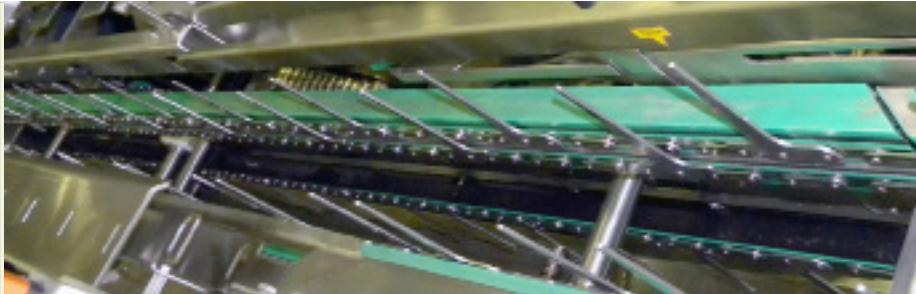
The Rotary Feeder is a patented servo driven mechanical gearbox with servo profile. This means it has the flexibility to uniquely alter its profile at any point in its cycle.

Adjustable vacuum cups are mounted on the three feed arms of the rotary feeder to pluck cartons from the gate and deliver them onto the conveyor. Each suction cup has its own vacuum generator which must be kept clean and free of carton debris.

The carton is transported through the machine from feeding to out-feed, between twin front and back lugs (retarding

and pushing) which are mounted to mechanical chains, each with servo driven control.

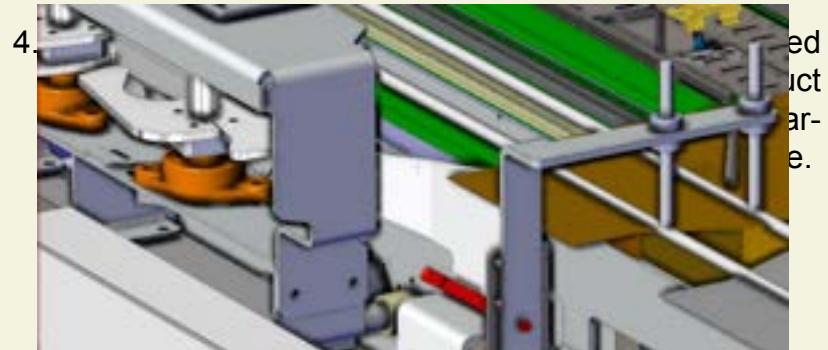
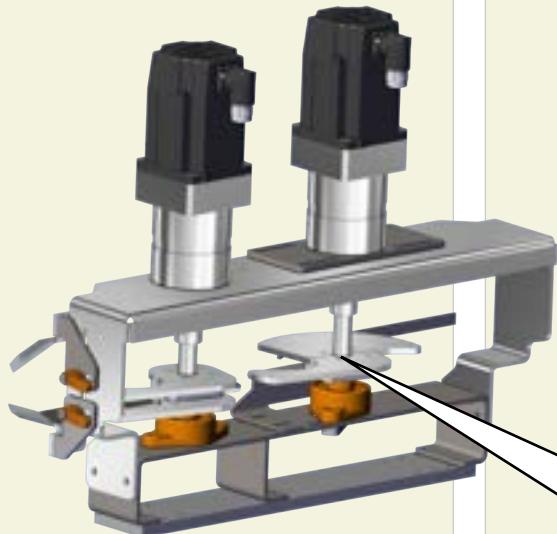




3.4 PRODUCT LOADING/CARTON CLOSING

The sequence of operations on the non-loading side of the machine, after the carton has been erected, is as follows.

1. The upper major flap is plowed up and retained open, but will be closed downstream after glue has been applied along the lower major flap.
2. The leading, and then trailing, minor carton flaps are tucked in by two (2) horizontally rotating Tucker Disc.
3. The upstream tucker is not used on a rectangular or square carton and gets “parked” out of the way. The downstream tucker is used to tuck rectangular or square cartons but one part gets removed on a size change (this part is marked). On a hexagon carton this part must be fitted.

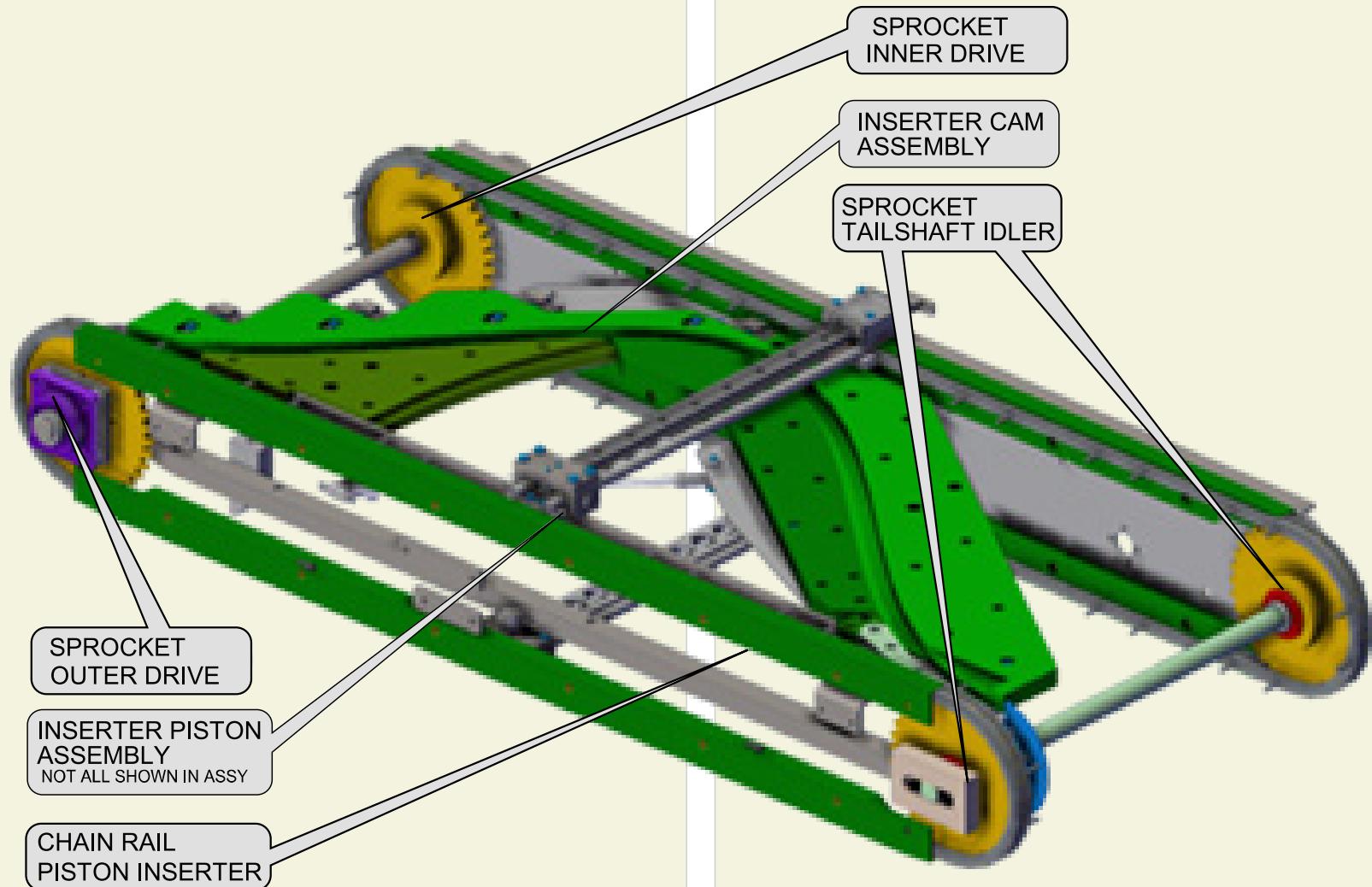


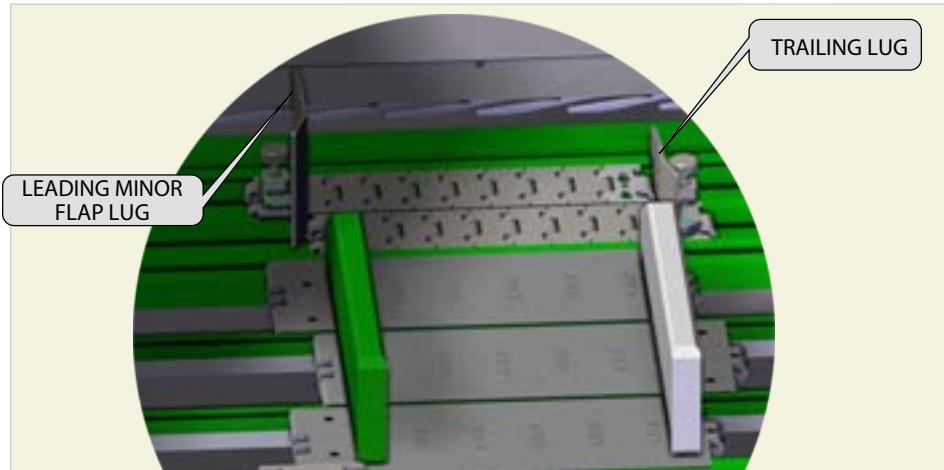
The sequence of operations on the loading side of the machine, after the carton has been erected, is as follows.

- 4.
5. The lower major flap is deflected downward behind a static guide.
6. The leading minor flap is collected by a lug on the TRANSFER CHAIN.
7. The trailing minor flap is collected and retained by the trailing lug of the transfer chain which holds the carton flap away from the mouth of the carton during product loading.
8. The upper major flap is deflected upwards and captured by an Overhead guide. This presents the open mouth of the carton during loading with no edges to interfere with the products entry.

Remove this change part when running rectangular or square cartons. This part must be fitted to run hexagonal cartons.



3.5 BARREL CAM INSERTER

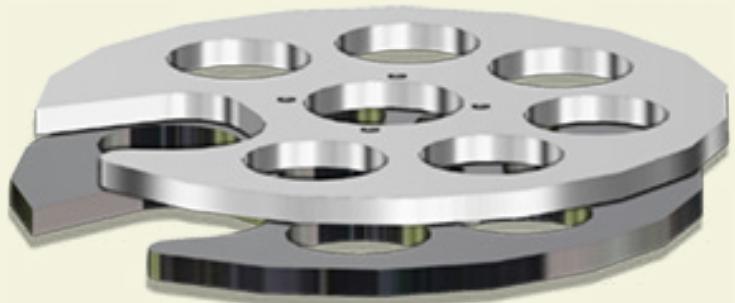


9. The Inserter pistons are then driven across the Product Infeed Conveyor, by means of a linear cam, pushing product into the open carton.

After the loading process is completed, the open carton flaps are closed in a way similar to the non-load side.

10. Once the product has been loaded, on the load side of the machine, the carton leading minor flap and then the trailing minor flap is tucked in by the downstream rotating tucker.

(Optional) In some cases the size of the carton is much larger than others, depending on the product. If your product requires a larger box you may have the Downstream Tucker Assembly utilizing a double set of Tucker wheels. In this case the 2 wheels are staggered slightly to begin the fold at the base and finalize the fold at the top. Of the 2 tucker wheels the lower wheel is the master wheel. Its location setting is the setting for homing.



11. Overhead carton guide rails retain and hold the carton on the conveyor as it is forwarded through the machine. These are height adjustable to accommodate a size change.

12. As the carton approaches the gluing station, the load side lower major flap is plowed up by a static guide.

13. An overhead sensor detects the presence of the carton and sends a signal to the PLC to initiate the application of the glue. Hot melt adhesive is applied via glue jet guns on both the load and non-load sides of the carton, along the lower major flap. (The parameters within which the adhesive is applied are controlled by the operator within the HMI recipe screen).

14. As the carton leaves the gluing station, the upper major flaps are plowed down via static guides or rollers.



15. A roller assembly then applies compression to the glued face of the carton.

16. As the retarding and then the pushing lugs fade down, faster running out-feed belts accelerate the cartons out of the cartoner and provide some extra compression contact time for sealing the glued carton faces.

The passage of the product through the machine is now complete.

3.5.1 SPEED OF OPERATION

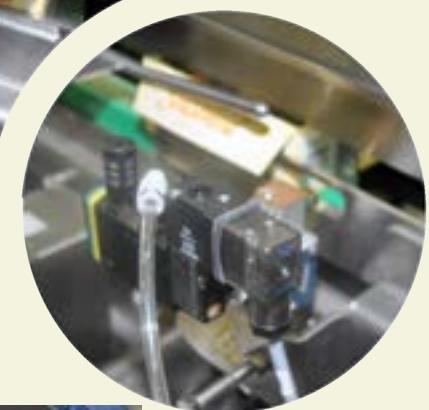
The speeds given below are the maximum continuous (cycling rate) rating of the machine. Factors such as carton board quality and product may affect the final operational speed.

30 – 150 cpm for the 12" pitch machine with Article Bucket Infeed.

30 – 175 cpm for the 12" pitch machine with P.I.C.

40 – 200 cpm for the 9" pitch machine

40 – 240 cpm for the Enterprise 9H, high speed.



3.6 CARTON SPECIFICATION

The basic carton style to run on this cartoner is a pre-glued sleeve conforming to Kliklok Specification 14-001. Elimination of the key cut out for minor flap control is possible with the use of an optional flap kicker assembly. See Kliklok specification 14-001. The carton travels through the machine with the factory glued seam down and trailing. If the aforementioned key cut out is used for minor flap control it must be on the lower portion of the leading minor flap.

**Note:**

The above specifications are based on a cartoner with 12" flight centers. All maximum dimensions cannot be applied for the same carton. When any carton dimension approaches a maximum condition the entire carton should be reviewed to verify that it does not exceed the cartoner's capabilities.

3.7 SERVICES

Electrical supply	380 to 480 volt, 3 phase, 50/60 Hz
Electrical consumption	40 Amps required
Air consumption	8 CFM at 80 PSI filtered plant air supply

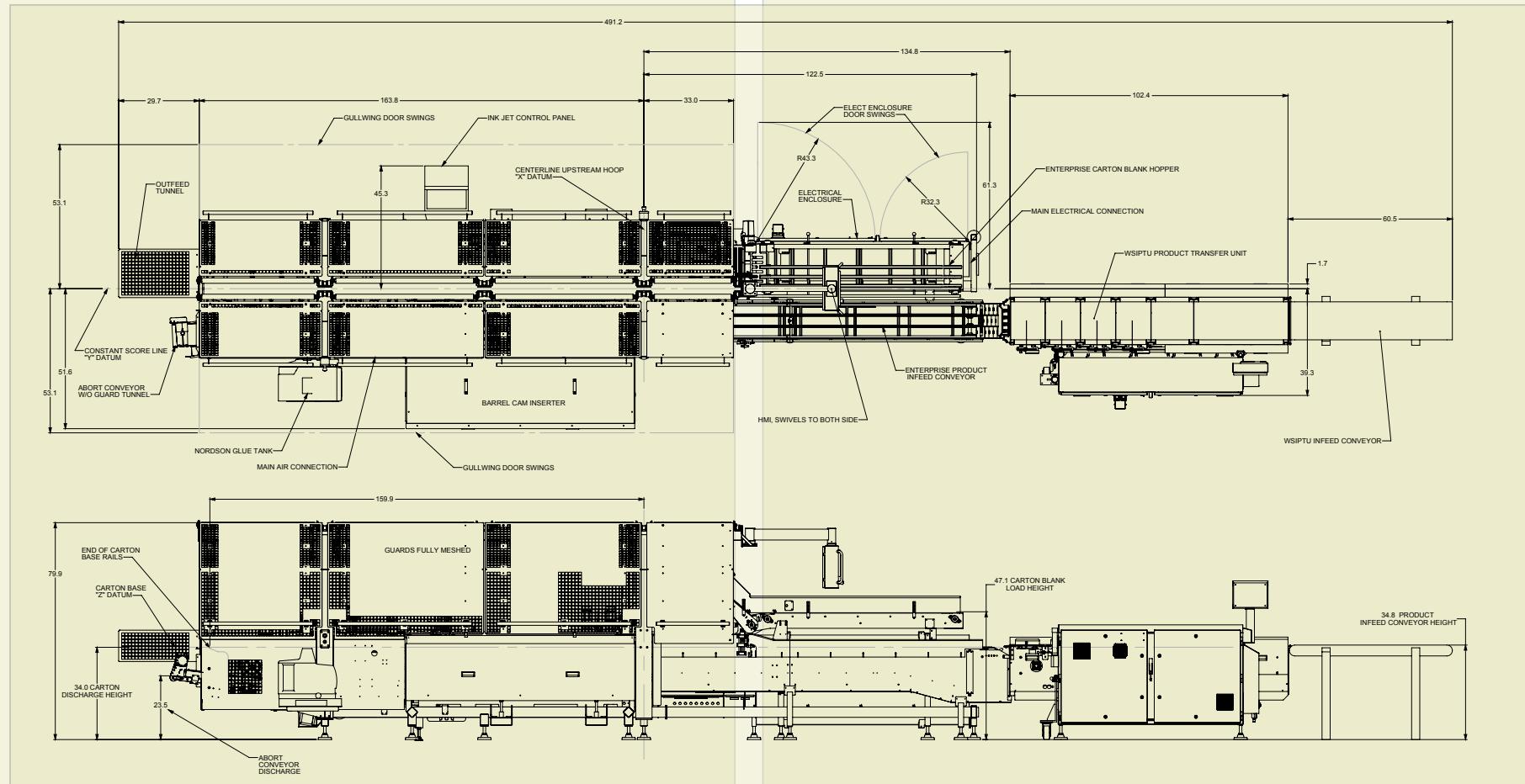
3.7.1 NOISE LEVELS

Less than 78 dBA free field, at max cycle rate

3.7.2 MACHINE LAYOUT & DIMENSIONS

Infeed and outfeed height 34" +/- 2" (865mm +/- 50mm)

Standard Hand Configuration is shown. See Machine Layout section 1.4.



3.7.3 ADHESIVE SYSTEM

Nordson Pro-Blue 7 integrated hot melt adhesive applicator with SureBead guns and water wash down hoses. Glue system is IP-54.

3.8 ELECTRICAL SYSTEM SPECIFICATIONS

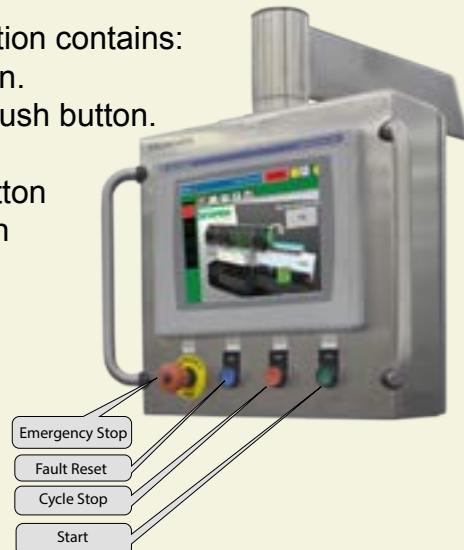
The electrical system is designed to comply with the latest editions of NFPA 79, as well as the HSW NIEC 204 (EN60204)

The electric will comply with a sanitary design. No open troughs, and exposed wires will have separation for easy cleaning.

Isolators in the door protect the main electrical control panel. The main electrical disconnect will be flange mounted with a lock-out feature.

The operators control station contains:

1. HMI color touch screen.
2. An Emergency Stop push button.
3. A Reset push button.
4. A Cycle Stop push button
5. A Machine Start Button



There are six (6) Emergency Stop push-button stations. One on each corner of the machine, one on the operator control station and one on the back of the hopper above the PIC Infeed.

The Jog Pendant can be used during machine set-up to force empty cartons in a run mode with no product present.

All guard doors and removable guards not requiring a tool to open will be equipped with interlock switches. These when opened will emergency stop the machine.

The control system of this machine is based on a PLC and Multi-axes Servo controller with a color touch screen HMI. The PLC handles all I/O, the major machine state functions, communication with the touch screen, and the servo controllers. All the programmable equipment is connected via high speed data networks such as Ethernet.

Standard control voltage is 24VDC.

3.8.1 DIAGNOSTIC AND PERFORMANCE MONITORING

The touchscreen will provide a full range of performance monitoring, glue control, diagnostics, and help functions. It has been designed to be intuitive, with a very small learning curve. Highlights include:

- Graphical glue control
- Basic on-screen help
- Semi automatic size change
- Performance monitoring
- Functional troubleshooting and diagnostics
- Insight look and feel
- On screen manuals (Optional)

3.8.2 ELECTRICAL COMPONENT VENDOR LIST

PLC System

Processor	Allen Bradley Control Logix
Digital Inputs	Allen Bradley Flex IO
Digital Outputs	Allen Bradley Flex IO

Drives and Amps

Servo Motors	Allen Bradley MPL / MPF Series Motors
Servo Amps	Allen Bradley Kinetix 5500 480 VAC Amplifiers
VFD Motor	Oriental Motors
VFD Drive	AB PowerFlex Drive

Graphical HMI

Touchscreen	Allen Bradley Panel View Plus 10" Diagonal
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Networks

Ethernet Hub	Hirschmann 5-port Hub
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Sensors

Fiber optic-diffused Send/Receive	AB Fiber Optic-diffused 42KL series AB Infrared 42KL series
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Other Components

Main Disconnect	Allen Bradley
E-Stops	Allen Bradley
Guard Switches	Schmersal
Fuses	Bussmann

Relays
Safety Relay

Solid-State Relays
Pneumatics
Power Supply
Filters

Allen Bradley / Finler
Allen Bradley Safety Monitoring
Relay
Allen Bradley
SMC / Festo
Sola
EMC / Allen Bradley

3.9 MECHANICAL SYSTEM SPECIFICATIONS

The Kliklok-Woodman Enterprise is washdown rated to NEMA 4 standards. However, the touch screen and glue tank will need to be completely wrapped for protection prior to any washdown procedure. (See section 6.5 Machine Cleaning).

3.9.1 FINISH

The machine will be constructed from the following: Imperial Stainless steel tube, sheet and bar stock Metric Stainless steel shafting. Aluminum, hard anodized, all sizes to be imperial Some components will be mild steel, electro-less nickel plated.

3.9.2 CHANGE PARTS

Change parts may require a tool for change over. Manual adjustments for size changes may require a tool. (See section 5.3 Performing a Size Change).

3.9.3 GUARDING

The machine will be fully guarded to meet OSHA requirements for packaging equipment. All guard doors will be interlocked as described in section 2.6. The machine will be safe to use provided it is operated in accordance with training and Operation & Maintenance Manual instructions. The upper guard doors are laser cut stainless steel guards.

3.9.4 ADHESIVE APPLICATION

This machine uses a hot melt glue system to apply glue to the lower major carton flaps. This system consists of an integrated glue tank, two heated hoses, and two glue guns with appropriate size nozzles. (See section 3.7.3 Adhesive System.) The guns and hoses are water wash down IP66 rated. The glue tank is rated at IP54.

3.9.5 SEMI-AUTOMATIC CHANGEOVER

The following list describes the items that need to be changed or adjusted to change the Enterprise cartoner from one carton size to another. The sequence of these events may change depending on whether the changeover is from a large carton to a small carton, or vice versa. Some of these items will change automatically when a recipe is selected on the touch screen. Each item below is listed as automatic or manual depending on how the change is to be made.

1. Adjust the carton carrying chains for carton length (automatic)

2. Adjust the pocket size of the Product Infeed Conveyor (automatic)
3. Phase load side minor flap lugs to carton length (automatic)
4. Phase the Product Infeed Conveyor to carton carrying lugs (automatic)
5. Re-synchronize the rotary feeder position (automatic)
6. Adjust the machine speed (automatic)
7. Adjust the glue pattern (automatic)
8. Adjust the cartoner depth of insertion size (manual)
9. Adjust the rotary feeder height for carton width (manual)
10. Adjust the overhead carton ski guides for carton depth (manual)
11. Re-synchronize the carton flap tuckers (automatic)
12. Adjust carton hopper feed rate (automatic)
13. Adjust the rotary feed arms for carton depth (manual)
14. Change the carton gate for carton size (manual)
15. Adjust the carton hopper rail for major flap size (manual)

16. Adjust the glue gun guides for carton width (manual)
17. Adjust the glue gun height for carton width (manual)
18. Adjust the overhead carton guides for carton width (manual)
19. (Carton Specific) Adjust the Upper and Lower major flap plows. Swap the upper to the lower and lower to the upper locations depending on the carton size used.
20. Add or remove the downstream Non Load side tucker change part.

3.10 MECHANICAL COMPONENT SPECIFICATIONS

A. BEARINGS

All bearings, wherever possible, have been spaced off the frame to facilitate wash down procedures and to promote sanitary conditions.

1. All flange bearings mounted in a vertical position are sealed bearings with a composite housing and ZMaRC coated inserts.
2. All flange bearings mounted in a horizontal position are sealed bearings with a composite housing and stainless steel inserts.
3. Ball bearings are hardened steel.
4. Rod end bearings are stainless steel housing with steel inserts.
5. Plastic bushings are Igus iglide T500.

B. BELTING

1. Brecoflex belting
2. Gates Poly Chain GT Carbon Drive Belt

C. CARTON CONTROL GUIDES

1. All plastic guides that contact the carton are made of green or white UHMW.
2. All metal guides to be stainless steel.

D. CHAINS

1. Carton Carrying chains. ANSI 2060, electro-less nickel plated with stainless steel lugs
2. Inserter Piston chains. ANSI #60, with extended pins, electro-less nickel plated
3. Drive chains. ANSI #40, and 50, electro-less nickel plated
4. Product Infeed Conveyor 4" wide series 820 tabletop chain.
5. Adjusting chains. ANSI #35, electro-less nickel plated

E. CHAIN GUIDES

1. Carton carrying chain guides are green plastic inserts in aluminum extrusions.
2. Inserter Piston chain guides are green plastic.
3. Product Infeed Conveyor chain guides are green plastic inserts in aluminum extrusions.

F. COLLARS & COUPLINGS

1. Collars and couplings are stainless steel.

G. COUNTERS & SCALES

1. Counters to be SIKO metric washdown counters, attached to stainless steel trapezoidal threaded shafts.

2. Scales to be metric laser etched in place with high visibility pointers.

H. GAS SPRINGS/STRUTS

1. SGS gas struts
2. NitroLift gas struts

I. GEAR BOXES

1. GAM EPL series.
2. GAM Dyna series.
3. GAM DynaLite series.

J. GLUE COMPONENTS

1. Nordson applicator, 230 volt ProBlue 7.
2. Nordson SureBead glue guns with removable, reduced cavity Saturn style nozzles.
3. Nordson heated washdown hoses.
4. Nordson 24 VDC Solenoid.
5. All components to meet a minimum IP-54 rating.

K. MOTORS

1. Servo motors Allen Bradley, MPL motors.
2. AC gear motor, Oriental motor (Powered Hopper)
3. AC gear motor, Oriental motor (Outfeed Belts)

L. PULLEYS & SPROCKETS

1. Metal sprockets to be made from mild steel, electro-less nickel plated.
2. Plastic sprockets to be made from green UHMW
3. Pulleys to be aluminum hard coat anodized.

M. PNEUMATICS

1. SMC
2. Festo

N. SHAFTS

1. All shafts to be G&P stainless steel

O. VACUUM COMPONENTS

1. Piab vacuum generators
2. VICAS vacuum cups VC-2C3

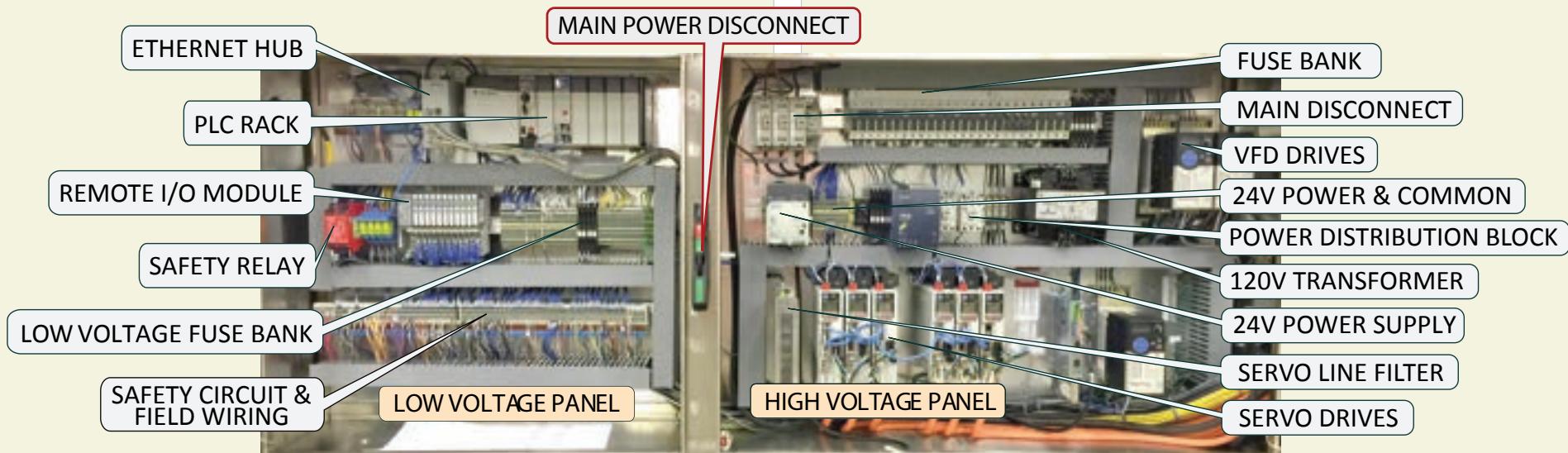
3.11 ELECTRICAL PANEL COMPONENT SPECIFICATIONS

3.11.1 Electrical Cabinet

The Electrical Cabinet is divided into two (2) sections. The Low Voltage Panel and The High Voltage Panel.



The remote I/O retrieves the inputs for various contacts and allows the output of power when told by the PLC.



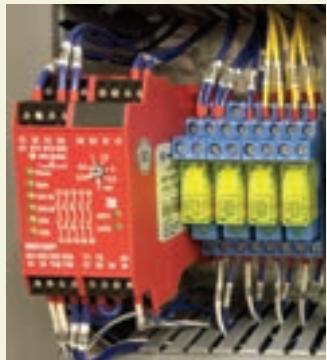
3.11.2 Low Voltage Panel



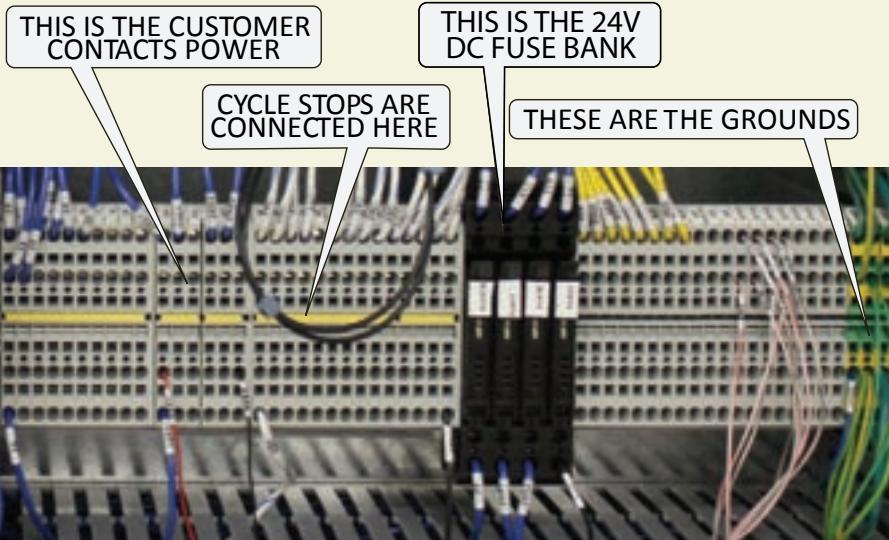
The Ethernet Hub can connect up to 8 different Ethernet cables. Parts such as the HMI connect here and are distributed to the Ethernet Module. of the PLC bank.

The PLC Bank Houses the Power Supply, Processor, Ser-cos Card, Ethernet Module and provides four (4) Blanks for future attachments.





This is the Main Safety Relay and the Solid State Relay. These are the main Safety Input and Output Communicators.



3.11.3 HIGH VOLTAGE PANEL

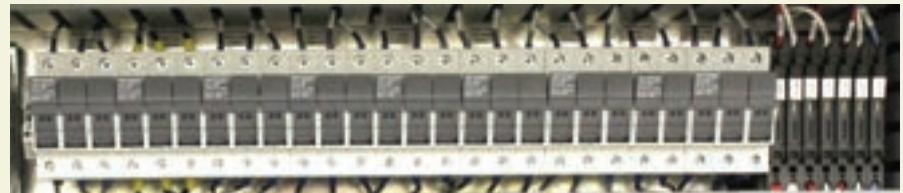


MAIN DISCONNECT

The Control Cabinet Main Disconnect is 3- Phase Power and is where the entire machine is fed.

HIGH VOLTAGE FUSE PANEL

Servo Drive, Transformer, Power Supply and VFD.



VFD DRIVES

These are the VFD Drives for the Hopper and Outfeed Belts. They receive 480V and Releases 230V



24V POWER SUPPLY

The Power Supply takes 480 Power and Distributes it into Low Voltage 24V for Relays and Solenoids.

The Thermostat for the Vortex Cooler (Electrical Cabinet is Air Conditioned)



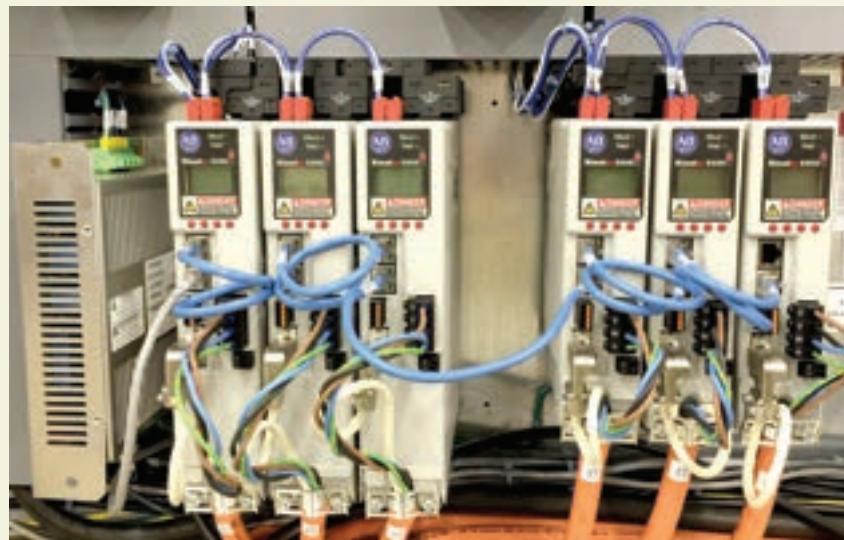
POWER DISTRIBUTION BLOCK

TRANSFORMER TAKES 480V AND DISTRIBUTES OUT 120V



SERVO DRIVES

This is all the Servo Drives with the First Drive Providing the Power Supply.



SERVO LINE FILTER



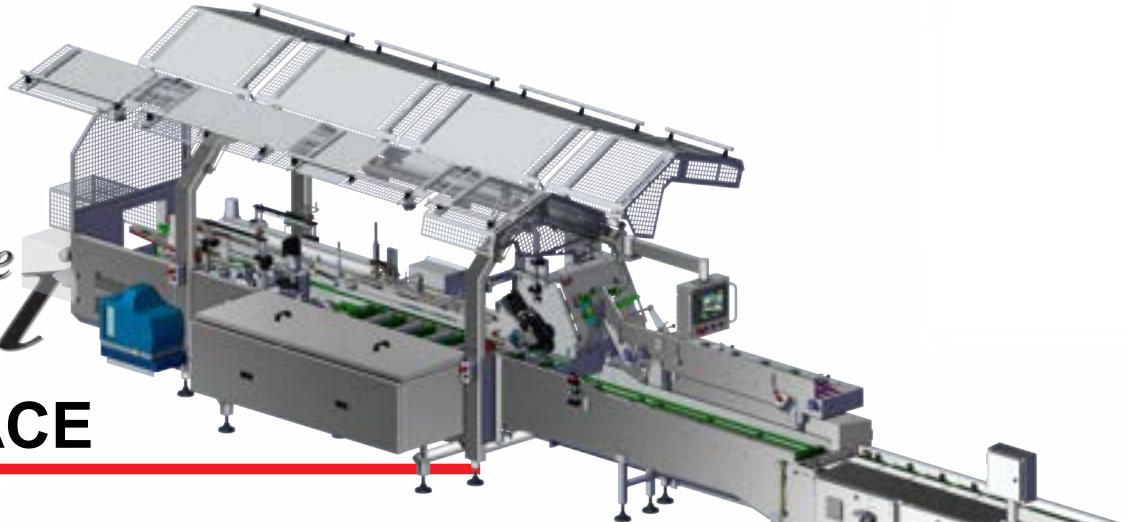
This is the Servo Line Filter, it keeps a clean source of Voltage Continuous to the Servos.

ENTERPRISE

Endload Cartoner

Operation Maintenance Manual

4.0 OPERATOR INTERFACE



4.0 OPERATOR INTERFACE

This section will identify the various operator controls you will encounter while working with the Enterprise Endload Cartoner.

Detailed instructions covering the use of these controls can be found in sections 5.0 Operator Instructions and 7.0 Product Setup and Component Adjustment.

This section should be read and understood by any personnel who will operate, maintain, or service the equipment.

4.1 INTRODUCTION

The Enterprise endload cartoning machine is mainly controlled by a software program written into the PLC which interfaces with the machine and its components. A comprehensive, password protected screen menu system is provided on a color, touch sensitive HMI (Human Machine



Interface), mounted on a moveable pivoting arm next to the main electrical panel.



Note! HMI passwords are not included in this manual.

Common terms you will encounter in the following section include:

ICON – Graphic symbol used to represent a command or function.

Navigate – Process of moving from one screen menu to another by using the buttons on the screen.

TAB – The icons located across the top and down the right side of the HMI display give the user access to the various screens and pages contained within the HMI.

PAGE – Pages are contained within various HMI screens, these are accessed by selecting the tabs running vertically along the right side of any given screen.

HOME SCREEN – Name used for the screen menu displayed during normal operation, (pictured below), also sometimes referred to as the “Running Screen”

KW GRAPHIC: Touching the KW Graphic on the Home Screen will open the Splash Screen. This screen gives the user contact information for Klik-lok-Woodman as well as the installed HMI and PLC versions.



4.2 HMI SCREENS, BUTTONS, AND FUNCTIONS

Operator machine controls are mounted on the HMI control panel, and consist of the following buttons.



Emergency Stop

Fault Reset

Cycle Stop

Start

4.3 HOME SCREEN

The Home Screen is the main screen displayed during normal production. This screen has been developed to give the operator pertinent production information at a glance such as Machine State, Machine Operating Speed, Loaded Recipe, and any Active Machine Faults. From here the different levels of operator access can be selected.

LOG-OFF COUNTER: This counter, located in the upper left hand of the Home Screen, counts-down the time until an automated log off from advanced level access to the HMI will be initiated.



MESSAGE BANNER: The message banner located at the top of the screen displays the current recipe, time, date, machine state, access level, and the help icon.

HELP ICON: Pressing the Help Icon activates the Help Function. Activating this feature will cause yellow question marks to be displayed over key controls. Touch any question mark and an explanation of that controls function will be given. (??)



HOME ICON: Returns the user to the home screen.

Servo Drives Ready Icon – This Icon will highlight GREEN once the servos on the Enterprise Cartoner have completed their homing sequence and the Enterprise is ready for production.

Ink Jet Printer- This Icon indicates that the Ink Jet printer is on line and enabled. When green the PLC is displaying that the system is ready with no known faults.

Prime Hopper Icon- Once the machine is ready to run, the prime hopper button is visible. Touch the button to engage the drive which will transfer the cartons to the Gate. This Button will not be visible if the machine is in the not ready mode or if the machine is running operation. All E-Stops and faulted messages must be cleared to have the ability to utilize this feature

MACHINE SPEED: The machines operating speed in Cartons Per Minute (CPM).

ACCESS LEVEL ICON: The screen menu structure has been developed for three levels of access:



- Operator Level-Only change machine speed although most buttons are visible they cannot be changed.



- Operator Level II-Can change certain buttons but cannot save any values.



- Maintenance Level-Can change, save & delete values

Touching the Maintenance Level "II" icon will bring up an alphanumeric key pad prompting the user for a password. Type the password and press enter for admittance to this level. Passwords are not included in this manual, contact Kliklok-Woodman Service for information.

Touching the "I" icon will return the user to the Operator Level of Access.

These Icons are displayed on all pages and can be accessed at anytime.



4.4 OPERATOR LEVEL "I" ACCESS

At the OPERATOR LEVEL you have access to view, but not change, five distinct screens in the HMI program. Each screen is accessed from tabs located horizontally along the top of the displayed home screen. Some screens are di-

vided into pages; these are accessed by selecting the tabs located vertically along the right side of the screen. These pages give the operator the settings needed to do a size changeover. The information contained within these pages will change with each recipe loaded/selected. Below is a description of each of these selectable screens and their pages.



4.4.1 HOME SCREEN

Returns user to the HOME SCREEN (see 4.3)

4.4.2 RECIPE SETTINGS SCREEN

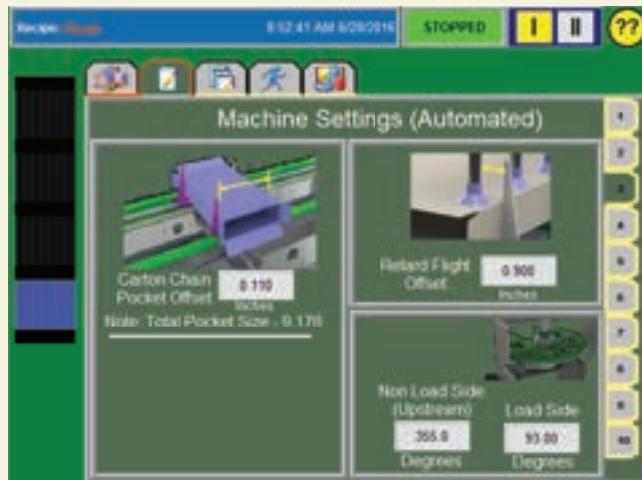
The RECIPE SETTINGS SCREEN gives the user the currently selected recipe name, carton dimensions, and settings of the various automatic and manually adjusted components within the machine. This screen is divided into 10 pages.



PAGE #1 – Loaded recipe name, carton dimensions, and



PAGE #2 – Automated glue stripe start/stop dimensions. Settings are relative to the leading edge of the upper major flaps.



PAGE #3 – Automated machine settings.



PAGE #4 - Automated Machine Settings displayed are pertinent to the proper forming of the carton.

Flap Kicker setting helps fold the lower major flap and is based off of the desired distance from the photo sensor located at the ski guides. The Enable feature is displayed for the Flap Kicker to show that it is functional when illuminated Green.

Cycle Stop Position- Is the determined position that the machine stop in when a cycle stop is pressed. This allows the machine to stop so that the cartons are not in a position which requires the physical removal of carton before restarting the machine. In the desired position the operator should be able to cycle stop the machine and then start without the requirement to open guards and clear cartons.

Double Stack Product - If desired the machine can utilize a secondary sensor setup to review the condition of a double stacked product. This Icon when illuminated green displays this function Enabled or On.



Hopper Gate Vibrator (Optional) - The carton Gate is equipped with a vibrator system that helps in the efforts to feed the cartons into the gate without gaps. When this icon is illuminated Green the vibrator is Enabled or On.

Non Load Side Double Tucker System

OFFSET – This starts the tucker moving relative to the flight chains, this is degrees.

TUCK START POSITION - This is the start of the pause of the tucker wheel relative to the flight chain position (the smaller the number the longer the pause and the larger the number the shorter the pause stopping the tucker) this is in inches.

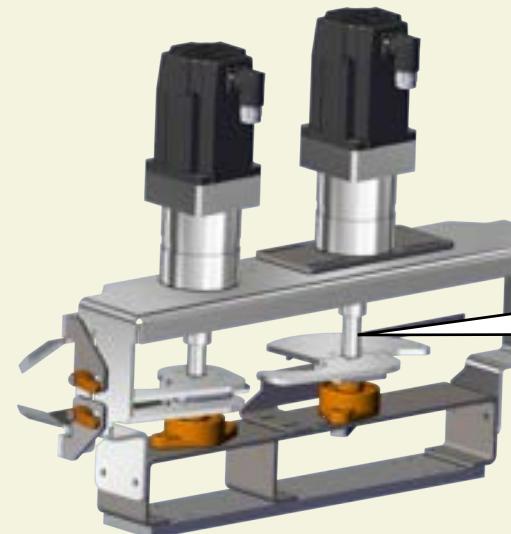
TUCKER END POSITION – This is the end of the pause of the tucker wheel i.e. when the tucker starts to move relative to the flight chains (the smaller the number the smaller the pause and larger the number the longer the pause starting the tucker) this is in inches.

TUCKER POSITION – This is the position the tucker stops (angular position) i.e. 1 o'clock, 2 o'clock etc. this is in inches.

Explanation of operation.....

The stationary downstream tucker knocks the leading edge of the carton backwards (upstream) into the carton and at approximately the same time the upstream tucker kicks the trailing edge of the carton forwards (downstream) into the carton. The downstream tucker then starts to move so the carton is not damaged by the tucker. The downstream tucker then completes the tucking of the trailing part of the carton. The downstream tucker then rotates to its stop position waiting for the next carton to approach and the process starts all over again, while the upstream tucker continues to rotate.

Park Upstream NLS Tucker - Depending on the carton shape, when using square or rectangle cartons the Upstream Non Load side Tucker wheel is disabled and put into the “park” position. The icon shown here will display a red illuminated feature to disable this tucker wheel. When using Hexagonal Cartons this icon will be illuminated green showing enabled and the Tucker will be functional for this type of carton.



Remove this change part when running rectangular or square cartons. This part must be fitted to run hexagonal cartons.



PAGE #5 – Manual Sensor & Guide recipe settings. Also available here is the referenced number for each recipe setting. This is displayed to reference the designated dimension or number written on the setup sheets. If at any point the displayed value on the screen is off the operator can reference back to the setup sheets to determine if that value has been changed as well as guidance for setup procedures.

PAGE #6 – Manual non-load side guide, rail, compression, and glue settings.



As discussed with page 5, available here is the referenced number for each recipe setting. This is displayed to reference the designated dimension or

number written on the setup sheets. If at any point the displayed value on the screen is off the operator can reference back to the setup sheets to determine if that value has been changed as well as guidance for setup procedures.

PAGE #7 – Manual load-side guide, rail, compression, and glue settings.



recipe setting. This is displayed to reference the designated dimension or number written on the setup sheets. If at any point the displayed value on the screen is off the operator can refer-

ence back to the setup sheets to determine if that value has been changed as well as guidance for setup procedures.

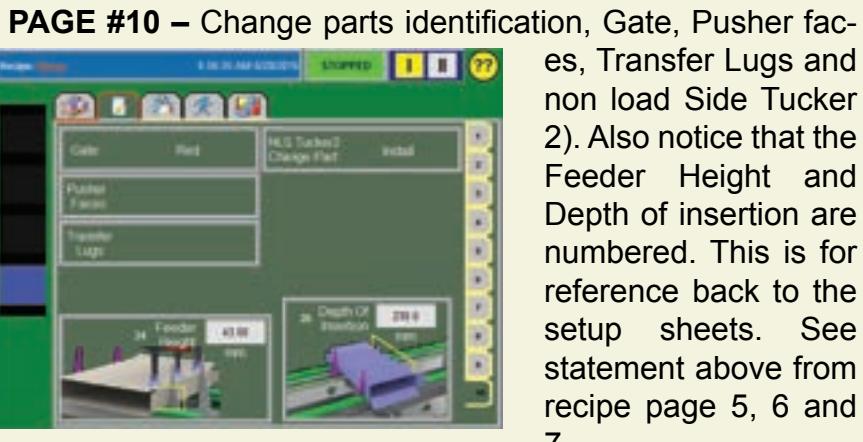
PAGE #8 – Manual Hopper settings.

Again, displayed are the numbered settings referenced on the setup



Glue type used and pneumatic pressure settings. Operational temperature of the glue tank, hoses, and guns. This screen is for informational purposes only.





The shown NLS Tucker 2 Change Part box is to remind the operator to make sure that the change part has been either installed or removed for the specific recipe during the size change procedure.

4.4.3 RECIPE MENU SCREEN

This screen displays all available recipes. The recipe currently loaded for production is revealed by an arrow ► to its left.



To do a size change load the new recipe and press Recipe Check list, a prompt will come which is a check to see if a size change is required.



Inserter Retract

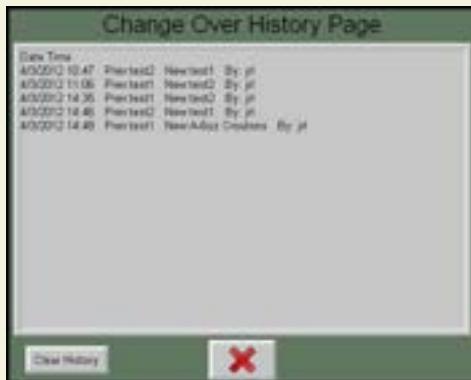
Are you sure you would like to move the Inserter rails to the retracted position?



Caution:
The machine will automatically move if the button is pressed.

⚠ CAUTION

The machine will automatically move and all the inserter pushers will go into abort. Care must be taken when changing machine parameters. Always ensure there is no interference between machine components. We recommend jogging the machine, prior to running, anytime changes have been made.

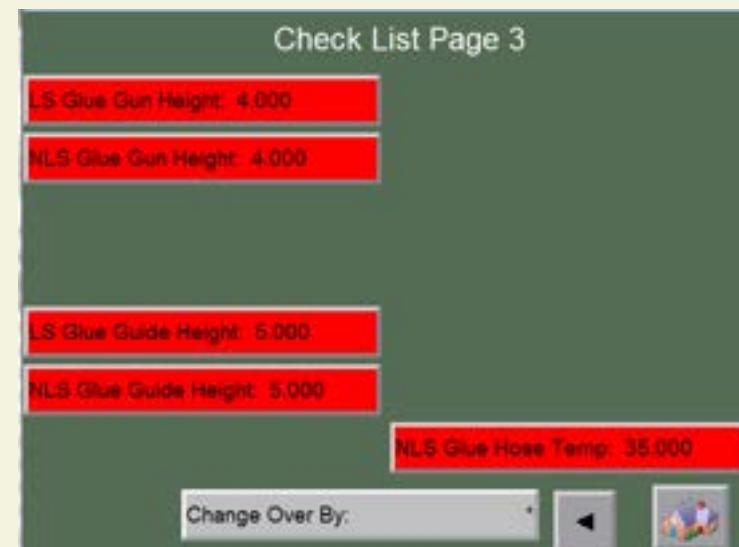
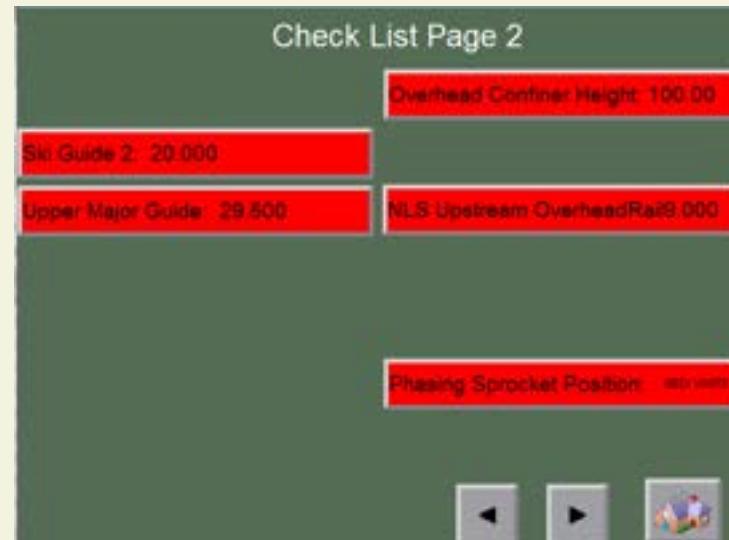


The change over history gives details of the size change, for example by whom and what date the size change was done.

Once the prompt screen has been ticked then the check box screens appear, these screens must be touched and will turn from red to green, next press the right arrow at the bottom of the page to go to the next screen and touch these boxes, then go to the last screen and do the same.



Note! Screens shown are for example only, actual change components are customer specific and may vary. Review HMI for accurate descriptions of change parts.



Once ALL adjustments have been completed, touch the Change Over By Icon and enter your initials on the popup keyboard.

4.4.4 MODE SCREEN

This screen gives the operator the ability to select between AUTOMATIC and MANUAL/JOG running modes.

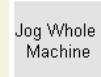


NOTE: That the machine must be reset with **No Faults** to enter Manual Mode

The JOG MODE allows the operator to slow machine motion to ensure no interference between machine components. Utilizing the JOG PENDANT gives the operator freedom to move around the machine while checking said components.



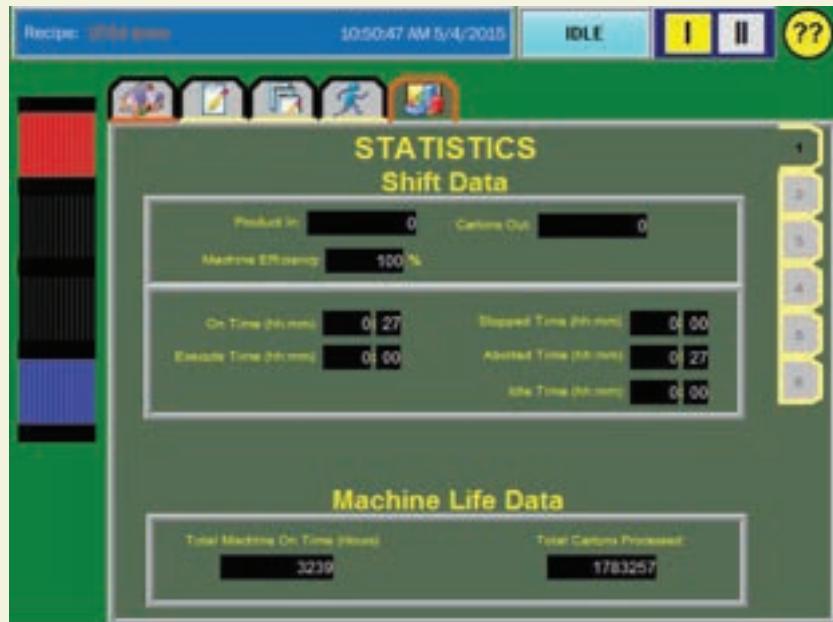
ENTERPRISE JOG SCREEN



To utilize the Jog function, “Jog the whole machine button” must be touched, the machine will synchronize all servos, Once this is completed, the Jog hole machine Icon will turn solid blue. Then the Jog function may be used.

4.4.5 STATISTICS SCREEN

This screen gives the operator a wealth of information pertaining to overall machine as well as individual component performance. This screen is divided into the six (6) pages identified below.



PAGE #1 – SHIFT STATISTICS

Statistics Screen 1 utilizes various sensors to gather production data such as the product in and the number of cartons out. This information is used to calculate machine efficiency.



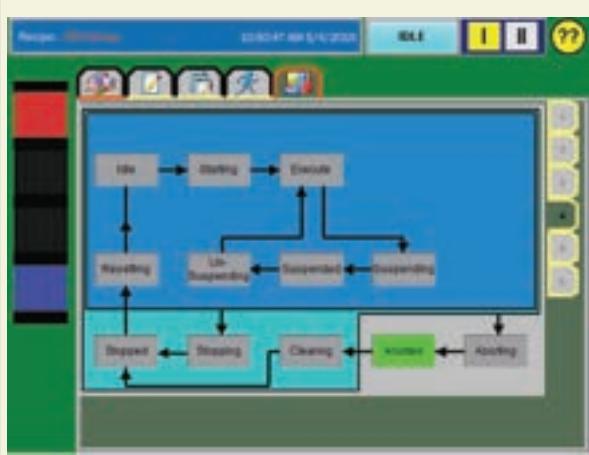
PAGE #2 – OVERALL EFFICIENCY

Statistics Page 2 utilizes the carton sensors to display a real-time Machine Efficiency Graph, when in production this screen allows the user to view the past hour of production.



PAGE #3 – REAL-TIME COMPONENT TORQUE GRAPH

Statistics Page 3 displays Servo Torque Trending for each of the five (5) servo driven components, this screen allows the user to view servo torque profiles while the machine is in production.



PAGE #4 – PACK ML STATES

Statistics Page 4 displays the Packaging Machine Language (PakML) flow chart. As the operational state of the machine changes it will display on this page.

The current machine state will be highlighted green.



PAGE #5 – SHIFT SET-UP

Statistics Page 5, Shift Setup Page, allows the user to define the shift start and end times. This information is utilized for the collection and archiving of shift statistics.

Up to three 3) shifts may be entered. It is important that the start and end time do not overlap.



Note! – Any Shift may possibly end the following day. Any figures going into the following day may be transferred into that day



Statistics Page 6, Shift Stats Archive Page, allows the user to view a history of past shift efficiency. Shift data is organized by shift number, date, and shift end time.

The scroll icons on the right side of the page permit the user to scroll through the stored data.

4.5 OPERATOR LEVEL “II”



Operator Level II allows access to all Level I screens with the addition of Diagnostics and Maintenance. When logged into Operator Level II, all recipe and machine parameters may be changed, however they may not be saved.

4.6 MAINTENANCE LEVEL “M”



MAINTENANCE LEVEL ACCESS is password protected. Selecting the “II” Maintenance Level button will display an alphanumeric keypad. Entering the wrong password will return the user to the “I” Operator Level.



Once logged into Maintenance Level, the "II" icon will change to a red highlighted "M" 

These Icons are displayed on all pages and can be accessed at anytime.

Once logged into Maintenance Level, a timer located in the upper left hand corner of the Home Screen will begin to countdown. When this counter reaches "0" the system will initiate an automatic log-off, reverting access to Level I, Operator Access.

Passwords are not included in this manual. Contact Kliklok-Woodman Customer Service Department for more information

Maintenance Level Access has all of the functionality of Operator Level access with the following features added:

- Access to Diagnostics, and Maintenance Screens.
- The ability to reset stored statistical data.
- The ability to create, modify, and delete many of the parameters relating to recipes, automated and manual machine settings, and component timing.
- Ability to jog an individual Servo Axis independently of all others.

CAUTION

It is required that this manual be read and fully understood prior to attempting any changes to the stored settings.

CAUTION

Care must be taken when changing machine parameters. Always ensure there is no interference between machine components. We recommend jogging the machine, prior to running, anytime changes have been made.

4.6.1 HOME SCREEN

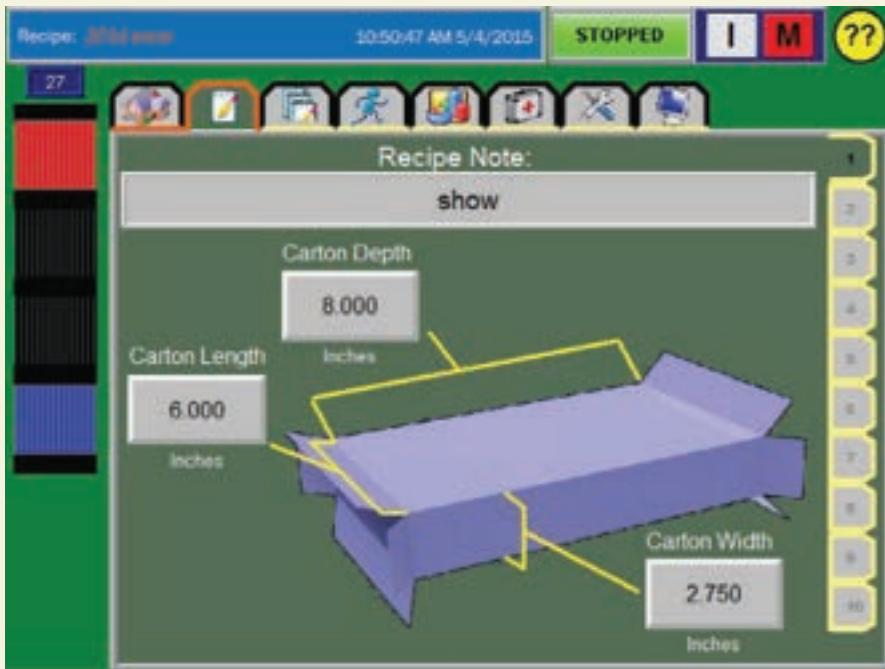
Returns user to the home screen (see 3.2)



When maintenance level is achieved, on the Home screen the Manual Carton Vacuum is now available. This icon displays the on / off feature for the engagement of pulling cartons regardless of product detection. If selected the feeder will start pulling cartons and continue to pull cartons until the feature is turned off by touching the icon again.

4.6.2 RECIPE SETTINGS SCREEN

The RECIPE SETTINGS SCREEN gives the user the currently selected recipe name, carton dimensions, and settings of the various adjustable components within the machine. This screen is divided into 10 pages. (See section 4.4.2 for page descriptions.)



CAUTION

These parameters are able to be edited when accessed in the maintenance level. It is required that this manual be read and fully understood prior to attempting any changes to the stored settings.

4.6.3 RECIPE MENU SCREEN

This screen displays all available recipes and empty recipe locations. The recipe currently loaded for production is revealed by an arrow ► to its left. When accessed at the maintenance level, recipes are able to be created, edited, saved, and deleted.

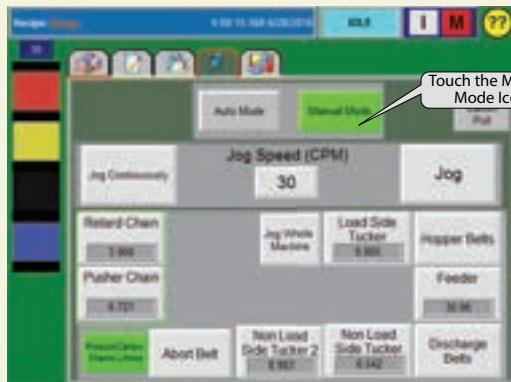


4.6.4 MODE SCREEN – MAINTENANCE LEVEL

This screen gives the user the ability to select between automatic and manual/jog running modes. In maintenance level the user has the option to jog each axis independently or as a whole machine. The Jog feature is especially helpful when setting the machine up to run a new carton, as well as

for troubleshooting. Utilizing the jog pendant gives the user freedom to move around the machine while checking said components.

Servo positions are displayed for the Retard Chain, Pusher Chain, both Tuckers, and the Feeder.



PRODUCT/ CARTON CHAINS LINKED BUT-TON-

This button allows the chains to be separated when jogging.

As with the Home Screen, the MANUAL CARTON PULL icon is available. This is

ENTERPRISE JOG SCREEN now available in maintenance level on the jog screen. If it is desired to pull cartons, regardless of product detection the operator can touch and hold this icon. Once the icon is released the feeder will stop pulling cartons.

NOTE: That the machine must be reset with **No Faults** to enter Manual Mode. When exiting the jog screen this feature is re-enabled.

CAUTION

Damage may occur when disabling this feature as the chains will not physically pass each other.



Note: To Jog the machine all guard doors must be closed and the machine reset and in a ready state.

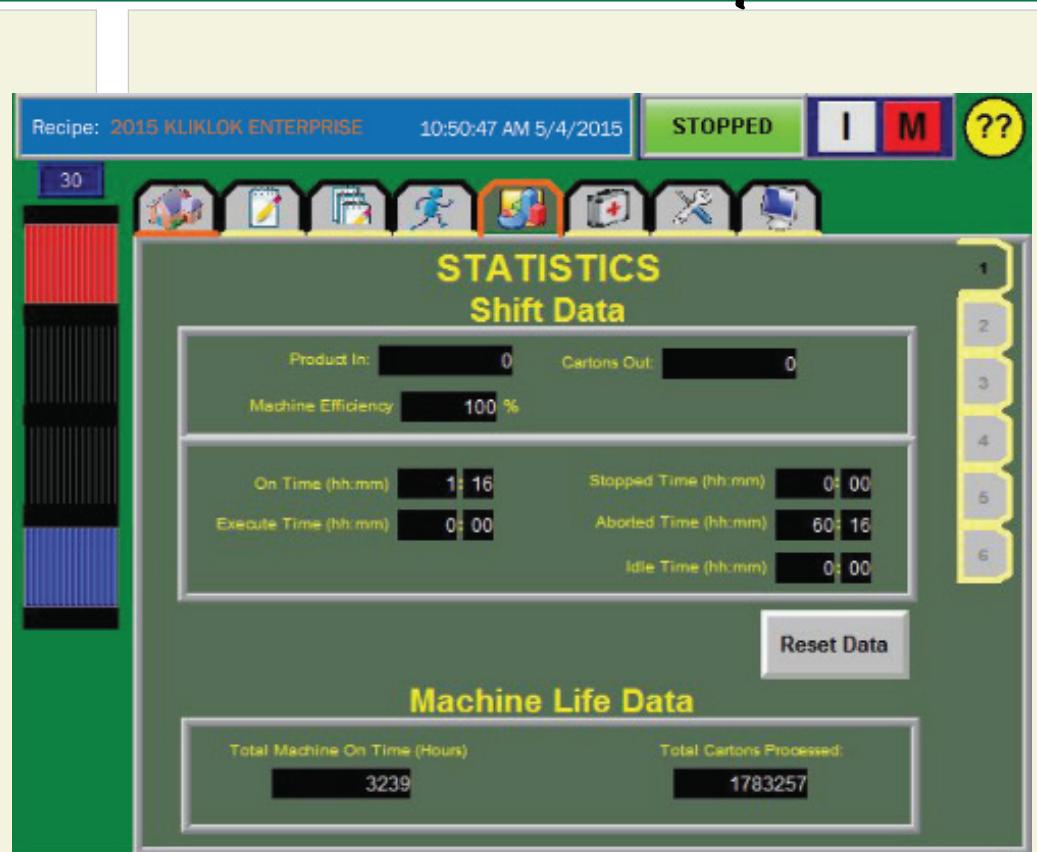
To operate the machine in Manual Mode:

1. Navigate to the Jog Screen.
2. Touch the Manual Mode Icon.
3. Touch the Jog Speed Icon and input the desired jog speed into the pop-up keypad.
4. Select individual components to jog or select Jog Whole Machine.
5. Touch the Jog Icon to place the machine into motion or utilize the Jog Pendant. The machine will stop all motion when the Jog Icon or Jog Pendant buttons are released.
6. The Jog Continuously Icon can be used to place the machine into constant motion. Touching the Jog Continuously Icon a second time will stop machine motion.
7. Exiting the Mode Screen will automatically place the machine back into Auto Mode.

4.6.5 STATISTICS SCREEN – MAINTENANCE LEVEL

This screen gives the user a wealth of information pertaining to overall machine as well as individual component performance. This screen is divided into the six (6) pages identified below.

In maintenance level the user has the ability to reset the stored statistical data.



PAGE #1 – SHIFT STATISTICS / MACHINE LIFE DATA
 Statistics Screen 1 utilizes the carton sensors to gather production data such as the product in and the number of cartons out. This information is used to calculate machine efficiency.

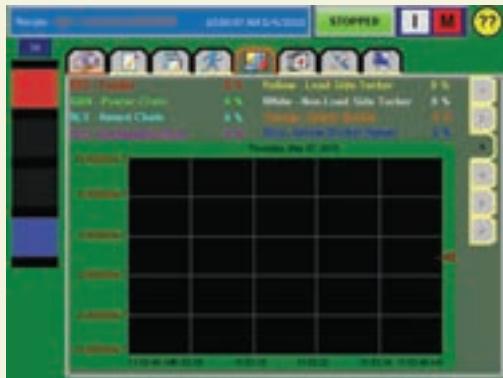
The Machine Life Data tracks the total time the machine is operational. This information is helpful in determining a schedule for performing preventative maintenance.

To reset the Shift Data, touch the Reset Data icon. The Machine Life Data values cannot be reset.



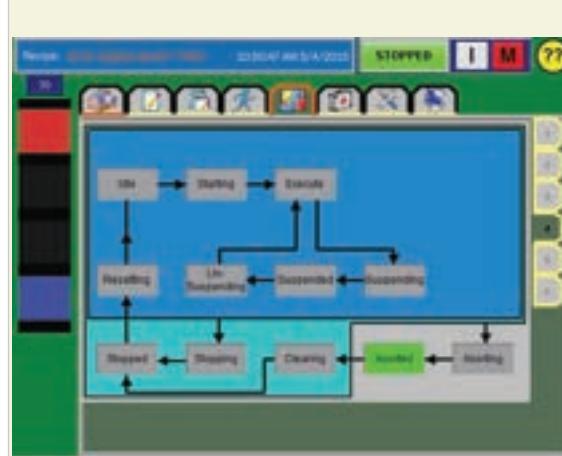
PAGE #2 – OVERALL EFFICIENCY

Statistics Page 2 utilizes the carton sensors and displays a real-time Machine Efficiency Graph, when in production this screen allows the user to view the past hour of production.



PAGE #3 – REAL-TIME COMPONENT TORQUE GRAPH

Statistics Page 3 displays Servo Torque Trending for each of the five (5) servo driven components, this screen allows the user to view servo torque profiles while the machine is in production.



PAGE #4 – PACK ML STATES

Statistics Page 4 displays the Packaging Machine Language (PakML) flow chart. As the operational state of the machine changes it will display on this page.

The current machine state will be highlighted green.

Shift Setup Page	
<input checked="" type="checkbox"/> Shift 1 Times	Start (HH:MM)
	00:01
	End (HH:MM)
	14:30
<input checked="" type="checkbox"/> Shift 2 Times	Start (HH:MM)
	14:31
	End (HH:MM)
	23:00
<input checked="" type="checkbox"/> Shift 3 Times	Start (HH:MM)
	23:01
	End (HH:MM)
	06:00

PAGE #5 – SHIFT SET-UP

Statistics Page 5, Shift Setup Page, allows the user to define the shift start and end times. This information is utilized for the collection and archiving of shift statistics. Up to three (3) shifts may be entered. It is important that the start and end time do not overlap.



Any shift may possibly end the following day, any figures from statistics going into the following day will be transferred into that day.



PAGE #6 – SHIFT STATISTICS ARCHIVE

Statistics Page 6, Shift Stats Archive Page, allows the user to view a history of past shift efficiency. Shift data is organized by shift number, date, and shift end time.

The scroll icons on the right side of the page permit the user to scroll through the stored data.

The following information is collected and stored in the Shift Stats Archive Page:

PRODUCT IN: The number of products processed as counted by the Product Sensor on the P.I.C.

CARTONS OUT: The number of filled cartons processed as counted by the Glue Sensor on the Discharge Conveyor.

EFFICIENCY: A calculation of Cartons Out divided by Product In. Displayed as Machine Efficiency %.

ON TIME: The total time the machine is powered up for the specific shift being viewed.

EXECUTE TIME: The total time the machine was in a production state for the specific shift being viewed.

STOPPED TIME: The total time the machine was in a stopped state for the specific shift being viewed.

ABORTED TIME: The total time the machine was in an aborted state for the specific shift being viewed.

IDLE TIME: The total time the machine spent in a ready to run state for the specific shift being viewed.

4.6.6 DIAGNOSTICS SCREEN

This screen provides information pertinent to troubleshooting machine faults. The pages accessed from this screen allow the user to monitor sensor input and output, set/view servo torque limits/statistics, and view stored servo fault history. Each page is further described below.

DIAGNOSTICS PAGE #1 – REMOTE I/O

Diagnostics Page 1 provides operational state of the eleven (11) Remote Input/Output Slots located within the PLC.

Red denotes an input/output that is HIGH (+24VDC).



DIAGNOSTICS PAGE #2 – INPUTS

Page 2 identifies each Input switch/sensor and its location within the PLC slots, and displays the operational state of said components.

	Inputs		I/O
11/0		MCH Ready	D1
11/1		Op Station Estop PB	D2
11/2		Upstream Load Side Estop PB	D3
11/3		Downstream Load Side Estop PB	D01
11/4		Downstream Non-Load Side Estop	D02
11/5		Upstream Non-Load Side Estop PB	TRQ
11/6		Upstream Load Side Guard Switch	SRVO
11/7		Upstream Non-Load Side Guard	TEMP
12/0		Main Load Side Guard Switch 1	
12/1		Main Load Side Guard Switch 2	
12/2		Main Non-Load Side Guard 1	
12/3		Main Non-Load Side Guard 2	
12/4		Discharge Load Side Guard	
12/5		Discharge Non-Load Side Guard	
12/6		Cat Flap Door Switch	
12/7		Pressure Sensor	
13/0		Start PB	
13/1		Stop PB	
13/2		Reset PB	
13/3		Jog PB	
13/4		Product Detect Sensor	
13/5		Overheight Product Sensor	
13/6		Customer Signal 1	
13/7		Customer Signal 2	

DIAGNOSTICS PAGE #3 – INPUTS

Page 3 identifies additional Input switch/sensor and its location within the PLC slots, and displays the operational state of said components.



DIAGNOSTICS PAGE #4 – INPUTS

Page 4 identifies each remaining Input switch/sensor and its location within the PLC slots, and displays the operational state of said components.



DIAGNOSTICS PAGE #5 – REMOTE OUTPUTS

Page 5 identifies each Remote Output switch/sensor within Slots 8 and 9, and displays the operational state of said components



(OPTIONAL) DIAGNOSTICS PAGE #6 ILOCAL OUTPUTS

PAGE #6 identifies each Local Output switch/sensor within Slots 10&11, and displays the operational state of said components



DIAGNOSTICS PAGE #7 – SERVO TORQUE

Page 7 allows the user to set Over-Torque trip points for each servo axis. This page also records the Maximum Torque an axis has encountered as well as Torque Averages.

To enter a Trip Point value, touch the corresponding icon and input the new value on the pop-up keypad that displays.

To clear the max recorded and average torque touch the Reset Values icon.

The screenshot shows the Diagnostics Page #7 - Servo Torque screen. At the top, it displays "Recipe: Pallet", the date and time "11:21:17 AM 6/28/2016", and status indicators "ABORTED", "I", "M", and a question mark icon. Below this is a toolbar with icons for various functions. The main area is a table with columns: Axis Name, Over Torque Trip Point, Max Recorded Torque, and Average Torque. The table rows are:

Axis	Over Torque Trip Point	Max Recorded Torque	Average Torque
Feeder Axis	80	60.766	1.191
Pusher Chain Axis	100	76.616	5.575
Retard Chain Axis	80	49.301	3.354
Load Side Tucker Axis	60	23.773	11.17
Non-Load Side Tucker Axis	60	32.453	7.360

TORQUE PAGE 2- In the upper left hand portion of the Diagnostics Screen #7 is the Torque Page 2 icon. Select this icon to review the additional torque values for the Non - Loadside Tucker 2 Servo axis. The following screen displays that value. On Torque page 2 in the upper left hand corner is the Torque Page 1 icon which will bring you back to Torque Page 1.



DIAGNOSTICS PAGE #8 – SERVO FAULT HISTORY

Page 8 records and displays Servo Faults. This page allows the user to view a history of fault codes, date and time the fault occurred, problem encountered, potential cause, and possible solutions.

To reset the stored history for a given servo drive; touch the Reset Servo Drive Fault History icon.



DIAGNOSTICS PAGE #9 – SERVO TEMPERATURES

Page 9 monitors and displays the internal temperature of all the servo motors serving the Enterprise Cartoner. This information is very helpful for troubleshooting potential problems.

Servo Temperatures		Internal Motor Temperature (F)	
Feeder Axis		89.907	IO
Pusher Chain Axis:		93.087	DH
Retard Chain Axis:		91.639	DQ
Load Side Tucker Axis:		92.151	DO1
Non-Load Side Tucker Axis:		91.963	DO2
Non-Load Side Tucker2 Axis:		91.617	TRG
			SRVO
			TEMP

4.6.7 MAINTENANCE SCREEN

This screen gives the user access to global set-up features, servo homing, sensor teach, and machine options. There are five (5) pages located within the MAINTENANCE SCREEN each of which is described below.

⚠ CAUTION

NEVER MAKE ANY CHANGES TO DATA CONTAINED WITHIN THE FOLLOWING SCREENS UNLESS THIS ENTIRE MANUAL HAS BEEN READ AND FULLY UNDERSTOOD.



MAINTENANCE PAGE #1 – GLOBAL SET-UP

Page 1 allows the user to set the Date, Time, and Distance Units (metric/imperial).

To enter a value, touch the corresponding icon and input the value with the pop-up keypad that displays.

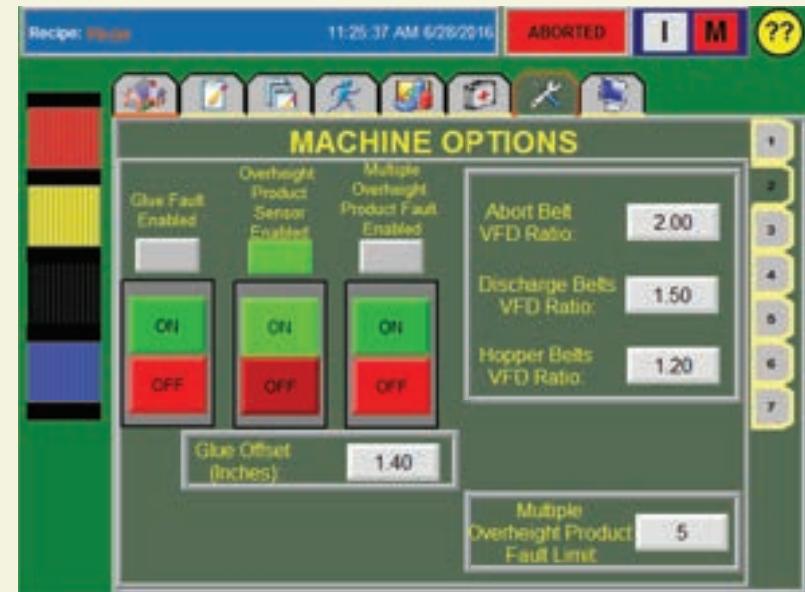
When changing the date/time, enter the desired values into the popup keypad and HOLD the blue clock icon for 5 seconds to apply the change.

MAINTENANCE PAGE #2 – MACHINE OPTIONS

Page 2 allows the user to enable/disable the Glue Fault and Over-Height sensors, as well as the glue gun offset (gun to eye) and discharge belt speed.

Glue Offset - is available here so that the operator can determine the necessary offset to fire the glue gun. This is based on the distance from the photoeye to the glue gun itself.

The Fault Limits allow a value to be set to define how many rejects/ over height products are allowed before the PLC will trigger a faulted state.



MAINTENANCE PAGE #3 – MACHINE OPTIONS

Page 3 allows the user to enable/disable the Start Delay, Discharge Jam Fault, Air Pressure Fault, Downstream Interlock, and the Upstream (Optional) Low Glue Audible Alarm enable / disable, is available here. The block at the bottom is the timeout setting in minutes.



MAINTENANCE PAGE #4 – SERVO HOMING

CAUTION

NEVER ATTEMPT TO RE-HOME A SERVO DRIVE UNLESS THIS ENTIRE MANUAL HAS BEEN READ AND THOROUGHLY UNDERSTOOD, AND YOU FULLY UNDERSTAND THE RAMIFICATIONS OF MAKING THE CHANGES.

Page 4 provides the user the ability to “Home” each Servo Axis to a predetermined position. Actual servo position is displayed for each axis.



MAINTENANCE PAGE #5 – SENSOR TEACH

Page 5 gives the user the ability to “Teach” each product, carton, and glue sensor listed an operational set point, and set the vacuum off and on positions (in degrees).



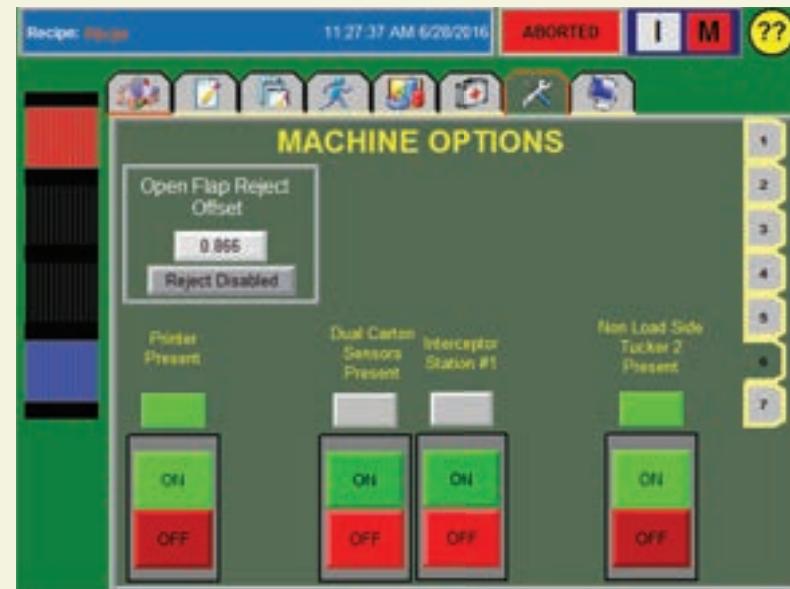
MAINTENANCE PAGE #6 – MACHINE OPTIONS

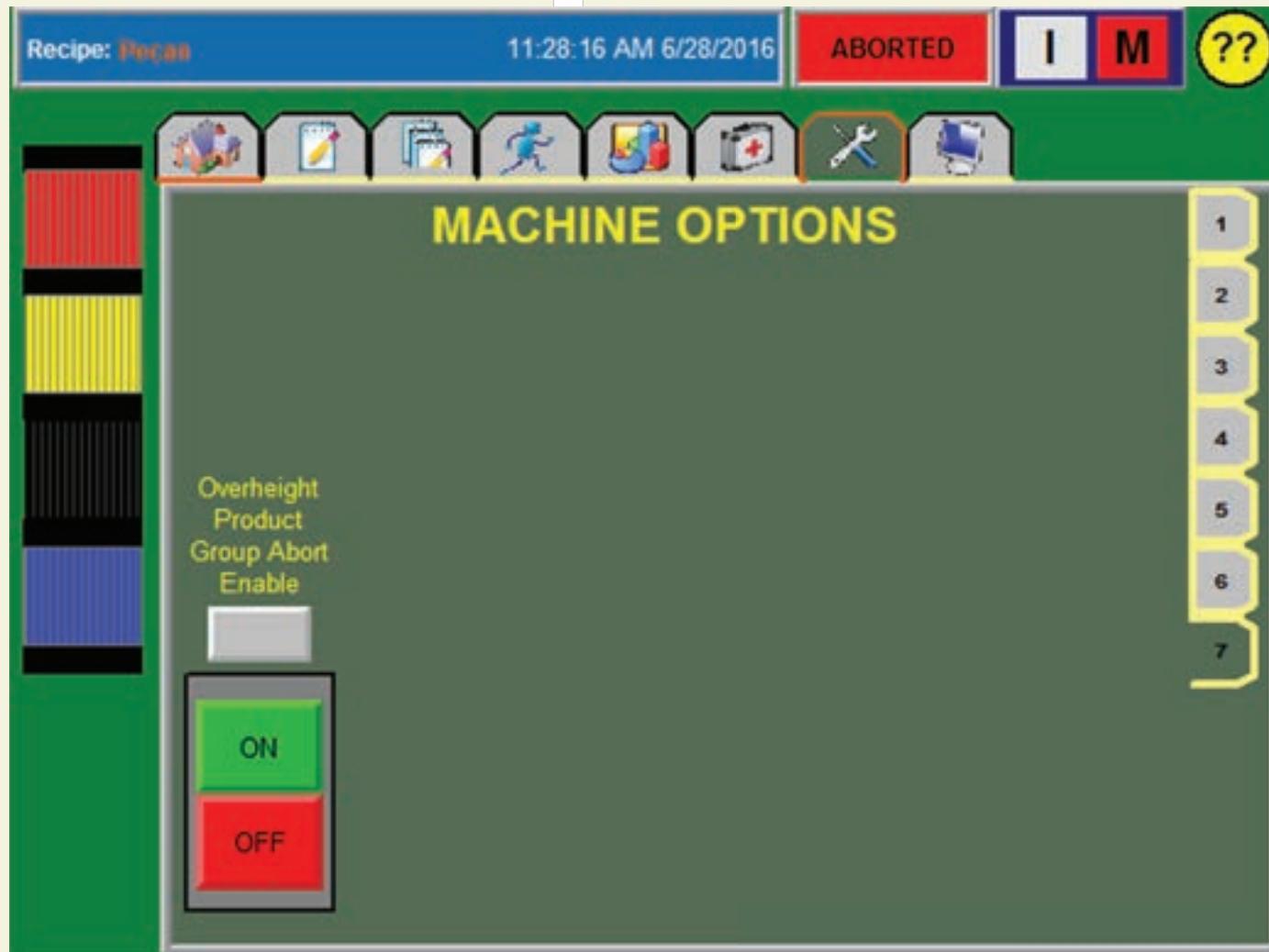
The Enable Disable Features available here are:

Printer Preset- Allows the machine to know if there is a printer enabled on.

Overhead Confiner Enable Disable- Allows the machine to know that the Overhead use is enabled.

Dual Carton Sensors Present- Enables the feature to detect the dual carton feature.



MAINTENANCE PAGE #7 - MACHINE OPTIONS

Page 7 displays the Enable Disable for the Product Group Abort feature. This is an optional feature which helps in detecting the presence of 2 or more products being joined together and then aborted from the machine.

This feature (When Enabled) aborts more products than a normal overheight system. This is to abort the overheight product which is connected (Joined Product) to another product. (Film not cut).

4.6.8 PVP DIAGNOSTICS

PVP Diagnostics provides access to the diagnostic and configuration screens for the Allen Bradley PanelView Plus HMI. This screen is divided into two pages, each identified below.

▲ CAUTION

NEVER ATTEMPT TO MAKE CHANGES TO THE HMI PROGRAMMING UNLESS THIS ENTIRE MANUAL HAS BEEN READ AND THOROUGHLY UNDERSTOOD, AND YOU FULLY UNDERSTAND THE RAMIFICATIONS **OF MAKING THE CHANGES.**

▲ WARNING

These screens are used by Kliklok-Woodman Engineering; DO NOT make any changes on the PVP Diagnostics screens UNLESS you thoroughly understand the ramifications of said changes.

PVP DIAGNOSTICS PAGE #1 – CONFIGURE

PVP Diagnostics Page 1 displays the computing memory used by the HMI and provides access into the configuration section of the display programming.

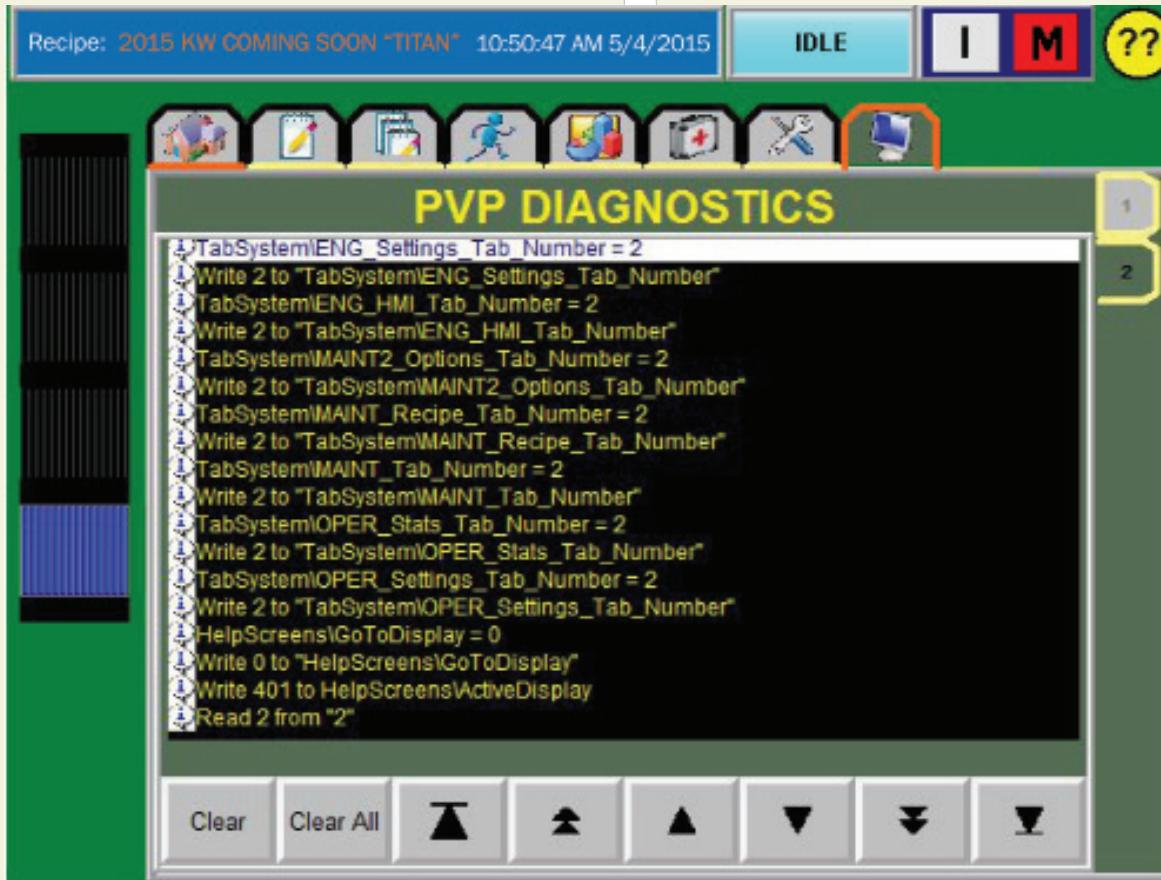


PVP DIAGNOSTICS PAGE #2

PVP Diagnostics Page 2 provides access to the computing log of the HMI program. This information can be helpful for troubleshooting potential problems.

Utilize the scroll arrows to move through the recorded data.

Utilize the clear and clear all icons to delete the recorded data.



Operation Maintenance
Manual

5.0 OPERATOR INSTRUCTIONS

5.0 OPERATOR INSTRUCTIONS

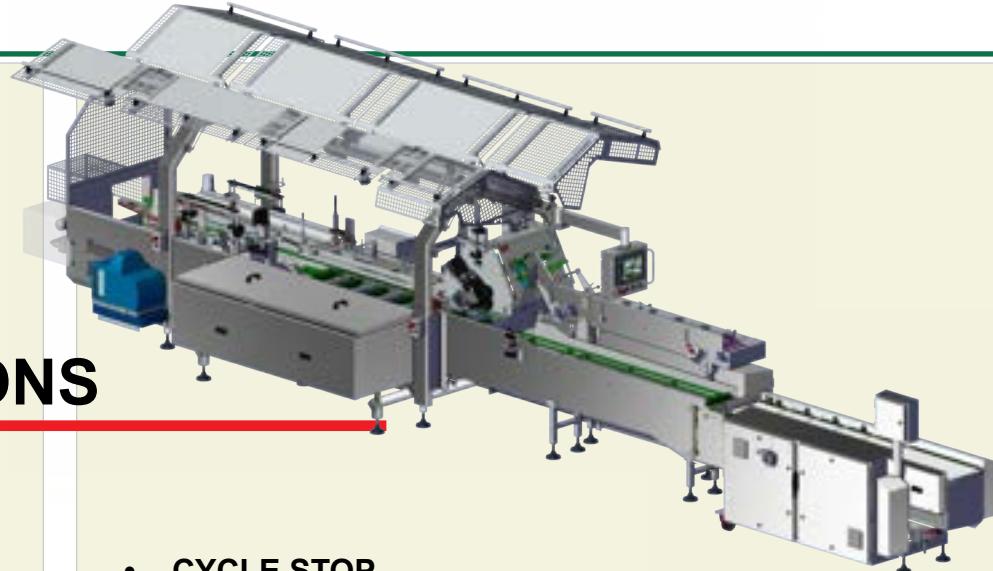
In this section, the Operator will learn how to load recipes, start, stop, and setup the Enterprise Cartoner for production and how to jog the machine manually. This section should be thoroughly read and understood prior to attempting any of the procedures outlined.

Any personnel that will work with this machinery should be familiar with the information provided in the previous sections of this manual. These sections give essential safety information and terminologies that will be utilized to complete the actions detailed.

5.1 MACHINE STATES

5.1.1 STOPS

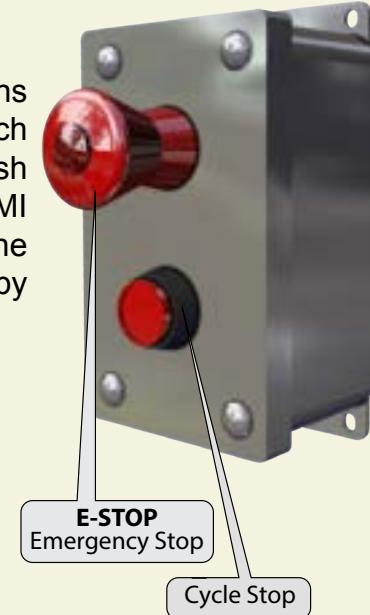
There are two types of stops, Cycle Stops and Emergency Stops. Each of these will be described below.



- **CYCLE STOP**

A CYCLE STOP is the standard means of stopping the machine. Unless required for safety concerns (i.e. when a guard door is opened, or the machine faults), all stops are cycle stops.

There are six (6) cycle stop buttons located on the machine. One on each of the four (4) emergency stop push button housings, one (1) on the HMI control panel and one (1) over the PIC. A cycle stop can be initiated by depressing any of these buttons.



- **EMERGENCY STOP**

There are six (6) EMERGENCY STOP buttons located on the machine. One on each of the four (4) corners of the machine, and one (1) on the HMI control panel and one (1) over the PIC.

An Emergency Stop (E Stop) situation exists when any of the following occur.

1. An E-Stop push button is depressed.
2. A guard door is opened.
3. A sensed jam.
4. A servo fault.
5. A glue fault

An Emergency Stop will immediately stop all machine motion, dump pneumatic air, and the control screen will display that an Emergency Stop has been actuated.

5.1.2 OPERATIONAL STATE IDENTIFICATION

The control system has four main operational states: E-Stop, Homing, Ready, and Run. These are explained in detail below.

- **E-STOP** – The machine is stopped, power is removed from components, and pneumatic pressure is released at the main regulator.
- **HOMING** – The machine is moving each axis to its home position.
- **READY** – Power is on, the servos are in their home position, and other systems are powered and ready to run.
- **RUN** – The system is running

Each state is identified either by the color coded light bar

located on the left side of the HMI screen, and/or on the message banner located at the top of the HMI screen. (see 4.3 Home Screen)

5.1.3 MACHINE STATE CHANGES

The system will enter an E-STOPPED STATE anytime a guard door is opened, an E-Stop button is pressed, or a machine fault occurs. This is also the initial state after a power-up. Change out of this state requires that all guard doors to be closed, all E-Stop buttons be reset, and all machine faults be cleared.

From E-Stop the system will change to a Resetting State, whenever the Reset button on the Control Panel is pressed. Once the safety circuit has been checked the machine will enter the “Ready State”.

In the READY STATE the system is primed to start production. To change from Ready to Run depress the Start button. Once the Start Button is pressed, the servos will move to the Start position for the selected recipe. Once this move is complete, the machine will Start. To change from Run to Ready press the cycle stop button.

Touching the red beacon will take the operator to the alarm history page.



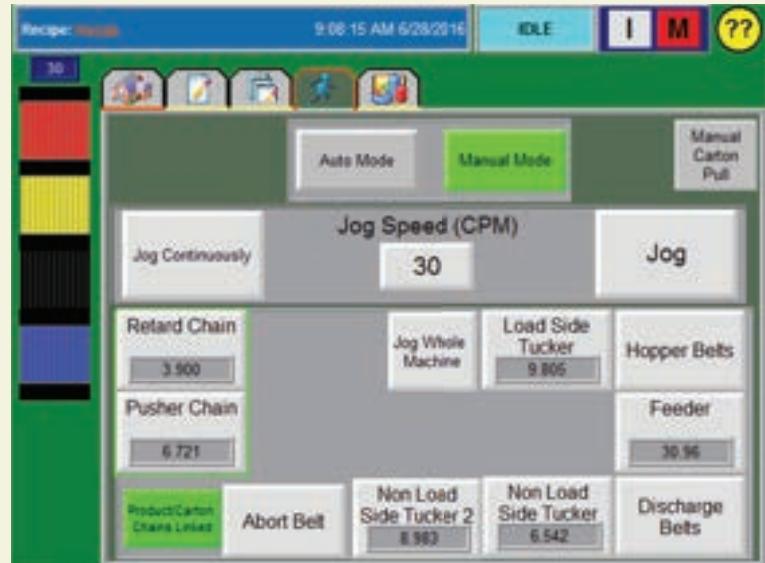
5.2 RUNNING THE MACHINE

This section will outline the steps required for a production run, how to restart the machine after a fault or jam, and how to operate the machine in manual mode.

The following procedure assumes that the machine has been setup, ready for production with the correct size change parts fitted and the required recipe selected.

The adhesive system should be at normal operating temperature, and the compressed air supply ON

5.2.1 RUNNING THE MACHINE IN MANUAL MODE



ENTERPRISE JOG SCREEN

1. Close all guard doors, clear all alarms, and reset the machine.
2. From the HOME SCREEN touch the MODE TAB.
3. Touch the MANUAL ICON to open the JOG SCREEN.
4. Touch the JOG SPEED ICON and enter the desired jog speed in the pop up keypad.
5. Touch the JOG WHOLE MACHINE ICON.



Note: In Operator mode the chains can only be jogged together.

5.2.2 RUNNING THE MACHINE IN AUTO MODE

1. Clear all machine faults.
2. Load product onto the upstream Product Infeed Conveyor.
3. Load cartons into the Hopper with the factory glue seams to the top facing upstream, and adjust guides accordingly.
4. Ensure the cartons are seated firmly and squarely in the Gate with no visible gaps.
5. Check that the Carton Sensors are reading the presence of the cartons in the hopper, adjust as necessary.
6. Check that all change parts are fitted and that all manual adjustments have been made.
7. Close all guards.
8. Check that the required recipe has been selected (see 5.4.1).
9. Check to ensure adhesive tank, hoses, and guns are at operating temperature.
10. Press the reset button to home servos.
11. Press the start button to begin production.

5.2.3 STOPPING THE MACHINE – CYCLE STOP

1. Remove any product from the Infeed Conveyor.
2. Press any of the five (5) Red Cycle Stop buttons.
3. If the machine is to be stopped for more than an hour, disable the power via the main electrical disconnect.

5.2.4 STOPPING THE MACHINE – EMERGENCY STOP

The Emergency Stop system is designed to prevent people from being injured while working on or around the machine. It is also automatically actuated when a jam occurs during operation, or if the guard doors are opened.

1. In the case of an emergency, press any of the Emergency Stop buttons positioned around the machine. The machine will come to an immediate stop, the pneumatic system will be disabled, and the control screen will display that an Emergency Stop has been actuated.
2. Remove any incompletely sealed cartons from the sealing and closing area of the machine.

CAUTION

use caution when working around hot components

3. Check the area of the machine where the jam occurred for damage.

4. Clear all machine faults that are indicated on the displayed alarm screen.
5. Close all guard doors.
6. Press the reset button to re-home the servos.
7. Press the start button.

5.2.5 RESTARTING THE MACHINE AFTER A FAULT

Recipe: A-6oz Croutons

3:20:14 PM 1/9/2016

Alarms are categorized into two types: Warnings and Faults

All warnings are self clearing and generally will not stop the machine. Warnings are displayed in the upper banner on the home screen.

In the event of a fault, the machine will stop, the pneumatic system will be disabled, and a red warning banner will be displayed on the HMI screen detailing the cause of the fault.

Clearing a fault message and resetting the machine:

1. Inspect the area where the fault has occurred and remove the cause of the fault.
2. Remove any incompletely sealed cartons from the sealing and closing area of the machine.

CAUTION

use caution when working around hot components

3. Inspect the surrounding area where the fault occurred for damage.
4. Close all guard doors.
5. Touch the displayed alarm banner to return to the home screen.
6. Press the reset button to clear the fault message.
7. Press the start button to resume production.

5.3 PERFORMING A SIZE CHANGE

The Enterprise Endload Cartoner has a semi automatic size change feature. By simply selecting a recipe, some components within the machine will automatically move and reset to new datum positions for the carton and product size while others will need to be manually adjusted.

The following sections identify the automatically adjusted components; the manually adjusted components, and describes the size change process for both.



Note: The photos and illustrations shown in this section may differ from the components on your machine. Though the size change components are customer specific and will change accordingly, the size change process remains the same.

5.3.1 ADJUSTMENT IDENTIFICATION

Automatic Servo Driven Adjustments

- Adjust the carton carrying chains to carton length.
- Adjust the P.I.C. pocket.
- Re-synchronize the Rotary Feeder position.
- Adjust the machine speed.
- Adjust the glue pattern.
- Re-synchronize carton flap tuckers.
- Phase P.I.C. to carton carrying chains.
- Park / Unpark 1st (upstream NLS) tucker.



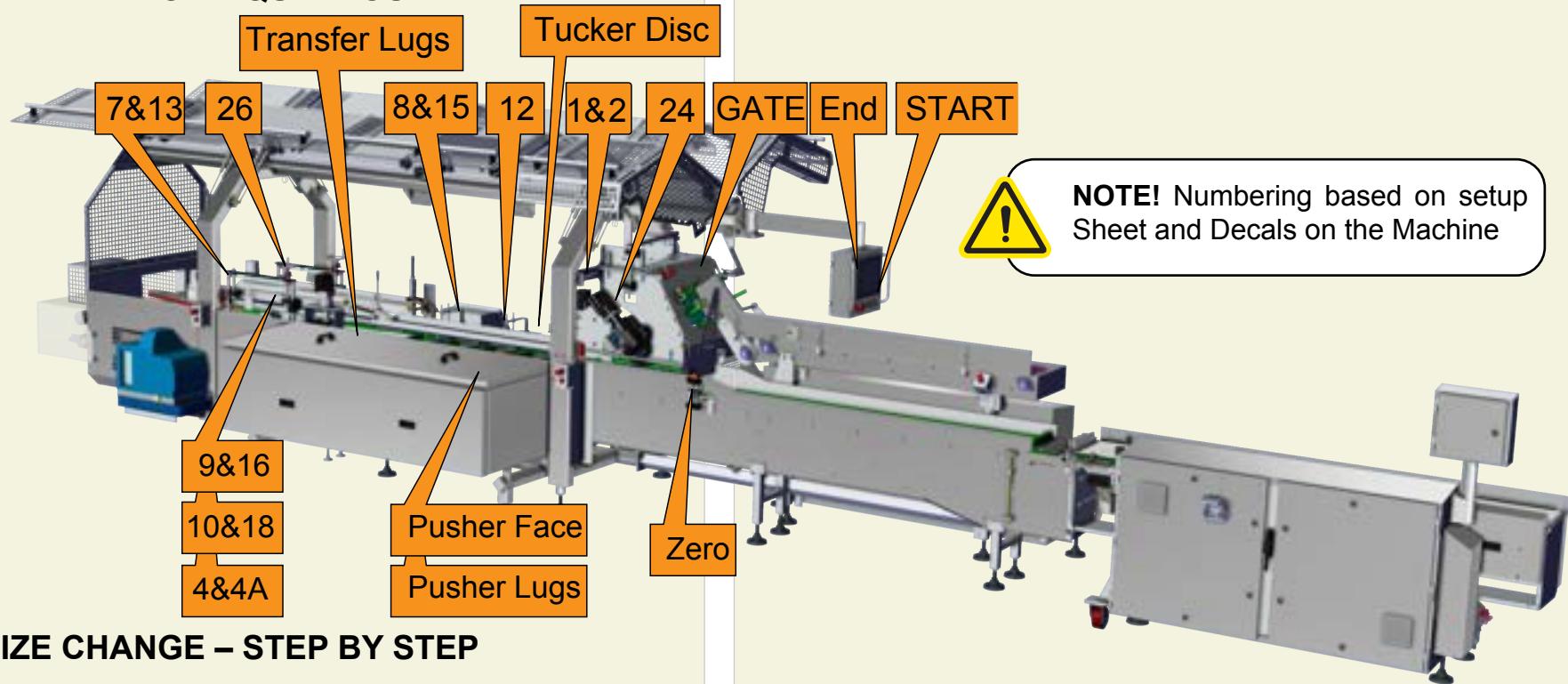
Note! If equipped with upstream equipment such as the SIPTU machine, when a new recipe is loaded the required recipe will also load with the joining equipment from KW.

Manual Adjustments

- Adjust the Cartoner Depth of Insertion.
- Adjust the Rotary Feeder Height.
- Adjust the Overhead Carton Guides.
- Adjust the Carton Hopper Feed Sensor.
- Adjust the Vertical and Horizontal Hopper Advance.
- Adjust the Rotary Feeder Feed Arms.
- Change the Quick Disconnect Inserter pusher faces.
- Change the Carton Gate.
- Adjust the Hopper Carton Guide Rail.
- Adjust the Glue Guns.
- Adjust the Over Height Product Sensor
- Phase P.I.C. to transfer chain.
- Phase transfer chain to carton carrying chains.
- Swap out Tucker disc's if required on the Upstream Flap Tucker Wheel.
- Adjust and or swap the upper major and lower major flap plow (Depending on Carton Size)
- Remove / add 2nd (downstream NLS) tucker change part.

5.4 DETAILED SIZE CHANGE INSTRUCTIONS

5.4.1 SIZE CHANGE – QUICK GUIDE



5.4.2 SIZE CHANGE – STEP BY STEP

The Change Parts required for a Size Change are identified on the RECIPE SETTINGS SCREEN. Prior to starting a Size Change it is recommended that you gather the needed Change Parts.

The numbers displayed are in reference to the setup sheets. In some cases the machine is equipped with additional change parts that are not required for the specific setup of the recipe. If shown as optional the operator must determine if part needs to be changed. Those are described and not numbered. Called out numbers are in sequence and does not reflect the order of the setup sheets. Setup Sheets follow screen pages.



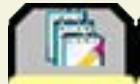
CHANGING THE RECIPE

START

Stop any upstream equipment and allow remaining product to run out of machine.

Stop the machine by pressing the **CYCLE STOP** button.

From the Home Screen on the HMI touch the **RECIPE MENU ICON**. This screen displays the currently selected recipe, with an arrow ► to its left as well as other accessible recipes.



To select a recipe for production, touch whichever of the ten (**10**) **BLUE RECIPE BARS** (containing the recipe name) you want to run. This will move the selection arrow ► to that recipe. You may also scroll the arrow ► up/down through the Recipe Bar by utilizing the scroll icons to its right. You may also scroll the arrow up/down through the available recipes by utilizing the Scroll Icons.



Pusher Face

Touch the **LOAD ICON**. This will cause a pop-up box to display asking you to confirm your selection. Touch the green check ✓ to confirm the change, touch the red X to cancel the change.

6. Before completing the checklist an “INSERTER RETRACT” pop-up box will display on the HMI, touch the green check to confirm the retraction of the Inserter Rails. This will facilitate changing the Inserter Piston Pusher Faces and ensure no machine damage from inserter piston interference with other components.

Touch the **RECIPE CHECK LIST ICON**.

Consecutively complete the required changes shown on the **RECIPE CHECK LIST** and by following the instructions below.

Inserter Retract

Are you sure you would like to move the Inserter rails to the retracted position?



Caution:

The machine will automatically move if the ✓ button is pressed.

CHANGING THE INSERTER PUSHER FACE (Optional Change Part - Change if required)

If the INSERTER PISTON PUSHER LUGS are to be changed, it will be necessary to manually jog the machine to gain access to the components. (see section 5.2.1)

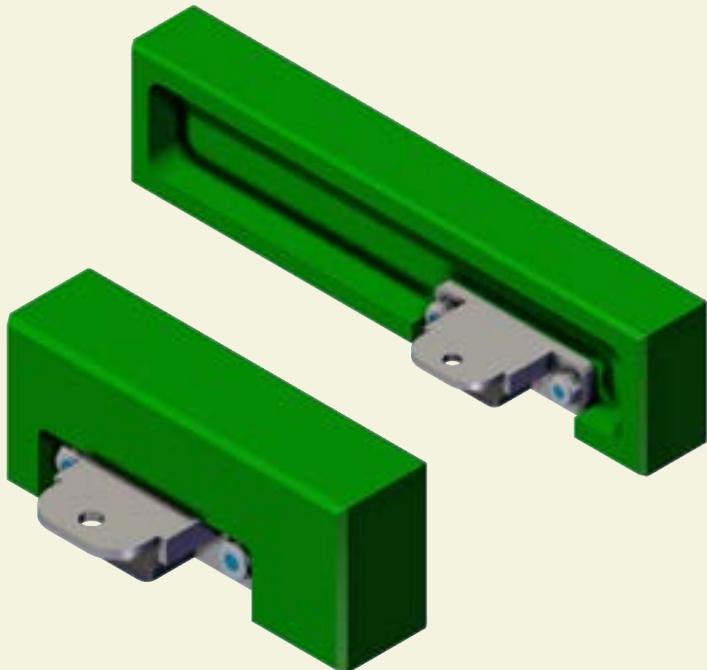
Open the guard door on the load side of the machine. Remove the QUICK DISCONNECT PISTON PUSHER LUGS that are accessible and install new ones.

Close the guard door and jog the machine until the remaining lugs and paddles are accessible, remove/install the remaining lugs and paddles.

Check the alignment of the PISTON PUSHER LUGS to ensure they do not clash with the TRANSFER CHAIN or each other.

Pusher Lugs

CHANGING THE INSERTER PISTON PUSHER LUGS.



If the **INSERTER PISTON PUSHER LUGS** are to be changed, it will be necessary to manually jog the machine to gain access to the components. (See 5.2.1). It is very important when changing the pusher lugs that when re-fitting them, the locking pins spring into the fixing holes.

9. Open the guard door on the load side of the machine. Remove the **QUICK DISCONNECT PISTON PUSHER LUGS** and **QUICK DISCONNECT** that

are accessible and install new ones. It is very important when changing the pusher lugs and transfer lugs that when re-fitting them the locking pins spring into the fixing holes.

Use a small pointed object to push the pusher pins so the pushers can be released.

Close the guard door and jog the machine until the remaining lugs are accessible, remove/install the remaining lugs.

Check the alignment of the **PISTON PUSHER LUGS** to ensure they do not clash with the **PIC** or **Transfer Chain**

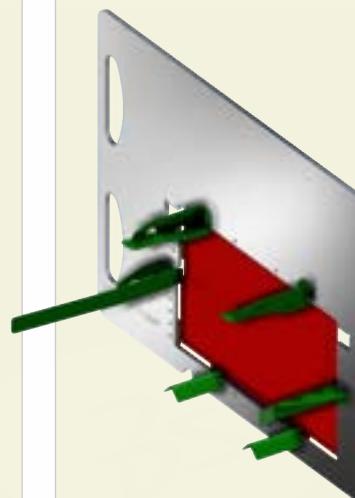
GATE

CHANGING THE CARTON GATE / ADJUSTING THE HOPPER (Color Coded Change part / Optional Change)

Release the locking handle on the **VERTICAL HOPPER ADVANCE** and slide upwards to clear the carton stack.

Empty the cartons from the **CARTON HOPPER**.

Remove the **LOW CARTON SAFETY SENSORS** from each side of the Carton Gate.



Pull the **GATE LATCH** down to release the **CARTON GATE**.

Remove the **CARTON GATE** by sliding outwards.

Refit the new **CARTON GATE**, ensuring that it is securely seated within the location slots, and that the **GATE LATCH** fully engages.

Refit the **LOW CARTON SAFETY SENSORS**.

Load the new cartons onto the gate with the factory glued seam to the top, facing upstream, pressing them firmly together so that no gaps are visible between cartons.

Adjust the **CARTON SIDE GUIDE** on the side of the hopper to accommodate the new carton size. Adjustment is achieved by turning the two (2) handles located on the non-load side of the Powered Hopper Conveyor.

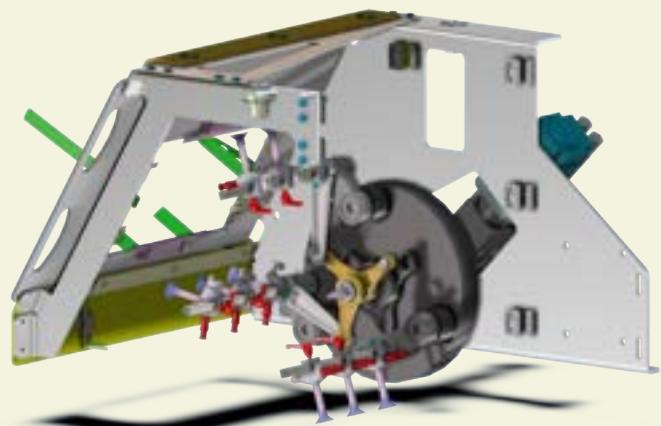
Slacken the fixing handle on the **VERTICAL HOPPER ADVANCE** and slide downwards. Position the guides so that they just contacts the tangent point of the carton stack profile. Tighten the fixing handle.

24

ADJUSTING THE ROTARY FEEDER

Loosen the handles on the **ROTARY FEED ARMS** and adjust the **VACUUM CUPS** to the desired setting on the etched scale. Tighten the handles and repeat the process for the two remaining arms.

Utilizing a suitable size socket (13mm), adjust the **HEIGHT** using the size change control until the desired setting is displayed on the digital indicator.



1&2

ADJUSTING THE CARTON ERECTOR SKI GUIDES



!NOTE! The following two steps must be completed simultaneously. Extra care must be taken to ensure no interference between the Erector Ski Guides, and Carton Conveyor Lugs. Interference between these components could result in personnel injury and/or machine damage.

Loosen the handle on the non-load side **CARTON ERECTOR SKI GUIDE**.

Move the guide so it does not contact with the main carton conveyor pushing/retarding lugs should adjustment to the **CARTON CONVEYOR DEPTH OF INSERTION** be carried out.

Adjust the **ERECTOR SKI GUIDES** to the desired setting on the etched scale, **AFTER** the **CARTON CONVEYOR DEPTH OF INSERTION** adjustment has been carried out.

26 ADJUSTING THE CARTON CONVEYOR – DEPTH OF INSERTION

Locate the size change control for the **CARTON CONVEYOR DEPTH OF INSERTION** adjustment on the non-load side of the machine.

Utilizing a suitable size socket (13mm), rotate the adjuster until the desired dimension is displayed on the digital indicator.

Adjust the **SKI GUIDES** to the desired settings as outlined in the previous steps.

Transfer LUG**Changing the TRANSFER LUG**

(Optional Change Part - Change if required)

During each Size change you may be required to change the transfer Lug Assembly. These come as retarder lug and a pusher lug. The lugs are located in sync with the inserter piston arms and the infeed lugs which carry the cartons. As stated before all change parts are labeled with a specific color coded system and a stamped letter. For each size box find the correct color or letter for the box and look for that on the Transfer lugs.



Note: Each Transfer Lug Assembly requires the operator to slide into place utilizing the key hole slots. Each one has a knob which is spring loaded. The pin must drop into the hole correctly. Be sure to check each lug once installed, that they are secure. Hold the top of the lug and lightly shake checking for loose connections.

12**ADJUSTING THE UPSTREAM OVERHEAD CARTON GUIDE**

Locate the **NON-LOAD SIDE OVERHEAD CARTON GUIDE** on the upstream end of the machine.

Loosen the three (3) handles securing the guide to its attachment points.

Adjust the **NON-LOAD SIDE OVERHEAD CARTON GUIDE** to the desired setting on the three (3) etched scales

Tighten the three (3) handles.

7 & 13**ADJUSTING THE DOWNSTREAM OVERHEAD CARTON GUIDES**

Locate the **OVERHEAD CARTON GUIDES** on the downstream end of the machine.

Utilizing the **HAND CRANK**, rotate the adjuster until the desired dimension is displayed on the digital indicator.

Repeat the process for the opposing side.

9 & 16 ADJUSTING THE GLUE GUN HEIGHT

Make sure all heated components are allowed time to cool completely prior to making adjustments to them. Failure to do so could result in severe injury.

Utilizing a suitable socket (10mm) slacken the three attachment bolts securing the **GLUE GUN BRACKET** to the **GLUE GUN MOUNT**.

Slide the **GLUE GUN** to the desired setting on the etched scale.

Tighten the three attachment bolts.

Repeat process for the opposing side.

10 & 18 ADJUSTING THE GLUE GUN ANGLE

Make sure all heated components are allowed time to cool completely prior to making adjustments to them. Failure to do so could result in severe injury.

Utilizing a suitable socket (10mm) Loosen the three (3) attachment bolts securing the **GLUE GUN ANGLE** adjustment point.

Rotate the glue gun to the desired setting on the etched scale.

Tighten the attachment bolts.

Repeat process for the opposing side.

4 & 4A ADJUSTING THE LOWER AND UPPER MAJOR FLAP PLOWS.

LOWER MAJOR FLAP PLOW : Locate the Lower major flap plow on the upstream end of the machine, just after the tuck wheel.

Utilizing a suitable socket (10mm), loosen the two (2) attachment bolts securing the plow to the bracket.

. Slide the PLOW to the desired setting on the etched scale.

Tighten the attachment bolts.

UPPER MAJOR FLAP PLOW : Locate the upper major flap on the downstream end just after the glue guns.

Utilizing a suitable socket (10mm), loosen the two (2) attachment bolts securing the plow to the bracket.

Slide the PLOW to the desired setting on the etched scale.

Tighten the attachment bolts.

8 & 15 ADJUSTING THE COMPRESSION ROLLER ASSEMBLIES

Locate the **COMPRESSION ROLLER ASSEMBLIES** on the downstream end of the machine, just prior to the out feed belts.

Utilizing a suitable socket (13mm) Loosen the attachment bolts securing the compression rollers.

Slide the assembly to the desired setting on the scale.

Tighten the attachment bolts

0 (Zero) ➔ ADJUSTING THE OVER HEIGHT PRODUCT DETECT SENSOR

Locate the **OVER HEIGHT PRODUCT SENSOR** on the upstream end of the machine, load side, prior to the **ROTARY FEEDER**.

65. Rotate the handle on the size change control until the desired dimension is displayed on the digital indicator.

When processing irregular shaped products it is recommended that you allow an extra 2mm - 3mm for the setting.

Tucker Disc ➔ Tucker Disc Swap (If Required)

Depending on the recipe it may be necessary to swap the tucker disc's or remove a portion of the disc. On the upstream tucker assembly the discs are color coded to match requirements for each recipe. Based on the setup sheets for each recipe determine the required method and perform the change.

Using a suitable wrench remove the screws and either remove or swap the necessary Tucker Disc assembly.

Install the required tucker disc (if any) and secure tightly back into place.

End**CHECKS AND FINAL ADJUSTMENTS**

Close all guard doors and reset any stops.

Retrieve the JOG Control Screen and **slowly** operate the machine.

Check that the **ROTARY FEEDER VACUUM CUPS** are correctly timed and will not clash with the **OVERHEAD CARTON ERECTOR SKI GUIDES**.

Check that the inserter pusher faces do not clash with the product infeed conveyor.

Check that the **PRODUCT INFEED CONVEYOR** does not clash with the **OVERHEAD CONFINER PADDLES (OPTIONAL)**

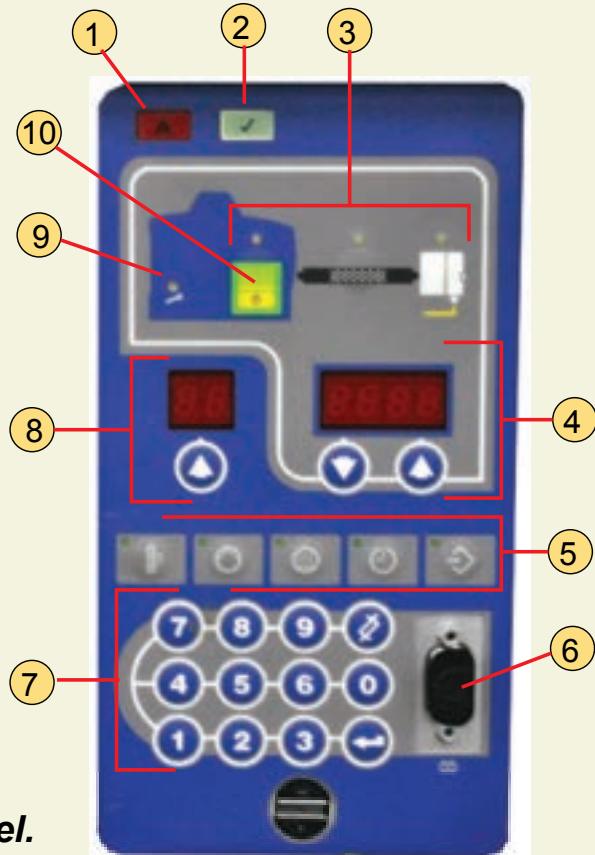
Check that the cartons are erecting correctly, and the glue stripe position is correct. This is achieved by briefly covering the product sensor on the infeed conveyor with a piece of card stock then running the machine.

Slowly run the machine with product. Check that the **P.I.C. POCKET** is set correctly for the product.

Check that the product passes smoothly from the a PIC under the overhead confiner, and into the carton.

Gradually increase the machine speed, checking that the machine continues to operate correctly.

5.5 NORDSON PRO-BLUE 7 USER'S GUIDE



Control panel.

1. Fault LED
2. Ready LED
3. Component keys/LEDs
4. Right display and scroll keys
5. Function keys
6. Serial port
7. Keypad
8. Left display and scroll key
9. Service LED
10. Tank low-level LED

DANGER

Safety when Gluing

As a safety feature the Nordson glue jetting is only enabled in the run condition, when in hand, jog or guard/emergency stop actuated mode the jetting is disabled.

5.5.1 ProBlue Melters - Symbols



ProBlue Melters



DuraBlue Melters



DuraBlue L Melters

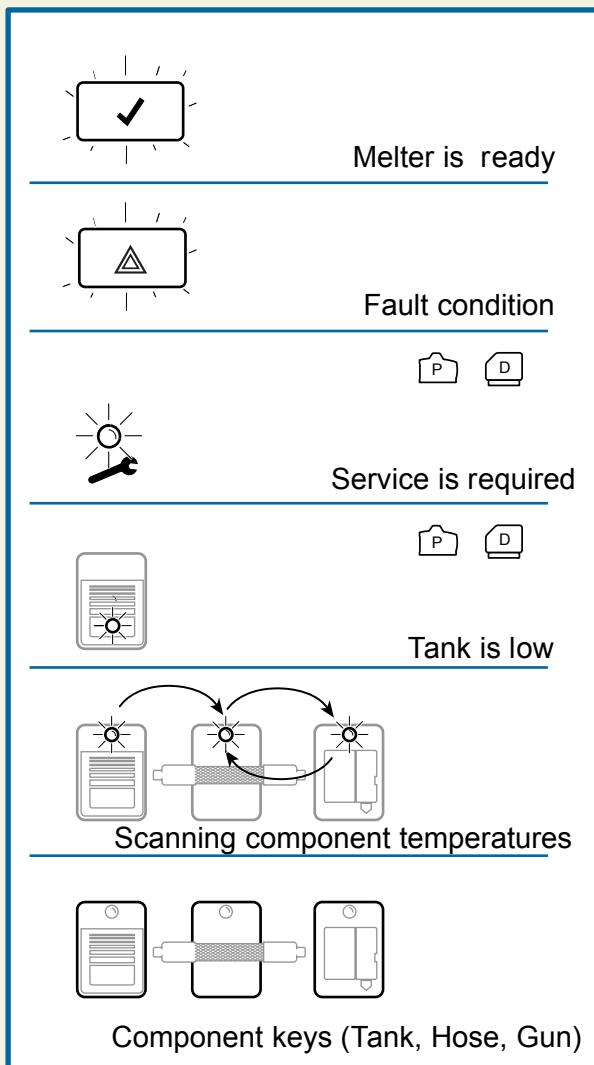


Observe
Attention
Beachten
Osservare

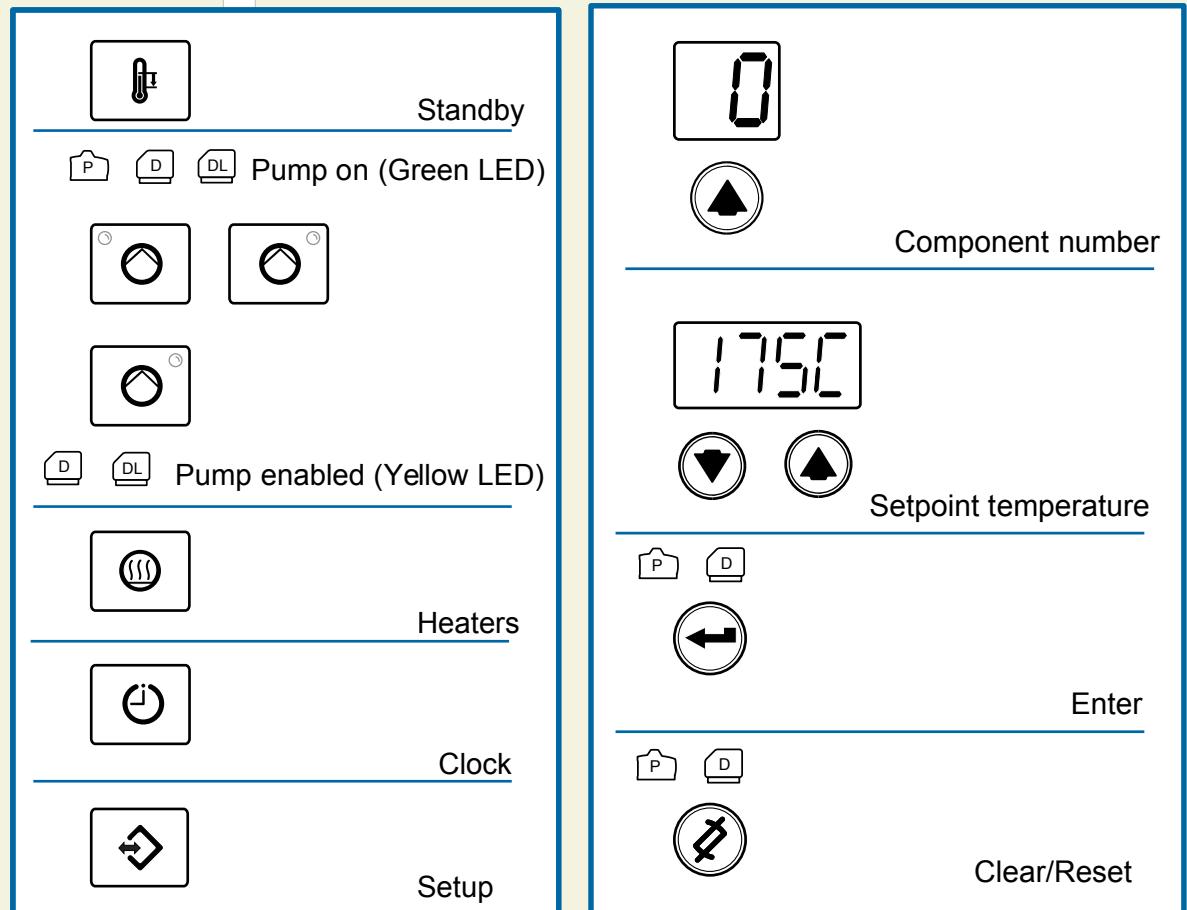


Press or hold

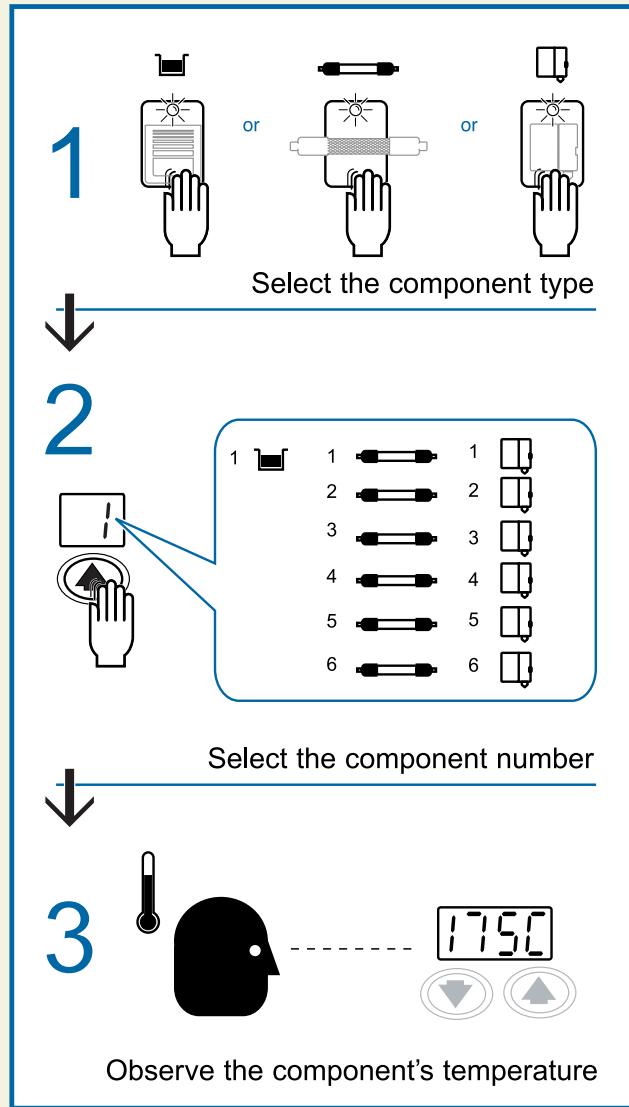
5.5.2 Controls and Indicators



5.5.3 Controls and Indicators



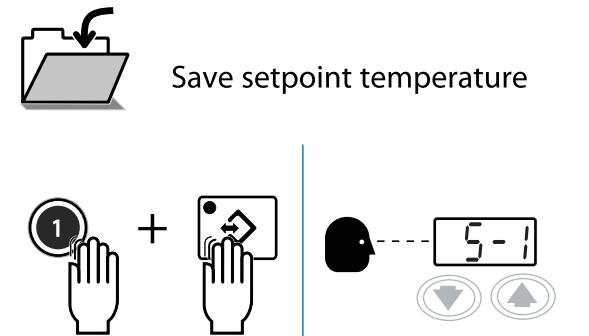
5.5.4 To Check Component Temperatures



5.5.5 To Save or Restore Set-point Temperatures

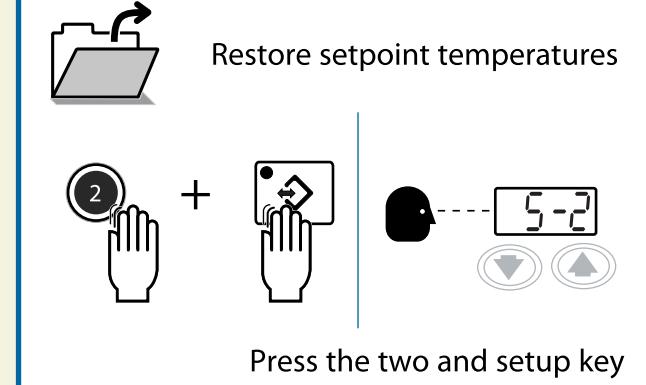
To save a set-point temperatures.

1. Press the one and setup key.

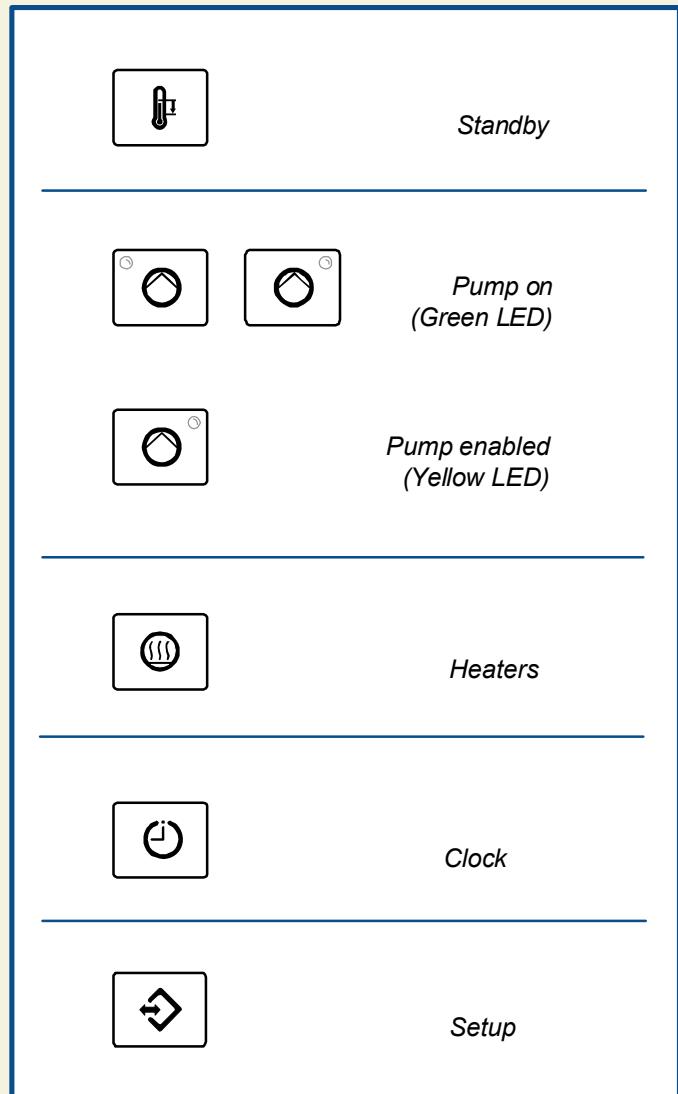


To Restore a set-point temperatures.

1. Press the one and setup key.



5.5.5 Controls and Indicators (contd.)



Operation Maintenance
Manual

6.0 MAINTENANCE

6.0 MAINTENANCE

This section will detail Recommended Maintenance Schedules, Lubrication Tables, Machine Cleaning, and Troubleshooting.

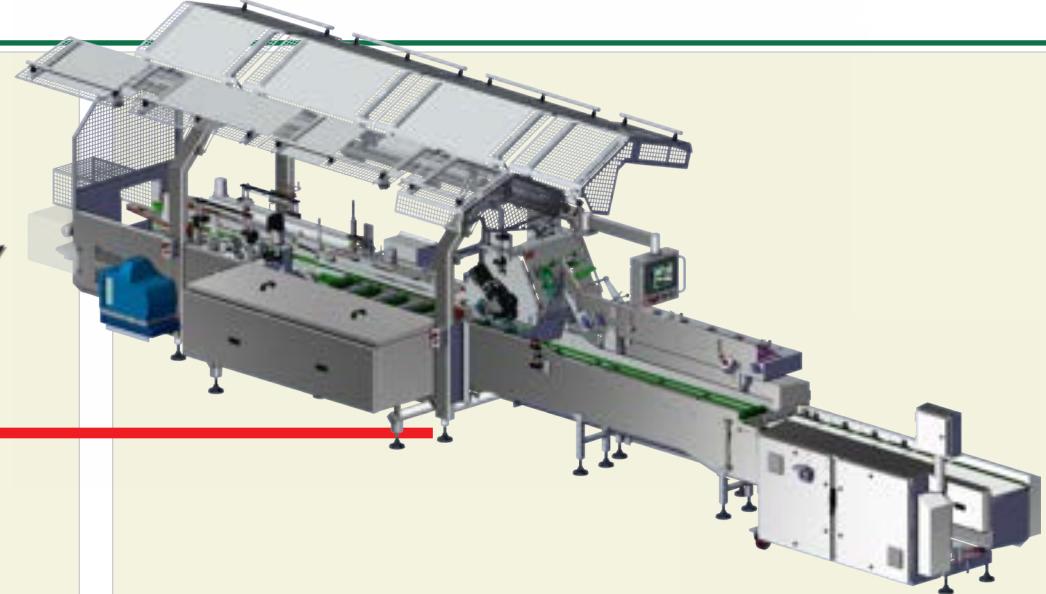
Any personnel responsible for completing maintenance tasks on the Enterprise Endload Cartoner must have thoroughly read, and completely understand, the information contained within this manual.

Prior to carrying out any maintenance activity, push in one of the emergency stop buttons and open a guard door to prevent machine from being started.



6.1 DAILY MAINTENANCE SCHEDULE

New parts, particularly conveyor or drive chains and belts, may affect machine operation and timing.



A preventative maintenance schedule should be employed every 8 hours. The following checks should be carried out daily before starting production.



1. Check for missing or damaged parts
2. Check all moving parts for signs of wear or insecure fixing.
3. Inspect the condition of all belts. Clean if required, with warm water and a soft cloth. Replace a belt that is damaged or broken.
4. Report noisy operation of the motors and gearboxes to Kliklok-Woodman Service Department.
5. Check that all interlock switches on the guards are working properly. Replace if damaged or defective.

6. Check that all Emergency Stop push buttons are working properly. Replace if damaged or defective.
7. Gently clean and inspect all sensors. Take care not to disturb the position of any sensor.
8. Inspect all pneumatic filters. Clean / replace as required.

Every 100 Hours of Operation

Component	Maintenance Task	Corrective Action
Chain Tracks	Check for wear and foreign objects or Glue build up	Clean or Scrape out as required
Gearboxes	Check for leaks and oil levels	Fill as required
Jack Shafts & Nuts	Check to make sure they are lobed and Operating normally	Lube as required

6.2 MAINTENANCE SCHEDULE

Every 8 Hours of Operation

Component	Maintenance Task	Corrective Action
Belts	Check for wear and proper tension	Replace and / or adjust
Glue System	Check for glue build up and / or charring on The glue nozzles	Clean with stiff bristle brush. Do not Use a steel brush.
	Check for contamination	Purge one cup of glue from tank
	Check for glue build up on plows and Folders	Scrape glue off
	Check for glue pattern accuracy and timing	Adjust as necessary through the HMI
Compression Rollers	Check for missing or loose roller rubbers	Replace and / or adjust as necessary
Pop-Up Lugs	Check for missing or damaged lugs	Replace as necessary
Bearings	Follow prescribed lubrication schedule	N/A
Sensors & Reflectors	Check for dirt build-up or damage	Clean with soft cloth
Air Filter	Check air filter for electrical enclosure Cooling system	Clean and / or replace as outlined in Owners manual
Interlocks	Check for proper operation	Replace as required
Lug Actuator	Check for proper operation	Adjust as necessary

Every 50 Hours of Operation

Component	Maintenance Task	Corrective Action
Chains	Check for wear and proper tension	Replace and / or adjust
Bearings	Check excessive play and / or noise	If worn, replace
Fasteners	Check for loose or missing fasteners	Tighten and / or replace as necessary
Guard Doors	Check for dirty build up	Scrape glue off
	Check to ensure that the actuator and Switch are still secure	Adjust as necessary through the HMI
	Check and examine all cable entries and Connections	Replace and / or adjust as necessary
	Check that the latch is adjusted correctly	Replace as necessary

6.2.1 GENERAL

8. Every 25 hours, check the tension on new chains. These stretch quickly during the first 200 hours of operation
9. Within four weeks of initial installation, check all nuts, bolts, and other fasteners for security. Tighten any that may have worked loose.
10. Within two weeks of fitting new parts, check that the parts are securely fastened. Tighten any loose fasteners.

6.2.2 EVERY 8 HOURS

Refer to the Daily Maintenance Schedule in 6.1 above.

6.2.3 EVERY 50 HOURS

1. Check the operation of the Electrical Power Isolator. Repair or replace as needed.
2. If the carton size has not been changed during the previous 50 hours running, after lubricating the screws, jack nuts, and splined shafts as laid out in the Lubrication section, adjust the Carton Conveyor, Hopper Side Guide, and Closing Guide Assemblies over the full size range. The movement of the adjustment screws carries lubricant into the threads and prevents them from seizing.
3. Inspect the Carton & Product Conveyors. Fit new belts / chains if needed.

4. Check/adjust the tension of all conveyor chains and bands. The main carton conveyor has visual tension gauges located beneath the carton gate. The Product Infeed Conveyor has visual tension gauges on the upstream end. If these gauges are in the red, add tension to the chains to move the indicator into the green. (see section 6.4 Conveyor Adjustments)
5. Check that all sensors and associated circuits operate correctly. Correct any faults.
6. Check the operation of the Load/Abort Jam Sensors on the Piston Inserter (If Equipped).. Replace if damaged or defective.

6.2.4 EVERY 250 HOURS

1. Inspect all sensors. Clean them or fit new ones as needed.
2. Check the operation of all Sensors.
3. Check the operation of all Guard Safety Switches.
4. Inspect all Drive Motors, Drive Belts, and/or Drive Chains.
5. Inspect all Conveyors.
6. Inspect all Chain Driven Sprockets for signs of wear/ damage. Replace as needed.
7. Check/change the bearings in Idler Sprockets.

8. Inspect all Pulleys for wear/damage. Replace as needed.

6.2.5 EVERY 500 HOURS

1. Inspect all chains. If the chain stretch exceeds 2%, fit new chains.
2. Lubricate the external grease fittings of the Rotary Feeder with: Tom-Pacific.....TP-2431, as defined on the included lubrication chart.

6.2.6 EVERY 750 HOURS

1. Inspect all gearboxes. Check for noisy operation and backlash.

6.2.7 EVERY 3000 HOURS

1. Remove all drive chains for cleaning and lubrication. Fit new chains if required.
2. Inspect all bearings. Check for bearing wear and damage to the bearings and housings.
3. Strip and inspect the overload clutches, if applicable. Clutch removal is described within manufactures bulletins located in the back of this manual.
4. If the clutches are serviceable, lubricate as recommended in the section 6.3 Lubrication. Reassemble and refit.
5. Fit new blades and filter to the vacuum pumps, if applicable, as described in the manufacture's literature located in the back of this manual.

6.3 LUBRICATION

Kliklok-Woodman Lubrication Instructions (Food Machinery Lubricants)

Oil applications		
• Oil cups-Daily (Formers).....	Lubriplate.....	FMO85AW
• General Use-Daily.....	Lubriplate.....	FMO85AW
• Chain-Weekly.....	Lubriplate.....	FP-150L

Grease Applications		
• Bearings-Weekly.....	Lubriplate.....	FML-1
• Cam Followers-Weekly.....	Lubriplate.....	FML-2
• Spine Shafts-Weekly.....	Locite Anti Seize :1167237	
• Jack Screws-Weekly.....	Locite Anti Seize ..	167237

Rotary Feeders		
• Servo Feeder Boxes.....	Klübersynth.GE 14-151 (Reconditioned Units Only)	
• Manual Rotary Feeders - Monthly.....	Tom-Pacific.....	TP-2431

Gear Boxes		
• Refer to Manufacturers instru		
• Tolo-Matic gearboxes-Monthly.....	Anderol.....	783-2

Central Lubrication System		
• Manual system (Oil)-Pump Once per day (check reservoir often)....	FMO85AW	
• Manual system (grease)-Pump Once per day (check reservoir often)....	FGL-0	

Open Drives		
• Open Gears-----Weekly---(Brush On).....	Lubriplate.....	FML-2
• Cam Tracks-----Weekly---(Brush On).....	Lubriplate.....	FML-2

RED = DailyBlue = WeeklyBlack = Monthly ... Green = Overhaul Only

Refer to the machine Manual if high Pressure wash down is used
039428C

6.3.1 GENERAL INFORMATION

The Enterprise Cartoner has been fitted with maintenance free, "lubricated for life" bearings. No further lubrication is required.

The Main Drive Gearbox is "lubricated for life" and requires no additional lubrication.

It is recommended that light weight oil be applied to the chains following any washdown procedure, to aid in the displacement of any remaining water.

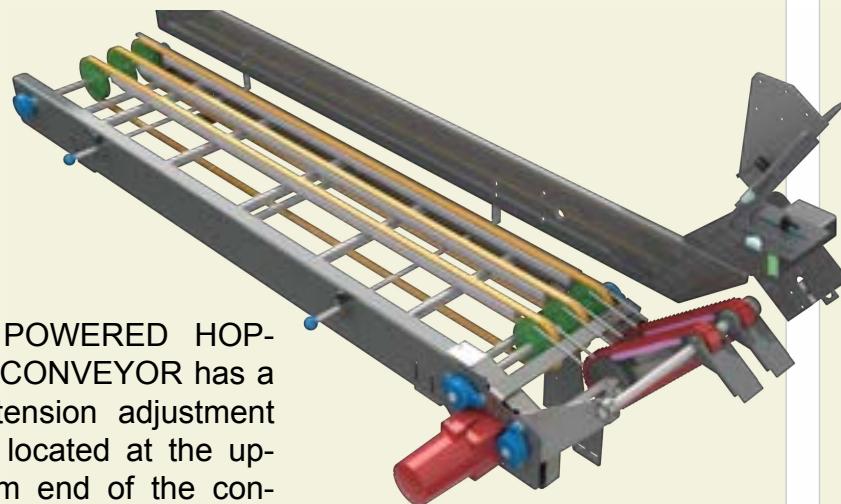
It is recommended that the Jacking Shafts be lubricated with an anti-seize lubricant. After lubricating the screws and jack nuts adjust the components through their entire adjustment range. The movement of the adjustment screws carries lubricant into the threads and prevents them from seizing.

6.4 CONVEYOR ADJUSTMENTS

It is recommended that the Jacking Shafts be lubricated with an anti-seize lubricant. After lubricating the screws and jack nuts adjust the components through their entire adjustment range. The movement of the adjustment screws carries lubricant into the threads and prevents them from seizing.

This section will identify the adjustment points of each and then explain the steps necessary to make any needed adjustments.

6.4.1 POWERED HOPPER CONVEYOR



The POWERED HOPPER CONVEYOR has a belt tension adjustment point located at the upstream end of the conveyor bed.

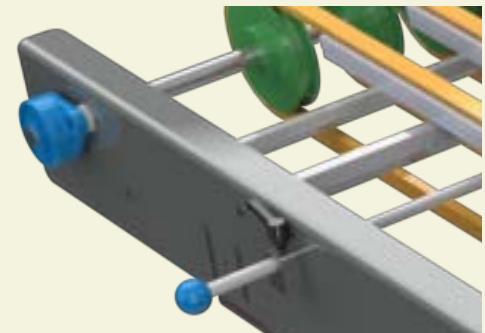
To adjust the conveyor belt tension:

1. Locate the four (4) attachment bolts securing the tail shaft bearings to the conveyor frame.

2. Utilizing a 17mm socket slacken these four attachment bolts.

3. Manually pull the shaft and bearings upstream, (away from the gate) applying tension to the belts.

4. While keeping the tension firm, tighten the four attachment bolts.



6.4.2 PRODUCT INFEED CONVEYOR

The PRODUCT INFEED CONVEYOR has two (2) conveyor tension adjustments. These are located on the upstream tail end of the conveyor, one on the load side and another on the non-load side.



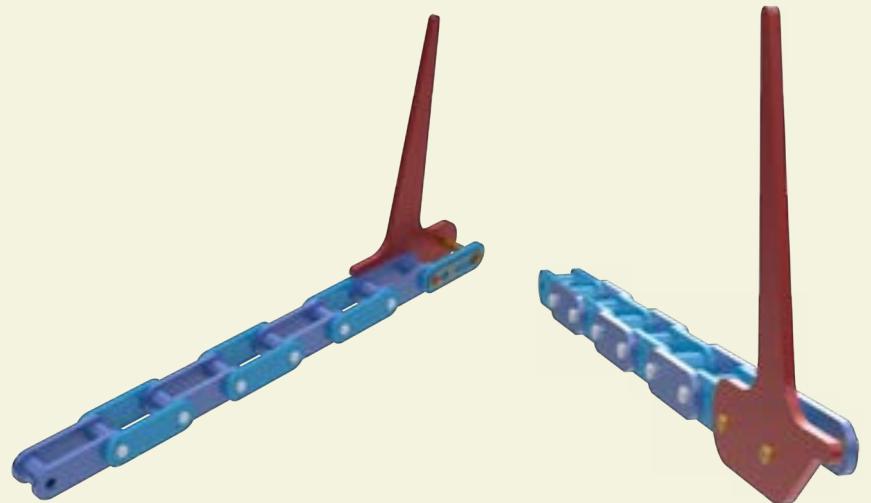
To adjust the tension:

1. Locate the two (2) TENSION ADJUSTMENT POINTS on the upstream end of the product infeed conveyor.
2. Utilizing a suitable wrench (19mm) loosen the jam nuts located on each of the JACKING SHAFTS.
3. Turn the adjustment nuts, adding/removing tension to the conveyor chains, until the POINTERS are just fully in the GREEN AREA.
4. Tighten the jam nuts, locking the jacking shafts in place.



6.4.3 FLIGHT CHAINS CONVEYOR

The **FLIGHT CHAINS CONVEYOR** has two (2) conveyor tension adjustments, each fitted with VISUAL INDICATORS. These are located on the non-load side, upstream end of the conveyor beneath the carton gate.



Inspection of the **VISUAL INDICATORS** will show if the conveyor is tensioned properly. A **POINTER IN THE GREEN** area indicates the conveyor is tensioned properly. A **POINTER IN THE RED** area indicates tension must be added.

To adjust the tension:

1. Locate the four (4) **TENSION ADJUSTMENT POINTS** on the non-load side, upstream end of the flight chains conveyor. Beneath the carton gate.
2. Utilizing a suitable wrench (17mm) turn the attached cap nuts, adding/removing tension to the conveyor chains, until the POINTERS are just fully in the GREEN AREA.

6.4.4 OUTFEED TAKEAWAY BELTS TENSIONING

The outfeed belts take the cartons away from flight chains as the flight lugs go around the head sprockets so that no damage is done to the cartons by the flight chains. The speed of the belts is controlled by the HMI and the belt tensioning is shown by loosening the motor and sliding it upstream. Do not over tighten the belt as it will become quite noisy.

6.4.5 INSERTER CHAIN TENSIONING

The inserter chain is tensioned by jacking the tail shaft on both sides of the inserter. The shaft should be kept parallel as the chains/sprockets will wear quickly if they are not kept parallel.

6.4.6 SERVO FEEDER HEIGHT BELT TENSIONING

To keep the feeder horizontal across the machine it is important to keep a good tension on the height adjustment belt.

Simply loosen the bolt and turn the tensioner pulley to tighten the belt.

6.5 MACHINE CLEANING

6.5.1 PRECAUTIONS

Stop the machine and set the electrical isolators to the OFF position before starting any cleaning procedure.

1. Consult the manufacturers bulletins located in the back of this manual prior to starting any cleaning procedures.

2. Use hot water with care. Overheating can damage components.
3. Germicidal solutions may, in time, degrade some materials.
4. If a water jet or steam hose is utilized for cleaning. DO NOT direct the jet at electrical boxes and motors.
5. Although the machine is sealed to resist penetration of the washing solution into working parts, electrical cabinets, etc., hose jets could penetrate the seals. Use caution.
6. Take care when cleaning items which could be damaged by washing down. For example
 - Hot Components
Allow to cool before cleaning
 - Chains
Lubricate after cleaning if required
 - Belts
Rinse off washing solutions and air dry
 - Grease Nipples, Sensors, Bearing Seals
Do not clean with direct high pressure
 - Lexan guarding

DO NOT USE DETERGENTS OR USE A SCRUBBING ACTION AS THE LEXAN WILL SCRATCH VERY EASILY.

7. Wash down the machine as specified in section 6.4.2
8. After washing with chemical solutions, rinse with clear water.

9. Do not rinse surfaces which are required to be sanitized and the sanitization would be destroyed by rinsing with clear water.

6.5.2 LOW PRESSURE WASH DOWN IP65

General Cleaning Procedures

1. First of all, power the machine down and allow the machine to cool for a minimum of 30 minutes. Heated motors could pull in moisture during the cooling process. Even though the motors are rated for washdown, it's better to establish a procedure on the more conservative side.
2. All electrical enclosures with cooling fans must be covered in plastic. All operator interface touch screens must be covered with plastic. The Nordson glue tank must be covered in plastic. Operators should avoid any direct water spray on the enclosures, operator interface, or Nordson tank.
3. A standard hose and sprayer head supplying approximately 20-70 PSI can be used to presoak the areas of the machine requiring cleaning. Never exceed a maximum spray pressure of 100 PSI.
4. A spray bottle or hose dispenser device can be used to apply a mild soap or non-caustic detergent.
5. The machine must be rinsed clean if soaps are used in the cleaning process. The rinse process will be done with the same 20-70 PSI hose.

6. The machine should be dried with cloths prior to power up. At a minimum, the product contact areas should be dried. Do not use compressed air blow-guns to dry the machine. The compressed air can drive water into the seals of motors, bearings, and electrical connections.
7. Uncover the machine and lubricate any points described in your manual. A good practice is to wipe down some obvious components with a light weight oil to avoid corrosion.
8. Power up and dry cycle the machine for a few minutes.

Kliklok-Woodman low pressure wash-down machine construction:

1. IP65 motors and connectors
2. IP65 sensors.
3. IP65 electrical enclosures.
4. Nordson wash-down guns and hoses.
5. Plastic or stainless steel bearing housings. Bearing inserts can be corrosion resistant steel.
6. Corrosion resistant coated or stainless steel bearings.
7. Stainless steel construction (Grade 304).

8. Some painted finish parts (frame)
9. All aluminum parts are anodized.
10. Nickel plated chain.
11. Splash guards fitted to some components.
12. Continuous welding where practical. Use of silicon to seal bug trap areas.

6.5.3 PROCEDURES FOLLOWING CLEANING

The following procedures replace grease forced out of the bearings and oil removed from the chains during cleaning.

1. Thoroughly dry the machine.
2. Lubricate bearings, cam followers, chains and exposed gears.

6.6 TROUBLESHOOTING

This section will aid in resolving any issues you may encounter with your equipment. It is recommended that you first consult the Diagnostics Screens in the HMI (section 4.5.6)

6.6.1 REPLACING A SERVO MOTOR

1. Remove power from the machine.
2. Remove old MOTOR, disconnecting the two attached cables.
3. Replace the MOTOR, and reconnect the two cables.
4. Re-apply Power to the machine.
5. Re-Home the axis. (see section 7.2 Component Homing)

6.6.2 REPLACING AN AMPLIFIER

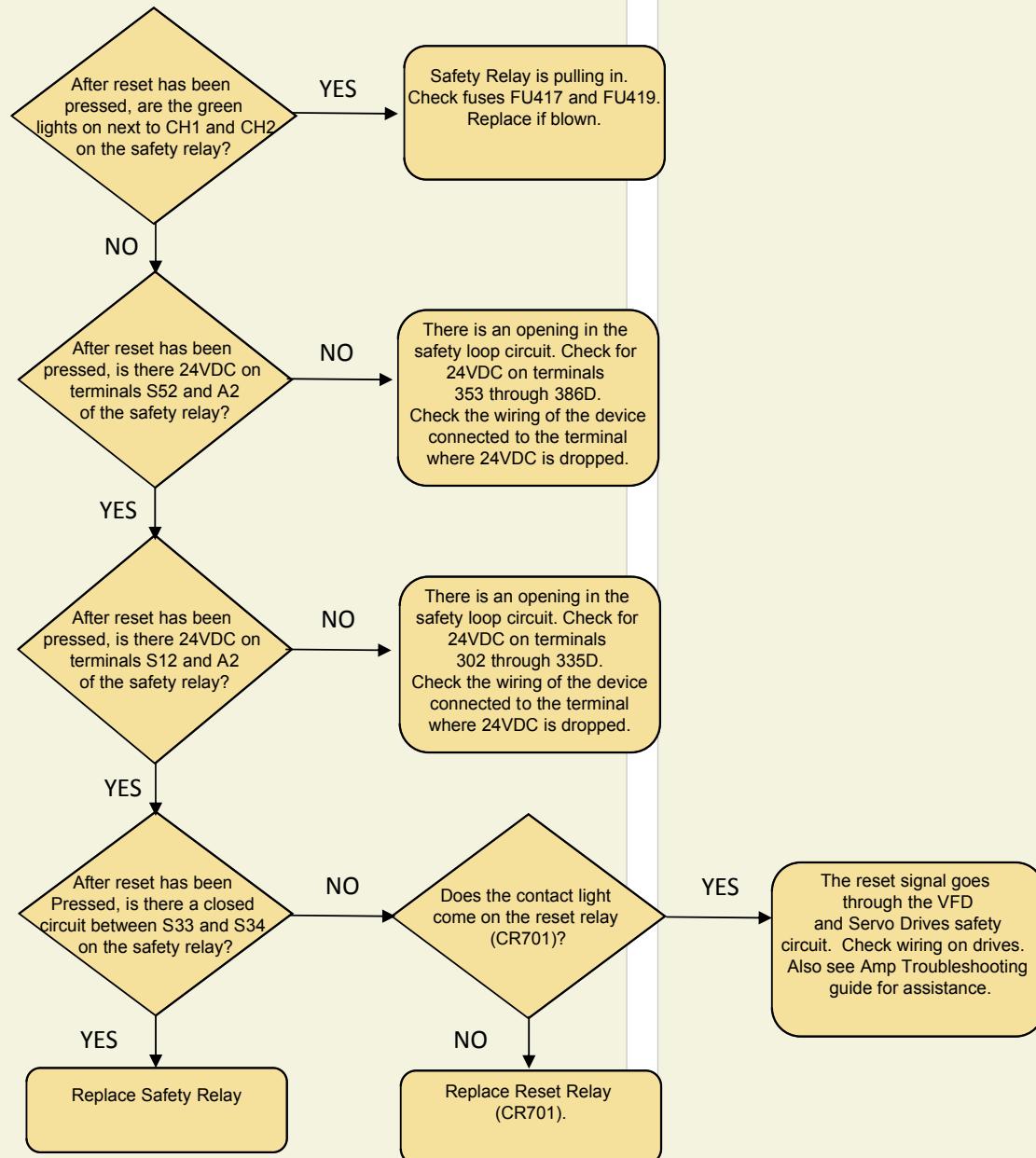
1. Remove power from the machine.
2. Remove the AMPLIFIER.
3. Reinstall the three (3) power wires to the new AMPLIFIER (power in to the amplifier).
4. Reinstall the four (4) motor power wires to the AMPLIFIER (power out to the motor).
5. Reconnect the serial cable (used for I/O to the amplifiers).
6. Reconnect the two (2) SERCOS fiber optic cables ensuring the correct positioning of the Optic cables.
Note: The cables form a ring with each amplifier as a node.

7. Set the MSD (Most Significant Digit) to 0.
8. Set the LSD (Least Significant Digit) to the previous value (found on the electrical schematic).
9. Set the BAUD Rate to 4 MB.
10. Re-apply Power to the machine.
11. Set the HOME position on the axis for the replacement amplifier. (see section 7.2 Component Homing)
12. Note: There is no program stored in the amplifier and nothing needs to be downloaded into the amplifier.



NOTE: Take extra care when replacing an amplifier as the connection between the amplifier and back plane are very fragile.

6.6.4 SAFETY CIRCUIT TROUBLESHOOTING



6.6.5 SERVO FAULTS AND ERROR CODES

Observe the following safety precautions when troubleshooting.

▲ CAUTION

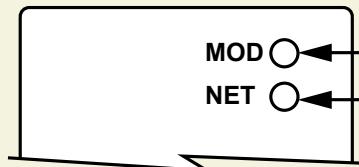
Observe the following safety precautions when troubleshooting.

Capacitors on the DC bus may retain hazardous voltages after input power has been removed. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

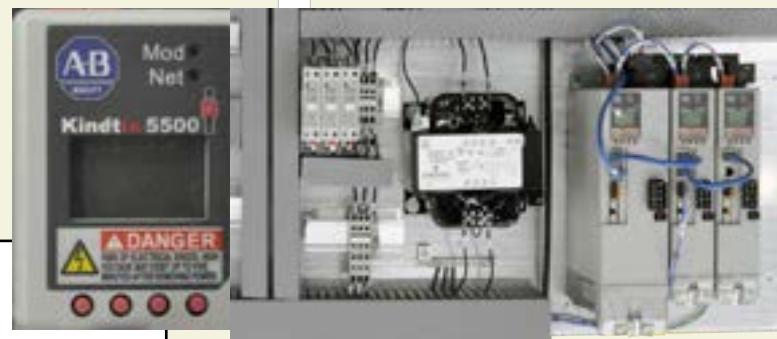
Do not attempt to defeat or override the drive fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.

Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

Kinetix 5500 Servo Drive



MOD Module Status
NET Network Status



MOD LED= STEADY GREEN
NET LED= STEADY GREEN

Refer to ROCKWELL Troubleshooting tables below:

Kinetix 5500 Drive Status Indicators		Table 48 Status Indicator
CONDITION	STATUS	
Steady Off	No Power Applied to drive	
Steady Green	Drive is Operational. No Faults or Failures.	
Flashing Green	Standby (drive not configured)	
Flashing Red	Major recoverable fault. The drive detected a recoverable fault, for example an incorrect or inconsistent configuration	
Steady Red	Major Fault. The Drive detected a non-recoverable fault.	
Flashing Green/Red	Self-Test. The Drive performs self-test during powerup.	

Table 49- Network Status	
CONDITION	STATUS
Steady Off	No power Applied to drive or IP address is not configured
Flashing Green	Drive connection is not established but has obtained an IP address.
Steady Green	Drive Connection is established. Normal Operation
Flashing Red	Connection timeout. One or more of the connections, for which this drive is target, has timed out
Steady Red	Duplicate IP address. IP address specified is already in use.
Flashing Green/Red	Self-Test. The Drive performs self-test during powerup.

Fault codes triggered by conditions that fall outside factory set limits are identified by FL at the end of the display message. For example, FLT S07 – MTR OVERLOAD FL.

Fault codes triggered by conditions that fall outside user set limits are identified by UL at the end of the display message. For example, FLT S08 – MTR OVERLOAD UL.

TABLE 56 - FLT SX Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S03 – MTR OVERSPEED FL	Motor Overspeed Factory Limit Fault	Motor speed has exceeded 125% of its maximum speed.	Check control loop tuning.
FLT S04 – MTR OVERSPEED UL	Motor Overspeed User Limit Fault	Motor speed has exceeded motor overspeed user limit.	<ul style="list-style-type: none"> Check control loop tuning Increase the Motor Overspeed UL attribute value
FLT S05 – MTR OVERTEMP FL	Motor Overtemperature Factory Limit Fault	Calculations based on the motor thermistor indicate that the motor factory temperature limit has been exceeded.	<ul style="list-style-type: none"> Operate motor within continuous torque rating Reduce motor ambient temperature Add motor cooling <small>Available only on Kinetix VP motors. Not supported on induction motors.</small>
FLT S07 – MTR OVERLOAD FL	Motor Thermal Overload Factory Limit Fault	The motor thermal model has exceeded its factory set thermal capacity limit of 110%.	Modify the command profile to reduce speed or increase time.
FLT S08 – MTR OVERLOAD UL	Motor Thermal Overload User Limit Fault	The motor thermal model has exceeded the thermal capacity limit given by Motor Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the command profile Increase the Motor Thermal Overload UL attribute value
FLT S09 – MTR PHASE LOSS	Motor Phase Loss	The motor has failed torque proving.	Check motor connections.
FLT S10 – INV OVERCURRENT	Inverter Overcurrent Fault	Inverter current has exceeded the instantaneous current limit (determined by hardware).	<ul style="list-style-type: none"> Check motor power cable for shorts Verify motor windings are not shorted Verify motor power wire gauge Operate within the continuous power rating Reduce acceleration times
FLT S11 – INV OVERTEMP FL	Inverter Overtemperature Factory Limit Fault	The measured inverter temperature has exceeded the factory set temperature limit.	<ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed
FLT S13 – INV OVERLOAD FL	Inverter Thermal Overload Factory Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the factory set thermal capacity rating of 110%.	Modify the command profile to reduce speed or increase time.
FLT S14 – INV OVERLOAD UL	Inverter Thermal Overload User Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the limit given by Inverter Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Increase the Inverter Thermal Overload UL attribute value
FLT S15 – CONV OVERCURRENT	Converter Overcurrent Fault	The measured converter current has exceeded the factory set current limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce number of capacitor modules
FLT S16 – GROUND CURRENT	Ground Current Factory Limit Fault	The sensing circuitry in the power stage has detected excessive ground current.	<ul style="list-style-type: none"> Check motor power wiring; check power cable for shorts Replace motor if the fault persists

TABLE 56 - FLT SXX FAULT CODES (CONTINUED)

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S18 – CONV OVERTEMP FL	Converter OverTemp Factory Limit Fault	The measured converter temperature has exceeded the factory set temperature limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Modify the command profile to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed
FLT S20 – CONV OVERLOAD FL	Converter Thermal Overload Factory Limit Fault	The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce duty-cycle of commanded motion
FLT S21 – CONV OVERLOAD UL	Converter Thermal Overload User Limit Fault	The converter thermal model indicates that the temperature has exceeded the limit given by Converter Thermal Overload User Limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce duty-cycle of commanded motion Increase the Converter Thermal Overload UL attribute value
FLT S23 – AC PHASE LOSS	AC Single Phase Loss Fault	A single AC input phase was lost while the drive was enabled.	Check AC input voltage on all phases.
FLT S25 – PRECHARGE FAILURE	Pre-charge Failure Fault	The pre-charge circuit monitoring algorithm detected that the DC bus did not reach a factory set voltage level after charging for a period of time.	<ul style="list-style-type: none"> Check AC input voltage on all phases Check input power wiring Replace drive if fault persists
FLT S29 – BUS REG OVERLOAD FL	Bus Regulator Thermal Overload Factory Limit Fault	The shunt thermal model has exceeded its factory set thermal capacity limit.	<ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Add capacitor module if needed
FLT S30 – BUS REG OVERLOAD UL	Bus Regulator Thermal Overload User Limit Fault	The shunt thermal model has exceeded the thermal capacity limit given by Bus Regulator Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Increase the Bus Regulator Thermal Overload UL attribute value Add capacitor module if needed
FLT S31 – BUS REG FAILURE	Bus Regulator Failure	The shunt driver IC has detected that the shunt resistor is shorted.	<ul style="list-style-type: none"> Check for shorts in the shunt connector Unplug the shunt connector and measure the resistance of the shunt Replace drive if shunt resistor is shorted
FLT S33 – BUS UNDERVOLT FL	Bus Undervoltage Factory Limit Fault	DC Bus voltage level is below the factory set limit as determined by the configured input voltage.	<ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input
FLT S34 – BUS UNDERVOLT UL	Bus Undervoltage User Limit Fault	DC Bus voltage level is below the user set limit as given by Bus Undervoltage User Limit.	<ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input Increase Bus Undervoltage UL attribute value
FLT S35 – BUS OVERVOLT FL	Bus Overvoltage Factory Limit Fault	DC Bus voltage level is above the factory set limit as determined by the configured input voltage.	<ul style="list-style-type: none"> Change the deceleration or motion profile of all drives connected to the DC bus Unplug the shunt connector and measure the resistance of the shunt Replace drive if shunt resistor is open
FLT S39 – BUS POWER LEAK	Bus Power Leakage Fault	Measured converter power exceeded estimated inverter output power by more than a factory limit.	<ul style="list-style-type: none"> Check bus power sharing configuration attribute Check AC input and DC bus sharing connections
FLT S45 – FDBK COMM FL	Motor Feedback Data Loss Factory Limit Fault	The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit.	<ul style="list-style-type: none"> Check motor feedback cable and connector Check motor power cable and feedback wire shields are secured correctly Check motor frame is grounded correctly

TABLE 56 - FLT SXX FAULT CODES (CONTINUED)

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S47 – FDBK DEVICE FAILURE nnF	Feedback Device Failure	The feedback device has detected an internal error. The nn sub-code is defined as follows: 1: ACCELERATION OVERFLOW 4: TRACKING FILTER ERROR 5: VECTOR LENGTH ERROR 6: COUNTER ERROR 7: SYNCHRONIZATION ERROR 16: SINGLE TURN ERROR 17: MULTI TURN AMPLITUDE ERROR 18: MULTI TURN SYNC ERROR 19: MULTI TURN VECTOR LENGTH ERROR 35: STANDARD PARAMETER ERROR 36: INTERNAL COMMUNICATION ERROR1 37: INTERNAL COMMUNICATION ERROR2 38: INTERNAL SYSTEM ERROR 48: CRITICAL TEMPERATURE 49: CRITICAL LED CURRENT 50: CRITICAL SUPPLY VOLTAGE 51: CRITICAL SPEED 52: CRITICAL ACCELERATION 53: COUNTER OVERFLOW 54: INTERNAL MONITORING ERROR 66: INTERNAL RESOURCE ACCESS ERROR	<ul style="list-style-type: none"> Check motor feedback cable and connector Cycle control power Replace motor if fault continues Check feedback shield connection Reduce shock and vibration to motor
FLT S49 – BRAKE SLIP FLT	Brake Slip ExceptionM	Motor slip has exceeded brake slip tolerance.	Check motor brake.
FLT S54 – POSN ERROR	Excessive Position Error Fault	The position error of the position control loop has exceeded the value given by Position Error Tolerance for a time period given by Position Error Tolerance Time.	<ul style="list-style-type: none"> Check position loop tuning Increase the feedforward gain Verify sizing of the drive and motor Check motor power wiring Increase Position Error Tolerance and/or Position Error Tolerance Time attribute values
FLT S55 – VEL ERROR	Excessive Velocity Error Fault	The velocity error of the velocity control loop has exceeded the value given by Velocity Error Tolerance for a time period given by Velocity Error Tolerance Time.	<ul style="list-style-type: none"> Check velocity loop tuning Reduce acceleration Verify sizing of the drive and motor Check motor power wiring Increase Velocity Error Tolerance and/or Velocity Error Tolerance Time attribute values
FLT S56 – OVERTORQUE LIMIT	Overtorque Limit Fault	Motor torque has risen above user defined maximum torque level given by Overtorque Limit for a time period given by Overtorque Limit Time.	<ul style="list-style-type: none"> Verify Torque Trim value Verify motion profile Verify sizing of the drive and motor Increase Overtorque Limit and/or Overtorque Limit Time attribute values
FLT S57 – UNDERTORQUE LIMIT	Undertorque Limit Fault	Motor torque has dropped below user defined minimum torque level given by Undertorque Limit for a time period given by Undertorque Limit Time.	<ul style="list-style-type: none"> Verify motion profile Verify sizing of the drive and motor Decrease Undertorque Limit and/or Undertorque Limit Time attribute values

Table 57 - FLT Mxx Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT M02 – MOTOR VOLTAGE	Motor Voltage Mismatch Fault	The configured voltage of the drive is greater than the motor rated voltage. For example, a 400V-class drive with a 200V-class motor.	Set the drive voltage to a lower value or replace motor with voltage rating that matches the drive.
FLT M25 – COMMON BUS	DC Common Bus Fault	AC power was detected by the drive while configured for shared DC operation.	<ul style="list-style-type: none"> • Check the drive power configuration from controller • Check wiring
FLT M26 – RUNTIME ERROR	Runtime Error	The drive firmware encountered an unrecoverable runtime error.	<ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues
FLT M28 – SAFETY COMM (2198-Hxxx-ERS2 drives only)	Safety Module Communication Error	Communication with the safety hardware within the drive has failed.	<ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues

Table 58 - INIT FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INIT FLT M01 – ENCODER DATA	Smart Encoder Data Corruption	The data stored in the encoder has a checksum error.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
INIT FLT M02 – MTR DATA RANGE	Motor Data Range Error	A motor data attribute stored in the encoder is out of range.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
INIT FLT M03 – MTR ENC STARTUP	Motor Feedback Communication Startup	Communication with the encoder could not be established.	<ul style="list-style-type: none"> • Cycle control power • Check motor feedback connector • Check motor power and feedback shield terminations on the drive • Return motor for repair if fault continues
INIT FLT M14 – SAFETY FIRMWARE	Safety Firmware	The loaded Safety firmware is not compatible with the drive firmware.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
INIT FLT M20 – UNKNOWN MODULE	Unknown Module	The product code of the power board is invalid.	<ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues

Table 59 - INHIBIT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INHIBIT S02 – MOTOR NOT CONFIGURED	Motor Not ConfiguredT	The motor has not been properly configured for use.	Verify motor configuration in the Logix Designer application.
INHIBIT S03 – FEEDBACK NOT CONFIGURED	Feedback Not Configured	The feedback has not been properly configured for use.	Verify feedback configuration in the Logix Designer application.
INHIBIT M05 – SAFE TORQUE OFF	Start Inhibit – Safe Torque Off	The safety function has disabled the power structure.	<ul style="list-style-type: none"> • Check safety input wiring • Check state of safety devices

Table 60 - NODE FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE FLT 01 – LATE CTRL UPDATEC	ontrol Connection Update Fault	Several consecutive updates from the controller have been lost.	<ul style="list-style-type: none"> • Remove unnecessary network devices from the motion network • Change network topology so that fewer devices share common paths • Use high performance network equipment • Use shielded cables • Separate signal wiring from power wiring
NODE FLT 02 – PROC WATCHDOG nnP	rocessor Watchdog Fault	The processor on the power board or control board failed to update in a certain amount of time. The nn sub-codes 00...06 are internal and result in the same possible solution.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 00H	ardware Fault -PwrIF	Communication with the power board could not be established.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 01	Hardware Fault - Power BoardD	SP chip on the power board failure.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
NODE FLT 03 – HARDWARE 02H	ardware Fault - DSL	Communication with the encoder could not be established.	<ul style="list-style-type: none"> • DSL feedback wiring is incorrect (check against wiring diagram) • DSL feedback wiring is shorted or open • DSL feedback cable is defective • Kinetix VP motor feedback device is defective • Cycle power • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 03	DSL Internal Hardware Fault	A DSL hardware error internal to the drive was detected.	<ul style="list-style-type: none"> • Check DSL feedback device, wiring, and cable • Cycle power • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 04	Hardware Fault - Board Compatibility	The control and power boards are incompatible.	Return drive for repair if fault continues
NODE FLT 05 – CLOCK SKEW FLT	Clock Skew Fault	The controller time and the drive's system time are not the same.	<ul style="list-style-type: none"> • Cycle control power • Check controller and Ethernet switch operation

Table 60 - NODE FLT Fault Codes (continued)

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE FLT 06 – LOST CTRL CONNL	ost Controller Connection Fault	Communication with the controller has been lost.	<ul style="list-style-type: none"> • Check Ethernet connection • Check controller and Ethernet switch operation
NODE FLT 07 – CLOCK SYNC	Clock Sync Fault	Drive's local clock has lost synchronization with controller's clock and was not able to resynchronize within allotted time.	<ul style="list-style-type: none"> • Check Ethernet connection • Check controller and Ethernet switch operation
NODE FLT 09 – DUPLICATE IP ADDRESS	Duplicate IP Address Fault	Several consecutive updates from the controller have been lost.	Select an IP address not already in use on the network

Table 61 - NODE ALARM Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE ALARM 01 – LATE CTRL UPDATE	Control Connection Update Alarm	Updates from the controller have been late.	<ul style="list-style-type: none"> • Remove unnecessary network devices from the motion network • Change network topology so that fewer devices share common paths • Use high performance network equipment • Use shielded cables • Separate signal wiring from power wiring
NODE ALARM 03 – CLOCK JITTER	Clock Jitter Alarm	The sync variance has exceeded the sync threshold while the device is running in sync mode.	<ul style="list-style-type: none"> • Check the Ethernet connection • Check controller and Ethernet switch operation
NODE ALARM 04 – CLOCK SKEW ALARM	Clock Skew Alarm	The controller time and the drive's time are not the same.	<ul style="list-style-type: none"> • Check the Ethernet connection • Check controller and Ethernet switch operation
NODE ALARM 05 – CLOCK SYNC ALARM	Clock Sync Alarm	Drive's local clock has lost synchronization with controller's clock for a short time during synchronous operation.	<ul style="list-style-type: none"> • Check the Ethernet connection • Check controller and Ethernet switch operation

6.6.5 TROUBLESHOOTING GUIDE

Troubleshooting General System Problems

Use the tables below for troubleshooting general system faults.

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in RSLogix 5000 software.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	<ul style="list-style-type: none"> • Check setups. • Run Tune in RSLogix 5000 software.
You cannot obtain the motor acceleration/deceleration that you want.	Mechanical resonance	Notch filter or output filter may be required (refer to Axis Properties dialog, Output tab in RSLogix 5000 software).
	Torque Limit limits are set too low.	Verify that current limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in RSLogix 5000 software again.
	The system inertia is excessive.	<ul style="list-style-type: none"> • Check motor size vs. application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size vs. application need.
	Available current is insufficient to supply the correct accel/decel rate.	<ul style="list-style-type: none"> • Check motor size vs. application need. • Review servo system sizing.
Motor does not respond to a velocity command.	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.
	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	Enable signal has not been applied or the enable wiring is incorrect.	<ul style="list-style-type: none"> • Check the controller. • Check the wiring.
	The motor wiring is open.	Check the wiring.
	The motor thermal switch has tripped.	<ul style="list-style-type: none"> • Check for a fault. • Check the wiring.
The motor has malfunctioned.		Repair or replace the motor.
The coupling between motor and machine has broken (i.e., the motor moves, but the load/machine doesn't).		Check and correct the mechanics.
Primary operation mode is set incorrectly.		Check and properly set the limit.
Velocity or current limits are set incorrectly.		Check and properly set the limits.

Condition	Potential Cause	Possible Resolution
Presence of noise on command or motor feedback signal wires.	Recommended grounding per installation instructions have not been followed.	<ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources. Refer to System Design for Control of Electrical Noise, publication GMC-RM001
	Line frequency may be present.	<ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources.
	Variable frequency may be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls etc. The frequency may be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	<ul style="list-style-type: none"> Decouple the motor for verification. Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism.
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	<ul style="list-style-type: none"> Check brake wiring and function. Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Loose parts are present in the motor.	<ul style="list-style-type: none"> Remove the loose parts. Return motor for repair. Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance	Notch filter may be required (refer to Axis Properties dialog, Output tab in RSLogix 5000 software).
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.
	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.
	Sine, Cosine, Rotor lead sets of resolver feedback are reversed.	Check and correct motor feedback wiring.

Nordson Troubleshooting

WARNING: Allow only personnel with appropriate training and experience to operate or service the equipment. The use of untrained or inexperienced personnel to operate or service the equipment can result in injury, including death, to themselves and others, and damage to the equipment.

This section provides quick-reference information for diagnosing melter faults indications as well as comprehensive melter diagnostic information that is provided in flowchart format. When required, the troubleshooting flowchart will refer you to diagnostic procedures provided later in this section.

If you cannot resolve the problem using the troubleshooting flowchart, contact your Nordson representative for technical assistance.

- Never disconnect cables from, or reconnect cables to, the main board while the melter is energized.
- Before breaking any hydraulic connection, always relieve system pressure.
- Refer to the safety information provided with optional equipment.
- If the melter is removed from its sub-base for diagnostic checks or service, ensure that the ground lead between the chassis and the sub-base is reattached when the melter is reconnected to the sub-base.

Melter Faults Table 6-1 lists the four types of melter faults, potential causes, and expected corrective actions.

Table 6-1 Melter Faults

Display Code/Sub-code	Name	Affect on Melter	Cause	Corrective Action
F1/None	RTD	Heaters turn off	The RTD for the component indicated has failed or the component was disconnected from the melter.	Replace RTD Check hose/gun connections See flowchart T.2
F2/None	Under temperature	Heaters turn off	The actual temperature of the component indicated has dropped below the under temperature delta, which was set using parameter 22.	Check for conditions that may cause a drop in ambient temperature Raise the set-point temperature of the component Replace RTD See flowchart T.2
F3/None	Over temperature	Heaters turn off	The actual temperature of the component indicated has increased beyond the over temperature delta, which was set using parameter 21.	Replace RTD See flowchart T.2
F4/1	RAM test	Melter stops functioning	Internal RAM failure	Replace CPU
F4/2	Internal Clock time	Heaters remain on, but fault condition persists	Internal clock failure	Replace CPU
F4/4	Internal clock battery backed RAM	Heaters remain on, but fault condition persists	Battery-backed RAM failure	Replace CPU
F4/5	Internal clock battery	Heaters remain on, but fault condition persists	Battery-backed RAM battery dead	Replace CPU
F4/6	Analog-to-digital	Melter stops functioning	RTD analog-to-digital converter failed	Replace main board or CPU
F4/7	Analog-to-digital calibration	Melter stops functioning	RTD analog-to-digital converter could not be calibrated	Replace main board or ribbon cable, or CPU
F4/8	Main board feedback	Melter stops functioning	Communication failure between main board and CPU	Replace main board, ribbon cable, or CPU
F4/A	Thermostat	Melter stops functioning	Tank or manifold thermostat is open	Replace thermostat, J7 harness, or main board
F4/d	Communications with optional I/O card	Heaters remain on, but fault condition persists	Communication failure between CPU and the optional I/O card	Replace the I/O card or CPU
F4/E	Fieldbus communications failure	Alert output (if output option 6 is selected) Melter continues to operate normally.	Fieldbus card failure.	Replace the Fieldbus card

Table 6-2 Main PCA

Item Number	Type	Description
Indicators		
DS1	LED (Yellow)	Control signal for tank heater
DS2	Neon (Orange)	Power available for manifold heater
DS3	LED (Yellow)	Control signal for manifold heater
DS4	Neon (Orange)	Power available into main board after fuses F3/F4
DS5	LED (Green)	+5 VDC control voltage present on board
Fuses		
F1/F2	—	15 A, 250 V, Fast-acting, 1/4 inch
F3/F4	—	2 A, 250 V, Slow-blow, 5 x 20 mm
Connection Points		
J1/J2	Jumper	Voltage configuration plug with and without neutral
TB1	Input	AC power into board
TB2	Input/output	Output contacts 1–6. Input contacts 7–14
J5	Input/output	Control signal between main board and tank driver board
J6	Output	Power harness to manifold heater
J7	Input/Output	Control signal harness (RTD, control switch, thermostat, solenoid). See Figure 6-2 for pin-out.
J8	Input/Output	Analog/digital signal cable

Table 6-3 Tank Driver Board

Item Number	Type	Description
Indicators		
DS1	Neon (Orange)	Power to tank present
Connection Points		
J1	Input/Output	Control signal between main board and the tank driver board
J3	Jumper	Voltage plug
J4	Output	Power harness to tank
Fuses		
FI/F2	—	25 A, 250 V, Fast-acting, 1 13/32 in. x 1.5 in.

Table 6-4 CPU board

Item Number	Type	Description
Indicators		
Red LED	—	Indicates that CPU board has failed
Green LED	—	+ 5 VDC control voltage is present at the CPU board
Connection Points		
J1	Input/Output	Control signal between main PCA and CPU
J5	Input/Output	Control signal between I/O expansion card or Anybus card and the CPU
Test Points		
TP2/TP4	Contacts	4.75–5.25 V control voltage present at CPU

Table 6-5 Hose/Gun Power Module

Item Number	Type	Description
Indicators		
DS1	LED (Yellow)	Control power present for odd numbered hose
DS2	LED (Yellow)	Control power present for odd numbered gun
DS3	LED (Yellow)	Control power present for even numbered hose
DS4	LED (Yellow)	Control power present for even numbered gun
DS5	Neon (Orange)	AC power present at module for odd hose/gun pair
DS6	Neon (Orange)	AC power present at module for even hose/gun pair
Fuses		
F1/F2 and F3/F4	—	6.3 A, 250 V, Fast-acting, 5 x 20 mm

Table 6-6 J7 Wire Harness Color Coding

Component	Wire Pair Color
Tank RTD	White
Manifold RTD	Black
On/Off control switch	Purple
Low leve switch	Red
Pump solenoid	Dark Blue
Tank thermostat	Gray
Manifold thermostat	Brown

Problem	Possible Causes	Possible Solution
Machine will not Run or Reset	1. Open Guard Door 2. Engaged E-Stop 3. HMI Alarm present 4. Glue System not Ready 5. Upstream/Downstream Interlocks 6. Faulty E-Stop Outputs	Verify doors closed Verify switches pulled out Resolve alarm and reset machine Verify Glue Power and Temperature Verify Peripheral Equipment ready Verify Control Relay (00) and E-Stop Output (01) are high.
Carton / Product Jams	At Gate/Hopper	1. Gate Improperly Installed 2. Cartons Improperly Loaded onto Hopper 3. Hopper Settings
		1. Feeder at Wrong Height 2. Feed Arm / Vacuum Cup Settings 3. Pushing/Retarding Lugs 4. Vacuum Timing 5. Carton Flap Plows, Guides 6. Carton Orientation
		Verify Gate fully seated into its mounting slots. Verify Cartons loaded properly onto Hopper, no gaps present. Verify Lower Hopper Depth Adjustments Verify Feeder Height for Recipe. Verify Feed Arm Setting for Recipe. Verify Pocket Size for Carton Width. Verify Vacuum release of carton at proper time. Verify no undue interference from Flap Plows. Verify Carton Orientation in Gate, Preglued Panel Down and Trailing.
	At Product Loading	1. Wrong Depth of Insertion 4. Wrong Inserter Pusher Lugs Installed 2. Conveyors Out of Phase 3. Overhead Confiner Height 4. Overhead Confiner Paddles 5. Wrong Product for Carton 6. Carton Guides, Flap Plows
		Verify Depth of Insertion to Carton Length. Verify Inserter Pusher Lugs for Product/Recipe. Verify Product Infeed / Carton Conveyor Phasing Verify Overhead Confiner Height for Recipe. Verify correct Confiner Paddles for Product/Recipe. Verify Product to Recipe Verify no undue interference from Flap Plows or Guides.
		1. Overhead Carton Guide Rail 2. Glue Guide Height 3. Adhesive Build-Up on Components 4. Glue System Components Interfering 5. Flap Plows 6. Compression too loose / tight
		Verify Guide Height to Recipe. Verify Glue Guide Height to Recipe. Remove any Adhesive Build-Up Verify no undue interference between Carton and Glue System components. Verify no undue interference from Flap Plows Verify Compression Settings for Recipe.
		1. Glue Tank / Hoses / Guns not to Operating Temperature. 2. Improper Glue Patterns Selected 3. Photo Eye Misaligned / Obstructed 4. Photo Eye Inoperable 5. Blown Fuse 6. Re-Teach Photo Eye
		Verify Component Temperature. Verify in Recipe Verify Alignment with Carton Flap / Clean Eye Verify Eye Input in Diagnostics Screen of HMI. Check PLC Output Fuses With carton in position, Reteach Sensor. Use Page 5 of Maintenance Screen.
Glue Guns not Firing		

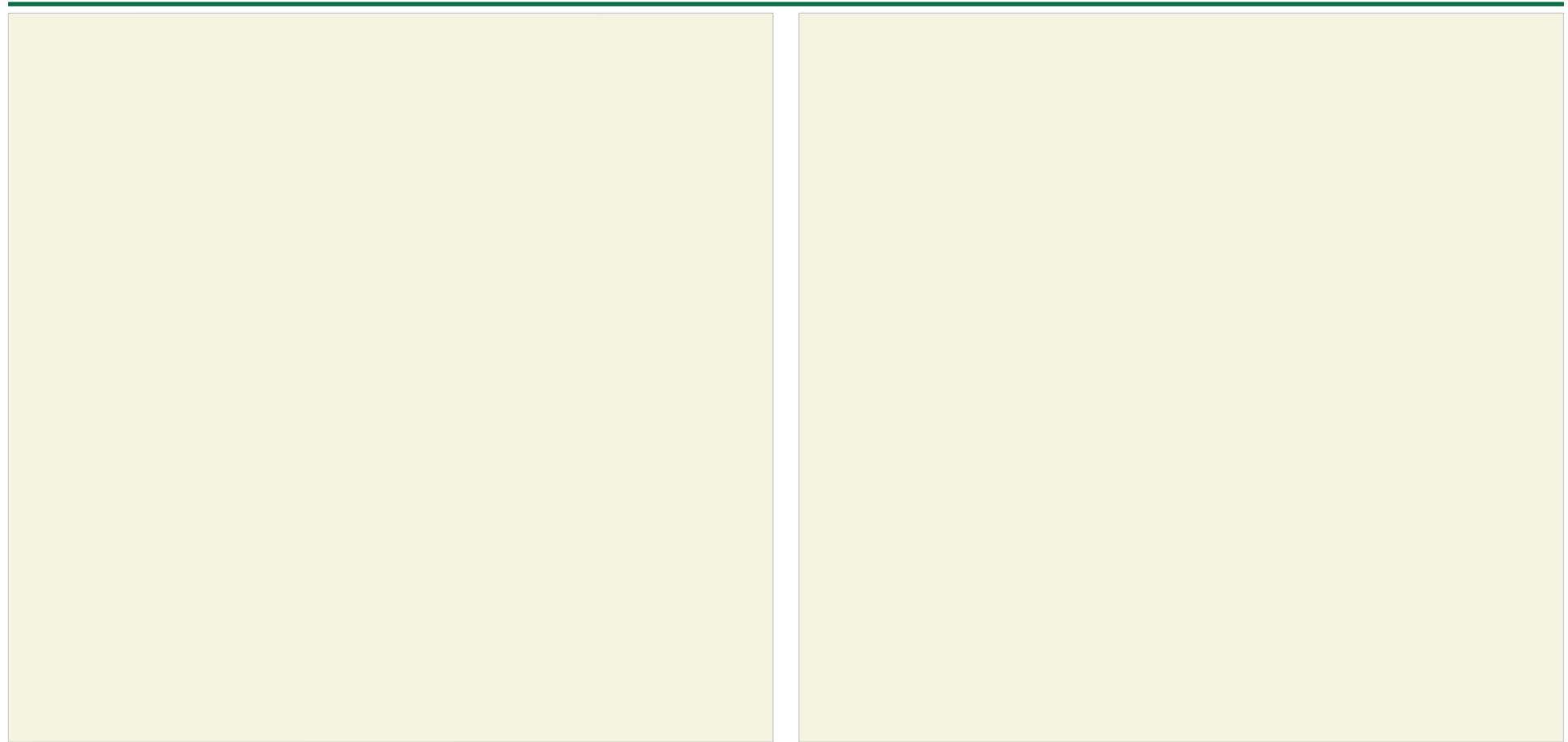
KLIKLOK-WOODMAN SERVICE DEPARTMENT

5224 SNAPFINGER WOODS DRIVE
DECATUR, GA 30035
TEL: 770/981-5200
FAX: 770/987-7160
Email: service@kliklok-woodman.com

ENTERPRISE

Endload Cartoner

Section 6 Maintenance and Adjustments



Operation Maintenance
Manual

7.0 PRODUCT SETUP AND COMPONENT ADJUSTMENT

7.1 SELECTING, EDITING, CREATING, AND PRODUCT SETUP AND COMPONENT ADJUSTMENT

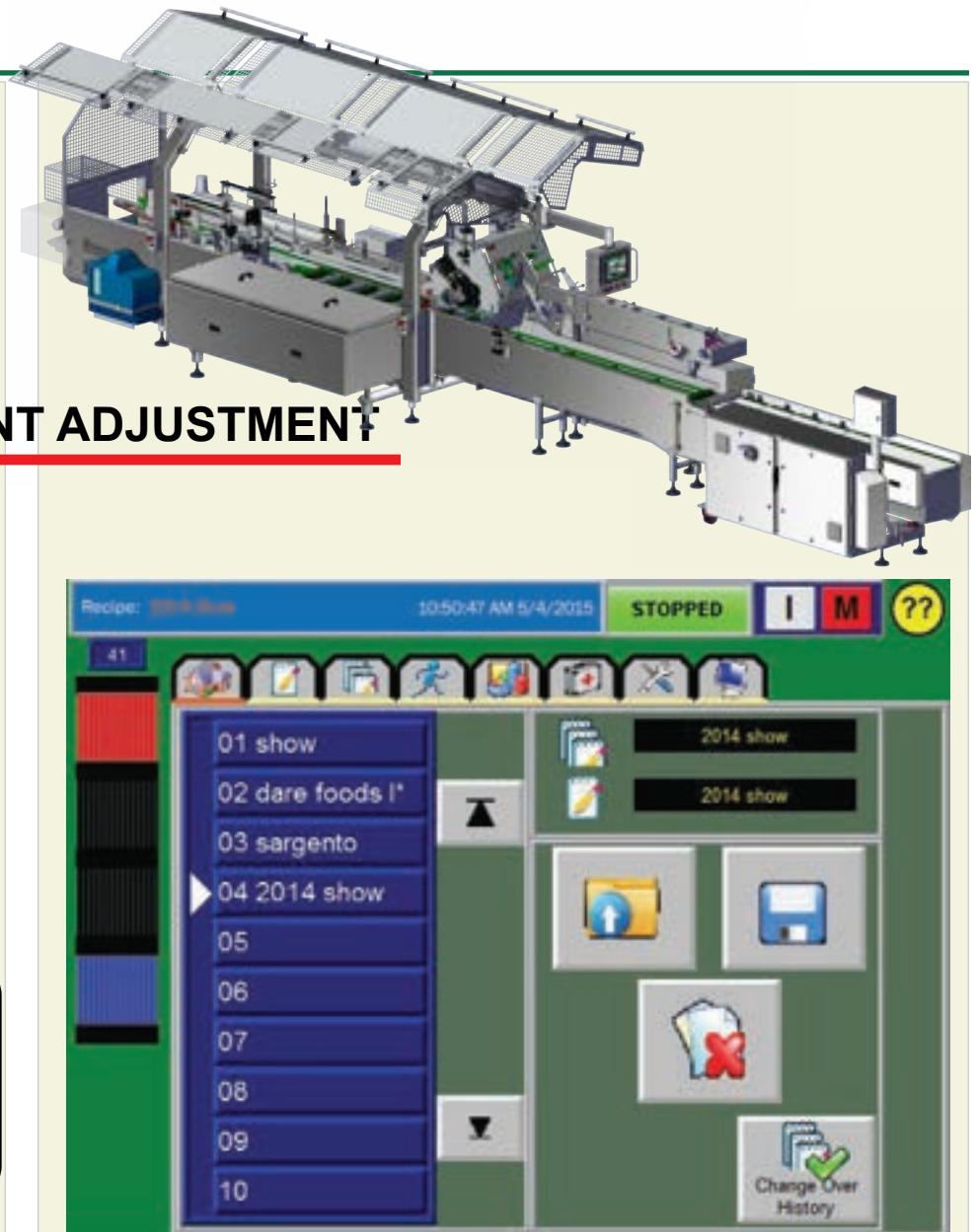
This section will detail the steps taken to CREATE and MODIFY RECIPE PARAMETERS, RESET DATUM TIMING POSITIONS, AND TEACH COMPONENT SENSOR OPERATIONAL LIMITS.

⚠ CAUTION

!!CAUTION!! Improperly adjusting these settings can have adverse results, resulting in poor machine performance and/or machine damage. DO NOT attempt making these adjustments unless you have thoroughly read this entire manual and completely understand the information contained herein.



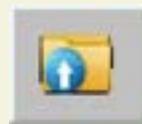
The procedures outlined in the following sections are performed while logged into the system with Maintenance Level II Access. Refer to section 4.5 for details.



7.1.1 SELECTING A RECIPE

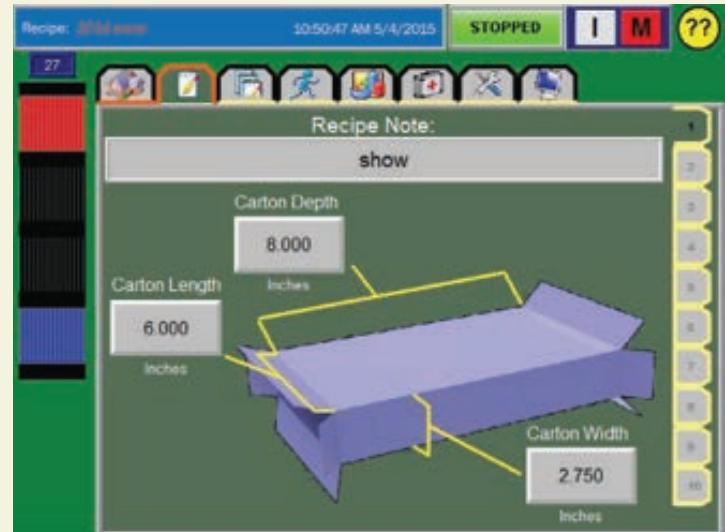


1. From the **HOME SCREEN** touch the **RECIPE MENU TAB**.
2. To select a recipe, touch the **BLUE RECIPE BAR** containing the recipe name you wish to choose. This will move the selection arrow ► to that recipe. You may also scroll the arrow ► up/down through the Recipe Bar by utilizing the scroll icons.
3. Touch the **LOAD ICON**.



4. A pop-up box will display asking you to confirm your selection.
5. Touch the green check ✓ to confirm the change, Touch the red X to cancel the change.

7.1.2 EDITING A RECIPE



1. Select the recipe to edit (as outlined in section 7.1.1.).
2. Touch the **RECIPE SETTINGS TAB**
3. Input the new carton dimensions, with the pop-up keypad, by touching the gray boxes containing the existing dimensions.
4. Touch the **PAGE 2 TAB**.



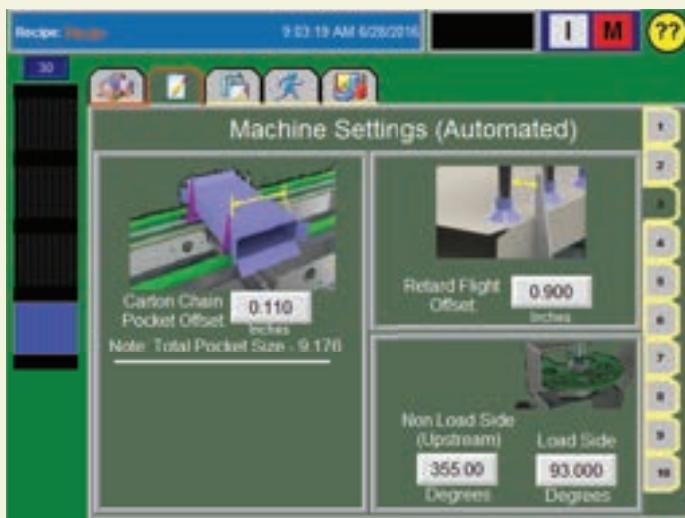
NOTE: Editing a Recipe can only be done in Operator II Level or above.

Editing, saving or Deleting a recipe can only be done in Main Mode.

5. Edit the GLUE STRIPE START and END SETTINGS for each machine side. This dimension is taken from the leading edge of the upper major carton flaps.



6. Touch the PAGE 3 TAB.



7. Edit the shown AUTOMATED MACHINE SETTINGS.
8. Touch the PAGE 4 TAB. (See Page 46 in Section 4.4.2 Recipe Setting Screens For Details of Described Features)



9. Edit the shown CYCLE STOP POSITION.
10. Touch the PAGE 5 TAB.



11. Edit the shown MANUAL SENSOR AND GUIDE SETTINGS.
12. Touch the PAGE 6 TAB.



13. Edit the MANUAL NON-LOAD SIDE MACHINE SETTINGS.
14. Touch the PAGE 7 TAB.



15. Edit the MANUAL LOAD SIDE MACHINE SETTINGS.
16. Touch the PAGE 8 TAB.



17. Edit the MANUAL HOPPER SETTINGS.
18. Touch the PAGE 9 TAB.



19. Edit the ADHESIVE SYSTEM INFORMATION

20. Touch the page 10 tab.

21. Edit the CHANGE PARTS, FEEDER HEIGHT, Over-head Confiner Height, Laser Height, and DEPTH OF INSERTION SETTINGS



22. Touch the RECIPE MENU TAB.



23. Touch the SAVE ICON.

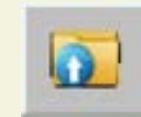


24. CONFIRM your selection.

7.1.3 CREATING A RECIPE



1. From the HOME SCREEN touch the RECIPE MENU TAB.
2. To select a recipe location, touch any empty, **Blue Recipe Bar**. This will move the selection arrow ► to that recipe location. You may also scroll the arrow ► up/down through the Recipe Bar by utilizing the scroll icons.
3. Touch the **LOAD ICON**.
4. Touch the green checkmark to confirm the change, Touch the red X to cancel the change.
5. Touch the **RECIPE SETTINGS TAB**.



6. Consecutively input the new **CARTON DIMENSIONS**, **MACHINE SETTINGS**, and **CHANGE PART** Information on each of the attached ten (10) pages. (see 7.1.2)

7. Touch the **RECIPE MENU TAB**.



8. Touch the **SAVE ICON**.



9. **CONFIRM** your selection.

7.1.4 DELETING A RECIPE

1. Touch the **RECIPE MENU TAB**.



2. Touch the **BLUE RECIPE BAR** containing the recipe name you wish to delete. This will move the selection arrow ► to that recipe. You may also scroll the arrow ► up/down through the Recipe Bar by utilizing the scroll icons.

3. Touch the **DELETE ICON**.



4. **CONFIRM** your selection.

7.2 COMPONENT HOMING

7.2.1 GENERAL GUIDELINES

The **HOME** option is used to move and reset individual mechanical assemblies to their respective **DATUM TIMING POSITIONS**. Once “**HOMED**”, all settings entered as part of a recipe or size change will be referenced from the **HOME POSITION** for the particular component.

IMPORTANT POINTS TO REMEMBER:



The Enterprise Cartoner generally only requires **HOMING** once, (during initial electrical start-up in the manufacturer's factory). From there on, the **HOME POSITIONS** for components are saved within the software from which the recipe parameters are referenced.

It does not need to be **HOMED** again, unless one of the following circumstances has occurred.

- **A DRIVE MOTOR GEARBOX IS REPLACED** – Only home the associated assembly which is driven by the gearbox.
- **A SERVO AMPLIFIER IS REPLACED** – Only home the associated assembly which is driven by the servo amplifier.

- **A MOTOR IS MECHANICALLY UNCOUPLED FROM THE DRIVE SHAFT-** Only home the associated assembly which is driven by the motor.

OTHER THAN THE ABOVE SITUATIONS, THERE IS NO NEED TO RE-HOME A SERVO DRIVEN ASSEMBLY.



WARNING – MACHINE DAMAGE.

BEFORE COMMENCING THE “HOME” PROCEDURE, ENSURE THAT THE FOLLOWING ITEMS DO NOT CLASH WITH OTHER COMPONENTS:

1. ALL INSERTER PUSHER FACES.
2. ROTARY FEED VACUUM ARMS.
3. NON-LOAD SIDE CARTON SKI GUIDE.

7.2.2 THE HOMING SCREEN MENU



NOTE; Refer to the instructions and photos on the following pages for the various “HOME” positions for each servo driven axis.



NOTE; You must be logged in with Maintenance Level II Access to complete the following procedures.

MACHINE OPTIONS – SERVO HOMING



From the **HOME SCREEN** select the **MAINTENANCE TAB** and then **PAGE 4**.

There are six (6) different servo driven components accessible on the Machine Option – Servo Homing Screen.



Each **SERVO AXIS** is shown with its current position, within the machine’s pitch, displayed numerically. Once homed, the servo position should read approximately the **MACHINE PITCH or ZERO (0)**.

The **ROTARY FEEDER** operates on a **360 ° RADIUS**; the positional number displayed will be proportional to that radius as divided across the three (3) **ROTARY FEED ARMS**.

CAUTION

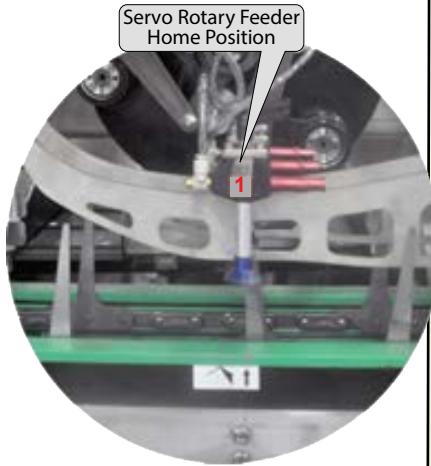
When homing the **ROTARY FEEDER VACUUM ARMS** it is very important that the datum position be set using **FEED ARM** as shown in the photo. (see figure below)

ONCE YOU SET THE HOME POSITION FOR A PARTICULAR SERVO, THAT HOME POSITION WILL NOT BE AFFECTED BY THE MOVEMENT REQUIRED TO HOME SUBSEQUENT SERVOS.

BE VERY CAREFUL DURING HOMING TO AVOID MECHANICAL JAMS, WHICH MAY DAMAGE THE MACHINE.

IF THE ARMS ARE EVER CHANGED OR THE NO. 1 LOST, PRESS THE OVERRIDE BUTTON ON THE VACUUM SOLENOID FOR THE SOLENOID NEAREST THE INCOMING CABLE.

WHICH EVER ARM VACUUM COMES OUT, THIS VACUUM ARM #1.



7.3 SETTING COMPONENT 'HOME' POSITIONS

7.3.1 FLIGHT CHAINS – RETARDING LUG SERVO

Servo Rotary Feeder Home Position



1. On the **JOG SCREEN** select the **RETARD CHAIN axis**.



2. Using the **JOG PENDANT** advance the axis to its home position, as shown in the photo.

3. Once the component is aligned with the timing mark, touch the **MAINTENANCE TAB** on the HMI.



4. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.

5. Touch the gray **HOME SERVO** button for the RETARD CHAIN SERVO.
6. **CONFIRM** your selection in the pop up box.

7.3.2 FLIGHT CHAINS – PUSHING LUG SERVO



1. On the **JOG SCREEN** select the **PUSHING CHAIN** axis.

2. Using the **JOG PENDANT** advance the axis to its home position, as shown in the photo.
3. Once the component is aligned with the timing mark, touch the **MAINTENANCE TAB** on the HMI.


4. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.


5. Touch the gray **HOME SERVO** button for the **PUSHING CHAIN SERVO**.
6. **CONFIRM** your selection in the pop up box.

7.3.3 ROTARY FEEDER

When homing the **ROTARY FEEDER VACUUM ARMS** it is very important that the datum position be set using the marked **MASTER FEED ARM** as shown in the photo.

See **Note** on page 118

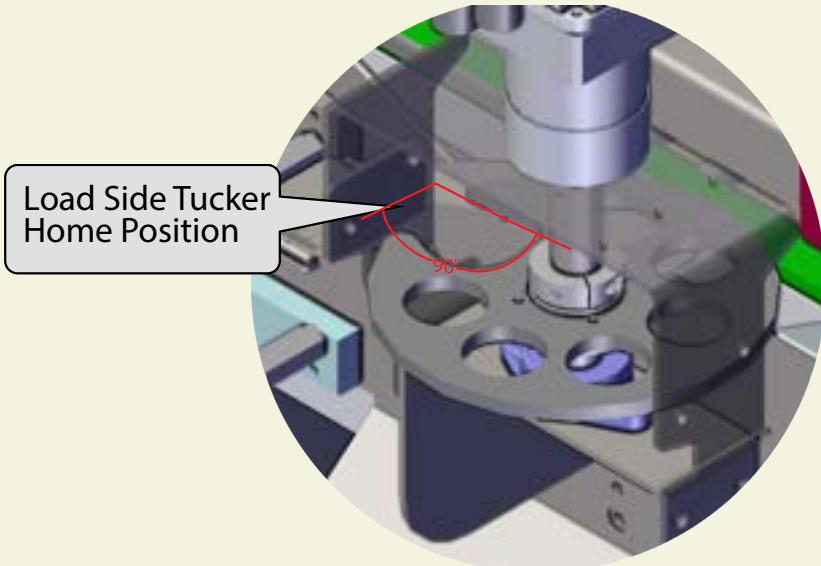
1. On the **JOG SCREEN** select the **FEEDER** axis.

2. Using the **JOG PENDANT**, advance the **MASTER FEEDER ARM**, to its home position.
3. As shown in the photo, the **ROTARY FEEDER HOME DATUM** is derived from the **CENTER LINE** of the **MASTER FEED ARM**. The **MASTER FEED ARM** should be **VERTICAL** to **CARTON RAILS**, use a “square” to correctly achieve this.

4. Once the component is aligned with the timing mark, touch the **MAINTENANCE TAB** on the HMI.

5. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.
6. Touch the gray **HOME SERVO** button for the **FEEDER SERVO**.
7. **CONFIRM** your selection in the pop up box.

7.3.4 LOAD SIDE ROTARY FLAP TUCKER



1. On the **JOG SCREEN** select the **LOAD SIDE TCKER** axis.



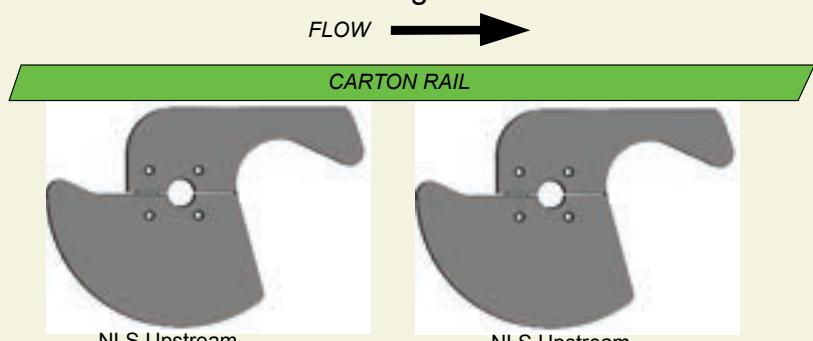
2. Using the **JOG PENDANT** advance the axis to its home position, as shown in the photo. The cutout in the Tucker disk should be parallel to the carton rails.
3. Once the component is aligned with the timing mark, touch the **MAINTENANCE TAB** on the HMI.



4. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.
5. Touch the gray **HOME SERVO** button for the **LOAD SIDE TUCKER SERVO**.
6. **CONFIRM** your selection in the pop up box.

7.3.5 NON - LOAD SIDE ROTARY FLAP TUCKER #1 & #2

Position of Tuckers for Homing.



1. On the **JOG SCREEN** select the **NON-LOAD SIDE TUCKER** axis.



2. Using the Jog Pendant, advance the axis so that the flat edge is parallel with the flight rails.
3. Once the component is aligned, touch the **MAINTENANCE TAB** on the HMI.

4. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.
5. Touch the gray **HOME SERVO** button for the **NON-LOAD SIDE TUCKER SERVO**.
6. **CONFIRM** your selection in the pop up box.
7. On the Jog Screen select the Non-Load side Tucker axis #2.
8. Using the Jog Pendant, advance the axis so that the flat edge is parallel with the flight rails.
9. Once the component is aligned, touch the **MAINTENANCE TAB** on the HMI.
10. Go to **PAGE 4 MACHINE OPTIONS – SERVO HOMING**.
11. Touch the gray **HOME SERVO** button for the **NON-LOAD SIDE TUCKER SERVO #2**
12. Confirm your selection in the pop up window.

7.4 SENSOR TEACH FUNCTION

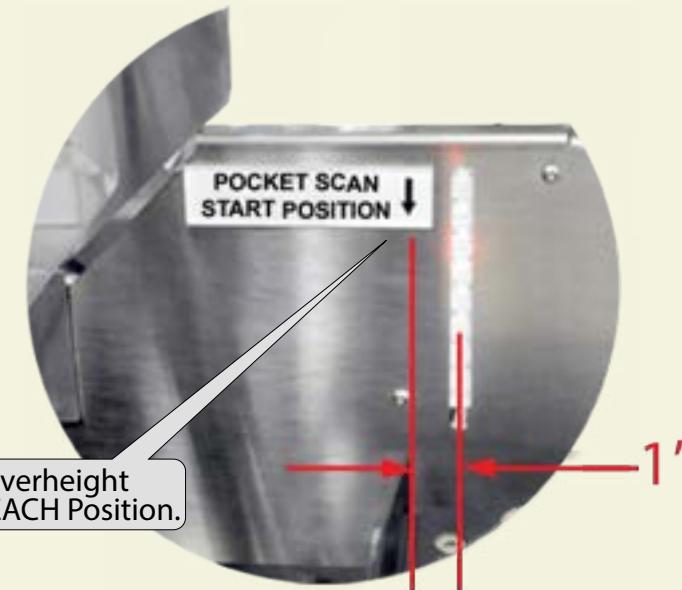


The Sensor Teach Function allows the user to define operational set points for several machine components.

These set points define the **START/ON POSITIONS** of the **SENSOR SCAN PERIODS**, which control the load/abort pulling cartons and gluing operations. Defining these set points ensures that when a sensor is activated, the machine is given time to respond appropriately and efficiently.

You must be logged in with Maintenance Level Access to complete the following procedures.

7.4.1 PRODUCT / OVER-HEIGHT SENSOR TEACH



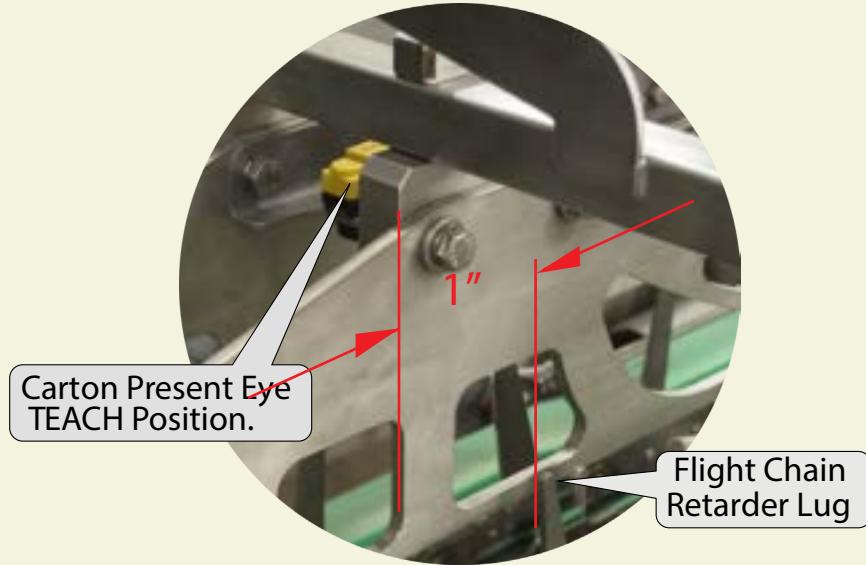
Also known as the “pocket scan start position” this sensor position allows the machine to differentiate between the product infeed conveyor and actual product.

To set the position:

1. Jog the PRODUCT INFEED CONVEYOR until the RETARD PANEL (front) is positioned 1" inch forward of the sensor, in the direction of product flow, as shown in the photo.
2. On the MAINTENANCE SCREEN PAGE 5, touch the PRODUCT / OVER-HEIGHT SENSOR TEACH icon.
3. CONFIRM your selection.



7.4.2 CARTON SENSOR TEACH



The **CARTON SENSOR** is mounted between the **CARTON ERECTOR SKI GUIDES** on the non-load side of the machine.

The **CARTON SENSOR** allows the machine to recognize the presence of a carton on the conveyor. Sensing a carton will cause the **PLC** to signal the inserter to initiate the product loading process. If no carton is present, the **PLC** will signal the inserter to abort the product loading process for that carton.

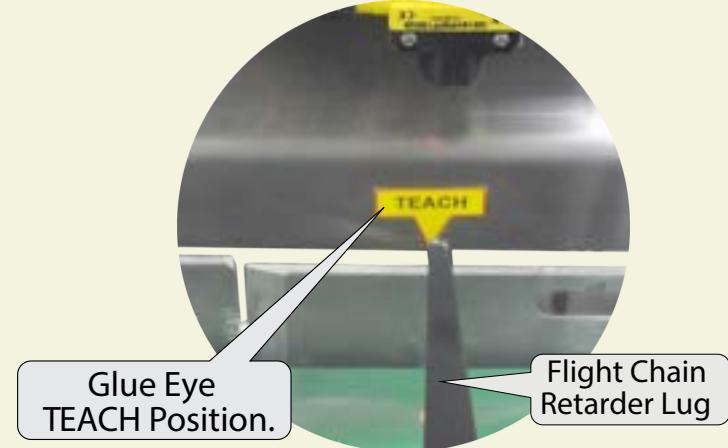
To complete this process it will be required that you jog the machine, allowing cartons to be pulled from the gate.

To set the position:

1. Jog the machine until the **LEADING EDGE** of a **CARTON** at the leading edge of the Carton **SENSOR**, as shown in the photo 7.4.2 .
2. The sensing of the carton's leading edge will cause the illumination of an **LED** located on the side of the sensor.
3. On the **MAINTENANCE SCREEN PAGE 5** touch the **CARTON SENSOR TEACH ICON**.
4. **CONFIRM** your selection.



7.4.3 GLUE SENSOR TEACH



The **GLUE SENSOR** is mounted above the **CARTON RAILS** just prior to the gluing station.

The **GLUE SENSOR** allows the machine to recognize the presence of a carton on the conveyor. Sensing a carton will

cause the PLC to signal the **GLUE SYSTEM** to initiate the application of adhesive to the carton flaps

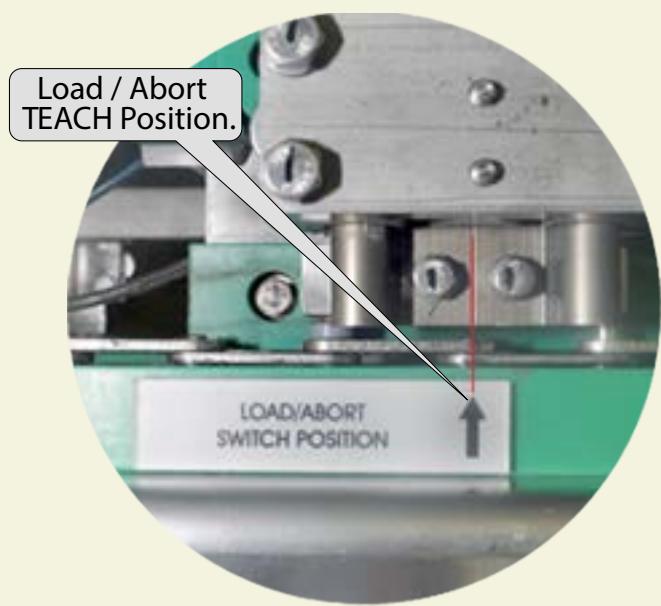
To complete this process it will be required that you jog the machine, allowing cartons to be pulled from the gate.

To set the position:

1. Jog the machine until the **LEADING EDGE** of a **CARTON SENSOR** which is 1-1/4" before the Glue Gun.
2. The sensing of the carton's leading edge will cause the illumination of an **LED** located on the side of the sensor.
3. On the **MAINTENANCE SCREEN PAGE 5** touch the **GLUE SENSOR TEACH ICON**.
4. CONFIRM your selection.



7.4.4 LOAD / ABORT ACTIVATION TEACH



The **LOAD/ABORT ACTIVATION TEACH** feature allows the user to set the **SWITCHING POSITION** of the **BARREL CAM INSERTER LOAD/ABORT FUNCTION**.

Prior to "teaching" this position, the inserter pusher piston must be mechanically set to the P.I.C. pusher lug. This setting has been completed by the machine manufacturer at the factory. This should not have require adjustment unless the drive chains have been mechanically uncoupled form the assemblies.

To set the **SWITCHING POSITION**:

1. Jog the barrel cam piston inserter until the center line of an inserter piston is located mid position along the inserter switch mechanism. This position is identified by a **TIMING MARK** located on the inserter frame, as show in the photo below.

2. On the **MAINTENANCE SCREEN PAGE 5** touch the **LOAD/ABORT ACTIVATION TEACH ICON**.
3. **CONFIRM** your selection.



7.4.5 VACUUM POSITION SET UP

The **ROTARY FEEDER** operates on a **360 ° RADIUS**; the positional numbers (in degrees) displayed for the **VACUUM ON/OFF POSITIONS** operate within a **120 ° ARC** of that radius.

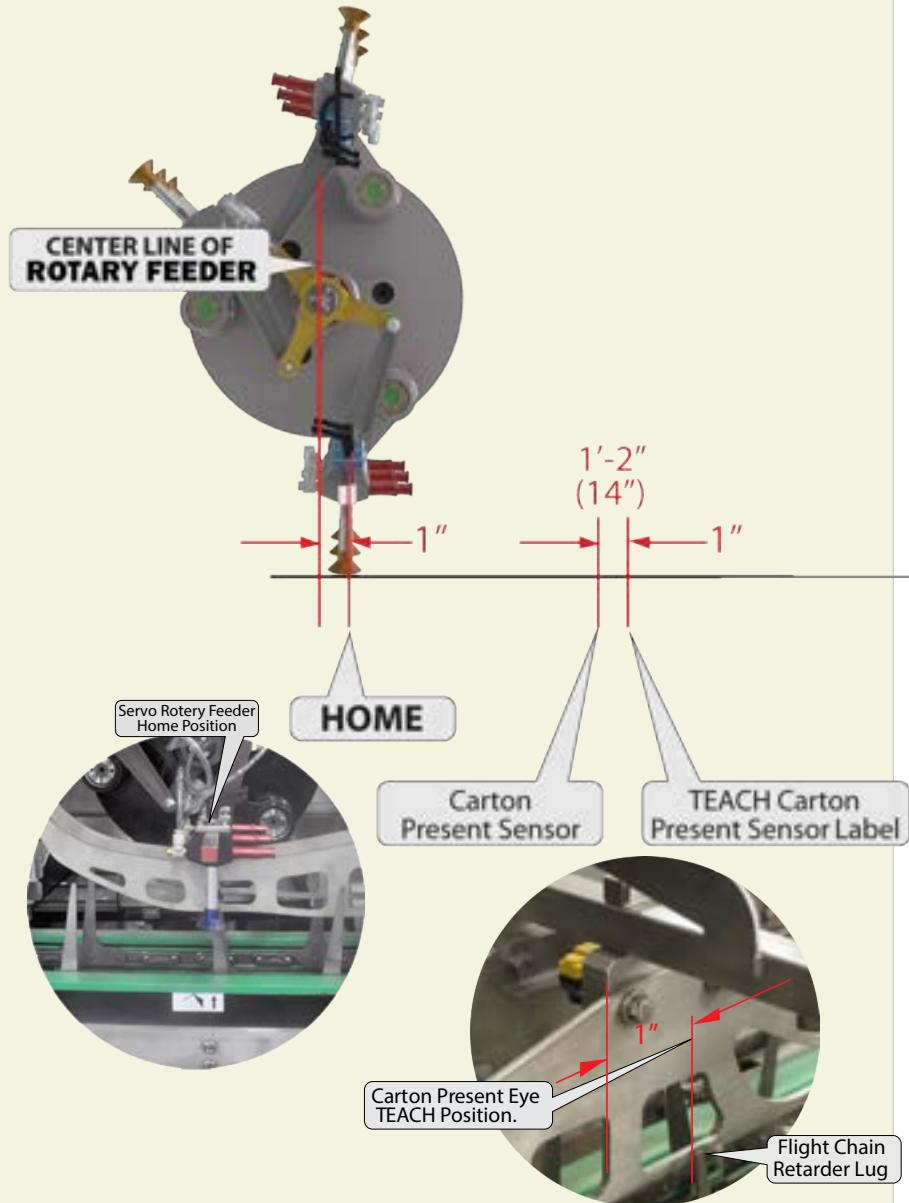
To set the vacuum positions:

1. Jog the **ROTARY FEEDER** until the **MASTER FEED ARM** is positioned where you would like the vacuum to **TURN ON**, typically just prior to the vacuum cups advancing toward the carton.
2. Note the number displayed in the “**FEEDER CURRENT POSITION**” box.
3. **TRANSFER** that number into the **VACUUM ON POSITION** box by touching the box and entering the number with the pop up keypad.

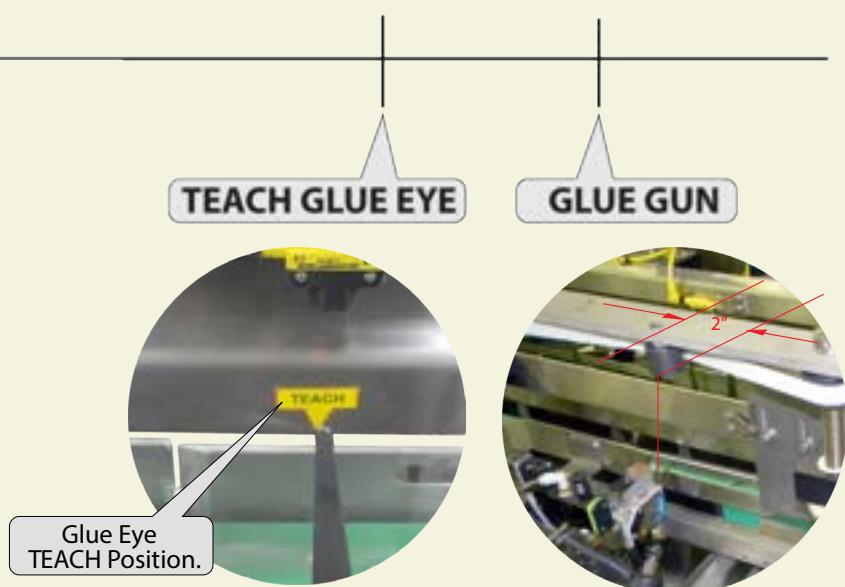
4. Jog the **ROTARY FEEDER** until the **SAME FEED ARM** is positioned where you would like the vacuum to **TURN OFF**, typically just as the carton pushing lugs are contacting the trailing edge of the carton.
5. Note the number displayed in the “**FEEDER CURRENT POSITION**” box.
6. Transfer that number into the **VACUUM OFF POSITION** box by touching the box and entering the number with the pop up keypad.
7. Jog a carton through to **VERIFY** proper carton handling.

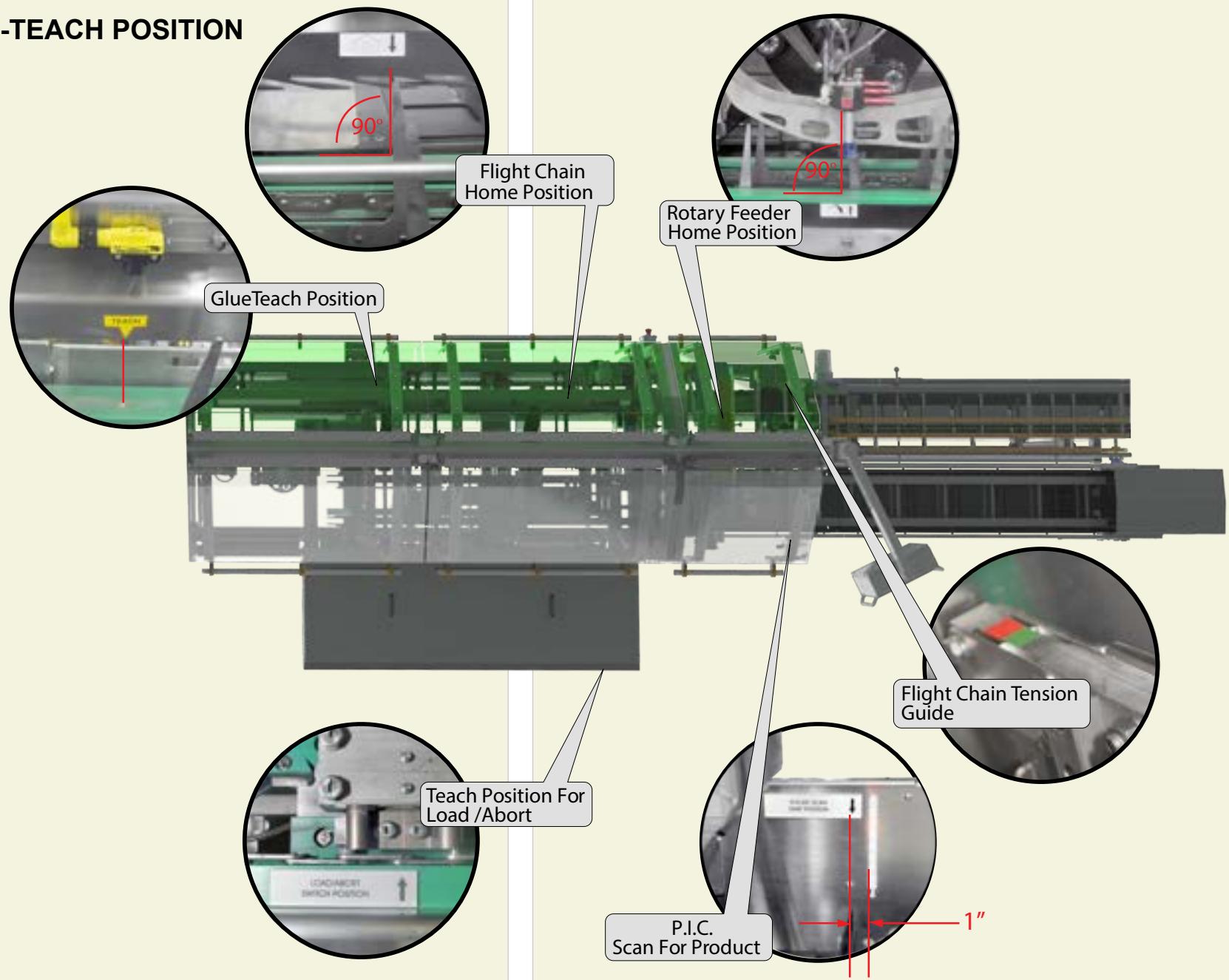
The **RETARD FLIGHT OFFSET** found in **RECIPE SETTINGS PAGE 3** can be utilized to fine tune the placement of the carton onto the carton rail

7.4.6 FEEDER, FLIGHT CHAIN, CARTON PRESENT AND GLUE POSITION



10'- 4-3/4" 10'- 6"



7.4.8 TIMING-TEACH POSITION

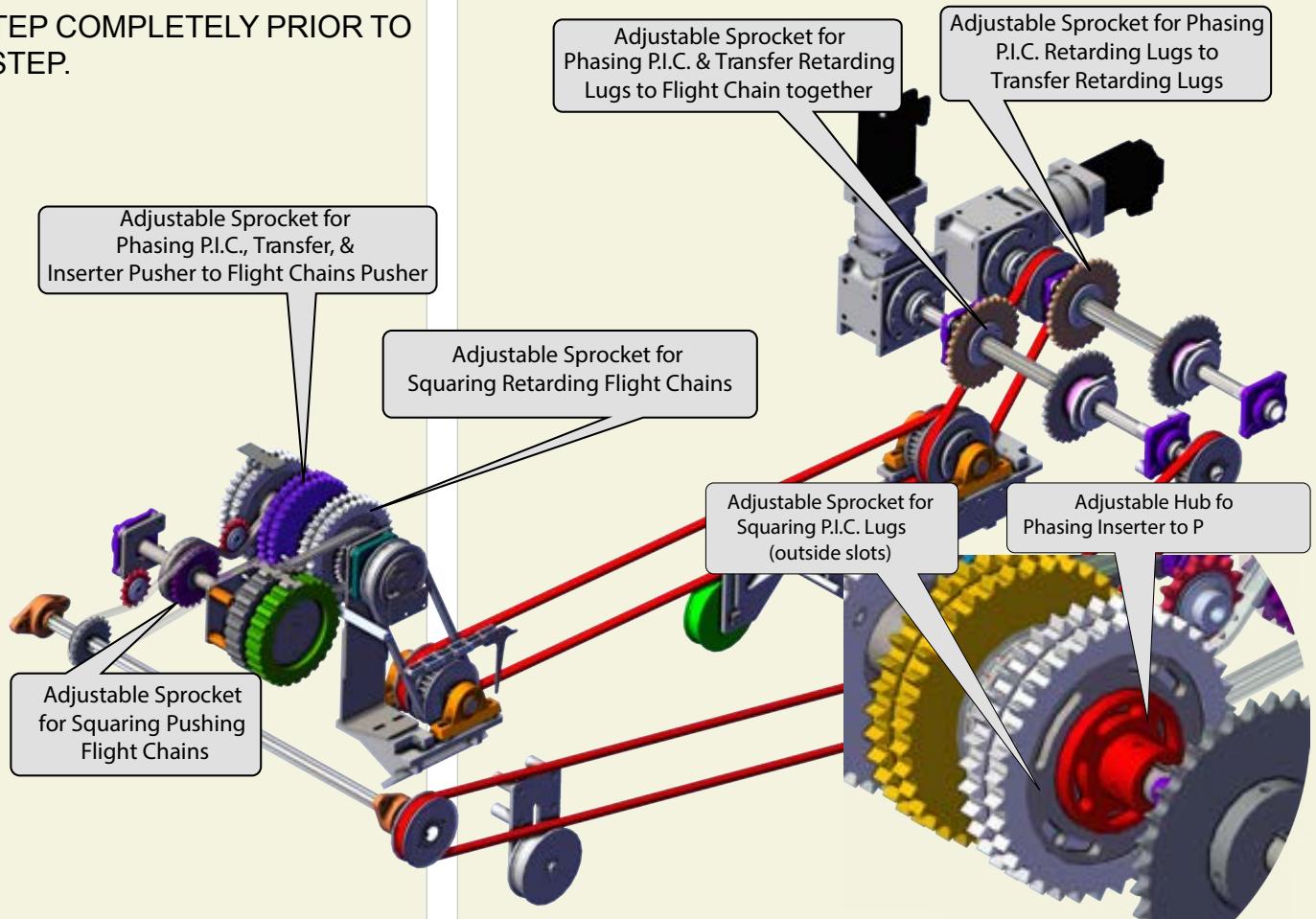
7.5 ENTERPRISE MECHANICAL CHAIN ALIGNMENT PROCEDURE

THESE ALIGNMENT PROCEDURES ARE GIVEN IN THE ORDER THEY SHOULD BE PERFORMED, FAILURE TO FOLLOW THE STEPS AS THEY ARE GIVEN WILL RESULT IN MISALIGNMENT AND POSSIBLE MACHINE DAMAGE.

ALWAYS COMPLETE ONE STEP COMPLETELY PRIOR TO ADVANCING TO THE NEXT STEP.

Follow all Lock-Out / Tag-Out procedures prior to starting the mechanical alignment process.

The following dimensions are the standard settings for an Enterprise Endload Cartoner; individual products may require variation from these standard settings.

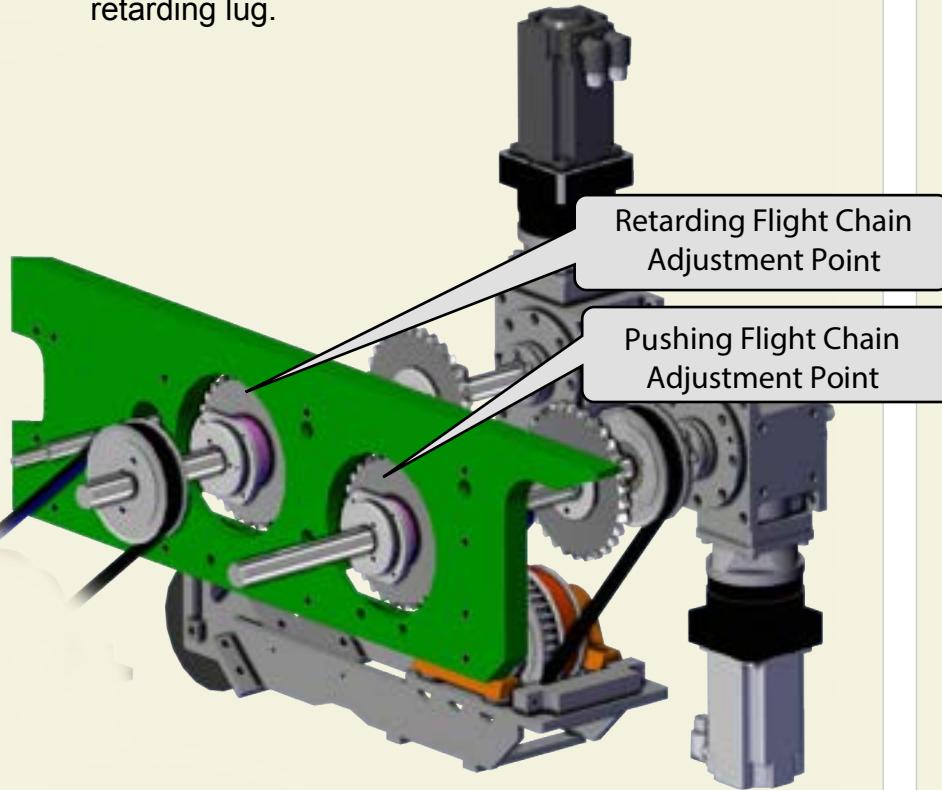


Step 1. Flight Chain Alignment

Located on the Load Side, Downstream end of the Enterprise Carton Rails, attached to the sprockets driving the Flight Chains, are two adjustable hubs. One for the Retarding Flight Chain and one for the Pushing Flight Chain. These hubs allow the Load Side Flight Chains to be squared / aligned with the Non-load Side Flight Chains.

To square the Load Side Retarding Flight Chain with the Non-Load Side Retarding Flight Chain:

- a) Locate the adjustable sprocket, downstream, driving the load side retarding flight chain.
- b) Utilizing a suitable wrench, loosen the three (3) M8 hex head bolts affixing the sprocket to the adjustable hub.
- c) Place one end of a square firmly against the side of the carton rail and the other end spanning across the carton rail, resting against the face of the non-load side retarding lug.



d) Push or pull the load side retarding flight chain until the Load Side Retarding Lugs face rests against the square, in line with the Non-Load Side Retarding Lug.

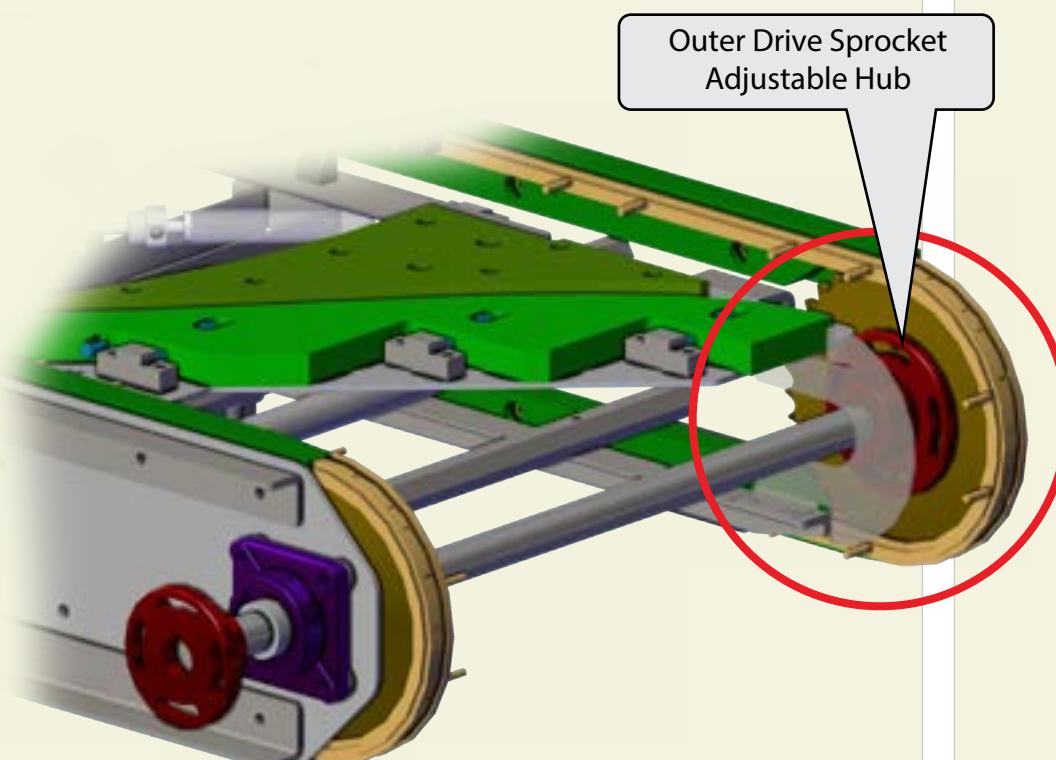
e) Retighten the three (3) previously loosened bolts on the adjustable hub to retain the now aligned position.

To square the Load Side Pushing Flight Chain with the Non-Load Side Pushing Flight Chain:

- a) Locate the adjustable sprocket, downstream, driving the load side pushing flight chain.
- b) Utilizing a suitable wrench, loosen the three (3) M8 hex head bolts affixing the sprocket to the adjustable hub.



- c) Place one end of a square firmly against the side of the carton rail and the other end spanning across the carton rail, resting against the pushing face of the non-load side pushing lug.
- d) Push or pull the load side pushing flight chain until the Load Side Pushing Lugs face rests against the square, in line with the Non-Load Side Pushing Lug.
- e) Retighten the three (3) previously loosened bolts on the adjustable hub to retain the now aligned position.

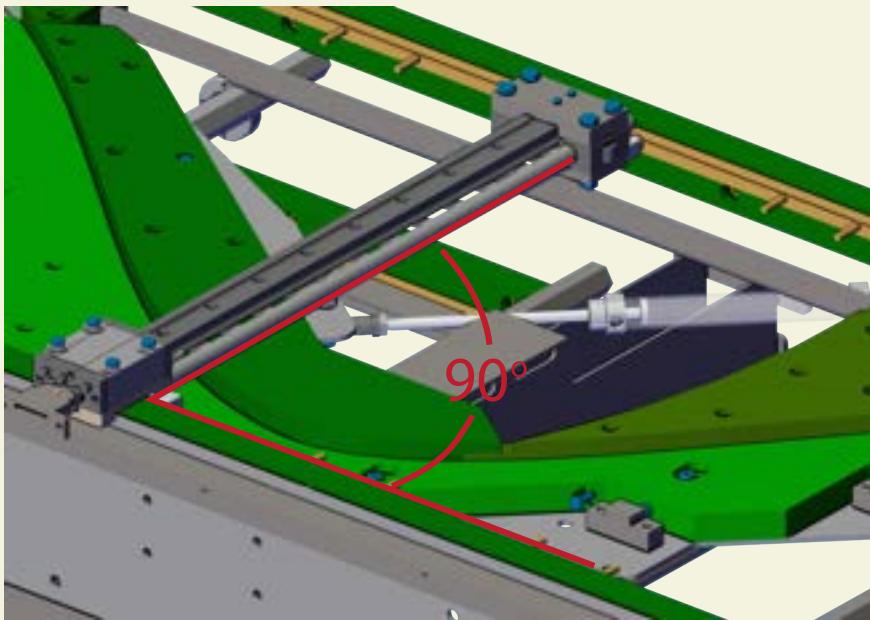


Step 2. Inserter Piston Arm Alignment

Located on the Downstream, Outside End of the Enterprise Inserter, attached to the Outer Drive Sprocket is an adjustable hub that allows the squaring of the Inserter Piston within the Inserter Assembly.

To square the Inserter Pistons within the Inserter Assembly:

- a) Locate the Adjustable Hub attached to the Outer Drive Sprocket as show in the diagram.
- b) Utilizing a suitable wrench, loosen the four (4) M10 hex head bolts attaching the sprocket to the hub.
- c) Place one end of a square against the Piston Inserter Chain Rail with the other spanning across the inserter, perpendicular to an Inserter Piston.
- d) Push or pull the tail end of the Inserter Piston until the Inserter Piston is square with the Inserter Chain Rail.
- e) Retighten the four (4) previously loosened bolts on the adjustable hub to retain the now squared position.



Step 3. PIC Pusher Lug Alignment

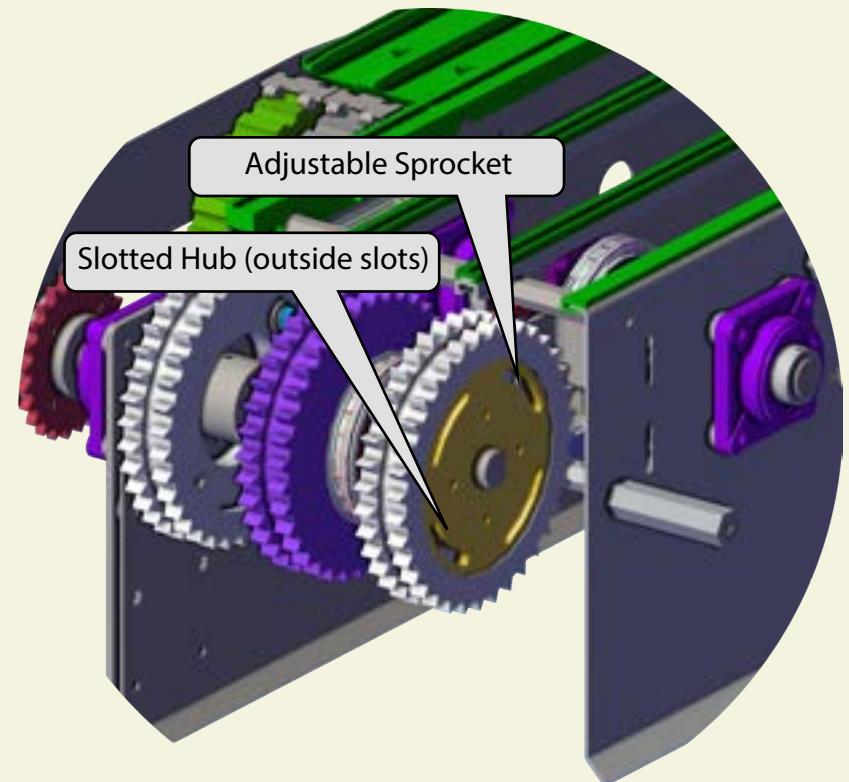
Located on the outboard end of the Head Shaft is an adjustable sprocket that allows the squaring of the P.I.C. Pusher Lug in relation to the overall assembly.

To square the P.I.C. Pusher Lug:

- Locate the adjustable sprocket as shown in the diagram.
- Loosen the four (4) M10 hex head bolts securing the adjustable sprocket to the slotted hub.
- Place a straight edge against an Inserter Piston and across the P.I.C Chain.

d) Grasp the P.I.C. Pusher Lug on the outboard end and move that end of the P.I.C. Pusher chain until it is parallel with the Inserter Piston (use a tape measure and pull off of the straight edge resting against the inserter Piston, adjust until the measurements are equal on both the inboard and outboard ends of the P.I.C. Pusher Lug).

e) While retaining this position, retighten the previously loosened four (4) hex head bolts.

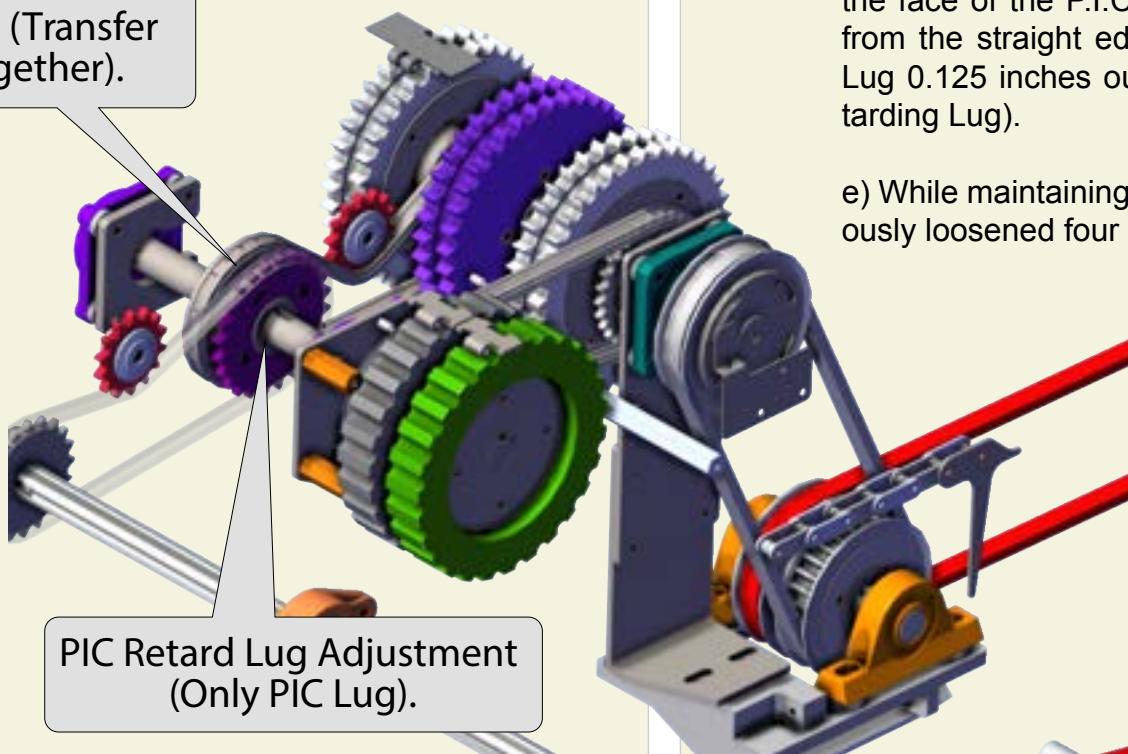


Step 4. PIC Retard to Transfer Retard Alignment

The next step in the Alignment Procedure is to phase the P.I.C. Retarding Lugs to the Transfer Chain Retarding Lugs.

Located on the Downstream End of the P.I.C., attached to the outboard side of the Transfer Chain Retard Drive Hub, is the Transfer Driven Adjustable Sprocket. This sprocket and hub allow the Retarding P.I.C. Lugs to be phased or aligned with the Retarding Lugs of the Transfer Chain.

Transfer Lug and PIC Retard Lugs Adjustment (Transfer and PIC move together).



To phase the P.I.C. Retarding Lugs to the Transfer Chains Retarding Lugs:

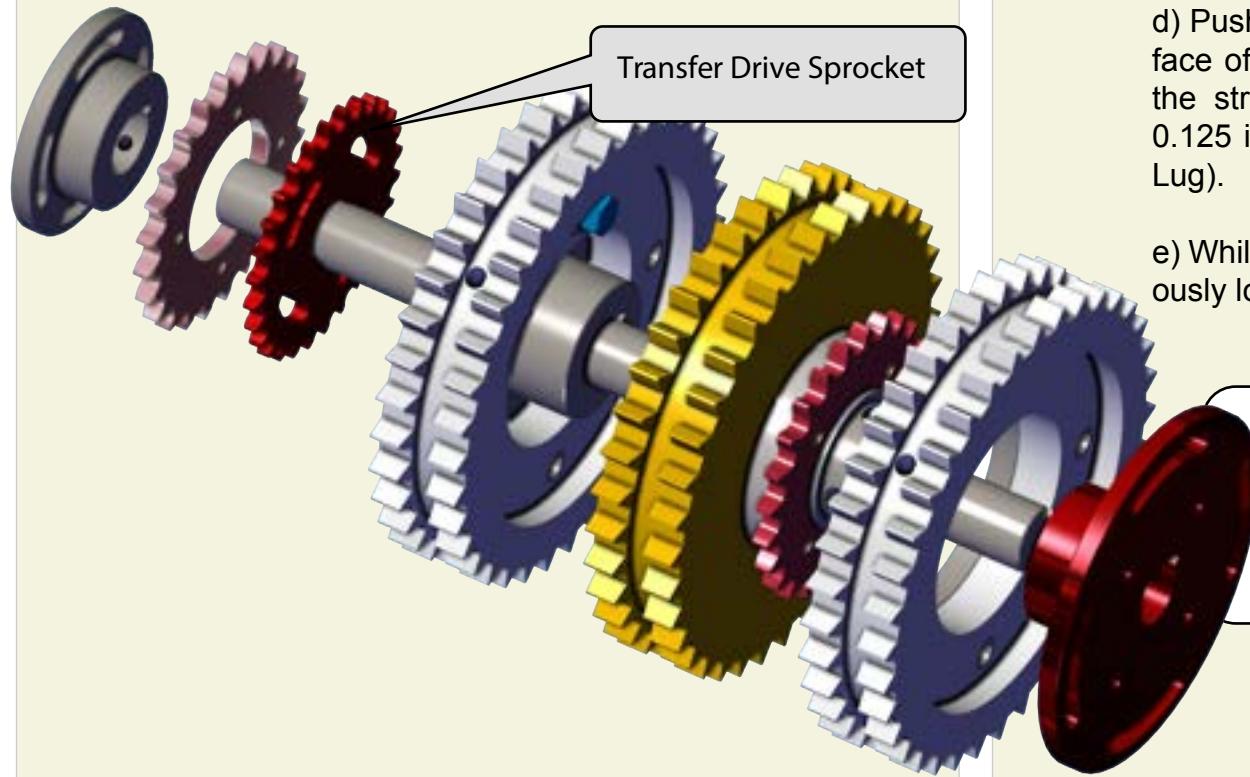
- a) Locate the Outboard Sprocket under / inside the PIC attached to the Transfer Chain Retard Drive Hub as shown in the diagram below.
- b) Using a suitable wrench, loosen the four (4) M8 hex head bolts attaching the sprocket to the hub.
- c) Place a straight edge against the face of the Retarding Lug of the Transfer Chain and across the P.I.C.
- d) Push or pull the Retarding Lug of the P.I.C. until the face of the P.I.C. Retarding Lug is 0.125 inches from the straight edge (placing the P.I.C. Retarding Lug 0.125 inches outside of the Transfer Chain Retarding Lug).
- e) While maintaining this position, retighten the previously loosened four (4) attachment bolts.

Step 5. PIC Pusher to Transfer Pusher Adjustment

The next step in the Alignment Procedure is to phase the P.I.C. Pushing Lugs to the Transfer Chain Pushing Lugs.

Located on the Downstream End of the P.I.C. and on the inboard side of the P.I.C. Headshaft Assembly is the Transfer Drive Sprocket.

This sprocket is mounted to the P.I.C. Headshaft Fixed Flange and is slotted to allow the Pushing P.I.C. Lugs to be phased or aligned with the Pushing Lugs of the Transfer Chain.



To phase the P.I.C. Pushing Lugs to the Transfer Chains Pushing Lugs:

- a) Locate the Transfer Drive Sprocket attached to the P.I.C. Headshaft Fixed Flange as shown in the diagram.
- b) Using a suitable wrench, loosen the four (4) M8 hex head bolts attaching the slotted sprocket to the hub.
- c) Place a straight edge against the face of the Pushing Lug of the Transfer Chain and across the P.I.C.
- d) Push or pull the Pushing Lug of the P.I.C. until the face of the P.I.C. Pushing Lug is 0.125 inches from the straight edge (placing the P.I.C. Pushing Lug 0.125 inches outside of the Transfer Chain Pushing Lug).
- e) While maintaining this position, retighten the previously loosened four (4) attachment bolts.



NOTE: When completing steps 4 & 5, the total opening of the P.I.C. Lugs should be 0.250" larger than the opening of the Transfer Lugs.

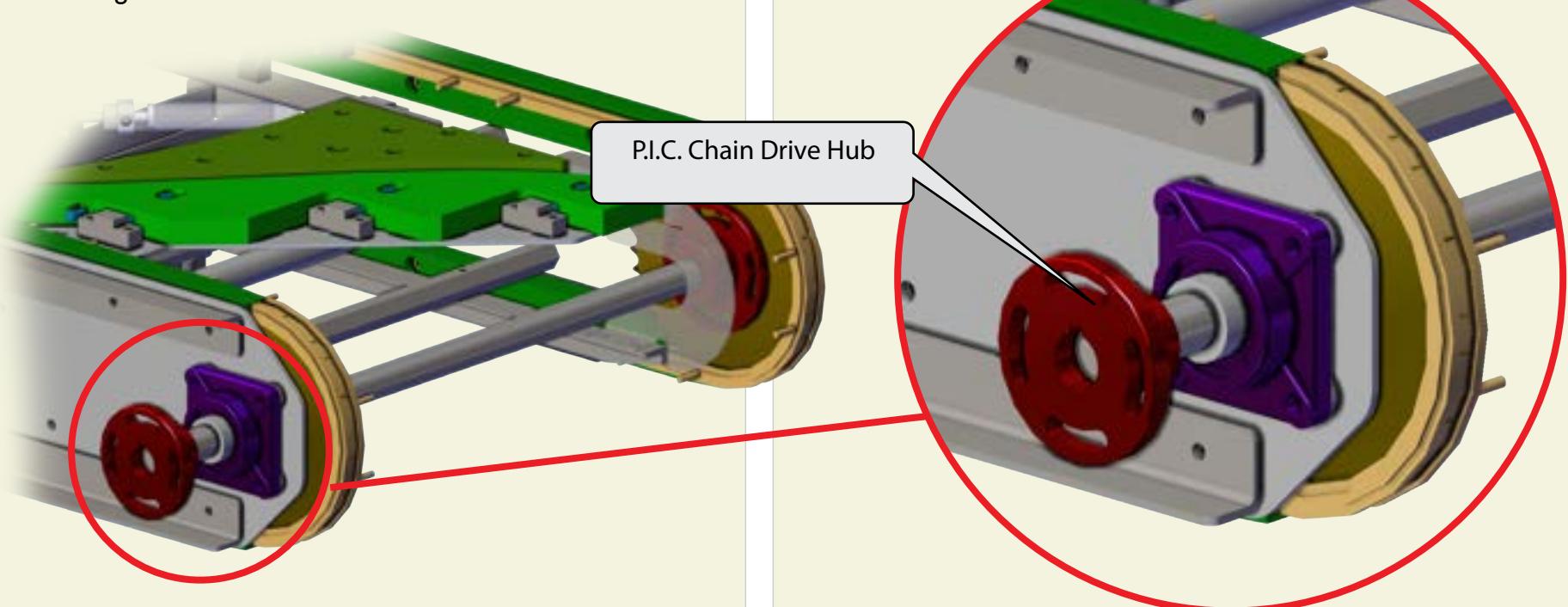
Step 6.

The next step in the Alignment Procedure is to phase the Inserter to the P.I.C. Pusher Chains.

Located on the inboard side of the Inserter Inner Side Plate is the P.I.C. Chain Drive Hub. This hub is slotted to allow movement of the Inserter independently of all other chains. This allows the inserter to be set to a pre determined dimension in relation to the P.I.C. Pusher Chains.

To phase the Inserter to the P.I.C. Pusher Chains:

- a) Locate the P.I.C. Chain Drive Hub as shown in the diagram.



b) Using a suitable wrench, loosen the four (4) M10 hex head bolts attaching the slotted hub to the head shaft assembly.

c) Grasping an Inserter Piston, move the Inserter Assembly until the center line of the Inserter Piston Arm is three inches (3") from the face of the Flight Chains Pusher Lug (3.100" from the face of the P.I.C. Pusher Lug).

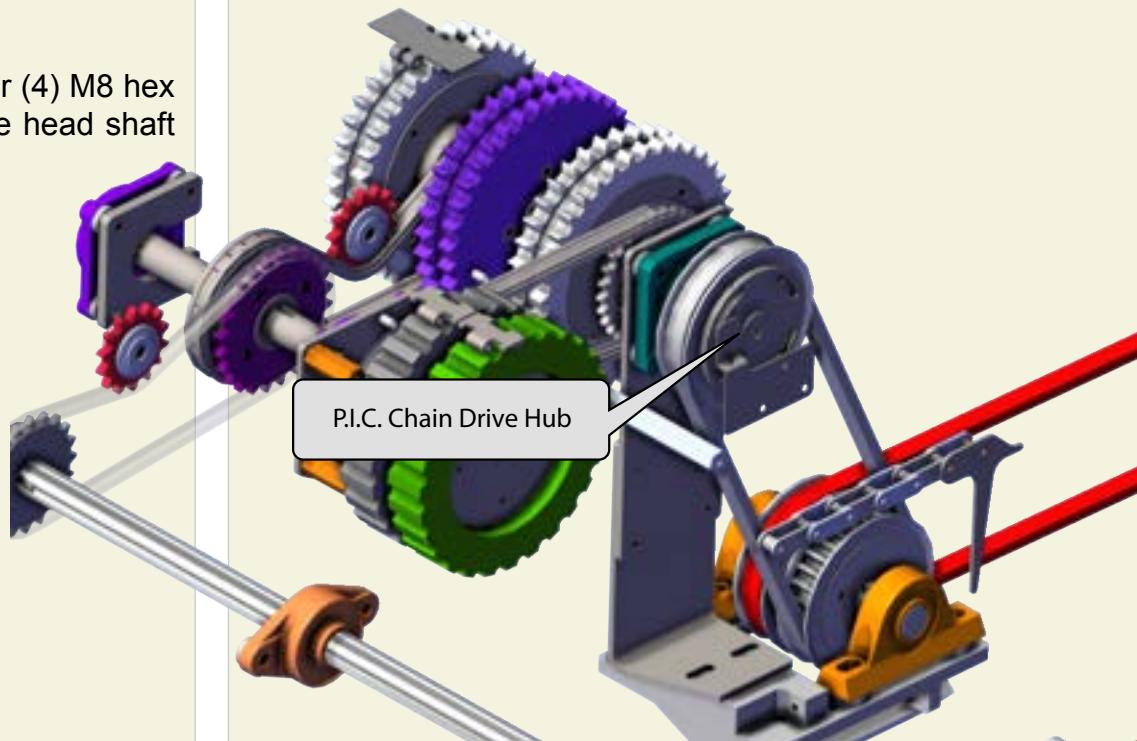
D) While maintaining this position, retighten the previously loosened four (4) attachment bolts.

The last step in the Alignment Procedure is to phase the P.I.C. Pusher Chains, Transfer Pusher Chains, and Inserter to the Flight Chains.

Located on the far inboard end of the Headshaft is a chain driven adjustable hub that allows movement of the P.I.C. Pusher Chains, Transfer Pusher Chains, and Inserter independently of the Flight Chains. This hub allows these components to be phased to the Flight Chains Pusher Lug.

To phase the P.I.C. Pusher Chains, Transfer Pusher Chains, and Inserter to the Flight Chains:

- a) Locate the Chain Driven Hub as shown in the diagram.
- b) Using a suitable wrench, loosen the four (4) M8 hex head bolts attaching the slotted hub to the head shaft assembly.



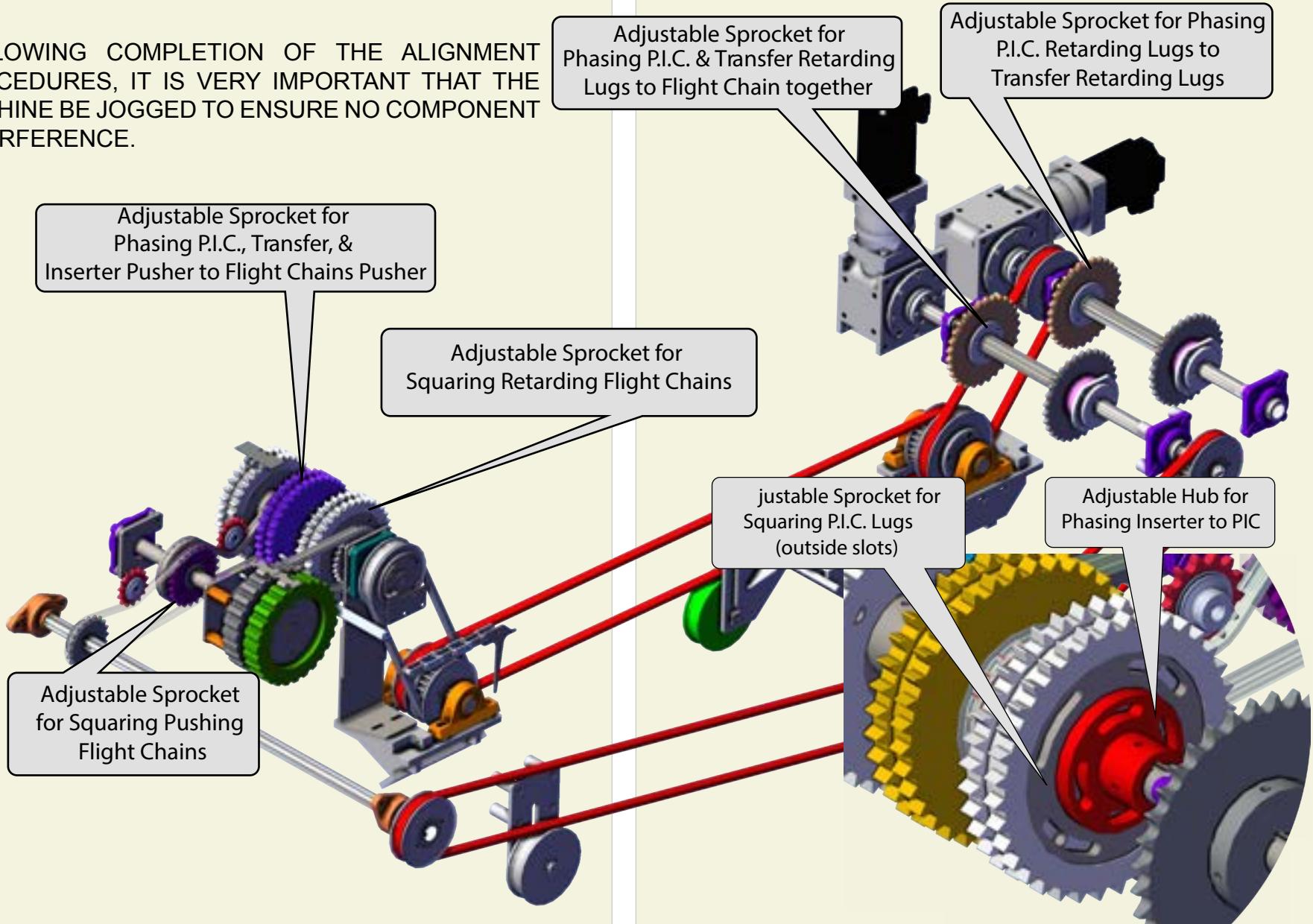
c) Place a straight edge against the face of a Transfer Chain Pushing Lug and across to the Flight Chains.

d) Grasping an Inserter Piston, move the Inserter, P.I.C., and Transfer Chains until the Flight Chain Pusher Lug is 0.025" from the straight edge. This will position the Transfer Chain Pushing Lug just inside the Flight Chain Pushing Lug, compensating for the board thickness of the carton being run.

e) While maintaining this position, retighten the previously loosened four (4) attachment bolts.

Mechanical Alignment Diagram

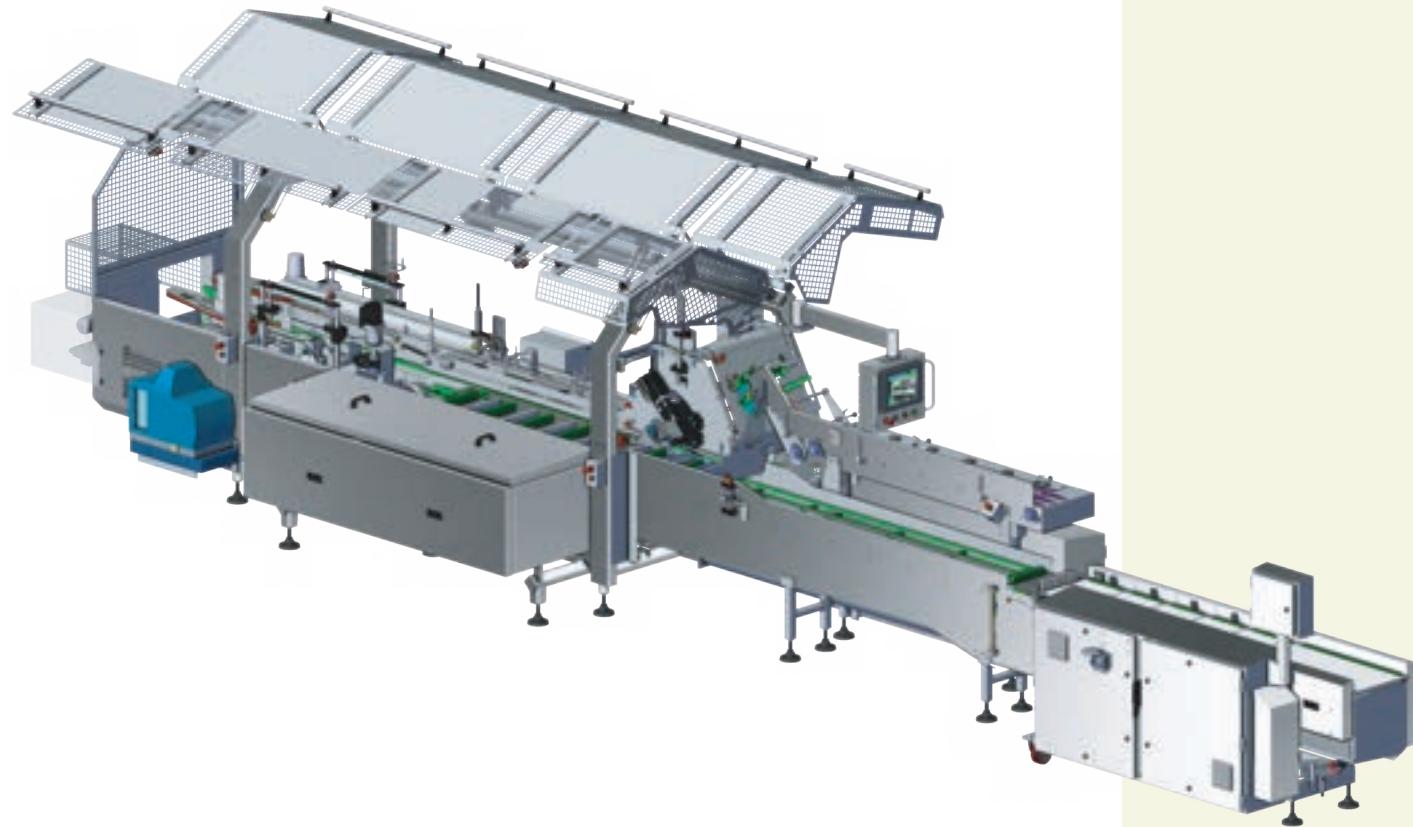
FOLLOWING COMPLETION OF THE ALIGNMENT PROCEDURES, IT IS VERY IMPORTANT THAT THE MACHINE BE JOGGED TO ENSURE NO COMPONENT INTERFERENCE.



KLIKLOK•WOODMAN®

5224 Snapfinger Woods Dr.
Decatur, Georgia 30035
Tel: 770 981 5200 • Fax: 770 987 7160
Email: sales@klikwood.com





ENTERPRISE

Endload Cartoner
SCHWANS - ATLANTA
HS5160

 **HOME**

**TOP ELECTRIC
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169100**

Find Num	Part Number	Item Description	Qty	Rev
				A
1	169101	ELECTRICAL WIRING SCHEMATICS, ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	D
2	169102	MAIN ELECTRICAL PANEL, (HIGH VOLTAGE) ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	B
3	169103	AUX ELECTRICAL PANEL, (LOW VOLTAGE) ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	C
4	169104	FRAME ELECTRICALS, ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	C
5	169105	OPERATOR INTERFACE, ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	A
6	169106	CONTROL PANEL AUXILIARY EQUIPMENT, ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	1	A

**TOP ELECTRIC
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169100**

KLIKLOK WOODMAN
5224 SNAPFINGER WOODS DR.
DECATUR, GA 30035 USA
TEL: 770-981-5200
FAX: 770-987-7160

NAME PLATE DATE:
VOLTS: 480 AMPS: 40
HERTZ: 60
PHASE: 3 DISCONNECT
RATING: 40A
SHORT CIRCUIT CURRENT RATING:
100KA
LARGEST CIRCUIT AMPS: 25

DRAWING LIST:
PAGE 0: DOCUMENTATION COVER SHEET
PAGE 1: MAIN POWER DISTRIBUTION, AC DRIVES
PAGE 2: 120VAC POWER DISTRIBUTION, AC DRIVES
PAGE 3: SAFETY CIRCUIT LOOPS
PAGE 4: SAFETY RELAY
PAGE 5: 24VDC POWER DISTRIBUTION
PAGE 6: ETHERNET/PLC CONNECTIONS
PAGE 7: REMOTE DIGITAL INPUT CONNECTIONS
PAGE 8: REMOTE DIGITAL INPUT CONNECTIONS
PAGE 9: REMOTE DIGITAL OUTPUTS CONNECTIONS
PAGE 10: SERVO DRIVES-FEEDER, PUSHER CHAINS
PAGE 11: SERVO DRIVES- RETARD CHAIN, LOAD SIDE TUCKER
PAGE 12: SERVO DRIVES-NON LOAD SIDE TUCKER, FLAP KICKER
PAGE 13: SERVO DRIVES-OVERHEAD CONFINER, ARTICLE BUCKET/ PIC PUSHER
PAGE 14: SERVO DRIVES-ARTICLE BUCKET/ PIC RETARD, SECONDARY NLS TUCKER

1
52

Page Number
Line Number

MFG\WIRING NOTES

Wire Colors:
480VAC: BLACK
120VAC
LINE(120L):BLACK
NEUTRAL (120N): WHITE
GROUND (GND): GREEN W/ YELLOW STRIPE
24VDC
POSITIVE (24P, 24AE): BLUE
COMMON (24C): WHITE W/ BLUE STRIPE
PANEL INTERCONNECTIONS: YELLOW

1. ALL UNGROUNDED 480VAC and 240 VAC WIRING TO BE 12 AWG BLACK UNLESS OTHERWISE SPECIFIED.
2. ALL DC VOLTAGE WIRING TO BE 18 AWG BLUE UNLESS OTHERWISE SPECIFIED.
3. ALL UNGROUNDED 120VAC CONTROL WIRING TO BE 18 AWG RED UNLESS OTHERWISE SPECIFIED.
4. ALL UNGROUNDED 24VDC "+" WIRING TO BE 18 AWG BLUE UNLESS OTHERWISE SPECIFIED.
5. ALL GROUNDED 24VDC "COM" WIRING TO BE 16 AWG WHITE/BLU UNLESS OTHERWISE SPECIFIED.
6. ALL UNGROUNDED WIRING TO REMOTE INLINE I/O MODULES TO BE 18 AWG BLUE (24VDC "+") AND GROUNDED WIRING BLU\WHITE (24VDC "COM")
7. ALL GROUND(PE) WIRING TO BE 14 AWG GREEN\YELLOW UNLESS OTHERWISE SPECIFIED AND OR MARKED AS GROUND. GROUND TERMINALS ARE MARKED "GND".
8. NO MORE THAN 2 CONDUCTORS ON ANY ONE TERMINAL.
9. POWER CABLING AND CONTROL WIRING TO BE KEPT SEPERATE WHERE EVER POSSIBLE AND RUN AT 90 ANGLE WHERE IT IS NOT POSSIBLE.
10. BOTTOM AND OR RIGHT SIDE OF TERMINAL BLOCKS ARE RESERVED FOR FIELD TERMINATIONS. FIELD TERMINATIONS ARE DESIGNATED BY DASHED LINES.
11. POWER WIRING TO TERMINATE TO DEVICES USING THE FOLLOWING RULES. TOP TO BOTTOM, LEFT TO RIGHT, FRONT TO BACK DEPENDING ON THE DEVICE ORIENTATION AS MOUNTED IN THE ENCLOSURE.
12. ALL COMPONENTS ARE TO BE LABELED FROM THE SCHEMATIC TAG NUMBER AND LOCATED DIRECTLY ABOVE OR BELOW THE COMPONENT ON THE SUBPANEL AND OR REAR OF DOOR AS APPLICABLE. THE SELF ADHESIVE LABEL WILL BE WHITE 0.5 INCH HIGH WITH 0.25 INCH HIGH BLACK LETTERS. CROY TAPE OR EQUAL. NO LABELS ARE TO BE APPLIED TO THE WIRE DUCT COVERS.
13. DO NOT USE SELF TAPPING SCREWS FOR MOUNTING - ONLY MACHINE SCREWS - DRILL AND TAP AS REQUIRED.

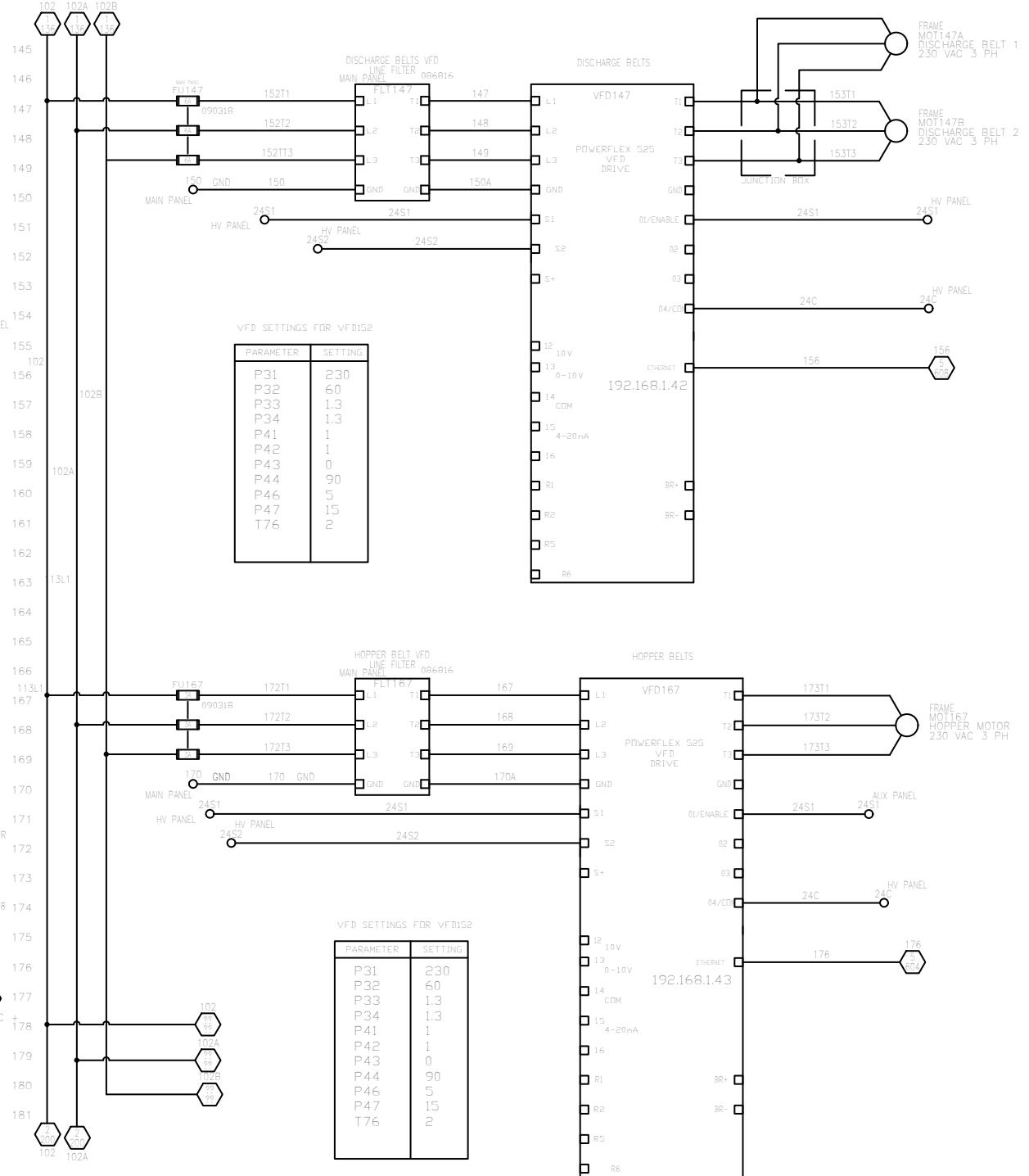
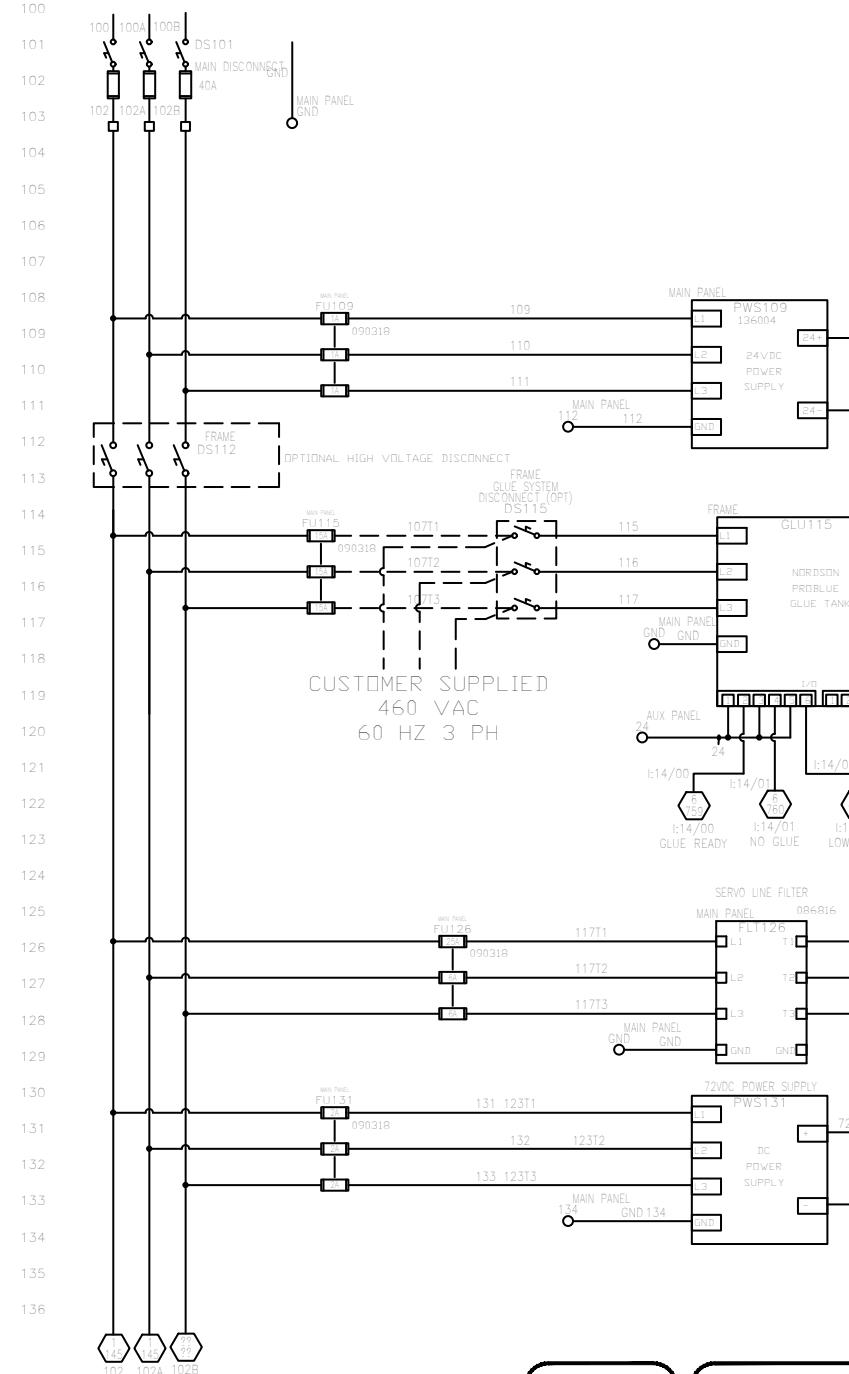
D
REVISION

TITLE PAGE
ENTERPRISE CARTONER, PIC INFEED, 480VAC

0 OF 14
SHEET NO

169101
DRAWING NUMBER

CUSTOMER SUPPLIED
460 VAC
60 HZ 3 PH



MAIN POWER DISTRIBUTION
ENTERPRISE CARTONER, PIC INFEED, 480VAC

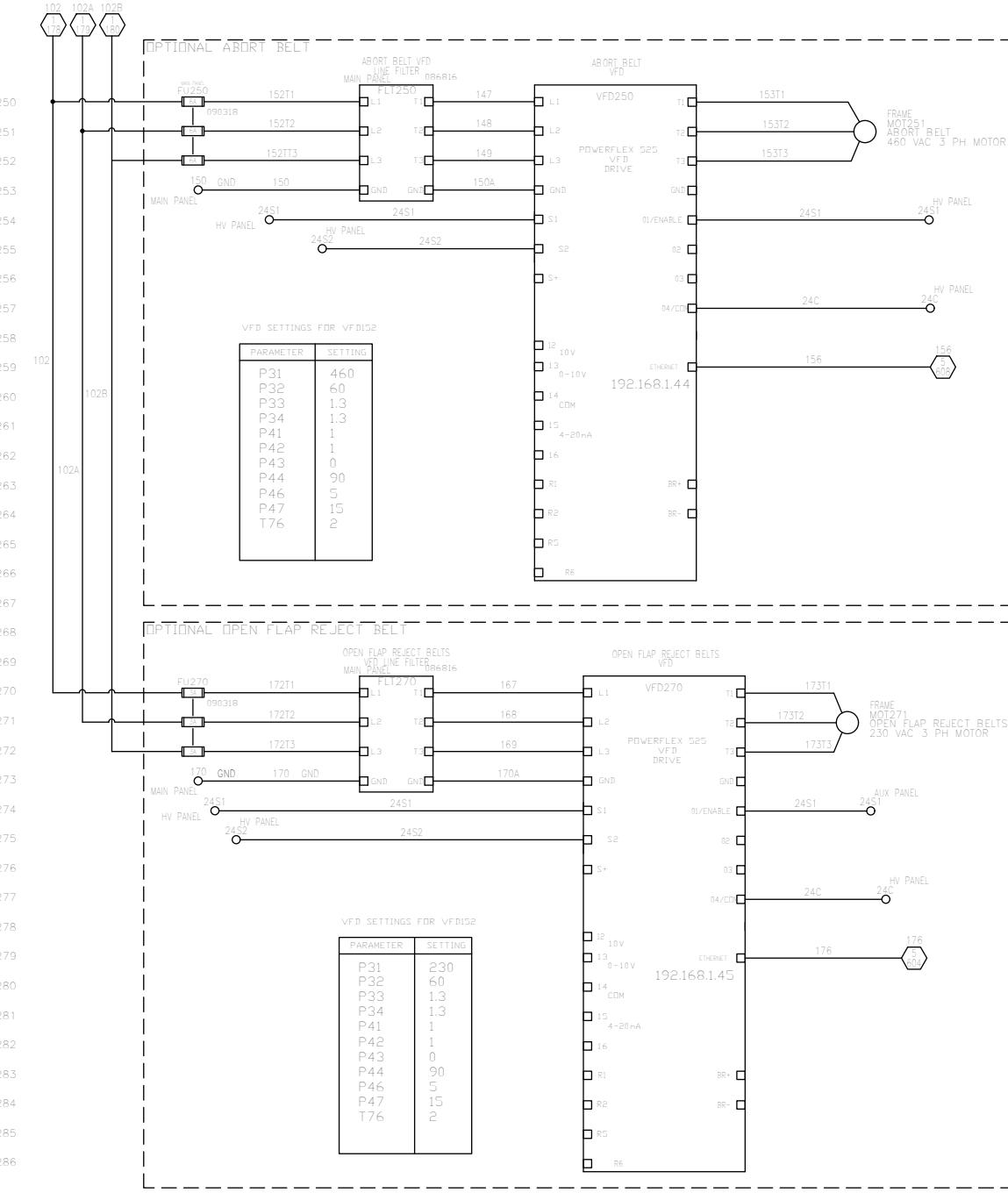
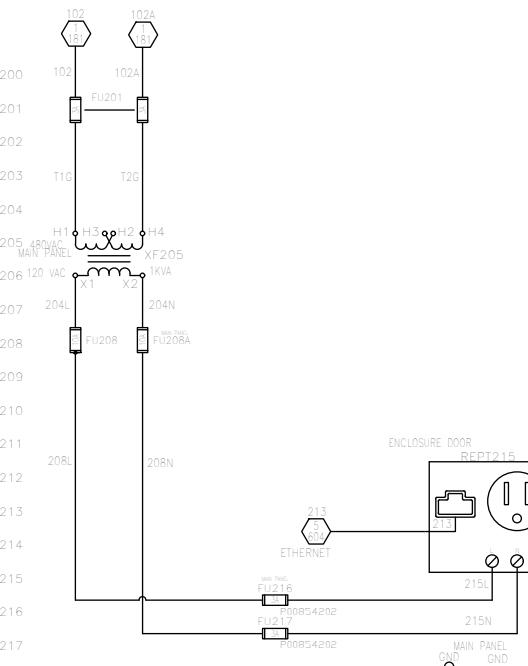
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REVISION

1 OF 14

169101

SHEET NO

DRAWING NUMBER



D
REVISION

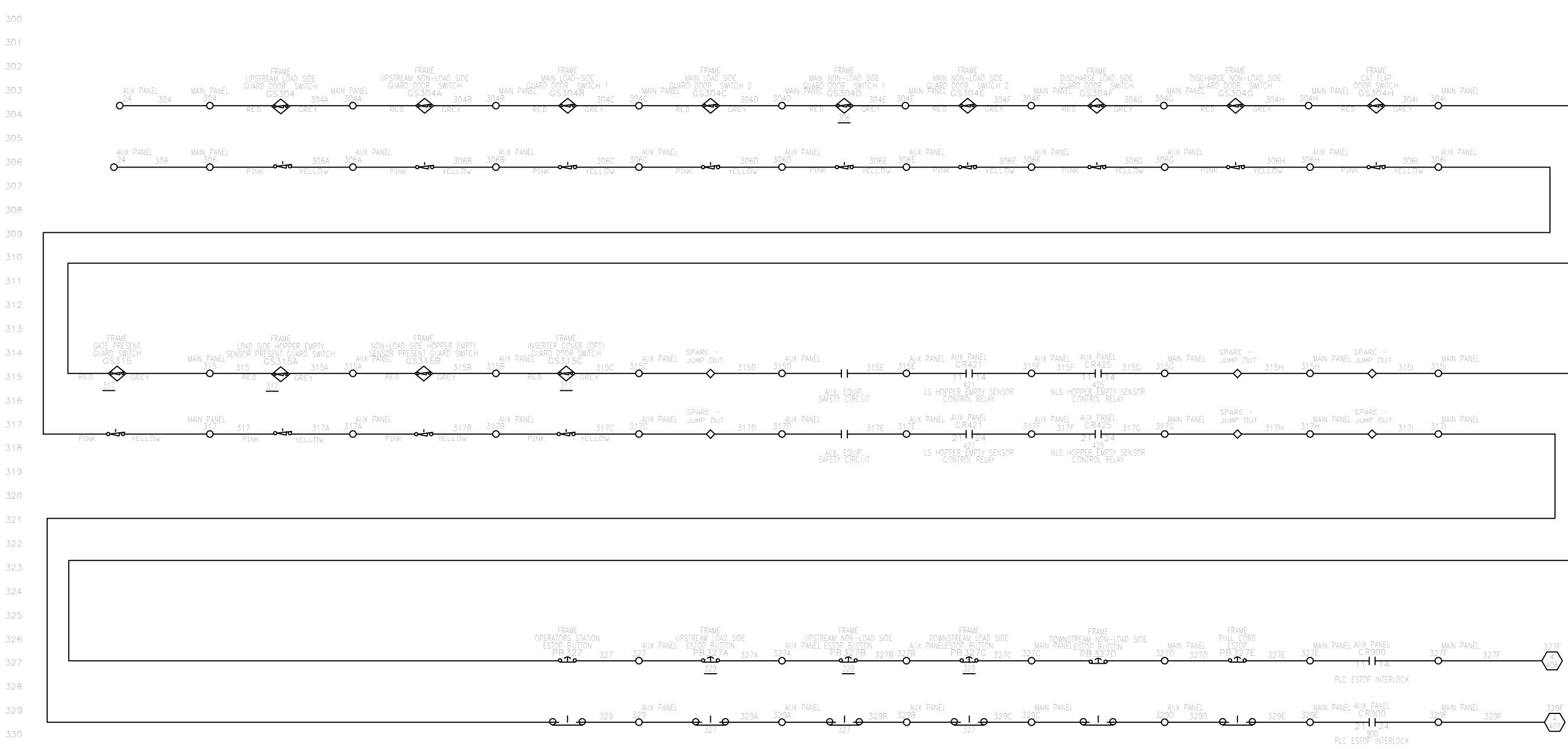
120VAC DISTRIBUTION
ENTERPRISE CARTONER, PIC INFEED, 480VAC

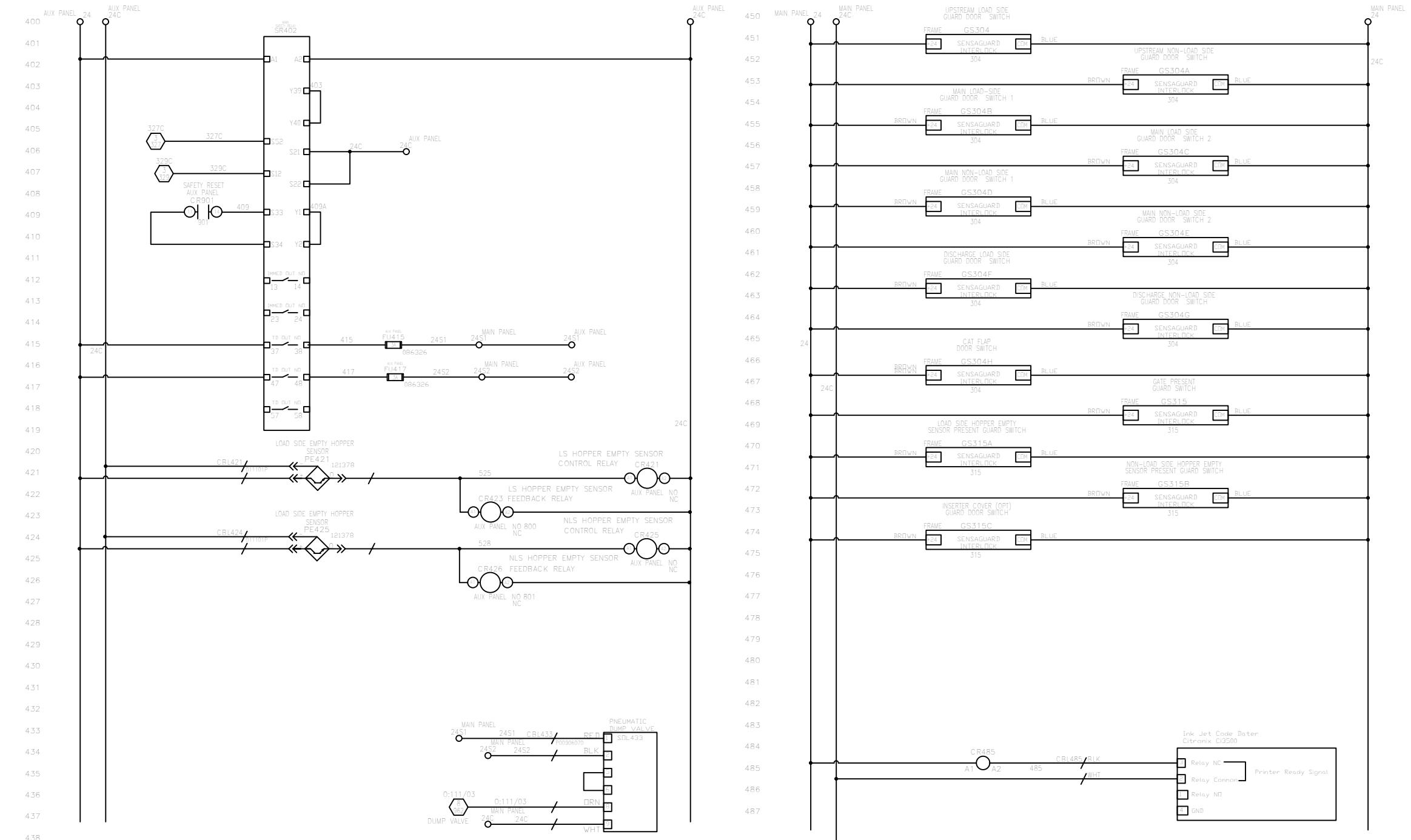
2 OF 14

SHEET NO

169101

DRAWING NUMBER





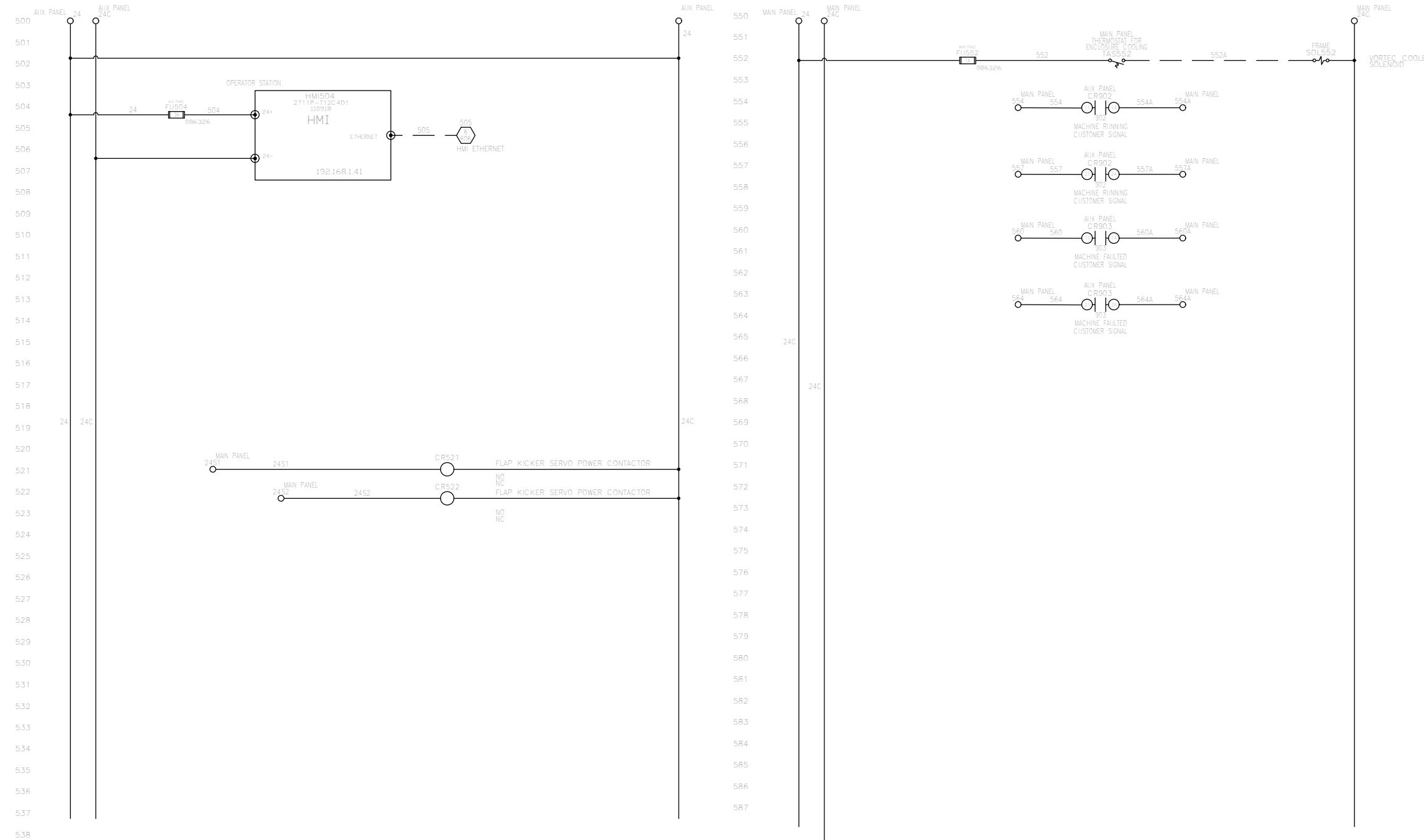
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REVISION

**SAFETY RELAY CIRCUIT
ENTERPRISE CARTONER, PIC INFEED, 480VAC**

4 OF 14

169101
DRAWING NUMBER

SHEET NO

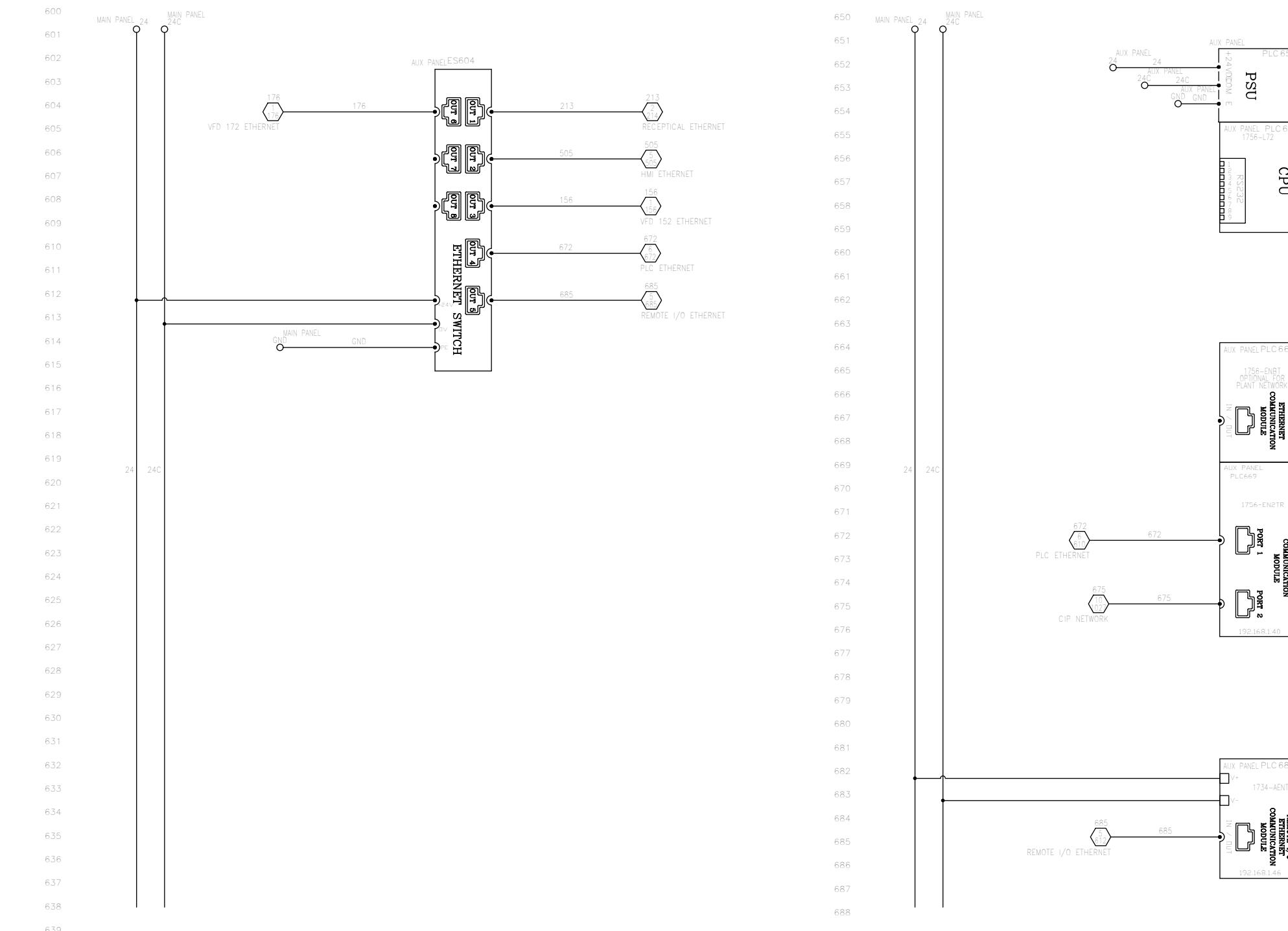


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REVISION

24 VDC DISTRIBUTION
ENTERPRISE CARTONER, PIC INFEED, 480VAC

5 OF 14
SHEET NO

169101
DRAWING NUMBER



D
REVISION

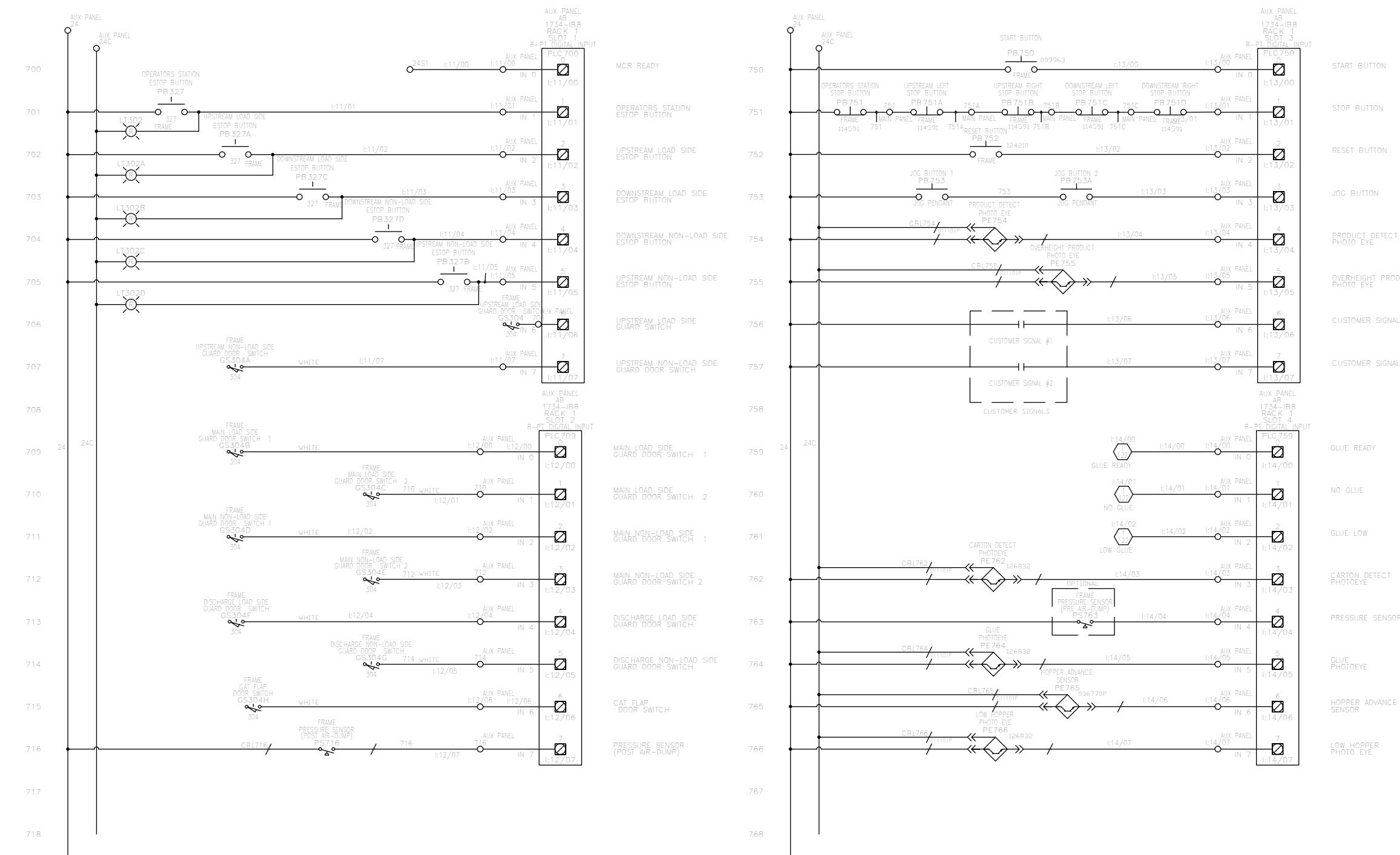
**ETHERNET/PLC CONNECTIONS
ENTERPRISE CARTONER, PIC INFEED, 480VAC**

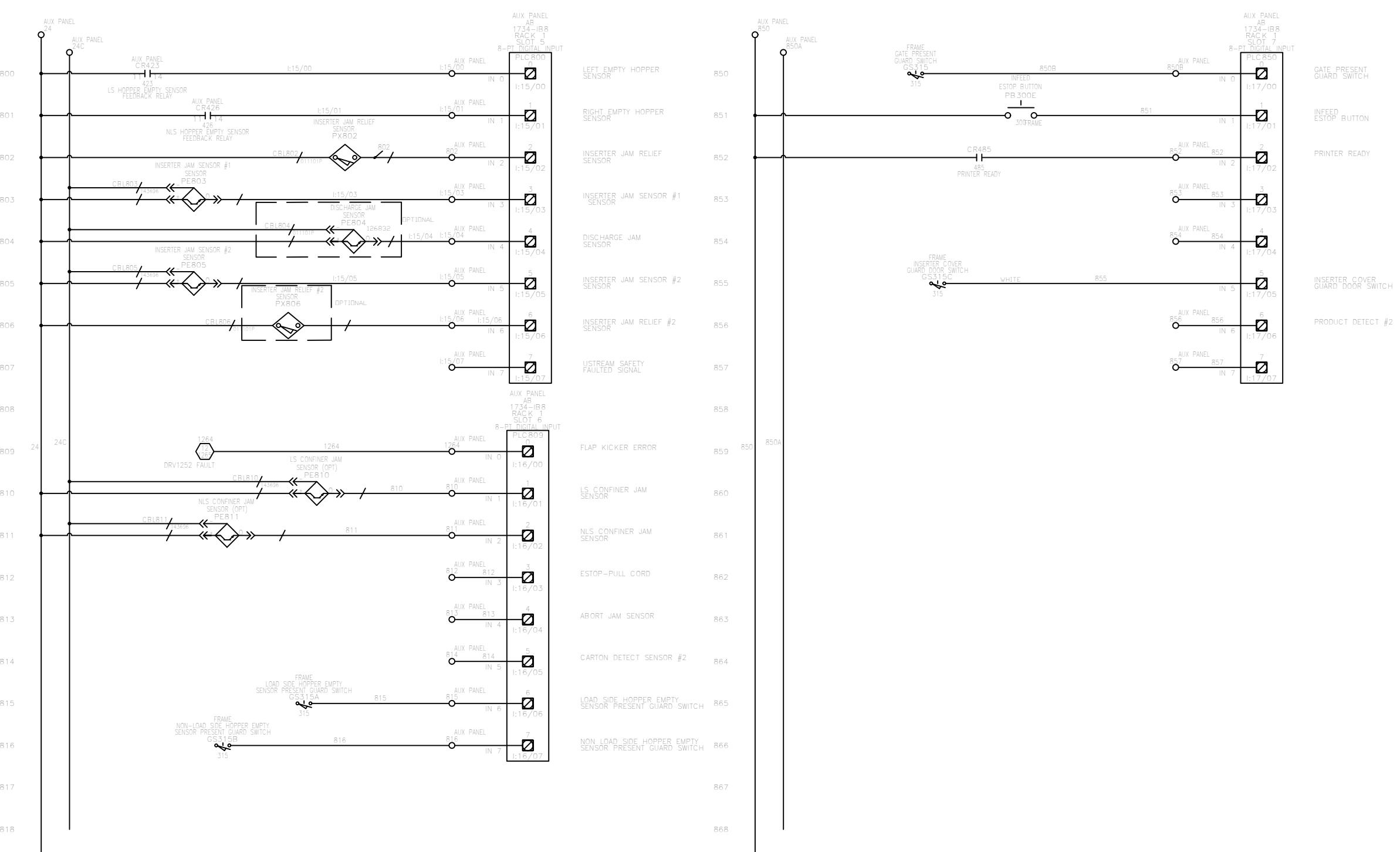
6 OF 14

SHEET NO

169101

DRAWING NUMBER



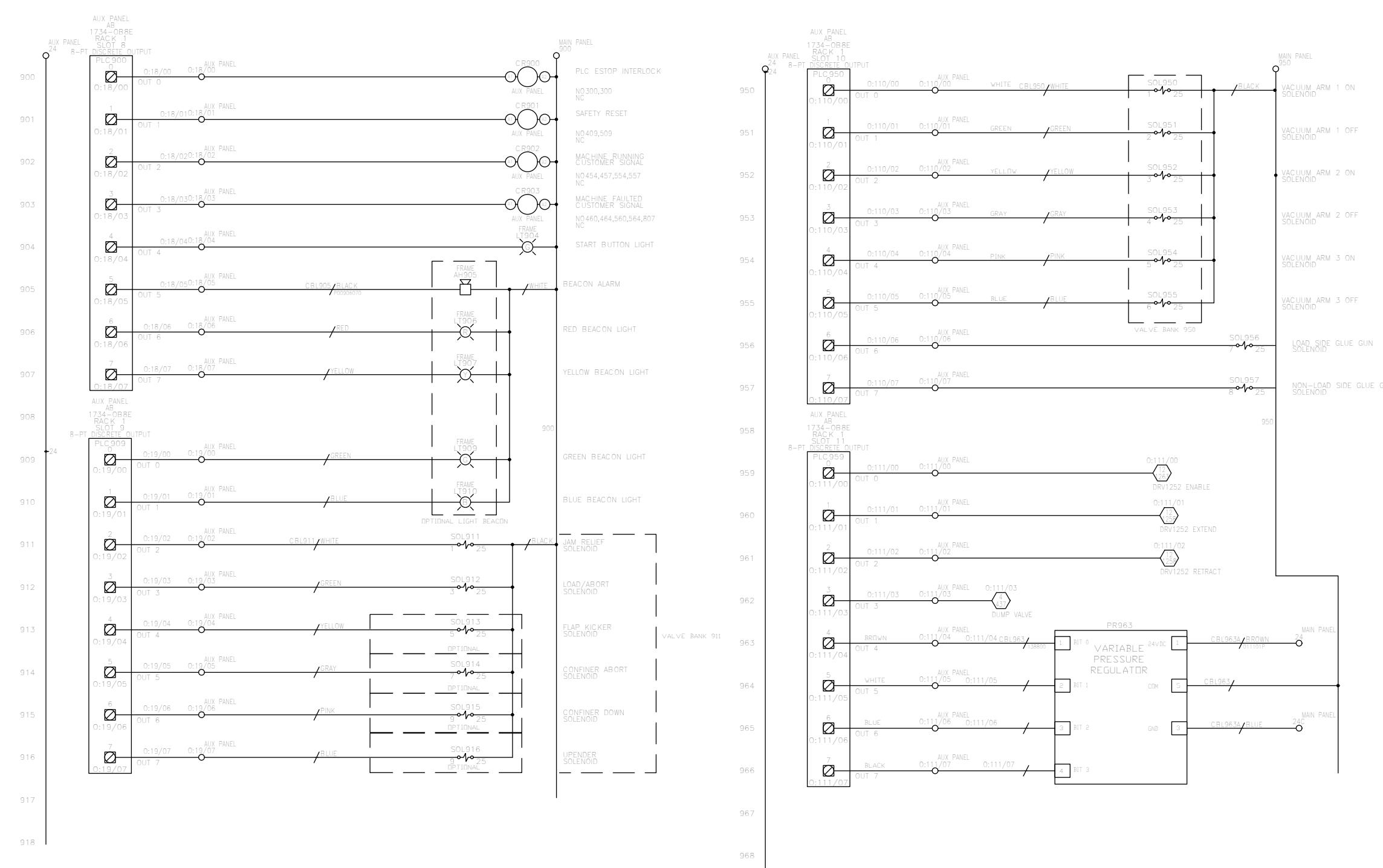


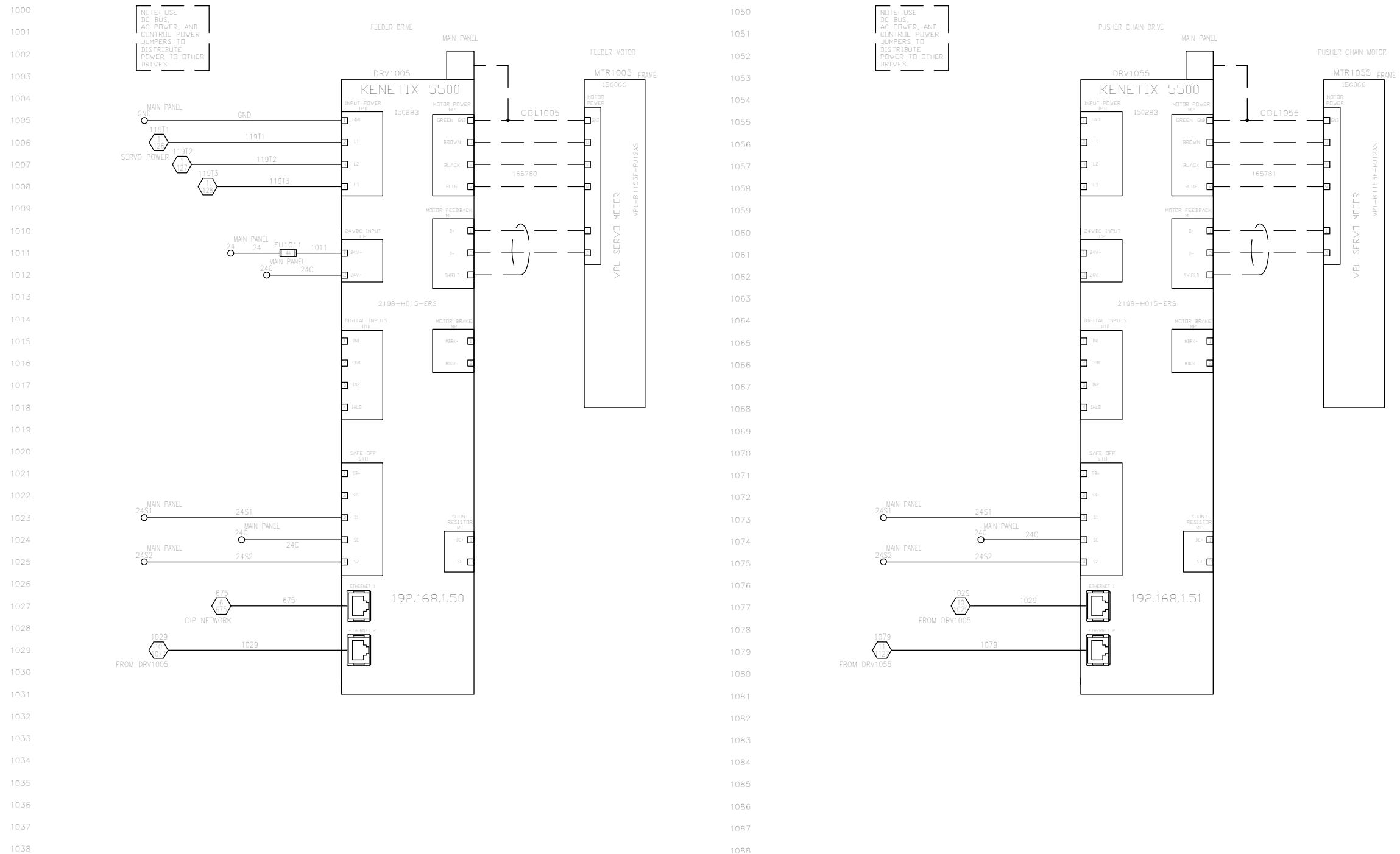
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REVISION

PLC INPUTS PAGE
ENTERPRISE CARTONER, PIC INFEED, 480VAC

8 OF 14

169101
WING NUMBER



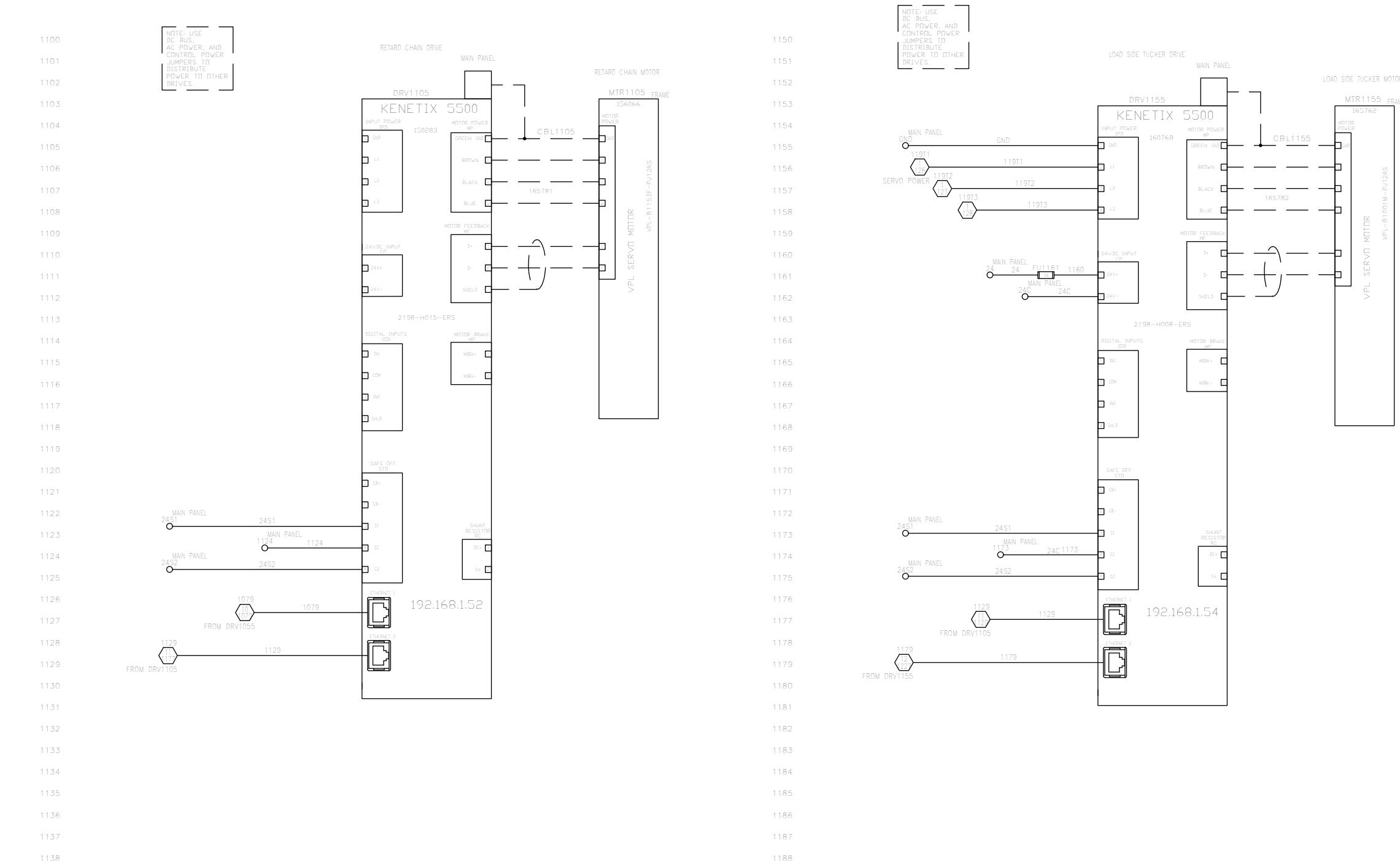


D
REVISION

**SERVO DRIVES PUSHER / RETARD
ENTERPRISE CARTONER, PIC INFEED, 480VAC**

10 OF 14
SHEET NO

169101
DRAWING NUMBER

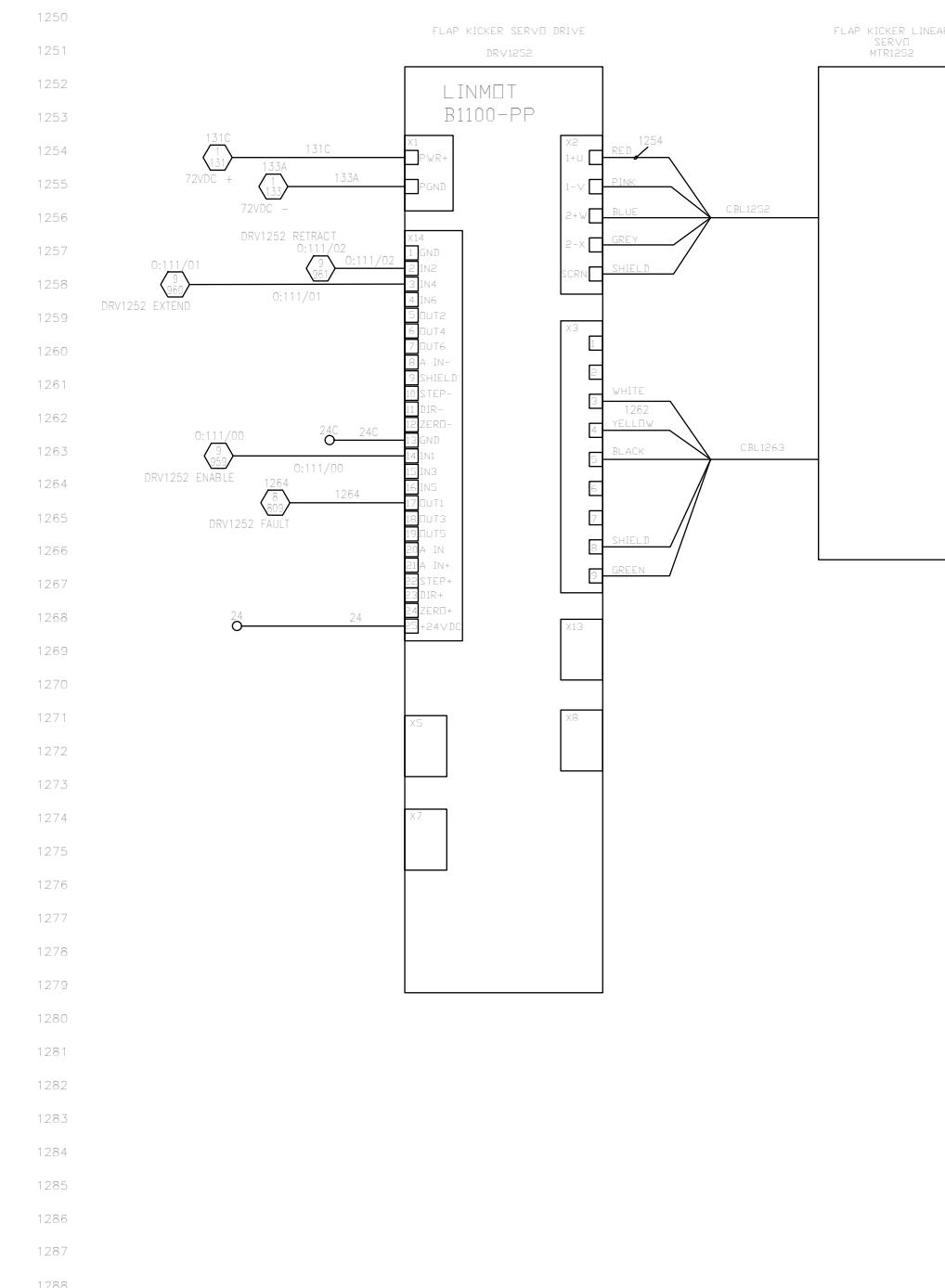
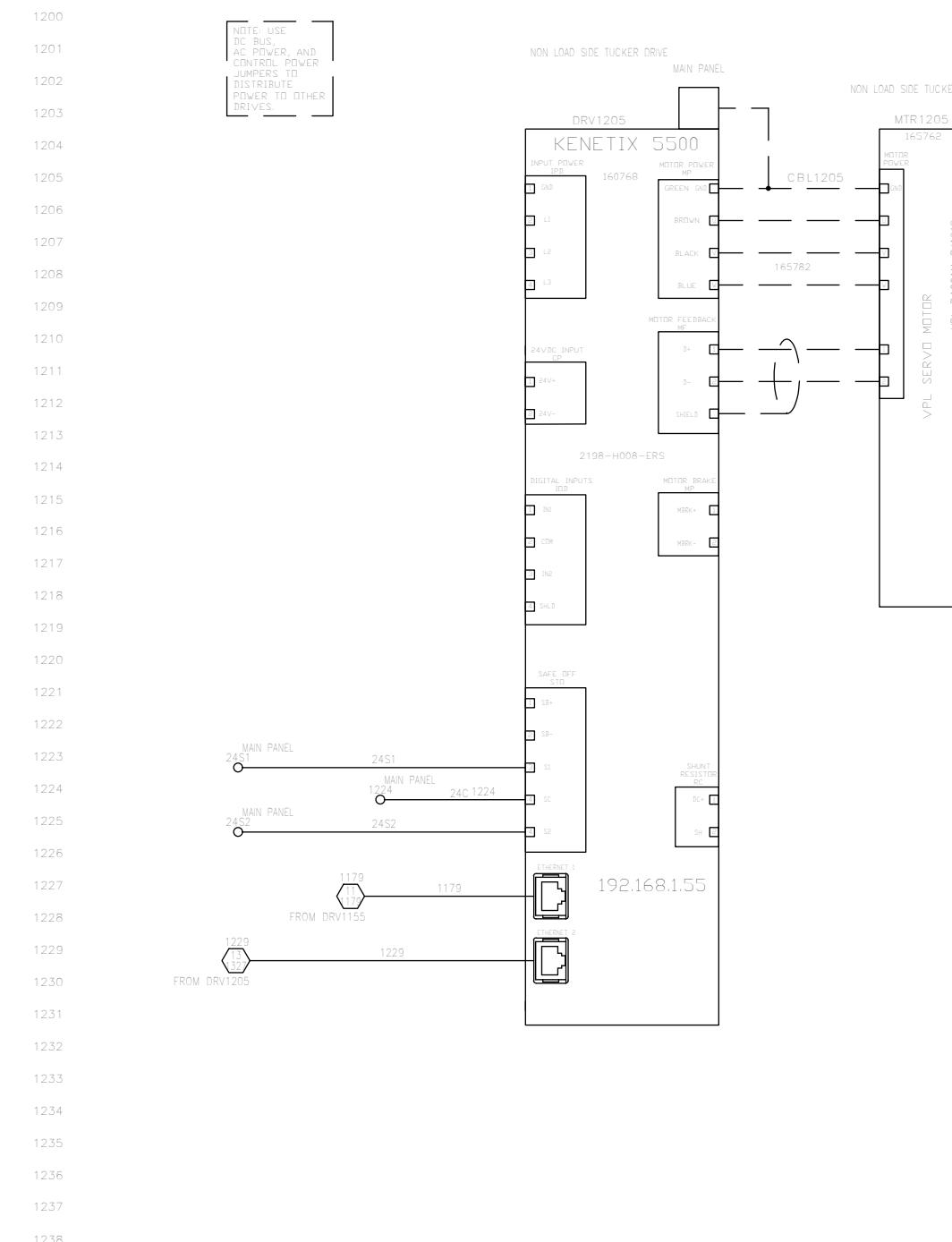


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REVISION

SERVO DRIVES - FEEDER/LOAD SIDE TUCKER
ENTERPRISE CARTONER, PIC INFEED, 480VAC

11 OF 14
SHEET NO

169101
DRAWING NUMBER

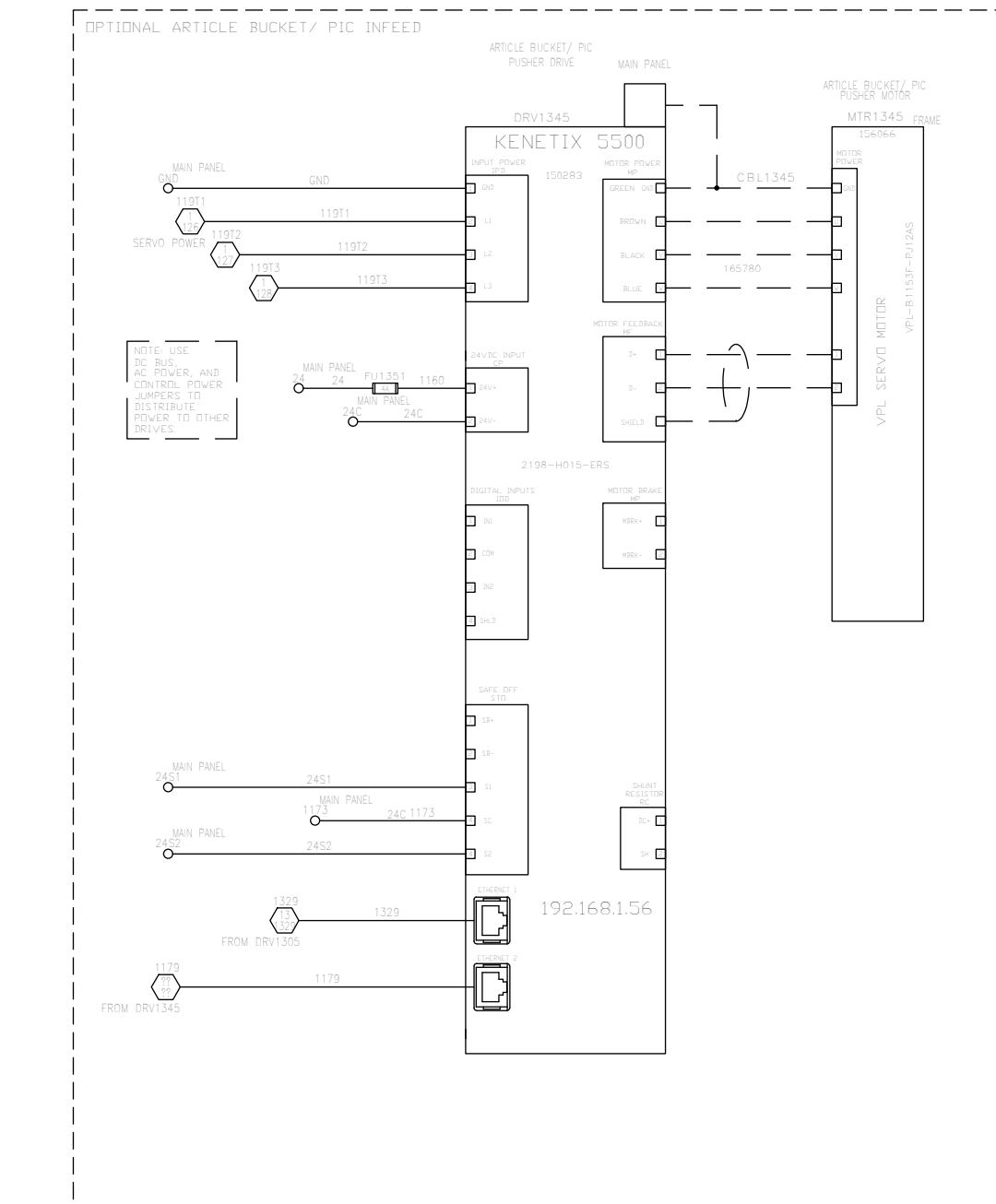
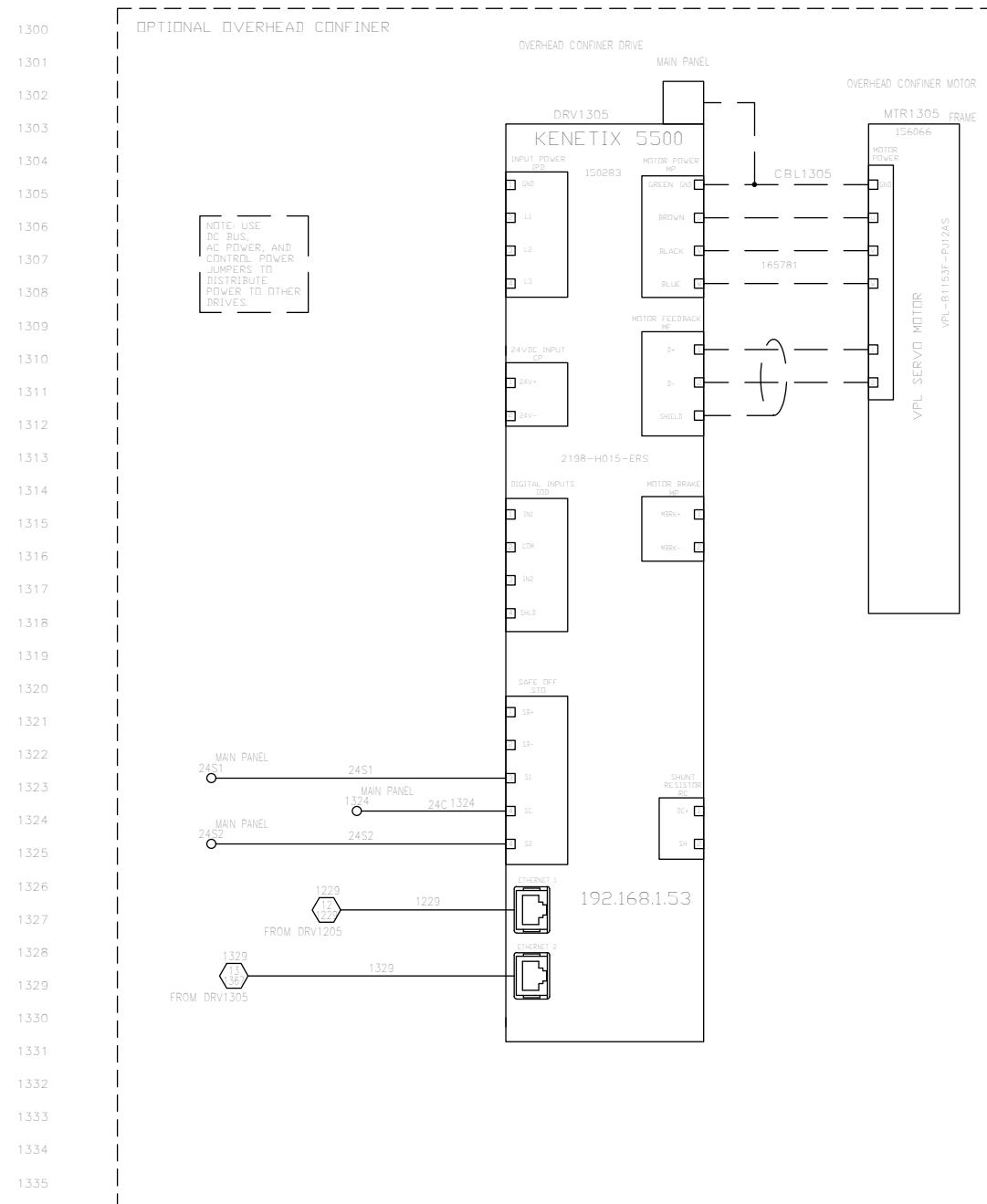


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SERVO DRIVES - NON LOAD TUCKER /FLAP KICKER ENTERPRISE CARTONER, PIC INFEED, 480VAC

12 OF 14

169101

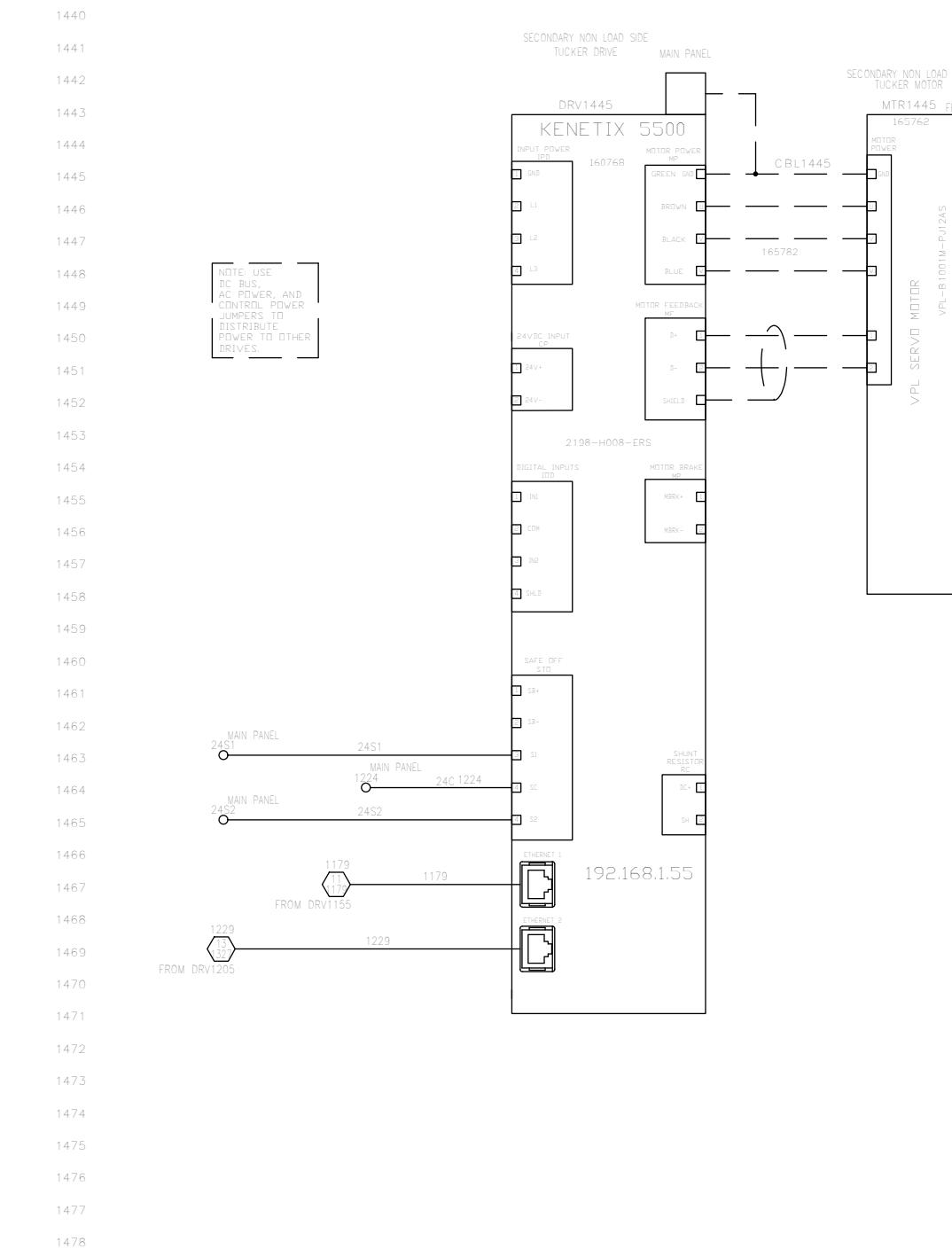
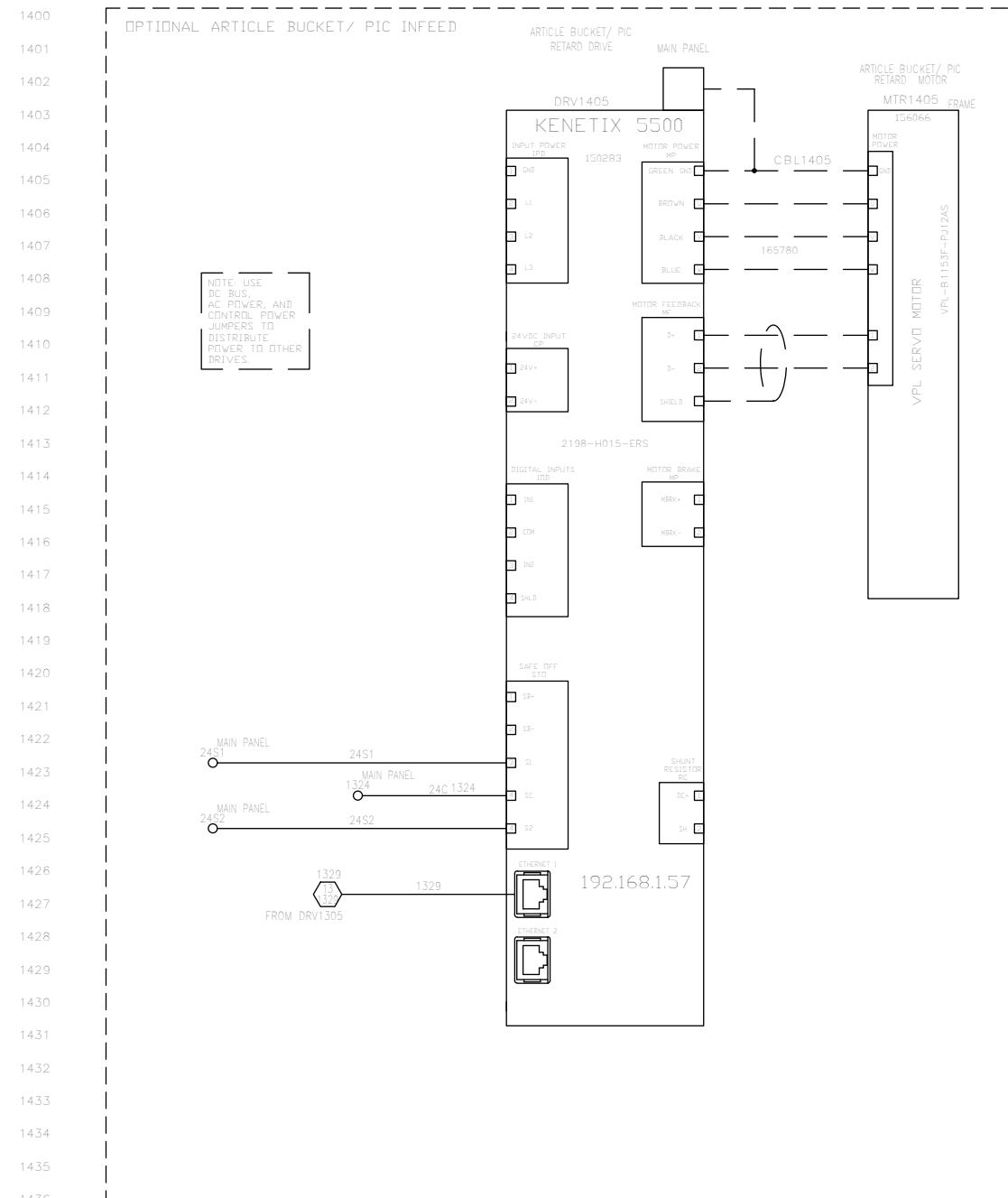


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SERVO DRIVES - OVERHEAD CONFINER ENTERPRISE CARTONER, PIC INFEED, 480VA

13 OF 14
SHEET NO

169101



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REVISION

SERVO DRIVES - OVERHEAD CONFINER
ENTERPRISE CARTONER, PIC INFEED, 480VAC

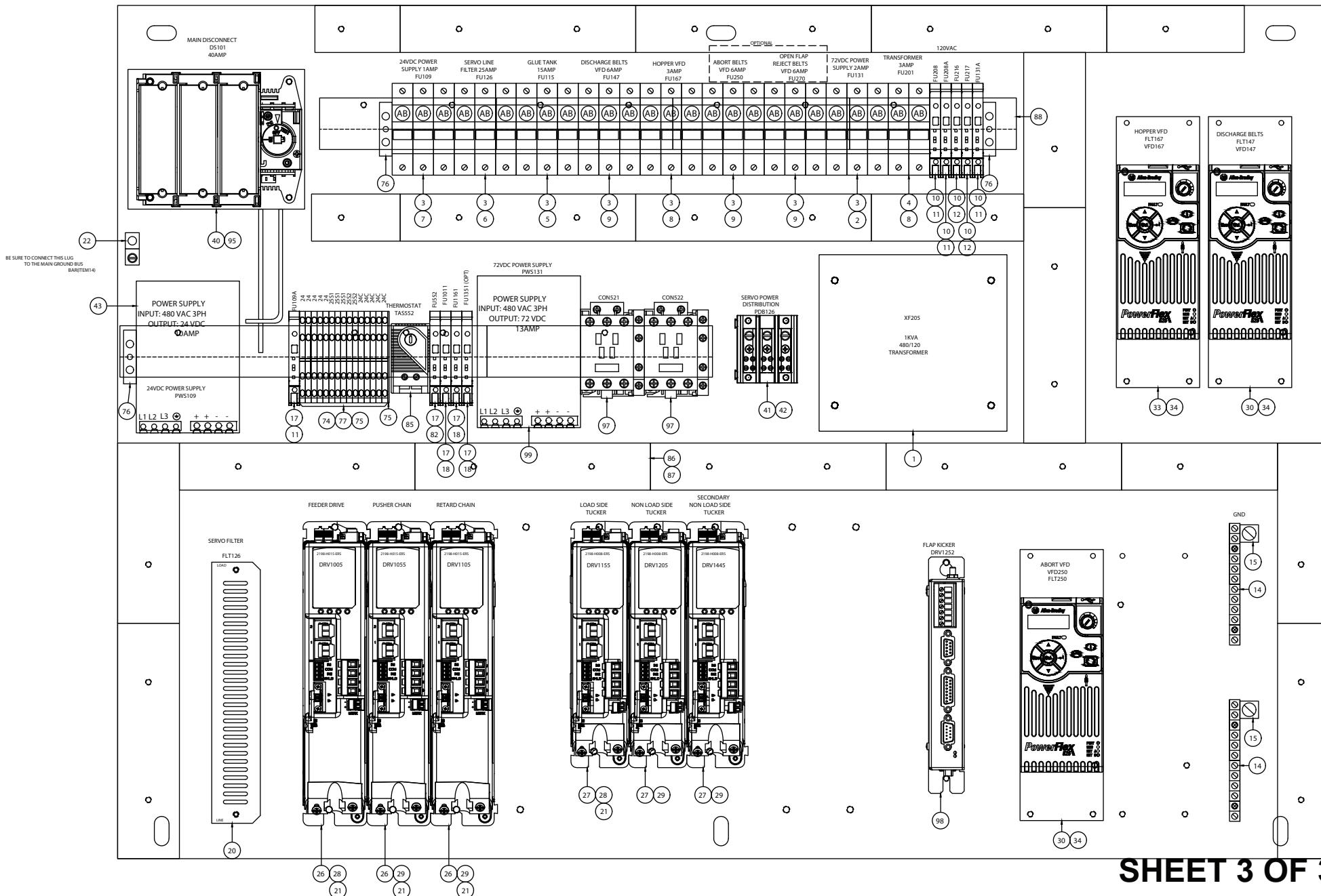
14 OF 14
SHEET NO

169101
DRAWING NUMBER

**SHEET 1 OF 3
MAIN ELECTRICAL PANEL
(HIGH VOLTAGE) ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169102**

SHEET 2 OF 3
MAIN ELECTRICAL PANEL
(HIGH VOLTAGE) ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169102

Find Num	Part Num	Item Description	Qty	Notes	Rev
0	166249	CONTROL PANEL BACK PLATE, MID-RANGE CARTONER, HIGH VOLTAGE	1		B D
1	134720	TRF-Transformer	1		A
2	095476	FUS-Fuse	3		A
3	090318	FSH-Fuse Holder	6		D
4	090319	FSH-Fuse Holder	1		D
5	065524	FUS-Fuse	3		-
6	165521	FUS-Fuse	3		A
7	096685	FUS-Fuse	3		A
8	125063	FUS-Fuse	5		A
9	086667	FUS-Fuse	6		A
10	147260	FSH-Fuse Holder	5		A
11	114543	FUS-Fuse	5		A
12	044232P	FUS-Fuse	4		A
14	037732P	TER-Terminal	2		B
15	037735P	TER-Terminal	2		B
17	147259	FSH-Fuse Holder	4		A
18	011165P	FUS-Fuse	2		A
20	086816	FLT-Filter	1		B
21	136162	CBL-Cable	5		A
22	P0085599	LUG-Lug	1		-
26	150283	DRV-Drive	3	DRV1305, DRV1345, DRV1405 OPTIONAL	A
27	160768	DRV-Drive	3		A
28	150284	CON-Connector	2		A
29	150285	CON-Connector	4		A
30	165524	VFD-Variable Frequency Drive	2		A
33	150280	VFD-Variable Frequency Drive	1		A
34	150282	FLT-Filter	3		A
40	145859	SWT-Switch	1		A
41	058847	PWB-Power Block	1		C
42	098232	CVP-Cover Plate	1		A
43	136004	PWS-Power Supply	1		A
44	145349	HAN-Handle	1		A
45	145348	CBL-Cable	1		A
46	147338	TER-Terminal	1		A
47	147339	TER-Terminal	3		A
48	150125	TER-Terminal	2		A
74	147254	TER-Terminal	15		A
75	147261	TER-Terminal	1		A
76	095671	TER-Terminal	4		A
77	134229	JMP-Jumper	3		A
82	P0072510	FUS-Fuse	1		A
85	012853P	THS-Thermostats	1		B
86	163862	PAN-Panel	12		A
87	P0085611	MNR-Mounting Rail	12		-
88	125025	MNR-Mounting Rail	3		A
89	096518	TER-Terminal	1		A
91	165609	TER-Terminal	1		A
92	114719	CBL-Cable	2	VFD	A
93	159233	PAN-Panel	1		A
94	P0085606	MNR-Mounting Rail	1		-
95	117610	FUS-Fuse	3		A
96	094857	REL-Relay	1		B
97	157603	CNT-Contactor	2		A
98	159733	SRV-Servo Motor	1		B
99	159734	PWS-Power Supply	1		B
100	098036	ADP-Adapter	1		A

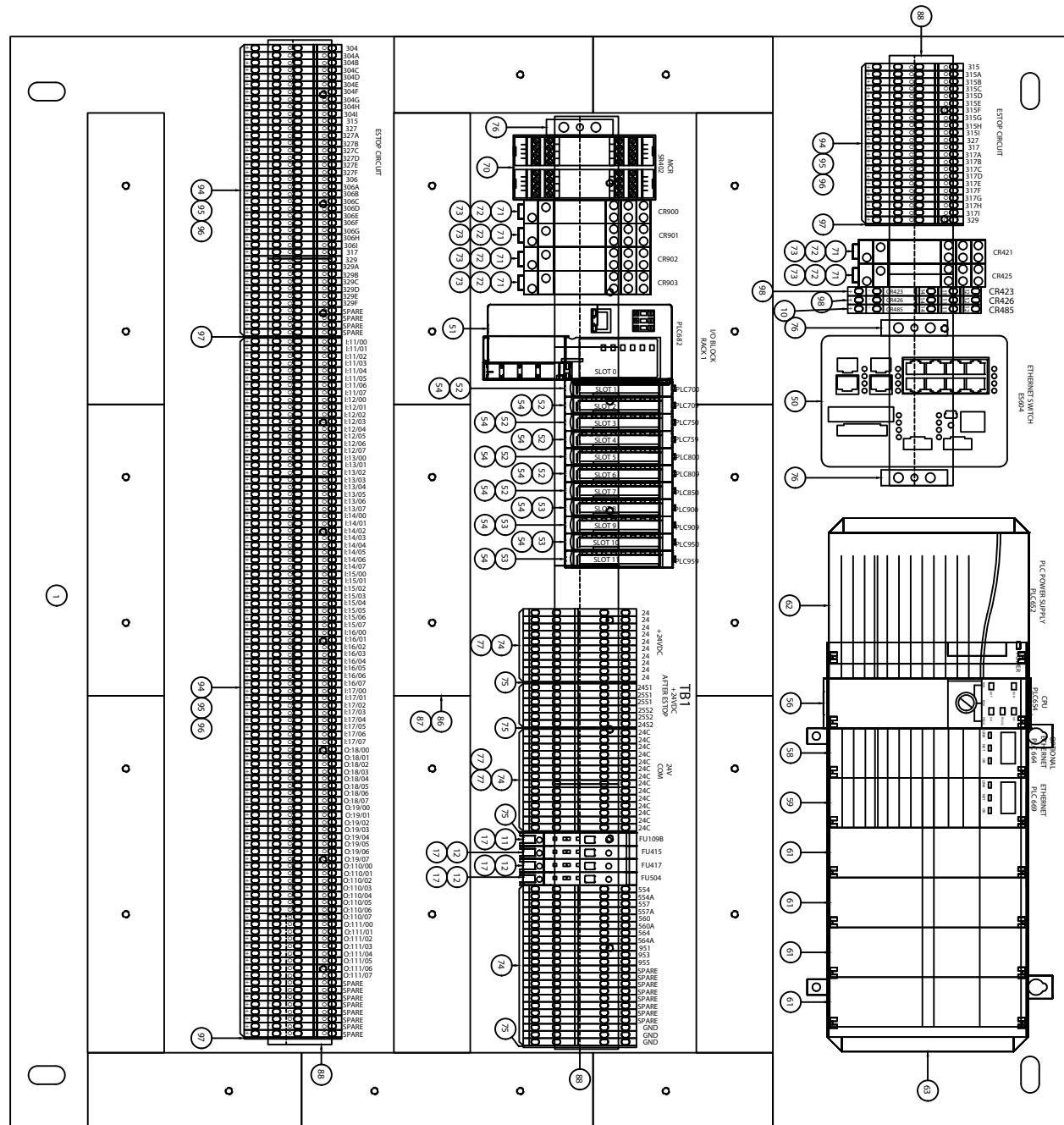


SHEET 3 OF 3
MAIN ELECTRICAL PANEL
(HIGH VOLTAGE) ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169102

SHEET 1 OF 3
AUX ELECTRICAL PANEL, (LOW VOLTAGE)
ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED
169103

Find Num	Part Number	Item Description	Qty	Notes	Rev
1	141497	CONTROL PANEL BACK PLATE, MID-RANGE CARTONER, LOW VOLTAGE,	1		C
10	149482	REL-Relay	1		A
11	114543	FUS-Fuse	1		A
12	044232P	FUS-Fuse	3		A
16	147258	TER-Terminal	3		A
17	147259	FSH-Fuse Holder	4		A
50	136005	HUB-Hub	1		A
51	131625	ADP-Adapter	1		A
52	134585	MOD-Module	7		A
53	136135	MOD-Module	4		A
54	147349	MOD-Module	11		A
56	168076	PLC-Programmable Logic Controller	1		A
58	086821	PLC-Programmable Logic Controller	REF		B
59	159043	PLC-Programmable Logic Controller	1		A
61	069835	PLC-Programmable Logic Controller	5		A
62	069833	PWS-Power Supply	1		D
63	069832	PLC-Programmable Logic Controller	1		A
70	133497	REL-Relay	1		A
71	111509	REL-Relay	6		B
72	111510	MOD-Module	6		B
73	111507	REL-Relay	6		A
74	147254	TER-Terminal	49		A
75	147261	TER-Terminal	4		A
76	095671	TER-Terminal	4		A
77	134229	JMP-Jumper	4		A
86	163862	PAN-Panel	15		A
87	P00856112	MNR-Mounting Rail	15		-
88	125025	MNR-Mounting Rail	3		A
89	096518	TER-Terminal	1		A
90	033324P	TER-Terminal	4		-
91	165609	TER-Terminal	4		A
92	091502	CBL-Cable	1	PLC	B
93	136162	CBL-Cable	1		A
94	147255	TER-Terminal	158		A
95	147256	TER-Terminal	158		A
96	147257	TER-Terminal	158		A
97	147262	TER-Terminal	3		A
98	094857	REL-Relay	2		B

SHEET 2 OF 3
AUX ELECTRICAL PANEL, (LOW VOLTAGE)
ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED
169103



SHEET 3 OF 3
**AUX ELECTRICAL PANEL, (LOW VOLTAGE)
ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED**
169103

FRAME ELECTRICALS, ENTERPRISE CARTONER

480VAC, K5500, PIC INFEED

169104

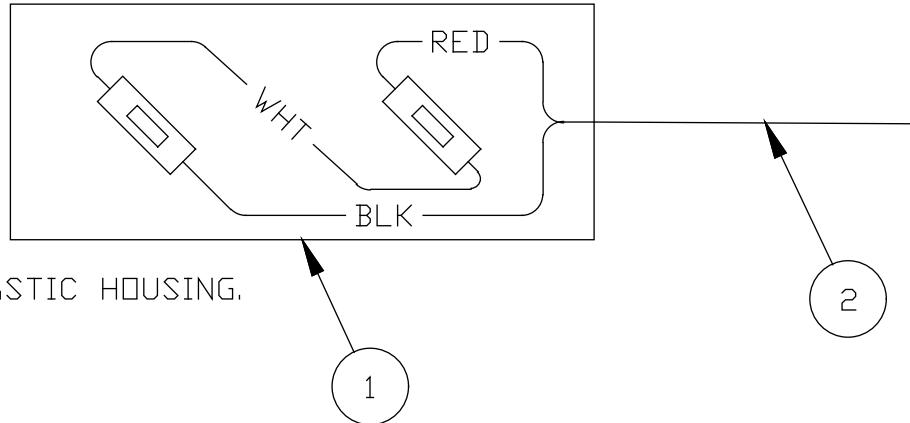
Find Num	Part Number	Item Description	Qty	Notes	Rev
1	165762	SRV-Servo Motor	3	LS tucker, NLS tucker	C
3	156066	SRV-Servo Motor	3	retard flight chains, pusher flight chains, feeder, overhead confiner	B
4	165780	CBL-Cable	1		A
5	165781	CBL-Cable	2		A
6	165782	CBL-Cable	3		A
8	167662	ASSY, STACK LIGHT; HORN, BLUE, GREEN YELLOW, RED; LED, IP65, 150MM POLE AND BASE, TERMINAL BLOCK CONNECTION	1		A
9	168890	SNR-Sensor	1	Trigger sensor for printer.	A
10	152386	CBL-Cable	1	CIP Sync Ethernet Cable	A
11	170994	PXS-Proximity Switch	1		B
12	170996	PXS-Proximity Switch	1		B
19	167932	SWT-Switch	3		A
20	086500	PXS-Proximity Switch	5	2 for overhead confiner, 2 for inserter	A
21	011101P	CBL-Cable	10		C
23	143311	CBL-Cable	13		A
24	113298	ASSY, E-STOP & CONTROL STOP STATION	4		F
25	125738	ASSY, JOG PENDANT; VARI-STRAIGHT	1		B
26	124930	NMP-Nameplate	4		A
27	126832	SNR-Sensor	3	carton detect, glue photoeye, low hopper, hopper advance	A
28	143296	SWT-Switch	10		A
29	121378	PXS-Proximity Switch	2	hopper empty	A
30	N8800689	SNR-Sensor	2	product detect, overheight product	A
31	112541	GMT-Gear Motor	2	discharge belts	B
32	112542	GMT-Gear Motor	1	hopper belt	A
33	143696	CBL-Cable	5	For Inserter Jam Sensors and Overhead confiner sensors	A
34	070020	CON-Connector	2	For inserter cylinder sensor	A
36	138800	CBL-Cable	1	For air regulator	A
37	101735	CBL-Cable	1	Pressure Sensor	B
38	4176-812-006	LAMINATE LABEL	2	Home	B
39	145168	LAMINATE LABELS - ENTERPRISE TEACH POSITIONS	1	Teach	A
41	114940	SWT-Switch	1		A
42	114487	NMP-Nameplate	1		A
43	034303P	ENC-Enclosure	1		-
44	148576	CBL-Cable	1		A
48	154816	ENC-Enclosure	1		A
50	140975	SWT-Switch	REF	Optional high voltage disconnect.	A
51	139445	SWT-Switch	1	Optional glue tank disconnect.	A
52	169316	SRV-Servo Motor	1		A
54	159708	SRV-Servo Motor	1		C
56	160943	GRO-Grommet	1		A
57	160910	GRO-Grommet	1		A

FRAME ELECTRICALS, ENTERPRISE CARTONER
 480VAC, K5500, PIC INFEED
 169104

NOTE:

USE 16 AWG MTW
WIRE FOR WHITE
WIRE.

CABLE LENGTH IS 20 FEET.
CUT OFF THIRD (GREEN)
WIRE. GND NOT USED ON PLASTIC HOUSING.



Find Num	Part Number	Item Description	Qty	Rev
				B
1	011296P	SWT-Switch	1	-
2	025230P	CBL-Cable	1	-
3	X5430026	PLG-Plug	1	A
4	X5490040	SRF-Strain Relief	1	A
5	X5420033	SCK-Socket	1	A
6	X5490041	CAP-Cap	1	A

**ASSEMBLY, JOG
PENDANT; VARI-STRAIGHT
125738**

**OPERATOR INTERFACE
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169105**

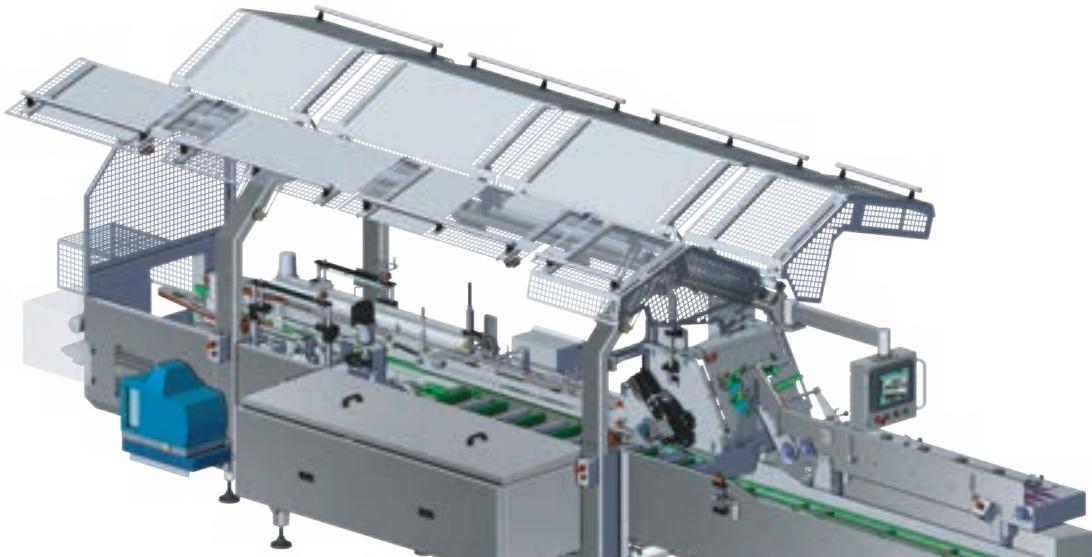
Find Num	Part Number	Item Description	Qty	Rev
				A
1	159517	DSP-Display	1	A
4	114940	SWT-Switch	1	A
5	114951	SWT-Switch	1	A
6	099963	SWT-Switch	1	C
8	124210	SWT-Switch	1	A
9	160199	LBL-Label	1	B
10	160207	LBL-Label	1	B
11	160211	LBL-Label	1	B
12	160493	DCL-Decal	1	A
14	143184	CRD-Card	1	A

**OPERATOR INTERFACE
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169105**

**CONTROL PANEL AUXILLARY EQUIPMENT
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169106**

Find Num	Part Number	Item Description	Qty	Notes	Rev
		SR4W Former			A
3	110901	ADP-Adapter	1		B
10	016866P	ENC-Enclosure	1		-
11	014389A	LATCH PIECE, ENCLOSURE DOOR;GENESIS LUGLESS CLOSER	1		-
12	N8800508	CDF-Conduit Fitting	25		A
13	114718	CBL-Cable	1	HMI	A
14	091501	CBL-Cable	5	RECPT	B
15	091613	CBL-Cable	1		B
16	091502	CBL-Cable	1		B
17	165490	CON-Connector	1		A
18	151288	SWT-Switch	1		A

**CONTROL PANEL AUXILLARY EQUIPMENT
ENTERPRISE CARTONER
480VAC, K5500, PIC INFEED
169106**



ENTERPRISE

Endload Cartoner

SCHWANS - ATLANTA

HS5160

Replacement Parts

1. When ordering replacement parts, the following information must be furnished:

Machine Model

Serial Number

Part Number and Description

Specific Quantity

2. Orders should be placed directly with the Parts Sales Department.

Kliklok-Woodman

5224 Snapfinger Woods Drive

Decatur, Georgia 30035

E-Mail:service@ kliklok-woodman.com

Telephone: 770/981-5200 • Fax: 770/987-7160

3. The last numerical grouping in a certain •B• standard part number signifies the length in inches. The length code usually applies to studs, spacers, shafts, keys, belts, rails and drive chains that have •B• numbers.

4. Motor: To reorder, please give the following information from the motor nameplate: Make, Model Number, H.P. Rating, RPM, Voltage, Brake or Non-Brake, Part Number, etc.

5. Sprockets: To replace, give Part Number, pitch, number of teeth and bore size.

SCHWANS - ATLANTA
KLIKLOK 'ENTERPRISE' AUTOMATIC
HORIZONTAL END LOAD CARTONING LINES
HS5160

Find Num	Part Number	Item Description	Qty	Rev
				H
1	HS5160-1	SCHWANS ENTERPRISE CARTONER, 12", PIC INFEED, STD HAND	1	H
2	HS5160-2	SCHWANS WSIPTU, IN-LINE STYLE PRODUCT INFEED UNIT	1	E
10	16-4485	LINE LAYOUT, ENTERPRISE WITH WSIPTU INFEED, HS5160 PORTABILITY KIT, ELEVATED KIT	REF	B

SCHWANS - ATLANTA
KLIKLOK 'ENTERPRISE' AUTOMATIC
HORIZONTAL END LOAD CARTONING LINES
HS5160

SCHWANS ENTERPRISE CARTONER

12", PIC INFEED, STD HAND

HS5160-1

Find Num	Part Number	Item Description	Qty	Rev
				I
1	168300	MECHANICAL ASSEMBLY, ENTERPRISE, 12" FLIGHTS, PIC INFEED, SEMI OCTAGON CARTON MODS	2	C
2	169100	TOP ELECTRIC, ENTERPRISE CARTONER, 480VAC, K5500, PIC INFEED	2	A
3	168789	CUSTOM FITS, HS5160 SCHWANS	2	*K
4	169012	MOUNT ASSEMBLY, CITRONIX INKJET HEAD	2	D
5	170930	ENTERPRISE ABORT CONVEYOR, DORNER WITH ROLLER CHUTE AND SS MESH TUNNEL	2	*B
6	168650	KIT, CASTERS, ENTERPRISE W NO PIC EXTENSION	1	*I
7	168875	6" HEIGHT EXTENSION KIT, ENTERPRISE	1	E
8	169212	CDD-Code Dater	2	B
9	SP01550-A	RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC INFEED - A HS5160 & HS5163 SCHWANS	1	*B
10	SP01550-B	RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC INFEED - B HS5160 & HS5163 SCHWANS	1	A
11	SP01550-C	RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC INFEED - C HS5160 & HS5163 SCHWANS	1	A
20	SP01550	RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC INFEED HS5160 & HS5163 SCHWANS	REF	*C
21	SP01536	ELECTRICAL SPARE PARTS LIST - ENTERPRISE CARTONER, 480VAC, K5500	REF	A

SCHWANS ENTERPRISE CARTONER
12", PIC INFEED, STD HAND
HS5160-1

**MECHANICAL ASSEMBLY, ENTERPRISE
12" FLIGHTS, PIC INFEED
SEMI OCTAGON CARTON MODS
168300**

Find Num	Part Number	Item Description	Qty	Rev
				C
10	149360	MAIN FRAME ASSEMBLY, ENTERPRISE	1	C
20	170390	ASSEMBLY, 12" FLIGHT CHAINS, PIC INFEED, OUTSIDE POLYCHAINS	1	A
30	134414	MOVEABLE SIDEPLATE ADJUSTING ASSEM	1	E
40	144960	ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC	1	B
50	164120	12" PIC OVERALL ASSEMBLY, ENTERPRISE, POLY CHAIN DRIVE	1	A
60	169950	ASSEMBLY, DRIVE TRAIN, PIC INFEED, OUTSIDE POLY CHAIN	1	A
70	139964	CARTON FEEDING ASSEMBLY, MID-RANGE CARTONER	1	J
80	168248	ASSEMBLY, NON-LOADSIDE FLAP CONTROL, ADJUSTABLE OFFSET	1	D
90	140360	ASSEMBLY, LOADSIDE FLAP CONTROL	1	F
100	149334	HOPPER, ENTERPRISE, 6 FT	1	C
110	141527	NORDSON GLUE SYSTEM, MIDRANGE, PROBLUE-7, 480V, SURE BEAD GUNS, WASH DOWN HOSES	1	E
120	170400	ASSEMBLY, MACHINE GUARDS, ENTERPRISE, LASER CUT MESH, LOWER WINDOWS, STD HANDLES & STRUTS, OUTSIDE POLYCHAINS	1	A
140	141932	PNEUMATICS ASSEMBLY - MID-RANGE CARTONER	1	K
150	150566	KIT, VORTEX COOLING ASSY, ENTERPRISE	1	C
160	144451	SAFETY SIGN KIT, ENTERPRISE	1	F
170	144332	ASSEMBLY, ENCODER DRIVE (12" MID-RANGE CARTONER)	1	C

**MECHANICAL ASSEMBLY, ENTERPRISE
12" FLIGHTS, PIC INFEED
SEMI OCTAGON CARTON MODS
168300**

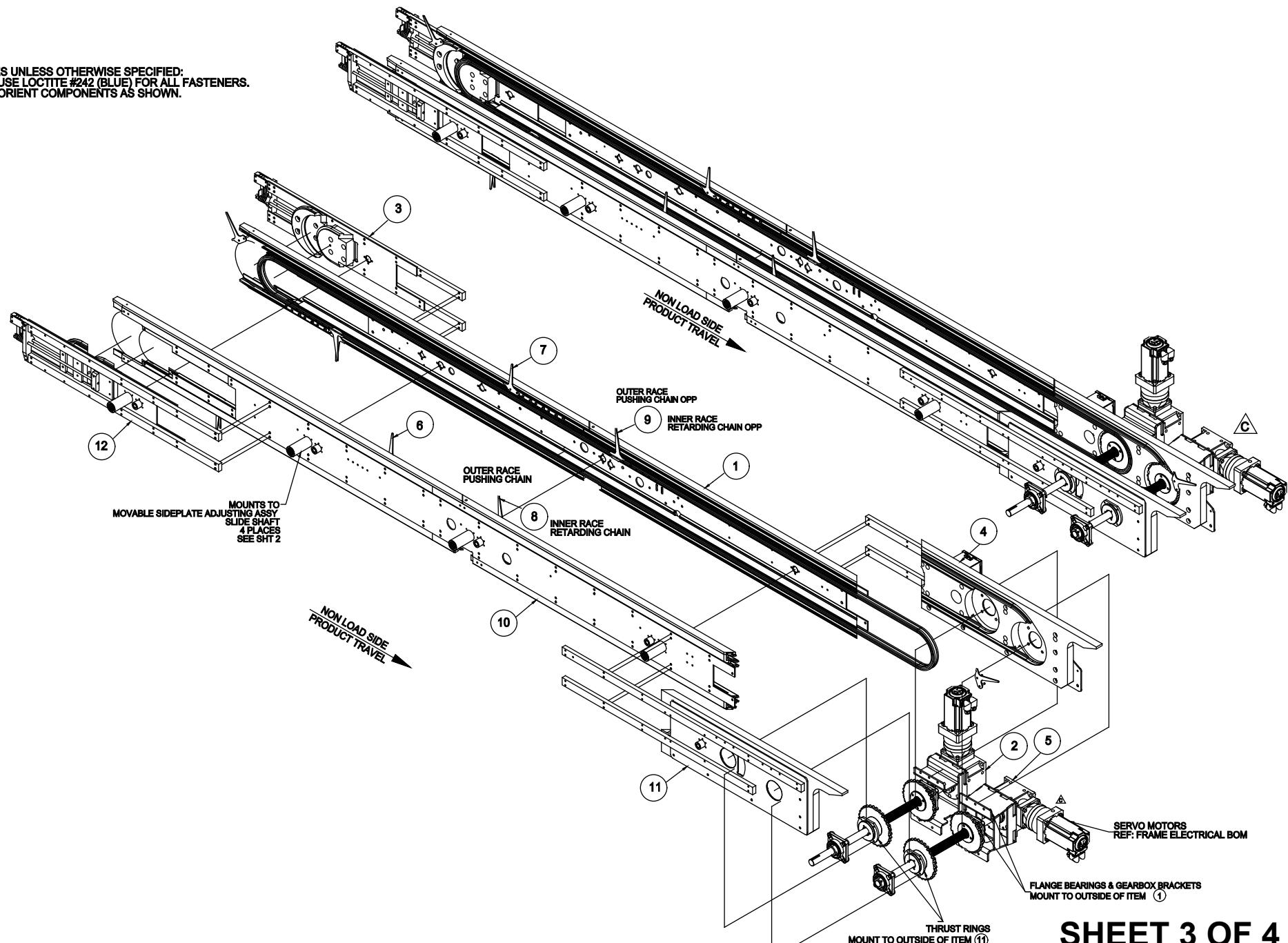
**SHEET 1 OF 4
ASSEMBLY, 12" FLIGHT CHAINS
PIC INFEED, OUTSIDE POLYCHAINS
170390**

Find Num	Part Number	Item Description	Qty	Rev
				A
1	134327	ASSEMBLY, LOADSIDE CHAIN RAILS	1	B
2	170380	DRIVE ASSEMBLY, RETARD CHAIN, PIC INFEED, OUTSIDE POLYCHAIN	1	B
3	148077	TENSIONER ASSEMBLY, LOADSIDE FLIGHT CHAINS, ACME THRDS	1	B
4	134311	OUTFEED FLIGHT CHAIN RAIL, LOADSIDE	1	C
5	162390	DRIVE ASSEMBLY, PUSHER CHAIN, PIC INFEED POLY CHAIN DRIVE	1	C
6	138437	CHA-Chain Assembly	1	C
7	138437-001	CHA-Chain Assembly	1	C
8	138438	CHA-Chain Assembly	1	D
9	138438-001	CHA-Chain Assembly	1	D
10	134340	ASSEMBLY, NONLOADSIDE CHAIN RAILS	1	B
11	134349	OUTFEED FLIGHT CHAIN RAIL, NON-LOADSIDE	1	D
12	148078	TENSIONER ASSEMBLY, NON-LOADSIE FLIGHT CHAINS, ACME THRDS	1	B

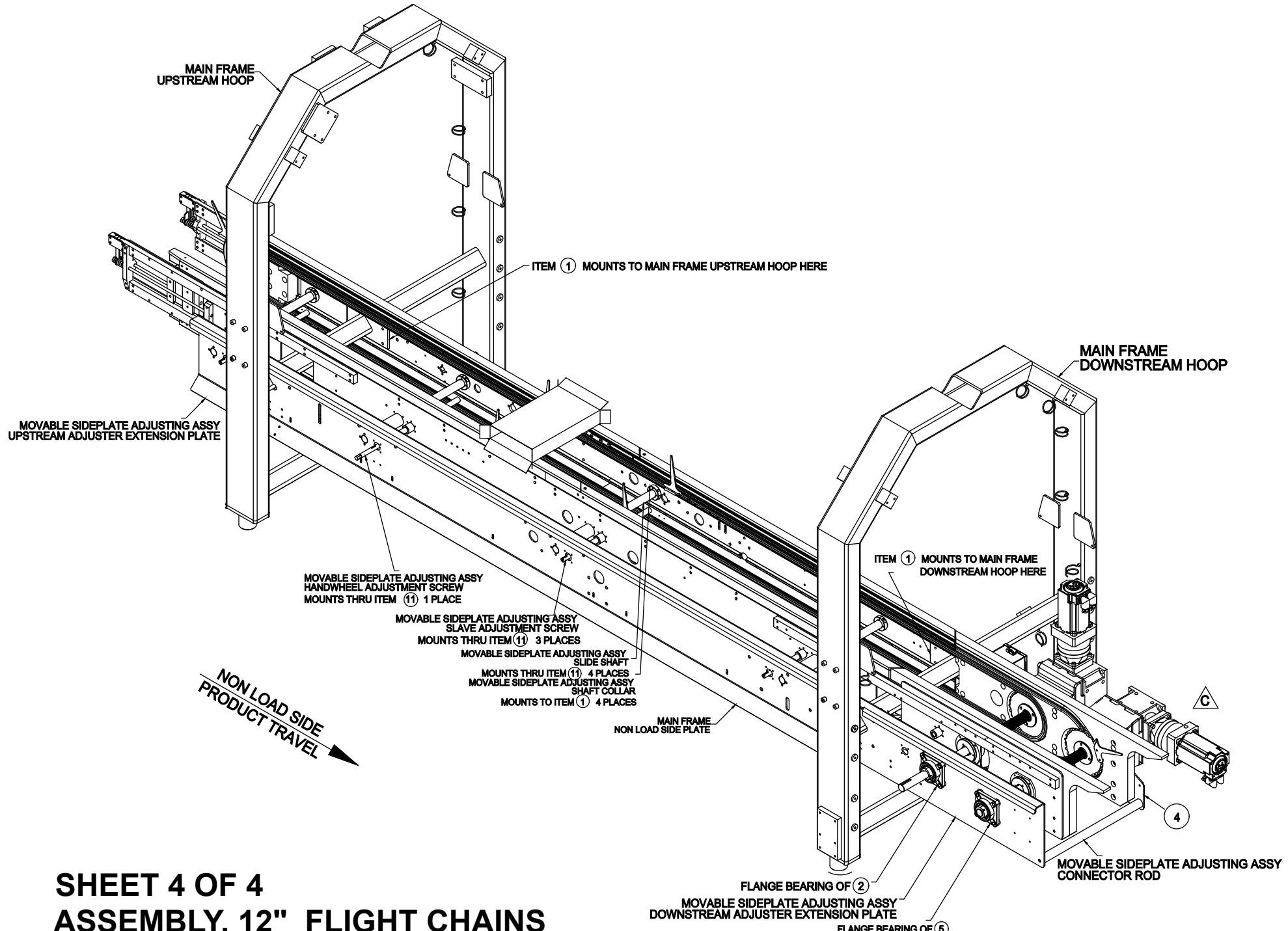
170390 ASSEMBLY, FLIGHT CHAIN, PIC INFEED, OUTSIDE POLYCHAINS (STANDARD HAND, SHOWN)
 170390-001 ASSEMBLY, FLIGHT CHAIN, PIC INFEED, OUTSIDE POLYCHAINS, OPP (OPPOSITE HAND)

SHEET 2 OF 4
ASSEMBLY, 12" FLIGHT CHAINS
PIC INFEED, OUTSIDE POLYCHAINS
170390

NOTES UNLESS OTHERWISE SPECIFIED:
 1. USE LOCTITE #242 (BLUE) FOR ALL FASTENERS.
 2. ORIENT COMPONENTS AS SHOWN.



SHEET 3 OF 4
ASSEMBLY, 12" FLIGHT CHAINS
PIC INFEED, OUTSIDE POLYCHAINS
170390



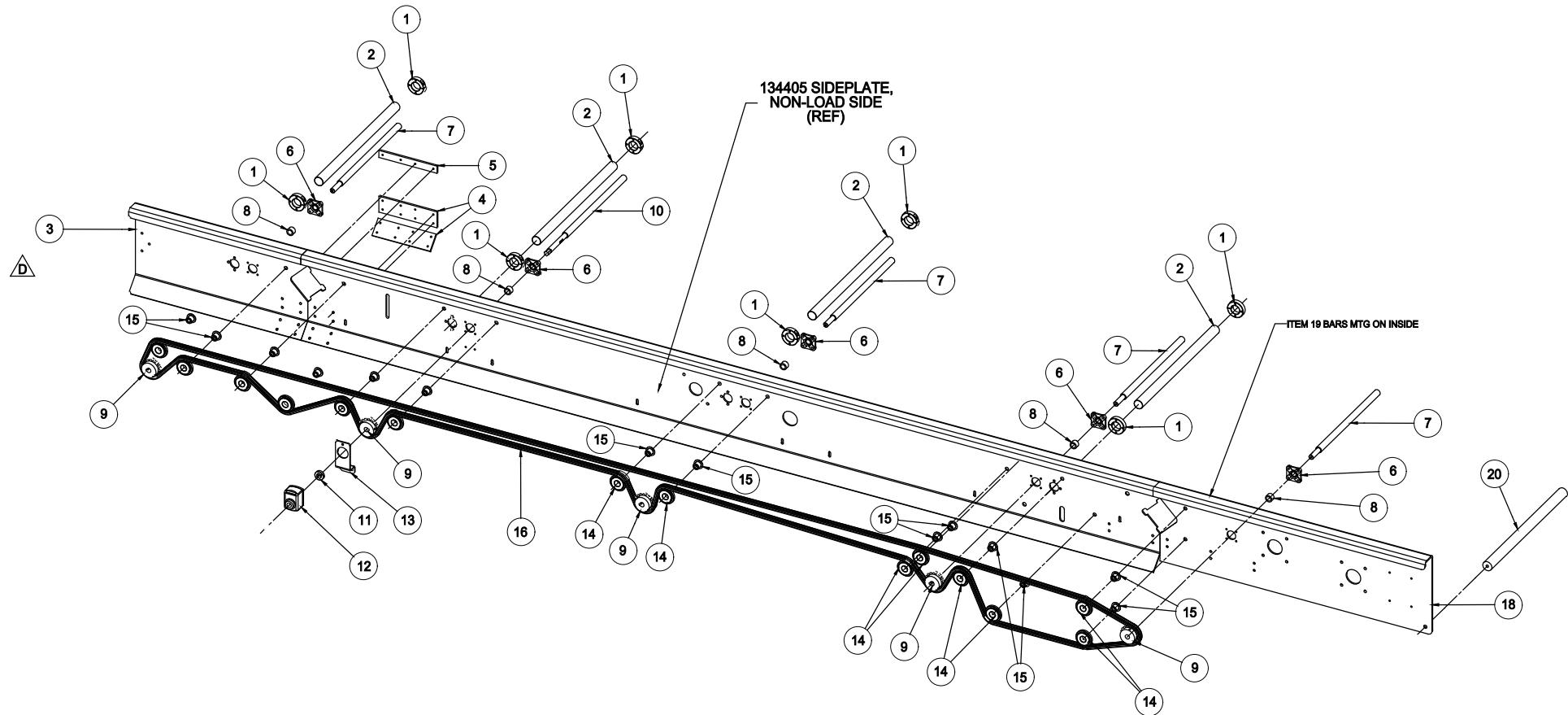
SHEET 4 OF 4
ASSEMBLY, 12" FLIGHT CHAINS
PIC INFEED, OUTSIDE POLYCHAINS
170390



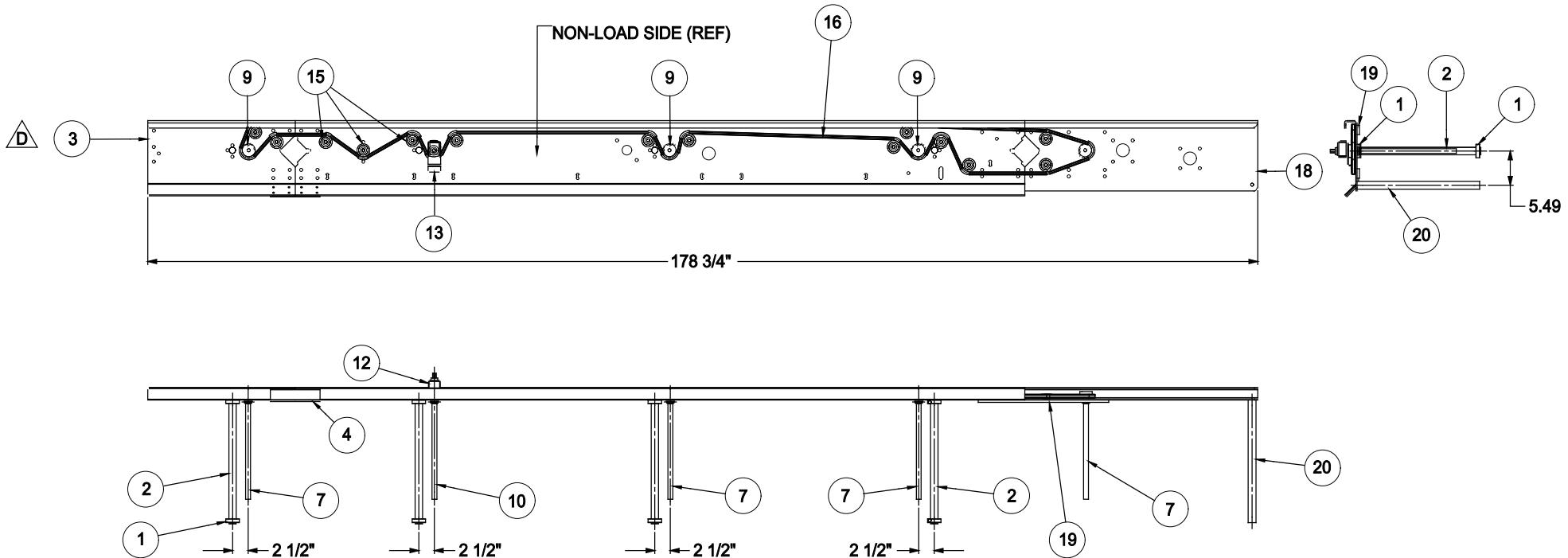
SHEET 1 OF 4
MOVABLE SIDE PLATE
ADJUSTING ASSEMBLY
134414

Find Num	Part Number	Item Description	Qty	Rev
				E
1	122427	STC-Set Collar	8	A
2	B09S30MM2010X	SHAFT, SIMPLE, 3MM X 20.10"LG	4	A
3	152092	PLATE, UPSTREAM ADJUSTER, LONG	1	A
4	134417	PLATE, LOWER CONNECTOR	2	A
5	134418	PLATE, UPPER CONNECTOR	1	A
6	132354	BFL-Bearing, Flange	5	A
7	134419	ADJUSTMENT SCREW, SLAVE	4	A
8	B14S08806006004	SPACER, 7/8" OD, .60 ID, X .600 LG	5	A
9	B79E4011615MM	40B16, 15MM BORE SPROCKET	5	B
10	134469	ADJ SCREW - HANDWHEEL	1	B
11	130594	STC-Set Collar	1	A
12	122519	COT-Counter	1	A
13	134471	BRACKET, COUNTER MTG	1	A
14	134475	IDLER ROLLER	14	A
15	134476	IDLER POST	14	A
16	134489	ADJUSTMENT CHAIN, MOVABLE SIDE, #40 NI.PLATED	1	A
18	139566	PLATE, DOWNSTREAM ADJUSTER EXTENSION	1	B
19	139568	BAR, DOWSTREAM CONNECTOR	2	A
20	139569	ROD, CONNECTOR	1	A

**SHEET 2 OF 4
MOVABLE SIDE PLATE
ADJUSTING ASSEMBLY
134414**



SHEET 3 OF 4
MOVABLE SIDE PLATE
ADJUSTING ASSEMBLY
134414



134414 MOVEABLE SIDEPLATE ADJUSTING ASSEM (STANDARD HAND, SHOWN)
 134414-001 MOVEABLE SIDEPLATE ADJUSTING ASSEM, OPP (OPPOSITE HAND)

134405 SIDEPLATE,

**SHEET 4 OF 4
 MOVABLE SIDE PLATE
 ADJUSTING ASSEMBLY
 134414**

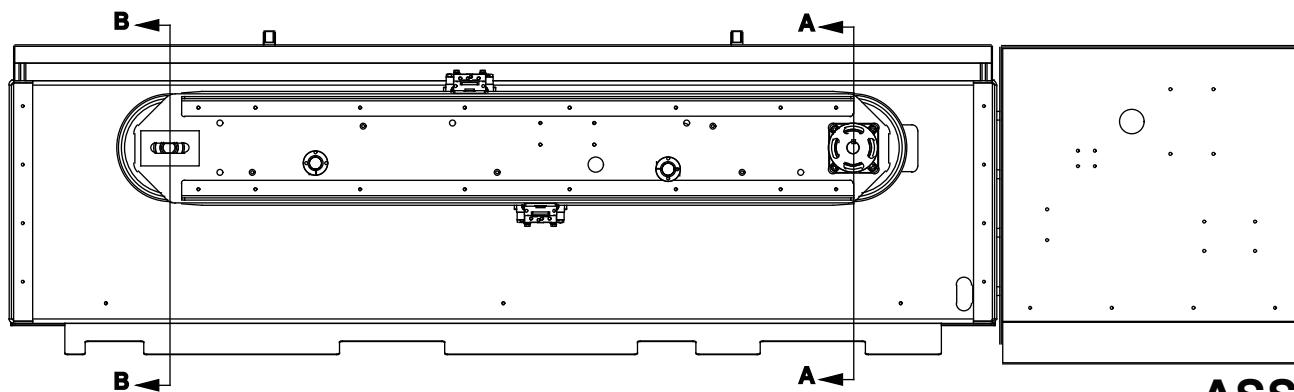
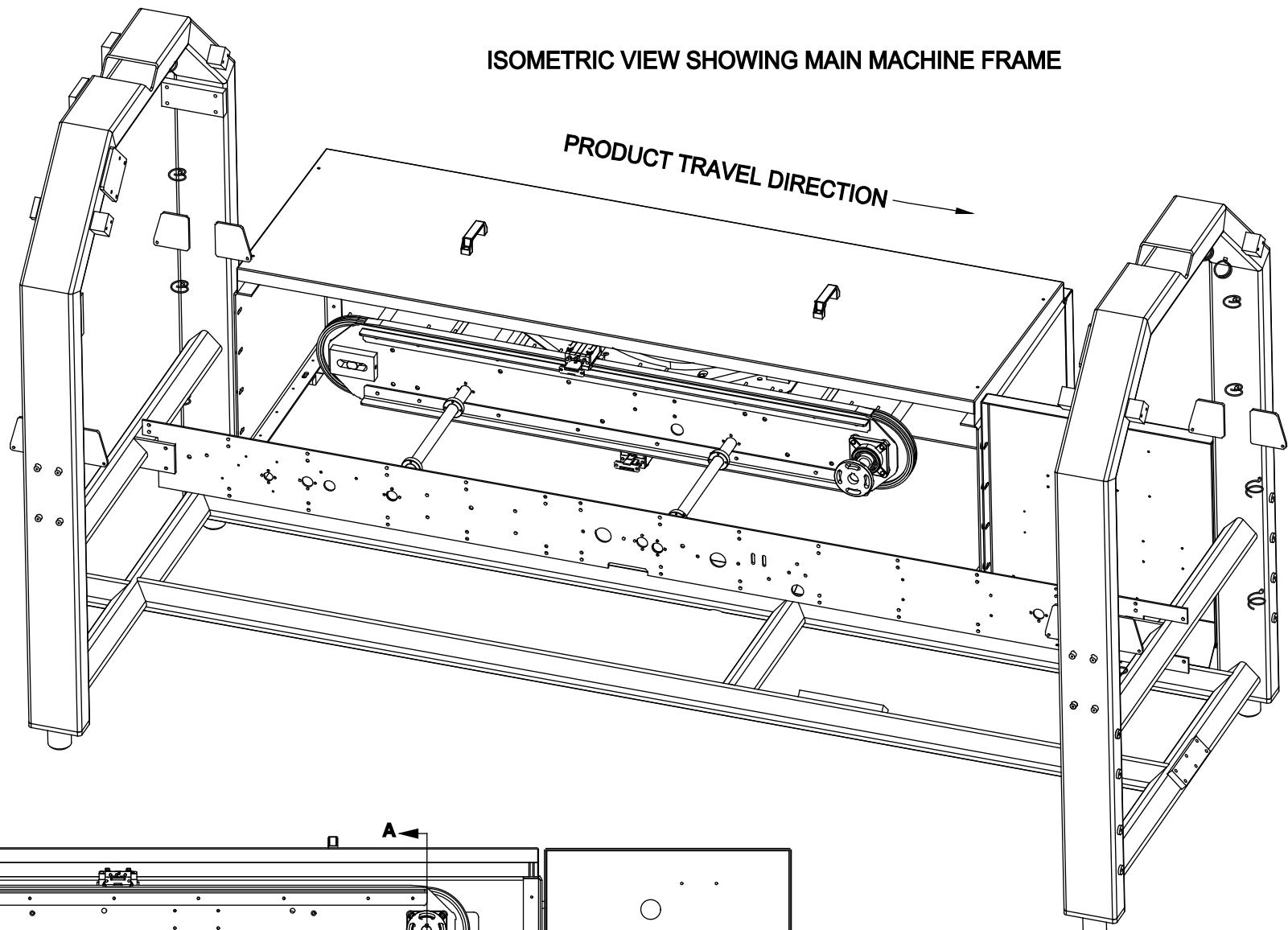
**SHEET 1 OF 5
ASSEMBLY, PISTON INSERTER
ENTERPRISE 12" PIC
144960**

Find Num	Part Number	Item Description	Qty	Rev
				B
1	145863	INSERTER PISTON ASSEMBLY, ENTERPRISE, PIC	12	C
2	145009	SPROCKET, INNER DRIVE	1	A
3	145010	SPROCKET, OUTER DRIVE	1	A
4	147528	CHAIN RAIL, PISTON INSERTER, PIC	4	A
5	B14S04403207504	SPACER 7/16 OD X .75 LG;	24	-
6	145525	SIDE PLATE, INSERTER INNER, PIC	1	A
7	145526	SIDE PLATE, INSERTER OUTER, PIC	1	A
8	119645	BFL-Bearing, Flange	2	B
9	134552	NUT PLATE, INSERTER DRIVE SHAFT	2	A
10	B14S10004102504	SPACER;	8	-
11	145864	SHAFT, INSERTER DRIVE, PIC	1	A
12	145874	HUB, SHAFT ADJUSTING, OUTER	1	A
13	145524	ASSEMBLY, INSERTER CHAIN , ENTERPRISE, 12" PIC	2	A
14	145883	SPROCKET, TAILSHAFT IDLER INSERTER PIC	2	A
15	107863	BRG-Bearing	4	A
16	134572	SHAFT, INSERTER TAIL	1	B
17	145885	RETURN GUIDE, CAM FOLLOWER, INNER PIC	1	A
18	145886	RETURN GUIDE, CAM FOLLOWER, OUTER PIC	1	A
19	134574	BLOCK, SHAFT ADJUSTING	2	A
20	134577	END PANEL, INSERTER	1	A
21	134577-001	END PANEL, INSERTER, OPP HAND	1	A
22	134588	STC-Set Collar	1	B
23	122427	STC-Set Collar	10	A
24	B09S30MM5000X	SHAFT, SIMPLE, 30MM X 50.00"LG	2	A
25	B78040130018	S.S. HEX SPACER, M6, 1.300" (33MM) LG	4	A
26	145527	ASSEMBLY, INSERTER CAM, PIC	1	A
27	134593	HEX SPACER, CAM MTG, DOWNSTREAM	1	B
28	145902	SPACER, CAM SUPPORT, PIC	1	B
29	145903	CAM GUIDE, HEADSHAFT, PIC	1	A
30	145901	ANGLE, RETURN CAM, PIC	1	A
31	136276	HEX SPACER, RETURN ANGLE MTG	3	B
32	136281	PANEL, INSERTER BOTTOM	1	C
33	145876	HUB, SHAFT ADJUSTING, INNER	1	A
34	139177	HEX SPACER, CAM MTG, UPSTREAM	1	B
35	140921	GUARD, INSERTER TOP	1	A
36	B78050290018	1/2" SS HEX SPACER, 2.900" LG, M6 TAPPED HOLES BOTH ENDS	2	A
37	B78050218818	1/2" HEX SPCR X 2 3/16" LG, M6 THREAD	5	A
38	X1610173	HDW-Handwheel	2	B
39	140943	GUARD, INSERTER FRONT	1	A
40	010583P	HAN-Handle	2	-
41	140954	PANEL, LEFT END FILLER	1	C
42	B14S07503402504	SPACER, .75 OD, .34 ID X .250 LONG	4	A
43	119145	STC-Set Collar	4	A
44	139058	SUPPORT, CABLE, LARGE	3	A
45	147529	RAIL, STIFFENER, INSERTER, PIC	2	A
46	B14S15011903504	SPACER 1.50 OD, 1.19 ID, X .350" LG	1	A

SHEET 2 OF 5
ASSEMBLY, PISTON INSERTER
ENTERPRISE 12" PIC
144960

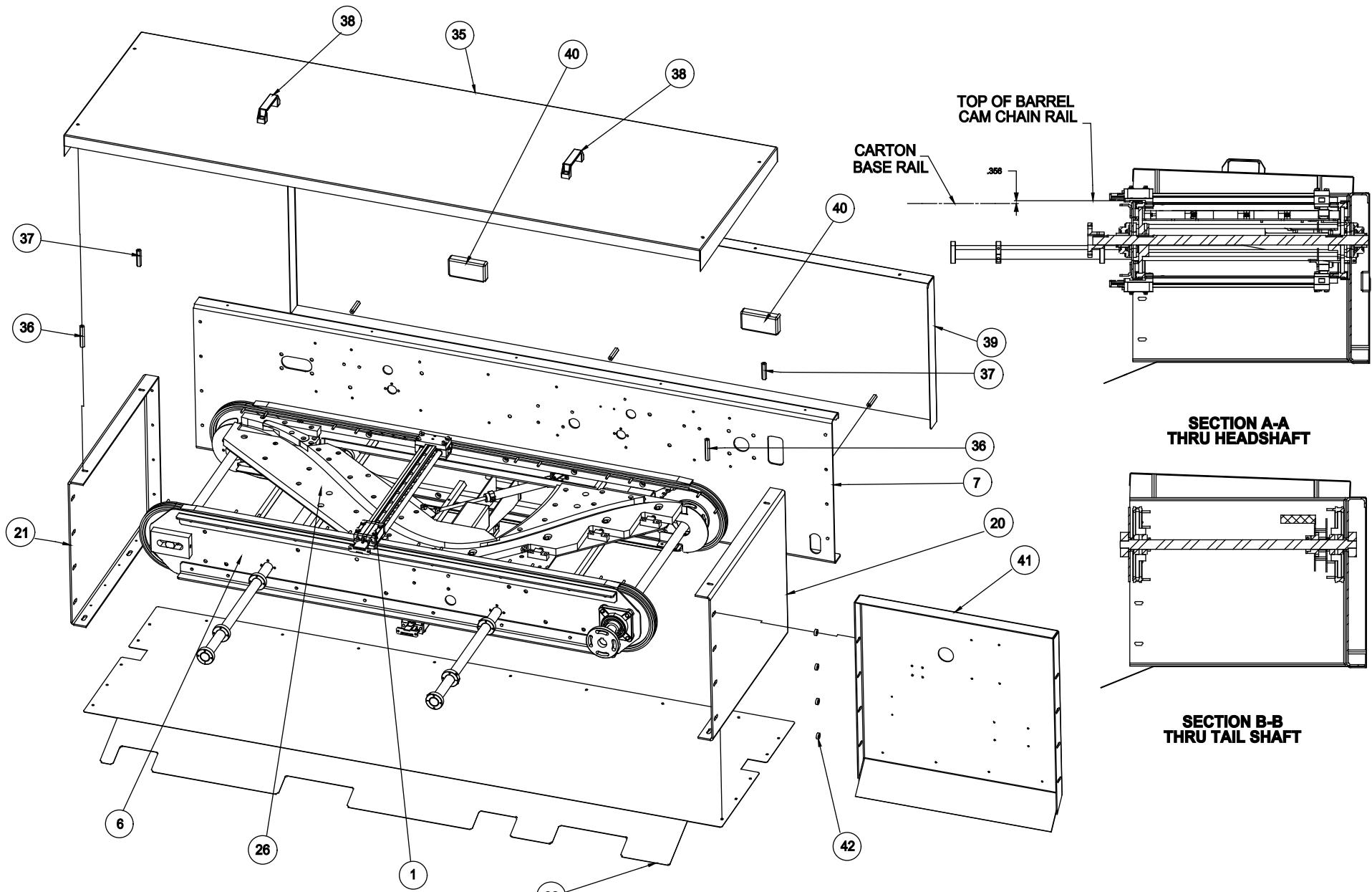
144960 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC (STANDARD HAND, SHOWN)
 144960-001 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC, OPP (OPPOSITE HAND)

ISOMETRIC VIEW SHOWING MAIN MACHINE FRAME



OPERATOR SIDE ELEVATION VIEW
SEE SHEET 2 FOR SECTION VIEWS

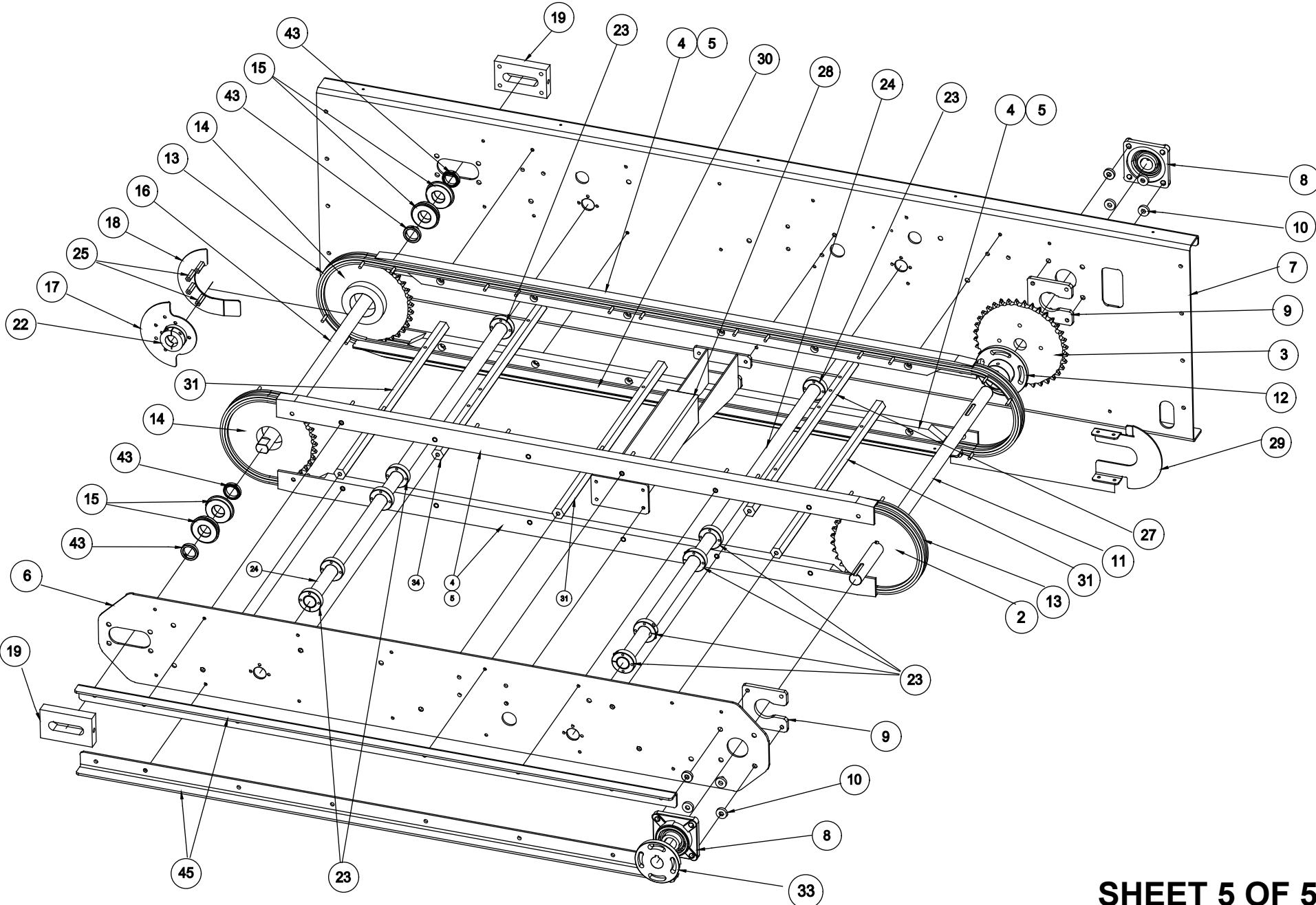
SHEET 3 OF 5
ASSEMBLY, PISTON INSERTER
ENTERPRISE 12" PIC
144960



ISO VIEW SHOWING FRAME AND GUARDS EXPLODED

SHEET 4 OF 5
ASSEMBLY, PISTON INSERTER
ENTERPRISE 12" PIC
144960

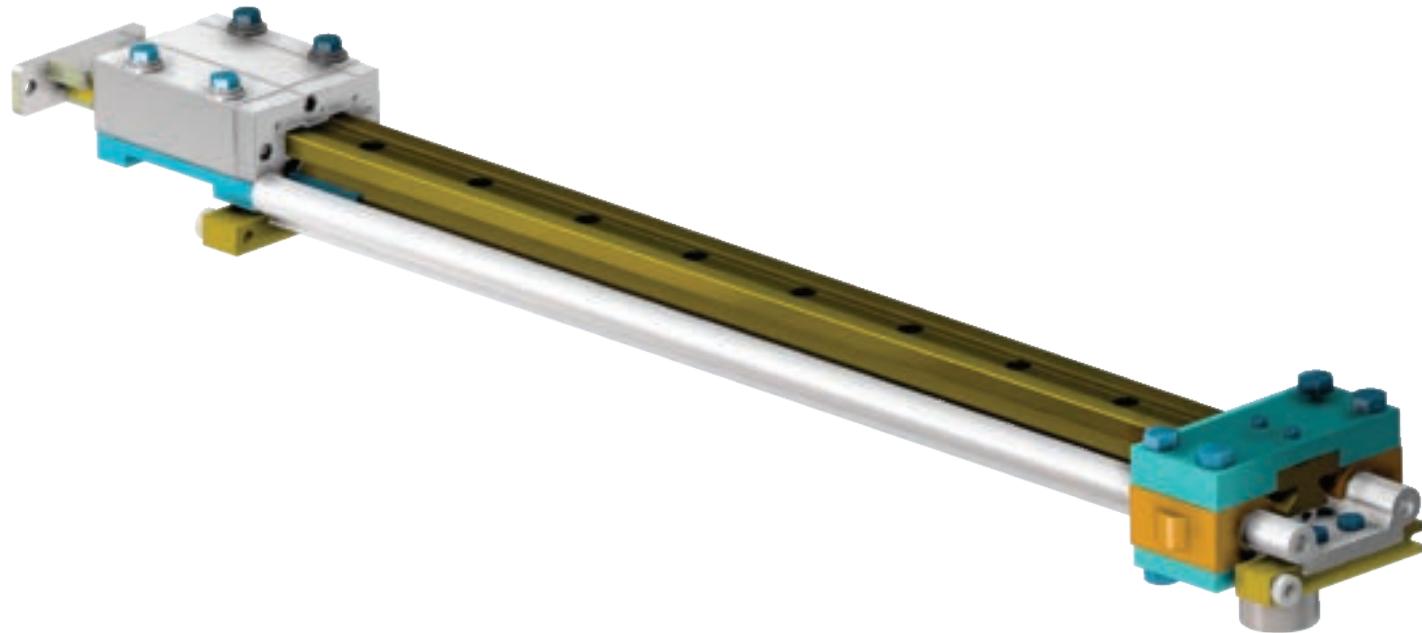
144960 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC (STANDARD HAND, SHOWN)
 144960-001 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC, OPP (OPPOSITE HAND)



ISOMETRIC EXPLODED VIEW
SHOWN WITHOUT FRAME, ASUB-ASSEMS AND GUARDS

144960 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC (STANDARD HAND, SHOWN)
144960-001 ASSEMBLY, PISTON INSERTER, ENTERPRISE 12" PIC, OPP (OPPOSITE HAND)

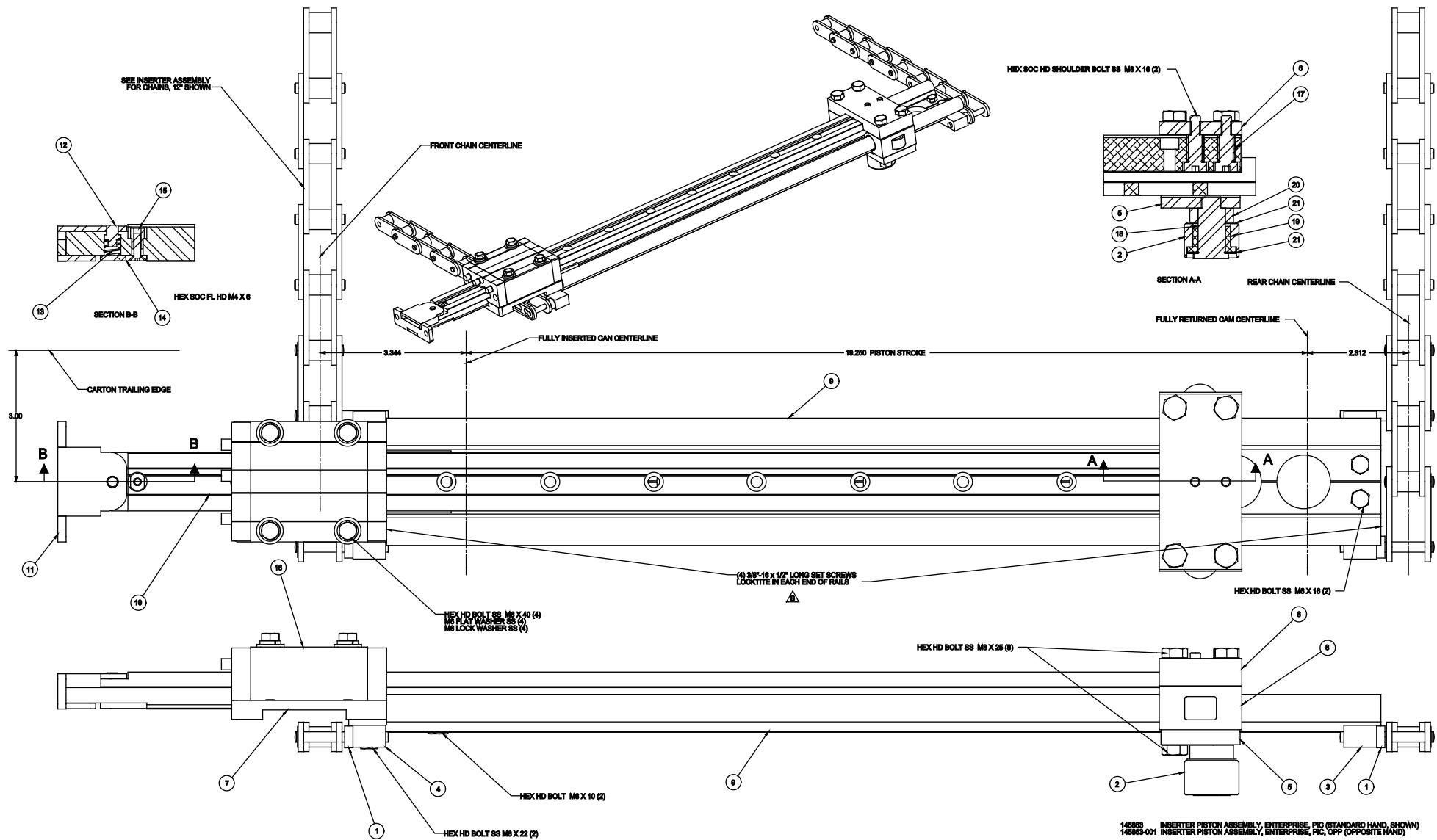
SHEET 5 OF 5
**ASSEMBLY, PISTON INSERTER
ENTERPRISE 12" PIC
144960**

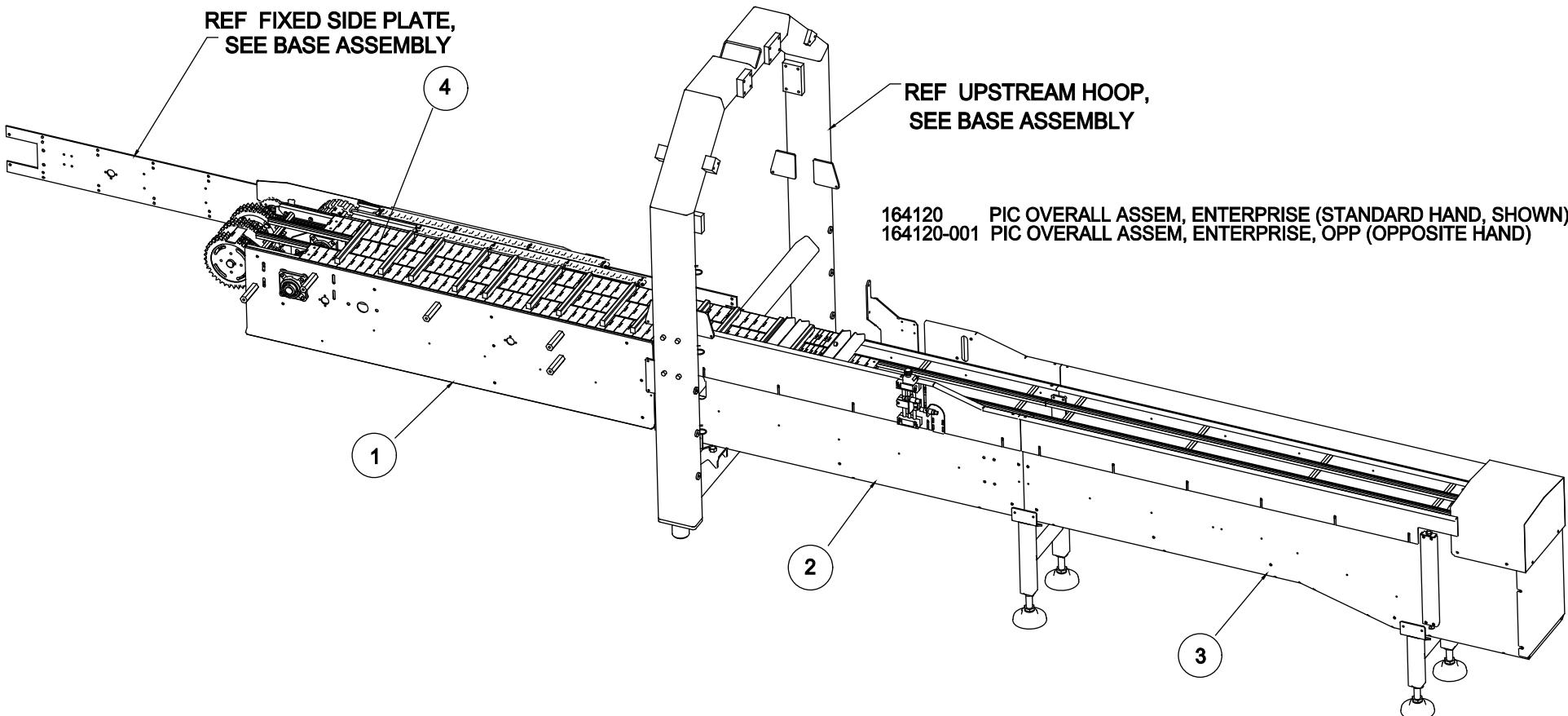


SHEET 1 OF 3
INSERTER PISTON ASSEMBLY
ENTERPRISE, PIC
145863

Find Num	Part Number	Item Description	Qty	Rev
				C
1	B14N05002501904	SPACER, DELRIN, .50 OD, .25 ID X .190 LG,	2	A
2	145454	ROLLER, CAM FOLLOWER, 1.25" DIA	1	A
3	147173	CHAIN MTG BLOCK, REAR, ENTERPRISE, PIC	1	A
4	147172	CHAIN MTG BLOCK, FRONT, ENTERPRISE, PIC	1	A
5	147174	BLOCK, MTG, CAM FOLLOWER, ENTERPRISE, PIC	1	A
6	138357	BLOCK, RAIL MOUNTING	1	A
7	131079	PLATE, FRONT CARRAGE MTG	1	C
8	138169	BLN-Bearing, Linear		A
9	134502	RAIL, MODIFIED IGUS WS-16-60	1	C
10	134504	RAIL, MODIFIED, INSERTER PISTON	1	A
11	138175	ADAPTER, PUSHER FACE	REF	A
12	133006	PIN, SPRING, PUSHER FACE ADAPTER	1	A
13	027893P	SPR-Spring	1	-
14	138356	PLATE, SPRING PIN RETAINER	1	A
15	138359	NUT, RETAINER PLATE	1	A
16	131692	SLD-Slide	1	B
17	132879	BSH-Bushing	2	B
18	147178	SHOULDER BOLT, CAM FOLLOWER, ENTERPRISE, PIC	1	A
19	145453	BSH-Bushing	1	A
20	147516	SPACER, CAM FOLLOWER	1	A
21	B14S11206300304	SPACER, 1.12 OD X .63 ID X .030" LG SS	2	A

SHEET 2 OF 3
INSERTER PISTON ASSEMBLY
ENTERPRISE, PIC
145863





	Part Number	Item Description	Qty	Rev
				A
1	164130	ASSEMBLY, 12" PIC HEAD SECTION / TRANSFER CONV, POLY CHAIN DRIVE	1	A
2	147251	ASSEMBLY, PIC CENTER SECTION, ENTERPRISE	1	C
3	147300	ASSEMBLY, PIC TAKE-UP SECTION, ENTERPRISE	1	A
4	147385	ENTERPRISE PIC CHAIN ASSY, BASIC 3-CHAIN, 12" FLIGHTS - COMPLETE CHAIN	REF	B

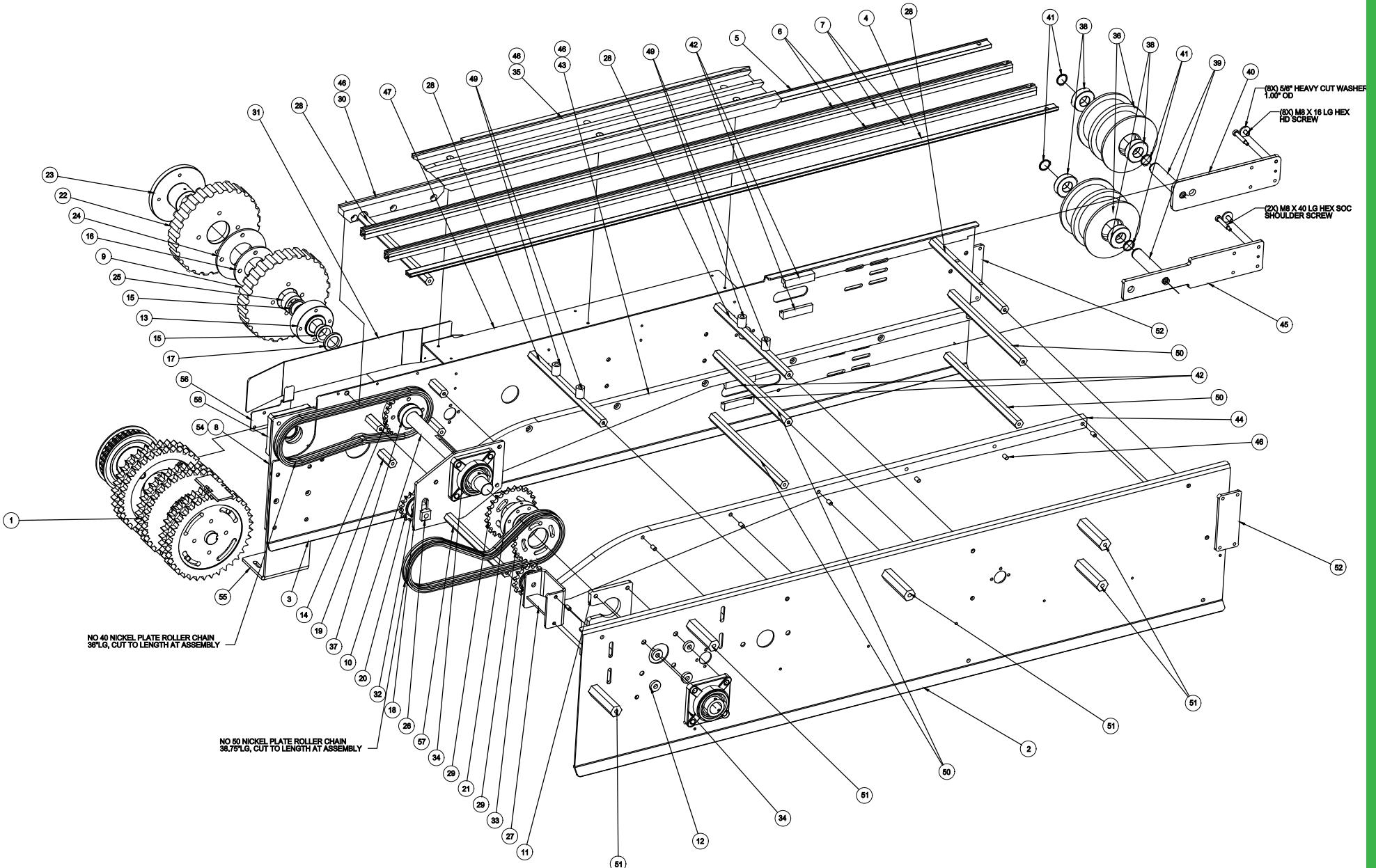
**12" PIC OVERALL ASSEMBLY
ENTERPRISE, POLY CHAIN DRIVE
164120**

**SHEET 1 OF 4
ASSEMBLY, 12" PIC HEAD SECTION
/ TRANSFER CONV, POLY CHAIN DRIVE
164130**

Find Num	Part Number	Item Description	Qty	Rev
1	162401	ASSEMBLY, PIC HEADSHAFT, POLY CHAIN DRIVE	1	B
2	136331	SIDEPLATE, PIC HEAD SECTION OUTER	1	B
3	136332	SIDEPLATE, PIC HEAD SECTION INNER	1	F
4	B84UGR06625	WRS-Wear Strip	1	A
5	B85UGR02150	WRS-Wear Strip	1	A
6	B82UGR06625	WRS-Wear Strip	2	A
7	B8306625	EXT-Extrusion	2	A
8	144496	BRACKET, BEARING MTG	1	B
9	136359	SPROCKET, TRANS CHAIN PUSHER	1	B
10	136361	HEADSHAFT, TRANSFER CONV	1	A
11	134552	NUT PLATE, INSERTER DRIVE SHAFT	1	A
12	B14S10004102504	SPACER;	8	-
13	136366	HUB, TRANSFER CHAIN PUSHER DRIVEN	1	A
14	136367	SPROCKET, TRANSFER CHAIN DRIVEN	1	A
15	114651	BSH-Bushing	2	A
16	136368	PLATE, TRANSFER SPROCKET CLAMP	1	A
17	136371	SPACER, TRANSFER SHAFT INNER	1	A
18	136372	PLATE, BEARING MTG	1	A
19	B78080200020	3/4 HEX SPACER, 2.000 LONG WITH M8 THRDS	4	A
20	B76E004011808	IDLER SPRKT,ER-8C;	1	-
21	136374	HUB, TRANSFER CHAIN RETARD DRIVE	1	B
22	136376	SPROCKET, TRANS CHAIN RETARD	1	A
23	136378	HUB, TRANSFER RETARD SPROCKET	1	A
24	136380	PLATE, TRANSFER SPROCKET CLAMP, OUTER	1	A
25	136384	SPACER, TRANSFER SHAFT OUTER	1	A
26	139596	NUT, TAKE-UP, 1/2-13	1	A

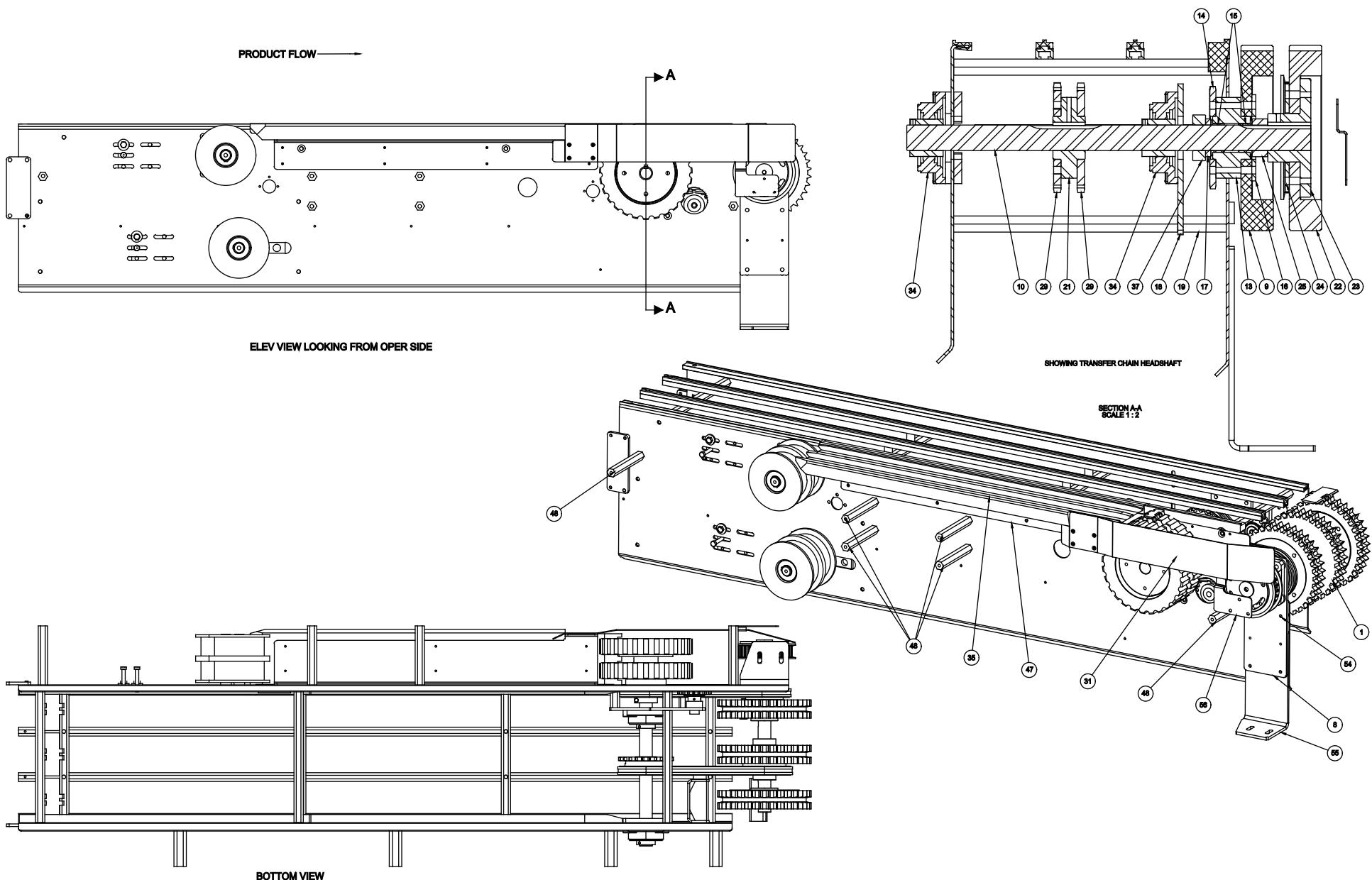
Find Num	Part Number	Item Description	Qty	Rev
27	136422	ADJUSTING BRACKET, CHAIN TIGHTENER	1	A
28	136425	SPACER, HEX GUIDE MTG	4	A
29	143718	SPROCKET, TRANSFER DRIVEN, ADJUSTABLE	2	B
30	147379	GUIDE, INNER DOWNSTREAM CHAIN	1	A
31	145006	GUIDE, LOWER MAJOR EXTENSION	1	A
32	B14S15005305954	SPACER 1.5 OD 17/32 ID X 0.595 LG	1	A
33	B76E005011408	IDLER SPRKT, 50A14 W/ER8C BRNG; .500" I.D., NICKEL PLATED	1	-
34	119645	BFL-Bearing, Flange	2	B
35	144360	GUIDE BED, TRANSFER CHAIN	1	A
36	144483	IDLER ROLLER, TRANSFER CHAIN	2	A
37	096479	STC-Set Collar	1	A
38	070038	BRG-Bearing	4	-
39	144502	SHAFT, TRANSFER CHAIN IDLER	2	C
40	144506	PLATE, IDLER MTG	1	B
41	008230P	RNG-Ring	4	A
42	144959	GIB, IDLER MTG PLATE	4	B
43	144968	LOWER CHAIN GUIDE, RIGHT, PIC HEAD SEC	1	B
44	144968-001	LOWER CHAIN GUIDE, LEFT, PIC HEAD SEC	1	B
45	144972	PLATE, IDLER SHAFT, LOWER	1	C
46	B14S03102505004	SPCR, .31 OD, .25 ID X .500 LG;	23	A
47	144973	MOUNTING BRACKET, TRANSFER BED	1	A
48	B78080547020	3/4 " HEX SPACER X 5.470" LG , M8 THREADS	6	A
49	B14S07503310004	SPACER 3/4 O.D..21/64 I.D.X. 1" LG	4	A
50	B78081265320	3/4" SS HEX SPACER, 12.653" LG, M8 TAPS BOTH ENDS	4	A
51	B78110394022	1" HEX SPACER, 3.940" LONG, M10 THRDS	5	A
52	147264	SPlice PLATE, PIC, OUTSIDE	2	A
53	123404-002	QUICK RELEASE TRANSFER CHAIN, 12" FLIGHTS	1	A
54	B14S10003402504	SPACER; 1.00 OD X .340 ID X .250 LG	2	B
55	162425	BRACKET, SUPPORT, PIC HEADSHAFT POLY CHAIN DRIVE	1	B
56	155623	SUPPORT, LOWER MAJOR GUIDE	1	A
57	B78081039420	3/4" HEX SPACER, 10.394" LG, M8 THRD	1	A
58	162426	BFL-Bearing, Flange	1	A

SHEET 2 OF 4
ASSEMBLY, 12" PIC HEAD SECTION
/ TRANSFER CONV, POLY CHAIN DRIVE
164130

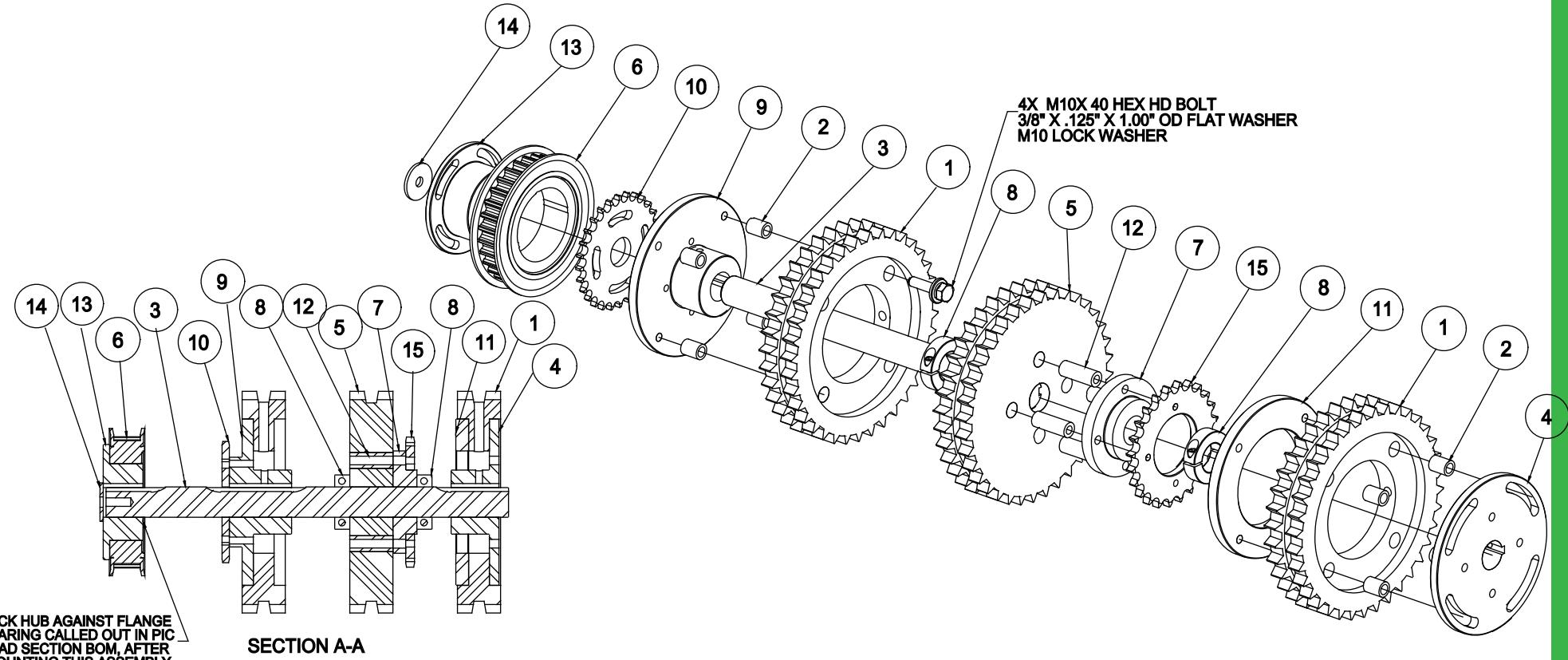


SHEET 3 OF 4
ASSEMBLY, 12" PIC HEAD SECTION
/ TRANSFER CONV, POLY CHAIN DRIVE
164130

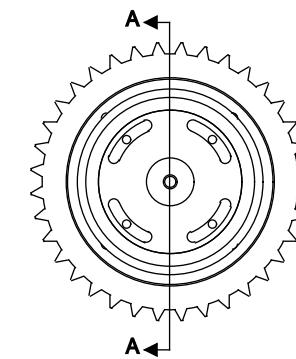
164130 ASSEM, PIC HEAD SECTION / TRANSFER CONV (STANDARD HAND, SHOWN)
164130-001 ASSEM, PIC HEAD SECTION / TRANSFER CONV, OPP (OPPOSITE HAND)



SHEET 4 OF 4
ASSEMBLY, 12" PIC HEAD SECTION
/ TRANSFER CONV, POLY CHAIN DRIVE
164130



Find Num	Part Number	Item Description	Qty	Rev
				B
1	136291	SPROCKET, PIC OUTER DRIVE	2	A
2	136295	INSERT, SPACER	8	A
3	162429	HEADSHAFT, PIC, POLY CHAIN DRIVE	1	A
4	136297	FLANGE, ADJUSTABLE, PIC HEADSHAFT	1	A
5	136317	SPROCKET, PIC CENTER DRIVE	1	A
6	162392	PULLEY, MODIFIED	1	A
7	143719	ADAPTER, CENTER DRIVE SPROCKET	1	A
8	104069	STC-Set Collar	2	A
9	136322	FLANGE, FIXED, PIC HEADSHAFT	1	B
10	136323	SPROCKET, TRANSFER DRIVE	1	A
11	143733	RING, TAPPED CLAMP	1	A
12	B14S06203416884	SPCR, 5/8 OD, .34 ID X 1.688 LG;	4	A
13	162393	HUB, PIC POLY CHAIN DRIVE	1	A
14	B32150406125	WASHER;	1	-
15	136318	SPROCKET, CHAIN DRIVEN	1	A



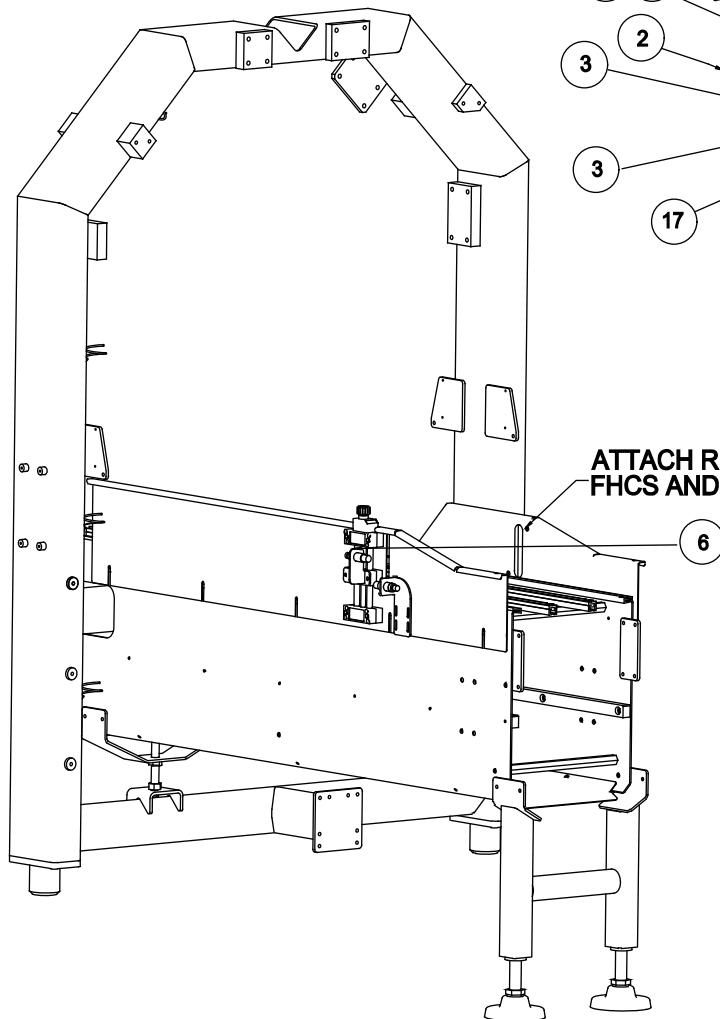
**ASSEMBLY, PIC HEADSHAFT
POLY CHAIN DRIVE
162401**

**SHEET 1 OF 3
ASSEMBLY, PIC CENTER
SECTION, ENTERPRISE
147251**

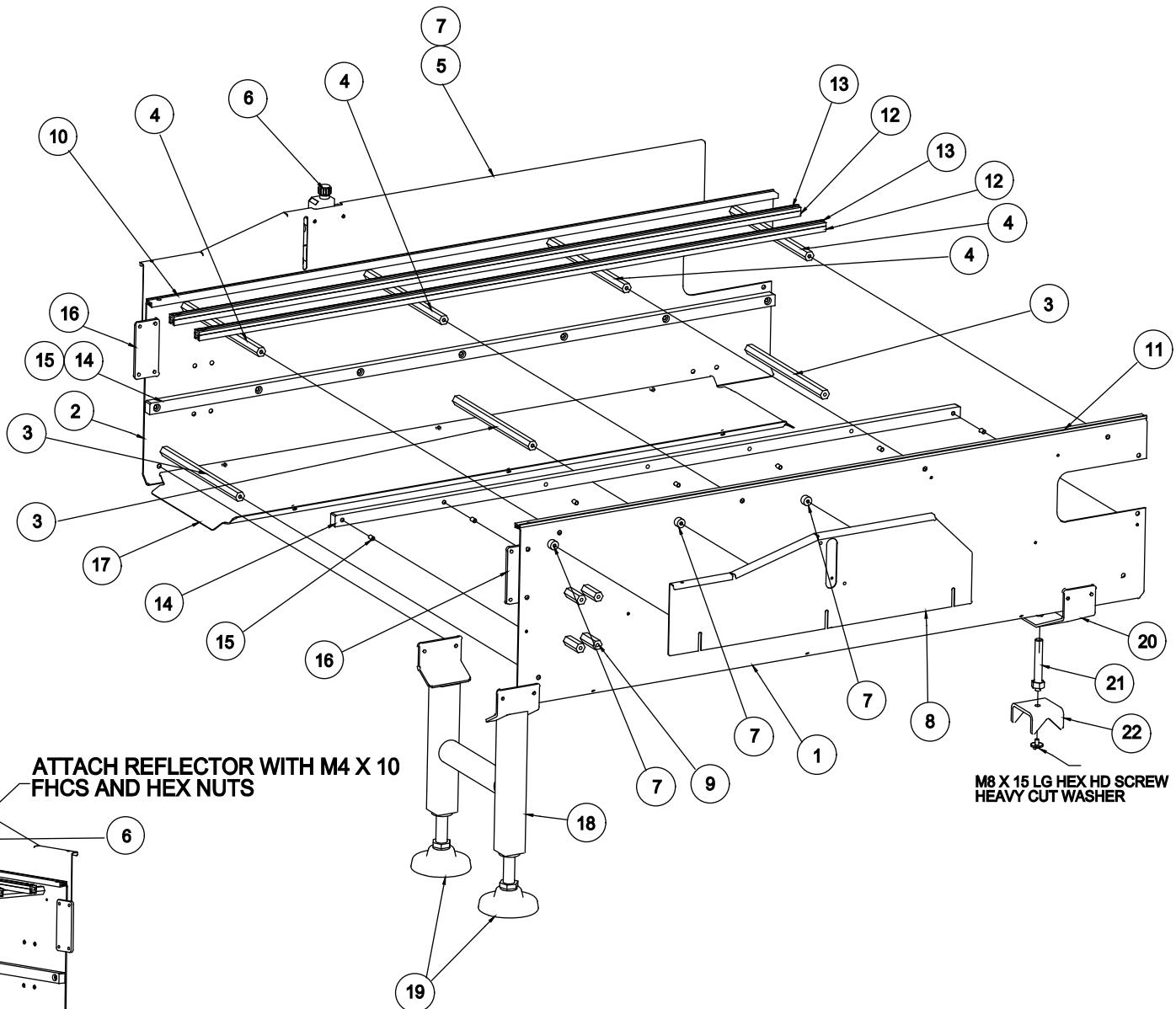
Find Num	Part Number	Item Description	Qty	Rev
				C
1	147252	SIDEPLATE, PIC CENTER SECTION INNER	1	A
2	147252-001	SIDEPLATE, PIC CENTER SECTION, OUTER, (OPP)	1	A
3	B78081265320	3/4" SS HEX SPACER, 12.653" LG, M8 TAPS BOTH ENDS	3	A
4	136425	SPACER, HEX GUIDE MTG	4	A
5	147266	PIC SIDE GUIDE, CENTER LOADSIDE	1	A
6	140631	MRC PRODUCT OVERHEIGHT DETECT ASSEMBLY	1	B
7	B14S07502505004	SPACER, 3/4 OD, 1/4 ID X .5;	8	A
8	147269	PIC SIDE GUIDE, CENTER NON-LOADSIDE	1	A
9	B78080150020	3/4" HEX SPACER, 1 1/2 LONG, M8 THREADS	4	A
10	B84UGR06000	WRS-Wear Strip	1	A
11	B85UGR06000	WRS-Wear Strip	1	A
12	B8306000	EXT-Extrusion	2	A
13	B82UGR06000	WRS-Wear Strip	2	A
14	147284	CHAIN RETURN GUIDE, CENTER, NOLU-S	2	A
15	B14S03102505004	SPCR, .31 OD, .25 ID X .500 LG;	14	A
16	147285	SPLICER PLATE, PIC, INSIDE	2	A
17	147286	GUARD, BOTTOM, CENTER	1	A
18	147287	WELDMENT, LEG, PIC	1	A
19	080705	FOT-Foot	2	A
20	147298	BRACKET, DOWNSTREAM SUPPORT	1	A
21	147301	JACK SCREW, PIC CENTER	1	A
22	147303	PAD, JACK SCREW	1	A

SHEET 2 OF 3
ASSEMBLY, PIC CENTER
SECTION, ENTERPRISE
147251

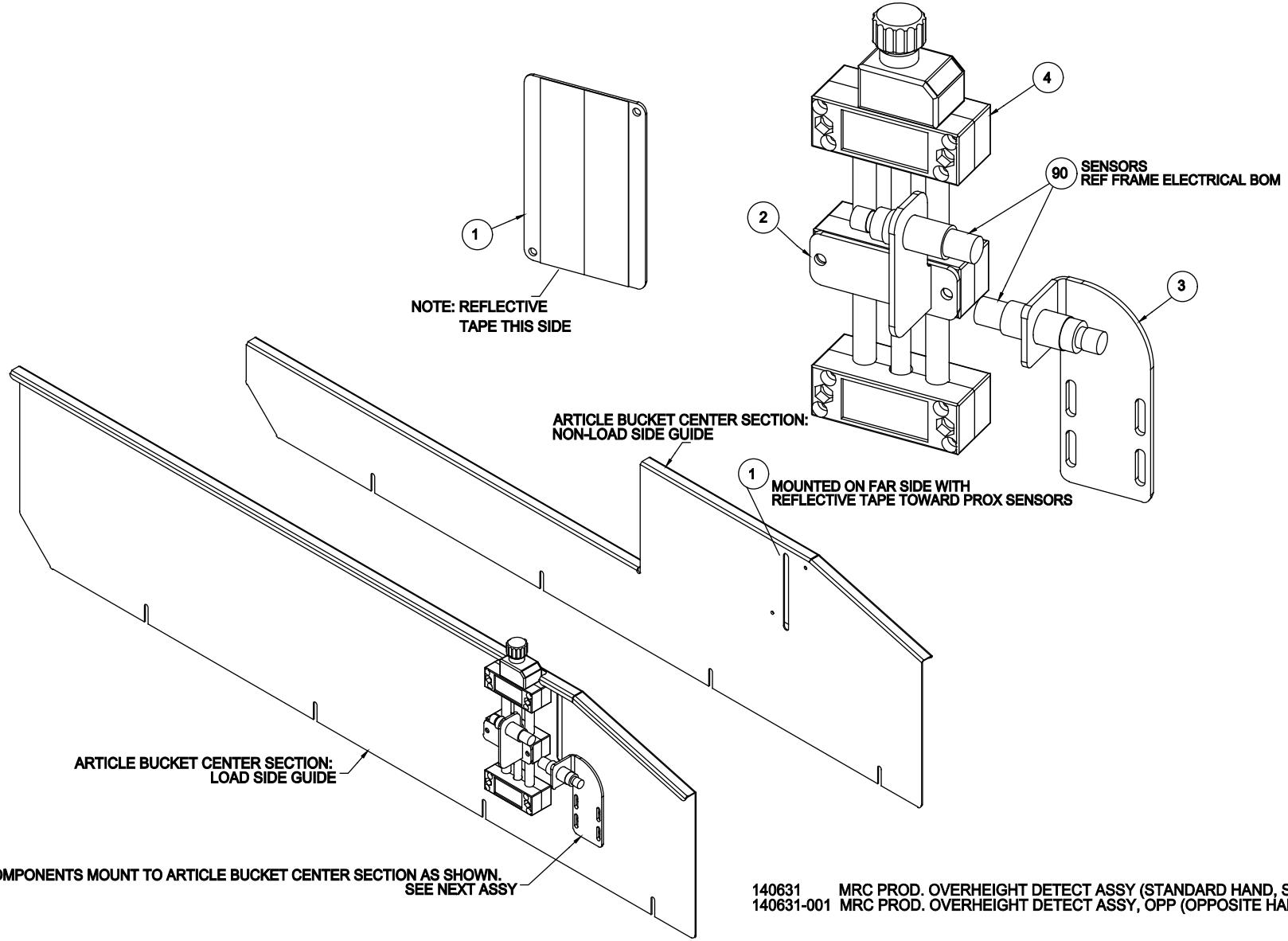
147251 ASSEM, PIC CENTER SECTION, ENTERPRISE (STANDARD HAND, SHOWN)
 147251-001 ASSEM, PIC CENTER SECTION, ENTERPRISE, OPP (OPPOSITE HAND)



ATTACH REFLECTOR WITH M4 X 10
FHCS AND HEX NUTS

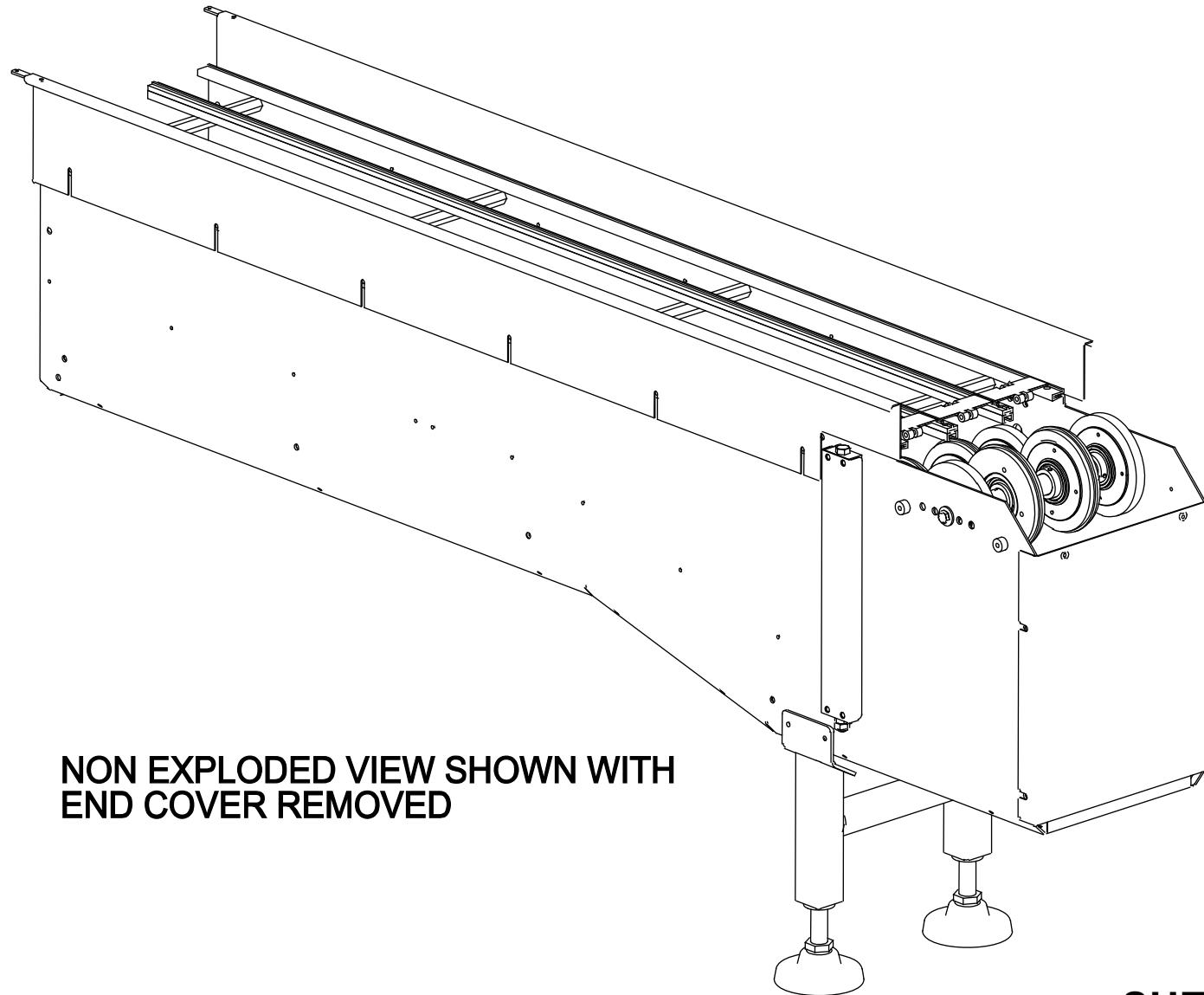


SHEET 3 OF 3
ASSEMBLY, PIC CENTER
SECTION, ENTERPRISE
147251



	Part Number	Item Description	Qty	Rev
				B
1	127621	REFLECTOR ASSY	1	A
2	137348	BRACKET, PHOTO EYE MTG	1	B
3	137360	BRACKET, PHOTO EYE MOUNT	1	C
4	137381	SLD-Slide	1	B
90	N8800689	SNR-Sensor	REF	A

**MRC PRODUCT OVERHEIGHT
DETECT ASSEMBLY**
140631

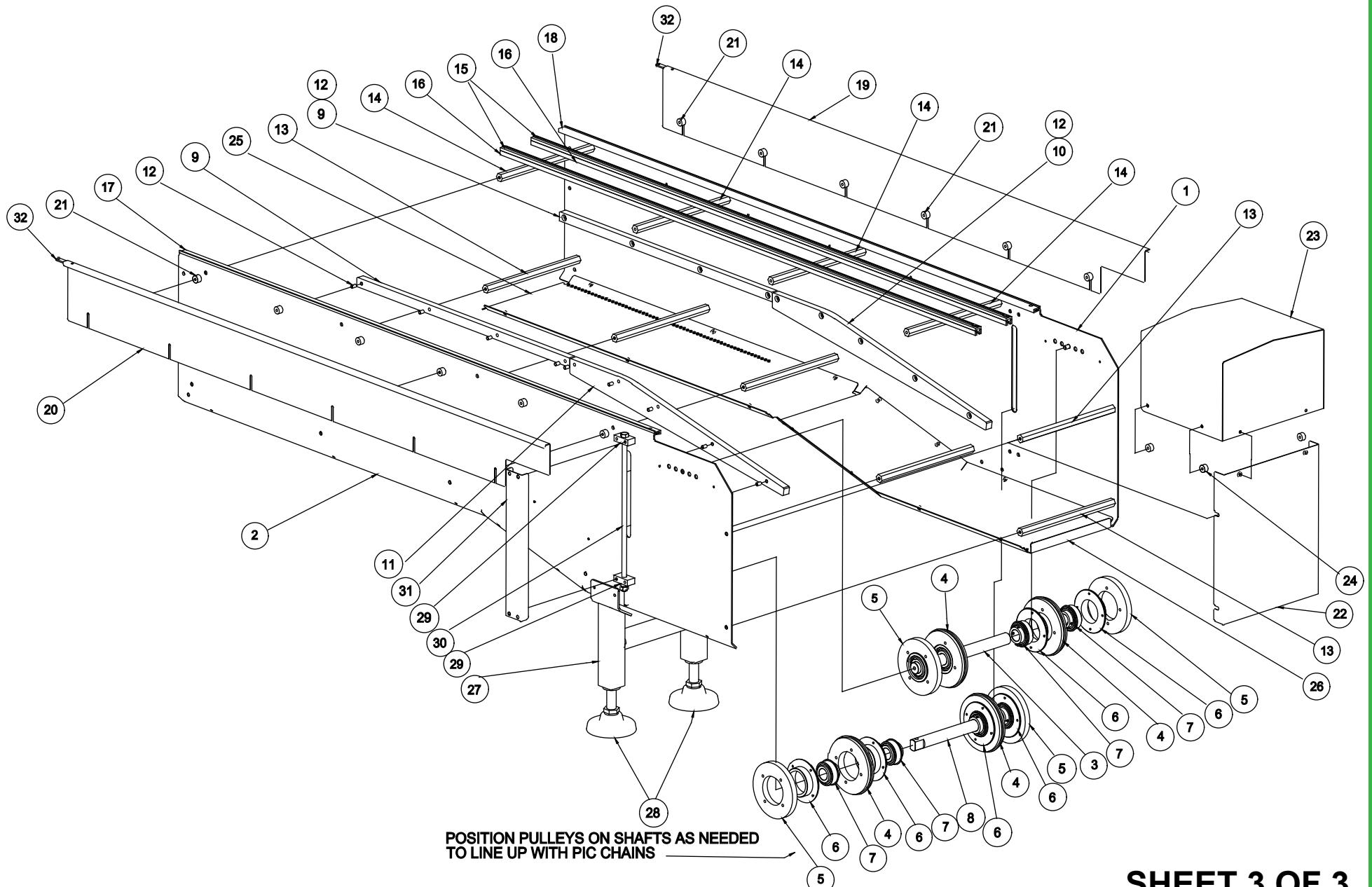


NON EXPLODED VIEW SHOWN WITH
END COVER REMOVED

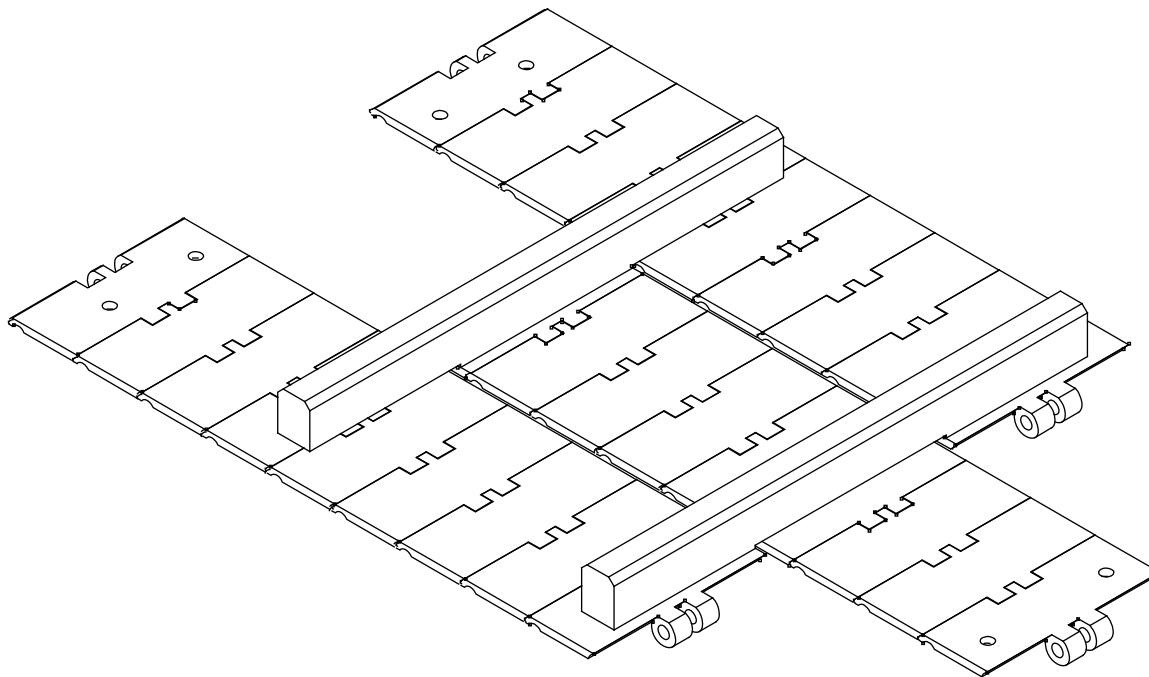
SHEET 1 OF 3
ASSEMBLY, PIC TAKE-UP
SECTION, ENTERPRISE
147300

Find Num	Part Number	Item Description	Qty	Rev
				A
1	147329	SIDEPLATE, PIC TAKE-UP SECTION INNER	1	B
2	147329-001	SIDEPLATE, PIC TAKE-UP SECTION OUTER	1	B
3	147332	SHAFT, TAKE-UP, STATIONARY	1	A
4	139910	PULLEY, IDLER, INNER PIC	4	A
5	139911	PULLEY, IDLER, OUTER PIC	4	B
6	139912	FLANGE, IDLER PULLEY	8	A
7	139235	BIN-Bearing Inserts	8	B
8	147337	SHAFT, TAKE-UP, ADJUSTABLE	1	A
9	147341	CHAIN RETURN GUIDE, TAKE-UP 1, NOLU-S	2	A
10	147344	CHAIN RETURN GUIDE, TAKE-UP 2, NOLU-S	1	A
11	147344-001	CHAIN RETURN GUIDE, TAKE-UP 2, NOLU-S, OPP	1	B
12	B14S03102505004	SPCR, .31 OD, .25 ID X .500 LG;	18	A
13	B78081265320	3/4" SS HEX SPACER, 12.653" LG, M8 TAPS BOTH ENDS	6	A
14	136425	SPACER, HEX GUIDE MTG	4	A
15	B82UGR07000	WRS-Wear Strip	2	A
16	B8307000	EXT-Extrusion	2	A
17	B84UGR07000	WRS-Wear Strip	1	A
18	B85UGR07000	WRS-Wear Strip	1	A
19	147351	PIC SIDE GUIDE, TAKE-UP, RH	1	A
20	147351-001	PIC SIDE GUIDE, TAKE-UP, LH	1	A
21	B14S07502505004	SPACER, 3/4 OD, 1/4 ID X .5;	12	A
22	147358	END GUARD, LOWER	1	A
23	147360	END GUARD, UPPER	1	A
24	B14S07502504384	SPACER, 3/4 OD, 1/4 ID X .438 LG	4	A
25	147364	GUARD, BOTTOM, #2 TAKE-UP	1	A
26	147367	GUARD, BOTTOM, #1 TAKE-UP	1	A
27	147369	WELDMENT, LEG, PIC, SHORT	1	A
28	080705	FOT-Foot	2	A
29	147370	BLOCK, TENSION SCREW MTG	4	A
30	B59SM12175420	HEX BOLT WMT, M12 X 420MM LG	2	A
31	147378	COVER, TENSION SCREW	2	A
32	145421	TIE BAR, STRAIGHT	2	A

**SHEET 2 OF 3
ASSEMBLY, PIC TAKE-UP
SECTION, ENTERPRISE
147300**



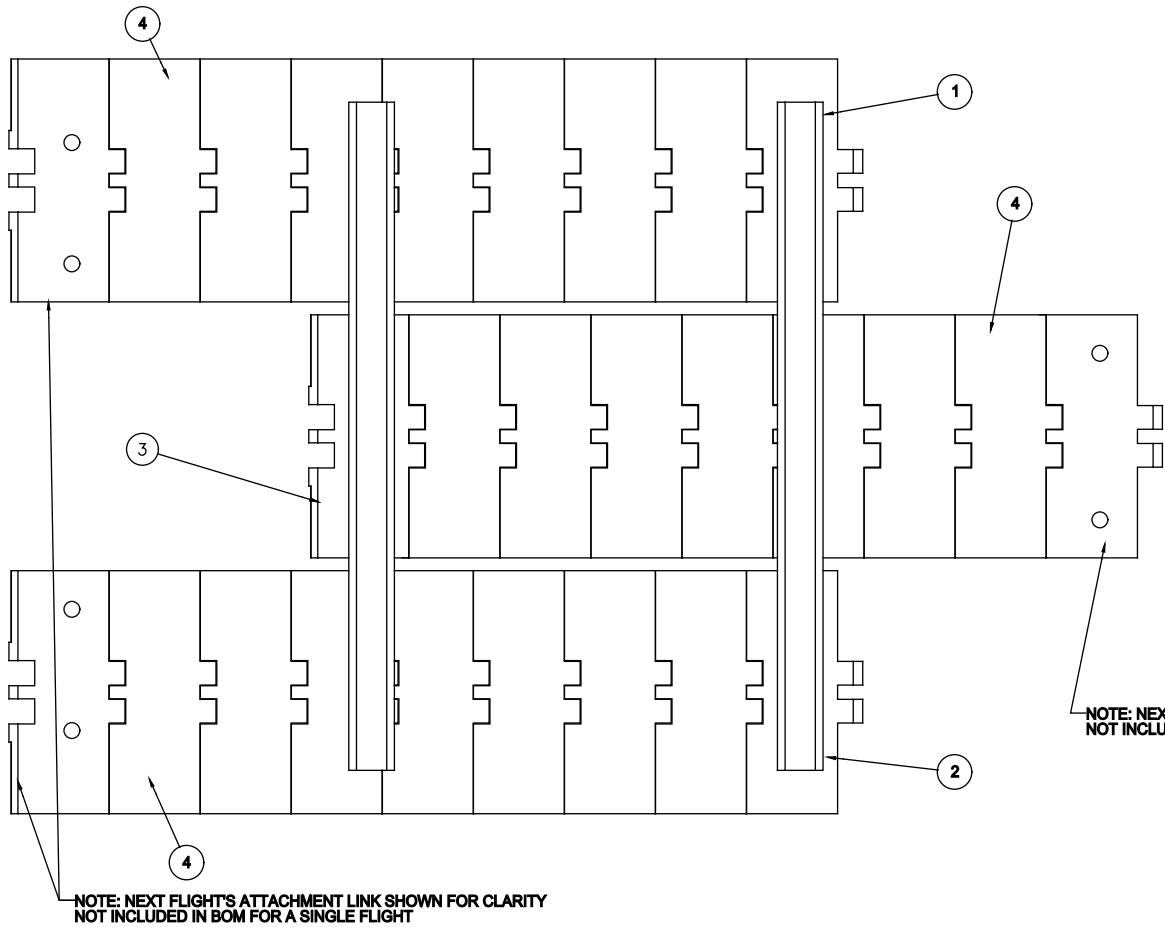
SHEET 3 OF 3
ASSEMBLY, PIC TAKE-UP
SECTION, ENTERPRISE
147300



SHEET 1 OF 3
ENTERPRISE PIC CHAIN ASSEMBLY, BASIC
3-CHAIN, 12" FLIGHTS - COMPLETE CHAIN
147385

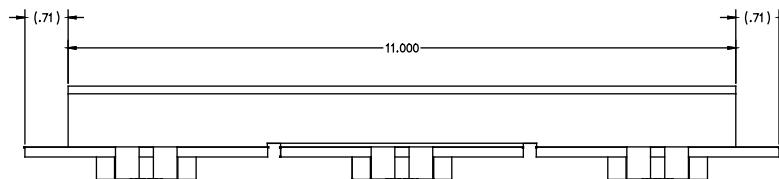
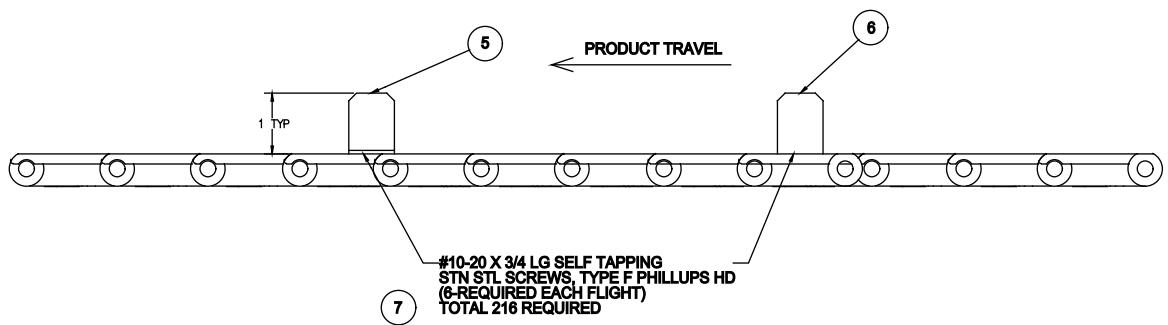
Find Num	Part Number	Item Description	Qty	Rev
				B
1	147388	LINK - TABLE TOP CHAIN 4", MODIFIED, RH	36	B
2	147389	LINK - TABLE TOP CHAIN 4", MODIFIED, LH	36	B
3	147390	LINK - TABLE TOP CHAIN 4", MODIFIED, CENTER	36	B
4	145729	TTC-Table Top Chain	756	A
5	150439	ENTERPRISE PIC LUG, RETARDING, GENERIC	36	A
6	150440	ENTERPRISE PIC LUG, PUSHING, GENERIC	36	A
7	FS	#10-20 X 3/4" S.S. TYPE F SELF TAPPING SCREW, PHILLUPS HD	216	-

SHEET 2 OF 3
ENTERPRISE PIC CHAIN ASSEMBLY, BASIC
3-CHAIN, 12" FLIGHTS - COMPLETE CHAIN
147385



NOTE: NEXT FLIGHT'S ATTACHMENT LINK SHOWN FOR CLARITY
NOT INCLUDED IN BOM FOR A SINGLE FLIGHT

NOTE: SINGLE FLIGHT SHOWN, COMPLETE CHAIN = 36 FLIGHTS



SHEET 3 OF 3
ENTERPRISE PIC CHAIN ASSEMBLY, BASIC
3-CHAIN, 12" FLIGHTS - COMPLETE CHAIN
147385

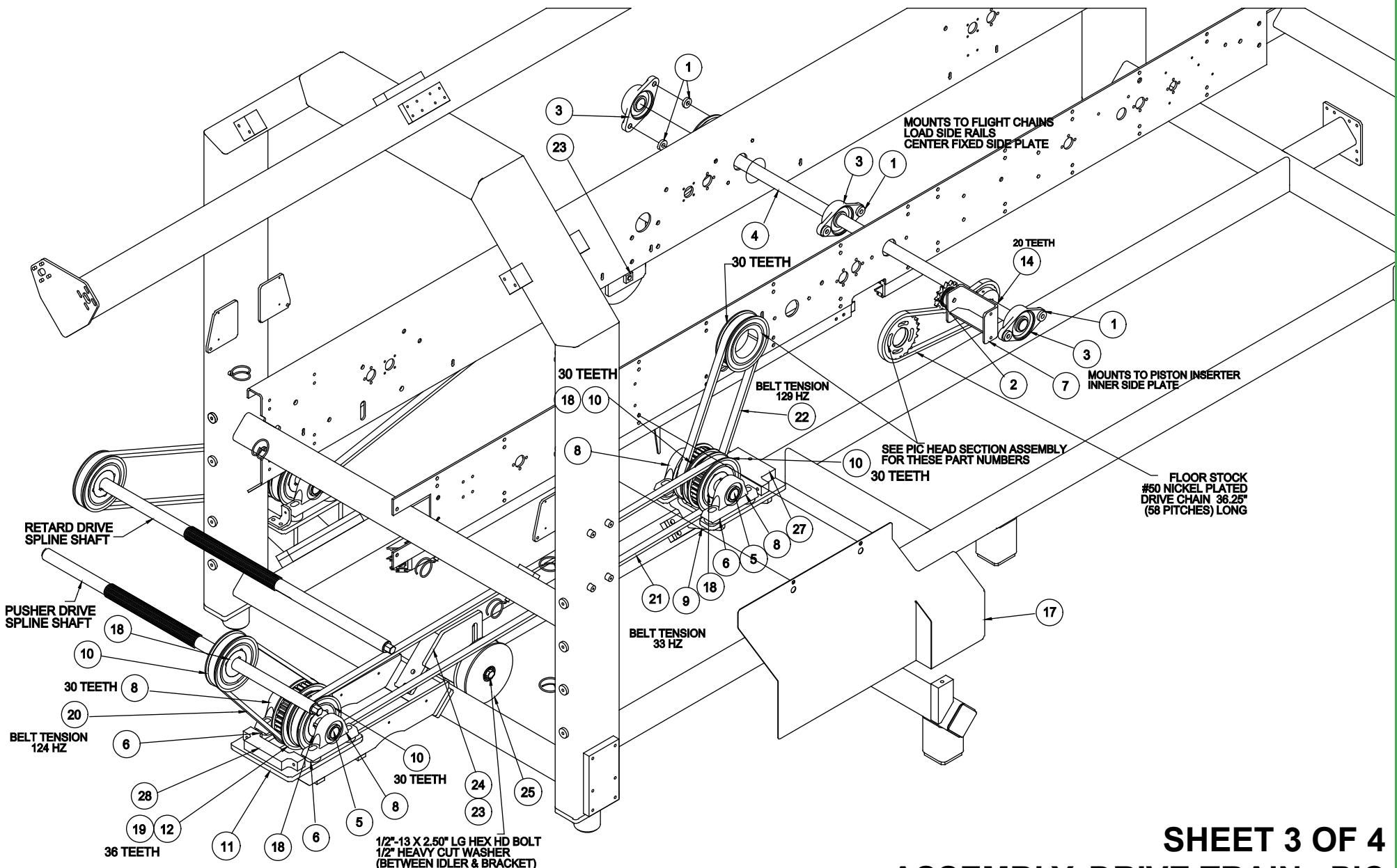
**SHEET 1 OF 4
ASSEMBLY, DRIVE TRAIN, PIC
INFEED, OUTSIDE POLY CHAIN
169950**

Find Num	Part Number	Item Description	Qty	Rev
				A
1	B14S10004102504	SPACER;	6	-
2	B76E005011408	IDLER SPRKT, 50A14 W/ER8C BRNG;.500" I.D., NICKEL PLATED	1	-
3	107725	BFL-Bearing, Flange	3	B
4	170303	SHAFT, RETARD DRIVE, PIC, EXTENDED	1	A
5	162394	SHAFT, INTERMEDIATE DRIVE	3	A
6	B14S15005303754	SPACER 1.5 OD 17/32 ID X 0.375 LG	8	A
7	143739	MOUNTING BRACKET, IDLER	1	B
8	119091	BPB-Bearing, Pillow Block	6	A
9	162398	WELDMENT, UPSTREAM SHAFT MTG, POLY CHAIN	1	B
10	162386	PLY-Pulley	8	B
11	162397	WELDMENT, DOWNSTREAM SHAFT MTG, POLY CHAIN	1	C
12	162388	PLY-Pulley	1	B
13	170221	WELDMENT, RETARD SHAFT MTG, POLY CHAIN	1	A
14	143794	SPROCKET, ARTICLE BUCKET INNER DRIVE, 50 CH	1	A
15	B14S15005307504	SPACER 1.5 OD 17/32 ID X 0.750 LG	4	A
16	170287	BLT-Belt	1	A
17	162465	SHIELD, BELT PROTECTOR	1	A
18	B72E070028	PLATED BSH MRT 2012-30MM	8	-
19	B72E087184P	BSH DGE 2517-30MM BORE	1	A
20	162434	BLT-Belt	1	A
21	162435	BLT-Belt	1	A
22	162436	BLT-Belt	1	A
23	139596	NUT, TAKE-UP, 1/2-13	2	A
24	162541	BRACKET, IDLER, BELT	1	A
25	162553	PLY-Pulley	2	A
26	170285	BRACKET, IDLER, BELT, OUTSIDE	1	A
27	167184	JACKING BLOCK, PIC INTERMEDIATE SHAFT	1	A
28	167189	JACKING BLOCK, RETARD INTERMEDIATE SHAFT	1	A
29	170256	BRACKET, TENSIONING	1	A
30	170256-001	BRACKET, TENSIONING, OPP HAND	1	A
31	170289	BLT-Belt	1	A

SHEET 2 OF 4

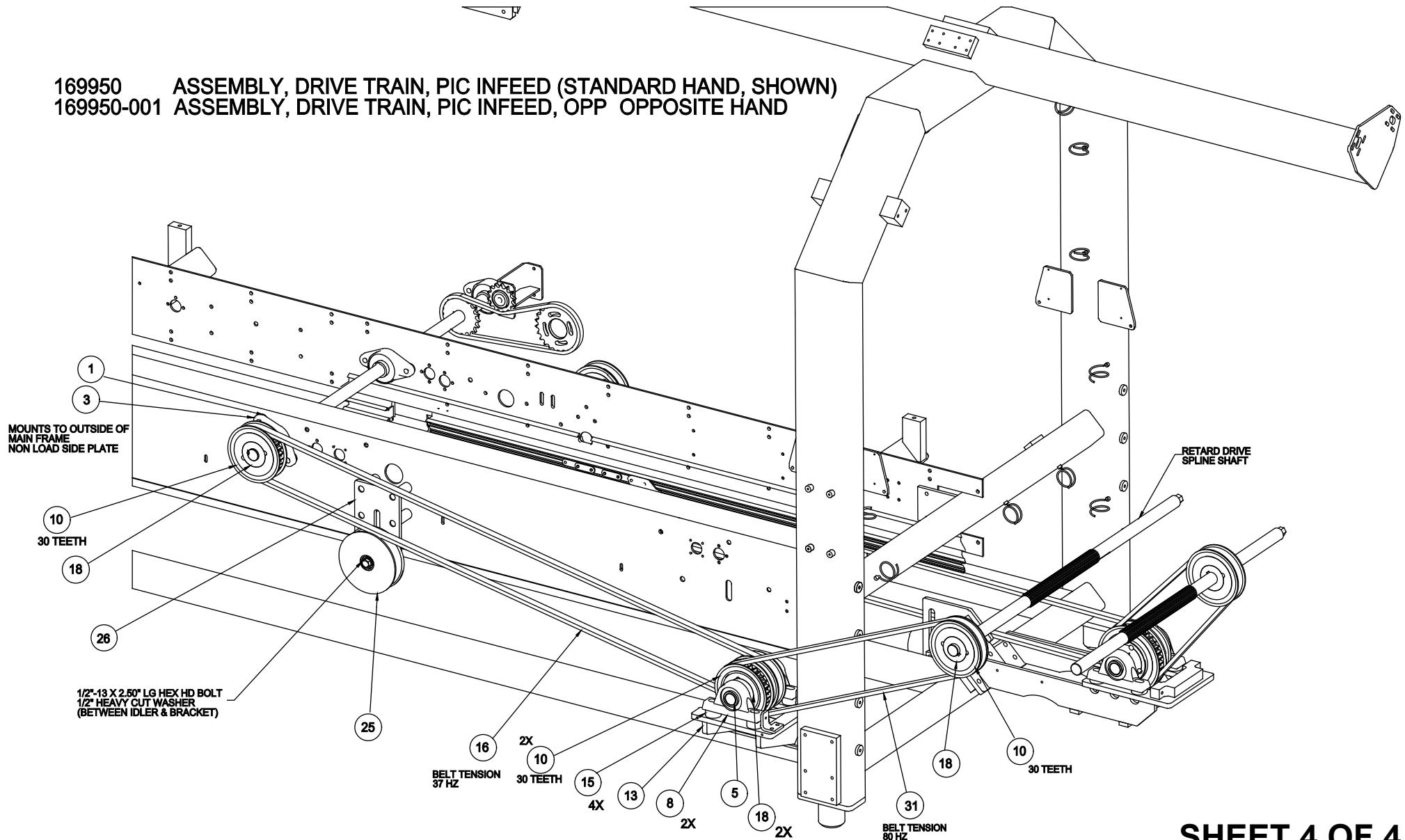
**ASSEMBLY, DRIVE TRAIN, PIC
INFEED, OUTSIDE POLY CHAIN**

169950



SHEET 3 OF 4
ASSEMBLY, DRIVE TRAIN, PIC
INFEED, OUTSIDE POLY CHAIN
169950

169950 ASSEMBLY, DRIVE TRAIN, PIC INFEED (STANDARD HAND, SHOWN)
169950-001 ASSEMBLY, DRIVE TRAIN, PIC INFEED, OPP OPPOSITE HAND



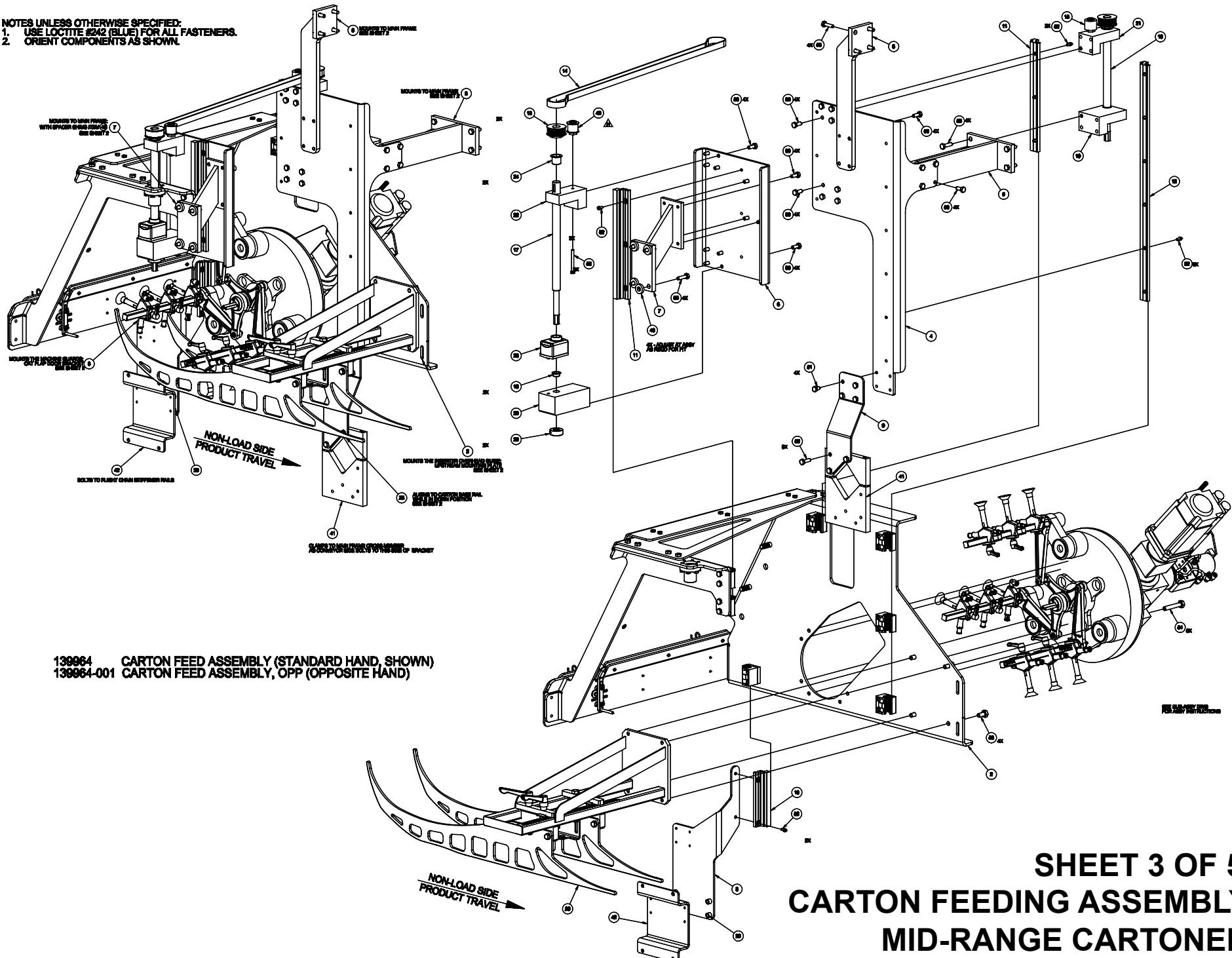
SHEET 4 OF 4
ASSEMBLY, DRIVE TRAIN, PIC
INFEED, OUTSIDE POLY CHAIN
169950

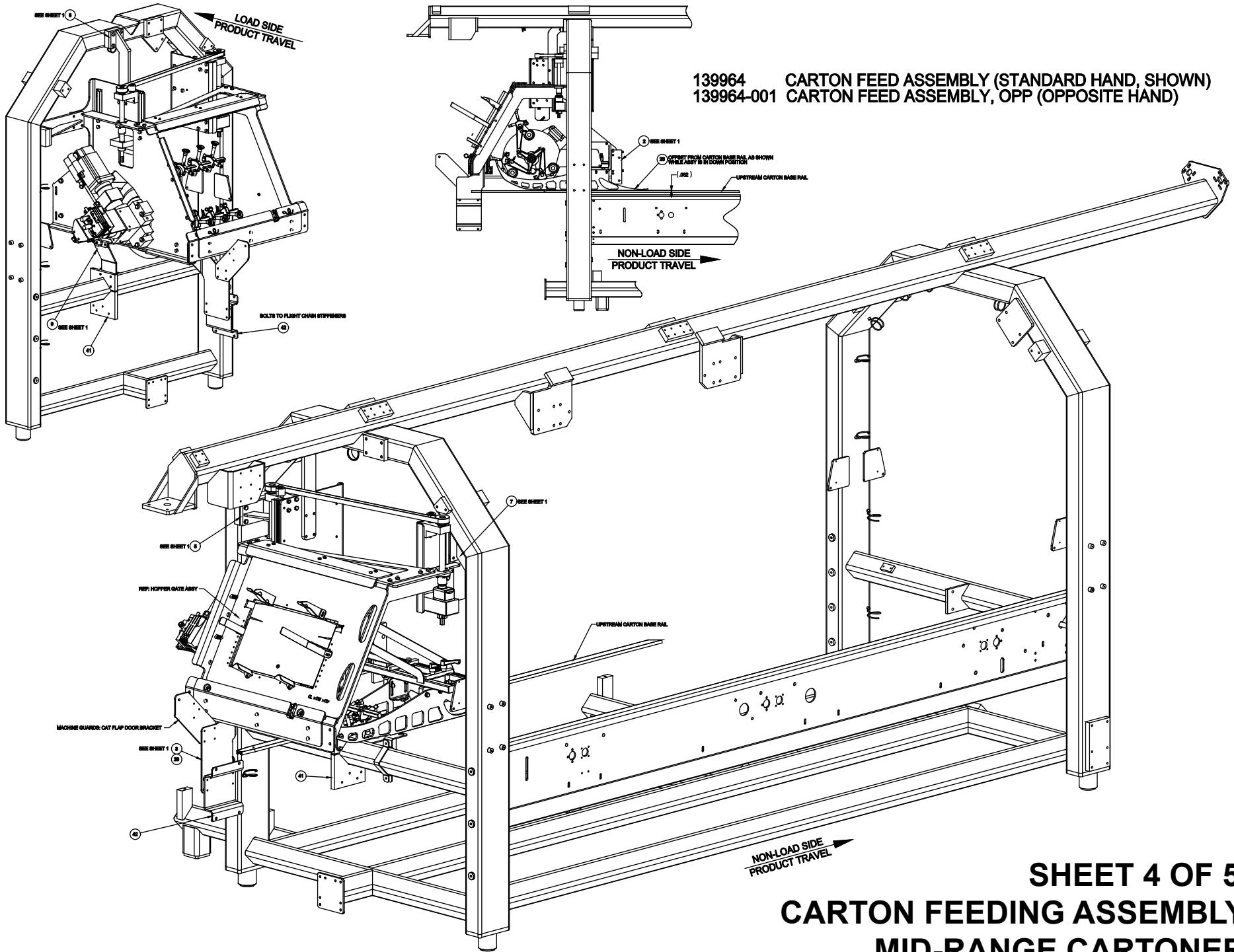
**SHEET 1 OF 5
CARTON FEEDING ASSEMBLY
MID-RANGE CARTONER
139964**

Find Num	Part Number	Item Description	Qty	Rev
				J
1	139952	FEEDER ASSEMBLY, 12" MID-RANGE	1	E
2	139963	12" FEEDER MOUNTING ASSEMBLY	1	H
3	140491	BOTTOM RAIL BRACKET - FEEDER	1	A
4	140492	FEEDER SIDE PLATE	1	D
5	140494	SLIDE POST MOUNTING BRACKET - FEEDER	1	A
6	140496	FEEDER MOUNTING PLATE	1	C
7	140497	SLIDE POST MOUNTING BRACKET - FEEDER	1	A
8	140498	CENTER POST MOUNTING BRACKET - FEEDER	1	A
9	140499	BOTTOM RAIL BRACKET - FEEDER	1	B
10	161166	MODIFICATION, SINGLE SQUARE RAIL, 149MM LG	1	A
11	140538	RAL-Rail	2	A
12	140539	RAL-Rail	1	A
13	140508	MODIFICATION, PULLEY 30 TEETH T5 - 20MM BORE W/ KEY	2	A
14	140554	BLT-Belt	1	A
15	120093	TENSIONER ASSY	1	A
16	140500	SHAFT, FEEDER ADJUSTING, DRIVEN	1	C
17	140501	SHAFT, FEEDER ADJUSTING, DRIVING	1	C
18	126351	BSH-Bushing	2	A
19	140504	SLIDE BLOCK, FEEDER, LS LOWER	1	C
20	140503	SLIDE BLOCK, FEEDER	1	B
21	140505	SLIDE BLOCK, FEEDER, LS UPPER	1	C
22	140506	SLIDE BLOCK, FEEDER, NLS UPPER	1	D
23	095802	STC-Set Collar	2	A
24	140573	BSH-Bushing	2	A
25	127281	COT-Counter	1	A
26	140656	SKI GUIDE ASSEMBLY, 12"	1	B
27	119106	BLOCK-SENSOR MTG, RH	1	B
28	119106-001	BLOCK-SENSOR MTG, LH	1	B
29	B400501200375	SPACER;	4	-
40	B14S10004402504	SPACER; 1.00 OD X 0.41 ID X 0.250 LG SS	4	A
41	139721	CONV MTG PLATE	1	B
42	147253	MOUNT, BOTTOM RAIL BRACKET	1	A
43	161126	TENSIONER ASSY, FLANGED	1	A
44	167936	BRACKET, SENSOR, PROX SENSOR PRESENT	1	A
45	167936-001	BRACKET, SENSOR, PROX SENSOR PRESENT, OPP	1	A
50	FS	M8x20 SS HHB	28	-
51	FS	M8x12 SS HHB	4	-
52	FS	M8x12 SS SHCS	14	-
53	FS	M10x20 SS HHB	4	-
54	FS	M10x60 SS HHB	6	-
55	FS	M10x30 SS HHB	12	-
56	FS	M8x25 SS HHB	3	-
57	FS	M6x10 SS HHB	8	-
58	FS	M6x60 SS HHB	2	-

SHEET 2 OF 5
CARTON FEEDING ASSEMBLY
MID-RANGE CARTONER
139964

NOTES UNLESS OTHERWISE SPECIFIED:
1. USE LOCTITE #242 (BLUE) FOR ALL FASTENERS.
2. ORIENT COMPONENTS AS SHOWN.





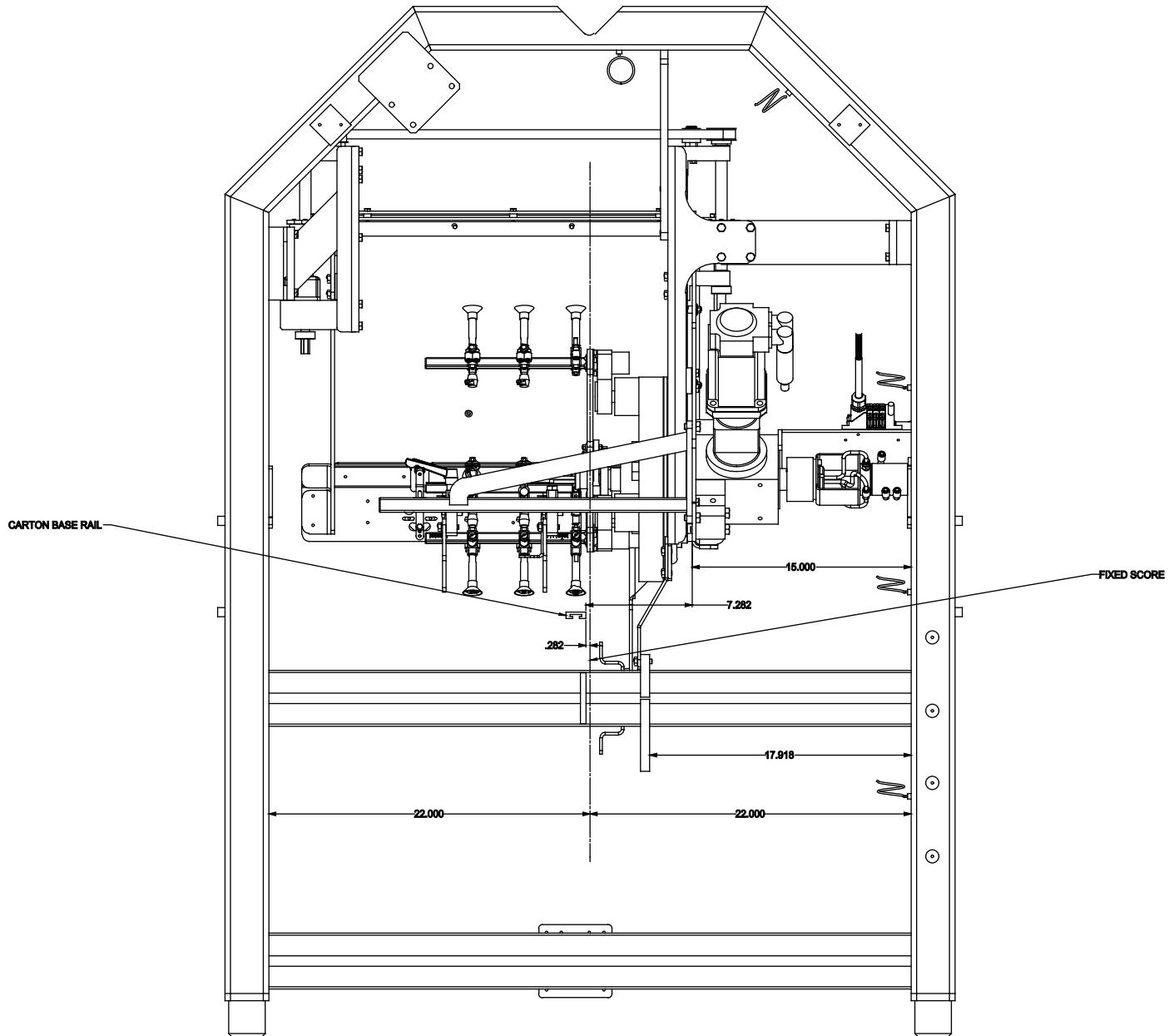
139964 CARTON FEED ASSEMBLY (STANDARD HAND, SHOWN)
139964-001 CARTON FEED ASSEMBLY, OPP (OPPOSITE HAND)

SHEET 4 OF 5

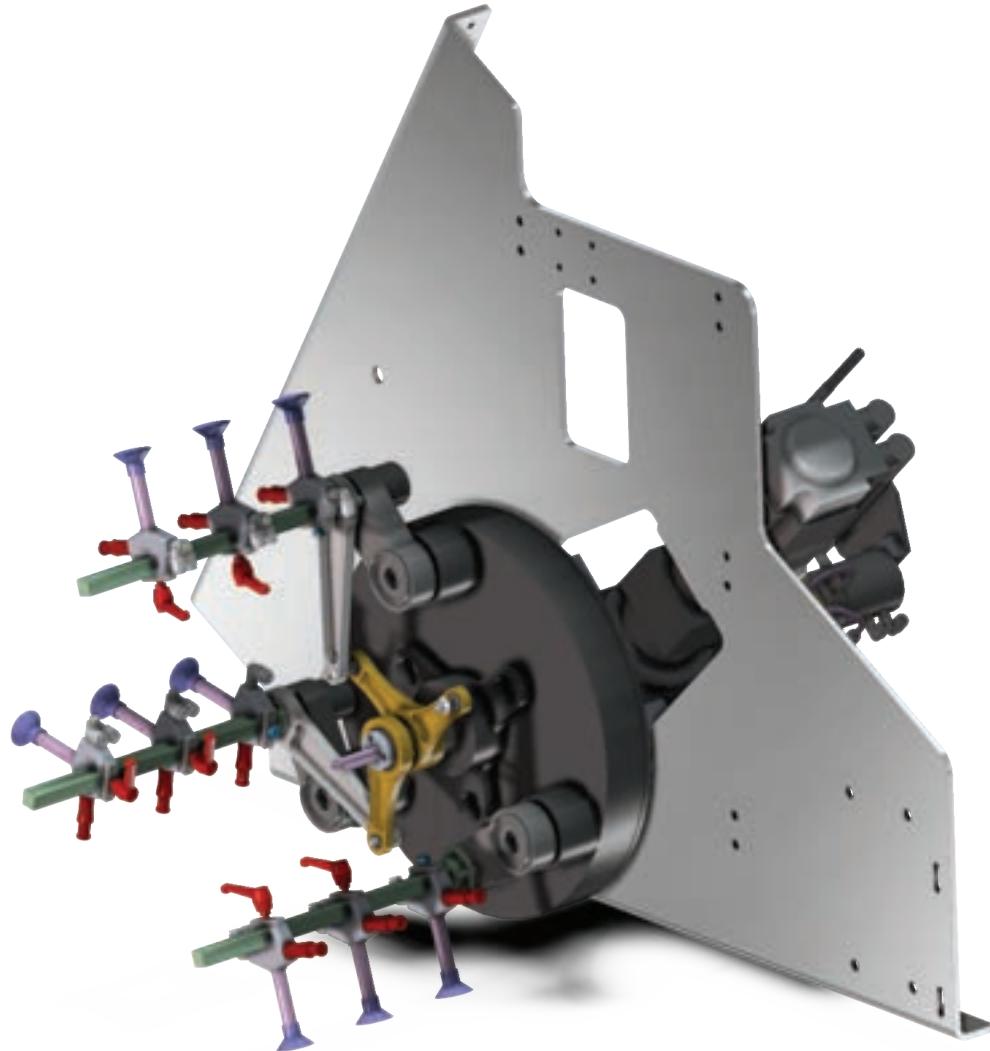
CARTON FEEDING ASSEMBLY

MID-RANGE CARTONER

139964



SHEET 5 OF 5
CARTON FEEDING ASSEMBLY
MID-RANGE CARTONER
139964



Fastest Feeder

KW's patented rotary carton feeder is the fastest, most positive in the industry. The straight-pick motion pre-breaks cartons out of the gate and short, rigid bars minimize deflection. The servo motion profile erects cartons in the direction of product flow with a 30% greater carton-open time.

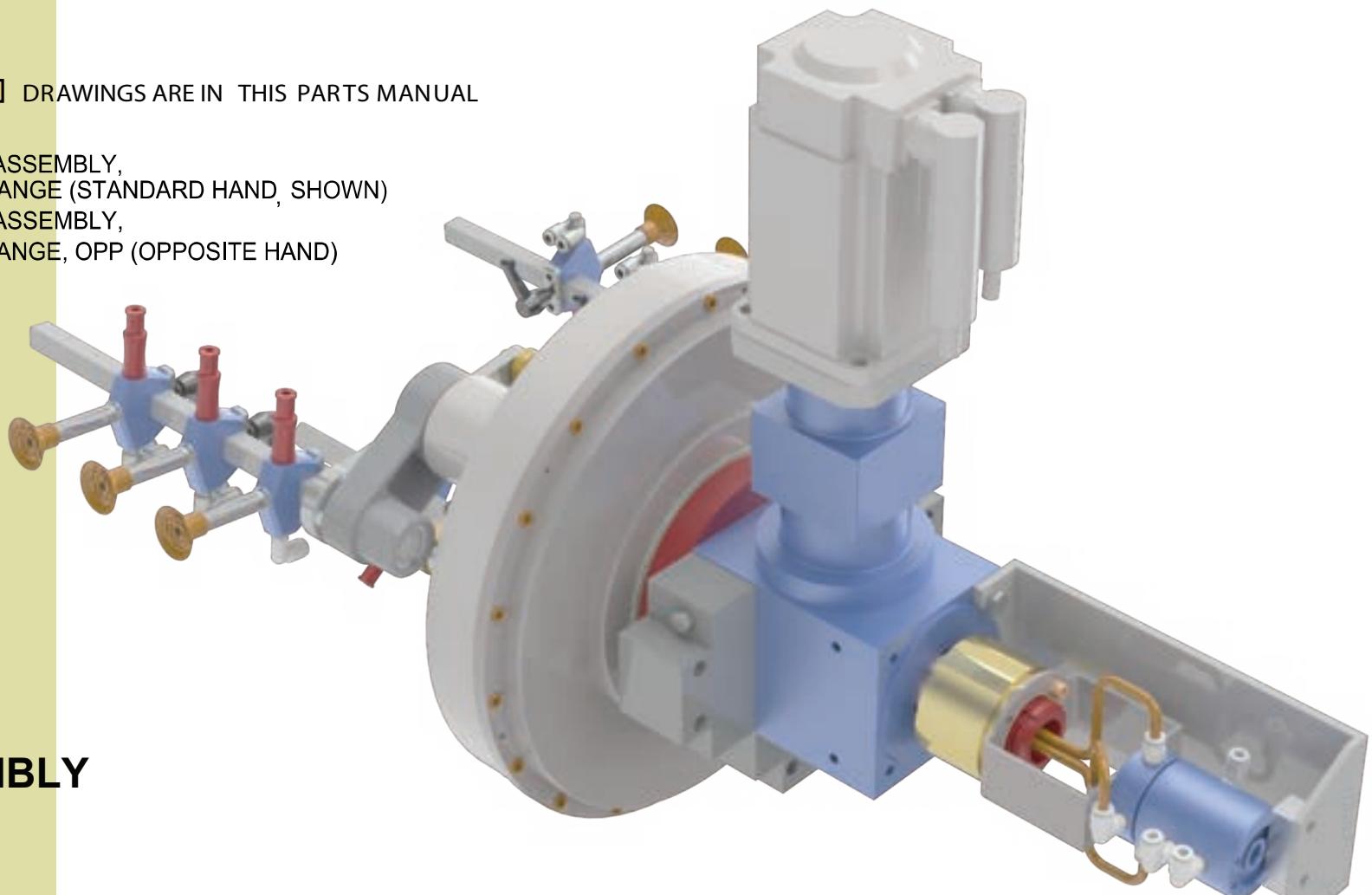
**SHEET 1 OF 3
FEEDER ASSEMBLY
12" MID-RANGE
139952**

Find Num	Part Number	Item Description	Qty	Rev
		CELOX		E
1	139965	FEEDER GEARBOX SUBASSY, 12"	1	F
2	N8100042	CPL-Coupling	1	B
3	140522	FEEDER MOUNTING BLOCK	3	C
4	131915	FEED BAR ASSEMBLY, ADJUSTABLE CUPS	3	F
5	142796	ROTARY UNION ASSEMBLY, MID-RANGE, LESS SOL VALVES	1	C
100	110756	SRV-Servo Motor	REF	E

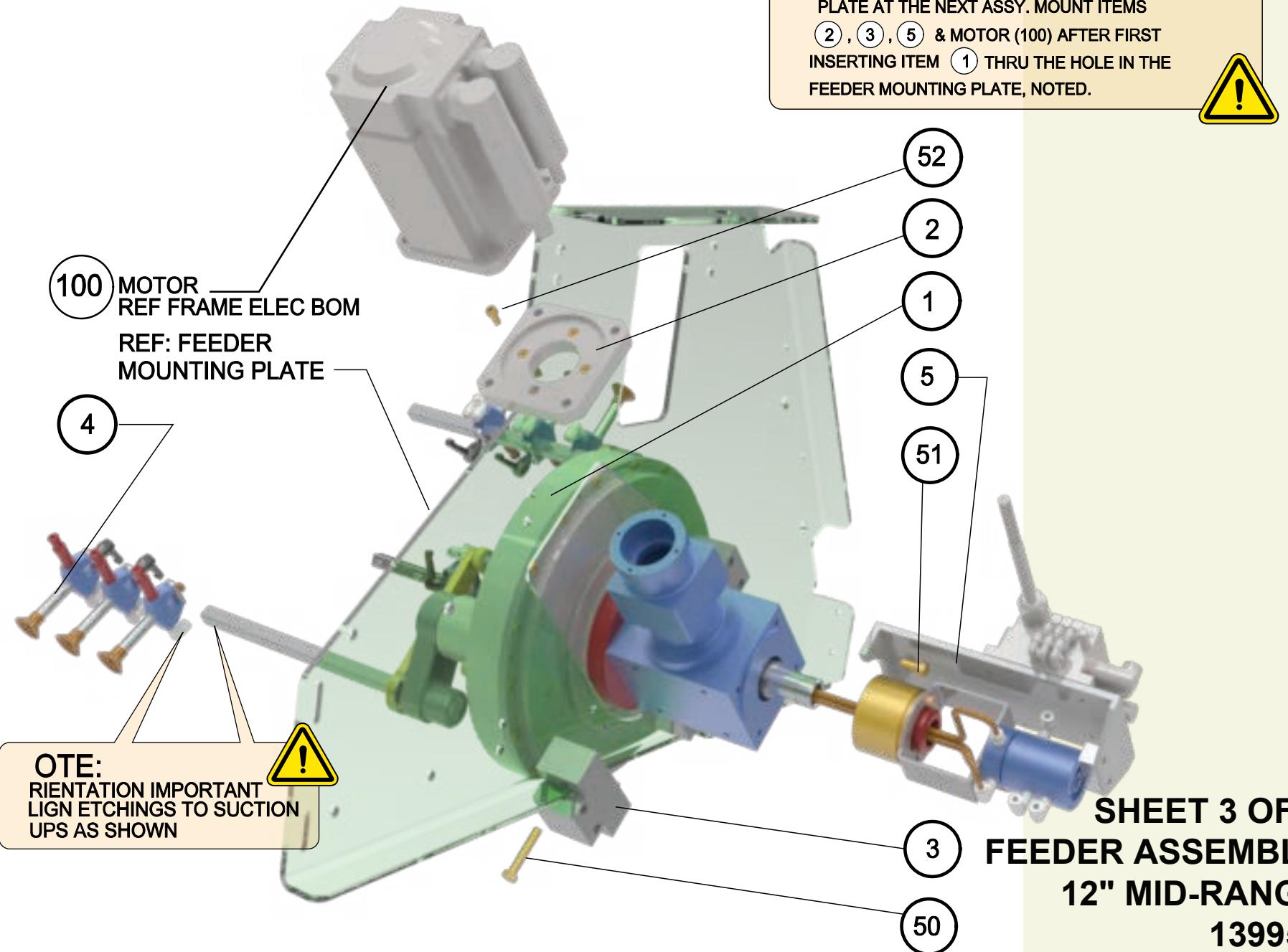


DRAWINGS ARE IN THIS PARTS MANUAL

- 139952 FEEDER ASSEMBLY,
12" MID-RANGE (STANDARD HAND, SHOWN)
139952-001 FEEDER ASSEMBLY,
12" MID-RANGE, OPP (OPPOSITE HAND)

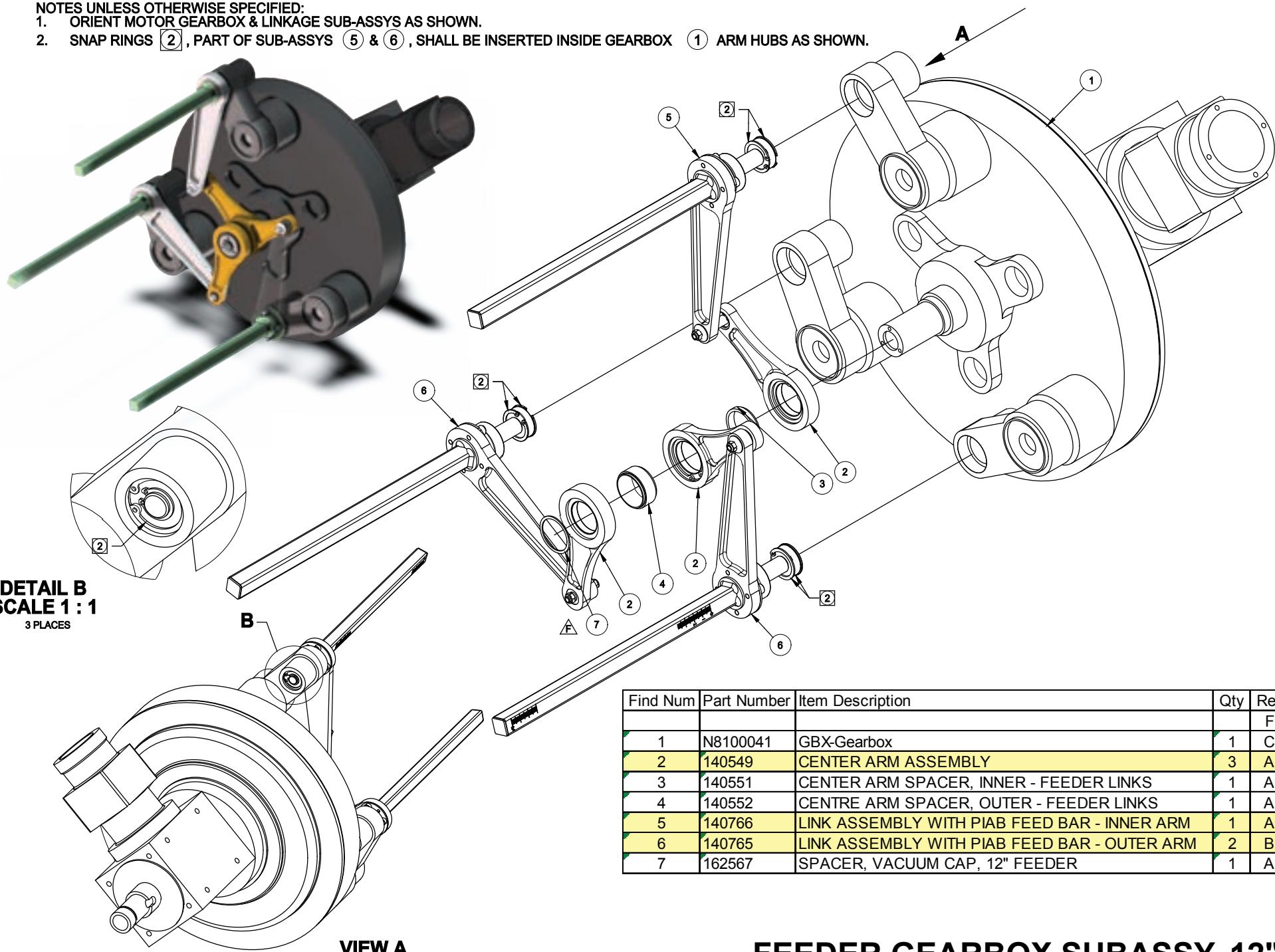


SHEET 2 OF 3
FEEDER ASSEMBLY
12" MID-RANGE
139952



NOTES UNLESS OTHERWISE SPECIFIED:

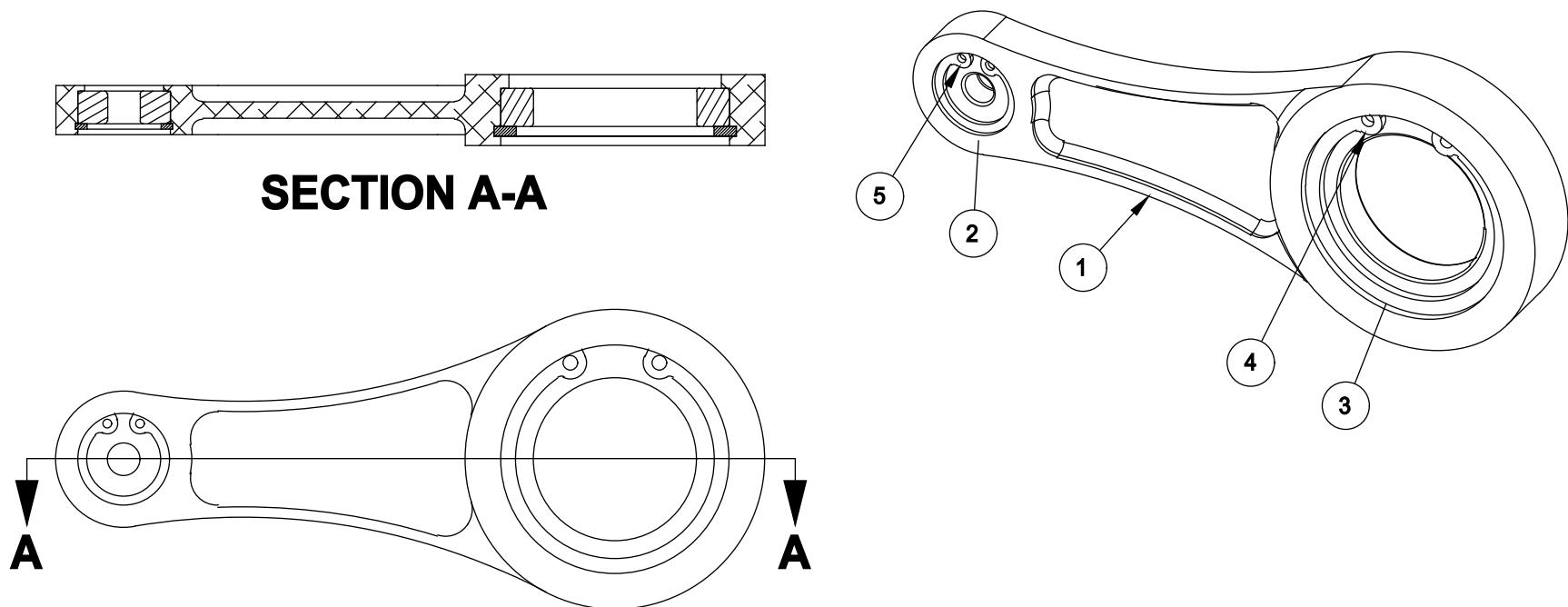
1. ORIENT MOTOR GEARBOX & LINKAGE SUB-ASSYS AS SHOWN.
2. SNAP RINGS **(2)**, PART OF SUB-ASSYS **(5) & (6)**, SHALL BE INSERTED INSIDE GEARBOX **(1)** ARM HUBS AS SHOWN.



Find Num	Part Number	Item Description	Qty	Rev
1	N8100041	GBX-Gearbox	1	F
2	140549	CENTER ARM ASSEMBLY	3	A
3	140551	CENTER ARM SPACER, INNER - FEEDER LINKS	1	A
4	140552	CENTRE ARM SPACER, OUTER - FEEDER LINKS	1	A
5	140766	LINK ASSEMBLY WITH PIAB FEED BAR - INNER ARM	1	A
6	140765	LINK ASSEMBLY WITH PIAB FEED BAR - OUTER ARM	2	B
7	162567	SPACER, VACUUM CAP, 12" FEEDER	1	A

FEEDER GEARBOX SUBASSY, 12"
139965

139965 FEEDER ASSEMBLY (STANDARD HAND, SHOWN)
139965-001 FEEDER ASSEMBLY, OPP (OPPOSITE HAND)



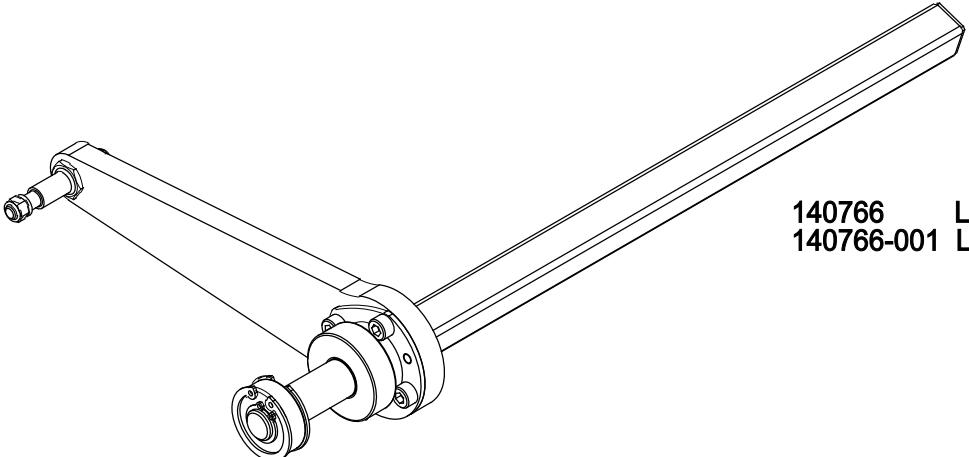
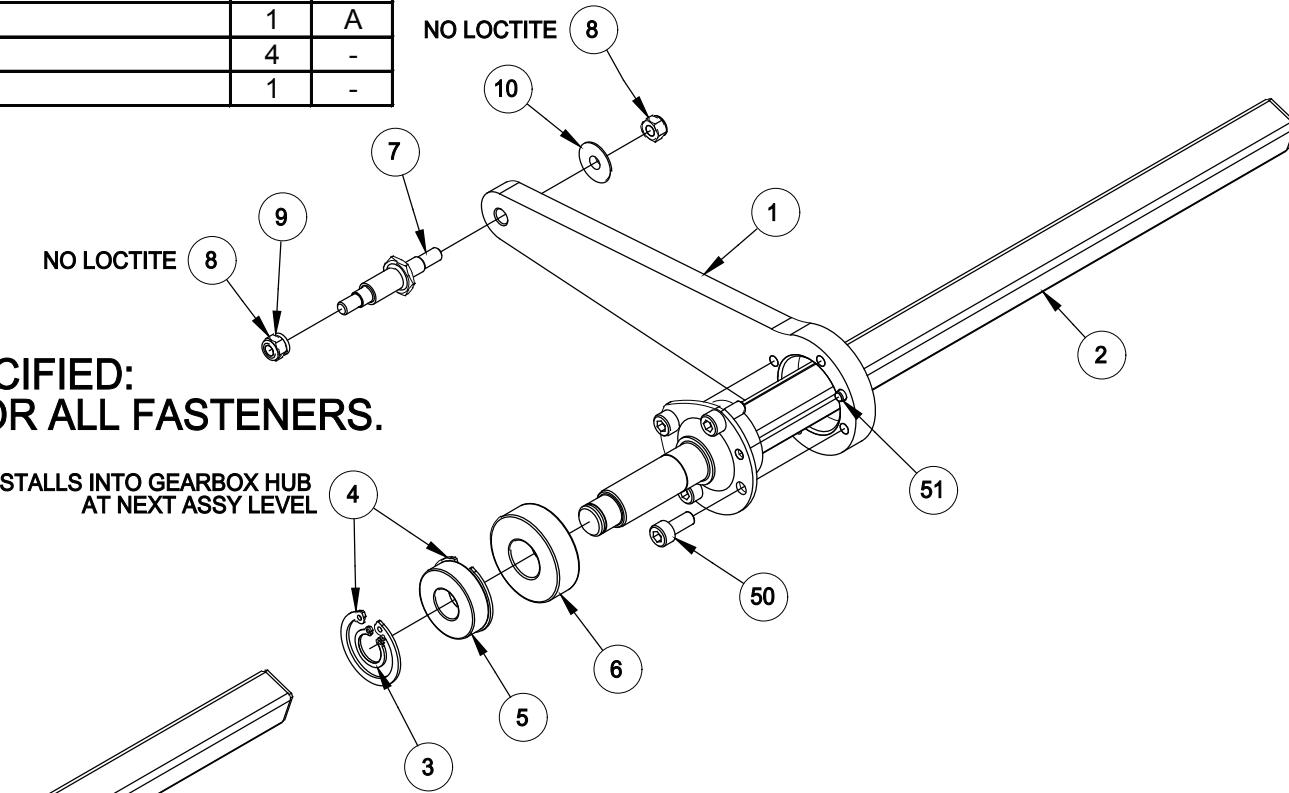
140549 CENTER ARM ASSEMBLY (STANDARD HAND, SHOWN)
 140549-001 CENTER ARM ASSEMBLY, OPP (OPPOSITE HAND)

Find Num	Part Number	Item Description	Qty	Rev
		CELOX		A
1	140550	FEEDER CENTER ARM	1	A
2	X0600171	BAL-Ball	1	A
3	X0600176	BAL-Ball	1	A
4	X1510251	STS INTERNAL CIRCLIP	1	A
5	X1510235	STS INTERNAL CIRCLIP	1	A

**CENTER ARM ASSEMBLY
140549**

Find Num	Part Number	Item Description	Qty	Rev
		CELOX		A
1	4176-521-003	FEED BAR MOUNTING LINK	1	B
2	140767	ROCKER SHAFT, ADJUSTABLE FEED BAR, 12" MID-RANGE	1	A
3	X1510258	STS EXTERNAL CIRCLIP - 12MM	1	B
4	X1510248	STS INTERNAL CIRCLIP	2	A
5	X0600021	BAL-Ball	1	A
6	X0600035	BAL-Ball	1	B
7	4176-521-012	PIN - SMALL END - INNER	1	C
8	X1370306	NUT-Nut	2	A
9	4176-521-015	WASHER - BEARING ABUTMENT - 606	1	A
10	4176-521-010	WASHER - SPREADER	1	A
50	FS	M5x12 SS SHCS	4	-
51	FS	M4x10 SS DOWEL PIN	1	-

NOTES UNLESS OTHERWISE SPECIFIED:
1. USE LOCTITE #242 (BLUE) FOR ALL FASTENERS.

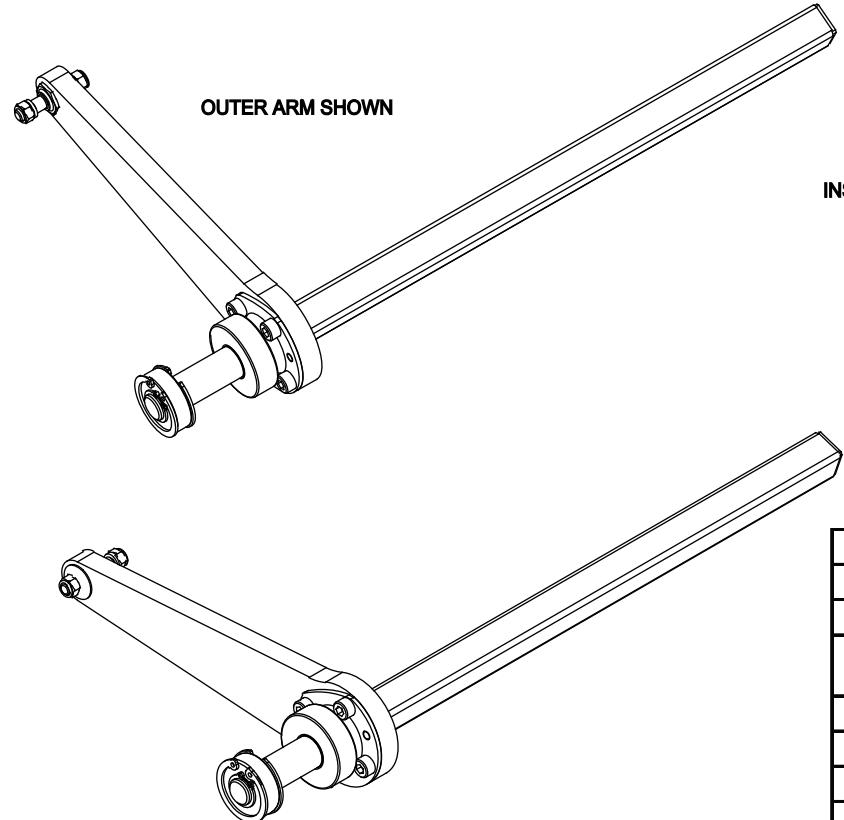


140766 LINK ASSY WITH PIAB FEED BAR - INNER ARM (STANDARD HAND, SHOWN)
140766-001 LINK ASSY WITH PIAB FEED BAR - INNER ARM, OPP (OPPOSITE HAND)

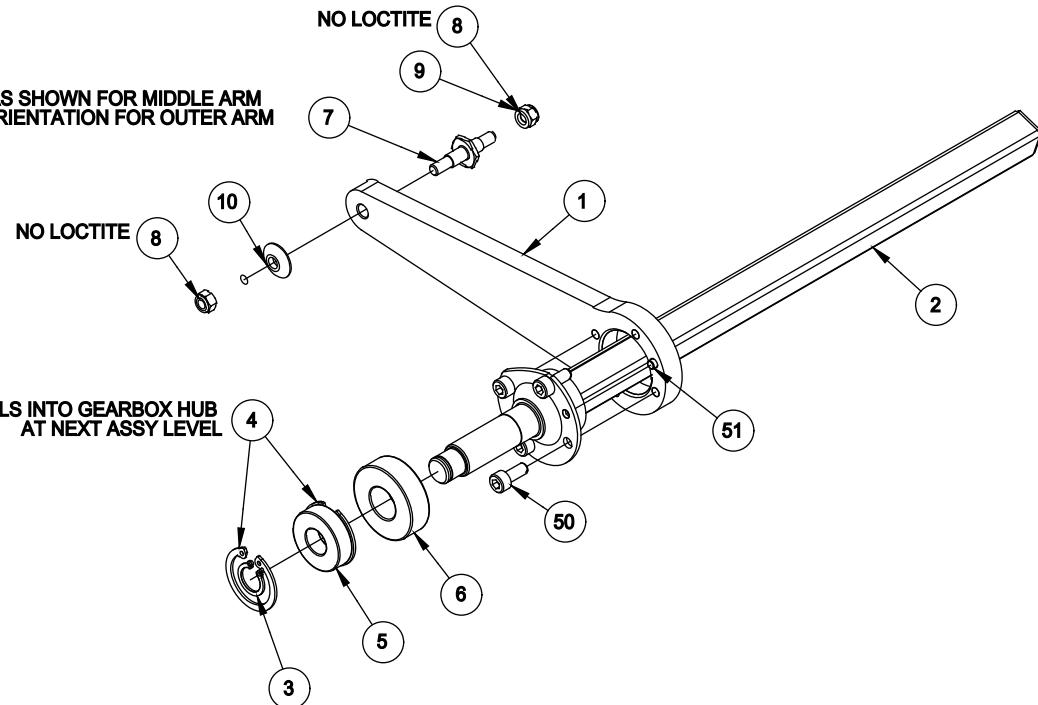
**LINK ASSEMBLY WITH PIAB
FEED BAR - INNER ARM
140766**

NOTES UNLESS OTHERWISE SPECIFIED:
1. USE LOCTITE #242 (BLUE) FOR ALL FASTENERS.

140765 LINK ASSY WITH PIAB FEED BAR - OUTER ARM (STANDARD HAND, SHOWN)
140765-001 LINK ASSY WITH PIAB FEED BAR - OUTER ARM, OPP (OPPOSITE HAND)

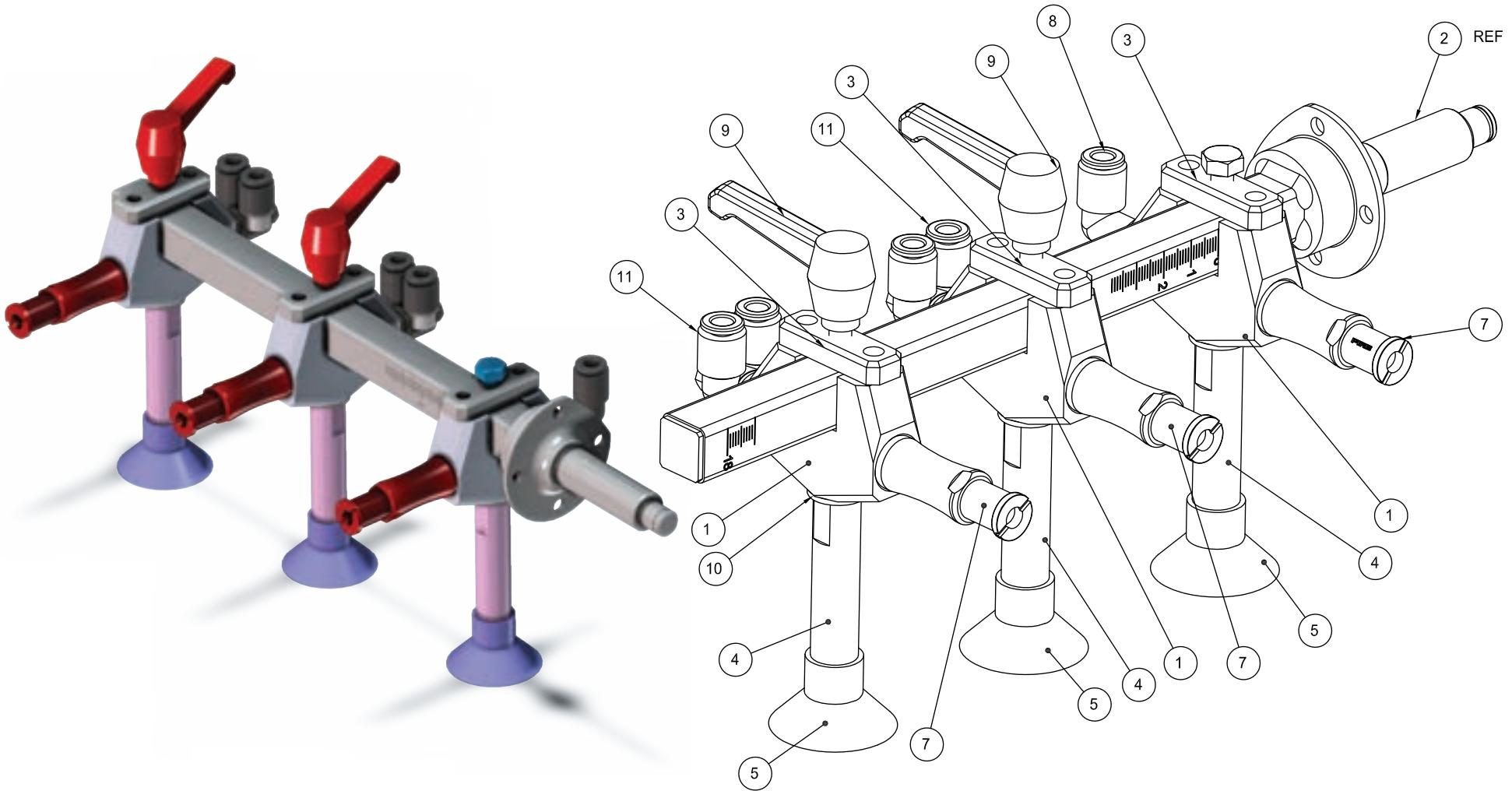


NOTE: ASSEMBLE AS SHOWN FOR MIDDLE ARM
REVERSE ITEM 7 ORIENTATION FOR OUTER ARM



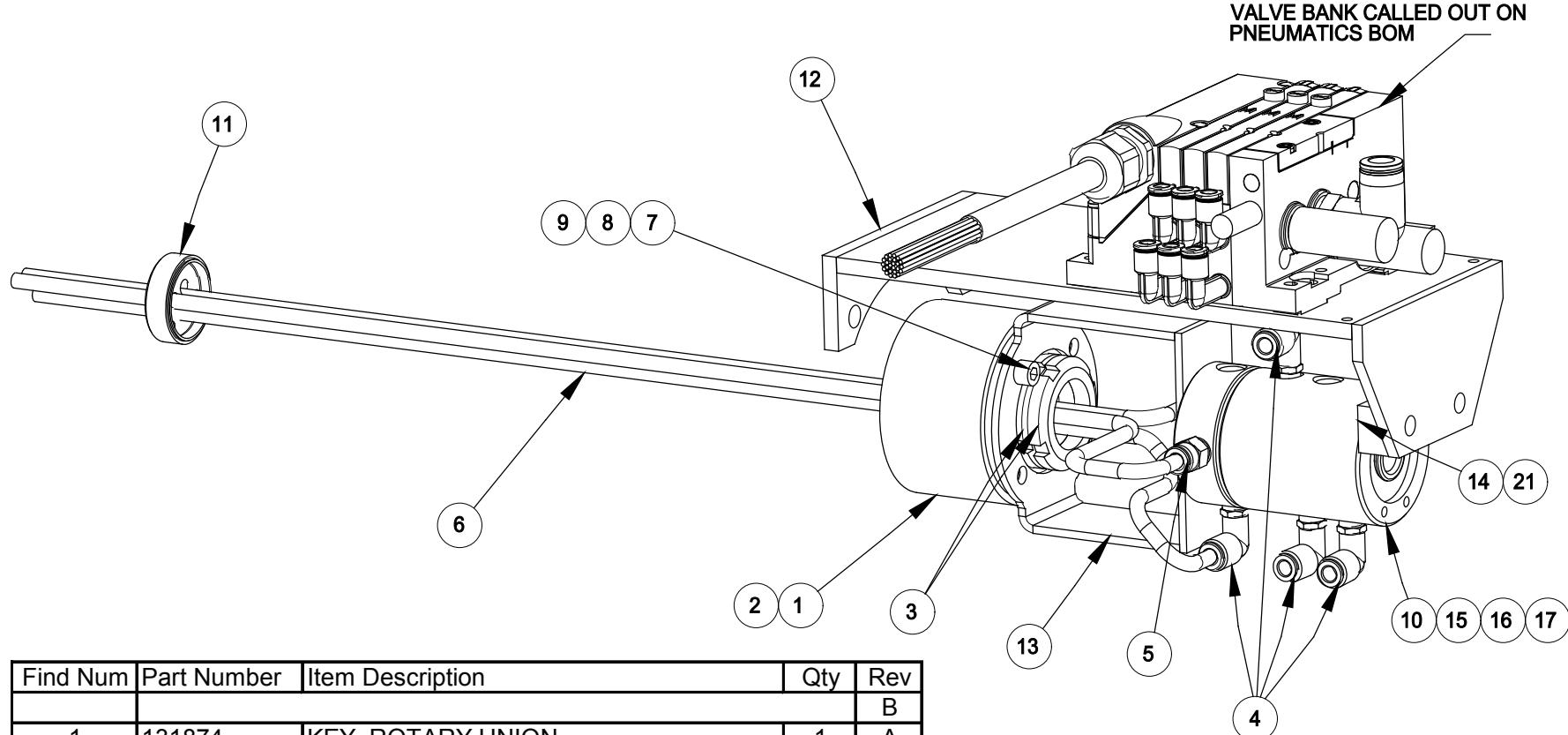
Find Num	Part Number	Item Description	Qty	Rev
		CELOX		B
1	4176-521-003	FEED BAR MOUNTING LINK	1	B
2	140767	ROCKER SHAFT, ADJUSTABLE FEED BAR, 12" MID-RANGE	1	A
3	X1510258	STS EXTERNAL CIRCLIP - 12MM	1	B
4	X1510248	STS INTERNAL CIRCLIP	2	A
5	X0600021	BAL-Ball	1	A
6	X0600035	BAL-Ball	1	B
7	4176-521-009	PIN - SMALL END - MIDDLE	1	C
8	X1370306	NUT-Nut	2	A
9	4176-521-015	WASHER - BEARING ABUTMENT - 606	1	A
10	4176-521-010	WASHER - SPREADER	1	A
50	FS	M5x12 SS SHCS	4	-
51	FS	M4x10 SS DOWEL PIN	1	-

**LINK ASSEMBLY WITH PIAB
FEED BAR - OUTER ARM
140765**



Find Num	Part Number	Item Description	Qty	Rev
				F
1	137079	VACUUM HOUSING, SMALL ADJUSTABLE	3	C
2	131912	ROCKER SHAFT, ADJUSTABLE FEED BAR	REF	D
3	137080	TOP COVER PLATE, SMALL	3	A
4	137078	ALUM FEED STEM, ADJUSTABLE, CELOX 9"	3	A
5	128565	VCP-Vacuum Cup	3	C
7	131872	PMP-Pump	3	A
8	057137P	CON-Connector	1	B
9	157581	HAN-Handle	2	A
10	FS	10 X 16 X 1.5MM FLAT WASHER	3	-
11	062167	FST-Fastener	2	-

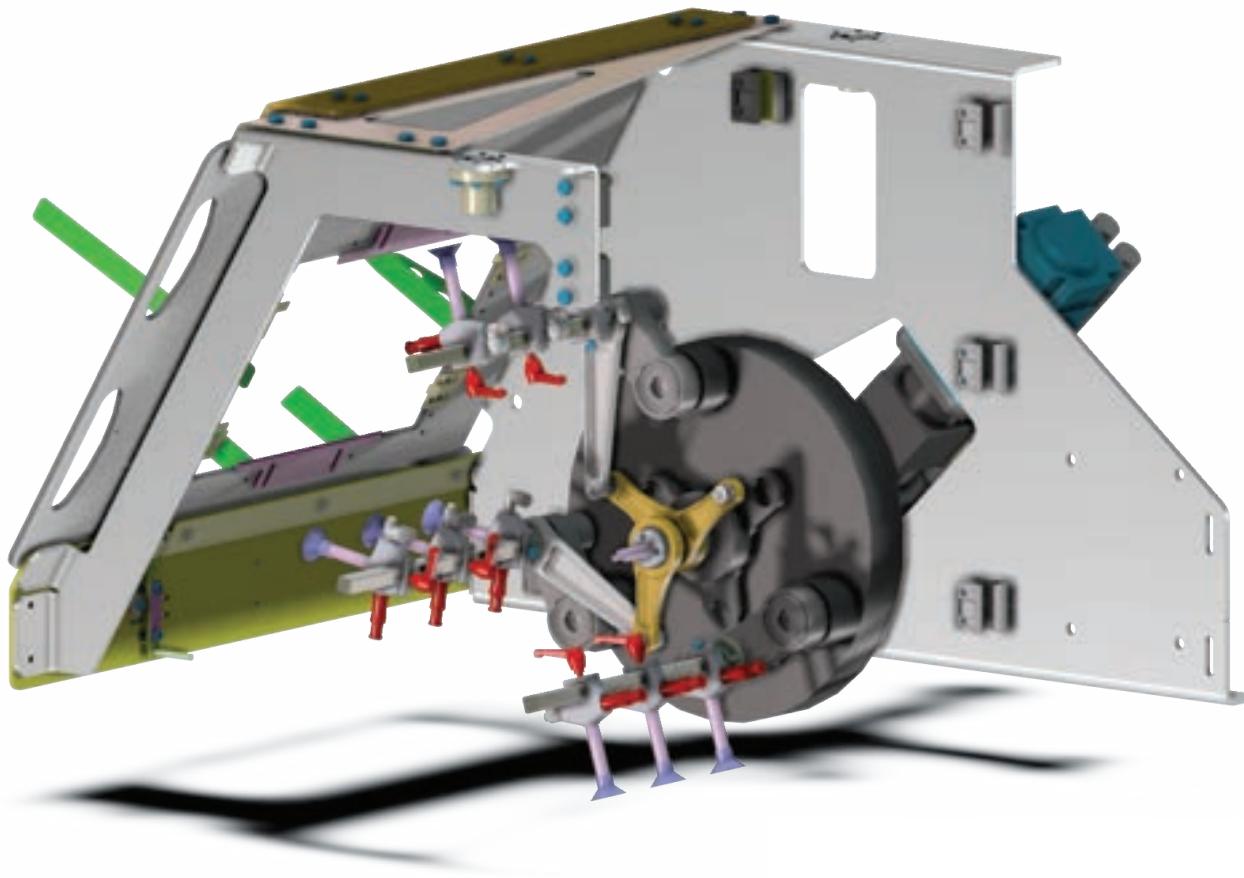
**FEED BAR ASSEMBLY
ADJUSTABLE CUPS
131915**



Find Num	Part Number	Item Description	Qty	Rev
				B
1	131874	KEY, ROTARY UNION VALVE ASSEMBLY	1	A
2	131820	COLLAR, GEARBOX	1	A
3	114609	LKN-Locknut	2	A
4	057137P	CON-Connector	4	B
5	058033	CON-Connector	2	-
6	FS	6mm TUBE	9	-
7	FS	1/4 STN STL LOCKWASER	4	-
8	FS	1/4 STN STL FLAT WASHER	4	-
9	FS	1/4-20 X 3/4 LG STN STL SOC HD BOLT	4	-
10	132142	VAL-Valve	1	A
11	131867	TUBE CAP	1	C
12	131817	ADAPTER BRACKET, ROTARY UNION	1	C
13	132140	BRACKET, ROTARY UNION MTG	1	A
14	132144	ADAPTER, ANTI-ROTATION	1	B
15	FS	#10 STN STL LOCKWASHER	4	-
16	FS	#10 STN STL FLAT WASHER	4	-
17	FS	#10-24 X 3/4 LG STN STL HEX HD BOLT	4	-
18	P0042070	FTG-Fitting	2	-
21	FS	#10-24 X 3/4 LG STN STL SET SCREW	1	-



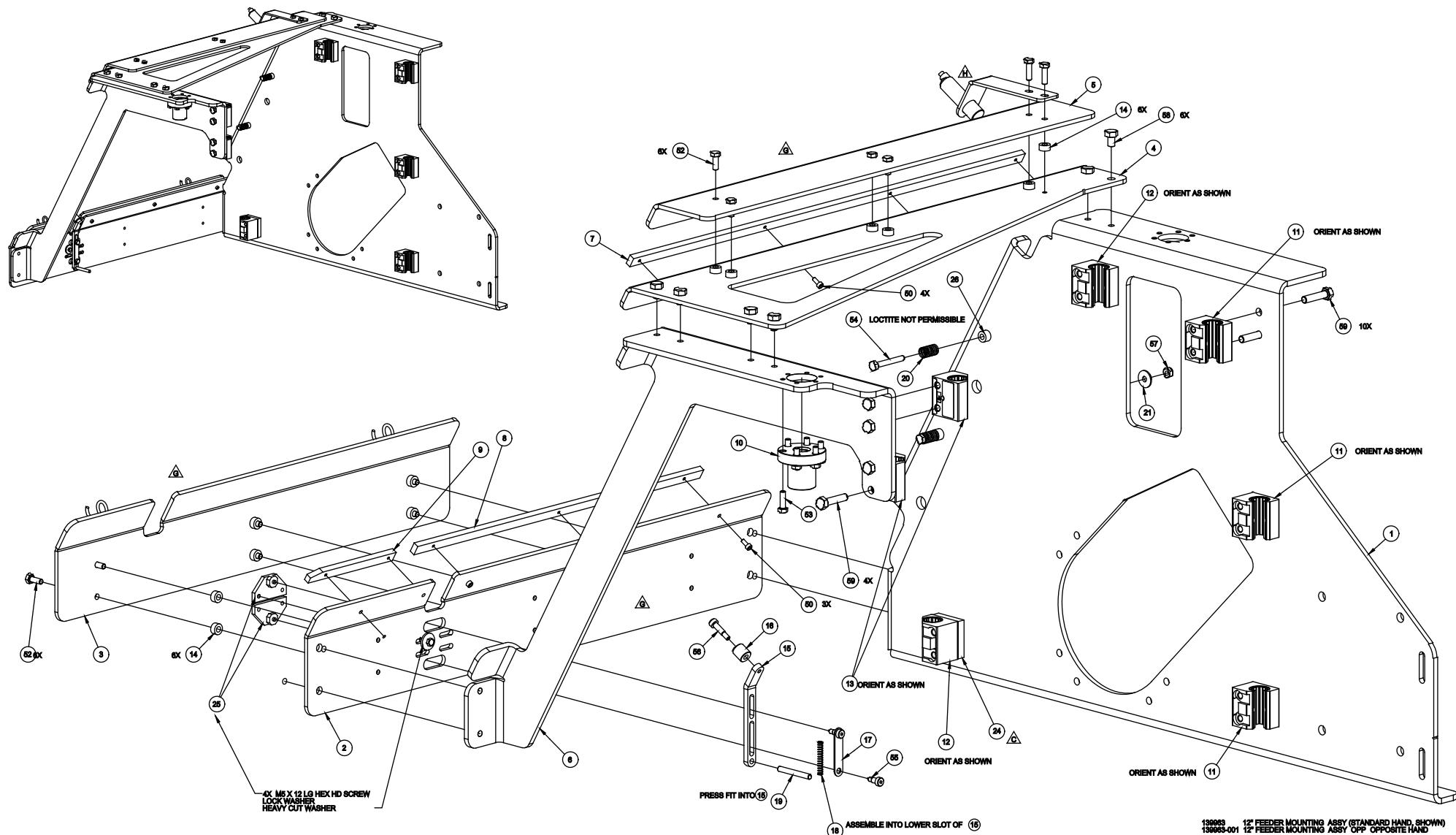
**ROTARY UNION ASSEMBLY
MID-RANGE, LESS SOL VALVES
142796**



**SHEET 1 OF 3
12" FEEDER
MOUNTING ASSEMBLY
139963**

Find Num	Part Number	Item Description	Qty	Rev
				H
1	140295	FEEDER MOUNTING PLATE, 12"	1	C
2	140297	GUIDE, GATE	1	D
3	140298	GUIDE, GATE	1	D
4	140299	GUIDE, GATE, TOP	1	C
5	140300	GUIDE, GATE, TOP	1	B
6	140296	FEEDER MOUNTING PLATE, 12"	1	D
7	140301	GUIDE, GATE, SPACER	1	A
8	140353	GUIDE, GATE, SPACER	1	A
9	140354	GUIDE, GATE, SPACER	1	B
10	139691	NUT-Nut	2	A
11	132484	BLN-Bearing, Linear	3	A
12	140514	BLN-Bearing, Linear	2	A
13	140516	BLN-Bearing, Linear	2	A
14	B400501200250	SPACER;	12	-
15	140305	BRACKET, GATE LOCK	1	B
16	140306	ROLLER - GATE LOCK ARM	1	A
17	140307	SPRING COVER, GATE LOCK	1	A
18	140311	SPR-Spring	1	A
19	140313	PIN-Pin	1	A
22	143830	SPR-Spring	2	A
23	MST456	THICK WASHER, M6 ST STEEL	2	B
24	144213	SPACER, IGUS BLOCK	1	A
25	147656	NUT, LATCH ADJUSTING	2	A
26	B14S05002503134	SPCR, .50 OD, .25 ID X .31 LG	2	A
27	167935	BRACKET, SENSOR, GATE PRESENT	1	A
50	FS	M4x10 SS SHCS	9	-
51	FS	M5 SS NUT	2	-
52	FS	M6x16 SS HHB	12	-
53	FS	M6x20 SS HHB	14	-
54	FS	M6x45 SS HHB	2	-
55	FS	M6x8 SS SH SHLDR BOLT	2	-
56	FS	M6x16 SS SH SHLDR BOLT	1	-
57	FS	M6 SS NYLOC NUT	2	-
58	FS	M8x12 SS HHB	10	-
59	FS	M8x35 SS HHB	14	-

**SHEET 2 OF 3
12" FEEDER
MOUNTING ASSEMBLY
139963**



**SHEET 3 OF 3
12" FEEDER
MOUNTING ASSEMBLY
139963**

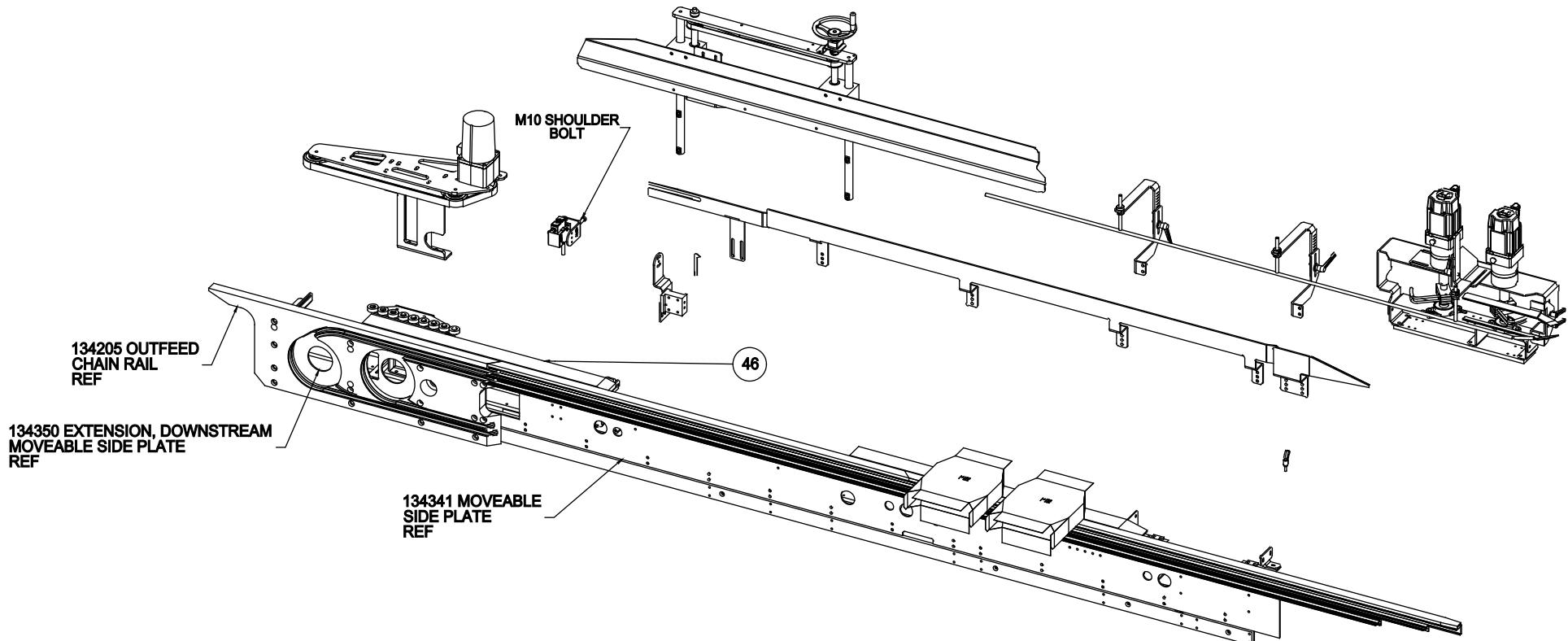
SHEET 1 OF 4
ASSEMBLY, NON-LOADSIDE FLAP
CONTROL, ADJUSTABLE OFFSET
168248

Find Num	Part Number	Item Description	Qty	Rev
1	168266	TUCKER ASSY	1	B
2	168345	GUIDE, TUCKER		REF A
3	168348	BRACKET, GUIDE, TUCKER		REF A
4	168267	GUIDE, PLOW UP	1	B
5	168249	BRACKET, DROP RAIL MTG, ENTERPRISE	1	A
6	168250	BRACKET, DROP RAIL MTG, ENTERPRISE	5	A
7	168250-001	BRACKET, DROP RAIL MTG, ENTERPRISE, OPP	1	A
8	168251	BEAM, BEARING MTG, DROP RAIL, ENTERPRISE	1	B
9	168265	ASSEM, DOWNSTREAM OVERHEAD GUIDES, NON-LOADSIDE	1	B
10	168271	ASSEMBLY, NLS UPSTREAM OVERHEAD GUIDE	1	E
11	168306	COMPRESSION ROLLER ASSEM, NON-LOAD SIDE	1	A
12	168287	OUTFEED BELT ASSEMBLY, NON-LOADSIDE	1	A
13	168253	BEARING SHAFT, BEARING MTG, DROP RAIL, ENTERPRISE	2	A
14	168278	BRACKET, DROP RAIL MTG, ENTERPRISE	1	A
15	170597	MOD TO - 168261 BLN IGU RJUI-11-16 HOUSED BEARING	2	A
16	168260	BEAM, DROP RAIL, ENTERPRISE	1	B
17	168264	MOUNT, DOWNSTREAM OH GUIDE	2	B
18	168268	GUIDE, LOWER MAJOR NON-LOAD. FLAT	1	A
19	168270	BRACKET, CARTON CONTROL MTG	6	A
20	168371	SQUARE SHAFT, BEARING MTG, DROP RAIL, ENTERPRISE	4	A
21	168283	BLOCK, GUIDE MTG, NON-LOAD	1	A
22	168284	BRACKET, GLUE GUN MTG, PIE CARTON	1	B
23	139833	POINTER, GLUE GUIDE AND GUN ANGLE	1	B
24	139753	GLUE GUIDE, NON LOAD SIDE	1	E
25	139677	GUN-Gun		REF B
26	161182	BRACKET, GLUE GUN HEIGHT ADJUSTING	1	A
27	161180	PIVOT BRACKET, GLUE GUN MTG, NON-LOAD	1	
28	B32100344125	SS WASHER; 1.00" OD, 0.344" ID, 0.125" THK	3	A
29	FS	M10x50		REF -
30	FS	5/16 FLAT WASHER		REF -
31	168311	BRACKET, COMP ROLLER MTG	1	A
32	168324	MOUNTING BKT, TUCK SERVOS, PIE CARTON	2	B
35	P0018047	STC-Set Collar	4	A
36	159373	HAN-Handle	5	A
37	168262	BLN-Bearing, Linear	2	A
38	168381	BRACE, CANTILEVER ROD	4	A
39	168905	BRACKET , ADJUSTMENT LOCK	2	B
40	170649	UPSTREAM BRACE PLATE	1	A
41	170650	UPSTREAM BRACE TAB	1	A
42	168873	7MM SLOT NUT, SPECIAL, M6 TAPPED	1	A
43	170651	MIDSTREAM BRACE TAB	2	A
44	170655	DOWNSTREAM BRACE TAB	1	B
45	170624	SPACE BLOCK, DOUBLE TUCKER	2	A
46	170792	KIT, LOWER SUPPORTS, PIE CARTON	1	B
47	170919	BRACE, DOWNSTREAM TUCKER	2	A

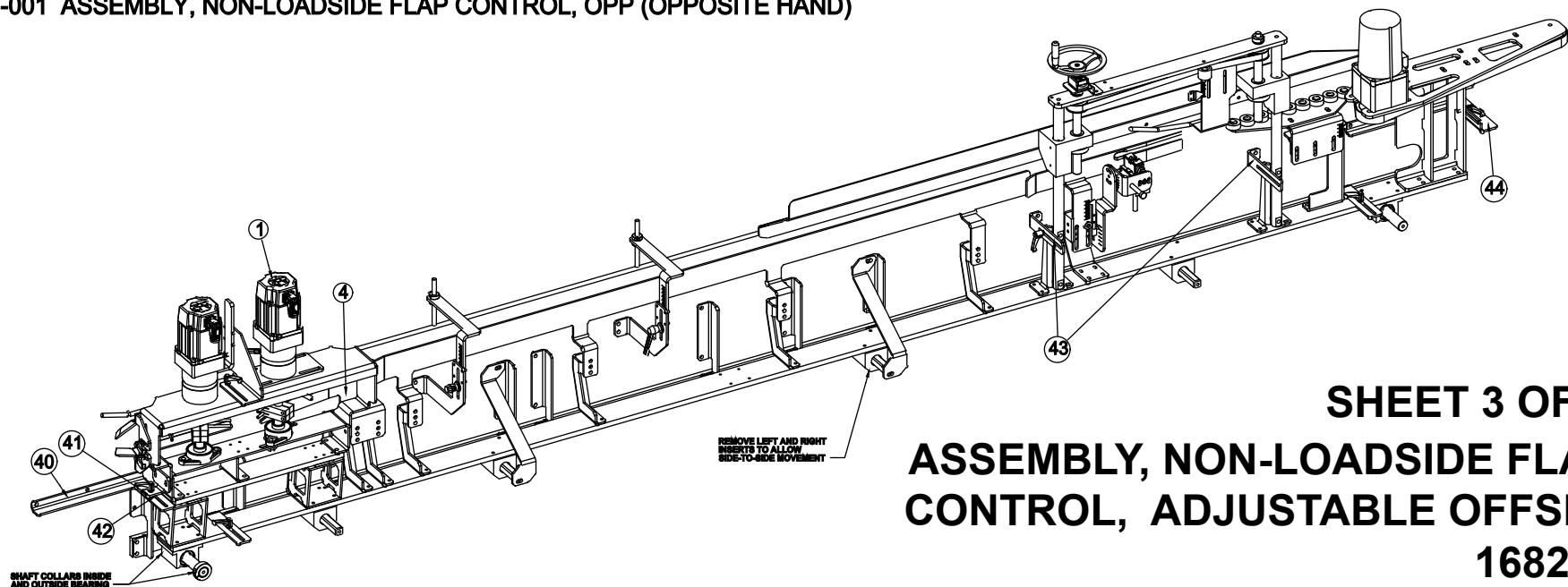
SHEET 2 OF 4

**ASSEMBLY, NON-LOADSIDE FLAP
CONTROL, ADJUSTABLE OFFSET**

168248

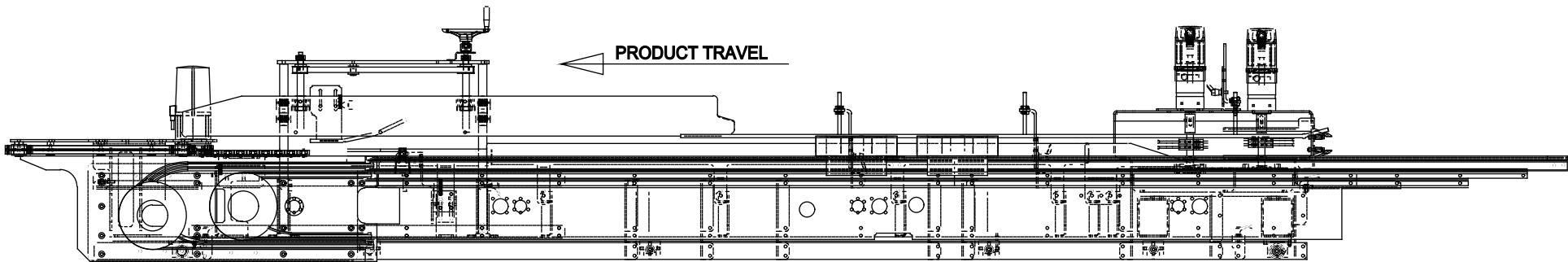


168248 ASSEMBLY, NON-LOADSIDE FLAP CONTROL (STANDARD HAND, SHOWN)
168248-001 ASSEMBLY, NON-LOADSIDE FLAP CONTROL, OPP (OPPOSITE HAND)

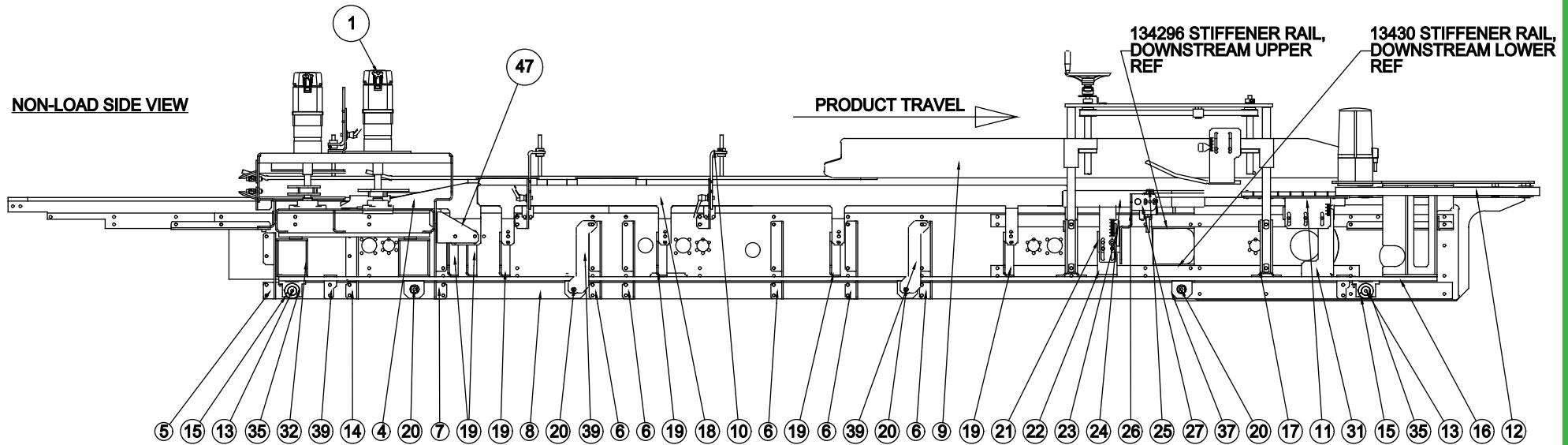


SHEET 3 OF 4
ASSEMBLY, NON-LOADSIDE FLAP
CONTROL, ADJUSTABLE OFFSET
168248

LOAD SIDE VIEW

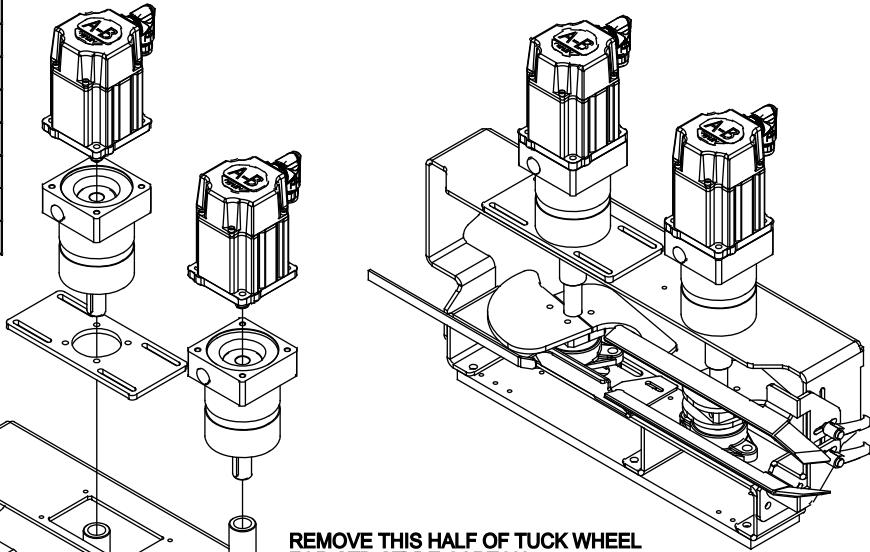
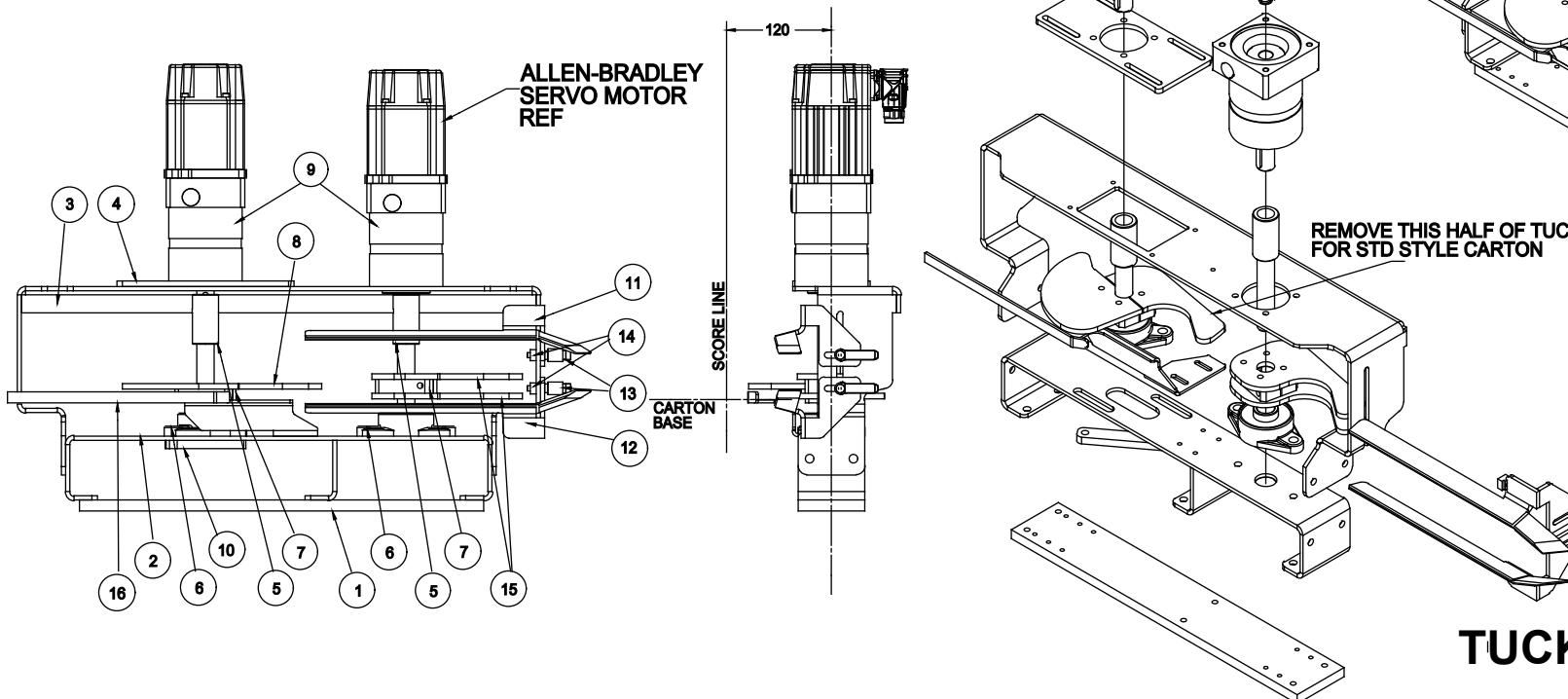


NON-LOAD SIDE VIEW



**SHEET 4 OF 4
ASSEMBLY, NON-LOADSIDE FLAP
CONTROL, ADJUSTABLE OFFSET
168248**

Find Num	Part Number	Item Description	Qty	Rev
1	168323	MOUNTING BEAM, TUCK SERVOS, PIE CARTON	1	B
2	168316	BRACKET, HAT SECTION. ENTERPRISE TUCK	1	A
3	168320	MOUNT, TUCKER SERVO MOTOR	1	A
4	168817	SLIDE PLATE, SERVO MTG	1	A
5	168338	SHAFT, TUCKER	2	A
6	121201	BFL-Bearing, Flange	2	B
7	170803	CLAMP BLOCK, TUCKER	2	B
8	170801	TUCKER DISC, OCTAGON CARTON	1	E
9	110153	RDC-Reducer	2	D
10	168881	NUT BAR, SPECIAL, 90MM	1	A
11	168832	FLAP PLOW, PIE CARTON, UPPER	1	A
12	168832-001	FLAP PLOW, PIE CARTON, UPPER, OPP	1	A
13	159373	HAN-Handle	3	A
14	168873	7MM SLOT NUT, SPECIAL, M6 TAPPED	2	A
15	170869	UPSTREAM TUCKER DISC, OCTAGON CARTON	2	A
16	170782	GUIDE, LOWER MAJOR PLOW	1	C



**TUCKER ASSEMBLY
168266**

SHEET 1 OF 3
ASSEMBLY, DOWNSTREAM OVERHEAD
GUIDES, NON-LOADSIDE
168265

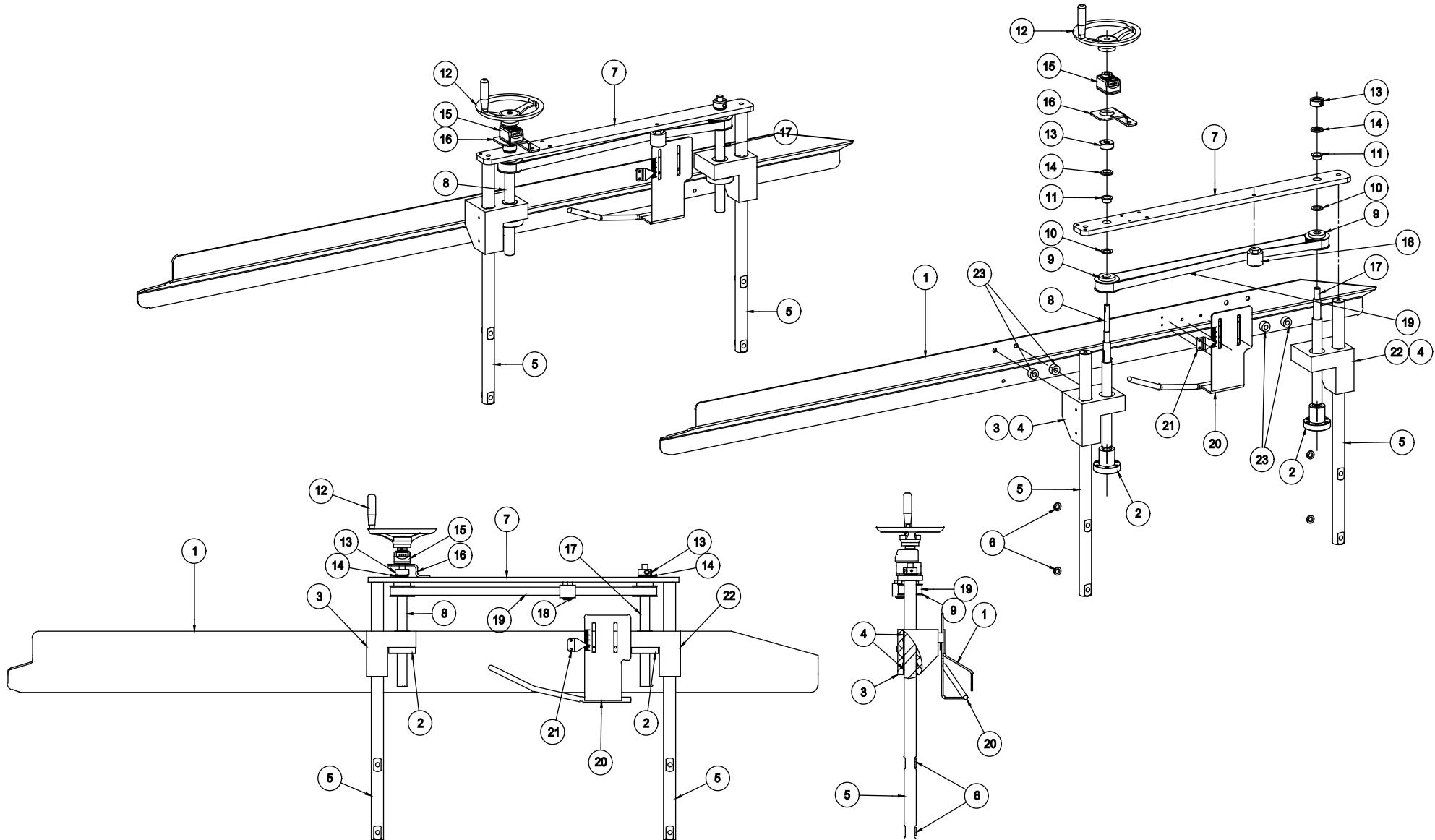
Find Num	Part Number	Item Description	Qty	Rev
				B
1	139675	GUIDE, OVERHEAD DOWNSTREAM, NL	1	C
2	139691	NUT-Nut	2	A
3	139693	MTG BLOCK, OVERHEAD GUIDE	1	D
4	139700	BSH-Bushing	4	A
5	139703	ROD, OVERHEAD GUIDE MTG	2	B
6	B400621200125	SPACER;	4	-
7	139712	BAR, TOP CONNECTION	1	B
8	139713	SHAFT, OVERHEAD ADJUSTING HANDWHEEL	1	A
9	139714	MODIFICATION, PULLEY 30 TEETH T5	2	A
10	139715	WSH-Washer	2	A
11	126351	BSH-Bushing	2	A
12	130559	SS 140MM HANDWHEEL, FIXED HANDLE, 10MM KEYED HOLE	1	A
13	139837	STC-Set Collar	2	A
14	139718	WASHER, BUSHING SUPPORT	2	A
15	139738	COT-Counter	1	A
16	139741	BRACKET, COUNTER MTG, OVERHEAD	1	B
17	139742	SHAFT, OVERHEAD ADJUSTING, DRIVEN	1	A
18	120093	TENSIONER ASSY	1	A
19	139745	BLT-Belt	1	A
20	139847	PLOW DOWN GUIDE, NON-LOAD SIDE	1	F
21	139857	POINTER, PLOW	1	A
22	139693-001	MTG BLOCK, OVERHEAD GUIDE, OPP HAND	1	D
23	B14S07503404384	SPACER;	4	-

168265 ASSEM, DOWNSTREAM OVERHEAD GUIDE (STANDARD HAND, SHOWN)
 168265-001 ASSEM, DOWNSTREAM OVERHEAD GUIDE, OPP (OPPOSITE HAND)

SHEET 2 OF 3

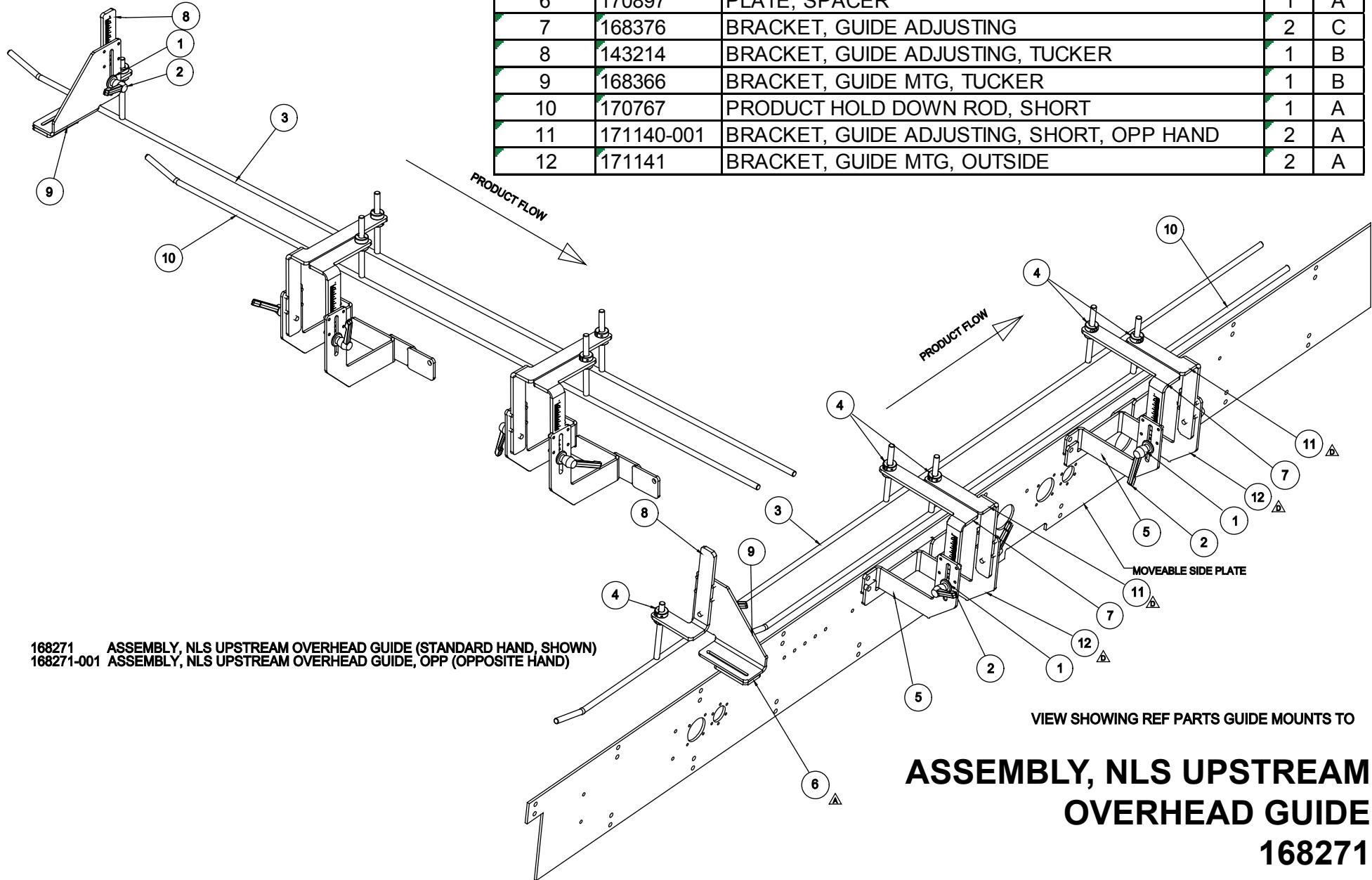
**ASSEMBLY, DOWNSTREAM OVERHEAD
 GUIDES, NON-LOADSIDE**

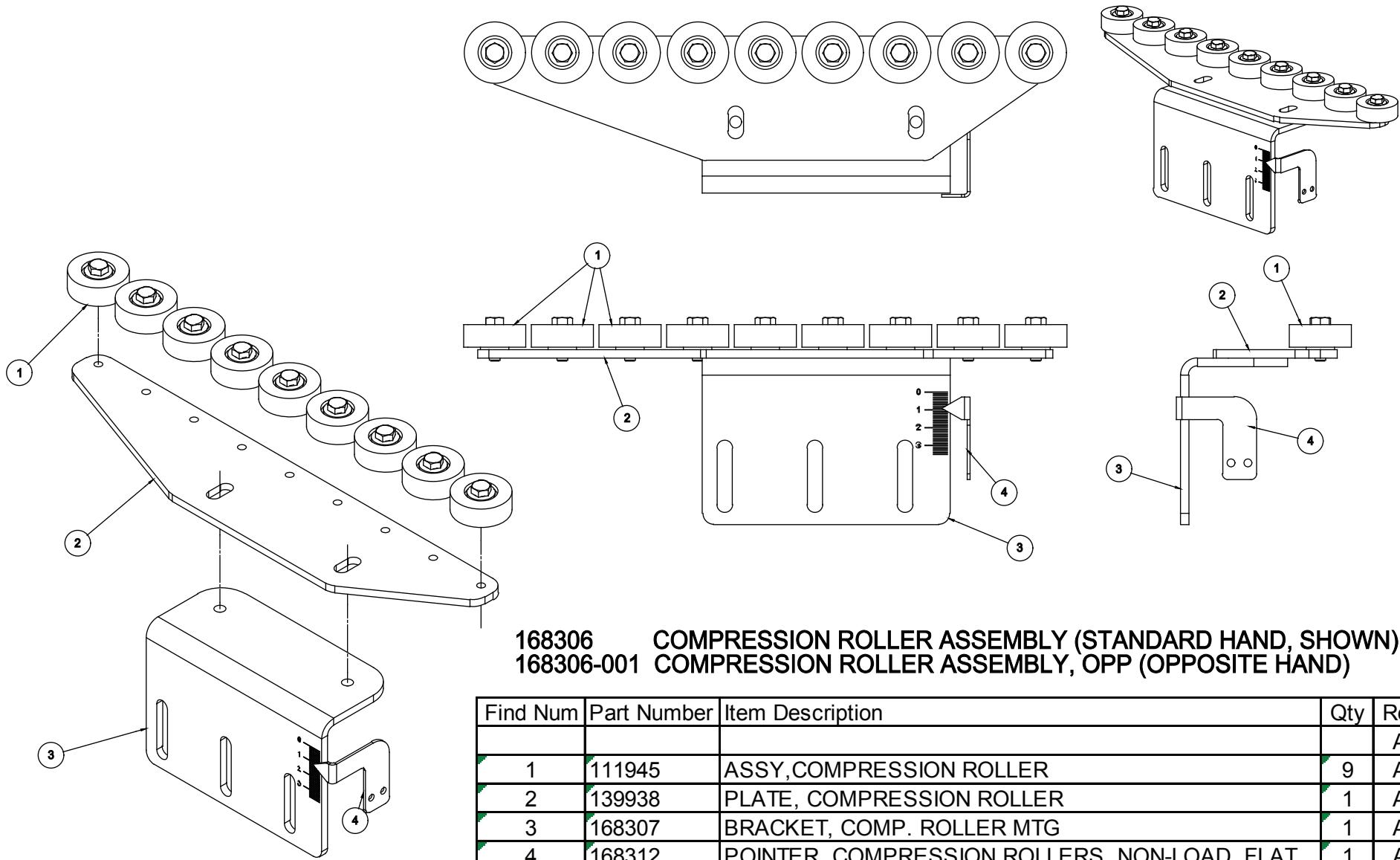
168265



SHEET 3 OF 3
ASSEMBLY, DOWNSTREAM OVERHEAD
GUIDES, NON-LOADSIDE
168265

Find Num	Part Number	Item Description	Qty	Rev
1	B08B	WASHER;	3	E
2	065623	HAN-Handle	5	B
3	140737	PRODUCT HOLD DOWN ROD	1	B
4	098267	STC-Set Collar	10	A
5	168364	BRACKET, GUIDE MTG, UPSTREAM	2	B
6	170897	PLATE, SPACER	1	A
7	168376	BRACKET, GUIDE ADJUSTING	2	C
8	143214	BRACKET, GUIDE ADJUSTING, TUCKER	1	B
9	168366	BRACKET, GUIDE MTG, TUCKER	1	B
10	170767	PRODUCT HOLD DOWN ROD, SHORT	1	A
11	171140-001	BRACKET, GUIDE ADJUSTING, SHORT, OPP HAND	2	A
12	171141	BRACKET, GUIDE MTG, OUTSIDE	2	A

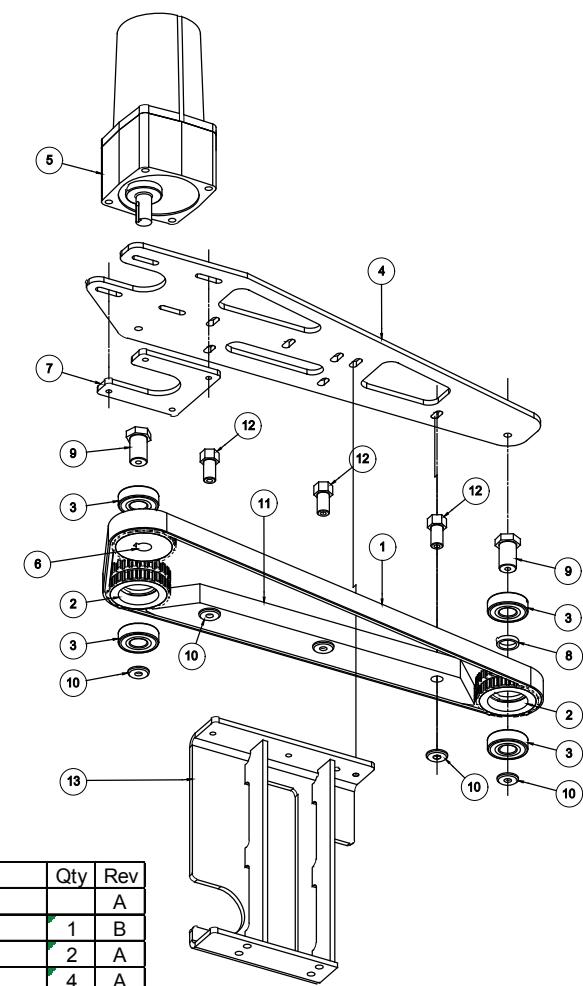
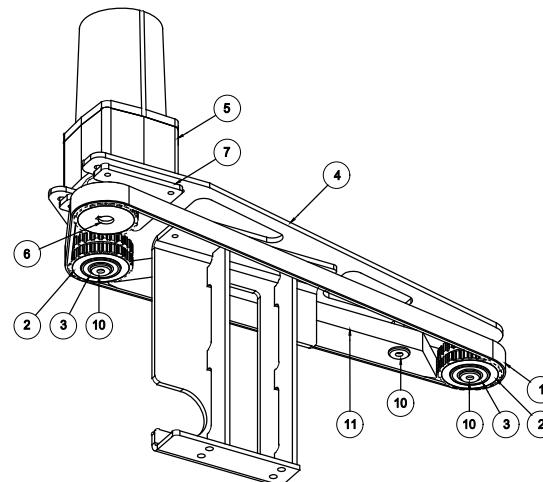
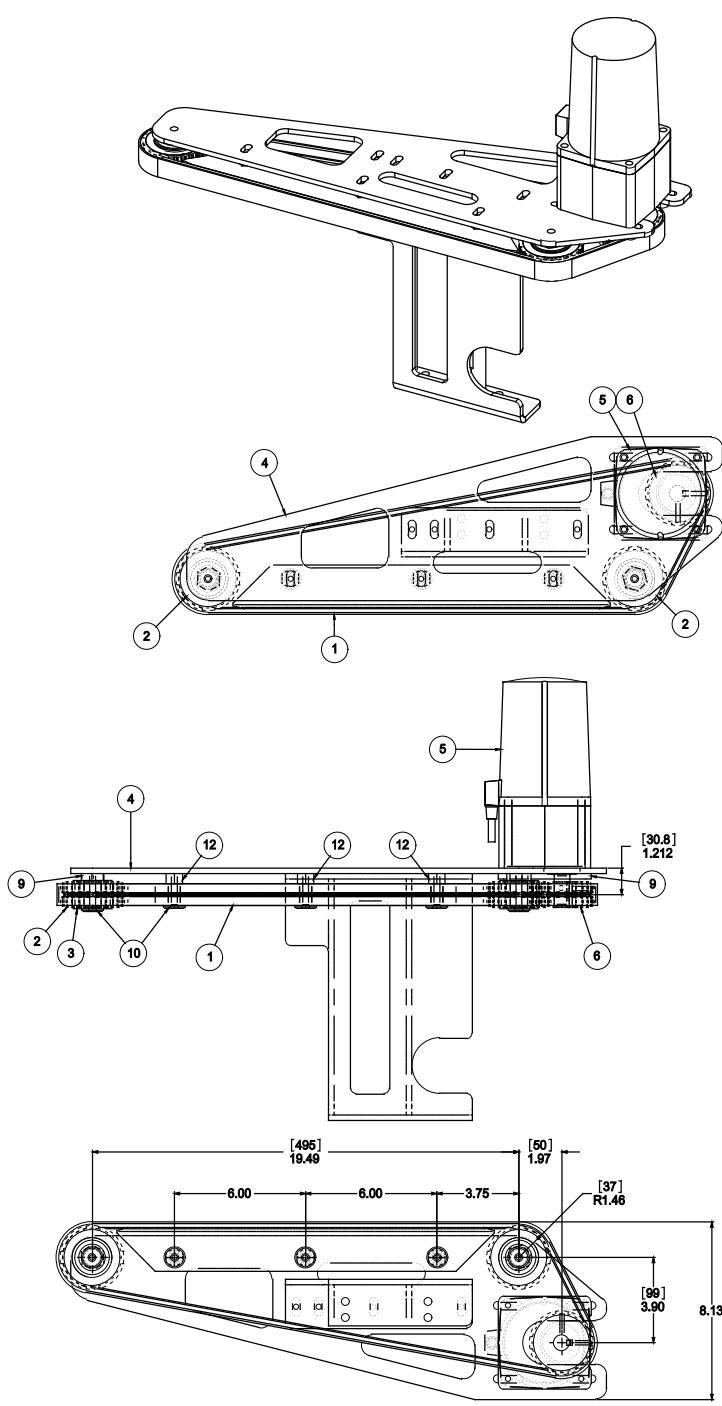




168306 COMPRESSION ROLLER ASSEMBLY (STANDARD HAND, SHOWN)
 168306-001 COMPRESSION ROLLER ASSEMBLY, OPP (OPPOSITE HAND)

Find Num	Part Number	Item Description	Qty	Rev
				A
1	111945	ASSY, COMPRESSION ROLLER	9	A
2	139938	PLATE, COMPRESSION ROLLER	1	A
3	168307	BRACKET, COMP. ROLLER MTG	1	A
4	168312	POINTER, COMPRESSION ROLLERS, NON-LOAD, FLAT	1	A

**COMPRESSION ROLLER
ASSEMBLY, NON-LOAD SIDE
168306**



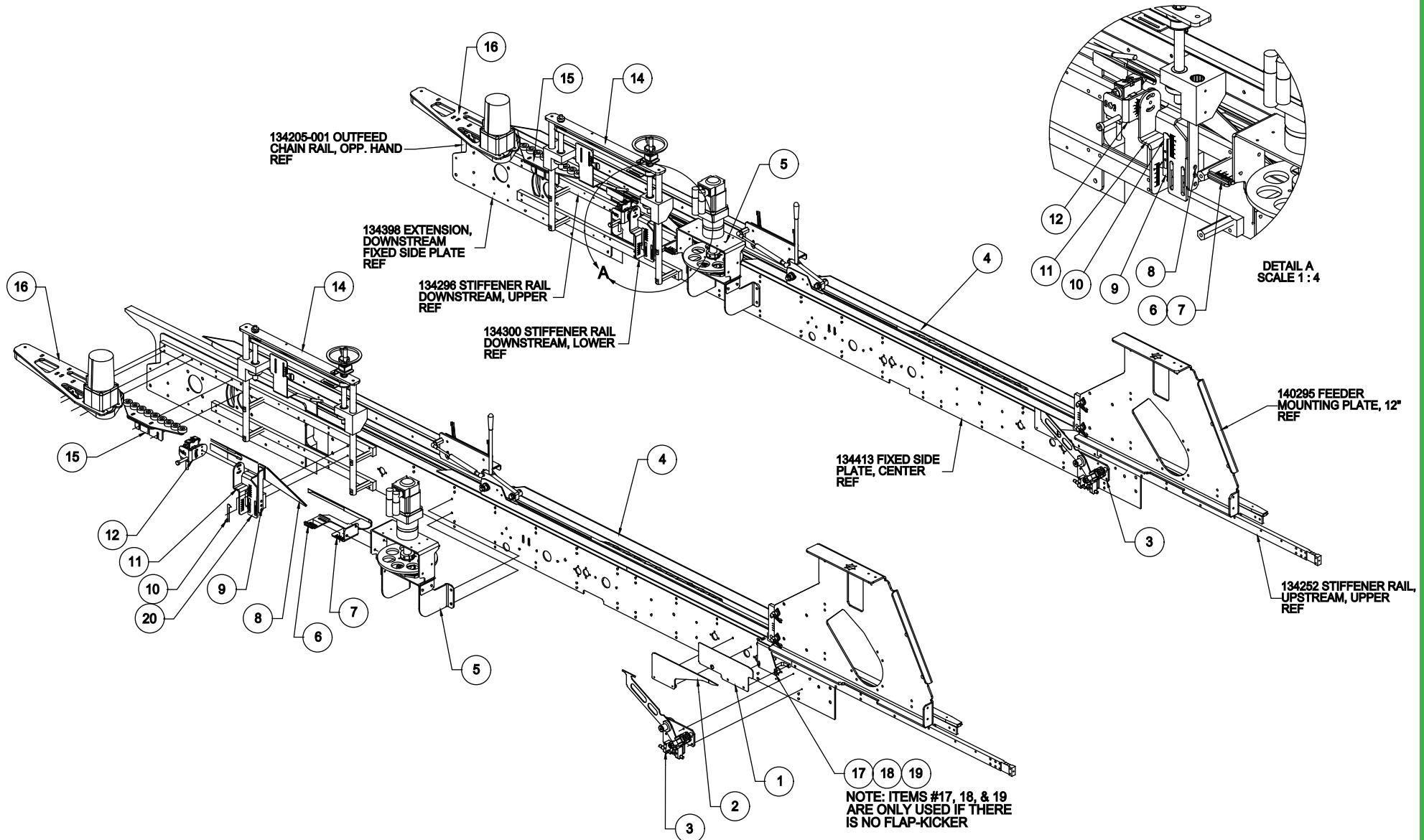
Find Num	Part Number	Item Description	Qty	Rev
1	140312	BLT-Belt	1	A
2	140316	PULLEY, IDLER, OUTFEED, MODIFIED	2	B
3	107862	BRG-Bearing	4	A
4	140320	PLATE, BASE, OUTFEED	1	A
5	112541	GMT-Gear Motor	REF	B
6	140330	DRIVE PULLEY, OUTFEED, MODIFIED	1	B
7	140331	NUT PLATE, MOTOR	1	A
8	140333	SPACER, BEARING	2	A
9	140334	SHAFT, IDLER	2	A
10	B32100344125	SS WASHER; 1.00" OD, 0.344" ID, 0.125" THK	5	A
11	140339	BACKSTOP, BELT	1	A
12	140340	SHAFT, BACKSTOP MTG	3	A
13	168295	BRACKET, BELT ASSEMBLY MTG	1	B

OUTFEED BELT ASSEMBLY NON-LOADSIDE 168287

**SHEET 1 OF 3
ASSEMBLY, LOADSIDE
FLAP CONTROL
140360**

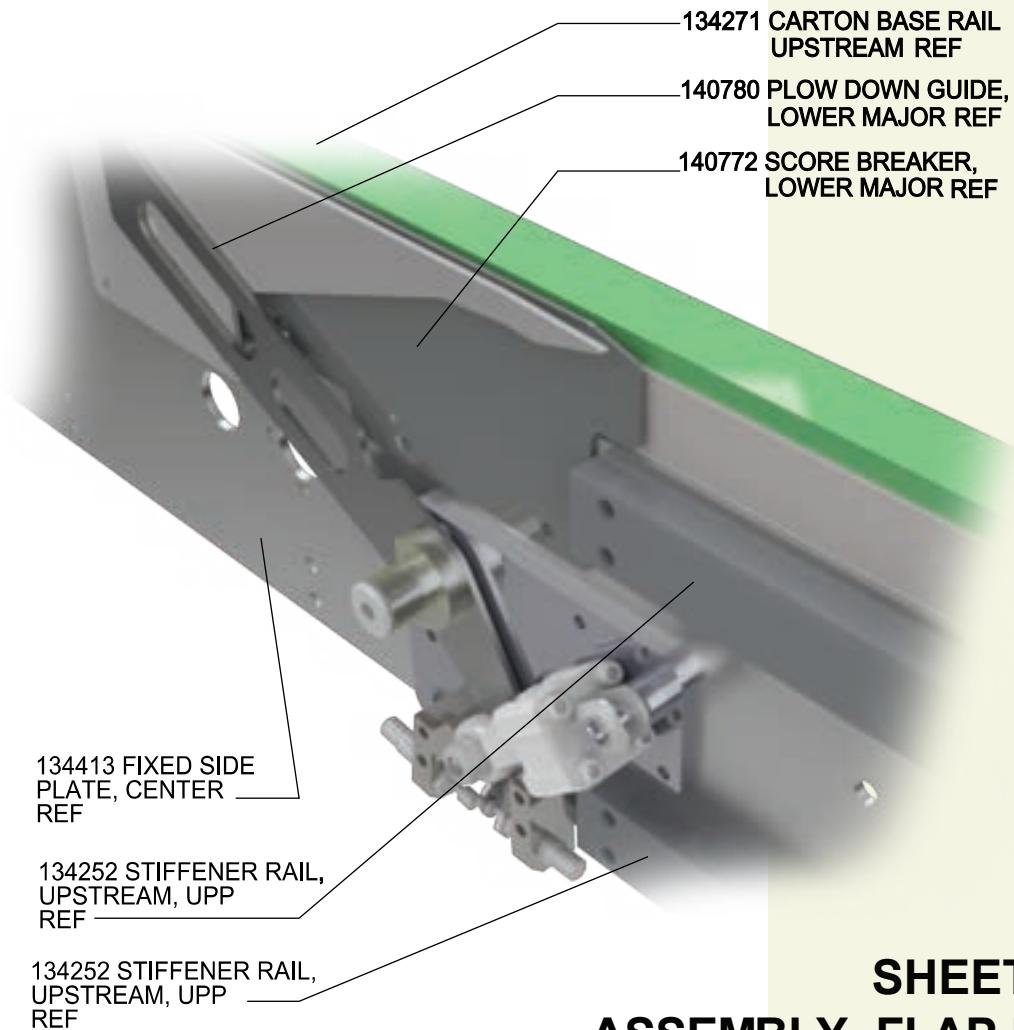
Find Num	Part Number	Item Description	Qty	Notes	Rev
					F
1	140772	SCORE BREAKER, LOWER MAJOR	1		B
2	140780	PLOW DOWN GUIDE, LOWER MAJOR	1		A
3	140795	ASSEMBLY, FLAP KICKER	REF		C
4	140630	ASSEMBLY, INSERTER OVERHEAD GUIDES	1		E
5	139608	TUCKER ASSY	1		B
6	139653-001	GUIDE, TUCKER, OPP HAND	1		E
7	139655-001	BRACKET, TUCKER GUIDE MTG, OPP HAND	1		A
8	140434	GUIDE, PLOUGH UP, LOAD SIDE	1		C
9	139756-001	BLOCK, GUIDE MTG, OPP-HAND (LOAD SIDE)	1		D
10	139833-001	POINTER, GLUE GUIDE AND GUN ANGLE, OPP HAND	1		B
11	161182-001	BRACKET, GLUE GUN HEIGHT ADJUSTING, OPP HAND	1		A
12	161324	PIVOT BRACKET, GLUE GUN MTG, LOAD SIDE	1		A
14	140375	ASSEM, DOWNSTREAM OVERHEAD GUIDES, LOADSIDE	1		C
15	140372	ASSEM, COMPRESSION ROLLER, LOAD SIDE	1		B
16	140361	ASSEM, OUTFEED BELT, LOADSIDE	1		B
17	140911	GUIDE, MINOR FLAP HOLD BACK	1	Only used without flap kicker, for cartons w key cut-outs	B
18	144185	SPACER, HOLD BACK MTG	1	Only used without flap kicker, for cartons w key cut-outs	C
19	140912	MOUNT, HOLD BACK	1	Only used without flap kicker, for cartons w key cut-outs	B
20	144575	GUIDE, GLUE, LOAD SIDE	1		C

SHEET 2 OF 3
ASSEMBLY, LOADSIDE
FLAP CONTROL
140360



SHEET 3 OF 3
**ASSEMBLY, LOADSIDE
FLAP CONTROL**
140360

140360 ASSEMBLY, LOADSIDE FLAP CONTROL (STANDARD HAND, SHOWN)
140360-001 ASSEMBLY, LOADSIDE FLAP CONTROL, OPP (OPPOSITE HAND)

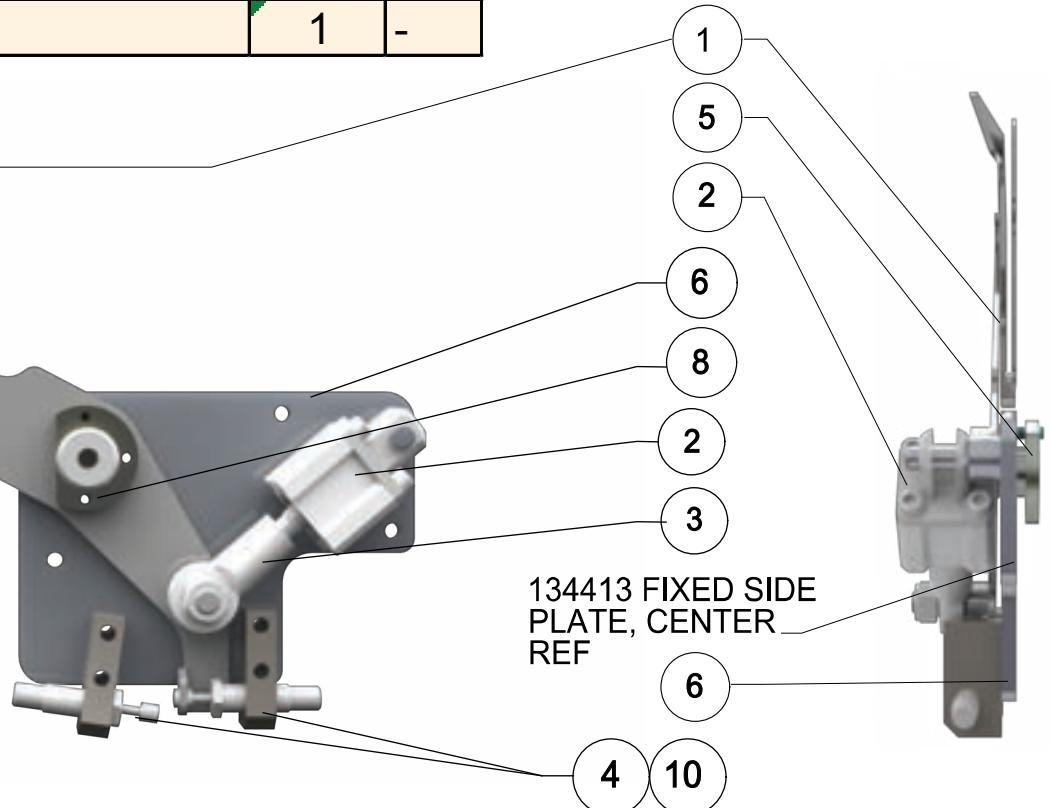


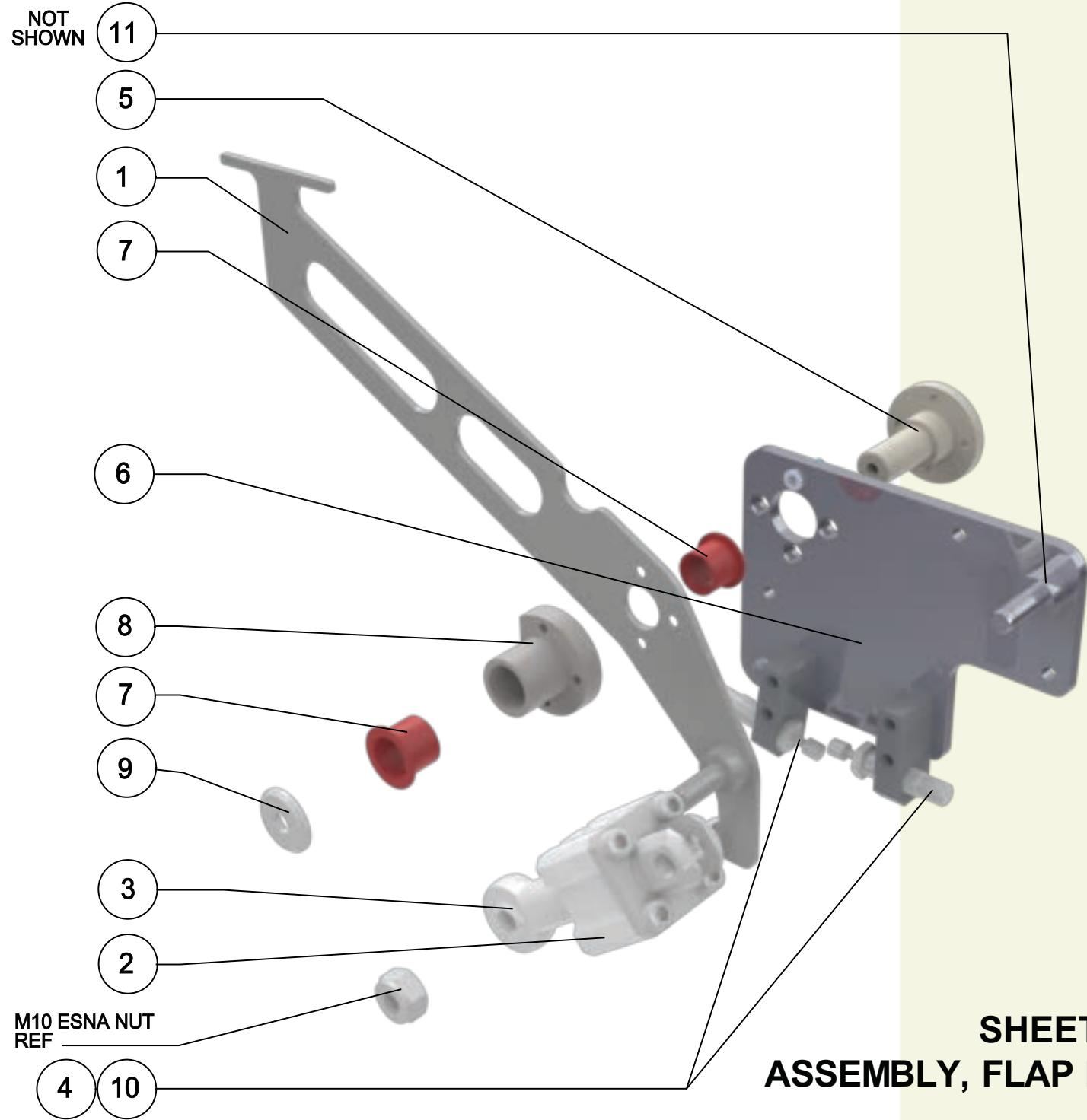
**SHEET 1 OF 3
ASSEMBLY, FLAP KICKER
140795**

Find Num	Part Number	Item Description	Qty	Rev
				C
1	140796	ARM, FLAP KICKER	1	B
2	140808	CYL-Cylinder	1	A
3	X0630159	ROD END BEARING	1	B
4	114577	SHA-Shock Absorber	2	A
5	140814	SHAFT, PIVOT, KICKER	1	A
6	140815	PLATE, KICKER MTG	1	A
7	126995	BSH-Bushing	2	A
8	140817	HUB, FLAP KICKER	1	B
9	B08B	WASHER;	1	-
10	140832	BLOCK, SHOCK MTG	2	A
11	076410	RNG-Ring	1	-

140795 FLAP KICKER ASSEMBLY
 (STANDARD HAND, SHOWN)
 140795-001 FLAP KICKER ASSEMBLY,
 OPP (OPPOSITE HAND)

SHEET 2 OF 3
ASSEMBLY, FLAP KICKER
140795





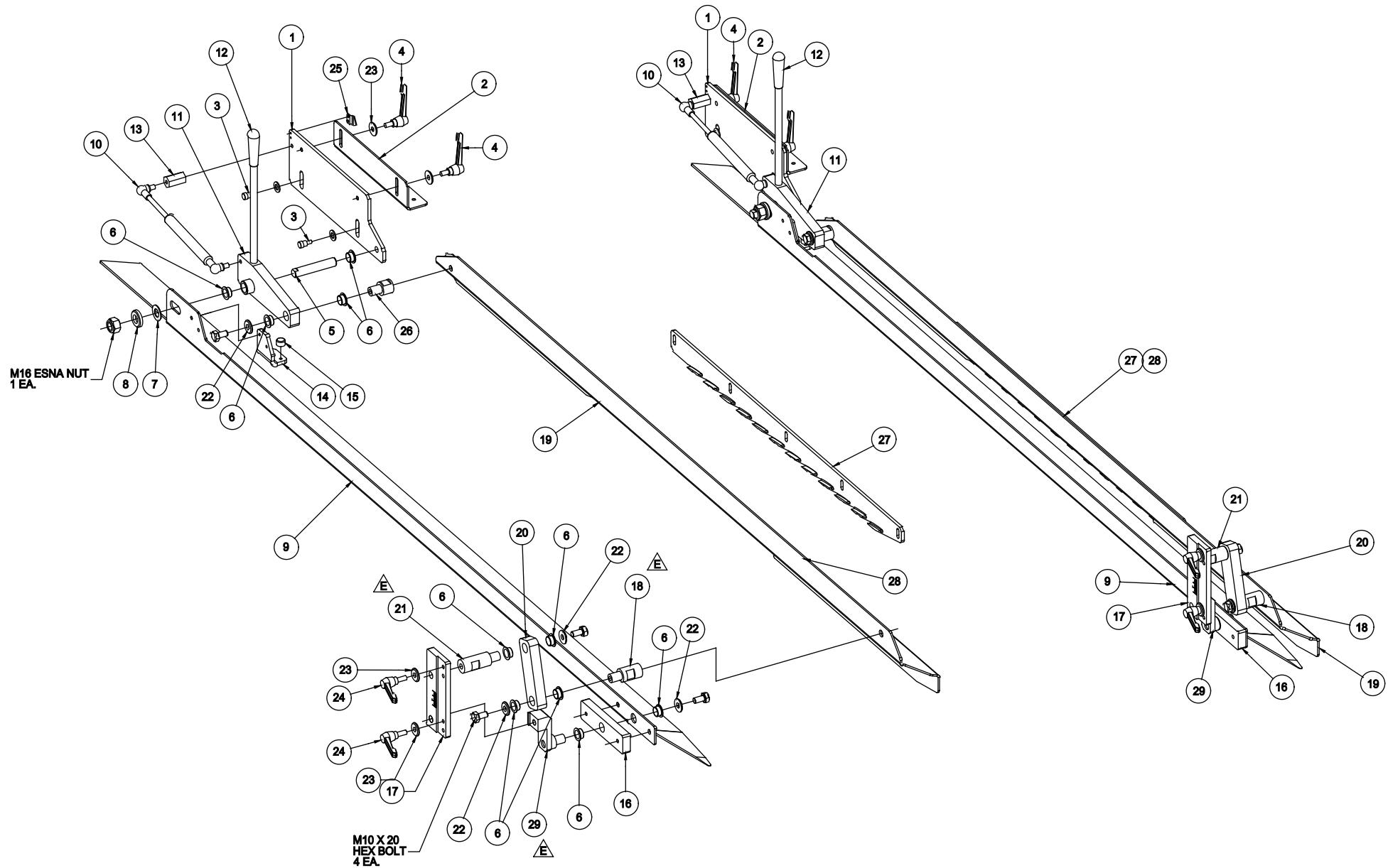
SHEET 3 OF 3
ASSEMBLY, FLAP KICKER
140795

**SHEET 1 OF 4
ASSEMBLY, INSERTER
OVERHEAD GUIDES
140630**

Find Num	Part Number	Item Description	Qty	Rev
				E
1	140627	PLATE, PIVOT MOUNT	1	A
2	140628	ANGLE BRACKET, GUIDE MTG	1	A
3	118147	SCR-Screw	2	A
4	073824	HAN-Handle	2	B
5	140645	PIVOT SHAFT	1	A
6	114576	BSH-Bushing	10	A
7	115292	WSH-Washer	1	A
8	B08T	WASHER;NX9408 KWF	1	-
9	140629	GUIDE, INSERTER UPPER FLAP	1	B
10	114582	CYL-Cylinder	1	A
11	140654	PIVOT WELDMENT, INSERTER OVERHEAD	1	B
12	119929	KNB-Knob	1	A
13	B78080137520	7/8" HEX SPACER, X 1.375" LG, M8 THRDS	1	A
14	140668	ANGLE, STOP MTG	1	B
15	120045	BMP-Bumper	1	B
16	140671	PLATE, UPSTREAM MTG	1	A
17	161001	PLATE, INSERTER GUIDE SHORT MTG	1	A
18	140676	PIVOT SHAFT, UPSTREAM	1	A
19	140681	GUIDE, OVERHEAD, UPSTREAM	1	C
20	119913	PIVOT ARM	1	A
21	140688	PIVOT SHAFT, UPSTREAM, LONG	1	A
22	B08C	WASHER;	4	-
23	B08B	WASHER;	4	-
24	065623	HAN-Handle	2	B
25	140703	POINTER, INSERTER OVERHEAD	1	A
26	140704	PIVOT SHAFT, DOWNSTREAM	1	A
27	145223	FINGERED HOLD DOWN, SCORELINE OVERHEAD	1	C
28	B14S03102502504	SPCR, 5/16 OD, 1/4 ID X 1/4" LG	5	A
29	161007	WELDMENT, UPSTREAM PIVOT	1	A

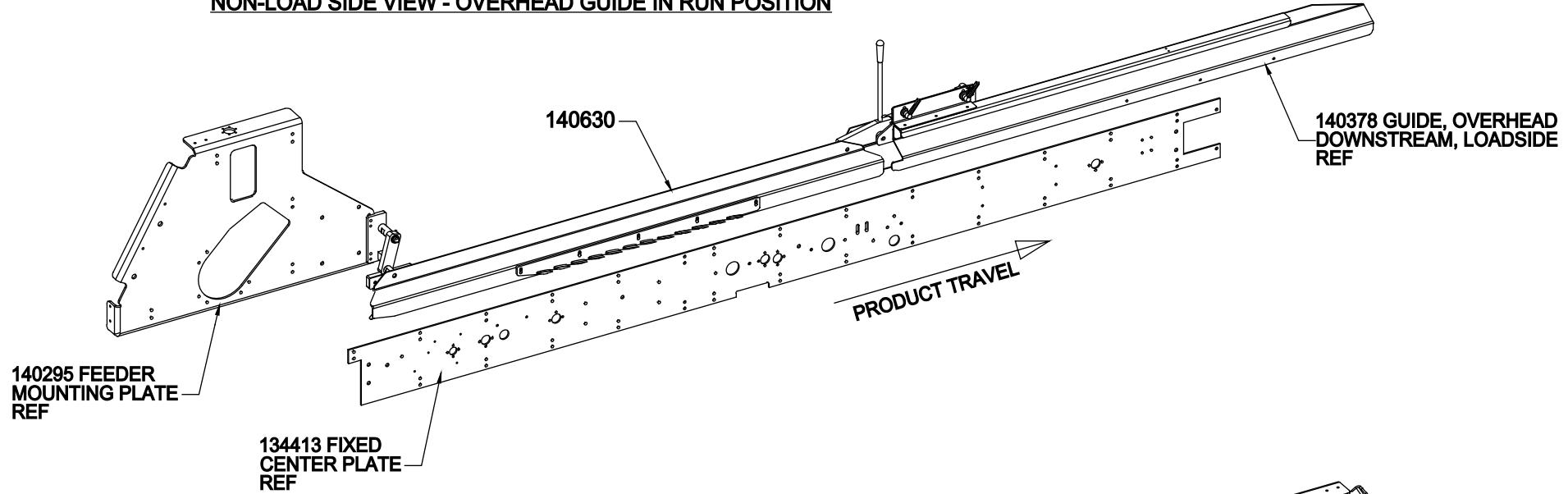
SHEET 2 OF 4
ASSEMBLY, INSERTER
OVERHEAD GUIDES
140630

140630 ASSEMBLY, INSERTER OVERHEAD GUIDES (STANDARD HAND, SHOWN)
 140630-001 ASSEMBLY, INSERTER OVERHEAD GUIDES, OPP (OPPOSITE HAND)

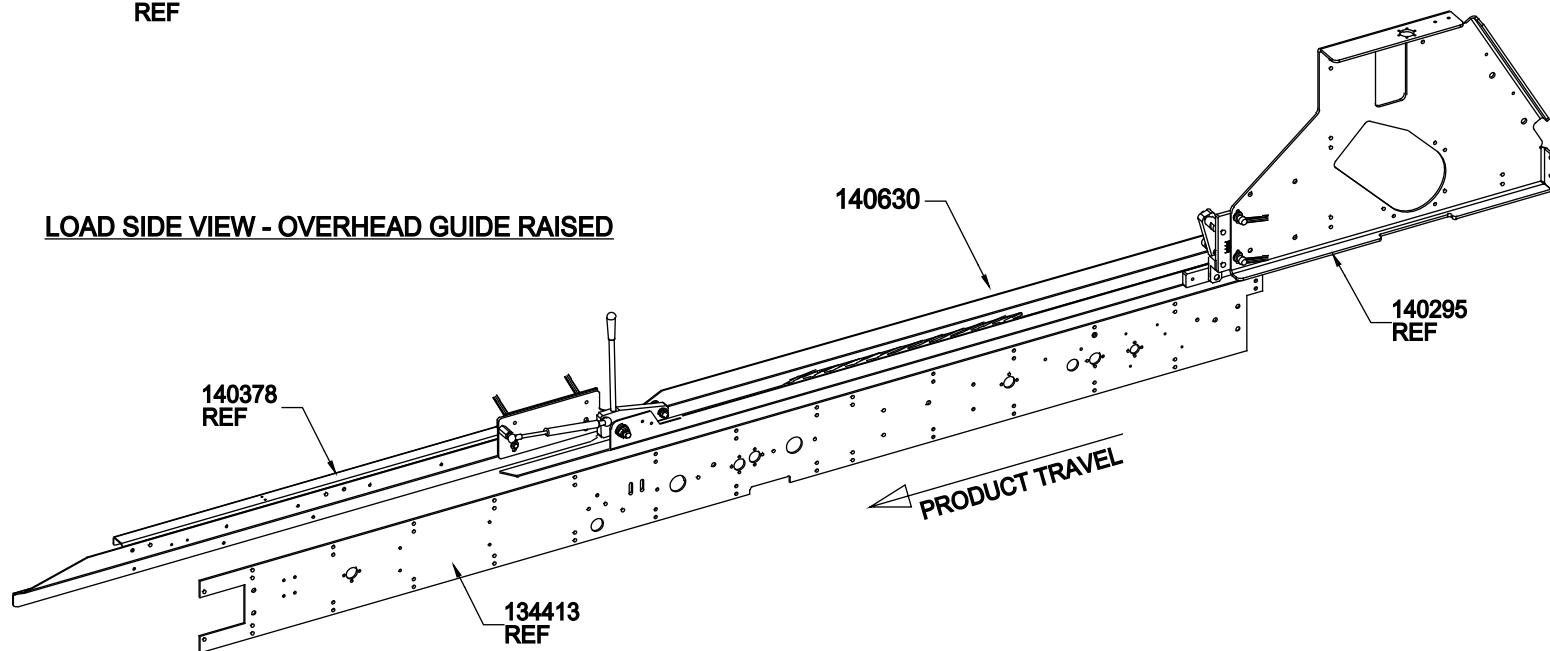


SHEET 3 OF 4
ASSEMBLY, INSERTER
OVERHEAD GUIDES
140630

NON-LOAD SIDE VIEW - OVERHEAD GUIDE IN RUN POSITION

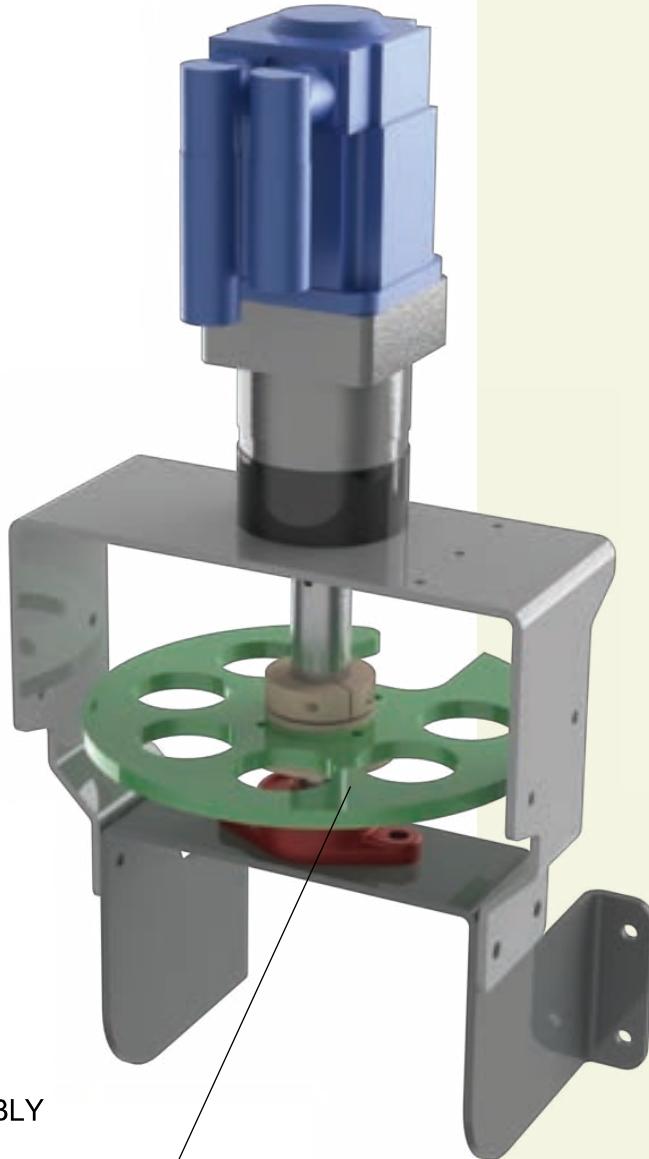


LOAD SIDE VIEW - OVERHEAD GUIDE RAISED



**SHEET 4 OF 4
ASSEMBLY, INSERTER
OVERHEAD GUIDES
140630**

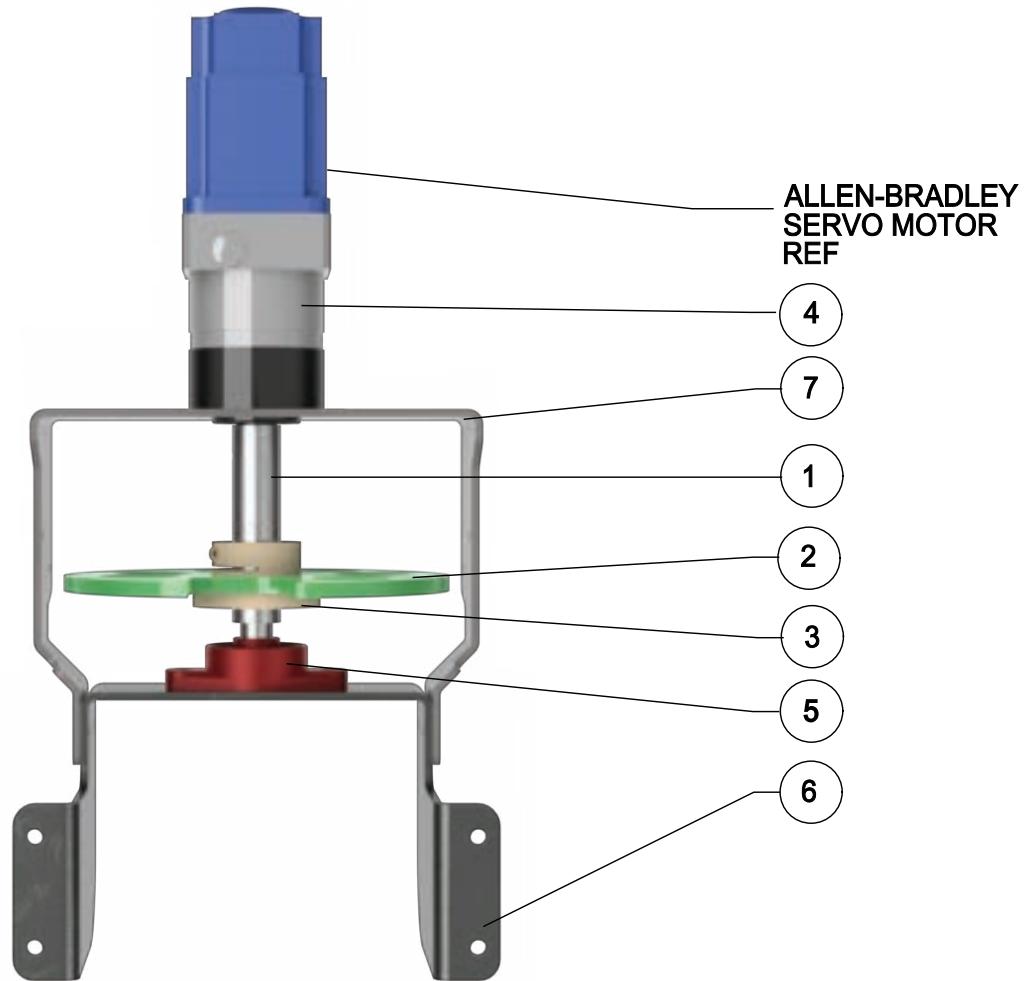
140630 ASSEMBLY, INSERTER OVERHEAD GUIDES (STANDARD HAND, SHOWN)
140630-001 ASSEMBLY, INSERTER OVERHEAD GUIDES, OPP (OPPOSITE HAND)



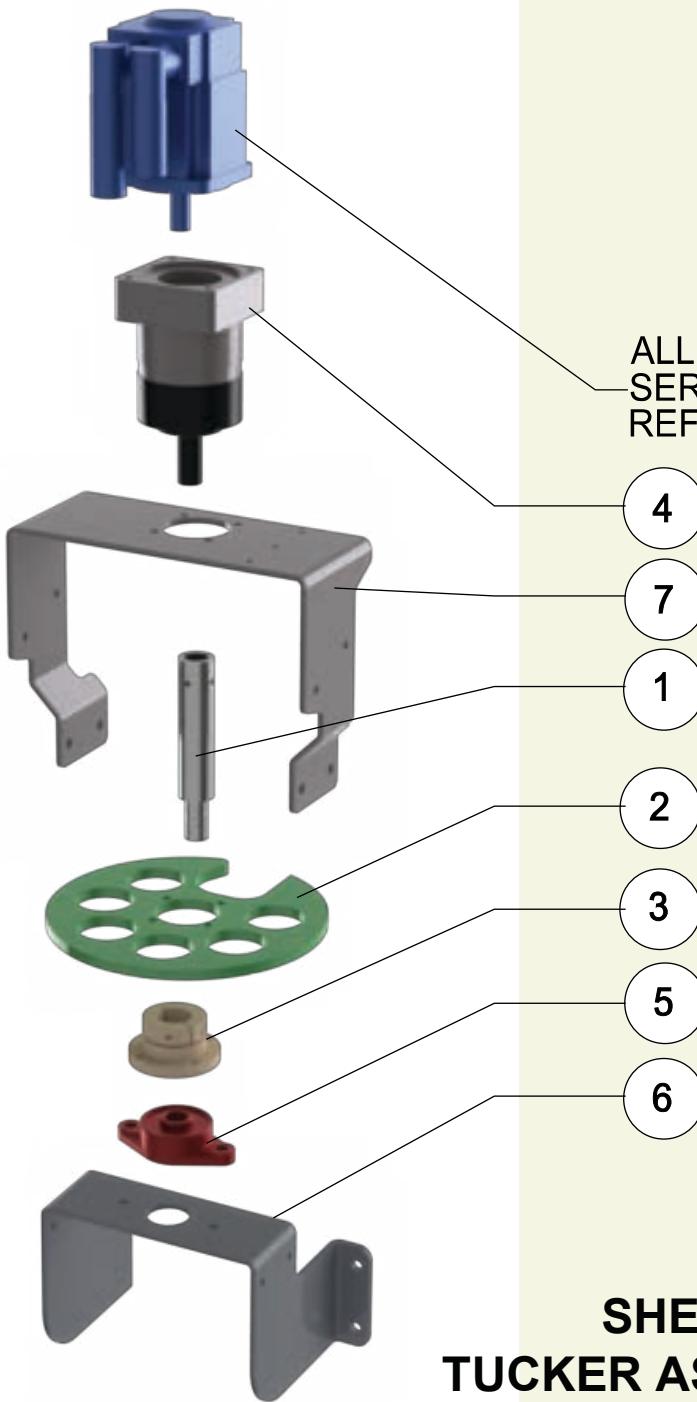
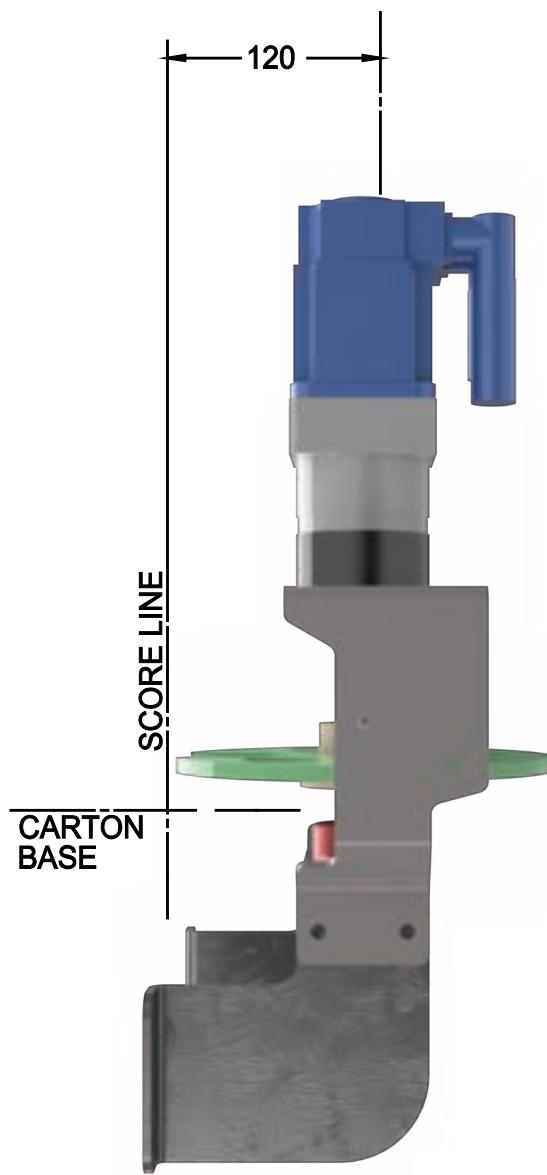
FOR OPPOSITE HAND ASSEMBLY
(SAME BOM STRUCTURE),
PLEASE FLIP OVER THE TUCKER DISK

SHEET 1 OF 3
TUCKER ASSEMBLY
139608

Find Num	Part Number	Item Description	Qty	Rev
				B
1	139619	SHAFT, TUCKER	1	C
2	139615	TUCKER DISC, MID RANGE	1	B
3	134588	STC-Set Collar	1	B
4	110153	RDC-Reducer	1	D
5	121201	BFL-Bearing, Flange	1	B
6	139641	MOUNT, UPSTREAM TUCKER	1	A
7	139643	MOUNT, TUCKER SERVO MOTOR	1	B
8	132651	SUPPORT, UPPER SOLENOID CABLE	1	A



SHEET 2 OF 3
TUCKER ASSEMBLY
139608



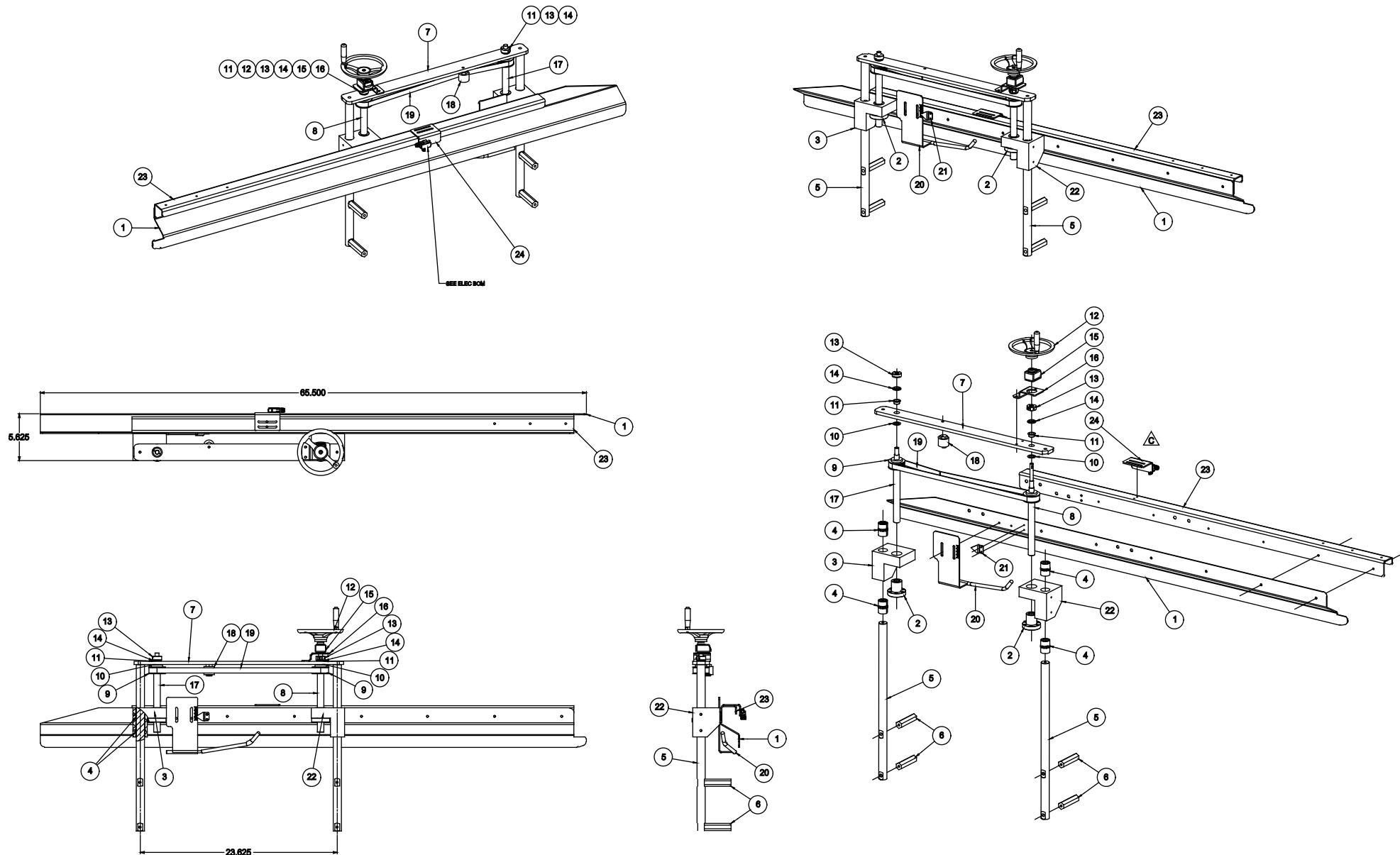
**SHEET 3 OF 3
TUCKER ASSEMBLY
139608**



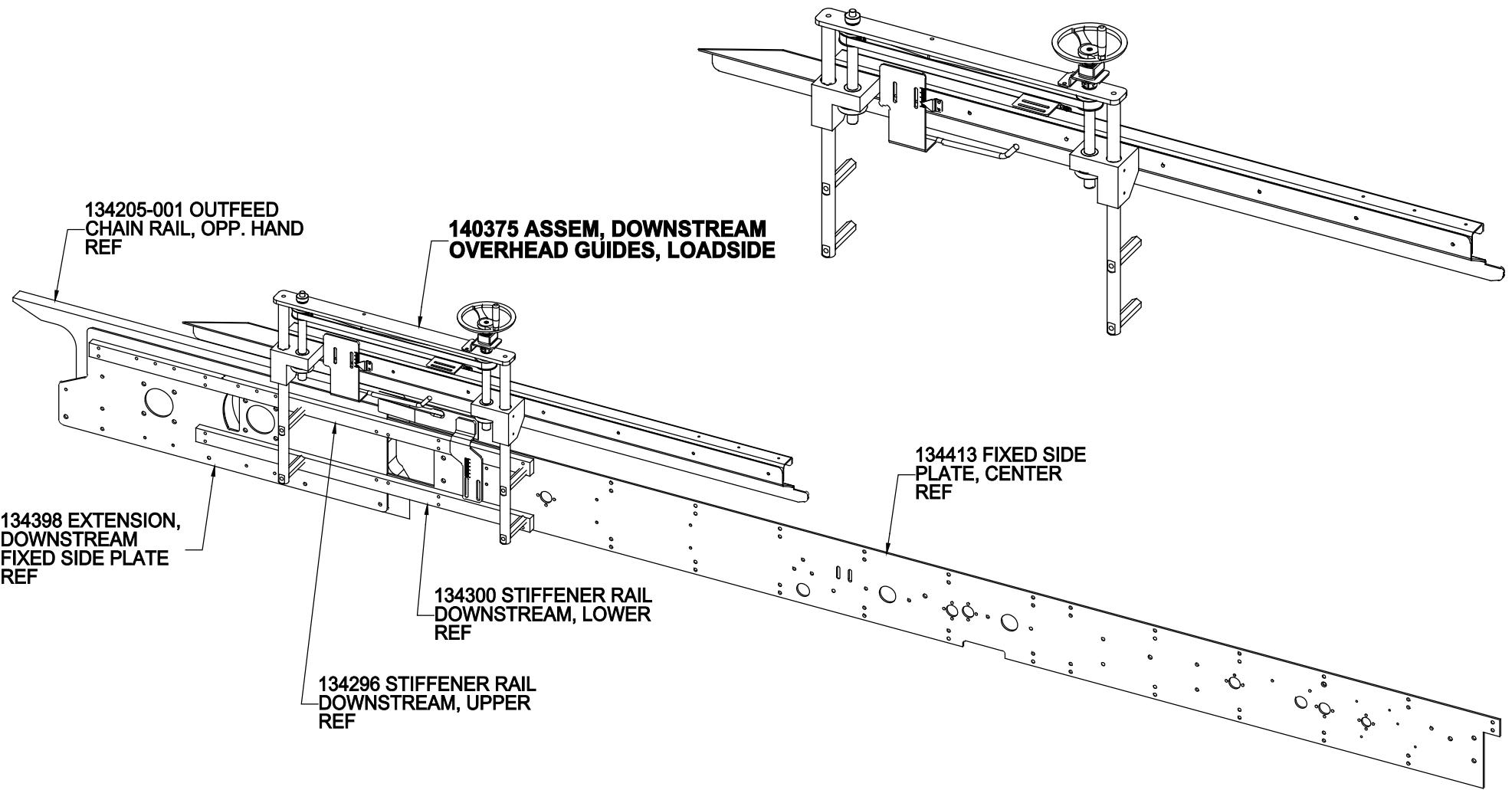
SHEET 1 OF 4
ASSEMBLY, DOWNSTREAM
OVERHEAD GUIDES, LOADSIDE
140375

Find Num	Part Number	Item Description	Qty	Rev
				C
1	140378	GUIDE, OVERHEAD DOWNSTREAM, LOADSIDE	1	A
2	139691	NUT-Nut	2	A
3	139693	MTG BLOCK, OVERHEAD GUIDE	1	C
4	139700	BSH-Bushing	4	A
5	139703	ROD, OVERHEAD GUIDE MTG	2	B
6	B78080319820	3/4" HEX SPACER 3.198 LG, M8 THREAD	4	A
7	139712	BAR, TOP CONNECTION	1	B
8	139713	SHAFT, OVERHEAD ADJUSTING HANDWHEEL	1	A
9	139714	MODIFICATION, PULLEY 30 TEETH T5	2	A
10	139715	WSH-Washer	2	A
11	126351	BSH-Bushing	2	A
12	130559	SS 140MM HANDWHEEL, FIXED HANDLE, 10MM KEYED HOLE	1	A
13	139837	STC-Set Collar	2	A
14	139718	WASHER, BUSHING SUPPORT	2	A
15	139738	COT-Counter	1	A
16	139741	BRACKET, COUNTER MTG, OVERHEAD	1	B
17	139742	SHAFT, OVERHEAD ADJUSTING, DRIVEN	1	A
18	120093	TENSIONER ASSY	1	A
19	139745	BLT-Belt	1	A
20	139847-001	PLOW DOWN GUIDE, OPP (LOAD SIDE)	1	D
21	139857	POINTER, PLOW	1	A
22	139693-001	MTG BLOCK, OVERHEAD GUIDE, OPP HAND	1	C
23	140617	SUPPORT, INSERTER OVERHEAD	1	C
24	147404	ANGLE BRACKET, GLUE SENSOR MTG	1	A

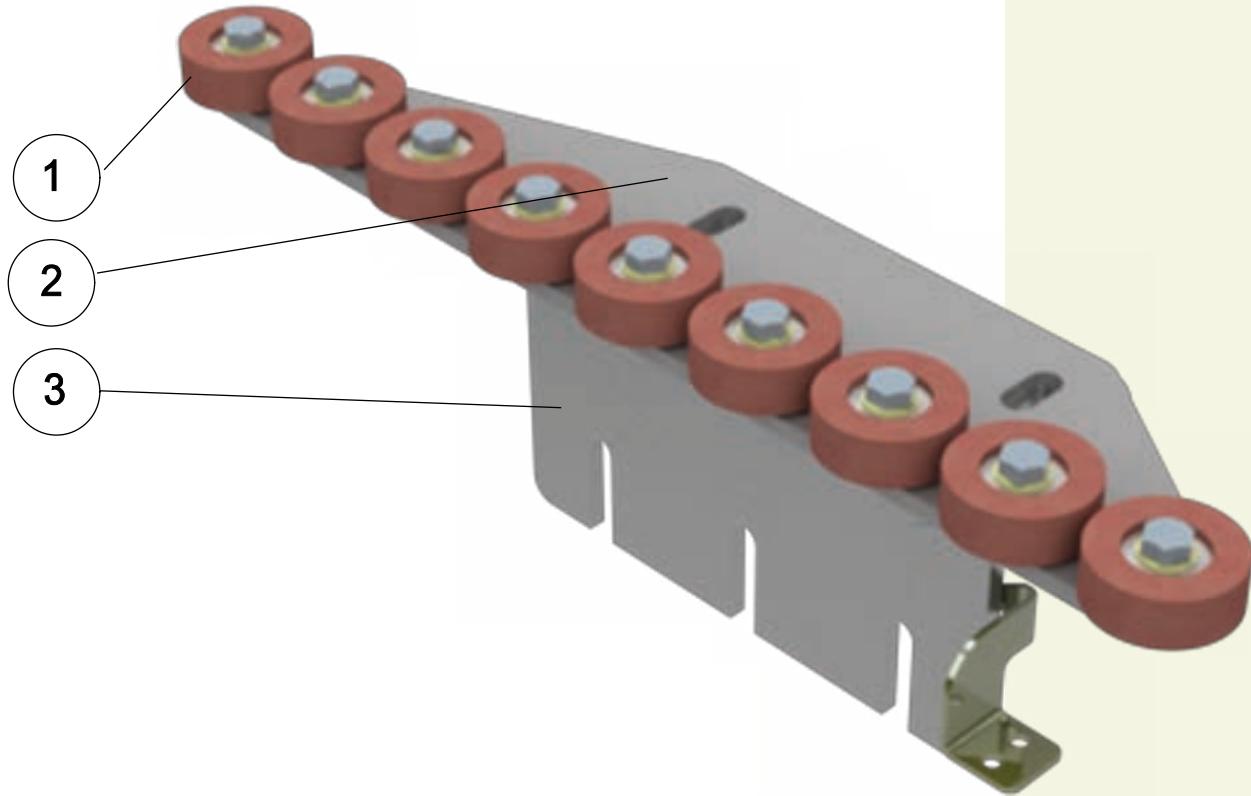
**SHEET 2 OF 4
ASSEMBLY, DOWNSTREAM
OVERHEAD GUIDES, LOADSIDE
140375**



SHEET 3 OF 4
ASSEMBLY, DOWNSTREAM
OVERHEAD GUIDES, LOADSIDE
140375



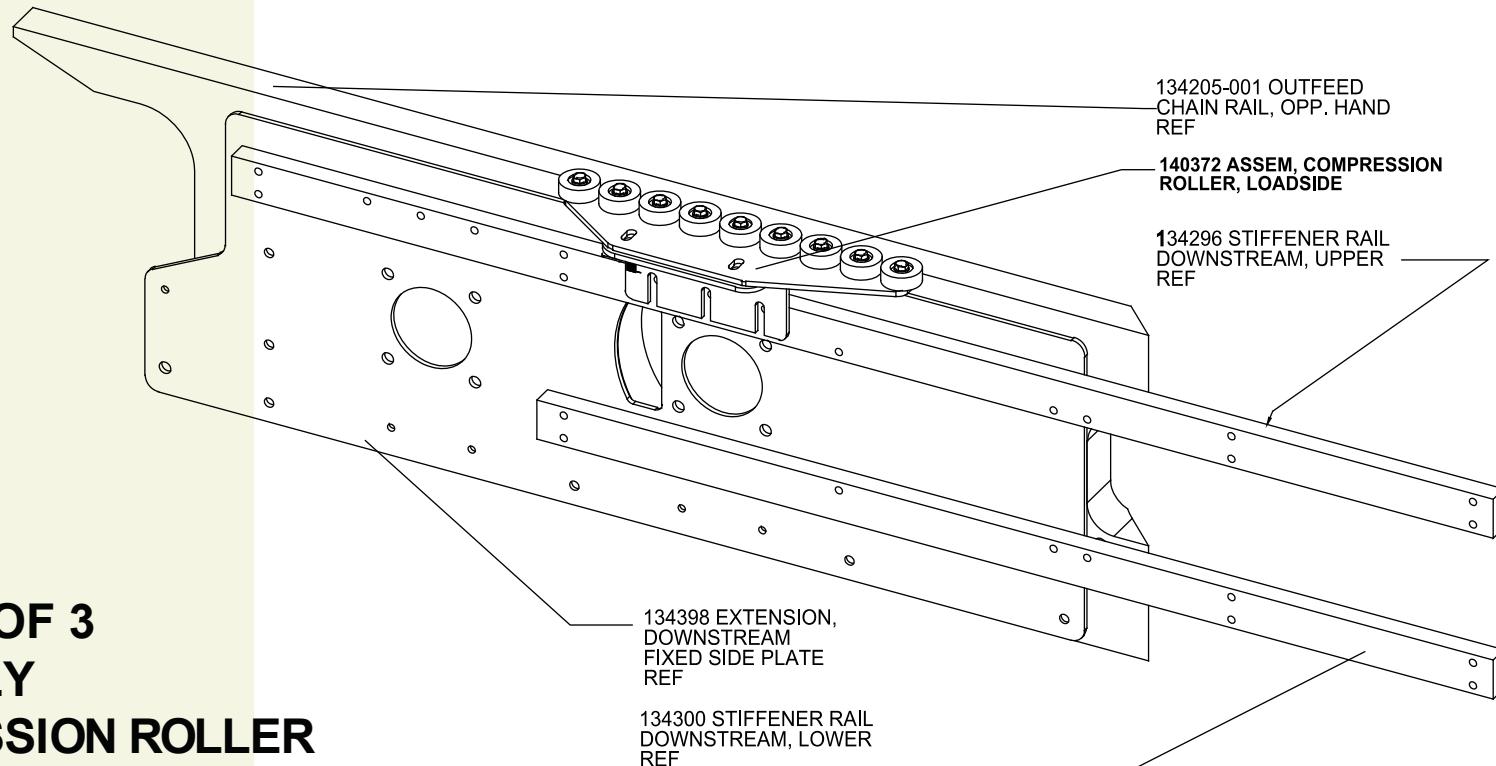
SHEET 4 OF 4
ASSEMBLY, DOWNSTREAM
OVERHEAD GUIDES, LOADSIDE
140375



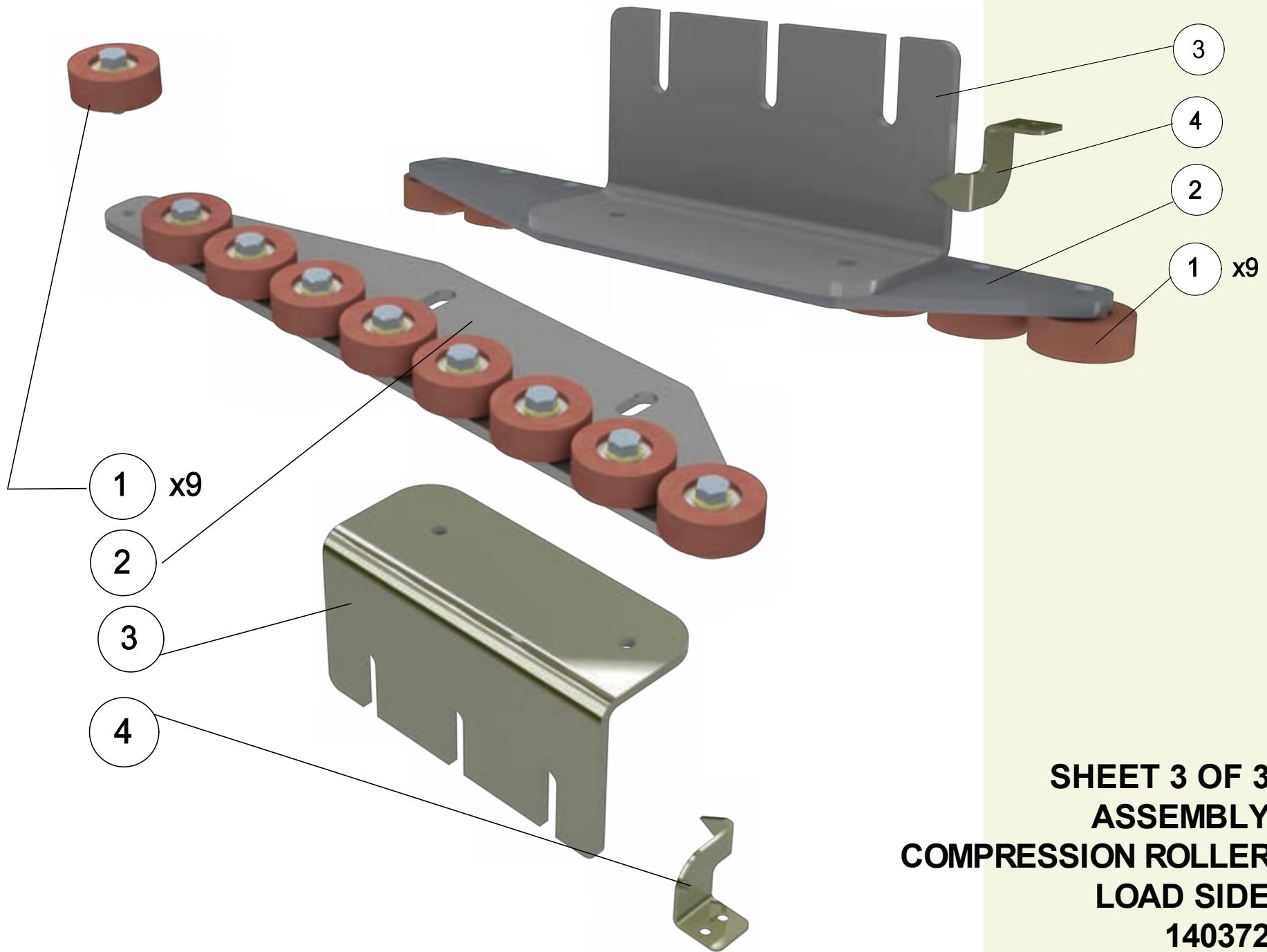
**SHEET 1 OF 3
ASSEMBLY
COMPRESSION ROLLER
LOAD SIDE
140372**

Find Num	Part Number	Item Description	Qty	Rev
				B
1	111945	ASSY, COMPRESSION ROLLER	9	A
2	139938	PLATE, COMPRESSION ROLLER	1	A
3	140374	BRACKET, COMP. ROLLER MTG, LOAD SIDE	1	A
4	140610	POINTER, COMPRESSION ROLLERS, LOAD SIDE	1	A

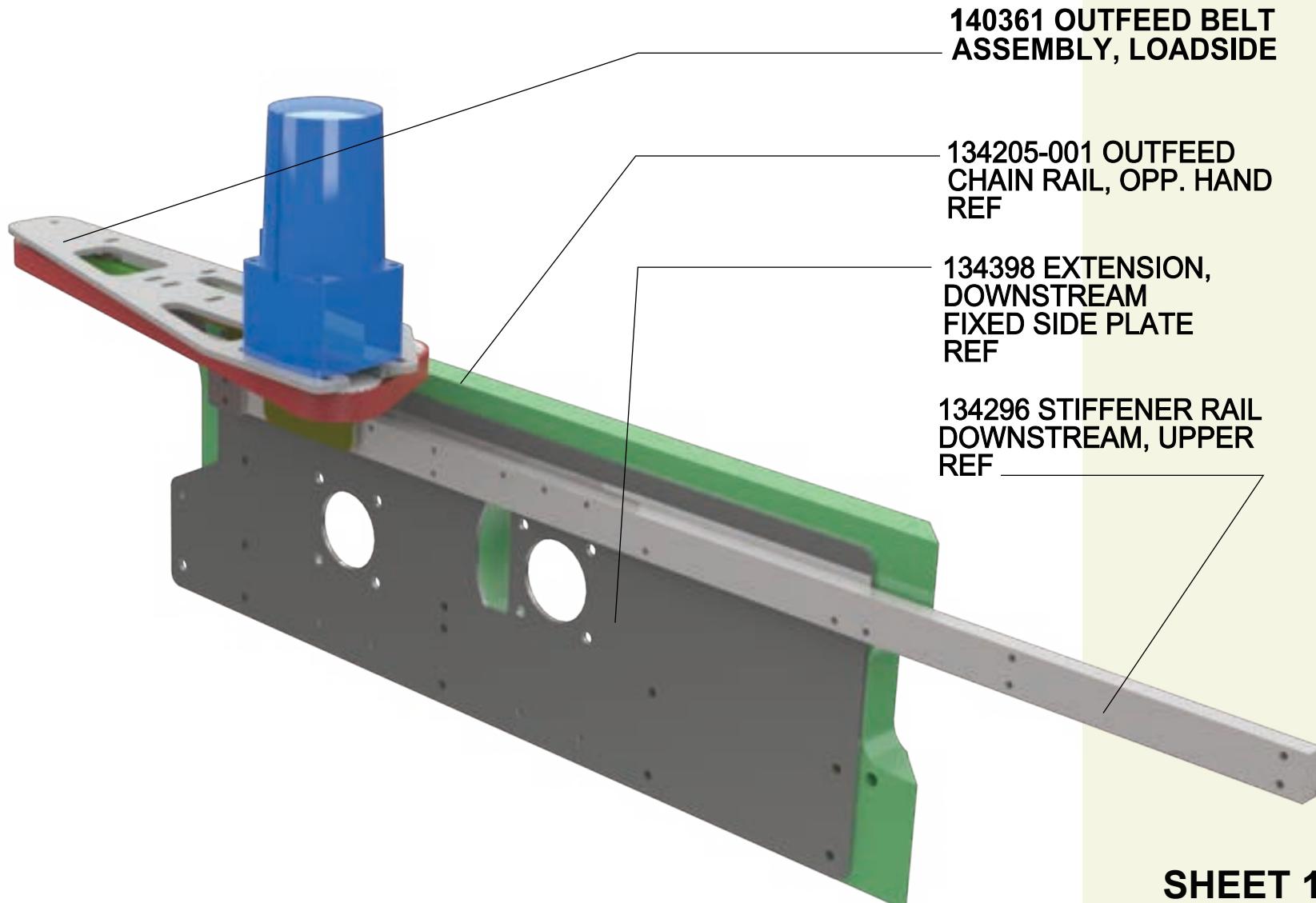
140372 COMPRESSION ROLLER ASSEM, LOAD SIDE (STANDARD HAND, SHOWN)
 140372-001 COMPRESSION ROLLER ASSEM, LOAD SIDE, OPP (OPPOSITE HAND)



**SHEET 2 OF 3
 ASSEMBLY
 COMPRESSION ROLLER
 LOAD SIDE
 140372**



**SHEET 3 OF 3
ASSEMBLY
COMPRESSION ROLLER
LOAD SIDE
140372**

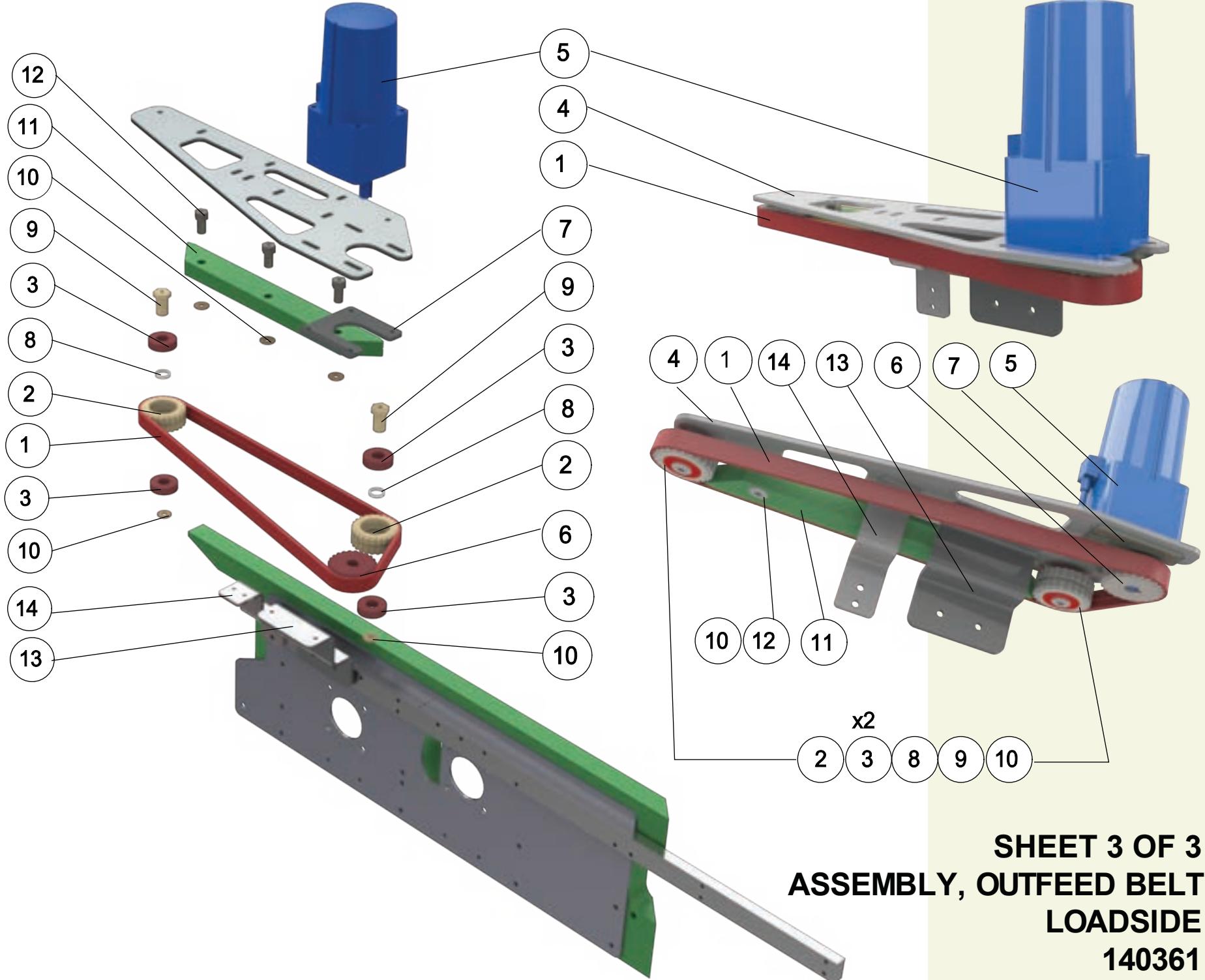


SHEET 1 OF 3
ASSEMBLY, OUTFEED BELT
LOADSIDE
140361

Find Num	Part Number	Item Description	Qty	Rev
				B
1	140312	BLT-Belt	1	B
2	140316	PULLEY, IDLER, OUTFEED, MODIFIED	2	A
3	107862	BRG-Bearing	4	A
4	140320	PLATE, BASE, OUTFEED	1	A
5	112541	GMT-Gear Motor	REF	A
6	140330	DRIVE PULLEY, OUTFEED, MODIFIED	1	A
7	140331	NUT PLATE, MOTOR	1	A
8	140333	SPACER, BEARING	2	A
9	140334	SHAFT, IDLER	2	A
10	B32100344125	SS WASHER; 1.00" OD, 0.344" ID, 0.125" THK	5	A
11	140339	BACKSTOP, BELT	1	A
12	140340	SHAFT, BACKSTOP MTG	3	A
13	140351	BRACKET, BELT ASSEMBLY MTG	1	A
14	140358	BRACKET, DOWNSTREAM MTG	1	A

140361 ASSEM, OUTFEED BELT, LOADSIDE (STANDARD HAND, SHOWN)
 140361-001 ASSEM, OUTFEED BELT, LOADSIDE, OPP (OPPOSITE HAND)

SHEET 2 OF 3
ASSEMBLY, OUTFEED BELT
LOADSIDE
140361



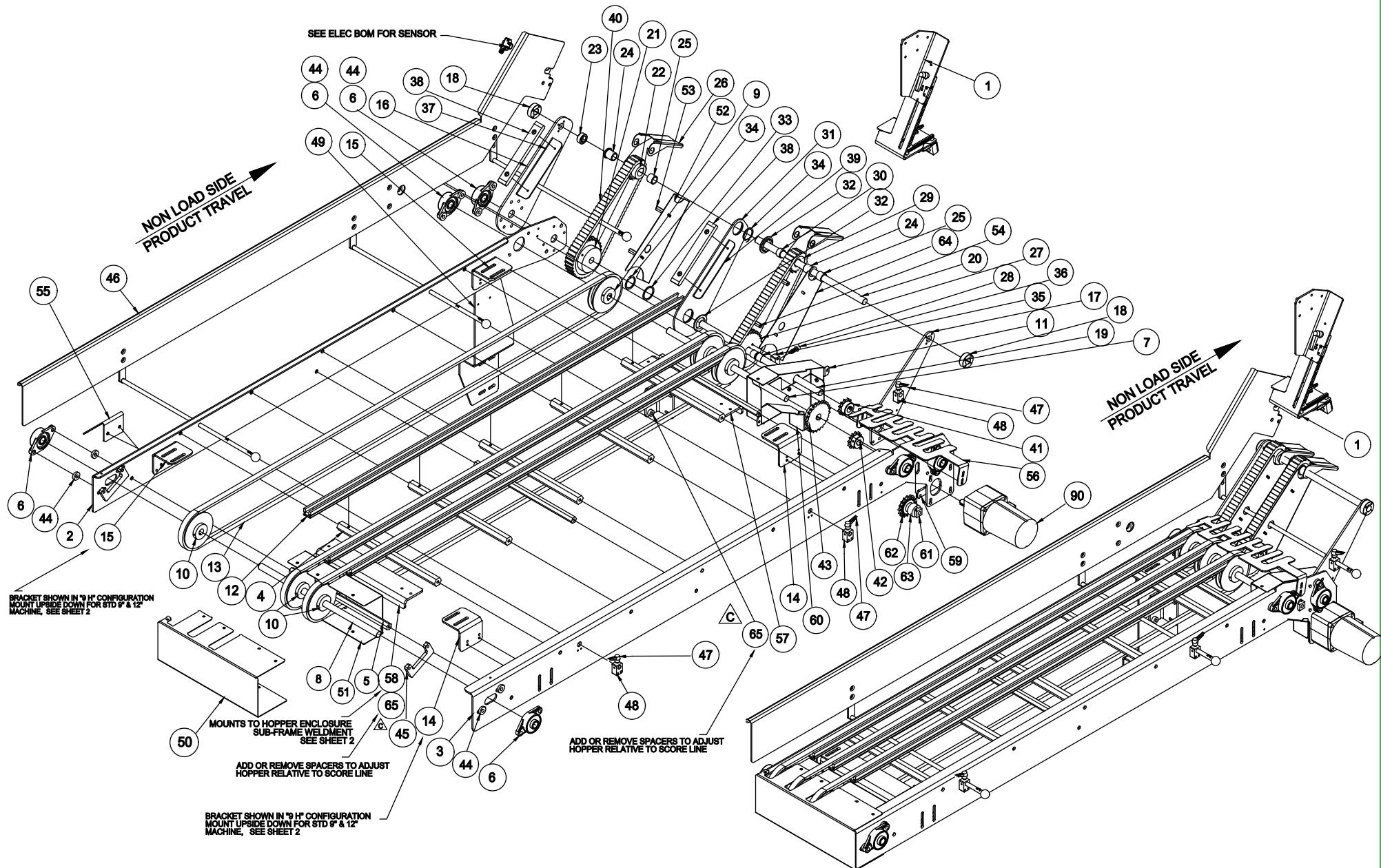
**SHEET 3 OF 3
ASSEMBLY, OUTFEED BELT
LOADSIDE
140361**

**SHEET 1 OF 4
HOPPER, ENTERPRISE, 6 FT
149334**

Find Num	Part Number	Item Description	Qty	Rev
				C
1	141126	CARTON TOP HOPPER WEDGE, MIDRANGE	1	A
2	149345	SIDE PLATE, LOAD SIDE	1	A
3	149336	SIDE PLATE, NL SIDE	1	A
4	140346	FEEDER SUPPORT	5	A
5	B78081650022	3/4" SS HEX SPACER; 16.50" LG, M10 TAPS BOTH ENDS	3	A
6	121201	BFL-Bearing, Flange	6	B
7	140914	PULLEY SHAFT, 20MM DIA X 20.00" LONG	1	B
8	B09S20MM2000X	SIMPLE SHAFT, 20MM DIA X 20.00" LONG, W/O LUBE	1	A
9	140731	DRIVE PULLEY, MIDRANGE CARTONER	3	A
10	140732	HOPPER IDLING PULLEY, MIDRANGE CARTONER	3	A
11	149376	UPPER CHAIN GUARD, HOPPER	1	A
12	141172	BELT GUIDE, MIDRANGE CARTONER	3	E
13	143970	BLT-Belt	44.57	A
14	149344	BRACKET, HOPPER MOUNT, ENTERPRISE	2	A
15	149344-001	BRACKET, HOPPER MOUNT, ENTERPRISE, OPP HAND	2	A
16	149446	INCLINE SIDE PLATE, REAR	1	A
17	149445	INCLINE FRONT SIDE PLATE	1	A
18	121860	STC-Set Collar	2	A
19	140902	HOPPER SHAFT, 20MM DIA X 20.25" LONG,	1	B
20	B09S20MM1825X	SIMPLE SHAFT, 20MM DIA X 18.25" LONG, W/O LUBE	1	A
21	140827	SPROCKET FOR MRC, 30 TOOTH 1/2 PITCH	1	A
22	140846	INCLINE HOPPER SPROCKET, D40B15	1	A
23	097984	STC-Set Collar	1	A
24	140915	BFL-Bearing, Flange	2	A
25	140962	BSH-Bushing	2	A
26	140872	HOPPER NOSE PLATE	2	F
27	140746	SPROCKET FOR MRC, INCLINED DRIVE END, 30 TOOTH 1/2 PITCH	1	A
28	118338	BSH-Bushing	1	A

Find Num	Part Number	Item Description	Qty	Rev
				C
29	140859	SPROCKET, D40B15	1	A
30	140963	BSH-Bushing	1	A
31	149480	INCLINE SIDE PLATE, FRONT	1	A
32	140842	MODIFICATION TO 121630, BSH IGU GFM-3842-22	2	A
33	130129	THRUST WASHER	1	A
34	121852	RNG-Ring	2	A
35	140810	SLIDE CONVEYOR LOCATE BLOCK	1	A
36	132476	PGR-Plunger	1	A
37	149477	INCLINE SLIDE SUPPORT, FWD SIDE	1	B
38	140956	INCLINE CHAIN TRACK	2	A
39	149481	INCLINE SLIDE SUPPORT, MOBILE SIDE	1	B
40	140758	ASSEMBLY, CHAIN, INCLINE	2	A
41	141278	SPROCKET, DISCHARGE BELT DRIVE	1	A
42	140884	SPROCKET, MOTOR BELT DRIVE	1	A
43	B79E4012420	SPROCKET, 40B24, 20MM BORE	1	A
44	B14S10004102504	SPACER;	12	-
45	140734	HOPPER NUT BAR	2	A
46	149440	SIDE GUIDE ASSEMBLY, ENTERPRISE HOPPER	1	B
47	069948	HAN-Handle	3	B
48	121883	ROD CLAMP	3	B
49	149364	BRACKET, HOPPER SUPPORT - PIC	1	A
50	145049	GUARD, HOPPER TAIL END	1	B
51	145050	GUARD, HOPPER BELT	1	B
52	149478	GUARD, PLASTIC CHAIN, LS	1	A
53	B78040200016	S.S. HEX SPACER, M5, 2.000" LG	2	B
54	B78040125016	S.S. HEX SPACER, M5, 1.250" LG	2	B
55	147353	BRACKET, E-STOP MTG	1	A
56	141240	CHUTE, HOPPER DISCHARGE, MIDRANGE CARTONER	1	D
57	149349	BRACKET, HOPPER CROSS MTG	1	B
58	149349-001	BRACKET, HOPPER CROSS MTG, OPP HAND	1	B
59	149378	NUT PLATE, MOTOR, HOPPER	1	A
60	149380	LOWER CHAIN GUARD, HOPPER	1	B
61	139596	NUT, TAKE-UP, 1/2-13	1	A
62	B76E004011608	IDLER SPROCKET, 40 16T, ER08	1	A
63	B14S15005307624	SPACER 1.5 OD 17/32 ID X 0.762 LG	1	A
64	149479	GUARD, PLASTIC CHAIN, NLS	1	A
65	B14S07503403754	SPCR, .75 OD .34 ID X .375 LG;	4	A
90	112542	GMT-Gear Motor	REF	A

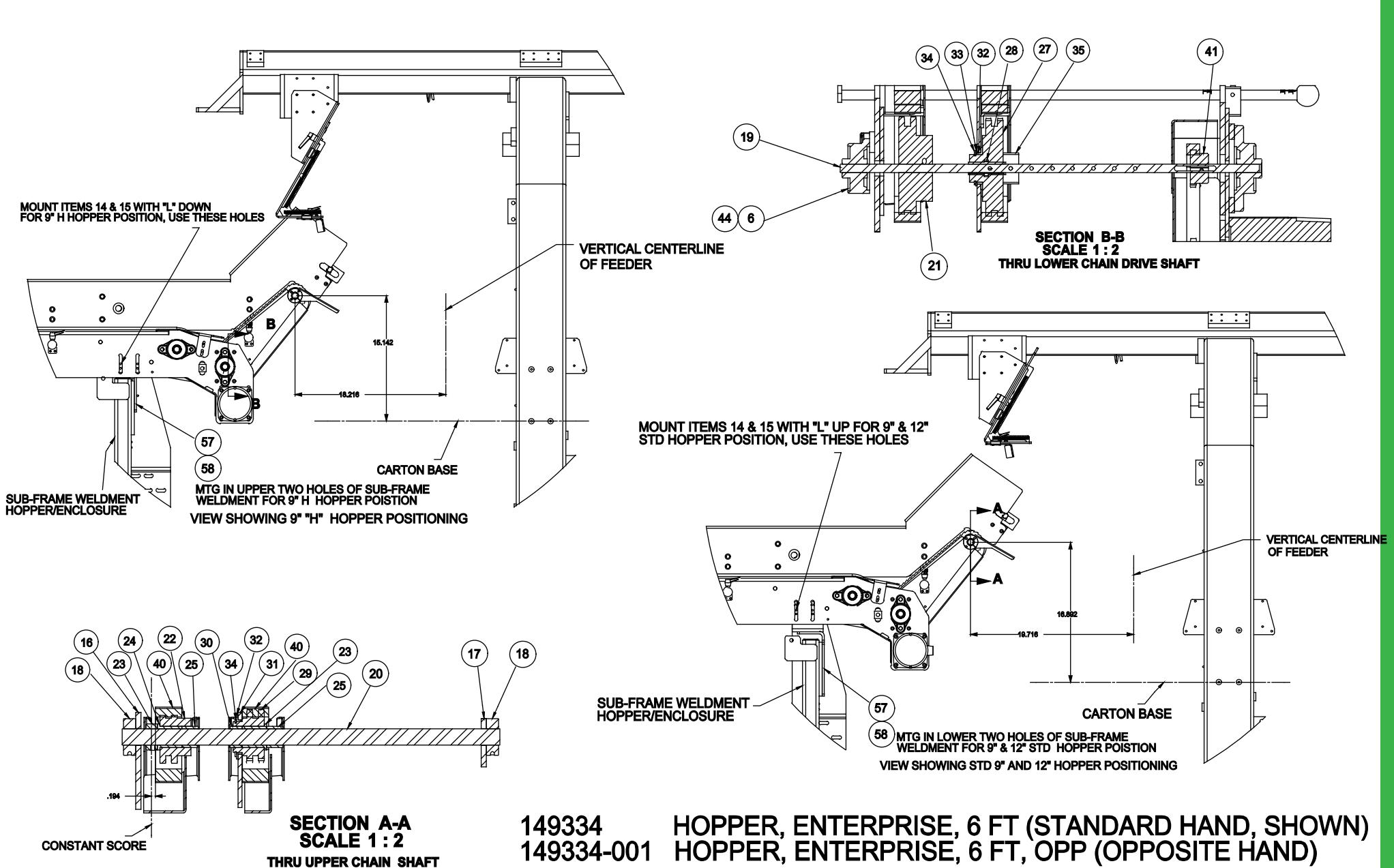
SHEET 2 OF 4
HOPPER, ENTERPRISE, 6 FT
149334



149334
149334-001

HOPPER, ENTERPRISE, 6 FT (STANDARD HAND, SHOWN)
HOPPER ENTERPRISE 6 FT OPP OPPOSITE HAND

SHEET 3 OF 4
HOPPER, ENTERPRISE, 6 FT
149334



SHEET 4 OF 4

HOPPER, ENTERPRISE, 6 FT

149334

**NORDSON GLUE SYSTEM
MIDRANGE, PROBLUE-7, 480V, SURE
BEAD GUNS, WASH DOWN HOSES
141527**

Find Num	Part Number	Item Description	Qty	Rev
				E
1	114587	TRF-Transformer	1	A
2	122572	APL-Applicator	1	B
3	P0011834	HOS-Hose	1	-
4	P0011837	HOS-Hose	1	-
5	099024	FLT-Filter	1	A
6	096893	FLT-Filter	1	A
7	139677	GUN-Gun	2	B
8	126608	VAL-Valve	2	A
9	P0042559	FTG-Fitting	2	-
11	141541	WELDMENT, GLUE TANK MOUNTING	1	C
12	127113	REG-Regulator	1	A
13	059743	CON-Connector	2	B

**NORDSON GLUE SYSTEM
MIDRANGE, PROBLUE-7, 480V, SURE
BEAD GUNS, WASH DOWN HOSES
141527**

SHEET 1 OF 3

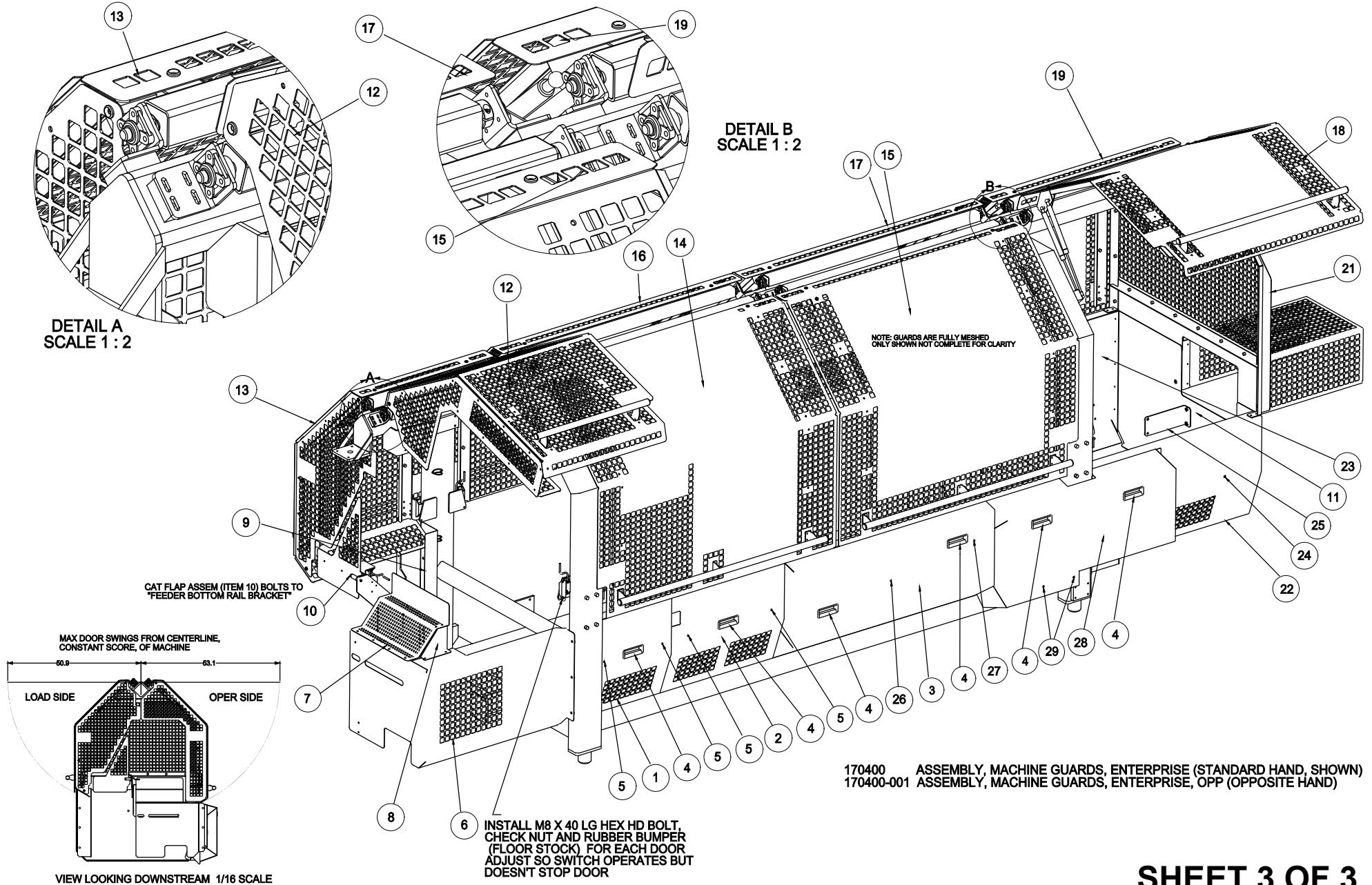
**ASSEMBLY, MACHINE GUARDS, ENTERPRISE, LASER CUT MESH
LOWER WINDOWS, STD HANDLES & STRUTS, OUTSIDE POLYCHAINS**

170400

Find Num	Part Number	Item Description	Qty	Rev
				A
1	150075	GUARD, LOWER, OPERATOR SIDE #1, W WINDOW	1	A
2	170308	GUARD, LOWER, OPERATOR SIDE #2 OUTSIDE BELTS	1	A
3	170310	GUARD #1, OPERATOR SIDE BELT	1	A
4	010583P	HAN-Handle	6	-
5	B78050225018	HEX SPACER, 1/2 " HEX 2 1/4"LG, M6 THRDS	4	A
6	150039	GUARD, OPER SIDE UPSTREAM END W WINDOW	1	B
7	154655	GUARD, UPSTREAM FILLER, SS MESH	1	A
8	141071	BRACKET, FILLER SUPPORT	1	B
9	141079	GUARD, FILLER, INFEED	1	B
10	154475	ASSEMBLY, CAT FLAP DOOR, MESH	1	A
11	141463	GUARD, OUTFEED END	1	C
12	159268	ASSEMBLY, INFEED OPER SIDE DOOR, MESH, STD STRUTS	1	A
13	159269	ASSEMBLY, INFEED LOAD SIDE DOOR, MESH, STD STRUTS	1	A
14	159270	ASSEMBLY, UPSTREAM MIDDLE OPER SIDE DOOR, MESH, STD STRUTS	1	A
15	159271	ASSEMBLY, DOWNSTREAM MIDDLE OPER SIDE DOOR, MESH, STD STRUTS	1	A
16	159272	ASSEMBLY, UPSTREAM MIDDLE LOAD SIDE DOOR, MESH, STD STRUTS	1	A
17	159273	ASSEMBLY, DOWNSTREAM MIDDLE LOAD SIDE DOOR, MESH, STD STRUTS	1	A
18	159274	ASSEMBLY, OUTFEED OPER SIDE DOOR, MESH, STD STRUTS	1	A
19	159275	ASSEMBLY, OUTFEED LOAD SIDE DOOR, MESH, STD STRUTS	1	A
20	126761	STP-Strap	8	A
21	154474	ASSEMBLY, OUTFEED UPPER GUARD, MESH	1	A
22	170320	GUARD, OPER SIDE OUTFEED, OUTSIDE BELTS	1	C
23	150085	GUARD, LOAD SIDE OUTFEED, W WINDOW	1	B
24	B78110225022	HEX SPACER, M10 X 2,25" LONG	1	A
25	141464	BRACKET, END GUARD SUPPORT	1	C
26	B78050506318	1/2" SS HEX SPACER, 5.063" LG, M6 TAPPED HOLES BOTH ENDS	1	A
27	170311	Z-BRACKET, GUARD MTG	1	A
28	170312	GUARD #2, OPERATOR SIDE BELT	1	A
29	B14S05002503754	SPCR, .50 OD, .25 ID X .375 LG	2	A

SHEET 2 OF 3

**ASSEMBLY, MACHINE GUARDS, ENTERPRISE, LASER CUT MESH
LOWER WINDOWS, STD HANDLES & STRUTS, OUTSIDE POLYCHAINS
170400**



SHEET 3 OF 3

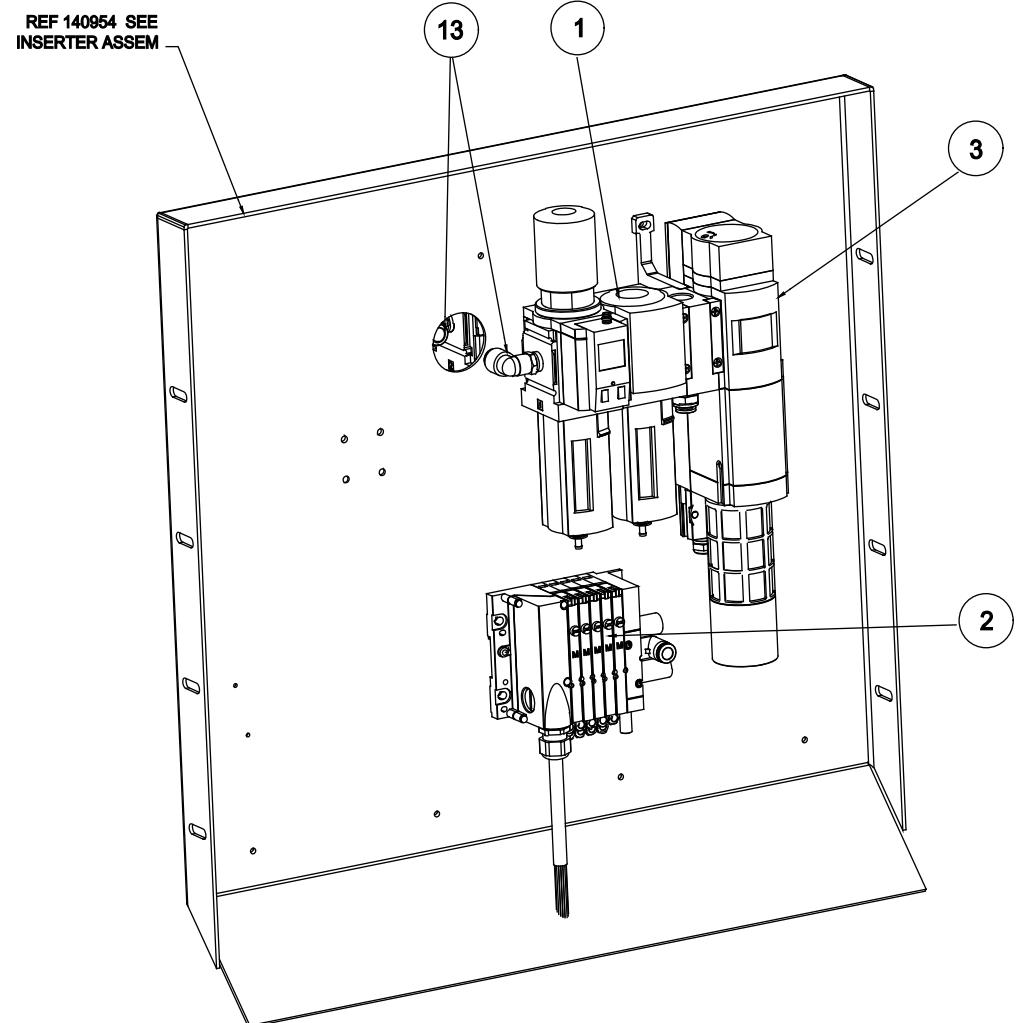
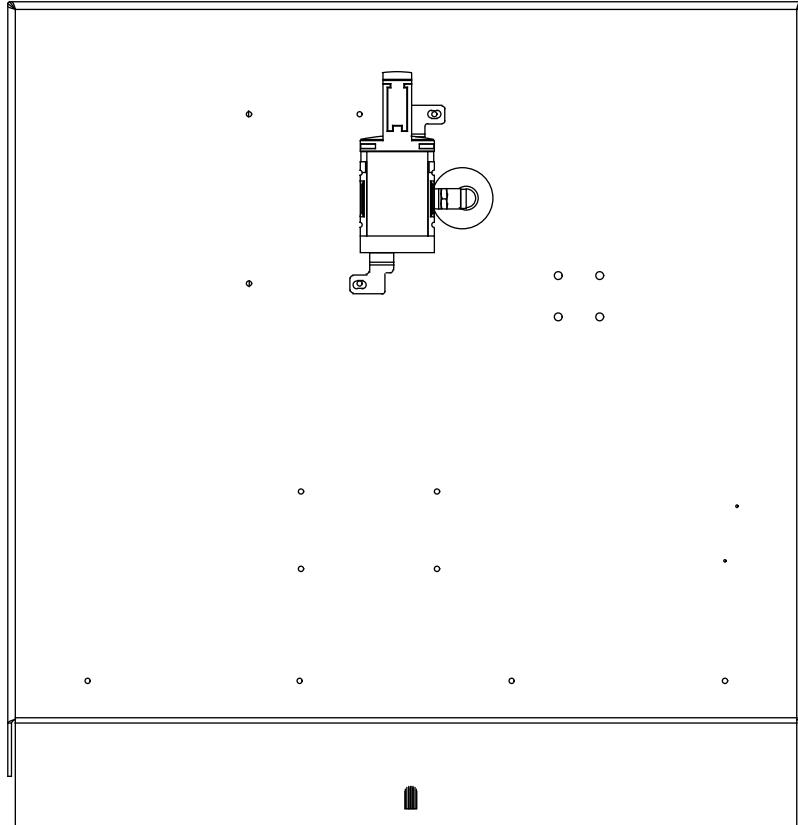
**ASSEMBLY, MACHINE GUARDS, ENTERPRISE, LASER CUT MESH
LOWER WINDOWS, STD HANDLES & STRUTS, OUTSIDE POLYCHAINS**

170400

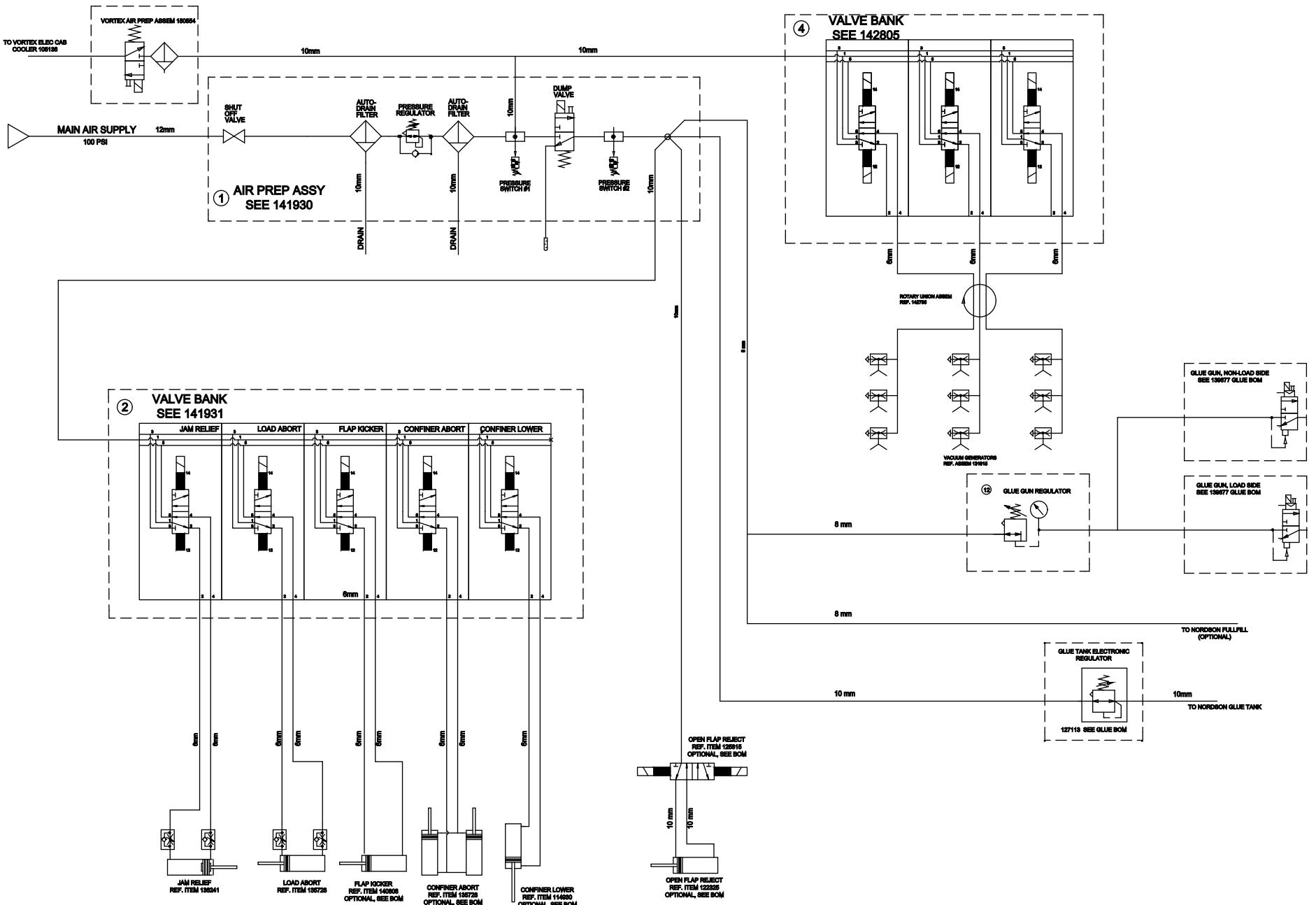
**SHEET 1 OF 4
PNEUMATICS ASSEMBLY
MID-RANGE CARTONER
141932**

Find Num	Part Number	Item Description	Qty	Rev
				K
1	158355	REG-Regulator	1	C
2	141931	VAL-Valve	1	B
3	165740	VAL-Valve	1	A
4	142805	VAL-Valve	1	A
6	123502	TUB-Tube	50	A
7	123503	TUB-Tube	20	A
8	123504	TUB-Tube	20	A
9	P0033046	TUB-Tube	20	B
12	123625	REG-Regulator	1	A
13	059742	CON-Connector	2	A
17	160377	FTG-Fitting	1	A
18	087157	VAL-Valve	2	A
20	088815	CON-Connector	4	A
23	057137P	CON-Connector	2	B
25	059418	CON-Connector	2	A
26	059743	CON-Connector	2	B
27	068362	CON-Connector	1	A
28	077540	CON-Connector	1	-
29	092356	CON-Connector	1	A
30	059415	PLUG, M6	9	-

SHEET 2 OF 4
PNEUMATICS ASSEMBLY
MID-RANGE CARTONER
141932



SHEET 3 OF 4
PNEUMATICS ASSEMBLY
MID-RANGE CARTONER
141932



SHEET 4 OF 4
PNEUMATICS ASSEMBLY
MID-RANGE CARTONER
141932

**KIT, VORTEX COOLING
ASSEMBLY, ENTERPRISE
150566**

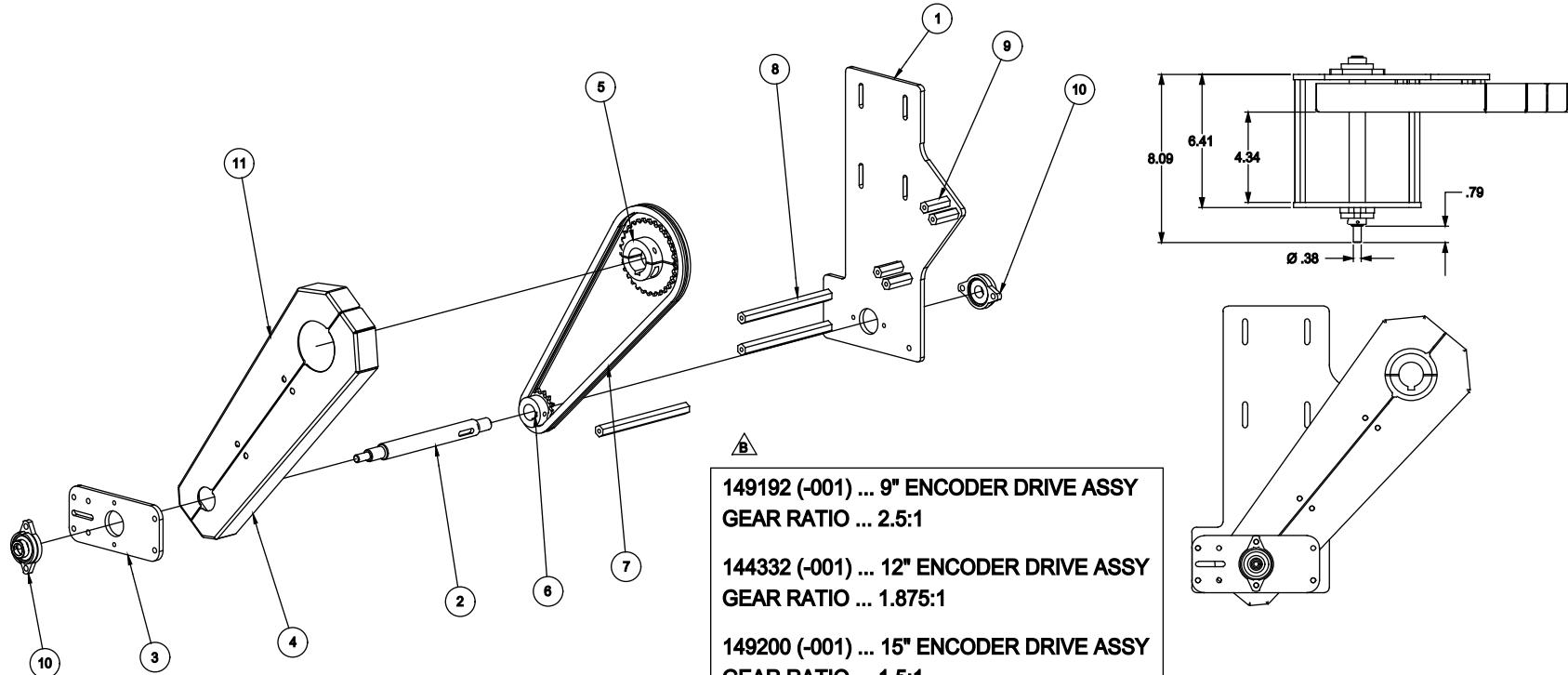
Find Num	Part Number	Item Description	Qty	Rev
				C
1	105136	VTC-Vortex Cooler	1	A
2	110077	MTG BLOCK, VORTEX COOLER, WASH DOWN VARI-RIGHT	1	D
3	014778P	TBG-Tubing	1	-
4	110080	ORG-O-Ring	1	A
5	N8500015	VAL-Valve	1	A
6	155054	PLG-Plug	1	A
7	P0042049	FTG-Fitting	1	-
8	P0042126	FTG-Fitting	1	-

**KIT, VORTEX COOLING
ASSEMBLY, ENTERPRISE
150566**

SAFETY SIGN KIT ENTERPRISE 144451

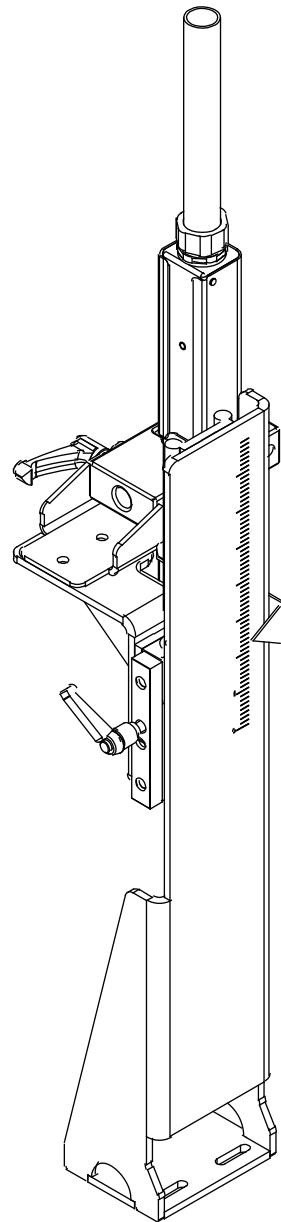
Find Num	Part Number	Item Description	Qty	Rev
				F
1	072361	DCL HCS H6060-H5WHPJ, ANSI GUARD REMOVED	30	B
2	072359	DCL HCS H6011-19WHPJ, ANSI LOCK OUT ELECT POWER	4	B
3	072358	DCL HCS H6010-KEDVPJ, ANSI ELECT SHOCK	2	B
4	072360	DCL HCS H6013-T8DHPJ, ANSI SAFETY LOCK	2	A
5	072356	DCL HCS H1102-T4WHPJ, ANSI DRAWING IN ROLLERS	4	A
6	072355	DCL HCS H1090-02WHPJ, ANSI BELT DRIVE	4	A
7	072357	DCL HCS H1057-FTWHPJ, ANSI CHAIN FEED	6	A
8	072363	DCL HCS H6043-BFCHPJ, ANSI HOT SURFACE	4	A
9	081313	DCL HCS 6043C-ISO HOT SURFACE	5	A
10	000150931000	SAFETY SIGN-ENGLISH;NX9210PURCHASE EXCESS	2	-
11	000150932000	SAFETY SIGN-SPANISH;NX9210PUR EXCESS	2	-
12	P0077653	DCL ANY DRW 15-832;	2	-
15	072252	DCL HCS 6013A-ISO SAFETY LOCK	2	A
17	102608	DECAL, STRIPING	10	C
18	144614	DECAL, ENTERPRISE, RH	1	B
19	144614-001	DECAL, ENTERPRISE, LH	1	B
20	P00776140	DCL WDE DRW P00776140, "WARNING" ELECTRICAL WIRING MODIFICATIONS-ENGLISH	1	B
21	042634B	DCL WDE DRW 042634B, "WARNING" ELECTRICAL WIRING MODIFICATIONS-SPANISH	1	B

**SAFETY SIGN KIT
ENTERPRISE
144451**



Find Num	Part Number	Item Description	Qty	Rev
				C
1	144359	INNER SIDE PLATE	1	B
2	144357	ENCODER SHAFT	1	B
3	144368	OUTER SIDEPLATE	1	A
4	144378	GUARD, ENCODER DRIVE CHAIN	1	A
5	144356	SPLIT SPROCKET; 35B30H WITH 30MM BORE	1	D
6	B79E3511620MM	35B16H, 20MM BORE SPROCKET	1	A
7	B31E35108603225	ROLLER CHAIN ASSY; #35 CHAIN, 86 PITCHES, 32.25" TOTAL LENGTH	1	A
8	B78050590618	SS HEX SPACER; 1/2" HEX, 5.906" (150MM) LG, M6 TAPPED BOTH ENDS	3	A
9	B78050150018	1/2" HEX SPCR X 1 1/2" LG, M6 THREAD	4	-
10	125152	BFL AMI MUFL 002 15MM BORE, TWO BOLT FLANGE BEARING SET SCREW, SS HOUSING WITH STN STL INSERT	2	A
11	144378-001	GUARD, ENCODER DRIVE CHAIN (OPP HAND)	1	A
12	112509	END-Encoder	REF	A
13	165305	SHIELD, ENCODER	REF	B

**ASSEMBLY, ENCODER DRIVE
(12" MID-RANGE CARTONER)
144332**

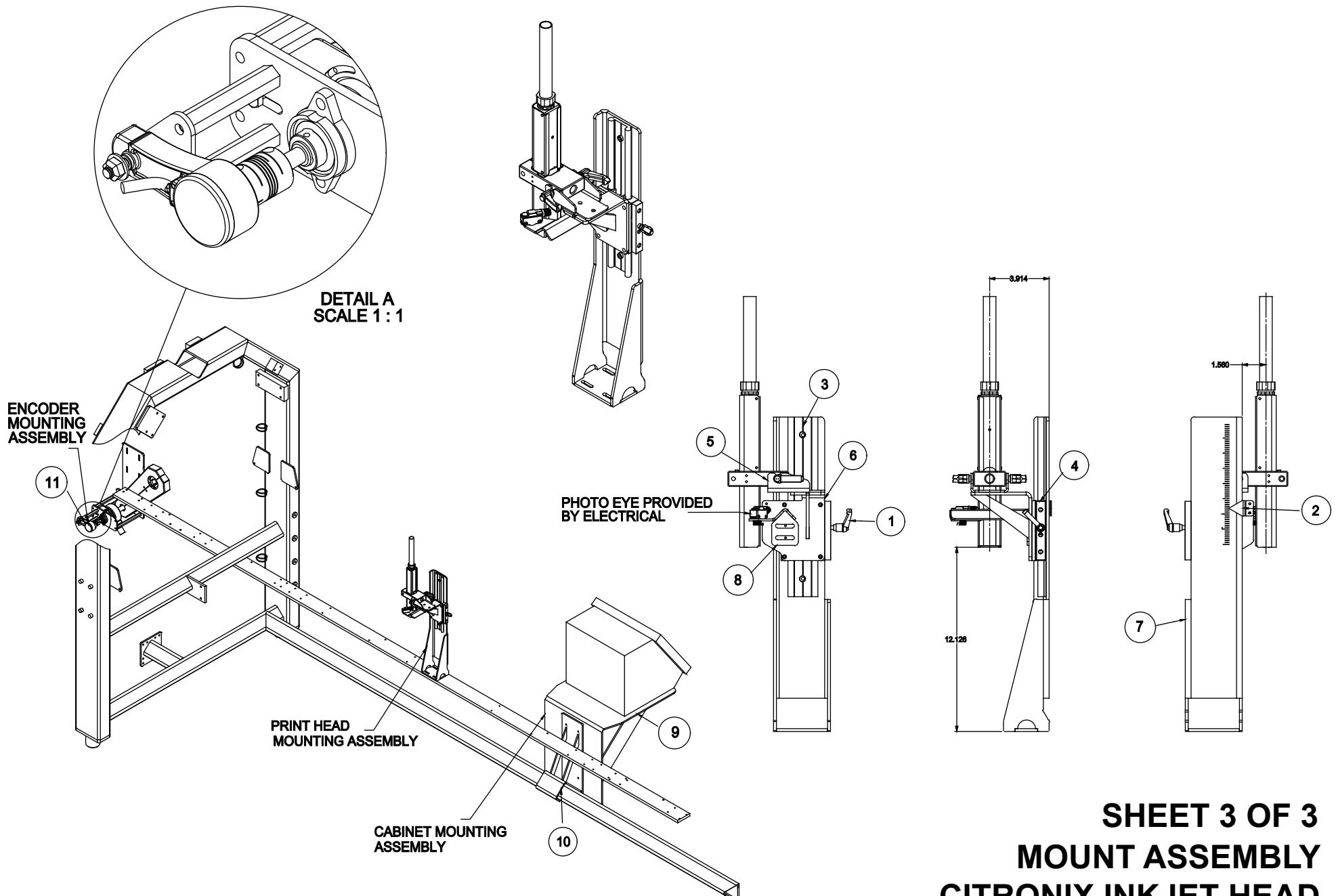


SHEET 1 OF 3
MOUNT ASSEMBLY
CITRONIX INKJET HEAD
169012

Find Num	Part Number	Item Description	Qty	Rev
				D
1	157786	HAN-Handle	1	A
2	159303	POINTER, LINEAR GUIDE	1	A
3	159326	RAL-Rail	1	A
4	159327	BLN-Bearing, Linear	1	A
5	169047	MOUNT BRACKET A, CITRONIX PRINT HEAD	1	B
6	169048	MOUNT BRACKET B, CITRONIX PRINT HEAD	1	B
7	169058	MOUNT BRACKET, CITRONIX PRINT HEAD MAIN	1	B
8	170951	MOUNT BRACKET, PHOTO SENSOR	1	B
9	171150	CITRONIX INK JET STAND, CASTERS	1	B
10	169155	MOUNT BRACKET B, CITRONIX CABINET	1	D
11	169169	ASSEMBLY, ENCODER MTG HS-5160 / (CITRONIX ENCODER)	1	B
12	170853	PRINT HEAD HOLDER MOUNT BRACKET	1	B

169012 ASSEMBLY, INKJET HEAD (STANDARD HAND, SHOWN)
 169012-001 ASSEMBLY, INKJET HEAD, OPP (OPPOSITE HAND)

SHEET 2 OF 3
MOUNT ASSEMBLY
CITRONIX INKJET HEAD
169012



SHEET 3 OF 3
MOUNT ASSEMBLY
CITRONIX INKJET HEAD
169012

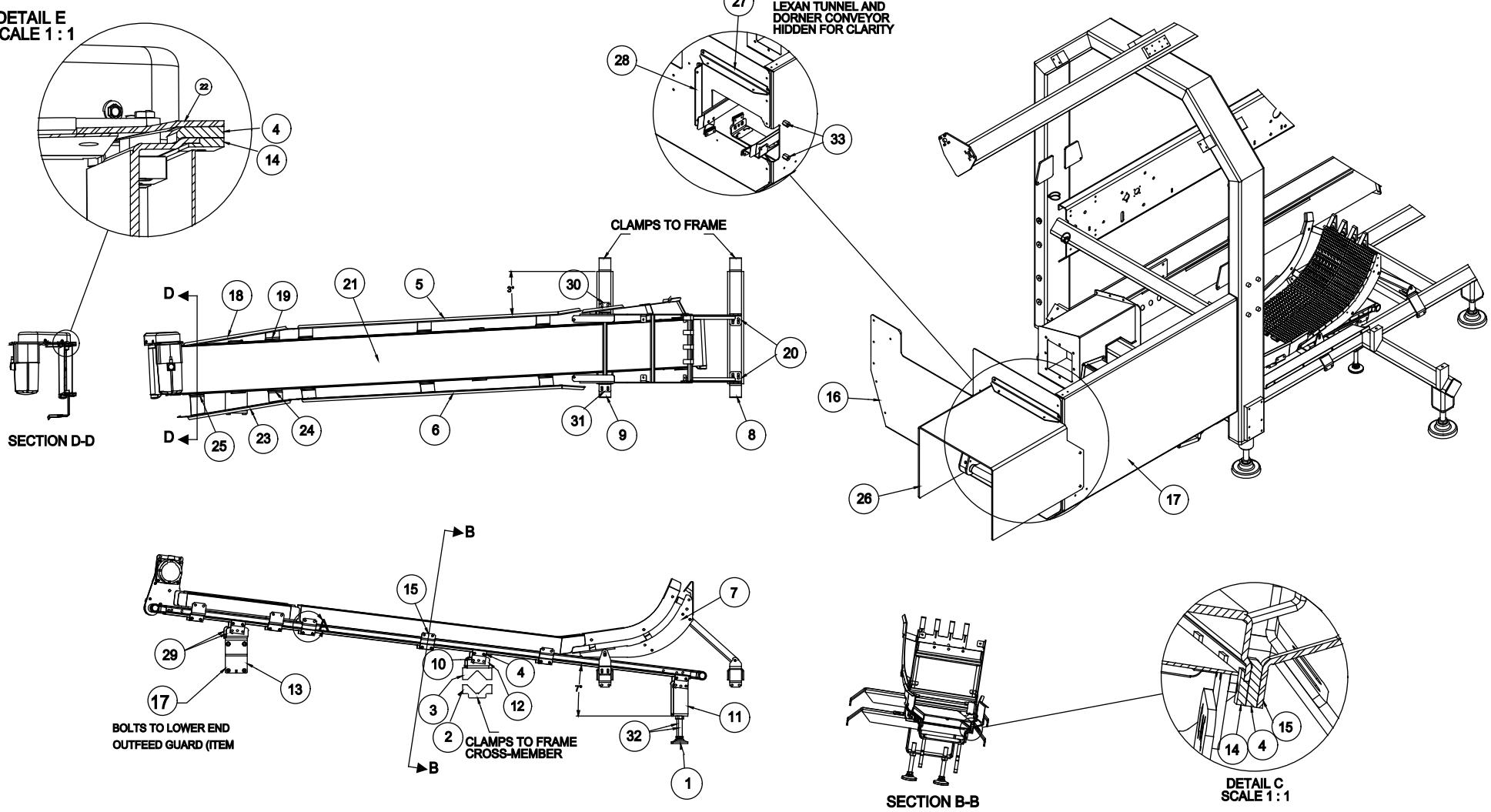
SHEET 1 OF 3
ENTERPRISE ABORT CONVEYOR DORNER
WITH ROLLER CHUTE & SS MESH TUNNEL
170930

Find Num	Part Number	Item Description	Qty	Rev
				A
1	118275	FOT-Foot	2	A
2	152345	CLAMP, TURNED TUBE	2	A
3	154714	BRACKET, TUBE CLAMP	2	A
4	164334	CLAMP, CONVEYOR MTG	16	A
5	168256	SIDE GUIDE, LOWER	1	A
6	168256-001	SIDE GUIDE, LOWER - MIRROR	1	A
7	168286	ABORT CHUTE RAMP ASSEMBLY	1	A
8	168322	SUPPORT BEAM A, ABORT CHUTE	1	A
9	168326	SUPPORT BEAM B, ABORT CHUTE	1	A
10	168361	COUPLING PLATE, LAUNCH CONVEYOR	6	A
11	168362	BRACKET, CONVEYOR FOOT	1	A
12	168363	BRACKET, MIDDLE CONV MTG	1	A
13	168370	SUPPORT BRACKET, ABORT CONVEYOR	1	A
14	168382	COUPLING PLATE, ABORT CONVEYOR	10	A
15	168413	SIDE GUIDE MOUNT BRACKET, ABORT CONVEYOR	6	A
16	168421	GUARD, OUTFEED END, ABORT CONVEYOR	1	B
17	168425	GUARD, LOAD SIDE OUTFEED	1	B
18	168427	JOGGED SIDE GUIDE, ABORT CONVEYOR	1	A
19	168429	JOGGED SIDE GUIDE BRACKET A, ABORT CONVEYOR	1	A
20	168438	RAMP MOUNT PLATE C	2	A
21	168446	CNV-Conveyor	1	B
22	168471	JOGGED SIDE GUIDE BRACKET B, ABORT CONVEYOR	1	B
23	168477	JOGGED SIDE GUIDE, ABORT CONVEYOR, OPP-SIDE	1	A
24	168479	JOGGED SIDE GUIDE BRACKET C, ABORT CONVEYOR	1	B
25	168481	JOGGED SIDE GUIDE BRACKET D, ABORT CONVEYOR	1	A
26	170910	SS MESH TUNNEL, ABORT CONVEYOR	1	B
27	168484	LEXAN TUNNEL MOUNT ANGLE A	1	A
28	168495	LEXAN TUNNEL MOUNT ANGLE B	1	A
29	168499	BRACKET, MIDDLE CONV MTG	2	A
30	168504	RAMP MOUNT PLATE B	1	A
31	168505	RAMP MOUNT PLATE A	1	A
32	B35SM160550	STUD, M16 THREAD, X 5-1/2"	2	A
33	B78080100020	HEX SPACER, METRIC	2	-
50	DELETIONS	DELETION LIST	1	-

SHEET 2 OF 3

**ENTERPRISE ABORT CONVEYOR DORNER
WITH ROLLER CHUTE & SS MESH TUNNEL
170930**

DETAIL E
SCALE 1:1



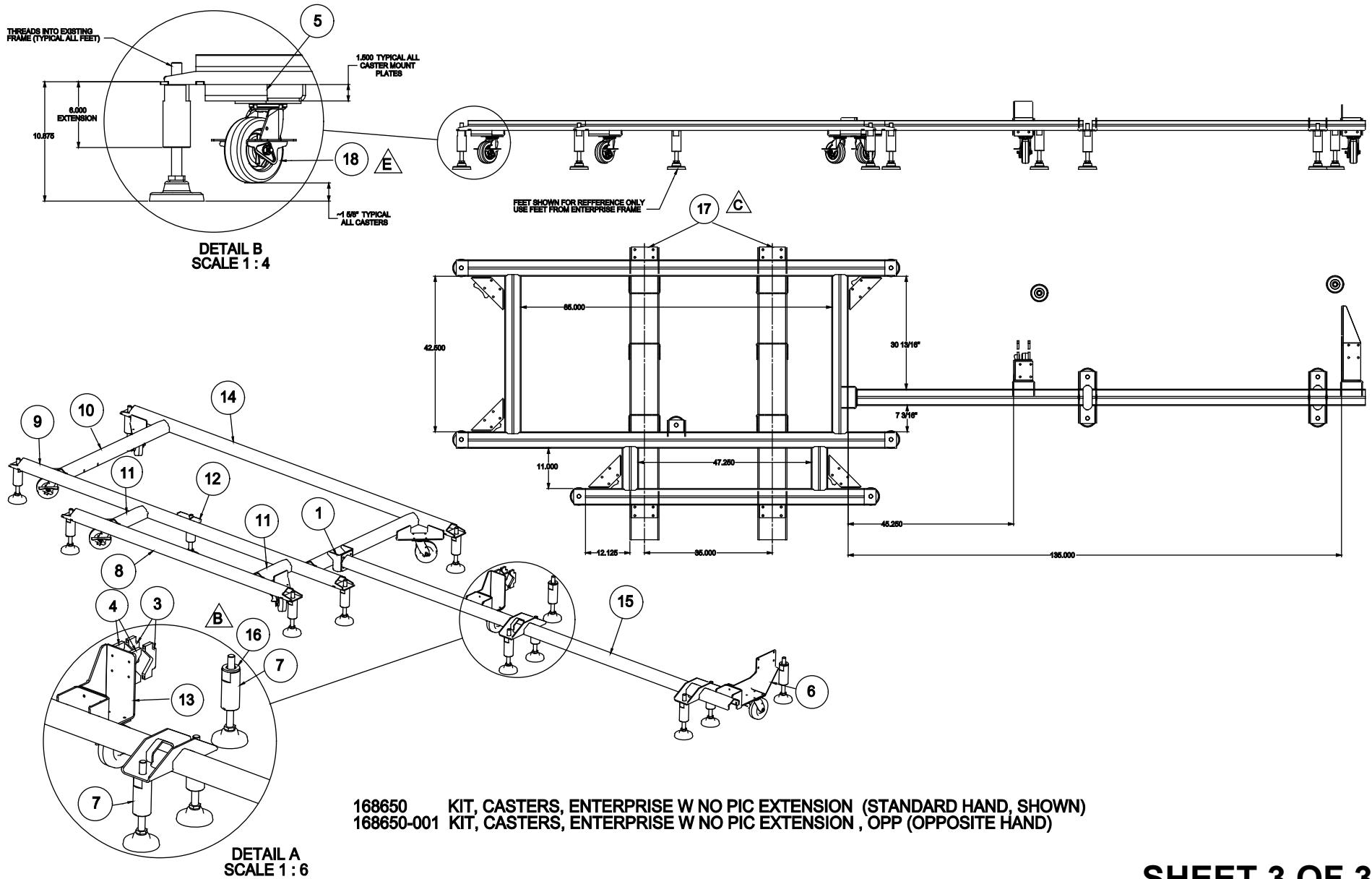
168247 ABORT CONVEYOR ASSEMBLY, ENTERPRISE (STANDARD HAND, SHOWN)
168247-001 ABORT CONVEYOR ASSEMBLY, ENTERPRISE, OPP (OPPOSITE HAND)

SHEET 3 OF 3
ENTERPRISE ABORT CONVEYOR DORNER
WITH ROLLER CHUTE & SS MESH TUNNEL
170930

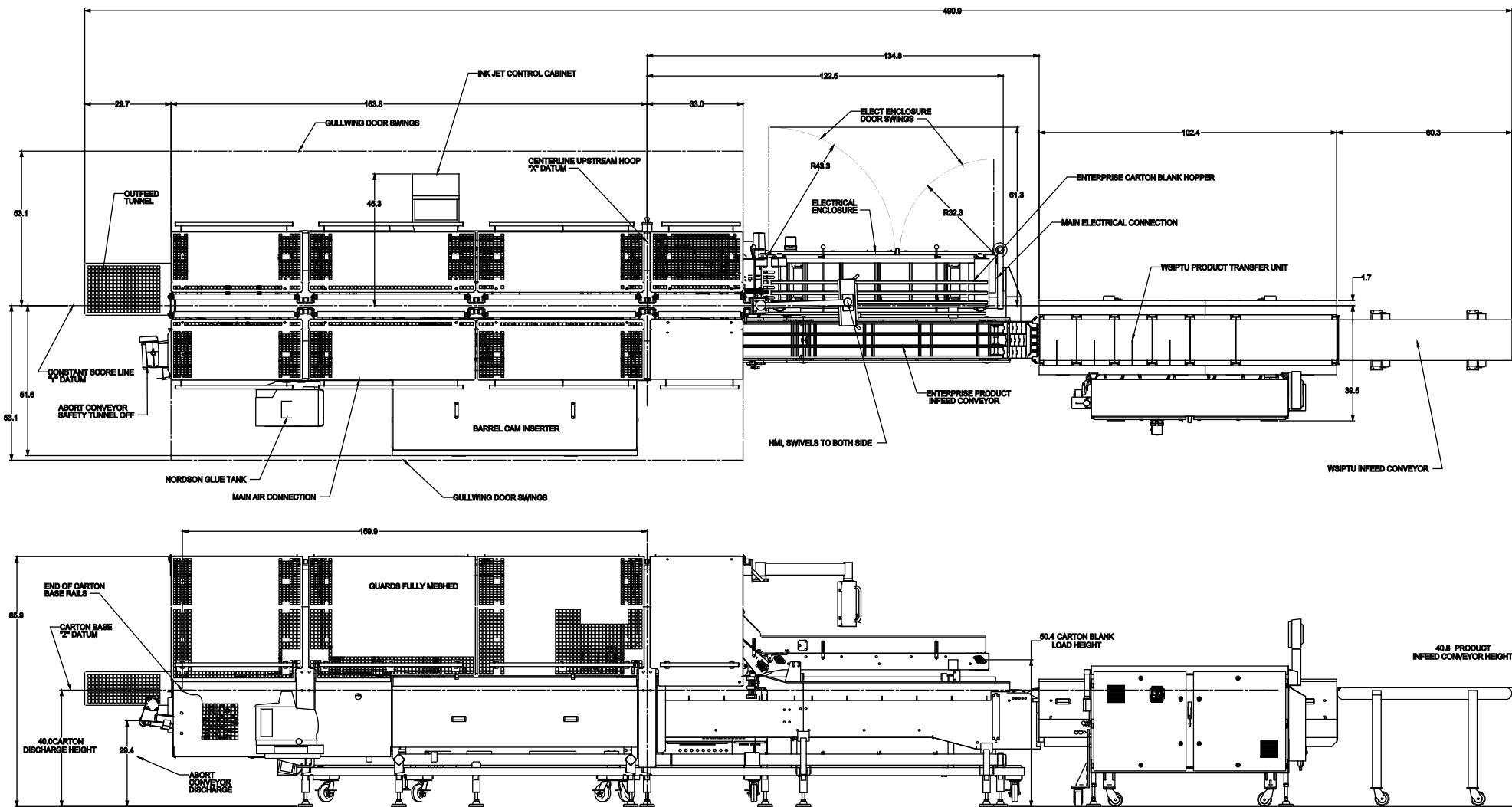
**SHEET 1 OF 3
KIT, CASTERS, ENTERPRISE
W/ NO PIC EXTENSION
168650**

Find Num	Part Number	Item Description	Qty	Rev
				E
1	168851	MOUNT PLATE	1	B
2	152233	BRACKET, VERT. GUN MTG	7	A
3	152345	CLAMP, TURNED TUBE	2	A
4	154714	BRACKET, TUBE CLAMP	2	A
5	168692	CASTER MOUNT PLATE A	5	A
6	168710	CASTER MOUNT PLATE B	1	A
7	168712	EXTENSION STILT WELDMENT	13	A
8	168721	MAIN BEAM B, PORTABILITY KIT FRAME	1	B
9	168723	MAIN BEAM A, PORTABILITY KIT FRAME	1	B
10	168724	CROSS BEAM A, PORTABILITY KIT FRAME	2	A
11	168782	CROSS BEAM B, PORTABILITY KIT FRAME	2	A
12	168792	LEG SUPPORT MOUNT BRACKET	1	A
13	168803	CASTER MOUNT PLATE C	1	A
14	168828	MAIN BEAM B, PORTABILITY KIT FRAME	1	C
15	168849	PIC PORTABILITY KIT WELDMENT	1	A
16	169315	EXTENSION BLOCK SPACER	2	A
17	169485	FORK TUBE ASSEMBLY, ENTERPRISE W/ PORTABILITY KIT	1	A
18	152333	CTR-Caster	7	A
50	DELETIONS	DELETION LIST	1	-

SHEET 2 OF 3
KIT, CASTERS, ENTERPRISE
W/ NO PIC EXTENSION
168650



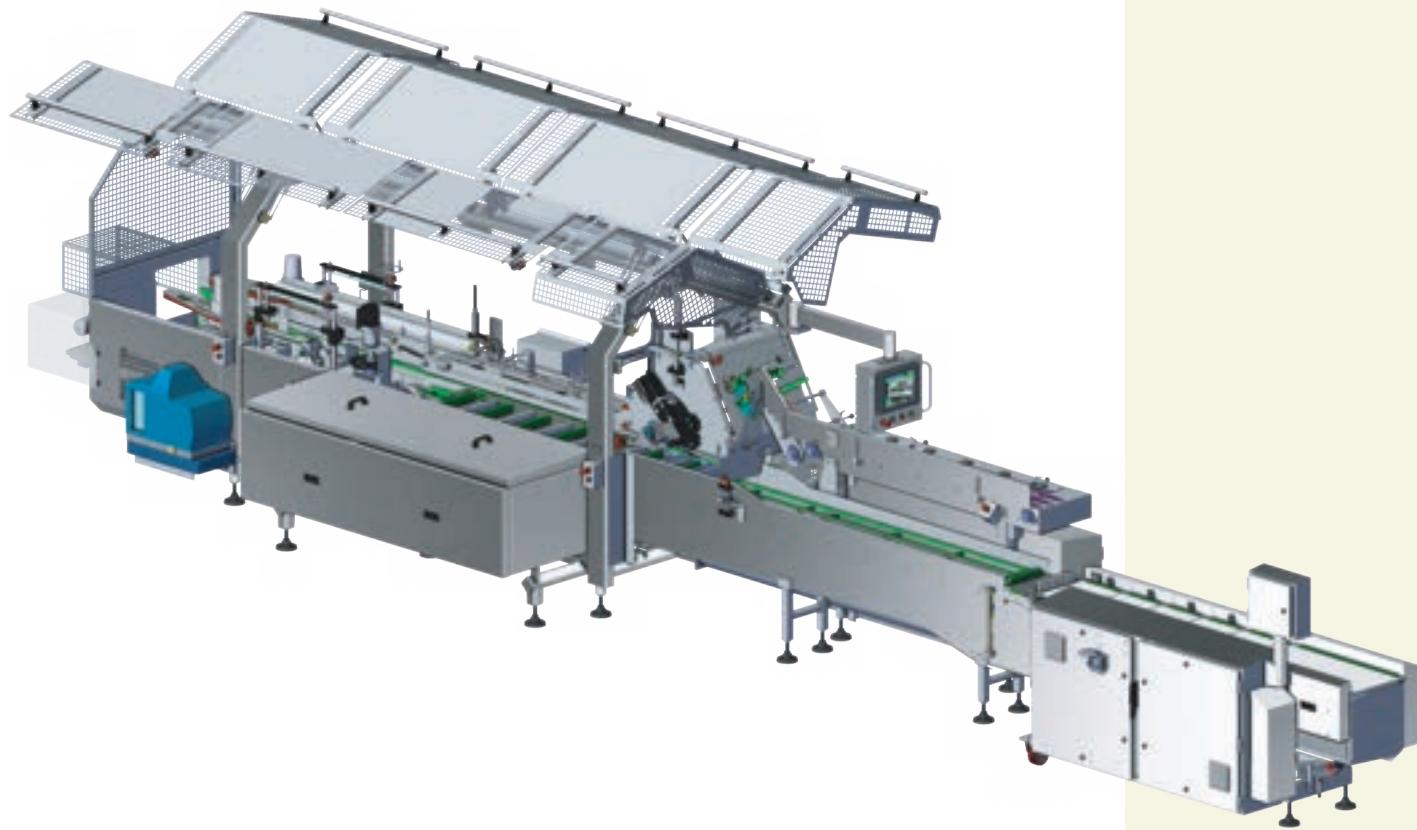
SHEET 3 OF 3
KIT, CASTERS, ENTERPRISE
W/ NO PIC EXTENSION
168650



NOTE: MACHINE SHOWN WITH CASTER KIT (SERIAL NO ENT-117)
 HEIGHT ADJUSTABLE PLUS OR MINUS 2"
 FROM DIMENSIONS SHOW WITHOUT CASTER KIT
 BUT WITH LEG EXTENSIONS (SERIAL NO ENT-118)

**LINE LAYOUT, ENTERPRISE WITH WSIPTU INFEED
 HS5160, PORTABILITY KIT, ELEVATED KIT**

16-4485



ENTERPRISE

Endload Cartoner
SCHWANS - ATLANTA
HS5160

HOME

RECOMMENDED MECH SPARE PARTS
ENTERPRISE 12" PIC INFEED
A HS5160 & HS5163 SCHWANS
SP01550-A

Find Num	Part Numb	Item Description	Qty	Rev	References
				B	10/31/2016 10:54:18 AM EDT
0	011165P	FUS-Fuse	2	A	
0	044232P	FUS-Fuse	2	A	
0	065524	FUS-Fuse	3	-	
0	086667	FUS-Fuse	3	A	
0	096685	FUS-Fuse	3	A	
0	114543	FUS-Fuse	3	A	
0	117610	FUS-Fuse	3	A	
0	125063	FUS-Fuse	3	A	
0	165921	BRG-Bearing	3	A	
0	P0072510	FUS-Fuse	1	A	
200	REF	REF	1	A	FLIGHT CHAIN ASSEMBLY, MAIN FRAME
207	123371	LUG-Lug	2	G	
210	123371-00	LUG-Lug	2	E	
211	123299	LUG-Lug	2	F	
212	123299-00	LUG-Lug	2	D	
700	REF	REF	1	A	CARTON FEEDING ASSEMBLY
703	173072	ALUM FEED STEM, SPECIAL VAC CUPS	6	A	
705	131872	PMP-Pump	3	A	
900	REF	REF	1	A	LOADSIDE FLAP CONTROL, NO FLAP KICKER
915	111945	ASSY, COMPRESSION ROLLER	8	A	
1100	REF	REF	1	A	GLUE SYSTEM ASSEMBLY

RECOMMENDED MECH SPARE PARTS
ENTERPRISE 12" PIC INFEED
A HS5160 & HS5163 SCHWANS
SP01550-A

Find Num	Part Number	Item Description	Qty	Notes	Rev
					A
1	134720	TRF-Transformer	1		A
2	095476	FUS-Fuse	3		A
3	090318	FSH-Fuse Holder	1		D
4	090319	FSH-Fuse Holder	1		D
5	065524	FUS-Fuse	3		-
6	165521	FUS-Fuse	3		A
7	096685	FUS-Fuse	3		A
8	125063	FUS-Fuse	3		A
9	086667	FUS-Fuse	3		A
10	147260	FSH-Fuse Holder	1		A
11	114543	FUS-Fuse	2		A
12	044232P	FUS-Fuse	2		A
14	147259	FSH-Fuse Holder	1		A
15	011165P	FUS-Fuse	2		A
16	086816	FLT-Filter	1		B
17	136162	CBL-Cable	1		A
18	150283	DRV-Drive	1	DRV1305, DRV1345, DRV1405 OPTIONAL	A
19	160768	DRV-Drive	1		A
19	167932	SWT-Switch	3		A
20	150284	CON-Connector	1		A
21	150285	CON-Connector	1		A
22	165524	VFD-Variable Frequency Drive	1		A
23	150280	VFD-Variable Frequency Drive	1		A
24	150282	FLT-Filter	1		A
25	145859	SWT-Switch	1		A
26	136004	PWS-Power Supply	1		A
27	145349	HAN-Handle	1		A
28	145348	CBL-Cable	1		A
29	P0072510	FUS-Fuse	2		A

SHEET 1 OF 2
ELECTRICAL SPARE PARTS LIST
ENTERPRISE CARTONER, 480VAC, K5500
SP01536

Find Num	Part Number	Item Description	Qty	Notes	Rev
					A
30	012853P	THS-Thermostats	1		B
31	114719	CBL-Cable	1	VFD	A
32	117610	FUS-Fuse	3		A
33	094857	REL-Relay	1		B
34	157603	CNT-Contactor	1		A
35	159733	SRV-Servo Motor	1		B
36	159734	PWS-Power Supply	1		B
37	098036	ADP-Adapter	1		A
38	165762	SRV-Servo Motor	1	LS tucker, NLS tucker	A
39	156066	SRV-Servo Motor	1	retard flight chains, pusher flight chains, feeder, overhead confiner	B
40	165780	CBL-Cable	1		A
41	165781	CBL-Cable	1		A
42	165782	CBL-Cable	1		A
43	167662	ASSY, STACK LIGHT; HORN, BLUE, GREEN, YELLOW, RED; LED, IP65, 150MM POLE AND BASE, TERMINAL BLOCK CONNECTION	1		A
44	086500	PXS-Proximity Switch	1	2 for overhead confiner, 2 for inserter	A
45	011101P	CBL-Cable	1		C
46	017773P	CBL-Cable	1		B
47	143311	CBL-Cable	1		A
48	126832	SNR-Sensor	1	carton detect, glue photoeye, low hopper, hopper advance	A
49	143296	SWT-Switch	1		A
50	121378	PXS-Proximity Switch	1	hopper empty	A
51	N8800689	SNR-Sensor	1	product detect, overheight product	A
52	112541	GMT-Gear Motor	1	discharge belts	B
53	112542	GMT-Gear Motor	1	hopper belt	A
54	143696	CBL-Cable	1	For Inserter Jam Sensors and Overhead confiner sensors	A
55	114940	SWT-Switch	1		A
56	148576	CBL-Cable	1		A
57	139445	SWT-Switch	1	Optional glue tank disconnect.	A
58	169316	SRV-Servo Motor	1		A
59	159708	SRV-Servo Motor	1		C

SHEET 2 OF 2
ELECTRICAL SPARE PARTS LIST
ENTERPRISE CARTONER, 480VAC, K5500
SP01536

Find Num	Part Number	Item Description	Qty	Rev
				A
200	REF	REF	1	A
201	167053	RDC-Reducer	1	B
202	114545	WSH-Washer	1	A
203	134317	SPROCKET - 30T, NON ADJUSTABLE	1	A
204	111290	SPROCKET - 30T	1	A
205	119645	BFL-Bearing, Flange	1	B
206	080705	FOT-Foot	4	B
207	123371	LUG-Lug	2	G
208	P00451384	SRC-Spring Clip	4	-
209	P00451264	CVP-Cover Plate	4	-
210	123371-001	LUG-Lug	2	E
211	123299	LUG-Lug	2	F
212	123299-001	LUG-Lug	2	D
213	134415	BSH-Bushing	1	A
214	139691	NUT-Nut	2	A
215	143826	SPR-Spring	4	A
216	134724	CHN DID 2060N (7P = 10.5") (SEE NOTE ON PAGE TWO)	2	A
217	134210	TENSIONER BLOCK, PUSHER CHAIN	2	A
218	134211	TENSIONER BLOCK, RETARD CHAIN	2	A
219	134285	CARTON BASE RAIL - DOWNSTREAM NO 2	1	C
220	134271	CARTON BASE RAIL - UPSTREAM	1	C
221	134199	CHAIN RAIL NO 1	1	D
222	134206	CHAIN RAIL INSERT 1	1	B
223	134235	CHAIN RAIL NO 3	1	C
224	134235-001	CHAIN RAIL NO 4	1	C
225	134236	CHAIN RAIL INSERT 2	1	B
226	134236-001	CHAIN RAIL INSERT 3	1	B

SHEET 1 OF 8
RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
SP01550

227	134239	CHAIN RAIL INSERT 4	1	B
228	134239-001	CHAIN RAIL INSERT 5	1	C
229	134337	CHAIN RAIL INSERT 6	1	B
230	134338	CHAIN RAIL NO 5	1	C
232	134316	SPLINED FLANGED BUSHING, SS	1	C
233	134199-001	CHAIN RAIL NO 2	1	D
234	134338-001	CHAIN RAIL NO 6	1	C
235	134273	CARTON BASE RAIL - DOWNSTREAM NO 1	1	D
300	REF	REF	1	A
301	122519	COT-Counter	1	A
302	132354	BFL-Bearing, Flange	2	A
303	134469	ADJ SCREW - HANDWHEEL	1	B
304	134419	ADJUSTMENT SCREW, SLAVE	1	A
305	134475	IDLER ROLLER	1	A
400	REF	REF	1	A
401	145863	INSERTER PISTON ASSEMBLY, ENTERPRISE, PIC	2	C
402	B14N05002501904	SPACER, DELRIN, .50 OD, .25 ID X .190 LG,	6	A
403	145454	ROLLER, CAM FOLLOWER, 1.25" DIA	3	A
404	138169	BLN-Bearing, Linear	6	A
405	138175	ADP-Adapter	4	B
406	131692	SLD-Slide	3	B
407	132879	BSH-Bushing	6	B
408	145453	BSH-Bushing	3	A
409	147178	SHOULDER BOLT, CAM FOLLOWER, ENTERPRISE, PIC	3	A
410	027893P	SPR-Spring	3	-
411	133006	PIN, SPRING, PUSHER FACE ADAPTER	3	A
412	119645	BFL-Bearing, Flange	1	B
413	127421	CNL-Connecting Link	10	B
414	124529-1	CHN DID 2060N (5P = 7.5") (SEE NOTE ON PAGE TWO)	2	A
415	P00451354	RLL-Roller Link	5	B
416	107863	BRG-Bearing	2	A
417	134604	CAM, ABORT SWITCH	1	C

SHEET 2 OF 8

**RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
SP01550**

418	095176	BSH-Bushing	2	A
419	135728	CYL-Cylinder	1	B
420	109316	CLV-Clevis	1	A
421	135748	BSH-Bushing	2	A
422	136241	CYL-Cylinder	1	C
423	111966	RDE-Rod Eye (Cylinder End)	1	A
424	136243	BKT-Bracket	1	A
425	071554	SPR-Spring	2	-
426	B14S11206300304	SPACER, 1.12 OD X .63 ID.X .030" LG SS	6	A
500	REF	REF	1	A
501	136291	SPROCKET, PIC OUTER DRIVE	2	A
502	136317	SPROCKET, PIC CENTER DRIVE	1	A
503	136318	SPROCKET, CHAIN DRIVEN	2	A
504	136323	SPROCKET, TRANSFER DRIVE	1	A
505	B82UGR06625	WRS-Wear Strip	2	A
506	B84UGR06625	WRS-Wear Strip	1	A
507	B85UGR02150	WRS-Wear Strip	1	A
508	136359	SPROCKET, TRANS CHAIN PUSHER	1	B
509	136376	SPROCKET, TRANS CHAIN RETARD	1	A
510	136367	SPROCKET, TRANSFER CHAIN DRIVEN	1	A
511	114651	BSH-Bushing	2	A
512	B76E004011808	IDLER SPRKT,ER-8C;	2	-
513	143718	SPROCKET, TRANSFER DRIVEN, ADJUSTABLE	1	B
514	147379	GUIDE, INNER DOWNSTREAM CHAIN	1	A
515	119645	BFL-Bearing, Flange	2	B
516	070038	BRG-Bearing	2	-
517	123404-002	QUICK RELEASE TRANSFER CHAIN, 12" FLIGHTS	1	A
518	147389	LINK - TABLE TOP CHAIN 4", MODIFIED, LH	10	B
519	147388	LINK - TABLE TOP CHAIN 4", MODIFIED, RH	10	B
520	147390	LINK - TABLE TOP CHAIN 4", MODIFIED, CENTER	10	B
521	145729	TTC-Table Top Chain	80	A
522	B82UGR06000	WRS-Wear Strip	2	A

SHEET 3 OF 8

RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC

INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER

SP01550

523	B84UGR06000	WRS-Wear Strip	1	A
524	B85UGR06000	WRS-Wear Strip	1	A
525	B82UGR07000	WRS-Wear Strip	2	A
526	B84UGR07000	WRS-Wear Strip	1	A
527	B85UGR07000	WRS-Wear Strip	1	A
528	139235	BIN-Bearing Inserts	4	B
529	139910	PULLEY, IDLER, INNER PIC	2	A
530	139911	PULLEY, IDLER, OUTER PIC	2	B
531	B84UGR04800	WRS-Wear Strip	1	A
532	B85UGR04800	WRS-Wear Strip	1	A
533	B82UGR04800	WRS-Wear Strip	2	A
600	REF	REF	1	A
601	B76E005011408	IDLER SPRKT, 50A14 W/ER8C BRNG;.500" I.D., NICKEL PLATED	2	-
602	107725	BFL-Bearing, Flange	2	B
603	119091	BPB-Bearing, Pillow Block	2	A
604	B72E070028	PLATED BSH MRT 2012-30MM	2	-
605	143794	SPROCKET, ARTICLE BUCKET INNER DRIVE, 50 CH	1	A
606	162386	PLY-Pulley	1	B
607	162388	PLY-Pulley	1	B
608	162587	BLT-Belt	1	A
609	162434	BLT-Belt	1	A
610	162435	BLT-Belt	1	A
611	162436	BLT-Belt	1	A
612	162553	PLY-Pulley	1	A
700	REF	REF	1	A
701	139965	FEEDER GEARBOX SUBASSY, 12"	1	F
702	137079	VACUUM HOUSING, SMALL ADJUSTABLE	3	C
703	137078	ALUM FEED STEM, ADJUSTABLE, CELOX 9"	6	A
704	128565	VCP-Vacuum Cup	20	C
705	131872	PMP-Pump	3	A
706	057137P	CON-Connector	3	B
707	069948	HAN-Handle	3	B

SHEET 4 OF 8

RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
 INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
 SP01550

708	062167	FST-Fastener	4	-
709	132142	VAL-Valve	1	A
710	058033	CON-Connector	2	-
711	139691	NUT-Nut	2	A
712	140516	BLN-Bearing, Linear	2	A
713	140514	BLN-Bearing, Linear	2	A
714	132484	BLN-Bearing, Linear	2	A
715	140537	RAL-Rail	1	A
716	140538	RAL-Rail	1	A
717	140539	RAL-Rail	1	A
718	140554	BLT-Belt	1	A
719	140500	SHAFT, FEEDER ADJUSTING, DRIVEN	1	C
720	140501	SHAFT, FEEDER ADJUSTING, DRIVING	1	C
721	126351	BSH-Bushing	2	A
722	140573	BSH-Bushing	2	A
723	127281	COT-Counter	1	A
724	120093	TENSIONER ASSY	1	A
725	140508	MODIFICATION, PULLEY 30 TEETH T5 - 20MM BORE W/ KEY	1	A
800	REF	REF	1	A
801	168261	BLN-Bearing, Linear	1	A
802	168262	BLN-Bearing, Linear	1	A
803	110153	RDC-Reducer	1	D
804	121201	BFL-Bearing, Flange	2	B
805	139691	NUT-Nut	2	A
806	139700	BSH-Bushing	4	A
807	139713	SHAFT, OVERHEAD ADJUSTING HANDWHEEL	1	A
808	139714	MODIFICATION, PULLEY 30 TEETH T5	1	A
809	139715	WSH-Washer	2	A
810	126351	BSH-Bushing	2	A
811	139738	COT-Counter	1	A
812	139742	SHAFT, OVERHEAD ADJUSTING, DRIVEN	2	A
813	120093	TENSIONER ASSY	1	A

SHEET 5 OF 8
**RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
 INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
 SP01550**

814	139745	BLT-Belt	1	A
815	111945	ASSY,COMPRESSION ROLLER	4	A
816	140312	BLT-Belt	1	B
817	107862	BRG-Bearing	2	A
900	REF	REF	1	A
901	139615	TUCKER DISC, MID RANGE	1	C
902	134588	STC-Set Collar	1	B
903	110153	RDC-Reducer	1	D
904	121201	BFL-Bearing, Flange	1	B
905	139691	NUT-Nut	2	A
906	139700	BSH-Bushing	1	A
907	139713	SHAFT, OVERHEAD ADJUSTING HANDWHEEL	1	A
908	139714	MODIFICATION, PULLEY 30 TEETH T5	1	A
909	139715	WSH-Washer	2	A
910	126351	BSH-Bushing	1	A
911	139738	COT-Counter	1	A
912	139742	SHAFT, OVERHEAD ADJUSTING, DRIVEN	1	A
913	120093	TENSIONER ASSY	1	A
914	139745	BLT-Belt	1	A
915	111945	ASSY,COMPRESSION ROLLER	4	A
916	140312	BLT-Belt	1	B
917	107862	BRG-Bearing	2	A
918	120402	HAN-Handle	1	B
919	114576	BSH-Bushing	6	A
920	115292	WSH-Washer	1	A
921	154332	CYL-Cylinder	1	A
922	145223	FINGERED HOLD DOWN, SCORELINE OVERHEAD	1	C
1000	REF	REF	1	A
1001	143970	BLT-Belt	20	A
1002	121201	BFL-Bearing, Flange	2	B
1003	140915	BFL-Bearing, Flange	2	A
1004	140962	BSH-Bushing	2	A

SHEET 6 OF 8

**RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
SP01550**

1005	118338	BSH-Bushing	1	A
1006	140963	BSH-Bushing	1	A
1007	132476	PGR-Plunger	1	A
1008	125560	CHN-Chain	3	A
1009	140731	DRIVE PULLEY, MIDRANGE CARTONER	2	A
1010	140842	MODIFICATION TO 121630, BSH IGU GFM-3842-22	2	A
1100	REF	REF	1	A
1101	139677	GUN-Gun	1	B
1102	126608	VAL-Valve	1	A
1103	127113	REG-Regulator	1	A
1104	P0011837	HOS-Hose	1	-
1105	P0011834	HOS-Hose	1	-
1200	REF	REF	1	A
1201	114614	BSH-Bushing	2	A
1202	132354	BFL-Bearing, Flange	4	A
1203	154503	GAS-Gas Strut	4	A
1400	REF	REF	1	A
1401	158355	REG-Regulator	1	C
1402	141931	VAL-Valve	1	B
1403	142805	VAL-Valve	1	A
1404	165740	VAL-Valve	1	A
1405	N8500015	VAL-Valve	1	A
1	123625	REG-Regulator	1	A
1	125152	BFL AMI MUFL 002 15MM BORE, TWO BOLT FLANGE BEARING SET SCREW, SS HOUSING WITH STN STL INSERT	2	A
1	144356	SPLIT SPROCKET; 35B30H WITH 30MM BORE	1	D
1	B79E3511620MM	35B16H, 20MM BORE SPROCKET	1	A
1	REF	REF	REF	A
1	165308	RDC-Reducer	1	A
1	142620	GAS-Gas Strut	2	A
1	119645	BFL-Bearing, Flange	2	B
1	127421	CNL-Connecting Link	8	B
1	142307	BLN-Bearing, Linear	2	A
1	147887	SWITCH BAR, CONFINER CAM, V2	1	A
1	147887-001	SWITCH BAR, CONFINER CAM, OPP HAND, V2	1	A

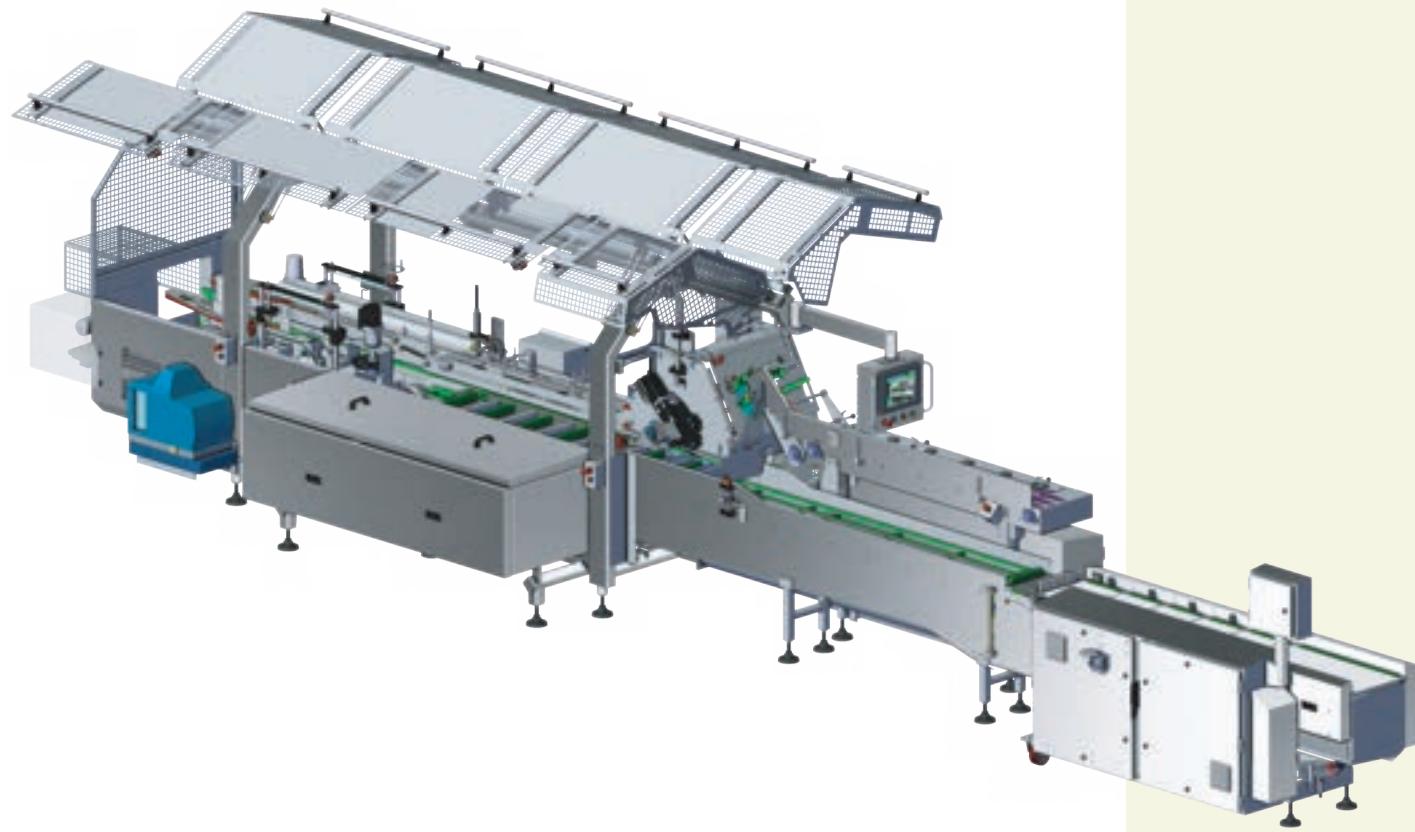
SHEET 5 OF 8

**RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
SP01550**

1	147933	CAM, OVERLOAD DETECT, V2	1	A
1	147933-001	CAM, OVERLOAD DETECT, OPP HAND, V2	1	A
1	144282	SWITCH BAR, DOWNSTREAM	1	B
1	144282-001	SWITCH BAR, DOWNSTREAM, OPP HAND	1	B
1	135728	CYL-Cylinder	2	B
1	147892	BSH-Bushing	4	A
1	128817	BSH-Bushing	4	A
1	000366P	BCF-Bearing, Cam Follow	8	-
1	124386	BRG-Bearing	4	A
1	147865	ASSEMBLY, OVERHEAD CONFINER HEAD, V2	2	A
1	114930	CYL-Cylinder	1	B
1	142608	SPR-Spring	6	A
1	REF	REF	1	A
1	143336	UPPER GUIDE WMT	1	A
1	143336-001	UPPER GUIDE WMT; OPP. HAND	1	A
1	143337	SIDE GUIDE WMT	1	B
1	147885	SIDE GUIDE WMT, EXTENDED	1	A
1	143338	LOWER GUIDE WMT	1	A
1	143339-200	TOP & BOTTOM DETENT; A = 2.00"	1	A
1	135557	SIDE TAB, CELOX MTG GATE	2	B
1	132476	PGR-Plunger	4	A
1	159605	BAR, FLAP KICKER	1	D
1	158587	LOWER GUIDE WMT	1	A
1	158715-100	TOP & BOTTOM TAB; CARTON DEPTH < 8 IN / 'A' = 1.00"	1	A
1	168920	ENTERPRISE PIC LUG, RETARDING, HS5160	4	A
1	168921	ENTERPRISE PIC LUG, PUSHING, HS5160	4	A
1	168927	ENTERPRISE TRANSFER RETARDING LUG ASSEMBLY, HS-5160 - SIZE "A"	2	B
1	168923	ENTERPRISE TRANSFER PUSHING LUG ASSEMBLY, HS5160 - SIZE "A"	2	B
1	168991	PUSHER FACE ASSEMBLY HS5160 - CARTON A & B	2	C
1	B84UGR07200	WRS-Wear Strip	1	A
1	B85UGR07200	WRS-Wear Strip	1	A
1	B82UGR07200	WRS-Wear Strip	1	A
1	165674	SPRING LEAF;	4	B
1	165588	VANE, ROTARY, NARROW	1	A
1	165588-001	VANE, ROTARY, NARROW, OPP HAND	1	A

SHEET 8 OF 8

**RECOMMENDED MECH SPARE PARTS, ENTERPRISE 12" PIC
INFEED HS5160 & HS5163 SCHWANS, OVERHEAD CONFINER
SP01550**



ENTERPRISE

Endload Cartoner

SCHWANS - ATLANTA

HS5160



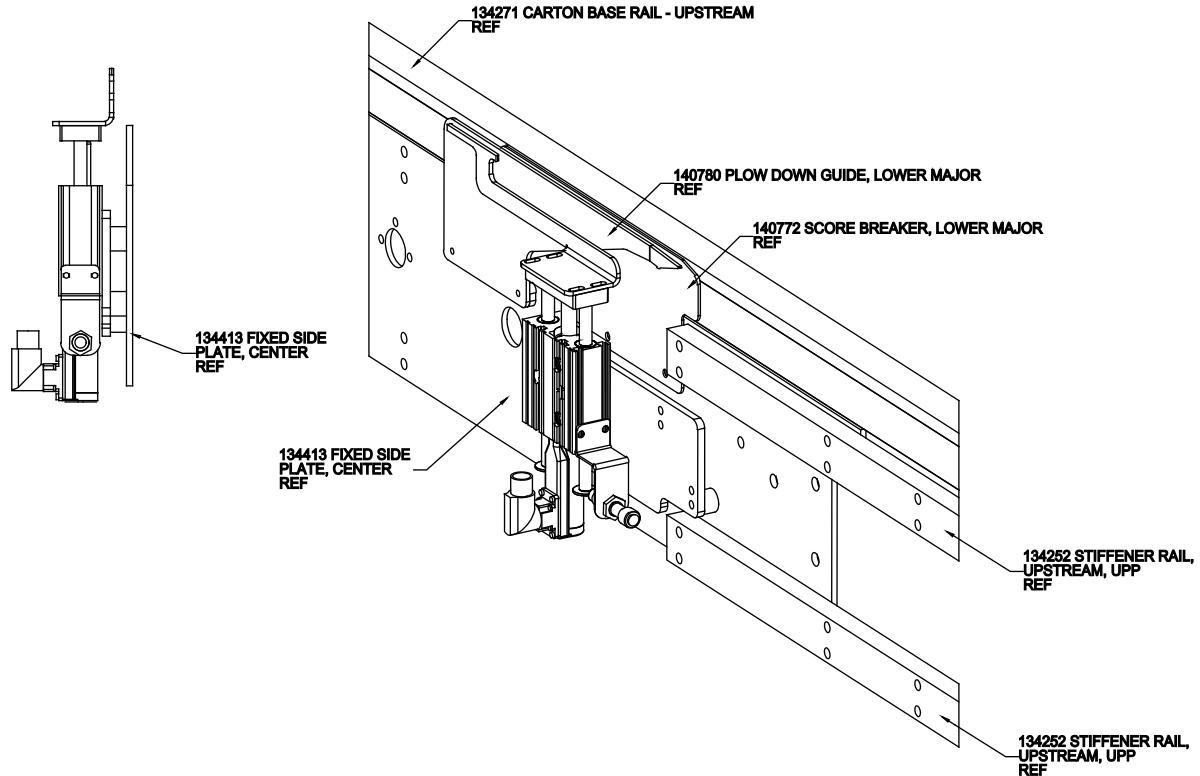
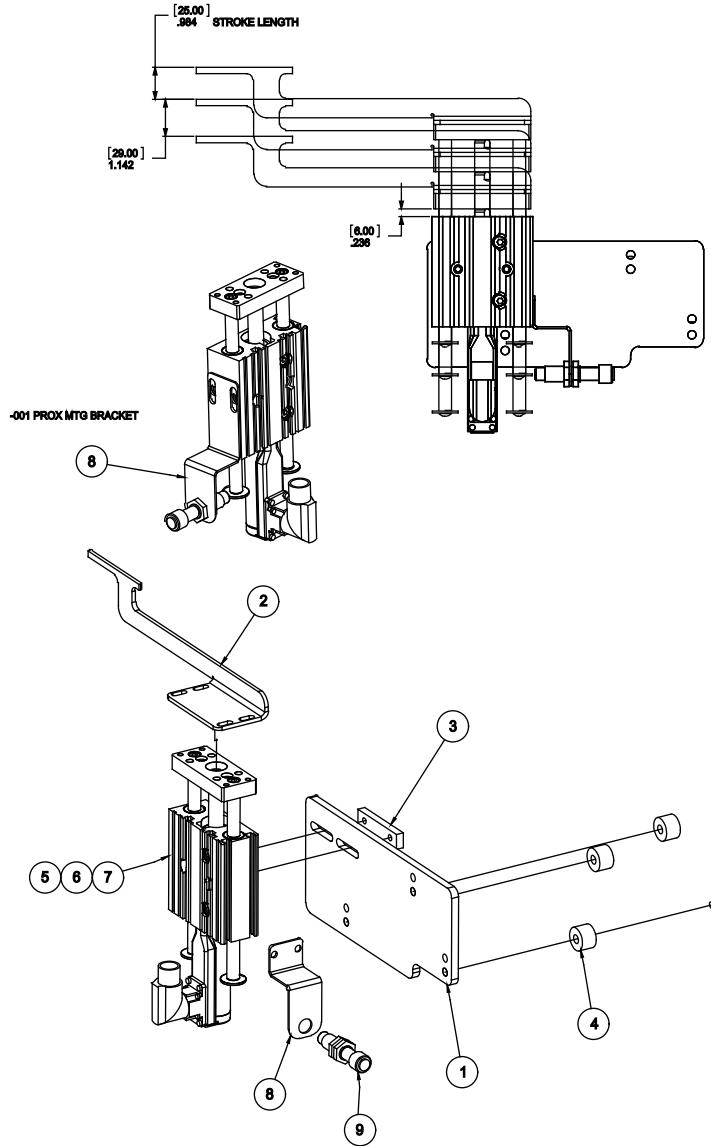
CUSTOM FITS

HS5160 SCHWANS

168789

Find Num	Part Number	Item Description	Qty	Rev
168789	CUSTOM FITS, HS5160 SCHWANS			K
1	159610	ASSEMBLY, SERVO FLAP KICKER	1	C
2	168891	HS-5160 GATE ASSY, CARTON A; 9.625" X 2.375" X 9.625"	1	A
3	168909	PRODUCT INSERTION ASSEMBLY, ENTERPRISE, 12" PIC HS5160 CARTON "A"	1	A
4	167752	PLATE, HOPPER FILLER	1	A
5	169839	STIFFENER, TOP COVER	1	A
6	171016	CON-Connector	1	A
7	158662	VIB-Vibrator	1	A
8	080678	VAL-Valve	1	A
9	057137P	CON-Connector	1	B
10	171022	FST-Fastener	1	A
11	128701	VEN-Vent Pneumatic	6	A
12	170801	TUCKER DISC, OCTAGON CARTON	1	E
13	B14S07502810004	SPACER	4	A
14	172847	GUIDE, LOWER MAJOR PLOW, HEAVY GAUGE	1	B
15	172848	FLAP PLOW, PIE CARTON, UPPER, TALL CARTON	1	A
16	172850	EXTENSION, LOWER SUPPORT	1	A
17	172899	BRACKET, TUCKER STABILIZATION	1	A
18	159373	HAN-Handle	2	A
19	173073	LABEL, ROTATION DIR	9	A
20	096484	STC-Set Collar	2	A
21	173305	GENTLE ABORT CHUTE RETROFIT KIT	1	B

CUSTOM FITS
HS5160 SCHWANS
168789

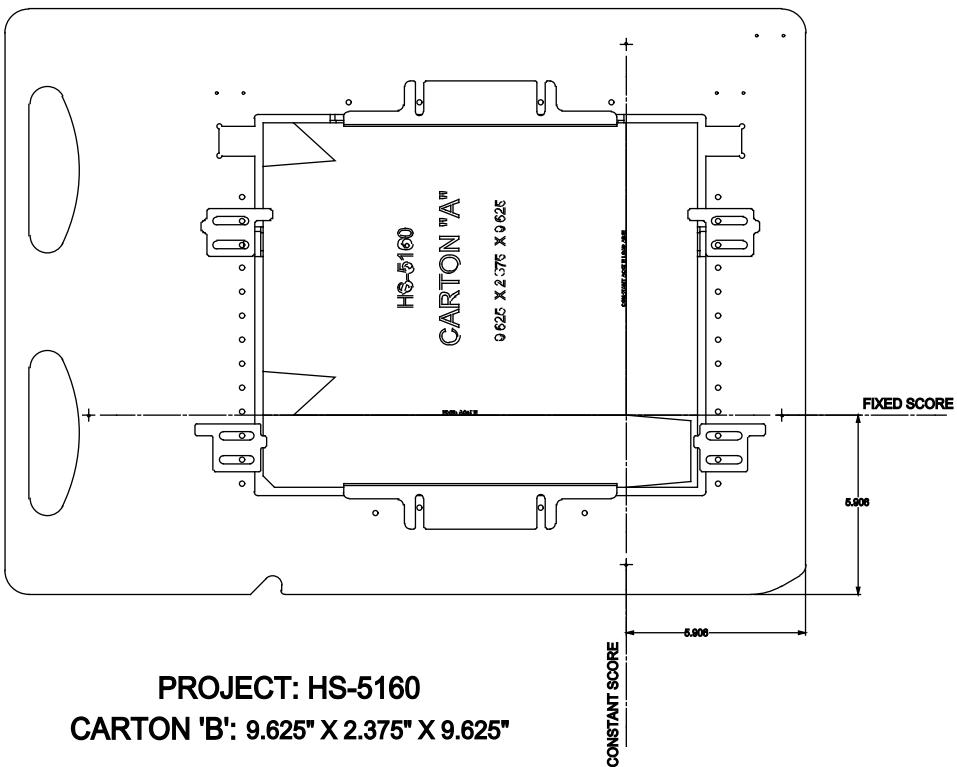
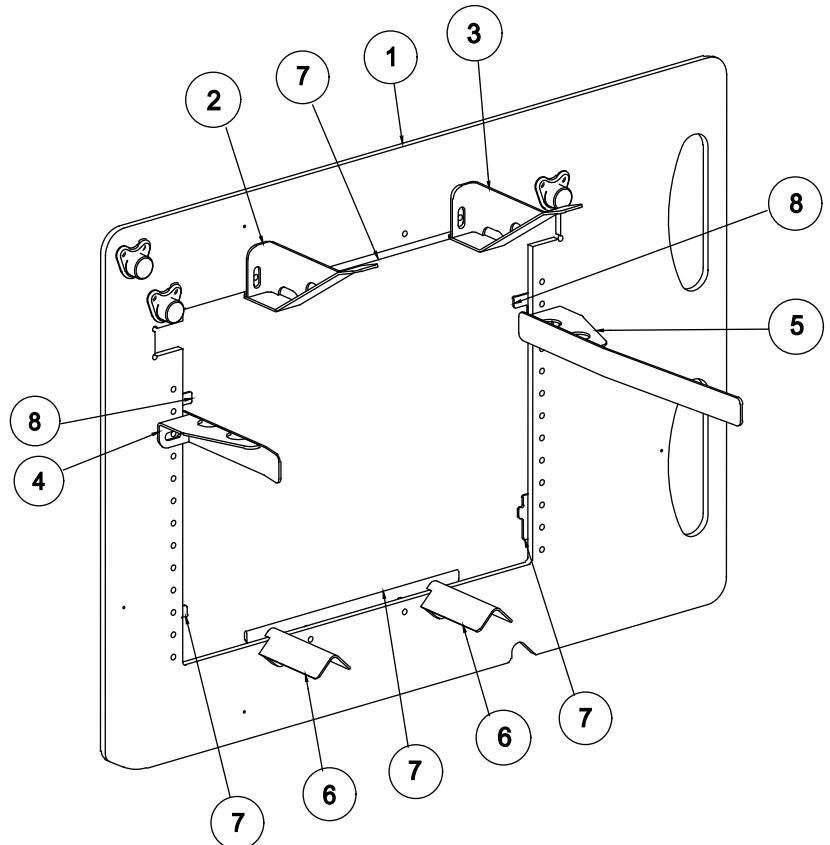


Find Num	Part Number	Item Description	Qty	Rev
1	159611	PLATE, KICKER MTG	1	A
2	159605	BAR-FLAP KICKER-WMT.	1	A
3	B77360500149605	NUT BAR, S.S.	1	A
4	B14S07502805004	SPACER, 3/4 OD, 9/32 ID X .500 LG	3	-
5	159709	SRV LMT H01-23X86/60-GF; LINEAR MOTOR, GUIDE, SLIDE BEARINGS	REF	A
6	159699	SRV LMT PS01-23X80-R; LINEAR MOTOR STATOR ,IP67	REF	A
7	159707	SRV LMT PL01-12X190/140; LINEAR MOTOR SLIDER	REF	A
8	159688	BRACKET, PROX MOUNTING	1	A
9	036770P	PXS-Proximity Switch	REF	B
100	DELETIONS	DELETION LIST	REF	-

ASSEMBLY, SERVO FLAP KICKER 159610

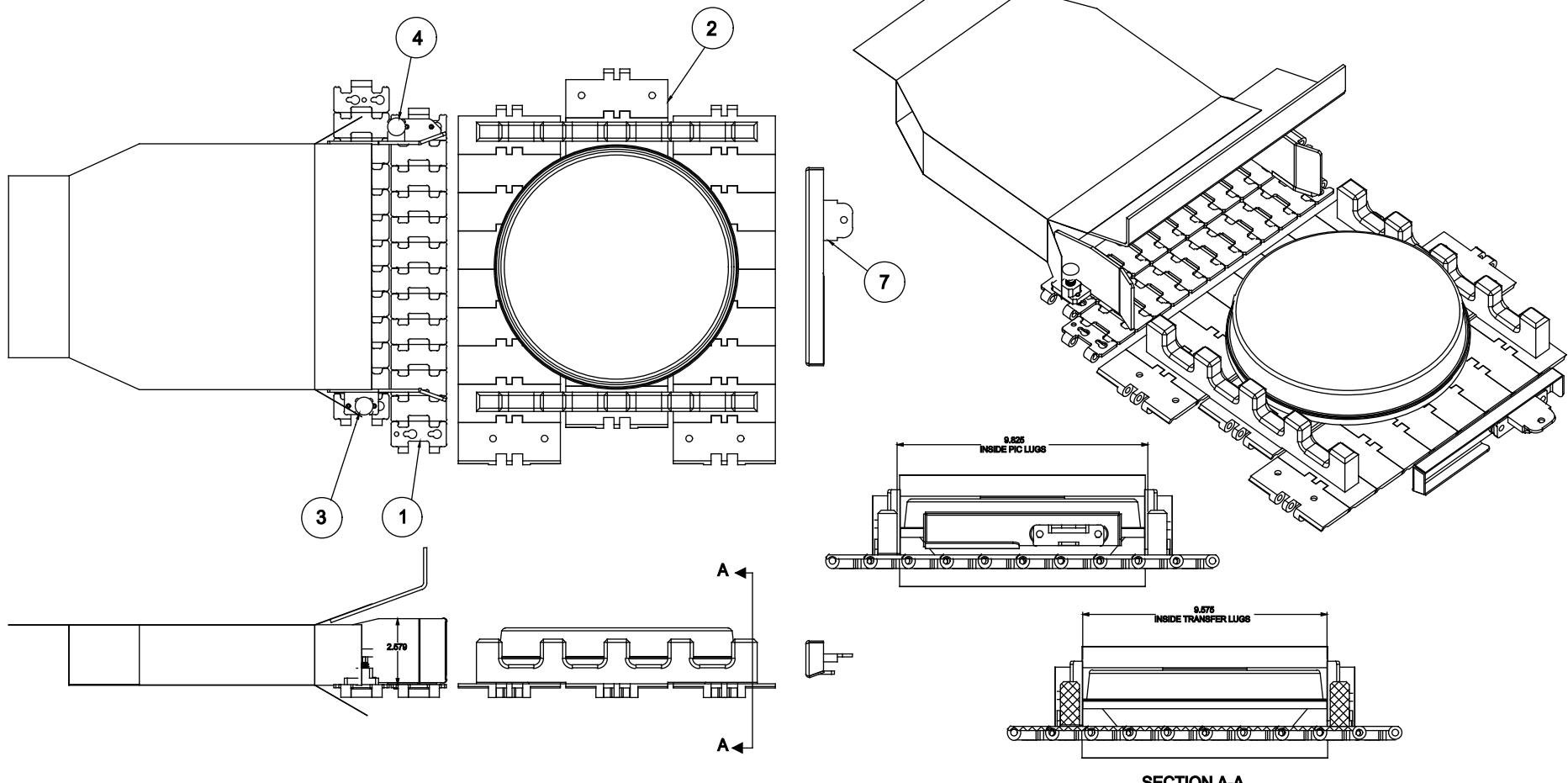
159610 SERVO FLAP KICKER ASSEMBLY (STANDARD HAND, SHOWN)
 159610-001 SERVO FLAP KICKER ASSEMBLY, OPP (OPPOSITE HAND)

Find Num	Part Number	Item Description	Qty	Rev
				A
1	168892	HS-5160 GATE, CARTON A; 9.625" X 2.375" X 9.625"	1	A
4	143337	SIDE GUIDE WMT	1	B
5	147885	SIDE GUIDE WMT, EXTENDED	1	A
6	143338	LOWER GUIDE WMT	2	A
7	143339-200	TOP & BOTTOM DETENT; A = 2.00"	2	A
8	135557	SIDE TAB, CELOX MTG GATE	4	B
9	166091	UPPER GUIDE WMT, LARGE OFFSET	2	A
10	167934	SWT-Switch	3	A



HS-5160 GATE ASSEMBLY, CARTON A
9.625" X 2.375" X 9.625"
168891

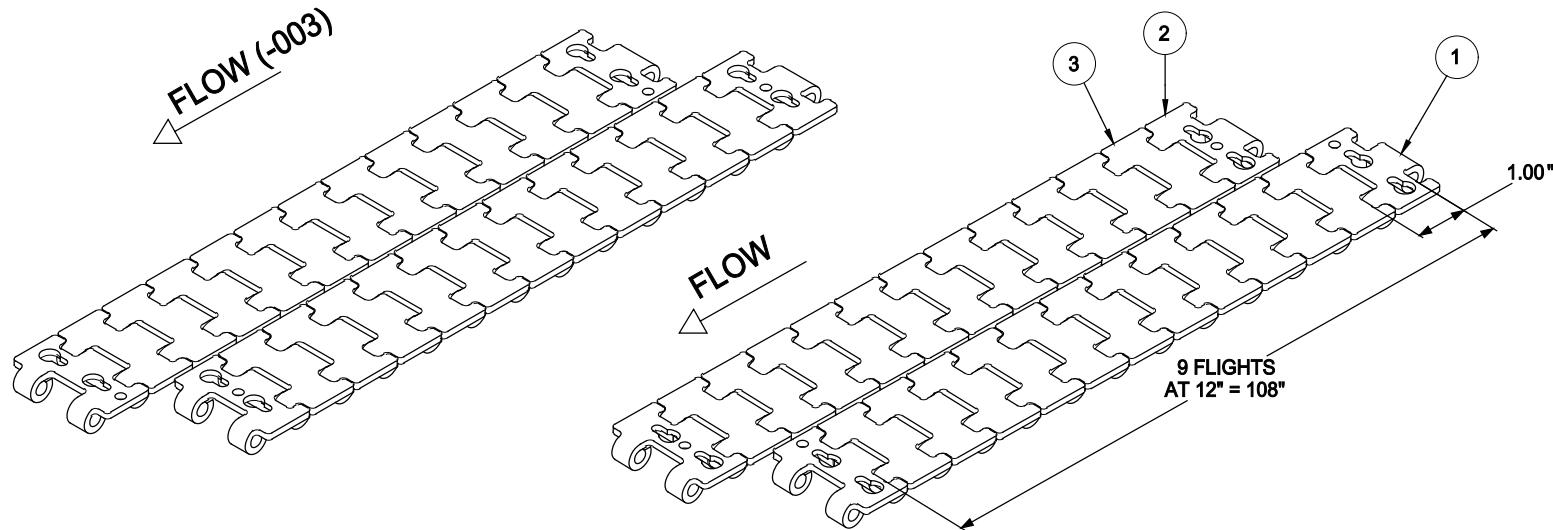
168909 PRODUCT INSERTION ASSEMBLY, ENTERPRISE, 12" PIC (STANDARD HAND, SHOWN)
 168909-001 PRODUCT INSERTION ASSEMBLY, ENTERPRISE, 12" PIC, OPP (OPPOSITE HAND)



CARTON A

Find Num	Part Number	Item Description	Qty	Rev
				A
1	123404-002	QUICK RELEASE TRANSFER CHAIN, 12" FLIGHTS	REF	A
2	168918	ENTERPRISE PIC CHAIN ASSY, NO EXT, CASTELLATED LUGS 12" FLIGHTS - COMPLETE CHAIN	1	A
3	168927	ENTERPRISE TRANSFER RETARDING LUG ASSEMBLY, HS-5160 - SIZE "A"	9	A
4	168923	ENTERPRISE TRANSFER PUSHING LUG ASSEMBLY, HS5160 - SIZE "A"	9	A
7	168991	PUSHER FACE ASSEMBLY HS5160 CARTON A & B	12	B

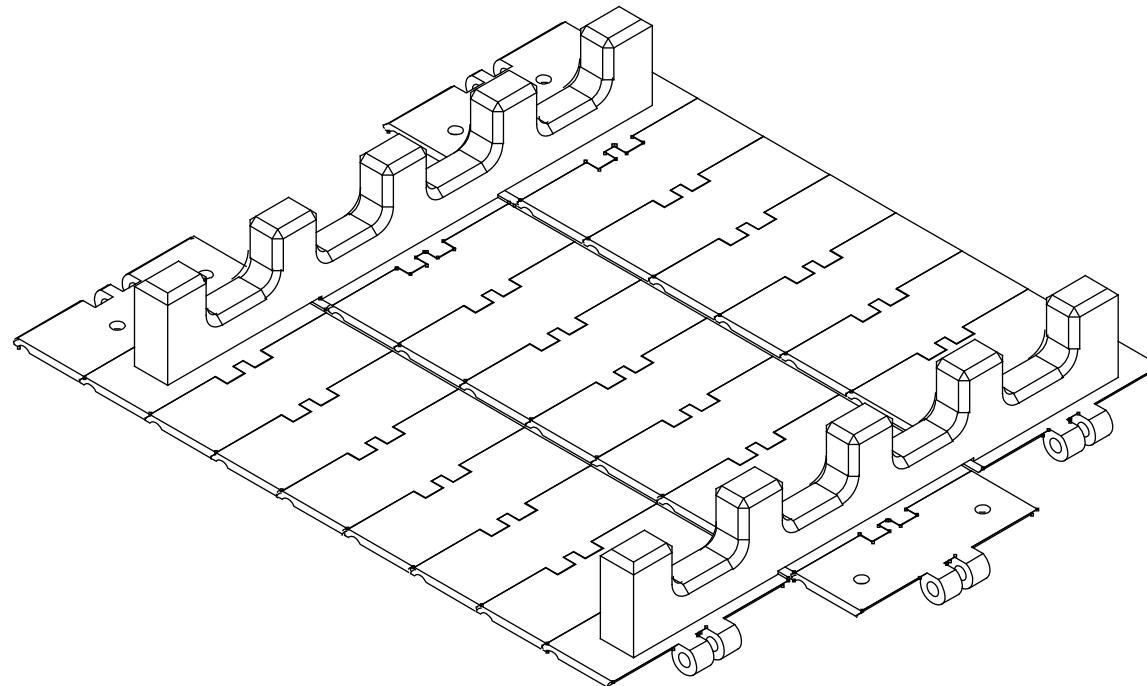
**PRODUCT INSERTION ASSEMBLY, ENTERPRISE
 12" PIC HS5160 CARTON "A"
 168909**



123404-002 QUICK RELEASE TRANSFER CHAIN, 12" FLIGHT (STANDARD HAND, SHOWN)
 123404-003 QUICK RELEASE TRANSFER CHAIN, 12" FLIGHT, OPP (OPPOSITE HAND)

Find Num	Part Number	Item Description	Qty	Rev
		CELOX		A
1	118285	LINK, TRANSFER CHAIN DRILL DETAILS 9 X 12" FLIGHTS	9	C
2	118269	LINK, TRANSFER CHAIN DRILL DETAILS 9 X 12" FLIGHTS	9	C
3	X0440030	STS T/TOP CHAIN 512 SERIES REX	16	A

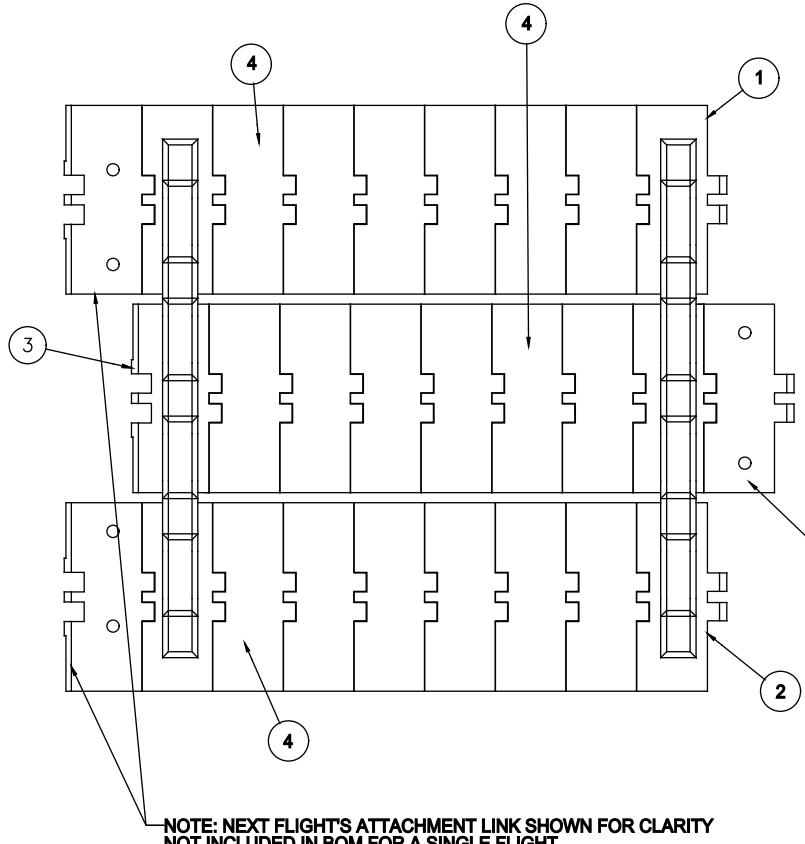
**QUICK RELEASE TRANSFER CHAIN
 12" FLIGHTS
 123404-002**



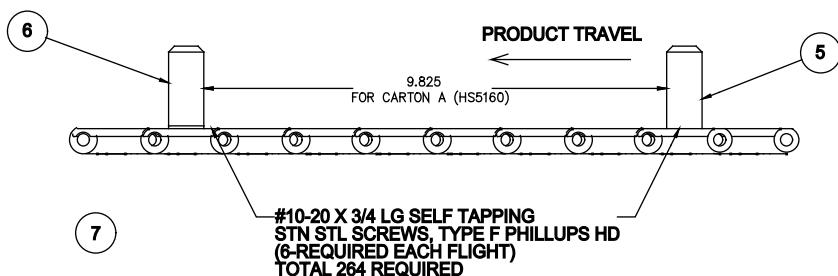
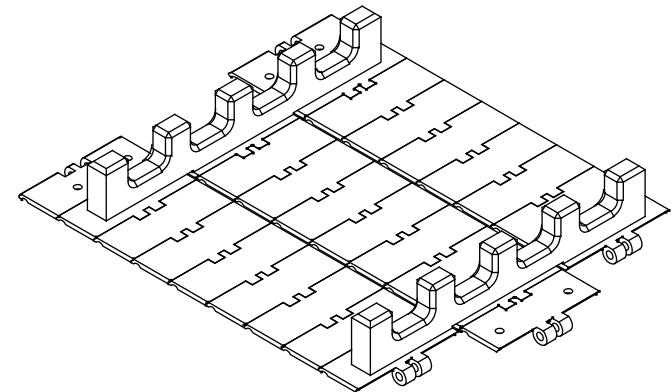
SHEET 1 OF 4
ENTERPRISE PIC CHAIN ASSEMBLY
NO EXT, CASTELLATED LUGS
12" FLIGHTS - COMPLETE CHAIN
168918

Find Num	Part Number	Item Description	Qty	Rev
				A
1	147388	LINK - TABLE TOP CHAIN 4", MODIFIED, RH	36	B
2	147389	LINK - TABLE TOP CHAIN 4", MODIFIED, LH	36	B
3	147390	LINK - TABLE TOP CHAIN 4", MODIFIED, CENTER	36	B
4	145729	TTC-Table Top Chain	756	A
5	168921	ENTERPRISE PIC LUG, PUSHING, HS5160	36	A
6	168920	ENTERPRISE PIC LUG, RETARDING, HS5160	36	A
7	FS	#10-20 X 3/4" S.S. TYPE F SELF TAPPING SCREW, PHILLUPS HD	216	-

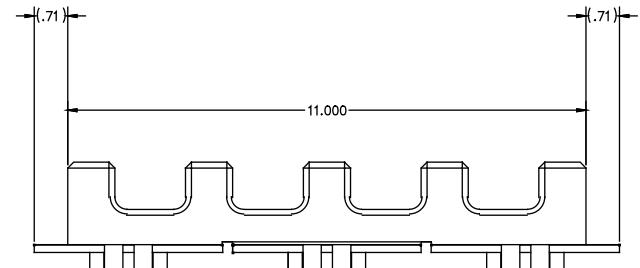
SHEET 2 OF 4
ENTERPRISE PIC CHAIN ASSEMBLY
NO EXT, CASTELLATED LUGS
12" FLIGHTS - COMPLETE CHAIN
168918



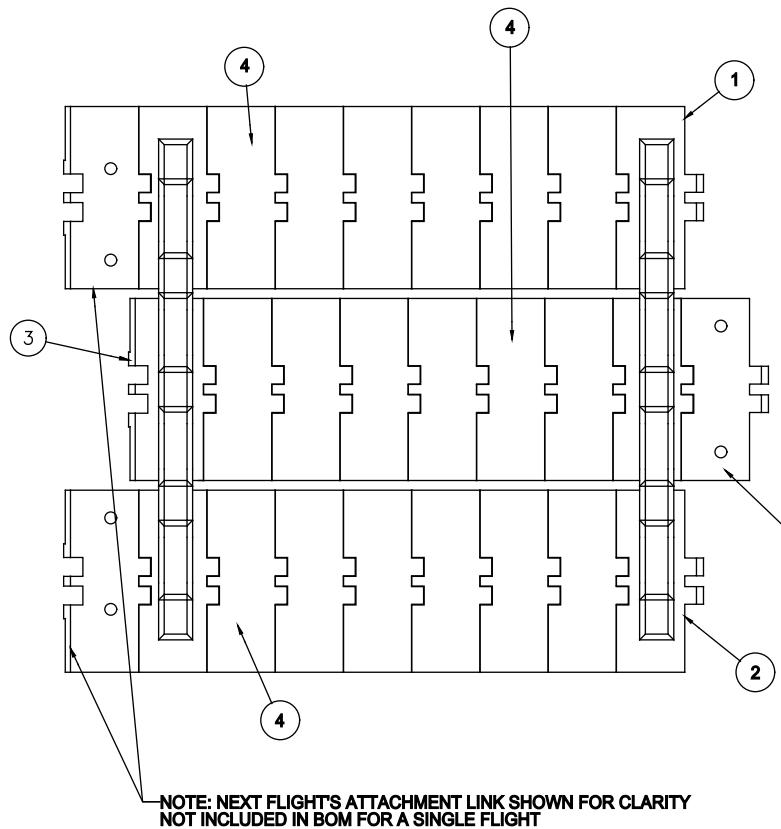
HS5160
CARTON A



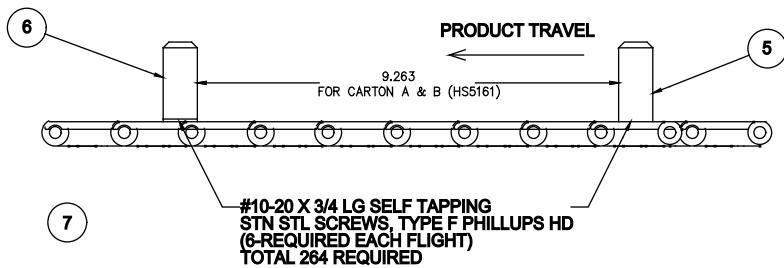
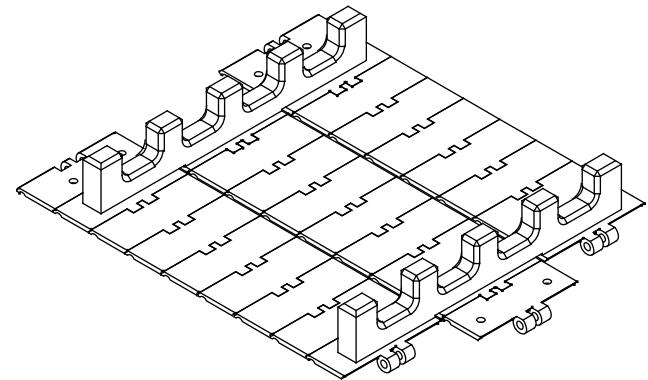
NOTE: SINGLE FLIGHT SHOWN, COMPLETE CHAIN = 44 FLIGHTS



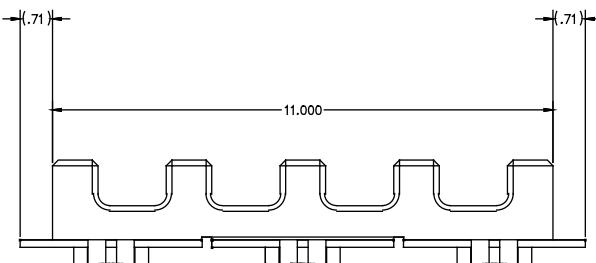
SHEET 3 OF 4
ENTERPRISE PIC CHAIN ASSEMBLY
NO EXT, CASTELLATED LUGS
12" FLIGHTS - COMPLETE CHAIN
168918



HS5161
CARTON A & B



NOTE: SINGLE FLIGHT SHOWN, COMPLETE CHAIN = 44 FLIGHTS



SHEET 4 OF 4
ENTERPRISE PIC CHAIN ASSEMBLY
NO EXT, CASTELLATED LUGS
12" FLIGHTS - COMPLETE CHAIN
168918

H2OMIT® Vent Drains, Type 4X



H2OMIT™

Industry Standards

Maintains UL/cUL Type 4, 4X rating when properly installed on a UL/cUL Type 4 or 4X enclosure.

UL 508A Component Recognized; Type 4, 4X; File No. E61997
cUL Component Recognized per CSA C22.2 No 94; Type 4, 4X;
File No. E61997

NEMA/EEMAC Type 4, 4X

Application

H2OMIT® Vent Drains allow accumulated water to drain out the bottom of an enclosure. The UL-approved vent drains also function as an air pressure equalizer, reducing the harmful effects of temperature-induced vacuums that could pull water and moisture into the enclosure.

Features

- Uses gravity to remove collected liquids
- One-way mechanical shut-off when pressure is equalized prevents water and contaminants from entering the enclosure
- Helps reduce corrosion that can limit the life of internal electrical and electronic components
- Installs in a 7/8-in. hole in the bottom of enclosure with provided nut or in a 1/2-in. NPT/NPS threaded conduit hub
- Installs in the bottom of mild steel, aluminum, stainless steel or non-metallic enclosures
- Maintains enclosure's UL Type rating when properly installed

Specifications

Stainless Steel Vent Drain

- Corrosion-resistant polyester material with a Type 304 stainless steel sleeve
- 2.00-in. long x 1.38-in outside diameter

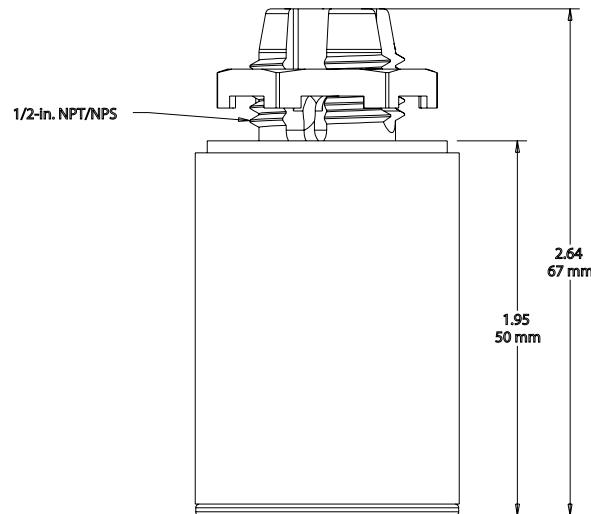
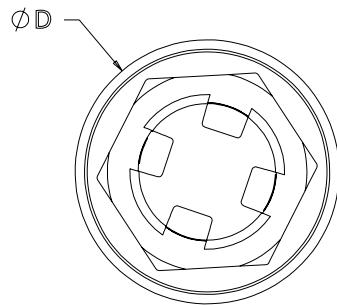
Non-Metallic Drain Vent

- Corrosion-resistant polyester material
- 2.00-in. long x 1.25-in. outside diameter

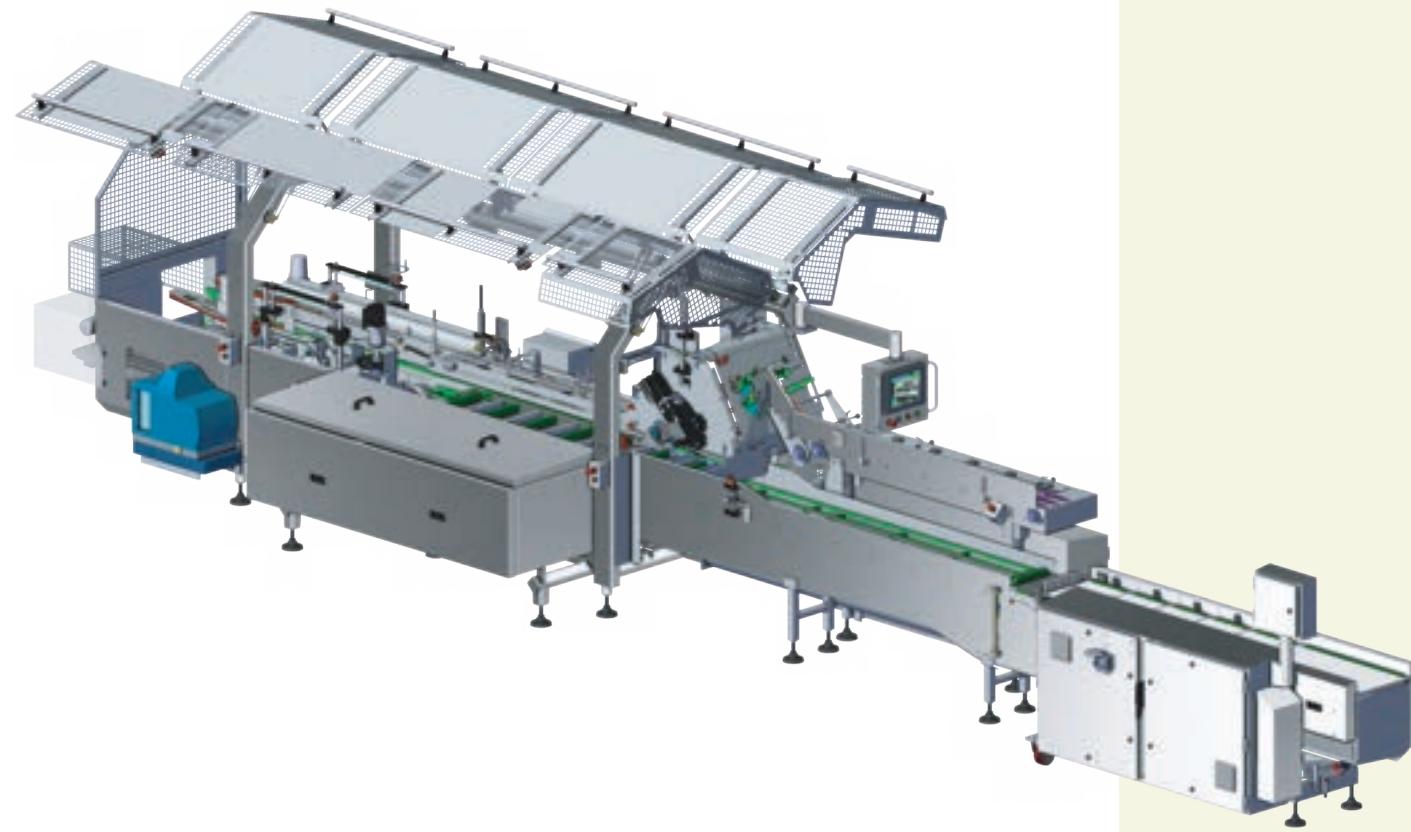
Bulletin: A1DR

Standard Product

Catalog Number	Description	D (in.)	D (mm)	Quantity
AVDR4NM	Non-metallic Vent Drain	1.25	32	1
AVDR4SS4	Stainless Steel Vent Drain	1.38	35	1



87937537



ENTERPRISE

Endload Cartoner
SCHWANS - ATLANTA
HS5160

 **HOME**



Enterprise Setup Sheet

Setup Sheet 1

5224 Snapfinger Woods Dr.
Decatur, Georgia 30035
Tel: 770 981 5200 • Fax 770 987 7160
Email: sales@klikwood.com

Western Drive, Hengrove Park Estate,
Whitchurch, Bristol, BS14 0AY, England
Tel: +44 1275 836131
Fax: +44 1275 891754
Email: sales@kliklook-woodman-int.com

Factory #	HS5160	FAT Date:	10/27/2016
Customer Name:	SFCGSC-Atlanta		
Customer Location:	One Lemon Lane NE		
	Atlanta, GA 30307-2899		
Machinery:	Enterprise with PIC	Serial Number:	ENT - 118
Machine Speed:	120 and 160 cpm	Recipe:	'A' Cream Pie

Machine Settings page 1

Carton Size:

Carton length: 9.623"
Depth: 2.375"
Width: 9.625"

Machine Settings page 2

Glue setting Load Side:

1 Start	1.50	Stop	10.0
2 Start		Stop	
3 Start		Stop	
4 Start		Stop	
5 Start		Stop	

Glue setting Non-Load Side:

1 Start	2.75	Stop	9.0
2 Start		Stop	
3 Start		Stop	
4 Start		Stop	
5 Start		Stop	

Machine Settings page 3

Carton Carrying Chain Offset: 0.125
Retard Flight Chain to Feeder Offset: 0.900
Non Load Side Tucker Offset: 330
Load Side Tucker Offset: 90
Product Chain Retard Offset: n/a
Product Chain Pusher Offset: n/a

Machine Settings page 4

Overhead Confiner Offset (Optional): n/a
Cycle Stop Position: 3.00 Inches
Flap Kicker: Enabled Disabled
Double Stack Product: Enabled Disabled
Hopper Gate Vibrator: Enabled Disabled
NSL Tucker 2 (Downstream)
Park N.L.S. Tucker Enabled Disabled
Offset: 320
Tuck Start Position: 5.5
Tuck End Position: 9.0
Tuck Position: 9.75
Flap Kicker: on ON off

Machine Settings page 5

0. High Product Sensor Height:	60.3	mm
1. Ski Guide 1:	7.3	cm
2. Ski Guide 2:	12.7	cm
3. Load Side Tucker Guide:	1.2	cm
4. Non-Load side Tucker Guide:	0.0	cm
4A. Upper Major Guide:	n/a	
27. Center Vacuum Cup Position:	6.0	
28. N.L.S. Vacuum Cup Position:	12.5	

Machine Settings page 6

Non Load Side;

5. Plow Guide Height:	1.0	cm
6. Overhead rail Height:	6.0	cm
7. Overhead Guide Height:	60.3	mm
8. Compression Height:	2.0	cm
9. Glue Gun Height:	2.2	
10. Glue Gun Angle:	0.0	
11. Glue Guide Height:	2.0	

Machine Settings page 7

Load Side

12. Upstream Overhead rail Height:	1.4	
13. Overhead Guide Height:	60.3	
14. Plow Guide Height:	1.0	
15. Compression Height:	1.8	
16. Glue Gun Height:	2.0	
17. Glue Guide Height:	2.3	
18. Glue Gun Angle:	10.0	

Machine Settings page 8

Hopper Advance

19. Vertical Adjustment:	144.0	mm
20. Horizontal Adjustment:	41.0	mm
21. Lower Hopper Depth Adjust 2:	5.0	mm
22. Lower Hopper Depth Adjust 1:	5.0	mm
23. Upper Hopper Depth Adjust:	5.2	cm

Machine Settings page 10

24. Feeder Height:	60.3	mm
25. Overhead Confiner Height:	n/a	
26. Depth of Insertion:	244.5	mm

N.L.S. Downstream Tucker

Remove / Add: Add Upper Tucker Blade

Enterprise Setup Sheet

Setup Sheet 2

Machine Settings page 9	
Glue Type	H.B. Fuller Advantra PHC-9250
Glue Tank Pressure	25.0
Glue Tank Temperature	325.0 F
Non-Load Side Gun Temperature	325.0 F
Non- Load Side Hose Temperature	325.0 F
Load Side Gun Temperature	325.0 F
Load Side Hose Temperature	325.0 F
Diagnostics Settings page TRQ	
Feeder Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	65.0
Average Torque	13.0
Pusher Chain Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	76.0
Average Torque	58.0
Retard Chain Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	54.0
Average Torque	39.0
Load Side Tucker Axis:	
Over Torque Trip Point	50.0
Max Recorded Torque	22.0
Average Torque	18.0
Non-Load Side Tucker Axis:	
Over Torque Trip Point	50.0
Max Recorded Torque	19.0
Average Torque	13.0
Article Bucket (Pusher):	
Over Torque Trip Point	n/a
Max Recorded Torque	n/a
Average Torque	n/a
Article Bucket (Retard):	
Over Torque Trip Point	n/a
Max Recorded Torque	n/a
Average Torque	n/a

Machine Options page 2	
Glue Fault	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Over height Product	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Multiple Over height Product	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Glue Offset	1.4 "
Discharge Belts VFD Ratio	1.5
Hopper Belts VFD Ratio	1.2
Abort Overflow Timer Duration:	n/a mSec.
Multiple Over height Limit Fault	n/a
Multiple Over Height Product Fault	5
Machine Options page 3:	
Discharge Jam Fault	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>
Feeding Fault	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>
Start Delay	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Air Pressure Fault	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Downstream Interlock	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>



Enterprise Setup Sheet

Setup Sheet 1

5224 Snapfinger Woods Dr.
Decatur, Georgia 30035
Tel: 770 981 5200 • Fax 770 987 7160
Email: sales@klikwood.com

Western Drive, Hengrove Park Estate,
Whitchurch, Bristol, BS14 0AY, England
Tel: +44 1275 836131
Fax: +44 1275 891754
Email: sales@kliklook-woodman-int.com

Factory #	HS5160	FAT Date:	10/27/2016
Customer Name:	SFCGSC-Atlanta		
Customer Location:	One Lemon Lane NE		
	Atlanta, GA 30307-2899		
Machinery:	Enterprise with PIC	Serial Number:	ENT - 117
Machine Speed:	70 and 160 cpm	Recipe:	'A' Cream Pie

Machine Settings page 1

Carton Size:

Carton length: 9.623"
Depth: 2.375"
Width: 9.625"

Machine Settings page 2

Glue setting Load Side:

1 Start	1.25	Stop	10.0
2 Start		Stop	
3 Start		Stop	
4 Start		Stop	
5 Start		Stop	

Glue setting Non-Load Side:

1 Start	2.5	Stop	9.0
2 Start		Stop	
3 Start		Stop	
4 Start		Stop	
5 Start		Stop	

Machine Settings page 3

Carton Carrying Chain Offset: 0.150
Retard Flight Chain to Feeder Offset: 0.925
Non Load Side Tucker Offset: 335
Load Side Tucker Offset: 90
Product Chain Retard Offset: n/a
Product Chain Pusher Offset: n/a

Machine Settings page 4

Overhead Confiner Offset (Optional): n/a
Cycle Stop Position: 3.00 Inches
Flap Kicker: Enabled Disabled
Double Stack Product: Enabled Disabled
Hopper Gate Vibrator: Enabled Disabled
NSL Tucker 2 (Downstream)
Park N.L.S. Tucker Enabled Disabled
Offset: 320
Tuck Start Position: 5.5
Tuck End Position: 9.0
Tuck Position: 9.75
Flap Kicker: on ON off

Machine Settings page 5

0. High Product Sensor Height:	60.3	mm
1. Ski Guide 1:	8.5	cm
2. Ski Guide 2:	12.4	cm
3. Load Side Tucker Guide:	1.2	cm
4. Non-Load side Tucker Guide:	0.0	cm
4A. Upper Major Guide:	n/a	
27. Center Vacuum Cup Position:	5.5	
28. N.L.S. Vacuum Cup Position:	12.5	

Machine Settings page 6

Non Load Side;

5. Plow Guide Height:	1.0	cm
6. Overhead rail Height:	6.0	cm
7. Overhead Guide Height:	60.3	mm
8. Compression Height:	1.5	cm
9. Glue Gun Height:	1.4	
10. Glue Gun Angle:	0.0	
11. Glue Guide Height:	1.3	

Machine Settings page 7

Load Side

12. Upstream Overhead rail Height:	1.4	
13. Overhead Guide Height:	60.3	
14. Plow Guide Height:	1.0	
15. Compression Height:	1.1	
16. Glue Gun Height:	1.0	
17. Glue Guide Height:	1.9	
18. Glue Gun Angle:	10.0	

Machine Settings page 8

Hopper Advance

19. Vertical Adjustment:	137.0	mm
20. Horizontal Adjustment:	45.0	mm
21. Lower Hopper Depth Adjust 2:	5.0	mm
22. Lower Hopper Depth Adjust 1:	5.0	mm
23. Upper Hopper Depth Adjust:	5.3	cm

Machine Settings page 10

24. Feeder Height:	60.3	mm
25. Overhead Confiner Height:	n/a	
26. Depth of Insertion:	244.5	mm

N.L.S. Downstream Tucker

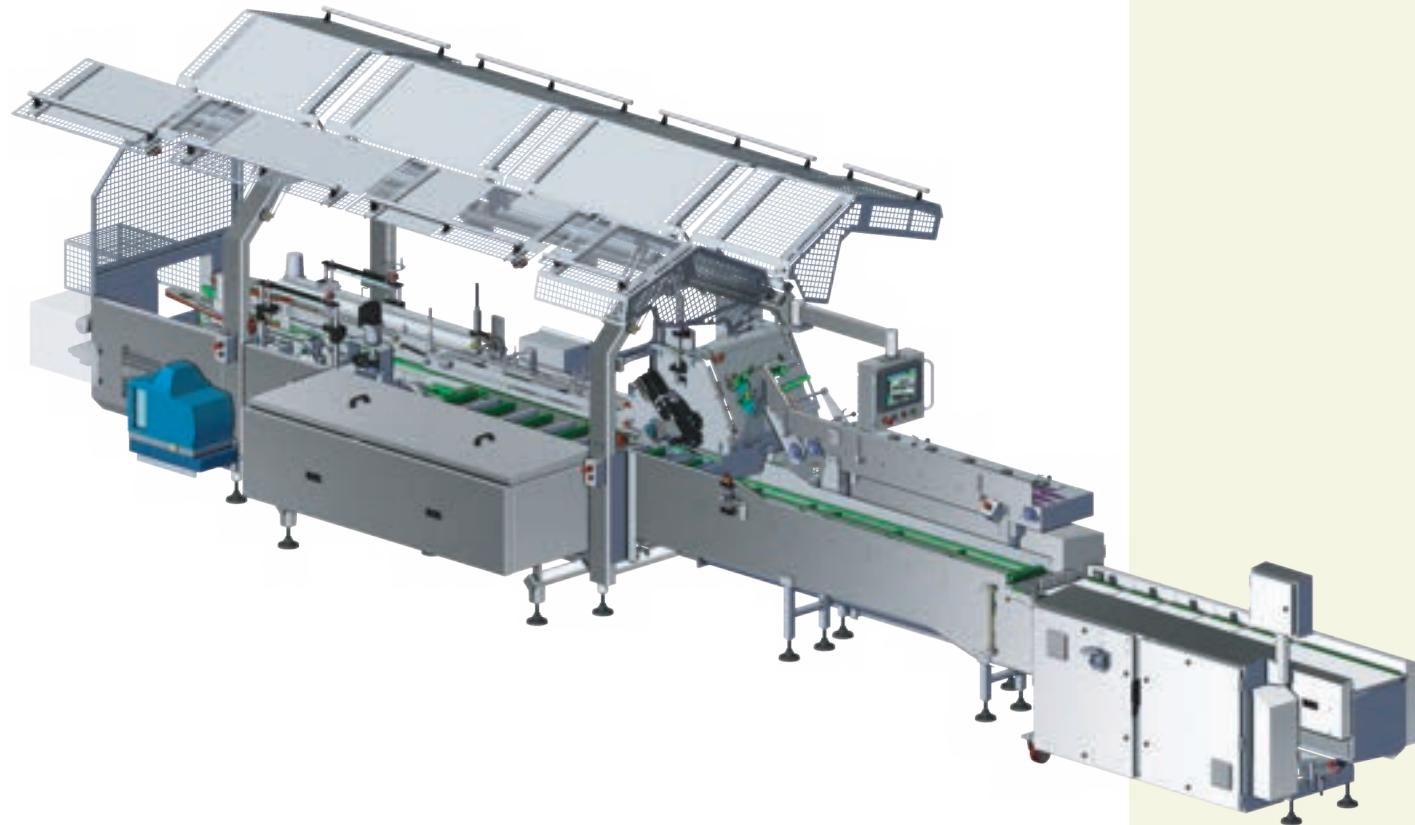
Remove / Add: Add Upper Tucker Blade

Enterprise Setup Sheet

Setup Sheet 2

Machine Settings page 9	
Glue Type	H.B. Fuller Advantra PHC-9250
Glue Tank Pressure	25.0
Glue Tank Temperature	325.0 F
Non-Load Side Gun Temperature	325.0 F
Non- Load Side Hose Temperature	325.0 F
Load Side Gun Temperature	325.0 F
Load Side Hose Temperature	325.0 F
Diagnostics Settings page TRQ	
Feeder Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	64.2
Average Torque	13.0
Pusher Chain Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	70.0
Average Torque	57.0
Retard Chain Axis:	
Over Torque Trip Point	100.0
Max Recorded Torque	53.0
Average Torque	40.0
Load Side Tucker Axis:	
Over Torque Trip Point	50.0
Max Recorded Torque	19.0
Average Torque	16.0
Non-Load Side Tucker Axis:	
Over Torque Trip Point	50.0
Max Recorded Torque	17.0
Average Torque	16.0
Article Bucket (Pusher):	
Over Torque Trip Point	n/a
Max Recorded Torque	n/a
Average Torque	n/a
Article Bucket (Retard):	
Over Torque Trip Point	n/a
Max Recorded Torque	n/a
Average Torque	n/a

Machine Options page 2	
Glue Fault	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Over height Product	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Multiple Over height Product	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Glue Offset	1.4 "
Discharge Belts VFD Ratio	1.5
Hopper Belts VFD Ratio	1.2
Abort Overflow Timer Duration:	n/a mSec.
Multiple Over height Limit Fault	n/a
Multiple Over Height Product Fault	5
Machine Options page 3:	
Discharge Jam Fault	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>
Feeding Fault	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>
Start Delay	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Air Pressure Fault	Enabled <input checked="" type="checkbox"/> Disabled <input type="checkbox"/>
Downstream Interlock	Enabled <input type="checkbox"/> Disabled <input checked="" type="checkbox"/>



ENTERPRISE

Endload Cartoner
**SCHWANS - ATLANTA
HS5160**

 **HOME**

Kinetix 5500 Servo Drives

Catalog Numbers 2198-H003-ERS, 2198-H008-ERS, 2198-H015-ERS, 2198-H025-ERS, 2198-H040-ERS, 2198-H070-ERS
2198-H003-ERS2, 2198-H008-ERS2, 2198-H015-ERS2, 2198-H025-ERS2, 2198-H040-ERS2, 2198-H070-ERS2,
2198-CAPMOD-1300



Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Summary of Changes

This manual contains new and updated information.

Topic	Page
Replaced catalog number string 2198-Hxxx-ERS with 2198-Hxxx-ERSx when there's no need to distinguish between -ERS or -ERS2.	
Added footnotes and other text to note that STO connector does not apply to 2198-Hxxx-ERS2 drives.	Throughout
Added references to the Hiperface-to-DSL (series B) feedback converter kit as needed.	
Added Kinetix VP (Bulletin VPF) food-grade motors.	
Added LDAT-Series integrated linear thrusters.	
Added 2198-Hxxx-ERS2 catalog numbers to front cover.	Front Cover
Added 2198-Hxxx-ERS2 and GuardLogix safety controller catalog numbers/descriptions to the System Overview table.	14
Removed Safety Device from Typical Hardware Configurations.	15...19
Added Safe Torque-off Configurations.	23...25
Added 2198-Hxxx-ERS2 catalog numbers to Catalog Number Explanation.	26
Corrected the short-circuit current rating from 150,000 to 200,000 A.	31
Updated Kinetix 5500 Drive Features and Indicators with 2198-Hxxx-ERS2 drive example.	58
Updated the Absolute Position Feature section with multi-turn catalog number strings for compatible motors and actuators.	65
Updated Safe Torque-off Safety Features with 2198-Hxxx-ERS2 drive description.	66
Updated Ethernet Cable Connections with ControlLogix EtherNet/IP communication modules.	97
Updated controller configuration by adding GuardLogix controller and ControlLogix EtherNet/IP communication module configuration.	105
Broke out Configure the Kinetix 5500 Drive with separate procedures for 2198-Hxxx-ERS and 2198-Hxxx-ERS2 servo drives.	110 and 112
Updated Tune the Axes with a reference to the load observer feature.	133
Added FLT-S04 - MTR OVERSPEED UL fault code. Added FLT S09 - MTR PHASE LOSS fault code. Added FLT S49 - BRAKE SLIP FLT fault code.	141
Added FLT-M28 - SAFETY COMM fault code.	143
Added INIT FLT-M14 - SAFETY FIRMWARE fault code.	144
Updated NODE FLT fault codes. Added NODE FLT 03 - HARDWARE 04 fault code.	144
Added NODE ALARM 04 – CLOCK SKEW ALARM.	145
Updated the configurable stopping action definitions.	149
Added FLT-S04 - MTR OVERSPEED UL fault behavior. Added FLT S15 – CONV OVERCURRENT fault behavior. Added FLT S49 - BRAKE SLIP FLT fault behavior.	150
Added FLT-M28 - SAFETY COMM fault behavior.	151
Added NODE FLT 05 – CLOCK SKEW FLT fault behavior	152
Updated Start and Configure the Drive with step to review an integrated safety configuration after replacing an integrated safety drive.	156
Updated Chapter 9 title by adding Hardwired Safety to distinguish it from Chapter 10.	157
Updated System Operation timing diagram with 100 ms.	159
Updated 2198-Hxxx-ERS troubleshooting table with fault code.	159
Added Chapter 10, Kinetix 5500 Safe Torque-off - Integrated Safety.	167

Summary of Changes

Topic	Page
Added Kinetix VP (Bulletin VPF) food-grade motors to the Kinetix VP interconnect diagram.	195
Corrected motor power and brake connection pinouts for MP-Series motor and actuator diagrams.	196, 198, 199
Added LDAT-Series linear thrusters interconnect diagram.	197

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About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting the Kinetix® 5500 servo drives, and system integration for your drive and motor/actuator combination with a Logix5000™ controller.

Audience

This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 5500 drives, and programmers directly involved in the operation, field maintenance, and integration of these drives with the EtherNet/IP communication module or controller.

If you do not have a basic understanding of Kinetix 5500 servo drives, contact your local Rockwell Automation sales representative for information on available training courses.

Conventions Used in This Manual

These conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Catalog number string 2198-Hxxx-ERSx is used when there's no need to distinguish between -ERS or -ERS2 servo drives.

Studio 5000 Environment

The Studio 5000 Automation Engineering and Design Environment™ combines engineering and design elements into a common environment. The first element in the Studio 5000® environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and continues to be the product to program Logix5000 controllers for discrete, process, batch, motion, safety, and drive-based solutions.



The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment is the one place for design engineers to develop all of the elements for their control system.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Kinetix 5500 servo drives Installation Instructions, publication 2198-IN001	Information on mounting and wiring the Kinetix 5500 servo drive.
Kinetix 5500 Feedback Connector Kit Installation Instructions, publication 2198-IN002	Information on installing and wiring the Kinetix 5500 motor feedback connector kit.
Kinetix 5500 AC Line Filter Installation Instructions, publication 2198-IN003	Information on installing and wiring the Kinetix 5500 AC line filters.
Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004	Information on installing and wiring the Kinetix 5500 capacitor module.
Kinetix 5500 Shared-bus Connector Kit Installation Instructions, publication 2198-IN005	Information on installing the Kinetix 5500 shared-bus connector kits.
Hiperface-to-DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006	Information on installing the Hiperface-to-DSL feedback converter kit.
Kinetix 300 Shunt Resistor Installation Instructions, publication 2097-IN002	Information on installing and wiring Kinetix 300 shunt resistors.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
Kinetix Motion Control Selection Guide, publication GMC-SG001	Overview of Kinetix servo drives, motors, actuators, and motion accessories designed to help make initial decisions for the motion control products best suited for your system requirements.
Kinetix 5500 Drive Systems Design Guide, publication GMC-RM009	System design guide to select the required (drive specific) drive module, power accessory, feedback connector kit, and motor cable catalog numbers for your Kinetix 5500 drive and Kinetix VP motor motion control system.
Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001	Product specifications for Kinetix VP (Bulletin VPL, VPF, and VPS), MP-Series™ (Bulletin MPL, MPM, MPF, and MPS), Kinetix 6000M (Bulletin MDF), TL-Series™, RDD-Series™, and HPK-Series™ rotary motors.
Kinetix Linear Motion Specifications Technical Data, publication GMC-TD002	Product specifications for MP-Series (Bulletin MPAS ballscrew, MPAR, and MPAI) and LDAT-Series linear actuators.
Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003	Product specifications for Kinetix Integrated Motion over the EtherNet/IP network, Integrated Motion over sercos interface, EtherNet/IP networking, and component servo drive families.
Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004	Product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items.
Rockwell Automation Configuration and Selection Tools website http://www.rockwellautomation.com/en/e-tools	Motion Analyzer application analysis software for drive/motor sizing. Online product selection and system configuration tools, including AutoCAD (DXF) drawings.
Rockwell Automation Product Certification, website http://www.rockwellautomation.com/products/certification	For declarations of conformity (DoC) currently available from Rockwell Automation.
Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003	Information on configuring and troubleshooting your ControlLogix® and CompactLogix™ EtherNet/IP network modules.
GuardLogix 5570 Controllers User Manual, publication 1756-UM022	Information on designing, installing, programming, or troubleshooting control systems that use GuardLogix 5570 controllers.
GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099	Information for development, operation, or maintenance of a GuardLogix 5570 controller-based safety system that uses the Studio 5000 Logix Designer™ application.
Safety Products Catalog website http://www.ab.com/catalogs	Information regarding Allen-Bradley safety products, including safety relays, light curtain, and gate interlock applications.
ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-QS105	For ControlFLASH™ information not specific to any drive family.
National Electrical Code, published by the National Fire Protection Association of Boston, MA	An article on wire sizes and types for grounding electrical equipment.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations.

You can view or download publications at <http://www.rockwellautomation.com/literature>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Start

Use this chapter to become familiar with the design and installation requirements for Kinetix 5500 drive systems.

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Typical Communication Configurations	20
Safe Torque-off Configurations	23
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About the Kinetix 5500 Servo Drive System

The Kinetix 5500 servo drives are designed to provide a Kinetix Integrated Motion solution for your drive and motor/actuator application.

Table 1 - Kinetix 5500 Drive System Overview

Drive System Component	Cat. No.	Description
Kinetix 5500 Servo Drives	2198-Hxxx-ERS	200V-class (single-phase or three-phase) and 400V-class (three-phase) drives operate in standalone and multi-axis shared AC, shared DC, shared AC/DC, and shared AC/DC hybrid configurations. Modules are zero-stacked from drive-to-drive and use the shared-bus connection system to extend power in multi-axis configurations. Safe torque-off via hardwired (STO) connector.
	2198-Hxxx-ERS2	Same power structures with standalone and multi-axis bus-sharing capability. Safe torque-off via the EtherNet/IP network.
Kinetix 5500 Capacitor Module	2198-CAPMOD-1300	Use for energy storage and/or to improve performance in applications producing regenerative energy and requiring shorter duty cycles (1360 μ F). Modules are zero-stacked side-by-side with servo drives and use the shared-bus connection system to extend power.
Shared-bus Connector Kits	2198-H040-x-x	Input wiring connectors and DC bus T-connector for frame 1 and 2 servo drives.
	2198-H070-x-x	Input wiring connectors and DC bus T-connector for frame 3 servo drives.
Feedback Connector Kit	2198-KITCON-DSL	Replacement feedback connector kit with 2-pin connector plug and grounding plate inside the connector housing.
Hiperface to DSL Converter Kit	2198-H2DCK	Use for Hiperface-to-DSL feedback conversion with 400V-class MP-Series (Bulletin MPL, MPM, MPF, and MPS) rotary motors and MP-Series (Bulletin MPAS ballscrew, MPAR, MPAI) linear actuators. Series B or later converter kit is required for LDAT-Series linear thrusters and 200V-class MP-Series motors and actuators.
I/O Connector Kits	2198-KITCON-IOSP	Replacement I/O connector kit (spring clamp) for I/O (IOD) connector.
	2198-KITCON-IOSC	Replacement I/O connector kit (screw terminal) for I/O (IOD) connector.
Connector Sets	2198-KITCON-PWR40	Replacement connector set, 40 A, for frame 1 and frame 2 drives.
	2198-KITCON-PWR70	Replacement connector set, 70 A, for frame 3 drives.
	2198-KITCON-CAP1300	Replacement connector set, 40 A, for capacitor module.
Logix5000 Controller Platform	1769-L18ERM 1769-L27ERM 1769-L3xERM	CompactLogix 5370 controllers with Integrated Motion on the EtherNet/IP network. Linear, ring, and star topology is supported.
	1756-EN2T module 1756-EN2TR module 1756-EN3TR module	ControlLogix 1756-L7x and GuardLogix 1756-L7xS controllers with Integrated Motion on EtherNet/IP networks. Linear, device-level ring (DLR), and star topology is supported.
Studio 5000 Environment	N/A	Studio 5000 Logix Designer application, version 21.00 or later, provides support for programming, commissioning, and maintaining the CompactLogix and ControlLogix controller families. Version 24.00 or later is required for 2198-Hxxx-ERS2 servo drives.
Rotary Servo Motors	VPL-Axxxx, VPL-Bxxxx VPF-Axxxx, VPF-Bxxxx VPS-Bxxxx	Compatible rotary motors include 200V and 400V-class Kinetix VP (Bulletin VPL, VPF, and VPS).
	MP-Series	Compatible rotary motors include 200V and 400V-class MP-Series (Bulletin MPL, MPM, MPF, and MPS) when used with the Hiperface-to-DSL feedback converter kit.
Linear Actuators	MP-Series LDAT-Series	Compatible linear actuators include 200V and 400V-class MP-Series (Bulletin MPAS ballscrew, MPAR, and MPAI) and LDAT-Series when used with the Hiperface-to-DSL feedback converter kit.
Induction motors	N/A	Induction motors with open loop volts/hertz frequency control are also supported.
Cables	2090-CSxM1DF-xxAxxx	Bulletin 2090 single-cable for motor power, feedback, and 24V DC brake power with Kinetix VP motors.
	2090-CFBM7DF-CEAxxx	Bulletin 2090 motor feedback cables for MP-Series motors and actuators.
	2090-CPxM7DF-xxAxxx	Bulletin 2090 motor power/brake cables for MP-Series motors and actuators.
	1585J-M8CBJM-x	Ethernet cables are available in standard lengths. Shielded cable is recommended.
AC Line Filters	2198-DB08-F 2198-DB20-F 2198-DB42-F	Bulletin 2198 three-phase AC line filters are required to meet CE and available for use in all Kinetix 5500 drive systems.
24V DC Power Supply	1606-XLxxx	Bulletin 1606 24V DC power supply for control circuitry, digital inputs, safety, and motor brake.
External Shunt Resistors	2097-R6 and 2097-R7	Bulletin 2097 external passive shunt resistors for when the drive's internal shunt capability is exceeded.

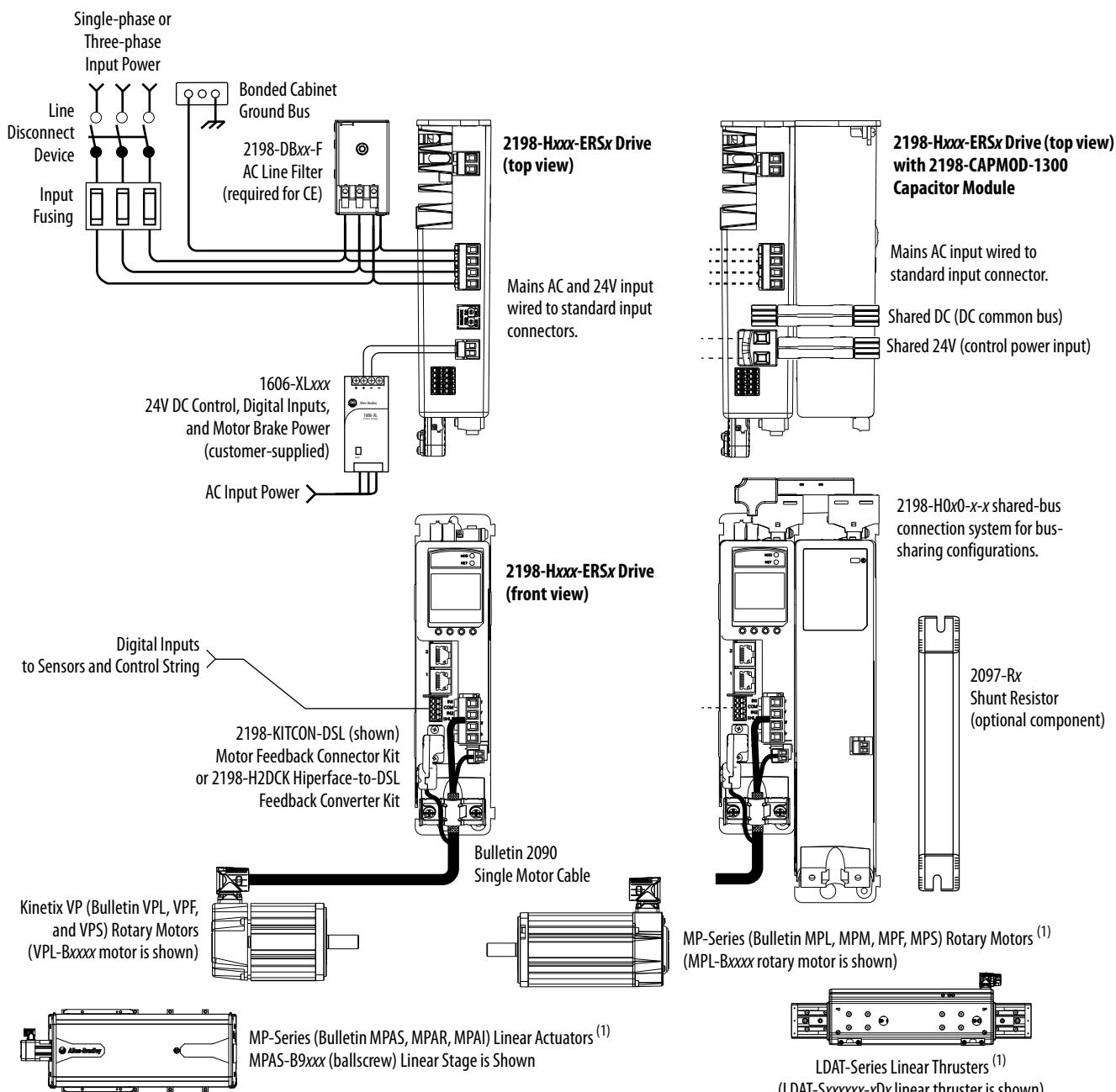
Typical Hardware Configurations

Typical Kinetix 5500 systems include single-phase and three-phase standalone configurations, three-phase shared AC, shared AC/DC, shared DC, and shared AC/DC hybrid configurations.

Standalone Configurations

In these examples, a single standalone drive is shown with and without the Bulletin 2198 capacitor module.

Figure 1 - Typical Kinetix 5500 Standalone Installation

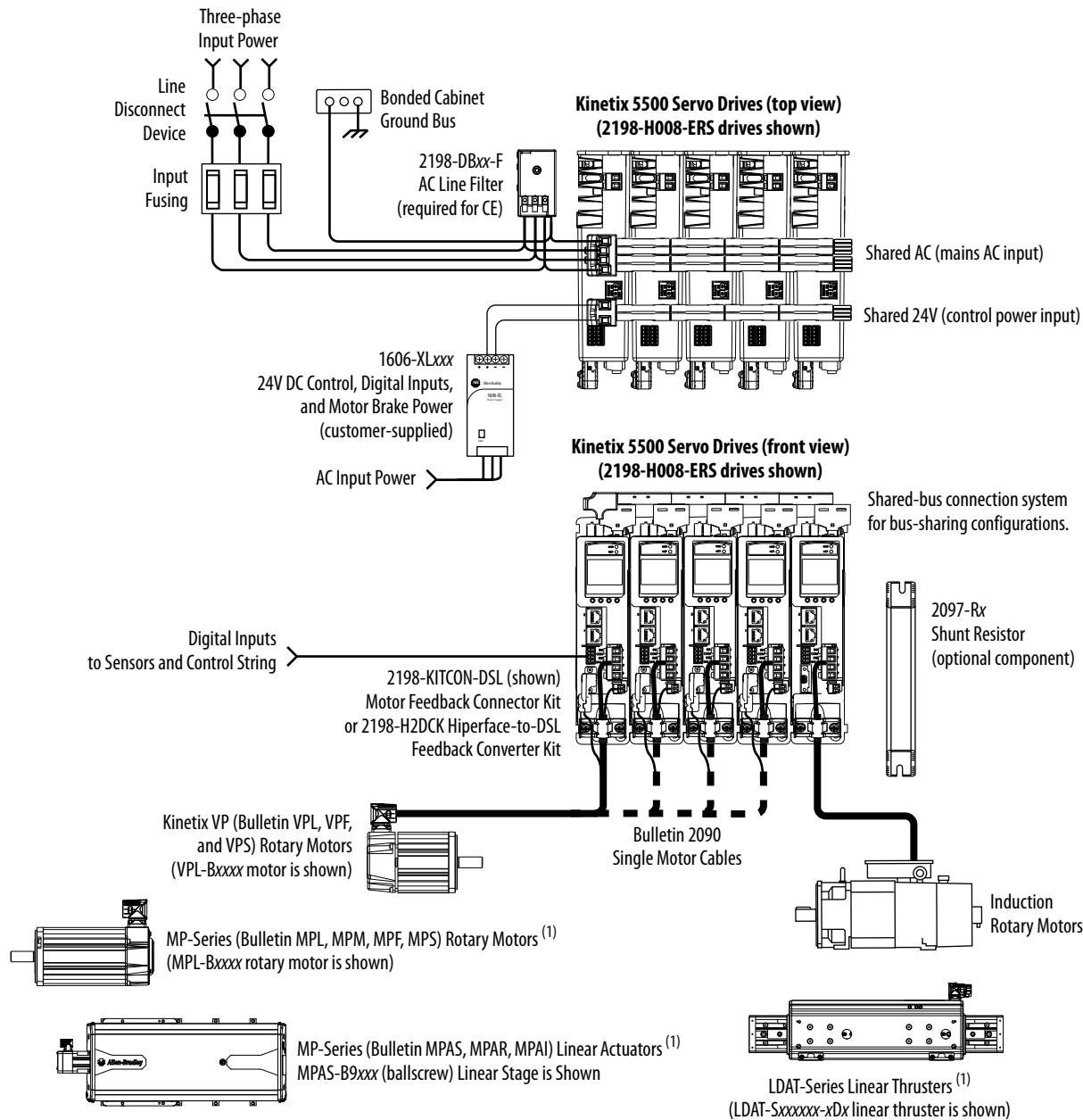


(1) Requires the 2198-H2DCK Hiperface-to-DSL feedback converter kit. LDAT-Series linear thrusters and MP-Series (200V-class) motors and actuators require the 2198-H2DCK (series B or later) converter kit.

Shared AC Configurations

In this example, three-phase AC power and 24V control power is shared in a multi-axis configuration. All drives must have the same power rating (catalog number).

Figure 2 - Typical Shared AC Installations



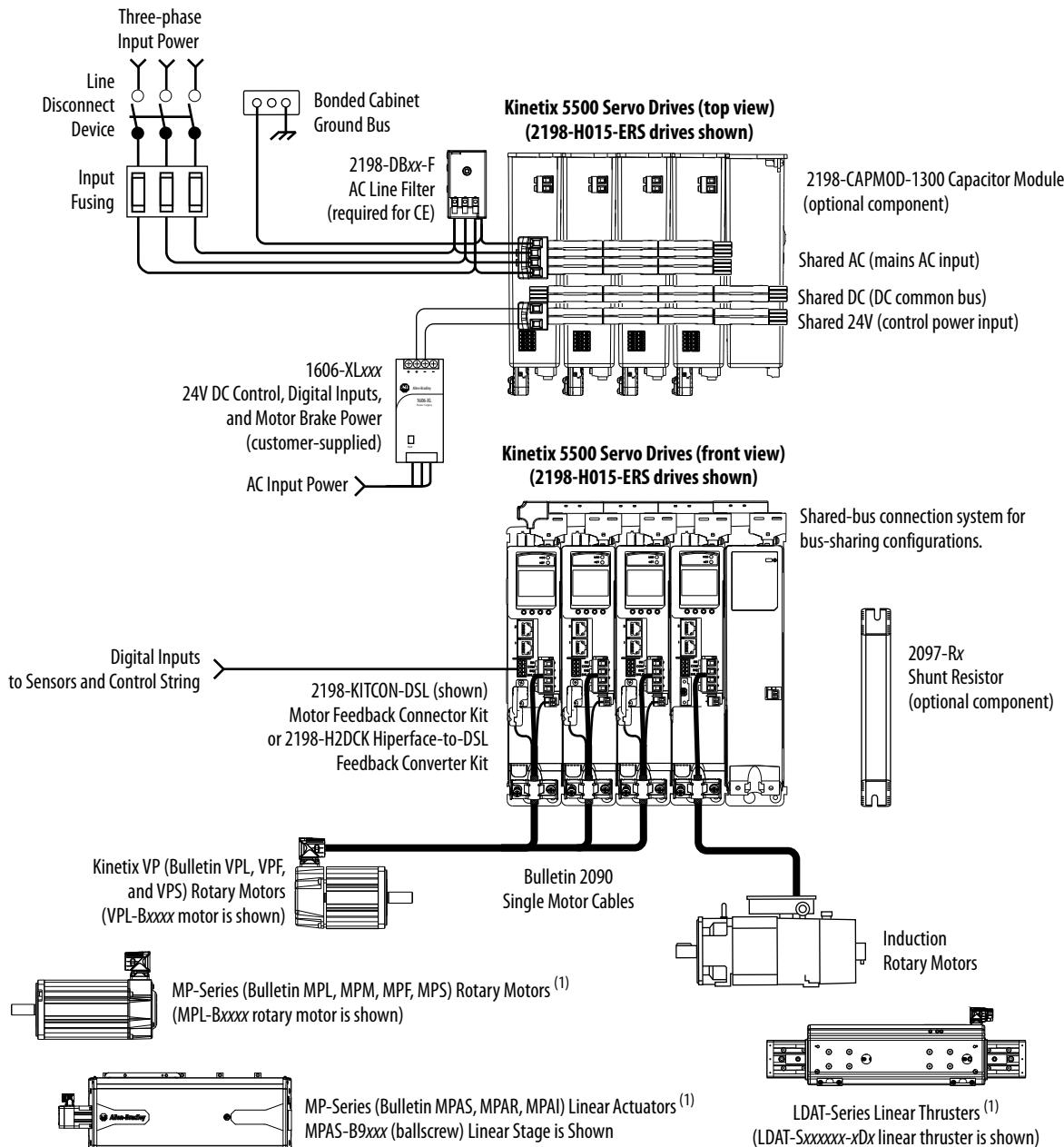
(1) Requires the 2198-H2DCK Hiperface-to-DSL feedback converter kit. LDAT-Series linear thrusters and MP-Series (200V-class) motors and actuators require the 2198-H2DCK (series B or later) converter kit.

IMPORTANT In shared AC configurations, all drives must have the same power rating. Shared AC configurations do not support Bulletin 2198 capacitor modules.

Shared AC/DC Configurations

In this example, three-phase AC input power, 24V control power, and DC bus power are shared in a multi-axis configuration. All drives must be the same power rating (catalog number).

Figure 3 - Typical Shared AC/DC Installations



- (1) Requires the 2198-H2DCK Hiperface-to-DSL feedback converter kit. LDAT-Series linear thrusters and MP-Series (200V-class) motors and actuators require the 2198-H2DCK (series B or later) converter kit.

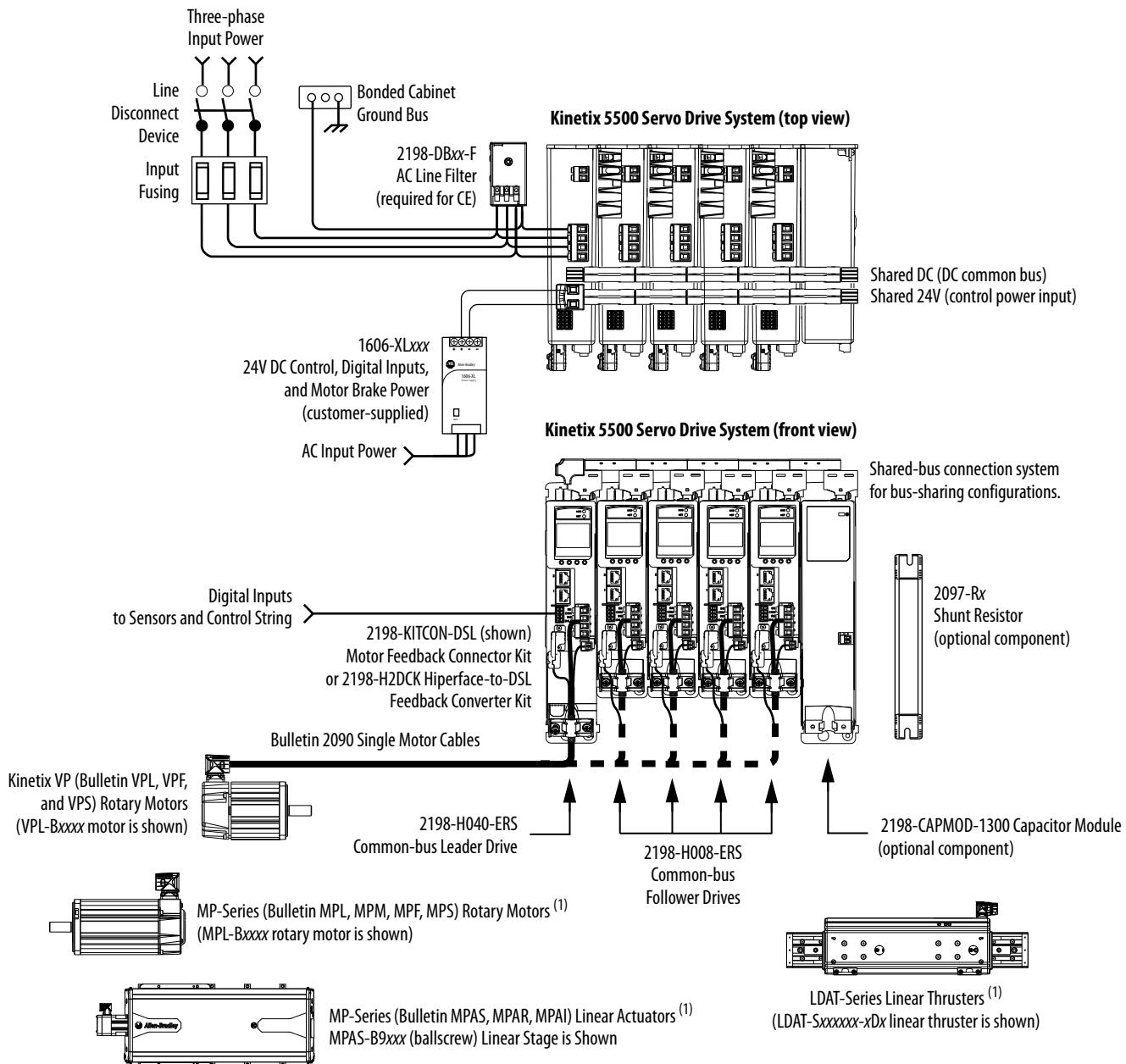
IMPORTANT

In shared AC/DC configurations, all drives must have the same power rating (catalog number).

Shared DC Common-bus Configurations

In this multi-axis example, the common-bus leader (sourcing) drive receives three-phase AC input power and supplies DC power to common-bus follower (sinking) drives. The common-bus leader drive power rating is greater than or equal to the power rating of each follower drive.

Figure 4 - Typical Shared DC Common-bus Installations



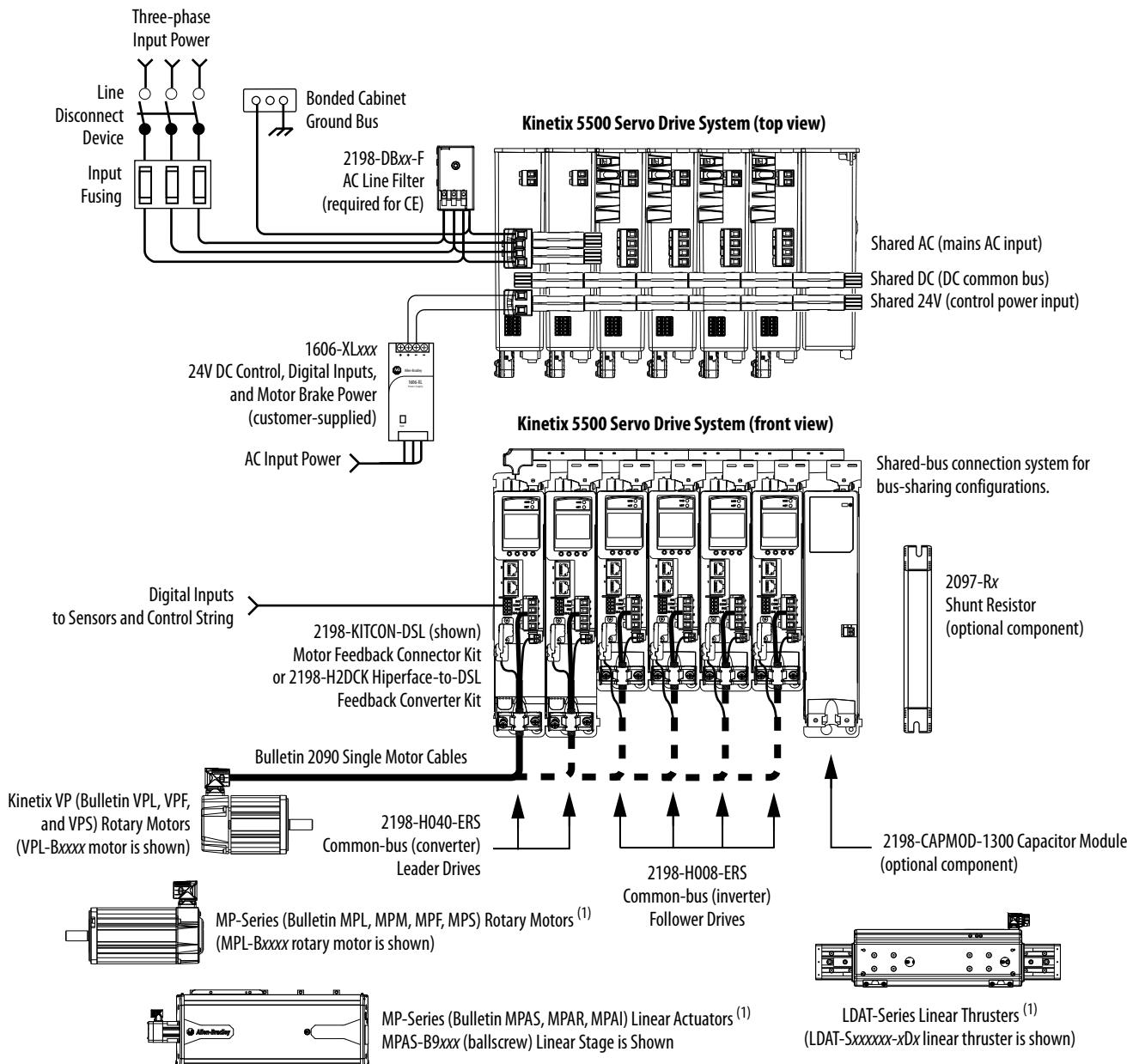
(1) Requires the 2198-H2DCK Hiperface-to-DSL feedback converter kit. LDAT-Series linear thrusters and MP-Series (200V-class) motors and actuators require the 2198-H2DCK (series B or later) converter kit.

IMPORTANT In shared DC common-bus configurations, the leader drive power rating must be greater than or equal to the power rating of the follower drives.

Shared AC/DC Hybrid Configuration

In this multi-axis example, three-phase AC input power is supplied to two converter drives. The converter drive ratings must be the same, and greater than or equal to the power ratings of the inverter drives. This parallel converter configuration increases the DC power supplied to the inverter drives.

Figure 5 - Typical Shared AC/DC Bus Hybrid Installations



(1) Requires the 2198-H2DCK Hiperface-to-DSL feedback converter kit. LDAT-Series linear thrusters and MP-Series (200V-class) motors and actuators require the 2198-H2DCK (series B or later) converter kit.

IMPORTANT

In shared AC/DC hybrid configuration, the converter drives must have the same power rating and must be greater than or equal to the power ratings of the inverter drives.

Typical Communication Configurations

The Kinetix 5500 drives support any Ethernet topology including linear, ring, and star.

These examples feature the CompactLogix 5370 programmable automation controllers (catalog number 1769-L36ERM) with support for Integrated Motion over the EtherNet/IP network. Controller features include the following:

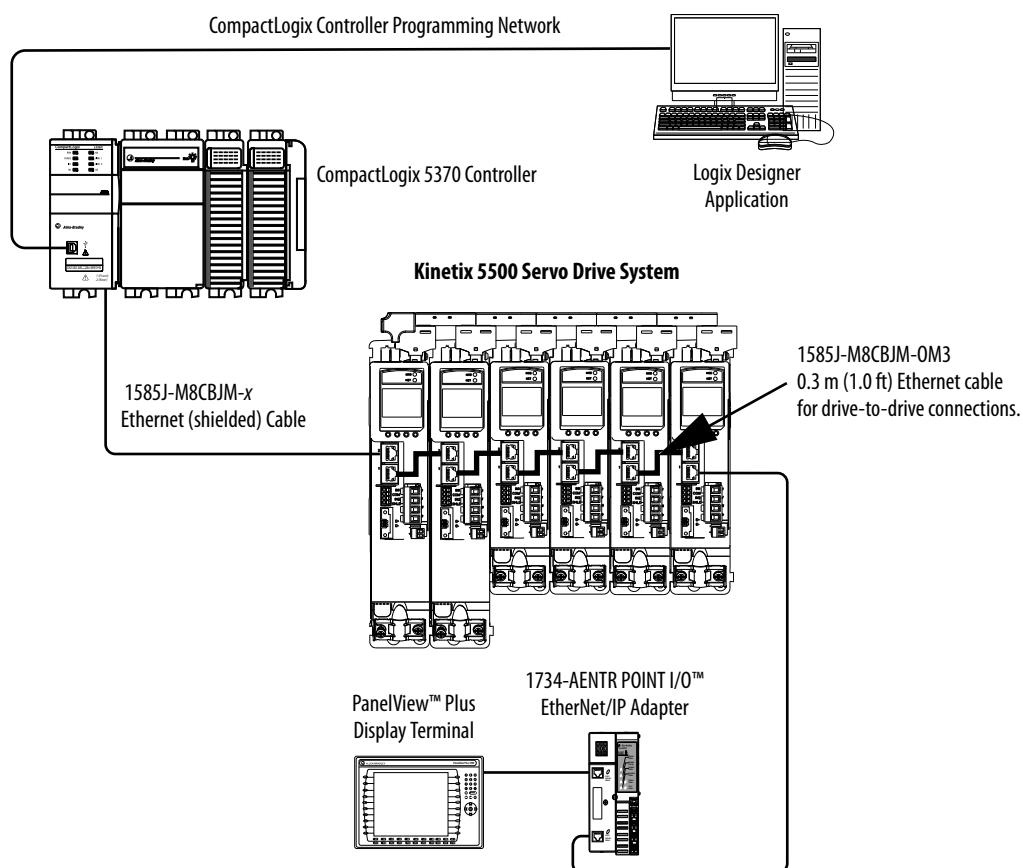
- Supports up to 16 axes
- Supports up to 48 devices in linear configurations
- Dual-port connectivity to support device-level ring (DLR) topology

Refer to CompactLogix Controllers Specifications Technical Data, publication [1769-TD005](#), for more information on CompactLogix 5370 L1, L2, and L3 controllers.

Linear Topology

In this example, all devices are connected in linear topology. The Kinetix 5500 drives include dual-port connectivity, however, if any device becomes disconnected, all devices downstream of that device lose communication. Devices without dual ports must include the 1783-ETAP module or be connected at the end of the line.

Figure 6 - Kinetix 5500 Linear Communication Installation

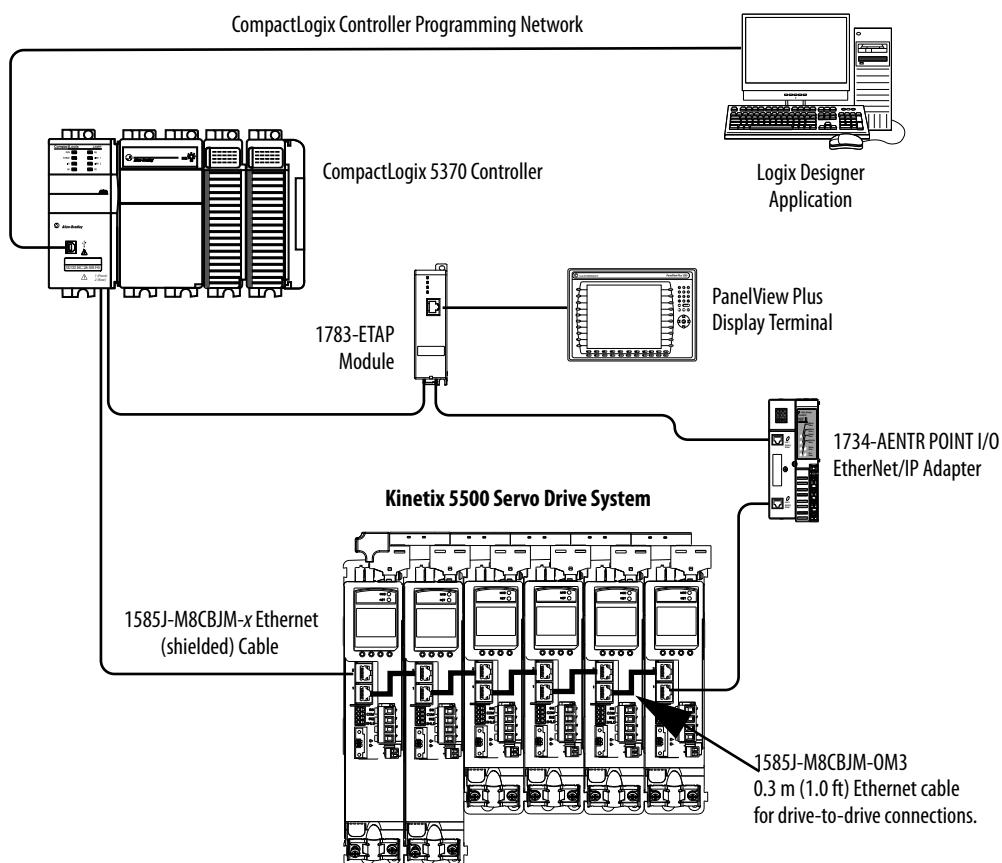


Ring Topology

In this example, the devices are connected by using ring topology. If only one device in the ring is disconnected, the rest of the devices continue to communicate. For ring topology to work correctly, a device level ring (DLR) supervisor is required (for example, the Bulletin 1783 ETAP device). DLR is an ODVA standard. For more information, refer to the EtherNet/IP Embedded Switch Technology Application Guide, publication [ENET-AP005](#).

Devices without dual ports, for example the display terminal, require a 1783-ETAP module to complete the network ring.

Figure 7 - Kinetix 5500 Ring Communication Installation

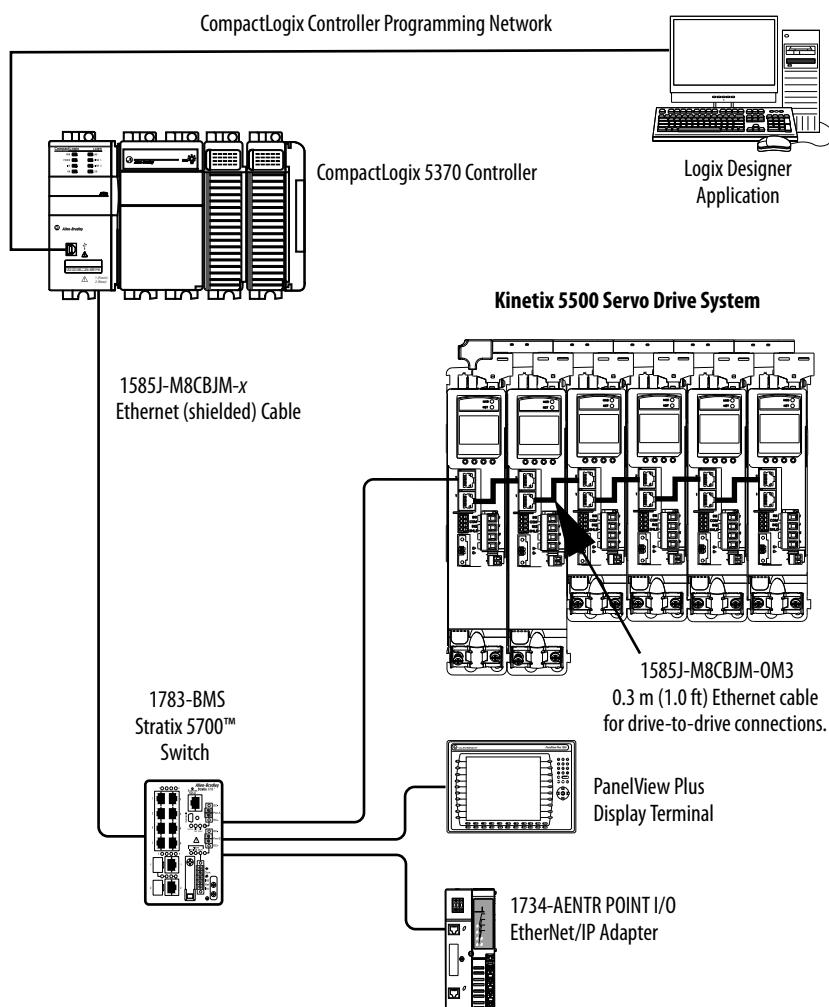


Star Topology

In this example, the devices are connected by using star topology. Each device is connected directly to the switch.

Kinetix 5500 drives have dual ports, so linear topology is maintained from drive-to-drive, but Kinetix 5500 drives and other devices operate independently. The loss of one device does not impact the operation of other devices.

Figure 8 - Kinetix 5500 Star Communication Installation



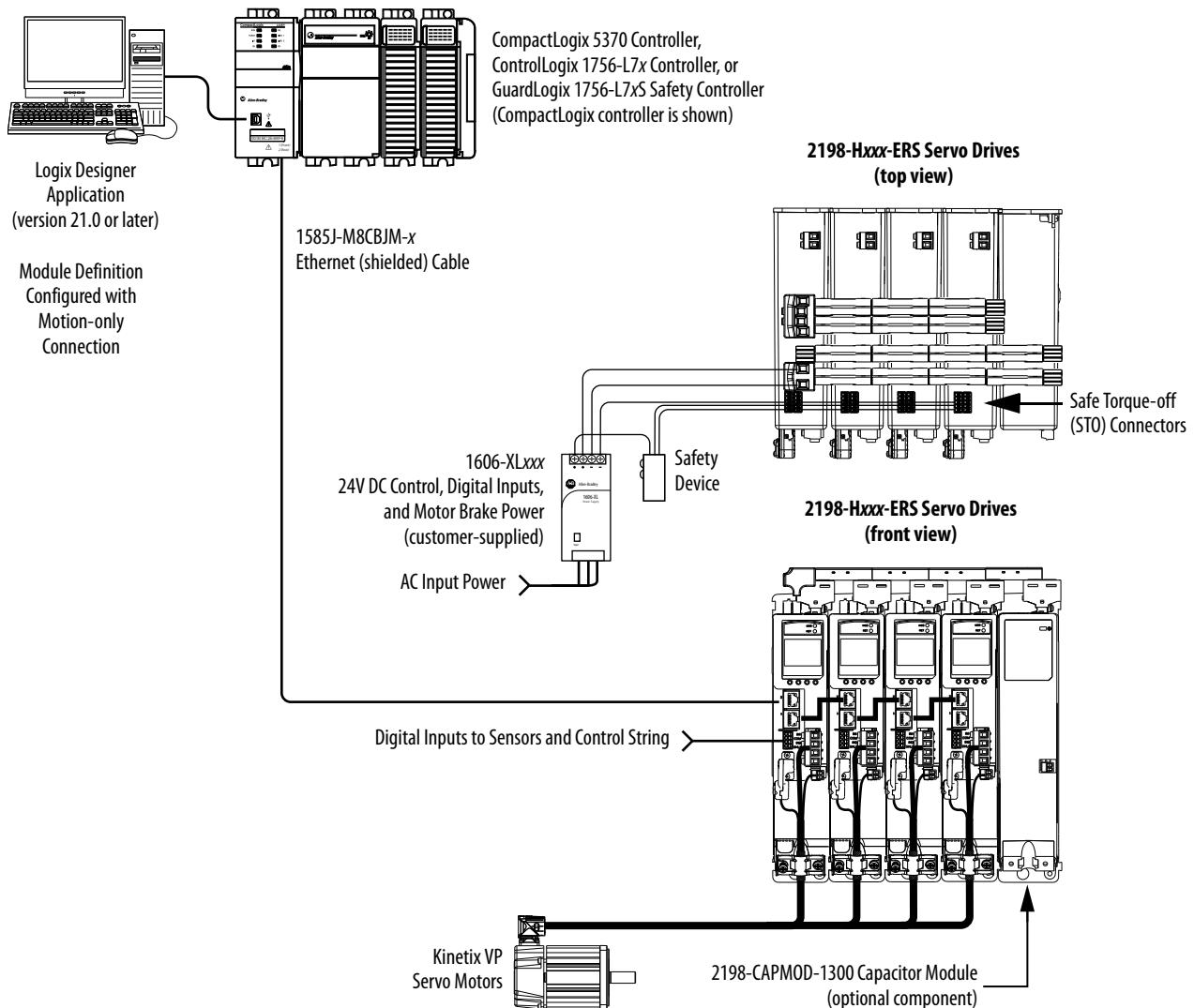
Safe Torque-off Configurations

Kinetix 5500 servo drives are available with safe torque-off via hardwired connections or integrated over the EtherNet/IP network. These examples illustrate the safe torque-off configuration options.

Hardwired Safety Configuration

The 2198-Hxxx-ERS drives use the safe torque-off (STO) connector for cascading hardwired safety connections from drive-to-drive.

Figure 9 - Safe Torque-off (hardwired) Configuration



Integrated Safety Configurations

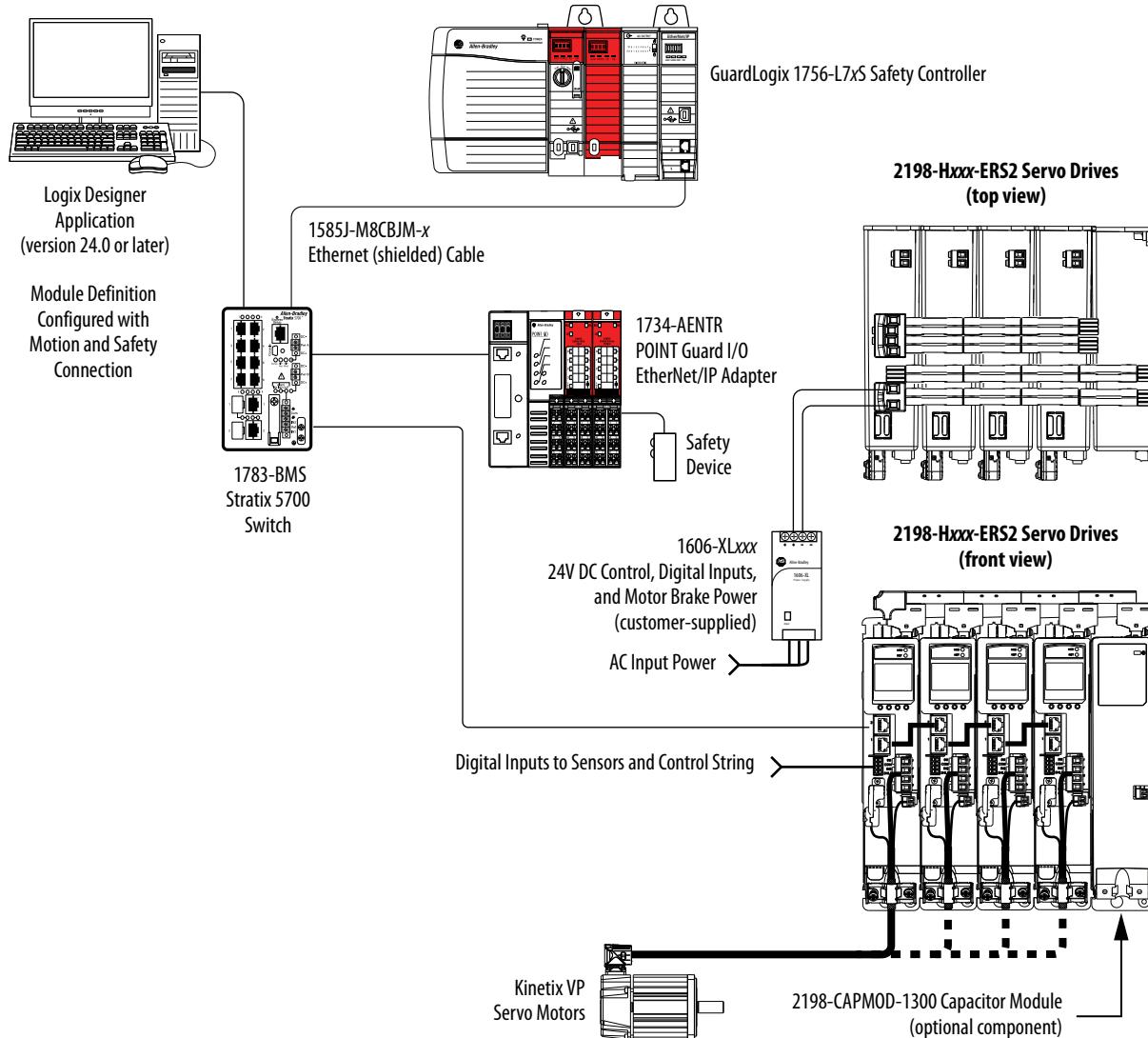
The 1756-L7xS GuardLogix safety controller issues the safe torque-off (STO) command over the EtherNet/IP network and the 2198-Hxxx-ERS2 integrated safety drive executes the command.

In this example, a single GuardLogix safety controller makes a Motion and Safety connection with the 2198-Hxxx-ERS2 integrated safety drives.

IMPORTANT

If only one controller is used in an application with Motion and Safety connections, it must be a 1756-L7xS GuardLogix safety controller.

Figure 10 - Motion and Safety Configuration (single controller)

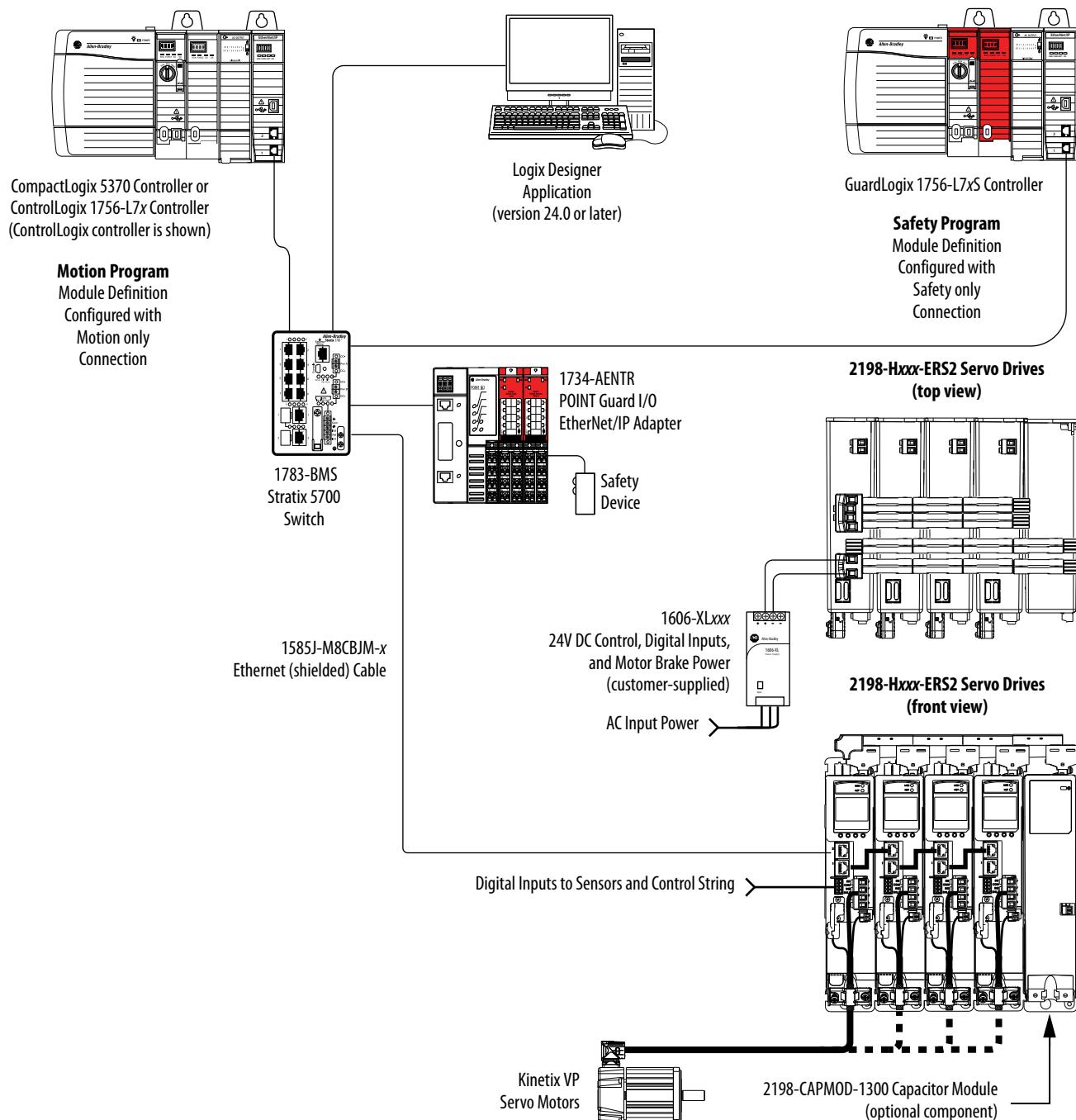


In this example, a non-safety controller makes the Motion-only connection and a separate GuardLogix safety controller makes the Safety-only connection with 2198-Hxxx-ERS2 integrated safety drives.

IMPORTANT

If two controllers are used in an application with Motion-only and Safety-only connections, the Safety-only connection must be a 1756-L7xS GuardLogix safety controller and the Motion-only connection must be a ControlLogix 1756-L7x or CompactLogix 5370 controller.

Figure 11 - Motion and Safety Configuration (multi-controller)



Catalog Number Explanation

Kinetix 5500 drive catalog numbers and performance descriptions.

Table 2 - Kinetix 5500 Drive Catalog Numbers

Drive Cat. No. (hardwired STO)	Drive Cat. No. (integrated STO)	Frame Size	Input Voltage	Continuous Output Power kW	Continuous Output Current A 0-pk
2198-H003-ERS	2198-H003-ERS2	1	195...264V rms, single-phase 195...264V rms, three-phase 324...528V rms, three-phase	0.2 kW 0.3 kW 0.6 kW	1.4
2198-H008-ERS	2198-H008-ERS2			0.5 kW 0.8 kW 1.6 kW	3.5
2198-H015-ERS	2198-H015-ERS2			1.0 kW 1.5 kW 3.2 kW	7.1
2198-H025-ERS	2198-H025-ERS2	2	195...264V rms, three-phase 324...528V rms, three-phase	2.4 kW 5.1 kW	11.3
2198-H040-ERS	2198-H040-ERS2			4.0 kW 8.3 kW	18.4
2198-H070-ERS	2198-H070-ERS2			7.0 kW 14.6 kW	32.5

Table 3 - Drive Components Catalog Numbers

Capacitor Module Cat. No.	Frame Size	Rated Voltage	Capacitance
2198-CAPMOD-1300	2	650V DC, nom	1360 µF, min

Table 4 - Shared-bus Connector Kit Catalog Numbers

Kit Cat. No.	Frame Size	Application	Description
2198-H040-ADP-IN	Frame 1 or 2	First drive	<ul style="list-style-type: none"> Mains AC input wiring connector 24V DC input wiring connector DC bus T-connector
2198-H040-A-T	Next drive is... Frame 1 drives: 2198-H003-ERSx 2198-H008-ERSx Frame 2 drives: 2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	AC sharing only	AC bus T-connector
2198-H040-D-T		DC sharing only	DC bus T-connector
2198-H040-P-T		Control power sharing only	Control power T-connector
2198-H040-AD-T		AC and DC bus sharing	AC and DC bus T-connectors
2198-H040-AP-T		AC and control power sharing	AC and control power T-connectors
2198-H040-DP-T		DC and control power sharing	DC and control power T-connectors
2198-H040-ADP-T		AC, DC, and control power sharing	AC, DC, and control power T-connectors
2198-H070-ADP-IN	Frame 3 drive: 2198-H070-ERSx	First drive	<ul style="list-style-type: none"> Mains AC input wiring connector 24V DC input wiring connector DC bus T-connector
2198-H070-A-T	Next drive is... Frame 3 drives: 2198-H070-ERSx	AC sharing only	AC bus T-connector
2198-H070-D-T		DC sharing only	DC bus T-connector
2198-H070-P-T		Control power sharing only	Control power T-connector
2198-H070-AD-T		AC and DC bus sharing	AC and DC bus T-connectors
2198-H070-AP-T		AC and control power sharing	AC and control power T-connectors
2198-H070-DP-T		DC and control power sharing	DC and control power T-connectors
2198-H070-ADP-T		AC, DC, and control power sharing	AC, DC, and control power T-connectors

Agency Compliance

If this product is installed within the European Union and has the CE mark, the following regulations apply.



ATTENTION: Meeting CE requires a grounded system, and the method of grounding the AC line filter and drive must match. Failure to do this renders the filter ineffective and can cause damage to the filter. For grounding examples, refer to [Grounded Power Configurations](#) on [page 69](#).

For more information on electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

To meet CE requirements, these requirements apply:

- Install an AC line filter (catalog number 2198-DBxx-F) for input power as close to the Kinetix 5500 drive as possible.
- Bond drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in [Figure 39 on page 73](#).
- Use Bulletin 2090 single motor cables with Kinetix VP servo motors. Use Bulletin 2090 motor power/brake and feedback cables for other compatible Allen-Bradley® motors and actuators.
- Combined motor cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor cables must not exceed 50 m (164 ft); however, use of continuous-flex cable and 2198-H2DCK converter kit limits the maximum length.

Table 5 - Drive-to-Motor Maximum Cable Length

Kinetix 5500 Servo Drive Cat. No.	Kinetix VP Servo Motors		Other Compatible Rotary Motors and Linear Actuators ⁽¹⁾ Motor Power/brake Cables (cat. no. 2090-CPxM7DF-xxAxxx) Feedback Cables (cat. no. 2090-CFBM7DF-CEAxxx) m (ft)	
	Standard (non-flex) Cables ⁽²⁾ (cat. no. 2090-CSxM1DF-xxAAxx) m (ft)	Continuous-flex Cables (cat. no. 2090-CSBM1DF-xxAFxx) m (ft)		
2198-H003-ERSx 2198-H008-ERSx	50 (164)	30 (98.4)		
2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	50 (164)			
2198-H070-ERSx	50 (164)			

(1) Requires use of the 2198-H2DCK Hiperface-to-DSL feedback converter kit.

(2) Can be used to replace Bulletin 2090 motor power/brake cables in 2198-H2DCK converter kit applications to increase the maximum length up to 50 m (164 ft). Applies to only power/brake cables. Refer to [Motor Power/Brake Cable Preparation](#) on [page 89](#) for more information.

- Install the Kinetix 5500 system inside an approved enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.
- Segregate input power wiring from control wiring and motor cables.

Refer to Appendix A on [page 189](#) for input power wiring and drive/motor interconnect diagrams.

Notes:

Planning the Kinetix 5500 Drive System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 5500 drive components.

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Electrical Noise Reduction	36



ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to the components.

System Design Guidelines

Use the information in this section when designing your enclosure and planning to mount your system components on the panel.

For on-line product selection and system configuration tools, including AutoCAD (DXF) drawings of the product, refer to <http://www.rockwellautomation.com/en/e-tools>.

System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 5500 drive systems must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP54 such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components.
- Combined motor power cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor cables must not exceed 50 m (164 ft), however use of continuous-flex cable and 2198-H2DCK converter kit limits the maximum length. Refer to [Table 5 on page 27](#) for specifications by frame size.

IMPORTANT System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

- Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).
- Registration and digital input cables greater than 30 m (98.4 ft) must be shielded.
- Segregate input power wiring from control wiring and motor cables.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

Bond drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in [Figure 39 on page 73](#).

Refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#), to better understand the concept of electrical noise reduction.

Transformer Selection

The servo drive does not require an isolation transformer for three-phase input power. However, a transformer can be required to match the voltage requirements of the drive to the available service.

To size a transformer for the main AC power inputs, refer to the Kinetix 5500 power specifications in the Kinetix Servo Drives Technical Data, publication [GMC-TD003](#).

IMPORTANT When using an autotransformer, make sure that the phase to neutral/ground voltage does not exceed the input voltage ratings of the drive.

IMPORTANT Use a form factor of 1.5 for three-phase power (where form factor is used to compensate for transformer, drive module, and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).

IMPORTANT 150 KVA, max and 3% impedance, min

EXAMPLE Sizing a transformer to the voltage requirements of this drive:
 $2198\text{-H040-ERSx} = 8.4 \text{ kW} = 12.6 \text{ KVA}$ transformer.

Circuit Breaker/Fuse Selection

The Kinetix 5500 drives use internal solid-state motor short-circuit protection and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 200,000 A.

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

IMPORTANT UL has not approved circuit breakers for use as branch circuit protection for Kinetix 5500 drive systems.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Refer to [Power Wiring Examples](#), on page 190, for the wiring diagram.



ATTENTION: Do not use circuit protection devices on the output of an AC drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not allow it to operate properly. As a result, damage to the device occurs.

*Standalone Drive Systems***Table 6 - Fuse Selection (Bussmann part numbers)**

Kinetix 5500 Drive Cat. No.	Three-phase	Single-phase
2198-H003-ERSx	KTK-R-3	KTK-R-2
2198-H008-ERSx	KTK-R-7	KTK-R-5
2198-H015-ERSx	KTK-R-15	KTK-R-10
2198-H025-ERSx	KTK-R-20	N/A
2198-H040-ERSx	KTK-R-25	
2198-H070-ERSx	LPJ-35SP	

Table 7 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	Three-phase ⁽¹⁾	Single-phase ⁽¹⁾
2198-H003-ERSx	140U-D6D3-B20	140U-D6D2-B10
2198-H008-ERSx	140U-D6D3-B60	140U-D6D2-B20
2198-H015-ERSx	140U-D6D3-C12	140U-D6D2-B80
2198-H025-ERSx	140U-D6D3-C20	N/A
2198-H040-ERSx	140U-D6D3-C25	
2198-H070-ERSx	N/A	

(1) UL has not approved circuit breakers for use as branch circuit protection for Kinetix 5500 drive systems.

*Shared DC (common-bus) Drive Systems***Table 8 - Fuse Selection (Bussmann part numbers)**

Kinetix 5500 Drive Cat. No.	Three-phase
2198-H003-ERSx	KTK-R-10
2198-H008-ERSx	KTK-R-15
2198-H015-ERSx	KTK-R-20
2198-H025-ERSx	KTK-R-25
2198-H040-ERSx	LPJ-35SP
2198-H070-ERSx	

Table 9 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	Three-phase ⁽¹⁾
2198-H003-ERSx	N/A
2198-H008-ERSx	140U-D6D3-C15
2198-H015-ERSx	140U-D6D3-C20
2198-H025-ERSx	140U-D6D3-C25
2198-H040-ERSx	N/A
2198-H070-ERSx	

(1) UL has not approved circuit breakers for use as branch circuit protection for Kinetix 5500 drive systems.

Shared AC Drive Systems

Table 10 - Fuse Selection (Bussmann part numbers)

Kinetix 5500 Drive Cat. No.	2 Axes	3 Axes	4 Axes	5 Axes
2198-H003-ERSx	KTK-R-15			
2198-H008-ERSx	KTK-R-15			
2198-H015-ERSx	KTK-R-20	KTK-R-25	N/A	
2198-H025-ERSx	KTK-R-30		N/A	
2198-H040-ERSx	LPJ-35SP	LPJ-45SP	N/A	
2198-H070-ERSx	LPJ-60SP	N/A		

Table 11 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	2 Axes ⁽¹⁾	3 Axes ⁽¹⁾	4 Axes ⁽¹⁾	5 Axes ⁽¹⁾
2198-H003-ERSx				
2198-H008-ERSx	N/A			
2198-H015-ERSx	140U-D6D3-C15	140U-D6D3-C20	N/A	
2198-H025-ERSx	140U-D6D3-C25	140U-D6D3-C30	N/A	
2198-H040-ERSx	N/A			
2198-H070-ERSx	N/A			

(1) UL has not approved circuit breakers for use as branch circuit protection for Kinetix 5500 drive systems.

Shared AC/DC and Hybrid Systems

Table 12 - Fuse Selection (Bussmann part numbers)

Kinetix 5500 Drive Cat. No.	2 Axes	3 Axes	4 Axes	5 Axes	6 Axes	7 Axes	8 Axes
2198-H003-ERSx	KTK-R-10					KTK-R-15	
2198-H008-ERSx	KTK-R-15				KTK-R-20		
2198-H015-ERSx	KTK-R-20			N/A			
2198-H025-ERSx	KTK-R-30			N/A			
2198-H040-ERSx	KTK-R-30	LPJ-45SP	LPJ-50SP	N/A			
2198-H070-ERSx	LPJ-50SP	N/A					

Table 13 - Circuit Breaker Selection (Allen-Bradley catalog numbers)

Kinetix 5500 Drive Cat. No.	2 Axes ⁽¹⁾	3 Axes ⁽¹⁾	4 Axes ⁽¹⁾	5 Axes ⁽¹⁾	6 Axes ⁽¹⁾	7 Axes ⁽¹⁾	8 Axes ⁽¹⁾
2198-H003-ERSx	N/A						
2198-H008-ERSx	N/A						
2198-H015-ERSx	140U-D6D3-C15	140U-D6D3-C20		N/A			
2198-H025-ERSx	140U-D6D3-C20	140U-D6D3-C30		N/A			
2198-H040-ERSx	140U-D6D3-C30	N/A					
2198-H070-ERSx	N/A						

(1) UL has not approved circuit breakers for use as branch circuit protection for Kinetix 5500 drive systems.

Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Kinetix 5500 drive system. You need heat dissipation data from all components planned for your enclosure to calculate the enclosure size (refer to [Table 14](#)).

With no active method of heat dissipation (such as fans or air conditioning) either of the following approximate equations can be used.

Metric	Standard English
$A = \frac{0.38Q}{1.8T - 1.1}$	$A = \frac{4.08Q}{T - 1.1}$
Where T is temperature difference between inside air and outside ambient ($^{\circ}\text{C}$), Q is heat generated in enclosure (Watts), and A is enclosure surface area (m^2). The exterior surface of all six sides of an enclosure is calculated as	Where T is temperature difference between inside air and outside ambient ($^{\circ}\text{F}$), Q is heat generated in enclosure (Watts), and A is enclosure surface area (ft^2). The exterior surface of all six sides of an enclosure is calculated as
$A = 2dw + 2dh + 2wh$	$A = (2dw + 2dh + 2wh) / 144$
Where d (depth), w (width), and h (height) are in meters.	Where d (depth), w (width), and h (height) are in inches.

If the maximum ambient rating of the Kinetix 5500 drive system is $50\ ^{\circ}\text{C}$ ($122\ ^{\circ}\text{F}$) and if the maximum environmental temperature is $20\ ^{\circ}\text{C}$ ($68\ ^{\circ}\text{F}$), then $T=30$. In this example, the total heat dissipation is 416 W (sum of all components in enclosure). So, in the equation below, $T=30$ and $Q=416$.

$$A = \frac{0.38(416)}{1.8(30) - 1.1} = 2.99\ \text{m}^2$$

In this example, the enclosure must have an exterior surface of at least $2.99\ \text{m}^2$. If any portion of the enclosure is not able to transfer heat, do not include that value in the calculation.

Because the minimum cabinet depth to house the Kinetix 5500 system (selected for this example) is 300 mm (11.8 in.), the cabinet needs to be approximately 1500 x 700 x 300 mm (59.0 x 27.6 x 11.8 in.) HxWxD.

$$1.5 \times (0.300 \times 0.70) + 1.5 \times (0.300 \times 2.0) + 1.5 \times (0.70 \times 2.0) = 3.31\ \text{m}^2$$

Because this cabinet size is considerably larger than what is necessary to house the system components, it can be more efficient to provide a means of cooling in a smaller cabinet. Contact your cabinet manufacturer for options available to cool your cabinet.

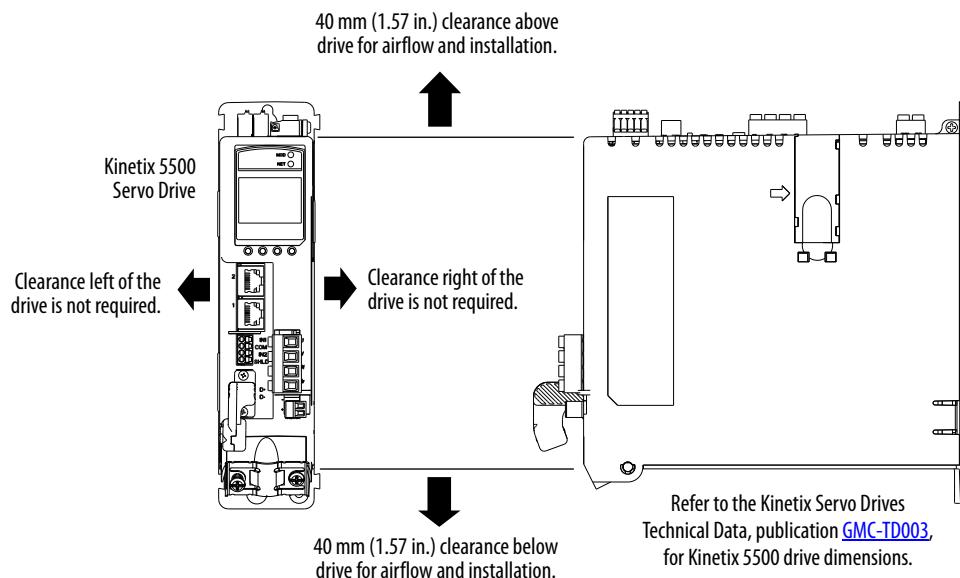
Table 14 - Power Dissipation Specifications

Kinetix 5500 Drive Cat. No.	Frame Size	Usage as % of Rated Power Output (watts)				
		20%	40%	60%	80%	100%
2198-H003-ERSx	1	12	25	37	50	62
2198-H008-ERSx						
2198-H015-ERSx	2	40	80	120	160	200
2198-H025-ERSx						
2198-H040-ERSx						
2198-H070-ERSx	3	64	128	192	256	320

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 5500 drive:

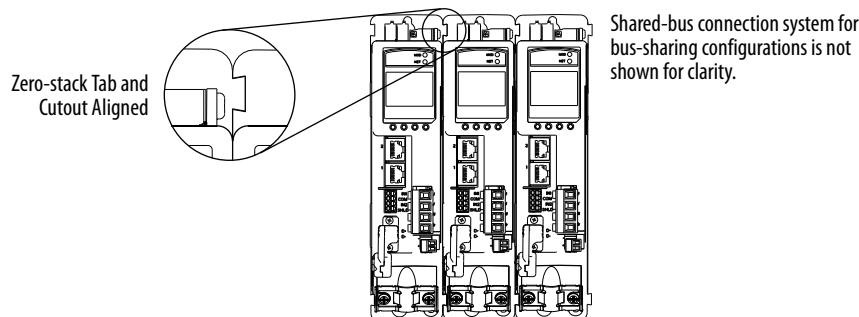
- Additional clearance is required for cables and wires or the shared-bus connection system connected to the top of the drive.
- Additional clearance is required if other devices are installed above and/or below the drive and have clearance requirements of their own.
- Additional clearance left and right of the drive is required when mounted adjacent to noise sensitive equipment or clean wire ways.
- The recommended minimum cabinet depth is 300 mm (11.81 in.).

Figure 12 - Minimum Clearance Requirements

IMPORTANT Mount the drive in an upright position as shown. Do not mount the drive on its side.

In multi-axis shared-bus configurations, drives must be spaced by aligning the zero-stack tab and cutout.

Figure 13 - Multi-axis Shared-bus Clearance Requirements



Electrical Noise Reduction

This section outlines best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 5500 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

Bonding Modules

Bonding is the practice of connecting metal chassis, assemblies, frames, shields, and enclosures to reduce the effects of electromagnetic interference (EMI).

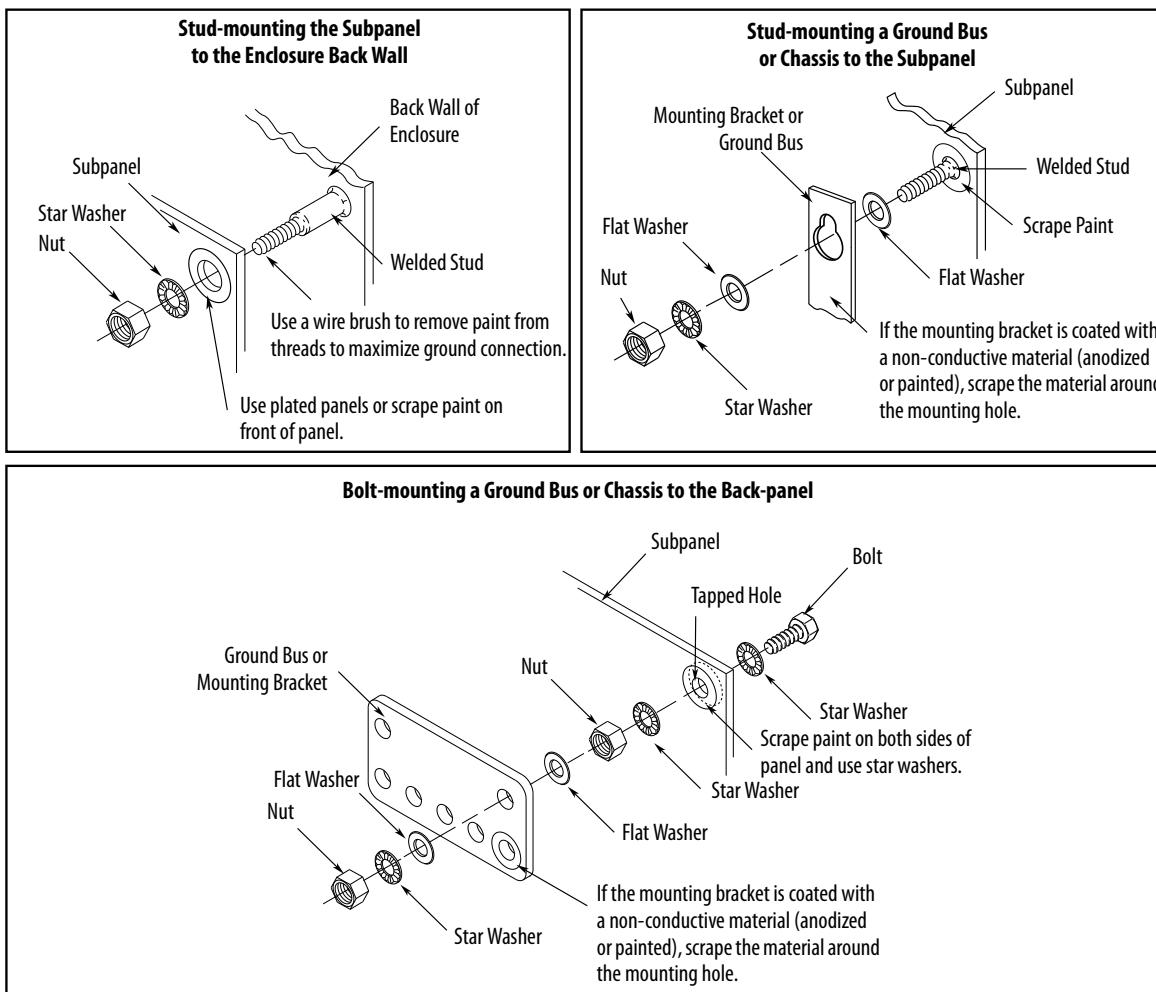
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Improper bonding of metal surfaces blocks the direct return path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.

These illustrations show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.

Figure 14 - Recommended Bonding Practices for Painted Panels

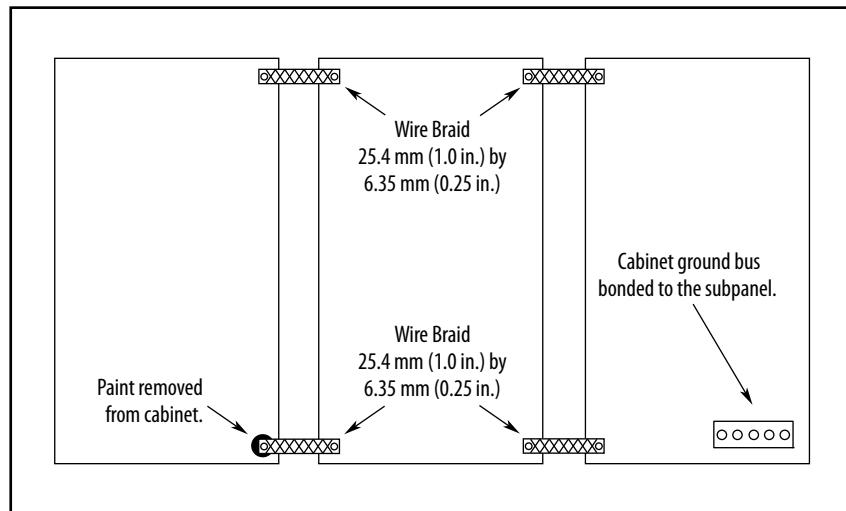


Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together do not necessarily share a common low impedance path. This difference in impedance can affect networks and other devices that span multiple panels:

- Bond the top and bottom of each subpanel to the cabinet by using 25.4 mm (1.0 in.) by 6.35 mm (0.25 in.) wire braid. As a rule, the wider and shorter the braid is, the better the bond.
- Scrape the paint from around each fastener to maximize metal-to-metal contact.

Figure 15 - Multiple Subpanels and Cabinet Recommendations

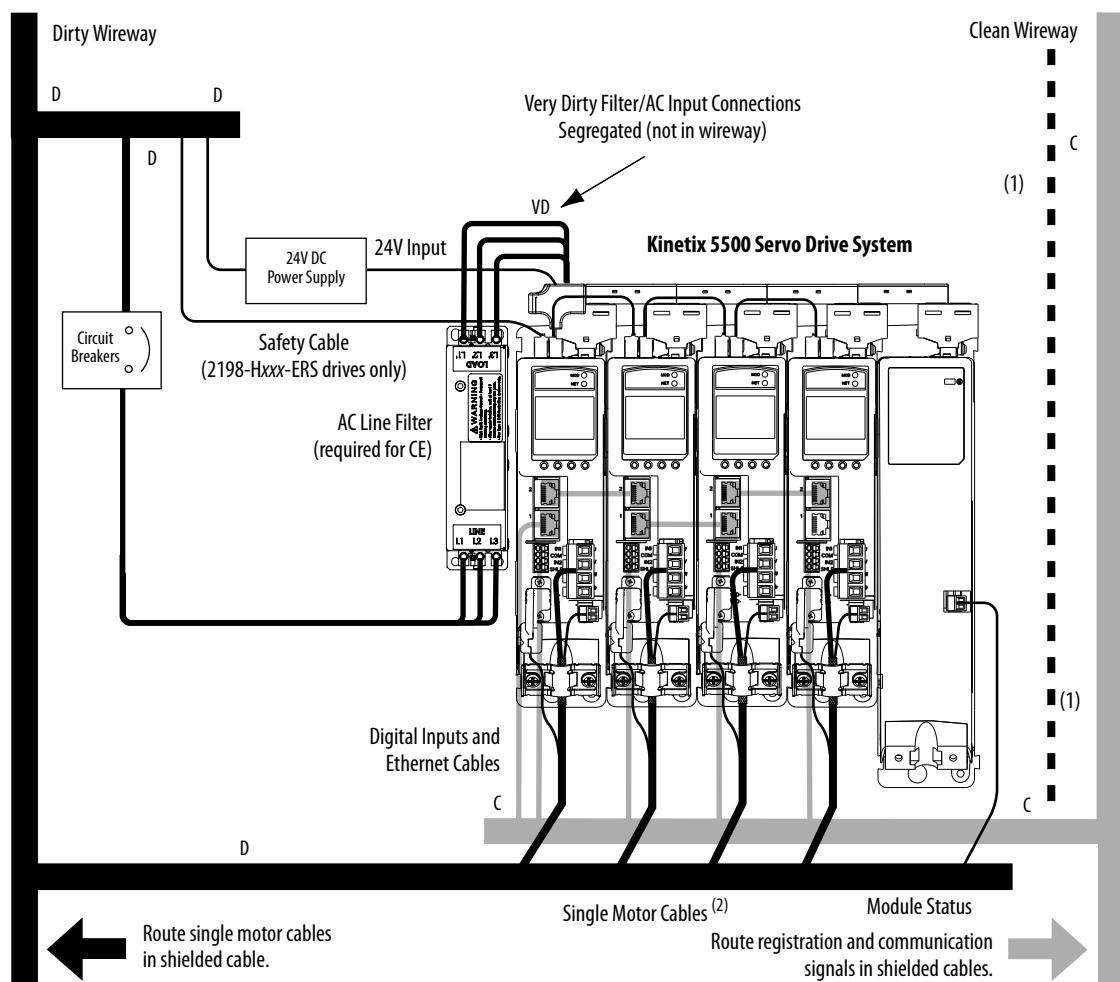


Establishing Noise Zones

Observe these guidelines when routing cables used in the Kinetix 5500 system:

- The clean zone (C) is beneath the drive system and includes the digital inputs wiring and Ethernet cable (gray wireway).
- The dirty zone (D) is above and below the drive system (black wireways) and includes the circuit breakers, 24V DC power supply, safety, and motor cables.
- The very dirty zone (VD) is limited to where the AC line (EMC) filter VAC output jumpers over to the drive (or first drive in multi-axis systems). Shielded cable is required only if the very dirty cables enter a wireway.

Figure 16 - Noise Zones



(1) When space to the right of the drive does not permit 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

(2) When 2198-H2DK converter kit is used, feedback cable routes in the clean wireway.

Cable Categories for Kinetix 5500 Systems

These tables indicate the zoning requirements of cables connecting to the Kinetix 5500 drive components.

Table 15 - Kinetix 5500 Drive

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
L1, L2, L3 (shielded cable)	IPD		X			X
L1, L2, L3 (unshielded cable)		X				
DC-/DC+ (DC bus)	DC	Bus-bar only, no wiring connector.				
DC+/SH (shunt)	RC		X			
U, V, W (motor power)	MP		X			X
Motor feedback ⁽¹⁾	MF		X			X
Motor brake	BC		X			X
24V DC	CP		X			
Safety enable for safe torque-off ⁽²⁾	STO		X			
Registration input, greater than 30 m (98.4 ft)	IOD			X		X
Registration input, less than 30 m (98.4 ft)				X		
Ethernet	PORT1 PORT2			X		X

(1) When the 2198-H2DCK converter kit is used, the feedback cable routes in the clean wireway.

(2) STO connector applies to only 2198-Hxxx-ERS (hardwired) servo drives.

Table 16 - Capacitor Module

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
DC-/DC+ (DC bus)	DC	Bus-bar only, no wiring connector.				
24V DC	CP	Bus-bar only, no wiring connector.				
Module status	MS		X			

Noise Reduction Guidelines for Drive Accessories

Refer to this section when mounting an AC (EMC) line filter or external shunt resistor for guidelines designed to reduce system failures caused by excessive electrical noise.

AC Line Filters

Observe these guidelines when mounting your AC (EMC) line filter (refer to the figure on [page 39](#) for an example):

- Mount the AC line filter on the same panel as the Kinetix 5500 drive and as close to the power rail as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on [page 37](#).
- Segregate input and output wiring as far as possible.

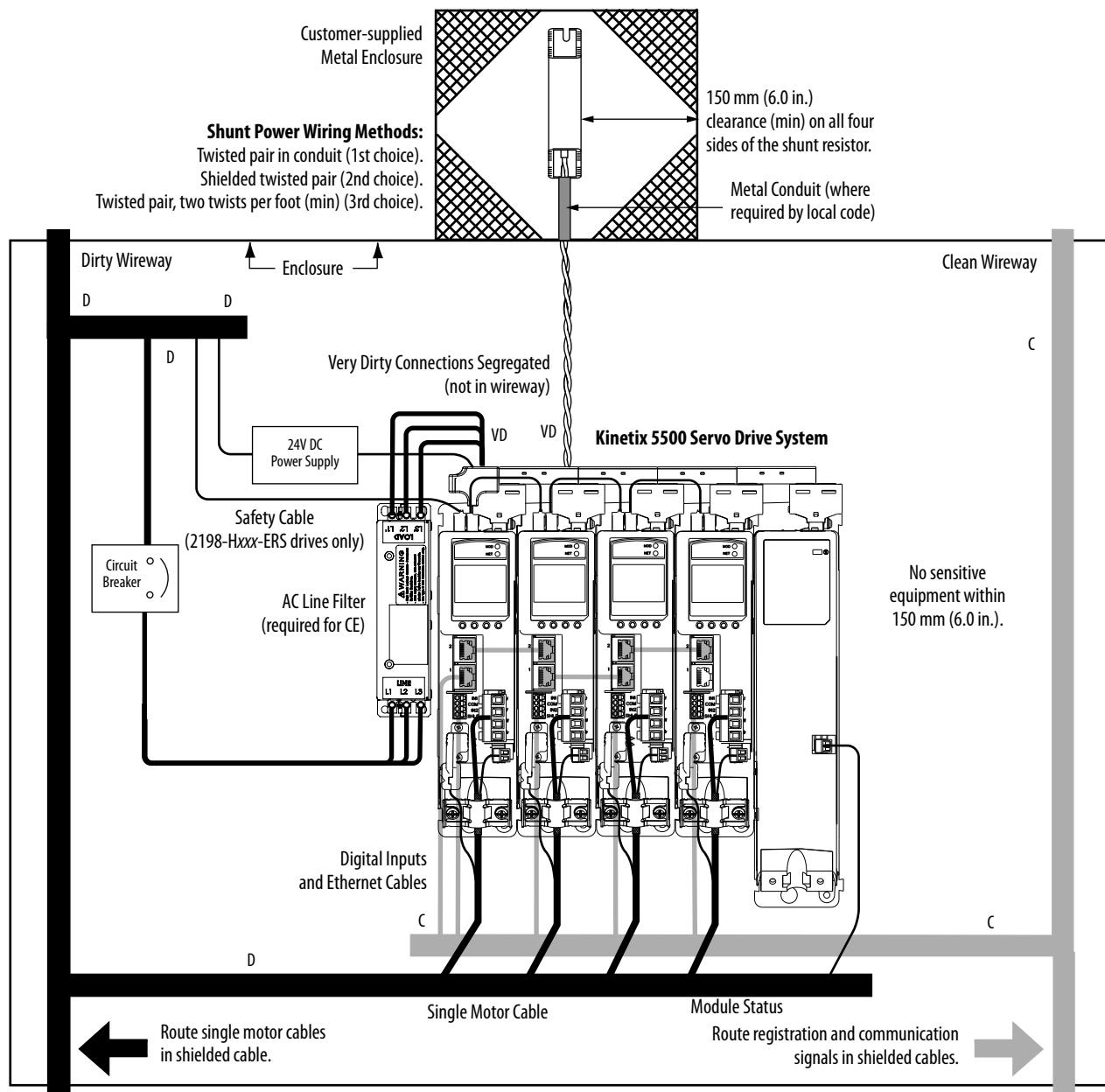
IMPORTANT CE test certification applies to only the AC line filter used with a single drive or the line filter used in multi-axis drive configurations. Sharing a line filter with more than one multi-axis drive configuration can perform satisfactorily, but the customer takes legal responsibility.

External Shunt Resistor

Observe these guidelines when mounting your external shunt resistor outside of the enclosure:

- Mount shunt resistor and wiring in the very dirty zone or in an external shielded enclosure.
- Mount resistors in a shielded and ventilated enclosure outside of the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.

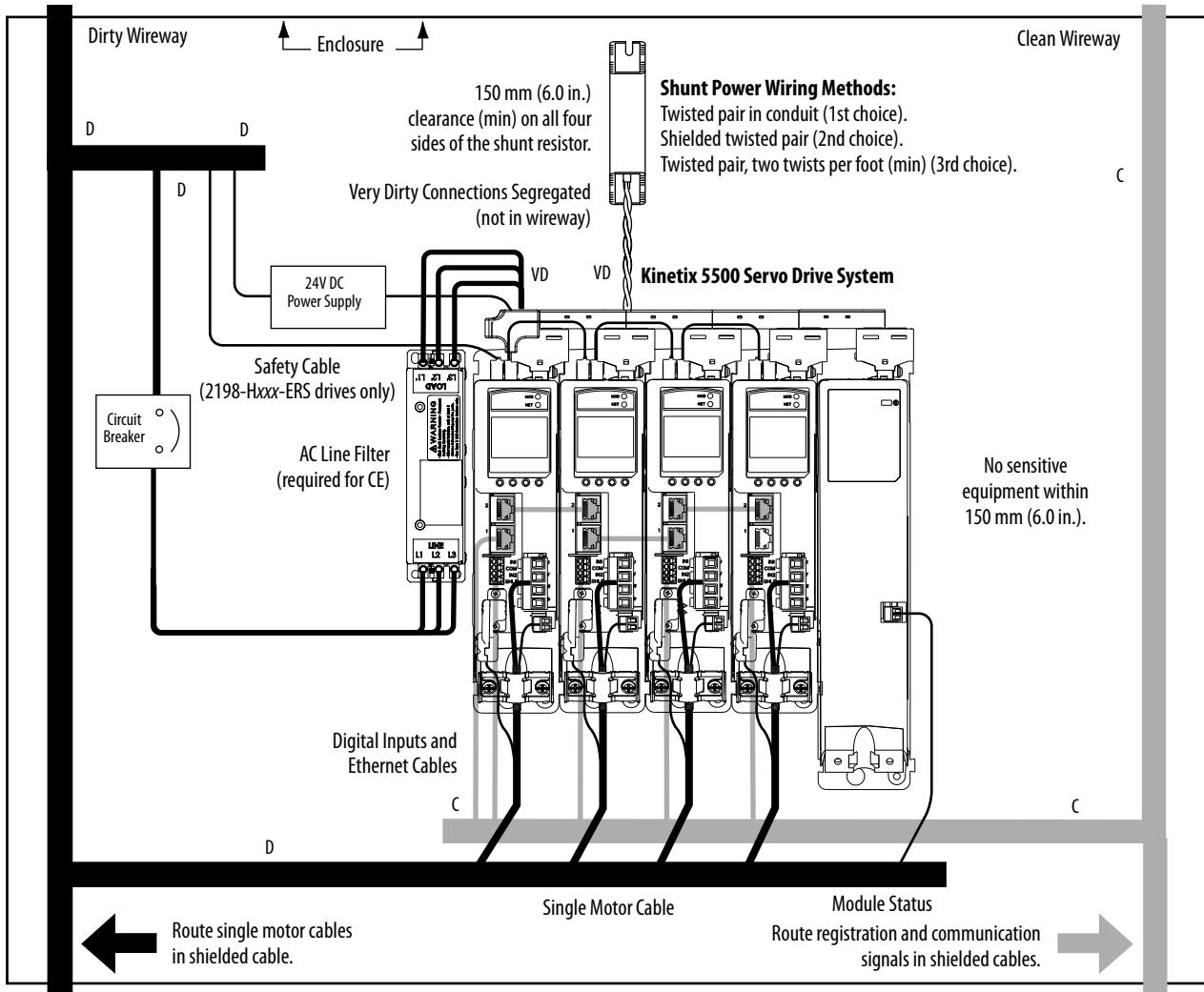
Figure 17 - External Shunt Resistor Outside the Enclosure



When mounting your shunt resistor inside the enclosure, follow these additional guidelines:

- Mount metal-clad modules anywhere in the dirty zone, but as close to the Kinetix 5500 drive as possible.
- Route shunt power wires with other very dirty wires.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.

Figure 18 - External Shunt Resistor Inside the Enclosure



Notes:

Mounting the Kinetix 5500 Drive System

This chapter provides the system installation procedures for mounting your Kinetix 5500 drives to the system panel.

Topic	Page
Determining Mounting Order	46
Drilling Hole Patterns	49
Mount Your Kinetix 5500 Drive	56

This procedure assumes you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Kinetix 5500 drives prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.



ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to the components.

Determining Mounting Order

Mount drives in order (left to right) according to power rating (highest to lowest) starting with the highest power rating. If power rating is unknown, position drives (highest to lowest) from left to right based on amp rating.

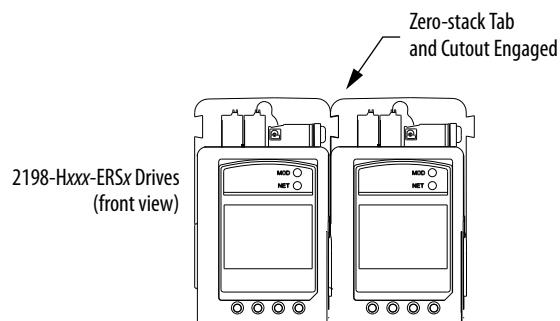
Zero-stack Tab and Cutout

Engaging the zero-stack tab and cutout from drive-to-drive makes efficient use of panel space for installations with multiple drives.

IMPORTANT

Engaging the zero-stack tab and cutout from drive-to-drive is required for shared-bus multi-axis drive systems. This is done to make sure the drive connectors are spaced properly to accept the shared-bus connection system.

Figure 19 - Zero-stack Tab and Cutout Example



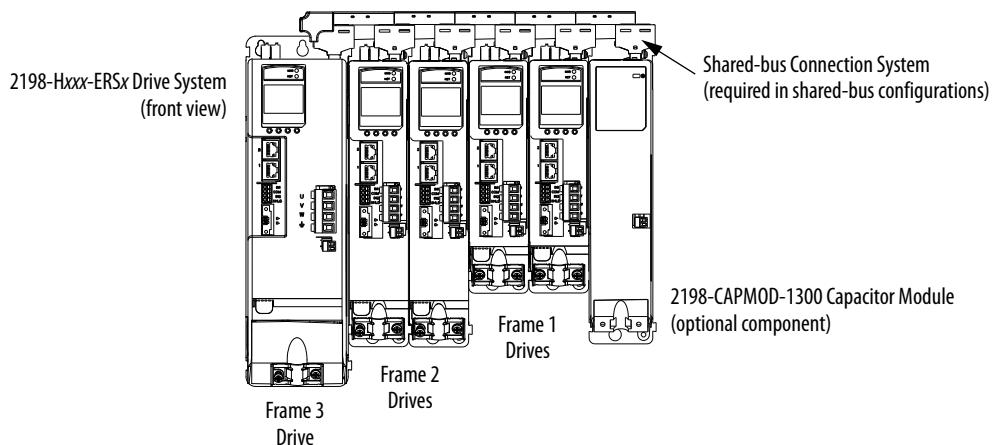
For the zero-stack feature to engage properly (when more than one frame size exists in the drive system) frame 3 drives must mount left of frame 1 or 2 drives, and frame 2 drives must mount left of frame 1 drives.

Capacitor modules can mount to the right of any frame size, but are always rightmost in any drive configuration.

IMPORTANT

Mount drives in descending order, left to right, according to frame size with capacitor modules always mounted on the far right.

Figure 20 - Shared-bus Connection System Example



Shared-bus Connection System

The shared-bus connection system is used to extend the mains AC input, 24V control input, and the DC bus power from drive-to-drive in shared-bus multi-axis configurations.

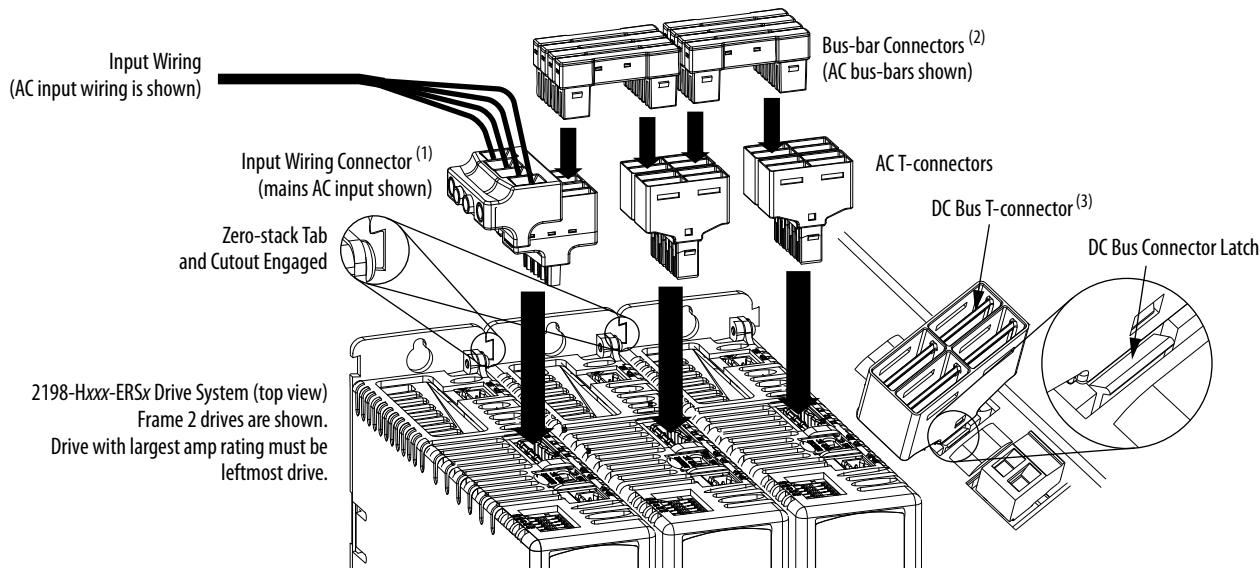
IMPORTANT

When the shared-bus connection system is used, the zero-stack tab and cutout must be engaged between adjacent drives.

The connection system is comprised of three components:

- Input wiring connectors that plug into the leftmost drive and receive input wiring for mains AC and 24V DC.
- AC bus, DC bus, and 24V DC T-connectors that plug into the drives downstream from the first where AC, DC, and/or 24V control power is shared. DC bus T-connectors also plug into the first drive where DC bus power is shared.
- Bus bars that connect between drives to extend the mains AC bus, DC bus, and 24V DC control power from drive-to-drive.

Figure 21 - Connection System Example



- (1) Due to the higher amp rating of frame 3 drives, input wiring connectors for frame 3 drives (catalog number 2198-H070-ADP-IN) are slightly larger than connectors for frame 1 and 2 drives (catalog number 2198-H040-ADP-IN).
- (2) Due to the extra width of frame 3 drives, bus-bar connectors between frame 3 drives are slightly longer (85 mm) than connectors between frame 3, frame 2, and frame 1 drives (55 mm).
- (3) DC bus T-connectors latch on both sides when inserted into the drive. To remove the DC bus T-connector, at least one latch must be pried away with a non-conductive probe.

The three components assemble from left to right across the drive system.

1. Attach wiring to input wiring connectors.
2. Insert input wiring connectors and T-connectors into the appropriate drive connectors.
3. Insert bus-bars to connect between wiring connectors and T-connectors.

Single-axis Configurations

The following restrictions exist for standalone (single-axis) configurations:

- Standalone (single-axis) drives can be mounted to the panel individually or by using the zero-stack tab and cutout (refer to [Figure 21 on page 47](#))
- The shared-bus connection system does not apply and must not be used

For a single-axis example configuration, refer to [Typical Kinetix 5500 Standalone Installation on page 15](#).

Multi-axis Configurations

Each multi-axis configuration has restrictions that apply:

- The shared-bus connection system must be used. Do not attach discrete wires from drive-to-drive.
- The maximum number of drives in Shared AC bus power-sharing groups cannot exceed 5.
- The maximum number of drives in any other bus power-sharing group cannot exceed 8.

For a multi-axis example configuration, refer to [Typical Shared AC/DC Bus Hybrid Installations on page 19](#).

Drilling Hole Patterns

Hole patterns for drives mounted in zero-stack or shared-bus configuration are provided for mounting your drives to the panel. Drives with the highest power rating are always mounted to the left of any drive with a lower power rating in shared-bus configurations:

- Frame 1 drives can be followed by only another frame 1 drive.
- Frame 2 drives can be followed by frame 1 drives or another frame 2 drive.
- Frame 3 drives can be followed by frame 1, frame 2, or another frame 3 drive.
- Mount Bulletin 2198 capacitor modules in the rightmost position.
 - Capacitor modules have the same hole pattern as frame 2 drives.
 - Only Shared DC, Shared AC/DC, and Shared AC/DC, hybrid configurations are compatible with Bulletin 2198 capacitor modules.

Table 17 - Hole Pattern Overview

Drive Cat. No.	Frame Size	Frame Size Patterns	Page
2198-H003-ERSx 2198-H008-ERSx	Frame 1	As many as eight frame 1 drives	51
2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	Frame 2	As many as 8 frame 2 drives One frame 2 drive followed by as many as seven frame 1 drives	52
2198-H070-ERSx	Frame 3	As many as 8 frame 3 drives One frame 3 drive followed by as many as seven frame 1 drives One frame 3 drive followed by as many as seven frame 2 drives	53 54 55

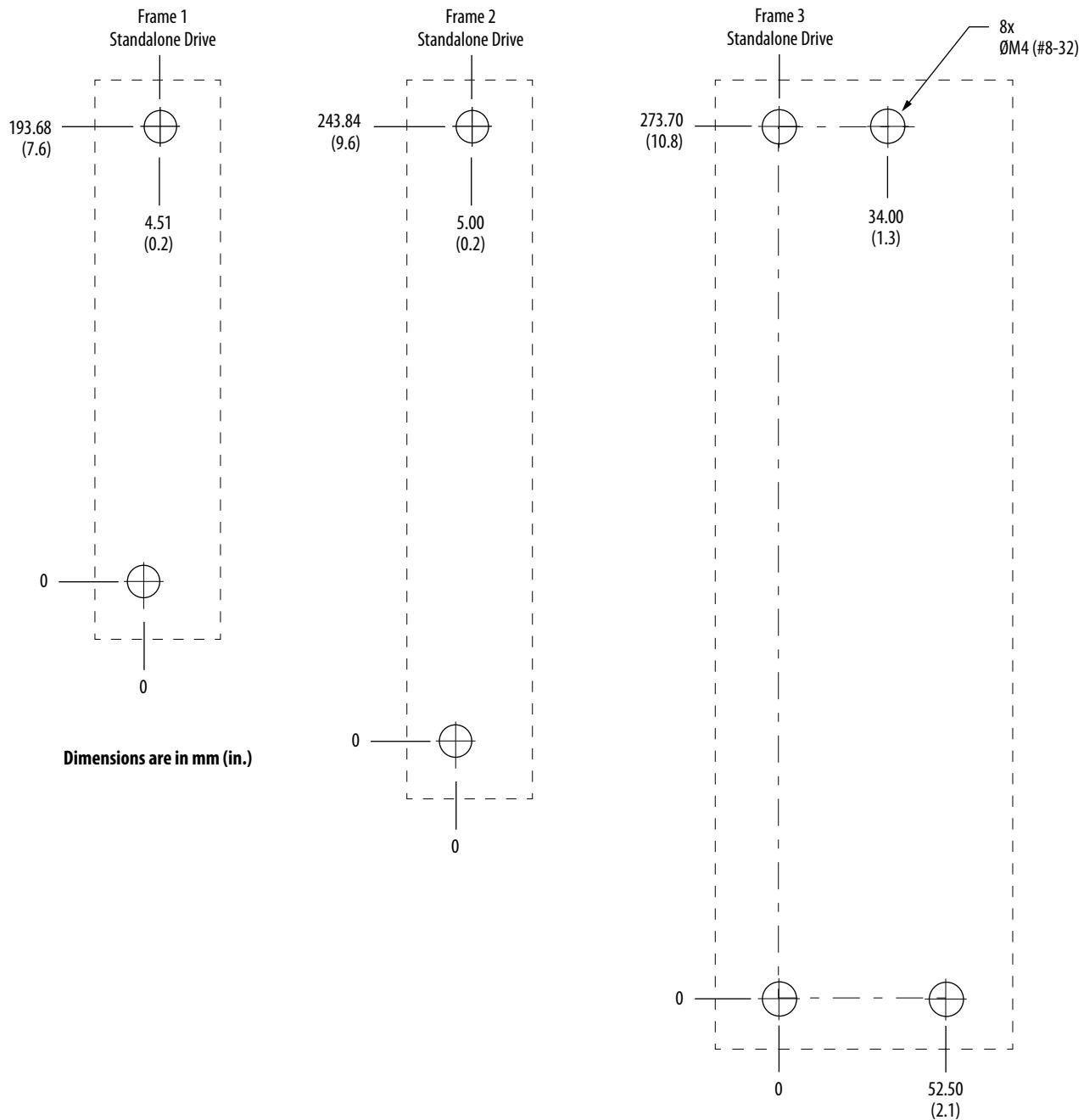
Table 18 - Capacitor Module Support

Drive Cat. No.	Frame Size	Standalone Single Phase Operation	Three-phase Operation			
			Standalone	Shared DC	Shared AC/DC	Shared AC/DC Hybrid
			Number of capacitor modules connected, max			
2198-H003-ERSx ⁽¹⁾	1	0	0			
2198-H008-ERSx ⁽¹⁾		0		2		
2198-H015-ERSx ⁽¹⁾		1				
2198-H025-ERSx	2		3		4	
2198-H040-ERSx		N/A				
2198-H070-ERSx	3		4			

(1) Catalog number 2198-H003-ERS and any drive in standalone single-phase operation is not compatible with the Kinetix 5500 capacitor module.

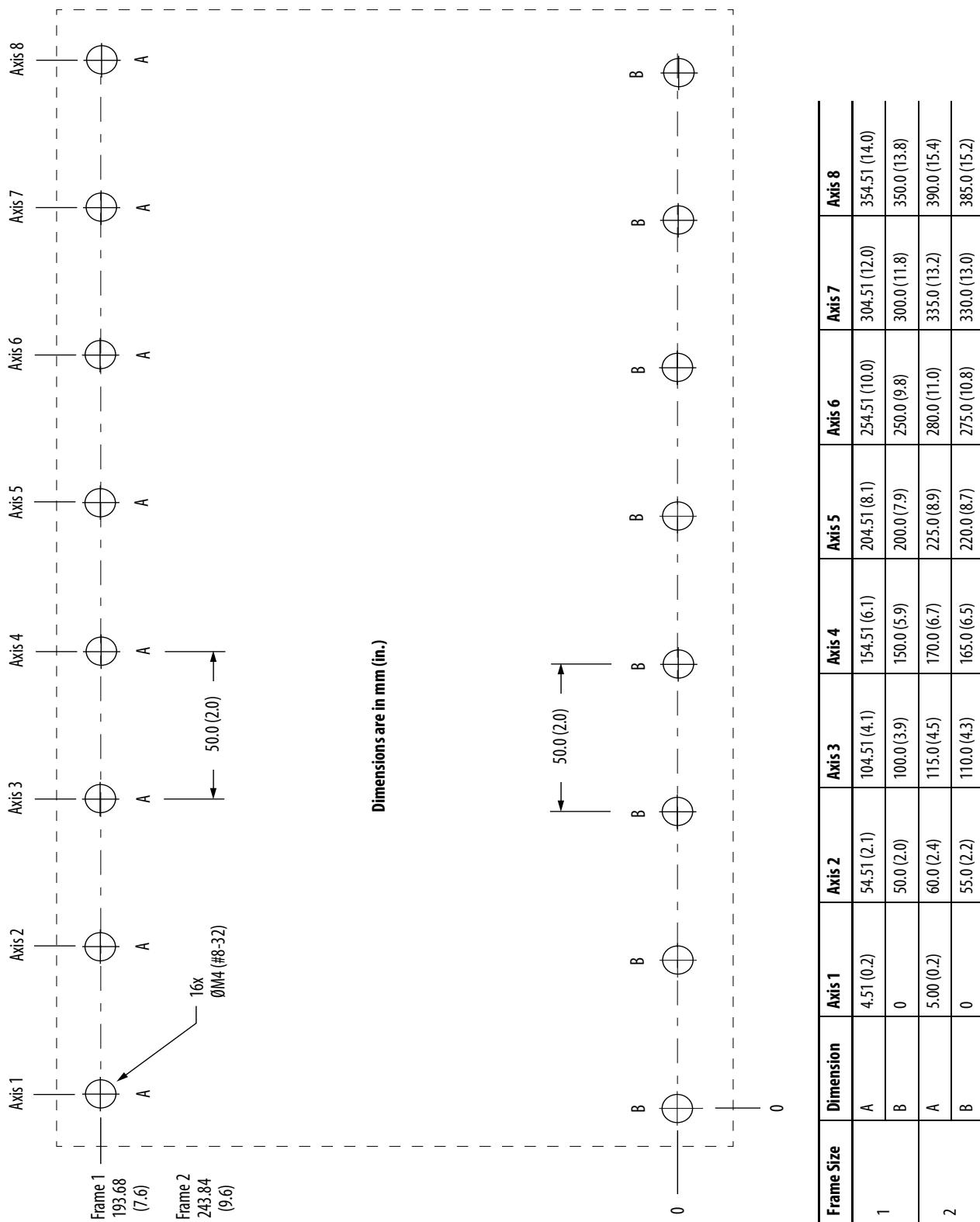
These hole patterns apply to standalone drives.

Figure 22 - Frame 1, Frame 2, and Frame 3 Standalone Hole Patterns



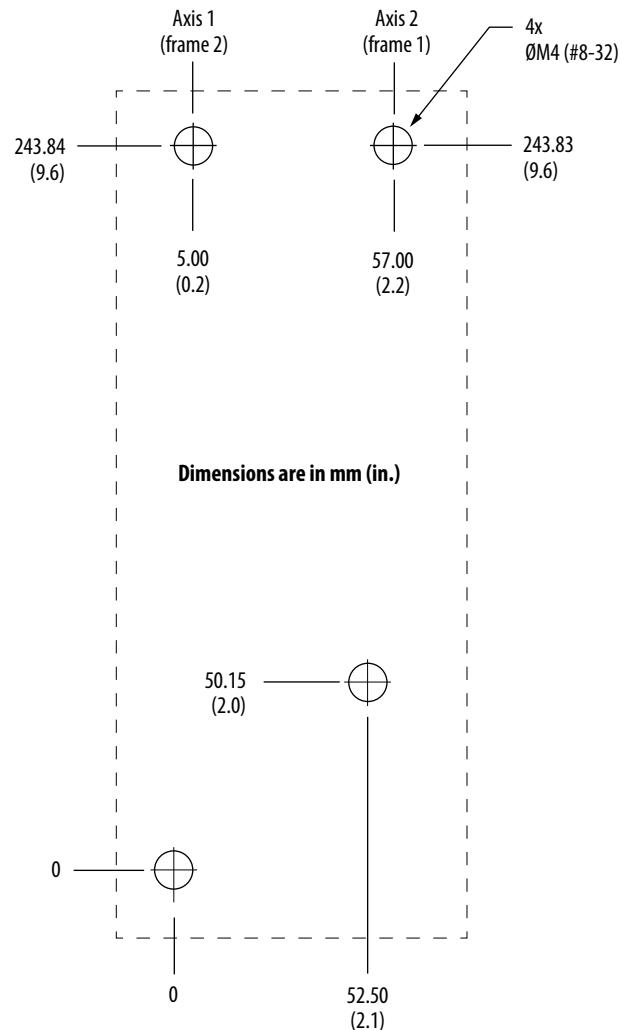
These hole patterns apply when all drives in the system are frame 1 or frame 2. There is 50 mm (2.0 in.) between mounting holes (A-to-A and B-to-B).

Figure 23 - Frame 1 and Frame 2 Hole Patterns



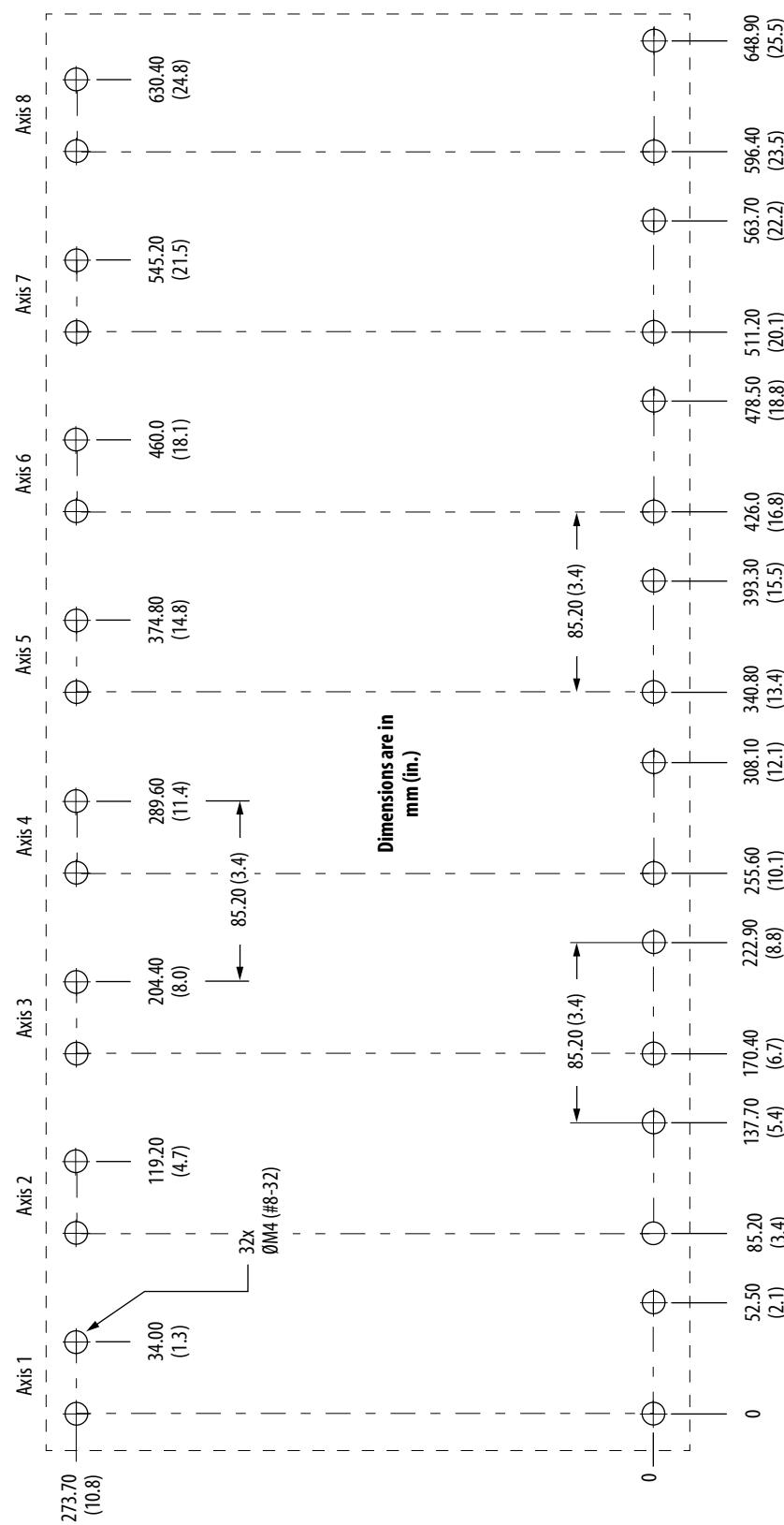
This hole pattern applies when transitioning from frame 2 drives to frame 1 drives. To mount additional frame 1 drives to the right of Axis 2 in this figure, refer to the frame 1 hole pattern in [Figure 23](#).

Figure 24 - Frame 2 to Frame 1 Hole Pattern



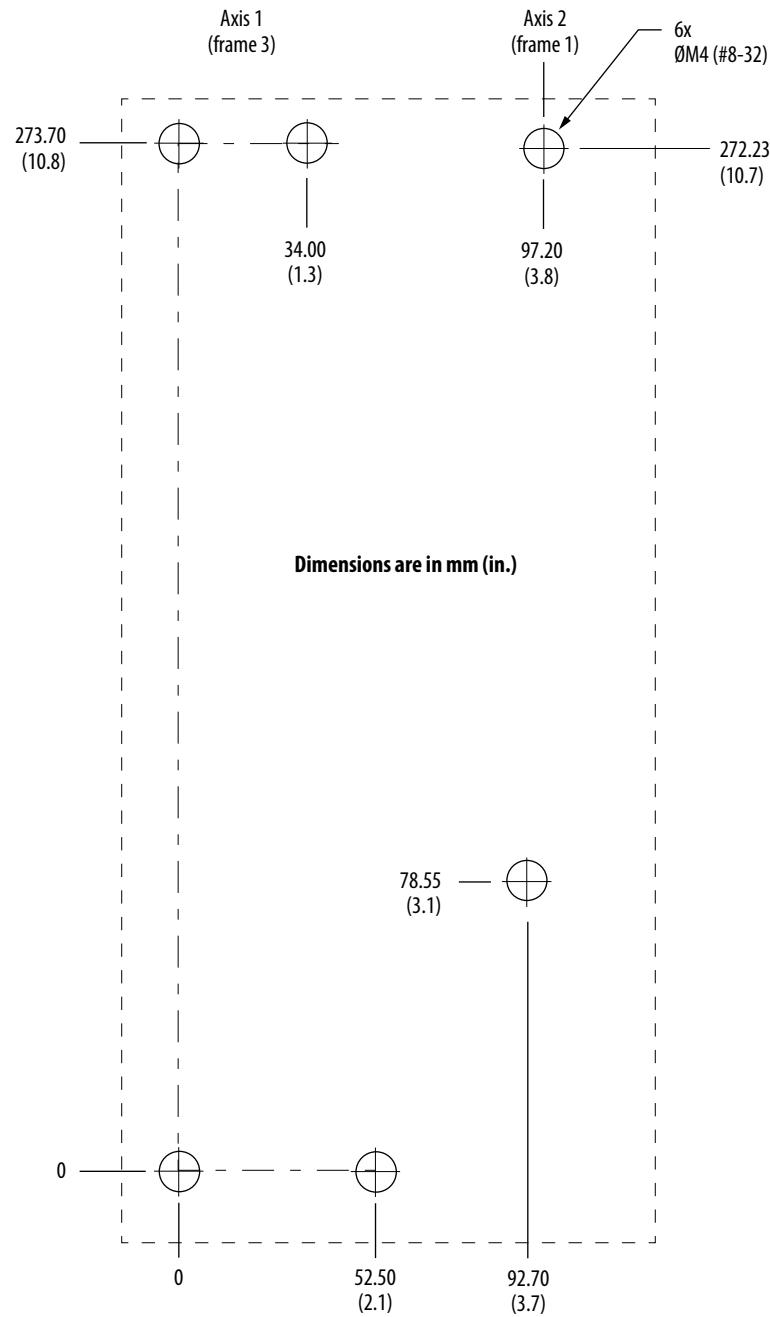
This hole pattern applies when all drives in the system are frame 3 drives. There is 85.20 mm (3.4 in.) between mounting holes, as shown.

Figure 25 - Frame 3 Hole Pattern



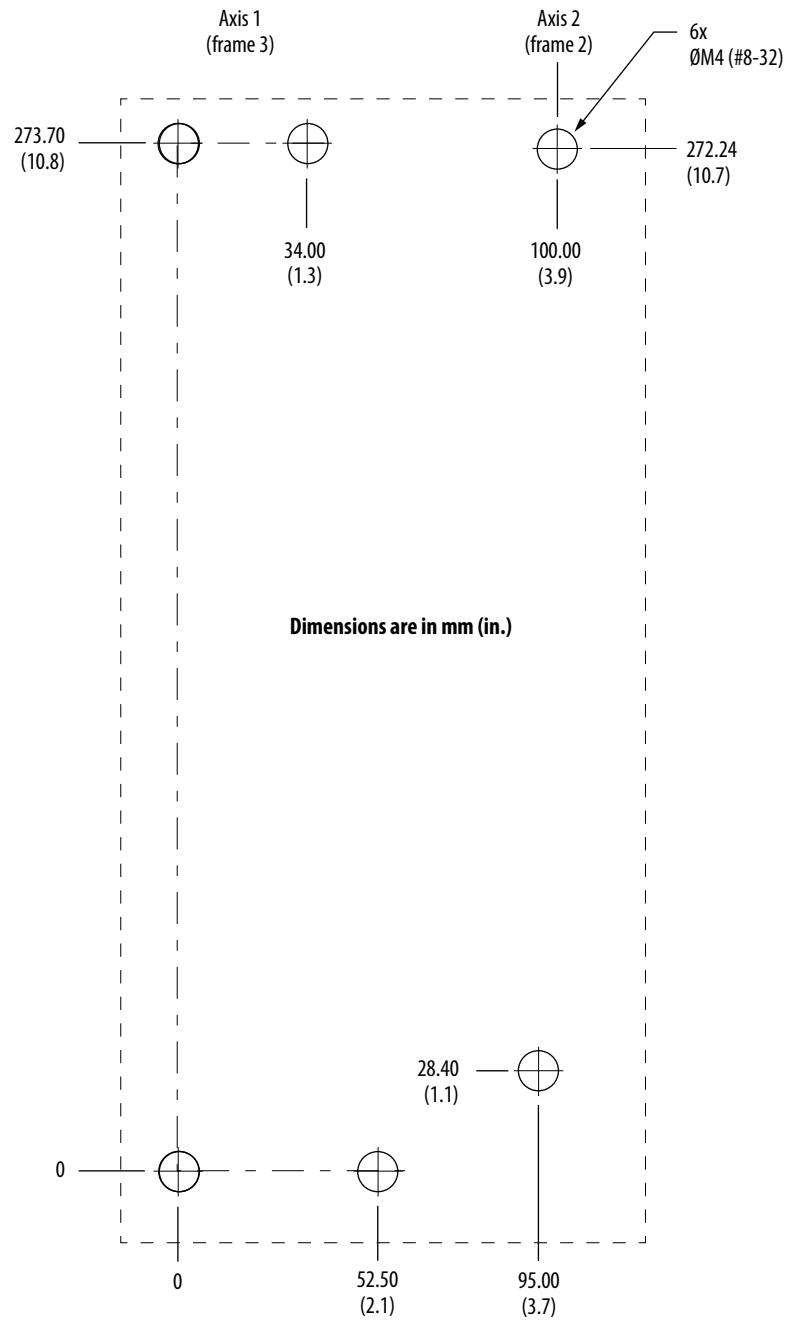
This hole pattern applies when transitioning from frame 3 drives to frame 1 drives. To mount additional frame 1 drives to the right of Axis 2 in this figure, refer to the frame 1 hole pattern in [Figure 23](#).

Figure 26 - Frame 3 to Frame 1 Hole Pattern



This hole pattern applies when transitioning from frame 3 drives to frame 2 drives. To mount additional frame 2 drives to the right of Axis 2 in this figure, refer to the frame 2 hole pattern in [Figure 23](#).

Figure 27 - Frame 3 to Frame 2 Hole Pattern



Mount Your Kinetix 5500 Drive

This procedure assumes you have prepared your panel and understand how to bond your system. For installation instructions regarding other equipment and accessories, refer to the instructions that came with those products.

Follow these steps to mount your Kinetix 5500 drives to the panel.

1. Lay out the hole pattern for each Kinetix 5500 drive in the enclosure.

Refer to [Establishing Noise Zones](#) on [page 39](#) for panel layout recommendations.

IMPORTANT To improve the bond between the Kinetix 5500 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

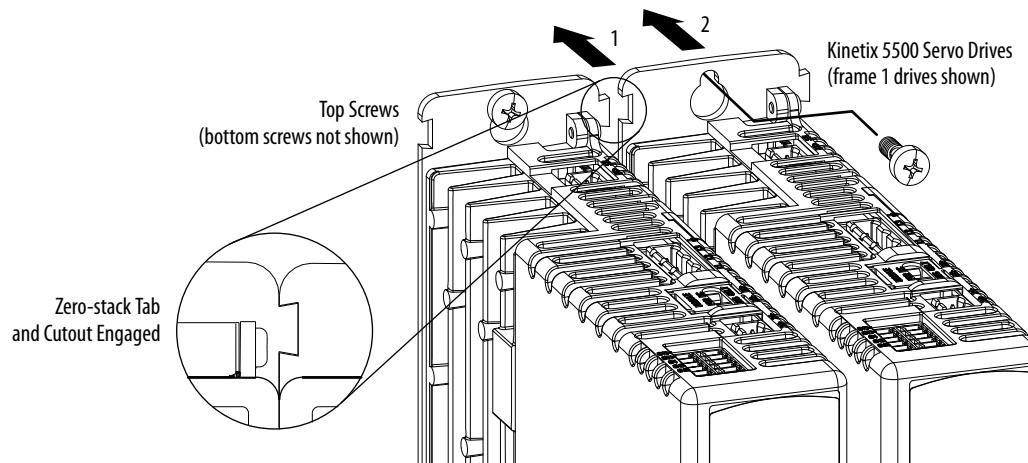
2. Drill holes in the panel for mounting your drive system.

Hole patterns, by frame size, are shown in [Drilling Hole Patterns](#) beginning on [page 49](#).

3. Loosely attach the mounting hardware to the panel.

The recommended mounting hardware is M4 (#8-32) steel bolts. Observe bonding techniques as described in [Bonding Modules](#) on [page 36](#).

4. Attach the leftmost drive to the cabinet panel.



5. Attach additional drives (if any) just to the right of the previous drive by using the same method, but also making sure the zero-stack tabs and cutouts are engaged.

Zero-stack mounting is required based on configuration, refer to the [Zero-stack Tab and Cutout Example](#) on [page 46](#).

6. Tighten all mounting fasteners.

Apply 2.0 N•m (17.7 lb•in) maximum torque to each fastener.

Connector Data and Feature Descriptions

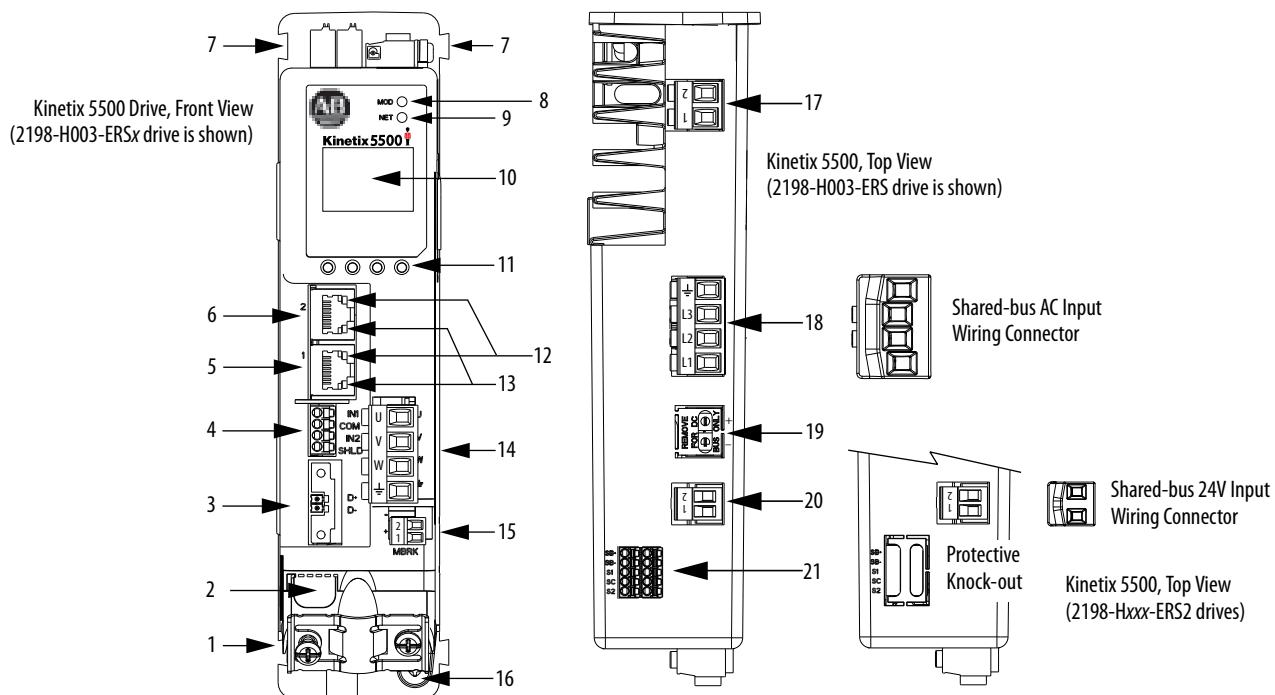
This chapter illustrates drive connectors and indicators, including connector pinouts, and provides descriptions for Kinetix 5500 drive features.

Topic	Page
Kinetix 5500 Connector Data	58
Understanding Control Signal Specifications	62
Feedback Specifications	65
Safe Torque-off Safety Features	66

Kinetix 5500 Connector Data

Use these illustrations to identify the connectors and indicators for the Kinetix 5500 servo drives.

Figure 28 - Kinetix 5500 Drive Features and Indicators



Item	Description
1	Motor cable shield clamp
2	Converter kit mounting hole ⁽¹⁾ (under cover)
3	Motor feedback (MF) connector
4	Digital inputs (IOD) connector
5	Ethernet (PORT1) RJ45 connector
6	Ethernet (PORT2) RJ45 connector
7	Zero-stack mounting tab/cutout

Item	Description
8	Module status indicator
9	Network status indicator
10	LCD display
11	Navigation pushbuttons
12	Link speed status indicators
13	Link/Activity status indicators
14	Motor power (MP) connector

Item	Description
15	Motor brake (BC) connector
16	Ground terminal
17	Shunt resistor (RC) connector
18	AC mains input power (IPD) connector
19	DC bus (DC) connector (under cover) ⁽²⁾
20	24V control input power (CP) connector
21	Safe torque-off (STO) connector ⁽³⁾ (does not apply to 2198-Hxxx-ERS2 drives)

(1) Protective knock-out covers the 2198-H2DCK Hiperface-to-DSL feedback converter kit mounting hole. Remove knock-out for use with the converter kit.

(2) DC bus connector ships with protective knock-out cover that can be removed for use in shared-bus configurations.

(3) Protective knock-out cover is removed on 2198-Hxxx-ERS (hardwired STO) drives.

Safe Torque-off Connector Pinout

For the hardwired safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to [Chapter 9](#) beginning on [page 157](#).

Input Power Connector Pinouts

Table 19 - Mains Input Power Connector

IPD Pin	Description	Signal
$\frac{1}{\text{--}}$	Chassis ground	$\frac{1}{\text{--}}$
L3		L3
L2	Three-phase input power	L2
L1		L1

Table 20 - 24V Input Power Connector

CP Pin	Description	Signal
1	24V power supply, customer supplied	24V+
2	24V common	24V-

DC Bus and Shunt Resistor Connector Pinouts

Table 21 - DC Bus Power Connector

DC Pin	Description	Signal
1		DC-
2	DC bus connections	DC+

Table 22 - Shunt Resistor Connector

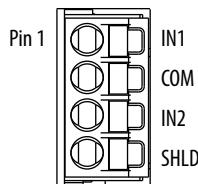
RC Pin	Description	Signal
1		DC+
2	Shunt connections (frames 2 and 3)	SH
1		SH
2	Shunt connections (frame 1)	DC+

Digital Inputs Connector Pinout

IOD Pin	Description	Signal
1	High speed registration/home position input. A low/high or high/low transition triggers a registration event. This is a dual-function input.	IN1 ⁽¹⁾
2	I/O common for customer-supplied 24V supply.	COM
3	High speed registration input. A low/high or high/low transition triggers a registration event.	IN2
4	I/O cable shield termination point.	SHLD

(1) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

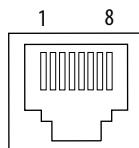
Figure 29 - Pin Orientation for 4-pin Digital Inputs (IOD) Connector



Ethernet Communication Connector Pinout

Pin	Description	Signal
1	Transmit+	TD+
2	Transmit-	TD-
3	Receive+	RD+
4	Reserved	-
5	Reserved	-
6	Receive-	RD-
7	Reserved	-
8	Reserved	-

Figure 30 - Pin Orientation for 8-pin Ethernet PORT1 and PORT2 Connectors



Motor Power, Brake, and Feedback Connector Pinouts

Table 23 - Motor Power Connector

MP Pin	Description	Signal	Color
U	Three-phase motor power	U	Brown
V		V	Black
W		W	Blue
$\frac{1}{-}$	Chassis ground	$\frac{1}{-}$	Green

IMPORTANT Drive-to-motor power cables must not exceed 50 m (164 ft).

System performance was tested at this cable length. These limitations also apply when meeting CE requirements.

Table 24 - Motor Brake Connector

BC Pin	Description	Signal
1	Motor brake connections	MBRK+
2		MBRK-

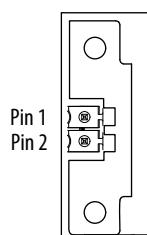
Motor Feedback Connector Pinout

MF Pin	Description	Signal
1	Bidirectional data and power for digital encoder interface	D+
2		D-
SHIELD	Cable shield and grounding plate (internal to 2198-KITCON-DSL connector kit) termination point.	SHIELD

IMPORTANT Drive-to-motor power cables must not exceed 50 m (164 ft).

System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Figure 31 - Pin Orientation for 2-pin Motor Feedback (MF) Connector



Understanding Control Signal Specifications

This section provides a description of the Kinetix 5500 digital inputs, Ethernet communication, power and relay specifications, encoder feedback specifications, and safe torque-off features.

Digital Inputs

Two digital inputs are available for the machine interface on the IOD connector. Digital inputs require a 24V DC @ 15 mA supply. These are sinking inputs that require a sourcing device. A common and cable shield connection is provided on the IOD connector for digital inputs.

The Registration 1 input is capable of dual functionality. You can also use this as the Home input. Configuration for dual functionality is not needed.

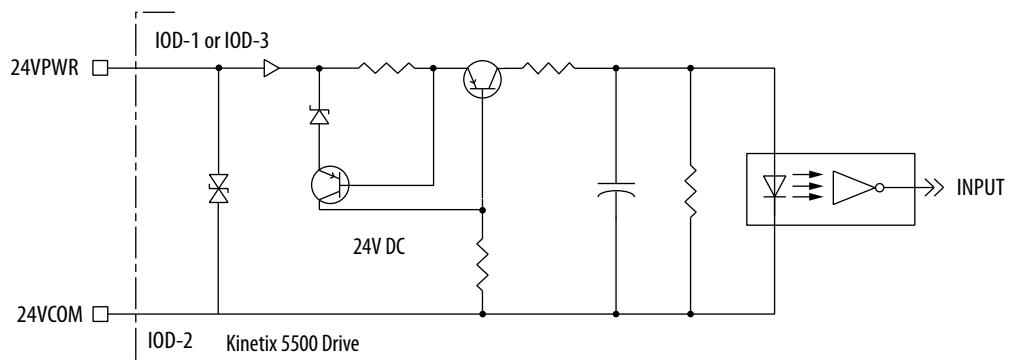
IMPORTANT To improve registration input EMC performance, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

Table 25 - Understanding Digital Input Functions

Function	Description	Default Behavior
Home/Reg1	An active state indicates to a homing sequence that the referencing sensor has been seen. Typically, a transition of this signal is used to establish a reference position for the machine axis.	
Registration 1	An inactive-to-active transition (also known as a positive transition) or active-to-inactive transition (also known as a negative transition) is used to latch position values for use in registration moves.	The function is always inactive. You can enable in the Logix Designer application.
Registration 2		

Table 26 - Digital Input Specifications

Attribute	Value
Type	Active high, single-ended, current sinking (EN 61131-2 Type 1)
Dedicated functions	Registration 1, Home, Registration 2
Input current (with 24V applied)	12 mA, typical
On-state input voltage	15...30V @ 15 mA, max
Off-state input voltage	-1.0...5.0V
Pulse reject filtering (registration functions)	12.0 µs
Pulse reject filtering (home input function) debounce filter	20 ms, nom
Propagation delay (registration functions)	0 (delay compensated)
Registration repeatability	700 ns
Windowed registration invalid-to-valid event delay	125 µs, min

Figure 32 - Digital Input Circuitry

Ethernet Communication Specifications

The PORT1 and PORT2 (RJ45) Ethernet connectors are provided for communication with the Logix5000 controller.

Attribute	Value
Communication	The drive auto-negotiates speed and duplex modes. These modes can be forced through the Logix Designer application. 100BASE-TX, full duplex is recommended for maximum performance.
Cyclic update period	500 µs, min
Embedded switch features	Three-port, cut-through, time correction on IEEE-1588 packets, limited filtering, quality of service with four priority levels
Auto MDI/MDIX crossover detection/correction	Yes
Port-to-port time synchronization variation	100 ns, max
Cabling	CAT5e shielded, 100 m (328 ft) max

Motor Brake Circuit

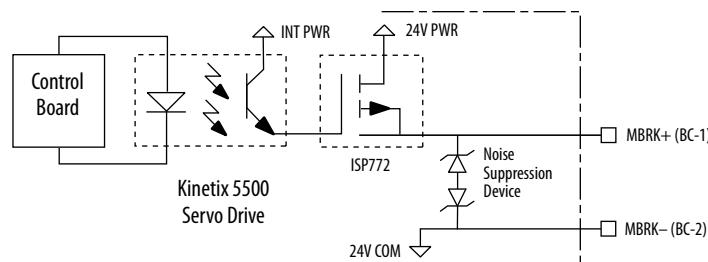
The customer-supplied 24V power supply drives the motor parking-brake output through a solid-state relay. The solid-state brake driver circuit provides the following:

- Brake thermal-overload protection
- Brake current-overload protection
- Brake over-voltage protection

Two connections (BC-1 and BC-2) are required for the motor brake output. Connections are rated for 2.0 A @ +24V (refer to [Figure 33](#)).

Control of the solid-state relay to release the motor brake is configurable in the Logix Designer application. An active signal releases the motor brake. Turn-on and turn-off delays are specified by the brake-active delay and brake-inactive delay (configurable in the Logix Designer application). Refer to Kinetix 5500 Drive and Motor/Actuator Wiring Examples beginning on [page 195](#) for wiring examples.

Figure 33 - Motor Brake Circuit



IMPORTANT Motor parking-brake switching frequency must not exceed 10 cycles/min.

Control Power

The Kinetix 5500 drive requires 24V DC input power for control circuitry.

IMPORTANT SELV and PELV rated power supplies must be used to energize external safety devices connected to the Kinetix 5500 safety inputs.
The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.

Table 27 - Control Power Input Power Specifications

Attribute	Frame 1	Frame 2	Frame 3
Input voltage	21.6...26.4V DC		
Control power AC input current Nom @ 24V DC ⁽¹⁾	400 mA 2.0 A	800 mA 3.0 A	1.3 A 3.0 A
Inrush, max			

(1) Plus BC connector (MBRK+) current.

Feedback Specifications

The Kinetix 5500 drive accepts motor feedback signals from Stegmann Hiperface digital-servo-link (DSL) encoders.

Kinetix 5500 drive and Kinetix VP motor combinations use single motor-cable technology with motor power, feedback, and brake wires (when specified) housed in a single cable. Feedback and brake wires are shielded separately and each provide a shield braid for grounding in the motor cable clamp.

TIP

Auto-configuration in the Logix Designer application of intelligent absolute, high-resolution encoders is possible with only Allen-Bradley motors.

Table 28 - Stegmann Hiperface DSL Specifications

Attribute	Value
Protocol	Hiperface DSL
Memory support	Programmed with Allen-Bradley motor data
Hiperface data communication	9.375 Mbits/s

Other Allen-Bradley motors and actuators with Stegmann Hiperface single-turn or multi-turn high-resolution absolute encoders are also accepted, but only when using drive firmware revision 2.002 or later and the 2198-H2DCK Hiperface-to-DSL feedback converter kit for Hiperface-to-DSL conversion.

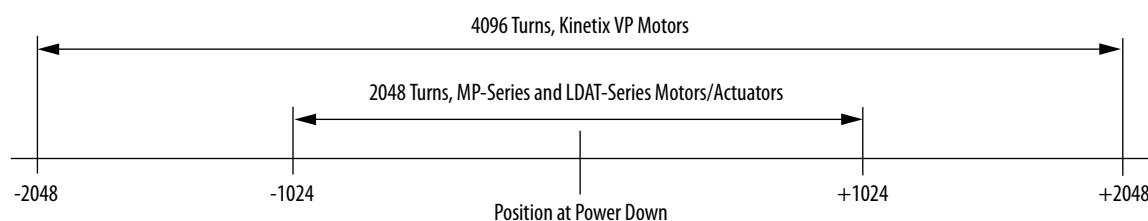
Absolute Position Feature

The drive's absolute position feature tracks the position of the motor, within the multi-turn retention limits, while the drive is powered off. The absolute position feature is available with only multi-turn encoders.

Table 29 - Absolute Position Designator Examples

Encoder Type	Cat. No. Designator	Cat. No. Examples	Motor Family
Stegmann Hiperface (DSL)	-P	VPL-xxxxx-P, VPF-xxxxx-P, VPS-xxxxx-P	Kinetix VP
Stegmann Hiperface	-M	MPL-B310P-M, MPM-xxxxx-M, MPF-xxxxx-M, MPS-xxxxx-M, MPAR-x3xxxx-M, MPAI-xxxxxM	MP-Series
	-V	MPL-B230P-V, MPAS-xxxx1-V05, MPAS-xxxx2-V20, MPAR-x1xxxx-V, MPAR-x2xxxx-V, MPAI-xxxxxV	
Stegmann Hiperface (magnetic scale)	-xDx	LDAT-Sxxxxx-xDx	LDAT-Series

Figure 34 - Absolute Position Retention Limits



Safe Torque-off Safety Features

Kinetix 5500 servo drives have safe torque-off (STO) capability and can safely turn off the inverter power transistors in response to a monitored digital input, according to Category 0 Stop behavior.

Servo Drives with Hardwired Safety

2198-Hxxx-ERS (hardwired) servo drives support parallel input terminals for cascading to adjacent drives over duplex wiring. For applications that do not require the STO safety function you must install jumper wires to bypass the safe torque-off feature.

Refer to [Chapter 9](#) on [page 157](#) for the STO connector pinout, installation, and wiring information.

Servo Drives with Integrated Safety

For 2198-Hxxx-ERS2 (integrated safety) servo drives, the 1756-L7xS GuardLogix safety controller issues the STO command via the EtherNet/IP network and the 2198-Hxxx-ERS2 servo drives execute the command.

Refer to [Chapter 10](#) on [page 167](#) for integrated safety drive specifications, configuring motion and safety connections, motion direct commands, and the STO bypass feature.

Connecting the Kinetix 5500 Drive System

This chapter provides procedures for wiring your Kinetix 5500 system components and making cable connections.

Topic	Page
Basic Wiring Requirements	68
Determine the Input Power Configuration	69
Removing the Grounding Screws in Ungrounded Power Configurations	71
Grounding the Drive System	73
Wiring Requirements	75
Wiring Guidelines	76
Wiring the Power Connectors	77
Wiring the Digital Input Connectors	79
Wiring Kinetix VP Motors	80
Wiring Other Allen-Bradley Motors and Actuators	86
Capacitor Module Connections	95
External Shunt Resistor Connections	96
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Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 5500 drives.



ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to components.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 drive modules prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.

IMPORTANT

This section contains common PWM servo system wiring configurations, size, and practices that can be used in a majority of applications. National Electrical Code, local electrical codes, special operating temperatures, duty cycles, or system configurations take precedence over the values and methods provided.

Routing the Power and Signal Cables

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic devices can be induced into I/O communication, or other sensitive low voltage signals. This can cause system faults and communication anomalies.

The Bulletin 2090 single motor cable contains the power, brake, and feedback wires, but is properly shielded to protect the noise-sensitive feedback signals.

Refer to [Electrical Noise Reduction](#) on [page 36](#) for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#), for more information.

Determine the Input Power Configuration

Before wiring input power to your Kinetix 5500 system, you must determine the type of input power you are connecting to. The drive is designed to operate in both grounded and ungrounded environments.



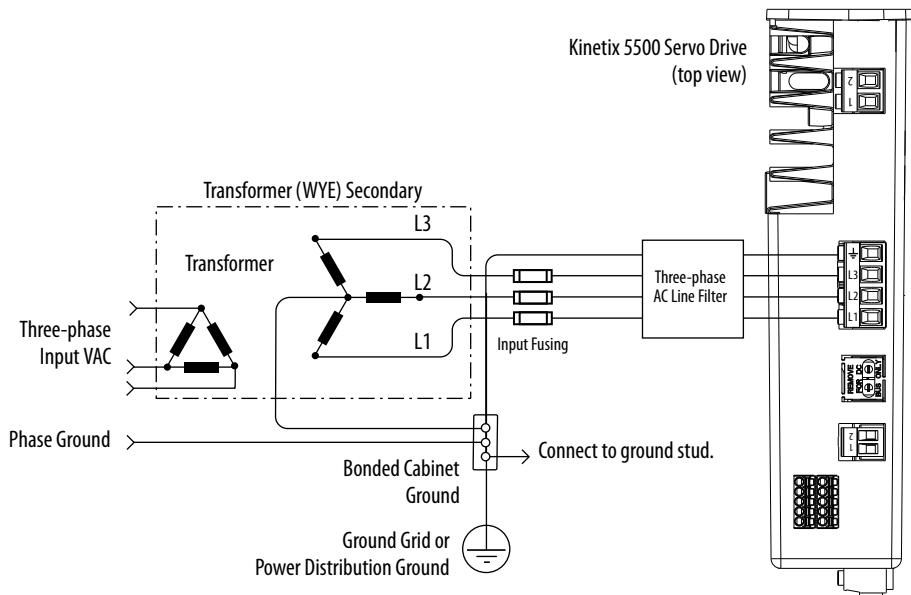
ATTENTION: Ungrounded and corner-grounded input power configurations are permitted, but you must remove the ground screws.

Refer to [Removing the Grounding Screws in Ungrounded Power Configurations](#) on [page 71](#) for more information.

Grounded Power Configurations

The grounded (WYE) power configuration lets you ground your three-phase power at a neutral point. This type of grounded power configuration is preferred.

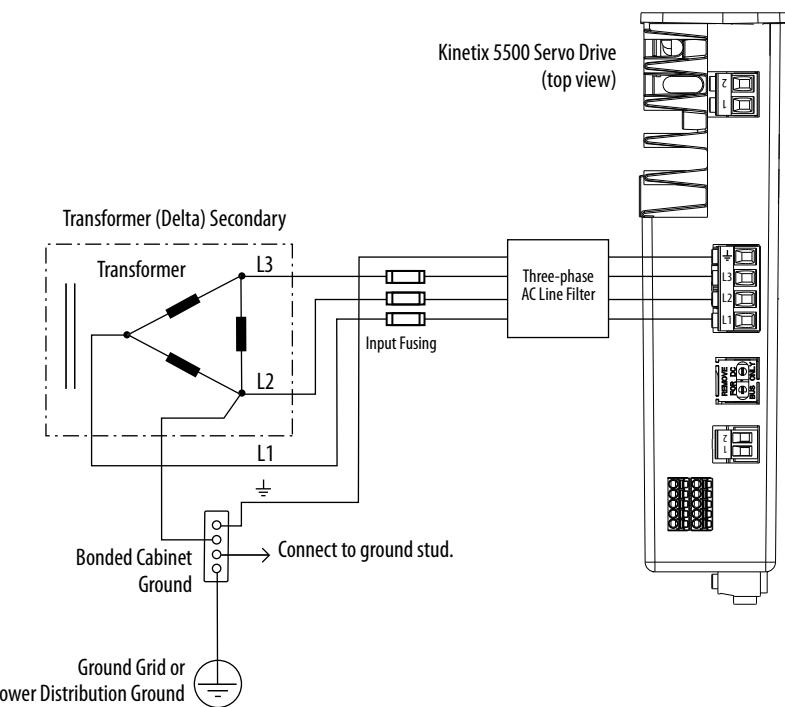
Figure 35 - Grounded Power Configuration (WYE Secondary)



The Kinetix 5500 drive has factory-installed grounding screws for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your plant, you do not need to remove the grounding screws.

Refer to [Power Wiring Examples](#) beginning on [page 190](#) for input power interconnect diagrams.

Figure 36 - Corner Grounded (B-phase) Power Configuration (Delta Secondary)

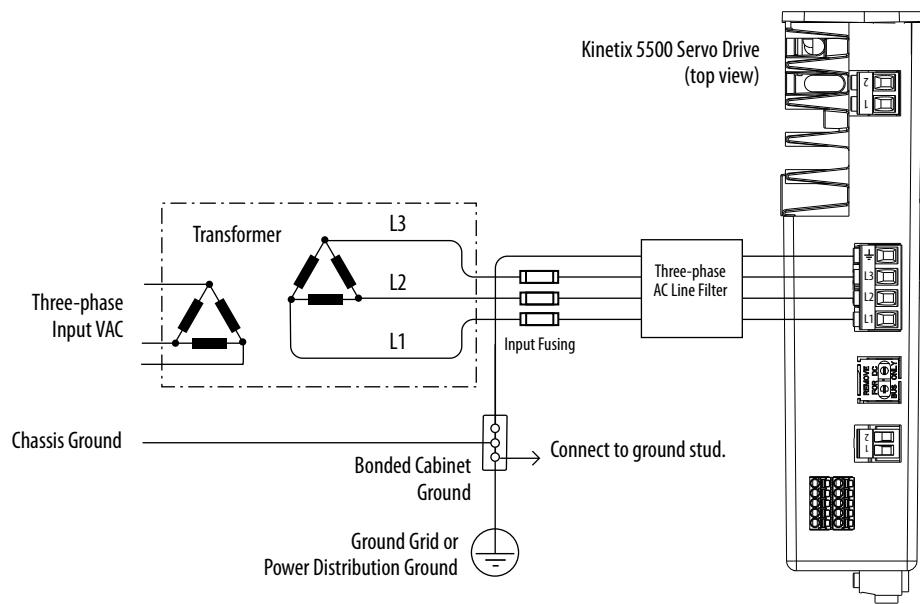
IMPORTANT Even though corner-grounded power configurations have a ground connection, treat them as ungrounded when installing Kinetix 5500 drive systems.

Refer to [Power Wiring Examples](#) beginning on [page 190](#) for input power interconnect diagrams.

Ungrounded Power Configurations

The ungrounded power configuration ([Figure 37](#)) does not provide a neutral ground point.

IMPORTANT If you determine that you have ungrounded or high-impedance grounded power distribution in your facility, you need to remove the grounding screws. Refer to [Removing the Grounding Screws in Ungrounded Power Configurations](#) on [page 71](#) for more information.

Figure 37 - Ungrounded Power Configuration

ATTENTION: Ungrounded systems do not reference each phase potential to a power distribution ground. This can result in an unknown potential to earth ground.

Refer to [Power Wiring Examples](#) beginning on [page 190](#) for input power interconnect diagrams.

Removing the Grounding Screws in Ungrounded Power Configurations

Removing the grounding screws is necessary only when using ungrounded or corner-ground power configurations. Removing the screws involves gaining access, opening the sliding door, and removing the screws.

IMPORTANT If you have grounded power distribution, you do not need to remove the grounding screws. Go to [Grounding the Drive System](#) on [page 73](#).

IMPORTANT Removing the grounding screws can affect EMC performance.

Removing the grounding screws in multi-axis configurations is best done when the drive is removed from the panel and placed on its side on a solid surface equipped as a grounded static-safe workstation.

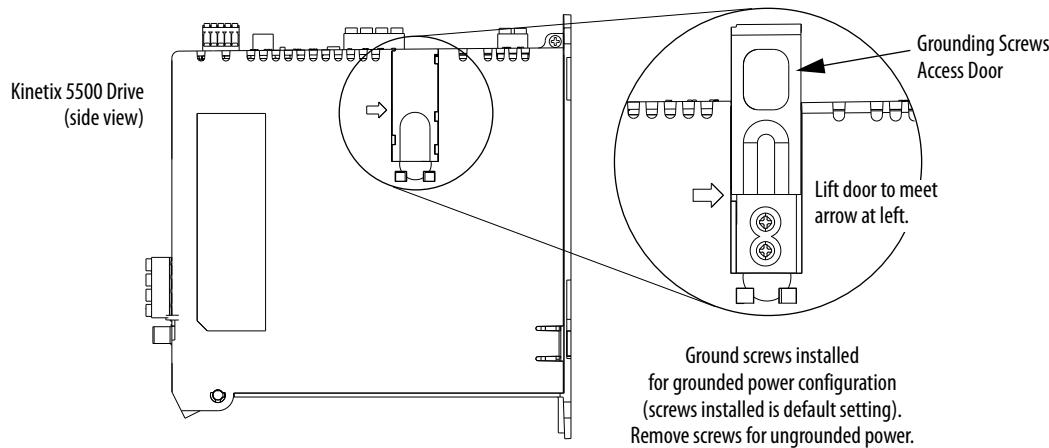


ATTENTION: By removing the grounding screws for ungrounded power configurations, you no longer maintain line-to-neutral voltage protection.



ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Guarding Against Electrostatic Damage, publication [8000-4.5.2](#), or any other applicable ESD awareness handbook.

Figure 38 - Removing the Ground Screws



ATTENTION: Risk of equipment damage exists. The drive ground configuration must be accurately determined. Leave the grounding screws installed for grounded power configurations (default). Remove the screws for ungrounded power.

Table 30 - Grounding Screw Configurations

Ground Configuration	Example Diagram	Grounding Screw Configuration	Benefits of Correct Configuration
Grounded (wye)	Figure 35 on page 69	Both screws installed (default setting)	<ul style="list-style-type: none"> • UL and EMC compliance • Reduced electrical noise • Most stable operation • Reduced voltage stress on components and motor bearings
<ul style="list-style-type: none"> • B-phase corner ground • AC fed ungrounded 	Figure 36 on page 70 Figure 37 on page 71	Both screws removed	<ul style="list-style-type: none"> • Helps avoid severe equipment damage when ground faults occurs • Reduced leakage current

Grounding the Drive System

All equipment and components of a machine or process system must have a common earth ground point connected to chassis. A grounded system provides a ground path for protection against electrical shock. Grounding your drives and panels minimize the shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis.



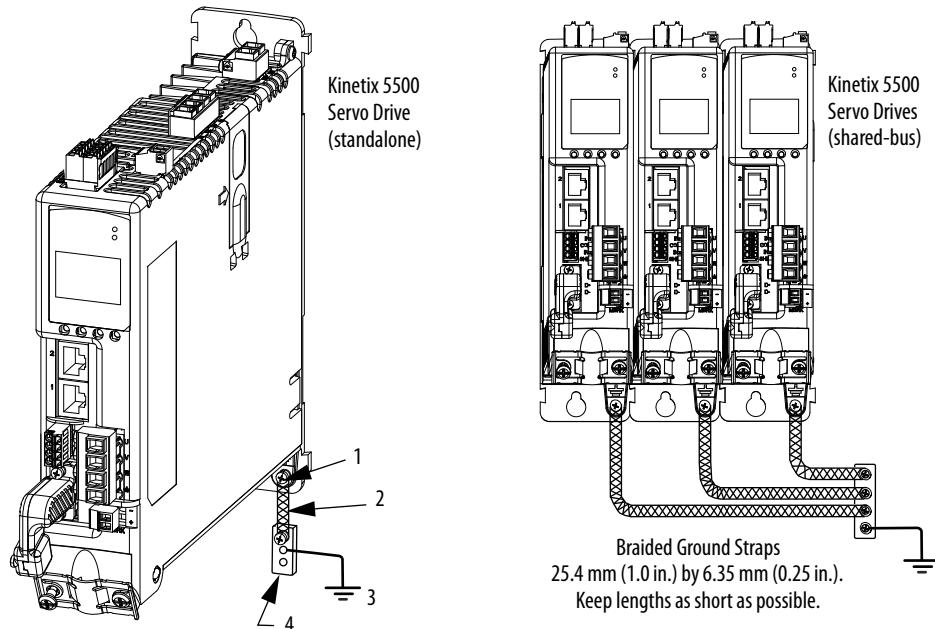
ATTENTION: The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system.

For CE grounding requirements, refer to [Agency Compliance](#) on page 27.

Ground the System Subpanel

Ground Kinetix 5500 drives and 2198-CAPMOD-1300 capacitor modules to a bonded cabinet ground bus with a braided ground strap or 4.0 mm² (12 AWG) copper wire.

Figure 39 - Connecting the Ground Terminal



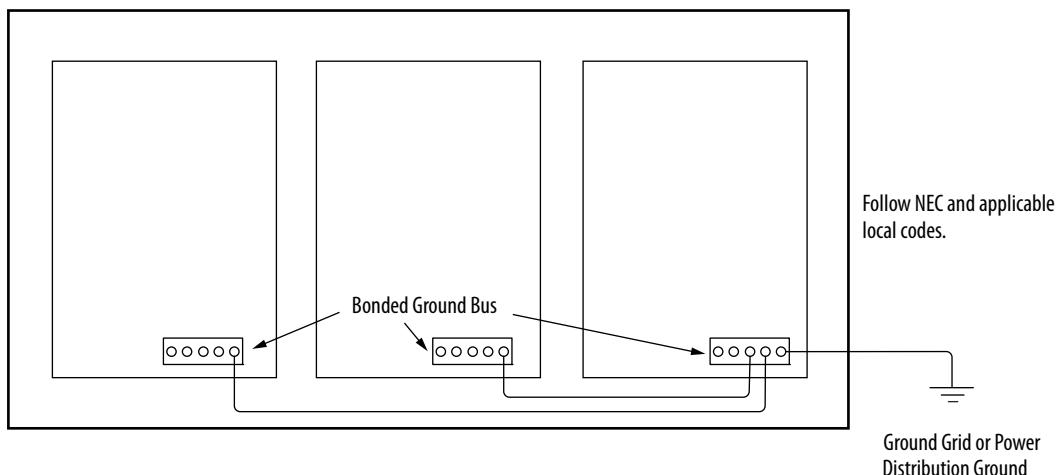
Item	Description
1	Ground screw (green) 2.0 N·m (17.7 lb·in), max
2	Braided ground strap (customer supplied)
3	Ground grid or power distribution ground
4	Bonded cabinet ground bus (customer supplied)

Refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#), for more information.

Ground Multiple Subpanels

In this figure, the chassis ground is extended to multiple subpanels.

Figure 40 - Subpanels Connected to a Single Ground Point



High-frequency (HF) bonding is not illustrated. For HF bonding information, refer to [Bonding Multiple Subpanels](#) on [page 38](#).

Wiring Requirements

Wires must be copper with 75 °C (167 °F) minimum rating. Phasing of main AC power is arbitrary and earth ground connection is required for safe and proper operation.

Refer to [Power Wiring Examples](#) on [page 190](#) for interconnect diagrams.

IMPORTANT

The National Electrical Code and local electrical codes take precedence over the values and methods provided.

Table 31 - Power and I/O Wiring Requirements

Kinetix 5500 Drive Cat. No.	Description	Connects to Terminals		Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb-in)
		Pin	Signal			
2198-H003-ERSx 2198-H008-ERSx 2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	Mains input power ⁽¹⁾ (single-axis IPD connector)	L3 L2 L1	L L3 L2 L1	1.5...4 (16...12)	8.0 (0.31)	0.5...0.6 (4.4...5.3)
2198-H070-ERSx	Motor power	U V W —	U V W —	Motor power cable depends on motor/drive combination. 0.75...2.5 ⁽²⁾ (18...14)	8.0 (0.31)	0.5...0.6 (4.4...5.3)
2198-xxxx-ERSx	PELV/SELV 24V power ⁽¹⁾ (single-axis CP connector)	CP-1 CP-2	24V+ 24V-	2.5...0.5 (14...20)	7.0 (0.28)	0.22...0.25 (1.9...2.2)
	Brake power	BC-1 BC-2	MBRK+ MBRK-	N/A ⁽³⁾		
	DC Bus power	DC-1 DC-2	DC- DC+	N/A ⁽⁴⁾	N/A ⁽⁴⁾	N/A ⁽⁴⁾
	Shunt resistor (frame 2 and 3)	RC-1 RC-2	DC+ SH	4...0.5 (12...20)	8.0 (0.31)	0.5...0.6 (4.4...5.3)
	Shunt resistor (frame 1)	RC-1 RC-2	SH DC+			
	Safety ⁽⁵⁾	STO-1 STO-2 STO-3 STO-4 STO-5	SB+ SB- S1 SC S2	1.5...0.2 (16...24)	10.0 (0.39)	N/A ⁽⁶⁾
	Digital inputs	IOD-1 IOD-2 IOD-3 IOD-4	IN1 ⁽⁷⁾ COM IN2 SHLD	1.5...0.2 (16...24)	10.0 (0.39)	N/A ⁽⁶⁾

(1) The wire size, strip length, and torque specifications shown here apply to the single-axis connector that ships with the drive. For the shared-bus connector specifications, refer to [Table 33 on page 77](#) (CP connector) and [Table 35 on page 79](#) (IPD connector).

(2) Building your own cables or using third-party cables is not an option. Use single motor cable catalog number 2090-CSxM1DF-xxAAxx. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [GMC-TD004](#), for cable specifications.

(3) Motor brake wires are part of the 2090-CSBM1DF-xxAAxx motor cable.

(4) DC bus connections are always made from drive-to-drive over the bus bar connection system. These terminals do not receive discrete wires.

(5) These signals and the safe torque-off (STO) connector apply to only the 2198-Hxxx-ERS drives.

(6) This connector uses spring tension to hold wires in place.

(7) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.



ATTENTION: To avoid personal injury and/or equipment damage, observe the following:

- Make sure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.
- Use motor power connectors for connection purposes only. Do not use them to turn the unit on and off.
- Ground shielded power cables to prevent potentially high voltages on the shield.

Wiring Guidelines

Use these guidelines as a reference when wiring the power connectors on your Kinetix 5500 drive.

IMPORTANT For connector locations of the Kinetix 5500 drives, refer to [Kinetix 5500 Connector Data](#) on [page 58](#).

When removing insulation from wires and tightening screws to secure the wires, refer to the table on [page 75](#) for strip lengths and torque values.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) on [page 39](#).

Follow these steps when wiring the connectors for your Kinetix 5500 drive.

1. Prepare the wires for attachment to each connector plug by removing insulation equal to the recommended strip length.

IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the cable/wires to your Kinetix 5500 drive.
3. Insert wires into connector plugs.
Refer to connector pinout tables in [Chapter 4](#) or the interconnect diagrams in [Appendix A](#).
4. Tighten the connector screws.
5. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.
6. Insert the connector plug into the drive connector.

Wiring the Power Connectors

This section provides examples and guidelines to assist you in making connections to the input power connectors.

Refer to [Power Wiring Examples](#) on [page 190](#) for an interconnect diagram.

Wire the 24V Control Power Input Connector

The 24V power (CP) connector requires 24V DC input for the control circuitry. The single-axis connector ships with the drive, shared-bus connector kits are purchased separately.

Figure 41 - CP Connector Wiring - Single Axis

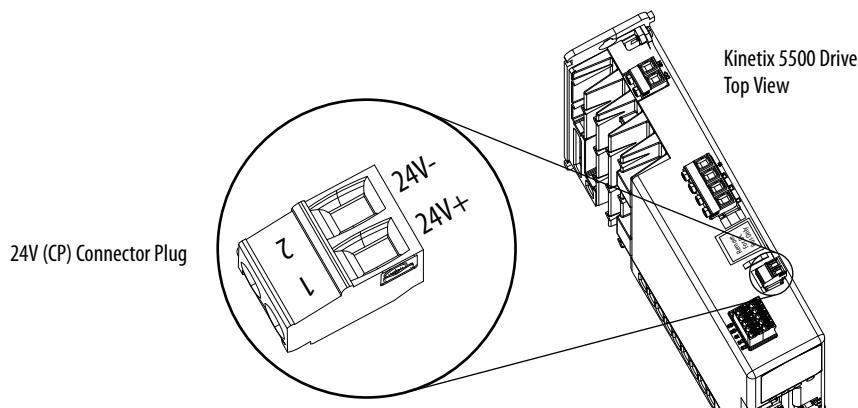


Table 32 - Single Axis CP Connector Wiring Specifications

Drive Cat. No.	CP Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-Hxxx-ERSx	CP-1	24V+	2.5...0.5 (14...20)	7.0 (0.28)	0.22...0.25 (1.9...2.2)
	CP-2	24V-			

Figure 42 - CP Connector Wiring - Shared Bus

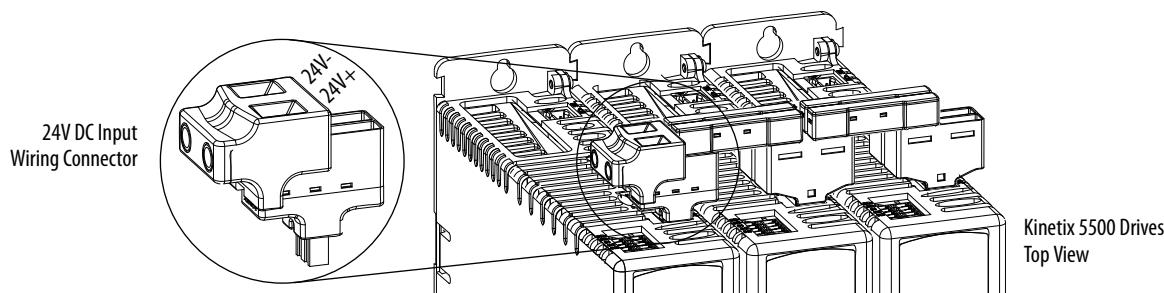


Table 33 - Shared Bus CP Connector Wiring Specifications

Drive Cat. No.	CP Pin	Signal	Input Current, max A rms	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-Hxxx-ERSx	CP-1	24V+	32	8.4 (8)	11.0 (0.43)	1.7...1.8 (15.0...15.9)
	CP-2	24V-				

Wire the Input Power Connector

The input power (IPD) connector requires 195...528V AC (single-phase or three-phase) for mains input power. The single-axis connector ships with the drive, shared-bus connector kits are purchased separately.



ATTENTION: Make sure the input power connections are correct when wiring the IPD connector plug or input wiring connector and that the plug/connector is fully engaged in the drive connector. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

Figure 43 - IPD Connector Wiring - Single Axis

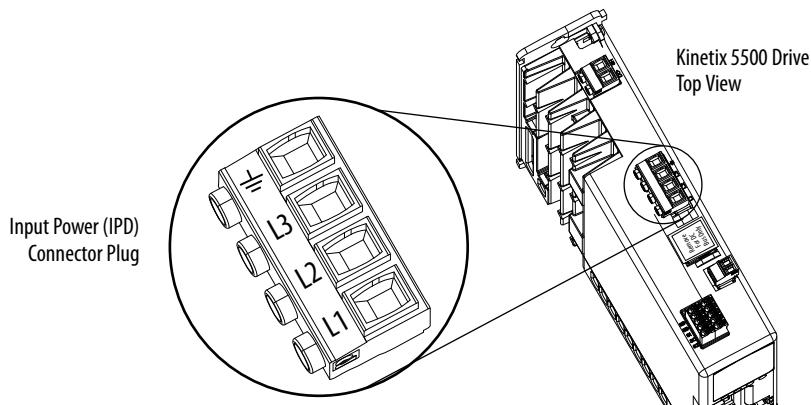
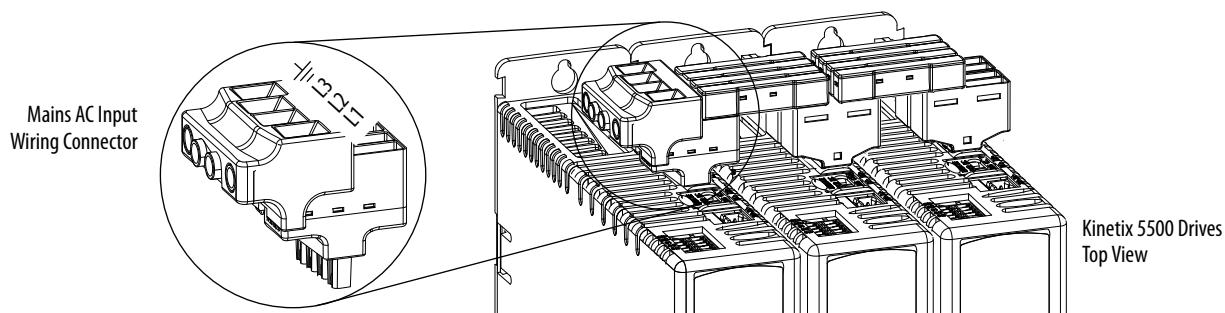


Table 34 - Single-axis IPD Connector Wiring Specifications

Kinetix 5500 Drive Cat. No.	Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-H003-ERSx 2198-H008-ERSx 2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	<u>L</u>	<u>L</u>	1.5...4 (16...12)	8.0 (0.31)	0.5...0.6 (4.4...5.3)
	L3	L3			
	L2	L2			
	L1	L1			
2198-H070-ERSx			1.5...6 (16...10)	10.0 (0.39)	

Figure 44 - IPD Connector Wiring - Shared Bus**Table 35 - Shared Bus IPD Connector Wiring Specifications**

Kinetix 5500 Drive Cat. No.	Pin	Signal	Input Current, max A rms	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-H003-ERSx	<u>L</u>	<u>L</u>				
2198-H008-ERSx	L3	L3				
2198-H015-ERSx	L2	L2				
2198-H025-ERSx	L1	L1	52	13.3...3.3 (6...12)	11.0 (0.43)	1.7...1.8 (15.0...15.9)
2198-H040-ERSx						
2198-H070-ERSx				13.3 (6)		

Wiring the Digital Input Connectors

This section provides guidelines to assist you in making digital input connections.

Wire the Safe Torque-off Connector

For the hardwired safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to [Chapter 9](#) beginning on [page 157](#).

Wire the Digital Inputs Connector

The digital inputs (IOD) connector uses spring tension to hold wires in place.

Figure 45 - IOD Connector Wiring

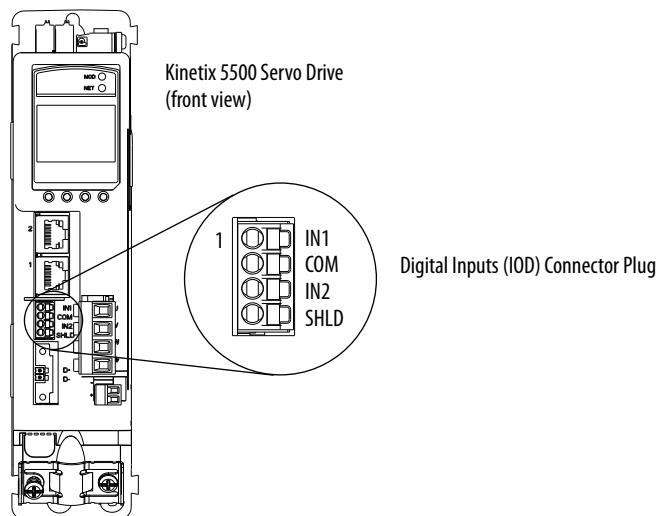


Table 36 - Digital Inputs (IOD) Connector Specifications

Drive Cat. No.	DC Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-Hxxx-ERSx	IOD-1 IOD-2 IOD-3 IOD-4	IN1 ⁽¹⁾ COM IN2 SHLD	1.5...0.2 (16...24)	10.0 (0.39)	N/A ⁽²⁾

(1) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

(2) This connector uses spring tension to hold wires in place.

Wiring Kinetix VP Motors

The Kinetix 5500 drives with Kinetix VP motors use a single cable that includes conductors for motor power, brake, and encoder feedback. Standard and continuous-flex (Bulletin 2090) cables are available with and without the motor brake conductors.

IMPORTANT

Due to the unique characteristics of single cable technology, designed for and tested with Kinetix 5500 drives and Kinetix VP motors, you cannot build your own cables or use third-party cables.

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [GMC-TD004](#), for cable specifications.

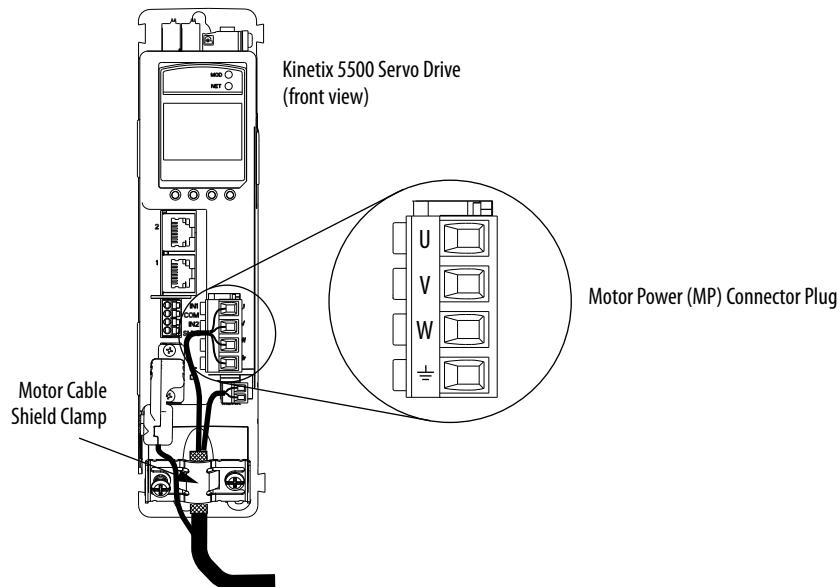
Table 37 - Single Cable Catalog Numbers

Motor Family	Feedback Kit Cat. No.	Motor Cat. No.	Motor Cable Cat. No. (with brake wires)	Motor Cable Cat. No. (without brake wires)
Kinetix VP	2198-KITCON-DSL	VPL-A/Bxxxx, VPF-A/Bxxxx, and VPS-Bxxxx	2090-CSBM1DF-xxAAxx (standard) cables 2090-CSBM1DF-xxAFxx (continuous-flex) cables	2090-CSWM1DF-xxAAxx (standard) cables

Motor Power Connections

Refer to [Kinetix 5500 Drive and Motor/Actuator Wiring Examples](#) on [page 195](#) for an interconnect diagram.

Figure 46 - MP Connector Wiring



ATTENTION: Make sure the motor power connections are correct when wiring the MP connector plug and that the plug is fully engaged in the module connector. Incorrect wiring/polarity or loose wiring can cause an explosion or damage to equipment.

Table 38 - Motor Power (MP) Connector Specifications

Drive Cat. No.	Pin	Signal/Wire Color	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-H003-ERSx 2198-H008-ERSx 2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx	U	U Brown	Motor power cable depends on motor/drive combination. 0.75...2.5 (18...14) max	8.0 (0.31) 0.5...0.6 (4.4...5.3)	
	V	V Black			
	W	W Blue			
	GND	GND Green/Yellow			
			2.5...6 (14...10) max	10.0 (0.39)	
2198-H070-ERSx					

Motor Brake Connections

Figure 47 - BC Connector Wiring

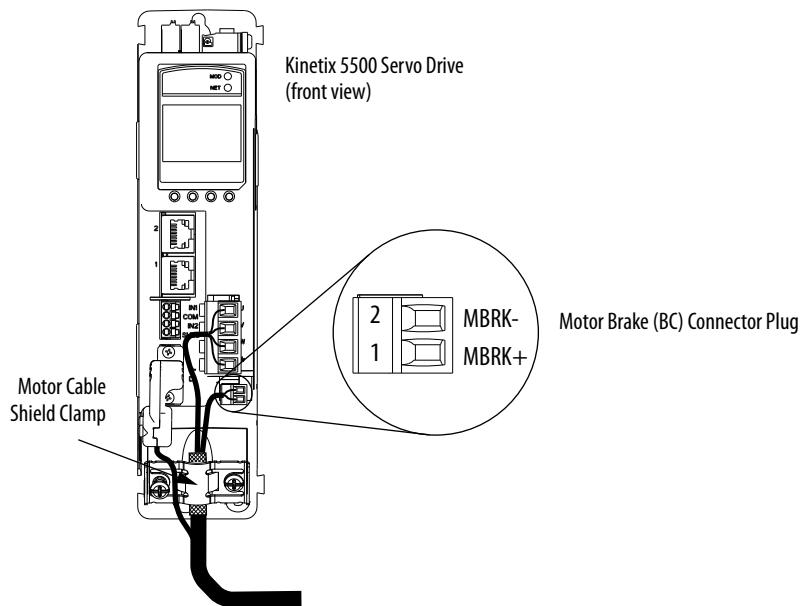


Table 39 - Motor Brake (BC) Connector Specifications

Drive Cat. No.	Pin	Signal/ Wire Color	Recommended Wire Size (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-Hxxx-ERSx	BC-1	MBRK+/Black	N/A ⁽¹⁾	7.0 (0.28)	0.22...0.25 (1.9...2.2)
	BC-2	MBRK-/White			

(1) Motor brake wires are part of the 2090-CSBM1DF-xxAAxx motor cable.

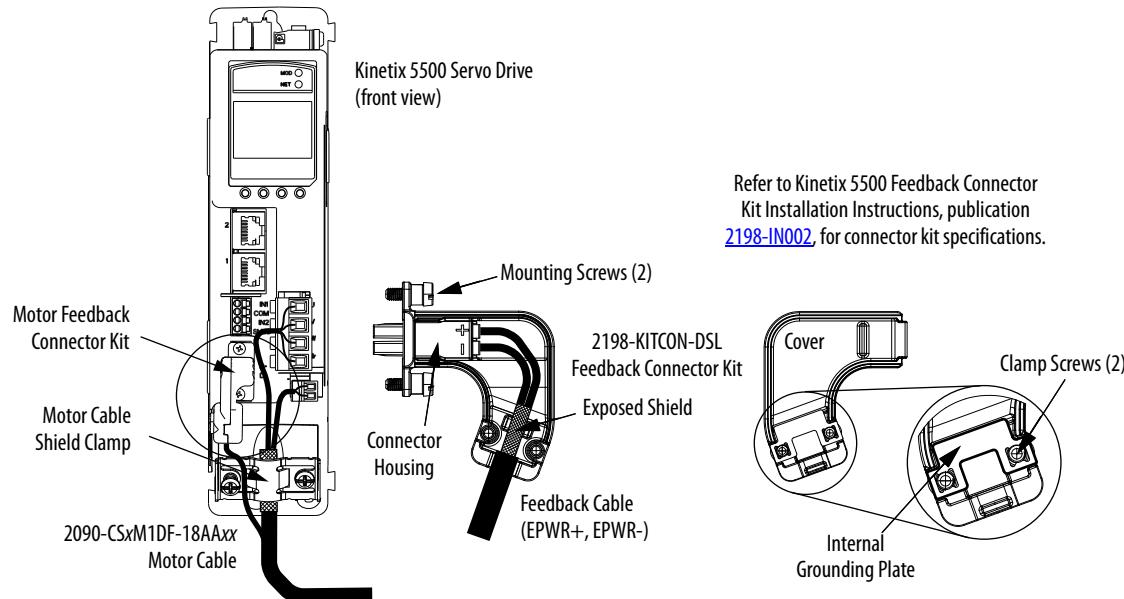
Motor Feedback Connections

Single motor cable feedback connections are made by using the 2198-KITCON-DSL feedback connector kit.

IMPORTANT

When using the 2198-KITCON-DSL feedback connector kit, the ambient temperature for the Kinetix 5500 drive enclosure is 0...50 °C (32...122 °F).

Figure 48 - MF Connector Wiring



IMPORTANT

Cable preparation and positioning that provides a high-frequency bond between the shield braid and grounding plate is required to optimize system performance.

Table 40 - Motor Feedback (MF) Connector Specifications

Drive Cat. No.	Pin	Signal/ Wire Color	Wire Size AWG	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-Hxxx-ERSx	MF-1	D+/Blue	22	10.0 (0.39)	0.4 (3.5)
	MF-2	D-/White/Blue			

IMPORTANT

The feedback bundle in 2090-CSxM1DF-18AAxx motor cables (typically used with frame 1 drives) route around the shield clamp (as shown in [Figure 48](#)). The feedback bundle in 14 and 10 AWG cables (typically used with frame 2 and 3 drives) route with the power and brake wires inside the cable shield.

Apply the Single Motor Cable Shield Clamp

Factory-supplied 2090-Series single motor cables are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket has been removed to expose the shield braid. The exposed area must be clamped (with the clamp provided) at the bottom front of the drive.



SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded according to recommendations.

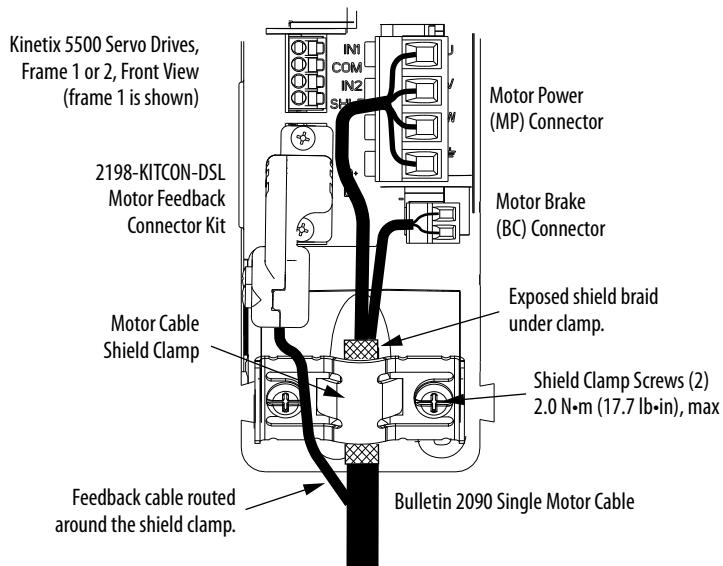
TIP Cables for Kinetix VP motors (catalog numbers 2090-CBxM1DF-18Axx) do not route the feedback bundle under the shield clamp. The same cables with 14 or 10 AWG conductors have the feedback bundle within the cable shield braid.

This procedure assumes you have completed wiring your motor power, brake, and feedback connectors and are ready to apply the cable shield clamp.

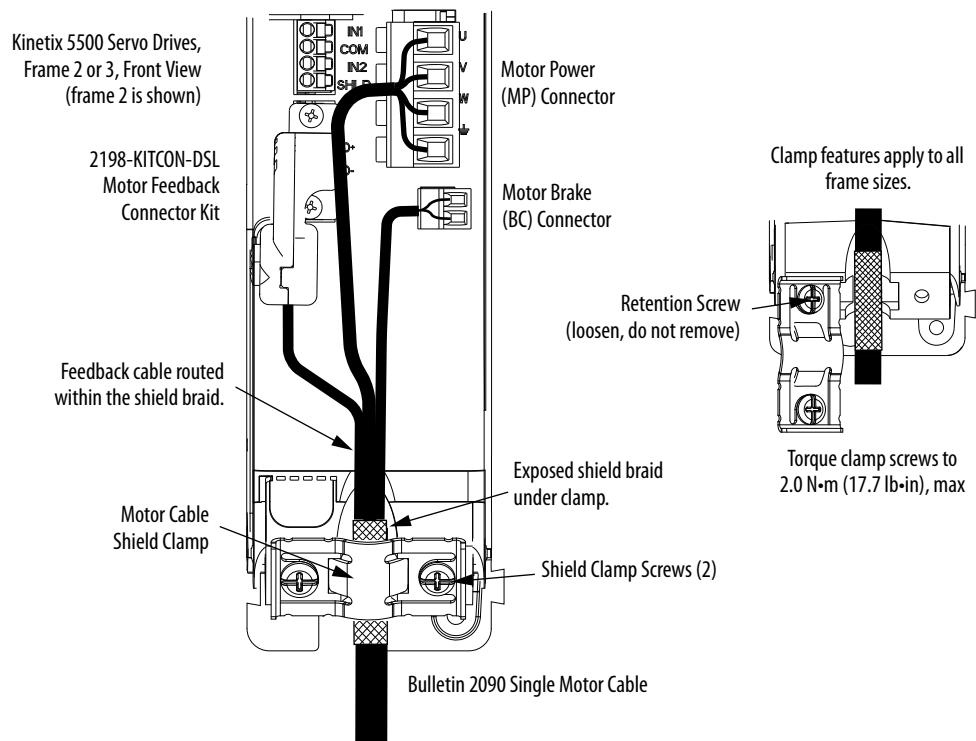
Follow these steps to apply the motor cable shield clamp.

1. Loosen the clamp screws and remove at least one of the screws.

Figure 49 - 18 AWG Cable Installation



When the drive/motor combination calls for 18 AWG cable, the feedback cable routes around the motor cable shield clamp.

Figure 50 - 14 and 10 AWG Cable Installation

When the drive/motor combination calls for 14 or 10 AWG cable, the feedback cable routes along with the power and brake wiring.

2. Position the exposed portion of the cable braid directly in line with the clamp.
3. Tighten the clamp screws. Torque value 2.0 N•m (17.7 lb•in) max.
4. Repeat [step 1](#) through [step 3](#) for each drive in multi-axis configurations.

Wiring Other Allen-Bradley Motors and Actuators

Kinetix 5500 drives are also compatible with other Allen-Bradley servo motors and actuators when wired at the drive by using the Hiperface-to-DSL feedback converter kit, catalog number 2198-H2DCK. The kit is required for converting the 15-pin Hiperface feedback signals to 2-pin DSL feedback signals.

Table 41 - Compatible Motors and Actuators

Motor/Actuator Families ⁽¹⁾	Encoder Feedback Type
MP-Series low-inertia motors (Bulletin MPL)	Single-turn or multi-turn high-resolution, absolute
MP-Series medium-inertia motors (Bulletin MPM)	
MP-Series food-grade motors (Bulletin MPF)	
MP-Series stainless-steel motors (Bulletin MPS)	
MP-Series integrated linear stages (Bulletin MPAS/MPMA) ballscrew	
MP-Series electric cylinders (Bulletin MPAR)	
MP-Series heavy-duty electric cylinders (Bulletin MPAI)	
LDAT-Series integrated linear thrusters	

(1) The 2198-H2DCK converter kit is required for all 400V-class MP-Series motors and actuators. The 2198-H2DCK (series B or later) converter kit is required for LDAT-Series linear thrusters and all 200V-class MP-Series motors and actuators.

IMPORTANT

To configure these motors and actuators with your Kinetix 5500 servo drive, you must have drive firmware 2.002 or later. Refer to [Table 42](#) to determine if you need to install the Kinetix 5500 Add-on Profile.

Table 42 - AOP Installation Requirement

Drive Firmware Revision	Logix Designer Application Version	Kinetix 5500 AOP Needed?
2.002 or later	21.00	Yes
	21.03 or later	No

Install the Kinetix 5500 Add-On Profile

Add-On profiles (AOP) are available for download at the Custom Downloads Add-On Profiles website: <https://download.rockwellautomation.com/csd/download.aspx?downloadid=addonprofiles>

Follow these steps to download the Kinetix 5500 Add-On profile.

1. Login to the Custom Download Add-On Profiles website.

The Custom Download Files dialog box opens.

Description	Download Code	Version	Release Date	Release Notes	Download Size	Comments
AOP for 2198-Hxx CIP Motion Kinetix5500		9.06.00	2014/03/27		373 MB	21.00.00 - Minimum RSLogix 5000 Software Revision Add-On Profile for Kinetix 5500 CIP Motion Drives with DSI Converter support.

2. Check AOP for 2198-Hxx CIP Motion Kinetix 5500.
3. Click Download Now and accept the user license agreement.
If prompted to install the Download Manager, allow the installation.
4. Click the Add-On Profile icon and follow the download instructions.
5. Extract the AOP zip file and run Setup.

Motor Power and Brake Connections

The motors and actuators in [Table 41](#) have separate power/brake and feedback cables. The motor power/brake cable attaches to the cable clamp on the drive and wires to the MP and BC connectors, respectively.

Table 43 - Current Motor Power Cable Compatibility

Motor/Actuator Cat. No. ⁽¹⁾	Motor Power Cat. No. ⁽²⁾ (with brake wires)	Motor Power Cat. No. ⁽²⁾ (without brake wires)
MPL-A/B15xxx-xx7xAA, MPL-A/B2xxx-xx7xAA, MPL-A/B3xxx-xx7xAA, MPL-A/B4xxx-xx7xAA, MPL-A/B45xxx-xx7xAA, MPL-A/B5xxx-xx7xAA, MPL-B6xxx-xx7xAA	2090-CPBM7DF-xxAAxx (standard) or 2090-CPBM7DF-xxAFxx (continuous-flex)	2090-CPWM7DF-xxAAxx (standard) or 2090-CPWM7DF-xxAFxx (continuous-flex)
MPM-A/Bxxxx, MPF-A/Bxxxx, MPS-A/Bxxxx		
MPAS-A/Bxxxx1-V05SxA, MPAS-A/Bxxxx2-V20SxA MPAI-A/Bxxxx, MPAR-A/B3xxx, MPAR-A/B1xxx and MPAR-A/B2xxx (series B)		
LDAT-Sxxxxxx-xDx	N/A	

(1) The 2198-H2DCK converter kit is required for all 400V-class MP-Series motors and actuators. The 2198-H2DCK (series B or later) converter kit is required for LDAT-Series linear thrusters and all 200V-class MP-Series motors and actuators.

(2) Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [GMC-TD004](#), for cable specifications.

Refer to [Motor Power Connections](#) on [page 81](#) and [Motor Brake Connections](#) on [page 82](#) for the MP and BC connector specifications.

Table 44 - Legacy Motor Power Cables

Motor Cable	Description	Motor Power Cat. No.
Standard	Power/brake, threaded	2090-XXNPMF-xxSxx
	Power-only, bayonet	2090-XXNPMP-xxSxx
Continuous-flex	Power/brake, threaded	2090-CPBM4DF-xxAFxx
	Power-only, threaded	2090-CPWM4DF-xxAFxx
	Power-only, bayonet	2090-XXTPMP-xxSxx

To use your existing Bulletin 2090 cables with Kinetix 5500 drives, some preparation is necessary so that the cable shield, conductor, and strip lengths are correct. Follow these cable preparation guidelines:

- Trim the shield flush so that no strands can short to adjacent terminals.
- Measure the conductor lengths and include a service loop.
- Remove just enough insulation to provide the proper strip length.

Maximum Cable Lengths

The power cable length for Kinetix 5500 drive and MP-Series motor/actuator combinations is limited to 20 m (65.6 ft); however, you can replace the existing motor power/brake cable with a 2090-CSBM1DF-xxAAxx single motor cable to extend the length up to 50 m (164 ft).

IMPORTANT

When replacing your existing motor power/brake cable with a 2090-CSBM1DF-xxAAxx single motor cable, only the motor power and brake conductors are used. Cut off the feedback conductors in the single motor cable and reuse the existing 2090-Series feedback cable.

Motor Power/Brake Cable Preparation

Power cable preparation on existing 16 and 14 AWG cables is sufficient to reuse on Kinetix 5500 frame 1 and 2 drives, except for the brake conductors, which are much longer than required.

However, for frame 3 drives with 14 or 10 AWG cables, the overall length of the cable preparation area needs to be increased for the motor power conductors to reach the MP connector and also provide a proper service loop.

Follow these steps to prepare your existing brake conductors and 14 or 10 AWG power cable.

1. Remove a total of 325 mm (12.8 in.) of cable jacket from your existing cable.

This exposes additional cable shield.

2. Remove all but 63.5 mm (2.5 in.) of the shield.

3. Cover 12.5 mm (0.5 in.) of the shield ends and an equal length of the conductors with 25 mm (1.0 in.) of electrical tape or heat shrink.

Do the same on the other side of the cable shield. This keeps the shield ends from fraying and holds the conductors together.

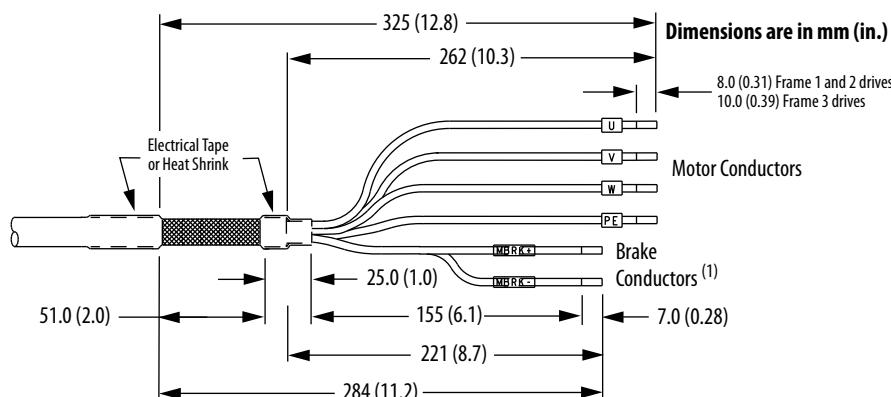
4. Cut the brake conductors back to 163 mm (6.4 in.) and trim the shield braid at the base of the jacket.

The shield braid covering the brake conductors is not needed.

5. Remove the specified length of insulation from the end of each wire.

This example applies to existing 2090-Series cables and 2090-Series single motor cables. If you are using a 2090-CSBM1DF-xxAxx single motor cable, you can remove the shield braid covering the brake conductors.

Figure 51 - Power/brake Cable (14 and 10 AWG)



Apply the Motor Power/brake Shield Clamp

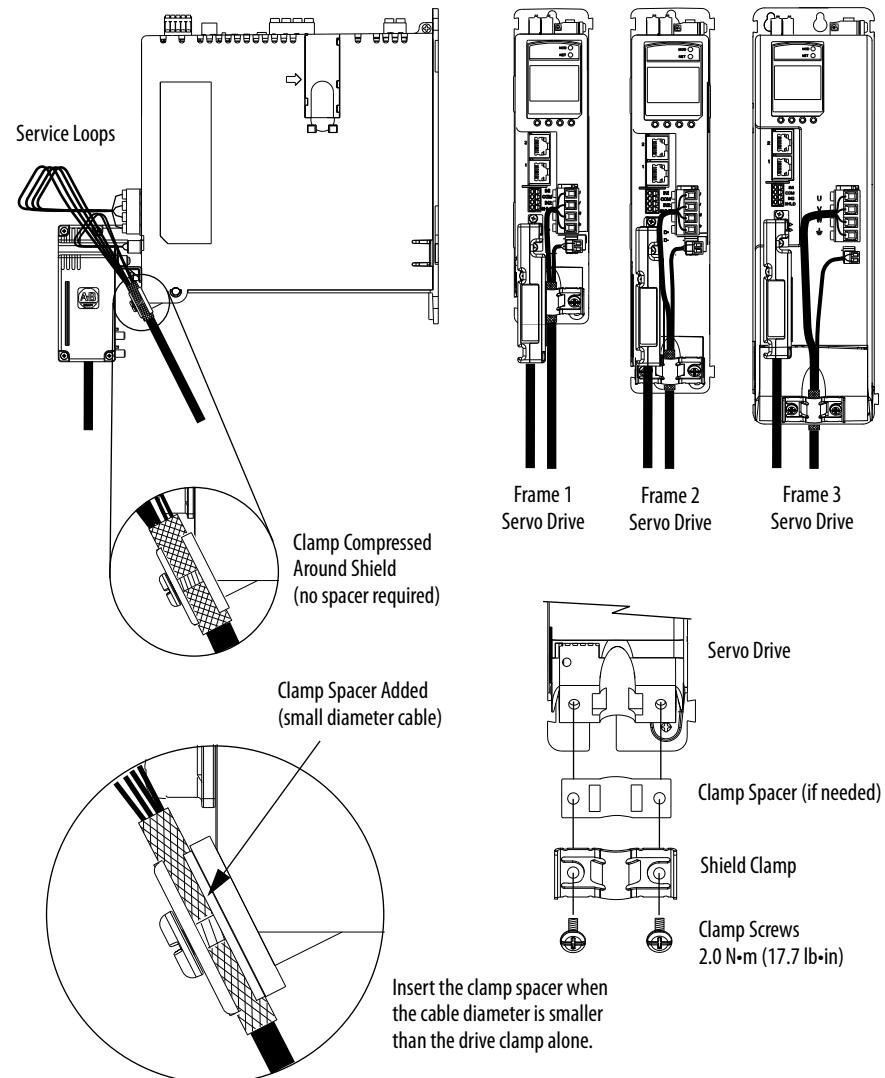
The power/brake cable shield attaches to the drive cable clamp. A clamp spacer is included with the kit for cable diameters that are too small for a tight fit within the drive clamp alone.

- Routing the conductors with service loops provides stress relief to the motor power and brake conductors.
- Make sure the cable clamp tightens around the cable shield and provides a good bond between the cable shield and the drive chassis.

IMPORTANT

If the power/brake cable shield has a loose fit inside the shield clamp, insert the clamp spacer between the shield clamp and the drive to reduce the clamp diameter. When the clamp screws are tight, $2.0\text{ N}\cdot\text{m}$ ($17.7\text{ lb}\cdot\text{in}$), the result must be a high-frequency bond between the cable shield and the drive chassis.

Figure 52 - Cable Clamp Attachment



Motor Feedback Connections

The feedback cable attaches to the 2198-H2DCK converter kit and is wired to the 10-pin connector. Bulletin 2090 feedback cables require preparation to make sure the shield clamp attaches properly and conductors route smoothly to the 10-pin connector terminals.

IMPORTANT	When using the 2198-H2DCK feedback connector kit and Bulletin 2090 feedback cables listed in Table 45 or Table 46 , the ambient temperature for the Kinetix 5500 drive enclosure is derated to 0...40 °C (32...104 °F).
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All of the current and legacy feedback cables listed below are compatible with the 2198-H2DCK converter kit.

IMPORTANT	Only Allen-Bradley motors and actuators with single-turn or multi-turn high-resolution absolute encoders are compatible.
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Table 45 - Motor Feedback Cable Compatibility

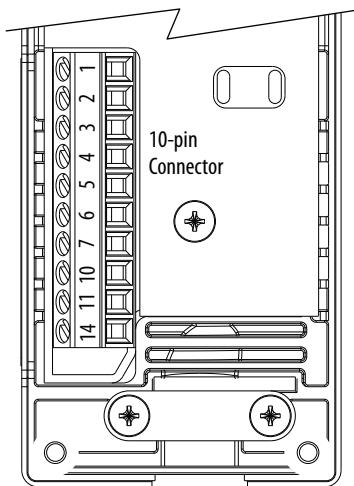
Motor/Actuator Cat. No. ⁽¹⁾	Feedback Kit Cat. No.	Feedback Cable Cat. No.
MPL-A/B15xxx-V/Ex7xAA	2198-H2DCK	2090-CFBM7DF-CEAxx 2090-CFBM7DD-CEAxx 2090-CFBM7DF-CERAxx (standard) or 2090-CFBM7DF-CEAFxx 2090-CFBM7DD-CEAFxx 2090-CFBM7DF-CDAFxx (continuous-flex)
MPL-A/B2xxx-V/Ex7xAA		
MPL-A/B3xxx-S/Mx7xAA		
MPL-A/B4xxx-S/Mx7xAA		
MPL-A/B45xxx-S/Mx7xAA		
MPL-A/B5xxx-S/Mx7xAA		
MPL-B6xxx-S/Mx7xAA		
MPM-A/Bxxxx-S/M		
MPF-A/Bxxxx-S/M		
MPS-A/Bxxxxx-S/M		
MPAS-A/Bxxxx1-V05SxA	MPAR-A/B1xxxx-V and MPAR-A/B2xxxx-V (series B) MPAR-A/B3xxxx-M	2090-CFBM7DF-CEAxx 2090-CFBM7DD-CEAxx 2090-CFBM7DF-CERAxx (standard) or 2090-CFBM7DF-CEAFxx 2090-CFBM7DD-CEAFxx 2090-CFBM7DF-CDAFxx (continuous-flex)
MPAS-A/Bxxxx2-V20SxA		
MPAR-A/B1xxxx-V and MPAR-A/B2xxxx-V (series B) MPAR-A/B3xxxx-M		
MPAI-A/BxxxxM3		
LDAT-Sxxxxx-xDx	MPAR-A/B1xxxx-V and MPAR-A/B2xxxx-V (series B) MPAR-A/B3xxxx-M	2090-XXNFMF-Sxx 2090-UXNFBMF-Sxx

(1) The 2198-H2DCK converter kit is required for all 400V-class MP-Series motors and actuators. The 2198-H2DCK (series B or later) converter kit is required for LDAT-Series linear thrusters and all 200V-class MP-Series motors and actuators.

Table 46 - Legacy Motor Feedback Cables

Motor Cable	Description	Feedback Cable Cat. No.
Standard	Encoder feedback, threaded	2090-XXNFMF-Sxx 2090-UXNFBMF-Sxx
	Encoder feedback, bayonet	2090-UXNFBMP-Sxx 2090-XXNFMMP-Sxx
Continuous-flex	Encoder feedback, bayonet	2090-XXTFMP-Sxx
	Encoder feedback, threaded	2090-CFBM4DF-CDAFxx

Figure 53 - 2198-H2DCK Converter Kit Pinout



Terminal	Signal	Wire Color	Strip Length mm (in.)	Torque Value N·m (lb·in)
1	SIN+	Black		
2	SIN-	White/Black		
3	COS+	Red		
4	COS-	White/Red		
5	DATA+	Green		
6	ECOM ⁽¹⁾	White/Gray	5.0 (0.2)	0.22...0.25 (1.9...2.2)
7	EPWR_9V ⁽²⁾	Orange		
10	DATA-	White/Green		
11	TS+	White/Orange		
14	EPWR_5V ⁽²⁾	Gray		

(1) The ECOM and TS- connections are tied together and connect to the cable shield.

(2) The converter kit generates 5V and 9V from a 12V supply coming from the drive. The 5V supply is used by 5V encoders in 230V motors. The 9V supply is used by 9V encoders in 460V motors.

Motor Feedback Cable Preparation

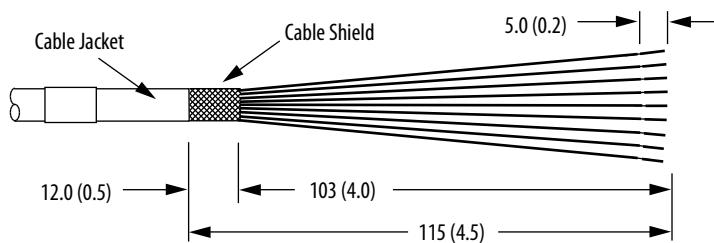
Follow these steps to prepare feedback cables.

1. Remove 115 mm (4.5 in.) of cable jacket and 103 mm (4.0 in.) of cable shield.

IMPORTANT This length of wire is needed to provide a service loop for the longest wires terminated at the 10-pin connector. However, most wires need to be trimmed shorter, depending on the terminal they are assigned to.

2. Determine the length for each of the 10 wires and trim as necessary.
3. Remove 5.0 mm (0.2 in.) of insulation from the end of each wire.

Dimensions are in mm (in.)



Apply the Converter Kit Shield Clamp

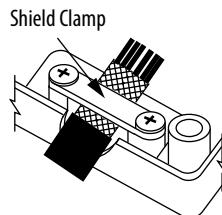
Follow these steps to apply the converter kit shield clamp.

1. Apply the shield clamp to the 12 mm (0.5 in.) of exposed cable shield to achieve a high-frequency bond between the shield braid and clamp.

IMPORTANT

Cable preparation and positioning that provides a high-frequency bond between the shield braid and clamp is required to optimize system performance.

Apply 0.30 N•m (2.6 lb•in) torque to each screw.



2. Route and insert each wire to its assigned terminal.

Include a service loop, as shown in [Figure 54](#), and refer to the connector pinout in [Figure 53](#).

3. Tighten each terminal screw.

Apply 0.22...0.25 N•m (1.9...2.2 lb•in) torque to each screw.

4. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.

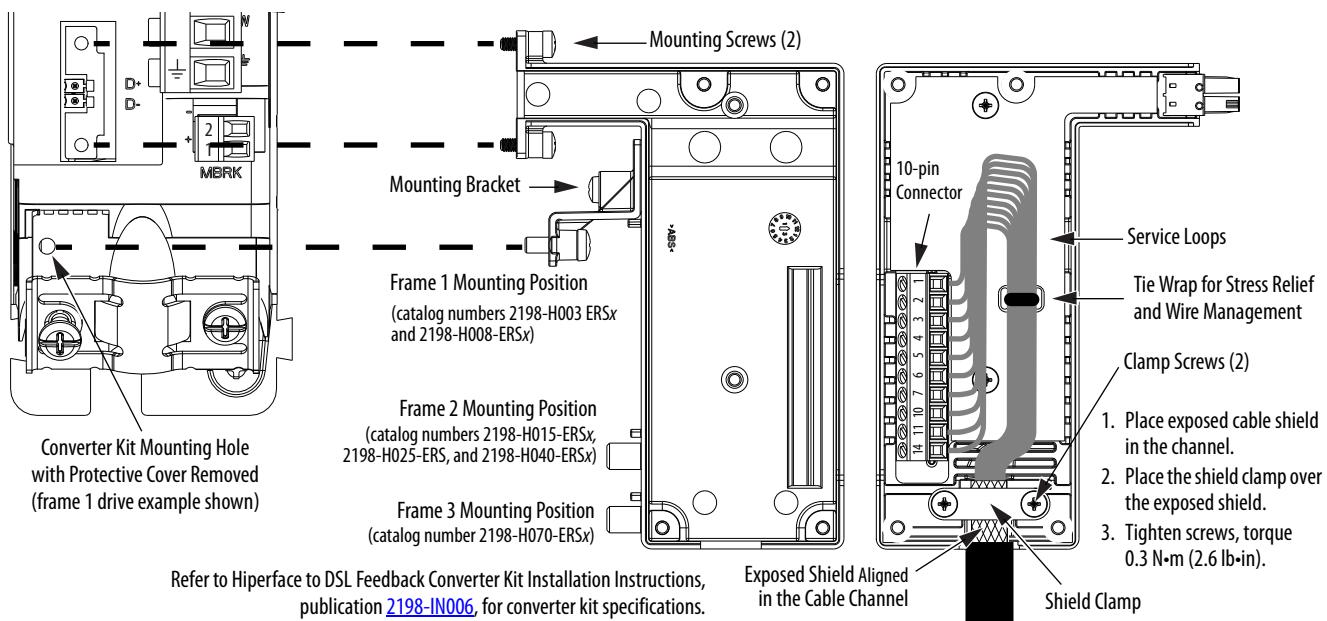
5. Attach the tie wrap for added stress relief.

Table 47 - 2090-CFBM7DF-CEAxxx Feedback Cables

Rotary Motors	MPL-B15xxx...MPL-B2xxx-V/Ex4/7xAA MPF/MPS-Bxxx-M/S MPF-A5xxx-M/S	MPL-A15xxx...MPL-A2xxx-V/Ex4/7xAA MPF/MPS-A3xx-M/S MPF/MPS-A4xx-M/S MPF/MPS-A45xx-M/S MPS-A5xxx-M/S MPL-A3xxx-M/Sx7xAA MPL-A4xxx-M/Sx7xAA MPL-A45xxx-M/Sx7xAA MPM-A115xxx...MPM-A130xxx-M/S	2198-H2DCK Converter Kit Pin
	MPL-B3xxx...MPL-B6xxx-M/Sx7xAA MPL-A5xxx-M/Sx7xAA MPM-A165xxx...MPM-A215xxx MPM-Bxxxx-M/S		
Linear Actuators	MPAS-Bxxxx-VxxSxA MPAR-Bxxx, MPAI-Bxxx LDAT-Sxxxxx-xDx	MPAS-Axxxx-VxxSxA MPAR-Axxx, MPAI-Axxx	
1	Sin+	Sin+	1
2	Sin-	Sin-	2
3	Cos+	Cos+	3
4	Cos-	Cos-	4
5	Data+	Data+	5
6	Data-	Data-	10
9	Reserved	EPWR_5V	14
10	ECOM	ECOM	6 ⁽¹⁾
11	EPWR_9V	Reserved	7
12	ECOM	ECOM	6
13	TS+	TS+	11

(1) The ECOM and TS- connections are tied together and connect to the cable shield.

A mounting bracket is included with the 2198-H2DCK converter kit to secure the kit to the drive. Install the mounting bracket in the mounting position specific to the frame size of your drive.

Figure 54 - Wiring the 2198-H2DCK Feedback Converter Kit

Capacitor Module Connections

Follow these guidelines when wiring the 2198-CAPMOD-1300 capacitor module:

- Wire relay output (MS) connections to the Logix5000 controller (optional).
- Refer to [Kinetix 5500 Capacitor Module wiring example on page 191](#).
- Refer to [Kinetix 5500 Capacitor Module Status Indicators on page 147](#) for troubleshooting the module status indicator and relay output.
- Refer to the installation instructions provided with your Bulletin 2198 capacitor module, publication [2198-IN004](#).

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Chapter 2](#).

Connections to the DC bus and 24V control power must be made with the shared-bus connection system.

Figure 55 - Capacitor Module Wiring

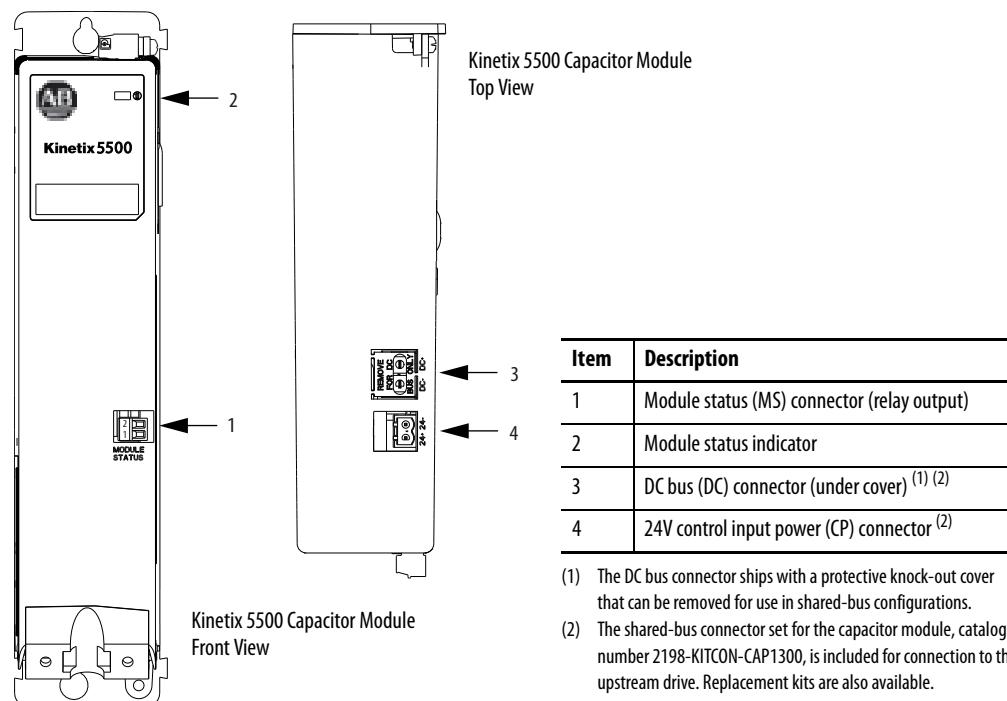


Table 48 - Capacitor Module Connector Specifications

Capacitor Module Cat. No.	Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb-in)
2198-CAPMOD-1300	MS-1	RELAY+	0.14...1.5 (28...16)	7.0 (0.28)	0.22...0.25 (1.9...2.2)
	MS-2	RELAY-			

External Shunt Resistor Connections

Follow these guidelines when wiring your 2097-Rx shunt resistor:

- Refer to [External Shunt Resistor](#) on [page 42](#) for noise zone considerations.
- Refer to [Shunt Resistor Wiring Example](#) on [page 194](#).
- Refer to the installation instructions provided with your Bulletin 2097 shunt resistor, publication [2097-IN002](#).

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Chapter 2](#).

Figure 56 - RC Connector Wiring

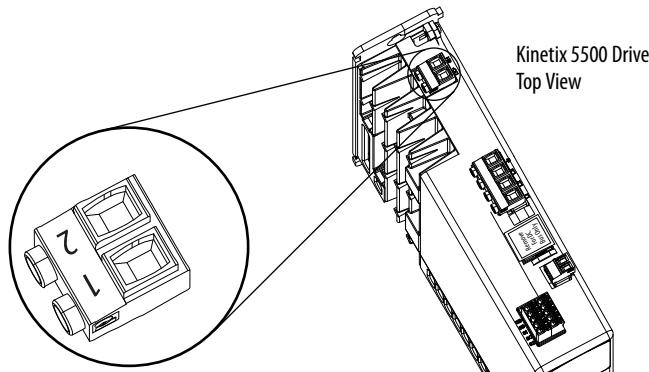


Table 49 - Shunt Resistor (RC) Connector Specifications

Drive Cat. No.	Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
2198-H003-ERSx 2198-H008-ERSx	RC-1 RC-2	SH DC+			
2198-H015-ERSx 2198-H025-ERSx 2198-H040-ERSx 2198-H070-ERSx	RC-1 RC-2	DC+ SH	4...0.5 (12...20)	8.0 (0.31)	0.5...0.6 (4.4...5.3)

IMPORTANT You must disconnect the internal shunt wires at the RC connector before connecting the Bulletin 2097 shunt resistor wires.

Table 50 - Shunt Resistor Selection

Drive Cat. No.	Bulletin 2097 Shunt Resistor Cat. No.
2198-H003-ERSx	2097-R7
2198-H008-ERSx	
2198-H015-ERSx	
2198-H025-ERSx	
2198-H040-ERSx	2097-R6
2198-H070-ERSx	

Ethernet Cable Connections

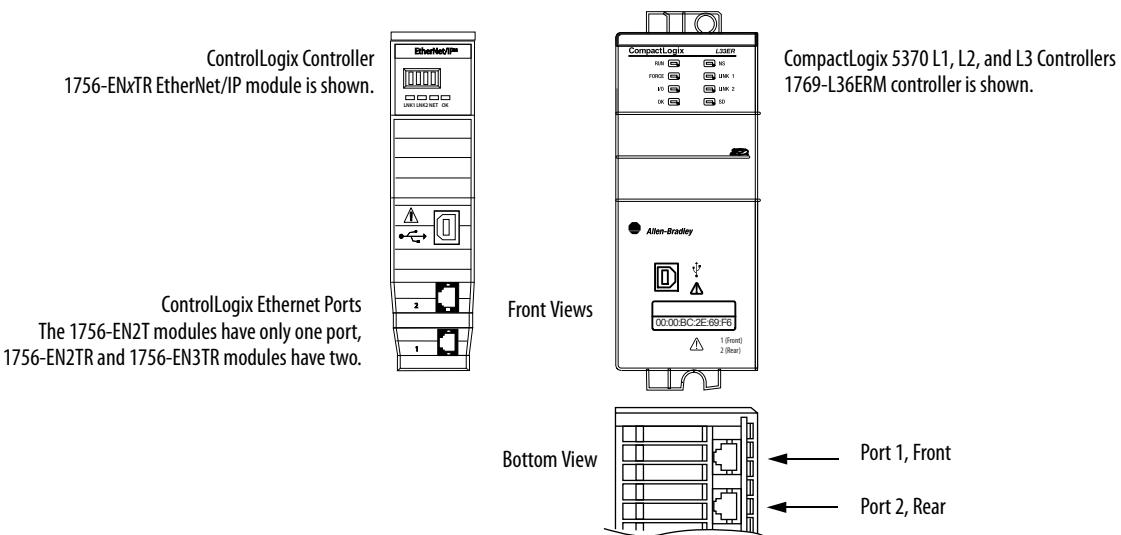
This procedure assumes you have your CompactLogix 5370 controller or ControlLogix EtherNet/IP module and Kinetix 5500 drives mounted and are ready to connect the network cables.

The EtherNet/IP network is connected by using the PORT 1 and PORT 2 connectors. Refer to [page 58](#) to locate the Ethernet connectors on your Kinetix 5500 drive. Refer to the figure below to locate the connectors on your Logix5000 controller.

Shielded Ethernet cable is available in several standard lengths. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [GMC-TD004](#), for more information.

Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).

Figure 57 - ControlLogix and CompactLogix Ethernet Port Locations



These Logix5000 controllers accept linear, ring (DLR), and star network configurations. Refer to [Typical Communication Configurations](#) on [page 20](#) for linear, ring, and star configuration examples.

IMPORTANT

When using an external Ethernet switch for routing traffic between the controller and the drive, switches with IEEE-1588 time synchronization capabilities (boundary or transparent clock) must be used to make sure switch delays are compensated.

Notes:

Configure and Start the Kinetix 5500 Drive System

This chapter provides procedures for configuring your Kinetix 5500 drive system with a Logix5000 controller.

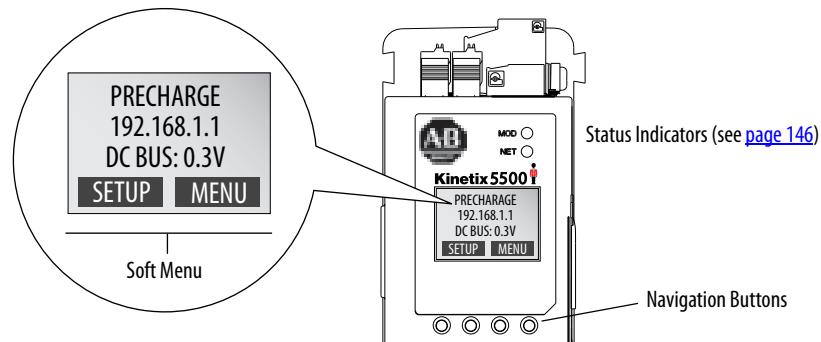
Topic	Page
Understanding the Kinetix 5500 Display	100
Configure the Drive	104
Configure the Logix Designer Application Project	105
Apply Power to the Kinetix 5500 Drive	129
Test and Tune the Axes	131
Understanding Bus Sharing Group Configuration	135

TIP Before you begin, make sure you know the catalog number for each drive component, the Logix module and /or controller, and the servo motor used in your motion control application.

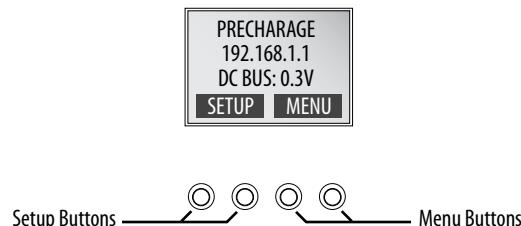
Understanding the Kinetix 5500 Display

The Kinetix 5500 drive has two status indicators and an LCD status display. The indicators and display are used to monitor the system status, set network parameters, and troubleshoot faults. Four navigation buttons are directly below the display and are used to select items from a soft menu.

Figure 58 - Kinetix 5500 Drive LCD Display and Status Indicators

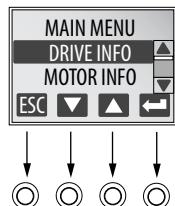


This is the Home screen. The SETUP selections are tied to the two left-side buttons and the MENU selections are tied to the two right-side buttons.



The soft menu provides a changing selection that corresponds to the current screen. Use the navigation buttons to perform the following.

Each soft menu item is executed by pressing the navigation button directly below the item, as shown in this example.



ESC	Press to go back. Pressing enough times results in the HOME screen.
▲ ▼	Pressing either arrow moves the selection to the next (or previous) item. When changing values, pressing the up arrow increments the highlighted value. Values rollover after reaching the end of the list.
◀	Press to select values to change, moving from right to left. Values rollover when reaching the end of the list.
→	Press to select a menu item.
HOME	Press to return to the Home screen.
LOG	Press to display the list of active fault codes.
TEXT	Press to display the fault text (exception code in troubleshooting tables). ⁽¹⁾
INFO	Press to display the fault details (the problem in troubleshooting tables). ⁽¹⁾
HELP	Press to display the fault help (possible solutions in troubleshooting tables). ⁽¹⁾

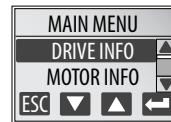
(1) Refer to [Fault Codes](#) beginning on [page 140](#) to review the troubleshooting tables.

Menu Screens

The menu screens provide information about the drive, motor, and fault log. There are no choices to make or settings to save. Press one of the MENU buttons to access the menu.

You can use the soft menu items and navigation buttons to view the information.

Table 51 - Navigating the Menu



Menu/Sub Menu Selections	Attributes	Description	Example Values
Drive Info	Catalog number		2198-H008-ERSx
	Firmware revision		FW REV: 1.1.33
	Hardware revision		HW REV: 1.1
	Serial number		SERIAL#xxxxxxxxxx
Motor Info	Model number		MODEL: VPL-B1003C
	Serial number		SERIAL#: xxxxxxxxxxx
Diagnostics> Drive Diagnostics	Bus diagnostics		BUS VOLT: 0.0V BUS CUR: 0.0A
	Converter diagnostics		CONV UTIL: 0.7% CONV TEMP: 31.7C
	Inverter diagnostics		INV UTIL: 0.0% INV TEMP: 31.7C
	Shunt utilization		SHUNT UTIL: 0.0%
Diagnostics> Motor Diagnostics	Motor speed		SPEED: 0.0 RPM
	Motor current		MTR CUR: 0.0A RMS
	Motor utilization		MTR UTIL: 0.0%
	Motor temperature		MTR TEMP: 0.00C
Diagnostics> Encoder Diagnostics	Serial number		SERIAL#xxxxxxxxxx
	Resolution		RESOLUTION: 262144
	Number of turns		NO OF TURNS: 1
	Encoder temperature		ENC TEMP: 33.7C
	Supply voltage		SUPP VOLT: 11.3V
	Link quality	The link quality attribute indicates how noisy a communication link is and also indicates if there is a communication link already established at the drive end. The LINK QUAL value must always be 100%. Persistent values below 100% indicates a poor feedback ground connection.	LINK QUAL: 100.0%
	Remote signal strength indicator	Similar to Link Quality, RSSI reports the quality of link as seen at the motor end by the encoder. Maintain the RSSI value between 80 and 100%. Persistent values below 80% indicates a poor feedback ground connection.	RSSI: 100.0%
	Accumulated position errors	This is an aggregated number of errors in the primary position feedback channel of DSL feedback.	POS ERRORS: 1
	Channel position errors	This is an aggregated number of errors on a secondary communication channel of the DSL feedback.	CHNL ERRORS: 5
Fault Log	Fault text	Fault code as listed in Fault Codes beginning on page 140 .	FLT S45 - FDBK COMM FL
	Fault details	The problem as reported in Fault Codes on page 140 .	The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit
	Fault help	The Possible Solution as reported in Fault Codes on page 140 .	Check motor feedback cable and connector

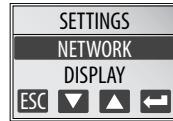
Setup Screens

The setup screens provide the means of changing drive settings, for example, the IP address. Press one of the SETUP buttons to access the setup screens.

You can use the soft menu items and navigation buttons to view the information and make changes.

Press  to validate your changes:

- If the change is invalid, the value doesn't change.
- If the change is valid, an asterisk appears next to the changed attribute.



IMPORTANT

You must cycle control power to make network configuration changes persistent. In this example, the IP address was changed. The change takes affect and the asterisk disappears after control power is cycled.

Display configuration changes take effect immediately.

Table 52 - Navigating the Settings Menu

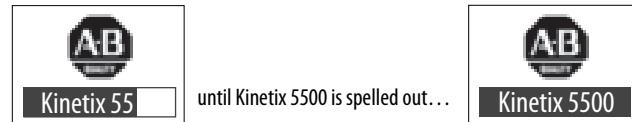
Settings Menu Selections	Sub Menu Selections	Attributes	Default	Description
Network	->Static IP ⁽¹⁾	IP address	192.168.1.1	Indicates current IP address
		Subnet mask	255.255.255.000	Indicates current subnet mask
		Gateway	192.168.001.001	Indicates current gateway
	DHCP	On		Turns DHCP on
		Off		Turns DHCP off
Display	Cyclic Data Select ⁽²⁾	Backlight Timeout	30 sec...NEVER (NEVER=no timeout period, the backlight is always on)	-> 3 min ⁽¹⁾
		Contrast	-10...+10	0
			->DC BUS ⁽¹⁾	DC bus voltage
			ENC TEMP	Encoder temperature in °C
			INV UTIL	Inverter utilization in percent
			INV TEMP	Inverter temperature in °C
			CONV UTIL	Converter utilization in percent
			CONV TEMP	Converter temperature in °C
			SHUNT UTIL	Shunt utilization in percent
			MOTOR UTIL	Motor utilization in percent
			SPEED	RPM
			OUT PWR	Output power in watts
			OUT FREQ	Output frequency in hertz
			OUT CUR	Output current in amps

(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.

(2) The DC bus voltage is one of several cyclic data attributes. You can select any of the Cyclic Data Select attributes to be displayed on the Home screen.

Startup Sequence

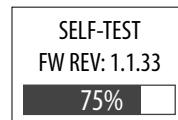
On initial powerup, the drive performs a self test. Upon successful completion, the drive firmware revision is displayed.



then...



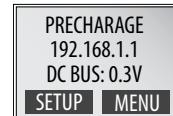
then...



until Kinetix 5500 is spelled out...



Next, the axis state, the IP address, and the default cyclic data attribute (in this example DC bus voltage) appears. In addition, the SETUP and MENU soft keys are displayed. This is the Home screen.



In this example PRECHARGE is the axis state attribute. [Table 53](#) lists the other axis states and their descriptions.

Table 53 - Axis States on the Home Screen

Axis State	Description
STANDBY	The drive is waiting to receive configuration information from the controller.
CONNECTING	The drive is trying to establish communication with the EtherNet/IP controller.
CONFIGURING	The drive is receiving configuration information from the controller.
SYNCING	The drive is waiting for a successful Group Sync service.
STOPPED	The drive is fully configured, but the control loops are not enabled.
PRECHARGE	The drive is ready for mains input power.
STARTING	The drive is enabled and checking various conditions before entering the RUNNING or TESTING state. For example, the drive checks the Brake Release delay time during the STARTING state.
RUNNING	<ul style="list-style-type: none"> The drive is enabled, configured with an active control mode, and actively tracking a command. The drive is configured for No Control and is fully operational.
TESTING	The drive is actively executing a test procedure, for example, a hookup test.
STOPPING	The drive is decelerating to a stop as the result of a disable.
ABORTING	The drive is decelerating to a stop as the result of a fault or an abort request.
MAJOR FAULTED	The drive is faulted due to an existing or past fault condition.
START INHIBITED	The drive has an active condition that inhibits it from being enabled.
SHUTDOWN	The drive has been shut down.

Configure the Drive

You can include the drive in your Logix Designer application by adding it to a configured EtherNet/IP module or controller and adding it under the I/O configuration tree. After setting network parameters, you can view the drive status information in Studio 5000 software and use it in your Logix Designer application.

Set the Network Parameters

You must program network parameters by using the LCD display.

1. From the LCD display, select SETUP>NETWORK and choose between STATIC IP and DHCP.
The default setting is STATIC IP.
2. If STATIC IP, then press  to configure the following parameters:
 - IP address
 - Gateway
 - Subnet mask

Settings are stored in nonvolatile memory. IP addressing can also be changed through the Module Configuration dialog box in RSLinx® software. Changes to the IP addressing take effect after power is cycled. The drive is factory programmed to static IP address of 192.168.1.1.

Refer to [Setup Screens](#) on [page 102](#) for help setting the network parameters.

Configure the Logix Designer Application Project

These procedures assume that you have wired your Kinetix 5500 drive system. In this example, the CompactLogix 5370 controller is used.

For help using Studio 5000 software and the Logix Designer application as it applies to configuring the ControlLogix or CompactLogix controllers, refer to [Additional Resources](#) on [page 12](#).

Configure the Logix5000 Controller

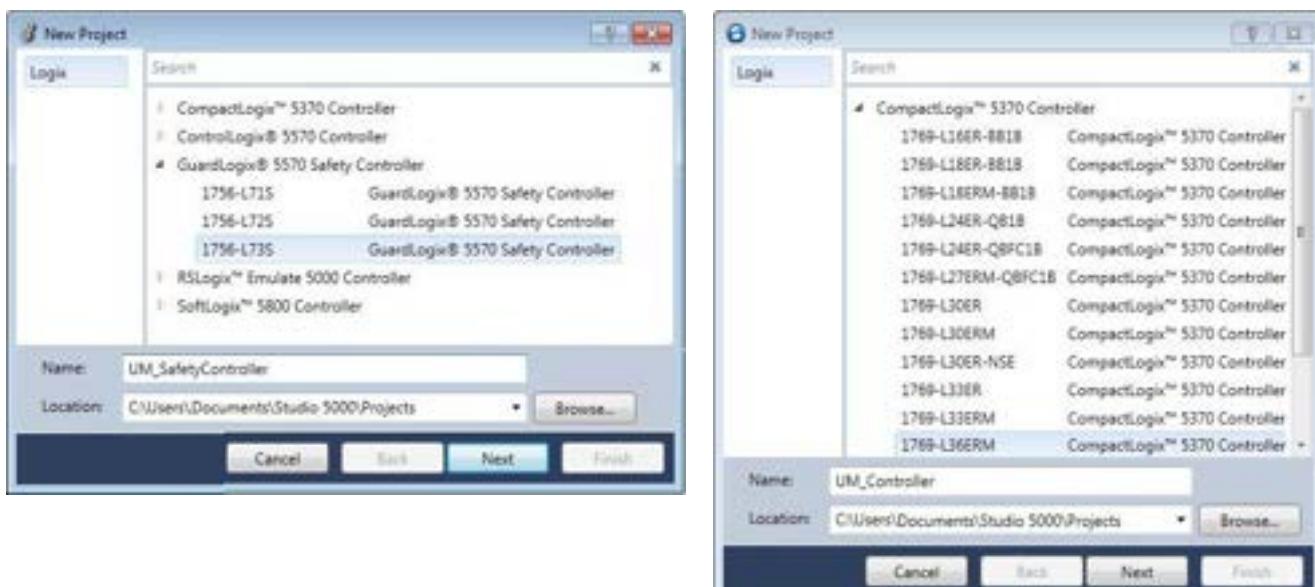
Follow these steps to configure the controller.

1. Apply power to your controller and open your Logix Designer application.



2. From the Create menu, choose New Project.

The New Project dialog box appears.



IMPORTANT

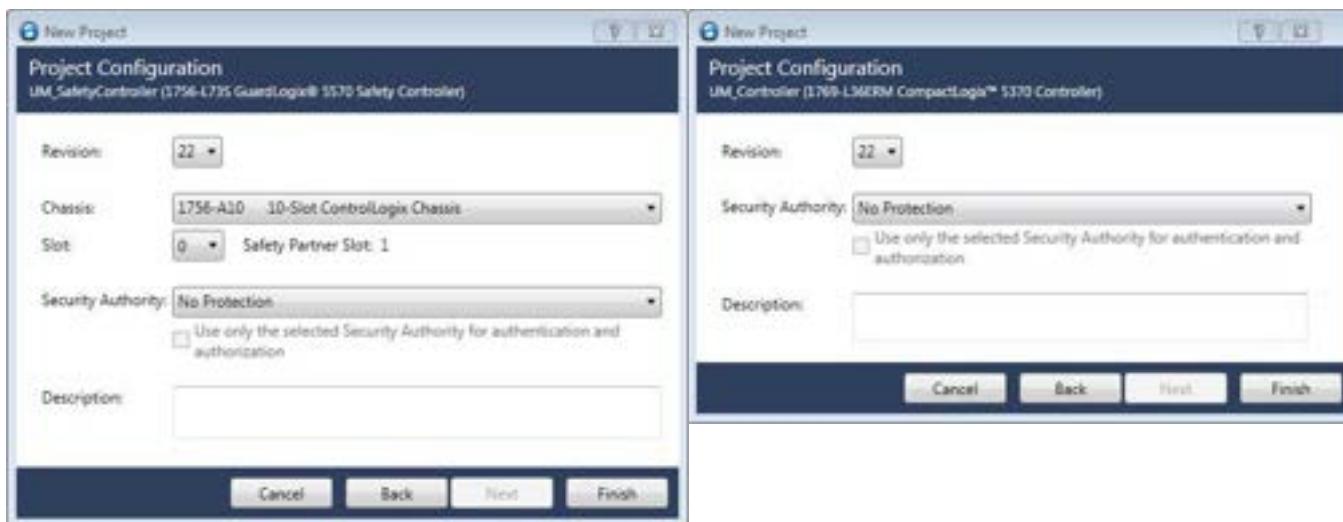
If you are configuring a 2198-Hxxx-ERS2 (integrated) servo drive in a safety application, you must use a GuardLogix safety controller.

In this example, the typical dialog boxes for 1756-ENxT EtherNet/IP modules and CompactLogix 5370 controllers with embedded Ethernet are shown.

Follow these steps to configure your Logix5000 controller.

1. Expand the Logix5000 controller family and select your controller.
2. Type the file Name.
3. Click Next.

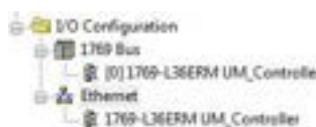
The New Project dialog box appears.



4. From the Revision pull-down menu, choose your software revision.
5. Click Finish.

The new controller appears in the Controller Organizer under the I/O Configuration folder.

Controller Organizer with
CompactLogix 5370 controller.



Controller Organizer with
GuardLogix 1756-L7xS controller.



IMPORTANT

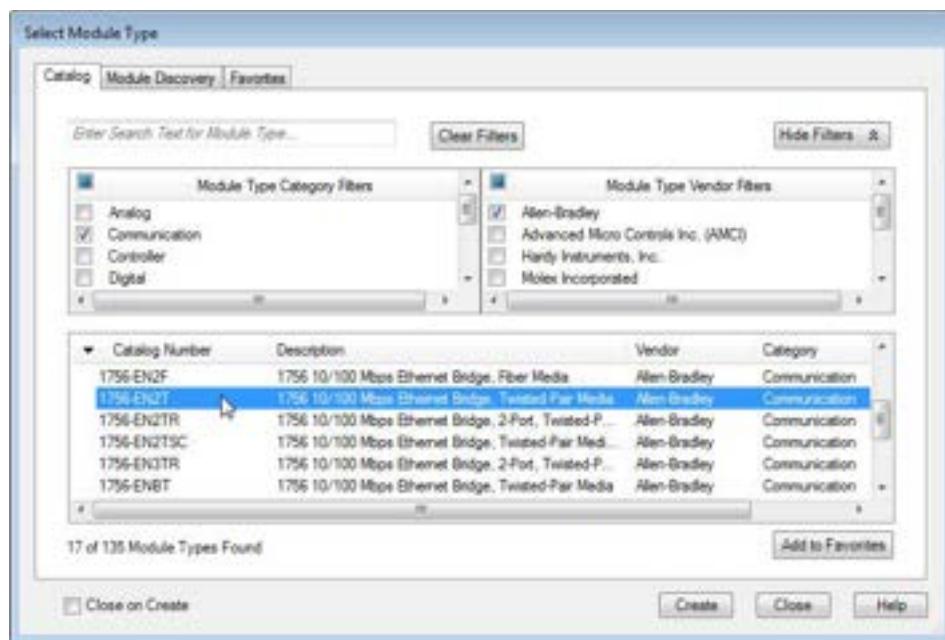
If your project includes a ControlLogix or GuardLogix controller, you need to add an Ethernet communication module to your Bulletin 1756 chassis and configure it for use in your application.

- For ControlLogix or GuardLogix controllers, go to [step 6](#)
- For CompactLogix 5370 controllers, go to [step 13](#)

Refer to the EtherNet/IP Network Configuration User Manual, publication, [ENET-UM001](#) for more information.

6. Right-click I/O Configuration in the Controller Organizer and choose New Module.

The Select Module Type dialog box appears.

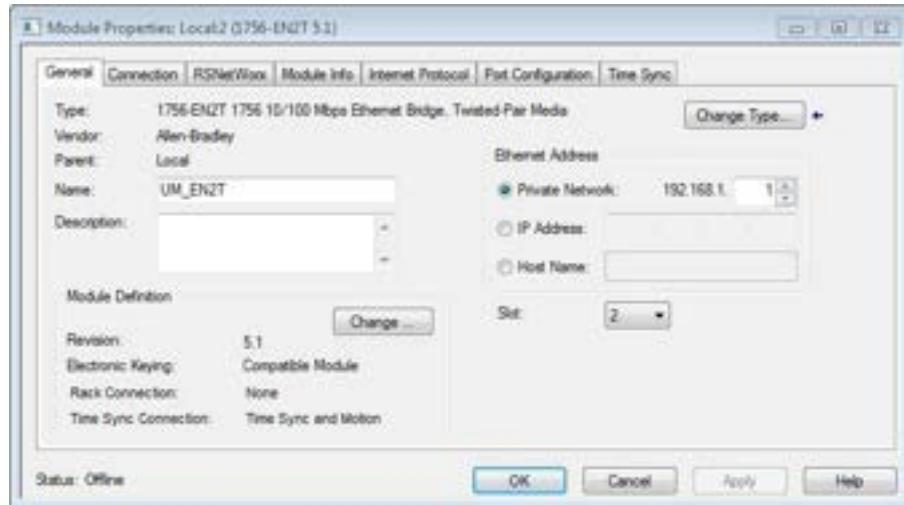


7. By using the filters, check Communication and Allen-Bradley, and select 1756-EN2T, 1756-EN2TR, or 1756-EN3TR as appropriate for your actual hardware configuration.

In this example, the 1756-EN2T module is selected.

8. Click Create.

The New Module dialog box appears.



- Configure the new module.
- Type the module Name.
- Enter the Logix EtherNet/IP module slot (leftmost slot = 0).

- d. Select an Ethernet Address option.

In this example, the Private Network address is selected.

- e. Enter the address of your EtherNet/IP module.

In this example, the last octet of the address is 1.

- f. Click Change in the Module Definition area.

The Module Definition dialog box opens.



9. From the Time Sync Connection pull-down menu, choose Time Sync and Motion.

IMPORTANT Time Sync functionality is what enables motion control on an Ethernet network. Without this setting, you won't be able to run your motion application.

10. Click OK to close the Module Definition dialog box.

11. Click Yes when prompted to confirm your module definition changes.



12. Click OK to close the New Module dialog box.

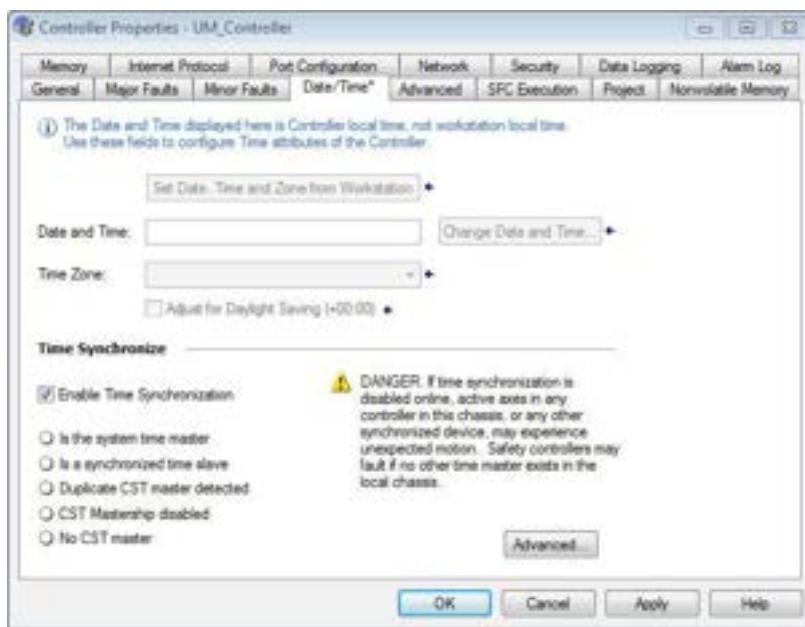
Your new 1756-ENxT Ethernet module appears under the I/O Configuration folder in the Controller Organizer.



13. From the Edit menu, choose Controller Properties.

The Controller Properties dialog box appears.

14. Click the Date/Time tab.



15. Check Enable Time Synchronization.

The motion modules set their clocks to the module you assign as the Grandmaster.

IMPORTANT Check Enable Time Synchronization for all controllers that participate in CIP Sync. The overall CIP Sync network automatically promotes a Grandmaster clock, unless the priority is set in the Advanced tab.

16. Click OK.

Configure the Kinetix 5500 Drive

IMPORTANT To configure 2198-Hxxx-ERS (hardwired safety) drives, you must be using the Logix Designer application, version 21.00 or later.

To configure 2198-Hxxx-ERS2 (integrated safety) drives, you must be using the Logix Designer application, version 24.00 or later.

Use this table to determine where to begin your drive configuration.

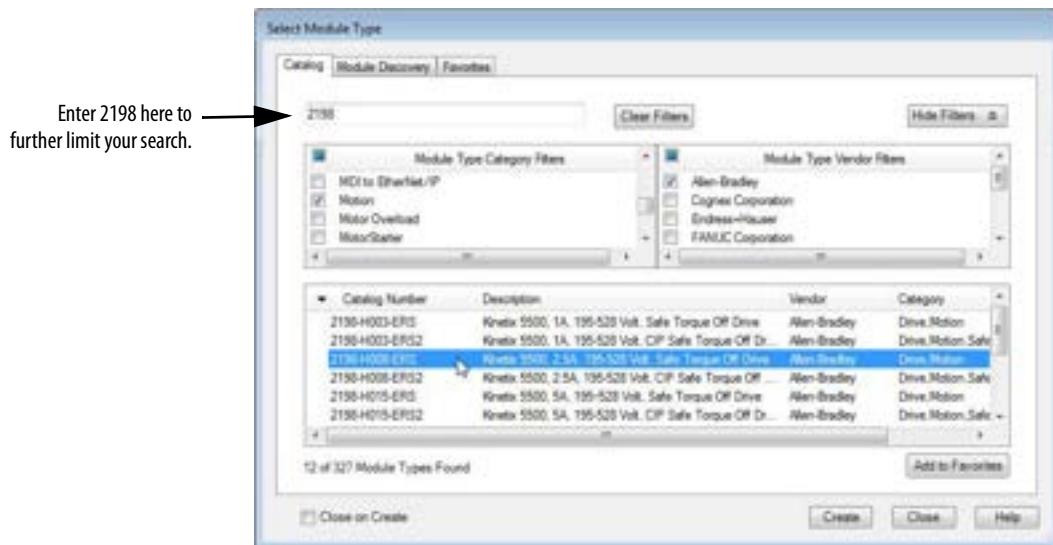
Drive Cat. No.	Start Here	Page
2198-Hxxx-ERS	Configure Drive with Hardwired Safety Connections	110
2198-Hxxx-ERS2	Configure Drive with Integrated Safety Connections	112

Configure Drive with Hardwired Safety Connections

Follow these steps to configure Kinetix 5500 drives with hardwired safety.

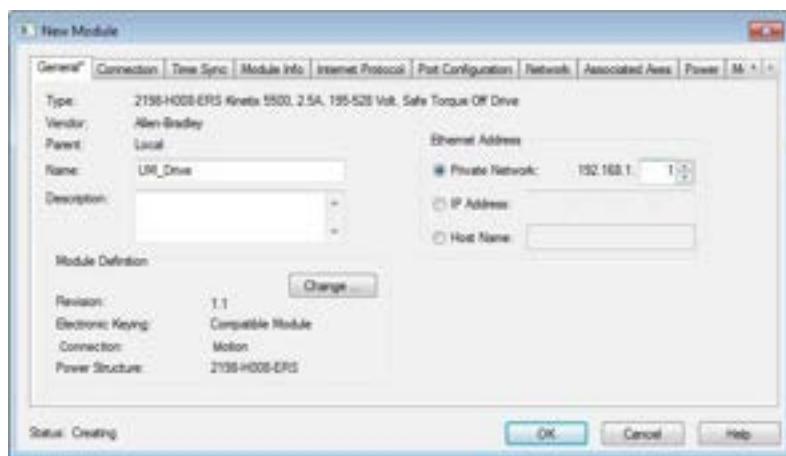
- Above the controller you just created, right-click Ethernet and choose New Module.

The Select Module Type dialog box appears.



- By using the filters, check Motion and Allen-Bradley, and select your 2198-Hxxx-ERS servo drive as appropriate for your actual hardware configuration.
- Click Create.

The New Module dialog box appears.



4. Configure the new drive.

- Type the drive Name.
- Select an Ethernet Address option.

In this example, the Private Network address is selected.

- Enter the address of your 2198-Hxxx-ERS drive.

In this example, the last octet of the address is 1.

5. Click OK to close the New Module dialog box.

Your 2198-Hxxx-ERS servo drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.



6. Click Close to close the Select Module Type dialog box.

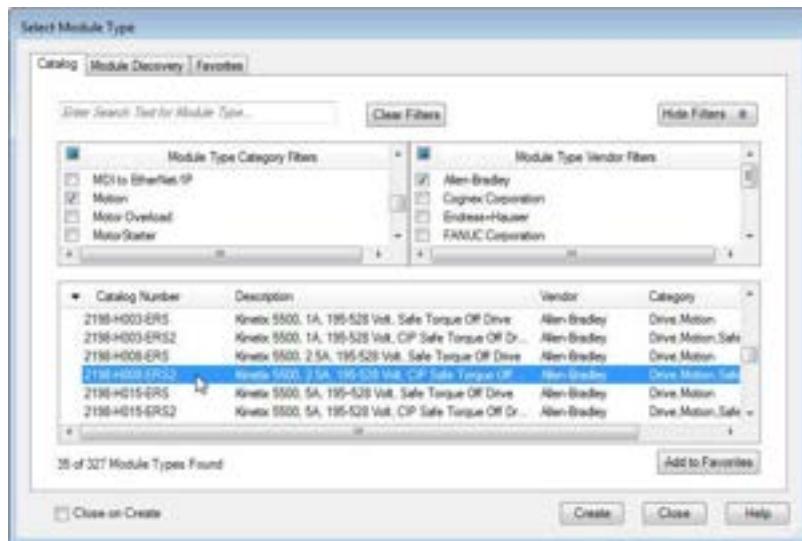
7. Jump to [Continue Drive Configuration](#) on [page 116](#) to continue with your drive configuration.

Configure Drive with Integrated Safety Connections

Follow these steps to configure Kinetix 5500 drives with integrated safety.

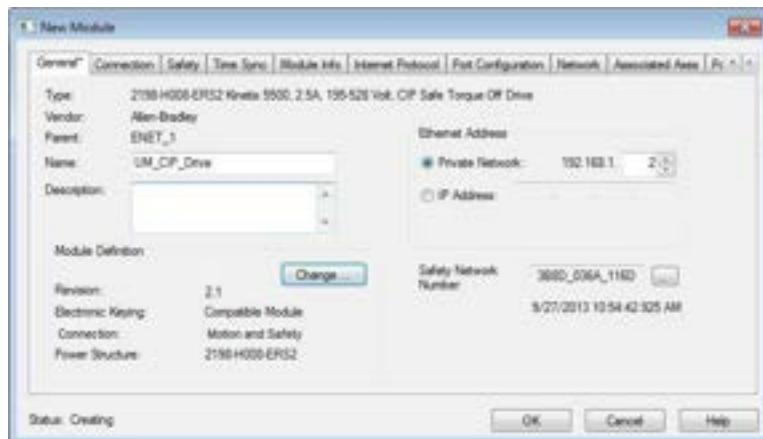
1. Above the controller you just created, right-click Ethernet and choose New Module.

The Select Module Type dialog box appears.



2. By using the filters, check Motion and Allen-Bradley, and select your 2198-Hxx-ERS2 servo drive as appropriate for your actual hardware configuration.
3. Click Create.

The New Module dialog box appears.



4. Configure the new drive.

- Type the drive Name.
- Select an Ethernet Address option.

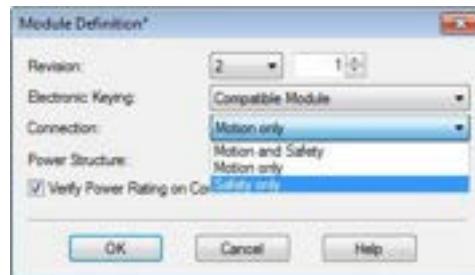
In this example, the Private Network address is selected.

- Enter the address of your 2198-Hxxx-ERS2 servo drive.

In this example, the last octet of the address is 2.

- Under Module Definition click Change.

The Module Definition dialog box appears.



- From the Connection pull-down menu, choose the Connection mode for your motion application.

TIP When 'Safety' appears in the Connection mode, integrated safety is implied.

Table 54 - Module Connection Definitions

Connection Mode	Controller Needed	Description Drive Cat. No. 2198-Hxxx-ERS	Description Drive Cat. No. 2198-Hxxx-ERS2
Motion only	ControlLogix 1756-L7x, GuardLogix 1756-L7xS, or CompactLogix 5370	Only hardwired safe torque-off connections are possible.	Motion is managed by this controller. Safety is managed by another controller that has a Safety-only connection to the drive.
Motion and Safety	GuardLogix 1756-L7xS	N/A	Motion and Safety are managed by this controller.
Safety only	GuardLogix 1756-L7xS	N/A	Safety is managed by this controller. Motion is managed by another controller that has a Motion-only connection to the drive.

The Safety Network Number (SNN) field populates automatically when the Connection mode includes an integrated Motion and Safety or Safety-only connection. For a detailed explanation of the safety network number, refer to the GuardLogix Controller Systems Safety Reference Manual, publication [1756-RM099](#).

- Click OK to close the Module Definition dialog box.
- Click OK to close the New Module dialog box.

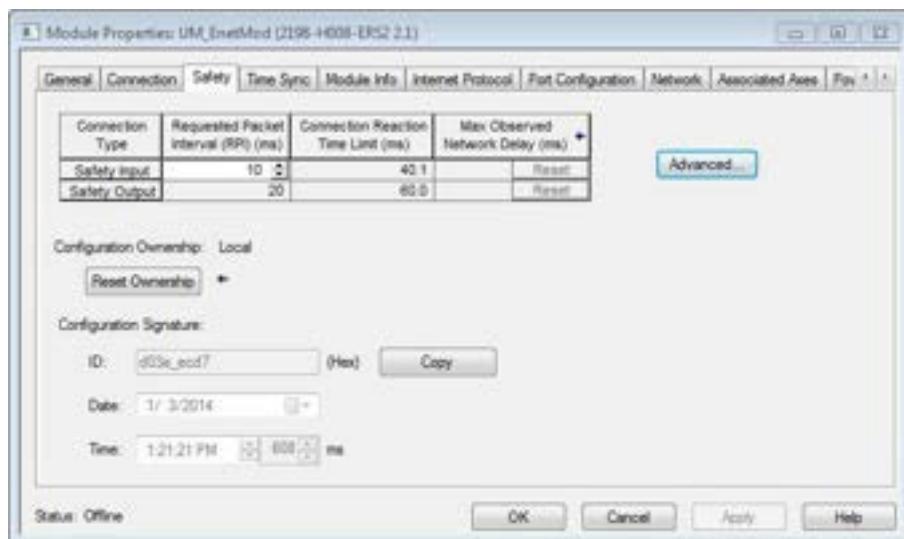
Your 2198-Hxxx-ERS2 servo drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.



7. Right-click the drive you just created in the Controller Organizer and choose Properties.

The Module Properties dialog box appears.

8. Click the Safety tab.



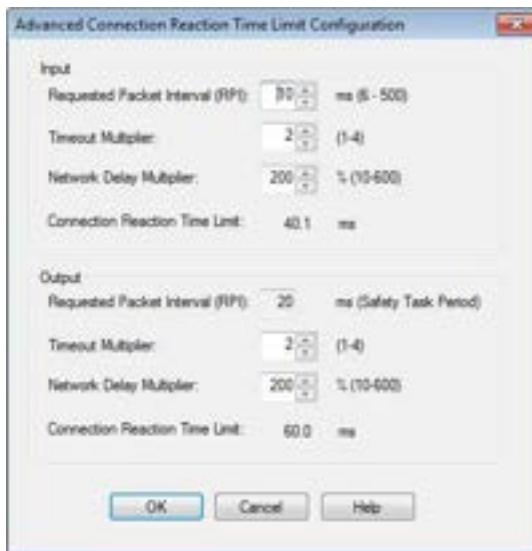
The connection between the owner and the 2198-Hxxx-ERS2 servo drive is based on the following:

- Servo drive catalog number must be 2198-Hxxx-ERS2 (integrated)
- Servo drive safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the 2198-Hxxx-ERS2 drive
- Configuration signature

If any differences are detected, the connection between the GuardLogix controller and the 2198-Hxxx-ERS2 drive is lost, and the yellow yield icon appears in the controller project tree after you download the program.

9. Click Advanced.

The Advanced Connection Reaction Time Limit Configuration dialog box appears.



Analyze each safety channel to determine the appropriate settings. The smallest Input RPI allowed is 6 ms. Selecting small RPI values consumes network bandwidth and can cause nuisance trips because other devices cannot get access to the network.

10. Click OK.

For more information about the Advanced Connection Reaction Time Limit Configuration, refer to the GuardLogix 5570 Controllers User Manual, publication [1756-UM022](#).

Continue Drive Configuration

After you've established your Kinetix 5500 drive in the Logix Designer application, the remaining configuration steps are the same regardless of the drive catalog number.

1. Right-click the 2198-Hxxx-ERSx servo drive you just created and choose Properties.

The Module Properties dialog box appears.

2. Click the Associated Axes tab.



3. Click New Axis.

The New Tag dialog box appears.

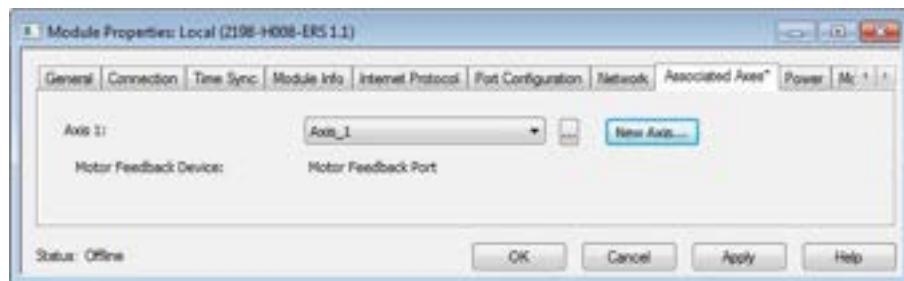


4. Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

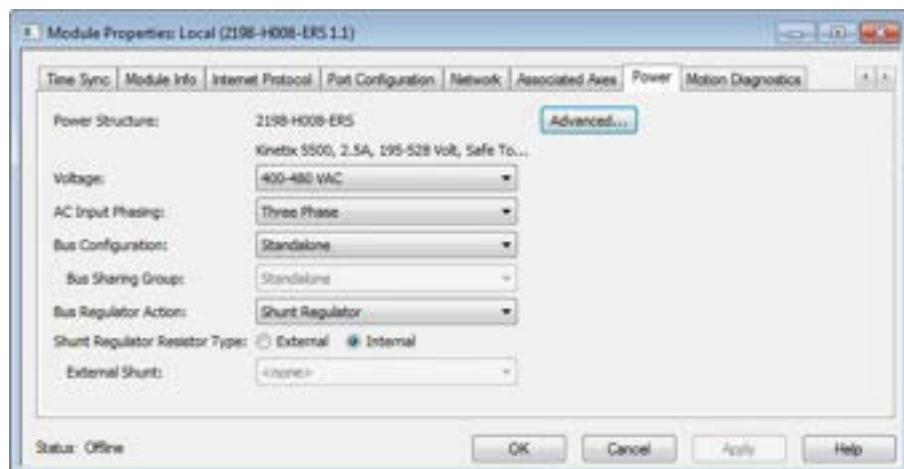
5. Click Create.

The axis (Axis_1 in this example) appears in the Controller Organizer under Motion Groups> Ungrouped Axes and is assigned as Axis 1.



TIP You can configure an axis as Feedback Only. Refer to [Configure Feedback Only Axis Properties](#) on page 124 for more information.

6. Click Apply.
7. Click the Power tab.



IMPORTANT Single-phase operation is possible only when Module Properties>Power tab>Bus Configuration is configured as Standalone.

IMPORTANT The Logix Designer application enforces shared-bus configuration rules for Kinetix 5500 drives, except for shared AC configurations.

8. From the pull-down menus, choose the power options appropriate for your actual hardware configuration.

Attribute	Menu	Description
Voltage	<ul style="list-style-type: none"> • 400-480 VAC • 200-240 VAC 	AC input voltage class.
AC Input Phasing	<ul style="list-style-type: none"> • Three Phase • Single Phase 	Input power phasing. Kinetix 5500 drives with single-phase operation is limited to 2198-H003-ERSx, 2198-H008-ERSx, and 2198-H015-ERSx.
Bus Configuration ^{(1) (2)}	Standalone	Applies to single-axis drives and drives with Shared AC input configurations.
	Shared AC/DC	Applies to converter drives with Shared AC/DC and Shared AC/DC Hybrid input configurations.
	Shared DC	Applies to inverter drives with Shared DC input (common-bus) configurations.
Bus Sharing Group ^{(3) (2)}	Standalone	Applies to standalone bus configurations.
	<ul style="list-style-type: none"> • Group1 • Group2 • Group3... 	Applies to any bus sharing configuration ⁽⁴⁾ .
Shunt Regulator Action	Disabled	Disables the internal shunt resistor and external shunt option.
	Shunt Regulator	Enables the internal and external shunt options.
Shunt Regulator Resistor Type	Internal	Enables the internal shunt (external shunt option is disabled).
	External	Enables the external shunt (internal shunt option is disabled).
External Shunt ⁽⁵⁾	<ul style="list-style-type: none"> • None • 2097-R6 • 2097-R7 	Selects external shunt option. Only the shunt model intended for the drive model is shown.

(1) Refer to [Chapter 3](#) for more information on single-axis and multi-axis configurations.

(2) Bus Configuration selection is not applicable to all EtherNet/IP drives.

(3) For more information on bus sharing groups, refer to [Understanding Bus Sharing Group Configuration](#) on [page 135](#).

(4) All drives physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.

(5) Refer to the Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#), for more information on the Bulletin 2097 external shunt resistors.

9. Click OK.

10. Repeat [step 1](#) through [step 9](#) for each 2198-Hxxx-ERSx servo drive.

Configure the Motion Group

Follow these steps to configure the motion group.

1. In the Controller Organizer, right-click Motion Groups and choose New Motion Group.

The New Tag dialog box appears.



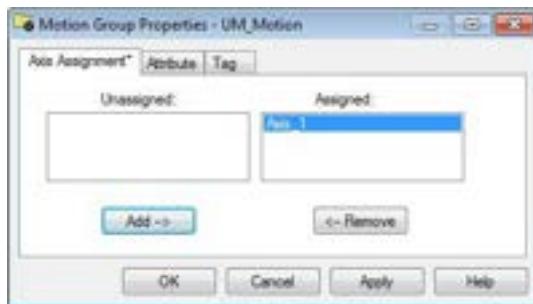
2. Type the new motion group Name.
3. Click Create.

Your new motion group appears in the Controller Organizer under the Motion Groups folder.



4. Right-click the new motion group and choose Properties.

The Motion Group Properties dialog box appears.



5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

Your axis moves to the new motion group.



Configure Axis Properties

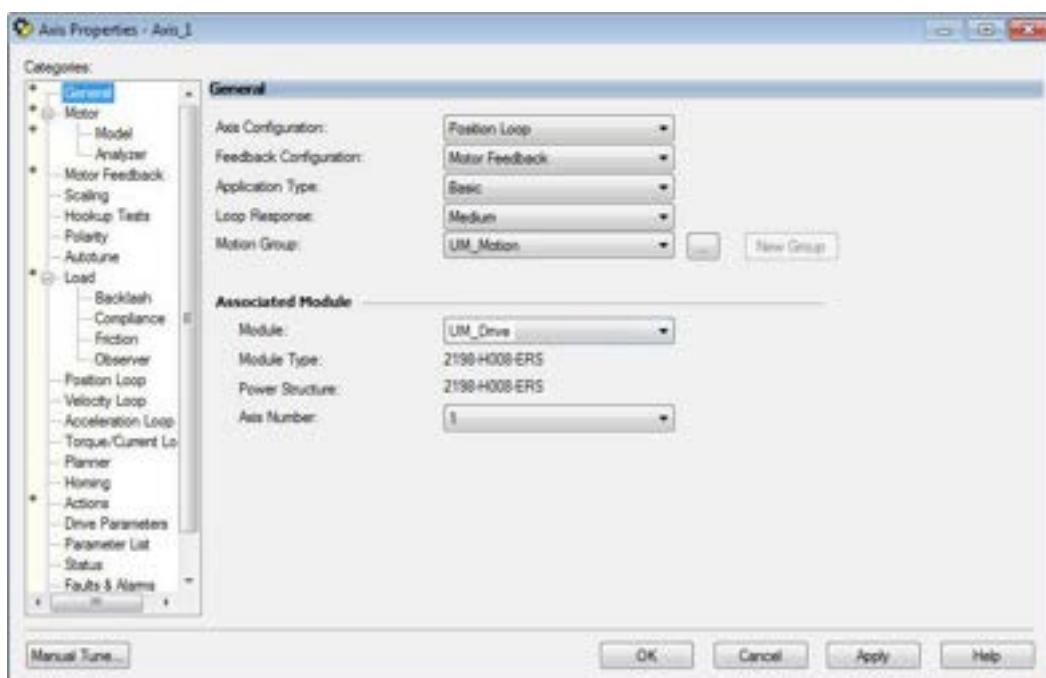
Axis configuration depends on the motor or other device (external encoder, for example) associated with each axis. This section provides guidelines for configuring servo motors, induction motors, and external encoder devices.

Configure Servo Motor Axis Properties

Follow these steps to configure servo motor axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General and Associated Module dialog box appears.

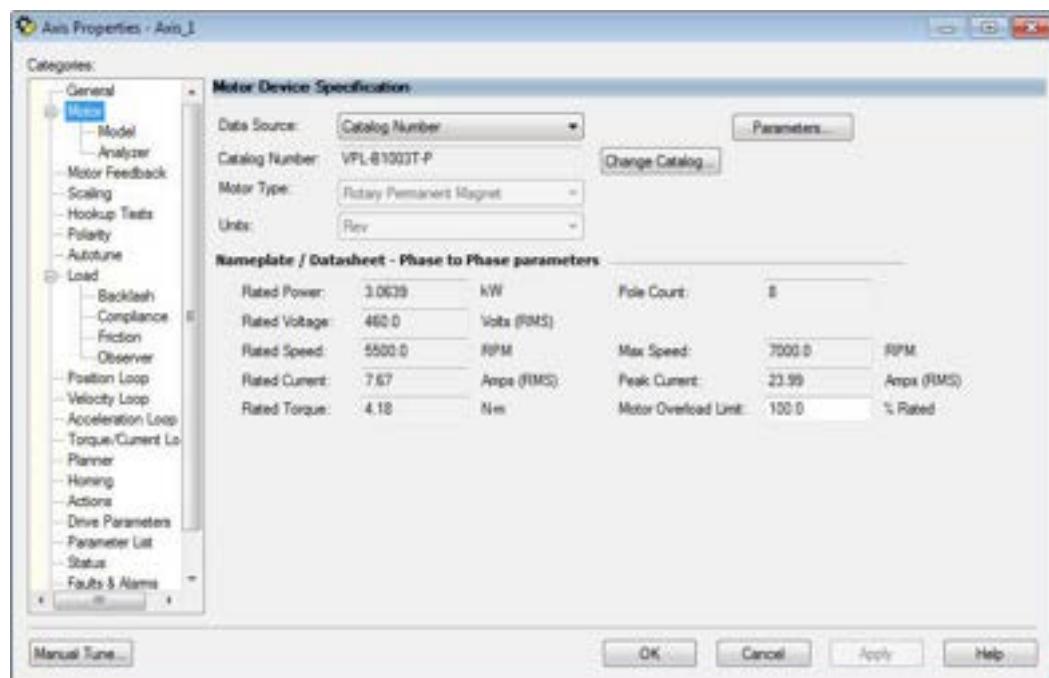


3. From the General pull-down menus, change configuration settings as needed for your application.
4. From the Associated Module>Module pull-down menu, choose your Kinetix 5500 drive.

The drive catalog number populates the Module Type and Power Structure fields.

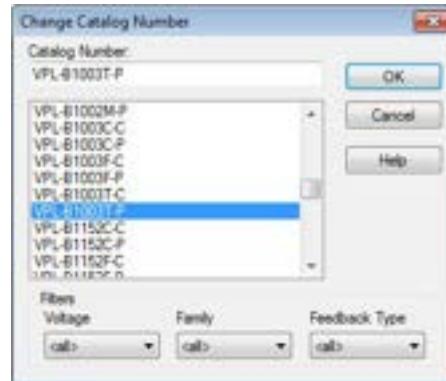
5. Click Apply.
6. Select the Motor category.

The Motor Device Specification dialog box appears.



7. From the Data Source pull-down menu, choose Catalog Number.
8. Click Change Catalog.

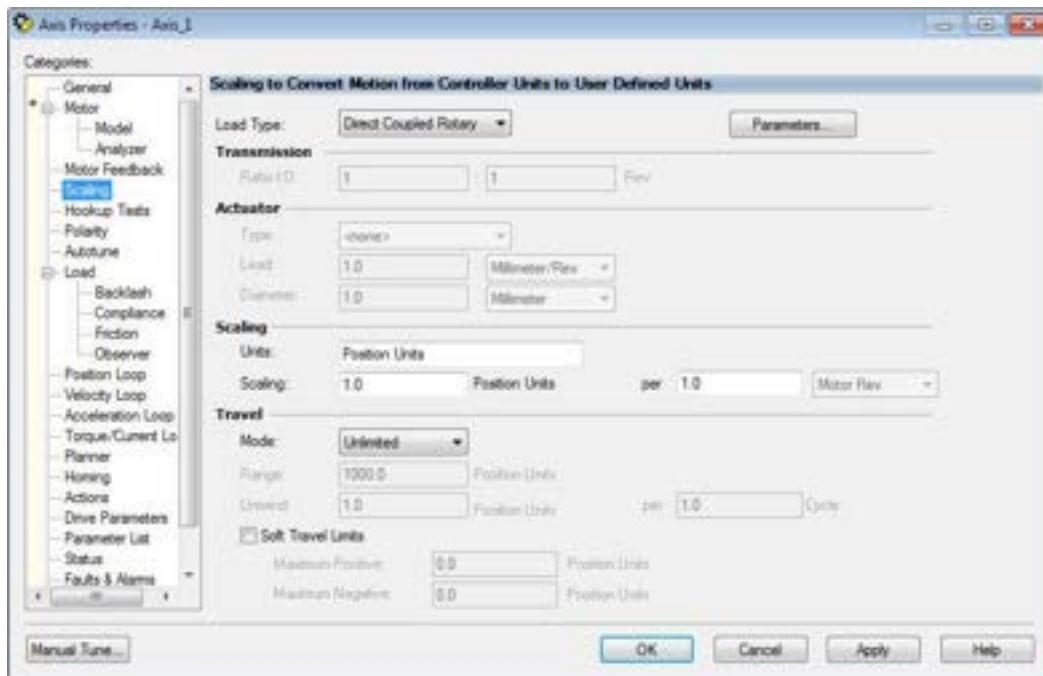
The Change Catalog Number dialog box appears.



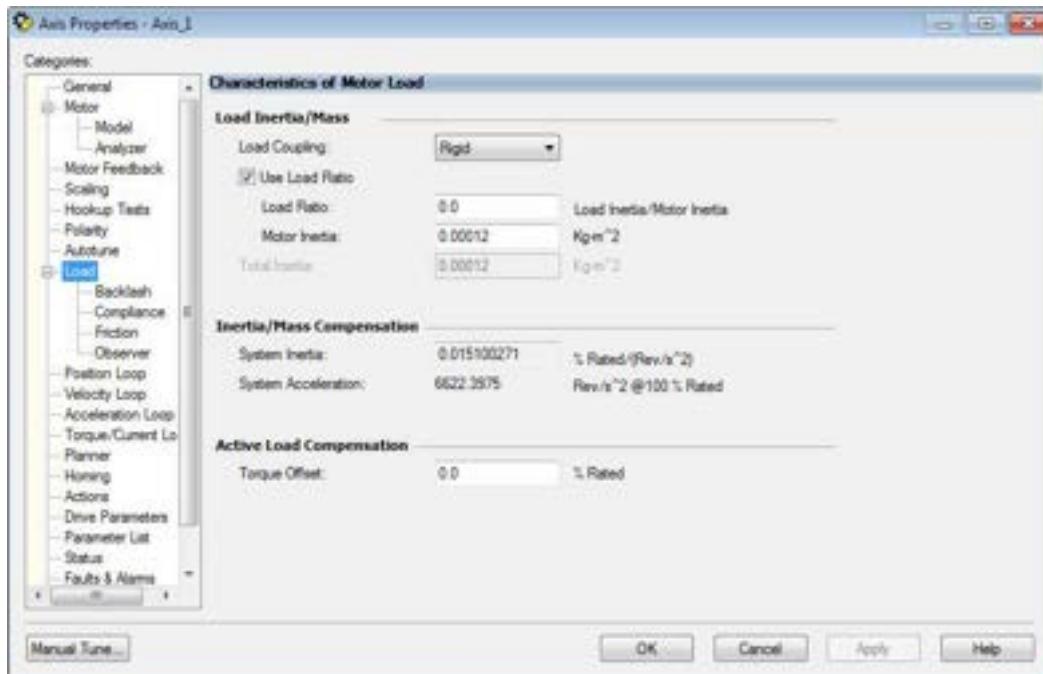
9. Select the motor catalog number appropriate for your application.
- To verify the motor catalog number, refer to the motor name plate.
10. Click OK to close the Change Catalog Number dialog box.
11. Click Apply.

Motor data specific to your motor appears in the Nameplate / Datasheet - Phase to Phase parameters field.

12. Select the Scaling category and edit the default values as appropriate for your application.

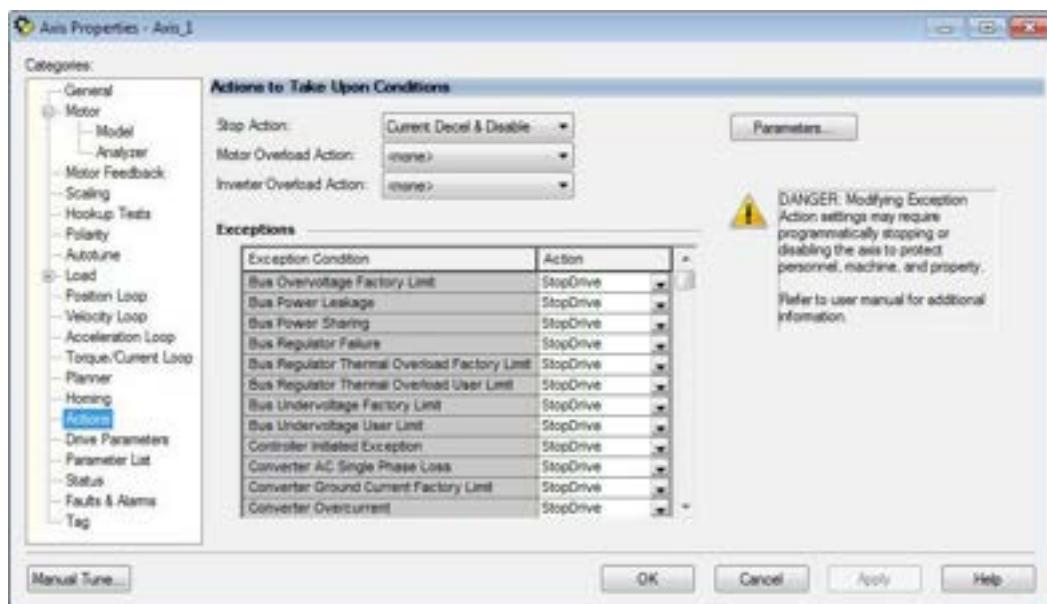


13. Click Apply, if you make changes.
14. Select the Load category and edit the default values as appropriate for your application.



15. Click Apply, if you make changes.
16. Select the Actions category.

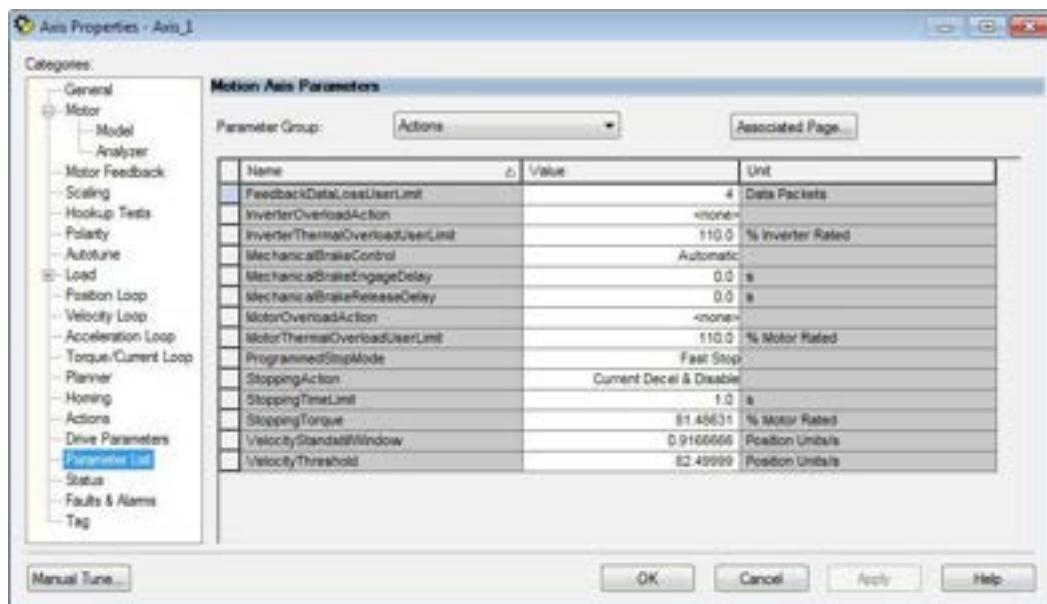
The Actions to Take Upon Conditions dialog box appears.



From this dialog box, you can program actions and change the action for exceptions (faults). Refer to [Logix5000 Controller and Drive Behavior](#) on [page 149](#) for more information.

17. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



From this dialog box you can set brake engage and release delay times for servo motors. For recommended motor brake delay times, refer to the Kinetix Rotary Motion Specifications Technical Data, publication [GMC-TD001](#).

18. Click OK.

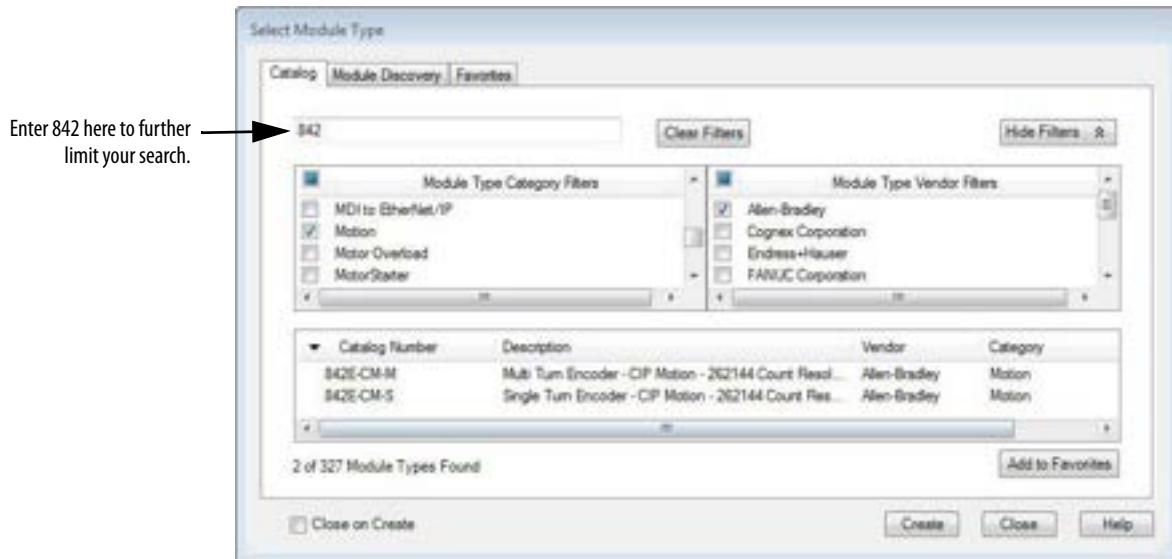
19. Repeat [step 1](#) through [step 18](#) for each servo motor axis.

Configure Feedback Only Axis Properties

Follow these steps to create your external encoder module and configure feedback-only axis properties if you are using the 842E-CM integrated motion encoder on the EtherNet/IP network.

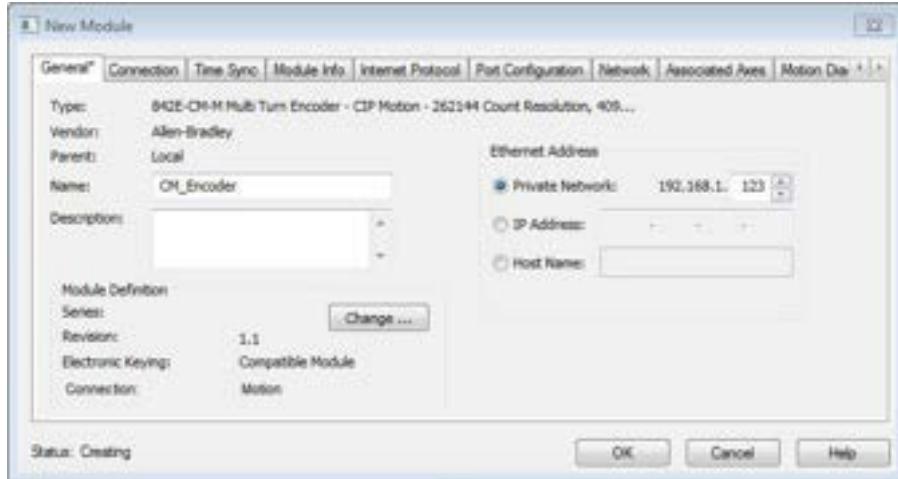
1. In the Controller Organizer, right-click Ethernet under the I/O Configuration folder and choose New Module.

The Select Module Type dialog box appears.



2. By using the filters, check Motion and Allen-Bradley, and select your 842E-CM encoder as appropriate for your actual hardware configuration.
3. Click Create.

The New Module dialog box appears.



4. Configure the 842E-CM encoder.

- Type the encoder Name.
- Select an Ethernet Address option.

In this example, the Private Network address is selected.

- Enter the address of your EtherNet/IP module.

In this example, the last octet of the address is 123.

5. Click OK to close the New Module dialog box.

Your 842E-CM encoder appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.



6. Click Close to close the Select Module Type dialog box.

7. Right-click the 842E-CM encoder you just created and choose Properties.

The Module Properties dialog box appears.

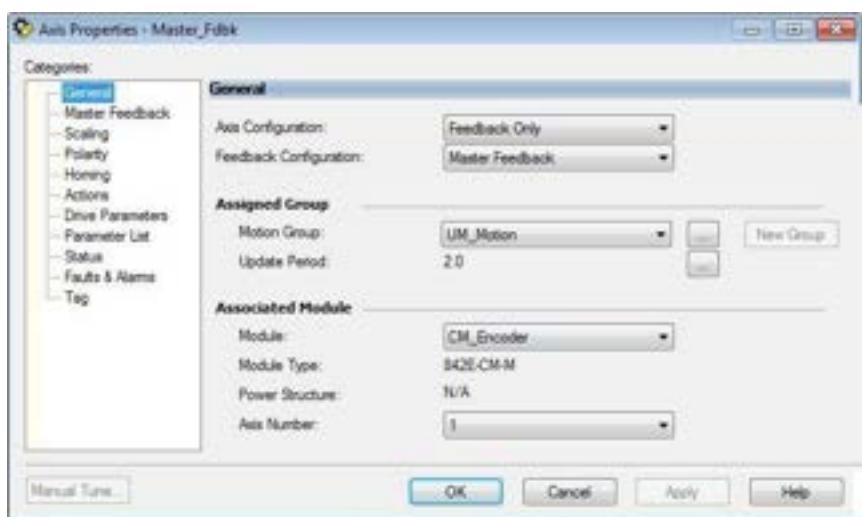
8. Configure the Associated Axis tab and the motion group for your 842E-CM encoder.

In this example, the feedback-only axis is named Master_Fdbk.



9. In the Controller Organizer, right-click the feedback-only axis and choose Properties.

10. Select the General category.



11. From the Module pull-down menu, choose the 842E-CM encoder to associate with your Feedback Only axis.

The Module Type field populates with the chosen encoder catalog number.

12. Select the Master Feedback category.



13. Set the resolution for the encoder as needed for your actual hardware.

In this example, the multi-turn (-M) resolution and number of turns is shown. For single-turn (-S) resolution, the number of turns is 1.

14. Click OK.

15. Repeat [step 1](#) through [step 14](#) for each feedback-only axis.

For more information on configuring Bulletin 842E-CM encoders, refer to the 842E-CM Integrated Motion Encoder on EtherNet/IP User Manual, publication [842E-UM002](#).

Configure Induction Motor Axis Properties

The Kinetix 5500 servo drives support basic volts/hertz and sensorless vector frequency control methods. For more information regarding frequency control methods, refer to [Induction Motor Control Methods](#) on page 223.

Follow these steps to configure induction motor axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

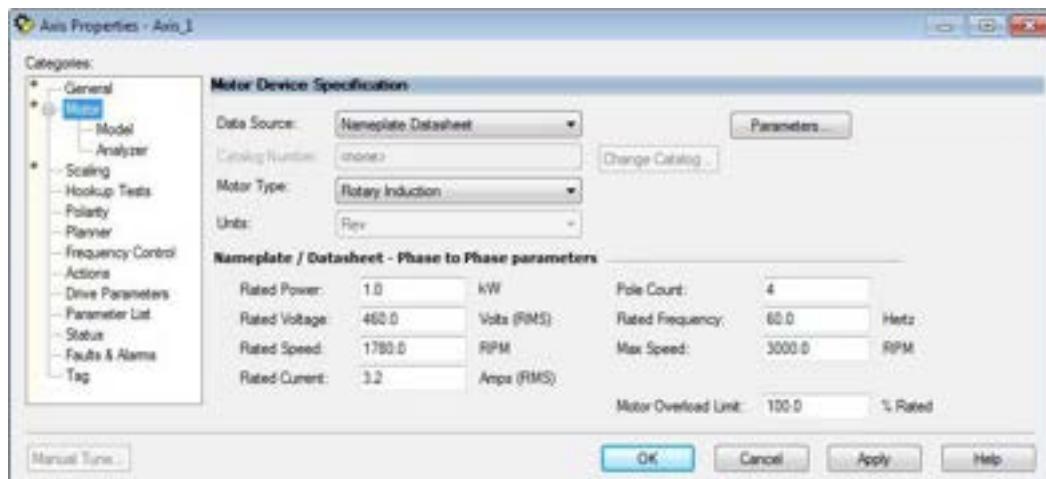
The General and Associated Module dialog box appears.



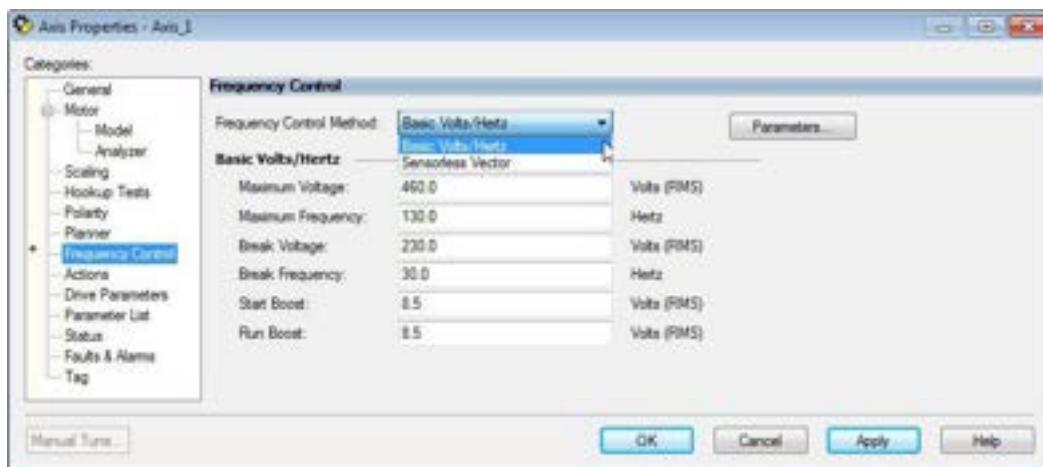
3. From the Axis Configuration pull-down menu, choose Frequency Control.
4. From the Module pull-down menu, choose the drive to associate with your Frequency Control axis.

The Module Type and Power Structure fields populate with the chosen drive catalog number.

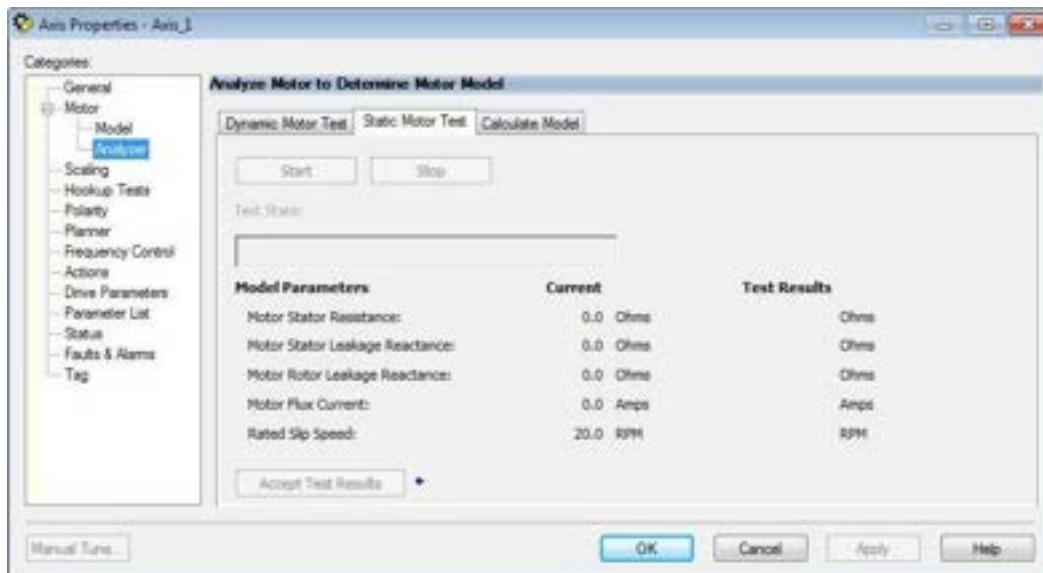
5. Click Apply.
6. Select the Motor category.



7. From the Data Source pull-down menu, choose Nameplate Datasheet.
This is the default setting.
8. From the Motor Type pull-down menu, choose Rotary Induction.
9. From the motor nameplate or datasheet, enter the phase-to-phase values.
10. Click Apply.
11. Select the Frequency Control category.

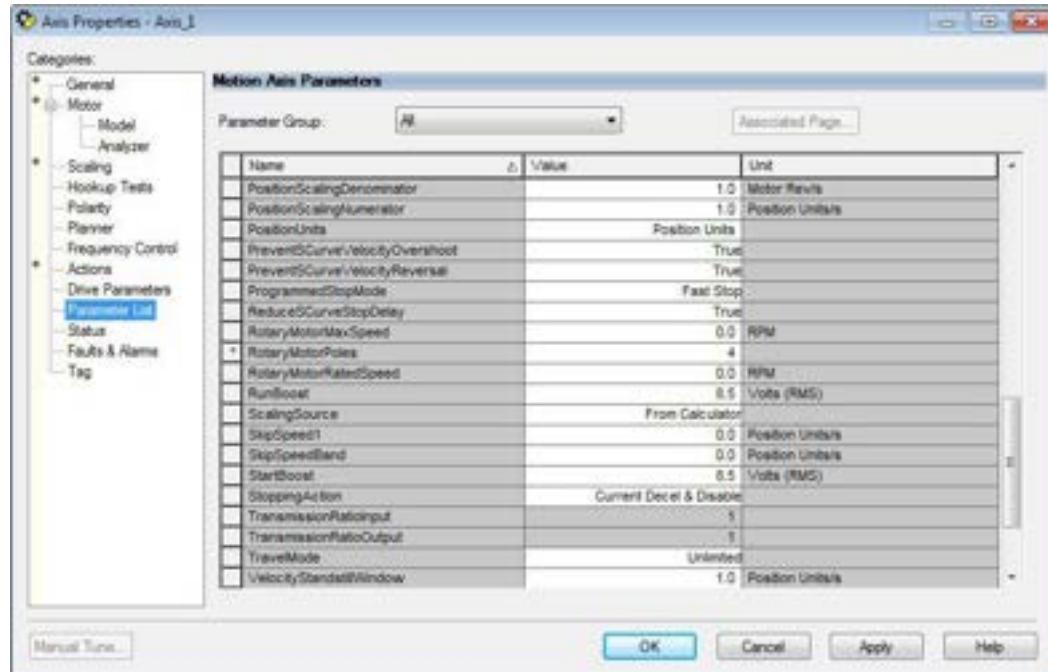


12. From the Frequency Control Method pull-down menu, choose the method appropriate for your application.
13. If you chose the Basic Volts/Hertz method, enter the nameplate data for your motor in the Basic Volts/Hertz fields.
If you chose the Sensorless Vector method, the Basic Volts/Hertz fields are dimmed.
14. Click Apply.
15. If you chose the Sensorless Vector method, select the Motor>Analyzer category.



16. Click the Static Motor Test tab.
17. Click Start to run the test and measure Motor Stator Resistance.
If you chose the Basic Volts/Hertz category, you can skip this test.
18. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



19. Enter values for the SkipSpeed1 and SkipSpeedBand parameters.
For more information regarding skip frequency, refer to [Skip Frequency](#) on [page 226](#).
20. Click OK.
21. Repeat [step 1](#) through [step 20](#) for each induction motor axis.

Download the Program

After completing the Logix Designer application and saving the file you must download your program to the Logix5000 processor.

Apply Power to the Kinetix 5500 Drive

This procedure assumes that you have wired and configured your Kinetix 5500 system and your Logix5000 controller.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 servo drives prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.

Follow these steps to apply power to the Kinetix 5500 system.

1. Disconnect the load to the motor.



ATTENTION: To avoid personal injury or damage to equipment, disconnect the load to the motor. Make sure each motor is free of all linkages when initially applying power to the system.

2. Apply 24V DC control power.

The LCD display begins the startup sequence. Refer to [Startup Sequence](#) on [page 103](#). If the startup sequence does not begin, check the 24V control power connections.

3. When the startup sequence completes, verify that the two status indicators are steady green and the axis state is PRECHARGE.

If the axis state does not reach PRECHARGE and the two status indicators are not solid green, refer to [Kinetix 5500 Drive Status Indicators](#) on [page 146](#).

IMPORTANT Apply control power before applying three-phase AC power. This makes sure the shunt is enabled, which can prevent nuisance faults or Bus Overvoltage faults.

4. Apply mains input power and monitor the DC BUS voltage on the LCD display.

If the DC BUS does not reach the expected voltage level, check the three-phase input power connections. Also, it can take as many as 1.8 seconds after input power is applied before the drive can accept motion commands.

5. Verify that the axis state changes to STOPPED.

If the axis state does not change to STOPPED, refer to [Fault Codes](#) on [page 140](#).

Applying Power after Changing Input Voltage Range

This step applies to any drive or multi-axis drive configuration.



ATTENTION: To avoid damage to equipment when the configured input voltage range of the drive or drives changes from 230V AC to 460V AC or from 460V AC to 230V AC, the bus voltage needs to bleed down below 50V DC before the new configured input voltage is applied.

Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 5500 drive, your Logix5000 controller, and applied power to the system.

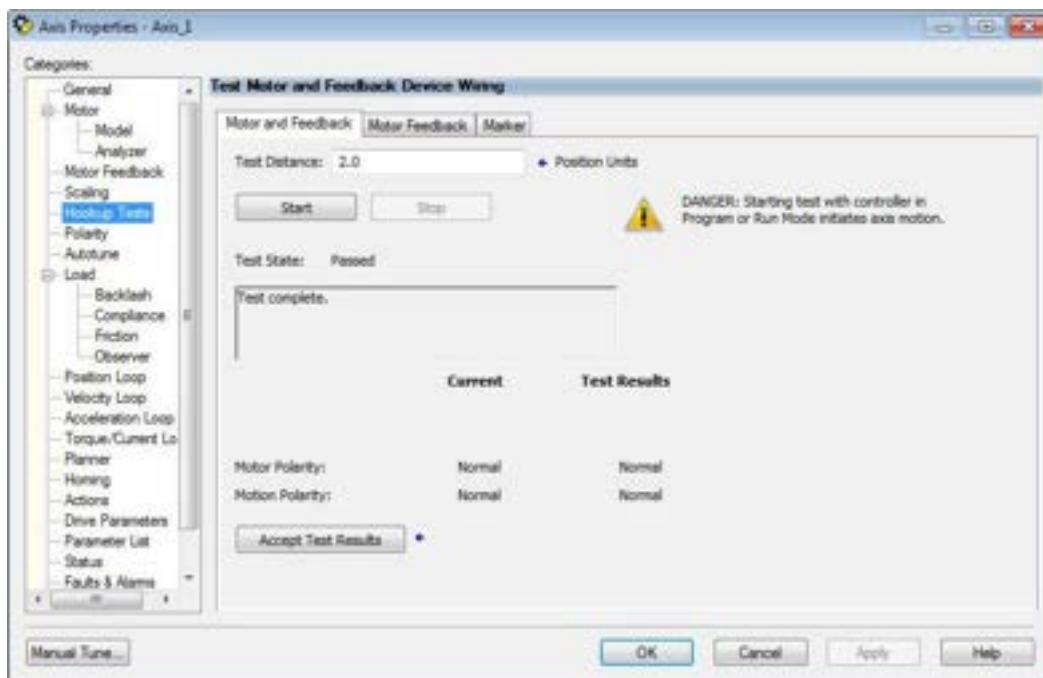
IMPORTANT Before proceeding with testing and tuning your axes, verify that the MOD and NET status indicators are operating as described in [Kinetix 5500 Drive Status Indicators](#) on page 146.

For help using the Logix Designer application as it applies to testing and tuning your axes with ControlLogix EtherNet/IP modules or CompactLogix 5370 controllers, refer to [Additional Resources](#) on page 12.

Test the Axes

Follow these steps to test the axes.

1. Verify the load was removed from each axis.
2. In your Motion Group folder, right-click an axis and choose Properties. The Axis Properties dialog box appears.
3. Click the Hookup Tests category.



- In the Test Distance field, type 2.0 as the number of revolutions for the test.

Test	Description
Marker	Verifies marker detection capability as you rotate the motor shaft.
Motor Feedback	Verifies feedback connections are wired correctly as you rotate the motor shaft.
Motor and Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate.

- Click the Motor and Feedback tab.

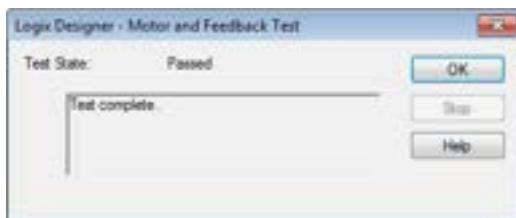
The Marker and Motor Feedback tests are not supported.

- Click Start.

The Logix Designer - Motor and Feedback Test dialog box appears. The Test State is Executing. TESTING appears on the drive LCD display.



When the test completes successfully, the Test State changes from Executing to Passed.



- Click OK.

This dialog box appears asking if the direction was correct.

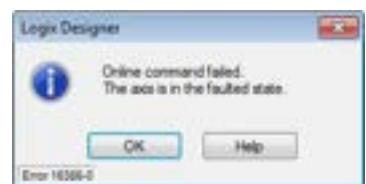


- Click Yes.

- Click Accept Test Results.

- If the test fails, this dialog box appears.

- Click OK.
- Verify the DC bus voltage.
- Verify unit values entered in the Scaling category.
- Return to [step 5](#) and run the test again.



Tune the Axes

The load observer feature provides high-performance motion control without having to tune your axis. Using load observer with auto-tuned gains can maximize system performance. Refer to Motion System Tuning Application Techniques, publication [MOTION-AT005](#) (Load Observer Feature section), for more load observer information.

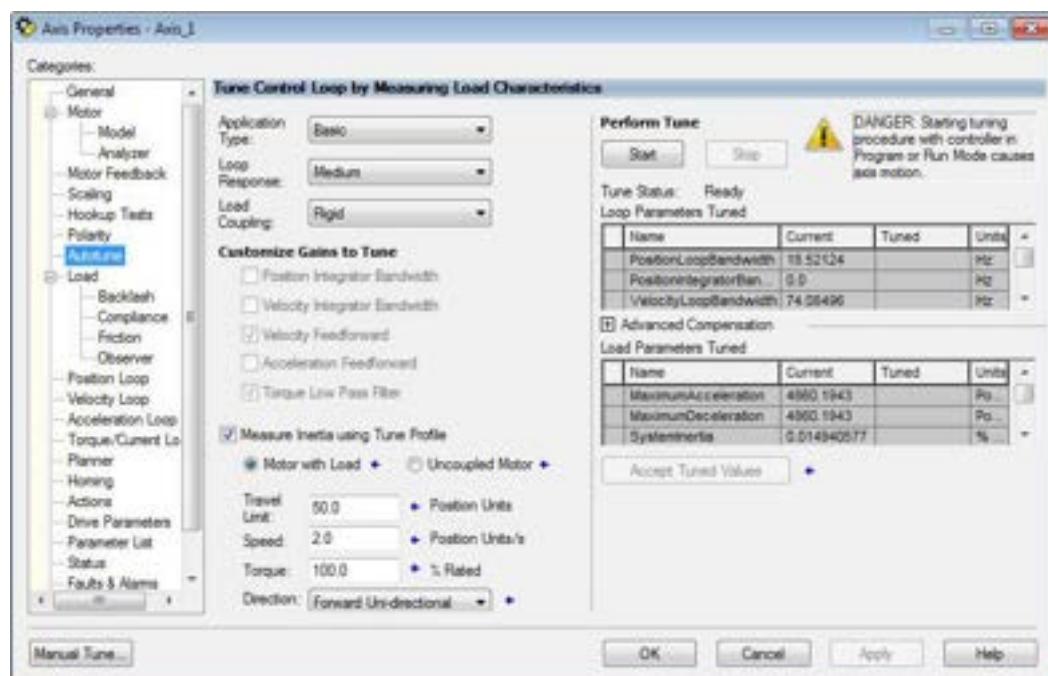
Follow these steps to tune the axes.

1. Verify the load is still removed from the axis being tuned.



ATTENTION: To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Autotune category.



3. Type values for Travel Limit and Speed.

In this example, Travel Limit = 5 and Speed = 10. The actual value of programmed units depend on your application.

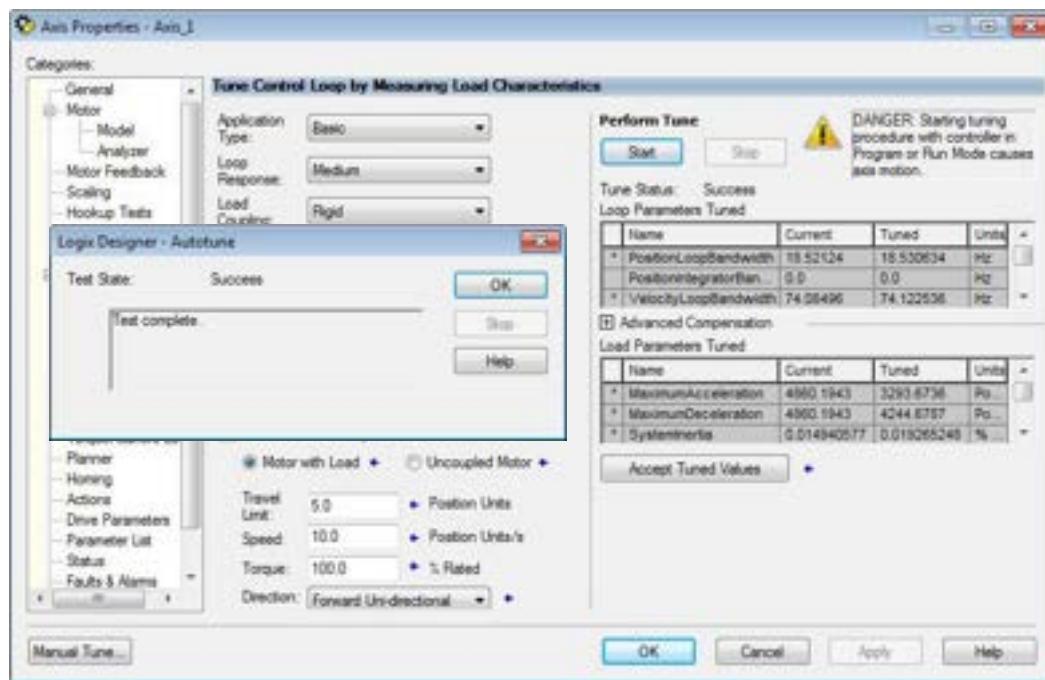
4. From the Direction pull-down menu, choose a setting appropriate for your application.

Forward Uni-directional is default.

5. Edit other fields as appropriate for your application.

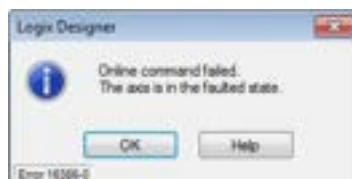
6. Click Start.

The Logix Designer - Autotune dialog box appears. When the test completes, the Test State changes from Executing to Success.



Tuned values populate the Loop and Load parameter tables. Actual bandwidth values (Hz) depend on your application and can require adjustment once motor and load are connected.

7. Click Accept Tuned Values.
8. Click OK to close the Logix Designer - Autotune dialog box.
9. Click OK to close the Axis Properties dialog box.
10. If the test fails, this dialog box appears.



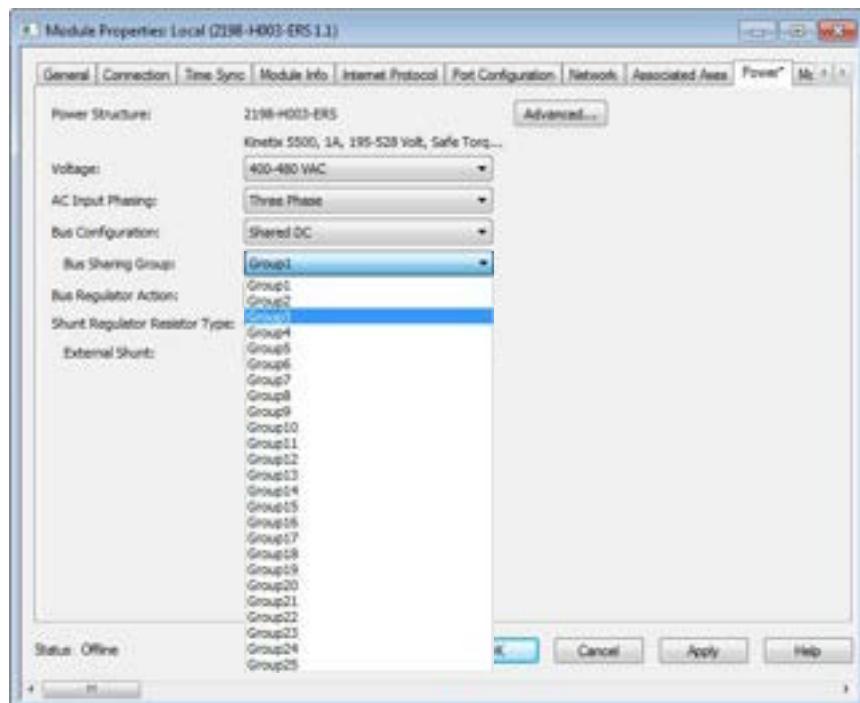
- a. Click OK.
- b. Make an adjustment to motor velocity.
- c. Refer to the controller user manual for more information.
- d. Return to [step 6](#) and run the test again.
11. Repeat [Test and Tune the Axes](#) for each axis.

Understanding Bus Sharing Group Configuration

When configuring Module Properties>Power tab for each Kinetix 5500 servo drive, you can breakout drives from one or more servo systems into multiple bus-sharing (power) groups.

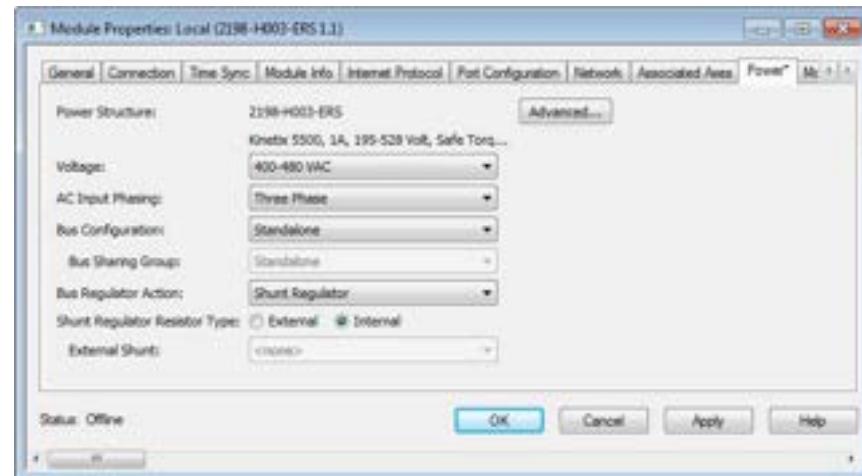
A drive that faults in Group 1 does not affect the operation of Group 2, even though all of the drives in Groups 1 and 2 are in the same Motion group in the Logix Designer application.

As many as 25 bus-sharing groups are possible.



IMPORTANT Bus-sharing groups do not apply to drives with a Bus Configuration of Standalone.

When Standalone is configured as the Bus Configuration, Standalone (dimmed) is also configured as the Bus Sharing Group.

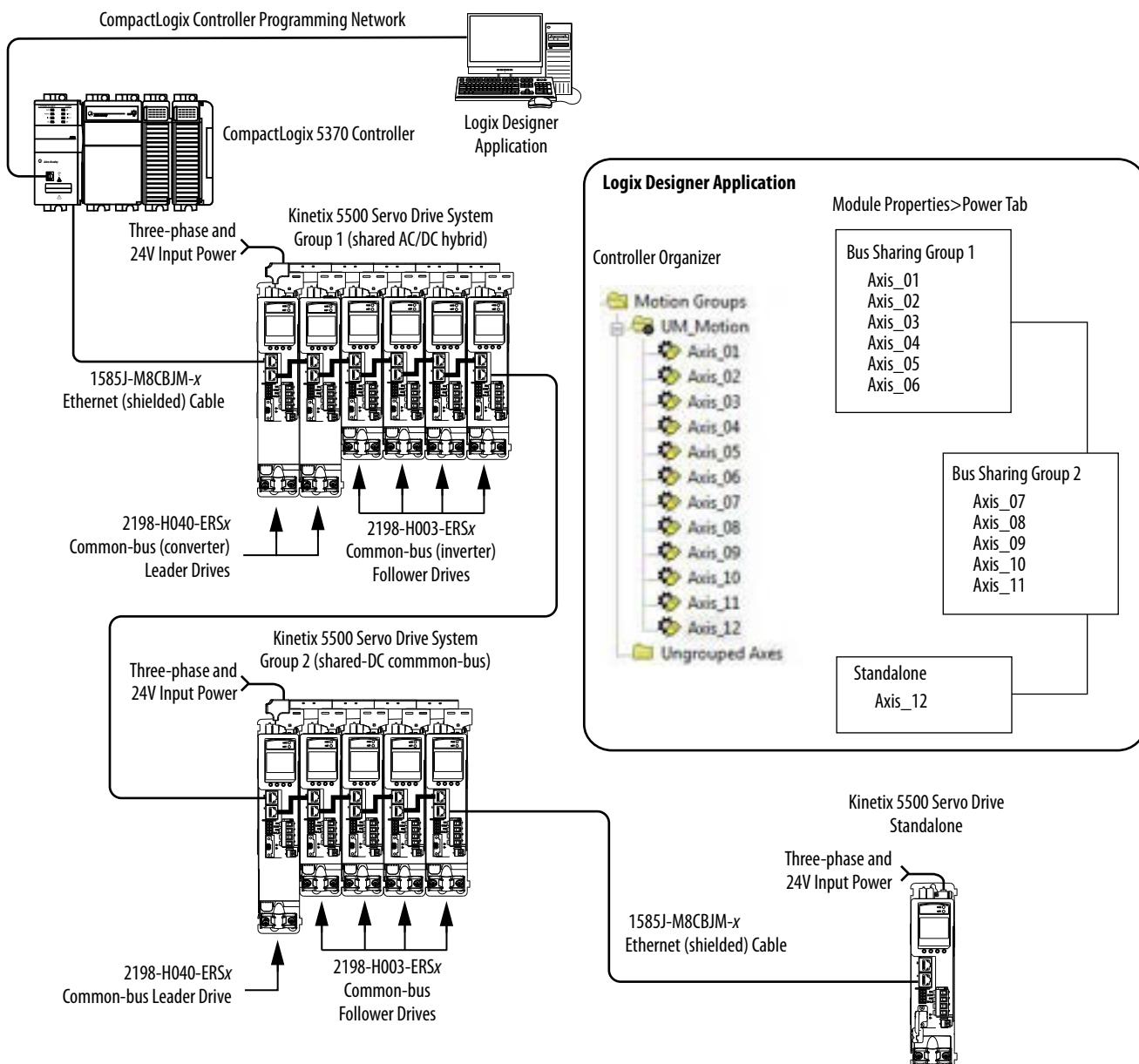


Bus Sharing Group Example

In this example, twelve axes are needed to support the motion application. All twelve axes are configured in the same Motion group in the Logix Designer application.

However, the twelve axes of motion are also configured as two bus-sharing groups and one standalone drive in Module Properties>Power tab. By creating two bus-sharing groups, a converter drive that faults in Group 1 only disables Group 1 drives, and has no effect on the drive operation of Group 2 or the Standalone drive.

Figure 59 - Bus-sharing Group Example



Configure Bus-sharing Groups

Group 1 is a shared AC/DC hybrid configuration. The Bus Configuration for the first two converter drives is Shared AC/DC. The Bus Configuration for the inverter drives is Shared DC.

Figure 60 - Group 1 Converter Drives Configuration

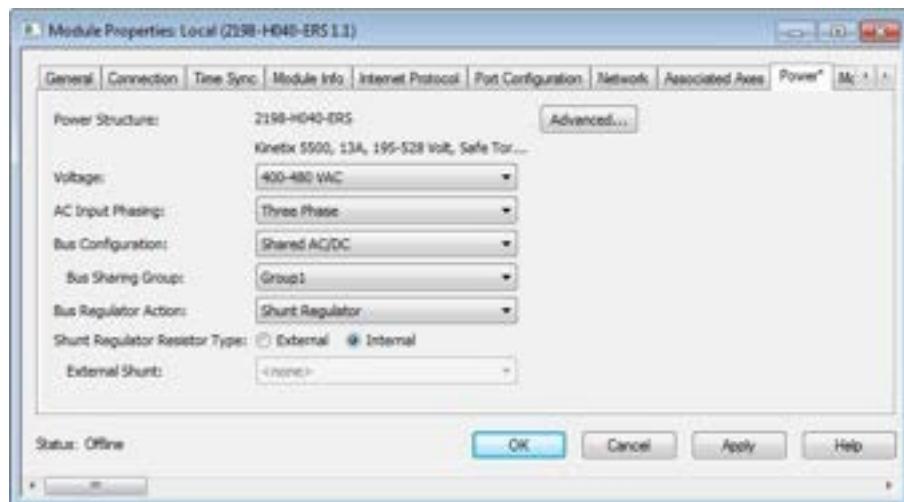
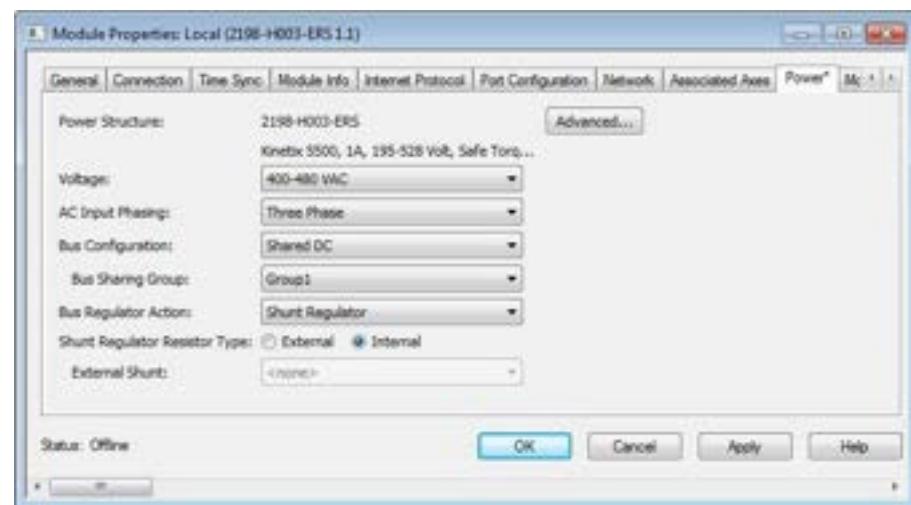


Figure 61 - Group 1 Inverter Drives Configuration



Group 2 is a shared DC (common-bus) configuration. The Bus Configuration for the leader drive is Shared AC/DC. The Bus Configuration for the follower drives is Shared DC.

Figure 62 - Group 2 Leader Drive Configuration

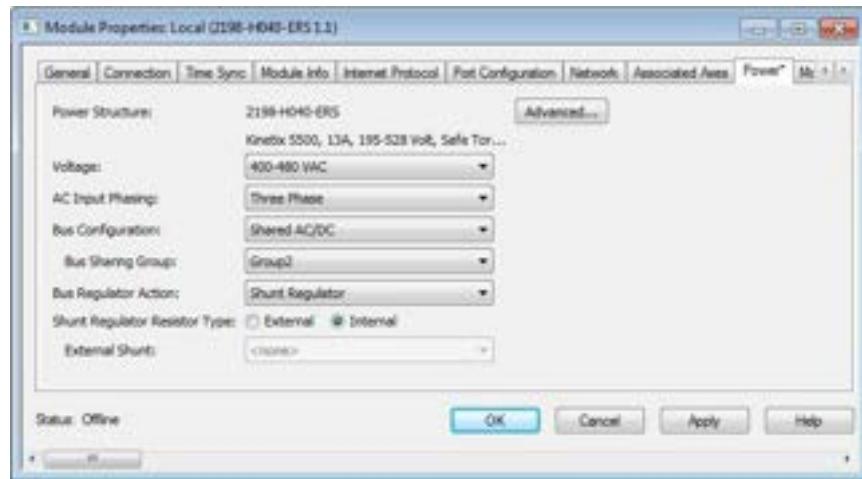


Figure 63 - Group 2 Follower Drives Configuration



Figure 64 - Standalone Drive Configuration



Troubleshooting the Kinetix 5500 Drive System

This chapter provides troubleshooting tables and related information for your Kinetix 5500 servo drives.

Topic	Page
Safety Precautions	139
Interpret Status Indicators	140
General Troubleshooting	147
Logix5000 Controller and Drive Behavior	149

Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 5500 servo drive.



ATTENTION: Capacitors on the DC bus can retain hazardous voltages after input power has been removed. Before working on the drive, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.



ATTENTION: Do not attempt to defeat or override the drive fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.



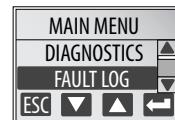
ATTENTION: Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

Interpret Status Indicators

Refer to these troubleshooting tables to identify faults, potential causes, and the appropriate actions to resolve the fault. If the fault persists after attempting to troubleshoot the system, please contact your Rockwell Automation sales representative for further assistance.

Display Interface

The LCD display provides fault messages and troubleshooting information by using the soft menu items and navigation buttons.



Refer to [Understanding the Kinetix 5500 Display](#) on [page 100](#) for more information on navigating the LCD display menu.

Use these soft menu items to access the fault log and troubleshooting information.

LOG	Press to display the list of active fault codes.
TEXT	Press to display the fault text (exception code in troubleshooting tables).
INFO	Press to display the fault details (the problem in troubleshooting tables).
HELP	Press to display the fault help (possible solutions in troubleshooting tables).

Fault Codes

The fault code tables are designed to help you determine the source of the fault or exception. When a fault condition is detected, the drive performs the appropriate fault action, the fault is displayed, and the fault is added to a persistent fault log (along with diagnostics data). The earlier faults have priority to be displayed.

The drive removes the fault text from the display when a Fault Reset service is sent from the controller and the fault is no longer active. If a fault is still active following a Fault Reset service, the fault is again posted to the display and written to the fault log.

The drive maintains a log of the last 25 faults with time stamps and stores the fault log in persistent memory. However, the fault log cannot be cleared on the drive.

Table 55 - Fault Code Summary

Fault Code Type	Description
FLT Sxx	Standard runtime axis exceptions.
FLT Mxx	
INIT FLT Sxx	Exceptions that prevent normal operation and occur during the initialization process.
INIT FLT Mxx	
NODE FLTxx	Exceptions that prevent normal operation of the drive.
NODE ALARM xx	Exceptions that prevent normal operation of the drive, but do not result in any action other than reporting the alarm to the controller.
INHIBIT Mxx	Exceptions that prevent normal operation and indicate whenever the drive is active.

Refer to [Chapter 9](#) on [page 157](#) for information on troubleshooting SAFE FLT fault codes.

TIP Fault codes triggered by conditions that fall outside factory set limits are identified by FL at the end of the display message. For example, FLT S07 – MTR OVERLOAD FL.

Fault codes triggered by conditions that fall outside user set limits are identified by UL at the end of the display message. For example, FLT S08 – MTR OVERLOAD UL.

Table 56 - FLT Sxx Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S03 – MTR OVERSPEED FL	Motor Overspeed Factory Limit Fault	Motor speed has exceeded 125% of its maximum speed.	Check control loop tuning.
FLT S04 – MTR OVERSPEED UL	Motor Overspeed User Limit Fault	Motor speed has exceeded motor overspeed user limit.	<ul style="list-style-type: none"> Check control loop tuning Increase the Motor Overspeed UL attribute value
FLT S05 – MTR OVERTEMP FL	Motor Overtemperature Factory Limit Fault	Calculations based on the motor thermistor indicate that the motor factory temperature limit has been exceeded.	<ul style="list-style-type: none"> Operate motor within continuous torque rating Reduce motor ambient temperature Add motor cooling <p>Available only on Kinetix VP motors. Not supported on induction motors.</p>
FLT S07 – MTR OVERLOAD FL	Motor Thermal Overload Factory Limit Fault	The motor thermal model has exceeded its factory set thermal capacity limit of 110%.	Modify the command profile to reduce speed or increase time.
FLT S08 – MTR OVERLOAD UL	Motor Thermal Overload User Limit Fault	The motor thermal model has exceeded the thermal capacity limit given by Motor Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the command profile Increase the Motor Thermal Overload UL attribute value
FLT S09 – MTR PHASE LOSS	Motor Phase Loss	The motor has failed torque proving.	Check motor connections.
FLT S10 – INV OVERCURRENT	Inverter Overcurrent Fault	Inverter current has exceeded the instantaneous current limit (determined by hardware).	<ul style="list-style-type: none"> Check motor power cable for shorts Verify motor windings are not shorted Verify motor power wire gauge Operate within the continuous power rating Reduce acceleration times
FLT S11 – INV OVERTEMP FL	Inverter Overtemperature Factory Limit Fault	The measured inverter temperature has exceeded the factory set temperature limit.	<ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed
FLT S13 – INV OVERLOAD FL	Inverter Thermal Overload Factory Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the factory set thermal capacity rating of 110%.	Modify the command profile to reduce speed or increase time.
FLT S14 – INV OVERLOAD UL	Inverter Thermal Overload User Limit Fault	The thermal model for the power transistors indicates that the temperature has exceeded the limit given by Inverter Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Increase the Inverter Thermal Overload UL attribute value
FLT S15 – CONV OVERCURRENT	Converter Overcurrent Fault	The measured converter current has exceeded the factory set current limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce number of capacitor modules
FLT S16 – GROUND CURRENT	Ground Current Factory Limit Fault	The sensing circuitry in the power stage has detected excessive ground current.	<ul style="list-style-type: none"> Check motor power wiring; check power cable for shorts Replace motor if the fault persists

Table 56 - FLT Sxx Fault Codes (continued)

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S18 – CONV OVERTEMP FL	Converter OverTemp Factory Limit Fault	The measured converter temperature has exceeded the factory set temperature limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Modify the command profile to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed
FLT S20 – CONV OVERLOAD FL	Converter Thermal Overload Factory Limit Fault	The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce duty-cycle of commanded motion
FLT S21 – CONV OVERLOAD UL	Converter Thermal Overload User Limit Fault	The converter thermal model indicates that the temperature has exceeded the limit given by Converter Thermal Overload User Limit.	<ul style="list-style-type: none"> Reduce acceleration times of all drives sharing the DC bus Reduce number of shared DC follower drives Reduce duty-cycle of commanded motion Increase the Converter Thermal Overload UL attribute value
FLT S23 – AC PHASE LOSS	AC Single Phase Loss Fault	A single AC input phase was lost while the drive was enabled.	Check AC input voltage on all phases.
FLT S25 – PRECHARGE FAILURE	Pre-charge Failure Fault	The pre-charge circuit monitoring algorithm detected that the DC bus did not reach a factory set voltage level after charging for a period of time.	<ul style="list-style-type: none"> Check AC input voltage on all phases Check input power wiring Replace drive if fault persists
FLT S29 – BUS REG OVERLOAD FL	Bus Regulator Thermal Overload Factory Limit Fault	The shunt thermal model has exceeded its factory set thermal capacity limit.	<ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Add capacitor module if needed
FLT S30 – BUS REG OVERLOAD UL	Bus Regulator Thermal Overload User Limit Fault	The shunt thermal model has exceeded the thermal capacity limit given by Bus Regulator Thermal Overload User Limit.	<ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Increase the Bus Regulator Thermal Overload UL attribute value Add capacitor module if needed
FLT S31 – BUS REG FAILURE	Bus Regulator Failure	The shunt driver IC has detected that the shunt resistor is shorted.	<ul style="list-style-type: none"> Check for shorts in the shunt connector Unplug the shunt connector and measure the resistance of the shunt Replace drive if shunt resistor is shorted
FLT S33 – BUS UNDERVOLT FL	Bus Undervoltage Factory Limit Fault	DC Bus voltage level is below the factory set limit as determined by the configured input voltage.	<ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input
FLT S34 – BUS UNDERVOLT UL	Bus Undervoltage User Limit Fault	DC Bus voltage level is below the user set limit as given by Bus Undervoltage User Limit.	<ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input Increase Bus Undervoltage UL attribute value
FLT S35 – BUS OVERVOLT FL	Bus Overvoltage Factory Limit Fault	DC Bus voltage level is above the factory set limit as determined by the configured input voltage.	<ul style="list-style-type: none"> Change the deceleration or motion profile of all drives connected to the DC bus Unplug the shunt connector and measure the resistance of the shunt Replace drive if shunt resistor is open
FLT S39 – BUS POWER LEAK	Bus Power Leakage Fault	Measured converter power exceeded estimated inverter output power by more than a factory limit.	<ul style="list-style-type: none"> Check bus power sharing configuration attribute Check AC input and DC bus sharing connections
FLT S45 – FDBK COMM FL	Motor Feedback Data Loss Factory Limit Fault	The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit.	<ul style="list-style-type: none"> Check motor feedback cable and connector Check motor power cable and feedback wire shields are secured correctly Check motor frame is grounded correctly

Table 56 - FLT Sxx Fault Codes (continued)

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT S47 – FDBK DEVICE FAILURE nn	Feedback Device Failure	The feedback device has detected an internal error. The nn sub-code is defined as follows: 1: ACCELERATION OVERFLOW 4: TRACKING FILTER ERROR 5: VECTOR LENGTH ERROR 6: COUNTER ERROR 7: SYNCHRONIZATION ERROR 16: SINGLE TURN ERROR 17: MULTI TURN AMPLITUDE ERROR 18: MULTI TURN SYNC ERROR 19: MULTI TURN VECTOR LENGTH ERROR 35: STANDARD PARAMETER ERROR 36: INTERNAL COMMUNICATION ERROR1 37: INTERNAL COMMUNICATION ERROR2 38: INTERNAL SYSTEM ERROR 48: CRITICAL TEMPERATURE 49: CRITICAL LED CURRENT 50: CRITICAL SUPPLY VOLTAGE 51: CRITICAL SPEED 52: CRITICAL ACCELERATION 53: COUNTER OVERFLOW 54: INTERNAL MONITORING ERROR 66: INTERNAL RESOURCE ACCESS ERROR	<ul style="list-style-type: none"> Check motor feedback cable and connector Cycle control power Replace motor if fault continues Check feedback shield connection Reduce shock and vibration to motor
FLT S49 – BRAKE SLIP FLT	Brake Slip Exception	Motor slip has exceeded brake slip tolerance.	Check motor brake.
FLT S54 – POSN ERROR	Excessive Position Error Fault	The position error of the position control loop has exceeded the value given by Position Error Tolerance for a time period given by Position Error Tolerance Time.	<ul style="list-style-type: none"> Check position loop tuning Increase the feedforward gain Verify sizing of the drive and motor Check motor power wiring Increase Position Error Tolerance and/or Position Error Tolerance Time attribute values
FLT S55 – VEL ERROR	Excessive Velocity Error Fault	The velocity error of the velocity control loop has exceeded the value given by Velocity Error Tolerance for a time period given by Velocity Error Tolerance Time.	<ul style="list-style-type: none"> Check velocity loop tuning Reduce acceleration Verify sizing of the drive and motor Check motor power wiring Increase Velocity Error Tolerance and/or Velocity Error Tolerance Time attribute values
FLT S56 – OVERTORQUE LIMIT	Overtorque Limit Fault	Motor torque has risen above user defined maximum torque level given by Overtorque Limit for a time period given by Overtorque Limit Time.	<ul style="list-style-type: none"> Verify Torque Trim value Verify motion profile Verify sizing of the drive and motor Increase Overtorque Limit and/or Overtorque Limit Time attribute values
FLT S57 – UNDERTORQUE LIMIT	Undertorque Limit Fault	Motor torque has dropped below user defined minimum torque level given by Undertorque Limit for a time period given by Undertorque Limit Time.	<ul style="list-style-type: none"> Verify motion profile Verify sizing of the drive and motor Decrease Undertorque Limit and/or Undertorque Limit Time attribute values

Table 57 - FLT Mxx Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
FLT M02 – MOTOR VOLTAGE	Motor Voltage Mismatch Fault	The configured voltage of the drive is greater than the motor rated voltage. For example, a 400V-class drive with a 200V-class motor.	Set the drive voltage to a lower value or replace motor with voltage rating that matches the drive.
FLT M25 – COMMON BUS	DC Common Bus Fault	AC power was detected by the drive while configured for shared DC operation.	<ul style="list-style-type: none"> Check the drive power configuration from controller Check wiring
FLT M26 – RUNTIME ERROR	Runtime Error	The drive firmware encountered an unrecoverable runtime error.	<ul style="list-style-type: none"> Cycle control power Reset the drive Return drive for repair if fault continues
FLT M28 – SAFETY COMM (2198-Hxx-ERS2 drives only)	Safety Module Communication Error	Communication with the safety hardware within the drive has failed.	<ul style="list-style-type: none"> Cycle control power Reset the drive Return drive for repair if fault continues

Table 58 - INIT FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INIT FLT M01 – ENCODER DATA	Smart Encoder Data Corruption	The data stored in the encoder has a checksum error.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
INIT FLT M02 – MTR DATA RANGE	Motor Data Range Error	A motor data attribute stored in the encoder is out of range.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
INIT FLT M03 – MTR ENC STARTUP	Motor Feedback Communication Startup	Communication with the encoder could not be established.	<ul style="list-style-type: none"> • Cycle control power • Check motor feedback connector • Check motor power and feedback shield terminations on the drive • Return motor for repair if fault continues
INIT FLT M14 – SAFETY FIRMWARE	Safety Firmware	The loaded Safety firmware is not compatible with the drive firmware.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
INIT FLT M20 – UNKNOWN MODULE	Unknown Module	The product code of the power board is invalid.	<ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues

Table 59 - INHIBIT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
INHIBIT S02 – MOTOR NOT CONFIGURED	Motor Not Configured	The motor has not been properly configured for use.	Verify motor configuration in the Logix Designer application.
INHIBIT S03 – FEEDBACK NOT CONFIGURED	Feedback Not Configured	The feedback has not been properly configured for use.	Verify feedback configuration in the Logix Designer application.
INHIBIT M05 – SAFE TORQUE OFF	Start Inhibit – Safe Torque Off	The safety function has disabled the power structure.	<ul style="list-style-type: none"> • Check safety input wiring • Check state of safety devices

Table 60 - NODE FLT Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE FLT 01 – LATE CTRL UPDATE	Control Connection Update Fault	Several consecutive updates from the controller have been lost.	<ul style="list-style-type: none"> • Remove unnecessary network devices from the motion network • Change network topology so that fewer devices share common paths • Use high performance network equipment • Use shielded cables • Separate signal wiring from power wiring
NODE FLT 02 – PROC WATCHDOG nn	Processor Watchdog Fault	The processor on the power board or control board failed to update in a certain amount of time. The nn sub-codes 00...06 are internal and result in the same possible solution.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 00	Hardware Fault - PwrIF	Communication with the power board could not be established.	<ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 01	Hardware Fault - Power Board	DSP chip on the power board failure.	<ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues
NODE FLT 03 – HARDWARE 02	Hardware Fault - DSL	Communication with the encoder could not be established.	<ul style="list-style-type: none"> • DSL feedback wiring is incorrect (check against wiring diagram) • DSL feedback wiring is shorted or open • DSL feedback cable is defective • Kinetix VP motor feedback device is defective • Cycle power • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 03	DSL Internal Hardware Fault	A DSL hardware error internal to the drive was detected.	<ul style="list-style-type: none"> • Check DSL feedback device, wiring, and cable • Cycle power • Return drive for repair if fault continues
NODE FLT 03 – HARDWARE 04	Hardware Fault - Board Compatibility	The control and power boards are incompatible.	Return drive for repair if fault continues
NODE FLT 05 – CLOCK SKEW FLT	Clock Skew Fault	The controller time and the drive's system time are not the same.	<ul style="list-style-type: none"> • Cycle control power • Check controller and Ethernet switch operation

Table 60 - NODE FLT Fault Codes (continued)

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE FLT 06 – LOST CTRL CONN	Lost Controller Connection Fault	Communication with the controller has been lost.	<ul style="list-style-type: none"> Check Ethernet connection Check controller and Ethernet switch operation
NODE FLT 07 – CLOCK SYNC	Clock Sync Fault	Drive's local clock has lost synchronization with controller's clock and was not able to resynchronize within allotted time.	<ul style="list-style-type: none"> Check Ethernet connection Check controller and Ethernet switch operation
NODE FLT 09 – DUPLICATE IP ADDRESS	Duplicate IP Address Fault	Several consecutive updates from the controller have been lost.	Select an IP address not already in use on the network

Table 61 - NODE ALARM Fault Codes

Exception Code on Display	Exception Text	Problem	Possible Solutions
NODE ALARM 01 – LATE CTRL UPDATE	Control Connection Update Alarm	Updates from the controller have been late.	<ul style="list-style-type: none"> Remove unnecessary network devices from the motion network Change network topology so that fewer devices share common paths Use high performance network equipment Use shielded cables Separate signal wiring from power wiring
NODE ALARM 03 – CLOCK JITTER	Clock Jitter Alarm	The sync variance has exceeded the sync threshold while the device is running in sync mode.	<ul style="list-style-type: none"> Check the Ethernet connection Check controller and Ethernet switch operation
NODE ALARM 04 – CLOCK SKEW ALARM	Clock Skew Alarm	The controller time and the drive's time are not the same.	<ul style="list-style-type: none"> Check the Ethernet connection Check controller and Ethernet switch operation
NODE ALARM 05 – CLOCK SYNC ALARM	Clock Sync Alarm	Drive's local clock has lost synchronization with controller's clock for a short time during synchronous operation.	<ul style="list-style-type: none"> Check the Ethernet connection Check controller and Ethernet switch operation

Kinetix 5500 Drive Status Indicators

The module status and network status indicators are just above the LCD status display.

IMPORTANT	Status indicators are not reliable for safety functions. Use them only for general diagnostics during commissioning or troubleshooting. Do not attempt to use status indicators to determine operational status.
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Table 62 - Module Status Indicator

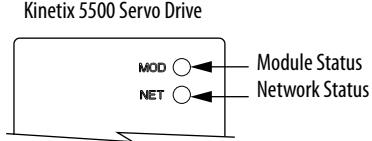


Table 62 - Module Status Indicator

Condition	Status
Steady Off	No power applied to the drive.
Steady Green	Drive is operational. No faults or failures.
Flashing Green	Standby (drive not configured).
Flashing Red	Major recoverable fault. The drive detected a recoverable fault, for example, an incorrect or inconsistent configuration.
Steady Red	Major fault. The drive detected a non-recoverable fault.
Flashing Green/Red	Self-test. The drive performs self-test during powerup.

Table 63 - Network Status Indicator

Condition	Status
Steady Off	No power applied to the drive or IP address is not configured.
Flashing Green	Drive connection is not established, but has obtained an IP address.
Steady Green	Drive connection is established. Normal operation.
Flashing Red	Connection timeout. One or more of the connections, for which this drive is the target, has timed out.
Steady Red	Duplicate IP address. IP address specified is already in use.
Flashing Green/Red	Self-test. The drive performs self-test during powerup.

Table 64 - Ethernet Link Speed Status Indicator

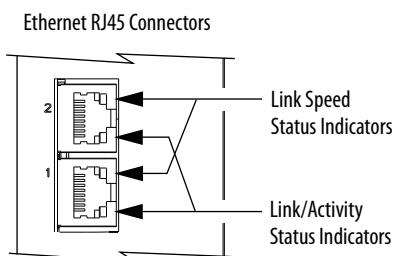


Table 64 - Ethernet Link Speed Status Indicator

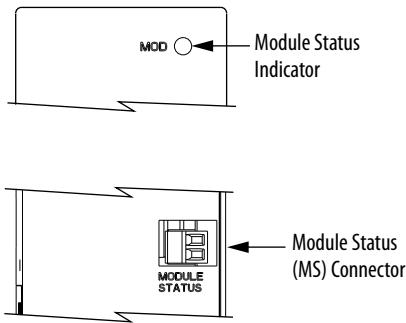
Condition	Status
Steady Off	10 Mbit
Steady On	100 Mbit

Table 65 - Ethernet Link/Activity Status Indicator

Condition	Status
Steady Off	No link
Steady On	Link established
Blinking	Network activity

Kinetix 5500 Capacitor Module Status Indicators

Kinetix 5500 Capacitor Module



The capacitor module status indicator and module status (MS) connector are on the front of the module. The module status connector is a relay output suitable for wiring to the Logix5000 controller.

Table 66 - Module Status Indicator and Relay Output

Module Status Indicator	Relay Output ⁽¹⁾	Status	Resolution
Steady Green	Closed	Bus is fully charged and no faults exist.	N/A
Flashing Green	Open	Control power is present and bus is waiting to charge up.	N/A
Flashing Red	Open	Recoverable fault (precharge or overvoltage fault).	<ul style="list-style-type: none"> • Cycle control and bus power • Verify that AC input meets specifications
Steady Red	Open	Internal, non-recoverable fault condition inside the module.	<ul style="list-style-type: none"> • Cycle control and bus power • Verify that AC input meets specifications • Replace the module if fault persists

(1) Wiring the module status relay output to the Logix5000 controller is optional.

General Troubleshooting

These conditions do not always result in a fault code, but can require troubleshooting to improve performance.

Table 67 - General Troubleshooting

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in Torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in the Logix Designer application.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	<ul style="list-style-type: none"> • Check setups. • Run Tune in the Logix Designer application.
	Mechanical resonance.	Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
You cannot obtain the motor acceleration/deceleration that you want.	Torque Limit limits are set too low.	Verify that torque limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in the Logix Designer application again.
	The system inertia is excessive.	<ul style="list-style-type: none"> • Check motor size versus application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size versus application need.
	Available current is insufficient to supply the correct accel/decel rate.	<ul style="list-style-type: none"> • Check motor size versus application need. • Review servo system sizing.
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.

Table 67 - General Troubleshooting (continued)

Condition	Potential Cause	Possible Resolution
Motor does not respond to a command.	The axis cannot be enabled until stopping time has expired.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	The motor wiring is open.	Check the wiring.
	The motor cable shield connection is improper.	<ul style="list-style-type: none"> Check feedback connections. Check cable shield connections.
	The motor has malfunctioned.	Repair or replace the motor.
	The coupling between motor and machine has broken (for example, the motor moves, but the load/machine does not).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the limit.
	Velocity or torque limits are set incorrectly.	Check and properly set the limits.
	Brake connector not wired	Check brake wiring
Presence of noise on command or motor feedback signal wires.	Recommended grounding per installation instructions have not been followed.	<ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources. Refer to System Design for Control of Electrical Noise, publication GMC-RM001.
	Line frequency can be present.	<ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources.
	Variable frequency can be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew, and so forth. The frequency can be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	<ul style="list-style-type: none"> Decouple the motor for verification. Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism.
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	<ul style="list-style-type: none"> Check brake wiring and function. Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Loose parts are present in the motor.	<ul style="list-style-type: none"> Remove the loose parts. Return motor for repair. Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance.	Notch filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.

Logix5000 Controller and Drive Behavior

By using the Logix Designer application, you can configure how the Kinetix 5500 drives respond when a drive fault/exception occurs.

TIP

The INIT FLT xxx faults are always generated after powerup, but before the drive is enabled, so the stopping behavior does not apply.

NODE ALARM xxx faults do not apply because they do not trigger stopping behavior.

The drive supports fault actions for Ignore, Alarm, Minor Fault, and Major Fault as defined in [Table 68](#). The drive also supports three configurable stopping actions as defined in [Table 69](#).

Refer to the drive behavior tables beginning on [page 150](#) to see how the fault and stopping actions apply to each of the exception fault codes.

Kinetix 5500 Drive Exception Behavior

For Kinetix 5500 drives, you can configure exception behavior in the Logix Designer application from the Axis Properties dialog box, Actions category.

Table 68 - Kinetix 5500 Drive Exception Action Definitions

Exception Action	Definition
Ignore	The controller completely ignores the exception condition. For some exceptions that are fundamental to the operation of the planner, Ignore is not an available option.
Alarm	The controller sets the associated bit in the Motion Alarm Status word, but does not otherwise affect axis behavior. Like Ignore, if the exception is so fundamental to the drive, Alarm is not an available option. When an exception action is set to Alarm, the Alarm goes away by itself when the exceptional condition has cleared.
Fault Status Only	Like Alarm, Fault Status Only instructs the controller to set the associated bit in the Motion Fault Status word, but does not otherwise affect axis behavior. However, unlike Alarm an explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. Like Ignore and Alarm, if the exception is so fundamental to the drive, Fault Status Only is not an available option.
Stop Planner	The controller sets the associated bit in the Motion Fault Status word and instructs the Motion Planner to perform a controlled stop of all planned motion at the configured maximum deceleration rate. An explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. If the exception is so fundamental to the drive, Stop Planner is not an available option.
Stop Drive	When the exception occurs, the associated bit in the Fault Status word is set and the axis comes to a stop by using the stopping action defined by the drive for the particular exception that occurred. There is no controller based configuration to specify what the stopping action is, the stopping action is device dependant.
Shutdown	When the exception occurs, the drive brings the motor to a stop by using the stopping action defined by the drive (as in Stop Drive) and the power module is disabled. An explicit Shutdown Reset is required to restore the drive to operation.

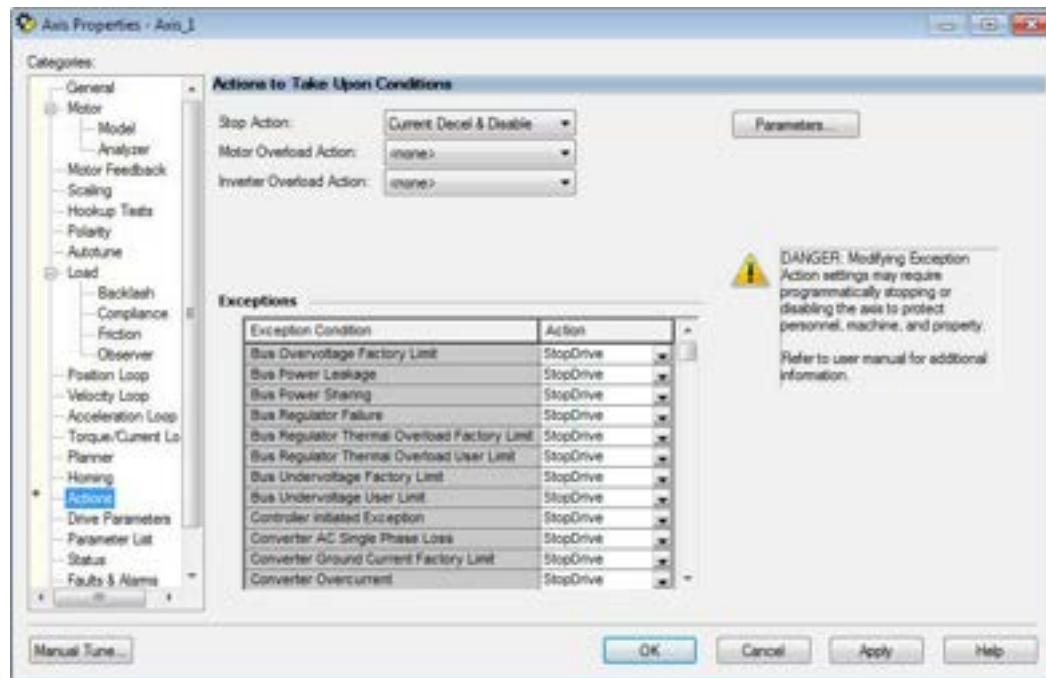
Table 69 - Configurable Stopping Actions

Stopping Action	Description
Decel and hold	Most control
Decel and disable	Less control
Disable and coast	Least control

The best available stopping action is the one that maintains the most control over the motor. However, not all faults support every stopping action.

Only selected drive exceptions are configurable. In the drive behavior tables, the controlling attribute is given for programmable fault actions.

Figure 65 - Logix Designer Axis Properties - Actions Category



This dialog box applies to Kinetix 5500 (EtherNet/IP network) servo drives.

Table 70 - Drive Behavior, FLT Sxx Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT S03 – MTR OVERSPEED FL	Motor Overspeed Factory Limit Fault	X					X	Disable/Coast
FLT S04 – MTR OVERSPEED UL	Motor Overspeed User Limit Fault	X		X	X	X	X	Decel/Hold
FLT S05 – MTR OVERTEMP FL	Motor Overtemperature Factory Limit Fault	X					X	Disable/Coast
FLT S07 – MTR OVERLOAD FL	Motor Thermal Overload Factory Limit Fault	X	X				X	Decel/Disable
FLT S08 – MTR OVERLOAD UL	Motor Thermal OverLoad User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S10 – INV OVERCURRENT	Inverter Overcurrent Fault	X	X				X	Disable/Coast
FLT S11 – INV OVERTEMP FL	Inverter Overtemperature Factory Limit Fault	X	X				X	Disable/Coast
FLT S13 – INV OVERLOAD FL	Inverter Thermal Overload Factory Limit Fault	X	X				X	Disable/Coast
FLT S14 – INV OVERLOAD UL	Inverter Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S15 – CONV OVERCURRENT	Converter Overcurrent Fault	X	X				X	Disable/Coast
FLT S16 – GROUND CURRENT	Ground Current Factory Limit Fault	X	X				X	Disable/Coast

Table 70 - Drive Behavior, FLT Sxx Fault Codes (continued)

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT S18 – CONV OVERTEMP FL	Converter OverTemp Factory Limit Fault	X	X				X	Disable/Coast
FLT S20 – CONV OVERLOAD FL	Converter Thermal OverLoad Factory Limit Fault	X	X				X	Disable/Coast
FLT S21 – CONV OVERLOAD UL	Converter Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S23 – AC PHASE LOSS	AC Single Phase Loss Fault	X	X	X	X	X	X	Disable/Coast
FLT S25 – PRECHARGE FAILURE	Pre-charge Failure Fault	X	X				X	Disable/Coast
FLT S29 – BUS OVERLOAD FL	Bus Regulator Thermal OverLoad Factory Limit Fault	X	X				X	Disable/Coast
FLT S30 – BUS OVERLOAD UL	Bus Regulator Thermal Overload User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S31 – BUS REG FAILURE	Bus Regulator Failure	X	X				X	Disable/Coast
FLT S33 – BUS UNDERVOLT FL	Bus Undervoltage Factory Limit Fault	X	X				X	Decel/Disable
FLT S34 – BUS UNDERVOLT UL	Bus Undervoltage User Limit Fault	X	X	X	X	X	X	Decel/Hold
FLT S35 – BUS OVERVOLT FL	Bus Overvoltage Factory Limit Fault	X	X				X	Disable/Coast
FLT S39 – BUS POWER	Bus Power Leakage Fault	X	X				X	Disable/Coast
FLT S45 – MTR FDBK COMM FL	Motor Feedback Data Loss Factory Limit Fault	X					X	Disable/Coast
FLT S47 – FDBK DEVICE FAILURE	Feedback Device Failure	X					X	Disable/Coast
FLT S49 – BRAKE SLIP FLT	Brake Slip Exception	X		X	X	X	X	Decel/Hold
FLT S54 – POSN ERROR	Excessive Position Error Fault	X		X	X	X	X	Disable/Coast
FLT S55 – VEL ERROR	Excessive Velocity Error Fault	X		X	X	X	X	Disable/Coast
FLT S56 – OVERTORQUE LIMIT	Overtorque Limit Fault	X		X	X	X	X	Decel/Hold
FLT S57 – UNDERTORQUE LIMIT	Undertorque Limit Fault	X		X	X	X	X	Decel/Hold

Table 71 - Drive Behavior, FLT Mxx Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
FLT M02 – MOTOR VOLTAGE	Motor Voltage Mismatch Fault	X		X	X	X	X	Disable/Coast
FLT M25 – COMMON BUS	DC Common Bus Fault	X	X				X	Disable/Coast
FLT M26 – RUNTIME ERROR	Runtime Error	X	X				X	Disable/Coast
FLT M28 – SAFETY COMM (2198-Hxx-ERS2 drives only)	Safety Module Communication Error	X	X				X	Disable/Coast

Table 72 - Drive Behavior, NODE FLT Fault Codes

Exception Fault Code	Exception Text	Permanent Magnet Motor	Induction Motor	Fault Action				Best Available Stopping Action (applies to major faults)
				Ignore	Alarm	Minor Fault	Major Fault	
NODE FLT 01 – LATE CTRL UPDATE	Control Connection Update Fault	X	X				X	Decel/Disable
NODE FLT 02 – PROC WATCHDOG	Processor Watchdog Fault	X	X				X	Disable/Coast
NODE FLT 03 – HARDWARE	Hardware Fault	X	X				X	Disable/Coast
NODE FLT 05 – CLOCK SKEW FLT	Clock Skew Fault	X	X				X	Disable/Coast
NODE FLT 06 – LOST CTRL CONN	Lost Controller Connection Fault	X	X				X	Decel/Disable
NODE FLT 07 – CLOCK SYNC	Clock Sync Fault	X	X				X	Disable/Coast
NODE FLT 09 – DUPLICATE IP ADDRESS	Duplicate IP Address Fault	X	X				X	Disable/Coast

Removing and Replacing Servo Drives

This chapter provides remove and replace procedures for Kinetix 5500 drives.

Topic	Page
Before You Begin	153
Remove and Replace Kinetix 5500 Servo Drives	154
Start and Configure the Drive	156



ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to *Guarding Against Electrostatic Damage*, publication [8000-4.5.2](#), or any other applicable ESD awareness handbook.

Before You Begin

When each drive is installed, network settings are configured from the setup screens. Before removing the drive, revisit the Network menu and make note of the static IP or DHCP settings. Refer to [Configure the Drive](#) on page 104 to access those settings.

IMPORTANT

If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive.

You also need these tools available before you begin removal and replacement procedures:

- Screwdrivers (to loosen/remove screws)
- Voltmeter (to make sure no voltage exists on drive connectors)
- Non-conductive probe for removing DC bus T-connectors

Remove and Replace Kinetix 5500 Servo Drives

Follow these steps to remove and replace servo drives from the panel.

Remove Power and All Connections

- Verify that all control and input power has been removed from the system.



ATTENTION: To avoid shock hazard or personal injury, assure that all power has been removed before proceeding. This system can have multiple sources of power. More than one disconnect switch can be required to de-energize the system.

- Wait five minutes for the DC bus to discharge completely before proceeding.



SHOCK HAZARD: This product contains stored energy devices. To avoid the hazard of electrical shock, verify that voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. Do not attempt the procedures in this document unless you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

- Label and remove all wiring connectors from the drive you are removing.

To identify each connector, refer to [Kinetix 5500 Connector Data](#) on [page 58](#).

TIP

You do not need to remove the shunt (RC) connector, unless there is an external shunt wired to it.

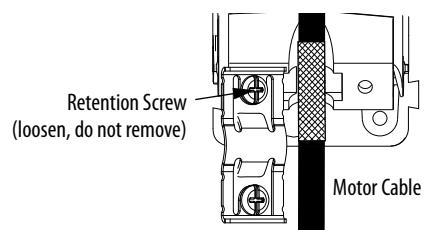
- Remove the shared-bus input wiring connectors, T-connectors, and bus-bars from the drive you are removing.

IMPORTANT

DC bus T-connectors latch on both sides when inserted into the drive. To remove the DC bus T-connector, at least one latch must be pried away with a non-conductive probe.

Refer to [Shared-bus Connection System](#) on [page 47](#).

- Use a screwdriver to loosen the two cable clamp screws, removing the one on the right.



- Remove the single motor cable from the cable shield clamp.

- Remove the ground screw and braided ground strap.

Refer to [Ground the System Subpanel](#) on [page 73](#).

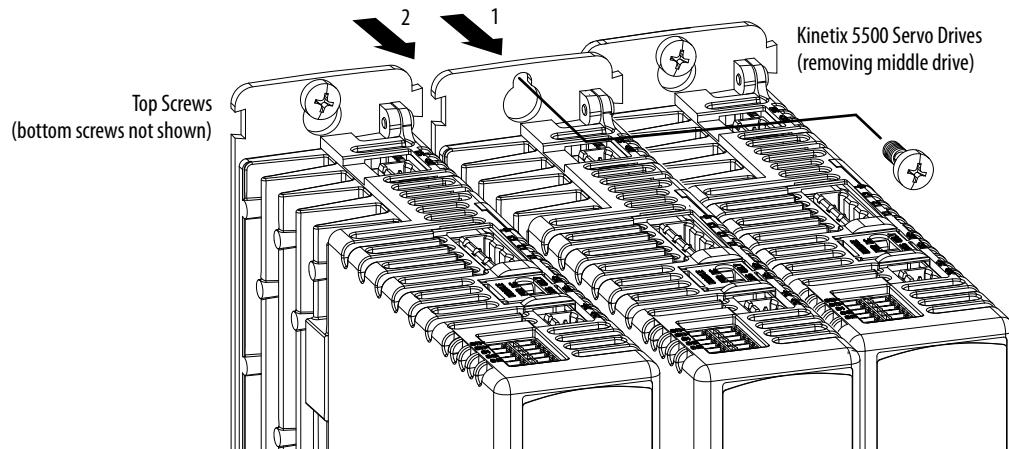
Remove the Servo Drive

You can remove single-axis drives from the panel or any single drive from a multi-axis configuration by using the same procedure.

IMPORTANT This procedure applies to any 2198-Hxxx-ERSx drive in any configuration.

Follow these steps to remove Kinetix 5500 servo drives from the panel.

1. Remove the top and bottom screws of the drive to remove.
Frame 1 and 2 drives have one top and bottom screw. Frame 3 drives have two top and bottom screws.
2. Grasp the top and bottom of the drive with both hands and pull the drive straight out and away from the panel, clearing the zero-stack mounting tabs and cutouts.



Replace the Servo Drive

To replace the servo drive, reverse the steps shown above or refer to [Mount Your Kinetix 5500 Drive on page 56](#):

- Torque mounting, shield clamp, and ground screws to 2.0 N•m (17.7 lb•in) max.
- Reconnect the feedback connector kit and torque the mounting screws to 0.4 N•m (3.5 lb•in) max.

Start and Configure the Drive

Follow these steps to configure the replacement drive.

IMPORTANT If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive.

1. Reapply power to the drive/system.

Refer to [Apply Power to the Kinetix 5500 Drive](#) on [page 129](#) for the procedure.

2. Configure the network settings for the drive.

a. If your old drive was configured as Static IP, you need to set the IP address, gateway, and subnet mask in the new drive identical to the old drive.

Refer to [Configure the Drive](#) on [page 104](#) to access those settings.

b. If you replaced a 2198-Hxxx-ERS2 servo drive in an integrated safety application, review [Understanding Integrated Safety Drive Replacement](#) on [page 174](#) and follow the appropriate procedure in [Replacing an Integrated Safety Drive in a GuardLogix System](#) on [page 175](#) to properly set the safety network number for the new drive.

3. Download the Logix Designer application to the controller.

4. Verify the drive/system is working properly.

Kinetix 5500 Safe Torque-off - Hardwired Safety

This chapter introduces you to how the hardwired safe torque-off feature meets the requirements of Performance Level d (PLd), Category 3 according to EN ISO 13849, and SIL CL2 according to IEC 61508, EN 61800-5-2, and EN 62061.

The 2198-Hxxx-ERS servo drives use the safe torque-off (STO) connector for cascading hardwired safety connections from drive-to-drive.

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Certification

The TÜV Rheinland group has approved the 2198-Hxxx-ERS servo drives with hardwired safe torque-off for use in safety-related applications up to PLd, Category 3 according to EN ISO 13849 and SIL CL2 according to IEC 61508, EN 61800-5-2, and EN 62061, in which removing the motion producing power is considered to be the safe state.

Refer to Appendix E on [page 229](#) for these certification documents.

- EC Type - Examination Certificate
- EC Declaration of Conformity
- European Union Directives

Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired EN ISO 13849 performance level or EN 62061 SIL level
- Project management and proof testing

Category 3 Requirements According to ISO 13849

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function.
- A single fault is detected whenever reasonably practicable.
- Accumulation of undetected faults can lead to the loss of the safety function and a failure to remove motion producing power from the motor.

Stop Category Definition

Stop category 0 as defined in EN 60204 or Safe Torque Off as defined by EN 61800-5-2 is achieved with immediate removal of motion producing power to the actuator.

IMPORTANT In the event of a malfunction, the most likely stop category is category 0. When designing the machine application, timing and distance must be considered for a coast to stop. For more information regarding stop categories, refer to EN 60204-1.

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849, and SIL levels, according to EN 61508 and EN 62061, include a rating of the systems ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the EN ISO 13849, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

Description of Operation

The safe torque-off feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When disabled, or any time power is removed from the safety enable inputs, all of the drive output-power transistors are released from the On-state. This results in a condition where the drive is coasting (stop category 0). Disabling the power transistor output does not provide mechanical isolation of the electrical output that is required for some applications.

Under normal operation, the safe torque-off inputs are energized. If either of the safety enable inputs are de-energized, then all of the output power transistors turn off. The safe torque-off response time is less than 12 ms.

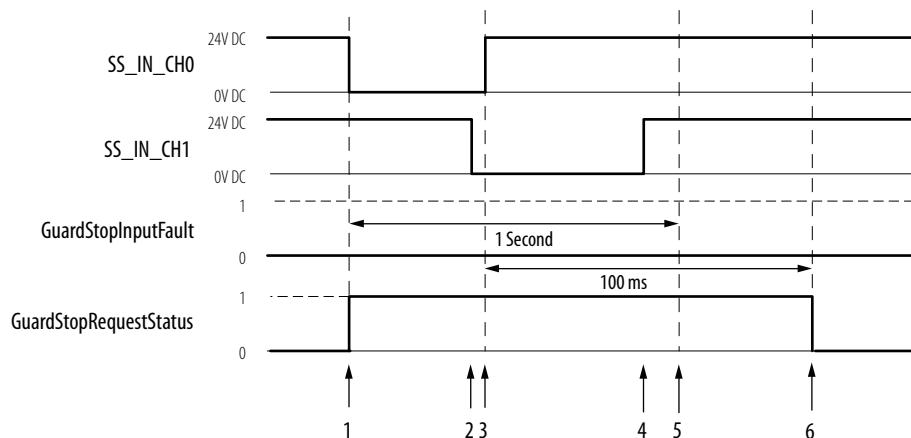


ATTENTION: Permanent magnet motors can, in the event of two simultaneous faults in the IGBT circuit, result in a rotation of up to 180 electrical degrees.



ATTENTION: If any of the safety enable inputs de-energize, the Start Inhibit field indicates SafeTorqueOffInhibit and GuardStopRequestStatus bit of AxisGuardStatus tag set to 1. Both inputs must be de-energized within 1 second and re-energized within 1 second to avoid GuardStopInputFault conditions.

Figure 66 - System Operation when Inputs are Meeting Timing Requirements



Event	Description
1	At least one input is switched-off. GuardStopRequestStatus bit is set to 1.
2	Second input is switched-off within 1 second. This event must always occur prior to Event 3 to prevent GuardStopInputFault.
3	First input is switched-on.
4	Second input is switched-on within 1 second of event 3.
5	Both inputs are in OFF state simultaneously within 1 second. As a result, GuardStopInputFault is not posted.
6	GuardStopRequestStatus bit sets back to 0 if event 4 occurred within 100 ms interval after event 3. If event 4 is outside of the 100 ms interval and within the 1 second (event 3) interval, then GuardStop RequestStatus bit sets back to 0 after the 1 second interval following event 3.

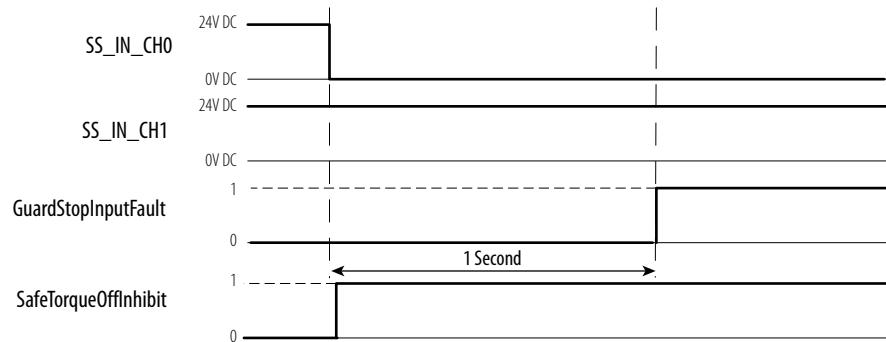
Troubleshoot the Safe Torque-off Function

Table 73 - 2198-Hxx-E RS Servo Drive Troubleshooting

Exception Code on Drive Display	Fault Message Logix Designer	Problem	Possible Solutions
SAFE FLT 09 - SS IN	GuardStopInputFault	Safe torque-off function mismatch. System does not allow motion. Safe torque-off mismatch is detected when safety inputs are in a different state for more than 1.0 second.	<ul style="list-style-type: none"> Verify safety wiring and connections: <ul style="list-style-type: none"> Wire terminations at safe torque-off (STO) connector Cable/header not seated correctly +24V power Check state of safety inputs. Reset error and run proof test. If error persists, return the drive to Rockwell Automation.

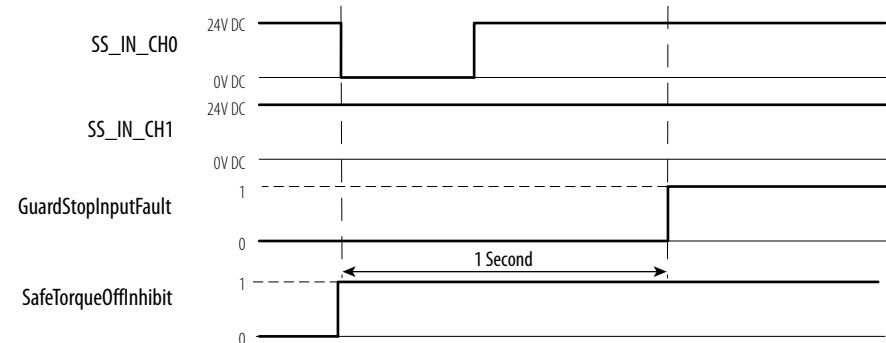
[Figure 67](#) demonstrates when the safe torque-off mismatch is detected and a GuardStopInputFault is posted.

Figure 67 - System Operation in the Event that the Safety Enable Inputs Mismatch



When one safety input is turned off, the second input must also be turned off, otherwise a fault is asserted (see [Figure 68](#)). The fault is asserted even if the first safety input is turned on again.

Figure 68 - System Operation in the Event that the Safety Enable Inputs Mismatch Momentarily



ATTENTION: The safe torque-off fault is detected upon demand of the safe torque-off function. After troubleshooting, a safety function must be executed to verify correct operation.

IMPORTANT

The Safe Torque Off fault can be reset only if both inputs are in the Off-state for more than 1 second. After the fault reset requirement is satisfied, an MASR command in the Logix Designer application must be issued to reset the GuardStopInputFault.

Probability of Dangerous Failure Per Hour (PFH)

Safety-related systems are classified as operating in a High-demand/continuous mode where the frequency of demands for operation made on a safety-related system is greater than once per year.

The SIL value for a High demand/continuous mode safety-related system is directly related to the probability of a dangerous failure occurring per hour (PFH).

PFH Data

These PFH calculation is based on the equations from EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

IMPORTANT	Determination of safety parameters is based on the assumption that the system operates in High demand mode and that the safety function is requested greater than once a year.
------------------	--

Table 74 - PFH for 20-year Proof Test Interval

Attribute	Value
PFH (1e-9)	0.35
Proof test (years)	20

Safe Torque-off Connector Data

The 10-pin connector consists of two parallel 5-pin rows for cascading safety connections from drive-to-drive in multi-axis configurations.

Figure 69 - Pin Orientation for 10-pin Safe Torque-off (STO) Connector

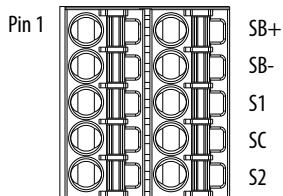


Table 75 - Safe Torque-off (STO) Connector Pinouts

STO Pin	Description	Signal
1	Safety bypass plus signal. Connect to both safety inputs to disable the STO function.	SB+
2	Safety bypass minus signal. Connect to safety common to disable the STO function.	SB-
3	STO input 1 (SS_IN_CH0).	S1
4	STO input common (SCOM).	SC
5	STO input 2 (SS_IN_CH1).	S2

Wire the Safe Torque-off Circuit

This section provides guidelines for wiring your Kinetix 5500 safe torque-off drive connections.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) beginning on [page 39](#).

IMPORTANT Pins 1 and 2 (SB+ and SB-) are used to disable the safe torque-off function. When wiring to the STO connector, the 24V supply (for an external safety device that triggers the safe torque-off request) must come from an external source, otherwise system performance is jeopardized.

Safe Torque-off Wiring Requirements

The safe torque-off (STO) connector uses spring tension to secure the wire. Depress the tab, along side each pin, to release the wire. Two rows of pins are provided for drive-to-drive connections. Wire must be copper with 75 °C (167 °F) minimum rating.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IMPORTANT Stranded wires must terminate with ferrules to prevent short circuits, per table D.7 of EN ISO 13849-2.

Figure 70 - Safe Torque-off (STO) Terminal Plug

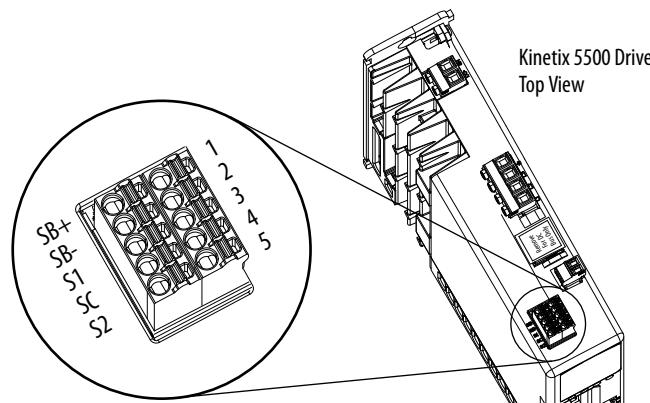


Table 76 - Safe Torque-off (STO) Terminal Plug Wiring

Safe Torque-off (STO) Connector		Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N·m (lb·in)
Pin	Signal			
STO-1	SB+			
STO-2	SB-			
STO-3	S1	1.5...0.2 (16...24)		
STO-4	SC		10 (0.25)	N/A
STO-5	S2			

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) beginning on [page 39](#).

Safe Torque-off Feature

The safe torque-off circuit, when used with suitable safety components, provides protection according to EN ISO 13849 (PLd), Category 3 or according to IEC EN 61508, EN 61800-5-2, and EN 62061 (SIL CL2). All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off circuit is designed to safely turn off all of the output-power transistors. You can use the safe torque-off circuit in combination with other safety devices to achieve the stop and protection-against-restart as specified in IEC 60204-1.



ATTENTION: This option is suitable only for performing mechanical work on the drive system or affected area of a machine. It does not provide electrical safety.



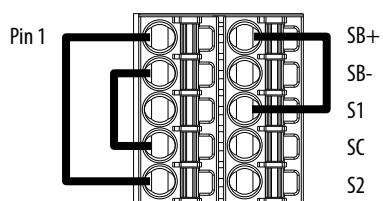
SHOCK HAZARD: In Safe Torque-off mode, hazardous voltages can still be present at the drive. To avoid an electric shock hazard, disconnect power to the system and verify that the voltage is zero before performing any work on the drive.

The 2198-Hxxx-ERS drives do not operate without a safety circuit or safety bypass wiring. For applications that do not require the safe torque-off feature you must install jumper wires to bypass the safe torque-off circuitry.

Safe Torque-off Feature Bypass

Each Kinetix 5500 drive ships with one 10-pin wiring plug for wiring to safety devices. To bypass the safety function, wire these signals as shown in [Figure 71](#). With the jumper wires installed, the safe-off feature is not used.

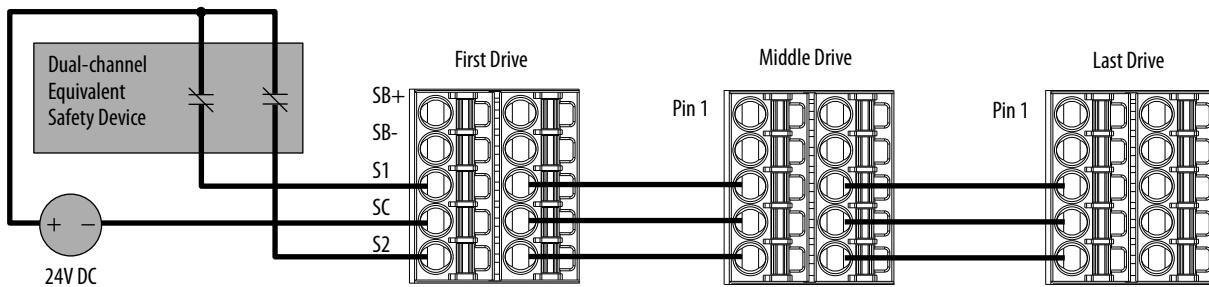
Figure 71 - Safe Torque-off Bypass Wiring



Cascade the Safe Torque-off Signal

The total number of drives in a single cascaded safety circuit is limited due to the current carrying capacity of the cascaded safety wiring. Refer to [Table 77](#) for current rating per channel, per drive.

Figure 72 - Cascaded Safe Torque-off Wiring



Safe Torque-off Specifications

To maintain safety rating, Kinetix 5500 drives must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet must be IP54 or higher.

Table 77 - Safe Torque-off Signal Specifications

Attribute	Value
Safety inputs (per channel)	Input current < 10 mA
	Input ON voltage range 18...26.4V DC
	Input OFF voltage, max 5V DC
	Input ON current 10 mA, each drive ⁽¹⁾
	Input OFF current 2 mA @ V in < 5V DC
	Pulse rejection width 700 µs
	External power supply SELV/PELV
	Input type Optically isolated and reverse voltage protected

(1) The maximum number of drives cascaded with safe torque-off wiring is 50.

Notes:

Kinetix 5500 Safe Torque-off - Integrated Safety

This chapter introduces you to how the integrated safe torque-off feature meets the requirements of Performance Level e (PL_e), Category 3 according to EN ISO 13849, and SIL CL3 according to IEC 61508, EN 61800-5-2, and EN 62061.

With integrated safety, the 1756-L7xS GuardLogix safety controller issues the safe torque-off (STO) command over the EtherNet/IP network and the 2198-Hxxx-ERS2 servo drive executes the STO command.

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Certification

The TÜV Rheinland group has approved the 2198-Hxxx-ERS2 servo drives with integrated safe torque-off for use in safety-related applications up to PL_e, Category 3 according to EN ISO 13849 and SIL CL3 according to IEC 61508, EN 61800-5-2, and EN 62061, in which removing the motion producing power is considered to be the safe state.

Refer to Appendix E on [page 229](#) for these certification documents.

- EC Type - Examination Certificate
- EC Declaration of Conformity
- European Union Directives

Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired EN ISO 13849 performance level or EN 62061 SIL level
- Project management and proof testing performed in accordance with EN ISO 13849

Safety Application Requirements

Safety application requirements include evaluating probability of failure rates (PFH), system reaction time settings, and functional verification tests that fulfill SIL 3 criteria.

Creating, recording, and verifying the safety signature is also a required part of the safety application development process. Safety signatures are created by the safety controller. The safety signature consists of an identification number, date, and time that uniquely identifies the safety portion of a project. This includes all safety logic, data, and safety I/O configuration.

For safety system requirements, including information on the safety network number (SNN), verifying the safety signature, and functional verification tests refer to the GuardLogix 5570 Controller Systems Safety Reference Manual, publication [1756-RM099](#).

IMPORTANT	You must read, understand, and fulfill the requirements detailed in this publication prior to operating a safety system that uses a GuardLogix controller and 2198-Hxxx-ERS2 servo drive.
------------------	---

Category 3 Requirements According to ISO 13849

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function.
- A single fault is detected whenever reasonably practicable.
- Accumulation of undetected faults can lead to the loss of the safety function and a failure to remove motion producing power from the motor.

Stop Category Definition

Stop category 0 as defined in EN 60204 or Safe Torque Off as defined by EN 61800-5-2 is achieved with immediate removal of motion producing power to the actuator.

IMPORTANT	In the event of a malfunction, the most likely stop category is category 0. When designing the machine application, timing and distance must be considered for a coast to stop. For more information regarding stop categories, refer to EN 60204-1.
------------------	--

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849, and SIL levels, according to EN 61508 and EN 62061, include a rating of the systems ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the EN ISO 13849, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

Description of Operation

The safe torque-off (STO) feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When the command to allow torque ceases from the GuardLogix controller, all of the drive output-power transistors are released from the On-state. This results in a condition where the motor is coasting. Disabling the power transistor output does not provide mechanical isolation of the electrical output that is required for some applications.

The 2198-Hxxx-ERS2 drive STO function response time is less than 10 ms. Response time is the delay between the time the drive STO function receives the integrated safety packet with an STO request and the time when motion producing power is removed from the motor.

STO State Reset

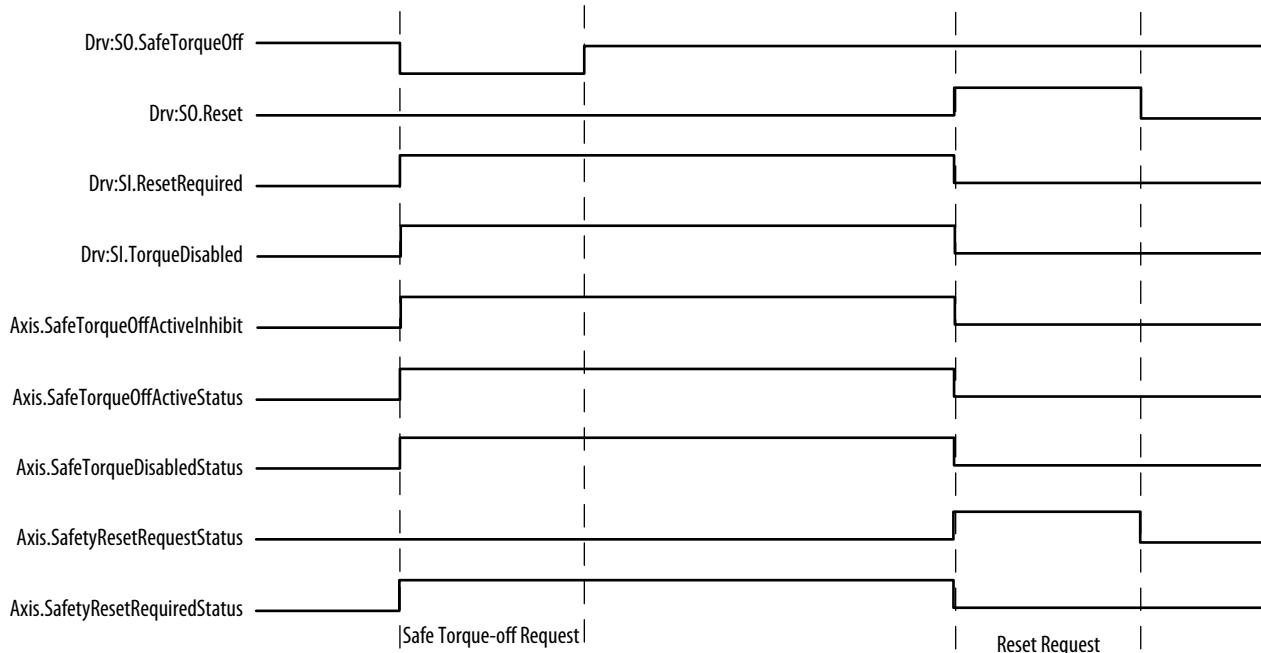
The 2198-Hxxx-ERS2 servo drives support only manual restart to exit the STO state. The transition from logic 0 to 1 of the SO.Reset tag is required after the SO.SafeTorqueOff tag has transitioned from logic 0 to 1.

IMPORTANT	Transition of the SO.SafeTorqueOff tag to logic 1 must always be executed prior to transition of the SO.Reset tag to logic 1.
------------------	---

IMPORTANT 2198-Hxxx-ERS2 servo drives enter the STO state if any STO function fault is detected. Refer to [Table 78](#) for integrated safety troubleshooting.

Refer to [Figure 73](#) for an understanding of the 2198-Hxxx-ERS2 STO state restart functionality.

Figure 73 - Kinetix 5500 STO Timing Diagram



Troubleshoot the Safe Torque-off Function

Table 78 - 2198-Hxxx-ERS2 Servo Drive Troubleshooting

Exception Code on Drive Display	Fault Message Logix Designer	Problem	Possible Solutions
SAFE FLT S01- Safety Core Internal	CPUWatchdogFault ⁽¹⁾	Drive safety diagnostic detected internal STO design failure.	<ul style="list-style-type: none"> • Cycle control power • Return drive for repair if fault continues
SAFE FLT S03- Safe Torque Off	SafeTorqueOffFault ⁽²⁾	Drive safety diagnostic detected internal STO design failure.	<ul style="list-style-type: none"> • Cycle control power • Execute STO function • Return drive for repair if fault continues

(1) Displayed in the Quick View Pane as Module Fault.

(2) Displayed in the Quick View Pane as Safety Fault.

Probability of Dangerous Failure Per Hour (PFH)

Safety-related systems are classified as operating in a High-demand/continuous mode where the frequency of demands for operation made on a safety-related system is greater than once per year.

The SIL value for a High demand/continuous mode safety-related system is directly related to the probability of a dangerous failure occurring per hour (PFH).

PFH Data

These PFH calculation is based on the equations from EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

Determination of safety parameters is based on the assumption that the system operates in high demand mode and that the safety function is requested at least once a year.

This table provides data for a 20-year proof test interval.

IMPORTANT	Determination of safety parameters is based on the assumption that the system operates in High-demand mode and that the safety function is requested at least once every three months.
------------------	--

Table 79 - PFH for 20-year Proof Test Interval

Attribute	Value
PFH (1e-9)	1.54
Proof test (years)	20

Safe Torque-off Feature

The safe torque-off feature, when used with suitable safety components, provides protection according to EN ISO 13849 (PLe), Category 3 or according to IEC 61508, EN 61800-5-2, and EN 62061 (SIL CL3). The safe torque-off option is just one safety control system. All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off feature is designed to safely turn off all of the output power transistors. You can use the safe torque-off feature in combination with other safety devices to achieve category 0 stop and protection-against-restart as specified in IEC 60204-1.



ATTENTION: This option is designed to restrict motion producing power on the drive system or affected area of a machine. It does not provide electrical safety.



SHOCK HAZARD: In Safe Torque-off mode, hazardous voltages can still be present at the drive. To avoid an electric shock hazard, disconnect power to the system and verify that the voltage is zero before performing any work on the drive.



ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

Out-of-Box State

The 2198-Hxxx-ERS2 servo drives ship in the out-of-box state.



ATTENTION: In the out-of-box state, motion producing power is allowed by the safe torque-off (STO) function unless an integrated safety connection configuration has been applied to the drive at least once.

In the out-of-box state, you can configure 2198-Hxxx-ERS2 servo drives:

- Without a GuardLogix® 5570 safety controller for a non-safety application.
- With a GuardLogix 5570 safety controller when the safe torque-off (STO) function is not required.

Out-of-Box State Support

After the integrated safety connection configuration is applied to the 2198-Hxxx-ERS2 servo drive at least once, you can restore the drive to the out-of-box state.

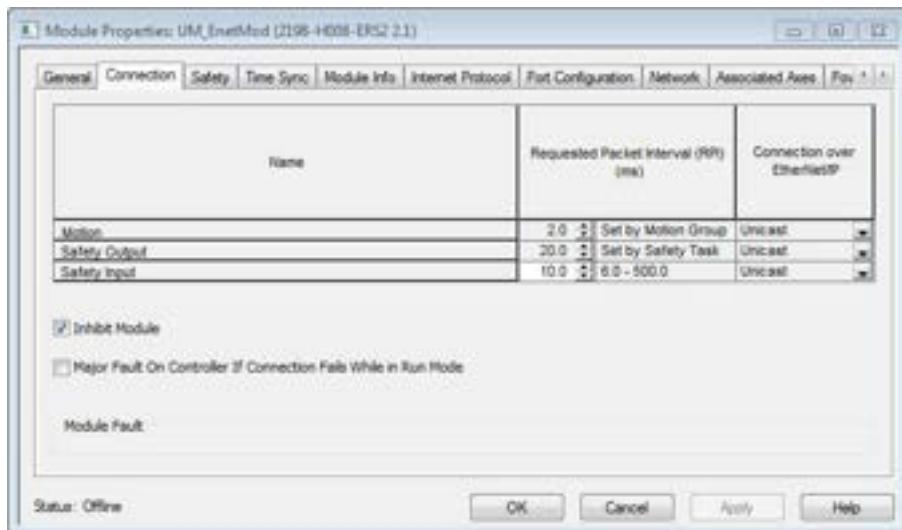
Follow these steps to restore your 2198-Hxxx-ERS2 servo drive to the out-of-box state.

1. Right-click the 2198-Hxxx-ERS2 servo drive you created and choose Properties.



2. Click the Connection tab.

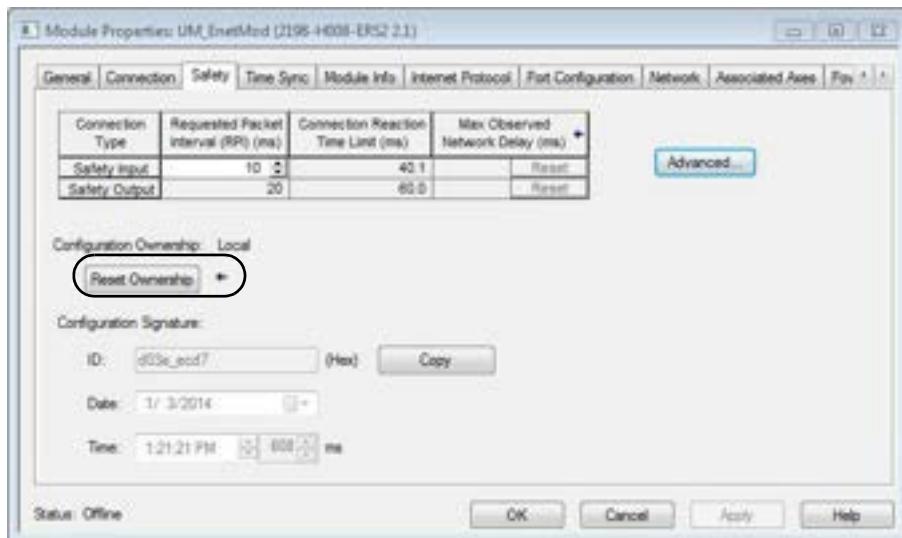
The Connection tab appears.



3. Check Inhibit Module.

4. Click Apply and click the Safety tab.

The Safety tab appears.



-
5. In the Configuration Ownership field, click Reset Ownership.

IMPORTANT Only authorized personnel should attempt Reset Ownership.

If any active connection is detected, the reset is rejected.

6. Cycle drive power.

The drive is in the out-of-box state.

IMPORTANT If power to the drive is not cycled after [Step 5](#), the drive does not transition to the out-of-box state and maintains STO function.

IMPORTANT When the drive returns to the out-of-box state, STO safety integrity is lost.

Understanding Integrated Safety Drive Replacement

GuardLogix controllers retain I/O device configuration on-board and are able to download the configuration to the replacement device.

IMPORTANT If a 2198-Hxxx-ERS2 servo drive was used previously, clear the existing configuration before installing it on a safety network by resetting the drive to its out-of-box condition. To see how this is done, refer to [Out-of-Box State Support](#) on [page 172](#).

Replacing a 2198-Hxxx-ERS2 servo drive that sits on an integrated safety network is more complicated than replacing standard devices because of the safety network number (SNN). The device number and SNN make up the safety device's DeviceID. Safety devices require this more complex identifier to make sure that duplicate device numbers do not compromise communication between the correct safety devices. The SNN is also used to provide integrity on the initial download to the 2198-Hxxx-ERS2 servo drive.

When the Logix Designer application is online, the Safety tab of the Module Properties dialog box displays the current configuration ownership. When the opened project owns the configuration, Local is displayed.

Configuration Ownership: Local

Communication error is displayed if the module read fails. Refer to [Replacing an Integrated Safety Drive in a GuardLogix System](#) on [page 175](#) for integrated safety drive replacement examples.

Replacing an Integrated Safety Drive in a GuardLogix System

If you are relying on a portion of the integrated safety system to maintain SIL 3 behavior during drive replacement and functional testing, do not use the Configure Always feature.

Use the Configure Always feature when you are not relying on the entire routable integrated safety control system to maintain PLe/SIL 3 behavior during the replacement and functional testing of a 2198-Hxxx-ERS2 servo drive. Drive replacement is configured on the Safety tab of the GuardLogix controller.

Figure 74 - Setting the SNN with a GuardLogix Controller



Replacement with Configure Only When No Safety Signature Exists Enabled

When a 2198-Hxxx-ERS2 servo drive is replaced and the DeviceID of the new drive matches the original, you can download the configuration from the safety controller. The DeviceID is a combination of the node/IP address and the safety network number (SNN), and is updated whenever the SNN is set.

If the project is configured as Configure Only When No Safety Signature Exists, follow the appropriate instructions in [Table 80](#) to replace a 2198-Hxxx-ERS2 drive based on your scenario. Once you have completed the steps correctly and the DeviceID matches the original, the safety controller is enabled to download the proper drive configuration and re-establish the safety connection.

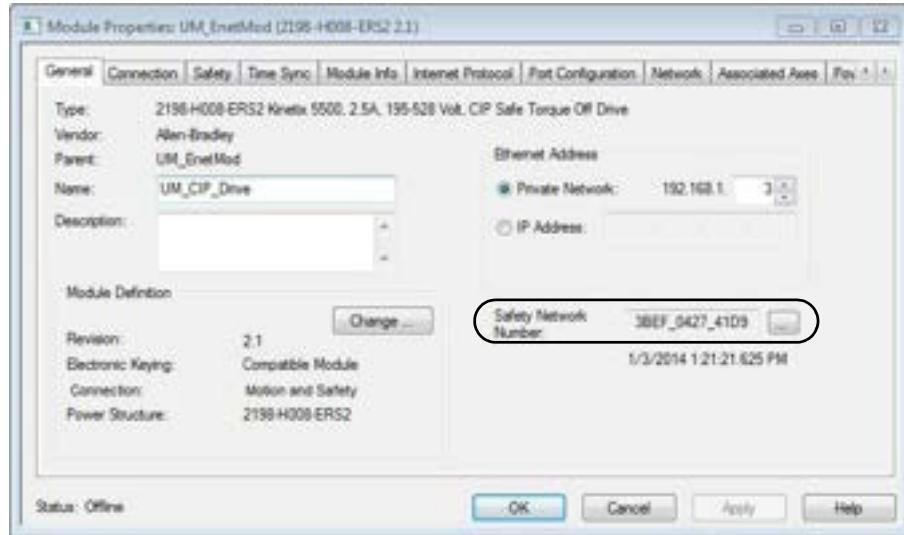
Table 80 - Replacing a 2198-Hxxx-ERS2 Servo Drive

GuardLogix Safety Signature Exists	Replacement Module Condition	Action Required
No	No SNN (out-of-box)	
Yes or No	Same SNN as original safety task configuration	None. The module is ready for use.
Yes	No SNN (out-of-box)	Refer to Scenario 1 on page 176 .
Yes	Different SNN than original safety task configuration	Refer to Scenario 2 on page 177 .
No		Refer to Scenario 3 on page 179 .

Scenario 1 - Replacement Integrated Safety Drive Is Out-of-box and Safety Signature Exists

1. Remove and replace the existing integrated safety drive.
2. Right-click the replacement drive and choose Properties.

The General tab appears in Module Properties dialog box.



3. Click to the right of the safety network number.

The Safety Network Number dialog box appears.



4. Click Set.

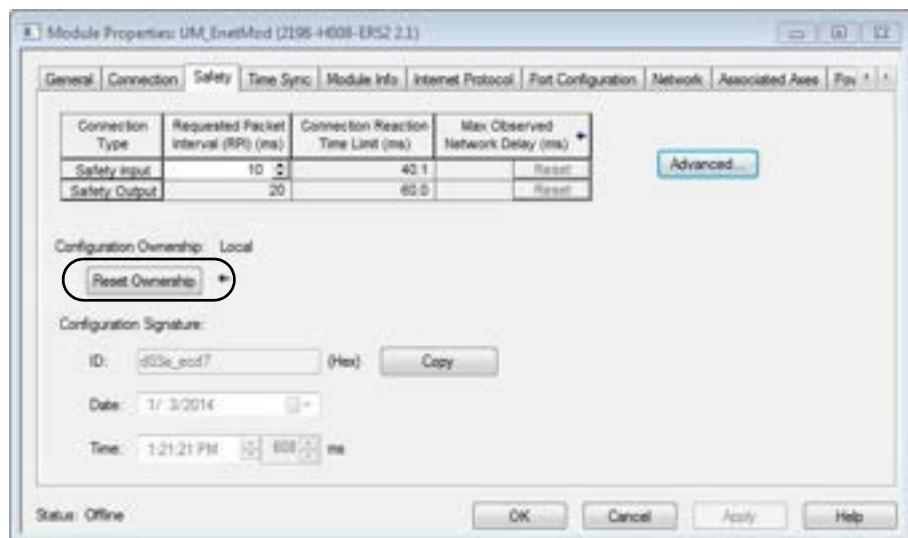
- Verify that the Network Status (NET) status indicator is alternating red/green on the correct drive.



- Click Yes to set the SNN and accept the replacement drive.

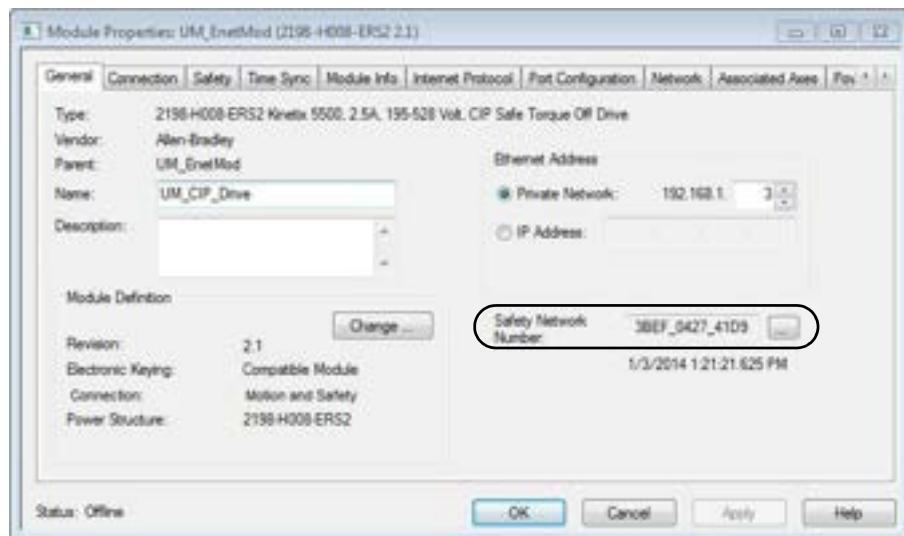
Scenario 2- Replacement Integrated Safety Drive SNN Is Different from Original and Safety Signature Exists

- Remove and replace the existing integrated safety drive.
- Right-click the replacement drive and choose Properties.
- Click the Safety tab.



- Click Reset Ownership.
- Click OK.
- Right-click the replacement drive and choose Properties.

The General tab appears in Module Properties dialog box.



7. Click to the right of the safety network number.

The Safety Network Number dialog box appears.



8. Click Set.

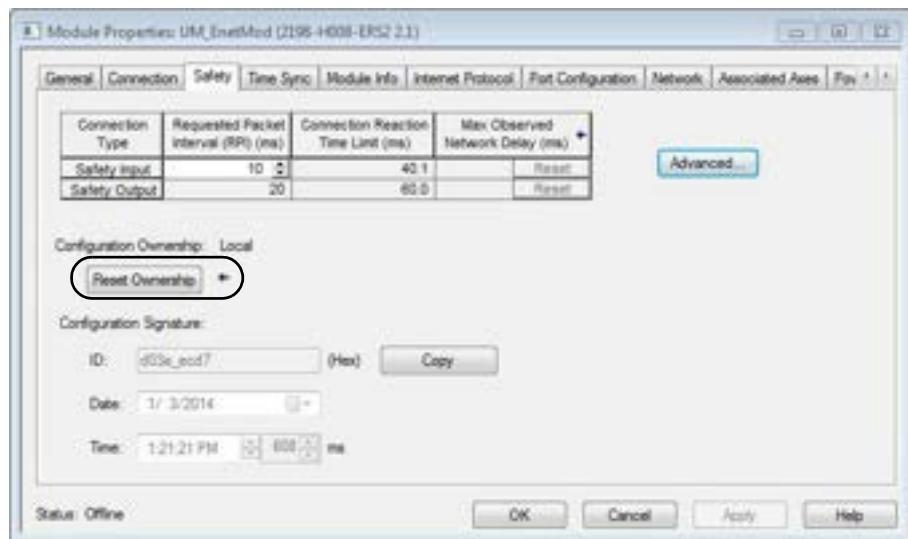
9. Verify that the Network Status (NET) status indicator is alternating red/green on the correct drive.



10. Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

Scenario 3- Replacement Integrated Safety Drive SNN Is Different from Original and No Safety Signature Exists

1. Remove and replace the existing integrated safety drive.
2. Right-click the replacement drive and choose Properties.
3. Click the Safety tab.



4. Click Reset Ownership.
5. Click OK.
6. Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

Replacement with Configure Always Enabled



ATTENTION: Enable the Configure Always feature only if the entire integrated safety control system is not being relied on to maintain SIL 3 behavior during the replacement and functional testing of a 2198-Hxxx-ERS2 servo drive. Do not place drives that are in the out-of-box condition on an integrated safety network when the Configure Always feature is enabled, except while following this replacement procedure.

When the Configure Always feature is enabled, the controller automatically checks for and connects to a replacement drive that meets all of the following requirements:

- The controller has configuration data for a compatible drive at that network address
- The drive is in out-of-box condition or has an SNN that matches the configuration

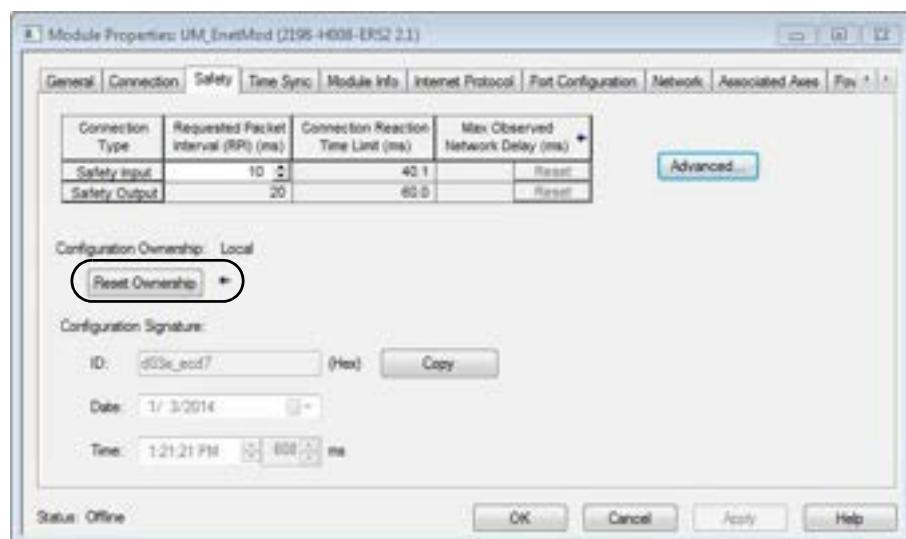
If the project is configured for Configure Always, follow the appropriate steps to replace a 2198-Hxxx-ERS2 servo drive.

Follow these steps when the Configure Always feature is enabled.

1. Remove and replace the existing integrated safety drive.

If	Then
The drive is in out-of-box condition	Go to step 6 . No action is needed for the GuardLogix controller to take ownership of the drive.
An SNN mismatch error occurs	Go to the next step to reset the drive to out-of-box condition.

2. Right-click the replacement drive and choose Properties.
3. Click the Safety tab.



4. Click Reset Ownership.
5. Click OK.
6. Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

Motion Direct Commands in Motion Control Systems

You can use the Motion Direct Command (MDC) feature to initiate motion while the controller is in Program mode, independent of application code that is executed in Run mode. These commands let you do a variety of functions, for example, move an axis, jog an axis, or home an axis.

A typical use might involve a machine integrator testing different parts of the motion system while the machine is being commissioned or a maintenance engineer, under certain restricted scenarios in accordance with safe machine operating procedures, wanting to move an axis (like a conveyor) to clear a jam before resuming normal operation.



ATTENTION: To avoid personal injury or damage to equipment, follow these rules regarding Run mode and Program mode.

- Only authorized, trained personnel with knowledge of safe machine operation should be allowed to use Motion Direct Commands
- Additional supervisory methods, like removing the controller key switch, should be used to maintain the safety integrity of the system after returning the safety controller to RUN mode

Understanding STO Bypass When Using Motion Direct Commands

If a Safety-only connection between the GuardLogix safety controller and the 2198-Hxxx-ERS2 servo drive was established at least once after the drive was received from the factory, the drive does not allow motion while the safety controller is in Program mode by default.

This is because the safety task is not executed while the GuardLogix safety controller is in Program mode. This applies to applications running in a single-safety controller (with Motion and Safety connections). When an integrated safety drive has a Motion connection to a standard controller and a separate Safety connection to a dual-safety controller, the standard controller can transition to Program mode while the safety controller stays in Run mode and continues to execute the safety task.

However, 2198-Hxxx-ERS2 drive systems are designed with a bypass feature for the STO function in single-safety controller configurations. You can use the MDC feature to allow motion while following all the necessary and prescribed steps per machine safety operating procedures.



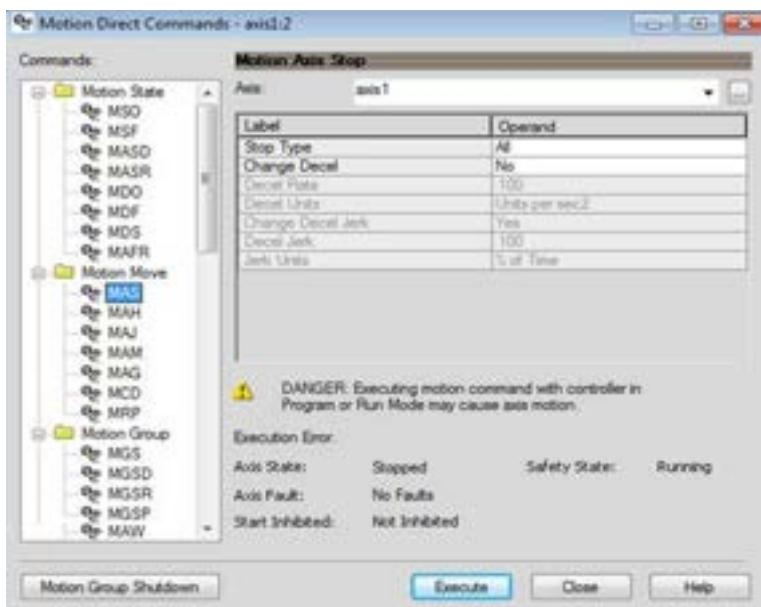
ATTENTION: Consider the consequences of allowing motion through the use of MDC when the controller is in Program mode. You must acknowledge warning messages in the Logix Designer application that warn of the drive bypassing the STO function and unintended motion can occur. The integrated safety drive does not respond to the request of STO function if MDC mode is entered.

ATTENTION: It is your responsibility to maintain machine safety integrity while executing motion direct commands. One alternative is to provide ladder logic for Machine Maintenance mode that leaves the controller in Run mode with safety functions executing.

Logix Designer Application Warning Messages

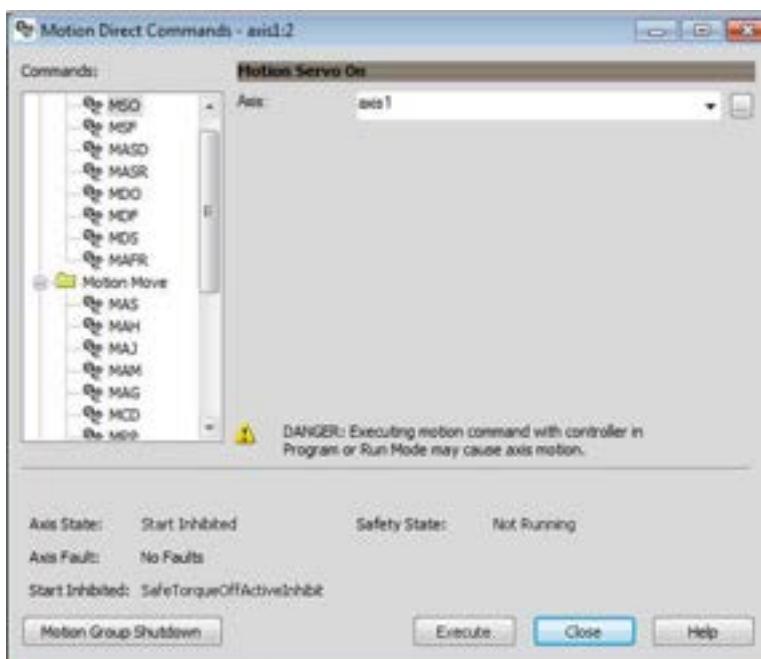
When the controller is in Run mode, executing safety functions, the 2198-Hxxx-ERS2 drive follows the commands that it receives from the safety controller. Safety state = Running, Axis state = Stopped/Running, as shown in [Figure 75](#).

Figure 75 - Safety State Indications When Controller is in Run Mode (safety task executing)



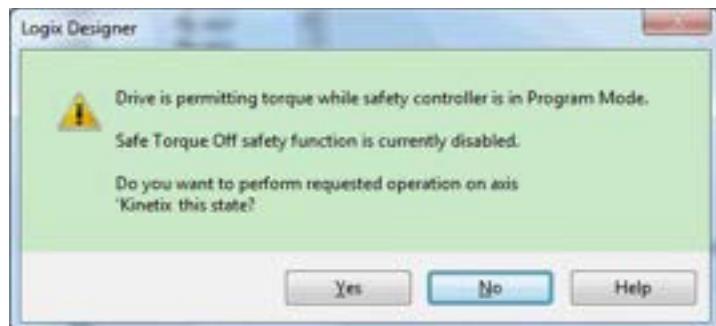
When the controller transitions to Program mode, the integrated safety drive is in the safe state (torque not permitted). Safety state = Not Running, Axis state = Start Inhibited, as shown in [Figure 76](#).

Figure 76 - Safety State Indications After Controller Transitions to Program Mode



When you issue a motion direct command to an axis to produce torque in Program mode, for example MSO or MDS, with the safety connection present to the drive, a warning message is presented before the motion direct command is executed, as shown in [Figure 77](#).

Figure 77 - STO Bypass Prompt When the Safety Controller is in Program Mode



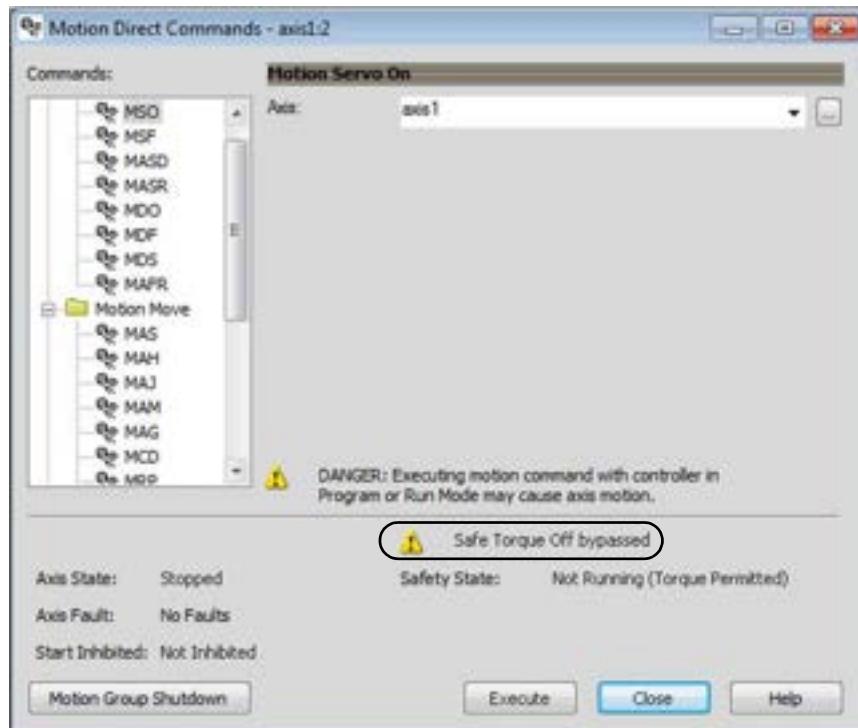
The warning in [Figure 77](#) is displayed the first time a motion direct command is issued.

After you acknowledge the warning message by clicking Yes, torque is permitted by the drive and a warning message is indicated in the software as shown in [Figure 78](#). Safety state = Not Running (torque permitted), Axis state = Stopped/Running, Persistent Warning = Safe Torque Off Bypassed.

IMPORTANT

Switch the controller to Run mode to exit Motion Direct Command mode with STO function bypassed.

Figure 78 - Safety State Indications After Controller Transitions to Program Mode (MDC executing)



IMPORTANT

The persistent warning message text Safe Torque Off bypasses appears when a motion direct command is executed.

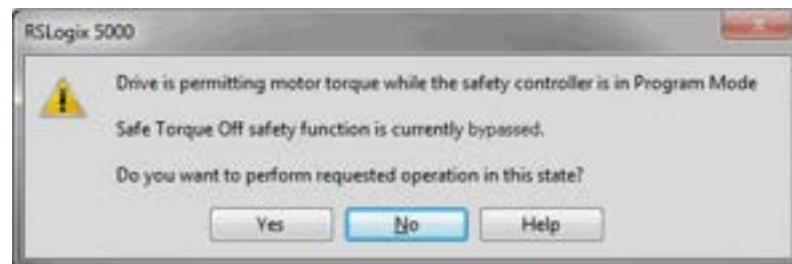
Warning message persists even after the dialog is closed and reopened as long as the integrated safety drive is in STO Bypass mode.

The persistent warning message is removed only after the integrated safety drive is restored to the Safe state.

Torque Permitted in a Multi-workstation Environment

The warning in [Figure 79](#) is displayed to notify a second user working in a multi-workstation environment that the first user has placed the integrated safety drive in the STO state and that the current action is about to bypass the STO state and permit torque.

Figure 79 - STO Bypass Prompt When MDC is Issued in Multi-workstation Environment



Warning Icon and Text in Axis Properties

In addition to the other warnings that require your acknowledgement, the Logix Designer application also provides warning icons and persistent warning messages in other Axis Properties dialog boxes when the integrated safety drive is in STO Bypass mode.

Figure 80 - Axis and Safe State Indications on the Hookup Services Dialog Box

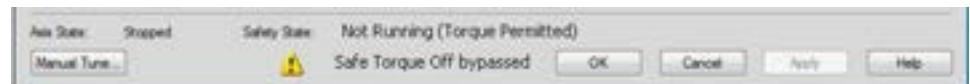


Figure 81 - Axis and Safe State Indications on Motion Direct Commands Dialog Box

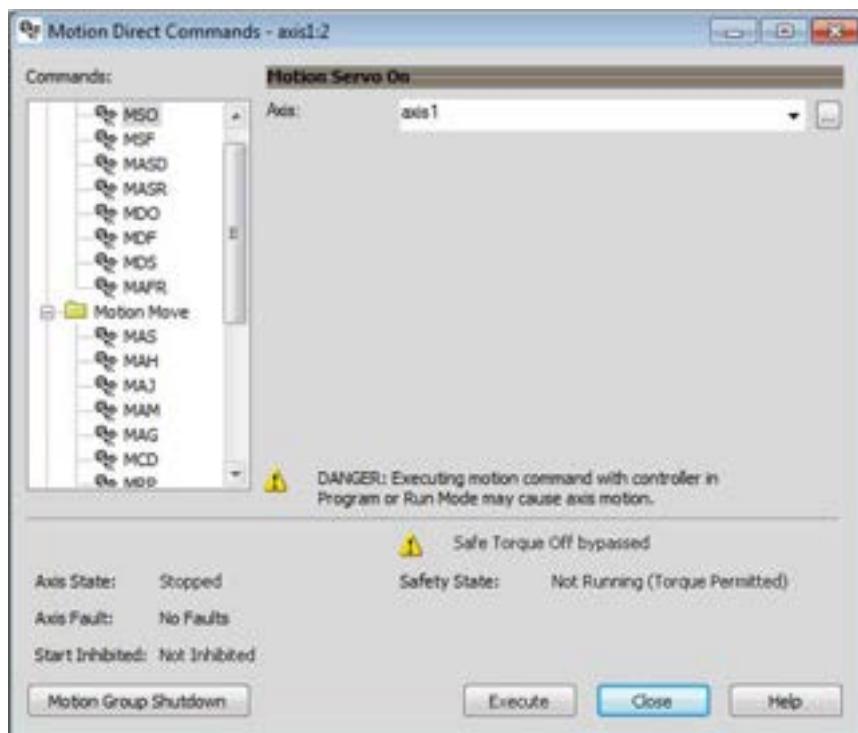
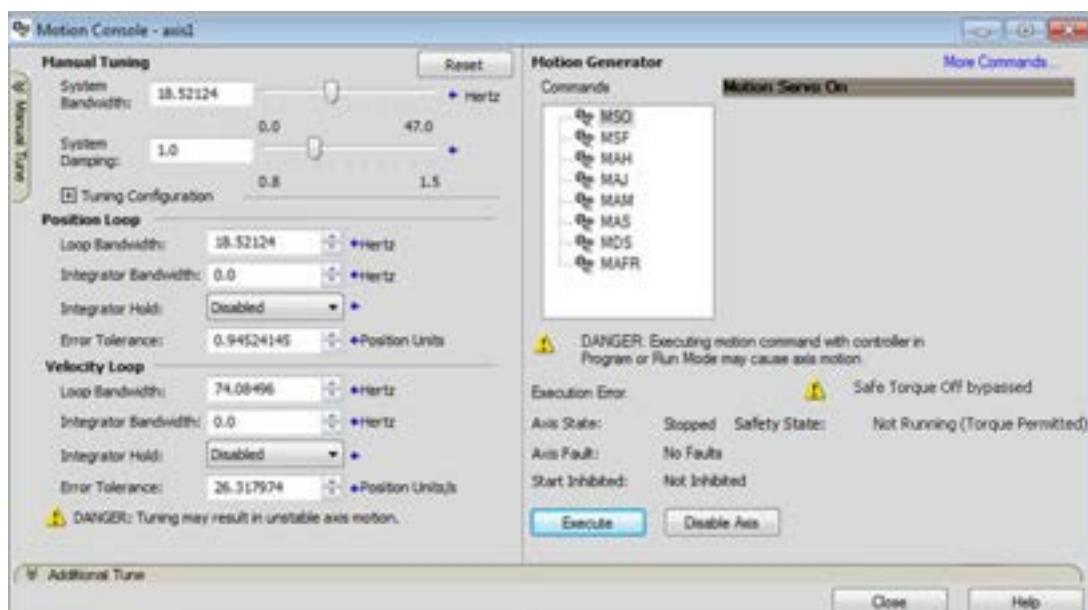


Figure 82 - Axis and Safe State Indications on the Motion Console Dialog Box



Functional Safety Considerations



ATTENTION: Before maintenance work can be performed in Program mode, the developer of the application must consider the implications of allowing motion through motion direct commands and should consider developing logic for run-time maintenance operations to meet the requirements of machine safety operating procedures.



ATTENTION: Motion is allowed when motion direct commands are used in Program mode and STO function is not available. Motion direct commands issued when the controller is in Program mode causes the drive to bypass the STO Active condition. It is your responsibility to implement additional preventive measures to maintain safety integrity of the machinery during execution of motion direct commands in Program mode.



ATTENTION: To avoid personal injury and damage to equipment in the event of unauthorized access or unexpected motion during authorized access, return the controller to RUN mode and remove the key before leaving the machine unattended.

Safe Torque-off Specifications

To maintain safety rating, Kinetix 5500 drives must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet must be IP54 or higher.

Table 81 - Safe Torque-off Network Specifications

Attribute	Value	Logix Designer Tag Name
Safety connection RPI, min	6 ms	N/A
Input assembly connections	3	N/A
Output assembly connections	1	N/A
Integrated safety open request support	Type 1 and Type 2 requests	N/A
Axis safety status	Bit 0: Safety fault	Axis.SafetyFaultStatus
	Bit 1: Safety reset request	Axis.SafetyResetRequestStatus
	Bit 2: Safety Reset Required	Axis.SafetyResetRequiredStatus
	Bit 3: Safe torque-off active	Axis.SafeTorqueOffActiveStatus
	Bit 4: Safe torque disabled	Axis.SafeTorqueDisabledStatus
	Bit 5...31: Undefined (0)	N/A
Axis safety faults	Bit 1: Safety core fault	Axis.SafetyCoreFault
	Bit 3: Safe torque-off fault	Axis.SafeTorqueOffFault
	All others: Undefined (0)	N/A

Table 82 - Safe Torque-off Assembly Specifications

Attribute	Instance Attribute	Value	Logix Designer Tag Name
Safety input assembly	0X1A0	Bit 0: Torque disabled	Drv:SI.TorqueDisabled
		Bit 6: Safety fault	Drv:SI.SafetyFault
		Bit 7: Reset required	Drv:SI.ResetRequired
Safety output assembly	0X180	Bit 0: Safe torque-off output	Drv:SO.SafeTorqueOff
		Bit 7: Reset request	Drv:SO.Reset

Notes:

Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix 5500 system components.

Topic	Page
Interconnect Diagram Notes	189
Power Wiring Examples	190
Bus-sharing Wiring Examples	192
Shunt Resistor Wiring Example	194
Kinetix 5500 Drive and Motor/Actuator Wiring Examples	195
System Block Diagrams	200

Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 5500 drive system. These notes apply to the wiring examples on the pages that follow.

Note	Information
1	For power wiring specifications, refer to Wiring Requirements on page 75 .
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Selection on page 31 .
3	AC (EMC) line filter is required for EMC compliance. Place line filter as close to the drive as possible and do not route very dirty wires in wireway. If routing in wireway is unavoidable, use shielded cable with shields grounded to the drive chassis and filter case. For AC line filter specifications, refer to Kinetix Servo Drives Specifications Technical Data , publication GMC-TD003 .
4	Terminal block is required to make connections.
5	Cable shield clamp must be used to meet CE requirements.
6	PE ground connection bonded to the panel must be used to meet CE requirements.
7	DC connector covered with protective knockout is default configuration. Remove knockout to insert DC bus T-connector and bus-bars. Do not attach discrete wiring to the DC bus terminals is.
8	Internal shunt wired to the RC connector is default configuration. Remove internal shunt wires to attach external shunt wires.
9	Default configuration for ground screws is for grounded power at user site. For ungrounded or corner-grounded power, remove the screws. Refer to Determine the Input Power Configuration on page 69 for more information.
10	 ATTENTION: Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards ISO 14121-1 and EN ISO 13849-1 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive , publication SHB-900 .
11	For motor cable specifications, refer to Kinetix Motion Accessories Specifications Technical Data , publication GMC-TD004 .
12	MPL-A15xx...MPL-A45xx, MPM-A115xx...MPM-A130xx, MPF-A3xx...MPF-A45xx, MPS-Axxx, MPAR-Axxx, and MPAS-Axxx, encoders use the +5V DC supply.
13	MPL-Bxx, MPL-A5xx, MPM-Bxx, MPM-A165xx...MPM-A215xx, MPF-Bxx, MPF-A5xx, MPS-Bxxx, MPAR-Bxxx, and MPAS-Bxxx encoders use the +9V DC supply.
14	Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and $\underline{\underline{L}}$ (GND) or A, B, C, and $\underline{\underline{L}}$ (D) respectively.
15	LDAT-Series linear thrusters do not have a brake option, so only the 2090-CPWM7DF-xxAAxx or 2090-CPWM7DF-xxAFxx motor power cables apply.

Power Wiring Examples

You must supply input power components. The single-phase and three-phase line filters are wired downstream of the input fusing.

Single-axis Drive Wiring Examples

Figure 83 - Kinetix 5500 Drives Power Wiring (three-phase operation)

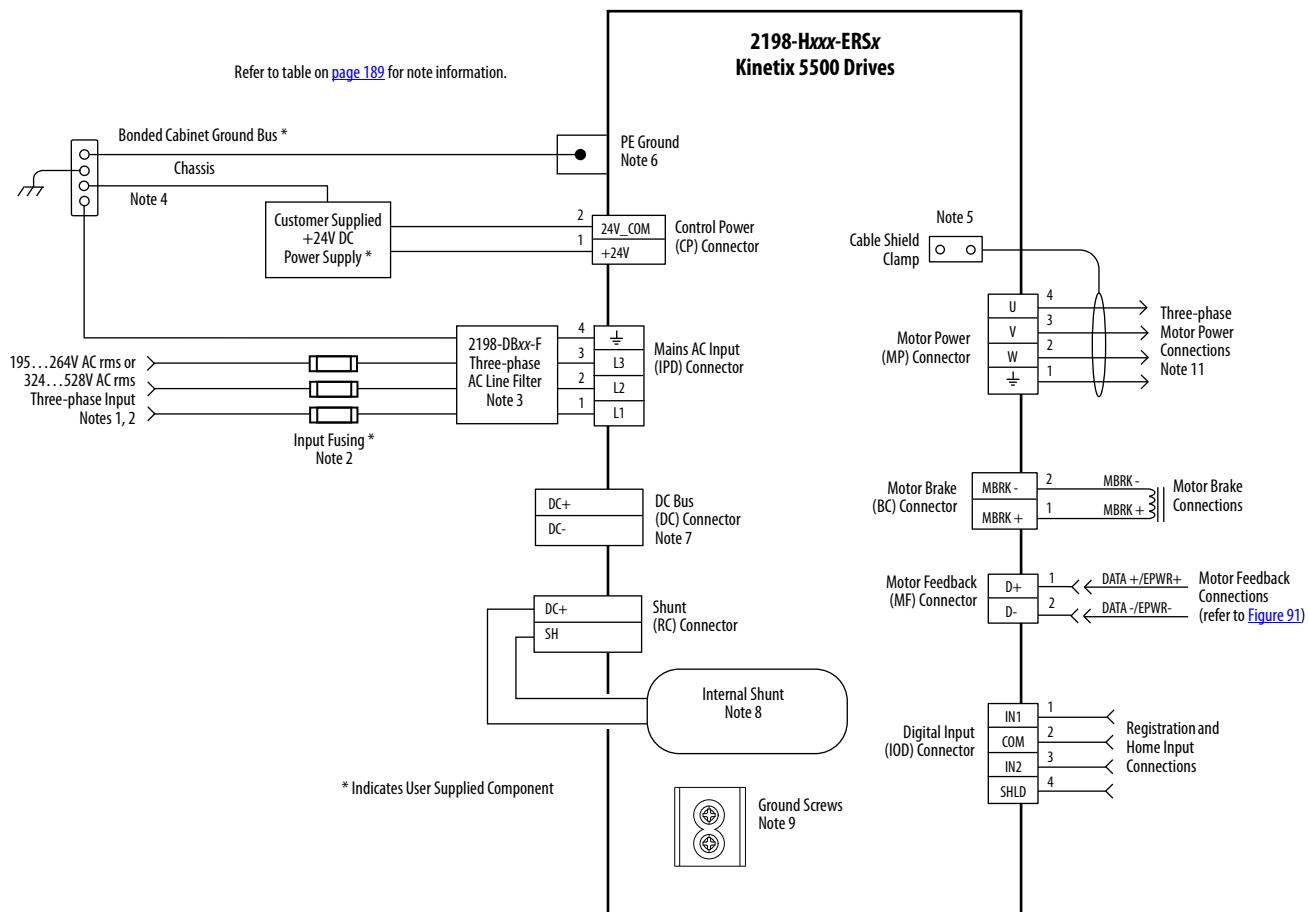
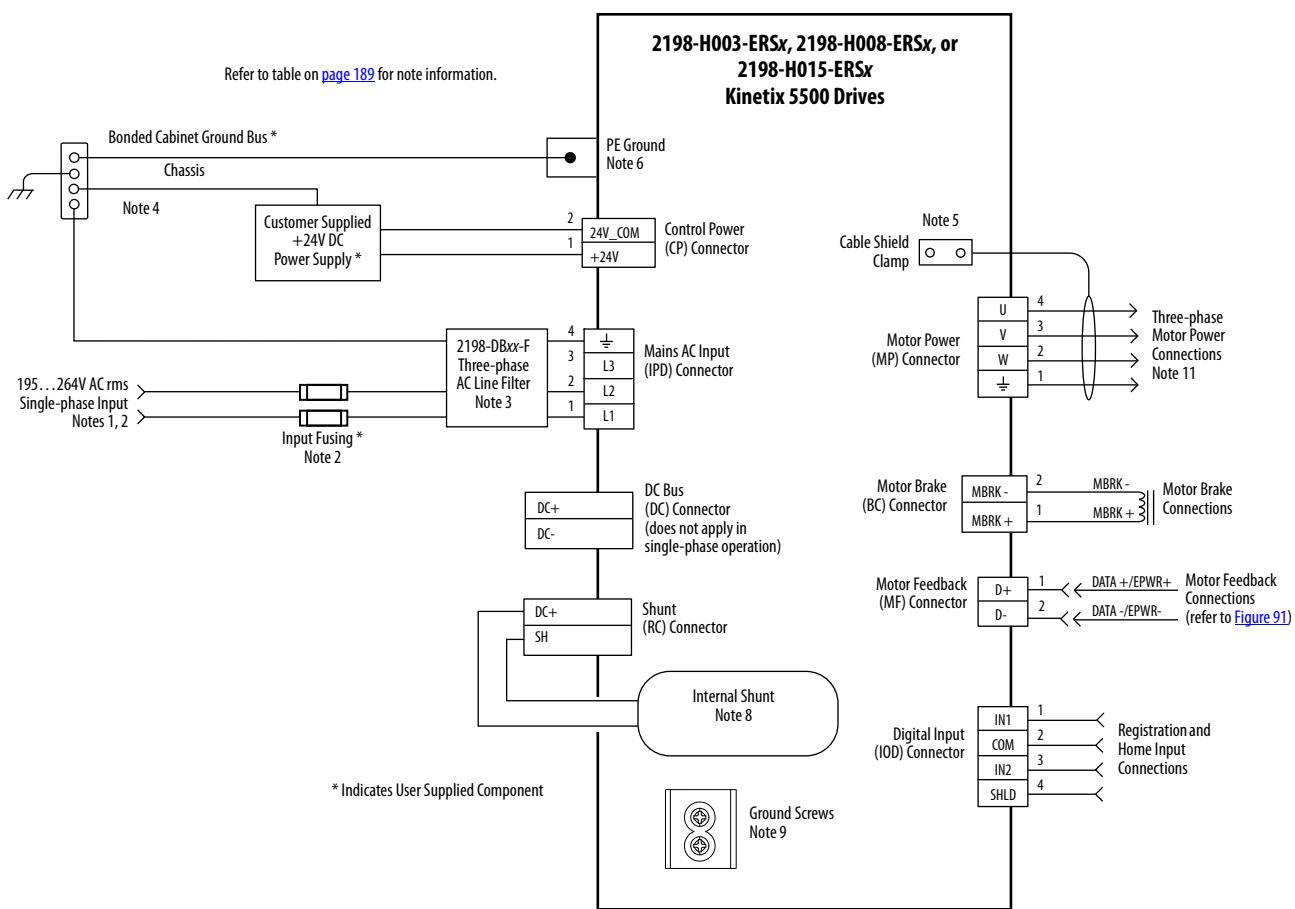
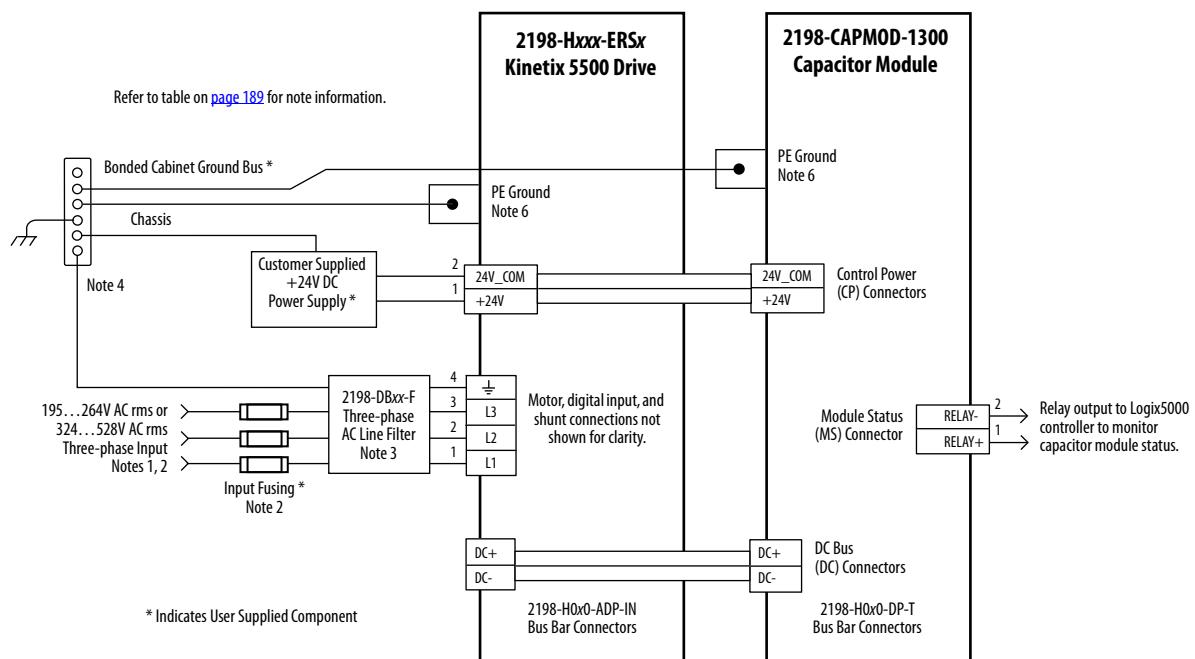


Figure 84 - Kinetix 5500 Drives Power Wiring (single-phase operation)**Figure 85 - Kinetix 5500 Capacitor Module**

Bus-sharing Wiring Examples

For bus-sharing configurations, use the 2198-H0x0-xx-x shared-bus connection system to extend power from drive to drive.

Figure 86 - Kinetix 5500 Drives with Shared AC Bus

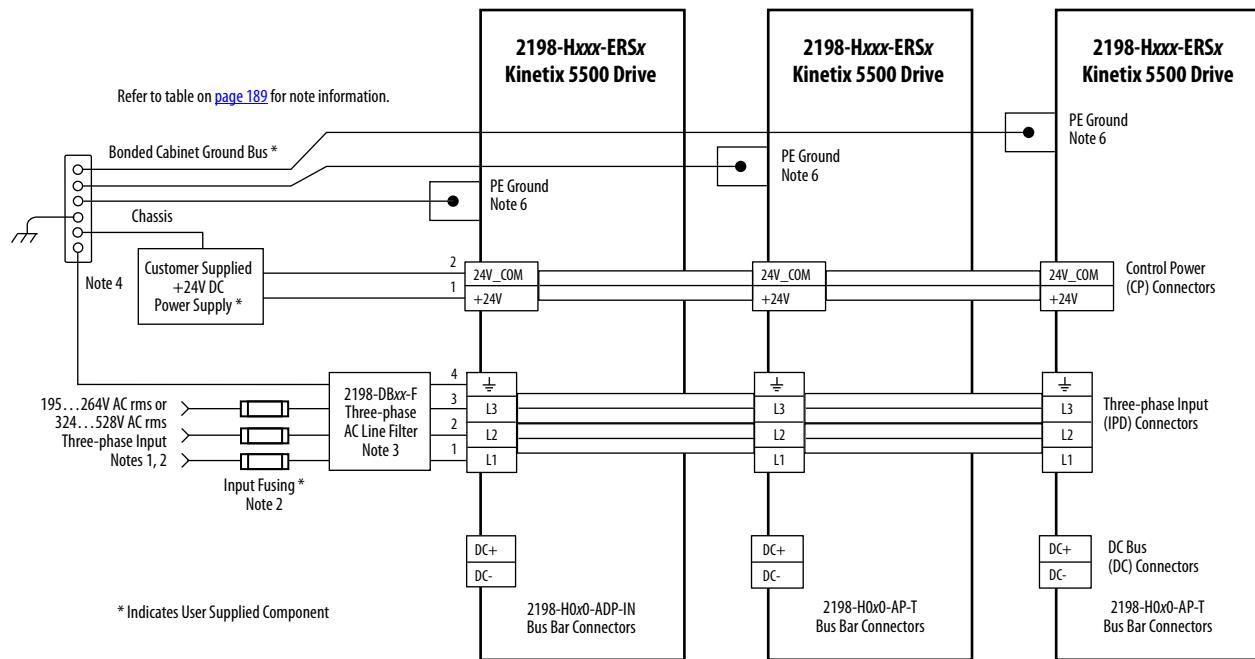


Figure 87 - Kinetix 5500 Drives with Shared AC/DC Bus

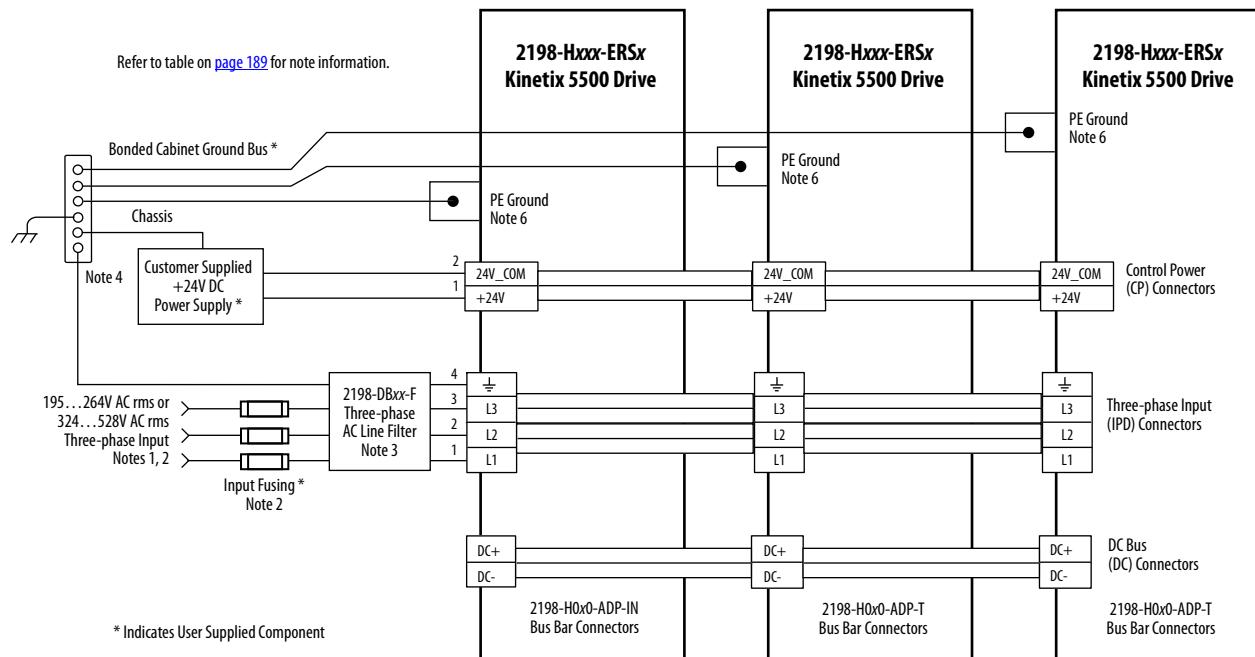
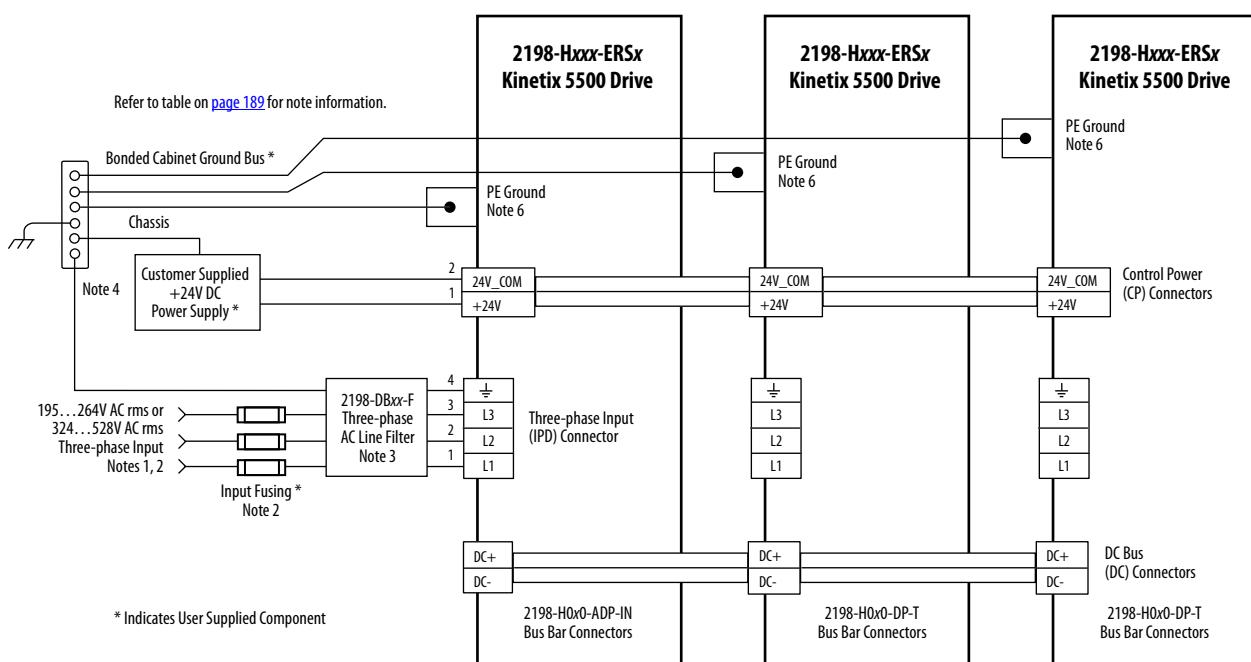
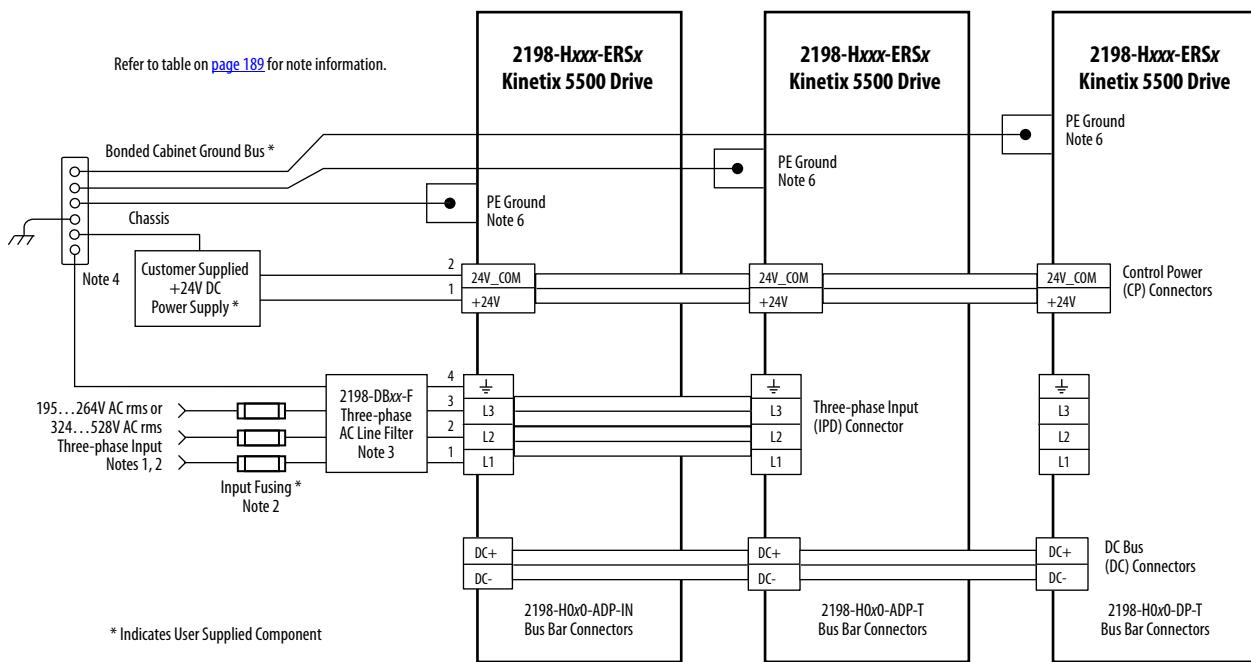


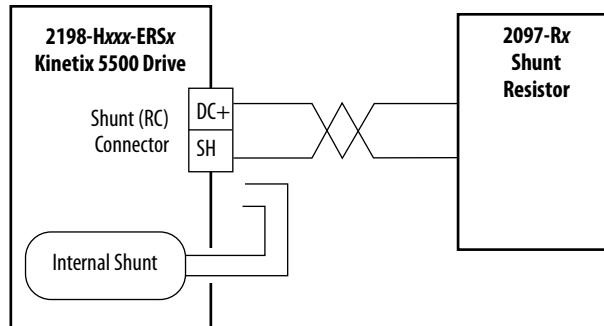
Figure 88 - Kinetix 5500 Drives with Shared DC (common bus)**Figure 89 - Kinetix 5500 Drives with Shared AC/DC Hybrid Bus**

Shunt Resistor Wiring Example

Refer to the [External Shunt Resistor Connections](#) on [page 96](#) for the Bulletin 2097 external shunt resistor catalog numbers available for Kinetix 5500 servo drives.

IMPORTANT Before wiring the Bulletin 2097 external shunt to the RC connector, remove the wires from the servo drive internal shunt. Do not connect internal and external shunt resistors to the drive.

Figure 90 - Shunt Resistor Wiring Example



Refer to the Kinetix 300 Shunt Resistor Installation Instructions, publication [2097-IN002](#), for shunt resistor installation instructions.

Kinetix 5500 Drive and Motor/Actuator Wiring Examples

The Kinetix VP motors use single cable technology. The motor power, brake, and feedback wires are all packaged in a single cable.

Figure 91 - Kinetix 5500 Drives with Kinetix VP Motors (Bulletin VPL, VPF, and VPS)

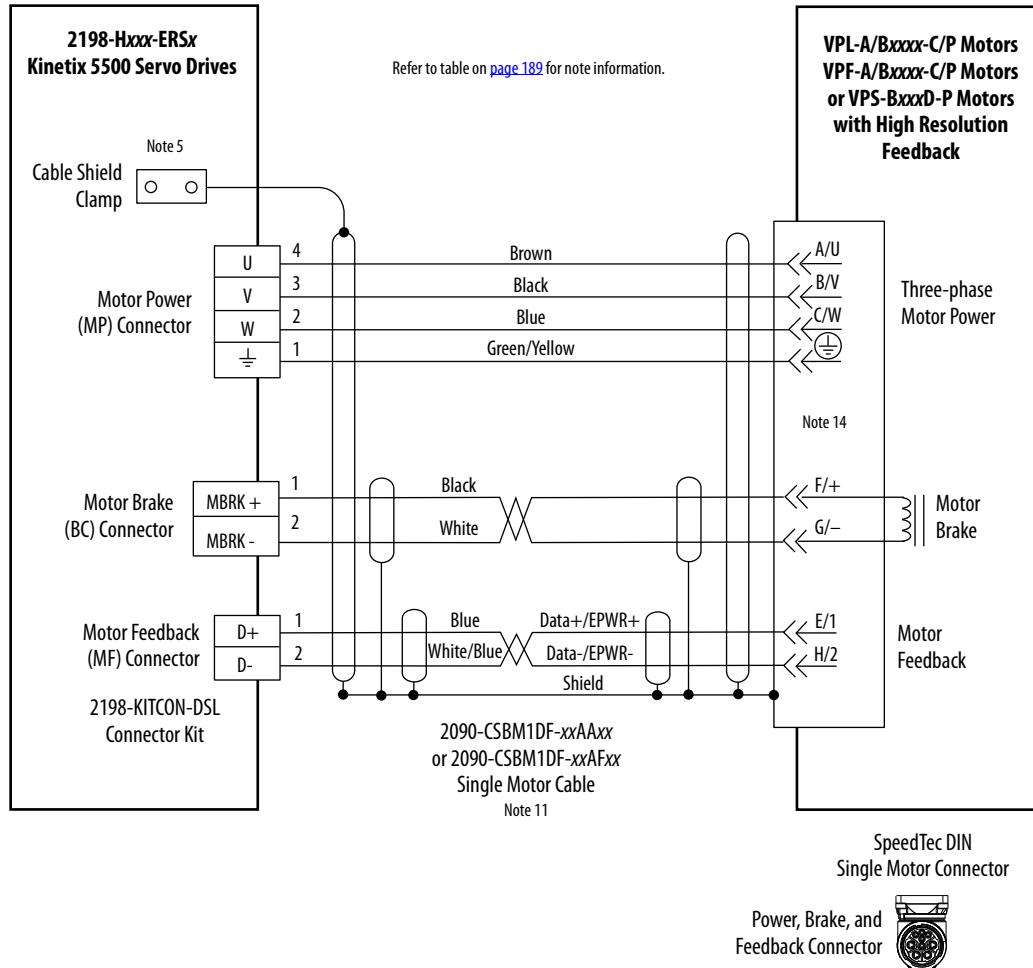
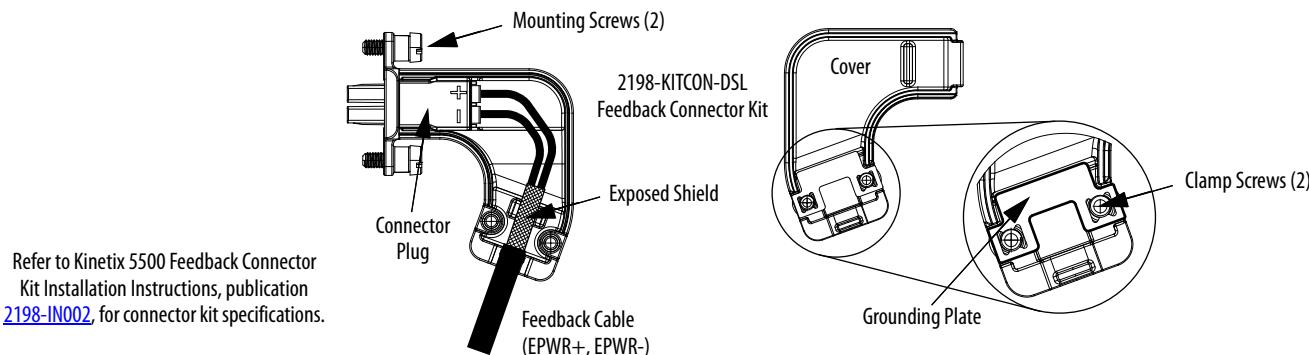
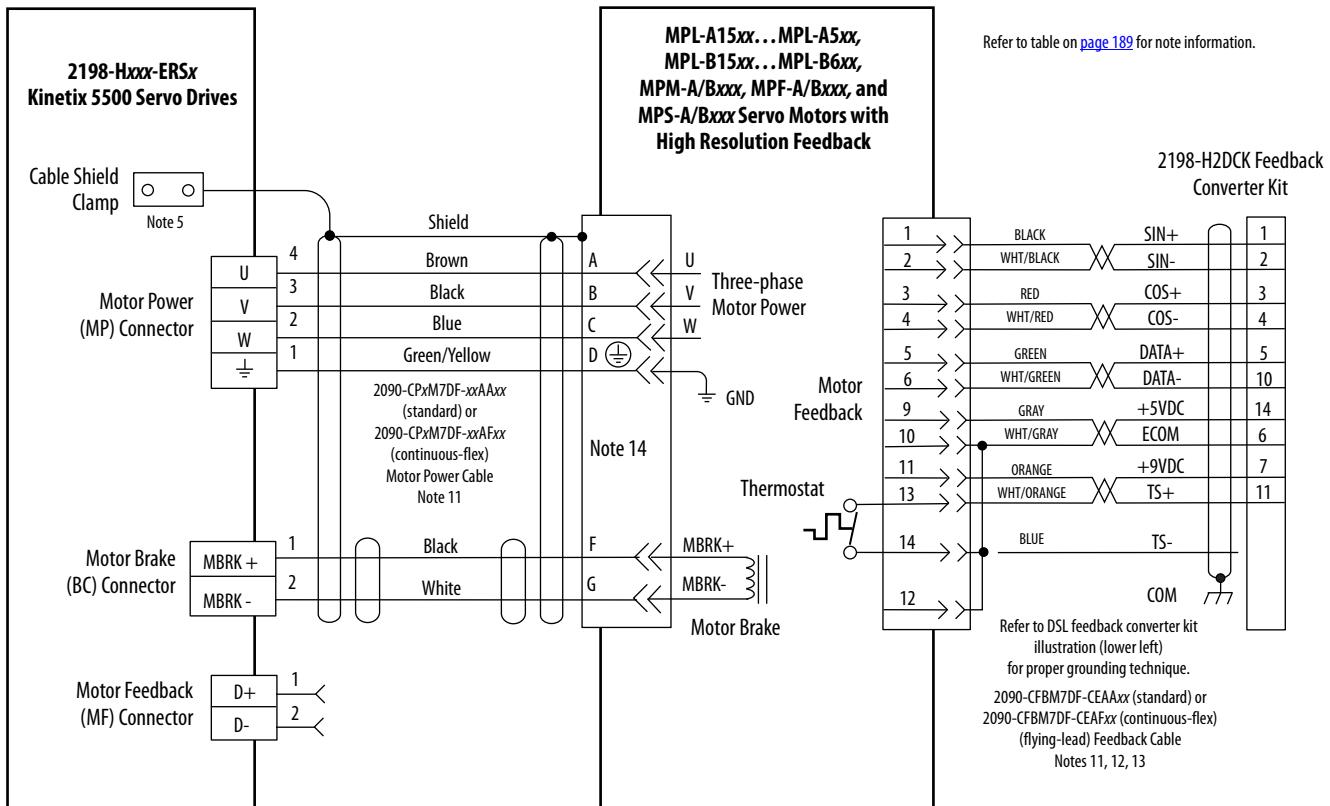


Figure 92 - Grounding Technique for Feedback Cable Shield

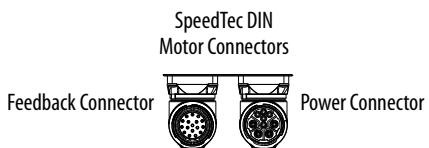
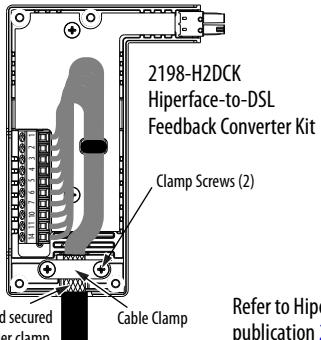


Compatible Allen-Bradley rotary motors (Bulletin MPL, MPM, MPF, and MPS) and linear actuators (Bulletin MPAS, MPAR, MPAI, and LDAT-Series) have separate connectors and cables for power/brake and feedback connections.

Figure 93 - Kinetix 5500 with MP-Series Rotary Motors



Grounding Technique for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.

Figure 94 - Kinetix 5500 with LDAT-Series Linear Thrusters

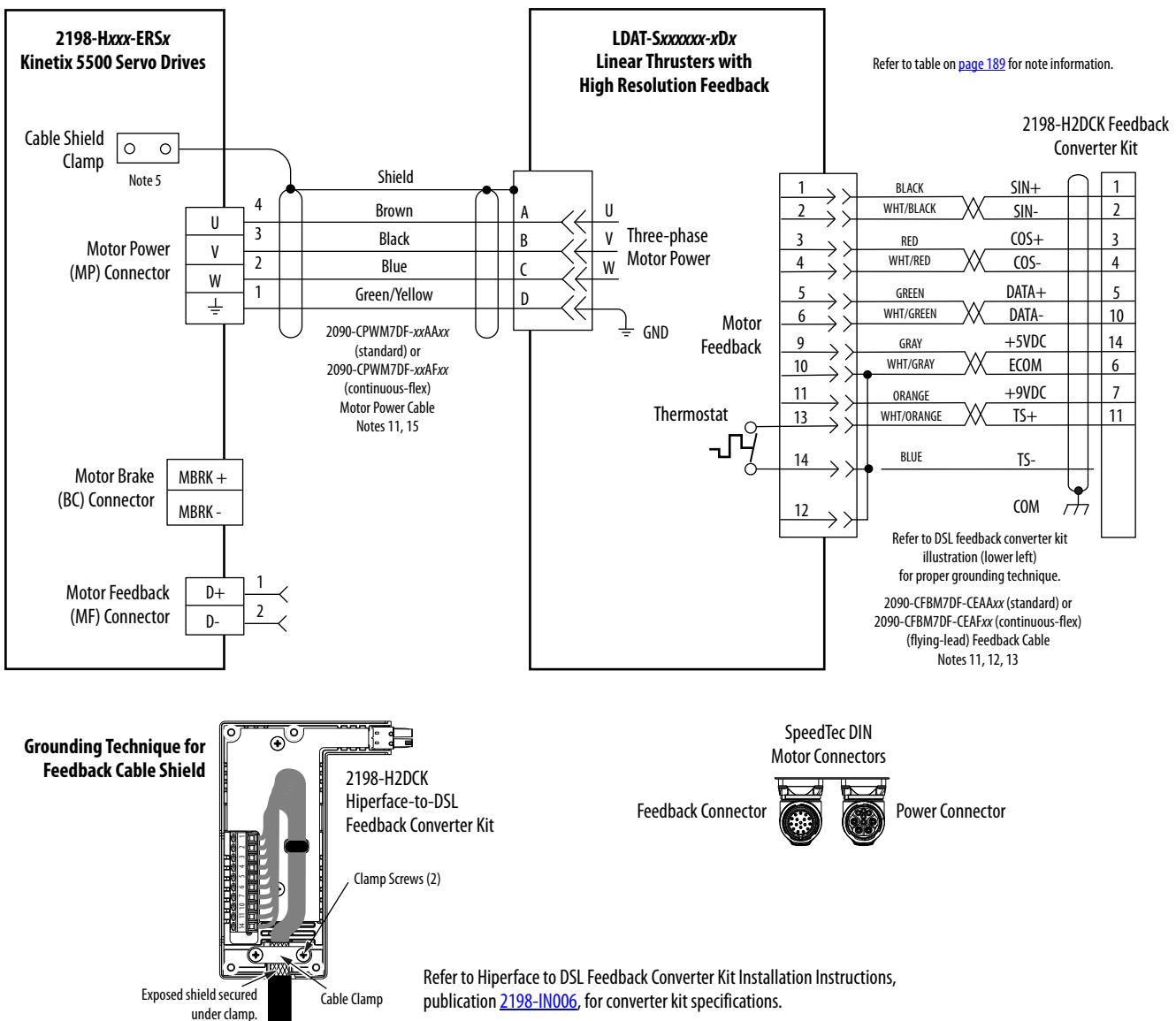
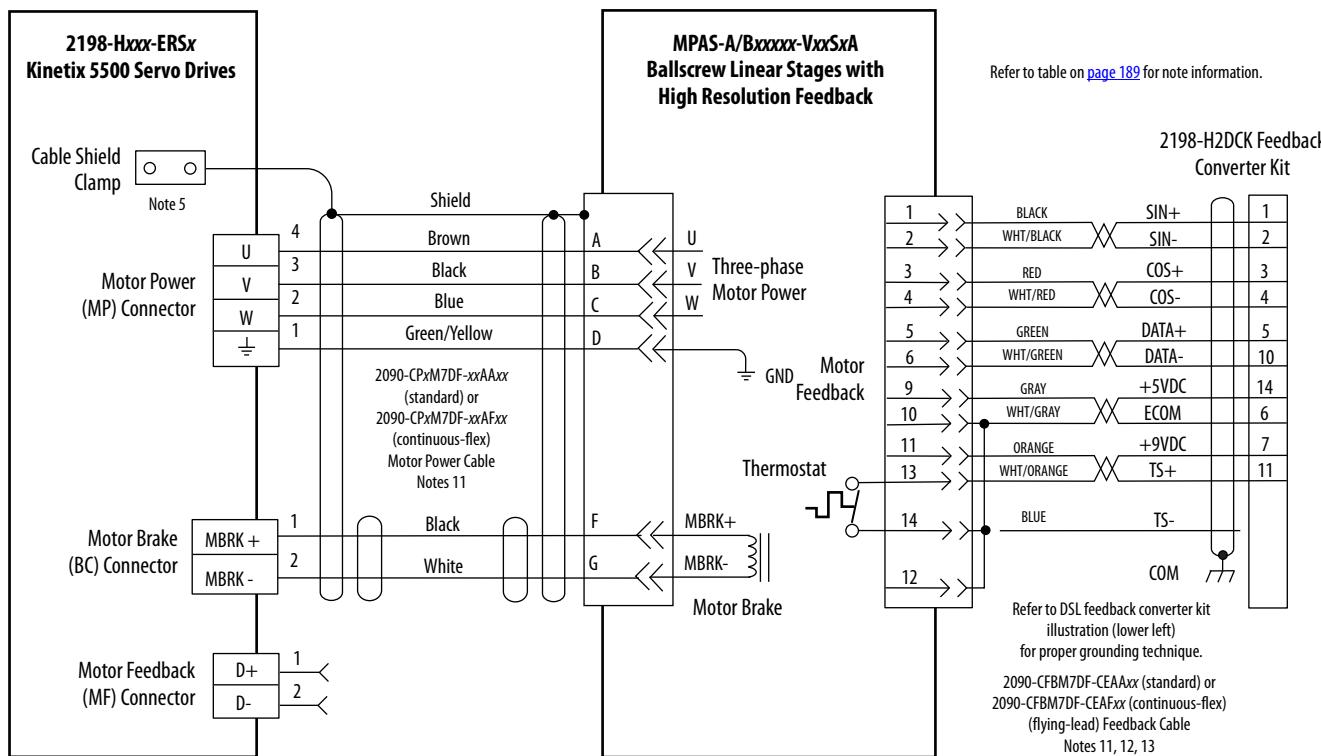
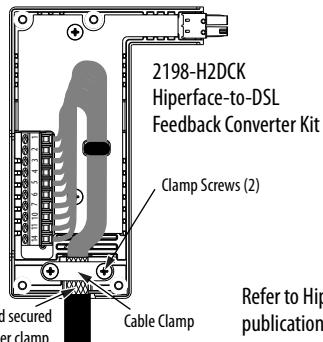


Figure 95 - Kinetix 5500 with MP-Series Linear Stages

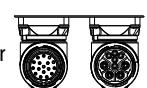


Grounding Technique for Feedback Cable Shield



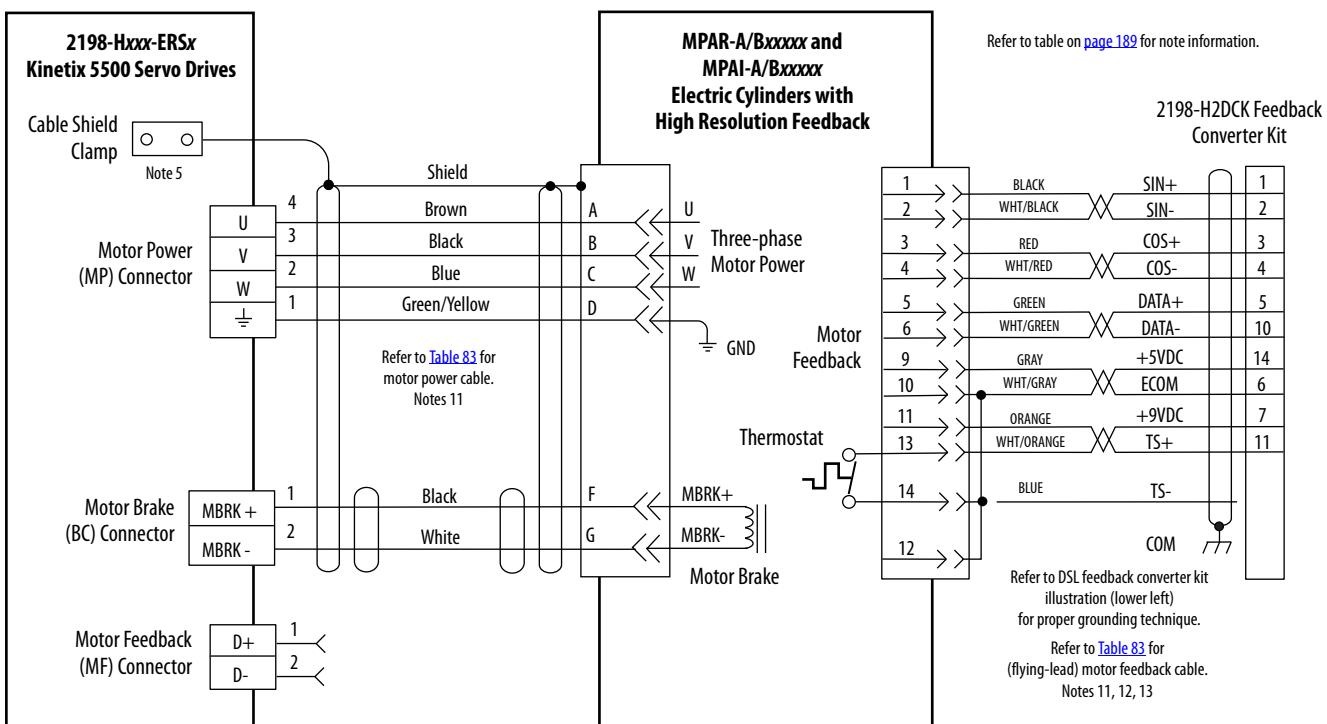
Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.

SpeedTec DIN Motor Connectors

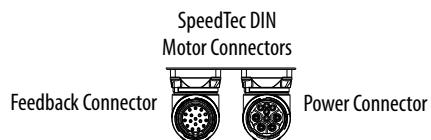
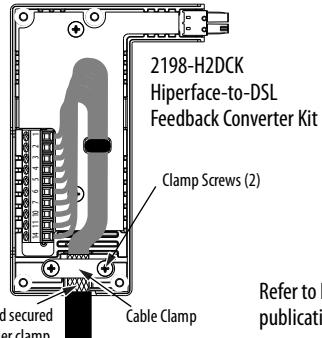


Power Connector

Figure 96 - Kinetix 5500 with MP-Series Electric Cylinders



Grounding Technique for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.

Table 83 - MP-Series Electric Cylinder Power and Feedback Cables

MP-Series Electric Cylinder Cat. No.	Frame	Power Cable Cat. No.	Feedback Cable Cat. No.
MPAR-A/B1xxx (series A)	32	2090-XXNPMF-16Sxx (standard) or 2090-CPxM4DF-16AFxx (continuous-flex)	2090-XXNFMF-Sxx (standard) or 2090-CFBM4DF-CDAFxx (continuous-flex)
MPAR-A/B2xxx (series A)	40		
MPAR-A/B1xxx (series B)	32		
MPAR-A/B2xxx (series B)	40		
MPAR-A/B3xxx	63		
MPAI-A/B2xxxx	64	2090-CPxM7DF-16AAxx (standard) or 2090-CPxM7DF-16AFxx (continuous-flex)	2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx (continuous-flex)
MPAI-A/B3xxxx	83		
MPAI-A/B4xxxx	110		
MPAI-B5xxxx	144		
MPAI-A5xxxx	144	2090-CPxM7DF-14AAxx (standard) or 2090-CPxM7DF-14AFxx (continuous-flex)	2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx (continuous-flex)

System Block Diagrams

This section provides block diagrams of the Kinetix 5500 drive modules.

Figure 97 - Kinetix 5500 Drive Block Diagram

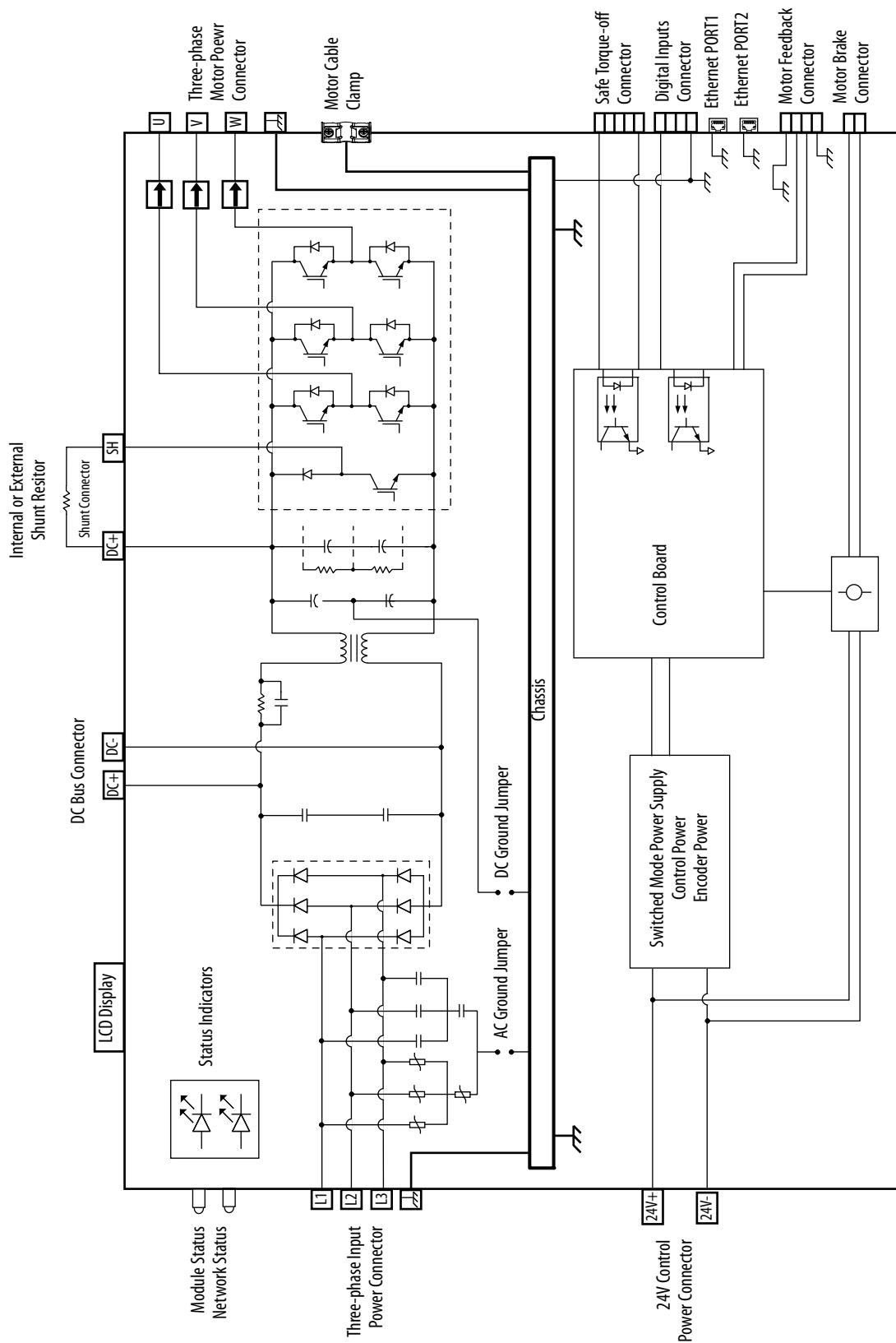
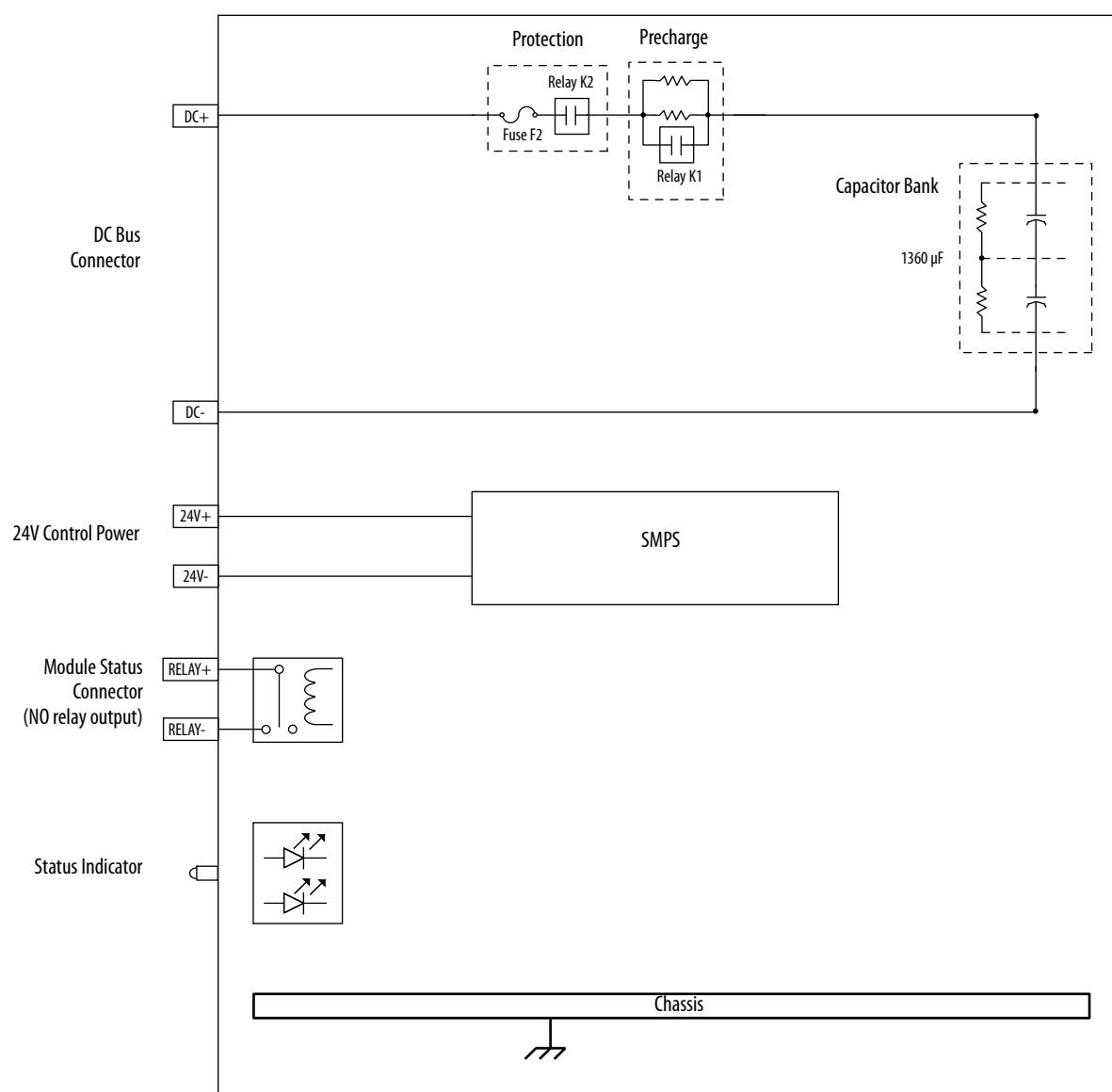


Figure 98 - Kinetix 5500 Capacitor Module Block Diagram

Notes:

Upgrade the Drive Firmware

This appendix provides procedures for upgrading firmware by using ControlFLASH software.

Topic	Page
Before You Begin	204
Upgrade Firmware	207
Verify the Firmware Upgrade	211

Upgrading drive firmware by using ControlFLASH software involves configuring your Logix5000 controller communication, selecting the drive to upgrade, and upgrading the firmware.

-
- IMPORTANT** If the drive firmware contains updated safety firmware, you must de-energize the safety inputs first or the upgrade fails.
To update the drive firmware in Feedback Only mode, you must inhibit the axis first. Refer to [Inhibit Feedback Only Axis](#) on [page 206](#) for more information.
-

Before You Begin

These are the minimum firmware revisions and software versions required for upgrading drive firmware.

Table 84 - Kinetix 5500 System Requirements

Description	Firmware Revision
Logix Designer application	21.00 or later
RSLinx software	2.58 or later
ControlFLASH software kit ⁽¹⁾	11.00 or later

Catalog numbers of the targeted Kinetix 5500 drive module you want to upgrade.

Network path to the targeted Kinetix 5500 drive module you want to upgrade.

- (1) Download the ControlFLASH kit from <http://support.rockwellautomation.com/controlflash>. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit Quick Start, publication [1756-0S105](#).

IMPORTANT Control power must be present at CP-1 (24V+) and CP-2 (24V-) prior to upgrading your target drive. The axis state on the LCD display must be STANDBY, CONFIGURING, STOPPED, or PRECHARGE before beginning this procedure.



ATTENTION: To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC or common-bus DC input power to the drive.

Configure Logix5000 Controller Communication

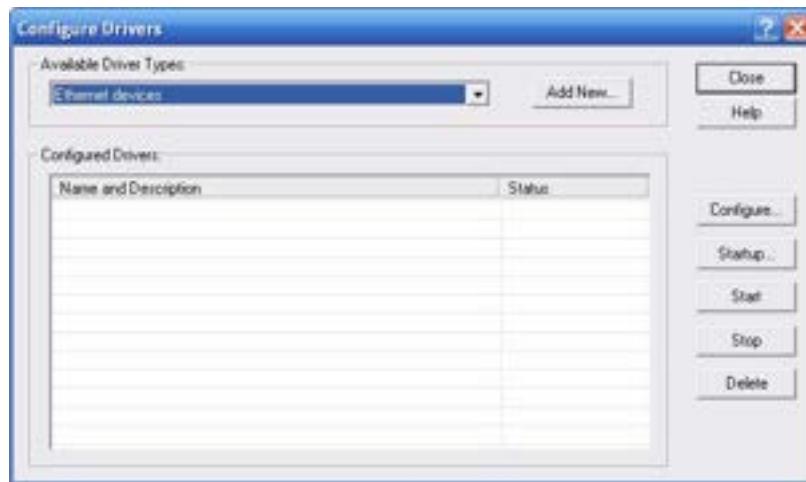
This procedure assumes that your communication method to the Logix5000 controller is the Ethernet network. It also assumes that your Logix5000 Ethernet module or controller has already been configured.

For more controller information, refer to [Additional Resources](#) on [page 12](#).

Follow these steps to configure Logix5000 controller communication.

1. Open your RSLinx Classic software.
2. From the Communications menu, choose Configure Drivers.

The Configure Drivers dialog box appears.



3. From the Available Driver Types pull-down menu, choose Ethernet devices.
4. Click Add New.

The Add New RSLinx Classic Driver dialog box appears.

5. Type the new driver name.



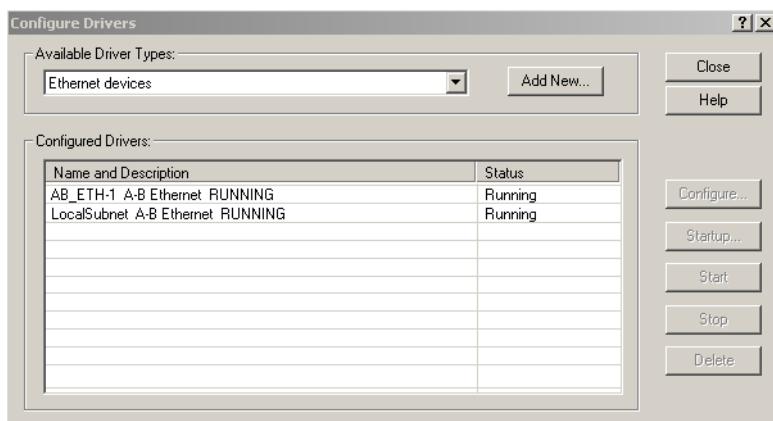
6. Click OK.

The Configure driver dialog box appears.



7. Type the IP address of your Kinetix 5500 servo drive.
8. Click OK.

The new Ethernet driver appears under Configured Drivers.

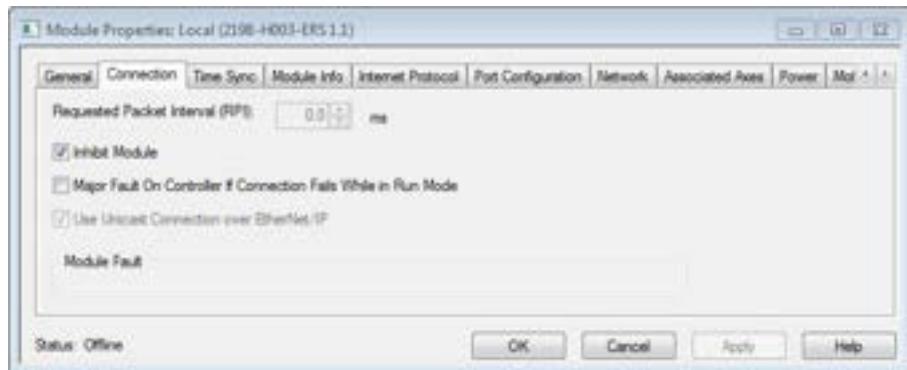


9. Click Close.
10. Minimize the RSLinx application dialog box.

Inhibit Feedback Only Axis

If an axis is configured as Feedback Only, you must inhibit the axis prior to performing the firmware upgrade. Follow these steps to inhibit an axis.

1. Open your Logix Designer application.
 2. Right-click the 2198-Hxxx-ERSx servo drive you configured as Feedback Only and choose Properties.
- The Module Properties dialog box appears.
3. Click the Connection tab.



4. Check Inhibit Module.
5. Click OK.
6. Save your file and download the program to the controller.

Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. In the Logix Designer application, from the Tools menu, choose ControlFLASH.

TIP You can also open ControlFLASH software by choosing Start>Programs>FLASH Programming Tools>ControlFLASH.

The Welcome to ControlFLASH dialog box appears.



2. Click Next.

The Catalog Number dialog box appears.

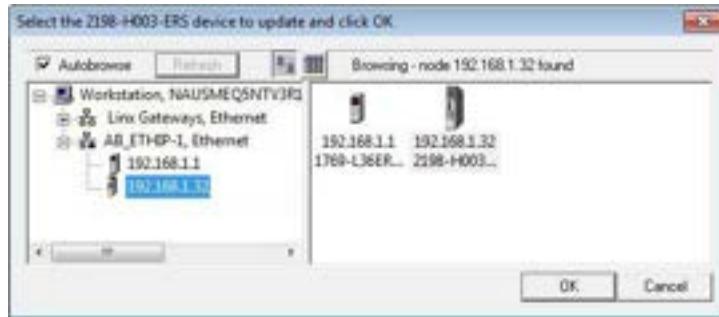


3. Select your drive module.

In this example, the 2198-H003-ERS servo drive is selected.

4. Click Next.

The Select Device to Update dialog box appears.



5. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.

6. Select the servo drive to upgrade.

7. Click OK.

The Firmware Revision dialog box appears.



8. Select the firmware revision to upgrade.

9. Click Next.

The Summary dialog box appears.



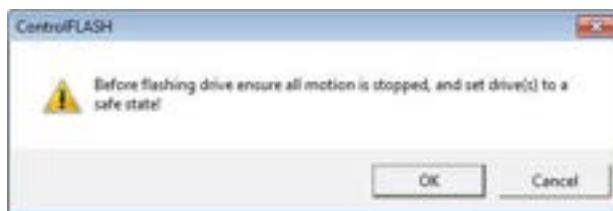
10. Confirm the drive catalog number and firmware revision.
11. Click Finish.

This ControlFLASH warning dialog box appears.



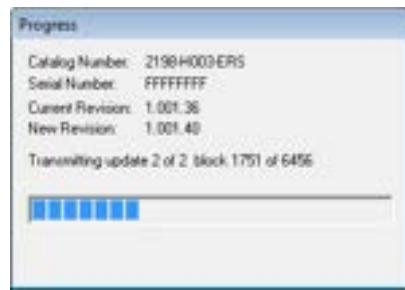
12. Click Yes (only if you are ready).

This ControlFLASH warning dialog box appears.



13. Acknowledge the warning and click OK.

The Progress dialog box appears and updating begins.

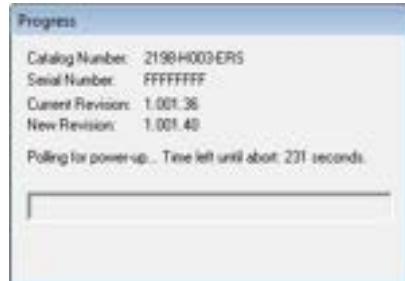


The axis state on the LCD display changes from CONFIGURING, STOPPED, or PRECHARGE to FIRMWARE UPDATE, which indicates that the upgrade is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.

14. Wait for the Progress dialog box to time out.

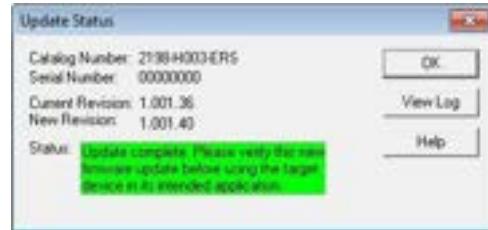
It is normal for this process to take several minutes.



IMPORTANT Do not cycle power to the drive during this process or the firmware upgrade does not complete successfully.

15. Verify that the Update Status dialog box appears and indicates success or failure as described below.

Upgrading Status	If
Success	Update complete appears in a GREEN Status dialog box, then go to step 16 .
Failure	Update failure appears in a RED Status dialog box, then refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105 , for troubleshooting information.



16. Click OK.

IMPORTANT If you are upgrading a feedback-only axis and you checked Inhibit Module on the Connection tab in Module Properties, you must clear the Inhibit Module checkbox before resuming normal operation.

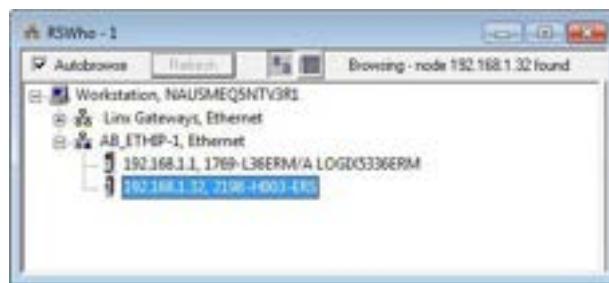
Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

TIP

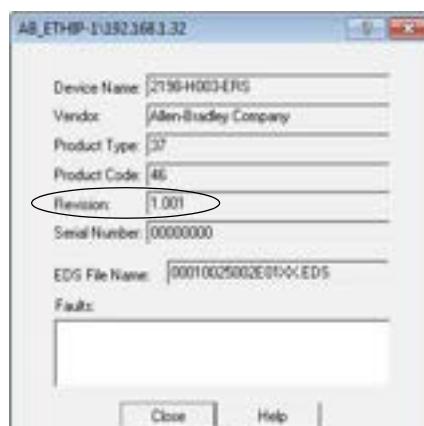
Verifying the firmware upgrade is optional.

1. Open your RSLinx software.
2. From the Communications menu, choose RSWho.



3. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
4. Right-click the drive module and choose Device Properties.

The Device Properties dialog box appears.



5. Verify the new firmware revision level.
6. Click Close.

Notes:

Sizing Multi-axis Shared-bus Configurations

This appendix provides information and examples for sizing your Kinetix 5500 drive shared-bus configurations.

Topic	Page
Shared-bus Configurations	213
Power Sharing Sizing Examples	218
Control Power Current Calculations	220
Energy Calculations	222

Shared-bus configurations include the following types:

- Shared AC
- Shared DC (common bus)
- Shared AC/DC
- Shared AC/DC Hybrid

These restrictions apply to all shared-bus configurations:

- Shared-bus configurations must use the shared-bus connection system.

IMPORTANT Do not make drive-to-drive connections with discrete wires.

- Single-phase drive operation is not supported.
- Shared AC/DC and shared AC/DC hybrid configurations result in a derating of 30% of the total converter power available.
- The zero-stack tabs and cutouts must be engaged from drive-to-drive. Systems cannot start in one cabinet and end in another.
- Program drives for the same converter AC input voltage.

Shared-bus Configurations

Shared AC configurations are configured as Standalone in the project file and do not share these restrictions that apply to multi-axis shared-bus configurations:

- All drives in a bus-sharing group must be configured with the same bus power-sharing group number in the Logix Designer application.
- The maximum number of drives in any bus power-sharing group cannot exceed eight.

Shared AC Configurations

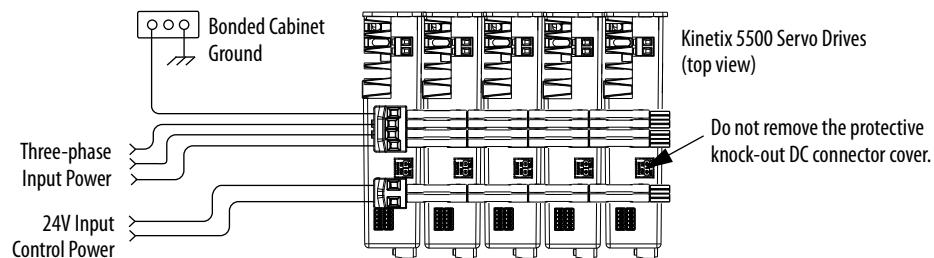
In shared AC configurations, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC bus to all downstream drives:

- All drives are configured in the project file as Standalone drives.
- Drives must be of the same power rating (catalog number).
- Shared AC configurations do not support Bulletin 2198 capacitor modules.
- The maximum number of drives in Shared AC configurations is restricted as described in [Table 85](#).

Table 85 - Shared AC Panel Layout

Drive Cat. No.	Frame Size	Number of Drives Configured as Shared AC, max
2198-H003-ERSx	1	5
2198-H008-ERSx		
2198-H015-ERSx		
2198-H025-ERSx	2	3
2198-H040-ERSx		
2198-H070-ERSx	3	2

Figure 99 - Typical Shared AC Configuration



For an example shared AC installation with additional details, refer to [Typical Shared AC Installations](#) on page 16.

Shared DC Configurations

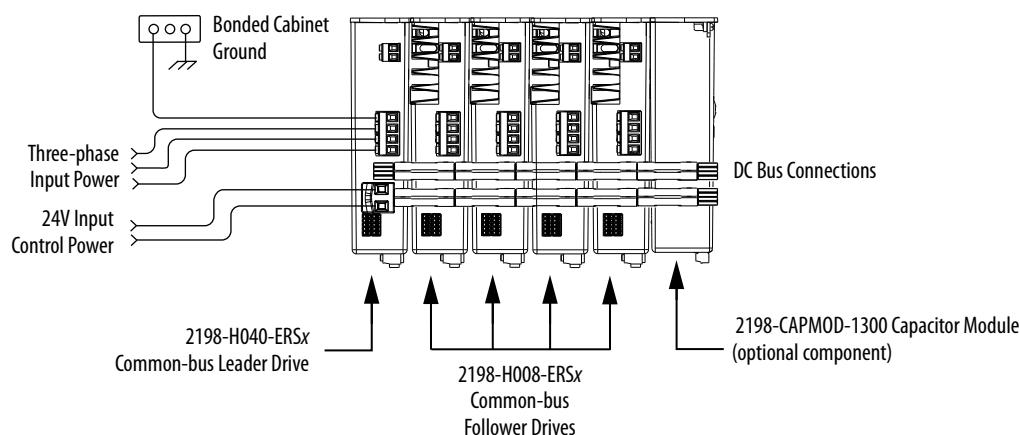
In a Shared DC (DC common bus) configuration, the first (leftmost) drive is the leader drive and is the only drive that receives the AC input voltage. All drives to the right of the leader drives are follower drives. They receive the DC bus voltage extended from the leader drive through the shared-bus connection system:

- For DC common-bus installations, the power rating of the leader drive must be greater than or equal to the power rating of the follower drives.
- The leader drive is configured in the project file as a Shared AC/DC drive.
- The follower drives are configured in the project file as Shared DC drives.
- Shared DC configurations support Bulletin 2198 capacitor modules.

Table 86 - Shared DC Panel Layout

Frame Size Combination	Leader Drive Cat. No.	Follower Drives, max ⁽¹⁾	Follower Cat. No.	Number of Capacitor Modules, max
1	2198-H003-ERSx	4	2198-H003-ERSx	0
	2198-H008-ERSx	4	2198-H003-ERSx	1
			2198-H008-ERSx	1
2 and 1	2198-H015-ERSx	6	2198-H003-ERSx	1
			2198-H008-ERSx	
			2198-H015-ERSx	
2	2198-H025-ERSx	6	2198-H003-ERSx	3
			2198-H008-ERSx	
			2198-H015-ERSx	
2 and 1	2198-H040-ERSx	6	2198-H003-ERSx	3
			2198-H008-ERSx	
			2198-H015-ERSx	
2	2198-H040-ERSx	6	2198-H025-ERSx	3
			2198-H040-ERSx	
			2198-H070-ERSx	
3 and 1	2198-H070-ERSx	7	2198-H003-ERSx	4
			2198-H008-ERSx	
			2198-H015-ERSx	
3 and 2	2198-H070-ERSx	7	2198-H025-ERSx	4
			2198-H040-ERSx	
			2198-H070-ERSx	

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication [2198-IN004](#).

Figure 100 - Typical DC Common Bus Configuration**IMPORTANT**

Total number of drives in Kinetix 5500 drive system must not exceed 8.

For an example shared DC installation with additional details, refer to [Typical Shared DC Common-bus Installations](#) on page 18.

Shared AC/DC Configurations

In a shared AC/DC configuration, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC and DC bus to all downstream drives:

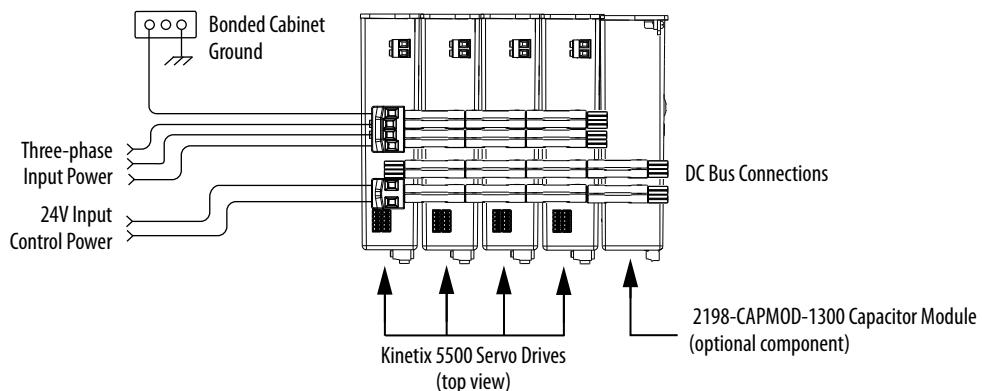
- All drives are configured in the project file as Shared AC/DC drives.
- Drives must be of the same power rating (catalog number).
- Shared AC/DC configurations support Bulletin 2198 capacitor modules
- Total available converter power is derated by 30%.
- The maximum number of drives configured as Shared AC/DC is described in [Table 87](#).

Table 87 - Shared AC/DC Panel Layout

Drive Cat. No.	Frame Size	Drives Configured as Shared AC/DC, max ⁽¹⁾	Number of Capacitor Modules, max
2198-H003-ERSx	1	8	0
2198-H008-ERSx			1
2198-H015-ERSx	2	4	
2198-H025-ERSx			4
2198-H040-ERSx			
2198-H070-ERSx	3	2	4

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication [2198-IN004](#).

Figure 101 - Typical Shared AC/DC Configuration



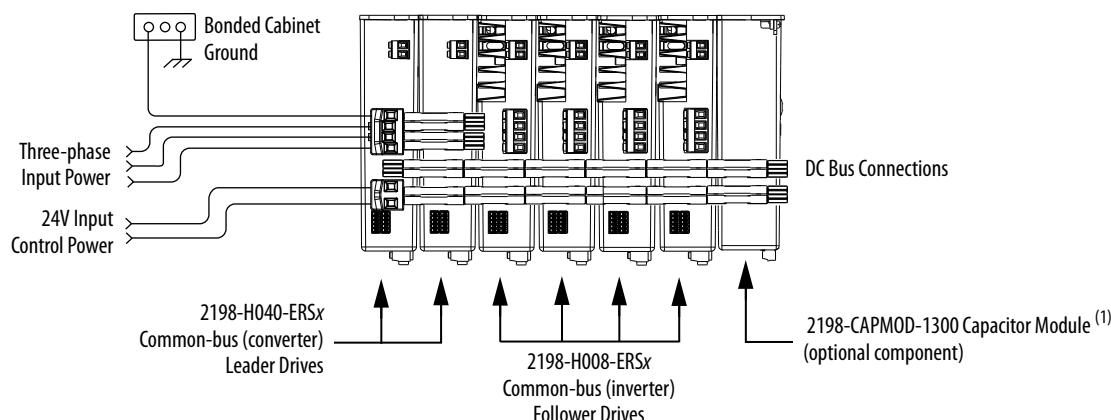
For an example shared AC/DC installation with additional details, refer to [Typical Shared AC/DC Installations](#) on page 17.

Shared AC/DC Hybrid Configurations

In shared AC/DC hybrid configurations, three-phase AC input power is supplied to two or more (leader) drives that act as converters. This parallel converter configuration increases the DC power supplied to the inverter (follower) drives:

- The leftmost drives in a hybrid configuration act as parallel converter drives and must be of the same power rating (catalog number).
- Shared DC (inverter) drives mounted to the right of the shared AC/DC (converter) drives must have the same or lower power rating (catalog number) than the shared AC/DC drives.
- The total motoring load must not exceed the rated load for the drives sourcing the DC power. Each follower drive must be sized for the motor load connected to it.
- Total available converter power is derated by 30%.
- The maximum number of drives configured in the project file as Shared AC/DC is restricted according to [Table 87 on page 216](#).
- The maximum number of drives configured in the project file as Shared DC is restricted according to [Table 86 on page 215](#).
- Shared AC/DC hybrid configurations support Bulletin 2198 capacitor modules.

Figure 102 - Typical Shared AC/DC Hybrid Configuration



(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication [2198-IN004](#).

For an example shared AC/DC hybrid installation with additional details, refer to [Typical Shared AC/DC Bus Hybrid Installations on page 19](#).

Power Sharing Sizing Examples

For best results, size motors based on load torque requirements by using Motion Analyzer software. Select drives based on continuous or peak torque requirements. Based on the load profile, use Motion Analyzer software to estimate the net converter and inverter power and bus regulator capacity.

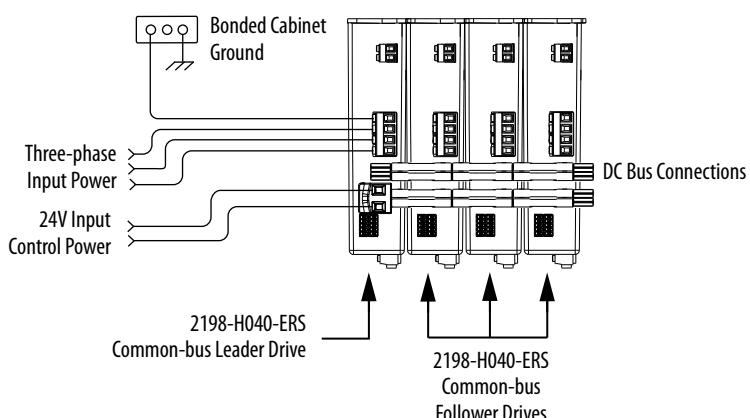
Table 88 - Converter and Bus Regulator Capacity

Configuration	Available Converter Capacity	Available Regenerative Capacity
Shared AC	Converter power rating of each drive	Internal shunt of each drive
Common bus	Converter power rating of leader drive	
Shared AC/DC	Sum of converter power ratings times 0.7	Sum of all internal shunts from each drive in bus-sharing group
Shared AC/DC hybrid	(70%)	

Shared DC Example

In this example four 2198-H040-ERS drives are used in a common-bus configuration.

Figure 103 - DC Common Bus Configuration



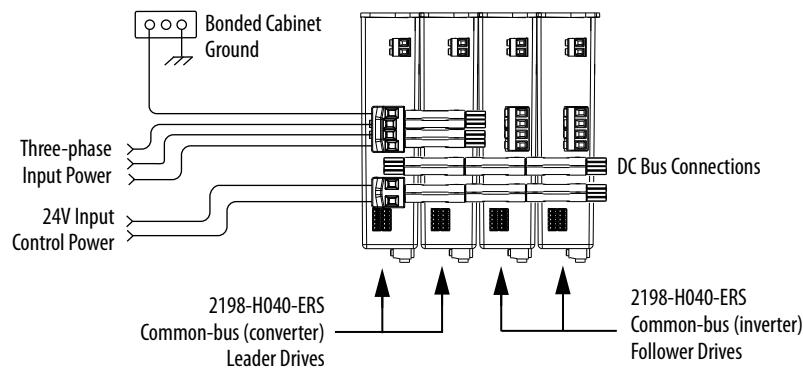
Each 2198-H040-ERS drive is rated at 8.4 kW continuous output power to bus. However, only the leader drive acts as the converter, so the available converter power to the system is 8.4 kW. In this example, total motoring load must not exceed 8.4 kW.

Shared AC/DC Hybrid Example

If the required motoring power exceeds the available converter power sourced by the shared DC configuration, then connect a second converter drive to make a shared AC/DC hybrid configuration. This increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, two are connected as parallel converter (leader) drives and the other two as common-bus (follower) drives. The total converter power is derated by 30%.

Figure 104 - Shared AC/DC Hybrid Configuration



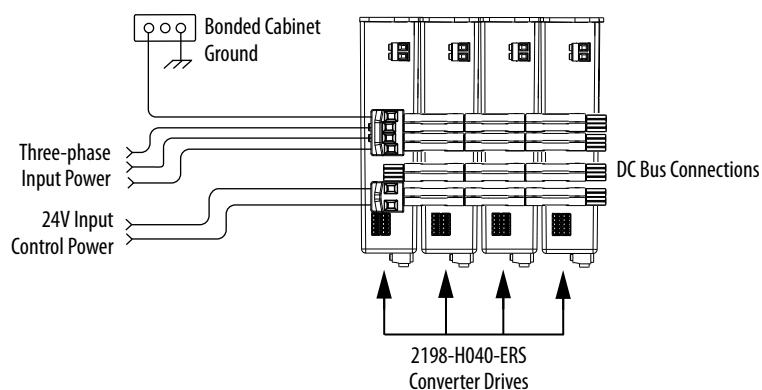
The available converter power to the system is $(8.4 \bullet 2) \bullet 0.7 = 11.76 \text{ kW}$. In this example, total motoring load must not exceed 11.76 kW. The available converter power was increased by 40% over the same drives in shared DC configuration.

Shared AC/DC Example

If the required motoring power exceeds the available converter power sourced by two leader drives, then connect all four drives as parallel converter drives. This further increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, all four are connected as parallel converter (leader) drives. The total converter power is derated by 30%.

Figure 105 - Shared AC/DC Configuration



The available converter power to the system is $(8.4 \bullet 4) \bullet 0.7 = 23.52$ kW. In this example, total motoring load must not exceed 23.52 kW. The available converter power was increased by 180% over the same drives in shared DC configuration.

Control Power Current Calculations

Kinetix 5500 servo drives and the Bulletin 2198 capacitor module have different 24V DC power consumption. Factors to consider when calculating the combined current demand from your 24V DC power supply includes the following:

- Catalog number for each drive in the system
- Whether the motor or actuator includes the holding brake option
- Whether the system includes Bulletin 2198 capacitor modules (1 to 4 modules are possible)

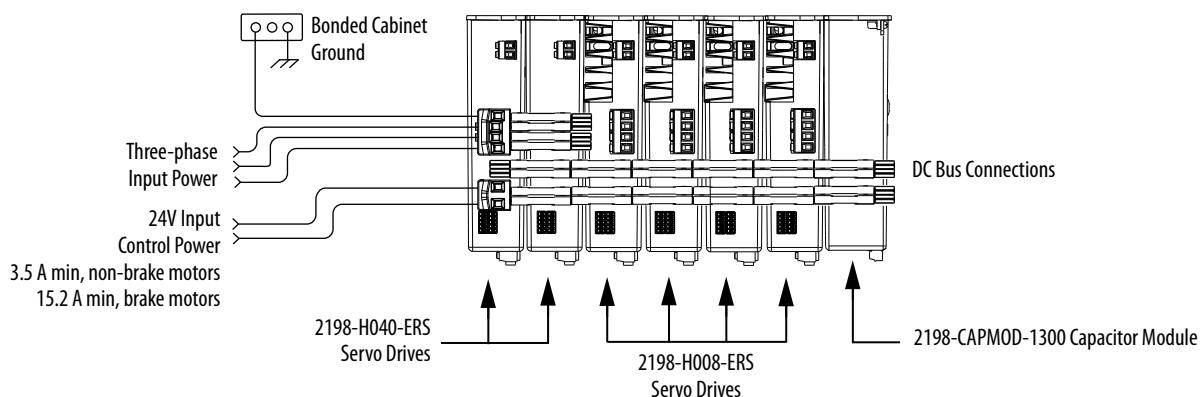
Table 89 - Control Power Current Demand

Cat. No.	24V Current (non-brake motor) A_{DC}	24V Current (2 A brake motor) A_{DC}	24V Inrush Current ⁽¹⁾ A
2198-H003-ERSx	0.4	2.4	2.0
2198-H008-ERSx			
2198-H015-ERSx			
2198-H025-ERSx	0.8	2.8	
2198-H040-ERSx			3.0
2198-H070-ERSx	1.3	3.3	
2198-CAPMOD-1300	0.3	N/A	2.0

(1) Inrush current duration is less than 30 ms.

Kinetix 5500 System Current Demand Example

In this example, the Kinetix 5500 drive system includes two 2198-H040-ERS drives, four 2198-H008-ERS drives, and one capacitor module.

Figure 106 - Shared AC/DC Hybrid Configuration**Table 90 - Kinetix 5500 System Current Demand Calculations**

Kinetix 5500 Module Cat. No.	Qty	24V Current (non-brake motors) A_{DC}	24V Current (2 A brake motors) A_{DC}	24V Inrush Current ⁽¹⁾ A
2198-H008-ERSx	4	$0.4 \times 4 = 1.6$	$2.4 \times 4 = 9.6$	$2 \times 4 = 8$
2198-H040-ERSx	2	$0.8 \times 2 = 1.6$	$2.8 \times 2 = 5.6$	$3 \times 2 = 6$
2198-CAPMOD-1300	1	$0.3 \times 1 = 0.3$	N/A	$2 \times 1 = 2$
Total current demand		3.5	15.2	16

(1) Inrush current duration is less than 30 ms.

Energy Calculations

The Kinetix 5500 servo drives have internal shunt resistors for dissipating excessive energy. In addition, Bulletin 2097 external shunt resistors and Bulletin 2198 capacitor modules are available to increase the shared DC bus capacitance.

Use this table to calculate the total energy absorbing potential (joules) and determine if a capacitor module or external shunt resistor is needed.

Table 91 - Energy Absorbing Potential

Kinetix 5500 Drive Cat. No.	Internal Shunt ⁽¹⁾ J	External Shunt kJ	Capacitor Module ⁽¹⁾ J	Capacitor Module, max ⁽²⁾ J
2198-H003-ERSx	427.09	12.51	N/A	N/A
2198-H008-ERSx			554.4	554.4
2198-H015-ERSx	549.01	12.521	676.32	676.32
2198-H025-ERSx	575.223	12.549	702.53	957.162
2198-H040-ERSx	601.434	22.647	728.74	983.373
2198-H070-ERSx	1827.01	27.218	1954.3	2208.95

(1) Value assumes the use of one servo drive and one capacitor module.

(2) Value assumes the use of one servo drive and the maximum number of capacitor modules allowed.

Refer to Motion Analyzer software, version 7.0 or later, for custom shunt sizing.

Induction Motor Support

This appendix provides induction motor feature descriptions supported by Kinetix 5500 servo drives.

Topic	Page
Induction Motor Control Methods	223
Skip Frequency	226

Induction Motor Control Methods

The Kinetix 5500 servo drives support two open-loop frequency control methods. These are the choices:

- **Basic Volts/Hertz** - This method is used in single or multi-motor asynchronous motor applications.
- **Sensorless Vector with Slip Compensation** - This method is used for most constant torque applications. Provides excellent starting, acceleration, and running torque.

To configure your induction motor in the Logix Designer application, refer to [Configure Induction Motor Axis Properties](#) on page 127.

Open-loop frequency control is suitable in applications such as conveyors, pumps, and fans. These are the features:

- Start Boost, Run Boost, and Auto Boost
- Electronic motor thermal overload protection per NEC/NEMA Class 10 requirements
- Single skip frequency, in which the drive does not operate
- All three-phase induction motors suitable for variable speed drives (VFD) operation are supported

Table 92 - Induction Motor Specifications

Attribute	Value
Output frequency, max	400 Hz
Pole pairs, max	50
Motor cable length, max	50 m (164 ft)

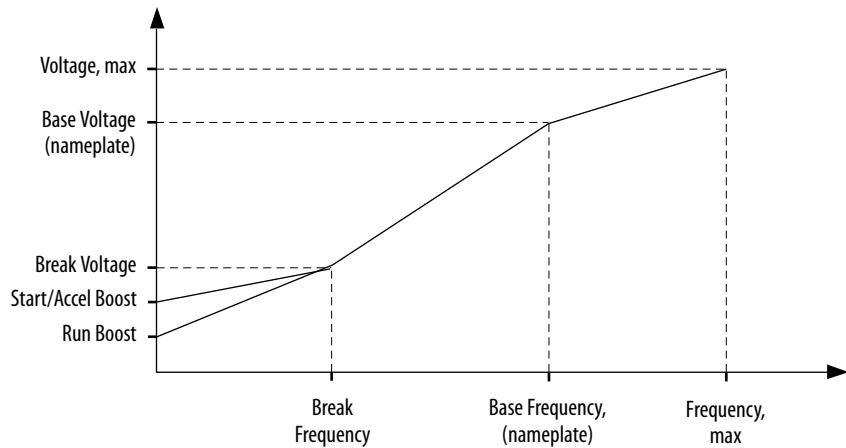
Basic Volts/Hertz

Volts/hertz operation creates a fixed relationship between output voltage and output frequency. Voltage is applied to the motor, based on the operating frequency command at a fixed volts/hertz ratio. The ratio is calculated from the motor nameplate data and entered into the Logix Designer application> Axis Properties>Frequency Control category.

The Basic Volts/Hertz method provides a variety of patterns. The default configuration is a straight line from zero to rated voltage and frequency. As seen in the diagram below, the volts/hertz ratio can be changed to provide increased torque performance when required by programming five distinct points on the curve:

- **Start Boost** - Used to create additional torque for breakaway from zero speed and acceleration of heavy loads at lower speeds.
- **Run Boost** - Used to create additional running torque at low speeds. The value is typically less than the required acceleration torque. The drive lowers the boost voltage to this level when running at low speeds (not accelerating). This reduces excess motor heating that could result if the higher start/accel boost level were used.
- **Break Voltage/Frequency** - Used to increase the slope of the lower portion of the Volts/hertz curve, providing additional torque.
- **Motor Nameplate Voltage/Frequency** - sets the upper portion of the curve to match the motor design. Marks the beginning of the constant power region.
- **Maximum Voltage/Frequency** - Slopes the portion of the curve used above base speed.

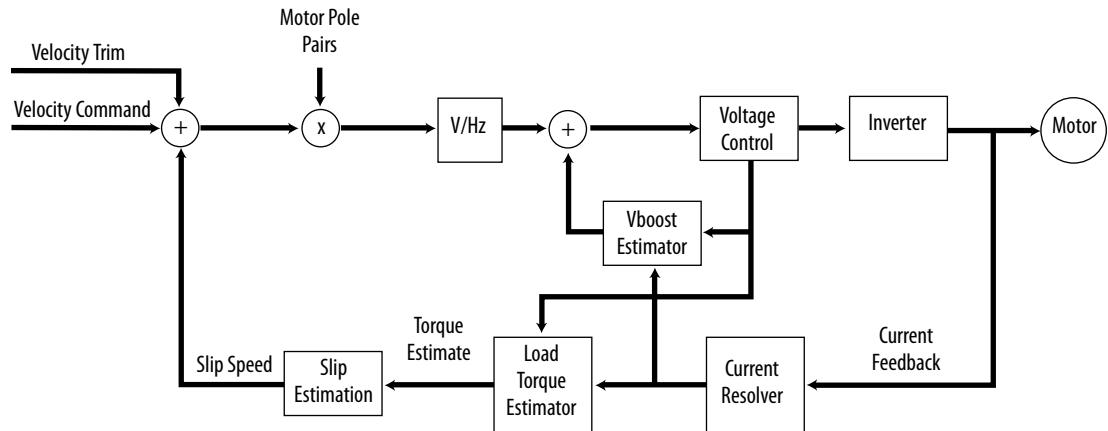
Figure 107 - Basic Volts/Hertz Method



Sensorless Vector

Sensorless Vector mode uses a volts/hertz core enhanced by a current resolver, slip estimator, and a voltage boost compensator based on the operating conditions of the motor.

Figure 108 - Sensorless Vector Method

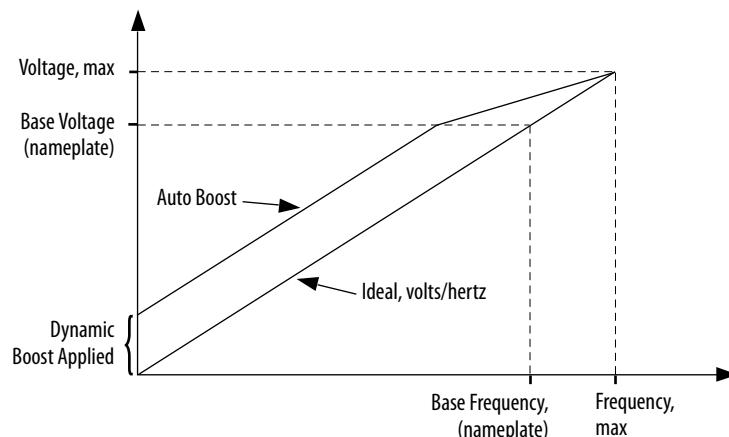


The algorithms operate on the knowledge of the relationship between the rated slip and torque of the motor. Drive uses applied voltages and measured currents to estimate operating slip frequency. You can enter values to identify the motor resistance value or you can run an autotune routine to identify the motor resistance value (see [Tune the Axes](#) on page 133). This is done so that the drive can accurately estimate the required boost voltage.

This method offers better torque production and speed regulation over a wider speed range than basic volts/hertz. However, it is not appropriate when more than one motor is connected to the same drive.

The auto boost feature is applied internally to compensate voltage drop and improve starting torque.

Figure 109 - Approximate Load Curve



Skip Frequency

Some machines have a resonant operating frequency (vibration speed) that is undesirable or could cause equipment damage. To guard against continuous operation at one or more resonant points, you can configure the SkipSpeed parameters in the Logix Designer application>Axis Properties>ParametersList category.

The value programmed into the SkipSpeed1 parameter, sets the center point for an entire skip band of frequencies. The width of the band (range of frequency around the center point) is determined by the SkipSpeedBand parameter. The range is split, half above and half below the SkipSpeed1 parameter.

If the commanded frequency is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive sets the output frequency to the high value of the band. See (A) in [Figure 110](#).

If the commanded frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive sets the output frequency to the low value of the band. See (B) in [Figure 110](#).

Figure 110 - Skip Frequency

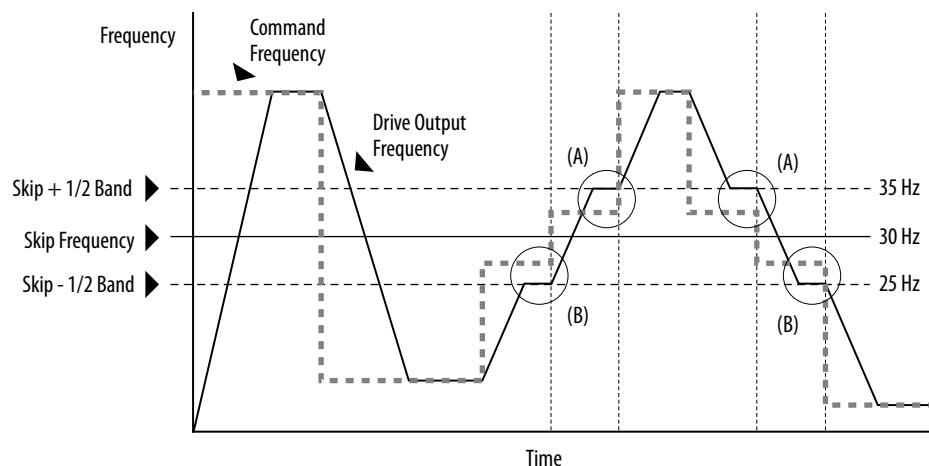


Table 93 - Skip Frequency Examples

Skip Band Description	Graphic Illustration
The skip frequency has hysteresis so the output does not toggle between high and low values. You can program three distinct bands. If none of the skip bands touch or overlap, each band has its own high/low limit.	
If the band is outside of the limits, the skip band is inactive.	

Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel proceeds through the band.

Notes:

EC Certifications

This appendix provides Kinetix 5500 servo drive certification information.

Topic	Page
EC Type - Examination Certificate	229
EC Declaration of Conformity	230
European Union Directives	233

EC Type - Examination Certificate

For product certifications currently available from Rockwell Automation, go to <http://www.rockwellautomation.com/products/certification>.



EC Declaration of Conformity

For all declarations of conformity (DoC) currently available from Rockwell Automation, go to <http://www.rockwellautomation.com/rockwellautomation/certification/overview.page>.

***EU Declaration of Conformity***

<i>Identification of the product:</i>	Kinetix 5500 Digital Servo Drives and Accessories	
<i>Name and address of the manufacturer:</i>	<i>Name and address of the authorised representative:</i>	
Rockwell Automation, Inc. 6400 W. Enterprise Drive Mequon, WI 53092 USA	Rockwell Automation B.V. Rivium Promenade 160 2909 LM Capelle aan den IJssel The Netherlands	
<i>This declaration of conformity is issued under the sole responsibility of the manufacturer.</i>		
<i>Object of the declaration:</i>	Allen-Bradley Bulletin 2198 (reference the attached list of catalogue numbers)	
<i>The object of the declaration described above is in conformity with the relevant EU harmonisation legislation:</i>		
2006/95/EC	Low Voltage Directive	(LVD)
2004/108/EC	EMC Directive	(EMC)
2006/42/EC	Machinery Directive	(MD)
<i>References to the relevant harmonised standards used or references to the specifications in relation to which conformity is declared:</i>		
EN 61800-5-1:2007	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.	
EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional	
EN 61800-3:2004	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods	
EN 60204-1:2006+A1:2009	Safety of machinery – Electrical equipment of machines – Part 1: General requirements	
EN 60034-1:2010	Rotating electrical machines – Part 1: Rating and performance	
IEC 61508: Part 1-7:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems	
EN 62061:2005	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems	
EN ISO 13849-1:2008	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design	
<i>Notified Body:</i>	TÜV Rheinland, Am Grauen Stein, 51105 Köln, (NB 0035)	
<i>performed:</i>	EC Type Examination	
<i>and issued the certificate:</i>	01/205/5255/12 (MD)	
<i>Additional information:</i>		
<i>Year of CE Marking (LVD):</i>	2012	
<i>Person authorised to compile the technical file (MD):</i>	Authorised representative (see details above).	
<i>Product Safety Function (MD):</i>	Safe Torque-Off	
<i>Signed for and on behalf of the above named manufacturer:</i>		
<i>Place and date of issue:</i>	Mequon, WI USA	05-Feb-2014
<i>Name, function:</i>	Thomas Van Groll, Director Engineering	
<i>Signature:</i>		



Catalogue number	Series ³	Description	Directive ⁴		
			EMC	LVD	MD
Bulletin 2198 Servo Drives¹					
2198-H003-ERS		Kinetix 5500, Frame 1, 195-528Vrms, 0.6 kW, Inverter 1.0Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H008-ERS		Kinetix 5500, Frame 1, 195-528Vrms, 1.6 kW, Inverter 2.5Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H015-ERS		Kinetix 5500, Frame 2, 195-528Vrms, 3.2 kW, Inverter 5.0Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H025-ERS		Kinetix 5500, Frame 2, 195-528Vrms, 5.2 kW, Inverter 8.0Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H040-ERS		Kinetix 5500, Frame 2, 195-528Vrms, 8.4 kW, Inverter 13.0Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H070-ERS		Kinetix 5500, Frame 3, 195-528Vrms, 14.9 kW, Inverter 23.0Amp, Safe Torque-Off	Yes	Yes	Yes
2198-H003-ERS2		Kinetix 5500, Frame 1, 195-528Vrms, 0.6 kW, Inverter 1.0Amp, Network Safe Torque-Off	Yes	Yes	Yes
2198-H008-ERS2		Kinetix 5500, Frame 1, 195-528Vrms, 1.6 kW, Inverter 2.5Amp, Network Safe Torque-Off	Yes	Yes	Yes
2198-H015-ERS2		Kinetix 5500, Frame 2, 195-528Vrms, 3.2 kW, Inverter 5.0Amp, Network Safe Torque-Off	Yes	Yes	Yes
2198-H025-ERS2		Kinetix 5500, Frame 2, 195-528Vrms, 5.2 kW, Inverter 8.0Amp, Network Safe Torque-Off	Yes	Yes	Yes
2198-H040-ERS2		Kinetix 5500, Frame 2, 195-528Vrms, 8.4 kW, Inverter 13.0Amp, Network Safe Torque-Off	Yes	Yes	Yes
2198-H070-ERS2		Kinetix 5500, Frame 3, 195-528Vrms, 14.9 kW, Inverter 23.0Amp, Network Safe Torque-Off	Yes	Yes	Yes
AC Line Filters					
2198-DB08-F		460 Volt 7.5 Amp Three-Phase AC Line Filter	Yes	Yes	N/R
2198-DB20-F		460 Volt 20 Amp Three-Phase AC Line Filter	Yes	Yes	N/R
2198-DB42-F		460 Volt 42 Amp Three-Phase AC Line Filter	Yes	Yes	N/R
Shunts					
2097-R6		75 Ohm, 150W, External Shunt Resistor	Yes	Yes	N/R
2097-R7		150 Ohm, 80 W, External Shunt Resistor	Yes	Yes	N/R
Capacitor Module					
2198-CAPMOD-1300		Kinetix5500 Capacitor Module	Yes	Yes	N/R

- 1) Only the following motor and cable families are compatible with the Kinetix 5500 servo drives.
- 2) The following letters are used in the compatibility matrix to indicate model number description fields that do not affect this DoC: x, y. These fields may be filled with any number(s) or letter(s).
- 3) If no series number is given, then all series are covered.
- 4) Legend as follows:
No = Product is not certified to this directive.
Yes = Product is certified to this directive.
N/R = this directive is not required for this product



Catalogue number	Series ³	Description	Directive ⁴		
			EMC	LVD	MD
Motor Compatibility^{1,2}					
VPL-Axxxxx-yyyyyy		230 Volt VP Low-inertia Servo Motor	Yes	Yes	N/R
VPL-Bxxxxx-yyyyyy		460 Volt VP Low-inertia Servo Motor	Yes	Yes	N/R
Cable Compatibility¹					
2090-CSWM1DF-YYAALL		Motor power/feedback cable for use with VP family motors, YY = wire gauge, LL = length in meters	N/R	N/R	N/R
2090-CSBM1DF-YYAALL		Motor power/feedback with brake cable for use with VP family motors, YY = wire gauge, LL = length in meters	N/R	N/R	N/R
Connector Kits and Miscellaneous Accessories²					
2198-H040-x-x		Input wiring connectors and DC bus T connector for frame 1 and 2 servo drives	N/R	N/R	N/R
2198-H070-x-x		Input wiring connectors and DC bus T connector for frame 3 servo drive.	N/R	N/R	N/R
1585J-M8CBJM-x		Shielded Ethernet cable	N/R	N/R	N/R
1606-XLxxx		24V DC Power Supply	N/R	N/R	N/R
2198-KITCON-DSL		Replacement feedback connector kit for Kinetix 5500	N/R	N/R	N/R
2198-KITCON-IOSP		Replacement I/O connector kit (spring clamp) for IOD connector	N/R	N/R	N/R
2198-KITCON-IOSC		Replacement I/O connector kit (screw terminal) for IOD connector	N/R	N/R	N/R
2198-KITCON-PWR40		Replacement connector set, 40 Amp, for Kinetix 5500 Frame 1 & 2 drives	N/R	N/R	N/R
2198-KITCON-PWR70		Replacement connector set, 70 Amp, for Kinetix 5500 Frame 3 drives	N/R	N/R	N/R

- 1) Only the following motor and cable families are compatible with the Kinetix 5500 servo drives.
- 2) The following letters are used in the compatibility matrix to indicate model number description fields that do not affect this DoC: x, y. These fields may be filled with any number(s) or letter(s).
- 3) If no series number is given, then all series are covered.
- 4) Legend as follows:
 No = Product is not certified to this directive.
 Yes = Product is certified to this directive.
 N/R = this directive is not required for this product

European Union Directives

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

CE Conformity

Conformity with the Low Voltage Directive and Electromagnetic Compatibility (EMC) Directive is demonstrated by using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The safe torque-off circuit complies with the EN standards when installed according instructions found in this manual.

EMC Directive

This unit is tested to meet Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) by using these standards, in whole or in part:

- EN 61800-3 - Adjustable Speed Electrical Power Drive Systems, Part 3 - EMC Product Standard including specific test methods
- EN 61326-3-1 EMC - Immunity requirements for safety-related systems

The product described in this manual is intended for use in an industrial environment.

CE Declarations of Conformity are available online at <http://www.rockwellautomation.com/rockwellautomation/certification/overview.page> and in [EC Declaration of Conformity](#) on [page 230](#).

Low Voltage Directive

These units are tested to meet Council Directive 2006/95/EC Low Voltage Directive. The EN 60204-1 Safety of Machinery-Electrical Equipment of Machines, Part 1-Specification for General Requirements standard applies in whole or in part. Additionally, the standard EN 61800-5-1 Electronic Equipment for use in Power Installations apply in whole or in part.

Refer to the Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#), for environmental and mechanical specifications.

Notes:

History of Changes

This appendix summarizes the revisions to this manual. Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

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2198-UM001C-EN-P, February 2014	235
2198-UM001B-EN-P, September 2013	236

2198-UM001C-EN-P, February 2014

Change
Added Hiperface-to-DSL feedback converter kit installation instructions to table.
Added Hiperface-to-DSL feedback converter kit to system overview table.
Added Kinetix VP (Bulletin VPS) stainless-steel motors to the system overview table and throughout the manual.
Added Hiperface-to-DSL feedback converter kit and compatible MP-Series motors and actuators to configuration diagrams.
Added Hiperface-to-DSL converter kit and footnote to noise zone diagram.
Added Hiperface-to-DSL converter kit and footnote to motor feedback in table.
Added paragraph describing motor feedback types accepted by the Hiperface-to-DSL converter kit.
Added section to support wiring the motor power/brake and feedback connectors when using the Hiperface-to-DSL converter kit.
Updated Configure Feedback Only Axis Properties to include the Bulletin 842E-CM integrated motion encoder on the EtherNet/IP network.
Added Kinetix VP (Bulletin VPS) stainless-steel motors to the Kinetix VP interconnect diagram.
Added interconnect diagrams to support wiring the motor power/brake and feedback connectors when using the Hiperface-to-DSL converter kit.
Added History of Changes appendix.

**2198-UM001B-EN-P,
September 2013**

Change
Added capacitor module shared-bus replacement kit to System Overview table.
Updated the Ring Topology diagram.
Added Drive-to-Motor Maximum Cable Lengths table to CE requirements.
Added IMPORTANT advisory regarding non-UL Listed circuit breakers.
Updated Circuit Breaker Selection tables with Allen-Bradley catalog numbers.
Updated Connection System Example diagram with DC bus T-connector removal instructions.
Updated Drilling Hole Patterns with corrected dimension values.
Updated Motor Brake Circuit text and diagram.
Updated Wire the Motor Power, Brake, and Feedback Connectors with continuos-flex cable catalog numbers and IMPORTANT advisory regarding single-cable technology.
Updated NODE FLT 03 HARDWARE 01 and added sub-codes HARDWARE 02 and HARDWARE 03.
Added non-conductive probe to bulleted list of tools.
Added IMPORTANT advisory regarding DC bus T-connector removal.
Added Input ON current specification and related footnote to Safety Inputs table.
Updated motor feedback (MF-2) wire color (from White to White/Blue).
Updated Kinetix 5500 drive block diagram to reflect a connection between the control board and brake circuit.
Updated Kinetix 5500 drive block diagram to reflect a connection between the control board and brake circuit.

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.

At <http://www.rockwellautomation.com/support> you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at <https://rockwellautomation.custhelp.com/> for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://www.rockwellautomation.com/services/online-phone>.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page , or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at <http://www.rockwellautomation.com/literature/>.

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TABLE 1: FILTER RECOMMENDATIONS

FILTER AND REPLACEMENT PART ITEM NUMBERS

Vortec Model	Oil Removal Filter	Valve & Thermostat Kit (120 VAC)	Valve & Thermostat Kit (240 VAC)	Replacement Generator Kits (5 pc)
727SS-15H, 737SS	701S-48	721T-70	721T-80	208GK-15H
727SS, 787SS	701S-48	721T-70	721T-80	208GK-25H
727SS-35H, 787SS-35H	701S-54	721T-100	721T-110	208GK-35H
747SS	701S-48	-	721T-80	208GK-15H
797SS	701S-48	-	721T-80	208GK-25H
797SS-35H	701S-54	-	721T-110	208GK-35H

TABLE 2: DETERMINING COMPRESSED AIR LINE SIZE

- Calculate total product compressed air consumption (SCFM, SLPM).
- Determine length of compressed air line required for connection to main supply.
- Locate pipe length in left column and read to the right to find the compressed air requirements.
- Locate pipe size at top of column.

MAXIMUM AIRFLOW (SCFM) THROUGH PIPE AT 5 PSIG PRESSURE DROP (100 PSIG AND 70°F)

Pipe Length (Feet)	Pipe Size (Nominal) - Schedule 40								
	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
10	29	65	120	254	480	978	1483	2863	4536
20	21	46	85	180	340	692	1049	2024	3208
30	17	37	70	147	277	565	856	1653	2619
40	15	32	60	127	240	489	792	1431	2268
50	13	29	54	114	215	437	663	1280	2029
60	12	26	49	104	196	399	606	1169	1852
70	11	25	46	96	181	370	561	1082	1715
80	10	23	43	90	170	346	524	1012	1604
90	10	22	40	85	160	326	494	954	1512
100	9	21	38	80	152	309	469	905	1435

MAXIMUM AIRFLOW (SLPM) THROUGH PIPE AT 0.3 BAR PRESSURE DROP (6.9 BAR AND 21°C)

Pipe Length (Meters)	Pipe Size (Nominal) - Schedule 40								
	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
3	821	1840	3396	7188	13584	27677	42117	81023	128369
6	594	1302	2406	5094	9622	19584	29687	57279	90786
9	481	1047	1981	4160	7839	15990	24225	46780	74188
12	425	906	1698	3594	6792	13839	20999	40497	64184
15	368	821	1528	3226	6085	12367	18763	36224	57421
18	340	736	1387	2943	5547	11292	17150	33083	52412
21	311	708	1302	2717	5122	10471	15877	30621	48535
24	283	651	1217	2547	4811	9792	14829	28640	45393
27	269	623	1132	2406	4528	9226	13980	26998	42790
31	255	594	1075	2264	4302	8745	13273	25612	40611

Rubber hose maximum airflow rating: 1/2" I.D. rubber hose = 3/8" pipe; 3/4" I.D. rubber hose = 1/2" pipe



OPERATION & SAFETY INSTRUCTIONS

VORTEX COOLER™ - UL TYPE 4X

Models 727SS, 727SS-15H, 727SS-35H, 737SS, 747SS, 787SS, 797SS, 787SS-35H, 797SS-35H

(Includes all BSP versions of models listed above)



IMPORTANT

Please read all instructions BEFORE attempting to use this product

ITW Air Management

10125 Carver Road, Cincinnati, OH 45242

Phone: 513-891-7474 • Fax: 513-891-4092

Toll Free: 800-441-7475

www.vortec.com • techsupport@vortec.com

GENERAL SAFETY CONSIDERATIONS

WARNING: COMPRESSED AIR COULD CAUSE DEATH, BLINDNESS OR INJURY

1. Do not operate a Vortex Cooler at compressed air pressures above 150 psig (10.3 Bar).
2. Do not operate at line temperatures above 110°F (43°C).
3. Avoid direct contact with compressed air.
4. Do not direct compressed air at any person.
5. When using compressed air, wear safety glasses with side shields.

INTRODUCTION

A Vortex Cooler is designed to use filtered compressed air to cool industrial cabinets without the use of any refrigerants. An internal Vortex tube lowers the temperature and pressure of the compressed air supplied to the enclosure. Hot air in the cabinet is vented to the surroundings through a built in relief valve in the Vortex Cooler.

Vortex Coolers can be used with or without electric thermostats and solenoid valves.

COMPRESSED AIR SUPPLY

The compressed air supply must be filtered to remove water and dirt using a 5 micron or smaller filter. Failure to use a filter may cause clogging (and freezing) of the compressed air paths inside the Vortec product. Filter recommendations are given in Table 1.

Filter elements must be changed on a regular basis. Frequency of change is determined by the condition of the compressed air supply. Filters should be installed in the compressed air supply line as close as possible to the Vortec product.

The appropriate size of compressed air supply line should be selected to ensure optimal performance of the Vortec product. Please refer to Table 2 to determine what supply line size is recommended for your application. Contact Vortec at 1-800-441-7475 for further assistance.

MAINTENANCE

Vortec Cooler systems have no moving parts and can be disassembled for cleaning.

INSTALLATION AND OPERATION

To maintain the Type 4X rating, Type 4X Vortex Coolers must be installed in a vertical orientation on a flat horizontal surface at the top of the cabinet.

Vents in the cabinets must be covered and sealed to ensure cooling efficiency and to keep out ambient air. When a thermostat is supplied with a Vortex Cooler system for Type 4X enclosures, the thermostat can be easily readjusted using the temperature indicator dial. All wiring must be installed in an approved conduit.

Installation procedures:

1. Cut a 1-15/16" (49 mm) (1-1/2" knockout size) hole in the enclosure.
2. Insert Vortex Cooler into cut-out and secure with the locknut.
3. Attach the cold air muffler to the outlet of the Vortex Cooler.
4. Perforate the ducting kit with several 1/8" holes and secure to interior of enclosure.
5. Attach the ducting kit to the cold air muffler.
6. Connect compressed air filter and/or valve and thermostat, to the Vortex Cooler (wire thermostat directly to solenoid valve). Install the compressed air filter and solenoid valve as close as possible to the Vortex Cooler, in a location where the temperature does not exceed 125°F (52°C).
8. Connect compressed air supply to the filter.

TROUBLESHOOTING

Insufficient airflow may be caused by the following:

1. Undersized compressed air line size.
2. Compressed air pressure too low.
3. Partial or complete blockage of internal compressed air path, due to dirt.

Insufficient cold air temperature may be caused by:

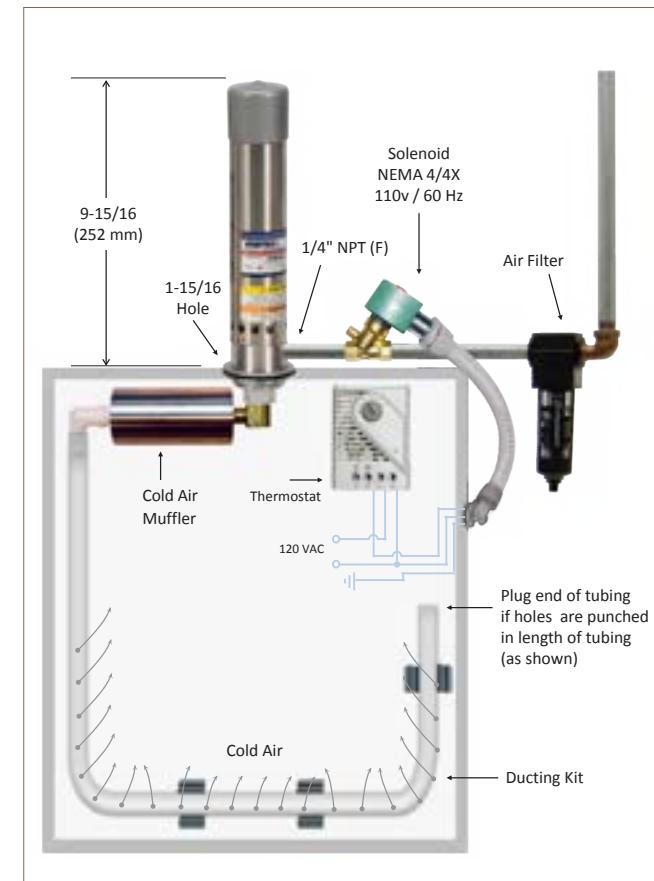
1. Compressed air line temperature too high.
2. Water vapor in the compressed air supply.
3. Loose cold cap. This may occur if not tightened properly after disassembled for cleaning.

If trouble persists, please contact Vortec at 1-800-441-7475.

VORTEX COOLER ASSEMBLY

(Drawings shown below are not to scale)

Models 727SS, 737SS, 747SS, 787SS, 797SS, and variants



LIMITED WARRANTY

Vortec compressed air products manufactured by ITW Air Management will be replaced or repaired if found to be defective due to manufacture defect within ten years from the date of invoice. Refer to our website www.vortec.com for full warranty details and limitations. ITW Air Management makes no specific warranty merchantability or warrant of fitness to a particular purpose.



Gates® Poly Chain® GT® Carbon® Belt DRIVE DESIGN MANUAL 2009

YOUR LOCAL DISTRIBUTOR :



A Tomkins Company

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1551 Wewatta Street, Denver, CO 80202
www.gates.com/drivedesign

DRIVE DESIGN MANUAL

Design your drives online at www.gates.com/drivedesign

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Foreword

Synchronous belts are being used more extensively than ever before in the industry where synchronization of one shaft speed to another is of primary importance. Gates Corporation has prepared this complete Poly Chain GT Carbon Belt Drive Design Manual to handle these exacting applications. Poly Chain drives also eliminate maintenance and noise problems associated with chain drives and reduce maintenance required on other problem power transmission drives.

Stock Belt Drives are presented in this manual for your convenience. If your drive requirements (Speed, Ratio, Center Distance, Space, Horsepower) are not met, contact your local Gates representative.

SAFETY POLICY

WARNING! Be Safe! Gates belt drive systems are very reliable when used safely and within Gates application recommendations. However, there are specific **USES THAT MUST BE AVOIDED** due to the risk of serious injury or death. These prohibited misuses include:

Primary In-Flight Aircraft Systems

Do not use Gates belts, pulleys or sprockets on aircraft, propeller or rotor drive systems or in-flight accessory drives. Gates belt drive systems are not intended for aircraft use.

Braking Systems

Do not use Gates belts, pulleys or sprockets in applications that depend solely upon the belt to slow or stop a mass, or to act as a brake without an independent safety backup system. Gates belt drive systems are not intended to function as a braking device in "emergency stop" systems.

DRIVE DESIGN SOFTWARE

Drive design software can be found at
www.gates.com/drivedesign.

This software assists designers in quickly selecting optimum drive solutions.

Gates Poly Chain® GT® Carbon® Belt System Specifications

To satisfy a wide range of loads, speeds and applications, Poly Chain GT Carbon belts and sprockets are made in a selection of sizes, capacities and dimensions.

The three principal dimensions of a belt are:

pitch pitch length width

Belt pitch is the distance in millimeters between two adjacent tooth centers as measured on the pitch line of the belt. Belt pitch length is the total length (circumference) in millimeters as measured along the pitch line. The theoretical pitch line of a Poly Chain GT Carbon belt lies within the tensile member.

The three principal dimensions of a sprocket are:

pitch number of sprocket grooves width

On the sprocket, pitch is the distance between groove centers and is measured on the sprocket's pitch circle. See illustration at right. The pitch circle of the sprocket coincides with the pitch line of the belt mating with it. The sprocket's pitch diameter is always greater than its outside diameter.

Any Poly Chain GT Carbon belt must be run with Poly Chain GT2 sprockets of the same pitch.

Gates Poly Chain GT Carbon belts are made in 8mm and 14mm pitches. Standard belt sizes are listed in the stock Poly Chain GT Carbon Belt Tables on page 3. Specifications for the 8mm and 14mm pitch belts list the belt pitch lengths, number of teeth, stock widths and appropriate weights. Using the information from these tables, a code for ordering a specific belt can be determined as shown in the following examples:

Belt Pitch (mm)	Belt Pitch Length (mm)	Belt Width (mm)
8MGT	640	12
14MGT	1190	37

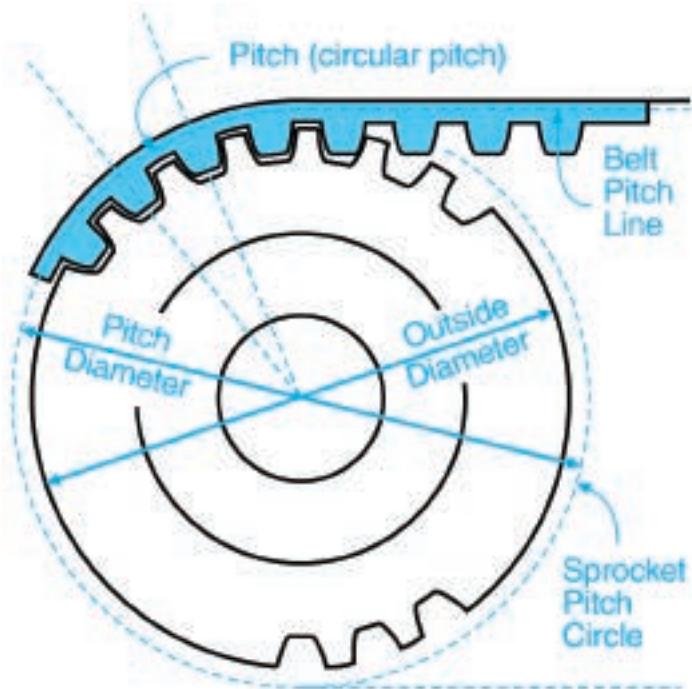
Sprockets for Poly Chain GT Carbon belts are also made in 8mm and 14mm pitches. Standard sprocket sizes are listed in the Sprocket Specification Tables on Pages 64 through 74. For each Poly Chain GT Carbon belt width, there is a table listing the sprocket code symbol, the applicable bushing style and pertinent dimensional information. The sprocket code symbol components are determined by using the following examples:

Pitch (mm)	Sprocket Designation & No. of Grooves	Width (mm)
8MX	48S*	12
14MX	36S*	37

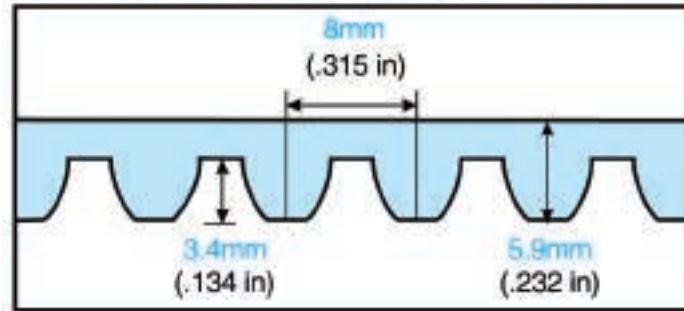
*The "S" is used after the number of grooves to help identify it is a sprocket and avoid any confusion with the belt code.

The bushing style to be used with a specific sprocket is listed in the Sprocket Specifications Tables. Reference to the Stock Bushings for Poly Chain GT2 plus Bore and Keyseat information will give you the data needed to order the proper bushing. For example,

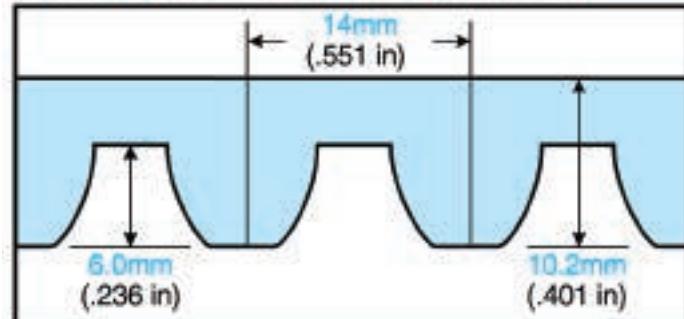
Style 2517 Bushing with a 2-inch bore



8mm Pitch — Reference Dimensions



14mm Pitch — Reference Dimensions



Gates Poly Chain® GT® Carbon® Belt Standard Line

Stock Sizes

8mm Pitch Lengths

Description	No. of Teeth	Length	
		mm	In
8MGT-640	80	640	25.20
8MGT-720	90	720	28.35
8MGT-800	100	800	31.50
8MGT-896	112	896	35.28
8MGT-960	120	960	37.80
8MGT-1000	125	1000	39.37
8MGT-1040	130	1040	40.95
8MGT-1120	140	1120	44.09
8MGT-1200	150	1200	47.24
8MGT-1224	153	1224	48.19
8MGT-1280	160	1280	50.39
8MGT-1440	180	1440	56.69
8MGT-1600	200	1600	62.99
8MGT-1760	220	1760	69.29
8MGT-1792	224	1792	70.55
8MGT-2000	250	2000	78.74
8MGT-2200	275	2200	86.61
8MGT-2240	280	2240	88.19
8MGT-2400	300	2400	94.49
8MGT-2520	315	2520	99.21
8MGT-2600	325	2600	102.36
8MGT-2800	350	2800	110.24
8MGT-2840	355	2840	111.81
8MGT-3048	381	3048	120.00
8MGT-3200	400	3200	125.98
8MGT-3280	410	3280	129.13
8MGT-3600	450	3600	141.73
8MGT-4000	500	4000	157.48
8MGT-4400	550	4400	173.23
8MGT-4480	560	4480	176.38

14mm Pitch Lengths

Description	No. of Teeth	Length	
		mm	In
14MGT-994	71	994	39.13
14MGT-1120	80	1120	44.09
14MGT-1190	85	1190	46.85
14MGT-1260	90	1260	49.61
14MGT-1400	100	1400	55.12
14MGT-1568	112	1568	61.73
14MGT-1610	115	1610	63.84
14MGT-1750	125	1750	68.90
14MGT-1890	135	1890	74.41
14MGT-1960	140	1960	77.17
14MGT-2100	150	2100	82.68
14MGT-2240	160	2240	88.19
14MGT-2310	165	2310	90.95
14MGT-2380	170	2380	93.70
14MGT-2450	175	2450	96.46
14MGT-2520	180	2520	99.21
14MGT-2590	185	2590	101.97
14MGT-2660	190	2660	104.72
14MGT-2800	200	2800	110.24
14MGT-3136	224	3136	123.46
14MGT-3304	236	3304	130.08
14MGT-3360	240	3360	132.28
14MGT-3500	250	3500	137.80
14MGT-3850	275	3850	151.58
14MGT-3920	280	3920	154.33
14MGT-4326	309	4326	170.32
14MGT-4410	315	4410	173.62

8mm Widths

12mm (.47 in.)	21mm (.83 in.)	36mm (1.42 in.)	62mm (2.44 in.)
-------------------	-------------------	--------------------	--------------------

14mm Widths

20mm (.79 in.)	37mm (1.46 in.)	68mm (2.68 in.)	90mm (3.54 in.)	125mm (4.92 in.)
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Long Length Poly Chain GT2 Belting Stock Widths

8mm Pitch Widths			14mm Pitch Widths	
12mm	21mm	36mm	20mm	37mm

Special widths available upon request.

Dimensions are given in inches and millimeters. Inches are shown in black type. Millimeters are shown in blue type.

Poly Chain® GT® Carbon® Low-Speed Design Load Calculations

For use when designing Poly Chain GT Carbon belt drives for gear reducer output shafts and general roller chain conversions.

When designing Poly Chain GT Carbon belt drives to be used in low-speed applications (generally 500 rpm and less), traditional drive design procedures may yield drives with greater-than-needed capacity. These design load calculations are intended primarily for applications on the output side of gear reducers, and will yield Poly Chain GT Carbon belt drives competitive in both cost and performance with roller chain and superior to other belt drives.

A recent power transmission industry publication estimated that half of all U.S. motors operate at less than 60 percent of their rated load and one third

operate at below 50 percent of their rated load. Significant power losses can also occur in speed reducers, further reducing the actual torque loads carried by belt drives.

In order to prevent over sizing belt drives for these low speed applications, the design should be based upon the actual system running load. Because the actual running load may or may not be known, the following three approaches are recommended to assist the designer in determining the appropriate design load:

I. Actual Operating Loads Known

In those cases where the actual operating load is known, design the belt drive for the actual operating load rather than for a load based upon the motor name plate. Use Formula 1 to calculate the proper drive design load based upon motor load (name plate or measured) when the belt drive will be installed on the reducer output shaft.

Design Load

Formula 1

$$\text{DesignLoad} = (\text{MotorLoad}) \times \text{ServiceFactor} \times (\% \text{ Reducer Efficiency}/100)$$

Motor Load: From user/OEM

Service Factor: From Service Factor table

% Efficiency: From Speed Reducer Catalog (also refer to the Reference Data Section)

II. Actual Operating Loads Unknown — With Measurements

When the actual system running load is unknown, it must be estimated. This can be done with reasonable accuracy by measuring the average electrical amperage draw from the motor while under load, and calculating a motor horsepower output. Speed reducer efficiency can also be calculated and applied as well.

Use Formulas 2-4 for the most accurate results if all of the needed formula values are available.

Because values for motor efficiency and power factor may not be readily available, a common industry accepted practice is to proportion the motor name plate horsepower rating with the motor name plate amperage rating and actual measured amperage value. Use Formula 5 for a reasonable estimate of actual motor horsepower load.

D.C. Motors

Formula 2

$$\text{Horsepower}^* = \frac{(\text{Amps}) \times (\text{Volts}) \times (\text{Eff})}{746}$$

Amps: as measured

Volts: as measured

Eff: % Eff/100 (from Motor Catalog or Motor Nameplate)

Single Phase A.C. Motor

Formula 3

$$\text{Horsepower}^* = \frac{(\text{Amps}) \times (\text{Volts}) \times (\text{Eff}) \times (\text{PF})}{746}$$

Amps: as measured

Volts: as measured

Eff: % Eff/100 (from Motor Catalog or Motor Nameplate)

Power Factor: as measured or from Motor Catalog

Three Phase A.C. Motors

Formula 4

$$\text{Horsepower}^* = \frac{1.73 \times (\text{Amps}) \times (\text{Volts}) \times (\text{Eff}) \times (\text{PF})}{746}$$

Amps: as measured (average of 3 phases)

Volts: as measured

Eff: % Eff/100 (from Motor Catalog or Motor Nameplate)

Power Factor: as measured or from Motor Catalog

(Note: Refer to Power Factor on page 5 for general power factor and efficiency values.)

Alternative Approach

Formula 5

$$\text{Horsepower} = \frac{(\text{Nameplate hp}) / (\text{Measured Amps})}{(\text{Nameplate Amps})}$$

Nameplate hp: maximum rated motor horsepower
(Motor Nameplate or Motor Catalog)

Measured Amps: as measured

(if 3 phase; average of 3 phases)

Nameplate Amps: maximum rated motor amps
(Motor Nameplate or Motor Catalog)

Now with a good estimate of the actual motor horsepower load, use Formula 6 to calculate the proper drive design load (when the belt drive will be installed on the reducer output shaft).

Formula 6

$$\begin{aligned} \text{Design Load} &= (\text{Estimated Motor Load}) \times (\text{Service Factor}) \\ &\times \frac{\% \text{ Reducer Efficiency}}{100} \end{aligned}$$

Estimated Motor Load: From Formulas 2-5

Service Factor: From Table 5

% Efficiency: from Speed Reducer Catalog
(also refer to Speed Reducer Efficiency on page 6).

*With an estimate of actual motor load, and the belt drive connected directly to a speed reducer output shaft, use Formula 1 to calculate the drive design load.

Poly Chain® GT® Carbon® Low-Speed Design Load Calculations – continued

III. Actual Operating Loads Unknown — Without Measurements

It is not always possible to determine actual motor operating loads, as it may not be possible to take amperage draw measurements from the motor. In those cases, the following guidelines should be used with caution, as they may not yield successful results in every case. They should, however, yield at least comparable, if not improved, service compared to the old roller chain drive.

The procedures which follow in Table 2 should yield at least comparable, if not improved, service compared to the old roller chain drive.

Table 1

Situation	Conclusion	Recommendation
Properly lubricated. Provides more than four months of continuous service	System is either properly designed or lightly loaded.	Base belt drive design load on the roller chain drive horsepower rating.
Properly lubricated. Provides less than four months of continuous service.	System may have less than adequate load capacity.	Belt drive design load based on roller chain drive horsepower rating may result in a poorly performing system. Exercise good engineering judgment.
Unlubricated. Provides more than four months continuous service.	System is lightly loaded.**	Base belt drive design load on roller chain drive horsepower rating.
Unlubricated. Provides less than four months continuous service.	It is difficult to conclude whether the system has been designed with adequate load capacity.**	Base belt drive design load on roller chain power rating but exercise good engineering judgment.

**Unlubricated roller chain drives do not typically provide more than three to four months of service regardless of design capacity.

In those cases where the belt drive design load is based upon the power rating of the existing roller chain drive, use Formula 7 along with good engineering judgment to calculate the proper drive design load.

Formula 7

$$\text{Design Load} = (\text{Roller Chain Power Rating}) \times \text{Service Factor}$$

Roller Chain Power Rating: from Roller Chain Manufacturer's Catalog

Service Factor: from Table 1

Drive Selection Procedure

Having used one of the previous three approaches to determine a belt drive design horsepower load, proceed to step 2 of the Belt Drive Selection Procedure on page 10.

Reference Information

Speed Reducer Efficiency

If the efficiency of a speed reducer is not published, it can be calculated indirectly from the catalog data. Speed reducer manufacturers generally publish rated input horsepower and rated output torque for each speed reducer unit in their product line. In order to calculate speed reducer efficiency, either the rated output torque must be converted to output horsepower or the rated input horsepower must be converted to input torque. The torque/horsepower conversion formulas are as follows:

$$(hp) = \frac{Q \times (rpm)}{63025}$$

hp = horsepower

Q = torque (lb-in)

rpm = shaft revolutions/min

$$Q = \frac{hp \times 63025}{rpm}$$

Q = torque (lb-in)

hp = horsepower

rpm = shaft revolutions/min.

Reducer efficiency is then calculated as follows:

$$\text{Reducer Efficiency} = \frac{\text{Output hp or Q}}{\text{Input hp or Q}}$$

A general comparison of speed reducer efficiency is included in Table 3.

Motor Data

Motor efficiency and power factor data may not be readily available. Actual values vary and are motor dependent. If catalog data are not available, typical values are as follows:

Power Factor

Standard Motor: 0.80 typical (range from 0.55 to 0.90)

High Efficiency Motor: 0.85 typical (range from 0.73 to 0.88)

Efficiency

Standard Motor: 80% typical (range from 70% to 87%)

High Efficiency Motor: 88% typical (range from 84% to 93%)

Belt Tensioning

Adequate belt installation tension is critical in preventing belt ratcheting under peak motor starting loads. To calculate proper belt installation tension values for Poly Chain GT Carbon belts, follow the procedures starting on page 103.

Poly Chain® GT® Carbon® Low-Speed Design Load Calculations – continued

Table 2

Reducer Type	Ratio Range	Reduction	Approx. Efficiency, (%)
Straight Bevel Reducer	1:1 - 4:1	Single	97.0%
Spiral Bevel Reducer	1:1 - 5:1	Single	97.0%
Helical Reducer	1.2:1 - 6:1	Single	97.0%
	to 30:1	Double	94.1%
	to 200:1	Triple	91.3%
Planetary Reducer	3.5:1 - 6:1	Single	97.5%
	to 30:1	Double	95.1%
	to 200:1	Triple	92.7%
	to 1800:1	Quadruple	90.4%
Cycloidal Reducer	6:1 - 119:1	Single	92.5%
	to 7,500:1	Double	85.6%
	to 658,000:1	Triple	79.1%
Worm Gear Reducer	5:1 - 75:1	Single	45%-94%
	to 6,000:1	Double	28%-65%

Note: Speed ratio ranges and efficiency values are approximate and vary with each manufacturer.

**Copy and use this worksheet to estimate actual belt drive operating loads
based upon the Low-Speed Drive Design Procedure**

Drive Design Load Worksheet for Low-Speed Poly Chain GT Carbon Drives

Table 3

To Find ▼	Known Values										Direct Current	Alternating Current	
	Amps	Volts	Motor %Eff/100	Power Factor	hp Load	Motor rpm	Reducer Ratio	Reducer %Eff/100	Motor Torque	Single Phase		Three Phase	
Motor Amps										$\frac{(hp) (746)}{(V) (Eff)}$	$\frac{(hp) (746)}{(V) (Eff) (PF)}$	$\frac{(hp) (746)}{(173) (V) (Eff) (PF)}$	
Motor hp										$\frac{(Amp) (V) (Eff)}{746}$	$\frac{(Amp) (V) (Eff) (PF)}{746}$	$\frac{(173) (Amp) (V) (Eff) (PF)}{746}$	
Motor Torque (lb-in)										$\frac{(hpLoad) (63025)}{(Motor rpm)}$			
Reducer Output Torque										(Motor Torque) (Reducer Speed Ratio) (Reducer Efficiency)			
Reducer Output Torque										$\frac{(hp Load) (Reducer Speed Ratio) (Reducer Efficiency) (63025)}{(Motor rpm)}$			

Notes:

1. Amperage measurements should be made under normal operating conditions, or recorded continuously as a function of time.
2. In three phase systems, the formula amperage value is determined by averaging the three individual phase measurements together.

See Low-Speed Drive Design Information Sheet on page 7

for assistance in collecting drive design information.

Low-Speed Drive Design Information Sheet

For Drive Selections with Shaft Speeds Less Than 500 rpm

Distributor: _____

Customer: _____

Drive Identification (location, number, etc.) _____

DriveR Information:

Motor Nameplate Data

Rated Horsepower = _____ Rated RPM = _____ Efficiency = _____

Rated Voltage = _____ Rated Amps = _____ Rated Torque = _____

Actual Motor Load = _____

Motor Type: AC DC Gear Motor

Output Speed: Constant Variable

Reducer Information:

Reducer Type (worm, right angle helical, cycloidal, etc.):

Reducer Efficiency = _____ Output RPM = _____ Reducer Ratio = _____

Rated Input HP/Torque = _____ Rated Output HP/Torque = _____

Existing Drive Information:

Drive Type: Chain V-Belt Synchronous Belt

If chain, type; 2/#60, #80, etc. Lubed Unlubed

Current Drive Service Life = _____

DriveR Sprocket/Sheave = _____ (teeth/OD) _____ DriveR Shaft Diameter = _____

DriveN Sprocket/Sheave = _____ (teeth/OD) _____ DriveN Shaft Diameter = _____

Center Distance = _____ + _____ - _____

Type of Center Distance Adjustment: _____

Idler used: Yes No Inside Backside

DriveN Information:

Type of Equipment: _____ Actual Horsepower Required = _____

DriveN RPM = _____

Hours/Day = _____ Days/Week = _____ Weeks/Year = _____

Special Requirements:

Space Limitations:

Maximum DriveR Dia. = _____ Maximim DriveN Dia. = _____

Maximum DriveR Width = _____ Maximum DriveN Width = _____

Environmental Conditions:

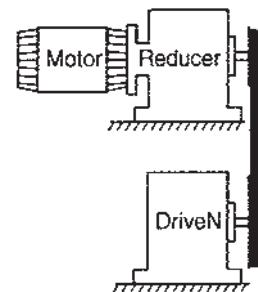
Temperature Range = _____ Belt Conductivity Required

Oil Mist Oil Splash Moisture Abrasives

Drive Layout

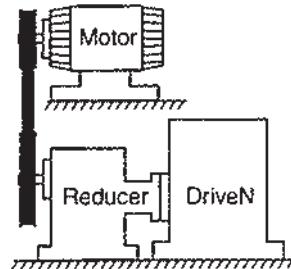
(check one)

Motor Reducer Belt Drive Driven



Belt Drive on Reducer Output Shaft

Motor Belt Drive Reducer Driven



Belt Drive on Reducer Input Shaft

High-Speed Drive Survey and Energy Savings Worksheet

Customer Information

Company: _____ Distributor: _____
Address: _____ Phone: _____ Fax: _____
E-mail: _____

Drive Information

I.D. of Drive (location, number, etc.) _____

Description of DriveN Equipment _____

Manufacturer of DriveN Equipment _____

Horsepower rating of Motor _____ DriveN HP Load (Peak) _____
(Normal) _____

Motor Frame Size _____ Motor Shaft Dia. _____ DriveN Shaft Dia. _____

Speed:

DriveR RPM _____ RPM Measured with Contact or Strobe Tachometer Yes No

DriveN RPM _____ RPM Measured with Contact or Strobe Tachometer Yes No

Speed Ratio _____ Speed Up _____ or Speed Down _____

Center Distance: Minimum _____ Normal _____ Maximum _____

Existing Drive Components: DriveR _____ DriveN _____

Belts _____ Belt Manufacturer _____

Ambient Conditions:

Temperature _____ Moisture _____ Oil, etc. _____

Abrasives _____ Shock Load _____

Static Conductivity Required? Yes No

Maximum Sprocket Diameter (OD) and Width Limitations (for guard clearance):

DriveR: Max. OD _____ Max. Width _____ DriveN: Max. OD _____ Max Width _____

Guard Description _____

Motor Mount:

Double Screw Base? Yes No Motor Mounted on Sheet Metal? Yes No

Adequate Structure? Yes No Floating/Pivot Motor Base? Yes No

Start Up Load:

% Motor Rating at Start Up _____ AC Inverter Yes No Soft Start? Yes No

Duty Cycle:

Number of Starts/Stops _____ times per _____ (hour, day, week, etc.)

Energy Savings Information

Energy Cost per KW-Hour _____

Hours of Operation _____ Hours per Day _____ Days per Week _____ Weeks per Year _____

Gates Design IQ Data Worksheet

Customer Information

Company: _____ **Distributor:** _____

Distributor: _____

Address: _____ **Phone:** _____ **Fax:** _____

Phone: _____ **Fax:** _____

E-mail: _____

Application Summary

General Description:

Product Type: _____ **Production Volume:** _____

Design Parameters

DriveR:

Motor Type & Description: _____ (Servo, Stepper, DC, AC, etc.) **Reversing:** _____ (Y/N)

Reversing: _____(Y/N)

Nominal Motor Torque/Power Output: _____ **RPM:** _____

Max/Peak Motor Torque/Power Output: _____ **RPM:** _____

Motor Stall Torque (If applicable): _____ **Driver Rotation:** _____ (CW / CCW / Rev)

DriveN's/dlers: (Specify appropriate units for each field: in, mm / hp, kw / lb-ft, lb-in, N-m, etc.)

Note: For complex drive layouts use additional pages as needed

Drive Sketch		Idler Details		Max Position																									
		Slot Movement: Spring: <input type="text"/>		<table border="1"> <thead> <tr> <th colspan="2">Min Position</th> </tr> <tr> <th>X</th> <th>Y</th> </tr> </thead> <tbody> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Pivot Point</th> </tr> <tr> <th>X</th> <th>Y</th> </tr> </thead> <tbody> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Movement Angle</th> </tr> <tr> <th>Min Deg</th> <th>Max Deg</th> </tr> </thead> <tbody> <tr><td></td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table>		Min Position		X	Y					Pivot Point		X	Y					Movement Angle		Min Deg	Max Deg				
Min Position																													
X	Y																												
Pivot Point																													
X	Y																												
Movement Angle																													
Min Deg	Max Deg																												
		Pivoting Movement: Spring: <input type="text"/>		Pivot Arm Radius: (in/mm): <input type="text"/>																									

Special Requirements

Product Design Life: _____ Belt Life: _____ Hours/Day: _____ Hours/Year: _____

Pulley Materials:

Prototype _____ Production _____

Ambient Conditions:

Temperature: _____ Moisture: _____ Oil: _____ Static Dissipation: _____ Abrasives: _____

Special Requirements:

Note: This worksheet may be used to survey multipoint drives. For more information on specifying shaft locations in multipoint drive layouts, see Engineering Section I-13 on page 99.

Page _____ Of _____

Poly Chain® GT® Carbon® Belt Drive Selection Procedure

Selection of a stock Poly Chain GT Carbon belt drive system involves these seven steps:

- 1. Calculate the Design Horsepower**
- 2. Select the Belt Pitch**
- 3. Select the Sprockets And Belt Length**
- 4. Select the Proper Belt Width**
- 5. Check and Specify Stock Drive Component**
- 6. Installation and Take-up**
- 7. Calculate Belt Tensioning Requirements**

Sample Drive Selection Problem

A gear pump is to be driven by a 20 hp normal torque electric motor with an output speed of 1160 rpm. The gear pump is to be driven at 580 rpm $\pm 5\%$. The center distance is to be approximately 30 inches, but can be altered ± 3 inches, if necessary. The motor shaft has a 1 7/8 inch O.D. and the pump shaft has a 2 inch O.D. The pump will operate 16 hours a day, five days a week. The pump sprocket is limited to a maximum of 18 inches O.D. There are no unusual drive conditions. Design using Poly Chain GT Carbon.

Step 1 Calculate The Design Horsepower

Procedure

To calculate the design horsepower, first determine the relative severity, then select a service factor for the drive. Average hours per day of service also should be considered. Locate the power source and the driveN unit in the Service Factor Table on page 15. The design hp then is determined by multiplying the rated hp (usually the nameplate rating) by the service factor determined above.

Example

Using the Service Factor Table, the driveR can be found in the first group. Since the pump will run 16 hours per day, follow the continuous service column down to the driveN machines group for gear pumps. The recommended Service Factor is 1.5.

$$\begin{aligned} \text{Design Horsepower} &= (\text{Motor Load}) \times (\text{Service Factor}) \\ &= (20) \times (1.5) \end{aligned}$$

Design Horsepower = 30 hp

Step 2 Select The Belt Pitch

Procedure

Using the design hp and the rpm of the smaller sprocket, select the belt pitch from the Belt Pitch Selection Guide on page 13.

Example

Design Horsepower = **30 hp**
Motor Speed = **1160 rpm**

Locate 1160 rpm on the "RPM of Faster Shaft" scale on the left side of the chart and move over to where the 34 Design Horsepower line intersects. The intersection falls within the 8mm pitch range.

Step 3 Select The Sprockets and Belt Length

Procedure

A. Determine the speed ratio: The speed ratio can be calculated by dividing the rpm of the faster shaft by the rpm of the slower shaft.

Example

Motor Speed = 1160 rpm

Gear Pump Speed = 580 rpm

$$\text{Speed Ratio} = \frac{\text{rpm of faster shaft}}{\text{rpm of slower shaft}} = \frac{1160}{580} = 2.00$$

B. Select the sprocket combination and belt length: Referring to the Stock Drive Selection Tables on pages 16-45, find the proper set of tables for the belt pitch (8mm or 14mm) found in Step 2. Looking down the speed ratio column, find the value which most closely matches the belt drive speed ratio required. Reading across the selected speed ratio line, find the stock DriveR and DriveN sprocket combination available. Reading further across, locate the belt drive center distance which most closely matches the target center distance specified. The belt sizes are listed across the top of the table for each corresponding center distance.

Multiple sprocket combinations will often be available for a given speed ratio. In such cases, selection of the proper drive combination will depend on the center distance required, minimum or maximum required sprocket diameters and the recommended minimum sprocket diameter for electric motors (see Table 4 on page 14).

After selecting possible sprocket combinations and center distances, record the belt length (top of column) and the length factor (bottom of column).

Example

Belt pitch = **8mm**

Belt Drive Speed Ratio = **2.00**

Center Distance = **30.00 ± 3.00 in.**

Refer to the 8mm Pitch Stock Drive Selection Tables on pages 16-31. Reading down the Speed Ratio column locate 2.00 on page 26. There are six various sprocket combinations within the allowable center distance range. The minimum sprocket diameter of 4.7 inches for a 20 hp motor at 1160 rpm (See Table 4 on page 14) eliminates the 25 to 50 and 40 to 80 groove sprocket combinations. Therefore, the 56 to 112 groove sprocket combination is selected.

The 56 groove driveR sprocket, 112 groove driven sprocket, and 8MGT-2240 (280 tooth) belt combination has a center distance of 30.74". Note that Belt Length Correction Factor is 1.26.

Poly Chain® GT® Carbon® Belt Drive Selection Procedure (continued)

C. Check the belt speed. Do not exceed 6500 fpm (feet per minute) with stock sprockets. Belt Speed can be calculated using the following formula:

$$V (\text{fpm}) = PD (\text{inches}) \times \frac{\text{Speed (rpm)}}{3.82}$$

Example

8mm Pitch Drive with 56 groove driveR:

$$V = \frac{5.614 \times 1160}{3.82} = 1704.8 \text{ fpm}$$

Calculating the belt speed for the drive system being considered shows that the belt speed does not exceed 6500 fpm and can be considered further.

Step 4 Select The Proper Belt Width

Procedure

Horsepower Rating Tables are located on Pages 46-63 for standard belt pitches and stock belt widths. The base horsepower rating is given in the upper table as a function of the speed (rpm) of the faster shaft and diameter of the small sprocket. The speed of the faster shaft is located in the left hand column. Across the top are various stock sprocket sizes. The base horsepower rating of a given sprocket, at a specific speed, is the point at which the "rpm" row and the "sprocket size" column intersect.

This base horsepower rating must be corrected for speed down speed ratios, and for the belt length selected. The following formula should be used to calculate the total drive horsepower rating:

$$\begin{aligned} \text{Rated Drive Horsepower} &= [\text{Rated Base Horsepower} \\ &\quad + \text{Additional Horsepower for Speed Ratio}] \\ &\quad \times (\text{Belt Length Correction Factor}) \end{aligned}$$

Referring to the Additional Horsepower for Speed Ratio Factor Table, select a value based upon the drive operating speed and the speed ratio. This value should be added to the base horsepower rating. Multiply the corrected rating by the applicable Belt Length Correction Factor determined in Step 3B or from the Belt Length Correction Factor Table. The drive horsepower rating must equal or exceed design horsepower.

Where there are several choices, space limitations may control the selection. In addition, the following guidelines should be considered:

1. Larger sprockets result in reduced belt width.
2. Larger sprockets yield longer drive service life.
3. Avoid drives where the belt width exceeds the smaller sprocket diameter.
4. Avoid drives where center distance is greater than 8 times the diameter of the smaller sprocket. Refer to Engineering Section I-10 on page 98 for additional details.

Example

Refer to the 8mm pitch Horsepower Rating Table for 12mm Wide belts on page 47. Read down the left hand column for "RPM of Faster Shaft" and locate 1160 rpm. Read the sprocket sizes listed across the top of the table and locate the 56 groove, 5.614 inch P.D. column. Read across the "RPM" row and down the sprocket size column until the two intersect at a **Rated Base Horsepower of 23.8 hp.**

Next, referencing the Additional Horsepower for Speed Ratio Factor Table, find the listing for a 2.00 speed ratio. An **add-on factor of .74 hp** is listed. Then, referencing the Belt Length Correction Factor Table, find the listing for an 8MGT-2240 belt. A **correction factor of 1.26** is listed.

Calculate the Corrected Horsepower Rating:

Rated Drive Horsepower =

$$[\text{Rated Base Horsepower} + \text{Added HP for Speed Ratio}] \times (\text{Belt Length Correction Factor}) = [23.8 \text{ hp} + .74 \text{ hp}] \times (1.26)$$

Rated Drive Horsepower = 30.92 hp

The Drive Horsepower Rating of 30.92 hp exceeds the Design Horsepower target of 30 hp. So, a **belt width of 12mm** is acceptable.

Step 5 Check and Specify Stock Drive Components

Procedure

A. Check the sprockets selected in Steps 3 and 4 against the design requirements using the dimensions provided in the Sprocket Specification Tables on pages 64 through 73. Use flange diameters when checking against maximum diameter requirements.

Example

From the table on page 65, we find the 8MX-112S-12 driveN Sprocket has an overall diameter of 11.166 inches, which is less than the 18 inch maximum diameter specified.

B. Determine the bushing size required for each sprocket and check bore sizes by using the Sprocket Specification Tables. From the Stock Bushing tables on page 77, check the bore range and keyway dimensions against the design requirements.

Example

Also from the sprocket data on page 65 we note that the **8MX-56S-12 sprocket requires a 2012 bushing** and the **8MX-112S-12 sprocket requires a 2012 bushing**. In the bushing table on page 80, a **2012 bushing has a bore range of 1/2 to 2 1/8 inches**, which includes the 1 7/8 inch bore required for the driveR shaft. The **2012 bushing has a bore range from 1/2 to 2 1/8 inches**, which includes the 2 inch bore required for the driveN shaft.

C. Specify stock drive components using proper designations.

Example

Stock drive components are as follows:

- 1 ea. 8MGT-2240-12 Poly Chain GT Carbon belt
- 1 ea. 8MX-56S-12 driveR sprocket
- 1 ea. 2012 Bushing with a 1-7/8 in. bore
- 1 ea. 8MX-112S-12 driveN sprocket
- 1 ea. 2012 Bushing with a 2 in. bore

Poly Chain® GT® Carbon® Belt Drive Selection Procedure (continued)

Step 6 Installation and Takeup

Procedure

Because of its high resistance to elongation (stretch), there is no need to re-tension and take up a Poly Chain GT Carbon belt drive. However, some adjustment must be provided when installing synchronous belt drives, as with nearly all power transmission systems, to account for manufacturing and assembly tolerances and initial tensioning requirements. Table 12 on page 105 lists the standard installation and take-up requirements for a given belt length. Additional center distance adjustment is needed when installing the belt over flanged sprockets (see Table 12 on page 105.)

Example

As can be seen in the Sprocket Specifications Table on page 65, one of the sprockets is flanged. The total installation and tensioning allowances, are shown below.

Installation Allowance = 0.13 in. + 0.86 in. = 0.99 in.

Tensioning Allowance = 0.04 in.

Subtracting this from the nominal center distance value gives a minimum center distance necessary for belt installation of (30.74 inch - .99 inch) = 29.75 inches. From the problem statement, the center distance can be reduced down to 27.0 in. if necessary. So, **there is sufficient center distance adjustment to easily install the belt.**

Step 7 Calculate Belt Tensioning Requirements

Procedure

A. Calculate base static tension using appropriate Formula 14 on page 103. The m value is listed in Table 11 on page 103.

Example

Belt Pitch = 8mm

Belt Size = 8MGT-2240, 280 teeth (88.19 in. P.L.)

Belt Width = 12mm

DriveR Sprocket = 56 grooves (5.614 in. P.D.)

DriveR Shaft Speed = 1160 rpm

DriveN Sprocket = 112 grooves (11.229 in. P.D.)

Actual Center Distance = 30.74 in.

Design Horsepower = 30 hp

$$T_{ST} = \frac{20 \text{ HP}}{S} + MS^2, \text{ pounds}$$

Where:

HP = Horsepower = **20 hp**

M = **0.33**, constant for 8mm pitch, 12mm wide belt from Table 11 on page 103

S = (Sprocket Diameter) x (Shaft Speed) / 3820

$$= (5.614 \text{ in.}) \times (1160 \text{ rpm}) / 3820$$

$$S = **1.70**$$

$$T_{ST} = \frac{20 (20)}{1.70} + (0.33)(1.70)^2$$

$$T_{ST} = 235.29 + 0.95 \text{ lb.}$$

$$T_{ST} = **236.24 lb.**$$

B. Calculate minimum and maximum deflection forces using Formulas 15 and 16 on page 104. The Y value is listed in Table 11.

Example

a. Calculate the belt span length

$$t = \sqrt{C^2 - \left(\frac{D - d}{2} \right)^2}$$

where:

t = Span Length, inches

C = Center Distance = **30.74 in.**

D = diameter of larger sprocket = **11.229 in. P.D.**

d = diameter of smaller sprocket = **5.614 in. P.D.**

$$t = \sqrt{30.74^2 - \left(\frac{11.229 - 5.614}{2} \right)^2}$$

$$t = **30.61 in.**$$

b. Calculate Minimum and Maximum belt deflection forces referring to Formulas 15 and 16 on page 104:

$$\text{Min Deflection Force} = \frac{1.1T_{ST} + \left(\frac{t}{L} \right)Y}{16}$$

where:

T_{ST} = **236.24** pounds static tension as calculated before

t = **30.61** inches span length as calculated before

L = **88.19** inches belt length

Y = **65** (constant for Table 11 on page 103)

$$\text{Min Deflection Force} = \frac{1.1(236.24) + \left(\frac{30.61}{88.19} \right)(65)}{16}$$

$$\text{Min. Deflection Force} = **17.65 lb.**$$

$$\text{Max Deflection Force} = \frac{1.2T_{ST} + \left(\frac{t}{L} \right)Y}{16}$$

$$\text{Max Deflection Force} = \frac{1.2(236.24) + \left(\frac{30.61}{88.19} \right)(65)}{16}$$

$$\text{Max. Deflection Force} = **19.13 lb.**$$

Poly Chain® GT® Carbon® Belt Drive Selection Procedure (continued)

Step 7 Calculate Belt Tensioning Requirements

Procedure - continued

C. Determine the deflection distance using $\frac{1}{64}$ " per inch of span length.

NOTE: Deflection forces must be applied evenly across the entire belt width.

Example

$$\text{Deflection Distance} = \frac{t}{64}, \text{ inches}$$

$$\text{Deflection Distance} = \frac{30.61}{64}$$

Deflection Distance = 0.48 in.

D. Applying The Tension:

At the center of span (t), apply a measured force perpendicular to the belt span large enough to deflect the belt 0.48 inch from its normal free position. Be sure that the force is applied evenly across the entire belt width. Note that one sprocket should be free to rotate during the belt tensioning process.

Compare the measured deflection force with the range of minimum to maximum deflection forces calculated before.

- 1. If the measured deflection force is less than the minimum recommended deflection force, the belt should be tightened.**
- 2. If the measured deflection force is greater than the maximum recommended deflection force, the belt should be loosened.**

Example

When the Gear Pump belt drive is properly tensioned, a belt span deflection of 0.48 in. should require a deflection force within the range of 17.65 to 19.13 lb.

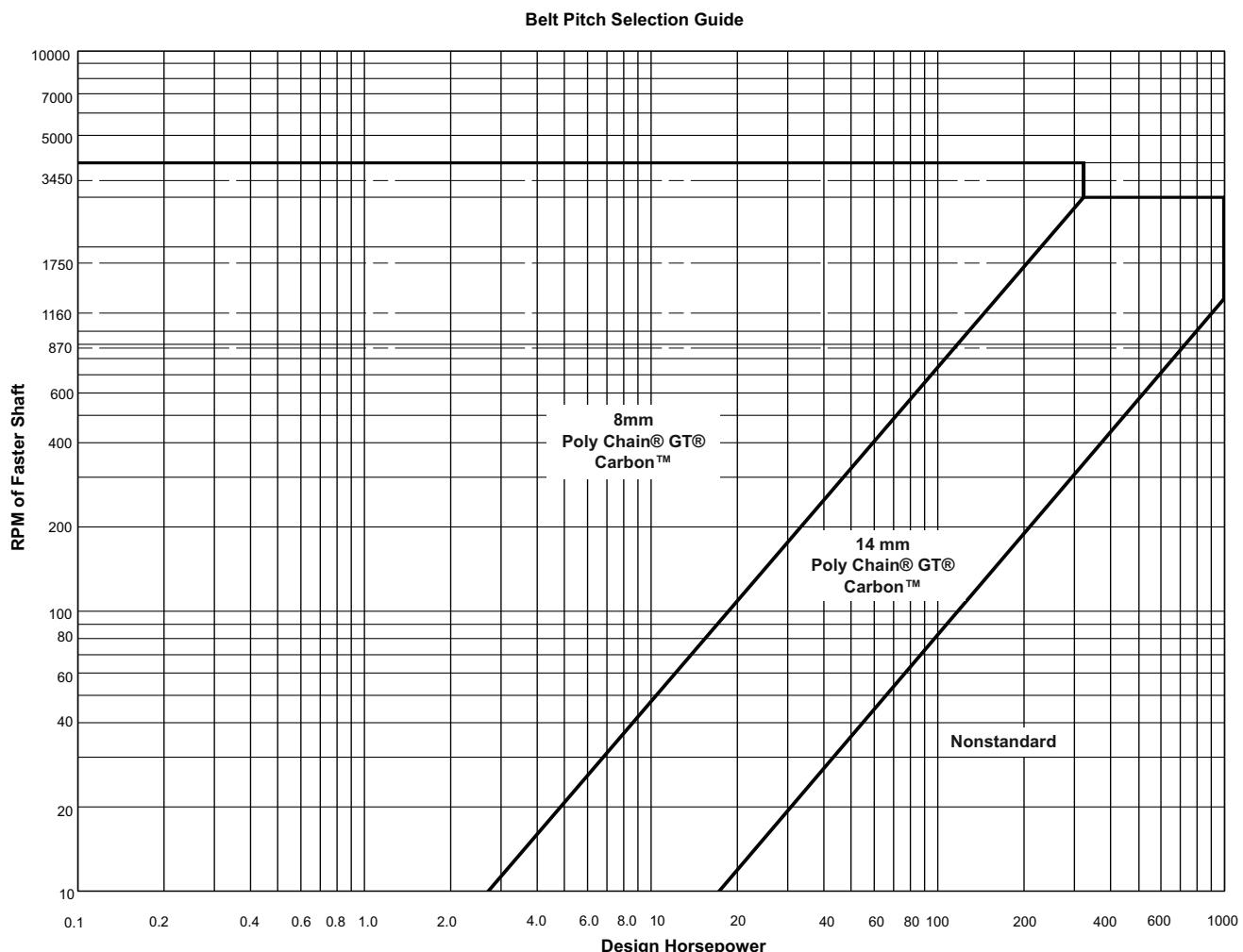


Table No. 4

Minimum Recommended Sprocket Pitch Diameters for General Purpose Electric Motors

Synchronous Belt Drives

For a given motor horsepower and speed, the total belt pull is related to the motor sprocket size. As this size decreases, the total belt pull increases. Therefore, to limit the resultant load on motor shaft and bearings, NEMA lists minimum sprocket sizes for the various motors. The sprocket on the motor (DriveR sheave) should be at least as large as the diameter specified in Table No. 4.

Motor Horsepower	Motor RPM (60 Cycle and 50 Cycle Electric Motors)						Motor Horsepower
	575 485*	690 575*	870 725*	1160 950*	1750 1425*	3450 2850*	
1/2	—	—	2.0	—	—	—	1/2
3/4	—	—	2.2	2.0	—	—	3/4
1	2.7	2.3	2.2	2.2	2.0	—	1
1 1/2	2.7	2.7	2.2	2.2	2.2	2.0	1 1/2
2	3.4	2.7	2.7	2.2	2.2	2.2	2
3	4.1	3.4	2.7	2.7	2.2	2.2	3
5	4.1	4.1	3.4	2.7	2.7	2.2	5
7 1/2	4.7	4.1	4.0	3.4	2.7	2.7	7 1/2
10	5.4	4.7	4.0	4.0	3.4	2.7	10
15	6.1	5.4	4.7	4.0	4.0	4.0	15
20	7.4	6.1	5.4	4.7	4.0	2.2	20
25	8.1	7.4	6.1	5.4	4.0	4.0	25
30	9.0	8.1	6.1	6.1	4.7	—	30
40	9.0	9.0	7.4	6.1	5.4	—	40
50	9.9	9.0	7.6	7.4	6.1	—	50
60	10.8	9.9	9.0	7.2	6.7	—	60
75	12.6	11.7	8.6	9.0	7.7	—	75
100	16.2	13.5	10.8	9.0	7.7	—	100
125	18.0	16.2	13.5	10.8	9.5#	—	125
150	19.8	18.0	16.2	11.7	9.5	—	150
200	19.8	19.8	19.8	—	11.9	—	200
250	19.8	19.8	—	—	—	—	250
300	24.3	24.3	—	—	—	—	300

* These RPM are for 50 cycle electric motors.

Use 8.6 for Frame Number 444 T only.

Data in the white area of Table No. 4 are from NEMA Standard MG-1-14-42, June, 1972. Data in the gray area are from MG-1-14-43, January, 1968. The blue area is a composite of electric motor manufacturers data. They are generally conservative, and specific motors and bearings may permit the use of a smaller motor sprocket. Consult the motor manufacturer. See Engineering Section I-3 page 96.

Table No. 5
Poly Chain® GT® Carbon® Service Factors

DriveN Machine	DriveR					
The driveN machines listed below are representative samples only. Select a driveN machine whose load characteristics most closely approximate those of the machine being considered.	AC Motors: Normal Torque, Squirrel Cage, Synchronous, Split Phase, Inverter Controlled DC Motors: Shunt Wound, Stepper Motors Engines: Multiple Cylinder Internal Combustion.			AC Motors: High Torque, High Slip, Repulsion-Induction, Single Phase, Series Wound, Slip Ring. DC Motors: Series Wound, Compound Wound, Servo Motors. Engines: Single Cylinder Internal Combustion. Line shafts Clutches		
	Intermittent Service	Normal Service	Continuous Service	Intermittent Service	Normal Service	Continuous Service
	Up to 8 Hours Daily or Seasonal	8-16 Hours Daily	16-24 Hours Daily	Up to 8 Hours Daily or Seasonal	8-16 Hours Daily	16-24 Hours Daily
Display, Dispensing Equipment Instrumentation Measuring Equipment Medical Equipment Office, Projection Equipment	1.0	1.2	1.4	1.2	1.4	1.6
Appliances, Sweepers, Sewing Machines Screens, Oven Screens, Drum, Conical Woodworking Equipment: (Light) Band Saws, Drills, Lathes	1.1	1.3	1.5	1.3	1.5	1.7
Agitators for Liquids Conveyors: Belt, Light Package Drill Press, Lathes, Saws Laundry Machinery Woodworking Equipment: (Heavy) Circular Saws, Joiners, Planers	1.2	1.4	1.6	1.6	1.8	2.0
Agitators: Semi-liquid Compressors: Centrifugal Conveyor Belt: Coal, Ore, Sand Dough Mixers Line Shafts Machine Tools: Grinder, Shaper Boring Mill, Milling Machines Paper Machinery (except Pulpers) Presses, Punches, Shears Printing Machinery Pumps: Centrifugal, Gear Screens: Revolving, Vibratory	1.3	1.5	1.7	1.6	1.8	2.0
Brick Machinery (except Pug Mills) Conveyor: Apron, Pan, Bucket, Elevator Extractors, Washers Fans, Centrifugal Blowers Generators & Exciters Hoists Rubber Calendar, Mills, Extruders	1.4	1.6	1.8	1.8	2.0	2.2
Centrifuges Screw Conveyors Hammer Mills Paper Pulpers Textile Machinery	1.5	1.7	1.9	1.9	2.1	2.3
Blowers: Positive Displacement Mine Fans Pulverizers	1.6	1.8	2.0	2.0	2.2	2.4
Compressors, Reciprocating Crushers: Gyratory, Jaw, Roll Mills: Ball, Rod, Pebble, etc. Pumps, Reciprocating Saw Mill Equipment	1.7	1.9	2.1	2.1	2.3	2.5

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches													
DriveR		DriveN			8MGT-640 PL. 25.20 80 Teeth	8MGT-720 PL. 35.25 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-966 PL. 35.25 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.09 140 Teeth	8MGT-1200 PL. 47.24 150 Teeth	8MGT-1224 PL. 48.19 153 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.69 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1750 PL. 69.29 220 Teeth
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)															
22	2.206	22	2.206	1.00	9.13	10.71	12.28	14.17	15.43	16.22	17.00	18.58	20.15	20.63	21.73	24.88	28.03	31.18
25	2.506	25	2.506	1.00	8.66	10.24	11.81	13.70	14.96	15.75	16.53	18.11	19.68	20.16	21.26	24.41	27.56	30.71
26	2.607	26	2.607	1.00	8.50	10.08	11.65	13.54	14.80	15.59	16.37	17.95	19.52	20.00	21.10	24.25	27.40	30.55
27	2.707	27	2.707	1.00	8.35	9.92	11.50	13.39	14.65	15.43	16.22	17.79	19.37	19.84	20.94	24.09	27.24	30.39
28	2.807	28	2.807	1.00	8.19	9.77	11.34	13.23	14.49	15.28	16.06	17.64	19.21	19.69	20.79	23.94	27.09	30.24
29	2.907	29	2.907	1.00	8.03	9.61	11.18	13.07	14.33	15.12	15.90	17.48	19.05	19.53	20.63	23.78	26.93	30.08
30	3.008	30	3.008	1.00	7.88	9.45	11.03	12.92	14.18	14.96	15.75	17.32	18.90	19.37	20.47	23.62	26.77	29.92
31	3.108	31	3.108	1.00	7.72	9.29	10.87	12.76	14.02	14.80	15.59	17.16	18.74	19.21	20.31	23.46	26.61	29.76
32	3.208	32	3.208	1.00	7.56	9.14	10.71	12.60	13.86	14.65	15.43	17.01	18.58	19.06	20.16	23.31	26.46	29.61
33	3.308	33	3.308	1.00	7.40	8.98	10.55	12.44	13.70	14.49	15.27	16.85	18.42	18.90	20.00	23.15	26.30	29.45
34	3.409	34	3.409	1.00	7.25	8.82	10.40	12.29	13.55	14.33	15.12	16.69	18.27	18.74	19.84	22.99	26.14	29.29
35	3.509	35	3.509	1.00	7.09	8.66	10.24	12.13	13.39	14.17	14.96	16.53	18.11	18.58	19.68	22.83	25.98	29.13
36	3.609	36	3.609	1.00	6.93	8.51	10.08	11.97	13.23	14.02	14.80	16.38	17.95	18.43	19.53	22.68	25.83	28.98
37	3.709	37	3.709	1.00	6.77	8.35	9.92	11.81	13.07	13.86	14.64	16.22	17.79	18.27	19.37	22.52	25.67	28.82
38	3.810	38	3.810	1.00	6.62	8.19	9.77	11.66	12.92	13.70	14.49	16.06	17.64	18.11	19.21	22.36	25.51	28.66
39	3.910	39	3.910	1.00	6.46	8.03	9.61	11.50	12.76	13.54	14.33	15.90	17.48	18.05	19.13	22.20	25.35	28.50
40	4.010	40	4.010	1.00	6.30	7.88	9.45	11.34	12.60	13.39	14.17	15.75	17.32	17.80	18.90	22.05	25.20	28.35
41	4.110	41	4.110	1.00	6.14	7.72	9.29	11.18	12.44	13.23	14.01	15.59	17.16	17.64	18.74	21.89	25.04	28.19
42	4.211	42	4.211	1.00	5.99	7.56	9.14	11.03	12.29	13.07	13.86	14.53	17.01	17.48	18.58	21.73	24.88	28.03
45	4.511	45	4.511	1.00	5.51	7.09	8.66	10.55	11.81	12.60	13.38	14.96	16.53	17.01	18.11	21.26	24.41	27.56
48	4.812	48	4.812	1.00														
50	5.013	50	5.013	1.00														
53	5.314	53	5.314	1.00														
56	5.614	56	5.614	1.00														
60	6.015	60	6.015	1.00														
63	6.316	63	6.316	1.00														
67	6.717	67	6.717	1.00														
71	7.118	71	7.118	1.00														
75	7.519	75	7.519	1.00														
80	8.020	80	8.020	1.00														
41	4.110	42	4.211	1.024	6.06	7.64	9.21	11.10	12.36	13.15	13.93	15.51	17.08	17.56	18.66	21.81	24.96	28.11
40	4.010	41	4.110	1.025	6.22	7.80	9.37	11.26	12.52	13.31	14.09	15.67	17.24	17.72	18.82	21.97	25.12	28.27
38	3.810	39	3.910	1.026	6.54	8.11	9.69	11.58	12.84	13.62	14.41	15.98	17.56	18.03	19.13	22.28	25.43	28.58
39	3.910	40	4.010	1.026	6.38	7.95	9.53	11.42	12.68	13.46	14.25	15.82	17.40	17.87	18.97	22.12	25.27	28.42
37	3.709	38	3.810	1.027	6.69	8.27	9.84	11.73	12.99	13.78	14.56	16.14	17.71	18.19	19.29	22.44	25.59	28.74
36	3.609	37	3.709	1.028	6.85	8.43	10.00	11.89	13.15	13.94	14.72	16.30	17.87	18.35	19.45	22.60	25.75	28.90
34	3.409	35	3.509	1.029	7.17	8.74	10.32	12.21	13.47	14.25	15.04	16.61	18.19	18.66	19.76	22.91	26.06	29.21
35	3.509	36	3.609	1.029	7.01	8.58	10.16	12.05	13.31	14.09	14.88	16.45	18.03	18.50	19.60	22.75	25.90	29.05
33	3.308	34	3.409	1.030	7.32	8.90	10.47	12.36	13.62	14.41	15.19	16.77	18.34	18.82	19.92	23.07	26.22	29.37
32	3.208	33	3.308	1.031	7.48	9.06	10.63	12.52	13.78	14.57	15.35	16.93	18.50	18.98	20.08	23.23	26.38	29.53
31	3.108	32	3.208	1.032	7.64	9.21	10.79	12.68	13.94	14.72	15.51	17.08	18.66	19.13	20.23	23.38	26.53	29.68
30	3.008	31	3.108	1.033	7.80	9.37	10.95	12.84	14.10	14.88	15.67	17.24	18.82	19.29	20.39	23.54	26.69	29.84
29	2.907	30	3.008	1.034	7.95	9.53	11.10	12.99	14.25	15.04	15.82	17.40	18.97	19.45	20.55	23.70	26.85	30.00
28	2.807	29	2.907	1.036	8.11	9.69	11.26	13.15	14.41	15.20	15.98	17.56	19.13	19.61	20.71	23.86	27.01	30.16
27	2.707	28	2.807	1.037	8.27	9.84	11.42	13.31	14.57	15.35	16.14	17.71	19.29	19.76	20.86	24.01	27.16	30.31
26	2.607	27	2.707	1.038	8.43	10.00	11.58	13.47	14.73	15.51	16.30	17.87	19.45	19.92	21.02	24.17	27.32	30.47
25	2.506	26	2.607	1.040	8.58	10.16	11.73	13.62	14.88	15.67	16.45	18.03	19.60	20.08	21.18	24.33	27.48	30.63
48	4.812	50	5.013	1.042	6.46	8.03	9.62	11.18	12.44	13.23	14.01	15.59	17.16	17.64	18.74	21.89	25.04	28.19
40	4.010	42	4.211	1.050	6.14	7.72	9.29	10.95	12.21	13.00	13.78	15.36	16.93	17.41	18.51	21.66	24.86	28.96
60	6.015	63	6.316	1.050														
39	3.910	41	4.110	1.051	6.30	7.88	9.45	11.34	12.60	13.39	14.17	15.75	17.32	17.80	18.90	22.05	25.20	28.35
38	3.810	40	4.010	1.053	6.46	8.03	9.61	11.50	12.76	13.54	14.33	15.90	17.48	17.95	19.05	22.20	25.35	28.50
37	3.709	39	3.910	1.054	6.62	8.19	9.77	11.66	12.92	13.70	14.49	16.06	17.64	18.11	19.21	22.36	25.51	28.66
36	3.609	38	3.810	1.056	6.77	8.35	9.92	11.81	13.07	13.86	14.64	16.22	17.79	18.27	19.37	22.52	25.67	28.82
71	7.118	75	7.519	1.056														
35	3.509	37	3.709	1.057	6.93	8.51	10.08	11.97	13.23	14.02	14.80	16.38	17.95	18.43	19.53	22.68	25.83	28.98
53	5.314	56	5.614	1.057														
34	3.409	36	3.609	1.059	7.09	8.66	10.24	12.13	13.39	14.17	14.96	16.53	18.11	18.58	19.68	22.83	25.98	29.13
50	5.013	53	5.314	1.060														
67	6.717	71	7.118	1.060			</											

8mm PITCH BELTS

Center Distance, Inches																Speed Ratio	Sprocket Combinations				
Driver								DriveN													
Number of Grooves		Number of Grooves																			
8MGT-1782 PL.10.55 224Teeth	8MGT-2000 PL.78.74 250 Teeth	8MGT-2200 PL.86.61 275 Teeth	8MGT-2240 PL.88.19 280 Teeth	8MGT-2400 PL.94.49 300 Teeth	8MGT-2520 PL.99.21 315 Teeth	8MGT-2600 PL.102.36 325 Teeth	8MGT-2840 PL.110.24 350 Teeth	8MGT-3048 PL.111.81 355 Teeth	8MGT-3220 PL.125.98 400 Teeth	8MGT-3280 PL.128.13 410 Teeth	8MGT-3600 PL.141.73 450 Teeth	8MGT-4000 PL.157.48 500 Teeth	8MGT-4480 PL.173.23 550 Teeth	8MGT-4480 PL.176.38 560 Teeth	Length Factor*						
31.81	35.90	39.84	40.63	43.78	46.14	47.71	51.65	52.44	56.53	59.52	61.10	67.40	75.27	83.15	84.72	1.000	22	22			
31.34	35.43	39.37	40.16	43.31	45.67	47.24	51.18	51.97	56.06	59.05	60.63	66.93	74.80	82.68	84.25	1.000	25	25			
31.18	35.27	39.21	40.00	43.15	45.51	47.08	51.02	51.81	55.90	58.89	60.47	66.77	74.64	82.52	84.09	1.000	26	26			
31.02	35.12	39.05	39.84	42.99	45.35	46.93	50.87	51.65	55.75	58.74	60.31	66.61	74.49	82.36	83.94	1.000	27	27			
30.87	34.96	38.90	39.69	42.84	45.20	46.77	50.71	51.50	55.59	58.58	60.16	66.46	74.33	82.21	83.78	1.000	28	28			
30.71	34.80	38.74	39.53	42.68	45.04	46.61	50.55	51.34	55.43	58.42	60.00	66.30	74.17	82.05	83.62	1.000	29	29			
30.55	34.65	38.58	39.37	42.52	44.88	46.46	50.40	51.18	55.28	58.27	59.84	66.14	74.02	81.89	83.47	1.000	30	30			
30.39	34.49	38.42	39.21	42.36	44.72	46.30	50.24	51.02	55.12	58.11	59.68	65.98	73.86	81.73	83.31	1.000	31	31			
30.24	34.33	38.27	39.06	42.21	44.57	46.14	50.08	50.87	54.96	57.95	59.53	65.83	73.70	81.58	83.15	1.000	32	32			
30.08	34.17	38.11	38.90	42.05	44.41	45.98	49.92	50.71	54.80	57.79	59.37	65.67	73.54	81.42	82.99	1.000	33	33			
29.92	34.02	37.95	38.74	41.89	44.25	45.83	49.77	50.55	54.65	57.64	59.21	65.51	73.39	81.26	82.84	1.000	34	34			
29.76	33.86	37.79	38.58	41.73	44.09	45.67	49.61	50.39	54.49	57.48	59.05	65.35	73.23	81.10	82.68	1.000	35	35			
29.61	33.70	37.64	38.43	41.58	43.94	45.51	49.45	50.24	54.33	57.32	59.90	65.20	73.07	80.95	82.52	1.000	36	36			
29.45	33.54	37.48	38.27	41.42	43.78	45.35	49.29	50.08	54.17	57.16	58.74	65.04	72.91	80.79	82.36	1.000	37	37			
29.29	33.39	37.32	38.11	41.26	43.62	45.20	49.14	49.92	54.02	57.01	58.58	64.88	72.76	80.63	82.21	1.000	38	38			
29.13	33.23	37.16	37.95	41.10	43.46	45.04	48.98	49.76	53.86	56.85	58.42	64.72	72.60	80.47	82.05	1.000	39	39			
28.98	33.07	37.01	37.80	40.95	43.31	44.91	48.82	49.61	53.70	56.69	58.27	64.57	72.44	80.32	81.89	1.000	40	40			
28.82	32.91	36.85	37.64	40.79	43.15	44.72	48.66	49.45	53.54	56.53	58.11	64.41	72.28	80.16	81.73	1.000	41	41			
28.66	32.76	36.69	37.48	40.63	42.99	44.57	48.51	49.29	53.39	56.38	57.95	64.25	72.13	80.00	81.58	1.000	42	42			
28.19	32.28	36.22	37.01	40.16	42.52	44.09	48.03	48.82	52.91	55.90	57.48	63.78	71.65	79.53	81.10	1.000	45	45			
27.72	31.81	35.75	36.54	39.69	42.05	43.62	47.56	48.35	52.44	55.43	57.01	63.31	71.18	79.06	80.63	1.000	48	48			
27.40	31.50	35.43	36.22	39.37	41.73	43.31	47.25	48.03	52.13	55.12	56.69	62.99	70.87	78.74	80.32	1.000	50	50			
26.93	31.02	34.96	35.75	38.90	41.26	42.83	46.77	47.56	51.65	54.64	56.22	62.52	70.39	78.27	79.84	1.000	53	53			
26.46	30.55	34.49	35.28	38.43	40.79	42.36	46.30	47.09	51.18	54.17	55.75	62.05	69.92	77.80	79.37	1.000	56	56			
25.83	29.92	33.86	34.65	37.80	40.16	41.73	45.67	46.46	50.55	53.54	55.12	61.42	69.29	77.17	78.74	1.000	60	60			
25.35	29.45	33.38	34.17	37.32	39.68	41.26	45.20	45.98	50.08	53.07	54.64	60.94	68.82	76.69	78.27	1.000	63	63			
24.72	28.82	32.75	33.54	36.69	39.05	40.63	44.57	45.35	49.45	52.44	54.01	60.31	68.19	76.06	77.64	1.000	67	67			
24.09	28.19	32.12	32.91	36.06	38.42	40.00	43.94	44.72	48.82	51.81	53.38	59.68	67.56	75.43	77.01	1.000	71	71			
23.46	27.56	31.49	32.28	35.43	37.79	39.37	43.31	44.09	48.19	51.18	52.75	59.05	66.93	74.80	76.38	1.000	75	75			
22.68	26.77	30.71	31.50	34.65	37.01	38.58	42.52	43.31	47.40	50.39	51.97	58.27	66.14	74.02	75.59	1.000	80	80			
28.74	32.83	36.77	37.56	40.71	43.07	44.64	48.58	49.37	53.46	56.45	58.03	64.33	72.20	80.08	81.65	1.024	41	42			
28.90	32.99	36.93	37.72	40.87	42.23	44.80	48.74	49.53	53.62	56.61	58.19	64.49	72.36	80.24	81.81	1.025	40	41			
29.21	33.31	37.24	38.03	41.18	43.54	45.12	49.06	49.84	53.94	56.93	58.50	64.80	72.68	80.55	82.13	1.026	38	39			
29.05	33.15	37.08	37.87	41.02	43.38	44.96	48.90	49.68	53.78	56.77	58.34	64.64	72.52	80.39	81.97	1.026	39	40			
29.37	33.46	37.40	38.19	41.34	43.70	45.27	49.21	50.00	54.09	57.08	58.66	64.96	72.83	80.71	82.28	1.027	37	38			
29.53	33.62	37.56	38.35	41.50	43.86	45.43	49.37	50.16	54.25	57.24	58.82	65.12	72.99	80.87	82.44	1.028	36	37			
29.84	33.94	37.87	38.66	41.81	44.17	45.75	49.69	50.47	54.57	57.56	59.13	65.43	73.31	81.18	82.76	1.029	34	35			
29.68	33.78	37.71	38.50	41.65	44.01	45.59	49.53	50.31	54.41	57.40	58.97	65.27	73.15	81.02	82.60	1.029	35	36			
30.00	34.09	38.03	38.82	41.97	44.33	45.90	49.84	50.63	54.72	57.71	59.29	65.59	73.46	81.34	82.91	1.030	33	34			
30.16	34.25	38.19	38.98	42.13	44.49	46.06	50.00	50.79	54.88	57.87	59.45	65.75	73.62	81.50	83.07	1.031	32	33			
30.31	34.41	38.34	39.13	42.28	44.64	46.22	50.16	50.94	55.04	58.03	59.60	65.90	73.78	81.65	83.23	1.032	31	32			
30.47	34.57	38.50	39.29	42.44	44.80	46.38	50.32	51.10	55.20	58.19	59.76	66.06	73.94	81.81	83.39	1.033	30	31			
30.63	34.72	38.66	39.45	42.60	44.96	46.53	50.47	51.26	55.35	58.34	59.92	66.22	74.09	81.97	83.54	1.034	29	30			
30.79	34.88	38.82	39.61	42.76	45.12	46.69	50.63	51.42	55.51	58.50	60.08	66.38	74.25	82.13	83.70	1.036	28	29			
30.94	35.04	38.97	39.76	42.91	45.27	46.85	50.79	51.57	55.67	58.66	60.23	66.53	74.41	82.28	83.86	1.037	27	28			
31.10	35.20	39.13	39.92	43.07	45.43	47.01	50.95	51.73	55.83	58.82	60.39	66.69	74.57	82.44	84.02	1.038	26	27			
31.26	35.35	39.29	40.08	43.23	45.59	47.16	51.10	51.89	55.98	58.97	60.55	66.85	74.72	82.60	84.17	1.040	25	26			
27.56	31.65	35.59	36.38	39.53	41.89	43.46	47.40	48.19	52.28	55.27	58.85	63.15	71.02	78.90	80.47	1.042	48	50			
28.82	32.91	36.85	37.64	40.79	43.15	44.72	48.66	49.45	53.54	56.53	58.11	64.41	72.28	80.16	81.73	1.050	40	42			
25.59	29.68	33.62	34.41	37.56	39.92	41.49	45.44	46.22	50.32	53.31	54.88	61.18	69.06	76.93	78.51	1.050	60	63			
28.98	33.07	37.01	37.80	40.95	43.31	44.88	48.82	49.61	53.70	56.69	58.27	64.57	72.44	80.32	81.89	1.051	39	41			
29.13	33.23	37.16	37.95	41.10	43.46	45.04	48.98	49.76	53.86	56.85	58.42	64.72	72.60	80.47	82.05	1.053	38	40			
29.29	33.39	37.32	38.11	41.26	43.62	45.20	49.14	49.92	54.02	57.01	58.58	64.88	72.76	80.63	82.21	1.054	37	39			
29.45	33.54	37.48	38.27	41.42	43.78																

Drive Selection Table

8mm Pitch Poly Chain® GT® Carbon® Belts

Sprocket Combinations				Speed Ratio	Center Distance, Inches																
DriveR		DriveN			8MGT-640 PL. 22.20 80 Teeth	8MGT-720 PL. 28.35 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-886 PL. 35.28 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.09 140 Teeth	8MGT-1200 PL. 47.24 150 Teeth	8MGT-1224 PL. 48.19 153 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.69 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1760 PL. 68.29 220 Teeth			
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)																		
36	3.609	39	3.910	1.083	6.69	8.27	9.84	11.73	12.99	13.78	14.56	16.14	17.71	18.19	19.29	22.44	25.59	28.74			
35	3.509	38	3.810	1.086	6.85	8.43	10.00	11.89	13.15	13.94	14.72	16.30	17.87	18.35	19.45	22.60	25.75	28.90			
34	3.409	37	3.709	1.088	7.01	8.58	10.16	12.05	13.31	14.09	14.88	16.45	18.03	18.50	19.60	22.75	25.90	29.05			
33	3.308	36	3.609	1.091	7.17	8.74	10.32	12.21	13.47	14.25	15.04	16.61	18.19	18.66	19.76	22.91	26.06	29.21			
32	3.208	35	3.509	1.094	7.32	8.90	10.47	12.36	13.62	14.41	15.19	16.77	18.34	18.82	19.92	23.07	26.22	29.37			
31	3.108	34	3.409	1.097	7.48	9.06	10.63	12.52	13.78	14.57	15.35	16.93	18.50	18.98	20.08	23.23	26.38	29.53			
41	4.110	45	4.511	1.098	5.83	7.40	8.98	10.87	12.13	12.91	13.70	15.27	16.85	17.32	18.42	21.57	24.72	27.87			
30	3.008	33	3.308	1.100	7.64	9.21	10.79	12.68	13.94	14.72	15.51	17.08	18.66	19.13	20.23	23.38	26.53	29.68			
29	2.907	32	3.208	1.103	7.80	9.37	10.95	12.84	14.10	14.88	15.67	17.24	18.82	19.29	20.39	23.54	26.69	29.84			
48	4.812	53	5.314	1.104		6.22	7.79	9.68	10.94	11.73	12.51	14.09	15.67	16.14	17.24	20.39	23.54	26.69			
38	3.810	42	4.211	1.105	6.30	7.87	9.45	11.34	12.60	13.38	14.17	15.74	17.32	17.79	18.89	22.04	25.19	28.34			
28	2.807	31	3.108	1.107	7.95	9.53	11.10	12.99	14.25	15.04	15.82	17.40	18.97	19.45	20.55	23.70	26.85	30.00			
37	3.709	41	4.110	1.108	6.46	8.03	9.61	11.50	12.76	13.54	14.33	15.90	17.48	17.95	19.05	22.20	25.35	28.50			
27	2.707	30	3.008	1.111	8.11	9.69	11.26	13.15	14.41	15.20	15.98	17.56	19.13	19.61	20.71	23.86	27.01	30.16			
36	3.609	40	4.010	1.111	6.61	8.19	9.76	11.65	12.91	13.70	14.48	16.06	17.63	18.11	19.21	22.36	25.51	28.66			
45	4.511	50	5.013	1.111		6.69	8.27	10.16	11.42	12.20	12.99	14.56	16.14	16.61	17.71	20.86	24.01	27.16			
35	3.509	39	3.910	1.114	6.77	8.35	9.92	11.81	13.07	13.86	14.64	16.22	17.79	18.27	19.37	22.52	25.67	28.82			
26	2.607	29	2.907	1.115	8.27	9.84	11.42	13.31	14.57	15.35	16.14	17.71	19.29	19.76	20.86	24.01	27.16	30.31			
60	6.015	67	6.717	1.117				7.63	8.89	9.68	10.46	12.04	13.62	14.09	15.19	18.34	21.49	24.64			
34	3.409	38	3.810	1.118	6.93	8.50	10.08	11.97	13.23	14.01	14.80	16.37	17.95	18.42	19.52	22.67	25.82	28.97			
67	6.717	75	7.519	1.119					7.71	8.49	9.28	10.86	12.43	12.91	14.01	17.16	20.31	23.46			
25	2.506	28	2.807	1.120	8.43	10.00	11.58	13.47	14.73	15.51	16.30	17.87	19.45	19.92	21.02	24.17	27.32	30.47			
50	5.013	56	5.614	1.120		5.82	7.40	9.29	10.55	11.33	12.12	13.70	15.27	15.75	16.85	20.00	23.15	26.30			
33	3.308	37	3.709	1.121	7.09	8.66	10.24	12.13	13.39	14.17	14.96	16.53	18.11	18.58	19.68	22.83	25.98	29.13			
32	3.208	36	3.609	1.125	7.24	8.82	10.39	12.28	13.54	14.33	15.11	16.69	18.26	18.74	19.84	22.99	26.14	29.29			
40	4.010	45	4.511	1.125	5.90	7.48	9.05	10.94	12.21	12.99	13.78	15.35	16.93	17.40	18.50	21.65	24.80	27.95			
56	5.614	63	6.316	1.125					8.26	9.52	10.31	11.09	12.67	14.25	14.72	15.82	18.97	22.12	25.27		
80	8.020	90	9.023	1.125												10.22	10.70	11.80	14.95	18.10	21.25
63	6.316	71	7.118	1.127						8.34	9.13	9.91	11.49	13.06	13.54	14.64	17.79	20.94	24.09		
71	7.118	80	8.020	1.127															16.45	19.60	22.75
31	3.108	35	3.509	1.129	7.40	8.98	10.55	12.44	13.70	14.49	15.27	16.85	18.42	18.90	20.00	23.15	26.30	29.45			
53	5.314	60	6.015	1.132		6.84	8.74	10.00	10.78	11.57	13.14	14.72	15.19	16.29	19.44	22.59	25.74				
30	3.008	34	3.409	1.133	7.56	9.13	10.71	12.60	13.86	14.64	15.43	17.00	18.58	19.05	20.15	23.30	26.45	29.60			
37	3.709	42	4.211	1.135	6.37	7.95	9.53	11.42	12.68	13.46	14.25	15.82	17.40	17.87	18.97	22.12	25.27	28.42			
22	2.206	25	2.506	1.136	8.90	10.47	12.05	13.94	15.20	15.98	16.77	18.34	19.92	20.39	21.49	24.64	27.79	30.94			
29	2.907	33	3.308	1.138	7.72	9.29	10.87	12.76	14.02	14.80	15.59	17.16	18.74	19.21	20.31	23.46	26.61	29.76			
36	3.609	41	4.110	1.139	6.53	8.11	9.68	11.57	12.84	13.62	14.41	15.98	17.56	18.03	19.13	22.28	25.43	28.58			
28	2.807	32	3.208	1.143	7.87	9.45	11.02	12.91	14.17	14.96	15.74	17.32	18.89	19.37	20.47	23.62	26.77	29.92			
35	3.509	40	4.010	1.143	6.69	8.27	9.84	11.73	12.99	13.78	14.56	16.14	17.71	18.19	19.29	22.44	25.59	28.74			
42	4.211	48	4.812	1.143	5.51	7.08	8.66	10.55	11.81	12.59	13.38	14.96	16.53	17.01	18.11	21.26	24.41	27.56			
34	3.409	39	3.910	1.147	6.85	8.42	10.00	11.89	13.15	13.93	14.72	16.29	17.87	18.34	19.45	22.60	25.75	28.90			
27	2.707	31	3.108	1.148	8.03	9.61	11.18	13.07	14.33	15.12	15.90	17.48	18.05	19.53	20.63	23.78	26.93	30.08			
33	3.308	38	3.810	1.152	7.01	8.58	10.16	12.05	13.31	14.09	14.88	16.45	18.03	18.50	19.60	22.75	25.90	29.05			
26	2.607	30	3.008	1.154	8.19	9.76	11.34	13.23	14.49	15.27	16.06	17.63	19.21	19.68	20.78	23.93	27.08	30.23			
39	3.910	45	4.511	1.154	5.98	7.56	9.13	11.02	12.28	13.07	13.85	15.43	17.00	17.48	18.58	21.73	24.88	28.03			
32	3.208	37	3.709	1.156	7.16	8.74	10.31	12.20	13.47	14.25	15.04	16.61	18.19	18.66	19.76	22.91	26.06	29.21			
25	2.506	29	2.907	1.160	8.35	9.92	11.50	13.39	14.65	15.43	16.22	17.79	19.37	19.84	20.94	24.09	27.24	30.39			
31	3.108	36	3.609	1.161	7.32	8.90	10.47	12.36	13.62	14.41	15.19	16.77	18.34	18.82	19.92	23.07	26.22	29.37			
30	3.008	35	3.509	1.167	7.48	9.05	10.63	12.52	13.78	14.56	15.35	16.92	18.50	18.97	20.07	23.23	26.38	29.53			
36	3.609	42	4.211	1.167	6.45	8.03	9.60	11.49	12.75	13.54	14.33	15.90	17.48	17.95	19.05	22.20	25.35	28.50			
48	4.812	56	5.614	1.167		5.97	7.55	9.44	10.70	11.49	12.27	13.85	15.43	15.90	17.00	20.15	23.30	26.45			
35	3.509	41	4.110	1.171	6.61	8.19	9.76	11.65	12.91	13.70	14.48	16.06	17.63	18.11	19.21	22.36	25.51	28.66			
41	4.110	48	4.812	1.171	5.58	7.16	8.74	10.63	11.89	12.67	13.46	15.03	16.61	17.08	18.18	21.33	24.49	27.64			
29	2.907	34	3.409	1.172	7.64	9.21	10.79	12.68	13.94	14.72	15.51	17.08	18.66	19.							

8mm PITCH BELTS

Center Distance, Inches																Sprocket Combinations		
Driver		DriveN																
Speed Ratio	Number of Grooves	Number of Grooves																
8MGT-1792 PL. 70.55 224 Teeth	8MGT-2000 PL. 78.74 250 Teeth	8MGT-2200 PL. 86.61 275 Teeth	8MGT-2240 PL. 88.19 280 Teeth	8MGT-2400 PL. 94.49 300 Teeth	8MGT-2520 PL. 99.21 315 Teeth	8MGT-2600 PL. 102.36 325 Teeth	8MGT-2800 PL. 110.24 350 Teeth	8MGT-2840 PL. 111.81 355 Teeth	8MGT-3048 PL. 120.00 381 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3280 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 450 Teeth	8MGT-4000 PL. 157.48 500 Teeth	8MGT-4400 PL. 173.23 550 Teeth	8MGT-4480 PL. 176.38 560 Teeth			
29.37	33.46	37.40	38.19	41.34	43.70	45.27	49.21	50.00	54.09	57.08	58.66	64.96	72.83	80.71	82.28	1.083	36	39
29.53	33.62	37.56	38.35	41.50	43.86	45.43	49.37	50.16	54.25	57.24	58.82	65.12	72.99	80.87	82.44	1.086	35	38
29.68	33.78	37.71	38.50	41.65	44.01	45.59	49.53	50.31	54.41	57.40	58.97	65.27	73.15	81.02	82.60	1.088	34	37
29.84	33.94	37.87	38.66	41.81	44.17	45.75	49.69	50.47	54.57	57.56	59.13	65.43	73.31	81.18	82.76	1.091	33	36
30.00	34.09	38.03	38.82	41.97	44.33	45.90	49.84	50.63	54.72	57.71	59.29	65.59	73.46	81.34	82.91	1.094	32	35
30.16	34.25	38.19	38.98	42.13	44.49	46.06	50.00	50.79	54.88	57.87	59.45	65.75	73.62	81.50	83.07	1.097	31	34
28.50	32.60	36.53	37.32	40.47	42.83	44.41	48.35	49.13	53.23	56.22	57.79	64.09	71.97	79.84	81.42	1.098	41	45
30.31	34.41	38.34	39.13	42.28	44.64	46.22	50.16	50.94	55.04	58.03	59.60	65.90	73.78	81.65	83.23	1.100	30	33
30.47	34.57	38.50	39.29	42.44	44.80	46.38	50.32	51.10	55.20	58.19	59.76	66.06	73.94	81.81	83.39	1.103	29	32
27.32	31.42	35.35	36.14	39.29	41.65	43.23	47.17	47.95	52.05	55.04	56.61	62.91	70.79	78.66	80.24	1.104	48	53
28.97	33.07	37.00	37.79	40.94	43.30	44.88	48.82	49.60	53.70	56.69	58.26	64.57	72.44	80.32	81.89	1.105	38	42
30.63	34.72	38.66	39.45	42.60	44.96	46.53	50.47	51.26	55.35	58.34	59.92	66.22	74.09	81.97	83.54	1.107	28	31
29.13	33.23	37.16	37.95	41.10	43.46	45.04	48.98	49.76	53.86	56.85	58.42	64.72	72.60	80.47	82.05	1.108	37	41
30.79	34.88	38.82	39.61	42.76	45.12	46.69	50.63	51.42	55.51	58.50	60.08	66.38	74.25	82.13	83.70	1.111	27	30
29.29	33.39	37.32	38.11	41.26	43.62	45.20	49.14	49.92	54.02	57.01	58.58	64.88	72.76	80.63	82.21	1.111	36	40
27.79	31.89	35.82	36.61	39.76	42.12	43.70	47.64	48.42	52.52	55.51	57.08	63.38	71.26	79.13	80.71	1.111	45	50
29.45	33.54	37.48	38.27	41.42	43.78	45.35	49.29	50.08	54.17	57.16	58.74	65.04	72.91	80.79	82.36	1.114	35	39
30.94	35.04	38.97	39.76	42.91	45.27	46.85	50.79	51.57	55.67	58.66	60.23	66.53	74.41	82.28	83.86	1.115	26	29
25.27	29.37	33.30	34.09	37.24	39.60	41.18	45.12	45.90	50.00	52.99	54.56	60.86	68.74	76.61	78.19	1.117	60	67
29.60	33.70	37.63	38.42	41.57	43.93	45.51	49.45	50.23	54.33	57.32	58.89	65.19	73.07	80.94	82.52	1.118	34	38
24.09	28.19	32.12	32.91	36.06	38.42	40.00	43.94	44.72	48.82	51.81	53.38	59.68	67.56	75.43	77.01	1.119	67	75
31.10	35.20	39.13	39.92	43.07	45.43	47.01	50.95	51.73	55.83	58.82	60.39	66.69	74.57	82.44	84.02	1.120	25	28
26.93	31.02	34.96	35.75	38.90	41.26	42.83	46.77	47.56	51.65	54.64	56.22	62.52	70.39	78.27	79.84	1.120	50	56
29.76	33.86	37.79	38.58	41.73	44.09	45.67	49.61	50.39	54.49	57.48	59.05	65.35	73.23	81.10	82.68	1.121	33	37
29.92	34.02	37.95	38.74	41.89	44.25	45.83	49.77	50.55	54.65	57.64	59.21	65.51	73.39	81.26	82.84	1.125	32	36
28.58	32.68	36.61	37.40	40.55	42.91	44.49	48.43	49.21	53.31	56.30	57.87	64.17	72.05	79.92	81.50	1.125	40	45
25.90	30.00	33.93	34.72	37.87	40.23	41.81	45.75	46.53	50.63	53.62	55.19	61.49	69.37	77.24	78.82	1.125	56	63
21.88	25.98	29.92	30.71	33.86	36.22	37.79	41.73	42.52	46.61	49.60	51.18	57.48	65.35	73.23	74.80	1.125	80	90
24.72	28.82	32.75	33.54	36.69	39.05	40.63	44.57	45.35	49.45	52.44	54.01	60.31	68.19	76.06	77.64	1.127	63	71
23.38	27.48	31.41	32.20	35.35	37.71	39.29	43.23	44.01	48.11	51.10	52.67	58.97	66.85	74.72	76.30	1.127	71	80
30.08	34.17	38.11	38.90	42.05	44.41	45.98	49.92	50.71	54.80	57.79	59.37	65.67	73.54	81.42	82.99	1.129	31	35
26.37	30.47	34.41	35.20	38.35	40.71	42.28	46.22	47.01	51.10	54.09	55.67	61.97	69.84	77.72	79.29	1.132	53	60
30.23	34.33	38.26	39.05	42.20	44.56	46.14	50.08	50.86	54.96	57.95	59.52	65.82	73.70	81.57	83.15	1.133	30	34
29.05	33.15	37.08	37.87	41.02	43.38	44.96	48.90	49.68	53.78	56.77	58.34	64.64	72.52	80.39	81.97	1.135	37	42
31.57	35.67	39.60	40.39	43.54	45.90	47.48	51.42	52.20	56.30	59.29	60.86	67.16	75.04	82.91	84.49	1.136	22	25
30.39	34.49	38.42	39.21	42.36	44.72	46.30	50.24	51.02	55.12	58.11	59.68	65.98	73.86	81.73	83.31	1.138	29	33
29.21	33.31	37.24	38.03	41.18	43.54	45.12	49.06	49.84	53.94	56.93	58.50	64.80	72.68	80.55	82.13	1.139	36	41
30.55	34.65	38.58	39.37	42.52	44.88	46.46	50.40	51.18	55.28	58.27	59.84	66.14	74.02	81.89	83.47	1.143	28	32
29.37	33.46	37.40	38.19	41.34	43.70	45.27	49.21	50.00	54.09	57.08	58.66	64.96	72.83	80.71	82.28	1.143	35	40
28.19	32.28	36.22	37.01	40.16	42.52	44.09	48.03	48.82	52.91	55.90	57.48	63.78	71.65	79.53	81.10	1.143	42	48
29.53	33.62	37.56	38.35	41.50	43.86	45.43	49.37	50.16	54.25	57.24	58.82	65.12	72.99	80.87	82.44	1.147	34	39
30.71	34.80	38.74	39.53	42.68	45.04	46.61	50.55	51.34	55.43	58.42	60.00	66.30	74.17	82.05	83.62	1.148	27	31
29.68	33.78	37.71	38.50	41.65	44.01	45.59	49.53	50.31	54.41	57.40	58.97	65.27	73.15	81.02	82.60	1.152	33	38
30.86	34.96	38.89	39.68	42.83	45.19	46.77	50.71	51.49	55.59	58.58	60.15	66.45	74.33	82.20	83.78	1.154	26	30
28.66	32.75	36.69	37.48	40.63	42.99	44.57	48.51	49.29	53.39	56.38	57.95	64.25	72.13	80.00	81.58	1.154	39	45
29.84	33.94	37.87	38.66	41.81	44.17	45.75	49.69	50.47	54.57	57.56	59.13	65.43	73.31	81.18	82.76	1.156	32	37
31.02	35.12	39.05	39.84	42.99	45.35	46.93	50.87	51.65	55.75	58.74	60.31	66.61	74.49	82.36	83.94	1.160	25	29
30.00	34.09	38.03	38.82	41.97	44.33	45.90	49.84	50.63	54.72	57.71	59.29	65.59	73.46	81.34	82.91	1.161	31	36
30.16	34.25	38.19	38.98	42.13	44.49	46.06	50.00	50.79	54.88	57.87	59.45	65.75	73.62	81.50	83.07	1.167	30	35
29.13	33.23	37.16	37.95	41.10	43.46	45.04	48.98	49.76	53.86	56.85	58.42	64.72	72.60	80.47	82.05	1.167	36	42
27.08	31.18	35.11	35.90	39.05	41.41	42.99	46.93	47.71	51.81	54.80	56.38	62.68	70.55	78.43	80.00	1.167	48	56
29.29	33.38	37.32	38.11	41.26	43.62	45.20	49.14	49.92	54.02	57.01	58.58	64.88	72.76	80.63	82.21	1.171	35	41
28.27	32.36	36.30	37.09	40.24	42.60	44.17	48.11	48.90	52.99	55.98	57.56	63.86	71.73	79.61	81.18	1.171	41	48
30.31	34.41	38.34	39.13	42.28	44.64	46.22	50.16	50.94	55.04	58.03	5							

Drive Selection Table

8mm Pitch Poly Chain® GT® Carbon® Belts

Sprocket Combinations				Speed Ratio	Center Distance, Inches															
DriveR	DriveN	Number of Grooves	Pitch Diameter (Inches)		8MGT-640 PL. 25.20 80 Teeth	8MGT-720 PL. 28.35 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-886 PL. 35.28 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.09 140 Teeth	8MGT-1200 PL. 47.24 150 Teeth	8MGT-1224 PL. 48.19 153 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.69 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1760 PL. 68.29 220 Teeth		
29	2.907	35	3.509	1.207	7.55	9.13	10.71	12.6	13.86	14.64	15.43	17	18.58	19.05	20.15	23.3	26.45	29.6		
33	3.308	40	4.01	1.212	6.84	8.42	10	11.89	13.15	13.93	14.72	16.29	17.87	18.34	19.44	22.59	25.75	28.9		
28	2.807	34	3.409	1.214	7.71	9.29	10.86	12.75	14.01	14.8	15.59	17.16	18.74	19.21	20.31	23.46	26.61	29.76		
37	3.709	45	4.511	1.216	6.13	7.71	9.29	11.18	12.44	13.22	14.01	15.58	17.16	17.63	18.73	21.89	25.04	28.19		
32	3.208	39	3.91	1.219	7	8.58	10.15	12.04	13.3	14.09	14.88	16.45	18.03	18.5	19.6	22.75	25.9	29.05		
41	4.11	50	5.013	1.22	5.42	7	8.57	10.47	11.73	12.51	13.3	14.87	16.45	16.92	18.02	21.17	24.33	27.48		
27	2.707	33	3.308	1.222	7.87	9.45	11.02	12.91	14.17	14.96	15.74	17.32	18.89	19.37	20.47	23.62	26.77	29.92		
31	3.108	38	3.81	1.226	7.16	8.73	10.31	12.2	13.46	14.25	15.03	16.61	18.18	18.66	19.76	22.91	26.06	29.21		
22	2.206	27	2.707	1.227	8.74	10.31	11.89	13.78	15.04	15.82	16.61	18.18	19.76	20.23	21.33	24.49	27.64	30.79		
26	2.607	32	3.208	1.231	8.03	9.6	11.18	13.07	14.33	15.11	15.9	17.48	19.05	19.53	20.63	23.78	26.93	30.08		
39	3.91	48	4.812	1.231	5.73	7.31	8.89	10.78	12.04	12.83	13.61	15.19	16.76	17.24	18.34	21.49	24.64	27.79		
30	3.008	37	3.709	1.233	7.32	8.89	10.47	12.36	13.62	14.41	15.19	16.77	18.34	18.82	19.92	23.07	26.22	29.37		
34	3.409	42	4.211	1.235	6.6	8.18	9.76	11.65	12.91	13.69	14.48	16.06	17.63	18.11	19.21	22.36	25.51	28.66		
25	2.506	31	3.108	1.24	8.19	9.76	11.34	13.23	14.49	15.27	16.06	17.63	19.21	19.68	20.78	23.93	27.08	30.23		
29	2.907	36	3.609	1.241	7.47	9.05	10.63	12.52	13.78	14.56	15.35	16.92	18.5	18.97	20.07	23.22	26.38	29.53		
33	3.308	41	4.11	1.242	6.76	8.34	9.92	11.81	13.07	13.85	14.64	16.21	17.79	18.26	19.36	22.52	25.67	28.82		
45	4.511	56	5.614	1.244		6.2	7.78	9.67	10.93	11.72	12.51	14.08	15.66	16.13	17.23	20.39	23.54	26.69		
28	2.807	35	3.509	1.25	7.63	9.21	10.78	12.67	13.94	14.72	15.51	17.08	18.66	19.13	20.23	23.38	26.53	29.68		
32	3.208	40	4.01	1.25	6.92	8.5	10.07	11.96	13.22	14.01	14.8	16.37	17.95	18.42	19.52	22.67	25.82	28.97		
36	3.609	45	4.511	1.25	6.21	7.78	9.36	11.25	12.51	13.3	14.09	15.66	17.24	17.71	18.81	21.96	25.11	28.26		
40	4.01	50	5.013	1.25	5.49	7.07	8.65	10.54	11.8	12.59	13.37	14.95	16.53	17	18.1	21.25	24.4	27.55		
48	4.812	60	6.015	1.25		7.22	9.12	10.38	11.17	11.95	13.53	15.1	15.58	16.68	19.83	22.98	26.13			
60	6.015	75	7.519	1.25					8.24	9.02	9.81	11.39	12.97	13.44	14.55	17.7	20.85	24		
31	3.108	39	3.91	1.258	7.08	8.65	10.23	12.12	13.38	14.17	14.95	16.53	18.1	18.58	19.68	22.83	25.98	29.13		
27	2.707	34	3.409	1.259	7.79	9.36	10.94	12.83	14.09	14.88	15.66	17.24	18.81	19.29	20.39	23.54	26.69	29.84		
50	5.013	63	6.316	1.26					6.82	8.72	9.98	10.77	11.55	13.13	14.71	15.18	16.28	19.44	22.59	25.74
42	4.211	53	5.314	1.262		6.67	8.25	10.14	11.41	12.19	12.98	14.55	16.13	16.6	17.71	20.86	24.01	27.16		
38	3.81	48	4.812	1.263	5.81	7.39	8.96	10.86	12.12	12.9	13.69	15.27	16.84	17.32	18.42	21.57	24.72	27.87		
53	5.314	67	6.717	1.264					8.16	9.42	10.21	11	12.58	14.15	14.63	15.73	18.88	22.03	25.19	
30	3.008	38	3.81	1.267	7.23	8.81	10.39	12.28	13.54	14.32	15.11	16.69	18.26	18.74	19.84	22.99	26.14	29.29		
56	5.614	71	7.118	1.268					7.6	8.87	9.66	10.44	12.02	13.6	14.08	15.18	18.33	21.48	24.63	
71	7.118	90	9.023	1.268								9.32	10.9	11.38	12.48	15.64	18.79	21.95		
26	2.607	33	3.308	1.269	7.95	9.52	11.1	12.99	14.25	15.04	15.82	17.4	18.97	19.45	20.55	23.7	26.85	30		
63	6.316	80	8.02	1.27							8.38	9.17	10.75	12.33	12.81	13.91	17.06	20.22	23.37	
22	2.206	28	2.807	1.273	8.66	10.23	11.81	13.7	14.96	15.74	16.53	18.11	19.68	20.16	21.26	24.41	27.56	30.71		
33	3.308	42	4.211	1.273	6.68	8.26	9.83	11.73	12.99	13.77	14.56	16.13	17.71	18.18	19.28	22.44	25.59	28.74		
29	2.907	37	3.709	1.276	7.39	8.97	10.55	12.44	13.7	14.48	15.27	16.84	18.42	18.89	19.99	23.15	26.3	29.45		
25	2.506	32	3.208	1.28	8.1	9.68	11.26	13.15	14.41	15.19	15.98	17.55	19.13	19.6	20.7	23.85	27	30.16		
32	3.208	41	4.11	1.281	6.84	8.42	9.99	11.88	13.14	13.93	14.72	16.29	17.87	18.34	19.44	22.59	25.74	28.89		
39	3.91	50	5.013	1.282	5.56	7.15	8.72	10.62	11.88	12.66	13.45	15.03	16.6	17.08	18.18	21.33	24.48	27.63		
28	2.807	36	3.609	1.286	7.55	9.13	10.7	12.59	13.86	14.64	15.43	17	18.58	19.05	20.15	23.3	26.45	29.6		
35	3.509	45	4.511	1.286	6.28	7.86	9.44	11.33	12.59	13.38	14.16	15.74	17.31	17.79	18.89	22.04	25.19	28.34		
31	3.108	40	4.01	1.29	6.99	8.57	10.15	12.04	13.3	14.09	14.87	16.45	18.02	18.5	19.6	22.75	25.9	29.05		
41	4.11	53	5.314	1.293		6.75	8.33	10.22	11.48	12.27	13.05	14.63	16.21	16.68	17.78	20.93	24.09	27.24		
27	2.707	35	3.509	1.296	7.71	9.28	10.86	12.75	14.01	14.8	15.58	17.16	18.73	19.21	20.31	23.46	26.61	29.76		
37	3.709	48	4.812	1.297	5.88	7.46	9.04	10.93	12.2	12.98	13.77	15.34	16.92	17.39	18.49	21.65	24.8	27.95		
30	3.008	39	3.91	1.3	7.15	8.73	10.31	12.2	13.46	14.24	15.03	16.61	18.18	18.66	19.76	22.91	26.06	29.21		
26	2.607	34	3.409	1.308	7.86	9.44	11.02	12.91	14.17	14.95	15.74	17.32	18.89	19.37	20.47	23.62	26.77	29.92		
29	2.907	38	3.81	1.31	7.31	8.89	10.46	12.36	13.62	14.4	15.19	16.76	18.34	18.81	19.91	23.07	26.22	29.37		
32	3.208	42	4.211	1.313	6.75	8.33	9.91	11.8	13.06	13.85	14.63	16.21	17.79	18.26	19.36	22.51	25.66	28.81		
48	4.812	63	6.316	1.313		6.97	8.87	10.13	10.92	11.71	13.28	14.86	15.34	16.44	19.59	22.74	25.89			
38	3.81	50	5.013	1.316	5.64	7.22	8.8	10.69	11.96	12.74	13.53	15.1	16.68	17.15	18.26	21.41	24.56	27.71		
22	2.206	29	2.907	1.318	8.58	10.15	11.73	13.62	14.88	15.67	16.45	18.03	19.6	20.08	21.18	24.33	27.48	30.63		
25	2.506	33	3.308	1.32	8.02	9.6	11.18	13.07	14.33	15.11	15.9	17.47	19.05	19.52	20.62	23.78	26.93	30.08		
28	2.807	37	3.709	1.321	7.47	9.05	10.62	12.51	13.77	14.56	15.35	16.92	18.5	18.97	20.07	23.22	26.37	29.52		
31	3.108	41	4.11	1.323	6.91	8.49	10.07	11.96	13.22	14.01	14.79	16.37	17.94	18.42	19.					

Center Distance, Inches														Sprocket Combinations				
Driver		DriveN																
Speed Ratio	Number of Grooves	Number of Grooves																
8MGT-1782 PL. 78.74 250 Teeth	8MGT-2000 PL. 86.61 275 Teeth	8MGT-2240 PL. 88.19 260 Teeth	8MGT-2400 PL. 94.49 300 Teeth	8MGT-2520 PL. 102.38 315 Teeth	8MGT-2800 PL. 110.24 350 Teeth	8MGT-2840 PL. 111.81 365 Teeth	8MGT-3048 PL. 120.00 381 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3280 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 500 Teeth	8MGT-4000 PL. 157.48 550 Teeth	8MGT-4480 PL. 173.38 560 Teeth	Length Factor*					
30.23	34.33	38.26	39.05	42.2	44.56	46.14	50.08	50.86	54.96	57.95	59.53	65.83	73.7	81.58	83.15	1.207	29	35
29.53	33.62	37.56	38.35	41.5	43.86	45.43	49.37	50.16	54.25	57.24	58.82	65.12	72.99	80.87	82.44	1.212	33	40
30.39	34.49	38.42	39.21	42.36	44.72	46.3	50.24	51.02	55.12	58.11	59.68	65.98	73.86	81.73	83.31	1.214	28	34
28.82	32.91	36.85	37.64	40.79	43.15	44.72	48.66	49.45	53.54	56.53	58.11	64.41	72.28	80.16	81.73	1.216	37	45
29.68	33.78	37.71	38.5	41.65	44.01	45.59	49.53	50.31	54.41	57.4	58.97	65.27	73.15	81.02	82.6	1.219	32	39
28.11	32.2	36.14	36.93	40.08	42.44	44.01	47.95	48.74	52.83	55.82	57.4	63.7	71.57	79.45	81.02	1.22	41	50
30.55	34.64	38.58	39.37	42.52	44.88	46.45	50.39	51.18	55.28	58.27	59.84	66.14	74.02	81.89	83.47	1.222	27	33
29.84	33.93	37.87	38.66	41.81	44.17	45.75	49.69	50.47	54.57	57.56	59.13	65.43	73.31	81.18	82.76	1.226	31	38
31.42	35.51	39.45	40.24	43.39	45.75	47.32	51.26	52.05	56.14	59.13	60.71	67.01	74.88	82.76	84.33	1.227	22	27
30.71	34.8	38.74	39.53	42.68	45.04	46.61	50.55	51.34	55.43	58.42	60	66.3	74.17	82.05	83.62	1.231	26	32
28.42	32.52	36.45	37.24	40.39	42.75	44.33	48.27	49.05	53.15	56.14	57.71	64.01	72.89	81.34	82.91	1.231	39	48
30	34.09	38.03	38.82	41.97	44.33	45.9	49.84	50.63	54.72	57.71	59.29	65.59	73.46	81.34	82.91	1.233	30	37
29.29	33.38	37.32	38.11	41.26	43.62	45.19	49.13	49.92	54.01	57	58.58	64.88	72.75	80.63	82.2	1.235	34	42
30.86	34.96	38.89	39.68	42.83	45.19	46.77	50.71	51.49	55.59	58.58	60.16	66.46	74.33	82.21	83.78	1.24	25	31
30.16	34.25	38.19	38.98	42.13	44.49	46.06	50	50.79	54.88	57.87	59.45	65.75	73.62	81.5	83.07	1.241	29	36
29.45	33.54	37.48	38.27	41.42	43.78	45.35	49.29	50.08	54.17	57.16	58.74	65.04	72.91	80.79	82.36	1.242	33	41
27.32	31.41	35.35	36.14	39.29	41.65	43.22	47.16	47.95	52.04	55.04	56.61	62.91	70.79	78.66	80.24	1.244	45	56
30.31	34.41	38.34	39.13	42.28	44.64	46.22	50.16	50.94	55.04	58.03	59.6	65.9	73.78	81.65	83.23	1.25	28	35
29.6	33.7	37.63	38.42	41.57	43.93	45.51	49.45	50.23	54.33	57.32	58.89	65.19	73.07	80.95	82.52	1.25	32	40
28.89	32.99	36.92	37.71	40.87	43.23	44.8	48.74	49.53	53.62	56.61	58.19	64.49	72.36	80.24	81.81	1.25	36	45
28.18	32.28	36.21	37	40.16	42.52	44.09	48.03	48.82	52.91	55.9	57.48	63.78	71.65	79.53	81.1	1.25	40	50
26.76	30.86	34.8	35.59	38.74	41.1	42.67	46.61	47.4	51.49	54.48	56.06	62.36	70.23	78.11	79.68	1.25	48	60
24.63	28.73	32.67	33.46	36.61	38.97	40.54	44.48	45.27	49.36	52.36	53.93	60.23	68.11	75.98	77.56	1.25	60	75
29.76	33.86	37.79	38.58	41.73	44.09	45.67	49.61	50.39	54.49	57.48	59.05	65.35	73.23	81.1	82.68	1.258	31	39
30.47	34.56	38.5	39.29	42.44	44.8	46.38	50.32	51.1	55.2	58.19	59.76	66.06	73.94	81.81	83.39	1.259	27	34
26.37	30.47	34.4	35.19	38.34	40.7	42.28	46.22	47	51.1	54.09	55.66	61.96	69.84	77.71	79.29	1.26	50	63
27.79	31.88	35.82	36.61	39.76	42.12	43.7	47.64	48.42	52.52	55.51	57.08	63.38	71.26	79.13	80.71	1.262	42	53
28.5	32.59	36.53	37.32	40.47	42.83	44.41	48.35	49.13	53.23	56.22	57.79	64.09	71.97	79.84	81.42	1.263	38	48
25.82	29.91	33.85	34.64	37.79	40.15	41.72	45.67	46.45	50.55	53.54	55.11	61.41	69.29	77.16	78.74	1.264	53	67
29.92	34.01	37.95	38.74	41.89	44.25	45.82	49.76	50.55	54.64	57.63	59.21	65.51	73.38	81.26	82.83	1.267	30	38
25.26	29.36	33.3	34.09	37.24	39.6	41.17	45.11	45.9	49.99	52.98	54.56	60.86	68.74	76.61	78.19	1.268	56	71
22.58	26.68	30.61	31.4	34.55	36.92	38.49	42.43	43.22	47.31	50.3	51.88	58.18	66.06	73.93	75.51	1.268	71	90
30.63	34.72	38.66	39.45	42.6	44.96	46.53	50.47	51.26	55.35	58.34	59.92	66.22	74.09	81.97	83.54	1.269	26	33
24	28.1	32.03	32.82	35.98	38.34	39.91	43.85	44.64	48.73	51.72	53.3	59.6	67.48	75.35	76.93	1.27	63	80
31.34	35.43	39.37	40.16	43.31	45.67	47.24	51.18	51.97	56.06	59.05	60.63	66.93	74.8	82.68	84.25	1.273	22	28
29.37	33.46	37.4	38.19	41.34	43.7	45.27	49.21	50	54.09	57.08	58.66	64.96	72.83	80.71	82.28	1.273	33	42
30.08	34.17	38.11	38.9	42.05	44.41	45.98	49.92	50.71	54.8	57.79	59.37	65.67	73.54	81.42	82.99	1.276	29	37
30.79	34.88	38.82	39.61	42.76	45.12	46.69	50.63	51.42	55.51	58.5	60.08	66.38	74.25	82.13	83.7	1.28	25	32
29.52	33.62	37.55	38.34	41.5	43.86	45.43	49.37	50.16	54.25	57.24	58.82	65.12	72.99	80.87	82.44	1.281	32	41
28.26	32.36	36.29	37.08	40.23	42.59	44.17	48.11	48.89	52.99	55.98	57.55	63.85	71.73	79.6	81.18	1.282	39	50
30.23	34.33	38.26	39.05	42.2	44.56	46.14	50.08	50.86	54.96	57.95	59.52	65.82	73.7	81.57	83.15	1.286	28	36
28.97	33.07	37	37.79	40.94	43.3	44.88	48.82	49.6	53.7	56.69	58.26	64.56	72.44	80.31	81.89	1.286	35	45
29.68	33.78	37.71	38.5	41.65	44.01	45.59	49.53	50.31	54.41	57.4	58.97	65.27	73.15	81.02	82.6	1.29	31	40
27.87	31.96	35.9	36.69	39.84	42.2	43.77	47.71	48.5	52.59	55.59	57.16	63.46	71.34	79.21	80.79	1.293	41	53
30.39	34.49	38.42	39.21	42.36	44.72	46.3	50.24	51.02	55.12	58.11	59.68	65.98	73.86	81.73	83.31	1.296	27	35
28.58	32.67	36.61	37.4	40.55	42.91	44.48	48.42	49.21	53.3	56.29	57.87	64.17	72.05	79.92	81.5	1.297	37	48
29.84	33.93	37.87	38.66	41.81	44.17	45.74	49.68	50.47	54.56	57.55	59.13	65.43	73.31	81.18	82.76	1.3	30	39
30.55	34.64	38.58	39.37	42.52	44.88	46.45	50.39	51.18	55.27	58.26	59.84	66.14	74.01	81.89	83.46	1.308	26	34
30	34.09	38.03	38.82	41.97	44.33	45.9	49.84	50.63	54.72	57.71	59.29	65.59	73.46	81.34	82.91	1.31	29	38
29.44	33.54	37.47	38.26	41.42	43.78	45.35	49.29	50.08	54.17	57.16	58.74	65.04	72.91	80.79	82.36	1.313	32	42
26.52	30.62	34.56	35.35	38.5	40.86	42.43	46.37	47.16	51.25	54.24	55.82	62.12	70	77.87	79.45	1.313	48	63
28.34	32.43	36.37	37.16	40.31	42.67	44.25	48.19	48.97	53.07	56.06	57.63	63.93	71.81	79.68	81.26	1.316	38	50
31.26	35.35	39.29	40.08	43.23	45.59	47.16	51	51.89	55.98	58.97	60.55	66.85	74.72	82.6	84.17	1.318	22	29
30.71	34.8	38.74	39.53	42.68	45.04	46.61	50.55	51.34	55.43	58.42	60	66.3	74.17	82.05	83.62	1.32	25	33
30.15	34.25	38.18	38.97	42.12	44.49	46.06	50	50.79	54.88	57.87	59.45	65.75	73.62	81.5	83.07	1.321	2	

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches														
DriveR		DriveN			8MGT-640 P.L. 25.20 80 Teeth	8MGT-720 P.L. 28.35 90 Teeth	8MGT-800 P.L. 31.50 100 Teeth	8MGT-896 P.L. 35.25 112 Teeth	8MGT-960 P.L. 37.80 120 Teeth	8MGT-1000 P.L. 39.37 125 Teeth	8MGT-1040 P.L. 40.94 130 Teeth	8MGT-1120 P.L. 44.08 140 Teeth	8MGT-1200 P.L. 47.24 150 Teeth	8MGT-1224 P.L. 48.19 153 Teeth	8MGT-1280 P.L. 50.39 160 Teeth	8MGT-1440 P.L. 56.69 180 Teeth	8MGT-1600 P.L. 62.98 200 Teeth	8MGT-1760 P.L. 68.25 220 Teeth	
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)																
41	4.11	56	5.614	1.366	6.49	8.08	9.97	11.24	12.02	12.81	14.39	15.97	16.44	17.54	20.69	23.85	27		
30	3.008	41	4.11	1.367	6.99	8.57	10.14	12.04	13.3	14.08	14.87	16.45	18.02	18.5	19.6	22.75	25.9	29.05	
27	2.707	37	3.709	1.37	7.54	9.12	10.7	12.59	13.85	14.64	15.42	17	18.57	19.05	20.15	23.3	26.45	29.6	
35	3.509	48	4.812	1.371	6.03	7.61	9.19	11.09	12.35	13.13	13.92	15.5	17.07	17.55	18.65	21.8	24.95	28.1	
29	2.907	40	4.01	1.379	7.15	8.72	10.3	12.19	13.46	14.24	15.03	16.6	18.18	18.65	19.75	22.91	26.06	29.21	
26	2.607	36	3.609	1.385	7.7	9.28	10.86	12.75	14.01	14.79	15.58	17.16	18.73	19.21	20.31	23.46	26.61	29.76	
36	3.609	50	5.013	1.389	5.79	7.37	8.95	10.85	12.11	12.89	13.68	15.26	16.83	17.31	18.41	21.56	24.71	27.86	
28	2.807	39	3.91	1.393	7.3	8.88	10.46	12.35	13.61	14.4	15.18	16.76	18.34	18.81	19.91	23.06	26.21	29.36	
38	3.81	53	5.314	1.395	5.38	6.97	8.55	10.45	11.71	12.5	13.28	14.86	16.44	16.91	18.01	21.17	24.32	27.47	
48	4.812	67	6.717	1.396			6.63	8.53	9.8	10.59	11.38	12.96	14.53	15.01	16.11	19.27	22.42	25.57	
25	2.506	35	3.509	1.4	7.86	9.44	11.01	12.91	14.17	14.95	15.74	17.31	18.89	19.36	20.46	23.62	26.77	29.92	
30	3.008	42	4.211	1.4	6.9	8.48	10.06	11.96	13.22	14	14.79	16.36	17.94	18.42	19.52	22.67	25.82	28.97	
40	4.01	56	5.614	1.4		6.57	8.15	10.05	11.31	12.1	12.89	14.46	16.04	16.52	17.62	20.77	23.92	27.07	
45	4.511	63	6.316	1.4			7.19	9.09	10.36	11.14	11.93	13.51	15.09	15.57	16.67	19.82	22.97	26.13	
80	8.02	112	11.229	1.4											9.95	13.13	16.3	19.46	
32	3.208	45	4.511	1.406	6.5	8.09	9.67	11.56	12.82	13.61	14.39	15.97	17.55	18.02	19.12	22.27	25.42	28.58	
27	2.707	38	3.81	1.407	7.46	9.04	10.62	12.51	13.77	14.56	15.34	16.92	18.49	18.97	20.07	23.22	26.37	29.52	
22	2.206	31	3.108	1.409	8.41	9.99	11.57	13.46	14.72	15.5	16.29	17.87	19.44	19.92	21.02	24.17	27.32	30.47	
34	3.409	48	4.812	1.412	6.1	7.69	9.27	11.16	12.42	13.21	14	15.57	17.15	17.62	18.73	21.88	25.03	28.18	
29	2.907	41	4.11	1.414	7.06	8.64	10.22	12.11	13.38	14.16	14.95	16.52	18.1	18.57	19.67	22.83	25.98	29.13	
53	5.314	75	7.519	1.415												18.23	21.39	24.54	
50	5.013	71	7.118	1.42												18.79	21.94	25.1	
26	2.607	37	3.709	1.423	7.62	9.2	10.78	12.67	13.93	14.71	15.5	17.08	18.65	19.13	20.23	23.38	26.53	29.68	
28	2.807	40	4.01	1.429	7.22	8.8	10.38	12.27	13.53	14.32	15.1	16.68	18.26	18.73	19.83	22.98	26.13	29.28	
35	3.509	50	5.013	1.429	5.86	7.44	9.03	10.92	12.18	12.97	13.76	15.33	16.91	17.39	18.49	21.64	24.79	27.94	
42	4.211	60	6.015	1.429			6.08	7.67	9.57	10.83	11.62	12.41	13.98	15.56	16.04	17.14	20.29	23.45	26.6
56	5.614	80	8.02	1.429												17.6	20.75	23.91	
63	6.316	90	9.023	1.429													19.4	22.56	
37	3.709	53	5.314	1.432	5.45	7.04	8.63	10.52	11.79	12.57	13.36	14.94	16.51	16.99	18.09	21.24	24.4	27.55	
39	3.91	56	5.614	1.436		6.64	8.23	10.12	11.39	12.18	12.96	14.54	16.12	16.59	17.69	20.85	24	27.15	
25	2.506	36	3.609	1.44	7.78	9.36	10.93	12.83	14.09	14.87	15.66	17.23	18.81	19.28	20.38	23.54	26.69	29.84	
27	2.707	39	3.91	1.444	7.38	8.96	10.54	12.43	13.69	14.48	15.26	16.84	18.41	18.89	19.99	23.14	26.29	29.44	
29	2.907	42	4.211	1.448	6.98	8.56	10.14	12.03	13.29	14.08	14.87	16.44	18.02	18.49	19.59	22.75	25.9	29.05	
31	3.108	45	4.511	1.452	6.58	8.16	9.74	11.63	12.9	13.68	14.47	16.05	17.62	18.1	19.2	22.35	25.5	28.65	
22	2.206	32	3.208	1.455	8.33	9.91	11.49	13.38	14.64	15.42	16.21	17.79	19.36	19.84	20.94	24.09	27.24	30.39	
33	3.308	48	4.812	1.455	6.18	7.76	9.34	11.24	12.5	13.29	14.07	15.65	17.23	17.7	18.8	21.95	25.11	28.26	
26	2.607	38	3.81	1.462	7.54	9.12	10.69	12.59	13.85	14.63	15.42	16.99	18.57	19.05	20.15	23.3	26.45	29.6	
41	4.11	60	6.015	1.463		6.15	7.74	9.64	10.91	11.69	12.48	14.06	15.64	16.11	17.22	20.37	23.52	26.68	
28	2.807	41	4.11	1.464	7.14	8.72	10.3	12.19	13.45	14.24	15.02	16.6	18.18	18.65	19.75	22.9	26.05	29.21	
34	3.409	50	5.013	1.471	5.93	7.52	9.1	11	12.26	13.05	13.83	15.41	16.99	17.46	18.56	21.72	24.87	28.02	
36	3.609	53	5.314	1.472	5.53	7.12	8.7	10.6	11.86	12.65	13.43	15.01	16.59	17.07	18.17	21.32	24.47	27.62	
38	3.81	56	5.614	1.474		6.71	8.3	10.2	11.46	12.25	13.04	14.62	16.19	16.67	17.77	20.92	24.08	27.23	
48	4.812	71	7.118	1.479				8.19	9.46	10.25	11.04	12.62	14.2	14.68	15.78	18.94	22.1	25.25	
25	2.506	37	3.709	1.48	7.7	9.27	10.85	12.74	14.01	14.79	15.58	17.15	18.73	19.2	20.3	23.46	26.61	29.76	
27	2.707	40	4.01	1.481	7.3	8.88	10.45	12.35	13.61	14.39	15.18	16.76	18.33	18.81	19.91	23.06	26.21	29.36	
45	4.511	67	6.717	1.489			6.84	8.75	10.02	10.81	11.6	13.18	14.76	15.24	16.34	19.5	22.65	25.8	
75	7.519	112	11.229	1.493												10.3	13.49	16.67	19.83
22	2.206	33	3.308	1.5	8.25	9.83	11.41	13.3	14.56	15.34	16.13	17.71	19.28	19.76	20.86	24.01	27.16	30.31	
26	2.607	39	3.91	1.5	7.45	9.03	10.61	12.5	13.77	14.55	15.34	16.91	18.49	18.97	20.07	23.22	26.37	29.52	
28	2.807	42	4.211	1.5	7.05	8.63	10.21	12.11	13.37	14.16	14.94	16.52	18.09	18.57	19.67	22.82	25.97	29.12	
30	3.008	45	4.511	1.5	6.65	8.24	9.82	11.71	12.97	13.76	14.55	16.12	17.7	18.17	19.27	22.43	25.58	28.73	
32	3.208	48	4.812	1.5	6.25	7.84	9.42	11.31	12.58	13.36	14.15	15.73	17.3	17.78	18.88	22.03	25.18	28.33	
40	4.01	60	6.015	1.5	6.22	7.81	9.71	10.98	11.77	12.56	13.44	15.71	16.19	17.29	20.45	23.6	26.75		
42	4.211	63	6.316	1.5	5.81	7.41	9.31	10.58	11.37	12.16	13.74	15.32	15.79	16.89	20.05	23.2	26.36		
50	5.013	75	7.519	1.5				7.7	8.97	9.76	10.55	12.14	13.72	14.2	15.3	18.46	21.62	24.77	
60	6.015	90	9.023	1.5							8.53	10.12	11.71	12.19	13.3	16.47	19.63	22.78	
53	5.314	80	8.02</td																

8mm PITCH BELTS

Sprocket Combinations	Center Distance, Inches												Speed Ratio	Number of Grooves	Number of Grooves				
	Driver		DriveN																
	Driver	DriveN																	
8MGT-1792 PL. 70.55 2241 teeth	8MGT-2000 PL. 78.74 250 Teeth	8MGT-2200 PL. 86.61 275 Teeth	8MGT-2240 PL. 88.19 280 Teeth	8MGT-2400 PL. 94.49 300 Teeth	8MGT-2520 PL. 98.21 315 Teeth	8MGT-2600 PL. 102.36 325 Teeth	8MGT-2800 PL. 110.24 350 Teeth	8MGT-2840 PL. 111.81 355 Teeth	8MGT-3048 PL. 120.00 381 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3280 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 450 Teeth	8MGT-4000 PL. 157.48 500 Teeth	8MGT-4480 PL. 173.23 550 Teeth	8MGT-4480 PL. 176.38 560 Teeth				
27.63	31.72	35.66	36.45	39.6	41.96	43.54	47.48	48.26	52.2	55.35	56.92	63.22	71.1	78.97	80.55	1.366	41	56	
29.68	33.78	37.71	38.5	41.65	44.01	45.59	49.53	50.31	54.25	57.4	58.97	65.27	73.15	81.02	82.6	1.367	30	41	
30.23	34.33	38.26	39.05	42.2	44.56	46.14	50.08	50.86	54.8	57.95	59.52	65.82	73.7	81.57	83.15	1.37	27	37	
28.73	32.83	36.76	37.55	40.7	43.06	44.64	48.58	49.37	53.3	56.45	58.03	64.33	72.2	80.08	81.65	1.371	35	48	
29.84	33.93	37.87	38.66	41.81	44.17	45.74	49.68	50.47	54.4	57.55	59.13	65.43	73.31	81.18	82.76	1.379	29	40	
30.39	34.48	38.42	39.21	42.36	44.72	46.3	50.24	51.02	54.96	58.11	59.68	65.98	73.86	81.73	83.31	1.385	26	36	
28.49	32.59	36.53	37.32	40.47	42.83	44.4	48.34	49.13	53.06	56.21	57.79	64.09	71.96	79.84	81.42	1.389	36	50	
29.99	34.09	38.03	38.82	41.97	44.33	45.9	49.84	50.63	54.56	57.71	59.29	65.59	73.46	81.34	82.91	1.393	28	39	
28.1	32.2	36.13	36.92	40.07	42.43	44.01	47.95	48.73	52.67	55.82	57.39	63.69	71.57	79.45	81.02	1.395	38	53	
26.2	30.3	34.24	35.03	38.18	40.54	42.11	46.06	46.84	50.78	53.93	55.5	61.8	69.68	77.55	79.13	1.396	48	67	
30.55	34.64	38.58	39.37	42.52	44.88	46.45	50.39	51.18	55.11	58.26	59.84	66.14	74.01	81.89	83.46	1.4	25	35	
29.6	33.69	37.63	38.42	41.57	43.93	45.51	49.45	50.23	54.17	57.32	58.89	65.19	73.07	80.94	82.52	1.4	30	42	
27.7	31.8	35.74	36.53	39.68	42.04	43.61	47.55	48.34	52.28	55.43	57	63.3	71.18	79.05	80.63	1.4	40	56	
26.76	30.85	34.79	35.58	38.73	41.09	42.67	46.61	47.39	51.33	54.48	56.05	62.35	70.23	78.11	79.68	1.4	45	63	
20.09	24.2	28.14	28.93	32.09	34.45	36.03	39.97	40.76	44.69	47.84	49.42	55.72	63.6	71.48	73.05	1.4	80	112	
29.21	33.3	37.24	38.03	41.18	43.54	45.11	49.05	49.84	53.77	56.92	58.5	64.8	72.67	80.55	82.12	1.406	32	45	
30.15	34.25	38.18	38.97	42.12	44.48	46.06	50	50.78	54.72	57.87	59.44	65.74	73.62	81.49	83.07	1.407	27	38	
31.1	35.19	39.13	39.92	43.07	45.43	47	50.94	51.73	55.66	58.81	60.39	66.69	74.57	82.44	84.02	1.409	22	31	
28.81	32.91	36.84	37.63	40.78	43.14	44.72	48.66	49.44	53.38	56.53	58.1	64.4	72.28	80.16	81.73	1.412	34	48	
29.76	33.85	37.79	38.58	41.73	44.09	45.66	49.61	50.39	54.33	57.48	59.05	65.35	73.23	81.1	82.68	1.414	29	41	
25.17	29.27	33.21	34	37.15	39.51	41.09	45.03	45.81	49.75	52.9	54.47	60.78	68.65	76.53	78.1	1.415	53	75	
25.73	29.82	33.76	34.55	37.7	40.06	41.64	45.58	46.37	50.3	53.45	55.03	61.33	69.2	77.08	78.66	1.42	50	71	
30.31	34.41	38.34	39.13	42.28	44.64	46.22	50.16	50.94	54.88	58.03	59.6	65.9	73.78	81.65	83.23	1.423	26	37	
29.91	34.01	37.95	38.74	41.89	44.25	45.82	49.76	50.55	54.48	57.63	59.21	65.51	73.38	81.26	82.83	1.429	28	40	
28.57	32.67	36.6	37.39	40.54	42.91	44.48	48.42	49.21	53.14	56.29	57.87	64.17	72.04	79.92	81.49	1.429	35	50	
27.23	31.33	35.26	36.05	39.2	41.56	43.14	47.08	47.87	51.8	54.95	56.53	62.83	70.7	78.58	80.15	1.429	42	60	
24.54	28.64	32.57	33.37	36.52	38.88	40.45	44.4	45.18	49.12	52.27	53.84	60.14	68.02	75.9	77.47	1.429	56	80	
23.19	27.29	31.23	32.02	35.17	37.53	39.11	43.05	43.84	47.77	50.92	52.5	58.8	66.68	74.56	76.13	1.429	63	90	
28.18	32.27	36.21	37	40.15	42.51	44.09	48.03	48.81	52.75	55.9	57.47	63.77	71.65	79.52	81.1	1.432	37	53	
27.78	31.88	35.81	36.6	39.76	42.12	43.69	47.63	48.42	52.35	55.5	57.08	63.38	71.25	79.13	80.71	1.436	39	56	
30.47	34.56	38.5	39.29	42.44	44.8	46.37	50.31	51.1	55.03	58.18	59.76	66.06	73.94	81.81	83.39	1.44	25	36	
30.07	34.17	38.1	38.89	42.04	44.4	45.98	49.92	50.7	54.64	57.79	59.36	65.67	73.54	81.42	82.99	1.444	27	39	
29.68	33.77	37.71	38.5	41.65	44.01	45.58	49.53	50.31	54.25	57.4	58.97	65.27	73.15	81.02	82.6	1.448	29	42	
29.28	33.38	37.31	38.1	41.26	43.62	45.19	49.13	49.92	53.85	57	58.58	64.88	72.75	80.63	82.2	1.452	31	45	
31.02	35.11	39.05	39.84	42.99	45.35	46.93	50.87	51.65	55.59	58.74	60.31	66.61	74.49	82.36	83.94	1.455	22	32	
28.89	32.98	36.92	37.71	40.86	43.22	44.8	48.74	49.52	53.46	56.61	58.18	64.48	72.36	80.23	81.81	1.455	33	48	
30.23	34.32	38.26	39.05	42.2	44.56	46.14	50.08	50.86	54.8	57.95	59.52	65.82	73.7	81.57	83.15	1.462	26	38	
27.31	31.4	35.34	36.13	39.28	41.64	43.22	47.16	47.94	51.88	55.03	56.6	62.91	70.78	78.66	80.23	1.463	41	60	
29.84	33.93	37.87	38.66	41.81	44.17	45.74	49.68	50.47	54.4	57.55	59.13	65.43	73.3	81.18	82.75	1.464	28	41	
28.65	32.75	36.68	37.47	40.62	42.98	44.56	48.5	49.28	53.22	56.37	57.94	64.25	72.12	80	81.57	1.471	34	50	
28.25	32.35	36.29	37.08	40.23	42.59	44.16	48.1	48.89	52.83	55.98	57.55	63.85	71.73	79.6	81.18	1.472	36	53	
27.86	31.96	35.89	36.68	39.83	42.19	43.77	47.71	48.5	52.43	55.58	57.16	63.46	71.33	79.21	80.78	1.474	38	56	
25.88	29.98	33.92	34.71	37.86	40.22	41.79	45.74	46.52	50.46	53.61	55.18	61.48	69.36	77.24	78.81	1.479	48	71	
30.39	34.48	38.42	39.21	42.36	44.72	46.29	50.24	51.02	54.96	58.11	59.68	65.98	73.86	81.73	83.31	1.48	25	37	
29.99	34.09	38.02	38.81	41.96	44.32	45.9	49.84	50.63	54.56	57.71	59.29	65.59	73.46	81.34	82.91	1.481	27	40	
26.43	30.53	34.47	35.26	38.41	40.77	42.35	46.29	47.07	51.01	54.16	55.74	62.04	69.91	77.79	79.36	1.489	45	67	
20.47	24.58	28.52	29.31	32.47	34.83	36.41	40.35	41.14	45.08	48.23	49.81	56.11	63.99	71.87	73.44	1.493	75	112	
30.94	35.03	38.97	39.76	42.91	45.27	46.85	50.79	51.57	55.51	58.66	60.23	66.53	74.41	82.28	83.86	1.5	22	33	
30.15	34.25	38.18	38.97	42.12	44.48	46.06	50	50.78	54.72	57.87	59.44	65.74	73.62	81.49	83.07	1.5	26	39	
29.75	33.85	37.79	38.58	41.73	44.09	45.66	49.6	50.39	54.32	57.47	59.05	65.35	73.22	81.1	82.68	1.5	28	42	
29.36	33.46	37.39	38.18	41.33	43.69	45.27	49.21	49.99	53.93	57.08	58.65	64.96	72.83	80.71	82.28	1.5	30	45	
28.97	33.06	37	37.79	40.94	43.3	44.87	48.81	49.6	53.54	56.69	58.26	64.56	72.44	80.31	81.89	1.5	32	48	
27.38	31.48	35.42	36.21	39.36	41.72	43.29	47.24	48.02	51.96	55.11	56.68	62.98	70.86	78.74	80.31	1.5	40	60	
26.99	31.08	35.02	35.81	38.96	41.32	42.9	46.84	47.63	51.56	54.71	56.29	62.59	70.46	78.34	79.92</td				

Drive Selection Table

8mm Pitch Poly Chain® GT® Carbon® Belts

Sprocket Combinations				Speed Ratio	Center Distance, Inches														
DriveR		DriveN			8MGT-640 PL. 25.20 80 Teeth	8MGT-720 PL. 28.35 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-896 PL. 35.28 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.09 140 Teeth	8MGT-1200 PL. 47.24 150 Teeth	8MGT-1224 PL. 48.19 153 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.69 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1760 PL. 69.29 220 Teeth	
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)																
45	4.511	71	7.118	1.578			6.49	8.41	9.68	10.47	11.26	12.85	14.43	14.9	16.01	19.17	22.32	25.48	
38	3.81	60	6.015	1.579		6.36	7.96	9.86	11.13	11.92	12.71	14.29	15.87	16.34	17.44	20.6	23.75	26.91	
22	2.206	35	3.509	1.591	8.09	9.66	11.24	13.14	14.4	15.18	15.97	17.54	19.12	19.6	20.7	23.85	27	30.15	
42	4.211	67	6.717	1.595			7.06	8.97	10.24	11.03	11.82	13.4	14.98	15.46	16.56	19.72	22.88	26.03	
25	2.506	40	4.01	1.6	7.44	9.03	10.61	12.5	13.76	14.55	15.33	16.91	18.49	18.96	20.06	23.22	26.37	29.52	
30	3.008	48	4.812	1.6	6.39	7.98	9.57	11.46	12.73	13.51	14.3	15.88	17.45	17.93	19.03	22.18	25.34	28.49	
35	3.509	56	5.614	1.6	5.33	6.93	8.52	10.42	11.69	12.48	13.26	14.84	16.42	16.9	18	21.15	24.31	27.46	
50	5.013	80	8.02	1.6				7.25	8.53	9.33	10.12	11.71	13.3	13.78	14.88	18.05	21.21	24.36	
33	3.308	53	5.314	1.606	5.74	7.33	8.92	10.82	12.09	12.87	13.66	15.24	16.82	17.29	18.4	21.55	24.7	27.86	
28	2.807	45	4.511	1.607	6.8	8.38	9.97	11.86	13.12	13.91	14.7	16.28	17.85	18.33	19.43	22.58	25.73	28.88	
56	5.614	90	9.023	1.607						8.01	8.81	10.41	12	12.48	13.59	16.76	19.93	23.09	
31	3.108	50	5.013	1.613	6.15	7.74	9.32	11.22	12.49	13.27	14.06	15.64	17.22	17.69	18.79	21.95	25.1	28.25	
26	2.607	42	4.211	1.615	7.2	8.78	10.36	12.26	13.52	14.31	15.09	16.67	18.25	18.72	19.82	22.98	26.13	29.28	
39	3.91	63	6.316	1.615		6.02	7.62	9.53	10.8	11.59	12.38	13.96	15.54	16.02	17.12	20.28	23.43	26.59	
37	3.709	60	6.015	1.622		6.43	8.03	9.94	11.2	11.99	12.78	14.36	15.94	16.42	17.52	20.68	23.83	26.98	
41	4.11	67	6.717	1.634			7.13	9.04	10.31	11.1	11.9	13.48	15.06	15.54	16.64	19.8	22.95	26.11	
22	2.206	36	3.609	1.636	8	9.58	11.16	13.05	14.32	15.1	15.89	17.46	19.04	19.52	20.62	23.77	26.92	30.07	
25	2.506	41	4.11	1.64	7.36	8.94	10.52	12.42	13.68	14.47	15.25	16.83	18.41	18.88	19.98	23.13	26.29	29.44	
34	3.409	56	5.614	1.647	5.4	7	8.59	10.5	11.76	12.55	13.34	14.92	16.5	16.97	18.07	21.23	24.38	27.54	
29	2.907	48	4.812	1.655	6.47	8.06	9.64	11.54	12.8	13.59	14.38	15.95	17.53	18.01	19.11	22.26	25.41	28.57	
32	3.208	53	5.314	1.656	5.81	7.41	9	10.9	12.16	12.95	13.74	15.32	16.89	17.37	18.47	21.63	24.78	27.93	
38	3.81	63	6.316	1.658		6.09	7.69	9.61	10.87	11.66	12.45	14.04	15.62	16.09	17.2	20.35	23.51	26.66	
27	2.707	45	4.511	1.667	6.87	8.46	10.04	11.94	13.2	13.99	14.77	16.35	17.93	18.4	19.51	22.66	25.81	28.96	
30	3.008	50	5.013	1.667	6.22	7.81	9.4	11.3	12.56	13.35	14.13	15.71	17.29	17.77	18.87	22.02	25.18	28.33	
36	3.609	60	6.015	1.667		6.5	8.1	10.01	11.28	12.07	12.85	14.44	16.02	16.49	17.6	20.75	23.91	27.06	
45	4.511	75	7.519	1.667				8.05	9.33	10.12	10.92	12.51	14.09	14.57	15.67	18.84	22	25.15	
48	4.812	80	8.02	1.667				7.39	8.67	9.47	10.27	11.86	13.45	13.92	15.03	18.2	21.36	24.51	
67	6.717	112	11.229	1.672										9.74	10.87	14.07	17.25	20.43	
40	4.01	67	6.717	1.675			7.2	9.11	10.39	11.18	11.97	13.55	15.13	15.61	16.72	19.87	23.03	26.19	
25	2.506	42	4.211	1.68	7.27	8.86	10.44	12.34	13.6	14.38	15.17	16.75	18.32	18.8	19.9	23.05	26.21	29.36	
22	2.206	37	3.709	1.682	7.92	9.5	11.08	12.97	14.23	15.02	15.81	17.38	18.96	19.43	20.54	23.69	26.84	29.99	
42	4.211	71	7.118	1.689			6.69	8.62	9.9	10.69	11.48	13.07	14.65	15.13	16.23	19.39	22.55	25.71	
33	3.308	56	5.614	1.697	5.47	7.07	8.67	10.57	11.84	12.62	13.41	14.99	16.57	17.05	18.15	21.31	24.46	27.61	
53	5.314	90	9.023	1.698					7.41	8.21	9.02	10.62	12.22	12.7	13.81	16.98	20.15	23.31	
37	3.709	63	6.316	1.703		6.16	7.77	9.68	10.95	11.74	12.53	14.11	15.69	16.17	17.27	20.43	23.59	26.74	
31	3.108	53	5.314	1.71	5.88	7.48	9.07	10.97	12.24	13.02	13.81	15.39	16.97	17.45	18.55	21.7	24.86	28.01	
28	2.807	48	4.812	1.714	6.54	8.13	9.71	11.61	12.88	13.66	14.45	16.03	17.61	18.08	19.18	22.34	25.49	28.64	
35	3.509	60	6.015	1.714		6.58	8.17	10.08	11.35	12.14	12.93	14.51	16.09	16.57	17.67	20.83	23.98	27.14	
39	3.91	67	6.717	1.718			7.27	9.19	10.46	11.25	12.04	13.63	15.21	15.69	16.79	19.95	23.11	26.26	
29	2.907	50	5.013	1.724	6.29	7.88	9.47	11.37	12.64	13.42	14.21	15.79	17.37	17.84	18.95	22.1	25.25	28.41	
22	2.206	38	3.81	1.727	7.83	9.42	11	12.89	14.15	14.94	15.72	17.3	18.88	19.35	20.45	23.61	26.76	29.91	
26	2.607	45	4.511	1.731	6.94	8.53	10.11	12.01	13.28	14.06	14.85	16.43	18	18.48	19.58	22.73	25.89	29.04	
41	4.11	71	7.118	1.732			6.76	8.69	9.97	10.76	11.55	13.14	14.72	15.2	16.31	19.47	22.63	25.78	
32	3.208	56	5.614	1.735	5.54	7.14	8.74	10.64	11.91	12.7	13.49	15.07	16.65	17.12	18.23	21.38	24.54	27.69	
36	3.609	63	6.316	1.735		6.23	7.84	9.75	11.02	11.81	12.6	14.19	15.77	16.24	17.35	20.51	23.66	26.82	
80	8.02	140	14.036	1.735														13.84	17.06
38	3.81	67	6.717	1.763			7.34	9.26	10.53	11.32	12.11	13.7	15.28	15.76	16.86	20.02	23.18	26.34	
34	3.409	60	6.015	1.765		6.65	8.25	10.15	11.42	12.21	13	14.59	16.17	16.64	17.75	20.9	24.06	27.21	
30	3.008	53	5.314	1.767	5.95	7.55	9.14	11.04	12.31	13.1	13.89	15.47	17.04	17.52	18.62	21.78	24.93	28.09	
22	2.206	39	3.91	1.773	7.75	9.33	10.91	12.81	14.07	14.86	15.64	17.22	18.8	19.27	20.37	23.53	26.68	29.83	
40	4.01	71	7.118	1.775			6.83	8.76	10.04	10.83	11.63	13.21	14.8	15.28	16.38	19.54	22.7	25.86	
27	2.707	48	4.812	1.778	6.61	8.2	9.79	11.69	12.95	13.74	14.53	16.11	17.68	18.16	19.26	22.41	25.57	28.72	
45	4.511	80	8.02	1.778				7.59	8.88	9.68	10.48	12.08	13.67	14.14	15.25	18.42	21.58	24.74	
63	6.316	112	11.229	1.778									9.52	10.01	11.14	14.35	17.54	20.72	
28	2.807	50	5.013	1.786	6.36	7.96	9.54	11.44	12.71	13.5	14.29	15.86	17.44	17.92	19.02	22.18	25.33	28.48	
42	4.211	75	7.519	1.786				8.26	9.54	10.34	11.13	12.72	14.31	14.79	15.9	19.06</			

8mm PITCH BELTS

Center Distance, Inches																Speed Ratio	Sprocket Combinations	
Driver								DriveN										
Number of Grooves				Number of Grooves														
8MGT-2000 PL. 70.55 224 Teeth	8MGT-2000 PL. 78.74 250 Teeth	8MGT-2200 PL. 86.61 275 Teeth	8MGT-2240 PL. 88.19 280 Teeth	8MGT-2400 PL. 94.49 300 Teeth	8MGT-2520 PL. 99.21 315 Teeth	8MGT-2600 PL. 102.36 325 Teeth	8MGT-2800 PL. 110.24 350 Teeth	8MGT-2840 PL. 111.81 365 Teeth	8MGT-3048 PL. 120.00 381 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3280 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 450 Teeth	8MGT-4000 PL. 157.48 500 Teeth	8MGT-4400 PL. 172.23 550 Teeth	8MGT-4460 PL. 176.38 560 Teeth			
26.11	30.21	34.15	34.94	38.09	40.45	42.03	45.97	46.75	50.85	53.84	55.42	61.72	69.59	77.47	79.05	1.578	45	71
27.54	31.63	35.57	36.36	39.51	41.87	43.45	47.39	48.18	52.27	55.26	56.84	63.14	71.01	78.89	80.47	1.579	38	60
30.78	34.88	38.81	39.6	42.75	45.11	46.69	50.63	51.41	55.51	58.5	60.07	66.37	74.25	82.12	83.7	1.591	22	35
26.66	30.76	34.7	35.49	38.64	41	42.58	46.52	47.31	51.4	54.39	55.97	62.27	70.15	78.02	79.6	1.595	42	67
30.15	34.24	38.18	38.97	42.12	44.48	46.06	50	50.78	54.88	57.87	59.44	65.74	73.62	81.49	83.07	1.6	25	40
29.12	33.22	37.15	37.94	41.09	43.45	45.03	48.97	49.76	53.85	56.84	58.42	64.72	72.59	80.47	82.04	1.6	30	48
28.09	32.19	36.12	36.91	40.07	42.43	44	47.94	48.73	52.82	55.81	57.39	63.69	71.57	79.44	81.02	1.6	35	56
24.99	29.1	33.03	33.83	36.98	39.34	40.92	44.86	45.64	49.74	52.73	54.31	60.61	68.49	76.36	77.94	1.6	50	80
28.49	32.58	36.52	37.31	40.46	42.82	44.4	48.34	49.12	53.22	56.21	57.78	64.09	71.96	79.84	81.41	1.606	33	53
29.52	33.61	37.55	38.34	41.49	43.85	45.42	49.37	50.15	54.25	57.24	58.81	65.11	72.99	80.86	82.44	1.607	28	45
23.72	27.82	31.76	32.55	35.71	38.07	39.65	43.59	44.38	48.47	51.47	53.04	59.34	67.22	75.1	76.68	1.607	56	90
28.88	32.98	36.91	37.7	40.86	42.32	44.79	48.73	49.52	53.61	56.6	58.18	64.48	72.36	80.23	81.81	1.613	31	50
29.91	34.01	37.94	38.73	41.88	44.24	45.82	49.76	50.54	54.64	57.63	59.2	65.51	73.38	81.26	82.83	1.615	26	42
27.22	31.32	35.25	36.04	39.2	41.56	43.13	47.07	47.86	51.95	54.95	56.52	62.82	70.7	78.57	80.15	1.615	39	63
27.61	31.71	35.65	36.44	39.59	41.95	43.53	47.47	48.25	52.35	55.34	56.92	63.22	71.09	78.97	80.54	1.622	37	60
26.74	30.84	34.78	35.57	38.72	41.08	42.66	46.6	47.38	51.48	54.47	56.05	62.35	70.22	78.1	79.68	1.634	41	67
30.7	34.8	38.73	39.52	42.67	45.03	46.61	50.55	51.33	55.43	58.42	59.99	66.29	74.17	82.04	83.62	1.636	22	36
30.07	34.16	38.1	38.89	42.04	44.4	45.98	49.92	50.7	54.8	57.79	59.36	65.66	73.54	81.41	82.99	1.64	25	41
28.17	32.26	36.2	36.99	40.14	42.5	44.08	48.02	48.81	52.9	55.89	57.47	63.77	71.64	79.52	81.1	1.647	34	56
29.2	33.29	37.23	38.02	41.17	43.53	45.11	49.05	49.83	53.93	56.92	58.49	64.8	72.67	80.55	82.12	1.655	29	48
28.56	32.66	36.6	37.39	40.54	42.9	44.47	48.42	49.2	53.3	56.29	57.86	64.16	72.04	79.91	81.49	1.656	32	53
27.29	31.39	35.33	36.12	39.27	41.63	43.21	47.15	47.94	52.03	55.02	56.6	62.9	70.78	78.65	80.23	1.658	38	63
29.59	33.69	37.63	38.42	41.57	43.93	45.5	49.44	50.23	54.32	57.31	58.89	65.19	73.07	80.94	82.52	1.667	27	45
28.96	33.06	36.99	37.78	40.93	43.29	44.87	48.81	49.6	53.69	56.68	58.26	64.56	72.43	80.31	81.88	1.667	30	50
27.69	31.79	35.73	36.52	39.67	42.03	43.6	47.55	48.33	52.43	55.42	56.99	63.29	71.17	79.05	80.62	1.667	36	60
25.78	29.88	33.82	34.61	37.77	40.13	41.7	45.65	46.43	50.53	53.52	55.1	61.4	69.28	77.15	78.73	1.667	45	75
25.15	29.25	33.19	33.98	37.13	39.49	41.07	45.01	45.8	49.9	52.89	54.46	60.77	68.64	76.52	78.1	1.667	48	80
21.06	25.17	29.12	29.92	33.07	35.44	37.02	40.96	41.75	45.85	48.84	50.42	56.73	64.61	72.49	74.06	1.672	67	112
26.82	30.92	34.85	35.64	38.8	41.16	42.73	46.68	47.46	51.56	54.55	56.12	62.43	70.3	78.18	79.75	1.675	40	67
29.99	34.08	38.02	38.81	41.96	44.32	45.9	49.84	50.62	54.72	57.71	59.28	65.58	73.46	81.34	82.91	1.68	25	42
30.62	34.72	38.65	39.44	42.59	44.95	46.53	50.47	51.25	55.35	58.34	59.91	66.22	74.09	81.97	83.54	1.682	22	37
26.34	30.44	34.38	35.17	38.32	40.68	42.26	46.2	46.98	51.08	54.07	55.65	61.95	69.83	77.7	79.28	1.69	42	71
28.24	32.34	36.28	37.07	40.22	42.58	44.16	48.1	48.88	52.98	55.97	57.55	63.85	71.72	79.6	81.17	1.697	33	56
23.94	28.05	31.99	32.78	35.94	38.3	39.88	43.82	44.61	48.7	51.7	53.27	59.58	67.45	75.33	76.91	1.698	53	90
27.37	31.47	35.41	36.2	39.35	41.71	43.29	47.23	48.01	52.11	55.1	56.68	62.98	70.85	78.73	80.31	1.703	37	63
28.64	32.74	36.67	37.46	40.62	42.98	44.55	48.49	49.28	53.37	56.36	57.94	64.24	72.12	79.99	81.57	1.71	31	53
29.27	33.37	37.31	38.1	41.25	43.61	45.18	49.13	49.91	54.01	57	58.57	64.87	72.75	80.62	82.2	1.714	28	48
27.77	31.87	35.8	36.59	39.75	42.11	43.68	47.62	48.41	52.5	55.5	57.07	63.37	71.25	79.12	80.7	1.714	35	60
26.89	30.99	34.93	35.72	38.87	41.23	42.81	46.75	47.54	51.63	54.63	56.2	62.5	70.38	78.26	79.83	1.718	39	67
29.04	33.13	37.07	37.86	41.01	43.37	44.95	48.89	49.67	53.77	56.76	58.34	64.64	72.51	80.39	81.96	1.724	29	50
30.54	34.64	38.57	39.36	42.51	44.87	46.45	50.39	51.17	55.27	58.26	59.83	66.14	74.01	81.89	83.46	1.727	22	38
29.67	33.77	37.7	38.49	41.64	44	45.58	49.52	50.31	54.4	57.39	58.97	65.27	73.14	81.02	82.59	1.731	26	45
26.41	30.51	34.45	35.24	38.4	40.76	42.33	46.28	47.06	51.16	54.15	55.73	62.03	69.91	77.78	79.36	1.732	41	71
28.32	32.42	36.36	37.15	40.3	42.66	44.23	48.18	48.96	53.06	56.05	57.62	63.92	71.8	79.68	81.25	1.75	32	56
27.45	31.55	35.48	36.27	39.43	41.79	43.36	47.31	48.09	52.19	55.18	56.75	63.06	70.93	78.81	80.38	1.75	36	63
17.7	21.84	25.81	26.6	29.77	32.14	33.72	37.68	38.46	42.57	45.57	47.15	53.46	61.34	69.23	70.8	1.75	80	140
26.97	31.07	35.01	35.8	38.95	41.31	42.89	46.83	47.61	51.71	54.7	56.28	62.58	70.46	78.33	79.91	1.763	38	67
27.84	31.94	35.88	36.67	39.82	42.18	43.76	47.7	48.49	52.58	55.57	57.15	63.45	71.33	79.2	80.78	1.765	34	60
28.72	32.81	36.75	37.54	40.69	43.05	44.63	48.57	49.36	53.45	56.44	58.02	64.32	72.19	80.07	81.65	1.767	30	53
30.46	34.56	38.49	39.28	42.43	44.79	46.37	50.31	51.09	55.19	58.18	59.76	66.06	73.93	81.81	83.38	1.773	22	39
26.49	30.59	34.53	35.32	38.47	40.84	42.41	46.35	47.14	51.24	54.23	55.8	62.11	69.98	77.86	79.43	1.775	40	71
29.35	33.45	37.38	38.18	41.33	43.69	45.26	49.2	49.99	54.08	57.07	58.65	64.95	72.83	80.7	82.28	1.778	27	48
25.37	29.48	33.42	34.21	37.36	39.72	41.3	45.24	46.03	50.13	53.12	54.7	61	68.88	76.75	78.33	1.778	45	80
21.35	25.47	29.42																

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches														8MGT-640 PL. 25.20 80 Teeth							8MGT-720 PL. 28.35 90 Teeth							8MGT-800 PL. 31.50 100 Teeth							8MGT-896 PL. 35.28 112 Teeth							8MGT-960 PL. 37.80 120 Teeth							8MGT-1000 PL. 39.37 125 Teeth							8MGT-1040 PL. 40.94 130 Teeth							8MGT-1120 PL. 44.09 140 Teeth							8MGT-1200 PL. 47.24 150 Teeth							8MGT-1224 PL. 48.19 153 Teeth							8MGT-1280 PL. 50.39 160 Teeth							8MGT-1440 PL. 56.68 180 Teeth							8MGT-1600 PL. 62.99 200 Teeth							8MGT-1760 PL. 69.29 220 Teeth						
Number of Grooves	Pitch Diameter (inches)	Number of Grooves	Pitch Diameter (inches)		8MGT-640 PL. 25.20 80 Teeth	8MGT-720 PL. 28.35 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-896 PL. 35.28 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.09 140 Teeth	8MGT-1200 PL. 47.24 150 Teeth	8MGT-1224 PL. 48.19 153 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.68 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1760 PL. 69.29 220 Teeth																																																																																																		
28	2.807	53	5.314	1.893	6.09	7.69	9.29	11.19	12.46	13.25	14.04	15.62	17.20	17.67	18.77	21.93	25.09	28.24																																																																																																		
42	4.211	80	8.020	1.905				7.80	9.09	9.89	10.69	12.29	13.88	14.36	15.47	18.64	21.81	24.97																																																																																																		
22	2.206	42	4.211	1.909	7.49	9.08	10.66	12.56	13.82	14.61	15.40	16.98	18.55	19.03	20.13	23.28	26.44	29.59																																																																																																		
33	3.308	63	6.316	1.909		6.44	8.05	9.97	11.24	12.03	12.82	14.41	15.99	16.47	17.57	20.73	23.89	27.04																																																																																																		
35	3.509	67	6.717	1.914		5.93	7.55	9.47	10.75	11.54	12.33	13.92	15.51	15.98	17.09	20.25	23.41	26.57																																																																																																		
37	3.709	71	7.118	1.919			7.04	8.97	10.25	11.05	11.84	13.43	15.02	15.50	16.60	19.77	22.93	26.09																																																																																																		
25	2.506	48	4.812	1.920	6.75	8.35	9.94	11.84	13.10	13.89	14.68	16.26	17.84	18.31	19.41	22.57	25.72	28.87																																																																																																		
26	2.607	50	5.013	1.923	6.50	8.10	9.69	11.59	12.86	13.65	14.44	16.02	17.59	18.07	19.17	22.33	25.48	28.63																																																																																																		
39	3.910	75	7.519	1.923			6.52	8.47	9.76	10.55	11.35	12.94	14.53	15.01	16.12	19.28	22.45	25.61																																																																																																		
29	2.907	56	5.614	1.931	5.75	7.36	8.96	10.86	12.13	12.92	13.71	15.29	16.87	17.35	18.45	21.61	24.77	27.92																																																																																																		
31	3.108	60	6.015	1.935	5.23	6.86	8.46	10.37	11.64	12.43	13.22	14.81	16.39	16.87	17.97	21.13	24.29	27.44																																																																																																		
41	4.110	80	8.020	1.951				7.87	9.16	9.97	10.77	12.36	13.96	14.44	15.55	18.72	21.88	25.04																																																																																																		
27	2.707	53	5.314	1.963	6.16	7.77	9.36	11.26	12.53	13.32	14.11	15.69	17.27	17.75	18.85	22.01	25.16	28.32																																																																																																		
32	3.208	63	6.316	1.969		6.51	8.12	10.04	11.31	12.10	12.90	14.48	16.06	16.54	17.65	20.81	23.96	27.12																																																																																																		
34	3.409	67	6.717	1.971		5.99	7.62	9.54	10.82	11.61	12.41	13.99	15.58	16.06	17.16	20.32	23.48	26.64																																																																																																		
36	3.609	71	7.118	1.972			7.11	9.04	10.33	11.12	11.92	13.51	15.09	15.57	16.68	19.84	23.00	26.16																																																																																																		
71	7.118	140	14.036	1.972															11.19	14.47	17.69																																																																																															
38	3.810	75	7.519	1.974				6.59	8.54	9.83	10.62	11.42	13.01	14.60	15.08	16.19	19.36	22.52	25.68																																																																																																	
25	2.506	50	5.013	2.000	6.57	8.17	9.76	11.67	12.93	13.72	14.51	16.09	17.67	18.15	19.25	22.40	25.56	28.71																																																																																																		
28	2.807	56	5.614	2.000	5.82	7.43	9.03	10.94	12.21	13.00	13.78	15.37	16.95	17.42	18.53	21.69	24.84	28.00																																																																																																		
30	3.008	60	6.015	2.000	5.30	6.92	8.53	10.44	11.72	12.51	13.30	14.88	16.46	16.94	18.05	21.21	24.36	27.52																																																																																																		
40	4.010	80	8.020	2.000				7.94	9.23	10.04	10.84	12.43	14.03	14.51	15.62	18.79	21.96	25.12																																																																																																		
45	4.511	90	9.023	2.000					7.95	8.76	9.57	11.19	12.79	13.27	14.39	17.57	20.74	23.91																																																																																																		
56	5.614	112	11.229	2.000									9.99	10.49	11.63	14.85	18.05	21.23																																																																																																		
37	3.709	75	7.519	2.027			6.66	8.61	9.90	10.70	11.49	13.09	14.68	15.16	16.26	19.43	22.60	25.76																																																																																																		
35	3.509	71	7.118	2.029			7.18	9.11	10.40	11.19	11.99	13.58	15.17	15.64	16.75	19.92	23.08	26.24																																																																																																		
33	3.308	67	6.717	2.030		6.06	7.69	9.61	10.89	11.69	12.48	14.07	15.65	16.13	17.24	20.40	23.56	26.72																																																																																																		
31	3.108	63	6.316	2.032		6.58	8.19	10.11	11.39	12.18	12.97	14.55	16.14	16.62	17.72	20.88	24.04	27.20																																																																																																		
26	2.607	53	5.314	2.038	6.23	7.84	9.43	11.34	12.61	13.40	14.18	15.77	17.35	17.82	18.93	22.08	25.24	28.39																																																																																																		
22	2.206	45	4.511	2.045	7.23	8.82	10.41	12.31	13.58	14.36	15.15	16.73	18.31	18.78	19.89	23.04	26.19	29.35																																																																																																		
39	3.910	80	8.020	2.051				8.00	9.30	10.11	10.91	12.51	14.10	14.58	15.69	18.86	22.03	25.19																																																																																																		
29	2.907	60	6.015	2.069	5.37	6.99	8.60	10.52	11.79	12.58	13.37	14.96	16.54	17.02	18.12	21.28	24.44	27.59																																																																																																		
27	2.707	56	5.614	2.074	5.88	7.50	9.10	11.01	12.28	13.07	13.86	15.44	17.02	17.50	18.60	21.76	24.92	28.07																																																																																																		
36	3.609	75	7.519	2.083			6.72	8.68	9.97	10.77	11.56	13.16	14.75	15.23	16.34	19.51	22.67	25.83																																																																																																		
34	3.409	71	7.118	2.088			7.24	9.18	10.47	11.26	12.06	13.65	15.24	15.72	16.82	19.99	23.15	26.31																																																																																																		
67	6.717	140	14.036	2.090														11.46	14.74	17.97																																																																																																
32	3.208	67	6.717	2.094		6.13	7.76	9.69	10.96	11.76	12.55	14.14	15.73	16.20	17.31	20.47	23.63	26.79																																																																																																		
30	3.008	63	6.316	2.100		6.65	8.26	10.18	11.46	12.25	13.04	14.63	16.21	16.69	17.80	20.96	24.12	27.27																																																																																																		
38	3.810	80	8.020	2.105			8.07	9.37	10.18	10.98	12.58	14.17	14.65	15.76	18.94	22.10	25.27																																																																																																			
53	5.314	112	11.229	2.113									10.20	10.69	11.83	15.06	18.26	21.45																																																																																																		
25	2.506	53	5.314	2.120	6.30	7.91	9.50	11.41	12.68	13.47	14.26	15.84	17.42	17.90	19.00	22.16	25.31	28.47																																																																																																		
28	2.807	60	6.015	2.143	5.43	7.06	8.67	10.59	11.86	12.65	13.45	15.03	16.61	17.09	18.20	21.36	24.51	27.67																																																																																																		
35	3.509	75	7.519	2.143			6.79	8.75	10.04	10.84	11.64	13.23	14.82	15.30	16.41	19.58	22.75	25.91																																																																																																		
42	4.211	90	9.023	2.143					8.15	8.97	9.78	11.40	13.00	13.49	14.60	17.79	20.96	24.13																																																																																																		
33	3.308	71	7.118	2.152			7.31	9.25	10.54	11.34	12.13	13.72	15.31	15.79	16.90	20.07	23.23	26.39																																																																																																		
26	2.607	56	5.614	2.154	5.95	7.57	9.17	11.08	12.35	13.14	13.93	15.52	17.10	17.57	18.68	21.84	24.99	28.15																																																																																																		
31	3.108	67	6.717	2.161		6.19	7.82	9.76	11.04	11.83	12.62	14.21	15.80	16.28	17.38	20.55	23.71	26.87																																																																																																		
37	3.709	80	8.020	2.162			8.14	9.44	10.25	11.05	12.65	14.24	14.73	15.84	19.01	22.18	25.34																																																																																																			
29	2.907	63	6.316	2.172		6.71	8.33	10.25</td																																																																																																												

8mm PITCH BELTS

Center Distance, Inches																		Speed Ratio	Sprocket Combinations		
Driver		DriveN																		Number of Grooves	
																			Number of Grooves		
8MGT-1792 PL. 10.55 2241 Teeth	8MGT-2000 PL. 78.74 250 Teeth	8MGT-2200 PL. 86.61 275 Teeth	8MGT-2240 PL. 94.49 300 Teeth	8MGT-2400 PL. 109.49 300 Teeth	8MGT-2520 PL. 98.21 315 Teeth	8MGT-2600 PL. 102.36 325 Teeth	8MGT-2800 PL. 110.24 350 Teeth	8MGT-2940 PL. 111.81 355 Teeth	8MGT-3048 PL. 120.00 400 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3448 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 450 Teeth	8MGT-4000 PL. 157.48 500 Teeth	8MGT-4400 PL. 173.23 550 Teeth	8MGT-4480 PL. 176.38 560 Teeth		Length Factor*				
28.87	32.97	36.91	37.70	40.85	43.21	44.78	48.73	49.51	53.61	56.60	58.17	64.47	72.35	80.23	81.80	1.893	28	53			
25.60	29.70	33.64	34.44	37.59	39.95	41.53	45.47	46.26	50.36	53.35	54.93	61.23	69.11	76.99	78.56	1.905	42	80			
30.22	34.32	38.25	39.04	42.19	44.55	46.13	50.07	50.86	54.95	57.94	59.52	65.82	73.69	81.57	83.14	1.909	22	42			
27.68	31.78	35.71	36.51	39.66	42.02	43.60	47.54	48.32	52.42	55.41	56.99	63.29	71.17	79.04	80.62	1.909	33	63			
27.20	31.30	35.24	36.03	39.18	41.54	43.12	47.06	47.85	51.94	54.94	56.51	62.81	70.69	78.57	80.14	1.914	35	67			
26.72	30.82	34.76	35.55	38.70	41.07	42.64	46.59	47.37	51.47	54.46	56.04	62.34	70.22	78.09	79.67	1.919	37	71			
29.50	33.60	37.54	38.33	41.48	43.84	45.42	49.36	50.14	54.24	57.23	58.81	65.11	72.98	80.86	82.43	1.920	25	48			
29.27	33.36	37.30	38.09	41.24	43.60	45.18	49.12	49.91	54.00	56.99	58.57	64.87	72.75	80.62	82.20	1.923	26	50			
26.24	30.34	34.28	35.07	38.23	40.59	42.17	46.11	46.89	50.99	53.98	55.56	61.86	69.74	77.62	79.19	1.923	39	75			
28.55	32.65	36.59	37.38	40.53	42.89	44.47	48.41	49.19	53.29	56.28	57.86	64.16	72.03	79.91	81.49	1.931	29	56			
28.07	32.17	36.11	36.90	40.05	42.41	43.99	47.93	48.72	52.81	55.81	57.38	63.68	71.56	79.44	81.01	1.935	31	60			
25.67	29.78	33.72	34.51	37.67	40.03	41.61	45.55	46.34	50.44	53.43	55.00	61.31	69.19	77.06	78.64	1.951	41	80			
28.95	33.04	36.98	37.77	40.92	42.29	44.86	48.80	49.59	53.68	56.68	58.25	64.55	72.43	80.30	81.88	1.963	27	53			
27.75	31.85	35.79	36.58	39.73	42.10	43.67	47.61	48.40	52.50	55.49	57.06	63.37	71.24	79.12	80.69	1.969	32	63			
27.27	31.37	35.31	36.10	39.26	41.62	43.20	47.14	47.92	52.02	55.01	56.59	62.89	70.77	78.64	80.22	1.971	34	67			
26.79	30.90	34.84	35.63	38.78	41.14	42.72	46.66	47.45	51.55	54.54	56.11	62.42	70.29	78.17	79.75	1.972	36	71			
18.33	22.49	26.46	27.26	30.43	32.81	34.39	38.35	39.14	43.25	46.25	47.83	54.14	62.03	69.92	71.49	1.972	71	140			
26.31	30.42	34.36	35.15	38.30	40.66	42.24	46.18	46.97	51.07	54.06	55.64	61.94	69.82	77.70	79.27	1.974	38	75			
29.34	33.44	37.38	38.17	41.32	43.68	45.26	49.20	49.98	54.08	57.07	58.65	64.95	72.82	80.70	82.28	2.000	25	50			
28.63	32.73	36.66	37.45	40.61	42.97	44.54	48.49	49.27	53.37	56.36	57.93	64.24	72.11	79.99	81.56	2.000	28	56			
28.15	32.25	36.19	36.98	40.13	42.49	44.07	48.01	48.80	52.89	55.88	57.46	63.76	71.64	79.51	81.09	2.000	30	60			
25.75	29.85	33.80	34.59	37.74	40.11	41.68	45.63	46.41	50.51	53.50	55.08	61.38	69.26	77.14	78.72	2.000	40	80			
24.54	28.65	32.60	33.39	36.55	38.91	40.49	44.43	45.22	49.32	52.31	53.89	60.19	68.07	75.95	77.53	2.000	45	90			
21.87	25.99	29.94	30.74	33.90	36.27	37.85	41.80	42.58	46.69	49.68	51.26	57.57	65.45	73.33	74.91	2.000	56	112			
26.39	30.49	34.43	35.23	38.38	40.74	42.32	46.26	47.05	51.15	54.14	55.71	62.02	69.90	77.77	79.35	2.027	37	75			
26.87	30.97	34.91	35.70	38.86	41.22	42.80	46.74	47.52	51.62	54.61	56.19	62.49	70.37	78.25	79.82	2.029	35	71			
27.35	31.45	35.39	36.18	39.33	41.70	43.27	47.22	48.00	52.10	55.09	56.67	62.97	70.85	78.72	80.30	2.030	33	67			
27.83	31.93	35.87	36.66	39.81	42.17	43.75	47.69	48.48	52.57	55.57	57.14	63.44	71.32	79.20	80.77	2.032	31	63			
29.02	33.12	37.06	37.85	41.00	43.36	44.94	48.88	49.67	53.76	56.75	58.33	64.63	72.51	80.38	81.96	2.038	26	53			
29.98	34.07	38.01	38.80	41.95	44.31	45.89	49.83	50.62	54.71	57.70	59.28	65.58	73.46	81.33	82.91	2.045	22	45			
25.82	29.93	33.87	34.66	37.82	40.18	41.76	45.70	46.49	50.59	53.58	55.16	61.46	69.34	77.22	78.79	2.051	39	80			
28.22	32.33	36.26	37.06	40.21	42.57	44.15	48.09	48.87	52.97	55.96	57.54	63.84	71.72	79.59	81.17	2.069	29	60			
28.70	32.80	36.74	37.53	40.68	43.05	44.62	48.56	49.35	53.44	56.44	58.01	64.31	72.19	80.07	81.64	2.074	27	56			
26.46	30.57	34.51	35.30	38.46	40.82	42.40	46.34	47.12	51.22	54.21	55.79	62.09	69.97	77.85	79.43	2.083	36	75			
26.94	31.05	34.99	35.78	38.93	41.30	42.87	46.82	47.60	51.70	54.69	56.27	62.57	70.45	78.33	79.90	2.088	34	71			
18.61	22.78	26.75	27.55	30.73	33.10	34.69	38.65	39.44	43.55	46.55	48.13	54.44	62.33	70.22	71.80	2.090	67	140			
27.42	31.53	35.47	36.26	39.41	41.77	43.35	47.29	48.08	52.18	55.17	56.74	63.05	70.92	78.80	80.38	2.094	32	67			
27.90	32.00	35.94	36.73	39.89	42.25	43.83	47.77	48.55	52.65	55.64	57.22	63.52	71.40	79.27	80.85	2.100	30	63			
25.90	30.00	33.95	34.74	37.90	40.26	41.84	45.78	46.57	50.67	53.66	55.23	61.54	69.42	77.30	78.87	2.105	38	80			
22.08	26.21	30.17	30.96	34.12	36.49	38.07	42.02	42.81	46.91	49.91	51.49	57.80	65.68	73.56	75.14	2.113	53	112			
29.10	33.20	37.14	37.93	41.08	43.44	45.02	48.96	49.74	53.84	56.83	58.41	64.71	72.58	80.46	82.04	2.120	25	53			
28.30	32.40	36.34	37.13	40.28	42.65	44.22	48.16	48.95	53.05	56.04	57.61	63.92	71.79	79.67	81.25	2.143	28	60			
26.54	30.64	34.59	35.38	38.53	40.89	42.47	46.42	47.20	51.30	54.29	55.87	62.17	70.05	77.93	79.50	2.143	35	75			
24.76	28.88	32.82	33.61	36.77	39.14	40.71	44.66	45.45	49.55	52.54	54.12	60.42	68.30	76.18	77.76	2.143	42	90			
27.02	31.12	35.06	35.86	39.01	41.37	42.95	46.89	47.68	51.78	54.77	56.34	62.65	70.53	78.40	79.98	2.152	33	71			
28.78	32.88	36.82	37.61	40.76	43.12	44.70	48.64	49.43	53.52	56.51	58.09	64.39	72.27	80.14	81.72	2.154	26	56			
27.50	31.60	35.54	36.33	39.49	41.85	43.43	47.37	48.15	52.25	55.24	56.82	63.12	71.00	78.88	80.45	2.161	31	67			
25.97	30.08	34.02	34.82	37.97	40.34	41.91	45.86	46.64	50.74	53.73	55.31	61.62	69.49	77.37	78.95	2.162	37	80			
27.98	32.08	36.02	36.81	39.96	42.33	43.90	47.85	48.63	52.73	55.72	57.30	63.60	71.48	79.35	80.93	2.172	29	63			
29.73	33.83	37.77	38.56	41.71	44.07	45.65	49.59	50.38	54.47	57.46	59.04	65.34	73.22	81.09	82.67	2.182	22	48			
24.84	28.95	32.90	33.69	36.85	39.21	40.79	44.74	45.52	49.62	52.62	54.19	60.50	68.38	76.26	77.84	2.195	41	90			
26.61	30.72	34.66	35.45	38.61	40.97	42.55	46.49	47.28	51.38	54.37	55.94	62.25	70.13	78.01	79.58	2.206	34	75			
27.09	31.20	35.14	35.93	39.09	41.45	43.03	46.97														

8mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Note: 26, 27, 29 and 31 groove sprockets are only available as stock products in 12 and 21 mm widths. 33, 35, 37, 39 and 41 groove sprockets are only available as stock products in 12, 21, and 36 mm widths. Check sprocket specification tables on pages 65 and 66 for stainless steel and nickel plated sprocket availability.

Check sprocket specification tables on pages 65 and 66 for stainless steel and nickel plated sprocket availability.

This length factor must be used to determine the proper belt width.

8mm PITCH BELTS

Center Distance, Inches																	Speed Ratio	Sprocket Combinations		
Driver		DriveN																		
																		Number of Grooves		
8MGT-1792 PL. 70.55 224Teeth	8MGT-2000 PL. 78.74 250 Teeth	8MGT-2200 PL. 86.61 275 Teeth	8MGT-2240 PL. 88.19 280 Teeth	8MGT-2400 PL. 94.49 300 Teeth	8MGT-2520 PL. 99.21 315 Teeth	8MGT-2800 PL. 102.36 325 Teeth	8MGT-2840 PL. 110.24 350 Teeth	8MGT-3048 PL. 111.81 355 Teeth	8MGT-3200 PL. 125.98 400 Teeth	8MGT-3280 PL. 129.13 410 Teeth	8MGT-3600 PL. 141.73 450 Teeth	8MGT-4000 PL. 157.48 500 Teeth	8MGT-4400 PL. 173.23 550 Teeth	8MGT-4480 PL. 176.38 560 Teeth	Number of Grooves					
28.53	32.63	36.57	37.36	40.51	42.88	44.45	48.40	49.18	53.28	56.27	57.85	64.15	72.03	79.90	81.48	2.400	25	60		
14.21	18.54	22.61	23.42	26.64	29.05	30.65	34.64	35.43	39.57	42.59	44.17	50.51	58.42	66.33	67.91	2.400	75	180		
29.33	33.43	37.37	38.16	41.31	43.67	45.25	49.19	49.97	54.07	57.06	58.64	64.94	72.82	80.69	82.27	2.409	22	53		
26.84	30.94	34.89	35.68	38.84	41.20	42.78	46.72	47.51	51.61	54.60	56.18	62.48	70.36	78.24	79.81	2.419	31	75		
28.21	32.31	36.25	37.04	40.19	42.56	44.13	48.08	48.86	52.96	55.95	57.53	63.83	71.71	79.59	81.16	2.423	26	63		
26.27	30.38	34.33	35.12	38.28	40.64	42.22	46.16	46.95	51.05	54.04	55.62	61.92	69.80	77.68	79.26	2.424	33	80		
25.13	29.25	33.20	33.99	37.15	39.52	41.09	45.04	45.83	49.93	52.92	54.50	60.81	68.69	76.57	78.15	2.432	37	90		
27.32	31.43	35.37	36.16	39.32	41.68	43.26	47.20	47.99	52.08	55.08	56.65	62.96	70.84	78.71	80.29	2.448	29	71		
27.80	31.91	35.85	36.64	39.79	42.16	43.73	47.68	48.46	52.56	55.55	57.13	63.43	71.31	79.19	80.76	2.481	27	67		
22.66	26.80	30.76	31.55	34.72	37.09	38.67	42.63	43.41	47.52	50.52	52.09	58.41	66.29	74.18	75.75	2.489	45	112		
26.91	31.02	34.96	35.76	38.91	41.28	42.85	46.80	47.58	51.68	54.68	56.25	62.56	70.44	78.31	79.89	2.500	30	75		
26.35	30.46	34.40	35.19	38.35	40.72	42.29	46.24	47.02	51.12	54.12	55.69	62.00	69.88	77.76	79.34	2.500	32	80		
25.21	29.32	33.27	34.07	37.23	39.59	41.17	45.12	45.90	50.01	53.00	54.58	60.88	68.77	76.65	78.22	2.500	36	90		
19.38	23.56	27.55	28.35	31.53	33.91	35.50	39.46	40.25	44.37	47.37	48.95	55.27	63.17	71.06	72.63	2.500	56	140		
28.28	32.39	36.33	37.12	40.27	42.63	44.21	48.15	48.94	53.04	56.03	57.60	63.91	71.79	79.66	81.24	2.520	25	63		
14.47	18.81	22.89	23.70	26.92	29.33	30.93	34.93	35.72	39.86	42.88	44.47	50.81	58.72	66.63	68.21	2.535	71	180		
27.40	31.50	35.44	36.24	39.39	41.75	43.33	47.28	48.06	52.16	55.15	56.73	63.03	70.91	78.79	80.37	2.536	28	71		
29.08	33.18	37.12	37.91	41.07	43.43	45.01	48.95	49.73	53.83	56.82	58.40	64.70	72.58	80.46	82.03	2.545	22	56		
25.28	29.40	33.35	34.14	37.30	39.67	41.25	45.19	45.98	50.08	53.08	54.65	60.96	68.84	76.72	78.30	2.571	35	90		
27.88	31.98	35.92	36.71	39.87	42.23	43.81	47.75	48.54	52.64	55.63	57.21	63.51	71.39	79.27	80.84	2.577	26	67		
26.42	30.53	34.48	35.27	38.43	40.79	42.37	46.31	47.10	51.20	54.19	55.77	62.08	69.96	77.84	79.41	2.581	31	80		
26.99	31.10	35.04	35.83	38.99	41.35	42.93	46.87	47.66	51.76	54.75	56.33	62.63	70.51	78.39	79.97	2.586	29	75		
27.47	31.58	35.52	36.31	39.47	41.83	43.41	47.35	48.14	52.24	55.23	56.81	63.11	70.99	78.87	80.44	2.630	27	71		
19.59	23.77	27.76	28.56	31.75	34.13	35.72	39.68	40.47	44.59	47.59	49.17	55.50	63.39	71.28	72.86	2.642	53	140		
25.36	29.47	33.42	34.22	37.38	39.74	41.32	45.27	46.06	50.16	53.15	54.73	61.04	68.92	76.80	78.38	2.647	34	90		
26.50	30.61	34.55	35.34	38.50	40.87	42.44	46.39	47.18	51.28	54.27	55.85	62.15	70.03	77.91	79.49	2.667	30	80		
22.88	27.02	30.98	31.77	34.94	37.31	38.90	42.85	43.64	47.74	50.74	52.32	58.63	66.52	74.41	75.98	2.667	42	112		
27.06	31.17	35.12	35.91	39.06	41.43	43.01	46.95	47.74	51.84	54.83	56.41	62.71	70.59	78.47	80.05	2.679	28	75		
27.95	32.06	36.00	36.79	39.95	42.31	43.89	47.83	48.62	52.71	55.71	57.28	63.59	71.47	79.34	80.92	2.680	25	67		
14.72	19.07	23.16	23.97	27.20	29.61	31.22	35.21	36.01	40.15	43.17	44.76	51.10	59.02	66.93	68.51	2.687	67	180		
28.76	32.86	36.80	37.59	40.74	43.11	44.68	48.63	49.41	53.51	56.50	58.08	64.38	72.26	80.14	81.71	2.727	22	60		
25.43	29.55	33.50	34.29	37.45	39.82	41.40	45.35	46.13	50.23	53.23	54.81	61.11	69.00	76.88	78.45	2.727	33	90		
27.54	31.65	35.60	36.39	39.54	41.91	43.48	47.43	48.21	52.31	55.31	56.88	63.19	71.07	78.94	80.52	2.731	26	71		
22.95	27.09	31.05	31.85	35.02	37.39	38.97	42.93	43.71	47.82	50.82	52.40	58.71	66.60	74.48	76.06	2.732	41	112		
26.57	30.68	34.63	35.42	38.58	40.94	42.52	46.47	47.25	51.35	54.35	55.92	62.23	70.11	77.99	79.57	2.759	29	80		
27.14	31.25	35.19	35.98	39.14	41.50	43.08	47.03	47.81	51.91	54.91	56.48	62.79	70.67	78.55	80.12	2.778	27	75		
23.02	27.16	31.13	31.92	35.09	37.46	39.04	43.00	43.79	47.90	50.89	52.47	58.79	66.67	74.56	76.14	2.800	40	112		
19.80	23.98	27.98	28.78	31.97	34.35	35.94	39.90	40.69	44.81	47.82	49.40	55.72	63.62	71.51	73.09	2.800	50	140		
	17.89	21.87	22.75	24.60	26.24	26.24	30.32	31.13	35.32	38.37	38.37	39.97	46.37	54.32	62.26	63.84	2.800	80	224	
25.50	29.62	33.57	34.37	37.53	39.89	41.47	45.42	46.21	50.31	53.30	54.88	61.19	69.07	76.95	78.53	2.813	32	90		
27.62	31.73	35.67	36.46	39.62	41.98	43.56	47.51	48.29	52.39	55.38	56.96	63.26	71.14	79.02	80.60	2.840	25	71		
26.64	30.76	34.70	35.50	38.65	41.02	42.60	46.54	47.33	51.43	54.42	56.00	62.31	70.19	78.07	79.64	2.857	28	80		
14.98	19.34	23.43	24.25	27.48	29.89	31.50	35.50	36.30	40.44	43.46	45.05	51.40	59.32	67.23	68.81	2.857	63	180		
28.51	32.61	36.55	37.35	40.50	42.86	44.44	48.38	49.17	53.27	56.26	57.84	64.14	72.02	79.90	81.47	2.864	22	63		
23.09	27.23	31.20	32.00	35.16	37.54	39.12	43.07	43.86	47.97	50.97	52.55	58.86	66.75	74.64	76.21	2.872	39	112		
27.21	31.32	35.27	36.06	39.22	41.58	43.16	47.10	47.89	51.99	54.98	56.56	62.86	70.74	78.62	80.20	2.885	26	75		
25.58	29.69	33.65	34.44	37.60	39.97	41.55	45.50	46.28	50.39	53.38	54.96	61.27	69.15	77.03	78.61	2.903	31	90		
19.94	24.12	28.12	28.92	32.11	34.49	36.08	40.05	40.84	44.96	47.96	49.55	55.87	63.77	71.66	73.24	2.917	48	140		
23.17	27.31	31.27	32.07	35.24	37.61	39.19	43.15	43.94	48.05	51.04	52.62	58.94	66.83	74.71	76.29	2.947	38	112		
26.72	30.83	34.78	35.57	38.73	41.09	42.67	46.62	47.41	51.51	54.50	56.08	62.38	70.26	78.14	79.72	2.963	27	80		
	18.21	19.07	22.45	24.93	26.58	30.66	31.47	35.67	38.72	40.33	46.72	54.69	62.63	64.21	2.987	75	224			
27.29	31.40	35.34	36.13	39.29	41.66	43.23	47.18	47.97	52.07	55.06	56.64	62.94	70.82	78.70	80.28	3.000	25	75		
25.65	29.77	33.72	34.51	37.68	40.04	41.62	45.57	46.36	50.46	53.46	55.03	61.34	69.23	77.11	78.68	3.000	30	90		

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches											
DriveR		DriveN			8MGT-640 PL. 25.20 80 Teeth	8MGT-720 PL. 28.35 90 Teeth	8MGT-800 PL. 31.50 100 Teeth	8MGT-866 PL. 35.25 112 Teeth	8MGT-960 PL. 37.80 120 Teeth	8MGT-1000 PL. 39.37 125 Teeth	8MGT-1040 PL. 40.94 130 Teeth	8MGT-1120 PL. 44.08 140 Teeth	8MGT-1280 PL. 50.39 160 Teeth	8MGT-1440 PL. 56.69 180 Teeth	8MGT-1600 PL. 62.99 200 Teeth	8MGT-1760 PL. 68.29 220 Teeth
63	6.316	224	22.457	3.556												
39	3.910	140	14.036	3.590												
25	2.506	90	9.023	3.600			7.90	9.27	10.10	10.93	12.57	14.19	14.68	15.80	19.01	22.20
50	5.013	180	18.046	3.600												15.11
31	3.108	112	11.229	3.613												
22	2.206	80	8.020	3.636		7.12	9.14	10.46	11.28	12.09	13.70	15.31	15.80	16.91	20.10	23.28
38	3.810	140	14.036	3.684												19.90
30	3.008	112	11.229	3.733												25.38
60	6.015	224	22.457	3.733												
48	4.812	180	18.046	3.750												23.03
37	3.709	140	14.036	3.784												15.23
29	2.907	112	11.229	3.862												20.04
36	3.609	140	14.036	3.889												23.17
28	2.807	112	11.229	4.000												20.11
35	3.509	140	14.036	4.000												23.24
45	4.511	180	18.046	4.000												20.17
56	5.614	224	22.457	4.000												11.77
22	2.206	90	9.023	4.091		5.92	8.09	9.46	10.30	11.12	12.77	14.40	14.88	16.01	19.22	22.42
34	3.409	140	14.036	4.118												25.60
27	2.707	112	11.229	4.148												20.31
53	5.314	224	22.457	4.226												
33	3.308	140	14.036	4.242												17.02
42	4.211	180	18.046	4.286												20.31
26	2.607	112	11.229	4.308												23.38
32	3.208	140	14.036	4.375												20.38
41	4.110	180	18.046	4.390												15.67
25	2.506	112	11.229	4.480												23.45
50	5.013	224	22.457	4.480												
40	4.010	180	18.046	4.500												12.07
31	3.108	140	14.036	4.516												20.45
39	3.910	180	18.046	4.615												12.13
30	3.008	140	14.036	4.667												15.79
48	4.812	224	22.457	4.667												20.51
38	3.810	180	18.046	4.737												12.18
29	2.907	140	14.036	4.828												20.58
37	3.709	180	18.046	4.865												12.24
45	4.511	224	22.457	4.978												15.92
28	2.807	140	14.036	5.000												20.65
36	3.609	180	18.046	5.000												12.30
22	2.206	112	11.229	5.091												23.66
35	3.509	180	18.046	5.143												16.04
27	2.707	140	14.036	5.185												20.72
34	3.409	180	18.046	5.294												16.10
42	4.211	224	22.457	5.333												12.42
26	2.607	140	14.036	5.385												20.78
33	3.308	180	18.046	5.455												16.16
41	4.110	224	22.457	5.463												
25	2.506	140	14.036	5.600												20.85
40	4.010	224	22.457	5.600												
32	3.208	180	18.046	5.625												16.22
39	3.910	224	22.457	5.744												
31	3.108	180	18.046	5.806												12.59
38	3.810	224	22.457	5.895												16.29
30	3.008	180	18.046	6.000												16.35
37	3.709	224	22.457	6.054												
29	2.907	180	18.046	6.207												16.41
36	3.609	224	22.457	6.222												
22	2.206	140	14.036	6.364												21.05
35	3.509	224	22.457	6.400												
28	2.807	180	18.046	6.429												16.47
34	3.409	224	22.457	6.588												
27	2.707	180	18.046	6.667												16.53
33	3.308	224	22.457	6.788												
26	2.607	180	18.046	6.923												16.59
32	3.208	224	22.457	7.000												
25	2.506	180	18.046	7.200												16.66
31	3.108	224	22.457	7.226												
30	3.008	224	22.457	7.467												
29	2.907	224	22.457	7.724												
28	2.807	224	22.457	8.000												
22	2.206	180	18.046	8.182												16.84
27	2.707	224	22.457	8.296												
26	2.607	224	22.457	8.615												
25	2.506	224	22.457	8.960												
22	2.206	224	22.457	10.182												

Length Factor* 0.79 0.83 0.87 0.91 0.94 0.96 0.97 1.00 1.03 1.03 1.05 1.10 1.14 1.17

Note: 26, 27, 29 and 31 groove sprockets are only available as stock products in 12 and 21 mm widths. 33, 35, 37, 39 and 41 groove sprockets are only available as stock products in 12, 21, and 36 mm widths.

Check sprocket specification tables on pages 65 and 66 for stainless steel and nickel plated sprocket availability.

* This length factor must be used to determine the proper belt width

Center distance is greater than eight times the small sprocket and the large sprocket is not flanged. See Engineering Section for details.



8mm PITCH BELTS

Center Distance, Inches																	Sprocket Combinations		
Driver	DriveN	Number of Grooves	Number of Grooves	Driver	DriveN	Number of Grooves	Number of Grooves	Driver	DriveN	Number of Grooves	Number of Grooves	Driver	DriveN	Number of Grooves	Number of Grooves	Driver	DriveN	Speed Ratio	
8MGT-1792 PL. 70.55 2241 teeth	8MGT-2000 PL. 78.74 250 Teeth	18.96	19.83	23.23	25.73	27.38	31.48	32.29	36.51	39.57	41.17	47.58	55.55	63.50	65.09	3.556	63	224	
20.55	24.76	28.76	29.57	32.76	35.14	36.74	40.71	41.50	45.62	48.63	50.21	56.54	64.45	72.34	73.92	3.590	39	140	
26.02	30.14	34.09	34.89	38.05	40.42	42.00	45.95	46.74	50.84	53.84	55.41	61.72	69.61	77.49	79.07	3.600	25	90	
15.80	20.20	24.32	25.13	28.38	30.80	32.41	36.43	37.22	41.38	44.40	45.99	52.35	60.28	68.19	69.77	3.600	50	180	
23.67	27.81	31.79	32.58	35.75	38.13	39.71	43.67	44.46	48.57	51.57	53.15	59.47	67.36	75.25	76.82	3.613	31	112	
27.09	31.20	35.15	35.95	39.11	41.47	43.05	47.00	47.79	51.89	54.88	56.46	62.77	70.65	78.53	80.11	3.636	22	80	
20.62	24.83	28.83	29.64	32.83	35.22	36.81	40.78	41.57	45.70	48.71	50.29	56.62	64.52	72.42	74.00	3.684	38	140	
23.74	27.88	31.86	32.65	35.83	38.20	39.79	43.75	44.53	48.64	51.64	53.22	59.54	67.43	75.32	76.90	3.733	30	112	
14.63	19.15	20.02	23.43	25.93	27.58	31.69	32.50	36.71	39.78	41.38	47.79	55.77	63.72	65.31	67.33	60	224		
15.93	20.33	24.45	25.27	28.52	30.94	32.55	36.57	37.36	41.52	44.55	46.14	52.49	60.42	68.34	69.92	3.750	48	180	
20.69	24.90	28.91	29.71	32.90	35.29	36.88	40.86	41.65	45.77	48.78	50.36	56.69	64.60	72.49	74.07	3.784	37	140	
23.81	27.96	31.93	32.73	35.90	38.28	39.86	43.82	44.61	48.72	51.72	53.30	59.62	67.51	75.40	76.98	3.862	29	112	
20.76	24.97	28.98	29.78	32.97	35.36	36.95	40.93	41.72	45.84	48.85	50.44	56.77	64.67	72.57	74.15	3.889	36	140	
23.88	28.03	32.00	32.80	35.97	38.35	39.93	43.89	44.68	48.79	51.79	53.37	59.69	67.58	75.47	77.05	4.000	28	112	
20.83	25.03	29.05	29.85	33.05	35.43	37.03	41.00	41.79	45.92	48.93	50.51	56.84	64.75	72.64	74.22	4.000	35	140	
16.12	20.53	24.65	25.47	28.73	31.15	32.76	36.78	37.58	41.73	44.76	46.35	52.71	60.65	68.56	70.15	4.000	45	180	
14.87	19.40	20.27	23.68	26.19	27.85	31.96	32.77	36.99	40.05	41.66	48.08	56.06	64.01	65.60	4.000	56	224		
26.23	30.36	34.32	35.11	38.27	40.64	42.22	46.17	46.96	51.07	54.06	55.64	61.95	69.84	77.72	79.30	4.091	22	90	
20.89	25.10	29.12	29.92	33.12	35.51	37.10	41.07	41.87	45.99	49.00	50.58	56.92	64.82	72.72	74.30	4.118	34	140	
23.95	28.10	32.08	32.87	36.05	38.42	40.01	43.97	44.76	48.87	51.87	53.45	59.77	67.66	75.55	77.13	4.148	27	112	
15.04	19.59	20.46	23.88	26.39	28.05	32.16	32.97	37.20	40.26	41.87	48.29	56.27	64.23	65.82	4.226	53	224		
20.96	25.17	29.19	29.99	33.19	35.58	37.17	41.15	41.94	46.07	49.07	50.66	56.99	64.90	72.80	74.37	4.242	33	140	
16.30	20.72	24.86	25.68	28.93	31.36	32.97	36.99	37.79	41.95	44.98	46.57	52.93	60.87	68.79	70.37	4.286	42	180	
24.02	28.17	32.15	32.95	36.12	38.50	40.08	44.04	44.83	48.94	51.94	53.52	59.84	67.74	75.63	77.20	4.308	26	112	
21.03	25.24	29.26	30.06	33.26	35.65	37.24	41.22	42.01	46.14	49.15	50.73	57.06	64.97	72.87	74.45	4.375	32	140	
16.37	20.79	24.92	25.74	29.00	31.43	33.04	37.06	37.86	42.02	45.05	46.64	53.01	60.94	68.86	70.44	4.390	41	180	
24.09	28.25	32.22	33.02	36.19	38.57	40.16	44.12	44.91	49.02	52.02	53.60	59.92	67.81	75.70	77.28	4.480	25	112	
15.22	19.77	20.65	24.07	26.59	28.25	32.36	33.18	37.40	40.47	42.08	48.50	56.49	64.45	66.04	4.480	50	224		
16.43	20.85	24.99	25.81	29.07	31.50	33.11	37.13	37.93	42.09	45.12	46.71	53.08	61.01	68.93	70.52	4.500	40	180	
21.10	25.31	29.33	30.13	33.33	35.72	37.31	41.29	42.08	46.21	49.22	50.81	57.14	65.05	72.95	74.52	4.516	31	140	
16.49	20.92	25.06	25.88	29.14	31.57	33.18	37.20	38.00	42.16	45.19	46.79	53.15	61.09	69.01	70.59	4.615	39	180	
21.17	25.38	29.40	30.20	33.40	35.79	37.39	41.37	42.16	46.28	49.29	50.88	57.21	65.12	73.02	74.60	4.667	30	140	
15.34	19.90	20.77	24.20	26.72	28.38	32.50	33.31	37.54	40.61	42.22	48.65	56.63	64.59	66.18	4.667	48	224		
16.55	20.99	25.12	25.95	29.21	31.64	33.25	37.27	38.07	42.23	45.26	46.86	53.22	61.16	69.08	70.67	4.737	38	180	
21.23	25.45	29.47	30.28	33.47	35.87	37.46	41.44	42.23	46.36	49.37	50.95	57.29	65.20	73.10	74.68	4.828	29	140	
16.62	21.05	25.19	26.01	29.28	31.70	33.32	37.34	38.14	42.30	45.34	46.93	53.30	61.23	69.16	70.74	4.865	37	180	
15.51	20.08	20.96	24.39	26.91	28.58	32.70	33.52	37.75	40.82	42.43	48.86	56.85	64.81	66.40	4.978	45	224		
21.30	25.52	29.54	30.35	33.55	35.94	37.53	41.51	42.30	46.43	49.44	51.03	57.36	65.27	73.17	74.75	5.000	28	140	
16.68	21.12	25.26	26.08	29.34	31.77	33.39	37.41	38.21	42.38	45.41	47.00	53.37	61.31	69.23	70.81	5.000	36	180	
24.30	28.46	32.44	33.24	36.41	38.79	40.38	44.34	45.13	49.24	52.24	53.82	60.14	68.04	75.93	77.51	5.091	22	112	
16.74	21.18	25.33	26.15	29.41	31.84	33.46	37.48	38.28	42.45	45.48	47.07	53.44	61.38	69.30	70.89	5.143	35	180	
21.37	25.59	29.61	30.42	33.62	36.01	37.60	41.58	42.38	46.50	49.52	51.10	57.44	65.34	73.25	74.83	5.185	27	140	
16.80	21.25	25.39	26.22	29.48	31.91	33.53	37.55	38.35	42.52	45.55	47.15	53.51	61.45	69.38	70.96	5.294	34	180	
15.69	20.27	21.15	24.59	27.11	28.78	32.90	33.72	37.95	41.03	42.64	49.07	57.06	65.03	66.62	5.333	42	224		
21.44	25.66	29.68	30.49	33.69	36.08	37.67	41.66	42.45	46.58	49.59	51.17	57.51	65.42	73.32	74.90	5.385	26	140	
16.87	21.31	25.46	26.28	29.55	31.98	33.60	37.62	38.42	42.59	45.62	47.22	53.59	61.53	69.45	71.04	5.455	33	180	
15.75	20.33	21.21	24.65	27.18	28.84	32.97	33.79	38.02	41.10	42.71	49.14	57.14	65.10	66.69	5.463	41	224		
21.51	25.73	29.75	30.56	33.76	36.15	37.75	41.73	42.52	46.65	49.66	51.25	57.58	65.49	73.40	74.98	5.600	25	140	
15.81	20.39	21.28	24.72	27.24	28.91	33.04	33.85	38.09	41.17	42.78	49.21	57.21	65.17	66.76	5.600	40	224		
16.93	21.38	25.53	26.35	29.62	32.05	33.67	37.69	38.49	42.66	45.69	47.29	53.66	61.60	69.53	71.11	5.625	32	180	
15.86	20.46	21.34	24.78	27.31	28.97	33.10	33.92	38.16	41.23	42.85	49.28	57.28	65.25	66.84	5.744	39	224		
16.99	21.44	25.59	26.42	29.69	32.12	33.74	37.76	38.57	42.73	45.76	47.36	53.73	61.67	69.60	71.18	5.806	31	180	
15.92	20.52	21.40	24.84	27.37	29.04	33.17	33.99	38.23	41.30	42.92	49.35	57.35	65.32	66.91	5.895	38	224		
17.05	21.51	25.66	26.48	29.75	32.19	33.80	38.64	40.44	42.80	45.84	47.43	53.80	61.75	69.67	71.26	6.000	30	180	
15.98	20.58	21.46	24.91	27.44	29.1														

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches															
DriveR		DriveN			14MGT-994 PL. 39.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth				
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)																	
28	4.912	28	4.912	1.000	11.85	14.33	15.71	17.09	19.84	23.15	23.98	26.73	29.49	30.87	33.62	36.38	37.75			
29	5.088	29	5.088	1.000	11.57	14.05	15.43	16.81	19.57	22.87	23.70	26.46	29.21	30.59	33.35	36.10	37.48			
30	5.263	30	5.263	1.000	11.30	13.78	15.16	16.54	19.29	22.60	23.43	26.18	28.94	30.32	33.07	35.83	37.20			
31	5.439	31	5.439	1.000	11.02	13.50	14.88	16.26	19.02	22.32	23.15	25.91	28.66	30.04	32.80	35.55	36.93			
32	5.614	32	5.614	1.000	10.75	13.23	14.61	15.99	18.74	22.05	22.88	25.63	28.39	29.77	32.52	35.28	36.65			
33	5.790	33	5.790	1.000	10.47	12.95	14.33	15.71	18.47	21.77	22.60	25.36	28.11	29.49	32.25	35.00	36.38			
34	5.965	34	5.965	1.000	10.20	12.68	14.06	15.44	18.19	21.50	22.33	25.08	27.84	29.22	31.97	34.73	36.10			
35	6.141	35	6.141	1.000	9.92	12.40	13.78	15.16	17.91	21.22	22.05	24.80	27.56	28.94	31.69	34.45	35.82			
36	6.316	36	6.316	1.000	9.64	12.12	13.50	14.88	17.64	20.94	21.77	24.53	27.28	28.66	31.42	34.17	35.55			
37	6.492	37	6.492	1.000	9.37	11.85	13.23	14.61	17.36	20.67	21.50	24.25	27.01	28.39	31.14	33.90	35.27			
38	6.667	38	6.667	1.000	9.09	11.57	12.95	14.33	17.09	20.39	21.22	23.98	26.73	28.11	30.87	33.62	35.00			
39	6.842	39	6.842	1.000	8.82	11.30	12.68	14.06	16.81	20.12	20.95	23.70	26.46	28.24	30.59	33.35	34.72			
40	7.018	40	7.018	1.000	8.54	11.02	12.40	13.78	16.54	19.84	20.67	23.43	26.18	27.56	30.32	33.07	34.45			
43	7.544	43	7.544	1.000		10.19	11.57	12.95	15.71	19.01	19.84	22.60	25.35	26.73	29.49	32.24	33.62			
45	7.895	45	7.895	1.000		9.64	11.02	12.40	15.16	18.46	19.29	22.05	24.80	26.18	28.94	31.69	33.07			
48	8.421	48	8.421	1.000			10.20	11.58	14.33	17.64	18.47	21.22	23.98	25.36	28.11	30.87	32.24			
50	8.772	50	8.772	1.000				9.65	11.03	13.78	17.09	17.92	20.67	23.43	24.81	27.56	30.32	31.69		
53	9.299	53	9.299	1.000					10.20	12.95	16.26	17.09	19.84	22.60	23.98	26.73	29.49	30.86		
56	9.825	56	9.825	1.000						12.13	15.43	16.26	19.02	21.77	23.15	25.91	28.66	30.04		
60	10.527	60	10.527	1.000							14.33	15.16	17.91	20.67	22.05	24.80	27.56	28.93		
63	11.053	63	11.053	1.000							13.50	14.33	17.09	19.84	21.22	23.98	26.73	28.11		
67	11.755	67	11.755	1.000								13.23	15.99	18.74	20.12	22.88	25.63	27.01		
71	12.457	71	12.457	1.000									14.88	17.64	19.02	21.77	24.53	25.90		
75	13.158	75	13.158	1.000										16.54	17.92	20.67	23.43	24.80		
80	14.036	80	14.036	1.000											15.16	16.54	19.29	22.05	23.42	
38	6.667	39	6.842	1.026	8.95	11.43	12.81	14.19	16.95	20.25	21.08	23.84	26.59	27.97	30.73	33.48	34.86			
39	6.842	40	7.018	1.026	8.68	11.16	12.54	13.92	16.67	19.98	20.81	23.56	26.32	27.70	30.45	33.21	34.58			
37	6.492	38	6.667	1.027	9.23	11.71	13.09	14.47	17.22	20.53	21.36	24.11	26.87	28.25	31.00	33.76	35.13			
36	6.316	37	6.492	1.028	9.51	11.99	13.37	14.75	17.50	20.81	21.64	24.39	27.15	28.53	31.28	34.04	35.41			
34	5.965	35	6.141	1.029	10.06	12.54	13.92	15.30	18.05	21.36	22.19	24.94	27.70	29.08	31.83	34.59	35.96			
35	6.141	36	6.316	1.029	9.78	12.26	13.64	15.02	17.78	20.18	21.91	24.67	27.42	28.80	31.56	34.31	35.69			
33	5.790	34	5.965	1.030	10.33	12.81	14.19	15.57	18.33	21.63	22.46	25.22	27.97	29.35	32.11	34.86	36.24			
32	5.614	33	5.790	1.031	10.61	13.09	14.47	15.85	18.60	21.91	22.74	25.49	28.25	29.63	32.38	35.14	36.51			
31	5.439	32	5.614	1.032	10.88	13.36	14.74	16.12	18.88	22.18	23.01	25.77	28.52	29.90	32.66	35.41	36.79			
30	5.263	31	5.439	1.033	11.16	13.64	15.02	16.40	19.15	22.46	23.29	26.04	28.80	30.18	32.93	35.69	37.06			
29	5.088	30	5.263	1.034	11.44	13.92	15.30	16.68	19.43	22.74	23.57	26.32	29.08	30.46	33.21	35.97	37.34			
28	4.912	29	5.088	1.036	11.71	14.19	15.57	16.95	19.71	23.01	23.84	26.60	29.35	30.73	33.49	36.24	37.62			
48	8.421	50	8.772	1.042					9.92	11.30	12.68	15.43	18.74	19.57	22.32	25.08	26.46	27.84	30.59	31.97
43	7.544	45	7.895	1.047						10.20	12.95	16.26	17.09	19.84	22.60	23.98	26.73	29.49	30.86	33.34
60	10.527	63	11.053	1.050							13.91	14.74	17.50	20.25	21.63	24.39	27.14	28.52		
38	6.667	40	7.018	1.053	8.82	11.30	12.68	14.06	16.81	20.12	20.95	23.70	26.46	27.84	30.59	33.35	34.72			
37	6.492	39	6.842	1.054	9.09	11.57	12.95	14.33	17.09	20.39	21.22	23.98	26.73	28.11	30.87	33.62	35.00			
36	6.316	38	6.667	1.056	9.37	11.85	13.23	14.61	17.36	20.67	21.50	24.25	27.01	28.39	31.14	33.90	35.27			
71	12.457	75	13.158	1.056								14.33	17.08	18.46	21.22	23.97	25.35			
35	6.141	37	6.492	1.057	9.64	12.12	13.50	14.88	17.64	20.94	21.77	24.53	27.28	28.66	31.42	34.17	35.55			
53	9.299	56	9.825	1.057							12.54	15.84	16.67	19.43	22.18	23.56	26.32	29.07	30.45	
34	5.965	36	6.316	1.059	9.92	12.40	13.78	15.16	17.91	21.22	22.05	24.80	27.56	28.94	31.69	34.45	35.82			
50	8.772	53	9.299	1.060					10.61	13.36	16.67	17.50	20.26	23.01	24.39	27.15	29.90	31.28		
67	11.755	71	12.457	1.060								15.43	18.19	19.57	22.32	25.08	26.45			
33	5.790	35	6.141	1.061	10.19	12.67	14.05	15.43	18.19	21.49	22.32	25.08	27.83	29.21	31.97	34.72	36.10			
32	5.614	34	5.965	1.063	10.47	12.95	14.33	15.71	18.47	21.77	22.60	25.36	28.11	29.49	32.25	35.00	36.38			
63	11.053	67	11.755	1.063							12.95	13.78	16.53	19.29	20.67	23.42	26.18	27.55		
31	5.439	33	5.790	1.065	10.74	13.22	14.60	15.98	18.74	22.05	22.88	25.63	28.39	29.77	32.52	35.28	36.65			
30	5.263	32	5.614	1.067	11.02	13.50	14.88	16.26	19.02	22.32	23.15	25.91	28.66	30.04	32.80	35.55	36.93			
45	7.895	48	8.421	1.067				9.23	10.61	11.99	14.74	18.05	18.88	21.63	24.39	27.57	28.52	31.28		
75	13.158	80	14.036	1.067									15.84	17.22	19.98	22.73	24.11			
29	5.088	31	5.439	1.069	11.30	13.78	15.16	16.54	19.29	22.60	23.43	26.18	28.94	30.32	33.07	35.83	37.20			
28	4.912	30	5.263	1.071	11.57	14.05	15.43	16.81	19.57	22.87	23.70	26.46	29.21	30.59	33.35	36.10	37.48			
56	9.825	60	10.5																	

14mm PITCH BELTS

Center Distance, Inches																Sprocket Combinations	
DriveR							DriveN									Speed Ratio	
Number of Grooves		Number of Grooves															
14MGT-2380 PL. 33.70 170 Teeth	14MGT-2450 PL. 36.46 175 Teeth	14MGT-2520 PL. 39.21 180 Teeth	14MGT-2590 PL. 40.97 185 Teeth	14MGT-2660 PL. 40.72 190 Teeth	14MGT-2800 PL. 40.24 200 Teeth	14MGT-3136 PL. 42.46 224 Teeth	14MGT-3304 PL. 40.08 236 Teeth	14MGT-3360 PL. 40.28 240 Teeth	14MGT-3500 PL. 37.79 250 Teeth	14MGT-3850 PL. 35.57 275 Teeth	14MGT-3920 PL. 35.33 280 Teeth	14MGT-4326 PL. 30.31 300 Teeth	14MGT-4410 PL. 31.62 315 Teeth		Length Factor*		
39.13	40.51	41.89	43.27	44.64	47.40	54.01	57.32	58.42	61.18	68.07	69.45	77.44	79.09	1.000	28	28	
38.86	40.24	41.61	42.99	44.37	47.13	53.74	57.05	58.15	60.90	67.79	69.17	77.16	78.82	1.000	29	29	
38.58	39.96	41.34	42.72	44.09	46.85	53.46	56.77	57.87	60.63	67.52	68.90	76.89	78.54	1.000	30	30	
38.31	39.69	41.06	42.44	43.82	46.58	53.19	56.50	57.60	60.35	67.24	68.62	76.61	78.27	1.000	31	31	
38.03	39.41	40.79	42.17	43.54	46.30	52.91	56.22	57.32	60.08	66.97	68.35	76.34	77.99	1.000	32	32	
37.76	39.14	40.51	41.89	43.27	46.03	52.64	55.95	57.05	59.80	66.69	68.07	76.06	77.72	1.000	33	33	
37.48	38.86	40.24	41.62	42.99	45.75	52.36	55.67	56.77	59.53	66.42	67.80	75.79	77.44	1.000	34	34	
37.20	38.58	39.96	41.34	42.71	45.47	52.08	55.39	56.49	59.25	66.14	67.52	75.51	77.16	1.000	35	35	
36.93	38.31	39.68	41.06	42.44	45.20	51.81	55.12	56.22	58.97	65.86	67.24	75.23	76.89	1.000	36	36	
36.65	38.03	39.41	40.79	42.16	44.92	51.53	54.84	55.94	58.70	65.59	66.97	74.96	76.61	1.000	37	37	
36.38	37.76	39.13	40.51	41.89	44.65	51.26	54.57	55.67	58.42	65.31	66.69	74.68	76.34	1.000	38	38	
36.10	37.48	38.86	40.24	41.61	44.37	50.98	54.29	55.39	58.15	65.04	66.42	74.41	76.06	1.000	39	39	
35.83	37.21	38.58	39.96	41.34	44.10	50.71	54.02	55.12	57.87	64.76	66.14	74.13	75.79	1.000	40	40	
35.00	36.38	37.75	39.13	40.51	43.27	49.88	53.19	54.29	57.04	63.93	65.31	73.30	74.96	1.000	43	43	
34.45	35.83	37.20	38.58	39.96	42.72	49.33	52.64	53.74	56.49	63.38	64.76	72.75	74.41	1.000	45	45	
33.62	35.00	36.38	37.76	39.13	41.89	48.50	51.81	52.91	55.67	62.56	63.94	71.93	73.58	1.000	48	48	
33.07	34.45	35.83	37.21	38.58	41.34	47.95	51.26	52.36	55.12	62.01	63.39	71.38	73.03	1.000	50	50	
32.24	33.62	35.00	36.38	37.75	40.51	47.12	50.43	51.53	54.29	61.18	62.56	70.55	72.20	1.000	53	53	
31.42	32.80	34.17	35.55	36.93	39.69	46.30	49.61	50.71	53.46	60.35	61.73	69.72	71.38	1.000	56	56	
30.31	31.69	33.07	34.45	35.82	38.58	45.19	48.50	49.60	52.36	59.25	60.63	68.62	70.27	1.000	60	60	
29.49	30.87	32.24	33.62	35.00	37.76	44.37	47.68	48.78	51.53	58.42	59.80	67.79	69.45	1.000	63	63	
28.39	29.77	31.14	32.52	33.90	36.66	43.27	46.58	47.68	50.43	57.32	58.70	66.69	68.35	1.000	67	67	
27.28	28.66	30.04	31.42	32.79	35.55	42.16	45.47	46.57	49.33	56.22	57.60	65.59	67.24	1.000	71	71	
26.18	27.56	28.94	30.32	31.69	34.45	41.06	44.37	45.47	48.23	55.12	56.50	64.49	66.14	1.000	75	75	
24.80	26.18	27.56	28.94	30.31	33.07	39.68	42.99	44.09	46.85	53.74	55.12	63.11	64.76	1.000	80	80	
36.24	37.62	38.99	40.37	41.75	44.51	51.12	54.43	55.53	58.28	65.17	66.55	74.55	76.20	1.026	38	39	
35.96	37.34	38.72	40.10	41.47	44.23	50.84	54.15	55.25	58.01	64.90	66.28	74.27	75.92	1.026	39	40	
36.51	37.89	39.27	40.65	42.02	44.78	51.39	54.70	55.80	58.56	65.45	66.83	74.82	76.47	1.027	37	38	
36.79	38.17	39.55	40.93	42.30	45.06	51.67	54.98	56.08	58.84	65.73	67.11	75.10	76.75	1.028	36	37	
37.34	38.72	40.10	41.48	42.85	45.61	52.22	55.53	56.63	59.39	66.28	67.66	75.65	77.30	1.029	34	35	
37.07	38.45	39.82	41.20	42.58	45.34	51.95	55.26	56.36	59.11	66.00	67.38	75.37	77.03	1.029	35	36	
37.62	39.00	40.37	41.75	43.13	45.89	52.50	55.81	56.91	59.66	66.55	67.93	75.92	77.58	1.030	33	34	
37.89	39.27	40.65	42.03	43.40	46.16	52.77	56.08	57.18	59.94	66.83	68.21	76.20	77.85	1.031	32	33	
38.17	39.55	40.92	42.30	43.68	46.44	53.05	56.36	57.46	60.21	67.10	68.48	76.47	78.13	1.032	31	32	
38.44	39.82	41.20	42.58	43.95	46.71	53.32	56.63	57.73	60.49	67.38	68.76	76.75	78.40	1.033	30	31	
38.72	40.10	41.48	42.86	44.23	46.99	53.60	56.91	58.01	60.77	67.66	69.04	77.03	78.68	1.034	29	30	
39.00	40.38	41.75	43.13	44.51	47.27	53.88	57.19	58.29	61.04	67.93	69.31	77.30	78.96	1.036	28	29	
33.35	34.73	36.10	37.48	38.86	40.23	42.99	49.60	52.91	54.01	56.77	63.66	65.66	71.31	1.042	48	50	
34.72	36.10	37.48	38.86	40.23	42.99	49.60	52.91	54.01	56.77	63.66	65.04	73.03	74.68	1.047	43	45	
29.90	31.28	32.66	34.04	35.41	38.17	44.78	48.09	49.19	51.95	58.84	60.22	68.21	69.86	1.050	60	63	
36.10	37.48	38.86	40.24	41.61	44.37	50.98	54.29	55.39	58.15	65.04	66.42	74.41	76.06	1.053	38	40	
36.38	37.76	39.13	40.51	41.89	44.65	51.26	54.57	55.67	58.42	65.31	66.69	74.68	76.34	1.054	37	39	
36.65	38.03	39.41	40.79	42.16	44.92	51.53	54.84	55.94	58.70	65.59	66.97	74.96	76.61	1.056	36	38	
26.73	28.11	29.48	30.87	32.24	35.00	41.61	44.92	46.02	48.78	55.67	57.05	65.04	66.69	1.056	71	75	
36.93	38.31	39.68	41.06	42.44	45.20	51.81	55.12	56.22	58.97	65.86	67.24	75.23	76.89	1.057	35	37	
31.83	33.21	34.58	35.96	37.34	40.10	46.71	50.02	51.12	53.87	60.76	62.14	70.13	71.79	1.057	53	56	
37.20	38.58	39.96	41.34	42.71	45.47	52.08	55.39	56.49	59.25	66.14	67.52	75.51	77.16	1.059	34	36	
32.66	34.04	35.41	36.79	38.17	40.93	47.54	50.85	51.95	54.70	61.59	62.97	70.96	72.62	1.060	50	53	
27.83	29.21	30.59	31.97	33.34	36.10	42.71	46.02	47.12	49.88	56.77	58.15	66.14	67.79	1.060	67	71	
37.48	38.86	40.24	41.62	42.99	45.75	52.36	55.67	56.77	59.52	66.41	67.79	75.78	77.44	1.061	33	35	
37.76	39.14	40.51	41.89	43.27	46.03	52.64	55.95	57.05	59.80	66.69	68.07	76.06	77.72	1.063	32	34	
28.93	30.31	31.69	33.07	34.44	37.20	43.82	47.13	48.23	50.98	57.87	59.25	67.24	68.90	1.063	63	67	
38.03	39.41	40.79	42.17	43.54	46.30	52.91	56.22	57.32	60.08	66.97	68.35	76.34	77.99	1.065	31	33	
38.31	39.69	41.06	42.44	43.82	46.58	53.19	56.50	57.60	60.35	67.24	68.62	76.61	78.27	1.067	30	32	
34.03	35.41	36.79	38.17	39.54	42.30	48.91	52.22	53.32	56.08	62.97	64.35	72.34	73.99	1.067	45	48	
25.49	26.87	28.24	29.62	31.00	33.76	40.37	43.68	44.78	47.53	54.43	55.81	63.80	65.45	1.067	75	80	
38.58	39.96	41.34	42.72	44.09	46.85	53.46	56.77	57.87	60.63	67.52	68.90	76.89	78.54	1.069	29	31	
38.86	40.24	41.61	42.99	44.37	47.13	53.74	57.05	58.15	60.90	67.79	69.17	77.16	78.82	1.071	28	30	
30.86	32.24	33.62	35.00	36.37	39.13	45.74	49.05	50.15	52.91	59.80	61.18	69.17	70.82	1.071	56	60	
35.41	36.79	38.17	39.55	40.92	43.68	50.29	53.60	54.70	57.46	64.35	65.73	73.72	75.37				

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches														
DriveR		DriveN			14MGT-994 PL. 38.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth			
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)																
28	4.912	31	5.439	1.107	11.43	13.91	15.29	16.67	19.43	22.73	23.56	26.32	29.07	30.45	33.21	35.96	37.34		
36	6.316	40	7.018	1.111	9.09	11.57	12.95	14.33	17.08	20.39	21.22	23.97	26.73	28.11	30.87	33.62	35.00		
45	7.895	50	8.772	1.111			10.33	11.71	14.46	17.77	18.60	21.36	24.11	25.49	28.25	31.00	32.38		
35	6.141	39	6.842	1.114	9.36	11.84	13.22	14.60	17.36	20.67	21.50	24.25	27.01	28.39	31.14	33.90	35.27		
43	7.544	48	8.421	1.116			9.50	10.88	12.26	15.01	18.32	19.15	21.91	24.66	26.04	28.80	31.55	32.93	
60	10.527	67	11.755	1.117						13.35	14.18	16.94	19.70	21.08	23.83	26.59	27.96		
34	5.965	38	6.667	1.118	9.64	12.12	13.50	14.88	17.64	20.94	21.77	24.53	27.28	28.66	31.42	34.17	35.55		
67	11.755	75	13.158	1.119							14.87	17.62	19.01	21.76	24.52	25.89			
50	8.772	56	9.825	1.120				10.19	12.94	16.25	17.08	19.84	22.59	23.97	26.73	29.48	30.86		
33	5.790	37	6.492	1.121	9.91	12.39	13.77	15.15	17.91	21.22	22.05	24.80	27.56	28.94	31.69	34.45	35.82		
32	5.614	36	6.316	1.125	10.19	12.67	14.05	15.43	18.19	21.49	22.32	25.08	27.83	29.21	31.97	34.72	36.10		
40	7.018	45	7.895	1.125		10.32	11.70	13.09	15.84	19.15	19.98	22.73	25.49	26.87	29.62	32.38	33.75		
56	9.825	63	11.053	1.125					11.15	14.45	15.29	18.04	20.80	22.18	24.93	27.69	29.07		
80	14.036	90	15.790	1.125										17.89	20.65	22.03			
63	11.053	71	12.457	1.127							13.21	15.97	18.73	20.11	22.86	25.62	27.00		
71	12.457	80	14.036	1.127								16.38	17.76	20.52	23.27	24.65			
31	5.439	35	6.141	1.129	10.46	12.95	14.33	15.71	18.46	21.77	22.60	25.35	28.11	29.49	32.24	35.00	36.37		
38	6.667	43	7.544	1.132	8.39	10.87	12.26	13.64	16.39	19.70	20.53	23.28	26.04	27.42	30.18	32.93	34.31		
53	9.299	60	10.527	1.132					11.97	15.28	16.11	18.87	21.62	23.01	25.76	28.52	29.89		
30	5.263	34	5.965	1.133	10.74	13.22	14.60	15.98	18.74	22.04	22.87	25.63	28.38	29.76	32.52	35.27	36.65		
29	5.088	33	5.790	1.138	11.02	13.50	14.88	16.26	19.01	22.32	23.15	25.90	28.66	30.04	32.79	35.55	36.92		
28	4.912	32	5.614	1.143	11.29	13.77	15.15	16.53	19.29	22.60	23.43	26.18	28.94	30.32	33.07	35.83	37.20		
35	6.141	40	7.018	1.143	9.22	11.70	13.08	14.46	17.22	20.53	21.36	24.11	26.87	28.25	31.00	33.76	35.13		
34	5.965	39	6.842	1.147	9.50	11.98	13.36	14.74	17.50	20.80	21.63	24.39	27.14	28.52	31.28	34.03	35.41		
33	5.790	38	6.667	1.152	9.77	12.25	13.63	15.01	17.77	21.08	21.91	24.66	27.42	28.80	31.55	34.31	35.68		
39	6.842	45	7.895	1.154		10.46	11.84	13.22	15.98	19.28	20.11	22.87	25.63	27.01	29.76	32.52	33.89		
32	5.614	37	6.492	1.156	10.05	12.53	13.91	15.29	18.05	21.35	22.18	24.94	27.69	29.07	31.83	34.58	35.96		
31	5.439	36	6.316	1.161	10.32	12.81	14.19	15.57	18.32	21.63	22.46	25.21	27.97	29.35	32.10	34.86	36.23		
37	6.492	43	7.544	1.162	8.52	11.01	12.39	13.77	16.53	19.83	20.66	23.42	26.18	27.56	30.31	33.07	34.44		
43	7.544	50	8.772	1.163		9.21	10.59	11.97	14.73	18.04	18.87	21.63	24.38	25.76	28.52	31.27	32.65		
30	5.263	35	6.141	1.167	10.60	13.08	14.46	15.84	18.60	21.90	22.73	25.49	28.24	29.63	32.38	35.14	36.51		
48	8.421	56	9.825	1.167				10.45	13.21	16.52	17.35	20.11	22.86	24.24	27.00	29.76	31.13		
29	5.088	34	5.965	1.172	10.88	13.36	14.74	16.12	18.87	22.18	23.01	25.77	28.52	29.90	32.66	35.41	36.79		
34	5.965	40	7.018	1.176	9.35	11.84	13.22	14.60	17.36	20.66	21.49	24.25	27.00	28.38	31.14	33.89	35.27		
45	7.895	53	9.299	1.178			9.90	11.28	14.04	17.35	18.18	20.93	23.69	25.07	27.83	30.58	31.96		
28	4.912	33	5.790	1.179	11.15	13.63	15.01	16.39	19.15	22.46	23.29	26.04	28.80	30.18	32.93	35.69	37.06		
33	5.790	39	6.842	1.182	9.63	12.11	13.49	14.87	17.63	20.94	21.77	24.52	27.28	28.66	31.41	34.17	35.54		
60	10.527	71	12.457	1.183						12.78	13.61	16.37	19.13	20.51	23.27	26.03	27.40		
38	6.667	45	7.895	1.184	8.10	10.59	11.97	13.35	16.11	19.42	20.25	23.00	25.76	27.14	29.90	32.65	34.03		
32	5.614	38	6.667	1.188	9.91	12.39	13.77	15.15	17.91	21.21	22.04	24.80	27.55	28.93	31.69	34.45	35.82		
53	9.299	63	11.053	1.189					11.54	14.85	15.69	18.44	21.20	22.58	25.34	28.10	29.47		
63	11.053	75	13.158	1.190							15.40	18.16	19.54	22.30	25.06	26.43			
31	5.439	37	6.492	1.194	10.18	12.66	14.04	15.43	18.18	21.49	22.32	25.07	27.83	29.21	31.97	34.72	36.10		
36	6.316	43	7.544	1.194	8.66	11.14	12.52	13.91	16.66	19.97	20.80	23.56	26.31	27.69	30.45	33.20	34.58		
67	11.755	80	14.036	1.194							14.15	16.91	18.29	21.05	23.81	25.19			
56	9.825	67	11.755	1.196						13.88	14.71	17.47	20.23	21.61	24.37	27.13	28.50		
30	5.263	36	6.316	1.200	10.46	12.94	14.32	15.70	18.46	21.76	22.59	25.35	28.11	29.49	32.24	35.00	36.37		
40	7.018	48	8.421	1.200		9.89	11.28	12.66	15.42	18.73	19.56	22.31	25.07	26.45	29.21	31.96	33.34		
50	8.772	60	10.527	1.200					12.37	15.68	16.51	19.27	22.03	23.41	26.17	28.92	30.30		
75	13.158	90	15.790	1.200								15.79	18.56	21.32	22.70				
29	5.088	35	6.141	1.207	10.73	13.22	14.60	15.98	18.73	22.04	22.87	25.63	28.38	29.76	32.52	35.27	36.65		
33	5.790	40	7.018	1.212	9.49	11.97	13.35	14.73	17.49	20.80	21.63	24.38	27.14	28.52	31.27	34.03	35.41		
28	4.912	34	5.965	1.214	11.01	13.49	14.87	16.25	19.01	22.32	23.15	25.90	28.66	30.04	32.79	35.55	36.92		
37	6.492	45	7.895	1.216	8.24	10.72	12.11	13.49	16.25	19.55	20.38	23.14	25.90	27.28	30.03	32.79	34.16		
32	5.614	39	6.842	1.219	9.76	12.25	13.63	15.01	17.77	21.07	21.90	24.66	27.42	28.80	31.55	34.31	35.68		
31	5.439	38	6.667	1.226	10.04	12.52	13.90	15.28	18.04	21.35	22.18	24.93	27.69	29.07	31.83	34.58	35.96		
35	6.141	43	7.544	1.229	8.79	11.28	12.66	14.04	16.80	20.10	20.94	23.69	26.45	27.83	30.58	33.34	34.71		
39	6.842	48	8.421	1.231		10.03	11.41	12.79	15.55	18.86	19.69	22.45	25.21	26.59	29.34	32.10	33.47		

14mm PITCH BELTS

Center Distance, Inches														Sprocket Combinations DriveR DriveN		Speed Ratio	Number of Grooves Number of Grooves		
14MGT-2380 PL. 93.70 170 Teeth							14MGT-2450 PL. 98.46 175 Teeth												
14MGT-2520 PL. 98.21 180 Teeth							14MGT-2590 PL. 101.97 185 Teeth												
38.72	40.10	41.47	42.85	44.23	46.99	53.60	56.91	55.67	58.42	65.31	66.69	74.68	76.34	1.111	36	40			
36.38	37.76	39.13	40.51	41.89	44.65	51.26	54.57	55.67	58.70	62.69	64.07	72.06	73.72	1.111	45	50			
33.76	35.14	36.51	37.89	39.27	42.03	48.64	51.95	53.05	55.80	65.59	66.97	74.96	76.61	1.114	35	39			
36.65	38.03	39.41	40.79	42.16	44.92	51.53	54.84	55.94	58.70	65.59	66.97	74.96	76.61	1.114	43	48			
34.31	35.69	37.06	38.44	39.82	42.58	49.19	52.50	53.60	56.35	63.24	64.62	72.61	74.27	1.116	43	48			
29.34	30.72	32.10	33.48	34.85	37.61	44.23	47.54	48.64	51.39	58.28	59.66	67.65	69.31	1.117	60	67			
36.93	38.31	39.68	41.06	42.44	45.20	51.81	55.12	56.22	58.97	65.86	67.24	75.23	76.89	1.118	34	38			
27.27	28.65	30.03	31.41	32.79	35.55	42.16	45.47	46.57	49.32	56.21	57.59	65.58	67.24	1.119	67	75			
32.24	33.62	34.99	36.38	37.75	40.51	47.12	50.43	51.53	54.29	61.18	62.56	70.55	72.20	1.120	50	56			
37.20	38.58	39.96	41.34	42.71	45.47	52.08	55.39	56.49	59.25	66.14	67.52	75.51	77.16	1.121	33	37			
37.48	38.86	40.23	41.61	42.99	45.75	52.36	55.67	56.77	59.52	66.41	67.79	75.78	77.44	1.125	32	36			
35.13	36.51	37.89	39.27	40.64	43.41	50.02	53.33	54.43	57.18	64.07	65.45	73.44	75.10	1.125	40	45			
30.45	31.83	33.20	34.58	35.96	38.72	45.33	48.64	49.74	52.49	59.38	60.76	68.75	70.41	1.125	56	63			
23.41	24.79	26.17	27.55	28.92	31.68	38.29	41.61	42.71	45.46	52.35	53.73	61.72	63.38	1.125	80	90			
28.38	29.76	31.13	32.51	33.89	36.65	43.26	46.57	47.67	50.43	57.32	58.70	66.69	68.34	1.127	63	71			
26.03	27.41	28.79	30.17	31.54	34.30	40.91	44.23	45.33	48.08	54.97	56.35	64.34	66.00	1.127	71	80			
37.75	39.13	40.51	41.89	43.26	46.02	52.63	55.94	57.04	59.80	66.69	68.07	76.06	77.71	1.129	31	35			
35.69	37.07	38.44	39.82	41.20	43.96	50.57	53.88	54.98	57.73	64.62	66.00	73.99	75.65	1.132	38	43			
31.27	32.65	34.03	35.41	36.78	39.54	46.15	49.46	50.56	53.32	60.21	61.59	69.58	71.24	1.132	53	60			
38.03	39.41	40.79	42.17	43.54	46.30	52.91	56.22	57.32	60.08	66.97	68.35	76.34	77.99	1.133	30	34			
38.30	39.68	41.06	42.44	43.82	46.58	53.19	56.50	57.60	60.35	67.24	68.62	76.61	78.27	1.138	29	33			
38.58	39.96	41.34	42.72	44.09	46.85	53.46	56.77	57.87	60.63	67.52	68.90	76.89	78.54	1.143	28	32			
36.51	37.89	39.27	40.65	42.02	44.78	51.39	54.70	55.80	58.56	65.45	66.83	74.82	76.47	1.143	35	40			
36.79	38.17	39.54	40.92	42.30	45.06	51.67	54.98	56.08	58.83	65.72	67.10	75.10	76.75	1.147	34	39			
37.06	38.44	39.82	41.20	42.57	45.33	51.94	55.25	56.35	59.11	66.00	67.38	75.37	77.03	1.152	33	38			
35.27	36.65	38.03	39.41	40.78	43.54	50.15	53.46	54.56	57.32	64.21	65.59	73.58	75.23	1.154	39	45			
37.34	38.72	40.09	41.47	42.85	45.61	52.22	55.53	56.63	59.39	66.28	67.66	75.65	77.30	1.156	32	37			
37.62	39.00	40.37	41.75	43.13	45.89	52.50	55.81	56.91	59.66	66.55	67.93	75.92	77.58	1.161	31	36			
35.82	37.20	38.58	39.96	41.33	44.09	50.70	54.01	55.11	57.87	64.76	66.14	74.13	75.78	1.162	37	43			
34.03	35.41	36.79	38.17	39.54	42.30	48.91	52.22	53.32	56.08	62.97	64.35	72.34	73.99	1.163	43	50			
37.89	39.27	40.65	42.03	43.40	46.16	52.77	56.08	57.18	59.94	66.83	68.21	76.20	77.85	1.167	30	35			
32.51	33.89	35.27	36.65	38.02	40.78	47.39	50.70	51.80	54.56	61.45	62.83	70.82	72.48	1.167	48	56			
38.17	39.55	40.92	42.30	43.68	46.44	53.05	56.36	57.46	60.21	67.10	68.48	76.47	78.13	1.172	29	34			
36.65	38.03	39.40	40.78	42.16	44.92	51.53	54.84	55.94	58.70	65.59	66.97	74.96	76.61	1.176	34	40			
33.34	34.72	36.09	37.47	38.85	41.61	48.22	51.53	52.63	55.39	62.28	63.66	71.65	73.30	1.178	45	53			
38.44	39.82	41.20	42.58	43.95	46.71	53.32	56.63	57.73	60.49	67.38	68.76	76.75	78.40	1.179	28	33			
36.93	38.31	39.68	41.06	42.44	45.20	51.81	55.12	56.22	58.97	65.86	67.24	75.23	76.89	1.182	33	39			
28.78	30.16	31.54	32.92	34.29	37.06	43.67	46.98	48.08	50.83	57.73	59.11	67.10	68.75	1.183	60	71			
35.41	36.79	38.16	39.54	40.92	43.68	50.29	53.60	54.70	57.45	64.35	65.73	73.72	75.37	1.184	38	45			
37.20	38.58	39.96	41.34	42.71	45.47	52.08	55.39	56.49	59.25	66.14	67.52	75.51	77.16	1.188	32	38			
30.85	32.23	33.61	34.99	36.37	39.13	45.74	49.05	50.15	52.90	59.79	61.17	69.17	70.82	1.189	53	63			
27.81	29.20	30.57	31.95	33.33	36.09	42.70	46.01	47.11	49.87	56.76	58.14	66.13	67.79	1.190	63	75			
37.48	38.86	40.23	41.61	42.99	45.75	52.36	55.67	56.77	59.52	66.41	67.79	75.78	77.44	1.194	31	37			
35.96	37.34	38.71	40.09	41.47	44.23	50.84	54.15	55.25	58.01	64.90	66.28	74.27	75.92	1.194	36	43			
26.57	27.95	29.33	30.71	32.08	34.85	41.46	44.77	45.87	48.63	55.52	56.90	64.89	66.54	1.194	67	80			
29.89	31.27	32.64	34.02	35.40	38.16	44.77	48.08	49.18	51.94	58.83	60.21	68.20	69.85	1.196	56	67			
37.75	39.13	40.51	41.89	43.26	46.02	52.63	55.94	57.04	59.80	66.69	68.07	76.06	77.71	1.200	30	36			
34.72	36.10	37.47	38.85	40.23	42.99	49.60	52.91	54.01	56.76	63.66	65.04	73.03	74.68	1.200	40	48			
31.68	33.06	34.44	35.82	37.19	39.95	46.56	49.87	50.98	53.73	60.62	62.00	69.99	71.65	1.200	50	60			
24.08	25.46	26.84	28.22	29.60	32.36	38.97	42.28	43.38	46.14	53.03	54.41	62.41	64.06	1.200	75	90			
38.03	39.41	40.78	42.16	43.54	46.30	52.91	56.22	57.32	60.07	66.96	68.34	76.33	77.99	1.207	29	35			
36.79	38.17	39.54	40.92	42.30	45.06	51.67	54.98	56.08	58.83	65.72	67.10	75.09	76.75	1.212	33	40			
38.30	39.68	41.06	42.44	43.81	46.57	53.18	56.49	57.59	60.35	67.24	68.62	76.61	78.27	1.214	28	34			
35.54	36.92	38.30	39.68	41.05	43.81	50.43	53.74	54.84	57.59	64.48	65.86	73.85	75.51	1.216	37	45			
37.06	38.44	39.82	41.20	42.57	45.33	51.94	55.25	56.35	59.11	66.00	67.38	75.37	77.02	1.219	32	39			
37.34	38.72	40.09	41.47	42.85	45.61	52.22	55.53	56.63	59.38	66.27	67.65	75.64	77.30	1.226	31	38			
36.10	37.48	38.85	40.23	41.61	44.37	50.98	54.29	55.39	58.14	65.03	66.41	74.40	76.06	1.229	35	43			
34.85	36.23	37.61	38.99	40.36	43.13	49.74	53.05	54.15	56.90	63.79	65.17	73.16	74.82	1.231	39	48			
37.61	38.99	40.37	41.75	43.12	45.88	52.49	55.80	56.90	59.66	66.55	67.93	75.92	77.58	1.233	30	37			
33.61	34.99	36.37	37.75	39.12	41.88	48.49	51.80	52.90	55.66	62.55	63.93	71.92	73.58	1.233	43	53			
37.89	39.27	40.64	42.02	43.40	46.16	52.77	56.08	57.18	59.94	66.83	68.21	76.20	77.85	1.241	29	36			
32.92	34.30	35.67	37.06	38															

14mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Note: Check Sprocket Specification table on page 69 for Nickel Plated sprocket availability.

* This length factor must be used to determine the proper belt width.

14mm PITCH BELTS

Center Distance, Inches														Speed Ratio	Sprocket Combinations														
DriveR		DriveN		14MGT-2380 PL. 98.70 170 Teeth	14MGT-2450 PL. 98.46 175 Teeth	14MGT-2520 PL. 98.21 180 Teeth	14MGT-2590 PL. 101.97 185 Teeth	14MGT-2660 PL. 104.72 190 Teeth	14MGT-2830 PL. 110.24 200 Teeth	14MGT-3136 PL. 123.46 224 Teeth	14MGT-304 PL. 130.08 236 Teeth	14MGT-3360 PL. 132.28 240 Teeth	14MGT-3500 PL. 137.73 250 Teeth	14MGT-350 PL. 151.57 275 Teeth	14MGT-3520 PL. 154.33 280 Teeth	14MGT-4310 PL. 170.31 309 Teeth	14MGT-4326 PL. 173.62 315 Teeth												
Number of Grooves		Number of Grooves																											
30.29	31.67	33.05	34.43	35.80	38.56	45.18	48.49	49.59	52.34	59.24	60.62	68.61	70.26	1.264	53	67													
36.23	37.61	38.99	40.37	41.74	44.50	51.11	54.42	55.52	58.28	65.17	66.55	74.54	76.20	1.265	34	43													
37.47	38.85	40.23	41.61	42.98	45.74	52.36	55.67	56.77	59.52	66.41	67.79	75.78	77.44	1.267	30	38													
29.32	30.70	32.08	33.46	34.83	37.60	44.21	47.52	48.62	51.38	58.27	59.65	67.64	69.30	1.268	56	71													
24.61	25.99	27.37	28.75	30.13	32.89	39.51	42.82	43.92	46.68	53.57	54.95	62.95	64.60	1.268	71	90													
27.10	28.49	29.86	31.24	32.62	35.38	42.00	45.31	46.41	49.17	56.06	57.44	65.43	67.09	1.270	63	80													
37.75	39.13	40.50	41.88	43.26	46.02	52.63	55.94	57.04	59.80	66.69	68.07	76.06	77.71	1.276	29	37													
34.57	35.95	37.33	38.71	40.09	42.85	49.46	52.77	53.87	56.62	63.51	64.89	72.89	74.54	1.282	39	50													
38.03	39.41	40.78	42.16	43.54	46.30	52.91	56.22	57.32	60.07	66.96	68.34	76.33	77.99	1.286	28	36													
35.82	37.20	38.57	39.95	41.33	44.09	50.70	54.01	55.11	57.86	64.76	66.14	74.13	75.78	1.286	35	45													
37.06	38.44	39.81	41.19	42.57	45.33	51.94	55.25	56.35	59.11	66.00	67.38	75.37	77.02	1.290	31	40													
35.12	36.50	37.88	39.26	40.64	43.40	50.01	53.32	54.42	57.17	64.07	65.45	73.44	75.09	1.297	37	48													
37.33	38.71	40.09	41.47	42.85	45.61	52.22	55.53	56.63	59.38	66.27	67.65	75.64	77.30	1.300	30	39													
33.19	34.57	35.95	37.33	38.70	41.46	48.07	51.39	52.49	55.24	62.13	63.51	71.50	73.16	1.302	43	56													
36.37	37.75	39.12	40.50	41.88	44.64	51.25	54.56	55.66	58.42	65.31	66.69	74.68	76.33	1.303	33	43													
37.61	38.99	40.36	41.75	43.12	45.88	52.49	55.80	56.90	59.66	66.55	67.93	75.92	77.57	1.310	29	38													
31.53	32.91	34.28	35.67	37.04	39.80	46.42	49.73	50.83	53.58	60.48	61.86	69.85	71.50	1.313	48	63													
34.71	36.09	37.46	38.84	40.22	42.98	49.59	52.90	54.00	56.76	63.65	65.03	73.02	74.68	1.316	38	50													
37.89	39.27	40.64	42.02	43.40	46.16	52.77	56.08	57.18	59.93	66.82	68.20	76.19	77.85	1.321	28	37													
35.95	37.33	38.71	40.09	41.46	44.22	50.84	54.15	55.25	58.00	64.89	66.27	74.26	75.92	1.324	34	45													
34.02	35.40	36.77	38.15	39.53	42.29	48.90	52.21	53.31	56.07	62.96	64.34	72.33	73.99	1.325	40	53													
37.19	38.57	39.95	41.33	42.71	45.47	52.08	55.39	56.49	59.24	66.13	67.51	75.50	77.16	1.333	30	40													
35.26	36.64	38.02	39.40	40.77	43.53	50.14	53.46	54.56	57.31	64.20	65.58	73.57	75.23	1.333	36	48													
32.35	33.74	35.11	36.49	37.87	40.63	47.24	50.55	51.65	54.41	61.30	62.68	70.67	72.33	1.333	45	60													
27.50	28.88	30.26	31.64	33.02	35.79	42.40	45.71	46.82	49.57	56.47	57.85	65.84	67.50	1.333	60	80													
28.75	30.13	31.51	32.89	34.27	37.03	43.65	46.96	48.06	50.82	57.71	59.09	67.08	68.74	1.339	56	75													
30.69	32.07	33.45	34.83	36.21	38.97	45.58	48.90	50.00	52.75	59.64	61.02	69.02	70.67	1.340	50	67													
29.72	31.10	32.48	33.86	35.24	38.00	44.61	47.93	49.03	51.78	58.68	60.06	68.05	69.70	1.340	53	71													
25.14	26.52	27.90	29.28	30.66	33.43	40.05	43.36	44.46	47.22	54.11	55.49	63.49	65.14	1.343	67	90													
36.50	37.88	39.26	40.64	42.01	44.78	51.39	54.70	55.80	58.55	65.44	66.82	74.81	76.47	1.344	32	43													
37.47	38.85	40.23	41.61	42.98	45.74	52.35	55.66	56.76	59.52	66.41	67.79	75.78	77.44	1.345	29	39													
34.84	36.22	37.60	38.98	40.36	43.12	49.73	53.04	54.14	56.90	63.79	65.17	73.16	74.81	1.351	37	50													
37.75	39.13	40.50	41.88	43.26	46.02	52.63	55.94	57.04	59.79	66.69	68.07	76.06	77.71	1.357	28	38													
34.15	35.53	36.91	38.29	39.66	42.43	49.04	52.35	53.45	56.20	63.10	64.48	72.47	74.12	1.359	39	53													
36.09	37.47	38.84	40.22	41.60	44.36	50.97	54.28	55.38	58.14	65.03	66.41	74.40	76.05	1.364	33	45													
35.39	36.78	38.15	39.53	40.91	43.67	50.28	53.59	54.69	57.45	64.34	65.72	73.71	75.36	1.371	35	48													
37.33	38.71	40.09	41.47	42.84	45.60	52.21	55.52	56.62	59.38	66.27	67.65	75.64	77.30	1.379	29	40													
36.64	38.02	39.39	40.77	42.15	44.91	51.52	54.83	55.93	58.69	65.58	66.96	74.95	76.61	1.387	31	43													
34.98	36.36	37.73	39.12	40.49	43.25	49.86	53.18	54.28	57.03	63.92	65.30	73.29	74.95	1.389	36	50													
37.61	38.99	40.36	41.74	43.12	45.88	52.49	55.80	56.90	59.66	66.55	67.93	75.92	77.57	1.393	28	39													
34.29	35.67	37.04	38.42	39.80	42.56	49.17	52.48	53.58	56.34	63.23	64.61	72.60	74.26	1.395	38	53													
32.62	34.00	35.38	36.76	38.14	40.90	47.51	50.83	51.93	54.68	61.57	62.95	70.95	72.60	1.395	43	60													
30.96	32.34	33.72	35.10	36.48	39.24	45.85	49.17	50.27	53.02	59.92	61.30	69.29	70.94	1.396	48	67													
33.59	34.97	36.35	37.73	39.11	41.87	48.48	51.79	52.89	55.65	62.54	63.92	71.91	73.57	1.400	40	56													
31.93	33.31	34.69	36.07	37.44	40.21	46.82	50.13	51.23	53.99	60.88	62.26	70.26	71.91	1.400	45	63													
20.20	21.59	22.98	24.37	25.75	28.52	35.16	38.48	39.58	42.35	49.25	50.63	58.63	60.29	1.400	80	112													
36.22	37.60	38.98	40.36	41.73	44.50	51.11	54.42	55.52	58.27	65.17	66.55	74.54	76.19	1.406	32	45													
35.53	36.91	38.29	39.67	41.04	43.80	50.42	53.73	54.83	57.58	64.47	65.85	73.85	75.50	1.412	34	48													
29.15	30.53	31.91	33.29	34.67	37.43	44.05	47.36	48.46	51.22	58.12	59.50	67.49	69.15	1.415	53	75													
30.12	31.50	32.88	34.26	35.64	38.40	45.02	48.33	49.43	52.19	59.08	60.46	68.46	70.11	1.420	50	71													
37.47	38.85	40.22	41.60	42.98	45.74	52.35	55.66	56.76	59.52	66.41	67.79	75.78	77.43	1.429	28	40													
35.11	36.49	37.87	39.25	40.63	43.39	50.00	53.31	54.41	57.17	64.06	65.44	73.43	75.09	1.429	35	50													
28.03	29.41	30.79	32.18	33.55	36.32	42.94	46.25	47.35	50.11	57.01	58.39	66.38	68.04	1.429	56	80													
25.66	27.04	28.42	29.81	31.19	33.95	40.58	43.89	45.00	47.75	54.65	56.03	64.03	65.68	1.429	63	90													
34.42	35.80	37.18	38.56	39.93	42.69	49.31	52.62	53.72	56.48	63.37	64.75	72.74	74.39	1.432	37	53													
36.77	38.15	39.53	40.91	42.29	45.05	51.66	54.97	56.07	58.83	65.72	67.10	75.09	76.74	1.433	30	43													
33.73	35.11	36.48	37.87	39.24	42.00	48.62	51.93	53.03	55.78	62.68	64.06	72.05	73.70	1.436	39	56													
36.36	37.74	39.11	40.49	41.87	44.63	51.24	54.55	55.65	58.41	65.30	66.68	74.67	76.33	1.452	31	45													
35.66	37.05	38.42	39.80	41.18	43.94	50.55	53.86	54.96	57.72	64.61	65.99																		

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches													
DriveR		DriveN			14MGT-994 PL. 39.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth		
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)															
53	9.299	80	14.036	1.509														
35	6.141	53	9.299	1.514		9.79	11.19	12.58	15.35	18.67	19.50	22.27	25.03	26.41	29.17	31.93	33.31	
37	6.492	56	9.825	1.514		9.08	10.48	11.87	14.65	17.97	18.81	21.57	24.33	25.72	28.48	31.24	32.61	
33	5.790	50	8.772	1.515	7.99	10.50	11.89	13.28	16.05	19.37	20.20	22.96	25.72	27.11	29.87	32.62	34.00	
28	4.912	43	7.544	1.536	9.69	12.19	13.58	14.96	17.73	21.04	21.87	24.63	27.39	28.77	31.53	34.29	35.66	
39	6.842	60	10.527	1.538				9.61	11.01	13.80	17.12	17.96	20.73	23.49	24.88	27.64	30.40	31.78
31	5.439	48	8.421	1.548	8.55	11.06	12.45	13.84	16.61	19.92	20.76	23.52	26.28	27.66	30.42	33.18	34.55	
29	5.088	45	7.895	1.552	9.26	11.76	13.15	14.54	17.31	20.62	21.45	24.21	26.97	28.35	31.11	33.87	35.25	
36	6.316	56	9.825	1.556		9.20	10.60	12.00	14.78	18.10	18.94	21.70	24.46	25.85	28.61	31.37	32.75	
43	7.544	67	11.755	1.558					12.22	15.56	16.40	19.18	21.95	23.33	26.10	28.86	30.24	
34	5.965	53	9.299	1.559		9.92	11.31	12.71	15.48	18.80	19.64	22.40	25.16	26.54	29.30	32.06	33.44	
32	5.614	50	8.772	1.563	8.11	10.63	12.02	13.41	16.18	19.50	20.33	23.10	25.86	27.24	30.00	32.76	34.13	
48	8.421	75	13.158	1.563					13.71	14.55	17.34	20.12	21.51	24.28	27.04	28.42		
40	7.018	63	11.053	1.575			10.42	13.21	16.55	17.38	20.16	22.92	24.31	27.07	29.83	31.21		
71	12.457	112	19.650	1.577												18.53	19.93	
45	7.895	71	12.457	1.578				11.35	14.70	15.54	18.32	21.10	22.48	25.25	28.02	29.40		
38	6.667	60	10.527	1.579		9.73	11.13	13.92	17.25	18.09	20.86	23.62	25.01	27.77	30.53	31.91		
30	5.263	48	8.421	1.600	8.67	11.19	12.58	13.97	16.74	20.06	20.89	23.65	26.41	27.79	30.55	33.31	34.69	
35	6.141	56	9.825	1.600		9.32	10.73	12.13	14.91	18.23	19.07	21.83	24.60	25.98	28.74	31.50	32.88	
50	8.772	80	14.036	1.600					12.68	13.52	16.32	19.11	20.50	23.28	26.05	27.43		
33	5.790	53	9.299	1.606		10.04	11.44	12.83	15.61	18.93	19.77	22.53	25.29	26.68	29.44	32.20	33.57	
28	4.912	45	7.895	1.607	9.39	11.89	13.28	14.67	17.44	20.75	21.58	24.35	27.11	28.49	31.25	34.00	35.38	
56	9.825	90	15.790	1.607							14.01	16.82	18.22	21.01	23.79	25.18		
31	5.439	50	8.772	1.613	8.23	10.75	12.15	13.54	16.31	19.63	20.47	23.23	25.99	27.37	30.13	32.89	34.27	
39	6.842	63	11.053	1.615				10.54	13.34	16.68	17.51	20.29	23.05	24.44	27.20	29.97	31.34	
37	6.492	60	10.527	1.622		9.85	11.26	14.05	17.38	18.22	20.99	23.75	25.14	27.90	30.66	32.04		
34	5.965	56	9.825	1.647		9.45	10.85	12.25	15.03	18.36	19.20	21.96	24.73	26.11	28.87	31.63	33.01	
43	7.544	71	12.457	1.651				11.59	14.95	15.79	18.58	21.35	22.74	25.51	28.28	29.66		
29	5.088	48	8.421	1.655	8.80	11.31	12.71	14.10	16.87	20.19	21.02	23.78	26.54	27.93	30.68	33.44	34.82	
32	5.614	53	9.299	1.656		10.16	11.57	12.96	15.74	19.06	19.90	22.66	25.43	26.81	29.57	32.33	33.71	
38	6.667	63	11.053	1.658			10.66	13.46	16.80	17.64	20.41	23.18	24.57	27.33	30.10	31.48		
30	5.263	50	8.772	1.667	8.36	10.88	12.28	13.67	16.44	19.76	20.60	23.36	26.12	27.51	30.27	33.03	34.40	
36	6.316	60	10.527	1.667			9.97	11.38	14.17	17.51	18.35	21.12	23.88	25.27	28.03	30.79	32.17	
45	7.895	75	13.158	1.667					14.08	14.93	17.72	20.50	21.89	24.66	27.43		28.81	
48	8.421	80	14.036	1.667					12.92	13.77	16.57	19.36	20.76	23.53	26.31	27.69		
67	11.755	112	19.650	1.672											16.19	19.02	20.42	
40	7.018	67	11.755	1.675				12.59	15.94	16.78	19.56	22.34	23.72	26.49	29.25	30.63		
33	5.790	56	9.825	1.697	9.57	10.98	12.38	15.16	18.49	19.33	22.09	24.86	26.24	29.01	31.77	33.14		
53	9.299	90	15.790	1.698						14.38	17.19	18.60	21.39	24.17		25.56		
37	6.492	63	11.053	1.703			10.78	13.59	16.93	17.77	20.54	23.31	24.70	27.47	30.23	31.61		
31	5.439	53	9.299	1.710		10.29	11.69	13.09	15.87	19.19	20.03	22.79	25.56	26.94	29.70	32.46	33.84	
28	4.912	48	8.421	1.714	8.92	11.44	12.83	14.22	17.00	20.32	21.15	23.91	26.68	28.06	30.82	33.58	34.95	
35	6.141	60	10.527	1.714			10.09	11.50	14.30	17.64	18.47	21.25	24.01	25.40	28.16	30.93	32.30	
39	6.842	67	11.755	1.718				12.72	16.07	16.91	19.69	22.46	23.85	26.62	29.39	30.77		
29	5.088	50	8.772	1.724	8.48	11.00	12.40	13.80	16.57	19.89	20.73	23.49	26.25	27.64	30.40	33.16	34.54	
43	7.544	75	13.158	1.744					14.33	15.18	17.97	20.76	22.15	24.92	27.69	29.08		
32	5.614	56	9.825	1.750		9.69	11.10	12.50	15.29	18.62	19.46	22.22	24.99	26.38	29.14	31.90	33.28	
36	6.316	63	11.053	1.750		9.49	10.91	13.71	17.06	17.90	20.67	23.44	24.83	27.60	30.36	31.74		
80	14.036	140	24.562	1.750														
38	6.667	67	11.755	1.763			10.01	12.84	16.20	17.04	19.82	22.59	23.98	26.75	29.52	30.90		
34	5.965	60	10.527	1.765		10.22	11.63	14.43	17.77	18.60	21.38	24.14	25.53	28.30	31.06	32.44		
30	5.263	53	9.299	1.767	10.41	11.82	13.21	16.00	19.32	20.16	22.92	25.69	27.07	29.83	32.60	33.97		
40	7.018	71	12.457	1.775				11.95	15.33	16.17	18.96	21.74	23.13	25.90	28.67	30.05		
45	7.895	80	14.036	1.778					13.28	14.14	16.95	19.74	21.14	23.92	26.69	28.08		
63	11.053	112	19.650	1.778											16.67	19.51	20.91	
28	4.912	50	8.772	1.786	8.60	11.13	12.53	13.92	16.70	20.02	20.86	23.62	26.39	27.77	30.53	33.29	34.67	
35	6.141	63	11.053	1.800			9.61	11.03	13.84	17.19	18.02	20.80	23.57	24.96	27.73	30.49	31.87	
50	8.772	90	15.790	1.800							14.74	17.56	18.97	21.77	24.55	25.94		
31	5.439	56	9.825	1.806		9.81	11.22	12.63	15.42	18.75	19.58	22.35	25.12	26.51	29.27	32.03	33.41	
37	6.492	67	11.755	1.811			10.13	12.96	16.32	17.16	19.94	22.72	24.11	26.88	29.65	31.03		
33	5.790	60	10.527	1.818		8.91	10.34	11.75	14.55	17.89	18.73	21.50	24.27	25.66	28.43	31.19	32.57	
39	6.842	71	12.457	1.821					12.07	15.45	16.30	19.09	21.87	23.26	26.03	28.80	30.18	
29	5.088	53	9.299	1.828	7.99	10.53	11.94	13.34	16.12	19								

14mm PITCH BELTS

Center Distance, Inches														Speed Ratio	Sprocket Combinations			
DriveR		DriveN													Number of Grooves			
14MGT-2380 PL. 93.70 170 Teeth	14MGT-2450 PL. 98.46 175 Teeth	14MGT-2520 PL. 98.21 180 Teeth	14MGT-2590 PL. 101.97 185 Teeth	14MGT-2660 PL. 104.72 190 Teeth	14MGT-2800 PL. 110.24 200 Teeth	14MGT-3136 PL. 123.46 224 Teeth	14MGT-304 PL. 130.08 236 Teeth	14MGT-3260 PL. 132.28 240 Teeth	14MGT-3500 PL. 137.73 250 Teeth	14MGT-350 PL. 151.57 275 Teeth	14MGT-3220 PL. 154.33 280 Teeth	14MGT-4226 PL. 170.31 309 Teeth	14MGT-4110 PL. 173.62 315 Teeth					
28.42	29.81	31.19	32.57	33.95	36.72	43.34	46.65	47.75	50.51	57.41	58.79	66.79	68.44	1.509	53	80		
34.69	36.07	37.45	38.83	40.20	42.96	49.58	52.89	53.99	56.75	63.64	65.02	73.01	74.67	1.514	35	53		
33.99	35.38	36.75	38.13	39.51	42.27	48.89	52.20	53.30	56.05	62.95	64.33	72.32	73.98	1.514	37	56		
35.38	36.76	38.14	39.52	40.90	43.66	50.27	53.58	54.68	57.44	64.33	65.71	73.70	75.36	1.515	33	50		
37.04	38.42	39.80	41.18	42.56	45.32	51.93	55.24	56.34	59.10	65.99	67.37	75.36	77.02	1.536	28	43		
33.16	34.54	35.92	37.30	38.67	41.44	48.05	51.37	52.47	55.22	62.12	63.50	71.49	73.15	1.538	39	60		
35.93	37.31	38.69	40.07	41.45	44.21	50.82	54.13	55.23	57.99	64.88	66.26	74.25	75.91	1.548	31	48		
36.63	38.01	39.38	40.76	42.14	44.90	51.51	54.83	55.93	58.68	65.57	66.95	74.95	76.60	1.552	29	45		
34.13	35.51	36.89	38.27	39.64	42.41	49.02	52.33	53.43	56.19	63.08	64.46	72.46	74.11	1.556	36	56		
31.62	33.01	34.38	35.77	37.14	39.91	46.52	49.84	50.94	53.70	60.59	61.97	69.97	71.62	1.558	43	67		
34.82	36.20	37.58	38.96	40.34	43.10	49.71	53.03	54.13	56.88	63.77	65.16	73.15	74.80	1.559	34	53		
35.52	36.90	38.27	39.65	41.03	43.79	50.41	53.72	54.82	57.57	64.47	65.85	73.84	75.49	1.563	32	50		
29.81	31.19	32.57	33.95	35.33	38.10	44.72	48.03	49.13	51.89	58.79	60.17	68.17	69.82	1.563	48	75		
32.59	33.98	35.35	36.74	38.11	40.88	47.49	50.81	51.91	54.66	61.56	62.94	70.93	72.59	1.575	40	63		
21.33	22.73	24.12	25.51	26.90	29.69	36.34	39.66	40.76	43.53	50.44	51.82	59.83	61.49	1.577	71	112		
30.78	32.16	33.54	34.93	36.30	39.07	45.69	49.00	50.10	52.86	59.76	61.14	69.13	70.79	1.578	45	71		
33.29	34.67	36.05	37.43	38.81	41.57	48.19	51.50	52.60	55.36	62.25	63.63	71.62	73.28	1.579	38	60		
36.07	37.45	38.83	40.21	41.58	44.34	50.96	54.27	55.37	58.13	65.02	66.40	74.39	76.05	1.600	30	48		
34.26	35.64	37.02	38.40	39.78	42.54	49.16	52.47	53.57	56.33	63.22	64.60	72.59	74.25	1.600	35	56		
28.82	30.20	31.58	32.97	34.35	37.11	43.74	47.05	48.15	50.91	57.81	59.19	67.19	68.85	1.600	50	80		
34.96	36.34	37.71	39.09	40.47	43.23	49.85	53.16	54.26	57.02	63.91	65.29	73.28	74.94	1.606	33	53		
36.76	38.14	39.52	40.90	42.28	45.04	51.65	54.96	56.06	58.82	65.71	67.09	75.08	76.74	1.607	28	45		
26.56	27.95	29.34	30.72	32.10	34.87	41.50	44.82	45.93	48.69	55.59	56.97	64.97	66.63	1.607	56	90		
35.65	37.03	38.41	39.79	41.16	43.93	50.54	53.85	54.95	57.71	64.60	65.98	73.97	75.63	1.613	31	50		
32.73	34.11	35.49	36.87	38.25	41.01	47.63	50.94	52.04	54.80	61.69	63.08	71.07	72.72	1.615	39	63		
33.42	34.80	36.18	37.56	38.94	41.70	48.32	51.63	52.73	55.49	62.39	63.77	71.76	73.42	1.622	37	60		
34.39	35.78	37.15	38.54	39.91	42.67	49.29	52.60	53.70	56.46	63.35	64.73	72.73	74.38	1.647	34	56		
31.04	32.43	33.81	35.19	36.57	39.33	45.96	49.27	50.37	53.13	60.03	61.41	69.40	71.06	1.651	43	71		
36.20	37.58	38.96	40.34	41.72	44.48	51.09	54.40	55.51	58.26	65.15	66.53	74.53	76.18	1.655	29	48		
35.09	36.47	37.85	39.23	40.61	43.37	49.98	53.30	54.40	57.15	64.05	65.43	73.42	75.07	1.656	32	53		
32.86	34.24	35.62	37.00	38.38	41.14	47.76	51.08	52.18	54.93	61.83	63.21	71.20	72.86	1.658	38	63		
35.78	37.17	38.54	39.92	41.30	44.06	50.68	53.99	55.09	57.85	64.74	66.12	74.11	75.77	1.667	30	50		
33.56	34.94	36.32	37.70	39.07	41.84	48.46	51.77	52.87	55.63	62.52	63.90	71.90	73.55	1.667	36	60		
30.20	31.59	32.96	34.35	35.73	38.50	45.12	48.43	49.54	52.29	59.19	60.57	68.57	70.23	1.667	45	75		
29.08	30.46	31.84	33.23	34.61	37.38	44.00	47.32	48.42	51.18	58.08	59.46	67.46	69.12	1.667	48	80		
21.83	23.23	24.62	26.02	27.41	30.20	36.85	40.18	41.29	44.05	50.97	52.35	60.36	62.02	1.672	67	112		
32.02	33.40	34.78	36.16	37.54	40.31	46.93	50.24	51.34	54.10	60.99	62.38	70.37	72.03	1.675	40	67		
34.53	35.91	37.29	38.67	40.05	42.81	49.42	52.74	53.84	56.60	63.49	64.87	72.86	74.52	1.697	33	56		
26.95	28.34	29.72	31.11	32.49	35.27	41.90	45.22	46.32	49.08	55.99	57.37	65.37	67.03	1.698	53	90		
32.99	34.37	35.75	37.14	38.51	41.28	47.90	51.21	52.31	55.07	61.96	63.34	71.34	72.99	1.703	37	63		
35.22	36.60	37.98	39.36	40.74	43.50	50.12	53.43	54.53	57.29	64.18	65.56	73.55	75.21	1.710	31	53		
36.34	37.72	39.09	40.48	41.85	44.61	51.23	54.54	55.64	58.40	65.29	66.67	74.66	76.32	1.714	28	48		
33.69	35.07	36.45	37.83	39.21	41.97	48.59	51.90	53.00	55.76	62.66	64.04	72.03	73.69	1.714	35	60		
32.15	33.53	34.91	36.30	37.67	40.44	47.06	50.37	51.48	54.23	61.13	62.51	70.51	72.16	1.718	39	67		
35.92	37.30	38.68	40.06	41.43	44.20	50.81	54.12	55.22	57.98	64.87	66.25	74.25	75.90	1.724	29	50		
30.46	31.85	33.23	34.61	35.99	38.76	45.38	48.70	49.80	52.56	59.46	60.84	68.84	70.49	1.744	43	75		
34.66	36.04	37.42	38.80	40.18	42.94	49.56	52.87	53.97	56.73	63.62	65.01	73.00	74.65	1.750	32	56		
33.12	34.51	35.89	37.27	38.65	41.41	48.03	51.34	52.44	55.20	62.10	63.48	71.47	73.13	1.750	36	63		
					19.97	21.39	24.23	30.97	34.32	35.43	38.22	45.16	46.55	54.59	56.25	1.750	80	140
32.28	33.67	35.04	36.43	37.81	40.57	47.19	50.51	51.61	54.37	61.26	62.64	70.64	72.30	1.763	38	67		
33.82	35.20	36.58	37.96	39.34	42.11	48.72	52.04	53.14	55.90	62.79	64.17	72.17	73.82	1.765	34	60		
35.36	36.74	38.11	39.50	40.87	43.64	50.25	53.57	54.67	57.42	64.32	65.70	73.69	75.35	1.767	30	53		
31.44	32.82	34.20	35.59	36.96	39.73	46.35	49.67	50.77	53.53	60.43	61.81	69.81	71.46	1.775	40	71		
29.47	30.85	32.23	33.62	35.00	37.77	44.40	47.72	48.82	51.58	58.48	59.86	67.86	69.52	1.778	45	80		
22.32	23.73	25.12	26.52	27.91	30.70	37.37	40.70	41.80	44.57	51.49	52.88	60.89	62.55	1.778	63	112		
36.05	37.43	38.81	40.19	41.57	44.33	50.95	54.26	55.36	58.12	65.01	66.39	74.38	76.04	1.786	28	50		
33.26	34.64	36.02	37.40	38.78	41.54	48.16	51.48	52.58	55.34	62.23	63.61	71.61	73.26	1.800	35	63		
27.33	28.72	30.11	31.50	32.88	35.66	42.29	45.61	46.72	49.48	56.38	57.77	65.77	67.43	1.800	50	90		
34.79	36.18	37.55	38.93	40.31	43.08	49.69	53.01	54.11	56.86	63.76	65.14	73.13	74.79	1.806	31	56		

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches													
DriveR		DriveN			14MGT-994 PL. 39.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth		
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)															
32	5.614	60	10.527	1.875														
40	7.018	75	13.158	1.875		9.03	10.46	11.87	14.68	18.02	18.86	21.63	24.40	25.79	28.56	31.32	32.70	
48	8.421	90	15.790	1.875					11.29	14.70	15.54	18.35	21.14	22.53	25.31	28.08	29.46	
28	4.912	53	9.299	1.893	8.11	10.66	12.06	13.46	16.25	19.58	20.42	23.18	25.95	27.34	30.10	32.86	34.24	
33	5.790	63	11.053	1.909			9.84	11.27	14.09	17.44	18.28	21.06	23.83	25.22	27.99	30.75	32.13	
35	6.141	67	11.755	1.914				10.37	13.21	16.57	17.41	20.20	22.98	24.37	27.14	29.91	31.29	
37	6.492	71	12.457	1.919					12.31	15.70	16.54	19.34	22.12	23.51	26.29	29.06	30.44	
39	6.842	75	13.158	1.923					11.41	14.82	15.67	18.47	21.26	22.66	25.44	28.21	29.59	
29	5.088	56	9.825	1.931		10.05	11.47	12.87	15.67	19.00	19.84	22.61	25.38	26.77	29.53	32.30	33.67	
31	5.439	60	10.527	1.935		9.15	10.58	11.99	14.80	18.15	18.98	21.76	24.53	25.92	28.69	31.45	32.83	
32	5.614	63	11.053	1.969			9.96	11.39	14.21	17.56	18.40	21.18	23.96	25.35	28.12	30.88	32.27	
34	5.965	67	11.755	1.971				10.49	13.33	16.70	17.54	20.33	23.11	24.50	27.27	30.04	31.42	
36	6.316	71	12.457	1.972					12.43	15.82	16.67	19.46	22.25	23.64	26.42	29.19	30.57	
71	12.457	140	24.562															
38	6.667	75	13.158	1.974					11.53	14.94	15.79	18.60	21.39	22.78	25.56	28.34	29.72	
28	4.912	56	9.825	2.000		10.17	11.59	13.00	15.79	19.13	19.97	22.74	25.51	26.90	29.66	32.43	33.81	
30	5.263	60	10.527	2.000		9.27	10.70	12.12	14.93	18.27	19.11	21.89	24.66	26.05	28.82	31.58	32.96	
40	7.018	80	14.036	2.000						13.88	14.74	17.56	20.37	21.77	24.55	27.33	28.72	
45	7.895	90	15.790	2.000						12.46	15.34	18.17	19.58	22.39	25.18	26.57		
56	9.825	112	19.650	2.000											17.50	20.35	21.76	
37	6.492	75	13.158	2.027					11.65	15.06	15.91	18.72	21.51	22.91	25.69	28.47	29.85	
35	6.141	71	12.457	2.029					12.55	15.94	16.79	19.59	22.37	23.77	26.55	29.32	30.70	
33	5.790	67	11.755	2.030			10.60	13.45	16.82	17.66	20.45	23.23	24.62	27.40	30.17	31.55		
31	5.439	63	11.053	2.032			10.08	11.51	14.33	17.69	18.53	21.31	24.09	25.48	28.25	31.02	32.40	
39	6.842	80	14.036	2.051						14.00	14.86	17.69	20.49	21.89	24.68	27.46	28.85	
29	5.088	60	10.527	2.069		9.38	10.82	12.24	15.05	18.40	19.24	22.02	24.79	26.18	28.95	31.71	33.09	
36	6.316	75	13.158	2.083					11.76	15.18	16.03	18.84	21.64	23.04	25.82	28.60	29.98	
34	5.965	71	12.457	2.088					12.67	16.07	16.91	19.71	22.50	23.90	26.67	29.45	30.83	
67	11.755	140	24.562	2.090														
43	7.544	90	15.790	2.093						12.69	15.57	18.42	19.83	22.64	25.43	26.83		
32	5.614	67	11.755	2.094			10.72	13.57	16.94	17.79	20.58	23.36	24.75	27.53	30.30	31.68		
30	5.263	63	11.053	2.100		10.20	11.63	14.45	17.81	18.66	21.44	24.22	25.61	28.38	31.15	32.53		
80	14.036	168	29.475	2.100						14.12	14.98	17.81	20.61	22.02	24.81	27.59	28.98	
38	6.667	80	14.036	2.105										14.94	17.85	20.71	22.13	
53	9.299	112	19.650	2.113														
28	4.912	60	10.527	2.143		9.50	10.94	12.36	15.17	18.53	19.37	22.15	24.92	26.31	29.08	31.85	33.23	
35	6.141	75	13.158	2.143					11.88	15.30	16.16	18.97	21.76	23.16	25.95	28.72	30.11	
33	5.790	71	12.457	2.152				9.91	12.79	16.19	17.04	19.84	22.63	24.02	26.80	29.58	30.96	
31	5.439	67	11.755	2.161			9.38	10.84	13.69	17.07	17.91	20.70	23.49	24.88	27.66	30.43	31.81	
37	6.492	80	14.036	2.162						14.24	15.10	17.93	20.74	22.14	24.93	27.72	29.10	
29	5.088	63	11.053	2.172		8.86	10.31	11.75	14.58	17.94	18.78	21.57	24.34	25.73	28.51	31.28	32.66	
34	5.965	75	13.158	2.206					12.00	15.42	16.28	19.09	21.89	23.29	26.07	28.85	30.24	
32	5.614	71	12.457	2.219				10.02	12.91	16.31	17.16	19.96	22.75	24.15	26.93	29.70	31.09	
36	6.316	80	14.036	2.222						10.88	14.36	15.22	18.05	20.86	22.27	25.06	27.84	29.23
63	11.053	140	24.562	2.222														
30	5.263	67	11.755	2.233			9.50	10.95	13.81	17.19	18.04	20.83	23.62	25.01	27.78	30.56	31.94	
50	8.772	112	19.650	2.240										15.28	18.20	21.07	22.49	
75	13.158	168	29.475	2.240														
28	4.912	63	11.053	2.250		8.98	10.43	11.87	14.70	18.06	18.91	21.69	24.47	25.86	28.64	31.41	32.79	
40	7.018	90	15.790	2.250						12.15	13.04	15.93	18.78	20.19	23.01	25.81	27.20	
80	14.036	180	31.580	2.250														
33	5.790	75	13.158	2.273					12.11	15.54	16.40	19.21	22.01	23.41	26.20	28.98	30.36	
35	6.141	80	14.036	2.286					11.00	14.48	15.34	18.17	20.99	22.39	25.18	27.97	29.36	
31	5.439	71	12.457	2.290			10.14	13.03	16.43	17.28	20.09	22.88	24.28	27.06	29.83	31.22		
39	6.842	90	15.790	2.308					12.26	13.15	16.05	18.90	20.32	23.13	25.93	27.33		
29	5.088	67	11.755	2.310		9.61	11.07	13.93	17.31	18.16	20.96	23.74	25.14	27.91	30.69	32.07		
48	8.421	112	19.650	2.333										15.51	18.43	21.30	22.73	
60	10.527	140	24.562	2.333														
32	5.614	75	13.158	2.344					12.23	15.67	16.52	19.34	22.14	23.54	26.33	29.11	30.49	
34	5.965	80	14.036	2.353					11.11	14.59	15.46	18.29	21.11	22.51	25.31	28.10	29.48	
71	12.457	168	29.475	2.366														
30	5.263	71	12.457	2.367			10.25	13.15	16.56	17.40	20.21	23.01	24.40	27.18	29.96	31.35		
38	6.667	90	15.790	2.368					12.38	13.27	16.16	19.02	20.44	23.25	26.06	27.45		
28	4.912	67	11.755	2.393		9.73	11.19	14.05	17.44	18.28	21.08	23.87	25.26	28.04	30.81	32.20		
75	13.158	180	31.580	2.400														
31	5.439	75	13.158	2.419					12.35	15.78	16.64	19.46	22.26	23.66	26.45	29.23	30.62	
33	5.790	80	14.036	2.424					11.22	14.71	15.57	18.42	21.23	22.64	25.43	28.22	29.61	

14mm PITCH BELTS

Center Distance, Inches														Sprocket Combinations	Speed Ratio	Number of Grooves	Number of Grooves		
DriveR		DriveN																	
PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth	PL	Teeth		
14MGT-2380	PL. 93.70	14MGT-2450	PL. 98.46	14MGT-2520	PL. 99.21	14MGT-2590	PL. 101.97	14MGT-2660	PL. 104.72	14MGT-2730	PL. 108.24	14MGT-2800	PL. 110.24	14MGT-2860	PL. 110.24	14MGT-2930	PL. 114.72	14MGT-2990	PL. 118.00
34.08	35.47	36.85	38.23	39.61	42.37	48.99	52.31	50.20	52.96	59.86	61.24	69.24	70.90	1.875	32	60			
30.85	32.24	33.62	35.00	36.38	39.15	45.78	49.10	50.20	52.96	59.86	61.24	69.24	70.90	1.875	40	75			
27.59	28.98	30.37	31.76	33.14	35.92	42.56	45.88	46.98	49.74	56.65	58.03	66.04	67.69	1.875	48	90			
35.62	37.00	38.38	39.76	41.14	43.90	50.52	53.83	54.93	57.69	64.59	66.97	73.96	75.62	1.893	28	53			
33.52	34.90	36.28	37.66	39.04	41.81	48.43	51.74	52.85	55.60	62.50	63.88	71.88	73.53	1.909	33	63			
32.67	34.06	35.44	36.82	38.20	40.97	47.59	50.91	52.01	54.77	61.67	63.05	71.04	72.70	1.914	35	67			
31.83	33.21	34.59	35.98	37.36	40.13	46.75	50.07	51.17	53.93	60.83	62.21	70.21	71.87	1.919	37	71			
30.98	32.37	33.75	35.14	36.52	39.29	45.91	49.23	50.33	53.09	59.99	61.38	69.38	71.03	1.923	39	75			
35.06	36.44	37.82	39.20	40.58	43.34	49.96	53.27	54.38	57.13	64.03	65.41	73.40	75.06	1.931	29	56			
34.22	35.60	36.98	38.36	39.74	42.50	49.12	52.44	53.54	56.30	63.19	64.58	72.57	74.23	1.935	31	60			
33.65	35.03	36.41	37.80	39.18	41.94	48.56	51.88	52.98	55.74	62.64	64.02	72.01	73.67	1.969	32	63			
32.80	34.19	35.57	36.95	38.33	41.10	47.72	51.04	52.14	54.90	61.80	63.18	71.18	72.84	1.971	34	67			
31.96	33.34	34.72	36.11	37.49	40.26	46.89	50.20	51.30	54.06	60.96	62.35	70.34	72.00	1.972	36	71			
		19.59	21.03	22.46	25.32	32.08	35.45	36.56	39.35	46.31	47.71	55.75	57.42	1.972	71	140			
31.11	32.50	33.88	35.27	36.65	39.42	46.05	49.36	50.47	53.23	60.13	61.51	69.51	71.17	1.974	38	75			
35.19	36.57	37.95	39.33	40.71	43.48	50.10	53.41	54.51	57.27	64.16	65.54	73.54	75.20	2.000	28	56			
34.35	35.73	37.11	38.49	39.87	42.64	49.26	52.57	53.67	56.43	63.33	64.71	72.71	74.36	2.000	30	60			
30.11	31.50	32.88	34.27	35.65	38.42	45.06	48.38	49.48	52.24	59.15	60.53	68.53	70.19	2.000	40	80			
27.97	29.36	30.75	32.14	33.53	36.30	42.95	46.27	47.37	50.14	57.05	58.43	66.44	68.09	2.000	45	90			
23.18	24.59	25.99	27.39	28.79	31.59	38.26	41.60	42.71	45.48	52.40	53.79	61.81	63.47	2.000	56	112			
31.24	32.63	34.01	35.39	36.78	39.55	46.18	49.49	50.60	53.36	60.26	61.64	69.64	71.30	2.027	37	75			
32.09	33.47	34.86	36.24	37.62	40.39	47.02	50.33	51.44	54.20	61.10	62.48	70.48	72.13	2.029	35	71			
32.94	34.32	35.70	37.09	38.46	41.23	47.86	51.17	52.28	55.03	61.93	63.31	71.31	72.97	2.030	33	67			
33.78	35.17	36.54	37.93	39.31	42.07	48.70	52.01	53.11	55.87	62.77	64.15	72.15	73.80	2.032	31	63			
30.24	31.63	33.01	34.40	35.78	38.55	45.19	48.51	49.61	52.37	59.28	60.66	68.66	70.32	2.051	39	80			
34.48	35.86	37.24	38.63	40.00	42.77	49.39	52.71	53.81	56.57	63.46	64.84	72.84	74.50	2.069	29	60			
31.37	32.76	34.14	35.53	36.91	39.68	46.31	49.63	50.73	53.49	60.39	61.78	69.78	71.43	2.083	36	75			
32.22	33.60	34.99	36.37	37.75	40.52	47.15	50.47	51.57	54.33	61.23	62.61	70.61	72.27	2.088	34	71			
		18.59	20.05	21.50	22.94	25.80	32.58	35.94	37.06	39.86	46.82	48.22	56.27	57.93	2.090	67	140		
28.22	29.62	31.00	32.40	33.78	36.56	43.21	46.53	47.63	50.40	57.31	58.69	66.70	68.36	2.093	43	90			
33.07	34.45	35.83	37.22	38.60	41.36	47.99	51.31	52.41	55.17	62.07	63.45	71.45	73.10	2.094	32	67			
33.91	35.30	36.68	38.06	39.44	42.21	48.83	52.15	53.25	56.01	62.90	64.29	72.28	73.94	2.100	30	63			
						26.42	29.86	31.00	33.84	40.88	42.28	50.39	52.06	2.100	80	168			
30.37	31.76	33.14	34.53	35.91	38.68	45.32	48.64	49.74	52.51	59.41	60.79	68.80	70.45	2.105	38	80			
23.54	24.95	26.36	27.76	29.16	31.96	38.65	41.98	43.09	45.87	52.79	54.18	62.20	63.86	2.113	53	112			
34.61	35.99	37.37	38.76	40.14	42.90	49.52	52.84	53.94	56.70	63.60	64.98	72.98	74.63	2.143	28	60			
31.50	32.89	34.27	35.65	37.04	39.81	46.44	49.76	50.86	53.62	60.53	61.91	69.91	71.57	2.143	35	75			
32.35	33.73	35.12	36.50	37.88	40.65	47.28	50.60	51.70	54.46	61.36	62.75	70.75	72.40	2.152	33	71			
33.20	34.58	35.96	37.35	38.73	41.50	48.12	51.44	52.54	55.30	62.20	63.58	71.58	73.24	2.161	31	67			
30.49	31.88	33.27	34.66	36.04	38.81	45.45	48.77	49.87	52.64	59.54	60.93	68.93	70.59	2.162	37	80			
34.04	35.43	36.81	38.19	39.57	42.34	48.96	52.28	53.38	56.14	63.04	64.42	72.42	74.07	2.172	29	63			
31.63	33.01	34.40	35.78	37.17	39.94	46.57	49.89	50.99	53.76	60.66	62.04	70.04	71.70	2.206	34	75			
32.48	33.86	35.25	36.63	38.01	40.78	47.41	50.73	51.83	54.59	61.50	62.88	70.88	72.54	2.219	32	71			
30.62	32.01	33.40	34.79	36.17	38.94	45.58	48.90	50.01	52.77	59.68	61.06	69.06	70.72	2.222	36	80			
		19.05	20.51	21.97	23.41	26.27	33.07	36.44	37.56	40.36	47.33	48.72	56.78	58.45	2.222	63	140		
33.33	34.71	36.09	37.48	38.86	41.63	48.25	51.57	52.67	55.43	62.33	63.72	71.72	73.37	2.233	30	67			
23.91	25.32	26.73	28.14	29.54	32.34	39.03	42.37	43.48	46.25	53.18	54.57	62.60	64.26	2.240	50	112			
						27.00	30.46	31.60	34.44	41.50	42.90	51.02	52.69	2.240	75	168			
34.17	35.56	36.94	38.32	39.70	42.47	49.10	52.41	53.51	56.27	63.17	64.55	72.55	74.21	2.250	28	63			
28.60	30.00	31.38	32.78	34.16	36.95	43.60	46.92	48.03	50.79	57.70	59.09	67.10	68.76	2.250	40	90			
						24.30	27.82	28.98	31.85	38.97	40.38	48.53	50.22	2.250	80	180			
31.75	33.14	34.53	35.91	37.30	40.07	46.70	50.02	51.13	53.89	60.79	62.17	70.18	71.83	2.273	33	75			
30.75	32.14	33.53	34.91	36.30	39.07	45.71	49.03	50.14	52.90	59.81	61.19	69.20	70.85	2.286	35	80			
32.61	33.99	35.38	36.76	38.14	40.91	47.54	50.86	51.97	54.73	61.63	63.01	71.01	72.67	2.290	31	71			
28.73	30.12	31.51	32.91	34.29	37.07	43.73	47.05	48.16	50.92	57.84	59.22	67.23	68.89	2.308	39	90			
33.46	34.84	36.22	37.61	38.99	41.76	48.39	51.70	52.81	55.57	62.47	63.85	71.85	73.51	2.310	29	67			
24.15	25.56	26.97	28.38	29.78	32.59	39.28	42.62	43.73	46.51	53.44	54.83	62.86	64.52	2.333	48	112			
19.39	20.85	22.31	23.76	26.63	33.43	36.81	37.93	40.73	47.71	49.10	57.16	58.83	62.33	64.00	2.333	60	140		
31.88	33.27	34.66	36.04	37.43	40.20	46.83	50.15	51.26	54.02	60.92	62.31	70.31	71.97	2.344	32	75			
30.88	32.27	33.65	35.04	36.43	39.20	45.84	49.17	50.27	53.03	59.94	61.32	69.33	70.99	2.353	34	80			
						27.47	30.93	32.07	34.92	41.99	43.39	51.52	53.19	2.366	71	168			
32.73	34.12	35.51	36.89	38.27	41.0														

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches												
DriveR		DriveN			14MGT-994 PL. 39.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-1960 PL. 77.17 140 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)														
67	11.755	168	29.475	2.507													
71	12.457	180	31.580	2.535													
28	4.912	71	12.457	2.536				10.48	13.38	16.80	17.65	20.46	23.26	24.65	27.44	30.22	31.60
35	6.141	90	15.790	2.571						12.71	13.61	16.52	19.38	20.80	23.62	26.43	27.83
31	5.439	80	14.036	2.581					11.45	14.95	15.81	18.66	21.48	22.88	25.68	28.47	29.86
29	5.088	75	13.158	2.586					12.58	16.02	16.88	19.71	22.51	23.91	26.70	29.49	30.88
43	7.544	112	19.650	2.605								14.57	16.07	19.01	21.89	23.32	
53	9.299	140	24.562	2.642													
34	5.965	90	15.790	2.647						12.83	13.72	16.63	19.50	20.92	23.74	26.55	27.95
30	5.263	80	14.036	2.667					11.56	15.06	15.93	18.78	21.60	23.01	25.81	28.60	29.99
63	11.053	168	29.475	2.667													
75	13.158	200	35.089	2.667													
28	4.912	75	13.158	2.679					12.69	16.14	17.00	19.83	22.64	24.04	26.83	29.62	31.00
67	11.755	180	31.580	2.687													
33	5.790	90	15.790	2.727						12.94	13.83	16.75	19.62	21.04	23.87	26.68	28.07
29	5.088	80	14.036	2.759					11.67	15.18	16.05	18.90	21.72	23.13	25.93	28.73	30.12
40	7.018	112	19.650	2.800								14.90	16.41	19.36	22.25	23.68	
50	8.772	140	24.562	2.800												17.47	
60	10.527	168	29.475	2.800													
80	14.036	224	39.300	2.800													
32	5.614	90	15.790	2.813					13.05	13.95	16.87	19.73	21.16	23.99	26.80	28.20	
71	12.457	200	35.089	2.817													
28	4.912	80	14.036	2.857					11.78	15.30	16.17	19.02	21.85	23.25	26.06	28.85	30.24
63	11.053	180	31.580	2.857													
39	6.842	112	19.650	2.872								15.01	16.52	19.47	22.36	23.80	
31	5.439	90	15.790	2.903					13.16	14.06	16.98	19.85	21.28	24.11	26.92	28.32	
48	8.421	140	24.562	2.917												17.69	
38	6.667	112	19.650	2.947								15.12	16.63	19.58	22.48	23.91	
67	11.755	200	35.089	2.985													
75	13.158	224	39.300	2.987													
30	5.263	90	15.790	3.000					13.27	14.17	17.10	19.97	21.40	24.23	27.05	28.45	
56	9.825	168	29.475	3.000													
60	10.527	180	31.580	3.000													
37	6.492	112	19.650	3.027								15.23	16.74	19.70	22.60	24.03	
29	5.088	90	15.790	3.103					13.38	14.28	17.21	20.09	21.52	24.35	27.17	28.57	
36	6.316	112	19.650	3.111								15.34	16.85	19.81	22.72	24.15	
45	7.895	140	24.562	3.111												18.01	
71	12.457	224	39.300	3.155													
53	9.299	168	29.475	3.170													
63	11.053	200	35.089	3.175													
35	6.141	112	19.650	3.200								15.45	16.97	19.93	22.83	24.27	
28	4.912	90	15.790	3.214					13.49	14.40	17.33	20.21	21.64	24.47	27.29	28.69	
56	9.825	180	31.580	3.214													
43	7.544	140	24.562	3.256												16.65	
34	5.965	112	19.650	3.294								15.56	17.08	20.04	22.95	24.39	
60	10.527	200	35.089	3.333													
67	11.755	224	39.300	3.343													
50	8.772	168	29.475	3.360													
33	5.790	112	19.650	3.394								15.66	17.19	20.16	23.07	24.50	
53	9.299	180	31.580	3.396													
32	5.614	112	19.650	3.500								15.77	17.30	20.27	23.18	24.62	
40	7.018	140	24.562	3.500												16.97	
48	8.421	168	29.475	3.500												18.55	
63	11.053	224	39.300	3.556													
56	9.825	200	35.089	3.571													
39	6.842	140	24.562	3.590												17.08	
50	8.772	180	31.580	3.600													
31	5.439	112	19.650	3.613								15.88	17.41	20.38	23.30	24.74	
38	6.667	140	24.562	3.684												17.18	
30	5.263	112	19.650	3.733								15.99	17.52	20.50	23.41	24.85	
45	7.895	168	29.475	3.733													
60	10.527	224	39.300	3.733													
48	8.421	180	31.580	3.750													
53	9.299	200	35.089	3.774													
37	6.492	140	24.562	3.784												17.29	
29	5.088	112	19.650	3.862								12.91	16.10	17.63	20.61	23.53	
36	6.316	140	24.562	3.889												17.39	
43	7.544	168	29.475	3.907													
28	4.912	112	19.650	4.000								13.01	16.21	17.74	20.72	23.65	
35	6.141	140	24.562	4.000												25.09	
45	7.895	180	31.580	4.000												17.50	
50	8.772	200	35.089	4.000												19.09	
56	9.825	224	39.300	4.000													

Note: Check Sprocket Specification table on page 69 for Nickel Plated sprocket availability.

* This length factor must be used to determine the proper belt width.



14mm PITCH BELTS

Center Distance, Inches														Speed Ratio	Sprocket Combinations		
DriveR		DriveN		Number of Grooves	Number of Grooves												
14MGT-2380 PL. 93.70 170 Teeth	14MGT-2450 PL. 98.46 175 Teeth	14MGT-2520 PL. 98.21 180 Teeth	14MGT-2590 PL. 101.97 185 Teeth	14MGT-2660 PL. 104.72 190 Teeth	14MGT-2730 PL. 109.24 200 Teeth	14MGT-3136 PL. 123.46 224 Teeth	14MGT-3104 PL. 130.08 236 Teeth	14MGT-3136 PL. 132.28 240 Teeth	14MGT-3500 PL. 137.73 250 Teeth	14MGT-3550 PL. 151.57 275 Teeth	14MGT-3520 PL. 154.33 280 Teeth	14MGT-4110 PL. 170.31 315 Teeth					
32.99	34.38	35.76	37.15	38.53	41.31	47.94	51.26	52.36	55.12	62.03	63.41	71.41	73.07	2.536	28	71	
29.23	30.62	32.02	33.41	34.80	37.59	44.24	47.57	48.68	51.44	58.36	59.75	67.76	69.42	2.571	35	90	
31.26	32.65	34.04	35.43	36.81	39.59	46.23	49.56	50.66	53.43	60.34	61.72	69.73	71.38	2.581	31	80	
32.27	33.66	35.04	36.43	37.81	40.59	47.23	50.55	51.65	54.41	61.32	62.70	70.71	72.37	2.586	29	75	
24.75	26.17	27.58	28.99	30.40	33.21	39.91	43.26	44.37	47.15	54.09	55.48	63.51	65.17	2.605	43	112	
18.67	20.17	21.65	23.12	24.57	27.46	34.28	37.67	38.79	41.60	48.59	49.99	58.06	59.73	2.642	53	140	
29.35	30.75	32.14	33.54	34.93	37.71	44.37	47.70	48.81	51.57	58.49	59.88	67.89	69.55	2.647	34	90	
31.39	32.78	34.17	35.56	36.94	39.72	46.36	49.69	50.79	53.56	60.47	61.85	69.86	71.52	2.667	30	80	
					21.26	28.39	31.87	33.02	35.88	42.96	44.37	52.51	54.19	2.667	63	168	
							24.67	25.89	28.90	36.22	37.66	45.95	47.65	2.667	75	200	
32.40	33.79	35.17	36.56	37.94	40.72	47.36	50.68	51.78	54.55	61.45	62.84	70.84	72.50	2.679	28	75	
						25.76	29.31	30.48	33.38	40.53	41.95	50.14	51.82	2.687	67	180	
29.48	30.88	32.27	33.66	35.05	37.84	44.50	47.83	48.94	51.70	58.62	60.01	68.02	69.68	2.727	33	90	
31.51	32.91	34.29	35.68	37.07	39.85	46.49	49.82	50.92	53.69	60.60	61.98	69.99	71.65	2.759	29	80	
25.11	26.53	27.94	29.36	30.76	33.58	40.29	43.64	44.75	47.53	54.47	55.86	63.90	65.56	2.800	40	112	
19.00	20.51	21.99	23.46	24.92	27.81	34.65	38.04	39.16	41.97	48.97	50.36	58.44	60.11	2.800	50	140	
					21.59	28.74	32.22	33.37	36.23	43.33	44.74	52.89	54.57	2.800	60	168	
									31.31	32.81	41.32	43.05	2.800	80	224		
29.60	31.00	32.39	33.79	35.18	37.97	44.63	47.96	49.07	51.83	58.75	60.14	68.15	69.81	2.813	32	90	
							25.10	26.33	29.34	36.68	38.13	46.43	48.13	2.817	71	200	
31.64	33.03	34.42	35.81	37.20	39.98	46.62	49.95	51.05	53.82	60.73	62.12	70.12	71.78	2.857	28	80	
							26.21	29.77	30.94	33.84	41.01	42.43	50.63	52.32	2.857	63	180
25.23	26.65	28.06	29.48	30.89	33.70	40.41	43.76	44.88	47.66	54.60	55.99	64.03	65.69	2.872	39	112	
29.73	31.13	32.52	33.92	35.31	38.09	44.76	48.09	49.19	51.96	58.88	60.27	68.29	69.95	2.903	31	90	
19.22	20.73	22.22	23.69	25.15	28.05	34.89	38.28	39.41	42.22	49.22	50.62	58.69	60.36	2.917	48	140	
25.34	26.77	28.18	29.60	31.01	33.83	40.54	43.89	45.00	47.78	54.73	56.12	64.16	65.82	2.947	38	112	
							25.53	26.76	29.79	37.15	38.60	46.91	48.61	2.985	67	200	
									31.86	33.37	41.90	43.64	2.987	75	224		
29.85	31.25	32.64	34.04	35.43	38.22	44.89	48.22	49.32	52.09	59.02	60.40	68.42	70.08	3.000	30	90	
					22.02	29.19	32.69	33.84	36.71	43.81	45.23	53.38	55.06	3.000	56	168	
25.46	26.89	28.31	29.72	31.13	33.95	40.66	44.02	45.13	47.91	54.86	56.25	64.29	65.95	3.027	37	112	
29.97	31.38	32.77	34.17	35.56	38.35	45.01	48.35	49.45	52.22	59.15	60.53	68.55	70.21	3.103	29	90	
25.58	27.01	28.43	29.84	31.25	34.07	40.79	44.14	45.25	48.04	54.99	56.38	64.42	66.08	3.111	36	112	
19.55	21.07	22.56	24.03	25.49	28.40	35.25	38.65	39.77	42.59	49.59	50.99	59.07	60.75	3.111	45	140	
									32.30	33.81	42.36	44.10	3.155	71	224		
					22.35	29.54	33.03	34.19	37.06	44.18	45.59	53.75	55.44	3.170	53	168	
							25.97	27.20	30.23	37.61	39.06	47.38	49.09	3.175	63	200	
25.70	27.13	28.55	29.96	31.37	34.19	40.91	44.27	45.38	48.16	55.11	56.50	64.55	66.21	3.200	35	112	
30.10	31.50	32.90	34.29	35.69	38.48	45.14	48.48	49.58	52.35	59.28	60.66	68.68	70.34	3.214	28	90	
						26.99	30.56	31.74	34.65	41.84	43.27	51.48	53.17	3.214	56	180	
19.77	21.29	22.78	24.26	25.72	28.63	35.49	38.89	40.02	42.83	49.84	51.24	59.33	61.00	3.256	43	140	
25.82	27.25	28.67	30.09	31.50	34.32	41.04	44.39	45.51	48.29	55.24	56.63	64.67	66.34	3.294	34	112	
							26.29	27.53	30.57	37.95	39.41	47.74	49.45	3.333	60	200	
									32.74	34.26	42.82	44.57	3.343	67	224		
					22.67	29.88	33.38	34.54	37.41	44.54	45.96	54.12	55.81	3.360	50	168	
25.94	27.37	28.79	30.21	31.62	34.44	41.16	44.52	45.63	48.42	55.37	56.76	64.80	66.47	3.394	33	112	
						27.32	30.90	32.08	35.00	42.20	43.63	51.85	53.54	3.396	53	180	
26.06	27.49	28.91	30.33	31.74	34.56	41.29	44.64	45.76	48.54	55.50	56.89	64.93	66.60	3.500	32	112	
20.10	21.62	23.12	24.60	26.07	28.98	35.85	39.25	40.38	43.20	50.21	51.61	59.71	61.38	3.500	40	140	
					19.71	22.89	30.11	33.61	34.77	37.65	44.78	46.20	54.37	56.06	3.500	48	168
							22.87	26.72	27.96	31.01	38.41	39.87	48.22	49.93	3.571	56	200
20.21	21.73	23.23	24.71	26.18	29.10	35.97	39.37	40.50	43.32	50.34	51.74	59.83	61.51	3.590	39	140	
							27.65	31.24	32.42	35.35	42.56	43.99	52.21	53.91	3.600	50	180
26.17	27.61	29.03	30.45	31.86	34.68	41.41	44.77	45.88	48.67	55.63	57.02	65.06	66.73	3.613	31	112	
20.32	21.84	23.34	24.83	26.30	29.21	36.09	39.49	40.62	43.44	50.46	51.86	59.96	61.63	3.684	38	140	
26.29	27.72	29.15	30.57	31.98	34.81	41.54	44.90	46.01	48.80	55.75	57.15	65.19	66.86	3.733	30	112	
					20.03	23.21	30.45	33.96	35.12	38.00	45.14	46.56	54.74	56.42	3.733	45	168
									25.60	33.51	35.03	43.63	45.38	3.733	60	224	
							27.87	31.47	32.65	35.58	42.79	44.22	52.45	54.15	3.750	48	180
							23.18	27.04	28.28	31.34	38.76	40.22	48.57	50.29	3.774	53	200
20.43	21.95	23.45	24.94	26.41	29.33	36.21	39.62	40.74	43.56	50.59	51.99	60.08	61.76	3.784	37	140	
26.41	27.84	29.27	30.69	32.10	34.93	41.66	45.02	46.14	48.92	55.88	57.27	65.32	66.98	3.862	29	112	
20.54	22.06	23.56	25.05	26.52	29.44	36.33	39.74	40.87	43.69	50.71	52.11	60.21	61.88	3.889	36	140	
					20.23	23.43	30.67	34.19	35.35	38.24	45.38	46.80	54.98	56.67	3.907	43	168
26.53	27.96	29.39	30.81	3													

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches												
DriveR		DriveN			14MGT-994 PL. 39.13 71 Teeth	14MGT-1120 PL. 44.09 80 Teeth	14MGT-1190 PL. 46.85 85 Teeth	14MGT-1260 PL. 49.61 90 Teeth	14MGT-1400 PL. 55.12 100 Teeth	14MGT-1568 PL. 61.73 112 Teeth	14MGT-1610 PL. 63.39 115 Teeth	14MGT-1750 PL. 68.90 125 Teeth	14MGT-1890 PL. 74.41 135 Teeth	14MGT-1960 PL. 77.17 140 Teeth	14MGT-2100 PL. 82.68 150 Teeth	14MGT-2240 PL. 88.19 160 Teeth	14MGT-2310 PL. 90.94 165 Teeth
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)														
34	5.965	140	24.562	4.118													
48	8.421	200	35.089	4.167													
43	7.544	180	31.580	4.186													
40	7.018	168	29.475	4.200													
53	9.299	224	39.300	4.226													
33	5.790	140	24.562	4.242													
39	6.842	168	29.475	4.308													
32	5.614	140	24.562	4.375													
38	6.667	168	29.475	4.421													
45	7.895	200	35.089	4.444													
50	8.772	224	39.300	4.480													
40	7.018	180	31.580	4.500													
31	5.439	140	24.562	4.516													
37	6.492	168	29.475	4.541													
39	6.842	180	31.580	4.615													
43	7.544	200	35.089	4.651													
30	5.263	140	24.562	4.667													
36	6.316	168	29.475	4.667													
48	8.421	224	39.300	4.667													
38	6.667	180	31.580	4.737													
35	6.141	168	29.475	4.800													
29	5.088	140	24.562	4.828													
37	6.492	180	31.580	4.865													
34	5.965	168	29.475	4.941													
45	7.895	224	39.300	4.978													
28	4.912	140	24.562	5.000													
36	6.316	180	31.580	5.000													
40	7.018	200	35.089	5.000													
33	5.790	168	29.475	5.091													
39	6.842	200	35.089	5.128													
35	6.141	180	31.580	5.143													
43	7.544	224	39.300	5.209													
32	5.614	168	29.475	5.250													
38	6.667	200	35.089	5.263													
34	5.965	180	31.580	5.294													
37	6.492	200	35.089	5.405													
31	5.439	168	29.475	5.419													
33	5.790	180	31.580	5.455													
36	6.316	200	35.089	5.556													
30	5.263	168	29.475	5.600													
40	7.018	224	39.300	5.600													
32	5.614	180	31.580	5.625													
35	6.141	200	35.089	5.714													
39	6.842	224	39.300	5.744													
29	5.088	168	29.475	5.793													
31	5.439	180	31.580	5.806													
34	5.965	200	35.089	5.882													
38	6.667	224	39.300	5.895													
28	4.912	140	29.475	6.000													
30	5.263	180	31.580	6.000													
37	6.492	224	39.300	6.054													
33	5.790	200	35.089	6.061													
29	5.088	180	31.580	6.207													
36	6.316	224	39.300	6.222													
32	5.614	200	35.089	6.250													
35	6.141	224	39.300	6.400													
28	4.912	180	31.580	6.429													
31	5.439	200	35.089	6.452													
34	5.965	224	39.300	6.588													
30	5.263	200	35.089	6.667													
33	5.790	224	39.300	6.788													
29	5.088	200	35.089	6.897													
32	5.614	224	39.300	7.000													
28	4.912	200	35.089	7.143													
31	5.439	224	39.300	7.226													
30	5.263	224	39.300	7.467													
29	5.088	224	39.300	7.724													
28	4.912	224	39.300	8.000													

Length Factor* 0.68 0.73 0.75 0.77 0.81 0.85 0.86 0.89 0.92 0.94 0.96 0.99 1.00

Note: Check Sprocket Specification table on page 69 for Nickel Plated sprocket availability.

* This length factor must be used to determine the proper belt width.



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14mm PITCH BELTS

Center Distance, Inches														Speed Ratio	Sprocket Combinations		
DriveR							DriveN										
															Number of Grooves		
14MGT-2380 PL. 93.70 170 Teeth	14MGT-2450 PL. 98.46 175 Teeth	14MGT-2520 PL. 98.21 180 Teeth	14MGT-2590 PL. 101.97 185 Teeth	14MGT-2660 PL. 104.72 190 Teeth	14MGT-2800 PL. 110.24 200 Teeth	14MGT-3136 PL. 123.46 224 Teeth	14MGT-304 PL. 130.08 236 Teeth	14MGT-3360 PL. 132.28 240 Teeth	14MGT-3500 PL. 137.73 250 Teeth	14MGT-350 PL. 151.57 275 Teeth	14MGT-3520 PL. 154.33 280 Teeth	14MGT-4326 PL. 170.31 309 Teeth	14MGT-4410 PL. 173.62 315 Teeth				
20.75	22.28	23.79	25.28	26.75	29.68	36.57	39.98	41.11	43.93	50.96	52.36	60.46	62.14	4.118	34	140	
						23.70	27.58	28.82	31.89	39.33	40.79	49.16	50.88	4.167	48	200	
					20.81	28.42	32.03	33.21	36.15	43.38	44.82	53.06	54.76	4.186	43	180	
			18.87	20.55	23.75	31.01	34.54	35.70	38.59	45.74	47.16	55.35	57.04	4.200	40	168	
20.86	22.39	23.90	25.39	26.86	29.79	36.68	40.10	41.23	44.05	51.08	52.49	60.59	62.26	4.242	33	140	
			18.97	20.65	23.86	31.13	34.65	35.81	38.71	45.86	47.28	55.47	57.16	4.308	39	168	
20.97	22.50	24.01	25.50	26.98	29.91	36.80	40.22	41.35	44.17	51.21	52.61	60.71	62.39	4.375	32	140	
			19.08	20.75	23.97	31.24	34.77	35.93	38.82	45.98	47.40	55.60	57.29	4.421	38	200	
					24.01	27.90	29.15	32.22	39.67	41.14	49.52	51.24	4.444	45	200		
								26.63	34.60	36.13	44.77	46.53	4.480	50	224		
						21.12	28.75	32.37	33.55	36.49	43.73	45.17	53.42	55.12	4.500	40	180
21.08	22.61	24.12	25.62	27.09	30.02	36.92	40.34	41.47	44.30	51.33	52.73	60.84	62.51	4.516	31	140	
			19.18	20.86	24.07	31.35	34.88	36.04	38.94	46.10	47.52	55.72	57.41	4.541	37	168	
					21.23	28.86	32.48	33.66	36.61	43.85	45.29	53.54	55.24	4.615	39	180	
21.19	22.72	24.23	25.73	27.21	30.14	37.04	40.46	41.59	44.42	51.45	52.86	60.97	62.64	4.667	30	140	
			19.28	20.96	24.18	31.46	35.00	36.16	39.06	46.22	47.64	55.84	57.53	4.667	36	168	
								26.84	34.82	36.35	45.00	46.76	4.667	48	224		
						21.33	28.97	32.59	33.78	36.72	43.97	45.41	53.66	55.36	4.737	38	180
			19.38	21.06	24.29	31.58	35.11	36.27	39.17	46.34	47.76	55.96	57.65	4.800	35	168	
21.30	22.83	24.34	25.84	27.32	30.25	37.16	40.58	41.71	44.54	51.58	52.98	61.09	62.77	4.828	29	140	
					21.43	29.08	32.70	33.89	36.84	44.09	45.52	53.78	55.48	4.865	37	180	
			19.48	21.17	24.39	31.69	35.23	36.39	39.29	46.46	47.88	56.08	57.78	4.941	34	168	
								27.14	35.15	36.68	45.34	47.10	4.978	45	224		
21.40	22.94	24.45	25.95	27.43	30.37	37.28	40.70	41.83	44.66	51.70	53.10	61.22	62.89	5.000	28	140	
					21.53	29.19	32.81	34.00	36.95	44.20	45.64	53.90	55.61	5.000	36	180	
						24.52	28.43	29.68	32.77	40.24	41.71	50.11	51.83	5.000	40	200	
			19.58	21.27	24.50	31.80	35.34	36.50	39.40	46.57	48.00	56.21	57.90	5.091	33	168	
					21.63	29.30	32.93	34.11	37.06	44.32	45.76	54.02	55.73	5.128	39	200	
			19.69	21.38	24.61	31.91	35.45	36.62	39.52	46.69	48.12	56.33	58.02	5.250	32	168	
					24.73	28.64	29.90	32.99	40.47	41.94	50.34	52.06	5.263	38	200		
			21.74		29.41	33.04	34.23	37.18	44.44	45.88	54.15	55.85	5.294	34	180		
					24.83	28.75	30.01	33.10	40.58	42.05	50.46	52.18	5.405	37	200		
18.00	19.79	21.48	21.48	24.71	32.03	35.57	36.73	39.64	46.81	48.24	56.45	58.14	5.419	31	168		
				21.84	29.52	33.15	34.34	37.29	44.56	45.99	54.27	55.97	5.455	33	180		
					24.93	28.85	30.11	33.21	40.70	42.17	50.58	52.30	5.556	36	200		
18.10	19.89	21.58	24.82	32.14	35.68	36.85	39.75	46.93	48.36	56.57	58.26	5.600	30	168			
					24.13	27.66	35.69	37.23	45.91	47.67	56.00	57.65	5.625	32	180		
			21.94	29.62	33.26	34.45	37.41	44.67	46.11	54.39	56.09	56.25	57.14	5.714	35	200	
				25.03	28.96	30.22	33.32	40.81	42.28	50.69	52.42	5.714	35	200			
					24.23	27.76	35.80	37.34	46.02	47.79	5.744	39	224				
18.19	19.99	21.69	24.93	32.25	35.80	36.96	39.87	47.05	48.48	56.69	58.39	5.793	29	168			
			22.04	29.73	33.37	34.56	37.52	44.79	46.23	54.51	56.21	5.806	31	180			
				25.14	29.07	30.33	33.43	40.92	42.39	50.81	52.53	5.882	34	200			
					24.32	27.86	35.91	37.45	46.14	47.90	5.895	38	224				
18.29	20.09	21.79	25.03	32.36	35.91	37.08	39.99	47.17	48.60	56.81	58.51	6.000	28	168			
			22.14	29.84	33.48	34.68	37.63	44.91	46.35	54.63	56.33	6.000	30	180			
				25.24	29.17	30.43	33.53	41.03	42.51	50.93	52.65	6.061	33	200			
			22.25	29.95	33.59	34.79	37.75	45.02	46.46	54.75	56.45	6.207	29	180			
				25.34	29.28	30.54	33.64	41.15	42.62	51.04	52.77	6.250	32	200			
			18.70	22.35	30.06	33.71	34.90	37.86	45.14	46.58	54.87	56.57	6.429	28	180		
				25.44	29.38	30.65	33.75	41.26	42.74	51.16	52.89	6.452	31	200			
				23.19	24.72	28.27	36.34	37.88	46.59	48.36	5.588	34	224				
				25.55	29.49	30.76	33.86	41.37	42.85	51.28	53.01	6.667	30	200			
				23.28	24.82	28.37	36.45	37.99	46.70	48.47	5.788	33	224				
				25.65	29.59	30.86	33.97	41.49	42.96	51.40	53.12	6.897	29	200			
				23.38	24.92	28.47	36.56	38.10	46.82	48.58	7.000	32	224				
			25.75	29.70	30.97	34.08	41.60	43.08	51.51	53.24	7.143	28	200				
				23.48	25.02	28.58	36.66	38.21	46.93	48.70	7.226	31	224				
				23.58	25.11	28.68	36.77	38.32	47.04	48.81	7.467	30	224				
				23.67	25.21	28.78	36.88	38.43	47.15	48.93	7.724	29	224				
				23.77	25.31	28.88	36.99	38.54	47.27	49.04	8.000	28	224				
1.01	1.02	1.03	1.04	1.05	1.07	1.12	1.14	1.14	1.16	1.19	1.20	1.24	1.25	Length Factor*			

Note: Check Sprocket Specification table on page 69 for Nickel Plated sprocket availability.

* This length factor must be used to determine the proper belt width.

Center distance is greater than eight times the small sprocket and the large sprocket is not flanged. See Engineering Section for details.

8mm Pitch Poly Chain® GT® Carbon® Belts

RPM OF FASTER SHAFT	22	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
	2,206	2,506	2,607	2,707	2,807	2,907	3,008	3,108	3,208	3,308	3,409	3,509	3,609	3,709	3,810	3,910	4,010	4,110	4,211	4,311	4,411	
10																						
20																						
35																						
44																						
58																						
70																						
88	0.72	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.75	1.85	
100	0.79	0.96	1.02	1.08	1.13	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.63	1.68	1.74	1.79	1.85	1.90	1.96	2.06	
117	0.90	1.10	1.16	1.23	1.29	1.35	1.42	1.48	1.55	1.61	1.67	1.74	1.80	1.86	1.93	1.99	2.05	2.11	2.18	2.26	2.36	
175	1.27	1.55	1.64	1.73	1.82	1.91	2.01	2.10	2.19	2.28	2.37	2.46	2.55	2.64	2.73	2.82	2.91	3.00	3.09	3.36	3.36	
200	1.42	1.73	1.84	1.94	2.05	2.15	2.25	2.36	2.45	2.56	2.66	2.77	2.87	2.97	3.07	3.18	3.28	3.38	3.48	3.78	3.78	
233	1.62	1.98	2.10	2.22	2.34	2.45	2.57	2.69	2.81	2.93	3.05	3.16	3.28	3.40	3.52	3.63	3.75	3.87	3.98	4.33	4.33	
300	2.01	2.46	2.61	2.76	2.91	3.06	3.21	3.36	3.51	3.66	3.81	3.96	4.10	4.25	4.40	4.55	4.69	4.84	4.99	5.43	5.43	
350	2.29	2.82	2.99	3.16	3.34	3.51	3.68	3.85	4.02	4.20	4.37	4.54	4.71	4.88	5.05	5.22	5.39	5.55	5.72	6.23	6.23	
400	2.57	3.17	3.36	3.56	3.75	3.95	4.14	4.34	4.53	4.72	4.92	5.11	5.30	5.49	5.69	5.88	6.07	6.26	6.45	7.02	7.02	
500	3.12	3.85	4.09	4.33	4.57	4.81	5.05	5.29	5.53	5.76	6.00	6.24	6.47	6.71	6.95	7.18	7.41	7.65	7.88	8.58	8.58	
575	3.53	4.35	4.63	4.90	5.17	5.44	5.72	5.99	6.26	6.53	6.80	7.07	7.34	7.60	7.87	8.14	8.41	8.67	8.94	9.73	9.73	
600	3.66	4.52	4.80	5.09	5.37	5.65	5.94	6.22	6.50	6.78	7.06	7.34	7.62	7.90	8.18	8.46	8.73	9.01	9.29	10.1	10.1	
690	4.13	5.11	5.43	5.76	6.08	6.40	6.72	7.04	7.36	7.68	8.00	8.32	8.64	8.95	9.27	9.59	9.90	10.2	10.5	11.5	11.5	
700	4.18	5.17	5.50	5.83	6.16	6.48	6.81	7.14	7.46	7.78	8.11	8.43	8.75	9.07	9.39	9.71	10.0	10.4	10.7	11.6	11.6	
800	4.70	5.82	6.19	6.56	6.93	7.30	7.67	8.04	8.40	8.77	9.14	9.50	9.86	10.2	10.6	11.0	11.4	11.8	12.2	13.1	13.1	
870	5.05	6.26	6.67	7.07	7.47	7.86	8.27	8.66	9.06	9.45	9.85	10.2	10.6	11.0	11.4	11.8	12.2	12.6	13.0	13.4	14.6	
900	5.20	6.45	6.87	7.28	7.69	8.11	8.52	8.93	9.34	9.74	10.2	10.6	11.0	11.4	11.8	12.2	12.6	13.0	13.4	14.6	14.6	
1000	5.70	7.08	7.54	7.99	8.45	8.90	9.36	9.81	10.3	10.7	11.2	11.6	12.1	12.5	12.9	13.4	13.8	14.3	14.7	16.0	16.0	
1160	6.49	8.07	8.59	9.12	9.64	10.2	11.2	11.7	12.2	12.7	13.3	13.8	14.3	14.8	15.3	15.8	16.3	16.8	18.3	18.3	18.3	
1750	9.27	11.6	12.3	13.1	14.6	15.4	16.1	16.9	17.7	18.4	19.2	19.9	20.7	21.4	22.1	22.9	23.6	24.4	26.6	26.6	26.6	
2000	10.4	13.0	13.9	14.7	15.6	16.5	17.3	18.2	19.0	19.9	20.7	21.6	22.4	23.3	24.1	25.0	25.8	26.6	27.5	29.9	29.9	
3000	14.7	18.5	19.8	21.0	22.3	23.5	24.8	26.0	27.2	28.5	29.7	30.9	32.1	33.4	34.6	35.8	37.0	38.2	39.4	43.0	43.0	
3450	16.6	20.9	22.3	23.8	25.2	26.6	28.0	29.4	30.8	32.2	33.6	35.0	36.3	37.7	39.1	40.5	41.8	43.2	44.5	48.6	48.6	
4000	18.8	23.7	25.4	27.0	28.6	30.2	31.8	33.4	35.0	36.6	38.2	39.8	41.4	42.9	44.5	46.0	47.6	49.1	50.7	55.2	55.2	
4500	20.8	26.3	28.1	30.7	32.7	34.6	36.6	38.6	40.5	42.4	44.4	46.3	48.2	50.1	52.0	53.9	55.7	57.6	59.4	61.1	61.1	
5000	22.7	28.7	30.7	32.7	34.6	36.6	38.6	40.5	42.4	44.4	46.3	48.2	50.1	52.0	53.9	55.7	57.6	59.4	61.3	66.8	66.8	
5500	24.6	31.1	33.3	35.4	37.5	39.7	41.8	43.9	46.0	48.1	50.2	52.2	54.3	56.3	58.4	60.4	62.4	64.4	66.4	72.2	72.2	

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Use this sprocket only if required to obtain speed ratio or to meet diameter limitations. See Engineering Section for details.

Poly Chain® GT® Carbon® Belt Length Correction Factor Table										
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation				
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14	350	1.35
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17	8MGT-2840	355
8MGT-352	44	0.55	8MGT-960	120	0.94	8MGT-1792	224	1.18	8MGT-3048	381
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	256	1.22	8MGT-3280	400
8MGT-456	57	0.66	8MGT-1040	130	0.97	8MGT-2200	275	1.26	8MGT-3600	410
8MGT-480	60	0.68	8MGT-1120	140	1.03	8MGT-2240	280	1.28	8MGT-4000	450
8MGT-544	68	0.72	8MGT-1200	150	1.03	8MGT-2400	300	1.31	8MGT-4400	550
8MGT-608	76	0.77	8MGT-1224	153	1.05	8MGT-2520	315	1.32	8MGT-4480	560
8MGT-640	80	0.79	8MGT-1280	160	1.05	8MGT-2600	325			
8MGT-720	90	0.83	8MGT-1440	160	1.10					



Horsepower Rating for 12mm Wide

8mm Pitch Poly Chain® GT® Carbon® Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)		Additional Horsepower per belt for Speed Ratio of Speed-Down Drives		RPM of FASTER SHAFT															
48	50	53	56	60	63	67	71	75	80	1.00 to 1.02	1.03 to 1.05	1.06 to 1.10	1.11 to 1.15	1.16 to 1.21	1.22 to 1.25	1.31 to 1.35	1.44 to 1.49	1.65 to 1.70	2.16 and Over
4.812	5.013	5.314	5.614	6.015	6.316	6.717	7.118	7.519	8.020										
2.00	2.09	2.24	2.38	2.57	2.72	2.91	3.10	3.29	3.52	0.00	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.06	88
2.23	2.34	2.50	2.66	2.87	3.03	3.25	3.46	3.67	3.93	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.06	100
2.55	2.68	2.86	3.05	3.29	3.48	3.72	3.97	4.21	4.51	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.07	117
3.63	3.81	4.07	4.34	4.69	4.96	5.31	5.66	6.00	6.44	0.00	0.01	0.03	0.04	0.06	0.07	0.08	0.10	0.11	175
4.08	4.29	4.59	4.89	5.28	5.58	5.98	6.37	6.76	7.25	0.00	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.13	200
4.68	4.91	5.25	5.60	6.05	6.40	6.85	7.30	7.75	8.31	0.00	0.02	0.04	0.06	0.07	0.09	0.11	0.13	0.15	233
5.86	6.15	6.59	7.02	7.59	8.02	8.59	9.16	9.73	10.4	0.00	0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.21	300
6.73	7.07	7.57	8.06	8.72	9.22	9.87	10.5	11.2	12.0	0.00	0.03	0.06	0.08	0.11	0.14	0.17	0.22	0.25	350
7.59	7.97	8.53	9.09	9.84	10.4	11.1	11.9	12.6	13.5	0.00	0.03	0.06	0.10	0.13	0.16	0.19	0.22	0.25	400
9.28	9.74	10.4	11.1	12.0	12.7	13.6	14.5	15.4	16.6	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.32	0.36	500
10.5	11.1	11.8	12.6	13.7	14.4	15.5	16.5	17.5	18.8	0.00	0.05	0.09	0.14	0.18	0.23	0.32	0.37	0.41	575
10.9	11.5	12.3	13.1	14.2	15.0	16.1	17.2	18.2	19.5	0.00	0.05	0.10	0.14	0.19	0.24	0.33	0.38	0.43	600
12.4	13.0	14.0	14.9	16.1	17.0	18.3	19.5	20.7	22.2	0.00	0.06	0.11	0.16	0.22	0.27	0.33	0.38	0.44	690
12.6	13.2	14.1	15.1	16.3	17.3	18.5	19.7	21.0	22.5	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45	700
14.2	14.9	16.0	17.0	18.4	19.5	20.9	22.3	23.7	25.4	0.00	0.06	0.13	0.19	0.25	0.32	0.38	0.45	0.51	800
15.3	16.1	17.2	18.4	19.9	21.0	22.5	24.0	25.5	27.4	0.00	0.07	0.14	0.21	0.28	0.35	0.42	0.48	0.55	870
15.8	16.6	17.8	18.9	20.5	21.7	23.2	24.8	26.3	28.2	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.57	900
17.4	18.2	19.5	20.8	22.6	23.9	25.6	27.3	29.0	31.1	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	1000
19.9	20.9	22.4	23.8	25.8	27.3	29.3	31.2	33.1	35.6	0.00	0.09	0.18	0.28	0.37	0.46	0.55	0.65	0.74	1160
28.8	30.2	32.4	34.6	37.4	39.6	42.4	45.2	48.0	51.5	0.00	0.14	0.28	0.42	0.56	0.70	0.84	0.97	1.11	1750
32.4	34.1	36.5	39.0	42.2	44.6	47.8	51.0	54.1	58.0	0.00	0.16	0.32	0.48	0.64	0.80	0.95	1.11	1.27	2000
46.5	48.9	52.4	55.8	59.2	63.0	68.2	68.3	72.7	82.5	0.00	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91	3000
52.6	55.2	59.2	63.0	67.2	71.6	77.3				0.00	0.28	0.55	0.82	1.10	1.37	1.65	1.92	2.20	3450
59.8	62.7	67.2	71.6	77.3						0.00	0.32	0.64	0.96	1.27	1.59	1.91	2.23	2.55	4000
66.1	69.3	74.2								0.00	0.36	0.72	1.08	1.43	1.79	2.15	2.51	2.87	3222
72.1	75.7									0.00	0.40	0.79	1.19	1.59	1.99	2.39	2.78	3.18	3558
										0.00	0.44	0.87	1.31	1.75	2.19	2.63	3.06	3.50	5500

Drives in this area should be designed using
Design Flex® Pro. Please consult
www.gates.com/drivedesign for details.

Drives in this area should be designed using
Design Flex® Pro. Please consult
www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon®

Belt Length Correction Factor Table

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17
8MGT-352	44	0.56	8MGT-960	120	0.94	8MGT-1792	224	1.18
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	250	1.22
8MGT-456	57	0.66	8MGT-1120	130	0.97	8MGT-2200	275	1.26
8MGT-480	60	0.68	8MGT-1140	140	1.00	8MGT-2240	280	1.26
8MGT-544	68	0.72	8MGT-1224	153	1.03	8MGT-2400	300	1.29
8MGT-608	76	0.77	8MGT-1280	160	1.05	8MGT-2520	315	1.31
8MGT-640	80	0.79	8MGT-1440	160	1.10	8MGT-2600	325	1.32
8MGT-720	90	0.83						

8mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 21mm Wide

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)											
	22	25	26	27	28	29	30	31	32	33	34	35
10	2.206	2.506	2.607	2.707	2.807	2.907	3.008	3.108	3.208	3.308	3.409	3.509
20	4.4	5.8	7.0	8.8	10.0	11.7	13.9	16.9	18.8	20.8	21.7	22.7
35	7.0	10.0	13.9	16.9	17.8	18.8	19.8	20.8	21.7	22.7	23.6	24.6
44	11.7	15.8	17.5	20.0	21.5	22.6	23.7	24.8	25.9	27.1	28.2	29.3
58	17.5	22.2	27.1	28.7	3.03	3.19	3.35	3.51	3.67	3.83	3.99	4.15
70	20.0	24.9	3.03	3.22	3.40	3.58	3.76	3.94	4.12	4.30	4.48	4.66
88	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
100	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
117	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
125	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
144	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
175	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
200	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
249	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
300	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
350	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
400	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
451	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
500	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
547	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
575	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
600	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
690	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
700	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
800	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
870	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
900	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
1000	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
1160	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
1750	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
2000	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
3000	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
3450	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
4000	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
4500	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
5000	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33
5500	23.3	28.9	3.46	3.67	3.88	4.09	4.30	4.51	4.71	4.92	5.13	5.33

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Use this sprocket only if required to obtain speed ratio or to meet diameter limitations. See Engineering Section for details.

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor	Belt Length Correction Factor Table		Pitch/Length Designation	Number of Teeth	Correction Factor
						Pitch/Length Designation	Number of Teeth			
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14	350	1.35
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17	380	1.36
8MGT-352	44	0.55	8MGT-960	120	0.94	8MGT-1792	224	1.18	381	1.38
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	256	1.22	400	1.40
8MGT-456	57	0.66	8MGT-1040	130	0.97	8MGT-2200	275	1.26	410	1.41
8MGT-480	60	0.68	8MGT-1120	140	1.03	8MGT-2240	280	1.28	400	1.45
8MGT-544	68	0.72	8MGT-1200	150	1.03	8MGT-2400	300	1.29	440	1.49
8MGT-608	76	0.77	8MGT-1224	153	1.03	8MGT-2520	315	1.31	440	1.52
8MGT-640	80	0.79	8MGT-1280	160	1.05	8MGT-2600	325	1.32	440	1.53
8MGT-720	90	0.83	8MGT-1440	160	1.10					



Horsepower Rating for 21mm Wide

8mm Pitch Poly Chain® GT® Carbon® Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)

		Additional Horsepower per belt for Speed Ratio of Speed-Down Drives																		
		1.00 to 1.02	1.03 to 1.05	1.06 to 1.07	1.11 to 1.15	1.22 to 1.21	1.31 to 1.30	1.44 to 1.43	1.65 to 1.64	2.16 and Over	RPM OF FASTER SHAFT									
48	50	53	56	60	63	67	71	75	80	100	70									
4.812	5.013	5.314	5.614	6.015	6.316	6.717	7.118	7.519	8.020	1.00 to 1.02	1.03 to 1.05	1.06 to 1.07	1.11 to 1.15	1.22 to 1.21	1.31 to 1.30	1.44 to 1.43	1.65 to 1.64	2.16 and Over		
Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.																				
3.49	3.66	3.92	4.17	4.50	4.75	5.09	5.42	5.75	6.16	0.00	0.01	0.02	0.04	0.05	0.06	0.07	0.09	0.10	0.11	0.88
3.90	4.09	4.37	4.65	5.03	5.31	5.68	6.05	6.42	6.88	0.00	0.01	0.03	0.04	0.06	0.07	0.08	0.10	0.11	0.13	1.00
4.46	4.68	5.01	5.33	5.76	6.08	6.51	6.94	7.36	7.89	0.00	0.02	0.03	0.05	0.07	0.07	0.08	0.10	0.11	0.13	1.17
6.35	6.66	7.13	7.59	8.21	8.67	9.29	9.90	10.5	11.3	0.00	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.19	0.22	1.75
7.15	7.50	8.03	8.55	9.25	9.77	10.5	11.1	11.8	12.7	0.00	0.03	0.06	0.08	0.11	0.14	0.17	0.19	0.22	0.25	2.00
8.19	8.59	9.20	9.80	10.6	11.2	12.0	12.8	13.6	14.5	0.00	0.03	0.06	0.10	0.13	0.16	0.19	0.23	0.26	0.29	2.33
10.3	10.8	11.5	12.3	13.3	14.0	15.0	16.0	17.0	18.3	0.00	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33	0.38	3.00
11.8	12.4	13.2	14.1	15.3	16.1	17.3	18.4	19.6	21.0	0.00	0.05	0.10	0.15	0.19	0.24	0.29	0.34	0.39	0.44	3.50
13.3	13.9	14.9	15.9	17.2	18.2	19.5	20.8	22.1	23.7	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45	0.50	4.00
16.2	17.0	18.3	19.5	21.1	22.3	23.9	25.4	27.0	29.0	0.00	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	5.00
18.4	19.3	20.7	22.1	23.9	25.3	27.1	28.9	30.7	32.9	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	5.75
19.1	20.1	21.5	23.0	24.9	26.3	28.1	30.0	31.9	34.2	0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	6.00
21.7	22.8	24.4	26.1	28.2	29.8	32.0	34.1	36.2	38.8	0.00	0.10	0.19	0.29	0.38	0.48	0.56	0.67	0.77	0.86	6.90
22.0	23.1	24.8	26.4	28.6	30.2	32.4	34.5	36.7	39.3	0.00	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78	0.88	7.00
24.8	26.1	27.9	29.8	32.3	34.1	36.5	39.0	41.4	44.4	0.00	0.11	0.22	0.33	0.45	0.56	0.67	0.78	0.89	1.00	8.00
26.8	28.1	30.1	32.2	34.8	36.8	39.4	42.1	44.7	47.9	0.00	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97	1.09	8.70
27.6	29.0	31.1	33.2	35.9	38.0	40.7	43.4	46.1	49.4	0.00	0.13	0.25	0.38	0.50	0.75	0.88	1.00	1.13	1.33	9.00
30.4	31.9	34.2	36.5	39.5	41.8	44.8	47.7	50.7	54.4	0.00	0.14	0.28	0.42	0.56	0.70	0.84	0.97	1.11	1.25	10.00
34.7	36.5	39.1	41.7	45.2	47.8	51.2	54.6	58.0	62.2	0.00	0.16	0.32	0.49	0.65	0.81	0.97	1.13	1.29	1.45	11.60
50.3	52.9	56.7	60.5	65.5	69.2	74.2	79.1	84.0	90.1	0.00	0.24	0.49	0.73	0.97	1.22	1.46	1.71	1.95	2.19	17.50
56.7	59.6	63.9	68.2	73.8	78.1	83.6	89.2	94.7	101.5	0.00	0.28	0.56	0.84	1.11	1.39	1.67	1.95	2.23	2.51	20.00
81.4	85.5	91.6	97.7	105.7	111.7	119.5	127.3	135.0	144.4	0.00	0.42	0.83	1.25	1.67	2.09	2.51	2.92	3.34	3.76	30.00
92.0	96.6	103.5	110.3	119.3	126.0	134.7	143.4	152.0	161.7	0.00	0.48	0.96	1.44	1.92	2.40	2.88	3.36	3.84	4.32	34.50
104.6	109.8	117.6	125.2	135.3						0.00	0.56	1.11	1.67	2.23	2.79	3.34	3.90	4.46	5.01	4.00
115.6	121.4	129.9								0.00	0.63	1.25	1.88	2.51	3.13	3.76	4.39	5.01	5.64	4500
126.3	132.5									0.00	0.70	1.39	2.09	2.78	3.48	4.18	4.87	5.57	6.27	5000
										0.00	0.77	1.53	2.30	3.06	3.83	4.60	5.36	6.13	6.89	5500



The Driving Force in Power Transmission.

Poly Chain® GT® Carbon®

Belt Length Correction Factor Table

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	224	1.17
8MGT-352	44	0.56	8MGT-960	120	0.94	8MGT-1792	250	1.22
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	275	1.26
8MGT-456	57	0.66	8MGT-1120	130	0.97	8MGT-2240	300	1.28
8MGT-480	60	0.68	8MGT-1140	140	1.00	8MGT-2400	315	1.29
8MGT-544	68	0.72	8MGT-1224	153	1.03	8MGT-2520	325	1.31
8MGT-608	76	0.77	8MGT-1280	160	1.05	8MGT-2600	325	1.32
8MGT-640	80	0.79	8MGT-1440	160	1.10	8MGT-4480	560	1.53
8MGT-720	90	0.83						

8mm Pitch Poly Chain® GT® Carbon® Belts

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)									
	22	25	28	30	32	33	34	35	36	37
2.206	2.506	2.807	3.008	3.208	3.308	3.409	3.509	3.609	3.709	3.810
10										
20										
35										
44										
58										
70										
88	2.15	2.60	3.05	3.35	3.64	3.79	3.94	4.09	4.23	4.38
100	2.38	2.89	3.39	3.73	4.06	4.22	4.39	4.56	4.72	4.88
117	2.71	3.29	3.87	4.26	4.64	4.83	5.02	5.21	5.40	5.59
175	3.80	4.64	5.47	6.02	6.57	6.84	7.11	7.38	7.66	7.93
200	4.26	5.20	6.14	6.76	7.38	7.68	7.99	8.30	8.61	8.91
233	4.85	5.93	7.01	7.72	8.43	8.79	9.14	9.49	9.85	10.2
300	6.03	7.39	8.74	9.64	10.5	11.0	11.4	11.9	12.3	12.8
350	6.88	8.45	10.0	11.0	12.1	12.6	13.1	13.6	14.1	14.6
400	7.72	9.50	11.3	12.4	13.6	14.2	14.8	15.3	15.9	16.5
500	9.37	11.5	13.7	15.2	16.6	17.3	18.0	18.7	19.4	19.9
575	10.6	13.1	15.5	17.2	18.8	19.6	20.4	21.2	22.0	22.8
600	11.0	13.5	16.1	17.8	19.5	20.3	21.2	22.0	22.9	23.7
690	12.4	15.3	18.2	20.2	22.1	23.0	24.0	25.0	25.9	26.9
700	12.5	15.5	18.5	20.4	22.4	23.3	24.3	25.3	26.3	27.2
800	14.1	17.5	20.8	23.0	25.2	26.3	27.4	28.5	29.6	30.7
870	15.2	18.8	22.4	24.8	27.2	28.4	29.6	30.7	31.9	33.1
900	15.6	19.4	23.1	25.6	28.0	29.2	30.5	31.7	32.9	34.1
1000	17.1	21.2	25.3	28.1	30.8	32.1	33.5	34.8	36.2	37.5
1160	19.5	24.2	28.9	32.0	35.1	36.7	38.2	39.8	41.3	42.8
1750	27.8	34.7	41.6	46.2	50.7	53.0	55.2	57.5	59.7	61.9
2000	31.2	39.0	46.8	52.0	57.1	59.6	62.2	64.8	67.3	69.8
3000	44.2	55.6	66.9	74.3	81.7	85.4	89.1	92.8	96.4	100.1
3450	49.8	62.7	75.5	84.0	92.4	96.6	100.8	104.9	109.0	113.2
4000	56.5	71.2	85.9	95.5	105.1	109.8	114.6	119.3	124.0	128.7
4500	62.3	78.7	95.0	105.7	116.3	121.6	126.9	132.1	137.3	142.5
5000	68.1	86.1	103.9	115.7	127.3	133.1	138.9	144.6	150.2	155.9
5500	73.7	93.3	112.6	125.4	138.0	144.2	150.5	156.7	162.8	168.9

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor	Poly Chain® GT® Carbon® Belt Length Correction Factor Table	
									Pitch/Length Designation	Number of Teeth
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14	8MGT-2800	350
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17	8MGT-2840	355
8MGT-352	44	0.55	8MGT-960	120	0.94	8MGT-1792	224	1.18	8MGT-3048	381
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	250	1.22	8MGT-3200	400
8MGT-456	57	0.66	8MGT-1040	130	0.97	8MGT-2200	275	1.26	8MGT-3280	410
8MGT-544	68	0.72	8MGT-1120	140	1.00	8MGT-2240	280	1.28	8MGT-3600	450
8MGT-608	76	0.77	8MGT-1224	153	1.03	8MGT-2400	300	1.31	8MGT-4000	500
8MGT-640	80	0.79	8MGT-1280	160	1.05	8MGT-2600	325	1.32	8MGT-4480	560
8MGT-720	90	0.83	8MGT-1440	160	1.10					

Use this sprocket only if required to obtain speed ratio or to meet diameter limitations. See Engineering Section for details.



Gates Corporation

Horsepower Rating for 36mm Wide 8mm Pitch Poly Chain® GT® Carbon® Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)		Additional Horsepower per belt for Speed Ratio of Speed-Down Drives														
53 5.314	56 5.614	60 6.015	63 6.316	67 6.717	71 7.118	75 7.519	80 8.020	1.00 to 1.02	1.03 to 1.05	1.06 to 1.10	1.11 to 1.15	1.22 to 1.30	1.31 to 1.43	1.44 to 1.64	1.65 to 2.15	2.16 and Over
Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.																
Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.																
6.71	7.14	7.72	8.15	8.72	9.29	9.86	10.6	0.00	0.02	0.04	0.06	0.11	0.13	0.15	0.17	0.19
7.49	7.98	8.62	9.10	9.74	10.4	11.0	11.8	0.00	0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.21
8.59	9.14	9.88	10.4	11.2	11.9	12.6	13.5	0.00	0.03	0.06	0.08	0.11	0.14	0.17	0.20	0.25
12.2	13.0	14.1	14.9	15.9	17.0	18.0	19.3	0.00	0.04	0.08	0.13	0.17	0.21	0.25	0.30	0.38
13.8	14.7	15.8	16.7	17.9	19.1	20.3	21.7	0.00	0.05	0.10	0.14	0.19	0.24	0.29	0.33	0.43
15.8	16.8	18.2	19.2	20.5	21.9	23.3	24.9	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45
19.8	21.1	22.8	24.1	25.8	27.5	29.2	31.3	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.57
22.7	24.2	26.2	27.7	29.6	31.6	33.5	36.0	0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67
25.6	27.3	29.5	31.2	33.4	35.6	37.8	40.6	0.00	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76
31.3	33.4	36.1	38.2	40.9	43.6	46.3	49.7	0.00	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96
35.5	37.9	41.0	43.3	46.4	49.5	52.6	56.4	0.00	0.14	0.27	0.41	0.55	0.69	0.82	0.96	1.10
36.9	39.4	42.6	45.0	48.3	51.5	54.8	58.6	0.00	0.14	0.29	0.43	0.57	0.72	0.86	1.00	1.15
41.9	44.7	48.4	51.1	54.8	58.4	62.1	66.6	0.00	0.17	0.33	0.49	0.66	0.82	0.99	1.15	1.32
42.4	45.3	49.0	51.8	55.5	59.2	62.9	67.4	0.00	0.17	0.33	0.50	0.67	0.84	1.00	1.17	1.34
47.9	51.1	55.3	58.5	62.7	66.8	71.0	76.1	0.00	0.19	0.38	0.57	0.76	0.95	1.15	1.34	1.53
51.7	55.1	59.7	63.1	67.6	72.1	76.6	82.2	0.00	0.21	0.41	0.62	0.83	1.04	1.25	1.45	1.66
53.3	56.8	61.5	65.1	69.7	74.4	79.0	84.7	0.00	0.22	0.43	0.65	0.86	1.07	1.29	1.50	1.72
58.6	62.5	67.7	71.6	76.7	81.8	86.9	93.2	0.00	0.24	0.48	0.72	0.95	1.19	1.43	1.67	1.91
67.1	71.5	77.5	81.9	87.8	93.6	99.4	106.7	0.00	0.28	0.55	0.83	1.11	1.38	1.66	1.94	2.22
97.2	103.7	112.3	118.7	127.2	135.7	144.0	154.5	0.00	0.42	0.83	1.25	1.67	2.09	2.51	2.92	3.34
109.6	116.9	126.6	133.8	143.4	152.9	162.3	174.0	0.00	0.48	0.95	1.43	1.91	2.39	2.86	3.34	3.82
157.1	167.5	181.2	191.4	204.9	218.2	231.4	247.6	0.00	0.72	1.43	2.15	2.86	3.58	4.30	5.01	5.73
177.5	189.1	204.5	216.0	231.0	245.8	261.6	281.2	0.00	0.83	1.65	2.47	3.29	4.12	4.94	5.76	6.59
201.5	214.7	231.9						0.00	0.96	1.91	2.87	3.82	4.77	5.73	6.68	7.64
222.6								0.00	1.08	2.15	3.23	4.30	5.37	6.45	7.52	8.60
								0.00	1.20	2.38	3.58	4.77	5.97	7.16	8.35	9.55
								0.00	1.32	2.62	3.94	5.25	6.56	7.88	9.19	10.7
								0.00	1.32	2.62	3.94	5.25	6.56	7.88	9.19	10.8

Poly Chain® GT® Carbon® Belt Length Correction Factor Table									
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14	8MGT-2800
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17	8MGT-2840
8MGT-352	44	0.56	8MGT-960	120	0.94	8MGT-1792	224	1.18	8MGT-3048
8MGT-416	52	0.62	8MGT-1000	125	0.96	8MGT-2000	250	1.22	8MGT-3200
8MGT-456	57	0.66	8MGT-1120	130	0.97	8MGT-2200	275	1.26	8MGT-3280
8MGT-480	60	0.68	8MGT-1200	140	1.00	8MGT-2240	280	1.26	8MGT-3600
8MGT-544	68	0.72	8MGT-1224	153	1.03	8MGT-2400	300	1.29	8MGT-4000
8MGT-608	76	0.77	8MGT-1280	160	1.05	8MGT-2520	315	1.31	8MGT-4400
8MGT-640	80	0.79	8MGT-1440	160	1.10	8MGT-2600	325	1.32	8MGT-4480
8MGT-720	90	0.83							8MGT-5600

Horsepower Rating for 62mm Wide 8mm Pitch Poly Chain® GT® Carbon® Belts

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)									
	22	25	28	30	32	34	36	38	40	42
10	2.206	2.506	2.807	3.008	3.208	3.409	3.609	3.810	4.010	4.211
20	4.11	4.98	5.84	6.42	6.99	7.56	8.13	8.70	9.26	9.83
35	4.68	5.67	6.67	7.33	7.99	8.65	9.30	9.95	10.6	11.2
44	5.58	7.0	8.70	9.48	10.25	10.96	11.63	12.29	12.95	13.61
58	7.55	9.42	10.4	11.3	12.3	13.2	14.1	15.1	16.0	17.4
70	8.8	10.6	11.6	12.7	13.8	14.8	15.9	16.9	18.0	19.5
88	117	12.1	13.3	14.5	15.7	17.0	18.2	19.4	20.6	22.4
100	117	12.1	13.3	14.5	15.7	17.2	18.4	19.6	20.8	22.7
117	117	12.1	13.3	14.5	15.7	17.2	18.4	19.6	20.8	22.7
175	175	12.1	13.3	14.5	15.7	17.0	18.2	19.4	20.6	22.4
200	200	12.1	13.3	14.5	15.7	17.2	18.4	19.6	20.8	22.7
233	233	10.2	11.6	12.7	13.8	14.8	15.9	16.9	18.0	19.5
300	300	10.4	12.7	15.1	16.6	18.1	19.7	21.2	22.7	24.3
350	350	11.9	14.6	17.2	19.0	20.8	22.6	24.3	26.1	27.8
400	400	13.3	16.4	19.4	21.4	23.4	25.4	27.4	29.4	31.4
500	500	19.9	23.6	26.1	28.5	31.0	33.4	35.9	38.3	40.7
575	575	22.5	26.7	29.5	32.3	35.1	37.9	40.7	43.4	46.2
600	600	18.9	23.3	27.8	30.7	33.6	36.5	39.4	42.3	45.1
690	690	21.3	26.4	31.4	34.7	38.0	41.4	44.6	47.9	51.2
700	700	21.6	26.7	31.8	35.2	38.5	41.9	45.2	48.5	51.8
800	800	30.1	35.8	39.6	43.4	47.2	51.0	54.7	58.5	62.2
870	870	26.1	32.4	38.6	42.7	46.8	50.9	55.0	59.0	63.0
900	900	26.9	33.3	39.8	44.0	48.2	52.5	56.7	60.8	65.0
1000	1000	29.5	36.6	43.7	48.3	53.0	57.7	62.3	66.9	71.5
1160	1160	33.5	41.7	49.8	55.2	60.5	65.9	71.1	76.4	81.7
1750	1750	59.8	71.7	79.5	87.3	95.1	102.8	110.6	118.2	125.9
2000	2000	53.7	67.2	80.6	89.5	98.3	107.2	115.9	124.6	133.2
3000	3000	76.1	95.7	115.2	128.0	140.8	153.5	166.1	178.7	191.1
3450	3450	85.8	108.0	130.1	144.7	159.1	173.6	187.8	202.0	216.1
4000	4000	97.2	122.7	147.9	164.5	181.0	197.4	213.7	229.8	245.8
4500	4500	107.4	135.6	163.6	182.1	200.4	218.6	236.5	254.4	272.1
5000	5000	117.3	148.3	179.0	199.3	219.3	239.2	258.8	278.3	297.5
5500	5500	126.9	160.6	194.0	216.0	237.7	259.2	280.4	301.5	322.3

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Use this sprocket only if required to obtain speed ratio or to meet diameter limitations. See Engineering Section for details.

Horsepower Rating for 62mm Wide 8mm Pitch Poly Chain® GT® Carbon® Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)				Additional Horsepower per belt for Speed Ratio of Speed-Down Drives								RPM OF FASTER SHAFT			
6.0	63	67	71	75	80	1.00 to 1.02	1.03 to 1.05	1.06 to 1.10	1.11 to 1.15	1.16 to 1.21	1.22 to 1.30	1.31 to 1.43	1.44 to 1.64	1.65 to 2.15	
6.015	6.316	6.717	7.118	7.519	8.020										
Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.				Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.								10 20 35 44 58			
13.3	14.0	15.0	16.0	17.0	18.2	0.00	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.33	88
14.8	15.7	16.8	17.9	19.0	20.3	0.00	0.04	0.08	0.12	0.16	0.21	0.25	0.29	0.33	100
17.0	18.0	19.2	20.5	21.7	23.3	0.00	0.05	0.10	0.14	0.19	0.24	0.29	0.34	0.37	117
24.2	25.6	27.4	29.2	31.0	33.3	0.00	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58	175
27.3	28.8	30.9	32.9	34.9	37.5	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.58	0.66	200
31.3	33.0	35.4	37.7	40.0	42.9	0.00	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.77	233
39.2	41.5	44.4	47.3	50.3	53.9	0.00	0.12	0.25	0.37	0.49	0.62	0.74	0.86	0.99	300
45.1	47.6	51.0	54.4	57.8	62.0	0.00	0.14	0.29	0.43	0.58	0.72	0.86	1.01	1.15	350
50.8	53.7	57.6	61.4	65.2	69.9	0.00	0.16	0.33	0.49	0.66	0.82	0.99	1.15	1.32	400
62.2	65.7	70.4	75.1	79.8	85.6	0.00	0.21	0.41	0.62	0.82	1.03	1.23	1.44	1.64	500
70.6	74.6	80.0	85.3	90.6	97.2	0.00	0.24	0.47	0.71	0.95	1.18	1.42	1.65	1.89	575
73.4	77.6	83.1	88.6	94.3	100.6	0.00	0.25	0.49	0.74	0.99	1.23	1.48	1.73	1.97	600
83.3	88.0	94.3	100.6	106.9	114.7	0.00	0.28	0.57	0.85	1.13	1.42	1.70	1.99	2.27	690
84.4	89.2	95.6	101.9	108.3	116.2	0.00	0.29	0.57	0.86	1.15	1.44	1.73	2.01	2.30	700
95.2	100.7	107.9	115.1	122.3	131.2	0.00	0.33	0.66	0.99	1.32	1.64	1.97	2.30	2.63	800
102.8	108.7	116.4	124.2	131.9	141.5	0.00	0.36	0.71	1.07	1.43	1.79	2.15	2.50	2.86	870
106.0	112.0	120.1	128.1	136.1	146.0	0.00	0.37	0.74	1.11	1.48	1.85	2.22	2.59	3.33	900
116.6	123.3	132.1	140.9	149.7	160.6	0.00	0.41	0.82	1.23	1.64	2.06	2.47	2.88	3.70	1000
133.4	141.0	151.2	161.2	171.3	183.7	0.00	0.48	0.95	1.43	1.91	2.38	2.86	3.34	3.82	1160
193.4	204.4	219.1	233.6	248.1	266.0	0.00	0.72	1.44	2.16	2.88	3.60	4.32	5.04	5.76	1750
218.0	230.4	246.9	263.3	279.5	299.6	0.00	0.82	1.64	2.47	3.29	4.11	4.93	5.75	6.58	2000
312.1	329.7	352.9	375.8	398.5	426.4	0.00	1.24	3.70	4.93	6.17	7.40	8.63	9.87	11.1	3000
352.3	377.0	397.8	423.3			0.00	1.42	2.83	4.26	5.67	7.09	8.51	9.93	11.3	3450
399.5						0.00	1.65	3.29	4.94	6.58	8.22	9.87	11.5	13.2	4000
						0.00	1.85	3.70	5.56	7.40	9.25	11.1	12.9	14.8	4500
						0.00	2.06	4.11	6.17	8.22	10.3	12.3	14.4	16.4	5000
						0.00	2.27	4.52	6.79	9.04	11.3	13.6	15.8	18.1	5500

Poly Chain® GT® Carbon® Belt Length Correction Factor Table														
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor	Pitch/Length Designation	Number of teeth	Correction Factor
8MGT-248	31	0.42	8MGT-800	100	0.87	8MGT-1600	200	1.14	8MGT-2800	350	1.35			
8MGT-288	36	0.48	8MGT-896	112	0.91	8MGT-1760	220	1.17	8MGT-2840	355	1.36			
8MGT-352	44	0.56	8MGT-1000	120	0.94	8MGT-1792	224	1.18	8MGT-3048	381	1.38			
8MGT-416	52	0.62	8MGT-1120	125	0.96	8MGT-2000	250	1.22	8MGT-3200	400	1.40			
8MGT-456	57	0.68	8MGT-1140	130	0.97	8MGT-2280	275	1.26	8MGT-3600	410	1.45			
8MGT-480	60	0.68	8MGT-1120	140	1.00	8MGT-2240	300	1.26	8MGT-4000	500	1.49			
8MGT-544	68	0.72	8MGT-1224	153	1.03	8MGT-2520	315	1.31	8MGT-4400	550	1.52			
8MGT-608	76	0.77	8MGT-1280	160	1.05	8MGT-2600	325	1.32	8MGT-4480	560	1.53			
8MGT-540	80	0.79	8MGT-1440	160	1.07									
8MGT-720	90	0.83												

14mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 20mm Wide

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)									
	28	29	30	31	32	33	34	35	36	37
70	5.72	5.96	6.20	6.44	6.68	6.92	7.15	7.39	7.63	7.87
88	6.35	6.62	6.88	7.15	7.42	7.68	7.95	8.22	8.48	8.74
100	7.23	7.54	7.84	8.15	8.45	8.76	9.06	9.36	9.66	9.97
117	10.1	10.6	11.0	11.4	11.9	12.3	12.7	13.1	13.6	14.0
175										
200	11.3	11.8	12.3	12.8	13.3	13.8	14.2	14.7	15.2	15.7
233	12.9	13.5	14.0	14.6	15.1	15.7	16.2	16.8	17.3	17.9
300	16.0	16.7	17.4	18.1	18.8	19.5	20.1	20.8	21.5	22.2
350	18.2	19.0	19.8	20.6	21.4	22.2	23.0	23.8	24.6	25.4
400	20.5	21.4	22.2	23.1	24.0	24.9	25.8	26.7	27.6	28.4
500	24.8	25.9	26.9	28.0	29.1	30.2	31.3	32.4	33.4	34.5
575	27.9	29.2	30.4	31.6	32.8	34.1	35.3	36.5	37.7	38.9
600	29.0	30.2	31.5	32.8	34.1	35.3	36.6	37.9	39.1	40.4
690	32.6	34.1	35.5	37.0	38.4	39.9	41.3	42.7	44.1	45.6
700	33.0	34.5	36.0	37.4	38.9	40.4	41.8	43.3	44.7	46.1
800	37.0	38.7	40.4	42.0	43.6	45.3	46.9	48.5	50.1	51.8
870	39.8	41.6	43.4	45.1	46.9	48.7	50.4	52.2	53.9	55.6
1000	41.0	42.8	44.6	46.5	48.3	50.1	51.9	53.7	55.5	57.4
1160	50.9	53.2	55.5	57.8	60.0	62.3	64.5	66.8	69.0	71.3
1750	72.1	75.4	78.6	81.9	85.1	88.4	91.6	94.8	97.9	101.1
2000	80.6	84.3	88.0	91.6	95.2	98.8	102.4	106.0	109.6	113.1
3000	112.6	117.8	122.9	127.9	133.0	138.0	142.9	147.9	152.8	157.6
3450	126.0	131.7	137.4	143.0	148.6	154.2	159.7	165.2	170.6	175.9
4000	141.4	147.9	154.2	160.5	166.7	172.8	178.9	185.0	190.9	

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon® Belt Length Correction Factor Table					
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-904	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3580	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				



Horsepower Rating for 20mm Wide

14mm Pitch Poly Chain® GT® Carbon® Belts

**Poly Chain® GT® Carbon®
Belt Length Correction Factor Table**

Poly Chain® GT® Carbon®					
Belt Length Correction Factor Table					
Pitch/L Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-994	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3186	224	1.12
14MGT-1615	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170	1.01			

14mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 37mm Wide

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)									
	28	29	30	31	32	33	34	35	36	37
10	4.912	5.088	5.263	5.439	5.614	5.790	5.965	6.141	6.316	6.492
20										
35										
44										
58										
70										
88	10.6	11.0	11.5	11.9	12.4	12.8	13.2	13.7	14.1	14.6
100	11.7	12.2	12.7	13.2	13.7	14.2	14.7	15.2	15.7	16.2
117	13.4	13.9	14.5	15.1	15.6	16.2	16.8	17.3	17.9	18.4
175	18.7	19.5	20.3	21.1	21.9	22.7	23.5	24.3	25.1	25.9
200	21.0	21.9	22.8	23.7	24.6	25.5	26.3	27.2	28.1	29.0
233	23.9	24.9	25.9	27.0	28.0	29.0	30.0	31.0	32.0	33.1
300	29.6	30.9	32.2	33.5	34.7	36.0	37.3	38.5	39.8	41.1
350	33.8	35.2	36.7	38.2	39.6	41.1	42.6	44.0	45.4	46.9
400	37.8	39.5	41.2	42.8	44.5	46.1	47.7	49.4	51.0	52.6
500	45.8	47.8	49.9	51.9	53.9	55.9	57.9	59.9	61.8	63.8
575	51.6	53.9	56.2	58.5	60.8	63.0	65.3	67.5	69.8	72.0
600	53.6	55.9	58.3	60.7	63.0	65.4	67.7	70.0	72.4	74.7
690	60.4	63.1	65.8	68.4	71.1	73.7	76.4	79.0	81.6	84.3
700	61.1	63.9	66.6	69.3	72.0	74.7	77.3	80.0	82.7	85.3
800	68.5	71.6	74.7	77.7	80.7	83.8	86.8	89.8	92.8	95.8
870	73.6	76.9	80.2	83.5	86.8	90.0	93.3	96.5	99.7	102.9
900	75.8	79.2	82.6	86.0	89.3	92.7	96.0	99.4	102.7	106.0
1000	82.9	86.7	90.4	94.1	97.8	101.5	105.1	108.8	112.4	116.0
1160	94.1	102.6	106.8	111.0	115.2	119.4	123.5	127.7	131.8	135.9
1750	133.4	139.4	145.4	151.5	157.5	163.5	169.4	175.3	181.2	187.0
2000	149.2	156.0	162.7	169.5	176.2	182.9	189.5	196.1	202.7	209.2
3000	208.3	217.9	227.3	236.7	246.0	255.3	264.4	273.6	282.6	291.6
3450	233.0	243.7	254.2	264.6	275.0	285.3	295.4	305.5	315.5	325.5
4000	261.7	273.5	285.2	296.9	308.3	319.8	331.0	342.2	353.2	355.2

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon® Belt Length Correction Factor Table					
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-904	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				



Gates Corporation

www.gates.com/pt

Horsepower Rating for 37mm Wide

14mm Pitch Poly Chain® GT® Carbon Belts

Rated Horsepower for Small Sprocket

(Number of Grooves and Pitch Diameter, Inches)

	53 9,299	56 9,825	60 10,527	63 11,053	67 11,755	71 12,457	75 13,158	80 14,036	1.00 1.03	1.04 1.10	1.11 1.19	1.20 1.30	1.31 1.45	1.46 1.67	1.68 2.02	2.03 2.02	2.70 2.69	4.65 4.64	RPM OF FASTER SHAFT
21.4	22.7	24.4	25.7	27.3	29.0	30.7	32.7	0.00	0.08	0.17	0.25	0.33	0.41	0.50	0.58	0.66	0.74	70	
23.9	25.3	27.2	28.6	30.4	32.3	34.1	36.4	0.00	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.84	88	
27.2	28.8	31.0	32.6	34.7	36.8	38.9	41.6	0.00	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	100	
38.3	40.6	43.6	45.9	48.9	51.8	54.8	58.5	0.00	0.16	0.33	0.49	0.66	0.82	0.99	1.15	1.31	1.48	117	
42.9	45.5	48.9	51.4	54.8	58.1	61.5	65.6	0.00	0.19	0.38	0.56	0.75	0.94	1.13	1.31	1.50	1.69	175	
48.9	51.9	55.7	58.6	62.5	66.3	70.1	74.8	0.00	0.22	0.44	0.66	0.88	1.09	1.31	1.53	1.75	1.97	233	
60.9	64.5	69.3	72.9	77.7	82.5	87.2	93.1	0.00	0.28	0.56	0.84	1.13	1.41	1.69	1.97	2.25	2.53	300	
69.6	73.7	79.2	83.4	88.8	94.3	99.7	106.4	0.00	0.33	0.66	0.94	1.31	1.64	1.97	2.30	2.63	2.96	350	
78.1	82.8	89.0	93.6	99.7	105.8	111.9	119.4	0.00	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	400	
94.8	100.5	108.0	113.6	121.0	128.4	135.8	144.9	0.00	0.47	0.94	1.41	1.88	2.35	2.82	3.29	3.75	4.22	500	
107.0	113.4	121.9	128.3	136.7	145.0	153.3	163.6	0.00	0.54	1.08	1.62	2.16	2.70	3.24	3.78	4.32	4.86	575	
111.0	117.7	126.5	133.1	141.8	150.4	159.0	169.7	0.00	0.56	1.13	1.69	2.25	2.82	3.38	3.94	4.51	5.07	600	
125.3	132.8	142.8	150.2	160.0	169.8	179.4	191.5	0.00	0.65	1.30	1.94	2.59	3.24	3.89	4.53	5.18	5.83	690	
126.9	134.5	144.6	152.1	162.0	171.9	181.7	193.8	0.00	0.66	1.31	1.97	2.63	3.29	3.94	4.60	5.26	5.91	700	
142.4	151.0	162.3	170.7	181.8	192.9	203.8	217.4	0.00	0.75	1.50	2.25	3.00	3.76	4.51	5.26	6.01	6.76	800	
153.1	162.3	174.5	183.5	195.5	207.3	219.1	233.6	0.00	0.82	1.63	2.45	3.27	4.08	4.90	5.72	6.53	7.35	870	
157.7	167.1	179.6	188.9	201.2	213.4	225.5	240.5	0.00	0.85	1.69	2.53	3.38	4.23	5.07	5.91	6.76	7.60	900	
172.6	183.0	196.7	206.8	219.3	233.6	246.8	263.1	0.00	0.94	1.88	2.82	3.76	4.69	5.63	6.57	7.51	8.45	1000	
196.1	207.8	223.3	234.8	250.0	265.0	279.8	298.2	0.00	1.09	2.18	3.27	4.36	5.45	6.53	7.62	8.71	9.80	1160	
227.6	293.9	315.4	331.3	352.1	372.6	392.8	417.5	0.00	1.64	3.29	4.93	6.57	8.22	9.85	11.5	13.1	14.8	1750	
309.9	328.0	351.7	369.1	392.0	414.4			0.00	1.88	3.76	5.63	7.51	9.39	11.3	13.1	15.0	16.9	2000	
								0.00	2.82	5.63	8.45	11.3	14.1	16.9	19.7	22.5	25.3	3000	
								0.00	3.24	6.48	9.71	13.0	16.2	19.4	22.7	25.9	29.1	3450	
								0.00	3.76	7.51	11.3	15.0	18.8	22.5	26.3	30.0	33.8	4000	

Drives in this area should be designed using
Design Flex® Pro. Please consult
www.gates.com/drivedesign for details.

Additional Horsepower per belt for Speed

Ratio of Speed-Down Drives

Drives in this area should be designed using

Design Flex® Pro. Please consult

www.gates.com/drivedesign for details.

www.gates.com/drivedesign

Poly Chain® GT® Carbon® Belt Length Correction Factor Table

Pitch/length Designation	Number of Teeth	Correction Factor	Pitch/length Designation	Number of Teeth	Correction Factor
14MGT-984	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				

14mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 68mm Wide

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)																	
	28	29	30	31	32	33	34	35	36	37								
70	10	20	35	44	58	70	88	100	117	125								
4.912	5.088	5.263	5.439	5.614	5.790	5.965	6.141	6.316	6.492	6.667								
28	29	30	31	32	33	34	35	36	37	38								
4.912	5.088	5.263	5.439	5.614	5.790	5.965	6.141	6.316	6.492	6.667								
70	88	194	20.3	21.1	21.9	22.7	23.5	24.3	25.1	25.9	26.7	27.5	28.3	29.1	31.5	33.1	35.5	37.1
100	21.6	22.5	23.4	24.3	25.2	26.1	27.0	27.9	28.8	29.7	30.6	31.5	32.4	35.1	36.8	39.5	41.2	47.1
117	24.6	25.6	26.7	27.7	28.7	29.8	30.8	31.8	32.9	33.9	34.9	35.9	36.9	40.0	42.0	45.0	47.0	66.1
125	34.4	35.9	37.4	38.8	40.3	41.8	43.2	44.7	46.1	47.6	50.5	51.9	56.2	59.1	63.3	66.1	74.1	87.72
200	38.5	40.2	41.8	43.5	45.1	46.8	48.4	50.1	51.7	53.3	54.9	56.4	63.0	66.2	71.0	75.5	80.9	84.5
233	43.9	45.8	47.6	49.5	51.4	53.3	55.2	57.0	57.9	60.8	62.6	64.4	66.3	71.8	75.5	80.9	84.5	105.1
300	54.4	56.8	59.1	61.5	63.8	66.2	68.5	70.8	73.2	75.5	77.8	80.1	82.4	89.3	93.8	100.6	105.1	105.1
350	62.0	64.8	67.5	70.2	72.8	75.5	78.2	80.9	83.5	86.2	88.8	91.5	94.1	102.0	107.2	115.0	120.1	120.1
400	69.5	72.6	75.6	78.7	81.7	84.7	87.7	90.7	93.7	96.7	99.7	102.6	105.6	114.4	120.3	129.0	134.8	134.8
500	84.2	87.9	91.6	95.3	99.0	102.7	106.3	110.0	113.6	117.3	120.9	124.5	128.1	138.8	146.0	156.6	163.6	163.6
575	94.9	99.1	103.3	107.5	111.7	115.8	120.0	124.1	128.2	132.3	136.4	140.5	144.6	156.7	164.8	176.8	184.7	184.7
600	98.4	102.8	107.2	111.5	115.8	120.2	124.4	128.7	133.0	137.3	141.5	145.7	150.0	162.6	171.0	183.4	191.7	191.7
690	111.0	115.9	120.8	125.8	130.6	135.5	140.4	145.2	150.1	154.9	164.5	169.3	183.5	192.9	207.0	216.4	216.4	216.4
700	112.4	117.4	122.3	127.3	132.3	137.2	142.1	147.1	151.9	156.8	161.7	166.5	171.4	185.8	195.4	209.6	219.1	219.1
800	126.0	131.6	137.2	142.8	148.4	153.9	159.5	165.0	170.0	176.0	181.4	186.9	192.3	208.5	219.3	235.3	245.9	245.9
870	135.3	141.4	147.4	153.5	159.5	165.5	171.4	177.4	183.3	189.2	195.1	200.9	206.8	224.2	235.8	253.0	264.4	264.4
900	139.3	145.6	151.8	158.0	164.2	170.3	176.5	182.6	188.7	194.8	200.8	206.9	212.9	230.9	242.8	260.5	272.2	272.2
1000	152.4	159.3	166.1	172.9	179.2	185.3	192.3	199.3	206.6	213.3	219.9	226.5	233.1	252.8	265.8	285.2	298.1	298.1
1160	173.0	180.8	188.6	196.4	204.1	211.8	219.4	227.1	234.7	242.3	249.8	257.3	264.8	287.2	302.0	324.0	338.6	338.6
1750	245.1	256.3	267.4	278.4	289.4	300.4	311.3	322.2	333.0	343.8	354.5	365.1	375.8	407.4	428.3	459.3	479.7	479.7
2000	274.1	286.7	299.1	311.5	323.8	336.1	348.2	360.4	372.5	384.5	396.5	408.4	420.3	455.5	478.8	513.2	535.9	535.9
3000	382.9	400.4	417.7	435.0	452.1	469.2	486.0	502.8	524.3	542.9	561.6	579.9	598.2	616.2	634.1	651.9	663.9	663.9
3450	428.3	447.8	467.1	486.4	505.3	524.2	545.6	566.7	587.7	608.3	628.9	649.1						
4000	480.9	502.7	524.2	545.6	566.7	587.7	608.3	628.9	649.1									

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon® Belts

Belt Length Correction Factor Table

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-904	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				



Horsepower Rating for 68mm Wide 14mm Pitch Poly Chain® GT® Carbon Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)										Additional Horsepower per belt for Speed Ratio of Speed-Down Drives									
53 9.299	56 9.825	60 10.527	63 11.053	67 11.755	71 12.457	75 13.158	80 14.036	1.00 to 1.03	1.04 to 1.10	1.11 to 1.19	1.20 to 1.30	1.31 to 1.45	1.46 to 1.67	1.68 to 2.02	2.03 to 2.69	2.70 to 4.64	4.65 and Over	RPM OF FASTER SHAFT	
Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.										Drives in this area should be designed using Design Flex® Pro. Please consult www.gates.com/drivedesign for details.									
39.4	41.8	44.9	47.2	50.3	53.3	56.4	60.2	0.00	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.21	1.37	88	
43.8	46.4	49.9	52.5	55.9	59.3	62.7	66.9	0.00	0.17	0.35	0.52	0.69	0.86	1.03	1.21	1.38	1.55	100	
50.0	53.0	56.9	59.9	63.8	67.7	71.5	76.4	0.00	0.20	0.40	0.61	0.81	1.01	1.21	1.41	1.61	1.82	117	
70.4	74.6	80.1	84.3	89.8	95.3	100.7	107.5	0.00	0.30	0.60	0.91	1.21	1.51	1.81	2.11	2.42	2.72	175	
78.9	83.6	89.8	94.5	100.7	106.8	113.0	120.6	0.00	0.35	0.69	1.03	1.38	1.73	2.07	2.42	2.76	3.11	200	
90.0	95.3	102.5	107.8	114.8	121.9	128.8	137.5	0.00	0.40	0.80	1.21	1.61	2.01	2.41	2.81	3.22	3.62	233	
111.9	118.6	127.4	134.1	142.9	151.6	160.3	171.1	0.00	0.52	1.04	1.55	2.07	2.59	3.10	3.62	4.14	4.66	300	
127.8	135.5	145.6	153.2	163.3	173.2	183.2	195.5	0.00	0.60	1.21	1.81	2.42	3.02	3.62	4.23	4.83	5.43	350	
143.5	152.1	163.5	172.0	183.3	194.5	205.6	219.5	0.00	0.69	1.38	2.07	2.76	3.45	4.14	4.83	5.52	6.21	400	
174.2	184.6	198.5	208.8	222.5	236.1	249.5	266.3	0.00	0.86	1.73	2.59	3.45	4.31	5.17	6.04	6.90	7.76	500	
196.6	208.4	224.1	235.7	251.1	266.5	281.7	300.6	0.00	0.99	1.98	2.98	3.97	4.96	5.95	6.94	7.94	8.93	575	
204.0	216.3	232.5	244.6	260.6	276.5	292.3	311.9	0.00	1.04	2.07	3.10	4.14	5.18	6.21	7.25	8.28	9.32	600	
230.3	244.1	262.4	276.0	294.1	312.0	329.8	351.9	0.00	1.19	2.38	3.57	4.76	5.95	7.14	8.33	9.52	10.7	690	
233.2	247.2	265.7	279.5	297.8	315.9	333.9	356.3	0.00	1.21	2.42	3.62	4.83	6.04	7.24	8.45	9.66	10.9	700	
261.7	277.4	298.2	313.7	334.2	354.5	374.6	399.6	0.00	1.38	2.76	4.14	5.52	6.90	8.28	9.66	11.0	12.4	800	
281.4	298.3	320.6	337.2	359.2	381.0	402.6	429.4	0.00	1.50	3.00	4.50	6.00	7.51	9.00	10.5	12.0	13.5	870	
289.8	307.1	330.1	347.2	365.9	382.3	414.5	442.0	0.00	1.55	3.11	4.66	6.21	7.76	9.31	10.9	12.4	14.0	900	
317.3	336.3	361.4	380.1	404.8	429.3	453.5	483.5	0.00	1.73	3.45	5.17	6.90	8.63	10.3	12.1	13.8	15.5	1000	
360.4	381.9	410.4	431.5	459.4	487.0	514.3	548.1	0.00	2.00	4.00	6.00	8.01	10.0	12.0	14.0	16.0	18.0	1160	
510.2	540.2	579.6	608.8	647.2	684.9	721.8	767.3	0.00	3.02	6.04	9.05	12.1	15.1	18.1	21.1	24.2	27.2	1750	
569.6	602.8	646.3	678.4	720.4	761.6			0.00	3.45	6.90	10.3	13.8	17.3	20.7	24.2	27.6	31.1	3000	
								0.00	5.18	10.4	15.5	20.7	25.9	31.0	36.2	41.4	46.6	3450	
								0.00	5.96	11.9	17.9	23.8	29.8	35.7	41.7	47.6	53.6	55.2	
								0.00	6.91	13.8	20.7	27.6	34.5	41.4	48.3	55.2	62.1	4000	

Poly Chain® GT® Carbon®
Belt Length Correction Factor Table

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-994	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				

14mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 90mm Wide

RPM OF FASTER SHAFT	(Number of Grooves and Pitch Diameter, Inches)										Rated Horsepower for Small Sprocket					
	28	29	30	31	32	33	34	35	36	37	38	39	40	43	45	48
70	25.7	26.8	27.9	29.0	30.0	31.1	32.2	33.3	34.3	35.4	36.5	37.5	38.6	41.7	43.8	47.0
88	28.6	29.8	31.0	32.2	33.4	34.6	35.8	37.0	38.2	39.3	40.5	41.7	42.9	46.4	48.7	52.2
100	32.5	33.9	35.3	36.7	38.0	39.4	40.8	42.1	43.5	44.8	46.2	47.5	48.9	52.9	55.6	59.6
117	47.5	49.5	51.4	53.3	55.3	57.2	59.1	61.1	63.0	64.9	66.8	68.7	70.4	74.4	78.2	83.8
175	54.2	55.4	57.6	59.7	61.9	64.1	66.3	68.4	70.6	72.7	74.9	77.0	83.4	87.6	93.9	98.1
200	51.0	53.2	55.4	57.6	59.7	61.9	64.1	66.3	68.4	70.6	72.7	74.9	77.0	83.4	87.6	93.9
233	58.0	60.6	63.1	65.6	68.0	70.5	73.0	75.5	77.9	80.4	82.9	85.3	87.8	95.0	99.9	107.1
300	72.0	75.1	78.2	81.4	84.5	87.6	90.7	93.8	96.8	99.9	102.9	106.0	109.0	118.1	124.2	133.2
350	82.1	85.7	89.3	92.9	96.4	100.0	103.5	107.0	110.6	114.1	117.6	121.1	124.6	135.0	141.9	152.1
400	92.0	96.1	100.1	104.1	108.1	112.1	116.1	120.1	124.0	128.0	131.9	135.8	139.8	151.5	159.2	170.8
500	111.4	116.4	121.3	126.2	131.0	135.9	140.7	145.6	150.4	155.2	160.0	164.8	169.5	183.8	193.2	207.3
575	125.6	131.2	136.7	142.3	147.8	153.3	158.8	164.2	169.7	175.1	180.5	185.9	191.3	207.4	218.1	234.0
600	130.3	136.1	141.8	147.6	153.3	159.0	164.7	170.4	176.0	181.7	187.3	192.9	198.5	215.2	226.3	242.7
690	146.9	153.4	159.9	166.5	172.9	179.4	185.8	192.2	198.6	205.0	211.3	217.7	224.0	242.9	255.4	274.0
700	148.7	155.3	161.9	168.5	175.1	181.6	188.1	194.6	201.1	207.6	214.0	220.4	226.8	245.9	258.6	277.4
800	166.7	174.2	181.6	189.0	196.4	203.7	211.1	218.4	225.6	232.9	240.1	247.3	254.6	276.0	290.2	311.4
870	179.1	187.2	195.1	203.1	211.1	219.0	226.9	234.7	242.6	250.4	258.2	265.9	273.7	296.8	312.1	334.8
900	184.4	192.7	200.9	209.1	217.3	225.5	233.6	241.7	249.7	257.8	265.8	273.8	281.8	305.6	321.3	344.8
1000	201.8	210.9	219.9	228.9	237.8	246.8	255.7	264.6	273.4	282.3	291.1	299.8	308.6	334.6	351.9	377.5
1160	229.0	239.4	249.6	259.9	270.1	280.3	290.4	300.5	310.6	320.6	330.6	340.6	350.5	380.1	399.7	428.9
1750	324.4	339.2	353.9	368.5	383.1	397.6	412.0	426.4	440.7	455.0	469.1	483.2	497.3	539.2	566.8	607.9
2000	362.8	379.4	395.8	412.3	428.5	444.8	460.9	477.0	493.0	509.0	524.8	540.5	556.3	602.9	633.7	679.2
3000	506.8	530.0	552.9	575.8	598.4	620.9	643.2	665.5	687.5	709.4	731.1	752.6	774.0	837.3	878.6	909.3
3450	566.8	592.7	618.3	643.7	668.9	693.9	718.6	743.2	767.7	791.8	815.6	839.3	862.9			
4000	636.5	665.4	693.8	722.2	750.1	777.8	805.1	832.3	859.1							

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon®
Belt Length Correction Factor Table

Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-904	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.16
14MGT-1890	135	0.92	14MGT-3500	250	1.18
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				



Gates Corporation

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Horsepower Rating for 90mm Wide

14mm Pitch Poly Chain® GT® Carbon Belts

Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)										Additional Horsepower per belt for Speed Ratio of Speed-Down Drives											
53	56	60	63	67	71	75	80	1.00 to 1.03	1.04 to 1.10	1.11 to 1.19	1.20 to 1.30	1.31 to 1.45	1.46 to 1.67	1.68 to 2.02	2.03 to 2.69	2.70 to 4.64	4.65 and Over	RPM OF FASTER SHAFT			
9.299	9.825	10.527	11.053	11.755	12.457	13.158	14.036	1.00 to 1.03	1.04 to 1.10	1.11 to 1.19	1.20 to 1.30	1.31 to 1.45	1.46 to 1.67	1.68 to 2.02	2.03 to 2.69	2.70 to 4.64	4.65 and Over	58			
52.2	55.3	59.4	62.4	66.5	70.6	74.6	79.6	0.00	0.20	0.40	0.60	0.80	1.00	1.21	1.41	1.61	1.81	20			
58.0	61.5	66.0	69.5	74.0	78.5	83.0	88.6	0.00	0.23	0.46	0.68	0.91	1.14	1.37	1.60	1.83	2.05	100			
66.2	70.1	75.3	79.2	84.4	89.6	94.7	101.1	0.00	0.27	0.53	0.80	1.07	1.34	1.60	1.87	2.14	2.40	117			
93.1	98.7	106.1	111.6	118.9	126.1	133.3	142.3	0.00	0.40	0.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	175			
104.4	110.6	118.9	125.1	133.3	141.4	149.5	159.6	0.00	0.46	0.91	1.37	1.83	2.28	2.74	3.20	3.65	4.11	200			
119.1	126.2	135.6	142.6	152.0	161.3	170.5	182.0	0.00	0.53	1.06	1.60	2.13	2.66	3.19	3.72	4.26	4.79	233			
148.1	156.9	168.7	177.4	189.1	200.6	212.1	226.4	0.00	0.69	1.37	2.05	2.74	3.43	4.11	4.79	5.48	6.16	300			
169.2	179.3	192.8	202.8	216.1	229.3	242.4	258.7	0.00	0.80	1.60	2.40	3.20	4.00	4.79	5.59	6.39	7.19	350			
190.0	201.3	216.4	227.7	242.6	257.4	272.2	290.5	0.00	0.91	1.83	2.74	3.65	4.57	5.48	6.39	7.31	8.22	400			
230.5	244.4	262.7	276.3	294.4	312.4	330.3	352.5	0.00	1.14	2.28	3.42	4.57	5.71	6.85	7.99	9.13	10.3	500			
260.2	275.9	296.6	312.0	332.4	352.7	372.8	397.8	0.00	1.31	2.63	3.94	5.25	6.57	7.88	9.19	10.5	11.8	575			
270.0	286.2	307.7	323.7	344.9	365.9	386.8	412.8	0.00	1.37	2.74	4.11	5.48	6.85	8.22	9.59	11.0	12.3	600			
304.8	323.1	347.3	365.4	389.3	413.0	436.5	465.7	0.00	1.58	3.15	4.73	6.30	7.88	9.45	11.0	12.6	14.2	690			
308.6	327.1	351.7	369.9	394.1	418.2	442.0	471.5	0.00	1.60	3.20	4.79	6.39	7.99	9.59	11.2	12.8	14.4	700			
346.4	367.2	394.7	415.2	442.3	469.2	495.8	528.9	0.00	1.83	3.65	5.48	7.31	9.14	11.0	12.8	14.6	16.4	800			
372.5	394.8	424.4	446.3	475.4	504.3	532.9	568.3	0.00	1.99	3.97	5.96	7.95	9.93	11.9	13.9	15.9	17.9	870			
383.5	406.5	436.9	459.6	489.5	519.2	548.6	585.1	0.00	2.06	4.11	6.16	8.22	10.3	12.3	14.4	16.4	18.5	900			
419.9	445.1	478.4	503.1	535.8	568.2	600.2	640.0	0.00	2.29	4.57	6.85	9.13	11.4	13.7	16.0	18.3	20.5	1000			
477.0	505.5	543.1	571.1	608.0	644.6	680.7	725.4	0.00	2.65	5.30	7.94	10.6	13.2	15.9	18.5	21.2	23.8	1160			
675.2	714.9	767.2	805.8	856.5	906.4	955.4	1016	0.00	4.00	7.99	12.0	16.0	20.0	24.0	28.0	32.0	36.0	1750			
753.9	797.8	855.4	897.9	953.5	1008			0.00	4.57	9.13	13.7	20.5	27.4	32.0	36.5	41.1	54.8	3000			
								0.00	6.86	13.7	23.6	31.5	39.4	47.3	55.1	63.0	70.9	3450			
								0.00	7.88	15.8	23.6	31.5	39.4	47.3	55.1	63.0	70.9	3450			
								0.00	9.14	18.3	27.4	36.5	45.7	54.8	63.9	73.1	82.2	4000			

Poly Chain® GT® Carbon®
Belt Length Correction Factor Table

Pitch/length Designation	Number of Teeth	Correction Factor	Pitch/length Designation	Number of Teeth	Correction Factor
14MGT-994	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170	1.01			

14mm Pitch Poly Chain® GT® Carbon® Belts

Horsepower Rating for 125mm Wide

RPM OF FASTER SHAFT	Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)									
	28	29	30	31	32	33	34	35	36	37
10										
20										
35										
44										
58										
70										
88	35.7	37.2	38.7	40.2	41.7	43.2	44.7	46.2	47.7	49.2
100	39.7	41.4	43.0	44.7	46.4	48.0	49.7	51.3	53.0	54.6
117	45.2	47.1	49.0	50.9	52.8	54.7	56.6	58.5	60.4	62.3
175	63.3	66.0	68.7	71.4	74.1	76.8	79.5	82.1	84.8	87.5
200	70.8	73.9	76.9	80.0	83.0	86.0	89.0	92.0	95.0	98.0
233	80.6	84.1	87.6	91.1	94.5	98.0	101.4	104.8	108.3	111.7
300	100.0	104.3	108.7	113.0	117.3	121.6	125.9	130.2	134.5	138.7
350	114.0	119.0	124.0	129.0	133.9	138.9	143.8	148.7	153.5	158.4
400	127.8	133.5	139.1	144.6	150.2	155.8	161.3	166.8	172.3	177.8
500	154.8	161.6	168.4	175.2	182.0	188.8	195.5	202.2	208.9	215.6
575	174.5	182.2	189.9	197.6	205.3	212.9	220.5	228.1	235.7	243.2
600	181.0	189.0	197.0	205.0	212.9	220.9	228.8	236.7	244.5	252.3
690	204.0	213.1	222.1	231.2	240.2	249.1	258.1	267.0	275.8	284.7
700	206.5	215.8	224.9	234.1	243.1	252.2	261.3	270.3	279.3	288.3
800	231.6	241.9	252.2	262.5	272.7	283.0	293.1	303.3	313.4	323.5
870	248.8	260.0	271.0	282.1	293.1	304.2	315.1	326.0	336.9	347.8
900	256.1	267.6	279.0	290.5	301.8	313.1	324.4	335.7	346.9	358.1
1000	280.2	292.9	305.4	317.9	330.3	342.8	355.1	367.5	379.8	392.1
1160	318.0	332.4	346.7	361.0	375.1	389.3	403.3	417.4	431.3	445.3
1750	450.5	471.1	491.5	511.8	532.0	552.2	572.2	592.2	612.1	631.9
2000	503.9	527.0	549.8	572.6	595.2	617.8	640.2	662.5	684.7	706.9
3000	703.8	736.1	767.9	799.7	831.1	862.4	893.4	924.3	954.8	985.3
3450	787.3	823.2	858.7	894.1	928.9	963.7	998.1	1032	1066	1100
4000	884.0	924.1	963.7	1003	1042	1080	1118	1156	1193	1220

Drives in this area should be designed using Design Flex® Pro.
Please consult www.gates.com/drivedesign for details.

Poly Chain® GT® Carbon® Belt Length Correction Factor Table					
Pitch/Length Designation	Number of Teeth	Correction Factor	Pitch/Length Designation	Number of Teeth	Correction Factor
14MGT-904	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				



Gates Corporation

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Horsepower Rating for 125mm Wide 14mm Pitch Poly Chain® GT® Carbon® Belts

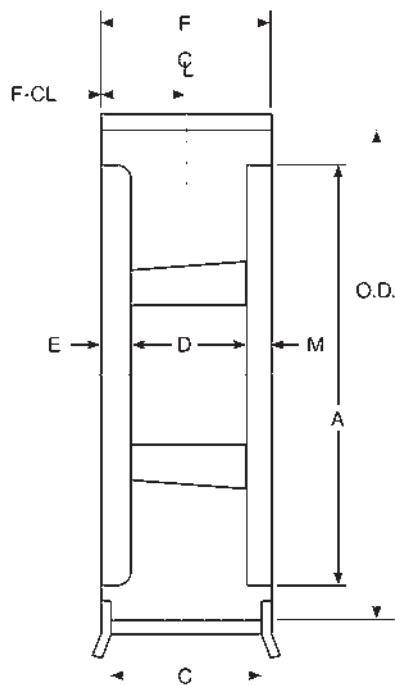
Rated Horsepower for Small Sprocket (Number of Grooves and Pitch Diameter, Inches)										Additional Horsepower per belt for Speed Ratio of Speed-Down Drives									
53 9,299	56 9,825	60 10,527	63 11,053	67 11,755	71 12,457	75 13,158	80 14,036	1.00 to 1.03	1.04 to 1.10	1.11 to 1.19	1.20 to 1.30	1.31 to 1.45	1.46 to 1.67	1.68 to 2.02	2.03 to 2.69	2.70 to 4.64	4.65 and Over	RPM OF FASTER SHAFT	
72.4	76.7	82.5	86.7	92.4	98.0	103.6	110.6	0.00	0.28	0.56	0.84	1.12	1.40	1.67	1.95	2.23	2.51	88	
80.6	85.4	91.7	96.5	102.8	109.0	115.3	123.0	0.00	0.32	0.63	0.95	1.27	1.59	2.22	2.54	2.85	100		
91.9	97.4	104.6	110.1	117.2	124.4	131.5	140.4	0.00	0.37	0.74	1.11	1.48	1.86	2.23	2.60	2.97	3.34	117	
129.4	137.1	147.3	154.9	165.1	175.2	185.2	197.7	0.00	0.56	1.11	1.66	2.22	2.78	3.33	3.88	4.44	4.99	175	
145.0	153.7	165.2	173.7	185.1	196.4	207.6	221.6	0.00	0.63	1.27	1.90	2.54	3.17	3.81	4.44	5.07	5.71	200	
165.4	175.2	188.3	198.1	211.1	224.0	236.8	252.8	0.00	0.74	1.48	2.22	2.96	3.70	4.43	5.17	6.65	7.33	233	
205.6	217.9	234.3	246.4	262.6	274.6	294.6	314.4	0.00	0.95	1.90	2.85	3.81	4.76	5.71	6.66	7.61	8.56	300	
235.0	249.1	267.7	281.6	300.1	318.5	336.7	359.4	0.00	1.11	2.22	3.33	4.44	5.55	6.66	7.77	8.88	9.99	350	
263.8	279.6	300.6	316.2	337.0	357.6	378.0	403.5	0.00	1.27	2.54	3.80	5.08	6.34	7.61	8.88	10.1	11.4	400	
320.2	339.4	364.8	383.8	409.0	433.9	458.7	489.6	0.00	1.59	3.17	4.76	6.34	7.93	9.51	11.1	12.7	14.3	500	
361.4	383.1	411.9	433.3	461.7	489.8	517.8	552.6	0.00	1.82	3.65	5.47	7.30	9.12	10.9	12.8	14.6	16.4	575	
375.0	397.5	427.4	449.6	479.0	508.2	537.2	573.3	0.00	1.90	3.81	5.71	7.61	9.52	11.4	13.3	15.2	17.1	600	
423.3	448.7	482.4	507.4	540.6	573.6	606.2	646.8	0.00	2.19	4.38	6.56	8.75	10.9	13.1	15.3	17.5	19.7	690	
428.6	454.4	488.4	513.8	547.4	580.8	613.8	654.9	0.00	2.22	4.44	6.66	8.88	11.1	13.3	15.5	17.8	20.0	700	
481.2	510.0	548.2	576.7	614.3	651.7	688.7	734.6	0.00	2.54	5.07	7.61	10.2	12.7	15.2	17.8	20.3	22.8	800	
517.3	548.3	589.4	619.9	660.3	700.4	740.1	789.4	0.00	2.76	5.52	8.28	11.0	13.8	16.6	19.3	22.1	24.8	870	
532.7	564.6	606.9	638.3	679.9	721.1	761.9	812.6	0.00	2.86	5.71	8.56	11.4	14.3	17.1	20.0	22.8	25.7	900	
583.3	618.2	664.9	698.7	744.1	789.1	833.7	888.8	0.00	3.17	6.34	9.51	12.7	15.9	19.0	22.2	25.4	28.5	1000	
662.4	702.0	754.3	793.1	844.5	895.2	945.4	1008	0.00	3.68	7.36	11.0	14.7	18.4	22.1	25.8	29.4	33.1	1160	
937.8	992.9	1066	1119	1190	1259	1327	1410	0.00	5.55	11.1	16.6	22.2	27.8	33.3	38.8	44.4	49.9	1750	
1047	1108	1188	1247	1324	1400			0.00	6.35	12.7	19.0	25.4	31.7	38.1	44.4	50.7	57.1	2000	
								0.00	9.52	19.0	28.5	38.1	47.6	57.1	66.6	76.1	85.6	3000	
								0.00	10.9	21.9	32.8	43.8	54.7	65.6	76.6	87.5	98.5	3450	
								0.00	12.7	25.4	38.0	50.8	63.4	76.1	88.8	101.5	114.2	4000	

Poly Chain® GT® Carbon®
Belt Length Correction Factor Table

Pitch/length Designation	Number of Teeth	Correction Factor	Pitch/length Designation	Number of Teeth	Correction Factor
14MGT-994	71	0.68	14MGT-2450	175	1.02
14MGT-1120	80	0.73	14MGT-2520	180	1.03
14MGT-1190	85	0.75	14MGT-2590	185	1.04
14MGT-1260	90	0.77	14MGT-2660	190	1.05
14MGT-1400	100	0.81	14MGT-2800	200	1.07
14MGT-1568	112	0.85	14MGT-3136	224	1.12
14MGT-1610	115	0.86	14MGT-3304	236	1.14
14MGT-1750	125	0.89	14MGT-3360	240	1.14
14MGT-1890	135	0.92	14MGT-3500	250	1.16
14MGT-1960	140	0.94	14MGT-3850	275	1.19
14MGT-2100	150	0.96	14MGT-3920	280	1.20
14MGT-2240	160	0.99	14MGT-4326	309	1.24
14MGT-2310	165	1.00	14MGT-4410	315	1.25
14MGT-2380	170				

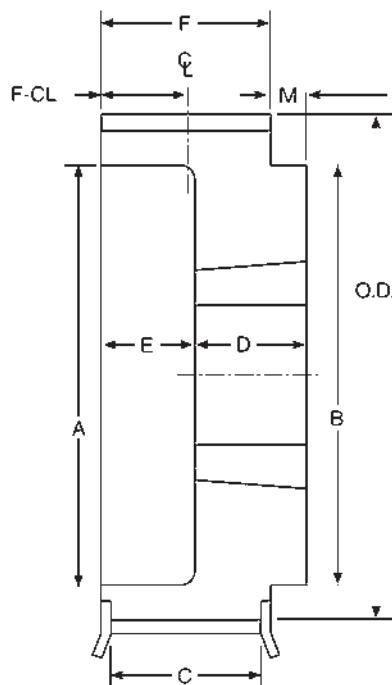
Gates Poly Chain® GT®2 Sprocket Specifications

Type A



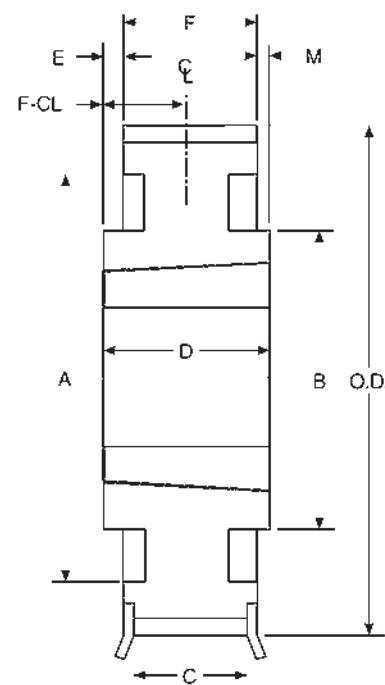
Type AF

Type B



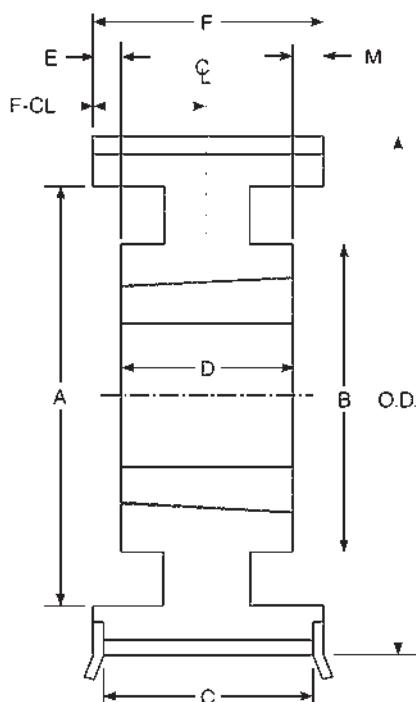
Type BF

Type C



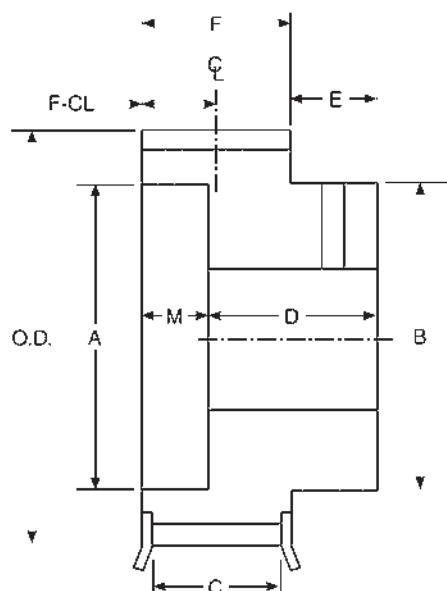
Type CF

Type D



Type DF

Type 6



Type 6F

2D and 3D Sprocket Drawings are available at www.gates.com/designview

Stock 8mm Gates Poly Chain® GT®2 Sprocket Specifications

Sprocket Number	Number of Teeth	Diameters (in)				Dimensions (in)						Approx Wt. (lb)	Approx WR ²	Matl. Spec					
		Pitch	O.D.	Flange Ref.	Design Type	A	B	C	D	E	F			Bushing Size	Bore Sizes		Min	Max	
8MK-22S-12	22	2.206	2.143	2.610	AF-1	0.00	—	0.60	0.88	—	0.88	0.01	0.44	1.008	0.500	1.000	0.4	0.002	DI
PB8MK-22S-12	22	2.206	2.143	2.610	6F-1	—	1.79	0.57	1.31	0.46	0.85	0	0.43	MPB	0.500	1.188	1.0	0.004	DI
8MK-22S-12	25	2.506	2.443	2.910	AF-1	0.00	—	0.60	0.88	—	0.88	0.01	0.44	1.108	0.500	1.125	0.6	0.004	GI
PB8MK-22S-12	25	2.506	2.443	2.910	6F-1	—	2.08	0.57	1.31	0.46	0.85	0	0.43	MPB	0.500	1.500	1.4	0.006	DI
8MK-26S-12	26	2.607	2.544	2.906	AF-1	—	—	0.60	0.88	—	0.88	0	0.44	1.108	0.500	1.125	0.60	0.005	GI
8MK-27S-12	27	2.707	2.644	3.207	AF-1	—	—	0.60	0.88	—	0.88	0	0.44	1.108	0.500	1.125	0.70	0.006	GI
8MK-28S-12	28	2.807	2.744	3.210	AF-1	0.00	—	0.60	0.88	—	0.88	0.01	0.44	1.108	0.500	1.125	0.9	0.007	GI SS
PB8MK-26S-12	28	2.807	2.744	3.210	6F-1	—	2.34	0.57	1.31	0.46	0.85	0	0.43	MPB	0.500	1.750	1.8	0.011	DI SS
8MK-29S-12	29	2.907	2.844	3.090	AF-1	—	—	0.68	0.88	—	0.88	0	0.44	1.108	0.500	1.125	1.10	0.008	GI SS
8MK-30S-12	30	3.008	2.945	3.410	AF-1	0.00	—	0.60	0.88	—	0.88	0.01	0.44	1.108	0.500	1.125	1.1	0.009	GI SS
PB8MK-30S-12	30	3.008	2.945	3.410	6F-1	—	2.54	0.57	1.42	0.57	0.85	0	0.43	MPB	0.500	1.813	2.2	0.015	DI SS
8MK-31S-12	31	3.108	3.045	3.328	AF-1	—	—	0.80	1.00	—	1.00	0	0.50	1210	0.500	1.250	1.10	0.012	GI
8MK-32S-12	32	3.208	3.145	3.610	AF-1	—	—	0.72	1.00	—	1.00	0	0.50	1210	0.500	1.250	1.2	0.012	DI SS
PB8MK-32S-12	32	3.208	3.145	3.610	6F-1	—	2.73	0.57	1.42	0.57	0.85	0	0.43	MPB	0.500	2.000	2.5	0.020	DI SS
8MK-33S-12	33	3.308	3.245	3.566	AF-1	—	—	0.80	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.10	0.014	DI
8MK-34S-12	34	3.409	3.346	3.810	AF-1	—	—	0.72	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.1	0.014	DI SS
8MK-35S-12	35	3.509	3.446	3.805	AF-1	—	—	0.80	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.30	0.019	GI
8MK-36S-12	36	3.609	3.546	4.010	AF-1	—	—	0.72	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.4	0.019	GI SS
8MK-37S-12	37	3.709	3.646	4.044	AF-1	—	—	0.80	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.60	0.024	GI
8MK-38S-12	38	3.810	3.747	4.210	AF-1	—	—	0.72	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.7	0.025	GI SS
8MK-39S-12	39	3.910	3.847	4.410	AF-1	—	—	0.72	1.00	—	1.00	0	0.50	1610	0.500	1.688	1.90	0.032	GI
8MK-40S-12	40	4.010	3.947	4.410	BF-1	—	3.56	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	1.7	0.031	DI SS
8MK-41S-12	41	4.110	4.047	4.520	BF-1	—	3.645	0.65	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	2.30	0.038	DI
8MK-42S-12	42	4.211	4.148	4.910	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	2.1	0.042	GI SS
8MK-43S-12	45	4.511	4.448	4.910	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	2.6	0.055	GI SS
8MK-48S-12	48	4.812	4.749	5.210	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	3.4	0.081	GI SS
8MK-50S-12	50	5.013	4.950	5.410	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	3.7	0.094	GI SS
8MK-53S-12	53	5.314	5.251	5.500	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	4.7	0.132	GI SS
8MK-56S-12	56	5.614	5.551	6.010	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	5.4	0.165	GI SS
8MK-60S-12	60	6.015	5.952	6.410	BF-1	—	3.76	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	6.3	0.217	GI SS
8MK-63S-12	63	6.316	6.253	6.720	CF-1	5.71	4.00	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	4.1	0.140	GI
8MK-67S-12	67	6.717	6.654	6.870	CF-1	6.14	4.00	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	4.3	0.164	GI
8MK-71S-12	71	7.118	7.055	7.500	CF-1	6.51	4.00	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	4.7	0.199	GI
8MK-75S-12	75	7.519	7.456	7.920	CF-1	6.90	4.00	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	5.1	0.239	GI
8MK-80S-12	80	8.020	7.957	8.420	CF-1	7.23	4.00	0.57	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	5.8	0.323	GI
8MK-90S-12	90	9.023	8.960	—	C-2	8.05	4.00	—	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	8.0	0.563	GI
8MK-112S-12	112	11.129	11.166	—	C-2	10.25	4.00	—	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	12.0	1.405	GI
8MK-140S-12	140	14.036	13.973	—	C-3	11.96	4.38	—	1.25	—	0.85	0.40	0.43	2012	0.500	2.125	17.0	3.176	GI
8MK-180S-12	180	18.046	17.983	—	C-3	15.80	4.88	—	1.75	—	0.85	0.90	0.43	2517	0.500	2.688	26.6	8.146	GI
8MK-224S-12	224	22.457	22.394	—	C-3	20.17	4.88	—	1.75	—	0.85	0.90	0.43	2517	0.500	2.688	37.0	17.98	GI

Material Spec: GI - Grey Iron DI - Ductile Iron SS - Stainless Steel

Design Type Suffix: 1 - Solid 2 - Web 3 - Arms

Note: 2D and 3D sprocket drawings are available at www.gates.com/picatolg
NOTE: Weights for Minimum Plain Bore (MPB) Sprockets do not include bushings. •WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.

Stock 8nm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Design Type		Dimensions (in)			Bore Sizes			Approx. Wt. (lb)	Approx. WR ²	Mati. Spec				
		Pitch	O.D.	Range Ref.	A	B	C	D	E	F	M	F-Cl.	Bushing Size	Min	Max				
8MAX-22S-21	22	2.206	2.143	2.610	AF-1	1.63	—	0.92	0.88	—	1.20	0.33	0.60	1.008	0.500	1,000	0.6	0.002	DI, NP
PB8MAX-22S-21	22	2.206	2.143	2.610	6F-1	—	1.79	0.92	1.65	0.45	1.20	0	0.60	MPB	0.500	1.188	1.3	0.005	DI
8MAX-25S-21	25	2.506	2.443	2.910	AF-1	1.92	—	0.92	0.88	—	1.20	0.33	0.60	1.108	0.500	1.125	0.8	0.005	GI, NP
PB8MAX-25S-21	25	2.506	2.443	2.910	6F-1	—	2.08	0.92	1.65	0.45	1.20	0	0.60	MPB	0.500	1.500	1.8	0.009	DI
8MAX-26S-21	26	2.607	2.544	2.906	AF	1.85	-	0.92	0.88	-	1.2	0.32	0.6	1.108	0.500	1.125	0.80	0.006	GI, NP
8MAX-27S-21	27	2.707	2.644	3.207	AF	1.95	-	0.92	0.88	-	1.2	0.32	0.6	1.108	0.500	1.125	0.90	0.007	GI, NP
8MAX-28S-21	28	2.807	2.744	3.210	AF-1	2.18	—	0.92	0.88	—	1.20	0.33	0.60	1.108	0.500	1.125	1.0	0.008	GI, SS, NP
PB8MAX-28S-21	28	2.807	2.744	3.210	6F-1	—	2.34	0.92	1.65	0.45	1.20	0	0.60	MPB	0.500	1.750	2.3	0.014	DI, SS
8MAX-29S-21	29	2.907	2.844	3.09	AF	2.15	-	0.92	0.88	-	1.2	0.32	0.6	1.108	0.500	1.125	1.00	0.010	GI, SS, NP
8MAX-30S-21	30	3.008	2.945	3.410	AF-1	2.38	—	0.92	0.88	—	1.20	0.33	0.60	1.108	0.500	1.125	1.3	0.011	GI, SS, NP
PB8MAX-30S-21	30	3.008	2.945	3.410	6F-1	—	2.54	0.92	1.77	0.57	1.20	0	0.60	MPB	0.500	1.813	2.8	0.020	DI, SS
8MAX-31S-21	31	3.108	3.045	3.328	AF	2.35	-	0.92	1	-	1.2	0.2	0.6	1210	0.500	1.250	1.10	0.013	GI, NP
8MAX-32S-21	32	3.208	3.145	3.610	AF-1	2.58	—	0.92	1.00	—	1.20	0.20	0.60	1210	0.500	1.250	1.4	0.015	DI, SS, NP
PB8MAX-32S-21	32	3.208	3.145	3.610	6F-1	—	2.73	0.92	1.77	0.57	1.20	0	0.60	MPB	0.500	2.000	3.2	0.026	DI, SS
8MAX-33S-21	33	3.308	3.245	3.566	AF	2.6	-	0.92	1	-	1.2	0.2	0.6	1610	0.500	1.688	1.10	0.016	DI, NP
8MAX-34S-21	34	3.409	3.346	3.810	AF-1	2.66	—	0.92	1.00	—	1.20	0.20	0.60	1610	0.500	1.688	1.4	0.018	DI, SS, NP
8MAX-35S-21	35	3.509	3.446	3.805	AF	2.75	-	0.92	1	-	1.2	0.2	0.6	1610	0.500	1.688	1.30	0.021	GI, NP
8MAX-36S-21	36	3.609	3.546	4.010	AF-1	2.96	—	0.92	1.00	—	1.20	0.20	0.60	1610	0.500	1.688	1.66	0.023	DI, SS, NP
8MAX-37S-21	37	3.709	3.646	4.044	AF	2.95	-	0.92	1	-	1.2	0.2	0.6	1610	0.500	1.688	1.60	0.028	GI, NP
8MAX-38S-21	38	3.810	3.747	4.210	AF-1	3.15	—	0.92	1.00	—	1.20	0.20	0.60	1610	0.500	1.688	1.9	0.030	DI, SS, NP
8MAX-39S-21	39	3.910	3.847	4.411	AF	3.14	-	0.92	1	-	1.2	0.2	0.6	1610	0.500	1.688	1.90	0.035	GI, NP
8MAX-40S-21	40	4.010	3.947	4.410	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	2.0	0.037	DI, SS, NP
8MAX-41S-21	41	4.110	4.047	4.52	BF	—	3.4	1	-	1.25	1.2	0.05	0.6	2012	0.500	2.125	2.30	0.043	DI, NP
8MAX-42S-21	42	4.211	4.148	4.910	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	2.4	0.048	GI, SS, NP
8MAX-45S-21	45	4.511	4.448	4.910	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	3.0	0.067	GI, SS, NP
8MAX-48S-21	48	4.812	4.749	5.210	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	3.7	0.092	GI, SS, NP
8MAX-50S-21	50	5.013	4.950	5.410	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	4.2	0.111	GI, SS, NP
8MAX-53S-21	53	5.314	5.251	5.500	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	5.0	0.145	GI, NP
8MAX-56S-21	56	5.614	5.551	6.010	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	5.8	0.184	GI, SS, NP
8MAX-60S-21	60	6.016	5.952	6.420	AF-1	—	—	0.97	1.25	—	1.25	0	0.63	2012	0.500	2.125	6.9	0.247	GI, SS, NP
8MAX-63S-21	63	6.316	6.253	6.720	CF-1	5.71	3.76	0.92	1.25	—	1.20	0.05	0.60	2012	0.500	2.125	4.1	0.154	GI, NP
8MAX-67S-21	67	6.717	6.654	6.880	CF-1	6.14	4.50	0.92	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	5.7	0.232	GI, NP
8MAX-71S-21	71	7.118	7.055	7.500	CF-1	6.51	4.50	0.92	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	6.1	0.275	GI, NP
8MAX-75S-21	75	7.519	7.456	7.920	CF-1	6.90	4.50	0.92	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	6.5	0.323	GI, NP
8MAX-80S-21	80	8.020	7.957	8.420	CF-1	7.23	4.50	0.92	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	7.5	0.432	GI, NP
8MAX-90S-21	90	9.023	8.960	—	C-2	7.78	4.50	—	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	11.0	0.825	GI, NP
8MAX-112S-21	112	11.229	11.166	—	C-2	10.00	4.50	—	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	16.0	1.892	GI, NP
8MAX-140S-21	140	14.036	13.973	—	C-3	11.74	4.88	—	1.75	—	1.20	0.55	0.60	2517	0.500	2.688	24.1	4.707	GI, NP
8MAX-180S-21	180	18.046	17.983	—	C-3	15.49	6.25	—	2.00	—	1.20	0.80	0.60	3220	0.875	3.250	39.0	12.02	GI, NP
8MAX-22S-21	224	22.394	—	C-3	19.86	6.25	—	2.00	—	1.20	0.80	0.60	3220	0.875	3.250	53.4	26.34	GI, NP	

Material Spec : GI - Grey Iron DI - Ductile Iron SS - Stainless Steel

Note: 2D and 3D sprocket drawings are available at www.gates.com/picatag

NOTE: •Weights for Minimum Plain Bore (MPB) Sprockets do not include bushings. •WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.



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Stock 8mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Design Type			Dimensions (in)			Bushings			Approx Wt. (lb)		Approx WR ²	Matl. Spec		
		Pitch	O.D.	Flange Ref.	A	B	C	D	E	F	M	F-CL	Bushing Size	Min	Max				
PBMX-22S-36	22	2.206	2.143	2.610	6F-1	—	1.79	1.58	2.44	0.58	0	0.93	MPB	0.500	1.188	2.0	0.008	DI	
PBMX-25S-36	25	2.506	2.443	2.910	6F-1	—	2.08	1.58	2.44	0.58	0	0.93	MPB	0.500	1.500	2.7	0.013	DI	
PBMX-28S-36	28	2.807	2.744	3.210	6F-1	—	2.34	1.58	2.44	0.58	0	0.93	MPB	0.500	1.750	3.4	0.021	DI	
PBMX-30S-36	30	3.008	2.945	3.410	6F-1	—	2.54	1.58	2.44	0.58	0	0.93	MPB	0.500	1.813	3.9	0.029	DI	
8MX-32S-36	32	3.208	3.145	3.610	AF-1	2.58	—	1.58	1.00	—	1.86	0.86	0.93	1210	0.500	1.250	1.7	0.02	DI
PBMX-32S-36	32	3.208	3.145	3.610	6F-1	—	2.73	1.58	2.44	0.58	0	0.93	MPB	0.500	2.000	4.5	0.038	DI	
8MX-33S-36	33	3.308	3.245	3.566	AF	2.56	—	1.66	1	—	1.86	0.86	0.93	1610	0.500	1.688	3.31	0.022	DI
8MX-34S-36	34	3.409	3.346	3.810	AF-1	2.66	—	1.58	1.00	—	1.86	0.86	0.93	1610	0.500	1.688	1.8	0.026	DI
PBMX-34S-36	34	3.409	3.346	3.810	6F-1	—	2.82	1.58	2.45	0.59	0	0.93	MPB	0.500	2.125	5.1	0.047	DI	
8MX-35S-36	35	3.509	3.446	3.805	AF	2.76	—	1.66	1	—	1.86	0.86	0.93	1610	0.500	1.688	3.51	0.029	DI
8MX-36S-36	36	3.609	3.546	4.010	AF-1	2.96	—	1.58	1.00	—	1.86	0.86	0.93	1610	0.500	1.688	2.1	0.032	DI
PBMX-36S-36	36	3.609	3.546	4.010	6F-1	—	3.13	1.58	2.51	0.65	0	0.93	MPB	0.500	2.313	5.9	0.063	DI	
8MX-37S-36	37	3.709	3.646	4.044	AF	2.9	—	1.66	1	—	1.86	0.86	0.93	1610	0.500	1.688	3.78	0.039	GI
8MX-38S-36	38	3.810	3.747	4.210	AF-1	3.15	—	1.58	1.00	—	1.86	0.86	0.93	1610	0.500	1.688	2.4	0.04	DI
PBMX-38S-36	38	3.810	3.747	4.210	6F-1	—	3.32	1.58	2.51	0.65	0	0.93	MPB	0.500	2.438	6.7	0.079	DI	
8MX-39S-36	39	3.910	3.847	4.41	AF	3.1	—	1.58	1	—	1.86	0.86	0.93	1610	0.500	1.688	3.91	0.048	GI
8MX-40S-36	40	4.010	3.947	4.410	AF-1	3.35	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	2.5	0.049	DI
8MX-41S-36	41	4.110	4.047	4.52	AF	3.36	—	1.66	1	—	1.86	0.51	0.93	2012	0.500	2.125	4.11	0.057	DI
8MX-42S-36	42	4.211	4.148	4.910	AF-1	3.62	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	2.8	0.061	DI
8MX-43S-36	45	4.511	4.448	4.910	AF-1	3.62	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	3.8	0.09	GI
8MX-46S-36	48	4.812	4.749	5.210	AF-1	4.14	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	4.3	0.114	GI
8MX-50S-36	50	5.013	4.950	5.410	AF-1	4.13	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	5.1	0.143	GI
8MX-53S-36	53	5.314	5.251	5.500	AF-1	4.76	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	5.5	0.169	GI
8MX-56S-36	56	5.614	5.551	6.010	AF-1	4.92	—	1.58	1.25	—	1.86	0.61	0.93	2012	0.500	2.125	6.5	0.221	GI
8MX-60S-36	60	6.015	5.952	6.420	AF-1	5.13	—	1.58	1.75	—	1.86	0.11	0.93	2517	0.500	2.688	8.9	0.352	GI
8MX-63S-36	63	6.316	6.253	6.720	AF-1	5.71	—	1.58	1.75	—	1.86	0.11	0.93	2517	0.500	2.688	10.4	0.556	GI
8MX-67S-36	67	6.717	6.654	6.880	DF-1	5.98	4.25	1.58	1.75	—	1.86	0.11	0.93	2517	0.500	2.688	6.5	0.307	GI
8MX-71S-36	71	7.118	7.055	7.500	DF-1	6.39	4.25	1.58	1.75	—	1.86	0.11	0.93	2517	0.500	2.688	7.0	0.365	GI
8MX-75S-36	75	7.519	7.456	7.920	DF-1	6.79	4.25	1.58	1.75	—	1.86	0.11	0.93	2517	0.500	2.688	7.3	0.423	GI
8MX-80S-36	80	8.020	7.957	8.420	BF-1	—	5.75	1.58	2.00	—	1.86	0.14	0.93	3020	0.875	3.250	17.9	1.202	GI
8MX-90S-36	90	9.023	8.960	—	B-1	—	5.75	—	2.00	—	1.86	0.14	0.93	3020	0.875	3.250	24.2	1.982	GI
8MX-112S-36	112	11.229	11.166	—	C-2	9.80	5.75	—	2.00	—	1.86	0.14	0.93	3020	0.875	3.250	22.7	2.768	GI
8MX-140S-36	140	14.036	13.973	—	C-3	11.72	6.25	—	2.00	—	1.86	0.14	0.93	3020	0.875	3.250	36.2	7.29	GI
8MX-150S-36	180	18.046	17.983	—	C-3	15.31	6.25	—	2.00	—	1.86	0.14	0.93	3020	0.875	3.250	54.4	18.67	GI
8MX-224S-36	224	22.457	22.394	—	C-3	19.62	8.75	—	2.50	—	1.86	0.64	0.93	3525	1.188	3.938	91.1	4240	GI



Stock 8mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Dimensions (in)							Bore Sizes Min	Bore Sizes Max	Approx Wt. (lb)	Approx WR ²	Mati. Spec				
		Pitch	O.D.	Flange Ref.	A	B	C	D	E	F	M									
PB8MK-22S-62	22	2.206	2.143	2.610	6F-1	—	1.79	2.63	3.56	0.65	2.91	0	1.46	MPB	1.000	1.188	2.4	0.011	DI	
PB8MK-25S-62	25	2.506	2.443	2.910	6F-1	—	2.08	2.63	3.56	0.65	2.91	0	1.46	MPB	1.000	1.500	3.4	0.019	DI	
PB8MK-28S-62	28	2.807	2.744	3.210	6F-1	—	2.34	2.63	3.56	0.65	2.91	0	1.46	MPB	1.000	1.750	4.5	0.032	DI	
PB8MK-30S-62	30	3.008	2.945	3.410	6F-1	—	2.54	2.63	3.50	0.58	2.92	0	1.46	MPB	1.000	1.813	5.2	0.042	DI	
PB8MK-32S-62	32	3.208	3.145	3.610	6F-1	—	2.73	2.63	3.50	0.59	2.91	0	1.46	MPB	1.000	2.000	6.1	0.055	DI	
8MX-24S-62	34	3.409	3.346	3.810	AF-1	—	2.66	—	2.63	1.00	—	2.91	1.91	1.46	1610	0.500	1.688	2.6	0.038	DI
PB8MK-34S-62	34	3.409	3.346	3.810	6F-1	—	2.82	2.63	3.50	0.59	2.91	0	1.46	MPB	1.000	2.125	6.9	0.070	DI	
8MX-36S-62	36	3.609	3.546	4.010	AF-1	2.96	—	2.63	1.00	—	2.91	1.91	1.46	1610	0.500	1.688	2.8	0.045	DI	
PB8MK-36S-62	36	3.609	3.546	4.010	6F-1	—	3.13	2.63	3.56	0.65	2.91	0	1.46	MPB	1.000	2.313	8.0	0.092	DI	
8MX-38S-62	38	3.810	3.747	4.210	AF-1	3.15	—	2.63	1.00	—	2.91	1.91	1.46	1610	0.500	1.688	3.1	0.056	DI	
PB8MK-38S-62	38	3.810	3.747	4.210	6F-1	—	3.32	2.63	3.56	0.65	2.91	0	1.46	MPB	1.000	2.438	9.1	0.115	DI	
8MX-40S-62	40	4.010	3.947	4.410	AF-1	3.35	—	2.63	1.25	—	2.91	1.66	1.46	2012	0.500	2.125	3.3	0.067	DI	
PB8MK-40S-62	40	4.010	3.947	4.410	6F-1	—	3.52	2.63	3.63	0.72	2.91	0	1.46	MPB	1.000	2.563	10.3	0.144	DI	
8MX-42S-62	42	4.211	4.148	4.910	AF-1	3.62	—	2.63	1.25	—	2.91	1.66	1.46	2012	0.500	2.125	3.6	0.079	DI	
PB8MK-42S-62	42	4.211	4.148	4.910	6F-1	—	3.79	2.63	3.63	0.72	2.91	0	1.46	MPB	1.000	2.750	11.6	0.178	DI	
8MX-45S-62	45	4.511	4.448	4.910	AF-1	3.62	—	2.63	1.25	—	2.91	1.66	1.46	2012	0.500	2.125	5.1	0.126	DI	
PB8MK-45S-62	45	4.511	4.448	4.910	6F-1	—	3.79	2.63	3.63	0.72	2.91	0	1.46	MPB	1.000	2.750	13.1	0.227	DI	
8MX-48S-62	48	4.812	4.749	5.210	AF-1	4.14	—	2.63	1.75	—	2.91	1.16	1.46	2517	0.500	2.688	5.1	0.15	GI	
8MX-50S-62	50	5.013	4.950	5.410	AF-1	4.13	—	2.63	1.75	—	2.91	1.16	1.46	2517	0.500	2.688	6.3	0.196	GI	
8MX-53S-62	53	5.314	5.251	5.500	AF-1	4.76	—	2.63	1.75	—	2.91	1.16	1.46	2517	0.500	2.688	6.7	0.229	GI	
8MX-56S-62	56	5.614	5.551	6.010	AF-1	4.92	—	2.63	1.75	—	2.91	1.16	1.46	2517	0.500	2.688	8.3	0.307	GI	
8MX-50S-62	60	6.015	5.952	6.420	AF-1	5.13	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	8.9	0.407	GI	
8MX-63S-62	63	6.316	6.253	6.720	AF-1	5.71	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	9.9	0.483	GI	
8MX-67S-62	67	6.717	6.654	6.880	AF-1	6.14	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	12.0	0.64	GI	
8MX-71S-62	71	7.118	7.055	7.500	AF-1	6.51	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	14.4	0.837	GI	
8MX-75S-62	75	7.519	7.456	7.920	AF-1	6.90	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	16.8	1.067	GI	
8MX-80S-62	80	8.020	7.957	8.420	AF-1	7.23	—	2.63	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	20.5	1.45	GI	
8MX-90S-62	90	9.023	8.960	—	D-1	7.39	5.42	—	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	30.1	2.631	GI	
8MX-112S-62	112	11.229	11.166	—	D-2	9.60	5.42	—	2.00	—	2.91	0.91	1.46	3020	0.875	3.250	31.0	4.255	GI	
8MX-140S-62	140	14.036	13.973	—	D-2	12.40	8.75	—	2.50	—	2.91	0.41	1.46	3625	1.188	3938	62.8	10.91	GI	
8MX-180S-62	180	18.046	17.983	—	D-3	15.33	8.75	—	2.50	—	2.91	0.41	1.46	3625	1.188	3938	91.6	29.51	GI	
8MX-22S-62	224	22.457	22.394	—	D-3	19.38	8.75	—	2.50	—	2.91	0.41	1.46	3625	1.188	3938	127.1	67.42	GI	

Material Spec : GI - Grey Iron DI - Ductile Iron SS - Stainless Steel
Note: 2D and 3D sprocket drawings are available at www.gates.com/picatlg
NOTE: • Weights for Minimum Plain Bore (MPB) Sprockets are with minimum bore. • WR² values do not include bushings. • WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.

Stock 14mm Gates Poly Chain® GT®2 Sprocket Specifications

Sprocket Number	Number of Teeth	Diameters (in)			Dimensions (in)						Bushing Size	Approx Wt. (lb)	Approx WR ²	Matl. Spec					
		Pitch	O.D.	Flange Ref.	A	B	C	D	E	F									
14N(X-28S-20	28	4.912	4.802	5.400	A1-F	3.61	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	3.9	0.105	Gl, NP
14N(X-28S-20	29	5.088	4.978	5.760	A1-F	3.99	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	4.3	0.122	Gl, NP
14N(X-30S-20	30	5.263	5.153	5.760	A1-F	3.99	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	4.8	0.143	Gl, NP
14N(X-31S-20	31	5.439	5.329	6.110	A1-F	4.22	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	5.3	0.165	Gl, NP
14N(X-32S-20	32	5.614	5.504	6.110	A1-F	4.22	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	5.8	0.191	Gl, NP
14N(X-33S-20	33	5.790	5.680	6.460	A1-F	4.53	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	6.3	0.217	Gl, NP
14N(X-34S-20	34	5.965	5.855	6.460	A1-F	4.53	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	6.8	0.248	Gl, NP
14N(X-35S-20	35	6.141	6.031	6.820	A1-F	4.95	—	1.04	1.25	—	1.36	0.11	0.68	2012	0.500	2.125	7.3	0.279	Gl, NP
14N(X-36S-20	36	6.316	6.206	6.820	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	8.4	0.346	Gl, NP
14N(X-37S-20	37	6.492	6.382	7.170	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	9.3	0.388	Gl, NP
14N(X-38S-20	38	6.667	6.557	7.170	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	9.9	0.443	Gl, NP
14N(X-39S-20	39	6.842	6.732	7.520	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	10.7	0.502	Gl, NP
14N(X-40S-20	40	7.018	6.908	7.520	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	11.4	0.554	Gl, NP
14N(X-43S-20	43	7.544	7.434	8.040	BF-1	—	4.25	1.04	1.75	—	1.36	0.39	0.68	2517	0.500	2.688	14.0	0.770	Gl, NP
14N(X-45S-20	45	7.895	7.785	8.400	BF-1	—	5.41	1.04	2.00	—	1.36	0.64	0.68	3220	0.875	3.250	15.0	0.948	Gl, NP
14N(X-48S-20	48	8.491	8.311	8.940	BF-1	—	5.75	1.04	2.00	—	1.36	0.64	0.68	3220	0.875	3.250	18.2	1.277	Gl, NP
14N(X-50S-20	50	8.772	8.662	9.290	BF-1	—	5.75	1.04	2.00	—	1.36	0.64	0.68	3220	0.875	3.250	20.8	1.561	Gl, NP
14N(X-53S-20	53	9.299	9.189	9.690	BF-1	—	5.75	1.04	2.00	—	1.36	0.64	0.68	3220	0.875	3.250	24.1	1.992	Gl, NP
14N(X-56S-20	56	9.825	9.715	10.360	BF-1	—	8.70	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	30.2	2.834	Gl, NP
14N(X-60S-20	60	10.527	10.417	11.070	BF-1	—	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	36.9	3.888	Gl, NP
14N(X-63S-20	63	11.053	10.943	11.590	BF-1	—	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	42.3	4.837	Gl, NP
14N(X-67S-20	67	11.755	11.645	12.500	BF-1	—	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	50.3	6.428	Gl, NP
14N(X-71S-20	71	12.457	12.347	13.070	CF-1	11.05	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	40.6	4.832	Gl, NP
14N(X-75S-20	75	13.158	13.048	13.730	CF-1	11.68	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	42.3	5.260	Gl, NP
14N(X-80S-20	80	14.036	13.926	14.620	CF-2	12.56	8.75	1.04	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	48.0	6.573	Gl, NP
14N(X-90S-20	90	15.790	15.680	—	C-2	14.26	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	53.8	9.215	Gl, NP
14N(X-112S-20	112	19.650	19.540	—	C-3	16.47	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	70.1	21.1	Gl, NP
14N(X-140S-20	140	24.562	24.452	—	C-3	21.04	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	94.8	48.06	Gl, NP
14N(X-168S-20	168	28.475	29.365	—	C-3	25.90	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	120.8	91.40	Gl, NP
14N(X-180S-20	180	31.580	31.470	—	C-3	27.99	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	134.6	118.6	Gl, NP
14N(X-200S-20	200	35.089	34.979	—	C-3	31.46	8.75	—	2.50	—	1.36	1.14	0.68	3225	1.188	3.938	158.1	176.5	Gl, NP
14N(X-224S-20	224	39.300	39.190	—	C-3	35.63	10.00	—	3.00	—	1.36	1.64	0.68	4030	1.438	4.438	201.1	271.7	Gl, NP

Material Spec : Gl - Grey Iron DI - Ductile Iron SS - Stainless Steel
 Note: 2D and 3D sprocket drawings are available at www.gates.com/ptcatalcg
 Note: •Weights for Minimum Plain Bore (MPB) Sprockets are with minimum bore. •Weights and WR² for Bushed Sprockets do not include bushings. •WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.

Stock 14mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Design Type		A	B	C	D	E	F	M	F-Cl.	Bushing Size	Dimensions (in)		Approx. Wt. (lb)	Approx. WR ²	Mati. Spec
		Pitch	0.D.	Flange Ref.	A	B										Min	Max			
14MX-28S-37	28	4.912	4.802	5.400	6F-1	—	3.97	1.74	2.86	0.80	2.06	0	1.03	MPB	1.000	2.938	11.7	0.228	DI	
14MX-28S-37	28	4.912	4.802	5.400	AF-1	3.61	—	1.74	1.25	—	2.06	0.81	1.03	20112	0.500	2.125	5.2	0.145	GI	
14MX-29S-37	29	5.088	4.978	5.760	AF-1	3.99	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	5.1	0.16	GI	
14MX-30S-37	30	5.263	5.153	5.760	AF-1	3.99	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	5.8	0.192	GI	
14MX-31S-37	31	5.439	5.329	6.110	AF-1	4.22	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	6.4	0.223	GI	
14MX-32S-37	32	5.614	5.504	6.110	AF-1	4.22	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	7.2	0.262	GI	
14MX-33S-37	33	5.790	5.680	6.460	AF-1	4.53	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	7.8	0.299	GI	
14MX-34S-37	34	5.965	5.855	6.460	AF-1	4.53	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	8.7	0.346	GI	
14MX-35S-37	35	6.141	6.031	6.820	AF-1	4.95	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	9.3	0.388	GI	
14MX-36S-37	36	6.316	6.206	6.820	AF-1	4.95	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	10.2	0.444	GI	
14MX-37S-37	37	6.492	6.382	7.170	AF-1	5.27	—	1.74	1.75	—	2.06	0.31	1.03	25117	0.500	2.688	10.8	0.496	GI	
14MX-38S-37	38	6.667	6.557	7.170	AF-1	5.27	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	10.3	0.687	GI	
14MX-39S-37	39	6.842	6.732	7.520	AF-1	5.54	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	11.3	0.757	GI	
14MX-40S-37	40	7.018	6.908	7.520	AF-1	5.54	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	12.3	0.862	GI	
14MX-43S-37	43	7.544	7.334	8.040	AF-1	6.16	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	15.6	1.148	GI	
14MX-45S-37	45	7.895	7.785	8.400	AF-1	6.42	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	18.0	1.394	GI	
14MX-48S-37	48	8.421	8.311	8.940	AF-1	6.96	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	21.5	1.802	GI	
14MX-50S-37	50	8.772	8.662	9.290	AF-1	7.44	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	24.1	2.102	GI	
14MX-53S-37	53	9.299	9.189	9.690	AF-1	7.84	—	1.74	2.00	—	2.06	0.06	1.03	3020	0.875	3.250	28.3	2.694	GI	
14MX-56S-37	56	9.825	9.715	10.360	BF-1	—	8.70	1.74	2.00	—	2.06	0.44	1.03	35225	1.188	3.938	33.0	3.247	GI	
14MX-60S-37	60	10.527	10.417	11.070	BF-1	—	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	40.6	4.499	GI	
14MX-63S-37	63	11.053	10.933	11.590	BF-1	—	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	46.7	5.631	GI	
14MX-67S-37	67	11.755	11.645	12.500	BF-1	—	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	55.6	7.476	GI	
14MX-71S-37	71	12.457	12.347	13.070	BF-1	—	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	61.2	8.443	GI	
14MX-75S-37	75	13.158	13.048	13.730	CF-1	11.68	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	46.9	6.468	GI	
14MX-80S-37	80	14.036	13.926	14.620	CF-2	12.56	8.75	1.74	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	52.5	7.891	GI	
14MX-90S-37	90	15.790	15.680	—	C-2	14.26	8.75	—	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	61.5	11.78	GI	
14MX-112S-37	112	19.650	19.540	—	C-3	16.39	8.75	—	2.50	—	2.06	0.44	1.03	35225	1.188	3.938	89.1	30.71	GI	

Material Spec: GI - Grey Iron DI - Ductile Iron SS - Stainless Steel

Note: 2D and 3D sprocket drawings are available at www.gates.com/pptacatcg

NOTE: • Weights for Minimum Plain Bore (MPB) Sprockets do not include bushings. • WR² values have lb-in² units.

Details shown which do not affect drive function may be changed without notification.

Design Type Suffix: 1 - Solid 2 - Web 3 - Arms



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Stock 14mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Design Type	Dimensions (in)						Approx Wt. (lb)	Approx WR ²	Matl. Spec					
		Pitch	O.D.	Flange Ref.		A	B	C	D	E	F	M	F-CL	Bushing Size	Bore Sizes Min	Bore Sizes Max			
PB14MK-28S-68	28	4.912	4.802	5.400	6F-1	—	3.97	3.01	4.13	0.80	3.33	0	1.67	MPB	1.000	2.938	17.4	0.348	DI
14MK-29S-68	29	5.088	4.978	5.760	AF-1	3.99	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	7.0	0.23	GI
PB14MK-29S-68	29	5.088	4.978	5.760	6F-1	—	4.35	3.01	4.13	0.80	3.33	0	1.67	MPB	1.000	3.188	19.1	0.412	DI
14MK-30S-68	30	5.263	5.153	5.760	AF-1	3.99	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	8.2	0.281	GI
PB14MK-30S-68	30	5.263	5.153	5.760	6F-1	—	4.35	3.01	4.13	0.80	3.33	0	1.67	MPB	1.000	3.188	20.3	0.466	DI
14MK-31S-68	31	5.439	5.329	6.110	AF-1	4.22	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	8.8	0.32	GI
PB14MK-31S-68	31	5.439	5.329	6.110	6F-1	—	4.57	3.01	4.13	0.80	3.33	0	1.67	MPB	1.000	3.438	21.9	0.537	DI
14MK-32S-68	32	5.614	5.504	6.110	AF-1	4.22	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	10.0	0.383	GI
PB14MK-32S-68	32	5.614	5.504	6.110	6F-1	—	4.57	3.01	4.13	0.80	3.33	0	1.67	MPB	1.000	3.438	23.2	0.603	DI
14MK-33S-68	33	5.790	5.680	6.460	AF-1	4.53	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	10.5	0.422	GI
PB14MK-33S-68	33	5.790	5.680	6.470	6F-1	—	4.89	3.01	4.33	1.00	3.33	0	1.67	MPB	1.000	3.500	25.9	0.714	DI
14MK-34S-68	34	5.965	5.855	6.460	AF-1	4.53	—	3.01	1.75	—	3.33	1.58	1.67	2517	0.500	2.688	11.8	0.498	GI
PB14MK-34S-68	34	5.965	5.855	6.470	6F-1	—	4.89	3.01	4.33	1.00	3.33	0	1.67	MPB	1.000	3.500	27.3	0.794	DI
14MK-35S-68	35	6.141	6.031	6.820	AF-1	4.95	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	10.3	0.498	DI
14MK-35S-68	36	6.316	6.206	6.820	AF-1	4.95	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	11.7	0.589	DI
14MK-37S-68	37	6.492	6.382	7.170	AF-1	5.27	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	12.3	0.646	GI
14MK-38S-68	38	6.667	6.557	7.170	AF-1	5.27	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	13.8	0.754	GI
14MK-38S-68	39	6.842	6.732	7.520	AF-1	5.54	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	14.6	0.831	GI
14MK-40S-68	40	7.018	6.908	7.520	AF-1	5.54	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	16.2	0.957	GI
14MK-42S-68	43	7.544	7.434	8.040	AF-1	6.16	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	18.4	1.22	GI
14MK-43S-68	45	7.895	7.785	8.390	AF-1	6.42	—	3.01	2.00	—	3.33	1.33	1.67	3020	0.875	3.250	21.9	1.571	GI
14MK-48S-68	48	8.421	8.311	8.940	AF-1	6.96	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	25.7	2.123	DI
14MK-50S-68	50	8.772	8.662	9.290	AF-1	7.44	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	28.5	2.506	DI
14MK-53S-68	53	9.299	9.189	9.690	AF-1	7.84	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	33.7	3.26	GI
14MK-55S-68	56	9.825	9.715	10.360	AF-1	8.35	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	39.0	4.119	GI
14MK-60S-68	60	10.527	10.417	11.070	AF-1	9.06	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	46.4	5.489	GI
14MK-63S-68	63	11.053	10.943	11.590	AF-1	9.59	—	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	52.3	6.713	GI
14MK-67S-68	67	11.755	11.645	12.500	DF-1	10.36	8.75	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	56.4	7.452	GI
14MK-71S-68	71	12.457	12.347	13.070	DF-1	11.05	8.75	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	64.1	9.377	GI
14MK-75S-68	75	13.158	13.048	13.730	DF-1	11.68	8.75	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	56.9	8.993	GI
14MK-80S-68	80	14.036	13.926	14.620	DF-2	12.56	8.75	3.01	2.50	—	3.33	0.83	1.67	3525	1.188	3.938	62.1	10.39	GI
14MK-90S-68	90	15.790	15.680	—	D-2	14.26	10.00	3.01	3.00	—	3.33	0.33	1.67	4030	1.438	4.438	86.2	17.66	GI
14MK-112S-68	112	19.540	—	D-3	16.35	10.00	3.01	3.00	—	3.33	0.33	1.67	4030	1.438	4.438	135.1	49.62	GI	
14MK-140S-68	140	24.562	24.452	—	D-3	20.78	10.00	3.01	3.00	—	3.33	0.33	1.67	4030	1.438	4.438	189.0	115.1	GI
14MK-168S-68	168	29.475	29.365	—	C-3	25.23	10.50	3.01	3.50	—	3.33	0.17	1.67	4535	1.938	4.938	259.5	228.9	GI
14MK-180S-68	180	31.580	31.470	—	C-3	27.16	10.50	3.01	3.50	—	3.33	0.17	1.67	4535	1.938	4.938	288.6	295.5	GI
14MK-200S-68	200	35.089	34.979	—	C-3	30.65	10.50	3.01	3.50	—	3.33	0.17	1.67	4535	1.938	4.938	331.9	422.1	GI
14MK-224S-68	224	39.300	39.190	—	C-3	34.82	11.00	3.01	4.00	—	3.33	0.67	1.67	5040	2.438	5.000	404.3	644.5	GI

Material Sööc : GI - Gray Iron DI - Ductile Iron SS - Stainless Steel
 Note: 2D and 3D sprocket drawings are available at www.gates.com/pptcatag
 NOTE: •Weights and WR² for Bushes Sprockets do not include bushings, •Weights and WR² units, •Weights and WR² for Bushes Sprockets are with minimum bore.

Details shown which do not affect drive function may be changed without notification.

Design Type Suffix: 1 - Solid 2 - Web 3 - Arms

Stock 14mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)			Design Type	Dimensions (in)						Approx Wt. (lb)	Approx WR ²	Matl. Spec					
		Pitch	O.D.	Flange Ref.		A	B	C	D	E	F								
PB14MX-28S-90	28	4.912	4.802	5.400	6F-1	—	3.97	3.88	5.14	0.94	4.20	0	2.10	MPB	1.500	2.938	20.4	0.432	D
PB14MX-29S-90	29	5.088	4.978	5.760	6F-1	—	4.35	3.88	5.00	0.80	4.20	0	2.10	MPB	1.500	3.188	22.0	0.503	D
PB14MX-30S-90	30	5.263	5.153	5.760	6F-1	—	4.35	3.88	5.00	0.80	4.20	0	2.10	MPB	1.500	3.188	23.6	0.571	D
PB14MX-31S-90	31	5.439	5.329	6.110	6F-1	—	4.57	3.88	5.00	0.80	4.20	0	2.10	MPB	1.500	3.438	25.5	0.656	D
PB14MX-32S-90	32	5.614	5.504	6.110	6F-1	—	4.57	3.88	5.00	0.80	4.20	0	2.10	MPB	1.500	3.438	27.1	0.741	D
PB14MX-33S-90	33	5.790	5.680	6.470	6F-1	—	4.89	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	3.500	30.2	0.871	D
PB14MX-34S-90	34	5.965	5.855	6.470	6F-1	—	4.89	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	3.500	31.9	0.971	D
14MX-35S-90	35	6.141	6.031	6.820	AF-1	4.95	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	12.1	0.602	D
PB14MX-35S-90	35	6.141	6.031	6.820	6F-1	—	5.30	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	3.813	34.6	1.120	D
14MX-36S-90	36	6.316	6.206	6.820	AF-1	4.95	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	13.9	0.717	D
PB14MX-36S-90	36	6.316	6.206	6.820	6F-1	—	5.30	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	3.813	36.4	1.240	D
14MX-37S-90	37	6.492	6.382	7.170	AF-1	5.27	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	14.2	0.773	G
PB14MX-37S-90	37	6.492	6.382	7.170	6F-1	—	5.63	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	4.125	38.0	1.408	D
14MX-38S-90	38	6.667	6.557	7.170	AF-1	5.27	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	16.1	0.909	G
PB14MX-38S-90	38	6.667	6.557	7.170	6F-1	—	5.63	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	4.125	41.0	1.549	D
14MX-39S-90	39	6.842	6.732	7.520	AF-1	5.54	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	16.8	0.992	G
PB14MX-39S-90	39	6.842	6.732	7.500	6F-1	—	5.89	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	4.375	43.6	1.737	D
14MX-40S-90	40	7.018	6.908	7.520	AF-1	5.54	—	3.88	2.00	—	4.20	2.20	2.10	30.20	0.875	3.250	18.8	1.152	G
PB14MX-40S-90	40	7.018	6.908	7.520	6F-1	—	5.89	3.88	5.20	1.00	4.20	0	2.10	MPB	1.500	4.375	45.6	1.903	D
14MX-43S-90	43	7.54	7.434	8.040	AF-1	6.16	—	3.88	2.50	—	4.20	1.70	2.10	35.25	1.188	3.938	20.9	1.151	D
14MX-43S-90	45	7.895	7.785	8.390	AF-1	6.42	—	3.88	2.50	—	4.20	1.70	2.10	35.25	1.188	3.938	24.3	1.878	D
14MX-46S-90	48	8.421	8.311	8.940	AF-1	6.96	—	3.88	2.50	—	4.20	1.70	2.10	35.25	1.188	3.938	28.9	2.477	D
14MX-50S-90	50	8.772	8.662	9.290	AF-1	7.44	—	3.88	2.50	—	4.20	1.70	2.10	35.25	1.188	3.938	31.5	2.877	D
14MX-53S-90	53	9.299	9.189	9.990	AF-1	7.83	—	3.88	2.50	—	4.20	1.70	2.10	35.25	1.188	3.938	37.4	3.753	G
14MX-56S-90	56	9.825	9.715	10.360	AF-1	8.35	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	43.2	4.893	G
14MX-60S-90	60	10.527	10.417	11.070	AF-1	9.06	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	52.2	6.574	G
14MX-63S-90	63	11.053	10.943	11.590	AF-1	9.59	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	59.3	8.076	G
14MX-67S-90	67	11.755	11.645	12.500	AF-1	9.88	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	71.3	10.79	G
14MX-71S-90	71	12.457	12.347	13.070	AF-1	10.67	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	81.6	13.58	G
14MX-75S-90	75	13.158	13.048	13.730	AF-1	11.63	—	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	95.9	16.50	G
14MX-80S-90	80	14.036	13.926	14.620	Df-1	12.56	10.00	3.88	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	94.1	17.78	G
14MX-90S-90	90	15.790	15.680	14.206	D-2	14.26	10.00	—	3.00	—	4.20	1.20	2.10	40.30	1.438	4.438	94.5	20.17	G
14MX-112S-90	112	19.650	19.540	—	D-2	16.35	10.50	—	3.50	—	4.20	0.70	2.10	45.35	1.938	4.938	173.7	64.28	G
14MX-140S-90	140	24.562	24.452	—	D-3	20.74	11.00	—	4.00	—	4.20	0.20	2.10	50.40	2.438	5.000	245.3	149.3	G
14MX-168S-90	168	29.475	29.365	—	C-3	25.11	15.50	—	5.00	—	4.20	0.80	2.10	60.50	4.438	6.000	395.1	321.7	G
14MX-180S-90	180	31.580	31.470	—	C-3	27.06	15.50	—	5.00	—	4.20	0.80	2.10	60.50	4.438	6.000	429.4	405.5	G
14MX-200S-90	200	35.089	34.979	—	C-3	30.29	15.50	—	5.00	—	4.20	0.80	2.10	60.50	4.438	6.000	493.0	586.1	G
14MX-224S-90	224	39.300	39.190	—	C-3	34.46	15.50	—	5.00	—	4.20	0.80	2.10	60.50	4.438	6.000	562.6	84.99	G

Material Spec : GI - Grey Iron DI - Ductile Iron SS - Stainless Steel

Note: 2D and 3D sprocket drawings are available at www.gates.com/ptcatalcg

NOTE: • Weights for Minimum Plain Bore (MPB) Sprockets are with minimum bore. • Weights and WR² for Bushtec Sprockets do not include bushings. • WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.



Stock 14mm Gates Poly Chain® GT®2 Sprocket Specifications—continued

Sprocket Number	Number of Teeth	Diameters (in)				Dimensions (in)						Approx. Wt. (lb)	Approx. WR ²	Matl. Spec	
		Pitch	O.D.	Flange Ref.	Design Type	A	B	C	D	E	F			Bore Sizes Min Max	
PB14M-28S-125	28	4.912	4.802	5.400	6F-1	—	3.97	5.29	6.50	0.89	5.61	0	2.81	MPB 1.500	24.8 0.562 D
PB14M-29S-125	29	5.088	4.978	5.760	6F-1	—	4.35	5.29	6.50	0.89	5.61	0	2.81	MPB 1.500	31.188 27.2 0.661 D
PB14M-30S-125	30	5.263	5.153	5.760	6F-1	—	4.35	5.29	6.50	0.89	5.61	0	2.81	MPB 1.500	31.188 28.2 0.732 D
PB14M-31S-125	31	5.439	5.329	6.110	6F-1	—	4.57	5.29	6.50	0.89	5.61	0	2.81	MPB 1.500	31.16 0.865 D
PB14M-32S-125	32	5.614	5.504	6.110	6F-1	—	4.57	5.29	6.50	0.89	5.61	0	2.81	MPB 1.500	31.16 0.976 D
PB14M-33S-125	33	5.790	5.680	6.470	6F-1	—	4.89	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.138 D
PB14M-34S-125	34	5.965	5.855	6.470	6F-1	—	4.89	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.138 D
PB14M-35S-125	35	6.141	6.031	6.820	6F-1	—	5.30	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 1.272 D
PB14M-36S-125	36	6.316	6.206	6.820	6F-1	—	5.30	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 1.461 D
PB14M-37S-125	37	6.492	6.382	7.170	6F-1	—	5.63	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 1.621 D
PB14M-38S-125	38	6.667	6.557	7.170	6F-1	—	5.63	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 1.835 D
PB14M-39S-125	39	6.842	6.732	7.520	6F-1	—	5.89	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 2.024 D
PB14M-40S-125	40	7.018	6.908	7.520	6F-1	—	5.89	5.29	6.69	1.08	5.61	0	2.81	MPB 1.500	31.16 2.267 D
PB14M-43S-125	43	7.544	7.434	8.040	6F-1	—	6.51	5.29	6.81	1.20	5.61	0	2.81	MPB 1.500	31.16 2.488 D
PB14M-45S-125	45	7.895	7.785	8.400	6F-1	—	6.76	5.29	6.81	1.20	5.61	0	2.81	MPB 1.500	31.16 3.413 D
PB14M-48S-125	48	8.421	8.311	8.940	6F-1	—	7.29	5.29	6.81	1.20	5.61	0	2.81	MPB 1.500	31.16 4.092 D
140IX-40S-125	50	8.772	8.662	9.290	AF-1	7.44	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 5.340 D
140IX-43S-125	53	9.299	9.189	9.690	AF-1	7.83	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 6.43 3.54 D
140IX-45S-125	56	9.825	9.715	10.360	AF-1	8.35	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 6.43 3.54 D
140IX-48S-125	60	10.527	10.417	11.070	AF-1	9.06	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 6.43 3.54 D
140IX-53S-125	63	11.093	10.943	11.590	AF-1	9.59	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 6.43 3.54 D
140IX-56S-125	67	11.755	11.645	12.500	AF-1	9.88	—	5.29	3.50	—	5.61	2.11	2.81	4F35 1.938	31.16 6.43 3.54 D
140IX-57S-125	71	12.457	12.347	13.070	AF-1	10.67	—	5.29	4.00	—	5.61	1.61	2.81	5040 2.438	31.16 7.05 4.705 D
140IX-58S-125	75	13.158	13.048	13.730	AF-1	11.63	—	5.29	4.00	—	5.61	1.61	2.81	5040 2.438	31.16 7.05 4.705 D
140IX-60S-125	80	14.036	13.926	14.620	AF-1	12.59	—	5.29	4.00	—	5.61	1.61	2.81	5040 2.438	31.16 7.05 4.705 D
140IX-63S-125	90	15.790	15.680	—	D-1	14.26	11.00	—	4.00	—	5.61	1.61	2.81	5040 2.438	31.16 7.05 4.705 D
140IX-7HS-125	112	19.650	19.540	—	A-1	16.35	—	—	5.00	—	5.61	0.61	2.81	6050 4.438	31.170 127.5 G
140IX-10GS-125	140	24.562	24.452	—	D-3	20.74	15.50	—	5.00	—	5.61	0.61	2.81	6050 4.438	31.170 225.4 G
140IX-16GS-125	168	29.475	29.365	—	C-3	25.11	17.00	—	6.00	—	5.61	0.39	2.81	7060 4.938	31.170 419.5 G
140IX-20GS-125	180	31.580	31.470	—	C-3	27.06	17.00	—	6.00	—	5.61	0.39	2.81	7060 4.938	31.170 525.2 G
140IX-20GS-125	200	35.089	34.979	—	C-3	30.29	17.00	—	6.00	—	5.61	0.39	2.81	7060 4.938	31.170 753.8 G
140IX-22GS-125	224	39.300	39.190	—	C-3	34.21	17.00	—	6.00	—	5.61	0.39	2.81	7060 4.938	31.170 753.0 G

Material Spec.: Gl - Grey Iron DI - Ductile Iron SS - Stainless Steel

Note: 2D and 3D sprocket drawings are available at www.gates.com/picatalog

NOTE: • Weights for Minimum Plain Bore (MPB) Sprockets are with minimum bore. • Weights and WR² for Bushed Sprockets do not include bushings. • WR² values have lb-ft² units.

Details shown which do not affect drive function may be changed without notification.

Design Type Suffix: 1 - Solid 2 - Web 3 - Arms

Sprocket Specifications

Sprocket Tolerance Specifications

Poly Chain® GT®2 sprockets are made to close tolerances. Modifications such as reboring may result in unsatisfactory drive performance. Strict adherence to the standard tolerances (as shown in table below) is highly recommended.

Table 6 - Sprocket Outside Diameter and Pitch

Outside Diameter Range (in)	Outside Diameter Tolerance (in)	Pitch To Pitch Tolerance (in)	
		Adjacent Grooves	Accumulative Over 90 Degrees
Over 2.000 to and including 4.000	+ 0.004 - 0.000	± 0.001	± 0.0045
Over 4.000 to and including 7.000	+ 0.005 - 0.000	± 0.001	± 0.005
Over 7.000 to and including 12.000	+ 0.006 - 0.000	± 0.001	± 0.006
Over 12.000 to and including 20.000	+ 0.007 - 0.000	± 0.001	± 0.0065
Over 20.000	+ 0.008 - 0.000	± 0.001	± 0.0075

Table 7 - Sprocket Runout

Radial Runout*

Outside Diameter	Outside Diameter	Total Eccentricity Total Indicator Reading	
		(in)	(mm)
Over 2 to 4	50 100	0.003	0.08
Over 4 to 8	100 200	0.004	0.10
Over 8	200	0.0005 per inch O.D. over 8" (may not exceed face diameter tolerance)	0.0005 per mm O.D. over 200mm

* Total Indicator Reading

Axial Runout*

For each inch of outside diameter up through 10.0 inches, add 0.001 inches

For each additional inch of outside diameter over 10.0 inches, add 0.0005 inches

* Total Indicator Reading

Table 8 - Sprocket and Bushing Keyseat

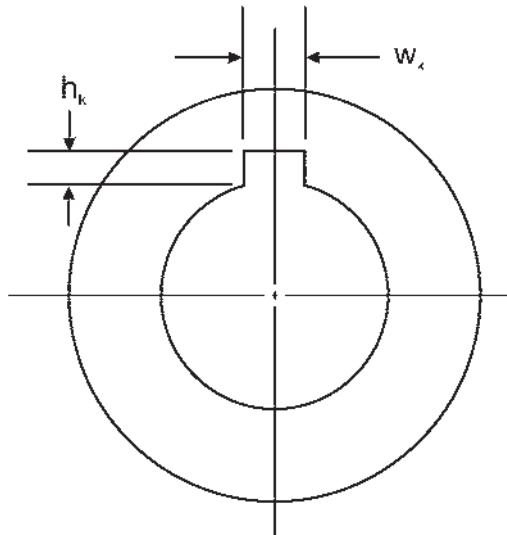
Shaft Diameter (in)	Width $W_k \dagger$ (in)	Depth, h_k (in) + 0.015 - 0.000
Up through 7/16 (0.44)	3/32 (0.0938)	3/64 (0.047)
Over 7/16 (0.44) to and incl. 9/16 (0.56)	1/8 (0.125)	1/16 (0.062)
Over 9/16 (0.56) to and incl. 7/8 (0.88)	3/16 (0.1875)	3/32 (0.094)
Over 7/8 (0.88) to and incl. 1 1/4 (1.25)	1/4 (0.250)	1/8 (0.125)
Over 1 1/4 (1.25) to and incl. 1 3/8 (1.38)	5/16 (0.3125)	5/32 (0.156)
Over 1 3/8 (1.38) to and incl. 1 3/4 (1.75)	3/8 (0.375)	3/16 (0.188)
Over 1 3/4 (1.75) to and incl. 2 1/4 (2.25)	1/2 (0.500)	1/4 (0.250)
Over 2 1/4 (2.25) to and incl. 2 3/4 (2.75)	5/8 (0.625)	5/16 (0.312)
Over 2 3/4 (2.75) to and incl. 3 1/4 (3.25)	3/4 (0.750)	3/8 (0.375)
Over 3 1/4 (3.25) to and incl. 3 3/4 (3.75)	7/8 (0.875)	7/16 (0.438)
Over 3 3/4 (3.75) to and incl. 4 1/2 (4.50)	1 (1.000)	1/2 (0.500)
Over 4 1/2 (4.50) to and incl. 5 1/2 (5.50)	1 1/4 (1.250)	5/8 (0.625)

† Tolerance on width, W_k

For width up through 1/2 (0.500) + 0.002, 0.000 inches

For width over 1/2 (0.500) up through 1 (1.000) . . . + 0.003, 0.000 inches

For width over 1 (1.000) + 0.004, 0.000 inches



Balancing

Stock Sprockets are statically balanced per MPTA (Mechanical Power Transmission Association) Standard Practice for Pulley Balancing SPB-86 using the weight based on the following two criteria:

1. Balance limit (ounces) = Sprocket Weight (lb) x 0.016; or
2. 0.176 ounce (5 grams), whichever is greater.

Caution: Stock sprockets should not be used on drives where rim surface speeds exceed 6,500 fpm. Sprocket construction and materials will determine the dynamic balancing requirements of the sprocket(s) where rim surface speeds exceed 6,500 fpm.

Sprocket Tooth Profile and Surface Quality

The Poly Chain GT2 sprocket tooth profile was designed and developed exclusively by Gates Corporation to operate with the Gates Poly Chain GT Carbon Belt. See Engineering Section II-3, Tooth Profile, on page 101 for a complete discussion of the performance characteristics of this new tooth profile. The tooth surface should be free of any surface defects and should be 80 microinches finish or better.

Sprocket Blanks

Sprocket blanks can be grooved by Gates for specially designed, made-to-order sprockets. If those sprockets are supplied in blank form, Gates can perform the "grooving" operation. The blank diameter must be 0.050" larger than the finished sprocket O.D. Contact your local Gates Representative for additional details.

Poly Chain® GT2 Bored-To-Size Sprocket Bore Range Listing

8mm Pitch Sprockets

Sprocket Size	Minimum Bore (In)	Full Keyway Bore Range (In)	Shallow Keyway Bore Range (In)
8MX-22S-12	0.500	0.500 - 1.063	1.125 - 1.188
8MX-22S-21	0.500	0.500 - 1.063	1.125 - 1.188
8MX-22S-36	0.500	0.500 - 1.063	1.125 - 1.188
8MX-25S-12	0.500	0.500 - 1.313	1.375 - 1.500
8MX-25S-21	0.500	0.500 - 1.313	1.375 - 1.500
8MX-25S-36	0.500	0.500 - 1.313	1.375 - 1.500
8MX-25S-62	1.000	1.000 - 1.313	1.375 - 1.500
8MX-28S-12	0.500	0.500 - 1.500	1.563 - 1.750
8MX-28S-21	0.500	0.500 - 1.500	1.563 - 1.750
8MX-28S-36	0.500	0.500 - 1.500	1.563 - 1.750
8MX-28S-62	1.000	1.000 - 1.500	1.563 - 1.750
8MX-30S-12	0.500	0.500 - 1.563	1.625 - 1.813
8MX-30S-21	0.500	0.500 - 1.563	1.625 - 1.813
8MX-30S-36	0.500	0.500 - 1.563	1.625 - 1.813
8MX-30S-62	1.000	1.000 - 1.563	1.625 - 1.813
8MX-32S-12	0.500	0.500 - 1.750	1.813 - 2.000
8MX-32S-21	0.500	0.500 - 1.750	1.813 - 2.000
8MX-32S-36	0.500	0.500 - 1.750	1.813 - 2.000
8MX-32S-62	1.000	1.000 - 1.750	1.813 - 2.000
8MX-34S-36	0.500	0.500 - 1.750	1.813 - 2.125
8MX-34S-62	1.000	1.000 - 1.750	1.813 - 2.125
8MX-36S-36	0.500	0.500 - 1.938	2.000 - 2.313
8MX-36S-62	1.000	1.000 - 1.938	2.000 - 2.313
8MX-38S-36	0.500	0.500 - 2.125	2.188 - 2.438
8MX-38S-62	1.000	1.000 - 2.125	2.188 - 2.438
8MX-40S-62	1.000	1.000 - 2.188	2.250 - 2.563
8MX-42S-62	1.000	1.000 - 2.375	2.438 - 2.750
8MX-45S-62	1.000	1.000 - 2.375	2.438 - 2.750

All bored-to-size Sprockets are available through Gates rebore center. Check with your local Gates representative or Customer Service for a quote and delivery.

14mm Pitch Sprockets

Sprocket Size	Minimum Bore (In)	Full Keyway Bore Range (In)	Shallow Keyway Bore Range (In)
14MX-28S-37	1.000	1.000 - 2.500	2.563 - 2.938
14MX-28S-68	1.000	1.000 - 2.500	2.563 - 2.938
14MX-28S-90	1.500	1.500 - 2.500	2.563 - 2.938
14MX-28S-125	1.500	1.500 - 2.500	2.563 - 2.938
14MX-29S-68	1.000	1.000 - 2.750	2.813 - 3.188
14MX-29S-90	1.500	1.500 - 2.750	2.813 - 3.188
14MX-29S-125	1.500	1.500 - 2.750	2.813 - 3.188
14MX-30S-68	1.000	1.000 - 2.750	2.813 - 3.188
14MX-30S-90	1.500	1.500 - 2.750	2.813 - 3.188
14MX-30S-125	1.500	1.500 - 2.750	2.813 - 3.188
14MX-31S-68	1.000	1.000 - 2.875	2.938 - 3.438
14MX-31S-90	1.500	1.500 - 2.875	2.938 - 3.438
14MX-31S-125	1.500	1.500 - 2.875	2.938 - 3.438
14MX-32S-68	1.000	1.000 - 2.875	2.938 - 3.438
14MX-32S-90	1.500	1.500 - 2.875	2.938 - 3.438
14MX-32S-125	1.500	1.500 - 2.875	2.938 - 3.438
14MX-33S-68	1.000	1.000 - 2.938	3.000 - 3.500
14MX-33S-90	1.500	1.500 - 2.938	3.000 - 3.500
14MX-33S-125	1.500	1.500 - 2.938	3.000 - 3.500
14MX-34S-37	1.000	1.000 - 2.938	3.000 - 3.500
14MX-34S-68	1.000	1.000 - 2.938	3.000 - 3.500
14MX-34S-90	1.500	1.500 - 2.938	3.000 - 3.500
14MX-34S-125	1.500	1.500 - 2.938	3.000 - 3.500
14MX-35S-90	1.500	1.500 - 3.250	3.313 - 3.813
14MX-35S-125	1.500	1.500 - 3.250	3.313 - 3.813
14MX-36S-90	1.500	1.500 - 3.250	3.313 - 3.813
14MX-36S-125	1.500	1.500 - 3.250	3.313 - 3.813
14MX-37S-90	1.500	1.500 - 3.563	3.625 - 4.125
14MX-37S-125	1.500	1.500 - 3.563	3.625 - 4.125
14MX-38S-90	1.500	1.500 - 3.563	3.625 - 4.125
14MX-38S-125	1.500	1.500 - 3.563	3.625 - 4.125
14MX-39S-90	1.500	1.500 - 3.750	3.182 - 4.375
14MX-39S-125	1.500	1.500 - 3.750	3.182 - 4.375
14MX-40S-90	1.500	1.500 - 3.750	3.182 - 4.375
14MX-40S-125	1.500	1.500 - 3.750	3.182 - 4.375
14MX-43S-125	1.500	1.500 - 4.125	4.188 - 4.813
14MX-45S-125	1.500	1.500 - 4.375	4.438 - 5.000
14MX-48S-125	1.500	1.500 - 4.688	4.750 - 5.625

All bored-to-size Sprockets are available through Gates rebore center. Check with your local Gates representative or Customer Service for a quote and delivery.

Recommended Re-bore Specifications and Instructions

For Minimum Plain Bore (MPB) Sprockets

When using MPB Poly Chain® GT2 sprockets in power transmission systems, important guidelines should be followed for proper product finishing and application. Due to the high load carrying capacity and high operating tensions often found in Poly Chain GT Carbon belt drive systems, it is imperative to use and adhere to industry standard practices.

When finishing MPB sprockets for high performance belt drive systems, care should be taken to ensure proper functionality and performance. General re-bore instructions and specifications are as follows:

- Materials used in Poly Chain GT2 sprockets are steel, gray iron, stainless steel and ductile iron. The materials used may vary with the size of the sprocket. See the Sprocket Specification Tables, pages 66 thru 75 for specific materials.
- The maximum bore diameter specified by the manufacturer for each sprocket size should **NOT** be exceeded, or a keyway used which reduces the hub thickness to less than its minimum allowable value. See the Sprocket Specification Tables for a listing of recommended bore ranges by sprocket size. Bores exceeding the maximum recommended value for a particular sprocket size can adversely affect the structural integrity, thereby reducing their load-carrying capability.

The minimum metal thickness between the keyway and hub O.D. should be no less than the set screw diameter specified for the corresponding sprocket size. See Figure 1. A listing of minimum set screw diameters is included below.

8M-22S thru 28S – 1/4	14M-28S – 7/16
8M-30S thru 34S – 5/16	14M-29S thru 32S – 1/2
8M-36S thru 38S – 3/8	14M-33S thru 40S – 5/8
8M-40S thru 45S – 7/16	14M-43S thru 48S – 3/4

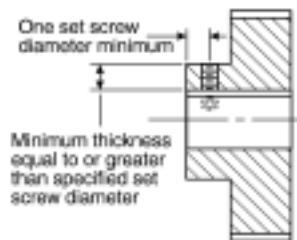


Figure 1 — Minimum Hub Thickness and Set Screw Placement Guidelines

- The fit between a finished sprocket bore and its mating shaft in a power transmission system must not allow relative movement between the bore and the shaft when the drive is subjected to belt tension and torque loads. This is accomplished, in the case of plain bore sprockets, with the use of set screws and keys and by controlling the fit or clearance between the sprocket bore and its mating shaft. Cyclical, pulsating, or reversing loads may wear the sprocket bore and/or keyway due to the relative movement between the contacting surfaces of the shaft and the bore. The resulting wear may increase the clearance further, if an interference fit is not used.

In order to maximize the performance of high capacity belt drives using plain bore style sprockets, the following recommendations presented in Table 8 should be followed:

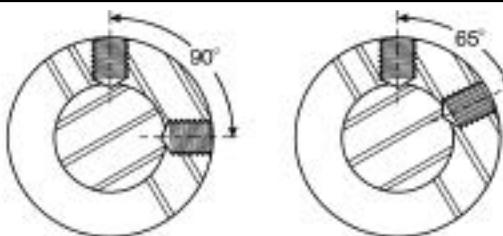


Figure 2 — Set Screw Angles

Each set screw should be placed axially – a minimum of one set screw diameter from the end of the sprocket hub extension. See Figure 1. For recommended set screw tightening torque values see Table 9.

- After reboring, the sprocket may require rebalancing. Vibration, noise, reduced bearing life, and undue stresses on the mechanical components in the system could result if improper rebalancing practices are used. See Sprocket Specifications, page 74, for recommended sprocket balancing specifications.

Class 1 Clearance Fits should be used when the transmitted load is smooth in nature.

Interference Fits should be used for Poly Chain GT Carbon curvilinear drives transmitting cyclical, pulsating, or reversing loads.

Table 9 - Recommended Shaft / Bore Fits (Inches)

Nominal Bore Range Over - To (Incl.)	Shaft Tol. (minus)	Clearance Fits		Interference Fits		
		Class 1- Smooth Load	Fit Tol. (Plus)	Bore Range (Minus) Tolerance	Fit Tolerance Range (Minus)	
0.4375 - 0.5626	0.0005	0.0010	0.0015	0.0005	0.0010	0.0000
0.5625 - 0.8750	0.0005	0.0010	0.0015	0.0005	0.0010	0.0000
0.8750 - 1.2500	0.0005	0.0010	0.0015	0.0005	0.0010	0.0000
1.2500 - 1.3750	0.0005	0.0010	0.0015	0.0005	0.0010	0.0000
1.3750 - 1.5000	0.0005	0.0010	0.0015	0.0005	0.0010	0.0000
1.5000 - 1.7500	0.0010	0.0010	0.0020	0.0010	0.0020	0.0000
1.7500 - 2.0000	0.0010	0.0010	0.0020	0.0010	0.0020	0.0000
2.0000 - 2.2500	0.0010	0.0015	0.0025	0.0010	0.0020	0.0000
2.2500 - 2.7500	0.0010	0.0015	0.0025	0.0010	0.0020	0.0000
2.7500 - 3.0000	0.0010	0.0015	0.0025	0.0010	0.0020	0.0000
3.0000 - 3.2500	0.0010	0.0015	0.0025	0.0015	0.0030	0.0005
3.2500 - 3.7500	0.0010	0.0015	0.0025	0.0015	0.0030	0.0005
3.7500 - 4.0000	0.0010	0.0015	0.0025	0.0015	0.0030	0.0005
4.0000 - 4.5000	0.0010	0.0015	0.0025	0.0020	0.0035	0.0010
4.5000 - 5.0000	0.0010	0.0015	0.0025	0.0020	0.0035	0.0010
5.0000 - 5.5000	0.0010	0.0015	0.0025	0.0025	0.0040	0.0015
5.5000 - 6.5000	0.0010	0.0015	0.0025	0.0025	0.0040	0.0015
						0.0040

Table 8 was extracted in part from AGMA Standard for Bores and Keyways for Flexible Couplings (Inch Series) AGMA 9002-A86 Table.

- DO NOT chuck or center the sprocket on guide flanges. Soft jaws should be used when chucking on the sprocket teeth. Center (indicate) the sprocket using the sprocket tooth O.D. If chucked on the Rim I.D. or Hub O.D., the sprocket should be centered with respect to the sprocket tooth O.D. Guide flanges are permanently mounted and should not be removed. If original flanges must be removed, they should be replaced with NEW flanges. New guide flanges should be attached securely with care using mechanical fasteners such as screws. Note: Improper guide flange reassembly may cause serious personal injury and/or mechanical damage.
- Set screw holes in the sprocket hub must be placed properly for maximum holding strength. For both standard and shallow keyseats, two (2) set screws should be used as illustrated in Figure 2. The total holding strength of the set screws is dependent upon their placement and design. Generally, one screw should be placed directly over the keyway, and the other screw at ninety degrees (90°) from the keyway, or at sixty-five degrees (65°) from the keyway – a more recent practice that improves holding power. Sometimes four set screws (or two pair) are used for increased holding strength.

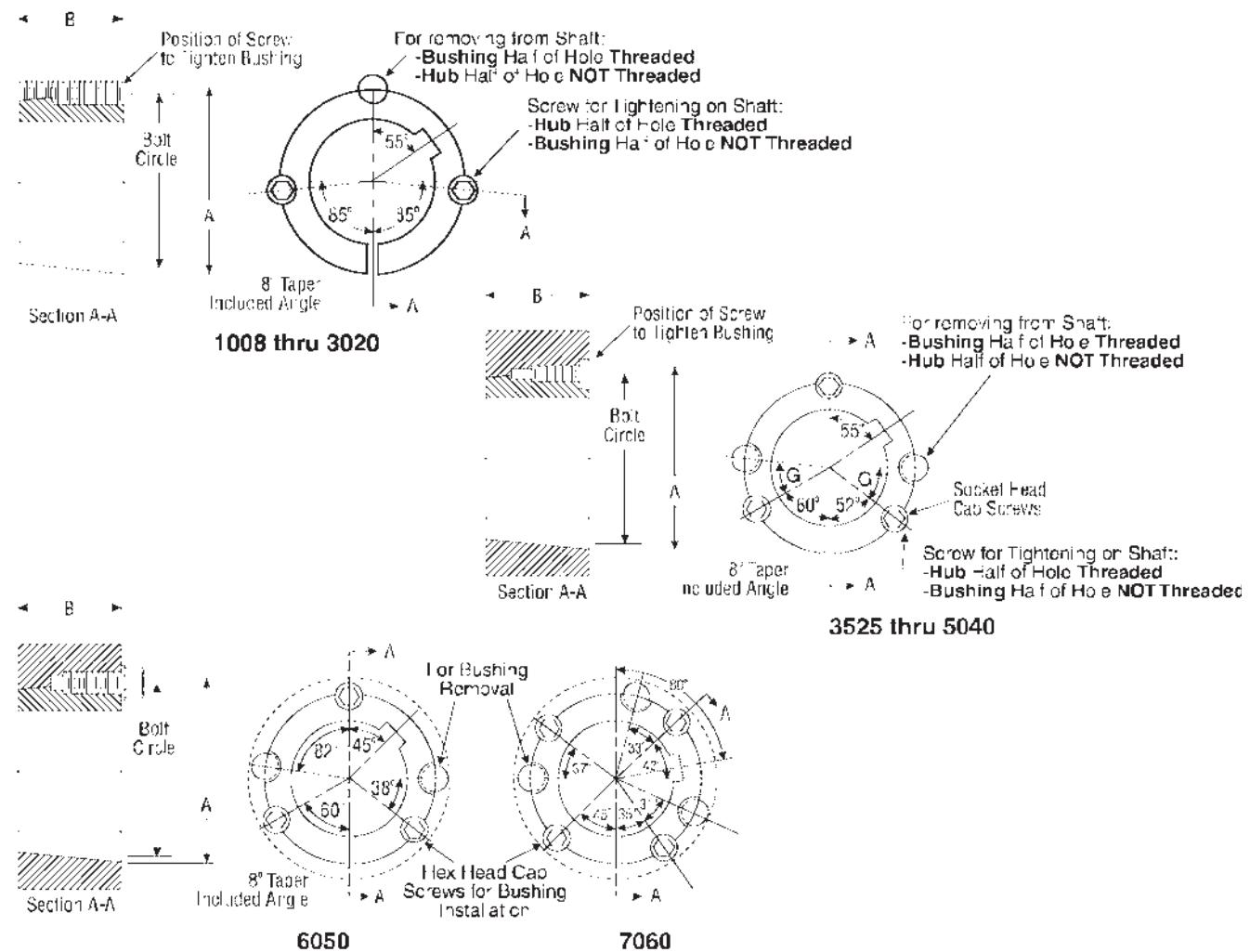
Table 10 — Recommended Tightening Torque Values For Set Screws

Set Screw Size	Hex Key Size (in)	Approximate Installation Torque Values (lb-in)
1/4	1/8	80
5/16	5/32	160
3/8	3/16	275
7/16	7/32	430
1/2	1/4	615
5/8	5/16	1315
3/4	3/8	2150
7/8	1/2	5130

7. Standard square or rectangular keys should be used. See page 78 and 79 for standard key dimensions.

Specifications and tolerances for sprocket eccentricity, parallelism, and balancing, etc. are all presented on page 74.

Stock Bushings for Sprockets



TAPER-LOCK® BUSHINGS

Bushing Size	Torque Capacity (lb-in)	Dimensions		Bolt Circle (in)	Mounting Screws			Bore Range (in)		Weight Range	
		A	B					Min. Bore	Max Bore		
					Qty.	Size	G (deg)	Standard Keyseat***	Shallow Keyseat**	Max Bore	Min. Bore
1008	1,200	1.386	0.875	1.328	2	1/4x1/2	—	0.500	0.875	1.000	0.2
1108****	1,300	1.511	0.875	1.453	2	1/4x1/2	—	0.500	1.000	1.125	0.1
1210****	3,600	1.875	1.000	1.750	2	3/8x5/8	—	0.500	1.250	—	0.4
1610****	4,300	2.250	1.000	2.125	2	3/8x5/8	—	0.500	1.500	1.688	0.5
1615	4,300	2.25	1.500	2.125	2	3/8x5/8	—	0.500	1.500	1.688	0.6
2012****	7,150	2.750	1.250	2.625	2	7/16x7/8	—	0.500	1.875	2.125	0.9
2517	11,600	3.375	1.750	3.250	2	1/2x1	—	0.500	2.250	2.688	1.8
3020	24,000	4.250	2.000	4.000	2	5/8x1 1/4	—	0.875	2.750	3.250	3.3
3525	44,800	5.000	2.500	4.830	3	1/2x1 1/2	39	1.188	3.250	3.938	3.7
3535	44,800	5.000	3.500	4.830	3	1/2x1 1/2	39	1.188	3.250	3.938	5.0
4030	77,300	5.750	3.000	5.540	3	5/8x1 3/4	40	1.438	3.625	4.438	6.4
4040	77,300	5.750	4.000	5.540	3	5/8x1 3/4	40	1.438	3.625	4.438	8.2
4535	110,000	6.375	3.500	6.130	3	3/4x2	40	1.938	4.250	4.938	8.8
4545	110,000	6.375	4.500	6.130	3	3/4x2	40	1.938	4.250	4.938	11.2
5040	126,000	7.000	4.000	6.720	3	7/8x2 1/4	37	2.438	4.500	5.000	15.9
6050	282,000	9.250	5.000	9.000	3	1 1/4x3 1/2	—	4.438	6.000	—	45.0
7060	416,000	10.250	6.000	10.000	4	1 1/4x3 1/2	—	4.938	7.000	—	66.0
*Taper-Lock® is a trademark of Reliance Electric											
**Key is furnished with each bushing having a shallow keyseat.											
***Keys are not furnished with bushings having standard keyseats.											
****1108, 1210, 1610, 2012 bushings are also available in stainless steel.											

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**Key is furnished with each bushing having a shallow keyseat.

***Keys are not furnished with bushings having standard keyseats.

****1108, 1210, 1610, 2012 bushings are also available in stainless steel.

Bushing Bore and Keyseat Information

Taper-Lock® Bushings are available from stock with all popular bores within the bore range of each size bushing.

The Taper-Lock Keyseat Dimension charts below list the bore range for each bushing and the appropriate keyseat dimensions.

Where standard keyseats are indicated, refer to the Standard Keyseat Dimensions chart. Where bores do not permit standard depth keyseats, a flat key of the proper dimension is furnished with the bushing.

Taper-Lock Bushing Keyseat Dimensions

Bushing	Bores (in)	Keyseat
1008	0.500 - 0.875	Standard
	0.938 - 1.000	1/4 x 1/16
1108	0.500 - 1.000	Standard
	1.062 - 1.125	1/4 x 1/16
1210	0.500 - 1.250	Standard
1610	0.500 - 1.500	Standard
	1.563 - 1.688	3/8 x 1/8
1615	0.500 - 1.500	Standard
	1.563 - 1.688	3/8 x 1/8
2012	0.500 - 1.875	Standard
	1.938 - 2.125	1/2 x 3/16
2517	0.500 - 2.250	Standard
	2.313 - 2.688	5/8 x 3/16
3020	0.875 - 2.750	Standard
	2.813 - 3.000	3/4 x 1/8
	3.125 - 3.250	3/4 x 1/4
3525	1.188 - 3.250	Standard
	3.313	7/8 x 1/8
	3.375 - 3.500	7/8 x 3/16
	3.625	7/8 x 1/4
	3.688 - 3.750	7/8 x 3/16
	3.875 - 3.938	1 x 1/4
3535	1.188 - 3.250	Standard
	3.313	7/8 x 1/8
	3.375 - 3.500	7/8 x 3/16
	3.625	7/8 x 1/4
	3.688 - 3.750	7/8 x 3/16
	3.875 - 3.938	1 x 1/4
4030	1.438 - 3.625	Standard
	3.688 - 3.750	7/8 x 3/16
	3.875 - 4.438	1 x 1/4
4040	1.438 - 3.625	Standard
	3.688 - 3.750	7/8 x 3/16
	3.875 - 4.438	1 x 1/4
4535	1.938 - 4.250	Standard
	4.375 - 4.500	1 x 1/4
	4.750 - 4.938	1 1/4 x 1/4
4545	1.938 - 4.250	Standard
	4.375 - 4.500	1 x 1/4
	4.750 - 4.938	1 1/4 x 1/4
5040	2.438 - 4.500	Standard
	4.875 - 5.000	1 1/4 x 7/16
6050	4.438 - 6.000	Standard
7060	4.938 - 7.000	Standard

Standard Keyseat Dimensions

Shaft Diameter (in)	Keyseat (in)		Key (in)	
	Width	Depth	Width	Depth
0.313 - 0.438	3/32	3/64	3/32	3/32
0.500 - 0.563	1/8	1/16	1/8	1/8
0.625 - 0.875	3/16	3/32	3/16	3/16
0.938 - 1.250	1/4	1/8	1/4	1/4
1.313 - 1.375	5/16	5/32	5/16	5/16
1.438 - 1.750	3/8	3/16	3/8	3/8
1.813 - 2.250	1/2	1/4	1/2	1/2
2.313 - 2.750	5/8	5/16	5/8	5/8
2.813 - 3.250	3/4	3/8	3/4	3/4
3.313 - 3.750	7/8	7/16	7/8	7/8
3.813 - 4.500	1	1/2	1	1
4.563 - 5.500	1 1/4	5/8	1 1/4	1 1/4
5.563 - 6.500	1 1/2	3/4	1 1/2	1 1/2
6.563 - 7.500	1 3/4	3/4	1 3/4	1 1/2
7.563 - 9.000	2 3/4	2	1	1/2

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Bushing Bore and Keyseat Information

Specifying English and Metric Keyways

Dimensioning and specifying metric keys and keyways varies significantly from the English system. In the English system, it is the standard practice to dimension the keyway, while in the metric system it is common practice to specify the key size. In the English system, the keyway in the hub is dimensioned by the width and depth at the side, but in the metric system the keyway is dimensioned by the width and the depth measured from the radius of the shaft to the center of the keyway. One of the following methods should be used to specify keyways:

English:

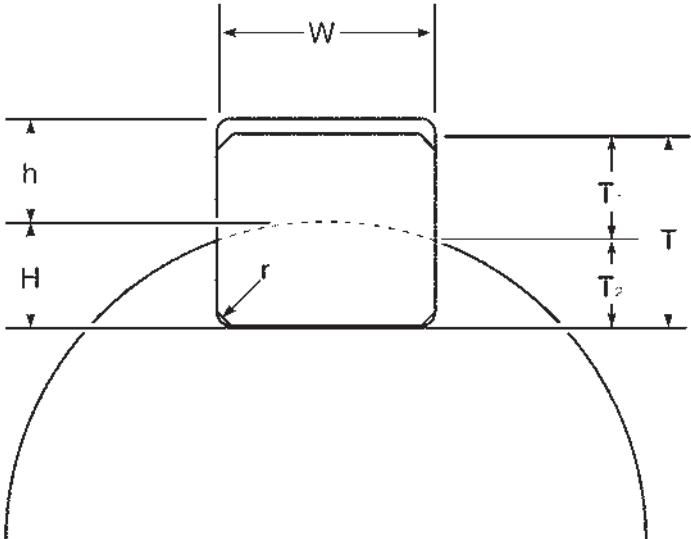
W x T₁ Keyway
W x T Key
W x T Key

Metric:

W x T Key
W x h Keyway

Unless otherwise noted, the keyway in the shaft is assumed to be standard. Also, T₁ and T₂ are not necessarily equal. The metric system does not refer to keyseat or keyway dimensions as does the English system. Instead, dimensions are given for the key itself which is rectangular in shape, not square, as in the English system. The correct terminology when ordering metric bored bushings with millimeter keyways will be either of the following:

1. Specify "standard keyway"
2. Customer to specify keysize (keyseat to be standard size in shaft)



Metric Bore and Key Dimensions for Taper-Lock® Bushings

Bushing	Bore (mm)	Keyway (WxT) (mm)	Key Size (ref.) (mm)
1008	14, 16, 18, 19, 20, 22, 24	5 X 2.3 6 X 2.8 8 X 3.3	5 X 5 6 X 6 8 X 7
	14*, 16, 18, 19, 20, 22, 24, 25	5 X 2.3 6 X 2.8 8 X 3.3	5 X 5 6 X 6 8 X 7
	14, 16 18, 19, 20, 22*, 24, 25, 28, 30	5 X 2.3 6 X 2.8 8 X 3.3	5 X 5 6 X 6 8 X 7
1108	14*, 16*	5 X 2.3	5 X 5
	18*, 19, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30,	8 X 3.3	8 X 7
	32, 35, 38,	10 X 3.3	10 X 8
	40	12 X 3.3	12 X 8
1210	14*, 16*	5 X 2.3	5 X 5
	18*, 19, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30	8 X 3.3	8 X 7
	32, 35, 38	10 X 3.3	10 X 8
	40, 42	12 X 3.3	12 X 8
	45, 48*	14 X 3.8	14 X 9
	48*		
1610	14, 16	5 X 2.3	5 X 5
	18, 19, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30	8 X 3.3	8 X 7
	32, 35, 38	10 X 3.3	10 X 8
	40, 42	12 X 3.3	12 X 8
	45, 48	14 X 3.8	14 X 9
	55	16 X 4.3	16 X 10
2012	14, 16	5 X 2.3	5 X 5
	18, 19, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30	8 X 3.3	8 X 7
	32, 35, 38	10 X 3.3	10 X 8
	40, 42	12 X 3.3	12 X 8
	45, 48	14 X 3.8	14 X 9
	55	16 X 4.3	16 X 10
2517	14, 16	5 X 2.3	5 X 5
	18, 19*, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30	8 X 3.3	8 X 7
	32, 35, 38	10 X 3.3	10 X 8
	40, 42	12 X 3.3	12 X 8
	45, 48, 50	14 X 3.8	14 X 9
	55	16 X 4.3	16 X 10
3020	14, 16	5 X 2.3	5 X 5
	18, 19*, 20, 22	6 X 2.8	6 X 6
	24, 25, 28, 30	8 X 3.3	8 X 7
	32, 35, 38	10 X 3.3	10 X 8
	40, 42	12 X 3.3	12 X 8
	45, 48, 50	14 X 3.8	14 X 9
	55	16 X 4.3	16 X 10
70*, 75*	60, 65	18 X 4.4	18 X 11
	70*, 75*	20 X 4.9	20 X 12

**Taper-Lock® is a trademark of Reliance Electric

*Non-stock, made to order bushing

Taper-Lock® Type Sprocket Installation and Removal



To Install TAPER-LOCK Type Bushings

1. Clean the shaft, bore of bushing, outside of bushing and the sprocket hub bore of all oil, paint and dirt. File away any burrs. **Note:** The use of lubricants can cause sprocket breakage. USE NO LUBRICANTS IN THIS INSTALLATION.
2. Insert the bushing into the sprocket hub. Match the hole pattern, not threaded holes (each complete hole will be threaded on one side only).
3. LIGHTLY oil the set screws and thread them into those half-threaded holes indicated by on the diagram above. Note: Do not lubricate the bushing taper, hub taper, bushing bore, or the shaft. Doing so could result in sprocket breakage.
4. With the key in the shaft keyway, position the assembly onto the shaft allowing for small axial movement of the sprocket which will occur during the tightening process.
Note: When mounting sprockets on a vertical shaft, precautions must be taken to positively prevent the sprocket and/or bushing from falling during installation.
5. Alternately torque the set screws until the sprocket and bushing tapers are completely seated together (at approximately half of the recommended torque; see table below). **Note:** Do not use worn hex key wrenches. Doing so may result in a loose assembly or may damage screws.
6. Check the alignment and sprocket axial runout (wobble), and correct as necessary.
7. Continue alternate tightening of the cap screws to the recommended torque values specified in the table below.
8. To increase the bushing gripping force, hammer the face of the bushing using a drift or sleeve (do not hit the bushing directly with the hammer).
9. Re-torque the bushing screws after hammering.
10. Recheck all screw torque values after the initial drive run-in, and periodically thereafter. Repeat steps 5 through 9 if loose.

To Remove

1. Loosen and remove all mounting screws.
2. Insert screws into all jack screw holes indicated by • (see figure above).
3. Loosen the bushing by alternately tightening the screws in small but equal increments until the tapered sprocket and bushing surfaces disengage.

Sprocket Installation

Bushing Style	Bolts		Torque Wrench	
	Qty.	Size	lb-ft	lb-in
1008	2	1/4-20 x 1/2	4.6	55
1108	2	1/4-20 x 1/2	4.6	55
1210	2	3/8-16 x 5/8	14.6	175
1610	2	3/8-16 x 5/8	14.6	175
1615	2	3/8-16 x 5/8	14.6	175
2012	2	7/16-14 x 7/8	23.3	280
2517	2	1/2-13 x 1	35.8	430
3020	2	5/8-11 x 1 1/4	66.7	800
3525	3	1/2-13 x 1 1/2	83.3	1000
3535	3	1/2-13 x 1 1/2	83.3	1000
4030	3	5/8-11 x 1 3/4	141.7	1700
4040	3	5/8-11 x 1 3/4	141.7	1700
4535	3	3/4-10 x 2	204.2	2450
4545	3	3/4-10 x 2	204.2	2450
5040	3	7/8-9 x 2 1/4	258.3	3100
6050	3	1 1/4-7 x 3 1/2	651.7	7820
7060	4	1 1/4-7 x 3 1/2	651.7	7820

Caution: Excessive bolt torque can cause sprocket and/or bushing breakage.

Note: To insure proper bushing/sprocket performance, full bushing contact on the shaft is recommended.

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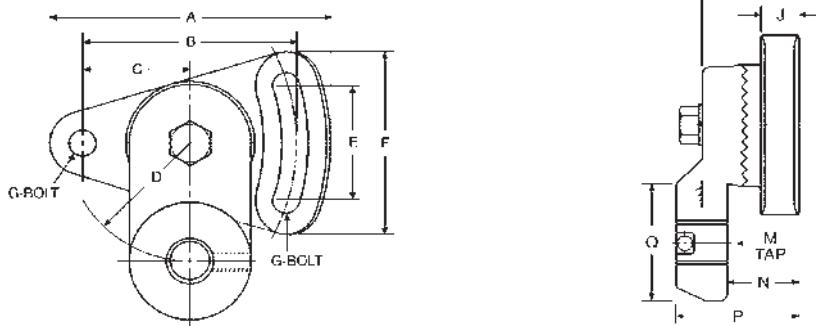


Gates Corporation

www.gates.com/pt

Belt Drive Tensioners

(Double Adjustable)



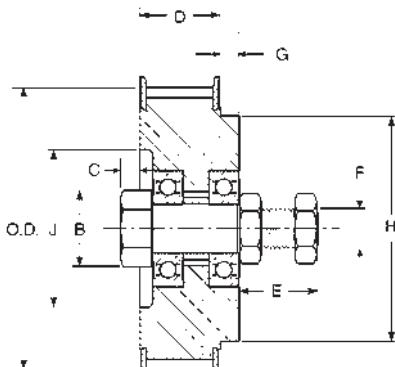
Idler Bracket Specifications

Part No.	Tensioner Part No.	Use With	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)	J (in)	M (Threads)	N (in)	P (in)	Q (in)	Weight (lb)
05-IDL-BRAK	7720-1005	1610-IDL-BUSH	4.62	3.50	1.75	2.00	2.06	3.06	0.38	1.40	0.62	5/8-18	0.90	1.77	1.94	2.80
10-IDL-BRAK	7720-1010	8mm Pitch Idler Sprockets, 2012-IDL-BUSH, 2517-IDL-BUSH, 20-IDL-BUSH (SK),	4.63	3.50	1.75	2.00	2.06	3.06	0.38	1.50	0.63	3/4-16	1.00	1.88	1.75	3.4
20-IDL-BRAK	7720-1020	14mm Pitch Idler Sprockets, 30-IDL-BUSH (SF), 40-IDL-BUSH (E)	6.94	5.25	2.63	5.00	3.00	4.56	0.63	2.38	1.00	1-14	1.63	2.94	2.75	11.2

Nickel Plated Idler Bracket Specifications

Part No.	Tensioner Part No.	Use With	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)	J (in)	M (Threads)	N (in)	P (in)	Q (in)	Weight (lb)
NP-10-IDL-BRAK	7720-1011	8mm Pitch Idler Sprockets, 2012-IDL-BUSH, 2517-IDL-BUSH, 20-IDL-BUSH (SK)	4.63	3.50	1.75	2.00	2.06	3.06	0.38	1.50	0.56	3/4-16	1.00	1.88	1.75	3.4
NP-20-IDL-BRAK	7720-1061	14mm Pitch Idler Sprockets, 30-IDL-BUSH (SF), 40-IDL-BUSH (E)	6.94	5.25	2.63	5.00	3.00	4.56	0.63	2.38	1.00	1-14	1.63	2.94	2.75	11.2

Idler Sprockets



Poly Chain® GT2 Idler Dimensions

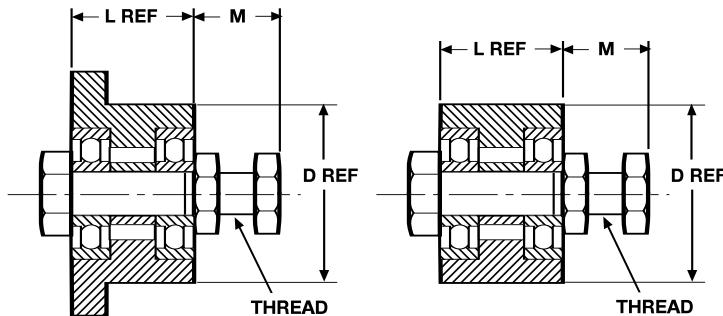
Part No.	Product No.	Use With	Size Designation	Belt Width (mm)	No. of Teeth	O.D. (in)	B Ref. (in)	C (in)	D (in)	E Ref. (in)	F (Threads) (in)	G Ref. (in)	H (in)	J (in)	Weight (lb)
12-IDL-SPRK	7720-1500	8mm Pitch Poly Chain GT Carbon	8MX-32S-12	12	32	3.145	1.25	0.50	0.85	1.56	3/4-16	0.94	2.75	-	1.0
21-IDL-SPRK	7720-1510		8MX-32S-21	21	32	3.145	1.25	0.50	1.24	1.56	3/4-16	0.56	2.75	-	1.1
36-IDL-SPRK	7720-1520		8MX-36S-36	36	36	3.546	1.91	0.75	1.86	1.63	3/4-16	-	-	-	2.0
62-IDL-SPRK	7720-1530		8MX-36S-62	62	36	3.546	1.91	0.75	2.91	1.69	3/4-16	0.69	3.13	-	2.1
20-IDL-SPRK	7720-1600	14mm Pitch Poly Chain GT Carbon	14MX-30S-20	20	30	5.153	2.55	1.00	1.36	2.25	1-14	1.00	4.38	-	9.0
37-IDL-SPRK	7720-1610		14MX-30S-37	37	30	5.153	2.55	1.00	2.06	2.25	1-14	0.25	4.38	-	12.0
68-IDL-SPRK	7720-1620		14MX-34S-68	68	34	5.855	3.38	0.56	3.33	2.25	1-14	1.00	4.88	4.34	15.6
90-IDL-SPRK	7720-1640		14MX-34S-90	90	34	5.855	3.38	0.31	4.20	2.25	1-14	1.00	4.88	4.34	16.7
125-IDL-SPRK	7720-1630		14MX-34S-125	125	34	5.855	3.38	0.19	5.63	2.25	1-14	1.09	4.88	4.34	23.1

Nickel Plated Poly Chain GT2 Idler Dimensions

Part No.	Product No.	Use With	Size Designation	Belt Width (mm)	No. of Teeth	O.D. (in)	B Ref. (in)	C (in)	D (in)	E Ref. (in)	F (Threads) (in)	G Ref. (in)	H (in)	J (in)	Weight (lb)
NP-12-IDL-SPRK	7720-1501	8mm Pitch Poly Chain GT Carbon	8MX-32S-12	12	32	3.145	1.25	0.50	0.85	1.56	3/4-16	0.94	2.75	-	1.0
NP-21-IDL-SPRK	7720-1511	8MX-32S-21	21	32	3.145	1.25	0.50	1.24	1.56	3/4-16	0.56	2.75	-	1.1	

Belt Drive Tensioners

Idler Bushings



Idler Bushings (Integral Shaft Included)

Product No.	Part No.	Use with Bracket	D (in)	L (in)	M (in)	Threads	Weight (lb)
7720-2610	1610-IDL-BUSH	05-IDL-BRAK	2.25	1.00	1.38	5/8-18	1.30
7720-2012	2012-IDL-BUSH	10-IDL-BRAK	2.75	1.25	1.56	3/4-16	2.30
7720-2517	2517-IDL-BUSH	10-IDL-BRAK	3.38	1.75	1.56	3/4-16	3.90
7720-1120	20-IDL-BUSH	(SK)10-IDL-BRAK	2.81	1.94	1.44	3/4-16	4.10
7720-1130	30-IDL-BUSH	(SF)20-IDL-BRAK	3.13	2.08	2.13	1-14	6.40
7720-1140	40-IDL-BUSH	(E)20-IDL-BRAK	3.83	2.75	2.19	1-14	8.60

Poly Chain® GT®2 Sprocket Diameter Table

8mm Pitch Sprocket Diameters

No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in	
	PD	OD		PD	OD		PD	OD		PD	OD		PD	OD
22	56.02 2.206	54.42 2.143	51	129.87 5.113	128.27 5.050	80	203.72 8.020	202.12 7.957	109	277.57 10.928	275.97 10.865	138	351.41 13.835	349.81 13.772
23	58.57 2.306	56.97 2.243	52	132.42 5.213	130.82 5.150	81	206.26 8.121	204.66 8.058	110	280.11 11.028	278.51 10.965	139	353.96 13.935	352.36 13.872
24	61.12 2.406	59.52 2.343	53	134.96 5.314	133.36 5.251	82	208.81 8.221	207.21 8.158	111	282.66 11.128	281.06 11.065	140	356.51 14.036	354.91 13.973
25	63.66 2.506	62.06 2.443	54	137.51 5.414	135.91 5.351	83	211.36 8.321	209.76 8.258	112	285.21 11.229	283.61 11.166	141	359.05 14.136	357.45 14.073
26	66.21 2.607	64.61 2.544	55	140.06 5.514	138.46 5.451	84	213.90 8.421	212.30 8.358	113	287.75 11.329	286.15 11.266	142	361.60 14.236	360.00 14.173
27	68.75 2.707	67.15 2.644	56	142.60 5.614	141.00 5.551	85	216.45 8.522	214.85 8.459	114	290.30 11.429	288.70 11.366	143	364.15 14.336	362.55 14.273
28	71.30 2.807	69.70 2.744	57	145.15 5.715	143.55 5.652	86	219.00 8.622	217.40 8.559	115	292.85 11.529	291.25 11.466	144	366.69 14.437	365.09 14.374
29	73.85 2.907	72.25 2.844	58	147.70 5.815	146.10 5.752	87	221.54 8.722	219.94 8.659	116	295.39 11.630	293.79 11.567	145	369.24 14.537	367.64 14.474
30	76.39 3.008	74.79 2.945	59	150.24 5.915	148.64 5.852	88	224.09 8.822	222.49 8.759	117	297.94 11.730	296.34 11.667	146	371.79 14.637	370.19 14.574
31	78.94 3.108	77.34 3.045	60	152.79 6.015	151.19 5.952	89	226.64 8.923	225.04 8.860	118	300.48 11.830	298.88 11.767	147	374.33 14.737	372.73 14.674
32	81.49 3.208	79.89 3.145	61	155.34 6.116	153.74 6.053	90	229.18 9.023	227.58 8.960	119	303.03 11.930	301.43 11.867	148	376.88 14.838	375.28 14.775
33	84.03 3.308	82.43 3.245	62	157.88 6.216	156.28 6.153	91	231.73 9.123	230.13 9.060	120	305.58 12.031	303.98 11.968	149	379.43 14.938	377.83 14.875
34	86.58 3.409	84.98 3.346	63	160.43 6.316	158.83 6.253	92	234.28 9.223	232.68 9.160	121	308.12 12.131	306.52 12.068	150	381.97 15.038	380.37 14.975
35	89.13 3.509	87.53 3.446	64	162.97 6.416	161.37 6.353	93	236.82 9.324	235.22 9.261	122	310.67 12.231	309.07 12.168	151	384.52 15.139	382.92 15.076
36	91.67 3.609	90.07 3.546	65	165.52 6.517	163.92 6.454	94	239.37 9.424	237.77 9.361	123	313.22 12.331	311.62 12.268	152	387.06 15.239	385.46 15.176
37	94.22 3.709	92.62 3.646	66	168.07 6.617	166.47 6.554	95	241.92 9.524	240.32 9.461	124	315.76 12.432	314.16 12.369	153	389.61 15.339	388.0 15.276
38	96.77 3.810	95.17 3.747	67	170.61 6.717	169.01 6.654	96	244.46 9.624	242.86 9.561	125	318.31 12.532	316.71 12.469	154	392.16 15.439	390.56 15.376
39	99.31 3.910	97.71 3.847	68	173.16 6.817	171.56 6.754	97	247.01 9.725	245.41 9.662	126	320.86 12.632	319.26 12.569	155	394.70 15.540	393.10 15.477
40	101.86 4.010	100.26 3.947	69	175.71 6.918	174.11 6.855	98	249.55 9.825	247.95 9.762	127	323.40 12.732	321.80 12.669	156	397.25 15.640	395.65 15.577
41	104.41 4.110	102.81 4.047	70	178.25 7.018	176.65 6.955	99	252.10 9.925	250.50 9.862	128	325.95 12.833	324.35 12.770	157	399.80 15.740	398.20 15.677
42	106.95 4.211	105.35 4.148	71	180.80 7.118	179.20 7.055	100	254.65 10.026	253.05 9.963	129	328.50 12.933	326.90 12.870	158	402.34 15.840	400.74 15.777
43	109.50 4.311	107.90 4.248	72	183.35 7.218	181.75 7.155	101	257.19 10.126	255.59 10.063	130	331.04 13.033	329.44 12.970	159	404.89 15.941	403.29 15.878
44	112.05 4.411	110.45 4.348	73	185.89 7.319	184.29 7.256	102	259.74 10.226	258.14 10.163	131	333.59 13.133	331.99 13.070	160	407.44 16.041	405.84 15.978
45	114.59 4.511	112.99 4.448	74	188.44 7.419	186.84 7.356	103	262.29 10.326	260.69 10.263	132	336.14 13.234	334.54 13.171	161	409.98 16.141	408.38 16.078
46	117.14 4.612	115.54 4.549	75	190.99 7.519	189.39 7.456	104	264.83 10.427	263.23 10.364	133	338.68 13.334	337.08 13.271	162	412.53 16.241	410.93 16.178
47	119.68 4.712	118.08 4.649	76	193.53 7.619	191.93 7.556	105	267.38 10.527	265.78 10.464	134	341.23 13.434	339.63 13.371	163	415.08 16.342	413.48 16.279
48	122.23 4.812	120.63 4.749	77	196.08 7.720	194.48 7.657	106	269.93 10.627	268.33 10.564	135	343.77 13.534	342.17 13.471	164	417.62 16.442	416.02 16.379
49	124.78 4.912	123.18 4.849	78	198.63 7.820	197.03 7.757	107	272.47 10.727	270.87 10.664	136	346.32 13.635	344.72 13.572	165	420.17 16.542	418.57 16.479
50	127.32 5.013	125.72 4.950	79	201.17 7.920	199.57 7.857	108	275.02 10.828	273.42 10.765	137	348.87 13.735	347.27 13.672	166	422.72 16.642	421.12 16.579

* Dimensions are given in inches and millimeters. Inches are shown in black in bold face type.

Millimeters are shown in blue in light face type.

Stock sprockets are shown shaded.

Poly Chain® GT®2 Sprocket Diameter Table

8mm Pitch Sprocket Diameters

No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in	
	PD	OD												
167	425.26	454.22	179	455.82	454.22	191	486.38	484.78	203	516.94	515.34	215	547.49	545.89
	16.743	16.680		17.946	17.883		19.149	19.086		20.352	20.289		21.555	21.492
168	427.81	426.21	180	458.37	456.77	192	488.92	487.32	204	519.48	517.88	216	550.04	548.44
	16.843	16.780		18.046	17.983		19.249	19.186		20.452	20.389		21.655	21.592
169	430.35	428.75	181	460.91	459.31	193	491.47	489.87	205	522.03	520.43	217	552.59	550.99
	16.943	16.880		18.146	18.083		19.349	19.286		20.552	20.489		21.755	21.692
170	432.90	431.30	182	463.46	461.86	194	494.02	492.42	206	524.57	522.97	218	555.13	553.53
	17.043	16.980		18.246	18.183		19.449	19.386		20.653	20.590		21.856	21.793
171	435.45	433.85	183	466.01	464.41	195	496.56	494.96	207	527.12	525.52	219	557.68	556.08
	17.144	17.081		18.347	18.284		19.550	19.487		20.753	20.690		21.956	21.893
172	437.99	436.39	184	468.55	466.95	196	499.11	497.51	208	529.67	528.07	220	560.23	558.63
	17.244	17.181		18.447	18.384		19.650	19.587		20.853	20.790		22.056	21.993
173	440.54	438.94	185	471.10	469.50	197	501.66	500.06	209	532.21	530.61	221	562.77	561.17
	17.344	17.281		18.547	18.484		19.750	19.687		20.953	20.890		22.156	22.093
174	443.09	441.49	186	473.65	472.05	198	504.20	502.60	210	534.76	533.16	222	565.32	563.72
	17.444	17.381		18.647	18.584		19.851	19.788		21.054	20.991		22.257	22.194
175	445.63	444.03	187	476.19	474.59	199	506.75	505.15	211	537.31	535.71	223	567.86	566.26
	17.545	17.482		18.748	18.685		19.951	19.888		21.154	21.091		22.357	22.294
176	448.18	446.58	188	478.74	477.14	200	509.30	507.70	212	539.85	538.25	224	570.41	568.81
	17.645	17.582		18.848	18.785		20.051	19.988		21.254	21.191		22.457	22.394
177	450.73	449.13	189	481.28	479.68	201	511.84	510.24	213	542.40	540.80			
	17.745	17.682		18.948	18.885		20.151	20.088		21.354	21.291			
178	453.27	451.67	190	483.83	482.23	202	514.39	512.79	214	544.95	543.35			
	17.845	17.782		19.048	18.985		20.252	20.189		21.455	21.392			

14mm Pitch Sprocket Diameters

No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in		No. of Grooves	Diameters mm in	
	PD	OD		PD	OD		PD	OD		PD	OD		PD	OD
28	124.78	121.98	40	178.25	175.45	52	231.73	228.93	64	285.21	282.41	76	338.68	335.88
	4.912	4.802		7.018	6.908		9.123	9.013		11.229	11.119		13.334	13.224
29	129.23	126.43	41	182.71	179.91	53	236.19	233.39	65	289.66	286.86	77	343.14	340.34
	5.088	4.978		7.193	7.0831		9.299	9.189		11.404	11.294		13.509	13.399
30	133.69	130.89	42	187.17	184.371	54	240.64	237.84	66	294.12	291.32	78	347.59	344.79
	5.263	5.153		7.369	7.259		9.474	9.364		11.579	11.469		13.685	13.575
31	138.15	135.35	43	191.62	188.82	55	245.10	242.30	67	298.57	295.77	79	352.05	349.25
	5.439	5.329		7.544	7.434		9.650	9.540		11.755	11.645		13.860	13.750
32	142.60	139.80	44	196.08	193.28	56	249.55	246.75	68	303.03	300.23	80	356.51	353.71
	5.614	5.504		7.720	7.610		9.825	9.715		11.930	11.820		14.036	13.926
33	147.06	144.26	45	200.54	197.74	57	254.01	251.21	69	307.49	304.69	81	360.96	358.16
	5.790	5.680		7.895	7.785		10.000	9.890		12.106	11.996		14.211	14.101
34	151.52	148.72	46	204.99	202.19	58	258.47	255.67	70	311.94	309.14	82	365.42	362.62
	5.965	5.855		8.071	7.961		10.176	10.066		12.281	12.171		14.387	14.277
35	155.97	153.17	47	209.45	206.65	59	262.92	260.12	71	316.40	313.60	83	369.88	367.08
	6.141	6.031		8.246	8.136		10.351	10.241		12.457	12.347		14.562	14.452
35	160.43	157.63	48	213.90	211.10	60	267.38	264.58	72	320.86	318.06	84	374.33	371.53
	6.316	6.206		8.421	8.311		10.527	10.417		12.632	12.522		14.737	14.627
37	164.88	162.08	49	218.36	215.56	61	271.84	269.04	73	325.31	322.51	85	378.79	375.99
	6.492	6.382		8.597	8.487		10.702	10.592		12.808	12.698		14.913	14.803
38	169.34	166.54	50	222.82	220.02	62	276.29	273.49	74	329.77	326.97	86	383.25	380.45
	6.667	6.557		8.772	8.662		10.878	10.768		12.983	12.873		15.088	14.978
39	173.80	171.00	51	227.27	224.47	63	280.75	277.95	75	334.23	331.43	87	387.70	384.90
	6.842	6.732		8.948	8.838		11.053	10.943		13.158	13.048		15.264	15.154

* Dimensions are given in inches and millimeters. Inches are shown in black in bold face type.

Millimeters are shown in blue in light face type.

Stock sprockets are shown shaded.

Poly Chain® GT®2 Sprocket Diameter Table

14mm Pitch Sprocket Diameters

No. of Grooves	Diameters mm In		No. of Grooves	Diameters mm In		No. of Grooves	Diameters mm In		No. of Grooves	Diameters mm In		No. of Grooves	Diameters mm In	
	PD	OD												
88	392.16 15.439	389.36 15.329	116	516.94 20.352	514.14 20.242	144	641.71 25.264	638.91 25.154	172	766.49 30.177	763.69 30.067	200	891.27 35.089	888.47 34.979
89	396.61 15.615	393.81 15.505	117	521.39 20.527	518.59 20.417	145	646.17 25.440	643.37 25.330	173	770.95 30.352	768.15 30.242	201	895.72 35.265	892.92 35.155
90	401.07 15.790	398.27 15.680	118	525.85 20.703	523.05 20.593	146	650.63 25.615	647.83 25.505	174	775.40 30.528	772.60 30.418	202	900.18 35.440	897.38 35.330
91	405.53 15.966	402.73 15.856	119	530.30 25.791	527.50 25.681	147	655.08 30.703	652.28 30.593	175	779.86 35.616	777.06 35.506	203	904.64 35.616	901.84 35.506
92	409.98 16.141	407.18 16.031	120	534.76 21.054	531.96 20.944	148	659.54 25.966	656.74 25.856	176	784.32 30.879	781.52 30.769	204	909.09 35.791	906.29 35.681
93	414.44 16.317	411.64 16.207	121	539.22 21.229	536.42 21.119	149	663.99 26.142	661.19 26.032	177	788.77 31.054	785.97 30.944	205	913.55 35.967	910.75 35.857
94	418.90 16.492	416.10 16.382	122	543.67 21.404	540.87 21.294	150	668.45 26.317	665.65 26.207	178	793.23 31.229	790.43 31.119	206	918.01 36.142	915.21 36.032
95	423.35 16.667	420.55 16.557	123	548.13 21.580	545.33 21.470	151	672.91 26.492	670.11 26.382	179	797.68 31.405	794.88 31.295	207	922.46 36.317	919.66 36.207
96	427.81 16.843	425.01 16.733	124	552.59 21.755	549.79 21.645	152	677.36 26.668	674.56 26.558	180	802.14 31.580	799.34 31.470	208	926.92 36.493	924.12 36.383
97	432.26 17.018	429.46 16.908	125	557.04 21.931	554.24 21.821	153	681.82 26.843	679.02 26.733	181	806.60 31.756	803.80 31.646	209	931.37 36.668	928.57 36.558
98	436.72 17.194	433.92 17.084	126	561.50 22.106	558.70 21.996	154	686.28 27.019	683.48 26.909	182	811.05 31.931	808.25 31.821	210	935.83 36.844	933.03 36.734
99	441.18 17.369	438.38 17.259	127	565.95 22.282	563.15 22.172	155	690.73 27.194	687.93 27.084	183	815.51 32.107	812.71 31.997	211	940.29 37.019	937.49 36.909
100	445.63 17.545	442.83 17.435	128	570.41 22.457	567.61 22.347	156	695.19 27.370	692.39 27.260	184	819.97 32.282	817.17 32.172	212	944.74 37.195	941.94 37.085
101	450.09 17.720	447.29 17.610	129	574.87 22.633	572.07 22.523	157	699.65 27.545	696.85 27.435	185	824.42 32.458	821.62 32.348	213	949.20 37.370	946.40 37.260
102	454.55 17.896	451.75 17.786	130	579.32 22.808	576.52 22.698	158	704.10 27.721	701.30 27.611	186	828.88 32.633	826.08 32.523	214	953.66 37.546	950.86 37.436
103	459.00 18.071	456.20 17.961	131	583.78 22.983	580.98 22.873	159	708.56 27.896	705.76 27.786	187	833.34 32.808	830.54 32.698	215	958.11 37.721	955.31 37.611
104	463.46 18.246	460.66 18.136	132	588.24 23.159	585.44 23.049	160	713.01 28.071	710.21 27.961	188	837.79 32.984	834.99 32.874	216	962.57 37.896	959.77 37.786
105	467.92 18.422	465.12 18.312	133	592.69 23.334	589.89 23.224	161	717.47 28.247	714.67 28.137	189	842.25 33.159	839.45 33.049	217	967.03 38.072	964.23 37.962
106	472.37 18.597	469.57 18.487	134	597.15 23.510	594.35 23.400	162	721.93 28.422	719.13 28.312	190	846.70 33.335	843.90 33.225	218	971.48 38.247	968.68 38.137
107	476.83 18.773	474.03 18.663	135	601.61 7.018	598.81 6.955	163	726.38 28.598	723.58 28.488	191	851.16 33.510	848.36 33.400	219	975.94 38.423	973.14 38.313
108	481.28 18.948	478.48 18.838	136	606.06 23.861	603.26 23.751	164	730.84 28.773	728.04 28.663	192	855.62 33.686	852.82 33.576	220	980.39 38.598	977.59 38.488
109	485.74 19.124	482.94 19.014	137	610.52 24.036	607.72 23.926	165	735.30 28.949	732.50 28.839	193	860.07 33.861	857.27 33.751	221	984.85 38.774	982.05 38.664
110	490.20 19.299	487.40 19.189	138	614.97 24.212	612.17 24.102	166	739.75 29.124	736.95 29.014	194	864.53 34.037	861.73 33.927	222	989.31 38.949	986.51 38.839
111	494.65 19.475	491.85 19.365	139	619.43 24.387	616.63 24.277	167	744.21 29.300	741.41 29.190	195	868.99 34.212	866.19 34.102	223	993.76 39.125	990.96 39.015
112	499.11 19.650	496.31 19.540	140	623.89 24.562	621.09 24.452	168	748.66 29.475	745.86 29.365	196	873.44 34.387	870.64 34.277	224	998.22 39.300	995.42 39.190
113	503.57 19.825	500.77 19.715	141	628.34 24.738	625.54 24.628	169	753.12 29.650	750.32 29.540	197	877.90 34.563	875.10 34.453			
114	508.02 20.001	505.22 19.891	142	632.80 24.913	630.00 24.803	170	757.58 29.826	754.78 29.716	198	882.36 34.738	879.56 34.628			
115	512.48 20.176	509.68 20.066	143	637.26 25.089	634.46 24.979	171	762.03 30.001	759.23 29.891	199	886.81 34.914	884.01 34.804			

* Dimensions are given in inches and millimeters. Inches are shown in black in bold face type.

Millimeters are shown in blue in light face type.

Stock sprockets are shown shaded.

Long Length Belting

Introduction

Long Length synchronous belting is a cost effective, low maintenance drive alternative that is especially suited for linear movement and positioning applications. Long Length belting is available in a wide variety of belt pitches and constructions. Applications as diverse as automated door openers, product conveying systems, positioning devices, and office equipment are possible using the different pitches and constructions available.

Long Length Belting Designations

PolyChain® GT® Carbon® long length belting is specified using width and pitch codes, a LL prefix, and omits the length code. For example, 8mm pitch PolyChain GT Carbon belting, 36mm wide, would be designated LL8MGT036.

Long Length Belting Product Listing

Standard Long Length belting is available in 8mm and 14mm pitch Poly Chain GT Carbon; 2mm, 3mm, 5mm, and 8mm PowerGrip GT2; 3mm, 5mm, 8mm, and 14mm PowerGrip® HTD®; MXL, XL, L, and H PowerGrip® Timing; and T5, T10, AT5, and AT10 Synchro-Power Urethane. Available standard Poly Chain GT Carbon Long Length belting is listed below.

Additional Urethane long length belting is also available.
Refer to Industrial Power Transmission Systems Catalog #19993 for available sizes.

Poly Chain® GT® Carbon® Long Length Belting

8mm—14mm Pitch			
Part No.	Product No.	Width (mm)	Net wt./ft (lb)
LL8MGT012	9302-1000	12	0.03
LL8MGT021	9302-1100	21	0.06
LL8MGT036	9302-1200	36	0.11
LL14MGT020	9302-1300	20	0.10
LL14MGT037	9302-1400	37	0.19

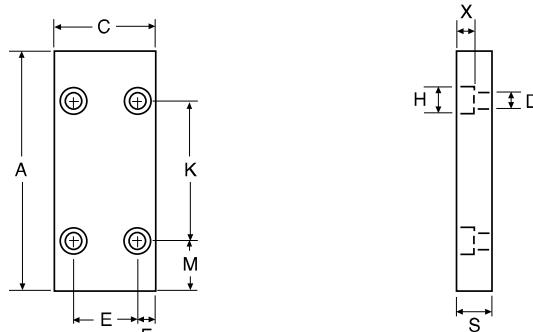
Long Length Belting

Drive Selection

Due to the unique nature of long length applications, special drive design procedures must be followed. Rather than designing a drive based on a single load at a continuous speed, long length application designs typically consider acceleration/deceleration loads generated by the mass being moved and placed, as well as the orientation of the drive (vertical or horizontal). Maximum dynamic drive tensions are then compared to allowable working tensions (T_a) for proper belt width selection. Considering the drive design procedures unique to Long Length belting applications, it is suggested that designers contact Gates Power Transmission Product Application for a drive system analysis.

Belt Clamping Fixtures

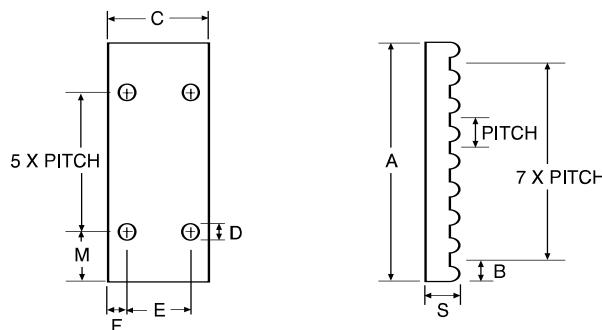
Long length applications typically require that the ends of the belt be mechanically fastened to the component being positioned. A common means of attachment is to use a belt clamping fixture, which clamps the ends of the belt between a grooved plate and a flat top plate. Belt clamping fixtures can have a variety of configurations, depending on belt pitch, belt tooth profile, and system attachment requirements. Contact Gates Power Transmission Product Application for groove dimensions that are suitable for use with clamping fixtures. A minimum of six belt teeth should be engaged in the belt clamping fixture to achieve optimum performance. The plates shown have 8 complete belt teeth engaged. Grooved clamp plates should end on the center of the belt tooth tip. As shown below, mechanical fasteners should be placed beyond the belt's top width in order to maintain belt integrity.



POLY CHAIN® GT®2 FLAT PLATES

PITCH: 8MGT												
Belt width (mm)	A (mm)	C (mm)	d (mm)	E (mm)	F (mm)	H (mm)	K (mm)	M (mm)	S (mm)	X (mm)	Weight (kg)	Part Number
12	72	42.5	9	22.5	10	15	40	16	16	8	0.13	CFP8MGT12
21	72	51.5	9	31.5	10	15	40	16	16	8	0.16	CFP8MGT21
36	72	67	9	47	10	15	40	16	16	8	0.20	CFP8MGT36
PITCH: 14MGT												
Belt width (mm)	A (mm)	C (mm)	d (mm)	E (mm)	F (mm)	H (mm)	K (mm)	M (mm)	S (mm)	X (mm)	Weight (kg)	Part Number
20	126	55.5	11	32.5	11.5	18	70	28	20	10	0.37	CFP14MGT20
37	126	73	11	50	11.5	18	70	28	20	10	0.49	CFP14MGT37

Note: Flat plates are 6061T6 aluminum.



POLY CHAIN® GT®2 GROOVED PLATES

PITCH: 8MGT												
Belt width (mm)	A (mm)	B (mm)	C (mm)	d (mm)	E (mm)	F (mm)	M (mm)	S (mm)	Weight (kg)	Part Number		
12	72	8	42.5	9	22.5	10	16	15	0.10	CGP8MGT12		
21	72	8	51.5	9	31.5	10	16	15	0.13	CGP8MGT21		
36	72	8	67	9	47	10	16	15	0.17	CGP8MGT36		
PITCH: 14MGT												
Belt width (mm)	A (mm)	B (mm)	C (mm)	d (mm)	E (mm)	F (mm)	M (mm)	S (mm)	Weight (kg)	Part Number		
20	126	14	55.5	11	32.5	11.5	28	22	0.34	CGP14MGT20		
37	126	14	73	11	50	11.5	28	22	0.45	CGP14MGT37		

Note: Grooved plates are 6061T6 aluminum.

Gates Short-Length Poly Chain® GT® Carbon® Belt Drive Systems

For especially small and compact drive systems that demand utmost robustness, Poly Chain GT Carbon belts are available in a series of short lengths. These unique belts are available in 8mm pitch only, and in standard 12mm, 21mm, and 36mm widths.



Short-Length Poly Chain GT Carbon belts utilize the same construction as conventional Poly Chain GT Carbon belts, that have proven themselves over and over in industry. Because of their unique manufacturing process, these short belts have a smooth back instead of the ribbed back used with conventional Poly Chain GT Carbon belts. They are also fully compatible with standard and Poly Chain GT2 sprockets.

Typical Applications

Short-Length Poly Chain GT Carbon belts should be considered in any application requiring heavy torque loads or rugged durability in a very compact area. Drives utilizing sprockets as small as 2.5" P.D. with a center distance of 3" are rated for loads in excess of 12 hp at 1800 rpm.

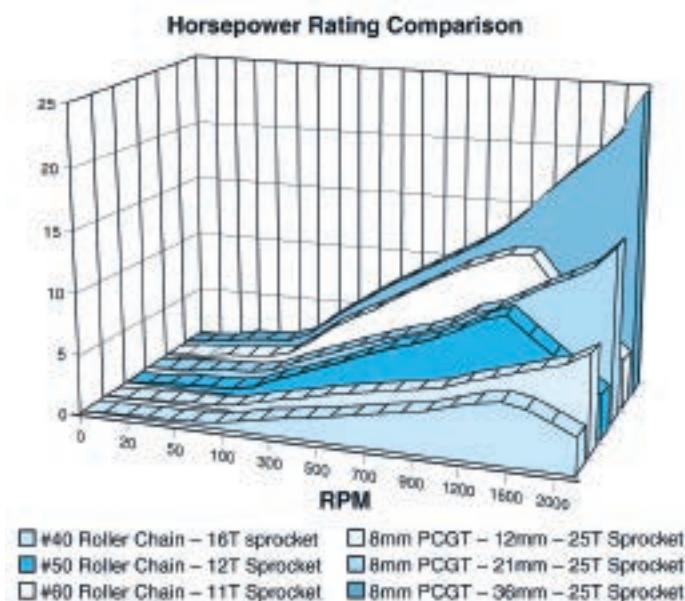
Live roller conveyors are a natural application for Short-Length Poly Chain GT Carbon belt drive systems. Live roller conveyors are used for controlled movement of a great variety of both regular and irregular shaped commodities, from light and fragile to heavy and rugged loading.

In the "Roll-to-Roll" conveying arrangement, two sprockets are attached to each roller, and individual loops of roller chain or belts connect pairs of rollers in a staggered pattern along the length of the conveyor. This design is ideal for handling heavy loads and for applications requiring frequent stopping or reversing service. Idler rollers without sprockets are sometimes inserted between the driven rollers. A typical "Roll-to-Roll" conveyor system is illustrated in the photo at left.

Positive driven live roller conveyors are better suited than V-belt or round belt driven units on applications where heat, dirt, oil, water and other contaminants are present.

Comparison To Roller Chain

Short-Length Poly Chain GT Carbon belts compete well on a width to width basis with roller chain on both low and high speed applications. The following chart compares 8mm Poly Chain GT with #40 and #50 roller chain.



Short-Length 8mm Poly Chain® GT® Carbon® Belt System Specifications

8mm Pitch Lengths

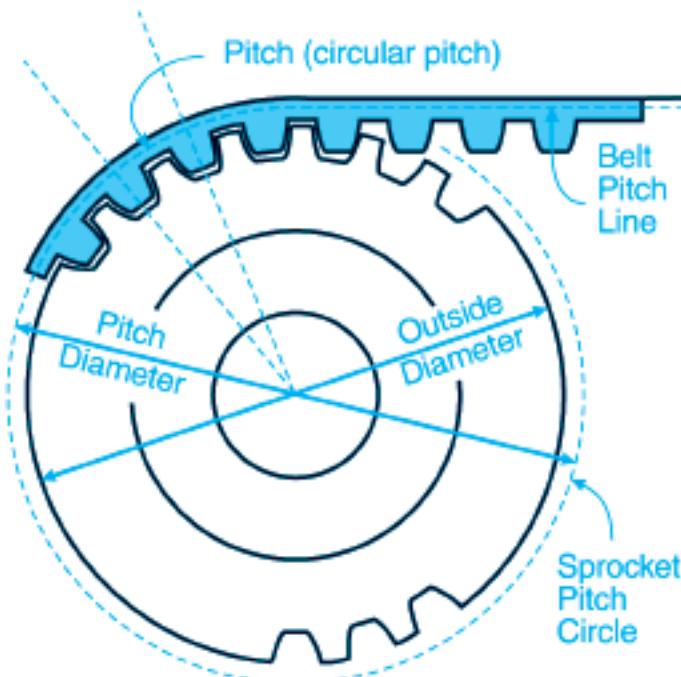
Designations	No. of Teeth	Length mm In
8M-352	44	352 13.858
8M-416	52	416 16.378
8M-456	57	456 17.953
8M-480	60	480 18.898
8M-544	68	544 21.417
8M-608	76	608 23.937

8mm Widths

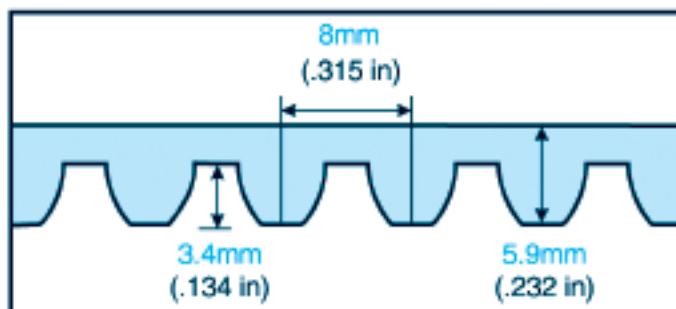
12mm .47"	21mm .83"	36mm 1.42"
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Dimensions are given in inches and millimeters. Inches are shown in black type. Millimeters are shown in blue type.

Gates Short-Length Poly Chain GT Carbon belts are designed to run in Gates Poly Chain GT2 sprockets. See the Sprocket Specification Tables on pages 66-68 for a listing of available sizes, pertinent dimensions, applicable bushing sizes, bore ranges, etc. See page 2 for an explanation for the sprocket code symbol used for Poly Chain GT2 sprockets. When designing Short-Length Poly Chain GT Carbon drives refer to either the Drive Design Procedure on pages 10-13, but substitute tables on pages 90-93 for belt length and center distance selections.



8mm Pitch — Reference Dimensions



8mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches						Speed Ratio	Sprocket Combinations		
Driver		Driven			SH-362 P.L. 13.38 44 Teeth	SH-416 P.L. 16.38 52 Teeth	SH-456 P.L. 17.95 57 Teeth	SH-480 P.L. 18.90 60 Teeth	SH-544 P.L. 21.42 68 Teeth	SH-606 P.L. 23.94 76 Teeth		DriveR	DriveN	
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)									Number of Grooves	Number of Grooves	
22	2.206	22	2.206	1.000	3.46	4.72	5.51	5.98	7.24	8.50	1.000	22	22	
25	2.506	25	2.506	1.000	2.99	4.25	5.04	5.51	6.77	8.03	1.000	25	25	
26	2.607	26	2.607	1.000		4.09	4.88	5.35	6.61	7.87	1.000	26	26	
27	2.707	27	2.707	1.000		3.94	4.72	5.20	6.46	7.72	1.000	27	27	
28	2.807	28	2.807	1.000		3.78	4.57	5.04	6.30	7.56	1.000	28	28	
29	2.907	29	2.907	1.000		3.62	4.41	4.88	6.14	7.40	1.000	29	29	
30	3.008	30	3.008	1.000			4.25	4.73	5.99	7.25	1.000	30	30	
31	3.108	31	3.108	1.000			4.09	4.57	5.83	7.09	1.000	31	31	
32	3.208	32	3.208	1.000			3.94	4.41	5.67	6.93	1.000	32	32	
33	3.308	33	3.308	1.000				4.25	5.51	6.77	1.000	33	33	
34	3.409	34	3.409	1.000				4.10	5.36	6.62	1.000	34	34	
35	3.509	35	3.509	1.000					5.20	6.46	1.000	35	35	
36	3.609	36	3.609	1.000					5.04	6.30	1.000	36	36	
37	3.709	37	3.709	1.000					4.88	6.14	1.000	37	37	
38	3.810	38	3.810	1.000					4.73	5.99	1.000	38	38	
39	3.910	39	3.910	1.000					4.57	5.83	1.000	39	39	
40	4.010	40	4.010	1.000						5.67	1.000	40	40	
41	4.110	41	4.110	1.000						5.51	1.000	41	41	
42	4.211	42	4.211	1.000						5.36	1.000	42	42	
41	4.110	42	4.211	1.024						5.43	1.024	41	42	
40	4.010	41	4.110	1.025						5.59	1.025	40	41	
38	3.810	39	3.910	1.026					4.65	5.91	1.026	38	39	
39	3.910	40	4.010	1.026					4.49	5.75	1.026	39	40	
37	3.709	38	3.810	1.027						4.80	6.06	1.027	37	38
36	3.609	37	3.709	1.028						4.96	6.22	1.028	36	37
34	3.409	35	3.509	1.029				4.02	5.28	6.54	1.029	34	35	
35	3.509	36	3.609	1.029					5.12	6.38	1.029	35	36	
33	3.308	34	3.409	1.030				4.17	5.43	6.69	1.030	33	34	
32	3.208	33	3.308	1.031			3.86	4.33	5.59	6.85	1.031	32	33	
31	3.108	32	3.208	1.032			4.01	4.49	5.75	7.01	1.032	31	32	
30	3.008	31	3.108	1.033			4.17	4.65	5.91	7.17	1.033	30	31	
29	2.907	30	3.008	1.034		3.54	4.33	4.80	6.06	7.32	1.034	29	30	
28	2.807	29	2.907	1.036		3.70	4.49	4.96	6.22	7.48	1.036	28	29	
27	2.707	28	2.807	1.037		3.86	4.64	5.12	6.38	7.64	1.037	27	28	
26	2.607	27	2.707	1.038		4.02	4.80	5.28	6.54	7.80	1.038	26	27	
25	2.506	26	2.607	1.040		4.17	4.96	5.43	6.69	7.95	1.040	25	26	
40	4.010	42	4.211	1.050						5.51	1.050	40	42	
39	3.910	41	4.110	1.051						5.67	1.051	39	41	
38	3.810	40	4.010	1.053					4.57	5.83	1.053	38	40	
37	3.709	39	3.910	1.054					4.72	5.99	1.054	37	39	
36	3.609	38	3.810	1.056					4.88	6.14	1.056	36	38	
35	3.509	37	3.709	1.057					5.04	6.30	1.057	35	37	
34	3.409	36	3.609	1.059					5.20	6.46	1.059	34	36	
33	3.308	35	3.509	1.061				4.09	5.35	6.62	1.061	33	35	
32	3.208	34	3.409	1.063				4.25	5.51	6.77	1.063	32	34	
31	3.108	33	3.308	1.065			3.93	4.41	5.67	6.93	1.065	31	33	
30	3.008	32	3.208	1.067			4.09	4.57	5.83	7.09	1.067	30	32	
29	2.907	31	3.108	1.069			4.25	4.72	5.98	7.25	1.069	29	31	
28	2.807	30	3.008	1.071		3.62	4.41	4.88	6.14	7.40	1.071	28	30	
42	4.211	45	4.511	1.071						5.12	1.071	42	45	
27	2.707	29	2.907	1.074		3.78	4.56	5.04	6.30	7.56	1.074	27	29	
26	2.607	28	2.807	1.077		3.94	4.72	5.20	6.46	7.72	1.077	26	28	
39	3.910	42	4.211	1.077						5.59	1.077	39	42	
38	3.810	41	4.110	1.079					4.49	5.75	1.079	38	41	
25	2.506	27	2.707	1.080		4.09	4.88	5.35	6.61	7.88	1.080	25	27	
37	3.709	40	4.010	1.081					4.65	5.91	1.081	37	40	
36	3.609	39	3.910	1.083					4.80	6.06	1.083	36	39	
35	3.509	38	3.810	1.086					4.96	6.22	1.086	35	38	
34	3.409	37	3.709	1.088					5.12	6.38	1.088	34	37	
33	3.308	36	3.609	1.091				4.01	5.28	6.54	1.091	33	36	
32	3.208	35	3.509	1.094				4.17	5.43	6.69	1.094	32	35	
31	3.108	34	3.409	1.097			3.85	4.33	5.59	6.85	1.097	31	34	
41	4.110	45	4.511	1.098						5.20	1.098	41	45	
30	3.008	33	3.308	1.100			4.01	4.49	5.75	7.01	1.100	30	33	
29	2.907	32	3.208	1.103			4.17	4.64	5.91	7.17	1.103	29	32	
38	3.810	42	4.211	1.105						5.67	1.105	38	42	
28	2.807	31	3.108	1.107		3.54	4.33	4.80	6.06	7.32	1.107	28	31	
37	3.709	41	4.110	1.108					4.56	5.83	1.108	37	41	

*This length factor must be used to determine the proper belt width.



Gates Corporation

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8mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches						Speed Ratio	Sprocket Combinations		
Driver		Driven			SH-322 P.L. 13.96 44 Teeth	SH-416 P.L. 16.38 52 Teeth	SH-456 P.L. 17.95 57 Teeth	SH-480 P.L. 18.90 60 Teeth	SH-544 P.L. 21.42 68 Teeth	SH-606 P.L. 23.94 75 Teeth		Driver	Driven	
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)									Number of Grooves	Number of Grooves	
27	2.707	30	3.008	1.111		3.70	4.48	4.96	6.22	7.48	1.111	27	30	
36	3.609	40	4.010	1.111					4.72	5.98	1.111	36	40	
35	3.509	39	3.910	1.114					4.88	6.14	1.114	35	39	
26	2.607	29	2.907	1.115		3.86	4.64	5.12	6.38	7.64	1.115	26	29	
34	3.409	38	3.810	1.118					5.04	6.30	1.118	34	38	
25	2.506	28	2.807	1.120		4.01	4.80	5.28	6.54	7.80	1.120	25	28	
33	3.308	37	3.709	1.121					5.19	6.46	1.121	33	37	
32	3.208	36	3.609	1.125				4.09	5.35	6.61	1.125	32	36	
40	4.010	45	4.511	1.125						5.27	1.125	40	45	
31	3.108	35	3.509	1.129				4.25	5.51	6.77	1.129	31	35	
30	3.008	34	3.409	1.133			3.93	4.41	5.67	6.93	1.133	30	34	
37	3.709	42	4.211	1.135					4.48	5.74	1.135	37	42	
22	2.206	25	2.506	1.136	3.23	4.49	5.27	5.75	7.01	8.27	1.136	22	25	
29	2.907	33	3.308	1.138			4.09	4.56	5.83	7.09	1.138	29	33	
36	3.609	41	4.110	1.139					4.64	5.90	1.139	36	41	
28	2.807	32	3.208	1.143			4.25	4.72	5.98	7.24	1.143	28	32	
35	3.509	40	4.010	1.143					4.80	6.06	1.143	35	40	
42	4.211	48	4.812	1.143						4.87	1.143	42	48	
34	3.409	39	3.910	1.147					4.96	6.22	1.147	34	39	
27	2.707	31	3.108	1.148		3.62	4.40	4.88	6.14	7.40	1.148	27	31	
33	3.308	38	3.810	1.152					5.11	6.37	1.152	33	38	
26	2.607	30	3.008	1.154		3.77	4.56	5.04	6.30	7.56	1.154	26	30	
39	3.910	45	4.511	1.154						5.35	1.154	39	45	
32	3.208	37	3.709	1.156				4.01	5.27	6.53	1.156	32	37	
25	2.506	29	2.907	1.160		3.93	4.72	5.19	6.46	7.72	1.160	25	29	
31	3.108	36	3.609	1.161				4.17	5.43	6.69	1.161	31	36	
30	3.008	35	3.509	1.167			3.85	4.32	5.59	6.85	1.167	30	35	
36	3.609	42	4.211	1.167					4.56	5.82	1.167	36	42	
35	3.509	41	4.110	1.171					4.72	5.98	1.171	35	41	
41	4.110	48	4.812	1.171						4.95	1.171	41	48	
29	2.907	34	3.409	1.172			4.01	4.48	5.74	7.00	1.172	29	34	
34	3.409	40	4.010	1.176					4.87	6.14	1.176	34	40	
28	2.807	33	3.308	1.179			4.16	4.64	5.90	7.16	1.179	28	33	
22	2.206	26	2.607	1.182	3.14	4.41	5.19	5.67	6.93	8.19	1.182	22	26	
33	3.308	39	3.910	1.182					5.03	6.29	1.182	33	39	
38	3.810	45	4.511	1.184						5.42	1.184	38	45	
27	2.707	32	3.208	1.185		3.54	4.32	4.80	6.06	7.32	1.185	27	32	
32	3.208	38	3.810	1.188					5.19	6.45	1.188	32	38	
26	2.607	31	3.108	1.192		3.69	4.48	4.96	6.22	7.48	1.192	26	31	
31	3.108	37	3.709	1.194				4.08	5.35	6.61	1.194	31	37	
25	2.506	30	3.008	1.200		3.85	4.64	5.11	6.37	7.64	1.200	25	30	
30	3.008	36	3.609	1.200				4.24	5.50	6.77	1.200	30	36	
35	3.509	42	4.211	1.200					4.63	5.90	1.200	35	42	
40	4.010	48	4.812	1.200						5.03	1.200	40	48	
34	3.409	41	4.110	1.206					4.79	6.05	1.206	34	41	
29	2.907	35	3.509	1.207			3.92	4.40	5.66	6.92	1.207	29	35	
33	3.308	40	4.010	1.212					4.95	6.21	1.212	33	40	
28	2.807	34	3.409	1.214			4.08	4.56	5.82	7.08	1.214	28	34	
37	3.709	45	4.511	1.216						5.50	1.216	37	45	
32	3.208	39	3.910	1.219					5.11	6.37	1.219	32	39	
27	2.707	33	3.308	1.222			4.24	4.72	5.98	7.24	1.222	27	33	
31	3.108	38	3.810	1.226				4.00	5.26	6.53	1.226	31	38	
22	2.206	27	2.707	1.227	3.06	4.32	5.11	5.59	6.85	8.11	1.227	22	27	
26	2.607	32	3.208	1.231		3.61	4.40	4.87	6.14	7.40	1.231	26	32	
39	3.910	48	4.812	1.231						5.10	1.231	39	48	
30	3.008	37	3.709	1.233				4.16	5.42	6.69	1.233	30	37	
34	3.409	42	4.211	1.235					4.71	5.97	1.235	34	42	
25	2.506	31	3.108	1.240		3.77	4.56	5.03	6.29	7.55	1.240	25	31	
29	2.907	36	3.609	1.241			3.84	4.32	5.58	6.84	1.241	29	36	
33	3.308	41	4.110	1.242					4.87	6.13	1.242	33	41	
28	2.807	35	3.509	1.250			4.00	4.48	5.74	7.00	1.250	28	35	
32	3.208	40	4.010	1.250					5.02	6.29	1.250	32	40	
36	3.609	45	4.511	1.250					4.31	5.57	1.250	36	45	
40	4.010	50	5.013	1.250						4.86	1.250	40	50	
31	3.108	39	3.910	1.258					5.18	6.45	1.258	31	39	
27	2.707	34	3.409	1.259			4.16	4.63	5.90	7.16	1.259	27	34	
38	3.810	48	4.812	1.263						5.17	1.263	38	48	
30	3.008	38	3.810	1.267				4.08	5.34	6.60	1.267	30	38	
26	2.607	33	3.308	1.269			3.53	4.32		6.05	7.32	1.269	26	33

Length Factor*



The Driving Force in Power Transmission.

8mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Sprocket Combinations			Speed Ratio	Center Distance, Inches						Speed Ratio	Sprocket Combinations			
DriveR		DriveN		8M-322 P.L. 13.88 44 teeth	8M-416 P.L. 16.38 52 teeth	8M-456 P.L. 17.95 57 teeth	8M-460 P.L. 18.90 60 teeth	8M-544 P.L. 21.42 68 teeth	8M-606 P.L. 23.97 76 teeth		DriveR		DriveN	
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)								Number of Grooves	Number of Grooves		
22	2.206	28	2.807	1.273		4.24	5.03	5.50	6.77	8.03	1.273	22	28	
33	3.308	42	4.211	1.273					4.78	6.05	1.273	33	42	
29	2.907	37	3.709	1.276				4.23	5.50	6.76	1.276	29	37	
25	2.506	32	3.208	1.280	3.69	4.47	4.95	6.21	7.47	1.280	25	32		
32	3.208	41	4.110	1.281				4.94	6.21	1.281	32	41		
39	3.910	50	5.013	1.282				4.93	1.282	39	50			
28	2.807	36	3.609	1.286		3.92	4.39	5.66	6.92	1.286	28	36		
35	3.509	45	4.511	1.286				4.38	5.65	1.286	35	45		
31	3.108	40	4.010	1.290				5.10	6.36	1.290	31	40		
27	2.707	35	3.509	1.296		4.07	4.55	5.81	7.08	1.296	27	35		
37	3.709	48	4.812	1.297					5.25	1.297	37	48		
30	3.008	39	3.910	1.300			3.99	5.26	6.52	1.300	30	39		
26	2.607	34	3.409	1.308			4.23	4.71	5.97	7.23	1.308	26	34	
29	2.907	38	3.810	1.310				4.15	5.42	6.68	1.310	29	38	
32	3.208	42	4.211	1.313				4.86	6.12	1.313	32	42		
38	3.810	50	5.013	1.316					5.00	1.316	38	50		
22	2.206	29	2.907	1.318		4.16	4.95	5.42	6.69	7.95	1.318	22	29	
25	2.506	33	3.308	1.320		3.60	4.39	4.87	6.13	7.39	1.320	25	33	
28	2.807	37	3.709	1.321			3.83	4.31	5.57	6.84	1.321	28	37	
31	3.108	41	4.110	1.323					5.02	6.28	1.323	31	41	
34	3.409	45	4.511	1.324				4.46	5.72	1.324	34	45		
27	2.707	36	3.609	1.333			3.99	4.47	5.73	6.99	1.333	27	36	
30	3.008	40	4.010	1.333					5.17	6.44	1.333	30	40	
36	3.609	48	4.812	1.333					5.32	1.333	36	48		
29	2.907	39	3.910	1.345				4.06	5.33	6.60	1.345	29	39	
26	2.607	35	3.509	1.346			4.15	4.62	5.89	7.15	1.346	26	35	
37	3.709	50	5.013	1.351					5.08	1.351	37	50		
31	3.108	42	4.211	1.355					4.93	6.20	1.355	31	42	
28	2.807	38	3.810	1.357				4.22	5.49	6.75	1.357	28	38	
25	2.506	34	3.409	1.360		3.52	4.31	4.78	6.05	7.31	1.360	25	34	
22	2.206	30	3.008	1.364		4.08	4.86	5.34	6.60	7.86	1.364	22	30	
33	3.308	45	4.511	1.364					4.53	5.80	1.364	33	45	
30	3.008	41	4.110	1.367					5.09	6.36	1.367	30	41	
27	2.707	37	3.709	1.370			3.90	4.38	5.65	6.91	1.370	27	37	
35	3.509	48	4.812	1.371					5.40	1.371	35	48		
29	2.907	40	4.010	1.379				3.98	5.25	6.51	1.379	29	40	
26	2.607	36	3.609	1.385			4.06	4.54	5.81	7.07	1.385	26	36	
36	3.609	50	5.013	1.389					5.15	1.389	36	50		
28	2.807	39	3.910	1.393				4.14	5.41	6.67	1.393	28	39	
25	2.506	35	3.509	1.400			4.22	4.70	5.96	7.23	1.400	25	35	
30	3.008	42	4.211	1.400					5.00	6.27	1.400	30	42	
32	3.208	45	4.511	1.406					4.60	5.87	1.406	32	45	
27	2.707	38	3.810	1.407			3.82	4.30	5.56	6.83	1.407	27	38	
22	2.206	31	3.108	1.409		3.99	4.78	5.26	6.52	7.78	1.409	22	31	
34	3.409	48	4.812	1.412					5.47	1.412	34	48		
29	2.907	41	4.110	1.414					5.16	6.43	1.414	29	41	
26	2.607	37	3.709	1.423			3.98	4.46	5.72	6.99	1.423	26	37	
28	2.807	40	4.010	1.429				4.05	5.32	6.59	1.429	28	40	
35	3.509	50	5.013	1.429					5.22	1.429	35	50		
37	3.709	53	5.314	1.432					4.82	1.432	37	53		
25	2.506	36	3.609	1.440			4.14	4.61	5.88	7.15	1.440	25	36	
27	2.707	39	3.910	1.444				4.21	5.48	6.75	1.444	27	39	
29	2.907	42	4.211	1.448					5.08	6.35	1.448	29	42	
31	3.108	45	4.511	1.452					4.67	5.94	1.452	31	45	
22	2.206	32	3.208	1.455		3.91	4.70	5.17	6.44	7.70	1.455	22	32	
33	3.308	48	4.812	1.455					5.54	1.455	33	48		
26	2.607	38	3.810	1.462			3.89	4.37	5.64	6.90	1.462	26	38	
28	2.807	41	4.110	1.464				3.96	5.24	6.50	1.464	28	41	
34	3.409	50	5.013	1.471					5.29	1.471	34	50		
36	3.609	53	5.314	1.472					4.89	1.472	36	53		
25	2.506	37	3.709	1.480			4.05	4.53	5.80	7.06	1.480	25	37	
27	2.707	40	4.010	1.481				4.12	5.40	6.66	1.481	27	40	
22	2.206	33	3.308	1.500		3.82	4.61	5.09	6.36	7.62	1.500	22	33	
26	2.607	39	3.910	1.500			3.80	4.28	5.55	6.82	1.500	26	39	
28	2.807	42	4.211	1.500					5.15	6.42	1.500	28	42	
30	3.008	45	4.511	1.500					4.74	6.02	1.500	30	45	
32	3.208	48	4.812	1.500					4.34	5.61	1.500	32	48	
35	3.509	53	5.314	1.514					4.96	1.514	35	53		
33	3.308	50	5.013	1.515					5.37	1.515	33	50		
Length Factor*				0.65	0.70	0.73	0.74	0.78	0.81	Length Factor*				



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8mm Pitch Poly Chain® GT® Carbon® Belts

Drive Selection Table

Sprocket Combinations				Speed Ratio	Center Distance, Inches						Speed Ratio	Sprocket Combinations			
DriveR		DriveN			SM-352 P.L. 13.86 44 Teeth	SM-416 P.L. 16.38 52 Teeth	SM-468 P.L. 17.95 57 Teeth	SM-480 P.L. 19.30 60 Teeth	SM-544 P.L. 21.42 68 Teeth	SM-598 P.L. 23.94 76 Teeth		DriveR	DriveN		
Number of Grooves	Pitch Diameter (Inches)	Number of Grooves	Pitch Diameter (Inches)									Number of Grooves	Number of Grooves		
27	2.707	41	4.110	1.519				4.03	5.31	6.58	1.519	27	41		
25	2.506	38	3.810	1.520			3.96	4.44	5.71	6.98	1.520	25	38		
26	2.607	40	4.010	1.538			4.19	5.47	6.74	8.04	1.538	26	40		
22	2.206	34	3.409	1.545		3.73	4.52	5.00	6.27	7.54	1.545	22	34		
31	3.108	48	4.812	1.548				4.41	5.69	6.98	1.548	31	48		
29	2.907	45	4.511	1.552				4.82	6.09	7.52	1.552	29	45		
27	2.707	42	4.211	1.556			3.94	5.22	6.49	7.82	1.556	27	42		
34	3.409	53	5.314	1.559					5.03	6.31	7.58	1.559	34	53	
25	2.506	39	3.910	1.560			3.87	4.35	5.63	6.90	1.560	25	39		
32	3.208	50	5.013	1.563					5.44	6.72	8.00	1.563	32	50	
26	2.607	41	4.110	1.577			4.11	5.38	6.65	8.04	1.577	26	41		
22	2.206	35	3.509	1.591		3.64	4.44	4.92	6.19	7.45	1.591	22	35		
25	2.506	40	4.010	1.600			3.78	4.27	5.54	6.81	1.600	25	40		
30	3.008	48	4.812	1.600				4.48	5.76	7.04	8.32	1.600	30	48	
33	3.308	53	5.314	1.606					5.10	6.38	7.66	1.606	33	53	
28	2.807	45	4.511	1.607				4.89	6.16	7.44	8.72	1.607	28	45	
31	3.108	50	5.013	1.613					5.51	6.79	8.07	1.613	31	50	
26	2.607	42	4.211	1.615			4.01	5.29	6.57	7.85	1.615	26	42		
22	2.206	36	3.609	1.636		3.55	4.35	4.83	6.10	7.37	1.636	22	36		
25	2.506	41	4.110	1.640				4.18	5.45	6.73	8.04	1.640	25	41	
29	2.907	48	4.812	1.655				4.55	5.83	7.11	8.39	1.655	29	48	
32	3.208	53	5.314	1.656					5.17	6.45	7.73	1.656	32	53	
27	2.707	45	4.511	1.667				4.96	6.24	7.52	8.80	1.667	27	45	
30	3.008	50	5.013	1.667				4.29	5.58	6.86	8.14	1.667	30	50	
25	2.506	42	4.211	1.680			4.09	5.37	6.64	7.92	1.680	25	42		
22	2.206	37	3.709	1.682		3.46	4.26	4.74	6.02	7.29	1.682	22	37		
33	3.308	56	5.614	1.697					4.82	6.10	7.38	1.697	33	56	
31	3.108	53	5.314	1.710					5.24	6.52	7.80	1.710	31	53	
28	2.807	48	4.812	1.714				4.62	5.90	7.18	8.46	1.714	28	48	
29	2.907	50	5.013	1.724				4.36	5.65	6.93	8.22	1.724	29	50	
22	2.206	38	3.810	1.727			4.17	4.66	5.93	7.20	1.727	22	38		
26	2.607	45	4.511	1.731					5.03	6.31	7.59	1.731	26	45	
32	3.208	56	5.614	1.750					4.89	6.19	7.47	1.750	32	56	
30	3.008	53	5.314	1.767					5.31	6.58	7.86	1.767	30	53	
22	2.206	39	3.910	1.773			4.08	4.57	5.84	7.12	1.773	22	39		
27	2.707	48	4.812	1.778				4.69	5.97	7.25	8.53	1.778	27	48	
28	2.807	50	5.013	1.786				4.43	5.72	7.00	8.28	1.786	28	50	
25	2.506	45	4.511	1.800				3.81	5.10	6.38	7.66	1.800	25	45	
31	3.108	56	5.614	1.806					4.96	6.26	7.54	8.82	1.806	31	56
22	2.206	40	4.010	1.818			3.99	4.48	5.76	7.03	1.818	22	40		
29	2.907	53	5.314	1.828					5.38	6.66	7.94	1.828	29	53	
26	2.607	48	4.812	1.846				4.75	6.04	7.32	8.50	1.846	26	48	
27	2.707	50	5.013	1.852				4.50	5.79	7.07	8.25	1.852	27	50	
22	2.206	41	4.110	1.864			3.90	4.39	5.67	6.94	1.864	22	41		
30	3.008	56	5.614	1.867					5.03	6.31	7.59	1.867	30	56	
28	2.807	53	5.314	1.893					5.45	6.73	8.01	1.893	28	53	
22	2.206	42	4.211	1.909			3.80	4.29	5.58	6.86	1.909	22	42		
25	2.506	48	4.812	1.920					4.82	6.11	7.39	1.920	25	48	
26	2.607	50	5.013	1.923				4.57	5.86	7.14	8.42	1.923	26	50	
29	2.907	56	5.614	1.931					5.10	6.49	7.77	1.931	29	56	
27	2.707	53	5.314	1.963					5.52	6.81	8.09	1.963	27	53	
25	2.506	50	5.013	2.000				4.63	5.93	7.21	8.49	2.000	25	50	
28	2.807	56	5.614	2.000					5.16	6.25	7.53	2.000	28	56	
26	2.607	53	5.314	2.038				4.27	5.58	6.86	8.04	2.038	26	53	
22	2.206	45	4.511	2.045				4.01	5.31	6.59	7.87	2.045	22	45	
27	2.707	56	5.614	2.074					5.23	6.53	7.81	2.074	27	56	
25	2.506	53	5.314	2.120				4.34	5.65	6.93	8.11	2.120	25	53	
28	2.807	60	6.015	2.143					4.77	6.03	7.31	2.143	28	60	
26	2.607	56	5.614	2.154					5.30	6.31	7.59	2.154	26	56	
22	2.206	48	4.812	2.182				5.03	6.59	7.87	2.182	22	48		
27	2.707	60	6.015	2.222					4.83	6.07	7.35	2.222	27	60	
25	2.506	56	5.614	2.240					5.37	6.45	7.73	2.240	25	56	
22	2.206	50	5.013	2.273				4.84	6.14	7.43	2.273	22	50		
26	2.607	60	6.015	2.308					4.90	6.42	7.70	2.308	26	60	
25	2.506	60	6.015	2.400					4.96	6.59	7.87	2.400	25	60	
22	2.206	53	5.314	2.409				4.53	5.86	7.14	2.409	22	53		
22	2.206	56	5.614	2.545				4.22	5.57	6.83	2.545	22	56		
22	2.206	60	6.015	2.727					5.16	6.85	7.13	2.727	22	60	
22	2.206	63	6.316	2.864					4.83	7.13	7.41	2.864	22	63	

Length Factor*

0.65

0.70

0.73

0.74

0.78

0.81

Length Factor*

ENGINEERING DATA

NOTE: This engineering section provides general engineering information for synchronous belts and sprockets (or pulleys) which are useful in general drive design work. If you need additional information, contact Gates Power Transmission Product Application.

When designing synchronous drives, there are several special circumstances that may require additional consideration:

Section I Application Design Considerations

When designing synchronous drives, there are several special circumstances that may require additional consideration:

- 1. Gear Motors/Speed Reducer Drives**
- 2. Electric Motor Frame Dimensions**
- 3. Minimum Sprocket Diameter Recommendations for Electric Motors**
- 4. High-Driven Inertia**
- 5. Air Moving Drives**
- 6. Linear Motion Drives**
- 7. High Performance Applications**
- 8. Belt Drive Registration**
- 9. Belt Drive Noise**
- 10. Use of Flanged Sprockets**
- 11. Fixed (Nonadjustable) Center Distance**
- 12. Use of Idlers**
- 13. Specifying Shaft Locations in Multipoint Drive Layouts**
- 14. Minimum Belt Wrap and Tooth Engagement**
- 15. Adverse Operating Environments**

Each of these circumstances and special considerations are reviewed below.

1. Gear Motors/Speed Reducer Drives

When designing a belt drive system to transfer power from the output shaft of a speed reducer to the final driven shaft, the designer must make certain that the belt drive does not exert shaft loads greater than the speed reducing device is rated to carry. Failure to do so can result in premature shaft/bearing failures whether the belt drive has been designed with the appropriate power capacity or not.

This concept is similar to the National Electric Motor Association (NEMA) establishing minimum acceptable sprocket diameters for each of their standardized motor frames. Abiding by these minimum recommended diameters, when designing a belt drive system, prevents the motor bearings from failing prematurely due to excessive shaft loads exerted by the belt drive.

Overhung load is generally defined as a force exerted by a belt or chain drive, that is perpendicular to a speed reducer shaft, and applied beyond its outermost bearing. Calculated overhung load values are intended to serve as an indication of how heavily loaded the shaft and outermost bearing of a speed reducer actually is.

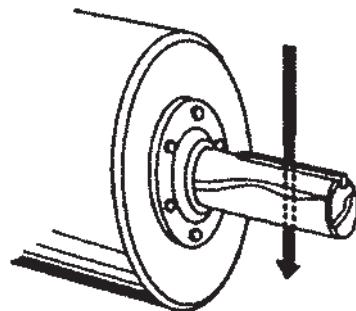


Figure 3 -Overhung Load

Overhung load calculations are generally assumed to apply to the slower output shaft of a speed reducer. It is important to note that these calculations apply to higher speed input shafts as well. Most speed reducer manufacturers publish allowable overhung load values for every model in their product line. This value represents the maximum load that the shaft and bearings can support without negatively impacting the durability of the speed reducer. When the actual overhung load exceeds the published allowable value, premature shaft or bearing failure may occur. In extreme cases, catastrophic failures can occur.

A general formula used to calculate overhung load (OHL) is as follows:

Formula 8

$$OHL = \frac{126,000 \times HP \times kLCF \times KSF \times KLLF}{PD \times RPM}$$

Where:

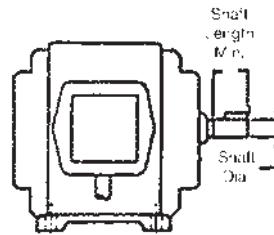
- HP = Actual horsepower being transmitted at the gear motor/reducer output shaft with no service factor applied
KLCF = Overhung load connection factor (1.3 for all synchronous belt drives)
KSF = Service factor for the speed reducer (available from the manufacturer)
KLLF = Load location factor for the speed reducer (available from the manufacturer)
PD = Pitch diameter of the speed reducer output shaft sprocket
RPM = RPM of the speed reducer output shaft

Speed reducer manufacturers each publish their own specific formula and constants to calculate overhung load. They also publish specific overhung load ratings for each speed reducer product that they produce. It is very important to use the correct overhung load calculation procedure in conjunction with the manufacturer's accompanying overhung load rating.

If the calculated overhung load for a particular belt drive system does exceed the speed reducer manufacturer's maximum recommended value, consider altering the belt drive design. In order to reduce the calculated overhung load, consider:

- Increasing sprocket diameters
- Reducing belt width
- Mounting the sprocket closer to the speed reducer outboard bearing

Increasing the sprocket diameter not only reduces calculated overhung load, it also potentially reduces the required belt width. Reducing the belt width and mounting the sprocket as close as possible to the outermost bearing of the speed reducer both move the center of the belt load closer to the speed reducer. This also reduces the calculated overhung load. Alterations to the belt drive design should be made until the calculated overhung load is within the speed reducer manufacturer's recommendations.



2. Electric Motor Frame Dimensions

Motor dimensions can be important considerations depending on the application and its requirements. If motor shaft length, motor shaft diameter, or clearance issues are a concern, refer to the motor dimension table on this page. The table lists common general purpose electric motors by frame size.

Frame Size	Shaft Dia. (in)	Shaft Length Min. (in)	Key (in)
48	1/2	—	3/64 Flat
56	5/8	—	3/16 x 3/16 x 1-3/8
143T	7/8	2	3/16 x 3/16 x 1-3/8
145T	7/8	2	3/16 x 3/16 x 1-3/8
182	7/8	2	3/16 x 3/16 x 1-3/8
182T	1-1/8	2-1/2	1/4 x 1/4 x 1-3/4
182	7/8	2	3/16 x 3/16 x 1-3/8
182T	1-1/8	2-1/2	1/4 x 1/4 x 1-3/4
213	1-1/8	2-3/4	1/4 x 1/4 x 2
213T	1-3/8	3-1/8	5/16 x 5/16 x 2-3/8
215	1-1/8	2-3/4	1/4 x 1/4 x 2
215T	1-3/8	3-1/8	5/16 x 5/16 x 2-3/8
254U	1-3/8	3-1/2	5/16 x 5/16 x 2-3/4
254T	1-5/8	3-3/4	3/8 x 3/8 x 2-7/8
256U	1-3/8	3-1/2	5/16 x 5/16 x 3-3/4
256T	1-5/8	3-3/4	3/8 x 3/8 x 2-7/8
284U	1-5/8	4-5/8	3/8 x 3/8 x 3-3/4
284T	1-7/8	4-3/8	1/2 x 1/2 x 3-1/4
284TS	1-5/8	3	3/8 x 3/8 x 1-7/8
286U	1-5/8	4-5/8	3/8 x 3/8 x 3-3/4
286T	1-7/8	4-3/8	1/2 x 1/2 x 3-1/4
286TS	1-5/8	3	3/8 x 3/8 x 1-7/8
324U	1-7/8	5-3/8	1/2 x 1/2 x 4-1/4
324T	2-1/8	5	1/2 x 1/2 x 3-7/8
324TS	1-7/8	3-1/2	1/2 x 1/2 x 2
326U	1-7/8	5-3/8	1/2 x 1/2 x 4-1/4
326T	2-1/8	5	1/2 x 1/2 x 3-7/8
326TS	1-7/8	3-1/2	1/2 x 1/2 x 2
364U	2-1/8	6-1/8	1/2 x 1/2 x 5
364US	1-7/8	3-1/2	1/2 x 1/2 x 2
364T	2-3/8	5-5/8	5/8 x 5/8 x 4-1/4
364TS	1-7/8	3-1/2	1/2 x 1/2 x 2
365U	2-1/8	6-1/8	1/2 x 1/2 x 5
365US	1-7/8	3-1/2	1/2 x 1/2 x 2
365T	2-3/8	5-5/8	5/8 x 5/8 x 4-1/4
365TS	1-7/8	3-1/2	1/2 x 1/2 x 2
404U	2-3/8	6-7/8	5/8 x 5/8 x 5-1/2
404US	2-1/8	4	1/2 x 4 x 2-3/4
404T	2-7/8	7	3/4 x 3/4 x 5-5/8
404TS	2-1/8	4	1/2 x 1/2 x 2-3/4
405U	2-3/8	6-7/8	5/8 x 5/8 x 5-1/2
405US	2-1/8	4	1/2 x 1/2 x 2-3/4
405T	2-7/8	7	3/4 x 3/4 x 5-5/8
405TS	2-1/8	4	1/2 x 1/2 x 2-3/4
444U	2-7/8	8-3/8	3/4 x 3/4 x 7
444US	2-1/8	4	1/2 x 1/2 x 2-3/4
444T	3-3/8	8-1/4	7/8 x 7/8 x 6-7/8
444TS	2-3/8	4-1/2	5/8 x 5/8 x 3
445U	2-7/8	8-3/8	3/4 x 3/4 x 7
445US	2-1/8	4	1/2 x 1/2 x 2-3/4
445T	3-3/8	8-1/4	7/8 x 7/8 x 6-7/8
445TS	2-3/8	4-1/2	5/8 x 5/8 x 3
447T	3-3/8	8-1/4	7/8 x 7/8 x 6-7/8
447TS	2-3/8	4-1/2	5/8 x 5/8 x 3
449T	3-3/8	8-1/4	7/8 x 7/8 x 6-7/8
449TS	2-3/8	4-1/2	5/8 x 5/8 x 3

3. Minimum Sprocket Diameter

Recommendations for Electric Motors

Minimum Recommended Sprocket /Sheave Diameters

NEMA (The National Electric Manufacturers Association) publishes recommendations for the minimum diameter of sprockets and sheaves to be used on General Purpose Electric Motors. The purpose of these recommendations is to prevent the use of excessively small sprockets or sheaves. This can result in motor shaft or bearing damage since belt pull increases as the diameter is reduced.

Table data has been compiled from NEMA Standard MG-1-14-42; 11/78, MG-1-14-43; 1/68, and a composite of electric motor manufacturers data. Values are generally conservative, and specific motors may permit the use of a smaller sprocket or sheave. Consult the motor manufacturer.

**Motor Frames and Minimum Diameters
for 60 Cycle Electric Motors**

Motor Frame Code	Shaft Dia.(in)	Horsepower at Synchronous Speed (rpm)				Synchronous Belts
		3600 (3450)	1800 (1750)	1200 (1160)	900 (870)	
143T	0.875	1-1/2	1	3/4	1/2	2.0
145T	0.875	2—3	1-1/2—2	1	3/4	2.2
182T	1.125	3	3	1-1/2	1	2.2
182T	1.125	5	—	—	—	2.4
184T	1.125	—	—	2	1-1/2	2.2
184T	1.125	5	—	—	—2.2	2.2
184T	1.125	7-1/2	5	—	—2.7	2.7
213T	1.375	7-1/2—10	7-1/2	3	2	2.7
215T	1.375	10	—	5	3	2.7
215T	1.375	15	10	—	—	3.4
254T	1.625	15	—	7-1/2	5	3.4
254T	1.625	20	15	—	—	4.0
256T	1.625	20—25	—	10	7-1/2	4.0
256T	1.625	—	20	—	—	4.0
284T	1.875	—	—	15	10	4.0
284T	1.875	—	25	—	—	4.0
286T	1.875	—	30	20	15	4.7
324T	2.125	—	40	25	20	5.4
236T	2.125	—	50	30	25	6.1
364T	2.375	—	—	40	30	6.1
364T	2.375	—	60	—	—	6.7
365T	2.375	—	—	50	40	7.4
365T	2.375	—	75	—	—	7.7
404T	2.875	—	—	60	—	7.2
404T	2.875	—	—	—	50	7.6
404T	2.875	—	100	—	—	7.7
405T	2.875	—	—	75	60	9.0
405T	2.875	—	100	—	—	7.7
405T	2.875	—	125	—	—	9.5
444T	3.375	—	—	100	—	9.0
444T	3.375	—	—	—	75	8.6
444T	3.375	—	125	—	—	9.5
444T	3.375	—	150	—	—	9.5
445T	3.375	—	—	125	—	10.8
445T	3.375	—	—	—	100	10.8
445T	3.375	—	150	—	—	9.5
445T	3.375	—	200	—	—	11.9

4. High-Driven Inertia

Many drives, such as piston compressors, punch presses and crushers, depend on the driveN pulley acting as a flywheel. This flywheel effect, or WR^2 is used to help moderate or smooth out fluctuations in driven load and speed. Failure to compensate for this during a redesign can result in premature damage to the prime mover or early belt failures. This can be a consideration when replacing older belt drives with new, higher capacity belts.

When replacing large pulleys or sheaves with sprockets, be careful not to remove a designed-in flywheel effect. Ask questions of the user to make sure there is not a concern for a high WR^2 . If there is a concern, you may have to use a wider sprocket, a larger diameter, or a special made-to-order sprocket designed with added weight and WR^2 .

Drives which have a high driveN inertia and are subjected to high acceleration or emergency stop conditions require additional design expertise. Contact Gates Power Transmission Product Application for further engineering assistance.

5. Air Moving Drives

HVAC Equipment Inspection

Many air handling drives have structures that are not particularly rigid, which can create belt tension and drive alignment problems resulting in unusual and premature belt wear. Synchronous belts are sensitive to fluctuations in center distance that can be caused by inadequate bracketry. Under start up conditions, an AC motor can be required to provide 150% to 200% of its rated capacity. Synchronous belts cannot slip, and must transmit the higher start-up torque. Under these conditions, the drive center distance may collapse if the structure is not sufficiently rigid.

With the drive shut off and safely locked out, a simple method to use when inspecting potential drive conversions is to grab the two belt spans and push them together while observing the motor. If any significant relative change in center distance or motor position is noticed, the drive's structural strength is most likely insufficient for a simple conversion. The structure would need to be reinforced to obtain optimum performance from a synchronous belt drive. The best conversion candidates have motors that are mounted solidly on support bracketry that is part of the fan's structural system. When possible, select synchronous drives with diameters similar to existing V-belt sheave diameters. This will maintain similar belt pulls and loads on the shafts and structure.

Air Handling Unit Start-Up Characteristics

Full Load Start Up

Start up loads can be a concern when evaluating potential drives for conversion to synchronous belts. Synchronous belts will transmit all of the start-up torque, where V-belts may slip if the load is excessive. Due to the inertia of the fan, start up loads can potentially be 150% to 200% of the normal operating load. It is important that the start up load be considered by selecting appropriate service factors when designing a belt drive system.

Controlled Start Up

An air handling drive with soft start or variable frequency controller (AC Inverter) is ideal for conversion to synchronous belts. The fan will be ramped up to speed slowly, with a corresponding increase in load as the speed increases. Structural flexing is typically not a concern when designing synchronous belt drives on systems using soft starts or variable frequency controllers.

Fan Speed

The volume of air being transmitted and the required horsepower are both sensitive to changes in the driveN fan speed. If designing a synchronous belt drive for energy savings, it is important that the synchronous belt drive be designed to operate at the proper driveN fan speed. All conversions from existing V-belt drives should have the synchronous belt drive speed ratio based on a measured driveN shaft RPM, and not calculated from the theoretical V-belt speed ratio. This measurement can be made by either using a mechanical contact tachometer or a strobe tachometer.

The horsepower requirement for fans varies with the cube of the fan speed. A small change in the fan speed makes a much larger difference in the actual horsepower and energy required.

Formula 9

$$HP_1/HP_2 = (RPM_1/RPM_2)^3$$

Where:
 HP₁ = Initial Horsepower
 HP₂ = New Horsepower @ New Fan RPM
 RPM₁ = Initial Fan RPM
 RPM₂ = New Fan RPM

Air-Cooled Heat Exchanger (ACHE) Applications

Air-cooled heat exchangers are used in Petrochemical, Oil and Gas Production, Power Generation, and Petroleum Refining Industries where process heat must be removed. Electric motors as large as 60 hp commonly drive the cooling fans with either large ratio V-belt or Synchronous belt drives.

According to the American Petroleum Institute (**API 661** - Air-Cooled Heat Exchangers for General Refinery Service), a safety factor of 1.8 must be used in the belt drive design process. Synchronous belt drives typically have higher horsepower capacities than V-belt drives with an equivalent width. This increased capacity results in narrower belt drives and lighter drive hardware. Synchronous belt drive systems are especially beneficial on higher horsepower heat exchanger units, and they are commonly used on new or redesigned units. V-belt drive systems are commonly used on low to medium HP fans because of their relatively low cost and good availability.

Surface rust on sheaves and sprockets is very abrasive, and rapidly wears belts. Sprockets on wet heat exchanger applications (water drawn through heat exchanger coils by fan) such as Cooling Towers, often rust and require the use of electroless nickel plating to prevent excessive corrosion. Cooling Towers are commonly used to cool large buildings (HVAC; Heating-Ventilating-Air Conditioning Systems). Misalignment is a common cause of premature belt failures on ACHE drive systems. Care should be taken to ensure proper sheave/sprocket alignment when installing the belt drive system.

See **Gates Belt Drive Preventative Maintenance and Safety Manual** for detailed information about proper belt drive alignment. Proper belt pre-tension is necessary to obtain optimum belt performance. This is particularly true for the high inertia start up loads seen in ACHE applications. If belt installation tension is too low, V-belts will be prone to slippage and synchronous belts will be prone to tooth jump or ratcheting. Motor controllers are sometimes used to bring the fan up to speed slowly (soft start), decreasing the chance of synchronous belt ratcheting.

6. Linear Motion Drives

In linear motion drives, such as a rack and pinion application, the belt is not transmitting a load in the conventional rotational manner. The two cut ends of the belt are connected to clamping fixtures and the belt travels back and forth a specified distance while rotating over a sprocket. Because of these characteristics, the drive design process will typically not follow standard catalog design procedures.

The designer will most likely have available a maximum belt load or pull which will need to be related to the belt's allowable working tension.

Reasonably sized sprocket diameters are still required to prevent excessive stress fatigue in the belt. In these applications, the designer may either use endless belts and cut them, or use standard long length belting when available. Gates Power Transmission Product Application may be consulted for design assistance.

7. High Performance Vehicle Applications

For special high performance applications, such as motorcycles or race car and boat supercharger drives, the design loads will typically exceed published data. Because of the extremely high loads and speeds (as much as 500 HP and belt speeds exceeding 10,000 fpm), it is necessary for the designer to contact Gates Power Transmission Product Application for additional assistance.

Although special considerations may be involved, it is important to remember that reasonable drive recommendations can be provided to the designer in most cases.

8. Belt Drive Registration

The three primary factors contributing to belt drive registration (or positioning) errors are belt elongation, backlash, and tooth deflection. When evaluating the potential registration capabilities of a synchronous belt drive, the system must first be determined to be either static or dynamic in terms of its registration function and requirements.

Static Registration: A static registration system moves from its initial static position to a secondary static position. During the process the designer is concerned only with how accurately and consistently the drive arrives at its secondary position. Potential registration errors that occur during transport are not considered. Therefore, the primary factor contributing to registration error in a static registration system is backlash. The effects of belt elongation and tooth deflection do not have any influence on the registration accuracy of this type of system.

Dynamic Registration: A dynamic registration system is required to perform a registering function while in motion with torque loads varying as the system operates. In this case, the designer is concerned with the rotational position of the drive sprockets with respect to each other at every point in time. Therefore, belt elongation, backlash, and tooth deflection will all contribute to registration inaccuracies.

Further discussion about each of the factors contributing to registration error is as follows:

Belt Elongation: Belt elongation, or stretch, occurs naturally when a belt is placed under tension. The total tension exerted within a belt results from installation as well as working loads. The amount of belt elongation is a function of the belt tensile modulus, which is influenced by the type of tensile cord and the belt construction. The standard tensile cord used in rubber synchronous belts is fiberglass. Fiberglass has a high tensile modulus, is dimensionally stable, and has excellent flex-fatigue characteristics. If a higher tensile modulus is needed in a rubber synchronous belt, aramid tensile cords can be considered, although they are generally used to provide resistance to harsh shock and impulse loads. Aramid tensile cords used in rubber synchronous belts generally have only a marginally higher tensile modulus in comparison to fiberglass. When needed, belt tensile modulus data is available from Gates Power Transmission Product Application.

Backlash: Backlash in a synchronous belt drive results from clearance between the belt teeth and the sprocket grooves. This clearance is needed to allow the belt teeth to enter and exit the grooves smoothly with a minimum of interference. The amount of clearance necessary depends upon the belt tooth profile. PowerGrip® Timing Belt Drives are known for having relatively little backlash. PowerGrip® HTD® Drives have improved torque carrying capability and resist ratcheting, but have a significant amount of backlash. PowerGrip® GT®2 and Poly Chain® GT® Carbon® Drives have considerably improved torque carrying capability, and backlash characteristics in between that of PowerGrip HTD and PowerGrip Timing Drives. In special cases, alterations can be made to drive systems to further decrease backlash. These alterations often result in increased belt wear, increased drive noise and shorter drive life. For additional information contact Gates Power Transmission Product Application.

Tooth Deflection: Tooth deformation in a synchronous belt drive occurs as a torque load is applied to the system, and individual belt teeth are loaded. The amount of belt tooth deformation depends upon the amount of torque loading, sprocket size, installation tension and belt type. Of the three primary contributors to registration error, tooth deflection is the most difficult to quantify. Experimentation with a prototype drive system is the best means of obtaining realistic estimations of belt tooth deflection. Additional guidelines that may be useful in designing registration critical drive systems are as follows:

- Design with large sprockets with more teeth in mesh.
- Keep belts tight, and control tension closely.
- Design frame/shafting to be rigid under load.
- Use high quality machined sprockets to minimize radial run out and lateral wobble.

9. Belt Drive Noise

V-belt, synchronous belt, roller chain, and gear drives will all generate noise while transmitting power. Each type of system has its own characteristic sound. V-belt drives tend to be the quietest and synchronous belt drives are much quieter than roller chain drives. When noise is an issue, there are several design and maintenance tips that should be followed to minimize belt drive noise.

Noise: Decibel and Frequency

Noise is an unwanted or unpleasant sound that can be described with two criteria – frequency and decibel (dB) levels. Frequency is measured in Hertz. A perfect human ear is capable of distinguishing frequencies typically from 20 to 20,000 Hertz. The human ear does not generally perceive frequencies higher than 20,000 Hertz. The sound pressure level or intensity of noise is measured in terms of decibels (dB). The decibel has become the basic unit of measure since it is an objective measurement that approximately corresponds to the subjective measurement made by the human ear. Since sound is composed of several distinct and measurable parts and the human ear doesn't differentiate between these parts, measuring scales that approximate the human ear's reaction have been adopted. Three scales – A, B, and C – are used to duplicate the ear's response over the scale's ranges. The A scale is most commonly used in industry because of its adoption as the standard in OSHA regulations. Noise described in decibels (dBA - "A" weighting for the human ear) is generally perceived as the loudness or intensity of the noise.

While the human ear can distinguish frequencies over a broad range, the ear is most sensitive in the range of normal speech – 500 to 2000 Hertz.. As a consequence, this is the range most commonly of concern for noise control ("A" weighting gives more weight or emphasis to sounds in the 500 to 2000 hz range). Frequency is most closely related to what the ear hears as pitch. High frequency sounds are perceived as whining or piercing, while low frequency sounds are perceived as rumbling. The combination of sound pressure level (dB) and frequency describes the overall level of loudness perceived by the human ear. One without the other does not adequately describe the loudness potential of the noise. For example, an 85 dBA noise at 3000 Hertz is going to be perceived as being much louder than an 85 dBA noise at 500 Hertz.

Reducing Noise

Following proper installation and maintenance procedures, as well as some simple design alternatives can reduce belt drive noise.

Belt Drive Tension and Alignment

Properly tensioning and aligning a belt drive will allow the belt drive to perform at its quietest level. Improper tension in synchronous belt drives can affect how the belt fits in the sprocket grooves. Proper tension minimizes tooth to groove interference, and thereby reduces belt noise.

Misaligned synchronous belt drives tend to be much noisier than properly aligned drives due to the amount of interference that is created between the belt teeth and the sprocket grooves. Misaligned synchronous belt drives also may cause belt tracking that forces the edge of the belt to ride hard against a sprocket flange. Misalignment causing belt contact with a flange will generate noise that is easily detected.

Noise Barriers and Absorbers

Sometimes, even properly aligned and tensioned belt drives may be too noisy for a work environment. When this occurs, steps can be taken to modify the drive guard to reduce the noise level.

Noise barriers are used to block and reflect noise. Noise barriers do not absorb or deaden the noise; they block the noise and generally reflect most of the noise back towards its point of origin. Good noise barriers are dense, and should not vibrate. A sheet metal belt guard is a noise barrier. The more complete the enclosure is, the more effective it is as a noise barrier. Noise barrier belt guards can be as sophisticated as a completely enclosed case, or as simple as sheet metal covering the front of the guard to prevent direct sound transmission.

Noise absorbers are used to reduce noise reflections and to dissipate noise energy. Noise absorbers should be used in combination with a noise barrier. Noise absorbers are commonly referred to as acoustic insulation. Acoustic insulation (the noise absorber) is used inside of belt guards (the noise barrier) where necessary. A large variety of acoustic insulation manufacturers are available to provide different products for the appropriate situation.

A combination of noise barrier (solid belt guard) and noise absorber (acoustic insulation) will provide the largest reduction in belt drive noise. While the noise reduction cannot be predicted, field experience has shown that noise levels have been reduced by 10 to 20 dBA when using complete belt guards with acoustic insulation.

10. Use of Flanged Sprockets

Guide flanges are needed in order to keep the belt on the sprocket. Due to tracking characteristics, even on the best aligned drives, belts will ride off the edge of the sprockets. Flanges will prevent this belt ride-off.

On all drives using stock or made-to-order sprockets, the following conditions should be considered when selecting flanged sprockets:

1. On all two-sprocket drives, the minimum flanging requirements are two flanges on one sprocket or one flange on each sprocket on opposite sides.
2. On drives where the center distance is more than eight times the diameter of the small sprocket, both sprockets should be flanged on both sides. (See Engineering Section II, Drive Alignment and Belt Installation on Pages 105 and 106.)
3. On vertical shaft drives, one sprocket should be flanged on both sides, and all the other sprockets in the system should be flanged on the bottom side only.
4. On drives with more than two sprockets, the minimum flanging requirements are two flanges on every other sprocket or one flange on every sprocket —on alternating sides around the system.

On made-to-order sprockets, flanges must be securely fastened, such as using mechanical fasteners, welding, shrink-fit or other equivalent methods.

11. Fixed (Nonadjustable) Center Distance

Designers sometimes attempt to design synchronous belt drive systems without any means of belt adjustment or take up. This type of system is called a Fixed Center Drive. While this approach is often viewed as being economical, and is simple for assemblers, it often results in troublesome reliability and performance problems in the long run.

The primary pitfall in a fixed center design approach is failure to consider the affects of system tolerance accumulation. Belts and sprockets are manufactured with industry accepted production tolerances. There are limits to the accuracy that the center distance can be maintained on a production basis as well. The potential effects of this tolerance accumulation is as follows:

Low Tension:

Long Belt with Small Sprockets on a Short Center Distance

High Tension:

Short Belt with Large Sprockets on a Long Center Distance

Belt tension in these two cases can vary by a factor of 3 or more with a standard fiberglass tensile cord, and even more with an aramid tensile cord. This potential variation is great enough to overload bearings and shafting, as well as the belts themselves. The probability of these extremes occurring is a matter of statistics, but however remote the chances seem, they will occur in a production setting. In power transmission drives, the appearance of either extreme is very likely to impact drive system performance in a negative manner.

The most detrimental aspect of fixed center drives is generally the potentially high tension condition. This condition can be avoided by adjusting the design center distance. A common approach in these designs is to reduce the center distance from the exact calculated value by some small fraction. This results in a drive system that is inherently loose, but one that has much less probability of yielding excessively high shaft loads. **NOTE:** This approach should not be used for power transmission drives since the potentially loose operating conditions could result in accelerated wear and belt ratcheting, even under nominal loading.

There are times when fixed center drive designs can't be avoided. In these cases, the following recommendations will maximize the probability of success.

1. Do not use a fixed center design for power transmission drives.
Consider using a fixed center design only for lightly loaded or motion transfer applications.
2. Do not use a fixed center design for drives requiring high motion quality or registration precision.
3. When considering a fixed center design, the center distance must be held as accurately as possible, typically within 0.002" — 0.003"
(0.05mm — 0.08mm). This accuracy often requires the use of stamped steel framework.
4. Sprockets for fixed center systems should be produced with a machining process for accuracy. Molding and sintering processes are generally not capable of holding the finished O.D. sufficiently accurate for these systems.
5. The performance capabilities of the drive system should be verified by testing belts produced over their full length tolerance range on drive systems representing the full potential center-distance variation.
Contact Gates Power Transmission Product Application for further details.
6. Contact Gates Power Transmission Product Application for design center distance recommendations and application assistance.

12. Use of Idlers

Use of idlers should be restricted to those cases in which they are functionally necessary. Idlers are often used as a means of applying tension when the center distance is not adjustable.

Idlers should be located on the slack side span of the belt drive. General size recommendations are listed for inside grooved, inside flat, and back-side idlers. In some cases, such as high capacity drives utilizing large sprockets, idlers as large as the smallest loaded sprocket in the system may be more appropriate.

Idler Size Recommendations

Belt	Minimum Inside Idler	Minimum Inside Flat Idler	Minimum Backside Idler
8M Poly Chain® GT® Carbon®	25 grooves	4.00" O.D.	3.00" O.D.
14M Poly Chain GT Carbon	28 grooves	7.00" O.D.	6.50" O.D.

Outside or backside idlers should be flat and uncrowned; flanges may or may not be necessary. Drives with flat inside idlers should be tested, as noise and belt wear may occur.

Idler arc of contact should be held to a minimum. All idlers should be rigidly mounted in place to minimize movement or deflection during drive start-up and operation.

13. Specifying Shaft Locations in Multipoint Drive Layouts

When collecting geometrical layout data for multiple sprocket drive layouts, it is important to use a standard approach that is readily understood and usable for drive design calculations. This is of particular importance when the data will be provided to Gates Power Transmission Product Application for analysis. Drive design software that allows designers to design multipoint drives can also be downloaded at www.gates.com/drivedesign.

Multipoint Drive

When working with a drive system having more than three shafts, the geometrical layout data must be collected in terms of X-Y coordinates for analysis. For those unfamiliar with X-Y coordinates, the X-Y cartesian coordinate system is commonly used in mathematical and engineering calculations and utilizes a horizontal and vertical axis as illustrated in Fig. 4.

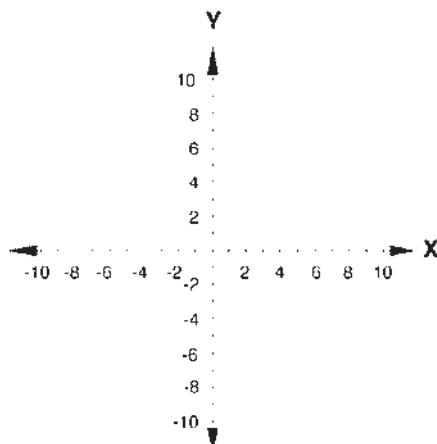


Figure 4

The axes cross at the zero point, or origin. Along the horizontal, or "X" axis, all values to the right of the zero point are positive, and all values to the left of the zero point are negative. Along the vertical, or "Y" axis, all values above the zero point are positive, and all values below the zero point are negative. This is also illustrated in Figure 4. When identifying a shaft center location, each X-Y coordinate is specified with a measurement in the "X" as well as the "Y" direction. This requires a horizontal and vertical measurement for each shaft center in order to establish a complete coordinate. Either English or Metric units of measurement may be used.

A complete coordinate is specified as follows:

(X,Y) where X = measurement along X-axis (horizontal)
Y = measurement along Y-axis (vertical)

In specifying X-Y coordinates for each shaft center, the origin (zero point) must first be chosen as a reference. The driveR shaft most often serves this purpose, but any shaft center can be used. Measurements for all remaining shaft centers must be taken from this origin or reference point. The origin is specified as (0,0).

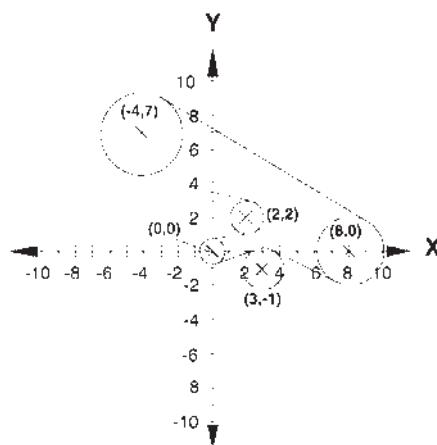


Figure 5

An example layout of a 5-point drive system is illustrated in Figure 5. Here each of the five shaft centers are located and identified on the X-Y coordinate grid. When specifying parameters for the moveable or adjustable shaft (for belt installation and tensioning), the following approaches are generally used:

Fixed Location: Specify the nominal shaft location coordinate with a movement direction.

Slotted Location: Specify a location coordinate for the beginning of the slot, and a location coordinate for the end of the slot along its path of linear movement.

Pivoted Location: Specify the initial shaft location coordinate along with a pivot point location coordinate and the pivot radius.

Performing belt length and idler movement/positioning calculations by hand can be quite difficult and time consuming. With a complete geometrical drive description, we can make the drive design and layout process quite simple for you. Contact Gates Power Transmission Product Application for computer-aided assistance.

14. Minimum Belt Wrap and Tooth Engagement

Horsepower ratings listed in this catalog are based on a minimum of six teeth in mesh between the belt and the sprocket. The ratings must be corrected for excessive tooth loading if there are less than six teeth in mesh. For non-stock drives not listed in the Drive Selection Tables, the teeth in mesh may be calculated by using this formula:

Formula 10

$$\text{Teeth in Mesh} = 0.5 - \left(\frac{D - d}{6C} \right) N_g$$

Where:
 D = pitch diameter, large sprocket, inches
 d = pitch diameter, small sprocket, inches
 C = center distance between shafts, inches
 Ng = number of grooves in small sprocket

In cases where fewer than six teeth are in full contact, 20% of the horsepower rating must be subtracted for each tooth less than six not in full contact. After computing the teeth in mesh, the belt rating should be multiplied by the appropriate K_{Tm} factor shown in the following table.

Teeth In Mesh Correction Factor

Teeth in Mesh	Factor K _{Tm}
6 or more	1.00
5	0.80
4	0.60
3	0.40
2	0.20

In addition to the number of teeth in mesh, some drives with more than two shafts may have a greater potential for the belts to ratchet where loaded sprockets have six teeth in mesh, but a small arc of contact. In order to minimize this condition, each loaded sprocket in the drive system should have an arc of contact or belt wrap angle of at least 60 degrees. Non-loaded idler sprockets do not have tooth meshing or wrap angle requirements.

15. Adverse Operating Environments

Debris

Be very careful when using synchronous drives in high debris environments. Debris can be more damaging to the positive belt drive than a V-belt drive, which has a tendency to remove debris from the sheave grooves through drive operation. Entrapment of debris in synchronous drives is a major concern. Debris can be packed into sprocket grooves causing improper belt tooth engagement, reducing belt life and accelerating belt and sprocket wear. Care must be taken to provide adequate shielding to drives in environments where debris is likely. Completely enclosing a synchronous belt drive may be acceptable. Since synchronous belts generate minimal heat during drive operation, air circulation is not critical except where extremely high temperatures already are present. Depending on the type and abrasive characteristics of the debris, excessive wear can be generated on both belt and sprockets.

Temperature

Belt performance is generally unaffected in ambient temperature environments between -65° and 185°F (-54° and 85°C). Temperature extremes beyond these limits should be reviewed by Gates Power Transmission Product Application.

High Humidity/Corrosive Environments

Many industrial applications face problems associated with rusting parts. Numerous applications in the food and beverage industry are located in areas that require periodic washdown. Unless a drive is completely shielded and protected from wash down, rust and corrosion will be rapidly apparent in these types of environments. This is equally true of sprockets when used in very wet or humid environments, such as seen with air moving drives on cooling towers or wood kilns. The constant effects of the wet air surrounding the belt drive can cause excessive rust.

Corrosion attacks sprocket grooves, building up rust deposits. The corrosion will increase over time, building up in the sprocket grooves and non-driving surfaces (flanges, sprocket faces, bushing face). Sprockets with corrosion in the grooves will rapidly wear the belt's teeth and wear through the abrasion resistant tooth fabric, resulting in tooth shear and premature belt failure.

When an application is in a corrosive environment, the designer may elect to use special sprockets and bushings to prevent premature failures. Using special stainless steel sprockets and bushings or electroless nickel-plated sprockets can help eliminate corrosion as a cause of failure on belt drives located in these damaging environments.

Section II

Engineering Design Considerations

All synchronous belt drives require proper installation procedures for optimum performance. In addition, topics such as tooth profile advantages, sprocket rim speed limitations, efficiency, and tolerances are common to all Gates synchronous belt drives.

1. Belt Storage and Handling
2. Center Distance and Belt Length
3. Tooth Profiles
4. Static Conductivity
5. Sprocket Diameter-Speed
6. Efficiency
7. Belt Tolerances
8. Belt Installation Tension
9. Center Distance Allowances for Installation and Tensioning
10. Drive Alignment
11. Belt Installation
12. Belt Pull Calculations
13. Bearing/Shaft Load Calculations
14. Self-Generated Tension

Each of these circumstances and special considerations are reviewed below.

1. Belt Storage and Handling

Storage Recommendations

In order to retain their serviceability and dimensions, proper storage procedures must be followed for synchronous belts. Quite often premature belt failures can be traced to improper belt storage procedures that damaged the belt before it was installed on the drive. By following a few guidelines, these types of belt failures can be avoided.

Recommended

Belts should be stored in a cool and dry environment with no direct sunlight. Ideally, belts should be stored at less than 85°F and with lower than 70% relative humidity.

Belts should be stored in original packaging.

Not Recommended

Belts should not be stored near windows, which may expose the belts to direct sunlight or moisture.

Belts should not be stored near heaters, radiators, or in the direct airflow of heating devices.

Belts should not be stored near any devices that generate ozone such as transformers and electric motors.

Belts should not be stored where they are exposed to solvents or chemicals in the atmosphere.

Do not store belts on the floor unless they are in a protective container. Floor locations are exposed to traffic that may damage the belts.

Do not crimp belts during handling or while being stored. To avoid this, belts must not be bent to diameters smaller than what is recommended (minimum recommended sprocket diameter for inside bends and 1.3 times the minimum recommended sprocket diameter for back side bends). Do not use ties or tape to pull belt spans tightly together near the end of the belt. Do not hang on a small diameter pin that suspends all of the belt weight and bends the belt to a diameter smaller than the minimum recommended sprocket diameter. Improper storage will damage the tensile cord and the belt will fail prematurely. Handle belts carefully when removing from storage and moving to the application.

Storage Effects

Belts may be stored up to six years if properly stored at temperatures less than 85°F and relative humidity less than 70%.

For every 15°F increase in storage temperature above 85°F, the time the belt can be stored without reduced performance decreases by one-half. Belts should never be stored at temperatures above 115°F.

At relative humidity levels above 70%, fungus or mildew may form on stored belts. This has minimal affect on belt performance, but should be avoided if possible. When equipment is stored for prolonged periods of time (over six months), the belt tension should be relaxed so that the belt does not take a set, and the storage environment should meet the 85°F and 70% or less relative humidity condition. If this is not possible, belts should be removed and stored separately in a proper environment.

2. Center Distance and Belt Length

The approximate relationship between a center distance and belt pitch length is given by the following formula:

Formula 11

$$L_p = 2C + 1.57(D + d) + \frac{(D - d)^2}{4C}$$

Where:
 L_p = belt pitch length, inches
 D = diameter of large sprocket, inches
 d = diameter of small sprocket, inches
 C = center distance, inches

A more precise formula is given below:

Formula 12

$$L_p = 2C \cos \phi + \frac{\pi (D + d)}{2} + \frac{\pi \phi (D - d)}{180}$$

Where:
 L_p = belt pitch length, inches
 C = center distance, inches
 D = pitch diameter of large sprocket, inches
 d = pitch diameter of small sprocket, inches

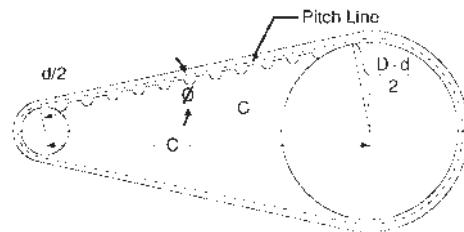
The approximate center distance can be found by this formula:

$$\phi = \sin^{-1} \left(\frac{D - d}{2C} \right) \text{ degrees}$$

Formula 13

$$C = \frac{K + \sqrt{K^2 - 32(D - d)^2}}{16}$$

Where: K = 4 L_p - 6.28 (D+d)



The exact center distance can be calculated using an iterative process between the center distance (Formula 13) and belt length (Formula 12) equations. The exact center distance has been found when the two equations converge. The pitch length increment of a synchronous belt is equal to a multiple of the belt pitch.

3. Tooth Profiles

Conventional trapezoidal belts (MXL, XL, etc.) were the earliest developments of positive drive belts. In more recent years, new curvilinear profiles have entered the market. The most predominant of these profiles is the HTD® system (5mm, 8mm, etc.). While these curvilinear profiles provide many advantages, they also can provide significant disadvantages.

With the development of the Gates GT® tooth profile, the combined advantages of the various curvilinear profiles have now been optimized. Characteristics such as ratcheting resistance, improved load/life and noise reduction were prime factors in the design of the Gates GT profile. Additionally, it allowed optimization in incorporating premium materials into its superior construction.

The GT tooth profile is based on the tractrix mathematical function. Engineering handbooks describe this function as a "frictionless" system. This early development by Schiele is described as an involute form of a catenary. With this system, the belt and sprocket teeth move substantially tangentially during entry and exit, thus improving significantly the belts' performance characteristics. This is illustrated in Fig. 6. For information on belt/sprocket interchangeability between various Gates products as well as interchange with other manufacturers, consult Gates Belt/Sprocket Interchange Guide (12998-B) or contact Power Transmission Product Application.

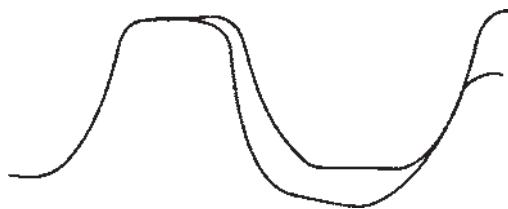


Figure 6

4. Static Conductivity

Static discharge can pose a hazard on belt drives that operate in potentially explosive environments. Static discharge can also interfere with radios, electronic instruments, or controls used in a facility. While uncommon, static discharge can also cause bearing pitting if the discharge occurs through the bearing. Static conductivity is a required belt characteristic in these cases in order to prevent static discharge.

The Rubber Manufacturer's Association (RMA) has published **Bulletin IP 3-3** for static conductivity. Static conductivity testing involves using an ohmmeter to pass an electrical current with a nominal open circuit 500 volt potential through a belt. The test should be performed with the belt off of the belt drive. The belt's resistance is measured by placing electrodes 8.5 inches apart on the clean driving surface of the belt. A resistance reading of six (6) megohms or more constitutes a test failure. Belts that measure a resistance of 6 megohms or more are considered to be non-conductive. Belts that measure a resistance of less than 6 megohms are considered to be static conductive. A static conductive belt with a resistance of 6 megohms or less has sufficient conductivity to prevent measurable static voltage buildup, thus preventing a static discharge.

When a belt is used in a hazardous environment, additional protection must be employed to assure that there are no accidental static spark discharges. The portion of the belt that contacts the sprocket must be conductive to ensure that static charge is conducted into the drive hardware. Synchronous belts must have a static conductive tooth surface in contact with conductive sprocket grooves. Unusual or excessive debris or contaminant on the belt contact surface or sprocket grooves should be cleaned and removed.

Any belt drive system that operates in a potentially hazardous environment must be properly grounded. A continuous conductive path to ground is necessary to bleed off the static charge. This path includes a static conductive belt, a conductive sprocket, a conductive bushing, a conductive shaft, conductive bearings, and the ground. As an additional measure of protection, a static-conductive brush or similar device should be employed to bleed off any residual static buildup that might remain around the belt. The user must ensure that belt drives operating in potentially hazardous or explosive environments are designed and installed in accordance with existing building codes, OSHA requirements, and/or recognized safety-related organizations.

5. Sprocket Diameter —Speed



Drives shaded in the Belt Width Selection Tables use sprocket diameters that may reduce belt life. The amount of reduction will depend on speed — the higher the speed, the greater the reduction. The drives are included for use where speed ratio or space requirements must be met. Blanks in the lower right-hand portions of the Belt Width Selection Tables occur because sprocket rim speed exceeds 6,500 feet per minute. Centrifugal forces developed beyond this speed may prohibit the use of stock gray cast iron sprockets. For rim speeds above 6,500 feet per minute, contact Gates Power Transmission Product Application for other alternatives.

6. Efficiency

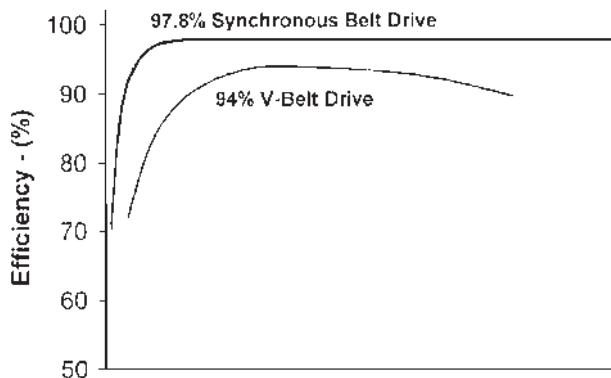
When properly designed and applied, PolyChain® GT® Carbon® belt drive efficiency will be as high as 98%. This high efficiency is primarily due to the positive, no slip characteristic of synchronous belts. Since the belt has a thin profile, it flexes easily, thus resulting in low hysteresis losses as evidenced by low heat buildup in the belt.

Gates synchronous belts are uniquely constructed because they use high performance materials. Optimization of these high-technology features provide maximum performance and efficiency. Synchronous belt drive efficiency can be simply defined as shown in the following equation:

$$\text{Efficiency, percent} = \frac{dN \text{ RPM} \times dN \text{ Torque}}{dR \text{ RPM} \times dR \text{ Torque}} \times 100$$

When examining the loss of energy, it is necessary to consider belt losses in terms of shaft torque and shaft speed. Torque losses result from bending stress and friction. Chain drives running unlubricated may generate significant heat build up due to increased friction in the roller joints. Even properly lubricated chains running at higher speeds tend to throw off the oil due to centrifugal forces, making it difficult to maintain proper lubrication at the load bearing surfaces. Consequently, chain drives are typically only 92-98% efficient.

Speed losses result from belt slip and creep. Unlike V-belts, slip is not a factor with synchronous belts. Well maintained V-belt drives are typically in the range of 95-98% efficient. However, on a poorly designed or maintained drive, the efficiency may drop as much as 5% or more. If proper maintenance cannot be scheduled for a V-belt drive or it is located in an inaccessible area, a positive belt drive system should be considered.



Increasing DriveN Torque

The belt drive is only part of the total system. Motors should be properly sized for the application. They must have sufficient capacity to meet the power needs, yet over designed motors will lead to electrical inefficiencies. DriveN machines also may have inherent inefficiencies which may contribute to overall system efficiency.

Sprockets Recommended

For maximum performance, use Gates sprockets

7. Belt Tolerances

These tolerances are for reference only. For fixed center drive applications and special tolerances, contact Gates Power Transmission Product Application.

Stock Belt Center Distance Tolerances			
Belt Length	(mm) (in)	Center Distance Tolerance	(mm) (in)
over 127 5	to 254 10	± 0.20 .008	
over 254 10	to 381 15	± 0.23 .009	
over 381 15	to 508 20	± 0.25 .010	
over 508 20	to 762 30	± 0.30 .012	
over 762 30	to 1016 40	± 0.33 .013	
over 1016 40	to 1270 50	± 0.38 .015	
over 1270 50	to 1524 60	± 0.41 .016	
over 1524 60	to 1778 70	± 0.43 .017	
over 1778 70	to 2032 80	± 0.46 .018	
over 2032 80	to 2286 90	± 0.49 .019	
over 2286 90	to 2540 100	± 0.52 .020	
over 2540 100	to 2794 110	± 0.54 .021	
over 2794 110	to 3048 120	± 0.56 .022	
over 3048 120	to 3302 130	± 0.58 .023	
over 3302 130	to 3556 140	± 0.60 .024	
over 3556 140	to 3810 150	± 0.63 .025	
over 3810 150	to 4064 160	± 0.66 .026	
over 4064 160	to 4318 170	± 0.69 .027	
over 4318 170	to 4572 180	± 0.72 .028	
over 4572 180		add $\pm .03$ every .01 254 increment 10	for increment

Stock Belt Width Tolerances			
Belt Pitch	Standard Belt Width	(mm) (in)	Tolerances (mm) (in)
8mm	12 0.47		± 0.36 .014
	21 .083		± 0.63 .025
	36 1.42		± 1.08 .43
	62 2.44		± 1.86 .73
14mm	20 0.79		$\pm .060$.024
	37 1.46		± 1.11 .044
	68 2.68		± 2.04 .080
	90 3.54		± 2.70 .106
	125 4.92		± 3.75 .148

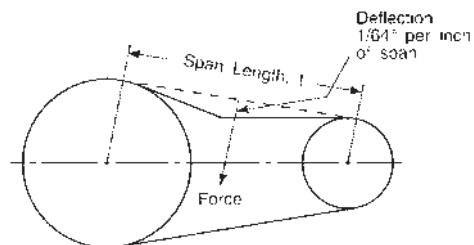
8. Belt Installation Tension

Standard Belt Tensioning Procedure

When installing a Gates belt:

- A. Be sure it is tensioned adequately to prevent tooth jumping (ratcheting) under the most severe load conditions which the drive will encounter during operation.
- B. Avoid extremely high tension which can reduce belt life and possibly damage bearings, shafts and other drive components.

The proper way to check belt tension is to use a tension tester. Gates has a variety of tension testers, ranging from the simple spring scale type tester to the sophisticated Sonic Tension Meter. The spring scale type tester is used by measuring how much force is required to deflect the belt at the center of its span by a specified distance (force deflection method), as shown in the sketch below.



The Sonic Tension Meter measures the vibration of the belt span and instantly converts the vibration frequency into belt static tension (span vibration method).

When you wish to use a numerical method for calculating recommended belt installation tension values, the following procedure may be used.

STEP 1: Calculate the required base static installation tension.

Use Formula 14 to calculate the required base static installation tension.

Formula 14

$$T_{st} = \frac{20HP}{S} + mS^2$$

Where: T_{st} = base static installation tension, pounds

HP = Horsepower

S = $\frac{PD \times RPM}{3820}$

M = Value from Table 11

PD = Sprocket Pitch Diameter, inches

RPM = Revolutions per minute of same sprocket

Table 11

Pitch	Belt Width	M	Y	Minimum T _s (lb) per span
8mm	12mm	0.33	65	28
	21mm	0.57	113	49
	36mm	0.97	194	84
	62mm	1.68	335	145
14mm	20mm	0.92	230	119
	37mm	1.69	426	220
	68mm	3.11	782	405
	90mm	4.12	1035	536
	125mm	5.72	1438	744

Because of the high performance capabilities of Poly Chain® GT® Carbon® belts, it is possible to design drives that have significantly greater load than are necessary to carry the actual design load. Consequently, Formula 14 can provide T_{st} values less than are necessary for the belt to operate properly, resulting in poor belt performance and reduced service life. If a more appropriately sized drive cannot be designed, minimum recommended T_{st} values are provided in Table 10 to assure that the belts function properly when lightly loaded.

Always use the greater T_{st} value; i.e., from T_{st} Formula 14 or Table 11.

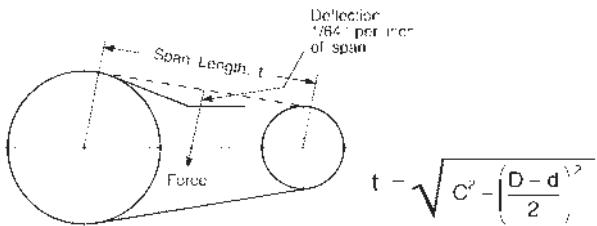
NOTE: When applying static belt tension values directly, multiply the required base static installation tension (T_{st}) calculated in Formula 14 by the following factors:

For New Belts:

$$\begin{aligned} \text{Minimum Static Tension} &= \text{Base Static Tension} \times 1.1 \\ \text{Maximum Static Tension} &= \text{Base Static Tension} \times 1.2 \end{aligned}$$

For Used Belts:

$$\begin{aligned} \text{Minimum Static Tension} &= \text{Base Static Tension} \times 0.8 \\ \text{Maximum Static Tension} &= \text{Base Static Tension} \times 0.9 \end{aligned}$$



STEP 2: Calculate the minimum and maximum recommended deflection forces.

- A. Measure the span length of your drive (see sketch).
- B. New belt minimum recommended force:

Formula 15

$$\text{deflection force, Min.} \quad 1.1 T_{st} = \frac{(t)}{L} Y, \text{ lbf}$$

16

- C. New belt maximum recommended force:

Formula 16

$$\text{deflection force, Max.} \quad 1.2 T_{st} = \frac{(t)}{L} Y, \text{ lbf}$$

16

Where:

T_{st} = Base Static tension, lbf

t = span length, inches

L = belt pitch length, inches

Y = constant from Table 11

USED BELT NOTE: For re-installation of a used belt, a recommended tension of $0.8 T_{st}$ to $0.9 T_{st}$ value should be used in calculating the deflection forces, instead of the $1.1 T_{st}$ to $1.2 T_{st}$ shown for new belts.

STEP 3: Applying the tension.

Force deflection tension method

- A.** At the center of the span (t) apply a force perpendicular to the span large enough to deflect the belt on the drive 1/64 inch per inch of span length from its normal position. One sprocket should be free to rotate. Be sure the force is applied evenly across the entire belt width. If the belt is a wide synchronous belt, place a piece of steel or angle iron across the belt width and deflect the entire width of the belt evenly.
- B.** Compare this deflection force with the range of forces calculated in Step 2.
 1. If it is less than the minimum recommended deflection force, the belt should be tightened.
 2. If it is greater than the maximum recommended deflection force, the belt should be loosened.

Span vibration tension method

The Sonic Tension Meter detects the vibration frequency in the belt span, and converts that measurement into the actual static tension in the belt. To use the Sonic Tension Meter, begin by entering the belt unit weight, belt width, and the span length. To measure the span vibration, press the "Measure" button on the meter, tap the belt span, and hold the microphone approximately 1/4" away from the back of the belt. The Sonic Tension Meter will display the static tension, and can also display the span vibration frequency.

The belt unit weights for use with the Gates Sonic Tension Meter are shown in the following table.

Belt Product Family	Belt Cross section	Adjusted Belt Weight (grams/meter)
Poly Chain GT Carbon	8mm	4.7
	14mm	7.9

9. Center Distance Allowances for Installation and Tensioning

Since fixed center drives are not recommended, center distance allowances for a Gates Poly Chain® GT® Carbon® belt drive are necessary to assure that the belt can be installed without damage and then tensioned correctly. The standard installation allowance is the minimum decrease in center distance required to install a belt when flanged sprockets are removed from their shafts for belt installation. This is shown in the first column of Table 12. This table also lists the minimum increase in center distance required to assure that a belt can be properly tensioned over its normal lifetime. If a belt is to be installed over flanged sprockets without removing them, the additional center distance allowance for installation shown in the second table below must be added to the first table data.

Table 12
Center Distance Allowance For Installation and Tensioning

Length Belt (mm) (in)	Standard Installation Allowance (Flanged Sprockets Removed For Installation) (mm) (in)	Tension Allowance (All Drives) (mm) (in)
Up to 125 5	0.5 0.02	0.5 0.02
Over 125 to 250 5 to 10	0.8 0.03	0.8 0.03
Over 250 to 500 10 to 20	1.0 0.04	0.8 0.03
Over 500 to 1000 20 to 40	1.8 0.07	0.8 0.03
Over 1000 to 1780 40 to 70	2.8 0.10	0.8 0.04
Over 1780 to 2540 70 to 100	3.3 0.13	1.0 0.04
Over 2540 to 3300 100 to 130	4.1 0.16	1.3 0.05
Over 3300 to 4600 130 to 180	4.8 0.19	1.3 0.05
Over 4600 to 6900 180 to 270	5.6 0.22	1.3 0.05

Additional Center Distance Allowance For Installation Over Flanged Sprockets*
(Add to Installation Allowance in Table No.12)

Pitch	One Sprocket Flanged (mm) (in)	Both Sprockets Flanged (mm) (in)
8mm	21.8 0.86	33.3 1.31
14mm	31.2 1.23	50.0 1.97

*For drives that require installation of the belt over one sprocket at a time, use the value for "Both Sprockets Flanged"

10. Drive Alignment

Provision should be made for center distance adjustment, according to the two tables on this page, or to change the idler position so the belt can be slipped easily onto the drive. When installing a belt, never force it over the flange. This will cause internal damage to the belt tensile member.

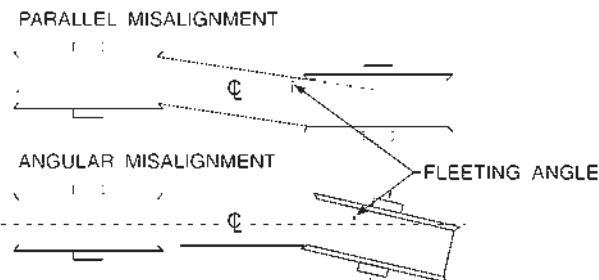
Synchronous belts typically are made with high modulus tensile members which provide length stability over the belt life. Consequently, misalignment does not allow equal load distribution across the entire belt top width. In a misaligned drive, the load is being carried by only a small portion of the belt top width, resulting in uneven belt wear and premature tensile failure.

There are two types of misalignment: parallel and angular (See Fig.7). Parallel misalignment is where the driveR and driveN shafts are parallel, but the two sprockets lie in different planes. When the two shafts are not parallel, the drive is angularly misaligned.

A fleeting angle is the angle at which the belt enters and exits the sprocket, and equals the sum of the parallel and angular misalignments.

Any degree of sprocket misalignment will result in some reduction of belt life, which is not accounted for in the normal drive design procedure. Misalignment of all synchronous belt drives should not exceed 1/4° or 1/16" per foot of linear distance. Misalignment should be checked with a good straight edge or by using a laser alignment tool. The straight edge tool should be applied from driveR to driveN, and then from driveN to driveR so that the total effect of parallel and angular misalignment is made visible.

Figure 7



Drive misalignment can also cause belt tracking problems. However, light flange contact by the belt is normal and won't affect performance.

For those drives in which the center distance is greater than eight times the small sprocket diameter, belt tracking can be a problem. In these cases, the parallel position of the two sprockets may need to be adjusted until only one flange guides the belt in the system and the belt tracks fully on all sprockets. Regardless of the drive center distance, the optimum drive performance will occur with the belt lightly contacting one flange in the system. The worst case is for the belt to contact flanges on opposite sides of the system. This traps the belt between opposite flanges and can force the belt into undesirable parallel misalignment.

Improper installation of the bushing can result in the bushing/sprocket assembly being "cocked" on the shaft. This leads to angular misalignment and sprocket wobble. Be sure to follow the instructions provided with the bushings.

11. Belt Installation

During the belt installation process, it is very important the belt be fully seated in the sprocket grooves before applying final tension. Serpentine drives with multiple sprockets and drives with large sprockets are particularly vulnerable to belt tensioning problems resulting from the belt teeth being only partially engaged in the sprockets during installation. In order to prevent these problems, the belt installation tension should be evenly distributed to all belt spans by rotating the system by hand. After confirming that belt teeth are fully engaged in the sprocket grooves, belt tension should be rechecked and verified. Failure to do this may result in an undertensioned condition with the potential for belt ratcheting.

12. Belt Pull Calculations

When the machine designer requests shaft load calculations from the drive designer, the following procedure can be applied:

A. Calculate Belt Span Tensions

Belt pull is the vector sum of T_T and T_S , the tightside and slackside tensions. T_T and T_S may be calculated using the following formulas:

Formula 17

$$T_T = \frac{144,067 \text{ HP}}{(\text{PD})(\text{RPM})}$$

Formula 18

$$T_S = \frac{18,008 \text{ HP}}{(\text{PD})(\text{RPM})}$$

Where: HP = Horsepower

PD = Sprocket Pitch Diameter (in)

RPM = Sprocket Speed (rev/min)

B. Solution For Both Magnitude and Direction

The vector sum of T_T and T_S can be found so that the direction of belt pull, as well as magnitude, is known. This is necessary if belt pull is to be vectorially added to sprocket weight, shaft weight, etc., to find true bearing loads. In this case, the easiest method of finding the belt pull vector is by graphical addition of T_T and T_S . If only the magnitude of belt pull is needed, numerical methods for vector additions are faster to use.

If both direction and magnitude of belt pull are required, the vector sum of T_T and T_S can be found by graphical vector addition as shown in Fig. 8. T_T and T_S vectors are drawn to a convenient scale and parallel to the tightside and slackside, respectively. Fig. 8 shows vector addition for belt pull on the motor shaft. The same procedures can be used for finding belt pull on the driveN shaft. This method may be used for drives using three or more sprockets or idlers.

For two-sprocket drives, belt pull on the driveR and driveN shafts is equal but opposite in direction. For drives using idlers, both magnitude and direction may be different.

C. Solution For Magnitude Only

If only the magnitude of belt pull is needed, follow the steps below. Use this method for drives with two sprockets. Use the graphical method shown if the drive uses idlers.

1. Add T_T and T_S

2. Using the value of $\frac{D - d}{C}$ for the drive, find the vector sum correction factor using Fig. 9, where:

D = large diameter

d = small diameter

C = center distance

Or, use the arc of contact on the small sprocket if known.

3. Multiply the sum of T_T plus T_S by the vector sum correction factor to find the vector sum of T_T plus T_S .

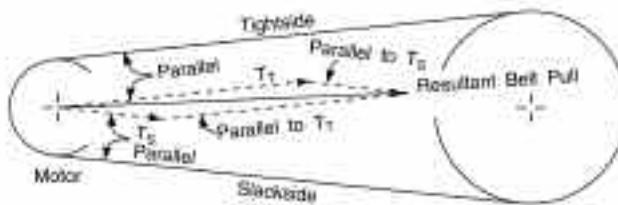


Figure 8

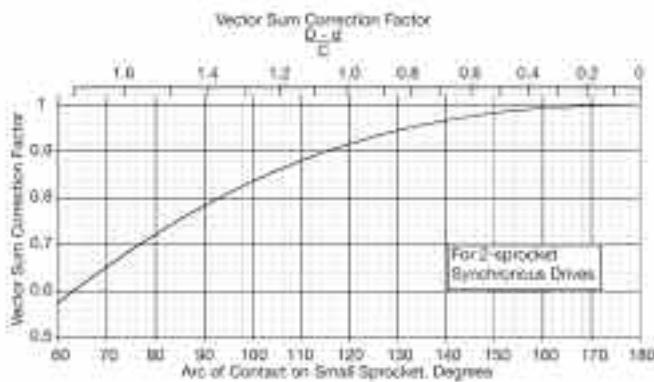


Figure 9

13. Bearing/Shaf t Load Calculations

A. Shaft Load Calculations

If true side load on the shaft, including sprocket weight, is desired, the sprocket weight can be added to the belt pull using the same graphical method shown in Fig. 8. The sprocket weight vector is vertical toward the ground. Weights for standard sprockets are shown in the sprocket specification tables.

B. Bearing Load Calculations

In order to find actual bearing loads, it is necessary to know weights of machine components and the value of all other forces contributing to the load. However, it is sometimes desirable to know the bearing load contributed by the synchronous drive alone. Bearing loads resulting from a synchronous belt drive can be calculated knowing bearing placement with respect to the sprocket center and the shaft load as previously calculated. For rough estimates, machine designers sometimes use belt pull alone, ignoring sprocket weight. If accuracy is desired, or if the sprocket is unusually heavy, actual shaft load values including sprocket weight should be used.

C. Overhung Sprocket

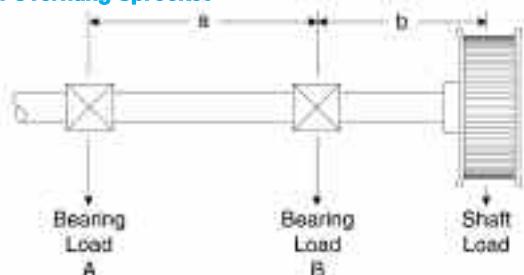


Figure 10

Formula 19

$$\text{Load at } B_1 \text{ (lb)} = \frac{\text{Shaft Load} \times (a + b)}{a}$$

Formula 20

$$\text{Load at } A_1 \text{ (lb)} = \text{Shaft Load} \times \frac{b}{a}$$

Where: a and b = spacing, (in), per Fig. 10

D. Sprocket Between Bearings

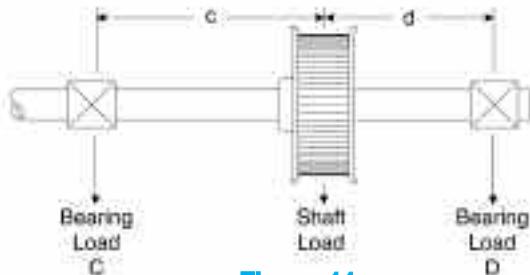


Figure 11

Formula 21

$$\text{Load at } D \text{ (lb)} = \frac{\text{Shaft Load} \times c}{(c + d)}$$

Formula 22

$$\text{Load at } C \text{ (lb)} = \frac{\text{Shaft Load} \times d}{(c + d)}$$

Where: c and d = spacing (in), per Fig. 11

14. Self-Generated Tension

All synchronous belt drives exhibit a self-generating or self-tightening characteristic when transmitting a load. Laboratory testing has shown this characteristic to be similar with all tooth profiles. The designer/user should be aware that self-tensioning can result in increased bearing and shaft loads and reduced drive performance; i.e., short belt life. This can be avoided by following proper tensioning procedures.

While belt overtensioning can impose higher bearing and shaft loads and lead to reduced belt life, undertensioning can result in self-tensioning. Properly designed and tensioned drives will not be significantly affected by self-generated tension.

When a belt is too loose for the design load, the self-tensioning characteristic results in the belt teeth climbing out of the sprocket grooves, leading to increased stresses on the belt teeth, accelerated tooth wear and reduced belt life. When a belt is severely undertensioned, this self-tensioning characteristic can result in the belt ratcheting (jumping teeth). When this occurs, significant shaft separation forces are instantaneously developed in the drive, resulting in damage to bearings, shafts, and other drive components including the belt.

NOTE: This is true for all synchronous belts.

Maximum drive performance and belt life are achieved when the belt is properly tensioned for the design load and maintained.

Troubleshooting

Symptom	Diagnosis	Possible Remedy
Unusual noise	Misaligned drive Too low or high belt tension Backside idler Worn sprocket Bent guide flange Belt speed too high Incorrect belt profile for the sprocket (i.e., HTD® etc.) Subminimal diameter Excess load	Correct alignment Adjust tension to recommended value Use inside idler Replace sprocket Replace sprocket/flange Redesign drive Use proper Gates Poly Chain® GT® Carbon® belt/sprocket Redesign drive using larger diameters Redesign drive for increased capacity
Tension loss	Weak support structure Excessive sprocket wear Fixed (nonadjustable) centers Excessive debris Excessive load Subminimal diameter Belt, sprockets or shafts running too hot Unusual belt degradation, such as softening or melting	Reinforce the structure Use alternate sprocket material Use inside idler for belt adjustment Protect drive Redesign drive for increased capacity Redesign drive using larger diameters Check for conductive heat transfer from prime mover Reduce ambient drive temperature to 180°F maximum
Belt tracking	Belt running partly off unflanged sprocket Centers exceed 8 times small sprocket Excessive belt edge wear	Correct alignment Correct parallel alignment to set belt to track on both sprockets Correct alignment
Flange failure	Belt forcing flanges off	Correct alignment or properly secure flange to sprocket
Excessive belt edge wear	Damage due to handling Flange damage Belt too wide Belt tension too low Rough flange surface finish Improper tracking Belt hitting drive guard or bracketry	Follow proper handling instructions Repair flange or replace sprocket Use proper width sprocket Adjust tension to recommended value Replace or repair flange (to eliminate abrasive surface) Correct alignment Remove obstruction or use inside idler
Premature tooth wear	Too low or high belt tension Belt running partly off unflanged sprocket Misaligned drive Incorrect belt profile for the sprocket (i.e., HTD, etc.) Worn sprocket Rough sprocket teeth Damaged sprocket Sprocket not to dimensional specification Belt hitting drive bracketry or other structure Excessive load Insufficient hardness of sprocket material Excessive debris Cocked bushing/sprocket assembly	Adjust tension to recommended value Correct alignment Correct alignment Use proper Gates Poly Chain® GT® Carbon® belt/sprocket Replace sprocket Replace sprocket Replace sprocket Replace sprocket Remove obstruction or use inside idler Redesign drive for increased capacity Use a more wear-resistant material Protect belt Install bushing per instructions

Troubleshooting

Symptom	Diagnosis	Possible Remedy
Tooth shear	Excessive shock loads Less than 6 teeth-in-mesh Extreme sprocket runout Worn sprocket Backside idler Incorrect belt profile for the sprocket (i.e., HTD®, etc.) Misaligned drive Belt undertensioned	Redesign drive for increased capacity Redesign drive Replace sprocket Replace sprocket Use inside idler Use proper Gates Poly Chain® GT® Carbon® belt/sprocket Correct alignment Adjust tension to recommended value
Tensile break	Excessive shock load Subminimal diameter Improper belt handling and storage prior to installation Debris or foreign object in drive Extreme sprocket runout Sprocket has too little wear resistance (i.e., plastic, aluminum, softer metals)	Redesign drive for increased capacity Redesign drive using larger diameters Follow proper handling and storage procedures Protect drive Replace sprocket Use alternate sprocket material
Belt cracking	Backside idler Extreme low temperature startup Extended exposure to harsh chemicals Cocked bushing/sprocket assembly Misaligned drive Too low or too high belt tension	Use inside idler Preheat drive environment Protect drive Install bushing per instructions Correct alignment Adjust tension to recommended value
Excessive temperature (belt, bearing, housing, shafts, etc.)	Incorrect belt profile (i.e. HTD, etc.) Incorrect belt profile for the sprocket (i.e. HTD, etc.)	Use proper Gates Poly Chain® GT® Carbon® belt/sprocket Use proper Gates Poly Chain® GT® Carbon® belt/sprocket
Vibration	Too low or too high belt tension Bushing or key loose	Adjust tension to recommended value Check and reinstall per instructions

Standard Calculations

Required	Given	Formula
Speed ratio (R)	Shaft speeds (rpm)	$R = \frac{\text{rpm (faster shaft speed)}}{\text{rpm (slower shaft speed)}}$
	Pulley diameter (D & d)	$R = \frac{D \text{ (larger pulley diameter)}}{d \text{ (smaller pulley diameter)}}$
	Number of pulley grooves (N & n)	$R = \frac{N \text{ (larger pulley groove no.)}}{n \text{ (smaller pulley groove no.)}}$
Horsepower (hp) (33,000 lb-ft/min)	Torque (T) in lb-in Shaft speed (rpm)	$hp = \frac{T \times rpm}{63,025}$
	Effective tension (Te) in lb. Shaft speed (rpm)	$hp = \frac{Te \times V}{33,000}$
Design horsepower (Dhp)	Rated horsepower (hp) Service factor (SF)	$Dhp = hp \times SF$
Power (kw)	Horsepower (hp)	$kw = .7457 \times hp$
Torque (T) in lb-in	Shaft horsepower (hp) Shaft speed (rpm)	$T = \frac{63,025 \times hp}{rpm}$
	Effective tension (Te) in lb. Pulley radius (R) in inches	$T = Te \times R$
Torque (T) in N-mm	Torque (T) in lb-inches	$T = 112.98 \times T$
Belt velocity in ft/min	Pulley pd in inches Pulley speed in rpm	$V = \frac{pd \times rpm}{3.82}$
Belt velocity in m/s	Pulley pd in mm Pulley speed in rpm	$V = .0000524 \times pd \times rpm$
Belt pitch length (PL) in inches (approximate)	Center distance (C) in inches Pulley diameters (D & d) in inches	$PL = 2C + [1.57 \times (D + d)] + \frac{(D - d)^2}{(4C)}$
Arc of contact on smaller pulley (A/Cs)	Pulley diameters (D & d) in inches Center distance (C) in inches	$A/Cs = 180 - \left[\frac{(D - d) \times 60}{(4C)} \right]$
Torque (T) due to flywheel effect (WR ²) in lb-inches (accel. and/or decel.)	Final speed (RPM) Initial speed (rpm) Flywheel effect (WR ²) in lb-ft ² Time (t) in seconds	$T = \frac{.039 \times (RPM - rpm) \times WR^2}{t}$
Flywheel effect (WR ²) in lb-ft ²	Face width of rim (F) in inches Material density (Z) in lbs/in ³ Outside rim diameter (D) in inches Inside rim diameter (d) in inches	$WR^2 = \frac{F \times Z \times (D^4 - d^4)}{1467}$

Useful Formulas and Calculations

Power Transmission Conversions

FORCE CONVERSION CONSTANTS

Metric to U.S.

Newton x 3.5969 = Ounces_f

Newton x 0.2248 = Pounds_f

Kilograms_f x 2.2046 = Pounds_f

U.S. to Metric

Ounces_f x 0.2780 = Newtons

Pounds_f x 4.4482 = Newtons

Pounds_f x 0.4536 = Kilograms_f

Metric to Metric

Kilograms_f x 9.8067 = Newtons

Newtons x 0.1020 = Kilograms_f

TORQUE CONVERSION CONSTANTS

Metric to U.S.

Newton Meters x 141.6119 = Ounce_fInches

Newton Meters x 8.8508 = Pound_fInches

Newton Meters x 0.7376 = Pound_fFeet

U.S. to Metric

Ounce_fInches x 0.0071 = Newton Meters

Pound_fInches x 0.1130 = Newton Meters

Pound_fFeet x 1.3558 = Newton Meters

Metric to Metric

Newton Meters x 10.1972 = Kilogram_fCentimeters

Kilogram_fCentimeters x 0.0981 = Newton Meters

Newton Meters x 0.1020 = Kilogram_fMeters

Kilogram_fMeters x 9.8067 = Newton Meters

POWER CONVERSION CONSTANTS

Metric to U.S.

Kilowatt x 1.3410 = Horsepower

Watt x 0.0013 = Horsepower

U.S. to Metric

Horsepower x 745.6999 = Watt

Horsepower x 0.7457 = Kilowatt

LINEAR BELT SPEED CONVERSION CONSTANTS

Metric to U.S.

Meters per second x 196.8504 = Feet per Minute

U.S. to Metric

Feet per Minute x 0.005080 = Meters per Second

Square Miles x 2.5900 = Square Kilometers

U.S. to U.S.

Feet per Second x 60.00 = Feet per Minute

Feet per Minute x 0.0167 = Feet per Second

Other Conversions

LENGTH CONVERSION CONSTANTS

Metric to U.S.

Millimeters x 0.0394 = Inches

Meters x 39.3701 = Inches

Meters x 3.2808 = Feet

Meters x 1.0936 = Yards

Kilometers x 3280.84 = Feet

Kilometers x 0.6214 = Statute Miles

Kilometers x 0.5396 = Nautical Miles

U.S. to Metric

Inches x 25.4000 = Millimeters

Inches x 0.0254 = Meters

Feet x 0.3048 = Meters

Yards x 0.9144 = Meters

Feet x 0.0003048 = Kilometers

Statute Miles x 1.6093 = Kilometers

Nautical Miles x 1.8532 = Kilometers

AREA CONVERSION CONSTANTS

Metric to U.S.

Square Millimeters x 0.0016 = Square Inches

Square Centimeters x 0.1550 = Square Inches

Square Meters x 10.7639 = Square Feet

Square Meters x 1.1960 = Square Yards

Hectares x 2.4711 = Acres

Square Kilometers x 247.105 = Acres

Square Kilometers x 0.3861 = Square Miles

U.S. to Metric

Square Inches x 645.160 = Square Millimeters

Square Inches x 6.4516 = Square Centimeters

Square Feet x 0.0929 = Square Meters

Square Yards x 0.8361 = Square Meters

Acres x 0.4047 = Hectares

Acres x 0.004047 = Square Kilometers

Square Miles x 2.5900 = Square Kilometers

Useful Formulas and Calculations

Other Conversions —continued

WEIGHT CONVERSION CONSTANTS

Metric to U.S.

Grams x 15.4324 = Grains
 Grams x 0.0353 = Ounces (Avd.)
 Grams x 0.0338 = Fluid Ounces (water)
 Kilograms x 35.2740 = Ounces (Avd.)
 Kilograms x 2.2046 = Pounds (Avd.)
 Metric Tons (1000 Kg) x 1.1023 = Net Ton (2000 lbs.)
 Metric Tons (1000 Kg) x 0.9842 = Gross Ton (2240 lbs.)

U.S. to Metric

Grains x 0.0648 = Grams
 Ounces (Avd.) x 28.3495 = Grams
 Fluid Ounces (water) x 29.5735 = Grams
 Ounces (Avd.) x 0.0283 = Kilograms
 Pounds (Avd.) x 0.4536 = Kilograms
 Net Ton (2000 lbs.) x 0.9072 = Metric Tons (1000 Kg)
 Gross Ton (2240 lbs.) x 1.0160 = Metric Tons (1000 Kg)

DECIMAL AND MILLIMETER EQUIVALENTS OF FRACTIONS

Inches			Inches		
Fractions	Decimals	Millimeters	Fractions	Decimals	Millimeters
1/64	.015625	.397	33/64	.515625	13.097
1/32	.03125	.794	17/32	.53125	13.494
3/64	.046875	1.1911	35/64	.546875	13.89
1/16	.0625	1.588	9/16	.5625	14.288
5/64	.078125	1.984	37/64	.578125	14.684
3/32	.09375	2.3811	19/32	.59375	15.08
7/64	.109375	2.778	39/64	.609375	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.140625	3.572	41/64	.640625	16.272
5/32	.15625	3.969	21/32	.65625	16.669
11/64	.171875	4.366	43/64	.671875	17.066
3/16	.1875	4.763	11/16	.6875	17.463
13/64	.203125	5.159	45/64	.703125	17.859
7/32	.21875	5.556	23/32	.71875	18.256
15/64	.234375	5.953	47/64	.734375	18.653
1/4	.250	6.350	3/4	.750	19.050
17/64	.265625	6.7477	49/64	.765625	19.44
9/32	.28125	7.144	25/32	.78125	19.844
19/64	.296875	7.5411	51/64	.796875	20.24
5/16	.3125	7.938	13/16	.8125	20.638
21/64	.328125	8.334	53/64	.828125	21.034
11/32	.34375	8.731	27/32	.84375	21.431
23/64	.359375	9.128	55/64	.859375	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.390625	9.922	57/64	.890625	22.622
13/32	.40625	10.319	29/32	.90625	23.019
27/64	.421875	10.716	59/64	.921875	23.416
7/16	.4375	11.113	15/16	.9375	23.813
29/64	.453125	11.509	61/64	.953125	24.209
15/32	.46875	11.906	31/32	.96875	24.606
31/64	.484375	12.303	63/64	.984375	25.003
1/2	.500	12.700	1	1.000	25.400

Synchronous Belt Product Design Catalogs

Gates Synchronous Belt Products	Pitch	For Design Information Refer to:
Poly Chain® GT® Carbon®	8mm, 14mm	Poly Chain® GT® Carbon® Belt Drive Design Manual Catalog 17595
PowerGrip® GT®2	5mm, 8mm, 14mm, 20mm	PowerGrip® GT2® Belt Drive Design Manual 17195
PowerGrip® GT®2	2mm, 3mm	Light Power & Precision Drives Design Manual Catalog 17183
PowerGrip® HTD®	3mm, 5mm	Light Power & Precision Drives Design Manual Catalog 17183
PowerGrip® Timing	XL, L, H	PowerGrip GT2 Belt Drive Design Manual 17195
PowerGrip® Timing	MXL, XL	Light Power & Precision Drives Design Manual Catalog 17183
Poly Chain® GT2® Long Length Belting	8mm, 14mm	Poly Chain GT Carbon Belt Drive Design Manual 17595
PowerGrip® Timing Long Length Belting	MXL, XL, L, H	PowerGrip GT2 Belt Drive Design Manual 17195
PowerGrip® HTD Long Length Belting	3mm, 5mm, 8mm, 14mm	PowerGrip GT2 Belt Drive Design Manual 17195
PowerGrip® GT® Long Length Belting	2mm, 3mm, 5mm, 8mm	PowerGrip GT2 Belt Drive Design Manual 17195
Twin Power®	XL, L, H PowerGrip Timing, 8mm, 14mm	PowerGrip GT2 Belt Drive Design Manual 17195

DRIVE DESIGN SOFTWARE

Drive design software can be found at
www.gates.com/drivedesign.

This software assists designers in quickly
selecting optimum drive solutions.

World Headquarters

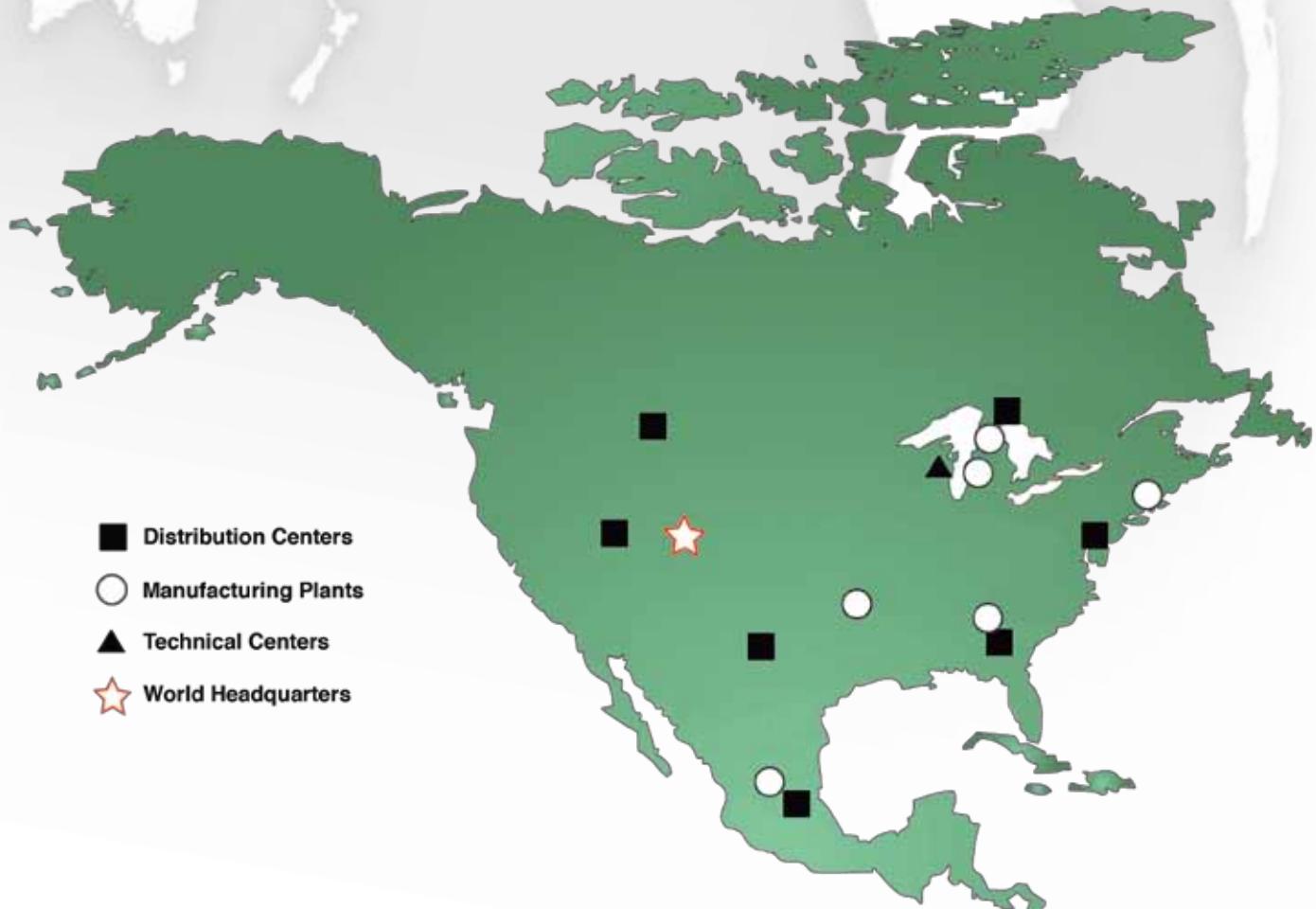
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HIGHEST PERFORMANCE: DYN A SERIES

GAM can.

If you don't see exactly what you need, let us know. We can modify the Dyna Series gearboxes to meet your needs. Page 4 provides a list of commonly requested modifications to give you a feel for our capabilities.

The Dyna Series is our highest performance right-angle gear reducer utilizing sophisticated hypoid gearing. The benefit of hypoid gearing is that it combines the space and configuration advantages of worm gearing with the high efficiencies of bevel gearing. The result is that the Dyna Series is able to achieve ratios up to 15:1 in a single stage and ratios up to 100:1 in 2 stages.

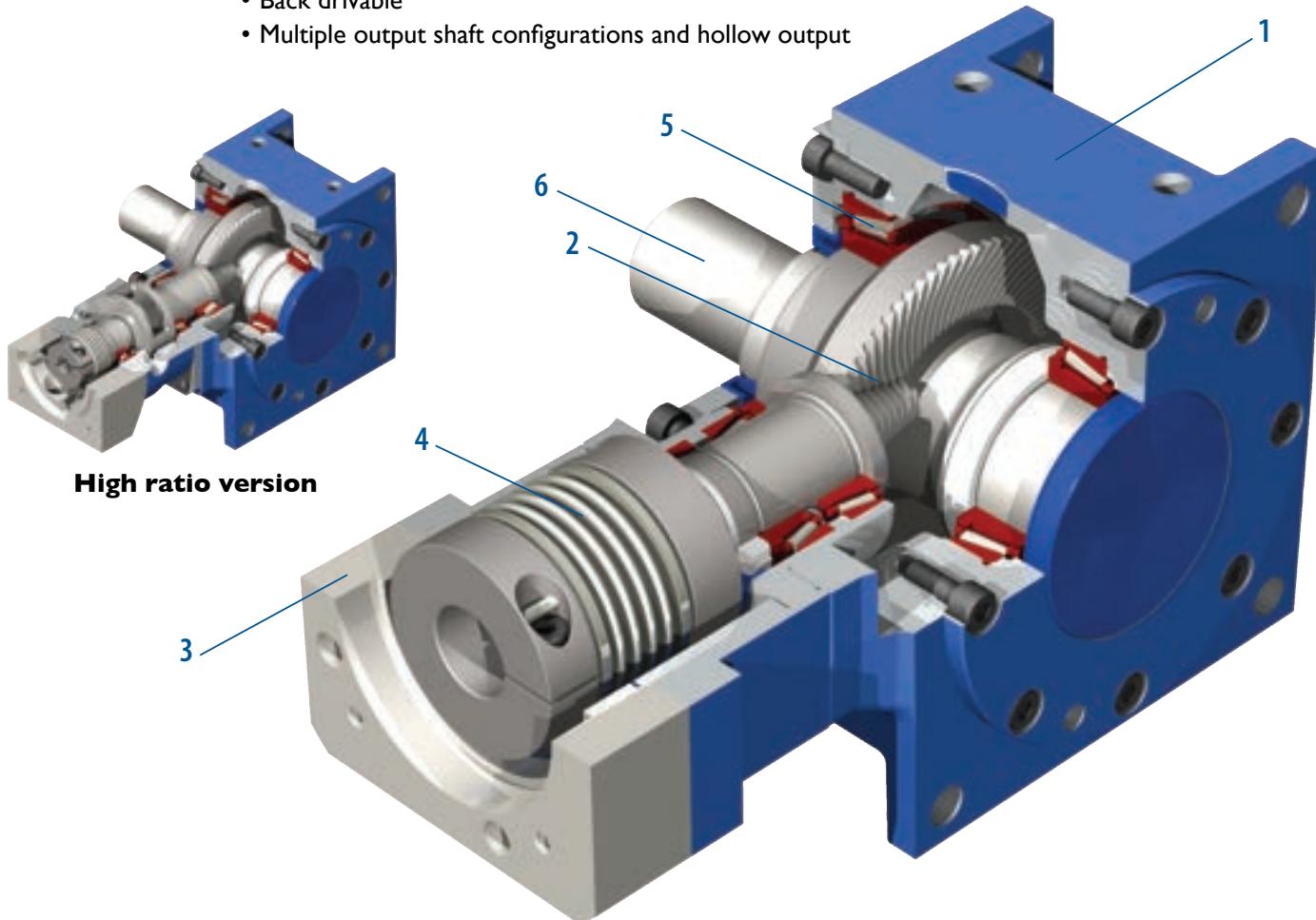
⚠ DSX version for the highest performance available!

The DSX is our flagship right angle hypoid gearbox that has been optimized for the most demanding motion control applications that require high angular accuracy. Featuring hypoid gears that have been ground, the DSX has the smoothest torque transmission and extremely low backlash and noise levels.

Contact GAM for further information on the DSX.

Dyna Series benefits include:

- Ratios up to 15:1 in a single stage – the highest in the market – and 100:1 in just two gear stages
- High efficiencies
- High allowable axial and radial loading
- Ultra low backlash
- Back drivable
- Multiple output shaft configurations and hollow output



1. Aluminum Housing
(Aluminum housing significantly reduces the weight of the gearbox)

2. Hypoid Gearing
(Optimized gearing allows ratios up to 15:1 in a single stage; 100:1 in two stages. DSX gears are ground for improved performance.)

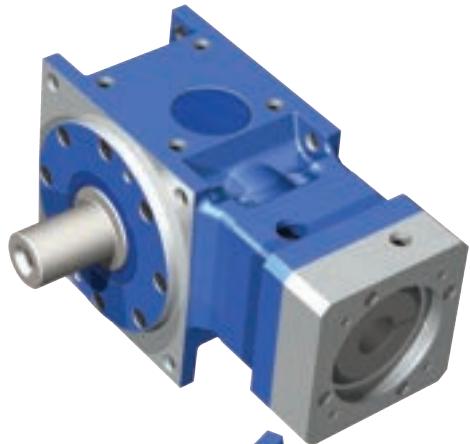
3. Adapter Flange
(Customized adapter flanges for quick and easy mounting to any motor)

4. Coupling
(Gearbox can be supplied with either a bellows or elastomer coupling)

5. Tapered Roller Bearings
(Roller bearings for high radial and axial loading)

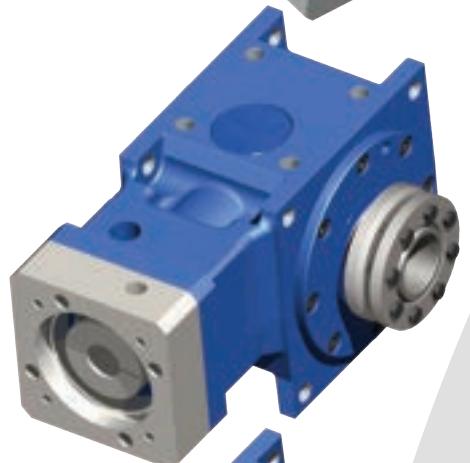
6. Output Shaft
(Gearbox can be supplied with one or two solid shafts or hollow shafts)

► HIGHEST PERFORMANCE: DYN A SERIES



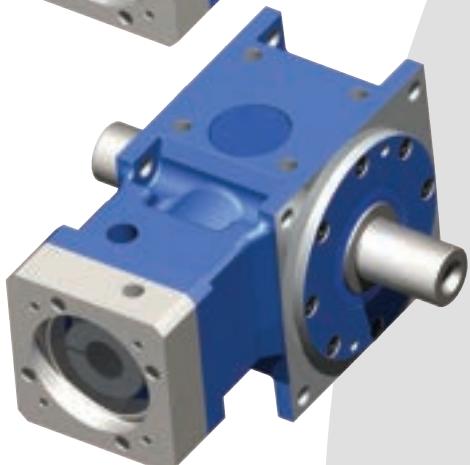
DS-W

- Single output shaft configuration with our high performance bellow coupling input and machined motor flange to mount to any servo motor
- Frame sizes from 55 mm to 190 mm
- DSX option available



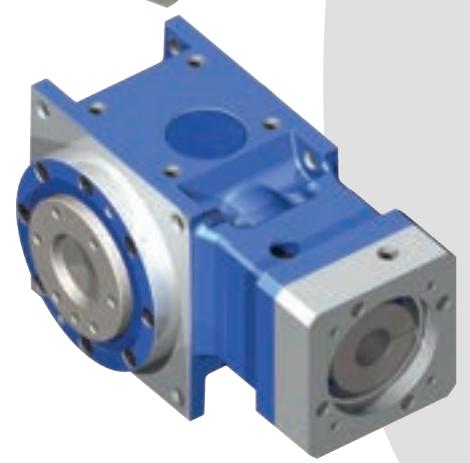
DS-H

- Hollow bore output configuration with our high performance bellow coupling input and machined motor flange to mount to any servo motor
- Zero-backlash shrink disk coupling on the output included with the gearbox
- Frame sizes from 55 mm to 190 mm
- DSX option available



DS-T

- Dual output shaft configuration with our high performance bellow coupling input and machined motor flange to mount to any servo motor
- Frame sizes from 55 mm to 190 mm
- DSX option available



DS-F

- Flange output allows connection of pinion gears, pulleys, rotary index tables, and transmission shafting directly to the output for a more compact and stiffer solution
- Frame sizes from 55 mm to 190 mm
- DSX option available



HIGHEST PERFORMANCE: DYNASERIES

The Advantage of Hypoid Gearing

The GAM Hypoid offers significant advantages over other conventional right-angle gears.

Conventional spiral bevel gearing, meshing in the position shown at the bottom of the drawing, has a purely rolling meshing action that is mechanically very efficient. Its drawback is that it offers the smallest total tooth contact area, so its torque throughput capacity is lower. Single-stage spiral bevel gearing is limited to about a 6:1 reduction ratio. It's easy to get higher ratios with multiple-stage configurations, but the additional gear stage lowers mechanical efficiency, increases backlash, consumes space and weight and reduces reliability.

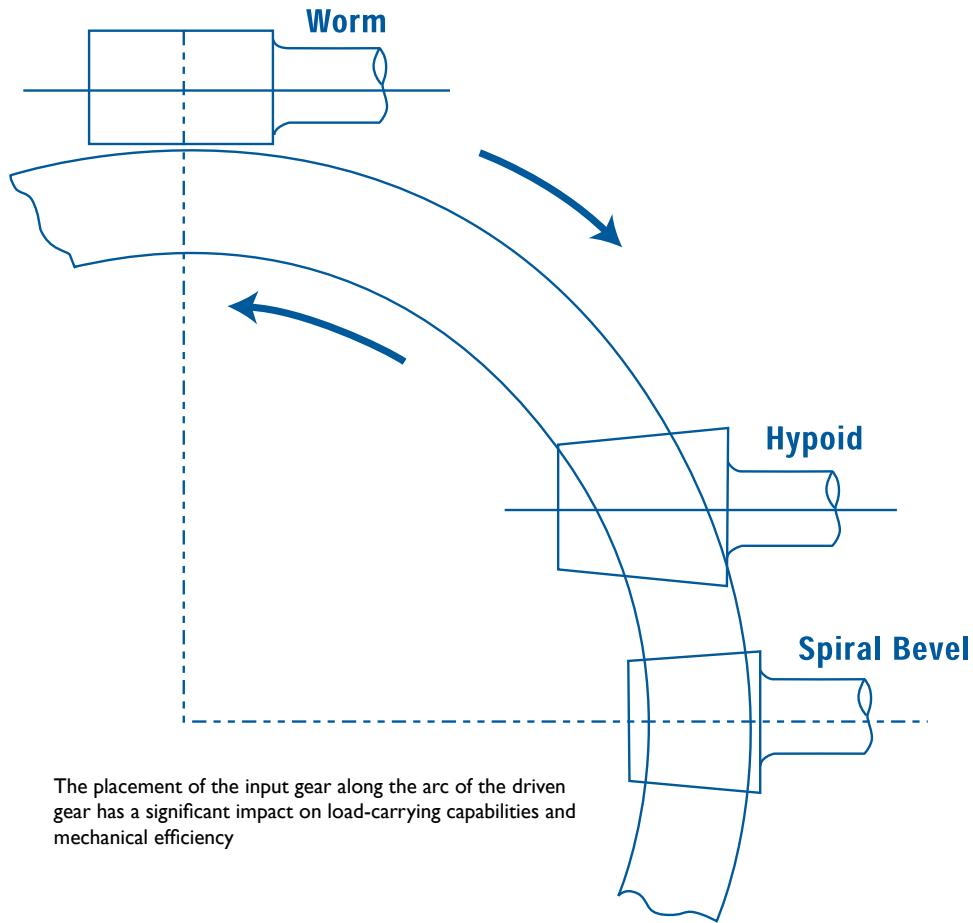
Conventional worm gearing, meshing in the position shown at the top of the drawing, has a very high total tooth contact area. While it offers high torque throughput and high ratio reduction, worm gearing has the lowest mechanical efficiency, due to the friction generated by its high component of sliding action. Worm gearing is also subject to the kind of wear that demands adjustment in order to maintain accuracy.

Hypoid gearing, meshing at the intermediate position, offers mostly rolling action with a small component of sliding action. It has a greater tooth contact area than bevel gearing, so its load-carrying capability is greater. The GAM Hypoid offers further advantages by going up to a 15:1 gear ratio in a single stage with efficiencies between 93% and 96%, depending upon ratio throughout the speed range. Another important design criterion for precision servo applications is, of course, low backlash in the gear box.

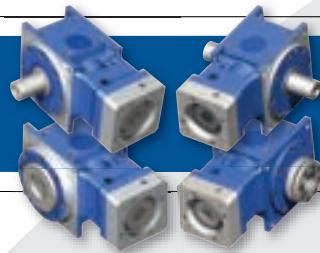
The GAM Hypoid offers two important advantages:

- Single-stage design eliminates backlash from a second set of meshing gears
- Accurate machining and assembly alignment – high-accuracy models offer backlash of ≤ 2 arcminutes.

GAM Hypoid gearing is available in two product ranges, our highest precision Dyna Series, and high precision, Dyna-Lite Series.



HIGHEST PERFORMANCE: DYN A SERIES



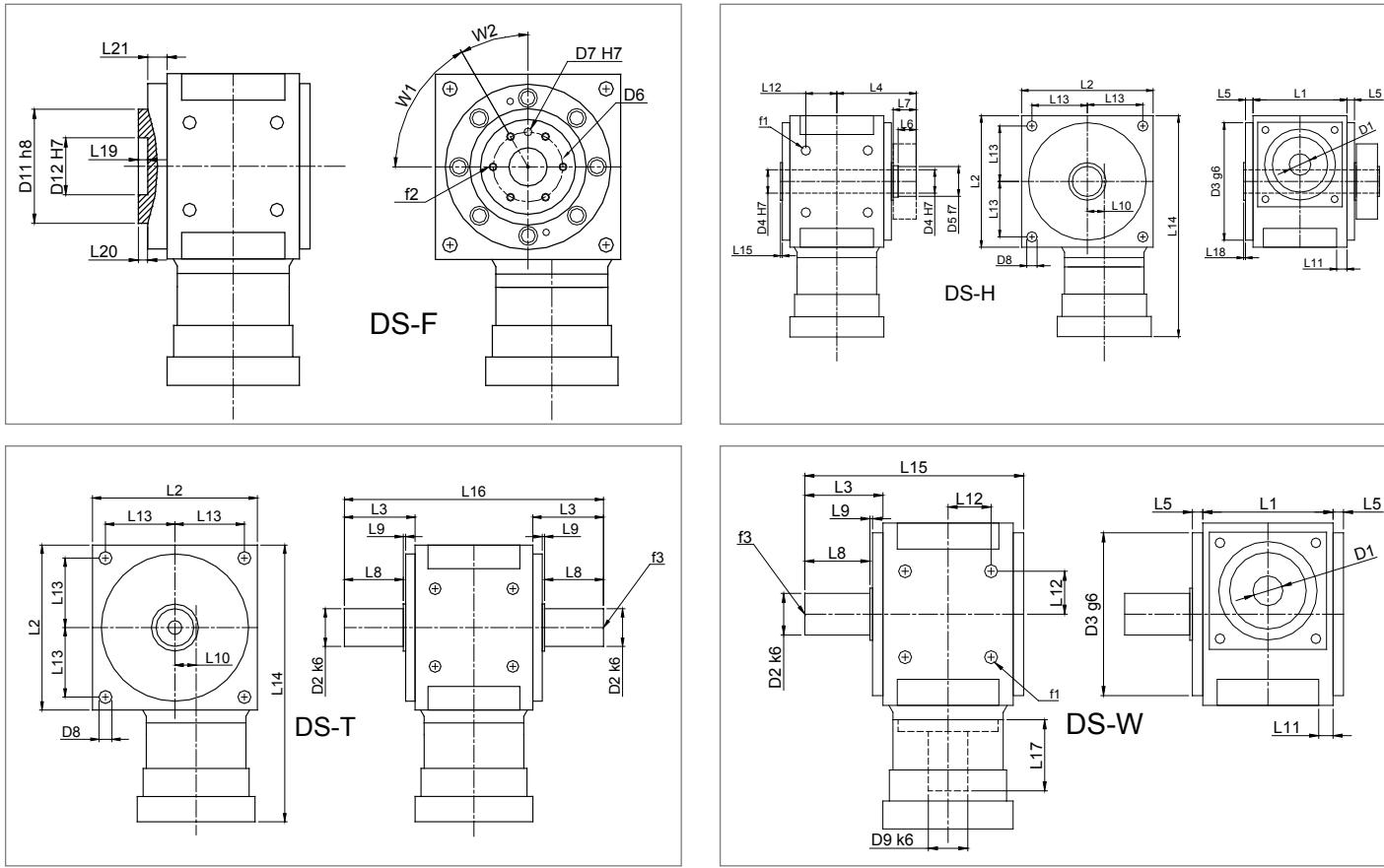
Dyna Series			55		75		90		115		140		190					
Stock Ratios ¹⁾			3, 5, 10, 15, 30, 50, 100				3, 5, 10, 15						N/A					
All Ratios Available			1-stage: 3, 4, 5, 6, 8, 10, 12, 15 2-stage: 25, 30, 40, 50, 70, 100 3-stage: consult GAM															
Nominal Output Torque (T_{2n})	Nm (lb-in)	3:1	35 (310)	70 (620)	140 (1239)	260 (2301)	700 (6196)	1400 (12391)										
		4:1	34 (301)	68 (602)	136 (1204)	255 (2257)	690 (6107)	1350 (11949)										
		5:1	33 (292)	65 (575)	131 (1159)	250 (2213)	670 (5930)	1280 (11329)										
		6:1	32 (283)	61 (540)	124 (1097)	240 (2124)	660 (5841)	1200 (10621)										
		8:1	30 (266)	56 (496)	115 (1018)	220 (1947)	640 (5664)	1120 (9913)										
		10:1	28 (248)	53 (469)	105 (929)	200 (1770)	560 (4956)	1040 (9205)										
		12:1	25 (221)	50 (443)	95 (841)	180 (1593)	480 (4248)	950 (8408)										
		15:1	22 (195)	45 (398)	80 (708)	160 (1416)	400 (3540)	800 (7081)										
		All 2-Stage Ratios	35 (310)	70 (620)	140 (1239)	260 (2301)	700 (6196)	1400 (12391)										
Max Acceleration Output Torque (T_{2B})	Nm (lb-in)	-	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal	1.5 x Nominal						
Emergency Output Torque (T_{2not})	Nm (lb-in)	3:1-6:1	70 (620)	140 (1239)	280 (2478)	520 (4602)	1400 (12391)	2800 (24782)										
		8:1-10:1	60 (531)	110 (974)	230 (2036)	440 (3894)	1280 (11329)	2240 (19826)										
		12:1-15:1	50 (443)	100 (885)	190 (1682)	360 (3186)	960 (8497)	1900 (16816)										
Nominal Input Speed ⁶⁾ (n_{in})	RPM	All 2-Stage Ratios	70 (620)	140 (1239)	280 (2478)	520 (4602)	1400 (12391)	2800 (24782)										
		1 Stage	6000	6000	5000	4000	3000	2500										
		2 Stage	3000	3000	3200	3200	2800	2500										
Max Input Speed ⁶⁾ (n_{1max})	RPM	1 Stage	8000	8000	7000	6000	5000	4500										
		2 Stage	6000	6000	6000	6000	6000	4500										
Standard Output Backlash (j)	arcmin	1 Stage	<5	<5	<4	<4	<4	<4										
		2 Stage	<7	<7	<6	<6	<6	<6										
Reduced Output Backlash (j)	arcmin	1 Stage	<3	<3	<2	<2	<2	<2										
		2 Stage	<4	<4	<3	<3	<3	<3										
Noise Level (L_A)	dB	-	<70	<71	<74	<74	<74	<74										
Allowable Radial Load ⁴⁾ (F_{rad})	N (lbs)	-	3500 (787)	3800 (854)	4000 (899)	7500 (1686)	11000 (2473)	15000 (3372)										
Allowable Axial Load (F_{axial})	N (lbs)	-	1400 (315)	1520 (342)	1600 (360)	3000 (674)	4400 (989)	6000 (1349)										
Maximum Tilting Moment	Nm (lb-in)	-	145 (1283)	173 (1531)	238 (2106)	510 (4513)	990 (8763)	1650 (14604)										
Torsional Stiffness (C_{21}) ⁵⁾	Nm/arcmin (lb-in/arcmin)	1 Stage	2.1 (18.6)	4.2 (37.2)	10.5 (92.9)	23.4 (207.1)	61.8 (547.0)	126 (1115.2)										
		2 Stage	2.1 (18.6)	4.2 (37.2)	10.2 (90.3)	22.8 (201.8)	60.1 (531.9)	119.2 (1055.0)										
Weight (m)	kg (lbs)	1 Stage	3 (6.6)	6 (13.2)	10 (22.0)	17 (37.5)	39 (86.0)	55 (121.3)										
		2 Stage	4 (8.8)	7 (15.4)	11 (24.3)	22 (48.5)	49 (108.0)	65 (143.3)										
Mass Moment of Inertia	kg cm ² (lb-in ²)	3:1	0.584 (0.200)	1.32 (0.451)	3.41 (1.165)	8.49 (2.901)	29.7 (10.149)	91.3 (31.199)										
		4:1	0.439 (0.150)	0.993 (0.339)	2.46 (0.841)	6.03 (2.061)	20 (6.834)	61.2 (20.913)										
		5:1	0.357 (0.122)	0.834 (0.285)	1.98 (0.677)	4.79 (1.637)	14.7 (5.023)	45.1 (15.412)										
		6:1	0.258 (0.088)	0.747 (0.255)	1.24 (0.424)	4.04 (1.381)	11.7 (3.998)	34.9 (11.926)										
		8:1	0.214 (0.073)	0.654 (0.223)	0.958 (0.327)	3.36 (1.148)	9.08 (3.103)	25.8 (8.816)										
		10:1	0.192 (0.066)	0.612 (0.209)	0.842 (0.288)	3.04 (1.039)	7.85 (2.683)	21.8 (7.449)										
		12:1	0.181 (0.062)	0.592 (0.202)	0.78 (0.267)	2.87 (0.981)	7.14 (2.440)	19.6 (6.698)										
		15:1	0.17 (0.058)	0.568 (0.194)	0.715 (0.244)	2.72 (0.929)	6.55 (2.238)	19.5 (6.664)										
		30:1	0.405 (0.138)	0.487 (0.166)	1.309 (0.447)	4.043 (1.382)	7.100 (2.426)	13.944 (4.765)										
		40:1	0.367 (0.126)	0.402 (0.137)	1.084 (0.370)	3.477 (1.188)	5.050 (1.726)	7.625 (2.606)										
		50:1	0.354 (0.121)	0.373 (0.128)	1.009 (0.345)	3.292 (1.125)	4.388 (1.499)	5.604 (1.915)										
		70:1	0.352 (0.120)	0.356 (0.122)	0.978 (0.334)	3.430 (1.172)	4.779 (1.633)	4.918 (1.681)										
		100:1	0.342 (0.117)	0.346 (0.118)	0.938 (0.321)	3.130 (1.070)	3.879 (1.325)	4.018 (1.373)										
Efficiency at Load		3:1-8:1 > 96% 10:1-15:1 > 93% 30:1-100:1 > 92%																
Service Life		>30,000 hours																
Lubrication		Synthetic Oil: ISO VG 100																
Protection Rating		IP 64																
Operating Temperature Range		-10°C to 90°C																

1) Stock ratios listed are available in Standard AND Reduced Backlash. 2) Nominal torque and speed values listed are for gear tooth ratings. Use thermal limit for continuous operation.

3) DSX Precision ground gearing for quieter and smoother operation, improved accuracy, and repeatability. 4) Load applied at center of output shaft @400 RPM. 5) Stiffness values relate to DS-W version only. Stiffness for DS-H,F may vary slightly- contact GAM for values. 6) Higher input speeds may be possible – consult GAM.



DYNA SERIES - DS-W, DS-H, DS-T, DS-F



Recommended Output Coupling (if necessary)						
metal bellows	KM-60	KM-170	KM-270	KM-400	KM-1300	KSD-2500
elastomer	EKM-60	EKM-150	EKM-300	EKM-500	EKM-1000	-

TYPE CODES FOR DYNA SERIES

Example: DS - W B - 090 - 005 G - [115-201] - S111

Gearbox Series
DS = Dyna Series
DSX = Dyna Series Extreme

Gearbox Style
W = Single output shaft
T = Dual output shaft
H = Hollow output shaft
F = Flange output

Input Type
B = Bellows coupling input
E = Elastomer coupling input
L = Shaft input

Gearbox Size
055, 075, 090, 115, 130, 140, 160, 190

Ratio
003, 004, 005, 006, 008, 010,
012, 015, 030, 040, 050, 070, 100

Contact GAM for DSX Drawings

Special Options
Assigned by GAM

Motor Mount Kit
Assigned by GAM

Options Available for This Product

	LOW	OUTPUT
OPTION	BACKLASH	KEYWAY
A=	Y	N
C=	Y	Y
G=	N	Y
H=	N	N

Options C and G N/A for DS-F/H models.

Tolerances (mm)						
Size	k6	g6	h8	f7	H7	h6
Over 6	+0.010	-0.005	0	-0.013	+0.015	0
Thru 10	+0.001	-0.014	-0.022	-0.028	0	-0.009
Over 10	+0.012	-0.006	0	-0.016	+0.018	0
Thru 18	+0.001	-0.017	-0.027	-0.034	0	-0.011
Over 18	+0.015	-0.007	0	-0.02	+0.021	0
Thru 30	+0.002	-0.020	-0.033	-0.041	0	-0.013
Over 30	+0.018	-0.009	0	-0.025	+0.025	0
Thru 50	+0.002	-0.025	-0.039	-0.05	0	-0.016
Over 50	+0.021	-0.010	0	-0.03	+0.030	0
Thru 80	+0.002	-0.029	-0.046	-0.06	0	-0.019
Over 80	+0.025	-0.012	0	-0.036	+0.035	0
Thru 120	+0.003	-0.034	-0.054	-0.021	0	-0.022
Over 120	+0.028	-0.014	0	-0.043	+0.040	0
Thru 180	+0.003	-0.039	-0.063	-0.083	0	-0.025

Dyna Series		55		75		90		115		140		190	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
D1 _{max 1-stage*}	input shaft diameter	21	(0.827)	28	(1.102)	35	(1.378)	43	(1.693)	55	(2.165)	55	(2.165)
D1 _{max 2-stage*}		14	(0.551)	14	(0.551)	24	(0.945)	24	(0.945)	38	(1.496)	38	(1.496)
D3 g6	pilot diameter	89	(3.504)	105	(4.134)	125	(4.921)	150	(5.906)	195	(7.677)	245	(9.646)
D8	mounting hole diameter	6.6	(0.26)	9	(0.354)	11	(0.433)	14	(0.551)	17.5	(0.689)	17.5	(0.689)
D9 k6	gearbox input shaft dia	14	(0.551)	18	(0.709)	22	(0.866)	28	(1.102)	32	(1.26)	40	(1.575)
f1	mounting hole thread	M6		M8		M10		M12		M16		M16	
L1	housing width	60	(2.362)	80	(3.15)	100	(3.937)	120	(4.724)	146	(5.748)	196	(7.717)
L2	housing size	90	(3.543)	115	(4.528)	140	(5.512)	170	(6.693)	215	(8.465)	260	(10.236)
L5	pilot height	13.5	(0.531)	8.5	(0.335)	8	(0.315)	8	(0.315)	10	(0.394)	10	(0.394)
L10	hypoid offset	9	(0.354)	14	(0.551)	18	(0.709)	23	(0.906)	32	(1.26)	42	(1.654)
L11	flange thickness	8	(0.315)	10	(0.394)	11	(0.433)	13	(0.512)	15	(0.591)	17	(0.669)
L12	hole location	22	(0.866)	27	(1.063)	33	(1.299)	40	(1.575)	52	(2.047)	70	(2.756)
L13	hole location	39	(1.535)	49	(1.929)	59	(2.323)	72	(2.835)	91	(3.583)	112	(4.409)
L14 1-stage **	input length	181	(7.126)	219	(8.622)	250.5	(9.862)	286.5	(11.28)	363.5	(14.311)	439	(17.283)
L14 2-stage **		229.5	(9.035)	262	(10.315)	247.5	(9.744)	280	(11.024)	372	(14.646)	591	(23.268)
L17	input shaft length	20	(0.787)	26	(1.024)	43	(1.693)	48	(1.89)	55	(2.165)	62	(2.441)

* for larger shaft diameters consult GAM ** depending on motor, length may vary

DS-F & DS-H		55		75		90		115		140		190	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
D4 H7 **	hollow bore	20	(0.787)	25	(0.984)	30	(1.181)	40	(1.575)	55	(2.165)	70	(2.756)
D5 f7	hollow outer diameter	24	(0.945)	30	(1.181)	36	(1.417)	50	(1.969)	68	(2.677)	80	(3.15)
D6	flange bolt circle	40	(1.575)	50	(1.969)	63	(2.48)	80	(3.15)	100	(3.937)	125	(4.921)
D7 H7	locating hole diameter	6	(0.236)	6	(0.236)	6	(0.236)	8	(0.315)	8	(0.315)	10	(0.394)
D11 h8	flange pilot (OD)	50	(1.969)	63	(2.48)	80	(3.15)	100	(3.937)	125	(4.921)	160	(6.299)
D12 H7	flange pilot (ID)	25	(0.984)	31.5	(1.24)	40	(1.575)	50	(1.969)	63	(2.48)	80	(3.15)
f2	flange tapped holes	7 x M6x9		7 x M6x9		7 x M6x9		11 x M8x12		11 x M8x12		11 x M10x15	
L4	hollow hub length	73	(2.874)	81	(3.189)	95	(3.74)	109	(4.291)	129	(5.079)	161	(6.339)
L6	hub length	20	(0.787)	22	(0.866)	26	(1.024)	29	(1.142)	32	(1.26)	34	(1.339)
L7	shoulder + hub length	23	(0.906)	25	(0.984)	29	(1.142)	33	(1.299)	37	(1.457)	40	(1.575)
L18	shoulder height	1.5	(0.059)	1.5	(0.059)	2	(0.079)	2	(0.079)	2	(0.079)	2	(0.079)
L19	inner flange pilot depth	6.5	(0.256)	6.5	(0.256)	6.5	(0.256)	8.5	(0.335)	8.5	(0.335)	10.5	(0.413)
L20	outer flange pilot height	6.5	(0.256)	6.5	(0.256)	6.5	(0.256)	8.5	(0.335)	8.5	(0.335)	8.5	(0.335)
L21	pilot height	20	(0.787)	15.5	(0.61)	17	(0.669)	20	(0.787)	17.5	(0.689)	22.5	(0.886)
W1	hole angle 1	45°		45°		45°		30°		30°		30°	
W2	hole angle 2	45°		45°		45°		30°		30°		30°	

* for larger shaft diameters, consult GAM ** mating shaft should have h6 tolerance *** depending on motor, length may vary

DS-W & DS-T		55		75		90		115		140		190	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
D2 k6	output shaft diameter	20	(0.787)	24	(0.945)	32	(1.26)	40	(1.575)	55	(2.165)	70	(2.756)
f3	shaft thread per DIN332/1	M6x16		M8x19		M12x28		M16x36		M20x42		M20x42	
L3	output shaft length	50	(1.969)	50	(1.969)	60	(2.362)	70	(2.756)	102	(4.016)	122	(4.803)
L8	usable shaft length	35	(1.378)	40	(1.575)	50	(1.969)	60	(2.362)	90	(3.543)	110	(4.331)
L9	shoulder height	1.5	(0.059)	1.5	(0.059)	2	(0.079)	2	(0.079)	2	(0.079)	2	(0.079)
L15	gearbox width	123.5	(4.862)	138.5	(5.453)	168	(6.614)	198	(7.795)	258	(10.157)	328	(12.913)
L16	gearbox width	160	(6.299)	180	(7.087)	220	(8.661)	260	(10.236)	350	(13.78)	440	(17.323)

* for larger shaft diameters consult GAM ** depending on motor, length may vary