



Zimmerman Metals Inc.

MODEL FF1000

Z-PANEL FORM MACHINE

OPERATING MANUAL

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SECTION 2

HYDRAULIC / TECHNICAL INFORMATION

WARRANTY

ZIMMERMAN METALS, INC. WARRANTS TO THE ORIGINAL PURCHASER THAT ALL PARTS MANUFACTURED BY ZIMMERMAN METALS, INC. WILL REMAIN FREE OF DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF TWELVE MONTHS FROM THE DATE OF PURCHASE. THIS WARRANTY DOES NOT COVER MISUSE, ABUSE, OR WEAR AND TEAR CAUSED BY NEGLIGENCE.

ALL PARTS NOT MANUFACTURED BY ZIMMERMAN METALS, INC. ARE COVERED BY THEIR OWN MANUFACTURER'S WARRANTY.

ZIMMERMAN'S OBLIGATION IS TO REPAIR OR REPLACE, AT OUR OPTION, ANY PARTS MANUFACTURED BY ZIMMERMAN METALS, INC. FOUND TO BE DEFECTIVE BY OUR INSPECTION AT NO COST TO THE ORIGINAL PURCHASER. ALL PARTS RETURNED UNDER WARRANTY MUST BE APPROVED AND MUST ARRIVE AT ZIMMERMAN METALS, INC. FREIGHT PREPAID. REPLACEMENT OR REPAIRED PARTS WILL BE RETURNED TO THE PURCHASER VIA NORMAL GROUND SERVICE FREIGHT PREPAID.

ZIMMERMAN METALS, INC. SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, PUNITIVE DAMAGES OR OTHER LOSSES.

THE ABOVE WARRANTY IS EXCLUSIVE AND ZIMMERMAN METALS, INC. DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

MACHINE SPECIFICATIONS

PANEL MACHINE LENGTH 94"
HEIGHT 22"
WIDTH 40"
WEIGHT- 2000 LBS
POWER – 110VAC 1 ½ HP 1 PH ELECTRIC MOTOR
OPTIONAL POWER-13 HP GASOLINE ENGINE
DRIVE-HYDRAULIC / GEAR & CHAIN
SHEAR-HYDRAULIC
SPEED-APPROX. 60 FT. PER MINUTE
MATERIAL WIDTH-16"-28"
MATERIAL WIDTH FOR NS1000 PANEL 16" OR 20"
MATERIAL TYPES-STEEL, 28GA.- 24GA.
ALUMINUM TO .030
COPPER TO 20 OZ.

UNCOILER SPOOL & STAND W/ BRAKE, 4000 LB. CAPACITY

TRAILER LENGTH-17 FT
HEIGHT-48" WITH MACHINE, SPOOL & STAND
WIDTH-91"
AXLES-2 @ 3500 LB. W/ ELECTRIC BRAKE
HITCH-2 5/16" BALL
TONGUE WEIGHT-APPROX. 450 LB
TOTAL WEIGHT-4000 LB

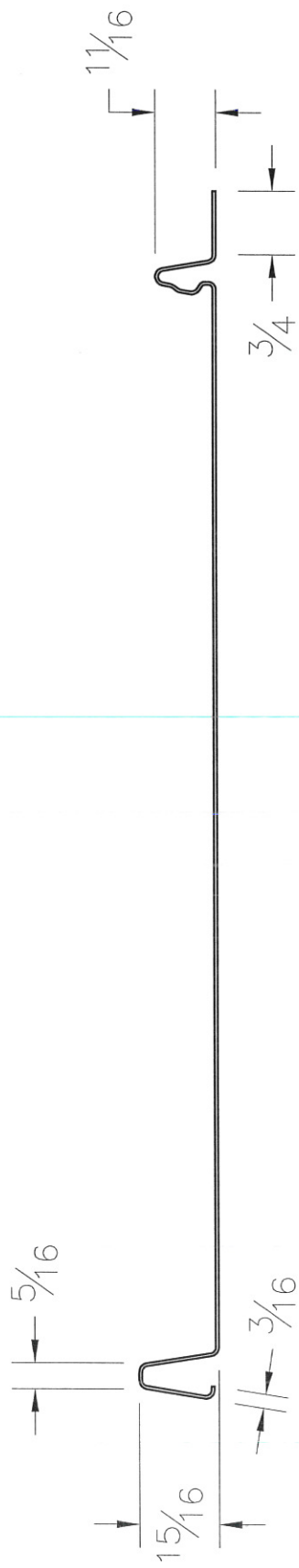
GENERAL SAFETY PRECAUTIONS

1. BEFORE ATTEMPTING OPERATE THE MACHINE, READ THIS MANUAL COMPLETELY. THIS MANUAL IS PREPARED FOR YOUR SAFETY AND EASE OF OPERATION. FAILURE TO FOLLOW SAFE PROCEDURES AND OPERATING INSTRUCTIONS MAY RESULT IN INJURY OR DAMAGE TO THE MACHINE.
2. NEVER ATTEMPT TO ADJUST, CLEAN, OR REPAIR THIS EQUIPMENT WITH THE ENGINE RUNNING OR THE POWER SOURCE CONNECTED. USE CARE THAT NO ONE ATTEMPTS TO START THE MACHINE WHILE IT IS BEING WORKED ON.
3. USE CARE WHEN HANDLING COIL STOCK AND PANELS. EDGES MAY BE VERY SHARP AND PROPER HAND PROTECTION IS ADVISED.
4. DO NOT WEAR LOOSE CLOTHING, JEWELRY, ECT., WHILE OPERATING THIS MACHINE OR SEAMING MACHINES.
5. NEVER ATTEMPT TO FORM OR INSTALL PANELS IN HIGH WIND CONDITIONS.
6. WHEN LIFTING MACHINE, COILS, OPTIONAL TRAILER, OR ANY RELATED EQUIPMENT, DO NOT EXCEED THE RATED LIMITS OF ANY LIFTING DEVICE.
7. BE AWARE THIS EQUIPMENT IS A VIRTUAL CONVEYOR AND MAY CAUSE INJURY OR DAMAGE TO THE MACHINE BY ALLOWING FOREIGN OBJECTS TO TRAVEL ON THE COIL INTO THE MACHINE.
8. DO NOT ALLOW ANYONE TO OPERATE THIS EQUIPMENT WITHOUT PROPER INSTRUCTION OR TRAINING.
9. ALWAYS FOLLOW AND ADHERE TO ALL LOCAL AND NATIONAL SAFETY CODES CONCERNING OPERATION OF THIS AND ALL RELATED EQUIPMENT.
10. NEVER OPERATE THIS MACHINE WITHOUT GUARDS AND SAFETY COVERS IN PLACE.

SAFETY IS COMMON SENSE-PLEASE BE CAREFUL

MAINTENANCE AND GENERAL INFORMATION

1. ALWAYS KEEP LIDS AND SAFETY COVERS ON DURING OPERATION AND STORAGE.
2. AVOID STORAGE OF THE MACHINE OUTDOORS FOR LONG PERIODS OF TIME. IF YOU COVER YOUR MACHINE WITH A TARP FOR OUTSIDE STORAGE, BE SURE TO PROVIDE GOOD VENTILATION TO PREVENT CONDENSATION.
3. ALWAYS KEEP THE MACHINE CLEAN. THIS WILL INSURE CONSISTENT QUALITY OF THE PRODUCT AND INCREASE THE LIFE OF THE MACHINE.
4. THE MAIN DRIVE CHAIN ON THE HYDRAULIC MOTOR SHOULD BE CHECKED PERIODICALLY FOR TENSION AND WEAR. TO ADJUST THE TENSION, LOOSEN THE 4 BOLTS IN THE MOTOR MOUNT AND USE THE JACK BOLTS TO TAKE UP THE SLACK. **DO NOT OVER TIGHTEN.**
5. ALL BEARINGS IN THE MACHINE ARE LIFETIME SEALED AND REQUIRE NO MAINTENANCE.
6. THE SHEAR BLADE AND DIES SHOULD BE LUBRICATED ON A REGULAR BASIS. USE A LIGHT- WEIGHT OIL OR SPRAY LUBRICANT. DO NOT USE A SILICONE BASE LUBRICANT. SILICONE HAS A TENDENCY TO BUILD UP AND CAUSE BINDING IN THE SHEAR.
7. THE CHAINS AND GEARS IN THE MACHINE WILL REQUIRE OCCASIONAL LUBRICATION. DO NOT APPLY TOO MUCH LUBRICANT AS IT WILL ATTRACT DIRT WHICH COULD BE TRANSFERRED TO THE PANEL. A LIGHT SYNTHETIC GREASE IS RECOMMENDED.
8. DO NOT USE SOLVENTS TO CLEAN THE POLYURETHANE COATED DRIVE ROLLERS. USE ONLY MINERAL SPIRITS.
9. A LIGHT OIL APPLIED TO THE SPOOL SHAFT WILL KEEP SPOOL SECTIONS EASY TO MOVE TO THE PROPER LOCATION.
10. GALVANIZE OR GALVALUME MATERIAL MUST BE PRE-OILED TO PREVENT BUILD-UP ON THE FORMING ROLLERS. SPECIFY LIGHT OIL ON COIL WHEN ORDERING. APPLICATION OF MINERAL OIL ON THE TOP AND BOTTOM FORMING ROLLERS, BEFORE RUNNING EACH COIL, WILL HELP PREVENT BUILD-UP. IF BUILD-UP OCCURS USE "GALV-OFF" OR SIMILAR PRODUCT TO REMOVE.
11. INSPECT MACHINE FOR FOREIGN OBJECTS AND LOOSE BOLTS EACH TIME THE MACHINE IS TRANSPORTED.
12. CHECK THE LEVEL OF THE HYDRAULIC OIL AT THE SIGHT GAUGE LOCATED ON THE RIGHT SIDE OF THE MACHINE. IF IT IS LOW, ADD MOBILE DTE25 OR EQUIVALENT. THE HYDRAULIC OIL SHOULD BE CHANGED AFTER 2000 HOURS OF OPERATION.
13. CHECK WHEEL LUGS, TIRE PRESSURE, BRAKES AND ALL LIGHTS BEFORE TRANSPORTING TRAILER TO JOB SITE.
14. REFER TO HONDA ENGINE OWNERS MANUAL FOR MAINTENANCE AND INFORMATION ON THE ENGINE.



ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180		TOLERANCES UNLESS OTHERWISE SPECIFIED .XX = ±.015 FRACTION = ±1/32" .XXX = ±.005 ANGLES = ±1° BREAK ALL UNMARKED CORNERS		3rd ANGLE PROJ.
TITLE FASTENING FLANGE		PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER CO.		
SNAP LOCK PROFILE		DO NOT SCALE DWG		
MACH. MOD. NO.		DRAWN BY		
DRAWING NO. FF-1000		SHEET / OF		DATE 8/27/07
NOTES:		SCALE:		APPVD BY
MAT'L:		DATE		

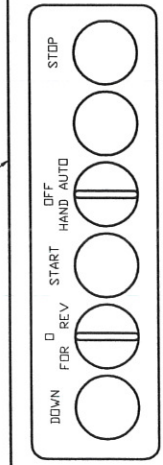
OPERATING THE MACHINE (ELECTRIC POWERED)

1. PLUG THE TWIST LOCK POWER CORD SUPPLIED WITH THE MACHINE INTO THE CONTROL BOX ON THE LEFT SIDE OF THE MACHINE AND CONNECT TO 110VAC POWER SOURCE. (NOTE: MINIMUM 20 AMP SERVICE IS REQUIRED)
2. PLUG HAND HELD REMOTE CONTROL INTO THE 12 PIN CONNECTOR ON THE CONTROL PANEL.
3. CHECK THE THREE EMERGENCY STOP SWITCHES, ENTRY END OF THE MACHINE-CONTROL PANEL-HAND HELD REMOTE CONTROL, TO BE SURE THEY ARE ALL PULLED OUT.
4. TURN MAIN POWER TOGGLE SWITCH TO THE ON POSITION.
5. FOR MANUAL OPERATION PLACE THE HAND-OFF-AUTO SWITCH IN THE HAND POSITION. YOU MAY NOW JOG THE MACHINE FORWARD OF REVERSE USING THE FOR-O-REV SWITCH. THE SHEAR WILL OPERATE USING THE DOWN BUTTON.
6. FOR AUTOMATIC OPERATION PLACE THE HAND-OFF-AUTO SWITCH IN THE AUTO POSITION. PLUG YOUR EXTENSION CORD INTO THE END STOP LIMIT SWITCH OUTLET AND PLUG THE END STOP LIMIT SWITCH INTO THE CORD. DEPRESS THE START BUTTON. A PANEL WILL RUN OUT UNTIL IT HITS THE END STOP LIMIT SWITCH. DEPRESS THE DOWN BUTTON TO ACTIVATE THE SHEAR CYCLE. WHEN THE PANEL IS REMOVED FROM THE END STOP LIMIT SWITCH, THE MACHINE WILL AUTOMATICALLY RUN ANOTHER PANEL.
7. **DEPRESSING ANY ONE OF THE THREE RED EMERGENCY STOP BUTTONS WILL STOP ALL OPERATIONS OF THE MACHINE.**
8. **POWER CORD REQUIREMENTS – CHECK WITH YOUR ELECTRICIAN
FAILURE TO USE THE PROPER SIZE EXTENSION CORD WILL CAUSE FUSES TO BLOW AND MAY DAMAGE THE ELECTRIC MOTOR.**

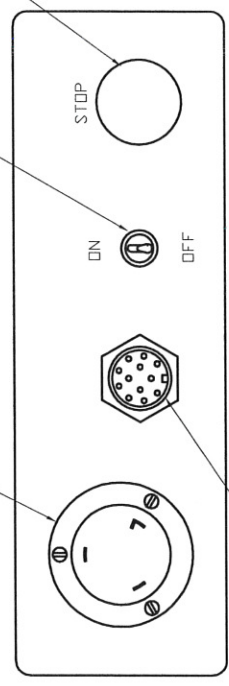
REFER TO CONTROLS DIAGRAM NEXT PAGE

ELECTRIC POWERED

HAND HELD
REMOTE CONTROL

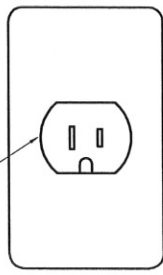


MAIN POWER SWITCH



POWER INLET

EMERGENCY
STOP SWITCH



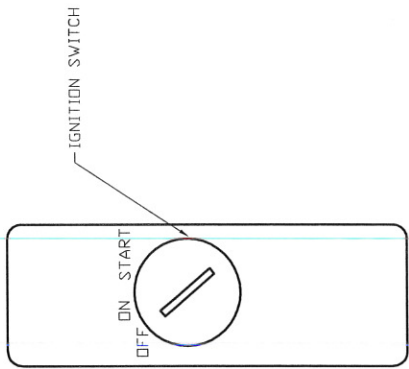
END STOP LIMIT
SWITCH OUTLET

OPERATING THE MACHINE (GASOLINE ENGINE POWERED)

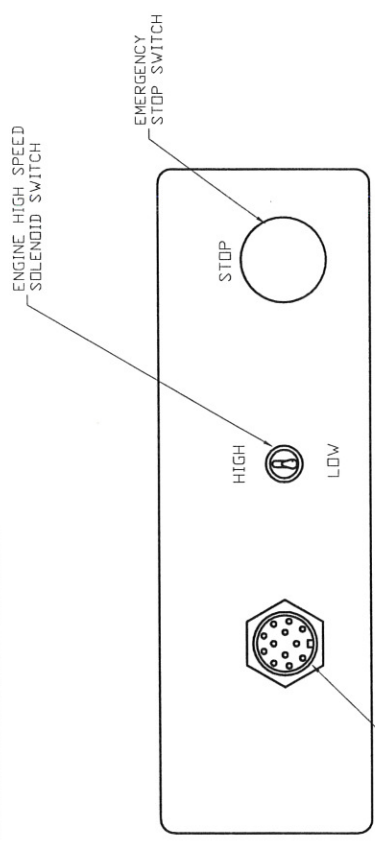
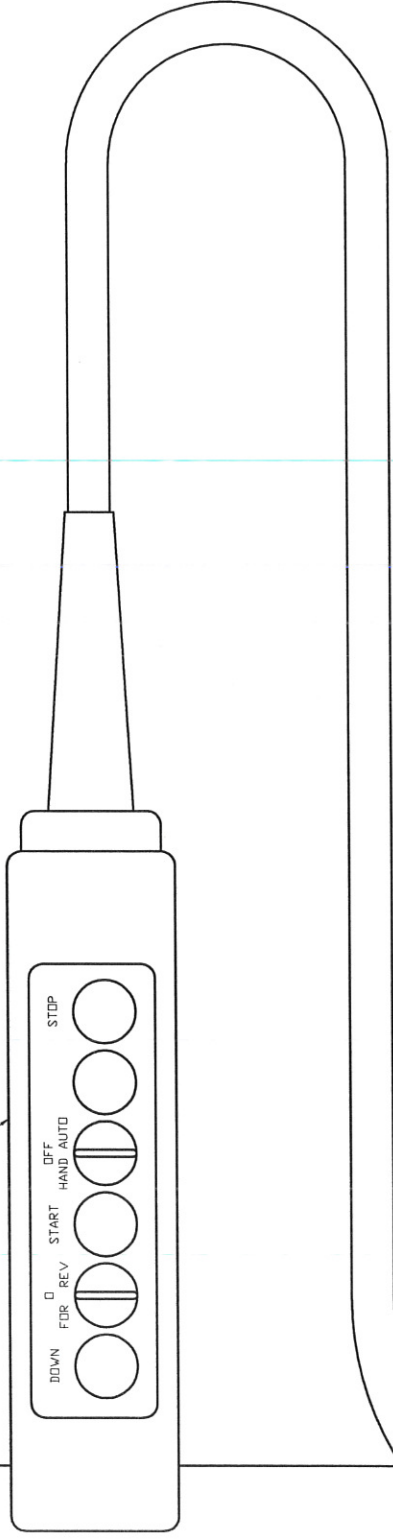
1. PLUG HAND HELD REMOTE CONTROL INTO THE 12 PIN CONNECTOR ON THE CONTROL PANEL.
2. CHECK THE THREE EMERGENCY STOP SWITCHES, ENTRY END OF THE MACHINE-CONTROL PANEL-HAND HELD REMOTE CONTROL, TO BE SURE THEY ARE ALL PULLED OUT.
3. MOVE THE FUEL VALVE LEVER TO THE ON POSITION. FOR COLD START, MOVE THE CHOKE LEVER TO THE CLOSED POSITION. (TO RE-START A WARM ENGINE, LEAVE THE CHOKE IN THE OPEN POSITION.) TURN THE KEY TO THE START POSITION AND HOLD UNTIL THE ENGINE STARTS. WHEN THE ENGINE STARTS, RELEASE THE KEY, ALLOWING IT TO RETURN TO THE ON POSITION. MOVE THE CHOKE LEVER TO THE OPEN POSITION AS THE ENGINE WARMS UP. (***READ HONDA ENGINES OWNER'S MANUAL BEFORE ATTEMPTING TO START.***)
4. TURN THE ENGINE HIGH SPEED SOLENOID SWITCH TO THE HIGH POSITION.
5. FOR MANUAL OPERATION PLACE THE HAND-OFF-AUTO SWITCH IN THE HAND POSITION. YOU MAY NOW JOG THE MACHINE FORWARD OR REVERSE USING THE FOR-O-REV SWITCH. THE SHEAR WILL OPERATE USING THE DOWN BUTTON.
6. FOR AUTOMATIC OPERATION, PLACE THE HAND-OFF-AUTO SWITCH IN THE AUTO POSITION. PLUG YOUR EXTENSION CORD INTO THE END STOP LIMIT SWITCH OUTLET AND PLUG THE END STOP LIMIT SWITCH INTO THE CORD. DEPRESS THE START BUTTON. A PANEL WILL RUN OUT UNTIL IT HITS THE END STOP LIMIT SWITCH. DEPRESS THE DOWN BUTTON TO ACTIVATE THE SHEAR CYCLE. WHEN THE PANEL IS REMOVED FROM THE END STOP LIMIT SWITCH, THE MACHINE WILL AUTOMATICALLY RUN ANOTHER PANEL.
7. **DEPRESSING ANY ONE OF THE THREE RED EMERGENCY STOP BUTTONS WILL STOP ALL OPERATIONS OF THE MACHINE.**
8. THE ENGINE MAY BE STOPPED BY TURNING THE KEY TO THE OFF POSITION.
9. IN THE EVENT OF A BATTERY FAILURE, THE ENGINE MAY BE STARTED USING THE RECOIL STARTER.

REFER TO CONTROLS DIAGRAM NEXT PAGE.

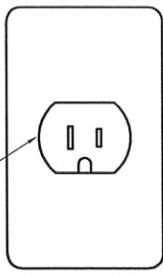
GASOLINE POWERED



HAND HELD
REMOTE CONTROL



END STOP LIMIT
SWITCH OUTLET

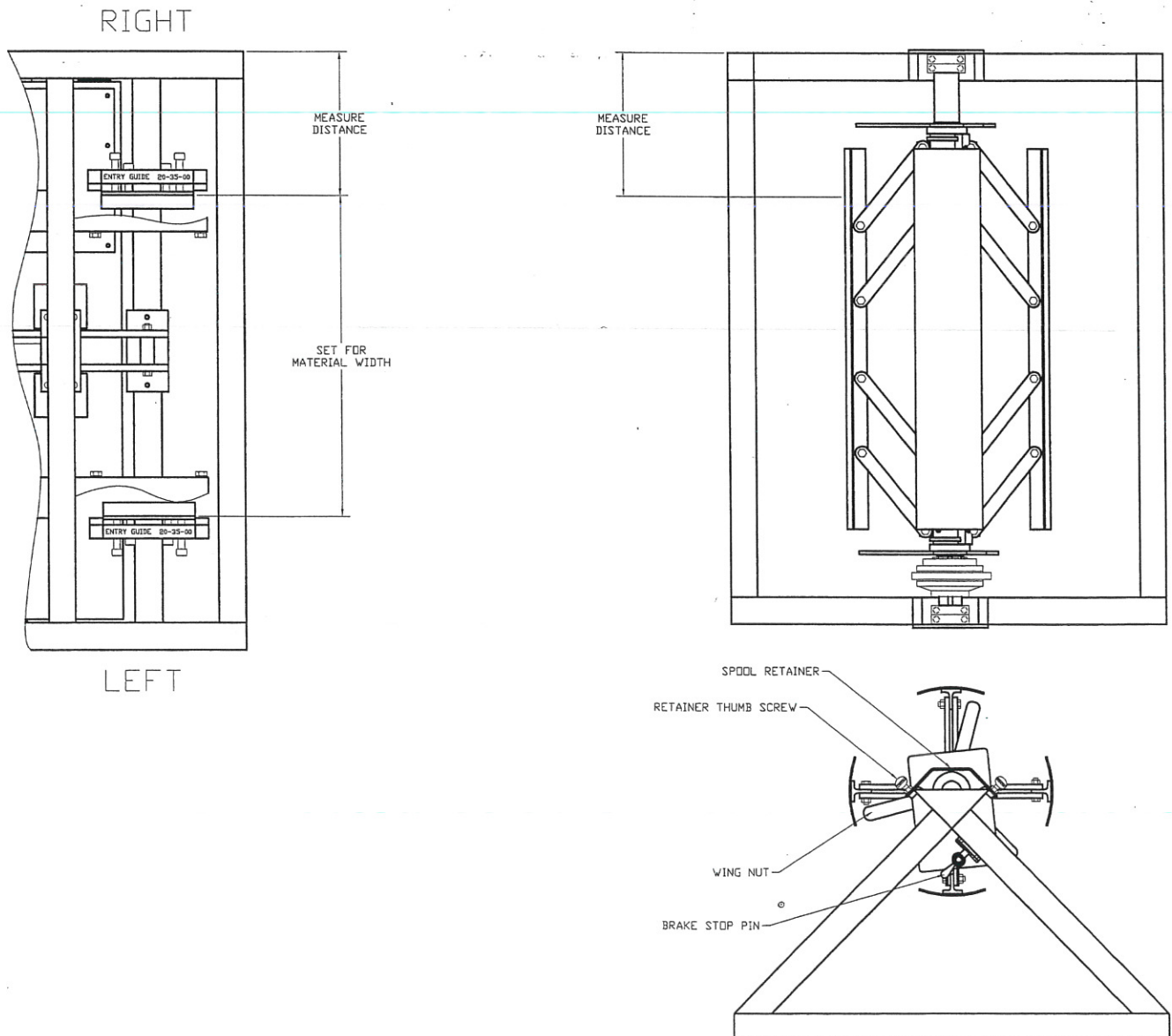


ALIGNMENT OF THE SPOOL

ALIGNMENT OF THE COIL FEEDING INTO THE ENTRY GUIDES IS FAIRLY CRITICAL. THE RIGHT SIDE OF THE EXPANDABLE SPOOL STAND IS ALIGNED WITH THE RIGHT SIDE OF THE MACHINE

TO OBTAIN PROPER ALIGNMENT, MEASURE THE DISTANCE FROM THE INSIDE OF THE RIGHT ENTRY GUIDE TO THE OUTSIDE OF THE MACHINE. (NOTE: THIS MEASUREMENT WILL ONLY BE ACCURATE AFTER THE MACHINE HAS BEEN SET FOR THE WIDTH OF MATERIAL TO BE RUN.)

MEASURE THE SAME DISTANCE FROM THE RIGHT SIDE OF THE SPOOL STAND AND PLACE A MARK ON THE EXPANDABLE SPOOL. AFTER RELEASING THE BRAKE STOP PIN, REMOVE THE EXPANDABLE SPOOL FROM THE STAND. INSERT THE EXPANDABLE SPOOL THROUGH THE EYE OF THE COIL AND ALIGN THE MARK WITH THE RIGHT SIDE OF THE COIL. ROTATE THE WING NUT CLOCKWISE TO TIGHTEN THE EXPANDABLE SPOOL IN THE I.D. OF THE COIL UNTIL TIGHT. BE SURE TO TIGHTEN BOTH SIDES OF THE EXPANDABLE SPOOL EVENLY.



LOADING THE COIL

AFTER THE RIGHT SIDE OF THE SPOOL IS PROPERLY LOCATED ON THE SPOOL SHAFT, REMOVE THE LEFT SPOOL SIDE AND SLIDE THE SPOOL ASSEMBLY THROUGH THE CENTER OF THE COIL.

REMEMBER TO LOCATE THE END OF THE COIL TO BE SURE THE MATERIAL IS COMING OFF THE ROLL IN THE PROPER DIRECTION FOR FEEDING INTO THE MACHINE.

AT TIMES THROUGH HANDLING OR TURNING THE COIL THE COIL BECOMES SLIGHTLY EGG SHAPED. IF THIS OCCURS, PLACE A STRAP AROUND THE COIL AND LIFT IT JUST ENOUGH TO CAUSE IT TO BECOME ROUND.

PLACE THE LEFT SPOOL SIDE AND BRAKE ASSEMBLY ON THE SHAFT AND FIX IN LOCATION.

THE SPOOL ASSEMBLY HAS CUT OUTS THROUGH THE SIDES TO ALLOW YOU TO USE A FORK LIFT OR A STRAP TO LIFT THE COIL INTO THE SPOOL STAND.

A LIFTING DEVICE ALSO HAS BEEN SUPPLIED TO ASSIST YOUR LOADING. TO USE THE LIFTING DEVICE PLACE THE HOOKS INTO THE CUT-OUTS OF THE SPOOL SIDES. THE MAXIMUM LOAD FOR THE COIL LIFTING DEVICE IS 4000 LBS.

WHEN PLACING THE COIL INTO THE SPOOL STAND, BE SURE THE BEARINGS ON THE END OF THE SPOOL SHAFT ARE IN PLACE. ALSO BE SURE THE BRAKE AND THE STOP PIN FOR THE BRAKE WILL NOT INTERFERE AS IT IS LOWERED.

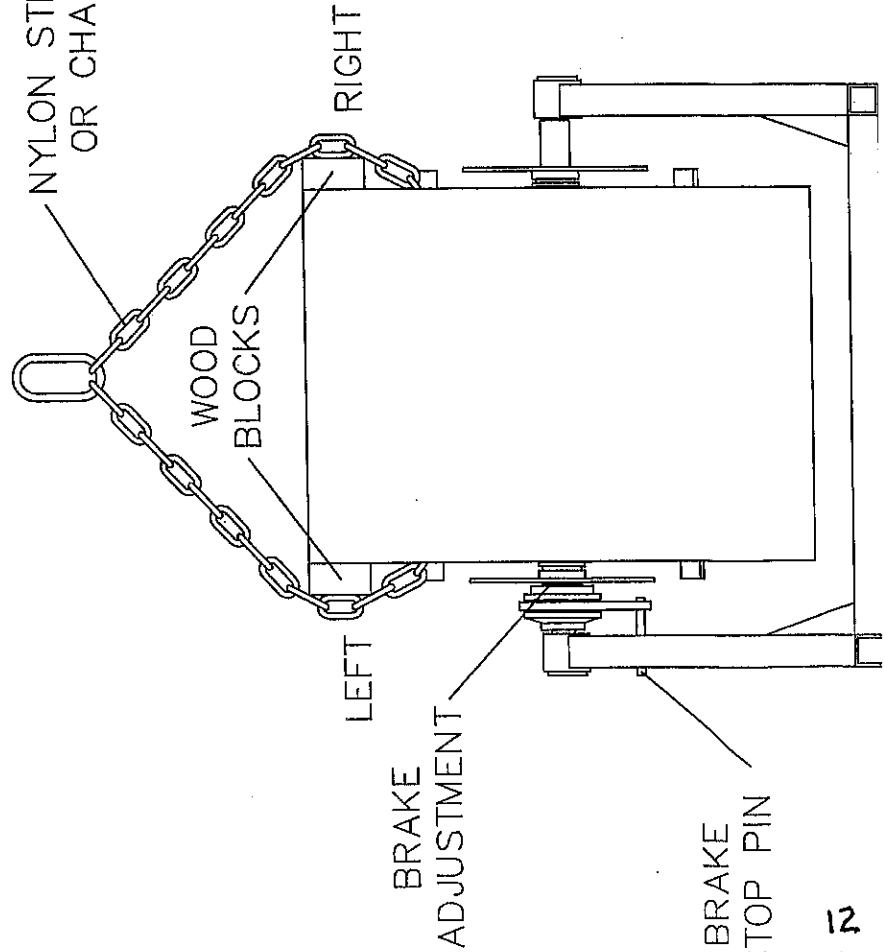
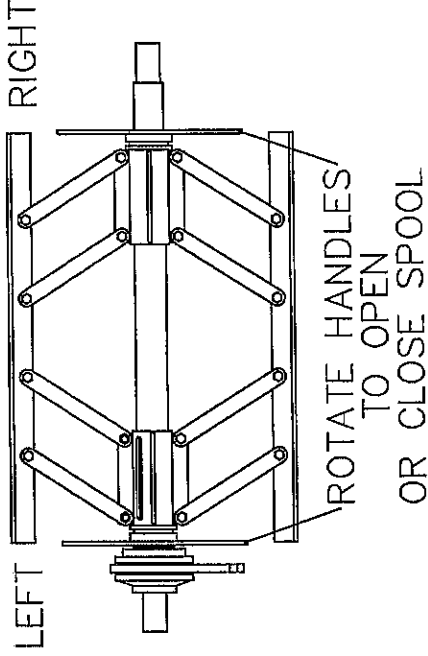
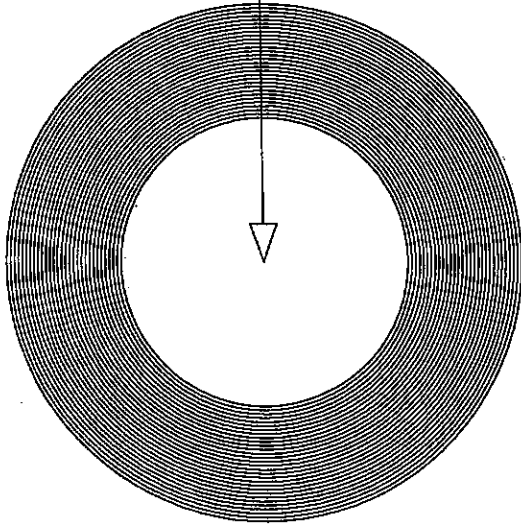
AFTER THE COIL IS LOADED INTO THE SPOOL STAND, SLIDE THE BRAKE ASSEMBLY OUT AGAINST THE SPOOL STAND. PLACE THE STOP BOLT INTO THE BRAKE PLATE, BETWEEN THE UPRIGHTS ON THE SPOOL STAND.

THE BRAKE ASSEMBLY IS ADJUSTABLE TO MAINTAIN THE PROPER AMOUNT OF TENSION ON THE COIL AS IT FEEDS THROUGH THE MACHINE. THERE SHOULD BE ENOUGH TENSION ON THE BRAKE TO KEEP THE COIL FROM UNWINDING AFTER THE MACHINE HAS STOPPED.

TO ADJUST THE BRAKE, USE THE THREE ADJUSTMENT SCREWS. TIGHTEN THE SCREWS FOR MORE TENSION AND LOOSEN THEM FOR LESS TENSION.

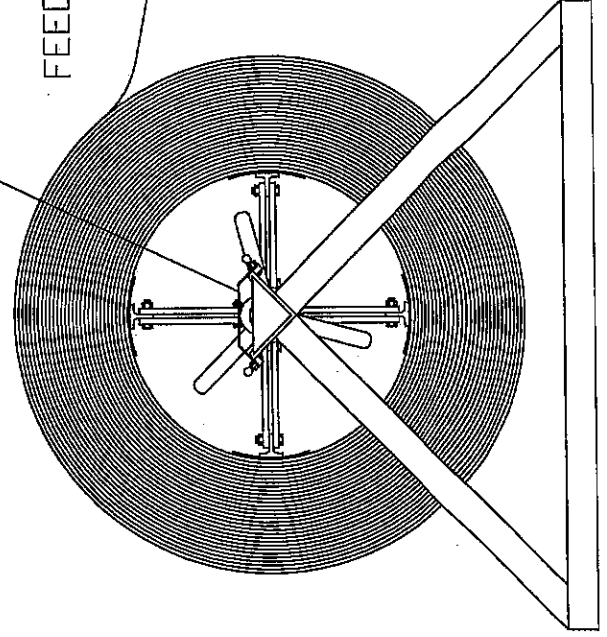
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LOADING THE COIL



RETAINING STRAPS
2 PLACES

FEED INTO MACHINE



SETTING THE WIDTH OF THE MACHINE

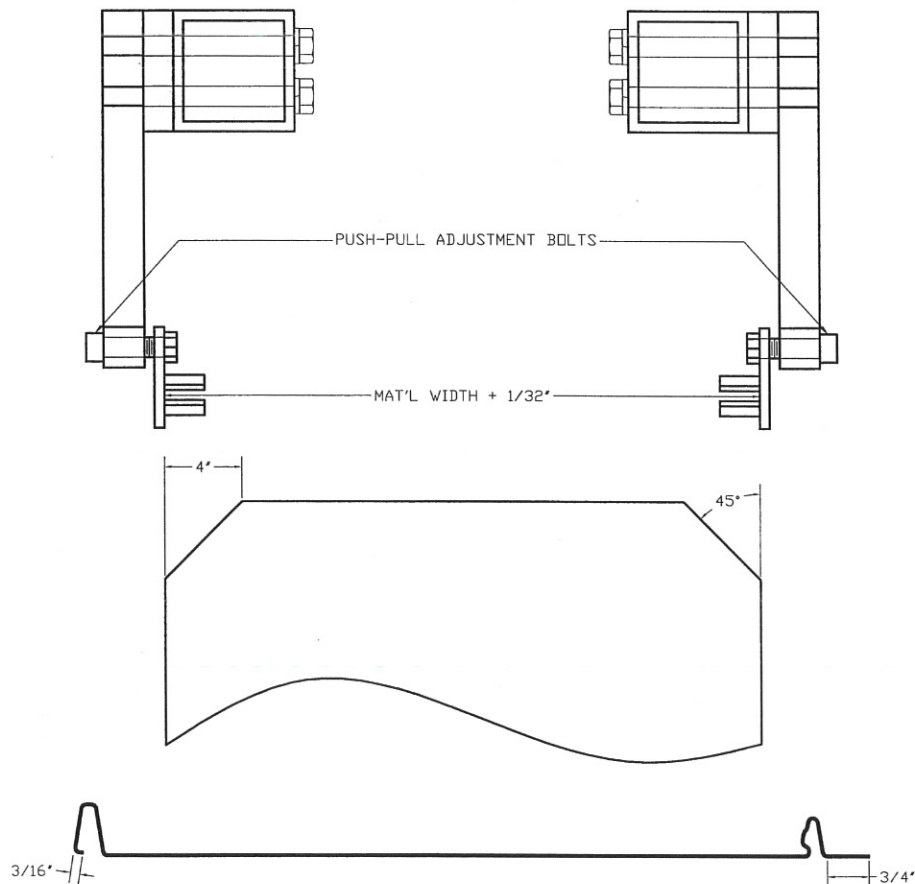
THE MACHINE IS DESIGNED TO RUN FROM 16" TO 28" WIDE MATERIAL. THE SUPPLIED CRANK HANDLE INSERTED INTO THE LEFT SIDE OF THE MACHINE AND ROTATED WILL CHANGE THE WIDTH OF THE MACHINE.

INSERT A SHORT PIECE OF COIL INTO THE ENTRY GUIDES AND ROTATE THE CRANK HANDLE TO SET THE MACHINE AS SHOWN.

USE THE PUSH-PULL ADJUSTMENT BOLTS TO ACHIEVE THE NOTED DIMENSIONS SHOWN ON THE PANEL. MOVING THE ENTRY GUIDES OUT WILL INCREASE THE LENGTH OF THE LEG AND MOVING THE ENTRY GUIDES IN WILL SHORTEN THE LEG. ANY ADJUSTMENT OF THE ENTRY GUIDES WILL REQUIRE RESETTING THE WIDTH OF THE MACHINE.

BE AWARE THAT DIFFERENT COIL TYPES AND GAUGES MAY REQUIRE A SMALL ADJUSTMENT TO MAINTAIN THE DIMENSIONS NOTED ON THE PANEL. BE SURE TO RUN OUT SOME SHORT SAMPLES AND CHECK FOR PANEL QUALITY AND A GOOD FIT WHEN PANELS ARE LAPPED TOGETHER.

TRIM THE LEADING CORNERS OF THE COIL AS SHOWN BEFORE FEEDING MATERIAL INTO THE MACHINE.



STIFFENING RIBS

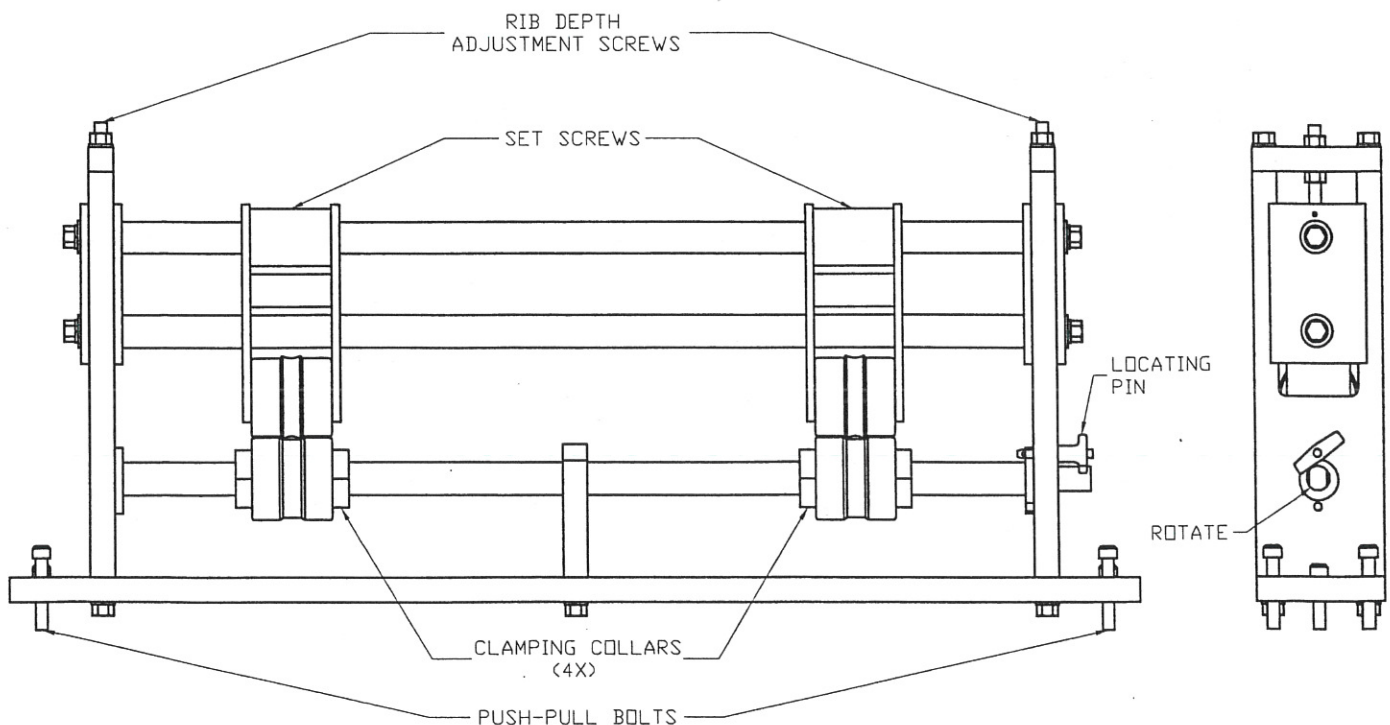
A STIFFENING RIB UNIT IS STANDARD EQUIPMENT ON THIS MACHINE. THE RIB ROLLER ASSEMBLY IS LOCATED AT THE EXIT END OF THE MACHINE BETWEEN THE LAST FORMING ROLLERS AND THE SHEAR ASSEMBLY.

THE PANEL MAY BE RUN WITH OR WITHOUT RIBS. TO ENGAGE RIB ROLLERS REMOVE THE LOCATING PIN IN LEFT SIDE OF THE RIB ROLLER ASSEMBLY. USE A 9/16" OPEN END WRENCH TO ROTATE THE BOTTOM SHAFT 180 DEGREES. REPLACE THE LOCATING PIN TO LOCK THE BOTTOM SHAFT IN PLACE. TO DISENGAGE THE RIBS, REVERSE THIS PROCEDURE.

THE RIB ROLLERS ARE ADJUSTABLE FROM LEFT TO RIGHT FOR THE DESIRED PLACEMENT IN DIFFERENT PANEL WIDTHS. TO LOCATE THE RIB ROLLERS IN THE DESIRED POSITION ON THE PANEL, DISENGAGE THE RIBS. LOOSEN THE ALLEN HEAD SCREW IN THE CLAMPING COLLARS ON EITHER SIDE OF THE ROLLERS ON THE BOTTOM SHAFT. SLIDE THE ROLLERS TO THE DESIRED LOCATION AND TIGHTEN THE CLAMPING COLLARS. LOOSEN THE SET SCREWS IN THE TOP RIB ROLLER UNITS AND LOCATE IN POSITION DIRECTLY ABOVE THE BOTTOM RIB ROLLER AND TIGHTEN THE SET SCREWS. ENGAGE THE RIB ROLLERS AND CHECK TO BE SURE THERE IS NO INTERFERENCE BETWEEN THE TOP AND BOTTOM RIB ROLLERS. BE AWARE IF THE TOP AND BOTTOM RIB ROLLERS ARE IMPROPERLY ALIGNED AND THEN ENGAGED, DAMAGE MAY OCCUR TO THE ROLLERS.

THE RIB ROLLER ASSEMBLY IS ADJUSTABLE TO MATCH THE PASS LINE OF THE PANEL. USE THE PUSH-PULL BOLTS TO ADJUST TO THE PROPER LOCATION. THE HEIGHT SHOULD BE SET WHERE THE BOTTOM RIB ROLLER JUST TOUCHES THE PANEL WHEN THE RIB ROLLER ARE DISENGAGED.

THE DEPTH OF THE RIB MAY BE ADJUSTED USING THE ADJUSTMENT SCREWS ON THE TOP OF THE UNIT. DO NOT OVER TIGHTEN. ATTEMPTING TO PUT THE RIBS IN TOO DEEP MAY CAUSE DISTORTION IN THE PANEL.



SETTING THE SHEAR

DO NOT ATTEMPT TO MAKE ANY ADJUSTMENTS WITH THE ENGINE RUNNING OR THE POWER SOURCE CONNECTED!

THE SHEAR DIE INSERTS NEED TO BE SET WHEN CHANGING WIDTH OF COIL OR ANYTIME A CHANGE IS MADE IN THE WIDTH ADJUSTMENT ASSEMBLY.

TO SET THE SHEAR DIE INSERTS, REMOVE THE 3/8" MOUNTING BOLTS (8 TOTAL) ON THE ENTRY AND EXIT SIDES OF THE SHEAR. SLIDE THE DIE INSERTS TO THE OUTSIDE OF THE MACHINE. CAREFULLY JOG THE PANEL UP TO THE SHEAR ASSEMBLY. ALIGN THE SHEAR DIE INSERTS WITH THE PANEL AND REPLACE THE MOUNTING BOLTS FINGER TIGHT. JOG THE PANEL THROUGH THE SHEAR ASSEMBLY. FINE ADJUST THE SHEAR DIE INSERTS TO MATCH THE PANEL PROFILE. TIGHTEN ALL 8 MOUNTING BOLTS.

JOG A SHORT PANEL OUT OF THE MACHINE AND ACTIVATE THE SHEAR CYCLE. INSPECT THE PANEL FOR ANY MARKING OR DEFORMATION AND MAKE THE NECESSARY ADJUSTMENTS.

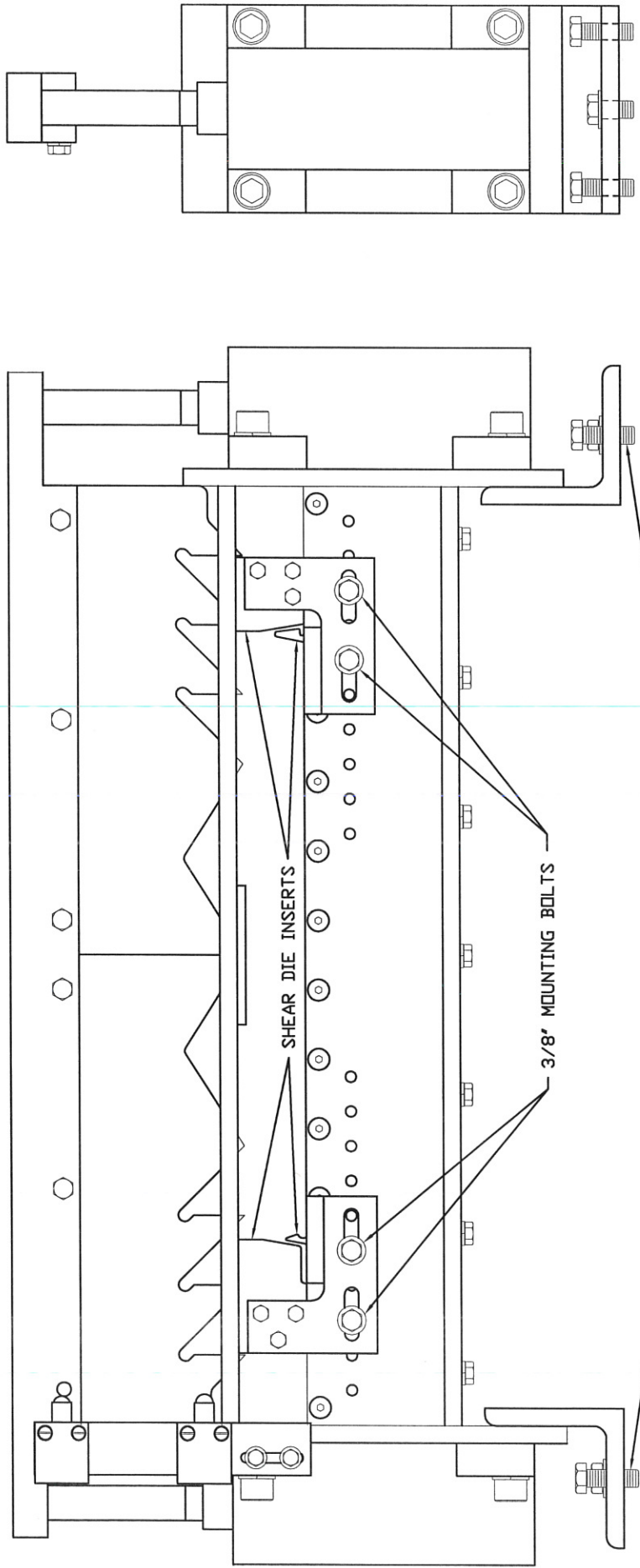
IF THE WIDTH OF THE MATERIAL YOU ARE USING CAUSES THE POINT OF THE SHEAR BLADE TO HIT DIRECTLY ON TOP OF ONE OF THE PANEL LEGS, THE SHEAR ASSEMBLY MAY NEED TO BE ADJUSTED Laterally. TO DO THIS, LOOSEN THE CENTER BOLTS IN THE SHEAR MOUNTING ANGLE. MOVE THE SHEAR TO THE LEFT OR RIGHT TO POSITION THE POINT OF THE BLADE OFF THE LEG OF THE PANEL AND TIGHTEN THE BOLTS. THE SHEAR CANNOT BE MOVED LEFT OR RIGHT WITHOUT RESETTING THE SHEAR DIE INSERTS.

THE HEIGHT OF THE SHEAR ASSEMBLY IS ADJUSTABLE BY USE OF THE PUSH-PULL BOLTS IN THE SHEAR MOUNTING ANGLES. TO RAISE THE SHEAR ASSEMBLY, LOOSEN THE CENTER BOLT AND TIGHTEN THE TWO OUTSIDE BOLTS. REVERSE THIS PROCEDURE TO LOWER THE SHEAR ASSEMBLY. SET THE HEIGHT OF THE SHEAR TO JUST CLEAR THE BOTTOM OF THE PANEL.

A SHEAR ASSEMBLY ADJUSTED IMPROPERLY WILL AFFECT THE STRAIGHTNESS AND QUALITY OF THE PANEL.

REFER TO SHEAR ASSEMBLY DIAGRAM NEXT PAGE

VIEW FROM EXIT END



PROFILE ADJUSTMENTS, STATION #8

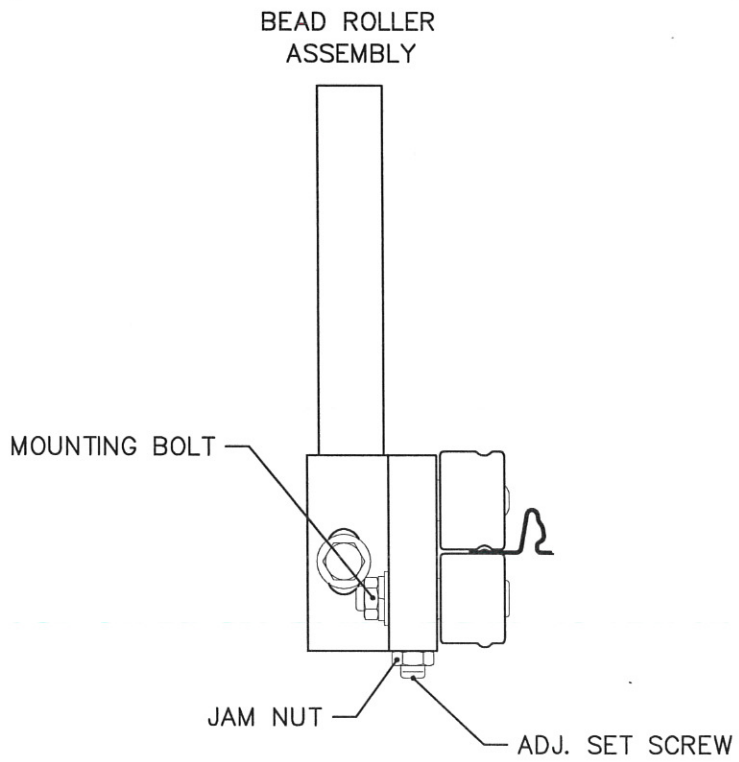
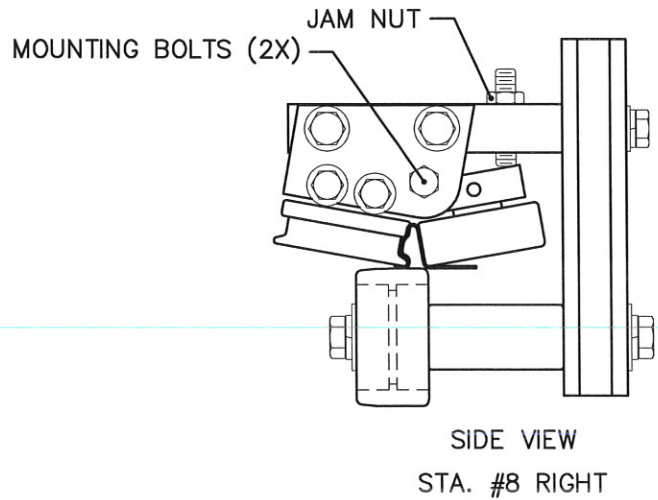
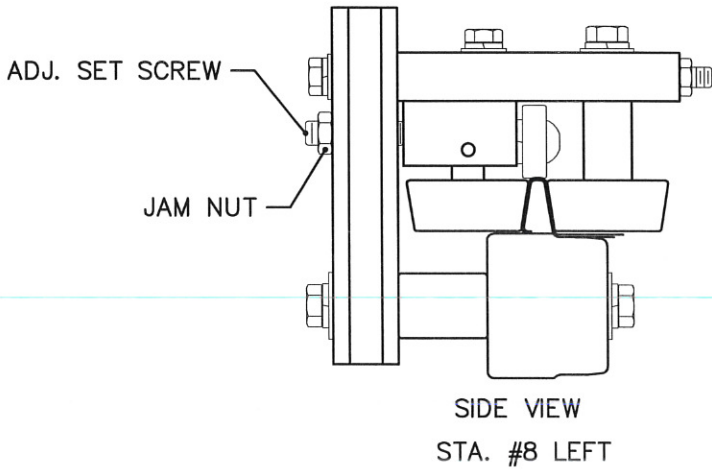
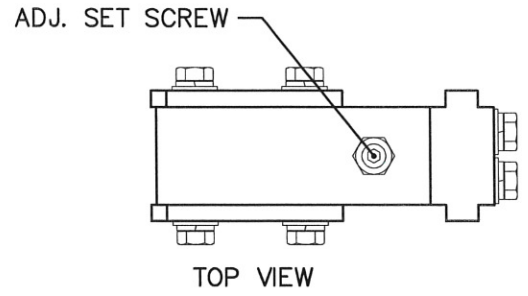
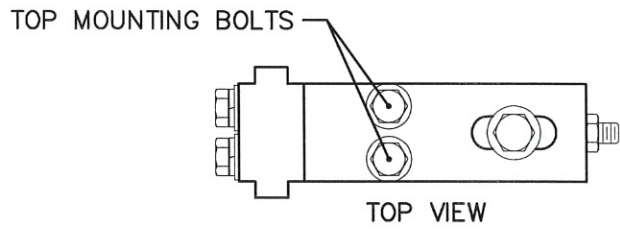
THE OUTSIDE ROLLER AT STATION #8 LEFT IS ADJUSTABLE Laterally TO CLOSE THE FEMALE PROFILE OF THE PANEL. TO ADJUST, LOOSEN THE TWO MOUNTING BOLTS IN THE TOP OF THE STATION. LOOSEN THE JAM NUT ON SET SCREW ON THE OUTSIDE OF THE STATION. ADJUSTING THE ROLLER IN WILL CLOSE AND ADJUSTING THE ROLLER OUT WILL ALLOW THE FEMALE LEG TO BE MORE OPEN.

STATION #8 RIGHT HAS AN OUTSIDE ROLLER MOUNTED ON A PIVOT ASSEMBLY. TO ADJUST, LOOSEN THE TWO MOUNTING BOLTS THAT HOLD THE PIVOT BLOCK IN PLACE. LOOSEN THE JAM NUT ON THE SET SCREW IN THE TOP MOUNTING BLOCK. TIGHTENING THE SET SCREW WILL CLOSE THE MALE LEG OF THE PANEL AND LOOSENING THE SET SCREW WILL ALLOW IT TO BE MORE OPEN.

A BEAD ROLLER ASSEMBLY IS MOUNTED AT THE EXIT SIDE OF STATION #8 RIGHT. THE BOTTOM BEAD ROLLER ON THE ASSEMBLY IS ADJUSTABLE. TO ADJUST, LOOSEN THE BOLT THAT MOUNTS THE BOTTOM ROLLER. LOOSEN THE JAMB NUT ON THE SET SCREW. ROTATE THE SET SCREW COUNTER CLOCKWISE TO TIGHTEN AND CLOCKWISE TO LOOSEN THE ROLLER.

NOTE: A SMALL AMOUNT OF ADJUSTMENT WILL HAVE AN EFFECT ON THE PANEL. ADJUSTMENTS SHOULD BE MADE IN ¼ TO ½ TURN INCREMENTS.

REFER TO DIAGRAMS NEXT PAGE



CURVATURE ADJUSTMENTS

STATION #7 AND STATION #8 IN THE MACHINE ARE ADJUSTABLE TO INSURE THE PANEL WILL RUN WITHOUT UPHILL OR DOWNHILL CURVATURE.

UPHILL CURVATURE IS WHEN BOTH ENDS OF A PANEL RISE UP FROM A FLAT SURFACE WHILE THE CENTER TOUCHES. DOWNHILL CURVATURE IS WHEN BOTH ENDS OF A PANEL TOUCH A FLAT SURFACE AND THE CENTER IS RAISED UP.

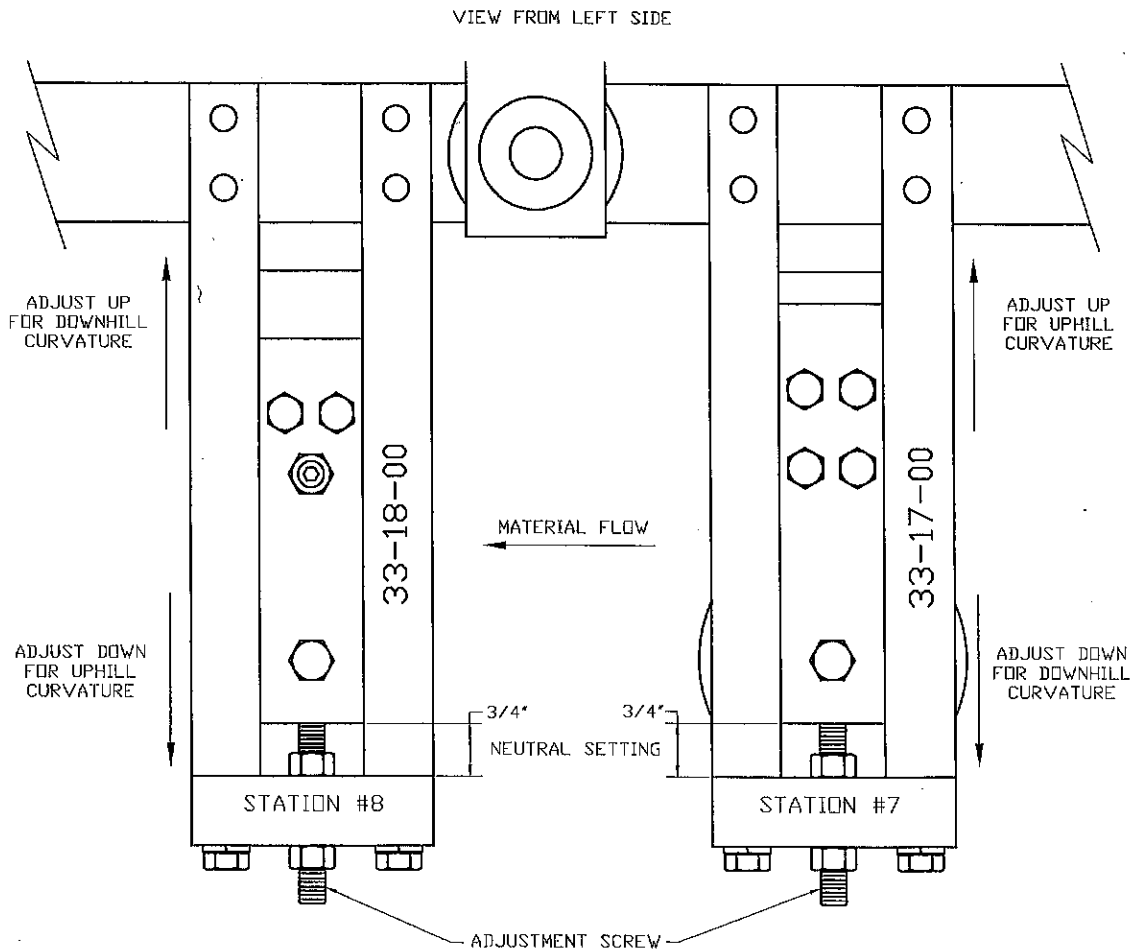
IF A PANEL HAS UPHILL CURVATURE, ADJUST STATION #9 UP. THE PANEL SHOULD REACT TO A SMALL AMOUNT OF ADJUSTMENT. MAKE THE ADJUSTMENTS IN $\frac{1}{4}$ TO $\frac{1}{2}$ TURN INCREMENTS. JOG THE MACHINE FORWARD PAST THE ADJUSTMENT AND CUT. RUN A PANEL LONG ENOUGH TO SEE IF THE DESIRED RESULT WAS ACHIEVED. IF THE PANEL STILL HAS UPHILL CURVATURE, ADJUST STATION #10 DOWN. AT NO TIME SHOULD MORE THAN $1 \frac{1}{2}$ TURNS OF EACH ADJUSTMENT SCREW BE REQUIRED.

IF ADJUSTMENTS ARE MADE AND THE RESULTS ARE NOT SATISFACTORY, RESET STATION #7 AND STATION #8 AT THE NEUTRAL POSITION, AND ATTEMPT THE PROCEDURE AGAIN.

IF THE PANEL HAS DOWNHILL CURVATURE REVERSE THE ABOVE ADJUSTMENT PROCEDURE.

THE SAME ADJUSTMENT PROCEDURE IS USED FOR BOTH THE MALE AND FEMALE LEGS OF THE PANEL.

IF ADJUSTMENTS ARE MADE TO STATION #8, THE HEIGHT OF THE SHEAR MAY NEED TO BE RESET.



AUXILIARY STATION ADJUSTMENTS

THERE ARE THREE AUXILIARY (ROLLER STATIONS IN BETWEEN MAIN ROLLER STATIONS) STATIONS IN THE MACHINE.

AUX. STATION #2-3 RIGHT IS ADJUSTABLE TO INSURE THE PROPER FINISHED PROFILE ON THE MALE LEG OF THE PANEL. WHEN CHANGING GAGES OF MATERIAL, THIS STATION WILL NEED TO BE ADJUSTED. TO ADJUST LOOSEN THE CLAMP BOLT ON THE OUTSIDE OF THE AUX. STATION. LOOSEN THE JAM NUT ON THE ADJUSTMENT SET SCREW. ROTATING THE ADJUSTMENT SCREW CLOCK WILL TIGHTEN THE SPACE BETWEEN THE ROLLERS FOR LIGHTER GAGE MATERIAL AND ROTATING COUNTER CLOCKWISE WILL OPEN THE SPACE FOR HEAVIER GAGE MATERIAL.

THE OUTSIDE ROLLER ON AUXILIARY STATION #5-6 LEFT IS ALSO ADJUSTABLE TO INSURE PROPER FORMING OF THE HEM ON THE FEMALE LEG OF THE PANEL WHEN RUNNING DIFFERENT GAGES OF MATERIAL. TO ADJUST LOOSEN THE JAM NUT ON THE OUTSIDE OF THE STATION. ROTATING THE ADJUSTMENT SET SCREW CLOCKWISE WILL TIGHTEN THE SPACE BETWEEN THE ROLLERS AND ROTATING COUNTER CLOCKWISE WILL OPEN THE SPACE BETWEEN THE ROLLERS.

AS WITH ALL ADJUSTMENTS, $\frac{1}{4}$ TO $\frac{1}{2}$ TURN WILL BE ENOUGH TO ACHIEVE THE REACTION REQUIRED.

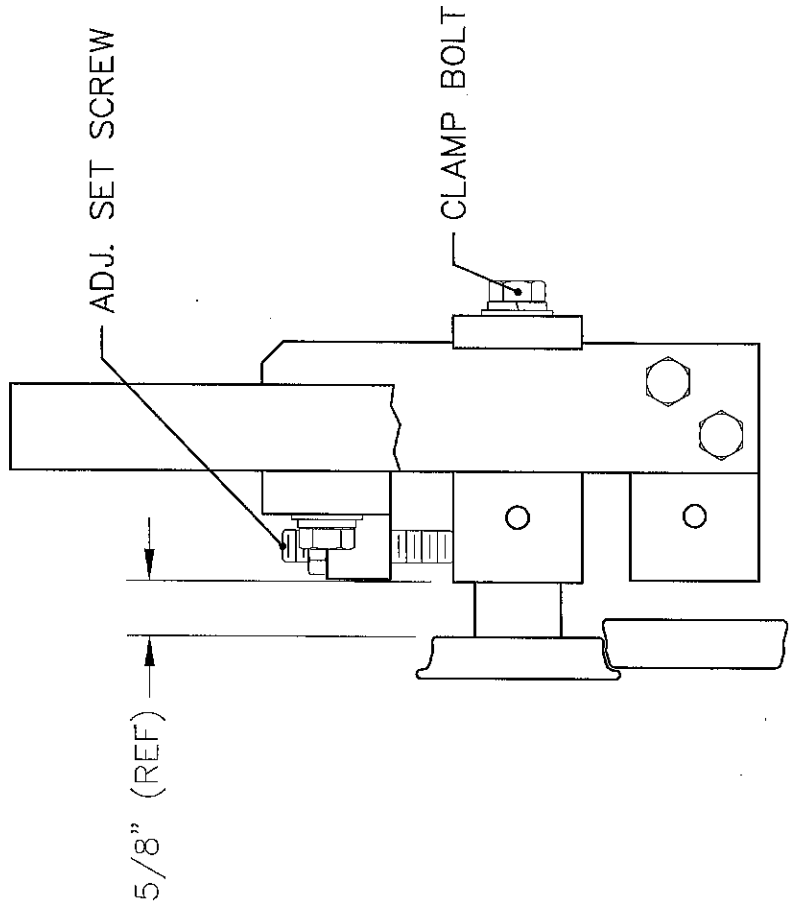
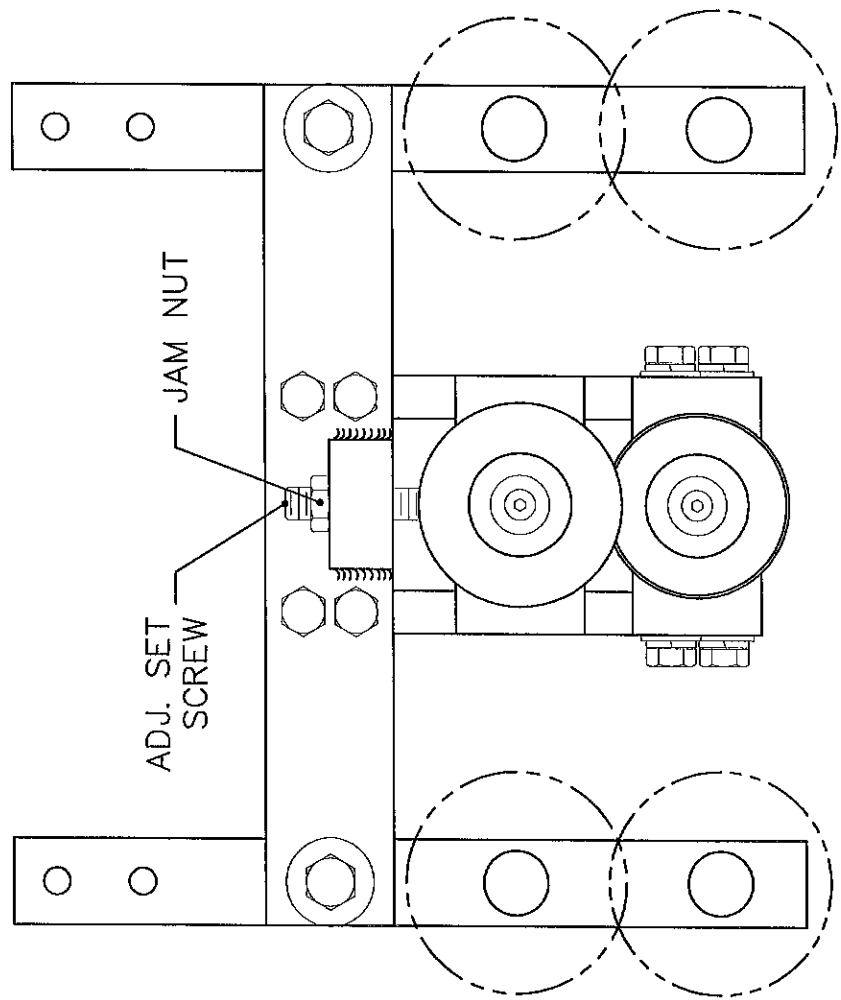
THE AUXILIARY STATION AT STATION #3-4 LEFT IS NOT ADJUSTABLE AND IS SET TO ACCOMMODATE ALL MATERIAL GAGES THE MACHINE IS DESIGNED TO RUN.

REFER TO DIAGRAMS NEXT TWO PAGES

AUX. STA #2-3 RIGHT

STA #2 RIGHT

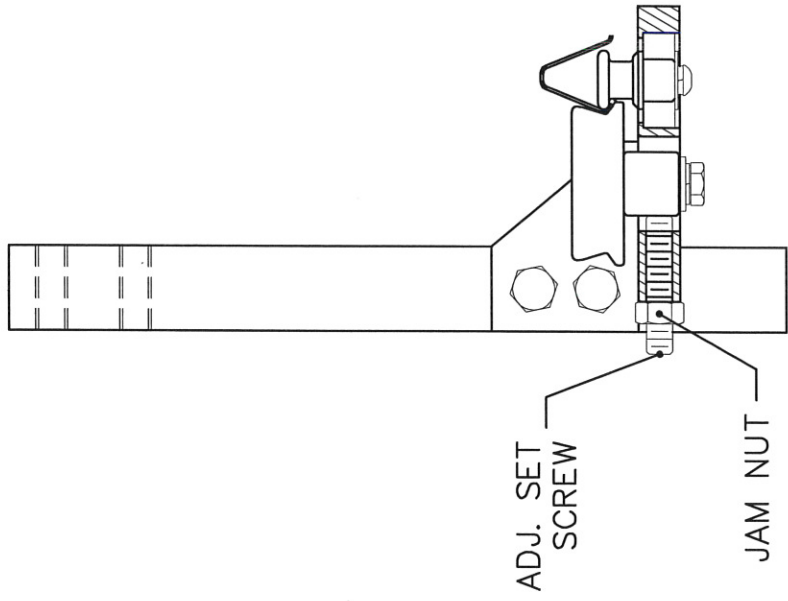
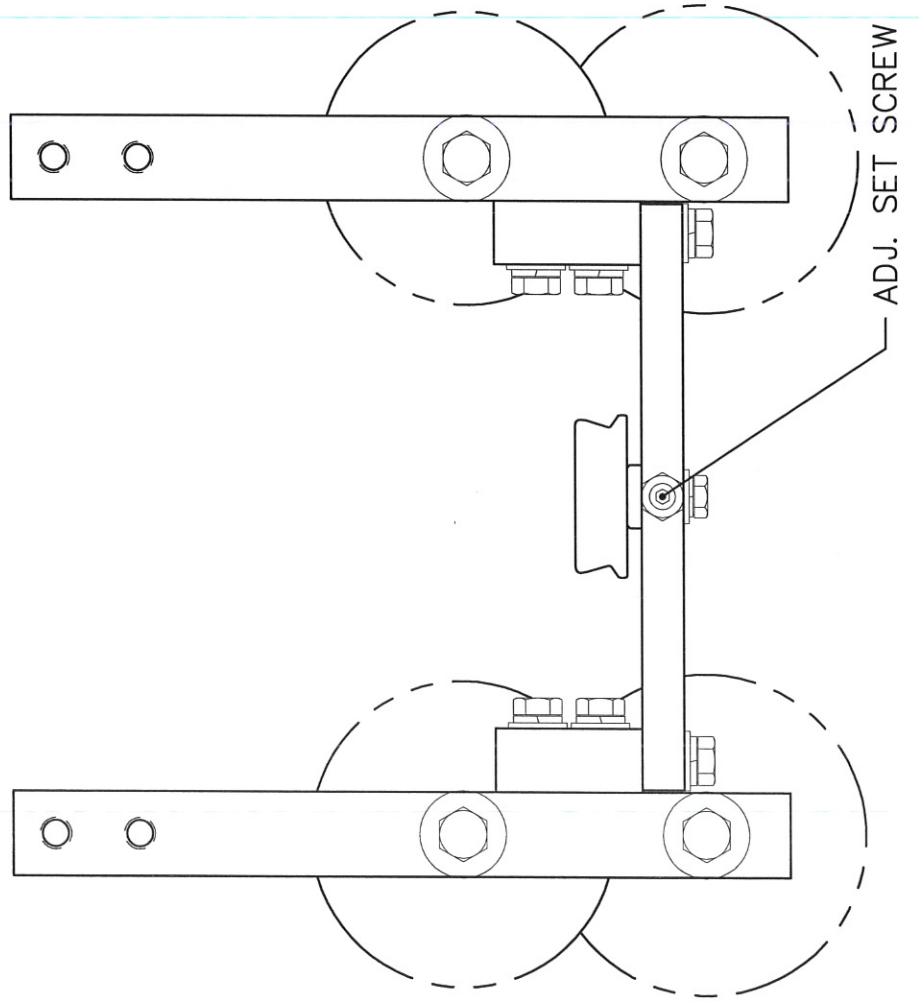
STA #3 RIGHT



VIEWED FROM ENTRY END

AUX. STA #5-6 RIGHT

STA #5 LEFT



VIEWED FROM ENTRY END
SOME PARTS REMOVED FOR CLARITY

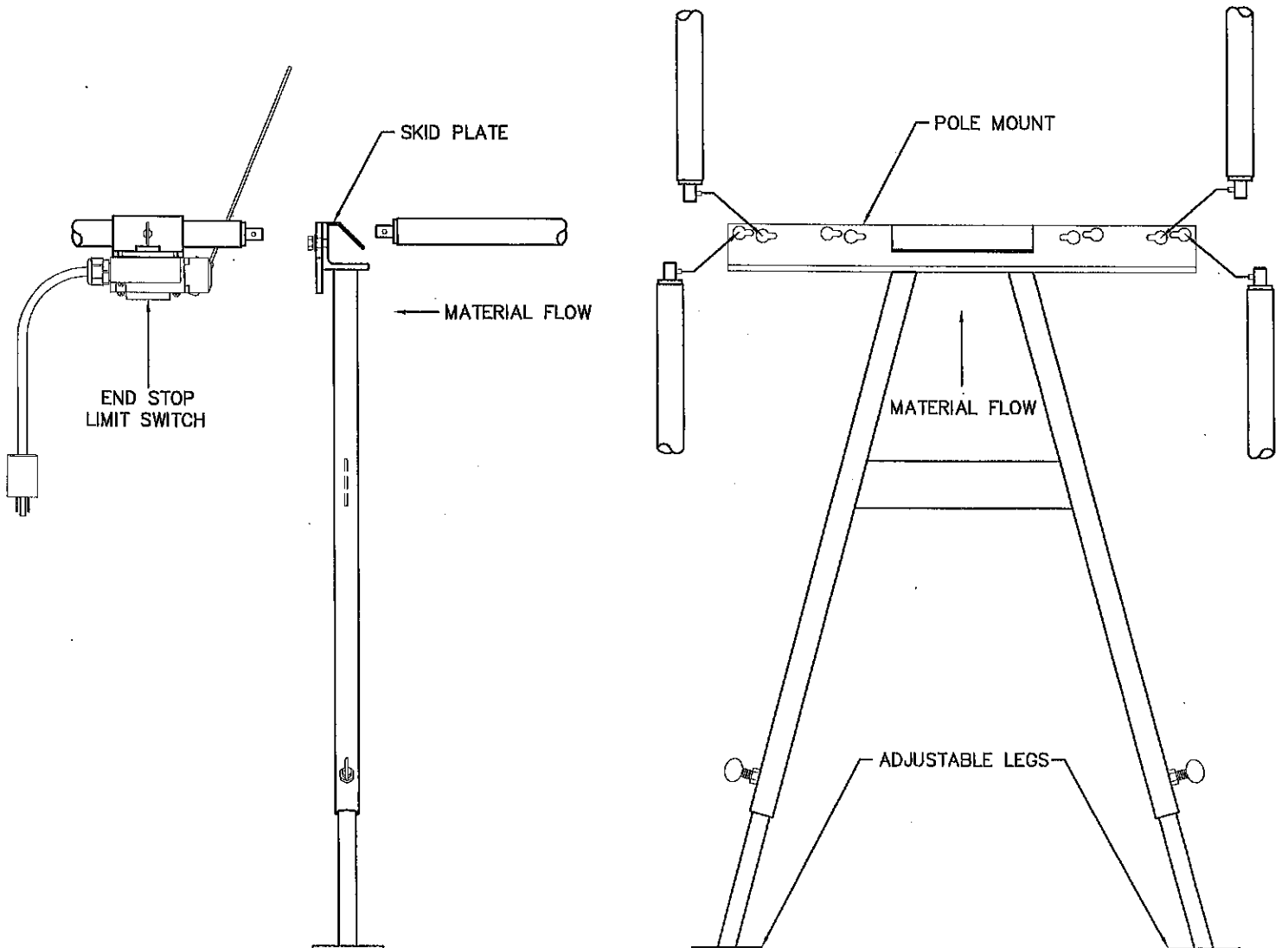
THE RUN-OUT STANDS

THE RUN-OUT STANDS HAVE KEYED HOLES FOR MOUNTING THE RUN-OUT POLES. THESE KEYED HOLES HAVE TWO DIFFERENT HEIGHTS.

TO PROPERLY SET UP THE RUN-OUT STANDS THE RUN-OUT POLES MUST BE MOUNTED IN THE HIGHEST HOLES ON THE ENTRY SIDE OF THE RUN-OUT STAND AND IN THE LOWEST HOLES ON THE EXIT SIDE OF THE RUN-OUT STAND. THE STAND MUST ALSO BE PLACED WITH THE SKID PLATE TOWARD THE ENTRY END. IF THE STANDS ARE SET UP IN THIS MANNER, THE PANEL WILL RUN OUT WITH OUT CATCHING ON THE STANDS.

THE END STOP LIMIT SWITCH IS MOUNTED BY SLIDING IT ON THE RUN-OUT POLE AND LOCKING IT IN THE DESIRED LOCATION WITH THE THUMB SCREW.

USE THE ADJUSTABLE LEGS TO MAKE SURE THE STANDS ARE LEVEL WITH THE MACHINE.



TROUBLE SHOOTING INSTRUCTIONS

When trouble shooting remove power by unplugging unit from main power source.

- A. Motor doesn't run or starter doesn't pull in when the E-Stops are pulled out
1. Using a volt/ohm meter - pull fuses from fuse holder and check condition of fuses - should be (0 ohms). Replace bad fuses.
 - a. Fuses good - re-install
 1. Check overload (OL) for a tripped state - Depress reset
 - a. Using a volt/ohm meter - check for continuity from wire #4 and white wire on overload relay - should be 0 ohms
- CHECK WITH POWER OFF AND POWER CORD UNPLUGGED**
- B. Starter pulls in, but motor doesn't run
1. Bad Motor - replace
- C. Starter pulls in, motor tries to run - (makes a grunting noise)
1. Bad Motor - replace
 2. Incoming voltage to low - Check voltage and extension cord for proper size
- D. Unit tripping breaker (Power feed from source)
1. Bad breaker or too small of rating - Must be 30 Amps.
 2. Check extension cord for proper size and condition - See instruction manual
 3. Motor bad
- E. Unit doesn't run in Hand or Automatic Mode, but motor is running
1. Check Run on light on PLC - Light must be on when motor is running
 2. Check for any lights on PLC - Motor must be running
 - a. No lights -- Pull fuse from fuse holder and use a volt/ohm meter check condition of fuses - should be (0 ohms). Replace bad fuse
REPLACE WITH SAME STYLE OF FUSE (ATMR-2) or equal
CHECK WITH POWER OFF AND POWER CORD UNPLUGGED
 - b. If fuse continues to blow - a short exists
possible problems -
 1. solenoid coils bad
 2. short in limit switches, material end stop switch, pendant, PLC
 3. Check Error light on PLC should be off
- F. Unit doesn't run in Hand either direction - Motor must be running
1. Check PLC input 7 wire #23 - should be on -- Blade up limit switch
 2. Check PLC input 2 wire #7 - should be on -- Pendant in hand mode and stop button pulled out

3. Check PLC input 0 wire #8 - should be on -- When Pendant momentary selector switch is made in the Forward selection
 Check PLC output 0 wire #24 - should be on (forward power to solenoid)
4. Check PLC input 1 wire #10 - should be on -- When Pendant momentary selector switch is made in the Reverse selection
 Check PLC output 1 wire #25 - should be on (reverse power to solenoid)
5. Check "E" above
6. Bad pendant - cord can be checked for continuity - see schematic

When trouble shooting remove power by unplugging unit from main power source.

- G. Unit doesn't (shear down) in Hand - Motor must be running
 1. Check PLC input 2 wire #7 - Must be on before going down -- Pendant in Hand mode and Stop button pulled out
 2. Check PLC input 5 wire #17 - should be on - When Pendant Down is depressed
 Check PLC output 2 wire #26 - should be on
 4. Check "E" above
 5. Prior to going down - PLC input 6 wire #16 and input 7 wire #23 should be on - Indicating blade is in the up position
 6. When going down - PLC input 6 wire #16 should be on and input 7 wire #23 should be off
 7. Bad pendant - cord can be checked for continuity - see schematic
- H. Unit does down shear in Hand - but shear doesn't return up
 1. Check PLC input 2 wire #7 - should be off in the down position
 2. At the Down position - PLC input 6 wire #16 and input 7 wire #23 should be off
 3. At the Mid position - PLC input 6 wire #16 should be on and input 7 wire #23 should be off
 4. At the Top position - PLC input 6 wire #16 and input 7 wire #23 should be on

If these items check good - unit should be able to run in the Hand control using the momentary selector switch for forward and reverse direction and a shear down cycle should operate.

- I. Unit won't run in Auto mode but will run in the Hand mode
 1. Check PLC input 8 wire #11 - should be on -- Material limit switch is made (no material)
 2. Check PLC input 7 wire #23 - should be on -- Blade up limit switch
 Check PLC input 6 wire #16 - should be on -- Blade up limit switch
 3. Check PLC input 3 wire #12 - should be on -- Pendant in auto mode and stop button pulled out

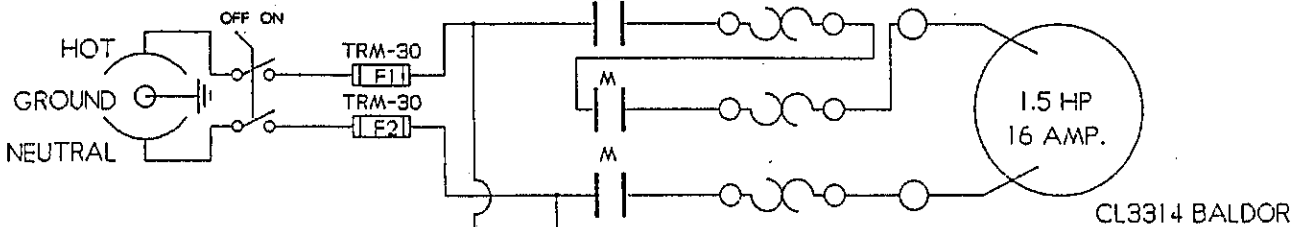
4. Check PLC input 4 wire #14 - should be on -- When Pendant is in auto mode, stop button pulled out, the motor is running, and start button is depressed

J. If no material end limit switch is used -- set Pot 1 to 0%
If material end limit switch is used -- set Pot 1 to 100%

K. Unit works improperly

1. Extension cord supplying power to unit too small
2. Check AC voltage at unit while running - should be 120 VAC. (+ / - 5%)

30 AMP 120 VAC. 50/60 HERTZ

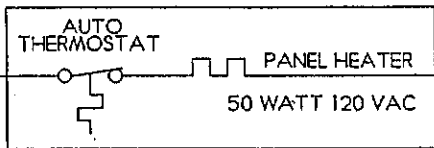


ATOR-2
F3

WHITE WIRE N

LOCAL UNIT OFF

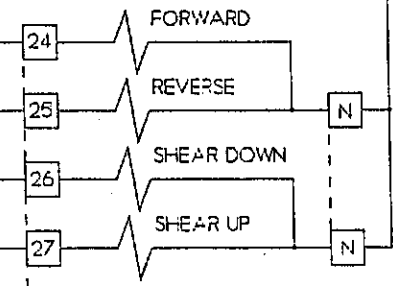
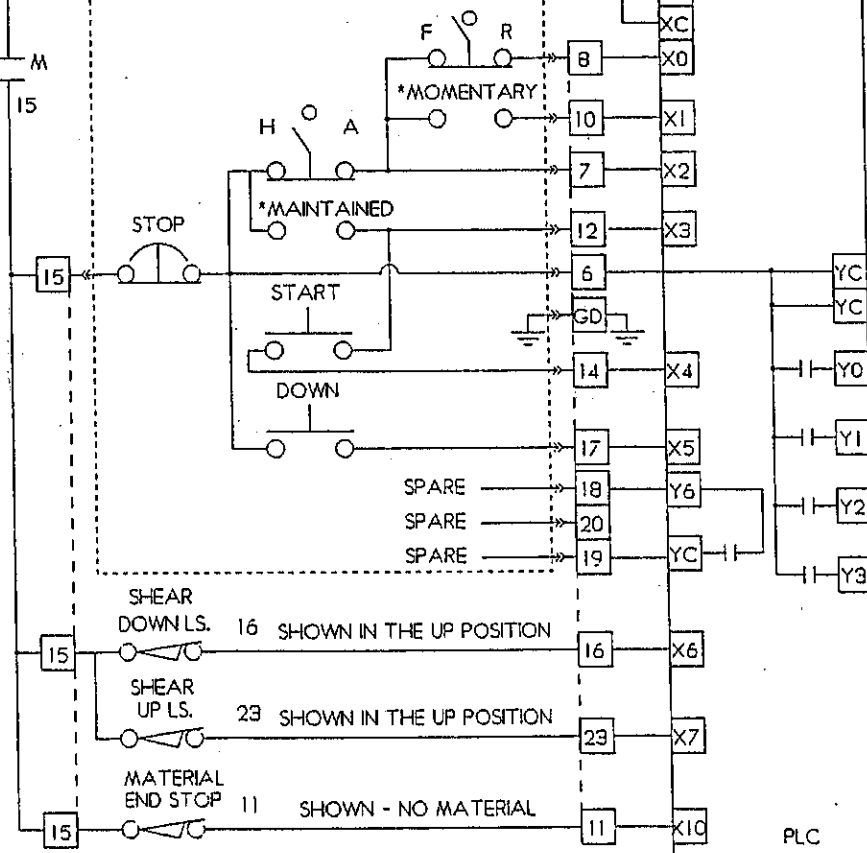
REMOTE UNIT OFF



12 PIN PENDANT STATION

PENDANT COLOR CODE

#	COLOR
15	BLUE
6	WHITE/BLACK
7	RED/BLACK
8	WHITE
10	GREEN/BLACK
12	BLACK
14	RED
17	ORANGE/BLACK
18	BLUE/BLACK
19	BLACK/WHITE
20	ORANGE
GD	GREEN

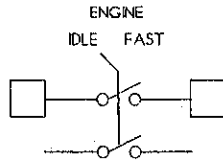


SHEAR DOWN LS. OPENS WHEN SHEAR GO DOWN
 SHEAR UP LS. SHEAR UP (15-23 CLOSED) SHEAR DN (15-23 OPEN)

INDUSTRIAL ELECTRIC AND CONTROL CO.
DENVER, COLORADO

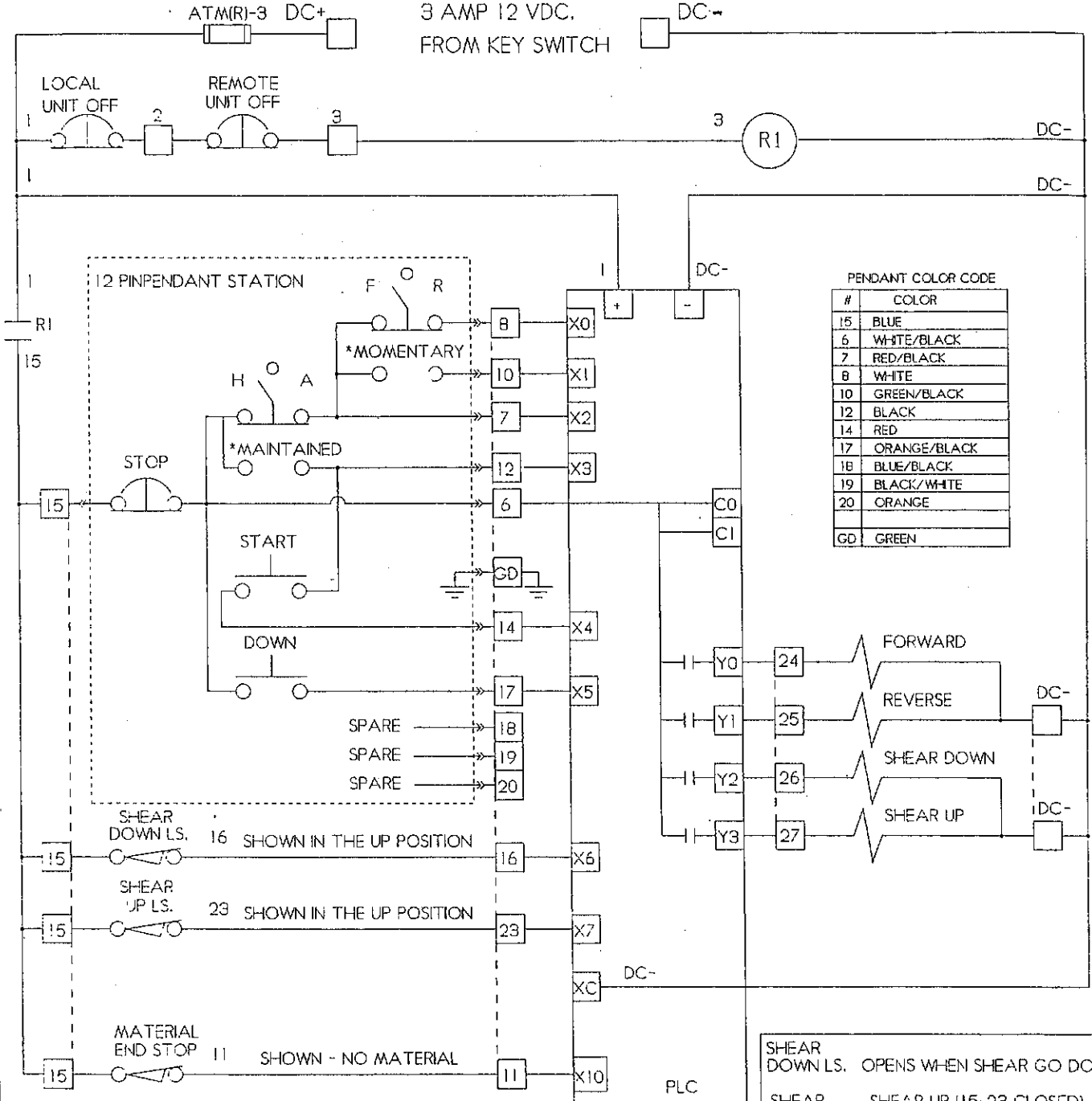
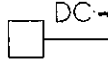
JOB NO. 10001	SCALE 1		
DATE: 4/10/97	SHEET 1 OF 1	CK'D:	APP'D:
REV. E	CUSTOMER: ZIMMERMAN METALS	DRAWING NO: 120/KOTO	

SEQUENCE	15-23	15-16
SHEAR UP	X	Y
SHEAR GOING UP	0	Y
SHEAR DOWN	0	0
SHEAR GOING DOWN	0	Y



GROUND

3 AMP 12 VDC.
FROM KEY SWITCH



PENDANT COLOR CODE

#	COLOR
15	BLUE
6	WHITE/BLACK
7	RED/BLACK
8	WHITE
10	GREEN/BLACK
12	BLACK
14	RED
17	ORANGE/BLACK
18	BLUE/BLACK
19	BLACK/WHITE
20	ORANGE
GD	GREEN

SHEAR DOWN LS. OPENS WHEN SHEAR GO DOWN
 SHEAR UP LS. SHEAR UP (15-23 CLOSED) SHEAR DN. (15-23 OPEN)

SEQUENCE	15-23	15-16
SHEAR UP	X	X
SHEAR GOING DN.	0	X
SHEAR DOWN	0	0
SHEAR GOING UP	0	X

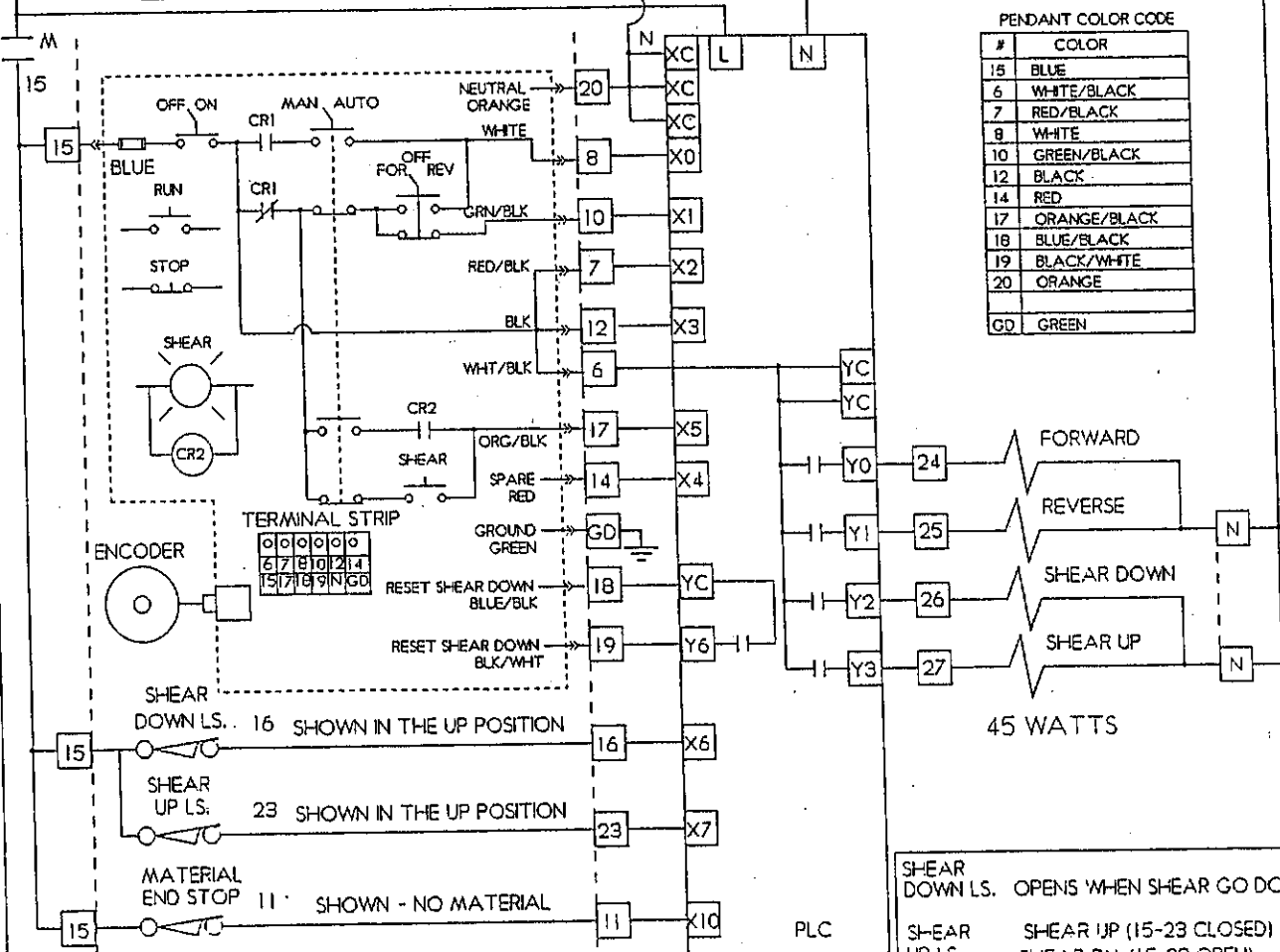
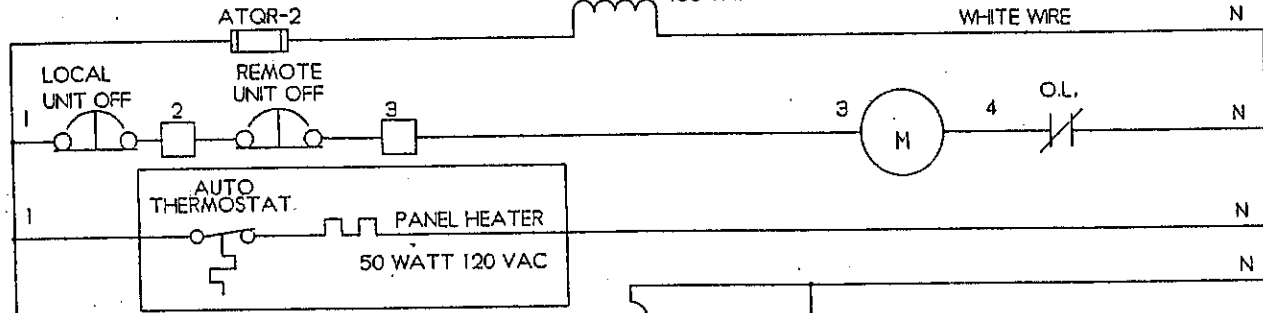
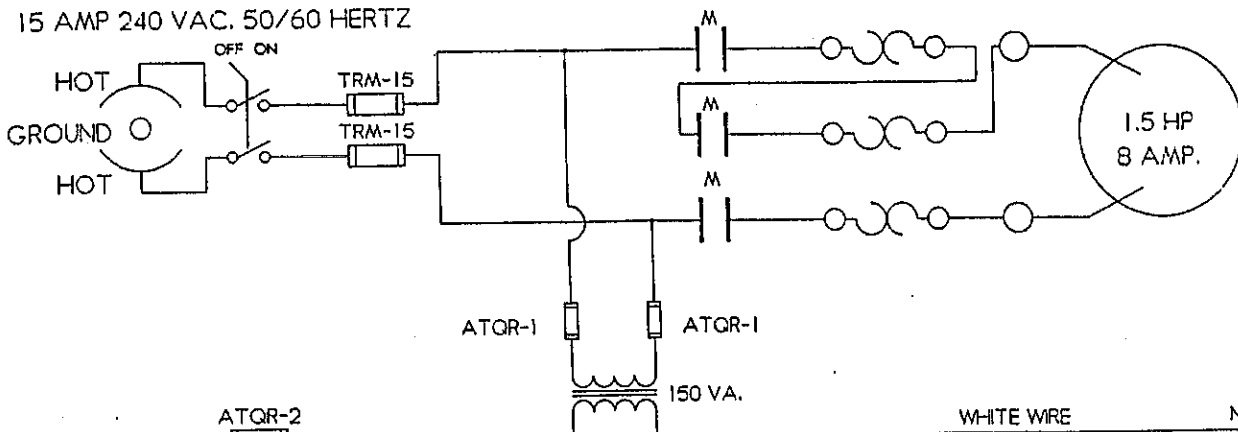
INDUSTRIAL ELECTRIC AND CONTROL CO.
LITTLETON, COLORADO

JOB NO. 10001 SCALE: 1

DATE: 2/3/98 SHEET 1 OF 1 CK'D: APP'D:

REV. E CUSTOMER: ZIMMERMAN METALS DRAWING NO: MAIN_DC_12

15 AMP 240 VAC. 50/60 HERTZ



PENDANT COLOR CODE

#	COLOR
15	BLUE
6	WHITE/BLACK
7	RED/BLACK
8	WHITE
10	GREEN/BLACK
12	BLACK
14	RED
17	ORANGE/BLACK
18	BLUE/BLACK
19	BLACK/WHITE
20	ORANGE
GD	GREEN

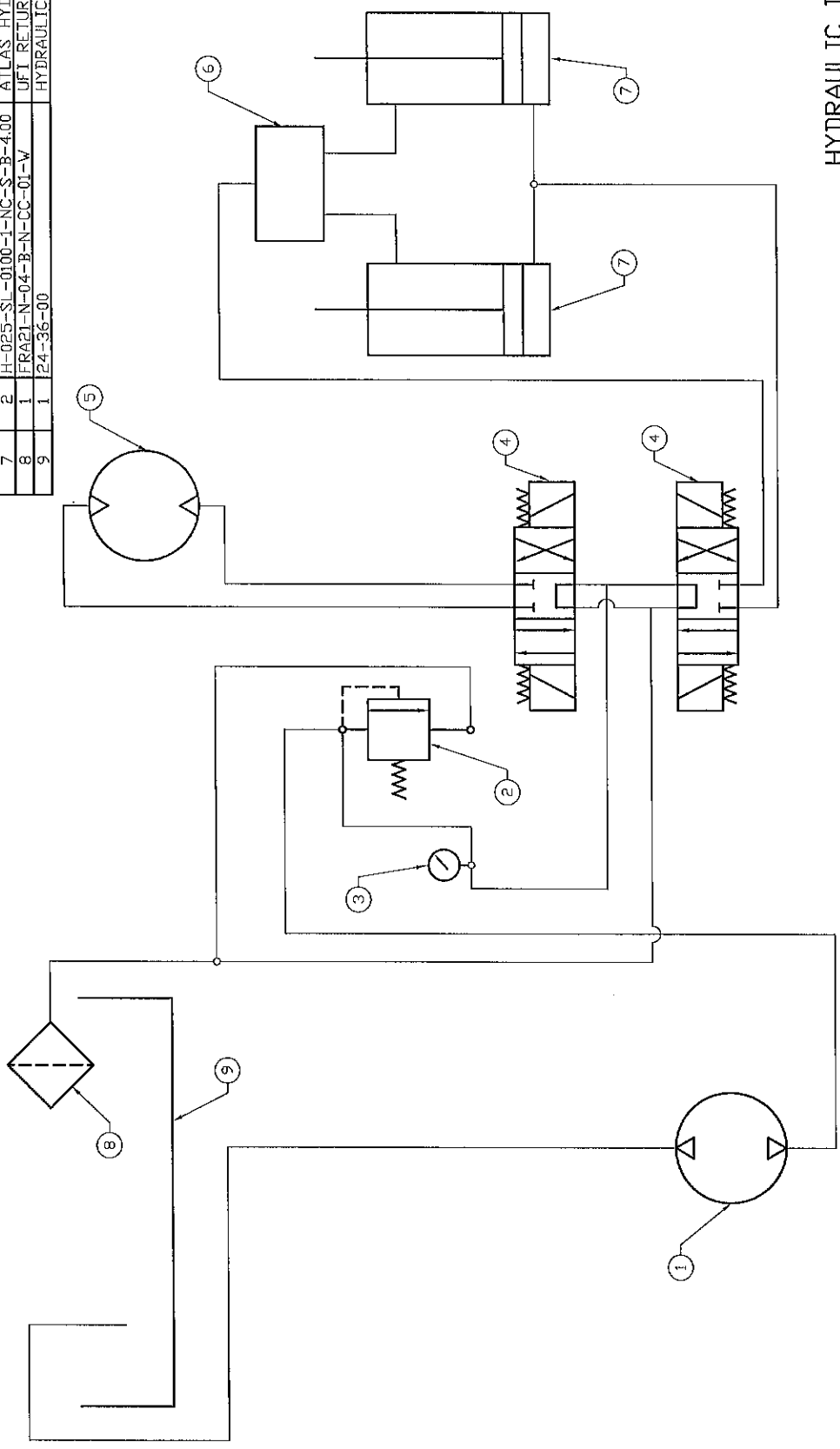
SHEAR DOWN LS. OPENS WHEN SHEAR GO DOWN
 SHEAR UP LS. SHEAR U/P (15-23 CLOSED) SHEAR DN. (15-23 OPEN)

SEQUENCE	15-23	15-16
SHEAR UP	X	/
SHEAR GOING DN.	0	/
SHEAR DOWN	0	0
SHEAR GOING UP	0	/

INDUSTRIAL ELECTRIC AND CONTROL CO.
 DENVER, COLORADO

JOB NO. 10001	SCALE: 1	CK'D:	APP'D:
DATE: 3/10/98	SHEET 1 OF 1	DRAWING NO:	
REV. E	CUSTOMER: ZIMMERMAN METALS	240-MP400	

ITEM QTY	PART NO.	DESCRIPTION
1	1300098 (ELEC MOTOR)	BARNES 'S' SERIES PUMP
1A	1300635 (GAS ENGINE)	BARNES 'S' SERIES PUMP
2	RV-4L	PRINCE RELIEF VALVE
3	CFIP-210A	PDI PRESSURE GAUGE
4	VSSM-3L-GB-60-J (120VAC)	CONTINENTAL SLENOID VALVE
4A	VSSM-3L-GB-75-J (12VDC)	CONTINENTAL SLENOID VALVE
5	103-1013-010	CHAR-LYNN HYD MOTOR
6	1300634	BARNES FLOW DIVIDER
7	H-025-SL-0100-1-NC-S-B-4.00	ATLAS HYD CYLINDER
8	FRA21-N-04-B-N-CC-01-W	UFI RETURN LINE FILTER
9	24-36-00	HYDRAULIC TANK



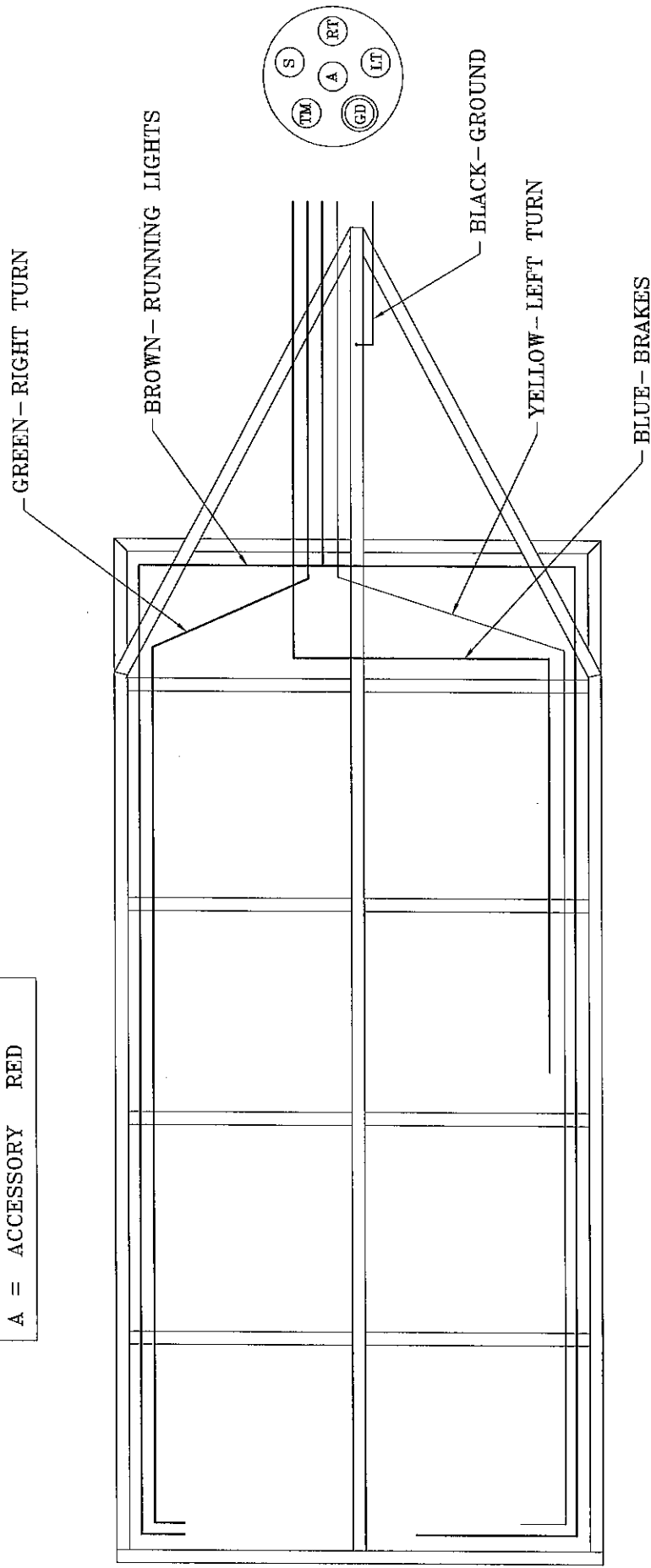
HYDRAULIC DIAGRAM

PART NO.	24-00-36
MAT'L	
QTY REQ.	1 PER MACH
NOTES	
X ± .030 .XX ± .015 .XXX ± .005 FRACTIONS ± 1/32"	

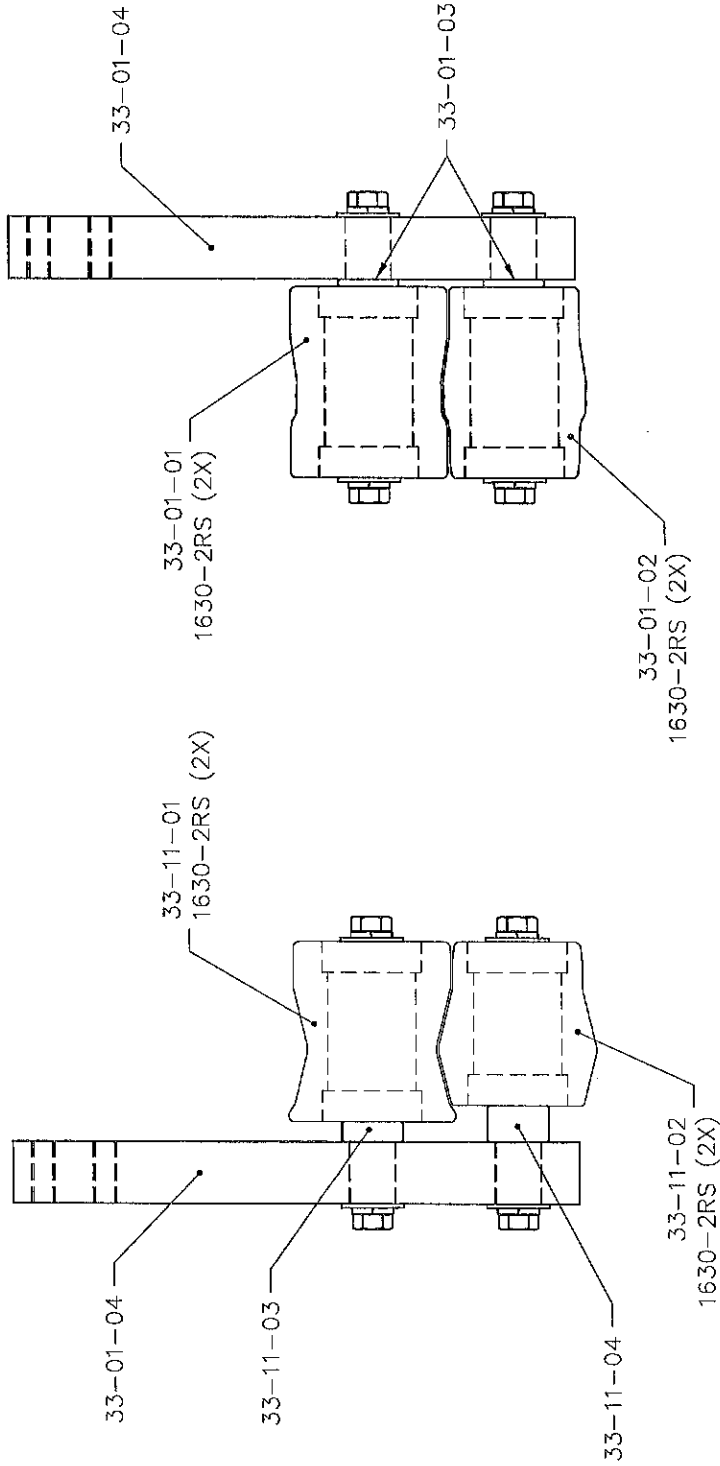
24-90-WD

TRAILER
WIRING DIAGRAM

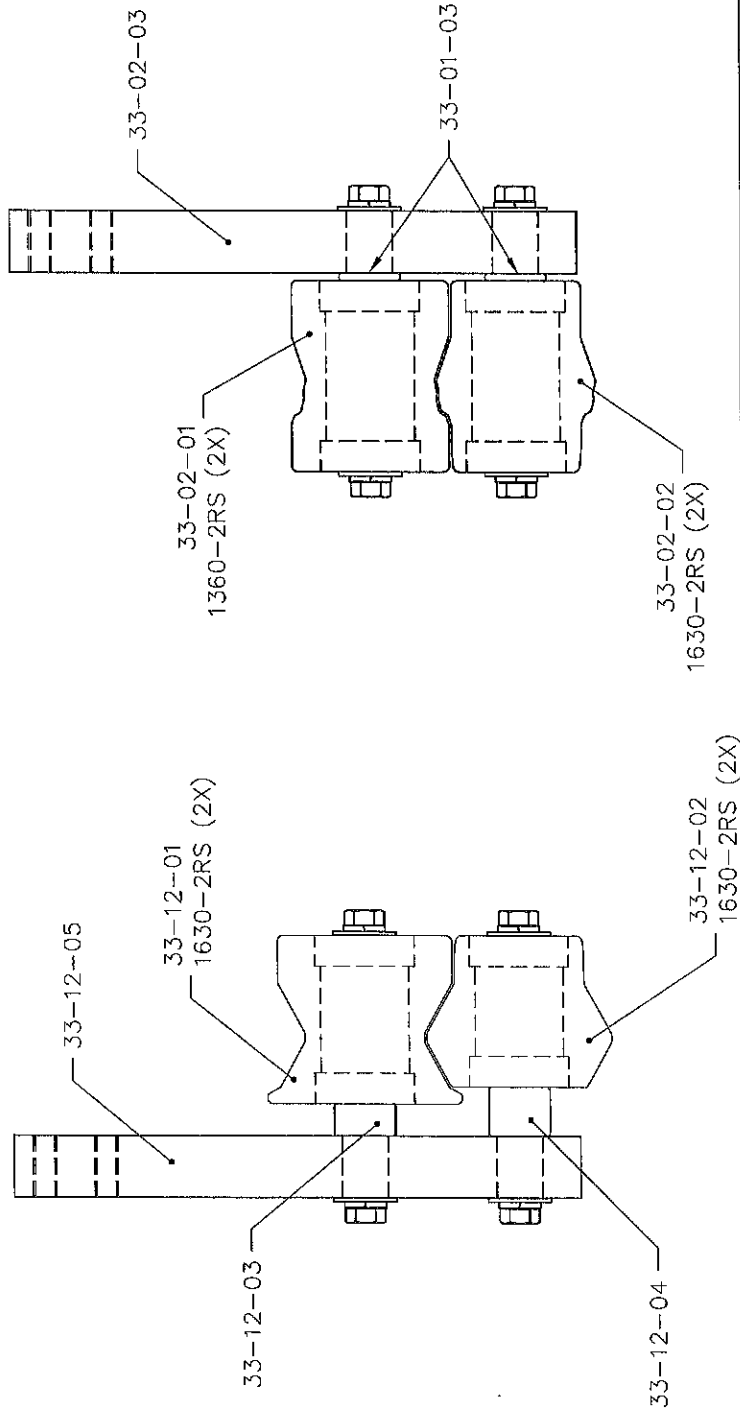
TM=	TAIL LIGHTS	BROWN
GD=	GROUND	BLACK
LT=	LEFT TURN	YELLOW
RT=	RIGHT TURN	GREEN
S =	BRAKES	BLUE
A =	ACCESSORY	RED



TRAILER VIEWED FROM BOTTOM

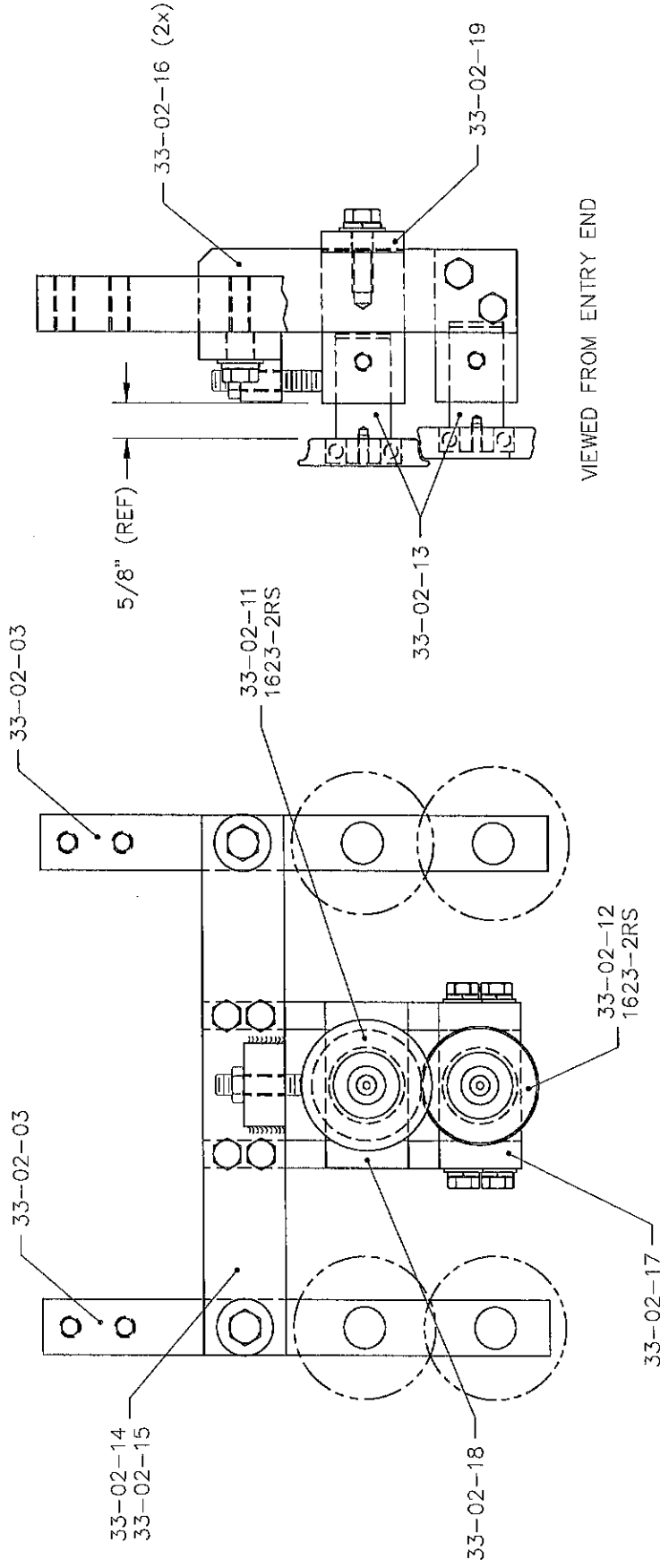


ZIMMERMAN METALS INC.		201 E. 58th AVE. DENVER, CO 80216 (303) 294-0180	
TITLE	STA #1 ASSEMBLY	TOLERANCES UNLESS OTHERWISE SPECIFIED	3rd ANGLE PROJ.
		.XX = ±.015 .XXX = ±.005	FRACTION = 1/32" ANGLES = ±1° BREAK ALL UNMARKED CORNERS
MACH. MOD. NO.	FF1K	PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT THE PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER CO.	
DRAWING NO.	33-00-01	SCALE:	DATE
		1:2	7/30/07
NOTES:	1 PER MACHINE	DRAWN BY	DATE
		BTO	10/18/07
		L.S. REV	



ZIMMERMAN METALS INC. 201 E. 58th AVE.
DENVER, CO 80216
(303) 294-0180

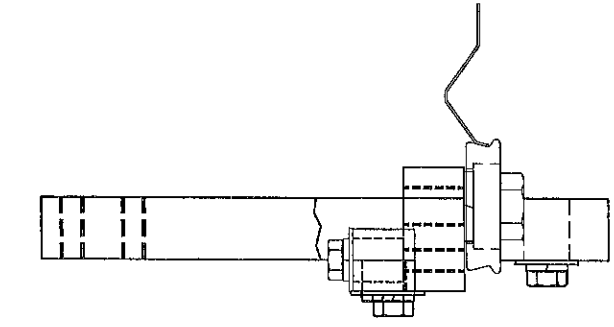
TITLE	STA #2 ASSEMBLY	TOLERANCES	UNLESS OTHERWISE SPECIFIED	3rd ANGLE PROJ.	DATE
		.XX = ±.015	FRACTION = 1/32"		7/30/07
		.XXX = ±.005	ANGLES = ±1°	BREAK ALL UNMARKED CORNERS	DATE
MACH. MOD. NO.	FF1K	PROPRIETARY INFORMATION NOTICE			DATE
DRAWING NO.	33-00-02	THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSMITTED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR ANY PURPOSES WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER CO.			DATE
SHEET / OF	1 / 1	SCALE:	1:2	DRAWN BY	BTO
NOTES:	1 PER MACHINE			APPROV BY	L.S. REV
MAT'L:					10/18/07



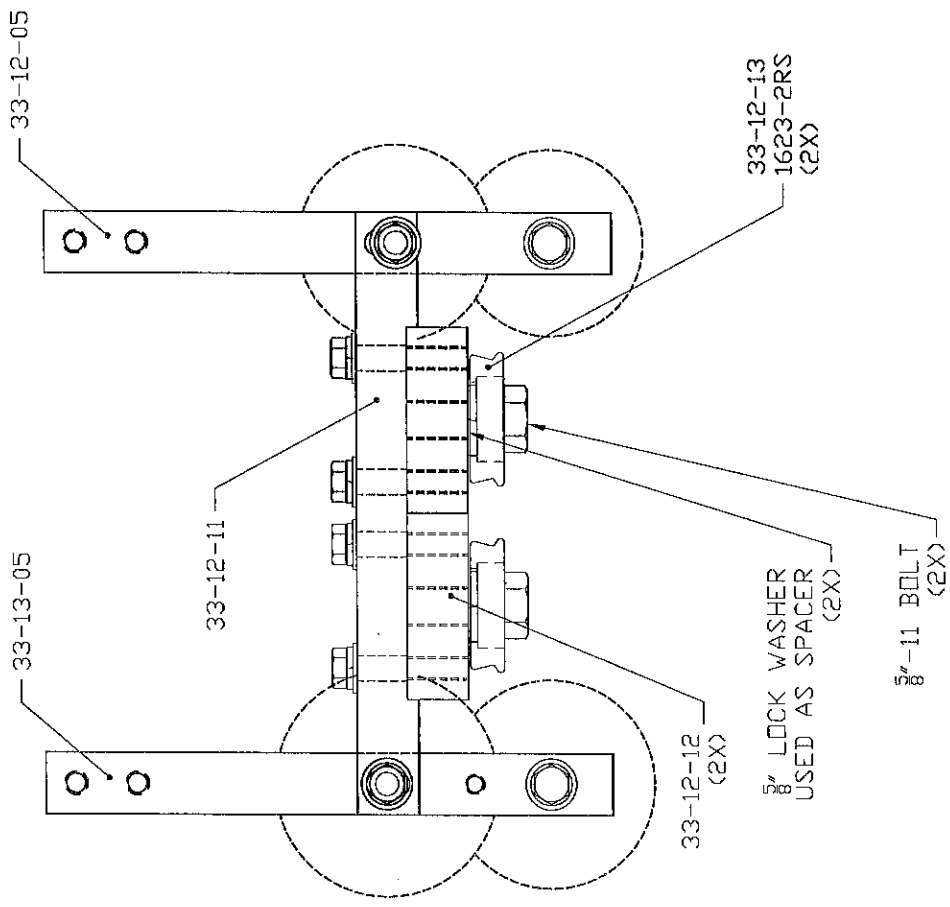
VIEWED FROM ENTRY END

ZIMMERMAN METALS INC. 201 E. 58th AVE. DENVER, CO 80216 (303) 294-0180	
TOLERANCES UNLESS OTHERWISE SPECIFIED .XX = ±.015 .XXX = ±.005 FRACTION = ±1/32" ANGLES = ±1° BREAK ALL UNMARKED CORNERS 3rd ANGLE PROJ.	PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT THE PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER CO.
TITLE AUX. STATION #2-3 RIGHT	DRAWN BY NOTED SCALE 1:2 DATE 8/28/07
MACH. MOD. NO. FF1K	SHEET / OF 1 / 2 APPROV BY DATE
NOTES: 1 PER MACHINE	
MAT'L:	

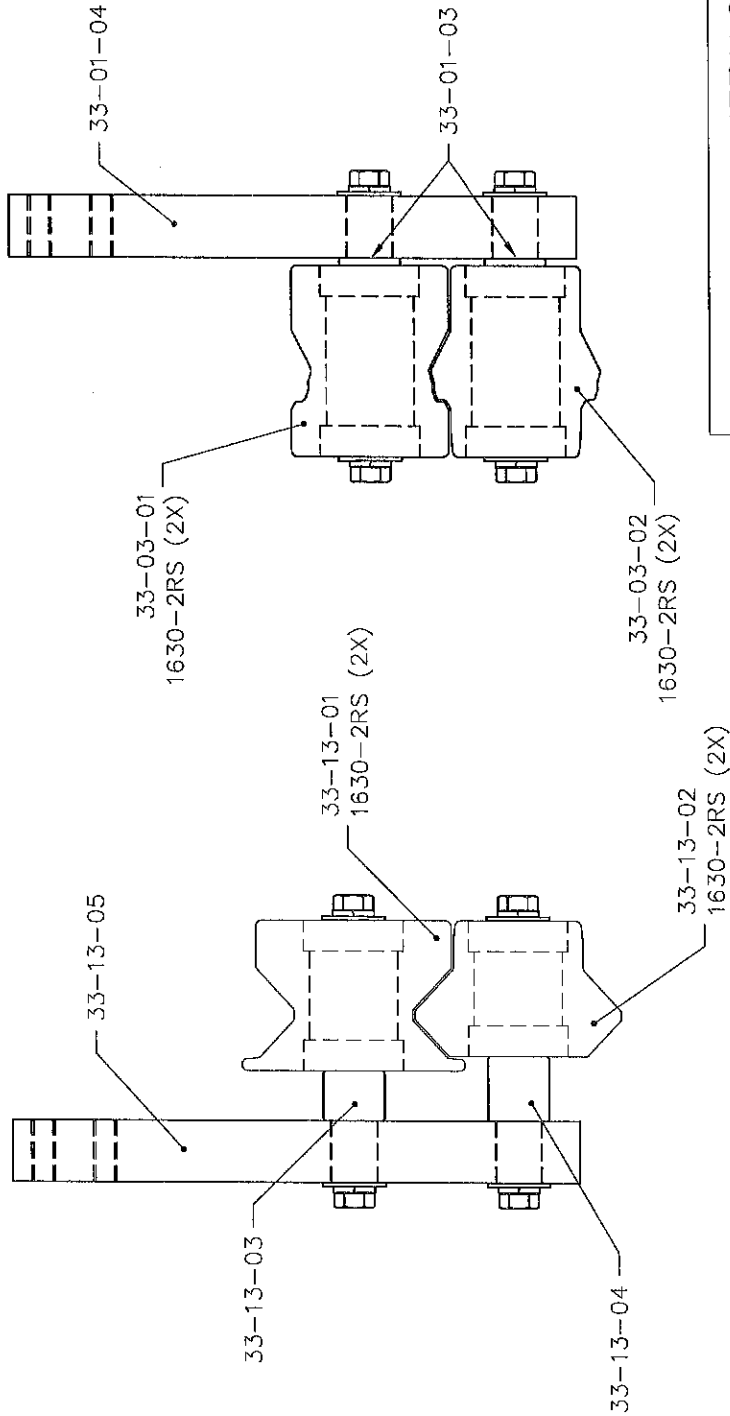
DATE	REV	REVISIONS	BY
4/18/05	A	MODIFIED ROLLER & CHANGED FROM 1 TO 2 ROLLERS AND RIG BRIDGES	COL



VIEWED FROM ENTRY END
STATION 2&3 ROLLERS & SHAFTS NOT SHOWN

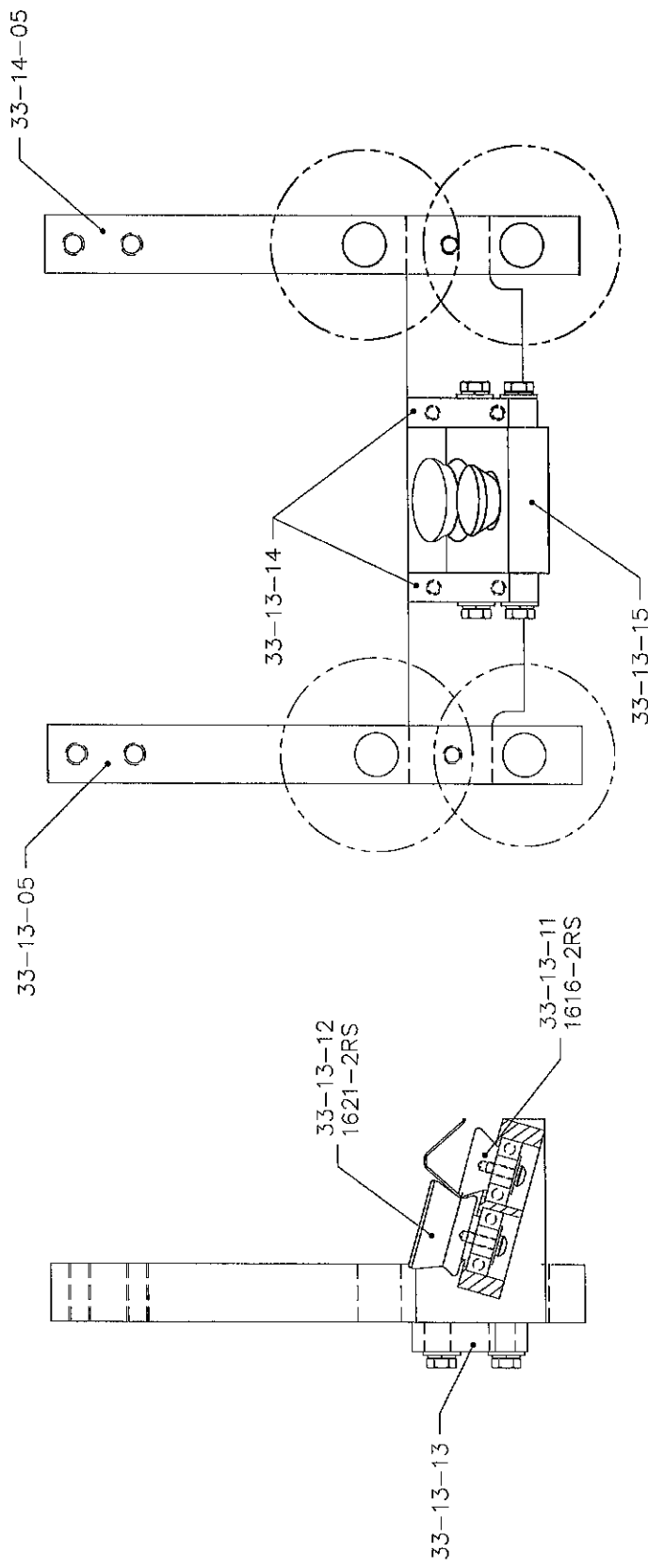


ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180		3rd ANGLE PROJ.
TOLERANCES UNLESS OTHERWISE SPECIFIED XX = ±.015 XXX = ±.005 BREAK ALL UNMARKED CORNERS	1:2 3/16"	DRAWN BY BTG
TITLE AUX. STATION #2-3 LEFT	1 / 1 1 / 1	DATE 10/5/09
MACH. MOD. NO. FF1K	1 PER MACHINE	DATE
DRAWING NO. 33-00-12a	1 PER MACHINE	DATE
NOTES: 1 PER MACHINE	1 PER MACHINE	DATE
MAT'L		



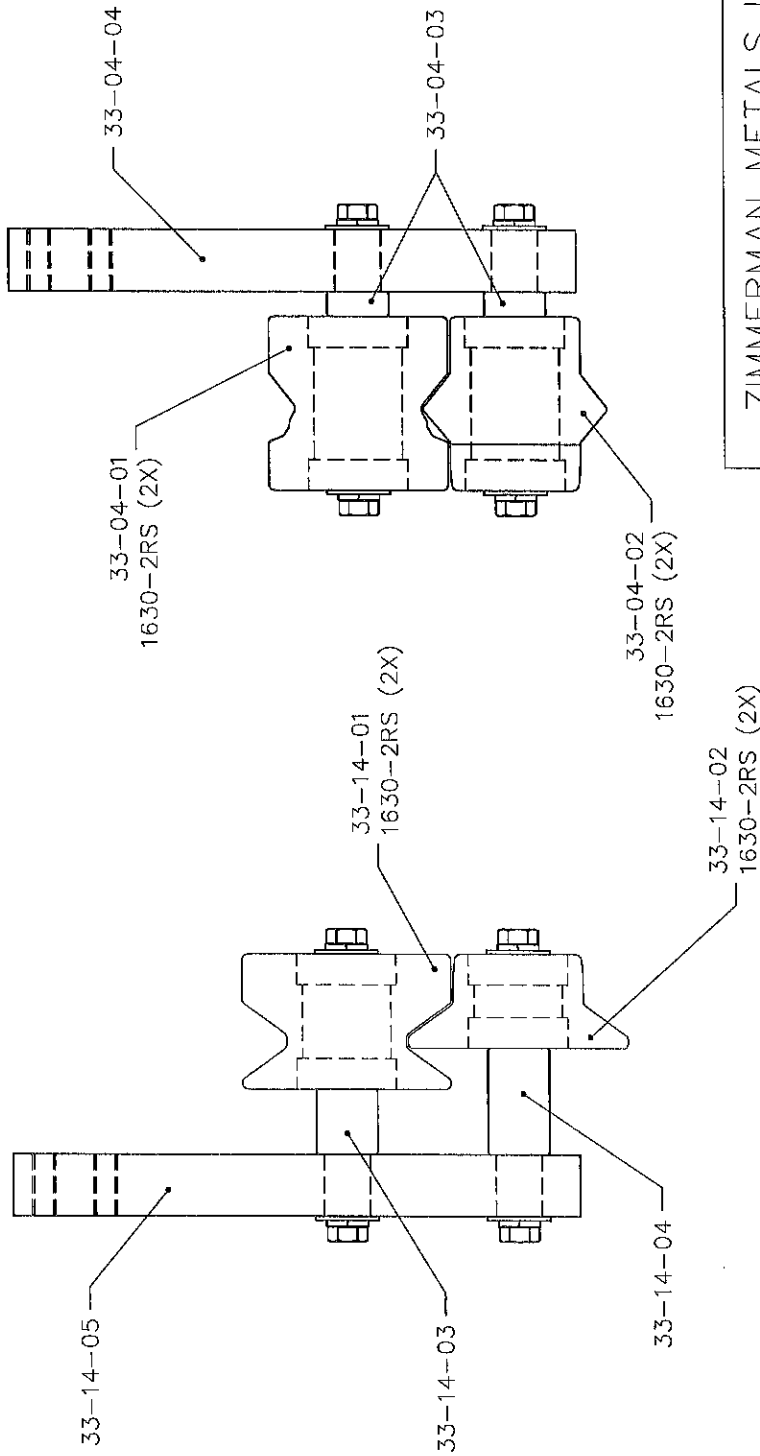
ZIMMERMAN METALS INC. 201 E. 58th AVE.
DENVER, CO 80216
(303) 294-0780

TITLE STA #3 ASSEMBLY		TOLERANCES UNLESS OTHERWISE SPECIFIED		3 rd ANGLE PROJ.	
		.XX = ±0.015		FRACTION = ±1/32"	
		.XXX = ±0.005		ANGLES = ±1°	
				BREAK ALL UNMARKED CORNERS	
MACH. MOD. NO. FF1K		PROPRIETARY INFORMATION NOTICE			
		THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER, CO.			
DRAWING NO. 33-00-03	SHEET 7 OF	SCALE: 1:2	DRAWN BY BTO	DATE 7/30/07	
NOTES: 1 PER MACHINE		APPROVED BY L.S.		REV 10/18/07	
MAT'L:					

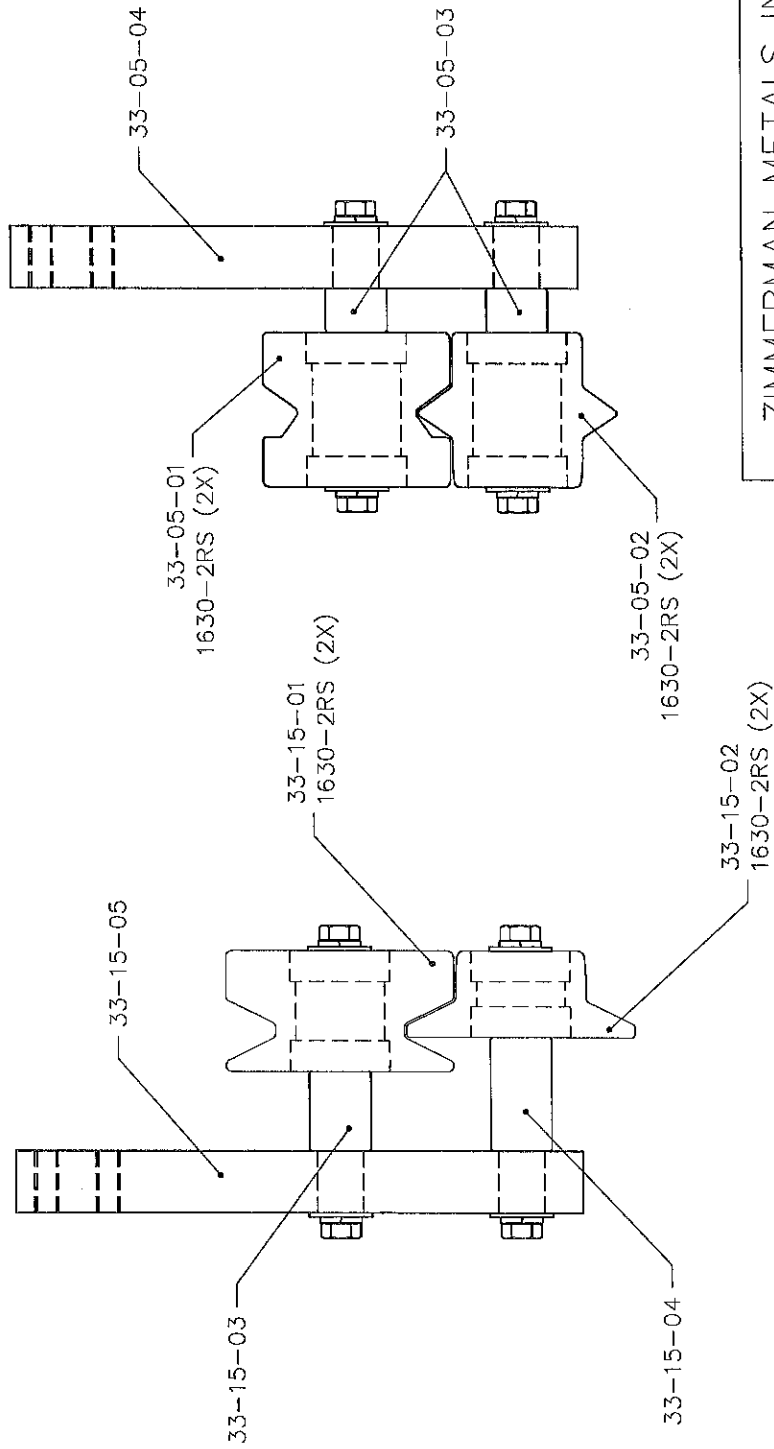


VIEWED FROM ENTRY END
SOME PARTS REMOVED FOR CLARITY

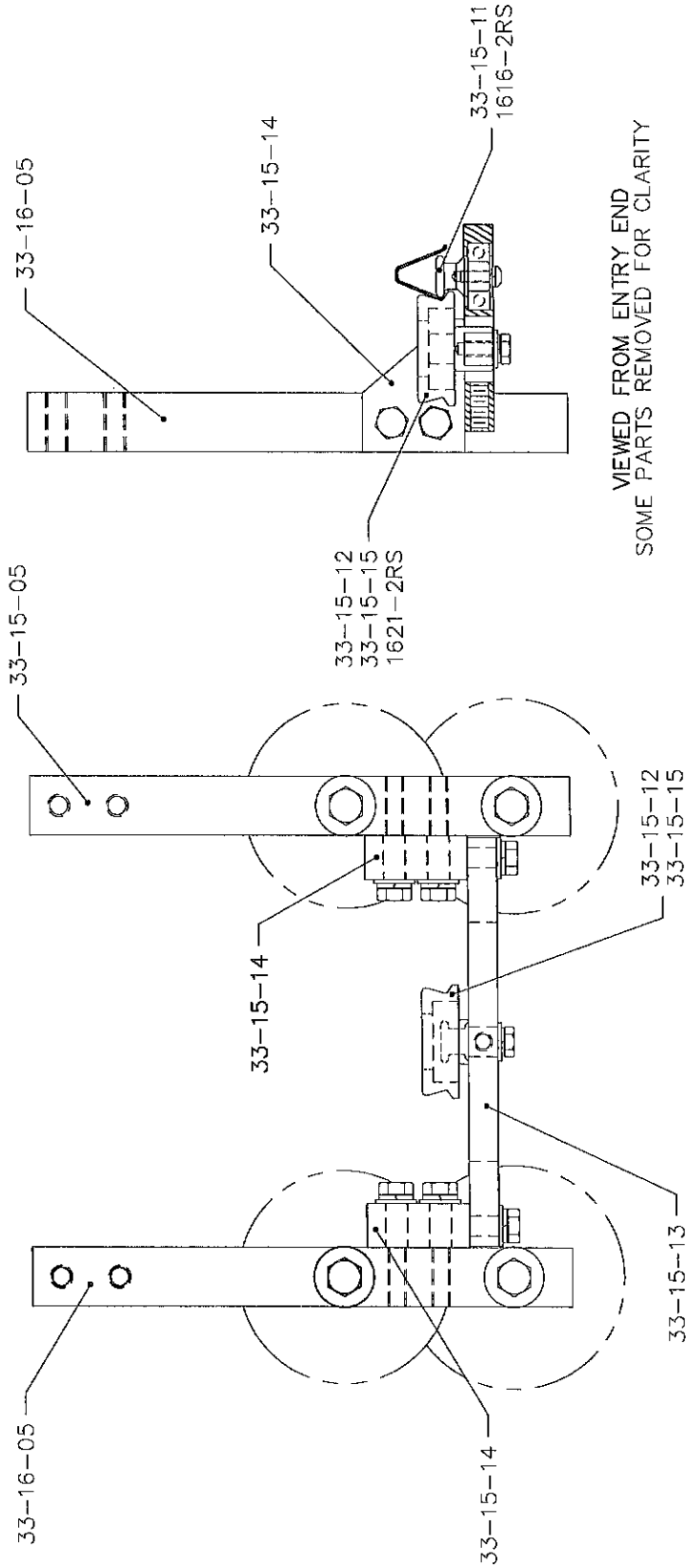
ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180	
TITLE AUX. STA. #3-4, LEFT	TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTION = ±1/32" ANGLES = ±1° BREAK ALL UNMARGED CORNERS
MACH. MOD. NO. FF1K	PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSMITTED TO OTHER PERSONS OR USED FOR ANY PURPOSES WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER CO.
DRAWING NO. 33-00-13A	SCALE 1:2
SHEET / OF 1 / 1	DATE 8/28/07
NOTES: 1 PER MACHINE	APPROVED BY L.S. REV 10/18/07
MATL:	



ZIMMERMAN METALS INC. 201 E. 58th AVE. DENVER, CO 80216 (303) 294-0180	
TITLE STA #4 ASSEMBLY	TOLERANCES UNLESS OTHERWISE SPECIFIED .XX = ±0.015 FRACTION = ±1/32" .XXX = ±.005 ANGLES = ±1° BREAK ALL UNMARKED CORNERS
MACH. MOD. NO. FF1K	PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSMITTED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER CO.
DRAWING NO. 33-00-04	SCALE: 1:2
SHEET / OF	DATE 7/30/07
NOTED BY BTO	DRAWN BY BTO
APPROVED BY L.S. REV 10/18/07	DATE
NOTES: 1 PER MACHINE	
MATERIAL:	

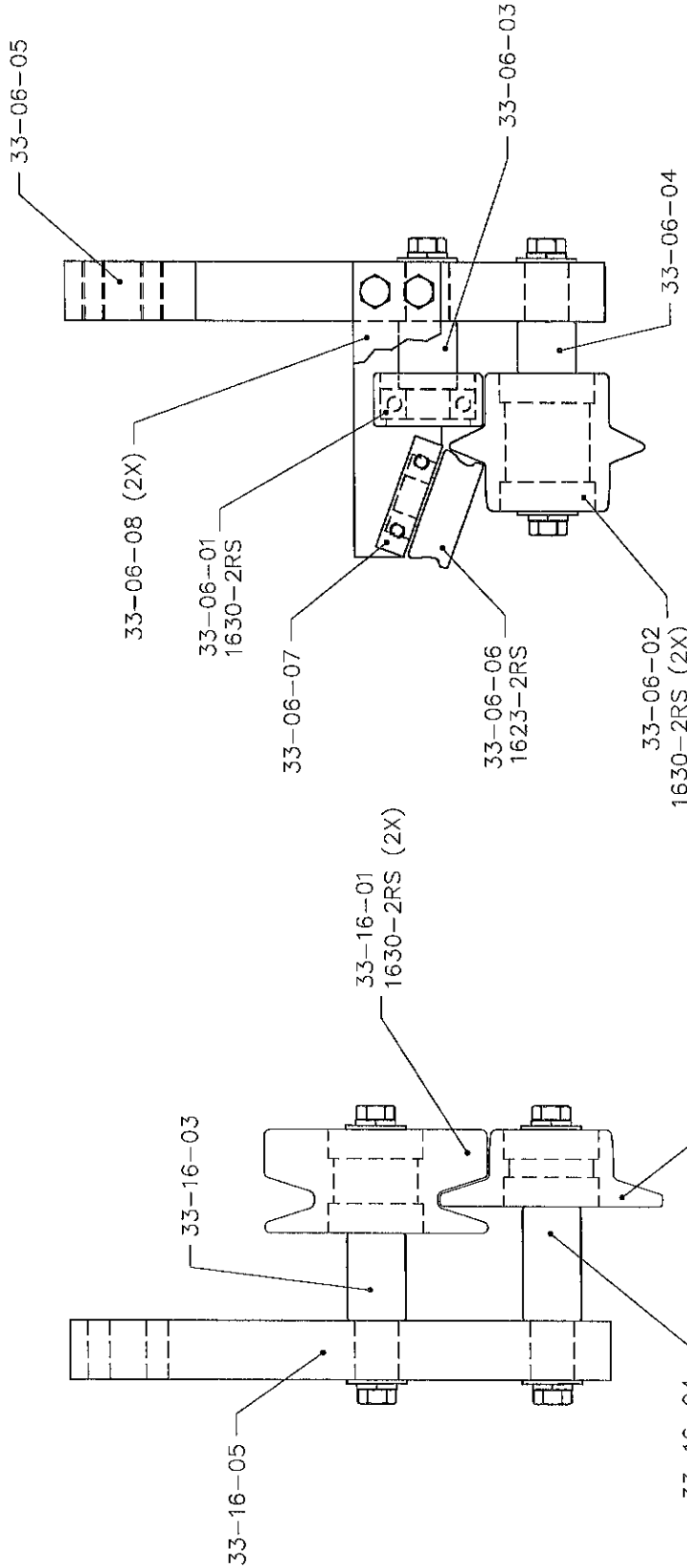


ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180	
TOLERANCES UNLESS OTHERWISE SPECIFIED	3rd ANGLE PROJ.
.XX = ±0.05 .XXX = ±0.005	FRACTION = 1/32" ANGLES = 31°
BREAK ALL UNMARKED CORNERS	
PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT THE PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER, CO.	
MACH. MOD. NO. FF1K	DATE 7/26/07
DRAWING NO. 33-00-05	APPROVED BY BTO
SHEET / OF	DATE
1 PER MACHINE	L.S. REV 10/18/07
MATT	

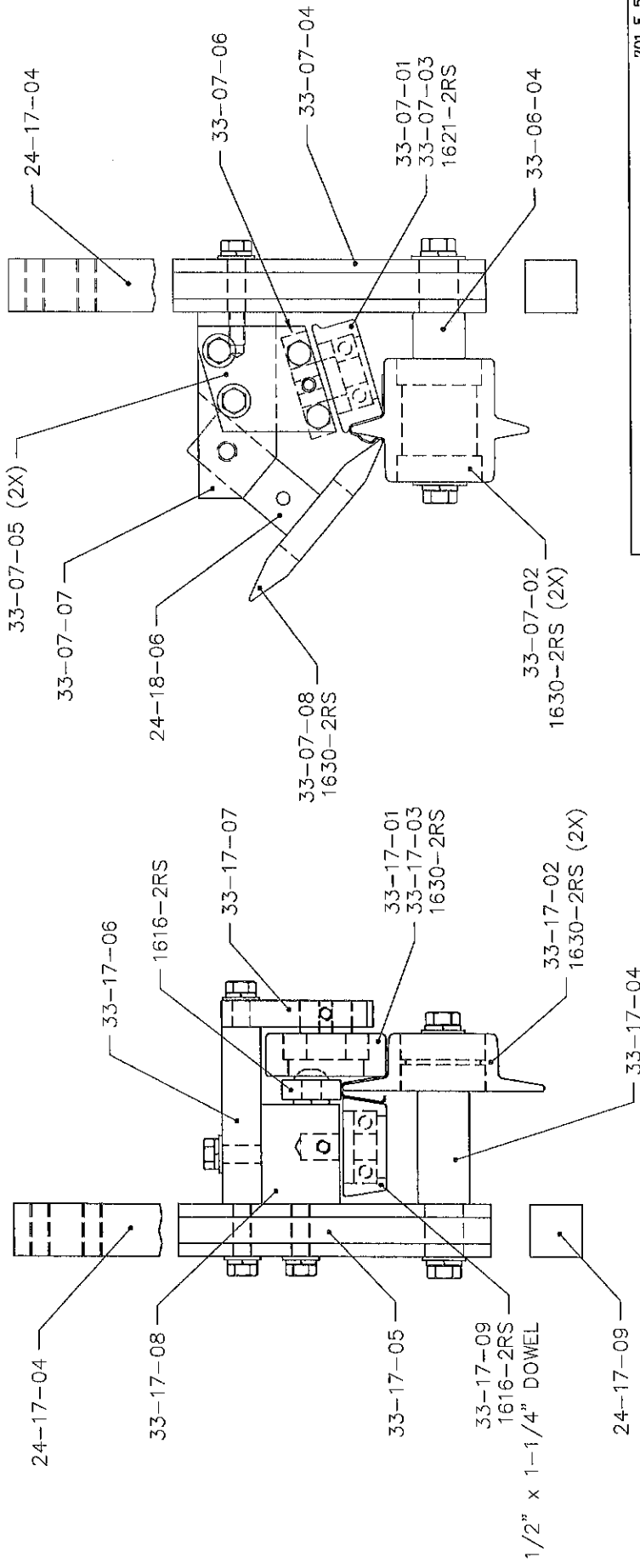


VIEWED FROM ENTRY END
SOME PARTS REMOVED FOR CLARITY

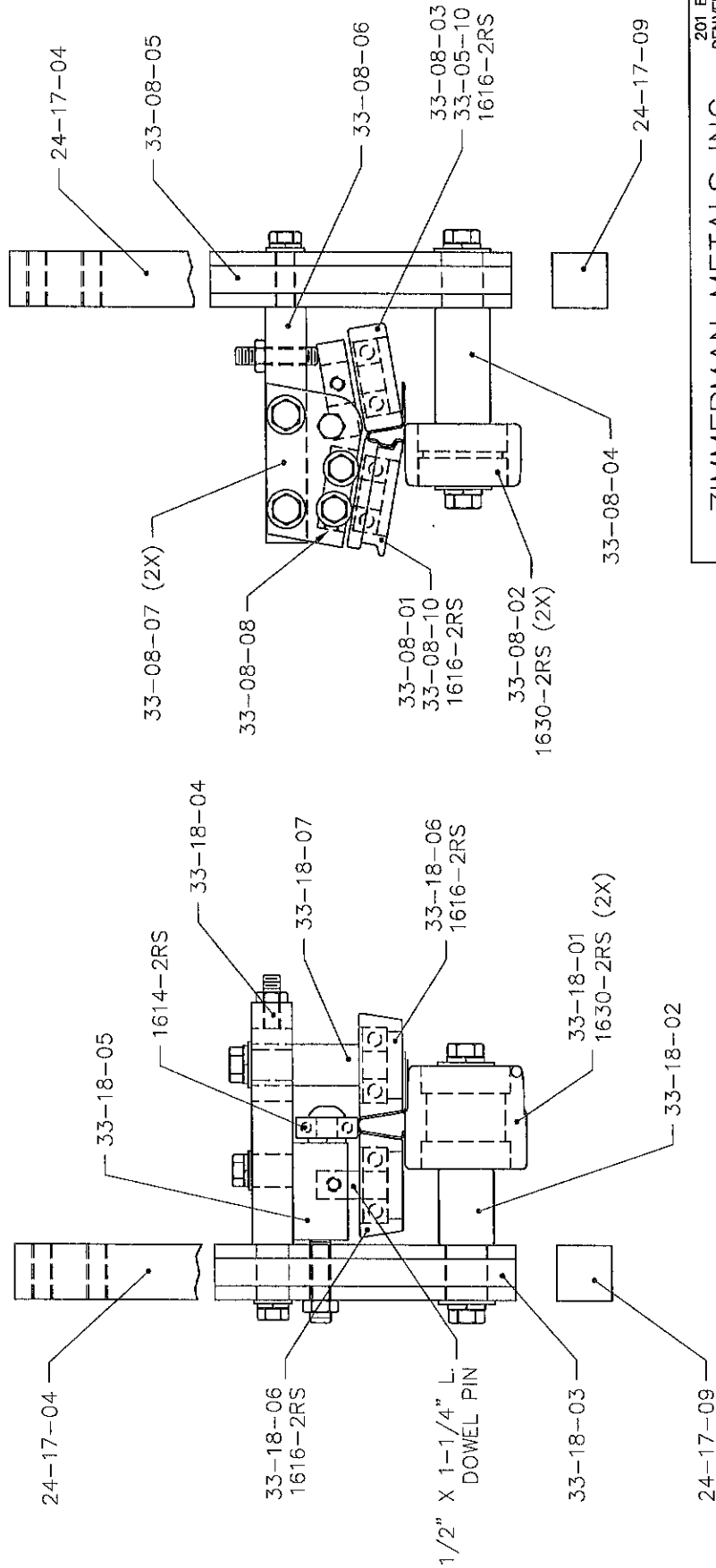
ZIMMERMAN METALS INC.		201 E. 58th AVE. DENVER, CO 80216 (303) 294-0180	
TITLE	AUX. STA. 5-6,	TOLERANCES	3/8 ANGLE PROJ.
	LEFT	UNLESS OTHERWISE SPECIFIED	
		XX = ±.015	FRACTION = #/32"
		XXX = ±.005	ANGLES = ±1°
			BREAK ALL UNMARKED CORNERS
MACH. MOD. NO.	FF1K	PROPRIETARY INFORMATION NOTICE	
DRAWING NO.	33-00-15A	THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS OR USED FOR OTHER PURPOSES WITHOUT PRIOR WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER CO.	
	SHEET / OF	DRAWN BY	DATE
	1 / 1	BTO	8/28/07
NOTES:	1 PER MACHINE	APP'D BY	DATE
		L.S.	10/18/07
		MAT'L:	



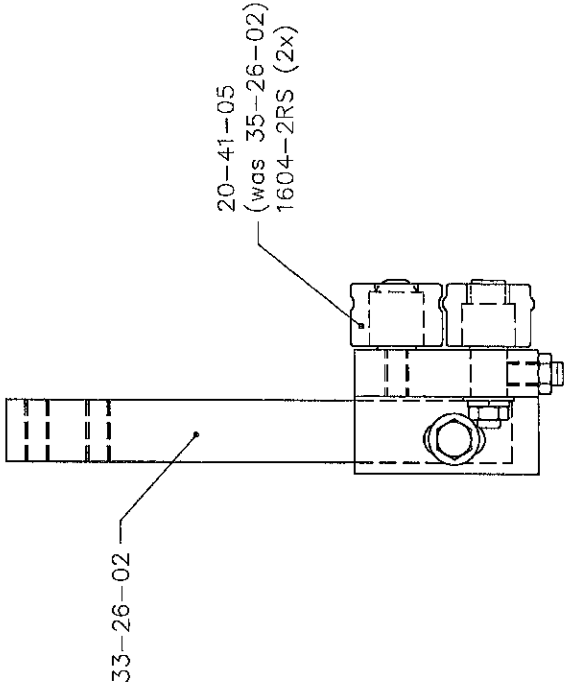
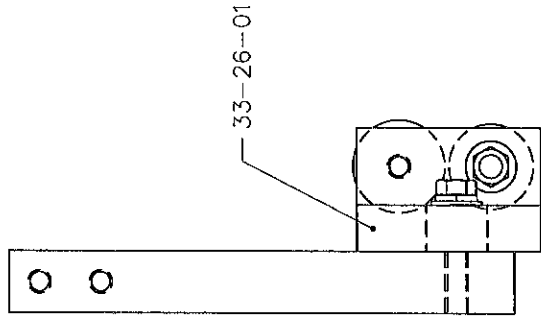
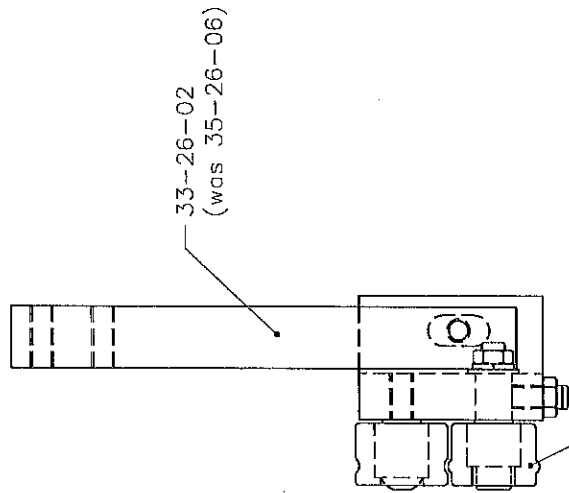
ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180		3rd ANGLE PROJ.	
TITLE	STA #6 ASSEMBLY	TOLERANCES UNLESS OTHERWISE SPECIFIED	3rd ANGLE PROJ.
		.XX = ±.015	FRACTION = 1/32"
		.XXX = ±.005	ANGLES = ±1°
		BREAK ALL UNMARKED CORNERS	
PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT YOUR WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF DENVER CO.			
DRAWING NO.	33-00-06	SCALE	1:2
SHEET / OF		NOTED	BTO
DATE	7/27/07	DRAWN BY	
APPROV BY		DATE	7/27/07
NOTES:	1 PER MACHINE	REV	L.S. REV 10/18/07
MATL:			



ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180		3rd ANGLE PROJ.	
TOLERANCES UNLESS OTHERWISE SPECIFIED	BREAK ALL UNMARKED CORNERS		
XX = ±.015 XXX = ±.006	FRACTION = 1/32"	3rd ANGLE PROJ.	
PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSMITTED TO OTHER PERSONS OR PLACES WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER, CO.			
MACH. MOD. NO.	FF1K	DATE	7/26/07
DRAWING NO.	33-00-07	SCALE	1:2
SHEET / OF		DRAWN BY	BTO
NOTES: 1 PER MACHINE		APPROV BY	
MATL:			



ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180	
TOLERANCES UNLESS OTHERWISE SPECIFIED .XX = ±.015 .XXX = ±.006 BREAK ALL UNMARKED CORNERS 3rd ANGLE PROJ.	DATE 7/26/07
TITLE STA #8 ASSEMBLY	DRAWN BY BTO
SCALE 1:2	APP'D BY DATE
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MACH. MOD. NO. FF1K	DRAWING NO. 33-00-08
NOTES: 1 PER MACHINE	MAT'L:



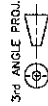
20-41-04
(was 35-26-01)
1604-2RS (2x)

VIEWED FROM ENTRY END

ZIMMERMAN METALS INC.
201 E 58th AVE.
DENVER, CO 80216
(303) 294-0180

TITLE BEAD ASSEMBLY

TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ±.015 FRACTION = 1/32
.XXX = ±.005 ANGLES = ±1°
BREAK ALL UNMARKED CORNERS



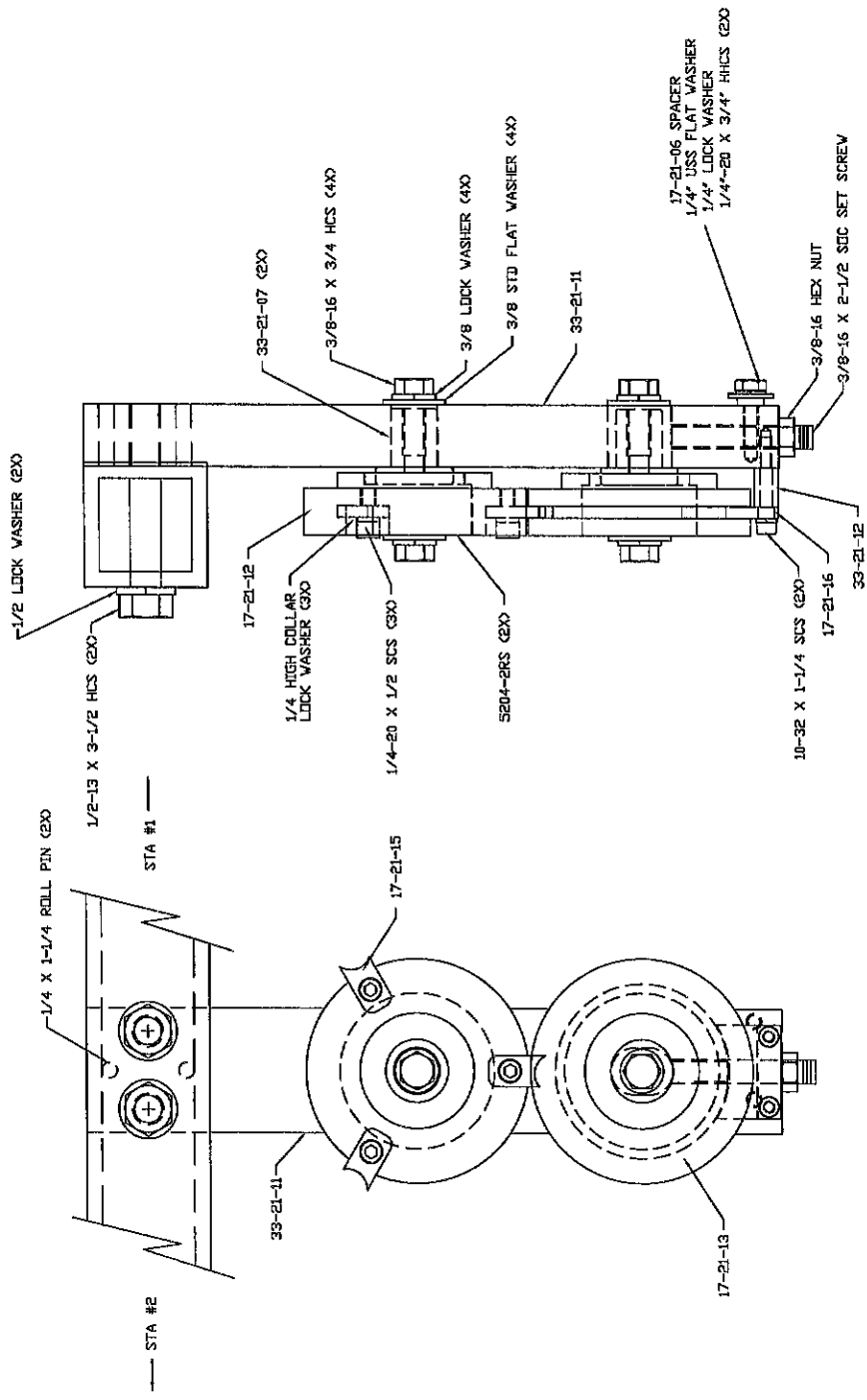
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MACH. MOD. NO. FF1K

DRAWING NO. 33-26-00 SHEET / OF 1 / 1
SCALE: 1:2 DRAWN BY BTO DATE 10/26/07
NOT FOR CONSTRUCTION
APPROVED BY DATE

NOTES: 1 PER MACHINE

MAT'L:



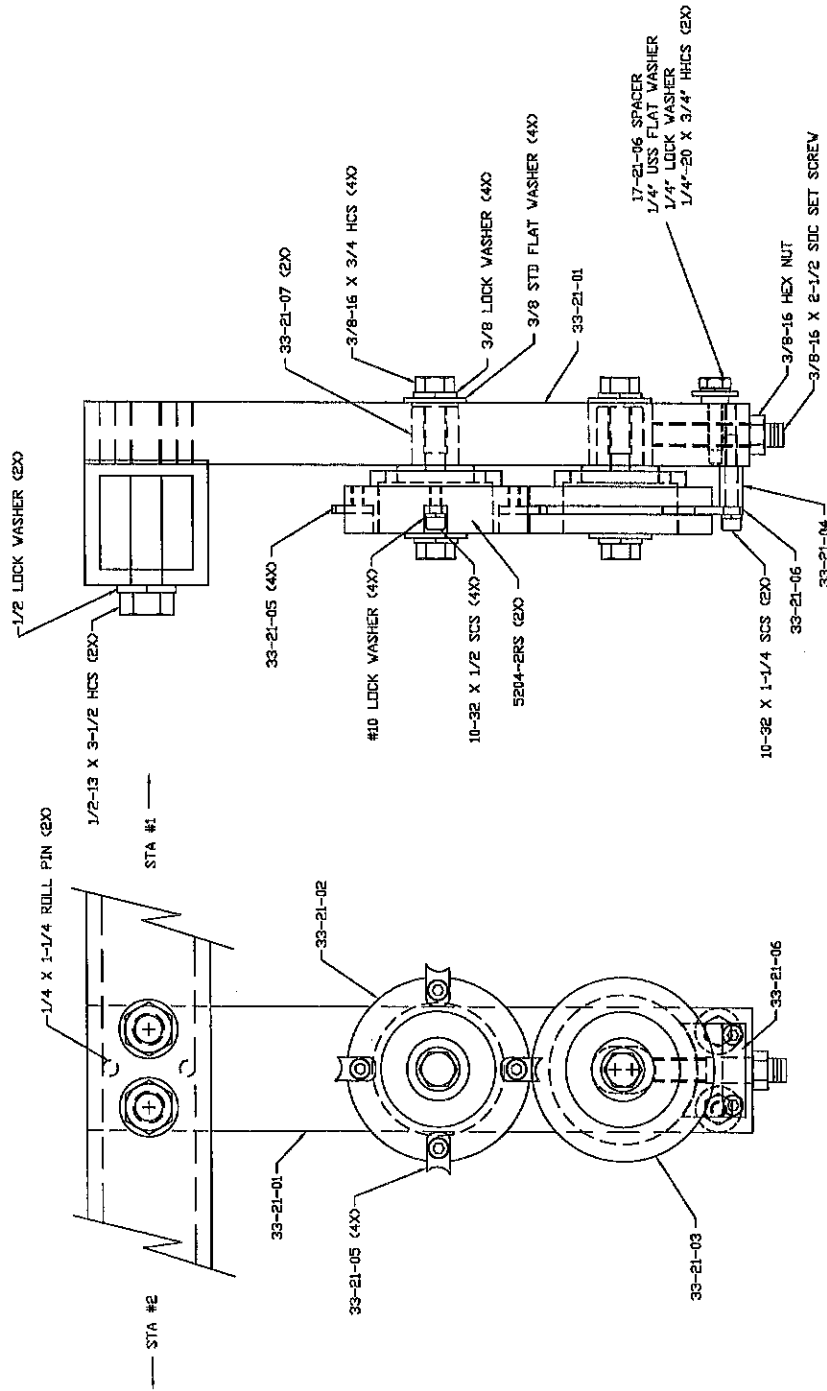
ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180	
TITLE ROTARY PUNCH	TOLERANCES UNLESS OTHERWISE SPECIFIED 3RD ANGLE PROJ. FRACTION = 1/32" ANGLES = 30° BREAK ALL UNMARKED CORNERS
ASSEMBLY, 3/16" WIDE	FF1000
MACH. MOD. NCL FF1000	PROPRIETARY INFORMATION NOTICE THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSFERRED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER THAN THE INTENDED PURPOSE WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC., OF DENVER, CO.
DRAWING NO. 33-21-10	DATE 9/20/13
SHEET / OF 1 / 1	APPROVED BY DATE
NOTES: 1 PER MACHINE	
MAT'L	

BY

REVISIONS

LETTER

DATE



ZIMMERMAN METALS INC.
 201 E 58th AVE.
 DENVER, CO 80216
 (303) 294-0180

TITLE	ROTARY PUNCH	TOLERANCES	UNLESS OTHERWISE SPECIFIED	3 RD ANGLE PROJ.
ASSEMBLY	FF1000	XX = ±.015	FRACTION = 1/32"	3 RD ANGLE PROJ.
1/8" WIDE		XXX = ±.005	ANGLES = 30°	BREAK ALL UNMARKED CORNERS
MACH. MOD. NO.	FF1000	PROPRIETARY INFORMATION NOTICE		
DRAWING NO.	33-21-00	THIS DOCUMENT CONTAINS PROPRIETARY & CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REPRODUCED, TRANSMITTED TO OTHER DOCUMENTS, DISCLOSED TO OTHERS, OR USED FOR OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC., DENVER, CO.		
SCALE	1" = 1"	DRAWN BY	DATE	
SHEET / OF	1 / 1	NTS	CEL	9/20/10
NOTES	1 PER MACHINE	APPROV'D BY	DATE	
MATERIAL				

UCF-205-16
50BS24X1FB SPKT (BOTTOM SKATE ONLY)

S1040X1FB GEAR

1' SPLIT SHAFT COLLAR (BOTTOM SKATE ONLY)

1' SPLIT SHAFT COLLAR

24-10-02 (4X)

24-10-01 (10X)

24-10-05 (2X)

#40 CHAIN X 145 1/2' LG

24-10-06 (5X)

1641ERSNR (10X)

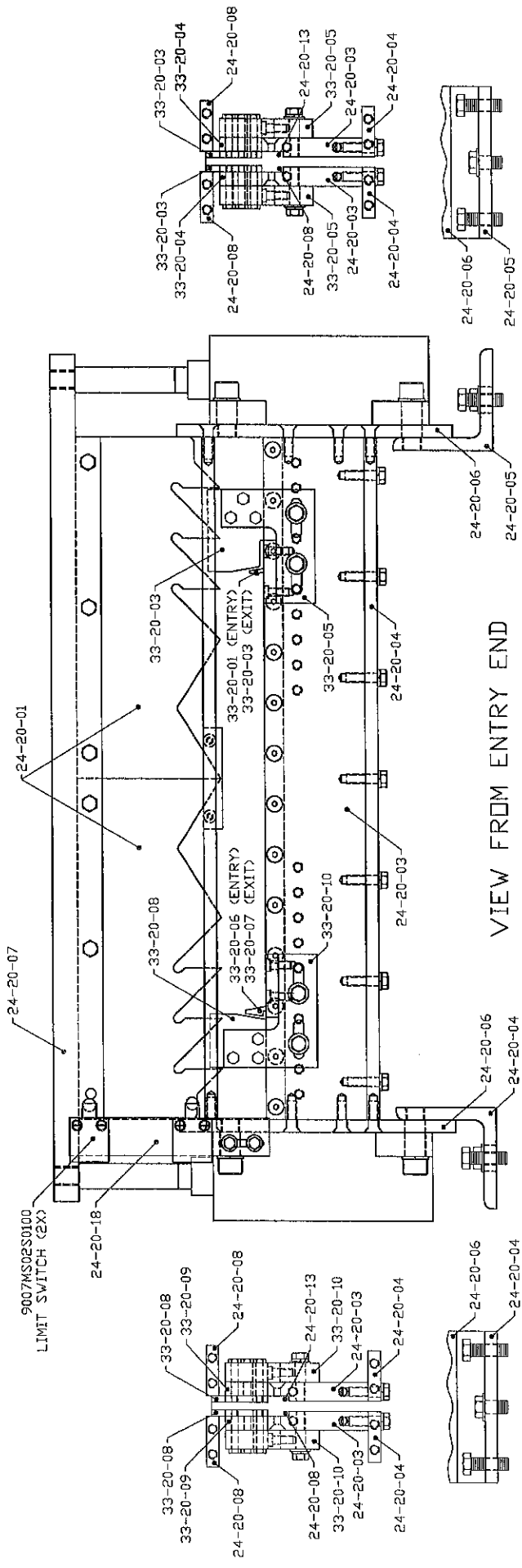
40BB17H (4X)

24-10-09 (10X)

SKATE BAR ASS'Y

NOTE: TOP SKATE ASS'Y SHOWN
ASSEMBLE BOTTOM SKATE AS MIRROR IMAGE

PART NO.	24-10-00
MAT'L	
QTY REQ.	2 PER MACH
NOTES	
.X ± .030 .XX ± .015 .XXX ± .005 FRACTIONS ± 1/32"	



ZIMMERMAN METALS INC. 201 E 58th AVE. DENVER, CO 80216 (303) 294-0180

TOLERANCES UNLESS OTHERWISE SPECIFIED 3rd ANGLE PROJ.
 XX = ±.015 FRACTION = 1/32"
 XXX = ±.005 ANGLES = 45°
 BREAK ALL UNMARKED CORNERS

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MACH. MOD. NO. FF-1000
 DRAWING NO. 33-20-00
 SHEET / OF 1 / 1
 SCALE: 1:2
 DRAWN BY: BMP
 DATE: 10/29/07

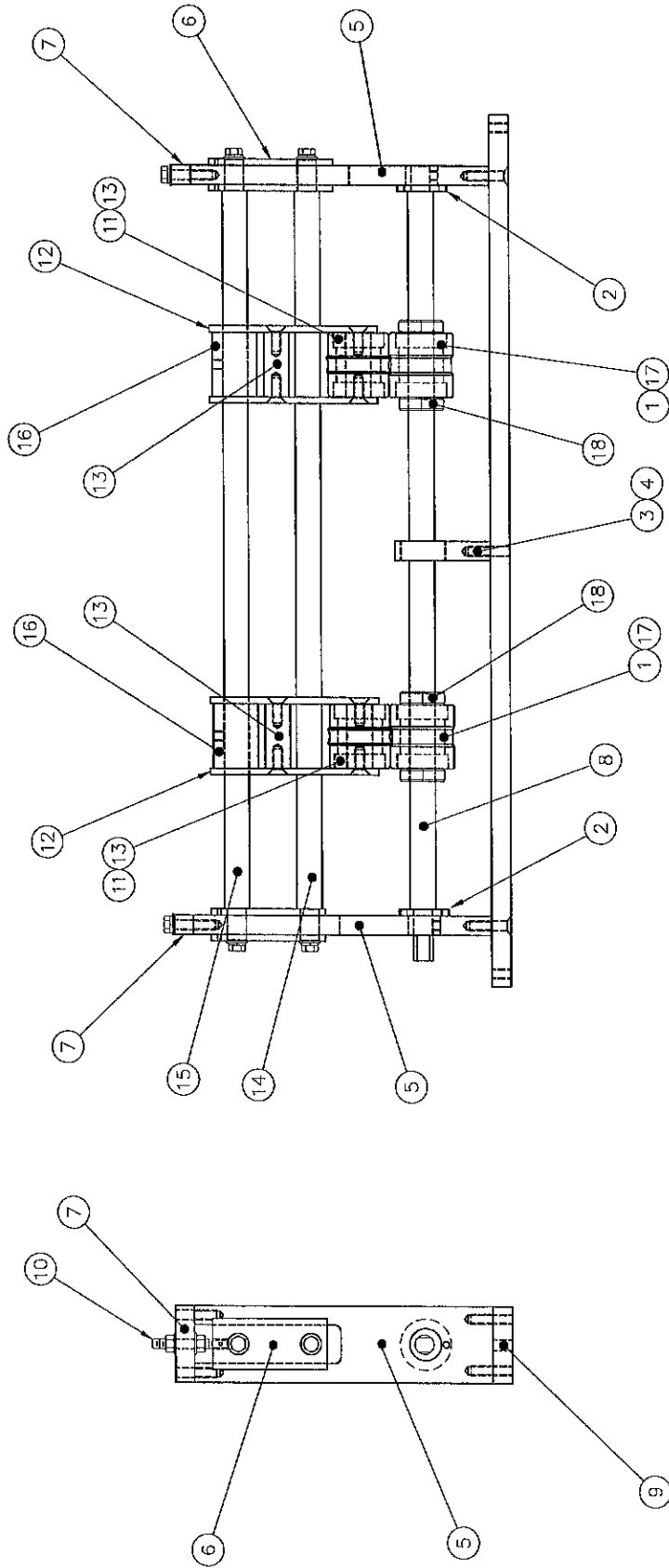
NOTES: 1 PER MACHINE
 MAT'L

MATERIAL LIST

ITEM	PART NAME	P/N	QTY
1	BOTTOM RIB ROLLER	24-25-01	2
2	RIB ROLLER CAM	24-25-03	2
3	RIB ROLLER CENTER CAM	21-25-01	1
4	CENTER SUPPORT BLOCK	24-25-05	1
5	RIB ROLLER UPRIGHT	24-25-06	2
6	TAKE UP BLOCK	24-25-07	2
7	TOP CROSS BLOCK	24-25-08	2
8	BOTTOM RIB ROLLER SHAFT	20-25-07	1
9	RIB ASSEMBLY BASE PLATE	24-25-11	1
10	ADJUSTMENT ROD	24-25-14	2
11	TOP RIB ROLLER	20-25-01	2
12	TOP ROLLER MOUNTING BAR	20-25-04	4
13	MID SUPPORT SHAFT	20-25-06	4
14	TOP SUPPORT SHAFT	20-25-08	1
15	TOP SUPPORT SHAFT	20-25-09	1
16	TOP SHAFT ADJUSTMENT SLEEVE	20-25-10	1
17	SHAFT COLLAR, 1 PC.	01-16-F	4
18	BEARING	1641-2RS	8
19	CARR LANE LOCK PIN	CL-48LPT-1.00-C	1
20			

PART NO.

DATE	LETTER	REVISIONS	BY
9/9/14	A	UPDATED BEARINGS TO 1641-2RS (WAS 2RSNR)	CEL



ZIMMERMAN METALS INC.
 201 E. 58th AVE.
 DENVER, CO 80216
 (303) 294-0180

TOLERANCES UNLESS OTHERWISE SPECIFIED
 DIMENSIONS IN INCHES
 ANGLES IN DEGREES
 BREAK ALL UNMARKED CORNERS
 3/4" ANGLE PINDA
 1/16" ANGLE PINDA

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 WITHOUT THE WRITTEN PERMISSION OF ZIMMERMAN METALS INC. OF
 DENVER, CO.

TITLE: RIB ROLLER ASSEMBLY
 MACH. MOD. NO. Z-PANEL
 DRAWING NO. 24-25-00
 SCALE: 1:4
 SHEET / OF: 1 / 4
 DATE: 7/12/00
 DRAWN BY: BTO
 APPROV BY: DATE

NOTES: 1 PER MACHINE
 MATL:

PART NO.

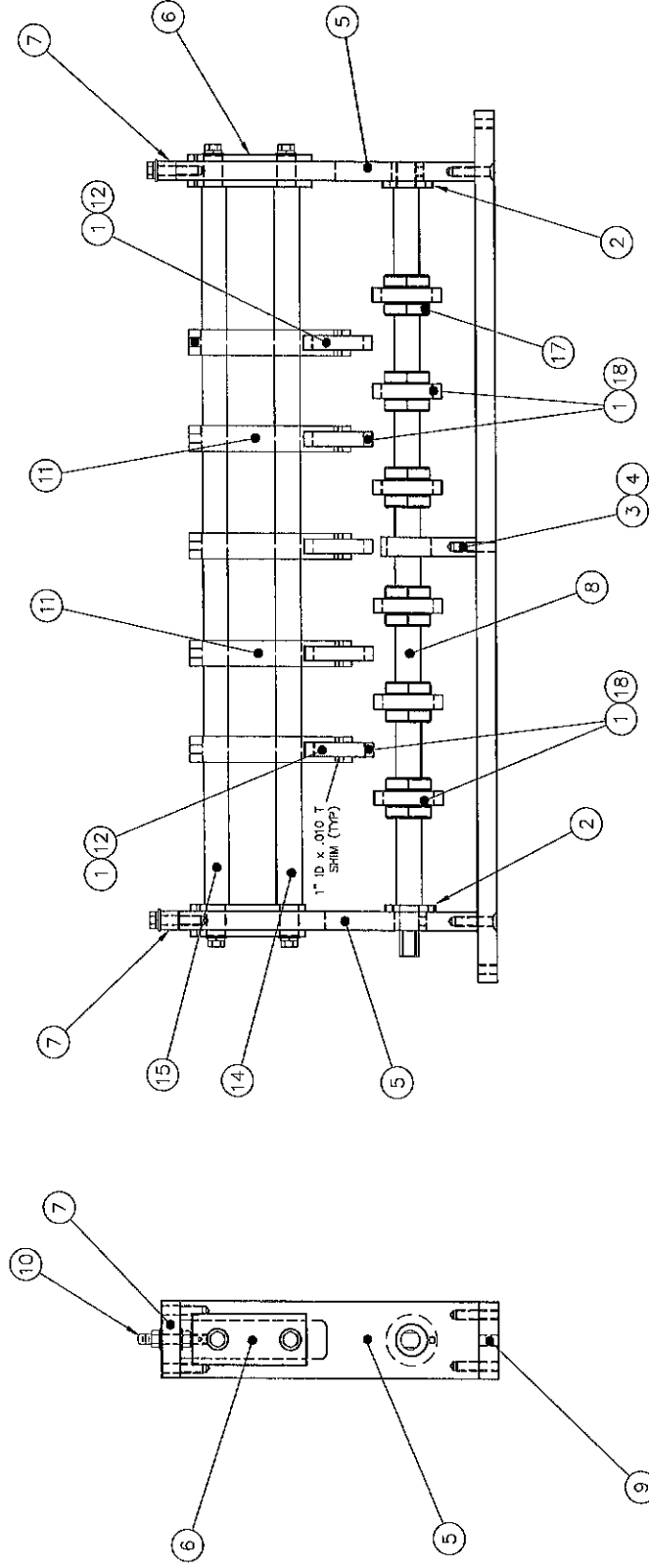
REVISIONS

DATE LETTER

BY

MATERIAL LIST

ITEM	PART NAME	P/N	QTY
1	BOTTOM STRIATION ROLLER	24-25-15	11
2	RIB ROLLER CAM	24-25-03	2
3	RIB ROLLER CENTER CAM	24-25-02	2
4	CENTER SUPPORT BLOCK	24-25-05	1
5	RIB ROLLER UPRIGHT	24-25-06	1
6	TAKE UP BLOCK	24-25-07	2
7	TOP CROSS BLOCK	24-25-08	2
8	BOTTOM RIB ROLLER SHAFT	20-25-07	1
9	RIB ASSEMBLY BASE PLATE	24-25-11	1
10	ADJUSTMENT ROD	24-25-14	2
11	TOP ROLLER MOUNTING BAR	20-25-01	5
12	TOP ROLLER SHAFT	20-25-02	5
13			
14	MID SUPPORT SHAFT	20-25-08	1
15	TOP SUPPORT SHAFT	20-25-09	1
16			
17	SHAFT COLLAR, 1 PC.	CL-16-F	12
18	BEARING	1841-2RS	10
19	CARR LANE LOCK PIN	CL-4BLPT-1.00-C	1
20			



ZIMMERMAN METALS INC.
 201 E 58TH AVE
 DENVER, CO 80216
 (303) 294-0180

TOLERANCES
 UNLESS OTHERWISE SPECIFIED
 .0015 ± .0005
 .0030 ± .0015
 .0045 ± .0020
 ANGLES = 31°/32°
 BREAK ALL UNMARKED CORNERS

3/4 ANGLE PROJ.

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 DENVER, CO.

MACH. MOD. NO. Z-PANEL

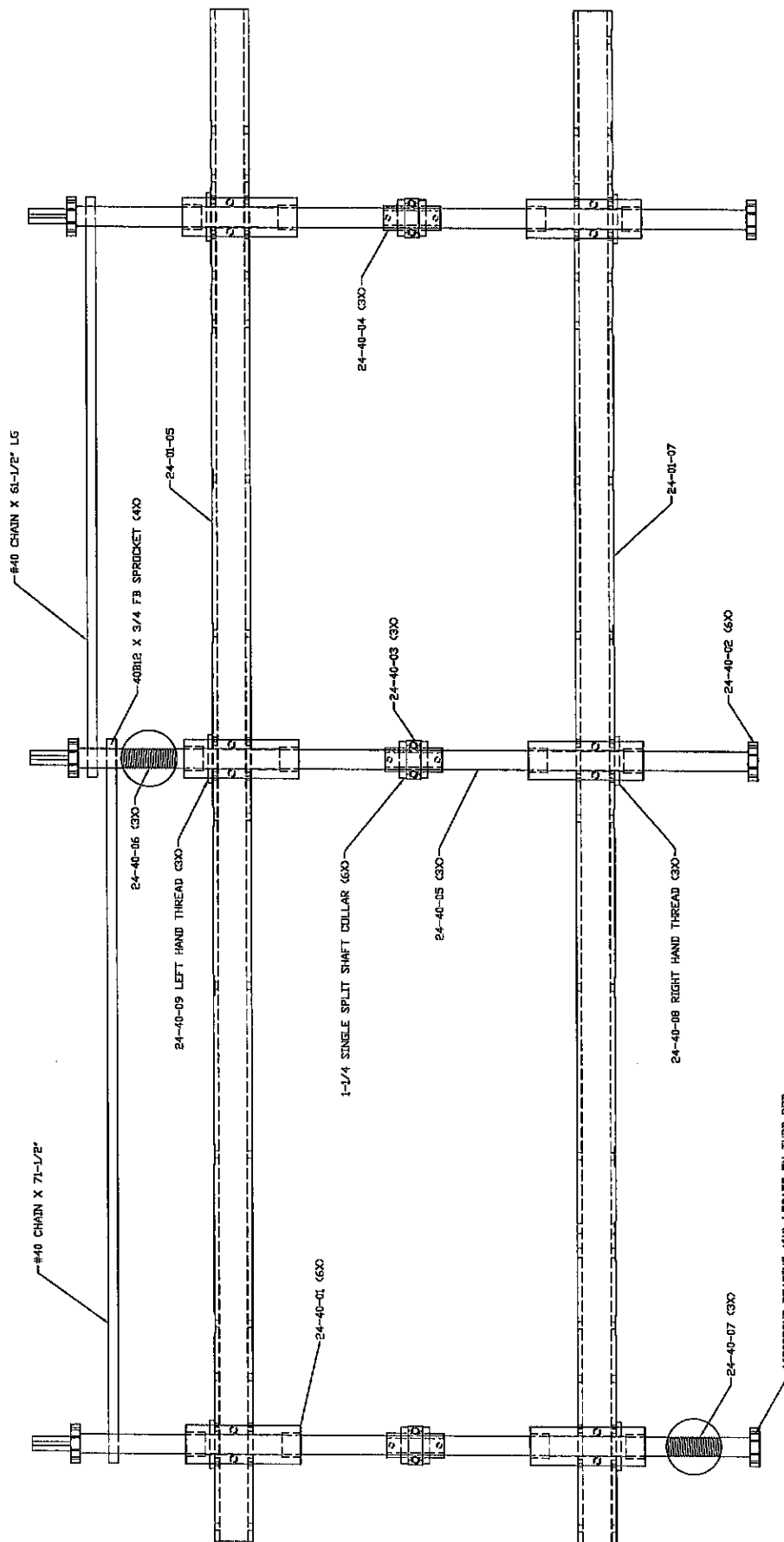
DRAWING NO. 24-26-00
 SCALE 1:4
 SHEET / OF 1 / 1

DRAWN BY BTG
 DATE 03/09/01

APPROV BY
 DATE

NOTES: 1 PER MACHINE

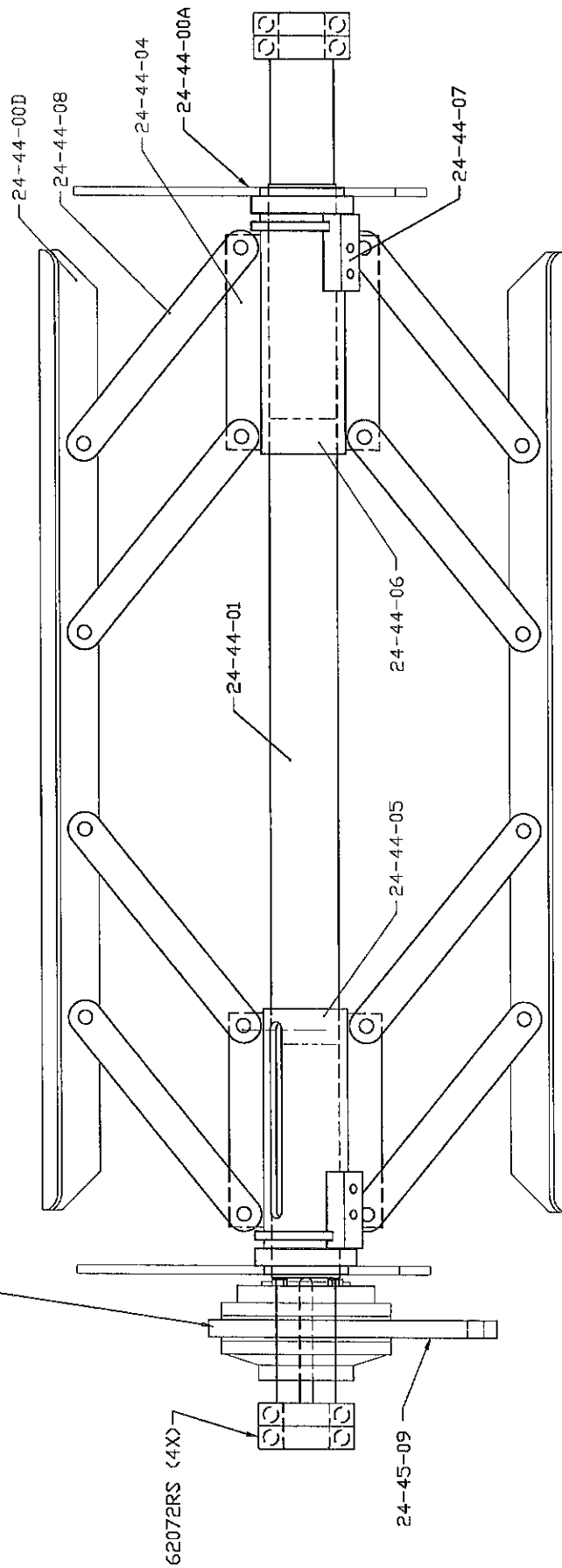
MATL:



WIDTH ADJUST ASSEMBLY

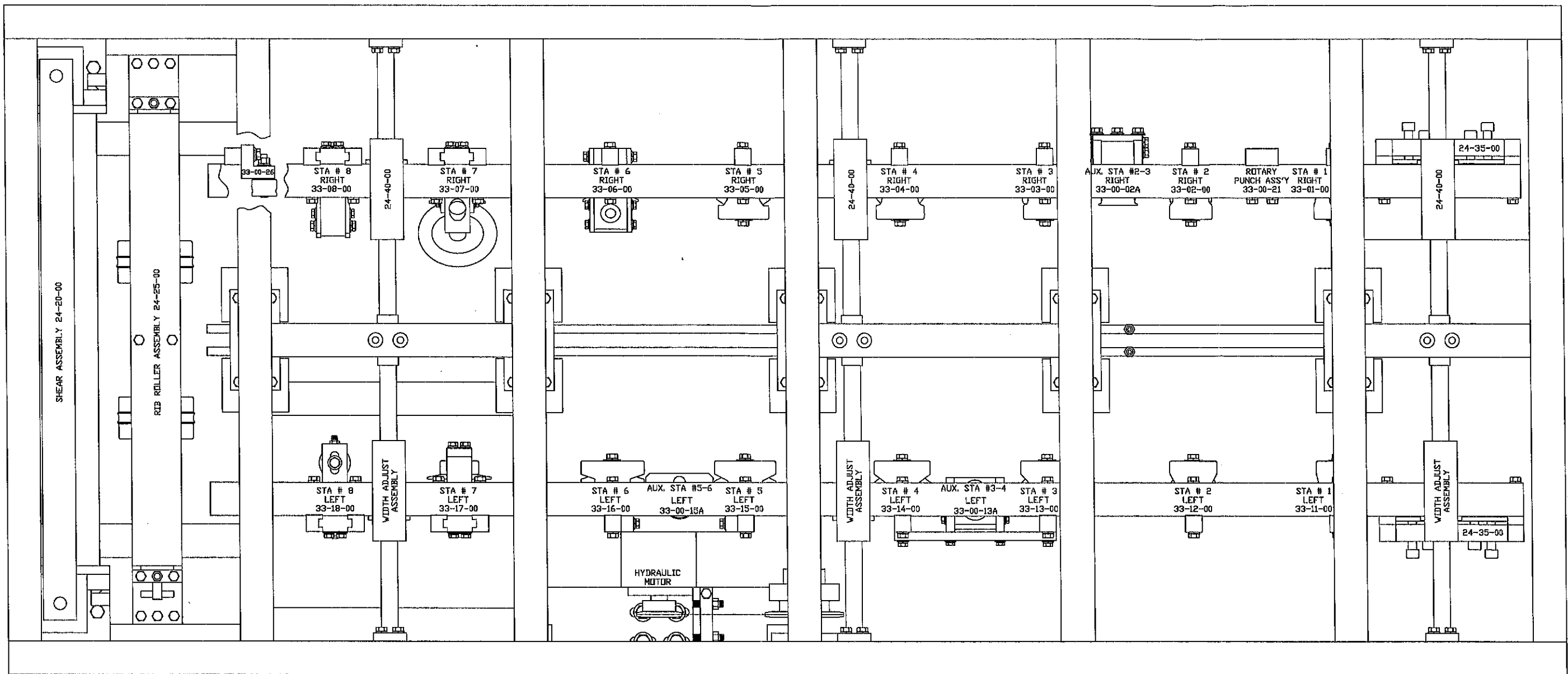
PART NO.	24-40-00
MAT'L	
QTY REQ.	1 PER MACH
NOTES	
X ± .030 XX ± .015 XXX ± .005 FRACTIONS ± 1/32"	

TT50BS X 1-3/4' TORQUE LIMITER

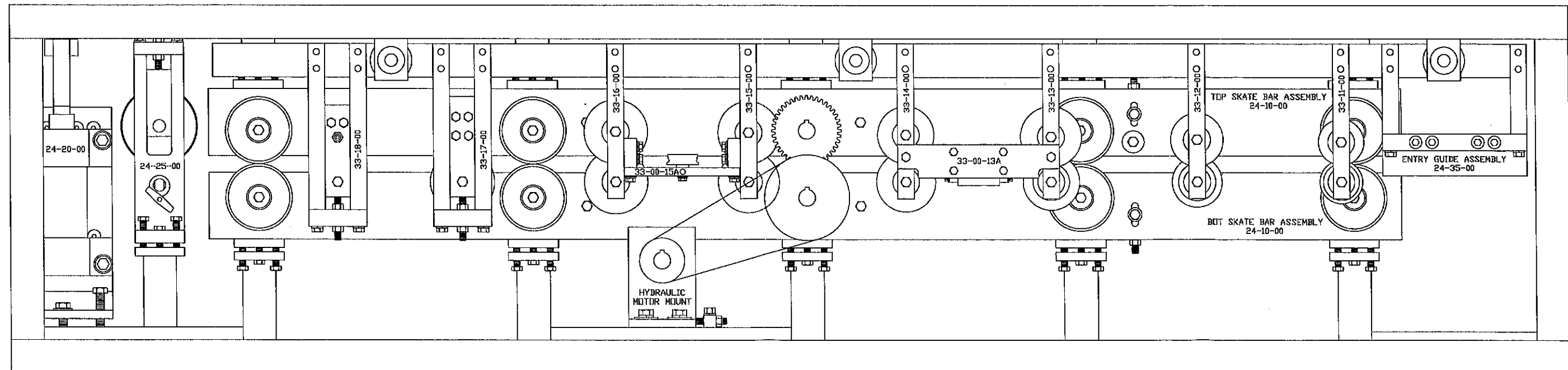


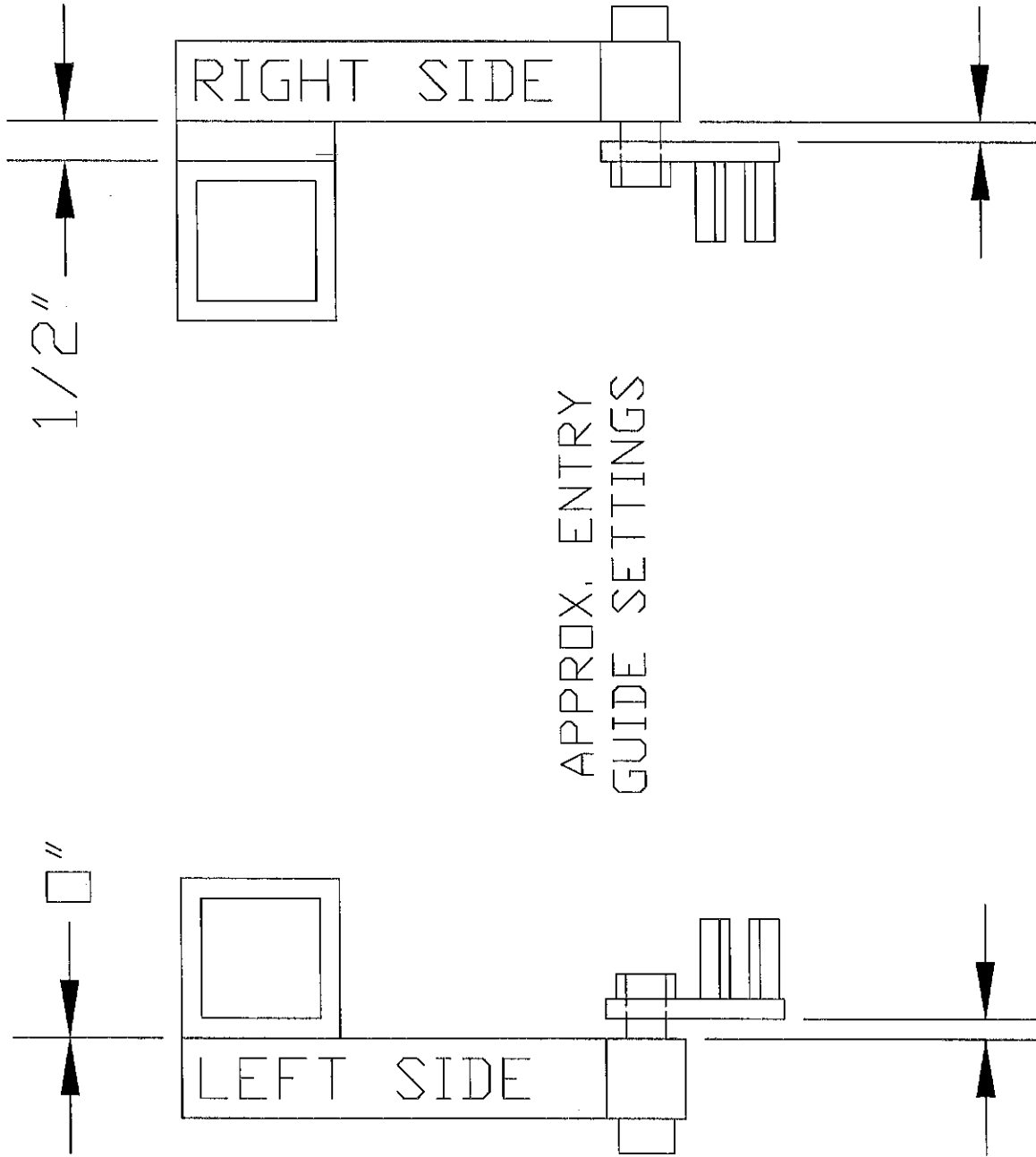
EXPANDABLE SPOOL ASSEMBLY

PART NO.	24-44-00
MAT'L	
QTY REQ.	1 PER MACH
NOTES	
.X ± .030 .XX ± .015 .XXX ± .005 FRACTIONS ± 1/32"	



MACHINE GENERAL LAYOUT

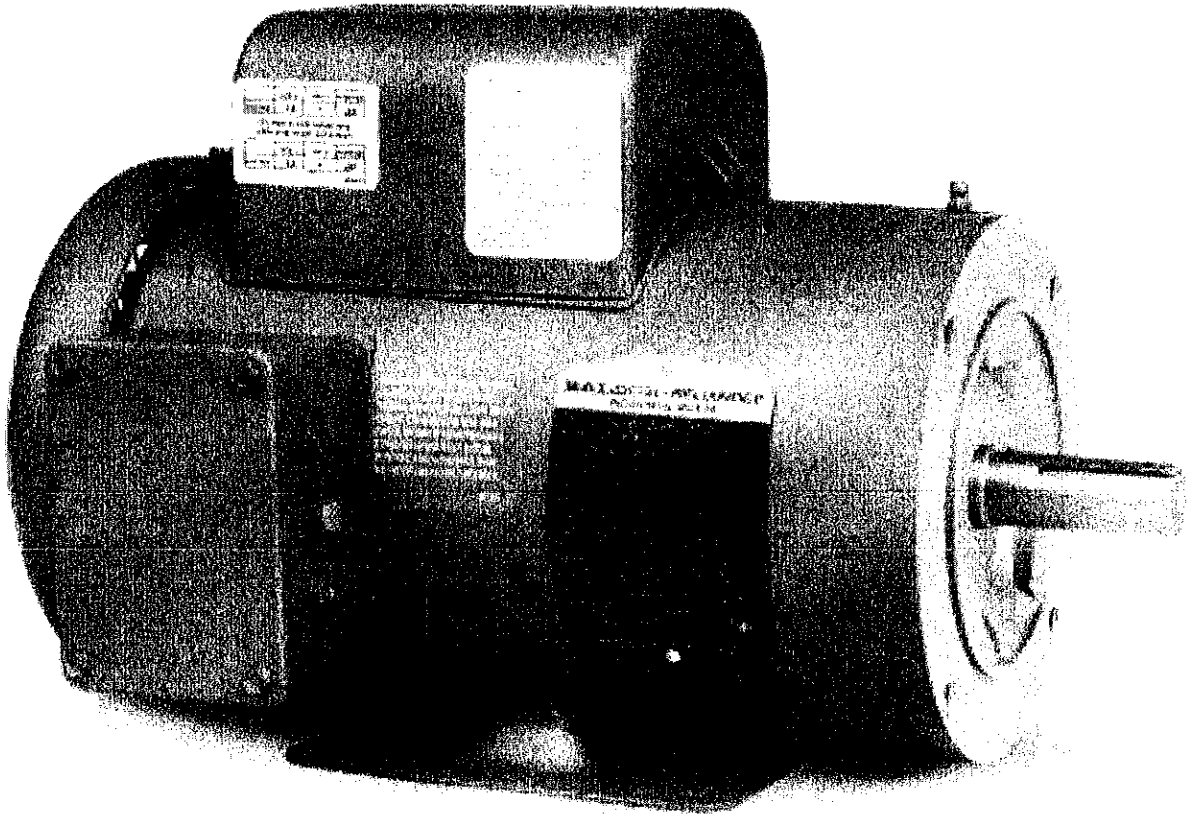




PANEL PROFILE FF1000

SECTION 2

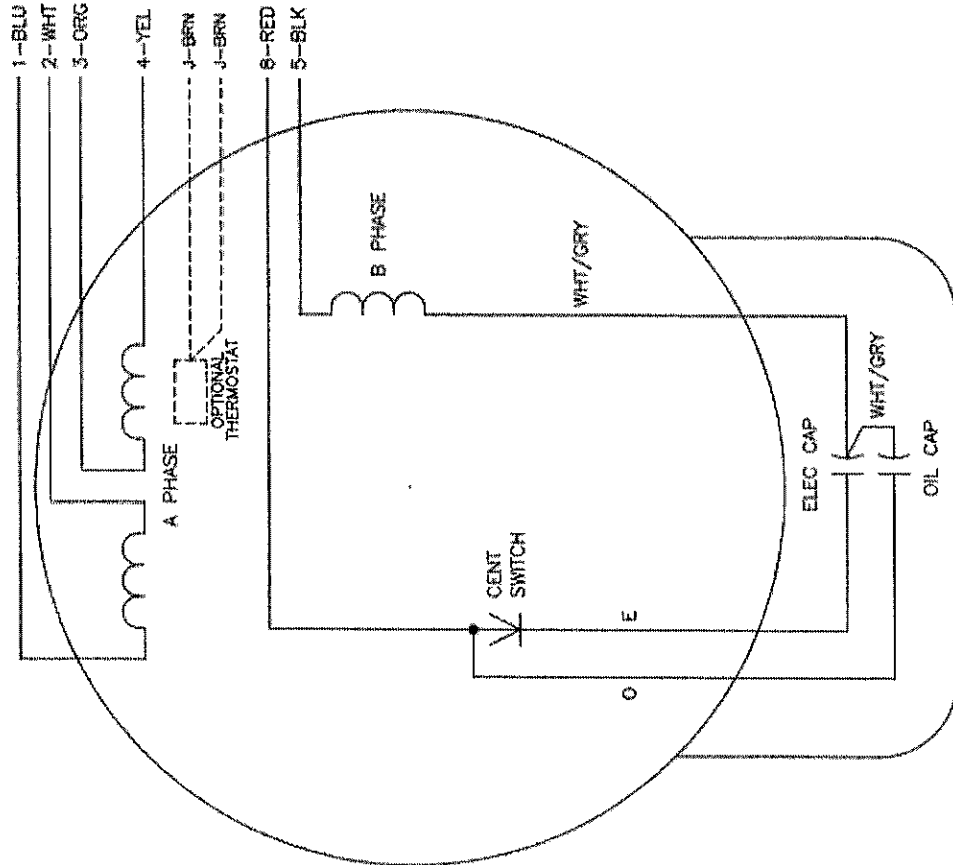
HYDRAULIC / GENERAL INFORMATION



ELECTRIC MOTOR

CONNECTION DIAGRAM

CD0055



	LINE A	LINE B	JOIN
HIGH STD	1	4,5	2,3,8
HIGH OPP	1	4,8	2,3,5
LOW STD	1,3,8	2,4,5	-
LOW OPP	1,3,5	2,4,8	-

- NOTES:
1. STANDARD ROTATION IS CCW FACING END OPPOSITE SHAFT EXTENSION.
 2. OPTIONAL THERMOSTAT IS PROVIDED WHEN SPECIFIED.
 3. MULTIPLE CAPACITORS ARE CONNECTED IN PARALLEL UNLESS OTHERWISE SPECIFIED.
 4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0055

BALDOR ELECTRIC Co.

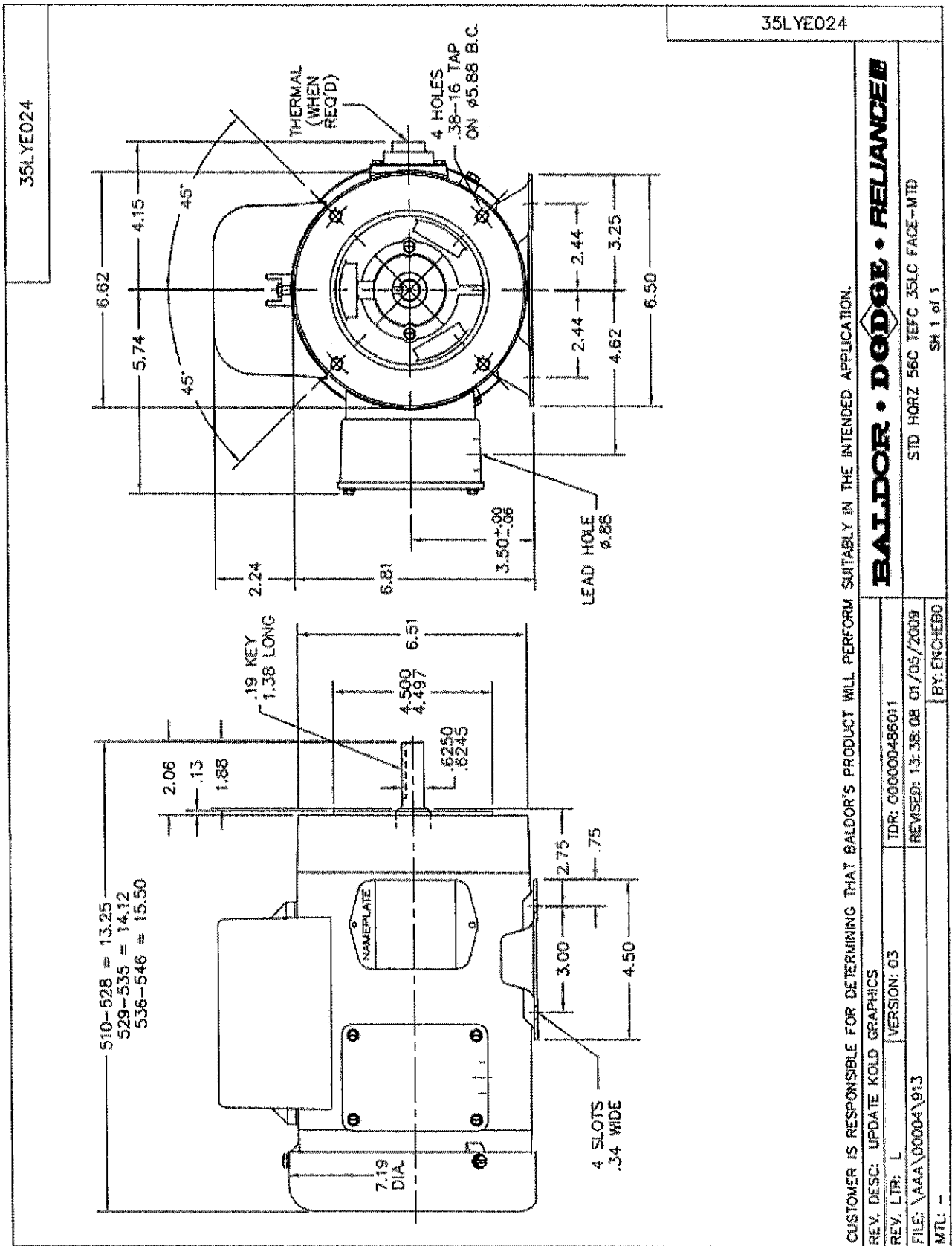
TYPE LC, DV, REV. 6 LEADS

REV. DESC: REVERSE TO SHOW OPTIONAL COLORS	TDR: 01/75636
REV. LTR: D BY: JLP	REVISED: 04/08/99 1:17
FILE: AAA00007414	MDL: -
MTL: -	

550000

PHYSICAL DIMENSIONS

BALDOR • RELIANCE Product Information Packet: CL3514 - 1.5HP, 1725RPM, 1PH, 60HZ, 56C, 3532LC, TEFC, F



PARTS LIST

BALDOR • RELIANCE Product Information Packet: CL3514 - 1.5HP, 1725RPM, 1PH, 60HZ, 56C, 3532LC, TEFC, F

Part Number	Description	Quantity
SA250420	SA 35E024N568G1	1,000 EA
RA237275	RA 35E024N568G1	1,000 EA
OC3060C09	CYL OIL CAP 60MFD/240V	1,000 EA
EC1540A04	ELEC CAP. 540-548 MFD. 125V. 1.81D X 4.	1,000 EA
WD3006A01	WSS-2-103.IT ZW 10K RES. METAL OXIDE 5%	1,000 EA
NS2512A01	INSULATOR CONDUIT BOX X	1,000 EA
34CS3007	35 CB CASTING 1/16 DIA LEAD HOLE	1,000 EA
36GS1000SP	GASKET-CONDUIT BOX .06 THICK #SV-330 LE	2,000 EA
51XB1016A07	10-18 X 7/16 HWSSLD SERTYB	1,000 EA
11XY1032G06	10-32 X .38 TAPTITE II HEX WSHR SLTD U	1,000 EA
35EP3100A102	FREP TEFC 203 BRG W/O GRSR (RAISED FH MT)	2,000 EA
51XY0832A07	8-32 X .44 TAPTITE II HEX WSHR SLTD SE	1,000 EA
35CS3801SP	CAPACITOR COVER, CAST	1,000 EA
34GS3002	GASKET, CAPACITOR BOX	1,000 EA
HA7010	CAPACITOR RETENTION CLAMP	1,000 EA
NS2501A02	INSULATOR, CAPACITOR BOX	1,000 EA
51XB1016A08	10-16X 1/2HWSSLD SERTYB	2,000 EA
HW5100A03SP	WAVE WASHER (W1543-017)	1,000 EA
35EP3300A33	SPL FACE MTD EP -ENCL-205 BRG	1,000 EA
51XN1032A20	10-32 X 1 1/4 HX WS SL SR	2,000 EA
51XB1214A16	12-14X1.00 HWSSLD SERTYB	1,000 EA
35FH4005A32SP	REC FH NO GRSR W/3 HOLES - W/AUTOPHERETI	1,000 EA
51XY1032A06	10-32 X .38 TAPTITE II HEX WSHR SLTD S	3,000 EA
35CB4521GX	CONDUIT BOX LID KIT	1,000 EA
51XY0832A07	8-32 X .44 TAPTITE II HEX WSHR SLTD SE	4,000 EA
HW2501D13SP	KEY, 3/16 SQ X 1.375	1,000 EA
HA7000A04	KEY RETAINER 0.625 DIA SHAFTS	1,000 EA
85XU0407S04	3/4 X 1/4 U DRIVE PIN STAINLESS	2,000 EA
WD1000A15	3-520132-2 AMP FLAG (4MR) NON-CANCON-	4,000 EA
NAJ1000A75	GREASE, POLYREX EM EXXON (US# 4824-15A)	0.050 LB
35FN3002A05SP	EXFN PLASTIC, 6.376 OD, 6.38 ID	1,000 EA
MG1000G27	MED CHARCOAL METALLIC GREY	0.017 GA
HA3100A15	THURBOLT 10-32 X 9.250	4,000 EA
34GS5003	FOAM SLEEVE, ID = 2 1/16" X 3 3/8"	2,000 EA
SP5181A01	MODEL 35 LC TORQ STAT SWITCH LEAD ASSY	1,000 EA
LB1125C01	STD (STOCK) CARTON LABEL BALDOR WITH FLA	1,000 EA
LC0001A01	CONN LABEL / WARNING LABEL (LC0001 / LB1	1,000 EA
AN415	TAG-INSTALLATION-MAINT. (1000px) 8/12	1,000 EA
NP1256L	ALUM UL CSA CC	1,000 EA
35PA1006	PACK GROUP W/LS5001	1,000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1,000 EA

PERFORMANCE DATA

1: Product Nameplate Data - CL3514 Motor

Rated Output	1.5 HP
Volts	115/230
Full Load Amps	12.4/6.2
Speed (RPM)	1725
Hertz	60
Phase	1
NEMA Design Code	L
LR KVA Code	J
NEMA Nom. Eff.	80%
Power Factor	96
Service Factor	1.15
Rating – Duty	40C AMB-CONT

2: Characteristics

Break Down Torque	14.5 (LB-FT)
Locked-Rotor Torque	15
Starting Current	57.0
No-Load Current	5.2
Line-line Resistance @ 25° C	1.41
Temperature Rise, (in degrees C @ F.L.)	76

3: Load Characteristics - Tested

% of Rated Load	25	50	75	100	125	150	SF
Power Factor	42	59	72	80	85	88	83
Efficiency	59.1	71.6	76.1	76.6	75.7	73.4	76.1
Speed (rpm)	1784	1773	1759	1743	1726	1706	1733
Line Amperes	5.3	5.9	6.7	7.9	9.4	11.0	8.80

HYDRAULIC CYLINDER

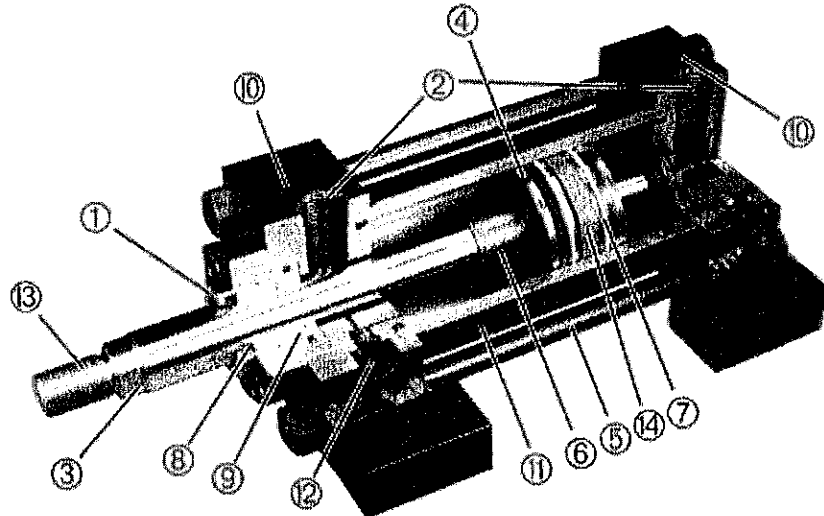
PARTS LIST – SERIES “HH” (NFPA CYLINDER)

Floating Rod Bushing

SELF ALIGNMENT FEATURE
Rod Bushing is designed to float .002", improving bearing surface alignment.

CUSTOMER EQUIPMENT CYLINDER ROD BUSHING CYLINDER PISTON

- Reduces cylinder drag and erratic operation
- Reduces cylinder wear
- Provides a minimum of 25% longer life than "fixed" Rod Bushing designs



HEAVY-DUTY DESIGN FOR RELIABLE, CONSISTENT OPERATION

- ① **FLOATING ROD BUSHING** – Precision machined from 150,000 PSI rated graphite filled ductile iron and PTFE coated to reduce friction and extend cycle life. Bushing design “traps” lubrication in effective bearing area. Bronze bushings also available.
- ② **PORTS** – NPTF and SAE ports available standard. Non-standard locations, sizes, and other port styles can be made to order to fit any application needs.
- ③ **PISTON ROD** – Steel piston rod provides high strength and damage resistance. Induction hardened and chrome plated for maximum wear resistance and long life. (100K min. yield up to 5” rod; 75K min. yield for 5½” rod)
- ④ **PISTON** – Precision machined ductile iron provides high strength and an excellent bearing surface for extended cylinder life.
- ⑤ **TIE RODS** – Pre-stressed high carbon steel tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube. (100K min. yield)
- ⑥ **CUSHION** – Precision machined cushions are available at either end and provide smooth deceleration which helps reduce end of stroke shock.
- ⑦ **PISTON SEALS** – Heavy lip design Carboxylated Nitrile

seals with back-up rings are pressure activated and wear compensating for extended life. Cast ring, EP, PTFE, and fluorocarbon designs available.

- ⑧ **ROD WIPER** – Flocked nitrile wiper removes contaminants on retract stroke, helping insure long life for all internal components.
- ⑨ **ROD SEALS** – Polyurethane seals offer high abrasion resistance and strength. Pressure activated double lip and wear compensating for extended life.
- ⑩ **HEAD & CAP** – Precision machined steel head and cap are held to tight tolerances and insure accurate alignment for a truly “square” cylinder.
- ⑪ **TUBE** – Precision machined steel tube with hard chrome I.D. is honed and micro finished for extended seal life and improved cycle rates.
- ⑫ **CUSHION ADJUSTMENT NEEDLE** – Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.
- ⑬ **PISTON ROD STUD** – Standard on KK1 and KK2 threads for ½” - 2” rods (125K min. yield). Available up to 2 times standard “A” thread length.
- ⑭ **WEAR BAND** – Wear Guard Nylon (standard); reinforced PTFE for E and V seal option.

OPERATING PRESSURE	3000 PSI HYD (207 BAR) Refer to page 31 for specific PSI
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OPERATING TEMPERATURE	Standard Seals: -20°F to 200°F (-29°C to 93°C) Fluorocarbon: 0°F to 400°F (-18°C to 204°C)
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Performance options:

- **RLH** – Rod locks are used to hold linear cylinder loads stationary in any mounting orientation during “power off” condition. See pages 22-26 for more information.
- **ST** – Stop tubes are used to reduce rod bearing and piston stress (refer to page 34 for cylinder design guidance).
- **CS** – Center Supports are recommended for cylinders with long strokes in horizontal applications to prevent buckling of the cylinder and extend cylinder life.
- **SSR** – 17-4 Chrome Plated Stainless Steel Piston Rod provide corrosion resistance in outdoor applications and wet environments. (100K min. yield up to 5” rod; 75K min. yield 5½” rod)
- **HIP** – High impact pistons use a high strength steel nut retained piston for fatigue resistance and additional strength in demanding applications.

HOW TO ORDER¹

HH - MF1 - 250 x 10 - H2C6 - 100 - KK1 - P15 = N375 - S S S S -

SERIES HH HEAVY DUTY HYDRAULIC	STYLE MF1 SINGLE DOUBLE PCB	STROKE 0" to 130" Made to Order (Use decimals for fractional strokes)	ROD SIZE 002 0.625" Rod Dia. 100 1.600" Rod Dia. 127 1.875" Rod Dia. 175 1.750" Rod Dia. 200 2.000" Rod Dia. 250 2.200" Rod Dia. 325 3.500" Rod Dia. 350 3.500" Rod Dia. 400 4.000" Rod Dia. 450 4.500" Rod Dia. 500 5.000" Rod Dia. 550 5.000" Rod Dia.	PORT LOC P 1 2 3 4 5 6 7 8 9 Call out "P" followed by all desired locations.	PORT SIZE N02 1/4" NPTF N12B 1/2" NPTF N25D 3/4" NPTF N37E 1" NPTF N50D 1 1/2" NPTF N75D 2" NPTF N100D 2 1/2" NPTF N150D 3" NPTF N200 1 1/2" NPTF S8 #8 SAE S10 #10 SAE S12 #12 SAE S16 #16 SAE S24 #24 SAE	SEALS See Below for Seal Ordering Instructions	OPTIONS A= EXTENDED PISTON ROD THREAD (Example: A = 3") (MAX = 2 INCHES STD. W/ DMI) AB= ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AB = 4") C= EXTENDED PISTON ROD (Example: C = 0.100", 1 Inch 1" ROD EXTENSION IS 0 = 1.50") CS CENTER SUPPORT EK1 EXTENDED KEYPATE (Refer to page 17 and 31 for specifications) EN ELECTROLESS NICKEL PLATED (Refer to page 37 for specifications) EP HIGH IMPACT PISTON NR NON-ROTATING (Refer to page 32 for specifications) RBS ROD SLUSHING MATERIAL: BRONZE RLH1 "ROD LOCK READY" CYLINDER ROD LOCK MODEL NUMBER (Example: RLH=MS200010000 (Refer to page 23-26 for ordering instructions for assembled rod locks)) SSR STAINLESS STEEL PISTON ROD ST STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: ST=MS2-250-MS-H2C6-S1=3") 4W4 FOUR WRENCH FLATS (ROD SIZES: 5/8"-3") XX= SPECIAL VARIATION (SPECIFY)
--	--	--	---	--	--	--	---

NFPA MOUNTS	BORE	CUSHIONS
N000 NO MOUNT (1.50" to 8.00" Bore)	150 1.50" Bore	H 1
MF1 HEAD RECTANGULAR FLANGE (1.50" to 8.00" Bore)	200 2.00" Bore	2
MF2 CAP RECTANGULAR FLANGE (1.50" to 8.00" Bore)	250 2.50" Bore	3
MF3 HEAD SQUARE FLANGE (1.50" to 8.00" Bore)	325 3.25" Bore	4
MF4 CAP SQUARE FLANGE (1.50" to 8.00" Bore)	400 4.00" Bore	5
ME5 HEAD RECTANGULAR MOUNTING HOLES (1.50" to 8.00" Bore)	500 5.00" Bore	6
ME6 CAP RECTANGULAR MOUNTING HOLES (1.50" to 8.00" Bore)	550 5.00" Bore	7
MP1 FIXED CAP PIVOT CLIPS (1.50" to 8.00" Bore)	600 6.00" Bore	8
MS2 SIDE LUGS (1.50" to 8.00" Bore)	650 6.00" Bore	9
MS3 CENTER LINE LUGS (1.50" to 8.00" Bore)		
MS4 BOTTOM TAPPED HOLES (1.50" to 8.00" Bore)		
MS7 END LUGS (1.50" to 8.00" Bore)		
MT1 HEAD TRUNNION (1.50" to 8.00" Bore)		
MT2 CAP TRUNNION (1.50" to 8.00" Bore)		
MT4 INTERMEDIATE (CENTER) TRUNNION (1.50" to 8.00" Bore)		
MX1 EXTENDED TIE RODS - HEAD & CAP (1.50" to 8.00" Bore)		
MX2 EXTENDED TIE RODS - CAP (1.50" to 8.00" Bore)		
MX3 EXTENDED TIE RODS - HEAD (1.50" to 8.00" Bore)		

ROD END
KK1 Small Male Thread
KK2 Large Male Thread
KK3 Female Thread
KK4 Full Dia. Male Thread
RRS Flare End
RRD Flared Coupler End
RRM Metric Thread
RXX Non-Std Thread

When additional thread details are required, use form of "Rod End" = "Modification".
Example: RRM=1.000d

HOW TO ORDER SEALS
S S S S

PISTON SEAL	ROD SEAL	TUBE SEAL	ROD WIPER *
S STAINLESS (Carbide) Seal	S STANDARD (Polyurethane)	S STAINLESS (Buna)	S STANDARD (Floated Keel)
C Carb-Ring	E EP	E EP	Ai Metallic (Boreplate)
E EP	V Fluorocarbon	V Fluorocarbon	T PTFE
T PTFE	V Fluorocarbon		V Fluorocarbon

Location 9 is center of cap face.

*Note: When cylinder design calls for all EP seals, use PTFE rod wiper.

MAXIMUM STROKE RECOMMENDATIONS			
BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION)	
		ONE SUPPORT	TWO SUPPORTS
1.50"	44 INCHES	STROKES OVER 44 INCHES	STROKES OVER 89 INCHES
2.00"	74 INCHES	STROKES OVER 74 INCHES	STROKES OVER 99 INCHES
2.50"	84 INCHES	STROKES OVER 84 INCHES	NOT REQUIRED
3.25" - 8.00"	99 INCHES	STROKES OVER 99 INCHES	

NFPA MOUNTS

MF1 1.50"-6" Bores Page 12	MF2 1.50"-6" Bores Page 12	MF5 1.50"-8" Bores Page 14	MF6 1.50"-8" Bores Page 14	ME5 1.50"-8" Bores Page 12	ME6 1.50"-8" Bores Page 13
MPT 1.50"-8" Bores Page 17	MS2 1.50"-8" Bores Page 15	MS3 1.50"-8" Bores Page 15	MS4 1.50"-8" Bores Page 16	MS7 1.50"-6" Bores Page 16	MT1 1.50"-8" Bores Page 8
MT2 1.50"-8" Bores Page 8	MT4 1.50"-8" Bores Page 8	MX0 1.50"-8" Bores Page 7	MX1 1.50"-8" Bores Page 10	MX2 1.50"-8" Bores Page 10	MX3 1.50"-8" Bores Page 10

¹ CYLINDER P/N: HH-MS2-250X4-100-KK1-P15=S8-TSSS

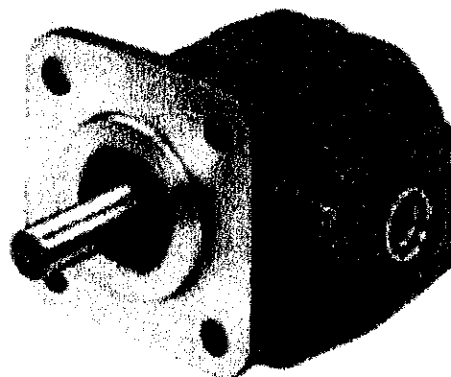
HYDRAULIC PUMP

SPECIFICATIONS^{1 2}

11 GPM/1800 PSI to 1/2 GPM/3000 PSI

Bi-Rotational • Use as a Pump or Motor

Includes bi-rotational check valves to allow it to be used either as a pump or a hydraulic motor in either direction of rotation. The maximum back pressure is 400 PSI on the low pressure port. Inboard bearings will accept a maximum of 150 lbs. of overhung load, an outward thrust of 60 lbs.; and an inward thrust of 76 lbs. Oil viscosity of 100 to 1000 SSU.



Pump body is cast iron with hardened steel gears running on needle bearings and with Viton seals. Listed below in the tables are some of the more popular pumps. The dimensions are: 3½" wide × 3½" high × the body length shown in table. Shaft dimension is: 1/2" diameter × 1½" length with a 1/8" key. These pumps come with a four bolt flange on a 2" hole pattern. Pilot diameter is 1.780".

Performance as a Pump

Model No.	Disp./ Rev. in ³ /rev.	GPM @ 1750 RPM	Max. PSI Cont.	Max. PSI Inter.	Port Size, SAE	Max. Recom. RPM	Body Length, inches
1300093	.065	1/2	3000	4000	9/16-18	4000	3.16
1300094	.129	1	3000	4000	3/4-16	4000	3.16
1300095	.194	1½	3000	4000	3/4-16	4000	3.16
1300096	.258	2	2300	4000	3/4-16	4000	3.16
1300097	.323	2½	1900	3000	7/8-14	4000	3.69
1300098	.388	3	1600	2500	7/8-14	3550	3.69
1300099	.453	3½	1300	2250	7/8-14	3000	3.69
1300100	.517	4	1200	2000	7/8-14	2500	3.69

Performance as a Hydraulic Motor

Model No.	Disp./ Rev. in ³ /rev	Displ., C.I.R.	GPM* per 1000 RPM	Torque** in-lbs. per 100 PSI	Max. PSI	HP @ Max. PSI & per 1000 RPM
1300093	0.065	0.065	0.280	1.03	3000	0.39
1300094	0.129	0.129	0.556	2.05	3000	0.77
1300095	0.194	0.194	0.883	3.09	3000	1.15
1300096	0.258	0.258	1.110	4.12	2300	1.54
1300097	0.323	0.323	1.390	5.14	1900	1.64
1300098	0.388	0.388	1.670	6.18	1600	1.82
1300099	0.453	0.453	1.940	7.21	1300	1.62
1300100	0.517	0.517	2.220	8.25	1200	1.54

*Idling GPM. Allow about 15% more for operation at maximum PSI.

**Theoretical Torque. Starting torque is about 60% of theoretical. Running torque is about 90% of theoretical.

¹ Gas machine uses G.C. Series Pump P/N: 1300097

² Electric machine uses G.C. Series Pump P/N: 1300098

PUMP DATA ¹²

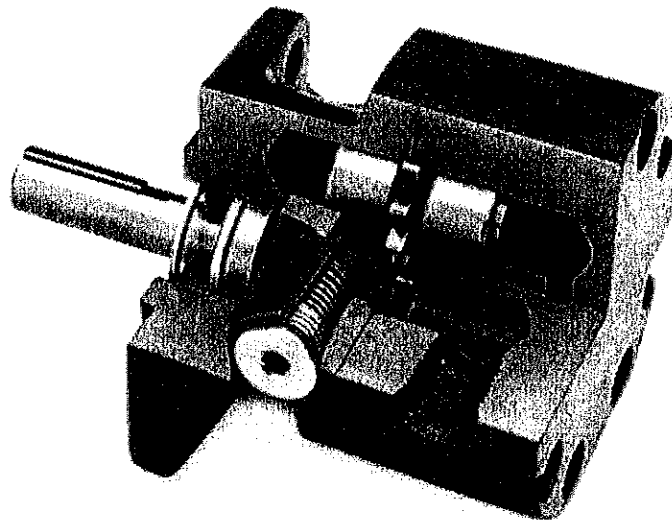
Concentric G.C. Series Hydraulic Pumps are compact, external gear models for use in pumping fluids with lubricating qualities. Suitable for use in a wide variety of material handling, agricultural, and construction equipment in addition to machine tools, robotics, and other types of machinery.

Designed to provide reliable, long-life service under rugged conditions, G.C. Series pumps are built with cast iron bodies and hardened steel gears. Among their other standard, extra-value features are:

- Speeds to 4000 RPM
- Pressures to 4000 PSI
- Superior volumetric efficiency
- Needle bearing construction
- High mechanical efficiency
- Temperature ratings to 250°F (120°C)*
- Wide variety of options

* Higher temperatures, consult factory.

See the chart on this page for basic sizes. Dimensional and option information is listed on pages 3-5 and performance curves are shown on pages 6 & 7. See page 8 for complete ordering information.



Order Code (Gear)	Displacement Revolution		Flow				Pressure Rating			
			At 1800 RPM		At 3600 RPM		Continuous		Intermittent	
	cu. in.	cc.	GPM	L/Min.	GPM	L/Min.	PSI	BAR	PSI	BAR
04	0.065	1.07	0.50	1.93	1.00	3.86	3000	207	4000	275
06	0.097	1.59	0.75	2.86	1.50	5.72	3000	207	4000	275
08	0.129	2.11	1.00	3.80	2.00	7.60	3000	207	4000	275
▲10	0.161	2.64	1.25	4.75	2.50	9.50	3000	207	4000	275
12	0.194	3.18	1.50	5.72	3.00	11.44	3000	207	4000	275
▲14	0.226	3.70	1.75	6.66	3.50	13.32	2600	179	4000	275
16	0.258	4.23	2.00	7.61	4.00	15.22	2300	159	4000	275
▲18	0.291	4.77	2.25	8.59	4.50	17.18	2100	145	3500	241
20	0.323	5.29	2.50	9.52	5.00	19.04	1900	131	3000	207
24	0.388	6.36	3.00	11.45	6.00	22.90	1600	110	2500	172
28	0.453	7.42	3.50	13.36	7.00	26.72	1300	90	2250	155
32	0.517	8.47	4.00	15.25	8.00	30.50	1200	83	2000	138
†36	0.581	9.52	4.50	17.17	9.00	34.34	2250	155	2475	171
†40	0.647	10.59	5.00	19.07	10.0	38.15	2000	138	2200	152
†44	0.711	11.65	5.50	20.98	11.0	41.97	1800	124	2000	138

Flow listed in U.S. gallons. 200 SSU oil.

▲ Available, but not standard (100-piece minimum order).

† For speed above 2400 RPM, 1-in. dia. inlet tube must be used.

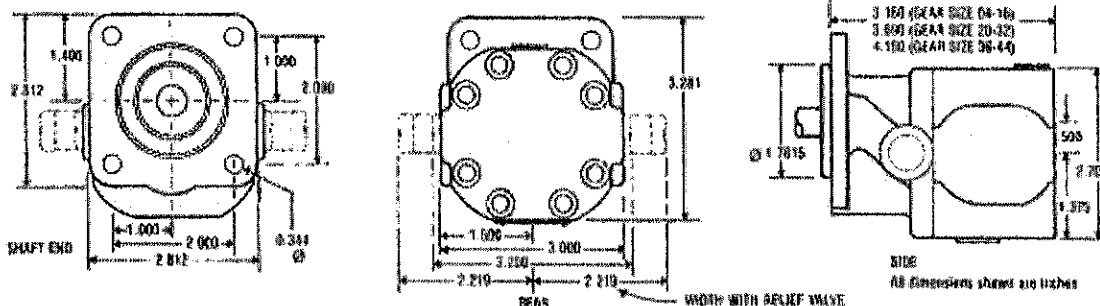
¹ Gas machine uses order code # 20

² Electric machine uses order code # 24

OPTIONS

DIMENSIONAL INFORMATION

Pumps use one of two basic castings: One size for gear faces 04 through 16 and a slightly larger size for gear faces 20 to 32. See the drawings for details.



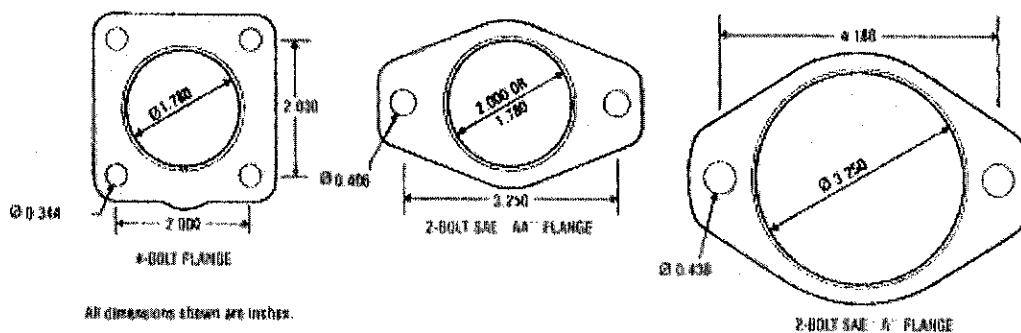
FLANGE OPTIONS

Standard options include three basic flanges:

4-Bolt with 1.78-inch Pilot, 2-Bolt SAE "AA" with 2-inch or 1.78-inch Pilot, and 2-Bolt SAE "A" with 3.25-inch Pilot. Consult factory for other flange requirements.

Order Code	Mounting Flange Options
1	4-Bolt w/1.78" Pilot
2	2-Bolt SAE "AA" w/2.0" Pilot
▲ 3	2-Bolt SAE "AA" w/1.78" Pilot
4	2-Bolt SAE "A" w/3.25" Pilot

▲ 100-piece minimum order

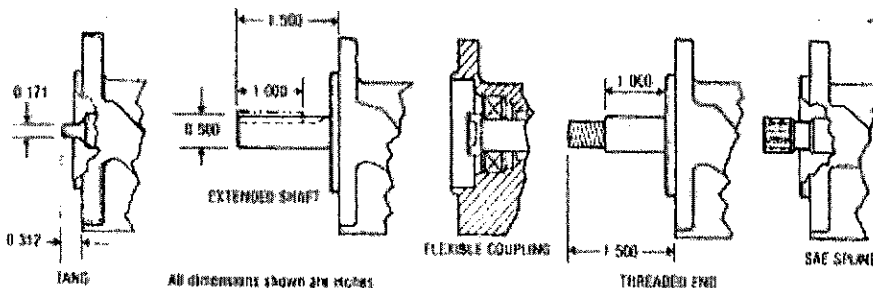


SHAFT OPTIONS

Five shaft options are standard: 0.171-inch Tang, 1/2-inch diameter x 1 1/2-inch Extension, Flexible Coupling, Threaded End, and SAE Spline. Consult factory for other shaft options.

Order Code	Mounting Flange Options
1	0.171" Tang
2	0.50" Diameter x 1.50" Extension, 1/8" Square Key
▲ 3	Flexible Coupling
▲ 4	Threaded End (Specify Thread)
* 5	SAE Spline (Specify)

▲ 100-piece minimum order
 * 9T, 20/40 DP standard with flange option 1, 2 & 3;
 9T, 16/32 DP standard with flange option 4.
 Selected sizes available from stock. Consult factory.



OPTIONS

VALVE OPTIONS

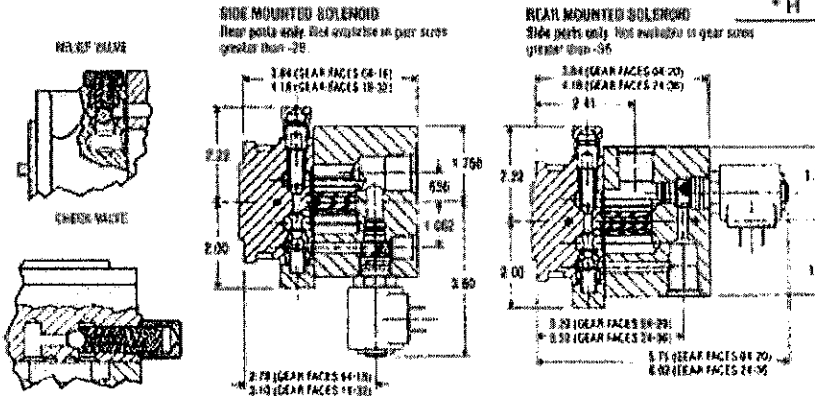
A variety of integral valves and valve combinations are available as standard. Options include: Relief, Check, and Check/Relief combination. A Check, Relief & Solenoid Release valve combination provides the lift-hold-lower function for power up and gravity down applications. Another unique option, for lift-hold-lower applications, incorporates an adjustable needle valve in the pump for controlling the lowering speed of the load.

Order Code	Valve Options
A	No Valves
B	Relief Valve
C	Direction Checks (Not Shown)
* D	Check Valve
* E	Check & Relief Valves (Not Shown)
* F	Check, Relief & Normally Closed Solenoid
* G	Check, Relief & Normally Open Solenoid
* H	Check, Relief & Solenoid Cavity Plugged

Pressure compensated flow control spools are available with options F and G.

* Available ONLY for gear sizes 04 through 36

Minimum full bypass relief valve settings:
200 psi for gear sizes 04-16 at 1725 rpm, 300 psi for gear sizes 18-44 at 1725 rpm. At speeds above 1725 rpm, the minimum relief valve settings increase. Contact factory for specific information.



SEAL & BEARING OPTIONS

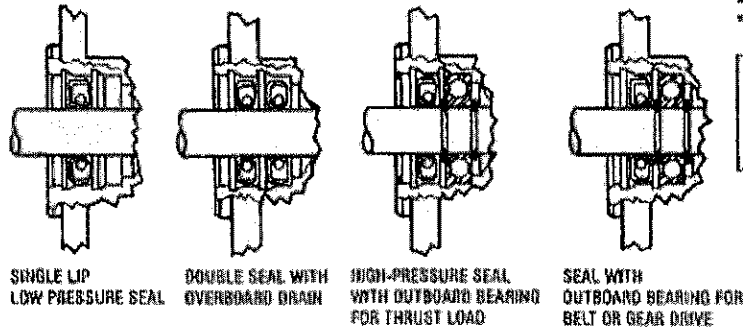
Five basic seal & bearing configurations are available as shown here. Oil seals are either Buna-N or Viton. Outboard ball bearings are available for "radial load" (bolt or gear drives and thrust loads). High-pressure seals are rated up to 25 PSI at 3000 RPM. Viton seals are rated at 350°F (176°C). Consult factory for other types of sealing materials and mechanical seals. Higher pressure seals available, consult factory.

Order Code	Seals & Bearings Options
1	Single Lip Buna-N Low Pressure Seal
2	Viton Seal
*3	Viton High-Pressure Seal w/Outboard Ball Bearing
▲*4	Double Seal w/Overboard Drain
*5	Buna-N Seal w/Outboard Ball Bearing

▲ 100-piece minimum order.

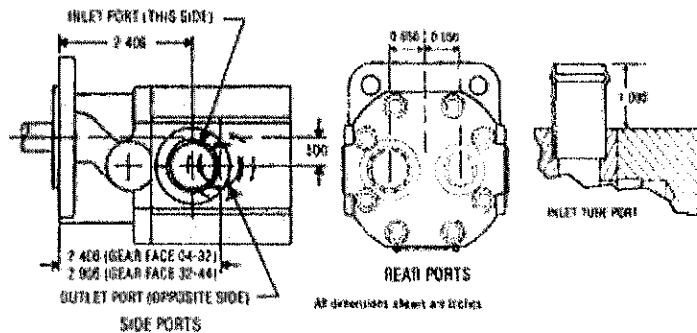
* Not available with shaft option 3.

Outboard ball bearing settings:
Maximum overhang load: 150 lbs.
Maximum inward thrust: 75 lbs.
Maximum outward thrust: 50 lbs.



PORT LOCATION OPTIONS

Standard porting is SAE Straight Thread O'Ring Ports. Depending on gear size, porting size varies as shown in the chart below. NPTF and Inlet Tube Ports are not standard, but can be supplied. The second chart shows the Order Code for port type and location.



* NOTE: Based on CCW rotation.

Gear Size	SAE Port Size	
	Unrotational (Birotational)	
Order Code	Low Pressure Port	High Pressure Port
04 & 06	9/16-18 (9/16-18)	9/16-18 (9/16-18)
08, 12 & 16	3/4-16 (3/4-16)	3/4-16 (3/4-16)
20, 24	7/8-14	3/4-16
28 & 32	7/8-14	7/8-14
36, 40 & 44	7/8-14	7/8-14

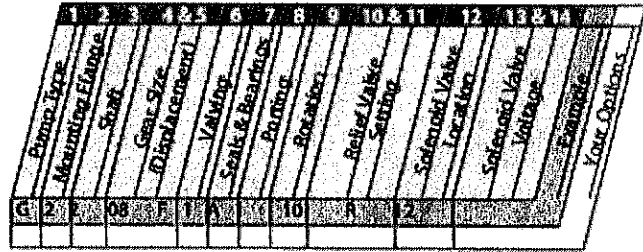
Order Code	Port Location Options
A	SAE Side Ports
▲ B	SAE Rear Ports
▲ C	NPTF Side Ports
▲ D	NPTF Rear Ports
▲* E	Inlet Tube, 1.0" w/SAE Side Outlet Port

NOTE: If ordering NPTF Ports, specify sizes (1/4, 3/8 or 1/2 in.) 100-piece minimum order. * For gear order codes 3, 40 and 44, 1 in. diameter Inlet Tube must be used for speeds above 2400 RPM.

HOW TO ORDER

ORDERING INFORMATION

Each option has been assigned an order code – listed in the tables below – for placement in the sequence shown to the right.



2

Order Code	Mounting Flange Options
1	4-Bolt w/1.78" Pilot
2	2-Bolt SAE "AA" w/2.0" Pilot
▲ 3	2-Bolt SAE "AA" w/1.78" Pilot
4	2-Bolt SAE "A" w/3.25" Pilot

▲ 100-piece minimum order

3

Order Code	Shaft Options
1	0.171" Tang w/ Short Coupling (.5" long) (For DC Motors)
2	0.50" Diameter x 1.58" Extension, 1/8" Square Key
▲ 3	Flexible Coupling
▲ 4	Threaded End (Specify Thread)
5	SAE Spline (9 tooth, 20/40DP standard with flange options 1, 2 and 3; 9 tooth, 16/32 DP standard for flange option 4.)
6	0.171" Tang w/Long Coupling (.8" long) (For AC Motors)

▲ 100-piece minimum order

4 & 5

Order Code	Gear Size Width, Inches	Displacement Cu. In./Rev. (cc)
04	0.125	0.065 (1.07)
06	0.138	0.097 (1.59)
08	0.250	0.129 (2.11)
▲ 10	0.312	0.161 (2.64)
12	0.375	0.194 (3.18)
▲ 14	0.437	0.226 (3.70)
16	0.500	0.258 (4.23)
▲ 18	0.562	0.291 (4.77)
20	0.625	0.323 (5.29)
24	0.750	0.388 (6.36)
28	0.875	0.453 (7.42)
32	1.000	0.517 (8.47)
36	1.125	0.581 (9.57)
40	1.250	0.647 (10.60)
44	1.375	0.711 (11.65)

▲ 100-piece minimum order

NOTE: Duplex and triple pumps available in minimum 100-piece order.

6

Order Code	Valve Options
A	No Valves
B	Relief Valve
1 C	Direction Checks (Not Shown)
* D	Check Valve
* E	Check & Relief Valves (Not Shown)
* F	Check, Relief & Normally Closed Solenoid
* G	Check, Relief & Normally Open Solenoid
* H	Check, Relief & Solenoid Cavity Plugged

1 Available only with option "3" of section 9

* Available ONLY for gear sizes 04 through 36

7

Order Code	Seals & Bearings Options
1	Single Lip Buna-N Low Pressure Seal
2	Viton Seal
* 3	Viton High-Pressure Seal w/Outboard Ball Bearing
▲ * 4	Double Seal w/Overboard Drain
* 5	Buna-N Seal w/Outboard Ball Bearing

▲ 100-piece minimum order.
* Not available with shaft option 3.

8

Order Code	Port Location Options
A	SAE Side Ports
▲ B	SAE Rear Ports
▲ C	NPTF Side Ports
▲ D	NPTF Rear Ports
▲ * E	Inlet Tube, 1.0" w/SAE Side Outlet Port

▲ 100-piece minimum order.
NOTE: If ordering NPTF Ports, specify size: 1/4, 3/8 or 1/2 in.

* For gear order codes 36, 40 & 44, 1-in. Diameter Inlet Tube must be used for speeds above 2400 RPM.

9

Order Code	Rotation Options
1	Clockwise
2	Counterclockwise
* 3	Birotational

* Must specify option "C" in section 6

10 & 11

Order Code	Relief Valve Setting
02-40	Full bypass pressure in hundreds of PSI. (Example: 00 = No Relief; 09 = 900 PSI (Full Bypass Pressure); 40 = 4000 PSI (Full Bypass Pressure).)

NOTE: The maximum relief valve full bypass setting for each gear size as listed on page 2, "Intermittent rating" pressure chart.

Minimum full bypass relief valve settings: 200 psi for gear sizes 04-16 at 1725 rpm, 300 psi for gear sizes 18-44 at 1725 rpm. At speeds above 1725 rpm, the minimum relief valve settings increase. Contact factory for specific information.

12

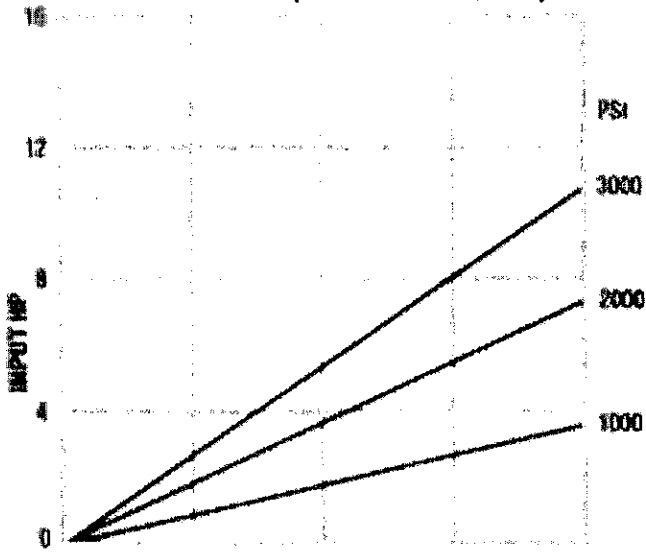
Order Code	Solenoid Valve Location
R	Rear Mounted Solenoid Valve
S	Side Mounted Solenoid Valve
N	No Solenoid Valve

13 & 14

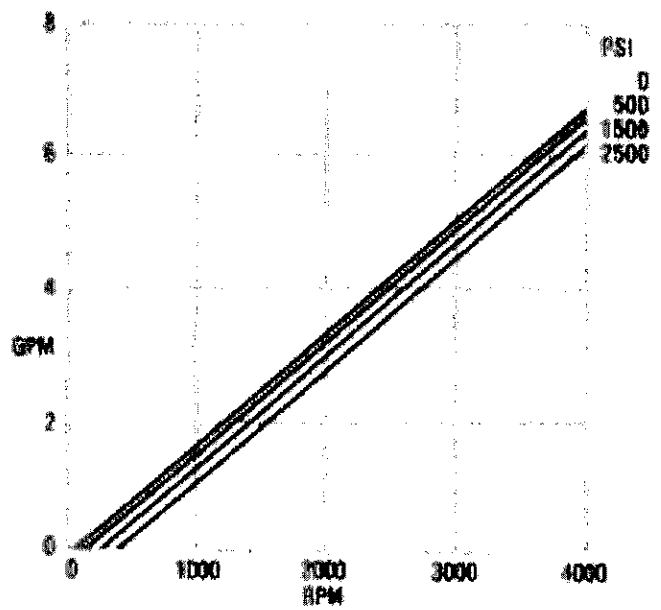
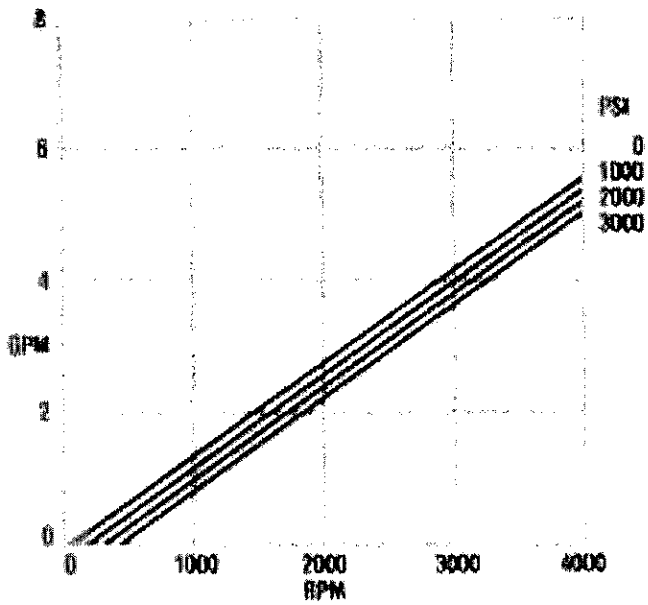
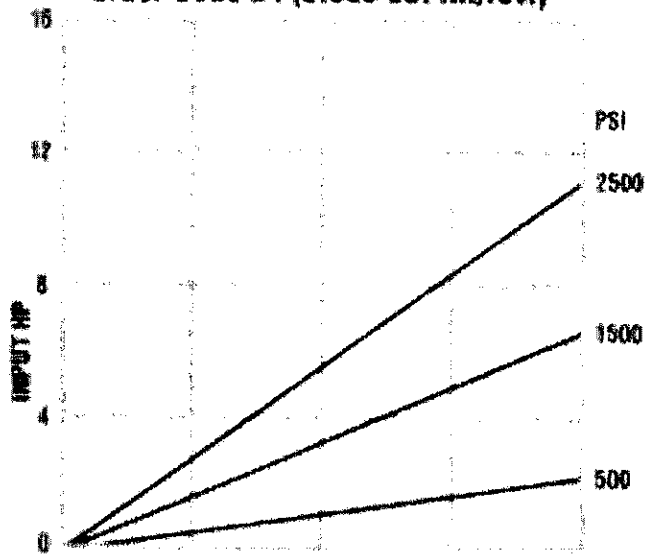
Order Code	Solenoid Valve Voltage
12	12 Volts DC
24	24 Volts DC
115	115 Volts AC
* PG	Solenoid Valve Cavity Plugged
00	No Solenoid Valve Cavity

* Must specify option "H" in section 6

Order Code 20 (0.323 cu. in./rev.)



Order Code 24 (0.388 cu. in./rev.)



FLOW DIVIDER

HOW TO ORDER¹

Stock Concentric Flow Dividers

GC Series (U.S. Version) Flow Dividers

Sections	Ports (SAE)		Relief Valve	Displacement (in. ³ /rev. Section)	Model Code (CR)	Stock P/N
	Inlet	Outlet				
2	3/4-16	9/16-18	Included	.097	FG1110021	1303574
2	3/4-16	3/4-16	Included	.129	FG1220021	1300634
2	7/8-14	7/8-14	Included	.258	FG1440021	1300635
2	7/8-14	7/8-14	Included	.388	FG1770021	1300636
2	7/8-14	7/8-14	Included	.517	FG1990021	1300637
4	3/4-16	3/4-16	Included	.129	FG3222221	1303139
4	7/8-14	9/16-18	Included	.258	FG3444421	1303140
4	7/8-14	3/4-16	Included	.388	FG3777721	1303142
4	7/8-14	7/8-14	Included	.517	FG3999921	1303143

How To Order Concentric GC Series Flow Dividers

Concentric stocks a selection of GC Series two section and four section flow dividers, which include a built-in adjustable differential relief valve in each section. See page 9 for a list of stock available. If the GC Series flow divider required is not a stock item at Concentric, it may be ordered by following the ordering code show below. Non-stock options require a 100-piece minimum.

Determine the number of sections needed.

Determine gear size of sections required:

Fill in all blanks in model code below:

1 2 3 4 5 6 7 8 9
F G _ _ _ _ _ _ _ _

1.	Type	
	F	Flow Divider
2.	Series	
	G	GC Series Flow Divider
3.	Number of Sections	
	1	Two Sections
	2	Three Sections
	3	Four Sections

4.	Relief Valve (CR)	
5.	0	None
6.	1	.097 in. ³ /rev.
7.	2	.129 in. ³ /rev.
	3	.194 in. ³ /rev.
	4	.258 in. ³ /rev.
	5	.291 in. ³ /rev.
	6	.323 in. ³ /rev.
	7	.388 in. ³ /rev.
	8	.453 in. ³ /rev.
	9	.517 in. ³ /rev.
8.	Port Type	
	1	None
	2	One Each Section
9.	Port Size	
	1	SAE (Standard)
	2	NPTF

EXAMPLE: FG1440021

Two section flow divider, .258 in.³/rev. gear first section, .258 in.³/rev. gear second section, no 3rd or 4th section, relief valve in each section, SAE ports.

¹ STOCK P/N: 1300634

PERFORMANCE DATA

GC Series Rotary Gear Flow Dividers

Order Code	Gear Face Width	Displacement		SAE Ports		Minimum Flow/Sec		Maximum Flow/Sec		Cont. Diff. Pressure Between Inlet/Outlet		Maximum Outlet Pressure Any Section	
		In. ³	Cm. ³	Inlet	Outlet	GPM	L/M	GPM	L/M	PSI	BAR	PSI	BAR
06	3/16	.097	1.59	9/16-18	9/16-18	0.8	3.0	1.7	6.4	1800	124	3500	241
08	1/4	.129	2.12	3/4-16	3/4-16	1.2	4.5	2.5	9.5				
12	3/8	.194	3.18	3/4-16	9/16-18	1.7	6.4	4.5	13.2				
16	1/2	.258	4.24	7/8-14	7/8-14	2.5	9.5	5.0	18.9				
20	5/8	.323	5.30	7/8-14	7/8-14	3.0	11.4	6.0	22.7				
24	3/4	.388	6.36	7/8-14	7/8-14	3.5	13.2	7.0	26.5	1600	110		
28	7/8	.453	7.42	7/8-14	7/8-14	4.0	15.1	8.0	30.3	1300	90		
32	1	.517	8.48	7/8-14	7/8-14	4.5	17.0	9.0	34.1	1200	83		

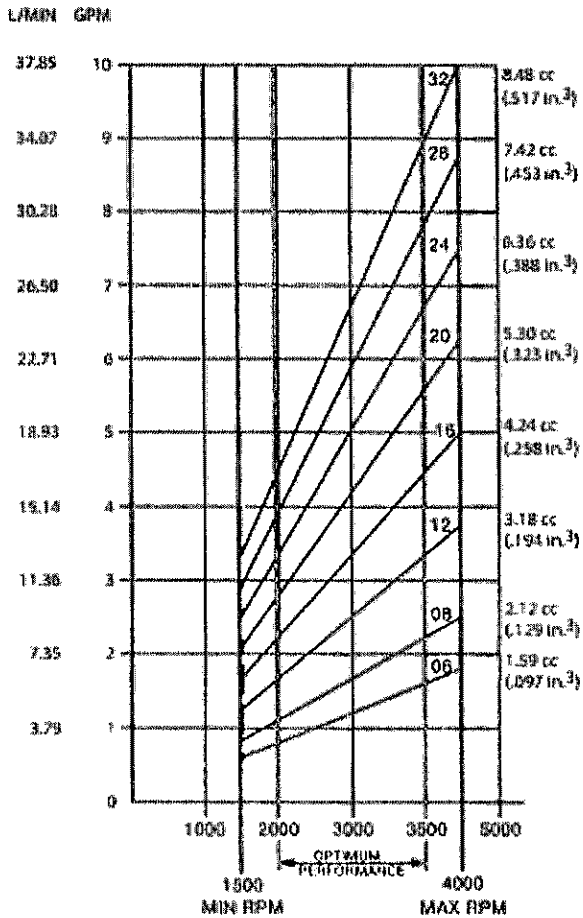
NOTE: Flows listed above are per section.

For European Style GC Flow Dividers, all inlet and outlet ports are 1/2-14 BSPP.

* Stock units available in two and four section versions, see page 9.

MAXIMUM inlet pressure 3000 psi (207 bar) - MAXIMUM outlet pressure 3500 psi (241 bar). For 3 section flow dividers or flow dividers with unequal sections, contact the factory. Recommended operating range 2000 rpm to 3500 rpm.

Performance



The curve on the left and the chart above can be useful in selecting the proper size flow divider sections. The curve shows speed vs. flow per section.

For equal sized sections:

Assume four section dividers with a total flow of 12 GPM (45.4 L/M) in and 3 GPM (11.4 L/M) per section out. From the chart, an order code 12 or 20 would be suitable for this flow. However, the nearer the mid-range, the better the efficiency. From the curve, order code 16 crosses the 3 GPM (11.4 L/M) line at 2750 RPM. The best selection is the order code 16 gear section.

For proportional flow, the curve is used as follows:

Assume a four section divider with an input flow of 19 GPM (71.9 L/M) and an outlet flow of 7 GPM (26.5 L/M), 5 GPM (18.9 L/M), 4 GPM (15.1 L/M), and 3 GPM (11.4 L/M). With a straight edge on the 3000 RPM line, proper flow for 7 GPM (26.5 L/M) is given with an order code 32 gear section, 5 GPM (18.9 L/M) with an order code 24 gear section, 4 GPM (15.1 L/M) with an order code 20 gear section and 3 GPM (11.4 L/M) with an order code 16 gear section.

The chart above also shows the allowable differential pressures. The differential relief valve setting is determined by the maximum pressure needed by the circuit minus the inlet pressure without exceeding the allowable differential pressure. Either the continuous or intermittent differential pressures are used, depending on the circuit requirement. The differential relief valve is adjustable through a range of 500 - 1000 PSI (34.5 - 69 BAR). Our standard setting for the differential relief valves is 750 PSI (51.7 BAR).

DIMENSIONS

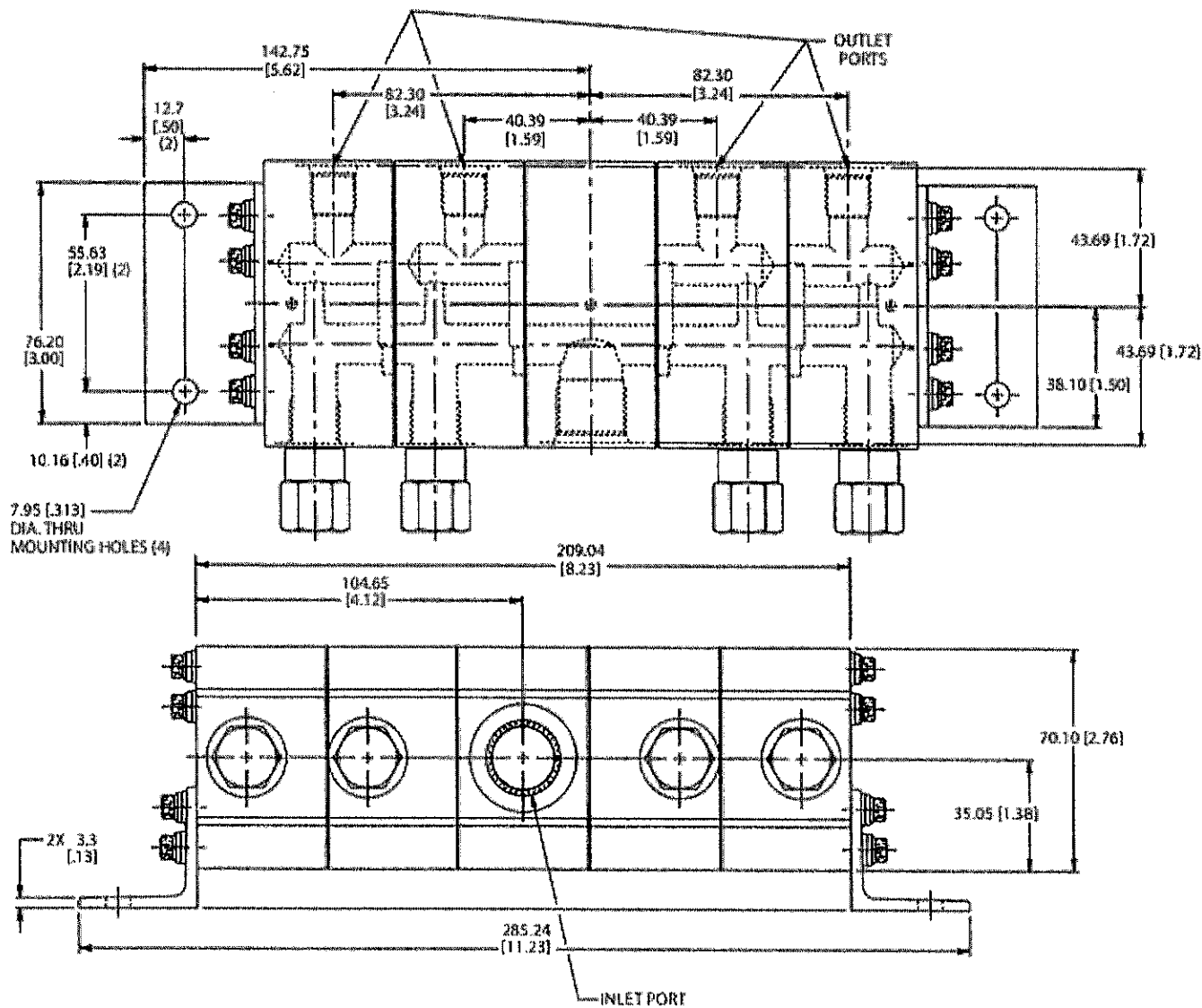
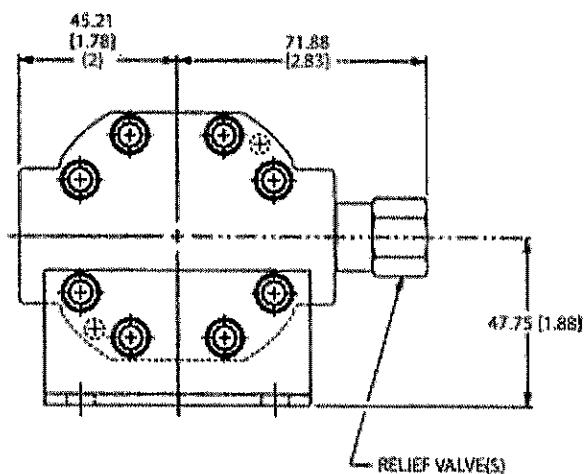
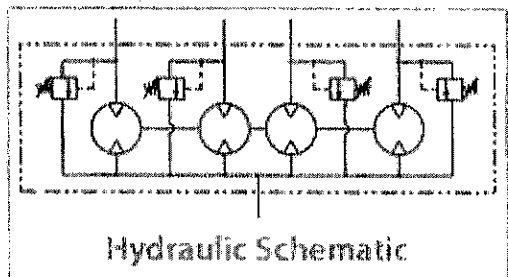
GC Series Flow Divider

U.S. & European Style

NOTE: The only difference between the U.S. version and European version is the porting configuration.

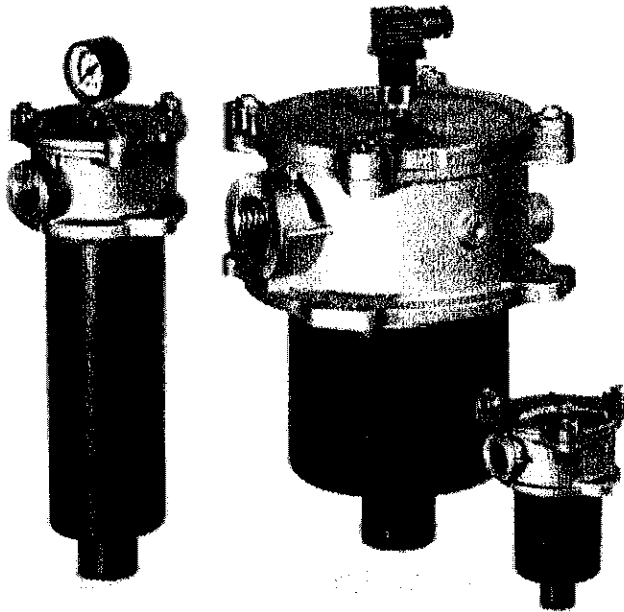
The U.S. version has SAE standard ports (refer to page 3) and the European version has 1/2-14 BSPP ports.

(inches are in brackets)



RETURN FILTER

SPECIFICATIONS



RA

MATERIALS

Head and cover:
Aluminium alloy

Bowl:
Polyamide for FRA21-31-32-33-41
Zinc plated steel for FRA11-42-51-52-
53-50

Bypass valve:
Polyamide

Seals:
NBR Nitrile
FKM Fluoroelastomer on request

Indicator housing:
Brass

PRESSURE (ISO 10771-1:2002)

Max working:
300 kPa (3 bar)

Test:
500 kPa (5 bar)

Bursting:
1 MPa (10 bar)

Collapse, differential
for the filter element (ISO 2941):
300 kPa (3 bar)

BYPASS VALVE

Setting:
170 kPa (1,7 bar) \pm 10%

WORKING TEMPERATURE

From -25° to +110° C

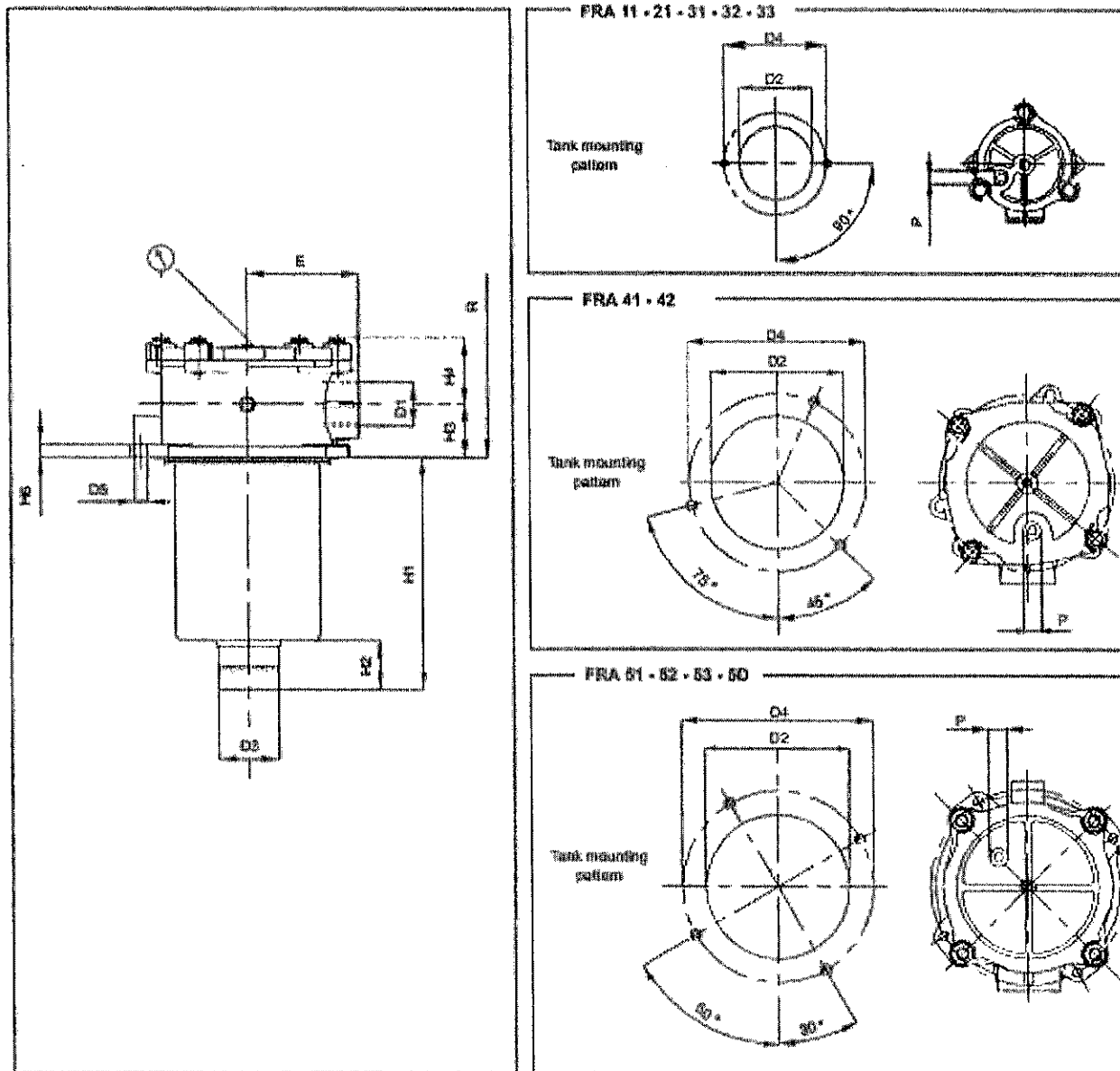
COMPATIBILITY (ISO 2943:1999)

Full with fluids: HM-HL-HM-HV-HTG
(according to ISO 6743/4)
For fluids different than the above mention-
ed, please contact our Sales Department.

APPLICATION EXAMPLE



INSTALLATION DRAWING



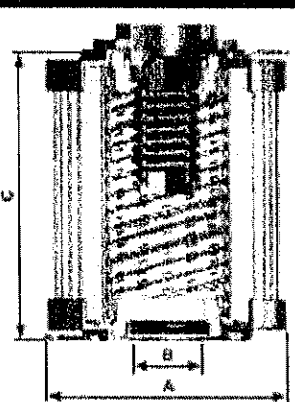
FILTER HOUSING

	D1	min D2	max D2	D3	D4	D5	E	H1	H2	H3	H4	H6	P	R	kg
FRA11	3/8"	50	50	12	80	6,5	40	59	18	12	33	9	1/8"	90	0,30
FRA21	1/2"	67	68	24	90	6,5	50	80	20	22	33	9	3/8"	120	0,45
FRA31	1/2" - 3/4"	89	90	28	115	9	67	102	25	28	47	10	3/8"	150	0,80
FRA32	3/4" - 1"	89	90	28	115	9	67	150	25	28	47	10	3/8"	190	0,95
FRA33	3/4" - 1"	89	90	40	115	9	67	234	30	28	47	10	3/8"	270	1,10
FRA41	1" - 1 1/4" - 1 1/2"	128	131	40	175	10,5	95	248	50	35	56	13	1/2"	289	2,10
FRA42	1" - 1 1/4" - 1 1/2"	128	131	40	175	10,5	95	265	30	35	56	13	1/2"	308	2,30
FRA51	1 1/4" - 1 1/2" - 2" - 2 1/2"	174	180	50	220	10,5	115	178	50	55	68	13	1/2"	250	3,10
FRA52	1 1/4" - 1 1/2" - 2" - 2 1/2"	174	180	63,5	220	10,5	115	240	50	55	68	13	1/2"	315	3,60
FRA53	2" - 2 1/2"	174	180	63,5	220	10,5	115	285	50	55	68	13	1/2"	355	4,10
FRA50	2" - 2 1/2"	174	180	63,5	220	10,5	115	300	50	55	68	13	1/2"	370	4,30

ORDERING AND OPTIONS¹

TYPE																					
F = FILTER COMPLETE											F	F	F	F	F	F	F	F	F	F	F
B = FILTER HOUSING											B	B	B	B	B	B	B	B	B	B	B
R A	FAMILY, NOMINAL SIZE & LENGTH											ELEMENT			E						
												FAMILY SIZE & LENGTH			R A						
											19	21	31	32	33	41	42	51	52	53	5D
PORT TYPE																					
B = BSR thread											B	B	B	B	B	B	B	B	B	B	B
N = NPT thread											N	N	N	N	N	N	N	N	N	N	N
S = SAE thread											-	S	S	S	S	S	S	S	S	S	S
F = SAE flange 3000 psi											-	-	-	-	-	-	-	F	F	F	F
PORT SIZE																					
03 = 3/8"											03	-	-	-	-	-	-	-	-	-	-
04 = 1/2"											-	04	04	-	-	-	-	-	-	-	-
06 = 3/4"											-	-	06	06	06	-	-	-	-	-	-
08 = 1"											-	-	-	08	08	08	08	-	-	-	-
10 = 1 1/4" (F10 not available)											-	-	-	-	-	10	10	10	10	-	-
12 = 1 1/2" (** F12 available for FRA4+ only)											-	-	-	-	-	(**)	(**)	12	12	-	-
16 = 2" (F16 not available)											-	-	-	-	-	-	-	16	16	16	16
20 = 2 1/2" (P20 only)											-	-	-	-	-	-	-	20	20	20	20
(*) special mounting pattern, pls ask for relevant information																					
B BYPASS VALVE																					
B = 170 kPa (1,7 bar)											X	B	B	B	B	B	B	B	B	B	B
SEALS																					
N = NBR Nitrile											N	N	N	N	N	N	N	N	N	N	N
F = FKM Fluoroelastomer											F	F	F	F	F	F	F	F	F	F	F
FILTER MEDIA																					
FA = fiber 5µm, β>1.000											FA	FA	FA	FA	FA	FA	FA	FA	FA	FA	FA
FB = fiber 7µm, β>1.000											FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB
FC = fiber 12µm, β>1.000											FC	FC	FC	FC	FC	FC	FC	FC	FC	FC	FC
FD = fiber 21µm, β>1.000											FD	FD	FD	FD	FD	FD	FD	FD	FD	FD	FD
CC = cellulose 10µm, β>2											CC	CC	CC	CC	CC	CC	CC	CC	CC	CC	CC
CD = cellulose 25µm, β>2											CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
ME = wire mesh 60µm											ME	ME	ME	ME	ME	ME	ME	ME	ME	ME	ME
CLOGGING INDICATOR																					
01 = 1/8" port, plugged											01	01	01	01	01	01	01	01	01	01	01
30 = press. gauge, rear connection											30	30	30	30	30	30	30	30	30	30	30
32 = press. gauge, bottom connection											32	32	32	32	32	32	32	32	32	32	32
P1 = SPOT, press. switch											P1	P1	P1	P1	P1	P1	P1	P1	P1	P1	P1
When the filter is ordered with FKM seals, the first digit of the indicator code is a letter (please see page 184 - 185).																					
ACCESSORIES																					
W = without											W	W	W	W	W	W	W	W	W	W	W
P = with filling plug											P	P	P	P	P	P	P	P	P	P	P
X ACCESSORIES																					
X = no other accessory available											X	X	X	X	X	X	X	X	X	X	X

FILTER ELEMENT						
	A	B	C	kg	Area (cm ²)	
					Media F+	Media C+
ERA11	38	13	50	0,05	270	345
ERA21	52	24	70	0,10	310	380
ERA31	70	28	85	0,20	620	990
ERA32	70	28	130	0,25	1.000	1.600
ERA33	70	40	210	0,40	1.680	2.670
ERA41	99	40	211	0,75	3.800	4.280
ERA42	99	40	250	0,90	4.560	5.100
ERA51	130	51	140	1,00	4.140	4.360
ERA52	130	63	200	1,35	6.190	6.520
ERA53	130	63	251	1,50	7.930	8.350
ERA5D	130	63	268	1,60	8.400	8.800



¹Return line filter P/N: FRA21-N-04-B-N-CC-01-W

SPARE PARTS

CLOGGING INDICATOR

A visual or electrical indicator is available as an option and allows monitoring of the element condition. The port for the indicator is a standard feature.

FILLING PLUG

The filling plug option gives the possibility of easy and efficiently filtering the oil from the drum.

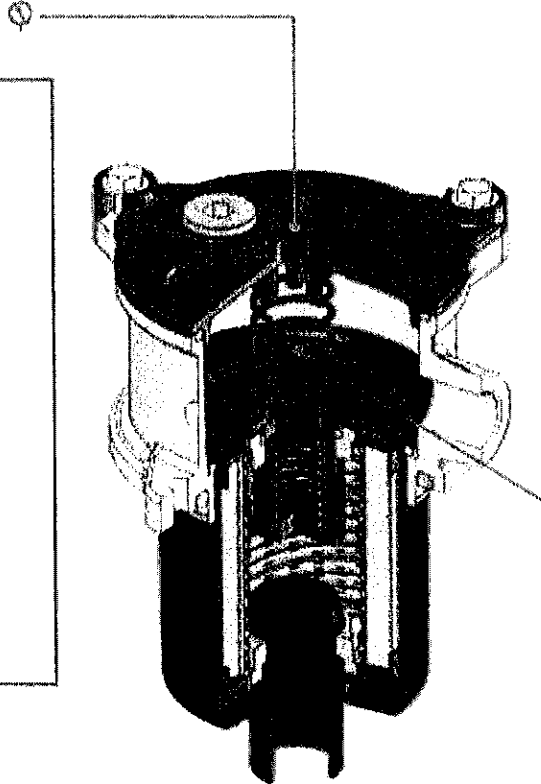
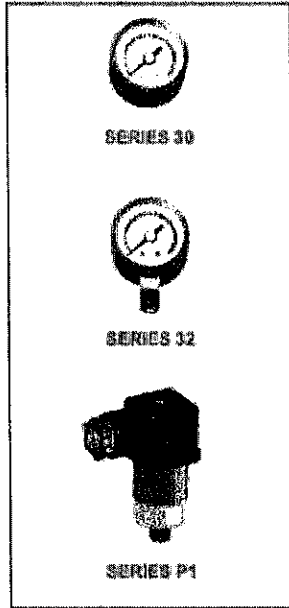
EASY REPLACEMENT

The top and cap includes a handle allowing an easy removal of the element and a complete cleaning of the bowl.

NO LEAKS

The end cap with captive O-ring ensures a perfect seal between filter element and bowl.

CLOGGING INDICATOR
For further technical informations and other options see page 134.



SPARE SEAL KIT

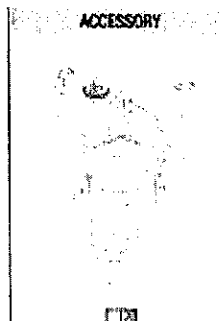
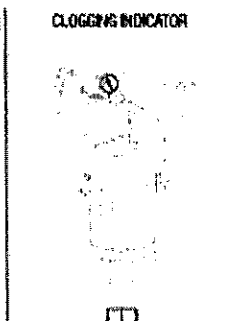
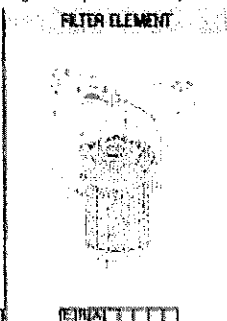
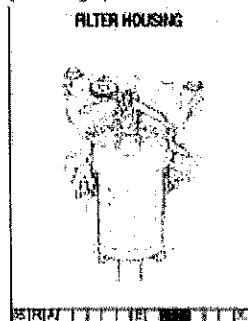
	NBR	FKM
FRA11	521.0032.2	521.0039.2
FRA21	521.0012.2	521.0040.2
FRA31	521.0013.2	521.0041.2
FRA32	521.0013.2	521.0041.2
FRA33	521.0013.2	521.0041.2
FRA41	521.0014.2	521.0043.2
FRA42	521.0014.2	521.0043.2
FRA51	521.0015.2	521.0044.2
FRA52	521.0015.2	521.0044.2
FRA53	521.0015.2	521.0044.2
FRA5D	521.0015.2	521.0044.2

SPARE SPRING

FRA11	008.0032.1
FRA21	008.0149.1
FRA31	008.0003.1
FRA32	008.0003.1
FRA33	008.0003.1
FRA41	008.0151.1
FRA42	008.0151.1
FRA51	008.0028.1
FRA52	008.0028.1
FRA53	008.0028.1
FRA5D	008.0028.1

SPARE PARTS ELEMENTS

(For filling up see table "Ordering and option chart")



FILLING PLUG



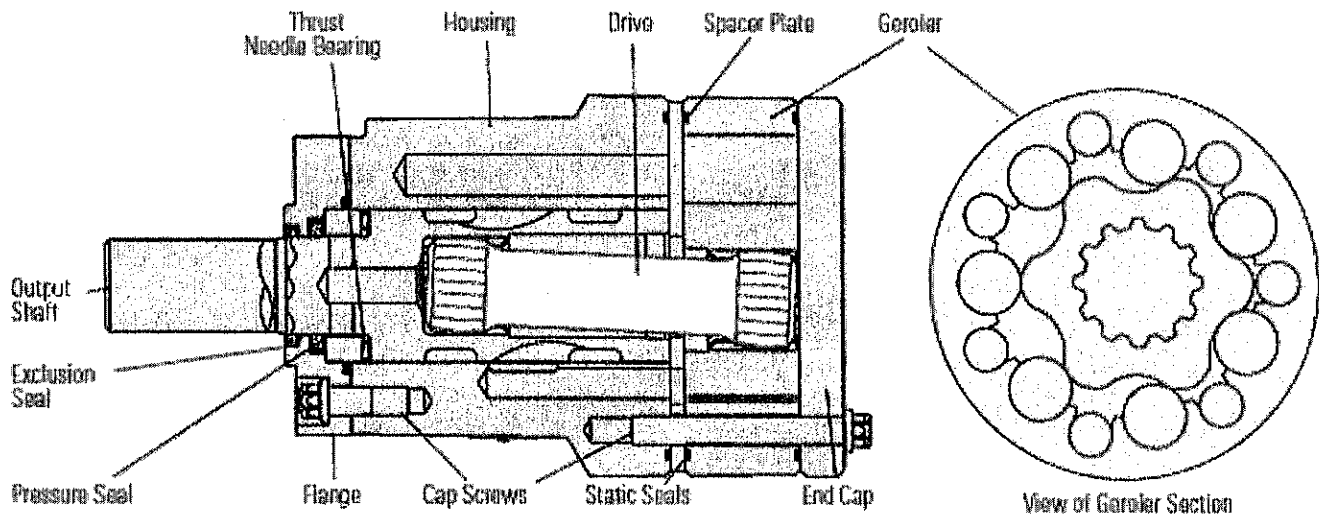
Is this document the latest release? Please check on our website.



Technical data subject to variations without prior notice. RA - EN - 05/2011

HYDRAULIC MOTOR: S-SERIES (103-)

SPECIFICATIONS



SPECIFICATION DATA - S MOTORS

Displ. cm ³ /r [in ³ /r]		59	75	97	120	144	166	187	225	298	372
		[3.6]	[4.6]	[5.7]	[7.3]	[8.8]	[10.1]	[11.4]	[13.7]	[18.2]	[22.7]
Max. Speed (RPM) @ Continuous Flow		963	792	607	472	394	343	304	253	190	153
Flow LPM [GPM]	Continuous	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]	57 [15]
	Intermittent	68 [18]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]	76 [20]
Torque Nm [lb-in]	Continuous	115 [1021]	150 [1325]	183 [1623]	237 [2010]	265 [2347]	301 [2662]	333 [2950]	372 [3290]	491 [4345]	528 [4672]
	Intermittent	144 [1271]	186 [1649]	225 [1992]	292 [2582]	324 [2870]	360 [3191]	399 [3533]	434 [3843]	505 [4467]	587 [5200]
Min. Starting Torque Nm [lb-in]	@ Cont. Pressure	90 [800]	113 [1000]	148 [1310]	184 [1630]	212 [2050]	232 [2330]	263 [2670]	202 [2990]	338 [3270]	369 [3270]
	@ Int. Pressure	116 [1030]	146 [1250]	190 [1680]	236 [2090]	271 [2400]	289 [2560]	329 [2910]	374 [3310]	417 [3690]	438 [3880]
Pressure Δ Bar [Δ PSI]	Continuous	138 [2000]	138 [2000]	138 [2000]	138 [2000]	131 [1900]	131 [1900]	128 [1850]	117 [1700]	103 [1500]	90 [1300]
	Intermittent	172 [2500]	172 [2500]	172 [2500]	172 [2500]	162 [2350]	159 [2300]	155 [2250]	141 [2050]	124 [1800]	103 [1500]

A simultaneous maximum torque and maximum speed NOT recommended.

Note:

To assure best motor life, run motor for approximately one hour at 30% of rated pressure before application to full load. Be sure motor is filled with fluid prior to any load applications.

Maximum Inlet Pressure:

172 Bar [2500 PSI] without regard to Δ Bar [Δ PSI] and/or back pressure ratings or combination thereof.

6B Splined or Tapered shafts are recommended whenever operating above 282 NM [2500 lb-in] of torque, especially for those applications subject to frequent reversals.

Δ Pressure:

The true Δ bar [Δ PSI] between inlet port and outlet port

Continuous Rating:

Motor may be run continuously at these ratings

Intermittent Operation:

10% of every minute

Recommended Fluids:

Premium quality, anti-wear type hydraulic oil with a viscosity of not less than 70 SUS at operating temperature.

Recommended System Operating Temp.:

-34°C to 82°C [-30°F to 180°F]

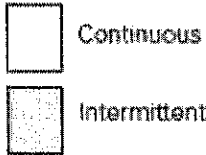
Recommended Filtration:

per ISO Cleanliness Code 4406, level 20/18/13

PERFORMANCE DATA

Motors run with high efficiency in all areas designated with a number for torque and speed, however for best motor life select a motor to run with a torque and speed range printed in the light shaded area.

Performance data is typical at 120 SUS. Actual data may vary slightly from unit to unit in production



S Motor 187 cm³/r [11.4 in³/r]

Δ Pressure Bar [PSI]

	[200]	[400]	[600]	[800]	[1000]	[1200]	[1400]	[1600]	[1800]	[1890]	[2250]
	14	28	41	55	69	83	97	110	124	138	172
[2]	298	627	944	1244	1532	1805	2090	2250	2478		
7.6	34	71	107	141	173	204	229	254	280		
[4]	298	640	963	1291	1607	1919	2219	2511	2799	2889	3411
15.1	34	72	109	148	182	217	251	284	316	324	385
[6]	279	621	953	1283	1608	1930	2243	2551	2850	2922	3502
22.7	32	70	108	145	182	218	253	288	322	330	396
[8]	252	593	928	1257	1579	1905	2224	2542	2855	2932	3539
30.3	29	67	106	142	178	215	251	287	323	331	400
[10]	211	558	888	1217	1546	1872	2193	2516	2831	2908	3518
37.9	24	52	100	138	176	211	248	284	320	329	397
[12]	182	502	835	1164	1490	1818	2139	2463	2789	2857	3478
45.4	18	57	94	131	169	206	242	278	314	323	393
[14]	118	452	786	1117	1443	1772	2095	2417	2736	2814	3438
53.0	13	51	89	126	163	200	237	273	309	319	389
[15]	91	425	759	1089	1418	1747	2068	2389	2708	2786	3410
56.8	10	49	86	123	160	197	234	270	306	316	385
[20]		258	590	825	1255	1585	1907	2229	2552	2633	3255
75.7		29	67	105	142	179	216	252	288	297	369
		403	400	394	387	379	370	359	347	344	319

S Motor 225 cm³/r [13.7 in³/r]

Δ Pressure Bar [PSI]

	[200]	[400]	[600]	[800]	[1000]	[1200]	[1400]	[1600]	[1700]	[1890]
	14	28	41	55	69	83	97	110	124	138
[2]	358	765	1139	1495	1842	2163	2474	2735	2894	
7.6	40	86	129	169	209	244	280	309	327	
[4]	367	774	1177	1577	1958	2325	2680	3022	3191	3753
15.1	41	87	133	178	221	263	303	341	361	424
[6]	343	758	1161	1567	1950	2344	2718	3083	3264	3863
22.7	39	88	131	177	221	265	307	348	369	437
[8]	313	721	1124	1529	1921	2312	2686	3073	3265	3894
30.3	35	81	127	173	217	261	305	347	369	440
[10]	282	669	1069	1473	1859	2247	2627	2997	3184	3810
37.9	30	76	121	166	210	254	297	339	360	430
[12]	203	609	1006	1400	1782	2160	2531	2912	3098	3721
45.4	23	69	114	159	201	244	298	329	350	420
[14]	143	514	938	1324	1700	2079	2452	2824	3008	3639
53.0	16	62	106	150	192	235	277	319	340	411
[15]	105	504	897	1281	1653	2027	2393	2761	2944	3576
56.8	12	57	101	146	187	229	270	312	333	404
[20]		303	697	1091	1477	1854	2214	2581	2765	3399
75.7		34	79	123	167	210	250	292	312	384
		336	334	330	325	318	312	304	298	282



OUTER DIMENSIONS

S Series (103-)

Dimensions

(Refer to pages B-4-19 thru B-4-22 for shaft and port dimensions.)

Ports

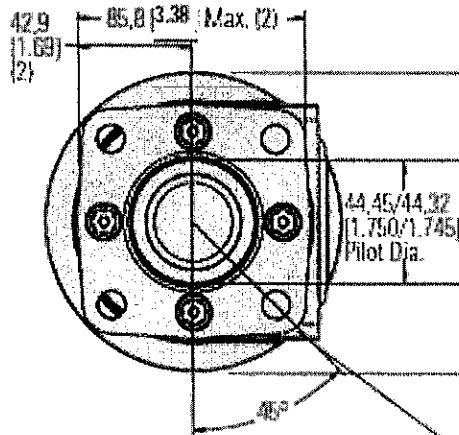
7/8-14 SAE O-Ring
6-1/2 (BSP) Straight thread manifold

Standard Rotation Viewed from Shaft End

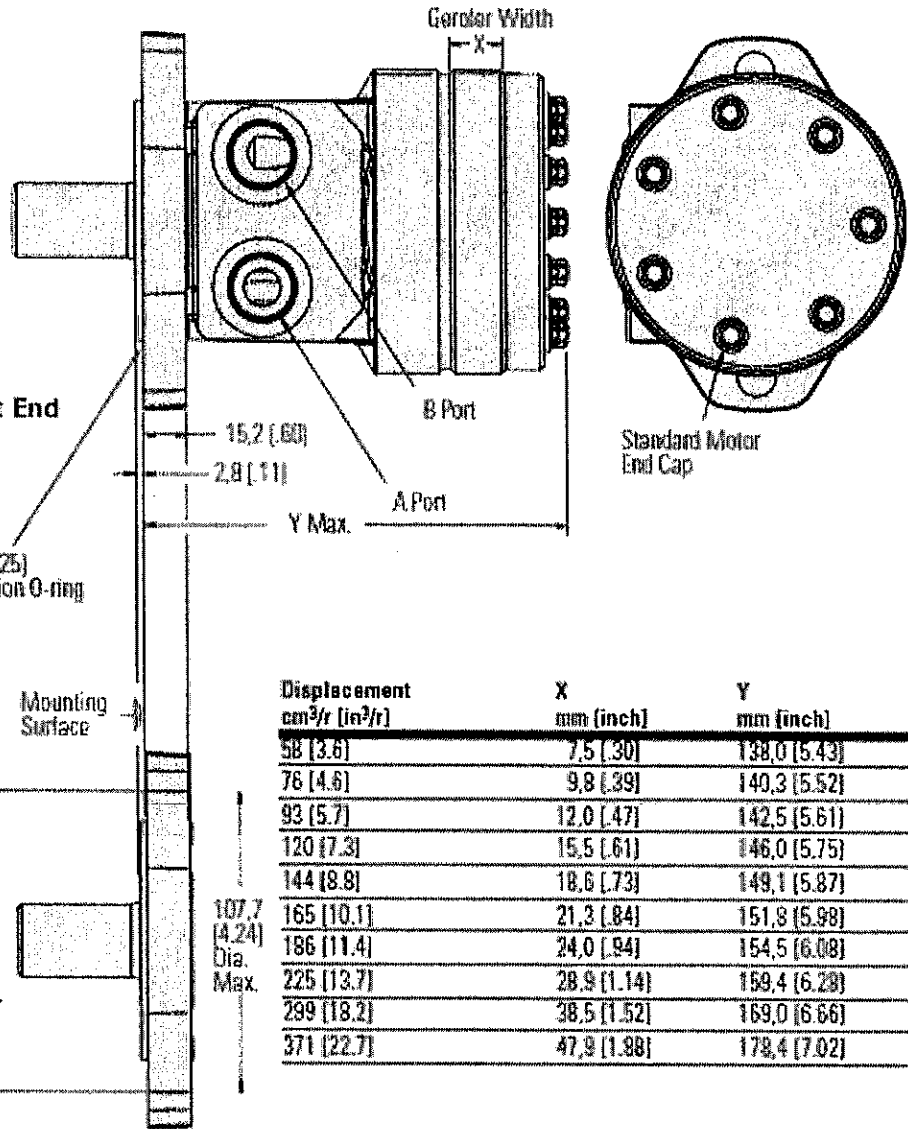
Port A Pressurized — CW
Port B Pressurized — CCW

Grooves Provided for $\varnothing 2,6$ (3,25)
I.D. x 2,62 (1,03) Cross Section O-ring
(Dash No. 152)

4 Bolt Flange



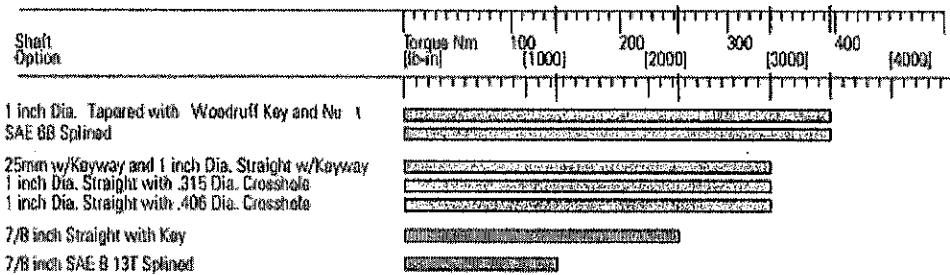
3/8-16 UNC (15,2 (1,60) Max. Bolt Thread Engagement)
Mounting Holes (4) Equally Spaced on $\varnothing 2,6$ (3,25) Dia. Bolt Circle
or
M10 x 1,5 (15,2 (1,60) Max. Bolt Thread Engagement) Mounting
Holes (4) Equally Spaced on $\varnothing 2,6$ (3,25) Dia. Bolt Circle



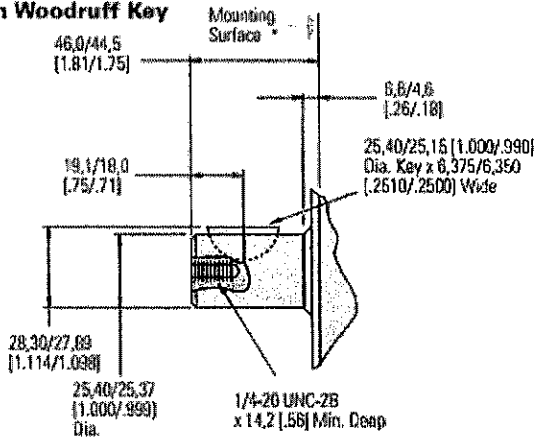
Displacement cm ³ /r (in ³ /r)	X mm (inch)	Y mm (inch)
58 (3.6)	7,5 (.30)	138,0 (5.43)
76 (4.6)	9,8 (.39)	140,3 (5.52)
93 (5.7)	12,0 (.47)	142,5 (5.61)
120 (7.3)	15,5 (.61)	146,0 (5.75)
144 (8.8)	18,6 (.73)	149,1 (5.87)
165 (10.1)	21,3 (.84)	151,8 (5.98)
186 (11.4)	24,0 (.94)	154,5 (6.08)
225 (13.7)	28,9 (1.14)	159,4 (6.28)
299 (18.2)	38,5 (1.52)	169,0 (6.66)
371 (22.7)	47,9 (1.88)	178,4 (7.02)

SHAFT DIMENSIONS

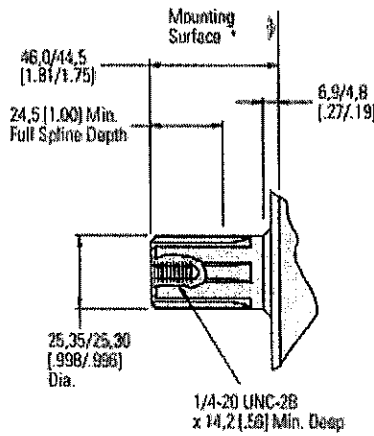
**Shaft Size
Motor Torque
Combination
Limit Guide**



1 in. Dia. Straight with Woodruff Key



SAE 6B Splined Shaft



PRODUCT NUMBERS

4 Bolt Flange

SHAFT	PORT SIZE	DISPL. cm ³ /r (in ³ /r) / PRODUCT NUMBER									
		59 [3.6]	75 [4.6]	93 [5.7]	120 [7.3]	144 [8.8]	166 [10.1]	187 [11.4]	225 [13.7]	298 [18.2]	372 [22.7]
1 in. Straight w/Woodruff Key	7/8-14 O-Ring	103-1570	-1010	-1011	-1571	-1572	-1012	-1013	-1014	-1015	-1016
	1/2 NPTF	103-1573	-1002	-1003	-1574	-1575	-1004	-1005	-1006	-1007	-1008
	Manifold	103-1576	-1018	-1019	-1577	-1578	-1020	-1021	-1022	-1023	-1024
1 in. SAE 6B Splined	7/8-14 O-Ring	103-1579	-1058	-1059	-1580	-1581	-1060	-1061	-1062	-1063	-1064
	1/2 NPTF	103-1582	-1050	-1051	-1583	-1584	-1062	-1063	-1064	-1065	-1066
	Manifold	103-1585	-1066	-1067	-1586	-1587	-1068	-1069	-1070	-1071	-1072

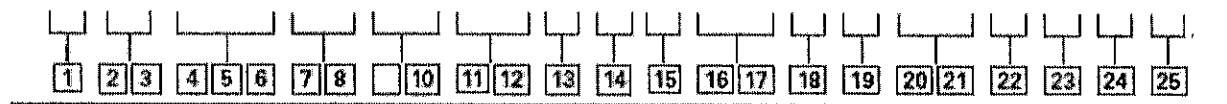
103-1089

HOW TO ORDER¹

S Series (103-)

Model Code

The following 25-digit coding system has been developed to identify all of the configuration options for the S motor. Use this model code to specify a motor with the desired features. All 25-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.



1 Product
M – Motor

2, 3 Series
S0 – S Series Motor

4, 5, 6 Displacement
cm³/r [in³/r]

- 036 – 58 [3.6]
- 046 – 76 [4.6]
- 057 – 93 [5.7]
- 073 – 120 [7.3]
- 088 – 144 [8.8]
- 101 – 165 [10.1]
- 114 – 186 [11.4]
- 137 – 224 [13.7]
- 182 – 299 [18.2]
- 227 – 371 [22.7]

7, 8 Mounting Type

- AA** – 2 Bolt Std: 82.50 [3.248] Dia. x 3.05 [1.20] Pilot, 13.59 [5.35] Dia. Mounting Holes on 106.35 [4.187] Dia. B.C.
- BA** – 4 Bolt Std: 44.40 [1.748] Dia. x 3.05 [1.20] Pilot, .375-16 UNC-2B Mounting Holes on 82.55 [3.250] Dia. B.C.
- CA** – 2 Bolt Std: 92.50 [3.248] Dia. x 6.10 [2.40] Pilot, 10.41 [4.10] Dia. Mounting Holes on 106.35 [4.187] Dia. B.C. (SAE A)
- DD** – 2 Bolt Std: 101.60 [4.000] Dia. x 6.10 [2.40] Pilot, 14.35 [5.65] Dia. Mounting Holes on 146.05 [5.750] Dia. B.C. (SAE B) (Ductile)
- EA** – 4 Bolt Magneto: 82.50 [3.248] Dia. x 3.05 [1.20] Pilot, 13.59 [5.35] Dia. Mounting Holes on 106.35 [4.187] Dia. B.C.
- FA** – 4 Bolt Std: 44.40 [1.748] Dia. x 3.05 [1.20]

Pilot, M10 x 1.5-6h Mounting Holes on 82.55 [3.250] Dia. B.C.

LA – 2 Bolt Std: 44.45 [1.750] Dia. x 3.05 [1.20] Pilot, 13.59 [5.35] Dia. Mounting Holes on 106.35 [4.187] Dia. B.C.

MA – 2 Bolt (Standard) 92.50 [3.248] Dia. x 8.13 [3.20] Pilot, 13.59 [5.35] Dia. Mounting Holes on 106.35 [4.187] Dia. B.C., w/o O-ring Groove

9, 10 Output Shaft

- 01** – 25.4 [1.00] Dia. Straight, Woodruff Key, .250-20 UNC-2B Hole in Shaft End
- 02** – 25.4 [1.00] Dia. SAE 6B Spline, .250-20 UNC-2B Hole in Shaft End
- 07** – 25.4 [1.00] Dia. Straight, 8.03 [3.16] Dia. Crosshole 11.2 [4.4] From End, 5.6 [2.2] Extra Length
- 08** – 25.4 [1.00] Dia. Straight, 10.31 [4.06] Dia. Crosshole 15.7 [6.2] From End, .250-20 UNC-2B Hole in Shaft End
- 16** – 22.22 [8.75] Dia. SAE 13 Tooth Spline (SAE B)
- 17** – 22.22 [8.75] Dia. Straight, 6.4 [2.5] x 19.0 [75] Square Key (SAE B)
- 18** – 25.4 [1.00] Dia. Tapered, Woodruff Key and Nut, 34.92 [1.375] Taper Length
- 24** – 25.00 [9.84] Dia. Straight, 8.00 [3.15] Key, M8 x 1.25-6H Hole in Shaft End

39 – 25.00 [9.84] Dia. Straight (k6), 8.00 [3.15] Key, M8 x 1.25-6H Hole in Shaft End

11, 12 Port Type
AA – .875-14 UNF-2B SAE O-Ring Ports

AB – .500-14 NPTF Dryseal Pipe Thread Ports

AC – Manifold Ports (.3125-18 UNC-2B Mounting Holes)

AD – Manifold Ports (M8 x 1.25-6H Mounting Holes)

AF – G 1/2 BSP Straight Thread Ports

13 Case Flow Options ††

- 0** – None Specified
 - 1** – 4375-20 UNF-2B SAE O-Ring Port (End Cap)
 - 2** – G 1/4 BSP Straight THD Port (End Cap)
 - 3** – Manifold Case Drain
- †† – Internal check valves are standard features.

14 Geroler Options

- 0** – None Specified

15 Shaft Options

- 0** – None Specified
- N** – Electroless Nickel Plated

16, 17 Seal Options

- 00** – Standard Seals
- 02** – Seal Guard
- 03** – Viton Seals
- 04** – Viton Shaft Seal
- 05** – Vented Two-Stage Seal
- 07** – High Pressure Shaft Seal

18 Speed Sensor Options

- 0** – None
- A** – Speed Sensor Options 12mm Digital Speed Pickup (15 pulse) without lead wire
- B** – Magnetic Speed Pickup (60 Pulse by Quadrature)

No lead wire with M12 connector

(A=Power, B=Common, C=Signal)

19 Manifold Block Options
0 – None

* Contact your Eaton sales representative for available options.

20, 21 Special Features (Hardware)

- 00** – None Specified
- AB** – Low Speed Valving
- SS** – Stainless Steel Flange Bolts

22 Special Assembly Instructions

- 0** – None
- 1** – Reverse Rotation
- 2** – Flange Rotated 90°
- 3** – Reverse Rotation, Flange Rotated 90°

23 Paint/Packaging Options

- 0** – No Paint
- A** – Low Gloss Black Primer
- D** – Environmental Coated Gloss White
- F** – Environmental Coated Black

24 Eaton Assigned Code When Applicable

- 0** – Assigned Code

25 Eaton Assigned Design Code

- M** – Twelve (12)

Feature in bold are preferred and allow for shorter lead time.

¹ Gas and electric machines use P/N: 103-1013-012

TROMBETTA SOLENOID THROTTLE CONTROL KIT

INSTALLATION INSTRUCTIONS

Trombetta 
ELECTROMAGNETICS

Trombetta Corporation
13901 Main Street
Menomonee Falls, WI 53051
(414)251-5454 Fax: 251-5757
<http://www.trombetta.com>

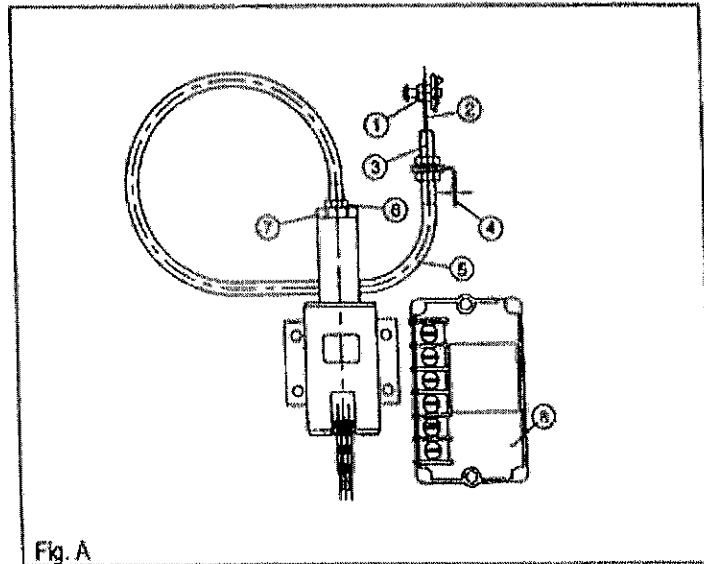
Installation Instructions

Patented Throttle Control Solenoid Kit

P613 - K Series (12 VDC Systems)
P613 - K Series (24 VDC Systems)

Parts List

Item No.	Replacement Part No.	Description
1	E07195	Cable Pivot
2	NA	Wire Core
3	NA	Cable Bulkhead Fitting
4	NA	Cable Bracket
5	Specify Kit No.	Cable Assembly
6	NA	Jam Nut UNF 3/8-24
7	NA	Aluminum Adjustment Nut 1.00 Inch Hex
8	S500-A6	Control Module



S500 - A6 Control Module Specifications

Specification		Note
Operating Temperature Range	-40 to 185° F (-40 to 85° C)	
Maximum (Jump Start) Voltage	32 VDC	1 and 2
Maximum Solenoid Wattage (12 VDC System)	1000 Watts	1 and 3
Pull-In Coil Activation Duration	0.5 Seconds	
Module Recycle Time	0.1 Seconds	4
Maximum Module Cycle Rate	6 per minute	5
Minimum Operating Voltage	8.8 VDC at 68° F (20° C)	
Voltage Loss Through Module	0.35 VDC Maximum	6

SPECIFICATIONS

Notes:

1. The output of the control module must be connected to the contactor/relay in 24 VDC systems. See wiring diagram.
2. Do not leave the module connected if you use over 32 VDC to jump-start a vehicle
3. If the load exceeds 1000 watts or if the voltage exceeds 32 VDC, use an external contactor as an interface between the module and the load.
4. Recycle time is the time the module must be de-energized before it will re-initiate the pull-in cycle.
5. Although the module can tolerate higher cycle rates, the solenoid may overheat in these situations. Consult the factory if you anticipate a high cycle rate.
6. This is the voltage drop anticipated between the input voltage and output voltage to the solenoid.

Solenoid Assembly Specifications

Specifications	P613-A41V12	P613-A41V24
Rated voltage	12 VDC	24 VDC
Pull-In Current	70.5 Amps	36.4 Amps
Hold-In Current	0.9 Amps	0.5 Amps
Pull-In Force (at 68° F [20° C])	20 lb.	20 lb.
Hold-In Force (at 68° F [20° C])	40 lb.	40 lb.
Maximum Ambient Temperature	257° F (125° C)	257° F (125° C)
Maximum Coil Temperature	380° F (193° C)	380° F (193° C)
Maximum Solenoid Cycle Rate	6/min. - see note 5 above	8/min. - see note 5 above

Safety First

Trombetta has made every effort to provide you with a safe solenoid kit, but wishes to point out information on safe installation and operation

⚠ WARNING

To avoid control module damage, always disconnect the module when you jump-start the vehicle with voltages that exceed 32 VDC.

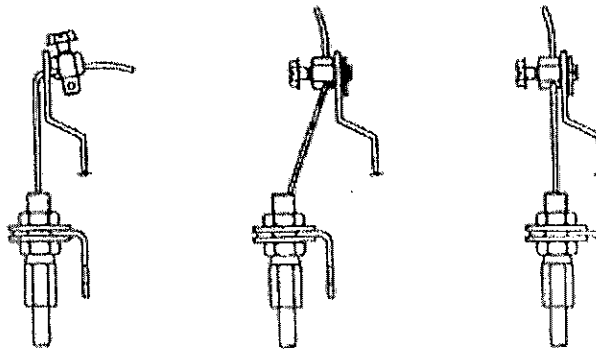
⚠ CAUTION

To avoid eye and/or face injury, eye and/or face protection must be worn when installing this device.

Improper installation of cable pivot can result in premature wire cable failure.

Consult the diagram below for proper installation.

Contact Trombetta service representatives at (414) 251-5454 with questions regarding your application.



INCORRECT

INCORRECT

CORRECT

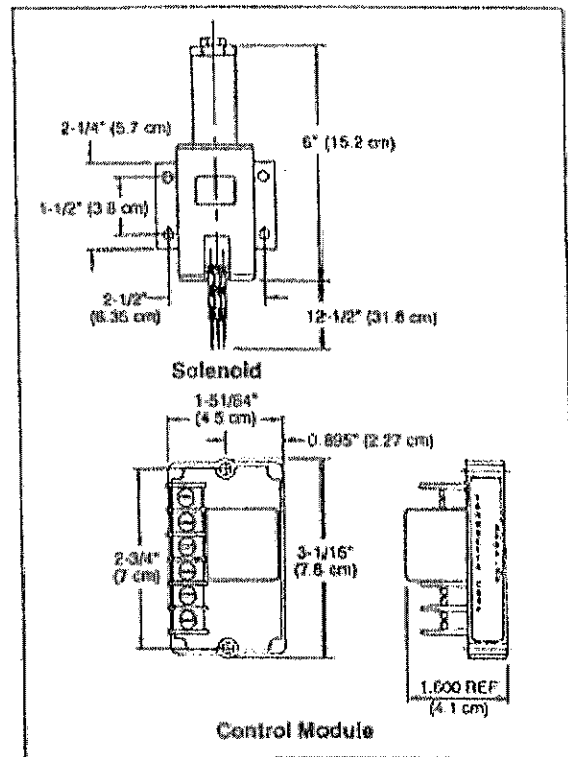
STEP BY STEP INSTRUCTIONS

Installing Your Throttle Control Solenoid

Location

Follow these simple rules to properly locate your throttle control kit:

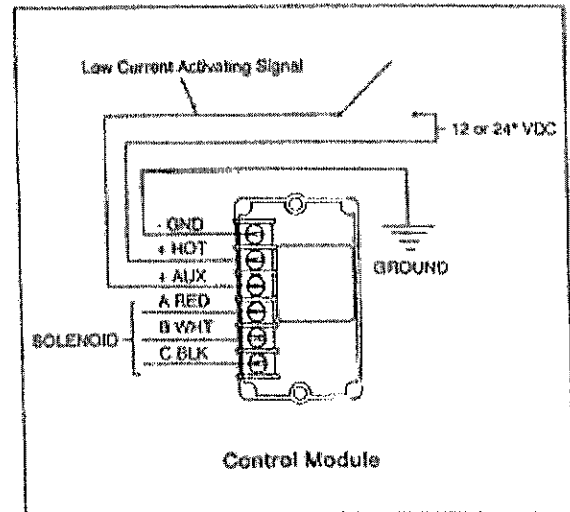
- Mount the solenoid off the engine but within 46 inches (116.8 cm) of the throttle lever, to avoid engine vibration and high temperature components (more than 257° F [125° C]).
- Mount Control Module out of the engine compartment if possible. If not possible, mount the module as far away from high temperature components as possible. Maximum temperature range is 185° F (85° C).
- Route the Flexible cable away from high temperature (220° F [105° C]) components such as exhaust manifolds.
- Avoid sharp bends in flexible cable. Bends should form a smooth arc (360° maximum) with a radius of 5 inches (12.7 cm) minimum.



Controlling the Solenoid Throttle Kit

The throttle kit can be controlled remotely by applying a low current 12 or 24 VDC signal to the module "AUX" terminal.

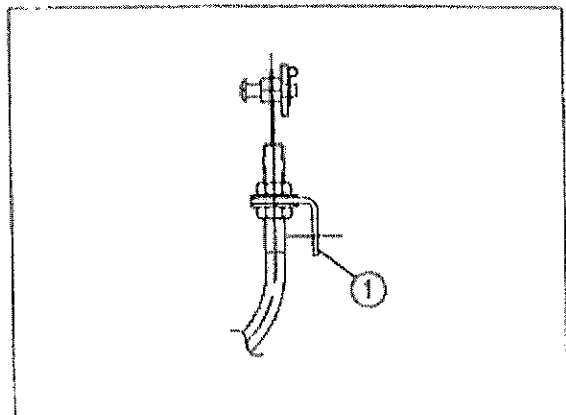
Examples of activating signals are the air compressor pressure switch or air conditioning switching circuits.



Mounting Procedures

Use the following procedure to mount your throttle controller:

1. Mount the solenoid and control module according to the recommendations on the "Location" instructions.
2. Electrically connect the solenoid to the control module and power source according to the wiring diagram.
3. Mount the cable bracket (1) and fasten the cable sheath to the bracket using the collar nut so the sheath does not turn during idle adjustment.



WIRING DIAGRAM

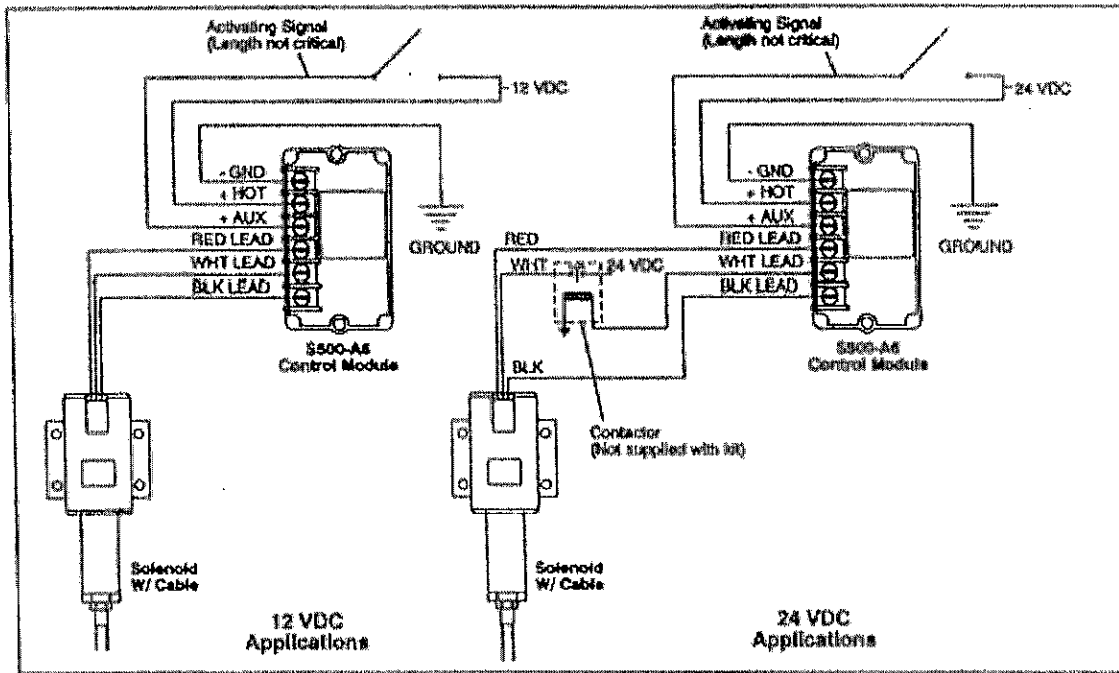
Use the following table to determine all wire lengths except "AUX" terminal:

Note: The wire size and length to "AUX" terminal of the control module is not critical because of low current; 16-18 gage wire may be used.

Maximum Lead Length - In Feet*

System Voltage	Wire Gage						
	18 AWG	16 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG
12 VDC	2.5 ft	4 ft.	6 ft.	10 ft.	16 ft.	25 ft.	40 ft.
24 VDC	10 ft.	16 ft.	25 ft.	40 ft.	64 ft.	100 ft.	160 ft.

* Total of "-GND" and "+HOT" wire lengths plus "B WHT" and "C BLK" wire length.



SET NORMAL/HIGH SPEED

Set Normal Engine Idle Speed

Use the following procedure to set the "normal" engine idle speed with the solenoid de-energized:

1. With the engine "off", attach the cable pivot assembly (1) to the throttle lever.
Note: DO NOT tighten the wire core pivot setscrew (1A). The wire core (2) must be free to move through the pivot until step 2.
2. Insert the wire core (2) into the wire core pivot (1).
3. If the cable adjuster is not fully retracted into the solenoid, loosen the jam nut (6) and turn the aluminum adjustment nut (7) counterclockwise until the cable adjustment nut (7) is flush with the solenoid (8).
4. With all connections made to the throttle control systems, apply 12 VDC to "AUX" terminal of the control module. Make sure the wire core (2) is free to move through the cable pivot (1) with out restriction.
5. Adjust "normal" engine idle speed using the "standard method" required for your engine.
6. Eliminate the slack in the cable (2).
7. Tighten the cable pivot setscrew (1A).

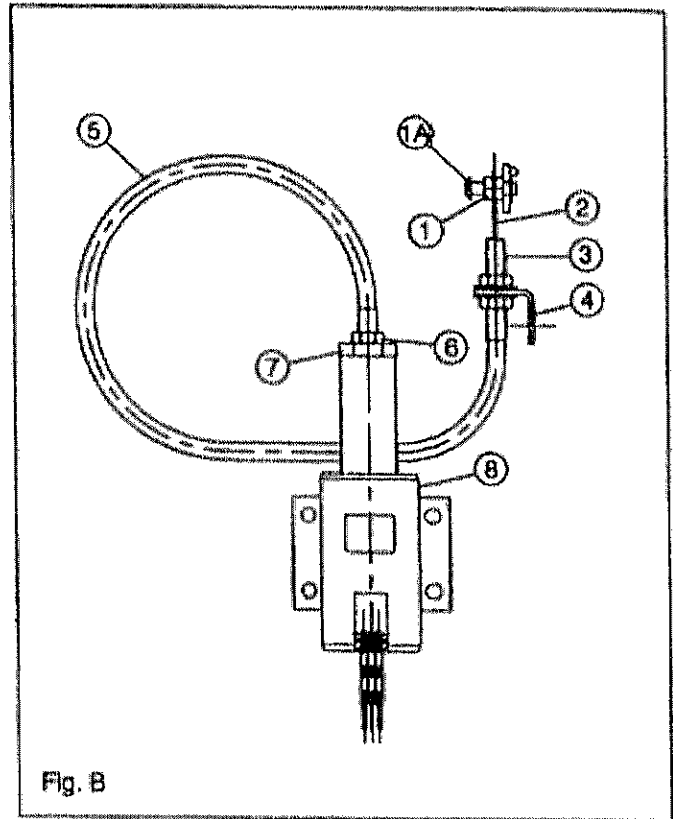


Fig. B

Set High Idle Speed

Use the following procedure to set the "high" engine idle speed with the solenoid activated:

1. Set the "normal" engine idle speed per the previous procedure.
2. With the engine running, apply 12 VDC to the "AUX" terminal of the control module.
3. Make sure the jam nut (6) is loose and turn the aluminum adjustment nut (7) clockwise until the high engine idle speed is reached.
4. Tighten the jam nut (6).
5. Check the throttle speed controller operation rechecking the "normal" engine idle speed with the solenoid deactivated and high engine idle speed with the solenoid activated. If necessary, repeat the "normal" idle speed and high idle speed adjustments.

Note: Do not leave the aluminum adjustment nut (7) tight against the solenoid body since this does not allow the cable (5) to float.

SYSTEM OPERATION

Trombetta's P613-K1 throttle control solenoid kit consists of a "three wire," dual coil solenoid, electromechanical control module and stainless steel sheathed pull cable. The sheathed pull cable allows the solenoid to be mounted away from hostile environments, such as engine vibration and high temperature.

The throttle solenoid can be activated automatically for "on demand" to bring the idle speed to a pre-set high idle position.

The control module allows the solenoid to operate as a continuous duty device. When the module is wired as recommended, applying 12 VDC to the "AUX" terminal applied voltage to the hold-in and pull-in coil of the solenoid. After 0.5 seconds to 0.75 seconds, power is automatically removed from the pull-in coil. Power will remain at the hold-in coil until the 12 VDC signal is removed from the "AUX" terminal.

Troubleshooting Hints

If the solenoid will not engage, check the following:

1. Check the stranded pull cable for damage (e.g., melted or crimped sheath).
2. Check the stranded pull cable for binding.
3. Check system voltage at the "+HOT" and "AUX" terminals.
4. Check module terminals for proper voltage and operation. If the module does not meet these specifications, replace it.
5. Check solenoid resistance (remove wires from module). If resistance is not within specifications listed below, replace the solenoid.
6. Make sure you have the recommended wire length and gage (refer to wire chart).
7. Be sure cable is not bent beyond guidelines.
8. Check for proper adjustments.
9. Contact the factory if you are unable to resolve the problem.

Control Module Voltage Measurements

Terminal Designation	Voltage
- GND	Chassis Ground
+ HOT	12 or 24 VDC at all times
+ AUX	12 or 24 VDC required to activate solenoid
A RED	12 or 24 VDC when signal is present at "AUX" terminal
B WHT	12 or 24 VDC for 0.5 to 0.75 seconds after signal at "AUX" terminal
C BLK	Common for solenoid

12 VDC System	24 VDC System
0.17 ohms White to Black wire	0.66 ohms White to Black wire
0.13 ohms Red to Black wire	0.48 ohms Red to Black wire

SHORTENING INSTRUCTIONS

Use the following procedures to shorten pull cables supplied with Trombetta products.

IMPORTANT!

DO NOT cut wire core (2) until step #11! Remove wire core (2) from cable sheath (5) *before* cutting the sheathing.

1. Remove the cable assembly (1-7) from the solenoid body (8) by loosening the jam nut (6) and turning the large aluminum adjusting nut (7) "clockwise".

Note: The solenoid "plunger" located inside the solenoid body can be removed at this point. Take care not to damage or contaminate the plunger while it is out of the solenoid body (8). Be sure to keep the inside of the solenoid body (8) "clean" while the plunger is removed.

2. Remove the wire core (2) from the cable sheath (5).
3. Lightly fixture the cable sheath (5) in a vise or other suitable holding device.

Note: Over tightening the vise may deform the cable sheath (5) and cause the wire core (2) to bind!

!! CAUTION !!

Safety Goggles must be worn before proceeding!

4. Use an abrasive "cut-off wheel" (eg. A Dremel tool and Dremel abrasive disk), to cut the cable sheath (5) to the desired length. Deburr and clean the "cut end" of the sheath (5).
5. Mark the cable sheath (5) 1" from the end with a wrap of masking tape (see Fig. C).
6. If the threaded-on bulkhead connector is to be reused, remove it from the cut-off piece of cable sheathing by unthreading it in a counter-clockwise direction. Wipe the connector clean and reuse it for step #8.
7. Wipe the wire core (2) clean and then re-insert this core (2) through the cable sheath (5).

Note: Make sure the wire core (2) moves "freely" inside the cable sheath (5). If it does not, discard the whole cable assembly and replace.

8. Turn the "cable bulkhead fitting" (see fig. A) onto the sheathing (5). Torque to maximum 8 pound - inches. At this point, the fitting should be approximately $\frac{1}{4}$ " or less from the tape mark on the sheath.

!! CAUTION !!
Cable bulkhead fitting must engage at least $\frac{1}{4}$ " of the cable sheath to be properly attached. Over tightening the fit may strip the threads.

9. Re-install the cable assembly.
10. Using the "throttle solenoid" setting instructions, proceed with setting the throttle solenoids.
11. After the throttle solenoid is set and connections are tightened, cut the excess wire core approximately "one" inch beyond the cable pivot (1).

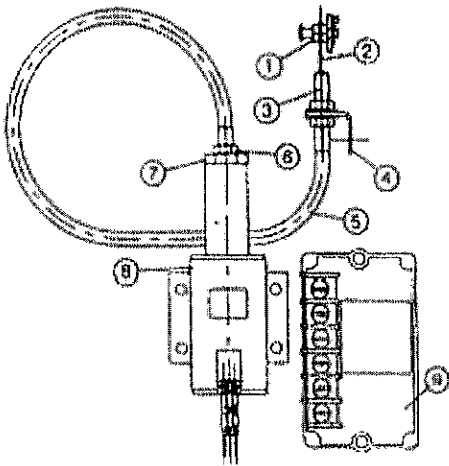


Fig. A

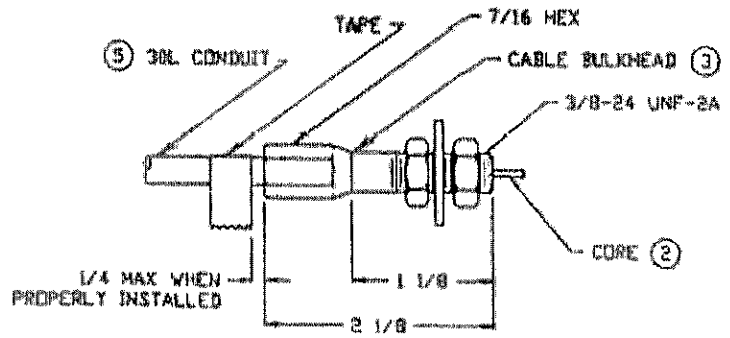


Fig. C